

Fracture–dislocation of the shoulder and brachial plexus palsy: a terrible association

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Abstract Primary post-traumatic anterior dislocation of the shoulder with associated fracture of the greater tuberosity and brachial plexus injury is rare and, to our knowledge, has never previously been reported in the literature. We present a case of this unhappy triad in which a brachial plexus injury was diagnosed and treated 3 weeks later. The characteristics of this rare condition are discussed on the basis of our case and the published literature in order to improve early diagnosis and treatment of this lesion.

Keywords Shoulder · Anterior dislocation · Fracture of the greater tuberosity · Plexus injury

Introduction

Anterior post-traumatic dislocation of the shoulder is the most common type of dislocation and is caused by

excessive external rotation and hyperextension of the arm in the overhead direction [1]. As the humeral head is levered out of the glenoid, the anterior post-traumatic dislocation of the shoulder can be associated with fracture of the glenoid (i.e. bony Bankart); seldom can it be associated with the impaction fracture of the humeral head or of the greater tuberosity [2]. Moreover, anterior shoulder dislocation may be associated with rotator cuff tears, especially in elderly patients [3]. In a very few cases, a traumatic shoulder dislocation could be associated with a tear of the subscapular artery [4].

The incidence of axillary nerve palsy following anterior dislocation is 9–10% [1]. In contrast, brachial plexus injury is rare and complicated, and very few cases have been reported in the literature [5]. Adult traumatic brachial plexus injuries are devastating, and they are occurring with increasing frequency. Patient evaluation consists of a focused assessment of upper extremity sensory and motor function, radiological studies and, most importantly, electrodiagnostic studies. Conservative management is usually successful, and recovery takes place after several months [6–8]. We report a unique case of anterior dislocation of the shoulder with associated fracture of the greater tuberosity and brachial plexus palsy.

Case report

A 27-year-old, right-handed male was involved in a high-speed car accident, when his left arm was in abduction-extra rotation. Later, the patient was unable to move his arm. The clinical examination performed in the emergency department showed an asymmetric profile of the left shoulder, with pain and no neurological or vascular problems. X-ray analysis of the shoulder revealed an

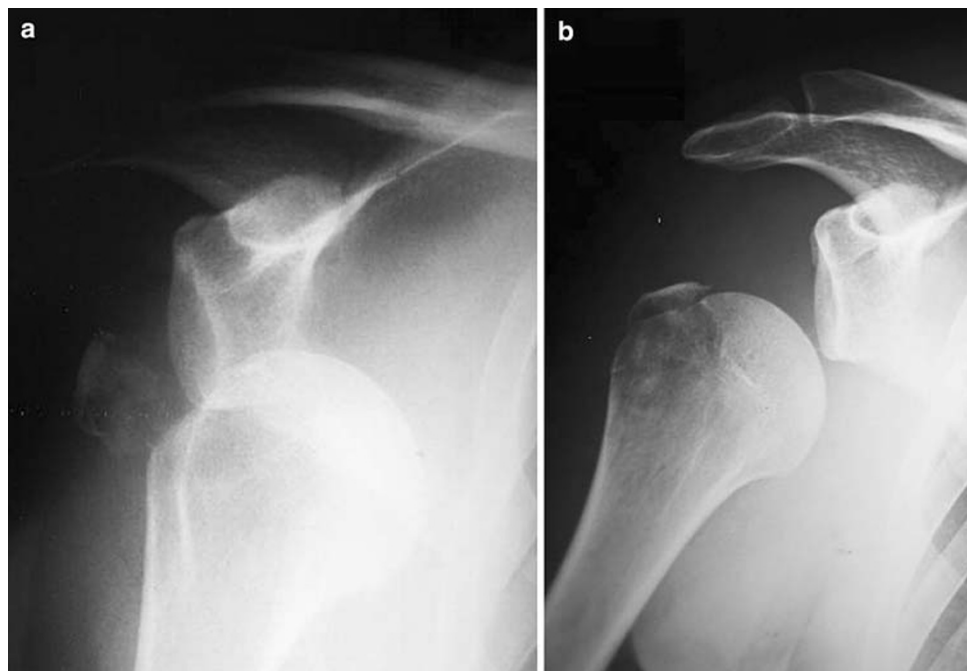
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Fig. 1 **a** X-ray of the right shoulder revealed an antero-medial dislocation associated with a fracture of the greater tuberosity. **b** At a 3-week follow-up, X-ray showed the prolapse of the humeral head, which appeared inferiorly subluxated



anteromedial dislocation associated with a fracture of the greater tuberosity (Fig. 1a). The treatment consisted of a closed reduction performed with the patient under anaesthesia. The shoulder was then immobilized in a sling (IR-15° ABD with a pillow).

After 3 weeks, the patient presented marked hypotonia of the deltoid and less of the triceps muscles (Fig. 2a, b). Radiograms showed the prolapse of the humeral head, which appeared inferiorly subluxated (Fig. 1b), and a good evolution of the fracture healing. A tear of the rotator cuff was excluded by means of magnetic resonance (MR).

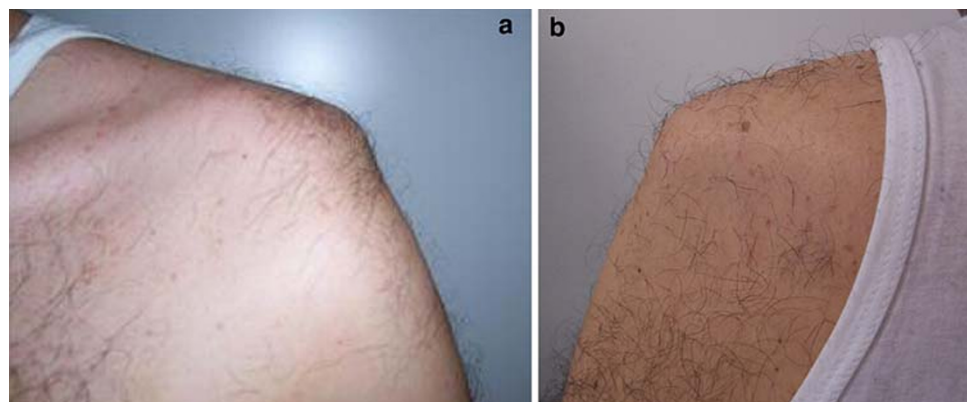
The electromyography (EMG) was performed after 3 weeks. It showed retroclavicular brachial plexus palsy with a mild denervation involving deltoid and, to a lesser extent, triceps muscles, and a sufferance of the posterior cord of brachial plexus with mild signs of denervation of both supra- and infra-spinatus. The treatment was

conservative, and physical therapy was instituted for 8 months to prevent soft-tissue contractures and strengthen functioning muscles.

A second EMG was performed after 2 months. It showed that denervation was absent in supra- and infra-spinatus. Signs of denervation were mild in deltoid (discrete fibrillations and positive sharp waves in 5–6 of 10 positions) and signs of reinnervation mild instability of isolated motor unit potentials (MUPs) appeared, as translation from acute to sub-acute lesion. Triceps showed isolated positive sharp waves in 3 of 10 positions. Study of recruitment of MUP showed for deltoid muscle a mild reduction in the number and a mild increase in the firing rate of MUP.

After 4 months, mild denervation (isolated fibrillations and positive sharp waves in 2–3 of 10 positions) was revealed in deltoid; reinnervation signs were predominant.

Fig. 2 The anterior (a) and posterior (b) aspects of the shoulder 3 weeks after dislocation: marked hypotonia of the deltoid and less of the triceps muscles



Triceps showed isolated positive sharp waves in 2 of 10 positions. At 6 months, there was no more denervation activity, and signs remained of mild stabilized reinnervation (increased amplitude and duration of MUP) in deltoid and to a lesser extent in triceps muscles. By 12 months after the accident, active shoulder abduction and forward elevation were 160° and external rotation was 40°. The triceps and biceps muscles were quoted at M4, and the patient recovered wrist and finger flexion and extension. The patient provided informed consent to the publication of his clinical case.

Discussion

The rate of neurological complications after anterior dislocation is probably underestimated. Liveson [9] reported the electrodiagnostic examination of 11 patients with shoulder dislocation and revealed nerve damage not previously reported. Although axillary nerve lesions were most common, posterior cord and musculocutaneous nerve damage occurred, each in five cases.

Lesions can be situated at any level from the base of the nerve roots to the division of the brachial plexus in the axillary region. Several types of lesions can be differentiated: supraclavicular lesions at the root or primary trunk level (75% of the cases); infra and retroclavicular lesions of the secondary trunk (10%); and lesions of the terminal branches (15% of the cases) [10].

Anterior shoulder dislocation may commonly be associated with retroclavicular or infraclavicular brachial plexus injury with an axillary nerve lesion [3, 11–17]. Travlos [18] reviewed 28 patients with brachial plexus lesions caused by shoulder dislocation. Contrary to most other reports, he found that the neurological lesions involved the infraclavicular and the supraclavicular brachial plexus. With supraclavicular lesions, the involvement was always of the suprascapular nerve, and this always recovered spontaneously. Isolated axillary nerve lesions had the poorest prognosis for spontaneous recovery.

Patients with brachial plexus stretch lesions are generally observed for spontaneous recovery for several months. Those patients who do not demonstrate clinical or electrical recovery by 3–6 months should undergo operative intervention. However, physicians need to be mindful that electrical signs of reinnervation do not always correlate with useful clinical recovery [8].

Alnot [10] reviewed cases of 420 adults treated with surgery for traumatic palsy of the brachial plexus. Decision criteria for nerve grafting or neurolysis were presented. Surgery was generally performed 3 weeks to 6 months after injury. Although secondary sutures could be performed on some injuries, nerve grafting was usually

necessary and depended on the length of the gap and the quality of surrounding tissues. The overall prognosis of infra- or retroclavicular plexus injuries is nevertheless better than that of supraclavicular lesions.

However, cases of concurrent anterior shoulder dislocation and brachial plexus injury with fracture of the tuberosity are extremely rare [8, 19]. In our case, the brachial plexus injury was due to an anteromedial shoulder dislocation, as described previously. Nerve injury with a shoulder dislocation has been reported to occur after low-velocity trauma, because the distance between the anchorage points of nerves in the upper limb is short, making the nerves vulnerable to traction [17]. However, in our case, the fracture of the greater tuberosity associated with nerve lesions revealed a high-velocity injury, resulting in a violent shoulder dislocation with significant migration of the humeral head.

EMG must be proposed 3 weeks after the injury in the case of severe palsies or paralysis of the upper limb associated with a shoulder dislocation [17]. Use of this technique can help clinically, because it is possible to miss a nerve palsy in a patient with a massive rotator cuff tear [20]. EMG gives reliable results for the phase and the grade of denervation of particular muscle groups; thus, it is possible to conclude, indirectly, which part of the plexus is in dysfunction.

Therefore, EMG allows us to verify the innervation of the supraspinatus and infraspinatus muscles that is normal in retroclavicular or infraclavicular brachial plexus injury. In the case of total brachial plexus palsy (associated with anterior shoulder dislocation and fracture or rotator cuff tear) confirmed by EMG, MRI or computed tomography scan must be performed to diagnose root avulsions (Fig. 3). However, to our knowledge, no case of all of these lesions occurring simultaneously has ever been described in the literature. In the case of complete infraclavicular brachial plexus palsy, a program of hand, wrist, and elbow mobilization has to be started.

The prognosis of this unhappy triad has been established principally for anterior dislocation with axillary nerve injuries. Conservative management affords good recovery

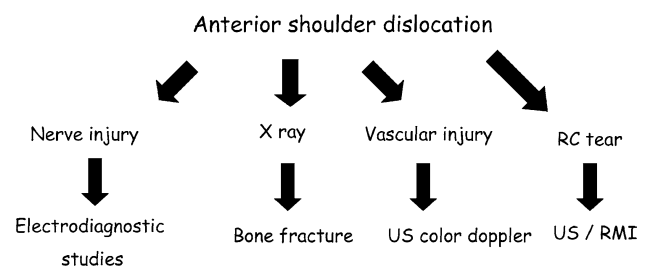


Fig. 3 The diagnostic algorithm in the case of anterior post-traumatic dislocation of the shoulder and its possible complications

from these injuries over a period of up to 18 months [6, 21, 22].

Shin [7] affirmed that the critical concepts in surgical treatment of brachial plexus are patient selection as well as the timing and prioritizing of restoration of function. Surgical techniques include neurolysis, nerve grafting, neurotization, and free muscle transfer.

In our case, the nerve lesions were not so serious—with incomplete infraclavicular brachial plexus palsy—and the return to previous range of motion and strength of the upper limb took no longer than reported elsewhere. Therefore, in our opinion, the prognosis depends essentially on brachial plexus recovery when the tuberosity has been repaired early.

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Conflict of interest statement The authors declare that they have no conflict of interest related to the publication of this manuscript.

References

1. Neviasser R, Neviasser T, Neviasser J (1988) Concurrent rupture of the rotator cuff and anterior dislocation of the shoulder in the older patient. *J Bone Joint Surg Am* 70:1308–1311
2. Zarins B, McMahon MS, Rowe CR (1993) Diagnosis and treatment of traumatic anterior instability of the shoulder. *Clin Orthop Relat Res* 291:75–84
3. Mehta M, Kottamasu S (1989) Anterior dislocation of the shoulders with bilateral brachial plexus injury. *Ann Emerg Med* 18:589–591
4. Nash E, Soudry M, Abrahamson J, Mendes DG (1984) Neuropraxis secondary to haemorrhage in a traumatic dislocation of the shoulder. *J Trauma* 24(6):546–547
5. Johnson JR, Bayley JI (1982) Early complications of acute anterior dislocation of the shoulder in the middle-aged and elderly patient. *Injury* 13(5):431–434
6. Shears E, Sunderamoorthy D, Ali SA (2005) Brachial plexus injury after anterior shoulder dislocation: a case report. *Acta Orthop Belg* 71(4):489–490
7. Shin AY, Spinner RJ, Steinmann SP, Bishop AT (2005) Adult traumatic brachial plexus injuries. *J Am Acad Orthop Surg* 13(6):382–396
8. Yip KM, Hung LK, Maffulli N, Chan KM (1996) Brachial plexus injury in association with fracture–dislocation of the shoulder. *Bull Hosp Jt Dis* 55(2):92–94
9. Liveson JA (1984) Nerve lesions associated with shoulder dislocation; an electrodiagnostic study of 11 cases. *J Neurol Neurosurg Psychiatr* 47(7):742–744
10. Alnot JY (1988) Traumatic brachial plexus palsy in the adult. Retro- and infraclavicular lesions. *Clin Orthop Relat Res* 237:9–16
11. Alnot J, Narakas A, Raimondi P, Morelli E (1995) Paralysies traumatiques du plexus brachial de l'adulte. In: Française ES (ed) *Lésions rétro et infra-claviculaires. Les paralysies du plexus brachial*, Paris
12. Celli L, Rovesta C, Marongiu M, Mingione A (1995) Nerve injuries in anterior shoulder dislocation. In: *Brachial plexus injuries*. Expansion Scientifique Française, Paris, pp 222–227
13. Gonzales D, Lopez R (1991) Concurrent rotator cuff tear and brachial plexus palsy with anterior dislocation of the shoulder. A report of two cases. *J Bone Joint Surg Am* 73:620–621
14. Groh G, Rockwood C (1995) The terrible triad: anterior dislocation of the shoulder with rupture of the rotator cuff and injury to the brachial plexus. *J Shoulder Elbow Surg* 4:51–53
15. Guven O, Akbar Z, Yalcin S, Gundes H (1994) Concomitant rotator cuff and brachial plexus injury in association with anterior shoulder dislocation: unhappy triad of the shoulder. *J Orthop Trauma* 8:429–430
16. Kay S, Yaszemski M, Rockwood C (1988) Acute tear of the rotator cuff masked by simultaneous brachial plexus injury. A case report. *J Bone Joint Surg Am* 70:611–612
17. Visser C, Coene L, Brand R, Tavy D (1999) The incidence of nerve injury in anterior dislocation of the shoulder and its influence on functional recovery. *J Bone Joint Surg Br* 81:679–685
18. Travlos J, Goldberg I, Boome RS (1990) Brachial plexus lesions associated with dislocated shoulders. *J Bone Joint Surg Br* 72(1):68–71
19. McManus F (1976) Brachial plexus lesions complicating anterior fracture–dislocation of the shoulder joint. *Injury* 8(1):63–66
20. Simonich SD, Wright TW (2003) Terrible triad of the shoulder. *J Shoulder Elbow Surg* 12(6):566–568
21. Berbig R, Weishaupt D, Prim J, Shahin O (1999) Primary anterior shoulder dislocation and rotator cuff tears. *J Shoulder Elbow Surg* 8(3):220–225
22. Goubier JN, Duranthon LD, Vandebussche E, Kakkar R, Augereau B (2004) Anterior dislocation of the shoulder with rotator cuff injury and brachial plexus palsy: a case report. *J Shoulder and Elbow Surg* 13(3):362–363