



**ORIGINAL RESEARCH PAPER**

**Orthopaedics**

**TO IDENTIFY SPECTRUM OF POST OPERATIVE COMPLICATIONS AND APPROPRIATE MANAGEMENT IN POLYTRAUMATIZED PATIENTS WITH MUSCULOSKELETAL INJURIES**

**KEY WORDS:**

Polytrauma, musculoskeletal injuries, complications, Delayed union, ARDS

**Dr. Shaneed Karinkappara**

Consultant orthopaedic surgeon, K.K hospital, Balussery, Calicut-673612 Kerala, India.

**Dr. Ankur Babu\***

Junior resident, SIMS hospital, Vadapalani, Chennai, Tamil nadu-60002, India  
\*Corresponding Author

**ABSTRACT**

The treatment of polytrauma patients with musculoskeletal injuries is fraught with various complications. The present study was conducted to identify the spectrum of post operative complications and appropriate management in polytraumatized patients with musculoskeletal injuries. The study was conducted at MIOT Hospitals, Chennai, India from 1-Oct-2014 to 1-Dec-2015 for a period of 14 months. One hundred and forty nine cases of poly-trauma with musculoskeletal injuries were selected and classified as stable, borderline, unstable and in extremis and received either ETC or DCO. The patients were objectively evaluated pre-operatively, post operatively and at 2 weeks, 2 months, 4 months and 6 months after discharge. Among the 149 patients, 140 instances of complication were noted. Delayed union and ARDS were the most common post operative complications found in this study.

**INTRODUCTION**

The term "polytrauma" has been in use for many decades. It is generally used to describe (mainly) blunt trauma patients whose injuries involve multiple body regions or cavities, compromise the patient's physiology and potentially cause dysfunction of uninjured organs. Keel and Trentz defined polytrauma as a syndrome of combined injuries with an injury severity score (ISS > 17) and consequent SIRS for at least one day, leading to dysfunction or failure of remote organs and vital systems, which had not been directly injured themselves(1).

Musculoskeletal injuries involve an extremity and/or pelvic girdle. Musculoskeletal injuries are seen in 70-80% of polytrauma patients(2). As opposed to those in isolated cases, musculoskeletal injuries in polytrauma patients can be complicated to treat. Immediate and early deaths in polytrauma are determined by severe primary brain injuries, or significant blood loss (haemorrhagic shock) after blunt, or penetrating, trauma(3). Late mortality is caused by secondary brain injuries and host defense failure(3). Direct, or indirect, mechanical forces induce organ and soft tissue injuries, or fractures. However, these first hits represent a greater challenge, as local tissue damage, such as contusions or lacerations, hypoxia and hypotension, induce further local and systemic host responses, to preserve the immune integrity and stimulate reparative mechanisms(4). This systemic inflammation was defined in 1991, through the consensus conference of the American College of Chest Physicians/Society of Critical Care Medicine (ACCP/SCCM), as systemic inflammatory response syndrome (SIRS)(5). At least two of the four clinical parameters (Figure 1) must be fulfilled for the diagnosis of SIRS(5).

Defined parameters of SIRS	
Body temperature	>38° or <36° C
Heart rate	>90 beats/min
Respiratory rate	>20 /min or Pao <sub>2</sub> <32 mm Hg
White blood cell count	>12,000 or <4000 mm <sup>-3</sup> or >10% band forms

**Figure 1 PARAMETERS OF SIRS**

It is characterized by the local and systemic production and release of different mediators, such as pro-inflammatory cytokines, complement factors, proteins of the contact phase and coagulation systems, acute phase proteins, neuroe

ndocrine mediators and an accumulation of immunocompetent cells at the local site of tissue damage(6,7). In addition, this systemic inflammation is augmented by second hits, such as ischaemia/reperfusion injuries, surgical interventions or infections (two-hit theory)(4,7).

**Therapeutic strategies for multiply injured patients**

Hypoxia and severe haemorrhagic shock correlate with high mortality rates, as well as with an high incidence of SIRS, sepsis and organ dysfunction(8). To reduce these high mortality and morbidity rates in the post-traumatic course, early "preventive" interventions are necessary. According to the guidelines of advanced trauma life support (ATLS), early oxygenation therapy by intubation and controlled assisted ventilation and an adequate volume therapy with crystalloids, colloids and/or blood products are essential(9). However, the large-volume loading scheme is the subject of controversial debate in severe haemorrhagic shock(10). Patients with blood loss > 2l should not be overwhelmed by crystalloids or colloids until surgical management of bleeding is undertaken, whereas in septic shock early, goal-directed, high volume therapy is successful(11).

After the primary survey, with basic imaging, multiply injured patients are graded as non-responders, "borderlines" and responders, according to the initial response to volume therapy, or pharmaceutical resuscitation(9). Lifesaving surgical procedures, such as decompressing pneumothorax, cardiac tamponade or acute epidural haematoma, and surgical control of massive haemorrhage in the thoracic or abdominal cavities and from pelvic fractures, or traumatic amputations are carried out without delay(9,12,13). These early interventions seem to limit the systemic inflammation and decrease the early and late mortality(14). Damage control includes haemorrhage control through tamponade, vascular repair or vessel ligation, and organ resections. Furthermore, the temporary stabilization of pelvic and long bone fractures, or dislocations of large joints, by rapidly assembled and applied external fixators seem to be beneficial(12). This concept decreases the systemic release of pro- and anti-inflammatory mediators, in comparison with definitive interventions, such as reamed nailing (early total care)(15). Debridement of open wounds and fractures, with resection of non-viable tissues, temporary closure by vacuum assisted closure therapy and second look interventions, contribute to a limited antigenic load, with a decrease in septic complications(16). However, the early stabilization of major skeletal injuries (early total care) represents still the concept for patients with isolated fractures and in the absence

of high traumatic impact and the risk factors mentioned above(15,16).The severity of consequent illness and the resulting disability is high compared with other disease processes(17).

**COMPLICATIONS OF MUSCULO-SKELETAL INJURIES**

- Complications can be
- A) General
    - .Haemorrhage
    - .Shock
  - B) Local
    - .Affection of peripheral nerves
    - .Affection of main blood vessels
      - Partial - ischaemia
      - Complete - gangrene
    - .Tendon injuries
    - .Affection of joints
    - .Affection of viscera
- Complications based on the timing of presentation:
- A)1st day to 2 weeks:
    - General
      - Crush syndrome
      - Fat embolism,ARDS, DVT
      - Fracture fever
      - Tetanus
      - Gas gangrene
      - Infection
      - Septicaemia.
    - Local
      - Blisters formation
      - Compartment syndrome
      - Myositis ossificans
      - Volkman's ischaemia
  - B)2weeks to 12 weeks:
    - .Pulmonary embolism
    - DVT
    - Tetanus
    - .compartment syndrome
    - Myositis ossificans
    - Nerve affection
    - Plaster disease
    - Mal union
    - .Delayed union
    - Non union
    - Cruse union
    - AVN
    - Rupture of tendon(eg. EPL in old collar )
    - Traumatic degenerative arthritis(knee, hip, ankle)
    - Delayed nerve complication(tardy ulnar nerve palsy, carpal tunnel syndrome)
    - Growth disturbances
    - .sudeck's osteodystrophy
    - .stiffness of joints- even ankylosis.

**Fig.2 LIST OF COMPLICATIONS**

**AIM OF THE STUDY**

The aim of the study is to identify the spectrum of post operative complications and appropriate management in polytraumatized patients with musculoskeletal injuries.

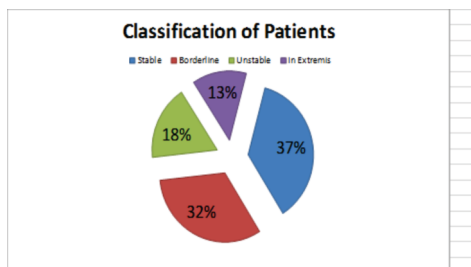
**MATERIALS AND METHODS**

This was a prospective study.The study was conducted on polytrauma patients with musculoskeletal injuries who were admitted to MIO T International hospitals from the period 1-10-2014 to 1-6-2015.Regular follow ups were post operatively before discharge and at 2 weeks, 2 months, 4 months and 6months after discharge till 1-12-2015. Initially 230 patients who fit the inclusion criteria were included for the study. Of these 81 were lost to follow up and thus excluded.Children, pregnant women, patients who were treated at other centers, patients with concomitant psychiatric or terminal illness and those with GCS 3 were excluded from the study.

**RESULTS AND OBSERVATIONS**

A total of 230 polytrauma patients with musculoskeletal injuries were seen in the emergency department in the period from 1-10-2014 to 1-6-2015. Eighty one patients were rejected because of the exclusion criteria or lost to follow up from the trial subsequently. One hundred and forty nine patients (n=149) with polytrauma and musculoskeletal injuries who fit the selection criteria were chosen from them to be the test subjects and they were then followed over a period of 4 to 12 months.

**CLASSIFICATION OF PATIENTS**

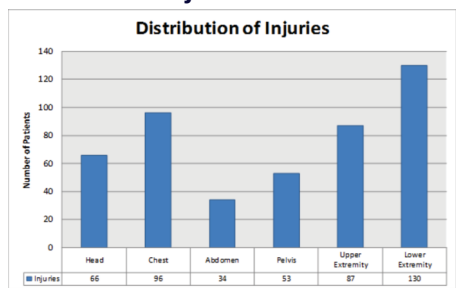


**Fig.3 CLASSIFICATION OF PATIENTS**

The patients were triaged into the stable, borderline, unstable and in extremis depending upon the condition at admission. Factors like shock, coagulation, hypothermia and soft tissue

injuries were taken into consideration. Data shows that 36.91% (n=55) of the patients were in stable condition, 32.20%(n=48) of the patients were in borderline condition, 17.45%(n=26) of the patients were classified as unstable and 13.42%(n=20) of the patients were classified to be in extremis condition.

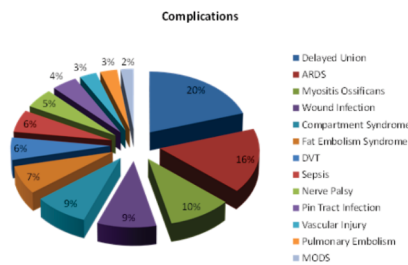
**DISTRIBUTIONS OF INJURIES**



**Figure 4 DISTRIBUTIONS OF INJURIES**

Head injuries were seen in 44.30% (n=66) of patients. Chest injuries were seen in 64.43% (n=96) of patients. Abdominal injuries were present in 22.82% (n=34) of patients.

**PERCENTAGES OF COMPLICATIONS OF POLYTRAUMA PATIENTS**



**Fig 5 PERCENTAGES OF COMPLICATIONS OF POLYTRAUMA PATIENTS**

Delayed union was 20% (n=28) and ARDS was 16.42% (n=23) of all complications (n=140). Together they made up for little less than half of all complications. There other complications were myositis ossificans at 10%(n=14), wound infection at 9.28%(n=13), compartment syndrome at 8.57%(n=12), fat embolism syndrome at 7.14% (n=10), DVT at 5.71%(n=8),sepsis at 5.71% (n=8),nerve palsy at 5%(n=7) pin tract infection at 4.28% (n=6),vascular injury at 2.85% (n=4),pulmonary embolism at 2.85% (n=4) and MODS at 2.14% (n=3).

**DISCUSSION**

Injury is a global pandemic and the second most costly disease worldwide, with the burden set to increase. The extremities and the pelvis are the most frequently injured body areas; however, thoracic trauma and abdominal trauma are specific markers for polytrauma and carry the greatest mortality risk in the young. Overall, most polytrauma deaths occur in the context of head and thoracic trauma. Polytrauma is rare in those over 65 years, and has double the mortality of younger adults. Within the younger age groups, the mortality associated with polytrauma is greater than the sum of its parts, suggesting a role for targeted improvements in care.

The study was able to observe the management of 149 polytrauma patients with musculoskeletal injuries that were admitted into a tertiary care facility. The treatment of polytrauma patients with musculoskeletal injuries is fraught with complications. Among the 149 patients, 140 instances of complication were noted.

Lower extremity injuries affected 87.2% (n=130) of the polytrauma patients which was more than upper extremity injuries in 58.39%(n=87) of patients. Chest and head injuries were next higher in frequency with 64.43% (n=96) and 44.30% (n=66). Pelvic injuries were rarer, affecting 35.57% (n=53) of patients. This pattern is consistent with what is expected in RTAs.

Complications	Instances	Percentage
Delayed Union	28	20%
ARDS	23	16.42%
Myositis Ossificans	14	10%
Wound Infection	13	9.28%
Compartment Syndrome	12	8.57%
Fat Embolism Syndrome	10	7.14%
DVT	8	5.71%
Sepsis	8	5.71%
Nerve palsy	7	5%
Pin Tract Infection	6	4.28%
Vascular injury	4	2.85%
Pulmonary embolism	4	2.85%
MODS	3	2.14%
Total	140	100%

**Table 1 LIST OF COMPLICATIONS**

**DELAYED UNION**

About 28 cases of delayed union has observed in this study and most of them are lower extremity fractures. Delayed union in the lower extremities were treated conservatively as well as surgical management. Conservative treatment in the form of wait and watch method by starting weight bearing and serial X rays to look for clinico-radiological union. We have waited period 4 to 5 months before initiating an intervention. Surgical method was cancellous bone grafting alone or associated with augmentation plating and dynamization in cases of standard femur/tibia nailing. There were no cases of non union noticed in this study.

**ARDS**

A total of 23 cases are noticed. Most of them improved with medications and ventilator support. In established cases, ventilation with positive pressure ventilation in combination with PEEP mode to maintain adequate tissue oxygenation. It will prevent atelectasis and minimize O2 toxicity. Combined treatment with high dose steroids and vasodilators also given.

**DVT**

A total of 8 cases has presented with DVT in post operative period and all cases were from third and fourth category. Prevention of DVT is the corner stone of management. Prophylactic use of antiplatelets drugs and anticoagulant therapy. All the patients with long bone injuries were started on anticoagulants as a prophylactic therapy .Injection heparin was given at a dose of 4000 to 6000 units twice or thrice daily according to the weight of the patients and LMWH (Enoxaparin sodium) given at a dose of 40mg to 60mg SC per day. Both are continued for a time period of 12 to 15days post operatively.

Physical and mechanical measures like free moving of joints, elevation of lower limbs, using elastic compression stocking , use of pneumatic external compression prevents DVT. Out of 8 patients 4 of them developed pulmonary embolism. All of them underwent resuscitative measures, balanced fluid administrations, positive pressure ventilation, vacopressors and heparin infusion. Two of them underwent pulmonary embolectomy also.

Patient with especially pelvic fractures and severe distal humerus fracture with intercondylar extension underwent radiotherapy (7Gy) in preoperative and postoperative period. Patient with pelvic injury also underwent IVC filter deployment to prevent PE.

**Myositis Ossificans**

13 cases of heterotopic ossification has found in this study. Most of them were seen in patients on ventilator support. Most common sites were acetabulum, elbow and shaft of femur etc.

Acute cases: rest and splints to the limb in neutral position to prevent stretching and movement to prevent haematoma formation. Passive stretching exercises were avoided. Chronic cases – considered excision of bony mass once the maturity has attained (Based on CRP and bone scan). Indomethacin or radiotherapy (7Gy units) given to prevent recurrence. As a prophylaxis, indomethacin 50mg given twice daily for 7days.

**Wound Infection**

Seen with compound fractures and patients in immunocompromised status. Mainly treated with repeated wound debridement and higher broad spectrum antibiotics. Some cases involving large areas needed soft tissue coverage later.

**Compartment Syndrome**

A total of 12 cases noticed in this study. All of them are associated with lower extremity fractures, especially proximal tibia fractures. Those cases with impending compartment syndrome was treated with strict limb elevation, ice pack application and continuous clinical evaluation. Those established cases treated immediately with surgery in the form of fasciotomy with or without spanning external fixator and later underwent definitive fracture stabilization and soft tissue coverage.



Figure shows double incision fasciotomy ,four compartments release and knee spanning ex.fixator application.

**Fig. 6 DOUBLE INCISION FASCIOTOMY AND KNEE SPANNING EXT.FIXATOR APPLICATION**

**Fat Embolism Syndrome**

Main aim is to relieve hypoxemia by administration of oxygen.

In severe cases:Oxygenation,Ventilator support, Steroids, Heparin Most important thing is early fracture fixation and mobilization of the patient. That decreases the incidence of fat embolism syndrome and respiratory failure.

**Nerve palsy**

The majority of nerve injuries are either neuropraxia or axonotemesis. Most of the injuries recover on their own by the time the fracture has united . Treatment includes supporting the paralysed muscles with appropriate position with splints to prevent the contracture.

**Pin Tract Infection**

Total 6 cases of pin tract infections were noticed. Most of them treated conservatively with antibiotics and daily dressings. Some cases required relocation of pin or removal of external fixator.

**Vascular injury**

Total 4 cases was in this study. All of them underwent emergency repair of vessel by vascular surgeon. Other cases with minimal vessel injury and vascular spasm treated conservatively.

**CONCLUSION**

Musculoskeletal injury in polytrauma cases warrant specialized care for achieving best outcomes. Polytrauma cases present with injuries to multiple systems of the body. They should ideally be treated in a tertiary center with access to multiple specialists like neurosurgeons, vascular surgeons, cardiothoracic surgeons, general surgeons and intensive care specialists, in addition to orthopaedic surgeons. Then we can reduce the post operative complications to a major extent.

There are advantages to early definitive surgery for most patients. Being forced to stay in a hospital in a recumbent and immobile condition can result in dysfunction of multiple organ systems, leading to a variety of disorders, including pneumonia, decubitus ulcers, vascular abnormalities, profound joint stiffness, disuse muscle atrophy, psychological disturbance, and gastrointestinal stasis, which is associated with a high risk of aspiration. Benefits of early fracture stabilization include early mobilization of the patient and beneficial effects on the clinical course of the multiply injured patient, decreasing above mentioned complications. Appropriate multidisciplinary approach in a tertiary care centre in the golden hour following injury can reduce early complications. Identification of appropriate complications on time and adequate management is essential for better functional outcome of polytrauma patients.

**LIMITATIONS**

As long term follow up is not available, occurrence of delayed complications in polytrauma patients with musculoskeletal injuries were not commendable. Total number of cases are less in this study to delineate the exact complications in a polytrauma patients. Lack of high level evidence with adequate size seems to be the major limitation.

**CONFLICT OF INTEREST STATEMENT**

There is no conflict of interest associated with this research article.

**REFERENCES**

1. Keel M, Eid K, Labler L, et al. Influence of injury pattern on incidence and severity of posttraumatic inflammatory complications in severely injured patients. *European Journal of Trauma*. 2006 32:387-395.
2. Lecky FE, Bouamra O, Woodford M, Alexandrescu R, O'Brien SJ. Chapter 2, Epidemiology of polytrauma; In: Pape HC, Peitzman A, Schwab CW, Giannoudis PV, editors. *Damage control management in the polytrauma patient*. DOI 10.1007/978-0-387-89508-6\_2, Springer Science+Business Media, LLC 2010, p 13-23
3. Acosta JA, Yang JC, Winchell RJ, et al. Lethal injuries and time to death in a level I trauma center. *J Am Coll Surg* 1998;186:528-33.
4. Rotstein OD. Modeling the two-hit hypothesis for evaluating strategies to prevent organ injury after shock/resuscitation. *J Trauma* 2003;54(Suppl. 5):203-6.
5. Definitions for sepsis and organ failure and guidelines for the use of innovative therapies in sepsis. In: American College of Chest Physicians/Society of Critical Care Medicine Consensus Conference. *Crit Care Med* 1992;20:864-74.
6. Smith RM, Giannoudis PV. Trauma and the immune response. *J R Soc Med* 1998;91:417-20.
7. Roumen RM, Redl H, Schlag G, et al. Inflammatory mediators in relation to the development of multiple organ failure in patients after severe blunt trauma. *Crit Care Med* 1995;23:474-80.
8. Jarrar D, Chaudry IH, Wang P. Organ dysfunction following haemorrhage and sepsis: mechanisms and therapeutic approaches. *Int J Mol Med* 1999;4:575-83 [review].
9. Collicott PE, Hughes I. Training in advanced trauma life support. *JAMA* 1980;243:1156-9.
10. Moore FA, McKinley BA, Moore EE. The next generation in shock resuscitation. *Lancet* 2004;363(9425):1988-96.
11. Rivers E, Nguyen B, Havstad S, et al., Early Goal-Directed Therapy Collaborative Group. Early goal-directed therapy in the treatment of severe sepsis and septic shock. *N Engl J Med* 2001;345:1368-77.
12. Ertel W, Keel M, Eid K, et al. Control of severe haemorrhage using C-clamp and pelvic packing in multiply injured patients with pelvic ring disruption. *J Orthop Trauma* 2001;15:468-74.
13. Ertel W, Trentz O. Causes of shock in the severely traumatized patient: emergency treatment. In: Goris RJA, Trentz O, editors. *The integrated approach to trauma care*. Berlin, Heidelberg, New York: Springer-Verlag; 1995. p. 78-87.
14. Baue AE, Durham R, Faist E. Systemic inflammatory response syndrome (SIRS), multiple organ dysfunction syndrome (MODS), multiple organ failure (MOF): are we winning the battle? *Shock* 1998;10:79-89.
15. Pape HC, Tornetta P 3rd, et al. Timing of fracture fixation in multi trauma patients: the role of early total care and damage control surgery. *J Am Acad Orthop Surg* 2009;17:541-549.

16. Hildebrand F, Giannoudis P, Krettek C, Pape HC. Damage control: extremities. *Injury* 2004;35:678-89.
17. Holbrook TL, Anderson JP, Sieber WJ, Browner D, Hoyt DB. Outcome after major trauma: 12-month and 18-month follow-up results from the Trauma Recovery Project. *J Trauma*. 1999;46-5:765-71; discussion 71-3.