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(CASE REPORT)

TRAUMATIC PREGANGLIONIC AVULSION OF LEFT C6, C7, AND C8 NERVE ROOTS WITH ROTATOR CUFF DENERVATION ATROPHY: AN MRI CASE REPORT

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ABSTRACT

Background: Differentiating preganglionic from postganglionic brachial plexus injuries on MRI is critical for surgical planning, as preganglionic avulsions preclude direct repair and require nerve transfer.

Case Presentation: A 38-year-old male motorcyclist sustained a high-velocity accident resulting in left upper limb sensorimotor deficit distal to the deltoid. MRI at 4 months post-injury demonstrated preganglionic avulsion of the left C6, C7, and C8 roots (root absence sign), a pseudomeningocele at the left C7–C8 neural foramen, and chronic asymmetric atrophy of the left paraspinal and periscapular musculature.

Conclusion: Combined cervical and shoulder MRI provided comprehensive injury mapping. The root absence sign and pseudomeningocele were the key direct diagnostic indicators, while paraspinal muscle denervation served as an indirect sign confirming chronicity and the preganglionic level of injury.

Keywords: Brachial Plexus; Preganglionic Avulsion; MRI; Pseudomeningocele; Denervation Atrophy; Nerve Transfer

1 INTRODUCTION

Traumatic brachial plexus injuries (TBPIs) predominantly affect young males after motorcycle accidents, with an incidence of 1–2 per 100,000 [1,2]. The brachial plexus arises from the C5–T1 ventral rami and is organized into roots, trunks, divisions, cords, and terminal branches [3]. Injuries are classified relative to the dorsal root ganglion (DRG) as preganglionic (intradural) or postganglionic [3–5]. This distinction is therapeutically critical: postganglionic lesions

may benefit from nerve grafting, whereas preganglionic avulsions sever rootlets from the spinal cord, precluding direct repair and requiring nerve transfer [4–6].

MRI has become the cornerstone non-invasive modality for brachial plexus evaluation, enabling visualization of intradural rootlets, pseudomeningoceles, cord signal changes, and downstream muscle denervation [7–9]. A systematic review reported a pooled sensitivity of 68% and specificity of 89% for MRI detection of root avulsion [10]. We present a case of left C6–C8 preganglionic avulsion with rotator cuff denervation demonstrated on multisequence MRI.

2 CASE PRESENTATION

2.1 Clinical History

A 38-year-old male with unremarkable medical history was admitted to Hassan II University Hospital, Fez, after a high-velocity motorcycle accident (overturned motorcycle) causing polytrauma. Examination revealed complete sensorimotor deficit distal to the deltoid affecting the entire left upper limb (C6–T1), preserved radial and ulnar pulses, paresthesias in C6–C8 dermatomes, and no Horner syndrome. Radiographs showed left trapezoid and ulnar styloid fractures. Initial management included analgesia, splint immobilization, and multidisciplinary consultations.

2.2 MRI Protocol

MRI was performed 4 months post-trauma using sagittal T1-weighted, sagittal T2-weighted, coronal T2, coronal STIR, and axial T2 sequences without gadolinium administration.

2.3 MRI Findings

The spinal cord demonstrated normal signal intensity without intramedullary lesion or extrinsic compression. Multiple pseudomeningoceles were identified along the left cervical neural foramina, extending from the C5 through the C8 levels. Fatty infiltration of the periscapular musculature was also noted.

Brachial plexus (Figures 1 and 2): The dominant findings involved the left brachial plexus. The left C5, C6, C7, and C8 nerve roots were not visualized at their intradural origin on axial T2 sequences, constituting the root absence sign – the most specific direct MRI indicator of preganglionic avulsion [7–10].

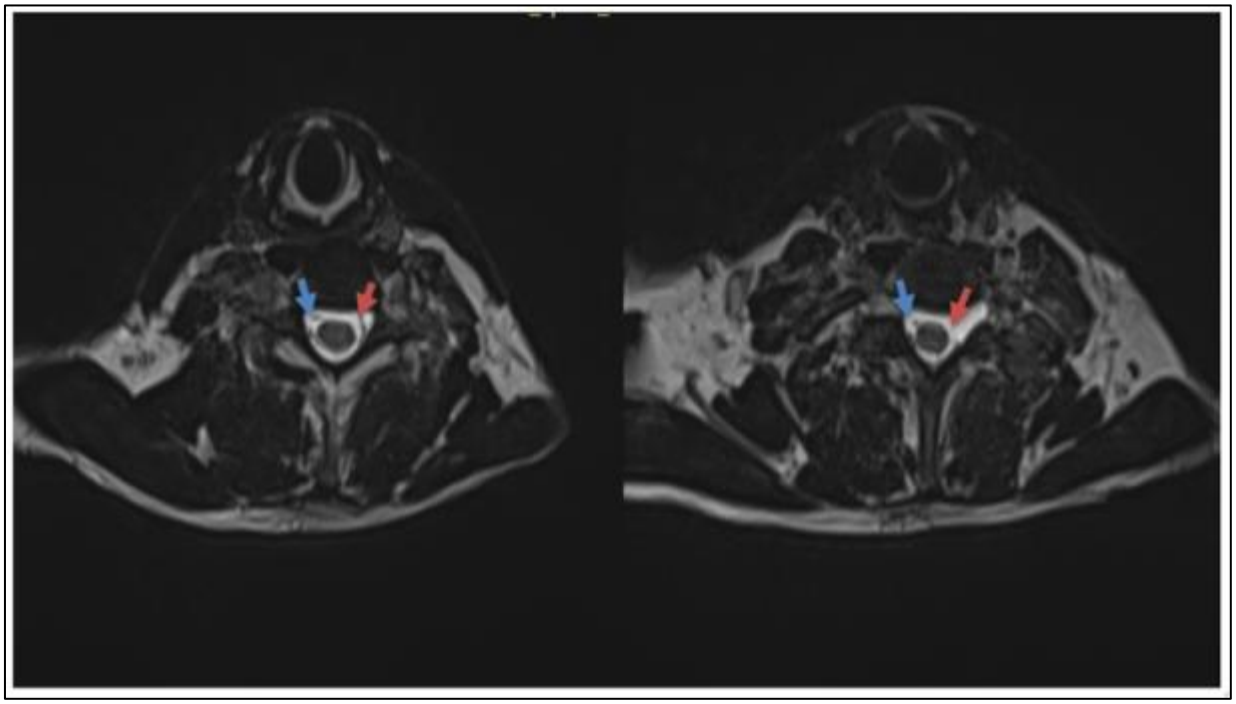

Figure 1: (A) Axial T2-weighted image at the C6–C7 level demonstrating non-visualization of the left C7 nerve root (orange arrow), with normal contralateral right C7 root visible as a hypointense dot within the hyperintense cerebrospinal fluid (blue arrow). (B) At the C7–T1 level: absence of the left C8 nerve root (orange arrow) with preserved right C8 root (blue arrow). These findings constitute the root absence sign, the most specific indicator of preganglionic avulsion.

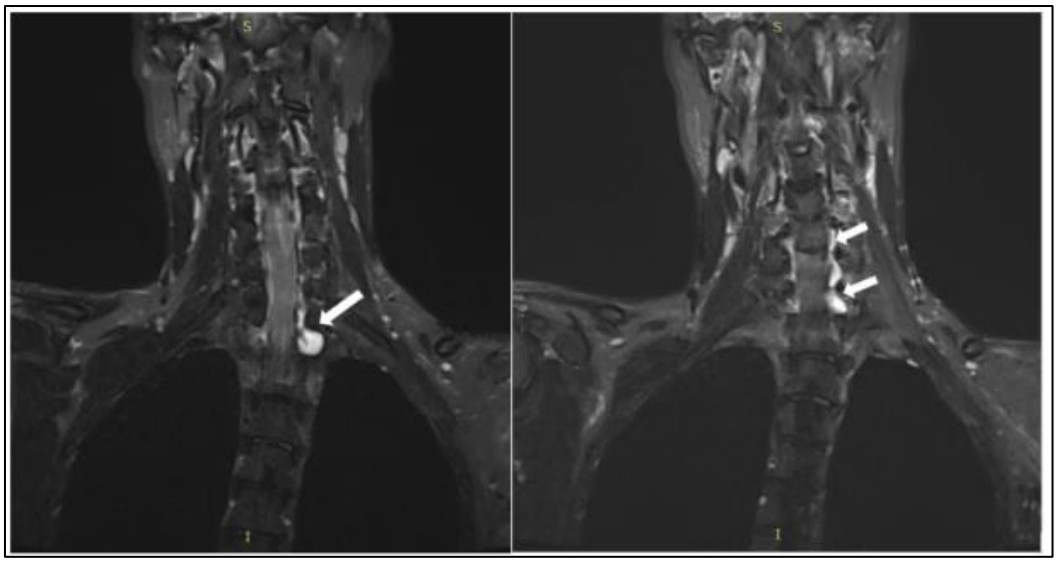

Figure 2: Coronal STIR images of the cervical region. (A) CSF-filled cystic structure protruding through the left C7–C8 neural foramen (white arrow), consistent with a post-traumatic pseudomeningocele. (B) Adjacent coronal STIR section demonstrating additional smaller multilevel pseudomeningoceles along the left C5–C6 and C6–C7 foramina (white arrow). These multilevel collections are direct signs of root sleeve disruption and confirm preganglionic avulsion.

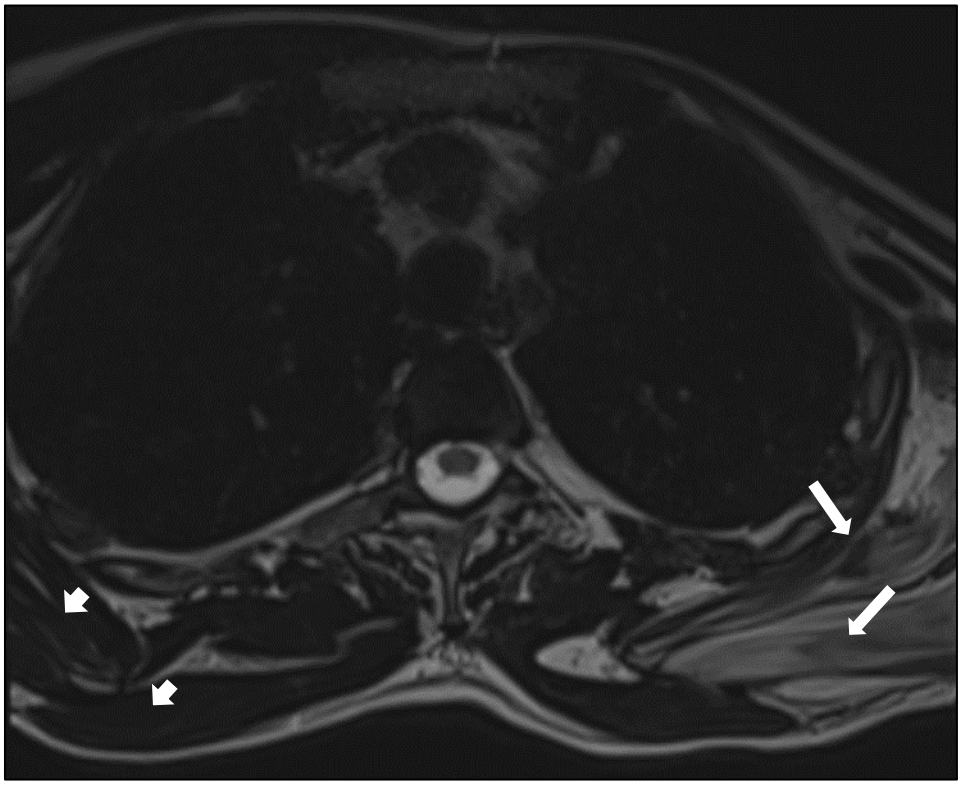

Figure 3: Axial T2-weighted image at the cervicothoracic level demonstrating asymmetric atrophy and signal heterogeneity of the left infraspinatus (IS), supraspinatus (SS), and subscapularis (Sub) musculature (white arrows), compared to the preserved muscle bulk on the contralateral right side (arrowheads). These findings reflect chronic denervation of muscles innervated by the posterior rami and proximal branches of the affected nerve roots, providing an indirect MRI sign of preganglionic injury.

The contralateral roots were normally visualized, providing an internal reference. Coronal STIR sequences demonstrated multilevel CSF-filled pseudomeningoceles protruding through the disrupted root sleeves at the left C5–C6, C6–C7, and C7–C8 neural foramina, constituting a second direct sign of root avulsion [7,11]. In addition, axial T2 images at the cervicothoracic level showed asymmetric fatty infiltration and atrophy of the left periscapular and

posterior paraspinal musculature, consistent with chronic denervation; is itself a recognized indirect sign of preganglionic injury [12,13]. No syringomyelia was detected.

3 DISCUSSION

TBPIs disproportionately affect young males in motorcycle accidents, with upper root avulsions (C5–C7) resulting from coronal-plane distraction when the head is laterally flexed away from the shoulder, and lower root injuries (C8–T1) from arm hyperabduction [1–3,7]. Our patient's mechanism is consistent with this model. The concurrent fractures illustrate the polytrauma context that commonly delays neurological diagnosis [4,15].

The preganglionic versus postganglionic distinction fundamentally governs management [3–6]. Preganglionic avulsions sever rootlets from the spinal cord, precluding direct repair; nerve transfer is the only reconstructive option. Our patient's C5–C8 avulsion explains the flail limb with absent shoulder, elbow, wrist, and hand function, with relative preservation only of T1-mediated sensation.

MRI plays a central role in the evaluation of traumatic brachial plexus injuries and should be performed with a dedicated, optimized protocol [7,8]. Recent recommendations advocate combining a standard cervical spine examination with two-dimensional turbo spin-echo sequences in the axial and coronal planes and three-dimensional sequences, from which sagittal planes can be reconstructed [8]. Heavily T2-weighted three-dimensional myelographic sequences (such as T2 SPACE or constructive interference in steady-state, CISS) are particularly valuable when post-traumatic root avulsion is suspected, as they optimize the cerebrospinal fluid–to–root contrast and improve detection of pseudomeningoceles and intradural rootlet loss; T2-weighted sequences also allow assessment of spinal cord signal abnormality, reported in approximately 20% of preganglionic injuries [7,8]. A systematic, sign-based reading approach further aids in localizing the injured segments and grading injury severity [10]. The multiplanar protocol used in our patient enabled both direct visualization of the avulsed roots and detection of the indirect denervation changes, providing a comprehensive injury map without the morbidity of invasive CT myelography.

The root absence sign – non-visualization of intradural rootlets on axial T2 – is the most specific direct MRI sign of preganglionic avulsion [7,9,11]. Pseudomeningoceles, observed in our case as multilevel collections at the left C5–C6, C6–C7, and C7–C8 foramina, represent a second well-recognized direct sign, reflecting dural and arachnoid disruption at each avulsed level [7,12]. The coexistence of the root absence sign and multilevel pseudomeningoceles provided converging direct findings that established the diagnosis with high confidence. Given the reported specificity of MRI of approximately 89% for root avulsion, the presence of these concordant direct signs allowed a confident preganglionic diagnosis without the need for invasive intraoperative exploration [11].

The asymmetric paraspinal and periscapular muscle denervation observed on axial T2 is diagnostically valuable [13,14]. Denervation of posterior paraspinal muscles is a well-established indirect sign of preganglionic injury, as these muscles are innervated by the dorsal rami arising proximal to the DRG [13]. Muscle denervation on MRI evolves from acute T2 edema (within days) to subacute fatty infiltration (weeks) to chronic fatty replacement with atrophy beyond 6–8 weeks [13,14]. The advanced fatty involution observed at 4 months confirms the chronicity of the injury [14].

From a management standpoint, the degree of muscle degeneration is decisive. Although nerve transfer (neurotization) is theoretically the only reconstructive option for preganglionic avulsion [5,6,16], its success depends on viable target motor endplates, and reinnervation must be achieved before irreversible muscular fatty replacement occurs, generally within 3–6 months of injury [5,6,17]. In our patient, the advanced fatty involution of the periscapular musculature already present at 4 months indicates that the denervated muscles are no longer viable targets for functional nerve transfer, and surgical neurotization is therefore not expected to restore useful function. Additional features supporting an unfavorable surgical prognosis in this case include the multilevel and complete (C5–C8) nature of the avulsion, the multilevel pseudomeningoceles reflecting extensive root disruption, and the flail, insensate limb. Consequently, the patient was not considered a candidate for reconstructive nerve surgery, and management was oriented toward rehabilitation, neuropathic pain control (gabapentinoids, with dorsal root entry zone lesioning reserved for refractory cases), and functional adaptation [18]. This case underscores the prognostic role of MRI: beyond confirming the diagnosis, the demonstration of advanced muscle involution directly informs the decision against futile surgery and the orientation toward conservative care.

4 CONCLUSION

This case illustrates the characteristic MRI presentation of a complete traumatic preganglionic brachial plexus avulsion. The root absence sign on axial T2 and the multilevel pseudomeningoceles on coronal STIR established the preganglionic diagnosis with high confidence, while the advanced fatty muscle involution defined the chronicity and dictated a

conservative, non-surgical management strategy. Radiologists should master both the direct and indirect MRI signs of brachial plexus avulsion, as imaging not only confirms the diagnosis but also critically guides the therapeutic decision.

STATEMENTS ON COMPLIANCE WITH ETHICAL STANDARDS

Disclosure of conflict of interest

The authors declare no conflicts of interest regarding this manuscript.

Statement of informed consent

Informed consent was obtained from the legal guardians of the patient included in this study.

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