Transport of the Pediatric Trauma Patient

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Goals/Objectives

- Describe age considerations for pediatric trauma
- Describe preparations for transfer of a pediatric trauma patient (ground vs. air transport)
- List equipment needs/requirements for transferring a pediatric trauma patient
- List information to share with parents of pediatric trauma patients
- Case examples

Unique Pediatric Considerations

- Compared to adults, children have unique anatomy and physiology.
- These differences must be taken into consideration when managing pediatric trauma patients.

Unique Pediatric Considerations cont.

- **Airway & Breathing**
  - Small oral cavities and large tongues: Predispose the child to airway obstruction
  - Large occiput: Flexes the neck, causing airway obstruction and worsening of any unstable cervical injury
  - Anterior larynx: Makes visualization during endotracheal intubation more difficult

Unique Pediatric Considerations cont.

- **Circulation**
  - Infants and small children increase their heart rates to increase stroke volume and improve cardiac output
  - Children are able to maintain a relatively normal blood pressure despite a significant blood loss
  - A normal blood pressure in a child does not necessarily mean there is not a significant volume loss

Unique Pediatric Considerations cont.

- **Head and Brain**
  - Disproportionately large head relative to their body (infants and small children): Causes injuries to the upper c-spine region rather than lower c-spine in adults
  - Instability of the head in infants and young children is dependent on ligaments rather than bony structure
  - Open sutures and fontanels in infants: Allows for better tolerance of expanding hematomas, edema, etc.

Unique Pediatric Considerations cont.

- **Variable** | **Significance**
  - Small oral cavities and large tongues | Predispose the child to airway obstruction
  - Large occiput | Flexes the neck, causing airway obstruction and worsening of any unstable cervical injury
  - Anterior larynx | Makes visualization during endotracheal intubation more difficult

Variable | Significance
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Infants and small children increase their heart rates to increase stroke volume and improve cardiac output | Any interventions/medications that decrease heart rate may cause a rapid loss of perfusion
Children are able to maintain a relatively normal blood pressure despite a significant blood loss | A normal blood pressure in a child does not necessarily mean there is not a significant volume loss
Unique Pediatric Considerations cont.

- **Chest & abdomen**
  - | Variable | Significance |
  - | ----------------- | ----------------- |
  - | Ribs and sternum are not fully ossified until late in adolescence | Chest wall provides less protection to underlying structures, leading to injuries such as tension pneumothorax, airway obstruction and massive hemothorax |
  - | Liver and spleen are less protected by the rib cage | Increased risk of injury during blunt trauma |

Unique Pediatric Considerations cont.

- **Child abuse**
  - Risk factors for abuse include:
    - Non-ambulatory infants and children
    - Evidence of excessive delay in seeking treatment, and the presence of other forms of injury
    - Injuries not consistent with the history or patient’s developmental stage

Unique Pediatric Considerations cont.

- **Child abuse**
  - Physical findings that should raise suspicion for abuse include:
    - Multiple injuries/types of injuries involving multiple areas of the body
    - Unexplained bruising or oral trauma
    - Bruising of ears, cheeks, buttocks, palms, soles, neck, genitals, and perineum
    - Patterned markings resembling objects, grab marks, slap marks, human bites, and loop marks
    - Contact burns in clear shape of hot object (e.g., clothing iron, cigarette lighter)
    - Classic forced immersion burn pattern

Preparations for transfer

- The transport of a pediatric trauma patient begins with the decision to transfer.
- The mode of transport is usually determined by the transferring physician, in consultation with the receiving physician
  - Mode of transport is determined based on the stability of the patient, time savings anticipated with air transport, weather conditions, medical interventions required during transport and the availability of personnel
- Preparations for transfer
  - Serious physiologic deterioration can occur during intra-hospital transport of critically ill children.
  - The occurrence of adverse events during transport are associated with the severity of illness and the duration of transport.
  - The transport team composition and equipment required on transport must be appropriate to provide for any ongoing or anticipated care needs for the duration of transport.
Preparations for transfer cont.

- All critically ill patients that are undergoing transport should receive the same level of monitoring during transport as they had in the sending unit.
  - This includes a minimum of EKG monitoring, pulse oximetry and regular blood pressure and respiratory rate measurement.
  - Other monitoring could include intra-arterial blood pressure and capnography.

Preparations for transfer

- Modes of transport options:
  - Local ambulance service (BLS or ACLS trained)
  - Neonatal/Pediatric Intensive Care Transport Team (most experience with infants/children medical illnesses and trauma)
  - Helicopter Transport Team (most experience with adult cardiac arrest and trauma)
  - The mode that provides the best care for the patient should be selected.

Equipment needed on transport

- Blood pressure monitor
- Pulse oximeter
- Cardiac monitor/defibrillator
- Equipment for airway management
- Basic resuscitation drugs
- Supplemental medications
- Portable mechanical ventilator
- Portable suction
- Trauma specific equipment

Preparing the patient

- All critically ill patients need secure intravenous/intraosseous access before transport.
- A patient should not be transported before airway stabilization has been performed.
  - If it is determined that airway intervention will be needed in route (a difficult process in the back of an ambulance or in a helicopter), then intubation should be performed at the referral hospital.

Preparing the patient cont.

- Prior to the transport of the intubated patient, it is important that:
  - The endotracheal tube position is evaluated and the tube is adequately secured.
  - Adequacy of oxygenation and ventilation is confirmed.
- Maintain spinal immobilization
  - C-collar/Aspen collar and backboard
- Splint any fractures
- Provide pain medication as needed

Preparing the patient cont.

- Prevent hypothermia
  - Children are at greater risk for hypothermia than adults because:
    - The ratio of body mass to surface area is smaller the younger the child. This leads to heat loss.
    - Young children have limited glycogen stores to fuel increased heat production in response to cold.
    - Very young infants do not have the ability to increase heat production by shivering.
Preparing the patient cont.

- Prevent hypothermia cont.
- Hypothermia can lead to:
  - Respiratory depression
  - Decrease in metabolism
  - Circulatory insufficiency and instability
  - Vasodilation
  - Hypovolemia
  - Impaired consciousness
- Methods to prevent hypothermia include:
  - Increased ambient room temperature
  - Radiant warmers
  - Warm IV fluids and humidified inspired oxygen
  - Covering the patient with warm blankets after full assessment is completed.

Preventing hypothermia

What you can expect

- Upon arrival to the referral hospital, the flight or ground crew can be expected to do the following:
  - Take history and do a physical assessment of the patient
  - Ascertain that the airway is adequately controlled for transport and continue oxygen therapy or ventilator support.
  - Initiate/continue cardiac, blood pressure, oxygen saturation monitoring

What you can expect cont.

- Set up infusion pumps and/or pressure bags for all intravenous fluid bags.
- Provide treatment based on the transport team’s guidelines.
- Transfer the patient to a stretcher and securely strap in place.
- Secure copies of patient’s chart and other pertinent data (family contact numbers).

What you can expect cont.

- What to tell the child’s family
  - If the patient is traveling by ground, one parent can travel in the ambulance.
  - If the patient is traveling by helicopter, the parent will be unable to fly as well

Case scenario

- A 6 week old presents to the ED with decreased eating and decreased urine output over the last 18 hours.
- Mom reports that the infant was born at full term without complications. The infant is bottle fed.
- Upon arrival to the ED, the infant was found to be apneic, unresponsive, febrile and seizing.
- Diagnosis?
Case scenario cont.

- The referral hospital suspects seizures related to meningitis.
- The infant is intubated and antibiotics are administered.
- Ativan is given x1, as well as a 20ml/kg 0.9NS fluid bolus.

Case scenario cont.

- Upon arrival, the Intensive Care Transport Team finds the infant lying supine, intubated and attached to a ventilator.
- Physical assessment reveals:
  - Bulging, tense fontanels
  - Separated sutures
  - Sluggish pupils
  - Infant irritable when touched

Case scenario cont.

- Continued seizure activity (repetitive eye movements) was observed and a loading dose of Phenobarbital was administered.
- The transport team examined the chest x-ray for ET tube placement prior to transport and observed multiple rib fractures.
- What do you think now?

Case scenario cont.

- The patient was brought into the ED as a trauma code.
- A CT scan was ordered and the results were as follows:
  - Cerebral edema
  - Multiple areas of infarct
  - Multiple rib fractures of varying age
  - Subdural and subarachnoid hemorrhages of varying age
  - C2 Hangman’s Fracture with further injury down to T2
  - Retinal hemorrhage

Case scenario cont.

- Patient was taken emergently to the OR where a craniectomy was performed along with a bone flap.
- An external ventricular drain as well as an intracranial pressure monitor were placed.

Case scenario cont.

- Treatment in the NICU involved a multidisciplinary team approach including:
  - Neurosurgery
  - General surgery
  - Neonatology
  - Social Work
  - Child Protection Team
  - Ophthalmology
Case scenario cont.

- Parents interviewed separately
- Information not consistent
- Both parents commented on how the infant was abnormally irritable and very difficult to console since birth
- Suggested mechanism of injury from parent was that father fell asleep while trying to console infant and rolled over on her

CPT stated that the infant's injuries were not consistent with the parent's story.

- The infant's injuries were suggestive of an injury much more forceful in nature and was deemed a non-accidental trauma
- Infant was removed from parent's custody
- Discharged home into foster care

References