

EVALUATION OF LATE BRACHIAL ARTERY EXPLORATION IN PEDIATRIC SUPRACONDYLAR HUMERUS WITH ABSENT PERIPHERAL PULSE AND PINK WARM HAND

¹Mahmoud Mohamed M. Mahdy, ²Waleed Abdelbadee Sorour, ³Sherif Mohamed Hulaeel
⁴Mahmoud Mohamed Salem

Vascular Surgery Department, Faculty of Medicine, Zagazig University, Egypt.

Corresponding author: Mahmoud Mohamed M. Mahdy, Email: mahmoudmahdy331@gmail.com

ABSTRACT

Background: Brachial artery injury is one of the commonest vascular injuries occurring in pediatric age group with supracondylar fractures of the humerus (SCHF) with an incidence of 3-14 % of cases as a result of falling on out stretched hand. The aim of the present study was to prevent all disabilities resulting from improper vascular intervention with SCHF affecting brachial artery by clearing the vision on the set point. **Patients and methods:** A study included 18 pediatric patients with SCHF and pulseless perfused upper limb were studied. They admitted to ZUH 12 cases were females (66.7%) and 6 were males (33.3%) with age 5.5 ± 1.72 (mean \pm SD). Patients were followed up for a period of 24 hours after bone fixation. **Results:** Time interval mean from accident to presentation was 7.44 ± 4.85 and Time interval from presentation to orthopedic intervention was 1.44 ± 0.41 . No cases had Limb ischemia or Nerve injury and only 4 cases (22.2%) had Rupture brachialis muscle. About 14 cases (77.8%) had no vascular injury as they spontaneously regained pulse after bone fixation with follow up in the ward, while three cases (16.6%) had Entrapped brachial artery in fracture site and contused segment and only one case (5.6%) had Contused segment. Majority of cases had no vascular intervention 14 cases (77.8%) while 2 cases (11.1%) underwent excision of contused part, thrombectomy and lry repair. 2 cases (11.1%) underwent excision of contused segment, thrombectomy and repair by reversed saphenous graft. Post fixation 14 cases (77.8%) had success of spontaneous pulse regaining at different times of follow up with a mean of 2.92 ± 1.23 hours with minimum 0.5 and maximum 8 mostly due to relief of arterial spasm of brachial artery. 22.2% (4 cases) failed to regain pulse spontaneously at 24 hours of follow up so they underwent vascular exploration. **Conclusion:** Patients with SCHF and absent peripheral pulsation while the hand is perfused and pulse was not regained after satisfactory bone reduction, immediate vascular exploration is not necessary and it is better to follow up the patient up to 24 hours as long as the hand remains perfused.

Keywords: Brachial Artery; SCHF; Peripheral Pulse; Pink Warm Hand

INTRODUCTION

Brachial artery injury is one of the most common vascular injuries that occurs with supracondylar fractures of the humerus (SCHF) it occurs with an incidence of 3-14 % of cases (1). SCHF itself is one of the commonest fractures in children usually due to falling on an out stretched hand during daily activities as doing exercise, slipping at home or falling from height it represents about 60 % of all fractures around elbow joints in pediatric population and about 16 % of all pediatric fractures (2).

Absent peripheral pulsation with SCHF is a result of variety of reasons as arterial spasm, compression by the displaced bone or arterial injury which may be contusion, partial or even complete transection. Missing the vascular injury is catastrophic to the outcome of the fracture and may end with limb amputation (3).

There is no doubt that surgical vascular exploration is needed to regain proper vascularization of the limb. Many sure signs which are leading for the most of surgical intervention such as active bleeding, pulsating expanding hematoma and pale cyanotic cold hand. What is arguing is when the hand is warm and not cyanotic after successful bone fixation and the peripheral pulsation is still absent. Is there a need for immediate vascular exploration or we can wait and conserve? prefer the open surgical way to restore the vascularity of the limb after proper bone fixation even if the limb is warm and pink (4).

Also Usman et al., (3) recommended immediate vascular exploration if there is no pulse immediately after fixation. But from point of view conservative treatment should be adopted after

successful closed reduction for the perfused hand with absent pulse unless there are new signs of vascular compromise (5).

This study is conducted to prevent all disabilities resulting from improper vascular intervention with SCHF affecting brachial artery by clearing the vision on the set point.

PATIENTS AND METHODS

A clinical trial included 18 patients with absent peripheral pulsations and non-ischemic hand post SCHF who attended to the vascular surgery department emergency room (ER) in Zagazig University Hospitals (ZUH).

A well-informed written and oral consent were taken from the patient parents. All the patients of the study had the right for complete confidentiality and kept dignity throughout the study. They had the right to refuse the participation in the study with nothing changed in the medical care they received.

Inclusion criteria

Pediatric patient with absent peripheral pulsations and non-ischemic hand post SCHF in age up to 15 years of both sexes. Patients who are presented early in the first 24 hours

Exclusion criteria

Patients who refuse to be in the study and those with age older than 15 years patients with sure signs of arterial damage as expanding pulsating hematoma, active bleeding, cyanosed cold hand. Nerve injury except anterior interosseous nerve, compound and comminuted fractures and late presentation after 24 hours were excluded from this study.

Initial assessment and management

As a general role in trauma it is very important to identify and correct any life threatening condition in a linear progression by following the Advanced Trauma Life Support (ATLS) protocol which are airway, breathing, circulation, disability, and exposure management (6).

Airway management:

The first step to start with in any trauma patient is airway assessment for its patency and the need for endotracheal intubation by Glasgow Coma Scale (GCS) scoring system as $GCS < 8$ means that the patient is unable to protect his air way (7).

Breathing management:

The chest must be examined for any life threatening condition that prevent proper ventilation as airway disruption, tension pneumothorax, hemothorax, and cardiac tamponade (8).

Circulation management:

Hemorrhage is the most common cause of shock in trauma patient and if not controlled it may endanger life. Hemorrhage control can be achieved simply by external compression over the bleeding point. If the patient is shocked, fluids or even cross matched blood are transfused to the patient to resuscitate the patient (9).

Disability and neurological assessment:

By the end of primary survey rapid neurological assessment by the level of consciousness, signs of lateralization, and GCS is done to evaluate the central nervous system integrity and exclude traumatic brain injury.

Patient exposure:

The last item in primary survey is to expose the patient from head to toes part by part to make proper assessment and diagnose any hidden injury then by using blankets the patient is covered again to prevent hypothermia, then for any unstable patient, FAST scan (focused assessment sonofigurey for trauma patient) and X- rays for the chest, pelvis, and spine should be done with primary survey (10).

All children were examined for the end level of pulsation, hard and soft signs of arterial injury, and Arterial Pressure Index (API).

Arterial Pressure Index:

By using the hand held Doppler SONOTRAX model sonotrax vascular and sphygmomanometer systolic pressures in ulnar and radial arteries distal to the fracture and in the other limb were recorded. Interpretatio revealed $API > 0.9$ is normal and is highly specific in excluding vascular injury. While, $API < 0.9$ indicates the further need for duplex ultrasonofigurey (DUS) and angiofigurey (11).

Postoperative vascular follow up:

In the ward, all children received their medications as antibiotics, analgesics, antiedemetous and papaverine as anti-spasmodic drug. Their pulses were checked every two hours for 24 hour during this period DUS was done for all children to assess vascular patency and flow.

Statistical analysis:

Data analyzed using Microsoft Excel software. Data were then imported into Statistical Package for the Social Sciences (SPSS version 20.0) software for analysis. Qualitative data represented as number and percentage while, quantitative data represented by mean \pm SD. The following tests were

used to test differences for significance; difference and association of qualitative variables by Chi square test (X²), while Differences between quantitative independent groups by t test. P value was set at ≤ 0.05 for significant results & ≤ 0.001 for highly significant result.

RESULTS:

The present study was included 18 patients with age ranged from 3 to 9 and distributed as 5.5±1.72. As regard to sex distribution 6 cases (33.3%) were males and 12 cases (66.7%) were females (**Table 1**). Time interval mean from accident to presentation was 7.44±4.85 and Time interval from presentation to orthopedic intervention was 1.44±0.41 (**Table 2**). No cases had Limb ischemia or Nerve injury and only 4 cases (22.2%) had Rupture brachialis muscle (**Table 3**). About 14 cases (77.8%) had no vascular injury as they spontaneously regained pulse after bone fixation with follow up in the ward, while three cases (16.6%) had Entrapped brachial artery in fracture site and contused segment and only one case (5.6%) had Contused segment (**Figure 1**). Majority of cases had no vascular intervention 14 cases (77.8%) while 2 cases (11.1%) underwent excision of contused part, thrombectomy and lry repair. 2 cases (11.1%) underwent excision of contused segment, thrombectomy and repair by reversed saphenous graft (**Table 4**).

Post fixation 14 cases (77.8%) had success of spontaneous pulse regaining at different times of follow up with a mean of 2.92 ±1.23hours with minimum 0.5 and maximum 8 mostly due to relief of arterial spasm of brachial artery. 22.2% (4 cases) failed to regain pulse spontaneously at 24 hours of follow up so they underwent vascular exploration (**Table 5**).

A case of female patient 3 years old presented with SCHF with history of falling on out stretched hand 3 hours before presentation. Left SCHF with small echymotic area over the elbow joint which fixated SCHF by K-wires lateral. The upper limb was in 120 degrees of flexion by posterior slab after bone fixation. By follow up in the ward there was pulse regaining after two hours. Post fixation Doppler follow up there is intact flow with triphasic waves in radial and ulnar arteries (**Figure 2**).

Table (1): age and sex distribution among studied group (N=18)

Age	Mean± SD	5.5±1.72	
	Median (Range)	5.0 (3.0-9.0)	
		N	%
Sex	Female	12	66.7
	Male	6	33.3
	Total	18	100.0

Table (2): Time interval from accident to presentation and Time interval from presentation to orthopedic intervention distribution:

	Time interval from accident to presentation/ hours	Time interval from presentation to orthopedic intervention/ hours
Mean± SD	7.44±4.85	1.44±0.41
Median (Range)	5.5 (2.0-24.0)	1.0 (1.0-6.0)

Table (3): Injuries associated characters:

		N	%
IschemicLimb	Not	18	100.0
	Yes	0	0.0
Nerve injury	Not	18	100.0
	Yes	0	0.0
Rupture brachialis	Not	14	77.8
	Yes	4	22.2

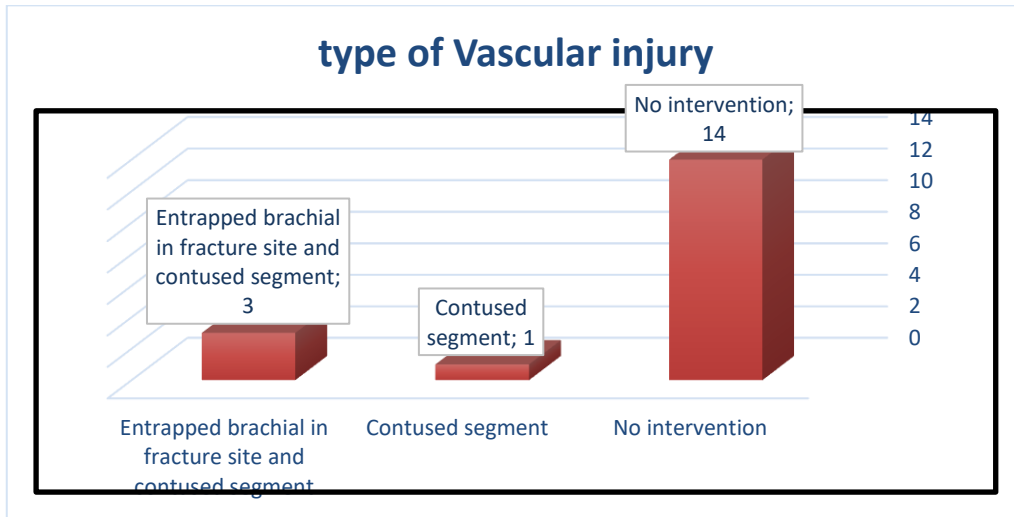


Figure (1): Type of Vascular injury

Table (4): Vascular intervention distribution:

		N	%
Vascular intervention	No intervention	14	77.8
	Excision of contused segment, thrombectomy and repair by reversed saphenous graft	2	11.1
	Thrombectomy, excision of contused part and lry repair	2	11.1
	Total	18	100.0

Table (5): Pulse return distribution among studied group:

Time of pulse Return post fixation	0.5 hour	1 hour	2 hours	3 hours	4 hours	6 hours	8 hours	No pulse for 24 hours	Total
No. of cases	2	2	3	2	3	1	1	4	18
Percentage %	11.1	11.1	16.7	11.1	16.7	5.5	5.5	22.2	100

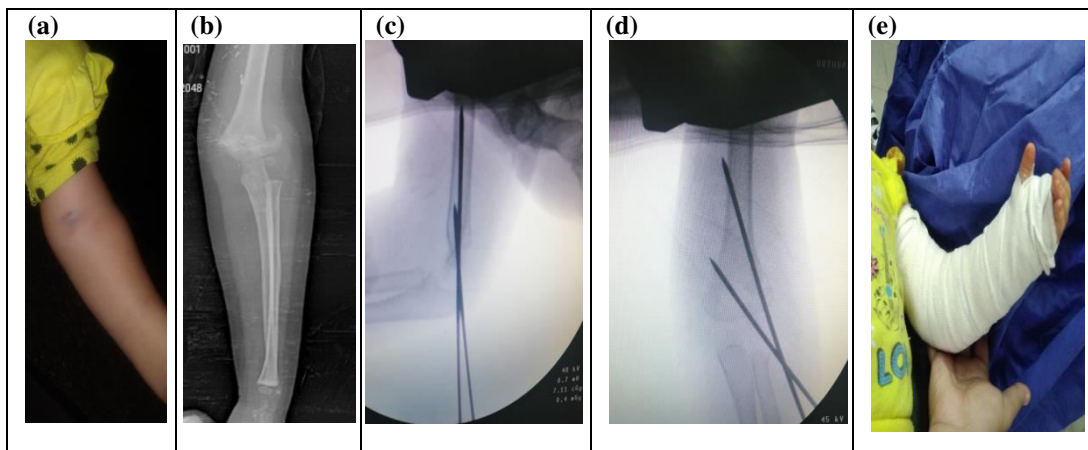


Figure (2): Female patient 3 years old presented with SCHF with history of falling on out stretched hand 3 hours before presentation; (a) Left SCHF with small echymotic area over the elbow joint; (b) Gartland grade III SCHF lateral view ; (c) fixated SCHF by K-wires lateral view ; (d) fixated SCHF by K-wires anteroposterior view ; (e) the upper limb was in 120 degrees of flexion by posterior slab after bone fixation.

DISCUSSION:

This study was carried out on 18 pediatric patients. They presented to ZUH with SCHF and pulseless pink warm upper limb, 12 female (66.7%) and 6 males (33.3%) with age 5.5 ± 1.72 (mean \pm standard deviation).

A retrospective study made by **Xie et al. (12)**, on a 13 patients presented with a pink, pulseless hand with SCHF of which eight were boys and five were girls. The average age was 6 years (range: 2–11 years).

In another study carried out by **Lukasz (13)**, on a 67 patients with SCHF and pulseless upper limb participated in the study. The patients consisted of 46 males and 21 females. Their mean age was 9.5 years and the range were 4 to 17 years.

It seems that our study is in concordance with the above-mentioned studies, except with male and female distribution as males are more affected than females as males are more outgoing and more engaged in doing activities, playing sports and accidents but, females plays amore dormant role and more involved in house hold activities **(14)**.

The difference could be explained that boys are more aggressive than females and exhibits more physical aggressive behaviors and presented with more severe injury as compound fractures or nerve injury, for that they were excluded from our study which focuses more on SCHF with warm, pink, pulseless upper limb **(15)**.

In our study 18 patients with pulseless upper limb with SCHF were followed up for 24 hours post bone fixation with expectations of spontaneous pulse regaining. At the end of the study we had 14 (77.8) patients who regained pulse spontaneously post bone fixation at different times with mean of 2.94 ± 1.23 . (4/18) 22.2% of cases did not regain pulse after 24 hours of follow up and underwent vascular exploration. One case (5.6%) had contused brachial artery segment. three cases (16.6%) had entrapped brachial artery segment in fracture site with one of them entrapped by just the adventitia. (2/4) 11.1% of patients underwent excision of contused segment, thrombectomy and repair by reversed saphenous graft. The other 2 cases underwent release and excision of the contused segment, thrombectomy and primary repair.

Also, **Xie et al. (12)** who performed a study on 13 patients with SCHF and pulseless upper limb. Nine of them had spontaneous pulse regaining immediately after bone fixation. Two cases had pulse return at 16 and 54 hours post bone fixation. The last 2 cases were discharged without pulse regaining, but their hands were pink and warm. By follow up those 2 cases had pulse return at 1 month and 6 weeks.

In contrast **korompilias et al. (4)** performed a study at which one patient out of five patients shows pulse return after closed bone reduction. 4 (80%) patients fail to restore pulse after closed reduction so they underwent arterial exploration. In comparison to our study, only 4 (22.2%) of 18 patients underwent vascular exploration may be due to less severe Gartland grade.

CONCLUSION:

We concluded that patients with SCHF and absent peripheral pulsation while the hand is perfused and pulse was not regained after satisfactory bone reduction, immediate vascular exploration is not necessary and it is better to follow up the patient up to 24 hours as long as the hand remains perfused.

However, if the state of hand perfusion deteriorates, vascular exploration should be done. If vascular exploration will be done, the presence of rupture brachialis muscle is indicative for brachial artery injury.

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