Management of Combat Related Vascular Injuries in a Zonal Hospital

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Abstract

Background : The extremity gunshot wound (GSW) and penetrating splinter injuries from mine blast present a surgical challenge in the treatment of arterial trauma especially at non-vascular surgery centre. Adherence to specific principles of management is required for optimal limb salvage.

Methods : Fourteen vascular injuries in patients of GSW and mine explosions were managed at a zonal military hospital with successful outcome in two years. The diagnosis of arterial injury was done clinically.

Results : The commonest site of vascular injury was femoral. The methods of choice for repair were autogenous vein interposition or end-to-end anastomosis. All except for two patients retained a functional limb.

Conclusion : All surgeons in peripheral hospitals should be trained in vascular injury repair to save life and limb. Our series shows that right timing and prompt treatment of vascular injuries in a peripheral hospital, can give satisfactory results.

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Key Words: Gunshot wounds; Mine blast injuries; Vascular trauma; Autogenous vein interposition; Fasciotomy

Introduction

Vascular injuries associated with open fractures occur in about 1% of the cases. Vascular lesions clinically diagnosed on hard signs of arterial trauma (pulselessness, pallor, paraesthesia, paralysis and pain) certainly indicate injury. The soft signs (a wound adjacent to a great vessel) only suggest vascular trauma. Doppler study allows differentiation of an ischemic extremity from a member still perfused by collaterals. Preoperative arteriography is indicated in patients presenting with soft signs of arterial injury. Fracture stabilisation is generally carried out before vascular repair [1]. However, in some cases fracture stabilisation may follow the vascular repair [2]. Arteries are repaired in healthy segments and in most cases, a venous interposition graft is placed. We present our experience of managing 14 cases of combat related vascular injuries managed at non-vascular centre in a peripheral hospital.

Material and Methods

Fourteen patients with combat related injuries of major limb arteries were managed at a zonal hospital. Patients were admitted within an hour to 6 hours, after injury and most of them were in severe hemorrhagic shock. The average distance from place of injury to the hospital was 30 km and patients were evacuated by ambulance. Preoperative angiography or doppler assessment was not done as most of the patients

were in critical condition and the diagnosis of acute vascular ischaemia was obvious. The vessels with complete transection and absence of distal pulsations were included in the study. Fogarty balloon catheter was used in all cases for distal arterial tree thrombectomy. The suture material used for vascular anastomosis was prolene 6/0 and CV-5. No synthetic graft was used in our study. Total limb ischaemia time varied from three to six hours. Local spasm of the vessel was controlled by topical installation of 2% lidocaine. Systemic heparinization was used on case to case basis and not in cases of multiple injuries. Extensive fasciotomy was done in six cases at the time of initial intervention due to prolonged arterial inflow occlusion. Thorough wound excision was done in all cases. The soft tissue cover was provided to vascular anastomosis and appropriate procedures for skeletal fractures and other injuries were carried out (Table 1). Broad spectrum antibiotics were used for perioperative coverage.

Results

Most of the patients were in their second or third decade of life (Table 2). The mechanism of injury was gun shot wounds (71%), mine fragments (22%), and penetrating injury (7%) due to fall after mine explosion. Most of the patients sustained injuries to vessels of lower limb (Table 3). In two cases there were multiple vessel injuries. Mobilization with resection of damaged segment and end to end anastomosis of the vessel was carried out in 38% of cases (Fig.1). In 31% cases, the length of the vessel was inadequate and interposition of reverse saphenous vein grafting (from other

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Table 1**Associated injuries**

Associated injury	Number of cases	Procedures
Bladder injury	1	Primary repair
Brachial plexus injury	2	Cable grafting
Fracture femur	3	Skeletal traction - 2 IM nailing - 1
Fracture clavicle	1	-
Fracture humerus	1	External fixation
Fracture pelvis	1	-

Table 2**Age distribution**

Age (in years)	Number of cases
11-20	4
21-30	5
31-40	3
41-50	2

Table 3**Site of vessel damage**

Vessel	Number of cases*
Subclavian vein	1
Axillary artery	1
Brachial artery	2
Ulnar artery	1
Radial artery	1
Inferior vena cava	1
External iliac vein	1
Femoral artery	4
Femoral vein	2
Popliteal vein	2

*The occurrence of multiple vessel injuries in 2 patients accounts for the percentage distribution of > 100%

Table 4**Operative procedure**

Operative procedure	Number of cases
Primary end to end anastomosis	Venous - 4 Arterial - 2
Reverse saphenous vein interposition	5
Vein patch graft	1
Ligation of vessel	4

healthy limb) was done (Table 4). Delayed primary closure was carried out in five cases due to extensively contaminated and devitalized wounds. Four cases of venous repair (two each of femoral and popliteal veins) were done and rest underwent venous ligation. The follow up could not be completed because these serving soldiers were either transferred to specialized centers for orthopaedic management or sent on sick leave with advice to report to vascular surgical centers after leave. However, follow up of a case with interposition venous graft for axillary artery injury revealed that graft was thrombosed and fibrosed on re-exploration.

Fig. 1 : Operative photograph showing end to end anastomosis of the divided femoral artery in progress

70% of that limb was functional and residual deformity was because of associated brachial plexus injury. One case with GSW abdomen and inferior vena cava injury died following exploratory laparotomy.

Discussion

The gunshot wounds and mine blast injuries present a surgical challenge in the management of peripheral arterial trauma. They produce large defects of soft tissues with high level of wound contamination, which interferes with reconstructive procedures and increases the risk of infection. When limb ischaemia is present, vascular reconstruction has priority over orthopaedic immobilisation. Reconstruction is necessary in cases of injury of proximal major limb arteries, but not of superficial femoral or brachial arteries [2]. Ligation of injured single forearm or crural arteries is well tolerated. In our series one forearm artery (ulnar) and three veins (subclavian vein, inferior vena cava and external iliac) were ligated. The types of arterial repair are autogenous vein interposition or bypass grafting,

polytetrafluoroethylene (PTFE), end-to-end anastomosis and ligation [3]. We performed six end to end anastomosis with five reverse saphenous vein interposition and one vein patch angioplasty. Amputation is usually not required, however the delay of operative intervention with subsequent infection, prolonged ischaemia, severity of injury, failure to reconstruct all injured vessels, inadequate initial fasciotomy and associated venous, soft tissue, and skeletal injury are factors that contribute to amputation in few patients [4,5]. Mine explosions were commonest causative agent for vascular injuries in a study from Afghanistan war [6]. In our study, the gunshot injuries were commonest cause because majority of blast injury patients underwent amputation due to factors mentioned above. When the period from injury to revascularization is more than six hours, the prophylactic fasciotomy is recommended [7].

Sheriff et al [6], found that all subclavian and axillary artery injury patients in Afghanistan war, had concomitant brachial plexus injury. In two of our case of GSW of axilla and shoulder with disruption of axillary artery, brachial plexus injury was present. In Lebanese war, the bullets were the commonest wounding agents (60% cases) and patients with fractures had an 11% amputation rate as compared to 1% for those without fractures [8]. In Vietnam vascular registry review, 78 abdominal vena caval injuries were associated with mortality in 18 (23%), where 56 underwent repair of the injury and 15 had ligation of the inferior vena cava [9].

In a study from Yugoslavia the authors found that the infection was significantly ($p < 0.05$) more common in the war vascular injuries and in secondary repairs of the vascular trauma [10]. In our study, there was no incidence of significant infection/wound disruption. A 15year Georgian experience revealed that the limb salvage rate was 77.7% (84.1% among surviving patients) after primary vascular repair in war injuries [11]. Thus, the successful management of arterial injuries in extremity shotgun and mine splinter wounds requires attention to an early evacuation, prompt operative intervention, fracture stabilization, repair of all injured major vessels, use of autogenous graft tissue, venous reconstruction, thorough wound excision, and fasciotomy.

The preoperative angiography is not mandatory in such acute injuries.

In conclusion, all surgeons in peripheral hospitals should be trained in vascular injury repair to save the life and functional limb of patients. The revascularization of arterial and venous injuries of the extremities with end to end anastomosis or interposition vein grafts is successful in most cases resulting in low amputation rates, and should be attempted in all major vascular injuries in viable limbs.

Conflicts of Interest

None identified

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