Late Brachial Artery Thrombosis after Supracondylar Humeral Fracture at 5 Years Old Boy

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Abstract: Supracondylar fractures in children is a well known problem, but late neuro-vascular complications related to the fractures of the distal part of the humerus in children are rare. There has been presented the case of a patient after a supracondylar fracture with slow brachial artery thrombosis.

Keywords: Supracondylar humerus fractures, children, vascular complications, brachial artery thrombosis.

INTRODUCTION

Supracondylar humerus fractures are the most common fractures of the elbow area in children. They are most common among children in the first decade of their life with a peak of 5-7 years old, mainly boys, although an increased proportion of these fractures in girls has recently been observed. The left or non-dominant limbs are most likely to be exposed to fractures [1, 2]. Due to the mechanism, such fractures can be divided into extensive and flexive fractures. The extensive type of fracture occurs in 98% of patients and is caused by the falling on the upper limb with a straightened elbow. Fractures are classified according to the Gartland classification [3] as Type I – non-dislocated, type II - dislocated with the contact between the fragments and type III - without contact. Neuro-vascular complications are the most common ones, accounting for 10 - 20% of all the complications. Acute neuro-vascular complications which appear immediately after a supracondylar humeral is a well known problem but late neuro-vascular complications related to the fractures of the distal part of the humerus in childrenare rare. We present the case of a patient after a supracondylar humeral fracture with late brachial artery thrombosis.

CASE STUDY

A 5-year-old patient in 2010 as a result of a fall suffered a supracondylar fracture of the left humerus (Figures **1** and **2**).

The child arrived at the emergency department within 1, 5 h of the injury. Radiographs showed a supracondylar fracture of the humerus classified as type III according to Gartland classification. The pulse oximetry showed a good waveform and the pulse on radial and ulnar artery was present. At the neurological examination the child presented no sensory deficit but there was a flexion impairment of finger I of the left hand which was mainly noticed in the area of the long flexor of the thumb and within the DIP joint of the second finger of the left hand. Active flexion of other fingers was normal. 2, 5 h after trauma under monitored sedation the closed reposition and fixation using 3 K-wires was performed. The plaster of Paris with 45 degrees flexion on elbow was used (Figure **3**). The next day after surgery, the continuity and blood circulation in the humerus, radius and ulnar arteries were retained, the patient was examined by a colour flow of Doppler ultrasound examination like every

Figure 1: Supracondylar humerus fracture - lateral view.

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patient in our department with the fractures of Gartland type III and IV. The result of the Doppler ultrasound examination showed the normal blood flow in brachial artery. The neurologic examination was the same as before the surgery. The post-surgery XR presented the correct fracture reposition with K-wires stabilization.

Figure 2: Supracondylar humerus fracture - AP view.

Figure 3: Supracondylar humerus fractures treated with Kirchner wires.

The patient whose general condition was good was allowed to go home. While at home, the boy showed no pain. The child was re-taken to hospital 17 days after trauma. He suffered from the pain of II finger of the left hand with hyperextension at DIP. In examination after the plaster had been removed, reduced warming of finger I and II was noticed when compared to other fingers. Oxygen saturation by means of pulse oximetry of all the fingers of the left hand amounted to 100%. There was the pulse at the wrist joint level. The warming of other fingers was correct, the capillary circulation returned after the pressure had been maintained. The mobility of the elbow joint was 30-60 degrees. Active and passive mobility of the wrist was normal. A colour flow of Doppler ultrasound examination on the upper limbs was performed and was normal.

19 days after the injury during examination the distal radial and ulnar pulse was not detected. A colour flow of Doppler ultrasound examination showed the lack of flow at the brachial artery on elbow over a distance of 1, 5 cm but above this level, there was a departure of an enlarged lateral branch revealed which constituted the collateral circulation supply in the forearm arteries in which the circulation was recorded.

No signs of venous thrombosis of the left upper limb were noticed. The neurological status was the same with the neuropraxia of the anteriorinterosseous nerve. During the next Doppler examinations (20 days and 32 days after injury) the lack of circulation revealed the brachial artery flow at a distance of about 4-5 cm, the circulation re-appeared in the initial section of the radial artery and the ulnar artery and was maintained at the periphery, however, the minute volume <50% when compared to the right side. There were no signs of acute, subacute, or critical ischemia. Angio-CT examination was performed 29 days after the fracture. The examination showed a segment of occlusion of brachial artery 4, 5 cm in length with the presence of collateral circulation (Figure **4**).

60 days after trauma during the neurological examination the child did not present the symptoms of the anterior interosseous nerve damage with symmetrical right hand active mobility of the thumb and second finger.

During the last control in June 2014 the patient presented the same length of the limbs, elbow mobility was 5/140 degrees. The patient complains about quicker cooling of the limb and about the fact that the nail of the second finger of the left hand grows more

slowly. A colour flow of Doppler ultrasound examination of the left upper limb was performed: the left brachial artery presented the segment of the occlusion 23 mm in length with filling of collateral vessels and distal reconstitution of the circulation. The circulation in the ulnar and the radial artery is smaller by approximately 10% when compared to the one in the healthy limb.

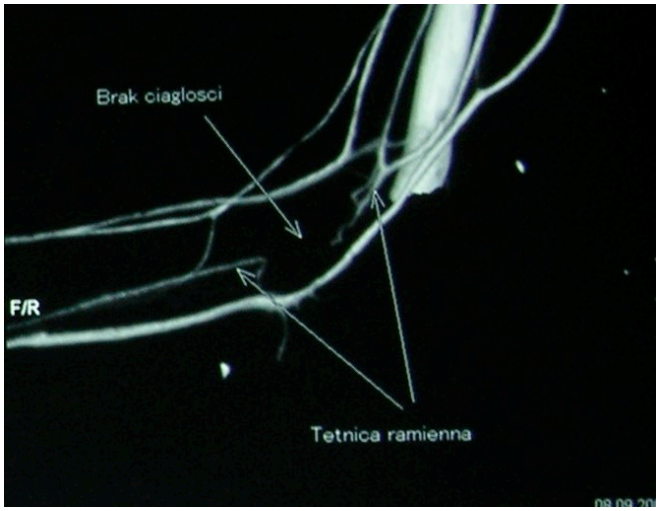

Figure 4: Supracondylar humerus fracture - CT angiography.

In the forearm arteries the circulation is preserved, monophasic and of reduced resistance. The peak circulation speed when compared to the right side is slower by approximately 0.1 m/s, respectively 0.4 m/s to 0.5 m/s in the ulnar artery and 0.35 m/s to 0.45 m/s in the radial artery.

DISCUSSION

Supracondylar humeral fracture occurs at about 3% of all pediatric fractures. Supracondylar fractures occur most commonly in children aged between 5 and 7 years [4].

Acute vascular injury may be present in approximately 10% of children with supracondylar humeral fractures [5]. Most frequently at Gartland grade III extension type fractures extension type [5-8]. Brachial artery lesion may be secondary to various insults, such as entrapment, division, spasm of the vessel, the presence of an intimal tear or thrombus formation. On the other hand, the relative incidence of nerve injuries has been reported as being 12–20% and they mainly (86–100%) consist of neurapraxias, which usually resolve spontaneously [7, 11, 13]. In patients with extension-type supracondylar fractures, anterior interosseous nerve injury is most common, followed by median, radial, and ulnar nerve injuries [4]. The literature has consistently shown that it is these fractures that are associated with brachial artery injury with flexion-type supracondylar fractures being relatively free of vascular complications [8]. It was found a statistically significant correlation between the median nerve injury and the brachial artery lesion. However, there is not notice a correlation between the type of vascular lesion and nerve injury [4, 7, 9]. The children who presented with an absent radial pulse had a 60% incidence of associated neurological injury [8, 10]. Frequency of acute nerves injuries accompanying supracondylar humeral fractures in children in different studies ranges from 10 to 20%. According to them, the most often complication is median nerve injury and anterior interosseus nerve injury. It was notice distinction between the median nerve damage and the pseudo-anterior interosseous neuropathy. Anterior interosseous nerve is a branch of the median nerve, which contains mostly motor fibers innervate muscles: a flexor pollicis longus, a felxor digitorum profundus of the index finger, and the pronator quadratus. Damage of this nerve revealed weakness / unnatural extension of the distal interphalangeal joint of the index fingerand interphalangeal joint of the thumb. A characteristic feature is the lack of loss of sensation. To assess this, you can use three tests: a hand clenching, making the "OK" sign, and the picking up a coin from the ground by typing the thumb and index finger. In addition to motor nerve branches anterior interosseus nerve gives sensory branches to the wrist, but it is not clinicaly important [8, 9]. An isolated neurological deficit is most commonly a neuropraxia following transient traction at the time of injury [13].

There is no consensus on the treatment of the pulseless perfused hand following operative fixation. Various treatments such as observation, arteriography, magnetic resonance angiography, emergent exploration and delayed exploration have been suggested following fracture stabilization [5]. The lack of a palpable radial pulse after closed reduction and percutaneous pinning is not an absolute indication to proceed with vascular exploration if clinical findings suggest that the limb is perfused [6]. Although the indications for exploration of the cubital fossa in the case of a pulseless, cool, white hand are clear, the management of patients with a pulseless but otherwise well perfused hand still remains controversial [7, 14, 15]. However, several options have been proposed for the treatment of a pulseless but otherwise well perfused hand. Observation is the treatment of choice for many authors. If the hand remains pulseless but well perfused after stabilisation, they suggest that the vascular injury should not be treated and instead rely

on collateral circulation [4, 8, 10, 16]. The upper limb has an extremely good collateral blood supply. The abundant collateral supply of the elbow comes from the superior and inferior ulnar collateral artery medially and the profunda brachii artery laterally. These arteries branch from the brachial artery proximal to the olecranon fossa, where supracondylar humerus fractures frequently occur. The profunda brachii artery branches to give a radial recurrent branch and an interosseous recurrent branch. The superior ulnar collateral artery runs posterior to the medial epicondyle to form the posterior ulnar recurrent artery. The inferior ulnar collateral artery runs anterior to the medial condyle of the humerus to become the anterior ulnar recurrent artery. The radial recurrent and both the ulnar recurrent arteries then rejoin the radial and ulnar artery respectively at the level of the biceps insertion on the radial neck. This rich collateral network forms the basis for pulseless perfused hands despite brachial artery entrapment at the level of the supracondylar humerus [5, 17].

The absence of the pulse alone is not an indication for immediate vascular exploration if there are no other signs of ischaemia [8]. Because the rich collateral circulation around the elbow is sufficient for the viability of the arm, whereas early revascularization procedures are associated with a high rate of asymptomatic reocclusion and residual stenosis of the brachial artery [7]. There is no correlation between the signs of ischaemia and the type of vascular injury [7]. Radiographic evaluation of the vascular lesion includes both invasive and non-invasive techniques. Doppler, magnetic resonance angiography and colour-flow duplex scanning are non-invasive techniques that may obtain anatomically and haemodynamically useful information. Angiography is an invasive technique and for some authors angiography present the best specificity and sensitivity than non-invasive methods [4-8].

It was recognized that a child who may have a diminished pulse at presentation may eventually have a pulseless hand as part of a continuum of fracture hematoma and compression of the brachial artery. A child with a brachial artery intimal damage which may progress to late brachial artery occlusion may also not be recognized in the initial setting [5]. The discovered injury include aneurysm, complete vascular injury, thrombosis, partial tears, entrapment [5]. Relating to compartment syndrome of the lower limb we have found no evidence for consideration of absolute values of upper limb compartment pressure or indeed for the usefulness of measuring the absolute values of radial pressure. The long-term sequelae of not diagnosing vascular injuries in the paediatric population has not been fully described in the literature. Although no paper described the development of late Volkmans contracture it may be that occult vascular complications (i. e. those that do not give rise to acute ischaemia) have other, more subtle, consequences such as limb length discrepancy and functional impairment [8]. Like claudication, cold intolerance and thrombus migration should be considered if this method of treatment is selected [7, 10]. Which was showed in our case.

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