

## Original research article

**Management of polytrauma-a prospective observational study****Dr. Sushil Kumar Singh<sup>1</sup>, Dr. Rakesh Kumar<sup>2</sup>****<sup>1</sup>Senior Resident, Department of Orthopaedics, Vardhman Institute of Medical Sciences, Pawapuri, Nalanda, India.****<sup>2</sup>Senior Resident, Department of Orthopaedics, Vardhman Institute of Medical Sciences, Pawapuri, Nalanda, Bihar, India.****Corresponding Author: Dr. Rakesh Kumar****Abstract**

**Background :** The definition of polytrauma varies among different specialty and different countries, polytrauma patients are the subgroup of severely injured patients who have sustained injuries to more than one body region and organ with any one of the injury being life threatening.

**Aim and objective:** The aim of the present study to assess the management of polytrauma with early appropriate care.

**Materials and Methods:** This prospective observational study was carried out in the department of Orthopaedics, Vardhman Institute of Medical Sciences, Pawapuri, Nalanda, India. from January 2017 to March 2018. Total 100 patients with polytrauma were included in the study all were managed by Early Appropriate Care.

**Result:** Of the 100 patients with poly trauma, 73 (73%) were male and 27 (27%) female. Most of the patients 44 (44%) with poly trauma were in the age group of 30 to 40 years, followed by 27(27%) above 40 years. Out of 100 patients managed using EAC protocol, 16 patients had major complications. 14 out of 16 cases developed fat embolism following surgical intervention as there was involvement of long bones and 2 patient developed deep vein thrombosis (DVT) and ultimately leading to pulmonary embolism (PE). All these cases were treated and managed in the intensive care unit (ICU) for an average period of around 10 days. 2 patients with DVT and PE required mechanical ventilation whereas in the other 3 patients with fat embolism, oxygenation via mask, intravenous fluids and supportive care were sufficient.

**Conclusion:** the low incidence of mortality seems to be associated with EAC protocol. Following adequate resuscitation and correction of acidosis early definitive fixation is possible for bony injuries of polytrauma patients which avoids the need of second surgery.

**Keywords:** poly trauma, hospital stay, EAC protocol

**Introduction**

The term “polytrauma” is mainly used to describe blunt trauma patients whose injuries involve multiple body regions or cavities, compromise patient’s physiology, and potentially cause dysfunction of uninjured organs.<sup>1</sup> Polytrauma is one of the main causes of death in the world. Since young people are frequently involved, trauma is the leading cause of death under the age of 40.<sup>2</sup> Fractures is frequently components of polytrauma patterns. These lesions must be considered as wounds of bone and soft tissue, giving rise to stress, pain, and hemorrhage. They can be contaminated and cause compartment syndromes with ischemia-reperfusion injury.<sup>3</sup> Patients are at risk of higher morbidity and mortality than the summation of expected morbidity and mortality of each individual injury. Although polytrauma patients represent a major therapeutic challenge, improved results can be achieved in dedicated institutions with efficient triage and focused trauma specialist care. The treatment of polytrauma patients noted a

significant development as a result of better understanding of the physiopathological mechanisms of injury, development of a network of prehospital trauma management, institution of multispecialist integrated groups, and improved intensive care resuscitation. In Bihar, there are many roads connecting the major State Highways and National highways which are the busy roads and most vulnerable for road traffic accident (RTA).<sup>4-7</sup> Polytrauma cases comprised 13.3% of all adult trauma cases. The majority of these (60.3%) were due to two wheeler accidents.<sup>8</sup>

Early total care', the first definitive orthopaedic management of all bony fractures is difficult since the additional hemorrhage with orthopaedic surgery may sometimes be connected with a deleterious systemic inflammatory response(SIRS) and related complications in under resuscitated patients, generating a 'second hit' beyond the systemic impact of the injury itself (first hit). In 2000, Scalea et al<sup>9</sup> coined the term 'Damage Control Orthopaedics'-(DCO), the aim was to prevent exsanguinations and death, rather than to definitely treat the broken bone. Stabilization of patient rather than fixation of broken bone becomes important in case of polytrauma, hence the purpose of Damage Control Orthopaedics is to prevent the patients condition worsen by the 'second hit' of a major orthopaedic surgical procedure and to wait for the definitive surgical fracture fixation up to a time where patient is medically fit to undergo the proposed orthopaedics surgery without any major grave risks. Minimally invasive surgical techniques such as external fixation are used initially. Then definitive surgeries will be done in later days. Early appropriate care (EAC), is an immediate resuscitative treatment protocol in orthopaedic trauma management in which we aim to feature any major trauma and address the most time critical injuries of body without adding to their physiological overload to the system. Polytrauma cases with mechanically unstable fractures of the central skeletal bones like pelvis, acetabulum and spine along with longer bones like femur will be stabilized definitively within first 36 hours in patients who responded to a positive response to early and adequate resuscitative care, defined as having either a lactate important to resuscitate the polytrauma patients and to acquire normal laboratory parameters before surgery to reduce post-operative complications.<sup>10-12</sup>

The management of polytrauma patients requires a multidisciplinary approach, usually managed by a trauma team, consisting of emergency physician, orthopedic surgeon, general Surgeon, neurosurgeon, and radiologist. This study aims to assess the prevalence and outcome of polytrauma patients,

### **Materials and Methods**

This prospective observational study was carried out in the department of Orthopaedics Vardhman Institute of Medical Sciences, Pawapuri, Nalanda, India. from January 2017 to March 2018.,after taking the approval of the protocol review committee and institutional ethics committee. Total 100 patients with polytrauma were included in the study all were managed by Early Appropriate Care.

### **Inclusion Criteria**

- Adults patients with polytrauma
- Patients with bilateral femoral fractures
- ISS score>16

### **Exclusion Criteria**

- Patients were excluded for having injuries sustained from low energy mechanisms
- Skeletally immature patients
- Having an ISS score <16
- Patients who needs immediate surgeries

### Methodology

All polytrauma patients getting admitted from the casualty were initially evaluated and assessed, proper history of the injury elicited, rapid systematic assessment is performed immediately to identify the possible life threatening conditions, fracture characteristics, associated injuries, medical co-morbidities, and the timing and techniques of provisional treatment were documented. Vital signs and laboratory parameters were documented. On arrival to casualty blood investigations for total count, haematocrit, blood grouping, arterial blood gas values, lactic acid, ph and base excess were obtained. Once the patients vitals are stabilized secondary survey has been done this being a complete acute diagnostic checkup. Various organ systems involved in trauma were assessed and ISS scoring system was applied to grade the severity of polytrauma. Injury Severity Score (ISS) >16 were involved in the study. Following initial assessment, stabilization and trauma scoring patients were shifted to ICU for further management, further evaluation of the patient done in ICU to obtain other associated medical conditions like hypertension, diabetes and previous cardiac respiratory problems, depending on the severity of injury and acidosis, patients managed aggressively by giving crystalloids, colloids and sodium bicarbonates, blood in case of patients with severe blood loss and in haemorrhagic shock. The second sample to assess haematocrit values, Hb, arterial blood gas values, lactic acid, ph and base excess was sent 8 hours following admission preoperatively following correction of acidosis and blood loss.

Once the acidosis is corrected which is assessed by ph, lactic acid and base excess values, patients were taken up for definitive surgeries according to fracture pattern and type of anaesthesia was chosen accordingly, we could neutralize the acidity level of all patients included in the study within 8- 12 hours, Following surgery patients shifted to ICU for post operative care, proper post operative care was done by ICU intensivist and the third sample 12 hours following surgery for ph base excess and lactic acid obtained. Once these values are normalized patients shifted out from ICU.

Total hospitalization duration, length of ICU stay required with or without ventilator assistance required and also the transfusion requirements during the whole course of treatment were determined. Complications associated to polytrauma and its treatment were assessed, like local wound infections and sepsis if associated, head injuries, pulmonary complications like adult respiratory distress syndrome; pulmonary embolism; pneumonia due to longer ICU stay, acute renal failure, multiple organ dysfunction syndrome (MODS), and deep venous thrombosis (DVT).

### Results

Of the 100 patients with poly trauma, 73(73%) were male and 27 (27%) female. Most of the patients 44(44%) with poly trauma were in the age group of 30 to 40 years, followed by 27(27%) above 40 years. Out of 100 patients managed using EAC protocol, 16 patients had major complications. 14 out of 16 cases developed fat embolism following surgical intervention as there was involvement of long bones and 2 patient developed deep vein thrombosis (DVT) and ultimately leading to pulmonary embolism (PE). All these cases were treated and managed in the intensive care unit (ICU) for an average period of around 10 days. 2 patients with DVT and PE required mechanical ventilation whereas in the other 3 patients with fat embolism, oxygenation via mask, intravenous fluids and supportive care were sufficient. The serum lactate, pH and base excess were assessed in all the patients on arrival at the casualty department. All the patients spent an average duration of 12.5 days in hospital.

**Table 1: gender base distribution**

Gender	N=100	%
--------	-------	---

Male	73	73
Female	27	27

**Table 2: Age distribution**

Age group in years	Cases	
	No.=100	%
below 20	9	9
20 – 30	19	19
30 – 40	44	44
Above 40	27	27
Total	100	100
Range	18– 60 years	
Mean S.D.	35.5yrs , 9.4	

**Table 3: Injury severity score**

Injury Severity Score	Cases	
	No.	%
Below 20	4	4
20 – 30	34	34
30 – 40	30	30
40 – 50	21	21
Above 50	11	11
Total	100	100
Range	18 – 65	
Mean S.D.	37.12,10.79	

**Table 4: Post operative complications**

Post operative Complications	Cases	
	No.	%
Present (Pulmonary Embolism)+ deep vein thrombosis (DVT)	14+2=16	16
Absent	84	84
Total	100	100

**Table 5: Changes in lactic acid values**

Lactic Acid Value	Lactic Acid Value		
	Range	Mean	S.D.
Initial	3 – 7	5.77	0.83
6-8 hours after stabilization (preoperative)	0.8 – 5.1	2.51	1.16
12-15 hours after surgery	0 – 1.9	0.77	0.56
Change in 6-8 hours	-5.5 – (-2.7)	-3.47	0.85
Change in 12-15 hours after surgery	-6.9– (-3.8)	-4.97	0.88

**Table 6: Changes in ph levels**

PH levels
-----------

<b>PH levels at</b>	<b>Range</b>	<b>Mean</b>	<b>S.D.</b>
Initial	7.15 – 7.5	7.3	0.11
8-10 hours after Stabilization	7.24 – 7.46	7.41	0.10
12-15 hours after Surgery	7.28 – 7.51	7.47	0.04
Change in 8-10 hours	0.02 – 0.4	0.09	0.08
Change in 12-15 hours after surgery	0.03 – 0.3	0.2	0.05

**Table 7: Changes in base excess values**

<b>Base Excess values at</b>	<b>Base Excess values</b>		
	<b>Range</b>	<b>Mean</b>	<b>S.D.</b>
Initial	-10.4 – (+1.2)	-3.55	2.77
8-10 hours after stabilization	-4 – (+1.3)	-1.83	1.19
12-15 hours after surgery	-4 – (+1.3)	-0.32	1.42
Change in 8-10 hours	-1.8 – (+6.4)	2.1	2.42
Change in 12-15 hours after surgery	-0.4 – (+8.7)	3.22	2.36

### Discussion

Debate still persists on the decision for Damage Control Orthopaedics (DCO) over early total care (ETC) of the patients. Clinically and mechanically unstable fractures of the long bones, and central skeletal system like pelvis, acetabulum, and thoracic- lumbar spine often require complete immobilization and bed rest until surgery. Damage control orthopaedics offers temporary stabilization to limit the complications, while providing time for complete recovery of the body. This demand in additional surgical interventions with requires mechanical stabilizers like orthopaedic implants and splints increasing the hospital tenure. Fracture patterns of those of the acetabulum-pelvis complex, and central spine complex (cervical spine, thoracic spine or lumbar spine) may prevent Damage Control Orthopaedics and, even if temporary stabilization is feasible, may not allow early mobilization of the patient. There are likely favourable conditions and possibilities along the management spectrum from Early Total Care to Damage Control Orthopaedics when early total care is adequate and appropriate which may be undertaken.

Major polytrauma cases many times requires and demands profound resuscitative measures to correct deranged blood markers and volume losses in shock and the resulting derangement of metabolic acidosis, reflected by changes in pH and excess base. These conditions demands quick transfusions of crystalloid, colloid, packed red blood cells (PRBC), fresh frozen plasma (FFP), and platelets (Plt) to maintain the haemostasis. Metabolic acidosis on presentation is a prognostic indicator for the development of pulmonary complications.<sup>13-15</sup> organ dysfunction, and death.<sup>15-18</sup>

The EAC protocol relies on continuous reassessment of acidosis as response to resuscitation, Surgery is permitted when specific laboratory criteria are met, and definitive fixation occurs within 36 hours of injury. The protocol will reduce pulmonary and other complications and will also reduce length of hospital stay.<sup>19,13</sup> Hence it is presumed that adherence to the early appropriate care-EAC protocol will be beneficial to the patient in all aspects by mainly reducing hospital stay due to adequate management of early complications and in turn aiding the financial benefits to the patients.

Definitive orthopaedic management protocol for clinically and mechanically unstable fractures of the long bones and central skeletal system bones like pelvi- acetabular complex, and dorso-lumbar spine was carried out within 36 hours in patients who responded adequately and positively to early resuscitative efforts, defined as having either a lactate <4.0 mmol/L, pH  $\geq 7.26$ , or base excess (BE)  $\geq -5.5$  mmol/L. Then post operatively complications are measured as outcome of resuscitation. Complications associated with the injury like the local wound

infections and sepsis if associated, head injuries, pulmonary complications like adult respiratory distress syndrome; pulmonary embolism; pneumonia due to longer ICU stay, acute renal failure, multiple organ dysfunction syndrome (MODS), and deep venous thrombosis (DVT).

In our study, a total of 100 patients were managed according to the EAC protocol. The serum lactate, pH and base excess were assessed in all the patients on arrival at the casualty department. This was followed by resuscitation of the patients to optimize the haemodynamic parameters. The metabolic markers (lactate, pH and base excess) were reassessed after 8-10 hours of resuscitation. If these parameters had returned to normal, the patients were shifted to the operation theatre for definitive stabilization of the bony injuries. If the parameters had not returned to normal levels by 8-10 hours, resuscitation was continued till the parameters returned to normal. In the earlier literature, resuscitation was continued till 12 to 15 hours to normalize the parameters.<sup>13</sup>

In our study, a maximum of 12-15 hours of resuscitation was required in only 8 of the 100 patients. Thus definitive operations are not unduly delayed by the resuscitation protocol.

In our study of 100 patients managed using EAC protocol, 16 patients had major complications. 14 out of 16 cases developed fat embolism following surgical intervention as there was involvement of long bones and 2 patient developed deep vein thrombosis (DVT) and ultimately leading to pulmonary embolism (PE). All these cases were treated and managed in the intensive care unit (ICU) for an average period of around 10 days. 2 patients with DVT and PE required mechanical ventilation whereas in the other 3 patients with fat embolism, oxygenation via mask, intravenous fluids and supportive care were sufficient. The patient with deep vein thrombosis was treated using low molecular weight heparin (LMWH) injections. The complication rates in our series are comparable with those reported earlier by Vallier HA et al 2013<sup>11</sup> and Vallier HA et al 2015<sup>12</sup> which is 12% and 16.3% respectively. Even those patients who developed complications were managed successfully without any mortality. Thus, a low incidence of mortality seems to be associated with EAC protocol in our series as well as in the existing literature<sup>11,19</sup> by reducing the complication rates and shorter ICU and hospital length of stay.

All the patients in our study spent an average duration of 12.5 days in hospital. This is comparable to the average hospital stay duration in the existing literature by Vallier HA et al 2013,<sup>11</sup> Vallier HA et al 2015<sup>12</sup> and Nahm J et al 2011<sup>13</sup> which is 10.8, 9.52 and 11.2 days respectively. This reduces the economic burden on the patients and the risk of nosocomial infections. The requirement for repeated secondary surgical interventions is also very low in the EAC protocol. There were no patients in our series who needed secondary surgical procedures prior to discharge from the hospital. This is the experience of other authors also who have adopted the EAC protocol.<sup>11,12</sup> Absence of repeated surgical interventions reduces the morbidity and allows rapid rehabilitation of these patients.

In our study, patients with poly trauma were most of the patients 44(44%) with poly trauma were in the age group of 30 to 40 years, followed by 27(27%) above 40 years with average age being 35.2 years. Mode of injury in all patients was road traffic accidents. This could be attributed to increased mobility in urban working people. Our study findings are comparable to the study made by Nahm J et al 2011.<sup>13</sup>

In our study there were 14 patients who developed pulmonary embolism, 7 out of them were younger age group patients (below 30 year) and the remaining was older age group patient above 40 year which is statistically not significant. Our study is comparable with the Reich et al (2016)<sup>20</sup> which concludes that EAC is associated with comparable complication rates in young and elderly patients. Our study had a male predominance with 73% and 27% females

which are comparable with all other studies. Male predominance can be well explained due to increased outdoor activity of males.

In our studies we have included the patients with ISS score more than 16. Injury severity score (ISS) is an anatomical scoring system that provides an overall score for patients with multiple injuries. It was understood that there was a statistically significant association between postoperative complications and ISS. 11 complications were seen in cases with mean ISS score of above 50 and no complications were seen in cases with mean ISS score of below 35. Our study is comparable with other studies stating that ISS grading is a reliable predictor of postoperative complications, mortality and morbidity. It is correlated to the length of hospital stay ie patients with longer hospital stay and a higher complication rates had higher ISS scores.

### Conclusion

We concluded that the low incidence of mortality seems to be associated with EAC protocol. Following adequate resuscitation and correction of acidosis early definitive fixation is possible for bony injuries of polytrauma patients which avoids the need of second surgery, also reduces the hospital stay duration, reduces post operative complications and early rehabilitation protocols can be made.

### Reference

1. Butcher N and Balogh Z J, "The definition of polytrauma: the need for international consensus," *Injury*.2009; 40(4). S12–S22.
2. World Health Organization, *The Global Burden of Disease: 2004 Update*, World Health Organization, Geneva, Switzerland. 2008
3. Trentz O L, "Polytrauma: pathophysiology, priorities, and management," in *AO Principles of Fracture Management*, T. P. Ruedi and W. M. Murphy, Eds., Cap. 5. 3, Thieme, Stuttgart, Germany, 2000.
4. Government of India, Ministry of Home Affairs National Crime Records Bureau: 2010 Accidental Deaths and Suicides in India. Government of India, Ministry of Home Affairs; 2010.
5. Nilanchal C, Abhilash KP, Gautham RP, Vineet SD, Bhanu TK, Krishna P. Profile of trauma patients in the emergency department of a tertiary care hospital in South India. *J Family Med Prim Care* 2016;5:558-63.
6. Gururaj G, Uthkarsh PS, Rao GN, Jayaram AN, Panduranganath V. Burden, pattern and outcomes of road traffic injuries in a rural district of India. *Int J Inj Contr Saf Promot* 2016;23:64-71.
7. Kiran ER, Saralaya KM, Vijaya K. A prospective study on road traffic accidents. *J Punjab Aced Forensic Med Toxicol* 2004;4:12-6.
8. Roy N, Murlidhar V, Chowdhury R, Patil SB, Supe PA, Vaishnav PD, et al. Where there are no emergency medical services-prehospital care
9. Scalea TM. Optimal timing of fracture fixation: have we learned anything in the past 20 years? *J Trauma* 2008;65:253- 60
10. Riska EB, Myllynen P. Fat embolism in patients with multiple injuries. *J Trauma* 1982;22:891-4
11. Vallier HA, Wang X, Moore TA, Wilber JH, Como JJ. Timing of orthopaedic surgery in multiple trauma patients: development of a protocol for early appropriate care. *J Orthop Trauma* 2013;27(10):543–51.
12. Vallier HA, Moore TA, Como JJ, Wilczewski PA, Steinmetz MP, Wagner KG, et al. Complications are reduced with a protocol to standardize timing of fixation based on response to resuscitation. *J Orthop Surg Res* 2015;10:155.
13. Nahm NJ, BS, Como JJ, Wilber JH, Vallier HA. Early Appropriate Care: Definitive

- Stabilization of Femoral Fractures within 24 Hours of Injury Is Safe in Most Patients with Multiple Injuries. *J Trauma* 2011;71:175–85.
14. Eberhard LW, Morabito DJ, Matthay MA, Mackersie RC, Campbell AR, Marks JD, et al. Initial severity of metabolic acidosis predicts the development of acute lung injury in severely traumatized patients. *Crit Care Med* 2000;28(1):125–31.
  15. Davis JW, Parks SN, Kaups KL, Gladen HE, O'Donnell-Nicol S. Admission base deficit predicts transfusion requirements and risk of complications. *J Trauma* 1996;41(5):769–74.
  16. Guyette F, Suffoletto B, Castillo JL, Quintero J, Callaway C, Puyana JC. Prehospital serum lactate as a predictor of outcomes in trauma patients: a retrospective observational study. *J Trauma* 2011;70(4):782–6.
  17. Callaway DW, Shapiro NI, Donnino MW, Baker C, Rosen CL. Serum lactate and base deficit as predictors of mortality in normotensive elderly blunt trauma patients. *J Trauma* 2009;66(4):1040–4.
  18. Claridge JA, Crabtree TD, Pelletier SJ, Butler K, Sawyer RG, Young JS. Persistent occult hypoperfusion is associated with a significant increase in infection rate and mortality in major trauma patients. *J Trauma* 2000;48(1):8–14.
  19. Weinberg DS, Narayanan AS, Moore TA, Vallier HA. Prolonged resuscitation of metabolic acidosis after trauma is associated with more complications. *J Orthop Surg Res* 2015;10:153
  20. Reich MS, A. J. Dolenc, T. A. Moore and H. A. Vallier. Is Early Appropriate Care of axial and femoral fractures appropriate in multiply injured elderly trauma patients? *J Orthop Surg Res* 2016;11:106.

Received :11-08-2020 Revised: 22-09-2020. Accepted:24-10-2020