PEDIATRIC BRAIN CARE

The brain matters most!

OVERVIEW OF NEURO ASSESSMENT

1. Overall responsiveness/activity
2. The eyes
3. ? Increased ICP
4. Movements
5. ? Seizures
6. Other

OVERALL RESPONSIVENESS/ ACTIVITY

Note: much of the initial assessment can be performed rapidly from a distance

VISUAL FINDINGS

1. Is he visually attentive?
2. Does he interact with parents?
3. What is his position?
4. Does he vocalize?
5. Could he be sleeping?
6. Are there movements suggestive of seizure activity?

BEHAVIOR ASSESSMENT

1. Requires an appreciation of normal for age
2. More important is the question of normal for the particular child
3. Use the available experts!

A detailed neuro exam is essential in a child with apparently altered LOC; a more abbreviated exam is appropriate for the alert, apparently normal child

GLASGOW COMA SCORE

1. Can be used in preverbal children if the verbal component is modified
2. Can potentially be assessed in the course of routine care
3. Should be assigned serially
4. “Under 8, intubate!" is sometimes appropriate

DIFFUSE CAUSES OF ↓ LOC

1. Hypo- or hyperglycemia
2. Meningitis/encephalitis
3. CNS hypoxia/ischemia
4. Intoxication
5. Sodium abnormalities
6. Hyperosmolar states

DIFFUSE CAUSES OF ↓LOC (II)

7. Reye syndrome
8. Uremia or liver failure
9. Post-ictal state
10. Inborn errors of metabolism
11. Hypertensive encephalopathy
12. Severe hyper- or hypothermia

STRUCTURAL CAUSES OF ↓LOC

1. Brain trauma/hemorrhage
2. Brain tumor
3. CNS infarction
4. Brain abscess
5. Hydrocephalus
6. Other

Note that diffuse metabolic causes of altered LOC typically do not result in focal findings, while structural, anatomic lesions often do.

Note also that decreasing LOC is a continuum!

THE EYES

1. Should be examined simultaneously if possible
2. Pupil exam
3. Assessment of eye movements
4. Funduscopic exam in the ED

PUPILS SHOULD BE:

1. Round, not irregular or oval
2. Equal
3. Reactive to light
4. Consensually reactive

PUPIL SIZE

1. May be clinically helpful
2. Many conditions result in large pupils, but pinpoint pupils should provoke consideration of opiate exposure

EYE MOVEMENT ABNORMALITIES

1. 6th nerve palsy may reflect ↑ICP
2. Sunsetting may result from uncontrolled hydrocephalus
3. Other gaze pareses
4. Doll's eyes
5. Other (e. g., nystagmus)

FUNDUSCOPIC EXAM

1. Should always be attempted in the ED in a child with decreased LOC
2. Retinal hemorrhages are a critical finding!
3. Papilledema reflects increased ICP

INCREASED ICP

1. May result from increase in normal intracranial contents
   - Blood (i.e., cerebral hyperperfusion)
   - Brain (i.e., cerebral edema)
   - CSF (i.e., hydrocephalus)
2. May result from a mass lesion such as hematoma, abscess, or tumor

Increased ICP may cause death or permanent injury

as a result of CNS ischemia or a herniation syndrome!

SIGNS/SX OF ↑ICP

1. Headache
2. Fussiness/irritability in an infant
3. Bulging anterior fontanel
4. Vomiting
5. Altered mental status
6. Eye findings

SIGNS/SX OF ↑ICP (II)

7. Seizures
8. Posturing
9. Cushing triad
   - Hypertension
   - Bradycardia
   - Respiratory abnormalities

MOVEMENTS

1. Assess for weakness or asymmetry
2. Horizontal cut-offs reflect spinal cord pathology, while right/left asymmetry reflects brain pathology
3. Consider the possibility of seizures

Seizures are a

common presenting complaint

in children requiring

an acute 911 response or ED care.

FEBRILE CONVULSIONS

1. Common
2. Limited to young children (usually 5 months to 5 years)
3. Associated with febrile illnesses

FEATURES OF FEBRILE SZ

1. Symmetrical, tonic/clonic, NOT focal
2. Relatively short (often <5 minutes)
3. Post-ictal depression short and mild
4. Tendency to recur
5. BENIGN: not associated with CNS injury

SEIZURE WITH FEVER

1. Not necessarily a "febrile seizure"
2. Meningitis and encephalitis can produce **BOTH** fever and seizure
3. Fever lowers the seizure threshold

CAUSES OF CHILDHOOD SEIZURES

1. Febrile convulsions
2. CNS infections
3. Trauma (consider NAT!)
4. Metabolic
5. Seizure disorder
6. Other (e. g., brain tumor or stroke)

METABOLIC CAUSES

1. CNS hypoxia / ischemia
2. Hypoglycemia
3. Acute hyponatremia
4. Drugs/toxins
5. Severe hyperthermia / heat stroke
6. Hypocalcemia

CLINICAL APPEARANCE

1. Usually unconscious / unarousable
2. Movements often but not always present
3. Findings may be subtle in infants
4. Respiratory changes
5. Color changes may be present
6. Cardiovascular changes

SEIZURES IN BABIES

1. Repetitive eye blinking
2. Repetitive sucking movements
3. “Bicycling" leg movements
4. Frequent Moro movements
6. Apnea or cyanosis

SEIZURES CAN BE DANGEROUS!

1. Cause of the Sz may be injurious
2. Prolonged electrical status can cause injury to the involved neurons
3. Apnea / hypoventilation
4. Vomiting/aspiration
5. Lactic acidosis, rhabdomyolysis, or severe hyperthermia

OTHER

1. Meningeal signs
2. Skin findings (rash or bruises)
3. Breath odor (DKA or poisoning)
4. Body temperature (profound hypothermia or heat stroke)

MENINGEAL SIGNS

1. Often result from CNS infection; use protection!
2. May or may not be tested in the prehospital environment
3. Stiff neck NOT seen in infants

PREHOSPITAL MANAGEMENT

1. Airway
2. Oxygenation / ventilation
3. Circulation
4. CNS care
5. Scene evaluation

AIRWAY ISSUES

1. Airway may be compromised by position or lack of gag / cough
2. Is there a quick fix?
3. Intubation is likely to be needed
4. Where and by whom intubation is done is a judgment call

BREATHING

1. High-flow oxygen is essential!
2. BEWARE of unstable respiratory drive
3. Is pCO_2 monitoring possible?
4. Average desirable pCO_2 is about 35

WHEN DOES HYPERCARBIA MATTER?

1. Increased ICP (ideal pCO_2 is ~35; it should be lower if herniation is impending)
2. Severe metabolic acidosis for which compensation is required to preserve a viable pH

CIRCULATION

1. Rate and rhythm abnormalities may result from the primary problem
2. ↑Rate and BP: ?stress response
3. Hypertension and bradycardia: ? Cushing response
4. Primary goal: assure CNS perfusion

BRAIN CARE

1. ABCs
2. Physical exam
3. Essential labs
4. Try "quick fixes" if available
5. Treat increased ICP if likely

ESSENTIAL LABS

1. Pulse oximetry
2. Blood glucose assessment
3. Electrolytes, calcium, blood gases if possible
4. Multiple others are essential in the ED

"QUICK FIXES"

1. Brain oxygenation/perfusion
2. Dextrose
3. Naloxone or flumazenil if not contraindicated
4. Control of seizures
5. Other (shunt pumping, etc.)

SEIZURE CONTROL

1. May require oxygen or dextrose, not anticonvulsants
2. Does not require an IV
3. Add a longer-acting agent such as fosphenytoin if possible
4. Note that paralytics DO NOT STOP ELECTIRCAL SEIZURES

PREHOSPITAL ↑ICP CARE

1. Elevate the child's head
2. Keep the head midline
3. Avoid jugular compression
4. Assure adequate ventilation
5. Control seizures, pain, fever
6. ? Diuretics

SCENE CLUES

1. Empty bottles?
2. Drug paraphernalia?
3. “Trauma site" not consistent with history
4. Reason to suspect CO poisoning
5. Other

SUMMARY

1. Neurological crises can be frightening!
2. Optimal planning and care can result in decades of good life!