

Trauma Critical Care

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Abstract: Trauma is one of the leading causes of death and morbidity. Most of the major trauma victims are critically ill and get admitted in ICU. They have different physiology as compared to other medical and surgical patients and unique problems attributed to trauma. It is therefore necessary that the intensivist managing them be aware of these issues. In this review, we discuss the management of various critical problems of these patients in ICU.

Trauma was the major cause of mortality and morbidity till last 2 decades but after that there have been major improvements in management and resuscitation of trauma patients. This does not imply only to emergency care but also ICU management.

It is well established that there is trimodal distribution of death in trauma patients. First peak is within seconds to minutes because of head or cervical spine injury or to injury to major blood vessel and much cannot be done about this. The second peak occurs in minutes to hours due to life threatening injuries and prognosis depends on initial resuscitation of the patients both in the emergency department and ICU. Then there is third peak which occurs several days to weeks and is often due to sepsis and multiorgan dysfunction¹. This third peak can be prevented by good ICU management of these patients. Here comes the role of good intensivist who has experience in managing trauma patients as trauma patients are different from other patients coming to ICU.

There are majorly two kinds of trauma patients coming to ICU; one who are still in the phase of ongoing resuscitation coming directly from the ED or Operation Theatre [OT] after damage control surgery. Secondly there are patients who were being treated in the ward, deteriorated and then shifted to ICU. There are certain problems particularly seen in trauma patients. In this review we will try to highlight certain these problems.

RESUSCITATION OF TRAUMA PATIENTS

Resuscitation of trauma patients start with airway control and ventilator support and then we come to circulation. Shock in these patients is considered to be hypovolemic until proved otherwise so volume replacement remains the mainstay of management. When starting with volume replacement, other causes of shock like pneumothorax and cardiac tamponade should be quickly ruled out and treated if present. Intensivist has to remember that the patients may develop pneumothorax after admission to ICU when attached to ventilator.

Depending on the class of hemorrhagic shock, volume replacement may be with just prewarmed crystalloid or crystalloid with blood products. Vasopressors are rarely required. Patients who require vasopressors are either underresuscitated or are in irreversible state of shock².

There is role of balanced resuscitation in trauma patients especially penetrating injury patients¹. In this systolic pressure is not allowed to increase above a certain level in order to prevent clot disruption and mean arterial pressure is just kept above the perfusion pressure of vital organs.

Massive transfusion is common in polytrauma patients. If massive transfusion trigger has been started then the patients should be given empiric ratios of FFP, RBC and platelets to prevent coagulopathy. Every institution should have predefined massive transfusion protocol.

Coagulopathy is common in ICU patients. The main reason is dilutional coagulopathy but can also occur because of hypothermia and acidosis³ so these should be prevented through out the resuscitation in ICU.

Prothombin time and INR are not very good predictors of bleeding in injured patients⁴ rather thromboelastography [TEG]⁵ should be used to guide administration of blood products.

Use of factor VII a in haemorrhagic shock is controversial. It acts only if platelets count and pH are normal and enough fibrinogen is present⁶. If bleeding continues after correction of coagulopathy then surgical reasons should be looked for. The intensivist should be able to make decision when to involve surgeons.

Lactate, base deficit and mixed venous saturation may be used as end points of resuscitation. Persistent elevation of serum base deficit or lactate levels are predictors of poor outcome^{7,8}.

Hypothermia is a major problem in trauma patients and patients coming to ICU either from OT or ED are often hypothermic especially patients who received massive blood transfusion. Hypothermia not only causes increased coagulopathy⁹ but also leads to dysrhythmias and increased chances of infection¹⁰. There is evidence of increased mortality in patients who have temperature less than 35°C. The patients should be rewarmed quickly with warming blankets and prewarmed fluids should be used for resuscitation.

RESPIRATORY COMPLICATIONS

Respiratory complications in trauma patients include acute respiratory distress syndrome [ARDS], transfusion related acute lung injury [TRALI], ventilator associated pneumonia [VAP], aspiration pneumonitis, recurrent lung collapse in patients with chest trauma and problems with chest mechanics in patients with flail chest.

ARDS can occur in trauma patients because of several reasons. Risk factors include lung contusion, aspiration pneumonitis, massive transfusion, severe sepsis, inhalational injury, pancreatitis following pancreatic injury and near drowning. Diagnosis and management remains the same as in non trauma patients with ventilation using low tidal volume and high PEEP.

TRALI is defined as acute lung injury which occurs during or within six hours of transfusion of blood products. It is characterized by acute onset hypoxemia and bilateral infiltrates and no evidence of pulmonary edema. If there are other risk factors present for acute lung injury, then diagnosis of TRALI cannot be made. The incidence is upto 8% in ICU patients¹¹. Management is supportive with avoidance of further blood products if possible and use of washed blood products and lung protective strategy is recommended for ventilation.

VAP is common especially in trauma patients¹² so all the components of VAP bundle should be strictly followed. One important point of VAP bundle that is head end elevation may not be possible in all patients particularly with unstable spine injuries so patients should be given antitrendelenburg position.

Aspiration pneumonitis is frequently seen in patients with head injury with low GCS, intoxicated patients and sometimes in patients given sedation in emergency department for some procedure or imaging. Treatment is supportive and there is no role of steroids.

Patients with chest trauma can have problems with ventilation and

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recurrent lung collapse due to inability to cough out because of pain. Multimodal analgesia is better than only intravenous drugs. A number of randomized controlled studies over last 2 decades have shown benefit of epidural analgesia in degree of pain control, appearance of nosocomial pneumonia, mean ICU and hospital stay and number of days on mechanical ventilation^[13]. Apart from analgesia, good chest physiotherapy is required for recovery.

SEPSIS AND MULTIORGAN FAILURE

The trauma patients can have bacteremia or sepsis from various sources. It can be from primary injuries like soft tissue injuries, abdominal injuries especially hollow viscus injuries, open wounds etc or from devices like central line, arterial lines, urinary catheter or ventilator. The management remains the same as in general patients, the main points being source control [which is sometimes not very evident], early antibiotic usage and other sepsis bundles^[14].

ACUTE RENAL FAILURE

Trauma patients are predisposed to renal injury and failure due to several factors. The foremost is prerenal factor because of volume depletion due to incomplete volume resuscitation at the earliest. Secondly, rhabdomyolysis is frequently seen in trauma victims following crush injury or compartment syndrome^[15]. Then patients are administered contrast media for various imaging which can lead to radiocontrast nephropathy and lastly kidney injury per se because of trauma adds to the insult.

The management principal behind all factors is adequate and rapid plasma volume expansion to maintain adequate perfusion to kidneys^[16]. Approximately 10-50% of patients with rhabdomyolysis develop ARF. For rhabdomyolysis it is recommended that urine output should be maintained approx. 1.5ml/kg body weight/ hour^[15]. If urine output cannot be maintained this high then is the role of alkalinisation of urine with sodium bicarbonate. There are no recommendations for mannitol. Radiocontrast nephropathy can be prevented by giving fluids prior and after the contrast. There is no role of N-acetyl cysteine [NAC] for prevention.

ELECTROLYTE IMBALANCE

Hyperkalemia is the most frequently encountered electrolyte abnormality seen in patients admitted to ICU after initial resuscitation. Various causes include massive blood transfusion, metabolic acidosis and acute renal failure. Stored blood components have varying amount of potassium and cause hyperkalemia^[17] when associated with crush injury or metabolic acidosis. Aggressive management should be initiated in ICU which includes glucose insulin drip, calcium gluconate, beta agonist nebulization, hyperventilation and bicarbonate administration. In cases of renal shut down, immediate hemodialysis may be required.

Similarly, hypocalcemia because of binding of calcium to citrate preservative in blood is commonly seen and can lead to hypotension in patients receiving massive transfusion. Calcium supplementation should be started early. In patients coming from the wards, sepsis is a contributing factor^[15].

Other electrolyte abnormalities like hyponatremia, hypokalemia, hypomagnesemia are encountered in patients coming to ICU after long term admission in the ward.

HEPATIC INJURY

Hemodynamically stable patients with liver trauma are frequently managed non-operatively and kept in ICU for monitoring. These patients are prone for hypoglycemia so blood glucose charting should be done more frequently and also vitamin K supplements should be given from the beginning. Hyperbilirubinemia with coagulopathy is common as a result of sepsis in trauma patients but acute liver failure is rare. Management of sepsis is all that is required.

MYOCARDIAL INJURY

Myocardial injury should be suspected in all blunt trauma chest patients and it can lead to myocardial ischemia and arrhythmias which should be managed accordingly.

ABDOMINAL COMPARTMENT SYNDROME [ACS]

This is the term used interchangeably with intraabdominal hypertension [IAH] in ICU frequently. IAH is repeated elevation of intraabdominal pressure > 12 mmHg and ACS is defined by the World Society for Abdominal Compartment Syndrome as an intraabdominal pressure of greater than 20 mmHg with an attributable organ failure^[18]. Trauma patients can develop either primary ACS because of hemoperitoneum or secondary due to bowel edema following massive fluid resuscitation. The major effect of ACS is on kidneys which can lead to oliguria and on venous return which may get compromised leading to hypotension^[15]. ACS should be suspected on physical examination and can be confirmed by measuring intraabdominal pressure via urinary catheter. Once confirmed, decompression should be done as early as possible either in OT or can be done bedside in ICU. Many patients come in the ICU with primary laprostomy wounds only. These patients can have substantial fluid loss and are also prone to peritonitis.

NEUROLOGICAL INJURY

This includes traumatic brain injury [TBI] and spine injury. TBI is commonly seen in polytrauma patients and still the leading cause of death. Patients with moderate to severe TBI land up in ICU. The major goal of treatment is first adequate resuscitation and stabilization and then prevention of secondary brain injury. Various strategies to prevent secondary damage include avoiding hypoxemia, hypotension, hypercarbia, fever, seizures, hypo or hyperglycemia, acidosis and electrolyte abnormalities^[19]. The patients should be nursed in neutral head position and jugular lines should be avoided on the side of brain injury. Apart from the general monitoring, ICP monitoring may be required. It is recommended by brain trauma foundation [BTF] that ICP should be monitored in all salvageable patients with severe TBI and abnormal CT scan and in patients with normal CT scan if two or more features are present: age more than 40 years, unilateral or bilateral motor posturing or systolic blood pressure < 90 mmHg. Mannitol which is commonly prescribed drug by neurosurgeons is to be given only in patients who are hemodynamically stable.

Similarly, during management of spine injuries, the major goal is to prevent further damage to spinal cord and further deficit. These patients are immobilized in bed till fixation occurs. It has been well documented that spinal injury patients are prone for deep venous thrombosis and bed sore so they should be started on DVT prophylaxis right from the beginning and care should be taken about the pressure areas for preventing bed sores.

In both TBI and spinal injury patients, early tracheostomy must be considered for early weaning and rehabilitation team has to be involved at the initial stage. Some TBI patients depending on the severity may go home with varying degree of disabilities and some may progress to chronic vegetative state. In these chronic patients, end of life decisions need to be taken in consultation with ethics team which sometimes become difficult for the intensivist.

Another very important role of ICU physician is regarding organ donation. Few patients land up in ICU either brain dead or become brain dead during the course of management. It becomes the duty of intensivist along with primary team to get the relatives convinced for organ donation. Moreover till the time organ donation actually happens, hemodynamic stability should be maintained. In conclusion the intensivist should be aware of all peculiar problems in this subset of patients and manage accordingly.

In India, critical care medicine has developed recently over the past

decade only but has been there in developed countries for long time. Moreover critical care of trauma patients is still in the infancy. With improvement in knowledge about early resuscitation and management of trauma, more and more trauma centres are coming up these days in India and there is ever increasing demand for intensivists who can manage trauma patients.

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