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The origin of a name that reflects Europe’s cultural roots.

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<tr>
<td>αἷμα [haima] = blood</td>
<td>haematologicus (adjective) = related to blood</td>
<td>haematologica (adjective, plural and neuter, used as a noun) = hematological subjects</td>
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<tr>
<td>αἷματος [haimatos] = of blood</td>
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<td>λόγος [logos] = reasoning</td>
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The oldest hematology journal, publishing the newest research results. 2015 JCR impact factor = 6.671

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10th International Symposium on Hodgkin Lymphoma

Cologne, Germany
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ABSTRACT BOOK
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Few studies have been aimed to the identification of driver mutations in classical Hodgkin lymphoma (cHL), and only occasional gene mutations in members of the NF-kappaB and JAK/STAT pathways, and, more recently B2M, have been previously described. We analyzed 57 cHL tumor samples (FFPE) using massive parallel sequencing (Ion Torrent™ semiconductor technology). To increase coverage a previous tumor cell enrichment process by punch tissue cores from selected tumor-rich areas was implemented. In addition, we have also analyzed an independent group of 12 patients with primary refractory cHL (patients that did not achieve complete response after first line ABVD, or who presented with primary progressive disease), using the same methodology for NGS, but with an enrichment procedure based on laser microdissection of HRS cells (CD30+). Overall, the results show very high genomic heterogeneity with a range of 10-400 SNVs per sample, most of them (~60%) missense type. We found a relatively large number of genes recurrently mutated at low frequency and only a few genes mutated in up to 15-20% of the patients, reflecting a high level of genomic instability in the neoplasm. Specific mutations in genes previously described in cHL (NFKBIA, TNFRSF14) and in diffuse large B-cell lymphomas (CARD11, STAT6, CREBBP, CMYB) were consistently found, as well as new SNVs in genes not previously described (STAT6, BTK, NFKB2). Of note, we found high prevalence of mutations affecting BTK and the BCR pathway, suggesting some dependencies of active BCR signaling albeit the absence of BCR expression by HRS cells. Consistent with this interpretation, incubation of a panel of cHL cellular models with either ibrutinib or AVL-292, selective-BTK inhibitors, in vitro constrains cell proliferation and causes cell death. Indeed, gene expression and GSEA analysis of the cHL HDML-2 cell line showed a similar basal BCR pathway activation levels than the HBL1 DLBCL cell followed by an intense inhibition after ibrutinib incubation. In conclusion, cHL is characterized by high genomic instability, including numerous mutations in genes related with B-cell function and specific signaling pathways. Pathogenic predictions of the different SNVs identify potential driver mutations that can be associated with the pathogenesis of the disease and might represent new therapeutic targets.
show that high expression of PD-1 in the tumor microenvironment of cHL is associated with inferior EFS (fully adjusted multivariate analyses). Patients with high expression of PD-1 have a tumor permissive exhausted immune system and may therefore be more likely to experience treatment failure after conventional treatment regimens.

T006
THE AP-1 TRANSCRIPTION FACTOR BATF3 REGULATES MYC EXPRESSION AND IS REQUIRED FOR TUMOR CELL SURVIVAL IN CLASSICAL HODGKIN LYMPHOMA AND ANAPLASTIC LARGE CELL LYMPHOMA

A. Lollies1, S. Hartmann2, M. Schneider1, T. Bracht2, J. Arnolds1, L. Klein-Hitpass2, B. Sitek3, M.-L. Hansmann2, R. Küppers1, M.A. Weniger2

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*Co senior authors

The malignant cells in classical Hodgkin lymphoma (cHL) and anaplastic large cell lymphoma (ALCL) are characterized by deregulated transcription factor activity of several signaling pathways including constitutive active JAK/STAT and AP-1. Our group and others have performed gene expression profiling (GEP) of cHL and ALCL and identified BATF3, a member of the AP-1 transcription factor family, as one of the most up-regulated genes in cHL and ALCL cells. In the present study, up-regulated expression of BATF3 was confirmed at mRNA and protein level in cHL and ALCL cells. To assess BATF3 function, small hairpin (sh)RNA vectors against BATF3 were generated to downregulate BATF3 in lymphoma cell lines. Transfection experiments demonstrate that downregulation of BATF3 leads to reduced cell proliferation and induced apoptosis in cHL and ALCL cell lines. To identify BATF3-regulated targets in BATF3-knockdown cells, GEP was performed. GEP after BATF3 knockdown demonstrated a significant downregulation of known MYC target genes and immunoblot analysis confirmed downregulation of MYC in shBATF3-transduced cells. Chromatin-immuno-precipitation (ChIP) experiments demonstrated that BATF3 regulates MYC expression by binding to an AP-1 element present in the MYC promoter. To examine whether BATF3 activity was connected to the constitutive JAK/STAT activation in cHL and ALCL, we treated cHL and ALCL cell lines with the JAK2 inhibitor TG101348 and found decreased levels of BATF3 protein, suggesting that BATF3 is regulated by STAT factors. Additionally, activation of JAK/STAT signaling by interleukin stimulation induced BATF3 expression in cHL and ALCL cell lines. ChIP experiments validated STAT binding to the BATF3 promoter, indicating that STATs directly regulate BATF3 expression. In conclusion, we recognized a new oncogenic axis in cHL and ALCL and revealed a complex transcription factor network in which BATF3 links STAT signaling to MYC expression.

P025
DETERMINATION OF THE MUTATIONAL LANDSCAPE OF PRIMARY HODGKIN AND REED-STERNBERG CELLS OF CLASSICAL HODGKIN LYMPHOMA

M. Schneider1,2, C. Döring1, J.C. Czeschik1, A. Lollies3, S. Hartmann1, S. Rahmann1, M.-L. Hansmann1, R. Küppers2

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Despite recent advances in our understanding of classical HL (cHL) the pathogenesis of this disease is still largely unknown. For instance, only a few genetic aberrations in the tumor cells of cHL, the Hodgkin and Reed/Sternberg (HRS) cells, have been identified. In general, the analysis of HRS cells is hampered by the rarity of the HRS cells which usually comprises only about 1% of the tumor tissue. To better understand the pathogenesis of cHL and to identify new genes critically involved in this process, we developed a method to perform whole exome sequencing of microdissected HRS cells. So far 11 primary cHL cases were successfully sequenced. The successful validation of 16 of 21 selected mutations in HRS cells of three cHL cases by direct PCR with microdissected cells and Sanger sequencing showed the reliability of the analysis. In a preliminary analysis of the data, NFKBIE mutations were identified in three cases. Thus, NFKBIE mutations are a recurrent event in cHL.

P026
HODGKIN CELL-DERIVED EXTRACELLULAR VESICLES SHAPE FIBROBLAST ACTIVITY

T. Bös, H.P. Hansen, A. Engert, E. Pogge von Strandmann

University Hospital of Cologne, Department of Internal Medicine I, Innate Immunity Group and German Hodgkin Study Group, Cologne, Germany

In Hodgkin lymphoma (HL) the malignant cells are greatly outnum-
bered by non-malignant immune cells supporting tumor growth and progression. Hodgkin Reed Sternberg (HRS) cells grow highly dependent on the microenvironment, which is actively shaped by a very complex cross-talk between the tumor cells and the reactive infiltrate. HRS cells secrete cytokines and angiogenic factors capable of recruiting and inducing the proliferation of surrounding cells to finally orchestrate their cellular microenvironment and to inhibit the development of an efficient antitumor immune response. Within this scenario, the role of extracellular vesicles (EVs) released by HRS cells which can communicate with other cells in trans has not been addressed yet. Recently, we demonstrated that EVs released by HRS cells impact on the formation of a tumor supportive niche by stimulating IL-8 release. Here, we investigate the role of tumor cell-derived vesicles on fibroblast activity and thus their impact on creating a tumor favorable surrounding. With single and co-cultures of the malignant cells and healthy stromal cells, the reciprocal effects on their cellular functions were analyzed. Using Fibroblast mediated exotaxin as a marker we could show that the bi-directional cross-talk is not entirely cell-cell contact dependent. Not only soluble factors, but also EVs had a positive effect on migration and chemotaxis, showing concentration depending effects. EVs released by malignant cells are internalized by fibroblasts and induce an inflammatory phenotype, which resembles the phenotype of cancer associated fibroblasts (CAFs). As a result of EV exposure, fibroblasts show selective changes in the secretome with enhanced expression of pro-inflammatory cytokines and hits related to NF B-Signaling. Further experiments indicate that in this context, NF B-Signaling is induced by TNF- trans- ported via EVs. Results are further supported by in vivo experiments using a HL Xenograft model.

**P027**

PROGNOSTIC IMPLICATIONS OF AN ACTIVE, INNATE OR ANERGIC IMMUNE RESPONSE IN THE HODGKIN LYMPHOMA TUMOR MICROENVIRONMENT

P. Hollander,1 K. Roostgaard,2 K.E. Smelby,3,4 D. Molin,1 L. Loskog,2 P. de Nully Brown,5 G. Enblad,1 R.-M. Amini1, H. Hjalgrim,1,2 I. Celimelius1,3 1Experimental and clinical oncology, Department of Immunology, Genetics and Pathology, Uppsala University, Uppsala, Sweden; 2Department of Epidemiology Research, Statens Serum Institut, Copenhagen, Denmark; 3Clinical Epidemiology Unit, Department of Medicine Solna, Karolinska Institutet, Stockholm, Sweden; 4Hematology Center, Karolinska University Hospital, Stockholm, Sweden; 5Clinical Immunology, Department of Immunology, Genetics and Pathology, Uppsala University, Uppsala, Sweden; 6Department of Haematology, Rigshospitalet, Copenhagen, Denmark; 7Clinical and Experimental Pathology, Department of Immunology, Genetics and Pathology, Uppsala University, Uppsala, Sweden

The classical Hodgkin lymphoma (cHL) tumor microenvironment includes a variable inflammatory response consisting of eosinophils, mast cells, macrophages, regulatory T lymphocytes (Treg) and active lymphocytes. We counted these inflammatory cells in tumor tissue from 459 patients with cHL from Sweden and Denmark, with complete clinical data available for 409 patients (Figure 1). Depending on the predominant cell types and their immunologic function we categorized the immune profile into an active, anergic or innate immune response with the aim to investigate if a specific tumor immune profile can predict survival. Time to progression (TTP) (primary progression, relapse or cHL death) and overall survival (OS) were analyzed using Cox proportional hazards regression. During follow-up (median 12.9 years) 49 patients had disease progression and 78 patients died. A high proportion of Treg (an anergic immune response) conferred shorter TTP when adjusted for age (hazard ratio (HR)=2.25; 95% confidence interval (CI) 1.15-4.41), especially in advanced stages (HR=2.83; 95% CI 1.25-6.40). In addition, a low proportion of Treg combined with a high proportion of macrophages conferred superior TTP when adjusted for age, stage, albumin and bulky tumor (HR=0.23; 95% CI 0.07-0.77). This is the first study to show that a tumor microenvironment characterized by an anergic immune response corresponds to a shorter TTP in cHL, indicating a reduced ability of an anergic immune system to attack the tumor cells. The programmed death receptor 1 (PD-1) is expressed by Treg, and these results warrant further investigation to determine if Treg is a predictor of response to PD-1 blocking drugs.

**P028**

STUDYING THE ROLE OF ONCOGENIC miR-24-3’ IN HODGKIN LYMPHOMA

Y. Yuan, J. Kluijer, J. Koerts, D. de Jong, B. Rutgers, A. Diepstra, L. Visser, A. van den Berg

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Introduction. Micro (mi)RNAs negatively regulate gene expression at the transcriptional level by binding to complementary regions in the 3’-UTR. They play important roles in biological processes such as proliferation, metabolism, differentiation and apoptosis. Abrupt expression of miRNAs contributes to several diseases including cancer. Although several miRNAs have been implicated in the pathogenesis of Hodgkin lymphoma (HL), the function of most of the aberrantly expressed miRNAs is unknown. Therefore, the aim of this study is to investigate the role of miRNAs and the underlying mechanism in HL. Results. Small RNA-seq revealed 84 significantly differentially expressed miRNAs in HL cell lines as compared to GC-B cells, including 55 up- and 29 downregulated miRNAs. QRT-PCR validation confirmed the differential expression pattern as observed with small RNA sequencing for 15 out of 19 selected miRNAs. Among the upregulated miRNAs, miR-23a, miR-24 and miR-27a were transcribed from one primary miRNA transcript. Loss-of-function analysis for these 3 miRNAs and their family members resulted in decreased growth upon miR-24 inhibition in L428, L1236 and KM12H and upon inhibition of miR-27a/b in L1236. No effect on cell growth was observed upon inhibition of miR-23a/b. Apoptosis analysis upon miR-24 inhibition revealed increased percentage of apoptosis cells, indicating that the decreased cell growth upon miR-24 inhibition was at least in part caused by an increase in apoptosis. To identify the target genes of these miRNAs we performed argonauta 2 (AGO2)-IP in four HL cell lines. This revealed 1,142 consistently AGO2-enriched genes. Gene set enrichment analysis revealed significant enrichment of the miR-23a/b, miR-24 and miR-27a/b target gene sets in the IP fraction. Furthermore, 51 out of 1,142 genes were predicated targets of miR-24 based on Targetscan, including 4 out of 5 proven miR-24 targets. Functional annotation analysis revealed a function related to cell growth, cell death and/or apoptosis for 15 out of the 52 genes. Western blotting for 2 of these genes, i.e. CDKN1B and MYC, showed downregulation at the protein level upon miR-24 inhibition.
Conclusions. A total of 84 miRNAs were significantly differently expressed in HL cell lines compared to GC-B cells. MiR-24 has an oncogenic role in HL by inhibiting apoptosis.

P029

CHARACTERIZATION OF HODGKIN LYMPHOMA CLONOGENIC CELLS USING A NEW L428 IN VIVO XENOGRAFT MODEL IN IMMUNODEFICIENT NOD/SCID-GAMMAC-/MICE AND PERIPHERAL LYMPHOCYTES STUDY IN HODGKIN LYMPHOMA PATIENTS

C. Cuceu1, M. Al Jawhari1, L. Morat1, M. Frenzel2, D. Lewandowski3, S. Junker4, P. Pflumio5, J. Bourhis3, T. Girinsky3, L. Sabater6, P. Carde4, R. M’kacher1,7

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The characterization of the cells at the origin of Hodgkin and Reed Sternberg cells in Hodgkin lymphoma (HL) is hampered mostly because of the poor growth of HL cells in vitro and in vivo. Investigation of cell markers and signaling pathways specific to HL clonogenic cells may lead to progress in therapy and improve the prognosis of patients with HL. Using a newly developed murine lead to progress in therapy and improve the prognosis of patients with markers and signaling pathways specific to HL clonogenic cells may establish an in vitro model of the poor growth of HL cells that could be used to determine the immunophenotype and cytogenetic profile of the clonogenic cells. Materials and Methods. L428 HL cell line was used to establish an in vivo xenograft model in immunodeficient NOD/SCID-gammac-/- mice. In vitro and in vivo clonogenic cells derived from L428 cell line and circulating lymphocytes of 50 HL patients were characterized using immunofluorescence, immunochromy and cytogenetic. Chromosomal instability was also investigated. Telomere maintenance mechanisms (telomerase activity (TA) and Alternative Lengthening Telomere (ALT)) were explored. Results. We confirmed previous data that L428 cell line contained small (<2%) subpopulations that lacked Telomere Maintenance Mechanism (TMM) and were characterized by a low G1-G2 DNA content. Over time, the cells acquired a higher telomere instability associated to the presence of higher frequency of dicentric chromosome. Conclusion. We better characterized the origin of the cells which grow in the L428 xenograft model, and their different steps of transformation from “clonogenic cells” to monocytes/macrophages and finally to Hodgkin and HRS cells due to the unique microenvironment of HL. The assessment of TA could be used as a biomarker of the prevalence of clonogenic cells in circulating lymphocytes.

P030

THE LYMPHOID CELL SPECIFIC TRANSCRIPTION FACTOR ELF-1 IS TRANSCRIPTIONALLY DOWNREGULATED AND RECURRENTLY DELETED IN CLASSICAL Hodgkin lymphoma

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ELF-1 and ELF-2 belong to the ETS-family of transcription activators or repressors implicated in processes recurrently deregulated in human neoplasms. Recently, we have shown that genes hypermethylated in cHL are enriched for binding sites of ETS-family members ETS-1 (1.28 fold), ELF-1 (1.07 fold) and ELF-2 (1.91 fold). We hypothesized that hypermethylation of genes in cHL might be secondary towards genomic alterations of these B-cell related transcription factors. In line, we have recently reported recurrent alterations and significant downregulation of ETS-1 expression in cHL. Encouraged by this finding, here we analyzed the two other ETS family members in cHL. We show significant downregulation of ELF-1 (1.82 fold, p=0.0001, tag 40067_at) and 1.36 fold of ELF-2 (tag 307_s_at) in cHL cell lines (n=4) compared to GCB pools (n=20) (U95 microarray). This was further validated for ELF-1 in primary biopsies where using immunohistochemistry (AB99401) we observed loss or downregulation of the protein in HRS cells in 26/35 (74%) cases but not in no-tumor bystander cells. In case of ELF-2 no reduction of protein abundance was observed. To identify the underlying mechanism we sequenced the ELF-1 coding region in 7 cHL cell lines but no mutations were identified. In contrast, we analyzed copy number (CN) alterations of the ELF-1 locus in primary biopsies using combined immunohisto- typing and in situ hybridization (FICTION) and identified deletions in 5/11 (45%) analyzed cases. Similarly, deletions or LOH were found in 4/7 (57%) cHL cell lines (Affymetrix SNP 6.0 array). Also epigenetic mechanism may contribute to ELF-1 downregulation as using next-generation miRnome sequencing we observed 3.26 fold overexpression (p=0.0018) of the hsa-miR-330-3p in cHL cell lines (n=7) compared to non-Hodgkin lymphomas (n=10). Hsa-miR-330-3p shows significant affinity (p=0.0013) towards the 3’UTR region of ELF-1 basing on in silico analysis (mirWalk). In conclusion, we show recurrent loss of ELF-1 expression in HRS cells that at least in part is attributable to the genomic deletions and overexpressed hsa-miR-330-3p. Moreover, our data support the concept, that downregulation of the ELF-1 transcription factor may lead to consequent hypermethylation and silencing of its target genes contributing to the loss of B-cell phenotype of HRS cells.

P031

MUTATIONS IN CD58 AND MYB IN HODGKIN LYMPHOMA

F.R. Abdul Razak, A. Diepstra, D. Jong, J. Koerts, B. Rutgers, J. Kluiver, L. Visser, A. van den Berg

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Hodgkin lymphoma (HL) is characterized by constitutive activation of several signaling pathways and expression of a distinct set of transcription factors. This characteristic phenotype is partly caused by gene mutations as determined by targeted and whole genome sequencing on cell lines and microdissected HRS cells. Here we gene studied CD58 and MYB, 2 genes we previously identified by whole exome sequencing (WES) in HL cell lines. CD58 gene mutations observed in 5 HL cell lines were confirmed by Sanger sequencing at the DNA and RNA level. CD58 protein expression as determined by flow western blot and IHC was absent in all 3 HL cell lines with mutations and present in 4 HL cell lines with wild type CD58. In primary tissue samples, loss of CD58 expression was observed in 11% of the patients. Lack of CD58 was specifically observed in patients who developed a relapse. This suggests that loss of CD58 is a potential
immune escape mechanism of HRS tumor cells, especially in clinically aggressive disease. Frame shift mutations resulting in a truncated MYB protein were found in L428 and SUPHD1 cells. The mutation in L428 causes complete loss of most of the C-terminal domain whereas the mutation in SUPHD1 results in a MYB protein with a partial loss of the C-terminal domain. We confirmed the mutations at the DNA and RNA level and confirmed presence of a truncated protein by Western blot with C-terminal and N-terminal domain specific antibodies. RT-PCR with primers specific for each of the alternatively spliced exons, indicated that these were not included in the MYB transcript in any of the HL cell lines. In tissue samples, staining of MYB in HL cases revealed no staining with both antibodies in the vast majority of the cases, indicating complete loss of the MYB protein. Inhibition of MYB by shRNA constructs induced negative effects on cell growth in HL cell lines with wild type MYB (L540 & KMH2) and no or limited effects in HL cell lines with truncated MYB (L428 & SUPHD1). Microarray analyses of L540 & KMH2 cells treated with non-targeting and MYB shRNA constructs revealed 63 consistently MYB induced and repressed genes. In conclusion, we show that loss of CD58 expression is common in HL cell lines and restricted to the HRS cells of tissue samples of relapsed HL. For MYB, strong oncogenic effects were observed especially for the HL cell lines with wild type MYB.

**P032**

**RE-FUSION OF SMALL MONONUCLEATED HODGKIN CELLS LEADS TO GIANT MULTINUCLEATED REED-STERNBERG CELLS IN HODGKIN LYMPHOMA**


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The multinucleated Reed-Sternberg (RS) cells are pathognomonic for classical Hodgkin lymphoma (HL) and their presence is essential for diagnosis. However, the development of these giant tumor cells is controversially discussed. It was postulated that RS cells arise from mononucleated Hodgkin cells via endomitosis. Conversely, continuous single cell tracking of HL cell lines by long-term time-lapse microscopy showed that cell fusion is the main route of RS cell formation. In contrast to growth-induced formation of giant Hodgkin cells, fusion of small mononucleated cells followed by size increase gives rise to giant RS cells. Importantly, we nearly exclusively observed fusion of cells originating from the same ancestor, termed re-fusion. In the majority of cases, re-fusion of daughter cells was preceded by an incomplete cytokinesis, visualized by a microtubule bond between the cells. We confirm at the level of individual tracked cells that giant Hodgkin and RS cells have little proliferative capacity, further specifying small mononucleated Hodgkin cells as the proliferative compartment of the HL tumor clone. In addition, sister cells showed a shared propensity for re-fusion, which provides evidence of early RS cell fate commitment. Thus, RS cell generation is neither due to cell fusion of unrelated Hodgkin cells nor to endomitosis, but is mediated by re-fusion of daughter cells that underwent mitosis. This surprising finding indicates the existence of a novel mechanism for the generation of multinuclear RS cells, which might have implications beyond HL, as RS-like cells are frequently observed in several other lymphoproliferative diseases.

**P033**

**MOLECULAR CHARACTERIZATION OF BRUTON’S TYROSINE KINASE INHIBITOR IN HODGKIN’S LYMPHOMA: CELLULAR AND ANIMAL MODELS**

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*Abstract. Classical Hodgkin Lymphoma (cHL) is a malignancy of mature (post germinal center) B-lymphocytes that affects almost 20,000 individuals annually in North America and Europe alone. While the majority of patients diagnosed with HL are cured with multi-agent chemotherapy, 15% of patients are refractory to conventional chemotherapy and almost half of patients with high-risk disease relapse. Only 2 agents have been approved in the last 30 years for relapsed HL and novel therapies are needed. Bruton’s Tyrosine Kinase (BTK) is a member of the Tec family and plays a central role in B-cell signaling, activation, proliferation and differentiation. Several studies have shown that BTK is upregulated in a proportion of Reed-Sternberg cells and has been associated with PI3K, mTOR, FAS and NF-κB signaling. Furthermore, pathways upregulated in cHL such as CD40 ligand and binding, elevated chemokines such as IL-6 and activation of toll-like receptor (TLR) pathways have been associated with BTK upregulation. Thus, BTK inhibition may have therapeutic potential in cHL. Methods. The BTK inhibitor Ibrutinib at 0-15 micro molar doses was incubated for 72 hrs. with a panel of HL cell lines (KM-H2, L1236, L-428). Cell viability was evaluated using trypan blue. Apoptosis was analyzed using annexin V FITC and histone DNA ELISA. Protein expression was analyzed using western blotting with RNA post ibrutinib treatment subjected to RT PCR. Results. Ibrutinib suppressed viability of these HL cell lines in a dose dependent manner (IC50s = 5-7.5 µM in KM-H2, L1236 and L-428). The drug induced statistically significant apoptosis in the responsive cell lines in a dose dependent manner (>50% apoptosis at IC50 doses). Molecular analysis using western blotting and RT-PCR revealed significant induction of apoptotic markers and down-regulation of pro-survival markers. Further characterization of the effect of Ibrutinib on PI3K, mTOR, FAS and NF-kB signaling is ongoing. Ibrutinib is now being evaluated in ICR SCID mice with sub-cutaneous xenografts of KM-H2 and L1236. A pre-clinical efficacy trial using maximum tolerated dose (MTD) given by gavage is ongoing. Conclusions. These are the first studies showing *in vitro* and *ex vivo* effects of BTK inhibitors in HL and may provide support for further clinical investigation.

**P034**

**FUNCTIONAL ANALYSIS TO ELUCIDATE THE SUSCEPTIBILITY MECHANISMS OF SNPs AT THE REL, GATA3 AND TCF3 LOCI IN CLASSICAL HODGKIN LYMPHOMA**

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*Introduction. Genome Wide Association Studies (GWAS) revealed significant associations for SNPs mapping at the REL, GATA3 and TCF3 loci with cHL susceptibility. In this study, we aim to elucidate the susceptibility mechanism of these associations by establishing possible expression quantitative trait loci (eQTL) effects. Methods. EQTL analysis was performed in EBV transformed lymphoblastoid cell lines (LCLs) generated from 96 controls and 70 former cHL patients as well as in three previously published large gene expression studies of HRS cells and total HL tissue samples. Results. An eQTL effect for REL was found using cHL total tissue array data with increased REL expression levels for individuals carrying the homozygous risk allele. No significant effects were observed for the HRS cell data and for the LCLs. For GATA3 a significant association was found...*
in the patient derived LCLs with lower GATA3 levels in LCLs of homozygous risk allele carriers, while no effect was observed for the control LCLs, or the HRS cell and the cHL total tissue array data. Only in the control LCLs lower TCF3 expression levels were found for individuals homozygous for the risk allele. To identify the downstream targets of these three transcription factors we performed gene expression arrays of cHL cell lines infected with shRNA constructs. We identified 1005, 1052, 1602 differentially expressed genes for REL, GATA3 and TCF3, respectively. eQTL analysis of the array data focusing only on these downstream targets is ongoing. Conclusions. For REL, GATA3 and TCF3 we observed an eQTL effect in at least one of the studied groups. For REL and TCF3 the eQTL pattern is consistent with the proposed susceptibility effects of these genes, i.e. higher REL levels stimulating cell growth and lower TCF3 levels supporting the loss-of-B-cell phenotype for the risk alleles. Surprisingly, for the T-helper 2 specific transcription factor GATA3 the risk allele is associated with decreased levels in B-cells, but apparently not in T-cells. Our data support a functional role for the risk and protective SNP alleles in cHL susceptibility.

**P035**

**IGH-MEDIATED TRANSLOCATIONS, RECURRENT IN CLASSIC HODGKIN LYMPHOMA, FREQUENTLY CORRELATE WITH AN AGGRESSIVE BEHAVIOR**


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Cytogenetic features of classic Hodgkin lymphoma (cHL) remain largely unknown. Interphase FISH (iFISH) studies, however, suggest that IGH-mediated t(14q32) are recurrent in cHL (PMID: 17079453, 18940474). Recently, we have identified t(14;18)(q32;q21)/IGH-BCL2 and inv(14)(q11q32)/IGH-CEPBE in two patients with nodular sclerosis Hodgkin lymphoma (NSHL) analyzed at time of relapse. To identify additional cHL cases with t(14q32/IGH) and check whether these rearrangements correlate with clinical outcome, we screened by iFISH: (i) 46 relapsed cHL, (ii) 40 control LCLs, or the HRS cell and the cHL total tissue array data. Only 3 cases with likely inv(14)/ins(14), CEPBE BA was applied. Altogether, 3 cases were successfully analyzed by iFISH: (i) 46 relapsed cHL, (ii) 40 cHL with a long-term remission, and (iii) 60 prospective cases. Altogether, IGH rearrangements were detected in 28 patients, including 17 representing the former group (35.4%), 4 cases representing the second group (10%) and 7 prospective cases (11.6%). LSI IGH FISH pattern suggested a reciprocal t(14q32/IGH) in 20 cases, nonreciprocal t(14q32/IGH) in 4 cases, inv(14q32/IGH) or ins(14q32/IGH) in 3 cases and interstitial deletions in 4 cases. Twenty six cases were further analyzed by iFISH with break-and-BA assays for BCL2, BCL3, BCL6 and MYC. In 3 cases with likely inv(14)/ins(14), CEPBE BA was applied. Altogether, we have identified the IGH-BCL2 rearrangement in two cases, including the index case with t(14;18), and the IGH-CEPBE rearrangement in the case with inv(14). All the remaining cases showed a non-rearranged status of the examined loci. The majority of patients (18/28) with t(14q32/IGH) were diagnosed with NSHL. There were 18 male and 10 female patients in age ranging from 18 to 91 years (mean 50). Patients presented with both early (10/26) and advanced (16/26) stage (two not staged). All were treated with chemotherapy with or without radiotherapy, except for two patients who were subjected to a palliative treatment. After induction therapy, complete and partial remission was achieved in 17 and 5 patients, respectively. Thirteen patients are alive (11 without disease and 2 with disease); 13 patients died, including 11 whose death was related with a disease, and two are lost for follow up. In summary, we confirmed that chromosomal aberrations involving 14q32/IGH occur recurrently in cHL. These rearrangements rarely target BCL2 and CEPBE, and do not affect BCL3, BCL6 and MYC. Interestingly, 17 out of 21 (81%) patients with t(14q32/IGH) showed an aggressive behavior. Our study allows a new insight into the pathogenesis of cHL and might help in further stratification of cHL patients.

**P036**

**TIGHTLY REGULATED FOXO3 EXPRESSION IS CRITICAL FOR THE MAINTENANCE OF cHL**

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FOXO (forkhead box O) transcription factors regulate genes involved in cell cycle arrest, apoptosis, or oxidative stress response. Recently, we have shown that FOXO1 is specifically repressed in classical Hodgkin lymphoma (cHL) and thus acts as a tumor suppressor in this tumor entity. In contrast, FOXO3 was reported to be markedly expressed in the malignant Hodgkin and Reed-Sternberg (HRS) cells of cHL, but not in other B-cell lymphoma subtypes. We confirmed a high FOXO3/FOXO1 ratio in cHL by analysing publicly available gene expression profiling (GEP) data and found that this ratio is similar to those of plasma cells (PC) and multiple myeloma (MM). Of note, cHL FOXO3 expression was higher than in non-HL, but still less than in terminally differentiated MM cell lines. These intermediate FOXO3 levels might reflect the ‘‘abruptive PC differentiation’’ phenotype of cHL. Moreover, analysis of GEP data of microdissected HRS cells revealed a positive correlation between FOXO3 and PRDM1 expression, the master regulator of PC differentiation and a tumor suppressor in cHL. This is similar to our previously published findings showing that FOXO1 regulates PRDM1, the active isoform of PRDM1. Using ChIP, we next proved that FOXO3, too, directly binds to the PRDM1 promoter in cHL. To further investigate this interaction, we overexpressed a constitutively active variant of FOXO3 (FOXO3(A53E)) in cHL cell lines. FOXO3 activation increased PRDM1 expression levels and inhibited proliferation of cHL cell lines. So far, frequent genomic deletions are known to restrict FOXO3 levels in cHL. Aiming to identify additional factors involved in the tight regulation of FOXO3 in cHL, we found that miR-155 negatively influences FOXO3 expression. Paradoxically, knockdown of FOXO3 with the help of a specific shRNA also showed an antitumor effect in two of three cHL cell lines, whereas FOXO1 downregulation was not toxic. Our data suggest that intermediate levels of FOXO3 contribute to abruptive PC differentiation of cHL and that tightly regulated FOXO3 expression might be critical for the oncogenic program of cHL.

**P037**

**IN VITRO AND IN VIVO PRECLINICAL ACTIVITY OF EDO-S101 IN HODGKIN LYMPHOMA**

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Background. EDO-S101 is a salting out histone-deacetylase inhibitor (HDACi) fusion molecule that combines the strong DNA damaging effect of Bendamustine, with a fully functional pan-HDAC inhibitor, vorinostat. In this work, we investigated the preclinical rationale for the use of EDO-S101 in Hodgkin lymphoma (HL). Materials and Methods. In vitro, a panel of 8 HL cell lines was used to study the cytotoxicity of EDO-S101 alone and combined with radiation therapy, and to investigate its cellular and molecular effects. In vivo, we investigated in immunodeficient NOD/SCID-gammag-/- mice xenografted with the
L428 the antitumor effect of EDO-S101 alone. This evaluation, based on organ infiltration and survival, was performed following one single (60mg/kg or 80mg/kg) dosing or a repeat- dose (60mg/kg) of EDO-S101. Results. In vitro, the IC50 of EDO-S101 ranged between 1.6 to 6.3 M in 8 HL cell lines after a 48-h exposure. All HL cell lines showed a high sensitivity to EDO-S101; a clonogenic survival assay confirmed these observations. Multiple mechanisms of action of EDO-S101 were identified.

In one group of HL cell lines (L428-L428-s, L540, SUP-HD), L591 and KM2), activation of apoptosis was independent of the F53 status. The combination of EDO-S101 with irradiation demonstrated a dramatical enhancement of apoptotic cell death via G2 arrest. In a second group (L1236 and HDLMM2), with the higher sensitivity to EDO-S101, resistance to apoptosis was associated with a higher frequency of chromatic aberrations involved in mitotic cell death. The effect of radiation was marginal in this group. In vivo, in mice engrafted with the L428 cells, treatment with EDO-S101 reduced drastically L428 cells infiltration, and prolonged survival of EDO-S101 treated mice in comparison with those untreated. Histological evaluation of the infiltration of tumoral cells after EDO-S101 treatment showed a significant reduction of tumour cell infiltration, more pronounced after a single dose of 80 mg/kg EDO-S101 than after two administrations of 60mg/kg. We observed a high liver weight heterogeneity in untreated mice, contrasting with homogeneous weight in treated mice. The absence of necrotic tumoral cells and cell degeneration in treated mice could be correlated to the anti-tumoral effect of EDO-S101 confirming the efficacy of EDO-S101. Conclusions. Our results show the antitumoral activity of EDO-S101 in pre-clinical models of HL, both in vitro and in vivo.

P038
HODGKIN REED-STEINBERG CELLS IN CLASSICAL HODGKIN LYMPHOMA ARE SURROUNDED BY T REGULATORY CELLS WHILE LYMPHOCYTE-PREDOMINANT CELLS OF NODULAR LYMPHOCYTE PREDOMINANT HODGKIN LYMPHOMA ARE SURROUNDED BY T FOLLICULAR HELPER CELLS
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While it is clear that there is an important role for the microenvironment in Hodgkin lymphoma (HL), the composition and functionality is still a matter of discussion. Both a Th2 and a Th1 phenotype has been described in classical HL (cHL), irrespective of the Epstein Barr virus (EBV) status of the tumor cells. A systematic comparison between cHL and nodular lymphocyte predominant HL (NLPHL) has not been performed before and studies on the composition of the cells in- versus outside of the tumor area are missing. We compared the composition of the microenvironment of 14 cHL (7 EBV+ and 7 EBV-) and 10 NLPHL suspensions by flowcytometry. CD26 expression was used to identify cells in- (CD26+) and outside (CD26+) the tumor cell area. Results. In EBV- cHL there were more CD56+CD16+ NK cells, and more CD69+, Granyme B+ and TIA-1+ CD8+ cells than in EBV- cHL. We saw no differences between EBV+ and EBV- cHL when looking at the location of the cells. Compared to cHL, NLPHL contained more PD-1+ CD4+ cells and PD-1+CD57+CD4+ cells, while cHL showed more CCR7+CD45RA+CD4+, FoxP3+CD4+, CD25+CD4+, CXCR5+ICOS+CD4+, CXCR3+CD8+ and CD56+ cells. In cHL, we found more CD69+CD4+ and FoxP3+CD4+ cells inside, and more CD25+CD8+ cells outside the tumor cell area. In NLPHL, the distribution of CD69+CD4+ cells and CD25+CD8+ cells was similar to cHL. In addition, we found more CD69+CD4+ and more PD1+CD4+ cells inside, and more FoxP3+CD25+CD4+ cells outside the tumor cell area. Both HL subtypes are characterized by high numbers of CD69+CD4+ cells inside the tumor cell area, and a shift of CD25+CD8+ cells from in- to outside the tumor cell area. Conclusions. PD-1+CD4+ T follicular helper cells normally provide help to germinal center B cells and the increase in the tumor cell area of NLPHL indicates a similar function for LP cells. In cHL, the increase of FoxP3+ T regulatory cells might provide an immune suppressive environment for the HRS cells. Both types of HL depend on different cells in the direct tumor cell environment, fitting the different nature of the tumor cells.

P039
THE INCIDENCE OF BLEOMYCIN INDUCED LUNG TOXICITY IS INCREASED IN HODGKIN LYMPHOMA PATIENTS EXPOSED FOR GRANULOCYTE-COLONY STIMULATING GROWTH FACTOR
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Background. In Hodgkin lymphoma (HL) the risk of developing bleomycin pulmonary toxicity (BPT) is well described. A number of factors that could potentially increase the risk of this condition have been suggested e.g. increasing age, bleomycin dose, smoking history. The use of granulocyte-colony stimulating factor (G-CSF) has also been proposed as a potential risk factor for BPT. In the present study, we have investigated the incidence of BPT in the face of possible risk factors in a cohort of HL patients treated at our institution between 1990 and 2014. Methods. Information on clinico-pathological parameters including the occurrence of BPT, the use of filgrastim/pegfilgrastim and smoke habits was obtained from clinical records. BPT was defined as pulmonary symptoms occurring during the course of chemotherapy, presence of infiltrates on chest X-ray or CT-scan and absence of infection. Patient characteristics were correlated to the presence of BPT and use of G-CSF using the chi2-test. Overall- and progression-free survival (OS and PFS), were analyzed by the Kaplan-Meier method. Results. 413 patients with a median age of 58.5 yrs (range: 16-86 yrs) were analyzed. The M:F ratio was 1.3. A total of 155 patients (38%) had disseminated disease. B-symptoms and bulky lesions were present in 48% and 31% of the patients, respectively. A history of smoking was reported in 47% of all patients. A total of 36 patients (9%) were diagnosed with BPT. The incidence of BPT was found to be higher among patients with high stage (p<0.001) and among those presenting with B-symptoms (p=0.008), i.e. the subsets that were likely to have received the largest amounts of bleomycin. A trend was found towards a higher incidence with increasing age (p=0.06). No correlation was found between BPT and a smoking history (p=0.57). Patients presenting with BPT were more likely to have been exposed to the use of G-CSF (p=0.03). Interestingly, the highest number of BPT events was observed among the patients exposed to the PEGylated forms of G-CSF (p=0.02). When stratifying the analysis according to age, the above correlations remained significant in the age group above 45 years, but did not seem to impact the younger patients. Conclusions. In the present study, the occurrence of BPT was correlated to the presence of disseminated disease and B-symptoms at the time of diagnosis. We also found a higher incidence of BPT among the patients that were exposed to G-CSF during the course of chemotherapy.

P040
CORRELATION BETWEEN PRE-TREATMENT LEVEL OF SOLUBLE PD-L1 AND OUTCOME IN CLASSICAL HODGKIN LYMPHOMA INCLUDED IN A PROSPECTIVE STUDY OF THE LYMPHOMA STUDY ASSOCIATION
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Introduction. Classical Hodgkin Lymphoma (CHL) is characterized by PD-L1/L2 deregulation with the effectiveness of PD-1 blockade
treatment. Pre-treatment level of soluble PD-L1 (sPD-L1) was more
diffuse large B-cell lymphoma (DLBCL) patients than in controls and was associated with overall survival. We evaluated pre-
treatment sPD-L1 level of 126 CHL patients included in a prospective study of the Lymphoma Study Association (LYSA) and 37 controls. Methods. The cohort consisted in 126 CHL patients enrolled between 1998 and 2002 in a prospective study of the LYSA assessing the prognostic values of plasma cytokines and soluble receptors. A peripheral blood sample for plasma was collected from all patients at diagnosis before any treatment. The protein expression of sPD-L1 was evaluated in duplicate using an ELISA kit. A Zero-Inflated Binomial-Negative
distribution linked to protein localization and transport were upregulated.

Methods. A Zero-Inflated Binomial-Negative regression model was used to compare sPD-L1 levels in CHL patients and controls. Correlation between log-transformed sPD-L1 level and clinical characteristics, EBV status and cytokine levels measured before any treatment (IL-10, TNF, TNF-R1, TNF-R2, IL-6, IL-18, sCD50), response to initial treatment and progression-free survival (PFS) were investigated. Results: the median age of the 126 CHL patients was 33 years (range, 15-93), 68% had an Ann Arbor stage I-II and 71% had an IPS score of 0-2. Nodular sclerosis was the main histologic subtype (83%). The EBV status was positive in 18 (27%) patients. 67% patients were treated with ABVD, 14% of patients progressed or relapsed and 11% died. sPD-L1 mean level in CHL patients was 5.6 times more elevated in cases than in controls (95% CI: 2.66-4.76, p= 8.2e-13; estimated means for cases and controls: 869 vs 309 pg/ml; medians: 549 vs 1954 pg/ml). No statistically significant correlation/association was found between sPD-L1 level and age, Ann Arbor stage, ECOG-PS, IPS, lymphocyte count, EBV status, the different evaluated cytokines, response to treatment and PFS. Conclusions. CHL patients have a PD-L1 level in plasma which is higher than controls and DLBCL patients. Further studies are needed to decipher the prognostic role of sPD-L1 level in larger cohort including patients with more advanced stages and treated with immune checkpoint inhibitors.

P041
PROTEASOME INHIBITOR THERAPY IN HODGKIN LYMPHOMA: LEVERAGING SYSTEMS BIOLOGY ANALYSES FOR CELL-SPECIFIC TRANSCRIPTOME ALTERATIONS AND OPTIMUM COMBINATORIAL THERAPY
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Introduction. NF-B has been shown to be critical for HL cell survival. Ixazomib is a new oral PI with favorable pharmacodynamic and pharmacokinetic; we recently reported activity of ixazomib in HL cells and in vivo SCID xenografts (Ravi et al. Cancer Research. 2016). SBA favored tumor inhibition via downregulation of MYC and CHK1 with CHK1 involved in Myc alteration through chromatin modification & histone H3 acetylation. Continued dissection of cell-specific transcriptome changes with PIT is needed and potential combination therapy with ixazomib should be explored. Methods. We examined ixazomib-induced transcriptome changes in L540 & L428 cells that were ixazomib sensitive and also with generated resistance. Key genes were derived from overlapping Ingenuity Pathway Analysis (IPA) and Gene Set Enrichment Analysis (GSEA). SBA were used to identify genes related to treatment response; and based upon the aforementioned results, we studied the HDAC inhibitor (HDACi), belinostat, combined with ixazomib. Results. On GSEA (Figure 1A), ixazomib induced downregulation of mitotic cell cycle in L540 cells, while L428 cells had noted upregulation. Chromatin architecture was downregulated in L540, while L428 had no change. Catabolic activity and vesicular transport sPD-L1 level of 126 CHL patients included in a prospective study of the LYSA assessing the prognostic values of plasma cytokines and soluble receptors. A peripheral blood sample for plasma was collected from all patients at diagnosis before any treatment. The protein expression of sPD-L1 was evaluated in duplicate using an ELISA kit. A Zero-Inflated Binomial-Negative regression model was used to compare sPD-L1 levels in CHL patients and controls. Correlation between log-transformed sPD-L1 level and clinical characteristics, EBV status and cytokine levels measured before any treatment (IL-10, TNF, TNF-R1, TNF-R2, IL-6, IL-18, sCD50), response to initial treatment and progression-free survival (PFS) were investigated. Results: the median age of the 126 CHL patients was 33 years (range, 15-93), 68% had an Ann Arbor stage I-II and 71% had an IPS score of 0-2. Nodular sclerosis was the main histologic subtype (83%). The EBV status was positive in 18 (27%) patients. 67% patients were treated with ABVD, 14% of patients progressed or relapsed and 11% died. sPD-L1 mean level in CHL patients was 5.6 times more elevated in cases than in controls (95% CI: 2.66-4.76, p=8.2e-13; estimated means for cases and controls: 869 vs 309 pg/ml; medians: 549 vs 1954 pg/ml). No statistically significant correlation/association was found between sPD-L1 level and age, Ann Arbor stage, ECOG-PS, IPS, lymphocyte count, EBV status, different evaluated cytokines, response to treatment and PFS. Conclusions. CHL patients have a PD-L1 level in plasma which is higher than controls and DLBCL patients. Further studies are needed to decipher the prognostic role of sPD-L1 level in larger cohort including patients with more advanced stages and treated with immune checkpoint inhibitors.
Hodgkin lymphoma (HL) still die following relapse or progressive disease and a similar proportion of patients are overtreated, leading to treatment-related late sequelae, including solid tumors and organ dysfunction. We analyzed telomere maintenance mechanisms (TMMs) of HL cell lines as well as the samples from HL patients treated with standard therapy and compared the TMMs with favorable and unfavorable clinical outcome. Materials and Methods. Frozen lymph node samples obtained from 38 HL patients during diagnostic lymph node biopsy and from 24 patients with lymphadenitis were entered in this study. All HL patients were stage I (84.2%) and II (15.8%) with mean age of 36.7 years and 94.7% were nodular sclerosis. Seven HL cell lines were used as a positive control. Telomerase activity (TA) and alternative lengthening telomere (ALT) profile were assessed as well as Epstein Barr Virus (EBV) status and protein expression levels. The TMMs were correlated to clinical outcomes of patients (10.3 years) as well as to radiation sensitivity of HL cell lines. Results. The major finding of this study is the presence of both TA and ALT mechanisms in selected lymph nodes of HL patients. This TMMs heterogeneity was confirmed in HL cell lines. Hodgkin and Reed Sternberg (HRS) cells demonstrated an ALT profile, while the small cells exhibited a higher telomerase activity. We identified in the same tumor lymph node HRS cells containing ALT-associated PML bodies, a hallmark of ALT, and separate small cells expressing telomerase. Similarly, in HL cell lines, a high level of TA was detected in L428 and SUP-HD1. L1226 cell line demonstrated a lower TA and presented an ALT profile. The latent membrane protein (LMP1) staining revealed the presence of EBV genome in HRS cells in 13 lymph nodes (34.2%). A higher expression of TREF2/PML (ALT profile) and CD68 in EBV positive patients was correlated with Overall Survival (p=0.02), Freedom From Progression (p=0.02) and Event Free Survival (p=0.003). ALT HL cell lines demonstrated a lower radiation sensitivity as compared to TA HL cell lines. Conclusions. The presence of both TMMs (TA and ALT) in HL lymph nodes and HL cell lines is a singular oncology phenomenon. TMMs, related to tumor microenvironment in HL lymph nodes, are associated with treatment response and survival of HL patients.

**P043**

PHENOTYPIC CHARACTERIZATION OF CIRCULATING LYMPHOCYTES IN HODGKIN’S LYMPHOMA WITH FOCUS ON T CELLS

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Background. The malignant cells in HL comprise only a small fraction of the total tumor population but orchestrate an inflammatory microenvironment of reactive cells that sustains tumor cell survival and growth. HL patients (pts) have high systemic levels of inflammatory cytokines and chemokines and low lymphocyte count (<0.6x10^9/L) is a well-established prognostic factor in advanced disease. The aim of this pilot study was to characterize the phenotype of circulating lymphocytes in HL pts. Materials and Methods. Peripheral blood samples were obtained from 10 HL pts and 12 sex- and age-matched healthy controls. Nine pts had classical HL and 1 had nodular lymphocyte predominance (NLP) HL. Five pts had limited (stage I-IIA) and 5 had advanced (IB-IV) disease. Pts with ongoing acute EBV infection were excluded. All pts had negative serology for HIV. Absolute numbers of CD19+, CD3+, CD4+, CD8+, NK and NKT cells, functional T helper subpopulations (Th1/Th2/Th17), CD4+ and CD8+ memory cell subsets and expression of CTLA-4, PD-1, CD69 and Ki-67 on CD4+ and CD8+ T cells were assessed by flow-cytometry. Results. HL pts with advanced disease had lower lymphocyte counts compared to controls (median 0.9 vs 1.7x10^9/L, p=0.01) while no difference was observed for pts with limited disease. Compared to controls, HL pts had lower CD19+ cell numbers irrespective of disease stage (0.075 vs 0.5x10^9/L in pts with limited and advanced disease vs 0.19x10^9/L in controls, p=0.009 and p=0.0008, respectively). Pts with advanced disease had also significantly lower numbers, compared to controls, of CD3+ (median 0.78 vs 1.6x10^9/L, p=0.04), CD4+ (median 0.3 vs 0.5x10^9/L, p=0.04), Tregs (median 0.008 vs 0.017x10^9/L, p=0.004), Th2 (median 0.18 vs 0.23x10^9/L, p<0.05) and Th17 cells (median 0.03 vs 0.05x10^9/L, p=0.006), while no difference was observed for Th1. HL pts had lower numbers of naive CD8+ cells irrespective of disease stage, while central memory CD4+ cells were lower in advanced disease. No difference was observed with regard either to the numbers of proliferating (Ki67+) or PD-1- and CTLA-4-expressing CD4+ and CD8+ cells. On the other hand, CD69+CD4+ cells were significantly higher in pts with limited disease compared to controls (median 0.04 vs 0.01x10^9/L, p=0.04) (Figure 1). Conclusions. These observations suggest that the immune microenvironment in HL plays a role that is far from being only local. Further studies are ongoing in larger cohorts of pts.

**P044**

SIP-F1: A NEW GRAY ZONE LYMPHOMA CELL LINE?

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Lymphoid cancers are mainly classified according to their clinical presentation, morphology, immunology and molecular genetic features. Diagnosis of Hodgkin lymphoma (HL) is mainly based on pathognomonic Hodgkin and Reed-Sternberg cells (HRS). However, in the group of non-Hodgkin lymphomas (NHL), diffuse large B-cell lymphoma (DLBCL) can resemble typical features of HL. In some cases, a diagnostic pitfall exists at the interface of HL and DLBCL, so that, morphological overlaps and missing clear-cut diagnostic criteria complicate classification of these so-called gray zone lymphomas (GZL). In a recent study, we analyzed a newly established GZL cell line (SIP-F1) derived from a lymph node biopsy of a male 20-year-old
CD4 LYMPHOPENIA AS A PROGNOSIS FACTOR IN PREVIOUSLY UNTREATED HODGKIN LYMPHOMA

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Peripheral lymphopenia (PL) is included in IPS for advanced Hodgkin lymphoma (HL). Prognostic value of PL in stages I-II of HL as well as lymphocyte subsets responsible for PL have to be clarified. To evaluate the influence of baseline lymphocyte count on the treatment efficacy in HL total of 838 patients were included in the study. Flow cytometry was done in 83 patients, 47 (57%) had PL defined as lymphocyte count less than 1000/mm³. CD4 counts were available in additional 72 patients. Progression-free survival (PFS) and overall survival (OS) were analysed with reference to lymphocyte count at diagnosis and CD4 content. Results PL was found in 116/838 (14%) HL patients: 1.4% in early favorable (Gr.1), 7.5% in early unfavorable (Gr.2) and 18.6% in advanced HL (Gr.3). Flow cytometry data of 47 patients with PL revealed low T-cell counts in 41 (87%) of cases, mixed T- and B-cell lymphopenia in 25/41 (61%) cases, B-cell lymphopenia in 6/47 (13%) of cases. Deep CD4 lymphopenia (less than 200/mm³) was observed in 24 (16%) out of 155 patients; it was associated with age ≥ 45 (p=0.017), lymphoid depletion (p=0.13), advanced stage (p=0.061) and IPS score ≥ 4 (p=0.000). At a median follow up of 60 months, PFS rate and OS were significantly impaired in 58 patients with low CD4 count (less than 400/mm³). In Gr.1 progression occurred in one of the two patients who had both PL and CD4 lymphopenia; OS was 100%. In Gr.2, six patients with low CD4 counts at diagnosis had PFS 80% vs 95% in the rest, p=0.007; OS was 30% vs 100%, p=0.001. In 115 patients from Gr.3 those with low CD4 count (n=49) had PFS 72% vs 89%, p=0.037; OS was 75% vs 95%, p=0.003. Subset analysis in 91 patients with stages III-IV and IPS 0-3 supported negative impact of CD4 lymphopenia (PFS 79% vs 90%, p=0.266; OS 84% vs 97%, p=0.018). Conclusion The study shows that absolute lymphopenia is an independent adverse factor for stages I-II and for advanced HL patients with IPS 0-3. These results may justify alternative therapeutic strategies, including early antiCD30 therapy to account for CD4 lymphopenia at diagnosis.

CAN PLASMA CHEMOKINES AND SOLUBLE RECEPTOR MONITORING PREDICT OUTCOME IN CLASSICAL HODGKIN'S LYMPHOMA PATIENTS?

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The usual prognostic scores used in HL fail to identify some patients with worst outcome either in early or advanced stage HL. Pre-treatment cytokines, soluble receptor, cytokine signature (Casavanas/ICO 2007) and TARC profile have been described as biological markers correlated to tumour burden, to response and outcome. To evaluate the impact of TARC, IL6, IL1-RA, sCD30 and TNF-R1 levels on response and outcome, we collected plasma from 50 newly diagnosed HL patients at baseline, during therapy and at the end of chemotherapy. We also analysed the correlation of usual prognostic factors with cytokines and soluble receptor level. Between April 2010 and November 2013, 50 HL patients were enrolled (26 M/24F), median age was 51 years (18.5-63). Main clinical characteristics were as follow: stage I-II in 24 patients (according to EORTC classification: favourable: 7 and unfavourable: 17) and stage III-IV in 26 patients (IPS 1-2: in 15 patients). Thirty five patients were treated with ABVD and 15 patients with eBEACCP. Radiotherapy was added in 24 patients. Mean TARC level was 281 pg/ml (27-83098), mean IL6 level was 2.9 pg/ml (0.6-175), mean IL1-RA was 252 pg/ml (0.9-6609), mean sCD30 level was 33 U/ml (3.8-1007), and mean TNF-R1 level was 2129.5 ng/ml (314-8463). Baseline cytokine levels or cytokines signature did not correlate significantly with any clinical or biological factors nor with FDG-PET response. Ten patients disclosed relapse or progressive disease (R/R), only two patients died. With a median follow-up of 48 months, the event free survival (EFS) and overall survival (OS) at 3 years are 82% (95% CI 68-90) and 96% (95% CI 85-99) respectively. None of the classical prognostic factors as early response evaluated with FDG-PET were correlated with PFS. Neither baseline cytokines levels nor cytokine signature or early reduction of IL1-RA, sCD30, TNR-F1 level impacted significantly the outcome, but a trend was noted with early reduction of TARC and IL6. The decrease of TARC and IL6 seems to predict response to therapy and EFS. Unfortunately we failed to demonstrate any correlation between baseline cytokines or cytokine signature with biological or clinical characteristics, and outcome in this population. Surprisingly none of the usual prognostic factors predict outcome. These results could be perhaps explained by the small number of patients and should be confirmed in a larger prospective study.

EXPRESSION AND PROGNOSTIC IMPACT OF INDOLEAMINE 2,3-DIOXGENASE IN HODGKIN’S LYMPHOMA

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Background Indoleamine 2,3-dioxygenase (IDO) catalyzes the rate-limiting step in the metabolism of tryptophan along the kynurenine pathway. IDO is a key factor maintaining immune tolerance and expression correlates with poor clinical outcome in different types of cancer and hematological malignancies. Nowadays, not enough attempts have been made to evaluate IDO expression and its prognostic score value. We assessed the impact of the IDO expression on clinical outcome in patients with Hodgkin lymphoma (HL). Methods The case group included 23 patients (5 male and 18 female) with HL (median age: 19-60 years, range: 39.5). With early stage were diagnosed 52.2% and 47.8% with
advanced. Only 26% cases had B-symptoms. ABVD or BEACOPP (14/esc) were administered as a first-line therapy. In 65.2% and 34.8% cases, achievement remission and progression disease after treatment, respectively. The relative mRNA expression levels of IDO were measured in pre-treatment tumor tissue specimens from HL patients using real-time qPCR analysis. Results. The mRNA expression of IDO was found in 15 cases (65.2%) and further this group was considered as IDO-positive. The presence of IDO expression was significantly associated with advanced stage of disease and B-symptoms (p<0.05). The relapse was more frequently found in cases with IDO+ compared IDO- HL (30.47% versus 4.3%, p<0.05). 13% patients with IDO+ expression died and had an early relapse or refractory disease. ROC analysis revealed that IDO+ expression in the tumor is an important marker which is associated with reduced progression-free (PFS) and overall survival (OS) in HL patients (Se=87.5%, Sp=78%, AUC=0.85). 5-year PFS for patients with IDO+ expression was 44% versus 89% of IDO- expression (p=0.0003). Two-sample comparison between the IDO+ versus IDO-expression was done by the Cox F-test. The difference was significant for PFS and OS (p=0.03) (Figure 1). Conclusions. The obtained results suggest that the IDO-positive expression can predict clinical outcome in patients with HL and seems to be promising for the future studies.

Figure 1.

**P048**

**REED-STERNBERG CELLS ON BONE MARROW CYTOLOGY: THE VERY EARLY FEATURE ON HEMOPHAGOCYTIC LYMPHOHISTIOCYTOSIS ASSOCIATED TO HODGKIN LYMPHOMA**


Introduction. Hemophagocytic lymphohistiocytosis (HLH) is a hyper-inflammatory disorder resulting from primary or acquired immune dys-function. In adults, HLH is most frequently associated to infections, autoimmune diseases, and lymphomas, although Hodgkin lymphoma (HL) has been less frequently described. This immune activation leads to a variety of clinical and laboratory features, including pancytopenia, which makes bone marrow examination an important tool in order to identify possible trigger factors for HLH. Case Report. A 55 year-old white female, was referred to the Hospital das Clínicas de Botucatu – UNESP (São Paulo, Brazil) with a 4-day history of mental confusion. She had no palpable lymphadenomegaly, hepatosplenomegaly or abdominal mass. Complete blood count showed markedly pancytopenia. Lactate dehydrogenase was normal and serum ferritin was 9,621 mg/dl. Bone marrow (BM) cytology evaluation showed markedly hemophagocytosis and some large cells were identified as “Owl Eye Cell” and “Mononuclear Hodgkin’s Cells”. The bone marrow clot evaluation showed frequent epithelioid granulomas, without necrosis, and bi-nucleated and mononuclear cells with large nuclei and evident nucleoli, featuring classic Reed-Sternberg cells and Hodgkin’s cells. Immunohistochemistry confirmed the diagnosis of bone marrow infiltration by HL with granulomatous reaction. The Ziehl-Neelsen and Grocott-Gomori stains were negative (Figure 1). Discussion. BM cytological evaluation is immediately required in cases of pancytopenia for diagnostic purpose, regardless the level of blood counts. Especially in HLH, it is part of a systematic front-line clinical investigation for possible immune triggers. Epithelioid granulomas in BM or lymph nodes of patients with a nonspecific clinical presentation is a diagnostic challenge as it can be associated with a variety of autoimmune, inflammatory and neoplastic conditions. HL can present with granulomas in about 14% of cases, although it is unusually seen in BM biopsy. In this context, a careful morphological analysis with immunohistochemistry study is highly recommended considering that the absence of a typical HL presentation can sometimes postpone diagnosis and compromise disease outcome. Conclusions. This case highlights the importance of prompt investigation of pancytopenia in the context of HLH, with an early diagnosis of HL being made by BM cytology in a patient with no other symptoms that could suggest lymphoma.

Figure 1.

**P048B**

**A NOVEL PTPN1 SPLICE VARIANT REGULATES JAK/STAT ACTIVITY IN CLASSICAL HODGKIN’S LYMPHOMA CELLS**


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Background. Chronic activation of the Janus kinase (JAK)/ Signal Transducer and Activator of Transcription (STAT) signaling pathways is a hallmark of a variety of B cell lymphomas including the classical Hodgkin’s lymphoma (cHL). Constitutive JAK/STAT signaling is crucial for survival and proliferation of Hodgkin/Reed-Sternberg (HRS) cells, the malignant cells of cHL. Although the exact molecular basis of this constitutive JAK/STAT signaling in cHL has not been understood completely, accumulating reports highlight the role of an inactivation or reduced expression of negative JAK/STAT regulators like Silencer of Cell signaling 1 (SOCS1) or Protein-Tyrosine Phosphatase 1B (PTP1B)
in this process. Given the essential role of PTP1B and SOCS1 for the constitutive JAK-STAT signaling in cHL, the identification and characterization of the regulatory mechanisms controlling the activity of these negative JAK/STAT regulators is crucial for the understanding of their role for the pathogenesis of cHL. Here, we report the expression of different truncated PTP1B mRNA variants identified in cHL cell lines and primary cHL tumor samples lacking either one or several exon sequences. We describe the expression of a shorter PTP1B isoform in cHL as a novel negative control mechanism for PTP1B involved in the dis-regulation of the JAK-STAT pathway. Methods. PTP1B mRNA of cHL cases and cell lines was isolated and sequenced by Sanger sequencing. PTP1B protein expression was determined by western blot and immunohistochemistry analyses. Expression analysis of PTP1B mRNA variants was done by qPCR. To determine the role of PTP1BΔ6 for JAK/STAT signaling, stably transfected L428 cell clones either expressing PTP1BWT, PTP1BC215S, or PTP1BΔ6 variant which acts as a positive regulator of JAK/STAT signaling in cHL.

Results. Expression of PTP1B variants in cHL cases and cell lines was isolated and sequenced by Sanger sequencing. PTP1B protein expression was determined by western blot and immunohistochemistry analyses. Expression analysis of PTP1B mRNA variants was done by qPCR. To determine the role of PTP1BΔ6 for JAK/STAT signaling, stably transfected L428 cell clones either expressing PTP1BWT, PTP1BC215S, or PTP1BΔ6 were generated. Functional analysis of the novel PTP1BΔ6 variant was achieved by western blot analysis using phospho-STAT antibodies, luciferase reporter analysis and EMSA. The impact of the PTP1B variants on cell proliferation was examined by MTS assays. Results. In order to determine the molecular basis of the reduced or absent PTP1B expression in selected cHL cases, we isolated and sequenced the PTP1B mRNA. In contrast to the previously published study highlighting inactivating point mutations in the PTP1B gene of PMBL and cHL cases, we obtained a set of PTP1B variants which lack different exon sequences. One of these novel PTP1B variants, lacking exon 6 (PTP1BΔ6), was found to be expressed at low levels in cHL cell lines. However, serum stimulation of cHL augmented the expression of PTP1BΔ6 significantly. Functional characterization of PTP1BΔ6 revealed a positive impact on IFN-α and IL-4 induced JAK/STAT activity in HEK293 or HEK293-STAT6 cells, and on the basal STAT activity in stably transfected L-428 and U-HO1 cHL cell lines. Furthermore, PTP1BΔ6 expression increased the proliferation of L-428 and U-HO1 cells and the reduced cytotoxic effect of the chemotherapeutical agents gemcitabine and etoposide distinctively. Conclusions. Collectively, these data suggest that the activity of PTP1B in cHL is regulated by different molecular mechanisms including the expression of shorter PTP1B variants like the novel PTP1BΔ6 variant which acts as a positive regulator of JAK/STAT signaling in cHL.

Early Stages

TO10
LONG-TERM FOLLOW-UP OF CONTEMPORARY TREATMENT IN EARLY-STAGE FAVORABLE HODGKIN LYMPHOMA: UPDATED ANALYSES OF THE GERMAN HODGKIN STUDY GROUP HD7 AND HD10 TRIAL
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Background. Combined modality treatment (CMT) is considered as standard of care in patients with early-stage favorable HL. During the years, a gradual toxicity reduction through balancing extent and intensity of radiotherapy (RT) and chemotherapy was achieved. Long-term follow-up (FU) of the pivotal trials is needed, to ensure the applied therapies are safe and beneficial for our patients. Methods. We analyzed updated FU data of 1817 patients who were treated for early-stage favorable HL in previously published GHSG trials between 1993 and 2008. In the HD7 trial patients were randomized to either 40Gy extended-field (EF)-RT only or CMT with 2xABVD, and in HD10 to either 4x or 2xABVD and 30 or 20Gy involved-field (IF)-RT respectively. Progression-free (PFS) and overall survival (OS) were analyzed according to the Kaplan-Meier method. Cumulative incidences of secondary neoplasias (SN) were compared using Pepe & Mori’s test. The level of significance was set to 0.05. Results. The median FU was 120 and 98 months for patients in HD7 (n=627) and HD10 (n=1190), respectively. New FU data beyond the last evaluation were available for <50% of patients and last information was obtained from population registries in 18-30%. In HD7, CMT was superior to EF-RT with 15-year PFS estimates of 72.8% vs 52.2% and a hazard ratio (HR) of 0.45 (95% confidence interval CI: 0.33-0.61). No significant differences were observed regarding OS or SN. In HD10, non-inferiority of 2xABVD+20Gy IF-RT to more intensive treatment was confirmed with HRs of 1.0 (CI:0.6-1.5) and 0.9 (CI:0.5-1.6) and 10-year estimates of 87.2% and 94.1% for PFS and OS, respectively. No significant differences in SN were observed.

Summary. Long-term FU data of HD7 and HD10 confirm the current treatment-standard in early-stage favorable HL consisting of 2xABVD+20Gy IF-RT. In order to assess the risk of secondary neoplasia and long-term organ toxicity a prolonged follow-up period is required.

TO11
PROTON RADIOTHERAPY FOR MEDIASTINAL HODGKIN LYMPHOMA: SINGLE INSTITUTION EXPERIENCE
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Introduction. Conventional radiotherapy (RT) based on photons has achieved its physical limits. Proton beam offers promising dosimetric benefits compared to photons, due to its potential to decrease unintended healthy tissue irradiation. Mediastinal proton RT can be safely provided with the awareness of targeting to a moving structure. The technological progress in proton RT allows solving this issue. It can be reasonably managed via pencil beam scanning technique with repainting and/or the use of deep inspiration breath hold method. We present our preliminary clinical experience with this technique. Methods. Between May 2013 and June 2016, 39 patients (pts) with Hodgkin lymphoma (HL) underwent
mediastinal proton RT. Pencil beam scanning technique was used in all pts. Overall 35 of 59 pts were evaluable for acute toxicity and early response. Proton RT was indicated in the first-line treatment in 50 pts, 3 pts were re-irradiated after previous photon RT. Median age at the time of RT was 52 years (range, 13-59 years). RT volume definition: involved field 9 pts, residual disease 10 pts, involved site 14 pts. RT to PET negative disease was indicated in 23 pts as a part of combined modality of treatment after chemotherapy. RT to PET positive disease after chemotherapy was performed in 10 pts. Median total dose was 30 GyE (range, 19.4-80 GyE). Overall 17 pts underwent RT in deep inspiration breath hold, the rest of pts received RT in free breathing after 4D CT of mediastinal structures movement. Results. Of evaluable pts, 31 are in complete remission. Two pts with multiple sites of progression achieved a local control of disease. Acute and subacute RT toxicity was mild (pharyngeal mucositis gr. 2 in 3 pts, leukopenia gr.3 in 1 pt, leukopenia gr 2 in 1 pt, radiodermatitis gr.2 in 1 pt). No case of radiation pneumonitis or Lhermitte sign was observed. No pt required growth factor application or hemostimulation during RT. Conclusions. Proton RT offers promising and safe option for most pts indicated for mediastinal RT. Proton irradiation has low acute toxicity profile and a potential to decrease the risk of significant late toxicity. Proton RT should be considered in all HL patients indicated for mediastinal RT or re-irradiation.

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T012
RESULTS OF US INTERGROUP TRIAL OF RESPONSE-ADAPTED CHEMOTHERAPY OR CHEMOTHERAPY/RADIATION THERAPY BASED ON PET FOR NON-BULKY STAGE I AND II HODGKIN LYMPHOMA (CALGB/ALLIANCE 50604)
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Background. Combined modality treatment (CMT) is currently considered standard of care in patients with early-stage unfavorable HL. By gradually increasing chemotherapy intensity an improvement of treatment efficacy and by reducing radiotherapy intensity a reduction of toxicity were attained. Long-term follow-up (FU) is needed to ensure the safety and efficacy of the applied therapies. Methods. We analyzed updated FU data of 2459 patients with early-stage unfavorable HL treated in the HD8 and HD11 trial. In HD8 patients were randomized to either 30Gy IF- or extended-field (EF)-RT after 2xCOPP/ABVD and in HD11 patients received 20 or 30Gy IF-RT after 2xCOPP/ABVD or 4xBEACOPPbase-line. Progression-free (PFS) and overall survival (OS) were analyzed according to the Kaplan-Meier method. Cumulative incidences of secondary neoplasias (SN) were calculated and compared between groups.

Figure 1. Kaplan Meier Plot of PFS for PET-negative and PET-positive patients.

PO49
LONG-TERM FOLLOW-UP OF CONTEMPORARY TREATMENT IN EARLY-STAGE UNFAVORABLE HODGKIN LYMPHOMA: UPDATED ANALYSES OF THE GERMAN HODGKIN STUDY GROUP HD8 AND HD11 TRIAL
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Background. Combined modality treatment (CMT) is currently considered standard of care in patients with early-stage unfavorable HL. By gradually increasing chemotherapy intensity an improvement of treatment efficacy and by reducing radiotherapy intensity a reduction of toxicity were attained. Long-term follow-up (FU) is needed to ensure the safety and efficacy of the applied therapies. Methods. We analyzed updated FU data of 2459 patients with early-stage unfavorable HL treated in the HD8 and HD11 trial. In HD8 patients were randomized to either 30Gy IF- or extended-field (EF)-RT after 2xCOPP/ABVD and in HD11 patients received 20 or 30Gy IF-RT after 4xABVD or 4xBEACOPPbase-line. Progression-free (PFS) and overall survival (OS) were analyzed according to the Kaplan-Meier method. Cumulative incidences of secondary neoplasias (SN) were calculated and compared between groups.
using Pepe & Mori’s test. Results. The median FU was 153 and 106 months for patients in HD8 (n=1064) and HD11 (n=1395), respectively. New FU data were available for less than 50% of patients and last information was obtained from population registries in 23-27%. In HD8, non-inferiority of IF- compared to EF-RT was confirmed with HRs of 0.98 (95% confidence interval CI: 0.76-1.25) and 0.88 (CI:0.66-1.16) for FFS and OS, respectively. We observed a non-significant trend towards more SN (15-year cumulative incidence 17.1% versus 14.2%, respectively, p=0.3) and deaths from SN after EF-RT versus IF-RT. In HD11, no difference in FFS was found with BEACOPP baseline compared to ABVD when followed by 30Gy IF-RT (HR: 1.1 (CI: 0.7-1.5)). In contrast, there was a significant difference in 10-year FFS rates estimated at 77.6% versus 83.3% in ABVD-treated patients who had received 20Gy instead of 30Gy IF-RT with a HR of 1.5 (CI: 1.0-2.1). After BEACOPP3, 20Gy were non-inferior to 30Gy IF-RT with a HR of 1.0 (CI: 0.7-1.5) for FFS. No differences in terms of OS or SN were observed. Moderate intensification of chemotherapy does not improve the outcome but might facilitate the reduction of IF-RT-dose. Continued FU is necessary to assess long-term toxicity of the applied treatment strategies. 10-year FFS and OS estimates in early-stage unfavorable HL treated with 4xABVD+30Gy IF-RT leave room for improvement.

P050
FINIAL RESULTS OF A QUALITY ASSURANCE PROGRAM WITHIN THE GERMAN HODGKIN STUDY GROUP HD13/14 TRIAL – A REPORT FROM THE RADIOTherapy REFERENCE PANEL INTEGRATING MODERN GUIDELINES

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Introduction. Since the foundation of the German Hodgkin Study Group (GHSG) in 1978 a central radiotherapy (RT) reference centre was established to evaluate and to improve the quality of treatment. During the study generations the quality assurance programs (QA) were continuously adapted and refined. The purpose of this analysis is to show the results of the work within the fifth study generation (HD13/14) and to demonstrate the establishment of a QA including modern RT-techniques e.g. intensity modulated RT (IMRT), image guided RT (IGRT) and involved node RT (IN-RT). Methods. With the fourth study generation (HD10-12) a central prospective review of all diagnostic imaging to create an individual treatment plan for every study patient was established in early stages and the quality of involved field RT was evaluated by an expert panel of radiation oncologists retrospectively. In the era of modern conformal RT this QA-program had to be adapted fundamentally and within several meetings a new process of evaluation has been developed. The findings were compared to the results of the QA within the fifth study generation (HD13-15). Results. The expert panel analyzed the RT-parameters of 1037 (28%) patients (HD13 n=465, HD14 n=572). In 85% simulation films and in 87% verification films were available. RT was assessed as unacceptable in 46% (HD13= 38%, HD14=52%), acceptable in 9% (HD13= 9%, HD14= 9%) and according to the protocol in 45% (HD13= 52%, HD14= 38%). These findings were compared to a data set of eleven patients treated within the sixth study generation (HD16-18) which was reviewed using the “new” revised QA-program including criteria for conformal techniques. Conclusions. The value for QA of RT within the GHSG trials is well known. To develop a QA-program of modern RT the expert panel defined criteria for analyzing current RT-procedures. With this schedule the QA of the GHSG serves as a model for other study groups.
Background and Objectives. A linear correlation was shown between the occurrence of coronary artery disease (CAD) and radiation dose received by coronary arteries for Hodgkin’s lymphoma (HL) patients, derived by mean heart dose/long-term follow-up datasets. The purpose of this study was to delineate coronary arteries and optimize radiation planning on these substructures by using an optimized multi-arcs volumetric arc therapy (VMAT) solution, then to compare it to standard 3D-CRT with the aim of showing a potential dosimetric benefit for VMAT. Materials and Methods. We compared the plans of 14 HL patients (3 males and 11 females) with stage I-IIA mediastinal disease without axillary involvement, treated with involved site radiotherapy (ISRT); 11 had a bulky presentation at diagnosis. In every patient, a deformable fusion was performed with a dedicated software between the planning CT and the pre-RT contrast enhanced CT scan. The following structures were delineated: whole heart, left main, left descending, circumflex and right coronary arteries; aortic, pulmonary, mitral and tricuspid valves; right and left atria; right ventricle, left ventricle and interventricular septum; left ventricular apex, mid cavity, base and lateral wall. Two experienced radiation oncologists contoured target volumes (CTV), and heart substructures, after a validation session with a cardiologist and a heart radiologist. The VMAT approach consisted of multi non-coplanar arcs (the so-called “butterfly” VMAT or B-VMAT) and was compared with 3D-CRT. Mean and max dose received by the coronary arteries were compared by Student’s T test. Results. Maximum doses to coronary arteries resulted similar; conversely, lower mean doses were delivered by using B-VMAT, reaching a significant difference for the left main trunk (p=0.002), the circumflex coronary artery (p=0.014) and the right coronary artery (p=0.002). Most significant findings are illustrated in the Figure 1. Discussion. This study suggests that an optimized intensity modulated RT solution (B-VMAT) is able to reduce the dose to coronary arteries for HL patients with mediastinal disease. As the dose-response relationship is linear, this reduction should translate in lower incidence of CAD.

Introduction. The aim of the present analysis is to evaluate the value of a biological treatment planning for patients with Hodgkin’s Lymphoma (HL). Because patients with HL have become longtime survivors the main goal of ongoing studies is to minimize treatment related late toxicity. Especially for patients with mediastinal involvement the use of IMRT should be considered carefully with regard to pulmonary toxicity. Methods. We included 27 patients with mediastinal involvement of HL. All patients received chemotherapy followed by 30.6 Gy Involved-Field RT. 20 patients were treated with APPA, 5 patients with a 5-field IMRT (5F-IMRT) and 5 patients with a 7-field IMRT (7F-IMRT). To compare the different techniques we calculated 3 treatment plans for every patient. We evaluated Dmean, V5, V10, V15, V20 and V30 of the lung, Dmax of the spinal cord and V50 of the body. To determine the probability of pneumonitis we used a biological evaluation of Eclipse® by Varian and compared them to values we calculated using the parameters of Quantec. We analyzed the follow-up CTs of all patients to test whether they had a radiographic pneumonitis. Results. A total of 81 plans were calculated. The 7F-IMRT achieves the highest values with respect to Dmean, V5, V10, V15 and V20 of the lung. Regarding V50 APPA is inferior (14.9 Gy APPA vs 2.9 Gy 7F-IMRT median). With respect to Dmax of the spinal cord the 7F-IMRT is superior to 5F-IMRT and APPA (32.1 Gy APPA, 24.9 Gy 5F-IMRT and 19.9 Gy 7F-IMRT median). The 7F-IMRT achieves the highest NTCP-values: Left lung: (range 0.0-2.1%); 5F-IMRT (range 0.0-4.0%) and 7F-IMRT (range 0.0 - 5.1%). Right lung: APPA (range 0.0-2.1%); 5F-IMRT (range 0.0-2.9%) and 7F-IMRT (range 0.0-8.0%). The values calculated by using the Quantec-parameters were as follows: Left lung: APPA (range 1.4-12.2%); 5F-IMRT (range 1.6-15%) and 7F-IMRT (range 1.7 - 16.4%). Right lung: APPA (range 2.3-12.6%); 5F-IMRT (range 2.4-13.9%) and 7F-IMRT (range 2.3-18.2%). No patient had radiologic signs of pneumonitis by reviewing the follow up CTs. Conclusions. APPA is superior to IMRT with respect to the mean lung doses. This finding is underlined by the NTCP-values. If the local doses (e.g. V30) in the field of the PTV are observed, IMRT is superior. The calculated values show an increased risk by using the 7F-IMRT. The biological evaluation achieves remarkable results in both cases, that are useful in the judgement of treatment plans.

Survivors of Hodgkin’s lymphoma (HL) have an increased risk of developing secondary malignancies and cardiovascular disease. This risk is directly correlated to the amount of radiation exposure and is significant even with the use of modern radiation therapy modalities. Deep inspiration breath hold (DIBH) techniques have been shown to lead to the delivery of lower amounts of radiation to organs at risk (OARs) during the treatment of breast cancer and Hodgkin’s lymphoma. In this study, we evaluated the ability to DIBH techniques to decrease the amount of radiation exposure of OAR in 16 consecutive HL lymphoma patients with mediastinal involvement. Majority of patients had Stage II bulky disease. For each patient four different plans were calculated – two utilizing deep inspiration breath hold technique and two with free breathing with IMRT and APPA plans created for both breathing modalities. DIBH plans delivered significantly decreased mean doses to the heart with Dmean of 47.4cGy (DIBH-IMRT) and 77.9cGy (DIBH-APPA), compared to the free breathing plans with 1125.6cGy (FB-IMRT) and 1709.3cGy (FB-APPA). In addition, specific cardiac substructures such as the coronary arteries and the aortic valve also received reduced mean doses of radiation. The coronary arteries in DIBH-IMRT plans received on average 41.4cGy for DIBH-IMRT and 50.5cGy for DIBH-APPA. Similar trend is present within the average dose delivered to the aortic valve with average Dmean of 468cGy for DIBH-IMRT plans of only 94cGy, compared to average Dmean of 1694cGy for DIBH-APPA plans, 2718cGy for FB-IMRT plans, and 2574cGy for FB-APPA plans. Mean dose of lung exposure for DIBH-IMRT plans is also significantly lower than FB-IMRT plans (p=0.003). The volume of lung tissue receiving low dose radiation is significantly decreased in the DIBH-IMRT plan compared to the FB-IMRT plan, however the volume receiving 2000cGy is comparable between the DIBH and FB plans. These findings are con-

Figure 1.
Our data do not show any difference among classical HL-directed regimens, B-cell lymphoma-directed regimens or composite approach. A prospective randomized large cohort evaluation should be taken into account.

**P056**

**CONSTRUCTION OF A DECISION MODEL TO AIM TREATMENT CHOICES FOR EARLY STAGE HODGKIN LYMPHOMA: BRINGING SURVIVORSHIP FORWARD**


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Introduction. Decision-making for the treatment of ES HL patients continues to involve consideration of the tradeoff between shorter-term progression-free survival (PFS) and the impact of late effects (LE) on overall survival (OS). To evaluate the complex decision process arising from these factors, there is a desire to obtain integrated data that assimilates short-term outcomes, LE, and quality adjusted life expectancy (QALE) to help aid treatment choices. Methods. We analyzed PFS and OS from 4 large, modern randomized trials comparing chemotherapy alone with combined modality therapy (CMT) for ES HL (Meyer NEJM 2012; Wolden JCO 2012; Raemackers JCO 2014; Radford NEJM 2015). We constructed a detailed Markov model comparing QALE after initial therapy for ES HL using chemotherapy alone vs CMT. The model incorporated: 3-year PFS from PET- patients; quality of life associated with relapse and cure; cure rates after relapse; 15-year latency period before onset of increased mortality from LE; and “discounting” of future life years. We also performed sensitivity analyses to determine the amount that CMT (with contemporary radiotherapy) must increase LE-associated mortality for that impact to outweigh its early PFS advantage. Results. All 4 trials demonstrated that short-term PFS was superior with CMT, including PET response-adapted paradigms, however OS was at least equivalent in each study. Collectively, the analyses showed that if CMT-associated LE increased deaths >15-20% (relative) compared with chemotherapy alone, then treatment with the latter was associated with overall improved QALE. This finding was consistent across a range of patient ages and among varied estimates for SMR after cure for those treated with chemotherapy alone (see Figure 1). Furthermore, sensitivity analyses demonstrated that these findings were most sensitive to assumptions regarding the impact of CMT on mortality after cure, and insensitive to moderate changes in the assumed short-term impact of CMT on PFS.

Conclusions. We identified the “break-even point” whereby chemotherapy alone was associated with superior QALE vs CMT (ie, 15-20% relative increased death from LE). This model provides the base analytic framework to aid the complex decision of treating ES HL. Future model iterations may incorporate patient & tumor characteristics, patient preferences, and cost-effectiveness of varied therapeutics in order to help guide individualized decisions for providers and patients with HL.
after treatment with CMT, then treatment with chemotherapy alone is associated with superior QALE. The X-axis plots the relative standardized mortality ratio (SMR) after cure when treating with CMT compared with chemotherapy alone. For example, a relative of SMR of 1.2 means that treatment with CMT is associated with a 20% higher risk of death from late effects than treatment with chemotherapy alone. We performed the analysis three times, each time choosing a different SMR for those treated with chemotherapy alone (1.0, 1.1, and 1.5). Thus, if there is expected to be a be a 15-20% or greater increase in deaths from late effects after treatment with CMT, then treatment with chemotherapy alone is associated with superior QALE.

Figure 1. Quality-adjusted life expectancy (QALE) examining varied SMR values and delayed effect. The Y-axis of the figure shows the gain in QALE when treating with a strategy of chemotherapy alone compared with combined modality therapy (CMT). Negative values indicate that CMT is associated with superior QALE, while positive values indicate that chemotherapy alone is associated with superior QALE. The X-axis plots the relative standardized mortality ratio (SMR) after cure when treating with CMT compared with chemotherapy alone. For example, a relative of SMR of 1.2 means that treatment with CMT is associated with a 20% higher risk of death from late effects than treatment with chemotherapy alone. We performed the analysis three times, each time choosing a different SMR for those treated with chemotherapy alone (1.0, 1.1, and 1.5) and adjusting the relative CMT for those treated with CMT. Additionally, we performed the analysis two different ways: 1) assuming that the SMR after cure is incorporated into the model immediately after subjects enter the cured state – depicted as dashed lines (representing the immediate onset of an increased susceptibility to deaths from late effects); and 2) holding the SMR at 1.0 for 15 years after subjects enter the cured state and then incorporating the SMR after 15 years (to represent the latency period of approximately 15 years until there is an observed increase in deaths from late effects). We assumed a base case age of the subjects to be 25 years old.

Figure 1. DOSES TO ORGANS AT RISK AT DIFFERENT MODES OF 3D-CONFORMAL RADIOTHERAPY FOR MEDIASTINAL STAGE II HODGKIN LYMPHOMA

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In randomized controlled trials, the addition of RT to chemotherapy increases the progression-free survival but not overall survival in early stage HL. Extended field (EF) and involved field (IF) RT are both associated with late morbidity and mortality, particularly due to second malignancies and cardiovascular events. There do not appear to be safe doses of RT that will remain therapeutic. Doses as low as 20 Gy in CMT do not seem to reduce the risk of second cancers below that seen with traditionally therapeutic doses of 35-45 Gy. The risk of coronary heart disease is increased by 7.4% per Gy in median heart dose. Likewise the reduction of radiation therapy portals from EF to IF RT has less compared with ISRT V20 left lung (24.0 ± 3.8% and 35.3 ± 1.4%, p<0.05), right lung (28.0 ± 3.5% and 16.6 ± 2.4%, p<0.05), V30 heart (50.0 ± 4.4% and 8.1 ± 2.2%, p<0.01), mean heart dose (29.4 ± 3.8 Gy and 7.0 ± 1.5 Gy, p<0.001). Mean dose for spinal cord was similar in these groups. Conclusions. IMRT compared to 3DCRT (ISRT) substantially reduces V20 lungs, V30 heart and mean dose for heart without compromising the dose to the target in patients with mediastinal stage II HL.
Given the paradigm of treating all initial nodal sites of involvement, it will also be difficult to further substantially reduce off-target radiation exposure, even with new techniques such as three-dimensional conformal RT, intensity modulated RT, deep inspiratory breath hold, or even proton beam RT. Because of these considerations, we propose a change in the paradigm of treating all initial nodal sites of involvement when administering adjuvant RT following adequate chemotherapy. It is unclear whether initial nodal sites that have completely resolved with chemotherapy are at increased risk for recurrence. Rather, we propose clinical trials to test the concept of only treating the PET-negative residual remaining masses on CT imaging following chemotherapy (residual site RT – RS RT). A step in this direction was taken with the HD15 trial.

Advanced Stages

**T001. BEACOPP-ESCALATED FOLLOWED BY RADIOTHERAPY OF INITIAL BULK OR RESIDUAL DISEASE IN ADVANCED-STAGE HODGKIN LYMPHOMA: LONG-TERM FOLLOW-UP OF THE GHSG HD9 AND HD12 TRIALS**

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**Introduction.** The HD9 trial had established 8xBEACOPP escalated followed by radiotherapy (RX) of initial bulk or residual tumors as standard of care for advanced Hodgkin Lymphoma (HL) at that time. The successor study of HD9, HD12, evaluated a reduction of chemotherapy and RX. Since the long-term safety and efficacy of BEACOPPescalated and RX has been debated, we report the HD9 and HD12 long-term follow-up. **Patients and Methods.** All patients had advanced HL. 1,282 HD9-patients were randomized between 8xCOPP/ABVD, 8xBEACOPPbaseline, and 8xBEACOPPescalated. 1,670 HD12-patients were randomized between 8xBEACOPPescalated, and 4xBEACOPPescalated followed by 4xBEACOPPbaseline ("4+ 4"), both with or without RX to initial bulk and residual disease. **Results.** In HD9-patients treated with COPP/ABVD, BEACOPPbaseline, and BEACOPPescalated, the 15-year progression-free survival (PFS) was 57%, 66.8%, and 74% with overall survival (OS) rates of 72.3%, 74.8%, and 80.9%, respectively. BEACOPPescalated remains significantly better than COPP/ABVD in terms of PFS (P<0.0001) and OS (P=0.02). A total of 123 second malignancies corresponding to 15-year cumulative secondary malignancy incidences of 7.2%, 13%, and 11.4% were reported for COPP/ABVD, BEACOPPbaseline, and BEACOPPescalated, respectively, without a difference between COPP/ABVD and BEACOPPescalated (p=0.5). Standardized incidence ratios (SIR) with 95%-CI were 2.0[1.2-3.2], 2.6[1.9-3.4] and 2.6[1.9-3.4]. The 10-year PFS and OS rates in the two HD12 chemotherapy groups were not significantly different with 82.6% and 87.3% in the BEACOPPescalated group and 80.6% and 86.8% in the 4+4 group, respectively. However, omitting RX resulted in a significantly inferior 10-year PFS of 83.5% in no RX patients with initial bulk/residual disease compared to RX (88.6%, difference -5.1%; 95%-CI,-9.9% to -0.4%; hazard ratio [HR] 1.47; Figure 1) and a trend towards inferior OS in no RX patients (RX 93%; no RX 90.2%; difference -2.7%; 95%-CI,-6.5% to 1%).

**Figure 1.**

Patients with residual lesions without RX had an inferior OS compared to patients with RX (as treated comparison: RX 94.4%; no RX 88.4%; difference -6%; 95%-CI,-11.4% to -0.5%). **Conclusions.** The superiority of BEACOPPescalated to COPP/ABVD is confirmed by this HD9 long-term analysis. The HD12 long-term analysis shows an inferior PFS and trend towards inferior OS in patients in the no RX groups, particularly in patients with residual lesions.
Overall Survival Impact of BEACOPP Versus ABVD in Advanced Hodgkin Lymphoma: A Pooled Analysis of 4 Randomized Trials


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Introduction. In 4 individual randomized trials comparing ABVD and BEACOPP in advanced HL, BEACOPP significantly improved disease control but not OS. We explored the potential OS benefit of BEACOPP in a pooled analysis of these 4 trials. Methods. The primary objective was to assess the impact of BEACOPP on OS by one-stage individual patient data meta-analysis stratified for trial. Secondary endpoints were PFS, early toxicities, second malignancies and use of hematopoetic stem cell transplantation (HSCT). Results. Four trials representing a total of 1227 patients (622 ABVD and 605 BEACOPP) were included (III. Viviani 2011, LIYS H34 Mounier 2014, EORTC 20012) Carde 2016, HD2000 Merli 2016). Patients characteristics: median age: 52 yrs, male 64%, nodular sclerosis 78%, stage II-III-IV: 13-32-55%, B symptoms: 77%, Bulky disease: 38%, IPS>3: 66%. With a median follow-up of 4.9 yrs, the 5-yrs OS is 86.59% for ABVD (95% CI=83.0-89.3) vs 90.8% for BEACOPP (95% CI=83.0-93.0). The data indicated that the HR is not constant over time (p<0.05) preventing the use of a simple Cox model. Per analysis plan, two time periods (< and ≥ 5yrs) were defined from the observed survival and hazard curves. In the first 18 months (N=1227, 54 events), no difference was detected (HR=0.75, 95% CI=0.41-1.28). After 18 months (N=1083, 68 events), the risk of death appeared higher in patients in ABVD arm than in BEACOPP arm (HRAVBD vs BEACOPP=2.52, 95% CI=1.48-4.28, p<0.001). Further adjustment for IPS showed that both treatment (p<0.001) and IPS group (p=0.0326) effects are significant. The 5-y PFS was 72.0% for ABVD (95% CI=67.3-76.1) vs 82.9% for BEACOPP (95% CI=78.7-86.4) (p<0.001). Grade 3-4 toxicities (ABVD vs BEACOPP): anemia: 4.3% vs 24.2%; leukopenia: 23.2% vs 76.8%; thrombocytopenia: 1.7% vs 26.4%; infection: 7.9% vs 34.2%. After ABVD, 17 second malignancies (0 AML) (2.7%) were reported and 21(7 AML)(3.6%) after BEACOPP. After ABVD, 86 patients (13.8%) received HSCT vs 39 (6.4%) after BEACOPP. Conclusions. This pooled analysis of 4 studies with increased power, indicated a non-constant treatment effect over time. A statistically significant OS benefit of BEACOPP was observed from 18 months after randomization. Frontline use of BEACOPP increased PFS, early hematological toxicity, secondary leukemia incidence but halved the need of HSCT. Further follow-up is needed to explore the impact of BEACOPP on fertility, second malignancies and long term survival.

Long-term Follow-up of SWOG S0816: Response-adapted Therapy of Advanced Stage Hodgkin Lymphoma Using Early Interim FDG-PET Imaging


United States National Clinical Trials Network: SWOG, Alliance, ECOG-ACrin and AIDS Malignancy Consortium

S0816 was the first US intergroup clinical trial using early interim FDG-PET imaging to determine the utility of response-adapted therapy for adults with stage III-IV classical Hodgkin Lymphoma. After 2 initial cycles of ABVD, PET2-negative patients (Deauville 1-3) received an additional 4 cycles of ABVD, while PET2+ patients (Deauville score 4-5) switched to eBEACOPP for 6 cycles. Among 356 eligible and evaluable patients, the median age was 52 (18-60), with 52% stage III, 48% stage IV, and 49% IPS 0-2, 51% IPS 3-7. Central review of the interim PET2 scan was performed in 331 evaluable patients, with 71 (52%) PET2-negative and 60 (18%) PET2+. Of 60 eligible PET2+ patients, 49 switched to eBEACOPP as planned and 11 declined. The median follow-up of patients last known alive now exceeds 45 months (range 2.1-76 months). Eighty-two patients have either progressed or died, for an estimated 2-year progression-free survival of 79% (95% CI: 73.8%-82.7%). There were 61 failures in the PET2-negative group (2-year PFS 82%) and 20 failures in the PET2+ group (2-year PFS 64%), see Figure 1. In the entire trial, only 19 patients died, for estimated 2-year overall survival of 98%. Long-term or late (post therapy) grade 3 adverse events on ABVD arm were uncommon including 1 case each of neuropathy, heart failure, DVT, diarrhea and prolonged neutropenia. There was one case of late grade 3 osteonecrosis on the eBEACOPP arm. Six patients (1.4%) have developed secondary malignancies, including 3 cases (1%) on ABVD (non-Hodgkin lymphoma, renal cell carcinoma, and melanoma) and 3 cases (6%) on eBEACOPP (non-Hodgkin lymphoma, renal cell carcinoma and skin cancer). We conclude that response-adapted therapy based on interim PET imaging after two cycles of ABVD appears promising and durable with a high 2-year PFS for PET2+ patients (64%), and outstanding overall survival. However, surprisingly, with prolonged follow-up, the majority of failures have occurred in PET2-negative patients, indicating the limitations to a PET-adapted approach. To further improve ABVD using precision medicine, we need to further refine predictive markers of failure at the time of Hodgkin lymphoma diagnosis.

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Figure 1.
**P001**

**SEQUENTIAL BRENTUXIMAB VEDOTIN AND ADRIAMYCIN, VINBLASTINE, AND DACarbazine FOR OLDER PATIENTS WITH UNTREATED HODGKIN LYMPHOMA: FINDINGS FROM A PHASE II WINDOW STUDY**

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Introduction. Outcomes for older patients (pts) with HL remain suboptimal. We initiated a multicenter study examining sequential brentuximab vedotin (BV) given before and after standard AVD chemotherapy (NCT01476410). Methods. Pts ages ≥60 years with stage II-IV, untreated HL were eligible. All pts received 2 “lead-in” cycles of single-agent BV 1.8 mg/kg (q 3 weeks), followed by 6 cycles of standard AVD chemotherapy. Responding pts then received consolidation therapy (Tx) with BVx4 cycles. Study design is Simon two-stage with plan of 48 total pts. The primary endpoint is complete remission (CR) rate after AVD (ie, prior to BV consolidation) using FDG-PET. If ≥2 CRs were observed among 20 evaluable pts, accrual continued to the 2nd stage. Results. 26 pts enrolled to the first study stage, of which 20 were evaluable for response. Characteristics for all pts included: median age 69 years (60-88); median ECOG PS of 1 (0-2); 92% stage III/IV disease; IPS 3.7 in 54%; and median CIRS co-morbidity score 5 (0-19). 6 pts were non-evaluable for response (n=3 withdrew consent/refused further therapy; n=2 toxicity; and n=1 death due to pancreatitis). Among 20 evaluable pts, overall response rate (ORR) to BV lead-in was 85% with 30% CR. After 3 AVD cycles, ORR and CR rates were 95% and 70%, respectively. The best ORR (including after BV consolidation therapy) was 95% with a CR rate of 90%. By intent-to-treat, best ORR and CR rates were 81% and 77%, respectively. Grade 3/4 AEs occurring in >1 pt were infection (15%), pancreatitis (4%), and peripheral neuropathy (PN) (4%); 31% of pts experienced grade 2 PN. Reasons for discontinuation of Tx included: 7/26 (27%) completed Tx; 7/26 (27%) on active Tx; 4/26 (15%) due to toxicity (grade 2: infusion reaction, hepatic, pneumonitis; and grade 3 wound infection); 3/26 (12%) refused additional Tx; 3/26 (12%) discontinued for PN (all grade 2 status-post cycles 6, 8, 10); 1/26 (4%) due to lack of response; and 1 (4%) death (due to pancreatitis). At median follow-up of 22 months, 92% of all pts are alive, the progression-free survival is 85%, and notably, 95% of all evaluable pts are disease-free. Conclusions. Sequential integration of BV before and after standard AVD chemotherapy for newly diagnosed older HL pts is feasible and highly promising. The planned interim analysis confirmed the requisite CR rate needed for continuation to the 2nd stage of this multicenter phase II study. Updated results will be reported at the meeting.

**P002**

**PRELIMINARY RESULTS OF A PHASE II STUDY OF BRENTUXIMAB VEDOTIN USING A RESPONSE ADAPTED DESIGN IN THE FIRST LINE TREATMENT OF PATIENTS WITH HODGKIN LYMPHOMA UNSUITABLE FOR CHEMOTHERAPY DUE TO AGE, FRAILTY OR CO-MORBIDITY (BREVITT)**

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Introduction. Results of standard treatment for older patients (pts) with classical Hodgkin lymphoma (cHL) are suboptimal and alternative approaches are required. Brentuximab vedotin (BV) is a CD30 targeted antibody-drug conjugate which in the pivotal phase 2 trial in relapsed/refractory cHL produced an objective response rate of 75%, complete remission rate of 34% and manageable toxicity. BREVITY is a study of efficacy/tolerability of BV in older, frail or comorbid pts with previously untreated cHL. Methods. This was a phase II, Simon 2-stage, single arm study requiring 30 evaluable pts. Primary outcome was complete metabolic response rate (CMR, Deauville Score 1-3) by centrally reviewed PET-CT after 4 cycles of BV. Secondary outcomes included PFS, OS, toxicity and comorbidity assessment (CIRS-G). Inclusion criteria were previously untreated cHL stage 2 (with B symptoms and/or mediastinal bulk) or stages 3/4 with cardiac/respiratory compromise (at any age) or an ECOG score 1-3 and considered unfit for standard chemotherapy (in pts ≥60 yrs). BV dose was 1.8 mg/kg every 3 weeks, reduced to 1.2 mg/kg for toxicity. Pts in CMR/PMR after 4 doses BV continued to a total of 16 cycles if CT and/or PET-CT every 4 cycles confirmed ongoing response. PFS/OS data is not mature. Results. 38 pts were recruited Feb 2014-Oct 2015 at 12 UK centres; demographics are shown in Table 1.

<table>
<thead>
<tr>
<th>Patient Characteristic</th>
<th>n=38</th>
<th>Median (Range)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age</td>
<td>76</td>
<td>59 (90)</td>
</tr>
<tr>
<td>CIRS-G Score</td>
<td>3</td>
<td>(0, 1)</td>
</tr>
<tr>
<td>No. categories endorsed</td>
<td>15</td>
<td>10 (6, 15)</td>
</tr>
<tr>
<td>Severity</td>
<td>1.5</td>
<td>0.5 (1, 5)</td>
</tr>
<tr>
<td>Total score</td>
<td>6</td>
<td>0 (11)</td>
</tr>
<tr>
<td>Gender</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Male</td>
<td>22</td>
<td>(57.9)</td>
</tr>
<tr>
<td>Female</td>
<td>16</td>
<td>(42.1)</td>
</tr>
<tr>
<td>Stage</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Stage 2</td>
<td>7</td>
<td>(18.4)</td>
</tr>
<tr>
<td>Stage 3</td>
<td>13</td>
<td>(34.2)</td>
</tr>
<tr>
<td>Stage 4</td>
<td>16</td>
<td>(47.4)</td>
</tr>
<tr>
<td>B symptoms</td>
<td>27</td>
<td>(71.1)</td>
</tr>
<tr>
<td>Bulky disease</td>
<td>5</td>
<td>(13.2)</td>
</tr>
<tr>
<td>Extramedullary disease</td>
<td>22</td>
<td>(57.9)</td>
</tr>
<tr>
<td>ECOG Performance Status</td>
<td></td>
<td></td>
</tr>
<tr>
<td>0</td>
<td>3</td>
<td>(7.9)</td>
</tr>
<tr>
<td>1</td>
<td>16</td>
<td>(42.1)</td>
</tr>
<tr>
<td>2</td>
<td>11</td>
<td>(28.9)</td>
</tr>
<tr>
<td>3</td>
<td>7</td>
<td>(18.4)</td>
</tr>
<tr>
<td>4</td>
<td>1</td>
<td>(2.6)</td>
</tr>
</tbody>
</table>

35 pts were treated and evaluable for toxicity, 31 are evaluable for response. Median follow-up for alive pts is 11.6(range 0.9, 21.4) months. A median of 4 cycles were given per pt (range 1, 16). 28(12%) cycles in 14 pts were modified due to toxicity and 11 pts stopped treatment due to adverse events (AEs). 695 AEs were reported of which 601(86%) were grade 1/2, 26(74%) pts had at least 1 AE grade 3, most commonly infection, myelosuppression or neuropathy. CMR rate at PET4 was 25.8%(95% CI 13.7, 43.2) and combined CMR/PMR rate was 83.7(95%CI: 67.4, 92.9). To date 21(67.7%) pts have progressed. Discussion. In this study BV monotherapy produced a high objective response rate although the CMR rate after 4 cycles did not meet the pre-specified 40% level. Toxicity was greater than in the pivotal study where pts were younger/fitter and led to treatment termination in some pts. Nevertheless BV is effective in this older comorbid population. A follow-on study incorporating BV at lower dose in combination with other agents and growth factor support aimed at improving the CMR rate is in development.
CAUTION IN THE ELIMINATION OF RADIOTHERAPY FROM THE TREATMENT OF PATIENTS WITH STAGE III CLASSICAL HODGKIN LYMPHOMA: A SURVEILLANCE, EPIDEMIOLOGY, AND END RESULTS DATABASE ANALYSIS

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Background. The role of radiotherapy (RT) in the primary management of advanced stage classic Hodgkin lymphoma (HL) remains controversial based on conflicting study results. While the definition for advanced stage is widely agreed upon as patients with stage III or IV disease, the difference in disease distribution and burden, as well as the difference in overall survival, between these stages may make RT more beneficial to patients with stage III disease. Methods. We queried the Surveillance, Epidemiology, and End Results (SEER) database, restricting our search to patients with stage III classical HL diagnosed from 2004-2012, to examine the difference in overall and cause-specific survival (OS and CSS) between patients who did or did not receive RT in combination with chemotherapy. Results. Patients treated with RT had improved OS and CSS relative to those treated without RT (5-year OS 91.6% with RT compared to 71.4% without RT, HR=0.34, p<0.001) and CSS (5-year OS 95.4% with RT compared to 84.7% without RT, HR=0.32, p<0.001). A benefit in OS and/or CSS was seen in both pediatric and adult patient subgroups, and patients with B symptoms and/or extranodal disease (Table 1).

Table 1. Multivariate Analysis of Treatment Outcomes in Patients with Stage III Classical Hodgkin Lymphoma (n=4,108).

<table>
<thead>
<tr>
<th>Variable</th>
<th>HR (95% CI)</th>
<th>p-value</th>
<th>HR (95% CI)</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pediatric (&lt;15 yrs)</td>
<td>0.23 (0.14-0.40)</td>
<td>&lt;0.001</td>
<td>0.23 (0.11-0.49)</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Adult (20-64 yrs)</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Older Adult (65+ yrs)</td>
<td>4.85 (4.17-5.65)</td>
<td>&lt;0.001</td>
<td>4.20 (3.18-5.21)</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>B Symptoms (n=3,787)</td>
<td>1.89 (1.10-3.26)</td>
<td>&lt;0.001</td>
<td>1.61 (1.10-2.30)</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>None</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>No</td>
<td>0.65 (0.50-0.85)</td>
<td>0.001</td>
<td>0.59 (0.41-0.87)</td>
<td>0.007</td>
</tr>
</tbody>
</table>

Conclusions. This large, hypothesis-generating, population-based study of the effect of radiotherapy in the treatment of stage III HL shows a benefit to radiotherapy across most subgroups. This supports a cautionary approach to omitting radiation therapy from treatment strategies for patients with advanced stage HL.

GRAY ZONE LYMPHOMA WITH FEATURES INTERMEDIATE BETWEEN DIFFUSE LARGE B-CELL LYMPHOMA AND CLASSICAL HODGKIN LYMPHOMA: DIAGNOSTIC EXPERIENCES AND CHALLENGES FROM A MULTICENTER STUDY

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Methods. Clinical data from cases originally diagnosed as GZL were collected from 19 academic centers across the US and Canada (Evans AM et al. Am J Hematol 90:778-83, 2015). To further characterize the diagnostic features and correlations, 73 cases (majority from the above series and n=4 subsequent cases) were submitted for central pathology review using criteria of the 2016 revised WHO classification. Initial diagnostic samples were evaluated with a panel comprising CD20, CD79a, PAX5, OCT2, BCL6, MUM1, CD30, CD15, CD3 and EBV by in situ hybridization (EBER). Beyond the tumor cell immunoprofile, diagnostic criteria included tumor cell density and morphology, necrosis, and the microenvironment. CHL nodular sclerosis grade 2 (CHL-NS2) were classified according to prior criteria (MacLennan K. et al. Cancer 64: 1669-93, 1989). 5 cases were rejected for insufficient material/technical issues; 68 cases were evaluated by 5 hematopathologists and consensus diagnosis was reached at multiheaded scope review. Results. Of 68 cases submitted with an original diagnosis of GZL, only 26 cases were confirmed as GZL on consensus review (14/4/2; median age 38 years, range 19-69). 11/26 biopsies were mediastinal in origin, and in an additional 4 cases, a mediastinal mass was present clinically; 11 had only peripheral lymphadenopathy (ie, non-mediastinal). 42 cases were reclassified as follows: NS chHL, n=27 (n=10 of which were chHL-NS2); DLBCL, n=4; nodular lymphocyte predominant HL (NLPHL), n=3; EBV positive LBCI, n=3; PMBCI, n=2; lymphocyte-rich chHL, n=1; and B-cell lymphoproliferative disorder, n=1. Most cases of chHL diagnosed as GZL had strong CD20 expression. Furthermore, CHL-NS2 was frequently misdiagnosed as GZL typically due to confluent growth of lacu...
Hodgkin Lymphoma in Sweden since 2000: Better Survival Only in Elderly Women - A Swedish Lymphoma Registry Study

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Two major areas of dispute in Hodgkin lymphoma are treatment of advanced stages and of elderly patients. For advanced stages the debate is whether BEACOPPesc/14 or ABVD is to be considered standard. ABVD is standard in many countries, especially for those with IPS 0-2. There is no golden standard for therapy in elderly patients. In Sweden 1.7; 95% CI, 1.1-2.7; P=0.027). Patients <61 with advanced stages treated by the increasing use of PET-CT. In multivariate analysis, adjusted for all factors significant in univariate analysis, of patients ≥61 years (P=0.027), but not among those <61 (P=0.49). This improvement was restricted to women with advanced stage disease (P=0.005). Stage IV disease was more common in the most recent calendar period (2010-2014) compared to the first (2000-2004), both in women (22% vs 15%, P=0.008) and in men (28% vs 21%, P=0.006), likely explained by the increasing use of PET-CT. In multivariate analysis, adjusted for all factors significant in univariate analysis, of patients ≥61 years, CHOP (compared with ABVD) was an independent adverse factor for OS (HR 1.7; 95% CI, 1.1-2.7; P=0.027). Patients ≥61 with advanced stages treated with BEACOPPesc/14 and ABVD showed identical OS in univariate and multivariate analysis (P=0.51). In conclusion, outcome was not improved over time except in elderly women. The implementation of FDG-PET/CT has resulted in a stage migration with an increased proportion of patients with stage IV disease. ABVD seems superior to CHOP for elderly who tolerate this regimen. BEACOPP and ABVD show equal OS in younger patients with advanced stage disease, supporting the use of PET/CT-adapted ABVD as initial therapy.

Superiority of Modified Progression Free Survival to Evaluate Chemotherapy Effectiveness for Advanced Stage Hodgkin Lymphoma


From the BC Cancer Agency Centre for Lymphoid Cancer, Vancouver, British Columbia, Canada

Background. Assessment of the effectiveness of chemotherapy for advanced stage Hodgkin lymphoma may be obscured by the incorporation of radiotherapy in primary treatment when standard endpoints such as progression free survival (PFS) are used. Ineffective chemotherapy may be “rescued” by the addition of radiotherapy residual PET-positive masses. Use of a modified PFS endpoint (mPFS), in which addition of radiotherapy after the conclusion of chemotherapy is scored as progression, more accurately assesses chemotherapy effectiveness. Methods. We examined the records of 207 consecutive adult patients (age 16-82 y, median 36; males 55%) with advanced stage HL (IIIA, 23%; IIIB, 24%; IVA, 17%; IVB, 36%) treated between 2004 and 2015 with ABVD or with involved field radiotherapy (IFRT). Standard PFS events were the first of relapse or progression (REL/PROG) despite primary treatment (ABVD +/- IFRT) or death from any cause; mPFS events were the first of radiotherapy given after ABVD if the post-ABVD PET was positive (PET-RT), relapse or progression after primary treatment (REL/PROG) or death from any cause. Results. We observed 56 PFS events (REL/PROG, 54; death 2) and 64 mPFS events (PET-RT, 17; REL/PROG 45; death 2). Thus, 8/64 (13%) of the relevant events (failure of the primary chemotherapy to cure the lymphoma) were unappreciated using the standard PFS endpoint. This resulted in an overestimate of the effectiveness of primary chemotherapy to cure the lymphoma.
relapse or progression (time to 25% treatment failures using standard PFS=2.8 y; using mPFS=1.1 y) (Figure 1). These overestimates occur because the addition of radiotherapy to the primary chemotherapy “rescues” patients whose primary chemotherapy has failed (PET positive residual disease still present after completion of the primary chemotherapy) and creates the appearance of successful treatment. Conclusions. Use of the mPFS endpoint provides a superior assessment compared to standard PFS if the goal of a clinical trial testing treatment for advanced stage Hodgkin lymphoma is to identify the most effective chemotherapy regimen. This is particularly important in an era when post-chemotherapy evaluation with PET has become standard and major efforts are being made to determine the potential benefit of adding novel agents such as antibody-drug conjugates and checkpoint inhibitors to standard chemotherapy.

Figure 1.

P008
TREATMENT RESULTS FOR HODGKIN LYMPHOMA IN BRAZIL: FIRST REPORT FROM THE BRAZILIAN PROSPECTIVE HODGKIN’S LYMPHOMA REGISTRY
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Introduction. Data about Hodgkin Lymphoma (HL) in developing countries are scarce. In 2009, a prospective registry of HL was implemented in Brazil. Methods. Twenty institutions take part in the registry. Clinical, treatment and outcome data were prospectively collected in a web-based platform, and are reported here for the first time. Results. 756 HL patients (pts) with diagnosis until December 31, 2014 were identified. Twenty-one pts with nodular-predominant HL, 11 pts younger than 13 years-old and 38 pts with HIV were excluded, with 686 pts available for this analysis. Median age was 30 years-old (13-90); 67 (10%) pts were older than 60. Females comprised 346 pts (50%). Median time from onset of symptoms to diagnosis was 6 (0-60) months. Forty-four (7%) pts had limited disease, 180 (26%) had intermediate disease and 445 (65%) had advanced disease by GHSG criteria. Stage IVB was present in 26%, B symptoms in 69%, low albumin in 63% and a high-risk IPS score in 58%. Median time from diagnosis to beginning of treatment was 0.72 months (0-10.87 months). Median follow-up was 37 months (0.53-94) for all patients, and 40 months (4-94) for patients alive. ABVD was the first-line treatment in 93% of pts. Twenty-one patients died during treatment. After completed treatment, the complete remission (CR) rate was 73%, unconfirmed CR was 12%, partial remission was 4%, stable disease was 2% and progressive disease was 9%. Among those who received ABVD, the median number of cycles was 4 for limited and intermediate and 6 for advanced disease. Radiotherapy (RT) was used in 33% of advanced disease pts, 65% of intermediate disease pts, and 77% of limited disease pts. The median dose of RT was 36 Gy for localized disease, and 52 Gy for advanced disease. The median time from the end of chemotherapy to the beginning of RT was 1.7 months. The 3-year OS and 3-year PFS were 90% and 74%, respectively. The 3-y PFS in limited disease, intermediate disease and advanced disease were 95%, 88% and 66% (p<0.0001), respectively. The 3-year OS for limited disease, intermediate disease and advanced disease were 100%, 96% and 86% (p=0.0001), respectively. Conclusions. Advanced stage and poor risk patients predominated. Radiation doses used for localized disease appear higher than current recommendations. Outcomes for advanced disease appear to be 5-10% lower than in developed countries, in part due to very advanced disease at diagnosis, and to an excess of deaths during treatment.

P009
DOSE-ENSE/DOSE-INTENSE ABVD IN ADVANCED-STAGE HODGKIN’S LYMPHOMA: A LONG-TERM FOLLOW UP STUDY
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One-hundred forty-three patients with advanced-stage HL were treated with a dose-dense three-weekly version of the ABVD regimen, which was also dose intensified, in the first 4 cycles, by escalating doxorubicin. Specifications are contained in the published article (Russo F BHJ 166,1,118, 2014). Twelve patients (8.4%) received radiotherapy (RT) on residual mediastinal or extramediastinal bulk disease. Results were compared with a historical series of 111 patients treated with standard ABVD +/- RT. The demographics and clinical characteristics are in Figure 1. Ninety-six percent of patients completed the planned 6 cycles (median time=16.8 weeks). Median actual dose intensities were 20.87 (23.11 cycles 1-4), 67.2, 3.89 and 245 mg/m2/week for doxorubicin, bleomycin, vinblastine and dacarbazine, respectively. This corresponded to a 66.9% (85.0%, cycles 1-4) increase in dose intensity for doxorubicin, (total dose 380 mg/m2) and of 32% for the other agents, over standard ABVD. Intensified ABVD confirmed to be highly tolerated with low rates of hospitalization during treatment, a low incidence of G3/4 events, low post-treatment cardiac and pulmonary toxicities and a very low rate of gonadic toxicity. Only two cases of second cancer were recorded. One-hundred-eleven out of 143 (79%) showed a PET normalization at the end of 2nd cycle. Comparison between intensified and standard ABVD showed complete remission (CR) rates 93.7% in intensified ABVD and 80.2% in standard ABVD, respectively (p=0.002). EFS and OS rates at 7 years were 85.7% vs 68.1% and 93.9% vs 76.3%. At univariate analysis the predictive factors of low CR rate were IPS≥3 (p=0.032), and PET2pos (p<0.001). At multivariate analysis PET2pos (p=0.001) was the only independent risk factor predictive of low CR rate. Seven-y EFS was significantly better in patients with PET2neg (log rank 13.2, p<0.001) and in patients with IPS 0-2 (log rank 4.5, p=0.032). At Cox regression analysis PET2 was the only independent factor predictive of EFS. As on
event-free survival of prognostic groups

When ABVD is used as the chemotherapy backbone for newly diagnosed cHL, patients with favorable stage I-II (EF), unfavorable stage I-II (EU), favorable stage III-IV (Hasenclever index 0-2) (AF) and unfavorable stage III-IV (Hasenclever index ≥3) (AU) differ in EFS with the latter having the worst prognosis. GHLSG has reported that the introduction of eBEACOPP-based chemotherapy for EU and advanced stage groups annuls this difference. To our knowledge, no other group has reproduced these findings.

Since 2010, after the end of accrual into the EORTC 20012 trial, we recommend eBEACOPP as front-line therapy for AU. During 2014/5 this recommendation was extended to AF and EU patients. Here we analyze the outcome of different prognostic groups of newly diagnosed cHL patients below 60 years of age treated at our institution during the period of almost 5 years when eBEACOPP was used as initial treatment for AU patients. There were 13 patients in the EF group, one was treated with ABVD only, one with radiotherapy (RT) only, and 11 with the combination of ABVD and RT. None relapsed or died. 38 patients were in the EU group. All started ABVD, two switched to eBEACOPP because of interim PET positivity; one received additional RT. One patient died during treatment, presumably due to pulmonary embolism; one relapsed. EFS at three years was 94% and OS 97%. The difference in EFS between EU and AF is statistically significant (p=0.023) (Figure 1). If eBEACOPP is used for front-line treatment only in patients with high-risk advanced stage disease, this results in paradoxical inversion of EFS between prognostic groups. eBEACOPP should be considered for all newly diagnosed HL patients younger than 60, except those in the lowest risk group.

Figure 1.

THE SWITCH FROM ABVD TO BEACOPP AS FRONT-LINE THERAPY FOR HIGH-RISK STAGE III-IV CLASSICAL HODGKIN LYMPHOMA PATIENTS RESULTS IN AN INVERSION OF EVENT-FREE SURVIVAL OF PROGNOSTIC GROUPS


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HALO STUDY: A PHASE 1/2 CLINICAL TRIAL OF BRENTUXIMAB-VEDOTIN AND BENDAMUSTIN IN ELDERLY PATIENTS WITH PREVIOUSLY UNTREATED ADVANCED HODGKIN LYMPHOMA. PRELIMINARY DATA

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Treatment of elderly patients with HL remains a difficult challenge as results and tolerance of the standard treatment with ABVD remains very inferior to adults. Bendamustine (Be), and with Brentuximab Vedotin (BV), are active drugs, which have demonstrated a good tolerance and an high level of response in relapsing/refractory HL. To assess the safety and the efficacy of the combination of these two drugs in elderly HL, we conduct a prospective multicentric open-label study of Brentuximab-Vedotin (BV): 1.2 mg/kg D1 and Bendamustin (Be) 90 mg/m²/day, D1 and D2, every 3 weeks up to 6 cycles, for patients from 60 to 80 years of age, with advanced HL, stage 2B or 4. Ten centers, 5 from Italy and 5 from France, participate to the study. A total of 60 patients are planned to be included. An evaluation by TEP-Scan will be performed after the 2nd cycle and treatment will be pursued until the 6th cycles for patients in CR according to Lugano’s criteria. A supplementary control by TEP-scan is planned after the 4th cycle for patients in PR after 2 cycles. Patients with progressive disease at any time or not in CR after 4 cycles will receive salvage therapy according the choice of the local investigator. A final evaluation by PET-Scan is planned for all patients after the 6th cycle. A centralized review of all TEP-Scan is planned. The patients will be followed up for 5 years. The study is divided in 2 phases: the phase 1 with 12 patients with the main objective to evaluate the tolerability and toxicity of Be-BV and
the phase 2 with 48 patients, with the primary objective to evaluate the efficacy in terms of response rate after treatment completion. The secondary objectives of the phase 2 are to evaluate the efficacy in terms of PFS, EFS and OS at 5 years, to evaluate the efficacy in terms of complete response rate after two cycles of Be-BV and to evaluate the feasibility of the treatment. Currently, we have enrolled 14 patients: 9 patients have performed the first TEP-Scan evaluation after 2 cycles: 7 were in complete response and 2 in partial responses according to local evaluation. The 2 patients in PR after 2 cycles were in CR at the evaluation by PET-Scan after 4 cycles. None unexpected toxicity has been observed and the trial remains open to inclusions. The precise design of the study and updated results will be presented for the symposium.  

Support. Study is supported by a grant of Millenium US/Takeda France.

P012
TRANSFORMATION OF NODULAR HODGKIN’S LYMPHOMA WITH LYMPHOCYTE PREDOMINANCE TO T-CELL-RICH LARGE B-CELL LYMPHOMA
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Aim. To describe clinical features of transformation of nodular Hodgkin’s lymphoma (HL) with lymphoid predominance (NLHLP) to T-cell-rich large B-cell lymphoma (TCRLBCL), to evaluate the effectiveness of therapy program BEACOPP-14 in this group of patients. Materials and Methods. During the period from 2010 to 2016 the transformation NLHLP to TCRLBCL was diagnosed in 15 patients. Male to female ratio: 4:1, median age 40 (23-68) years. NLHLP diagnosis was based on histological and immunohistochemical study of the biopsy of the tumor, the stage of disease - by standard for HL methods. Results. Of the 46 patients with NLPHL observed in National Research Center for Hematology, transformation NLHLP to TCRLBCL was diagnosed in 15 (33%) patients (13 untreated patients with a long history of lymphadenopathy, and 2 patients with relapsed Hodgkin’s lymphoma after 3 years and 21 years). All patients had advanced stages of disease. All untreated patients had previous long-term asymptomatic lymphadenopathy. B symptoms were noted in 11 (73%) cases. Extranodal involvement had 12 (80%) patients: liver damage - in 7 (47%), lung involves - in 5 (33%), spleen involves - in 10 (67%), bone marrow lesions was found in 9 (60%) patients and was proved by histological and immunohistochemical study. Follow-up of the 15 patients: 1 patient with transformation to TCRLBCL in relapse (in 21 year after the end of HL treatment) was not treated (refusal of treatment, death), 1 patient received ABVD and achieved complete remission, the remaining 13 patients received BEACOPP-14, complete remission was achieved in 11 (85%), partial remission - in 2 (15%) patients. In one young patient with transformation NLHLP to TCRLBCL with aggressive clinical presentation of disease complete remission was consolidated by high-dose chemotherapy followed by autologous peripheral blood stem cells transplantation. Conclusions. The clinical features of transformation NLHLP to TCRLBCL are advanced stages of disease with presence of B-symptoms, frequent involvement of extranodal sites and bone marrow. Therapy by BEACOPP-14 program can lead to complete remission in 85% of patients.

P013
ABVD AS THE TREATMENT OPTION IN HODGKIN LYMPHOMA WITH LARGE MEDIASTINAL TUMOR
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Background. Large mediastinal tumor is considered as an unfavorable prognostic factor for Hodgkin’s lymphoma (HL). Patients with advanced Ann Arbor clinical stages (CS III and IV) are considered as advanced disease. Nevertheless, some study groups are also stratifying patients with large mediastinal tumor as advanced disease. Aim. The aim of this study was to assess the outcome of ABVD treated HL patients with large mediastinal tumor, as well to identify risk factors for poor outcome. Patients and Methods. A study was performed on 173 HL patients with large mediastinal tumor (more than one-third of the maximum horizontal chest diameter on CXR) diagnosed between 1997 and 2011. The standard initial treatment was 6-8 cycles of ABVD +/- radiotherapy. Beside the patients with advanced CS, this study also included patients with CS II who were according to institutional guidelines treated the same as patients with advanced CS. Results. The median age was 29 (range 16-68). The median follow up was 94 months. Five-year event free survival (EFS) was 62% and 5-year overall survival (OS) was 76%. In univariate analysis, there was no difference in survival based on CS, both in OS (log rank: p=0.180) and EFS (log rank: p=0.126). Worse OS was found only in patients with IPS≥3 (5-year OS 62.5% vs 82.1%; log rank, p=0.011), while presence of age>45, male gender, ESR≤50 mm/h, B symptoms or EN disease didn’t influence OS (log rank: p=0.499, p=0.145, p=0.631, p=0.111, p=0.900, respectively). Worse EFS was found in patients with IPS≥3 (5-year EFS 51.8% vs 67.6%) and males (5-year EFS 54.8% vs 66.7%) (log rank; p=0.037, p=0.016, respectively), while presence of age>45, ESR≤50 mm/h, B symptoms or EN disease didn’t influence EFS (log rank; p=0.960, p=0.885, p=0.295, p=0.887, respectively). The multivariate Cox regression analysis identified IPS≥3 as the independent prognostic factor for OS (p=0.023; RR=1.982, 95% CI 1.100-3.570) and male gender for EFS (p=0.011; RR=1.852, 95% CI 1.153-2.974). Conclusions. The initial approach in patients with CS II and large mediastinal tumor shouldn’t be different from advanced clinical stages. More effective approach seems to be required, especially in males and patients with high IPS.

P014
PERIPHERAL BLOOD EOSINOPHILIA IS A GOOD RISK FACTOR IN POOR PROGNOSIS GROUP: ADVANCED HODGKIN LYMPHOMA WITH LOW ALC/AMC
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We studied the prognostic significance of the absolute neutrophil/lymphocyte ratio (ANC/ALC), the absolute lymphocyte/monocyte ratio (ALC/AMC), absolute eosinophil count (AEOc) and their contribution to prognostic value of the International Prognostic Score (IPS) in 361 advanced Hodgkin lymphoma (HL) patients. The receiver operating characteristic curve identified the best cut-off values as 4.3 for ANC/ALC and 2.0 for ALC/AMC. Univariate analysis showed that all analyzed factors were associated with lower OS: ANC/ALC<4.3 (OS5yrs with/without risk factor 72% vs 85%, respectively, p<0.01); ALC/AMC<2 (OS5yrs vs 86%, respectively, p<0.01); IPS>2 (OS5yrs vs 66% vs 86%, respectively, p<0.01); AEOc<0.5x10e6/L (OS5yrs with/without risk factor 76% vs 88%, respectively, p<0.01); IPS >2 (OS5yrs vs 66% vs 86%, respectively, p<0.01). Apart from AEOc, these factors also had a significant impact on EFS - ANC/ALC<4.3 (EFS5yrs with/without risk factor 55% vs 72%, respectively, p<0.01); ALC/AMC<2 (EFS5yrs with/without risk factor 64% vs 86%, respectively, p<0.01); IPS>2 (EFS5yrs vs 50% vs 66%, respectively, p<0.01). Overall survival multivariate analysis identified ALC/AMC<2, IPS>2 and AEOc<0.5x10e6/L as prognostic factors for poor OS (p<0.01; p<0.01; p<0.01 respectively). In a respective model for EFS, ALC/AMC<2 and IPS>2 were also significant (p<0.01; p<0.05, respectively). After evaluating ALC/AMC and IPS, we stratified patients into 3 progressively-worse-outcome groups (low-risk: 0; intermediate: 1 risk factor; high: 2
risk factors) both for OS (91%; 74%; 56%, p<0.01) and EFS (77%; 58%; 41%; p<0.01). Furthermore, we observed that patients with eosinophilia, AEOc>0.5x10^6/L had significantly better OS in group with ALC/AMC<2 (82% vs 58%, p<0.01), as well as in low IPS group (97% vs 64%, p<0.05), but not in group with high IPS (75% vs 64%, p>0.05). Our study endorses the combination of ALC/AMC with IPS, thus providing an improved risk prediction in advanced HL patients. Moreover, present peripheral blood eosinophilia separates patients with better prognosis in poor prognostic group.

**P015**

LOWER SOCIOECONOMIC STATUS IS ASSOCIATED WITH SHORTER SURVIVAL IN HL PATIENTS - AN ANALYSIS FROM THE BRAZILIAN HODGKIN LYMPHOMA REGISTRY

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Introduction. Socioeconomic status (SES) is a well-known determinant of outcomes in cancer. We have previously reported that Hodgkin’s lymphoma (HL) patients (pts) with a lower SES had inferior survival in a different cohort from Rio de Janeiro. Methods. SES stratification was done using an asset/education-based household index widely used in publicity and political polls in Brazil. Results. 624 classical HL pts with diagnosis until December 31 2014, ≥18 y-old and HIV-, treated with ABVD, were analysed. The median follow-up was 35.6 months for all pts, 67% (390/578) were classified as higher SES and 33% (188/578) as lower SES. The 3-y PFS in higher and lower SES were 78% and 64% (p<0.0001), respectively. The 3-year OS in higher and lower SES were 94% and 82% (p<0.001), respectively. Lower SES pts were more likely to be ≥60 years (16% vs 8%, p=0.003), to have a poor performance status (20% vs 10%, p=0.001) and high risk IPS (44% vs 31%, p=0.004), to present with advanced disease (71% vs 58%, p=0.003) and to have histopathology other than nodular sclerosis (51% vs 19%, p=0.002). Also, time to diagnosis >4 months was more frequent in lower SES pts (69% vs 55%, p=0.0001). Of the 60 pts who not done iPET, 24 (40%) were iPET-positive (DS 4-5). Patients with residual metabolic activity had equally good outcomes (100% vs 92%; p=0.1). Of the 60 pts who not done iPET, 24 (40%) were performed PET\CT after the end of 6 EACOPP-14. There is not difference of outcome between 19 pts with CMR after the end of chemotherapy and 36 pts with CR\uCR according chest\abdominal\pelvic CT with contrast of diagnostic quality (3-PFS 78% vs 91%; p<0.01). Conclusions. The intensive EACOPP-14 program showed good and early response for pts with advanced stage chL. Predictive value of metabolic response after 2 cycles was higher than PET-negativity after the end of chemotherapy.

**P016**

THE IMPACT OF OUTCOME OF INTERIM PET/CT ON ADVANCED HODGKIN LYMPHOMA TREATED WITH EACOPP-14

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Introduction. To assess the role of interim positron emission tomography/computed tomography (PET/CT) and compare its with PET\CT results after the end of the treatment the patients (pts) with advanced stages classical Hodgkin lymphoma (cHL). Methods. 114 newly diagnosed cHL pts received 6 cycles EACOPP every 14 days (doxorubicin 50 mg\m^2, cyclophosphamide, etoposide, procarbazine, vincristine, prednisone). Consolidation radiotherapy was given to 78 (68%) pts. Interim PET/CT (iPET) imaging after 2 cycles was done in 54 (48%) pts. Results. With a median follow-up 35 months, 3-year progression-free survival (3-PFS) were 85%, overall survival - 92%. In 33 pts (61%) the iPET was negative - Deauville score 1-2 (DS 1-2). The residual uptake was higher than the mediastinal blood pool (MBF) uptake but below the liver uptake (DS 3) in 17 pts (51%) and 4 pts (8%) were PET-positive (DS 4-5). Complete metabolic response (CMR) after 2 cycles predicted higher 3-PFS compared PETpos (100% vs 75%; p=0.0055 - Figure 1).

**P017**

ADVANCED HODGKIN LYMPHOMA - A RISK STRATIFICATION OF ABVD TREATED FEMALES IN GENERATIVE AGE

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Background. Recent trials demonstrated that treatment results of
BEACOPPesc are likely better than ABVD for advanced Hodgkin Lymphoma (HL). However, BEACOPPesc is associated with more toxic effects, with post treatment infertility as one of the major concerns. Aim: The aim of this study was to identify females in generative age with advanced HL who do not require more aggressive approach than ABVD. Patients and Methods: This study was performed on 147 females younger than 40 years with advanced HL, diagnosed between 1997 and 2011. The initial treatment was 6-8 cycles of ABVD +/- radiotherapy. Prognostic relevance of IPS, ESRa50 mm/h, as well presence of B symptoms, bulky disease and extranodal disease (EN) were examined. Results: For the whole group 5-year overall survival (OS) was 81% and 5-year event free survival (EFS) was 66%. Based on examined parameters, in univariate analysis worse OS had patients with IPS≥3 (5-year OS 61.1% vs 87.3%; log rank, p=0.000) and EN (5-year OS 71.9% vs 83.5%; log rank, p=0.036). Worse EFS had patients with IPS≥3 (5-year EFS 41.7% vs 73.9%) and EN (5-year EFS 40.6% vs 73.0%) (log rank; p=0.000, p=0.000, respectively). Moreover, bulky disease in this subgroup retained its prognostic significance in multivariate analysis for OS (p=0.002) and EFS (p=0.023), as well as EN for EFS (p=0.027). Subsequently, we analyzed the subgroup of 111 patients with low IPS. Thirty patients without bulky disease (27.0% of low IPS patients, 20.4% of the entire group) had better OS (5-year OS 100% vs 82.7%; log rank, p=0.028) and trend toward better EFS (5-year EFS 90% vs 67.9%; log rank; p=0.06), with only 2 deaths until the end of follow up. Based on IPS score (0, 1, 2), presence of ESRa50 mm/h, B symptoms and EN there was no difference both in OS (log rank; p=0.166, p=0.359, p=0.459, p=0.385, respectively) and EFS (log rank; p=0.098, p=0.933, p=0.383, p=0.187, respectively). Moreover, bulky disease in this subgroup retained its prognostic significance in multivariate analysis for OS (p=0.044; RR=4.577; 95% CI 1.042-20.106). Conclusions. ABVD is very effective for females with advanced HL younger than 40 years with low IPS and without bulky disease.

P018
ADVANCED STAGE HODGKIN LYMPHOMA IN MOROCCAN ADULTS: CLINICO-PATHOLOGICAL FEATURES AND THERAPEUTIC OUTCOMES
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Introduction. Advanced stage Hodgkin lymphoma (ASHL) is still a major concern to face in both developed and developing countries. Five-year survival rate ranges between 51% and 94.6% in Western literature. However, few is known about the features of ASHL in developing countries. The purpose of this study is to describe the clinic-pathological features of ASHL in Morocco. Methods. Retrospective descriptive study of diagnosed ASHL carried over a period of 6.5 years from January 2007 to August 2015 in a single Moroccan University Hospital, including all patients with ASHL (stage III and IV of Ann Arbor) aged over 18. Patients with retroviral infections and secondary HL were excluded. The diagnosis was based on histological examination of biopsy and immunohistochemistry. Patients were classified according to the classification of Ann Arbor, and stratified according to the score of IPS. Results. Four hundred and seventy-eight patients were diagnosed with HL (all stages) during the period study, among them 200 patients ASHL account for 46.3. The age was ranged between 18 and 91 years old (yo) with a median age of 52 yo. Sex ratio H/F was 1.66. Seventy three percent of ASHL patients didn’t have medical insurance and 47% were jobless. The median time to diagnosis was 6 months [1-52]. Lymphadenopathy was the most common presentation (61.5%). Eighty three patients (41.5%) were stage III, 117 patients (58.5%) were stage IV. Eighty two percent of the patients reported B symptoms. Nodular sclerosis was the predominant histological presentation of ASHL in adult (60.5%) followed by mixed cytology (17.5%). Ninety nine percent of lymphoma’s biopsies were CD30+, 82.5% were CD15+ and LMP-1 was positive in 35.6%. Bulky disease was present in 37% of the ASHL. IPS score was ranged between 0 and 6 with a median of 3. 42.5% patients had a score less than 2. Survival was rated in patients treated with 3 cycles of ABVD +/- Radiotherapy (150 patients fulfilled the inclusion criteria). Twenty-one percent of patients were treatment failure, 12% relapsed. The death rate was 20.6% of which 45% was by progression disease. The 5-years overall survival and event free survival of ASHL patients were 70.9% and 41.7% respectively. Conclusions. This current pattern for epidemiological features and outcomes of ASHL enables delineate key populations in order to explore risk factors for ASHL and strategies to improve treatment outcomes, especially intensification strategies.

P019
GENERAL POPULATION-DERIVED SPECIFIC SURVIVAL APPLIED TO HODGKIN LYMPHOMA
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Mortality of patients (pts) affected with cancer can be partially unrelated to tumor, while accurate clinical investigation must be focused mainly on that tumor related. Specific survival (SS) is obtained by subtracting expected mortality (EM) – inferred from national or regional mortality tables – to the observed one. The expected survival (ES) is that enjoyed in the absence of tumor. ES corresponds to the time still at patients’ disposal in case of hypothetical full recovery and repre-
Hodgkin lymphoma is one of the most frequently diagnosed malignancies in pregnancy. In the group of nine patients of one center with manifestation of Hodgkin lymphoma in pregnancy we demonstrate the management of diagnostic and therapeutic procedures. Seven patients were diagnosed in 20-30th week of pregnancy; one with progressive lymphadenopathy already before confirmation of pregnancy and one patient with the diagnosis in 7th week. Only in one case there was induced abortion, and in one case the corticotherapy was started in the third trimester, in the rest of patients (7) the therapy was started after the delivery. Although there are some publications about therapy with single vinblastin, respectively combination chemotherapy ABVD in the second half of pregnancy, our experiences are based on preparation of thorough observation in pregnancy and indication of specific chemotherapy after delivery.

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bendamustine (starting dose reduced to improve tolerability after 10 patients treated) (6 cycles). Patients with clinical benefit could subsequently continue BV treatment. Responses were assessed per the Revised Response Criteria for Malignant Lymphoma (Cheson 2007).

**Results.** Enrollment was completed sequentially (treated patients: n=27 BV; n=22 BV+DTIC; n=20 BV+bendamustine), all patients are off treatment, and 44 remain in long-term follow-up (n=16 BV; n=18 BV+DTIC; n=10 BV+bendamustine). Overall, median age was 76 years (range, 62–92). At baseline, 70% of patients had Stage III-IV HL, 15% presented with bulky disease, 41% had B symptoms, 25% had ECOG 2-3, and 72% were ineligible for frontline chemotherapy. Treatment was discontinued for adverse events (n=35; mostly peripheral neuropathy, n=24), progressive disease (PD; n=15), or other reasons (n=19). Although no specific safety signal was identified, the sponsor suspended treatment with bendamustine because the tolerability did not meet the study goal of defining a low toxicity regimen for this patient population (Table 1). Median number of treatment cycles, median observation time, ORR, and overall survival (OS) are presented by cohort (Table 1). **Conclusions.** Both BV monotherapy and BV+DTIC appear tolerable and yield high response rates (ORR 92-100%) in this fragile patient population. Furthermore, the combination with DTIC appears to increase the durability of response without increasing toxicity; and therefore, may represent a reasonable frontline treatment option for elderly HL patients. Other treatment combinations are being considered.

**Table 1.**

<table>
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<tr>
<th></th>
<th>BV (n=27)</th>
<th>BV+DTIC (n=22)</th>
<th>BV+bendamustine (n=20)</th>
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<td>Median number of treatment cycles</td>
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<td>Median observation time, months (range)</td>
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<td>ORR, n(%)</td>
<td>24 (92)</td>
<td>21 (91)</td>
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<td>CR rate, n(%)</td>
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<td>19 (82)</td>
<td>18 (90)</td>
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<td>Median FNS, metastasis ranges</td>
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<tr>
<td>FFS rate at 18 months [95% Confidence Interval]</td>
<td>56% (29-73%)</td>
<td>55% (27-72%)</td>
<td>55% (20-78%)</td>
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<tr>
<td>Mean OS, months (range)</td>
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<tr>
<td>OS rate at 18 months [95% Confidence Interval]</td>
<td>100% (100-100%)</td>
<td>94% (78-100%)</td>
<td>85% (60-93%)</td>
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<td>Treatment-related AE ≥ grade 3, n(%)</td>
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<td>10 (45)</td>
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<td>Any SAE, n(%)</td>
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<td>9 (41)</td>
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<td>Death within 30-day safety period</td>
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* a. Time from first dose to death or last contact.
  b. Responses as per the Response Evaluation Criteria in Solid Tumors (RECIST).
  c. 18-months from entry into treatment.

**Immunotherapy (Basic Science)**

**T007**

**HODGKIN LYMPHOMA INFILTRATING T CELLS: CONSIDERING VARIOUS MEANS OF TUMOR EVASION**

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The cellular microenvironment in classical Hodgkin lymphoma (cHL) is dominated by a mixed infiltrate of inflammatory cells with typically only one or a few percent of Hodgkin and Reed/Sternberg (HRS) tumor cells. HRS cells orchestrate this infiltrate by the secretion of a multitude of chemokines and direct cell–cell interactions. T cells are usually the largest population of cells in the HL tissue, encompassing T helper (Th) cells, regulatory T (Treg) cells and cytotoxic T cells. Helper and regulatory T cells presumably provide essential survival signals for the HRS cells, and the regulatory T cells also play an important role in rescuing HRS cells from cellular immune response. Here, we investigate the significance of the cHL-specific T cell infiltrate in regard to its role in tumor evasion. Comparing the global gene expression profiles of T cells isolated from cHL lymph nodes (LN) and reactive human tonsils revealed substantial phenotypical differences. Performing gene expression profiling, the T cell compartment in the cHL microenvironment featured an activated, highly proliferative and yet immunosuppressive phenotype. However, the nature of the regulative phenotype in both cHL CD4+ T cell subsets (Th: CD25- and CD127+; Tregs: CD25+ and CD127-) differs to the corresponding tonsillar Treg subset that comprises a purer population of natural FOXP3+ T cells. The ability of HRS cells to induce suppressive T cells was analyzed with an *in vitro* model system using human CD4+ peripheral blood (PB) T cells that were cocultured with cHL cell lines. Co-cultured, naive T cells displayed an induced, CD25+ subpopulation and upregulated levels of FOXP3, CTLA4 and IRF4. Moreover, the exposure to HRS cells caused a dampened Th1 specific immune response. As for specific means of tumor evasion, the purinergic pathway seems an attractive co-factor. Based on *in vitro* observations support a HRS-dependent generation of environmental adenosine. Additionally, we observed an increase expression of the surface molecules BTLA and CD200R in cHL-infiltrating T cell subsets. Regarding their corresponding binding partners, typically expressed on tumor cells, most cHL cell lines were positive for HVEM and CD200. Taken together, we provide a novel perspective on the complex HRS –T cell interaction, verify its immunosuppressive nature and provide further insights into various means of tumor evasion in cHL.

**T008**

**CCRS BLOCKING BY MARAVIROC INHIBITED RECRUITMENT, PROLIFERATION AND PRO-TUMOR EFFECTS OF MESENCHYMAL STROMAL CELLS AND MONOCYTES IN 2D AND 3D MODELS OF HODGKIN LYMPHOMA MICROENVIRONMENT**

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In classical Hodgkin Lymphoma (cHL), the tumor microenvironment (TME) is dominated by an extensive mixed cellular inflammatory infiltrate that plays a decisive role in the pathobiology of the disease. CCL5 and its main receptor CCR5, expressed by cHL cells and by bystander cells including stromal cells and macrophages, are increased in cHL lymph nodes respect to normal lymph nodes. Recently, CCL5 and CCR5 have been implicated in cancer progression. Our hypothesis is that CCL5 secreted by cHL cells could recruit Mesenchymal Stromal cells (MCS) and monocytes, which in turn educated by tumor cells may affect tumor progression. To demonstrate the involvement of CCL5 in...
the cross-talk of cHL cells with the TME we used neutralizing anti-
CCL5 antibody and the CCR5 antagonist Maraviroc. We found that
CCL5 secreted by L-1236, L-428, KM-H2 and HDLM-2 cHL cell lines, recruited and increased the proliferation of MSCs from Bone Marrow and Adipose Tissue. In turn, tumor-educated MSCs (E-MSCs) secreted higher amounts of CCL5, which increased the proliferation, the clono-
genic growth and the movement/spread of cHL cells. Both E-MSCs and cHL cells by secreting CCL5 were able to recruit monocytes purified from Peripheral blood, suggesting that monocytes may be recruited directly by tumor cells and indirectly by E-MSCs. Treatment of mono-
cytes with L-1236-conditioned medium (CM) enhanced the surface expression of CCR5, the proliferation and induced the secretion of CCL5. In turn, tumor-educated monocytes, by secreting CCL5, increased the proliferation and the clonogenic growth of L-1236 and HDLM2 cells. Only CM from tumor-educated monocytes inhibited the proliferation of PHA activated peripheral blood mononuclear cells. Finally, using a new threedimensional (3D) approach (mixed organoids) to mimic the TME, we found that the cocultivation of L1236 and HDLM-2 cells with monocytes, MSCs and especially the combination cHL/monocytes/MSCs increased the survival/proliferation of tumor cells. Treatment with Maraviroc not only decreased cHL cell survival/proliferation due to the cocultivation with MSCs and mono-
cytes, but also disrupted the 3D mixed organoids. Taken together our results suggest that CCL5 secreted by cHL cells, as well as by tumor-
educated MSCs and monocytes, may build the protective TME and suggest a potential for Maraviroc as adjuvant therapy to block TME formation and tumor cell proliferation due to CCR5 ligands.

TO09

DISTURBED ANTIGEN PRESENTATION IN CLASSICAL HODGKIN LYMPHOMA; IMPLICATIONS FOR IMMUNE CHECKPOINT INHIBITOR THERAPY?

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Immune checkpoint inhibitors are being tested in clinical trials and show great promise in the treatment of classical Hodgkin lymphoma (cHL). The proposed mechanism of action of these inhibitors consists of reactivating T lymphocytes that have become unresponsive as a conse-
quence of inhibitory mechanisms exerted by the tumor cells. These reactivated T cells are expected to kill tumor cells after recognizing tumor cell derived antigens that are presented by Human Leukocyte Antigens (HLA) at the tumor cell surface. Consequently, lack of tumor cell surface expression of HLA may be one of the explanations why immune checkpoint inhibitor therapy does not always result in a com-
plete remission in cHL. We evaluated expression of HLA class I, HLA class II and HLA-DM in primary diagnostic tissue in a large population based cohort of cHL, by using immunohistochemistry. HLA class I cell surface expression was lacking in tumor cells in 229 out of 361 cases (63.3%), more often in EBV- cHL (83.2%) than in EBV+ cHL (27.4%). HLA class II cell surface expression was missing in 147 out of 361 cHL cases (40.8%; EBV- 46.8% and EBV+ 29.7%). In addition, we scored lack of cytoplasmic expression of the non-polymorphic HLA-DM. This molecule is essential in the intracellular assembly of HLA class II-anti-
gen peptide complexes. HLA-DM displaces the invariant chain pep-
tide CLIP from the antigen binding groove of HLA class II molecules, to make this groove accessible for loading of antigens. We show that in the absence of HLA-DM, CLIP is not displaced and is aberrantly expressed on the cell surface of Hodgkin tumor cells in frozen sections (n=8). We found that in HLA class II cell surface expressing tumor cells, HLA-DM expression was lacking in 44 out of 89 cases of cHL (49.4%), indicating that no immunogenic peptides are being presented. Com-
bined results for HLA class I, class II and DM show that only 12.4% of cHL cases show HLA expression that is compatible with normal antigen presentation. In conclusion, antigen presentation is often disturbed in cHL. It is expected that this will influence the success of immune check-
point inhibitors. We therefore propose to take tumor cell HLA expres-
sion into account in the evaluation of (lack of) clinical response to these inhibitors.

P059

TUMOR INFILTRATING HLA-MATCHED CD4+ T CELLS RETARGETED AGAINST HODGKIN AND REED-STERNBERG CELLS

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Hodgkin lymphoma (HL) presents with a unique histologic pattern. Pathognomonic Hodgkin and Reed-Sternberg (HRS) cells usually account for less than 1% of the tumor and are embedded in a reactive infiltrate mainly comprised of CD4+ T cells. HRS cells induce an immunosuppressive microenvironment and thereby escape anti-tumor immunity. To investigate the impact of interactions between HRS cells and T cells, we performed long-term co-culture studies that were fur-
ther translated into a xenograft model. Surprisingly, we revealed a strong anti-tumor potential of allogeneic CD4+ T cells against HLA cell lines. HRS and CD4+ T cells interact by adhesion complexes similar to immunological synapses. Tumor-cell killing was likely based on the recognition of allogeneic major histocompatibility complex class II (MHC-II) receptor, while CD4+ T cells from MHC-II compatible donors did not develop any anti-tumor potential in case of HLA cell line L428. However, gene expression profiling of co-cultured HRS cells as well as tumor infiltration of matched CD4+ T cells indicated cellular interac-
tions. Moreover, matched CD4+ T cells could be activated to kill CD30+ HRS cells when redirected with a CD30-specific chimeric anti-
gen receptor. Our work gives novel insights into the crosstalk between HRS and CD4+ T cells, suggesting the latter as potent effector cells in the adoptive cell therapy of HL.
**Minimal Residual Disease and Prediction**

**T013**  
**PLASMA VESICLE-ASSOCIATED miRNAs AS THERAPY RESPONSE BIOMARKERS IN HODGKIN LYMPHOMA**

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Cure rates for classical Hodgkin Lymphoma (CHL) patients are generally high. CHL patients that are cured remain at risk for long-term side effects from the aggressive radiation/chemotherapy regimens and relapses occur. Upcoming treatment strategies aim towards personalized therapy by early assessment of the effectiveness of active treatment by measuring vital tumor tissue with FDG-PET/CT imaging. Apart from radiation burden, imaging is costly and reported positive predictive values by measuring vital tumor tissue with FDG-PET/CT imaging. Apart from mid-treatment TARC and mid-treatment FDG-PET imaging. TARC might serve as a substitute for mid-treatment FDG-PET imaging. TARC might serve as a substitute for mid-treatment FDG-PET imaging.

**T014**  
**MID-TREATMENT TARC AND MID-TREATMENT FDG-PET PREDICT FOR PROGRESSION FREE SURVIVAL IN CLASSICAL HODGKIN LYMPHOMA**

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Background. Plasma or serum CC-chemokine ligand 17 (CCL17) or Thymus and Activation Regulated Chemokine (TARC) is a highly specific biomarker for classical Hodgkin lymphoma (CHL) disease activity. Serial TARC levels correlate with treatment response as early as after one cycle of chemotherapy. In the current study we compared predictive value of mid-treatment TARC with mid-treatment FDG-PET for modified progression free survival (mPFS) in primary CHL patients. Patients and Methods. Serial serum or plasma samples were prospectively obtained from 112 newly diagnosed (65 early stage and 57 advanced stage) CHL patients. Patients were mainly treated with ABVD or eBEACOPP based treatment regimens. TARC levels were quantified using ELISA. FDG-PET results were quantified and reassessed according to the Lugano classification including Deauville five point score. Events for mPFS were scored in case of death due to any cause, progression of CHL or start of second line treatment. Patients without elevated TARC at pre-treatment and patients with active atopic dermatitis were excluded for survival analysis on TARC. Results. Median follow-up was 45 months for the entire cohort. Out of 112 patients, 108 (92%) achieved a complete remission, 8 patients (7%) had a partial response and one patient (1%) had progressive disease. Of 92 patients with a mid-treatment FDG-PET scan 16 (17%) were positive (Deauville ≥4). Mid-treatment FDG-PET positive patients had significantly reduced mPFS compared to mid-treatment FDG-PET negative patients (56% versus 93% at 3 years, p<.001, Figure 1A). Pre-treatment TARC levels were elevated in 100/112 patients (90%) of which two patients had active atopic disease. Of 92 patients with a mid-treatment plasma or serum sample, TARC was elevated (>900 pg/ml) in 8 (9%), mPFS at 3-years was 25% for patients with high mid-treatment TARC and 92% for patients with low mid-treatment TARC levels (p<.001, Figure 1B). Elevated mid-treatment TARC levels were associated with mid-treatment Deauville score of 5. In multivariate analysis both mid-treatment FDG-PET and mid-treatment TARC independently predicted for mPFS. Conclusions. Elevated levels of TARC at mid-treatment are highly predictive for inferior mPFS. Both negative and positive predictive value of mid-treatment TARC are at least as good or even better than mid-treatment FDG-PET imaging. TARC might serve as a substitute for mid-treatment FDG-PET imaging in future response evaluation.

**T015**  
**A COMPREHENSIVE ANALYSIS OF HODGKIN LYMPHOMA SEASONALITY ACROSS VARIOUS GEOGRAPHIC REGIONS**

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Introduction. Seasonal variations in incidence and mortality after a Hodgkin lymphoma (HL) diagnosis have been previously described with partly conflicting results. The goal of this study is to comprehensively analyze seasonal variation in incidence and mortality risk of HL with a focus on geographic differences. Methods. HL cases diagnosed between 1973 and 2012 in the 18 Surveillance, Epidemiology, and End Results (SEER) registries were eligible (n=50,179). Cases with missing data for at least one of the analyzed variables (n=8,700) and from the two SEER registries “Alaska natives” (n=17) and “Rural Georgia” (n=57) were excluded, leaving 41,405 cases for the study. Seasonality of inci-
dence was analyzed using cosinor analysis. The risk of overall mortality within 3 years following a HL diagnosis in winter (Sep.-Feb.) vs summer (Mar.-Aug.) was analyzed by employing a Cox proportional-hazards model with correction for known risk factors. Results. HL shows a season- 
al incidence pattern with a peak in March and a trough in September (p<0.001). In predefined subgroup analyses, cases of the mixed cellular subtype (p=0.002) showed a seasonal incidence pattern. Seasonality was particularly pronounced in the age groups 20-29, 30-39 and 60-69, coinciding with age groups of increased HL incidence. Cases from lower (<38.05°N) latitudes showed a decreased seasonality of incidence (amplitude=0.055) compared to cases from higher (≥38.05° latitudes (amplitude=0.102) (p(diff.)=0.023). The risk of dying in winter vs summer is increased at higher latitudes (HR: 1.082[1.009;1.161], p=0.027), whereas no seasonal difference in mortality was observed for cases from lower latitudes (HR: 0.990[0.926;1.059], p=0.772). A multiplicative interaction term showed interaction between the latitude and a diagnosis in winter on mortality risk (HR(interaction): 1.119[1.009;1.241], p=0.038). Conclusions. HL exhibits a seasonal incidence and mortality pattern in this most comprehensive analysis performed to date. The seasonal effect on incidence is exacerbated at and the effect on mortality restricted to higher latitudes. As latitude is closely linked to seasonal variations in Vitamin D serum levels, a protective effect of Vitamin D in HL is a possible explanation. Evidence on the direct association of Vitamin D levels and the clinical course of HL should be collected to improve the understanding of Vitamin D in HL.

**P060**

**EVALUATION OF SERUM TARC LEVELS IN PATIENTS AT RISK OF PROGRESSION FOLLOWING AUTOLOGOUS STEM CELL TRANSPLANT FOR HODGKIN LYMPHOMA: RESULTS FROM THE AETHERA TRIAL**

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Background. In patients with Hodgkin lymphoma (HL), serum concentrations of thymus and activation-regulated chemokine (TARC) and other cytokines may have prognostic significance in both the front-line and salvage therapy settings. The potential utility of TARC to predict relapse or progression of HL following autologous hematopoietic cell transplant (AHCT) is unknown. AETHERA (NCT01100502) is a phase 3, randomized, placebo-controlled trial that demonstrated improved progression-free survival (PFS) in patients with high risk HL who received post-AHCT consolidation treatment with brentuximab vedotin (BV) (hazard ratio [HR]=0.57, P=0.001), and an acceptable safety profile. Methods. In this exploratory analysis, we measured baseline serum TARC levels in patients enrolled in AETHERA, and evaluated impact of TARC on outcomes after AHCT with or without BV consolidation therapy. Additional serum biomarkers under analysis include sCD30, sCD163, IL-6, sIL-2R, and sCD68. Descriptive statistics were used to characterize baseline TARC concentrations as a function of baseline clinical characteristics, and Kaplan-Meier analysis was used to assess PFS over 24 months of follow-up. Results. Among 329 patients enrolled, 312 (156 BV and 156 placebo) had available serum samples collected between days 28-45 post-AHCT. The median (range) baseline TARC concentration was 472 (18-18,092) pg/mL, and was similar among patients in the BV (481 [18-18,092] pg/mL) and placebo (446 [43-9,756] pg/mL) arms. Median TARC levels were higher among patients with (vs without) established risk factors for progression; these included B symptoms (557 vs 414 pg/mL), extranodal involvement (501 vs 450 pg/mL), FDG-avid PET status (543 vs 453 pg/mL), and incomplete response to salvage therapy (532 [stable disease] vs 474 [partial remis- sion] vs 404 [complete remission] pg/mL, respectively). The median TARC level was also higher among patients with ≥2 risk factors vs those with 1 risk factor (487 vs 410 pg/mL). PFS at 12 months decreased progressively with increasing TARC among patients who received placebo, but not among those who received BV consolidation (Figure). PFS at 24 months was more similar across TARC levels within each treatment arm. Conclusions. Overall, these data suggest that serum TARC may help to identify HL patients at increased risk of disease progression following AHCT.

**Figure 1.**

**P061**

**VALIDATION OF A CLINICAL/BIOLOGICAL PROGNOSTIC MODEL IN A LARGE COHORT OF ELDERLY PATIENTS WITH A CLASSICAL HODGKIN LYMPHOMA**

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Introduction. Our goal is to investigate the external validity of two previously developed prognostic models for overall survival (OS) and progression free survival (PFS) using a scoring system counting unfavorable risk factors (age, performances status, bone marrow involvement, gamma globulin level and fibrinogen level) in elderly patients with a classical Hodgkin lymphoma (cHL). Methods. The performance of the prediction models was evaluated on a retrospective cohort of patients ≥69 years with newly diagnosed cHL treated in eight hospitals in France. Model discrimination was evaluated by computing hazard ratio (HR) across risk groups. A comparison with the International Prognostic Score (IPS) was performed using ROC curves. Results. 288 patients were included (November 1990 –June 2015): median age at diagnosis was 70 years (range, 59-93), 55% were male, 53% presented with B symptoms, 25% had a PS>2, 61% had Ann Arbor stage III/IV, 26% had at least one comorbidity scored 3 or 4 on CIRS. Median follow up is 64 months (0-252), 25% of patients have progressed or relapsed and 103 patients died, 40% within the first year of treatment. OS and PFS at 36 months were 72.1% [95% CI: 66.2%; 77.1%] and 63.5% [57.5%; 68.9%], respectively. On 188 evaluable patients, HR for PFS were 8.2, 7.9, and 9.6 for the presence of 1, 2, and 3/4 factors respectively (reference-absence of factor). On 215 evaluable patients, HR for OS
OUTCOMES AND PROGNOSTIC FACTORS IN HODGKIN LYMPHOMA – A SINGLE CENTER EXPERIENCE

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Background. Identification of patients with Hodgkin lymphoma (HL) at risk of treatment failure remains an important unsolved question. Several prognostic models have been proposed to define risk-adapted therapeutic strategies, avoiding overtreatment and identifying in whom standard treatment is not sufficient.

Aims. To test validated prognostic factors and identify other predictors of survival in a cohort of patients with classical HL (cHL) in a tertiary health institution. Methods. Retrospective analysis of patients with cHL treated between 1990 and 2015. Univariate analysis was performed and significant predictors at the level of 0.05 were used to adjust a multivariate Cox regression model. Results. We included 355 cHL patients, mainly males (55.2%) with a median age at diagnosis of 29 years (12-80). The most prevalent histological subtype was nodular sclerosis (78.3%). Ann Arbor stage III/IV was observed in 41.1% (n=146) patients, B symptoms in 54.6% (n=194) and bulky disease in 22.8% (n=81). According to GHSG criteria, 50.1% (n=178) had advanced disease of which 49.4% (n=88) had an IPS≥3. Among the 344 patients treated, ABVD was performed in 210 (59.2%); MOPP/ABVD in 78 (21.9%); MOPP/MOPP like in 30 (8.5%); BEACOPP in 25 (7.0%); other regimens in 17 patients (4.8%) and radiotherapy alone in 11 (3.1%). Overall response rate was 83.9% (77.2% of complete responses). With a median follow-up of 100.1 months (0.3-316.0), overall survival (OS) at 5, 10 and 20 years was 84.3%, 78.1% and 67.8% and progression free survival (PFS) was 71.6%, 67.3% and 57.9%, respectively. We analyze the prognostic significance of several factors accepted previously with regard to survival. On multivariate regression analysis only 3 factors were associated with impact on OS: age (HR 1.04; 95%CI 1.02-1.06, p<0.001); hemoglobin level (HR 0.78; 95%CI 0.66-0.93, p=0.005) and LDH>2xULN (HR 2.13; 95%CI 1.06-4.28, p=0.034). Four factors were predictors of PFS: age (HR 1.02; 95%CI 1.01-1.04, p<0.004); lymphocyte count (HR 0.60; 95%CI 0.39-0.92, p=0.02); LDH>2xULN (HR 2.55; 95%CI 1.31-4.97, p=0.006) and Ann Arbor stage III/VI (HR 2.40; 95%CI 1.18-4.86, p=0.015). Conclusions. This data provides evidence for age, hemoglobin and LDH as independent predictors of OS and age, lymphocyte count, LDH and Ann Arbor stage as predictors of PFS in patients with cHL. Further work in larger groups is warranted to create an accurate predictive model for adequate stratification of newly diagnosed patients.
Pediatric Hodgkin Lymphoma

**T016**

**WHOLE BODY FUNCTIONAL AND ANATOMICAL MRI: ACCURACY IN STAGING AND TREATMENT RESPONSE MONITORING IN CHILDHOOD AND ADOLESCENT HODGKIN’S LYMPHOMA COMPARED TO CONVENTIONAL MULTIMODALITY IMAGING**

(Cruk C23580/A21707)


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This is a single centre cohort trial to compare whole body MRI (WB-MRI) & conventional investigations for staging & treatment response monitoring in childhood Hodgkin’s lymphoma. A total of 50 patients (32 male, median age 16, range 6-19) prospectively underwent WB-MRI in addition to conventional CT & PET CT at initial staging and during response assessment (n=57) after 2 chemotherapy cycles. WB-MRI included axial/coronal FS T2/T1 TSE, axial FS DWI (5 b values 0 to 800), & dynamic contrast enhanced T1 FLASH through the liver/spleen. The reference standard disease status at 30 sites (17 nodal, 13 extra nodal) & Ann Arbour stage was assigned by a multidisciplinary committee using PET CT and CT, based on EUронET trial criteria (nodal positivity >2cm and/or focal 18-FDG uptake above background). Treatment response (progression, none, partial inadequate (PR), partial adequate (PAR) and complete) was defined using nodal volume change & FDG avidity. WB-MRI was read in consensus by 2 radiologists blind to conventional imaging. Based on pilot data, nodal positivity was defined as >2cm &/or mean ADC <1,2 x 10-3 mm2 s-1. Nodes 1 to 2cm with ADC 1,2-1.8 were equivoc. Treatment response was assigned using nodal volume change and rise in ADC (cut off of 70%) to differentiate between PRI & PAR). Agreement between WB-MRI and the reference was expressed as percentage concordance for all reported disease sites and kappa statistics. Equivocal sites were treated as disease positive. Results are uncorrected for discrepancies in nodal site description. A total of 44 (88%) patients were concordant for at least 80% of nodal sites, although only 12 (24%) achieved 100% concordance between WB-MRI and the reference standard. Equivalent results for extra nodal disease were 48 (96%) and 34 (68%) respectively. There was 72% agreement for stage (36/50), (kappa 0.56-moderate), with 10 (20%) patients under staged by WB-MRI and 4 (8%) over staged. There was 68% agreement for response classification (25/37) (kappa 0.34-fair) with described staging algorithms. Conclusions. Among pediatric patients with VHR HL, a response directed approach with limited chemotherapy and risk-directed RT achieved EFS and OS rates comparable with results of recent trials for this population (POG 9425: IIB/IVB, n=88: 4yr EFS 81.7%; 4 yr OS 92.9%) despite reduction in RT volumes. The similar EFS/2ndEFS for RER and SER supports therapeutic tailoring based on response. Persistent PET at end of chemotherapy identifies a cohort at especially high risk for relapse/early PD. Novel approaches are needed for this group.

**T017**

**PHASE III STUDY OF RESPONSE ADAPTED THERAPY FOR THE TREATMENT OF CHILDREN WITH NEWLY DIAGNOSED VERY HIGH RISK HODGKIN LYMPHOMA (STAGES IIB/IVB) (AHOD0831): A REPORT FROM THE CHILDREN’S ONCOLOGY GROUP**

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**Purpose.** AHOD0831 tested a response-based treatment approach for children with very high risk Hodgkin lymphoma (HL). Central review following 2 cycles by FDG-PET was used to assign consolidation chemotherapy and radiotherapy (RT). As many patients with relapsed HL can be successfully cured with retrieval therapy, 2ndEFS (freedom from 2nd relapse or malignancy) was used as a surrogate for long term HL-related cause of death. AHOD0831 tested whether this treatment would maintain 4yr 2ndEFS ≥95%. Methods. Patients ≥21 with stage IIB/IVB HL were nonrandomly assigned to receive two 21-day cycles of ABVE-PC (doxorubicin, bleomycin, vincristine, etoposide, prednisone, cyclophosphamide). Rapid Early Response (RER) was defined by FDG-PET without activity above background, irrespective of residual masses. RER received 2 additional cycles of ABVE-PC. Slow early responders (SER) received 2 cycles of ifosfamide/vinorelbine and 2 more ABVE-PC. Sites of initial bulky involvement (large mediastinal mass, nodal aggregate >6cm, splenic macronodules) and regions of SER received RT 21 Gy. 2nd events were defined as relapse/ PD of HL or SMN, new SMN or death after a 1st event (relapse/PD, SMN, biopsy proven HL at end of chemotherapy). Results. The 165 eligible patients were: median age 15.8 yrs (5.2-21.4), 61% male, 43% stage IIIb. 50% were RER. Median follow-up was 42 mos. 1st events: 29 relapse/PD, 1 SMN, 1 fungal death. 4yr 1stEFS rates 80.2% (73%-85.6%), 4yr OS 95.9% (90%-98.4%). 12 SER were persistently PET+ at end of chemotherapy; 8 had clinical evidence of active HL: 3 biopsy-proven HL, 2 PD by clinical or radiographic criteria, and 3 relapsed. 20 patients were excluded from 2ndEFS analysis due to premature termination or deviation of protocol therapy. 2ndEFS at 4yrs is 89.8% (95% CI:80.8%-94.8%). 4yr 2ndEFS was 91.9% (76.3%-97.4%) for RER, 87.8% (78.5%-94.1%) for SER (n=68) and 89.6% (76.3%-95.7%) for stage IVB. Conclusions. Pediatric patients with VHR HL, a response directed approach with limited chemotherapy and risk-directed RT achieved EFS and OS rates comparable with results of recent trials for this population (POG 9425: IIB/IVB, n=88: 4yr EFS 81.7%; 4 yr OS 92.9%) despite reduction in RT volumes. The similar EFS/2ndEFS for RER and SER supports therapeutic tailoring based on response. Persistent PET at end of chemotherapy identifies a cohort at especially high risk for relapse/early PD. Novel approaches are needed for this group.

**T018**

**OUTCOMES IN ADOLESCENTS AND YOUNG ADULTS WITH HODGKIN LYMPHOMA TREATED ON US COOPERATIVE GROUP PROTOCOLS: AN ADULT INTERGROUP (E2496) AND CHILDREN’S ONCOLOGY GROUP (COG AHOD0031) COMPARATIVE ANALYSIS**


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**Introduction.** The optimal therapeutic approach for AYAs with HL remains unclear. We examined AYAs treated on 2 recent, randomized pediatric and adult North American HL studies. Methods. The characteristics, failure free survival (FFS) and overall survival (OS) of 114 AYA HL patients (pts) [17-21 years( yr)] treated on E2496 (ABVD vs Stanford
respectively, with significant variations identified by pt age (Table).

In E2496, the 5-year FFS and OS rates for AYAs were 68% and 89%, received radiotherapy (76% (21 Gy vs SV) (P=0.005) but appeared more similar to patients aged 45-59 yr. There was no significant difference in sex, race, or histology in COG or E2496 AYAs. Due in part to trial design differences, a larger proportion of E2496 AYAs were stage III or IV vs COG AYAs (63% vs 29%, P<0.001) and had B symptoms (63% vs 27%, P<0.001); fewer E2496 pts had bulk disease (33% vs 77%, P<0.001). There was no significant difference in extralymphatic disease, anemia or low albumin. More COG AYAs received radiotherapy (76% vs 66%, P=0.05), though in smaller doses (21 Gy vs 36 Gy). The 5-year FFS and OS for COG AYAs were 80% and 97%, respectively. COG AYAs appeared to have superior FFS compared with E2496 AYAs (P=0.001). In multivariable analyses (controlled for stage, anemia, bulk), E2496 AYAs appeared to have worse FFS compared with COG AYAs in all strata except among those with stage I/II without anemia. Propensity score analysis matched on stage, anemia, and bulk disease confirmed inferior FFS for E2496 compared with COG AYAs (P=0.004). The AYA survival disparity across studies persisted after additional covariates were incorporated into the propensity score (ie, age, gender, B symptoms and hypoalbuminemia; P=0.026). Conclusions. AYA HL pts treated on E2496 had inferior outcomes compared with older pts (22-44 yr) on same study, and to similarly matched AYA pts treated on COG AHOD0081. This may reflect differing treatment regimens, risk profiles, biology, or other factors. Prospective examination of these issues in AYA HL pts is warranted.

### Table 1. Survival outcomes within E2496 by age.

<table>
<thead>
<tr>
<th>Age Group</th>
<th>3-yr FFS</th>
<th>5-yr FFS</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>17-21</td>
<td>70%</td>
<td>68%</td>
<td>0.005</td>
</tr>
<tr>
<td>21-44</td>
<td>79%</td>
<td>76%</td>
<td></td>
</tr>
<tr>
<td>45-59</td>
<td>68%</td>
<td>68%</td>
<td></td>
</tr>
<tr>
<td>&gt;60</td>
<td>56%</td>
<td>48%</td>
<td></td>
</tr>
</tbody>
</table>

### P065

**JOINT PEDIATRIC HODGKIN AND NON-HODGKIN LYMPHOMA STUDY GROUP ON GREY ZONE LYMPHOMA IN CHILDREN AND ADOLESCENTS**

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Background. In the current version of the WHO classification of lymphoid tumors the term ‘grey zone lymphoma’ (GZL) was introduced for the first time. The cases of GZL with characteristics of Hodgkin lymphoma (HL) and Non-Hodgkin lymphoma (NHL) are poorly characterized in children and adolescents and need further improvement of diagnostic and treatment approaches. Patients and Methods. We evaluated patient’s characteristics, treatment and outcome of young GZL patients reported to the German Pediatric Hodgkin lymphoma study center and/or to the NHL-Berlin-Frankfurt-Muenster study center. Results. Between 2003 and 2015, 27 children and adolescents with GZL, comprised of 22 boys and 5 girls, with a median age of 15 years, were identified. The GZL was identified at the time of initial diagnosis in 19 patients, in six patients the diagnosis was established at the time of relapse by comparing initial and relapse samples, and in two patients by

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Hodgkin lymphoma (HL) treatment protocols for adolescents and young adults traditionally vary by age, but the biological and clinical rationale for this remains uncertain. Our aim was to investigate clinical presentation and outcome in different age groups (0-9, 10-17, 18-24 years) and to compare prognosis among patients treated in pediatric or adult departments. 

**Patients and Methods.** 1345 classical HL (cHL) 0-24 years were diagnosed in Denmark 1990-2010 and Sweden 1992-2009. Disease characteristics and treatment outcome were available for 1083 patients, 325 in pediatric and 758 in adult departments. Patients in Danish pediatric departments had lower EFS than patients in Swedish pediatric departments and Swedish and Danish adult departments. This correlated to a lower use of RT in primary treatment. OS was equal between the groups.

**Conclusion.** The diagnosis of GZL requires expert reference pathology and centralized review of staging and response evaluation. Since the relapse incidence of GZL is higher than in both “pure” entities HL and NHL, implementation of optimized treatment strategies for GZL is urgently needed. Therefore, global cooperative initiatives have to be undertaken, since GZL is a rare entity.

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**Hodgkin Lymphoma in Children, Adolescents and Young Adults: A Comparative Study of Clinical Presentation and Treatment Outcome**


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Hodgkin lymphoma (HL) treatment protocols for adolescents and young adults traditionally vary by age, but the biological and clinical rationale for this remains uncertain. Our aim was to investigate clinical presentation and outcome in different age groups (0-9, 10-17, 18-24 years) and to compare prognosis among patients treated in pediatric or adult departments. **Patients and Methods.** 1345 classical HL (cHL) 0-24 years were diagnosed in Denmark 1990-2010 and Sweden 1992-2009. Disease characteristics and treatment outcome were available for 1083 patients treated in pediatric (n=325) or adult departments (n=758). Outcome was estimated as event free survival (EFS) and overall survival (OS) and using Cox regression. Patients treated in adult departments were mainly treated with ABVD (doxorubicin, bleomycin, vinblastine, dacarbazine) or BEACOPP (bleomycin, etoposide, doxorubicin, cyclophosphamide, vincristine, procarbazine, prednisone) +/- radiotherapy (RT) and the majority of the pediatric patients with OPPA/OPEPA (vincristine, etoposide vs procarbazine, prednisone, doxorubicin) and COPP/COPDAC (cyclophosphamide, vincristine, prednisone, procarbazine vs dacarbazine) +/- RT. **Results.** Children0-9yrs had made male predominance and presented with lower stage disease and lower frequency of B-symptoms and extra nodal disease. Five-year EFS was lower among Danish pediatric patients (0-14 years) [0.81 (95% confidence interval [95% CI]:0.72-0.88)] than among Danish adults [0.85 (0.81-0.88)], Swedish pediatric patients (0-17 years) [0.89 (0.85-0.93)] and adults (0.90 (0.86-0.92)] (Figure 1A). There was no difference in 5- or 10-year OS (Figure 1B). Danish pediatric patients received RT (82%) less frequently than Swedish pediatric patients (71%), p<0.002, while in adults the difference was not as pronounced (Denmark 67%, Sweden 56%). In analyses adjusted for sex, stage and country, EFS and OS did not vary among patients treated in pediatric compared to adult departments. **Conclusions.** Children 0-9yrs had a different clinical presentation in several aspects, whereas adolescents 10-17yrs and young adults 18-24yrs shared similar features. There was no difference in treatment outcome between pediatric and adult departments overall. Patients in Denmark treated in pediatric departments had lower EFS than patients in Swedish pediatric departments and Swedish and Danish adult departments. This correlated to a lower use of RT in primary treatment.

OS was equal between the groups.
large cell lymphoma. Based off the success of phase 1 and II trials it is now used as a frontline agent in a high-risk pediatric HL trial HLHR13.

**Purpose.** The primary goal of this study was to evaluate the variability of pharmacokinetics for weekly dosing of 1.2 mg/kg of brentuximab vedotin, determine factors that may explain this variability, compare our drug exposure with published data for the recommended 1.8 mg/kg every 3 week dosing and evaluate toxicity with this novel agent in the pediatric population. **Methods.** Serum samples for brentuximab vedotin levels were collected at day 1 pre and post infusion, 48 hours and day 8 pre-infusion for 16 patients. A compartmental pharmacokinetic model was fit to the data using non-linear mixed effects modeling methods. Serum concentration of anti-therapeutic antibody was measured prior to the first 3 courses and at the end of therapy. **Results.** Brentuximab vedotin and MMAE clearance and volume were significantly correlated with weight (p<1e-10) and accounting for weight explained 75%, 84%, 61%, and 94% of the inter-individual variability in the ADC clearance, ADC volume, MMAE apparent clearance, and MMAE apparent volume respectively. The ADC clearance and volume differed by gender; clearance and volume were higher in male vs female patients (17%; p=0.08, and 17%; p=0.08, respectively) and explained an additional 11% and 36% of the inter-individual variability in the ADC clearance and volume respectively compared to the weight-normalized model. The ADC AUC and Cmax in our pediatric study were lower compared to those reported in adult studies (25% and 11%, respectively at 1.2 mg/kg and 35% and 16%, respectively at 1.8 mg/kg). Toxicity was comparable to that published for the standard of care backbone. All 16 patients remained negative for anti-therapeutic antibodies during and at the end of therapy. **Conclusions.** As in previous studies, weight continues to be the most significant factor explaining brentuximab vedotin pharmacokinetic variability in pediatric patients. Exposure with weekly dosing appeared safe and tolerable in pediatric patients. Given the promising clinical results of brentuximab vedotin, more studies are warranted to demonstrate safety and allow for increased use in the pediatric population.

**P068**

**APPROACH AND FEASIBILITY OF PATIENT-REPORTED OUTCOMES IN A PHASE III CLINICAL TRIAL FOR ADVANCED STAGE CLASSICAL HODGKIN LYMPHOMA IN CHILDREN AND ADOLESCENTS**


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*Co-first authors

**Objectives.** We describe the feasibility of embedding PROs for chemotherapy-induced peripheral neuropathy (CIPN) and cost effectiveness (CEA) in a randomized, multi-institutional Phase III study (NCT02166463), evaluating the efficacy of the novel agent, brentuximab vedotin, determine factors that may explain this variability, compare our drug exposure with published data for the recommended 1.8 mg/kg every 3 week dosing and evaluate toxicity with this novel agent in the pediatric population. **Methods.** Serum samples for brentuximab vedotin levels were collected at day 1 pre and post infusion, 48 hours and day 8 pre-infusion for 16 patients. A compartmental pharmacokinetic model was fit to the data using non-linear mixed effects modeling methods. Serum concentration of anti-therapeutic antibody was measured prior to the first 3 courses and at the end of therapy. **Results.** Brentuximab vedotin and MMAE clearance and volume were significantly correlated with weight (p<1e-10) and accounting for weight explained 75%, 84%, 61%, and 94% of the inter-individual variability in the ADC clearance, ADC volume, MMAE apparent clearance, and MMAE apparent volume respectively compared to the weight-normalized model. The ADC clearance and volume differed by gender; clearance and volume were higher in male vs female patients (17%; p=0.08, and 17%; p=0.08, respectively) and explained an additional 11% and 36% of the inter-individual variability in the ADC clearance and volume respectively compared to the weight-normalized model. The ADC AUC and Cmax in our pediatric study were lower compared to those reported in adult studies (25% and 11%, respectively at 1.2 mg/kg and 35% and 16%, respectively at 1.8 mg/kg). Toxicity was comparable to that published for the standard of care backbone. All 16 patients remained negative for anti-therapeutic antibodies during and at the end of therapy. **Conclusions.** As in previous studies, weight continues to be the most significant factor explaining brentuximab vedotin pharmacokinetic variability in pediatric patients. Exposure with weekly dosing appeared safe and tolerable in pediatric patients. Given the promising clinical results of brentuximab vedotin, more studies are warranted to demonstrate safety and allow for increased use in the pediatric population.

**P069**

**PREDICTION OF PRIMARY TREATMENT RESPONSE AND OUTCOME IN PEDIATRIC HODGKIN LYMPHOMA USING DIGITAL GENE EXPRESSION PROFILING**

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**Introduction.** Hodgkin lymphoma (HL) is a common pediatric malignancy, and although considered highly curable, treatment success comes at a high cost in the form of long-term toxicity and morbidity. To overcome this challenge clinical trials have evaluated risk-adapted treatment regimens aiming to maintain high survival rates and reduce treatment-related toxicity. However, risk stratification is currently limited to the use of clinical factors as there are no validated molecular biomarkers that can be employed as predictors for treatment outcome in pediatric HL. Therefore, we aimed to perform gene expression profiling (GEP) to uncover disease biology underlying treatment response and develop a prognostic model to tailor first-line therapy in pediatric HL. **Methods.** We selected specimens from patients enrolled in a phase 3 clinical trial (AHOD0081) of the Children’s Oncology Group (COG) randomizing patients dependent on CT imaging-based early response criteria (slow early response, SER; rapid early response, RER). We performed intermediate density GEP (784 genes) using NanoString on RNA extracted from pre-treatment formalin-fixed, paraffin-embedded tissue biopsies. **Results.** Of the 206 tissue samples obtained, 185 (89.9%) passed quality assurance testing. We applied our previously published 23-gene predictor - developed to predict OS in adult HL patients - to the pediatric cohort. This assay failed to predict outcomes, with patients in the “high-risk” group, as assigned by the assay, trending to have superior outcomes than the “low risk” patients. Therefore, we sought to develop a novel EFS predictive model for pediatric patients. Using penalized Cox regression, we developed a 16-gene model to predict EFS in a training cohort. This model was applied to an independent cohort of 117 specimens from the same clinical trial which were enriched for treatment failure (no EFS event to EFS event ratio=1:1). Using this validation cohort, the 16-gene model separated high-risk and low-risk groups with significantly different EFS in the SER (p=0.034), but not in the RER group (p=0.81). **Conclusions.** Failure of the GEP-based model developed in adult HL suggests distinct biology underlies treatment failure in the
pediatric age group, although differences in therapy may also be a contributing factor. We describe the development of a novel predictive model for EFS in intermediate-risk pediatric HL patients which successfully risk-stratifies patients in the SER subgroup.

**P070**

**DOES INVOLVED FIELD RADIOTHERAPY IMPROVE SURVIVAL RATES IN PEDIATRIC CLASSIC HODGKIN’S LYMPHOMA? A RETROSPECTIVE STUDY OF 694 CHILDREN**


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**Background.** Pediatric Hodgkin’s lymphoma represents survival success story, however late toxicity remains as a big consideration issue. Patients and Methods. During the period July 2007 and December 2014, 694 pediatric classic Hodgkin’s lymphoma patients were treated according to risk-adapted protocol consisted of 4-8 ABVD chemotherapy courses and involved field radiotherapy (IFRT). Out of them 543 (78.2%) received IFRT with a dose of 19.8 Gy, while the other 151 (21.8%) did not receive radiotherapy for different reasons. Results. The 5-year overall (OS) and event-free survival (EFS) for the low risk patients were 99.7% and 92.6% respectively. These rates were 93.1% and 85.9% for the intermediate risk and 95.4% and 75.3% for the high risk respectively. The 5-year OS and EFS for those received IFRT were 98.0% and 86.9% respectively, while those who receive chemotherapy only were 92.9% and 77.8% respectively (p 0.001 for each). Radiotherapy could improve the 5-year EFS in the advanced (intermediate and high-risk) patients from 76.6% to 79.4% with marginal statistical significance (0.073). On the other hand, the OS improved from 94.5% to 96.0% though this difference did not reach the level of significance. Only one out of 318 low-risk patients died and 14 relapsed and could be salvaged. Only 25 low-risk patients did not receive IFRT and those did not show OS nor EFS differences from the 293 patients who received IFRT. Two patients developed acute myeloid leukemia & one developed thyroid cancer as second primary (0.43%). All of them received chemotherapy and IFRT. Conclusions. Involved field radiotherapy marginally improved the EFS in intermediate and high-risk pediatric Hodgkin’s lymphoma significantly, while its improvement in OS in such patients did not reach the significant statistical level. Low-risk patient needs prospective randomized trial to thoroughly investigate this issue.

**P071**

**CHIPS AS A PREDICTOR OF OUTCOME IN RADIATED VS UNRADIATED HL**

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**Purpose.** To evaluate the CHIPS (Childhood Hodgkin International Prognostic score) in patients with intermediate risk (IR) Hodgkin Lymphoma (HL) randomized to +/- 21 Gy of involved field radiation (IFRT) after completing 4 cycles of ABVE-PC. These patients had achieved a rapid early response (RER) to 2 cycles of ABVE-PC (RER) and complete response (CR) at the end of chemotherapy. Methods. Patients enrolled on COG AHOD were <21 years with IR HL. The CHIPS score was derived from clinical data on 1103 patients who had received 4 ABVE-PC and radiation. Four factors (fever, low albumin, large mediastinal adenopathy, stage 4) were identified as independent predictors of EFS. CHIPS was then examined in the cohort of RER who achieved CR and were randomized to receive or not receive IFRT. Results. There were 664 RER/CR patients with CHIPS scores available; 329 were randomized to no RT and 335 were randomized to RT. 4 year EFS was similar between CHIPS cohorts except for CHIPS 1. CHIPS 1 patients showed an advantage to the addition of IFRT (p=0.035). CHIPS 0 patients did well with or without IFRT. CHIPS 3 patients had poor outcomes with or without RT (Table 1). Conclusions. CHIPS was derived based on patients treated on COG protocol AHOD0051 who received IFRT after ABVE-PC chemotherapy. For this report, we compared CHIPS in the RER/CR cohort randomized to IFRT vs no IFRT. Although the overall randomization to +/- RT (Friedman, JCO 2015) did not detect any advantage to the addition of IFRT, this sub-analysis shows that 1) CHIPS was predictive of outcome in both the radiated and the un-irradiated cohort and 2) there may be a benefit for IFRT in the CHIPS 1 cohort. As in the overall cohort, CHIPS 2 and 3 patients should be considered for augmented therapy.

**Table 1.**

<table>
<thead>
<tr>
<th>CHIPS</th>
<th>No RT</th>
<th>IFRT</th>
<th>4 year EFS ± S.E.</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>No RT</td>
<td>IFRT</td>
<td></td>
</tr>
<tr>
<td>0</td>
<td>157</td>
<td>154</td>
<td>89.9 ± 2.5</td>
</tr>
<tr>
<td>1</td>
<td>116</td>
<td>114</td>
<td>83.8 ± 3.5</td>
</tr>
<tr>
<td>2</td>
<td>45</td>
<td>57</td>
<td>84.1 ± 5.5</td>
</tr>
<tr>
<td>3</td>
<td>11</td>
<td>10</td>
<td>60.6 ± 15.7</td>
</tr>
</tbody>
</table>

**P072**

**CYCLOOXYGENASE-2 EXPRESSION AS A PROGNOSTIC FACTOR IN PEDIATRIC CLASSICAL HODGKIN LYMPHOMA**

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**Introduction.** Cyclooxygenase-2 (COX-2) is an inflammatory enzyme and it was proved to have a role in tumor initiation, angiogenesis, and proliferation. It has been demonstrated that COX-2 expression increases in many tumors as a negative prognostic parameter. Objectives. We investigated the prognostic value of COX-2 expression among pediatric Classical Hodgkin Lymphoma patients. Methods. It is a retrospective analysis of group of pediatric patients (n=151), who were diagnosed as Classical Hodgkin Lymphoma and treated in the Pediatric Oncology department, National Cancer Institute, Cairo University, Egypt during the period from January 2005 till June 2013, and all of them were followed up till August 2015. We analyzed the relation of COX-2 expression to the most recognized clinical variables and its impact on outcome. Results. COX-2 was expressed in Reed-Sternberg cells in 37.4% of the whole group. The frequency of expression was found to be more among patients with bulky disease in comparison to non-bulky and the same applies to B symptoms, high ESR, extranodal extension, and advanced stage without statistical significance. With a mean follow-up period of 54.4 months, 5-year overall survival and progression free survival was lower in COX-2 positive cases than that in COX-2 negative cases; 85.3% and 78.6% versus 96% and 84.3%; respectively but still without statistical significance. The impact on prognosis was observed in male group of patients. 5-year overall survival in COX-2 positive cases was lower than that in COX-2 negative cases (82.9% versus 100%) (P value: 0.045). And there was tendency for statistical significant regarding 5-year progression free survival (75.7% versus 90.2%) in positive and negative cases respectively (P value: 0.06) (Figures 1 and 2). Conclusions. COX-2 was expressed on Reed-Sternberg cells in 37.4% of pediatric C-HL patients. It was found to be an unfavorable prognostic factor in males and might be a therapeutic target. However, further studies including larger numbers of HL patients are needed to investigate that COX-2 may be a major prognostic variable in HL.
were independently associated with the occurrence of event. Conversely, nodular sclerosis subtype was associated with a favourable outcome. Conclusions. Our large prospective cohort revealed interesting features of HL in AYA. Considering data from the literature, our study suggests a more frequent mediastinal involvement and a more advanced stage of disease in AYA compared to children and adults. Despite these prerogative features, relapse rate and mortality rates remain low.

P074

PROGNOSTIC VALUE OF ‘INTERIM’ POSITRON EMISSION TOMOGRAPHY AMONG CHILDREN WITH ADVANCED HODGKIN LYMPHOMA IN DEVELOPING COUNTRIES; CHILDREN CANCER HOSPITAL EGYPT EXPERIENCE

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Rationale and Aim of the Study. This is a retrospective, single center study was done to assess the prognostic role of ‘interim’ positron emission tomography (PET) performed during treatment of advanced stages HL with doxorubicin, bleomycin, vinblastine and dacarbazine (ABVD) in pediatric patients. Patients and Methods. Three hundred and eighty one patients with newly diagnosed Hodgkin lymphomas were enrolled. One hundred sixty five patients with early unfavorable and 216 with advanced-stage disease were treated with ABVD ± involved-field radiotherapy (IFR). PET scan was performed at baseline and after two cycles of chemotherapy. Treatment was not changed according to the results of the interim scan. PET scans reports was used using the Deauville five-point scale, blinded to treatment outcome. Results. Eighty-seven scans out of 336 were scored as positive (17.3%) and 249 (82.7%) as negative. The 5-years overall survival (OS) was 94% (95% Confidence Interval (CI): 91.5 – 96.6), 86.2% (95% CI: 78.3 - 94) for patients with interim positive scans and 97% (95% CI:94.2 - 99.3) for patients with interim negative scans (P<0.0001). The 5-year Event-free survival (EFS) rate was 80% (95% CI: 74.3 – 84.4) for patients with the whole study population, 63.2% (95% CI :48.6 – 77.4) for patients with interim positive scans and 82.6% (95% CI :76.3 – 88.3) for patients with interim negative scans (P<0.0001). EFS in correlation with patients who received IFR was 82.4% (95% CI: 74.3-90.4) and in those who did not receive IFR was 71.9% (95% CI: 63.6-76.1) (Figure 1).
Conclusions. The prognostic role and validity of using the interim PET scan response have been confirmed to be strongly related to treatment outcome by the present study. These results confirm that ABVD with or without IFR is an adequate treatment for more than 70% of patients in advanced stages HL.

P075
LONG-LASTING REMISSION IN AN ADOLESCENT WITH REFRACTORY HODGKIN LYMPHOMA AFTER BRENTUXIMAB VEDOTIN–CONTAINING TREATMENT. A CASE REPORT
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Background. Despite the high cure rate of childhood Hodgkin lymphoma (HL) patients with refractory HL remain incurable with standard therapies. Autologous or allogeneic hematopoietic stem cell transplantation (HSCT) is considered the most effective method of consolidation in relapsed or refractory HL treatment. Brentuximab vedotin (BV) is an anti-CD30 antibody-drug conjugate that has become the preferred therapy option for adults with HL who have relapsed after or are ineligible for auto HSCT, but data relating to pediatric patients are very limited.

Objectives. We aimed to report a case of effective and tolerable BV-containing treatment in an adolescent with refractory HL. Case Report. A 17-year-old female with enlarged cervical, supra-/subclavicular, axillary, mediastinum lymph nodes and multiple lesions in both lungs was admitted to our hospital. FDG-PET/CT and lymph node biopsy were performed and nodular sclerosis HL stage IVA was diagnosed. Treatment was administered according to modified DAL-HD-95 protocol, and consisted of 6 courses of chemotherapy (2OPPA/4COPP) plus radiation therapy of the involved fields (20 Gy). Partial response was achieved after the 2nd cycle OPPA and stable disease was observing during the all remaining treatment. One month after the end of treatment the patient showed disease progression in mediastinum and lungs, confirmed by FDG-PET/CT and lung biopsy. Positive response was obtained after the two courses (IEP, ABVD) of second-line therapy, but patient remained PET-positive. Treatment was continued with 3 cycles VV (BV 1.8 mg/kg/bendamustine/dexamethasone), PET-negative complete remission was achieved and autoHSCT (conditioning regimen consisted of BEAM) with allogeneic bone marrow-derived mesenchymal stem cells cotransplantation was subsequently performed. Further the patient received adjuvant monotherapy with BV 1.2 mg/kg every 3 weeks (a total of 12 doses). The only evident side effect seen in BV treatment was deteriorating peripheral neuropathy. Patient remains in PET-negative complete remission for 14 months after autoHSCT and 4 months after the last dose of BV. Conclusions. Our experience should encourage to use BV in combination with chemotherapy or even alone in pediatric patients with refractory HL.

Figure 1.
T019

ONLY FOCAL BONE MARROW FDG UPTAKE IN BASELINE FDG-PET SCAN HAS A DIAGNOSTIC AND PROGNOSTIC IMPACT IN HODGKIN LYMPHOMA: RESULTS FROM AN INTERNATIONAL COLLABORATIVE STUDY


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Background. PET/CT-ascertained bone marrow involvement (BMI) is the most frequent reason for Hodgkin Lymphoma (HL) upstaging by baseline PET/CT (PET-0). However, shared rules for BMI detection in PET/CT still lack. This study analyzed the diagnostic and prognostic value of BM FDG uptake pattern in PET-0.

Patients and Methods. 186 early unfavorable and advanced stage HL patients (pts), enrolled in two International studies on the role of interim PET (PET-2) in HL, were analyzed. Treatment (Tx) was ABVD×6 cycles (advanced) or ≥4 cycles plus IF radiation (early unfavorable). No Tx adaptation on PET-2 was allowed. Two reviewers blinded to Tx outcome independently reviewed PET-0; discordant results were jointly discussed. Focal BM lesions (fPET+) were defined as focally increased FDG uptake >liver uptake (with or without CT abnormalities), visible in ≥2 slices of fused images. Diffusely increased FDG-uptake was defined as a diffuse uptake >liver (dPET+). No uptake (nPET+) was defined as absent or faint (<liver) diffuse uptake.

Results. After a median follow-up of 33.8 (16.6–109.4) months, 40 pts (21.5%) progressed or relapsed, and 9 (4.9%) died. The 3-Y OS and PFS was 98.0% and 83.8%, respectively. In 33/40 (82.5%) pts with a fPET+ all the PET-0 focal lesions had disappeared in PET-2. Half of pts (90/186; 48.4%) had a nPET+. dPET+ recorded in 56 (30.1%) pts, correlated with younger age, low hemoglobin, leukocytosis, low albumin and diffuse FDG spleen uptake. Notably, dPET+ had an identical 3-Y PFS to nPET+ pts: 83.2% and 81.6%, respectively (p=0.752). Out of 40 (21.5%) fPET+ pts, 11 had unifocal and 29 multifocal (<2 lesions), with a 3-Y PFS of 70.1% and 67.0%, respectively. Multifocal fPET+ pts had a worse PFS compared to dPET+ p. (p=0.05). BM biopsy (BMB) was positive in 6/40 (15%) of fPET+ and 0/56 (0%) of dPET+ pts. In univariate analyses, bulky disease (HR 2.4, p=0.008), IPS (HR 3.4, p=0.001), and PET-2 (HR 11.0, p<0.001) were significantly associated with PFS, but only PET-2 was still significant in multivariate analysis (p<0.001). The kappa-value for inter-observer agreement was 0.83 for focal and 0.78 for diffuse uptake. Conclusions. The study confirms that (1) FDG-PET scan is a reliable tool for BMI assessment in HL; (2) only focal FDG uptake in PET-0 has an adverse prognostic value and should be considered to represent BMI; (3) BMI could be detected with high accuracy and inter-observed agreement in routine HL staging with PET/CT.

Support. Supported by the Fulbright commission grant.

T020

STRONG PREDICTIVE VALUE OF PET BASED METABOLIC TUMOR VOLUME ON SURVIVAL AFTER AUTOLOGOUS HCT FOR HODGKIN LYMPHOMA

V. Procházk1, R.R. Gawande1, Z. Cayci2, J.W. Froelich2, Q. Cao3, V. Bachanova4

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Background. High-dose chemotherapy with autologous hematopoietic cell transplant (AHCT) is a standard treatment for relapsed/refractory Hodgkin lymphoma patients (R/R HL); however, 40-50% fail therapy. Metabolic FDG-PET is a powerful tool to predict treatment responses in HL. The value of more precise quantitative measurements combining volume with the metabolic activity in patients having residual HL before AHCT is unknown. Aim. To determine the predictive value of total metabolic volume (TMV) and total lesion glycolysis (TLG) in R/R HL patients undergoing AHCT. Methods. We analyzed 96 consecutive patients with R/R HL undergoing AHCT in 2004-2014. All had PET/CT ≤4 weeks before AHCT. Two independent radiologists assessed PET images using semi-quantitative Deauville (D) 5-point scale and selected all hypermetabolic sites to determine regions of interests. Analytic software was used to calculate TMV and TLG. Results. Median age at transplant was 33.1 years (range 18.0-71.3); 51% of patients were males. Patients were limited stage (60%) or advanced, commonly with extranodal (82%) and bone marrow (11%) disease. Nodular sclerosis (86%) was most common. Most patients (69%) relapsed in <1 year or were refractory to front-line therapy. PET negativity (neg) was achieved in 61 patients (63.5%), whereas 35 remained PETpos, with D1-2 (n=61), D3 (n=11), D4 (n=19), and D5 (n=5). Median TMV was 8.0 cm3 (range 1.3-102.1), median TLG was 23.7 (range 4.0-313.1), and median SUVmax was 5.2 (range 2.7-23.2). Two-year PFS in PETneg patients (63%; 95% CI 50-74%) was significantly better than in PETpos patients (35%; 19-51%; p=0.014). In Cox regression analysis, D4 was associated with a 3.7-fold increased risk of failure compared to D1-3 (HR 3.73; 95% CI 1.92-7.28; p=0.01). PETpos patients with high TMV (>8 cm3) had significantly lower 2-year PFS than those with low TMV (11% vs 53%; p=0.05). High TLG (>24) identified patients with poor 2-year PFS (12% vs 57%; p=0.04). Conclusions. Patients with R/R HL and low MTV and TLG prior to AHCT have similar outcomes to PETneg patients. Quantitative pretransplant PET may identify subgroups of very poor AHCT responders in whom alternative therapies should be considered.

Interim FDG-PET/CT (iPET), according to the 5-point Deauville score (5p-DS) is the strongest predictor for outcome in Hodgkin Lymphoma (HL). In PET-guided treatment approaches, iPET-positive patients are candidates for more intensive and potentially more toxic treatments. Nevertheless, recent studies have shown that the positive predictive value (PPV) of iPET visual analysis with 5p-DS has still some limitations to optimally identify patients at different prognosis. Semi-quantitative parameters could improve PPV of iPET. Aim of this retrospective study is to compare PPV of visual and semi-quantitative analysis of iPET in HL patients treated with ABVD. We studied 67 HL patients (median age 39 years; 30 females, 37 males; 38 limited Stage, 29 advanced) at
our Institution between 2007 and 2013, who were treated with ABVD. iPET was performed after 2 cycles of ABVD. For visual analysis, the 5p-DS was used, setting different cut-points at 5p-DS>3 and 5p-DS>4 as positive. For semi-quantitative analysis, we evaluated the ratio between lesion and liver SUVmax (iPET); the ratio between lesion and mediastinal blood pool SUVmax (mPET); the ratio between lesion SUVpeak and liver SUVmean (qPET). Primary endpoint was two-year progression-free survival (PFS). ROC analysis was used to determine the best cut-point of semi-quantitative parameters to identify treatment failures. In visual analysis, 25/67 patients had 5p-DS >3, and 5p-DS was >4 in 14/67 patients. PFS according to 5p-DS>3 and 5p-DS>4 was 55% and 27%, respectively and their PPV was 40% and 57%, respectively. The semi-quantitative parameters between residual lesion and the different backgrounds iPET, mPET and qPET were prognostic factors in our population (p<0.01). The most accurate cut-point in predicting adverse events for iPET, mPET and qPET were 1.14, 2 and 1.46, respectively. For values higher than these cut-point, PFS were 15%, 25% and 20% and the PPV were 70%, 63% and 90%, respectively. iPET semi-quantitative parameters appear to perform better than visual analysis for outcome prediction in HL. In particular, ratios between residual lesion and background SUV (liver or mediastinal blood pool) could improve the predictive value of relapse or progression.

**Background.** 18F-FDG-PET/CT is an established method for staging patients with newly diagnosed Hodgkin Lymphoma (HL). It has a high ability to detect skeletal and bone marrow involvement. It has been discussed whether diffusely increased bone marrow uptake (BMU) of 18F-FDG indicates bone marrow involvement or not. In addition, the importance of unifocal versus multifocal bone lesions on survival is under debate. Thus, the aim of our study was to examine the prognostic value of BMU and compare it with that of uni- and multifocal lesions.

**Materials and Methods.** 217 patients from Aarhus and Uppsala university hospitals (mean age 42, range 8-83) with newly diagnosed HL were included. BMU was calculated as SUVmax in the vertebral column (L3/L4) divided by liver SUVmax. In case of focal 18F-FDG-uptake in bone, patients were categorized as having uni- or multifocal lesions. For survival analysis, patients were divided into four groups: Patients with BMU below the median and no focal lesions (lowBMU), patients with BMU higher than the median and no focal lesions (highBMU), patients with a single bone lesion (unifocal), and patients with multifocal bone lesions (multifocal). **Results.** Median BMU was 1.15 (range 0.52-5.56). 42/217 (19.4%) patients had either unifocal (21/217) or multifocal lesions (21/217). With a median follow-up time of 41 months, 53% and 27%, respectively and their PPV was 40% and 57%, respectively. The semi-quantitative parameters between residual lesion and the different backgrounds iPET, mPET and qPET were prognostic factors in our population (p<0.01). The most accurate cut-point in predicting adverse events for iPET, mPET and qPET were 1.14, 2 and 1.46, respectively. For values higher than these cut-point, PFS were 15%, 25% and 20% and the PPV were 70%, 63% and 90%, respectively. iPET semi-quantitative parameters appear to perform better than visual analysis for outcome prediction in HL. In particular, ratios between residual lesion and background SUV (liver or mediastinal blood pool) could improve the predictive value of relapse or progression.
IS FDG-PET THE MOST SENSITIVE TOOL TO DIAGNOSE BLEOMYCIN INDUCED PNEUMONITIS IN HODGKIN’S LYMPHOMA?

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Clinic of Hematology, Koç University Hospital Istanbul, Istanbul, Turkey; Clinic of Nuclear Medicine, Koç University Hospital Istanbul, Istanbul, Turkey; Clinic of Radiation Oncology, Koç University Hospital Istanbul, Istanbul, Turkey; Clinic of Radiology, American Hospital Istanbul, Istanbul, Turkey

Bleomycin is an antineoplastic agent which may cause fatal pulmonary toxicities where early diagnosis of bleomycin induced pneumonitis (BIP) is crucial. In clinical practice, formal pulmonary function testing with inclusion of carbon monoxide diffusion capacity, is quite unpredictable at isolating patients at risk for major bleomycin toxicity. In small numbered case series, FDG PET/CT scan have shown to be helpful to reveal the inflammation secondary to the BIP, but FDG is not known to be specific to diagnose this fatal side effect. We analyzed FDG-PET/CT scans of 77 Hodgkin Lymphoma (HL) patients retrospectively to evaluate BIP. Thirteen patients have augmented abnormal FDG activity at their lungs after the exclusion of lymphoma involvement of the lung or pleura, radiation pneumonitis, infection, or cardiogenic pulmonary edema. Median age of the study population was 41 years and the average bleomycin dose was 134 mg. The FDG activities on the lungs were predominantly diffuse, bilateral, and mostly localized at the lower lobes and subpleural places. Interim PET revealed BIP in 8 of these 13 patients. Six of the 13 patients (46%) were asymptomatic during PET imaging. One of the patients without any clinical symptoms related to BIP continued to take bleomycin despite findings of FDG-PET, and ultimately lost secondary to bleomycin toxicity. The rest of the patients that bleomycin was omitted from the treatment regime and methylprednisolone was administered as routine approach demonstrated a favorable clinical course. Clinical and radiologic findings of BIP have been completely resolved. This study results suggest that routine interim or end of treatment PET/CT scan could have an additional benefit in clinic by alarming the diagnosis of asymptomatic BIP patients.

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Cohort C subgroups

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Background. Nivolumab (nivo), a fully human IgG4 immune checkpoint inhibitor monoclonal antibody targeting programmed death receptor-1 (PD-1), is approved in the USA for classical Hodgkin lymphoma (cHL) that has relapsed or progressed after autologous hematopoietic stem cell transplantation (ASCT) and post-transplantation brentuximab vedotin (BV). CheckMate 205 is a multicohort international phase 2 trial (NCT02181738) of nivo that treated 243 pts with cHL after failure of ASCT in 3 cohorts: A (BV-naïve pts), B (pts with BV treatment after ASCT), and C (pts who received BV prior to and/or after ASCT). With a minimum 6-mo follow-up in Cohort B, ORR per independent radiologic review committee (IRRC) was 66% and 6-mo PFS was 77%, with an acceptable safety profile (Younes et al. Lancet Oncol 2016 [in press]) Here we present preliminary results of pts from Cohort C, with a minimum follow-up of 6 mo. Aim. Assess efficacy and safety of nivo in previously unreported Cohort C pts, including those who received BV prior to ASCT (not tested in Cohort B).

Relapsed Hodgkin Lymphoma

T022

CHECKMATE 205 COHORT C: NIVOLUMAB IN PATIENTS WITH CLASSICAL HODGKIN LYMPHOMA AFTER PRIOR BRENTUXIMAB VEDOTIN AND AUTOLOGOUS HEMATOPOIETIC STEM CELL TRANSPLANTATION


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Background. Nivolumab (nivo), a fully human IgG4 immune checkpoint inhibitor monoclonal antibody targeting programmed death receptor-1 (PD-1), is approved in the USA for classical Hodgkin lymphoma (cHL) that has relapsed or progressed after autologous hematopoietic stem cell transplantation (ASCT) and post-transplantation brentuximab vedotin (BV). CheckMate 205 is a multicohort international phase 2 trial (NCT02181738) of nivo that treated 243 pts with cHL after failure of ASCT in 3 cohorts: A (BV-naïve pts), B (pts with BV treatment after ASCT), and C (pts who received BV prior to and/or after ASCT). With a minimum 6-mo follow-up in Cohort B, ORR per independent radiologic review committee (IRRC) was 66% and 6-mo PFS was 77%, with an acceptable safety profile (Younes et al. Lancet Oncol 2016 [in press]) Here we present preliminary results of pts from Cohort C, with a minimum follow-up of 6 mo. Aim. Assess efficacy and safety of nivo in previously unreported Cohort C pts, including those who received BV prior to ASCT (not tested in Cohort B).

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Cohort C subgroups

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</table>

NA, not achieved

Median and rates calculated using Kaplan-Meier method.
Methods. Pts in Cohort C received nivo 3 mg/kg IV q2 wk until disease progression, unacceptable toxicity, or investigator-assessed complete response (CR) lasting 1 yr. Pts who discontinued nivo with CR could re-initiate nivo if they relapsed ≤2 yr from discontinuation. The primary endpoint was ORR per IRRC using 2007 International Working Group criteria, based on CT and PET imaging. Pts were divided into subgroups by timing of prior BV treatment relative to ASCT. Results. 100 pts were treated, with a median age of 52 (range 19-69), and a median of 4 (range 2-9) prior lines of therapy. ORR by IRRC after a median follow-up of 2.1 mo was 93.9% (95% CI 86.9%, 97.2%). 68% of pts had drug-related AEs between first dose and 30 days after last dose of nivo, most commonly fatigue, diarrhea, and infusion reactions (11% each). 19% had G3-4 drug-related AEs. At present, no pt has discontinued study therapy due to persistent CR lasting 1 yr.

Conclusions. Nivo had clinically meaningful antitumor activity and acceptable safety in heavily pretreated cHL pts, regardless of the timing of prior BV relative to failure of ASCT.

Funding. BMS. Medical writing: Caudex, funded by BMS.

T023 PEMBROLIZUMAB FOR RELAPSED/REFRACTORY CLASSICAL HODGKIN LYMPHOMA: MULTICENTOR, PHASE 2 KEYNOTE-087 STUDY

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1Memorial Sloan Kettering Cancer Center, New York, USA; 2Institute of Hematology “Seràgnoli”, University of Bologna, Bologna, Italy; 3The University of Texas MD Anderson Cancer Center, Houston, USA; 4Dana-Farber Cancer Institute, Boston, USA; 5Jeux General Hospital, Montreal, Canada; 6Gustave Roussy, Villejuif, France; 7Christie Hospital NHS Foundation Trust, Manchester, UK; 8Uniklinik Kob, Cologne, Germany; 9Fujita Health University School of Medicine, and Nagoya University, Toyake, Japan; 10Merck & Co., Inc., Kenilworth, USA; 11City of Hope National Medical Center, Duarte, USA

Background. In the phase 1b KEYNOTE-013 study, PD-1 blockade with pembrolizumab demonstrated high antitumor activity (65% ORR) in heavily pretreated cHL patients. KEYNOTE-087 (NCT02453594) is a phase 2 study designed to further evaluate the clinical activity of pembrolizumab in patients with R/R cHL. Methods. Patients were enrolled into 3 cohorts: R/R cHL after autologous stem cell transplantation (ASCT) and subsequent brentuximab vedotin (BV) therapy (cohort 1); ineligible for ASCT because of chemotherapy resistance (no response to salvage chemotherapy) and BV therapy failure (cohort 2); or R/R cHL after ASCT, but not treated with BV after ASCT (cohort 3). Patients received pembrolizumab 200 mg Q3W. Primary end point was ORR, with response assessed Q12W according to Revised Response Criteria for Malignant Lymphoma. A prespecified interim analysis, based on investigator-assessed response, was performed after 30 patients in cohorts 1 and 2 reached the first response assessment. Results. At the time of data cutoff (April 8, 2016), 90 patients were enrolled (30 in each cohort). Median (range) age was 56 (19-64) years in cohort 1, 33 (20-71) years in cohort 2, and 30 (18-67) years in cohort 3. 42% had primary refractory disease (no response to frontline therapy), and 57% received ≥3 prior lines of therapy. By investigator review, ORR was 73% (95% CI, 54%-88%) in cohorts 1 and 3, and 85% (95% CI, 65%-94%) in cohort 2. Complete remission rates (residual mass permitted if PET negative) were 27% in cohort 1 and 30% in cohorts 2 and 3. With a median of 9 treatment cycles, the most common treatment-related AEs (TRAEs) were pyrexia (13%), diarrhea (10%), and cough, fatigue, and neutropenia (8% each). There were 8 grade 3-4 TRAEs occurring in 4 patients (grade 3 neutropenia, colitis, diarrhea, cytokine release syndrome, herpes zoster infection, increased amylase, lichenoid keratosis, and grade 4 increased lipase). There were no treatment-related deaths.

Conclusions. Pembrolizumab showed frequent responses in heavily pretreated patients with cHL, and provided a high ORR (83%) in patients who were not candidates for ASCT and failed previous BV therapy.

T024 TRANSPLANT BRAVE: COMBINING BRENTUXIMAB VEDOTIN WITH DHAP AS SALVAGE TREATMENT IN RELAPSED/REFRACTORY HODGKIN LYMPHOMA. A PHASE 1 DOSE-ESCALATION STUDY

A. Hagenbeek1, J.M. Zijlstra2, P. Lugtenburg3, G.W. van Imhoff4, M. Hutchings5, R. Liu5, M. Spiering5, H. van Tinteren4, M.J. Kersten1
1Academic Medical Center, Amsterdam, The Netherlands; 2Free University Medical Center, Amsterdam, The Netherlands; 3Erasmus Medical Center, Rotterdam, The Netherlands; 4University Medical Center Groningen, Groningen, The Netherlands; 5Rigshospitalet, Copenhagen, The Netherlands; 6Netherlands Cancer Institute, Amsterdam, The Netherlands

Achieving a PET-negative CR with salvage chemotherapy prior to ASCT in r/r HL is a strong predictor for long-term progression-free survival (PFS). This phase 1 dose-escalation study explored the toxicity and feasibility of adding Brentuximab Vedotin (BV) to DHAP and established the recommended Dose Level (DL) for a phase 2 study. Final objective: to increase the metabolic CR rate after BV-DHAP and to make more patients eligible for auto-SCT with curative intent. BV was given at the standard dose of 1.8 mg/kg and combined with 3 courses of DHAP q 3 weeks at 3 DL in 3 patients per DL (3+3 design), i.e. dexamethasone 40 mg iv d1-4, Cisplatin (CP) and Cytarabine at 75%-DL1; CP75% and Cytarabine 100%-DL2 and CP 100 mg/m2 iv d1 and Cytarabine 2x2g/m iv d2 (full dose DHAP)= DL3 (6 patients). Out of 12 patients (8 E; median age 30.5 yr) 2 were primary refractory and 10 were in 1st relapse. 1st line induction: ABVD (n=9) or BEACOPPesc (n=3). Median time between response to 1st line treatment and the first course of BV-DHAP: 9.2 mo (range:2-134.5). Neutropenia grade 4 more than 10 days (causing 1 week delay of BV-DHAP) 2 out of 3 patients at DL1. Neulasta became mandatory after course 1 and 3, reducing the duration of neutropenia. Stem cells were harvested after the 2nd course (median yield:5.3x10^6 CD34+/kg;range:3.0-25.9). Seven AE’s gr3-4 were observed: neutropenia gr4 (n=2), neutropenia gr3 and trombopenia gr4 (n=1), thromboembolism gr3 (n=1), elevated transaminases gr3 (n=1) and hypokalaeemia gr4 (n=1). SAE’s occurred in 4 patients, all at DL3: CVC-related infection gr3, zoster infection gr3, fever gr3 (n=1), elevated transaminases gr3 (n=1), reduced kidney function gr3, pneumonitis gr3 (n=1), hypokalaeemia gr4, fever gr3, acute liver failure gr4 lasting longer than 14 days (likely related to antibiotics), atrial fibrillation gr3 (unlikely related;n=1). These last two SAE’s were classified as DLT’s. Sensory PNP gr1-2 was seen in 4 patients which fully resolved in 2. 11/12 patients reached a PET- complete metabolic remission after 3x BV-DHAP. In one PET+ PR a biopsy did not show HL. Thus, 12/12 achieved a CR. With a median FU of 15.4 mo (range:8.4-22.7) all patients are alive and in CR. In conclusion, BV-DHAP given at full doses is feasible with acceptable toxicity with G-CSF support and this dose will be used in the phase 2 part of the study. The CR rate, although assessed in only 12 patients, is 100%.

Support. This study is supported by Takeda,USA.

P080 A PHASE 1 STUDY WITH AN EXPANSION COHORT OF THE COMBINATION OF IPILIMUMAB AND BRENTUXIMAB VEDOTIN IN PATIENTS WITH RELAPSED/REFRACTORY HODGKIN LYMPHOMA: A TRIAL OF THE ECOG-ACRIN CANCER RESEARCH GROUP (E4412)

1New York University Perlmutter Cancer Center, New York, USA; 2Dana Farber Cancer Institute, Boston, MA, USA; 3Johns Hopkins University, Baltimore, MD, USA; 4Emory University, Atlanta, GA, USA; 5Indiana University Hospital, Indianapolis, IN, USA; 6Medical College of Wisconsin, Milwaukee, WI, USA; 7Stanford University, Stanford, CA, USA; 8Washington University, Saint Louis, MO, USA; 9Mayo Clinic, Rochester, MN, USA

In the phase 1b KEYNOTE-013 study, PD-1 blockade with pembrolizumab showed frequent responses in heavily pretreated cHL, and provided a high ORR (83%) in patients who were not candidates for ASCT and failed previous BV therapy.
Background. Despite advances in chemotherapy, relapsed/refractory (R/R) Hodgkin lymphoma (HL) remains an unmet medical need. HL has a unique biology in which a small number of malignant Hodgkin Reed-Sternberg (HRS) cells propagate an immunosuppressive microenvironment. We hypothesized that using immune checkpoint inhibitor therapy to activate the immune microenvironment, and concurrently targeting HRS cells with the CD50 antibody-drug conjugate brentuximab vedotin (BV), could overcome tumor cell resistance. E4412 is a phase 1 ECOG-ACRIN sponsored study of the combination of BV and ipilimumab (IPI) and nivolumab (NIVO) in patients with R/R HL. Here we present the updated safety and response data on the full cohort of patients treated with BV+IPI. Methods. Patients were treated with BV 1.8mg/kg and IPI: 1 mg/kg or 3mg/kg, followed by an expanded cohort of BV+IPI 3mg/kg. BV was administered every 21 days for 16 cycles; IPI every 21 daysx4 and then every 3 months for one year. Results. As of 5/26/16, 23 planned patients have been treated; 21 patients were eligible for response assessment. The median age was 32 years (range: 20-49). Patients were heavily pretreated with a median of 4 prior therapies (1-13). Four patients had prior CPT with BV; 10 had prior SCT. BV+IPI was well tolerated, with no DLTs noted. The most common treatment-related adverse events (AEs) were: rash, diarrhea, and peripheral sensory neuropathy. Grade 3 and 4 AEs included: grade 3 infusion reaction, rash, vomiting, peripheral sensory neuropathy, and grade 4 thrombocytopenia. For 21 evaluable patients, the overall response rate (ORR) for BV+IPI was 71% with a complete response (CR) rate of 48%. An additional 2 patients had stable disease (SD). The median progression free survival (PFS) is 1.0 years with a median follow-up of 0.48 years; the median overall survival (OS) has not been reached with a median follow-up of 1.16 years (Figure 1).

Conclusions. Our data confirms the tolerability and activity of BV+IPI in a heavily pretreated R/R HL patient population. Optimization of this combination strategy is ongoing with accrual to cohorts receiving BV+NIVO, and BV+IPI+NIVO.

![Figure 1.](image1.jpg)

**P081**

**BENEFIT OF TANDEM STEM CELL TRANSPLANTATION FOR HIGH RISK RELAPSED/REFRACTORY HODGKIN LYMPHOMA PATIENTS: A FRENCH PROSPECTIVE MULTICENTER OBSERVATIONAL STUDY ON 120 PATIENTS**


1Hopital Cochin, Paris, France; 2Hopital Saint Louis, Paris, France; 3CHU Nancy, Vandavioire-lès-Nancy, France; 4CHU Montpellier, Montpellier, France; 5Institut Cancérologique de la Loire, Saint-Priest-en-Jarez, France; 6CH Argen- teuil, Argenteuil, France; 7CH Amines, Aixen, France; 8CHU Strasbourg, Strasbourg, France

Tandem stem cell transplantation (SCT) is an option for High Risk relapsed/refractory Hodgkin lymphoma (HR R/R HL) patients. We conducted a prospective multicenter observational study to evaluate the feasibility of tandem SCT in the routine clinical practice. HR R/R HL patients have primary refractory disease, or stage III/IV disease with early (<12 months) relapse. Inclusion criteria were: HR R/R HL, age 55 or younger, eligibility for salvage chemotherapy and SCT. 18FDG PET CT/scan (PET) performed after 2 or 3 cycles of salvage chemotherapy, stem cell harvesting after the first cycle of salvage chemotherapy, and investigation for HLA-matched donor were required. We included 120 HL patients over a 5 years period. Median age was 26 (14-56) y and 57% of patients were female. 61 (51%) patients had refractory disease and 59 (49%) had relapsing HL. 60 (50%) had a HLA-matched donor including 27 (47%) with sibling donors. Among our patients, 39 (33%) had chemosensitive disease as defined by PET negativity (Deauville score 1-2) after 2-3 cycles of first line salvage therapy. Before transplant, complete metabolic remission (CR) was achieved in 72 (60%) patients, partial response occurred in 38 (32%) patients, and PET positivity concerned 10 (8%) patients. Overall, 50 (66%) patients received brentuximab vedotin (BV) before SCT. 115 (96%) patients received high-dose chemotherapy by BEAM followed by autologous SCT. 73 (61%) patients received a second SCT : 42 (58%) had a reduced-intensity conditioning allogeneic SCT and 29 (40%) had a second autologous SCT conditioned by BAC. Reasons for not performing a second transplant were: progression (n= 22), stem cell mobilization failure (n=5), patient decision (n=4), toxicity (n=4) and investigator decision (n=7). The median follow-up was 48 months (4,8-78,7), Progression-Free Survival (PFS) was 57% (95% CI 47-66%) at 2 year. Disease control before the first SCT (CR and PR) was associated with a better 2-y-PFS of 59,3% (95% CI: 49-68%) compared to 20% (95% CI 8,1-47,5%) for stable or progressive disease (p=0,007). Patients who underwent two SCT had a 2-y-PFS of 69% compared to 31% for patients treated with a single transplant (HR: 0.30; 95% CI 0.17-0.52; p<0.001). The 2-year overall survival of our patients was 82% (95% CI: 73-88). 29 (24%) patients died and 91 (76%) were alive. Causes of death were : GVH (n=2), LEMP (n=1), sepsis (n=5), allo toxicity (n=2), SDRA (n=1), progression (n=7) (missing n=11) (Figure 1).

**P082**

**BRENTUXIMAB VEDOTIN PLUS BENDAMUSTINE AS A SALVAGE TREATMENT REGIMEN FOR PATIENTS WITH RELAPSED OR REFRACTORY HODGKIN LYMPHOMA**


1 Dana-Farber Cancer Institute, Boston, MA, USA; 2University of Nebraska Medical Center, Omaha, NE, USA; 3Columbia University Medical Center, New York, NY, USA; 4University Hospitals Case Medical Center, Cleveland, OH, USA; 5Charles A. Sammons Cancer Center, Dallas, TX, USA; 6Columbus Blood Cancer Institute, Denver, CO, USA; 7Mayo Clinic, Rochester, MN, USA; 8St. Francis Hospital, Greenville, SC, USA; 9The Jewish Hospital-Mercy Health, Cincinnati, OH, USA; 10Pacific Hematology Oncology Associates, San Francisco, CA, USA; 11The Oncology Institute of Hope & Innovation, Whittier, CA, USA; 12University of Alabama at Birmingham, Birmingham, AL, USA; 13Seattle Genetics, Inc., Bothell, WA, USA; 14Stanford Cancer Institute, Stanford, CA, USA
Conventional salvage therapy for patients (pts) with relapsed/refractory (R/R) Hodgkin lymphoma (HL) is associated with variable complete remission (CR) rates (19%-60%) and substantial toxicity. Brentuximab vedotin (BV) and bendamustine are active as single agents in pts with R/R HL (54% and 33% CR rates, respectively), with manageable safety profiles. This phase 1/2 open-label study was designed to evaluate the safety and efficacy of BV in combination with bendamustine in pts with primary refractory disease or in first relapse (NCT01874054). Pts received BV (1.8 mg/kg on Day 1) plus bendamustine (90 mg/m² on Days 1 and 2) in 3-week cycles (up to 6 cycles total). Pts could undergo autologous stem cell transplant (ASCT) any time after Cycle 2 and could receive BV monotherapy (up to 16 total doses) post-ASCT, or after completion of combination therapy if not proceeding to ASCT. Response was assessed by the investigator per Cheson 2007. A total of 55 pts (51% refractory; 49% relapsed) were enrolled. Median age was 36 years (range 19-79), 56% were female, and median time from HL diagnosis was 14 months (range 3-98). Pts received a median of 2 cycles (range 1-6) of the combination and 11 cycles (range 1-14) of BV monotherapy. Infusion-related reactions (IRRs) were reported in 58% of pts; however, a protocol amendment requiring premedication with corticosteroids and antihistamines during combination therapy reduced the IRR-related discontinuation rate from 24% (6/25 pts) to 7% (2/30 pts). Common IRRs were pyrexia (26%), chills (20%), dyspnea (16%), nausea and flushing (15% each), and hypotension and pruritus (11% each). The CR rate of the combination was 74% (39/53 pts evaluable for response); objective response rate (CR and partial remission) was 98% (49/53 pts). Stem cell mobilization succeeded with 1st-line agents in 59/41 pts (95%); median yield was 4.2x10⁶ CD34+ cells/kg. Median follow-up was 19 months (range 1-38). To date, 17 progression events have occurred in 53 pts: 11 in 40 pts who underwent ASCT and 6 in 13 pts who did not. The estimated 24-month progression-free survival was 66% for the ASCT population (95% CI: 46%, 82%) and 61% for the overall population (95% CI: 44%, 75%). Of 13 deaths, 2 were attributed to HL progression and 1 to septic shock after ASCT. Overall, these data demonstrate that the outpatients regimen of BV plus bendamustine is an active salvage therapy for pts with HL in first relapse and can be used prior to ASCT (Figure 1).

**Figure 1.**

**Table 1.**

### Table 1.

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<td>Relapsed (within 7 months)</td>
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poorly understood. Methods. Cumulative incidence of VLR was retrospectively estimated in 5149 patients of the GHSG HD7-HD12 trials, who were observed and relapse-free for >5 years; risk factors were analyzed using Gray's test and Cox regression. Standardized incidence ratio (SIR) was estimated using age- and sex-specific reference values for the German population. Overall and progression-free survival were estimated according to Kaplan-Meier from first diagnosis (OS/PFS) and date of relapse (OSr/PF Sr). Hazard Ratios (HR) were obtained from Cox regressions adjusted for relevant risk factors such as age, sex and initial stage. Relapse localizations and therapies, OSr and PF Sr were compared with a group of 487 patients having earlier relapse. Patient characteristics were analyzed descriptively. Results. With a median observation time of 10.3 years, a total of 169 relapses >5 years were observed. Cumulative incidences at 10, 15 and 20 years were 2.8%, 5.1% and 8.6%, respectively, with an SIR of 97.1 (95% CI: 83.0-112.9). VLR were more frequently observed in patients with early-stage favorable than early-stage unfavorable or advanced-stage disease at first diagnosis (15-year cumulative incidence 8.0%, 4.4%, 4.2%, respectively, p<0.001). Male patients and those with nodular-lymphocyte predominant subtype were also found to be at increased risk for VLR. VLR occurred more frequently outside initially involved areas and radiation fields than earlier relapse. OS was significantly worse compared to non-relapse survivors (10-year OS: 95.9% vs 93.5%; HR: 2.4, 95% CI: 1.7-3.4, p<0.001). For earlier relapse, we observed inferior 5-year PF Sr and OSr compared to VLR (55.7% vs 64.3% HR: 1.6, 95% CI: 1.1-2.4, p=0.08; 63.0% vs 76.3%, HR: 2.1, 95% CI: 1.3-3.4, p<0.01, respectively). Summary: Besides therapy-associated side effects, survivors after initially successful HL-therapy are at a 100-fold increased risk of re-occurrence of disease compared to German reference values. After modern risk-adapted treatment strategies were analyzed descriptively.

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Results. With a median observation time of 10.3 years, a total of 169 relapses >5 years were observed. Cumulative incidences at 10, 15 and 20 years were 2.8%, 5.1% and 8.6%, respectively, with an SIR of 97.1 (95% CI: 83.0-112.9). VLR were more frequently observed in patients with early-stage favorable than early-stage unfavorable or advanced-stage disease at first diagnosis (15-year cumulative incidence 8.0%, 4.4%, 4.2%, respectively, p<0.001). Male patients and those with nodular-lymphocyte predominant subtype were also found to be at increased risk for VLR. VLR occurred more frequently outside initially involved areas and radiation fields than earlier relapse. OS was significantly worse compared to non-relapse survivors (10-year OS: 95.9% vs 93.5%; HR: 2.4, 95% CI: 1.7-3.4, p<0.001). For earlier relapse, we observed inferior 5-year PF Sr and OSr compared to VLR (55.7% vs 64.3% HR: 1.6, 95% CI: 1.1-2.4, p=0.08; 63.0% vs 76.3%, HR: 2.1, 95% CI: 1.3-3.4, p<0.01, respectively). Summary: Besides therapy-associated side effects, survivors after initially successful HL-therapy are at a 100-fold increased risk of re-occurrence of disease compared to German reference values. After modern risk-adapted treatment strategies were analyzed descriptively.

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Besides therapy-associated side effects, survivors after initially successful HL-therapy are at a 100-fold increased risk of re-occurrence of disease compared to German reference values. After modern risk-adapted treatment strategies were analyzed descriptively.
Gr 8 or 4 post-ASCT toxicities through d+30. With a median follow up of 25.7 months, the 2-yr PFS was 72%, OS was 94%, and NRM was 3%. Patients who received only BV had 2-yr PFS of 80% vs 69% in patients who received BV followed by chemotherapy. Patients in CR at ASCT, had 2-yr PFS of 78% vs 56% for non-CR patients (Table 1). Conclusions. 89% of patients who received BV as first-line salvage therapy successfully underwent ASCT. Outcomes compare favorably with historical data, including patients who received BV salvage alone without chemotherapy. BV is a promising first-line salvage therapy for rel/ref HL patients undergoing ASCT.

Table 1. Patient characteristics.

<table>
<thead>
<tr>
<th>Characteristics</th>
<th>N (%)</th>
<th>Median (Range)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age</td>
<td>34 (11-47)</td>
<td></td>
</tr>
<tr>
<td>Institution</td>
<td>31 (84%)</td>
<td></td>
</tr>
<tr>
<td>City of Hope &amp; Well Cereall</td>
<td>6 (10%)</td>
<td></td>
</tr>
<tr>
<td>Stage of Diagnosis</td>
<td></td>
<td></td>
</tr>
<tr>
<td>I-II</td>
<td>19 (81%)</td>
<td></td>
</tr>
<tr>
<td>III-IV</td>
<td>18 (48%)</td>
<td></td>
</tr>
<tr>
<td>B symptoms</td>
<td>23 (62%)</td>
<td></td>
</tr>
<tr>
<td>Bulky Disease (&gt; 5 cm)</td>
<td>23 (80%)</td>
<td></td>
</tr>
<tr>
<td>Induction Chemotherapy</td>
<td></td>
<td></td>
</tr>
<tr>
<td>ABVD</td>
<td>24 (92%)</td>
<td></td>
</tr>
<tr>
<td>ABVD/BEACOPP</td>
<td>2 (5%)</td>
<td></td>
</tr>
<tr>
<td>ABVE-PC</td>
<td>1 (3%)</td>
<td></td>
</tr>
<tr>
<td>Prior XRT</td>
<td>9 (24%)</td>
<td></td>
</tr>
<tr>
<td>Best Response to Induction</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Primary Refractory</td>
<td>24 (60%)</td>
<td></td>
</tr>
<tr>
<td>Relapsed (within 7 months)</td>
<td>13 (33%)</td>
<td></td>
</tr>
</tbody>
</table>

T CELL REPELTE HAPLOIDENTICAL TRANSPLANTATION WITH POST-INFUSION CYCLOPHOSPHAMIDE IN POOR PROGNOSIS HODGKIN LYMPHOMA

In advanced Hodgkin lymphoma, allogeneic hematopoietic stem cell transplantation can represent a potential curative option. In this study, we analyzed the outcome of advanced HL patients who received haplo-HSCT using the unmanipulated stem cell and PT-Cy. 62 consecutive HL patients undergoing T-cell replete haploidentical transplantation with PT-Cy, ANC and platelets engraftment was observed in 94% and 82% of patients. The 100-day cumulative incidence (CI) of grade 2-4 and 3-4 aGVHD was 25% and 4%, respectively and the CI of GVHD (overall) was 16. The median follow-up was 32 months. The 3-year OS, FFS, relapse rate was 63%, 59%, and 21%, respectively. The 1-year NRM was 20%. In multivariate analysis, factors negatively associated with OS were uncontrolled disease status and higher than 2 HCT-CI. FBSC was an independent protective factor. The same factors were predictive for FFS, except for HCT-CI 1. Disease status other than CR was predictive of relapse. Haplo-HSCT with PT-Cy looks particularly effective against HL cells, and it seem to work better than other donors. However, prospective studies are needed to confirm the these results.

PET ADAPTED THERAPY WITH BRENTUXIMAB VEDOTIN AND AUGMENTED ICE FOR RELAPSED/REFRACTORY HODGKIN LYMPHOMA – LACK OF IMPROVEMENT WITH 3 VERSUS 2 CYCLES OF WEEKLY BRENTUXIMAB VEDOTIN


Lymphoma Disease Management Team, Memorial Sloan Kettering Center, New York, USA

Introduction. PET-adapted salvage therapy with brentuximab vedotin (BV) and augmented ICE (augICE) produced a PET-negative (neg) rate of 76% (Moskowitz, AJ. Lancet Oncology 2015). In this study, 45 patients (pts) received 2 cycles of BV (1.2mg/kg weekly, 6 doses over 8 weeks) and those with residual PET-avidity received 2 cycles of augICE (ifosfamide 5000mg/m² x2 doses, carboplatin AUC 5, etoposide 200mg/m² x3 doses) prior to ASCT. With a median follow-up of 40 months, 44 of 45 patients proceeded to ASCT and 3-year event free survival (EFS) and overall survival (OS) were 80% and 93%, respectively. 27% achieved PET-neg status following BV and received no additional chemotherapy before ASCT. We enrolled a second cohort aimed at improving the PET-neg rate to BV by administering 3 rather than 2 cycles. Methods. On cohort 2, pts received 3 cycles of weekly BV (1.2mg/kg weekly, 9 doses over 12 weeks). PET-neg pts (by Deauville 1-2) proceeded to ASCT while those with residual PET-avidity received augICE for 2 cycles before ASCT. Transplant conditioning included involved field radiation for eligible patients. Results. 20 pts enrolled onto cohort 2. Characteristics appear in the Table 1.

Table 1. Summary of patient characteristics and outcomes according to treatment cohort.

<table>
<thead>
<tr>
<th>Characteristics</th>
<th>Cohort 1 (n=45)</th>
<th>Cohort 2 (n=20)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fresnel (n)</td>
<td>20 (44%)</td>
<td>21 (52%)</td>
</tr>
<tr>
<td>Age, median (range)</td>
<td>31 (23-65)</td>
<td>28 (19-59)</td>
</tr>
<tr>
<td>Stage. n (%)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Early</td>
<td>23 (51%)</td>
<td>25 (62%)</td>
</tr>
<tr>
<td>Advanced</td>
<td>22 (49%)</td>
<td>12 (30%)</td>
</tr>
<tr>
<td>Refractory</td>
<td>25 (55%)</td>
<td>15 (37%)</td>
</tr>
<tr>
<td>E symtoms</td>
<td>11 (24%)</td>
<td>22 (55%)</td>
</tr>
<tr>
<td>Extramedrical disease</td>
<td>71 (63%)</td>
<td>80 (63%)</td>
</tr>
<tr>
<td>Bulky (n=43)</td>
<td>12 (27%)</td>
<td>12 (36%)</td>
</tr>
</tbody>
</table>

Outcomes

PET-Gr to BV (Deauville 1-2) 16 (36%) 35 (176)
PET-Gr to ICE (Deauville 1-2) 14 (31%) 35 (176)

Pre-ASCT PET Status

PET-neg (Deauville 1-2) 36 (80%) 80 (100%)
PET-neg (Deauville 1-3) 36 (80%) 80 (100%)

Progression (1) grade 3 or 4 post-ASCT toxicities through d+30.

In cohort 2, reasons for not completing BV included disease progression (1), grade 3 or 4 post-ASCT toxicities through d+30.

PET-Gr to BV (Deauville 1-2) 16 (36%) 35 (176)
PET-Gr to ICE (Deauville 1-2) 14 (31%) 35 (176)

EFS** 80% 80%
OS** 80% 80%

**EFS* and OS* reported at 3 years for cohort 1 and 2 years for cohort 2.

After BV, 6 (50%) pts were PET-neg (by Deauville 1-2) and 7 (6 Deauville 1, 1 Deauville 3) proceeded directly to ASCT. 13 pts received additional treatment before ASCT; 10 received augICEx2, 2 received ICEx2, and 1 received ICEx1 and augICEx1. All patients proceeded to ASCT and pre-transplant PET was negative by Deauville 1-2 for 16 (80%) pts. The median follow-up for cohort 2 was 24 months and 2-year EFS and OS were 85% and 100%, respectively. For cohorts 1 plus 2, the PET-neg rate following BV and before transplant were 28% and 78%, respectively. The 2 year EFS was 82%. By multivariate analysis, factors predictive of EFS included age<40 (p<0.001), advanced stage (p=0.001), refractory disease (p=0.001), and pre-transplant PET (p=0.005).

Conclusions. PET-adapted salvage therapy with BV followed by augICE produces a PET-neg rate of 78%. With this treatment program, 28% patients achieved PET-neg status and proceeded to ASCT following BV alone. Increasing the number of weekly BV cycles from 2 to 3 did not improve the PET-neg rate achieved with single-agent BV. Pre-transplant PET remains an important prognostic factor for relapsed/refractory HL and achievement of PET-negative status should continue to be the primary objective of studies evaluating novel salvage regimens.
BRENTUXIMAB VEDOTIN AFTER AUTOLOGOUS STEM CELL TRANSPLANT YIELDS THE STRONGEST BENEFIT IN HODGKIN LYMPHOMA PATIENTS WITH ≥2 RISK FACTORS: RESULTS OF A MULTIVARIATE ANALYSIS

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1 Memorial Sloan-Kettering Cancer Center, New York, New York, USA; 2 Huntsman Cancer Institute, University of Utah, Salt Lake City, Utah, USA; 3 Oregon Health and Science University, Portland, Oregon, USA; 4 H. Lee Moffitt Cancer Center & Research Institute, Tampa, Florida, USA; 5 Szent Istvan & Szent Laszlo Corporate Hospital Hematology & Stem Cell Dept., Budapest, Hungary; 6 Department of Bone Marrow Transplantation & Oncohematology, Maria Skłodowska-Curie Institute of Oncology, Gliwice, Poland; 7 Loyola University Medical Center, Maywood, Illinois, USA; 8 IRCCS Azienda Ospedaliera Universitaria San Martino-IST, Genoa, Italy; Istituto Nazionale dei Tumori, Milano, Italy; 9 University of Minnesota Medical Center, Minneapolis, MN, USA; 10 Institut Catalá d’Oncologia, Hospital Durnat i Reynals, Barcelona, Spain; 11 Millennium Pharmaceuticals, Inc., Cambridge, MA, a wholly owned subsidiary of Takeda Pharmaceuticals Limited; 12 Seattle Genetics, Inc., Bothell, WA, USA; 13 Maria Skłodowska-Curie Institute and Oncology Center, Warszawa, Poland

Background. In the phase 3 AETHERA trial, PFS was significantly improved with brentuximab vedotin (BV) versus placebo (PB) (HR=0.57, P=0.001) in HL patients at high risk of progression post-ASCT1. In a previous MVA of the study population, consolidation treatment with BV was significantly associated with improved PFS compared with placebo after adjustment for clinical factors2. Here we present an MVA among the remaining covariates.

A univariate CPH model with treatment-covariate interactions was developed to identify the most significant interaction (smallest p-value of risk factors for a general population was not explored. Methods. To identify qualitative treatment-subgroup interactions, Martingale residuals from a null Cox proportional hazard (CPH) model were used as a continuous outcome variable for a qualitative interaction tree (QUINT); 18 covariates were used to define potential subgroups. Some subgroups were based on number of established risk factors present in a patient, including relapse <12 months or refractory to frontline therapy, best response of partial remission or stable disease to salvage therapy, extranodal disease at pre-ASCT relapse, B symptoms at pre-ASCT relapse, and ≥2 prior salvage therapies. As a sensitivity analysis, a multivariate CPH model with treatment-covariate interactions was developed to identify the most significant interaction (smallest p-value <0.05). This interaction was retained in the model, and a second-round analysis was performed to identify the next most significant interaction among the remaining covariates. Results. The most significant qualitative treatment-subgroup interaction identified in the QUINT model was in the subgroup of patients with 1 versus ≥2 risk factors, with greater treatment benefit for patients with ≥2 risk factors. The sensitivity analysis confirmed this outcome (P=0.0006) and, after adjusting for this interaction, found no other interaction among the covariates tested to be significant. Analysis details will be presented with updated PFS and safety data after ~4 years since last patient enrolled. Conclusions. Treatment with BV appears to have the strongest impact for patients with ≥2 risk factors.

REFERENCES

2 Walewski J et al. J Clin Oncol 2015. 33(suppl; abstr 8519)

NIVOLUMAB RE-TREATMENT IN PATIENTS WITH RELAPSED/REFRACTORY HODGKIN LYMPHOMA: SAFETY AND EFFICACY OUTCOMES FROM A PHASE 1 CLINICAL TRIAL

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Background. In classical Hodgkin lymphoma (cHL), malignant Reed-Sternberg cells almost uniformly overexpress the programmed death receptor-1 (PD-1) ligands, PD-L1 and PD-L2, through genetic amplification at 9p24.1; therefore, cHL may be particularly sensitive to PD-1 blockade. Nivolumab (nivo), a fully human anti-PD-1 IgG4 monoclonal antibody checkpoint inhibitor, showed acceptable safety and high efficacy in a phase 1 trial (NCT01592370) of patients (pts) with relapsed/refractory cHL-a group with limited treatment options. Among 23 pts treated with nivo, investigator-assessed ORR was 87% and PFS at 24 weeks was 86.2%. Median duration of response was not reached after 101 weeks1. Pts who progressed after stopping nivo were eligible for re-treatment. Aim. Assess the safety and efficacy of nivo re-treatment in pts with progression after initial response. Methods. In this phase 1 trial, adults with relapsed/refractory cHL were treated with nivo until progression, CR, or for a maximum of 2 years. 3 pts with ongoing disease control (CR, PR, or stable disease) after discontinuation entered a protocol-specified follow-up period. Pts with PD <1 year after discontinuing nivo were eligible for re-treatment for ≤1 year. Toxicity, treatment response, and duration of response were assessed during re-treatment. Results. In total, 3 pts (age 26, 55, and 43 at baseline; 2 female) were retreated with nivo. All had prior systemic treatment (4, 3, and 15, therapies, respectively) and had undergone autologous stem cell transplantation; 2 had prior treatment with brentuximab vedotin. ECOG performance status was 0 or 1. Nivo treatment course and outcomes are summarized in the Table 1. All 3 pts achieved a response with re-treatment. All experienced treatment-related AEs during the initial treatment period (1 grade 3 lymphopenia; all others grade 1–2). During re-treatment, 1 pt experienced treatment-related grade 2 neutropenia after 18 re-treatment cycles. Conclusions. All 3 pts re-treated with nivo responded to treatment, with 2 achieving PR and 1 discontinuing due to CR. These data provide preliminary evidence that re-treatment with nivo after progression may be an option for further treatment response. Funding. Bristol-Myers Squibb.

Previous presentation. Preliminary data on 1 patient presented at ASH 2015.

Table 1.

<table>
<thead>
<tr>
<th>Patient</th>
<th>1</th>
<th>2</th>
<th>3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Initial treatment period</td>
<td>PR</td>
<td>CR</td>
<td>CR</td>
</tr>
<tr>
<td>Duration of therapy (weeks)</td>
<td>102</td>
<td>95</td>
<td>37</td>
</tr>
<tr>
<td>Off therapy time to progression (weeks)</td>
<td>12</td>
<td>37</td>
<td>44</td>
</tr>
<tr>
<td>Re-treatment</td>
<td>PR</td>
<td>PR</td>
<td>CR</td>
</tr>
<tr>
<td>Best response</td>
<td>9</td>
<td>16</td>
<td>18</td>
</tr>
<tr>
<td>Time to best response (weeks)</td>
<td>30</td>
<td>24</td>
<td>52</td>
</tr>
<tr>
<td>Duration of therapy upon re-treatment (weeks)</td>
<td>Yes</td>
<td>No</td>
<td>(discontinued due to CR)</td>
</tr>
<tr>
<td>Remaining on re-treatment</td>
<td>Yes</td>
<td>No</td>
<td>(discontinued due to CR)</td>
</tr>
<tr>
<td>Total time from start of nivo</td>
<td>148</td>
<td>149</td>
<td>135</td>
</tr>
<tr>
<td>treatment to last re-treatment (dose weeks)</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

REFERENCES

3 Ansell SM et al. ASH 2015 [oral 583].
P091
STEM CELL COLLECTION AFTER FAILURE OF UPFRONT ABVD OR BEACOPP IN PATIENTS WITH HIGH RISK ADVANCED STAGE III-IV HODGKIN’S LYMPHOMA

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Treatment of relapsed/refractory (R/R) Hodgkin’s lymphoma (HL) usually relies on high dose chemotherapy (HDT) followed by autologous stem cell transplantation (ASCT). Whether the myelotoxicity of BEACOPP may have consequences on stem cell harvest in patients with R/R HL has not been evaluated. Methods. Among 549 patients enrolled in the 20012 Intergroup randomized phase III trial, which compared 4 cycles of escalated BEACOPP followed by 4 cycles of BEACOPP with 8 cycles of ABVD in high risk stage III-IV HL, we identified, 91 patients (67 ABVD and 24 BEACOPP arm) with R/R HL. Additional data on stem cell collection, transplantation and engraftment outcome was obtained in 64/91 patients, 46 in the ABVD and 18 in the BEACOPP arm.

Results. Mobilization was carried out in 48 patients (35 ABVD and 13 BEACOPP arm). 14 patients had no mobilization (death, refractory disease, ineligibility for HDT). Data were incomplete in 2 patients who were excluded from analysis. One mobilization was sufficient in 91% of ABVD and 69% of BEACOPP patients. 3 (9%) ABVD patients required 2 mobilizations, and 31% of BEACOPP patients had ≥2 mobilizations (2-5). Stem cell collection required one, two or ≥2 cytophereses (3-5) in 52%, 32% and 16% of cases in the ABVD arm and 31%, 23% and 46% in the BEACOPP arm. A graft ≥3.10e6 CD34+ cell/kg was obtained in 33 (94%) patients in the ABVD and 8 (61%) in the BEACOPP arm. In this group, ASCT was not performed in 5 (12%) because of refractory disease or death. In the 36 patients (88%), it proceeded as initially planned. Eight (24%) patients in the ABVD arm and 5 (65%) in the BEACOPP arm had a double ACST. One patient was considered unfit for a second transplant (ABVD arm). Two patients (6%) in the ABVD arm and 5 (39%) in the BEACOPP arm had a graft ≥3.10e6 CD34+ cell/kg. In this group 5 patients proceeded to single ASCT and 2 did not because of death (BEACOPP arm) or insufficient graft (ABVD arm). Two patients had engraftment failures (ABVD arm). At the time of analysis, median overall survival from the date of randomization was 5.8 years in the ABVD and 4.3 years in the BEACOPP arm (Figure 1).

Conclusions. Stem cells harvest is more difficult after first line BEACOPP, requiring more mobilizations and more cytophereses. This is consistent with the greater bone marrow toxicity of BEACOPP. Remarkably, this had very limited impact on the strategy salvage treatment strategy as nearly all patients could proceed to transplantation as initially planned.

Figure 1.

P092
COMPLETE RESPONSES TO IMMUNE CHECKPOINT INHIBITORS IN PATIENTS WITH RELAPSED OR REFRACTORY HODGKIN LYMPHOMA PREVIOUSLY TREATED WITH 5- AZACITIDINE: A POSSIBLE ROLE FOR EPIGENETIC PRIMING

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Background. Patients with relapsed/refractory (R/R) classical Hodgkin lymphoma (cHL) after brentuximab vedotin (bvd) and autologous stem cell transplantation (ASCT) have limited treatment options. Immune checkpoint inhibitors (ICI) are active in this population, but rarely induce complete response (CR). Evidence suggests that exposure of tumor cells to 5-azacitidine may activate a T-cell-mediated immune responses, thus enhancing the efficacy of ICI. We reviewed our experience with ICI in patients with R/R cHL, and compared responses between those who had been exposed to 5-azacitidine to those not previously exposed to a hypomethylating agent. Methods. Eleven patients with R/R cHL received pembrolizumab at the dose of 2 mg/kg every 3 weeks (N=9), or nivolumab at the dose of 3 mg/kg every 2 weeks (N=2). Response was assessed by positron emission tomography/computed tomography (PET/CT). Results. The patient population was very heavily treated, with a median of 12 [8-16] prior treatments. All had received ASCT and bvd. Six had been exposed to 5-azacitidine on a Phase 1 study. Four of them had received it immediately prior to ICI, all of them within 14 months. Grade ≥3 adverse events (AE) included: infusion reaction (N=1) thrombocytopenia (N=1), grade-5 respiratory failure (N=1), myelodysplastic syndrome (N=2, one pre-existent), and acute kidney injury (N=1, pre-existent). Nine patients were evaluable for response: 7 (78%) achieved CR, one PR, and one a reduction of tumor burden. All five evaluable patients who received 5-azacitidine prior to ICI achieved CR (one is pending evaluation and will be reported), while only 2 of 4 who did not receive prior 5-azacitidine achieved CR. At a median follow-up of 9.0 months [0.5-14.3], 9 patients are alive and 6 are still receiving treatment. Conclusions. We documented an unprecedented rate of CR to ICI in patients with heavily pre-treated R/R cHL. The most serious AE’s were unrelated to ICI therapy. We believe this experience supports the notion of epigenetic priming, as shown in lung cancer studies, and is now being studied in the context of a clinical trial.

P093
BRENTUXIMAB VEDOTIN IN PATIENTS WHO ARE INELIGIBLE FOR AUTOLOGOUS STEM CELL TRANSPLANT WITH RELAPSED OR REFRACTORY HODGKIN LYMPHOMA: A UNITED KINGDOM AND GERMANY RETROSPECTIVE STUDY

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1Department I of Internal Medicine and German Hodgkin Study Group (GHSG), University Hospital of Cologne, Germany; 2Millennium Pharmaceuticals, Cambridge, MA, USA; 3Department of Haematology, University College Hospital, London, UK

Background. In Hodgkin lymphoma (HL), brentuximab vedotin (BV) has demonstrated clinical activity in relapsed/refractory (R/R) HL. More recently, BV has been shown to have clinical activity in patients who are inelig...
Background. Brentuximab Vedotin (BV) is an anti-CD30 antibody-drug conjugate indicated for the treatment of CD30+ rrHL following Autologous Stem-Cell Transplantation (ASCT) or following at least two prior therapies in patients who are ASCT-ineligible. Clinical outcomes in the ASCT-ineligible population have not yet been evaluated in a real-world study. We aimed to describe outcomes in real-world ASCT-ineligible patients with relapsed/refractory Hodgkin lymphoma (rrHL) in two countries known to have different practice patterns in rrHL. Methods. This was a retrospective medical chart review study that enrolled patients at 45 clinical sites representative of routine practice in Germany and the UK. The study included patients ≥18 years old at the time of HL diagnosis, who progressed after multi-drug chemotherapy regimens between 1 January 2008 and 30 June 2014 and were not ASCT candidates as identified by their clinicians, were subsequently treated with BV, and were not enrolled in an HL-related clinical trial. Patient demographics, clinical characteristics, and treatment characteristics were described. Clinical outcomes included best response to treatment, progression-free survival (PFS), overall survival (OS), and adverse events (AEs). All outcomes were descriptive, and reported in the full study population and by country. Results. A total of 136 patients were included in this analysis (78 in Germany and 58 in the UK). The median age of study patients at HL diagnosis was 70 years, and 58% were male. Nearly all patients had classical HL (96%), and over half had non-bulky (<5 cm) disease (55%). The most common reasons for ASCT ineligibility were comorbidities (74%), age (57%), and disease progression (12%). Coronary artery disease (39%), diabetes (38%), and chronic pulmonary disease (24%) were the most common comorbidities among study patients. Eighty-five percent of patients received at least 2 lines of treatment prior to initiating BV. At the time of BV initiation, 24% of patients had stage IV disease and 21% had extranodal involvement. The median duration of follow-up was 3.2 years from the time of HL diagnosis. Three fourths of patients had a partial or complete response (Table 1). Other events of interest included leukopenia (13%; of which 53% were serious), neuropathy (10%; 8% serious), and anemia (9%; 42% serious). Conclusions. Progression-free and overall survival in ASCT-ineligible patients receiving BV were 15.1 and 17.8 months, respectively, after initiation of therapy.

Table 1. Treatment and response in ASCT-Ineligible patients receiving Brentuximab Vedotin.

<table>
<thead>
<tr>
<th>Outcome</th>
<th>ASCT-Ineligible Patients Receiving BV N=128</th>
</tr>
</thead>
<tbody>
<tr>
<td>Response</td>
<td></td>
</tr>
<tr>
<td>Complete response</td>
<td>12%</td>
</tr>
<tr>
<td>Partial response</td>
<td>40%</td>
</tr>
<tr>
<td>Stable disease</td>
<td>1.3%</td>
</tr>
<tr>
<td>Progressive disease</td>
<td>1.2%</td>
</tr>
<tr>
<td>PFS from start of BV (months), median (95% CI)</td>
<td>15.1 (8.9-22.0)</td>
</tr>
<tr>
<td>OS from start of BV (months), median (95% CI)</td>
<td>17.8 (13.7-21.5)</td>
</tr>
</tbody>
</table>

P094

REAL-WORLD EFFECTIVENESS OF BRENTUXIMAB VEDOTIN VS OTHER TREATMENTS IN PATIENTS WITH RELAPSED/REFRACTORY HODGKIN LYMPHOMA POST AUTOLOGOUS STEM-CELL TRANSPLANTATION

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Background. Brentuximab Vedotin (BV) is an anti-CD30 antibody-drug conjugate indicated for the treatment of CD30+ rrHL following Autologous Stem-Cell Transplantation (ASCT) or after ≥2 prior therapies in patients who are ASCT-ineligible. We aimed to compare effectiveness in post-ASCT patients with relapsed/refractory Hodgkin Lymphoma (rrHL) receiving BV to those receiving other or no treatment in clinical settings in Germany and the UK. Methods. This retrospective medical chart review enrolled patients at 45 clinical sites in Germany and the UK. The study included patients ≥18 years old at HL diagnosis, who received ASCT between 1 January 2008-30 June 2014, had ≥2 months of available clinical data from the start of post-ASCT treatment, and were not enrolled in an HL-related clinical trial. This analysis included post-ASCT patients who subsequently relapsed, and an augmented sample of patients who relapsed post-ASCT. Patients were grouped according to the subsequent line of therapy (LOT) received after post-ASCT relapse (BV, salvage chemotherapy, or no treatment). Patient demographics, clinical, and treatment characteristics were described, and clinical outcomes included progression-free survival (PFS), OS, and best response. Median PFS and OS were calculated using Kaplan-Meier methods; other outcomes were summarized using descriptive statistics. Results. A total of 360 patients were included in the study (161 in Germany, 199 in the UK). Of these, 213 received BV, 128 received other treatments, and 19 received no treatment for post-ASCT relapse. Groups were similar in age at diagnosis, gender, and HL type. The most commonly applied chemotherapy regimens were gemcitabine-based (38% and 42% in Germany and UK) and ICE (17% and 8%, respectively). Patients in the BV group received a median of 7 of the recommended 16 treatment cycles (Table 1). Median PFS was 11.7 months longer in patients receiving BV compared to those receiving salvage chemotherapy. Median OS from start of therapy was 32.0 months in the salvage chemotherapy group and was not estimable in the BV group due to >50% of patients surviving at last follow-up (P=0.014). Other events that occurred during treatment include leukopenia (12%) and peripheral neuropathy (10%) for BV and leukopenia (12%), anemia (6%), and diarrhea (6%) for salvage chemotherapy. Conclusions. In this real-world study, rrHL patients receiving BV as the first post-relapse LOT after ASCT relapse tended to have longer PFS and OS than patients receiving salvage chemotherapy; however, confidence intervals were wide.

P095

RISK FACTORS FOR RELAPSE IN PATIENTS WITH RELAPSED OR REFRACTORY HODGKIN LYMPHOMA AFTER AUTOLOGOUS STEM CELL TRANSPLANTATION: A REAL-WORLD ANALYSIS IN GERMANY AND THE UNITED KINGDOM

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Background. With the advance of novel therapeutic options, RFs for post-ASCT outcomes in patients with rHL are of immediate interest. Several RFs for relapse have been previously documented; however, there are limited data with respect to the prevalence and distribution of RFs in post-ASCT rHL patients who have and have not had a subsequent relapse. We aimed to describe the prevalence and distribution of RFs after ASCT in patients with rHL in a sample of real-world patients in Germany and the UK. Methods. We retrospectively evaluated patients who were ≥18 years old at the time of HL diagnosis, received ASCT between 1 January 2006 and 30 June 2014, were not enrolled in an HL-related clinical trial and treated under real-world setting at 45 clinical sites in Germany and the UK. This analysis included randomly selected post-ASCT patients, and was augmented by patients who relapsed post-ASCT. RFs of interest included patient age, sex, B symptoms, extranodal disease, bulkiness, clinical stage, ECOG performance status, erythrocyte sedimentation rate (ESR), white blood cell (WBC) count, lymphocyte count, hemoglobin (Hgb), and lactate dehydrogenase (LDH) at the time of relapse preceding ASCT (ie, pre-ASCT relapse), number of salvage regimens prior to ASCT; response to salvage treatment; and time to relapse after front-line treatment. Results. A total of 398, predominantly male patients, with a median follow-up of 2.2 years post-ASCT were included (196 in Germany, 202 in the UK). The mean age at diagnosis was 45 years. In total, 329 (83%) had a relapse during the follow-up period. A greater proportion of patients who relapsed were ≥45 years old, had stage IV disease, B symptoms, bulky disease, ECOG ≥2, anemia, and elevated LDH at the time of pre-ASCT relapse. Conclusions. This real-world study demonstrates the prevalence and distribution of a myriad of RFs in patients post-ASCT rHL. RF profiles are different in patients who did and did not have a subsequent relapse, and, as such, clinical evaluation of RFs is critical to identify patients at a truly increased risk of subsequent relapse.

Table 1. Prevalence of risk factors in patients who did and did not relapse after Autologous Stem-Cell Transplantation.

<table>
<thead>
<tr>
<th>Risk Factor, N (%)</th>
<th>Relapsed</th>
<th>Did not relapse</th>
<th>P-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Male</td>
<td>298 (60.9)</td>
<td>57 (39.1)</td>
<td>0.958</td>
</tr>
<tr>
<td>Age ≥45 years</td>
<td>171 (52.8)</td>
<td>113 (38.8)</td>
<td>&lt;0.000</td>
</tr>
<tr>
<td>B symptoms at the time of ASCT</td>
<td>43 (12.1)</td>
<td>2 (2.9)</td>
<td>0.928</td>
</tr>
<tr>
<td>Extraneural disease at the time of ASCT</td>
<td>288 (82.5)</td>
<td>46 (66.6)</td>
<td>0.94</td>
</tr>
<tr>
<td>≥2 salvage regimens prior to ASCT</td>
<td>31 (9.1)</td>
<td>5 (7.3)</td>
<td>0.741</td>
</tr>
<tr>
<td>Non-responsive to salvage therapy (positive or progressive disease)</td>
<td>43 (12.1)</td>
<td>5 (6.8)</td>
<td>0.009</td>
</tr>
<tr>
<td>Bulky disease (≥5 cm) at pre-ASCT relapse</td>
<td>265 (71.5)</td>
<td>54 (74.3)</td>
<td>0.665</td>
</tr>
<tr>
<td>Clinical stage at pre-ASCT relapse</td>
<td>0.916</td>
<td></td>
<td></td>
</tr>
<tr>
<td>I</td>
<td>31 (9.3)</td>
<td>2 (2.9)</td>
<td></td>
</tr>
<tr>
<td>II</td>
<td>100 (34.1)</td>
<td>26 (37.7)</td>
<td></td>
</tr>
<tr>
<td>III</td>
<td>107 (33.1)</td>
<td>30 (43.1)</td>
<td></td>
</tr>
<tr>
<td>IV</td>
<td>95 (28.9)</td>
<td>10 (14.5)</td>
<td></td>
</tr>
<tr>
<td>Not associated</td>
<td>31 (9.3)</td>
<td>1 (1.4)</td>
<td></td>
</tr>
<tr>
<td>ECOG status ≥3 at pre-ASCT relapse</td>
<td>0.001</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Time to relapse ci months after transplant therapy</td>
<td>0.115</td>
<td></td>
<td></td>
</tr>
<tr>
<td>EOR ≥50 mgh/ml at pre-ASCT relapse</td>
<td>0.198</td>
<td></td>
<td></td>
</tr>
<tr>
<td>WBC ≥15 × 10⁹/l at pre-ASCT relapse</td>
<td>0.103</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Anemia at pre-ASCT relapse</td>
<td>0.009</td>
<td></td>
<td></td>
</tr>
<tr>
<td>UCH ≥1.50 × 10⁹/l at pre-ASCT relapse</td>
<td>&lt;0.001</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

P096

VERY LATE RELAPSES OCCURING AT LEAST 5 YEARS AFTER THE INITIATION OF TREATMENT WITH CHEMOTHERAPY OR COMBINED MODALITY THERAPY IN PATIENTS WITH HODGKIN: INCIDENCE, RISK FACTORS AND OUTCOME

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‘Department of Haematology; 2Department of Haematology, Athens Medical Center, Athens, Greece; 31st Department of Internal Medicine; 41st Propedeutic Department of Internal Medicine of National and Kapodistrian University of Athens, Laiko General Hospital, Athens, Greece

Introduction. Most relapses in HL patients (pts) occur within 5 yrs from diagnosis. However, there are pts who do relapse later on, even after decades. The exact incidence of VLRs, especially after CT/CMT, is not well established. Similarly, there are very limited data on baseline disease features associated with VLRs as well as the outcome of these pts. Aim. The estimation of the probability of VLR in pts with HL who remain in 1st complete remission (CR1) for 5 years after institution of CT/CMT, the identification of risk factors for VLR and the evaluation of the outcome of VLRs. Pts/Methods. Retrospective study of 764 HL pts in CR1 for ≥5 years. Initial CT was anthracycline-based in 87% of pts [mainly ABEV] and MOPP-like in 13%. The Kaplan-Meier method and Cox’s model were used for univariate and multivariate survival analysis. Results. Among 764 pts, 44 had a VLR (2/44 had a composite HL and non-Hodgkin lymphoma): 24, 13, 4 and 3 between 5-10, 10-15, 15-20 and beyond 20 years from diagnosis. Starting from diagnosis, the 10-year and 15-year VLR rate were 3.7% and 8.0%. In univariate analysis, higher risk for VLR was observed for pts treated with CT only vs CMT (p=0.0006), non-nodular scle- rohistologies (non-NS) (p=0.002) and age ≥45 yrs (p=0.02). In multivariate analysis, independent predictors of VLR were non-NS (HR 2.39, p=0.006) and CT vs CMT (HR 2.56, p=0.005). At 15 yrs from diagnosis, the probability of VLR was 3.0%, 10.3% and 24.0% (p<0.0001) for pts with 0, 1 and 2 risk factors (RFs). Among 663 anthracycline-treated pts, independent predictors for VLR were non-NS histologies (HR 2.56, p=0.02) and age ≥45 yrs (HR 2.29, p=0.04). At 15 yrs from diagnosis, the probability of VLR was 2.7%, 10.8% and 27.5% (p<0.0001) for patients with 0, 1 and 2 RFs. Conventional salvage therapy was given to 87 pts (mostly non-cross resistant), 4 received salvage RT only, 2 salvage with autoSCT, while 1 pt has not received salvage therapy yet. The 5- and 10-yr survival after failure was 70% and 42%. Conclusions. Among pts with HL who remain in CR1 at 5 years following CT w/wo RT, approximately 3-4% relapse within the next 5 yrs and even more thereafter. This observation is important when counselling pts in CR1 regarding their chance of ultimate cure. Younger pts with NS who receive CMT have the lowest risk for VLR. AutoSCT should not be spared solely on the basis of a very long CR1, since the results of conventional salvage do not appear satisfactory.

P097

LONG-TERM OUTCOME OF REDUCED-INTENSITY ALLOGENEIC TRANSPLANT IN RELAPSED/REFRACTORY HODGKIN’S LYMPHOMA: THE TIMING OF RELAPSE AFTER AUTOLOGOUS TRANSPLANT AND PRIMARY REFRACTORY DISEASE DO NOT IMPACT THE LONG-TERM SURVIVAL

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1Division of Hematology, Fondazione IRCCS Istituto Nazionale Tumori, Milan, Italy; 2Chair of Hematology, Università degli Studi di Milano, Milan, Italy

This study analyzed a cohort of consecutive patients with relapsed/refractory Hodgkin’s lymphoma (RR-HL) receiving reduced intensity allogeneic transplant (alloSCT) in a single center to understand whether the timing of relapse after autologous transplant (ASCT) or primary refractory disease would change the survival after allotraft. Of 245 patients with HL referred to our division from 2001 to 2014, 105 had RR-HL (64 primary refractory). After salvage treatment, 62 patients (59%) underwent alloSCT with thiopeta-based conditioning, 43 patients did not receive alloSCT due to progressive disease (31), age >65 years (5) or complete remission after third line chemotherapy and ASCT (9 patients). Multivariate analysis of alloSCT outcomes included disease pre-transplant status (CR vs PR vs resistant [SD or PD]), donor type (HLA identical, matched unrelated
Brentuximab vedotin (BV) is an antibody-drug conjugate (ADC) approved for the treatment of relapsed Hodgkin lymphoma (HL) and systemic anaplastic large cell lymphoma (ALCL). Brentuximab vedotin is comprised of a chimeric IgG1-directed antibody against CD30 and the small molecule, MMAE, a microtubule-disrupting agent covalently attached to the antibody via a cleavable linker. The primary anticancer activity of BV is believed to be the binding of the ADC to CD30-expressing cells, followed by internalization, release of MMAE which results in microtubule network disruption, cell cycle arrest, and apoptotic death. In addition to classical ADC activity, the antibody and auristatin drug payload components of BV have additional and distinct modalities that may contribute to its overall function and antitumor activity in the heterogeneous and complex immune microenvironment of lymphoma. In addition to classical ADC activity, recent evidence elucidates new functionality of BV including antibody-dependent cellular phagocytosis (ADCP); bystander-killing of nearby CD30-negative tumor cells in the tumor microenvironment due to MMAE release from CD30-expressing tumor cells and macrophages; and immunogenic cell death driven by endoplasmic reticulum (ER) stress that can promote an antigen specific T-cell response. Decoration of CD30-expressing cells with BV mediates macrophage recognition and phagocytosis promoting the removal of tumor cells independent of antibody internalization and release of the auristatin payload (MMAE). This activity occurs in vitro and contributes to in vivo activity seen with the antibody backbone. Furthermore, cell-permeable MMAE released from proteolytic processing of BV by macrophages within the tumor microenvironment or CD30-expressing tumor cells is able to kill antigen-negative tumor cells in a variety of in vivo tumor models. Additionally, in vitro characterization has demonstrated that MMAE-mediated disruption of microtubules not only drives tumor cell apoptosis but results in ER stress leading to surface exposure of immune-activating molecules that can drive innate and adaptive immune response that may contribute to the overall and long-term antitumor activity of BV. Taken together, these data provide rationale for the activity of BV in tumors with low and heterogeneous CD30 expression and for ongoing combinatorial trial with immunoncology agents.

P100
THE LONG-TERM OUTCOME OF PATIENTS WITH CLASSICAL HODGKIN LYMPHOMA AND NEGATIVE INTERIM PET FAILING ABVD MIGHT BE WORSE THAN THAT OF INTERIM PET POSITIVE PATIENTS UNDERGOING EARLY TREATMENT INTENSIFICATION WITH ESCALATED BEACOPP
1Gdynia Oncology Center, Gdynia and Department of Oncological Propedeutics, Medical University of Gdansk, Gdansk, Poland; 2Department of Hematology, Military Institute of Medicine, Warsaw, Poland; 3Department of Hematology, University Medical Center, Poznan, Poland; 4Clinical Department of Hematology, Internal Medicine Hospital, Warmia and Mazury Medical University, Olsztyn, Poland; 5Department of Cellular Biotechnology and Hematology, University "La Sapienza" of Rome, Italy; 6Hematology Unit, Regional Hospital, Opole, Poland; 7Department of Hematology, Blood Neoplasms and Bone Marrow Transplantation, Wroclaw Medical University, Wroclaw, Poland; 8Department of Hematology, University Medical School, Poznan, Poland; 9Department of Hematology, Central Clinical Hospital MSW, Warszawa, Poland; 10Department of Clinical Oncology, Oncology Center, Bydgoszcz, Poland; 11Medical Center Mrukmed with Outpatient Chemotherapy

P099
IMMUNE SYSTEMS ENGAGEMENT RESULTS IN NON-CLASSICAL ANTIBODY-DRUG CONJUGATE ANTITUMOR ACTIVITY OF BRENTUXIMAB VEDOTIN
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Purpose. Despite high NPV of negative iPET in patients with HL about 10% of them relapse/progress after completion of ABVD. Here we present clinical characteristics and outcome of such patients comparing them to patients with positive iPET and interim treatment escalation [iPET(+)&TE]. Patients and Methods. Data of the Polish patients were retrieved from the prospective observational study of the Polish Lymphoma Research Group on the predictive role of iPET after 1 ABVD cycle. Briefly, intermediate and advanced stage (IIB-IVB) HL patients were treated with ABVD followed by iPET after each of the first 2 ABVD cycles. iPET(+) patients continued with ABVD, while some iPET2(+) had at the discretion of a local physician treatment intensification with BEACOPP esc. with a median of 6 (2-8) cycles. iPET(-) patients failing ABVD had second line treatment with ICE(3), IGEV(6), DHAP(5),ESHAP(5), BEACOPP esc(8), ABVD/MOPP(2) Brentuximab(1), IVOX(1), ASCT(1).

iPETS were interpreted according to the Deauville scale as negative(-) (score 1,2,3) and positive (+)(score 4,5). The primary endpoints were: overall survival (OS) and time (EFS2) to the second event (no complete remission or allogeneic HCT at the day of last follow-up), respectively. The secondary endpoint: time to first event (2nd progression for iPET(-)) or 1st one for iPET(+) & TE after treatment escalation. Results. After a median follow-up of 48.8 (range 15 – 84) months 29 iPET(-) failing ABVD and 26 iPET(+) & TE patients were identified. (Table 1).

Table 1. Demographics and treatment outcome of patients.

<table>
<thead>
<tr>
<th>Age</th>
<th>Sex</th>
<th>Staging</th>
<th>Clinical stage</th>
<th>EFS2</th>
<th>Sex</th>
<th>Sex</th>
<th>Age</th>
<th>Sex</th>
<th>EFS2</th>
<th>Sex</th>
<th>Age</th>
</tr>
</thead>
<tbody>
<tr>
<td>22</td>
<td>23.8</td>
<td>Male</td>
<td>IA</td>
<td>12.7</td>
<td>22</td>
<td>27</td>
<td>12.1</td>
<td>22</td>
<td>27</td>
<td>12.1</td>
<td>22</td>
</tr>
<tr>
<td>17.6</td>
<td>22.8</td>
<td>Female</td>
<td>IL-IV</td>
<td>12.7</td>
<td>22</td>
<td>27</td>
<td>12.1</td>
<td>22</td>
<td>27</td>
<td>12.1</td>
<td>22</td>
</tr>
<tr>
<td>22</td>
<td>22</td>
<td>Male</td>
<td>3/4</td>
<td>12.7</td>
<td>22</td>
<td>27</td>
<td>12.1</td>
<td>22</td>
<td>27</td>
<td>12.1</td>
<td>22</td>
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<tr>
<td>22</td>
<td>22</td>
<td>Female</td>
<td>3/4</td>
<td>12.7</td>
<td>22</td>
<td>27</td>
<td>12.1</td>
<td>22</td>
<td>27</td>
<td>12.1</td>
<td>22</td>
</tr>
</tbody>
</table>

The two cohorts were not different with regard to sex, age, stage, histological subtype, presence of: B symptoms, bulky mass and extranodal disease, absolute number of lymphocytes, lymphocyte to monocyte ratio, and type of relapse. Six(21%) iPET(-) and 4(15%) iPET(+)&TE died. However, in the former group deaths occurred during the longer follow-up, whereas in the latter occurred in the 25 months after treatment onset (Figure 1). Similarly more patients experienced S2 events in iPET(+) group (12-41% vs 8-31%) that tended to occur within longer time in iPET(-) patients. This translated to a significant difference (p=0.04) in the probability of EFS2 events between the two cohorts as shown by the landmark analysis @25 months. Conclusions. Patients with iPET(-) interim BEACOPP escalation despite iPET(+) may experience better long-term OS and significantly better EFS than patients with iPET(-) failing ABVD. Markers to improve NPV of iPET are warranted.
The complete response, partial response, stable disease and progressive disease rates were 31.8% (Figure 2), 35.1%, 19.5% and 11.7% respectively.

Figure 2: Pooled response rate to Brentuximab Vedotin (Random effect).

The one year progression free survival and estimated one year overall survival were 47.6% (Figure 3) and 79.5% (Figure 4) respectively. Additional fixed effect model meta-analysis showed similar results (difference: <2%) except for progressive disease (difference: 9.3%) and progression at one year (difference: 5.2%) (Table 1). Conclusions. In this largest published pooled cohort BV produces high responses with encouraging progression free and overall survival in relapsed/refractory HL patients. Our results enhance the role of BV in heavily pretreated HL patients.

Figure 3: Pooled rate of disease progression one year after treatment with Brentuximab Vedotin (Random effect).

Figure 4: Pooled rate of mortality events one year after treatment with Brentuximab Vedotin (Random effect).

Table 1. Results of random and fixed effect meta-analysis models.

<table>
<thead>
<tr>
<th>Outcome</th>
<th>Result of random effect model (95% CI)</th>
<th>Result of fixed effect model (95% CI)</th>
<th>I²</th>
</tr>
</thead>
<tbody>
<tr>
<td>Overall response rate</td>
<td>62.7% (58.1-67.9)</td>
<td>63.4% (59.6-67.7)</td>
<td>61%</td>
</tr>
<tr>
<td>Complete response</td>
<td>31.8% (27.6-36.4)</td>
<td>32.1 (29.5-34.4)</td>
<td>54%</td>
</tr>
<tr>
<td>Partial response</td>
<td>33.1% (28.7-34.2)</td>
<td>35.7% (32.4-39.1)</td>
<td>68%</td>
</tr>
<tr>
<td>Stable disease</td>
<td>19.3% (13.9-26.8)</td>
<td>20.1% (17.2-23.4)</td>
<td>72%</td>
</tr>
<tr>
<td>Progressive disease</td>
<td>31.7% (7.6-17.5)</td>
<td>21% (18-24.4)</td>
<td>72%</td>
</tr>
<tr>
<td>Progression at 1 year</td>
<td>52.4% (41.8-62.8)</td>
<td>57.6% (52.7-62.4)</td>
<td>76%</td>
</tr>
<tr>
<td>Mortality (death)</td>
<td>20.5% (15.7-26.3)</td>
<td>22% (19-25.4)</td>
<td>53%</td>
</tr>
</tbody>
</table>

Conclusions.

In this largest published pooled cohort BV produces high responses with encouraging progression free and overall survival in relapsed/refractory HL patients. Our results enhance the role of BV in heavily pretreated HL patients.

P102

A ROLE FOR ALLOGENEIC STEM CELL TRANSPLANTATION IN THE ERA OF NOVEL AGENTS FOR HODGKIN'S LYMPHOMA?

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Patients with relapsed Hodgkin's lymphoma (HL) can achieve long term remission after high-dose chemotherapy and autologous stem cell transplantation (SCT). However the prognosis is dismal for patients relapsing after autologous SCT. The advent of novel agents such as brentuximab vedotin or checkpoint-inhibitors has enabled a
large proportion of patients to achieve responses, but these remissions are often not durable. On the other hand there have been several attempts to use allogeneic SCT as a potentially curative treatment modality in HL. While progress has been made to reduce the transplant-related mortality, relapse after transplant remains the biggest challenge for allogeneic SCT. In order to investigate how the availability of novel agents may have influenced the results of allogeneic SCT we performed a retrospective single centre analysis in our institution. Thirty seven patients with relapsed/refractory HL were transplanted between 2005 and 2016. Median overall survival (OS) after transplant was 4.4 years with 57% OS at 3 years. There was no difference in OS in patients transplanted before or after 2010. Remission status before allogeneic SCT had a significant impact on 3 yr OS which was 75% in patients transplanted in CR, 66% in PR, 66% in SD and 22% in patients with progressive disease. Of the 20 patients in CR or PR before transplant 2 (10%) died from transplant-related causes. Eight patients (40%) in this group relapsed after transplant. While four patients eventually died from relapsed HL, four patients are long term survivors 5–6.6 years from transplant after being treated with novel agents such as brentuximab, everolimus or nivolumab.

In the era of novel agents performing allogeneic SCT in patients with relapsed HL at the time of maximum response may provide long term survival with acceptable transplant-related risks. In addition using these agents to treat relapse after transplant can further improve the long term prognosis. While more and more options are available to optimize the remission status before transplant, new approaches will incorporate novel agents in the early post-transplant phase before day 100, such as everolimus in our current single-centre OCTET-Ever protocol or brentuximab vedotin in a planned multi-centre protocol by the German Hodgkin Study Group.

**P103**

**SALVAGE TREATMENTS FOR RELAPSED CLASSICAL HODGKIN LYMPHOMA IN CHILDREN AND ADOLESCENTS: A 10-YEAR EXPERIENCE IN A SINGLE CENTRE.**

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**Background.** The optimal treatment for paediatric relapsed/refractory (R/R) classical Hodgkin lymphoma (cHL) is undefined. Standard salvage treatment is re-induction chemotherapy followed by consolidation with high dose chemotherapy (HDCT) / autologous stem cell transplantation (ASCT). However some patients may be salvaged with chemo-radiotherapy only thereby avoiding toxicity of transplant while in others the standard HDCT/ASCT would be predicted to fail and allogeneic transplant has been proposed as an alternative approach.

**Purpose:** To evaluate outcomes of risk and response adapted salvage strategies in R/R cHL in our centre. **Patients and Methods.** A retrospective study between 2005-16 identified 23 first relapse patients; median age 14 (3-19) years; M:F ratio 1.6:1; median time to relapse 10 months (1 month - 180). First line treatment was multi-agent chemotherapy with n=5 or without radiotherapy (n=18). Salvage was re-induction chemotherapy in all patients followed by consolidation treatment which was selected based on an assessment of prognostic factors and assessment of response to salvage chemotherapy. RT consolidation was used in 4 patients with later relapse who achieved a complete metabolic remission (CMR) with one line of salvage. HDCT/ASCT was used in 13 patients, all in a CMR after one (n=5), two (n=7) or four (n=1) lines of salvage. Alo-SCT was used in 6 patients, five in CMR [after one (n=1), two (n=2), three (n=1) or four (n=1)] lines of salvage. Results. 4/4 consolidated with RT only (no transplant) remain well in second remission, median follow-up 66 months. 11/13 consolidated with HDCT/ASCT (conditioning BEAM/LEAM) remain in second remission, median follow-up 18 months. Only 2/6 consolidated with allo-SCT (conditioning regimen BEAM-Campath in 5 and FMC in 1) remain in second remission, median follow up of 24 months while 2/6 relapsed and 2/6 died of early treatment toxicities.

**Conclusions.** Only 4/23 patients experienced a second relapse. 0/4 in the RT group, 2/15 in the HDCT/ASCT group, 2/6 in the Allo-SCT group. Two patients died of infection / toxicity post allo-SCT. The disease free survival (DFS) by consolidation group was 100% in the RT group, 85% in the HDCT/ASCT group, and 33% in the allo-SCT group. A risk and response adapted salvage approach achieved excellent outcomes with RT or HDCT/ASCT consolidation but the outcomes with allogeneic transplant are less encouraging due to relapse and toxicity in this small study.

**P104**

**SINGLE-ARM STUDY OF BRENTUXIMAB VEDOTIN IN PATIENTS WITH RELAPSED OR REFRACTORY HODGKIN LYMPHOMA WHO ARE INELIGIBLE FOR STEM CELL TRANSPLANTATION OR MULTIAGENT CHEMOTHERAPY.**

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**Background.** CD30 is a cell surface antigen expressed on malignant HL. Reed-Stenenberg cells and targeted by the antibody-drug conjugate (ADC) brentuximab vedotin (ADCETRIS®), which comprises a CD30-targeted monoclonal antibody conjugated to the microtubule disrupting agent monomethyl auristatin E via a protease-cleavable linker. Brentuximab vedotin has received US and European approval for treatment of RRHL following failure of autologous SCT (ASCT) or following ≥2 prior therapies when ASCT or multiagent chemotherapy is not a treatment option. Treatments are limited for patients ineligible for ASCT or multiagent chemotherapy; results of this ongoing Phase 4 trial (NCT01990534) will further investigate the anti-tumor activity of brentuximab vedotin in this difficult-to-treat population.

**Methods.** Eligible patients are ≥18 years of age with Eastern Cooperative Oncology Group performance status 0–1, RRHL after ≥1 prior therapy, and considered ineligible for SCT or multiagent chemotherapy due to progression within 90 days of complete response (CR) or unconfirmed CR to multiagent frontline chemo/radiotherapy, progressive disease (PD) during frontline multiagent chemotherapy, or relapse after ≥2 prior treatments (including salvage). Patients must have measurable disease (≥1.5 cm) by CT scan. Patients will receive an intravenous infusion of brentuximab vedotin 1.8 mg/kg on day 1 of 21-day cycles for up to 16 cycles or until disease progression or unacceptable toxicity. The primary objective is overall response rate (ORR) assessed by an independent review committee; secondary objectives include duration of response, CR rate, progression-free survival (PFS), overall survival (OS), pharmacokinetics, immunogenicity, safety and tolerability, and proportion of patients receiving ASCT or allogeneic SCT following brentuximab vedotin treatment. CT scans of chest, neck, abdomen, and pelvis will be performed at baseline and cycles 2, 4, 7, 10, 13, and 16; PET scans at baseline and cycles 4 and 7. Post treatment follow-up for PFS and OS will be performed every 5 months, for 18 months after end of treatment. OS assessment will continue thereafter every 6 months until death or study closure. Incidence and severity of adverse events will be evaluated according to NCI CTCAE v4.03. Enrollment has finished with 60 patients across 20 international sites. Final data will be provided at the congress.
P105
OUTCOME OF VERY LATE RELAPSE IN HODGKIN LYMPHOMA – A REPORT FROM DEBRECEN, HUNGARY

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Introduction. With modern risk-adapted treatment modalities 80-90% of Hodgkin lymphoma (HL) patients can be cured, however, 50% of the patients may relapse after the first line treatment. Late relapses, that occurred 5 or more years after first diagnosis are rare. Neither clinical characteristics, nor risk factors, nor optimal treatment are well described for very late relapse (VLR) patients. Aim. To describe the incidence, clinical presentation, treatment and outcome of VLR in HL patients between 1970 and 2010 at our institute. Results. Of 669 consecutive HL patients treated at our institute between 1970 and 2010, 617 (92.2%) patients achieved complete remission after the first line treatment. Relapse occurred in 188 (28.1%) patients, 26 (3.8%) of them 5 or more years after the first diagnosis. VLR were more frequently observed in patients with mixed cellularity histological subtype and stage II/III disease at first diagnosis. In 15 (57.7%) patients, the histologic subtype remained the same at VLR, in 8 (30.8%) cases the region of the relapse was also identical. 24 (92.3%) patients with VLR received polychemotherapies, 5 (20.8%) of them also received involved-field radiotherapy. Primary diagnosis before the age of 20 and treatment with radiotherapy alone at first diagnosis was associated with a higher risk of VLR (p=0.009 and p=0.004 respectively). Compared to early relapse we observed superior OS after VLR. At a median of 244 (91 - 560) months of follow-up, 22 (84.6%) patients with VLR are still alive and disease free. In addition, relapse characteristics, therapeutic approaches, and changes in histologic subtype will be presented. Conclusions. VLR occurs in a small number of patients diagnosed with HL. Besides the rarity of these cases, with adequate treatment, late relapse oHL appears to have a favorable prognosis to early relapse HL cases. Subgroup analyses suggest that treatment with radiotherapy alone and first diagnosis before adulthood conveys worse prognosis. Continuous investigations are needed in this setting to determine further risk factors of VLR in HL.

P106
LIMITED EFICACY OF Brentuximab vedotin IN A HEAVILY PRE-TREATED HODGKIN LYMPHOMA POPULATION

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Although HL is highly curable, 10-30% patients (pts) are refractory or relapse after treatment. Salvage second line chemotherapy with autologous stem cell transplant (ASCT) usually achieves 50% responses. Refractory pts and those who relapse after ASCT have a poor prognosis. BV is an anti-CD30 antibody-drug-conjugate with significant activity against refractory/relapsed HL. We report a multicentric retrospective analysis of 34 Portuguese pts receiving BV monotherapy for refractory/relapsed HL between 9/2011 and 2/2016 at 10 centers. BV (1.2 or 1.8 mg/Kg) was administered every 3w. Response was evaluated by PET-CT. Overall (OS) and progression-free-survival (PFS) were estimated using the Kaplan-Meier method; chi-square text was used to evaluate relation between clinical variables and response. Pts (53% female) were diagnosed between 1997 and 2015; 62% had advanced disease. First-line treatment was ABVD in 91% with a 74% overall response rate (ORR). Twenty-eight pts (82%) received salvage chemotherapy with intent to perform ASCT, and 64% underwent transplant. Median age at BV was 45.3 yo (23-69); 76% had advanced disease and 1/3 B symptoms. Median time from initial diagnosis was 44 mo; median number of prior treatments was 4 (2-6), with 79% pts refractory to last one. Median number of BV cycles was 7.5. In 18 pts with early evaluation of response (at cycles 2 to 4), ORR was 67% and CR 38%. At the end of treatment, ORR was 21% (5 CR, 15%), while 76% had either stable or progressive disease. Pts with ≤3 prior lines had ORR 47% as compared to none in pts with ≥3 (p<0.001). No difference in ORR was noted according to gender, refractory/relapsed state and number of involved nodal areas. Ten pts (29%) were transplanted after BV, only 4 in response; 18 started subsequent treatment after BV. After a median follow-up of 12 mo 11 pts died, mostly of progressive disease. OS and PFS at 12 months were 75.5% and 19% respectively. BV was well tolerated with 15% peripheral neurotoxicity, 33% at least one hematological toxicity and 9% grade 3-4 infections in all pts. In a real life setting, with a heavily pre-treated and mainly refractory population, responses to BV were lower than previously described. In agreement to others we observed loss of responses with prolonged treatment, suggesting a benefit for early evaluation and treatment consolidation to maximize the benefit of BV. Better ORR was observed after ≤3 prior treatments, suggesting that BV should be offered early.

P107
THE ROLE OF STEM CELL TRANSPLANTATION IN HODGKIN’S DISEASE: PERSPECTIVES FROM RETROSPECTIVE ANALYSIS

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Purpose. To disclose the prognostic value of status of disease and lines of therapy at transplantation (SCT) either autologous or allogeneic in Hodgkin lymphoma we did a retrospective evaluation. Patients and Methods. We accrued all patients who did a stem cell transplant (SCT) procedure following resistance, residual disease, or relapse after previous conventional therapy. The accrual started in October 1998 when we did the first autologous SCT with the use of peripheral stem cells (PSC) and included patients up to December 2015. One hundred eighty one patients with Hodgkin lymphoma did autologous and 40 patients did allogeneic SCT and analyzed for prognosis according to status and number of lines of therapy at transplant. Five categories of patients were identified according the status at transplant: primary resistant, with residual disease, in first relapse, in second relapse and more than second relapse. Autologous SCT was done as II, III, IV line and more than IV line of therapy. High dose therapy followed by autologous PSCT represented a line of therapy for almost all patients who did allogeneic SCT. The analysis included the evaluation of survival according to groups identified and see if there are significant differences. Results. Worse chances of survival were for patients primary resistant, 6% at 138 months, and for those with more than two relapses,10% at 120 months; better chance were for patients with residual disease, 88% and those who did transplantation following I relapse, 96% at 194 months (p<0.0001) (Figure 1). In addition better survival was for patients who received autologous SCT as II line of therapy, 93% survival at 194 months, and worse those with more than IV line of therapy, 12% at 146 months (p<0.0001). Allogeneic SCT was done in 38 (95%) patients following autologous SCT; survival was 16% at 175 months and relapse-free survival (RFS) was 18% at 174 months. The stratification of survival in the setting of allogeneic SCT was worse for patients resistant and with previous more lines of therapy. Conclusions. Our study demonstrates that Hodgkin lymphoma may be cured by high-dose ther-
Allogeneic hematopoietic cell transplantation (allo-HCT) is an option for patients with Hodgkin’s lymphoma (HL) who relapse after autologous HCT. Recently, response rates of 87% after treatment with nivolumab (a monoclonal IgG4 anti-PD-1 antibody) in relapsed/refractory HL even after autologous HCT were published (Ansell et al., NEJM 2015). Yet, the impact of nivolumab with its immune-related mechanism of action after allo-HCT is unknown. We report the use of nivolumab after allo-HCT for relapsed HL. Patient and Methods. The patient is a 52-year-old female with HL, stage IVL in 5th relapse. Earlier treatments were standard chemotherapies prior to and after autologous HCT. In 2010, the patient received an allo-HCT from an HLA-identical unrelated donor. She developed extensive graft versus host disease (GVHD) of the skin and liver. The patient suffered further relapses and was treated with brentuximab, and gemcitabine. Immunosuppression could be discontinued in 2014. Peripherally, NK- and T-cells were 100% of donor origin. A PET-CT prior to nivolumab displayed a generalized lymph node, pulmonary and bone involvement by HL. Immunohistochemical staining of a tissue biopsy revealed that the Hodgkin- and Reed-Sternberg cells expressed the PD-1 protein. Results. Nivolumab was started (3mg/kg at week 1 and 4, and then every 2 weeks) in July, 2015. A PET-CT at week 5 revealed a complete remission which is now maintained for 8 months. Two weeks after the first infusion, an upsurge in eosinophils, NK- and T-cell populations occurred (Table 1). CD279 (PD-1) was expressed on lymphocytes and NK-cells. Thus, further data are needed to establish the impact of PD-1/PD-L1 blockade after allo-HCT.

Table 1. Peripheral WBC counts under nivolumab.

<table>
<thead>
<tr>
<th>Cell Type</th>
<th>Prior to nivolumab</th>
<th>2 weeks after the start of nivolumab</th>
<th>5 months under nivolumab</th>
</tr>
</thead>
<tbody>
<tr>
<td>Eosinophils (%)</td>
<td>0.7</td>
<td>0.7</td>
<td>0.7</td>
</tr>
<tr>
<td>Lymphocytes (×10^9/L)</td>
<td>0.7</td>
<td>1.5</td>
<td>1.6</td>
</tr>
<tr>
<td>CD3+ cells (×10^9/L)</td>
<td>0.4</td>
<td>1.0</td>
<td>1.0</td>
</tr>
<tr>
<td>CD3+HLA-DR+ cells</td>
<td>0.1</td>
<td>0.2</td>
<td>0.2</td>
</tr>
<tr>
<td>CD5+CD4+ cells</td>
<td>0.3</td>
<td>0.8</td>
<td>0.7</td>
</tr>
<tr>
<td>CD5+CD8+ cells</td>
<td>0.1</td>
<td>0.3</td>
<td>0.3</td>
</tr>
<tr>
<td>CD5+CD3+CD8+ cells</td>
<td>0.2</td>
<td>0.4</td>
<td>0.2</td>
</tr>
</tbody>
</table>

Background. Brentuximab Vedotin (BV) is currently used for the treatment of relapsed/refractory Hodgkin Lymphoma (HL). Accordingly to preliminary data, BV might be useful also against Mycosis Fungoides (MF), even in patients with weak CD30 expression. Here we describe a case of relapsed HL and concomitant MF treated with BV. Case Report. A 73-year-old man was referred to our Center in September 2015 for relapsed HL and simultaneous MF. Medical history included hypertension, moderate chronic renal impairment and acute heart failure secondary to aortic valvular block. MF was diagnosed
in 1987 and UVA, UVB and PUVA were delivered, with short term partial remissions. Classical HL, clinical stage IIIB, was diagnosed in 2004 and patient obtained complete remission (CR) after 6 ABVD cycles. After 7 years (68 years-old), HL relapse was histologically documented and clinical stage was IIIA. Three cycles of IGEV chemotherapy obtained a second CR and 30 Gy involved-field radiotherapy was given as consolidation. A third HL relapse, biopsy proven with strong CD30 expression, occurred 3 years later and clinical stage was IIIA. At time of HL relapse MF was in stage III and patient presented scaly erythematous plaques distributed over most of his body. Patient started BV therapy at the reduced dose of 1.2 mg/kg/3ws due to creatinine-clearance of 53 ml/min. A significant regression of the skin lesions was observed after the first BV dose, and after 4 BV cycles both MF and HL achieved a CR, documented by clinical examination and PET scan, respectively. Twelve of the 16 BV planned doses have been administered, with no significant toxicity and no recurrence of both HL and MF. Conclusions. This case confirms that BV is a well tolerated and effective treatment for HL; the quick response of the concomitant MF that we observed encourages further investigations on the role of BV also in this setting.

![Before treatment](image1)

![After treatment](image2)

**Figure 1.**

**P111**

**PROGRAMMED DEATH 1 BLOCKADE WITH NIVOLUMAB AS SALVAGE THERAPY FOR HEAVILY PRE-TREATED CLASSICAL HODGKIN’S LYMPHOMA RELAPSING AFTER ALLOGENIC STEM CELL TRANSPLANTATION: A CASE REPORT**

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Introduction. Monoclonal antibody nivolumab (NIVO) blocks Programmed Death-1 ligands avoiding overstimulation of 1-cell activity therefore preventing autoimmunity. On May 2016, US Food and Drug Administration granted its accelerated approval in patients with Hodgkin’s lymphoma (HL) relapsed after both autologous stem cell transplantation (ASCT) and brentuximab vedotin (BV), based on the overall response rate (ORR) of 65% from the combined analysis of phase I CheckMate-039 and phase II CheckMate-205 trials. In the setting of allo-SCT, NIVO seems to be associated with increased transplant related toxicity and mortality, e.g. higher incidence of veno-occlusive disease and graft versus host disease (GVHD). Case Report. A 43 years-old male was diagnosed of classical HL stage IIA with bulky mediastinal disease in June 2008. After achieving a PET negative complete remission (CR) with ABVD x6 cycles and involved field radiotherapy, the patient presented an early relapse with stage IIIA disease. He was then treated with salvage second-line therapy with DHAP x3 cycles and consolidated with ASCT with BEAM as conditioning regimen. He achieved a second PET negative CR but experienced a second early relapse (<1 year) after the ASCT that was treated with NOVPx6 cycles and consolidated with an allo-SCT from his HLA-identical brother in November 2009. In spite of developing clinical significant acute and chronic GVHD, the patient experienced two more relapses treated with BV (1.8 mg/kg iv every 21 days up to 10 cycles – disease progression) and bендамустine single drug (120 mg /m² x v2 days, 3 cycles) with disease progression. In September 2015, NIVO was requested through the name patient program in our country. At that time, the patient had progressive disease, stage IVA (bone marrow), no clinically relevant GVHD and no need for active immunosuppression. NIVO was started in October 2015 at a dose of 3 mg/kg iv every 2 weeks with very good tolerance and no reactivation of the prior history of GVHD. The patient achieved a PET negative CR after 6 cycles and nowadays has an excellent performance status under NIVO treatment, in continuous CR by PET CT 8 months after starting this latter therapy. Conclusions. Our patient, treated in the absence of immunosuppression and almost 6 years after allo-SCT, has significantly benefited from NIVO with no relevant toxicity. Further studies on the role of NIVO before and after allo-SCT should be pursued.

**P112**

**MAJOR RESPONSE OF HEAVILY PRETREATED HODGKIN LYMPHOMA TO NIVOLUMAB: THE IMMUNE SYSTEM RELOADED**

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Background. Cancer can escape the immune system through different mechanisms. One of which is the expression of program death ligand-1 (PD-L1). This ligand binds to PD-1 receptor on activated T cells, subsequently leading to inhibition of the immune response. Nivolumab is novel antibody that binds to PD-1 and prevents such immune tolerance. Several recently published clinical trials confirmed the clinical efficacy of single agent Nivolumab in pretreated patients with different cancer types. Publications on Nivolumab in Hodgkin lymphoma (HL) are very scarce. The available literature is limited to only one phase 1 clinical study with 23 pretreated patients (Ansell et al., N Engl J Med 2015;372:511-9). Case description: We report on a 30 year-old man with stage IVB HL. He failed 9 lines of prior therapy including: ABVD, ICE, radiation, ESHAP and high dose BEAM chemotherapy and autologous stem cell transplantation, IGEV, Brentuximab vedotin, Brentuximab and Ifosfamide, GVD and Bendamustine. The patient has multiple visceral involvement including lung and liver proven by histopathology. He was wheelchair bound (ECOG 5) and oxygen dependent. He received Nivolumab achieving a major radiological response after 4 cycles (Figure 1 and 2). The lung involvement by the HL has nearly completely disappeared. The involved liver has markedly decreased in size, in addition to improvement of splenomegaly. This radiological response was associated with significant clinical improvement. The performance status improved to ECOG 1 and became oxygen independent. No treatment related significant side effects were observed. Conclusions. Pre-treated HL is amenable to novel immunotherapy. Nivolumab induces clinically meaningful responses with excellent tolerance. The drug enriches our treatments options by reloading the immune system response against cancer. Further clinical studies are needed to determine the effectiveness on large patients’ cohort.

Cologne, Germany, October 22-25, 2016
TREATMENT OF A PATIENT WITH PRIMARY REFRACTORY HODGKIN LYMPHOMA AND CONCURRENT CENTRAL NERVOUS SYSTEM INVOLVEMENT

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Background. The incidence of CNS involvement in Hodgkin lymphoma (HL) is 0.05% and it can occur at the time of initial diagnosis or in a relapsed/refractory disease. Case Report. 32-year-old female immunocompetent patient with classical HL (mixed cellularity) in initial clinical stage IIB was treated in Libya between 2011-2014 (6xABVD, 3x ICE, 4x ASHAP), involved field irradiation of 36 Gy on cervical lymph nodes, 2 cycles of Gemcitabine and Navelbine, steroid treatment) without achieving a sustained remission and HL was considered primary refractory. The patient was admitted to our hospital with headache, blurred vision and with disseminated disease in clinical stage IVA (2015). PET/CT confirmed involvement of lymph nodes on both sides of diaphragm, liver, diffuse skeletal and muscle infiltration. MRI of the brain revealed involvement of paranasal sinuses, focal lesions in the right temporal lobe with perifocal oedema and dislocation of the right lateral ventricle. A new biopsy of the cervical lymph node confirmed HL-nodular sclerosis. Cerebrospinal fluid and bone marrow examinations were negative for HL involvement. She was treated with two cycles of brentuximab vedotin and bendamustine (BVB) in combination with dexamethasone. Two cycles of BVB alternated with two cycles of high-dose methotrexate 3,5 g/m² with procarbazine and dexamethasone. She achieved a partial remission according to PET/CT and MRI of the brain after above mentioned treatment. The patient received conditioning regimen BCNU/etoposide/thiotepa followed by autologous stem cell transplantation (ASCT) in February 2016. Neutrophil and platelet engraftment was reported on day+10 after ASCT. Currently, consolidation treatment with brentuximab vedotin is ongoing since day+30 after ASCT. Conclusions. BVB combination is a highly effective salvage chemotherapy for relapsed/refractory systemic Hodgkin lymphoma, and additional effect of bendamustine on CNS involvement in combination with high-dose methotrexate, procarbazine and dexamethasone can be anticipated. Conditioning regimen directed against CNS and systemic HL involvement CNS may further potentiate the effect of salvage chemotherapy.

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PEMBROLIZUMAB VERSUS BRENTUXIMAB VEDOTIN IN RELAPSED OR REFRACTORY CLASSICAL HODGKIN LYMPHOMA: RANDOMIZED, PHASE 3 KEYNOTE-204 STUDY

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Background. The PD-1 ligands, PD-L1 and PD-L2, are frequently over-expressed in relapsed or refractory classical Hodgkin lymphoma (R/R cHL), and this is typically associated with chromosome 9p24.1 amplification. In the phase 1b KEYNOTE-013 study, PD-1 blockade with pembrolizumab demonstrated high antitumor activity (65% ORR) in heavily pretreated patients with cHL. KEYNOTE-204 (NCT02684292) is a randomized, international, open-label phase 3 study designed to compare the efficacy and safety of pembrolizumab versus brentuximab vedotin (BV) in patients with R/R cHL. Methods. This study will enroll patients aged ≥18 years with R/R cHL who (1) have failed to achieve a response or progressed after autologous stem-cell transplantation (auto-SCT) and have not had previous treatment with BV; or (2) are not auto-SCT candidates because of chemotherapy-resistant disease (unable to achieve complete remission or partial remission to salvage chemotherapy), advanced age, or comorbidities, and have received at least 2 prior multi-agent chemotherapy regimens that did not include BV. ~300 patients will be randomized 1:1 to receive either pembrolizumab 200 mg Q3W or BV 1.8 mg/kg Q3W. Treatments will continue for up to 35 cycles or until documented disease progression, unacceptable adverse events (AEs), or investigator decision. Response will be assessed Q12W by PET/CT scans per International Working Group (IWG) Revised Response Criteria for Malignant Lymphoma by central imaging vendor review. After the end of treatment, patients will be followed for 30 days for AE monitoring (90 days for serious AEs and events of clinical interest). All patients will be followed for overall survival until death, withdrawal of consent, or the end of the study, whichever comes first. Primary end points are PFS and OS; secondary end points are ORR and complete remission rate (CRR). Exploratory end points include PK profile, duration of response, and comparison of ORR in patients with PD-L1–positive versus PD-L1–negative lymphoid tumors. Assessment of primary efficacy end points are based on blinded independent central review according to IWG criteria; secondary/exploratory efficacy analyses are based on investigator assessment. Enrollment to KEYNOTE-204 is ongoing.
Survivorship

T025
PATIENT PREFERENCES - SURVEY OF HL SURVIVORS ON TREATMENT-ASSOCIATED BURDENS AND SIDE EFFECTS
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Hodgkin lymphoma (HL) survivors often report impaired quality of life due to side effects. For evaluation of the relevance of efficacy outcomes and side effects from the patient’s point of view, we created a questionnaire for HL long-term survivors. The questionnaire was sent to randomly selected patients (male and female 150 each) of every trial of our 5th trial generation (HD13, HD14, HD15) with no documented refractory disease or relapse (N=900) and to all patients with documented refractory disease or relapse (R/R) (N=249). 52% of contacted patients participated and median follow up time was 106 month. R/R was reported by 16% of the participants. Chemotherapy was a great or very great burden for 77% of the participants, independent of stage of disease, treatment and study. In early favorable (HD13) and early unfavorable stages (HD14) treatment standard included radiotherapy (RT) of 30 Gy. For 64% of participants this was a great or very great burden. In advanced stages (HD15) RT was only performed in patients with PET-positive residual tissue after chemotherapy, 26% of them rated RT as great or very great burden. Most frequent side effect was fatigue reported by 87% during and 41% after treatment. About of patients who experienced fatigue consider it as a great or very great burden. Most long-term side effects were significantly more frequent for participants with R/R. At time of first diagnosis ≈50% had concerns about acute and long-term side effects, relapse and death due to HL. Most frequently the concern about relapse is mentioned. At time of survey, ≈25% without R/R worried much or very much about side effects or death because of HL and ≈40% about long-term effects or possibility of relapse. Of those participants with R/R, concern of side effects or death because of HL was present in ≈35% and about long-term effects or another relapse in ≈60%. Cure of HL was rated as the most important treatment goal by 72% of patients. Only 9 participants (2%) would have chosen a slightly less effective therapy to avoid side effects. Chemotherapy is a great burden independent of duration and intensity of administered regimen. HL Survivors are more concerned about relapsing than dying from HL, which could be interpreted as fear of another treatment. Results suggest that avoidance of relapse should be the primary therapy goal and cure is above possible side effects. Thus, progression-free survival is an important patient-relevant endpoint in clinical trials.

Background. Short telomeres in peripheral blood lymphocytes are associated to an increased cancer risk as well as age-related diseases. Our previous studies demonstrated the significant correlation between telomere dysfunction in peripheral blood lymphocytes of retrospective cohorts of Hodgkin lymphoma (HL) patients and the high risk of late complications, in particular secondary cancers and cardiovascular disease. In this study, we investigate telomere length in a prospective cohort of HL patients followed more than 12 years after diagnosis. Patients and Methods. Telomere length measurements were performed at several time points in a prospective cohort of 220 HL survivors patients (85.9% stage I and II). Patients were diagnosed between 1997 and 2005 with a median follow-up 11.2 years. All patients were treated with a combination of chemotherapy and radiation therapy. We evaluated the association between telomere length measured at diagnosis, after treatment and during follow-up. The dynamics of telomere change between those time points in relation to HL cancer specific and all-cause mortality and morbidity was assessed using Cox proportion hazards models. Cardiovascular evaluation has been described previously (Girinsky et al. 2014). Results. Fifty-seven patients developed cardiovascular disease, 19 a secondary cancer and 10 died. Telomere length at baseline and follow-up after treatment were associated with all-cause mortality (p=0.02 and p=0.008, respectively). A stable telomere length was associated with the absence of late complication. Changes in telomere length were associated to the occurrence of a late complication, either cardiovascular or secondary cancer (p<0.03). A high variation of telomere length and the presence of a sub population of cells with drastic telomere shortening was observed during follow-up preceding a secondary cancer (p<0.03). Telomere dysfunction was related to the presence of complex chromosomal exchanges. Conclusions. Telomere shortening was associated with an increased risk of the occurrence of secondary cancer and all-cause mortality. Changes in telomere length in circulating lymphocytes over time may represent valid biomarkers for the prognosis. Telomere dysfunction may play a significant role in the initiation of genomic instability during carcinogenesis. Further investigation to determine causes of telomere change is needed.

T026
CHANGE IN PERIPHERAL BLOOD LYMPHOCYTE TELOMERE LENGTH IN RELATION TO MORTALITY AND MORBIDITY IN HODGKIN LYMPHOMA PATIENTS

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This analysis examined the differential effects upon ovarian function of the treatment strategies within the international RATHL study (NCT00678327). Women with newly diagnosed advanced HL (stages IIb to IV, Ila with bulk or ≥2 involved sites) had two cycles of ABVD followed by PET/CT scan. Those with negative scans were randomised to ABVD or AVD for 4 more cycles, those with positive scans were escalated to either BEACOPP-14 or escalated BEACOPP for 8-9 weeks. Reproductive hormones were measured in women in the main cohort of the trial (n=390) with additional samples taken in a sub-group for measurement of anti-Müllerian hormone (AMH) as a marker of the ovarian reserve (n=65). There were no differences between the ABVD and AVD groups. AMH fell markedly from baseline to end of treatment, but equally in all 3 groups. Thereafter, there was a return to concentrations not different from pre-treatment in the ABVD/AVD groups within 1 year, but no recovery in the BEACOPP groups over 3 years. An FSH threshold of ≥25IU/L was used to indicate premature ovarian insufficiency (POI). The prevalence of this threshold was substantially higher for women treated with BEACOPP than those treated with ABVD/AVD (see Table 1), with longer and less complete recoveries. Patients aged over 35 were more likely to exhibit POI, especially after BEACOPP
therapy. Pre-treatment AMH was associated with post-chemotherapy ovarian damage in all groups. ABVD/AVD regimens are regarded as low risk to fertility, and these results confirm the absence of detectable ovarian damage in women aged <35, although there was some evidence of ovarian toxicity in older women. Pre-treatment AMH may be of value to predict early POI and loss of fertility following treatment by identifying those women at particular risk who may wish to consider fertility preservation strategies.

| Table 1 |

#### OSTEONECROSIS AFTER TREATMENT FOR HODGKIN LYMPHOMA: THE GERMAN HODGKIN STUDY GROUP EXPERIENCE


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**Background.** Osteonecrosis (ON) has been reported as an infrequent but sometimes debilitating late effect of HL therapy. The goal of this study is to provide a detailed analysis of ON as a late effect after treatment for HL. **Methods.** 12,083 patients treated within first-line GHSG trials between 05/98 and 07/14 were evaluated. ON cases were identified and information on patient characteristics, localizations, interventions and outcomes was collected. Risk factors for ON were analyzed by multivariate logistic regression. **Results.** 66 patients had a total of 140 ON. The cumulative incidence of ON was 0.16% (CI: 0.08-0.30) in early (favorable or unfavorable) stage HL (eHL) (n=10) and 0.93% (CI: 0.71-1.21) in advanced stage HL (aHL) (n=54). 75% of ON cases were male. 71% of patients had more than one area affected and in 75% ON of the femoral head was present. 54% of patients needed surgical intervention and 66% had lasting symptoms despite treatment. Peak incidence (41%) was observed in the second year after diagnosis and 88% of cases occurred within 3 years after HL diagnosis. In a multivariate logistic regression comprising all patients, male gender (OR 2.1; CI: 1.2-3.7) and asHL (OR 3.9; CI: 2.3-6.9) were identified as risk factors for ON. Because ON was a rare complication in eHL, the following results focused on survivors of asHL. The median cumulative prednisone dose in ON cases after asHL was 8,400mg (range: 3,920-10,800) versus 7,350mg (range: 0-16,800) in not affected patients. In a multivariate logistic regression model including only asHL patients, young age (OR 0.7 for each additional 10 years; CI: 0.5-0.9) and a higher cumulative dose of prednisone during therapy (OR 1.8 for each additional 1g); CI: 1.1-1.5) were identified as additional risk factors. Nodal pain after alcohol ingestion (p=0.78), radiotherapy (p=0.29), a large mediastinal tumor (p=0.15), international prognostic score (IFS) (p=0.09) and body-mass-index (BMI) (p=0.99) did not influence ON risk. **Conclusions.** We provide the most comprehensive analysis of ON after HL therapy performed so far. ON after HL therapy is infrequent but often leads to significant disease burden in affected patients. The described risk factors and peak incidence timeframe could help to identify patients at high risk for ON. Early evaluation of patients with suggestive symptoms is recommended. Decreasing the cumulative corticosteroid dose in future regimens might reduce the incidence of ON after HL therapy.

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Background. After chest radiotherapy (RT) for Hodgkin lymphoma (HL), women experience a dose-dependent increase of breast cancer risk. It is unknown whether endogenous and exogenous gonadal hormones affect the radiation dose-response relationship. Methods. We conducted a case-control study nested within a cohort of female 5-year HL survivors treated before age 41 years between 1965 and 2000. Detailed data on HL treatment, reproductive factors and hormone use were collected through medical records and questionnaires for 174 breast cancer cases and 466 matched HL controls who did not develop breast cancer. RT charts, simulation films and mammography reports were used to estimate the radiation dose to the location of the breast tumor (and similar location for oophoropexy) compared with 92% and 9% of the controls respectively. We observed a linear radiation dose-response relationship for risk of breast cancer with an adjusted excess odds ratio (EOR) of 5.4%/Gray (95%CI:1.8%-13.3%). Women who reached menopause before age 30 years with intact ovarian function or HRT use did not appear to increase breast cancer risk in these women. There was no evidence for interaction between RT dose and number of years with intact ovarian function or HRT use.

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Introduction. Women who received radiotherapy (RT) involving breast tissue when aged 36 yrs most usually for Hodgkin lymphoma are at high risk of developing breast cancer. UK national guidelines published in 2003 recommend that breast screening should start 8 years after RT or at age 25 whichever is later. Screening depends upon individual haematono- oncologists referring at-risk women to breast screening centres and this is prone to delay/error leading to survivor anxiety/frustration and time consuming troubleshooting to correct. A decision was therefore taken to develop a single national dataset of at-risk women (BARD) from which annual screening appointments could be generated. Methods. 3 at-risk cohorts were identified: Cohort 1 women irradiated pre-2003 identified from a national recall exercise in 2003 to inform about risk and advise screening in accordance with national guidelines (n=6,500); Cohort 2 women irradiated 2003-2016 identified from National Cancer Registry and Radiotherapy Centre Records (n=2,500); Cohort 3 women irradiated from now into the future identified prospectively at the time of consent for RT. Prior to registration with BARD family physicians were contacted to enquire whether a screening appointment was still appropriate for each survivor. Results. Project sign-off from NHS England and Public Health England occurred January 2016. A pilot phase across 4 RT centres in the northwest of England is currently completing (May 2016) and once any learning from this has been incorporated into the processes a national rollout will occur with planned completion in Q4 2016. The NHS Breast Screening Programme will use BARD to identify women irradiated under age 30 years who require screening in any given year. Screening of women irradiated aged 30-35 years will be arranged by their family physician. Discussion. An England wide dataset of ~9,000 women who have received RT involving breast tissue when aged 36 yrs has been launched to optimise breast screening in this high risk group. It is hoped that as a result the service to women will be enhanced and breast cancer outcomes improved. A BARD research group has also been formed to undertake relevant research; this will include qualitative assessments of the user experience, evaluation of the effectiveness of current screening with a view to improving the screening regime, studies of the biological characteristics of RT induced vs sporadic breast cancers and risk reduction trials.

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Introduction. A high proportion of patients treated for Hodgkin lymphoma and diffuse large B cell lymphoma are cured following chemotherapy/radiotherapy but long term quality of life and survival are undermined by the late toxicities of treatment including second cancers, cardiovascular disease and hormonal disorders. For best outcome these need to be anticipated/well managed and survivors/health care professionals made aware of how best to achieve this. The aim of ADAPT is to improve the management of patients likely cured of lymphoma by increasing survivor/primary care physician awareness of late treatment toxicities whilst reducing the burden on survivors of attendance at hospital clinics and maintaining accurate outcomes data. Methods. After 5 yrs of hospital follow-up, likely cured patients are offered a final “ADAPT consultation” focused on the future low risk of recurrence and potential for late treatment toxicity. An individualised treatment summary and late toxicity management plan (LTMP) is given to survivors and copied to their primary care physician. The LTMP is constructed by selecting from a menu of pre-written paragraphs describing the possible late toxicities of each treatment, their symptoms, manage-
ment and key points (cardiac key points; don’t smoke, take exercise, check blood pressure). These paragraphs were all reviewed and approved for relevance and readability by a panel of 25 lymphoma survivors. Following the ADAPT consultation, survivors receive no further routine hospital appointments but can access the service immediately if the need arises. An annual questionnaire is issued by e-mail or letter according to survivor preference enquiring about quality of life, new diagnoses, new medication or surgical interventions and this information added to the survivor database. Results. 600 survivors have so far been ADAPTed and anecdotal evidence suggests satisfaction with the service. On the basis that the average time for a return journey from home or work, waiting and consultation is 3 hours, 600x3=1800 survivor hours or 1800/40=45 working weeks have been saved per year.

Conclusions. The ADAPT programme provides long term lymphoma survivors and their primary care physician with individualised information about late treatment toxicity, shifts the focus of management of this from the hospital to primary care and saves time whilst maintaining accurate long term outcomes data. Formal evaluation of this new service is planned.

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THE ROLE OF WATCH AND WAIT IN NODULAR LYMPHOCYTE PREDOMINANT HODGKIN LYMPHOMA: SINGLE CENTRE DATA FROM THE MODERN ERA
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Nodular Lymphocyte Predominant Hodgkin Lymphoma (NLPHL) is an indolent lymphoma with excellent overall survival (OS) and distinct clinicopathological characteristics reclassified as separate to Classical Hodgkin Lymphoma (CHL). Debate is ongoing as to optimum management. Guidelines differ in approach, particularly around watch and wait (W+W); ranging from selected use in all stages (B J Haem 2015), to advanced disease (NCCN 2015) to not at all (ESMO 2014). Few studies have assessed W+W, with discordant results. All were retrospective and include cases diagnosed before reclassification. We conducted a retrospective analysis to investigate outcomes of adults with NLPHL diagnosed and managed at St Bartholomew’s hospital from 1994 (reclassification) to 2014. This represents the largest single centre study reporting data obtained since reclassification. Clinical characteristics, treatment, OS, progression free survival (PFS) and Disease Free Survival (DFS) were collected. Forty-four patients were included. 82% had limited (stage IIA or IIA) disease, 78% were male. Median age was 38. Patients of Black (25%) and Asian (39%, mainly Bangladeshi) origin were overrepresented compared to CHL cases (7% Black, 13% Asian) or any haematological malignancy (8% Black, 10% Asian) managed during this period. Initial management consisted of W+W +/- excision (52%), Radiotherapy +/- excision (29%) and Chemotherapy (mostly ABVD; in 2 cases R-ABVD) or Combined Modality (39%). W+W was used in 36% of patients with limited and 25% with advanced disease. Median follow-up was 68 months. 10-year OS and PFS estimates were 100% and 60% respectively. Two transformation events were observed, none in the W+W group. One patient died from an unrelated cause. 80% of W+W patients remained untreated at median follow up of 29 (5-198) months. No significant differences were seen in PFS, DFS or OS between W+W and immediate treatment. Our data is consistent with an increased incidence seen in African-Americans. Raised incidence in Asian groups has not previously been reported. The differing racial demographic profile to CHL supports NLPHL’s separate classification. The relatively good PFS and excellent OS support consideration of W+W as a management option, given that most patients remained treatment free after long follow up. Our data support the need for a clinical trial to assess W+W versus immediate treatment. Given the rarity of NLPHL this would require an international collaborative study.

P121
NEURO-BEHAVIORAL CHANGES IN HODGKIN LYMPHOMA SURVIVORS
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Background. Hodgkin lymphoma (HL), frequently diagnosed at the young age, is currently treated with chemotherapy and/or radiotherapy (RT). The combination of malignancy and chemotherapy is often associated with neuro-behavioral impairment (NI), reported in up to 75% of adult survivors in various malignantities. NI involves fatigue and cognitive changes such as slowness and impairment of memory, concentration and executive functioning. NI is particularly dramatic for young adult HL survivors (YAHLS), given their age at diagnosis, long life expectancy and high curability. The current research aimed to assess the incidence and characteristics of NI in YAHLS. Methods. The study evaluated YAHLS, who completed first-line therapy (chemo+RT) and remained in complete remission (CR) for 6 months-5 years after the end of treatment. All participants completed questionnaires evaluating fatigue (MFI-20), depression (BDI-II), anxiety (HA), quality of life (QLQ-C30) and cognitive function (FACT-cog), and underwent neuropsychological evaluation. The test battery included California verbal learning test, Digit span (WAIS-III), Trail making test A+B, subtests from the Computerized Battery (CANTAB), Stroop and Raven progressive matrix tests. Processing speed, memory, and executive functions were assessed and calculated for each subject. Test and subtest results were presented in standard scores. Results. We report results of 21 YAHLS, aged 19-47 years (median 28), with median education duration of 14.4±2.2 years. No significant depression or anxiety was observed in study participants. Severe fatigue was reported in 33% of patients. Impairment in executive functions, with scores below 1.5SD in at least 2 parameters, was observed in 33% of patients (76% below 1SD). Scores below 1.5SD in at least 2 parameters of memory were found in 19% of patients (53% below 1SD). Slow processing speed was depicted in 38% of patients (TMT-B). No correlation was found between NI and fatigue. Conclusions. NI and fatigue were observed in one third of patients. An impairment score above 1SD and especially above 1.5SD below that expected for age and education is usually regarded significant. Our results were unexpected. Given the enormous impact of these symptoms on all aspects of life, they need to be taken into consideration while assessing the efficacy of therapeutic protocols applied in YAHLS.

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HEALTHCARE USE AMONG YOUNG HODGKIN LYMPHOMA SURVIVORS IN THE ERA OF INTENSIFIED CHEMOTHERAPY AND LIMITED RADIOTHERAPY
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Purpose. With today’s excellent cure rates for Hodgkin lymphoma (HL), the number of long-term survivors is increasing. This study provides a global assessment of late effects for working-age HL survivors treated with contemporary protocols (intensive chemotherapy and lim-
Hodgkin lymphoma (HL) survivors are at increased risk to develop late treatment-related complications, including second malignant neoplasms (SMNs) and cardiovascular disease (CVD). Research to date has focused on separate risk estimates for these outcomes. We aimed to examine the combined risk of SMN and CVD, providing more insight into the total burden of morbidity from these severe late effects.

Methods. Our multicenter cohort comprised 2,908 5-year HL survivors, treated before age 51 between 1965 and 2000. CVD endpoints (coronary heart disease, cardiomyopathy and congestive heart failure, and valvular heart disease) were assessed through general practitioners. Data on SMNs were obtained from linkage with the Netherlands Cancer Registry, including all invasive cancers except basal cell carcinomas. Cumulative incidences of SMN and/or CVD were calculated with death from other causes as competing risk. Treatment-specific risks of developing SMN and/or CVD were quantified using Cox regression analysis. The mean cumulative count (MCC) will be calculated as the average number of events per individual in our cohort over a given follow-up period (results will be available in October 2016).

Results. After a median follow-up of 22 years, we identified 874 SMNs and 1044 CVDs. 1249 patients developed ≥1 major event; of those 240 developed both an SMN and CVD. After a follow-up of 40 years, at a median attained age of 60 years, the cumulative incidence of SMN or CVD was 67.4% (95%CI: 64.6-70.0), with 22.5% (95%CI: 19.8-25.3) of patients being diagnosed with both events. Both supradiaphragmatic RT (Hazard Ratio [HR]: 2.5, 95%CI: 2.1-3.1) and anthracycline-containing CT (HR: 1.2, 95%CI: 1.0-1.4) independently increased the risk of SMN or CVD. Supradiaphragmatic RT was associated with a 4.1-fold increased (95%CI: 2.3-7.3) risk of developing both SMN and CVD. Conclusions. HL survivors experience a high disease burden from SMN and/or CVD during follow-up. The cumulative incidence of SMN and/or CVD in our HL population treated between 1965 and 2000 amounted to 67% after 40 years from initial treatment. Supradiaphragmatic RT most strongly increased the risk developing SMN and/or CVD.

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THE IMPACT OF FERTILITY PRESERVATION ON TREATMENT DELAY AND PROGRESSION-FREE SURVIVAL IN WOMEN WITH LYMPHOMA: A SINGLE-CENTER EXPERIENCE

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Background. Lymphoma affects many women of childbearing age. Fertility preservation (FP) prior to chemotherapy offers women an opportunity for future pregnancy if fertility is compromised. Fear of treatment delay is one factor contributing to low rates of referral for fertility preservation. Methods. We performed a retrospective review of female lymphoma patients who contacted a fertility preservation patient navigator (FPPN) at Northwestern University from May 2006 until August 2015. Our primary objective was to assess the median treatment delay associated with FP. Our secondary objective was to assess progression-free survival (PFS). Patients who underwent FP were compared to women that contacted a FPPN but did not undergo preservation. Results. Thirty-three subjects who underwent FP and 50 controls were analyzed. Among FP patients, 21 had Hodgkin lymphoma, 12 had non-Hodgkin lymphoma; 25 presented for upfront treatment and 8 with relapsed/refractory disease. Controls had a higher median age (29 in control versus 26 in FP, p=0.001); however, there was no difference between groups in histology, treatment setting, or stage. Median follow-up was 39.3 (1.5 – 103.4) months, and did not differ between controls and those undergoing FP (p=0.16). Median time to treatment among FP patients was 28 days (range: 18-76) versus 15.5 days (range: 0-74) for controls, resulting in a median delay of 12.5 days (p<0.001).

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HIGH BURDEN OF MORBIDITY FROM SECOND MALIGNANT NEOPLASMS AND CARDIOVASCULAR DISEASE IN LONG-TERM HODGKIN LYMPHOMA SURVIVORS

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Background. Hodgkin lymphoma (HL) survivors are at increased risk to develop late treatment-related complications, including second malignant neoplasms (SMNs) and cardiovascular disease (CVD). Research to
The median time to first contact with a fertility specialist was 0 days (range -15 to +11) from hematologic consult, with several patients having contact prior to their hematologic visit. There was no difference in 5 year PFS between FP and controls (71.4% vs 83.7%, respectively, p=0.11). Median time to complete the stimulation protocol was 11 days (range: 5-14). A median of 14 oocytes (range: 0-87) was retrieved per patient. In 2 women, no oocytes could be successfully retrieved. Five women achieved pregnancy following fertility preservation. Of these, 3 were spontaneous, and 2 required reproductive assistance, one from frozen embryos and one from frozen oocytes. Of three women returning to use their frozen gametes, 2 were successful, and one was unsuccessful. Conclusions. This study demonstrates that fertility preservation is feasible and results in a small delay in therapy. This approach does not significantly impact PFS in our series.

**P125**

COMORBIDITY ASSESSMENT USING THE CIRS IN ELDERLY PATIENTS WITH Hodgkin lymphoma: PREDICTION OF SURVIVAL

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The ABVD regimen is the standard of care for patients with Hodgkin lymphoma up to 70 years. This regimen has been considered to be too toxic for elderly patients, and alternative regimens have been proposed, that are often associated with a reduced efficacy. The evaluation of comorbidity has not been extensively studied in HL. We reasoned that evaluation of comorbidity according to a standardized approach, the Cumulative Illness Scaling Rate (CIRS) might be a predictor for overall survival (OS). We studied 62 consecutive elderly patients with HL (median age 68 years, range 60-83 years), who had been treated in our institution between 1999 and 2016. Chemotherapy was ABVD in 47 (76%) patients, COPP in 12 (19%) patients, and other in 3 (5%) patients. OS at 2 years was 70% (95% C.I., 55-81%). Comorbidity was rated on the 4-point CIRS scale for 13 main organ systems. 36 patients had no severe comorbidity (score >3) and were considered fit (58%), while 26 patients had at least one severe comorbidity and were considered frail (42%). Patients with at least one severe comorbidity were more likely to be >70 years old (p=0.03), to have advanced stage disease (p=0.02) and not to receive ABVD (p=0.01). Patients with at least one severe comorbidity had a 2-year OS of 17% (95% C.I. 8-41%) versus 89% (95% C.I., 73-96%) in fit patients (p=0.001). We next restricted the analysis to ABVD-treated patients. Frail patients still had a significantly worse 2-year OS (65%; 95% C.I., 25-88%) with respect to fit patients (97%; 95% C.I., 79-99%; p=0.02), that was however better than for patients treated with MOPP (2-year OS: 11%). We conclude that a significant proportion of elderly HL patients have severe comorbidity on the CIRS scale, that impacts on prognosis. Prospective studies including comprehensive geriatric assessment are warranted to better tailor therapy in the often frail elderly patients with HL.

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RISK ADAPTED ABVD BASED PROTOCOL WITH RESTRICTED RADIOTHERAPY TO BULky DISEASE FOR Hodgkin lymphoma: A 20 YEAR FOLLOW UP MULTICENTER ANALYSIS

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Introduction. The combination of radio and chemotherapy in HL has led to the greatest advances in disease response. The benefit in terms of overall survival (OS) has been jeopardized by long term toxicity related to second malignancies and cardiovascular events. Aim. Analyze the risk factors associated with survival and assess the frequency of secondary malignancies with an ABVD based regimen that restricted radiotherapy only to bulky disease. Methods and Methods. We retrospectively analyzed HL patients diagnosed in 4 centers in Tarragona area (Catalonia, Spain), between 1995 and 2015 treated uniformly according to a local protocol. Patients were assigned into 4 groups: G1: favorable early stage: ABVD×6 cycles, G2: Bulky early stage without other risk factors: ABVD×6+IPRDT. G3: unfavorable early stage (B symptoms) and advanced stage without bulky disease: ABVD×3, G4: Bulky advanced stage: ABVD×8+IPRDT. Results. A total of 183 patients were analyzed with a median follow up of 62 months (range 1-244). Male/female ratio was 1,29. Median age was 36 years (range 16-82). Complete response was achieved in 160 patients (87,4%). The estimated OS at 20 years for the whole group was 62,7%. In univariate analysis, worse OS was found in patients with increased LDH, non-NS subtype, albumin <3,5 g/d, B symptoms, HIV+, advanced stage and ESR >50 mm (log rank p=0.012; p=0.049; p=0.024; p=0.002; p=0.005; p=0.004 and p=0.001 respectively). The multivariate Cox regression analysis identified B symptoms and ESR >50 mm as independent prognostic factors for OS (p=0.002; p=0.006 respectively). Furthermore, B symptoms was also found as an independent prognostic factor for OS when patients were analyzed according according to disease stage (localized and advanced) (p=0.018; p=0.014) while ESR >50 mm was an independent prognostic factor for the advanced disease group only (p=0.038). Secondary malignancies were observed in 18 patients (9,8%). The most frequent were hematological in 6 patients (3 myelodysplastic syndrome, 3 non Hodgkin lymphoma), gynecological 4 patients (2 breast cancer, 2 adnexal carcinoma) and colorectal 2 patients. Two patients developed 2 malignancies. Conclusions. Our risk adapted protocol showed a good rate of response and overall survival with low rate of secondary malignancies.

**P127**

INFRA DIAPHRAGMATIC HODGKIN LYMPHOMA: A LARGE SERIES OF PATIENTS STAGED WITH PET-CT. A PARTICULAR SUBSET OF HL?

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Introduction. Infradiaphragmatic Hodgkin Lymphoma (IDHL) accounts for 3-11% of adult cases of stage I-II Hodgkin Lymphoma. While the treatment strategy of most clinical subsets of HL has been improved and standardized along the last decades, it remains more heterogeneous in IDHL. Moreover, previous studies considered IDHL, patients on the basis of CT-scan staging which could underestimate advanced disease compared to the more sensitive PET-CT staging currently widely available. Thus, this study aimed to evaluate the characteristics of PET-staged IDHL patients compared to patients with IDHL disease defined on the basis of CT scan assessment, and to analyse the outcome of patients with PET-defined disease. Methods. The baseline clinical, biological data, and the outcome of patients with a first diagnosis of stage I-II of IDHL treated with ABVD +/- radiotherapy were retrospec-
tively collected in 8 French departments of hematology. Patients with a positive HIV serology and those treated with radiotherapy alone were excluded. Results. From 1986 to 2014, 99 patients were included whose 65 (66%) of them were staged with PET-CT. PET-CT staged patients were older (58 years vs 47 years, p=0.048), had lower ESR (27 vs 58 mm, p=0.022), higher haemoglobin level (13.6 vs 12.8 g/dL, p=0.015), less frequent Ann Arbor stage II (74% vs 91%) and less frequently central adenopathy involvement (60% vs 80%, p=0.024). The median follow-up of 99 patients was 3.8 years. For the PET-CT staged patients, at five years, PFS was 78% (IC95% 64.0-87.8) and OS was 88% (IC95% 73.0-95.9). Thirteen relapses occurred (20%) whose eleven (16%) within the five-years after diagnosis, and five patients died (8%), 3 from HL progression and 2 from toxicity of chemotherapy. In univariate analysis, patients with crural adenopathy involvement and treated with chemotherapy alone (p=0.026) had a poorer PFS. The treatment modality retained significance (p=0.036) in the modelisation analysis and also performing status (0.045) and stage (0.005).

This multicenter study of IDHL shows that CT-scan defined IDHL retained significance (p=0.04) in the modelisation analysis and also received 57 pts (58%), 6 cycles 39 pts (40%) and 4 cycles 2 pts (2%).

Patients with crural adenopathy involvement and treated with chemotherapy alone (p=0.026) had a poorer PFS. The treatment modality retained significance (p=0.036) in the modelisation analysis and also performing status (0.045) and stage (0.005).

Conclusions. This prospective study analyzed fertility of 98 female patients (pts) with initial diagnosis of Hodgkin lymphoma (HL) in advanced stages treated with BEACOPP escalated. Patients and Methods. Overall, 98 women aged 18 – 34 years (median age at diagnosis was 27 years) were treated with BEACOPP escalated between 1997 and 2015: 8 cycles received 57 pts (58%), 6 cycles 39 pts (40%) and 4 cycles 2 pts (2%). Additional radiotherapy was indicated in 33 pts (32%). Forty nine pts (48%) received GnRH analogue (Diphereline) during chemotherapy to preserve their ovarian function. Median follow-up after the end of treatment was 144 months (range, 57 – 210). Results. Overall 26 women delivered 33 babies including 7 (27%) women with 2 deliveries. Median age at diagnosis HL was 24 years (range, 19 – 32). Number of all delivered healthy babies was 32 and only one baby was born with small cleft lip. All pregnancies were spontaneous except of 2 women that underwent in vitro fertilization. Another 5 female pts are still pregnant. Median time from the end of chemotherapy until the delivery of the first baby was 78 months (range, 21 – 169). Two pregnancies were terminated prematurely (week 20 and 22) due to congenital malformations: monosomy 45,X0 Turner syndrome and serious cleft lip. Despite the low number of pts and a relatively short-term follow-up we assume, that we can expect a higher rate of pregnancies and deliveries after the reduction from 8 to 6 cycles of BEACOPP escalated. Conclusions. New strategies for the protection of fertility should be offered to young female HL patients treated with BEACOPP escalated therapy. Reduced number of cycles of BEACOPP escalated may further contribute to preservation of their fertility.

A RETROSPECTIVE ANALYSIS OF FERTILITY IN FEMALE PATIENTS WITH ADVANCED STAGES OF HODGKIN LYMPHOMA TREATED WITH BEACOPP ESCALATED CHEMOTHERAPY (20 YEAR EXPERIENCE OF A SINGLE CENTRE)

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Background. BEACOPP escalated includes alkylating agents and its gonadal toxicity has been reported in prospective and retrospective studies. This retrospective study analyzed fertility of 98 female patients (pts) with initial diagnosis of Hodgkin lymphoma (HL) in advanced stages treated with BEACOPP escalated. Patients and Methods. Overall, 98 women aged 18 – 34 years (median age at diagnosis was 27 years) were treated with BEACOPP escalated between 1997 and 2015: 8 cycles received 57 pts (58%), 6 cycles 39 pts (40%) and 4 cycles 2 pts (2%). Additional radiotherapy was indicated in 33 pts (32%). Forty nine pts (48%) received GnRH analogue (Diphereline) during chemotherapy to preserve their ovarian function. Median follow-up after the end of treatment was 144 months (range, 57 – 210). Results. Overall 26 women delivered 33 babies including 7 (27%) women with 2 deliveries. Median age at diagnosis HL was 24 years (range, 19 – 32). Number of all delivered healthy babies was 32 and only one baby was born with small cleft lip. All pregnancies were spontaneous except of 2 women that underwent in vitro fertilization. Another 5 female pts are still pregnant. Median time from the end of chemotherapy until the delivery of the first baby was 78 months (range, 21 – 169). Two pregnancies were terminated prematurely (week 20 and 22) due to congenital malformations: monosomy 45,X0 Turner syndrome and serious cleft lip. Despite the low number of pts and a relatively short-term follow-up we assume, that we can expect a higher rate of pregnancies and deliveries after the reduction from 8 to 6 cycles of BEACOPP escalated. Conclusions. New strategies for the protection of fertility should be offered to young female HL patients treated with BEACOPP escalated therapy. Reduced number of cycles of BEACOPP escalated may further contribute to preservation of their fertility.

CAUSE-SPECIFIC MORTALITY AMONG HODGKIN LYMPHOMA PATIENTS UP TO 40 YEARS AFTER TREATMENT


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Background. Hodgkin Lymphoma treatment is associated with high risk of treatment-related morbidity, including second cancers and cardiovascular diseases. However, only few studies examined long-term excess mortality. Methods. We studied cause-specific mortality in a multicenter cohort comprising 3,575 5-year HL-survivors, diagnosed before age 51 and treated between 1965 and 1995. Follow-up was complete until at least January 2010 for 96% of the patients. For 93% of deaths, the cause was known. Mortality after HL was compared with mortality in the general population by calculating standardized mortality ratios (SMRs) and absolute excess mortality (AEM), expressed per 10,000 person-years. Treatment-specific SMRs were compared by Poisson regression. Results. After a median follow-up of 21.6 years since HL treatment 1,328 patients had died (19.5% from HL, 32.5% from solid tumors, 15.5% from cardiac diseases, 7.0% from NHL/leukemia). The SMR for causes other than Hodgkin Lymphoma was 8.2-fold that of the general population. The cohort experienced 149.2 excess deaths per 10,000 patients per year. The SMR and AEM for causes of death other than Hodgkin Lymphoma increased throughout follow-up: after ≥35 years the SMR was 19.2, translating to 50.9 excess deaths per 10,000 patients per year. Solid tumors accounted for the largest part of the excess mortality (overall SMR 5.6, AEM 56.1). While the SMR for solid tumors remained stable, the SMR for cardiac diseases (overall SMR 9.8, AEM 29.4) increased during follow-up (SMR at ≥35 years 28.8, p-trend<0.001). Adjusted for sex, age and follow-up time, risk of death from cardiac diseases was increased for patients treated with supradiaphragmatic radiotherapy (Relative Risk (RR) 4.8, p=0.001) or anthracyclines (RR 1.5, p=0.044). The SMR for infectious causes (2.9% of all deaths, including deaths due to influenza/pneumonia) was 6.5-fold increased. Both splenectomy (RR 3.2, p=0.001) and spleen radiotherapy (RR 3.2, p=0.001) were associated with increased risk of death due to infectious causes compared to patients not receiving such treatment. Conclusions. Even 35 years after treatment, HL Hodgkin Lymphoma patients experienced elevated SMRs and AEMs from solid tumors and cardiac diseases. Both splenectomy and spleen radiotherapy increased mortality due to infections.
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ELDERLY HODGKIN LYMPHOMA – MULTICENTER RETROSPECTIVE DATA ANALYSIS FROM THE CZECH HODGKIN LYMPHOMA REGISTRY

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Background. The portion of elderly Hodgkin lymphoma (HL) patients (age ≥60 years) ranges between 15% and 35%. Outcome of this group of patients (pts) is significantly inferior compared with younger pts. Management of therapy is still unclear, standard treatment is not yet defined. Purpose of this study was to analyze treatment and outcome of elderly HL pts prospectively registered in Hodgkin Lymphoma Project in the Czech Republic. Patients and Methods. The proportion of elderly patients in the Czech HL Registry was 11%. We analyzed 151 pts ≥60 years with classical HL (pts with nodular lymphocyte predominant HL were excluded) diagnosed between 2000 and 2016. Median age was 67 (60-83) years, 68.9% of them were 60-69 years old and male gender represented 55% (83 pts). Histological subtype mixed cellularity occurred in 55%. Advanced clinical stage (CS) was confirmed in 60.9%. Chemotherapy (CT) alone was used in 66.2% of pts (initial/intermediate CS 23 pts, advanced CS 76 pts). Combined modality of treatment (CT and radiotherapy, RT) was used in 40 pts (initial/intermediate CS 27 pts, advanced CS 13 pts). Anthracycline – based CT received 79.4% of pts (86 pts). Five pts (4%) were treated with RT alone, three pts received supportive care only and treatment in three pts was not reported to the Registry. Results. Overall response rate after the first-line treatment was observed in 70.9% (57.6% CR), SD in 0.7% and primary disease progression in 7.3% of pts. Treatment response was not evaluable in 21.2% of pts. Relapses occurred in 12.6% (19 pts) and 3 pts underwent high dose CT and autologous stem cell transplantation (age 61, 63, 64 years). Median PFS and OS was 7.9 years (y) and 10.2y, respectively. Two – year PFS and OS was 73.1% and 81.5%, respectively. Overall 53.6% pts are alive and 31.8% (48 pts) of pts died. HL progression 11 pts, toxicity of treatment 14 pts, others causes 13 pts. Conclusions. Outcome of our retrospectively analyzed pts with classical HL compares favorably with other reported data in the group of elderly pts. Long-term survival of our pts depended on use of anthracycline-containing CT. Prospective clinical studies are still needed to determine an optimal effective regimen with low toxicity in elderly pts.

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INCIDENCE OF HYPERLIPOPROTEINEMIA IN LONG-TERM SURVIVORS OF HODGKIN LYMPHOMA IN CHILDHOOD OR ADOLESCENCE AND IN HEALTHY CONTROLS

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Background. The development of curative therapies has led to a growing population of childhood Hodgkin lymphoma survivors. Approximately 75% of survivors experience some adverse event. Cardiovascular events are among most important adverse events, causing long-term morbidity and early mortality. Seriousness of these cardiovascular late adverse events could be reduced only by their early recognition and also by recommendation of preventive measurements for modifiable cardiovascular risk factors - hyperlipoproteinemia, hypertension, overweight or obesity, smoking. Methods. The aim of our prospective observation study is to compare the lipid profiles, markers of oxidative stress and endothelial dysfunction together with evaluation of atherosclerotic changes at main carotid artery between the long-term survivors of childhood Hodgkin lymphoma more than 10 years after the treatment and the matched group of healthy volunteers at the age of 25-40 years. Results. Forty-seven long-term survivors of childhood Hodgkin lymphoma (29 males, 18 females) were recruited - all underwent clinical examination, completed questionnaire collecting information on family history of cardiovascular diseases, subject's health habits and medical conditions, underwent ultrasound examination of the carotid arteries and their blood specimens were analyzed. Preliminary results are available in forty-four long-term survivors - abnormal levels of blood lipids were found in 52.3% of them. Elevated cholesterol levels (LDL and total cholesterol) were detected in 12 pts. (in three of them also with elevated levels of triglycerides), elevated level of triglycerides was found in four pts., hyperglycemia was found in 12 patients (in 7 patients together with elevated cholesterol or triglycerides levels), Plaques in main carotid artery were found by ultrasonography in two patients, both of them have elevated cholesterol levels. Recruitment of the long-term survivors will continue and of matched group of healthy volunteers will start soon. Conclusions. Our results will give us insight into atherosclerosis development in this specific population and potential impact of hyperlipoproteinemia. It will help us to introduce appropriate guidelines for follow-up and examinations of long-term survivors in the field of specialized health care providers, but also in primary care together with the recommendation of therapeutic interventions in this population.

Support. Supported by grant NV15-30494A.

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SURVIVORS OF ADULT HODGKIN LYMPHOMA: A FRAIL POPULATION. THE EXPERIENCE OF THE SURVIVORSHIP CLINIC FOR ADULT HL SURVIVORS AT ISTITUTO NAZIONALE TUMORI DI MILAN, ITALY

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Background. Nowadays more than 80% of adult patients (pts) diagnosed with HL have a long-life expectancy. Pts diagnosed from late 1960’s to 2000’s are at risk of developing long-term complications from chemotherapy (CT) and radiation therapy (RT). The majority of data on iatrogenic late effects are derived from registries or self-reported interviews and only a few data on clinical outcome of survivors followed in survivorship clinics (SC) are available. Aim. To evaluate the incidence of long-term complications among pts, in complete remission (CR) for >5 years from the end of first-line treatment (EOT), followed in the SC for adult HL survivors at INT. Methods. Medical records of 359 AHLS, who underwent a routine visit, were analyzed to evaluate data on demographic characteristics, treatment and incidence of late complications. Descriptive statistics were calculated. Results. From May 2014 to April 2016, 359 AHLS (168 males, 191 female) diagnosed at a median age of 31 (range, 17-71), underwent a routine visit at SC. Median time from EOT and last follow-up visit was 17 years (range, 5-41 years). Late complications were reported in 116 pts (32%), the majority of whom had been treated with CT+RT. After a median of 19 years (range,1-35) from EOT, 23 pts (6%) developed 29 second cancers (9
Among CVD, myocardial infarction occurred in 8 pts, ischemic heart after a median of 13.5 years (range, 3-32), and 10 pts had multiple CVDs. Conventional CVD risk factors were observed in 58 pts (16%). Hypothyroidism occurred in 9% of pts.

Conclusions. Results of our study confirm that a substantial proportion of survivors of adult HL develop late complications. Specific health resources should be addressed for prolonged follow-up programs, lifestyle advices as well as prompt and aggressive management of risk factors to improve health in this frail patient population.

Introduction. Elderly patients (>60 years old) with Hodgkin lymphoma have inferior rates of survival compared to patients <60 years old due to multiple factors including treatment toxicity and comorbidities influencing the intensity of chemotherapy that can be successfully delivered. Hodgkin lymphoma is derived from germinal centre B-cells and contributed to by latent Epstein Barr Virus (EBV) infection in a number of patients. Aims. To examine the incidence and treatment outcomes of B-cell NHL following completion of treatment for CHL in elderly patients compared with younger patients. Methods. Adult patients diagnosed with CHL at our institutions from 2000-2015 were followed prospectively following initial treatment for survival and toxicity outcomes. Any subsequent diagnosis of B-cell NHL was confirmed by two expert lymphoma anatomical pathologists consistent with WHO 2008 diagnostic criteria. Results. 165 adult patients were available for analysis, of which 56 (34%) patients were >60 years old. There was no significant difference between elderly and young cohorts in the number of patients with early stage favourable, unfavourable or advanced stage CHL. Less elderly patients received ABVD-like chemotherapy (71% vs 95%). There was a higher number of relapses of CHL in elderly patients (51 vs 20%). At a median follow-up of surviving patients at 2.7 years, there was a much higher incidence of secondary malignancy in elderly patients (31% vs 20%). At a median follow-up of patients at 2.7 years, there was a much higher incidence of secondary malignancy in elderly patients (n=11 vs n=2 (24% vs 2%), of which there were far more haematological compared to solid malignancies n=8 (17%) vs n=3 (6%). Specific histologies included Diffuse Large B-cell Lymphoma (5), Follicular lymphoma (1), Lymphoplasmacytic lymphoma (1) and Chronic lymphocytic leukaemia (1). Patients with DLBCL were treated with R-CEOP and resulted in 2 patients achieving long-term relapse free survival. Conclusions. There is a high incidence of B-cell NHL in elderly patients with CHL, suggestive of a common germinal centre derived progenitor cell of origin. Comparative genomic annotation of such cases is required to better understand the lymphoma initiating events in this cohort to enable selection of treatment which may reduce this complication.

Introduction. Due to demographic changes, it is expected that the incidence of the HL will increase in patients (pts) over 65 years (y), highlighting the need for therapeutic strategies designed specifically for the geriatric population. The objective of this review is to evaluate our everyday life practice and analyze the characteristics, prognostic factors and survival of pts over 65y diagnosed of HL in our center. Methods. This is an observational, retrospective review. A total of 44 pts over 65y and diagnosed of HL from May 2005 to December 2015 were included. The Charlson Comorbidity Index (CCI) was used to evaluate the comorbidities. Pt’s and disease’s characteristics are listed in Table 1.

Introduction. Elderly patients with classical B-cell non-Hodgkin lymphoma have high rates of secondary B-cell non-Hodgkin lymphoma. M. Gilbertson1, K. Maclaughlan1, G. Gregory1, S. Ratnasingham1, I. Simpson1, B. Kumar1, G. Grigoriadis1, S.S. Opat1, J. Shortt1, S. Patil1, E. Hawkes1, E. Ha-he2

Table 1.

<table>
<thead>
<tr>
<th>Characteristics</th>
<th>No. of patients (n)</th>
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<tr>
<td>Age (median (range))</td>
<td>75 (66-81)</td>
</tr>
<tr>
<td>Sex</td>
<td>46</td>
</tr>
<tr>
<td>Male</td>
<td>22 (50%)</td>
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<td>ELDERLY PATIENTS WITH CLASSICAL HODGKIN LYMPHOMA HAVE HIGH RATES OF SECONDARY B-CELL NON-HODGKIN LYMPHOMA</td>
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Results. The treatment and the response rate are shown in Table 1. 58% of pts achieved CR and there were only 2 relapses recorded in this group. 16% progressed during treatment (most of them had an advanced stage at diagnosis). 18% did not receive any treatment owe to comorbidities or denial by the pt. The estimated 5y overall survival (OS) was 45%. Mortality rate was 54.5%: half due to the disease itself, 27% as a result of the treatment’s toxicity (60% of this group owe to pulmonary involvement), 14% by other neoplasia and 9% due to comorbidities. In the univariate analysis factors associated with poor survival were a CCI ≥3 and the age >80y, with a 5 y-OS of 28% vs 51% (p=0.003) and 8% vs 60% (p=0.0002), respectively. Because of the low sample size it is not rentable to assess a multivariate analysis.
er toxicity associated with treatment compared to young patients. The fundamental cause of death remains being the disease. The age over 80 years and CCI ≥5 are associated with a worse prognosis. The management of patients over 80 years represents a major therapeutic challenge because of the high toxicity and low efficiency of current treatments. It is important to include these patients in clinical trials covering new drugs. The new drugs and new easy geriatric assessment tools, which detect frailty, should assist in the better management of these elderly patients. Our hospital intends to initiate a care protocol that covers the assessment using the CIRS-C and GAH scales.

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**AN UPDATE ON BETER, THE DUTCH NATIONWIDE SURVIVORSHIP CARE PROGRAMME FOR Hodgkin LYMPHOMA SURVIVORS**

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**Background.** Survivors of Hodgkin lymphoma (HL) are at increased risk of various late adverse effects of treatment, leading to substantial excess morbidity and mortality. The Dutch BETER consortium (Better care after Hodgkin lymphoma: Evaluation of long-term Treatment Effects and screening Recommendations) aims at improving life expectancy and quality of life for HL survivors. **Methods.** The BETER consortium has developed: (1) evidence-based follow-up guidelines for HL survivors according to (inter)national standards; (2) a nationwide infrastructure for survivorship care clinics in which risk-based care is provided to ≥5-year survivors of HL, who were treated after 1965 at ages 15-60 years. Moreover, the BETER consortium aims at improving knowledge about late adverse effects of HL treatment in patients as well as health care providers, e.g. through the website www.beternl.org. **Results.** BETER-guidelines for secondary malignancies, cardiovascular disease, thyroid disease, osteoporosis and fertility, functional asplenia, neck muscle weakness and other problems (quality of life, weight, dental health, neurological problems, and pulmonary disease) are expected to be approved soon by the respective medical societies. Currently, 11 out of 23 centres participating in the BETER consortium have established a BETER Survivorship Care Clinic. Other centres are planning to start shortly. The proportion of HL survivors still under medical surveillance varied substantially across BETER clinics. For these patients follow-up care is adapted to the new screening guidelines. Among the HL survivors who were discharged from follow-up care, there was a large variation in attendance rate between BETER clinics, varying from 25% to 90%. Five to 35% of patients did not respond to the invitation and 5 to 40% did not wish to attend. Most common reasons to not attend were: undergoing screening or treatment for late effects elsewhere, not wanting to be reminded of HL, emotional burden and financial reasons. We will evaluate reasons for non-attendance in more detail in the near future. **Conclusions.** Clinical attendance rates of HL survivors who were previously discharged from follow-up, vary substantially between BETER clinics. Evaluation of reasons for non-attendance will be used to improve survivorship care.

**P136**

**PROSPECTIVE EVALUATION OF PULMONARY TOXICITY IN FIRST LINE TREATMENT OF Hodgkin LYMPHOMA PATIENTS**

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**Introduction.** Bleomycin (bleo) containing first-line therapy ± irradiation may cause pulmonary toxicity in Hodgkin lymphoma (HL) patients.

**Patients and Methods.** Pulmonary function of newly diagnosed HL patients were assessed, by using St. George Respiratory Questionnaire (SGRQ), dynamic inhalation lung scintigraphy, diffusion capacity of the lung for carbon monoxide (DLCO) and spirometry before, during and after treatment, prospectively. Bleo hydrolase (BLMH) SNP A1450G genotype polymorphism was determined by TaqMan genotyping assay. **Results.** A total of 50 classical HL pts. data were available for analysis, treated between February 2012 and March 2016 in our Institution. 38 pts. received ABVD (median cumulative bleo dose: 120 mg/m²) chemotherapy, 18 pts. received bleo intramuscularly (im.) and 20 intravenously (iv.). As control group, 12 pts. were treated with brentuximab vedotin (BV)-AVD. Chest irradiation was involved in 11 pts.’ treatment. Pulmonary complaints measured by SGRQ slightly improved over treatment. Lung scintigraphy results of bleo-treated pts. significantly worsened over treatment. More interestingly, results of BV-treated pts. not only significantly worsened over treatment, but was significantly inferior to bleo treated patients. By excluding smoker pts., difference became not significant, but still inferior to bleo treated pts. DLCO much less explicitly confirmed these results. Spirometry parameters improved over treatment in both groups, with no significant differences. Chest irradiation did not significantly worsen pulmonary function. Pts. receiving iv. bleo had significantly worse results measured with lung scintigraphy at the end of treatment and during treatment with DLCO, than those receiving im.. BLMH SNP A1450G didn’t distinguish in this short run of bleo treated pts. **Discussion.** Pulmonary function test results of bleo treated pts. worsened over treatment as previously reported, however we found these results only with lung scintigraphy. DLCO was much less supportive. Moreover, only one patient was found with acute bleo induced lung injury in contrast with the literature (20-46%). Surprisingly, BV-AVD, which is considered non-pulmonary toxic, produced inferior results to bleo treated pts.. We have to compliment, that these results were only seen with lung scintigraphy, which has no literature, and data lacks of confirmation with gold-standard DLCO. Nevertheless, lung scintigraphy is supposed to measure earlier epithelial damage.

**P137**

**HODGKIN LYMPHOMA AND PREGNANCY - DILEMMAS OF HOW TO TREAT?**

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**Introduction.** The incidence of malignant neoplasms in women at reproductive age has increased dramatically over the past decade and is still rising. Hodgkin’s lymphoma (HL) is one of the most frequent hematological malignancies in young women. When diagnosed HL during pregnancy, it represents a major clinical dilemma and there is a lack of established standards defining its optimal treatment during gestation. The coincidence of HL and pregnancy poses an unusual challenge for the mother and the medical team. Materials. 102 patients with Hodgkin lymphoma (HL) were treated at the MScMCC Warsaw between 01/1986 and 12/2015. Age: range (mean): 16-39 (29). Most patients
Hodgkin’s lymphoma (HL) in the second stage of clinical Ann Arbor (CS), histopathological type of NS (nodular sclerosis) and in the second trimester of pregnancy. B symptoms: 51%, tumor mass -41%, MMR-1/3-38%. Methods of treatment: I trimester: therapeutic abortion or radiotherapy (IF) upper cervical or axillary lymph nodes or mis- carriage (7-8 Hbd), III trimester: method “watch and wait” and delivery 37-39 Hbd or chemotherapy scheme EVA (1-2 cycles before delivery) (Etoposide 100mg/m²/days 1-3, Vinblastine 6 mg/m² day 1, Doxorubicin 50mg/m² day 1 repeated every 28 days) before delivery. II trimester method “watch and wait” or radiotherapy (IF) total dose between 20-44 Gy before delivery and chemotherapy COPP, MOPP, MOPP/ABV after delivery or radiotherapy (IF) total dose 30-35 Gy and chemotherapy scheme EVA (2 cycles) before delivery or chemotherapy scheme EVA (3-4 cycles) before delivery and radiotherapy (IF) total dose 30-40 Gy after delivery. In vivo dosimetry before delivery during radiotherapy by irregular fields Thermoluminescent dosimetry HARSHAW 100 or Thomson and Nielsen t.MOSFET TN – RD 51 and individually blocks of the abdomen and fetus were used. The dose of the fetus was estimated individually in all. Total dose 0 cGy -19.19 cGy. Results. Out of 102 treated women now live 94 (92%). Most of the living patients in complete remission. In 2 patients after childbirth was made a full panel of diagnostic tests. They remain in partial remission and continued treatment regimen ABVD. Cause of death in 8 patients: relapse or pri- mary refractory disease. Was born 90 children. Parturition and postpartum correct. All bearings were subjected to histopathological examination. There was no cell lymphoma in the tested material. There were no developmental or genetic defects in children. Children are under constant medical care. Physical and mental development correct. One infant developed acute respiratory distress syndrome and died 6 days after delivery. Age surviving children 6 months - 29 years.

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SECOND CANCER RISKS IN PATIENTS WITH SUPRADIAPHRAGMATIC Hodgkin Lymphoma

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**Background.** Second cancer s (SC) developing in Hodgkin Lymphoma (HL) patients after treatment significantly affect survival. The studies defining relative risc (RR) of SC in the cohort s of HL patients treated with similar radiotherapy (RT) target volumes and total tumor doses (TTD) are rare. **Purpose.** The aim was to evaluate RR of SC in HL patients treated with RT alone or chemoradiotherapy (CRT) when irra- diation was limited to the lymphatic areas above diaphragm and the spleen. **Methods.** The study included 1789 initial HL pts, stages I, II, IV (supradiaphragmatic, age 13-69 (87% under 40). Women 1177 (66%), men 612 (34%). The treatment period was between 1968 and 1998. Patients were given either RT alone limited to the lymphatic areas above diaphragm and the spleen, TTD 40 Gy (363 pts, 20.3%) or 6 cycles of chemotherapy COPP+similar RT (1426 pts, 79.7%). The incidence of SC was compared with the data from Cancer Register of Russian Federation. **Results.** Follow-up was 6 months - 36 years (median 18 years). The overall follow-up for the cohort was 18949 patients/years (men 5917, women 13032). SC developed in 80 (4.5%) patients: after RT in 27 (7.4%) of 363 pts, after CRT in 53 (3.7%) of 1426 patients. One tumor occurred in 74 pts, two tumors, two tumors successively in 5 patients and three tumors in 1 patient. The total number of tumors was 87, including 85 (97.7%) solid tumors, 2(2.3%) hemoblastosis. The time of SC occurrence was 1-51 years (median 18), SC RR: overall for the cohort - 2.85 (95% confidence interval (95% CI) 1.85-2.98); in women - 3.02 (95% CI 1.93-3.12); in men - 2.46 (95% CI 1.23-2.91). After RT alone: in women - 3.22 (95% CI 2.11-4.75); in men - 2.51 (95% CI 0.9-4.65). After CRT: in women - 2.9 (95% CI 1.43-3.02); in men - 2.4 (95% CI 1.04-2.96). The prevailing tumors were mammal, thyroid, gastric. The RR of mammal cancer was 4.01 (95% CI 2.46-5.98); gastric cancer: in women - 7.95 (95% CI 3.2-14.4), in men - 4.03 (95% CI 1.0- 9.0); thyroid cancer: in women - 7.8 (95% CI 3.47-13.9), in men - beyond 95% CI. 19 (21.8%) of 87 tumors occurred within irradiation fields. **Conclusions.** In our study the RR of SC in HL patients was 2.85, which is lower than reported by other authors. This probably could be explained by the fact that the study included HL patients in whom irra- diation was limited to supradiaphragmatic areas and spleen.

**P139**

PROGNOSTIC VALUE OF CLINICAL, TREATMENT AND SOCIO-DEMOGRAPHIC RESULTS OF PSYCHOLOGICAL DISTRESS AMONG HODGKIN LYMPHOMA SURVIVORS IN HUNGARY

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**Objectives.** Due to risk and response adapted treatment strategies, more than 80% of newly diagnosed classical Hodgkin lymphoma (HL) patients can be cured, and are expected to be long-term survivors. A remarkable number of HL survivors suffer from treatment related long- term side effects, such as secondary malignancy, organ failure, persistent fatigue and psychological distress. **Purpose.** The aim of this study was to evaluate the frequency of psychological distress and it’s risk factors among HL survivorsin Hungary. Patients and Methods. 163 (38 female and 73 male) adult HL survivors were identified between 1st January 2012 and 31st March 2015 in our outpatient centre. The patients were asked and agreed to completestandardized, self-administeredquestion- naires: Hospital Anxiety and Depression scale (HADS14), General Health Questionnaire (GHQ12), Perceived Stress Scale (PSS4) and socio- demographic questions. Disease and treatment data were based on the hospital records. **Results.** The mean age at the time of diagnosis was 32.16±12.97 years, at the completion of the survey was 44.8±14.51 years. A total of 25% had caseness scores with HADS14. Anxiety case- ness scores were high in female patients (p=0.003), and were strongly associated with lack of employment (p=0.011) and treatment related long-term side effects (p=0.001). Depression caseness scoreswere increasedamong female patients (p=0.020), and were related to baseline comorbidities (p=0.001), lack of employment (p<0.001), higher ECOG scores at the time of diagnosis (p=0.058) and treatment related long- term side effects (p=0.001). 14.11% of HL survivors had abnormal levels of distress with GHQ12, which were significantly associated with base- line comorbidities (p=0.041), lack of employment (p=0.001), higher ECOG score at diagnosis (p=0.020) and treatment related long-term side effects (p=0.001). The PSS4 scale results were found significantly lower among employees (p=0.001), and in subjects without comorbidities (p=0.008) and with bulk tumor (p=0.026). There was a tight corre- lation between the questionnaires and the time of survey completion. **Conclusions.** Related to the literature and our own results, the majority of cured HL patients survive without distress at caseness level. Based on our experience HL survivors should be closely followed up by clini- cians. If mental health disorder is suspected further psychologic or psychi- atric treatment is strongly recommended.

**P140**

HODGKIN LYMPHOMA IN ELDERLY PATIENTS - A SINGLE CENTER EXPERIENCE

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**Background.** Classical Hodgkin lymphoma occurs in 20% of patients aged over 60 years. Survival rates for elderly patients with Hodgkin Lymphoma (eHL) are disproportionately inferior compared with younger patients. In eHL poor outcome is related with biologically more aggressive disease, treatment toxicity and comorbidities. Although ABVD is regarded as standard of care for most eHL patients, adjusted treatment strategies are lacking for this particular population and inno- vative approaches are awaited. **Aims.** Characterize an elderly population
with HL and analyze the impact of different treatment approaches (response to treatment, long-term outcome and occurrence of secondary neoplasms). Methods. We performed a retrospective analysis of elderly patients with HL (≥60 years) treated between 1991 and 2015, in a tertiary center. Results. Forty-six eHL patients were considered, mainly males (58.7%) with a median age of 70 years (60-80). The most prevalent histological subtype was nodular sclerosis (n=30; 65.2%). Ann Arbor stage III/IV was observed in 31 patients (67.4%), B symptoms in 34 (75.9%) and bulky disease in 2 (4.3%). The risk stratification (GHSG) was: limited n=4 (8.7%), intermediate n=10 (21.7%) and advanced n=32 (69.6%). ABVD was performed in 19 patients (41.3%); ORR was 67.5% (all with CR). With a median follow-up of 34.6 months (0.3-273.4), 5-year overall survival (OS) and progression free survival (PFS) were 46.1% and 35.9%, respectively. Among 33 patients who died, 20 were due to HL. Median OS and PFS were superior in patients treated with ABVD when compared with other approaches (156.6 vs 22.5 months, p=0.047 and 156.6 vs 20.3 months, p=0.085). Using a univariate analysis most International Prognostic Score factors didn’t show prognostic value, although multivariate analysis identified hemoglobin as a predictive factor of OS (HR 0.59; 95%CI 0.40-0.87, p=0.007) and PFS (HR 0.11; 95%CI 0.45-0.90, p=0.011). Four patients presented late second malignant neoplasms (n=2, ABVD; n=2, other regimen). Conclusions. ABVD remains a standard of care in eHL. In our cohort we observed that this regimen was effective and can improve survival. We concluded that hemoglobin level is an independent predictor of survival in this population.

### P141

**ARE WE AWARE OF NUTRITIONAL STATUS AND VITAMIN D LEVEL IN HODGKIN LYMPHOMA PATIENTS?**

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**Background.** Patients with Hodgkin lymphoma usually have weight loss at the diagnosis of disease. None of the prognostic parameters so far did not evaluate prognostic significance of weight loss. Also, vitamin D is not usually assed in lymphomas. **Aim.** Evaluation of nutritional status and level of vitamin D in de novo patients with Hodgkin lymphomas. **Methods.** 22 de novo pts diagnosed from January 2014. At Clinic for hematology, Clinical center of Serbia, median age 34.5(19-60)years. Initial clinica stage (CS) was: I in 1/22; II in 11/22; III in 4/22 ans IV5/22. ECOG PS: 0 in 5/22pts, 1 in 12/22, 2 in 5/22. All pts were treated initially with ABVD. Nutritional status was screened by NRS 2002 and vitamin D was assed with the chemiluminescent immunoassay for the quantitative determination of total serum 25-hydroxyvitamin D (25(OH) vitamin D). Pts were followed for median 18,5(12-26) months. **Results.** Mean BMI was 24.08±3.39 while 3/22 pts had BMI less than 20.5kg/m². 7/22 pts have lost ≥10%body weight (BW) during previous 6mts. 9/22pts had NRS 2002≥2. Median 25-OH vitamin D 26(7,10-62,05)nmol/l and none of pts had normal level. 9/22 had severe deficieny <25nmol/l, 9/22 deficieny 25-50nmol/l and 4/22 had unsufficient level 50-75nmol/l. 7/22 pts progressed within one year. Median PFS 8(3-12) months. Pearson correlation between pts with weight loss over 10% BW and progression is 0.4, p=0.66, while for 25-OH vitamin D lower than 25nmol/l and progression was 0.589, p=0.005. In binary logistic model only severe deficieny 25-OH vitamin D was significant for progression while CS, NRS and ECOGFS were not significant. **Conclusions.** Around 40%pts are malnourished or in nutritional risk. Any of pts had normal 25-OH vitamin D, there was a significant cor-

### P142

**MENTAL DISORDERS IN HODGKIN’S DISEASE PATIENTS**

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**Background.** Data on mental disorders, manifesting in Hodgkin’s disease patients are rather limited. Such disorders are considered as within somatogenic psychoses and adjustment disorders. Among described psychoses identified isolated cases of delusional disorders, delirium, oneric. Among the adjustment disorders described is mainly anxiety, depression, or combinations thereof. Systematic studies of psychiatric disorders in patients with Hodgkin’s disease have not been conducted. **Aim.** To identify the structure of mental disorders in patients with Hodgkin’s disease. **Materials and Methods.** There were examined 95 patients with Hodgkin’s disease by clinical-psychopathological method. Results of the study were subjected to statistical analysis using Stat for Windows 5.5 licensing programs. **Results and Discussion.** It was revealed that endogenomorphical psychoses (hallucinatory-paranoid and depressive-delusional states) and somatogenically provoked schizophrenia attacks in Hodgkin’s disease patients are much more likely (17 and 6, respectively) than delirium, unlike other hematological malignancies, in which be present (or was found observed) the opposite trends. In addition, Hodgkin’s disease is the only hematological malignancy in the studied sample, in which the schizophrenia attacks are detected (were detected). Among adjustment disorders in Hodgkin’s disease patients were identified as follows: anxiety and dissociative (n=29) (anxiety and dissociative reactions occur with symptoms of the phenomenon of alienation of real hematological disease and signs of latent somatization of anxiety, accompanied by abnormal behavior in the disease), hypomaniac (n=4), dissociative (n=25) (dominated by the phenomenon of alienation of the hematological malignancy, reaching the degree of total denial of the fact of the blood system diseases, revealed gross cognitive disorders characterized by distinct partial peculiar syndrome pseudodementia) and anxiety-koenestopathical (n=14) (somatogenically and / or psychogenic provoked polymorphic functional symptoms, abnormal bodily sensations). **Conclusions.** The study results show that in a sample of Hodgkin’s disease patients schizoid spectrum disorders accumulate, what could serve as a reason for further studies of this phenomenon, involving both clinical and biological research methods.

### P143

**ANALYSIS OF ACCESS TIME TO CARE FOR PATIENTS WITH HODGKIN’S LYMPHOMA IN PUBLIC HOSPITAL IN SAO PAULO**


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**Introduction.** Cancer is responsible for over 12% of all causes of death in the world, where more than 7 million people die each year from this evil. Early diagnosis coupled with existing therapeutic methods allow higher survival rates for cases considered incurable before. **Objectives.** To analyze the time spent on the access of patients with Hodgkin’s disease in philanthropic Hospital in São Paulo (SP) to the specialized service. **Methods.** query the records with tabulation and analysis of data of 67 patients. **Results.** male Majority N=35 (52.2%) aged between 15 and 75 years and frequency of single N=33 (80.0%). As for the disease, 25 (37.3%) were in stage IVB and the waiting time interval until the first examination was 0.085. Gender variations, age and education were significant in the elapsed time of the first signs and symptoms until the first examination (p=0.008) and attendance at the Santa Casa to consultation with a specialist (p=0.012). Younger patients (15 and 55) sought the first faster service, and the time was 31 days; older (56 and
75) took more average time: 304 days. Conclusions. The most economically disadvantaged patients were in advanced stage. There is an increased time interval to access health services, especially regarding the type of service for the first visit. The variables showed significant when analyzed “type of service” and “age” over time.

P144
THE USE OF COPING STRATEGIES AND SOCIAL SKILLS IN YOUNG ADULT PATIENTS WITH HODGKIN’S LYMPHOMA: CORRELATION WITH ANXIETY AND/OR DEPRESSION SYMPTOMS
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Introduction. The oncologic disease exposes the patient into a dynamic and complex treatment process along different steps of the disease, requiring him/her adaptive coping answers; in other words, the patient with cancer needs to mobilize psychosocial resources to deal with the stress due to this illness. The Hodgkin’s lymphoma is a type of cancer potentially curable, and the age range of this type of disease, presents a bimodal distribution, having its first incidence peak between 15 and 35 years olds. Objectives. This study aimed to evaluate the coping strategies and social skills in young adults against the oncologic treatment and the correlation of these variables with anxiety and/or depression symptoms. Materials and Methods. The sample was composed of 44 patients with Hodgkin’s lymphoma diagnosis between the ages of 18-35 years old. There have been used as research tools: Socio-demographic Record, Ways of Coping Scale - EMEP, Social Skills Inventory – HIS, Hospital Anxiety and Depression Scale – HAD. Results. By a quantitative analysis of data, it has been possible to conclude that the coping strategy focused on the problem presented higher scores in this population, while the coping strategy focused on the emotion presented lower scores. The correlation of coping strategy focused on the emotion showed symptoms (p=0.000) and depression (p=0.002). It has been verified that in this population, the social skills factors related to the self-affirmation in expression of positive affection, conversation and social resourcefulness, and self-exposure to unknown or new situations, are above the average if compared to the general population of the validation study. These factors might be associated to the oncologic treatment, environmental factors involved in this process, which favor the development of these skills. There has not been significant statistically correlation among these social skills and anxiety and depression symptoms.

P145
QUALITY-OF-LIFE OUTCOMES IN PATIENTS WITH CLASSICAL HODGKIN LYMPHOMA TREATED WITH NIVOLUMAB MONOTHERAPY IN CHECKMATE 205 (COHORT B), A PHASE 2 STUDY
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Background. Nivolumab (nivo), a fully human IgG4 immune checkpoint inhibitor targeting PD-1, showed encouraging efficacy in relapsed/refractory cHL in a phase 1 study (Ansell et al. NEJM 2014). Cohort B of CheckMate 205 ph2 study investigated nivo in cHL pts who had failed autologous hematopoietic stem cell transplantation (auto-HSCT) and brentuximab vedotin (BV): ORR per independent radiologic review committee was 66% and 6-m PFS was 77% (Engert et al. EHA 2016; abstr S793). Due to limited treatments there is a need to provide durable efficacy while maintaining/improving QoL. Aim. Evaluate QoL in pts receiving nivo in CheckMate 205 cohort B. Methods. This ongoing ph2 study (NCT02181738) assessed QoL in cHL pts receiving nivo 3 mg/kg IV q2w. Pt-reported QoL was assessed using European Organization for Research and Treatment of Cancer Quality of Life Questionnaire – Core 30 (EORTC QLQ-C30) and EuroQol Five Dimensions Questionnaire (EQ-SD) q4 cycles on treatment. EQ-5D visual analog scale (VAS) scores range 0–100 and EQ-5D utility index scores –0.6–1 (higher scores=better health state). A 7- and 0.08-point change from baseline (BL) in VAS and utility index score, respectively, represent a clinically meaningful improvement (CMI). QLQ-C30 scores range 0–100 (high scores=higher level of function/global health status [GHS]; for symptom scales, higher level of symptom burden); 10-point change represents a CMI. Changes from BL estimates are based on a mixed model with time point as a fixed effect. Missing data was investigated to assess possible bias. Results. By a quantitative analysis of data, it has been possible to conclude that the coping strategy focused on the problem presented higher scores in this population, while the coping strategy focused on the emotion presented lower scores. The correlation of coping strategy focused on the emotion showed symptoms (p=0.000) and depression (p=0.002). It has been verified that in this population, the social skills factors related to the self-affirmation in expression of positive affection, conversation and social resourcefulness, and self-exposure to unknown or new situations, are above the average if compared to the general population of the validation study. These factors might be associated to the oncologic treatment, environmental factors involved in this process, which favor the development of these skills. There has not been significant statistically correlation among these social skills and anxiety and depression symptoms.

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