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Case Report

The MRI manifestations of intramedullary germinoma of the spinal cord:a case report and review of the literature

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Abstract

Primary germinoma in the spinal cord is very rare. Preoperative diagnosis is important because germinomas are sensitive to radiation therapy and chemotherapy so that treatment trends and prognosis differ from other intramedullary spinal cord tumors. Preoperative radiologic diagnosis is very difficult because of this rarity. In this case a 22-year-old woman with a 4-month history of gradual numbness and weakness of both lower extremities was found to have a solid tumor in the thoracic cord between the T9 and T11 vertebral bodies. No other neoplastic lesion was found inside or outside the central nervous system. The patient underwent surgery, and the intramedullary lesion was almost totally resected. Serum HCG was elevated postoperatively without pregnancy. The pathological diagnosis was conclusively that of a germinoma. The previous 23 cases of primary spinal cord germinoma were reviewed for comparison.

Keywords: spinal cord; intramedullary germinoma; magnetic resonance imaging

Running title: The MRI manifestations of intramedullary germinoma of spinal cord

INTRODUCTION

Germinomas in the central nervous system are known to occur usually in the pineal or suprasellar regions and, less frequently, in the thalamus, basal ganglia, and other ventricular sites. Primary germinoma in the spinal cord is very rare. Preoperative diagnosis is important because germinomas are sensitive to radiation therapy and chemotherapy so that treatment trends and prognosis differ from other intramedullary spinal cord tumors. Herein, we reported a case of an intramedullary spinal cord germinoma in a young Chinese female, and review the literature.

CASE REPORT

A 22-year-old Chinese woman had a 4-month history of gradual numbness and weakness of both lower extremities, especially the left. Ten days prior to admission, she became aware of difficulty in walking and urinary incontinence. A neurologic examination revealed paraplegia in both lower extremities, pain and numbness at the left T9-T11 region. An increase of deep tendon reflexes and muscle tone with positive Babinski, Hoffman sign and ankle clonus in the bilateral lower extremities were noted. A decrease of sensation below the inguinal fold and urinary incontinence was also observed.

MR findings

MR images of the thoracic spine revealed a mass lesion in the spinal cord between the level of the T9 and T11 vertebral bodies with isointensity on T2WI and isointensity on T1WI, and heterogeneous enhancement on T1WI obtained after an intravenous injection of contrast medium, which indicated an intramedullary tumor. There were dot-like hyperintense areas within the lesion, suggesting small cysts(***Fig. 1-3***). MR imaging of the head and abdomen, and cavitas pelvis examination revealed no abnormalities.

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Image showed isointensity on T1WI mass at the level of the T9~11 vertebral body, There were dot-like areas of hypointensity on T1WI within the mass lesion, suggesting intratumoral small cysts.

Fig. 1 Sagittal T1-FSE MR image of the thoracic spine

Image showed isointensity on T2WI mass at the level of the T9~11 vertebral body, There were dot-like areas of hyperintensity on T2WI within the mass lesion, suggesting intratumoral small cysts.

Fig. 2 Sagittal T2-FRFSE MR image of the thoracic spine

Image showed a homogenous enhancement on T1WI obtained after an intravenous injection of contrast medium, the small cysts had not enhanced.

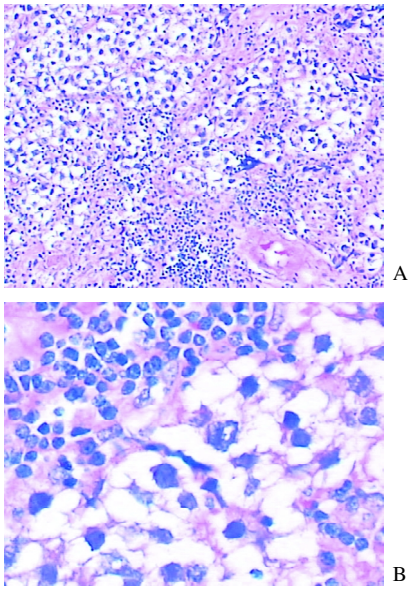
Fig. 3 Sagittal enhanced MR image of the thoracic spine

Surgery and Pathology

Laminectomy was performed from T9 to T11. The thoracic portion of the cord exposed after incision of the dura was enlarged and was occupied from T9 to T11 by an intramedullary tumor. There was no apparent spinal dissemination of the tumor. Although an attempt was made to resect the tumor completely, surgery was confined to partial resection because of the difficulty distinguishing between the tumor and the normal spinal cord.

Macroscopically, the resected tumor was pink and fragile, and some spinal cord was necrotic. On histo-pathologic examination, microscopic inspection of the specimens of the tumor revealed that the tumor tissues were composed of 2 distinct cell types. Large round cells with clear cytoplasm and central nuclei were admixed with small lymphocytes along fibrovascular septa (***Fig. 4***). The tumor was diagnosed conclu-sively as a germinoma.

An increase in the serum hCG level(89.1 mIU/mL, normal value < 0.7) was confirmed postoperatively. The patient received regional radiation therapy(40 Gy) to her spine and is being followed with serial MRI scans. Six months after completion of her course of radiation, MRI scans showed no evidence of residual or recurrent tumor.



A

B

A: HE, × 50; B: HE, × 200

Fig. 4 Tumor with sheets of epithelial cells and perivas-cular lymphoid infiltrate

DISCUSSION

Most germinomas arise intracranially, although extremely rare cases are found in the spinal cord. Preoperative radiologic diagnosis is very difficult because of this rarity. If these tumors are correctly identified, patients can be spared radical surgery, because germinoma are readily cured using radio and chemotherapy. Diagnosis requires a thorough workup of the patient in order to exclude a metastasis from a primary intra- or extragonadal tumor. In our case, the MR imaging of the head and abdomen, and cavitas pelvis examination revealed no abnormalities.

To our knowledge, there have been 23 previously published cases of primary germinomas in the spinal cord confirmed by surgery or biopsy. The frequency of germinomas appears to be higher in East Asia than in

Western countries[1]. The age, sex, clinical and MR imaging findings of the 24 reported cases and our case were summarized in ***Table 1***[2-23]. The ages of patients ranged from 5 to 43 years(25.58 ± 9.74 years old). There were 11 male and 13 female patients. Seventeen (70.8%) of the 23 cases were between 20 and 35 years of age. Therefore, primary spinal cord germinomas have a predilection for affecting a relatively older age group than primary intracranial germinomas that mainly affect children and young adults. In intracranial germinomas, 60-70% of cases occur in individuals under the age of 19 years. In 13 reported cases, the interval between onset of clinical symptoms and hospital admission was shorter than 6 months. This may indicate a rapid tumor progression. However, there have also been 5 reports of the slow progression of the disease(2-4 years).

Regarding tumor location, spinal cord germinomas have a strong predilection for the thoracic cord; all but 4 tumors were located at either the thoracic or thoracolumbar vertebral levels, 2 were located at cervical

Table 1 **Summary of previously reported cases of primary intramedullary spinal cord germinoma**

Case no.	Authors /year	Age/ sex	Tumor location	Duration of symptoms	HCG	MRI findings		
						T1WI	T2WI	Enhancement
1	Hisa et al. 1985	5/M	T11-L3	1 Month	Elevated	N.D.	N.D.	N.D.
2	Matsuoka et al. 1991	31/F	T12-L2	8 Months	N.D.	Isointense with small cysts	Not described	Clearly enhanced
3	Hanafusa et al. 1993	34/F	T10-T11	3 Years	N.D.	Isointense	Isointense	Not enhanced
4	Slagel et al. 1995	16/F	T11-L4	Several months	N.D.	N.D.	N.D.	N.D.
5	Matsuyama et al. 1995	34/F	T6-T8	4 Months	N.D.	Enlargement with a small cyst	Small cyst	Enhanced, margin not clear
6	Hao et al.1995	22/F	T11	6M	N.D.	Isointense	Hyperintense	heterogeneous
7	Itoh et al. 1996	24/M	T11-T12	2 Months	N.D.	Iso-and hypointense	Hypointense with hyperintense spots	Moderate
8	Ganslandt et al, 2000	29/M	Th12-L4	N.D.	Elevated	N.D.	N.D.	Enhanced
9	Miyauchi et al. 1996	24/M	T12-L3	4 Months	N.D.	N.D.	N.D.	Enhanced, homogenous
10	Horvath et al. 2001	43/M	L1-L2	2 Months	N.D.	Mass lesion	Mass lesion	
11	Hata et al. 2002	33/M	T7-T9	1 Month	N.D.	Slightly hyperintense	Hyperintense with peritumoral cysts	Enhanced, heterogeneous
12	Sasaki et al. 2002	32/F	T3-4	1 Year	Elevated	N.D.	Hyperintense	Enhanced
13	Zhu et al. 2002	7/M	T12-L1	1 Month	N.D.	N.D.	N.D.	Enhanced, homogenous
14	Chute et al. 2003	18/M	T6-T8	2 Years	Elevated	N.D.	Mildly hyperintense	Mild
15	Huang et al, 2004	18/M	C3-C6	2 Months	N.D.	N.D.	Heterogeneous, marked	Intense, slightly
16	Masaaki Takahashi 2005	22/F	L1-L2	3 Months	elevated	Isointense	Isointense	Enhanced
17	Watanabe et al, 2005	33/F	Th1-Th3	3 Years 9 months	N.D.	Isointense	Isointense with peritumoral Cysts	Moderate, heterogeneous, margin not clear
18	Y. Nakata,2006	35/M	Th6-Th7	4 Years 8 months	elevated	isointense	Hyperintense	Enhanced
19	Y. Nakata,2006	27/M	Th7-Th9	10 Months	elevated	isointense	Hyperintense	Enhanced
20	Shunsuke Onodera,2006	16/F	Th8 to Th12	5 Months	Elevated	Hypointense	Heterogeneous, mildly yperintense, small cysts	Mild, heterogeneous
21	Shunsuke Onodera,2006	16/F	Th9 to Th12	3 Months	slightly elevated	hypointense	slightly hyperintense	Moderate, homogeneous
22	Takeshi Aoyama, 2007	34/F	Th8-Th10	N.D.	slightly elevated	isointense	slightly hyperintense	Slight, homogeneous
23	Ka-Yen Yang, 2009	39/F	C2 to T1	7 Months	elevated	isointense	slightly hyperintense	Enhanced, heterogeneous
24	Present case	22/F	Th9-11	4 Months	Elevated	isointense	Isointense with small hyperintense cysts	Enhanced, heterogeneous

N.D. : Not described

levels, and the others at lumbar vertebral levels. Elevated level of beta-hCG in the CSF or serum was described in all of the 12 patients in whom beta-hCG assessment was done. Therefore, elevated level of beta-hCG strongly suggests a germinoma.

A preoperative MR imaging study was carried out in 22 cases. In 2 cases, the MR findings were described as a mass lesion or contrast-enhancing lesion[10-11], but the details were not mentioned. Among the remaining 20 cases, signal intensity of the tumor was described in 14 cases on T1-weighted images, and the major part of the tumor was isointense or hypointense in 13 cases, but slightly hyperintense in 1 case. In 17 cases on T2-weighted images, the tumor was hyperintense in 9 cases, isointense in 4, hypointense with hyperintense spots in 1, and heterogeneous in 2. Cysts or cystic cavities were observed in 6 cases, either on T1-or T2-weighted images. In 4 of the 6 cases, the cysts were small and located within the tumor[4,7]. In the other cases, the cystic cavities were found above and below the tumor[13,17]. Findings on contrast enhancement were described in 20 cases. Contrast enhancement was observed in 19 of the 20 cases. The signal intensity and enhancement pattern of the spinal cord germinoma varied among these cases.

It is difficult to draw conclusions on the characteristic MRI findings of primary spinal cord germinomas from these case reports because the signal intensity and enhancement pattern varied. However, these tumors tend to show iso-or hypointensity on T1-weighted images, iso-or hyperintensity on T2-weighted images, and contrast enhancement. They are solid lesions and sometimes have small cystic component within the tumor. Germinoma should be considered in the differential diagnosis in cases of rapid deterioration in young patients with intramedullary lesion. Because germinomas are highly sensitive to radiation and chemotherapy, radical resection of the tumor will not be required.

An ependymoma is the most frequent intramedullary tumor, followed by astrocytoma. Together they make up for about 95% of all intramedullary tumors[24]. The typical ependymoma is more common in the adult age group and is usually located in the cervical region, frequently associated with large satellite cysts, larger than those in germinomas. Ependymomas do enhance vividly and homogeneously, and have well-defined borders.

Astrocytomas are more common tumors in children and are usually located in the thoracic region. If a cystic component is present, it is typically an intratumoral one; however, satellite cysts and secondary hydromyelia are also observed. Moreover, a panmedullary infiltrating tumor is usually an astrocytoma. Ependymomas originate from the ependymal walls and as such are more centromedullarly located compared with astrocytomas. The mean size of the ependymoma corresponds to a mean height of three to four vertebral bodies(min. 2, max. 13), whereas astrocytomas are usually more extensive, with a mean height of 5.6 vertebral bodies[25].

A hemangioblastoma is the third most frequent intramedullary tumor. Hemangioblastomas can be found at any level. Among these intramedullary tumors, hemangioblastomas can be differentiated by their characteristic MR findings. Usually a spinal hemangioblastoma is composed of a highly vascular solid portion with small arteries, capillaries and large dilated draining veins. This tumor nidus consists mainly of endothelial cells and interspersed stromal cells. Accompanying this solid portion are large cysts lined by fibrillary cells. For these reasons hemangioblastomas are often easily identified.

CONCLUSIONS

In summary, intramedullary spinal cord germinomas usually affect patients between 20 and 35 years of age, and are commonly located in the thoracic or thoracolumbar region. MRI findings are usually nonspecific, and these tumors sometimes have small intratumoral cysts. Germinomas should be considered in the differential diagnosis of intramedullary spinal cord tumors because treatment trends and prognosis differ, especially when an intramedullary spinal cord tumor is found in the thoracic or thoraco-lumbar region in a young adult patient. An elevated level of beta-hCG in CSF strongly suggests a germinoma.

References

[1] Horowitz M, Hall W. Central nervous system germinomas. A review. *Arch Neurol* 1991; 48: 652-7.

[2] Hisa S, Morinaga S, Kobayashi Y, Ojima M, Chikaoka H, Sasano N. Intramedullary spinal cord germinoma producing HCG and precocious puberty in a boy. *Cancer* 1985; 55: 2845-9.

[3] Matsuoka S, Itoh M, Shinonome T, Tanimura A. Intramedullary spinal cord germinoma: case report. *Surg Neurol* 1991; 35: 122-6.

[4] Hanafusa K, Shibuya H, Abe M, Yamaura K, Suzuki S. Intramedullary spinal cord germinoma. *Rofo1* 1993; 59: 203-4.

[5] Slagel DD, Goeken JA, Platz CA, Moore SA. Primary germinoma of the spinal cord: a case report with 28-year follow-up and review of the literature. *Acta Neuropathol* 1995; 90: 657-9.

[6] Matsuyama Y, Nagasaka T, Mimatsu K, Inoue K, Mii K, Iwata H. Intramedullary spinal cord germinoma. *Spine* 1995; 20: 2338-40.

[7] Hao J, Zhu A, Gao H. Primary intramedullary spinal cord germinoma: a case report. *Chin J Neurosury*(in Chinese) 1995; 11: 186.

[8] Itoh Y, Mineura K, Sasajima H, Kowada M. Intramedullary spinal cord germinoma: case report and review of the literature. *Neurosurgery* 1996; 38: 187-90.

[9] Ganslandt O, Buchfelder M, Grabenbauer GG. Primary spinal

germinoma in a patient with concomitant Klinefelter's syndrome. *Br J Neurosurg* 2000; 14: 252-5.

[10] Miyauchi A, Matsumoto K, Kohmura E, Doi T, Hashimoto K, Kawano K. Primary intramedullary spinal cord germinoma. *J Neurosurg* 1996; 84: 1060-1.

[11] Horvath L, McDowell D, Stevens G, Parkinson R, McCarthy S, Boyer M. Unusual presentations of germ cell tumors. Case 2. Seminoma of the conus medullaris. *J Clin Oncol* 2001; 19: 911-5.

[12] Hata M, Ogino I, Sakata K, Murata H, Kawano N, Matsubara S. Intramedullary spinal cord germinoma: case report and review of the literature. *Radiology* 2002; 223: 379-83.

[13] Sasaki T, Amano T, Takao M, Shibata M, Shigematsu N, Fukuuchi Y.A case of intramedullary spinal cord tumor producing human chorionic gonadotropin. *J Neurooncol* 2002; 56: 247-50.

[14] Zhu J, Gao Y, Zheng W, Yang J: Intramedullary spinal cord germinoma: a case report. *Chin Med J* 2002 ; 115: 1418-9.

[15] Chute DJ, Burton EC, Klement IA, Frazee JG, Vinters HV. Primary intramedullary spinal cord germinoma: case report. *J Neurooncol* 2003; 63: 69-73.

[16] Huang JH, Tsui I, Judkins AR, Simon E, Birknes JK, Sutton LN. Intramedullary cervical spine germinoma: case report. *Neurosurgery* 2004; 55: 1432.

[17] Takahashi M, Koyama H, Matsubara T, Murata H, Miura K, Nagano A. Mixed germinoma and choriocarcinoma in the intramedullary spinal cord: case report and review of the literature. *J Neurooncol* 2006; 76: 71-5.

[18] Watanabe A, Horikoshi T, Naganuma H, Satoh E, Nukui H. Intramedullary spinal cord germinoma expresses the protooncogene c-kit. *Acta Neurochir* 2005(Wien); 147: 303-8.

[19] Nakata Y, Yagishita A, Arai N. Two patients with intraspinal germinoma associated with Klinefelter syndrome: case report and review of the literature. *Am J Neuroradiol* 2006; 27: 1204-10.

[20] Shunsuke Onodera, Satoshi Terae, Kohsuke Kudo, Khin Khin Tha, Kazuo Miyasaka, Kazutoshi Hida, *et al.* Primary intramedullary spinal cord germinoma: Case report and review of the literature. *Eur J Radiol* 2006; 57: 41-5.

[21] Yang KY, Li SH, Lin JW, Su TM, Ho JT, Chen WF. Concurrent chemoradiotherapy for primary cervical spinal cord germinoma. *J Clin Neurosci* 2009;16:115-8.

[22] Tubbs RS, McKinley JE, Joseph DB, Atchison J, Loukas M, Pugh J, *et al.* Isolated intraspinal germinoma in a child with congenital adrenal hyperplasia. *Spinal Cord* 2008;46: 707-8.

[23] Aoyama T, Hida K, Ishii N, Seki T, Ikeda J, Iwasaki Y. Intramedullary spinal cord germinoma-2 case reports. *Surg Neurol* 2007; 67:177-83.

[24] Parizel PM, Baleriaux D, Rodesch G, Segebarth C, Lalmand B, Christophe C, *et al.* Gd-DTPA-enhanced MR imaging of spinal tumors. *Am J Roentgenol* 1989; 152:1087-96.

[25] D. L. Bal ériaux. Spinal cord tumors. *Eur Radio* 1999; l9: 1252-8.