Education-Family Physician Corner

Vascular Injuries in Children with Humeral Supracondylar Fractures

Rani Al-Agha, MD, FRCS (Ire), CABS* Husain Alaradi, MD**

Ali R. Karashi, MD, MUD, CABS (Ortho)***

Supracondylar Humeral fracture is common among children; it might be associated with neurovascular injuries due to the proximity of these structures to the fracture site. Management of a well-perfused limb with absent pulses post-reduction and fixation of these fractures remains a source of controversy worldwide. In this review, we will highlight the trends of management and present our pro posed protocol for managing such conditions.

Bahrain Med Bull 2017; 39(4): 236 - 237

Supracondylar fractures of the humerus are common fractures in children, accounting for up to 70% of all pediatric elbow fractures[1]. Neurovascular injury complications are not uncommon due to the adjoining nerves and vascular structures to the joint. Vascular complications could range from 3.2% to 14.3%[2].

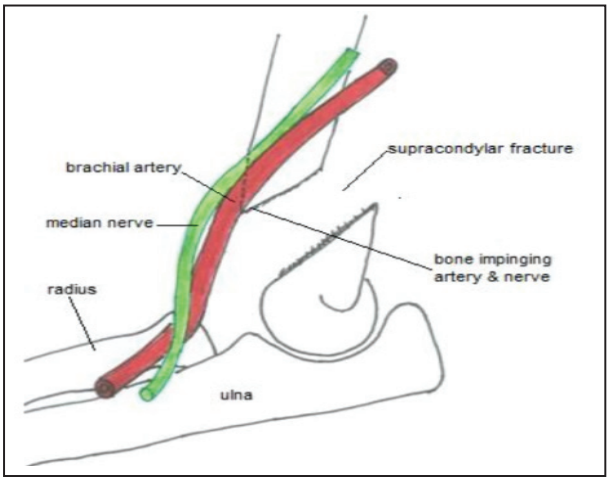

Figure 1: Diagrammatic Representation of Supracondylar Fracture and Neurovascular Bundle

Vascular and orthopedic surgeons encounter three scenarios with patient's post-supracondylar fracture reduction and fixation. The first scenario is a patient who presents with a pulseless limb, in which the pulse returns post-fracture reduction and fixation. The second scenario is a patient who has a persistent absence of the pulse post-reduction and fixation; however, the hand is well perfused and warm. The third scenario is a patient who presents with a persistent absence of the pulse, and the hand is showing signs of acute ischemia such as coldness, duskiness and poor capillary refilling time.

In the first scenario, it is not necessary to explore the brachial artery, whereas, in the third scenario, it is mandatory to explore and repair the brachial artery or the patient may lose his limb. However, the second scenario remains a source of controversy whether or not to explore the brachial artery immediately or to observe and re-evaluate the patient[3].

We will highlight the various approaches to management of such fracture and present our point of view of what could be the ideal management of such cases.

We did not encounter a certain protocol in managing such a condition with universal agreement. Some authors have advocated observation for 24 hours post-reduction and fixation and then re-evaluate as a treatment of choice. On the other hand, others have advocated early intervention once the pulse is absent, regardless of the hand status, well-perfused or not[4,5].

Blakey et al recommended urgent exploration of the brachial artery in a child with a 'pink pulseless hand', not relieved by reduction of a supracondylar fracture. He claims that early recognition of an ischemic injury is a matter of utmost importance for an optimal outcome as reversibility of any ischemic damage is related inversely to the duration of ischemia[6]. White et al showed that majority of perfused, pulseless limbs following supracondylar humeral fractures have a vascular injury. He advised aggressive vascular evaluation and vascular exploration even if the hand appears pink and warm. Furthermore, patency rates for revascularization procedures appear sufficiently high, making this intervention worthwhile[7]. Immediate surgical exploration was advocated because of concern for long-term cold intolerance, exercise-induced ischemia, brachial artery thrombus with potential propagation, limb contracture and limb loss[8]. On the other hand, Pirone et al proposed a "watch and wait" approach with careful observation and regular assessment of neurovascular status; they concluded that "persistent absence of radial pulse, but with good distal perfusion justifies an expectant treatment approach"[9].

In a study by Choi et al, 24 of 33 patients with a well perfused but pulseless hand, the fractures were reduced and stabilized and the hand remained perfused through the observation period[10]. Authors advocate that the pulseless hand is most likely due to brachial arterial spasm or a brachial artery injury with distal perfusion maintained by rich collateral circulation at the elbow[5]. Soh et al also agreed on expectant treatment, provided that the pulse oximetry shows O_2 saturation of more than 99% with good wave pulse. He proposed a treatment algorithm using the pulse oximeter for children with supracondylar humerus

fractures presenting with an absent pulse; he proposed to explore the patient when there is an absence of good waveforms in the pulse oximetry, see figure 2 (A and B)[11-14]. Careful monitoring post-reduction for 24-48 hours is mandatory. Exploration of the brachial artery is indicated if the hand perfusion deteriorates, the pain intensity increases and there are signs of neurological deteriorating[15]. Until now, there are no local or regional studies to resolve this issue.

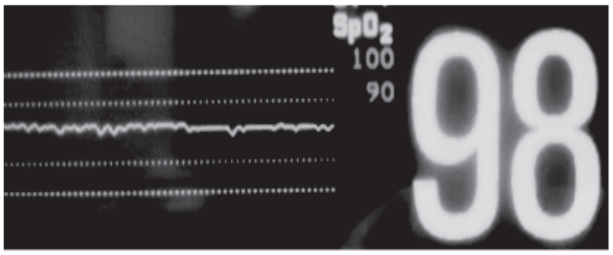

Figure 2 (A): Poor Waveform on Pulse Oximeter

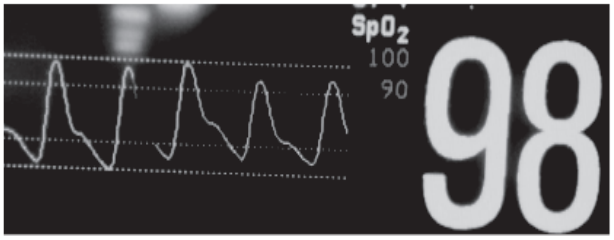

Figure 2 (B): Good Waveform on Pulse Oximeter

In our institution, the vascular surgeons would explore the brachial artery instantly if the pulse did not return immediately after fracture reduction and fixation, even in a well perfused warm hand. Nevertheless, after a series of observations, this practice has been modified, as most of the explorations were negative for any vascular injury as well as the return of the pulse within 24 hours.

Accordingly, we proposed the following protocol, see figure 2. In the protocol, we favor watchful policy for a pulseless limb but well-perfused, provided O2 saturation is above 95% with good waveform pulse. Nevertheless, we advise immediate exploration if the hand is showing signs of acute ischemia. Further research should be performed for these cases to reach to an evidence-based conclusion. This protocol and algorithm of management should be tested by a well-designed study.

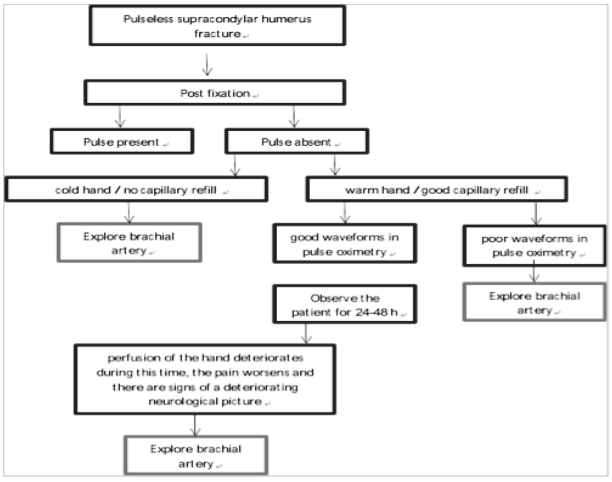

Figure 2: Proposed Protocol

Author Contributions: All authors share equal effort contribution towards (1) substantial contribution to conception and design, acquisition, analysis and interpretation of data; (2) drafting the article and revising it critically for important intellectual content; and (3) final approval of the manuscript version to be published. Yes.

Potential Conflicts of Interest: None.

Competing Interest: None.

Sponsorship: None.

Acceptance Date: 14 October 2017.

Ethical Approval: Approved by Department of Surgery, Salmaniya Medical Complex, Bahrain.

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