IOSR Journal of Dental and Medical Sciences (IOSR-JDMS)
e-ISSN: 2279-0853, p-ISSN: 2279-0861.Volume 16, Issue 7 Ver. V (July. 2017), PP 25-33
www.iosrjournals.org

Pediatric Trauma And Role of The Anesthesiologist

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Abstract: *Trauma is the leading cause of mortality and morbidity in pediatric population more than one year of age. Moreover, it incurs significant monetary burden on the healthcare establishments as well as the society due to lifelong disability resulting from injury. Implementation of various child safety devices and enforcement of law regarding safety practices can reduce the incidence of trauma in the young population. Rapid and effective improvement in the vital functions of an injured child has been achieved through advances in airway management and resuscitation strategies. Anesthesiologist is an integral member of the trauma care team to provide airway control, ventilation, hemodynamic resuscitation, monitoring and management during imaging studies, perioperative management, intensive care, and pain relief. Knowledge and understanding of the pathophysiology of trauma in children is essential to provide effective care of a traumatized child. A timely protocol based multidisciplinary team approach only can improve outcome and survival.*
Keywords: *children, injury, pediatric, trauma*

I. Introduction

Trauma is the leading cause of death in children over one year of age.[1] Prolonged hospital stay and life-long disabilities in children suffering from injuries specially those of brain and spinal cord incur considerable financial involvement.[2] Strict implementation of preventive measures, for example, seatbelt use, and wearing helmets while riding bicycle as well as public education can help to reduce traumatic injuries in childhood. Anesthesiologist is one of the essential members of the trauma care team. Airway control, ventilation, hemodynamic resuscitation, monitoring and management during imaging studies, intensive care, and pain relief demand services of the anesthesia care team. As a perioperative physician, anesthesiologist plays significant role during emergent and planned surgical interventions in pediatric trauma based upon adequate knowledge and understanding of the psychologic, anatomic, and physiologic characteristics of the injured child.[3] This article is a review of the principles of management of pediatric trauma both in the acute setting and in the perioperative period.

II. Search Strategy

We searched Pub Med, Google, and Google Scholar from January 1997 to March 2017 for the terms "pediatric or childhood trauma and injury" and "anesthesia" or "surgery". Search was based solely on references published in English. We also considered relevant references from within citation lists. All articles were considered; those with the most robust methodology and sample size were given most weight. Major reviews are cited to provide additional details and references. Due to the paucity of literature reports from India, we also assigned relevant topics published in the medical textbooks related to the pediatric patients.

III. Epidemiology

In India, trauma is most common in school going age group (6-12 years). Among childhood trauma victims, male children comprised 69.86%; whereas females comprised only 30.13%. Common causes of injuries are Road Traffic Accident (RTA) (59.47%) and fall from height (29.42%) among male children. In females, fall was the most common mode of trauma (52.31%), followed by RTA (36.70%). Fall injuries occurred mostly at homes while playing.[4]

IV. Mechanism of Injury

The mechanism of injury in children is somewhat different from that of an adult and is most often caused by abrupt transfer of energy from fast acceleration, deceleration, or a combination of both.[5] The small child involved in RTA will more often sustain visceral injuries due to the close proximity of vital organs whereas the cartilaginous nature of children's bones tends to prevent them from fracturing.[6]

V. Prevention

The most important and effective measures to reduce childhood injury focus on public awareness towards prevention of accidents. This can be achieved by continuous and targeted campaigns to adopt protective measures, for example, wearing seatbelts, helmets etc., implementation of electrical and fire safety in home and enforcement of law by the administration.[7]

VI. Triage

The so-called "Golden Hour" is the first hour post injury when there is potential to intervene and save the patients' life. However, the first "half hour "of the initial one hour post injury has been reaffirmed as the "Platinum Half Hour" in pediatric trauma. This half an hour can be the initial period of ''stability'' despite a life threatening injury and is much shorter than the time referred to in the adult trauma population.[8] Therefore, the injured children should be transferred directly to the designated trauma centers or tertiary care hospitals after proper triage based on Pediatric Trauma Score (Table 1).[9]

Table I. Pediatric Trauma Score (PTS)

Pediatric Trauma Score (PTS)	+2	+1	-1
Weight	> 20 kg (44 lbs.)	10-20 kg (22-44 lbs.)	< 10 kg (22 lbs.)
Airway	Patent	Maintainable	Not maintainable
Systolic blood pressure	> 90 mm Hg	50-90 mm Hg	< 50 mm Hg
CNS	Awake	History of loss of consciousness	Unresponsive
Fractures	None	Closed or suspected	Multiple closed or open
Wounds	None	Minor	Major, penetrating or burns

Mortality is estimated at 9% with a PTS > 8, and at 100% with a PTS ≤ 0. There is a linear relationship between the decrease in PTS and the mortality risk (i.e. the lower the PTS, the higher the mortality risk). The minimal score is -6 and the maximum score is +12.

VII. Pre Hospital Care

Pre hospital management of potential multisystem trauma in pediatric age group requires establishment of adequate airway, spinal cord immobilization, and attainment of venous access, especially for long transports by adequately educated, experienced and skilled pre hospital care providers.[10]

VIII. Initial Assessment and Resuscitation

This includes primary survey with simultaneous resuscitation and secondary survey with definitive care according to the protocol of the Advanced Trauma Life Support (ATLS) course of the American College of Surgeons Committee on Trauma (ASCOT).[11] The primary survey consists of establishment of adequate airway, breathing, and circulation, whereas the secondary survey deals with a thorough examination followed by necessary investigations to detect the extent and severity of injury.

8.1. Airway

Children are more prone to suffer from airway obstruction due to their relatively larger head and tongue in comparison to the body. Moreover, increased respiratory rate, and oxygen consumption, along with reduced functional residual capacity (FRC) make a pediatric trauma victim susceptible to respiratory compromise. Furthermore, potential traumatic brain injury (TBI), cervical spine injuries, and possible presence of full stomach necessitate urgent airway management.

Important indications for tracheal intubation among others include:

- Respiratory insufficiency
- Glasgow Coma Scale (GCS) ≤ 8
- Cardiovascular instability
- Restless children suffering from hypoxia or emotional distress
- Need to undergo investigations e.g. computed tomography (CT) scanning
- Transport to distant tertiary referral hospital

Rapid sequence induction (RSI) followed by orotracheal intubation with manual in-line stabilization in unclear potential cervical spine injury is the standard practice to secure the airway. The endotracheal tube size can be roughly approximated by the size of the child's little finger. Auscultation of bilateral equal breath sounds along with symmetrical chest excursion followed by detection of end-tidal CO2 (ETCO2) tracing confirm proper placement of the endotracheal tube. Gastric decompression by passing a nasogastric or orogastric tube should be done after securing the airway since a distended stomach will impair diaphragmatic excursion leading to respiratory compromise in small children.High flow oxygen through facemask may be sufficient for patients with a lesser degree of respiratory compromise who are hemodynamically stable.

8.2. Circulation

Hemodynamic status of an injured child can be assessed by examining heart rate, capillary refill time, skin color, blood pressure and mental status. Initial signs of hypovolemia are subtle in children and are limited to tachycardia and lethargy. Peripheral vasoconstriction promptly occurs after major hemorrhage increasing the systemic vascular resistance to maintain perfusion pressure. Blood pressure in an injured child is maintained within normal range till > 25-40% blood volume is lost.[12] Therefore, hypotension in this age group which is defined as less than 70mmHg plus twice the age in years, is a late sign of hypovolemic shock.

8.3. Vascular Access

Securing intravenous access in pediatric trauma patients is a challenging job due to lack of cooperation from the frightened and distressed child who is in pain. Presence of smaller veins with more subcutaneous fat, hypovolemia, hypothermia with resultant peripheral vasoconstriction, and presence of fractures in the extremities may make the situation more difficult. Vene-section at the saphenofemoral junction can be an alternative if peripheral venous access seems impossible.[13] In case intravenous access cannot be established within three attempts or 90 seconds, whichever is sooner, both Pediatric Advanced Life Support (PALS) and Advanced Trauma Life Support (ATLS) recommend obtaining an intraosseous (IO) route[14] which can be achieved by inserting a bone marrow needle into the tibial shaft approximately 1-3 cms below and medial to the tibial tuberosity in children less than 6 years of age.[15]

8.4. Disability

A brief and rapid neurological evaluation to determine the Glasgow Coma Scale score[16] (Table 2) as part of the primary survey must be done to determine the severity of TBI if any, and therefore the need for urgent neurosurgical intervention or neuroprotective management in the intensive care unit. Periodic assessment of the level of consciousness and pupillary reaction is necessary to detect any neurologic deterioration happening owing to the progression of TBI, hypoxia, and hypovolemia.

Table 2. Modified Glasgow Coma Scale for Infant and Child

	Child	Infant	Score
Eye Opening	Spontaneous	Spontaneous	4
	To verbal stimuli	To verbal stimuli	3
	To pain only	To pain only	2
	No Response	No Response	1
Verbal Response	Oriented, appropriate	Coos, babbles	5
	Confused	Irritable cries	4
	Inappropriate words	Cries to pain	3
	Incomprehensible words/ nonspecific sounds	Moans to pain	2
	No response	No response	1
Motor Response	Obeys commands	Moves spontaneously	6
	Localizes painful stimulus	Withdraws to touch	5
	Withdraws in response to pain	Withdraws in response to pain	4
	Flexion in response to pain	Abnormal flexion in response to pain	3
	Extension in response to pain	Abnormal extension in response to pain	2
	No response	No response	1

8.5. Exposure

Removal of garments to assess the extent and severity of injury can potentially lead to hypothermia in a small child. Therefore, assessment of the effects of trauma should be done as quickly as possible. Other measures to prevent hypothermia include increasing the temperature of the examination room to 37^0C or more, and use of forced air convection heating blankets apart from warming the intravenous fluids that are being transfused.[17]

8.6. Fluid Resuscitation

ATLS recommends initial fluid resuscitation in case of inadequate tissue perfusion with isotonic crystalloid solution (lactated Ringer's solution) at body temperature in bolus of 10 or 20ml kg^{-1}. A second rapid infusion of 20ml kg^{-1} can be administered if the signs of inadequate tissue perfusion still present after the initial bolus of fluid.[14,15] Signs of adequate resuscitation include resolution of tachycardia, return of capillary refill, clearing of sensorium, and sustained urine output of 1 to 2 ml/kg/hour.

8.7. Blood Transfusion

Use of blood products should be considered in patients not responding to crystalloid boluses or who have more severe injuries. Transfusion of group O Rh-negative packed red blood cells (PRBCs) in boluses of 10-20ml/kg can be considered if time does not permit waiting for crossmatched blood.[18] Assessment of blood loss in pediatric trauma is often difficult due to the reasons described earlier. Laboratory analysis of serial hematocrits, platelets, coagulation profile, and thromboelastography as well as serum lactate and base deficit can help guide fluid and blood product administration although it takes time to get the results. One of the important considerations during fluid resuscitation is prevention of hypothermia so that the injured child does not become victim of the lethal triad of hypothermia, coagulopathy, and acidosis. On the other hand, hyperthermia is to be avoided in case of traumatic brain injury.[19]

IX. Secondary Survey

The secondary survey includes a detailed evaluation of each organ system, thorough head-to-toe examination, and reassessment of hemodynamic status of the injured child.

X. Diagnostic Investigations

10.1. Radiograph

X ray of chest, pelvis, and the injured extremities are taken based on the history of injury and physical examination.

10.2. Ultrasonography of Abdomen

Positive predictors of intra abdominal injury are[20,21]

- Abdominal tenderness
- Ecchymosis, abrasions on the abdominal wall
- Abnormal urine analysis in presence of abdominal tenderness
- Low systolic blood pressure
- Decreased mental status

Focused **A**ssessment with **S**onography for **T**rauma (FAST) detects presence of blood in the dependent parts including both the upper quadrants, and the pelvis. However, FAST cannot differentiate between intraperitoneal and retroperitoneal bleeding and is inefficient in grading solid organ injuries.[22]

10.3. Computed Tomography (CT) Scan

CT scan of head is done in children with obvious evidence of trauma to the head, history of loss of consciousness, presence of headache, vomiting, or convulsion.[23,24]

CT scan of chest is indicated in children with abnormal chest radiograph, obvious trauma to the chest, or high forced impact.[25,26]

CT scan of the cervical spine is done in patient with head injury, obvious trauma to the neck, and neurologic disability.[27]

Due to the limitations of FAST, CT scan of the abdomen has become a popular diagnostic tool in blunt trauma abdomen in recent years.[28] In fact, "PanScan" i.e. CT scan of head, chest, abdomen and pelvis is practiced in polytrauma patients at the earliest opportunity depending upon the extent and severity of the injury.[29]

10.4. Laboratory Studies

Routine laboratory tests in the emergency department do not necessarily alter the clinical management in the pediatric trauma population and delay the decision making of the same.[30] However, specific tests such as urine analysis and arterial blood gas study to detect base deficit and serum lactate may be of limited benefit in selected circumstances.[31]

11. Perioperative Anesthetic Considerations

Most of the injured children do not need immediate surgery and anesthesia unless they suffer either from TBI with resultant subdural or extradural hematoma that needs urgent evacuation, or major abdominal trauma requiring emergent laparotomy.[32] In actual scenario of pediatric trauma, anesthesiologists are involved mainly during the initial phase of resuscitation and airway management, transporting the injured child to the CT scan and taking care of the patient at the time of investigation as well as intensive care management and pain control. However, in many cases, the trauma victim will undergo anesthesia for fixing of fractures and definitive surgeries on a semi urgent basis.

11.1. Preoperative Evaluation of the injured child

Preliminary information about the nature and severity of injury may be obtained from the family members, the transport team, as well as the emergency department physician. A past medical history should also be collected. In emergent situations, a brief history as described with the mnemonic AMPLE is quite useful.[33]

A = Allergies
M = Medications
P = Past medical history
L = Last oral intake, last tetanus immunization
E = Events related to the injury

Physical examination, which could be an important diagnostic tool,[34] includes vital signs, neurologic status, and a brief yet systematic examination of the organs. Serial hematocrit, typing and cross matching of blood products are required for hemodynamically unstable patients.[35] A coagulation profile containing prothombin time (PT), partial thromboplastin time (PTT), and international normalized ratio (INR) may be useful in TBI.[36] Serial blood gas analysis can identify changes in hematocrit, oxygenation, acid base status, and serum biochemistry. Radiology and imaging studies include X ray of chest, limbs and spine, and CT scan of head, chest, abdomen and pelvis as and when necessary.

11.2. Preoperative Preparation

Apart from routine checking of anesthesia machine and monitors, heating devices, rapid infusion systems, a "crash" trolley for resuscitation, as well as a "difficult airway cart" should be made available. The ambient temperature of the anesthetic room should be raised to 26^0C.[37]

Medications should be drawn up and diluted according to the body weight and age of the child, and the syringes labeled in advance.

11.3. Monitors

Standard monitors include pulse oximeter, non invasive blood pressure, ECG, capnography, precordial or esophageal stethoscope, temperature probe, and FiO_2 monitor. Invasive arterial blood pressure monitoring may be required in severely injured hemodynamically unstable child, child with TBI, and during prolonged surgery with anticipated massive blood loss. Urine output is considered as one of the important indicators of organ perfusion. Central venous pressure monitoring may be helpful during surgery with anticipated large fluid shifts.[32]

11.4. Induction of Anesthesia

In case the injured child is coming to the operating room already intubated, the anesthesiologist should ensure proper positioning of the endotracheal tube, presence of air leak, if any, and adequacy of ventilation and oxygenation. Since an injured child should always be considered full stomach, rapid sequence induction (RSI) with the application of cricoid pressure is the standard practice in trauma anesthesia for tracheal intubation[38]. However, cricoid pressure is contraindicated in patients with suspected cricotracheal injury, active vomiting, and unstable cervical spine injury.[39]

If endotracheal intubation seems difficult in the presence of cervical collar, the anterior part of the collar should be removed and manual-in-line stabilization is applied.[40]

Induction agents must be chosen with due considerations to the hemodynamic status, ongoing hemorrhage, if any, and the consciousness level of the injured child. Furthermore, the risk of increase in intracranial pressure (ICP) in patients with TBI during induction of anesthesia and intubation should be taken into account.

Commonly used induction agents are:

11.4.1. Thiopentone

Thiopentone 3-5mg kg^{-1} combined with lidocaine 1-1.5 mg kg^{-1} and fentanyl 1-2 mcg kg^{-1} are suitable induction agents because it causes dose dependent decrease in cerebral oxygen consumption ($CMRO_2$), cerebral blood flow (CBF), and ICP.[41] Slow intravenous titration of thiopentone is necessary to minimize decrease in blood pressure in the hypovolemic patient due to reduction in systemic vascular resistance, cardiac contractility, and preload.

11.4.2. Etomidate

Etomidate at a dose of 0.2-0.3mg/kg provides hemodynamic stability due to its minimal effects on the cardiovascular system. It decreases CMRO2, CBF, and ICP. Cerebral perfusion pressure is maintained because of the maintenance of mean arterial pressure.[42]

11.4.3. Propofol

Propofol causes dose dependent reduction of systemic vascular resistance and hence is not suitable as an induction agent in a traumatized child[43] although the agent decreases CBF and ICP.

11.4.4. Ketamine

Ketamine 2mg kg^{-1} may be an ideal induction agent for hypovolemic, hypotensive, and severely injured child without TBI having emergent surgery to control hemorrhage due to its stimulatory effect on sympathetic nervous system. Moreover, induction doses of ketamine minimally affect ventilatory drive and do not depress airway reflexes. . However, ketamine, a potent cerebrovasodilator, markedly increases CBF and ICP, which can be reduced, but not prevented, by hyperventilation. While some recent clinical adult TBI studies have argued that ketamine may be safe,[44,45] there is no data on ketamine in pediatric TBI.

11.4.5. Suxamethonium

Suxamethonium 1.5-2 mg kg^{-1} may be the drug of choice for RSI and intubation due to its rapid onset (30-60 seconds) and rapid offset of action (5-10 minutes) in view of the anticipated difficult airway management. Suxamethonium may cause bradycardia following repeated doses[46] which can be prevented by pretreatment with atropine.[47] Suxamethonium transiently increases intraocular, intragastric, and intracranial pressures. Moreover, use of the drug may result in hyperkalemia followed by cardiac arrest in children with undiagnosed myopathy and muscular dystrophies.[48] Administration of suxamethonium should also be avoided in burns more than 24 hours old, and disuse atrophy of muscles e.g. spinal cord trauma.[49]

11.4.6. Non depolarizing muscle relaxants without releasing histamine

Rocuronium is often used for RSI and intubation as an alternative to suxamethonium in a dose of 0.9-1.2 mg kg^{-1} although the mentioned dose may prolong the duration of action upto 90 minutes.
Vecuronium, free from adverse cardiovascular effects, in a dose of 0.25 mg kg^{-1} provides good intubating conditions in 60-90 seconds.

11.5. Maintenance of Anesthesia

Maintaining anesthesia should follow the principles of balanced anesthesia providing adequate sedation, analgesia, and muscle relaxation with due consideration to the clinical status of the patient, associated injuries, nature of the surgical procedure, and the postoperative needs of the patient. Isoflurane, and sevoflurane are widely used in pediatric anesthesia although they may potentially cause hypotension by direct myocardial depression and peripheral vasodilatation.[50] However, sevoflurane has the least cardiovascular depressant effect. Total intravenous anesthesia (TIVA) using continuous propofol and remifentanil infusion is often used specially during neurosurgical procedures.[51]

11.6. Intraoperative fluids

In case of an infant or small child, even small volume of blood loss can lead to hemorrhagic shock as the preinjury blood volume is less in comparison to that of an adult. Use of too much crystalloid to replace circulating volume during trauma resuscitation has been associated with hemodilution, coagulopathy, and acidosis.[52] Hence, the concept of damage control resuscitation (DCR) has come into practice in recent years. DCR aims to rapid surgical control of bleeding, allowing permissive hypotension to help preserve freshly formed thrombus, minimal use of non blood products to prevent hemodilution and coagulopathy, and early administration of packed red blood cells (PRBCs), fresh frozen plasma (FFP), and platelets in a ratio of 1:1:1.[53] Although most of the available data regarding DCR are from studies involving adults, the concept has been applied in pediatrics. [54] Minimal hospital stay and improved survival have been associated with adoption of DCR in adult trauma.[55] More clinical data are needed in pediatric trauma resuscitation using the principles of DCR.

11.7. Prevention of hypothermia

Hypothermia is very common in infants and young children due to their immature thermoregulation, and disproportionately greater body surface area to body weight ratio leading to rapid heat loss when exposed to cold operating rooms, cold intravenous fluids and blood products. Moreover, presence of large open wounds and exposure of body cavities during surgery will further lead to heat loss; while anesthesia itself affect physiology of thermal regulation. Adverse effects of hypothermia include:

- Increased oxygen consumption
- Left shift of oxyhemoglobin dissociation curve
- Coagulopathy with prolonged bleeding
- Metabolic and lactic acidosis, hypoglycemia
- Apnea, delayed recovery from anesthesia
- Depressed myocardial contractility, arrhythmias

- Increased mortality[17]

Normothermia must be maintained by warming all intravenous fluids, blood products transfused, and irrigation fluids, using warming blankets, wrapping the head and uninvolved exposed extremities, and increasing the ambient temperature of the operating room.

11.8 Emergence from anesthesia

Decision to extubate the child at the completion of surgery is taken if the child is awake and alert, hemodynamically stable without the need of inotropic support, normothermic, and maintaining adequate oxygen saturation with spontaneous respiration after complete reversal from neuromuscular blockade giving due consideration to the nature, extent and duration of surgery.

XI. Management in the intensive care unit (ICU)

Postoperatively children with multiple injuries are frequently managed in the ICU for close observation. Anticipated complications resulting from polytrauma, significant blood loss, large fluid shifts, aggressive volume resuscitation, and major surgery could be acidosis, hypothermia, and coagulopathy[56] apart from airway swelling, abdominal compartment syndrome, and pulmonary complications.[57]

XII. Postoperative pain management (Acute)

Acute pain resulting from trauma can be detrimental to the physiology and behavioral pattern of the injured child.[58] Analgesics used to treat postoperative pediatric trauma patients include paracetamol, nonsteroidal anti-inflammatory drugs (NSAIDs), and opioids; each group of drugs either administered alone, or in combination . Analgesics should be titrated to the desired effect.[59] Assessment of pain is challenging in pediatric practice. For verbal children of age 7 years or older different pain assessment scales are used. For preverbal children objective rating system using monitoring of vital signs and assessment of behavior are practiced. Unfortunately, it has been observed that young children receive less analgesics than their older counterparts.[60]

Paracetamol 15mg kg^{-1} orally or intravenously every four to six hourly is effective and safe in mild postoperative pain. Absorption of paracetamol administered rectally is often unpredictable and should be given at a dose of 20-40 mg kg^{-1} extending the interval between two doses to six to eight hours. Maximum dose of paracetamol is 60mg kg^{-1} in 24 hours.[61] Among other NSAIDs, Ibuprofen 5-10mg kg^{-1} orally every six to eight hourly, and diclofenac 1-1.5 mg kg^{-1} orally or rectally eight to twelve hourly are frequently used. Commonly reported side effects of NSAIDs include bleeding, and gastric, renal as well as hepatic toxic effects. NSAIDs should not be used in infants less than six months of age, in hypovolemic and hypotensive children, and in those at risk of hemorrhage.[62,63] However, NSAIDs possess opioid sparing effect and are very useful in hemodynamically stable patients with minor injuries.[64]

For moderate to severe pain, continuous intravenous infusion of morphine 10 to 30 mcg kg^{-1} is an effective method with limited adverse consequences, when practiced under proper surveillance.[65] Clearance of intravenous morphine in term infants above one month of age is similar to that in children from one to seventeen years.[66] Therefore, morphine should not be withheld in term infants aged above one month. Patient controlled analgesia (PCA) and nurse controlled analgesia (NCA) are used in many centers within the set guidelines, and under close supervision in children of all ages.[67,68]

Continuous peripheral nerve blockade e.g. femoral, sciatic, fascia illiaca, and brachial plexus etc. by placing catheter under ultrasonographic guidance is safe and effective technique for pain relief after both upper and lower extremity surgery.[69,70] Levobupivacaine and ropivacaine have reduced potential for systemic toxicity and less chance of undesirable motor block in comparison to bupivacaine.[71,72]

XIII. Conclusion

Trauma is the leading cause of morbidity and mortality in pediatric age group. To improve outcome and survival of the injured child, a team approach involving emergency physicians, anesthesiologists, pediatricians, pediatric surgeons, orthopedic surgeons, neurologists, neurosurgeons and radiologists is required. Primary survey involves airway management, obtaining vascular access, hemodynamic resuscitation, and prevention of brain injury due to secondary causes. Secondary survey includes detailed systemic examination, assessment of neurological disability, as well as diagnostic imaging and ultrasound study. Proper assessment of the extent and severity of trauma, and management according to the protocol without unnecessary delay are the two most important factors in reducing mortality, improving the quality of life of the survivors, and contributing to a positive outcome. Anesthesiologists with the knowledge and understanding of different aspects of pediatric trauma can undertake key role during initial resuscitation as well as perioperative care of an injured child.

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*Anuradha Mitra. "Pediatric Trauma And Role of The Anesthesiologist." IOSR Journal of Dental and Medical Sciences (IOSR-JDMS) 16.7 (2017): 25-33.