ScientificScholar®
Knowledge is power
Publisher of Scientific Journals

www.surgicalneurologyint.com

Surgical Neurology International

Editor-in-Chief: Nancy E. Epstein, MD, Professor of Clinical Neurosurgery, School of Medicine, State U. of NY at Stony Brook.

SNI: Neuro-Oncology

Editor
Mitsutoshi Nakada, MD
Kanazawa University, Ishikawa, Japan

SNI
Open Access

Case Report

Spinal cord diffuse midline glioma with postoperative acute swelling: A case report and review of literature

Hiroki Karita[1], Takao Tsurubuchi[1], Taishi Amano[2], Takao Koiso[1], Noriaki Sakamoto[1], Eiichi Ishikawa[1]

Departments of [1]Neurosurgery and [2]Diagnostic and Interventional Radiology, Faculty of Medicine, University of Tsukuba, Tsukuba, Japan.

E-mail: Hiroki Karita - tsukuba.kagawa@gmail.com; *Takao Tsurubuchi - t-tsurubuchi@md.tsukuba.ac.jp; Taishi Amano - taishi-amano@umin.ac.jp; Takao Koiso - s0201534@hotmail.co.jp; Noriaki Sakamoto - n.sakamoto@md.tsukuba.ac.jp; Eiichi Ishikawa - e-ishikawa@md.tsukuba.ac.jp

***Corresponding author:**
Takao Tsurubuchi,
Department of Neurosurgery,
Faculty of Medicine, University of Tsukuba, Tsukuba, Japan.

t-tsurubuchi@md.tsukuba.ac.jp

Received: 29 July 2023
Accepted: 08 September 2023
Published: 13 October 2023

DOI
10.25259/SNI_636_2023

Quick Response Code:

ABSTRACT

Background: H3K27-altered diffuse midline glioma (DMG) is a newly classified disease according to the 5th edition of the World Health Organization classification of the central nervous system tumors. However, little is known about its progression pattern and the timing of surgical intervention, especially regarding spinal cord lesions.

Case Description: A 26-year-old man presented with rapid muscle weakness progression in both upper and lower extremities and urinary dysfunction. Magnetic resonance imaging showed diffuse swelling of the cervicothoracic spinal cord. He underwent decompressive laminectomy with expansive duroplasty and tumor biopsy. The surgical specimen revealed DMG. Immediately after surgery, deterioration of limb paresis was observed, and the patient developed respiratory failure the day after surgery. Head-and-neck computed tomography on the 7th day after surgery showed spinal cord swelling and acute obstructive hydrocephalus.

Conclusion: We report a rare case of a spinal DMG with acute postoperative swelling. Neurological deterioration in patients with spinal cord DMG is often exacerbated, so it is essential to suspect DMG at an early stage based on neuroimaging, and if surgery is performed on the edematous spinal cord, further rapid swelling can occur, as in the present case.

Keywords: Cervical tumor, Diffuse midline glioma, H3K27-altered, H3K27M

INTRODUCTION

The histone H3-K27M mutation was first reported as causative for malignant gliomas, including brainstem gliomas, in 2012.[12,18] It was later found to be highly frequent in midline gliomas, such as those occurring in the thalamus, pons, and spinal cord.[2,14] In the 2016 WHO classification, diffuse midline glioma (DMG) with H3K27M mutation was recognized as a separate disease entity.[11] The term "diffuse midline glioma, H3K27-altered (DMG)" was introduced in the 5th edition of the WHO classification to encompass a broader concept. The diagnostic criteria[10] for DMG with the loss of H3K27me3 include one of the following: (1) H3K27M mutation, (2) EGFR mutation or amplification, (3) EZHIP overexpression, or (4) DNA methylation profiling consistent with DMG. The prognostic factors and clinical characteristics of spinal DMG remain unknown due to its rarity and heterogeneity of molecular markers. Moreover, there is no consensus about the best timing for biopsy with or without decompressive laminectomy.

Very few spinal cord DMG cases with rapid neurological deterioration have been reported.[8,19] Herein, we report a rare case of spinal cord DMG with unusual magnetic resonance (MR) imaging findings and rapid neurological deterioration. We emphasized that it is important to suspect DMG early on neuroimaging and discussed the timing of image acquisition.

CASE REPORT

A 26-year-old man was diagnosed with an autism spectrum disorder in childhood and had been walking on tiptoes. At the age of 18, he started holding on to something when he stood, and 12 months ago, he began to drag his feet, gradually becoming unable to stand up straight, and developed frequent urination. Although MR imaging revealed a cervical cord enlargement, it was judged to have no pathological significance, and the patient was followed up by MR imaging at that time. Three months ago, he was referred to our hospital, complaining of urinary retention and progressive right upper limb movement disorder. Steroid pulse therapy was applied as a demyelinating disease was suspected. However, 1 month ago, the upper limb paralysis worsened. Due to the rapid progression of the symptoms, he was referred to our department. At the examination, the patient's consciousness level was JCS I-3, and both upper and lower extremities showed severe paresis. Cervical T2-weighted MR imaging showed diffuse spinal cord swelling from the C2 to the Th2 level, and gadolinium-enhanced T1 images showed heterogeneous enhancement of the swollen spinal cord [Figure 1]. The patient's symptoms rapidly progressed just before surgery, resulting in abdominal breathing. Therefore, the patient underwent tumor biopsy, C2 domotomy, and C3–C7 decompressive laminectomy with expansive duroplasty to verify the final diagnosis and decide further therapy options. The pathological diagnosis was DMG, H3K27-altered. On the day after surgery, contrast-enhanced head-and-neck computed tomography (CT) showed no obvious abnormalities. Still, on the same day, consciousness disorder and complete paralysis of both lower limbs developed, and spontaneous breathing deteriorated, requiring tracheal intubation. At that time, there was no low attenuation in the cervical spinal cord on imaging. On postoperative day 7, when the patient's overall condition stabilized, head-and-neck CT revealed acute hydrocephalus and diffuse hypodensity in the cervical spinal cord [Figure 2], and an emergency third ventriculostomy was performed. However, his spontaneous breathing disappeared the day after the ventriculostomy. Contrast-enhanced MR imaging of the whole spine 2 months after the surgery revealed diffuse heterogeneous enhancement of the atrophic spinal cord in suspicion of the disseminated lesion or residual tumors with multiple syrinxes [Figure 3]. The patient died after his transfer to a convalescent care facility.

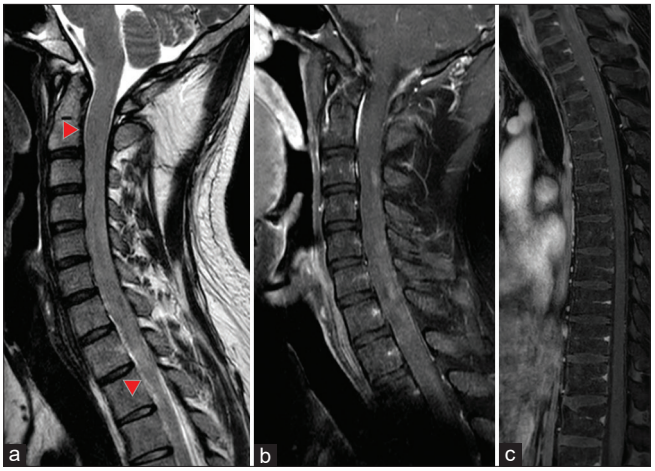

Figure 1: Preoperative gadolinium contrast-enhanced magnetic resonance imaging images of the spinal cord. (a) T2-weighted sagittal image. Spinal cord enlargement is seen from C2 to Th2 levels (red arrowhead), with no spinal fluid cavity signal identified. (b and c) Sagittal T1-weighted images of the whole spinal cord with gadolinium contrast enhancement. Diffuse patchy enhancement is evident.

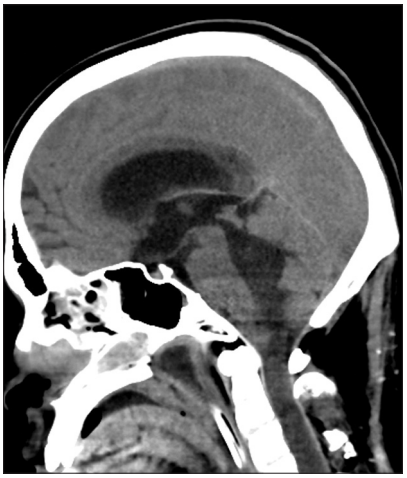

Figure 2: Nonenhanced head-and-neck computed tomography scan on the 7th day after surgery. Acute obstructive hydrocephalus developed due to spinal cord swelling from the lower part of the medulla oblongata to the level of the upper cervical spine at the craniovertebral junction.

DISCUSSION

There have been few reports on H3K27-altered spinal cord DMG where acute deterioration in such a short period of time occurred. We summarized the reported cases, as shown in Table 1.[8,19] Although our patient could not receive chemoradiotherapy due to his severely disabled condition, the other two patients could. Due to the limited number of

Table 1: List of reported cases of acute deterioration in adult spinal diffuse midline glioma.

Author	Age	Sex	Location	Symptom	Time to diagnosis	Time to deterioration	Surgical intervention	H3K27M	H3K27me3	Treatment	Outcome	Follow-up
Yabuno *et al.*[19]	47	F	C6–Th1	Sensory impairment of the right leg	1 month	2 months	Biopsy and decompression	(+)	NA	Chemoradiation	Died	17 months
Yabuno *et al.*[19]	46	F	C1–C4	Sensory impairment of the right upper	5 months	2 weeks	Biopsy and decompression	(+)	NA	Chemoradiation	Died	11 months
Kamidani *et al.*[8]	32	M	C3–Th1	Muscle weakness in legs	2 weeks	2 weeks	Biopsy and decompression	(+)	NA	NA	PD	NA
Present case	26	M	C2–Th1	Gait disorder and urinary disorder	12 months	1 month	Biopsy and decompression	(+)	loss	BSC	Died	4 months

The present case is at the end of the list, PD: Progressive disease, BSC: Best supportive care, F: Female, M: Male, (+): Positive, NA: Not applicable

documented cases involving DMG arising in the thalamus or the spinal cord, the significance of H3K27 mutation in terms of prognosis remains insufficiently understood.

The preoperative radiological diagnosis of spinal cord DMGs is difficult.[16] Differential diagnosis includes intramedullary lesions with, diffuse and ill-defined enhancement, such as includes transverse myelitis, neuromyelitis optica, multiple sclerosis, and neuroinflammatory diseases, other than DMG, that lead to spinal cord enlargement.[5,15,17] Our patient's symptoms were slowly progressing, and a diffusely swollen cervicothoracic spinal cord was seen on noncontrast T2-weighted images obtained at the previous hospital (data not shown), suspecting a demyelinating or neuroinflammatory disease. Follow-up gadolinium-enhanced MR images taken at our hospital showed multiple diffusely enhanced heterogeneous patchy lesions from the C2 to the Th2 level. In nonacute inflammatory, demyelinating, and metabolic disorders, it is generally expected to observe long-segment nonexpansile T2 hyperintensity,[7] and it was considered inconsistent with the imaging findings. In this particular case, the possibility of glioma was higher due to the gadolinium contrast enhancement observed on MR images obtained during the stage of advanced symptoms. Therefore, it can be suggested that early contrast-enhanced MR imaging should be actively recommended in such cases. However, it should be noted that approximately 29% of H3K27M-altered DMG cases exhibit a lack of contrast enhancement,[13] making it challenging to definitively rule out the presence of glioma in the absence of contrast enhancement.

In our case, there was considerable postoperative swelling of the cervical spinal cord. The causative mechanism of acute disease deterioration might be the rapid progression of the spinal cord swelling around the craniovertebral junction even after the decompression. Preoperative MR imaging showed the progression of the diffuse spinal cord swelling from the medulla oblongata level to the upper thoracic spine. It was assumed that decompression from C2 to C7 was insufficient to relieve the tension of the swollen spinal cord, resulting in obstructive hydrocephalus due to its upward herniation. Acute hydrocephalus caused by upward herniation has never been reported in spinal cord DMG, but it has been previously reported in hypertensive encephalopathy patients with the same mechanism as in our case.[1] Another possible cause of the deterioration could be the spinal shock caused by the compression of the swollen spinal cord itself at the level of the foramen magnum.

Furthermore, 2 months later, a follow-up contrast-enhanced MR imaging revealed signs of multiple syrinxes. Spinal syrinx (syringomyelia) usually develops after spinal trauma, in Chiari malformation, other head-and-neck abnormalities, and meningitis.[6] It can also be caused by ischemia,[4] minor trauma,[3] and rebound effects due to

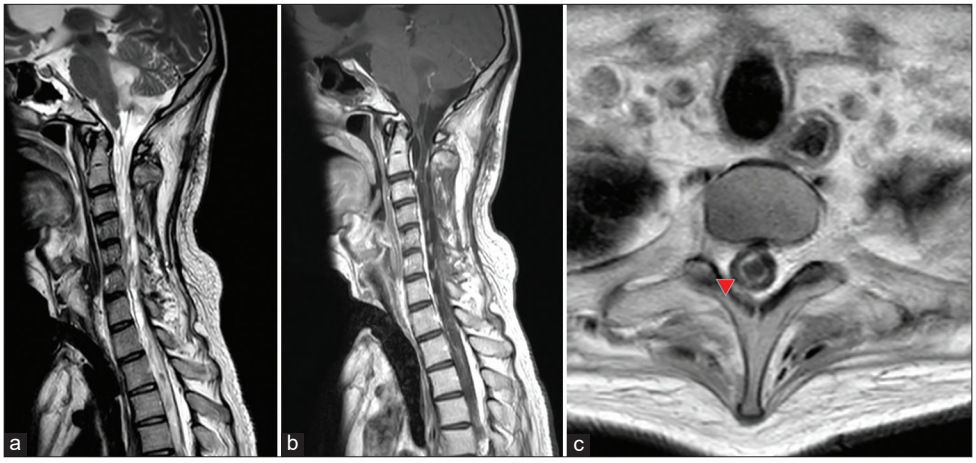

Figure 3: Cervical gadolinium contrast-enhanced magnetic resonance (MR) imaging. (a) T2-weighted sagittal image showing severe atrophy of the spinal cord with little or no normal spinal cord tissue present. A liquid mass was observed in the fourth ventricle, suggesting a tumor with liquefaction changes. (b) Gadolinium-contrasted T1-weighted sagittal image. Partial contrast enhancement diffusely presented in the spinal cord, with spinal cord dissemination or residual tumor suspected. (c) Syringomyelia was observed on the axial T1-weighted plain MR image (red arrowhead).

localized obstruction of the cerebrospinal fluid flow in cervical spondylotic myelopathy.[9] Our patient was thought to have multiple syrinxes mainly due to the localized obstruction of the cerebrospinal fluid at the level of the foramen magnum. Upward herniation and compression of the upper cervical spinal cord at the level of the foramen magnum might obstruct the cerebrospinal fluid flow after cervical cord swelling caused by the rapid growth of the tumor. DMG of the cervical spinal cord is rare, but it should be considered in the differential diagnosis, it is essential to perform contrast-enhanced magnetic resonance imaging (MRI) in time to differentiate malignant tumors and ensure timely surgical intervention without delay.

CONCLUSION

We reported a rare case of acute spinal cord swelling in DMG after decompressive laminectomy with expansive duroplasty and tumor biopsy. The neurological deterioration in spinal cord DMG patients is often exacerbated, so it is essential to suspect DMG at an early stage based on neuroimaging, and if surgery is performed on the edematous spinal cord, further rapid swelling can occur, as in our case. It is important to monitor the symptoms closely and make a critical decision about the tumor biopsy with decompressive laminectomy before the deterioration of the patient's condition.

Acknowledgments

The authors would like to thank Alexander Zaboronok of the Department of Neurosurgery, Institute of Medicine, the University of Tsukuba, for professional and language revision.

Declaration of patient consent

Patient's consent not required as patient's identity is not disclosed or compromised.

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 author(s) confirms 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.

REFERENCES

1. Adamson DC, Dimitrov DF, Bronec PR. Upward transtentorial herniation, hydrocephalus, and cerebellar edema in hypertensive encephalopathy. Neurologist 2005;11:171-5.
2. Aihara K, Mukasa A, Gotoh K, Saito K, Nagae G, Tsuji S, *et al*. H3F3A K27M mutations in thalamic gliomas from young adult patients. Neuro Oncol 2014;16:140-6.
3. Badri M, Gader G, Bahri K, Zammel I. Cervicothoracic syringomyelia caused by cervical spinal stenosis: Case report and literature review. Surg Neurol Int 2017;8:288.
4. Bhagavathula Venkata SS, Arimappamagan A, Lafazanos S, Pruthi N. Syringomyelia secondary to cervical spondylosis:

Case report and review of literature. J Neurosci Rural Pract 2014;5:S78-82.
5. Dormegny L, Chibbaro S, Ganau M, Santin M, Kremer L, Proust F. Biopsying a spinal cord lesion: A diagnostic dilemma. Case report and review of literature. Neurochirurgie 2018;64:425-30.
6. Greitz D. Unraveling the riddle of syringomyelia. Neurosurg Rev 2006;29:251-63; discussion 264.
7. Jung JS, Choi YS, Ahn SS, Yi S, Kim SH, Lee SK. Differentiation between spinal cord diffuse midline glioma with histone H3 K27M mutation and wild type: Comparative magnetic resonance imaging. Neuroradiology 2019;61:313-22.
8. Kamidani R, Okada H, Yasuda R, Yoshida T, Kusuzawa K, Ichihashi M, *et al*. Diffuse midline glioma in the spinal cord with rapid respiratory deterioration. Acute Med Surg 2020;7:e500.
9. Kimura R, Park YS, Nakase H, Sakaki T. Syringomyelia caused by cervical spondylosis. Acta Neurochir (Wien) 2004;146:175-8.
10. Kurokawa R, Kurokawa M, Baba A, Ota Y, Pinarbasi E, Camelo-Piragua S, *et al*. Major changes in 2021 world health organization classification of central nervous system tumors. Radiographics 2022;42:1474-93.
11. Louis DN, Perry A, Reifenberger G, von Deimling A, Figarella-Branger D, Cavenee WK, *et al*. The 2016 world health organization classification of tumors of the central nervous system: A summary. Acta Neuropathol 2016;131:803-20.
12. Schwartzentruber J, Korshunov A, Liu XY, Jones DT, Pfaff E, Jacob K, *et al*. Driver mutations in histone H3.3 and chromatin remodelling genes in paediatric glioblastoma. Nature 2012;482:226-31.
13. Shih RY, Koeller KK. Intramedullary masses of the spinal cord: Radiologic-pathologic correlation. Radiographics 2020;40:1125-45.
14. Solomon DA, Wood MD, Tihan T, Bollen AW, Gupta N, Phillips JJ, *et al*. Diffuse midline gliomas with histone H3-K27M mutation: A series of 47 cases assessing the spectrum of morphologic variation and associated genetic alterations. Brain Pathol 2016;26:569-80.
15. Thrower BW. Clinically isolated syndromes: Predicting and delaying multiple sclerosis. Neurology 2007;68 24 Suppl: S12-5.
16. Won YL, Choi Y, Yuh WT, Kwon SW, Kim CH, Yang SH, *et al*. Validity of magnetic resonance imaging (MRI) in the primary spinal cord tumors in routine clinical setting. Sci Rep 2022;12:10151.
17. Wingerchuk DM, Lucchinetti CF. Comparative immunopathogenesis of acute disseminated encephalomyelitis, neuromyelitis optica, and multiple sclerosis. Curr Opin Neurol 2007;20:343-50.
18. Wu G, Broniscer A, McEachron TA, Lu C, Paugh BS, Becksfort J, *et al*. Somatic histone H3 alterations in pediatric diffuse intrinsic pontine gliomas and non-brainstem glioblastomas. Nat Genet 2012;44:251-3.
19. Yabuno S, Kawauchi S, Umakoshi M, Uneda A, Fujii K, Ishida J, *et al*. Spinal cord diffuse midline glioma, H3K27M-mutant effectively treated with bevacizumab: A report of two cases. NMC Case Rep J 2021;8:505-11.

How to cite this article: Karita H, Tsurubuchi T, Amano T, Koiso T, Sakamoto N, Ishikawa E. Spinal cord diffuse midline glioma with postoperative acute swelling: A case report and review of literature. Surg Neurol Int 2023;14:360.