

of whole exome sequence that iGCTs frequently harbored mutations in the KIT gene and its downstream MAPK/PI3K pathway, regardless of tumor subtype. However, no mutations were detected in about one-quarter of germinomas and half of non-germinatous germ cell tumors. A genome-wide methylation profiling revealed that only germinomas exhibited extreme DNA hypomethylation among iGCTs. Moreover, in mixed iGCT tumors which contained more than one tumor subtypes, each component exhibited distinct methylation status depending on the subtype, while they shared the same mutations. These data suggested that not only mutations in the coding region as previously reported, but also genetic alterations in regulatory regions including promoters and enhancers as well as non-coding RNA genes may be involved in the tumorigenesis of iGCTs. In order to comprehensively search for driver gene alterations, we performed whole genome sequence in 18 paired tumor blood samples from iGCT tumors (16germinomas and two yolk sac tumors (YST)) registered in the Intracranial Germ Cell Tumor Genome Analysis Consortium. In a preliminary analysis of four cases, YSTs harbored a significantly higher number of structural abnormalities, compared with germinomas. Of note, 62 structural abnormalities were clustered within the small genomic region of 95Mb at 1q21-44 in one YST case, suggesting a possibility of chromothripsis. A full analysis of somatic alterations is underway and will be reported.

GCT-35. SALVAGE CRANIOSPINAL IRRADIATION FOR RECURRENT GERMINOMAS

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BACKGROUND: The treatment strategies for recurrence has not been established. **PURPOSE:** To clarify the tumor control and complications of salvage craniospinal irradiation (CSI) for recurrent germinoma. **METHODS:** We retrospectively reviewed the medical record. Among 153 germinomas treated in Tohoku University Hospital since 1983, 22 had recurrence of germinoma. At first recurrence, 7 cases received CSI, whereas 15 cases did chemotherapy and/or radiation therapy other than craniospinal field (non-CSI). CSI was performed at 24 Gy/ 12 fractions or 30 Gy/ 25 fractions. **RESULTS:** CSI had statistically significant better recurrence-free survival rate after recurrence than non-CSI (100% vs 33%, p<0.001: log-rank test). In addition, tumor control was obtained in all of four cases with the failure after non-CSI treatments for recurrence. The late complications of these 11 cases were examined. The local dose before CSI was 24- 50 Gy, and the median interval from last irradiation to CSI was 33 months. Median follow-up period after CSI was 126 months. Three patients developed newly developed visual or cognitive deficits. These patients received high-dose irradiation at initial treatment or multiple treatment before CSI. There were no late complications in the cases which had prior chemotherapy and 24 Gy of irradiation to whole ventricle only before CSI. **CONCLUSION:** Low dose CSI for the first recurrence of germinoma is effective and safe in the cases treated by chemotherapy and low dose irradiation to whole ventricle only.

GCT-36. TREATMENT RESULTS AND RADIATION-INDUCED TUMORS IN CASES OF CENTRAL NERVOUS SYSTEM GERM CELL TUMOR: A LONG-TERM FOLLOW-UP STUDY IN KUMAMOTO PREFECTURE

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INTRODUCTION: Central nervous system germ cell tumor (GCT) is one of the pediatric brain tumors. Although there have been epidemiological studies in the past, long-term prognosis and the late effects remained unclear. In this study, we examined GCT over the past 41 years in Kumamoto prefecture. **METHODS:** Epidemiological features and complications with radiation-induced tumors were searched in patients diagnosed with GCT in the 41-year period from 1977 to 2018. **RESULTS:** There were 93 patients diagnosed with GCT. These cases were divided into 14-year periods before and after incorporation of chemotherapy into the treatment, and the results for germinomas were compared. An improvement in the 10-year survival rate from 12 of 23 cases (52.2%) between 1977 and 1991 to 19 of 28 cases (67.9%) between 1992 and 2006 was observed. The 10-year survival rate for germinoma cases that received medical treatment during a more recent 5-year period between 2004 and 2009 increased to over 90%. However, 10.3% of all long-term survivors of GCT developed radiation-induced glioblastoma. The examination results showed that regardless of the tumor type,

patients who received a high dose of radiation during their initial treatment developed the complication of radiation-induced glioblastoma within 10 to 25 years after their initial treatment. **CONCLUSION:** This study suggests that the long-term survival rates for GCT are improving but the rate of radiation-induced glioblastoma in these cases are too high to be ignored. Long-term follow-up of at least 10 years is essential to effectively evaluate the details of treatment for pediatric brain tumors.

GCT-37. PREVALENCE OF AUTISM SPECTRUM DISORDER AND OTHER NEURODEVELOPMENTAL DISORDERS IN PEDIATRIC PATIENTS WITH INTRACRANIAL GERM CELL TUMORS

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PURPOSE/OBJECTIVE(s): Intracranial germ cell tumors (IGCTs) are rare tumors of the central nervous system with peak incidence around puberty. Due to the developmental origins of IGCTs, we investigated the prevalence of neurodevelopmental disorders (NDDs), including autism spectrum disorder (ASD), in our retrospective institutional cohort of patients diagnosed with IGCTs. **MATERIALS/METHODS:** A retrospective review of medical records was conducted for 105 patients who were diagnosed with IGCTs and treated at Massachusetts General Hospital between 1998 and 2016. All patients with ASD had thorough neuropsychological assessment at the time of radiotherapy that confirmed their diagnoses. **RESULTS:** Median age at diagnosis was 12.8 years (range: 4.3–21.6) and median follow-up time was 4.7 years (range: 0.4–15.8). Seventeen patients with IGCTs were diagnosed with NDDs prior to cancer diagnoses, including five patients with ASD, and three patients with chromosomal abnormalities, including one patient with Down syndrome. Interestingly, four of five patients with ASD developed pure germinomas, giving an ASD prevalence rate of 6.5% and 2.3% in the pure germinoma and NGGCT cohorts, respectively. All other patients had no known diagnoses of NDDs. **CONCLUSIONS:** Our study found 17 patients with IGCTs were diagnosed with NDDs prior to their cancer diagnoses. An ASD prevalence of 6.5% in the pure germinoma cohort is more than three-fold greater than the national prevalence, suggesting there may be an association between ASD and pure germinomas. Future prospective studies with larger cohorts are still needed to examine associations between NDDs and ASD and IGCTs.

GCT-38. RELAPSE PATTERNS OF INTRACRANIAL GERMINOMAS BEFORE AND AFTER ENDOSCOPIC ERA

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PURPOSE: We evaluated the relapse patterns of CNS germinomas before and after introducing neuroendoscopic biopsy in 2000. **METHODS:** We retrospectively assessed the relapse patterns of 57 patients treated as pure germinoma or germinoma with STGC between 1980 and 2019 at University of Tsukuba, partially containing the patients of the previous report (Takano S et al., World Neurosurg, 2015). Median age was 15 y.o.(7y.o.-38y.o.), and men was 80.7%. Tumor locations were pineal 35, sellar 19, basal ganglia 3, others 11. Group A;1980~1999 was 20, and group B;2000~2019 was 37. From 1980 to 1994, whole brain irradiation(WB) 30.6 Gy plus whole ventricle irradiation(WV) 19.8 Gy. From 1995 to 1999, WV 26~30.6 Gy with Chemotherapy(Chem) or Chem alone. Since 2000, Chem for 3 kurr with WV 24~30.6 Gy, and 6~19.8 Gy as local boost to residual lesion. **RESULTS:** Follow up periods were median 121 M(4.5M~386M; group A), and median 89 M(4 M~231 M; group B). Six patients(30%) recurred in the group A, as ex field 4(1;brain and extramedullary, 1;brain and paranasal sinus, 1;LV & third ventricle, 1;extramedullary), in field 1(LV). Chem only 1(LV & third ventricle). Two patients(5.4%) recurred in the group B, as ex field 2(1;intramedullary, 1;extramedullary). The group A showed CR;18, PR;1, Dead;1(Dissemination), and the group B showed CR;35, PR;1 Dead;1(Encephalopathy). **CONCLUSION:** WV and Chem prevented extrafield recurrence keeping good quality of life. Neuroendoscopy biopsy with ETV did not increase CSF seeding.

GCT-40. PROGNOSTIC FACTORS FOR PATIENTS WITH RELAPSED CENTRAL NERVOUS SYSTEM (CNS) NON-GERMINOMATOUS GERM CELL TUMORS (NGGCTS)

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