

Prehospital Pediatric Care Course

Medical Emergencies

Lesson 5

This lesson will focus on assessment and management of *non-traumatic* causes of pediatric emergencies including:

- hypoperfusion (shock)
- cardiopulmonary failure
- altered mental state
- seizures
- fever
- poisoning/allergies
- diabetic emergencies
- Sudden Infant Death Syndrome

What's the Connection?

- A child becomes severely dehydrated through repeated vomiting and diarrhea.
- A curious toddler finds Mom's "special M&M's" in her purse and greedily eats them up. A few minutes later, she is unresponsive.
- An infant has a soaring fever, diaper rash and cannot be comforted.

While the problem of each child is very different from the others, they all share a similar potential to develop hypoperfusion and eventually, cardiopulmonary failure.

This lesson deals with a variety of common medical emergencies, unrelated except in their life threatening potential.

Hypoperfusion (Shock) Review

Hypoperfusion is a “low flow state” of perfusion also called shock.

Hypoperfusion occurs when the circulatory system is unable to deliver enough oxygenated blood to all of its organs and tissues to support normal function

There are three elements of the circulatory system necessary for adequate perfusion:

- A heart capable of pumping a sufficient volume of blood.
- A large volume of blood containing a high concentration of oxygen.
- Blood vessels capable of carrying blood volume.

Heart

In children, the heart muscle is usually healthy and so myocardial infarction is rare.

Heart rates that are too slow or too fast (less than 60/min or too fast to count) may indicate a pumping problem is the cause of hypoperfusion.

- When the rate is too slow, less blood volume is being circulated.
- When the rate is too fast, the heart’s ventricles do not fill with blood, because there is not enough time between contractions, therefore, each contraction of the heart pumps out less blood than normal. Therefore, less blood volume is being circulated causing hypoperfusion.

Blood

Blood is about 55% plasma (liquid) and 45% blood cells (solid).

- Blood volume (plasma) can be lost without bleeding.
- Plasma is lost due to repeated vomiting and/or diarrhea.

Blood Vessels

- Vascular tone is the term for the forces that constrict and dilate the diameters of blood vessels to maintain adequate perfusion.
- When vessels are too dilated, there is not enough pressure to move blood through the vessels.
- When blood vessels are extensively dilated blood takes longer to return to the heart, so less blood is available to be pumped.
- Blood vessels that are torn or damaged are a source of whole blood loss.

Non-Traumatic Hypoperfusion

- Children are able to maintain perfusion to their vital organs by increasing heart rate and constricting their peripheral blood vessels.
- Respiratory rate increases in order to supply additional oxygen needed to maintain increased heart rate.
- These increases eventually deplete the energy stores of the child.

Early Hypoperfusion

- In early hypoperfusion, increases in heart rate and peripheral constriction are slight but rising.
- RFI (Rapid First Impression) may appear close to normal due to compensation for low blood flow.
- Initial assessment may reveal few findings.
- Focused history questions may alert EMTs to cause of urgent condition.
- Repeat Initial Assessment frequently.
- Initiate treatment and transportation based on the urgency of the child's condition.

Late Hypoperfusion

- Over time, greater increases in heart rate and vasoconstriction are needed, energy supplies are depleted and the child tires.
- RFI reveals more obvious signs of an urgent condition.
- The child's condition appears urgent. EMTs should support ABC's and transport without delay.
- Early recognition and treatment are the keys to survival.
- Follow RFI steps.
- Repeat Initial Assessment frequently.
- Transportation is the priority when the child appears urgent.
- EMTs should not expect to make precise diagnoses in the field and should not spend additional time on the scene attempting to do so.
- EMTs should make an early decision to transport any child who may be in any stage of hypoperfusion.

- Early transport is a crucial piece of recognition and assessment of hypoperfusion.

Progression of Hypoperfusion

- Eventually, the effort and energy to maintain perfusion will exhaust the child, as is seen in late stages of hypoperfusion.
- As the child tires, compensatory abilities fail, leading to cardiopulmonary failure.

Cardiopulmonary Failure

- Cardiopulmonary failure occurs when a child experiences respiratory failure together with late hypoperfusion.
- Cardiopulmonary arrest occurs when a child's heart and lungs stop functioning.

Although children rarely die from sudden cardiac death, cardiopulmonary failure is a major cause of death in children.

Cardiopulmonary failure develops *gradually*.

Death is due to low blood oxygen delivery to the vital organs and tissues.

Oxygen deprivation severely damages the organs and tissues so that they cannot be made functional, despite resuscitation efforts.

Cardiopulmonary Failure Signs

EMTs will observe a combination of findings from respiratory failure and late hypoperfusion including:

- weak respiratory effort
- slow, shallow breathing
- pale or blue skin tones in the chest region

These signs indicate the immediate need for assisted ventilation.

- slow pulse rate
- weak or absent peripheral pulses
- cool extremities
- delayed capillary refill time
- altered mental status (P or U on AVPU)

Slow heart rate with signs of poor perfusion indicate the need for chest compressions.

Cardiopulmonary Failure Management

AIRWAY

- Use head tilt with chin lift to open airway when trauma is not suspected.
- Avoid hyperextension of the head and neck as it causes airway obstruction.

BREATHING

- Mask size and seal are essential.
- Use E-C Clamp Method.
- Attach high concentration oxygen source.
- Ventilate over 1 - 1.5 seconds with only enough volume to cause chest rise at a rate of 20/min.

CIRCULATION

- Check central pulse for presence and rate.
- If absent or rate less than 60/min with signs of hypoperfusion, begin chest compressions.

Chest Compressions – Infant

EMTs should begin chest compressions in addition to assisted ventilation when:

- An infant has a pulse rate slower than sixty beats per minute with signs of hypoperfusion or poor peripheral perfusion.
- An infant has no pulse.

Using two fingers, compress the lower half of the sternum about one third to one half the depth of the chest or about 0.5 to 1 inch at a rate of at least 100/minute.

Deliver five compressions for each ventilation until the pulse rate exceeds 60/minute.

Chest Compressions – Child

EMTs should begin chest compressions in addition to assisted ventilation when:

- A child has a pulse rate slower than sixty beats per minute with signs of hypoperfusion or poor peripheral perfusion.

A child has no pulse.

- Using the heel of the hand, compress the lower half of the sternum about one third to one half the depth of the chest or about 0.5 to 1 inch at a rate of 100/minute.
- Deliver five compressions for each ventilation until the pulse rate exceeds 60/minute.

Altered Mental Status

Altered mental status (AMS) is a sign that the brain is not working properly.

AMS in children often results in:

- change in behavior
- change in responsiveness to surroundings

Altered or Normal MS?

How To Tell

A child with **normal mental status** is

- alert
- easily awakened from sleep
- responsive to parents
- aware of the EMTs
- Parents can tell if the child is simply “not acting right.”

AMS Signs

Children with AMS may appear

- unusually agitated
- combative
- sleepy
- difficult to rouse from sleep
- totally unresponsive.

Rapid First Impression – AMS

Rapid First Impression findings:

- unusual agitation
- reduced responsiveness
- abnormal muscle tone or body position for the child's age

In addition, look for

- excess breathing effort
- pale skin

AMS Causes

Children can develop AMS due to:

- respiratory failure
- hypoperfusion
- head trauma
- low blood sugar
- seizures
- poisoning
- infection with fever
- brain tumor.

Initial Assessment – AMS

Findings include signs of

- airway compromise
- respiratory failure
- hypoperfusion
- AVPU of A - with unusual agitation or confusion
- AVPU of V, P, or U

Focused History for AMS

Findings include:

- history of trauma or seizures
- poisoning
- infection with fever
- brain tumor
- history of diabetes
- poor appetite

Detailed Physical Exam – AMS

Look for:

- signs of head injury
- unequal pupils
- weakness or unequal strength in extremities

Treatment of AMS

- Assure an open airway.

If the child has good muscle tone,

- Provide high concentration oxygen by non-rebreather mask.
- Obtain focused history regarding:

Recent falls? Last oral intake? Seizures?

Poisons? Medical History?

- If the child's muscle tone is limp, or she cannot be roused, the airway may be obstructed.
- Loss of muscle tone affects internal structures as well as skeletal muscle. The upper airway can easily be obstructed by the tongue and/or secretions that are not swallowed.

To treat altered mental status, focus first on the airway, providing positioning and suctioning as needed, then give high-concentration oxygen. Provide assisted ventilation if necessary.

Head position should be neutral if:

- trauma is suspected or
- cause of AMS is unknown.

Always immobilize the cervical spine in an unresponsive patient if there is any possibility of trauma or when the cause is unknown.

- Provide oxygen and assist ventilations, if needed.
- A child should respond to increased oxygenation by improved responsiveness.

Change in MS

- Mental status can improve in response to interventions.
- Mental status can also worsen if the child's airway, breathing, or circulation worsens.
- If MS worsens, reassess ABC status.

Seizures

- Involve abnormal electrical activity of the brain cells.
- 4 to 6 percent of all children will have at least one seizure before age 16.
- Most seizures are brief, lasting less than 2 minutes, and do not harm the child.

During a seizure, the child may have:

- altered mental status
- behavioral changes
- uncontrolled muscle movements
- loss of bowel or bladder control may occur.

Seizure Treatment

- Protect child from injury while seizing, but do not attempt to restrain the child.
- Loosen restrictive clothing
- During any seizure:
 - Put nothing in the mouth.
 - Turn child on his left side (recovery position) if trauma is not involved.

NOTHING in the Mouth? Why?

During an active seizure:

- Bite blocks or oropharyngeal airways may break, causing choking.
- A broken bite block can lacerate the mouth.
- Unbreakable bite blocks can damage the teeth if a child bites down hard.

Status Epilepticus

- For pre-hospital care providers, any seizure that:
- Is ongoing when EMTs arrive at the patient's side, or
- Lasts more than 5 minutes, or
- Leaves the child unresponsive is treated as status epilepticus.

Dangers of Status Epilepticus

- Low blood oxygen occurs due to lack of ventilation
- Airway and breathing problems due to decreased muscle tone and function
- Risk of aspiration due to vomiting

- Brain damage or death can result if left untreated.

Status Epilepticus Treatment

- Because continuing seizures are more dangerous than brief seizures, they require more aggressive management.
- If the child is actively experiencing a seizure, the airway is unprotected.
- EMTs should call for ALS backup if available
- Provide initial interventions and rapid transport without delay.
- If the child has uncontrolled muscle movements, support the head, maintain the airway.
- Protect from injury.

Post Seizure Treatment

- Place in recovery position, if there is no indication of trauma.
- Provide high concentration oxygen by non-rebreather face mask.
- Be prepared to suction.
- If trauma is not suspected, place child in “sniffing” position and open airway.
- If the child vomits, position on left side to reduce risk of aspiration.
- If there is history or evidence of trauma to the head or neck, place the child face up and immobilize the spine.

As soon as seizure activity stops:

- If not already accomplished, and trauma is not a factor, turn the patient on the left side
 - Reduces the risk of aspiration if vomiting occurs.
- Position the airway as necessary, observing spinal precautions if trauma is possible.

Manage the airway:

- Provide gentle suctioning as needed.
- Give high-concentration oxygen.
- If the patient shows signs of respiratory failure or arrest, begin assisted ventilation and initiate transport.

CUPS Assessment of Pediatric Seizures		
Category	Assessment	Actions
Critical	Absent airway, breathing, or circulation; AVPU=U; ongoing seizure	Perform initial interventions and transport simultaneously; consider ALS backup if available
Unstable	Compromised airway, breathing, or circulation; AVPU=V or P; history of brief seizure that has ended	Perform rapid initial assessment and interventions; transport as soon as possible; consider ALS backup if available
Potentially unstable	Normal airway, breathing, and circulation; AVPU=A or V that quickly improves to A; history of brief seizure that has ended	Perform initial assessment and interventions, provide oxygen, monitor airway and ventilation, and transport promptly; do focused history and physical exam during transport if time allows
Stable	Normal airway, breathing, and circulation; AVPU=A; no history of seizure	Perform initial assessment and interventions; do focused history and detailed physical exam

Focused History

Seek information that can help hospital personnel determine the cause of the seizure, including:

- Length of seizure
- Specific seizure activity
 - child's degree of responsiveness
 - the location and characteristics of abnormal muscle movements
 - loss of bladder or bowel control
- How many seizures occurred.
- Exposure to a toxic substance or medication
- Fever
- Head injury or recent trauma
- History of seizures
- History of a known seizure disorder, such as epilepsy
- Medications being taking for a seizure disorder and time of last dose.

Additional Focused History

- Consider possible causes of low blood sugar:
 - ◆ Diabetes in children of all ages
 - ◆ Alcohol poisoning
 - ◆ Not eating due to illness in infants and toddlers

Detailed Physical Exam

Examine the child for:

- signs of head injury
- a purplish skin rash that accompanies septic shock (hypoperfusion caused by infection)
- injuries to extremities caused by muscle movements during the seizure
- Treat as needed
- Transport immediately

Head Injury and Seizures

Seizures following a head injury are more common in children than in adults.

- Find out the time and cause of injury
- How long after the injury the seizure occurred
- Whether a period of unresponsiveness or signs of breathing problems followed the injury

Seizures and Fever

- Children 6 months to 6 years can sometimes experience febrile seizures
- Cause is rapid climb of high fever.
 - Results in brief seizures with no long term harm to the child
- Notable exception is meningitis.
 - Life-threatening infection involving the brain and spinal cord
 - Requires immediate medical care.

Fever

Definition: Rectal temp. 100.5 degrees Fahrenheit or higher.

Usually caused by a minor viral or bacterial infection.

May be caused by serious or even life threatening infection.

Urgent Fever Signs

Consider any child as Urgent when fever is accompanied by:

- altered mental status
- respiratory distress
- signs of hypoperfusion
- a history of recent seizures
- a bruise-like or spotty rash on the trunk or extremities
- a stiff neck

Fever and Age

More of a concern for young infants than for older children.

Any child with fever should be evaluated by a physician.

Special Risk Children

- The ability to fight infection is compromised in children who have:
 - Sickle cell anemia
 - HIV infection
 - Recent cancer therapy
- Children who have no spleen and infants aged younger than three months are also at risk.

Fever Assessment

Common findings include:

- Slightly increased respiratory rate
- Slightly increased pulse rate

Fever and Heat Stroke

- Heat stroke occurs when a child has a rectal temperature higher than 106 degrees Fahrenheit.
- Heat stroke can occur from exposure to a very warm environment, such as a closed car on a hot day.
- Older children and adolescents may develop heat stroke from exercising strenuously during hot weather.

Signs of Heat Stroke

A child with heat stroke will have:

- AMS with decreased responsiveness
 - Can progress to unresponsiveness
- Limp muscle tone
- Slow, shallow breathing
- Red, flushed skin initially
 - Can progress to pale skin with signs of hypoperfusion

Heat Stroke Treatment

- Remove child to cool environment.
- Assess and manage airway.
- Provide high concentration oxygen
- Assist ventilations, as needed.
- Transport immediately.

- Cool the child
 - Remove clothing
 - Place cold packs or damp towels against skin.
 - Cover with a dry sheet.

- If shivering occurs, remove cold packs and keep child covered with a dry sheet.

Fever Treatment

Treat assessment findings:

- respiratory distress, hypoperfusion, or altered mental status
- Give high-concentration oxygen and assist ventilations if necessary.
- Consider hypoperfusion from septic shock (hypoperfusion caused by infection)

Comparative Assessment Findings for Septic Shock

Early septic shock

- fast pulse rate
- slow capillary refill time
- warm, pink skin
- bounding pulses

Other shock

- fast pulse rate
- slow capillary refill time
- cool, pale skin
- weak pulses

Fever: To Cool or Not *Too* Cool

Fever helps the immune system fight infections.

Risks of cooling include:

- hypothermia
- inadvertent production of additional body heat by inducing shivering

CUPS Assessment of Pediatric Fever		
Category	Assessment	Actions
Critical	Absent airway, breathing, or circulation; AVPU=P or U	Perform initial interventions and transport simultaneously; consider ALS backup if available
Unstable	Compromised airway, breathing, or circulation; AVPU=V or P	Perform rapid initial assessment and interventions; transport promptly; consider ALS backup if available
Potentially unstable	Normal airway, breathing, and circulation; AVPU=A with unusual agitation; history of fever with other risk factors	Perform initial assessment and interventions; begin focused history and physical exam; initiate transport promptly if risk factors are found
Stable	Normal airway, breathing, and circulation; AVPU=A; history of fever without other risk factors	Perform initial assessment and interventions; complete focused history and detailed physical examination; transport