Pediatric Nurse Practitioners®
NATIONAL ASSOCIATION OF

The Leader in Pediatric Education for Nurse Practitioners®

Disorders of the Neurologic System

Sharon Stevenson DNP, APRN, PPCNP-BC

Disclosures

Sharon B. Stevenson, DNP, APRN, PPCNP-BC

- Has no financial relationship with commercial interests
- This presentation contains no reference to unlabeled/unapproved uses of drugs or products

Pediatric Nurse Practitioners
The Leader in Pediatric Education for Nurse Practitioners

Learning Objectives

- Describe the history and physical assessment process of the neurological system.
- Review components of the neurological examination specific to primary care.
- Describe common neurological disorders seen in infants, children and adolescents.
- List common diagnostic studies (neuroimaging and lab tests) used when evaluating a neurological concern.
- Discuss common treatments used in managing pediatric neurologic disorders.

Pediatric Nurse Practitioners
The Leader in Pediatric Education for Nurse Practitioners

Key Points

- Look for findings in the general physical examination
- Take developmental level into account
- Assess all components in the neurological examination
- Observe the patient first
- Report findings in order

Neurological Assessment

- History
  - Onset and duration
  - Constant or episodic
  - Static, progressive or resolving
  - Localization
- Past medical history
  - Prenatal, perinatal, neonatal course
  - Injury/infections
  - Environmental exposures
  - Metabolic disorders
- Growth and developmental history
  - Delay, slowing, cessation, or regression
- Family history
  - Neuromuscular or other neurologic conditions
  - Developmental or intellectual delays
- Medications
  - CAMS or supplements
- Review of systems
  - Underlying medical conditions

- **Red flags: Abnormalities in activity or feeding difficulty after birth**

Pediatric Nurse Practitioners
The Leader in Pediatric Education for Nurse Practitioners

Neurological Examination

- Physical examination
  - **Growth**
    - Height, weight, head circumference
    - **Head circumference until age 2 years (AAP) or until 36 months (CDC)**
  - **Dysmorphic features**
    - Mid-face- often associated with underlying brain anomalies
  - **Eyes**
    - Fundus
  - **Skin abnormalities**
    - Stigmata i.e., café au lait, ash leaf lesions, associated with neurocutaneous syndromes
  - **Abdomen**
    - Hepatosplenomegaly, possibility of one of the storage diseases
  - **Spine**
    - Scoliosis or any sacral anomalies

Neurological Examination (continued)

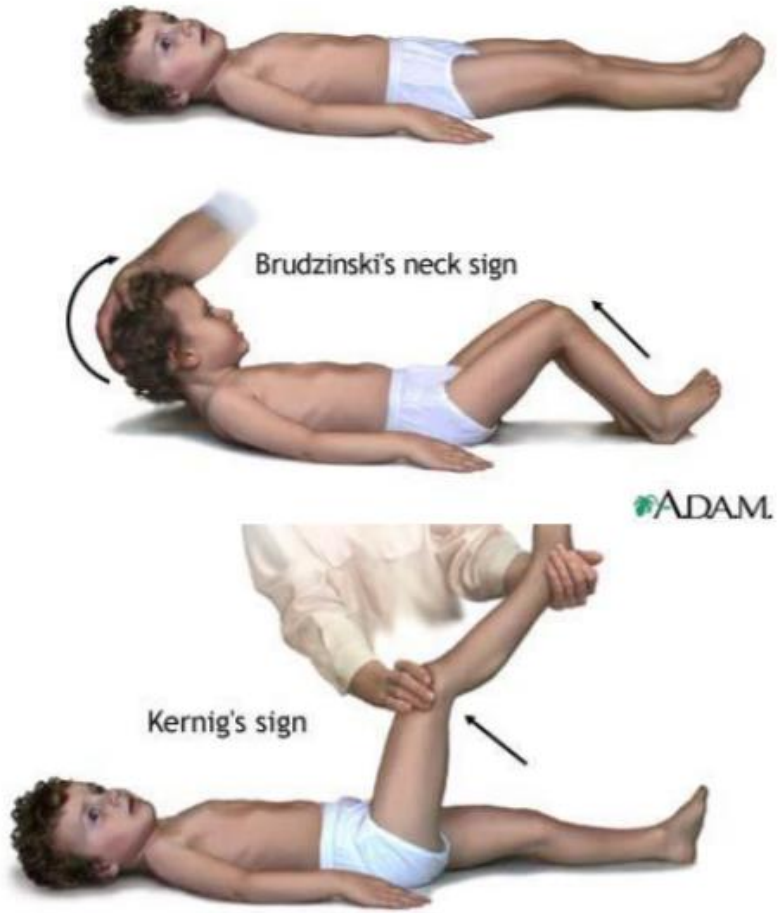
- **Behavior/Mental status**
  - Alertness, orientation, age-appropriate responses **(see handout)**
- **Cranial nerves (see handout)**
- **Motor (see handout)**
- **Sensory**
  - Testing more reliable in child > 5 or 6 years
- **Reflexes**
  - Primitive reflexes appear and disappear with maturity
    - Plantar, suck, root, Moro, grasp, asymmetric tonic neck

Common Developmental Reflexes

Reflex	Description	Age at Appearance	Age at Resolution
Moro (Startle)	Sudden head extension produced by a light drop of the head	34 to 36 weeks PCA	5-6 months
Asymmetric tonic neck reflex	Rotation of the infant's head to one side for 15 seconds	38-40 weeks	2-3 months
Trunk incurvation (Galant)	Scratching the skin of the infant's back from the shoulder downwards, 2-3 cm lateral to the spinous processes	38-40 weeks	1-2 months
Palmar grasp	Placing the index finger in the palm of the infant	38-40 weeks	5-6 months
Plantar grasp	Pressing a thumb against the sole just behind the toes in the foot	38-40 weeks	9-10 months
Rooting	Infant's head turns toward cheek that is stroked to suck	38-40 weeks	2-3 months
Parachute	Arms and legs extend in a protective fashion when suspended in prone	8-9 months of age	Persists

Neurological Examination (continued)

- Meningeal signs
  - **Kernig:** In supine position with the hip and knee flexed at 90°, patient has pain with extension at the knee.
  - **Brudzinski**: While in supine position, patient flexes the lower extremities during passive flexion of the neck.



Question 1

A mother reports that her 10 month old boy is right handed because he reaches for most objects with that hand. She asks you if this is normal for his age. What should your answer be?

A. It is normal.
B. It’s a little early but probably normal and don’t worry about it.
C. It's a little early but probably normal. It's something that needs to be watched over time.
D. It's abnormal for a baby to have a hand preference at this age.

Question 1

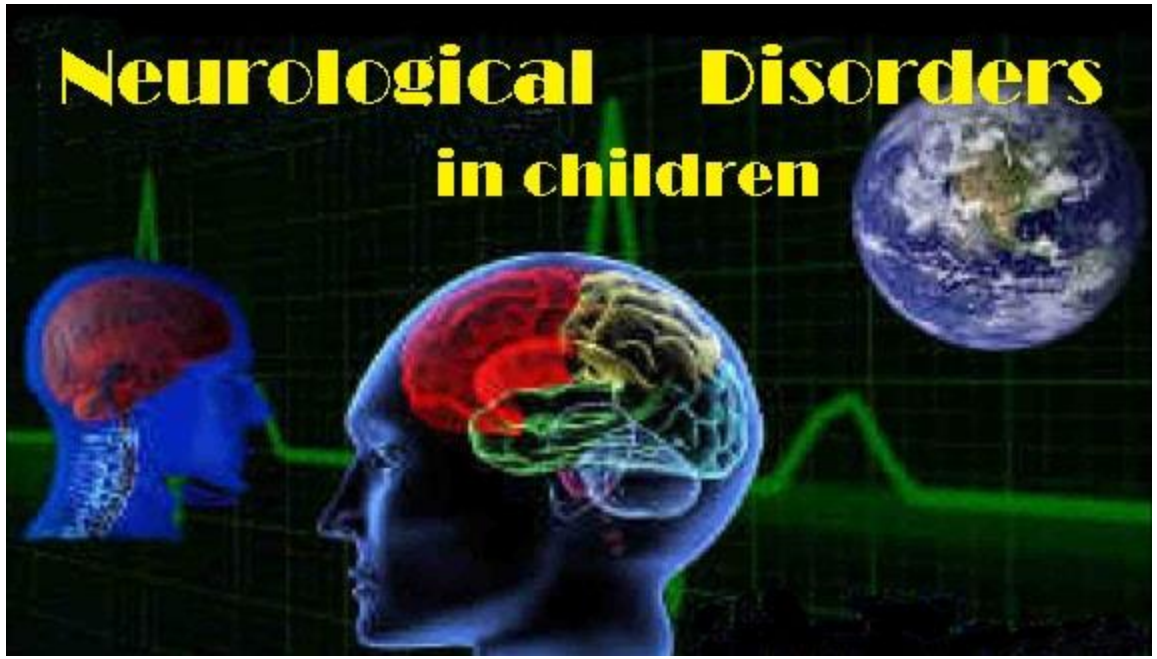
A mother reports that her 10 month old boy is right handed because he reaches for most objects with that hand. She asks you if this is normal for his age. What should your answer be?

Answer: It's abnormal for a baby to have a hand preference at this age.

Neurological Evaluation

- **Diagnostic Studies**
  - CT/MRI – **order CT with caution, not routinely 2° radiation exposure**
  - Laboratory studies for systemic disease, infection, inflammation
  - Lumbar puncture
  - Electroencephalogram
  - US in infants
  - Polysomnography, electromyography/nerve conduction

Common Neurological Disorders



Headaches

- **Key Characteristics:**
  - Common during childhood; increases in adolescence
  - The majority due to primary headache or acute benign process
  - **Must discern primary from secondary headaches**
- **History:**
  - Age of onset
  - Mode of Onset (gradual versus acute)
  - **Location – occipital or consistently localized, possible underlying pathology**
  - Course and Duration
  - Frequency and pattern
  - Character
  - Precipitating (triggers) and relieving factors
  - Always the same type of headache

Headaches

- **History**
  - Associated symptoms
  - Recent head/neck trauma
  - Current or past medical problems
  - Medications
  - Psychosocial history
  - Family history of headaches and mental health problems
  - Menstrual history
  - Headache burden

- **Secondary headache**
  - Worse in morning upon awakening
  - Nocturnal awakening
  - Projectile vomiting without nausea
  - Seizures
  - Fever
  - VP shunt, hydrocephaly

Characteristics of Common Headaches

Symptom	Migraine	Tension-type headache	Trigeminal autonomic cephalagia
Location	Commonly bilateral in young children; in adolescents and young adults, unilateral in 60 to 70% and bifrontal or global in 30%	Bilateral	Always unilateral, usually begins around the eye or temple
Characteristics	Gradual in onset, crescendo pattern; pulsating; moderate or severe intensity; aggravated by routine physical activity	Pressure or tightness that waxes and wanes	Pain begins quickly, reaches a crescendo within minutes; pain is deep, continuous, excruciating, and explosive in quality
Patient appearance	Patient prefers to rest in a dark, quiet room	Patient may remain active or may need to rest	Patient remains active
Duration	2 to 72 hours	Variable	30 minutes to 3 hours
Associated symptoms	Nausea, vomiting, photophobia*, phonophobia*; may have aura (usually visual, but can involve other senses or cause speech or motor deficits)	None	**Ipsilateral lacrimation and redness of the eye; stuffy nose; rhinorrhea; pallor; sweating; Horner syndrome**; focal neurologic symptoms rare; sensitivity to alcohol

International Headache Society

ICHD - Diagnostic Criteria

Migraine without Aura

A. At least 5 attacks fulfilling criteria B-D

B. Attacks lasting 4-72 hours

C. At least 2 characteristics
   - Unilateral location
   - Pulsating quality
   - Moderate or severe pain intensity
   - Aggravation by or causing avoidance of routine activity

D. During headache, at least one
   - Nausea and/or vomiting
   - Photophobia/phonophobia

E. Headache not attributed to other disorder

Migraine with Aura

A. At least 2 attacks fulfilling criteria B-D

B. Aura consisting of at least 2
   - Fully reversible visual symptoms
   - Fully reversible sensory symptoms
   - Fully reversible speech disturbance

C. At least one
   - Migraine without aura begins during the aura or follows aura within 1 hour
   - Gradual or different aura symptoms develop over 5 minutes
   - At least one aura unilateral
   - Each aura symptom lasts 5 to 60 minutes

D. Headaches not attributed to another disorder

Headaches

- **Physical Examination**
  - Vital signs (blood pressure and temperature)
  - Eyes (**funduscopic & visual fields**), ears, neck, sinuses, teeth, TMJ
  - Growth parameters
  - Thyroid gland
  - Head and neck
  - Extremities
  - Nerves, reflexes

Headaches

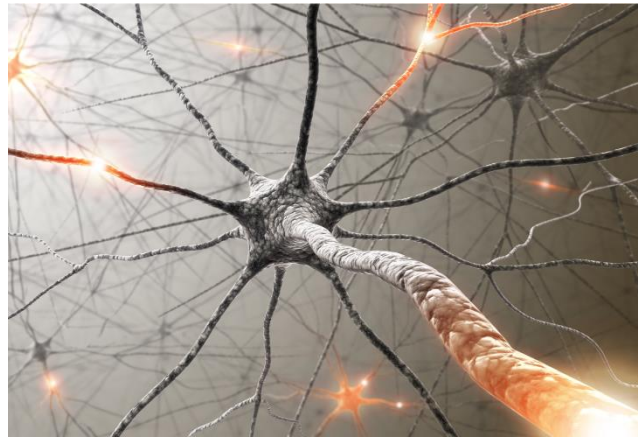
- **Red Flags and Neuroimaging indications**
  - Abnormal neurological examination
  - Children < 6 years
  - Nocturnal awakening headaches
  - Associated neurologic signs and symptoms (persistent nausea/vomiting, altered mental status, ataxia, etc.)
  - Worsening headache when recumbent, straining, coughing, micturition, defecation or physical activity
  - Chronic progressive headache, more severe/more frequent
  - Occipital/neck pain
  - Recurrent localized headache
  - Lack of response to medicines
  - Sudden or explosive onset of severe headache duration <6 months

Headaches

- **Management**:
  - Migraine headaches
    - **Lifestyle modifications and behavioral factors should be standard of care.**
    - Acute Migraine Treatment – **NSAIDS, acetaminophen (first-line)**; Triptans; antiemetics
    - Almotriptan, rizatriptan, sumatriptan/naproxen, zolmitriptan NS are FDA approved in children.
    - Preventives – **Topiramate 25 – 100 mg/d (FDA approved ≥ 12 years)**

AAN.com/guidelines

Seizures and Epilepsy



Seizures and Epilepsy

- **Key Characteristics**:
  - Abnormal brain functioning caused by abrupt, uncontrolled repetitive discharges of cortical neurons within the brain
  - **Seizure**: Sudden and stereotyped alteration in motor activity, sensation, behavior, or consciousness due to an abnormal electrical discharge of neurons
  - **Epilepsy**: Chronic neurological condition characterized by recurrent seizures (2 or more >24 hours apart) which are not provoked by systemic or acute neurologic insults

Seizures and Epilepsy

- **History:**
  - Character of the seizure
  - Underlying medical diagnoses
  - Associated signs of illness
  - Toxic exposure, substance abuse or ingestion
  - Recent head trauma
  - Family history of seizures
  - Pregnancy/birth complications
  - Intellectual or developmental delay
  - Current medications i.e., anti-epileptic drugs

Seizures and Epilepsy

- **Physical Examination**:
  - Focal abnormalities/weakness
  - Vital signs (blood pressure)
  - Cardiovascular
  - Signs of trauma
  - Signs of infection i.e., nuchal rigidity, fever
  - Neurocutaneous i.e., café au lait, ash leaf, facial hemangiomas

Seizures and Epilepsy

- **Evaluation**:
  - CBC with differential, blood chemistry, LFTs
  - **Blood glucose**
  - Lumbar puncture if <6 months
  - **EEG (routine sleep deprived)**
  - MRI
  - Metabolic screen in neonates and infants

Seizures and Epilepsy

- **Management**:
  - Referral to pediatric neurologist for confirmatory diagnosis and treatment initiation
  - Monitor anti-epilepsy medicines

- **Key points about AEDs:**
  - Carbamazepine (Tegretol®)and valproic acid (Depakote®)potential bone marrow suppression and liver damage
  - Phenytoin (Dilantin®) gingival hypertrophy
  - Oxcarbazepine (Trileptal®) significant hyponatremia may occur; possible Stevens-Johnson syndrome
  - Folic acid in females of child bearing age
  - **Certain anti-epilepsy medicines interact with oral contraceptives and can be teratogenic**

Febrile Seizures

- **Key Characteristics**:
  - Neurologically healthy
  - Most commonly occurs ages 6 months – 5 years
  - Simple febrile convulsion: brief, generalized and associated with concurrent febrile illness
  - Complex febrile convulsion: prolonged (>15 minutes), focal, or repeated episodes within 24 hours
  - Genetic predisposition

Febrile Seizures

- **Evaluation**:
  - Lumbar puncture
  - Serum glucose
  - CBC, calcium, electrolytes,
  - EEG and MRI with complex febrile convulsions

- **Management**:
  - Anti-epilepsy medicine not indicated simple febrile convulsions
  - Reduce fever with ibuprofen of acetaminophen
  - Educate family

Tourette Syndrome

- **Key Characteristics**:
  - **Manifested by both motor and phonic tics with onset during childhood**
  - **Tics, clinical hallmark of Tourette syndrome**
  - Brief and intermittent movements or sounds
  - Waxing and waning nature
  - Irresistible urge before and relief after a tic
  - Temporary suppressibility
  - Presence of premonitory feelings or sensations

- **S/S**:
- Vocal tics:
  - Simple noises (grunting, throat clearing, snorting)
  - Coprolalia (obscene words)-up to 40%
  - Echolalia (repetition of words)
  - Palilalia (repetition of a phrase or word with increasing rapidity)
  - Complex vocal tic is one that produces a word, not just a sound
- Motor tics:
  - Simple (eye blinking, facial grimaces, shoulder shrugging, head jerking)
  - Complex (bizarre gait, kicking, jumping, body gyrations)

Pediatric Nurse Practitioners
The Leader in Pediatric Education for Nurse Practitioners

Tourette Syndrome

- **Evaluation**:
  - Diagnosis based on clinical features
  - Onset of tics before the age of 21 years (**the DSM-5 criteria require onset of tics before age 18 years**)
  - Involuntary movements and noises must not be explained by another medical condition (or by the physiological effects of substances as per the DSM-5)
- **Management**:
  - **Most important is to educate the patient and family**
  - Treatments can minimize tics but usually cannot complete stop them
- **Medications**:
  - Alpha adrenergic agonists
    - Clonidine
    - Guanfacine
      - Both can also be used to treat symptoms of ADHD or prominent behavioral problems
  - Antidopaminergic drugs
    - Risperidone (block dopamine receptors)
    - Tetrabenazine (dopamine depletory)
    - Haloperidol
      - Can be associated with liver and blood dysfunctions, weight gain, allergic reactions, dystonic reactions and tardive dyskinesia

Breath-holding Spells

- **Key Characteristics**:
  - Non-epileptic, paroxysmal events
  - Occur between ages 6 months and 4 years, peak age 18 months
- **S/S**:
  - Distinctive sequence of events
    - Provoking factor ie., frustration, anger, fright, and minor trauma resulting in crying or emotionally upset state leading to a noiseless state of expiration (“silent scream”) with color change and ultimately loss of consciousness and tone.
    - Tonic, clonic movements and posturing

Breath-holding Spells

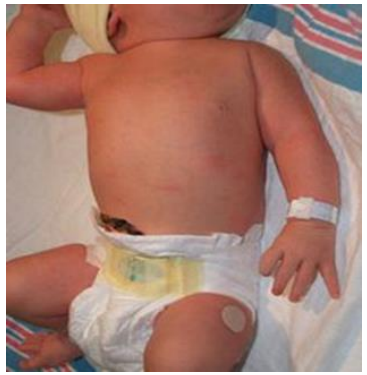
- **Evaluation**:
  - No diagnostic confirmatory test
  - Iron-deficiency anemia should be excluded (ferritin level)

- **Management**:
  - Iron supplementation in anemic or iron-deficient patients appears to reduce the frequency of breath-holding attacks
  - **Anti-epileptic drugs are not indicated**

Neuromuscular

Neonatal Brachial Plexus Palsy (Erb's)

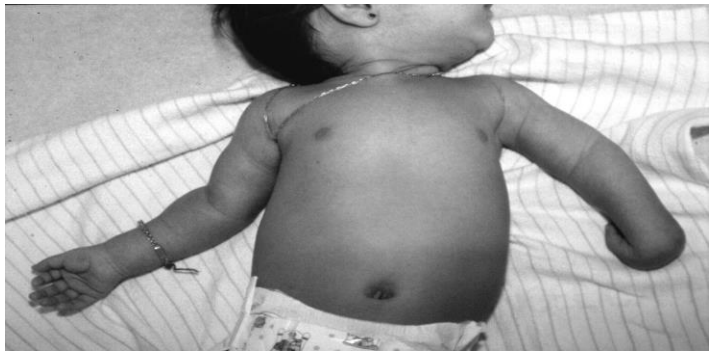
- **Key characteristics**:
  - **Upper trunk nerve injury to C5 and C6 (can include C7) nerve roots, attributed to stretching of the brachial plexus**
  - Typically occurs when shoulder dystocia impedes delivery
- **S/S**:
  - **Most cases unilateral, weakness of deltoid and infraspinatus muscles, and biceps**
  - **Upper arm adducted and internally rotated, forearm extended, hand/wrist movement preserved**



Pediatric Nurse Practitioners
The Leader in Pediatric Education for Nurse Practitioners

Neonatal Brachial Plexus Palsy (Erb's)

- Evaluation:
  - **Complete family, maternal, perinatal history; Physical/neurological exam**
  - Radiographs – r/o fractures and injuries
  - CT or MRI of cervical spinal cord
  - EMG/NCS
- Management:
  - **PT including passive ROM**
  - Surgery only in select cases



Cerebral Palsy

- **Key Characteristics**:
  - Heterogeneous group of conditions involving permanent non-progressive central motor dysfunction that affect muscle tone, posture, and movement
  - Commonly associated with epilepsy and musculoskeletal disorders
  - 3 main types:
    - Spastic – muscle stiffening and tightness
    - Athetoid – involuntary, purposeless movements
    - Ataxic – affects balance and coordination

Cerebral Palsy

- **History**:
  - Prenatal, perinatal, postnatal
  - Early head trauma or CNS infection
  - Developmental milestones
- **Physical Examination**:
  - Skin abnormalities
  - Musculoskeletal i.e, scoliosis, fractures, dislocations
  - Neurological examination: DTR, tone, atrophy, fasciculation, reflexes, asymmetric movements, head size
  - Development
  - Diet, height, weight, BMI

Cerebral Palsy

- **Evaluation**:
  - Neuroimaging studies, chromosomal and metabolic studies

- **Management**:
  - Referral to neurology for complete evaluation
  - Nutrition/elimination
  - Movement/mobility
  - Therapy services: Early Intervention, School IEP/504
  - Audiology evaluation if speech delays are present
  - Vision
  - Find support for families

Question 2

An adolescent female with epilepsy is taking lamotrigine for seizure control admits that she is sexually active. She will begin taking a combination oral contraceptive. What should the PNP caution the adolescent?

A. Estrogen in contraceptives increase the seizure threshold

B. Anti-seizure medicine levels increase before menses

C. Taking oral contraceptive is contraindicated

D. Many anti-seizure medications are teratogenic

Question 2

An adolescent female with epilepsy is taking lamotrigine for seizure control admits that she is sexually active. She will begin taking a combination oral contraceptive. What should the PNP caution the adolescent?

Answer: Many anti-seizure medications are teratogenic

Question 3

The PNP know that to help prevent neural tube defects adolescent females on anti-epilepsy medicines should take daily:

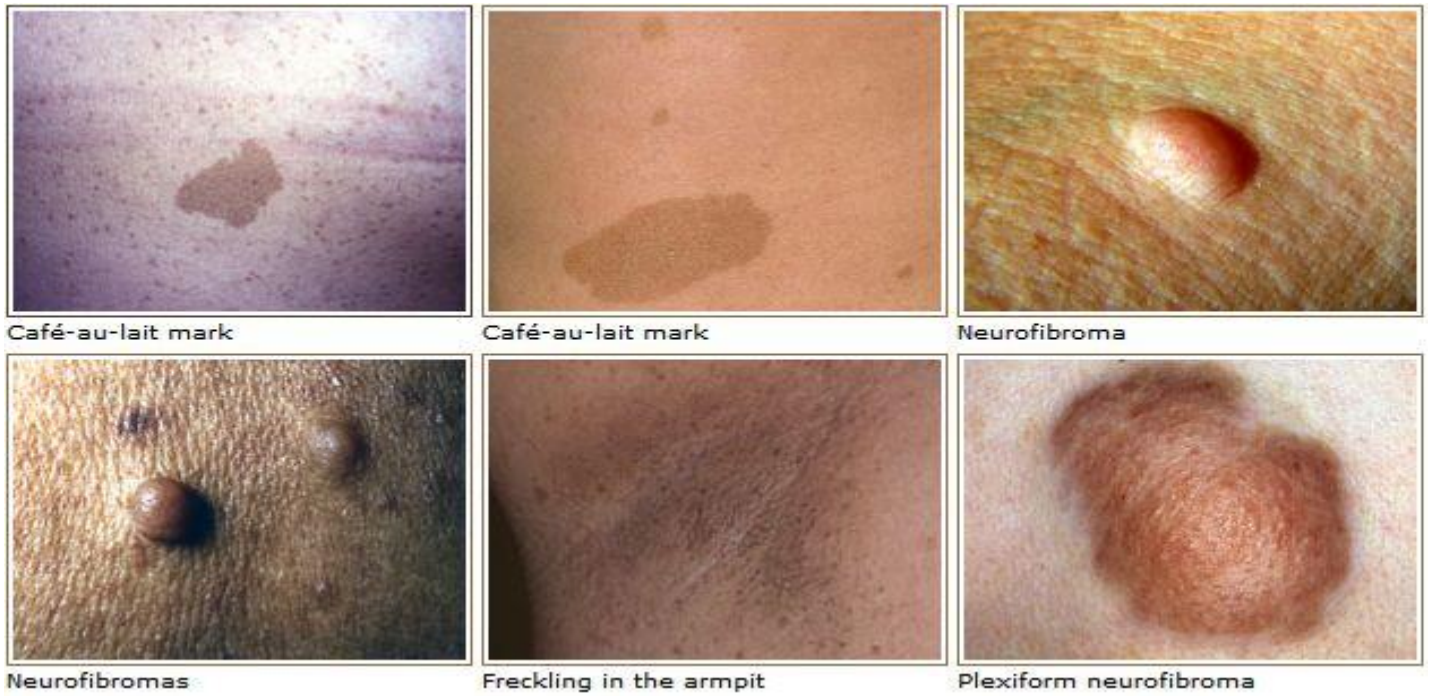
A. Folic acid
B. Calcium with vitamin-D
C. Vitamin E
D. Magnesium sulfate

Question 3

The PNP know that to help prevent neural tube defects adolescent females on anti-epilepsy medicines should take daily:

Answer: Folic acid

Neurocutaneous Syndromes

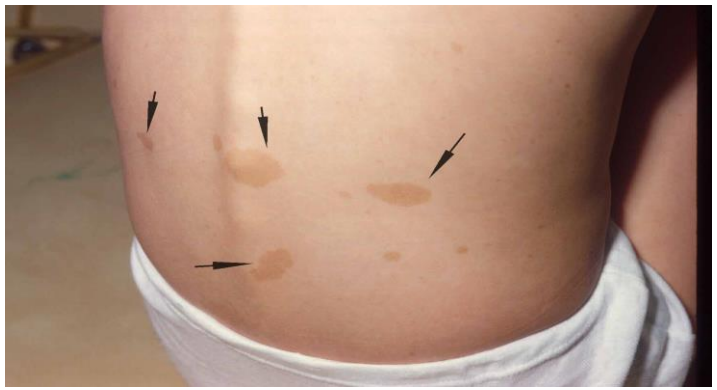


Pediatric Nurse Practitioners
The Leader in Pediatric Education for Nurse Practitioners

Neurofibromatosis 1 (NF-1)

- **Key Characteristics**:
  - Genetic disorder of the nervous system that primarily affects development and growth of nerve cell tissues
  - Up to 50% of new cases can arise sporadically
  - Tumors grow on nerves and cause skin changes and bone deformities
  - **Multiple café'-au-lait spots a clinical hallmark**

- **Key clinical features**:
  - Multiple hyperpigmented skin macules (café-au-lait spots), axillary or inguinal freckling, multiple skin neurofibromas, and iris hamartomas (Lisch nodules)



Pediatric Nurse Practitioners
The Leader in Pediatric Education for Nurse Practitioners

Neurofibromatosis 2 (NF-2)

- **Key Characteristics**:
  - Genetic disorder resulting in development of bilateral acoustic neuromas.
  - Pressure on the vestibulocochlear or facial nerve.
  - **Typical first appearance in adolescent or early 20's.**

- **Key clinical features**:
  - Impaired or hearing loss, tinnitus, unsteadiness, or facial weakness.
  - Skin abnormalities less common than NF-1

NF-1 and NF-2

- **Key Differences:**
  - **Lisch nodules (raised, pigmented hamartomas of the iris) are characteristic of NF1 and are not seen in significant numbers in NF2**.
  - The schwannomas associated with NF2 rarely, if ever, undergo malignant transformation into a neurofibrosarcoma (malignant peripheral nerve sheath tumor).
  - The "dumbbell" spinal root tumors that are seen with both NF2 and NF1 are schwannomas in NF2 and neurofibromas in NF1.
  - **NF2 is not associated with the cognitive impairment that is often seen with NF1**.

NF-1 Diagnostic Criteria (2 or more of the following)

- 6 or more café-au-lait macules > 5 mm in greatest diameter in prepubertal children, and > 15 mm in greatest diameter in postpubertal individuals
- 2 or more neurofibromas of any type or one plexiform neurofibroma
- Axillary or inguinal freckling
- Optic glioma
- 2 or more Lisch nodules (iris hamartomas)
- Distinctive bony lesion, ie., sphenoid dysplasia, or medullary narrowing and cortical thickening of the long bone cortex with or without pseudoarthrosis
- A first-degree relative (parent, sibling, or offspring) with NF1 based on the above criteria

NF-2 Diagnostic Criteria

- Bilateral 8th nerve masses seen on neuroimaging (e.g., MRI, CT)

OR

- A first-degree relative with NF2 (ie, affected parent, sibling, or offspring)
- Multiple spinal tumors (schwannomas, meningiomas)
- Cutaneous schwannomas
- An apparently sporadic vestibular schwannoma in an individual younger than 30 years of age
- A solitary meningioma or non-vestibular schwannoma in an individual younger than 25 years of age

Pediatric Nurse Practitioners
The Leader in Pediatric Education for Nurse Practitioners

NF-1 and NF-2

- **Management NF-1**:
  - Surveillance and screening with AAP health supervision guidelines https://pediatrics-aappublications-org.libproxy.uams.edu/content/121/3/633.full
  - Individual treatment as symptoms arise

- **Management NF-2**:
  - Tumor surveillance with annual H&P to include:
    - Audiology
    - Ophthalmology
    - Skin examination
    - Annual brain & spine MRI

Pediatric Nurse Practitioners
The Leader in Pediatric Education for Nurse Practitioners

Tuberous Sclerosis Complex

- **Key Characteristics**:
  - Genetic disorder caused by a mutation in TSC1 gene or TSC2 gene
  - Affects many organ systems, including multiple benign hamartomas of the brain, eyes, heart, lung, liver, kidney, and skin
  - **Most common skin lesions**:
    - Ashleaf spots
    - Adenoma sebaceum
    - Shagreen patches
    - Forehead fibrous plague

- **Key Prominent Associated Features**:
  - Seizures, cognitive delay, learning disabilities

Tuberous Sclerosis Complex

- **Major Clinical Features**:
  - Hypomelanotic macules
  - Angiofibromas
  - Ungual fibromas
  - Shagreen patch
  - Multiple retinal hamartomas
  - Cortical dysplasias
  - Subependymal nodules
  - Subependymal giant cell astrocytoma
  - Cardiac rhabdomyoma
  - Lymphangioleiomyomatosis
  - Angiomyolipomas

- **Minor Clinical Features**:
  - "Confetti" skin lesions
  - Dental enamel pits
  - Intraoral fibromas
  - Retinal achromic patch
  - Multiple renal cysts
  - Non-renal hamartomas
- **Definite TSC**:
  - **2 major clinical features, or 1 major and 2 minor clinical features**
- Possible TSC:
  - Either 1 major clinical feature or 2 or more minor clinical features

Tuberous Sclerosis Complex

- **Management**:
  - Monitor for seizures
  - Brain MRI every one to three years
  - Neuropsychiatric assessment for aggressive behaviors
  - Annual skin examination
  - Periodic dental and oral inspections or examinations
- Children < 3 years old:
  - Baseline echocardiography and electrocardiography (rhabdomyoma and arrhythmia)
  - Repeat echocardiography every 1-3 years; electrocardiography every 3-5 years

Question 4

The PNP visualized light brown lesions that are large, round, and flat as cafe-au-lait spots . The PNP understands the importance of documenting the number of spots, size, and the location because:

A. The presence of six or more café-au-lait spots larger than 0.5 cm in diameter in children and 1.5 cm in adolescents suggests the possibility of NF1
B. The presence of six or more café-au-lait spots larger than 1.5 cm in diameter in children and 0.5 cm in adolescents suggests the possibility of NF1
C. The presence of six or more café-au-lait spots larger than 0.5 cm in diameter in children and 1.5 cm in adolescents suggests the possibility of mongolian spots
D. The presence of three or more café-au-lait spots larger than 0.5 cm in diameter in children and 1.5 cm in adolescents suggests the possibility of NF1

Question 4

The PNP visualized light brown lesions that are large, round, and flat as cafe-au-lait spots . The PNP understands the importance of documenting the number of spots, size, and the location because:

Answer: The presence of six or more café-au-lait spots larger than 0.5 cm in diameter in children and 1.5 cm in adolescents suggests the possibility of NF1

Traumatic Brain Injury

Traumatic Brain Injury

- **Key Characteristics**:
  - Mild to severe tissue damage to the brain and surrounding structures
  - Long-term sequelae more common in children
  - Infants and toddlers head trauma from falls and non-accidental trauma
  - Highest risk (ages 0 to 4 years and 15 to 24 years)

- **Assessment**:
  - **Glasgow Coma Scale score:**
    - 13 to 15 – mild head injury
    - 9 to 12 – moderate head injury
    - 8 or < - severe head injury
  - Post-concussion symptom checklist
    - Post-Concussion Symptom Scale
    - Health and Behavior Inventory
    - Post-Concussion Symptom Inventory
    - Acute Concussion Evaluation

Pediatric Nurse Practitioners
The Leader in Pediatric Education for Nurse Practitioners

Traumatic Brain Injury

Signs and Symptoms of a Concussion

Physical	Vestibular and/or Oculomotor	Cognitive	Emotional	Sleep
• Headache • Nausea and/or vomiting • Neck pain • Light sensitivity • Noise sensitivity	• Vision problem • Hearing problems and/or tinnitus • Balance problems • Dizziness	• Confusion • Difficulty concentrating • Difficulty remembering • Answers questions slowly • Repeats questions	• Irritable • More emotional than usual • Sadness • Nervous and/or anxious	• Drowsiness and/or fatigue • Trouble falling asleep • Sleeping too much • Sleeping to little

AAP https://pediatrics.aappublications.org/content/142/6/e20183074

Traumatic Brain Injury

Key Recommendations from the CDC Pediatric mTBI Guidelines
• Do not routinely image patients to diagnose mTBI.
• Use validated, age-appropriate symptom scales to diagnose mTBI.
• Assess evidence-based risk factors for prolonged recovery.
• Provide patients with instructions on return to activity customized to their symptoms.
• Counsel patients to return gradually to non-sports activities after no more than 2-3 days of rest.

CDC Pediatric mTBI Guidelines https://www.cdc.gov/traumaticbraininjury/PediatricmTBIGuideline.html

Pediatric Nurse Practitioners
The Leader in Pediatric Education for Nurse Practitioners

Traumatic Brain Injury

- **Evaluation indicating neuroimaging**:
  - Age < 2 years old
  - Recurrent vomiting
  - Loss of consciousness
  - Severe mechanism of injury
  - Severe or worsening headache
  - Amnesia
  - Non-frontal scalp hematoma
  - Glasgow Coma Score < 15
  - Clinical suspicion for skull fracture

- **Management**:
  - Minor head trauma
    - Observation in clinic, ED or home
    - Physical rest 24 to 48 hours followed by gradual and progressive return to non-contact, supervised physical activity
    - Athletes should follow return to play (RTP) protocol
    - Acetaminophen or ibuprofen briefly for symptomatic treatment
    - Neuropsychological testing
  - Moderate head trauma
    - Admit for prolonged observation in ED

Question 5

Joseph is a 9-year old with a 2 month history of throbbing headache associated with nausea absent of vomiting, positive for photophobia and noise sensitivity lasting 4-5 hours. He has had 6 attacks. His physical examination is unremarkable. The PNP knows the first-line treatment for acute migraine in children is:

A. ibuprofen
B. topiramate
C. hydrocodone
D. sumatriptan

Question 5

Joseph is a 9-year old with a 2 month history of throbbing headache associated with nausea absent of vomiting, positive for photophobia and noise sensitivity lasting 4-5 hours. He has had 6 attacks. His physical examination is unremarkable. The PNP knows the first-line treatment for acute migraine in children is:

Answer: ibuprofen

Question 6

Typical symptoms of migraine headache in a 14 year-old usually include recurrence and:

A. Unilateral forehead pain, nausea and photophobia
B. Bilateral temporal pain, cyclical vomiting and vertigo
C. Unilateral forehead pain, ataxia and photophobia
D. Bilateral forehead pain, nausea and an aura

Question 6

Typical symptoms of migraine headache in a 14 year-old usually include recurrence and:

Answer: Unilateral forehead pain, nausea and photophobia

Question 7

Which of the following children who have just had a seizure would you NOT need to order a MRI or CT scan?

A. A 6 year old with a weak right hand grip
B. A 14 year old who just had a first time seizure lasting 17 minutes
C. A 6 month old with a one day history of a 103 fever
D. A 4 year old with recent onset of headaches that include early morning vomiting and nighttime awakening

Question 7

Which of the following children who have just had a seizure would you NOT need to order a MRI or CT scan?

Answer: A 6 month old with a one day history of a 103 fever

Question 8

For children 1 to 4 years of age, the most common cause of head injury is:

A. Motor vehicle accidents
B. Falls
C. Sports-related accident
D. Tricycle accidents

Question 8

For children 1 to 4 years of age, the most common cause of head injury is:

Answer: Falls

Question 9

An 8 y/o with a history of frequent vomiting and her mom has frequent migraine headaches. Recently the child has more frequent and prolonged episodes accompanied by headaches. Exam reveals mild dystaxia and unilateral esotropia. What is the correct action?

A. Begin sumatriptan NS 5 mg to manage acute headache
B. Prescribe ondansetron to manage cyclical vomiting
C. Reassure mom that the symptoms are associated with migraine
D. Refer to a pediatric neurologist for further workup.

Question 9

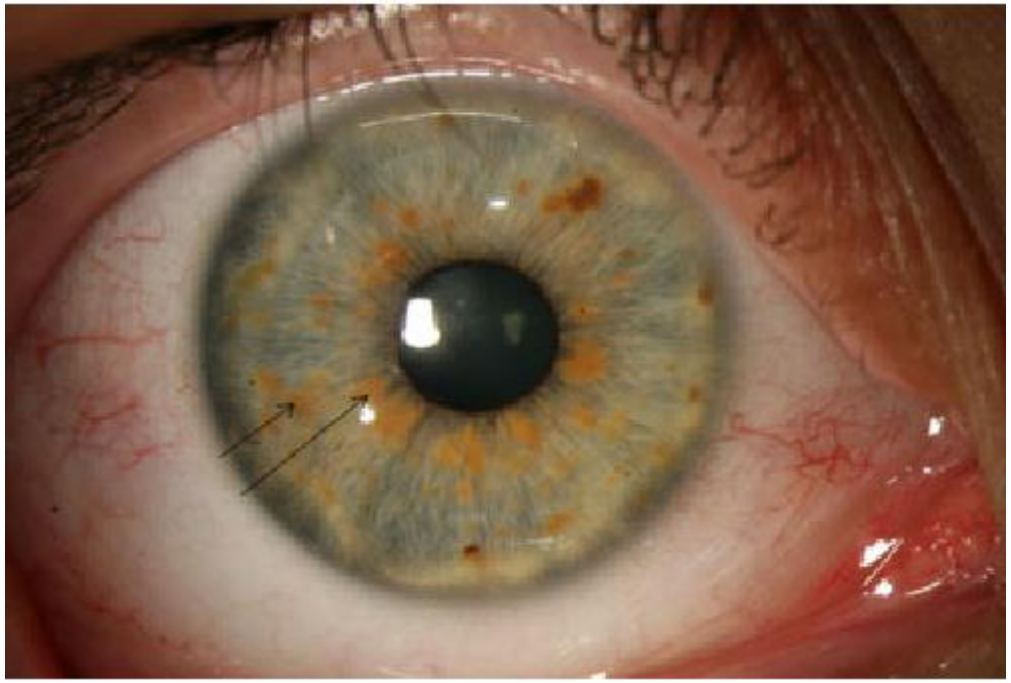
An 8 y/o with a history of frequent vomiting and her mom has frequent migraine headaches. Recently the child has more frequent and prolonged episodes accompanied by headaches. Exam reveals mild dystaxia and unilateral esotropia. What is the correct action?

Answer: Refer to a pediatric neurologist for further workup.

Question 10

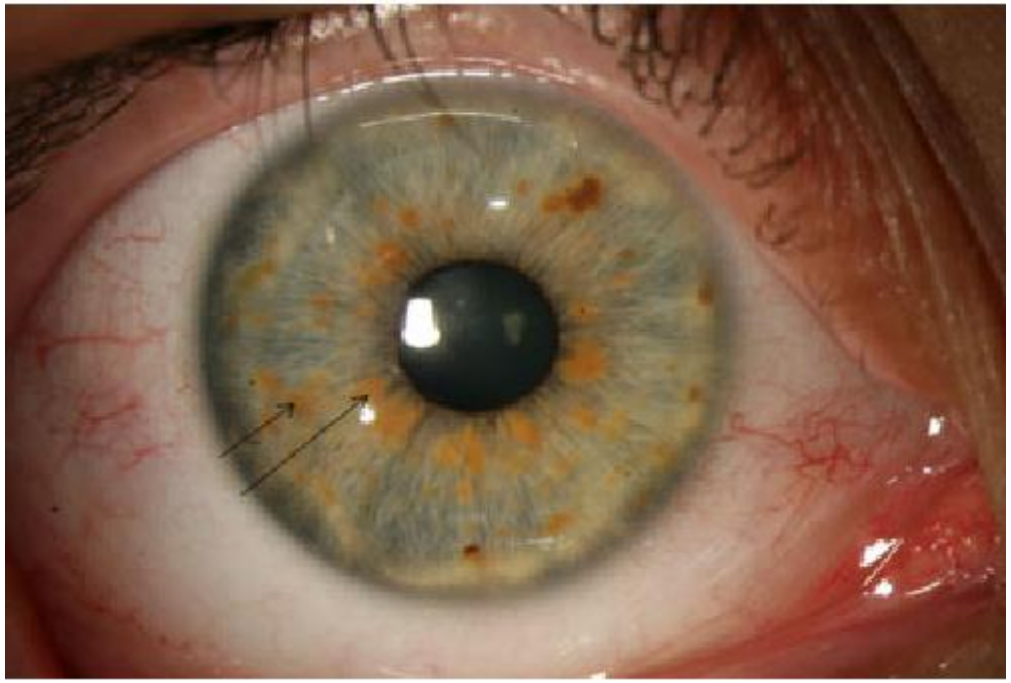
A 15 y/o presents with c/o headache. On exam, she has multiple hyperpigmented macules on various body parts. What term best describes the ophthalmology findings:

A. Kayser-Fleischer rings
B. Iris coloboma
C. Lisch-nodules
D. Brushfield spots



Question 10

A 15 y/o presents with c/o headache. On exam, she has multiple hyperpigmented macules on various body parts. What term best describes the ophthalmology findings:

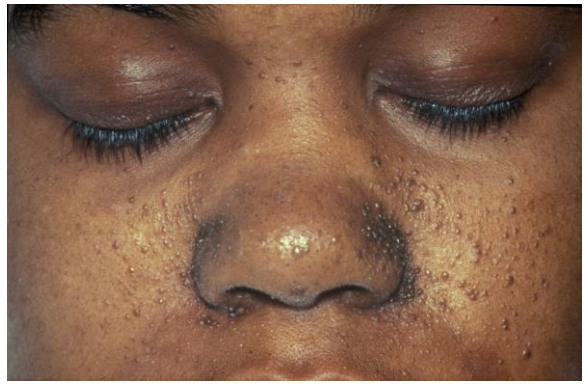


Answer: Lisch-nodules

Question 11

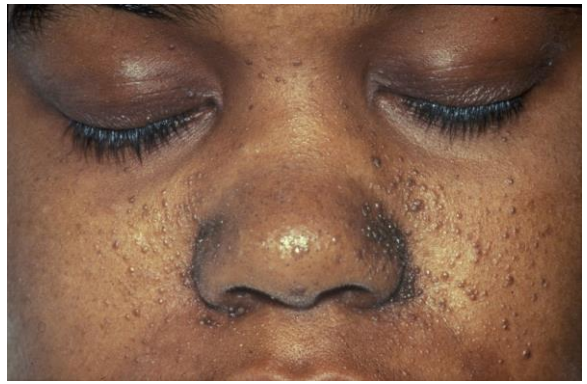
What is the most likely diagnosis of the patient with the cutaneous lesions in the image?

A. TSC
B. NF-1
C. NF-2
D. Sturge-Weber syndrome



Question 11

What is the most likely diagnosis of the patient with the cutaneous lesions in the image?



Answer: TSC