Pediatric Vascular Trauma in association with supracondylar fracture humerus

100 cases Tanta Experience

By Ehab Hamdy

Assistant Lecturer of Vascular and Endovascular Surgery

Tanta university

Introduction

Vascular injuries associated with pediatric displaced supracondylar fractures of humerus is about 10-20%.

Pathology :

Thrombus, Contusion, Complete or Partial Transection, Pseudoaneurysm Or

Introduction

Humeral supracondylar fracture with distal radial pulse doesn't exclude arterial injury.

Management

Cases presenting with a pulseless hand after closed reduction

1- Pale and unperfused limb:

Emergency exploration of the artery and arterial repair is the current recommendation. (on Clinical Basis)

Pulseless Pink and well perfused limb

Exploration or Observation

Is there a Consensus ??

?

AAOS

AMERICAN ACADEMY OF ORTHOPAEDIC SURGEONS

THE TREATMENT OF PEDIATRIC SUPRACONDYLAR HUMERUS FRACTURES

EVIDENCE-BASED GUIDELINE AND EVIDENCE REPORT

9. We cannot recommend for or against open exploration of the antecubital fossa in patients with absent wrist pulses but with a perfused hand after reduction of displaced pediatric supracondylar humerus fractures.

Strength of Recommendation: Inconclusive

Description: Evidence from a single low quality study or conflicting findings that do not allow a recommendation for or against the intervention. An **Inconclusive** recommendation means that there is a lack of compelling evidence resulting in an unclear balance between benefits and potential harm.

Implications: Practitioners should feel little constraint in following a recommendation labeled as **Inconclusive**, exercise clinical judgment, and be alert for emerging evidence that clarifies or helps to determine the balance between benefits and potential harm. Patient preference should have a substantial influencing role.

10. We are unable to recommend an optimal time for removal of pins and mobilization in patients with displaced pediatric supracondylar fractures of the humerus.

Strength of Recommendation: Inconclusive

Description: Evidence from a single low quality study or conflicting findings that
recommendation for or against the intervention. An **Inconclusive**
of compelling evidence resulting in an unclear

Implications: Practi
Incon

We cannot recommend for or against open exploration of the antecubital fossa in patients with absent wrist pulses but with a perfused hand after reduction of displaced pediatric supracondylar humerus fracture.

For Exploration

Systematic analysis of 98 children with pink pulseless supracondylar fractures concluded that there is significant arterial injury in **70%** of patients and thus need vascular exploration & repair in selected cases.

J Pediatr Orthop. 2010 Jun;30(4):328-35. doi: 10.1097/BPO.0b013e3181da0452.

Perfused, pulseless, and puzzling: a systematic review of vascular injuries in pediatric supracondylar humerus fractures and results of a POSNA questionnaire.

White L[1], Mehlman CT, Crawford AH.

Author information

Abstract

BACKGROUND: Supracondylar humerus fractures that present with a perfused, viable hand yet no pulse continue to be a source of controversy. The purpose of this study was to conduct a systematic review of the literature and perform a Pediatric Orthopaedic Society of North America (POSNA) opinion poll regarding management of pulseless supracondylar humeral fractures in children.

METHODS: A systematic review of the literature was conducted for relevant observational studies concerning neurovascular injuries in supracondylar humerus fractures. Single case reports and non-English language studies were excluded. Data were pooled for defined subgroups and 95% confidence intervals were reported. The results from the literature were then compared to popular opinion via a POSNA-approved survey concerning management of pulseless supracondylar humerus fractures.

RESULTS: A total of 331 cases of pulseless supracondylar fractures were identified from the literature, irrespective of perfusion status. In all, 157 fractures remained pulseless after closed reduction and stabilization. Of the fractures that continued to be pulseless despite adequate reduction, 82% [95% confidence interval (CI)=0.82 (0.76-0.88)] were found to have a documented brachial artery injury. POSNA members presumed this number would be 28% [95% CI=0.28 (0.22-0.34)]. A total of 98 perfused (aka pink) supracondylar fractures were identified. Of these pulseless, perfused fractures, 70% [95% CI=0.70 (0.58-0.82)] had a documented brachial artery injury. POSNA members speculated that this number would be 17% [95% CI=0.17 (0.12-0.22). A total of 54 patients had minimum 1 year follow-up data after vascular revascularization, and 91% [95% CI=0.91 (0.83-0.99)] of these patients had a patent artery based on vascular studies. POSNA members believed this number would be 55% [95% CI=0.55 (0.48-0.62)].

CONCLUSIONS: Our study revealed that common dogma regarding watchful waiting of pulseless and perfused supracondylar fractures needs to be questioned. In the vast majority of published cases, an absence of pulse is an indicator of arterial injury, even if the hand appears pink and warm, suggesting the need for more aggressive vascular evalvation and vascular exploration and repair in selected cases. Moreover, patency rates for revascularization procedures appear sufficiently high, making this intervention worthwhile.

For Exploration

Twenty three patients of pink, pulseless hand with delayed presentation had evidence of **ischemic contracture** and they advocated for urgent exploration to relieve entrapment and to minimize future disturbance of growth.

J Bone Joint Surg Br. 2009 Nov;91(11):1487-92. doi: 10.1302/0301-620X.91B11.22170.

Ischaemia and the pink, pulseless hand complicating supracondylar fractures of the humerus in childhood: long-term follow-up.

Blakey CM[1], Biant LC, Birch R.

Author information

Abstract

A series of 26 children was referred to our specialist unit with a 'pink pulseless hand' following a supracondylar fracture of the distal humerus after a mean period of three months (4 days to 12 months) except for one referred after almost three years. They were followed up for a mean of 15.5 years (4 to 26). The neurovascular injuries and resulting impairment in function and salvage procedures were recorded. The mean age at presentation was 8.6 years (2 to 12). There were eight girls and 18 boys. Only four of the 26 patients had undergone immediate surgical exploration before referral and three of these four had a satisfactory outcome. In one child the brachial artery had been explored unsuccessfully at 48 hours. As a result 23 of the 26 children presented with established ischaemic contracture of the forearm and hand. Two responded to conservative stretching. In the remaining 21 the antecubital fossa was explored. The aim of surgery was to try to improve the function of the hand and forearm, to assess nerve, vessel and muscle damage, to relieve entrapment and to minimise future disturbance of growth. Based on our results we recommend urgent exploration of the vessels and nerves in a child with a 'pink pulseless hand', not relieved by reduction of a supracondylar fracture of the distal humerus and presenting with persistent and increasing pain suggestive of a deepening nerve lesion and critical ischaemia.

For Observation

Analysis of 20 children with pink pulseless hands have concluded that lack of palpable radial pulse is not an absolute indication for arterial exploration if **Doppler signals and good capillary refill** suggesting a well perfused hand.

J Bone Joint Surg Am. 2013 Nov 6;95(21):1906-12. doi: 10.2106/JBJS.L.01580.

Management of the pediatric pulseless supracondylar humeral fracture: is vascular exploration necessary?

Weller A[1], Garg S, Larson AN, Fletcher ND, Schiller JR, Kwon M, Copley LA, Browne R, Ho CA.

Author information

Abstract

BACKGROUND: Radically different conclusions exist in the pediatric orthopaedic and vascular literature regarding the management of patients with a pink hand but no palpable radial pulse in association with a supracondylar humeral fracture.

METHODS: One thousand two hundred and ninety-seven consecutive, operatively treated supracondylar humeral fractures in patients presenting to a level-I pediatric trauma center from January 2003 through December 2007 were studied retrospectively. Clinical records were reviewed to determine vascular and neurological examination findings, Gartland classification, timing of surgery, and postoperative complications.

RESULTS: One thousand two hundred and sixty-six patients had a documented radial pulse examination at the time of arrival in the emergency room; fifty-four (4%) of those patients lacked a palpable radial pulse. All fifty-four patients had type-3 fractures. Five (9%) of the fifty-four patients underwent open exploration of vascular structures on the basis of clinical findings of a pale hand, sluggish capillary refill, and/or weak or no pulse detected with use of Doppler ultrasound after closed reduction and percutaneous pinning. All five underwent vascular surgery to restore blood flow (two primary repairs, three saphenous vein grafts). Twenty (37%) of the fifty-four patients had a pulse documented with use of Doppler ultrasound and a pink hand after closed reduction and percutaneous pinning, but the radial pulse remained nonpalpable. These patients were observed in the hospital for signs of ischemia; one of the twenty patients required vascular repair after developing a pale hand nine hours after closed reduction and percutaneous pinning, and the other nineteen patients were also observed while they were in the hospital, and they all regained a palpable pulse either prior to discharge or by the time of the first postoperative visit. When compared with the group of patients with type-3 fractures for whom data regarding nerve examination were available, patients with type-3 fractures who lacked a palpable radial pulse had a higher rate of nerve palsy postoperatively (31% versus 9%, $p < 0.0001$).

CONCLUSIONS: In this cohort, nearly 10% of patients who presented with a type-3 supracondylar humeral fracture and no palpable radial pulse underwent immediate vascular repair to restore blood flow following closed reduction and percutaneous pinning. However, in our series, the lack of a palpable radial pulse after closed reduction and percutaneous pinning was not an absolute indication to proceed with vascular exploration if clinical findings (i.e., Doppler signal and capillary refill) suggested that the limb was perfused. Careful inpatient monitoring of these patients postoperatively is mandatory to identify late-developing vascular compromise.

LEVEL OF EVIDENCE: Prognostic level III. See Instructions for Authors for a complete description of levels of evidence.

For Observation

A follow-up study for patients with SFH treated with arterial exploration and revascularisation found a **high rate of asymptomatic reocclusion** and hence stated that collateral circulation would have been adequate to maintain a viable extremity.

J Pediatr Orthop. 1997 May-Jun;17(3):303-10.

Management of pulseless pink hand in pediatric supracondylar fractures of humerus.

Sabharwal S[1], Tredwell SJ, Beauchamp RD, Mackenzie WG, Jakubec DM, Cairns R, LeBlanc JG.

Author information

Abstract

Thirteen (3.2%) of 410 patients seen in British Columbia's Children's Hospital in Vancouver from January 1984 to September 1992 with supracondylar fractures did so with an absence of a radial pulse in an otherwise well perfused hand. A combination of segmental pressure monitoring, color-flow duplex scanning, and magnetic resonance angiography (MRA) appears to be a valid, noninvasive, and safe technique in evaluating patency of the brachial artery and collateral circulation across the elbow. Based on this study, early revascularization of a pulseless otherwise well-perfused hand in children with type 3 supracondylar fractures, although technically feasible and safe, has a high rate of asymptomatic reocclusion and residual stenoses of the brachial artery. Therefore a period of close observation with frequent neurovascular checks should be completed before more invasive correction of this problem is contemplated.

Comment in

The role of angiography in assessing vascular injuries associated with supracondylar humerus fractures remains controversial. [J Pediatr Orthop. 1998]

For Observation

Another study on 68 pink, pulseless hands, also recommended early closed reduction with closed observation and exploration only for cases with acute ischemia.

Injury. 2016 Apr;47(4):848-52. doi: 10.1016/j.injury.2016.01.010. Epub 2016 Jan 16.

Acute ischemia and pink pulseless hand in 68 of 404 gartland type III supracondylar humeral fractures in children: Urgent management and therapeutic consensus.

Lousahem D[1], Cottalorda J[2].

Author information

Abstract

No consensus exists regarding pulseless otherwise well-perfused hand in pediatric Gartland type III fractures. The purpose of this retrospective study was to describe our strategy and to determine the guidelines of therapeutic consensus.

PATIENTS AND METHODS: 404 children were treated for a type III supracondylar humeral fracture. Extension fractures-induced acute vascular injuries were noticed in 68 patients and nerve injuries were associated in 32 of them. The radial pulse was absent in all patients with two clinical situations at the initial presentation: well-perfused hand with 'pink and warm' hand in 63 patients and ischemia with 'white and cold' hand in five. Urgent closed reduction of the fracture and stabilization were performed in 63 patients with pink pulseless hand, and immediate surgical exploration in the five patients with ischemia.

RESULTS: 63 patients with vascular injury had posterolateral displacement and 5 had posteromedial displacement. Sixty-three of 68 patients had posterolateral displacement of whom 28 had concomitant median nerve injury and 4 had a deficit to both median and ulnar nerves. The palpable radial pulse was immediately restored in 42 patients and between few hours to eleven days later in eighteen. Three patients with ischemia after unsuccessful reduction required immediate surgical exploration revealing incarceration of the brachial artery at the fracture site. Release and decompression of the brachial artery restored a normal limb perfusion. The five patients with primary ischemia underwent immediate open exploration and vascular repair. One of them had a compartment syndrome and required anterior fasciotomy. The restoration of blood flow with palpable radial pulse was observed in all patients. Full spontaneous nerve recovery was observed in all patients. At an average follow-up of 8.4 years, all patients had normal circulatory status, including a palpable radial pulse.

DISCUSSION: This study highlighted the reliability of non invasive strategy with good outcomes. We recommend urgent closed reduction of fracture. Close observation and monitoring is mandatory if pulseless hand remains warm and well-perfused. If the patients develop blood circulation disturbances or compartment syndrome following closed reduction, immediate vascular exploration is recommend.

KEYWORDS: Ischemia; Pulseless; Supracondylar humeral fracture; Vascular injury

Materials

100 children with supracondylar fracture of humerus with absent distal pulses post reduction, fixation. In Vascular and Endovascular Surgery Department, Tanta University Hospitals. Between December 2016 till February 2022

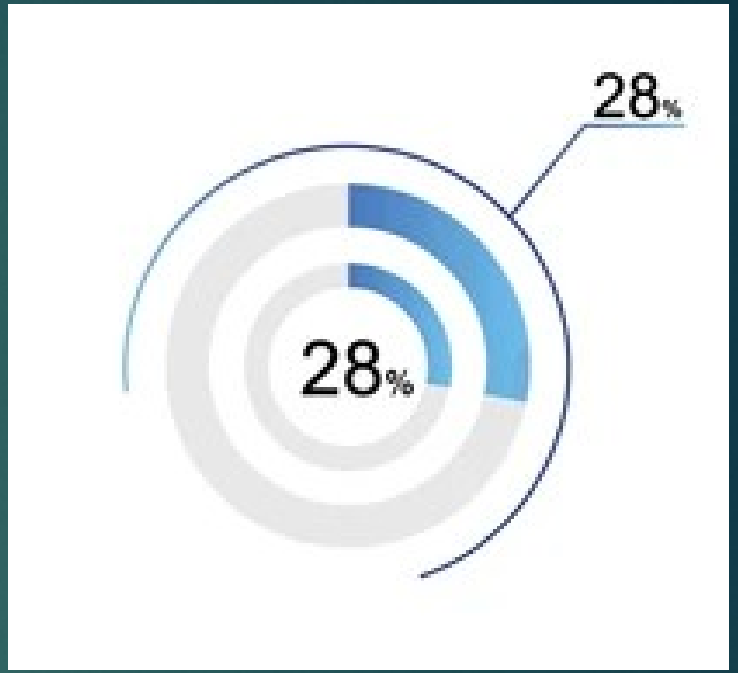
Results

After closed reduction and fixation by K wires

Immediate exploration

11 Cases showed entrapped brachial artery and dis-impaction was done **But 2 Cases were re-explored based on Clinical + CTA**

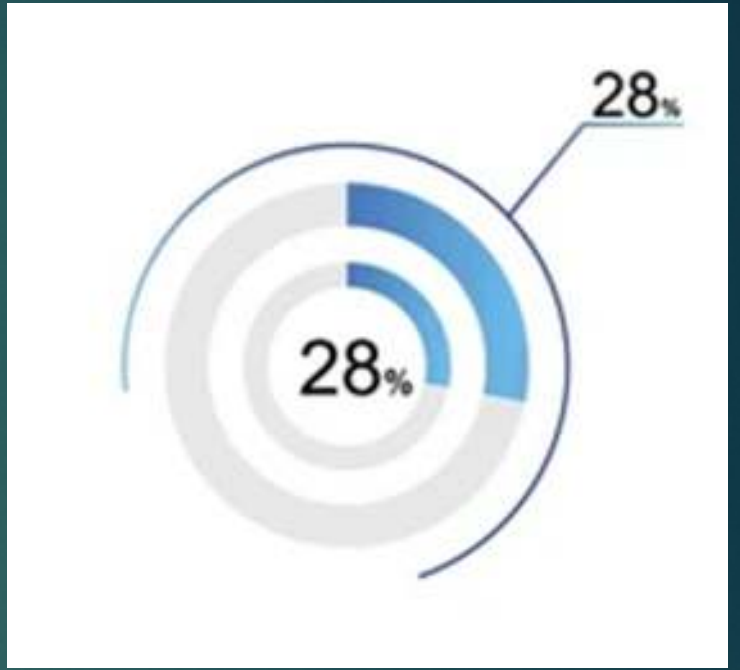
9 Contused brachial artery segment at fracture site to which vein interposition grafting was performed



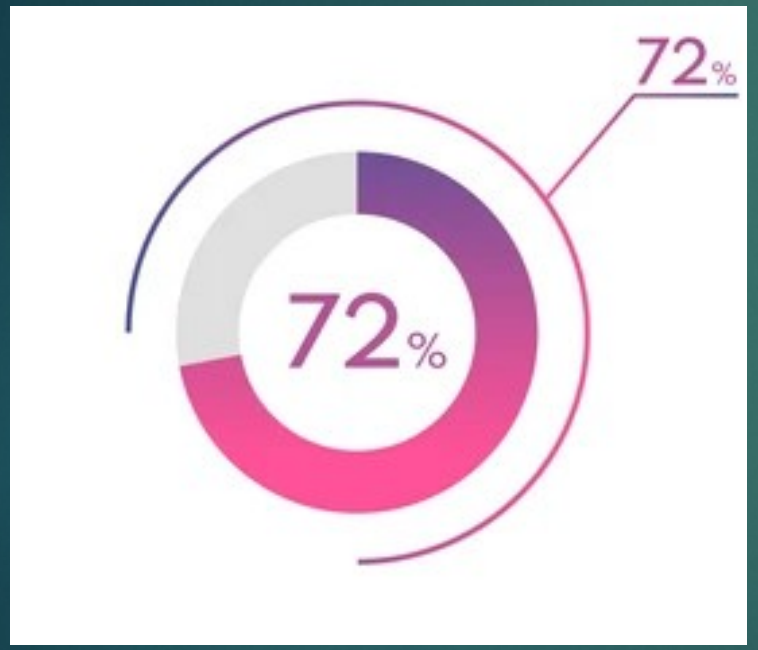
Immediate exploration

5 Cases showed complete brachial artery transection and arterial reconstruction was performed (2 cases primary anastomosis,3 cases vein interposition graft)

3 Partial brachial artery laceration to which patch angioplasty was performed



Close observation was performed for children with pink pulseless hand (72 cases)



17 Cases regained distal pulses within 24 hours and continued for observation

55 Didn’t regain distal pulse and CT angiography was performed next day

CT angiography performed the next day for 55 cases who didn't regain distal pulse

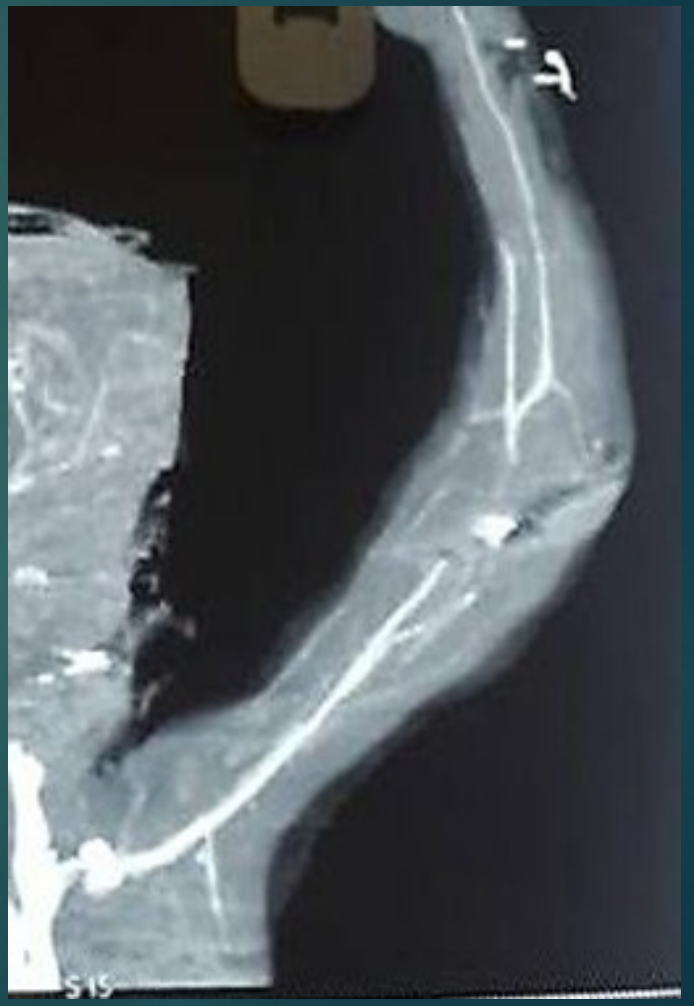
49 Cases revealed brachial artery injury

6 Cases showed normal arterial tree and continued for observation

43 Cases were explored for disimpaction and repair of brachial artery

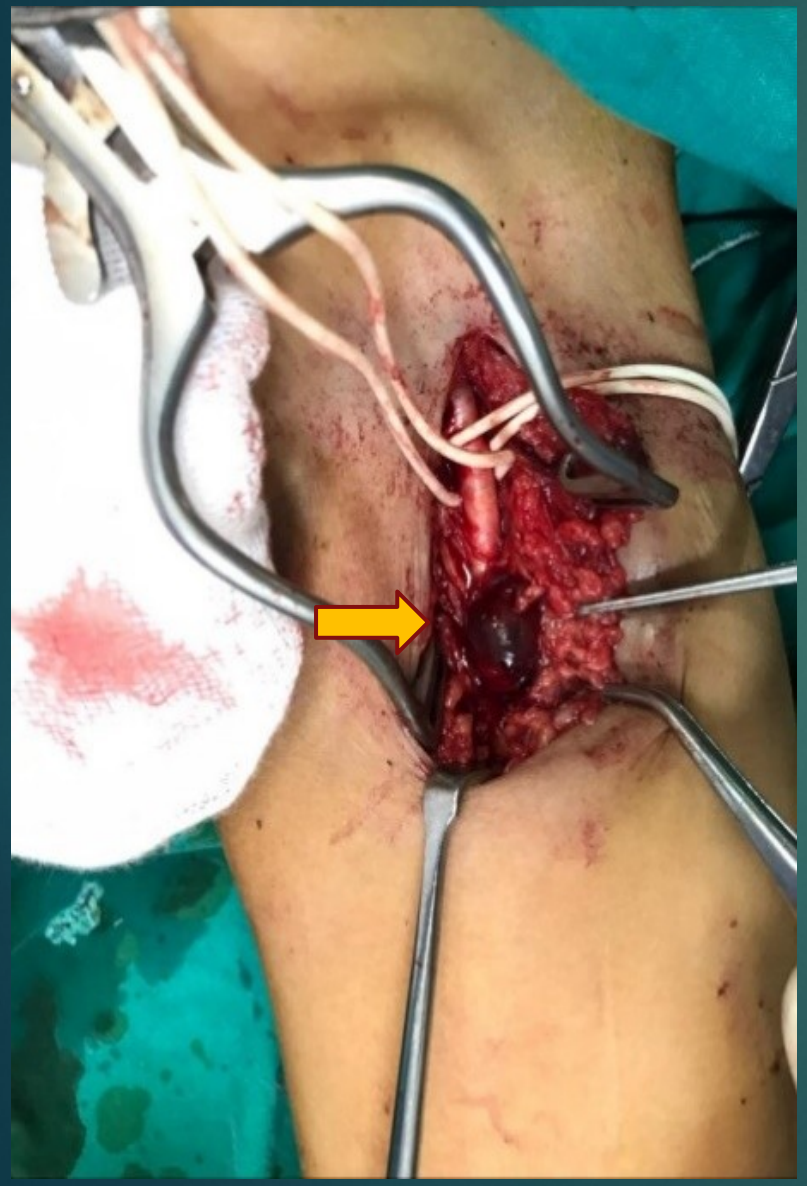
6 Cases whose age was < 2.5 years were closely observed

CT angiography used to diagnose arterial injury

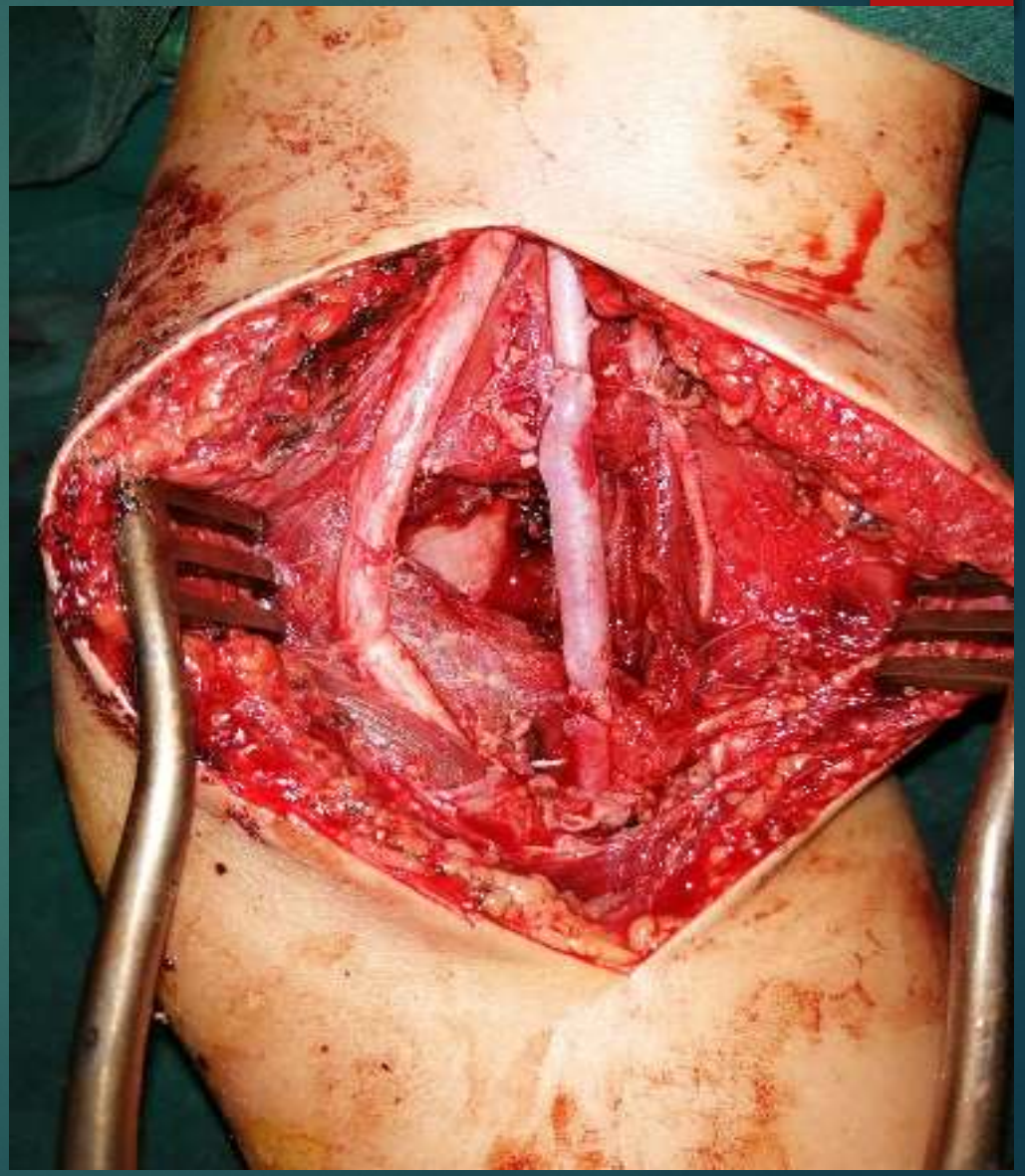



MOHAMED REDA
TANTA UNI EDU

Brachial artery transection



Contused segment of brachial artery



Contused segment of brachial artery, entrapped by K wire

Contused segment of brachial artery

Conclusion

CT angiography was used in 57 Cases:

55 cases of pink perfused pulseless hands and

2 cases of pale pulseless ischemic hands after initial immediate exploration with failure to regain distal pulse and showed excellent diagnostic performance for diagnosis of site and pathology as well as hard documentation for medico legal aspect of arterial injury.

Thank you