Ischemia of the Throwing Hand in Major League Baseball Pitchers: Embolic Occlusion from Aneurysms of Axillary Artery Branches

Ischemia of the upper limb can be caused by a wide variety of disease processes including atherosclerosis, arterial emboli, vasculitides, thoracic outlet syndrome, and vasomotor disorders such as Raynaud disease (1–3). Trauma to the arm can result in damage to the proximal vessels causing distal ischemia (4,5), and recurrent injury to the hands, such as occurs in workers using vibrating hand tools, may lead to digital artery spasm or occlusion (1,6–8).

Arterial emboli in the hand can originate from a cardiac source, from an iatrogenic catheter-induced thrombus, or from proximal vascular disease (9). We report an unusual cause of digital emboli in the throwing arms of two professional baseball pitchers, both of whom had aneurysms of axillary artery branches.

CASE REPORTS

Case 1.—A 25-year-old left-handed relief pitcher presented with a 2-month history of discomfort in the first and second digits of his throwing hand. Discomfort was most apparent after pitching and was associated with digital pallor and coolness. He had been evaluated 1 month earlier at another institution. The work-up, which included a limited upper extremity arteriogram to evaluate the clinical suspicion of thoracic outlet syndrome, revealed no abnormality. The digital arteries were not examined. Oral administration of a calcium channel blocker, nifedipine (Miles Pharmaceuticals, Elkhart, Ind) 10 mg three times per day, for presumed Raynaud phenomenon provided no relief; ischemic symptoms increased with continued pitching.

On physical examination at our institution, a small necrotic area, 3 mm in diameter, was noted at the tip of the left second finger. Axillary, brachial, radial, and ulnar pulses were normal and symmetric. Allen test showed delayed filling of the left thumb and second finger.

Noninvasive Doppler studies showed diminished photoplethysmograph (PPG) waveforms in the first and second finger of the left hand relative to the right hand (Fig 1). Color Doppler flow imaging did not show an abnormality.

A repeated left upper extremity arteriogram, including views of the lower arm and hand, showed multiple filling defects in the digital arteries (Fig 2). The posterior circumflex humeral artery was occluded 0.5 cm distal to its origin (Fig 3). Arteriography, performed with the arm in multiple positions, demonstrated no evidence of thoracic outlet compression of either the subclavian or axillary artery.

Operative exploration of the occluded posterior circumflex artery revealed a 1.5-cm-diameter aneurysm containing thrombus. Repair consisted of resection of the branch artery and lateral repair of the axillary artery.

The patient made a rapid recovery and was discharged without complication 3 days after surgery. Results from noninvasive studies performed 3 months later were normal (Fig 1). One year after surgery the patient returned to major league pitching and remains symptom free.

Case 2.—A 22-year-old right-handed starting pitcher presented with a 4-month history of recurrent numbness in the second and third fingers of his throwing hand. On physical examination, a shallow dry ulcer, 5 mm in diameter, was evident at the tip of the right second finger. Upper extremity pulses were normal and symmetric. Allen test showed delayed filling of the right second finger.

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Figure 1. Case 1. On the left, Doppler study shows diminished PPG waveforms in the digits of the left hand, in particular, the first and second digits. The study of the right hand is normal. On the right, the follow-up study, performed 3 months after surgical repair of the posterior circumflex humeral artery aneurysm, shows normal waveforms.

Doppler studies showed diminished PPG waveforms in the right second and third fingers (Fig 4). Color Doppler flow imaging of the right upper extremity showed an aneurysm of the subscapular artery containing intraluminal thrombus (Fig 5).

Arteriography helped confirm the presence of an aneurysm and demonstrated multiple digital emboli (Fig 6). No evidence of arterial compression in the thoracic outlet was identified. The patient underwent resection of the branch artery, and lateral repair of the axillary artery.

Results from noninvasive studies performed 2 months later were normal (Fig 4). Seven months after surgery, the patient resumed pitching and remains symptom free.

**DISCUSSION**

Upper extremity ischemia is well recognized in persons with repetitive blunt trauma to the hands. Digital arterial occlusion and forearm vessel aneurysms have been reported in workers using vibrating hand tools or hammers (1,10). Similarly, athletes who experience repetitive trauma to the hands, such as handball players and karateists, have developed these vascular lesions (6–8,11).

Similar patterns of digital ischemia have been identified in athletes who engage in extreme exertion of the shoulder on a recurrent basis (9,12–14). In the majority of these cases, ischemia has been secondary to arterial compression of the subclavian or axillary artery in the thoracic outlet. This may be caused by bony or muscular compression (13).

Aneurysms of axillary artery branches have been reported previously and occur almost exclusively in athletes who practice repetitive rotary movements of the shoulder girdle. Reeke and coworkers (15) identified posterior circumflex humeral aneurysms in three top-level volleyball players, all of whom had thrombus in the aneurysm and distal emboli.

McCarthy and colleagues (13) described 11 athletes with symptoms suggestive of thoracic outlet compression of the subclavian arteries. Two athletes (one kayaker and one tennis player) had subclavian artery aneurysms with distal emboli, and another athlete, a baseball pitcher, had occlusion of the posterior circumflex humeral artery, also with distal emboli. The remaining eight athletes had muscular compression of the subclavian or axillary artery by either the anterior scalene or the pectoralis minor muscle. In a recent follow-up article from the same institution,
Figure 4. Case 2. On the left, Doppler study shows diminished PPG waveforms in the digits of the right hand, in particular, the second and third digits. The study of the left hand is normal. On the right, the follow-up study, performed 3 months after surgical repair of the subscapular artery aneurysm, shows normal waveforms.

Figure 5. Case 2. Color Doppler flow image of the right shoulder and proximal arm shows an aneurysm of the visualized axillary branch vessel containing thrombus (arrow).

Figure 6. Case 2. Right axillary arteriogram, obtained with the arm in the abducted position, demonstrates an aneurysm of the subscapular artery (arrow).

Nijhuis and Muller-Wheeler (16) described a handball player with an aneurysm of the anterior circumflex humeral artery with distal ischemia. At surgery, this patient had impingement of the anterior circumflex humeral artery by the tendon of the coracobrachialis.

Rohrer et al (17) performed a study with 35 baseball pitchers and a control group of 11 non-athletes and failed to establish any significant increase in arterial ischemia associated with the extreme repetitive motion of pitching. They did, however, report a decrease in arterial blood pressure by at least 20 mm Hg in the arms of both pitchers and non-athletes when the arm was hyperextended into the throwing position, suggesting that there was considerable compression of the subclavian or axillary artery in that position. Their study was stimulated by a baseball pitcher with thrombosis of the midpart of the axillary artery. An arteriogram with the shoulder hyperextended into the pitching position demonstrated compression of the artery by the humeral head.

The presumed cause of the aneurysms in these reports and in our two patients was repetitive trauma to the vessel during exercise. During a volleyball "smash" the shoulder is hyperextended and externally rotated. This is immediately followed by very rapid flexion and internal rotation. A similar movement occurs during a tennis serve, a baseball pitch, and while kayaking. It is postulated that the hyperextension and external rotation of the shoulder causes a degree of compression of the axillary artery branches against the humerus. When the shoulder is suddenly hyperflexed and internally rotated, these branches are unable to move freely and become stretched. This stretching of the arteries creates shearing forces that eventually cause the arterial wall to weaken, possible dissection of the branches, and the formation of an aneurysm that may then develop mural thrombus. Squeezing of the aneurysm during vigorous movement may cause retrograde exudation of the thrombus. Emboli occur when the thrombus is pushed back into the main axillary artery trunk, and the resultant digital ischemia, if sufficiently bothersome, is often what prompts individuals to seek medical attention.

We did not detect any direct inducible compression of the subclavian or axillary artery in our two patients. However, it is likely that these patients were experiencing repeated injury to the branches of the axillary artery during their throwing action.
Correct diagnosis of an axillary branch aneurysm requires knowledge of the disease process, a high index of suspicion based on predisposing physical activity, and detailed imaging investigation. While in retrospect, the initial limited arteriogram of our first patient clearly showed an abnormality of the posterior circumflex humeral artery, the lack of awareness of this abnormality could have proved disastrous. In the month before arteriography was repeated, the patient developed further digital ischemia, subsequently proved to be caused by digital emboli. The abnormality was diagnosed at repeated arteriography. Surgery relieved the symptoms, and the digital ischemia resolved.

This article emphasizes the benefits of a directed noninvasive vascular laboratory examination. The abnormal waveforms seen in the digits of both patients reinforced the clinical suspicion of digital embolization. Also, careful examination of our second patient with use of color Doppler imaging demonstrated a subscapular artery aneurysm. Coming shortly after our first patient, there is little doubt the entity was searched for with unusual diligence.

At our institution, we have embarked on a program to screen local pitchers with use of noninvasive PPG studies and color Doppler studies to determine if any have evidence of axillary artery injury or compression. Some authors have emphasized the need for these athletes to modify their technique to reduce stress on the axillary artery (9).

On the basis of our experience and previous reports, it seems prudent to suggest that individuals who repeatedly perform strenuous shoulder rotations, and demonstrate symptoms of upper limb ischemia, undergo noninvasive testing and, if warranted, detailed arteriography to exclude abnormalities of the axillary artery and its branches.

References
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