NEUROLOGY PROBLEMS OF BABIES

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Disclosures

• I have no relevant financial relationships with the manufacturers of any commercial products and/or provider of commercial services discussed in this CME activity.

• I do not intend to discuss any unapproved/investigative use of a commercial product/device in our presentation.
Learning objective: To become facile in the neurologic evaluation of the baby and toddler, while developing an understanding of their most common neurologic problems.

- Examination of a baby
  - Floppy baby (RS)
  - Skin lesions (PF)
  - Brachial plexopathy (PF)
  - Neonatal Seizures (RS)

- Examination of a toddler
  - Macro/microcephaly (PF)
  - Ataxia (RS)
  - Developmental Delay (PF)
  - Cerebral palsy (RS)
Examining a baby is easy!
Components of the exam

• General exam
  – Head circumference
  – Weight, length %ile
  – Dysmorphic features
  – Skin lesions
  – Sacral dimple

• Neurologic exam
  – Mental status
  – Cranial nerves
  – Motor exam
    • Bulk/tone/strength
  – Deep tendon reflexes
  – Sensory
  – Primitive reflexes
    • Root, suck, grasp, Moro, Landau, Gallant, etc.
Examining a baby is easy!
Floppy Babies

• Central vs. Peripheral Hypotonia
  – Head circumference
  – Dysmorphic features?
  – CNS signs (seizures?)
  – Is the baby weak?
  – Are deep tendon reflexes present?
NEONATAL HYPOTONIA

Physical Exam

Central

Dysmorphic?

Y

Karyotype (or CMS); PWS

N

Diagnosis?

N

brain MRI
genoetic/metabolic (PWS and CMS)

Periphera

CK, cDM1, SMA
CXR for Pompe
Diagnosis?

N

Muscle Biopsy
EMG/NCV
Tensilon Test
brain MRI

Uncertain

brain MRI
CXR for Pompe
Karyotype/CMS
CK, PWS

Muscle Biopsy
EMG/NCV
Tensilon Test

You are seeing a 6-month-old girl in well-child care. She has 4 café-au-lait spots, measuring about 4 to 5 mm. The infant is developmentally appropriate with a normal head circumference and normal exam.

- What do you tell her parents?
- Do you order a brain MRI?
Among the following, the child most likely to benefit from early referral to a neurosurgeon is:

A. 1-month-old who has an eccentric sacral dimple.
B. 1-week-old who has a solitary sacroccocygeal pit.
C. 2-month-old who has a sacroccocygeal dimple.
D. 3-month-old who has a dimple superior to the gluteal cleft with discharge.
E. 3-week-old who has a palpable coccyx beneath the dimple.
Concerning sacral dimples

- Diameter >5 mm
- >2.5 cm above anal verge
- Multiple dimples
- Other cutaneous markers

Further investigation required:

- Hypertrichosis,
- Capillary hemangioma
- Atretic meningocele
- Subcutaneous mass
  - (e.g., lipoma)
- Caudal appendage

*Pediatr Rev 2011;32:109-114*
An 8-month-old girl presents to your clinic with multiple dimples superior to the gluteal cleft, and you suspect occult spinal dysraphism. Among the following, the most appropriate next step in her evaluation is:

A. Computed tomography scan of the spine.
B. Lumbar puncture.
C. Magnetic resonance imaging of the spine.
D. Ultrasonography of the spine.
E. Radiographs of the spinal column.
You are seeing a newborn who has an asymmetric Moro reflex with a flaccid left arm. The child has full breath sounds, but you note that his left pupil is 2 mm and the right 4 mm.

• What do you tell the parents?
• Do you arrange for PT?
• Do you refer to an orthopedist?
Congenital brachial plexopathies

**Erb palsy (C4, 5, 6)**
- Upper arm
- 80% of brachial plexopathies
- Unilateral, often right
- Arm adducted, rotated inward at shoulder
- Wrist extension and fingers might be involved
- Check for hemi-diaphragm weakness
- Rule out clavicle fracture
- Rx: gentle positioning, ROM and PT
- Majority recover

**Klumpke paralysis (C7, 8, T1)**
- Lower arm
- Less common
- More severe
- Weak triceps, intrinsic hand muscles, wrist and finger flexors
- Check for Horner syndrome; can indicate root avulsion
- Rule out clavicle and humerus fracture
- Rx: positioning, ROM, PT, and orthopedics referral
- Outcome can be poor
Case

- Baby K is a 40 2/7 week EGA infant
- 25-year-old G2P1 mother
- Placental abruption
- Loss of fetal heart tones $\rightarrow$ emergent c-section
- Apgar scores $1^1, 2^5, 3^{10}$
- Rhythmic mouth and arm movements noted
- Referred for therapeutic hypothermia
Neonatal seizures

- Seizure = sign of underlying big trouble
  - Meningitis, hemorrhage, stroke, HIE, electrolyte disturbance, etc.
  - Rarely due to neonatal epilepsy

- ↑ risk for death or neurologic morbidity.
  - Mortality: 25-40% (may be higher in preterm)
  - Developmental delay or cerebral palsy: ~67% @ 2-3 yrs
  - Post-neonatal epilepsy: 17-56%

- Should prompt emergent evaluation
  - Sepsis evaluation
  - Electrolytes & glucose
  - Imaging
# Neonatal Seizure Semiology

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<th>Seizures</th>
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<tbody>
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<tr>
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<td>Rarely isolated ↑ HR, BP</td>
<td>Opisthotonos</td>
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<td>W.B.S.</td>
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*Myoclonic sz often assoc w/ inborn errors of metabolism

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Back to our CASE

• High-risk infant
• Abnormal mouth movements
• How sure are we that she is having seizures?
Most neonatal seizures are subclinical

• >50% of neonatal seizures have no outward manifestation.
  – Therefore require EEG for diagnosis
• Most reliable semiology = focal clonic/tonic
• Neonates don’t have generalized tonic-clonic seizures.
Scenarios in which to consider EEG monitoring

- **Acute neonatal encephalopathy**
  - Birth depression
  - Following cardiopulmonary resuscitation
- **Clinical encephalopathy and cardiac or pulmonary risks for acute brain injury**
  - ECMO; Congenital heart defects requiring early surgery
- **Central nervous system infection** (suspected or confirmed)
- **Central nervous system trauma or hemorrhage**
  - Subarachnoid, subdural, or intraventricular bleeding
  - Encephalopathy and suspicion for acquired brain injury
- **Inborn errors of metabolism**
- **Perinatal stroke**
- **Acute sinovenous thrombosis**
- **Premature infants with additional risk factors**
  - Acute high grade intraventricular hemorrhages
  - Very low birth weight with clinical concern for encephalopathy
- **Genetic/Syndromic disease involving CNS**
  - Cerebral dysgenesis
  - Dysmorphic features or multiple anomalies with associated microcephaly

Standard neonatal EEG

Single channel raw EEG

Filter <2Hz and >15Hz, rectify, smooth, amplitude-integrate, compress time scale

Amplitude Integrated EEG (aEEG)
Amplitude-integrated EEG
Seizures complicate HIE

- HIE = common cause of neonatal seizures
  - Usually infants HIE are cooled
- aEEG and/or EEG *recommended* during therapeutic hypothermia
  - ~50% have electrographic seizures
    * Clinical factors do not reliably predict EEG seizures
  - Seizures = ↑risk for bad outcomes
Treatment of Neonatal Seizures

• Correct the obvious (glucose, calcium, etc.)
• First line – phenobarbital
  – 20 to 30 mg/kg loading dose
  – If still *electrographic* seizures, continue 10mg/kg mini-
    loads to level ~50
  – Standing dose ≥ 5mg/kg/day
• Second line – fosphenytoin
  – 20mg/kg loading dose (and continue phenobarbital)
  – Free levels 2-3, total levels ~20
  – Standing dose 4-8mg/kg/day IV divided BID-TID
• Third line –
Examining a toddler is easy!

- Head circumference
- Dysmorphism, skin lesions, organomegaly
- Mental status (language, stranger anxiety, social skills)
- Cranial nerves
- Motor
- Reflexes
- Sensory
- Coordination
CASE

• An 18-month-old with longstanding macrocephaly – head circumference 54.0 cm (>95%) – and strabismus presents to you with delay in walking.

• You refer him to a neurologist and he is diagnosed with “cerebral palsy.”

• The parents are told to obtain a brain MRI at their convenience.

• What bothers you in this story?
**Head circumference (HC)**

Term gestation babies on average have HC 35 cm ♂, 34 cm ♀ ...

**Or...**

<table>
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<tr>
<th>Age</th>
<th>HC (cm)</th>
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<tr>
<td>0 (birth)</td>
<td>35 cm</td>
</tr>
<tr>
<td>3 months</td>
<td>40 cm</td>
</tr>
<tr>
<td>9 months</td>
<td>45 cm</td>
</tr>
<tr>
<td>3 years</td>
<td>50 cm</td>
</tr>
<tr>
<td>Adult</td>
<td>55 cm</td>
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<table>
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<tr>
<th>Time Period</th>
<th>Rate</th>
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<tr>
<td>3rd trimester</td>
<td>3 cm/month</td>
</tr>
<tr>
<td>Months 1-3</td>
<td>2 cm/month</td>
</tr>
<tr>
<td>Months 4-6</td>
<td>1 cm/month</td>
</tr>
<tr>
<td>Months 7-12</td>
<td>½ cm/month</td>
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**Or...**

(baby length [cm] ÷ 2) + 9.5 cm = appropriate HC +/- 2 cm
Macrocephaly

• Primary macrocephaly
• Hydrocephalus
• Hydraencephaly
• Subdural hematoma
• Metabolic
  – Leukodystrophy
  – MPS
  – Lipidoses
• Tumor
• Neurocutaneous
  – Tuberous sclerosis
  – NF-1
  – Sturge-Weber
• Bony disease
  – Rickets
  – Achondroplasia
  – OI
• Megalencephaly
• Soto syndrome
Microcephaly

- Chromosomal abnormality
- TORCH infection
- HIV
- Fetal alcohol syndrome
- Toxins – mercury, anticonvulsants
- Irradiation
- HIE/neonatal encephalopathy
- Metabolic diseases
- Maternal PKU
- Glucose transporter deficiency
A healthy 2-year-old boy presents to the E.R. because of a wobbly gait. She has difficulty sitting and is unable to walk independently.

What do you need to know?
Ataxia – differential diagnosis

• **Acute**
  – **Toxic ingestion**
  – **Acute cerebellar ataxia** (acute postinfectious cerebellitis)
  – Stroke (ischemia or hemorrhage)
  – CNS infection

• **Subacute**
  – Tumor
  – Guillain-Barré Syndrome

• **Chronic**
  – Ataxia-telangiectasia
  – Spinocerebellar ataxias
Ataxia - evaluation

- Urine toxicology screen
- Electrolytes, CBC, LFTs
- Neuroimaging to evaluate for structural lesion
  - And then consider lumbar puncture
CASE

• An 11-month-old boy presents for well-child care.
• He can roll, sits propped but not without support. He is starting to creep.
• He babbles, but does not say mama or dada specifically or have any words.
• He has a poor pincer grasp, but waves.
• He does not drink from a cup.
• On exam, HC is 44.5 cm and he seems mildly hypotonic, but does not slip through with vertical suspension. Strength is good and reflexes are normal. He still has bilateral Babinski signs.
Global developmental delay: What to do?

- Refer for auditory and ophthalmologic screening
- High-resolution karyotype (> 650 bands), with FISH subtelomeric analysis, plus fragile X testing ...?chromosomal microarray...whole exome screening?
- If no universal newborn screening, consider TSH, T4
- If regression, seizures, or vomiting → venous pH, serum ammonia and lactate; plasma amino acids, urine organic acids, and mitochondrial testing
- If history of possible seizures → EEG
- Consider screening for autism spectrum disorder
- Consider testing for Rett syndrome in girls with unexplained moderate to severe delay
- Refer to neurology, developmental pediatrics, and/or genetics

*Neurology* 2003;60:367-380

*Pediatrics* 2006;117:2304-2316
Case

• A 2-year-old girl is brought to your office because she has never learned to walk.
• Birth history: 29-week AGA infant.

What is the most likely diagnosis?
Cerebral palsy

- **Motor** impairment due to a brain lesion early in development.

- **Diplegia**
  - Most often preterm infant

- **Hemiplegia**
  - Perinatal Stroke

- **Quadriplegia**
  - Diffuse injury or injuries that affect all of the motor fibers.
Diplegia

- Preterm infants
- Periventricular leukomalacia
- Intraventricular hemorrhage

Blue = most affected area(s). Yellow = less affected area(s).
Hemiplegia

- Early handedness
- Perinatal stroke
- Other unilateral injury or malformation

Blue = most affected area(s).
Yellow = less affected area(s).
Quadriplegia

- Diffuse brain injury or injuries that affect all of the motor fibers.

- Hypoxic ischemic encephalopathy

Blue = most affected area(s).
Yellow = less affected area(s).
CP - Evaluation algorithm

- History & exam – exclude progressive or degenerative disorders

- Classify the type of CP
  - Brain MRI normal → consider genetic/metabolic testing
  - Brain MRI abnormal → evaluate specific etiologies

- Screen for comorbidities
  - Intellectual disabilities
  - Vision & hearing problems
  - Feeding/swallowing difficulties
  - Epilepsy
  - Osteopenia/orthopedic problems
Conclusions

• Examining a baby is easy!

• Examining a toddler is easy!

• You now know how to approach:
  – Floppy babies
  – Skin lesions
  – Sacral dimples
  – Neonatal seizures
  – Erb/Klumpke palsies
  – Macro/microcephaly
  – Ataxia
  – Developmental Delay
  – Cerebral Palsy
Suggested changes in practice and additional reading

• Post a diagnostic algorithm for neonatal hypotonia in your staff work room.

• Document head circumference and percentile for every <3-year-old patient.

• Review relevant practice parameters with colleagues: