

Pediatric Trauma Assessment

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Reviewed May, 2017, Expires May, 2019

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Pediatric trauma has a greater impact on pediatric mortality and morbidity than any other disease. Trauma is the number one cause of death in children older than one year. Motor vehicle-related injury is the number one killer of children and adolescents. Evaluation of a young patient unable to describe pain and localize symptoms requires patience and skill. Any child with multiple injuries or a significant mechanism of injury receives spinal immobilization. Assessment and interventions of the injured child must take into consideration the child's age, size, growth and development and medical or physical disabilities. Re-evaluation and child or infants response should take place after each intervention. Always maintain universal precautions. Any findings that suggest or suspect child maltreatment must be reported to the proper authorities.

Anticipation and organized interventions are the keys to a more efficient, most accurate, and less stressful approach to the injured child. Understanding pediatric anatomy, physiology, and injury patterns will help incorporate knowledge of a prioritized assessment and intervention process. This will help identify the most important problems before they occur.

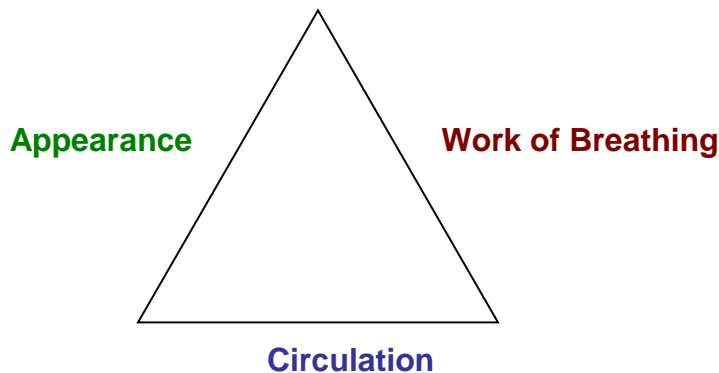
NEVER forget your ABC's!

Course Objectives

Completion of this lesson the participants will be able to:

1. Systematically prioritize, identify, assess and organize intervention in life-threatening injuries.
2. Perform the primary and secondary survey.
3. Understand the significance of the anatomical characteristics that are unique in pediatric trauma victims.

Pediatric Assessment Triangle



The triage triangle is a tool to evaluate an initial rapid assessment on a child. The method is a determination of severity of the child's injury or illness regardless of diagnosis. It identifies physiologic problems. The triangle starts with the appearance, the look of the child along with the breathing or work of breathing. Circulation is the color of the skin.

It is a direct observation of the child before touching (PALS, 2002)

APPEARANCE

- Tone
- Consolability
- Look or gaze
- Speech or cry
- Intractability

BREATHING

- Retractions
- Position of comfort
- Labored respiratory rate
- Nasal flaring
- Stridor, croup cough, noises

CIRCULATION

- Pale
- Mottling
- Cyanosis

Priorities of pediatric assessment and stabilization are identical to those in adult except for the following important differences which include:

- ❖ Airway management
- ❖ Vascular access
- ❖ Definition and recognition of shock
- ❖ Fluid requirements
- ❖ Medication doses
- ❖ Equipment needs
- ❖ Importance of the family unit

Airway Management

The infant has a more prominent occiput than an adult which results in neck flexion and potential for airway obstruction when lying supine on a flat surface. Assess airway for obstruction, perform jaw thrust method, assess breathing & perform cervical spine immobilization simultaneously. This is the preferred airway positioning practice if head and neck or multiple trauma injuries are suspected. Always manage the child placed in supine position with head and neck and cervical spine alignment simultaneously. The tongue is large and displaced which obstructs the oropharynx in an unconscious child. Look for loose teeth and/or foreign debris in the mouth. The head tilt chin lift method of airway positioning is used when no head or neck trauma is suspected.

Rapid cardiopulmonary assessment (accomplished in 30 second looks good vs. looks bad).

Assess activity & movement of extremities.

Age-appropriate response (e.g. Separation from the primary caregiver and “stranger anxiety” in the toddler).

All children with trauma injuries receive 100% O₂ with (non-rebreather) mask 10-15 liter flow.

Vascular Access

Access routes include peripheral, external jugular, central lines and intraosseous. All IV solutions & boluses of fluid, blood products and medications can be administered via intraosseous needle. When rapid fluid administration is required insert the largest catheter that the vessel will accommodate. Over the catheter needles are preferred because of their stability in the vein. The larger veins with fixed anatomical location are located at the median cubital fossa both arms and the saphenous vein of the feet. The saphenous vein is situated about 1 cm above and in front of the medial malleolus. For safety of the IV site T-connector tubing is placed at the needle hub of the IV to promote stability. It adds security for taping and prevents dislodgement of the IV catheter.

Definition and Recognition of Shock

SHOCK: Inadequate systemic perfusion and oxygen delivery.

Signs and symptoms of shock may be gradual or immediate. Always look at the child's appearance and assess mental status, tone, and responses to stimulation. The most common type, after trauma, is hypovolemic shock.

Classifications of Shock:

- Stable
- Respiratory distress

- Respiratory failure
- Shock Compensated or Decompensated
- Cardiopulmonary failure
- Cardiopulmonary arrest

Compensated shock is defined as a clinical state of tissue perfusion that is inadequate to meet metabolic demand in the presence of blood pressure within normal range. Decompensated shock is associated with hypotension and decreased cardiac output (PALS, 2002),

Fluid Requirements

Inadequate peripheral perfusion requires rapid volume replacement. Fluids are calculated at 10-20/ml/kg. Boluses of isotonic crystalloids, Normal saline, or Lactated Ringer's solutions are utilized for volume replacement.

Two large size IV's is recommended to provide fluid and medication routes. Intraosseous access can be life saving devices. All drugs and fluids can be infused here. Special caution; when infusing large amounts of fluids via the intraosseous needle reassessment of the back of the leg behind of the needle entry will assure observation of early infiltration. When you aspirate the bone marrow do not throw away use to measure the glucose. Intraosseous needles should not be left in place for more than 24 hours. They are used only to help resuscitation efforts. Antibiotic therapy should be considered after successful resuscitation to decrease the risk of infection to the open fracture (Henretig & King, 2000).

Obtain blood samples and crossmatch tests as quickly as possible if IV access is successful. Use pressured systems to infuse the fluids rapidly to hypotensive children. With infants, fluids can be given rapidly in a 20ml. large syringe and pushed as fast as the syringe will allow usually about three minutes. If shock persists despite control of hemorrhage and volume resuscitation, internal bleeding is likely present. Early surgeon notification is considered if the child presents with multiple trauma injuries and fluid resuscitation is unsuccessful. Also consider warming fluids to prevent hyperthermia.

Medication Doses

Caution and time is important in preparing and administering emergency medications. Medications are calculated by the various formulas involving age, weight, and body surface area (BSA). Most emergency medication is supplied in bristo-jets for adult usage. They are calculated by formulas or charts and drawn up in appropriate syringes followed by normal saline flushes for each dose. Resuscitation medications for infants and children can be found on the BROSELOW tape pre-calculated for weights from 2kg. - 35kg. and also other pediatric emergency charts.

If IV access is not obtained and the child or infant has tracheal access via endotracheal tube three emergency meds; Lidocaine, Epinephrine, and Atropine can be given via this route. These drugs are absorbed differently in the alveolar and bronchiolar epithelium and studies have proven that they adhere to the endotracheal tube wall. The dosage for epinephrine is 10 times the normal dose given. Please refer to the American Heart Association Pals Provider Manual for details (PALS, 2000).

Equipment

Equipment should be available for the entire range of the pediatric patient from birth to adolescent. Age appropriate size equipment is listed by weight/kg on the BROSELOW Pediatric Emergency Tape. Manual resuscitation bags (Ambu bags) should be self filling. Child and adult bags are adequate. A measuring pressure gauge is added to the child Ambu bag for infants. (BROSELOW, 1993).

Family Unit

The importance of the family being involved in the care of a child is evident. Most family members would like to be present during resuscitation of a child or infant. Studies have shown fewer anxieties in adjustment to their death. Parents with chronic children often are more comfortable with the emergency procedures and being at the bedside provides an opportunity of saying good-bye in their last moments. One member of the healthcare team should remain with the family member to answer questions and clarify information.

Common Physical Characteristics and Injuries

The infant and the child's head is the most common body part that is responsible for up to 50% of pediatric trauma deaths. The head is commonly injured due to its relative large size and its height above ground. Head injuries may be very dramatic due to bleeding, open fractures, and swelling. Don't let these dramatic injuries distract you from looking at other injuries that are more dangerous.

Look for interactions with the parents and response to their environment related to their growth and development. Perform a quick check of response to pain and verbal stimuli. The face and head are very vascular making the bleeding and injury look more serious than it really is. If there is a good history of loss of consciousness and vomiting observation of the child for neurological changes is important. Concussion involves a temporary or permanent loss of consciousness, temporary amnesia and severe headache.

Skull fractures are rarely cause problems unless they are depressed or involve the basilar skull. This indicates a relatively high energy mechanism of injury, placing the child at a higher risk for brain and spinal injury. Most common and early sign of basilar

skull fracture is bleeding from the ears, although Battle's sign (mastoid bruising) and Raccoon eyes (periorbital bruising) may occur.

Any head injury patient must be considered to be at risk for spinal injury. Immobilization of the head and neck is essential until ruled out.

The chest wall is thin and resilient. The chest wall will bend instead of breaking. Rib fractures are rare. If rib fractures are evident then the need for evaluation of deeper chest injury is indicated. Most preventable trauma deaths are related to inadequate diagnosis or treatment of abdominal injuries.

*Bicycle handlebars: most common duodenal hematoma/rupture. A hand or foot that was caught in the spokes of a revolving wheel or in a moving bicycle chain can present as a crush injury.

* Compression mechanisms (run over by a vehicle, seat belt compression): intestinal rupture and perforation.

* Crying children swallow a lot of air, leading to abdominal distension, which is one of the key signs of injury. Gastric tubes are useful for both diagnosis and management.

* Infants may not be able to localize pain.

* Children's bones are flexible and may fracture without completely breaking through the bony cortices. Fractures may be present without gross deformities.

* Some fractures more than others cause neurovascular compromise.

* Fracture of the pelvis and the femur may cause a lot of bleeding leading to shock.

* Pelvic fractures are increased risk for spinal injury.

* Crush injuries present some hours after the injury, usually when swelling increases to the point of pain.

* Animal bites to the hand can cause neurovascular compromise.

Waddell's Triad

This is a classic pediatric injury pattern based on the anatomy and mechanism of injury and is one of the rare things in medicine that consistently show up and actually makes sense! It involves a child (about 5 years old) who runs into the street and is struck by a car. The following triad of injuries commonly occurs:

- A) Left femur fracture
May be the pelvis or the tib-fib if the child is smaller or larger
- B) Left chest injury
May be abdominal injury if child is larger
- C) Right sided head injury

The least consistent as related to site may be anywhere on the head. It is a reflection of the relatively large mass of the head that is acting as a missile head when the child becomes airborne. This triad of injuries holds true in America where it was described first, but in countries where the drive on the opposite side of the road the triad changes to right femur and chest and left head injury.

The skin of a child regulates temperature, prevents fluid loss and protects from infection. One of the roles is that of temperature regulation. Small children are at increased risk of hypothermia because: they have a higher body surface area to mass ratio; meaning they have more skin through which to lose heat. Children have thinner skin and less fatty insulation than adults. Temperature is most forgotten in the pediatric population. Infants less than 9 months have immature hypothalamic function. The hypothalamus is part of the brain responsible for temperature regulation.

Primary Survey

Primary Survey begins with physical examination of the ABC's and only when these three categories together are maintainable other assessments continue. Obtain documentation of pre-hospital mechanism of injury, injuries observed, vital sign's and treatment from rescue team. As a part of the primary survey is the search for limb-threatening injuries and obvious bleeding.

Airway, Breathing, Circulation, Disability, & Exposure (ABCDE)

Air way is clear, maintainable, and /or not maintainable without intubation. Airway opening with cervical spine immobilization requires the use of the jaw-thrust technique. One person can open the airway while immobilizing the cervical spine. The one person uses the middle fingers of both hands to elevate the mandible while both of the person's hands immobilize the head and neck.

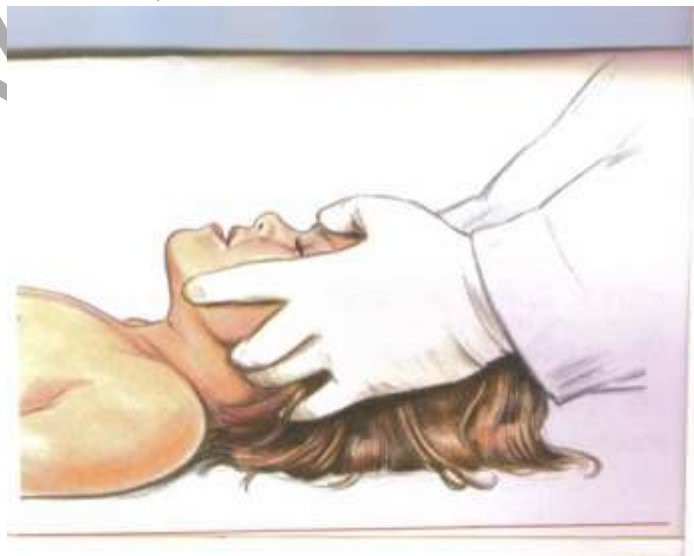


Figure 1. Jaw thrust method to open airway in child with potential head and neck trauma. (PALS, 2002).

A rigid collar is used if it is the appropriate size where the chin fits snugly in the collar without posterior displacement of the mandible. If a rigid collar is not available, a rolled

towel may used placed on either side of head, secured with tap, to maintain the head in neutral position upright and non-moveable.

Secure the patient using 3 points: shoulders, pelvis, and thighs (in addition to the head). Any gaps in the child's body should be supported with towels or sheets to prevent moving. The child is always secured for transport, transfer, and for turning of the board if vomiting occurs. Frequent airway reassessment is necessary (PALS, 2002).

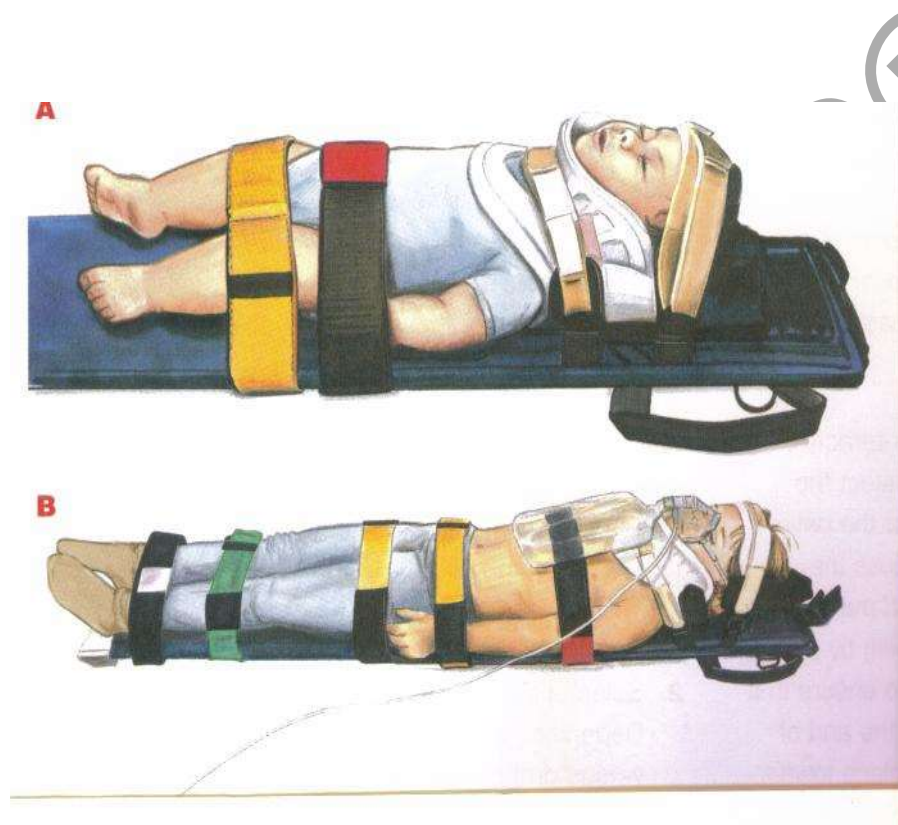


Figure 2. (A) Infant spinal immobilization
(B) Child spinal immobilization (PALS, 2002).

Airway & Breathing + Cervical spine immobilization

- Airway patent, clear, maintainable, not maintainable without intubation
- Free of oral secretions and or foreign objects or obstruction
- Breathing is spontaneous and respiratory rate is appropriate for age. What is rate and depth?
- Effort of breathing relates to work of breathing and breathing mechanics
- Breath sounds audible & clear with symmetrical chest rise
- Oxygen saturation by pulse oximetry 100%

Circulation

- a) Heart rate appropriate for age.
- b) Pulses palpable and quality of central and peripheral pulses equal.
Palpating a pulse in the infant, the brachial artery (upper arm) is easier to detect than carotid artery.
- c) Skin is dry.
- d) Capillary refill is less than 2 seconds
- e) Temperature of extremities is normal.
- f) B/P: appropriate for age
- g) Color of skin; pink, pale, blue, mottled

Disability (Neuro Exam)

- a) Pupils assessed by size, shape, equality, & reaction to light
- b) Normal tone and movement of all extremities appropriately.
- c) Evaluation of responsiveness (reflecting brain perfusion)
 - *A - Awake and alert
 - *V - Responsive to voice
 - *P - Responsive to pain
 - *U - Unresponsive

Then give them a letter (A, V, P, or U)

Base this on the child's age and developmental level. If the child has a chronic neurological impairment, assess responsiveness in relation to their normal accepted responses.

- d) Or calculate (GCS) Glasgow Coma Score appropriate for infants and children
- e) OR a three part assessment: Eye opening, Verbal response, Motor response

When assessing the level of consciousness it is often useful to have the parents present to help obtain a response that reflects the category. Expected verbal and motor responses must be related to the child's age. The pediatric coma scale does not assess verbal responses, but records, smiling, crying, and interaction: it uses a 6-point motor scale that is appropriate for children below 6 months of age.

Numerical values of 1- 5 are assigned to the levels of response in each category. The sum of these numerical values provides an objective measurement of the patient's level of consciousness.

A person with unaltered LOC scores the highest 15: a score of 8 or below indicates coma: the lowest score is 3 (PALS, 2002).

***Glasgow Coma score less than 8 proceed to Intubate**

NEUROLOGIC ASSESSMENT

Pupils	Right	Size	
		Reaction	
	Left	Size	
		Reaction	

++ = Brisk
 + = Sluggish
 - = No reaction
 C = Eye closed by swelling

Eyes open	Spontaneously	4	
	To speech	3	
	To pain	2	
	None	1	

Usually record best arm or age-appropriate response

Best motor response	Obeyes commands	6	
	Localizes pain	5	
	Flexion withdrawal	4	
	Flexion abnormal	3	
	Extension	2	
	None	1	

Pupil scale (mm)

- 1
- 2
- 3
- 4
- 6
- 7
- 8

Best response to auditory and/or visual stimulus	>2 years		<2 years
	Orientation	5	5 Smiles, listens, follows
	Confused	4	4 Cries, consolable
	Inappropriate words	3	3 Inappropriate persistent cry
	Incomprehensible words	2	2 Agitated, restless
	None	1	1 No response

Endotracheal tube or trach T	
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COMA SCALE TOTAL	
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HAND GRIP:
 Equal
 Unequal
 R ___ L
 Weakness

LOC:
 Alert/oriented x4
 Sleepy
 Irritable
 Comatose
 Disoriented
 Combative
 Lethargic
 Awake
 Sleeping
 Drowsy
 Agitated

MUSCLE TONE:
 Normal
 Arching
 Spastic
 Flaccid
 Weak
 Decorticate
 Decerebrate
 Other _____

EYE MOVEMENT:
 Normal
 Nystagmus
 Strabismus
 Other _____

FONTANEL/WINDOW:
 Soft
 Flat
 Sunken
 Tense
 Bulging
 Closed
 Other _____

MOOD/AFFECT:
 Happy
 Content
 Quiet
 Withdrawn
 Sad
 Flat
 Hostile

Figure 3. Glasgow Coma Scoring (Hockenberry, 2007)

E Exposure (Environmental control)

Undress and identify extremity-threatening injuries. Expose and cover to prevent heat loss. Look for bleeding. Document all findings; contusions, deformities, lacerations, burns and any indication of injury related to blunt or penetrating force. All clothing is

removed and saved. Prevent heat loss. Cover and keep warm. Use overhead radiant warmer or warm room temperature.

***If all of the Primary survey and initial assessment does not require further intervention continue with Secondary Survey.**

F Full set of vital signs with rectal temperature and include weight in kilograms

The BROSELOW Pediatric Emergency Tape can be used as a clinical guideline for the infant/child weight, sizes of equipment, and calculation of emergency medications. The tape is height vs. weight based measurement. This tape measures 2kg - 35 kg. All calculations of medications are measured dose/kg (BROSELOW, 1993).

Talk with family for a clearer history of events prior to injury. Invite family presence with a healthcare person as a family representative to explain what is going on during the assessment process.

Repeated re-assessments are necessary to evaluate the child's condition, response to therapy, application of interventions, and maintenance.

G General Appearance

Give comfort measures. Assess pain. (Pain is assessed by using different pain scales appropriate for age).

- Put "gadgets" on patient.

- Place on pulse oximetry

- Cardiac Monitor

- Use distraction techniques (stickers, bubbles)

H History & Head to Toe assessment

Talk with family for a clearer history of events prior to injury. Invite family presence with a healthcare person, as a family representative, to explain what is going on during the procedure and assessment process.

Obtain documentation of pre-hospital mechanism of injury, injuries observed, vital sign's and treatment from rescue team.

Complete -Medical & Surgical History

- C - Chief complaint

- I - Immunizations, Isolations

- A - Allergies

M- Medications
P - Past Medical/Surgical history parent impression
E - Events (Mechanism of injury) Loss of Consciousness, events surrounding occurrence
D - Diet & Diapers
S- Symptoms associated

Inspect, Auscultate, Palpate

Head, face, eye, ears, nose, and neck...Inspect and Palpate. Check eye opening and best response & record (GCS) Glasgow Coma Score. Look for fluid in nose and/or ears. When fluid is noticed place a few drops on a white towel paper and check for the "Halo sign" (light outer ring with dark inner ring) which indicates positive for (CSF) cerebral spinal fluid.

Chest: Inspect for bruising, contusions, and symmetrical chest rise.
Palpitate for crepitus or pain.
Auscultate presence and type of breath sounds and heart tones.

Abdomen: Auscultate only (do not palpate) for bowel sounds. Measure abdominal girth at the umbilicus and mark for reassessment accuracy.

Pelvis & Genitalia: Assess for pain with gentle pelvic squeeze. Assess blood at meatus or penis.

Rectum: Rectal exam of anal sphincter. Anal /sphincter tone is decreased or absent with spinal cord injury.

Extremities: Both arms & both legs; inspect, palpitate, and immobilize any deformities above and below the joints and the deformity. Assess the neurovascular status before and after immobilization.

I Inspect

Logroll with minimum of two people, with one person in charge of securing the head and neck and maintaining cervical spine immobilization. Logroll simultaneously on the count of three. Always utilize two or more healthcare providers for assistance. Auscultate then palpate and check for breath sounds & cardiac sounds.
Inspect & palpate genitalia then arms and legs.

Summary:

The Family Centered Care Model is always practiced creating a partnership with the healthcare provider, child, and family. The family and child experiencing anxiety, fear, and separation, related to illness or injury, need support and guidance. Address the

parents with a positive attitude and include the parent into every aspect of planning and care.

Children have been historically mistaken for small adults. They have their own unique growth and development milestones that lead them to adulthood. The treatment is based on weight, age, growth, and development. The pediatric triangle is an organized quick look at the child as a whole.

Oxygen is a harmless drug in pediatrics. Oxygen delivery of 100% by non-rebreather mask is recommended when treating a child with potential for shock. Use it liberally.

Gastric distention often from crying and swallowing air may inhibit downward diaphragmatic movement, thereby compromising ventilation. Gastric decompression with an NG or OG tube may be the key to adequate respiratory management.

It is important to have the proper sizes of equipment available for treatment of all sizes of the pediatric population.

The blood pressure can be taken on all four extremities with the cuff valves facing downwards and with the proper size; two thirds the size of the arm. If limbs are used then the limb circumference chart is used.

The critical details of pediatric trauma assessment and resuscitation and training can be obtained by courses offered by the Emergency Nurse Association and the American Heart Association.

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