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NEUROLOGICAL ASSESSMENT OF THE NEWBORN, INFANT, AND TODDLER

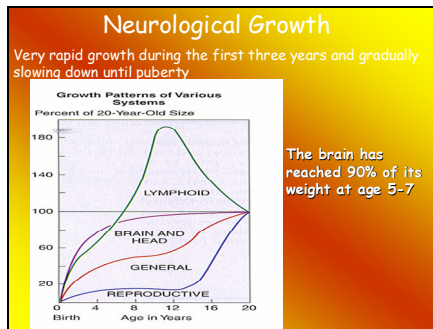
Reading Assignment Davies Ch. 7

- 84-94 (THE NEUROLOGICAL HISTORY AND EXAMINATION...)
- 98-99 (Neurological causes of headache)
- 101-103 (NEUROCUTANEOUS SYNDROMES)
- 107- 113 (ABNORMAL GROWTH OF THE HEAD & CEREBRAL PALSY)
- 114 (GENERALIZED HYPOTONIA - FLOPPY INFANT)

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Brain tumor most common solid tumor in children
child shouldn't be floppy at birth

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Wide range of Abilities in Newborns

- Dynamic interaction
- Attachment
- Habituation
- State Regulation
- Can use their 5 senses

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State Regulation

- Consolability
- Self-consoling
- Self-quieting activities
- Hand-to-mouth
- Cuddliness

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Neurological Assessment

- The child must not be hungry, tired, or have dirty diapers during the examination

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Neurological Assessment

- The neurological maturity of a newborn is directly related to the length of pregnancy

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Neurological Assessment

- The normal full term child should always react to stimulus by light, sound, taste, pain, touch and temperature and have primitive reflexes

Sensory assessment:

- Touch & pain (vibration?)
- Facial and motor response

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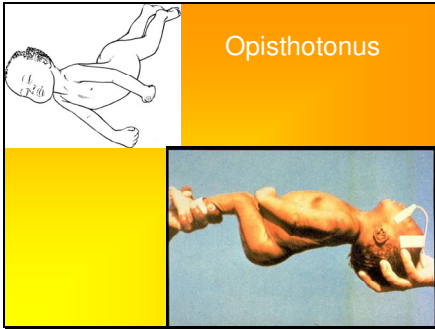
Signs of Severe Neurologic Disease

- Extreme irritability
- Persistent posture asymmetry
- Persistent extension of extremities
- Opisthotonus
- Consistent turning of the head to one side
- Severe flaccidity
- Limited response to pain

Posture asymmetry- may be result of brain hemorrhage or something more benign like torticollis
Opisthotonus most likely due to injury to CNS
Turning head to one side may also be result of torticollis

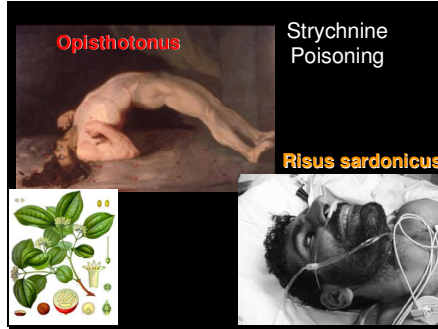
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Opisthotonus



The slide contains two images illustrating opisthotonus. The top-left image is a line drawing of a newborn baby lying on its back with its head and neck hyperextended backwards, and its arms and legs also extended backwards. The bottom-right image is a photograph of a newborn baby in a similar hyperextended posture, held by a person's hands. The word 'Opisthotonus' is written in white text on an orange background to the right of the top image.

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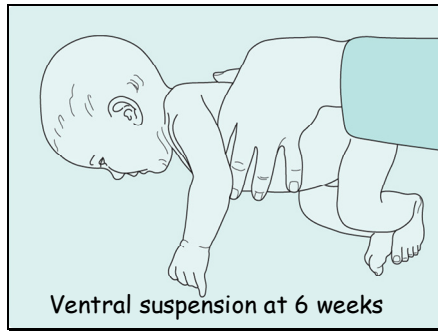


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Muscle Tone Assessment

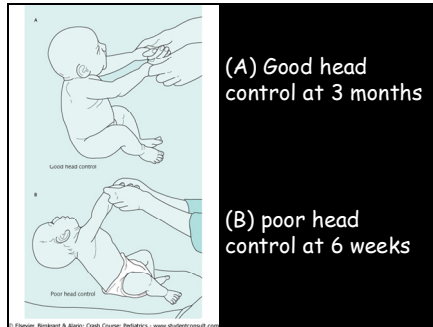
- Observe resting position/motion
- Resistance to passive movement
- Hold the baby - note muscle tone
- Move joints through range of motion
- Note spasticity or flaccidity

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- Should have some extension in the muscles

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- Palmar grasping reflex- baby holds finger

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Plantar Stimulation:

- Although most infants exhibit flexion plantar response, Babinski response (B/L) may occur in healthy infants (until 2 years of age)

Ankle Reflex:

- No response normal in many children
- Unsustained ankle clonus (<10 beats) = normal
- Sustained ankle clonus = abnormal

Ref: Bates' Guide to Physical Examination and History Taking, Rickley, S., Lippincott, 2003, 8th ed.

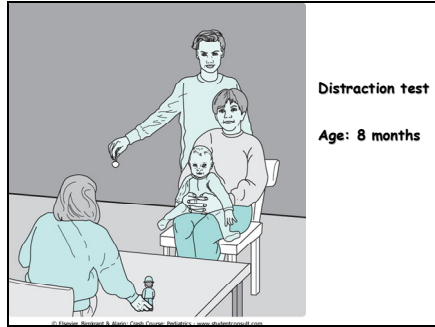
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Cranial Nerves (neonates/infants)

- CN I Difficult to test (Davies a 88: error)
- CN II Facial response and tracking
- CN II, III, VII Optic blink reflex (dark room, otoscope); pupil response to light
- CN III, IV, VI Tracking: Observe eye movements
- CN V Rooting, sucking reflexes
- CN VII Facial symmetry, crying, smiling
- CN VIII Acoustic blink reflex; tracking/sound
- CN IX, X Swallowing coordination, gag reflex
- CN XI Shoulder symmetry
- CN XII Tongue in midline; tongue thrusting

Ref: Bates' Guide to Physical Examination and History Taking, Rickley, S., Lippincott, 2003, 8th ed.

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Deep Tendon Reflexes

- The biceps, triceps, and patellar reflexes may be elicited after 6 months of age
- Of little value during infancy
- The anal reflex is present at birth (intact spinal cord)
- Progressively increasing DTRs indicate CNS disease - often accompanied with increased muscle tone

- Anal reflex demonstrates intact parasympathetic nervous system and intact spinal cord

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Primitive Reflexes (that should be Part of the Routine Neurologic Examination of Infants)

| Primitive Reflex | Maneuver | Ages |
|------------------------------------|--|-------------------------|
| <p>Palmar Grasp Reflex</p> | <p>Place your fingers into the baby's hands and press against the palmar surfaces. The baby will flex all fingers to grasp your fingers.</p> | <p>Birth to 2-4 mos</p> |
| <p>Plantar Grasp Reflex</p> | <p>Touch the sole at the base of the toes. The toes curl.</p> | <p>Birth to 6-8 mos</p> |

Palmar Grasp Reflex
 Persistence beyond...
 2 months: CNS damage if clenched fist w/adducted thumb
 4 months: Cerebral dysfunction

Plantar Grasp Reflex
 Persistence beyond 8 mos. suggests cerebral dysfunction

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| Reflex | Maneuver | Age | Notes |
|------------------------------|---|----------------------------|--|
| Moro Reflex (Startle Reflex) |  | Birth to 4-6 mos | Hold the baby upright, supporting the head, back, and legs. Abruptly lower the entire body about 1 foot. The arms abduct and extend, hands open, and legs flex. Baby may cry. |
| Asymmetric Tonic Neck Reflex |  | Birth to 2 mos | With baby supine, turn head to one side, holding jaw over shoulder. The arms/legs on side to which head is turned extend while the opposite arm/leg flex. Repeat on other side. |
| Postural Support Reflex |  | Birth to 2 mos until 6 mos | Hold the baby around the trunk and lower arm so the feet touch a flat surface. The hips, knees, and ankles extend, the baby stands up, partially bearing weight, soon after 20-30 seconds. |

Asymmetric response indicates fracture of clavicle or humerus, or injury of the brachial plexus
 Persistence beyond 4 - 6 mos. very likely due to neurologic disease




Persistence beyond 2 mos. suggests neurologic disease

Lack of reflex indicates hypotonia or flaccidity

Scissoring (fixed extension and adduction of the legs) suggests spasticity due to neurological disease

Moro (startle reflex) and asymmetric tonic neck reflex are important to know
 Tonic neck reflex important for cross crawl reflex development

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| Stimulus Reflex | Maneuver | Age | Notes |
|------------------------------------|--|-----------------------------------|---|
| Sucking Reflex |  | Birth to 2-4 mos | Stroke the posterior side of the corner of the mouth with open and baby will turn the head toward the stimulated side and suck. |
| Trunk Incubation (Galant's) Reflex |  | Birth to 2 mos | Support the baby prone with one hand. Stroke one side of the back 1 cm from midline, from shoulder to buttocks. The spine will curve toward the stimulated side. |
| Palming and Stepping Reflexes |  | Birth (but past 4 days) Variables | Hold baby upright from behind in a passive support. Have one side touch the midline. The hip and knee of that side will flex and step forward. Alternate stepping will occur. |

Rooting Reflex
 Absent reflex indicates severe neurologic disorder

Galant's (Trunk Incubation) Reflex
 Absence indicates possible transverse spinal cord lesion

Palming and Stepping Reflexes
 Absence indicates possible paralysis
 Breach delivery may cause absent reflex

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| | | | |
|------------------|---|--------------------------------|---|
| Landau Reflex |  | Birth to 6 mos | Suspend the baby prone with one hand. The head will lift up and the spine will straighten. |
| Parachute Reflex |  | 4-6 mos and does not disappear | Suspend the baby prone and slowly lower the head toward a surface. The arms and legs will extend in a protective fashion. |

Landau Reflex
 Persistence may indicate delayed development

Parachute Reflex
 Delay in appearance may predict future delay in voluntary motor development

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Primitive Reflexes
The Moro Reflex

- Elicited by lifting the head of the lying infant and letting it fall back in the examiner's hands
- The reflex involves rapid abduction of the shoulder, extension of the humerus and fingers followed by slow adduction in the shoulder (looks like a hug)
- Should disappear after 4-6 months

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Primitive Reflexes
The Palmar Grasp Reflex

- Elicited by stroking the palm of the hand over the MCP joints toward the fingertips or by placing a finger in the baby's hand
- The reflex involves powerful grasping which cannot be released voluntarily
- Should disappear after 2-4 months

Elicited by stroking the palm of the hand over the MCP joints toward the fingertips or by placing a finger in the baby's hand

The reflex involves powerful grasping which cannot be released voluntarily

Should disappear after 2-4 months

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The Asymmetric Tonic Neck Reflex - ATNR

- Elicited by turning the head 90 degrees in a supine child.
- Ipsilateral extension of the extremities on the side towards which the face is turned
- Contralateral flexion of the extremities on the opposite side
- The reflex is present at birth and should disappear after \approx 2 months

Elicited by turning the head 90 degrees in a supine child.

Ipsilateral extension of the extremities on the side towards which the face is turned

Contralateral flexion of the extremities on the opposite side

The reflex is present at birth and should disappear after \approx 2 months

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Persistence of ATNR

- Neurological disease
- Risk for future developmental delay in crawling, coordination of vision, hearing, and upper and lower extremities.
- Learning dysfunction and concentration difficulties

Neurological disease

Risk for future developmental delay in crawling, coordination of vision, hearing, and upper and lower extremities.

Learning dysfunction and concentration difficulties

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Other Primitive Reflexes

Perez reflex
Running a finger down the spine of a prone supported infant ⇒ whole body extended

Glabellar Tap Reflex
Tapping on glabella ⇒ blink response. No habituation

Acoustic Blink Reflex
Sudden sound ⇒ blink response

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Indicators of CNS Disease

- Abnormal localized neurologic findings
- Asymmetry of extremity motions/reflexes
- Failure to elicit expected primitive reflexes
- Late persistence of primitive reflexes
- Reemergence of primitive reflexes
- Delays in developmental milestones:

Fine Motor and Gross Motor
Cognitive and language
Social and emotional

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Neural Tube Defects - NTD

- **Defective closure of the neural tube** results in neural tube defects which are classified as
- **Anterior** (anencephaly, encephalocele, exencephaly)
- **Posterior** (spina bifida: meningocele, myelomeningocele)
- The most critical period for malformations is the 3rd to 8th week of gestation, during which most organs, including the brain, take form.

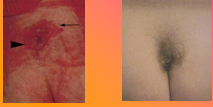
anencephaly- no brain
Encephalocele- brain outside of skull
Exencephaly- brain herniates through skull

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Spine Neural Tube Defects (NTD)

1. Subtle midline defects (within 1 cm of the midline)

- Pigmented spots
- Hairy patch
- Deep pits
- **RISK FOR INFECTION**




2. Major spinal or cranial defects

- Anencephaly / encephalocele / exencephaly
- Spina bifida vera: meningocele / myelomeningocele

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Spina Bifida

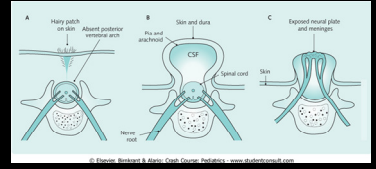
- malformations of the spinal cord
- caused by failure of closure of the neural tube and...
- defective fusion or lack of fusion of the vertebral arches (laminae), soft tissues, and skin that cover the back
- usually located in the lumbosacral area but may involve the entire spinal cord.
- **Spina Bifida Occulta**, slight defect of the vertebral arch, but there may be a hairy patch of skin over the defect.



Hairy Patch
A hairy patch is typically associated with a tethered spinal cord (filum terminale is attached to the subcutaneous tissue)

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NTD



A Hairy patch on skin, Absent posterior vertebral arch

B Skin and dura, Pro and archoid, CSF, Spinal cord

C Exposed neural plate and meninges

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Meningocele

- is a bulge in the lumbosacral area consisting of a **meningeal sac** protruding through the **bone defect** (spina bifida vera)

Spina Bifida Vera



- No closure at all

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Meningomyelocele or Myelomeningocele

- The sac contains malformed **spinal cord tissue** protruding through the **bone defect**
- Severe disability







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EXCLUDED FROM THE FINAL EXAM

- Anencephaly**
 - The brain is gradually destroyed because of mechanical injury and vascular disruption
 - is often accompanied by spina bifida
- Encephalocele**
 - protrusion of part of the brain through a defect of the skull (occipital area)

Encephalocele



Anencephaly

Exencephaly

The whole brain protrudes through a defect in the cranial vault (exencephaly)

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What is Hydrocephalus?

- Pathologic enlargement of the ventricles
- CSF production > CSF absorption
- Blockage within ventricular system

Presentation depends on age:

- ↑ head size (infants)
- ICP ↑ (older children)

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Cerebral Palsy - CP

- CP is a disorder of motor function due to a **nonprogressive lesion of the developing brain**.
- Although the lesion is nonprogressive, the clinical manifestations evolve as the nervous system develops.
- Children with cerebral palsy often have problems in addition to disorders of movement and posture, reflecting more widespread damage to the brain.

- Typically a retrospective diagnosis

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CP - Causes

- ??? in many patients
- Identifiable causes: antenatal, intrapartum, and postnatal
- Perinatal asphyxia is a rather **uncommon** cause (3-21%) of CP

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Causes of cerebral palsy

Antenatal (80%)
Congenital infections:

- Rubella
- CMV
- Toxoplasmosis

Intrapartum (10%)
Birth asphyxia

Postnatal (10%)
Preterm birth

- Hypoxic-ischemic encephalopathy
- Intraventricular hemorrhage

Hyperbilirubinemia
Hypoglycemia
Head injury

Intracranial infection:

- Meningitis
- Encephalitis

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Febrile Seizures - Precautions

- **Meningitis can present with seizures and fever, so it is very important to exclude this diagnosis.**
- **First febrile seizure**
- **Absence of specific signs of meningitis**

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Febrile Seizures - Prognosis

- Most children are well after the seizure
- Prognosis is very good
- 30% chance of recurrence
- Normal neurologic outcome expected