

CASE REPORT

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Spinal schwannoma presenting with intraspinal hematoma: a case report and review of the literature

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Abstract

Background Spinal schwannomas presenting with an intraspinal hematoma or subarachnoid hemorrhage are extremely rare, and patients often have severe spinal cord compression symptoms. However, the mechanism underlying the bleeding remains unclear.

Case presentation We present the case of a 53-year-old Chinese female diagnosed with a T12 schwannoma accompanied by an intratumoral hematoma. The patient suddenly experienced unbearable pain in the lower limbs. An emergency operation was necessary, and during surgery, we resected a tumor and evacuated a hematoma. We found a spinal nerve root fracture, intratumoral congestion, tumor capsule rupture, and bleeding. Pathological analysis indicated a schwannoma.

Conclusion Injury to the nerve roots and vessels during motion, nerve root torsion, twisting, venous obstruction, tumor congestion, swelling, and capsule rupture are important processes in spinal schwannoma hemorrhage. Early diagnosis and proactive surgery are key points for treatment.

Keywords Schwannoma, Spinal tumor, Subarachnoid hemorrhage, Intratumoral hematoma

Background

Schwannomas are common benign tumors that usually occur in the posterolateral region of the spinal canal [1]. Intraspinal hematoma or subarachnoid hemorrhage due to a schwannoma stroke is extremely rare. However, patients often have severe spinal cord compression symptoms that require emergency surgery. However, the mechanism underlying the bleeding remains unclear. This case describes a patient with an intraspinal schwannoma that presented with breakage and bleeding of the spinal nerve root, intratumoral congestion, tumor envelope rupture and bleeding, and intraspinal hematoma. In

addition, we review studies on spinal schwannoma hemorrhage and explore the mechanisms of bleeding.

Case presentation

Informed consent was obtained from the patient. We present the case of a 53-year-old Chinese female who had no chronic diseases. The patient was hospitalized for surgical treatment of a lumbar disc herniation in November 2022. Magnetic resonance imaging (MRI) revealed a space-occupying lesion in the spinal canal at T12 measuring 1 cm × 1 cm × 1 cm (Fig. 1). The lesion was not treated further at that time. Fifty days before admission, the patient suddenly experienced pain in both lower limbs after long-distance running. The pain was mild, tolerable, and relieved with painkillers. On 13 April 2023, the pain suddenly increased and became unbearable. Lumbar MRI showed that the spinal canal at T12–L1 was occupied, with a 2 cm × 2 cm × 3 cm T11–L1 intraspinal

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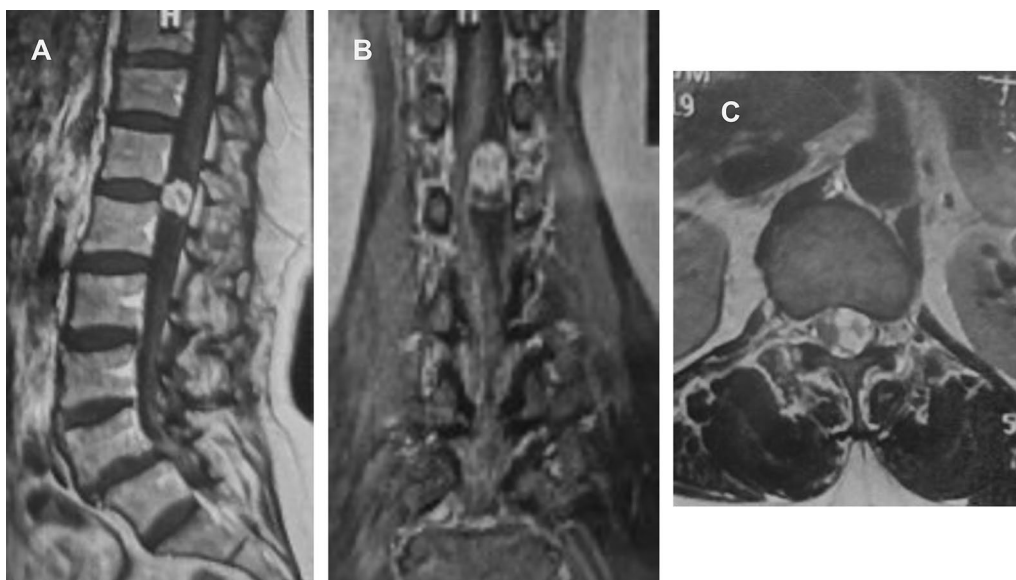


Fig. 1 Three months before admission, magnetic resonance imaging revealed a 1 cm × 1 cm × 1 cm space-occupying lesion of the spinal canal at T12. The tumor is enhanced and considered a schwannoma. **A** Sagittal position, **B** Coronal position, **C** Axial position

hematoma (Fig. 2). The patient was transferred to our hospital for treatment. Physical examination revealed decreased sensation in both lower limbs, and no obvious positive signs were detected in the rest of the body. The pain was unbearable, and the patient underwent emergency surgery.

A T11–L1 laminectomy was performed using an ultrasonic bone scalpel to expose the spinal canal. After a longitudinal incision, the dura showed that the arachnoid

membrane was intact (Fig. 3), and many subarachnoid hematomas (approximately 5 ml) were found. The main body of the tumor was located at the T12–L1 vertebral body level. The tumor was tough, reddish brown, and a rupture of the tumor envelope was visible (Figs. 4, 5, 6). The rostral nerve root was broken and fractured (Fig. 4), and the tumor was tightly connected to the caudal nerve root (Fig. 6). The hematoma was completely removed under the microscope, the carrier nerve was cut off, and

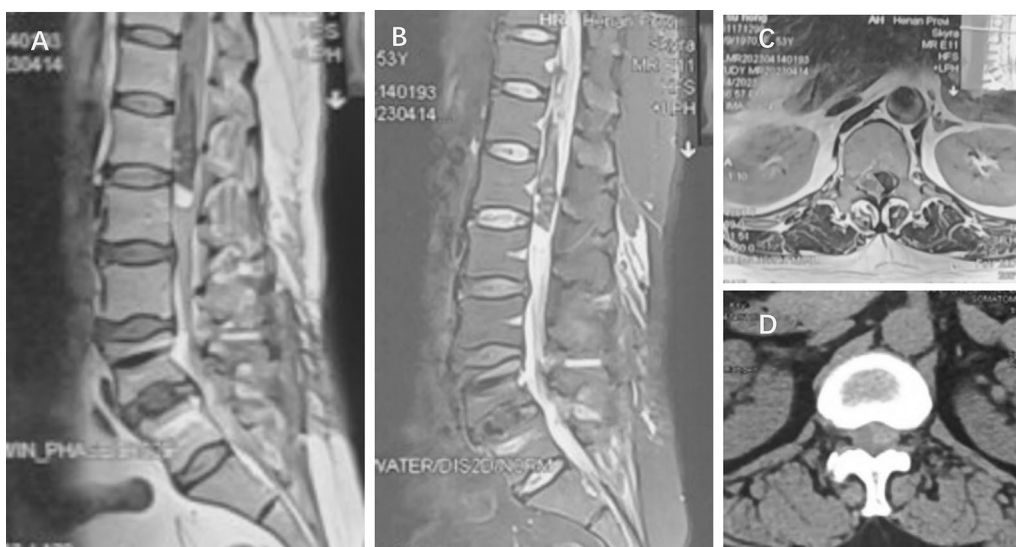


Fig. 2 Two days before admission, the patient experienced increased pain. Magnetic resonance imaging showed the spinal canal at T12–L1 was occupied, with a 2 cm × 2 cm × 3 cm T11–L1 intraspinal hematoma. **A** T1 weighted, **B** T2 weighted, **C** Magnetic resonance imaging axial position showed the lesion on the left side, **D** Computed tomography axial position showed a highly dense lesion

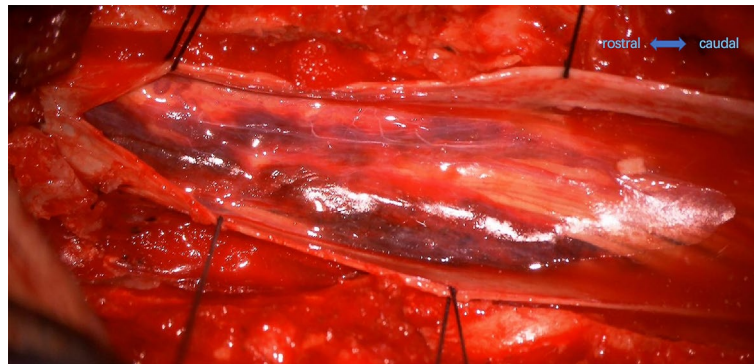


Fig. 3 After opening the dura, the arachnoid membrane was visibly intact

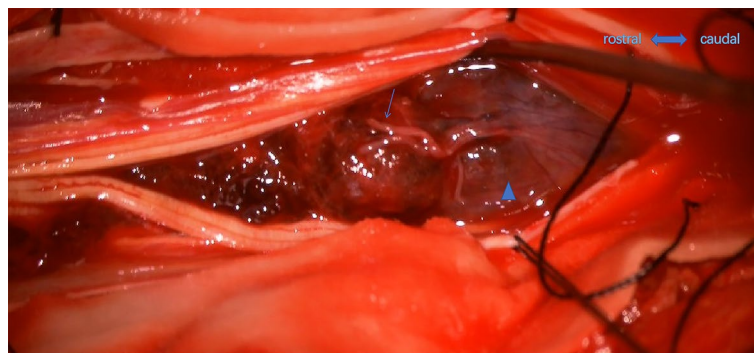


Fig. 4 The tumor (triangle) is reddish brown. The rostral nerve root was broken and fractured (arrow)

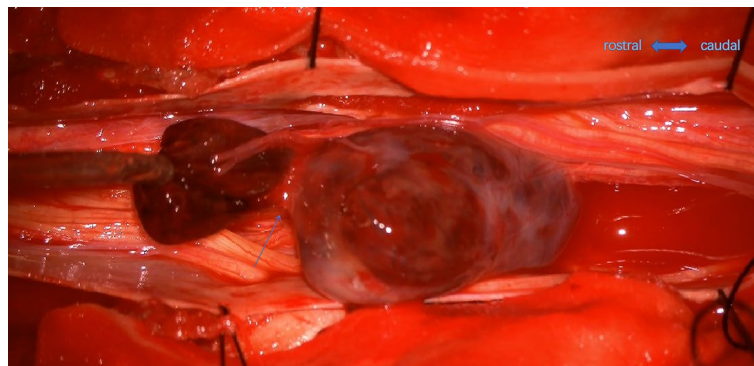


Fig. 5 The breakage of the tumor capsule (arrow) is on the rostral side, with a hematoma connected with the intratumor

the tumor was completely resected. Longitudinal sectioning of the tumor revealed diffuse congestion and swelling (Fig. 7A).

After formalin treatment, the specimens were yellowish brown and 2 cm × 2 cm × 3 cm in diameter. Hematoxylin and eosin-stained sections showed a tumor dominated by a loose matrix with uniformly distributed round to oval regular nuclei. Many dilated blood vessels and numerous intravascular red blood cells were observed on a

clear mucoid background. No necrotic tissue, signs of nuclear atypia, or mitotic activity were found (Fig. 7B, C). Immunohistochemical results revealed: EMA (–), GFAP (–), S-100 (+), SOX-10 (+), DES (–), STAT-6 (–), CD34 (blood vessels+), Ki67 (2%+), and SMA (–). The pathological analysis indicated a schwannoma.

The patient recovered well, with no complications. After surgery, the pain in the right lower limb was significantly relieved, and urine and bowel movements were

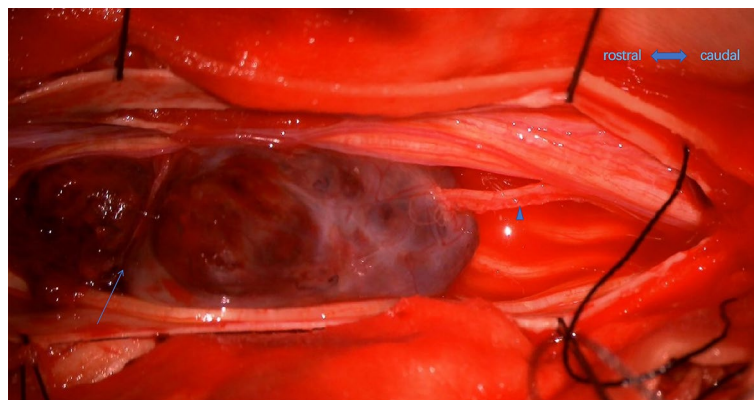


Fig. 6 The tail of the tumor is tightly connected to the nerve root (triangle). On the rostral part, the breakage of the tumor capsule was visualized (arrow)

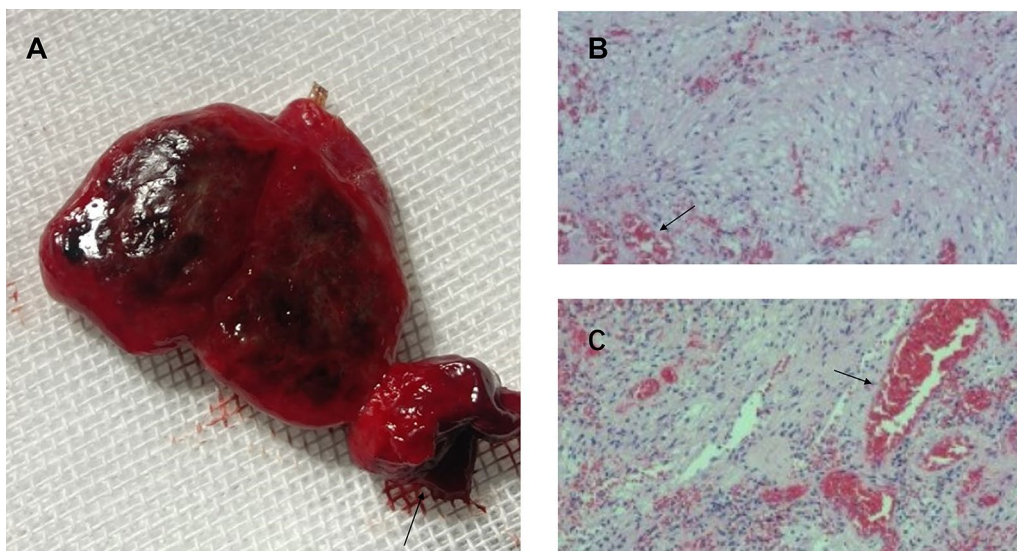


Fig. 7 **A** The tumor is reddish brown in the whole body. The breakage of the tumor capsule (arrow) was apparent. After longitudinal sectioning, diffuse congestion and edema were seen in the tumor. **B, C** Hematoxylin and eosin staining at 100× magnification showed a tumor dominated by loose cells, many dilated blood vessels (arrow), and many intravascular red blood cells (arrow). No necrotic tissue was found

normal. The patient was satisfied with the treatment she received. Two weeks postoperatively, the patient underwent rehabilitation exercises and gradually began to walk. Three months after surgery, the patient had returned to her normal life and work but still had mild numbness and pain in the left lower limb.

Discussion

Intraspinal schwannoma hemorrhage is rare and may present as an intratumoral hemorrhage, subarachnoid hemorrhage, or both. To explore the mechanism underlying the bleeding, we reviewed the literature published over the past 30 years and found 23 cases of intraspinal schwannoma hemorrhage, summarized in Table 1

[2–23]. Among all patients, 9 (39.1%) occurred in the cervical spine, 8 (34.8%) in the cauda equina, and 17 (73.9%) in the craniocervical, cervicothoracic, or thoracolumbar joints. Nine patients (39.1%) had definite induction of spinal movement before bleeding. Five patients had only subarachnoid hemorrhage (SAH). Four patients experienced only intratumoral bleeding. Seven patients experienced both SAH and intratumoral bleeding. Among the patients, 3 had clear tumor capsule rupture and bleeding, and 18 had intact and unbroken tumor capsules. In addition, three patients experienced nerve root injury, including torsion, rupture, and drainage vein bleeding.

Two main theories have been proposed to explain the mechanisms of spinal schwannoma hemorrhage. First is

Table 1 Summary of the cases of spinal schwannomas with intraspinal hemorrhage in the last 30 years

Author, year	Country	Age	Gender	Site of tumor	SAH	Intratumoral hemorrhage	Inducing factor
Chalif et al. 1990	America	56	F	C1–2	Yes	NR	NR
Mills et al. 1993	New Zealand	53	M	C7–T1	Yes	Yes	NR
Barquero et al. 1994	Spain	68	M	C5–7	Yes	NR	NR
Corriero et al. 1996	Italy	37	M	C7–T1	Yes	NR	Physical stress
Uemura et al. 1998	Japan	58	F	T11–L2	No	Yes	NR
Cordan et al. 1999	Turkey	28	F	L1–2	Yes	NR	NR
Cohen et al. 2000	Israel	52	M	L1	Yes	Yes (rupture of capsule)	Fall from a ladder
Ng.2001	Singapore	43	NR	C6–7	Yes	Yes (rupture of capsule)	NR
Parmar et al. 2004	Singapore	56	M	T11–L1	Yes	No	NR
Ciappetta et al. 2008	Italy	44	F	C2	Yes	Yes	NR
Ji et al. 2010	Korea	44	M	C1–2	Yes	No	Sneezing
Sun et al. 2010	China	32	M	T4–5	Yes	NR	Sneezing
Kukreja et al. 2014	America	47	M	L1–2	Yes	Yes	Seizure episode
Bennett et al. 2015	America	66	F	L4	Yes	No	NR
Jenkins et al. 2015	America	62	M	L2–3	No	Yes (nerve root torsion)	NR
Zhang et al. 2016	China	47	F	T9	Yes	No	Cough
Tanki et al. 2018	India	11	F	T11–L1	Yes	NR	NR
Gandhoke et al. 2018	India	38	F	C2–4	No	Yes	NR
Dobran et al. 2019	Italy	38	M	T11	Yes	Yes	Car accident
Singh et al. 2020	India	35	F	C3–T3	No	Yes	NR
Chen et al. 2021	China	45	M	T2	Yes	NR (nerve root bleeding)	Hard physical work
Zhang et al. 2022	China	40	M	L3	Yes	No	No
This case 2023	China	53	F	T12–L1	Yes	Yes (rupture of capsule and nerve root rupture)	Long-distance running

M male, F female, C cervical, T thoracic, L lumbar, NR not reported, SAH subarachnoid hemorrhage

the vascular theory, where the proliferative and dilated blood vessels of tumors may cause spontaneous thrombus formation. The distal end of the thrombus can cause tumor necrosis and bleeding [3]. No histological signs of necrosis were found in our case. Although bleeding may be a common finding in schwannoma histology, necrosis has not been observed in any other case report [2–23]. Moreover, the vascular theory does not explain the pathogenesis in patients with SAH and without intratumoral hemorrhage. In the longitudinal section of the gross specimen, we saw that the tumor was dark red throughout, with diffuse congestion and swelling rather than local necrosis and bleeding. Similar pathological specimens have been previously reported [14, 16, 19]. Furthermore, on pathological examination, the tumor cells were relatively sparse but rich in dilated blood vessels and intravascular red blood cells. Similar histology has been reported in other cases [3, 5, 8, 19, 20, 22]. Therefore, we believe that the pathological type of bleeding within a schwannoma is congestion caused by venous obstruction rather than bleeding.

The other proposed theory to explain spinal schwannoma hemorrhage is the mechanical theory. The location

of the tumor is vital for hemorrhage, especially in the cauda equina and cervical vertebra [11]. Excessive movement between the tumor and spinal cord attachment produces traction, destroying the fragile vascular structure on the surface, leading to subarachnoid hemorrhage. We believe this explanation is reasonable. We observed a rupture of the tumor-bearing nerve root during surgery, and other cases have reported torsion of the nerve root [16] and venous bleeding drainage [22]. This theory also supports our statistical results, in which 39.1% of the patients had a clear inducement of spinal movement before bleeding. The rate of bleeding in males is slightly higher than in females. The proportion of bleeding occurring in the cervical vertebrae, cauda equina, and spinal junction area is relatively higher, possibly related to increased movement. Owing to the effect of gravity on the tumor, repeated pulling and dragging from the tumor during movement may damage the carrier nerve root and its blood vessels, even causing a rupture of the nerve root, which leads to SAH. Degenerative changes in the spine can exacerbate the injury [14]. Similarly, tumor movement may cause distortion or rotation of the nerve roots. Blood supply to the tumor comes entirely from

the bidirectional supply of vessels that run through the tumor carrier nerve roots. The rotation of a schwannoma can cause twisting of blood vessels. Because of the higher pressure of the arterial blood vessels, the impact of the vascular kink is relatively small, resulting in the occlusion of drainage veins, leading to diffuse congestion and swelling of the tumor. This is similar to the effect of drainage vein blockage during arteriovenous malformation resection. In severe cases, tumor capsule rupture and bleeding may occur.

In summary, we conclude that three important processes are involved in the occurrence of hemorrhage in spinal schwannoma: (1) injury and bleeding of the carrier nerve root and its vessels during tumor motion, (2) tumor carrier nerve root torsion, twisting, and venous obstruction, and (3) tumor congestion and swelling with capsule rupture and bleeding in severe cases (Fig. 8).

We believe that early surgery should be performed to treat schwannoma hemorrhages. Surgical treatment should be performed once a diagnosis is made. Hematomas should be removed as soon as possible, and tumors should be completely resected. This course of action will relieve the compression of the spinal cord and nerves caused by tumors and hematomas, minimizing the dysfunction and nerve root stimulation symptoms caused by compression. For an accurate diagnosis and corresponding treatment, it is necessary to fully understand the

pathogenesis and pathological processes of schwannoma hemorrhage.

Conclusion

Injury to tumor carrier nerve roots and vessels during motion, nerve root torsion, twisting, venous obstruction, tumor congestion and swelling, and capsule rupture are important in spinal schwannoma hemorrhage processes. Early diagnosis and proactive surgery are critical for treatment.

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Author contributions

Zhe She: clinical data collection, writing—draft preparation, literature search. Haoyang Chen: literature search and organization. Haosheng Wang: writing—polishing. Yaoqi Wang: clinical data collection. Tao Li: supervision, writing, review and editing. All authors read and approved the final manuscript.

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Availability of data and materials

Available on demand.

Declarations

Ethics approval and consent to participate

No ethical approval was sought for this report as this is not a research study. As this case report involved private information disclosure, informed consent was obtained from the reported patient.

Consent for publication

Written informed consent was obtained from the patient for publication of this case report and any accompanying images. A copy of the written consent is available for review by the Editor-in-Chief of this journal.

Competing interests

The authors declare that they have no conflicts of interest.

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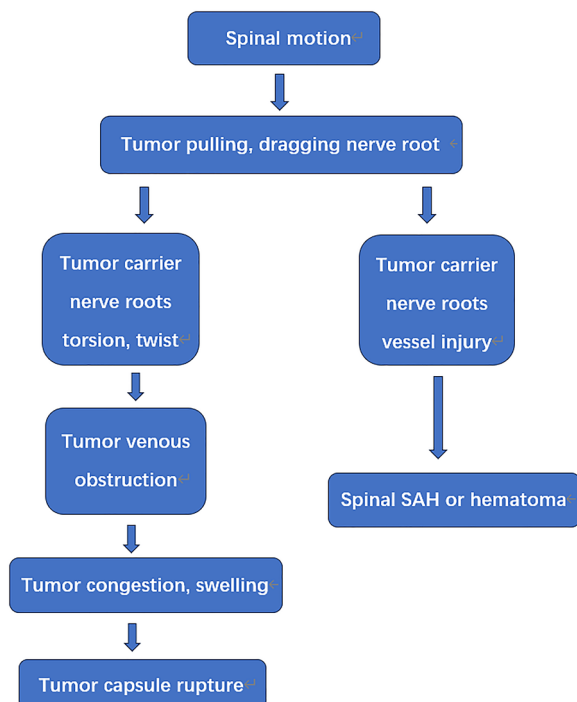


Fig. 8 The hemorrhaging processes in a spinal schwannoma

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