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A Case of Spinal Ependymoma Developed in the Extramedullary Location: A Case Report and Literature Review

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Abstract

Intradural extramedullary (IDEM) ependymoma except for tumors originated from the filum terminale or conus medullaris is rare. The present study showed a case of IDEM ependymoma. A 16-year-old boy was referred to our hospital with a complaint of right hypochondriac pain and motor weakness in his right leg. MRI revealed a solitary intradural tumor at Th5–8 level with syringomyelia at Th2–4 level. Microscopic total tumor resection was performed with right hemi-laminectomy of Th4–9. Histological diagnosis was ependymoma (WHO grade 2). Although his leg weakness was worsened transiently, he showed improvement in leg weakness being able to go up and down the stairs 1 month after the surgery. There was no tumor recurrence until now, 7 years after the surgery, without any adjunctive therapies. A total of 44 cases of IDEM ependymoma had been reported in the past literatures. They are thought to arise from ependymal cells which remained during the process of neural tube closure. Like intramedullary ependymomas, most of the IDEM ependymomas have clear border to surrounding tissue and often removed completely. However, a small number of recurrences and malignant transformations had been reported after complete resections despite benign histological features tumors. In the case of totally resected low grade IDEM ependymoma, it is thought to be reasonable to perform long-term periodical radiographic follow-up without postoperative adjunctive therapy.

Keywords: ependymoma, intradural extramedullary spinal cord neoplasms

Introduction

Ependymoma is the most common spinal intramedullary tumor in adults and arises from ependymal cells at the central canal of spinal cord. Except for the tumors that occurred in the filum terminale or the conus medullaris, spinal ependymoma rarely develops as an intradural extramedullary (IDEM) tumor. IDEM ependymoma had been described only in some case reports; therefore, there is no enough knowledge on its clinical characteristics.

We reported a case of IDEM ependymoma surgically treated in our hospital with a review of the past literatures.

Case Presentation

A 16-year-old boy was referred to our hospital from an orthopedic clinic with a complaint of right hypochondriac pain and motor weakness in his right leg. He had no specific past medical history. Three years before, he had recognized asymptomatic muscle atrophy of the right leg, and he came to disable to run 10 months before. Right hypochondriac pain appeared 2 months before. His neurological symptoms at the first time visit are described as follows:

1) Muscle weakness in his right lower limb valued as MMT 4/5 in each.

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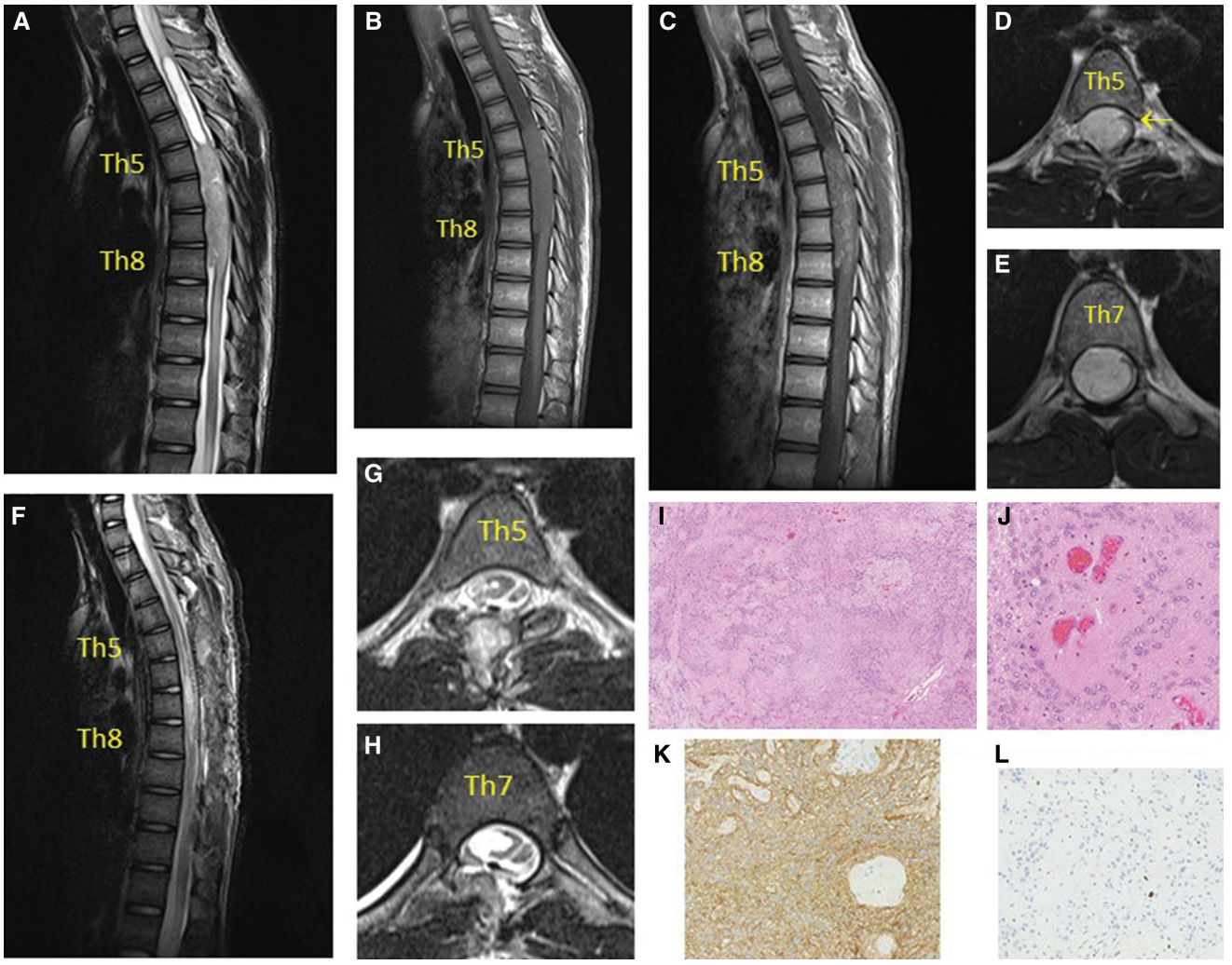

Fig. 1 Preoperative and postoperative MRI and pathological findings. (A–C) Sagittal scan of the thoracic spine. An intradural tumor at Th5–8 level accompanied by syrinx cranial to the lesion was observed. The tumor showed hyperintensity in T2-weighted image (A), isointensity in T1-weighted image (B), and slight heterogeneous enhancement with contrast medium (C). (D and E) Axial scan of the thoracic spine. Spinal cord compressed in crescent shape, and at Th5 level the ventral part of the deformed spinal cord was involved into the tumor (D; arrow). (F–H) T2-weighted images of postoperative MRI (sagittal scan (F) and axial scans (G and H)). The tumor was completely resected, and compression of the spinal cord was improved with some residual deformity. (I and J) Microscopic view of the stained tissue specimens (hematoxylin & eosin). They showed perivascular pseudorosettes, which is a typical characteristic of ependymoma. (K and L) Immunohistochemical analysis of the specimens (GFAP (K) and MIB-1 (L)). GFAP-positive cells were observed especially in perivascular region (K). MIB-1 positive cells were exceptional (L).

2) Sensory disturbance in body trunk and lower limbs on both sides with niveau at Th6 dermatome.
3) Abnormal exaggeration of patellar tendon reflex and achilles tendon reflex on both sides.
4) No vesico-rectal disturbance.

MRI of thoracic spine revealed a solitary intradural tumor at Th5–8 level that showed iso-intensity in T1-weighed image and hyper-intensity in T2-weighed image compared with the spinal cord, and was slightly enhanced with Gd-DTPA (Fig. 1A–1C). In the axial section, the lesion occupied most of the thecal sac compressing the spinal cord unilaterally to the left side indicating that the tumor had extramedullary location. Demarcation between the lesion and the spinal cord was clear. The compressed spinal cord was deformed in crescent shape (Fig. 1D and 1E), and at Th5 level the ventral part of the deformed spinal cord was involved into the tumor and covering some part of the tumor as is the case

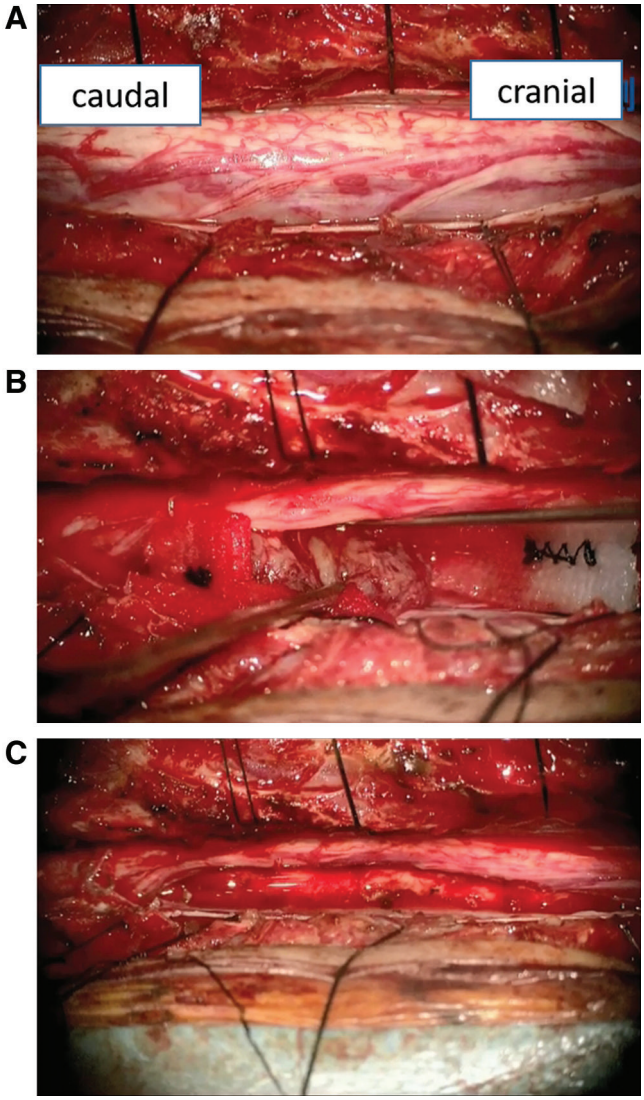

Fig. 2 Intraoperative view with microscope. (A) After completing laminectomy, the tumor compressing the spinal cord was directly observed without myelotomy. A yellow broken line indicates the tumor. (B) The tumor was grayish and easy to bleed. The lesion could be easily dissected from the spinal cord using various dissectors. (C) The tumor was completely resected.

of intramedullary tumor (Fig. 1D). A syringomyelia was found cranial to the lesion at Th2–4 level (Fig. 1A). With these findings, this tumor was supposed to have natures of both intramedullary and extramedullary locations. The most possible diagnosis was ependymoma with extramedullary extension, and the differential diagnoses were subependymoma, neurinoma, and meningioma.

Microscopic tumor resection was performed with right hemi-laminectomy of Th4–9 (Fig. 2A). The extramedullary tumor was observed directly without myelotomy (Fig. 2B). The tumor was covered with the pia mater without any adhesion to the dura nor any connection to the nerve roots. Because dissection plane with the spinal cord was quite clear, microscopic total resection of tumor was achieved (Fig. 2C). The postoperative MRI showed total removal of the tumor and shrinkage of the syrinx (Fig. 1F–1H). Histological diagnosis was ependymoma (WHO grade 2) (Fig. 1I–1L). Immediately after the surgery, his leg weakness was worsened up to 2/5 in MMT evaluation on the right side and 4/5 on the left. Hypesthesia in his both legs was left unchanged. One month after the surgery, he showed improvement in leg weakness being able to go up and down the stairs by himself, and the leg hypesthesia also improved to be left only on the right side. Because the tumor was diagnosed as WHO grade 2 ependymoma and completely resected, we did not perform any adjunctive therapy. The periodical MRI scan has been performed, and there was no tumor recurrence until now, 7 years after the surgery.

Review of the Literatures

The case reports on IDEM ependymoma except for the lesion in the filum terminale and the conus medullaris were searched, and 44 cases in 41 articles were found finally.[1–41] Characteristics of all 45 cases (including the present case) are summarized in Table 1. There were more women than men (19 men and 26 women), and tumor location was mainly in thoracic level; two tumors were in cranio-cervical junction, six in cervical, 23 in thoracic, four tumors lay from cervical to thoracic level, and 10 cases showed multiple lesions. Patients showed pain most frequently, and paraparesis, paresthesia, and/or sensory loss were other main symptoms. Except for the cases of multiple lesions, in preoperative axial MRI images which were presented in 32 cases, the number of ventral lesions was almost equal to that of dorsal lesions (ventral: 10 and dorsal: 13), and six tumors located laterally and three were dumbbell-shaped tumors (Fig. 3).

The major approach to expose dura mater was laminectomy, and craniectomy was performed or combined with it in three cranio-cervical junction tumors.[14,27,30] In two of three cases of dumbbell-shaped ependymoma, additional technique to laminectomies was performed and they were described as an extended laminectomy or a spinosectomy.[26,34] A less invasive technique, hemilaminectomy was selected in three cases, including the present case, and complete resection of tumor was achieved in each case.[24,28] These three cases were two tumors located in dorsal-lateral of spinal canal and a tumor in lateral (the present case). In one case of thoracic

Table 1 Summary of characteristics of the reported IDEM ependymoma cases (including the present case)

	Number of cases
Total number	45
Sex	
Male : Female	19:26
Age	
10–19	3
20–39	18
40–59	18
60–	6
Level	
Cranio-cervical junction	2
Cervical spine	6
Cervical-thoracic spine	4
Thoracic spine	23
Multiple	10
Location (showed in axial plane)	
Dorsal (and medial or lateral)	13 (4 or 9)
Ventral (and medial or lateral)	10 (6 or 4)
Lateral	9
No detail (multiple or no axial image)	13
Diagnosis	
Myxopapillary ependymoma (WHO grade 1)	5
Ependymoma (WHO grade 2)	29
Tanycytic ependymoma (WHO grade 2)	2
Anaplastic ependymoma (WHO grade 3)	9
The site of adhesion or pia attachment (wrote in the records of surgeries)	
Cord	12
Root	3
Cord and root	1
No attachment	12
Intramedullary	7
No detail	10
Initial symptom	
Pain	35
Sensory loss	27
Paresthesia	20
Paraparesis sensory loss	18
Bladder and rectal disorder	13
Gait disturbance	8
Monoparesis	5
Upper limb weakness	7

IDEM: intradural extramedullary.

lesion, the combination of hemilaminectomy and costotransversectomy was selected to achieve complete resection.[4]

In 35 cases, operative findings on relationship between the tumor and surrounding structures were described. Seven tumors had intramedullary component. In 28 cases without intramedullary component, 16 tumors had adhesion or connection with surrounding structures as follows: there were connecting tissues with spinal cord in four cases and nerve root in two respectively; nerve root was involved in tumor in two, and attachment to pia was seen in nine. In 32 cases in which preoperative MRI axial images were available, operative findings were obtained in 26 cases (Fig. 3). None of the lateral type and dumbbell-type tumors was separated from spinal cord or root, but there was no significance about the frequency of adhesion between these two types and other location types (dorsal-medial, dorsal-lateral, ventral-medial, and ventral-lateral type) by Fisher's exact study using JMP Pro version 15.1.0 software (SAS Institute, Cary, NC, USA).

In many cases surgeon could specify the clear border of tumor using operative microscope. In 10 cases total resection of the tumor was not achieved. The reasons for tumor residuum in these 10 cases were as follows: four cases with intramedullary portion, four cases with multiple lesion or dissemination, one case with giant cystic lesion, and one case in which the tumor had firm adhesions with both spinal cord and nerve roots.

Histological diagnoses of the 45 tumors were 29 ependymoma (WHO grade 2), nine anaplastic ependymoma (WHO grade 3), five myxopapillary ependymoma, and two tanycytic ependymoma. Postsurgical treatment was performed in 13 cases that included six anaplastic ependymoma, six grade 2 ependymoma (three multiple lesions and three not completely resected), and one multiple myxopapillary ependymoma. On another view, in seven grade 2 ependymoma which was reported with residuum after surgery, five received adjutant therapy. Conventional radiotherapy was performed in 11 cases and proton emission therapy in one. Chemotherapy with carboplatin was performed in one case, and chemoradiotherapy with temozolomide or carboplatin was selected in one case in each. In 29 grade 2 ependymoma cases, 23 cases did not receive postsurgical treatment, and six cases received postsurgical treatments because of the tumor residue. In nine anaplastic ependymoma cases, three cases were observed without postsurgical treatment, and six cases received postsurgical treatment whether the tumor removals showed total resection. In five myxopapillary ependymomas, all of which showed

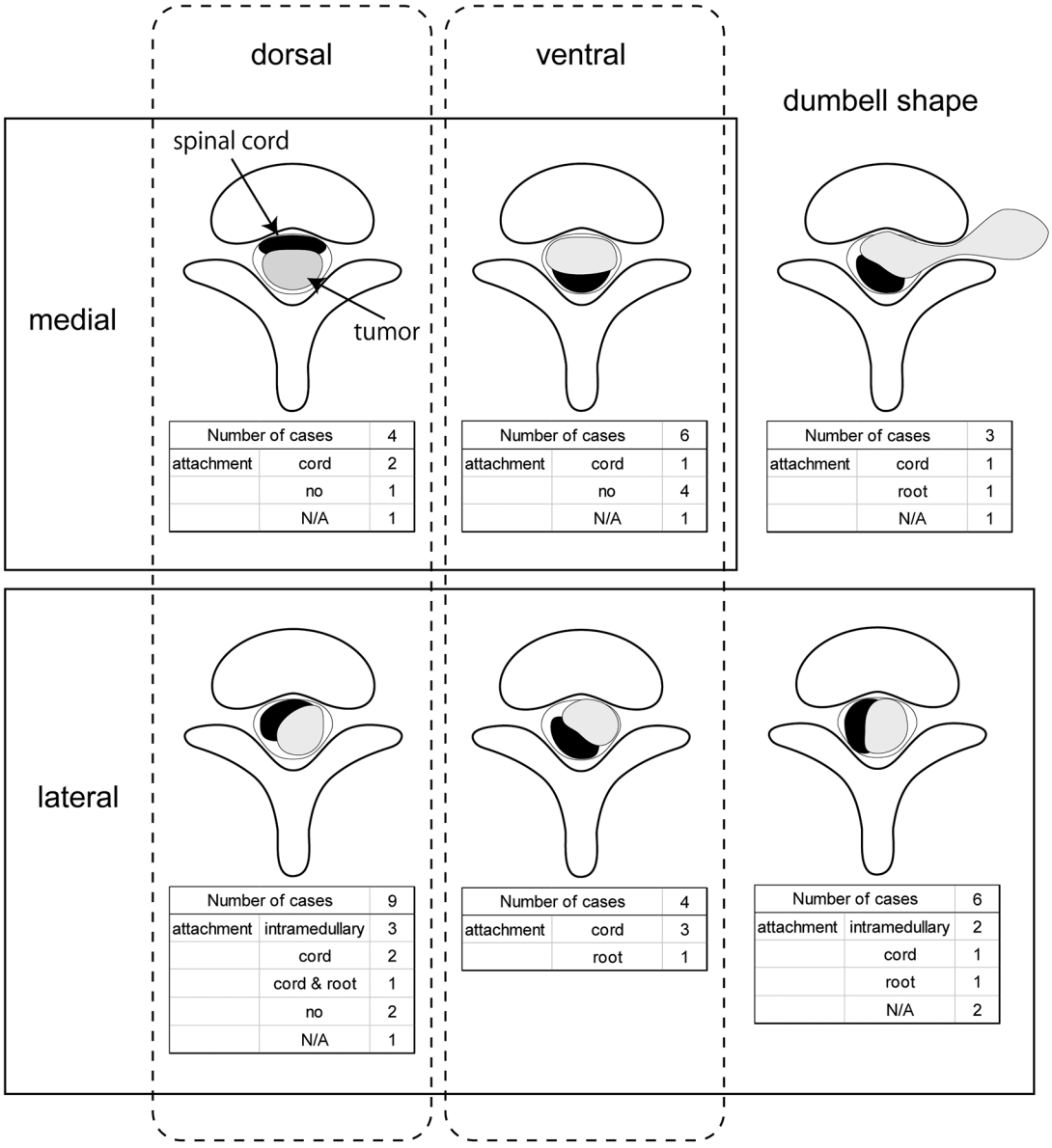

Fig. 3 The schema of classification of intradural extramedullary ependymomas based on the tumor locations. All 32 axial images which were obtained from reviewed articles were listed in this figure. Tumors were classified into 10 medial type, 19 lateral type, and three dumbbell-shaped tumors. Ten medial type tumors were separated into four dorsal-medial type and six ventral-medial type tumors. Nineteen lateral type tumors were classified into nine dorsal-lateral type and four ventral-lateral type tumors, and remaining six tumors were difficult in defining dorsal or ventral. The number of attachment portion of each tumor was counted and listed in tables in the figure. N/A: not available.

multiple lesions, one case received radiotherapy and the others were observed. Two tanycytic ependymomas were completely resected and the patients were observed without postsurgical treatment.

There were nine cases of recurrence. In four cases, malignant transformations from grade 2 to grade 3 lesions were observed. In other five recurrent cases, histological diagnoses were grade 2 ependymoma in two, and anaplastic ependymoma in three, and recurrence pattern was recorded as two intracranial metastases, two dissemination, and one drop metastasis. The intervals between initial surgery and recurrence were 6 months to 2 years.

Discussion

Ependymoma is thought to arise from ependymal cell. In the spinal cord, ependymal cells are mainly

arrayed at the central canal, but during the process of neural tube closure, some ependymal cells are supposed to remain and to become the origin of IDEM ependymoma.[2,11] In the present case, the spinal ependymoma was located extramedullary compressing the spinal cord unilaterally. This peculiar location implied the presence of heterotopic ependymal cells apart from the central canal as origins of tumor. In the review of IDEM ependymomas described by Das et al., they classified all 54 reported cases into four types, and showed "pure IDEM ependymoma" was the most common type (32 cases).[41] Like their report, our literature review revealed that almost all IDEM ependymoma had no connection with spinal cord, nerve root, or dura mater, and the present case was also thought to be "pure IDEM ependymoma."

In the first step of surgery, laminectomy was the most common technique to approach the dura maters and tumors, and extended technique was performed in some cases. However, some tumors which located laterally in spinal canal can be resected completely with hemilaminectomy. In preoperative imaging, it is difficult to distinguish IDEM ependymoma from meningioma or schwannoma. Sometimes it even shows dumbbell tumor pattern extending into paravertebral location.[13,15,26,34] In many cases, IDEM ependymoma was encapsulated and has no attachment with dura mater or nerve root, unlike meningioma or schwannoma, and thus this tumor was often removed completely. But, based on the review of the present study, it is difficult to decide whether a tumor attaches spinal cord or nerve root if there is no finding of intramedullary tumors. In summary, many IDEM ependymoma can be resected completely, but it is essential to confirm the presence of attachment during surgery, and maximum safe resection should be considered in the case with tight adhesion to a spinal cord or a nerve root.

Because of the small number of cases, there is no standard postsurgical treatment for IDEM ependymoma. Many cases were only followed-up with serial imaging study. If postsurgical treatment was needed, many authors selected radiotherapy, and many cases had been observed without recurrence. On the other hand, even in the cases of grade 2 ependymoma which was removed totally, unpreferable courses such as malignant transformation or drop metastasis were sometimes reported. According to these facts, in the case of totally resected low grade IDEM ependymoma, it is thought to be reasonable to perform long-term periodical radiographic follow-up without postoperative adjunctive therapy.

Conclusion

We reported a rare case of IDEM ependymoma. It was totally resected without major deterioration of neurological functions, and there was no recurrence for more than 7 years after the surgery. Further follow-up was thought to be necessary.

Conflicts of Interest Disclosure

The authors have no conflicts of interest.

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