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Spontaneous Spinal Epidural Hematoma in Children: MRI Findings in 03 Cases

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Spontaneous Spinal Epidural Hematoma in Children: MRI Findings in 03 Cases

ABSTRACT:

Spontaneous spinal epidural hematoma (SSEH) is a rare but potentially serious condition in children, with an estimated incidence of 0.1 per 100,000, accounting for less than 1% of all spinal epidural compression syndromes. Although SSEH can occur at any age, it is exceptionally rare in infants. Rapid accumulation of blood in the epidural space may lead to spinal cord compression and irreversible neurological damage, making early diagnosis and prompt intervention critical.

SSEH can occur idiopathically or in association with underlying conditions such as vascular malformations, coagulation disorders, or prior lumbar puncture. Clinical presentation is often nonspecific, especially in young children, and may range from back pain to motor deficits. The severity of symptoms varies depending on the hematoma's size and location.
Magnetic resonance imaging (MRI) remains the diagnostic modality of choice, allowing accurate assessment of the hematoma and associated spinal cord involvement.

We report three pediatric cases of SSEH: two boys aged 9 and 7 years, and one infant aged 18 months. Hematomas were located posteriorly, posterolaterally, and anteriorly. Two cases showed extensive lesions, and one was limited to two vertebral levels. Two cases were idiopathic, while one was associated with thrombocytopenia due to thalassemia. Two patients achieved full neurological recovery; the third showed progressive improvement.
These cases highlight the diagnostic value of MRI and emphasize the importance of early individualized management—whether surgical or conservative—for achieving favorable neurological outcomes in pediatric SSEH.

INTRODUCTION:

Spontaneous spinal epidural hematoma (SSEH) is a rare clinical entity defined by the accumulation of blood in the spinal epidural space in the absence of identifiable traumatic, surgical, or vascular causes. First described by Jackson in 1869 (1), SSEH accounts for less than 1% of all spinal epidural compression syndromes (2) and is particularly rare in the pediatric population, where it is mostly reported as isolated cases or small series (3).
In children, SSEH most frequently involves the cervico-thoracic junction, typically extending over two to three vertebral levels. Older children may present with localized pain, limb weakness, or gait disturbances, while infants often show nonspecific symptoms such as irritability or hypotonia, complicating early diagnosis (4).

Most hematomas are located in the posterior epidural space, while anterior locations remain exceptional. The underlying cause is often idiopathic, although cases linked to hemophilia, coagulopathies, and vascular malformations have been reported (5). The pathogenesis may involve rupture of the valveless epidural venous plexus (6), or, in some cases, arterial bleeding—particularly in rapidly progressing, lateralized presentations (7).
Early diagnosis is critical to prevent irreversible neurological deficits. Magnetic resonance imaging (MRI) is the gold standard for detecting hematoma location, extent, and associated spinal cord compression (8).

This article presents three pediatric cases of SSEH with variable clinical and radiological features, aiming to emphasize the diagnostic challenges and the central role of imaging in guiding treatment decisions.

Keywords:
children, spinal, epidural, hematoma, magnetic resonance, compression.

CLINICAL PRESENTATION:
We report here three cases of spontaneous spinal epidural hematoma, emphasizing the MRI signs of this condition, which can be a surgical emergency.
These cases were selected for their illustrative value, reflecting the diversity of SSEH presentations in children. They differ in terms of hematoma location (posterior, posterolateral,

and anterior), clinical severity, underlying etiology, and management approach (surgical vs. conservative). Together, they provide a representative overview of the spectrum of pediatric SSEH and highlight the importance of early MRI diagnosis and individualized treatment strategies.

Case 1 – Extensive posterior SSEH in an 18-month-old with thrombocytopenia

An 18-month-old boy with a history of G6PD deficiency and sickle cell disease was admitted for acute bilateral lower limb weakness, evolving over two days. His mother reported that he had become unable to stand without preceding trauma or fever.

Neurological examination revealed bilateral hyperreflexia and positive Babinski signs. No extremity mottling was noted. Guillain–Barré syndrome was initially suspected.

Laboratory evaluation showed thrombocytopenia (platelet count: 80,000/μL) but normal coagulation parameters (PT, aPTT, fibrinogen). Brain CT was unremarkable.

Spinal MRI **(Fig 1)** demonstrated an extensive epidural collection extending from C7 to the lumbar region, hypointense on T1 and hyperintense on T2, with anterior displacement of the spinal cord but no signal abnormality within the cord.

A D10–D11 laminotomy was performed, and the hematoma was successfully evacuated. The patient exhibited progressive neurological recovery, with no residual sensorimotor deficits observed at the 14-day postoperative follow-up.

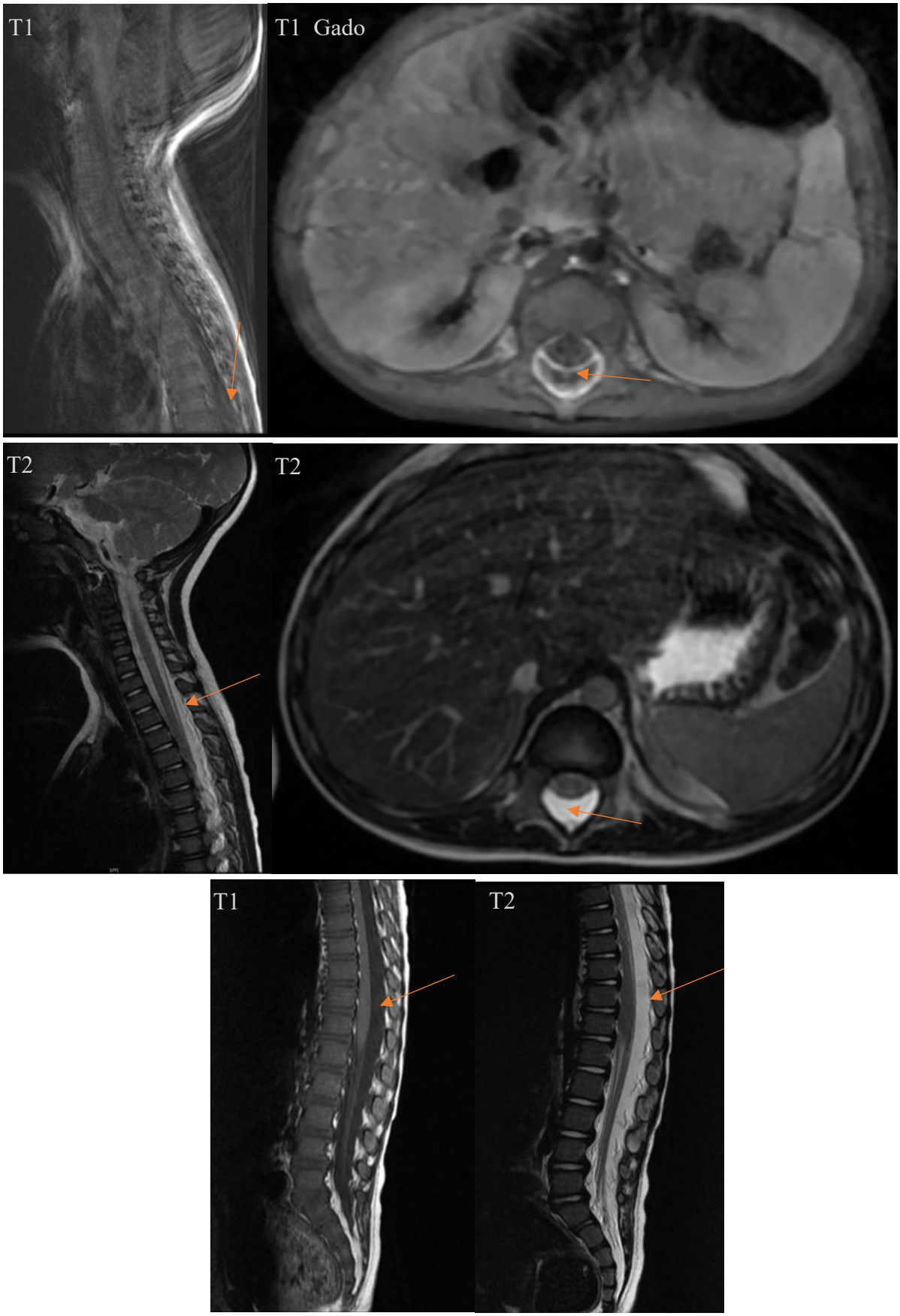


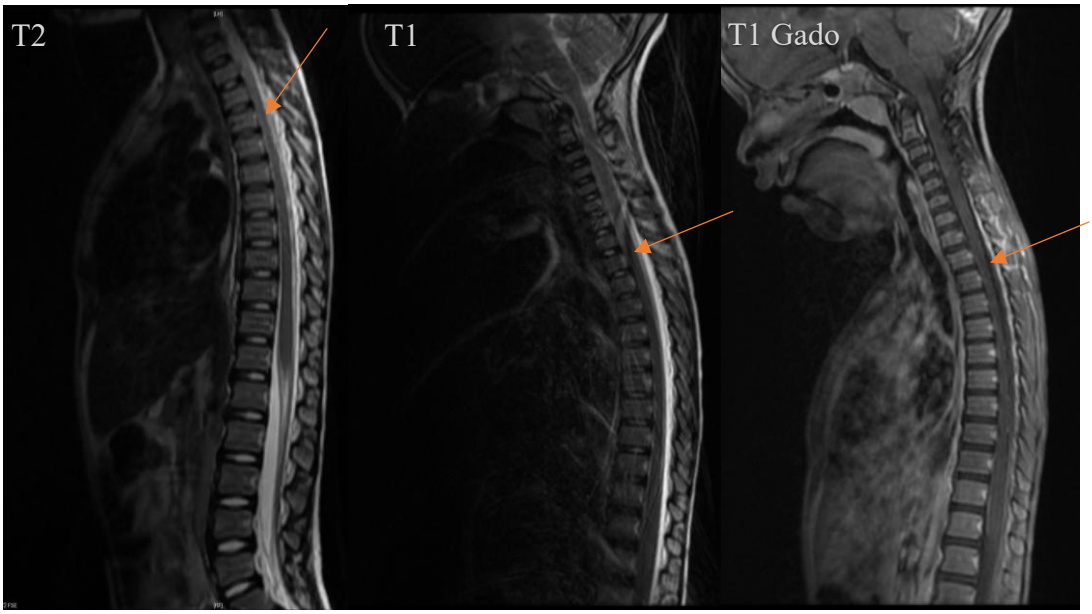
Fig. 1. Sagittal spinal MRI: large posterior epidural hematoma extending from C7 to the lumbar spine, appearing hypointense on T1-weighted and hyperintense on T2-weighted sequences, causing anterior displacement of the spinal cord without intramedullary signal abnormality.

Case 2 – Extensive posterior SSEH in a 7-year-old boy managed conservatively

A 7-year-old boy with no notable medical history presented with progressive ataxia and muscle weakness affecting all four limbs. There was no reported trauma, fever, or anticoagulant use. On neurological examination, the child was alert and afebrile. He exhibited deep tendon reflexes, a positive Babinski sign, impaired balance, and symmetric limb weakness. A lumbar puncture was performed due to initial suspicion of a central nervous system infection; cerebrospinal fluid (CSF) analysis was normal. Coagulation profile was also within normal limits.

Brain CT revealed no abnormalities. Spinal MRI **(Fig2)** identified an extensive epidural collection extending from C6 to L2, hypointense on T1 and hyperintense on T2, consistent with a liquefied hematoma. The lesion measured up to 4 mm in thickness and caused mild compression of the spinal canal without cord signal changes.

Given the absence of significant neurological deficits or cord compression, a conservative treatment approach was adopted. The child was monitored clinically and radiologically, with progressive improvement in motor function over time.



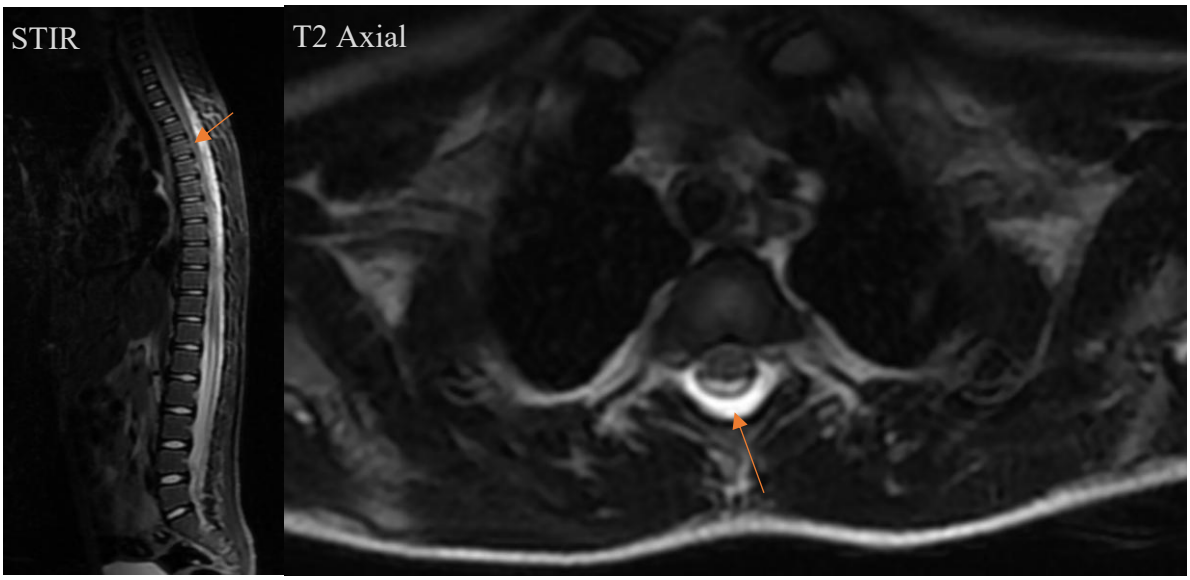


Fig. 2. Sagittal spinal MRI: extensive posterior epidural hematoma extending from C6 to L2, hypointense on T1-weighted and hyperintense on T2-weighted images, consistent with a liquefied hematoma. The lesion measures up to 4 mm in thickness and causes mild spinal canal compression without spinal cord signal abnormality.

Case 3 – Anterior SSEH with spinal cord compression in a 10-year-old boy

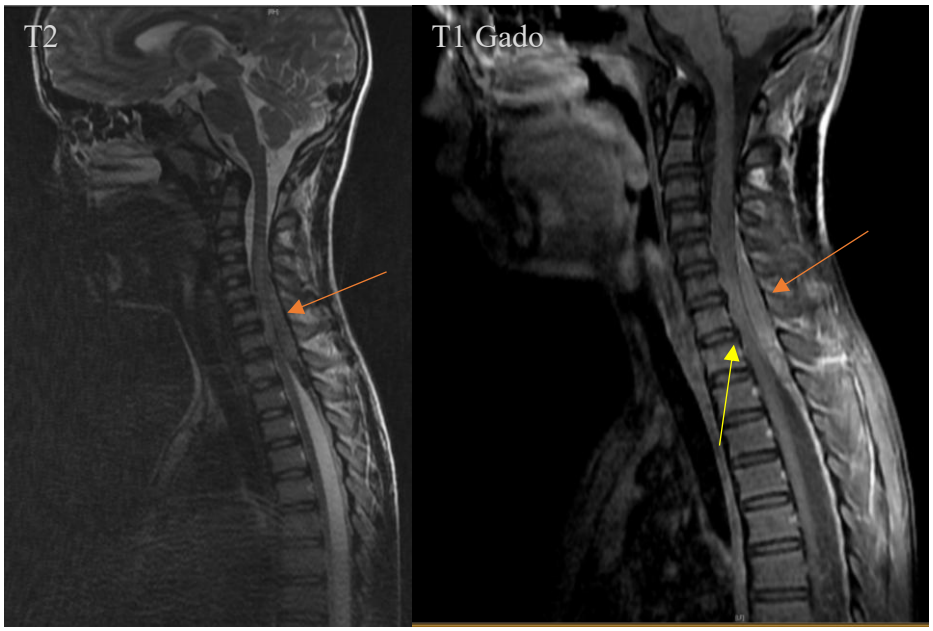
A 10-year-old boy with no known medical conditions presented with acute lower limb paralysis and bowel incontinence, progressing over 24 hours. The weakness began distally and ascended to involve the hips.

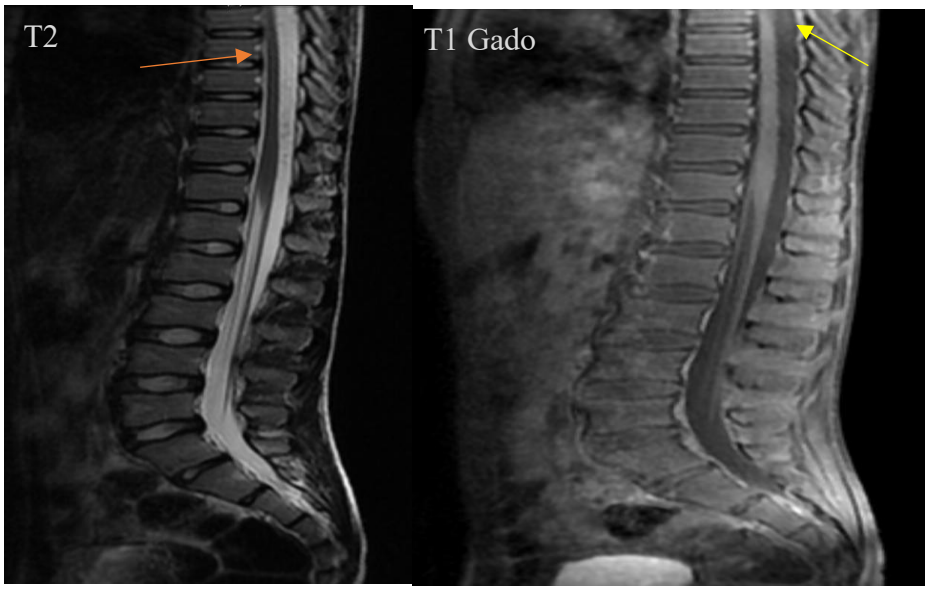
Neurological examination revealed flaccid paralysis and complete sensory loss in the lower limbs, but a negative Babinski sign. He was unable to stand or ambulate.

Laboratory tests, including CSF analysis and coagulation studies (PT, aPTT, fibrinogen), were normal. Brain CT showed no abnormalities.

Spinal MRI **(Fig3)** demonstrated a well-defined epidural collection anterior to the spinal cord from C6 to D4, hypointense on T2, compressing the cord. Hyperintense signal changes within the cord at C6–D1 levels indicated edema or injury.

A cervical laminectomy was performed to evacuate the hematoma, and a biopsy was taken for histopathological analysis (no tumor or vascular malformation was found). Postoperatively, the patient recovered progressively. A follow-up MRI at 3 months **(Fig4)** showed complete hematoma resolution, with residual medullary signal abnormalities. He regained independent ambulation and had no neurological deficits at discharge.





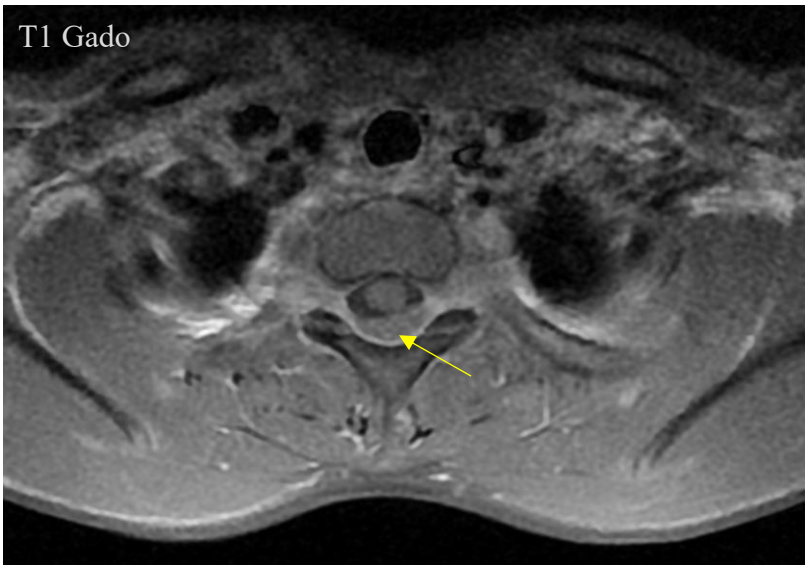


Fig. 3. Sagittal spinal MRI: well-defined anterior epidural collection extending from C6 to D4, with regular margins, hypointense on T2-weighted sequences and heterogeneous in signal. The hematoma encroaches upon the perimedullary space and compresses the spinal cord, with associated intramedullary hyperintensity at C6 and D1 levels, indicating spinal cord edema or injury.

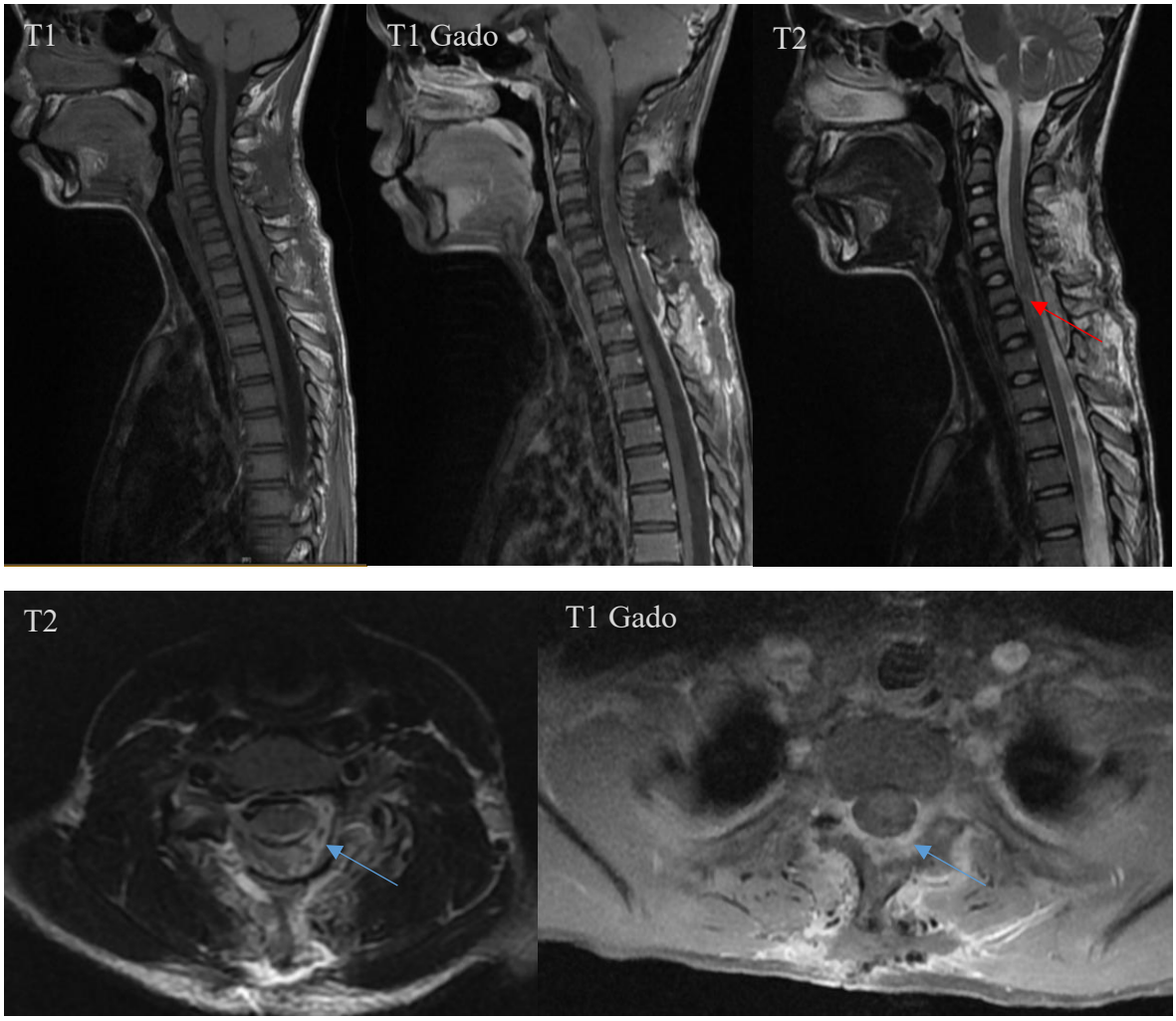


Fig. 4. Follow-up sagittal spinal MRI: complete resolution of the posterior cervico-dorsal epidural hematoma, with persistent central intramedullary hyperintensity suggestive of residual spinal cord injury.

DISCUSSION:

In pediatric patients, spontaneous spinal epidural hematoma (SSEH) constitutes a neurosurgical emergency due to the risk of acute spinal cord compression and resulting neurological deficits. Although SSEH can occur at any level of the spinal canal, it most commonly affects the cervico-thoracic junction in children, whereas in adults, it typically involves the cervico-thoracic and thoraco-lumbar regions. The hematoma usually spans two to three vertebral levels, although more extensive involvement of the entire spinal axis has been documented (9). The upper lumbar spine appears to demonstrate greater clinical tolerance, likely due to the infrequent involvement of the spinal cord and the absence of focal neurological signs, which can lead to diagnostic confusion with lumbar disc herniation (10).

Spinal epidural hematomas predominantly involve the posterior epidural space, while the anterior compartment is typically spared. Dorsal localization is the most common, with anterior SSEH being particularly rare. In fact, only a few anterior cases have been documented in the literature to date (11). The current series illustrates both typical and atypical patterns of distribution, including one case of anterior hematoma, highlighting the variability in localization.

In pediatric populations, the etiology of SSEH is most often idiopathic. Nonetheless, several underlying conditions have been reported, including hemophilia, vascular malformations, and coagulopathies. The designation “spontaneous” applies when no specific precipitating factor such as trauma, vertebral fracture, spinal procedure, or other medical intervention is identified. In some instances, contributory factors—such as anticoagulant use, bleeding diathesis, hypertension, or intense physical activity—have been noted (5).

While a few reports have linked SSEH to vascular malformations, this interpretation is debated. Many authors reserve the term SSEH for hematomas with no identifiable cause (12), and some propose a distinction between "spontaneous" and "idiopathic" cases (13). Two primary mechanisms are proposed for epidural bleeding: venous and arterial. Most commonly, hemorrhage arises from the fragile, valveless venous plexus within the epidural space, which is

susceptible to rupture under increased pressure (6). This venous vulnerability may explain many cases, particularly in the postnatal period (7). However, when the hematoma appears lateralized and coincides with acute onset and elevated blood pressure, an arterial origin may be considered. Beatty suggested that cervical SSEHs may stem from rupture of free epidural arteries, which are anatomically exposed to mechanical stress during movement, potentially leading to arterial rupture (14). This hypothesis is further supported by the structural sensitivity of the epidural arterial plexus to tension and stretch forces (7).

In acute cases of spontaneous spinal epidural hematoma (SSEH), clinical presentation and neurological deficits are influenced by several factors, including patient age, etiology, and especially the anatomical location of the hematoma. In younger children, symptoms are often nonspecific, which complicates early diagnosis and delays identification of the underlying cause. Due to this lack of specificity, some patients have experienced significant delays in diagnosis and treatment (15). In older children, the clinical picture more commonly begins with sudden, localized back pain, quickly followed by signs of spinal cord compression or cauda equina syndrome. In contrast, infants often present with vague symptoms such as irritability, inconsolable crying, or vomiting, while cervical pain is rarely evident or recognized (2). These nonspecific signs, combined with the child's inability to verbalize complaints, make diagnosis particularly challenging. In most cases, neurological deterioration occurs rapidly—within minutes or seconds after hematoma expansion—although delayed presentations spanning several days have also been reported without clear explanation (4). In older children, verbal communication facilitates clinical assessment. Recognizing the signs of SSEH is crucial, as spinal cord compression remains its defining feature and can lead to permanent neurological deficits if missed. According to Kreppel et al., SSEH accounts for the majority of spinal hematomas, comprising approximately 74.2% of reported cases (16).

Given its variable presentation, SSEH is often misdiagnosed. Several reported cases have initially been mistaken for conditions such as photophobia-associated meningitis, subarachnoid hemorrhage, Guillain–Barré syndrome, or even cerebral infarction (17). While paraparesis or tetraparesis are common in cervical SSEH, hemiparesis may occur when the hematoma

compresses one side of the corticospinal tract. Lesions at the cervico-thoracic junction may present with progressive paraplegia and cervical pain. For instance, Cakir et al. described a pediatric SSEH case that clinically mimicked Guillain–Barré syndrome. In acute or subacute stages, non-contrast CT may reveal a spontaneously hyperdense lesion; however, MRI remains the gold standard for diagnosis. It enables precise localization of the hematoma, assessment of spinal cord compression, and differentiation between fluid and clot components, as well as staging of the hematoma's evolution (8). The MRI signal changes over time, primarily influenced by the oxygenation state of hemoglobin, which affects T1-weighted sequences, and the integrity of red blood cell membranes, which alters T2 signals. T1-weighted sequences are particularly useful, as the temporal evolution of signal intensity is often characteristic, and in some cases, pathognomonic for hematoma (18).

The MRI appearance of SSEH varies depending on the patient's age and the time elapsed since the bleeding event. Within the first 24 hours, clots typically appear hyperintense on T1-weighted sequences and even more hyperintense on T2 (13). After this period, the signal often remains hyperintense on T1 but becomes hypointense on T2. Administration of gadolinium helps to better delineate the lesion by enhancing the dural margins (18). In some cases, contrast extravasation through the posterolateral epidural veins leads to focal enhancement. Although rare, such enhancement may reflect active bleeding and should be interpreted with caution, as it may mimic neoplastic or infectious processes and justify urgent surgical intervention (13).

From a diagnostic standpoint, MRI is valuable in ruling out other potential causes of spinal cord compression, such as herniated discs or intrinsic cord pathologies like infarction or myelitis. Epidural abscesses and neoplastic lesions may present with similar signal characteristics in early phases. However, the presence of associated disc abnormalities or vertebral anomalies, along with clinical and laboratory findings, can aid differentiation. Reported differential diagnoses in the literature have included Guillain–Barré syndrome, extradural arteriovenous fistulas, and various infections (13).

In idiopathic cases where conservative treatment is being considered, spinal angiography may be indicated to rule out underlying vascular malformations. It is particularly useful when MRI fails to reveal small lesions or when a vascular origin is strongly suspected (19).

Surgical decompression remains the standard of care in most cases, as it facilitates both evacuation and investigation of any bleeding source. However, in select cases where clinical signs are minimal and MRI shows a small, non-compressive hematoma conservative approach with close monitoring may be appropriate.

Functional prognosis depends largely on the initial neurological status, the size and level of the hematoma, and the time interval before treatment. In our series, two patients recovered fully, one showed improvement, and one retained some residual deficit.

In comparison with previously published pediatric series, the cases we report are consistent with several key trends described in international literature. Similar to findings by Patel and Yu (20), the cervico-thoracic junction was the most frequently affected site in our patients. Age-wise, our cases span from infancy to late childhood, reflecting the broad age range reported in other series (4 months to 16 years) (11). Notably, two of our three cases were idiopathic, in line with the predominance of idiopathic presentations in pediatric SSEH (12). Only one patient had an underlying hematologic condition (thrombocytopenia due to thalassemia), a known but uncommon risk factor (20).

In terms of outcome, the favorable neurological recovery observed in our patients supports existing evidence that early diagnosis and timely intervention are strongly associated with good prognosis (19). Our series also confirms the critical diagnostic value of MRI, as well as the feasibility of conservative management in selected cases, which has been highlighted by authors such as La Rosa and Halim (21).

The advent of MRI has greatly facilitated diagnosis. Factors associated with poorer outcomes include rapid onset of symptoms, complete neurological deficits, and thoracic hematoma

location. In contrast, early clinical improvement, partial or motor-only deficits, and cervical or lumbosacral localization are associated with better recovery prospects.

CONCLUSION:

Pediatric spontaneous spinal epidural hematoma (SSEH) is a rare neurosurgical emergency that requires high clinical suspicion and prompt imaging. MRI enables rapid diagnosis and guides effective management. While surgical decompression remains the standard, carefully selected patients without neurological compromise may benefit from conservative treatment. Favorable outcomes depend largely on early recognition and timely intervention.

CONSENT

Written informed consent was obtained from the parents or legal guardians of all pediatric patients included in this study for the publication of the case details and accompanying images.

ETHICAL APPROVAL

All procedures performed in this case series were reviewed and approved by the appropriate institutional ethics committee. The study was conducted in accordance with the ethical standards of the 1964 Declaration of Helsinki and its later amendments.

DISCLAIMER (ARTIFICIAL INTELLIGENCE)

The authors declare that no generative AI technologies (e.g., ChatGPT, Copilot, or other large language models or text-to-image generators) were used in the writing, editing, or preparation of this manuscript.

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