Pediatric Trauma

July 27th, 2016.

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Schulich MEDICINE & DENTISTRY

Western

Case

5yoM fall from roof

- Fall from roof of home while father was shingling

5yoM fall from roof

- Fall from roof of home while father was shingling, 8 ft. high
- No loss of consciousness, ambulating immediately after injury, actual fall not witnessed
- Previously healthy
- No home meds, no allergies, immunizations up to date

- Speaking, airway protected, patent
- GAEB, trachea midline, 98%SpO2 on RA
- HR 115, BP 111/65, FAST Positive, Abdomen tender diffusely, guarding
- Bilateral tenderness/edema/bruising at wrists

CT head, c-spine, C/A/P

- Head/C-spine/Thorax – no injury
- Segment 7/8 Liver Grade 4 laceration, extravasation of contrast, free fluid

Objectives

Objectives – Medical Expert

1. Describe the types of pediatric injuries sustained with a given mode of trauma, and identify the most common injuries occurring in various age groupings.

2. Identify unique anatomic or physiologic differences in children, when compared to adult patients.

3. Discuss the components of the primary survey in the pediatric trauma patient

4. Outline the secondary survey, and identify controversies in pediatric shock trauma management

5. Differentiate between mild, moderate, and severe head injuries in children

Objectives – Medical Expert

6. Describe unique traumatic injuries to the spine that occur in children and measures to treat these injuries

7. Differentiate the types of cardiothoracic trauma, and list appropriate management of each type

8. Identify signs, symptoms, and management of pediatric abdominal and genitourinary trauma

9. Recognize the risks and appropriate management of traumatic amputation and soft tissue trauma in children

10. Recognize the risks and appropriate interventions in the management of orthopedic pediatric trauma

Objectives - Collaborator

1. Understand the post injury components of care for pediatric trauma patients

2. Describe the levels of pediatric trauma care and how to prepare an ER for treatment of the injured child

Objectives – Health Advocate

1. Describe the impact of pediatric trauma on Canadian society and healthcare.

2. Identify the importance of pain management with practical strategies for managing pain in pediatric trauma patients

3. Outline the role of family centered care in pediatric trauma

Objectives - Scholar

1. Identify and understand the implications of one recent sentinel paper in pediatric trauma care

Pediatric Trauma

Background

- Trauma is the leading cause of death in children and adolescents
  - Most due to preventable injuries
  - For every injury mortality, estimated 25 hospitalizations and 925 emergency room visits
  - Leading cause of years of life lost
  - Leading cause of medical costs
  - Emotional trauma for parents and families

Background

- Injury prevention through awareness and increased safety measures has lead to the reduction in death from trauma in Canada
  - Seatbelts
  - Vehicle Design
  - Car seats
  - Reduction in drunk driving
  - Child resistant packaging
  - Safety awareness
  - Improved medical care

Rank	Age groups (years)				
	<1	1-4	5-9	10-14	15-19
1	Congenital anomalies 4758	Unintentional injury 1316*	Unintentional injury 746*	Unintentional injury 775*	Unintentional injury 3652*
2	Short gestation 4202	Congenital anomalies 476	Malignant neoplasms 447	Malignant neoplasms 448	Suicide 1748¶
3	Maternal pregnancy complications 1595	Homicide 337Δ	Congenital anomalies 179	Suicide 386¶	Homicide 1407Δ
4	SIDS 1563	Malignant neoplasms 328	Homicide 125Δ	Congenital anomalies 161	Malignant neoplasms 627
5	Unintentional injury 1156*	Heart disease 169	Chronic lower respiratory disease 75	Homicide 152Δ	Heart disease 297

Mortality

Incident	1987	2004	Change
Motor vehicle crash	3,587	2,431	↓32%
Drowning	1,363	761	↓44%
Pedestrian injury	1,283	583	↓55%
Fire and/or burn injury	1,233	512	↓58%
Suffocation	690	963	↑28%
Falls	149	107	↓28%
Poisoning	100	86	↓14%
Firearm	247	63	↓74%

Rank	Age groups, years				
	<1	1-4	5-9	10-14	15-19
1	Unintentional suffocation 979	Unintentional drowning 393	Unintentional MV traffic 342	Unintentional MV traffic 414	Unintentional MV traffic 2338
2	Unintentional MV traffic 66	Unintentional MV traffic 327	Unintentional drowning 116	Unintentional drowning 93	Unintentional poisoning 587
3	Unintentional drowning 23	Unintentional suffocation 161	Unintentional fire/burn 87	Unintentional other land transport 49	Unintentional drowning 241
4	Unintentional natural/environment 19	Unintentional fire/burn 129	Unintentional suffocation 44	Unintentional fire/burn 48	Unintentional other land transport 69
5	Unintentional fire/burn 17	Unintentional pedestrian, other 90	Unintentional other land transport 29	Unintentional suffocation 37	Unintentional fall 62

Rank	Age groups, years				
	<1	1-4	5-9	10-14	15-19
1	Unintentional fall 134,229	Unintentional fall 852,884	Unintentional fall 624,890	Unintentional struck by/against 561,690	Unintentional struck by/against 530,301
2	Unintentional struck by/against 28,786	Unintentional struck by/against 336,917	Unintentional struck by/against 403,522	Unintentional fall 558,177	Unintentional fall 408,054
3	Unintentional other bite/sting 12,186	Unintentional other bite/sting 158,587	Unintentional cut/pierce 112,633	Unintentional overexertion 294,669	Unintentional overexertion 360,680
4	Unintentional foreign body 10,650	Unintentional foreign body 139,597	Unintentional other bite/sting 107,975	Unintentional cut/pierce 114,285	Unintentional MV-occupant 263,871
5	Unintentional other specified 10,511	Unintentional cut/pierce 83,575	Unintentional overexertion 93,612	Unintentional pedal cyclist 84,732	Unintentional cut/pierce 180,602

Approach to injured child

ATLS

- Based on trimodal death distribution
  - First peak – seconds to minutes immediately after injury (only prevention can affect mortality)
  - Second peak – minutes to hours – rapid assessment and treatment can improve mortality
  - Third peak – days to weeks – multi-organ system failure – definitive care at specialized pediatric center may mitigate delayed mortality

Injury classification

- Many pediatric trauma classification systems used to predict mortality, morbidity, resources, operative intervention, etc.
    - GCS, Trauma Score, Revised Trauma Score, Pediatric Trauma Score, Age-specific pediatric trauma score, Anatomic systems, abbreviated injury scale, injury severity score, mechanism, etc.
- Objectives are in 1) triage decision support in prehospital setting and 2) predicting severity of illness and mortality

Injury classification

- Extent – multiple (two or more body areas) vs. localized; may be obvious or evolve over time
- Type – blunt vs. penetrating
- Severity – mechanism of injury, vita signs, physical exam findings

Mechanism

Blunt
Motor vehicle collision
Ejection from the automobile
Death of another passenger in same vehicle compartment
Vehicle roll over
High speed automobile crash
• Initial speed >40 mph (64 kph)
• Auto deformity >20 inches (50 cm)
• Intrusion into passenger compartment >12 inches (30 cm)
Extrication time >20 minutes
Motorcycle crash >20 mph (32 kph) or with separation of rider from bike
Motor vehicle pedestrian injury
Pedestrian thrown or run over
Automobile-pedestrian injury with >5 mph (8 kph) impact
Falls
Adult: >20 ft (6 m)
Child: >10 ft (3 m) or more than 2 to 3 times patient height
Penetrating
Any penetrating trauma to head, neck, chest, abdomen, or extremities proximal to elbow or knee

Physical findings

Vital signs and level of consciousness
GCS <14
Shock (compensated or uncompensated)*
RR lower or higher than normal for age¶
Anatomy of injury
Airway trauma with compromise
Chest trauma with respiratory compromise or shock
Abdominal pain or distension with shock
Pelvic fracture
Two or more proximal long-bone fractures
Amputation proximal to wrist or ankle
Crushed, mangled, or degloved extremity
Open or depressed skull fracture
Paralysis
Penetrating trauma to head, neck, chest, abdomen, or proximal extremities

Goals

- Rapidly assess injuries, determine management priorities, provide critical interventions
- Primary survey, resuscitation, adjuncts to primary survey, secondary survey, continued resuscitation and monitoring, adjuncts to secondary survey, transition to definitive care

What is different about children?

ANATOMY

Airway

Differences from adult airways:

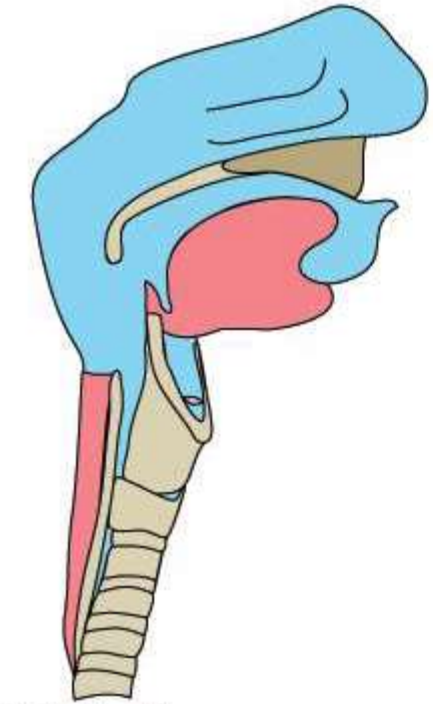
1. small oral cavity and large tongue - obstruction
2. large occiput, neck flexion – obstruction, c-spine
3. larynx cephalad/anterior, floppy epiglottis
4. short narrow trachea, narrow distance between rings

Airway

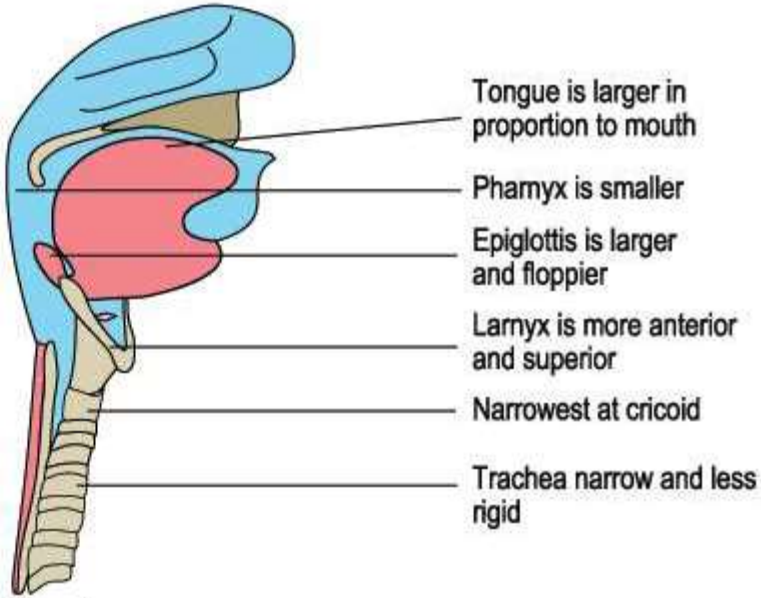
- What is the narrowest point in the pediatric airway?

- Would you use a cuffed or un-cuffed tube?

Airway



Adult's Upper Airway

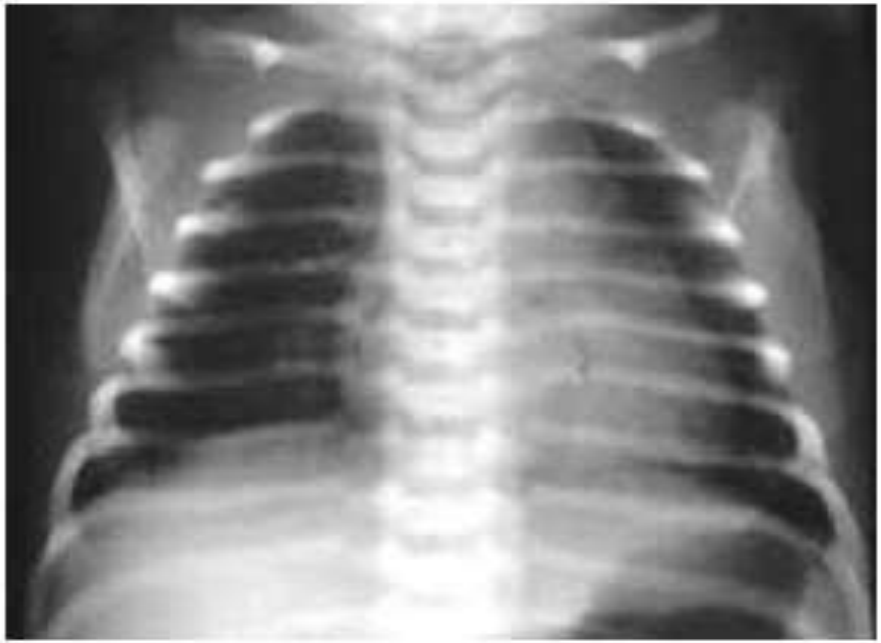


Child's Upper Airway

Breathing

- More or less compliant than adult?

Diaphragmatic Breathing



Summary

Anatomy	PEDIATRIC	ADULT
Tongue	Large	Normal
Epiglottis Shape	Floppy, omega shaped	Firm, flatter
Epiglottis Level	Level of C3 - C4	Level of C5 - C6
Trachea	Smaller, shorter	Wider, longer
Larynx Shape	Funnel shaped	Column
Larynx Position	Angles posteriorly away from glottis	Straight up and down
Narrowest Point	Sub-glottic region	At level of Vocal cords
Lung Volume	250ml at birth	6000 ml as adult

Abdomen

- Thin abdominal wall
- Which two organs are more likely to be injured in children?
- Which organ is intra-abdominal in infants but not adults?

Bones

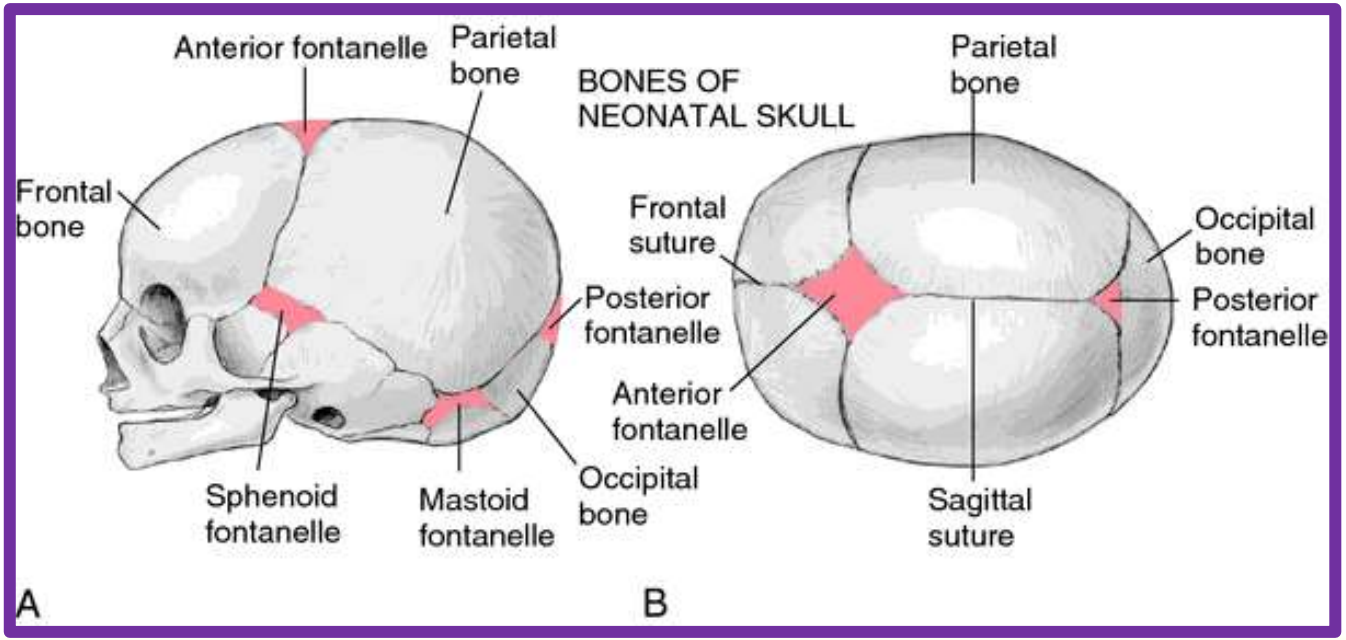
- When do children reach skeletal maturity?
- Why is this important?

Bones

- What is a green stick fracture?
- Why do they occur in children and not adults?

Skull

- When do anterior fontanelles close?



General

- Smaller size → increased likelihood for injury to multiple organ systems

- Higher metabolic rate and larger surface area to body-mass ratio → increased heat loss

What is different about children?

PHYSIOLOGY

Circulation

- Blood volume is larger but absolute volume is smaller
  - **A relatively small amount of blood loss can be a significant % of total blood volume**
  - **Need to record even small volume loses you might ignore in an adult**

Circulation

- Fixed Stroke Volume in infants

- Hypotension is a late sign of shock. What's a better indicator?

Normal Vitals

Pediatric Vital Sign Normal Ranges

Age Group	Respiratory Rate	Heart Rate	Systolic Blood Pressure	Weight in kilos	Weight in pounds
Newborn	30 - 50	120 - 160	50 - 70	2 - 3	4.5 - 7
Infant (1-12 months)	20 - 30	80 - 140	70 - 100	4 - 10	9 - 22
Toddler (1-3 yrs.)	20 - 30	80 - 130	80 - 110	10 - 14	22 - 31
Preschooler (3-5 yrs.)	20 - 30	80 - 120	80 - 110	14 - 18	31 - 40
School Age (6-12 yrs.)	20 - 30	70 - 110	80 - 120	20 - 42	41 - 92
Adolescent (13+ yrs.)	12 - 20	55 - 105	110 - 120	>50	>110

Shock

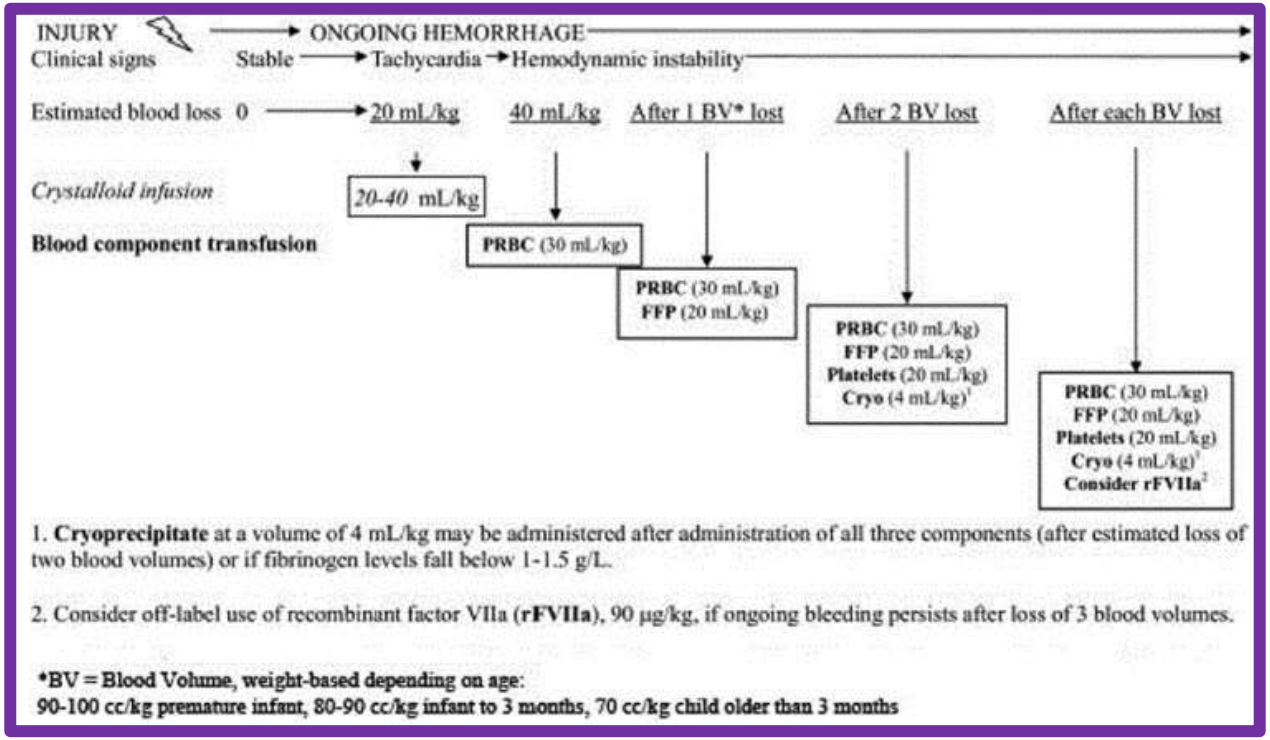
System	Mild Hemorrhage Compensated Shock (<30% blood volume loss)	Moderate Hemorrhage Decompensated Shock (30-45% blood volume loss)	Severe Hemorrhage Cardipulmonary Failure (>45% blood volume loss)
Cardiovascular	Mild tachycardia Weak peripheral pulses Strong central pulses Mild acidosis	Moderate tachycardia Weak peripheral pulses Weak central pulses Moderate acidosis	Severe tachycardia No peripheral pulses Weak central pulses Hypotension *(SBP < 70 + [2× age in years])* Severe acidosis
Respiratory	Mild Tachypnea	Moderate Tachypnea	Severe Tachypnea
CNS	Irritable, anxious	Agitated, lethargic	Obtunded, comatose
Skin	Cool extremities, mottling. Cap refill > 2 s	Cool extremities, pallor. Cap refill > 3 s	Cold extremities, cyanosis. Cap refill > 5 s
Urinary	Mild oliguria	Marked oliguria; increased BUN	Anuria

Intravenous Fluids

- Access is typically more challenging in pediatrics

- How much fluid to give? What kind?

Access/Fluids



1. **Cryoprecipitate** at a volume of 4 mL/kg may be administered after administration of all three components (after estimated loss of two blood volumes) or if fibrinogen levels fall below 1-1.5 g/L.

2. Consider off-label use of recombinant factor VIIa (**rFVIIa**), 90 µg/kg, if ongoing bleeding persists after loss of 3 blood volumes.

***BV = Blood Volume, weight-based depending on age:**
90-100 cc/kg premature infant, 80-90 cc/kg infant to 3 months, 70 cc/kg child older than 3 months

Head/Spinal Injury

Head

- Leading cause of death from trauma leading to significant lifelong disability
- However, over 80% are mild traumatic brain injury

- Classification:
  - Mild (Ped-GCS 13-15)
  - Moderate (Ped-GCS 9-12)
  - Severe (Ped-GCS <8)

Head - Management

- Principles:
  - Airway
  - Avoiding hypoxia (02)
  - Avoiding hypotension
  - Ensuring adequate resuscitation

- **ICP monitoring in those with severe head injury**
  - Raised ICP:
    - Hypertonic saline 0.1-1cc/kg
    - Mannitol 0.25-1cc/kg

Spine

- Very rare in children younger than 17 year olds
- C2 lesions in young, C4 in teen (A-O dislocation)
- Mechanism MVC in young, sports in teens
- **SCIWORA** – need high suspicion of injury (PH Exam)

- **Neurologic Recovery**
  - Likely better compared to adult population
  - No evidence for hypothermia/steroids

Case

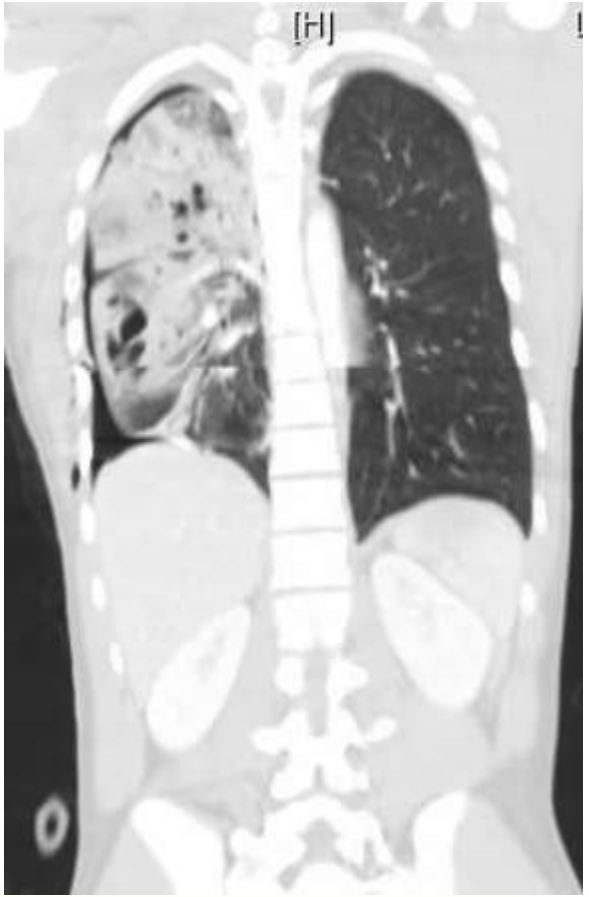
15 yoM ATV crash from community

- Not helmeted, thrown off ATV, landed on right side
- No loss of consciousness, but amnesia
- Taken to community ER, HD stable, Chest Xray showed right pneumo/haemo, chest tube placed (750mL blood)
- Transferred to LHSC Peds Emerg

- Healthy, allergy to penicillin
- Airway patent, protected, speaking
- Decreased AE on the right, midline trachea, no sub/q emphysema, 96% on 5L, continuous air leak
- No further blood drained on transfer, HR 110, BP 132/90, abdomen soft, no obvious long bone fractures, FAST negative, peripheral pulses palpable
- PEARL. GCS 15.

CT scan C/A/P

- Right pneumothorax
- Right lung contusion
- Grade 1 liver laceration
- Bilateral scapular fractures



Cardiothoracic

Thoracic

- Much less common secondary to small size
- Approximately 6%, almost all of which are blunt
- 3:1 male to female ratio

- Greater flexibility results in more pulmonary contusions or pneumatoceles with no rib fractures
- 30-40% of injuries are missed on initial CXR

- Vast majority only require observation or chest tube

Thoracic – Hemothorax or Pneumothorax

- Clinical findings of a tension pneumothorax may be impressive (mobile mediastinum)

- Nipple Level

Table 4 Chest Tube Size (French)

Size of patient (kg)	Pneumothorax	Hemothorax
<3	8–10	10–12
3–8	10–12	12–16
8–15	12–16	16–20
16–40	16–20	20–28
>40	20–24	28–36

Thoracic – Rib

- Marker of energy transfer OR child abuse
- 1st or 2nd rib fractures raise suspicion for vascular injury
- **Management**
  - Analgesia
  - Suspicion of pulmonary contusion if deteriorating

Abdominal

Case

5yoM fall from 8 ft height

- Fall from roof of home while father was shingling
- No loss of consciousness, ambulating immediately after injury, actual fall not witnessed
- Previously healthy

- Speaking, airway protected, patent
- GAEB, trachea midline, 98%SpO2 on RA
- HR 115, BP 111/65, FAST Positive, Abdomen tender diffusely, guarding
- Bilateral tenderness/edema/bruising at wrists

CT head, c-spine, C/A/P

- Head/C-spine/Thorax – no injury
- Segment 7/8 Liver Grade 4 laceration, extravasation of contrast, free fluid

Abdominal – Solid Organs

- 8-12% of pediatric trauma
- Spleen and liver most common

- Current management is largely non-operative (>90% success even in high grade injuries)

- **Management**
  - Non-operative
  - Continued instability → operating room for laparotomy, control of bleeding and packing

Abdominal – Solid Organs

Table 4 Proposed Guidelines for Resource Utilization in Children with Isolated Spleen or Liver Injury

CT grade	I	II	III	IV
ICU days	None	None	None	1 day
Hospital stay	2 days	3 days	4 days	5 days
Pre-discharge imaging	None	None	None	None
Post-discharge imaging	None	None	None	None
Activity restriction[a]	3 weeks	4 weeks	5 weeks	6 weeks

[a]Return to full-contact, competitive sports (i.e., football, wrestling, hockey, lacrosse, mountain climbing, etc.) should be at the discretion of the individual pediatric trauma surgeon. The proposed guidelines for return to unrestricted activity include "normal" age-appropriate activities.

Abdominal – Hollow Viscous Injury

- Crush, burst and sheer injuries
- Rapid contamination of abdominal cavity

- Serial physical exams are more sensitive than CT

- **Management**
  - Early recognition and repair are key
  - High index of suspicion in unwell patients

Pain Management

Pain

- **Mild (Pain score 1-3)**

  eg. Superficial cuts, bruises, sprains

  1) Acetaminophen or Non-Steroidal Anti-Inflammatory (NSAIDs)

- **Moderate (Pain score 4-6)**

  eg. Significant cuts on the extremities, minor surgical procedures, chronic pain and cancer pain

  1) Regular dosing of acetaminophen **and/or** NSAIDs

  2) Consider adding opioids such as codeine or oxycodone

- **Severe (Pain score 7-10)**

  eg. Moderate to major surgical procedure, kidney stones, biliary colic, traumatic injuries, severe chronic pain and cancer pain, sickle cell crisis.

  1) Give regular dosing of acetaminophen **and/or** NSAIDs

  WITH

  2) Opioids PO or IV such as morphine, hydromorphone or oxycodone

Pain

Table 1. Starting dosage for opioid-naive pediatric patients (Older than 3 months old*)

Drugs	Risk Factors		No Risk Factors	
	P.O (mg/kg)	IV (mg/kg)	PO (mg/kg)	IV (mg/kg)
Morphine	**0.15** max 5 mg/dose	**0.05** max 2.5 mg/dose	**0.3** max 10 mg/dose	**0.1** max 5 mg/dose
HYDROmorphone	**0.02** max 1 mg/dose	**0.01** max 0.5 mg/dose	**0.04** max 2 mg/dose	**0.02** max 1 mg/dose
Oxycodone	**0.05** max 2.5 mg/dose		**0.1** max 5 mg/dose	
Codeine	**0.5** max 30 mg/dose		**1** max 60 mg/dose	

Papers for Discussion

Original Investigation

Mortality Among Injured Children Treated at Different Trauma Center Types

Chethan Sathya, MD; Aziz S. Alali, MD, PhD; Paul W. Wales, MD; Damon C. Scales, MD, PhD; Paul J. Karanicolas, MD, PhD; Randall S. Burd, MD, PhD; Michael L. Nance, MD; Wei Xiong, MSc; Avery B. Nathens, MD, PhD, MPH

IMPORTANCE Trauma is the leading cause of death among US children. Whether pediatric trauma centers (PTCs), mixed trauma centers (MTCs), or adult trauma centers (ATCs) offer a survival benefit compared with one another when treating injured children is controversial. Ascertaining the optimal care environment will better inform quality improvement initiatives and accreditation standards.

OBJECTIVE To evaluate the association between type of trauma center (PTC, MTC, or ATC) and in-hospital mortality among young children (5 years and younger), older children (aged 6-11 years), and adolescents (aged 12-18 years).

DESIGN, SETTING, AND PARTICIPANTS In this retrospective cohort study, injured children aged 18 years or younger who were hospitalized in the United States from January 1, 2010, to December 31, 2013, were observed for the duration of their admission until discharge or death. We included patients with an Abbreviated Injury Score of 2 or greater in at least 1 body region. Random-intercept multilevel regression was used to evaluate the association between center type and in-hospital mortality after adjusting for confounders. Stratified analyses in young children, older children, and adolescents were performed. We conducted secondary analyses limited to patients with severe injuries (Injury Severity Score >25). Both

Sathya et al 2015

- Retrospective cohort study of 175 585 children 18 and younger in US from Jan 2010 to Dec 2013 of Abbreviated Injury Score 2 or higher from 252 Level I and II trauma centers participating in the Trauma Quality Improvement Program

- Compared in hospital mortality in children treated at adult trauma centers, mixed trauma centers, pediatric trauma centers

Sathya et al 2015

- Performed multilevel regression analysis to evaluate association between center type and mortality
- Also did stratified analysis in different ages
- Secondary analyses in patients with severe injuries (ISS over 25)

Sathya et al 2015

- After adjustment, children had higher mortality at ATCs and MTCs than PTCs
- Younger children had this association but not older children or adolescents
- Similar results for severely injured children

Original Investigation

Association Between Trauma Center Type and Mortality Among Injured Adolescent Patients

Rachel B. Webman, MD; Elizabeth A. Carter, PhD, MPH; Sushil Mittal, PhD; Jichaun Wang, PhD; Chethan Sathya, MD; Avery B. Nathens, MD, PhD; Michael L. Nance, MD; David Madigan, PhD; Randall S. Burd, MD, PhD

Supplemental content at jamapediatrics.com

IMPORTANCE Although data obtained from regional trauma systems demonstrate improved outcomes for children treated at pediatric trauma centers (PTCs) compared with those treated at adult trauma centers (ATCs), differences in mortality have not been consistently observed for adolescents. Because trauma is the leading cause of death and acquired disability among adolescents, it is important to better define differences in outcomes among injured adolescents by using national data.

OBJECTIVES To use a national data set to compare mortality of injured adolescents treated at ATCs, PTCs, or mixed trauma centers (MTCs) that treat both pediatric and adult trauma patients and to determine the final discharge disposition of survivors at different center types.

DESIGN, SETTING, AND PARTICIPANTS Data from level I and II trauma centers participating in the 2010 National Trauma Data Bank (January 1 to December 31, 2010) were used to create multilevel models accounting for center-specific effects to evaluate the association of center characteristics (PTC, ATC, or MTC) on mortality among patients aged 15 to 19 years who were treated for a blunt or penetrating injury. The models controlled for sex; mechanism of injury (blunt vs penetrating); injuries sustained, based on the Abbreviated Injury Scale scores (post-dot values <3 or ≥3 by body region); initial systolic blood pressure; and Glasgow Coma Scale scores. Missing data were managed using multiple imputation, accounting for multilevel data structure. Data analysis was conducted from January 15, 2013, to March 15, 2016.

Webman et al 2016

- Differences in mortality between different trauma centers have not previously been consistent for adolescents
- Data from National Trauma Bank using 29 613 injured adolescents from 2010 in Level I and II trauma centers
- Multilevel models accounting for center specific effects
- Mortality was higher among adolescents treated at ATCs and MTCs rather than PTCs

Questions?

Drugs in Pediatric Trauma

DRUG	IV DOSE (MG/KG)	ONSET (MIN)	DURATION (MIN)	INDICATIONS	CONTRAINDICATIONS
Thiopental	2–5 mg/kg	2–5 seconds	10–30	Increased ICP, status epilepticus	Hypotension, porphyria, bronchospasm
Ketamine	0.5–2 mg/kg	1–2	10–30	Hypotension, reactive airway disease	Increased ICP, glaucoma
Midazolam	0.1–0.4 mg/kg	1–2	30–60	Status epilepticus	Hypotension
Fentanyl	2–10 mcg/kg	1	30–60	Airway obstruction, head trauma	Respiratory depression, risk of chest wall rigidity
Etomidate	0.2–0.4 mg/kg	1	5–14	Hypotension, trauma	Adrenal insufficiency, seizure disorder
Propofol	1–2 mg/kg	.05–1	10–15	Prolonged sedation, vomiting	Hypotension, lecithin allergy

Key: ICP, intracranial pressure

Case 1

Case 1

8 yoM helmeted cyclist struck by car

Unresponsive on arrival, tachypnea with pale, dusky extremities

HR 144

RR 38

BP 84/60

GCS 5 (E = 1; V = 2; M = 2)

What is the most common cause of cardiac arrest in pediatric trauma?

PEDIATRIC GLASGOW COMA SCALE (PGCS)				
	> 1 Year		**< 1 Year**	**Score**
EYE OPENING	Spontaneously		Spontaneously	4
	To verbal command		To shout	3
	To pain		To pain	2
	No response		No response	1
MOTOR RESPONSE	Obeys		Spontaneous	6
	Localizes pain		Localizes pain	5
	Flexion-withdrawal		Flexion-withdrawal	4
	Flexion-abnormal (decorticate rigidity)		Flexion-abnormal (decorticate rigidity)	3
	Extension (decerebrate rigidity)		Extension (decerebrate rigidity)	2
	No response		No response	1
	> 5 Years	**2-5 Years**	**0-23 months**	
VERBAL RESPONSE	Oriented	Appropriate words/phrases	Smiles/coos appropriately	5
	Disoriented/confused	Inappropriate words	Cries and is consolable	4
	Inappropriate words	Persistent cries and screams	Persistent inappropriate crying and/or screaming	3
	Incomprehensible sounds	Grunts	Grunts, agitated, and restless	2
	No response	No response	No response	1
TOTAL PEDIATRIC GLASGOW COMA SCORE (3-15):				

Endotrachial Tubes

- Predicted Size for Un-cuffed Tube = (Age / 4) + 4
- Predicted Size for Cuffed Tube = (Age / 4) + 3

Equipment	Newborn/ Small infant (3-6 kg)	Infant (6-9 kg)	Toddler (10-11 kg)	Small Child (12-14 kg)	Child (15-18 kg)	Child (19-22 kg)	Large Child (24-30 kg)	Adult (31-32 kg)
Resuscitation bag	Infant	Child	Child	Child	Child	Child	Child/adult	Adult
O_2 mask	Newborn	Newborn	Pediatric	Pediatric	Pediatric	Pediatric	Adult	Adult
Oral airway	Infant/small child	Infant/small child	Small child	Child	Child	Child/small adult	Child/small adult	Medium adult
Laryngoscope blade (size)	0-1 straight	1 straight	1 straight	2 straight	2 straight or curved	2 straight or curved	2-3 straight or curved	3 straight or curved
Tracheal tube (mm)	Premature infant 2.5 Term infant 3.0-3.5 uncuffed	3.5 uncuffed	4.0 uncuffed	4.5 uncuffed	5.0 uncuffed	5.5 uncuffed	6.0 cuffed	6.5 cuffed
Tracheal tube length (cm at lip)	10-10.5	10-10.5	11-12	12.5-13.5	14-15	15.5-16.5	17-18	18.5-19.5
Stylet (F)	6	6	6	6	6	14	14	14
Suction catheter (F)	6-8	8	8-10	10	10	10	10	12
BP cuff	Newborn/ infant	Newborn/ infant	Infant/child	Child	Child	Child	Child/adult	Adult
IV catheter (G)	22-24	22-24	20-24	18-22	18-22	18-20	18-20	16-20
Butterfly (G)	23-25	23-25	23-25	21-23	21-23	21-23	21-22	18-21
Nasogastric tube (F)	5-8	5-8	8-10	10	10-12	12-14	14-16	16
Urinary catheter (F)	5-8	5-8	8-10	10	10-12	10-12	12	12
Defibrillation/ cardioversion external paddles	Infant paddles	Infant paddles until 1 yr or 10 kg	Adult paddles when >1 yr or ≥10 kg	Adult paddles	Adult paddles	Adult paddles	Adult paddles	Adult paddles
Chest tube (F)	10-12	10-12	16-20	20-24	20-24	24-32	28-32	32-40