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Original Research Paper

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SPONTANEOUS SPINAL SUBDURAL HEMATOMA IN AN ADOLESCENT WITH APLASTIC ANEMIA: THE INVERTED MERCEDES-BENZ SIGN AS A KEY MRI CLUE

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ABSTRACT

Background: Spinal subdural hematoma (SSDH) is a rare cause of acute spinal cord or cauda equina compression and is exceptionally uncommon in adolescents with aplastic anemia. Severe thrombocytopenia predisposes these patients to spontaneous hemorrhage; however, isolated spinal involvement without associated intracranial hemorrhage is exceedingly rare. **Case Presentation:** A 17-year-old adolescent with aplastic anemia presented with acute neck and lower back pain, progressive radicular symptoms, and paresthesias. Laboratory investigations revealed pancytopenia with severe thrombocytopenia (platelet count: 15,000/μL). MRI demonstrated a long-segment spinal subdural hematoma extending from T11 to S3. Axial images revealed the characteristic inverted Mercedes-Benz sign, representing loculated subdural blood surrounding the cauda equina. Considering the severe thrombocytopenia and high operative risk, conservative management was undertaken. Despite intensive supportive care, the patient's neurological status deteriorated rapidly, and he succumbed two days later due to complications of severe aplastic anemia with progressive neurological deterioration secondary to spinal cord compression. **Conclusion:** This case highlights the rare occurrence of isolated spontaneous spinal subdural hematoma in an adolescent with aplastic anemia. Recognition of characteristic MRI findings, particularly the inverted Mercedes-Benz sign, may facilitate early diagnosis, accurate differentiation from spinal epidural hematoma, and timely management in patients with hematological disorders.

KEYWORDS : Spinal Subdural Hematoma; Aplastic Anemia; Magnetic Resonance Imaging; Adolescent; Cauda Equina; Inverted Mercedes-Benz Sign.

INTRODUCTION

Aplastic anemia is a rare bone marrow failure syndrome characterized by hypocellular bone marrow and peripheral pancytopenia, resulting in an increased susceptibility to infections and spontaneous hemorrhage secondary to severe thrombocytopenia [1]. Although bleeding most commonly involves the skin, mucosal surfaces, and intracranial compartment, spontaneous spinal hemorrhage is an exceptionally uncommon manifestation of the disease [1,4].

Spinal subdural hematoma (SSDH) is a rare cause of acute spinal cord or cauda equina compression, accounting for only a small proportion of all spinal hematomas [2]. Reported etiologies include trauma, anticoagulant therapy, lumbar puncture, spinal anesthesia, vascular malformations, coagulation disorders, and, less commonly, hematological disorders such as aplastic anemia [2,6]. Regardless of the underlying cause, delayed diagnosis may result in irreversible neurological deficits due to persistent spinal cord or nerve root compression [5,6].

SSDH associated with aplastic anemia is exceedingly rare. To date, only a few pediatric and adolescent cases have been reported in the literature, and all previously published cases were associated with concomitant intracranial hemorrhage [3]. In contrast, the present case describes an isolated spontaneous spinal subdural hematoma without associated intracranial bleeding, thereby expanding the recognized clinical spectrum of hemorrhagic complications in aplastic anemia.

Magnetic resonance imaging (MRI) is the imaging modality of choice for evaluating suspected SSDH because of its excellent soft-tissue contrast, precise delineation of the craniocaudal extent of hemorrhage, and ability to differentiate subdural from epidural collections [5,7]. Recognition of characteristic imaging findings, particularly the inverted Mercedes-Benz sign, can substantially improve diagnostic confidence and facilitate timely management.

We report a rare case of spontaneous SSDH in a 17-year-old adolescent with aplastic anemia, emphasizing the characteristic MRI findings and highlighting the inverted Mercedes-Benz sign as a valuable radiological clue for the diagnosis of spinal subdural hematoma.

Case Report

A 17-year-old adolescent with a known diagnosis of aplastic anemia presented to the pediatric emergency department with sudden-onset, progressively worsening pain involving the neck, lower back, left posterior thigh, posterolateral aspect of the leg, and lateral aspect of the foot for five days. He also complained of progressive paresthesias in the same distribution without associated numbness. The pain was aggravated by walking for a few minutes and was relieved with rest. There was no history of trauma, spinal intervention, anticoagulant therapy, fever, bladder or bowel dysfunction, or preceding neurological illness.

General physical examination was unremarkable. Local examination revealed no cervical or lumbar paraspinal muscle spasm or tenderness; however, mild restriction of forward flexion of the lumbar spine was noted. Plain radiographs of the cervical and lumbar spine were unremarkable.

Laboratory investigations demonstrated pancytopenia, with a hemoglobin level of 9 g/dL, total leukocyte count of 1,600/μL, and severe thrombocytopenia (platelet count: 15,000/μL). Coagulation parameters, including prothrombin time (PT) and activated partial thromboplastin time (aPTT), were within normal limits. D-dimer, liver function tests, and serological tests for hepatitis B and C were also unremarkable. Bone marrow biopsy demonstrated markedly hypocellular marrow

with approximately 20% cellularity, consistent with aplastic anemia.

Considering the patient's hematological background and progressive neurological symptoms, MRI of the spine was performed. MRI demonstrated a long-segment spinal subdural hematoma extending from T11 to S3. The hematoma appeared hyperintense on T1-weighted images and predominantly hypointense on T2-weighted and STIR sequences. Axial T1-weighted fat-suppressed post-contrast images demonstrated homogeneous enhancement of the subdural collections. Axial images demonstrated three loculated subdural collections situated ventrally and bilaterally dorsally around the cauda equina, producing the characteristic inverted Mercedes-Benz sign (Figure 1). The hematoma produced marked mass effect on the cauda equina nerve roots with displacement of the neural elements while preserving the epidural fat plane, findings consistent with a spinal subdural rather than epidural hematoma. (Figure 1).

Given the profound thrombocytopenia and the high operative risk, conservative management with close neurological monitoring, supportive care, and hematological management was undertaken. Despite aggressive supportive treatment, the patient's neurological status deteriorated rapidly, necessitating admission to the intensive care unit and mechanical ventilation. Unfortunately, he succumbed two days later due to complications of severe aplastic anemia with progressive neurological deterioration secondary to spinal cord compression.

DISCUSSION

Spontaneous spinal subdural hematoma (SSDH) is an uncommon but potentially devastating cause of acute spinal cord or cauda equina compression. Although most cases are associated with trauma, anticoagulant therapy, spinal procedures, vascular malformations, or coagulation disorders, spontaneous SSDH may rarely occur in patients with hematological disorders such as aplastic anemia [1,2,6]. In aplastic anemia, severe thrombocytopenia predisposes patients to spontaneous hemorrhage, and rupture of fragile vessels within the spinal subdural compartment is considered the most likely mechanism of hematoma formation [1].

Clinically, SSDH typically presents with sudden-onset severe back pain followed by radicular pain and progressive neurological deficits, depending on the level and extent of spinal cord or cauda equina compression. Sensory disturbances, motor weakness, and bladder or bowel dysfunction may also occur, making early recognition essential for preventing permanent neurological impairment [2,5,6].

MRI is the investigation of choice for diagnosing SSDH because it provides excellent soft-tissue contrast, accurately defines the craniocaudal extent of hemorrhage, and reliably differentiates subdural from epidural collections [5,7]. Unlike intracerebral hemorrhage, however, the MRI appearance of spinal hematomas is variable and depends on several factors, including the age of the hemorrhage, oxygenation state of hemoglobin, and imaging parameters. Therefore, signal characteristics should always be interpreted in conjunction with the clinical presentation rather than applying the staging system used for intracerebral hemorrhage directly to spinal hematomas [5,7]. In the present case, the lesion demonstrated T1 hyperintensity with predominantly T2/STIR hypointensity.

Differentiation between spinal epidural hematoma and SSDH is clinically important because their imaging appearances, differential diagnoses, and management strategies differ [5,7]. Spinal epidural hematomas are located external to the dura mater, commonly occupy the dorsal epidural space, frequently obliterate the epidural fat plane, and may extend into the neural foramina. In contrast, spinal subdural hematomas are located between the dura mater and arachnoid mater, usually preserve the epidural fat plane, remain confined within the dural sac, and generally do not extend into the neural foramina [5,7].

One of the most characteristic MRI findings of SSDH is the inverted Mercedes-Benz sign observed on axial imaging. This appearance results from compartmentalization of subdural blood by the midline dorsal septum and the paired dentate ligaments, producing three triangular loculations surrounding the cauda equina. Nevertheless, this sign is not universally present and should be interpreted together with the overall MRI findings and clinical context rather than in isolation [5,7]. In the present case, the characteristic inverted Mercedes-Benz configuration was clearly demonstrated on axial MRI, substantially increasing diagnostic confidence.

Management of SSDH depends on the severity of neurological impairment, the extent of hemorrhage, and the underlying clinical condition [6,8]. Patients with severe or rapidly progressive neurological deficits generally require urgent surgical decompression, whereas conservative management may be considered in carefully selected patients with minimal neurological deficits or in those with severe coagulopathy in whom operative intervention carries substantial risk [6,8]. In patients with aplastic anemia, treatment decisions require close collaboration between hematologists, neurosurgeons, and radiologists because profound thrombocytopenia increases the risk of operative bleeding while delayed decompression may result in irreversible neurological injury [1,6]. In our patient, profound thrombocytopenia (platelet count 15,000/μL) precluded immediate surgical intervention. Despite intensive supportive care, progressive neurological deterioration occurred, and the patient ultimately succumbed to complications of severe aplastic anemia with secondary spinal cord compression.

To our knowledge, only a few pediatric and adolescent cases of SSDH associated with aplastic anemia have been reported previously, all of which were accompanied by concomitant intracranial hemorrhage [3]. In contrast, the present case represents isolated spontaneous spinal subdural hematoma without associated intracranial bleeding, thereby expanding the recognized clinical spectrum of hemorrhagic complications in aplastic anemia. Furthermore, this report emphasizes the inverted Mercedes-Benz sign as a valuable radiological clue that can facilitate early diagnosis and improve differentiation of SSDH from other spinal hemorrhagic lesions.

CONCLUSION

Spontaneous spinal subdural hematoma is an exceptionally rare but potentially life-threatening neurological complication of aplastic anemia. Prompt recognition is essential because delayed diagnosis may result in irreversible spinal cord or cauda equina injury. MRI remains the imaging modality of choice for accurately localizing the hematoma, determining its extent, differentiating subdural from epidural hemorrhage, and guiding clinical management.

The present case highlights the diagnostic value of the inverted Mercedes-Benz sign, a characteristic axial MRI finding produced by compartmentalization of subdural blood around the cauda equina. Although not universally present, recognition of this imaging sign can substantially improve diagnostic confidence in appropriate clinical settings.

This report also expands the limited literature on spinal hemorrhagic complications of aplastic anemia by describing isolated spontaneous spinal subdural hematoma without

associated intracranial hemorrhage in an adolescent. Increased awareness of this rare entity among radiologists, neurosurgeons, and hematologists may facilitate earlier diagnosis, multidisciplinary management, and improved clinical decision-making in patients presenting with acute neurological symptoms and severe thrombocytopenia.

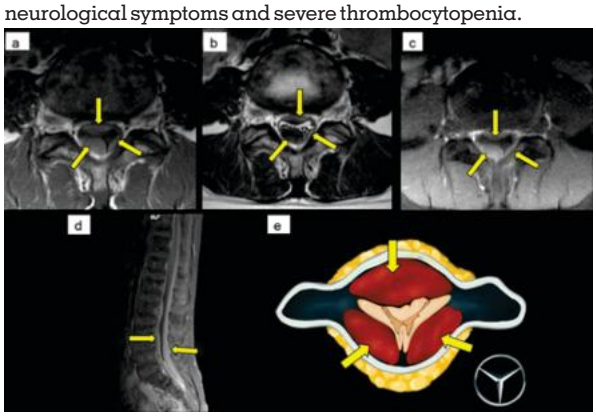

Figure 1: (A) Axial T1-weighted and (B) Axial T2-weighted images show loculated subdural collections (yellow arrows) that appear hyperintense on T1-weighted and hypointense on T2-weighted images. These collections are seen along the ventral, right dorsal, and left dorsal aspects of the thecal sac, resulting in compression of the neural elements. The axial distribution forms the characteristic "inverted Mercedes-Benz sign."
(C) Axial T1 fat-suppressed post-contrast image demonstrates homogeneous enhancement of the collections.
(D) Sagittal T1 fat-suppressed post-contrast image reveals the craniocaudal extent of the subdural hematoma, spanning from the T11 to the S3 vertebral level.
(E) Schematic axial illustration of the spinal cord highlighting the classic inverted Mercedes-Benz sign formed by the subdural collections.

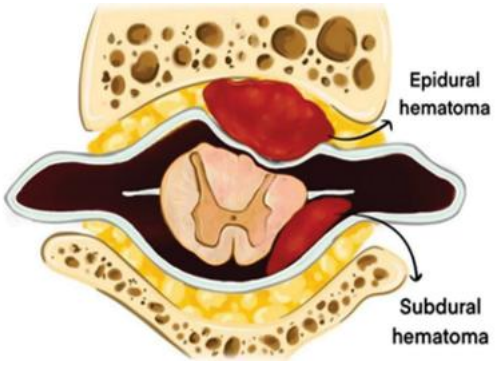

Figure 2: Schematic Illustration Depicting the Anatomical and Imaging Differences Between Spinal Epidural and Spinal Subdural Hematomas.

Table 1: Data Summary of Reported Pediatric Cases of Aplastic Anemia with Spinal Subdural Hematoma (SDH) Reported in Literature.

No.	Author	Year	Age/ sex	Clinical presentation	Imaging findings	Management	Outcome
1.	Jain et al.4	2008	12/M	Headache and back pain for 3 days	Posterior fossa and C1 to S3 SDH	Conservative management	Good
2.	Satyarthee and Ahmed.5	2017	14/M	Headache and back pain for 12 hours	Bi-frontal, posterior fossa, cervical and dorsal SDH	Conservative management	Good
3.	Ali M et al.6	2022	11/M	Headache, neck and back pain for 3 days	Posterior fossa and C2 to sacrum SDH	Conservative management	Good
4.	Present case	2025	17/M	Progressive neck pain, back pain, leg pain for 5 days and parasthesia	T11-S3 spinal SDH.	Conservative management	Succumb to death

Abbreviations: SDH = subdural hematoma; M = male; C = cervical spine; D = dorsal spine; S = sacral spine.

Table 2: Differentiating MRI Features of Spinal Epidural and Subdural Hematomas.

Imaging Features	Epidural Spinal Hematoma	Subdural Spinal Hematoma
Location	• Outside dura • Mostly dorsal	• Within dural sac, • can be dorsal, ventral, or circumferential
On Sagittal images	• Well-demarcated biconvex lesion with tapered superior and inferior edges. • Effacement of the epidural fat • Present in epidural space with contact with the osseous structure	• Confines to the shape of the spinal canal • No obliteration of the epidural fat • Separate from the osseous structure
On Axial images	• Biconvex in shape • Obliteration of the epidural fat with dural displacement	• Crescentic/biconvex in shape • Separated from the epidural fat without dural displacement
Neural foraminal extension	Can extend	Does not extend
Classic MRI sign	Dural sac compression	Inverted Mercedes-Benz sign

MRI- Magnetic Resonance Imaging

Declarations:

Ethical Approval: It was carried out under declaration of Helsinki and patient consent was obtained for publishing the report.

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Conflict of Interest: The authors declare that they have no conflicts of interest.

Data Availability: All data generated or analyzed during this study are included in this published article.

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