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GRAND ROUNDS

Acute non-traumatic idiopathic spinal subdural hematoma: radiographic findings and surgical results with a literature review

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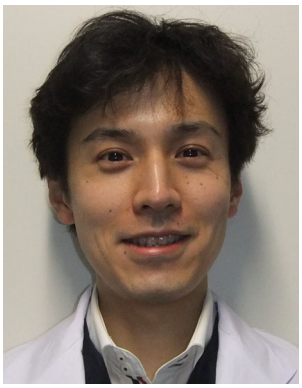
Abstract



Purpose Intraspinal hematoma is a serious condition, and early diagnosis is necessary to permit emergency treatment. Among such hematomas, non-traumatic spinal subdural hematoma is a rare occurrence. We have experienced three patients with surgically proven subdural spinal hematoma, and here we report these cases with a review of their clinical and imaging characteristics.
Methods All three cases were idiopathic with no history of disease, no coagulopathy, and no trauma. All had acute onset that brought about paralysis of the lower limbs with severe pain. Early surgery was performed, based on a relatively early diagnosis using thoracolumbar MRI and CT.
Results Since the epidural fat is not affected by bleeding, the normal structure remains and the boundary between hematoma and fat is a significant feature in MRI and CT. Partial Gd enhancement in MRI and ring enhancement in contrast CT were also apparent. Two of the cases had subarachnoid hematomas.
Conclusions Preoperative diagnosis of spinal subarachnoid hematoma is difficult because there are no specific radiological findings and confirmation can only occur intraoperatively. In particular, one case had a massive hematoma causing canal stenosis, and it was difficult to distinguish between intradural and extradural hematoma. In all cases of subarachnoid or subdural hematoma, decompression was performed within 24 h after onset, and consequently, the patients had relatively good outcomes.

Keywords Hematoma · Diagnostic imaging · Spinal arachnoid hematoma · Spinal subdural hematoma · Surgery

Presentation of cases

Case 1 A 43-year-old man presented with sudden bilateral severe lower leg pain and numbness. He then suffered dysuria and motor loss of the lower extremities. He had no history of trauma. A manual muscle test (MMT) of the lower extremities gave a score of 3/5 with hypothesia below the L1 dermatome. MRI revealed a dorsal subdural hematoma extending from the L1–L2 level with compression of the spinal cord (Fig. 1). The lesion was hyperintense on a T2-weighted image and hypointense on a T1-weighted image. Preoperative blood tests indicated that platelet count (PLT), prothrombin time (PT), partial thromboplastin time (PPT), and international normalized ratio (INR) were normal.

Case 2 A 61-year-old woman presented with sudden severe low back pain and paraparesis. She had no history of

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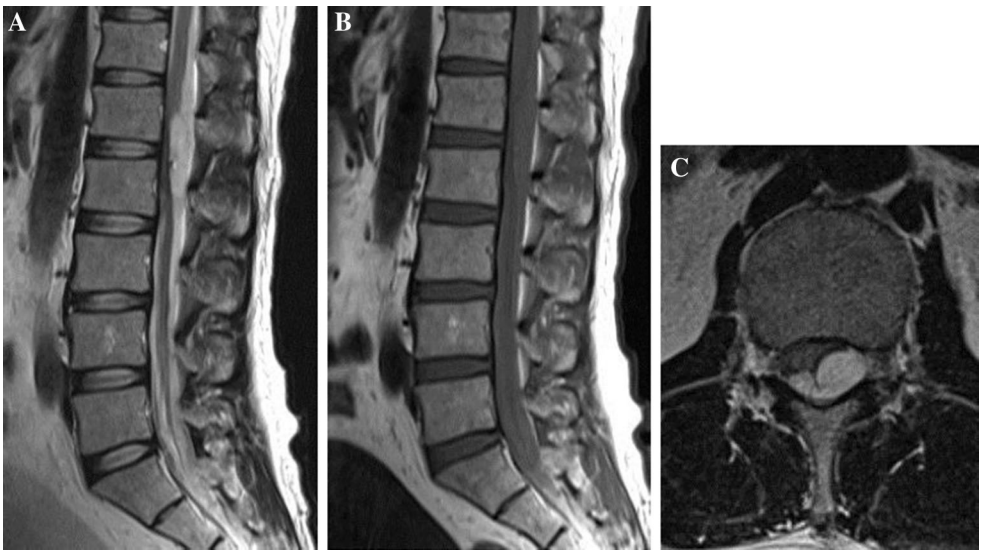

Fig. 1 Case 1: preoperative images from **a** sagittal T2-weighted MRI, **b** sagittal T1-weighted MRI, and **c** axial T2-weighted MRI revealed a spinal subdural hematoma between L1 and L2

trauma or bleeding diathesis. The MMT score for the lower extremities was 3/5. Thoracolumbar MRI revealed a dorsal subdural hematoma extending from the L2 level with compression of the spinal cord (Fig. 2). The lesion was hyperintense on T2-weighted and T2-weighted fast spin echo (FSE) images. Preoperative blood tests were normal.

Case 3 A 60-year-old female developed acute onset of right extremity weakness with bilateral severer lower leg pain and was unable to walk by herself. She had no major medical history, including no hypertension, diabetes mellitus, or other chronic disease. Cranial nerve and cerebellar tests were normal. Muscle power decreased over the lower extremities, with an MMT score of 3/5. MRI revealed a mass posterior-laterally compressing Th12 of the spinal cord, with partial Gd enhancement. Ring enhancement was seen on contrast CT (Fig. 3). Preoperative blood tests were normal.

Historical review

Intraspinal hematoma is an emergency condition that requires early diagnosis for treatment with a successful outcome. The condition is divided into extradural hematoma, subdural hematoma, subarachnoid hematoma, and hematomyelia, depending on the location [1]. Spinal extradural hematoma is the most frequent entity showing spinal bleeding, whereas subdural hematoma is rare and the

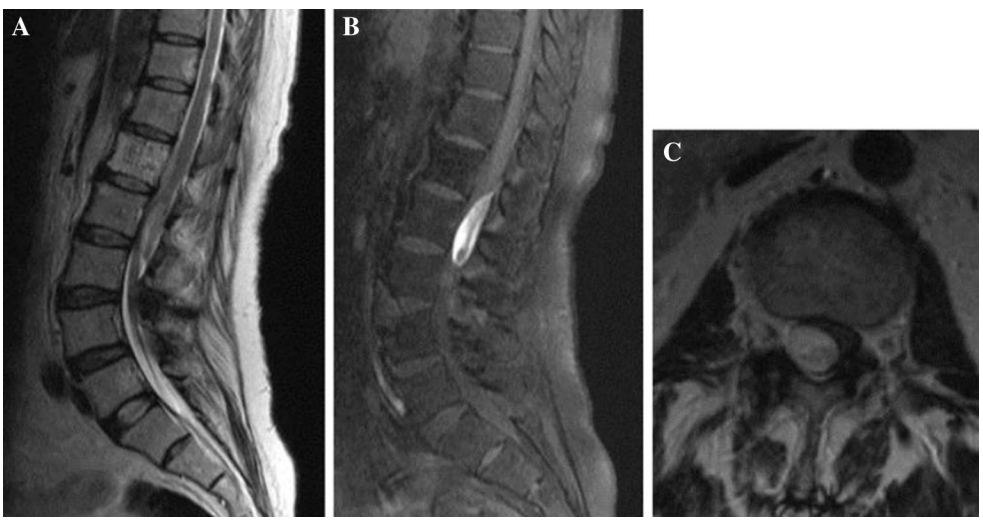

Fig. 2 Case 2: preoperative images from **a** sagittal T2-weighted MRI, **b** sagittal T2-weighted FSE MRI, and **c** axial T2-weighted MRI revealed a spinal subdural hematoma at L2

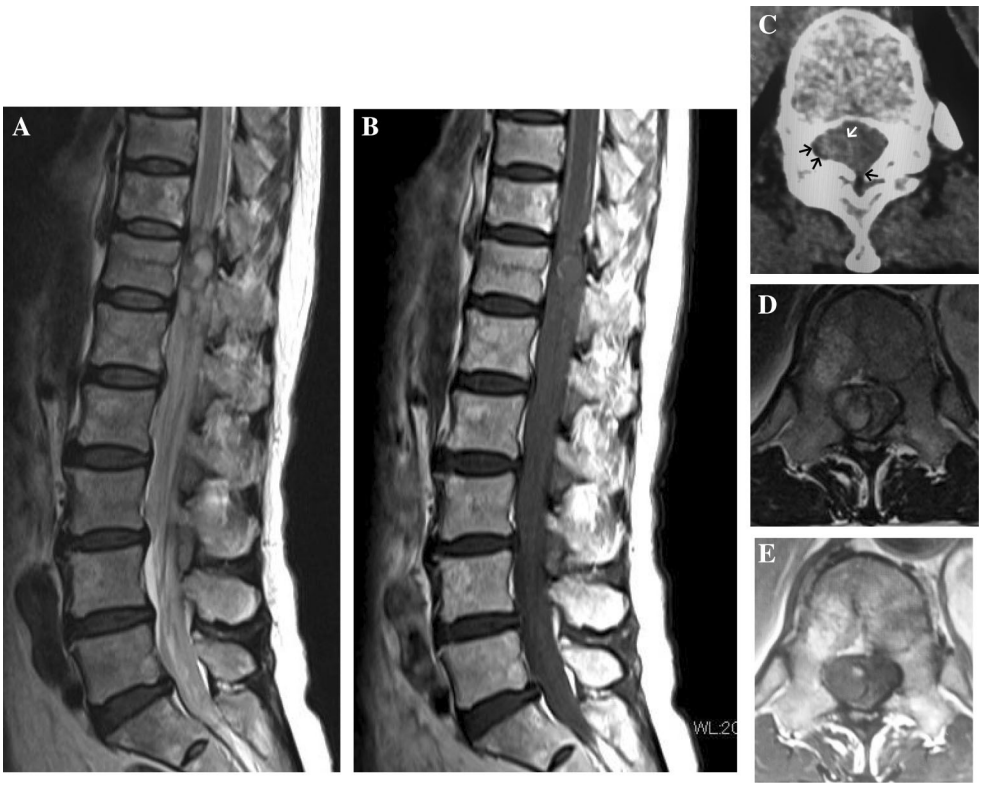

Fig. 3 Case 3: preoperative images from **a** sagittal T2-weighted MRI and **b** sagittal T1 gadolinium-enhanced MRI. **c** Corresponding contrast-enhanced CT clearly shows an acute subdural hematoma with ring enhancement, with contrasting low-density epidural fat (*black arrows*) around the hematoma (*white arrows*). **d** T2-weighted MRI. **e** Axial T1 gadolinium-enhanced MRI

frequency of subarachnoid hematoma is very low. Spinal subarachnoid hematoma accounts for <1% of all cases of subarachnoid hematoma [5]. Among 106 surgeries for spinal subdural hematoma, subarachnoid hematoma accounted for 13% [4]. The thoracolumbar and lumbar regions are the most frequently involved spinal segments, and there is no gender predominance and only a slightly higher incidence in the fifth to sixth decades of life [4].

The etiology of intraspinal hematoma includes coagulopathy, iatrogenesis (spinal or epidural anesthesia, lumbar puncture, and spinal surgery), spinal trauma, bleeding disorders (hemophilia, leukemia, and thrombocytopenia), arteriovenous malformations, and tumors [1–3, 6, 7]. Spontaneous spinal subdural hematoma is a rare disease, and in our series all cases were idiopathic and had no history of disease. In a case with degenerative spinal canal stenosis, a large amount of bleeding is likely to block the subdural and subarachnoid space, and thus a hematoma is likely to form [3, 4]. However, our cases did not have degenerative canal stenosis. The pathogenesis of subdural hematoma has also been suggested to be due to collapse of the microvasculature between the dural and arachnoid area with minor trauma [6], or due to spread of a subarachnoid hematoma to outside the arachnoid to become a subdural hematoma [7]. Subdural bleeding may be extraarachnoidal, and the hematoma is separated from the subarachnoid space [4]. The spinal subdural space is a potential avascular space, and thus bleeding might come from a subarachnoid source, which is more likely because the arachnoid is more brittle and penetrable than the dura mater [8]. The frequency of subarachnoid hematoma is very low due to pulsation of the CSF in the subarachnoid space.

Symptoms of spinal subdural hematoma include sudden-onset back pain, which may radiate to the limbs or trunk, weakness, and urinary or fecal incontinence. Physical findings differ according to the level of the lesion and include varying degrees of motor, sensory, and sphincter deficits [1–3]. Some cases do not have motor or sensory loss [9, 10]. Our cases all had acute onset that brought about paralysis of the lower limbs with strong pain. For patients with these symptoms, early diagnosis using thoracolumbar MRI and CT is particularly important to facilitate early surgery.

For diagnosis and subsequent surgery, localization of the hematoma is important, especially to distinguish the condition from epidural hematoma. Differentiation is based on the positional relationship between the hematoma and the dura mater. Since epidural fat is not affected by bleeding, the structure remains normal, and the boundary between hematoma and fat is a significant feature that should be

clear in imaging, using MRI as the modality of choice. The classic appearance of a spinal subdural hematoma is an inverted Mercedes Benz sign, in which enhancement of the film terminale and exiting nerve roots by the subdural hematoma results in a star-like appearance [11]. Xanthochromic CSF in MRI may also be useful for diagnosis [8]. In our series, these characteristics were present, and one hematoma also showed partial Gd enhancement in subarachnoid hematoma (case 3). CT myelography clearly shows contrast medium inside the subarachnoid space, which is reduced or displaced together with the spinal cord, as if there was an extradural mass effect [4]. In plain CT, the hematoma has high density and fat has low brightness, which makes it relatively easy to define the epidural fat region due to the clear contrast, and this is useful for localization [12].

In one of our cases (case 3), the boundary of the epidural fat and the hematoma was clear. The lesion could be seen to be confined to within the dura, and contrast-enhanced CT clearly showed ring enhancement of the hematoma. However, preoperative diagnosis of subarachnoid hematoma in subdural hematoma is difficult. In a case with a small hematoma, the border between CSF and the subarachnoid hematoma will be clear, and a gentle shape of the head-to-tail side in a sagittal image allows recognition of the subarachnoid hematoma (case 2). However, the hematoma can vary in size, and a huge thoracic subdural hematoma spanning 10 levels from T1 to T10 has been described [13]. In a case with a massive subarachnoid hematoma, the hematoma cannot be distinguished on a preoperative image, and confirmation of the subarachnoid hematoma can only be achieved through intraoperative findings.

Rationale for treatment and evidence-based literature

For paralyzed cases, an emergency operation and preparation for surgery using an intradural procedure are desirable. Non-operative treatment may be justified in a case with minimal neurological deficits, but patients with major deficits or a rapidly deteriorating clinical and radiological (CT, MRI) pattern are likely to benefit from drainage or surgery [14–16]. In such cases, early decompressive laminectomy with evacuation of the hematoma is considered to be the best treatment for spinal subdural hematoma [13]. Early surgery is mandatory in cases presenting with severe deficits and an aggressive approach should be considered as a viable option in cases of spontaneous spinal subdural hematoma, even after long-lasting spinal cord compression [17]. Patients with paraplegia and bowel and bladder dysfunction have the poorest prognosis, regardless of surgical or conservative treatment [15, 18, 19].

Procedures

Case 1 The patient was transported to a specialist spinal hospital for emergency surgery. Firstly, L1–L2 bilateral laminectomy revealed no hematoma in the extradural space, but after opening of the dura, the spinal cord at the conus region was centrally retracted to reveal a hematoma in the dorsal region. The hematoma was scraped out and removed, and then the spinal cord was decompressed.

Case 2 An emergency operation was performed. L1–L3 bilateral laminectomy indicated that the epidural space was normal, but exposure of the dura and arachnoid membrane revealed a hematoma. After complete removal of the hematoma, the spinal conus was decompressed (Fig. 4). Thus, we diagnosed subarachnoid hematoma.

Case 3 In emergency surgery, bilateral laminectomy at Th11–Th12 revealed no hematoma in the extradural space. The dura and arachnoid membrane were exposed, and the spinal cord was centrally retracted to reveal a hematoma in the ventral space. These findings resulted in diagnosis of subarachnoid hematoma. The hematoma was scraped out and removed.

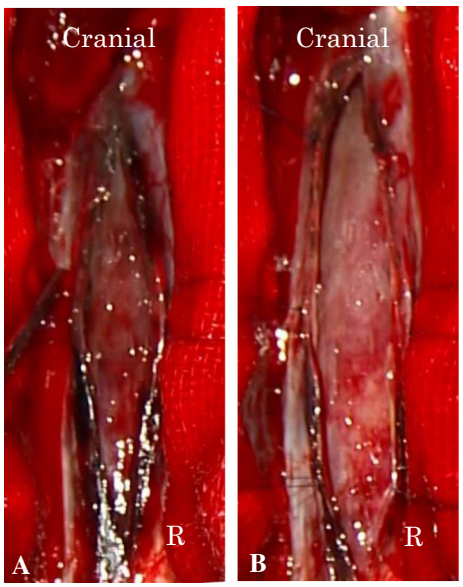

Fig. 4 Case 2: intraoperative photographs. **a** The dura and arachnoid membrane were exposed, and the spinal cord was centrally retracted to reveal a hematoma in the ventral space. This led to diagnosis of subarachnoid hematoma. **b** After removal of the hematoma, the spinal cord was decompressed

Outcome and follow-up

Case 1 Three months after surgery, motor status and dysuria had recovered.

Case 2 Three months after surgery, the patient was free of neurological deficits.

Case 3 Numbness in the lower extremities disappeared after surgery, and 6 months later motor weakness had resolved.

Compliance with ethical standards

Conflict of interest None of the authors have a conflict of interest with regard to the contents of the study. The study was approved by the ethical committee of our institution (IRB No. 354-3).

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