

Pediatric Trauma

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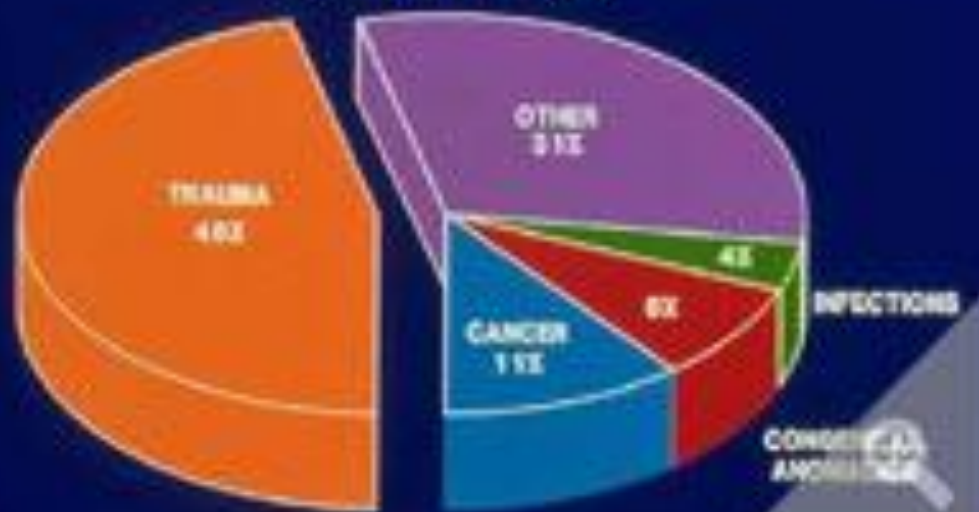
Pediatric Trauma: the Problem

- Trauma leading cause of death > 1 year
- 65% of deaths due to unintentional injury
- 20,000 pediatric deaths/year in US
- 40 children hospitalized for each death
- 1120 children treated in ER for each death

<http://www.emedicine.com/med/topic3223.htm>



CAUSES OF DEATH AGE 1-14 YRS.



Unique Problems in the Pediatric Population

□ Size

- small size = increased energy/unit surface area
- Less fat/soft tissue = high frequency of multiple organ injury

□ Skeleton

- Less calcified therefore more flexible
- Greater incidence of abdominal, chest and spinal cord injury without fracture



Unique Problems in the Pediatric Population

□ High Surface Area/Body Volume = Greater Heat Loss -- THINK TEMPERATURE CONTROL

- Baer Hugger
- Heat Lamps
- Wrap arms and legs in wool cast padding
- Hat
- Warm iv fluids
- Heated nubliser for O2 administration



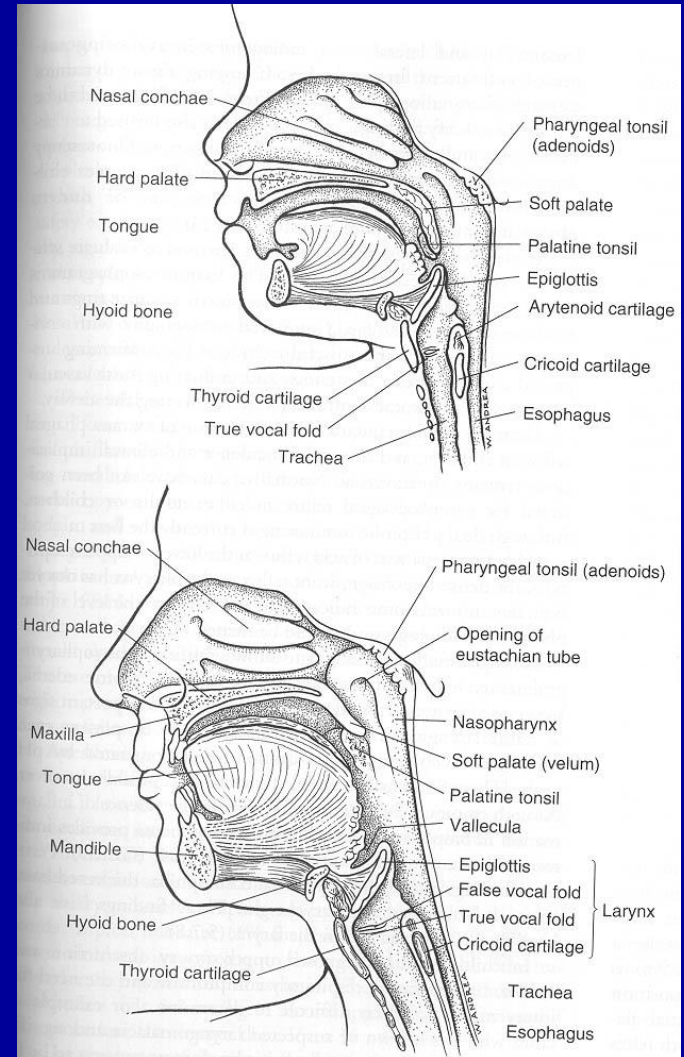
Unique Problems in the Pediatric Population

- Psychological Stress
 - The child
 - The family
 - The staff
- Equipment



Airway

- Large head, small midface—buckling of pharynx
- Larger soft tissues—tongue and tonsils
- “Anterior” Larynx



Oral Airway

- Only in unconscious children
- Use a tongue blade to facilitate insertion
- **DO NOT INSERT AND ROTATE 180 degrees**—this maneuver can tear the soft palate and cause bleeding



Endotracheal Intubation

- What size endotracheal tube
 - Broeslow Tape
 - Tube diameter should be the size of the child's 5th finger
 - New born 3.5, 1 year 4.0, 2 years 4.5, >2 years $4.5 + \text{age}/4$



Broeslow System

ALWAYS USE LENGTHS TO DETERMINE EQUIPMENT ZONES.

WARNING: All dosage calculations are based on the concentrations recommended in the calculation basis. Use of any other drug concentrations will result in dosage error.



MEASURE CHILD TO DETERMINE WEIGHT/COLOR ZONES.

HUF			
6x 5l	6x 6l	6x 6c	6x 6c
...



Failure of Intubation?

Needle Cricothyroidotomy is best

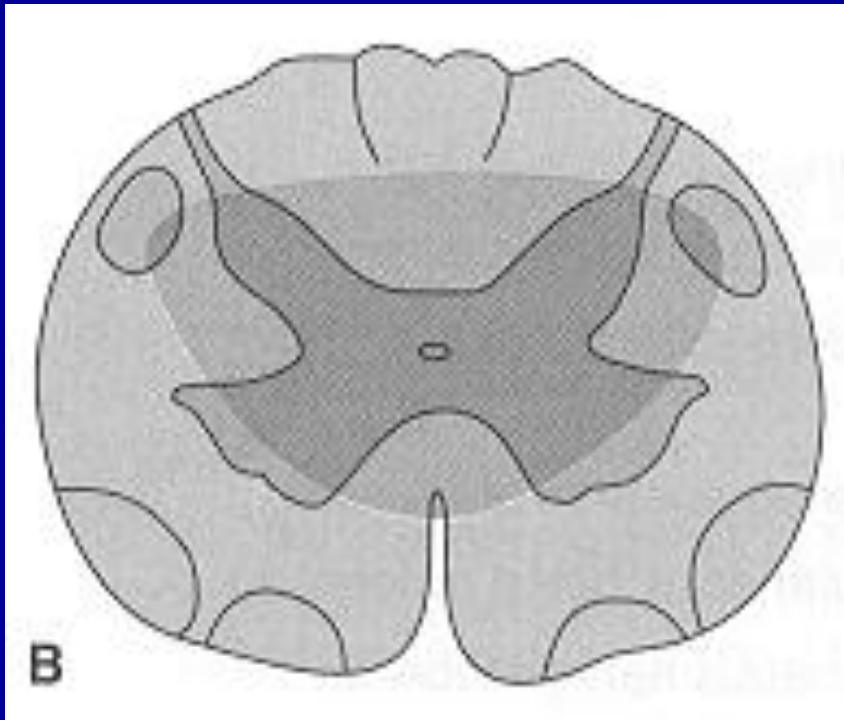


C/Spine Control

- Spinal Cord Injury Without Radiological Abnormality (SCIWORA)
 - More common in Pediatric Population due to flexibility of Spine and Ligaments
 - Results in stretching of cord and nerve roots
 - 50% of young children with high spinal cord injuries have no fractures!!
 - Maintain C/Spine control during airway manipulation



Fractures in the Middle of the Cervical Spine



- Associated with dysfunction of upper extremities > lower extremities (Central Cord Syndrome)



Breathing

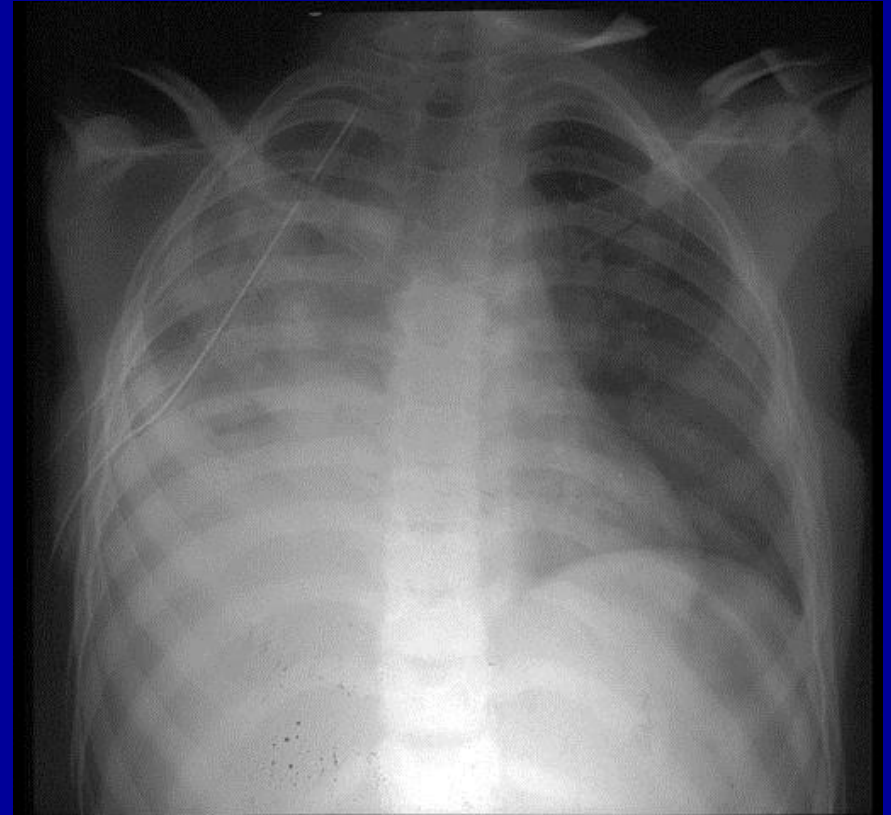
- Pneumothorax without fractures common
- 12-16 chest tube in a baby
- 28-32 chest tube in a small teenager

Tension Pneumothorax



Pulmonary Contusion

- Common in children after blunt chest injury
- Often no associated rib fractures
- Often associated with pneumothorax



D'Alessandro MP: <http://www.vh.org/pediatric/provider/radiology/TAP/Cases/Case17/Image02.html>



Circulation

- Broselow Tape
- Weight
 - Measure
 - Estimate
 - Ask an experienced mother!!
 - $2 \times \text{age} + 8$ in kgs (ref: Dr. David Wesson*)
- Estimated Blood Volume = 80cc/kg
- Fluid Bolus = 20cc/kg of crystalloid x 3
- Colloid/Blood Bolus = 10cc/kg

*http://www.baylorcme.org/critical/presentations/wesson/presentation_text.html



Normal Pediatric Vital Signs

	Pulse	Systolic Pressure	Resp Rate
Neonate	95-145	60-90	30-60
Infant	125-170	75-100	30-60
Toddler	100-160	80-110	24-40
Preschool	70-110	80-110	22-34
School age	70-110	85-120	18-30
Adolescent	55-100	95-120	12-16



Response to Blood Loss

System	<25% Blood Loss	25-45% Blood Loss	>45% Blood Loss
Cardiac	Weak pulse, increased heart rate	same	Hypotension, tachycardia to bradycardia
CNS	Lethargy, irritable, confused	Same, dulled response to pain	Comatose
Skin	Cool	Cyanotic, decrease capillary refill	Pale, cold
Kidneys	Increased specific gravity	Minimal urine output	No urine output



Signs of Response of Child to Fluid Resuscitation

- Decreasing heart rate
- Increased pulse pressure
- Normal skin color
- Increased warmth of extremities
- Improved level of consciousness
- Increase bp
- 1-2 cc/kg/hr urine output
- Improving base deficit

ATLS

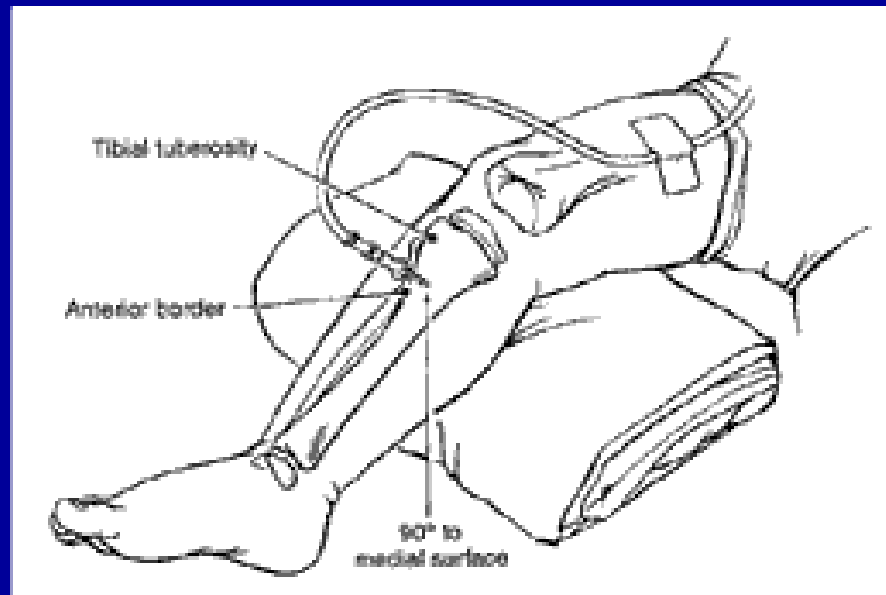


Vascular Access

- 2 attempts at percutaneous venous access
- Interosseous infusion
- Saphenous vein cutdown above the medial malleolus
- Percutaneous femoral vein catheter
- Internal Jugular catheter
- Subclavian catheter



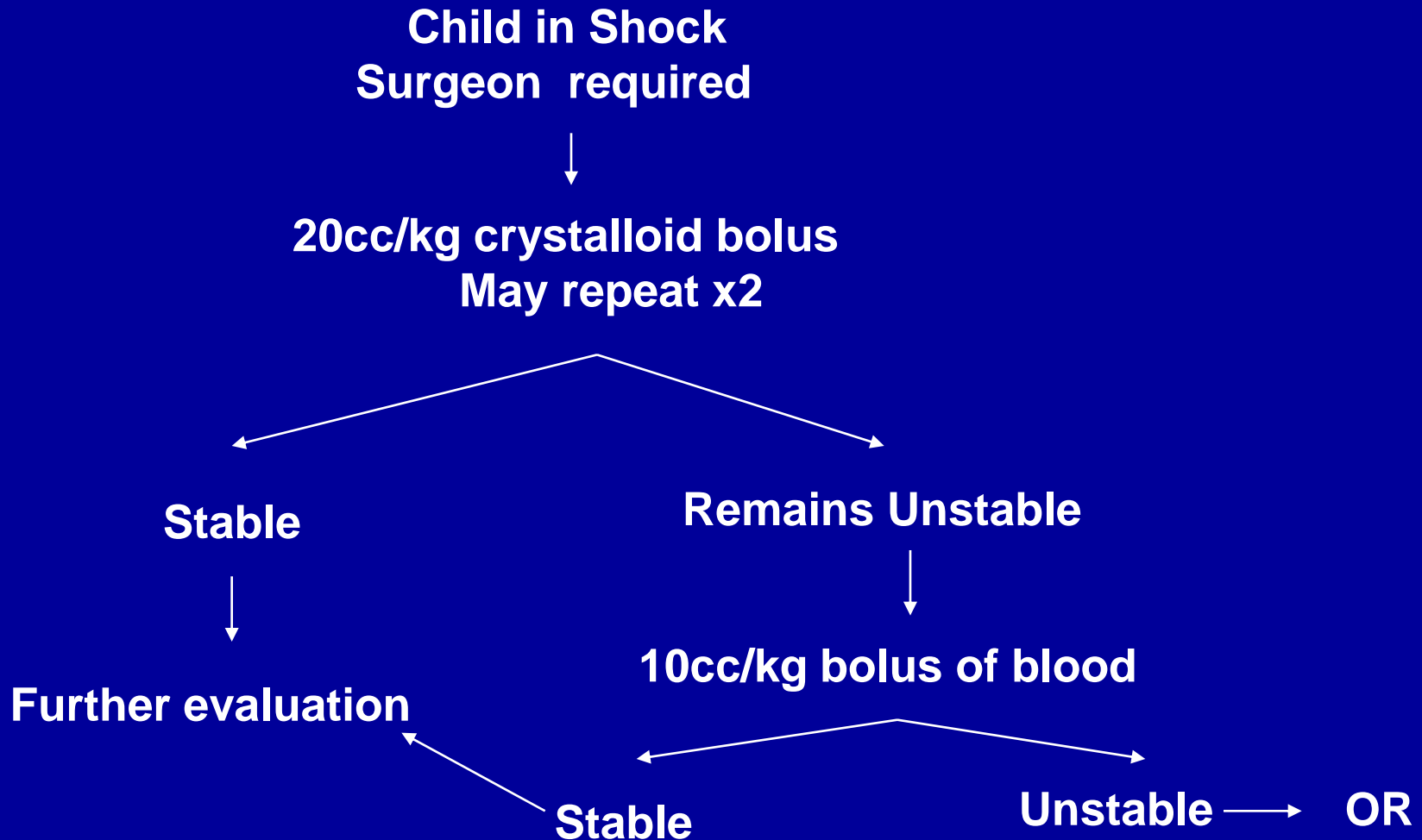
Interosseous Line



http://www.baylorcme.org/critical/presentations/wesson/presentation_text.html



Resuscitation Algorithm



After ATLS



Disability

- Pediatric Glasgow Coma Scale
 - Eye Response

Open Spontaneously	4
Opens to speech	3
Cries to pain	2
Does not open	1



Pediatric Glasgow Coma Scale

– Verbal Response

Coos, babbles	5
Irritable cries	4
Cries to pain	3
Moans to Pain	2
No motor response	1



Pediatric Glasgow Coma Scale

– Motor Response

Normal Spontaneous Movements	6
Withdraws to Pain	5
Abnormal flexion	4
Extensor response	3
Withdraws to touch	2
No motor response	1



Exposure

- Keep the child WARM!!!!
 - Baer Hugger
 - Heating Lamps (be careful of burning the skin!)
 - Wrap the extremities in wool cast padding
 - Each child should wear a hat to prevent heat loss from the scalp



Blunt torso injury in children

- 90% of children with solid organ injury stop bleeding and are managed conservatively
- CT Scan of abdomen, chest and head are the usual screening studies done in children with potentially severe injury
- Remember the possibility of hollow viscus injury—particularly with seat belts!!!!



Splenic Rupture



Partial Splenectomy



http://www.baylorcme.org/critical/presentations/wesson/presentation_text.html



Seat belt injury

Mesenteric Injury

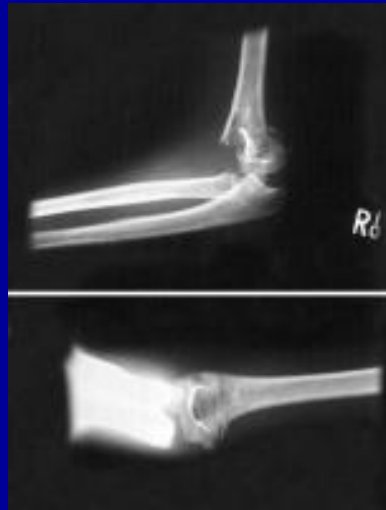


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Orthopedic Injuries

- Supracondylar Fracture of Humerus
 - Observe for Compartment Syndrome
 - Prevent Volkmann's Ischemic Contracture



Chance Fracture: Failure of all three columns due to flexion-distraction



Airbag Injuries

- Deploying Airbag reaches speeds of 240 km/hr
 - Can cause decapitation in young children
 - Severe face, chest and abdominal injuries
- The safest place for a child is in a car seat in the back seat of the car!!



Unique Problems in the Pediatric Population

- Shaken Baby Syndrome
 - < 2 years of age
 - Retinal hemorrhage
 - Subdural and subarachnoid hemorrhage
 - Little sign of external injury
- Child Abuse
 - Multiple fractures of various ages
 - Multiple bruises and/or burns of various ages
 - 14% of US children (>1million) abused each year*

*http://www.healthatoz.com/healthatoz/Atoz/ency/battered_child_syndrome.html



Summary

- ATLS priorities are the same for adults and children
- Special equipment for resuscitation should be available in color coded carts for immediate access to care for the injured child
- All those who MAY be involved in pediatric resuscitation should prepare for this possibility

