

Vascular trauma and its management: one and a half years after the 25th January revolution

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Background/Aim

Vascular trauma is a common life-threatening injury leading to serious consequences if not timely and efficiently managed. Although they represent less than 3% of all injuries, they deserve special attention because of their severe complications. The aim of this study was to analyze the causes of injury, presentations, surgical (recent) approaches, outcomes, and complications of vascular trauma.

Patients and methods

This was a retrospective analysis performed over 1.5 years. From January 2011 to June 2012, 48 patients were included in the study and were operated upon for peripheral vascular injuries. Diagnosis was made by physical examination as well as with hand Doppler alone or in combination with Doppler scan/angiography. Primary vascular repair was carried out whenever possible; however, if it was not possible, an interposition vein graft was placed. In some patients, endovascular approaches were applied, whereas in other patients a combination of open surgical and endovascular approaches was used (hybrid technique).

Results

Of the total 48 patients who sustained major vascular injuries during this period, 17 sustained injuries to the upper limb vessels, 26 had injuries of the lower limb vessels, two patients had injuries of the abdominal vessels, and three patients had injuries of the neck. A penetrating trauma was the cause in 45 cases and a blunt trauma was the cause in three cases. Of the 48 patients, 46 patients were successfully managed by vascular reconstruction without any residual disability. There were 46 male patients (95.83%) and two female patients (4.16%), and their ages ranged from 17–40 years (mean 28.5 years).

Conclusion

Patients who suffer vascular injuries should be transferred to vascular surgery centers as soon as possible. Decisive management of peripheral vascular trauma will maximize patient survival and limb salvage. Priorities must be established in the management of associated injuries, and delay must be avoided when ischemic changes are present.

Keywords:

Egypt, 25th January revolution, management, vascular trauma

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Introduction

Trauma has become a public health problem in many parts of the world, with vascular trauma being an important component. A great majority of these injuries are due to penetrating traumas, such as stab and gunshot wounds and road traffic accidents [1]. If not recognized and treated rapidly, injuries to major arteries, veins, and nerves may have disastrous consequences resulting in loss of life or the limb. Vascular injuries can be classified as: contusions, intimal disruptions, punctures, lateral disruptions, transactions, arteriovenous fistulae (A-V fistulae), and pseudoaneurysms [2]. During the first and second world wars, important knowledge had been gained both in diagnosis and treatment of vascular injuries; however, vascular reconstructive methods were mainly introduced during the Korean and Vietnamese wars with tremendous

progress [3]. Consequently, a dramatic decrease in the amputation rate was achieved. Although successful treatment of major arterial injuries may be life-saving and may allow limb salvage and restoration of function, [4] return of function is often related to the presence of concomitant injury to peripheral nerves [5]. The lower extremities are involved in two-thirds of all patients with vascular injuries [6]. Trauma patients with penetrating firearm injuries may have multiple injuries, complicating routine approaches to vascular repair; therefore, endovascular intervention offers a new and less invasive technique for the treatment of acute traumatic vascular injuries [7]. Although the management of acute arterial injuries has been established, there is little interest in repairing acute venous injuries, and an effort to repair major venous injuries should be made [8]. In broad terms, a vascular injury takes priority because of the ongoing

limb ischemia or hemorrhage. However, when there is an unstable fracture, for example, an open book fracture of the pelvis, it should be stabilized first. A dislocated joint should also be reduced first before arterial injuries are assessed and managed. However, with all other stable orthopedic fractures without gross deformities, the vascular injury should be repaired first to minimize ischemic time. When limb viability is threatened and orthopedic stabilization is imperative, the use of temporary plastic or silastic shunts may be employed to re-establish perfusion to the distal extremity [9].

The present study aims to analyze the causes of injury, presentations, surgical (recent) approaches, outcomes, and complications of vascular trauma.

Patients and methods

The study was carried out at Al-Hussein University hospital between January 2011 and June 2012. All patients with vascular trauma were included. The protocol was revised for management of these patients. Initial resuscitation including management of shock, securing hemostasis by application of a tourniquet for few minutes or by application of vascular bulldog clamps, and management of other life-threatening injuries was performed simultaneously.

A detailed history was taken, and all patients were examined to exclude any associated injuries. The patients were subjected to ultrasound examinations, Doppler studies, and radiographs. All patients were monitored during the postoperative period for impending ischemia, hemorrhage, sepsis, and other possible complications. All patients were followed up for 30 days after discharge from the hospital.

Results

The patients in the present study consisted of 46 males (95.83%) and two females (4.16%), with a mean age of 28.5 years (range 17–40 years). The mechanisms of injuries sustained by them are shown in Table 1.

Fourteen patients (29.16%) presented with ischemia, 25 patients had bleeding (52.08%), five had delayed presentations of vascular injuries with pseudoaneurysms (10.41%), and four patients had post-traumatic A-V fistulae (8.33%). The distribution of the injured vessels in these patients is shown in Table 2.

Concomitant vein injury occurred in 16 patients (33.33%). Orthopedic injuries were in the form of a fracture in 10 patients (20.83%), fracture/dislocation in three patients (6.25%), and dislocation alone in two patients (4.16%) (Figs 1 and 2). Arterial repair was preferred over orthopedic fixation in all the threatened limbs. Shunt placement allowed perfusion of the injured extremity; the Argyle shunt, Javid shunt, and Sundt shunt were all acceptable. The shunt was placed first at the proximal end and then at the distal end. The shunt was secured in position with 0 silk ties. Shunts were used in

Table 1 Mechanism of injury in the patients under investigation

Mechanism of injury	Number of patients
Penetrating	
Gunshot	27
Stab	15
RTA	3
Blunt	
RTA	1
Fall	1
Iatrogenic	1

RTA, road traffic accident.

Table 2 The distribution of injured vessels

Localization	Artery	Vein
Neck		
Carotid a	5	–
Vertebral a	1	–
IJV	–	1
Upper limb		
Subclavian	2	–
Axillary	2	–
Brachial	8	6
Radial	2	2
Ulnar	1	1
Abdomen lower limb		
Aorta	3	–
IVC	–	1
CIA	1	–
EIA	3	1
Femoral	10	2
Popliteal	3	2
AT	1	1
PT	1	1

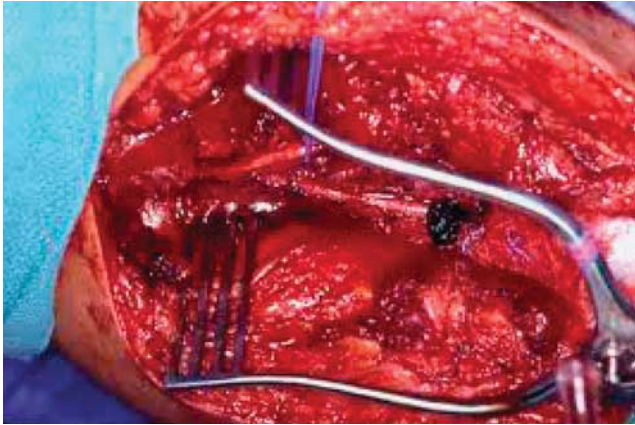
a, artery; AT, anterior tibial; CIA, common iliac artery; EIV, external iliac artery; IJV, internal jugular vein; IVC, inferior vena cava; PT, posterior tibial.

Figure 1



A controlled section of the vessel wall in a lesion with a circumferential extent of 33%.

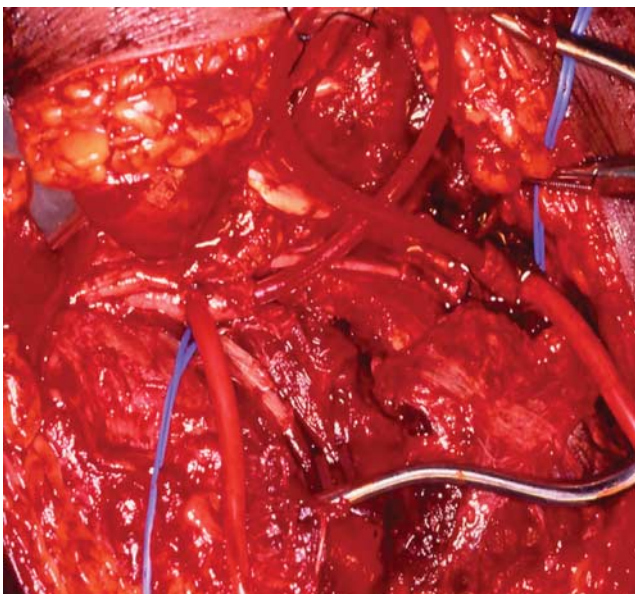
three patients (6.25%) with fracture dislocations and in two patients (4.16%) with unstable fractures for whom orthopedic reduction and fixation was the priority before vascular reconstruction and limb viability was threatened due to ischemia. A balloon embolectomy catheter was used routinely for all patients who underwent an open surgical approach, not only to clean the vessel but also to relieve the spasm (Figs 3 and 4). Although synthetic grafts were not used for any arterial repair, an interposition vein graft was used in 14 patients (29.16%).

Figure 2

A brachial injury with a thrombosed segment.

Figure 3

Intraoperative with iliac injury.

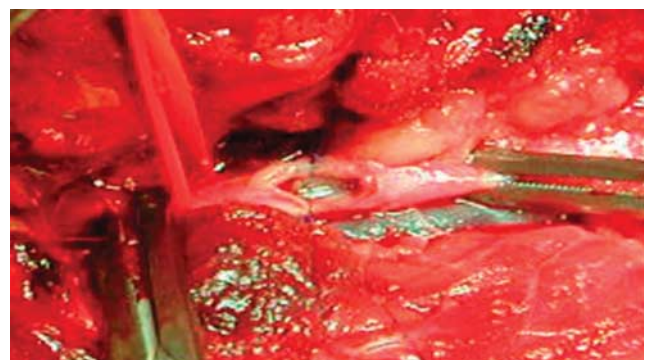
Figure 4

An intraoperative vascular shunt.

End-to-end anastomosis after the resection of contused segment was the most frequently used single technique of arterial repair in 18 patients (37.5%). Other techniques used included vein patch angioplasty in two patients (4.16%) and lateral arteriorrhaphy in five patients (10.41%). Among the five patients with pseudoaneurysms, three underwent excision of the pseudoaneurysm and repair of the vessel, one patient underwent a subclavian artery pseudoaneurysm stent graft insertion, and one patient with a small localized neck underwent ultrasound-guided compression using a 7.5 MHz linear array color probe. The patients received analgesia and sedation before the procedure. The site of the arterial jet and the neck of the aneurysm were localized and gradually compressed with the scanner probe obliterating the flow in the aneurysm sac, without compressing parent artery patency. Compression was performed for 10 min. The patient was then rescanned within 2 weeks to confirm a cessation of flow. A-V fistulas were repaired in two patients using open surgical techniques (one A-V fistula was between superficial femoral artery and superficial femoral vein and another was between the common carotid artery and IJV). One patient had an aortocaval A-V fistula that was treated successfully using a covered stent graft. One patient had an A-V fistula between the subclavian artery and vein that was treated using a hybrid technique in which a proximal endovascular occlusion balloon was applied for proximal arterial control (to avoid sternotomy), followed by an open surgical repair.

Three patients (6.25%) required revision procedures such as embolectomies, revision of the anastomosis, and revision of the graft (Fig. 5).

Fifteen patients (38.46%) developed infection, most of whom had sustained lower limb traumas. The infected wounds were treated with the appropriate antibiotics according to the culture and sensitivity as well as with frequent wound dressings. However, despite this, a secondary hemorrhage resulted in five patients (12.82%). Eight patients (16.66%) underwent delayed amputations, seven of which were above the knee and one was above the elbow. A limb salvage rate of 83.33% was therefore achieved in 40 patients (Figs 6 and 7).

Figure 5

Direct arterial repair.

Discussion

Injuries to peripheral vessels have a potential to cause morbidity and mortality if they are not recognized and treated promptly. Strict criteria need to be followed to make the diagnosis and hence help avoid the incidence of complications of limb amputation, contractures, and even death. The use of the classical six P's of ischemia and the 'Hard and Soft' signs [10] in the assessment of injuries to limbs will help to identify these injuries promptly to avoid complications. The high incidence of patients with vascular injuries who presented late with A-V fistulae,

false aneurysms, and gangrene shows that there was failure of adherence to these protocols at diagnosis of these injuries by the first attending doctors. Most of the injuries seen were penetrating in nature and should therefore not have posed any diagnostic problems. The time lapse between injury and treatment is of critical importance for the outcome. In our study, we found that 6 h was the critical limit that determined the outcome. Patients reporting within 6 h of injury had better overall results as compared with those presenting after 6 h [11].

The complication rate in emergency revascularization has been reported in different studies to be between 10 and 18%. In our study, 10% of the patients developed various complications, which is compatible with international standards [12,13].

Prompt vascular repair and attention to associated injuries result in minimum morbidity and zero mortality. In our study, we dealt with vascular injuries and associated problems in one session, and these patients did very well at the follow-up.

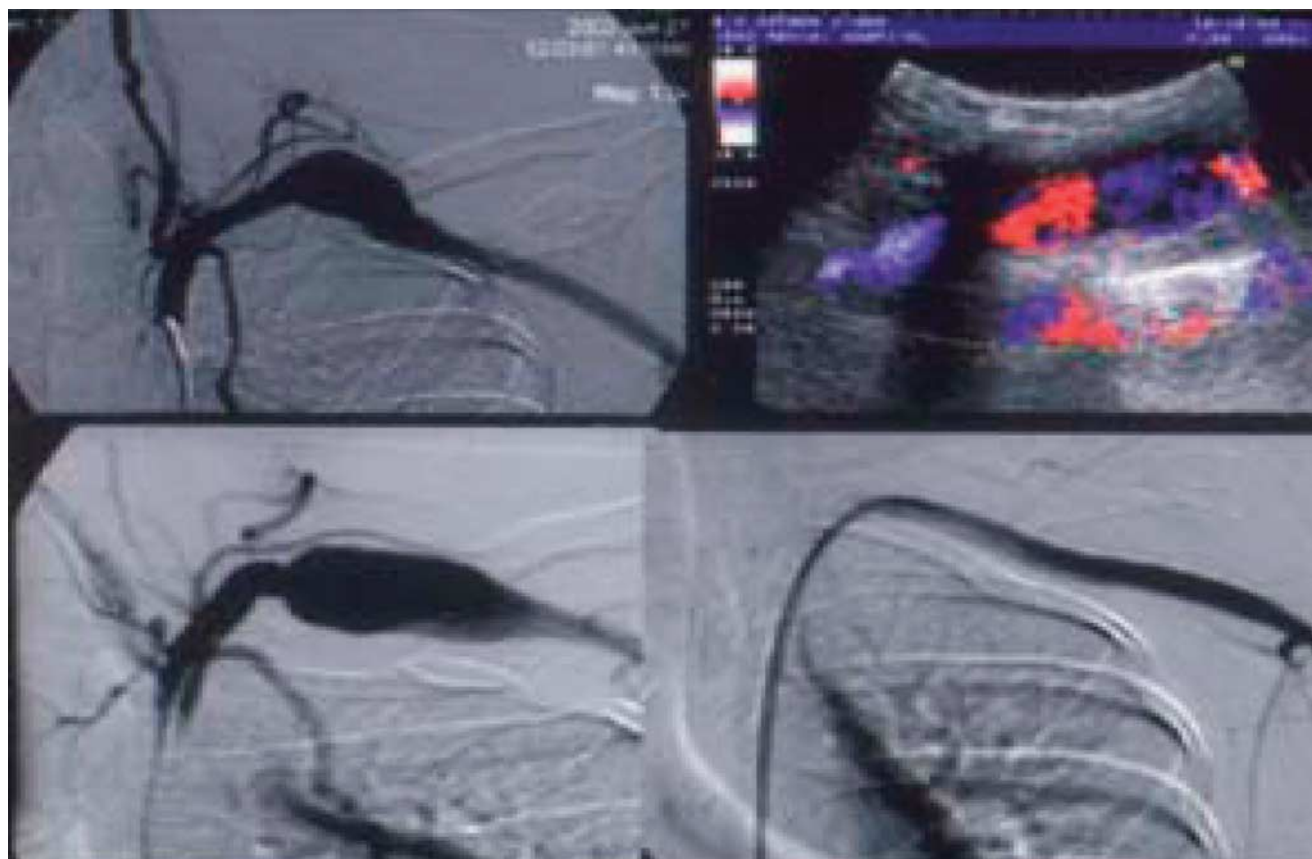
Vascular reconstruction is carried out by different means and in different ways depending upon the nature and extent of vascular injury, size and caliber of the injured vessel, its area of supply, nature of the concurrent trauma, general condition of the patient, and the available resources, including expert vascular services. In modern-

Figure 6



An interposition vein graft.

Figure 7



Stent graft treatment of a subclavian artery pseudoaneurysm.

day surgeries, 95% of limbs can successfully be salvaged by early surgical intervention and revascularization [14]; in our study, the salvage percentage was 83.33%.

Conclusion

Investigations in stable patients and operative exploration in unstable or bleeding patients remain the accepted standards of care. The management plan and priorities in treatment for the patient must be decided and agreed upon in the presence of all the various teams involved. Every effort should be made to achieve revascularization within 6 h. Open surgical techniques, endovascular intervention, or combined techniques can be used. Endovascular management of vascular injuries is expanding in use, whether alone or in combination with open surgery (hybrid technique). An endovascular approach to the treatment of vascular injuries has the advantages of being minimally invasive and being able to treat vessels that are difficult to access through conventional surgery. Patients presenting with late or crush injuries are usually treated by amputation.

Acknowledgements

Conflicts of interest

There are no conflicts of interest.

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