Tabriz Experience in the Management of Extremity Vascular Trauma

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Abstract

Background: Epidemiologic studies on civilian vascular trauma in developing countries are rather few. Although Iran encounters vascular injury far more frequently than developed countries, the predominance of blunt trauma with associated complex injuries continues to pose problems for clinicians. The present paper retrospectively reviews a tertiary referral center experience of extremity vascular trauma.

Methods: All individuals who presented to the Imam Khomeini Hospital, Tabriz/Iran, with a vascular injury between March 1998 and February 2000 were retrospectively identified from a trauma database. The aim was to study the etiology, signs and symptoms, pattern of injuries, the implemented treatment strategies, and the mortality and morbidity rates due to vascular trauma in our population.

Results: During the study period, 124 patients (5 female) with a mean age of 23 years (7-65 years) sustained vascular injuries. The most common injury was arterial and isolated venous injuries were seen in only 15 cases. Penetrating injuries were the causes in 63% of patients, blunt trauma in 21%, and both in 16% of the rest. The commonest injured artery and vein were the femoral artery and the popliteal vein, respectively. All of the patients underwent surgical repair in 1-48 hours (mean 9.5 hours) after trauma, with the most common procedure being the end-to-end anastomosis. Three underwent primary amputation and 3 required secondary amputation, mostly due to infection. The mortality rate was 3.2% (4 cases) with a median hospital stay of 13 days.

Conclusion: Most vascular injuries due to limb trauma can be managed successfully unless associated with severe damage to bones, nerves or soft tissues. The injury patterns emerging from the present study will hopefully help all medical personnel to recognize the potential for vascular injury in a trauma setting.


Keywords: Extremity Vascular Trauma ● Blunt Trauma ● Penetrating Trauma ● Amputation

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**Introduction**

The incidence of vascular injuries in the civilian population has increased steadily over the past three decades due to an increase in automobile accidents and criminal violence. Complex trauma to the extremities can be fatal unless a prompt diagnosis is made and appropriate surgical management applied. Delay allows irreversible ischemic injury to take place resulting in impairment of limb function or limb loss. Therefore, time from vascular injury to hospital treatment is a key factor in eventual outcome. The present paper reviews our experience as a tertiary referral center in Tabriz/Iran with civilian vascular trauma over a two year period. The aim was to study the etiology, signs and symptoms, pattern of injuries, the implemented treatment strategies, and the mortality and morbidity rates due to vascular trauma with primary focus on extremity vascular trauma as they form the main bulk of the patient population.

**Methods**

The case records of all patients with vascular injuries treated between March 1998 and February 2000 in our institute were retrieved from the medical records and the data were collected retrospectively. Patients who presented with late complications of vascular injuries (pseudoaneurysms and arteriovenous fistulas) were also included. Patients who underwent primary amputation due to non-salvageable injuries were not included. Patients who had injuries of small caliber vessels like distal radial and ulnar arteries, and distal anterior/posterior tibial and peroneal arteries were also excluded as these repairs were carried out by plastic surgeons. All trauma patients were initially resuscitated by emergency trauma teams. Those with vascular injuries were evaluated by vascular, orthopedic and plastic surgeons to assess the salvageability of the involved limb as well as the extent of bone, soft tissue and nerve injury. Vascular injuries were never a limiting factor for condemning a limb to primary amputation and the intent was always to err in favor of limb salvage to give the patient a benefit of doubt. The diagnosis of a vascular injury was mainly based on clinical findings. No arteriographic studies and only a few duplex ultrasound examinations were done. Duplex ultrasonography was only used to identify patients with proximity vascular injuries. Standard incisions were used to expose the arteries. Methods used to repair the injured arterial segments included lateral arteriorrhaphy, resection and end-to-end anastomosis, autogenous vein graft interposition, and ligation as was felt appropriate. Veins were repaired if it could be done by lateral venorrhaphy or resection and end-to-end anastomosis, but graft interposition was not used. Fracture fixation preceded arterial repair in all cases, however, temporary shunts were used to decrease warm ischemia time in patients who had critically ischemic limbs. Nerve injuries were repaired as was appropriate and soft tissue cover was provided whenever necessary by rotation or pedicle flaps after thorough debridement of the wound. Systemic heparinization was used during repair of isolated vascular injuries while flushing with heparinised saline (10 U/mL) was used if associated injuries precluded systemic use. Fasciotomies were used liberally especially with delayed presentation, extremity swelling and/or combined arteriovenous injuries. Associated organ injuries were managed as indicated by relevant surgical teams. Antibiotics, mainly cefazoline, were used in all patients between 2-14 days, depending on the extent of associated injuries.

**Results**

During the study period from March 1998 and February 2000, 119 men and 5 women with a mean age of 23 years (range 7-65 years) were treated surgically for vascular trauma. The mechanism of vascular injuries is listed in Table 1. Blunt injuries resulting from motor vehicle accidents, falls, industrial or farm accidents and assault with blunt weapons accounted for 20.9% (n = 26) of the injuries while penetrating trauma due to knife, bullet or glass accounted for the remaining 79.1% (n = 98). In 2 patients in the later group the cause of trauma was iatrogenic. The most common injured arteries in penetrating traumas were the brachial in the upper and the femoral in the lower extremities. Arterial injuries occurred in 79% (n = 98) and isolated venous injuries in 9.7% (n = 12), while
combined arteriovenous injuries occurred in 11.3% (n= 14) of the patients. The upper extremity was injured in 70.1% (n= 87), while the lower extremity accounted for 29.9% (n= 37). Injuries of the vessels of the extremities represented 88% (n= 124) of the total injuries. The abdominal aorta was injured in two patients and the carotids in four, which were excluded from the study. Table 2 shows the patterns of vessel injuries in our patients. Vessel transection (complete or incomplete) made up 85.4% (n= 106) of the injuries, while 14.6% (n= 30) of rest had pseudo-aneurysms, AV fistula, hematoma, distal emboli, and contusion/thrombosis of the arteries. Soft tissue injury was the most common associated injuries. Ninety three percent (n= 115) of the blunt trauma patients had one or more associated injuries, while 70% (n= 86) of the patients with penetrating trauma had no other associated injuries. Patients presented to the emergency department from 1 to 48 hours after the injury. The median delay however was 4.5 hours. The physical examination upon arrival to the emergency department showed absent or reduced distal pulses in 61% and active hemorrhage at the site of injury in 42% of patients (Table 3). In 17 patients the repair was done in the first 6-8 hours after injury, all with successful outcomes. Among 70 patients that arrived after 8 hours, amputation was undertaken in 6 cases. Secondary infection seemed to be the cause of amputations in about 50% of cases. Four patients died in the postoperative period accounting for a mortality rate of 3.2%. All patients who underwent amputation and the 3 who died had concomitant arterial, venous and bony injuries signifying severe trauma. Overall, 92% of the patients had successful surgical outcomes. Surgical procedures undertaken in these patients are listed in Table 4. The injuries were mostly repaired by end-to-end anastomosis (35.4%). Autogenous vein grafts was used for repair in 31.4% of the cases, either as a conduit for bypass or venous patch repair. The great saphenous vein of the contralateral extremity was the most commonly used source for autogenous vein. Concomitant vein repairs were done in 10 patients and transected veins were ligated in three. Isolated venous injuries were repaired in six patients. Cover for reconstructed vessels were provided with muscle flaps in 16 patients. Fasciotomy was performed intraoperatively in 10% (n= 8) of patients (7 lower extremities and 3 upper extremities). In the postoperative period, 3 more patients required fasciotomy to relieve high compartment pressures. Primary ligation was the only practical option in 11.2% cases (n= 14). Surgical debridement was done in 70% (n= 87) of the cases, either before or after vessel repair. The length of in-hospital stay ranged from 2-39 days with a median of 13 days.

**Discussion**

Vascular injuries of the extremities remain the most important cause of limb amputation, if not treated early and competently. According to Andrikopoulos and colleagues 5, the amputation rate can be as high as 78%. On the other hand, Razmadze and colleagues 6 reported a limb salvage rate of 77.7%. In our series, a limb salvage rate of 92% was achieved. The mainstay of diagnosis in our patients was critical clinical assessment, keeping in mind both the hard and soft signs of vascular trauma and the elapsed time from injury. Significant experience and advances in the treatment of vascular injuries have been made by our vascular surgeons in Iran-Iraq wartime. There has been even more improvement in outcome following vascular injury in recent years, because of better understanding of the pathophysiology of reperfusion injury 7 and the development of injury severity scoring systems 8. State-of-the-art technology and expert radiologists are usually not available in developing countries, where the majority of the world’s armed conflicts are taking place. Surgical management in these areas, like ours, is usually dependent on clinical examination and perioperative anatomical diagnosis. Vascular injury has the highest resuscitative priority after the airway and breathing has been protected 9. The classical signs of limb ischemia (i.e. pain, pallor, lack of a pulse, paraesthesia, and paralysis) are not always evident. Up to 40% of our patients with significant vascular injuries of the extremities did not have diminished or absent pulses. Other studies have shown similar results 10. In a recent study of 489 injured extremities, the sensitivity and specificity of physical examination compared to arteriography was 92% and 95%, respectively 11. Routine use of arteriography is declining 12. None of the patients in this study had an arteriogram. The majority of
Injuries were arterial, with one-fifth having a venous component either exclusively or with an arterial component. This reflects the penetrating rather than the blunt nature of the vascular injury. Vascular trauma from civilian gunshot or stab injuries is usually associated with few, if any, concomitant injuries and this leads to expedient management and successful outcomes. Patients with blunt trauma typically have severe associated injuries involving bone, soft tissues, nerves and viscera. This accounts for a higher mortality and morbidity of these patients, as could be seen in our patients too. The delay between injury and restoration of perfusion to the injured limb is an important factor in determining outcome. While trauma centers in the West have highly efficient rescue and transfer programs with some urban centers reporting a transfer time of approximately 1 h, our patients presented with a median delay of 9.5 h. However, the results of our approach are comparable to those reported from other recent series. While a part of this may be explained from a protocol of aggressive management of associated injuries, improved antibiotic therapy, liberal use of fasciotomies, repair of venous injuries and the use of temporary intravascular shunts, the main factor has been the proper selection of cases and possibly the long term experience of our center in dealing with vascular trauma patients. Due to the delay in presentation, patients in whom collateral circulation is poor or damaged by crush injuries develop gangrenous changes by the time they arrive to the emergency department. Any limb which has absent distal pulses but no ischemic signs after 6-8 h of injury are eminently salvageable as adequate collateral circulation is available to keep the distal tissues alive, thus guaranteeing a good functional outcome. There is no specific time limit to salvageability and we have salvaged limbs even 24 h after injury with complete transection or contusion of the proximal arteries. It must be realized that functional outcome of the reconstructive procedure is as important as the salvage of the limb itself. A patient may be better served by a primary amputation and a good prosthesis than a non-functional extremity salvaged by multiple operations, more so in the lower extremity. This also reduces time spent in the hospital and costs. Our secondary amputation rate (4.8%) is comparable to figures quoted by recent studies from other countries (3-12%). Humphrey et al. in a 20-year study of rural vascular trauma from Missouri, reported a complication rate of 16.7%. Of these the most common were infection and vascular thrombosis occurring in 10 patients (5%) each out of a total patient population of 210, very similar to the findings in our study. This study shows that in a hospital with limited modern diagnostic facilities in a developing country, vascular trauma can be managed successfully by early resuscitation, clinical diagnostic skills, and expert surgical repair. The injury patterns emerging from the present study will hopefully help all medical personnel to recognize the potential for vascular injury in a trauma setting.

References


