

A Roadmap for Early Management of Trauma Patients

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Abstract: Trauma is primarily a health hazard of the young and results in loss of precious productive years. It is the leading cause of death in young adults. Most of the health care workers are faced with management of these patients on a regular basis. The concept of 'Platinum 10 minutes' or an extended Platinum time of 20 minutes should be strictly adhered to optimize survival. The team of well trained first responders at the accident team should ensure that the patient receives resuscitative care during the early phase of trauma management. To enhance trauma care, management has been revolutionized over the past few decades by adopting evidence based recommendations that has led to improved outcome following trauma. The main issues in the acute phase of trauma management includes securing the airway and providing optimal ventilation, fluid and blood product management, control of body temperature and intracranial pressure. A well structured trauma resuscitation approach in a step-wise manner is essential to address all issues that contribute to reduction in mortality and functional disability. An optimal pre-hospital care at the site of the trauma with efficient transfer of the patients to designated trauma centres and maintaining continuity of care has been outlined in this article without daunting the reader with intricacies of trauma care.

Keywords: Trauma Management, Platinum-Ten Minutes, Golden Hour

1. Introduction

In recent years trauma has become the leading cause of death in population under 45 years of age who essentially are the most productive group of the society, [1]. Unfortunately, despite all the progress made in emergency trauma services over the past few decades, immediate post-trauma deaths have remained largely static between 50% to 60%, [2]. Lately, the trimodal mortality model comprising immediate, early, and late deaths has shown a shift towards a bimodal mortality model. This is secondary to decline in late deaths due to rapid developments in care provided by advanced trauma centers, [2]. It is time to relook and adopt positive steps to prevent these unfortunate immediate, early and most of the time avoidable, post-trauma deaths. In this article, the main emphasis is laid on early management of adult trauma patients by carrying out primary assessment and simultaneously judicious resuscitation followed by reassessment of airway, breathing and circulation. The other steps that has been highlighted is the secondary and tertiary assessment and trauma care.

2. Main Body

Majority of the fatalities in trauma patients occurs in a bimodal fashion either at the trauma site or within the first four hours after the patient reaches a trauma center. Relatively few patients succumb to their injuries after the first 24 hours, [3, 4].

The first peak of deaths occurs within seconds to minutes after sustaining the trauma. This is the 'Platinum 10 minutes' or an extended Platinum time of 20 minutes that makes the difference between life and death. It has been estimated that 35-50% of trauma deaths secondary to road traffic accidents occur at the accident site or during early treatment at the hospital, [5]. Majority of these patients have inadequate airway / breathing or have sustained major head injuries, hemopneumothorax, splenic/liver laceration, tears in large vessels, and other injuries associated with significant blood loss. It is this period of first 10-20 minutes that requires implementation of strategies to maximize survival rate. The much needed steps in this direction are:

Step 1: It is vital that the emergency response team (ERT) is swiftly alerted by the victim or passerby. This can be expedited by incorporating a call button in every mobile phones that alerts the ERT with exact location of the mishap.

Step 2: Arrival of the ERT by helicopter or road ambulance should be accompanied by a doctor as in the Japan model of the Emergency Medical Service (EMS), [6]. This would enable the seriously injured patient to receive initial assessment and institution of appropriate measures to prevent the patient's condition from worsening during transportation.

A near similar model is operational 24 x 7 in United Kingdom. In this model, paramedic, specialist paramedic and doctor-led Medical Emergency Response Incident Teams (MERIT) arrives at the trauma site via road or air, [7]. Time is of essence and advanced care initiation at the site of trauma should be the new goal.

Step 3: Once the ERT has reached the site of the trauma, immediate assessment for inadequate airway and ventilation should be performed on the trauma victims by the specialist paramedics or the team doctor. The 2007 National Confidential Enquiry into Peri-Operative Deaths made an interesting observation in their report 'Trauma: Who cares' that 9.6% and 8% of severely injured trauma patients reached the hospital with an inadequate airway and ventilation respectively, [8]. 10th ATLS guidelines, strongly advocates that life-threatening airway and inadequate breathing should get priority over circulatory issues, [9]. NICE guidelines of 2018 is more vigorous in its recommendation that tracheal intubation with a cuffed tube should be performed in patients with an inadequate airway prior to transportation of the patient to hospital to optimize oxygenation, ventilation and prevent aspiration, [10]. After attending to the airway and breathing, patients assessed to be hemodynamically unstable, should now receive approximately 1 L of crystalloids. If patient is unresponsive to crystalloid, the emergency team should quickly switch to blood products. However, a recent multicentric trial reported in 2022 that prehospital administration of packed red blood cell and lyophilized plasma to adult trauma patients with hemorrhagic shock was not superior to 0.9% sodium chloride, [11].

Step 4: Lately, prehospital echocardiography and ultrasound is being encouraged to identify life-threatening injuries though this intervention would necessitate longer on-scene times, [8].

Once the patient has received optimal care and stabilization at the trauma site, patient should be rapidly transported to hospital. Before shifting the patient, the ERT or the EMS should relay patient's details to the trauma center using SBAR (situation, background, assessment and recommendations) communication tool.

Golden hour: The first 60 min after sustaining the trauma is called the 'golden hour'. Survival of the trauma victims is heavily weighed by the care that is given to the victim in the first 60 minutes preferably in a trauma center, [12]. A series of well-established steps should be initiated during the golden hour period in each trauma hospital so that every member of the team has the same management focus.

Before beginning step wise approach to trauma patient's care, the attending physician at the accident and trauma center or any other medical facility that the patient has been brought should take a proper hand over from the ambulance paramedical staff/ accompanying physician. 'MIST' is an easy to remember hand over procedure where M-Mechanism of injury, I-Injuries observed, V-Vital signs, T- Therapy established.

After appropriate hand over, Steps I-III should be followed.

Step 1: Primary survey and trauma care- It should be done within 2-5 minutes. During this period, confirm that the victim has a patent airway and an adequate ventilation with acceptable oxygen saturation. Assess for adequacy of circulation including cardiac function and intravascular status. Evaluation of the neurological status should be included during the primary survey. The 10th edition of Advance Trauma Life Support course strongly advocates that the mnemonic ABCDE should be followed for evaluation and intervention in all trauma patient during this phase of early trauma care, [9].

- 1) Airway, assess and clear airway while restricting cervical spine motion using manual in-line stabilization.
- 2) Breathing, confirm adequacy of ventilation.
- 3) Circulation, stop the bleeding.
- 4) Disability or neurologic status.
- 5) Exposure (undress) and Environment (temperature control).

Judging adequacy of airway and breathing poses no difficulty in a talking patient. However, in an obtunded patient one should look for symmetrical rise/fall of chest, listen for air entry on both sides of the chest, and feel for patient's breath to assess adequacy of breathing.

Once the primary survey has been completed, and if an inadequate airway and ventilation have been noted, immediate definitive airway (tracheal intubation) should be secured after a quick assessment for a difficult intubation using mnemonic LEMON (Look-Evaluate-MallampatiObstruction-Neck mobility), [13]. Preoxygenate the patient well and keep suction, oxygen, oro- and nasopharyngeal airways, bag-mask, gum elastic bougie, laryngoscope, supraglottic airway device, equipment for cricothyrotomy, pulse oximetry and capnographic device and drugs ready.

In recent times, video laryngoscopy has proven itself a good intubation aid that improves vocal cords visualization during intubation. However, it is better to use a Macintosh design of videolaryngoscope blade instead of the hyper-acute design blades. The advantage of using a Macintosh design videolaryngoscope blade is that one can still visualize the glottis as direct-line-of-sight in case blood in the oropharynx blurs the camera lens. It is prudent to remember that videolaryngoscopes do not necessarily improve successful first pass laryngoscopy and tracheal intubation or result in faster time to intubation, [14]. Cardinal rule remains, use an airway device with which you are familiar.

Drug assisted intubation has replaced rapid sequence intubation with video or direct Macintosh laryngoscope using ketamine (1 mg/kg) or etomidate (0.3 mg/kg). These agents

have established themselves as safe induction agents in trauma patients with substantial blood loss as they will not decrease the systemic vascular resistance. They also help to quieten the agitated patient. Succinylcholine (1 mg/kg) or rocuronium bromide (1.0-1.2 mg/kg) are the recommended muscle relaxants to aid laryngoscopy and tracheal intubation in these patients, if required.

Once tracheal intubation has been successfully achieved and pneumothorax, if present, is attended by performing needle decompression via the 4th/5th intercostal space anterior to mid-axillary line in adults, lung protective ventilation should be instituted in patients with trauma and shock. Either a volume- or pressure-limited ventilation mode may be used with a low tidal volumes of 6 to 8 mL/kg and a respiratory rate between 8 to 10 breaths/minute, with adequate expiratory time to reduce air trapping. In non-head injury patients, mild permissive hypercapnia between 40 to 45 mmHg is acceptable. One should maintain a peak airway pressure < 28 cmH₂O and FiO₂ < 0.6 so as to maintain a PaO₂ of 60-80 mmHg to give a saturation of >90%, [15].

Administration of 1 g of tranexamic acid over 10 min within 3 hours of injury followed by its infusion of 1g over 8 hr has been demonstrated to improve survival in bleeding trauma patients, [16]. One should also consider antibiotics that will be effective against skin flora (gram-positive organisms). In case of bowel injury, select antibiotic against gastrointestinal flora (anaerobes and gram negative organisms), [17].

Once airway and ventilation has been taken care of, optimal volume resuscitation is the next step lest these patients crash. Current ATLS guidelines suggests to administer no more than 1 L of warm 0.9% saline prior to administration of blood components. Not exceeding 1 L of crystalloid is essential to prevent dilutional coagulopathy, [9]. This should be done through at least two functioning vascular access (either intravenous or interosseous). In patients with suspected abdominal trauma and pelvic fractures, two wide bore intravenous cannulas > 16 G should be placed one each in the upper and lower limbs. Early administration of blood components is essential to patient's favorable outcome. Do not insist on full cross-match in patients with hemorrhagic shock. It is safe to administer group specific, un-cross matched blood until cross-matched blood is available. A ratio of 1:1:1 or 2:1:1 (red blood cells: plasma: platelet packs respectively) should be the aim while transfusing blood products, [18]. Unfortunately, in many situations there is a delay of approximately 20-30 min in receiving the first batch of thawed fresh frozen plasma. In recent times, protocols have been developed to keep thawed plasma in either the blood bank or the emergency department at all times, [19, 20]. This has been noted to significantly decrease mortality, blood product utilization, and massive transfusion rates, [21]. Magnotti *et al* reported that the presence of low (<1 mmol/L) ionized calcium levels on admission is responsible for doubling the mortality rates from 8.7% up to 15.5%, [22]. Consider administration of 1 g calcium chloride to correct potentially life-threatening hypocalcemia especially that follows administration of blood products and the hypotension associated with it.

A good indicator of initiating massive blood transfusion protocol is a systolic BP < 90 mmHg and base deficit > 10, [23]. During initial resuscitation, aim for a systolic blood pressure of approximately 90 mmHg in younger patients and ≤110 mmHg in older adults. This strategy of permissive hypotension aims to keep the blood pressure low enough to avoid exsanguination and clot disruption, yet allowing acceptable end organ perfusion.

While establishing all these primary care steps within the first hour and subsequent secondary survey, keep in mind that hypothermia (body core temperature below 35°C [95°F]) is one of the most important factor for the development of acidosis and coagulopathy, [24]. The harmful effects of hypothermia are known to persist beyond the hypothermic period, [25]. Adopt measures like keeping the surroundings warm, application of forced air warmer, and rapid infuser with warming capability to prevent hypothermia.

Analgesic needs of the trauma patient can be met with administration of ketamine, fentanyl, and morphine provided they have no evidence of head injury. A meta-analysis by Haske *et al* revealed no evidence for the superiority of any of these three agents over the others, [26].

Step 2: Secondary survey and trauma care- This is undertaken in trauma patients after the primary survey has been completed and the patient is considered to be stable. It is during this survey where a detailed history, physical examination, a rapid focused assessment should be done. This should include focused assessment with sonography in trauma and other select diagnostic studies such as conventional x-rays/computed tomography or other imaging procedures to rule out injuries of abdomen, head, cervical spine, chest and pelvis. This phase of the survey is of prime importance as it helps to detect commonly missed injuries during the primary survey.

Laboratory tests should include (but not limited to) complete blood count, prothrombin time, urinalysis, blood glucose, lactate levels and other basic chemistries.

During the primary and secondary survey, ensure availability of functional suction equipment to prevent aspiration and be prepared to have a team to log roll the patient laterally for a complete examination while ensuring restriction of cervical spinal motion.

Step 3: Tertiary survey and trauma care- This phase of trauma care is usually performed 24 hour after the initial admission. Here the main goal should be to identify changes that could be secondary to previously unrecognized injuries.

Benefits of the well-managed platinum 10 minutes and the golden hour period may be lost unless the patient is properly handed over to the physicians responsible for continuity of care. A proper face-to-face handover with the critical care team is essential. Patient's record should be meticulously entered in his/her hard file or the e-system detailing the resuscitation and the patient status at the time of handing over to the next of care person. It is equally important to be immediately available to answer queries to clarify any issues that may arise.

3. Conclusion

Trauma is the leading cause of serious morbidity and mortality especially in young adults who are in their prime of life. Life threatening injuries involving airway, circulation and the central nervous system often contribute to mortality in the early period following trauma. A step wise approach starting with primary survey (Airway, Breathing, Circulation, Disability, Exposure) and rapidly attending to the identified instability, to secondary survey performed during the Platinum 10 minutes to the Golden hour by a multi-disciplinary team can play a vital role in patient survival. Tertiary survey, by the trauma team should confirm patient stability and attend to previously unrecognized injuries. Proper documentation of all events and an early rehabilitation course should be undertaken so that the patient with trauma can return early to normal life.

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