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Case Report

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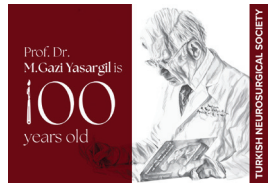

Traumatic Spinal Epidural Hematoma Associated with Cervical Nerve Root Avulsion without Vertebral Fractures: Case Report

Rafael APONTE-CABALLERO[1,2], Valentina OSEJO-ARCOS[1,2], Luis Carlos AVELLANEDA C[3], Humberto MADRINAN-NAVIA[1,2], Mario FERNANDO RODRÍGUEZ S[1,3], William Mauricio RIVEROS-CASTILLO[1,2], Javier Mauricio SAAVEDRA G[1,3], Camilo E PEÑA[1,3]

[1]Center for Research and Training in Neurosurgery (CIEN), Bogotá, Colombia
[2]Universidad del Rosario, School of Medicine, Bogotá, Colombia
[3]Orinoquia Hospital, Neurosurgery Department, Yopal, Colombia

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Corresponding author: Rafael APONTE-CABALLERO ✉ rafael.aponte@urosario.edu.co

ABSTRACT

Traumatic spinal epidural hematoma (TSEH) is a rare condition that may cause acute spinal cord compression and lead to irreversible neurological impairment. TSEH not only compresses the cord, but it can also worsen cervical nerve root avulsion. To our knowledge, only five cases of combined TSEH and cervical nerve root avulsion have been reported in the literature. We present the case of a 42-year-old woman who suffered a motorcycle accident. On admission, she presented with mild traumatic brain injury and cervical spine and right shoulder trauma. A physical examination revealed numbness and flaccid paresis in her right arm, compromising the C5 to T1 dermatomes and myotomes. MRI images showed evidence of a right anterolateral spinal epidural hematoma (SEH) that extended from the C2 to C7 vertebral levels. MRI and electromyography findings of the presence of a pseudomeningocele from the C4-C5 to C7-T1 levels indicating brachial plexus neurotmesis supported the presence of a cervical nerve root avulsion associated with TSEH. Cervical plexus syndrome requires a comprehensive diagnostic workup. SEH should be considered a cause of nerve root avulsion and brachial plexus syndrome. We believe that the extension of SEH into the intervertebral foramina could be a radiological sign related to nerve root avulsion.

KEYWORDS: Spinal cord, Epidural, Brachial plexus neuropathies

INTRODUCTION

Spinal epidural hematoma (SEH) is a rare condition that causes acute spinal cord compression and may lead to irreversible neurological impairment (9,13). This condition requires early diagnosis and high-priority surgery because early evacuation is associated with better functional outcomes in certain cases (9,13). Although multiple causative factors have been described, 40–50% of cases are of unknown origin. The remaining cases can be attributed to trauma, surgically induced lesions, malignancy, and other causes (1,9,13). Spontaneous SEH is defined as a hematoma that appears after a minor trauma that is not sufficiently severe to cause vertebral fractures (VFs) or a hematoma without an identifiable cause (1,9,13). A traumatic spinal epidural hematoma (TSEH) is uncommon, occurring in only 0.5–1.7% of all spinal injuries,

Rafael APONTE-CABALLERO : 0000-0002-2740-8837
Valentina OSEJO-ARCOS : 0000-0002-2037-0506
Luis Carlos AVELLANEDA C : 0000-0002-2833-2985
Humberto MADRINAN-NAVIA : 0000-0001-7862-4057
Mario Fernando RODRIGUEZ S : 0000-0002-2093-9299
William Mauricio RIVEROS-CASTILLO : 0000-0003-3978-2153
Javier Mauricio SAAVEDRA G : 0000-0001-9935-3903
Camilo E PEÑA : 0000-0001-8006-2348

but it is often associated with VFs (2,3,8). TSEH presents more frequently in men, with the usual location being the posterior aspect of the spinal canal (9,13).

The presence of nerve root avulsion (NRA) and TSEH on the cervical spine (C-spine) is rare, with only five cases reported in the literature (3–5,10,15). This combination can occur when a sufficiently disruptive force exerted on the spine exceeds the nerve root's elastic limit and causes its separation from the spinal cord (12). Herein, we describe the case of a 42-year-old woman with a brachial plexus NRA related to a high-impact cervical injury and subsequent TSEH.

CASE REPORT

History and Physical Examination

A 42-year-old woman presented to the emergency department after a motorcycle accident in which she suffered mild trauma to her right shoulder, cervical spine, and head. Her medical history was unremarkable.

Her vital signs and mental status were normal. A physical examination revealed numbness and flaccid paresis of the right arm involving the C5 to T1 myotomes. She also had areflexia of the biceps, brachioradialis, and triceps muscles.

Imaging and Management

X-rays and CT scans of the cervical and thoracic spine showed a fracture of the right first rib but no C-spine lesion. A C-spine MRI conducted due to the neurological deficit revealed a right SEH that extended from the C2-C7 vertebral levels and compromised the C4-C5, C5-C6, and C6-C7 right foramina. The SEH was associated with a right anterior subdural spinal hematoma that deviated posteriorly and contralaterally (Figure 1). An MRI of the brachial plexus also demonstrated edema and altered signal intensity in the scalene muscles (SMs), which hindered the optimal visualization of the plexus trunks on the right side (Figure 2).

The neurological status of the patient remained stable during the ER visit. Conservative medical treatment with rehabilitation was initiated, and an outpatient-clinic follow-up was scheduled.

A follow-up performed one month after the traumatic lesion revealed no change in the patient's right superior limb monoplegia. However, a C-spine MRI taken during that visit showed absorption of the SHE, and a brachial plexus MRI revealed a pseudo-meningocele arising from the C4-C5 to C7-T1 levels (Figure 3).

Electromyography and nerve conduction velocity tests revealed H-reflexes and F-waves, indicating brachial plexus neurotmesis, denervating lesions, and limited voluntary activity from the primary inferior trunk. Conservative treatment with physical therapy was prescribed.

DISCUSSION

Our literature review uncovered only five reported cases of cervical TSEH associated with brachial plexus nerve root avulsion (Table I) (3–5,10,15). All five cases were preceded by high-energy trauma that caused nonvertebral fractures. Our findings are consistent with these previous reports, as our patient presented with only a rib fracture. Moreover, the

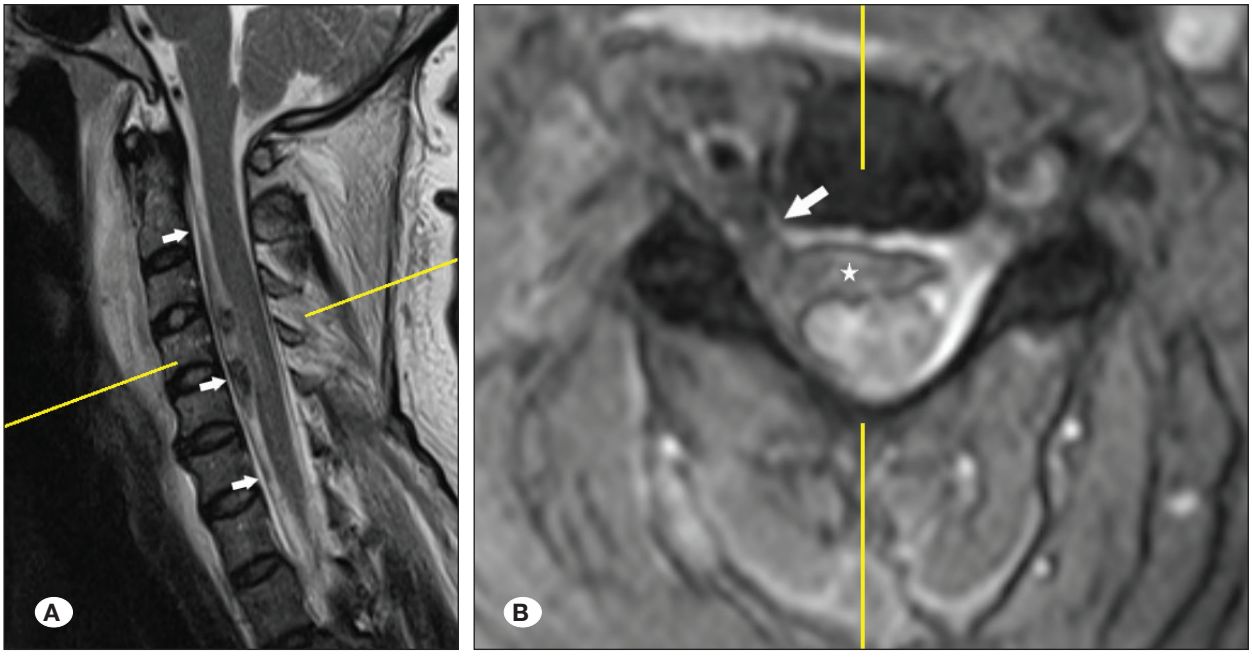

Figure 1: Cervical spine MRI. **A)** T2 sagittal sequence showing an anterior spinal hematoma (white arrows) that extends from C2-C7 with subdural characteristics due to preservation of peridural fat. **B)** T2 axial sequence, showing right anterolateral subdural hematoma (white star), causing posterior spinal cord compression limited by a denticulate ligament. The epidural component extends from the C4 to C5 right foramen (white arrow).

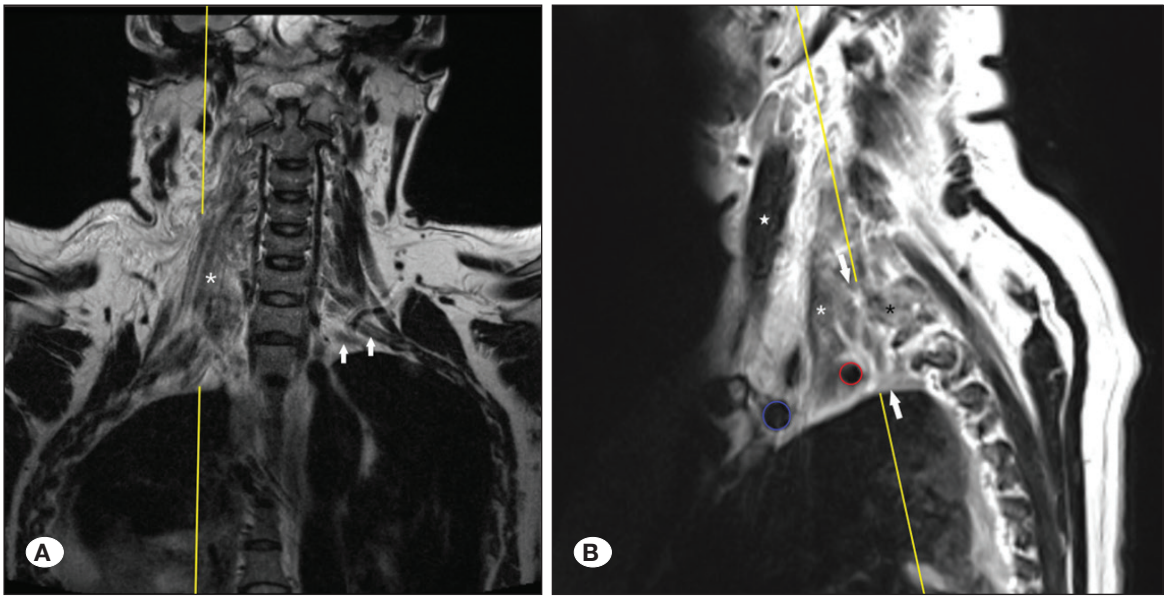

Figure 2: MRI of the brachial plexus. **A)** T2W coronal sequence showing edema of the right scalene muscles (SM) (white asterisk) that obscures the trunks of the right plexus, which can be seen contralaterally (white arrows). **B)** T2W sagittal sequence showing the trunks of the right plexus (white arrows) and the anterior and middle SM (white and black asterisks). The edema of the SM can be compared with the normal sternocleidomastoid muscle (white star).

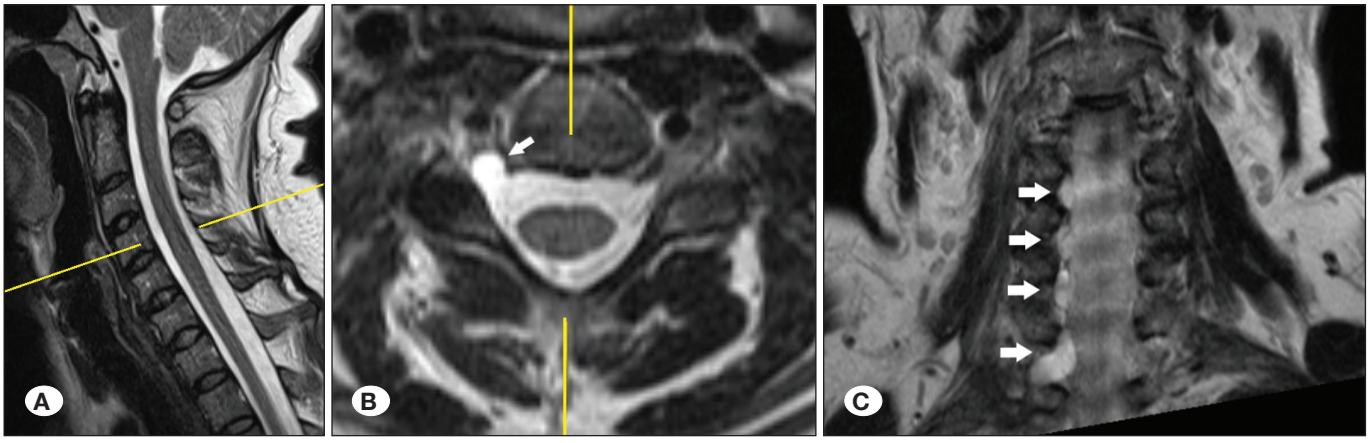

Figure 3: T2W cervical spine MRIs at 30-day follow-up. **A)** Sagittal view. **B)** Axial view of C4-C5 vertebral levels showing complete hematoma reabsorption. Presence of C4-C5 right pseudomeningocele (white arrow). **C)** Coronal view, showing C4-C5 to C7-T1 right pseudomeningoceles (white arrows).

Table I: Comparative Table of Published Cases Involving a Combination of Cervical Spine Epidural Hematoma and Nerve Root Avulsion in the Brachial Plexus

Case	Non-Cervical Fracture	C-spine Fracture	Electrophysiologic Study	Sphincter Injury	Spinal Level	Surgical Treatment	Outcome of motor deficit at follow-up
Giugale et al. (4)	Yes	Yes	Yes	No	C2-T4	Yes[a]	Not mentioned
Haider et al. (5)	Yes	No	No	No	C5-T11	No	No improvement
Newman et al. (10)	Yes	No	No	No	C5-T10	No	No improvement
Garg et al. (3)	Yes	No	Yes	No	C3-T2	Yes[a]	No Improvement
Zubair et al. (15)	Yes	Yes	No	No	C6-T1	No	Partial Improvement
Current Case	Yes	No	Yes	No	C4-C7	No	No Improvement

a: Significant cervical spinal cord compression.

high-energy trauma associated with motorcycle accidents increases the risk of brachial plexus lesions (11). These lesions affected the entirety of the brachial plexus in 64.4% of the cases and the superior trunk in 25% of the cases. They are most frequently encountered as neurapraxia and axonotmesis, which account for 41.6% and 50% of SEH cases, respectively. The least frequent injury type is neurotmesis, which occurs in the remaining 8.4% of cases (8). When SEH is associated with nerve root avulsion, the most frequent symptoms are cervicalgia, thoracic pain, hemiparesis, radicular pain, and Brown–Sequard syndrome (6,7,14).

Of the six reported cases, including this one, only two involved VF. Garg et al. and Giugale et al. described fractures at the C1, C7, and T1 vertebrae (3,4). When the nerve roots are stretched beyond their elastic limits, this raises the possibility of traumatic avulsion of the cervical nerve roots, resulting in separation from the spinal cord (12). Therefore, by definition, VF is not a prerequisite for trauma-causing NRA.

As in our case, Giugale et al. and Garg et al. used MRI to diagnose brachial plexus injuries. They also carried out electromyography to assess the type of nerve lesion and to improve diagnostic accuracy (3,4). In these studies, the most frequent MRI finding associated with brachial plexus avulsion was a pseudomeningocele in the intervertebral foramina. The MRI receiver operating characteristics (ROC) used to diagnose pseudomeningocele increase when MRI is performed 30 days after the primary lesion (7). However, pseudomeningocele is not present in all cases of traumatic NRA (13). Moreover, the use of diffusion tensor imaging (DTI) of the spinal cord to visualize inflammatory and degenerative disorders, such as Brown-Séquard syndrome, is increasing (2). However, the improvement in diagnostic accuracy using DTI in patients with traumatic monoparesis requires further assessment.

In the present case, the SEH extended to the intervertebral foramina. In our opinion, this wide extension of bleeding could be an early sign of NRA, and it may contribute to an increase in the exerted tractive force of high-impact trauma, thereby worsening the avulsion. Further studies are needed to assess the sensitivity and specificity of this sign, as well as the validity of this hypothesis. The diagnostic workup of the case is summarized in a timeline that could be used in future cases of C-spine trauma associated with monoparesis (Figure 3). The present case had diagnostic intricacies because, in cervical trauma, the areas that are first evaluated are usually the C-spine and spinal cord, not the peripheral nerves. One month after the initial complaint, electromyography was performed, and a C-spine MRI was repeated. Both tests confirmed peripheral nerve avulsion.

In previous reports, all patients were admitted to the emergency department and presented with flaccid monoplegia in their affected superior limb. Only two cases had motor deficits in a different limb. The case reported by Newman et al. involved a 3-year-old child with a contralateral upper limb strength of 3/5, whereas the case by Garg et al. involved a 33-year-old man with paraparesis. However, both patients had full recovery from their non-nerve avulsion motor deficits (3,10). Decompressive surgery was performed in only two cases to alleviate spinal cord compression in life-threatening segments (4,15). Conservative treatment is recommended in most instances unless the patient presents signs of compressive myelopathy. In these situations, decompressive surgery becomes mandatory even though this intervention will not impact the prognosis of NRA (5,10,15).

CONCLUSION

SEH is deemed a surgical emergency due to its potential to cause irreversible neurological impairment and life-threatening lesions. Nevertheless, when SEH is associated with mild symptoms, medical treatment is a reasonable alternative. TSEH should be ruled out as a possible contributing factor to brachial plexus neurotmesis. Further studies are needed to create a more thorough diagnostic algorithm for cervical NRA that presents as brachial plexus neurotmesis.

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Declarations

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Availability of data and materials: The datasets generated and/or analyzed during the current study are available from the corresponding author by reasonable request.

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AUTHORSHIP CONTRIBUTION

Study conception and design: RAC, VOA, CEP

Data collection: RAC, LCAC, HMN

Analysis and interpretation of results: RAC, HMN, MFR

Draft manuscript preparation: RAC, VOA, WMRC, JMSG

Critical revision of the article: MFR, WMRC, JMSG, CEP

Other (study supervision, fundings, materials, etc...): JMSG, WMRC

All authors (RAC, VOA, LCAC, HMN, MFR, WMRC, JMSG, CEP) reviewed the results and approved the final version of the manuscript.

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