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Original Research Article

Study of lower limb musculoskeletal trauma and its associated vascular injuries

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Abstract

Aim: The aim of this study was to study lower limb musculoskeletal trauma and associated vascular injury in SMS Hospital Jaipur in India in terms of epidemiology and patient outcome.

Methods: This was a single center cross sectional descriptive observational study conducted at SMS Hospital Jaipur in India and for the study purpose 100 cases of lower limb injury was taken.

Results: The Age group between 11 years to 65 years was included in the study. Most common involved population between 31 to 50 years (49%) then comes 51 to 60 years (19%). There were 91 males and 9 females in study. Most common cause of lower limb musculoskeletal trauma with vascular injuries is road traffic accidents accounts for 87% of all injuries. Popliteal artery is most common injured vessel 59 cases total out of which 46 (78%) were amputated and 13 (22%) were salvaged. P value is significant. Popliteal artery injuries have higher chances of amputation. Total cases of Ant tibial artery injuries are 7 out of which 5 (71.4%) were amputated and 2 (28.6%) were salvaged.

Conclusion: Popliteal artery is the most commonly injured vessel, but the prognosis is much better in femoral artery injuries. Open fractures had worse morbidity and mortality outcomes. Patients presenting in the first 12 h after injury had a better limb salvageability rate. Motor vehicle safety and prevention programs targeting young males are most likely to have a greatest effect on vascular injury rate, and the results of this study may be used for preventive strategic planning of these injuries.

Keywords: Fracture-associated vascular damage, surgical trauma room, extremity trauma

Introduction

Orthopedic injuries associated with vascular insult are an important cause of morbidity and mortality. There is a paucity of literature regarding the epidemiology, management strategies, and outcome of vascular trauma in India. And in particular, there have been very few studies highlighting the pattern, causes, and effects of lower extremity vascular trauma [1].

Whenever the body's integrity is compromised by contusion, concussion or fracture, surgical trauma care is necessary for rapid damage control and specific individualized treatment. This remains, a major challenge for clinicians due to varying patterns of injuries and occasional major traumas, requiring urgent, yet highly specialized therapy [2, 3]. Fast, conclusive and complete injury assessment by examination of head and neck, thorax, abdomen, pelvis and the extremities is further supported by computed tomography (CT) and CT-angiography

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(CTA) [4, 5]. Head and thoracic injuries are found in approximately 50% of all trauma patients and extremity or pelvic fractures in roughly 30% [6]. Additional vascular damage, especially of arteries or venous plexus is acutely life threatening and further reduces time for decision-making and treatment [7] Vascular damage in combination with fractures is associated with higher mortality and inferior outcome, especially due to rapid and voluminous blood loss into pelvic or femoral soft tissue compartments. Correct diagnosis may be difficult due to low body temperature and masking effects of other injuries [8-10].

The successful management of patients with lower extremity arterial injuries has two goals. The first is to save the patient's life and the second is to save the extremity. The limb salvage rate following uncomplicated penetrating arterial injuries is over 95%. However an associated skeletal injury may still result in amputation rates as high as 70%, despite successful arterial repair. These results are most pronounced in the lower extremity, which has more tenuous vascular collaterals and more adverse consequences from vessel injury than the upper extremity [11]. For persistently hemodynamically unstable patients and those in extremis, life comes before limb. A team approach with different specialties, including orthopaedics, plastic surgery, vascular surgery and trauma general surgery, is recommended for treating patients with a mangled extremity [12]. Results from vascular repairs are encouraging despite significant delays [13].

Trauma in India is an increasingly significant problem, particularly in light of rapid development and increasing motorization. Social changes are resulting in alterations in the epidemiology of trauma. Strict enforcement of traffic rules, combined with improved infrastructure and behavior change can decrease the burden of road traffic accidents in India and other developing countries [14]. Patients with traumatic limb amputations are likely to experience several complications and comorbidities. Prevention of secondary conditions affecting those living with the loss of a limb is an important part of amputee rehabilitation and may prevent re hospitalization [15]. Measures against road accidents that include the interaction between road users, vehicle, and road environment are crucial. Hence, a multidimensional approach is the need of the hour [16].

The aim of this study was to study lower limb musculoskeletal trauma and associated vascular injury in SMS Hospital Jaipur in India in terms of epidemiology and patient outcome.

Materials and Methods

This was a single center cross sectional descriptive observational study conducted at SMS Hospital Jaipur in India and for the study purpose 100 cases of lower limb injury was taken.

Inclusion criteria: All patients with traumatic lower extremity injury and associated vascular injury are included in the study.

Exclusion criteria: Patients with traumatic amputations and those with head injury and blunt trauma to chest or abdomen are excluded from study.

Clinical parameters

Clinical data including demographics, mechanism of injury, severity of vascular lesions, diagnostic and therapeutic management, and complications were evaluated by a review of patient files. Whenever a patient with lower extremity injury presented to the emergency department, the orthopedic surgeon at the emergency department attended the patient first, and if the surgeon suspected a vascular injury, the vascular surgeons were called for help. If it was an open fracture wound, it was washed with 6 liters of normal saline, betadine and hydrogen peroxide and the patients were started on triple antibiotics [Injection Cefuroxime 1.5g, Injection Amikacin 1g, Injection Metronidazole 800 mg]. Doses were altered according

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to the patient's renal function. After ruling out head injury, chest and abdominal injury, patients were included in the study.

Computed tomography angiography was used for localizing the site of vascular injury in all the patients with clinical suspicion of vascular injury. The patients were managed by a team of surgeons, including orthopedic, vascular, and plastic surgeons.

Statistical analysis

Statistical analysis was performed by utilizing the IBM SPSS statistics software program (version: 20.0, SPSS Inc., Chicago, IL, USA). Fisher's exact test was used for the univariate risk factor analysis of variables related to amputations. Stepwise logistic regression analysis was used to identify independent risk factors for amputations. Odds ratio (OR), 95% confidence interval, and P value were calculated. P value was assumed to be statistically significant if ≤0.05 in all tests.

Results

Table 1: Patient characteristics

Age group (years)	N	Percentage
11-20	14	14
21-30	18	18
31-40	30	30
41-50	19	19
51-60	16	16
61-70	3	3
Gender		
Male	91	91
Female	9	9
Cause of injury		
Pedestrian	9	9
RTA	87	87
Train injury	4	4
Vessel injured		
Anterior Tibial	7	7
Femoral	27	27
Popliteal	64	64
Posterior Tibial	2	2
Time of presentation		
<12h	63	63
12-24h	12	12
>24 h	25	25
Associated bony fracture		
Closed	35	35
Open	65	65
Type of vessel injury n=94		
Complete transaction	53	56.4
Partial tear	12	12.8
Thrombosis	29	30.8

The Age group between 11 years to 65 years was included in the study. Most common involved population between 31 to 50 years (49%) then comes 51 to 60 years (19%). There were 91 males and 9 females in study. Males are more commonly affected because in Indian scenario males are more dominant perform more outdoor activities, more vehicle driving. Most common cause of lower limb musculoskeletal trauma with vascular injuries is road traffic accidents accounts for 87% of all injuries. Out of total 100 case of lower limb vascular

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trauma 63% cases presents in less than 12 hours which associated with better prognosis of patients. 25% patients presents late after 24 hours. Open or compound fractures are more common than closed fractures there are 65% cases of open fractures and 35% cases are closed fractures. Angiographic evaluation of vascular injuries showed that most common type of vascular injury is complete transaction of vessel which is 56.4%.

Table 2: Limb amputation in relation to gender

Gender	Amputated N%	Salvaged N%	Total	P Value
Female	3 (37.5)	5 (62.5)	8	P = 0.413
Male	51 (59.3)	35 (40.7)	86	
Cause of injury				
Pedestrian	4 (44.4)	5 (55.6)	9	P = 0.165
RTA	46 (56.8)	35 (43.2)	81	
Train injury	4 (100)	0	4	
Vessel injured				
Anterior Tibial	5 (71.4)	2 (28.6)	7	P < 0.001
Femoral	46 (78)	13 (22)	59	
Popliteal	3 (11.5)	23 (88.5)	26	
Posterior Tibial	0	2 (100)	2	
Type of fracture				P = 0.004
Closed	13 (37.1)	22 (62.9)	35	
Open	41 (69.5)	18 (30.5)	59	
Time of presentation				
<12h	30 (48.4)	32 (51.6)	62	P = 0.024
12-24h	6 (60)	4 (40)	10	
>24 h	18 (81.8)	4 (18.2)	22	
Type of vessel injury				
Complete transaction	43 (81.1)	10 (18.9)	53	
Partial tear	4 (33.3)	8 (66.7)	12	
Thrombosis	7 (24.1)	22 (75.9)	29	

Amputation percentage in females was 37.5% and amputation percentage in males are 59.3% with P value (0.413). RTA is the most common cause of lower limb musculoskeletal vascular trauma 81 cases total out of which 46 were amputated (56.8%) and 35 were salvaged (43.2%). P value is non-significant gender and cause of injury does not affect limb outcome. Popliteal artery is most common injured vessel 59 cases total out of which 46 (78%) were amputated and 13 (22%) were salvaged. P value is significant. Popliteal artery injuries have higher chances of amputation. Total cases of Ant tibial artery injuries are 7 out of which 5 (71.4%) were amputated and 2 (28.6%) were salvaged. Open or compound fractures are more common 59 cases out of which 41 (69.5%) amputated and 18 (30.5%) salvaged. P value is significant. Open fractures are more prone to ampute than closed. There were total 35 close fractures out of Which 22(62.9%) were salvaged. Patients who present early <12 hours of lower limb vascular and bony injuries were 62 out of them 30 (48.4%) limb were amputated and 32 (51.6%) limbs were salvaged. Patients present >24 hours of injury 22 out of them 18 (81.8%) amputated and only 4 (18.2%) were salvaged. P value is significant (0.024).Late presented lower limb musculoskeletal trauma associated with more chance of amputation. Total 53 cases were of complete transaction of vessels 43(81.1%) were amputated and only 10 (18.9%) were salvaged.29 cases of thrombosis 7 of them (24.1%) were amputated and 22 (75.9%) were salvaged. 12 cases of partial tear 4 of them 33.3% were amputated and 8 cases (66.7%) were salvaged. P value is significant complete transaction more associated with amputation, thrombosis more associated with limb salvageability.

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Discussion

The incidence of lower extremity vascular trauma has been on the rise mainly due to increase in high-speed MVAs in India. Limb salvagibility could not be predicted accurately by only one variable it depends on group of variables such as age, mechanism of injury, injury severity score, presence of shock, level of injury, venous injury or repair, sequence of repair (vascular vs skeletal), time of fasciotomy, arteriography, blood requirement and duration of ischemia [17, 18] Early diagnosis and immediate intervention are mandatory to save the extremities and lives of the patients [19].

Mean age of patients admitted at SMS hospital with lower limb musculoskeletal Trauma with associated vascular injury in this following study is 37.32 years. Most of the patients in the young and middle age group 48% of the population in this study between 20 to 40 years. Kidmas *et al*., study eighty seven patients in 2004 and they were between 3 to 83 years and their mean age was 44.5 which is nearly same to this study [20]. Males are affected the most. In the following study only 9 were females and 91 were males most of studies which related to trauma concluded that males are more commonly affected than females. Devarshi Rastogi Sanjay Meena *et al*., conducted a study in 2014 over 748 patients to study epidemiology of major trauma admitted to tertiary care centre in northern India they concluded that males incurred trauma more than females with male to female ratio 6:1 [21].

Out of 100 cases 87 cases were due to RTA (road traffic accidents), 9 cases were Due to pedestrian injuries and 4 cases were due to train injuries. The association between the mechanism of injury and anatomical distribution of injury has been well recognized. Lower limb injury is most commonly associated with motorbike crash and MVAs. There were 6 cases of RTA where patients died, out or remaining 81 patients in 46 (56.8%) amputation occurred and 35 (43.2%) were salvaged. Scalea *et al*., conducted a study at western trauma association and conclude motor vehicle accidents are the leading causes of such injuries and lower extremities involved in 78%, they also said the most significant factor involved with the injury mechanism is the amount of energy transferred to the extremity rather than the actual mechanism, there amputation rates were 62.13% in MVA [22].

There were 59 open fractures and 35 closed fracture in this series and as expected, morbidity and mortality were more in the open fracture group. Open fractures associated with high amputation rates. Whereas there was a salvageability rate of 62.9% and amputation rate of 37.1% in the closed fractures group. Gopinathan *et al*., study 2017 there were 62% open fractures and amputation rate was 60% in them and 31% salvageability rates [23]. Tibia is the most common bone fractured 57%, followed by femur 29% remaining 14% patient had both tibia and femur bone fractured, 6 patient died. Study of Gopinathan *et al*., also said that tibia is the most common bone fractured [23].

Limb salvageability percentage was 51.6% when the patient presents within 12h of injury. Total 60 patients presented within 12 h out of which 32 (51.6) salvaged and 30 (48.4%) amputated. This salvageability percentage reduced drastically to 18.2% if the patient had presented more than 24 h after injury. Cakir o *et al*., also concluded that delay in vascular surgery associated with higher rate of amputations [24]. In our series, there were 64 cases of popliteal artery injury, 27 cases of femoral artery injury, and 7 cases of anterior tibial and 2 cases of posterior tibial artery injury. This goes in hand with some of the other studies which show that popliteal artery is the most common injured structure in lower limb vascular injuries [25]. On the contrary to our findings in Indian patients, according to Gupta *et al*., femoral artery is the most common injured structure in lower extremity vascular trauma in Australian population [26]. Nevertheless, the limb salvageability percentage in popliteal artery injury group was a mere 22%, 13 patients which had popliteal artery injury limb is salvaged and 46 patients of popliteal artery injury limb is amputated 78%, whereas limb salvageability percentage was as much as 88.5% in the femoral artery injury group, showing that the prognosis was much better when the patient had femoral artery injury. Study of Shi L *et al*., also said that popliteal arteries are most common injured and amputation rates are also higher

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in them. Gopinathan *et al*., there were 31 cases (62%) of popliteal artery injury, 14 cases (28%) of femoral artery injury, and 5 cases of anterior tibial and posterior tibial artery injury. the limb salvageability percentage in popliteal artery injury group was a mere 25% whereas it was as much as 64% in the femoral artery injury group.

In this study 53 cases of complete transaction of vessel out of which 43 amputated (81.1%) and only 18.9% salvaged. Partial tear in 12 cases out of them 66.7%, 8 cases salvaged and 33.3% cases amputated, thrombosis of vessels had best salvagibility of 75.9%. There were 21 cases where vessel repaired out of them 52.4% salvaged.

Conclusion

This study shows the epidemiology of lower limb vascular injury trauma associated with lower limb fractures in India. MVA in young males is the leading cause of these injuries in India. Motorbikes with high speed trauma cause more severe injury to lower limbs. Popliteal artery is the most commonly injured vessel, but the prognosis is much better in femoral artery injuries. Open fractures had worse morbidity and mortality outcomes. Patients presenting in the first 12 h after injury had a better limb salvageability rate. Motor vehicle safety and prevention programs targeting young males are most likely to have a greatest effect on vascular injury rate, and the results of this study may be used for preventive strategic planning of these injuries.

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