CASE REPORT

Thoracic spinal meningioma in a child with Down syndrome: A case report and review of the literature

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Abstract
Down syndrome is the most common genetic chromosomal disorder and occurs in one out of every 700 newborns. It is well-established that individuals with Down syndrome exhibit a unique tumor profile. These individuals are predisposed to certain neoplasms, such as leukemia and other hematological malignancies. However, solid tumors are exceptionally rare. Central nervous system (CNS) tumors in individuals with Down syndrome have been reported in only a small number of case reports. The majority of these tumors are gliomas and germ cell tumors. Meningiomas have yet to be reported in Down syndrome. We report the first case of a meningioma tumor in an individual with Down syndrome. We present a case of spinal meningioma in a 14-year-old boy with Down syndrome.

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1. Introduction

Down syndrome is the most common genetic chromosomal disorder and occurs in one out of every 700 newborns [1]. It is well-recognized that individuals with this chromosomal disorder exhibit a unique tumor profile. These individuals have a greater risk of developing hematological malignancies such as acute lymphoblastic and acute megakaryoblastic leukemias. These tumors are 19-fold more common among individuals with Down syndrome than in the
normal population [2]. Testicular cancer is also markedly more prevalent among individuals with Down syndrome. However, other solid tumors are generally uncommon [3,4]. These observations clearly indicate a role of genetic factors in this altered susceptibility. Such genetic factors remain poorly understood. Tumors of the central nervous system (CNS) in individuals with Down syndrome have been reported in the literature in only a few case reports, and the reported tumors are primarily gliomas and germ cell tumors. Meningiomas have yet to be reported. Here, we present a case of a 14-year-old boy with Down syndrome who was diagnosed with a thoracic spine meningioma. This case report is the first published description of a meningioma in a patient with Down syndrome.

2. Case

A 14-year-old boy known to have trisomy 21 (Down syndrome) based on his morphological features presented with a 2-year history of progressive spastic paraparesis. His weakness progressed in the 4 months before presentation at our institute. He became wheelchair-bound with urinary incontinence. This presentation was initially thought by the referring hospital to be of musculoskeletal origin and related to his genetic disorder. He was overweight with a BMI of 43. He also complained of back pain for the past few months. The patient and his family denied any history of trauma, upper limb symptoms, exposure to ionized radiation, or any family history suggestive of neurofibromatosis disorders or CNS tumors. He went through multiple inpatient and outpatient physiotherapy programs with no clinical improvement, and his symptoms continued to deteriorate with time. On physical examination, the patient displayed a significant mental delay for his age. He was able to communicate with simple dialog only. He had the classical morphological features of Down syndrome in his face, neck, hands, and soles. No obvious cutaneous stigmata suggestive of neurofibromatosis were observed. Cranial nerve examination revealed no obvious abnormalities. An examination of the upper limbs was within normal limits. In his lower limbs, he had bilateral spastic weakness with a motor power of 2–3 on a scale of 5 proximally and 3/5 distally. He had impairment of all sensory modalities in the lower limbs with a partial sensory level at T4. Due to his lower limb weakness, he had been wheelchair-bound for the last 3 months. His muscles tone was increased with brisk deep tendon reflexes, a sustained ankle clonus and an up-going bilateral Babinski’s sign. Chromosomal analysis in our institute confirmed the karyotype of trisomy 21; 47,XY, +21. Magnetic resonance Imaging (MRI) of the thoracic spine revealed an intradural extramedullary dural-based mass measuring 3 cm in length that was compressing and displacing the spinal cord anteriorly. The lesion extended from the vertebral body level of T5–T6. The lesion was isointense on T2-weighted (A) and T1-weighted images with homogenous enhancement following intravenous gadolinium injection. The lesion also had a small dural-based tail [Fig. 1]. The radiological features were highly suggestive of a spinal meningioma. MRI of the brain and the rest of the spine revealed no other lesions. The patient underwent a surgical intervention that included T5 and T6 bilateral laminectomies, a midline dural incision and resection of the dural-based lesion with coagulation of the tumor bed (Simpson grade II). Intralesional calcifications were noted. The surgery was uneventful with no intraoperative complications. A few days postoperatively, he experienced a cerebrospinal fluid leak that was managed with a temporary lumbar drain. Histopathological study revealed classical transitional meningothelial cells with the psammomatous subtype in many areas [Fig. 2]. His physical evolution was very satisfactory. He exhibited gradual Figure 1  Sagittal MRI showing a dural-based lesion compressing the spinal cord at the level of T5–T6. The mass is isointense on T2-weighted (A) and T1-weighted images with homogenous enhancement following contrast injection (B).

Figure 2  This figure illustrates the arrangement of the cells in a whirling pattern. The cells have round to oval nuclei and exhibit nuclear inclusions in some places. Variable numbers of calcified psammoma bodies were also identified (H&E stain).
3. Discussion

In this case report, we presented a unique case of a meningioma encountered in a boy with Down syndrome (trisomy 21 karyotype). This is the first case report of a meningioma anywhere in the CNS that has been reported in an individual with this chromosomal abnormality. Individuals with Down syndrome have a unique tumor profile. In a Japanese population study of more than 112 benign and malignant tumors in Down syndrome, hematological malignancies comprised the vast majority and accounted for 87 (78%) of the reviewed cases. Only 3 cases of CNS tumors were encountered. Two of these cases were germ cell tumors, and one case was reported as unknown [3]. In a comprehensive review of the literature published in 1998, Satgé et al. reviewed all reported tumor cases in Down syndrome prior to 1998. The review collected 26 CNS tumors that had been reported in the literature. These tumors composed of 9 (35%) gliomas, 6 (23%) germ cell tumors, and 11 (42%) other different types of CNS tumors, none of which were meningiomas [4]. We reviewed all PubMed indexed literature after that date for reports of CNS tumors associated with Down syndrome and found no reports of a meningioma tumor.

Evidence explaining the unique tumor profile in Down syndrome remains sparse. It is believed that mutations in GATA1 (a gene that encodes an essential transcription factor for the proper development of hematopoietic megakaryocytes and other cells) are largely responsible for the predisposition to transient myeloproliferative disorder and acute megakaryoblastic leukemia in Down syndrome [5]. More recent studies have implicated JAK2 mutations in acute lymphoblastic leukemia associated with Down syndrome. In one study, this mutation was present in 18% of the patients, and it was also correlated with early disease manifestation [6]. Regarding the notable rarity of solid tumors in Down syndrome, it has been suggested that increased expressions of genes on chromosome 21 that encode endogenous angiogenesis inhibitors provides at least a partial explanation. These antiangiogenic genes include COL18A, Adam TS-1, and DCR1, all of which have been reported to be elevated in Down syndrome [7]. Furthermore, the S-100 b protein is also encoded by a gene localized to chromosome 21. This protein has been shown to inhibit the growth of human neuroblastoma cell lines and might be a factor that contributes to the low incidence of neuroblastoma in particular [8]. Additionally, the merlin/schwannomin tumor suppressor gene mutation in neurofibromatosis type 2 is known to correlate with the growth of tumors, such as schwannomas and meningiomas [9]. Such a gene mutation has yet to be reported in Down syndrome.

In the adult population, meningiomas represent 30% of all primary CNS tumors [8]. However, in children and adolescents, meningiomas account for less than 5% of all CNS tumors [10]. Meningiomas in the spine are uncommon and account for approximately 10% of all meningiomas [9]. Nevertheless, they represent approximately 20% of all intradural spinal tumors and are the second-most common tumor type after schwannomas [11]. In the medical literature, approximately 60 cases of spinal meningioma have been reported in the otherwise normal pediatric population. A case series of 10 cases of spinal meningiomas in children was published from China [12]. A male predominance is evident in this study (8M-2F), which contrasts the adult population in which a clear female predominance with a ratio of more than 3:1 has been observed [11]. In terms of prognosis, pediatric patients exhibit an increased rate of recurrence. The rate of recurrence in the aforementioned Chinese study reached 70% (7/10 patients) [12].

4. Conclusions

Meningiomas are notably rare in Down syndrome. Spinal meningiomas can be easily missed until late in the course of the disease. The presence of any atypical presentation such as upper motor neuron weakness should be taken as indications for radiological investigations to exclude the possibility of this rare but treatable spinal lesion.

Conflict of interest

The authors have no conflicts of interest.

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References


