Case Report

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Pulse oximetry of pink pulseless hand in supracondylar fracture of humerus in a pediatric patient

Vitaliy Petrov

Department of Surgery, Danylo Halytsky Lviv National Medical University, Lviv, Ukraine

ABSTRACT

A five-year-old boy was admitted with a supracondylar fracture of the distal humerus. After the closed reduction, the hand was pink, but persistent absence of radial pulse was revealed. Pulse oximetry detected flattened waveform compared to the unaffected limb. Doppler ultrasound examination suggested distal brachial artery occlusion. During operation, artery dissection was found, the injured segment was resected, and the vessel was repaired in an end-to-end fashion. In conclusion, pulse oximetry with waveform analysis is a valuable method for screening of brachial artery injuries in children with a pink pulseless hand.

Keywords: Brachial artery, humeral fractures, photoplethysmography, vascular injuries.

Supracondylar fractures of the distal humerus are the most common fractures of the distal elbow in children.[1,2] Brachial artery involvement with the radial pulse loss may complicate this common pediatric trauma.[1] Fracture reposition typically restores the hand perfusion. If the hand remains pulseless after the reduction, brachial artery injury is suspected.[1-3] Diagnosis and management of these patients still remain controversial. Herein, we report a pediatric case of a distal humeral fracture complicated by brachial artery injury.

CASE REPORT

A five-year old male patient was admitted with a humeral fracture after a fall from height. He received closed reduction and percutaneous pinning was performed. The radial pulse absence was noted two hours later after the procedure. On physical examination, the hand was pink and warm (Figure 1). Pulse oximetry was applied and the saturation was 100% on both hands; however, the waveform pattern differed. On the healthy unaffected limb, the waveform was normal, while the waveform was damped on the affected limb (Figure 2a, b).

Ultrasound examination revealed that the brachial artery was in its distal part and non-patent due to an echogenic filling and there was flow in the radial and ulnar arteries collateral. Surgery was decided, and a written informed consent was obtained from the parents of the patient.

The patient was operated. During surgery, brachial artery dissection was revealed, the affected segment of

Figure 1. Pink pulseless hand.

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Correspondence: Vitaliy Petrov, MD. Danylo Halytsky Lviv National Medical University, Surgery Department #2, Pekarska str., 69, 79010 Lviv, Ukraine.
e-mail: medicine_mail@yahoo.com

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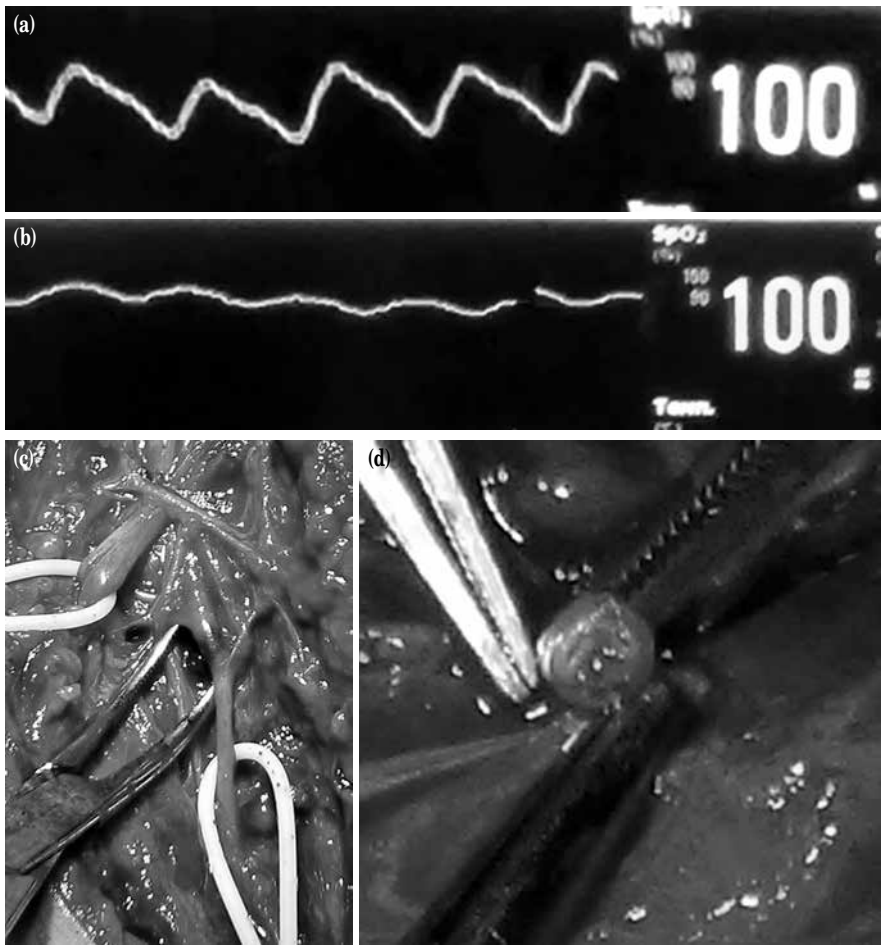

Figure 2. (a, b) Results of pulse oximetry of healthy and affected hand. **(c, d)** General appearance of the brachial artery and view of dissection.

the vessel was resected, and the artery was anastomosed in an end-to-end fashion with interrupted sutures (Figure 2c, d).

The postoperative course was uneventful, and the patient was discharged with clopidogrel daily for six months.

DISCUSSION

A supracondylar fracture of the distal humerus carries a potential brachial artery challenge particularly in pediatric cases. In the benign course, the artery may experience spasm, kinking, stretching or compression, and all these are usually improved by the bone reduction.[1,3] In a more grieve clinical setting, the vessel develops dissection of the intima, partial or complete tear, thrombosis or entrapment. As a result, the pulsatile blood flow is persistently ceased.[1-4] However, significant brachial artery injuries in children do not necessarily lead to a sudden-onset clinical picture of limb ischemia. The hand may appear compensated, as rich collateralization from the deep brachial artery and collateral ulnar arteries develops. The limb receives oxygenated blood with a non-pulsatile flow and despite being pulseless, it looks pink.[1-3]

The term pink pulseless hand describes an apparently well perfused hand with an absent radial pulsatility in a child with supracondylar fracture of the distal humerus. Historically, there was misconception of the pink pulseless hand expression due to a common belief that the condition could be attributed to the contusion or reduction maneuvers with subsequent elevation of subfascial pressure, but not the arterial blood flow compromise. However, over time, a considerable amount of data has been accumulated to state that the pink pulseless hand is referred to brachial artery involvement.[1-5]

Debates still continue how to manage the pink pulseless hands. The radial pulse absence per se is not recognized as an indication for the surgical exploration by many surgeons. An observation tactic is applied, and intervention is indicated only, when clinical evidence of limb ischemia occurs.[2,5] A more aggressive approach includes early exploration in patients with persistently absent radial pulses, as severely diminished arterial blood supply poses the patient to the risk of ischemic neural or muscle consequences.[1,3] In addition, the extent and effectiveness of collateralization may be unpredictable, or the network is absent due to extended trauma.[1-5]

Visualization diagnostic tools have not helped to reduce the acuity of this debate. Angiography shows limited value for such patients, as the method is invasive, time-consuming, and does not seem to alter the clinical course of the patient. Artery ultrasound with Doppler examination is a promising instrumental diagnostic tool, although experience in children is lacking, yet. Therefore, many authors highlight the potential benefits of pulse oximetry in the pink pulseless hand evaluation.[2-4]

Pulse oximetry with visual waveform display has become a routine monitoring element in the health care facilities. Devices provide information about the oxyhemoglobin saturation percentage and draw the photoplethysmogram. Both the saturation level and pulsation waveform analysis have shown their usefulness in objectification of various limb arterial trauma diagnostics.[6] For brachial artery injury in the distal humeral fracture, Soh et al.[4] showed that diminished waveform was a strong sign of brachial artery involvement. Pulse oximeter waveform rather than the saturation level showed high sensitivity to identify the status of the brachial artery and helped in decision-making.

In our case, a five-year-old boy acquired the humeral fracture and presented with a pink pulseless hand. After his percutaneous pinning, the pulse was still not possible to palpate. Digital pulse oximetry was applied, and the regional hemodynamics evaluated: normal saturation with a damped waveform. The findings were accurately interpreted in a trauma unit, and the patient was sent to the vascular center. Doppler ultrasonography suspected brachial artery lumen occlusion. The latter was confirmed during the operation and the vessel repair was performed.

In conclusion, our case demonstrates that altered pulse oximetry waveform is correlated with the injured brachial artery status. We, therefore, conclude that pulse oximetry of the pink pulseless hand after the reduction of the supracondylar humeral fracture in a child has a high value in the brachial artery evaluation. In addition, this tool is cost-effective, reproducible, and easily available in all trauma centers; therefore, we suggest wide application of pulse oximetry in the brachial artery screening for children with distal supracondylar humeral fractures. We believe that it may also help health care givers to detect the pathology timely and more precisely.

Declaration of conflicting interests

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