RNA-Seq, ChIP-Seq (H3K27ac, H3K27me3, H3K27M) and genome-wide chromatin conformation capture (Hi-C), as well as tissue ATAC-Seq. Publicly available pediatric glioma tissue ChIP-Seq data was integrated with cell data. CRISPR knock-down of target enhancer regions was performed. RESULTS: We identified tumor-specific enhancers and regulatory networks for known oncogenes in DIPG and GBM. In DIPG, *FOX*, *SOX*, *STAT* and *SMAD* families were among top H3K27Ac enriched motifs. Significant differences in Topologically Associating Domains (TADs) and DNA looping were observed at *OLIG2* and *MYCN* in H3K27M mutant DIPG, relative to wild-type GBM and normal cells. Pharmacologic treatment targeting H3K27Ac (BET and Bromodomain inhibition) altered these 3D structures. Functional analysis of differentially enriched enhancers in DIPG implicated *SOX2*, *SUZ12*, and *TRIM24* as top activated upstream regulators. Distinct genomic structural variations leading to enhancer hijacking and gene co-amplification were identified at *A2M*, *JAG2*, and *FLRT1*. **CONCLUSION:** We show genome structural variations enhancer-promoter interactions that impact gene expression in pHGG in the presence and absence of the H3K27M mutation. Our results imply that tridimensional genome alterations may play a critical role in the pHGG epigenetic landscape and thereby contribute to pediatric gliomagenesis. Further studies examining the impact of the alterations are therefore underway.

HGG-03. PEDIATRIC BITHALAMIC GLIOMA H3K27M NEGATIVE AND EGFR POSITIVE: A DISTINCT ENTITY WITH POTENTIAL SENSIBILITY TO EGFR INHIBITORS

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INTRODUCTION: Brain tumors are the most common solid tumors of childhood and optimal therapeutic strategies for many subtypes remain unknown. Bithalamic gliomas, in contrast with unilateral, have frequent mutations in the EGFR oncogene and only rare Histone H3 mutation. These EGFR mutations are small inframe insertions within exon 20 or missense mutations within exon 7 and occur in absence of gene amplification. CASE REPORT: A previously healthy 10-years-old boy with adequate neuropsychomotor development was admitted with a 5-day-long headache. A brain magnetic resonance imaging (MRI) showed an expansive midline lesion with thalamic extension. The tumor showed no diffusion restriction or contrast enhancement. An endoscopic septostomy and biopsy were performed.The histopahotology showed a diffused astrocytoma grade II. The immunohistochemistry was negative for IDH1 and 2, BRAF mutation, P53 and H3K27M. Next generation sequencing (NGS) ruled out histone H3K27M mutation and showed EGFR mutation in exon 7. The patient experimented clinical and radiological disease progression in a few weeks, confirming the high grade glioma despite the histopahological diagnosis.He received radiotherapy (Total dose 54Gy) and after radiation he started target therapy with Osimertinib, a third generation tirosin kinase inhibitor. As a toxiticy, he experienced neutropenia Grade 2. Disease evaluation performed after 2 cycles showed stable disease. DISCUSSION: Our case report represents a distintc molecular class of pediatric-type bithalamic glioma characterized by EGFR alteration and absence of H3K27M mutation. EGFR inhibition may represent a potential therapeutic strategy in these highly aggressive gliomas.

HGG-04. INTRAMEDULLARY SPINAL HIGH GRADE GLIOMA WITH ALK FUSION AND EXCELLENT RESPONSE TO TARGETED TREATMENT WITH ALECTINIB: CASE REPORT

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INTRODUCTION: Intramedullary spinal cord high grade gliomas are rare pediatric tumors , with a grim prognosis. Current therapeutical strategies include a surgical resection if feasible, and radiotherapy. Additional treatments with various chemotherapy agents have had a minor effect and did not change the course of the disease. New molecular targets are a source of hope. Recent molecular evidence regarding high grade infantile hemispheric gliomas describe specific tyrosine kinase receptor fusions or mutations in ALK, ROS, NTRK and MET domains which may lead to therapeutical targets. There is no data regarding these molecular changes in infantile intramedullary high grade gliomas. We present a two year old girl with a cervical high grade glioma with an ALK mutation which received targeted therapy. CASE REPORT: A two year old girl presented with progressive torticollis and hemiparesis. An intramedullary cervical tumor with ill -defined borders was diagnosed. A limited partial excision was performed and the pathological diagnosis was high grade glioma. Within weeks she developed progressive clinical and radiological deterioration. Molecular studies (Oncomine) revealed an ALK fusion (KIF5B) which was confirmed by immunohistochemistry. Treatment with ALK inhibitor alectinib at 150mg daily was initiated. Torticollis resolved within a week, and MRI after 3 months showed outstanding tumor shrinkage with a small residual mass. There were no adverse events to treatment. DISCUSSION: ALK fusion positive high grade glioma has recently been recognized in infants with hemispheric tumors, and a preliminary recent case report demonstrated excellent response to ALK inhibitors. Intramedullary spinal cord high grade gliomas are rare and harbor poor prognosis. This is the first case of ALK fusion glioma of the spine with excellent preliminary response to alectinib. The duration of treatment and long term prognosis is unknown. Molecular investigations can change the approach to pediatric rare CNS tumors.

HGG-05. SYSTEMATIC REVIEW OF DIFFUSE HEMISPHERIC GLIOMA, H3 G34-MUTANT AND CLINICAL FACTORS INFLUENCING OUTCOMES

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BACKGROUND: A comprehensive description of clinical features and factors impacting prognosis for patients with diffuse hemispheric glioma, H3 G34-mutant (DHG H3G34) is not easily accessible. Understanding survival data and prognostic features is paramount for clinical advancements and ensuring patients/families are fully informed. METHODS: To summarize clinical, basic histomolecular, and treatment variables and their impacts on survival of DHG H3G34, a systematic review was undertaken. PubMed, Embase, and Google Scholar were searched for English articles published between January 1, 2012, and June 30, 2021. Eligible studies included patient(s) of any age diagnosed with an H3 G34-mutant brain tumour with at least one measure of survival or progression. A protocol was prospectively registered in PROSPERO (CRD42021267764) and PRISMA guidelines were followed. RESULTS: 27 studies met criteria for inclusion (13 pediatric-focused, 3 adult-focused, and 11 all ages). 135 unique patients with DHG H3G34 were included (118 G34R, 8 G34V, and 9 determined via methylation alone). Median age at diagnosis was 15.8 years (IQR=13.3-22.0). At presentation, 90% had localized disease. Co-occurring alterations included *ATRX* mutation 93%, *TP53* mutation 88%, *PDGFRA* mutation 46%, *PDGFRA* amplification 13%, and *MGMT* promoter methylation in 70%. 89% of patients reported progressive disease with a median time-to-progression of 10.0 months. At last follow-up, 71% had died. Median time from progression to death was 5.0 months (IQR=3.0-12.0). Median overall survival was 17.3 months (95% CI 13.5-21.1) with a 1-, 2-, 3-, 5-year survival of 75, 39, 24, and 12%, respectively. Factors found to influence survival duration were presence of *MGMT* promoter methylation (HR=0.48, 95% CI 0.25-0.90) and less than near-total resection upfront (HR=3.59, 95% CI 2.07-6.22). CONCLUSION: This review highlights the poor prognosis, available survival measures, important prognostic features of DHG G34, and serves as a baseline for future clinical trials, though further study to identify prognostic biomarkers is needed.

HGG-06. PHASE 2 STUDY OF VELIPARIB AND LOCAL IRRADIATION, FOLLOWED BY MAINTENANCE VELIPARIB AND TEMOZOLOMIDE, IN PATIENTS WITH NEWLY DIAGNOSED HIGH-GRADE GLIOMA WITHOUT H3 K27M OR BRAF MUTATIONS: A REPORT FROM THE CHILDREN'S ONCOLOGY GROUP ACNS1721 STUDY

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BACKGROUND: The outcome for pediatric patients with high-grade glioma (HGG) remains poor. Veliparib, a potent oral PARP1/2 inhibitor, enhances the activity of radiotherapy and DNA-damaging chemotherapy.

Preclinical data indicates that veliparib crosses the blood-brain-barrier and enhances the efficacy of radiotherapy and temozolomide in IDH mutant and wild-type HGG models. ACNS1721 was a single-arm, non-randomized phase 2 clinical trial designed to determine whether treatment with veliparib and radiotherapy, followed by the poly (ADP-ribose) polymerase (PARP) inhibitor veliparib and temozolomide, improves progression-free survival (PFS) in pediatric patients with newly diagnosed HGG without H3 K27M or BRAF mutations compared to patient level data from historical cohorts with closely matching clinical and molecular features. METHODS: Following surgical resection, newly diagnosed children with non-metastatic HGG were screened by rapid central pathology review and molecular testing. Eligible patients without somatic H3 K27M or BRAF mutations were enrolled on Stratum 1 (IDH wild-type) or Stratum 2 (IDH mutant). Protocol radiochemotherapy consisted of involved field radiotherapy with concurrent veliparib at 65 mg/m^2 twice daily. Adjuvant chemotherapy consisted of up to 10 cycles of veliparib 25 mg/m^2 twice daily and temozolomide 135 mg/m^2 once daily for 5 days every 4 weeks. RESULTS: Both strata were closed to accrual for futility after planned interim analyses. Among the 23 eligible patients who enrolled on Stratum 1 and received protocol therapy, the 1-year progression-free survival (PFS) was 0.29 (SE = 0.09) and 1-year overall survival (OS) was 0.67 (SE = 0.10). Among the 14 eligible patients who enrolled on Stratum 2 and received protocol therapy, the 1-year PFS was 0.57 (SE = 0.15) and 1-year OS was 0.90 (SE = 0.09). **CONCLUSION:** Rapid central pathology review and molecular testing was feasible. The protocol therapy was well tolerated but failed to improve outcome compared to clinically and molecularly matched historical control cohorts.

HGG-08. LORLATINIB FOR THE TREATMENT OF ALK FUSION POSITIVE INFANT HIGH GRADE GLIOMA

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BACKGROUND: High grade gliomas (HGG) are very rare in the infant age group with approximately 800 cases diagnosed in the USA and Europe each year. Histologically, HGG in infants resemble HGG in older children and adults but have distinct molecular features like ALK, NTRK, MET and ROS1 fusions. HGG in infants have superior outcomes compared to older age groups (5-year overall survival >50%) when treated with a radiation sparing regimen. Here we present the unique treatment course for an infant with ALK fusion positive HGG, including molecularly targeted therapy. CASE DESCRIPTION: A 3-month-old African-American female presented with acute onset vomiting, right facial droop and focal seizures. MRI of the brain revealed a right frontal intraparenchymal mass. Upfront gross total resection (GTR) was performed and histologic diagnosis of epithelioid glioblastoma was made. The molecular analysis of the tumor showed ZNF397-ALK fusion. The patient was treated with a radiation sparing regimen consisting of Carboplatin 8 mg/kg x 2 days and Etoposide 3 mg/kg x 3 days for 6 cycles. The patient tolerated the chemotherapy and had no evidence of disease recurrence at the completion of chemotherapy. However, 8 months after completion of therapy, she had a localized relapse and underwent a second GTR. Repeat molecular analysis confirmed the presence of ZNF 397-ALK fusion. She was started on Lorlatinib at 95 mg/m2/day once a day. She continued on the medication for 15 months and had no evidence of disease at the end of 15 months. During the course of her treatment, she had excessive weight gain (CTCAE grade-3) despite dose reduction. CONCLUSION: Infant high grade gliomas have a high prevalence of gene fusions including ALK fusions. This case shows that these fusions may be amenable to molecularly targeted treatments and should be studied in prospective clinical trials.

HGG-09. MICRORNAS EXPRESSION PROFILE IN MENINGIOMA 1 (MN1) GENE ALTERED ASTROBLASTOMA

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Astroblastoma is a rare glial neoplasm arising more frequently in young, predominantly female, patients and with unclear clinical behavior and outcome. The diagnostic molecular alteration is the rearrangement of meningioma 1 (MN1) gene.However, little is known about the specific mechanism of tumor development driven by such genetic change. microRNAs (miRNAs) are important gene expression regulators with strong implications in several biological processes. In this study we investigated the microRNAs' expression and regulation in MN1 altered neoplasms. We collected a cohort of 14 formalin-fixed, paraffin-embedded (FFPE) tumor samples histologically defined classified as astroblastoma. The DNA methylation analysis showed that only 8 cases harbored the MN1 rearrangement characteristic of astroblastoma. The 8 MN1 altered tumors were analyzed for their expression pattern of miRNAs by Nanostring technology. Thirty-nine deregulated miRNAs were found in the 8 astroblastomas compared to normal brain tissue. In order to understand the underlying mechanisms of the miRNAs aberrant expression, we first investigated the methylation status of themicroRNA promoters. Thirty-two out 39 deregulated miRNA resulted epigenetically regulated. with methylation status coherent with microRNA expression in 14/32 miRNAs.. Secondly, we investigated the hypothesis of a genomic alteration as a reason for the abnormal expression of the remaining 18/32 deregulated miRNAs by analyzing the Copy Number Variation (CNV) of tumor samples. but no alteration was found on miRNAs chromosome loci. Finally, we identified validated targets of the 32 deregulated miRNAs and uncovered biological processes putatively correlated to miRNA target genes, clinically and pathologically relevant in MN1-altered astroblastomas. Our findings shed light on the biology of this rare disease with potential implications on prognostic markers and therapy.

HGG-10. EFFICACY OF CONVECTION-ENHANCED DELIVERY OF GB-13 (IL13.E13K-PE4E) IN AN ORTHOTOPIC XENOGRAFT MODEL OF HIGH-GRADE GLIOMA IS PREDICATED ON IL-13RA2 EXPRESSION.

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High-grade gliomas (HGG) encompass a large proportion of malignant tumors within the central nervous system. Despite advances in our understanding of underlying disease mechanisms, the prognosis remains dismal and efficacious therapies are lacking. As such, there is a dire, unmet, gap in clinical practice for treating this devastating disease. Here, we performed convection-enhanced delivery (CED) of GB-13 (also known as IL13.E13K-PE4E), a tumor-specific immunotoxin, into the mouse brain in an effort to assess safety and efficacy. Fifty-five nude mice were inoculated with cells from 3 distinct patient-derived HGG cell lines (low, medium and high IL-13Rα2 expression). After tumor size reached a pre-determined threshold, mice underwent stereotactic cannula placement into the tumor followed by a single 40-min ramped infusion (rate 0.2-0.8 ul/min) of GB-13 (volume of infusion 20 ul) at concentrations ranging from 5 to 50 ug/ml. Tumor progression was monitored semiweekly and animals were euthanized at the indication of progressive neurologic deficit. All animals tolerated the infusions without exhibiting any neurological changes. GB-13 decreased tumor burden and prolonged survival in a manner strongly associated with IL-13Rα2 expression. While no survival benefit was observed in animals harboring IL-13Rα2-low expressing HGG, IL-13Rα2-medium and -high animals lived significantly longer after GB-13 infusion than vehicle-treated animals (median survival prolongation >25 days). Postmortem examination of the brains revealed no morphological changes beyond the site of the cannula tract. While GB-13 decreased cell proliferation and increased the number of apoptotic cells, neuronal cell density in ipsilateral brain regions was retained and no monocyte infiltrate was evidenced following GB-13 exposure. These findings indicate that a single therapeutic infusion of GB-13 administered by CED is well tolerated and underscore the potential of IL-13Rα2-targeted therapies in a subset of HGG with increased IL-13Rα2 expression.

HGG-11. CLINICAL CHARACTERISTICS AND CLINICAL EVOLUTION OF A LARGE COHORT OF PEDIATRIC PATIENTS WITH PRIMARY CENTRAL NERVOUS SYSTEM (CNS) TUMORS AND TROPOMYOSIN RECEPTOR KINASE (TRK) FUSION.

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