

Symposium

Golden Hour Management of Pediatric Polytrauma in India- Emergency Department Resuscitation

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ABSTRACT

Trauma is one of the most neglected preventable diseases in India, with the 2014 National Crime Records Bureau report, detailing 63% rise in injury deaths in the past decade. Despite the worrying figures, this preventable endemic has not received much attention and a significant proportion of trauma victims do not receive timely and appropriate medical care.

There is often an enormous amount of anxiety and confusion in the Emergency Department (ED) when it comes to resuscitating a child with polytrauma. Emergency triage, application of algorithms of primary and secondary survey which are easily remembered and reproducible all over the world, should be applied to simplify trauma resuscitation in children. Skilled team approach during the first hour ('Golden Hour') by focussing on 3 critical 'H's - H (Hypoxia prevention), H (Hemorrhage control) and H (Herniation of brain prevention) could save thousands of lives and is urgently needed across India

Key words: Pediatric, Poly trauma, Triage, Primary survey, Secondary survey, Resuscitation

Introduction

India has one of the highest numbers of trauma deaths in the world. According to the WHO injury kills more people every year than human immunodeficiency virus (HIV), tuberculosis, and malaria combined in low income countries¹. National Crime Records Bureau 2014 report shows that there has been 63% rise in injury deaths in in India in the past decade (451,757 deaths compared 277, 263 in 2004)². Interestingly the population growth during the period 2004-2014 was 14.6%. Data from Medical Certification of Causes of Death, Government of India 2014 reveals unintentional injury as the 3rd leading cause of death in children 5-14 years and 4th leading cause of death in 1-4 year age³. For each death, there will be 4 children who will be permanently disabled. Environmental hazards, small stature, inexperience, curiosity to explore new environment, bravado and inadequate supervision puts the child at risk for trauma. World Health Organisation estimates that nearly 2 million lives could be saved every year if timely emergency

care given in low income group countries matches the care given to injury victims in high resource countries.

What are the challenges in Children?

- Mechanism of trauma in children differs from adults. Unlike adults where road traffic injury is the leading cause, falls contribute to most of the pediatric trauma in India⁴⁻⁶. Road traffic injury is the second common cause followed by drowning, poisoning, smoke inhalation, scalds and burns. As most of the childhood trauma occurs in and around the house or playground, a huge proportion of children in India are not brought to hospital by ambulance and hence do not receive lifesaving prehospital care.
- Trauma training is not considered an essential part of the curriculum in Indian pediatric training. Most pediatric trauma cases are seen by an adult trauma team in India. Children cannot be managed as mini adults as they are physically and physiologically different from adults. It is vital for the trauma team to be skilled in managing children; should we hope to see a declining trend in these preventable deaths in future.
- Psychological effects of pediatric trauma should not be forgotten, many children with polytrauma suffer from post- traumatic stress disorder^{7,8}.

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How can we make a difference?

Trimodal Distribution Trauma Death⁹:

- i) First Peak: Seconds to minutes- Preventive measures only can help
- ii) Second Peak: Minutes to hours- called the 'Golden Hour' during which timely and effective resuscitation can save many lives and reduce morbidity
- iii) Third peak: Days to week after trauma

Rapid assessment of life threatening problems and effective resuscitation in the Golden Hour can improve survival significantly. To obtain the best outcome, each trauma centre should have written plan, tested locally for a systematic approach of these children. Some of the points to consider are,

- Preparation
- Triage
- Equipment
- Trauma Team— composition and capability
- Assessment and resuscitation
- Communication
- Transfer to definitive care

Preparation

This is one of the most important aspects of resuscitation in polytrauma (two or more significant injuries). Obtaining prehospital information regarding the mechanism, types of injury and age of the child will help to mobilise the right team, to prepare the right bed space with right equipment and calculate the right medication dosages. Prehospital notification is generally poor in India and leaves trauma team at a disadvantage. It is our responsibility to patients; to encourage the pre-hospital transportation (ambulance and public) to provide notification to emergency department (ED) prior to presentation.

We would encourage the development of local protocols and processes that allow for this communication to occur, and for hospitals to develop an appropriate response to this information (see below).

Triage

Pediatric Trauma Hospital response should include a variable response based on prehospital information or, if pre-hospital information not provided, on triage (rapid assessment on arrival to hospital)

Triage is the sorting of patients into priority groups to

ensure appropriate response according to their need and the resources available^{9, 10, 11}. Children should be rapidly screened soon after their arrival in the hospital in order to identify:

- **Emergency signs-** require immediate emergency treatment.
- **Priority signs-** Priority in the queue so that they can be assessed and treated without delay in arrival to hospital).
- **Non urgent cases-** who have neither emergency nor priority signs.

Criteria for activation of “Trauma Code” (Emergency)¹²: Airway or respiratory compromise, facial or tracheal injury including burns, signs of shock, Glasgow Coma Scale (GCS) level <12, penetrating injuries to head, neck chest, abdomen or pelvis, suspected spinal injury (flaccidity, areflexia, unexplained hypotension), amputation above wrist and ankle.

Criteria for activation of “Trauma Alert” (Priority): No airway, respiratory or circulatory compromise and GCS greater than 13 with- ejection of patient from vehicle, prolonged extrication (>20 mins), death of an occupant in same vehicle, impact speed > 50kms/hr, motor vehicle vs pedestrian or bicycle, fall > 3 metres, bilateral femur fractures or >2 long bone fractures, crush injuries proximal to wrist or ankle.

Practicing a robust triaging system regularly will help tremendously during mass casualties or disasters. Factors that may affect triage and treatment priority during mass casualty include injury severity, salvageability, and available resources.

Equipment

- It is not uncommon to see adult endotracheal tube or fluids handed over while managing a trauma child in the emergency department (ED). Keeping the right size of equipment for the child's age requires pediatric trained personnel.
- Having a chart available in the ED (or smart phone app) with pediatric drug dosages and equipment size is essential in a crisis.
- The essential things to keep around the bed space are oxygen, suction, bagging circuit and monitor.
- A pediatric resuscitation trolley with airway,

working laryngoscope, endotracheal tubes for different age groups, intravenous cannula, emergency drugs and fluids, intraosseous line, glucometer, torch, C spine collar, hand sanitiser and gloves should be kept close to the bed space.

- Team members should know the location of needle thoracocentesis, chest drain tray, O negative blood, cricothyroidotomy tray, dressings and splints in the ED.

Pediatric Trauma Team

- Every trauma centre should have a dedicated pediatric trauma code team consisting of
 - Team leader (usually ED consultant or registrar)
 - Maintains an overview, often stands at the foot end of the bed
 - Airway doctor (eg- PICU registrar or anesthetist)
 - Trained in the pediatric airway
 - Examination doctor (eg Pediatric registrar)
 - Procedure doctor (eg Surgical registrar)
 - Nursing
 - At least two nurses to connect monitoring, draw up medications, assist with procedures, documentation and obtain intravenous access.
 - Radiographer

More help from senior consultants from orthopedic, neurosurgery, pediatric surgery, ENT should be available should the need arise.

Prior to the arrival of the patient, team should preferably wear eye protection, mask, gown, and gloves to prevent exposure to patient secretions.

When there is more than one life threatening state, simultaneous treatment of injuries is essential and requires effective teamwork. The team performance will be more effective if the leader allocates individual roles and communicates clearly prior to patient arrival. Successful management of polytrauma (reducing mortality and morbidity) needs the entire team to function effectively together, requiring team members to have knowledge and understanding of the principles of 'Crisis Resource Management'

A typical example of a Trauma Alert (Priority) team would be an ED consultant or senior registrar, surgical registrar and 2 nurses. Consultation would then occur as required with Pediatric intensive care unit (PICU), orthopaedics, neurosurgery and anesthetics

Assessment and Management^{9,13} (fig 1)

- Take 1 minute handover from the prehospital team or parents prior to assessment
- Key principle of trauma management is to treat the greatest threat to life first.
- Assessment and management occur simultaneously during the primary survey
- The lack of a definitive diagnosis should never stop the treatment
- A detailed history is not essential to begin the evaluation of a patient unlike other medical conditions.

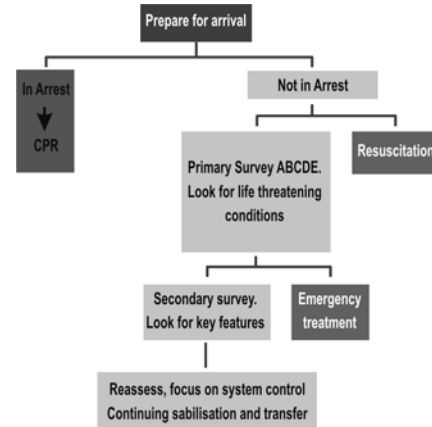


Figure1. ED Resuscitation polytrauma. (Adapted from APLS13)

Primary survey and resuscitation: The initial rapid assessment is known as 'the primary survey'. The algorithm for primary survey is standardised and successful- one algorithm, reproducible all over the world. The main goal is to resuscitate, identify, and prevent secondary injuries. Trauma deaths occur in certain reproducible time frames. The loss of an airway kills more quickly than does the loss of the ability to breathe. The loss of ability to breathe kills more quickly than loss of circulating blood volume. The presence of an expanding intracranial mass lesion is the next most lethal problem (table 1).

Assessment	Primary Survey	Goals
A	Airway with C-spine control	Maintain patency Protect cervical spine
B	Breathing	Maintain oxygenation Maintain ventilation
C	Circulation	Seek & control hemorrhage Restore & maintain perfusion
D	Disability	Identify neurological injury Prevent secondary insult
E	Exposure	Identify other threats to life & limb Normothermia & euglycemia

Table1. Primary survey-adapted from Advanced Paediatric Life Support¹³ (APLS)

A: Airway stabilisation is the most important part as it is the greatest threat to life. Lack of airway causes nearly 1/3 of the brain injury deaths in pediatric trauma. Clear any secretions in the mouth and if maintenance of airway is required, use jaw thrust as head tilt and chin lift is contraindicated in trauma. Child may need adjuncts, laryngeal mask airway (LMA), intubation or even surgical airway in rare cases. Airway is patent if the child is crying or talking. Please see table 2 for indications for intubation (rapid sequence).

Indications for intubation in Trauma	
➤	Upper airway obstruction
➤	Poor breathing effort (hypoxia, flail chest)
➤	GCS of < 8 or rapidly declining GCS (AVPU- P / U)
➤	Signs of ? Intra Cranial Pressure (ICP)
➤	Significant maxillofacial, neck injury
➤	Persistent Seizures
➤	Trauma with inhalation bum injury

Table2. Indications for intubation in trauma (AVPU score - Alert, Verbal, Pain, Unresponsive. GCS- Glasgow Coma Scale)

Cervical spine injury should be considered and if considered likely, then reduce the spinal movement using in-line stabilisation and log rolling. Routine immobilisation using cervical collars and other restraints is not recommended¹⁴ (Fig2).



Fig2. C- Spine immobilisation

B: Breathing- Assess tracheal position, rapid or slow rate, recession, breath sounds, and asymmetry. Look for and address tension pneumothorax, open pneumothorax, hemopneumothorax, flail chest and lung contusion. Do not forget to administer high flow oxygen and analgesia.

C: Circulation- children have good reserve; hence signs of blood loss are seen late.

- Rapid check for significant external hemorrhage, brachial or femoral pulse, skin colour and level of consciousness should be assessed simultaneously.

- Look for and address massive hemothorax, cardiac tamponade, hemoperitonium, unstable pelvic fracture. Suspect spinal cord injury if no obvious cause found.
- Minimum 2 large bore IV access or intraosseous line is essential.
- Initial fluid will be crystalloid 20ml/kg and if no response, surgical opinion should be sought along with a second bolus 20 ml/kg.
- Further treatment should be blood preferably O negative 10ml/kg until cross matched blood available.
- Stop obvious external hemorrhage with direct compression or tourniquet. Be aware that in penetrating trauma- urgent surgical intervention is required.
- There is increasing evidence for the utility of the early administration of blood in trauma. FFP, platelets, fibrinogen, fibrin sealant and tranexemic acid should be considered in uncontrolled hemorrhage^{9,15}

D: Disability- It may not be possible to assess GCS immediately on arrival. Quick assessment of AVPU (Alert, responds to Voice, responds to Pain, Unresponsive to all stimuli), pupils and posture is an instrument to rapidly assess the disability. Look for signs raised ICP, pupillary asymmetry and Cushing's triad. Consider 3% saline (preferred) or mannitol if signs of raised intracranial pressure and urgent neurosurgical consultation¹⁶.

E- Exposure of the whole body and looking for injuries is an essential part of primary survey

Adjuncts to the primary survey (Please see table 3)

➤	Establish monitoring- ECG, pulse oximetry, blood pressure.
➤	Blood for cross match, glucose, CBC, LFT and urine microscopy
➤	Cervical spine, chest and pelvic X-Rays – if indicated on examination or in shock
➤	Consider ultrasound of the abdomen and chest: FAST scan (or E- FAST)
➤	Consider orogastric tube, urinary catheter if significant injury
➤	Computerised tomography (CT) scan should be done if indicated by clinical examination. PAN (Whole body) CT is not advisable in children due to risk of radiation.
➤	AMPLE history- Allergy, Medication, Past history, Last meal, Events

Table 3- Adjuncts to Primary survey (ECG- Electro cardiogram. CBC- complete blood count. LFT- Liver function test. FAST scan

- Focussed Assessment by Sonography in Trauma. E- FAST- Extended FAST)

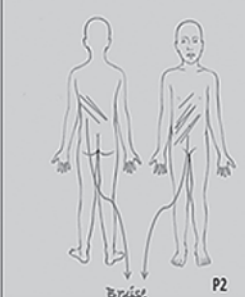
Secondary Survey and emergency treatment

- Head to toe evaluation - should take 10-15 minutes if performed systematically.
- All surfaces, cavities, orifices, pulses and limbs must be thoroughly checked
- Looking for cerebrospinal fluid (CSF) leak from ears and nose and complete neurological examination are essential.
- Log roll when head and neck are being stabilised and examination of back and spine are essential.
- Need for further investigations assessed
- Reassessment of vital signs and should there be any deterioration in patients condition, reassessment of ABC is crucial

Communication: Communication is the glue that holds crisis management together. During a crisis, members of the team may have information and different ideas. This information may be critical to the patient's survival. It is important to create a respectful environment where information is shared. This creates situational awareness and equal distribution of work load. 3 Cs of communication- Clarity, Cite name, Close the loop. The team leader should be able to organise the team, control communication, verbalise clear goals and transmit plans with frequent updates. Nearly 1/3 of the children are known to have post-traumatic stress disorder. Frequent communication with child and parents, allowing the parents to stay with the child whenever possible, might help to alleviate this

Transfer to definitive care

Once the child is stabilised in the ED, transport to the most appropriate care area- PICU, HDU (high dependency unit), ward or sometimes Operating Theatre is necessary. Early decision should be made as resuscitation is continuing, regarding personnel and equipment requirements. Ambulance may be necessary in some hospitals if the PICU is in a different hospital or if the child needs to be transported for scanning. Documentation of injuries and resuscitation is essential (fig3a, 3b)

Secondary survey ct..	
Allergies: None	Medications: None
Last meal: 4 hours	Past medical History: Occasional wheeze
Trauma X-ray series <input checked="" type="checkbox"/>	Log roll <input checked="" type="checkbox"/>
Additional Notes:	
Road Traffic Injury at 10 45 hrs . Crush injury, Wheel of the car ran over whilst reversing. Cried at the scene immediately. Was brought to the ED by ambulance. Was conscious at the time of arrival becoming more drowsy.....	
Police accompanied.....	
Form completed by: Dr Savijar child	
Signature: <u>Savijar</u>	
	
Fig3b. Sample trauma flow sheet Page2. – ED documentation	

PRIMARY SURVEY Commenced :11:10 hrs. Completed: 11:25hrs	
Name: Baby child	
Hospital ID: 19845XUK	
Airway: Clear <input checked="" type="checkbox"/>	Compromised <input type="checkbox"/> Artificial <input type="checkbox"/>
C/Spine: Protected <input checked="" type="checkbox"/>	Unprotected <input type="checkbox"/>
Breathing: Spontaneous <input checked="" type="checkbox"/> Bagmask <input type="checkbox"/> Intubated <input type="checkbox"/> Air entry L <input type="checkbox"/> R <input type="checkbox"/>	
Tension pneumothorax <input type="checkbox"/> Resp Rate: 36/min	
Circulation: Capillary refill-normal/Delayed <input checked="" type="checkbox"/> External hemorrhage <input checked="" type="checkbox"/>	
Pulse: 120. BP 90/50. Stable/Unstable <input checked="" type="checkbox"/> ECG rhythm: Normal	
Disability: Alert <input type="checkbox"/>	Voice <input checked="" type="checkbox"/> Pain <input type="checkbox"/> Unresponsive <input type="checkbox"/>
Pupils: R. N..... L. N.....	Posture: N Exposure : Undress completely <input checked="" type="checkbox"/>
SECONDARY SURVEY Commenced :11:30 hrs. Completed: 11:50hrs	
Head: N	Pale: Y <input checked="" type="checkbox"/> /N Sweating: Y <input checked="" type="checkbox"/> /N
Face: N	Cyanosis: Y <input checked="" type="checkbox"/> /N Agitated: Y <input checked="" type="checkbox"/> /N
Neck: N	GCS: Eyes: 4. Verbal: 5. Motor: 5. Total: 14
Chest: Bruise	Neurologic Exam
Abdomen: Bruise	Limb movements: Full
Pelvis & perineum: Painful	Sensation: N
Limbs: N	P1
Fig 3a Sample trauma flow sheet Page1. – ED documentation	

Conclusion

Pediatric trauma is a significant problem in India, resulting in a large burden of mortality and morbidity. Appropriate and timely trauma management is known to significantly improve outcomes following trauma, but will require the development of standardised trauma training across the country. The sequence of structured approach to a polytrauma patient is preparation, triage, primary survey with resuscitation, adjuncts to primary survey with stabilisation, re-evaluation and definitive care. The need for

transferring the patient to another higher centre should be discussed early during resuscitation. Each hospital and health system should study their situation, make modifications/improvements to the team approach according to the local resources and prepare action plan for successful management of an injured child.

Conflict of Interest: None.

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