

## ORIGINAL RESEARCH

## WAR TRAUMA

# Outcome of patients with upper limb vascular injuries during civil war in Iraq

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## Abstract

**Background & Objective:** Vascular trauma constitutes a major part of the violent body injuries and accounts for one of the high incidence injuries in Iraq. We retrospectively collected the relevant data of vascular injuries and their management in our hospitals over a period of seven years, to stress early intervention to manage vascular injuries.

**Methodology:** In this retrospective, descriptive study, the relevant data of 321 patients with upper limb vascular injuries were collected from the hospital data management system. The data were analyzed according to history, examination, investigations and methods of treatment of arterial and associated injuries.

**Results:** Out of 321 patients, 98.13% were males and 1.87% females. The most frequent injured vessel was the brachial artery seen in 64.48% patients and end to end arterial anastomosis was done in 52.02% of the patients. The limb salvage rate was 98.75%, and was achieved in 317 patients.

**Conclusion:** In conclusion, the limb salvage rate is increased if the vascular injury is treated within the golden period.

**Abbreviations:** ATLS - Advanced Trauma Life Support; OR - Operating room; SSG - Split skin grafting

**Key words:** Amputation; Iraqi civil war; Vascular trauma

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## 1. Introduction

Trauma is a major health problem in Iraq, due to continuous exposure to violence and conflicts for the last two decades.<sup>1</sup> Vascular trauma constitutes a major component of this health problem, the high incidence of vascular injuries (about five times of previous war) is challenging to manage, as it is well known that time factor is crucial for successful outcomes.<sup>1,2</sup>

In this study, we analyzed the results of surgical intervention in upper limbs vascular injuries and identified the risk factors associated with amputation.

## 2. Methodology

It was a retrospective, descriptive study; data were collected from the patient files and hospital database for

a period from January 2013 to December 2019. A total of 321 patients with upper limb vascular injuries were admitted to the vascular surgery department of Ghazi Al-Hariri Surgical Specialties Hospital. The patients' data retrieved included patient's age, sex, residence, type and mechanism of injury, site and type of vessel/s injured, presence of any associated injuries, and types of vascular repairs performed. All patients underwent full physical examination. Initial resuscitation and evaluation was done according to Advanced Trauma Life Support (ATLS) guidelines.

The diagnosis of upper extremity vascular injury and the decision to proceed with surgical intervention were based on clinical presentation and the Doppler study. Patients with confirmed signs of vascular injury were rushed immediately to the operating room (OR). Relatively stable cases were investigated with additional

imaging (Duplex sonography, conventional angiography or CT angiography) to identify the exact location and extent of arterial damage. All confirmed arterial injuries were surgically treated as soon as possible, using standard arterial exposure and repair procedures. The patients with co-existing injuries including fractures, soft tissue damage of an extremity, nerve, and other organs were assessed by medical staff of the relevant specialty, and taken to the OR for surgery afterwards.

All patients with combined orthopedic injuries, and who needed reduction of joint dislocation or bone fracture immobilization by internal or external fixation, were dealt with first, to avoid critical limb ischemia developing. Associated venous injuries were repaired, whenever feasible, either by simple lateral repair or end-to-end anastomosis; vessel ligation was one of the options as well. Primary epineurial suture carried out in selected cases with clean nerve transection and if the patient was hemodynamically stable.

In grossly contaminated wounds with extensive tissue destruction, nerve endings were identified and marked with non-absorbable sutures for delayed repair. Postoperatively, patients were closely monitored for signs of compartment syndrome or revascularization failure. Any of those complications were dealt with fasciotomy; however, no prophylactic fasciotomies were carried out. Embolectomy with or without revision was also done in some patients.

General anesthesia was the main choice for all of the patients. Intravenous antibiotics were given to all patients at the time of induction and continued as prophylactic measure for five days, unless extended use was indicated for infection. Drastic soft tissue and muscle injuries were treated with extensive debridement, removal of foreign bodies and copious irrigation with isotonic saline solution. Tissue defects were managed by the plastic surgery colleagues with split skin grafting (SSG) or flap techniques. The anastomosis site had to be covered with muscles and soft tissue to prevent desiccation and disruption. Successful repair was assessed intraoperatively by palpating the distal pulse at the end of the procedure and intraoperative doppler examination. Outpatient follow up was not possible in all patients. Unless there were contra-indications, all patients received intravenous heparin infusion for a period of 5-7 days postoperatively and were discharged home on oral aspirin 100 mg per day for a period of twelve weeks.

### 3. Results

A vast majority of the patients were males, e.g., 315 (98.13%); and only 6 (1.87%) were females. The age ranged 6-72 y. The predominant injury was due to penetrating trauma (bullets, shells, stabbing injury or

glass injury), and it was found in 288 (89.72%) patients, while blunt trauma caused injury in 33 (10.28%) patients.

There were 264 (82.24%) patients, who presented within the "Golden period" (6-8 h), the rest of the patients reported within 8-12 h from the start of the trauma. There were 212 (66.04 %) patients, who presented with absent distal pulses. Active bleeding was found in 53 (16.51%) patients. Other presentations included expanding hematoma, pseudo aneurysms, traumatic A-V fistula as shown in Table 1.

**Table 1: Type of clinical presentation**

Type of clinical presentation	No. (%)
Negative distal pulse	212 (66.04)
Active bleeding	53 (16.51)
Expanding hematoma	27 (8.41)
pseudoaneurysm	16 (4.98)
Post traumatic AVF	13 (4.05)

The most frequent injured vessel was the brachial artery, seen in 207 patients (64.48%), Others included radial and ulnar arteries, axillary artery, and subclavian artery (Table 2). Associated orthopedic injuries were in the form of a fracture in 44 (13.7%) patients. Arterial repair was the primary decision over orthopedic fixation in all the threatened limbs. About 37 (11.53%) patients with nerve injuries, so the proximal and distal nerve ending were marked with non-absorbable sutures. Concomitant venous injury occurred in 58 (18.07%) patients, of them venorrhaphy and end to end anastomosis was done in 26 (8.1%) patients, while in other patients, ligation was done (Table 2).

**Table 2: Types of injuries**

Type of injuries	N (%)
Brachial artery	207 (64.48)
Radial and ulnar artery injuries	64 (19.94)
Axillary artery	33 (10.28)
Subclavian artery	17 (5.29)
Fractures	44 (13.7)
Nerve injury	37 (11.53)
Venous injury	58 (18.07)

Regarding the surgery, a balloon embolectomy catheter was used routinely for all patients for both removal of clots and relief of spasm. End-to-end anastomosis after the resection of contused segment was the most frequently used single technique of arterial repair in 167 (52.02%) patients. Other techniques used included vein interposition graft (basilic and saphenous veins), and arterial ligation. Synthetic grafts were used for repair in

23 (7.16%), patients. Less common procedures included lateral arteriorrhaphy, venous patch angioplasty and excision of the pseudoaneurysm and repair of the vessels (Table 3).

**Table 3: Type of vascular repair**

Type of vascular repair	No. (%)
End-end arterial anastomosis	167 (52.02)
Vein interposition graft	76 (23.68)
Arterial ligation	27 (8.41)
Synthetic graft	23 (7.16)
Lateral arteriorrhaphy	19 (5.92)
Vein patch angioplasty	9 (2.8)

Regarding postoperative complications, 17 (5.29%) patients required revision procedures such as embolectomy, revision of the graft and anastomosis, and 42 (13.08%) patients developed infection, most of whom had severe upper limb soft tissue injury. The infected wounds were treated with the appropriate antibiotics according to the culture and sensitivity as well as with frequent wound debridement and dressings. Four patients underwent delayed amputation above the elbow due to blast injury and severe soft tissue loss in which saphenous vein interposition graft was used.

The limb salvage rate of 98.75% was achieved in 317 patients. Successful outcome in vascular trauma depends on early diagnosis and referral to specialized center. The average time to arrive at our center was 8 h after the injury

## 4. Discussion

Males were the most affected gender in this study; females represented only 1.87% of the total victims, this result is corresponding to other studies.<sup>3,4,5</sup> Majority of the victims were transferred to our center within the golden time frame (an average of 8 h); therefore, we were able to save the limbs in majority of the patients. The rate was 98.75% at our center; indeed it was an impressive result when compared to other studies. Peck et al. reported a secondary amputation rate of 3% and mortality of 1.5% in vascular repairs during Operation Iraqi Freedom.<sup>6</sup> Velinovic et al. described amputation rates of 20% in vascular injuries during the height of the Balkan conflict.<sup>7</sup> In another series, Sohn et al. alluded to limb salvage rates of 80% and all-cause mortality of 6%.<sup>8</sup>

Our approach to the final diagnosis mainly relied on clinical examination. Radiological investigations were used exclusively in reasonably stable patients to accurately localize the site of arterial injury. This approach was in agreement to studies by Dennis et al. and Gillespie et al. where they established the primacy of clinical examination over radiological arteriography

in diagnosing vascular injury among penetrating or blunt causes.<sup>9,10</sup>

This study demonstrated that the most injured artery was the brachial artery, and it was repaired by end to end arterial anastomosis. This finding is consistent with those of other reports which reported such injury to be 37-66%.<sup>11,12</sup> In concomitant orthopedic injuries, limb ischemia is thought to be reduced by performing vascularization prior to bony fixations. Same goes with other studies.<sup>13</sup>

## 5. Conclusions

In conclusion, the limb salvage rate is increase if the vascular injury is treated within the golden period, so the diagnosis and referral of those patients from remote areas to specialized center should be as early as possible to deal with such injuries especially in high violence countries like Iraq.

## 6. Data availability

The numerical data generated during this research is available with the authors.

## 7. Conflict of interest

Authors declare no conflict of interest.

## 8. Authors' contributions

AMH: Concept, conduction of the study work, manuscript writing

AMG: Conduction of the study work, manuscript editing

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