Case 1

A 15 y/o boy was brought with his abnormal gait that started about 5-6 yrs back. Speech is normal, he is unable to walk on heels. Romberg sign is positive. Plantars are downgoing. There are no cerebellar signs. The mother mentioned that his father’s feet look odd.

The diagnosis is most likely to be:
- a) Congenital myopathy
- b) Friedreich ataxia
- c) Charcot-Marie-Tooth disease
- d) Juvenile onset SMA

Charcot-Marie-Tooth disease (HMSN)

- Heterogeneous group of disorders
- Slowly progressive hereditary neuropathy
- May be demyelinating or axonal in pathology
- May be AD, AR or X-linked in inheritance
- Present 1st-2nd decade
- Distal LE wasting and weakness (stork leg), hyporeflexia
- Hypertrophic nerves in some
Charcot-Marie-Tooth disease (HMSN)
- Loss of sensory function, specially proprioception
- Later wasting of intrinsic hand muscles
- High-stepping gait
- Pes cavus, hammer toes, may develop scoliosis
- Diagnosis based on family history, NCS (conduction velocity > or < 38 m/sec) and genetic testing
- Commonest type demyelinating, AD; cause: duplication PMP 22 gene

Friedreich ataxia
- AR condition, progressive course
- FRDA gene encodes iron-binding mitochondrial protein, frataxin
- GAA trinucleotide repeat expansion
- Present in the latter half of 1st decade
- Pathology in spinocerebellar tracts + corticospinal tracts + dorsal columns + dorsal root ganglion + large myelinated peripheral nerves
- Characteristic: absent ankle reflex + extensor plantar response
- Cerebellar signs including gait ataxia
- Scoliosis, pes cavus
- Cardiomyopathy 50%, optic atrophy 30%, hearing loss 10%
- In~10%, abnormal glucose tolerance

Case 2
- An 8 y/o boy was brought to clinic by his anxious parents because he is so full of energy that they are exhausted. Further history reveals he has had odd neck twists and eye blinking intermittently. He does not display any of these in the office.
- All of the following will help you establish this child has Tourette syndrome except:
  a) Duration of the above movements
  b) Hyperactivity
  c) Odd repetitive sounds
  d) Age of onset of the above symptoms
Tourette Syndrome

- Multiple motor and phonic tics starting in childhood < 18 yrs
- Tics lasting > 1 year
- Waxing and waning course
- Although involuntary some can suppress them
- Some feel increasing tension/urge until tic is completed
- Not uncommon to see few or no tics in the clinic
- More than 50% have ADHD
- Other co-morbidities: OCD, LD, anxiety, behavior problems, co-existing PDD
- Prevalence: 1 in 100 to 1 in 1000, M:F = 4:1
- Cause: dopamine excess, genes play some role
- Investigations: MRI, EEG, lab draws - no role
- Treatment: for tics: observation, specific meds
  for co-morbidities

Case 3

A 12 y/o girl comes to the ER with headache. That morning she started having throbbing bifrontal headache, felt sick and vomited. Her mother gave her Ibuprofen after which she went to bed thus missing school. On awakening after 2 hrs the headache was gone. This is the fifth such episode in the last 4 months. Her mother has menstrual related headaches. In the ER her exam was normal.

Which of the following would you do as ER physician apart from a thorough H&P?
- a) admit the patient for observation
- b) get MRI brain
- c) ask for urgent neurology consult
- d) discharge with appropriate advice

Childhood migraine

- Prevalence of pediatric migraine:
  - 3-7 yrs: ~ 2%
  - 7-11 yrs: ~ 7%
  - adolescents: ~ 15%
- At least 5 attacks each lasting 1-72 hrs, throbbing, frontotemporal, worsened by physical activity with nausea/vomiting or phono-/photophobia (IHS, 2004)
- Indications of imaging: based on clinical judgement, new onset headache, change in headache type, abnormal exam, seizures, signs of raised ICP
- NSAIDs
- Acetaminophen
- Triptans
- Preventive medications
- Acute management
- Lifestyle modifications
- Management:
Case 4

A 4 month old girl is brought to the outpatients' clinic for a concern about motor delay. On exam the infant is lying in a frog-leg posture, spontaneous movements are decreased in all extremities, there is marked hypotonia and reflexes are not elicitable. You are not sure if there are fasciculations in the tongue. CK is normal.

What will you order next?

a) X-ray spine
b) Detailed eye exam
c) SMN gene test
d) PT consult

Spinal muscular atrophy

AR disease characterized by degeneration of anterior horn cells in spinal cord and sometimes motor cranial nuclei of lower brainstem

Caused by mutation or deletion in SMN gene on chromosome 5
Incidence 1:8000 births
3 types according to age of onset
Neonatal onset: Werdnig Hoffman disease, majority die before age 1 yr
Type 2: onset between 6–18 months
Onset > 18 months: Kugelberg Welander disease
Type 4: adult onset
Diffuse symmetric proximal weakness more in LEs
Chronic progressive respiratory insufficiency
Supportive treatment
Drugs (eg. valproate) being tried to increase SMN protein

Case 5

A 3 month infant was brought by anxious parents for a concern about asymmetry of the face.

After examining the patient what would be the most appropriate step for the pediatrician?

a) tell the parents the obstetrician did not do a good job
b) prescribe steroids per latest guidelines
c) reassure parents that in a few months it will be gone
d) reassure parents with cautionary note
Asymmetric crying facies

- Close differential diagnosis of birth related facial palsy
- Absent DAOM (80%) or compression of mandibular branch of facial nerve
- Only smile or cry asymmetric
- The side that droops is the normal side
- May occur in isolation or in association with other anomalies
- Incidence: 1 in 160 live births
- Other anomalies in 10% of those with absent muscle, important: heart

Facial weakness:
- UMN: contralateral face weak sparing ability to wrinkle the brow
- L MN: ipsilateral whole half of face weak

Case 6

The mother of a 9 month old girl said “my daughter has suddenly clammed down. She stares at the art pieces on the wall but does not look into our eyes, she has stopped smiling, it is odd that she does not resist to her toys being taken away”. On exam you note that her head circumference has fallen from 19th centile at 4 months age to 11th centile now and she is busy doing an odd repetitive movement with her hands.

Which of the following would be true for your presumptive diagnosis?
- a) she is likely to be dysmorphic
- b) in all likelihood there is antenatal exposure to alcohol
- c) a genetic test is the most appropriate next step
- d) there is a risk of raised ICP since the head size is falling

Rett Syndrome

- X-linked disorder affecting 1 in 10,000 to 20,000 females.
- Majority have mutations in MECP2 gene on Xq28
- Normal development for the first 6 months of life
- Development plateaus, head growth slows down, loss of social skills
- Autistic features
- Most characteristic: purposeful hand movements replaced by odd hand-wringing movements
- Seizures in ~50%, increases with age
- Other features: abnormal breathing patterns, bruxism, swallowing dysfunction, gait apraxia, scoliosis, cardiac rhythm instability, insomnia
- No specific treatment
Case 7

A newborn male at 6 hrs of life, born after shoulder dystocia, is noted to be moving the right arm less than the left.

All of the following deficits are consistent with Erb's palsy except:
- a) Loss of shoulder abduction
- b) Loss of elbow flexion
- c) Loss of forearm supination
- d) Loss of grasp reflex

Brachial plexus injuries

- Incidence of birth related brachial plexus injury 0.5 to 1 per 1000 live births
- Can occur in normal-sized babies in the absence of fetal trauma
- 80-90% brachial plexus injuries - Erb’s
- Look for diaphragmatic weakness, Horner's, clavicle fracture.
- Immobilize for 7-10 days, then start passive movements
- Most often quick recovery, may take months
- Surgical reconstruction considered if no recovery in 4 months

Case 8

A 7 y/o girl presented to the ER with 12 days h/o difficulty walking, now completely unable to walk. She had a runny nose without fever 5 days before that which was followed by non-specific pain in the thighs. There are no bladder/bowel symptoms. On exam there is weakness in the LES, reflexes are not elicitable anywhere. She appears to have intact pinprick sensation. Romberg's sign is positive.

All of the following can cause death in the above case except:
- a) Cardiac arrhythmias
- b) Respiratory failure
- c) Bulbar weakness
- d) Increased intracranial pressure
Guillain-Barre syndrome

- Inflammatory, demyelinating disorder of spinal nerve roots, peripheral nerves
- Antecedent infection in 2/3 cases
- Neurodeficit motor + mild sensory + autonomic (up to 25%)
- Symptoms progress for up to 4 weeks, then stabilize
- 85% make complete recovery
- EMG/NCV suggestive of patchy demyelination
- CSF increased protein, no increase in cells (after the 1st week)
- Rarely MRI done, shows enhancing nerve roots
- Treatment with IVIg or plasmapheresis
- Miller-Fisher variant: ophthalmoplegia + ataxia + areflexia

Case 9

- The mother of a 10 month old brings her daughter to switch primary care. She has brought it up to the previous PCP from 6 months age that when she approaches the little girl intending to lift her up she stretches out the left arm more spontaneously than the right. She also grabs her left foot with the left arm when lying supine, not so much the right.
- What will be your next course of action?
  a) reassure mother, ask for physical therapy and follow
  b) inform mother that her daughter is left-handed
  c) ask for neurology consult
  d) ask for orthopedics consult

Acute ischemic stroke (AIS) in children

- Old terminology: acute hemiplegia of childhood, congenital hemiplegia
- Incidence of AIS in children: 3.3 per 100,000 children per yr
- Perinatal strokes (20 weeks gestation – 28 days postnatal life) 25-30% of all childhood strokes
- Commonest site of stroke: left MCA territory
- Cause both morbidity and mortality
- Motor deficits are left in 2/3 of childhood stroke patients (< ½ in neonatal stroke)
- Other sequelae: cognitive, behavioral
- Seizures: acute or as a long-term complication
Acute ischemic stroke (AIS) in children

- Causes: idiopathic in ~30%, cardiac disorders or procedures, prothrombotic states, vasculopathies, infections, others (dissection, drugs)
- Always remember sickle cell disease in Afro-Americans
- Overall recurrence risk 15-20% (vascular abnormalities, prothrombotic conditions), data not well established in perinatal stroke
- Diagnosis: MRI, MRA
- Management: no guidelines, acutely supportive, no recommendations for tPA as in adults, no consensus on anticoagulants except cardiac stroke or dissection
- Other etiologic possibilities in case 9: developmental malformations, tumor, chronic infections

Case 10

- An 11-month-old girl is brought to the clinic referred by PCP for a concern about rapidly increasing head size. At 11 months she can say baba, mama, walk independently, pick up small things neatly, interact with peek-a-boo but does not imitate adults. Exam shows bifrontal prominence, normal neurological exam including fontanel.

- What is the most likely diagnosis?
  a) cerebral gigantism
  b) hydrocephalus
  c) benign increase in subarachnoid space
  d) autistic spectrum disorder

Benign macrocrania of infancy

- A common cause of macrocephaly
- Other names: extra-axial collection of infancy, benign enlargement of subarachnoid space, external hydrocephalus
- Cause: increase in subarachnoid space, usually bifrontal, in some cases mild increase in ventricular size also
- Need to differentiate from subdural hygroma
- Neurologically patient normal or mildly abnormal, mostly hypotonia and motor delay, other delays rare
- Abnormalities on imaging tend to resolve by 2 yrs age, some persist
- D/d: familial megalencephaly
- Some genetic conditions with increased subarachnoid space: MPS, achondroplasia, Sotos syndrome, glutaric aciduria type I
Case 11

- A prior well 3 y/o girl is brought to the clinic with h/o abnormal gait for the last 3 months. Developmentally she has been normal although she is not fully toilet-trained yet. On exam she has mild hypertonia in the LEs with brisk knee and ankle reflexes. Heel cords are tight. Plantars are upgoing. A sacral dimple is noted. Rest of the exam is normal.

- What will be your next step?
  - Scoliosis X-ray spine
  - EMG/NCV
  - MRI brain
  - MRI spine

Developmental spinal lesions

- Occult spinal dysraphism
- Meningocele
- Myelomeningocele
- Spinal lipomas often associated with myelomeningocele, most common association of tethered cord.
- Tethered cord-thick filum terminale prevents cord from ascending
- Caudal regression syndrome- lumbosacral agenesis, sirenomelia, known association in IDM babies
- Diastematomyelia-split cord with bony septum
- Hydromyelia-fluid collection within cord lined by ependyma

Tethered Cord

- Thickened filum terminale (FT), low lying conus medullaris
- Normal lower extent of spinal cord: lower border of L1
- Tethered by lipoma, dermal sinus tract or simply a short FT
- Motor, sensory, sphincter related symptoms
- Careful exam for foot deformities
- May present at any age, childhood most common
- Cause of symptoms: traction to lower cord ----> local hypoxia
- Untethering surgery restores normal function
Case 12

- This 6 week old boy was brought to the clinic since he was first seen by neurology services for neonatal hypotonia. At that point the NICU nurses were having a difficult time feeding him. He had retrognathia and undescended testes. At the current visit his diagnosis has already been established.

- Which of the following tests do you think clinched the diagnosis?
  - Genetic test
  - Echocardiography
  - Urine drug screen
  - Brain MRI

Prader Willi syndrome

- Hypotonic infants typically with poor feeding
- Initial failure to thrive, later indiscriminate eating and obesity
- Short stature, hypogonadism, small hands & feet, cognitive delay
- Genomes have genetic information in 15q11-13 derived only from mother (70%)
- Genomes have intact chr 15 both derived from mother (30%)
- Two ways of testing: FISH, methylation test
- PWS and Angelmann syndrome demonstrate paternal origin of genetic material can have profound effect on clinical phenotype

Thank You