



Posterior Circumflex Humeral Artery Injury with Distal Embolisation in Professional Volleyball Players: A Discussion of Three Cases

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WHAT THIS PAPER ADDS

- Our article describes a rare occupational vascular injury associated with a specific type of athletic activity. Similar symptoms in athletes will often be caused by and attributed to musculoskeletal injuries. Knowledge about this vascular injury will raise awareness and enable recognition, important to prevent serious ischaemic complications. Moreover, the article describes possible treatment options and proposes a rehabilitation programme.

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ABSTRACT

Presented are three cases of volleyball players with ischaemia of the hand due to arterial emboli originating from an injured posterior circumflex humeral artery (PCHA). An operative treatment with ligation of the PCHA was performed in all patients because of the proximity of the occlusion to the axillary artery. After a rehabilitation programme, all patients could return to their previous level of competition.

During overhead motion, the PCHA is prone to injury in its position overlying the humeral head and its course through the quadrilateral space. Recognition of the vascular origin of these symptoms in athletes is important to prevent serious ischaemic complications. Signs of ischaemia might be subtle and may be misdiagnosed as musculoskeletal injuries. Therefore, the examining physician must have a high index of suspicion and awareness about these injuries is important.

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Ischaemia of the hand is frequently caused by proximal arterial disease with an atherosclerotic, thrombo-embolic or traumatic aetiology. In the last decade, arterial emboli in overhead throwing athletes have been reported with increased frequency. Most of them are baseball players with embolic lesions of the axillary artery.^{1–3} The symptoms of hand ischaemia in athletes are mostly relatively subtle and are frequently unrecognised as vascular problems.⁴

We report three recent cases of professional volleyball players with ischaemia of the right hand caused by arterial emboli originating from an injured posterior circumflex humeral artery (PCHA). Only 12 cases of this condition are previously described in the literature.^{5–11} This case report emphasises the importance of

recognising the symptoms in these athletes and discusses the various treatment possibilities.

Cases

Patient 1

A 32-year-old right-hand dominant professional volleyball player presented himself to our clinic with complaints of his dominant hand. Shortly after exercise the patient experienced weakness and coolness of the affected hand, which persisted for several hours. Physical examination revealed, except for coolness, no other abnormalities. Radial, ulnar, axillary and brachial pulses were normal. No Allen test was performed. Adson's test was negative for thoracic outlet syndrome. No other provocation tests for thoracic outlet syndrome were performed. Systolic brachial pressures were identical on both arms and pressures over the

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fingers were normal except for the fifth finger, 81 mmHg (82%). Duplex ultrasound revealed an occlusion of the posterior humeral circumflex artery. No duplex of the digital arteries was performed. Angiography confirmed the occlusion of the posterior humeral circumflex artery (Fig. 1A). The complete axillary artery was normal. In the hand there were multiple embolic occlusions involving the ulnar artery and distal radial artery located proximal to the palmar arcade. Due to the limited available length between the origin of the PCHA and the occlusion (1 cm) an operative treatment was chosen. Operation was conducted through a longitudinal incision in the pectoral fold. Preoperatively the origin of the circumflex humeral artery was marked by duplex. The axillary artery was identified and traced to the posterior humeral circumflex artery. The posterior humeral circumflex artery was detached from the axillary artery and the ostium was oversewed. The posterior humeral circumflex artery was dilated in the occluded segment and the lumen was filled with thrombus. Attention was given in prevention of a cul-de-sac or narrowing of the axillary artery. The distal posterior circumflex artery was ligated. The patient was discharged home on postoperative day 2 on a regimen of aspirin 100 mg daily and was advised to keep rest for 2 weeks. Subsequently, he could start exercising without making overhead motions. At final clinical follow-up of 2 months, the patient had no

complaints and he could successfully start volleyball practice. Aspirin was continued for 6 months.

Patient 2

A 22-year-old right-hand-dominant professional volleyball player was referred to our clinic with a history of cyanosis and pain in his dominant hand after playing competitive volleyball. Physical examination revealed no abnormalities. Radial, ulnar, axillary and brachial pulses were normal. Adson's test was negative. Finger pressures were low in all fingers of the right hand: 10081 mmHg, 11981 mmHg, 10481 mmHg, 9681 mmHg and 8481 mmHg (respectively 86%, 94%, 90%, 83% and 72%) compared to a systolic brachial pressure of 11681 mmHg (11181 mmHg on the opposite arm). Duplex and angiography revealed a thrombosis of the posterior humeral circumflex artery at the takeoff from the axillary artery (Fig. 1B). No abnormalities of the axillary artery were found. Distally there were no evident embolic occlusions. Operation was chosen for the same reasons and conducted in the same manner as described above in patient 1. The patient was discharged home on postoperative day 2 on a regimen of aspirin 100 mg daily and was advised to avoid overhead motions for 1 month. At final clinical follow-up, the

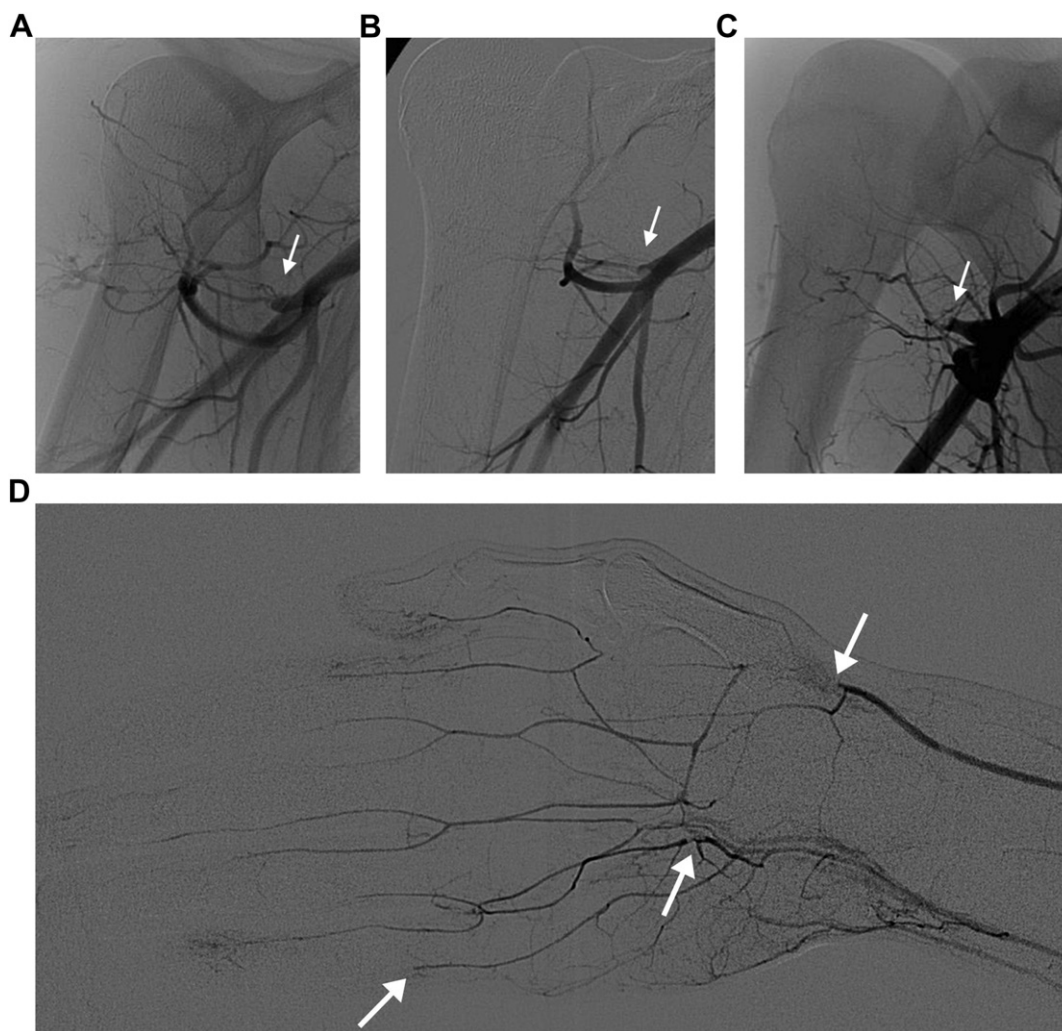


Figure 1. Angiography (AP view) showing occlusion of the PCHA with distal filling via collaterals in patient 1 (A), thrombosis of the PCHA in patient 2 (B) and an occlusion of the proximal PCHA in patient 3 (C). Angiography (AP view) of the right hand of patient 3 (D) reveals extensive abnormalities with occlusion of the distal radial artery, emboli in the palmar arch and occlusion of digital artery (arrows).

patient had no complaints and he could successfully restart practising volleyball. Aspirin was continued for 6 months.

Patient 3

A 29-year-old right-hand-dominant professional volleyball player was referred to our clinic with a history of coolness and numbness in his dominant hand. Physical examination revealed no abnormalities. Angiography revealed a thrombosis of the posterior humeral circumflex artery at the takeoff from the axillary artery, and embolic lesions of radial, palmar and digital arteries (Fig. 1C,D). The complete axillary artery was normal. Due to the close relation of the occlusion and the axillary artery coiling was not possible. Operation was conducted in the same manner as described above. The patient was discharged home on postoperative day 2 on a regimen of aspirin 100 mg. At final clinical follow-up, the patient could successfully start volleyball training and revalidation. Aspirin was continued for 6 months. The patient returned after 12 months with a recurrence of symptoms, however much less severe. Finger pressures were normal in all fingers. Magnetic resonance angiography (MRA) was conducted; no new emboli or thrombosis was seen. Believed to be a musculoskeletal injury, the patient was referred to a physiotherapist. Aspirin was continued for another 12 months. His symptoms resolved slowly and he could return to his previous level of competition.

Discussion

The PCHA arises from the distal third of the axillary artery and runs with the axillary nerve through the quadrilateral space. The PCHA is considerably larger than the anterior circumflex humeral artery. The quadrilateral space is the anatomical compartment bounded by the teres major inferiorly, the long head of triceps medially, the teres minor posteriorly, the subscapularis anteriorly and the surgical neck of humerus laterally (Fig. 2).

The PCHA is particularly prone to injury in its position overlying the humeral head.¹ It is speculated that with forceful overhead motion, stretching of the artery occurs as it winds around the neck of the humerus, producing a traction effect on its junction with the

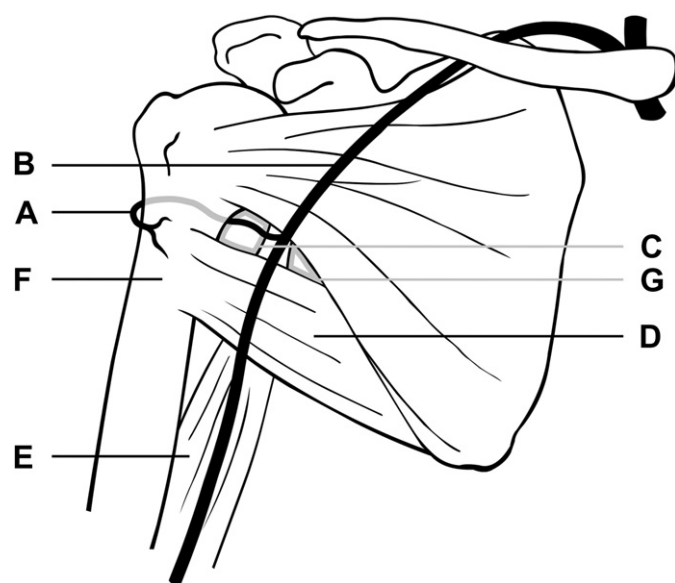


Figure 2. Anterior view showing the PCHA (A), arising from the axillary artery (B), running through the quadrilateral space (C) bounded by the teres minor (dorsally), teres major (D), the long head of the triceps (E) and the neck of the humerus (F). Also depicted is the triangular space (G).

axillary artery which can lead to intimal lesions and subsequent aneurysmal degeneration and thrombosis.^{6,9} Thereupon, overhead actions can compress the thrombus leading to a squeezing force on the artery which causes retrograde embolism in the nearby axillary artery.^{1,4}

The quadrilateral space syndrome (QSS) is a rare entity caused by compression of the contents of the quadrilateral space, the axillary nerve and the PCHA (resulting in symptoms of poorly localised pain, paraesthesia and tenderness over the quadrilateral space on palpation), aggravated by abduction and external rotation of the arm.^{12–14} Our cases differ from the above-described pathology as there were no symptoms of pain and paraesthesia located at the quadrilateral space, shoulder or upper arm.¹⁵

Clinical presentation can be with relatively subtle symptoms. Most cases have presented with digital ischaemia due to arterial embolisation from proximal arterial injury. Symptoms vary from coolness of fingers to loss of endurance during athletic activity. Correct diagnosis of this entity requires a high index of suspicion. The problem is frequently not recognised as being vascular and is mistaken for common musculoskeletal complaints. Due to the abundant collateral network in the upper extremity, small emboli in hand remain undetected for a long time. However, significant arm claudication and limited endurance are disabling symptoms, especially in the high-performance athlete. Moreover, chronic digital embolism may result in disabling pain, numbness and even ulcerations. Furthermore, serious complications following upper limb arterial injury in athletes have been described.¹⁶

Physical examination should include careful inspection and a pulse examination of the affected and contralateral limb in resting and stress positions. Any change in colour and temperature or embolic lesions should be noticed. Neurologic examination to detect motor and sensory disturbances as well as provocation tests (Adson's, Wright's and Roos) to assess thoracic outlet syndrome should be performed. A DASH (Disabilities of the Arm, Shoulder and Hand) questionnaire can be used to further evaluate arm function. Any suspicion of a vascular abnormality must be investigated with brachial and finger pressure measurement. The presence of diminished pressures or blunting of the arterial waveform should lead to a duplex ultrasound examination of the entire arm. A chest X-ray can exclude the presence of a cervical rib.

For imaging in patients suspected of having embolic lesions from a PCHA, it is essential to obtain high-quality images from the beginning of the axillary artery all the way to the palmar arch and digital arteries. Because the occlusions and the aneurysms are difficult to detect, all of the artery branches must be methodically examined and visualised during the imaging study. Imaging should be performed with the arm both at rest and in the overhead throwing position (90–120° shoulder abduction, full external rotation).

In the past, digital subtraction angiography (DSA) was used as our preferred diagnostic study. Modern contrast-enhanced magnetic resonance (MR) or computed tomography (CT), which is able to visualise these subtle lesions, can replace DSA.^{17,18}

The proximity of the aneurysmatic dilatation of the PCHA to the axillary artery determines the possible treatment options. Provided that the beginning of the PCHA is unaffected, contains no thrombi and is relatively long (approximately 1.5 cm), successful coil embolisation is possible, as described previously in three cases.^{6,7,9} An endovascular approach can result in a shortened rehabilitation programme and an earlier return to the previous level of competition. A possible complication of coiling is the potential for further embolism. Furthermore, if the aneurysmatic dilatation is too close to the origin of the PCHA, coils or plugs might dislocate, especially during forceful overhead actions producing a squeezing force on the artery.

If the conditions for an endovascular approach are not present, ligation of the PCHA should be performed. Preoperatively,

identification using duplex ultrasound enables minimal dissection with a targeted approach to the PCHA which reduces the risk of injury to venous or neuronal structures.

The revalidation programme should consist of early mobilisation without making the overhead motion, if necessary supervised by a physical therapist. Approximately 6 weeks after surgery full active range of motion exercise can be started. Subsequently, a full return to the level of previous activity is realised within 3–4 months after surgery.¹⁹ A regimen of aspirin 100 mg daily is continued for an arbitrary total of 6 months.

In conclusion, symptoms caused by arterial emboli originating from an injured PCHA are often difficult to diagnose because signs of ischaemia can be subtle. Examining physicians must have a high index of suspicion for this disorder in professional volleyball players with complaints of a cold hand. Early recognition is important to prevent serious ischaemic complications and to ensure a full return to competitive sports after treatment.

Conflict of interest

No conflict of interest, no disclaimers.

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