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CASE REPORT

Scapulothoracic Dissociation in a Patient with Polytrauma: a Case Report

HM Kwok, ES Lo, NY Pan, RLS Chan, SC Wong, LF Cheng, JKF Ma

Department of Diagnostic and Interventional Radiology, Princess Margaret Hospital, Hong Kong

INTRODUCTION

Scapulothoracic dissociation (SD) is a rare but severe injury to the shoulder girdle. It is characterised by complete disruption of the scapulothoracic articulation with lateral scapular displacement and intact skin.[1-3] It is a spectrum of musculoskeletal and neurovascular injuries,[3] involving high-energy trauma with lateral tractional forces applied to the shoulder girdle.[2,4] Scapular Index (SI) is an indicator that is relevant to SD. It is obtained by measuring the distance from the spinous process to the medial border of the scapula, then divide the value of the injured side by the value of the non-injured side. Laterally displaced scapula with SI >1 has been commonly used as a diagnostic criterion for SD in previous studies.[5] Nonetheless this requires a non-rotated anteroposterior (AP) chest radiograph that may be impractical in the urgent trauma setting. Moreover, SD may be initially missed in the polytrauma setting with multiple significant injuries.[2] Herein, we report a case of SD in a young adult who was involved in a road traffic accident with polytrauma presenting with absent brachial pulse and significant vascular injuries on initial trauma computed tomography (CT) with CT angiogram.

CASE REPORT

In December 2020, a 23-year-old man was admitted to the Accident and Emergency Department of Princess Margaret Hospital, Hong Kong having been found lying on the ground after his motorcycle was involved in a traffic accident. On admission, he had stable vital signs with 98% oxygen saturation on 2 L/min oxygen. Left-sided pneumothorax was detected and chest drain insertion was required. There was left shoulder swelling and left forearm deformity. The left brachial, radial, and ulnar pulses were all non-palpable with absence of Doppler signal on bedside ultrasound. Delayed capillary refill time was also evident. Other limb pulses were normal. The Glasgow Coma Scale score was 3/15 and the patient was intubated for airway protection.

Correspondence: *Dr HM Kwok, Department of Diagnostic and Interventional Radiology, Princess Margaret Hospital, Hong Kong. Email: khm778@ha.org.hk*

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Ethics Approval: The patient was treated in accordance with the tenets of the Declaration of Helsinki. The requirement for patient consent was waived by the Kowloon West Cluster Research Ethics Committee [Ref: KW/EX-21-056(157-21)].

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Supine AP chest radiograph on admission was significantly rotated and measurement of the SI was not feasible. Left acromioclavicular joint dislocation was the only salient finding on frontal left shoulder radiograph (Figure 1).

Urgent trauma CT series and CT angiogram (with delayed images included) of the left upper limb (Figure 2) revealed lateral displacement and comminuted fracture of the left scapula, dislocated left acromioclavicular joint and evidence of subclavian artery dissection with high-grade thrombosis. There was also evidence of left subclavian vein injury and left supraclavicular fossa haematoma. No active contrast extravasation was detected. The constellation of findings was suggestive of left SD and associated neurological injury of the brachial plexus was strongly suspected. Faint, delayed opacification of the left axillary and brachial arteries, with non-opacification of distal branches was evident, suggestive of acute left upper limb ischaemia.

Other significant CT findings included a treated small left pneumothorax, and bilateral lung contusions and lacerations. Fracture of the left humerus, left radius and ulna, and left distal femur were also evident. Thin layers of left perinephric haematoma, perisplenic haematoma, together with the American Association for the Surgery of Trauma grade II splenic laceration were noted intraabdominally. A thin layer of subdural haematoma along the right tentorium cerebelli and posterior cerebral falx were detected intracranially.

An urgent digital subtraction angiography (Figure 3) performed on the same day confirmed a short segment focal dissection at the left mid subclavian artery, causing proximal flow stagnation. No active contrast extravasation was seen. Post-stenting left upper limb angiogram revealed a patent left subclavian artery without significant residual stenosis. Clinically there was normalisation of capillary refill time.

Open reduction and internal fixation of the scapula, clavicle and left acromioclavicular joint were performed 1 week after the initial injury. With a gradual return of Glasgow Coma Scale score to 15/15, the patient was extubated. Magnetic resonance imaging (MRI) of the cervical spine showed no evidence of spinal cord injury (Figure 4).

One month after the accident, there was persistent complete loss of motor and sensory function of the left upper limb. MRI of the left brachial plexus (Figures 5 and 6) revealed evidence of a high-grade brachial

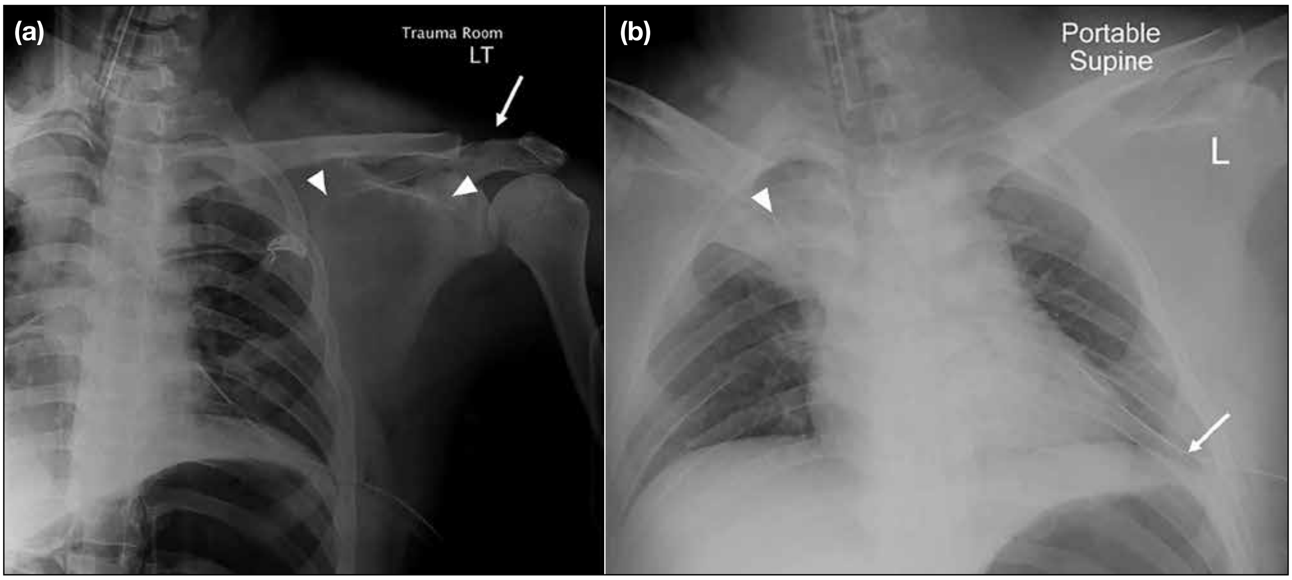

Figure 1. A 23-year-old motorcyclist had a road traffic accident and was found unconscious by the accident and emergency department. (a) Initial anteroposterior left shoulder radiograph revealed left acromioclavicular joint dislocation (arrow), and a sclerotic line over the scapula was suggestive of scapular fracture (arrowheads). (b) Portable supine anteroposterior chest radiograph post-intubation was not optimal for measurement of the scapular ratio to support a diagnosis of scapulothoracic dissociation. It showed left chest drain in-situ (arrow) with right upper zone opacification (arrowhead) due to lung contusion.

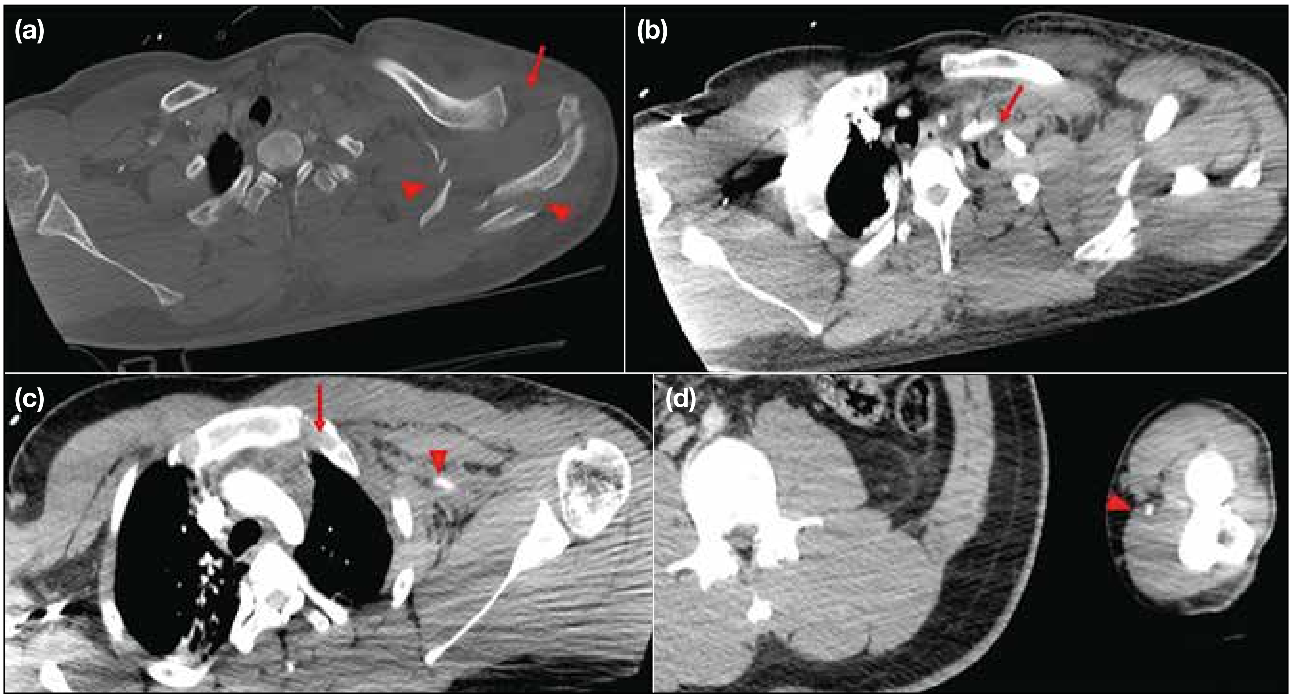

Figure 2. (a) Initial trauma computed tomography in bone window setting revealed diastasis of the left acromioclavicular joint (red arrow) and fracture of the left scapular body and acromion process (red arrowheads). (b) Computed tomography angiogram of left upper limb showing abrupt attenuation (red arrow) with a short segment of non-opacification of the left subclavian artery. At a more inferior level (c), there is preserved enhancement more distally (red arrowhead). The left sternoclavicular joint is normal (red arrow). At the level of the left proximal forearm on the delayed image (d), there is faint but delayed enhancement of the left brachial artery that is narrow in calibre (red arrowhead).

plexus injury with postganglionic injury of C5 but preganglionic injury at C6 to T1 level. Electromyography of the left upper limb showed absent motor response of both ulnar and median nerves, and sensory response of the ulnar nerve. There was a markedly decreased median nerve sensory response with preserved conduction velocity. Overall findings were compatible with left brachial plexopathy with doubtful viability of the nerves.

The patient commenced rehabilitation of his left upper limb to preserve elbow, wrist, and distal hand joint mobility. Nortriptyline 10 mg night time and pregabalin 300 mg three times daily and at night were prescribed for neuropathic pain. He was referred to a subspecialist orthopaedic hand team for brachial plexus reconstruction.

DISCUSSION

Oreck et al[4] coined the term ‘scapulothoracic dissociation’ in 1984 to describe an injury involving complete closed separation of the scapula and upper extremity from the thoracic attachments. SD is defined as violent lateral or rotational displacement of the shoulder girdle from its thoracic attachments and causes severe neurovascular injury.[1-3]

First, SD is an easily overlooked injury in the polytrauma setting.[2,6] It has been suggested that the diagnosis of SD requires a combination of clinical findings and radiographic findings that rely heavily on the SI.[3] The SI is calculated by measuring the distance from the medial border of the scapula to the thoracic spinous process of both the injured and uninjured sides on a non-rotated posteroanterior or AP chest radiograph.[5] The normal value is 1.07 ± 0.04.[5] A SI >1.29 is consistent with SD until proven otherwise.[6] The limitation of the need for a well-centred radiograph for measurement has been addressed, and no similar technique for CT measurement has been described.[3] It is impractical to obtain a non-rotated radiograph due to use of multiple immobilisation and monitoring devices in the polytrauma setting. Also, urgent trauma series CT would be performed to facilitate clinical management in the urgent setting. The above case nicely illustrates how a diagnosis of SD is established with typical clinical findings of an absent

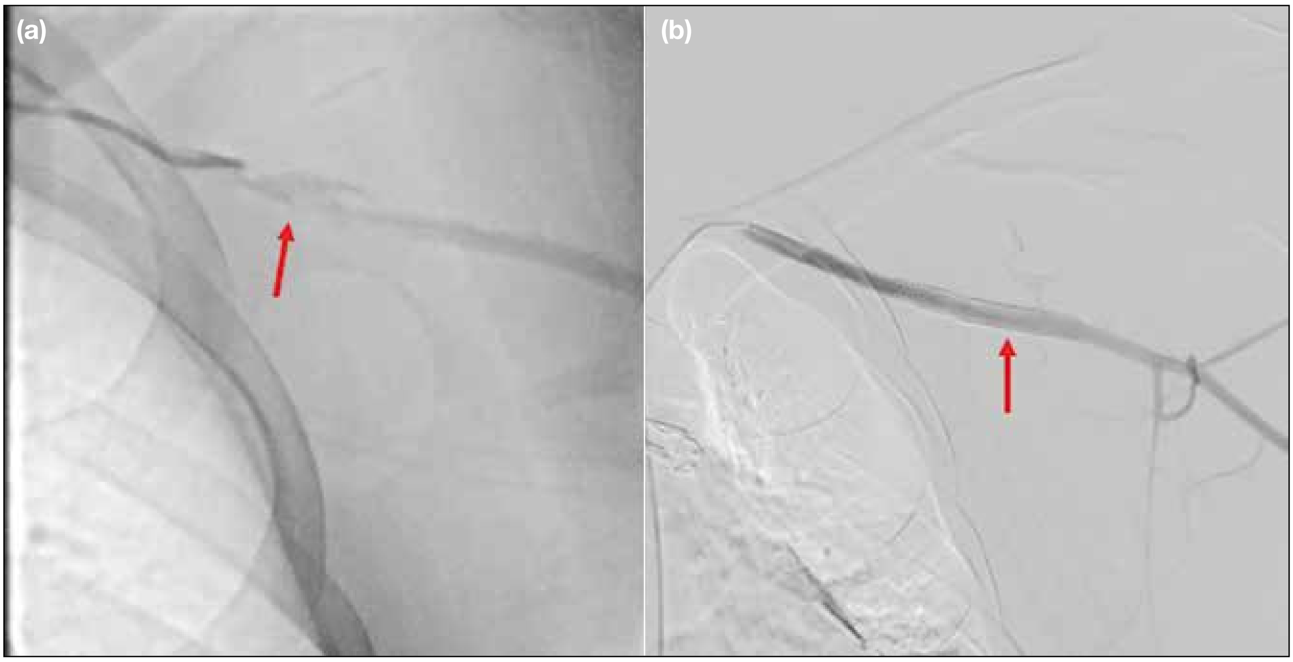

Figure 3. Urgent left upper limb digital subtraction angiography (a) showing focal dissection (red arrow) and partial thrombosis at the left subclavian artery, about 3 cm long. No active contrast extravasation was detected. The peripheral stent was deployed. Post-stenting angiogram (b) showing a stent in situ (red arrow) with patent left subclavian artery without significant residual stenosis.

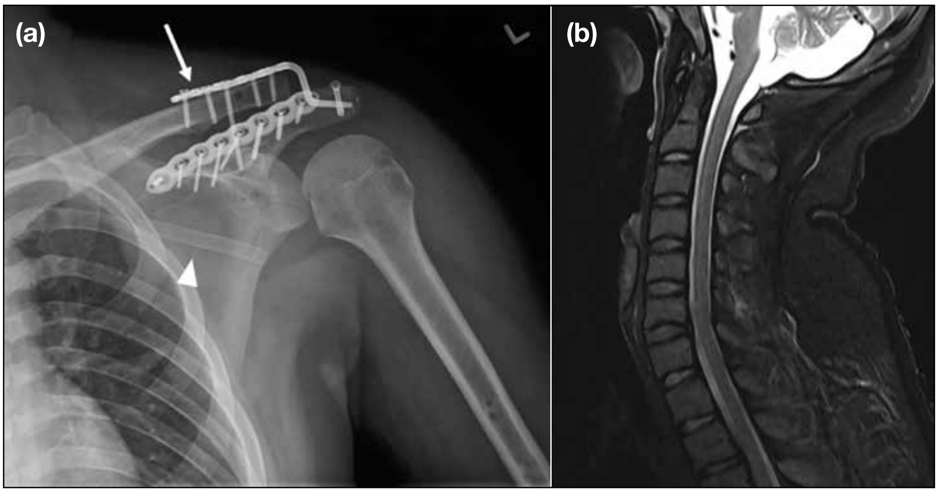

Figure 4. (a) Postoperative frontal left shoulder radiograph after 1 week showing interval internal fixation of the scapula and clavicle (arrow) and reduction of acromioclavicular joints. The metallic stent for subclavian artery dissection was also evident (arrowhead). (b) T2-weighted turbo spin echo sagittal magnetic resonance imaging of the cervical spine with fat suppression (repetition time: 3040 ms, echo time: 66 ms) showing normal spinal cord without abnormal cord signal.

brachial pulse with CT angiography showing subclavian artery dissection with thrombosis, together with the scapular fracture and dislocated acromioclavicular joint.

Second, SD is a spectrum of injuries that comprises muscular, osseous, ligamentous, nerve, and vascular injuries of varying degrees and combination. The high-energy lateral distraction force disrupts muscular tissues and acromioclavicular ligaments and/or sternoclavicular ligaments.[4] What radiologists can ‘see’ on initial trauma CT or radiographs is the ‘tip of the iceberg’, and the associated neurological injury in particular should alert the clinical team to a need for subsequent investigation after initial resuscitation. It is not surprising that SD is associated with other life-threatening injuries[7] that should also be reported and prioritised in order to facilitate acute management.

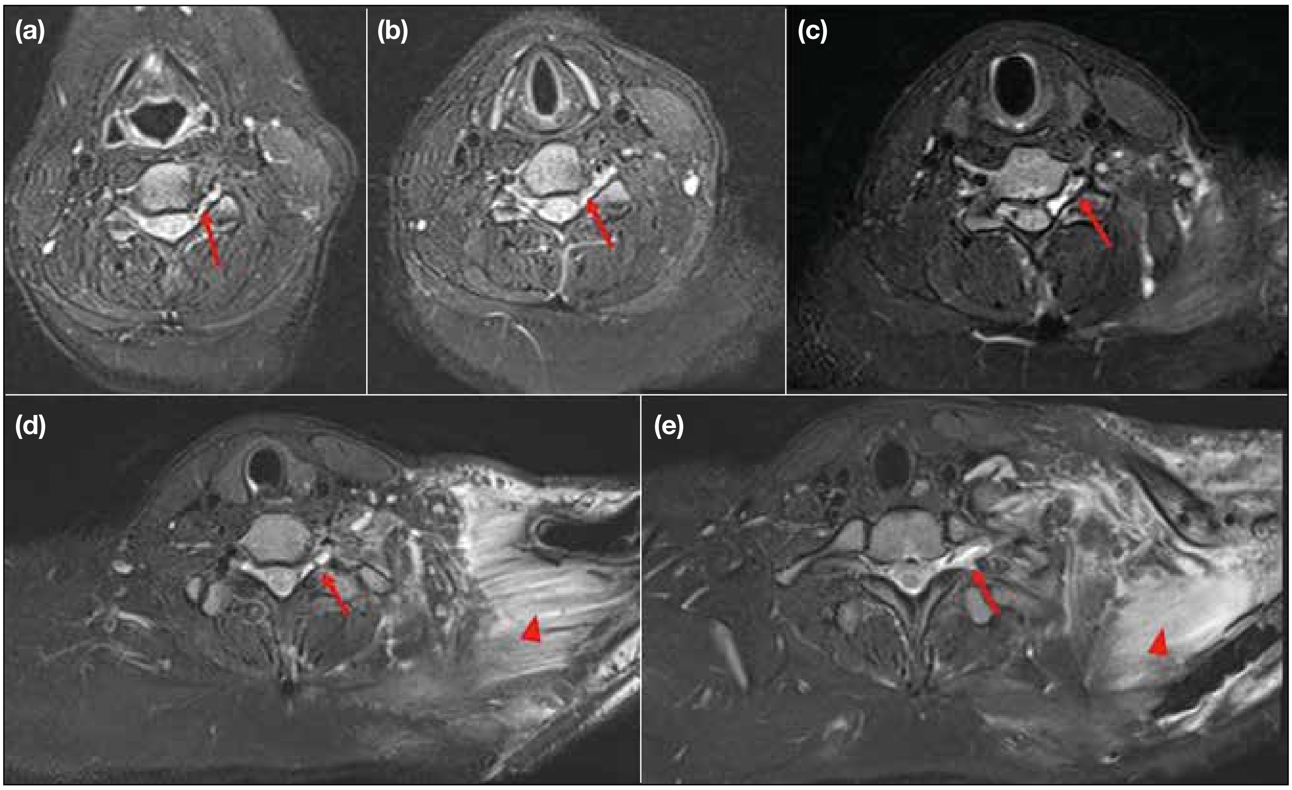

Figure 5. T2-weighted turbo spin echo axial magnetic resonance imaging of the left brachial plexus with fat suppression (repetition time: 5480 ms, echo time: 85 ms): The left C5 nerve root (a) is continuous but thickened (red arrow). There is T2-weighted hyperintense cystic signal along C6 to T1 nerve roots at foraminal level (b-e) [red arrows], suggestive of pseudomeningocele indicating preganglionic injury. The C6 nerve root (b) was seen to be continuous but thickened with T2-weighted hyperintense signals, suggestive of traction injury (red arrow). Indistinct C7 (c) and C8 (d) nerve roots with T2-weighted hyperintense signals were suggestive of high-grade injury (red arrows). Indistinct T1 nerve root (e) replaced by cystic signal was suggestive of neurotmesis (red arrow). The T2-weighted hyperintense signals at the left supraspinatus muscle (red arrowheads in [d] and [e]) could be due to trauma or acute denervation.

There is no current universally agreed treatment algorithm for SD due to its rarity and variation of injury pattern and presence of systemic injuries.[3] General principles of polytrauma care with cardiopulmonary stabilisation and resuscitation should be the top priority.[2] For SD, the urgency of surgical intervention is determined by vascular injury and the need to prevent ischaemic complications, while neurological injury is managed in a delayed manner.[2,3] There is little evidence for the best timing of osseous stabilisation.[3] In haemodynamically stable patients, angiography is widely recommended prior to surgery. Nonetheless in haemodynamically unstable cases, urgent surgical intervention is required to control arterial bleeding.[2,8] Prior studies with analysis of angiographic findings suggested that subclavian or axillary artery active haemorrhage is exceedingly rare, and angiography of the injured extremity is recommended for all haemodynamically stable patients to determine the presence and location of a vascular lesion.[3] As endovascular repair becomes more popular,[3] our case illustrates that successful stenting can help blunt subclavian arterial injury to re-establish upper limb perfusion in the urgent setting. Sampson et al[9] suggested a conservative approach to revascularisation for the arterial injury in SD in view of the dismal functional outcome of brachial plexus injury. Nonetheless in the urgent setting with acute upper limb ischaemia with unknown neurological status of the upper limb, revascularisation is our preferred approach.

Finally, SD contributes about 10% of the overall mortality rate and the clinical outcome of patients is largely determined by neurological recovery.[3,6] Zelle et al[10] established a classification system for SD (Table) and regarded the presence of a complete brachial plexus avulsion as a predictor of poor functional outcome. Differentiating a partial from a complete and a postganglionic from a preganglionic brachial plexus

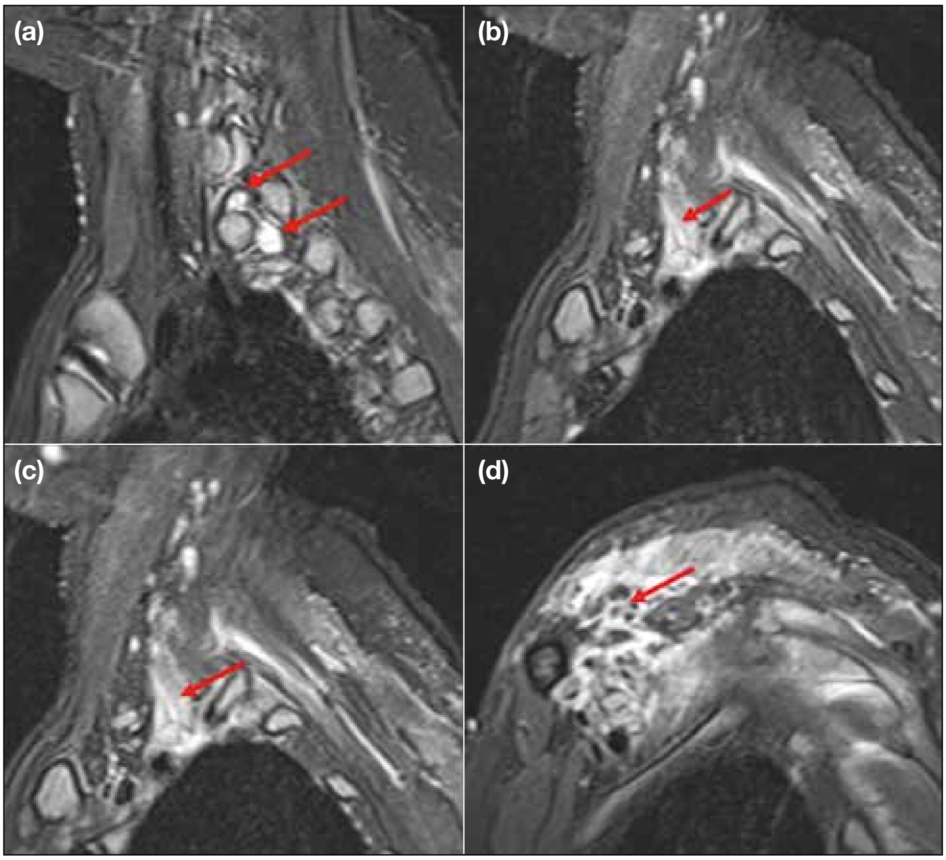

Figure 6. T2-weighted turbo spin echo sagittal magnetic resonance imaging of left brachial plexus with fat suppression (repetition time: 7550 ms, echo time: 85 ms): At the nerve root level (f), there were T2-weighted hyperintense cystic signals at C7/T1 and T1/T2 levels, in keeping with pseudomeningocele. The trunks (g) were replaced by diffuse high T2-weighted signal and cystic change (red arrow), suggestive of high-grade injury. Thickened divisions (h) and cords (i) with high T2-weighted signals (red arrows) were in keeping with traction injury.

injury is of utmost importance because the injury type determines the expected chance of spontaneous neurological recovery and responsiveness to surgical intervention.[3] The extent of neurological injury is characterised by clinical findings, CT myelography, MRI, and electromyography.[3] The presence of a pseudomeningocele on magnetic resonance images has been strongly correlated with nerve root avulsion. Therefore, it is important for radiologists to identify nerve injuries in the brachial plexus and differentiate between incomplete and complete avulsion. This will guide subsequent management and overall prognosis. Concomitant spinal cord injury, due to direct contusion or as an indirect sign of nerve root avulsion, should also be sought.[1] Historically, complete preganglionic injury has been managed with early above-elbow amputation with or without shoulder arthrodesis,[1,3] with consequent superior functional outcomes.[2] In recent decades, there has been increasing interest in nerve transfer with adjacent uninjured donor nerves or neurotisation as a way of reconstruction, and a means to restore elbow function, shoulder stability, hand grasp, and sensation.[1]

Table. The classification system for injury severity of scapulothoracic dissociation by Zelle et al.[10]

Type	Clinical findings
1	Musculoskeletal injury alone
2A	Musculoskeletal injury with vascular disruption
2B	Musculoskeletal injury with incomplete neurological impairment of upper extremity
3	Musculoskeletal injury with incomplete neurological impairment of upper extremity and vascular injury
4	Musculoskeletal injury with complete brachial plexus avulsion

CONCLUSION

SD is a limb-threatening and life-threatening injury that physicians should take care not to overlook in patients with polytrauma. The highly complex injury spectrum requires case-to-case multidisciplinary management in which radiologists play a pivotal role.

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