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CASE REPORT

Case Reports

Unusual Cause of Shoulder Pain in a Collegiate Baseball Player

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Abstract The objective of reporting this case was to introduce a unique cause of shoulder pain in a high-level Division I NCAA collegiate baseball player. Various neurovascular causes of shoulder pain have been described in the overhead athlete, including quadrilateral space syndrome, thoracic outlet syndrome, effort thrombosis, and suprascapular nerve entrapment. All of these syndromes are uncommon and frequently are missed as a result of their rarity and the need for specialized tests to confirm the diagnosis. This pitcher presented with nonspecific posterior shoulder pain that was so severe he could not throw more than 50 feet. Eventually, intermittent axillary artery compression with the arm in abduction resulting from hypertrophy of the pectoralis minor and scalene muscles was documented by performing arteriography with the arm in 120° abduction. MRI-MR angiographic evaluation revealed no anatomic abnormalities. The patient was treated successfully with a nonoperative rehabilitation program and after 6 months was able to successfully compete at the same level without pain.

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Each author certifies that his or her institution either has waived or does not require approval for the reporting of this case and that all investigations were conducted in conformity with ethical principles of research.
This study was performed at Stanford University and the University of California, Berkeley.

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Introduction

Athletes who compete in throwing sports often have shoulder pain and injury develop, including neurovascular problems about the shoulder [4, 5, 16, 22, 23]. With the increasing level of competition and intensity of training, pain in an overhead athlete's shoulder is likely to have a mechanical origin, which results from the athlete performing repetitive high-stress maneuvers [5, 13, 18, 23]. In baseball players, especially the high biomechanical stresses required to throw hard and the repetitive nature of pitching lead to numerous injuries about the shoulder [4, 5, 23, 28, 29]. Common shoulder problems in overhead athletes include rotator cuff injury (partial and complete tears), instability, secondary impingement, internal impingement, and superior labrum from anterior to posterior lesions [22, 23, 28–30]. Less common causes of shoulder pain in the overhead athlete include nerve injuries to the suprascapular nerve [13, 34], axillary nerve (including quadrilateral space syndrome) [6, 15, 39], and long thoracic nerve in addition to vascular problems including effort thrombosis of the axillary artery or vein [1, 21, 24, 27, 38, 41] and thoracic outlet syndrome [7, 10, 25, 35, 42]. These neurovascular causes of shoulder pain can be difficult to diagnose and often require special diagnostic tests such as electromyography and arteriography [13, 22, 34, 35].

The purposes of this report are to highlight a unique case of intermittent compression of the middle portion of the axillary artery in a collegiate athlete and to stress the importance of considering vascular injuries when examining and treating overhead athletes. To date, reports of outlet syndrome and arterial injury in baseball pitchers are rare. This specific case illustrates an unusual cause of shoulder pain that was treated nonoperatively with excellent success. In addition, the patient's injury was not an isolated diagnosis, but found in combination with a flap tear of the glenoid labrum and electromyography-proven suprascapular nerve entrapment.

Case Report

A 19-year-old right hand-dominant NCAA Division I collegiate baseball pitcher presented with right posterior shoulder pain, which occurred at the midpoint of his throwing motion, and was of 1-month duration. The patient had a history of anterior shoulder pain while pitching during his first collegiate season. He did not have pain with other activities. During the summer season after his freshman year, his shoulder pain worsened and pain began in the posterior shoulder, even when throwing lightly with a short toss program. He initially was treated with rest from throwing. An examination by an orthopaedic surgeon with many years experience as a major league baseball physician was inconclusive and an MRI arthrogram was obtained and noted to be normal. He presented to his collegiate trainer and physician after the summer season noting the pain was improving with rest, but he could not throw beyond 50 feet without pain. This pitcher throws with over-the-top mechanics. He throws a fastball, change-up, slider, and curve ball, with his fastball velocity recorded to peak at 92 mph.

The patient's history was unremarkable and included reports of pitching since elementary school. On examination, a positive impingement sign (pain with forced full forward elevation) was noted along with a 45° loss of glenohumeral internal rotation as measured in 90° abduction, weakness of external rotation in adduction, mild atrophy of his dominant infraspinatus region, and mild pain when the shoulder was externally rotated when in abduction.

As a result of the findings of glenohumeral internal rotation deficit and nondiagnostic MRI, it was believed the patient's pain was the result of internal impingement. The patient was treated with rehabilitation, specifically stretching of the posterior shoulder capsule, and rotator cuff and scapular strengthening. This treatment course improved internal rotation of the shoulder when abducted but a loud audible clunk in the shoulder developed. As a result of a persistent inability to throw and development of this clunk, which appeared to be indicative of intraarticular pathology, shoulder arthroscopy was recommended to identify the source of the clunk.

At arthroscopy, the patient was noted to have a flap tear of the posterior labrum and some posterior inferior labral fraying with no other intraarticular disorder noted. The labral tear was débrided arthroscopically, the patient wore a sling for comfort and progressed postoperatively with standard rehabilitation. Shoulder range of motion, and strength rapidly improved, however, 5 weeks after the arthroscopic labral débridement, the patient continued to experience incomplete symptom relief and persistent weakness of shoulder external rotation. Because the patient continued to experience sharp posterior shoulder pain, atrophy, and weakness in external rotation, he underwent electromyography (EMG) to rule out suprascapular entrapment neuropathy. The EMG revealed the presence of a right (dominant arm) suprascapular neuropathy affecting only the innervation to the infraspinatus, consistent with suprascapular nerve entrapment at the spinoglenoid notch. Six weeks after the labral débridement, the patient underwent decompression of the suprascapular nerve. A muscle-sparing approach was used to release the spinoglenoid ligament and an osteoplasty of the base of the scapular spine was performed. The patient's recovery was rapid, gaining full range of motion and strength. The patient was able to return to throwing; however, early fatigue and recurrence of posterosuperior shoulder pain persisted. As a result of the inability to continue to pitch at a high level despite full shoulder range of motion and strength 3 months after the nerve decompression, an angiogram was obtained of his shoulder to rule out quadrilateral space syndrome. With the arm in adduction, there was normal flow and appearance of the arterial structures about the shoulder. However, in 120° abduction and external rotation, the entire axillary/brachial artery occluded. Excellent collateral vessel blood flow was noted indicating the chronic nature of this obstruction (Fig. 1).

A vascular surgical consultant ordered an MRI-MR angiographic assessment, which documented narrowing of the thoracic outlet with moderate hypertrophy anterior of the scalene muscles, resulting in extrinsic compression of the subclavian artery and vein during hyperabduction. The critical finding was that at 120°, a position similar to the patient's pitching motion, there was occlusion of the mid-axillary artery. On physical examination, the Adson's maneuver was positive bilaterally. The vascular surgeon's opinion was that the patient's muscular build was contributing to the intermittent arterial compression. Intermittent arm numbness at night and intermittent posterior shoulder tightness, dull pinching sensations, and minor pain, which spread into the biceps area, was believed

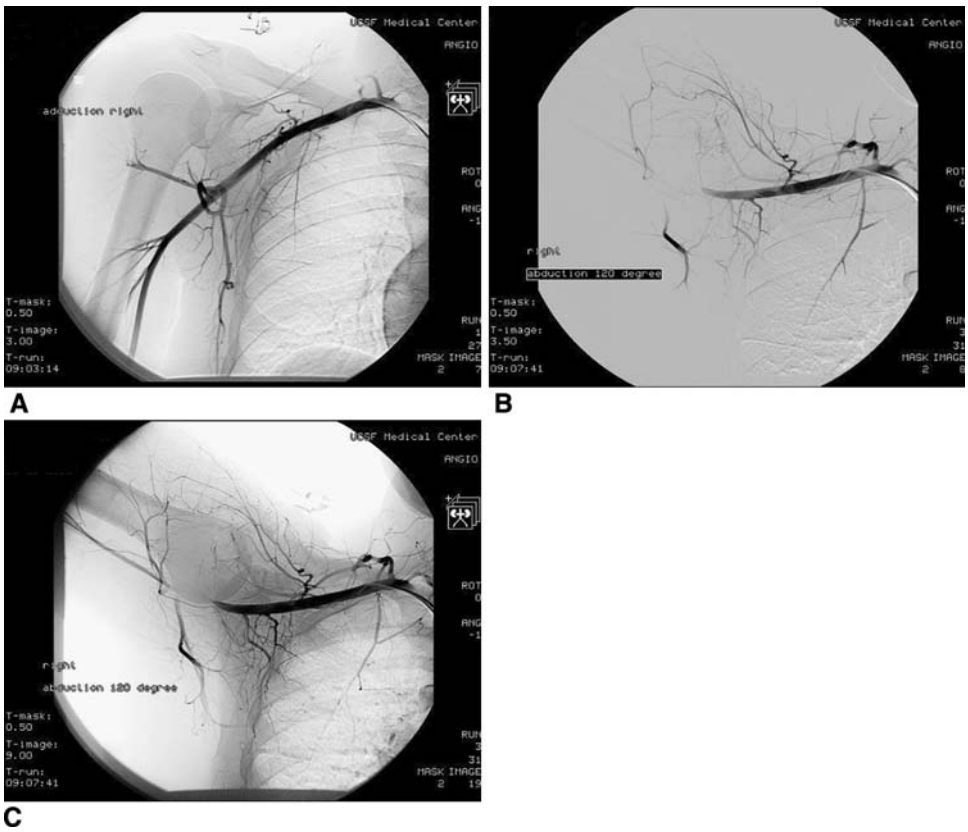

Fig. 1A–C (**A**) Normal flow is seen in the axillary, brachial, and posterior circumflex arteries with the arm at 30° abduction. (**B**) The initial blockage of the axillary artery was evident with initial collateralization at 120° abduction. (**C**) The axillary artery flow was blocked at the level of the humeral head with excellent collateralization and reconstitution of flow in the brachial artery owing to the collateral vasculature.

to be consistent with this diagnosis. Physical examination revealed the right hand to be slightly cooler than the left (1.5° at the index finger). Furthermore, the patient was noted to be breathing more from his neck muscles, which was believed to contribute to the occlusion of the axillary artery. The vascular surgeon recommended elimination of strength training of these muscles to allow a reduction in their bulk along with compensatory physical therapy.

A nonoperative approach to treatment was chosen [10, 14]. Specifically, rehabilitation focused on reestablishing neuromuscular control, normal shoulder kinematics, and proper throwing mechanics. Because the patient's hypertrophied pectoralis minor and anterior scalene muscles were causing occlusion of the right axillary artery, a swimming program was developed to maintain his cardiovascular and muscular endurance without creating more muscle mass. By swimming, the athlete was able to reproduce overhead activity while not stressing the axillary artery and maintain overhead and cardiovascular endurance without throwing. To reduce the muscle activity of the pectoralis minor and anterior scalene, the patient was taught proper diaphragmatic breathing [10]. As the patient became more proficient in proper breathing techniques, traditional shoulder rehabilitation exercises were added. As a result of the large role the lower trapezius muscle plays in maintaining proper scapulohumeral rhythm, close attention was paid to developing an exercise program that would emphasize depression and retraction of the scapula. By establishing this neuromuscular control, the subacromial space would remain open and free while the arm is in the late cocking phase of the pitch. Furthermore, emphasis was placed on stretching of contracted posterior capsular tissues (sleeper stretch) to prevent the loss of internal rotation. The "sleeper stretch" has the patient side-lying on the affected shoulder with the shoulder abducted 90° and passively internally rotated.

As the patient regained kinematic and neuromuscular control, he began to work with the strength and conditioning staff to maintain his upper body strength. Attention was paid to using lighter weights and increasing repetitions to maintain strength without having hypertrophy of the muscles develop. As the patient's strength increased, eccentric and plyometric strengthening of the rotator cuff was added to mimic the deceleration and follow-through phase of the throwing motion. Once his shoulder external rotation strength was 75% of his nondominant shoulder, an interval throwing program was initiated. The patient continued with the collaborative program for 6 months, and at the time of his next collegiate season, was able to compete successfully without pain.

The patient made a successful return to his collegiate program and pitched effectively the entire season without recurrence of his shoulder symptoms.

Discussion

Vascular injuries of the shoulder often escape diagnosis in throwing athletes as a result of the fact that they are uncommon sports-related injuries and at times may be overlooked on examination. The majority of acute sports-related neurovascular injuries often are associated with contact sports and not necessarily overhead-throwing sports such as baseball [5, 22, 26, 27, 40, 41]. More common causes of shoulder pain in overhead athletes include internal impingement, instability, superior labral damage, rotator cuff injury (partial or complete tears), bursitis, and impingement syndrome. Less common injuries include axillary artery thrombosis or occlusion, peripheral nerve injuries (quadrilateral space syndrome, axillary nerve injury, suprascapular nerve injury, and long thoracic nerve injury); compression syndromes; effort-induced thrombosis; and thoracic outlet syndrome [1, 6, 7, 13, 15, 21, 24, 25, 27, 34, 35, 41, 42].

Because any factor that causes narrowing along the course of neurovascular structures, including thoracic outlet or angled deviation of the neurovascular structures as they pass through the outlet, can result in compression of the neurovascular structures resulting in symptoms, thoracic outlet syndrome can initiate from such various etiologies as the compression of the brachial plexus and/or the subclavian vasculature by the scalene muscles or by a cervical rib, excessive shoulder girdle depression, greater muscle development of a dominant arm (usually seen in overhead athletes), or narrowing of the space between the clavicle and first rib as a the result of a clavicle fracture [7, 25, 35, 42]. There are also variations of thoracic outlet syndrome such as hyperabduction syndrome, which is known to result from compression/traction of neurovascular structures beneath the coracoid and the pectoral tendon while in abduction.

This specific case highlights an extremely unusual cause of shoulder pain, in which the patient experienced posterior shoulder pain in the overhead pitching position as a result of hypertrophy of the pectoralis minor and scalene muscles. The compression was intermittent, only seen on angiography with the arm in 120° abduction, highlighting the necessity of testing in the position of symptomatology. Although thoracic outlet syndrome was suspected during the workup, the patient actually had an unusual compression of the right axillary artery at its midway point. Another aspect of the case that makes it unique is that it was treated successfully with nonoperative management. Although there are no published data regarding the success rates of physical therapy, it is reported that physical therapy can be successful in the treatment of thoracic outlet syndrome and its variants, particularly if there is no structural abnormality [3, 33]. Thus, we always use this as a first-line treatment in the management of thoracic outlet syndrome and its variants, if the extremity is not at risk of permanent damage due to acute vascular compromise.

The definitive diagnosis in this case may have been confused by the coincidence of two other objectively identified lesions that could cause pain and/or dysfunction in the shoulder that when corrected eliminated some, but not all, of his pain.

This case study serves as a reminder to team physicians, therapists, and athletic trainers that neurovascular injuries, although at a significantly lower incidence than other shoulder injuries, are still prevalent in overhead athletes, especially baseball players. Currently, there are a limited number of case reports that address the less common injuries to baseball players. There are only approximately 15 case reports on neurovascular injury in baseball players, nine mainly addressing arterial injury [2, 8, 9, 17, 19, 20, 26, 36, 38, 39], three that observed specifically thoracic outlet syndrome [11, 12, 37], and three that reported a combination of the two [31, 32, 39]. Although arterial injuries, including those resulting from thoracic outlet syndrome, are not reported frequently, it is important that healthcare professionals responsible for the care of athletes be diligent when evaluating patients with shoulder pain, even after initial diagnosis and prescription of treatment. Those evaluating overhead athletes, such as baseball players, should be familiar with the clinical symptoms of neurovascular disorders about the shoulder in athletes and should recognize that although it is an uncommon diagnosis, neurovascular disorders are still plausible diagnoses for shoulder weakness and pain.

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