

# Pediatric Emergency Medicine Case Studies: Altered Mental Status

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# Case One - History

A previously healthy two-year-old boy is brought to the Pediatric ER with altered mental status after his mother found him limp and unresponsive in his room.

His mother put him down for a nap about one hour after he ate lunch; when she went to check on him two hours later, he was laying on the floor and was unable to be aroused from sleep.

She immediately called EMS for assistance.

# Case One – Vital Signs

Upon your arrival, his initial vital signs are as follows:

Heart Rate	120
Respiratory Rate	24
Blood Pressure	90/60
Oxygen Saturation:	98 % on room air

# Case One – Physical Exam

- Maintaining a patent airway, normal lung and cardiac exam
- Responsive only to painful stimuli by pulling away from the painful stimulus
- Occasionally moans but has no purposeful verbal communication
- Eyes remain closed to verbal and tactile stimuli.
- When manually opened, pupils are 3mm, equal, and reactive to light bilaterally
- Muscle tone is diminished throughout
- No skin lesions, rashes, or external evidence of trauma
- Remainder of physical exam is normal

# Questions

- What are your initial treatment goals in the field?
- How would you calculate his Glasgow Coma Score?
- What additional elements would you like to learn about his history?
- How would you prepare this patient for transport?
- To which facility would you want to take this patient?

# Initial Treatment Goals

- A, B, C's of trauma management – rapidly use your pediatric assessment triangle and primary survey to determine if the patient is sick or not sick:
  - Airway
  - Breathing
  - Circulation
  - Disability
  - Exposure
- Which interventions are appropriate in this patient?

# Primary Survey and Resuscitation

## Airway with Cervical Spine Protection

- Assessment
  - Ascertain patency of airway
  - Rapidly assess for airway obstruction
- Management
  - Chin Lift or Jaw Thrust
  - Clear airway of foreign bodies
  - Insert oro- or nasopharyngeal airway

# Primary Survey and Resuscitation

## Airway with Cervical Spine Protection

- Establish definitive airway
  - Oro- or nasotracheal airway
  - Surgical cricothyroidotomy
- Maintain cervical spine in neutral position with manual immobilization as necessary when establishing airway
- Reinstatement of immobilization of c-spine with appropriate device after establishing airway



# Primary Survey and Resuscitation

## Breathing: Ventilation and Oxygenation

- Assessment
  - Expose neck and chest
  - Assure immobilization of head and neck
  - Determine depth and rate of respirations
  - Inspect and palpate neck and chest for tracheal deviation, unilateral and bilateral chest movement, use of accessory muscles, any signs of injury
  - Percuss chest for dullness or hyper-resonance
  - Auscultate chest bilaterally

# Primary Survey and Resuscitation

## Breathing: Ventilation and Oxygenation

- Management
  - Administer high concentration oxygen
  - Ventilate with bag-valve-mask device
  - Alleviate tension pneumothorax
  - Seal open pneumothorax
  - Use end-tidal CO<sub>2</sub> monitoring device in conjunction with pulse oximetry

# Primary Survey and Resuscitation

- **Circulation with Hemorrhage Control**
  - Assessment
    - Identify source of external, exsanguinating hemorrhage
    - Identify potential sources of internal hemorrhage
    - Pulse (quality, rate, regularity, paradoxical)
    - Skin color
    - Decrease in blood pressure is a late finding in pediatric shock

# Primary Survey and Resuscitation

## Circulation with Hemorrhage Control

- Management
  - Apply direct pressure to external bleeding site
  - Consider presence of internal hemorrhage and potential need for operative management
  - Insert 2 large-caliber IV catheters
  - IV hydration with warm LR/NS or blood replacement
  - Prevent hypothermia

# Primary Survey and Resuscitation

## Disability: Brief Neurologic Examination

- Determine level of consciousness
  - AVPU method
    - A = Alert at baseline
    - V = Verbal stimuli
    - P = Painful stimuli
    - U = Unresponsive
  - GCS score (score ranges from 3 to 15)
    - Severe (GCS  $\leq$  8)
    - Moderate (GCS 9 – 12)
    - Minor (GCS  $\geq$  13)
- Assess pupils for size, equality, reactivity

# Pediatric Glasgow Coma Score: Eye Opening

Age > 2yrs	Score	Age < 2 yrs
Spontaneous	4	Spontaneous
To Voice	3	To Speech
To Pain	2	To Pain
None	1	None

# Pediatric Glasgow Coma Score: Verbal Response

Age > 2 yrs	Score	Age < 2yrs
Oriented	5	Coos, Babbles
Confused	4	Irritable, Cries
Inappropriate	3	Cries to Pain
Incomprehensible	2	Moans to Pain
None	1	None

# Pediatric Glasgow Coma Score: Motor Response

Age > 2yrs	Score	Age < 2yrs
Obeys Commands	6	Normal, Spontaneous
Localizes Pain	5	Withdraws to Touch
Withdraws to Pain	4	Withdraws to Pain
Flexion to Pain	3	Abnormal Flexion
Extension to Pain	2	Abnormal Extension
None	1	None



# Levels of consciousness

Conscious

Normal mental status



Confused

Disoriented, impaired thinking and responses



Delirious

Disoriented, restless, hallucinations, delusions



Somnolent

Sleepy



Obtunded

Decreased alertness, slowed psychomotor responses



Stuporous

Sleep-like state, little or no spontaneous activity



Comatose

Cannot be aroused, no response to stimuli

# Primary Survey and Resuscitation

- Environment / Exposure
  - Completely undress patient
  - Prevent hypothermia
- Secondary survey once all primary survey interventions are met – more detailed head to toe physical exam

# Secondary Survey

- Obtain AMPLE history
  - A = Allergies
  - M = Medications
  - P = Past Medical History
  - L = Last Meal
  - E = Events Leading to Injury
- Thorough systematic physical exam

# Secondary Survey

## Head and Maxillofacial

- Inspect and palpate entire head and face for lacerations, contusions, fractures
- Re-evaluate pupils, level of consciousness
- Assess eyes for hemorrhage, penetrating injury, visual acuity, presence of contact lens
- Evaluate cranial nerve function
- Inspect ears and nose for CSF leakage
- Inspect mouth for evidence of bleeding, soft-tissue lacerations, dentition

# Secondary Survey

## **Cervical Spine and Neck**

- Inspect for signs of blunt trauma or penetrating injury, tracheal deviation, use of accessory muscles
- Palpate for tenderness, deformity, swelling, subcutaneous emphysema, tracheal deviation, symmetry of pulses
- Auscultate carotids for bruits
- Cervical spine immobilization

# Management of C-Spine

- Any time an infant or child sustains a significant head injury, assume a neck injury may also be present
  - Children should remain immobilized in a cervical collar until cleared by hospital personnel
  - Multiple devices can be utilized
  - Try to have family member or caretaker nearby to help keep the child calm
  - Maintain supine, neutral, in-line position by placing padding from shoulders to hips

# Secondary Survey

## Chest

- Inspect chest wall for signs of blunt or penetrating trauma, use of accessory muscles
- Auscultate for breath and cardiac sounds
- Palpate entire chest wall for evidence of blunt or penetrating trauma, subcutaneous emphysema, tenderness, crepitus
- Percuss for evidence of hyper-resonance or dullness

# Secondary Survey

## Abdomen

- Inspect anterior and posterior abdomen for signs of blunt or penetrating trauma or ecchymosis
- Auscultate for presence or absence of bowel sounds
- Percuss to assess for subtle rebound tenderness
- Palpate for tenderness, involuntary guarding, rebound tenderness



# Secondary Survey

## **Genitourinary / Rectal**

- Inspect for contusions, hematomas, lacerations, urethral bleeding
- Rectal exam to assess for gross blood, anal sphincter tone, bowel wall integrity, bony fragments

# Secondary Survey

## **Skin / Extremities**

- Bruising, abrasions, lacerations, swelling, deformities
- Tenderness to palpation, limitation of movement of joints
- Skin color, temperature, cyanosis, pallor

# Altered Mental Status

- Once history and physical are complete, now it is time to piece together the pieces of the puzzle to figure out what is going on



# Altered Mental Status



Differential Diagnosis is **HUGE!**

# Altered Mental Status



# AMS – Differential Diagnosis

## Trauma

- Epidural, subdural, subarachnoid hematoma
- Cerebral contusion, intra-cerebral bleed
- Diffuse cerebral swelling
- Concussion
- Hypovolemic shock due to external/internal bleeding
- Obstructive shock due to tension pneumothorax or cardiac tamponade

# AMS – Differential Diagnosis

## **Hypoxia/ischemia**

- Respiratory illness
- Shock
  - Cardiogenic
  - Hypovolemic
  - Distributive
    - Septic
    - anaphylactic
  - Neurogenic
  - Obstructive

# AMS – Differential Diagnosis

## Infection

- CNS Infection
  - Meningitis, Encephalitis, Empyema
- Bacteremia
  - Toxic shock syndrome
- Urinary Tract Infection
- Pneumonia
- Viremia
- Tick-borne illnesses
  - Rocky Mountain spotted fever / Lyme



# AMS – Differential Diagnosis

## **Neurologic Disorders**

- Seizure, post-ictal period
- Increased intracranial pressure
  - VP shunt malfunction
- Mass/bleed affecting ventricular outflow
  - Hemorrhage from AVM
  - Aneurysm
  - Cerebral venous thrombosis
  - Tumors

# AMS – Differential Diagnosis

## Poisoning

- You name it, kids will get into it!
  - Household cleaners
  - Pesticides
  - Fertilizers
  - Medications – over the counter, prescription
  - Alcohol
  - Gasoline
- Carbon Monoxide

# AMS - Differential Diagnosis

## Metabolic Disorders

- Hypoglycemia
  - Salicylate, ethanol intoxication
  - Hyper-insulinemia
- Diabetes ketoacidosis
- Electrolyte abnormalities (Na, K, Ca, Mg)
- Hepatic / uremic encephalopathy
- Inborn errors of metabolism
- Hormonal abnormalities (thyroid, adrenal, pituitary)

# AMS – Differential Diagnosis

- Hyperthermia
- Hypothermia
- Cardiac arrhythmias
  - Supraventricular tachycardia
  - Prolonged QT syndrome
- Intestinal obstruction
  - Intussusception
  - Adhesions from prior abdominal surgery

# AMS – Differential Diagnosis



# AMS - Workup



No zebras were **harmed** in the making of this presentation .....

# AMS - Workup

- IV/labs:
  - Bedside glucose
  - Basic metabolic panel
  - ABG, lactate
  - CBC
  - Toxicology screen
  - Hepatic transaminases
  - Ammonia
  - Coagulation factors

# AMS - Workup

- Electrocardiogram
- Head CT if indicated
- C-spine films if indicated
- Lumbar puncture if indicated
- EEG if indicated
- Abdominal imaging if indicated
  
- Who knows what else .... If indicated .....



# Case One

- Workup Results:
  - Accucheck – LOW
  - Glucose on basic metabolic panel – 16
- Patient woke up after receiving a D25 bolus
- Etiology of hypoglycemia?

# Common Toxidromes

- **Sympathomimetic** (Cocaine, Amphetamines, PCP)
  - Hypertension, Tachycardia, Diaphoresis, Mydriasis, Agitation
- **Anticholinergics** (TCA, Benadryl, Antihistamines, Jimson Weed, Belladonna products)
  - Tachycardia, Hyperthermia, Dry skin, Mydriasis, Decreased bowel sounds, Urinary retention, Delirium, Agitation
- **Sedatives** (Benzodiazepines)
  - Altered mental status with low blood pressure

# Common Toxidromes

- **Cholinergics** (Organophosphates, carbamates, nerve agents)

- Muscarinic Effects:

S:	Salivation, Seizure
L:	Lacrimation
U:	Urination
G:	GI Distress (diarrhea & vomiting)
B:	Bronchorrhea
A:	Abdominal cramps
M:	Miosis

- Nicotinic Effects:

M	Mydriasis
T	Tachycardia
W	Weakness
TH	Hyperthermia
F	Fasciculations

# Common Toxidromes

- **Opiates** (morphine, codeine, clonidine, dextromethorphan, heroin, fentanyl)

Miosis

Hypotension

Bradypnea

Bradycardia

Hypothermia

CNS Depression

# Antidotes

- Flumazenil for benzodiazepine ingestion
  - flumazenil is contraindicated in drug ingestions that may precipitate seizures and in patients with a known seizure disorder. It also may precipitate withdrawal in patients with benzodiazepine dependence.
- Glucose for insulin or oral hypoglycemic agent ingestion.
- Physostigmine for anticholinergic agent ingestion
  - Contraindicated in tricyclic antidepressant overdoses.
  - Should not be administered to patients who have a widened QRS interval on electrocardiogram.
- Naloxone for opiate ingestion.
- Protamine for heparin overdoses.

# Case Two

A twelve year old boy presents with brief loss of consciousness and vomiting after colliding with another soccer player during a game.

Per his mother, he struck heads with the other player, fell forward to the ground, and was unconscious for less than a minute.

When he woke up, vomited twice, and complained of the front of his head hurting.

The patient does not recall the incident in which he was injured, and he continues to ask the same questions over and over again on the field.

EMS called to transport patient to the local ER.

# Case Two

- His initial vital signs are as follows:

Heart Rate	80
Respiratory Rate	16
Blood Pressure	100/60
Oxygen Saturation:	99% (room air)

- He easily awakens to verbal and tactile stimuli but otherwise drifts off to sleep when left un-stimulated; his physical exam is normal with the exception of a right frontal scalp hematoma that measures 3cm in diameter; his pupils are 3cm and equally reactive bilaterally; there is no evident bony step-off underlying the hematoma; the patient does not recall the injury and continues to ask why he is in the hospital.

# Questions

- What are your initial treatment goals in the field?
- How would you calculate his Glasgow Coma Score?
- What additional elements would you like to learn about his history?
- How would you prepare this patient for transport?
- To which facility would you want to take this patient?



# Symptoms of concussion

- **Cognitive Symptoms** Include:
  - Difficulty thinking clearly, slurred speech
  - Feeling slowed down
  - Difficulty concentrating
  - Difficulty remembering new information, amnesia
  - Disoriented
- **Physical Symptoms** Include:
  - Headache
  - Fuzzy or blurry vision
  - Nausea or vomiting (early on)
  - Dizziness
  - Sensitivity to noise or light
  - Balance problems, poor coordination
  - Feeling tired, having no energy

# Symptoms of concussion

- **Emotional/Mood Symptoms Include:**
  - Irritability
  - Sadness
  - More emotional/emotionally labile
  - Nervousness or anxiety
- **Disturbances in Sleep Pattern Include:**
  - Sleeping more than usual
  - Sleep less than usual
  - Trouble falling asleep

# Diagnosis of Concussion

- The suspected diagnosis of concussion can include one or more of the following clinical domains:
  - **Physical signs:** *loss of consciousness, vomiting, headache*
  - **Behavioral changes:** *irritability, labile emotions*
  - **Cognitive impairment:** *slowed reaction times, feeling like in a fog*
  - **Sleep disturbance:** *drowsiness*
- If any one or more of these components is present, a concussion should be suspected and the appropriate management strategy instituted.
- No longer utilize grading systems to determine treatment

# Acute Sideline Management

- Medically evaluated onsite using EMT principles
  - Attention to Cervical spine
- SCAT2 (or similar)
  - Sideline evaluation tool
- Should not be left alone, serial assessments for next few hours to evaluate for deterioration
- No Same-Day Return To Play!
- Refer to appropriate medical setting

# SCAT-2

- **Sports Concussion Assessment Tool – 2:**
  - Standardized sideline assessment tool that is easy to administer and can be repeated over time to help determine progression of symptoms
- Online access to full SCAT-2:  
<http://www.neurosurgery.net.au/SCAT2.html>
- Available as an app for iPhones, iPod, iPad:  
<https://itunes.apple.com/us/app/scat2/id434110174?mt=8>

# Transport Considerations

- A, B, C's of trauma management – rapidly use your pediatric assessment triangle and primary survey to determine if the patient is sick or not sick:
  - Airway
  - Breathing
  - Circulation
  - Disability
  - Exposure
- Secondary survey once all primary survey interventions are met – more detailed head to toe physical exam
  - Cervical Spine Immobilization
  - Spinal Immobilization

# Arrival in Hospital

- Provide overview of patient's presentation to hospital care providers including:
  - Mechanism of the injury
  - Symptoms demonstrated by the patient at the time of injury, upon your arrival, and during transport
  - Physical exam and vital signs
  - Changes in symptoms or physical exam findings over time
  - Pertinent medical history (SAMPLE history is sufficient)
  - Results of any screening tests performed by trainer or EMS providers en route to hospital
- Physician will perform primary and secondary survey to determine further treatment needed

# Management of Concussion

- **Indications for CT:**
  - Posttraumatic seizure
  - Amnesia
  - Progressive headache
  - Distracting history / exam
    - Intoxicants
    - Other injuries
  - LOC > 5 minutes
  - Signs of basilar skull fracture
  - Repetitive emesis
  - Emesis > 8 hours post injury
  - Instability following multiple traumas



# Management of Concussion

- **Indications for Outpatient Care**
  - Minor head injury (GCS 13 – 15)
  - **Reliable** adult caretaker \*
  - LOC < 5 minutes
  - Normal neurological exam
  - No ↑ ICP symptoms
  - Normal CT (?)
  - No signs of basilar skull fracture

# Management of Concussion

- **Indications for Admission:**
  - Documented LOC > 5 minutes
  - Any persistent altered mental status, amnesia
  - Posttraumatic seizures
  - Protracted emesis
  - Persistent headache
  - Intoxication
  - Suspected child abuse
  - Unreliable caregiver
  - Underlying pathology
    - Coagulopathy
    - Hydrocephalus

# Follow Up Management

- List of symptoms that would require immediate follow-up:
  - Worsening headache, protracted vomiting
  - Worsening fatigue or alteration in mental status
  - Any seizure
  - Numbness or weakness of any part of the body
- The cornerstone of concussion management is **Physical and Cognitive Rest** until symptoms resolve and then a graded program of exertion prior to medical clearance and return to play.
- **Cognitive Rest** means limiting exertion with activities of daily living and limiting scholastic and other cognitive stressors (e.g. text messaging, videogames, etc.) while symptomatic.
  - School attendance and activities may also need to be modified to avoid provocation of symptoms.

# Return to play protocol

- For persons participating in athletics, the 2008 Zurich Consensus Statement on Concussion in Sport recommends persons be symptom free before restarting and then, not all at once, but rather through a series of graded steps
- These steps include: complete physical and cognitive rest, light aerobic activity (less than 70% of maximum heart rate), sport-specific activities such as running drills and skating drills, non-contact training drills (exercise, coordination, and cognitive load), full-contact practice, and full-contact games
- Only if a person is symptom free for 24 hours, should he or she proceed to the next step
  - If symptoms occur, the person should drop back to the previous asymptomatic level for at least another 24 hours

## Graduated return to play protocol

Rehabilitation stage	Functional exercise at each stage of rehabilitation	Objective of each stage
1. No activity	Complete physical and cognitive rest	Recovery
2. Light aerobic exercise	Walking, swimming or stationary cycling keeping intensity <70 percent MPPHR; no resistance training	Increase HR
3. Sport-specific exercise	Skating drills in ice hockey, running drills in soccer; no head impact activities	Add movement
4. Non-contact training drills	Progression to more complex training drills, eg, passing drills in football and ice hockey; may start progressive resistance training	Exercise, coordination, and cognitive load
5. Full contact practice	Following medical clearance, participate in normal training activities	Restore confidence and assess functional skills by coaching staff
6. Return to play	Normal game play	

Six-day return to play protocol. Each day the athlete makes a stepwise increase in functional activity, is evaluated for symptoms, and is allowed to progress to the next stage each successive day if asymptomatic.

*Reproduced with permission from: McCrory, P, Meeuwisse, W, Johnston, K, et al. Consensus Statement on Concussion in Sport 3rd International Conference on Concussion in Sport Held in Zurich, November 2008. Clin J Sport Med 2009; 19:185. Copyright © 2009 Lippincott Williams & Wilkins.*

# Case Three

- 8 month old male has had several episodes of vomiting that started earlier in the day associated with intermittent periods of crampy abdominal pain.
- Decreased appetite today, has only had three wet diapers.
- No bowel movements today.
- Parents called EMS because now infant is lethargic and only arouses to tactile stimuli.

# Case Three

- His initial vital signs are as follows:

Heart Rate	140
Respiratory Rate	26
Blood Pressure	100/60
Oxygen Saturation:	98% (room air)

- Patient is drowsy but awakens briefly to tactile stimuli. Pupils are equal and reactive to light. Chest and cardiac exam normal. Pain with palpation of right lower quadrant. Passes red, jelly-like stool during the ambulance ride.

# Questions

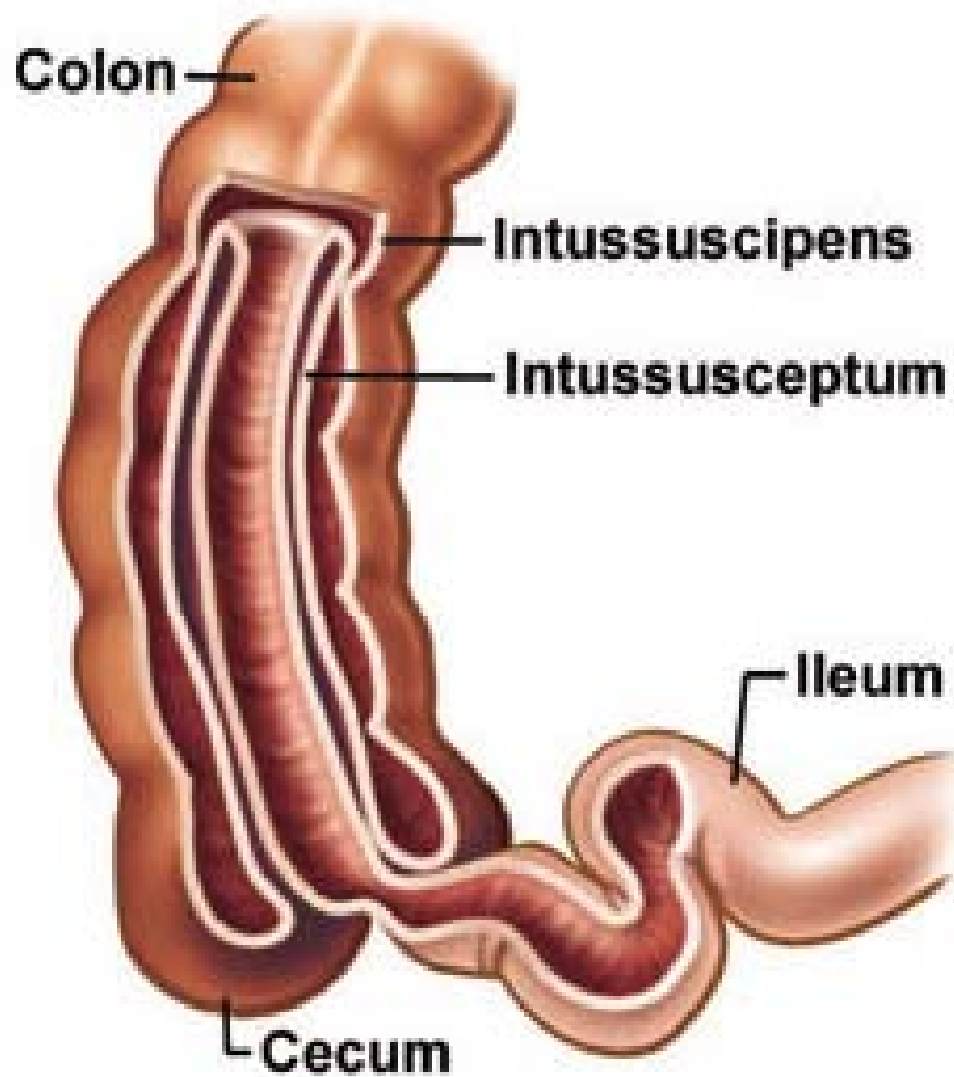
- What are your initial treatment goals in the field?
- What additional elements would you like to learn about his history?
- How would you prepare this patient for transport?
- To which facility would you want to take this patient?



# Intussusception

- An **intussusception** is a medical condition in which a part of the intestine has invaginated into another section of intestine, similar to the parts of a collapsible telescope that slide into one another
- Can lead to bowel obstruction
- Symptoms can include intermittent crampy abdominal pain, vomiting, pulling of legs up into the abdomen, and classic red currant stools (actually a late finding)
  - Often will have periods of increased work of breathing or lethargy in between episodes of pain
- More common in infants 3 months to 12 months of age, three times more common in males

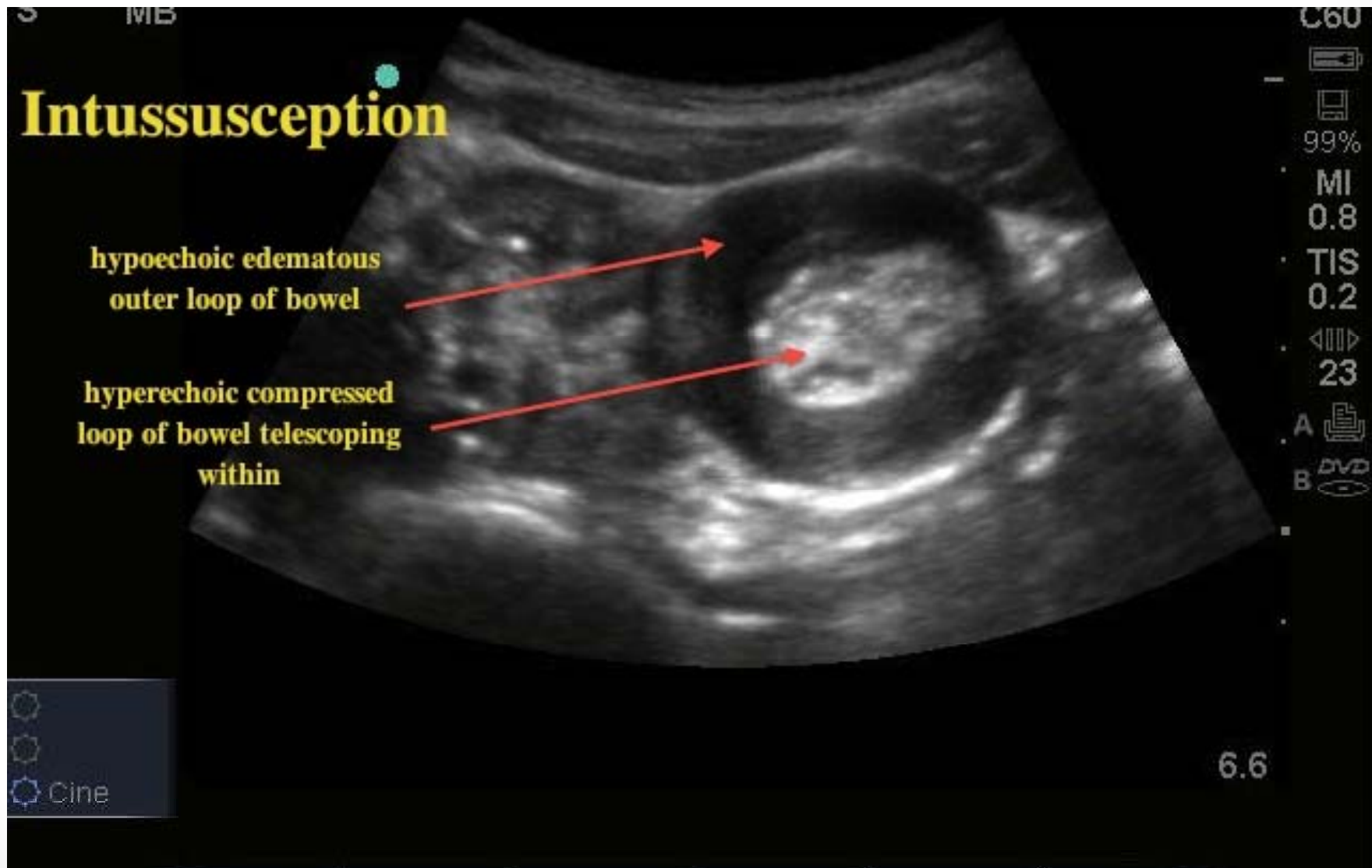
# Intussusception



# Intussusception on CT



# Intussusception on US



# Treatment

- Diagnosis can be confirmed and treatment rendered by completing an air contrast barium enema
- If ACBE does not work, patient typically requires surgical correction
- Outside of typical age range, think of other etiologies including lead points for tumors including lymphoma as well as intestinal hematomas caused by Henoch Schonlein purpura

# Case Four

- Patient is a 14 year old female who was staying at home by herself after school while mom was pulling a late shift at work
- When mom arrived home, she noticed the patient was laying on the floor in the kitchen unresponsive but breathing
- Mom called EMS immediately, and mom began to complain of a headache prior to the arrival of EMS

# Case Four

- Her initial vital signs are as follows:

Heart Rate	120
Respiratory Rate	30
Blood Pressure	100/60
Oxygen Saturation:	98% (room air)

- Patient is responsive only to painful stimuli. Pupils are equal and reactive to light. Chest and cardiac exam normal. Remainder of physical exam appears normal.

# Questions

- What are your initial treatment goals in the field?
- What additional elements would you like to learn about his history?
- How would you prepare this patient for transport?
- To which facility would you want to take this patient?



# Case Four

- Patient placed on oxygen peripheral IV placed, NS bolus started
- Labs reveal:
  - pH – 7.35
  - PCO<sub>2</sub> – 40
  - PO<sub>2</sub> – 125
  - CO-HB – 30%

# Carbon Monoxide Poisoning

- **Carbon monoxide (CO)** is a colorless, odorless, and tasteless gas that is slightly less dense than air
  - It is toxic to humans and animals when encountered in higher concentrations
- The most common symptoms of carbon monoxide poisoning may resemble other types of poisonings and infections, including symptoms such as headache, nausea, vomiting, dizziness, fatigue, and a feeling of weakness
  - Affected families often believe they are victims of food poisoning.
  - Infants may be irritable and feed poorly
  - Neurological signs include confusion, disorientation, visual disturbance, syncope and seizures.

# Carbon Monoxide Poisoning

- Treatment involves:
  - Washout with high flow oxygen
  - Serial blood gas values until carboxyhemoglobin levels are less than 5%
  - Very high levels may require hyperbaric treatment
- Evaluate / fix source of carbon monoxide in the home environment

# Case Five

- Patient is an 18 month old female who has had a three day history of low grade fever, vomiting, cough and nasal congestion.
- Symptoms seemed to get worse today, patient is no longer interested in feeding, has been lethargic for the past hour at which time parents called EMS.

# Case Five

- Her initial vital signs are as follows:

Heart Rate	160
Respiratory Rate	52
Blood Pressure	100/60
Oxygen Saturation:	94% (room air)

- Patient is drowsy but awakens briefly to tactile stimuli. Pupils are equal and reactive to light. Mucous membranes are dry. Breath sounds are clear but respiratory rate and effort are increased. Normal S1/S2, tachycardic without murmurs. Abdomen soft, non-tender, non-distended. Cap refill 4 seconds, poor muscle tone.

# Questions

- What are your initial treatment goals in the field?
- What additional elements would you like to learn about his history?
- How would you prepare this patient for transport?
- To which facility would you want to take this patient?

# Case Five

- Patient placed on oxygen, CXR revealed no evidence of pneumonia
- IV NS bolus provided, patient became slightly more responsive
- Labs returned:
  - Na – 124
  - K – 4.2
  - CO<sub>2</sub> – 8
  - Glucose - 640

# Diabetic Ketoacidosis

- **Diabetic ketoacidosis (DKA)** is a potentially life-threatening complication in patients with diabetes mellitus
  - Predominantly occurs in those with type 1 diabetes, but can occur in type 2 under certain circumstances
  - Results from a shortage of insulin – in response, body burns fatty acids and produces ketone bodies that lead to the symptoms and complications
- DKA may be the first symptom of previously undiagnosed diabetes, but it may also occur in people known to have diabetes as a result of a variety of causes, such as intercurrent illness or poor compliance with insulin therapy
  - Vomiting, dehydration, deep gasping breathing, confusion, and occasionally coma are typical symptoms



# Diabetic Ketoacidosis

- Treatment includes fluid resuscitation, insulin, and potassium replenishment
  - Close monitoring of labwork and mental status
- Complications can include cerebral edema, usually associated with coma
  - Often necessitates admission to intensive care, artificial ventilation, and close observation
  - Intravenous mannitol and hypertonic saline are often used in an attempt to reduce the cerebral swelling

# Questions / Comments?

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