CASE REPORT

Transected brachial artery with pink pulseless perfused limb in an open grade III supracondylar fracture of humerus
A case report and review of literature

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Introduction

The incidence of brachial artery injuries in grade 3 supracondylar fractures of the humerus has been reported to be 3–12%. The vascular injury may be due to thrombosis with intimal tear, brachial artery entrapment in the fracture site, compression of the artery due to deformity or swelling and partial or complete transection of the artery. Very rarely the artery is transected by the impaling spike of the fractured bone. Immediate vascular reconstruction is required to ensure a functional recovery of the limb.

We report a rare case of complete transection of the brachial artery following an open supracondylar fracture treated with venous graft and fasciotomy.

Case report

A 9-year-old girl presented with a Grade IIIC open supracondylar fracture of her right humerus within 2 h of injury. On examination she had a swollen elbow with small wound (~1 cm) over the antero-medial aspect of the elbow. The fractured bone end was impaled out of the contaminated and dirty wound. She had an impalpable radial pulse and paraesthesia in the median nerve distribution. Forearm looked pink with a capillary refilling time of 3 s (normal < 2 s). X-rays revealed a spiral posterolaterally displaced supracondylar fracture of the humerus with the spiked proximal fragment (Fig. 1).

She underwent an emergency exploration and debridement with a lazy-S shaped incision incorporating the small wound. The bone ends were irrigated with normal saline, reduced and held with three K-wires (1.25 mm). The median nerve was intact but mildly contused. The brachial artery was found to be completely transected with the proximal and distal ends retracted deep under the muscle. The proximal stump was lacerated and thrombosed with visible pulsation 2 cm above the stump. The two ends were resected and a Fogarty embolectomy catheter was introduced through both ends to ensure patency of the vessel.

A segment (5 cm) of the long saphenous vein from the right groin was harvested. An interposition...
reversed bypass vein graft was performed using 9-0 nylon sutures. A forearm fasciotomy was performed to prevent compartment syndrome due to re-perfusion injury. At conclusion of surgery, she had complete restoration of her radial pulse. Postoperatively, the patency of the vessel was monitored. The injured arm was maintained in a long arm plaster splint in 100° flexion. A secondary closure of the fasciotomy wound was performed at 48 h (Fig. 2).

The paraesthesia in her left hand resolved prior to discharge at 5 days. The K-wires were removed at 4 weeks (Fig. 3a and b). At 6 months follow-up, she had no cold intolerance or exercise induced ischemic symptoms but complained of a discharging sinus. On physical examination she had normal carrying angle (equal to the other side), full range of motion at the elbow with normal radial pulse and no neurological deficit. She had a small discharging sinus over the medial aspect of the distal humerus.

Peripheral blood count revealed Hb%: 13.9 g%, WCC: 7.2 \times 10^9 \text{ mm}^{-3} \text{ and CRP } <10 \text{ mg/L}. Swab cultures from the sinus grew Coliforms which was sensitive to Cefuroxime. She was treated with 2 weeks of intravenous Cefuroxime without improvement. Plain radiographs revealed healed fracture with no signs of bone infection. A sinogram (Fig. 4) suggested a blind ending sinus extending in the olecranon fossa with the contrast filling an irregular cavity. Further exploration of the sinus revealed a small “black seed” embedded in the soft tissue, lying close to the olecranon fossa. At 1 year follow-up, she had healed soft tissue following removal of the seed with a fully functional elbow (Fig. 5a and b).

Discussion

Incidence of vascular injury is higher in open injuries than closed injuries.\(^{20}\) The open supracondylar fractures treated with thorough debridement and internal fixation resulted in 81% good results.\(^{22}\) In open injuries the spiked end of proximal fragment penetrates the skin. This spiked end may impale through the brachialis muscle and cause injury to the neurovascular structures.\(^{17}\) The displacement of the fracture is usually posterolateral (64%).\(^ {10,16}\)

Absent radial pulse raises alarm for the surgeon to recognise the severity of injury. The controversy exists regarding the exploration of the brachial
artery in closed injuries.²,¹⁰,²¹ Clement⁴ recommended immediate exploration of the artery if there is "no improvement in circulation" but did not specifically discuss those patients with pulseless well-perfused hand.⁴ Angiographic assessment prior to surgery is controversial and some authors favour exploration without angiogram.⁵,⁸ Exploration of the antecubital fossa when ischemia of the limb complicates a supracondylar fracture of the humerus in a child was originally introduced in an attempt to relieve the arterial obstruction.⁹ At exploration most common injury observed in most series is entrapment or tethering of the adventitia at the fracture site with thrombosis of the artery.³ The transection of the artery is a rare incidence (0.9%).¹⁴ The artery runs deep to the deep fascia throughout its course and divides into radial and ulnar arteries. For adequate collateral circulation, the rupture of the brachial artery should be distal to the take off of the inferior ulnar collateral artery.¹⁶

From the time of injury to the time of restoration of adequate circulation, the limb is subjected to a period of ischemia. An early exploration reduces the possibility of further ischemia. The child in this case had undergone wound debridement and fracture reduction within 3 h of injury. At exploration, it was difficult to identify the proximal end of the brachial artery which was found rolled and retracted under the deep fascia. The distal end was also lacerated and had retracted under the forearm muscles. Meticulous release of the deep fascia and the lacerated muscles exposed the arterial ends. A reverse saphenous vein graft followed by long fasciotomy restored the radial pulse.

Reverse saphenous vein graft has been used to re-establish the flow across the damaged brachial artery.¹,³,⁶,⁷,¹⁴,¹⁸ Schoenecker et al.¹⁸ reported three patients requiring repair of the transected brachial artery with saphenous vein bypass grafting resulting in a functional viable hand.¹⁷ They also suggested immediate exploration if arm remains pulseless after stabilization. However, a recent audit by Malviya et al shows that majority of paediatric orthopaedic surgeons in UK preferred to observe and rely on collat-
eral circulation rather than treating it more aggressively when the arm remains pink, pulseless and well perfused following stabilization.\textsuperscript{13} The re-establishment of circulation diminishes the risk of development of Volkman’s contracture. Lewis et al.\textsuperscript{11} demonstrated that the basilic vein as a good alternative to the saphenous vein graft.\textsuperscript{11} Benefits include a single surgical wound, reduced operating time and preservation of saphenous vein for future surgical procedures.\textsuperscript{11} In our case, the basilic vein was found to be lacerated and could not be used as a graft. A compartment syndrome may develop either due to insufficient arterial flow or following restoration of the circulation.\textsuperscript{15} A fasciotomy must be performed to prevent a secondary ischemia.\textsuperscript{12}

**Conclusion**

This case highlights the fact that total transection of brachial artery can occur in a pink pulseless perfused limb. High index of suspicion is needed especially when associated with this type of fracture configuration. Complete functional recovery can be achieved by early exploration, bypass vein grafting and fasciotomy following fracture reduction and fixation. Careful exploration and debridement is required to remove any foreign bodies at the time of primary surgery to achieve a successful outcome.

**References**