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Quadrilateral space syndrome and acute suprascapular neuropathy: Diagnosis and surgical treatment

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Abstract
We report a case of a recreational athletic patient 38 years old in which the patient simultaneously presented 2 compressive syndromes: compression of the Suprascapular nerve at the spinoglenoid notch and Quadrilateral Space Syndrome. Each of these nerve compressions is relatively rare and the association of two syndromes at the same time is an even rarer situation that makes this clinical case difficult to diagnose and clinically challenging. The diagnosis was confirmed by magnetic resonance imaging (MRI) and electromyography (EMG), which revealed muscle involvement, atrophy of the infraspinatus and teres minor, as well as the presence of labral cyst in the spinoglenoid notch. Surgical treatment was promptly instituted by shoulder arthroscopy which consisted of decompression of the cyst and repair of the labrum. Shoulder function significantly improved 3 months after surgery and remained constant up to 2 years after surgery.

Keywords: Quadrilateral space syndrome, axillary nerve, supraescapular nerve compression, paralabral cyst

Introduction

The quadrilateral space is an anatomical region formed inferiorly by the teres major, medially by the long head of the triceps brachii, posteriorly by the teres minor, anteriorly by the subscapularis and laterally by the surgical neck of the humerus (Hong *et al*., 2019) [5]. The Quadrilateral space syndrome is a neurovascular compression of the posterior circumflex artery and/or the axillary nerve. The first reports were made by Cahill and Palmer in 1983 (Cirpar *et al*., 2007) [1]. Its incidence is around 0.8% in shoulder MRI for different causes and it occurs more frequently in young people under 40 years of age (Cirpar *et al*., 2007 [1]; Hangge *et al*., 2018) [4].

The clinical presentation is characterized by poorly localized pain in the shoulder region, paresthesia radiating to the arm, exacerbation of pain during abduction and external rotation movements against resistance, deltoid weakness and possible atrophy of the teres minor. Paresthesia may occur in the cutaneous sensory distribution of the axillary nerve, overlapping the deltoid muscle on the lateral (Flynn *et al*., 2018) [2].

Several causes are postulated for axillary nerve compression: fibrous bands, trauma, vascular congestion, osteochondroma, bone spurs, and paralabral cysts (Cirpar *et al*., 2007 [1]; Robinson *et al*., 2000 [10]; Vlychou, 2001) [14]. The incidence appears to be higher in overhead athletes, however many cases have no defined cause (Hangge *et al*., 2018) [4].

The suprascapular nerve can also be subjected to extrinsic compression. However, this condition is rare representing only 1-2% of all causes of shoulder pain. The most common aetiology is the formation of cysts in the spinoglenoid notch, caused by Superior Labral Anterior and Posterior (SLAP) lesions (Zehetgruber *et al*., 2002) [18]. Usually, the cysts are located in the posterosuperior region of the glenoid, leading to isolated atrophy of the infraspinatus muscle and loss of strength of the external rotation of the arm (Yanny & Toms, 2010) [17]. Such injuries can cause pain and dysfunction in the shoulder depending on their size and location. The most accepted hypothesis for the aetiology of the cyst is a unidirectional valve mechanism created by the capsulolabral lesion. The diagnosis of suprascapular nerve neuropathy can be confirmed by EMG (Post & Grinblat, 1993) [8].

The association of these 2 compressive syndromes is extremely rare which makes this clinical case in such difficult diagnostic and challenging case.

Case presentation

Thirty eieght-year-old male patient, right-handed, recreational swimmer (3 x week of 1000-1500m) for 2 years. He, also, goes regurlarly to the gym and exercises with weights alternating with swimming training days. He has no other known pathologies, except controlled high blood pressure.

One day, when he was training, he felt a sudden and severe pain in his left shoulder during inclined bench press exercise with 8 kg dumbbells. He also had instantly significant loss of muscle strength of his left shoulder and arm. Since then, he had stopped doing physical exercises and sports. The loss of muscle strength was his major concern, reason why he sought for medicaladvice.

At the first medical consultation, which was 1 month after initial symptoms, he had a diffuse intermittent pain that manifested when performing tasks with his arm above shoulder level.figur

The physical examination clearly showed hypotrophy of the posterior region of the left shoulder, below the scapular spine (Fig 1).

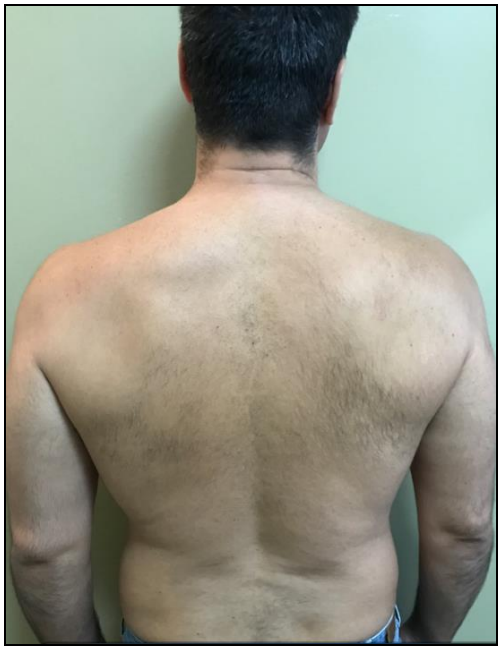

Fig 1: Inspection showed hypotrophy of the left posterior shoulder region

Dynamic inspection of the shoulder movement demonstrated obvious scapular dyskinesis (Uhl *et al*., 2009) [12]. The level of pain and function in the patient's shoulder was evaluated following the ASES questionnaire, which ranges from 0 to 100 points, 100 being the best result. The score obtained in the questionnaire was 82 points in the first evaluation and 98 points in the evaluation 6, 12 and 24 months after surgery.

The total range of passive shoulder motion was complete and painless. Active movements showed the strength of external rotation to be Grade 4 based on the Medical Research Council grading.

The specific orthopedic tests before the surgical procedure were negative, except for the O'Brien test which was positive (Table 1).

Table 1: Result of special tests.

	Preoperative		Postoperative	
Teste	(+)	(-)	(+)	(-)
Neer		x		X
Hawkins		x		X
Jobe		x		X
Hornblower's		x		X
Drop arm		x		X
Obrien	x	-		X
Anterior Apprehension		x		X
Belley press		x		x
Gerber		x		x

Legend: (+) positive test; (-)negative test

MRI performed soon after the first consultation, (1 months after initial symptoms), showed infraspinatus muscle with normal dimensions, but with a diffuse muscle belly edema and Goutallier I fatty atrophy, while the teres minor muscle showed a significant atrophy and Goutallier IV fatty substitution.

The posterior portion of the deltoid presented slightly reduced dimensions and signal alteration suggesting edema. In relation to the glenoid labrum, clear signs of posterior and superior rupture were observed. In addition, there was a perilabral cystic formation extending to the spinoglenoid notch, measuring 3.0cm x 1.5cm x 1.0cm (Fig 2 and 3).

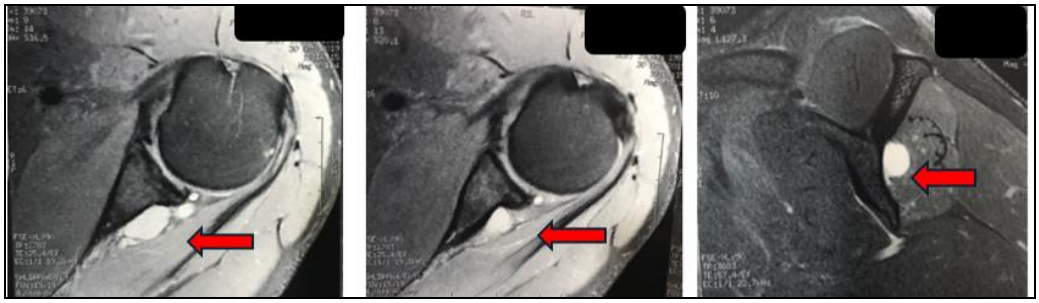

Fig 2: Preoperative imaging: red arrows indicating the paralabral cyst.

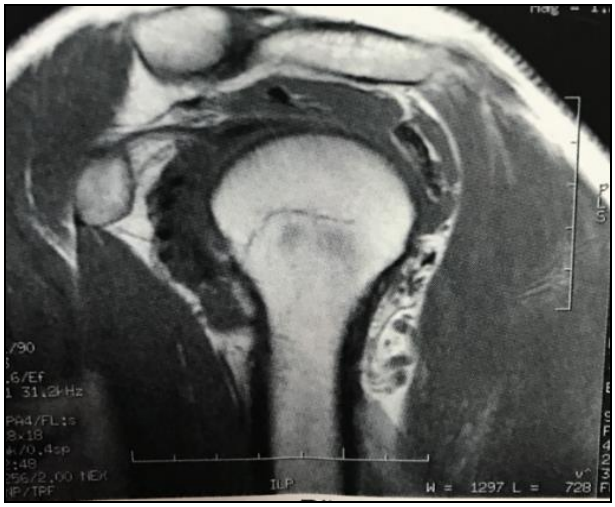

Fig 3: Preoperative imaging: Teres minor muscle presenting Goutallier IV atrophy

EMG showed moderate chronic partial axonal involvement of the posterior branch of the axillary nerve to the teres minor muscle and mild involvement of the anterior branch to the left deltoid muscle. The EMG also showed moderate/severe partial axonal impairment of the left suprascapular nerve branch to the infraspinatus muscle.

Surgical procedure

After the initial diagnosis made by imaging and confirmed by electroneuromyography, surgical procedure was chosen. The surgery was performed with the patient under general anesthesia and anesthetic block of the brachial plexus in the lateral decubitus position. The posterior portal was used, 2 cm medial to the posterolateral angle of the acromion and 2 cm inferior, articular inspection was performed. An expectedly detachment of the posterosuperior labrum was observed, however, extending from the 10:00 to the 6:00 o'clock position.The insertion of the long head of biceps was

intact. Drainage of the posterior perilabral cyst was performed, thus decompressing the suprascapular nerve. The posterosuperiorinferior labrum was sutured with 2 Gryphon Polyetheretherketone (PEEK) anchors (Johnson) with an accessory 7 o'clock posterolateral portal was established and used for placement of the posteroinferior anchor. Bursal inspection was performed and finally the portals were sutured. Postoperatively, the patient remained immobilized for one month, followed by physiotherapeutic rehabilitation with progressive load increase (Fig 4, 5).

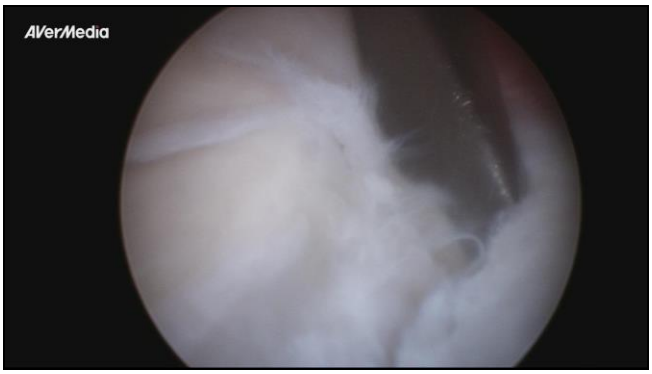

Fig 4: view intraoperative of posterior labrum

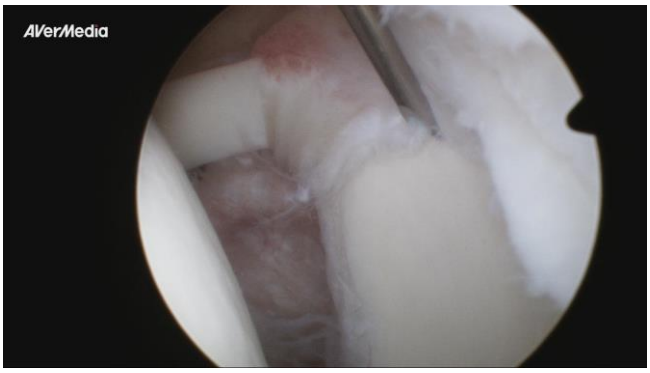

Fig 5 : view intraoperative of posteriorsuperior labrum

At the Follow-up 3 months consultation, MRI of the left shoulder showed significant improvement in the quality of the posterior deltoid and infraspinatus muscles compared to the previous exam. In addition, the paralabral cyst was no longer visualized (Fig 6).

Fig 6: Postoperative imaging: red arrows indicating regression of the paralabral cyst.

Discussion

This is the clinical presentation of a rare case of association of two uncommon peripheral nerve compressive conditions, suprascapular nerve compression and quadrilateral space syndrome, with simultaneous appearance, making it a major clinical challenge.

The first mentions in the literature on quadrilateral space syndrome were in the 1980s (Cahill and Palmer). Since then, few cases have been described in the literature. The diagnosis of quadrilateral space syndrome can be difficult and many patients with this condition are often diagnosed and treated for other conditions before the diagnosis is finally made (Flynn *et al*., 2018) [2]. This can complicate the clinical picture. Patients are often misdiagnosed with impingement syndrome and undergo unnecessary subacromial decompressions or other surgical interventions (Hangge *et al*., 2018) [4]. The aetiology appears uncertain but is due to some factors such as: trauma, muscle edge bands or hypertrophy, in rarer cases even due to labrals cysts, hematomas, lipomas, osteochondromas and shawnnomas. Aneurysms and pseudoaneurysms of the posterior humeral circumflex artery may also be the cause of the syndrome (Hoskins, 2005) [6].

On the other hand, compression of the suprascapular nerve in the spinoglenoid notch results in paralysis of the terminal motor branch of the nerve, with isolated atrophy of the infraspinatus muscle, which leads to a loss of external rotation and pain in the posterior region of the shoulder. This condition is also known as infraspinatus syndrome. This compression can be due to the formation of paralabral ganglion cysts, overuse injuries in repetitive movements in sports such as volleyball and can cause dynamic compressions of the spinoglenoid ligament. The first time a ganglion cyst was reported was in 1981. Studies with magnetic resonance imaging in cases with posterior shoulder pain have reported a prevalence of 0.27% to 0.50% in cases of compression by posterior ganglion cysts (Iossifidis *et al*., [s.d.]). The trajectory of the suprascapular nerve after innervating the supraspinatus continues in the scapular spine through the spinoglenoid notch. After crossing this incision, it terminates through 2 to 4 motor branches in the infraspinatus (Fig 7). In relation to the compression sites of the suprascapular nerve, in addition to the spinoglenoid notch it can also be compressed in the suprascapular notch, with compression in the latter leading to weakness of the supraspinatus and infraspinatus muscles, while compression in the spinoglenoid notch leads to isolated infraspinatus weakness (Westerheide *et al*., 2006) [15].

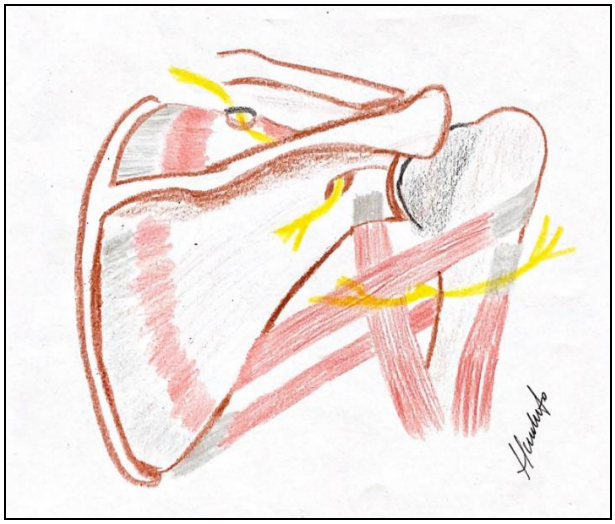

Fig 7: Illustration of posterior view of left shoulder showing paths of axillary and suprascapular nerve.

Paralabral cysts are expansions that arise around the glenoid rim. They are formed by joint fluid that extravasates from the joint through labral lesions. They can be diagnosed by

magnetic resonance imaging or arthro-magnetic resonance imaging. They can be located anywhere around the glenoid (Gupta *et al*., 2015) [3]. Paralabral cysts are an uncommon cause of shoulder pain in young adults. The site of occurrence is 57% in posterior labrum, 21% in anterior labrum, 14% in superior labrum, and 8% in inferior labrum (Ramaswamy *et al*., 2021) [9]. Most paralabral cysts are formed on the posterosuperior glenoid rim, some are asymptomatic however many with symptoms have posterior shoulder pain as the main complaint. Anterior cysts are the least worryng in relation to nerve compression, unless they have an extension to the inferior part (Schroeder *et al*., 2018) [10]. They often do not cause pain unless they are related to labral lesions. They can increase in volume and cause compression of the nerves in the shoulder joint. When the location of the cyst is inferior, compression of the axillary nerve occurs, however compression of the suprascapular nerve, although rare, is more frequent than compression of the axillary nerve.

In the literature, we recently found one similar case of suprascapular nerve compression and quadrilateral space syndrome. In this the authors, Wilson *et al*. (2023) [16] described a patient who had a paralabral cyst arising from an acutely occurring traumatic accident that resulted in an inferior glenoid labrum tear and moderate to severe suprascapular neuropathy and believe that the injury to the suprascapular nerve may have been caused by traction on the nerve during his fall (Wilson *et al*., 2023) [16]. Another similar case was published by Vigasio *et al*. (2009) [13]. The patient had a suprascapular nerve compression that affected the supra and infraspinatus tendons and only after 7 years he had a quadrilateral space syndrome in the same shoulder, being the two situations submitted to open surgical explorations on different occasions, while Wilson *et al*. (2023) [16] case underwent arthroscopic surgery (Vigasio & Marcoccio, 2009; Wilson *et al*., 2023) [13].

Opposite to Wilson *et al* (2023) [16], in our case it was possible to determine the cause of compression of the suprascapular nerve but not the axillary nerve compression in the quadrilateral space, although due to a labral lesion with an inferior extension location, a labral cyst may have been the cause, but it was not evident on MRI. EMG can aid in the early diagnosis of this neuropathy. In this case,it showed great involvement of the axillary nerve branch to the teres minor. Therefore, preserving the integrity of the infraspinatus became extremely important for the function of the shoulder joint.

Regarding the treatment of labral lesions, the literature has provided contradictory information regarding the management of labral lesions, with no consensus on conservative or surgical treatment. In cases with mild strength loss and mild pain, conservative treatment with physiotherapy and non-steroidal anti-inflammatory drugs can provide some benefits, however in cases of compression by cysts, surgery can bring better results (Gupta *et al*., 2015) [].

Our approach, in this case, was an arthroscopic surgical intervention with cyst drainage and labral lesion repair, to reverse the infraspinatus muscle impairment as quickly as possible. Saving this external rotator muscle was our major concern, as recommended by Ramaswam *et al* 2021. In cases with great functional loss and intense pain, paralabral cysts should be addressed arthroscopically and the associated labral lesion repaired. Cyst aspiration has a recurrence rate of around 48% and a puncture failure rate of approximately 18%. The arthroscopic treatment aims to empty the cyst and correct the labral lesion, nullifying the valvular mechanism and cyst recurrence. The aim of this surgical treatment is to close the unidirectional valve with labral sutures, the pathological mechanism will be resolved, and the painful condition eliminated (Flynn *et al*., 2018) [2].

A new imaging exam was performed 90 days after the surgical procedure showed significant improvement in the quality of the infraspinatus muscle, suggesting that the suffering of the suprascapular nerve had ceased. In addition, at the FU the patient was asymptomatic and at the physical examination, and the specific tests did not demonstrate involvement of the rotator cuff and subacromial structures postoperatively.

Re-evaluations were subsequently performed at 6, 12 and 24 months, with all the provocative test negative and normal scapulothoracic movements.

As EMG demonstrated a greater involvement of the branch to the teres minor muscle of the axillary nerve. This helps to explain the good postoperative result even without specific surgical intervention for this nerve. Addressing the suprascapular nerve, the function of the infraspinatus muscle completely recovered. Bringing this main external rotator muscle to normal, the dynamic stability of the shoulder was fully reestablished.

Conclusion

Early arthroscopic treatment, cyst drainage and labral suture, as well as accurate clinical and imaging examinations were extremely important to avoid prolonged suffering of the neural structures. Magnetic resonance imaging and postoperative clinical condition showed good muscle quality and improvement in infraspinatus muscle strength combined with absence of pain, suggesting a positive outcome. Performing cyst drainage and fixation of the labral lesion in cases of suprascapular nerve compression together with advanced quadrilateral space syndrome shows us an option for improving function and clinical results.

Conflicts of interest

All authors have none to declare.

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