MISSED VASCULAR INJURIES

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ABSTRACT

Objective: To evaluate vascular injuries for the cause, site of injury, presentation and treatment.

Design: Descriptive study.

Place and duration of study: Surgical unit I, Combined Military Hospital, Rawalpindi. Surgical Unit 2, Combined Military Hospital, Lahore. 1st August 2005 to 30th June 2010.

Subjects and Methods: All cases of missed vascular injuries (MVI) who presented to a single vascular surgeon, between 1st August 2005 and 30th June 2010 were examined in detail. Only cases with viable limbs and reversible ischaemia were included in the study. Patients with gangrene of the limbs of any extent were excluded. Record was made of the cause, site, mode of presentation and treatment. MVI was defined as vascular injury which was missed in the initial evaluation, operative procedure or intervention.

Results: Out of 41 cases, 31(75.6%) were due to gunshot or splinter injuries, 3(7.3%) external fixator injuries, 2(4.8%) carotid stentings , 2(4.8%) cardiac angiographies, 1(2.4%) fine needle biopsy, 1(2.4%) metallic rod penetrating injury and 1(2.4%) elective lumbar disc surgery. Neck was affected in 9(21.9%), upper limb in 7(17%) and lower limb in 25(60.9%) patients. There were 20(48.7%) false aneurysms, 8(19.5%) traumatic arteriovenous fistula (AVF), 5 (12.1%) false aneurysms with traumatic AVF, 3(7.3%) thrombosis, 1(2.4%) stenosis, 3(7.3%) hematoma and 1(2.4%) hemorrhagic shock. In 39(95.1%) cases surgical intervention was done. In 2(4.8%) cases, vascular injury was missed in polytrauma and mass casualty situation while 3(7.3%) cases were of polytrauma only.

Conclusion: Penetrating trauma was the commonest cause of MVIs. Lower limbs were mostly affected. Most of the cases presented with pseudoaneurysms. Few cases had polytrauma/mass casualty situation at the time of initial presentation indicating that vascular injuries were missed either due to low index of suspicion by clinician or not following the proper protocol to avoid these injuries.

Key words: Arteriovenous fistula, False aneurysm, Thrombosis, Vascular injury.

INTRODUCTION

With rapidly changing geopolitical situation, increase in civil violence and road traffic accidents[1], there is significant increase in trauma cases in developing countries[2].

While resuscitating a polytrauma case, especially when there are multiple casualties in emergency department, associated injuries can be missed. Incidence of missed injuries varies between 1.5 to 19.4 % in different studies[3]. Arterial injuries are likely to be missed if there is altered level of consciousness, associated sensory loss, absence of pulsatile bleed, presence of palpable distal pulses and associated life threatening injuries[4].

Various recommendations have been made to avoid missing these injuries. These include high index of suspicion[5] especially in certain injuries well known for associated vascular trauma[6,7], awareness about hard and soft signs of arterial injuries, measuring ankle-brachial pressure index (ABPI) in all asymptomatic extremity penetrating injuries in close proximity to neurovascular bundle, tertiary survey immediately before ambulation or upon regaining consciousness[4] and following an appropriate diagnostic algorithms for vascular injuries[5,6].

Our study was conducted to evaluate MVI for the cause of injury, site of trauma, mode of presentation and the treatment offered.

PATIENTS AND METHOD

This descriptive study was conducted at surgical unit 1 Combined Military Hospital Rawalpindi and Surgical unit 2, Combined

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Military Hospital, Lahore between 1st August 2005 and 30th June 2010. All cases of MVIs irrespective of etiology, site and mode of presentation were included. Cases which presented with gangrene of any extent were excluded from the study as in most of these cases imaging modalities to delineate the exact site and type of lesion was not indicated and amputation was required in majority of these cases. Vascular injury was considered to be missed if it was diagnosed after the initial evaluation, operative procedure or intervention was completed. Total 41 cases of MVI were treated. All patients were seen by a single vascular surgeon. Clinical history was taken and detailed physical examination was done. As most of the cases in our study were either clinically obvious or late presentations of MVIs in the form of false aneurysms or traumatic AVF, ABPI was not of much significance and was not measured. Duplex scan was done in 3 (7.3%) cases of neck injuries. However in all the 3 cases conventional angiography was also done to know the exact site of injury and details of the complication. In 37 (90.2%) cases conventional angiography was advised while in 4 (9.7%) cases who presented very early (one in shock after lumbar disc surgery, other with expanding hematoma due to missed common femoral vein injury and 2 cases of common femoral artery thrombosis after coronary angiography) it was not done. Management plan was made according to clinical presentation and angiographic findings. Record was made of mechanism of injury, site of injury, mode of presentation, final diagnosis and treatment on a pre-designed proforma. Data was analyzed using SPSS version 10. Frequency and percentages were used to describe the data.

RESULTS

Forty one cases of MVI were managed. There were 37 (90.2%) males and 4 (9.8%) females. Age of the patients ranged from 7 to 61 years with mean age of 32.63+13.8 years. Nineteen cases (46.3%) were caused by bullet injury, 9(22%) were due to splinter injury, 3(7.3%) each due to shotgun injury and external fixator; 2(4.9%) cases each due to carotid stenting and coronary angiography and 1(2.4%) case each was caused by penetrating injury by a metallic rod, needle biopsy of jugular lymph node and lumbar discectomy. In 9(22%) cases neck vessels were affected. Upper limb missed vascular injuries were seen in 7(17.1%) cases while 25(61%) cases had involvement of lower limb vessels. Pseudoaneurysm was the most common presentation (48.8%) followed by traumatic AVF (19.5%) and traumatic AVF along with pseudoaneurysm (12.2%).Rest of the cases presented with thrombosis (7.3%), hematoma (7.3%), stenosis (2.4%) and shock (2.4%). Operative repair was done in 39(95.1%) cases. Two (4.9%) cases of hematoma after carotid stenting were managed conservatively. Eighteen (43.9%) excision with graftings and 2 (4.9%) ligations were done for pseudoaneurysms. Traumatic AVF were treated by 2 (4.8%) patchplasties with repair of vein, 3 (7.3%) arterial grafting with ligation of vein, 1 (2.4%) excision and grafting of both artery and vein and 2 (4.9%) arterial grafting with repair of vein. Traumatic AVF with pseudoaneurysms were managed by 4 (9.8%) excisions and graftings and 1 (2.4%) repair of artery with ligation of vein. Two (4.9%) Iliofemoral bypasses, 2 (4.9%) repair of veins, 2 (4.9%) thrombectomies with patchplasties were done. Details of vessels affected, mode of presentation and operations performed are shown in table.

DISCUSSION

Vascular injuries that are not diagnosed at the time of initial presentation and management are labeled as missed vascular injuries (MVI). Vascular injuries can be missed during physical examination[5,8-10], various diagnostic modalities[11], exploration of an injury or while performing an elective surgical[12] or endovascular procedure[13,14] (missed iatrogenic injuries).

MVI can present early or late. MVI can present early after initial surgery as persisting hypotension/falling hematocrit, expanding hematoma, unusual bleed from operation site, excessive hemorrhagic drain[15], ischemic symptoms after regaining consciousness and hard signs of vascular injury noticed after initial exploration. Late presentation of MVI is as false

Table1: Vessels affected, mode of presentation and operations

Site	Presentation	Number	Operations/Management
Carotid artery (n=7, 17%)	Carotico-jugular fistula Carotid pseudoaneurysm Haematoma (after stenting)	2 3 2	Patch plasty of ICA and repair of IJV Excision and grafting Conservative management
Vertebral artery (n=1, 2.4%)	Pseudoaneurysm	1	Ligation
Sup Thyroid artery (n=1, 2.4%)	Pseudoaneurysm	1	Ligation
Axillary artery (n=4, 9.7%)	Pseudoaneurysm Traumatic AVF with pseudoaneurysm	3 1	Excision and grafting Excision and grafting
Brachial artery (n=2, 4.8%)	Pseudoaneurysm Traumatic AVF with pseudoaneurysm	1 1	Excision and end-to-end anastomosis Repair of artery and ligation of vein
Radial artery (n=1, 2.4%)	Pseudoaneurysm	1	Excision and vein grafting
Ext Iliac artery (n=2, 4.8%)	Pseudoaneurysm Stenosis	1 1	Excision and grafting Ilio-femoral bypass
Ext Iliac vein (n=1, 2.4%)	Shock (after L discectomy)	1	Repair
Common femoral artery (n=8, 19.5%)	Pseudoaneurysm Traumatic AVF with Ps An Thrombosis	3 2 3	Excision and grafting Excision and grafting Thrombectomy and patchplasty(2 cases) Ilio-femoral bypass(1 case)
Common femoral vein (n=1, 2.4%)	Haematoma	1	Repair of vein
Sup femoral artery (n=8, 19.5%)	Pseudoaneurysm Traumatic AVF - Traumatic AVF with Ps An	4 3 - 1	Excision and grafting Grafting of artery/ repair of vein(2cases) Grafting of artery/ligation of vein(1 case) Excision and grafting
Popliteal artery (n=3, 7.3%)	Pseudoaneurysm Traumatic AVF	2 1	Excision and grafting Excision and grafting
Post Tibial artery (n=2, 4.8%)	Traumatic AVF	2	Graftng of artery and ligation of vein

aneurysms (pseudoaneurysms), traumatic AVF, arterial stenosis, dissection, thromboembolism and chronic venous insufficiency[16].

The problems associated with early presenting MVI are that they require urgent re-exploration[15] which increases both morbidity and mortality. Patients can even go into shock or there can be irreversible ischaemia by the time it is diagnosed. MVI which present late, although, mostly do not require urgent intervention, an extensive vascular reconstructive procedure is usually required causing inconvenience and more expense[16]. There are numerous studies which highlight the importance of history and physical examination in diagnosing vascular injuries[17,18]. A relevant clinical history should include the mechanism of injury, amount of hemorrhage, whether the bleeding was pulsatile or there was a rapidly increasing swelling (expanding hematoma)[16]. Patients should be asked about any severe pain in limb distal to injury, feeling of numbness or

coldness in limb or paresis[10]. A history of stroke in case of neck injury may suggest carotid artery injury. Patients should be examined for hard signs of vascular injury[19] (pulsatile bleeding, arterial thrill on palpation, bruit over or near artery, visible expanding hematoma and signs of distal ischemia-pain, paresthesia, pallor, paralysis and pulselessness) proximity of wound to neurovascular bundle and any neurological deficit.

In many cases a careful clinical history and examination will be sufficient in making a decision to operate or not[20,21]. Frykberg et al have shown that all cases that underwent exploration on the basis of presence of hard signs had major arterial injury requiring repair indicating 100% positive predictive value for physical examination[17]. At times physical examination can be deceptive due to palpable pulse even when a major artery is injured5. This is due to a pulse wave that travels through a fresh soft clot or intimal flap[8,16]. At times good collaterals at certain sites contribute to this[5]. Gunshot wounds may result in intimal arterial injury without breach of the arterial wall integrity. Hemorrhage, hematoma, pulse deficit may not be present[9,10]. Selective nonoperative management of neck injuries based on clinical examination and selective use of adjunctive investigational studies have been shown to be safe in a high volume trauma center[22,23]. In another study, even in stable patients with gunshot wound to the neck, physical examination was shown not to be a good predictor of vascular injury[24]. In our study, 7(17.1%) cases of acutely presenting MVI had obvious hard signs. One (2.4%) case of carotid artery injury also had contralateral hemiparesis. Rest of the cases which presented to us lately as pseudoaneurysms and traumatic AVF were initially treated in other hospitals. All (n=41) had close proximity of injury to neurovascular bundle. History of profuse bleeding was present in all except 2(4.9%) cases of pseudoaneurysms (one of vertebral artery and other of superior thyroid artery).

Angiography has been considered as gold standard investigation for vascular injuries. Clinically obvious vascular injuries rarely require imaging modalities and most of these cases are explored surgically on the basis of physical examination. Angiography is mainly done in cases where the injury is in close proximity to the vascular bundle (proximity wounds) and there are no obvious signs of vascular injury[25] or when exact localization of vascular injury are required. Although some recommend arteriography to evaluate potential vascular injuries even when overt clinical features are absent, various studies suggest that the number of vascular injuries diagnosed on angiography in proximity wounds without obvious physical feature of vascular trauma is very less[26]. So in proximity wounds without obvious vascular injury features, routine angiographic evaluation not only exposes of patient to unnecessary radiation and contrast hazards but also not cost effective[16]. Some researchers have proposed an alternative approach in such cases. Proximity wounds without hard signs of vascular trauma are further evaluated by DPI. Only those cases in which DPI are low are further subjective to angiography[27]. Similarly these cases can be evaluated by duplex scan and angiography is only done in those cases in which there is evidence of vascular injury on duplex scan. Hence a significant number of unnecessary angiographies are avoided. In our cases, angiography was done in all except 4 (9.7%) cases which presented very early- 1 (2.4%) in shock after lumbar disc surgery, other (2.4%) with expanding hematoma due to missed common femoral vein injury and 2(4.9%) cases of common femoral artery thrombosis after cardiac catheterization. In 2(4.9%) cases of carotid artery injury after carotid stenting, angiography was done by interventional cardiologist before the cases were referred to us. This high frequency of angiography was not for diagnostic purpose but for the exact map of arteries, pseudoaneurysms and AVF required for the surgery.

Computerised tomographic angiography (CTA) provides accurate peripheral vascular imaging and has proved to be an effective

alternative to conventional arteriography in assessing vascular trauma. Additionally, it has an advantage of being noninvasive and immediately available[28].

In mass casualty situation many injuries including vascular injuries can be missed. Enderson and Reath have suggested tertiary trauma survey to avoid missing injuries in these cases[4]. In tertiary trauma survey patients are reexamined immediately before ambulation or in head injury patients, upon regaining consciousness. By following this routine in one study, 9% patients were found to have missed injuries out of which 0.5% were MVI[4].

CONCLUSION

Penetrating trauma is the most common cause of vascular injuries which were missed in our study. Lower limb vessels were most frequently affected. Pseudoaneurysm is the most common presentation followed by traumatic AVF. Although MVI are attributed mainly to mass casualty situation or polytrauma with unstable status, only 5(12.1%) cases had polytrauma/mass casualty situation indicating that in our study vascular injuries were missed either due to low index of suspicion by clinician or not following a proper diagnostic algorithm to investigate these injuries.

REFERENCES

1. Kopits E, Cropper M. Traffic fatalities and economic growth. Washington, DC, World Bank; 2003 (Policy Research Working Paper No. 3035)
2. MurrayCJ, Lopez AD. Alternative projections of mortality and disability by cause 1990-2020: Global Burden of Disease Study. Lancet 1997; 349:1498-504.
3. Okello CR , Ezati IA, Gakwaya AM .Missed injuries: A Ugandan experience. Injury, Int. J. Care Injured 2007; 38:112-17.
4. Enderson BL, Reath DB, Meadors J, Dallas W, DeBoo JM, Maull KI. The tertiary trauma survey: a prospective study of missed Injury. J Trauma 1990;30:666-9.
5. Bravman JT, Ipaktchi K, Biffl WL, Stahel PF. Vascular injuries after minor blunt upper extremity trauma - pitfalls in the recognition and diagnosis of potential "near miss" injuries. Scand J Trauma Resusc Emerg Med 2008;16:16.
6. Levy BA, Zlowodzki MP, Graves M, Cole PA. Screening for extermity arterial injury with the arterial pressure index. Am J Emerg Med 2005;23:689-95.
7. Anderson RJ, Hobson RW, II, Padberg FT, jr.,Swan KG, Lee BC, Jamil Z, et al . Penetrating extremity trauma: Identification of patients at high-risk requiring arteriography. J Vasc Surg 1990;11:544-8.
8. Tufaro A, Arnold T, Rummel M,Matsumoto T, and Kerstein MD. Adverse outcome of nonoperative management of intimal injuries caused by penetrating trauma. J Vasc Surg 1994;20:656-9.
9. Pillay WR, Pillay B, Mulaudzi TV, Mohamed GS, Robbs JV. Fluctuating pulse deficits associated with intimal arterial injury following gunshot wounds of the extremity--a sign not to be missed. S Afr J Surg 2005;43:22-4.
10. Drapanas T, Hewitt RL, Weichert RF, Smith AD. Civilian vascular injuries: a critical appraisal of three decades of management. Ann Surg 1970;172:351–60.
11. Richardson JD, Bergamini TM, Spain DA, Wilson MA, Carrillo EH, Garrison RN, et al. Operative strategies for management of abdominal aortic gunshot wounds. Surgery 1996;120:667-71.
12. Shoenfeld NA, Stuchin SA, Pearl R, and Haveson S. The management of vascular injuries associated with total hip arthroplasty. J Vasc Surg 1990;11:549-55.
13. Kresowik TF, Khoury MD, Miller BV, Winniford MD, Shamma AR, Sharp WJ, et al . A prospective study of the incidence and natural history of femoral vascular complications after percutaneous transluminal coronary angioplasty. J Vasc Surg 1991;13:328–35.
14. McCann RL, Schwartz LB, Pieper KS. Vascular complications of cardiac catheterization. J Vasc Surg 1991;14:376–81.
15. Rotondo MF, Schwab CW, McGonigal MD, Phillips GR 3rd, Fruchterman TM, Kauder DR, et al. Damage control: an approach for improved survival in exsanguinating penetrating abdominal injury. J Trauma 1993;35:373-83.
16. Perry MO. Complications of missed arterial injuries. J Vasc Surg 1993;17:399-407.
17. Frykberg ER, Dennis JW, Bishop K, Laneve L, Alexander RH. 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.
18. Weaver FA, Yellin AE, Bauer M, Oberg J,Ghalambor N,Emmanuel RP, et al. Is arterial proximity a valid indication for arteriography in penetrating extremity trauma? A prospective analysis. Arch Surg 1990;125:1256-60.
19. Spencer AD. The reliability of signs of peripheral vascular injury. Surg Gynecol Obstet 1962;114:490-97.
20. Gomez GA, Kreis DJ, Ratner L, Hernandez A, Russell E, Dove DB, et al. Suspected vascular trauma of the extremities: the role of arteriography in proximity injuries. J Trauma 1986; 26:1005-8.
21. Hartling RP, McGaham IP, Blaisdell FW, Lindfors KK. Stab wounds to the extremities: indications for arteriography. Radiology 1987;162:465-7.
22. Thoma M, Navsaria PH, Edu S, Nicol AJ. Analysis of 203 patients with penetrating neck injuries. World J Surg 2008;32(12):2716-23.
23. Bell RB, Osborn T, Dierks EJ, Potter BE, Long WB. Management of penetrating neck injuries: a new paradigm for civilian trauma. J Oral Maxillofac Surg 2007;65:691-705.
24. Mohammed GS, Pillay WR, Barker P. The role of clinical examination in excluding vascular injury in hemodynamically stable patients with gunshot wounds to the neck. A prospective study of 59 patients.Eur J Vasc Endovasc Surg 2004;28:425-30.
25. Yilmaz AT, Arslan M, Demirkiliç U, Ozal E, Kuralay E, Tatar H, et al. Missed arterial injuries in military patients. Am J Surg 1997;173(2):110-4.
26. O'Gorman RB, Feliciano DV, Bitondo CG, Mattox KL, Burch JM, Jordan GL Jr. Emergency center arteriography in the evaluation of suspected peripheral vascular injuries. Arch Surg 1984;119:568-73.
27. Conrad MF, Patton JH Jr, Parikshak M, Kralovich KA. Evaluation of vascular injury in penetrating extremity trauma: angiographers stay home. Am Surg 2002;68:269-74.
28. Peng PD, Spain DA, Tataria M, Hellinger JC, Rubin GD, Brundage SI. CT angiography effectively evaluates extremity vascular trauma. Am Surg 2008;74(2):103-7.