EVALUATION OF EMERGENCY REVASCULARISATION IN VASCULAR TRAUMA

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Background: Vascular trauma is a common life threatening injury leading to serious consequences if not timely and efficiently managed. We evaluated early surgical interventions aimed at revascularization and thus salvaging limb/ organ in life threatening vascular injuries. Aims of our study were to evaluate the outcome of available diagnostic modalities, earliest possible surgical intervention and rate of related complications with particular reference to our existing situation. **Methods**: Emergency diagnostic workup based mainly on clinical evaluations and required laboratory and imaging parameters leading to revascularisation was performed in 48 patients in Combined Military Hospital (CMH) Muzaffarabad and Islamic Medical College Hospitals between June 1997 and December 2001. Data was collected on pre-designed computerized proforma's which were completed by the treating surgeon and data was entered and analyzed accordingly. **Results:** Out of the total 48 patients who sustained major vascular injuries during this period, 14 (29.2%) were having injury to upper limb vessels, 26 (54.2%) patients had injury to the lower limb vessels, 6 (12.5%) patients reported with injury to abdominal vessels. One (2%) patient had injury to common carotid artery, while an other patient to thoracic aorta respectively (2%). Penetrating trauma caused 38 (79%) and blunt trauma caused 10 (21%) major vascular injuries. Out of 48 patients, 41 (85.4%) patients were successful managed by vascular reconstruction without any residual disability. **Conclusion:** Speedy diagnostic work up and early revascularization yields favourable outcome in vast majority of patients requiring vascular repair. Selections of surgical technique including use of autologous vein graft or artificial vascular graft can save many limbs. In order to achieve good results the time lapse between injury and revascularisation should be less than 6 hours.

Key words: vascular injury, emergency revascularisations, limb umasalvage.

INTRODUCTION

Vascular injury is common in poly trauma. Peripheral vascular injuries may result from penetrating or blunt trauma to the extremities. If not recognized and treated rapidly, injuries to major arteries, veins, and nerves may have disastrous consequences resulting in the loss of life or limb. Peripheral injuries account for 80% of all cases of vascular trauma. Vascular injuries are classified as: contusion, intimal disruption, puncture, lateral disruption, transaction, arterio-venous fistulae and pseudoanerysm.[1-2] First document repair of vessel by Hollowell in 1759 was unsuccessful. In 1889, Jassinowsky performed the first successful arterial repair with preservation of the lumen. Saphenous vein graft was used by Lexter in 1907 [2-3] The concept of "Golden Hour" and trimodal pattern of death has further high lightened that immediate intervention and the well-equipped operating room and trained staff is the key to success Once identified, all other arterial injuries should be repaired in operating room. In a few patients, immediate repair of vessel may be more hazardous, ligation of vessel may be a safer option in these circumstances [4].

The lower extremities are involved in two thirds of all patients with vascular injuries.[5] The management and outcome of vascular repair has remarkably improved over past decade due to better understanding of the trauma mechanism, early detection of the nature and extent of vascular injury and speedy surgical intervention aiming to revascularization.[6,7]

Vascular injury is a major complication of military and civilian trauma. Major developments in this field have been related to military conflicts during the past 100 years. In World War I, most of the vascular injuries were treated with vascular ligation, there was 49% rate of limb amputations. This was reduced to 35.8% in World War II thanks to increased attempts at vascular repairs.[8,9] In Korean and Vietnam conflicts major arterial repairs were carried

out and amputation rate further declined to 13%.[10-12] During Afghan war, vascular reconstructions were successfully carried out even in field hospitals saving many precious limbs and lives.[13]

Vascular reconstruction is carried out by different means and ways depending upon the nature and extent of vascular injury, size and caliber of injured vessel, its area of supply, nature of concurrent trauma, general condition of the patient and available resources including expert vascular services. In modern days surgeries, 95% limbs are successfully salvaged by early surgical intervention and revascularization.[14-16]

In Pakistan not enough research work has been done in the field of vascular injuries. The scientific guidelines pertaining to our particular situation are lacking. Our study emphasizes the importance of early recognition of vascular injury and immediate revascularization aimed to salvage limbs / organs. Most advanced diagnostic tools are not always prerequisite to diagnose major vascular injuries.

MATERIAL AND METHODS

The study was conducted at Combined Military Hospital Muzaffarabad and Islamic International Medical College Hospitals Rawalpindi / Islamabad between June 1997 and December 2001. All patients with major vascular trauma leading to vascular insufficiency, were included.

Protocol was revised for management of these patients. Initial resuscitation, included management of shock, securing haemostasis by application of tourniquet for few minutes or by application of vascular bull-dog clamps and management of other life threatening injuries was done simultaneously.

Detail history and examination was done in all patients to exclude any associated injury. Ultrasound examination, Doppler studies, radiographs was done in all patients. Preoperative angiogram was done only in seven patients. Any associated injury was dealt with at the same time. Emergency exploration and revascularization was carried out in all patients. The operative findings are included in Table - 1

Table-1:Operative Procedures in 48 patients

Type of repair	Number of vessels	Number of veins
Primary suturing	10 arteries	16 veins
Primary anastommosis	15 arteries	3 veins
Saphenous vein graft	17 arteries	-
Prosthetic grafts	4 arteries	-
Ligations of vessels	2 arteries	9 veins

All the patients were monitored in the postoperative period for impending ischaemia, haemorrhage, sepsis and other possible complications. All patients were followed up for 30 days after discharge from the hospital.

The main variables included sensitivity of clinical impression, ultrasound and radiological investigations, time lapsed between onset of injury and revascularization, the efficacy and benefits of revascularization, morbidity and mortality. Data was analyzer by using SPS 10 version and *p* – value calculated using *chi* square test.

RESULTS

Surgical repair of major vessels was carried out in 48 patients. These included 41 males and 7 female. Associated injuries were seen in 29 patients (table-3) Penetrating trauma was the most common etiological factor for vascular injuries. The mechanism of vascular injury is summarized in table-2.

Table-2: Mechanism of vascular injury (n= 48)

Cause of injury	Number	%

Bullet injury	24	50
Shrapnel injury	14	29
Blunt injuries	10	21

Table-3: Associated injuries (seen in 29 patients)

Nature of associated injuries	Number of patients	%
Fracture of lower limb bones	18	38
Abdominal injuries	12	25
Thoracic injuries	4	8
Soft tissue injuries only	8	17
Head injuries	3	6

The regional distribution in 48 patients is summarized in table – 4.

Table-4: Regional distribution (n=48)

Artery	Number	%
Carotid artery	1	2
Carotid artery	1	2
Subclanian artery	4	8
Axillary artery	9	19
Brachial artery	1	2
Thoracic aorta	7	15
Iliac artery abdominal aorta and IVC	7	35
Femoral artery popliteal arteries.	8	17

Four (8%) patients succumbed despite all efforts for resuscitation due to vascular and severe associated conditions. One (2%) patient presented two hours after injury had residual neurological deficit despite carotid artery repair. One (2%) patient developed Volkman's ischaemic contracture after brachial artery repair, an other (2%) patient required below knee amputation even after repair of popliteal artery, both these patients presented more than 14 hours after injury. Re-exploration was done in 4 (8%) patients, for 2 (4%) patients who had thrombosis of repaired vessels both with end to end technique and 2 (4%) patients bleed after vascular repair all these four patients presented more than 10 hours of injury. Revasculisation was done with successful outcome in all these 4 patients saving good functional limbs. One patient developed compartment syndrome because 16 hours late presentation which was managed by fasciotomy. Rest of the patients had uneventful recovery.

Our patients reported to the hospital between 30 minutes to 28 hours after injury. The time lapse between injury and revascularization ranged from 1 to 32 hours. The complication rate was directly related to the time interval between injury and revascularisation. In our series those reporting 6 hours after injury had the maximum complication rate. Average hospital stay was 9 days.

DISCUSSION

Trauma is a major health problem world-wide. Vascular trauma is an important component of this critical scenario. Incidence of vascular trauma is on rise. Approximately 90% of arterial insults are due to penetrating injuries. In our series, it was responsible for 79% of all injuries.[13]

Vascular injuries are life and limb threatening situation demanding prompt decision by the treating surgeon. In these critical situations, most surgeons rely on clinical evaluation, external haemorrhage, expanding or pulsatile haematoma, absent peripheral pulses, sign of ischaemia and haemodynamic instability. In our study we mainly relied on clinical parameters mentioned above with 100% sensitivity for vascular injury. We did a few arteriograms and they also confirmed our clinical impression. Modern but time consuming investigations like Pre-op angiography, CT-Scan,

Helical angiography, magnetic resonant angiogram (MRA) and MRI are not required in vast majority of patient and these tests should be reserved only for doubtful cases.[14-15]

Modern concept of trauma management consists of immediate resuscitation followed by quick evacuation preferably by air transport to base hospital well equipped with modern facilities of trauma management including vascular repair and availability of skill staff. In our series 9 patients were transferred by helicopter to CMH, Muzaffarabad. All these 9 patients had excellent postoperative results.

Prompt vascular repair and attention to associated injuries result in a 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 in the follow up.

Increasing domestic violence and war situation have resulted in major advancement in field of emergency revascularization. War like situation in our region till recently has alerted health authorities to expand such facilities in forward hospitals.[17]

Vascular trauma management essentially entails three steps, namely (i) compression and cautery of vessels (ii) ligation of vessels (iii) vascular repair. We carried out ligation of two vessels (brachial and popliteal) because of delay in presentation and possibility of severe reperfusion injury. Both these limbs were saved and fuctional perfusion was improved later by bypass surgery.[11]

Various modalities of dealing with vascular injuries are mentioned in table – 4. Complication rate in emergency revascularization has been reported in different studies to be between 10 – 18%. In our study 10% of patient developed various complications which are compatible with the International standards.[18-22]

Time lapse between injury and treatment is of critical importance in the outcome. In our study we found the six hours was the critical limit that determined the outcome. Patients reporting within six hours of injury had better overall results as compared to those presenting in after six hours[22]

CONCLUSION

Rapid clinical evaluation and resuscitation along with correction of hypovolaemic shock has saved many lives and limbs. Pre operative work up did not require any sophisticated diagnostic tools. Adhering to the basic principles of vascular repair and speedy intervention aiming at revascularization remarkably reduces mortality and morbidity. Surgical techniques, use of autologous vein grafts as well as artificial vascular graft has saved many limbs which otherwise would have been lost if not properly and timely handled. Most of these injuries are potentially life threatening to the patient if not managed in time.

REFERENCES

1. Frykberg E R. Advances in the diagnosis and treatment of extremity vascular trauma. Surg Clin North Am 1995;75:207-23.

2. Rich NM, Baugh JH, Hugh as CW: Acute arterial injuries in Vietnam. 1000 cases. J Trauma 1970;10:359-69.

3. Frykberg ER, Dennis JW, Bishop K: The reliability of physical examination in the evaluation of penetrating extremity trauma for vascular injury: results at one year. J Trauma 1991;31(4): 502-11

4. Guraya SY, Gardezi JR, Sai GA, Malik U, Nasim A, Imran A. "Peripheral vascular injuries – Jinnah hospital Lahore experience. Pakistan Post Graduate Med J 2000;11(3)99-102

5. Nassoura ZE, Ivatury RR, Somon RJ: A reassessment of Doppler pressure indices in the detection of arterial lesions in proximity penetrating injuries of extremities: a prospective study. Am J Emerg Med 1996;14(2):151-5

6. Sheriff AA. Vascular injuries, Experience during the Afghanistan War. Int Surg 1992;77:133-4

7. Hafez HM, Woolgar J, Robbs JV: Lower extremity arterial injury: results of 550 cases and review of risk factors associated with limb loss. J Vasc Surg 2001;33(6): 1212-9

8. Siegmeth A, Mullner T, kukla C, Vecsei V." Associated injuries in severe pelvic trauma. Unfallchirurg 2000;103(7):572-81 [German]

9. Jahnke EJ. Late structural and functional results of arterial injuries primarily repaired. Surgery 1998;43:175-83.

10. Miller PR, Kortesis BG, McLauhilin CA, Chen My, Chang MC. Complex blunt aortic injury or repair; beneficial effects of cardiopulmonary bypass use. Ann Surg 2003;237(6) 877-83.

11. Espinosa Ga, Chiu JC, Samett EJ: Clinical assessment and arteriography for patients with penetrating extremity injuries: a review of 500 cases with the Veterans West Side Medical Center. Military Medicine 1997;162:19-23

12. Gahtan V, Bramson RT, Norman J. The role of emergent arteriography in penetrating limb trauma. Am Surg 1994; 60(2):123-7.

13. Jan WA, Samad A, Anwar R. Mortality and morbidity of abdominal inferior vena cava injuries. J Coll Physician Surg Pak 2004;14910) 622-5

14. Starnes BW, Bruce JM. Popliteal artery trauma in a forward deployed Mobil Army surgical hospital. Lessons learned from the war in Kosovo. J Trauma 2000;48:1144-9

15. Davidovic L, Lotina S, Kostic D. Popliteal artery war injuries. Cardiovasc Surg 1997;5:133-7

16. Bynoe RP, Miles Ws, Bell RM. Noninvasive diagnosis of vascular trauma by duplex ultrasonography. J Vasc Surg 1991;14(3):346-52

17. Bouchart F, Bessou J, Tabley A, Litzler PY, Haas-Hubscher C. Acute traumatic rupture of the thoracic aorta and its branches. Result of surgical management. Ann 2001; 126(3) 201-11 [French[.

18. Meimner M, Paun M, Johansen K: Duplex scanning for arterial trauma. Am J Surg 1991;161:552-5.

19. Cuschieri A, Steele RJC, Moossa AR. Essential surgical practice by Butterworth. 4th ed Rome, Heinemann, Italy, fourth edition 2000.

20. Hood DB, Weaver FA, Yellin AE: Changing perspectives in the diagnosis of peripheral vascular trauma. Semin Vasc Surg 1998;11(4):255-60

21. Knudson MM, Lewis FR, Atkinson K. The role of duplex ultrasound arterial imaging in patients with penetrating extremity trauma. Arch Surg 1993;128(9): 1033-7.

22. Nassoura ZE, Ivatury RR, Somon RJ. A reassessment of Doppler pressure indices in the detection of arterial lesions in proximity penetrating injuries of extremities: a prospective study. Am J Emerg Med 1996;14(2):151-5

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