Fracture of the proximal humerus with injury to the axillary artery in a boy aged 13 years

G. D. Wera,
D. M. Friess,
P. O. Getty,
D. G. Armstrong,
S. H. Lacey,
H. R. Baele

From University Hospitals of Cleveland, Cleveland, USA

Fractures of the proximal humerus with concomitant vascular injury are rare in children. We describe the presentation, diagnosis, and treatment of a fracture of the proximal humerus in association with an axillary artery injury in a child.

Several studies have described fractures of the proximal humerus in adults with concomitant vascular or neurological injury. However, the management of such fractures in children has not been described. To our knowledge, there are no specific descriptions of paediatric fractures of the proximal humerus with associated vascular injury. These type of fractures account for approximately 0.45% of all paediatric fractures, and approximately 3% of epiphyseal fractures.

Case report
A right-handed 13-year-old boy with no previous medical or surgical history presented with pain in the right arm and an obvious deformity. He stated that a falling television set had struck the arm just above the elbow on the medial side, approximately one hour prior to presentation. He lay supine with the right arm abducted to 90°. He complained of pain and was unable to dorsiflex the wrist or extend the thumb. Sensation to light touch was intact. However, his radial, ulnar, and brachial pulses were not recordable by palpation or Doppler. The injury was closed and no ecchymoses were present.

Anteroposterior (axillary) and scapula Y views of the right shoulder (Fig. 1) showed a Salter-Harris type II fracture of the proximal humerus. The patient received ketamine sedation in the Emergency Department to allow reduction of the fracture (Fig. 2). However, following reduction the pulses did not return in the radial, ulnar, or brachial arteries. A firm, nonpulsatile haematoma in the axilla was noted after reduction and the advice of a vascular surgeon obtained. During examination by the vascular and orthopaedic surgeons, approximately 30 minutes after reduction, variable Doppler signals at the brachial, ulnar, and radial arteries were seen. However, they were

Fig. 1
Anteroposterior radiograph of the right shoulder taken at presentation showing a displaced Salter-Harris type II fracture of the proximal humerus.
not palpable or consistent, and an angiogram showed occlusion at the junction of the brachial and axillary arteries (Fig. 3).

The patient was taken to the operating theatre for percutaneous pinning of the right proximal humerus followed by reverse saphenous vein interposition grafting of the right brachial and axillary arteries. The intra-operative findings showed a haematoma and arterial contusion, but no active bleeding or laceration of the brachial or axillary arteries. There was no haematoma within the common sheath of the axillary artery and brachial plexus. The axillary artery itself was stretched and thrombosed (Fig. 4). The cords of the brachial plexus were intact on inspection.

The patient's post-operative course was uneventful. He was monitored for 48 hours in the paediatric intensive care unit where his radial and ulnar pulses remained palpable. He was given a sling and a volar splint in 15˚ of dorsiflexion to prevent a flexion contracture of the wrist. One week after the injury his motor function had returned and his pulses were stable. The percutaneous pins were removed three weeks after operation, and anteroposterior and scapular Y radiographs taken at three months showed no deformity or epiphyseal damage.

**Discussion**

Fractures of the proximal humerus with absent distal pulses are very rare in children. One case was included in a review of 57 proximal humeral epiphyseal fractures by Baxter and Wiley. Their case, like ours, had a completely displaced Salter-Harris type-II fracture and a cool, pulseless arm. Angiography revealed interruption of the brachial artery at the lateral border of the axilla. Another report of injury to the axillary artery in fractures of the neck of the humerus found the mean age of such patients to be 66 years. In 1968 McQuillan and Nolan described 37 cases of ischaemic limb injuries, five of which involved the brachial or axillary arteries. Among these five, there was one failure of treatment resulting in amputation. Overall, there were 12 failures attributed to extensive intimal damage, inadequate immobilisation, impaired venous return, thrombosis and delay in diagnosis or treatment.

These fractures heal quickly in children and have an excellent long-term prognosis even when left unreduced. A nine-year follow-up of 64 cases of fractures of the proximal humerus in children showed no sequelae except for four
cases which had a decreased range of movement. A series of 15 cases of fractures of the proximal humeral epiphysis in children with a mean age of 12 years concluded that they heal well despite severe displacement. Six of their cases were Neer type 2, one was type 3 and eight were type 4.

The patient in our report sustained a Neer type 4 fracture (a subclassification of the Salter-Harris type II fracture) which required reduction because of the associated vascular injury. This necessitated prompt percutaneous fixation in order to position the upper limb in abduction and external rotation for revascularisation. Injury to the growth plate is described more frequently when fractures of the proximal humerus are treated by operation. Our patient did require surgical stabilisation to facilitate vascular repair but we did attempt to minimise any damage to the epiphysis by using a single attempt at reduction with smooth pins for fixation. Other complications of operative fixation include re-fracture, infection, and shoulder impingement. After three months there was no radiological evidence of epiphyseal damage, infection, or impingement.

We believe his inability to extend the wrist and thumb was the result of a neurapraxia of the posterior cord of the brachial plexus. In adults with this injury, an enlarging haematoma within the common sheath may explain a progressive or delayed neurological deficit. However, our patient did not have an active axillary artery bleed or haematoma within the sheath. The case illustrates the importance of a thorough vascular examination in all cases of fracture and of co-operation between vascular and orthopaedic surgeons when such injury is suspected.

The patient and his guardian both gave informed consent. No benefits in any form have been received or will be received from a commercial party related directly or indirectly to the subject of this article.

References