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Case Report

Radiological and pathological findings of spinal intramedullary granular cell tumor

Ryo Inagaki[1], Daisuke Kohno[1], Seiji Shigekawa[1], Akihiro Inoue[1], Riko Kitazawa[2], Takeharu Kunieda[1]

[1]Department of Neurosurgery, Ehime University School of Medicine, [2]Division of Diagnostic Pathology, Ehime University School of Medicine, Toon, Ehime, Japan.

E-mail: Ryo Inagaki - r.inagaki0608@gmail.com; Daisuke Kohno - kouno_daisuke_h0413a@yahoo.co.jp; Seiji Shigekawa - shigekaw@m.ehime-u.ac.jp; *Akihiro Inoue - iakihiro3@gmail.com; Riko Kitazawa - riko@m.ehime-u.ac.jp; Takeharu Kunieda - kuny@m.ehime-u.ac.jp

***Corresponding author:**
Akihiro Inoue,
Department of Neurosurgery, Ehime University School of Medicine, Toon, Ehime, Japan.

iakihiro3@gmail.com

Received: 24 November 2024
Accepted: 04 January 2025
Published: 31 January 2025

DOI
10.25259/SNI_993_2024

Quick Response Code:

ABSTRACT

Background: Granular cell tumors (GCTs) are rare, usually benign, tumors with classic histomorphology. This tumor can occur throughout the body, but the spine is a distinctly rare location. Here, we report a very rare case of intramedullary GCT arising in the thoracic spinal cord.

Case Description: A 36-year-old woman presented to our hospital with an approximately 1-year history of gradually worsening numbness in the left toe and weakness in both lower limbs. Neuroimaging showed a tumor mass in the upper spine at the level of thoracic vertebrae 7-8, appearing hypointense on T2-weighted imaging (WI) and showing uniform gadolinium enhancement on T1-WI. Complete surgical resection was successfully performed. Histopathological examination revealed round or polygonal cells with abundant granular eosinophilic cytoplasm strongly staining for S-100 and SOX10, and benign intramedullary GCT in the thoracic spinal cord was diagnosed. Postoperative magnetic resonance imaging (MRI) showed no residual tumor, and the patient recovered well from this intervention, showing no sequelae. Follow-up neuroimaging after 2 years showed no signs of recurrence.

Conclusion: This report describes an extremely rare case of GCT arising from the intramedullary thoracic spinal cord, which is difficult to diagnose by routine neuroimaging. Therefore, accurate diagnosis requires careful identification of clinical signs, MRI including hypointensity on T2-WI, and analysis of combined morphologic and immunohistochemical studies.

Keywords: Granular cell tumor, Intramedullary spinal tumor, Pathological findings, Radiological findings, Thoracic spinal cord

INTRODUCTION

Granular cell tumor (GCT) is a rare neoplasm characterized by nests of polyhedral cells with abundant granular eosinophilic cytoplasm and was originally described as granular cell myoblastoma by Abrinkossoff in 1926.[14,16] This tumor is a rare soft-tissue tumor that most commonly involves the neck, head, and skin, with a particular predisposition to the tongue.[16] Other common sites include the respiratory tract, breast, and gastrointestinal tract. While virtually any part of the body can be affected,[11] spinal GCT is an extremely rare entity with only a few cases reported in the literature, but it remains an important differential diagnosis.[4,16] Due to the small number of reported cases and the lack of characteristic imaging findings, distinguishing

spinal GCT from other intradural spinal tumors can be difficult. Recognizing the characteristic features of GCT, including neuroimaging and pathological findings, and understanding the risks of surgical procedures is, therefore, very important. We report herein our experience with a case of intramedullary GCT arising in the thoracic spinal cord that was difficult to diagnose and treat. We also present the radiological and pathological features and suggest useful indicators for the accurate diagnosis of this tumor.

CASE DESCRIPTION

A 36-year-old woman presented to our department with an approximately 1-year history of gradually worsening numbness in the left toe and weakness in both lower limbs. She had no obvious history of trauma, congenital scoliosis, systemic diseases, or metabolic disorders. Neurological examination on admission revealed dysesthesia in the thoracic (Th)7-8 region and hyperreflexia in both lower limbs. Hemiparesis and marked numbness were present in both lower limbs, particularly on the left side. Decreased superficial sensation and paresthesia were evident in both lower limbs below the Th7 dermatome, and cysto-rectal dysfunction was also observed. Magnetic resonance imaging (MRI) of the spine revealed a well-defined intradural intramedullary lesion measuring 14 mm × 10 mm × 25 mm in the Th7-8 region that appeared ISO-to hypointense on T1-weighted imaging (WI) and hypointense on T2-WI, with uniform uptake on gadolinium (Gd)-enhanced T1-WI [Figures 1a-c]. The lesion was slightly eccentric and in contact with the soft tissue. T2-WI showed extensive hyperintensity in the spinal cord at the Th6-12 level, consistent with edematous changes. No hemorrhage was evident in or around the mass and no syringomyelia was evident. Computed tomography showed an indistinct mass, no calcification, and no enlargement of the spinal canal or foramen. Preoperative differential diagnoses included ependymoma and astrocytoma. To confirm the histological diagnosis and plan effective treatment for the primary disease, we performed surgical resection of the lesion under a posterior approach (total Th7-Th8 laminectomy) by incising the spinal cord through the posterior median sulcus. Intraoperative examination revealed a soft, yellow lesion without hemorrhage below the incision site. No adhesions between the tumor and dura mater were present. The tumor margin was clear of the spinal cord. The tumor was carefully separated and removed [Figure 1d], and no spinal fusion was performed. Histological examination revealed spindle-shaped cells with cytoplasm containing fine eosinophilic granules, consistent with Schwann cell morphology. Overall, microgranular areas comprised the majority of cells. No mitotic activity, necrosis, or marked pleomorphism was seen. Immunohistochemical studies showed that the tumor was positive for S-100 and sry-related *HMG-BOX* gene 10 (SOX10) and negative for glial fibrillary acidic protein (GFAP). In addition, the Ki-67 proliferation index was approximately 1.0%. GCT was therefore diagnosed [Figure 2]. Postoperative MRI showed no residual tumor [Figure 3], and the perioperative course was uneventful. The patient recovered well from the surgical intervention, showing no sequelae. Follow-up neuroimaging after 2 years showed no signs of recurrence. Informed consent was obtained from the patient.

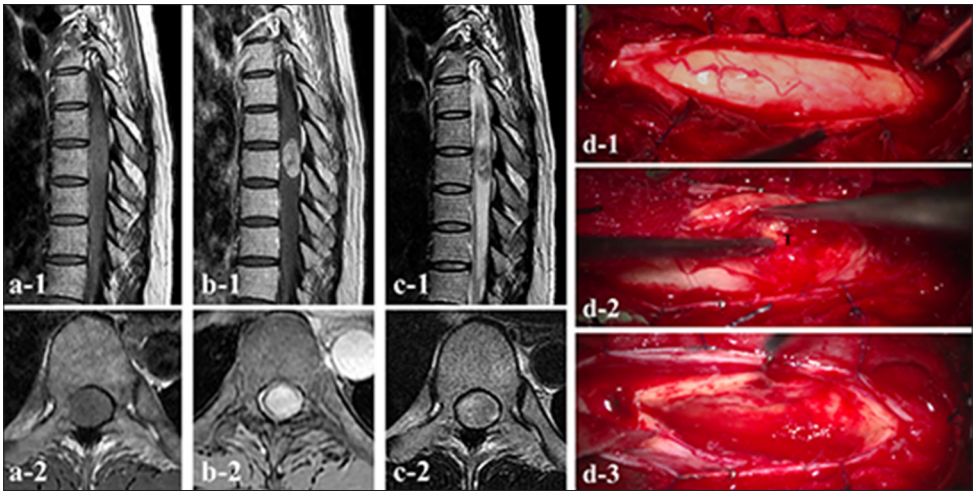

Figure 1: (a-c) Preoperative magnetic resonance imaging (MRI) on initial admission shows a well-defined intradural intramedullary lesion in the region of thoracic vertebrae (Th)7-8. Lesions are hypointense on (a-1: sagittal view, a-2: axial view) T1-weighted imaging (WI) and hypointense on (b-1: sagittal view, b-2: axial view) T2-WI. The lesion appears enhanced following administration of (c-1: sagittal view, c-2: axial view) gadolinium (Gd). (d-1, d-2) Intraoperative findings reveal a soft, yellow lesion below the incision site. No adhesions are evident between the tumor and dura mater. (d-3) The tumor margin appears free of the spinal cord and is carefully dissected and removed. T, tumor.

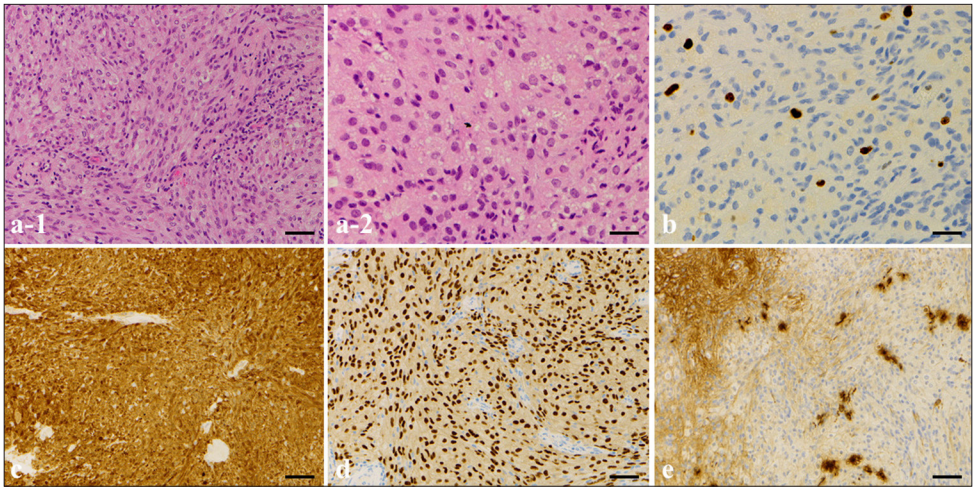

Figure 2: (a-1, a-2) a paraffin-embedded specimen from surgical biopsy shows round and polygonal cells with abundant granular eosinophilic cytoplasm and perivascular lymphocytic aggregates. Most nuclei are round to oval in appearance without evidence of cellular atypia and mitotic figures (hematoxylin and eosin staining). (b) This tumor shows slight positive staining for Ki-67 monoclonal antibody (MIB-1) (MIB-1 labeling index: 1.0%). Most tumor cells are immunoreactive for (c) S-100 and (d) SOX10 protein, but negative for (e) glial fibrillary acidic protein (GFAP) (3,3'diaminobenzidine staining). a-1, c, d, e: Magnification, x200; scale bar, 50 μm. a-2, b: Magnification, x400; scale bar, 100 μm.

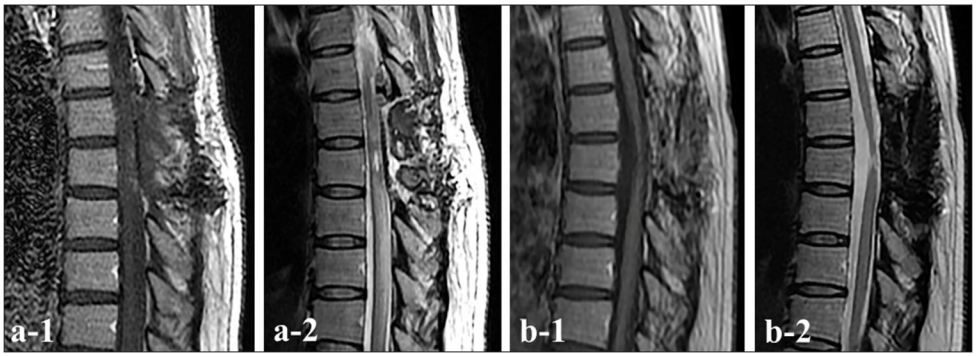

Figure 3: Postoperative (a-1, b-1) T1-Gd and (a-2, b-2) T2-WI. a) One week after successful tumor resection. b) One year after surgery, no recurrences are apparent on MRI.

DISCUSSION

Abrinkossoff first described GCT as granular cell myoblastoma and has been reported in a variety of anatomic sites, but very few cases in the spinal cord have been reported.[1,4,13,14,16] This tumor is a peripheral nerve sheath tumor with neuroectodermal differentiation and is thought to be of Schwann cell origin based on immunohistochemical and ultrastructural findings.[4,17] The brain and pituitary gland are another uncommon site for GCT within the central nervous system. In particular, GCT within the spinal cord is extremely rare.

Clinically, the median age of patients with intraspinal GCT is 23 years, with a typical age range of 13–49 years, and the vast majority of cases have been reported in females.[16] Intradural extramedullary tumors were reported in 18 cases, with intramedullary tumors reported in only three cases.[4] Symptoms have included back pain, nerve root symptoms and weakness, paresthesias, gait disturbances, gastrointestinal and bladder dysfunctions, and upper and lower motor neuron dysfunctions, often with slowly progressive neurological abnormalities.[14] Radiologically, GCTs are best evaluated with MRI because they are typically intradural extramedullary masses. MRI generally depicts the tumor mass as isointense on T1-WI and ISO-to-hypointense on T2-WI, and homogeneous enhancement has been seen after administration of contrast agents. In addition, other reports have noted that the hypointense visualization on MRI/T2-WI may represent the countless eosinophilic granules in the cytoplasm within the solid mass of the GCT.[5,6,9] We hypothesize that this intra-tumoral hypointense sign on T2-WI is an extremely interesting and important finding that may be key to reaching a preoperative diagnosis

of spinal intramedullary GCT. However, MRI is not specific to this tumor because similar signal changes may be seen with other spinal cord tumors, including schwannomas, meningiomas, paragangliomas, meningiomas, paragangliomas, ependymomas, and metastatic tumors.[2,13,14,16] In the present case, the patient was a 36-year-old woman with numbness and weakness in the lower limbs, which seems typical for intramedullary GCT of the spine. In addition, MRI demonstrated moderate and homogeneous enhancement with Gd, and the inside part of the solid mass showed signal hypointensity on T2-WI. Such clinical signs and imaging findings are very important for diagnosing spinal intramedullary GCT accurately before surgery, and we think that recognition of this pattern may lead to safe and effective resection of spinal intramedullary GCT.

GCTs are rare neoplasms derived from Schwann cells with characteristic pathological findings.[4,10,16] Pathologically, the cells are eosinophilic with indistinct cell borders, large amounts of granules in the cytoplasm, and a low nucleo-cytoplasmic (N/C) ratio.[15] The granules are small and regular, focally aggregating into larger fragments, and the cytoplasmic granules are periodic acid-Schiff-positive, diastase resistant. Tumor cells are characterized by positive immunohistochemistry for S-100 protein, cluster of differentiation 68, neuron-specific enolase, inhibin-alpha, and vimentin. The cells do not react with GFAP, neurofilament protein, human melanin black-45, keratin, epithelial membrane antigen, cytokeratin 7, chromogranin, or synaptophysin.[8,16] Malignant cases are extremely rare, but some reports indicate that malignancy is present if three or more of the following six criteria are met: the presence of necrosis, spindle-shaped tumor cells, vacuolated nuclei with well-defined nucleoli, highly fissionable nuclei, high N/C ratio, and polymorphism. In addition, p53 and Ki-67 are highly positive for immunohistochemistry in malignant cases.[3,12] In the present case, the tumor comprised round or polygonal cells with abundant granular eosinophilic cytoplasm. Most nuclei were round to oval with no evidence of cellular atypia or mitotic figures, and perivascular lymphocytic aggregates were recognized microscopically. This structure was immunopositive for S-100 and SOX10 and negative for GFAP. These findings are consistent with GCT in consideration of morphological studies and immunohistochemical analyses.

Regarding the treatment of GCT in the spinal region, surgical resection has the most important role. The treatment advocated for GCT at more usual sites is excision with wide margins. While complete resection should be attempted, the recurrence rate is high after partial resection. Local recurrence is observed in more than 20% of cases with positive resection margins, even if the disease is benign. In general, radio- and chemotherapy are not recommended.[4,7,14,16] However, radiotherapy has been used in the past in the presence of malignant disease or when complete tumor excision with wide margins is not possible, although the efficacy of this method remains unproven. Although few cases of intraspinal GCT have been reported, radiotherapy has been successfully used to stabilize recurrent/residual disease in one case.[2] In the present case, adhesions to the spinal cord were not strong, and the margins were fortunately clear. Gross total resection was therefore possible, and we did not need to introduce radiotherapy after surgery. If tumor growth is detected during long-term observation, we will start radiotherapy. Fortunately, follow-up neuroimaging after 12 months showed no signs of recurrence, and no neurological complications have been identified. Accumulation of more cases, longer patient follow-up, and further experience with therapy for this pathological entity are required.

CONCLUSION

This case is one of the few reported adult cases of spinal intramedullary GCT. Given the rarity of this pathology, a multidisciplinary approach is essential. At present, surgical resection of the tumor remains the logical approach to tumor management to maximize long-term survival. In this case, surgery was performed as early as possible, yielding favorable clinical outcomes. To the best of our knowledge, as of the time of writing, no such cases have been reported previously in which complete removal of a spinal intramedullary GCT was possible. Therefore, this report should prove invaluable in elucidating the importance of the surgical procedure for spinal intramedullary GCT. Further research and accumulation of cases are needed to understand the behavior of these tumors better, identify optimal treatment plans, and standardize immunohistochemical and imaging analyses for diagnosis.

Ethical approval: The Institutional Review Board approval is not required.
Declaration of patient consent: The authors certify that they have obtained all appropriate patient consent.
Financial support and sponsorship: Nil.
Conflicts of interest: There are no conflicts of interest.
Use of artificial intelligence (AI)-assisted technology for manuscript preparation: The authors confirm that there was no use of artificial intelligence (AI)-assisted technology for assisting in the writing or editing of the manuscript and no images were manipulated using AI.

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How to cite this article: Inagaki R, Kohno D, Shigekawa S, Inoue A, Kitazawa R, Kunieda T. Radiological and pathological findings of spinal intramedullary granular cell tumor. Surg Neurol Int. 2025;16:28. doi: 10.25259/SNI_993_2024