Print ISSN: 2321-6379
Online ISSN: 2321-595X
DOI: 10.17354/ijss/2017/502

Original Article

Functional Outcome Analysis of Long Bone Fractures and Dislocation with Vascular Injury

G Balasubramanian[1], S Marimuthu[2], Heber Anandan[3]

[1]Assistant Professor, Department of Orthopaedics, Tirunelveli Medical College, Tirunelveli, Tamil Nadu, India, [2]Senior Assistant Professor, Department of Orthopaedics, Thoothukudi Medical College, Thoothukudi, Tamil Nadu, India, [3]Senior Clinical Scientist, Department of Clinical Research, Dr. Agarwal's Health care Limited, Tirunelveli, Tamil Nadu, India

Abstract

Introduction: Fractures with an arterial injury requiring vascular repair are severe injuries. This type of fracture is often associated with severe soft tissue compromise and damage of neurological structures.

Aim: To study the pattern of fractures and dislocations associated with vascular injury of extremities and outcomes of fracture union, function of the limb and complications in relation to fracture pattern and modality of treatment.

Materials and Methods: A total of 31 patients admitted in the emergency ward with fractures and associated with vascular injury was taken into this study. All patients have been taken up for surgical intervention both for vascular repair by vascular surgeons and skeletal fixation by us.

Results: Mode of injury was road traffic accidents in 27 patients (87%) of which fall from riding a two-wheeler predominated. Lower limb was most commonly involved (26 cases) and most common bone fractured was tibia. Closed fractures with vascular injury occurred in 10 cases and open injury in 21 cases. Most common artery to be involved was popliteal artery (21 cases). Patients with less Ganga Hospital scoring had improved outcome in the form of early soft tissue healing and early rehabilitation. One patient with mangled extremity severity score of 8 and Ganga Hospital score of 15 expired because of crush syndrome.

Conclusion: Initial management with external fixation allows time to assess the viability of limb, edema to subside and soft tissue to recover. Delay in surgery and extensive soft tissue injury are associated with increased amputation rate.

Key words: Arterial injury, Bone fracture, Thrombolysis

INTRODUCTION

Trauma frequently involves the bones of the extremities. This can also involve the vessels of the extremities either directly from the initial injury or secondarily from the fragments of the fractured bone.[1] 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 and the function of the limb. With advanced improvement of arterial repair and regaining the vascularity of the limb, issues to be noted are methods of fracture management and complications associated with it. Furthermore, adequate vascularity of the limb is needed for the fracture union. As a result, there can be delay in union or non-union of the fracture fragments.[2-4] Furthermore, decreased vascularity alters the local immunity leading to the development of infection. Peripheral arterial injuries occur 90% in the extremity associated with fractures and dislocation.[5] Early mobilization of the limb prevents the development of disuse atrophy and makes the patient return to his daily activities. Popliteal artery injuries are among the most challenging of all extremity vascular injuries. The outcome depends predominantly on the force of injury. The popliteal vein and popliteal nerve are frequently involved associated injuries with popliteal artery. Popliteal artery (20-60%) is at risk during traumatic dislocation of the knee owing to the bowstring effect across the popliteal fossa secondary to proximal and distal tethering.[6-8]

Access this article online

www.ijss-sn.com

Month of Submission : 08-2017
Month of Peer Review : 09-2017
Month of Acceptance : 10-2017
Month of Publishing : 10-2017

Corresponding Author: S Marimuthu, Department of Orthopaedics, Thoothukudi Medical College, Thoothukudi, Tamil Nadu, India. Phone: +91-9894447770. E-mail: drsmms74@gmail.com

Aim

To study the pattern of fractures and dislocations associated with vascular injury of extremities and outcomes of fracture union, function of the limb and complications in relation to fracture pattern and modality of treatment.

MATERIALS AND METHODS

This prospective study was conducted in a tertiary care hospital. 31 Patients admitted to emergency ward with fractures and associated with vascular injury was taken into this study. The study was Approved by the Ethical Committee of the Hospital, and informed consent has been obtained from the patient. All patients have been taken up for surgical intervention both for vascular repair by vascular surgeons and skeletal fixation by us. Wounds were classified into open and closed. For Grade III A and III B wounds plastic surgeon opinion and if needed intervention has been done.

Inclusion Criteria

Age >18 years, fracture of femur, tibia, humerus, radius and ulna with vascular injury, knee and elbow dislocation with vascular injury, Class I and II ischemia, mangled extremity severity score (MESS) ≤8.

Exclusion Criteria

Crush injury, train traffic accident, polytrauma patient (associated with abdomen and chest injury), Class III ischemia, MESS score >8.

RESULTS

Mean age of the patients at the time of presentation was 30.9 years (range: 17-50 years). Majority of them were male (29 patients), with road traffic accidents (RTA) were the predominant mode of injury (27 cases). In upper limb fractures of 5 cases, 3 cases of dominant right side, and 2 of the left side (Table 1). In lower limb fractures equal distribution of right and left side was present. Average delay between injury and repair was 10.25 h range between 4 h and 24 h in 28 patients. Closed fractures with vascular injury occurred in 10 cases and open injury in 21 cases. Most common artery to be involved was popliteal artery (21 cases) (Table 2). In 4 patients with closed fractures with immediate primary fixation, there was one delayed union in shaft of femur, and superficial infection in one case of shaft of femur. One patient developed graft failure and AK amputation done. In 12 cases of open injuries with fractures with viable limb all developed knee stiffness. In 8 closed fractures with viable limb 5 knee stiffness. Knee stiffness developed in patients treated with external fixation primarily. Malunion developed in 3 cases treated with external fixation alone (Table 3). Infection was present in 6 cases of open injuries and 4 closed injuries. 4 were superficial and 6 required debridement. Infection occurs in about 10 cases of lower limb fractures 8 were open and 2 were closed injuries, requiring repeated debridement in 5 cases. Patients with less Ganga Hospital scoring had improved outcome in the form of early soft tissue healing and early rehabilitation. One patient with MESS score of 8 and Ganga Hospital score of 15 expired because of crush syndrome. In 4 cases of brachial artery injuries, 3 patients had associated median nerve injury. 5 patients had above-knee amputation after vascular repair. It was done in 4 patients with open injuries and 1 with closed injuries, 4 due to graft failure, and 1 due to infection. Amputation rate was 16%. There was 1 death due to crush syndrome, reverse saphenous vein graft was the vascular repair done in 27 cases. There was a mean hospital stay of 4 months with open Grade III injuries.

DISCUSSION

In patients with fractures or dislocation associated vascular injury may be due to the effect of direct trauma, or fracture fragments may tent on the vessel causing occlusion.

Table 1: Distribution of fractures

Fractures	Number of cases (%)
BB leg or proximal tibia	13 (42)
Distal femur and tibia	3 (10)
Supra condylar femur	3 (10)
Shaft of femur	6 (19)
Shaft of humerus	3 (10)
Distal radius	1 (3)
Knee dislocation	1 (3)
Elbow dislocation	1 (3)

Table 2: Distribution of artery injured

Artery injured	Number of cases
Femoral artery	4
Femoral vein	1
Popliteal artery	21
Brachial artery	4
Radial artery	1

Table 3: Distribution of mode of treatment

Mode of treatment	Number of cases (%)
External fixation alone	19 (61)
External fixation with minimal internal fixation	3 (10)
Minimal internal fixation alone	1 (3)
Primary external fixation/secondary ORIF and plating	4 (13)
Primary ORIF and plating	4 (13)

ORIF: Open reduction and internal fixation

Immediate decision has to be taken to avoid the serious catastrophe of limb amputation in such patients.[9] The time of pre-operative evaluation should be as short as possible to minimize ischemia time and thus prevent potential necrotic changes. The severity of ischemia depends not only on its duration but also on the level of arterial injury, extent of soft tissue damage, and efficiency of collateral circulation. The average age in a series by Mirdad[6] 29.6 years and male to female ratio of 9.8-1 which suggests that these serious injuries occur in people engaged with active and probably dangerous activities in the most productive stages of life. In our study, mean age was 30.9 years with a male to female ratio of 9.3-0.7. In Mirdad[6] study, RTA were primarily responsible for this type of injury (67.4%). In our study also RTA predominate in 87% of patients. Early application of systemic anticoagulation therapy[4] (heparin 100 U/kg i.v) reduces amputation rate. It also prevents thrombosis in microcirculation. In our cases, the anticoagulant treatment was initiated in the emergency if systemic anticoagulation was not contra-indicated (active hemorrhage, coagulopathy, and craniocerebral injury) in the dose of 5000 IU i.v stat (100 U kg/i.v). Then, the decision is to be taken whether to fix the fragment first or to vascular repair and also to do definitive or temporary fixation. Starr *et al*.[2] in his study on 19 patients with femoral fractures in 10 patients he performed primary internal fixation followed by vascular repair and in 9 patients initial vascular repair followed by internal fixation he found no difference. In their study, he used temporary shunts in patients with prolonged ischemia time. Al-Salman[4] in his study preferred primary vascular repair in cases involving stable fractures. Then, after fixation checked for damage to the vascular structures. With unstable fractures, they performed bone fixation before vascular repair. In our study, we performed vascular repair primarily in all cases before bone fixation and checked for vascular damage after fixation (Table 4). Graft failure was in 4 cases. Iannacone *et al*.[1] in his study in patients with associated injury and for time constraints he temporarily stabilized the fragments with external fixator in femoral shaft fractures then converted into exchange nailing or plating. DiChristina *et al*.[3] in 8 open femoral fractures 3 patients had persistent discharge and 2 patients had AK amputation. None of the patients had more than 90° of knee flexion whereas there is a full range of knee motion in patients with closed fractures. In our study, all patients with open injuries had decreased range of knee motion. In our study, 7 patients with open femur fracture had knee stiffness and range of motion was <90°. Topal *et al*.[8] in his study performed prophylactic fasciotomy in patients with ischemia duration longer <6 h or major soft tissue disruption. Major soft tissue defect renders vascular repair impossible. Even if repair is possible, it may cause the development of compartmental hypertension by interrupting collateral blood supply to distal arteriolar bed. In his study, he also concluded prophylactic fasciotomy prevents the development of compartmental hypertension in those with two bone fractures below knee multiple arterial injuries and gross soft tissue disruption. Al-Salman *et al*.[4] also showed doing fasciotomy in vascular injuries associated with orthopedic trauma decrease the risk of compartment syndrome. Cakir[10] in a series of 192 cases between 1982 and 2005 preferred external fixation in the majority of cases of about 76 cases. The advantage includes less tissue destruction, less operative time for immobilization and less potential for infection in contaminated wounds. Furthermore, daily debridement and irrigation of the wound in case of severe soft tissue injury. Repair of concomitant venous injuries[11] is recommended this prevents post-operative edema and keeps the arterial repair open. Proximal vein injuries such as axillary vein, brachial vein in the arm and femoral vein has to be repaired primarily to improve outcome. Treatment of vascular trauma also includes appropriate management of soft tissue injury. Multiple debridements were needed in several of our patients to control the infection.

Table 4: Distribution of vascular procedure

Vascular procedure	Number of cases (%)
RSV graft	27 (87)
Thrombectomy	2 (6.5)
Topical papaverine application	1 (3.25)
Observation	1 (3.25)

RSV: Reverse saphenous vein

CONCLUSION

Assessment of vascular injuries in fractures and dislocation based on clinical examination and hand Doppler reduces the assessment time than on imaging. Patients with Grade I, II, and III A injuries with vascular injury internal fixation are the ideal method to fix the fracture. Initial management with external fixation allows time to assess the viability of limb, edema to subside and soft tissue to recover. Delay in surgery and extensive soft tissue injury are associated with increased amputation rate. In closed injuries with stable fracture can be stabilized through the same approach undertaken for vascular repair. Earlier rehabilitation reduces joint stiffness and improves muscle power. Early intervention prevents myonecrosis and its complication.

REFERENCES

1. Iannacone WM, Taffet R, DeLong WG Jr, Born CT, Dalsey RM, Deutsch LS. Early exchange intramedullary nailing of distal femoral fractures with vascular injury initially stabilized with external fixation. J Trauma 1994;37:446-51.
2. Starr AJ, Hunt JL, Reinert CM. Treatment of femur fracture with associated vascular injury. J Trauma 1996;40:17-21.

3. DiChristina DG, Riemer BL, Butterfield SL, Burke CJ 3rd, Herron MK, Phillips DJ. Femur fractures with femoral or popliteal artery injuries in blunt trauma. J Orthop Trauma 1994;8:494-503.
4. al-Salman MM, al-Khawashki H, Sindigki A, Rabee H, al-Saif A, al-Salman F. Vascular injuries associated with limb fractures. Injury 1997;28:103-7.
5. Boisrenoult P, Lustig S, Bonneviale P, Leray E, Versier G, Neyret P, *et al*. Vascular lesions associated with bicruciate and knee dislocation ligamentous injury. Orthop Traumatol Surg Res 2009;95:621-6.
6. Mirdad T. Neuro-vascular injuries associated with limb fractures. East Afr Med J 2009;77:663-6.
7. Halvorson JJ, Anz A, Langfitt M, Deonanan JK, Scott A, Teasdall RD, *et al*. Vascular injury associated with extremity trauma: Initial diagnosis and management. J Am Acad Orthop Surg 2011;19:495-504.
8. Topal AE, Eren MN, Celik Y. Lower extremity arterial injuries over a six-year period: Outcomes, risk factors, and management. Vasc Health Risk Manag 2010;6:1103-10.
9. Cone JB. Vascular injury associated with fracture-dislocations of the lower extremity. Clin Orthop Relat Res 1989;243:30-5.
10. Cakir O, Subasi M, Erdem K, Eren N. Treatment of vascular injuries associated with limb fractures. Ann R Coll Surg Engl 2005;87:348-52.
11. Feliciano DV, Herskowitz K, O'Gorman RB, Cruse PA, Brandt ML, Burch JM, *et al*. Management of vascular injuries in the lower extremities. J Trauma 1988;28:319-28.

How to cite this article: Balasubramanian G, Marimuthu S, Anandan H. Functional Outcome Analysis of Long Bone Fractures and Dislocation with Vascular Injury. Int J Sci Stud 2017;5(7):90-93.

Source of Support: Nil, **Conflict of Interest:** None declared.