The Neurologic System

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UMDNJ PANCE/PANRE Review Course
(becoming Rutgers University July 1, 2013)

PANCE/PANRE Breakdown

- Neurologic system – 6% of exam content
- PANCE
  - 360 questions x 0.06 = 21.6
- PANRE
  - 300 questions x 0.06 = 18
- NCCPA Blueprint available at http://www.nccpa.net/ExamsContentBlueprint.aspx
  - Content of this presentation follows NCCPA Blueprint

NCCPA Blueprint

- Diseases of Peripheral Nerves
- Headaches
- Infectious Disorders
- Movement Disorders
- Vascular Disorders
- Other Neurologic Disorders

Diseases of Peripheral Nerves

- Complex Regional Pain Syndrome
- Peripheral Neuropathies

Complex Regional Pain Syndrome

- Formerly called Reflex Sympathetic Dystrophy
- Autonomic and vasomotor dysfunction in the extremities
- One extremity affected
  - Pain, swelling, color/temperature changes
    - Pain is burning, exacerbated by light touch
  - Skin and nail dystrophy
  - Muscle atrophy
  - Limited ROM
- Does not follow one peripheral nerve distribution
- No systemic symptoms

CRPS

- Usually follows trauma to affected limb (may be minor)
  - Most commonly affects hand and ipsilateral shoulder
- Early mobilization can help prevent CRPS
  - Vitamin C 500mg/day reduces risk in wrist fractures
- Increased uptake on bone scan
- In late CRPS, osteopenia seen on x-ray
- Treatment – early intervention is best
  - NSAID, corticosteroids, PT/OT, pain management
  - Antidepressants and anticonvulsants (gabapentin) used
  - Regional nerve block and spinal stimulation

Peripheral Neuropathies

- Many possible etiologies
- May be primarily sensory…
  - Inflammatory/immune (vasculitis, paraneoplastic)
  - Metabolic (diabetes)
  - Infectious (HIV, HSV, leprosy)
  - Toxic (chemotherapy, vitamin B6)
  - Deficiency (vitamin B12, vitamin B1, vitamin E)
  - Alcohol-related
- Primarily motor…
  - Inflammatory/immune (Guillian-Barre)
  - Toxic – lead

Peripheral neuropathies – signs and symptoms

- May be motor, sensory, autonomic or combination
- Presentation depends on etiology
  - Acute vs. chronic, symmetric vs. asymmetric
- Motor (weakness)
  - In legs – tripping on carpeting, curbs
  - In hands – difficulty with fine movements (buttons, zippers, keys)
- Sensory loss, loss of proprioception
  - In feet – "walking on pebbles", "ice cold"
  - Dysesthesias – "on fire", "stuck with pins", numbness, tingling

Peripheral neuropathies – exam

- Atrophy/muscle wasting (hands, feet, anterior tibialis)
- Fasciculations
- Muscle weakness
- Stocking-glove sensory loss
- Cold, erythematous or bluish hands and feet
- May have impairment of vibration sense, position sense, light touch, pain sense, temperature sense, heel/toe walk, tandem gait
- Diminished deep tendon reflexes (distal first)

Peripheral neuropathies - diagnosis

- EMG/NCV
- Nerve/skin biopsy
  - Typically for vasculitis-related neuropathy
- Labs – glucose, BUN/Cr, CBC, vitamins B6 and B12, RPR
- Genetic tests if indicated

Diabetic neuropathy

- Most common cause of neuropathy in the Western world
- If the patient has albuminuria or retinopathy – 2x more likely to develop neuropathy
- Typically a distal symmetric polyneuropathy
  - Autonomic neuropathy also common (erectile dysfunction)
- Elevated glucose = increased risk and progression of neuropathy
- No treatment to halt progression
  - Tight sugar control!
  - Gabapentin, nortriptyline, pregabalin (Lyrica), duloxetine, opioids

Bell's Palsy

- Lower motor neuron facial nerve paresis
  - Infection, pregnancy, diabetes
- Abrupt onset of facial paresis
  - Ipsilateral ear pain, restriction of eye closure, difficulty eating
- 60% recover completely without treatment
  - 10% have long term or permanent sequelae
- Steroids must be initiated within 5 days to see benefit
  - Acyclovir has not been shown to provide benefit
- Lubricating drops and/or eye patch

Bell's Palsy

http://en.wikipedia.org/wiki/Bell's_palsy

Peripheral neuropathies - others

- Charcot-Marie-Tooth disease (inherited)
  - Sensory loss and weakness of hands/fingers and legs (anterior tibialis weakness = "drop foot")
  - No treatment
    - Use ankle-foot orthoses, genetic counseling
- Vasculitic (nerve ischemia)
  - Painful, acute onset or motor and sensory symptoms
    - Depends on underlying vasculitis
  - Etiologies – rheumatoid arthritis, Churg-Strauss, Wegener's granulomatosis, polyarteritis nodosa, Sjogren's, SLE
  - Diagnosed with nerve/vessel biopsy, EMG
  - Treat with steroids, methotrexate, azathioprine

Peripheral neuropathies - more

- Compression/entrapment neuropathies
  - Carpal-tunnel syndrome, radiculopathies
- Trigeminal neuralgia
- Post-herpetic neuralgia
  - Pain persisting >6 weeks after herpes zoster infection
  - Treat with acyclovir (steroids reduce pain but do not prevent onset or severity of neuralgia)

Headaches

- Cluster Headaches
- Migraine Headaches
- Tension Headaches

Cluster Headaches

- Primarily affects middle-aged men
- Mechanism not fully understood
- No family history
- Symptoms
  - Severe unilateral periorbital pain
  - Ipsilateral nasal congestion and rhinorrhea
  - Redness of the eye
  - Horner syndrome

Cluster Headaches

- Timing
  - Episodes often at night
  - Daily for several weeks
  - Last 15 minutes to 3 hours
  - Occur in "clusters"
    - Lasts 4-8 weeks, with weeks to months of remission
    - May be seasonal
- Triggers – similar to migraines

Cluster Headaches

- Exam normal except rhinorrhea, lacrimation, maybe Horner syndrome
- Treatment
  - Abortive
    - Triptans
    - 100% oxygen
    - Intranasal lidocaine
    - Corticosteroids
  - Prophylactic
    - Verapamil, topiramate, lithium, ergotamine

Migraine Headaches

- Headache of neurovascular dysfunction
  - Dilatation of blood vessels innervating the trigeminal nerve causes headache (mechanism not entirely understood)
- Regional cortical blood flow reduced, resulting in clinical symptoms
  - Symptoms correspond to affected area of cortex
- Classic and variant forms
- Onset typically in teens – early thirties
- More common in women
- Often a family history of migraine-like headaches

Migraine Headache

- Classic symptoms:
  - Unilateral throbbing headache (severe)
  - Nausea, vomiting, photophobia, phonophobia
- May also include:
  - Cognitive impairment, blurred vision
  - Focal neurologic dysfunction
    - Aphasia, numbness/paresthesias, focal weakness, dysarthria, disequilibrium
  - Visual field defects (aura)
    - "Zigzags" or "flashes" of light, visual hallucinations, scintillating scotomas

Migraine Headache

- "Migraine equivalent"
  - Somatic symptoms without headache
- Variants
  - Ophthalmoplegic (ophthalmic) migraine
    - 3rd and/or 6th nerve palsy
  - Basilar artery migraine

Migraine Headache

- Common triggers
  - Stress
  - Foods (chocolate, alcohol)
  - Smells (perfume)
  - Bright lights, loud noises
  - Menstruation

Migraine Headaches

- Clinical diagnosis
  - Imaging generally not warranted
- Treatment
  - Avoid triggers!
  - Stay in dark, quiet room
  - Abortive medication
  - Preventive therapy

Migraine Headaches

- Abortive medications
  - Analgesics (ASA, APAP, NSAIDs)
  - Ergotamine + caffeine = Cafergot
  - Triptans (sumatriptan) – mainstay of treatment
    - Contraindicated in CVD, PVD
    - Avoid in pregnancy
    - May cause nausea/vomiting
    - Combine with naproxen for greater benefit
  - Droperidol, metoclopramide, prochlorperazine
  - Opioids

Migraine Headaches

- Preventive Therapy
  - Antiepileptics
    - Topiramate, valproic acid
  - Antihypertensives
    - Propranolol, verapamil, candesartan
  - Amitriptyline
  - Botox

Tension Headaches

- Most common primary headache
- Generalized, constant/daily headache
- Vise-like, gripping, tightness, squeezing
  - NOT typically pulsatile
  - Non-specific, non-focal
  - Poor concentration
  - Head and neck tenderness
- Exacerbated by stress, fatigue, glare, loud noise

Tension Headache

- Treatment
  - Stress reduction
  - Improve sleep hygiene
  - ASA, APAP, NSAIDs
    - Caution: rebound headaches
  - Caffeine, butalbital used (not recommended in practice)

Infectious Disorders

- Encephalitis
- Meningitis

Encephalitis

- Inflammation/infection of brain parenchyma
- Viral, amebic, tick-borne
- Hashimoto's encephalopathy
- Often occurs with concomitant meningitis = meningoencephalitis

Encephalitis - etiologies

- Seasonal
  - West Nile, equine encephalitis virus, enteroviruses (Coxsackie)
- HSV-1 is most common non-epidemic cause in US
- West Nile is most common epidemic cause in US
- If immunosuppressed:
  - HIV, Varicella/Zoster, CMV, EBV
- Others
  - HSV-2, measles, mumps, rubella, Dengue fever, rabies

Encephalitis – signs/symptoms

- Prodrome…
  - Fever, malaise, myalgia, nausea, vomiting, diarrhea, rash
- As disease progresses…
  - headache, photophobia, altered sensorium, seizures
- May exhibit…
  - meningeal signs, hemiparesis, aphasia, behavioral changes (depending on area(s) of brain affected)

Encephalitis – diagnosis/treatment

- Diagnosis
  - Lumbar puncture – elevated opening pressure, elevated protein and lymphocytes, normal glucose
  - CT head prior to LP if risk factors for cerebral herniation present…
  - CSF serology or PCR
- Treatment
  - Treat causative agent
  - If HSV – acyclovir (often empirically)
  - Supportive – ICU, treat seizures
- Prognosis is variable (HSV-1 mortality is 20%)

Meningitis

- Inflammation/infection of arachnoid membrane, pia mater and intervening CSF
- Bacterial, viral and other
- Decreased incidence due to vaccines for Haemophilus influenzae, Streptococcus pneumoniae and Neisseria meningitidis
- Predisposing factors
  - Otitis media, pneumonia, sinusitis, head injury, cirrhosis/alcoholism, immunodeficiency

Bacterial Meningitis - etiologies

- Haemophilus influenzae
  - Primarily affects children
- Streptococcus pneumoniae
  - Predominantly adults (>50 years old) with comorbidities
- Neisseria meningitidis
  - Outbreaks (dorms, barracks, jails)
  - Meningococcal vaccine 85% effective
- Listeria monocytogenes
  - Emerging in developed countries as most common cause of bacterial meningitis

Bacterial Meningitis - presentation

- Acute onset of fever, headache, vomiting, stiff neck, myalgia, backache, generalized weakness
  - Can rapidly progress to confusion, obtundation, loss of consciousness, focal neurologic deficit
- Kernig and Brudzinski signs
- Petechiae or ecchymotic rash = meningococcal
  - Rapidly progressive
- Seizures, hydrocephalus, CN abnormalities, hearing loss, visual field defects, coma

Bacterial Meningitis - diagnosis

- Lumbar puncture – opening pressures and CSF analysis
  - Elevated opening pressure
  - CSF - elevated protein, decreased glucose, elevated cell count (PMN cells)
  - CSF – gram stain, culture and PCR
- Blood cultures
- CT/MRI brain and spine
- X-ray chest, sinus, mastoid

Bacterial Meningitis – treatment

- Bacterial meningitis is a medical emergency!
  - Rapid initiation of IV antibiotics
    - Empiric – vancomycin and 3rd generation cephalosporin or ampicillin
      - Trimethoprim-sulfa if PCN-allergic
    - Pneumococcal – PCN and vancomycin or chloramphenicol
      - 3rd generation cephalosporin if resistant
    - Meningococcal – Penicillin G and ampicillin
      - 3rd generation cephalosporin if resistant
    - H. flu – 3rd generation cephalosporin or chloramphenicol and ampicillin
- 3rd generation cephalosporin = ceftriaxone or cefotaxime

Bacterial Meningitis – more treatment

- Re-examine CSF 24-48 hours later if poor response
- Dexamethasone to reduce sequelae
  - No effect on mortality
- Mannitol if elevated intracranial pressure
- Chemoprophylaxis of close contacts

Meningitis – viral and other

- "Aseptic meningitis"
  - Viral, fungal, chemical, neoplastic, arthropod-borne
  - 60% are enteroviruses (echovirus, Coxsackie)
  - Fecal-oral transmission > respiratory (seasonal)
  - Mumps
- Abrupt onset of fever, headache, stiff neck, nausea, vomiting, myalgia, photophobia, +/- rash
  - Benign clinical course, recovery in 1 – 3 weeks
- CSF – lymphocytic pleocytosis, normal glucose, elevated protein (run PCR and culture)
- Prevention is key (MMR vaccine)
- Acyclovir if HSV, otherwise supportive treatment

Movement Disorders

- Essential Tremor
- Huntington Disease
- Parkinson Disease

Essential Tremor

- Postural (sustention) tremor of hands, head and/or voice
  - Etiology unclear
- Often a family history (familial tremor)
  - Autosomal dominant
- May begin at any age
  - Exacerbated by stress
  - Alcohol tends to relieve symptoms
- No other associated neurologic abnormalities

Essential Tremor - treatment

- Usually not disabling
- If treatment necessary:
  - Start with propranolol if possible
    - 60 – 240 mg/day
  - Primidone next – patients tend to be sensitive to this drug
  - Other options include alprazolam, topiramate, gabapentin

Huntington Disease

- Autosomal dominant inheritance (chromosome 4)
  - Worldwide, all ethnic groups
- Gradual onset of chorea, dementia and behavioral changes
  - Progressive disease
- Onset between 30-50 years old
  - Typically fatal within 15-20 years
- CT or MRI reveals cerebral atrophy
- Genetic test available for definitive diagnosis

Huntington Disease - differential

- Other causes of chorea
  - Stroke
  - SLE
  - Paraneoplastic syndromes
  - HIV
  - Group A strep infection (children)

Huntington Disease - treatment

- Treatment is symptomatic
  - No halting progression or reversal of disease
- Tetrabenazine for dyskinesias
  - Also consider reserpine for dyskinesias, haloperidol for behavioral changes.
- Genetic counseling for children

Parkinson Disease

- Dopaminergic nigrostriatal system degenerates
  - Imbalance of dopamine and acetylcholine in corpus striatum
- Typically not inherited
- Onset usually between 45-65 years old
- Diagnosis based on clinical findings
- Lies on a spectrum of disorders called Parkinsonism

Parkinson - presentation

- Classic findings:
  - Resting tremor
  - Rigidity
  - Bradykinesia
  - Postural instability
  - Masked faces
- Typically no muscle weakness or reflex changes

Parkinson Disease - treatment

- Levodopa
  - Converted in body to dopamine
  - Side effects: nausea, vomiting, hypotension, dyskinesias, restlessness, confusion
  - Avoid in patients with psychosis, narrow angle glaucoma
- Carbidopa
  - Inhibits enzyme that breaks down dopamine
  - Does not cross blood-brain barrier
  - Combine with levodopa = lower effective dose of levodopa to diminish side effects (Sinemet)

Parkinson Disease - treatment

- Other medications:
  - Amantadine may be effective early
  - Anticholinergics
    - Benztropine mesylate (Cogentin), Trihexyphenidyl (Artane), orphenadrine (Norflex)
  - Dopamine agonists
    - Pramipexole (Mirapex) and ropinirole (Requip)
  - Selective MAOI – rasagiline and selegiline
- Deep brain stimulation

Vascular Disorders

- Cerebral aneurysm
- Intracranial hemorrhage
- Stroke
- Transient Ischemic Attack

Cerebral aneurysm

- Saccular ("berry") aneurysms
  - Arterial bifurcations, often multiple
  - Typically asymptomatic until rupture
  - Most found in anterior Circle of Willis
- Risk factors
  - Smoking, hypertension, hyperlipidemia
- Major complication is subarachnoid hemorrhage
- Angiography is gold standard for diagnosis
  - CT or MRA often used but less sensitive
- Monitor if <10mm
- Surgical or endovascular intervention

Stroke

- Ischemic – 85%
  - Thrombotic
  - Embolic
  - Small vessel disease
- Hemorrhagic – 15%
  - Intracerebral
  - Subarachnoid
- 2nd leading cause of death worldwide
  - 3rd in developed countries

Stroke Risk Factors

- Black/Hispanic:White = 2:1
- Men 40% more likely than women
- Hypertension = 4X risk
- Diabetes = 2-6X risk
- Smoking = 2X risk
- Carotid stenosis
- Atrial fibrillation
- Others: obesity, hyperlipidemia, elevated homocysteine, EtOH, OCP

Ischemic Stroke

- Thrombotic
  - Atherosclerotic plaque
- Embolic
  - Piece of mural thrombus breaks off and lodges in cerebral vasculature (afib)
- Lacunar infarct
  - Smaller arterioles occluded

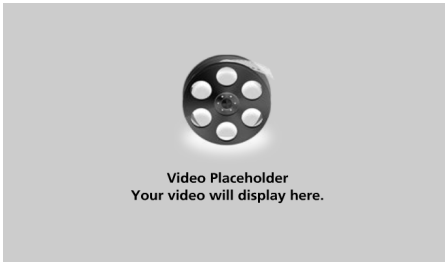
Ischemic stroke vs. TIA

- TIA
  - Symptoms <24 hours
  - No infarction = no permanent damage
- Stroke
  - Symptoms >24 hours
  - Brain infarction = permanent damage
- But…
  - If sxs >1-2 hours, possibly infarction/stroke and generally worse outcome
  - 1/3 of patients who experience a TIA eventually have a stroke

Ischemic stroke - presentation

- Time at onset of symptoms
  - If <3 hours, thrombolysis may be possible
- Usually painless
- Exam to localize lesion
  - Focal neurologic deficit
    - Mental status, speech, cranial nerves, strength, sensation, reflexes
    - Findings depend on the occluded vessel

Cerebral vasculature



http://www.cixip.com/index.php/page/content/id/1007

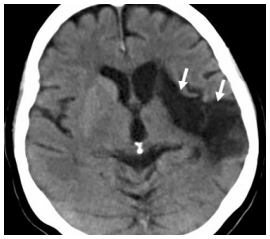
Ischemic Stroke - presentation

Occluded artery	Common symptoms
Internal carotid artery	ipsilateral blindness, other symptoms similar to MCA stroke
Middle cerebral artery	contralateral hemiparesis, arm/face > leg sensory loss, expressive aphasia
Anterior cerebral artery	contralateral hemiparesis, leg > arm/face sensory loss
Posterior cerebral artery	contralateral homonymous hemianopia, memory impairment
Basilar artery	contralateral hemiparesis and sensory loss, ipsilateral bulbar or cerebellar signs
Vertebral artery	ipsilateral sensory loss in face, ataxia, contralateral hemiparesis and sensory loss
superior cerebellar artery	gait ataxia, nausea/dizziness, dysarthria, gaze paresis, contralateral hemiparesis

Ischemic stroke - diagnosis

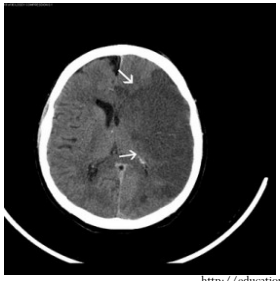
- CT-brain!!!
- Investigate etiology of the stroke
  - CBC
    - Polycythemia vera, anemia, thrombocytosis, infection
  - ESR
    - Hypercoaguable states
    - Giant cell arteritis
  - Glucose, electrolytes, LFTs
  - PT/PTT/INR
- Cardiac investigation
  - EKG, cardiac enzymes

CT scan – ischemic stroke



http://radiographics.rsna.org/content/23/3/565/F10.expansion.html

CT scan – ischemic stroke



http://education.vrad.com/interesting-cases/cerebral-ischemiastroke-case-4/

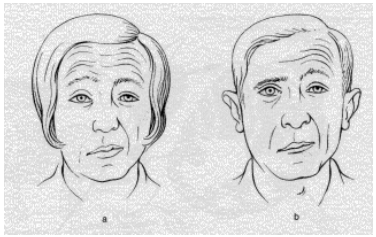
Differential Diagnoses

- Subdural hematoma/hemorrhagic stroke vs. ischemic stroke
- TIA
- Seizure
- Hyper/hypoglycemia
- Bell's palsy
- Tumor
- Radiculopathy
- Guillain-Barre

Bell's Palsy vs. Stroke

http://en.wikipedia.org/wiki/Bell's_palsy

Bell's Palsy vs. Stroke



http://www.ihnigmuh.com

Acute Ischemic Stroke Treatment

- Thrombolytic therapy
  - Tissue plasminogen activator (t-PA)
  - Must be given within 3 hours of onset
  - CT first!!!
  - Monitor CBC

t-PA contraindications

- BP >185/110
- Major surgery (especially intracranial) or trauma in previous 2 weeks
- GI bleeding
- Evidence or history of ICH
- Recent anticoagulation/bleeding diathesis
- No anticoagulants or platelet-inhibitors for at least 24 hours after administration of t-PA

Prevention

- Anti-platelet therapy
  - ASA
  - Plavix
- Control lipids
  - statins
- Control BP – antihypertensives
  - ACE-I in diabetics
- Smoking cessation
- Anticoagulation for afib patients
- Carotid endarterectomy or stenting

Hemorrhagic Stroke

- 2/3 subarachnoid hemorrhage (SAH)
  - Ruptured vessel on surface of brain
- 1/3 intracerebral hemorrhage (ICH)
  - Ruptured vessel within brain substance
- Etiology
  - Trauma, aneurysm (usually Berry aneurysm in Circle of Willis), arteriovenous malformation (AVM)
- 25% die within 24 hours
- 50% die within 6 months

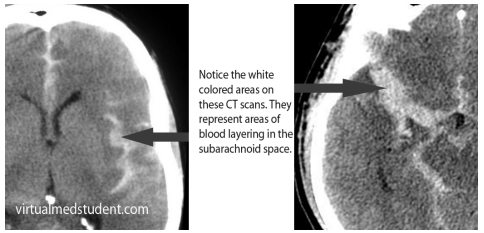
SAH Symptoms

- Rapid onset, severe headache
  - "Thunderclap"
  - "Worst headache of my life"
- Prodromal less severe headaches
- Nausea/vomiting
- Altered mental status
- Neck stiffness

Diagnosis

- CT
- Lumbar puncture
- Cerebral angiography
  - Definitive study to define source of bleeding
- CBC, PT/PTT/INR, electrolytes

SAH CT scan



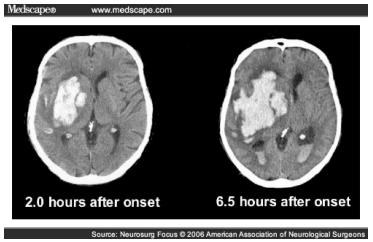
SAH Treatment

- BP control
  - Beta-blockers
- Clipping or coiling
- Nimodipine
  - CCB to reduce vascular spasm
- Reduce ICP – prevent hydrocephalus
  - Mannitol
  - Diuretics
- Supportive
  - Ventilation, seizure prophylaxis, nutritional support

Intracerebral Hemorrhage

- Usually due to hypertension
- Other risk factors
  - EtOH
  - Bleeding disorder
  - Cancer (leukemia)
  - Anticoagulation

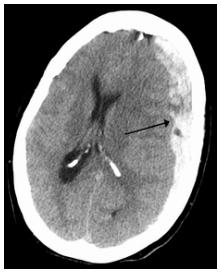
ICH



ICH

- Symptoms
  - Consciousness is lost or impaired, variable headache, vomiting, focal neurologic symptoms
- Diagnosis
  - CT
- Management
  - Supportive
    - Ventilation, BP control, seizure prophylaxis
    - Osmotic agents, nutritional support
  - Monitor ICP
  - Surgical decompression

Subdural Hematoma



http://en.wikipedia.org/wiki/Subdural_hematoma

SDH - etiology

- Trauma
- Anticoagulation
- EtOH
- Frequent falls
- More common in very young and very old

SDH

- Symptoms are variable
  - Confused speech
  - Difficulty with balance or walking
  - Headache
  - Lethargy or confusion
  - Loss of consciousness
  - Nausea and vomiting
  - Numbness
  - Seizures
  - Slurred speech
  - Visual disturbances
  - Weakness

SDH

- Treatment varies with severity
  - Watch and wait
  - Craniotomy
  - Diuretics and steroids to reduce brain swelling/ICP
  - Seizure prophylaxis

Other Neurologic Disorders

- Altered level of consciousness
- Concussion
- Post-concussion Syndrome
- Cerebral Palsy
- Dementias
- Delirium
- Guillain-Barré Syndrome
- Multiple Sclerosis
- Myasthenia Gravis

Other Neurologic Disorder (cont'd)

- Seizure disorders
- Status epilepticus
- Syncope
- Tourette disorder

Altered level of consciousness

- Stupor, coma, vegetative state, brain death
- Stupor = unresponsive except to repeated vigorous stimuli
- Comatose = unarousable, no response to external events
  - Reflex movements and posturing may be intact
- Vegetative state = wakefulness is retained but awareness of self and environment is absent
- Results from serious CNS disorder
  - Seizure, structural lesion, hypothermia, metabolic disorder, toxic/drug-induced

Altered level of consciousness

- History
  - Abrupt onset – SAH or brainstem stroke
  - Prior intoxication or delirium – toxic/metabolic
- Exam
  - Response to painful stimuli, pupil reaction to light, eye position and response to passive movement of head, respiration (GCS)
  - Ice water caloric stimulation, "doll's head response"
- Serum glucose, electrolytes, calcium, LFTs, BUN/Cr, toxicology studies
- EEG, brain imaging (CT, MRI)
- Supportive treatment
  - Dextrose, naloxone, thiamine IV, flumazenil

Concussion

- Transient trauma-induced change in mental status
  - May or may not involve loss of consciousness
- Primary (coup-contracoup injury) and secondary (inflammation, diffuse axonal injury) phases
- Vigilance necessary to detect hematoma or edema
  - Symptoms may appear several days later

Concussion - presentation

- Headache, nausea/vomiting, disorientation, impaired concentration, irritability, amnesia, clumsiness, visual disturbance, focal neurologic deficits
- Glasgow Coma Scale and thorough neurologic exam
- CT brain
- Treatment depends on severity of injury

Concussion - treatment

- Grade I (mild) – transient confusion, symptoms last <15 minutes, no loss of consciousness
  - Remove from work/duty/play
  - Return in 15 minutes
  - Grade increases with each subsequent concussion
- Grade II (moderate) moderate transient confusion <15 minutes, no loss of consciousness
  - Remove for 1 day,
  - Return after one asymptomatic week
- Grade III (severe) – loss of consciousness
  - ER evaluation, consider admission

Post-concussion syndrome

- May last several weeks to > 1 year
- Headache is primary symptom
  - Difficulty concentrating, changes in appetite, sleep abnormalities, irritability
- Neuropsychology evaluation and treatment
- NSAIDs or triptans for headache
- Greater risk for Alzheimer, Parkinsonism, ALS, CTE

Cerebral Palsy

- Chronic, static impairment of muscle tone, strength, coordination and/or movement
  - Non-progressive
- Likely results from cerebral injury prior to, during or soon after birth
  - Genetic etiologies less common
- Higher incidence with extreme prematurity and small for gestational age
  - Intrauterine hypoxia is frequent cause
  - Bleeding, infection, birth hypoxia and many more…

Cerebral Palsy

- Spasticity is common (75%)
  - Variable number of limbs affected
  - Ataxia, chorea/dystonia and hypotonia less common
- Associated disorders
  - Seizures (50%)
  - Mental retardation (may be mild or severe)
  - Language, speech, vision, hearing, sensation disorders
- Exam:
  - Spasticity (hyperreflexia), ataxia, microcephaly

Cerebral Palsy

- MRI brain, genetic studies may help determine etiology
- Treatment to maintain maximal physical function
  - PT/OT, speech therapy
  - Counseling and education for child and parents
- Medications for spasticity as needed
  - Baclofen, botox injections
- Prognosis depends on severity of physical/cognitive deficits
  - Aspiration, pneumonia and other concurrent infections most common causes of death
  - In mild cases motor deficits may resolve by age 7

Dementia

- Progressive decline in intellectual/cognitive function that compromises social or occupational function and leads to loss of independence.
  - Not due to delirium or psychiatric illness
- Typically >60 years old
- Risk factors
  - Stroke/vascular disease
  - Family history
  - Diabetes
  - Head injury

Dementia

- Collateral history necessary
- Symptoms depend on region(s) of brain affected
  - Short term memory loss
  - Word finding difficulty
  - Visuospatial dysfunction
  - Executive dysfunction
  - Apathy/indifference
  - Apraxia
  - Impaired language, loss of insight

Dementia

- Exam to rule out other medical or psychiatric illness
  - May identify reversible conditions
  - B12, folate, free T4, TSH, RPR, CBC, electrolytes, glucose, lipids
    - Consider cancer screening
  - MRI brain (CT if MRI contraindicated)
- Mini Mental State Exam, Montreal Cognitive Assessment
- Neuropsychology evaluation
- Screen for depression!

Dementia - treatment

- Aerobic exercise, "mental stimulation"
- Cholinesterase inhibitors
  - Donepezil (Aricept), rivastigmine (Exelon), galantamine
    - Side effects – nausea/vomiting, syncope, dysrhythmia
- Memantine (Namenda)
- Mood/behavior: SSRIs (except paroxetine – anticholinergic)
- Insomnia: Trazodone (avoid antihistamines and benzos)
- Agitation: behavioral exercise, address sleep disorder
  - Rule out delirium
  - Last resort – low does quetiapine (atypical antipsychotic)
    - Black box warning

Dementia

- Alzheimer Disease
- Vascular Dementia
  - Cognitive disorder must begin within 3 months of stroke or,
  - Multiple bilateral infarcts in cerebral hemispheres (lacunar)
- Lewy body Dementia
  - Parkinsonism, visual hallucinations, fluctuating alertness, antipsychotic drugs worsen condition
- Frontotemporal Lobar Degeneration
  - Disorder of behavior and personal relationships
  - Rude, irresponsible, sexually explicit, impulsive, poor judgment, poor hygiene/grooming, binging, loss of empathy

Alzheimer Disease

- Anterograde amnesia first and most intense symptom
  - 60-80% of dementias
  - Accumulation of β-amyloid = neuritic plaques and neurofibrillary tangles
- Early – difficulty managing finances, independent travel, meal preparation
- Late – difficulty with ADLs
  - Bathing, dressing, toileting, feeding
- Typically no motor deficits

Alzheimer Disease

- Typically sporatic, not genetic
- Mild dementia to death: 2-3 years to >10 years
- If rapid onset, fluctuating course or systemic symptoms consider alternate diagnosis
- Death from infections (pneumonia), nutrition/eating problems, PE, cardiovascular disease
- At greater risk for delirium
- Need assistance, possibly 24/7 care
  - Cease driving
  - Financial planning

Delirium

- Acute state of confusion
- Transient global disorder of attention
- Clouding of consciousness
- Usually result of systemic problem with identifiable trigger
- Rapid onset, fluctuating course (may improve in AM)
  - Sundowning – PM onset of delirium in demented patient
- Many possible etiologies
- Risk factors – dementia, sleep deprivation, immobilization, psychiatric meds, impaired vision/hearing, dehydration

Delirium - etiologies

- Intoxication/drug withdrawal/long-term alcohol use
- Infection
- Endocrine disorder
- Respiratory disorder
- Metabolic disorder/nutritional deficiency
- Trauma
- Cardiovascular disorder
- Neoplasm
- Seizures
- Medications

Delirium

- Anterograde AND retrograde amnesia
  - impaired short-term memory and recall
- Disorientation, altered perception, visual hallucinations, insomnia
- Autonomic changes
  - Tachycardia, dilated pupils, sweating
- Typically lasts <1 week with full recovery
- DSM-IV and CAM diagnostic criteria

Delirium - treatment

- Identify and treat underlying disorder(s)
  - Comprehensive exam, MRI/CT brain, EEG
  - Electrolytes, glucose, BUN/Cr, LFTs, TFTs, CBC, calcium, phosphate, magnesium, B12/folate, ABGs, blood cultures, UA
  - CSF analysis
  - Consider d/c anticholinergics, analgesics, steroids, CNS depressants
- If alcohol withdrawal – meds only if necessary
  - Benzos, ß-blockers, haloperidol
- PREVENTION!

Guillain-Barre Syndrome

- Acute or subacute progressive polyradiculoneuropathy
  - Follows infection, vaccine, surgery
    - Campylobacter jejuni has been implicated
- Weakness > sensory disturbance
  - Typically begins in legs and spreads proximally
- Autonomic disturbances may be severe
  - Cardiopulmonary dysfunction
- CSF = ↑protein and normal cell count
- Rule out other neuropathies

Guillain-Barre Syndrome

- Treatment
  - Plasmapheresis early
  - IVIG 400mg/kg/day x 5days
  - ICU/ventilatory support if necessary
  - Volume replacement and pressors may be required
  - STEROIDS ARE INEFFECTIVE
- Recovery takes months
  - 20% left with persisting disability

Multiple Sclerosis

- Diagnosis most common in young adults, especially women
  - Western European lineage
  - Temperate climate
  - Likely autoimmune
- Focal areas of demyelination
  - Reactive gliosis – scattered white matter changes in central nervous system
    - Periventricular
    - Spinal cord

Multiple Sclerosis - presentation

- Symptoms
  - Weakness, numbness, tingling, spasticity, diplopia, disequilibrium, urinary urgency/hesitancy
  - Fatigue
  - Symptoms can migrate from limb to limb
  - May be triggered by stress (i.e. infection)
- Signs
  - Nystagmus, optic atrophy, UMN findings (i.e. hyperreflexia), sensory and/or cerebellar deficits
- Pregnancy reduces relapses, but they are more likely 2-3 months postpartum

Multiple Sclerosis

- Relapsing-remitting (most common)
  - Period of remission after initial episode
  - Over time periods of remission are shorter and incomplete
  - Progressively deteriorating
- Secondary progressive
  - Initially relapsing-remitting, then course changes to a steady deterioration
- Primary progressive (least common)
  - Steady deterioration from the onset

Multiple Sclerosis - diagnosis

- MRI brain and spinal cord
  - Multi-focal white matter disease
  - "Black holes" – areas of axonal damage
- Lumbar puncture
  - Oligoclonal bands (IgG)
  - Myelin basic protein
  - Mildly elevated protein and lymphocytosis
- Electrodiagnostic studies (EMG + NCV)
- Diagnosis is clinical – criteria always changing
  - Dissemination in time and space is important

Multiple Sclerosis - treatment

- Acute relapse treated with corticosteroids
  - Methylprednisolone IV 1g/day x 3 days
  - Then oral prednisone 60-80mg/day x 1 week followed by taper
- Steroids improve symptoms but do not prevent progression
- Progressive disease - indefinite treatment with B-interferon or glatiramer
  - Natalizumab – progressive multifocal leukoencephalopathy
  - Immune modulators
- Treat fatigue, depression, spacticity also

Myasthenia Gravis

- Fluctuating weakness of voluntary muscles
- Autoantibodies to acetylcholine receptors
  - Women>men (HLA-DR3)
  - All ages
  - Often associated with thymus dysfunction (thymoma) and other autoimmune disorders (SLE, rheumatoid arthritis)
- Insidious onset
  - Exacerbated by illness, pregnancy, menstruation
- Slow, progressive course
  - Aspiration pneumonia may prove fatal

Myasthenia gravis - presentation

- Symptoms
  - Ptosis, diplopia, difficulty chewing/swallowing, limb weakness
  - Ocular muscles more commonly affected
  - Activity increases the weakness
- Diagnosis
  - Weakness on exam
    - Peek sign, tensilon test
  - Repetitive nerve stimulation, single fiber EMG (jitter)
  - Serum acetylcholine receptor antibodies
  - CXR or CT to investigate for thymoma

Myasthenia gravis - Treatment

- Acetylcholinesterase inhibitors
  - Pyridostigmine (Mestinon), neostigmine (Prostigmin)
  - Symptomatic benefits but does not change course of disease
- Avoid aminoglycosides
- Thymectomy should be considered if <60 years old
- Steroids, IVIG, plasmapheresis also considered

Seizure Disorders

- Epilepsy – recurrent, unprovoked seizures
- Transient disturbance of cerebral function due to neuronal hyperexcitability
- Etiology may be:
  - Genetic
  - Structural/metabolic
    - Congenital anomaly, trauma, tumors/lesions, vascular abnormalities (AVM), degenerative disorders (Alzheimer), infectious diseases
  - Unknown

Seizure classification - focal

- With (simple partial) or without (complex partial) impaired consciousness
  - Focal part of one cerebral hemisphere activated
  - May evolve to generalized seizure
- Motor (jerking) or somatosensory (paresthesias) symptoms may spread along limb or other parts of body
  - Jacksonian March
  - Visual, olfactory, auditory and gustatory regions of brain may be involved
  - Autonomic symptoms possible (sweating, flushing)

Seizure classification - generalized

- Absence (petit mal)
  - Brief impairment of consciousness – patient often unaware
  - May include tonic/clonic movements
  - Atonic component
  - Automatisms possible
  - Autonomic component possible (enuresis)
  - Occurs almost exclusively in childhood

Seizure classification - generalized

- Tonic-clonic (grand mal)
  - Sudden loss of consciousness with rigidity (tonic)
    - Respiratory arrest lasting <1minute
  - Jerking, convulsive movements (clonic)
    - 2-3 minutes
  - Urinary/fecal incontinence, tongue biting, aspiration
  - Followed by a flaccid coma and possibly a postictal state of confusion
    - Upgoing toes on plantar reflex testing may indicate postictal state

Seizures - prodrome

- Headache, myoclonic jerks, lethargy, mood changes may occur hours before attack
- Aura may arise seconds-minutes before generalized seizure
- Most occur unpredictably
  - Triggers may include lack of sleep, stress, missed meals, menstruation, alcohol (consumption or withdrawal), flashing lights, music.

Seizures - evaluation

- MRI brain (CT if MRI contraindicated)
  - MRA may be necessary to view vascular anomaly
- EEG
- Labs
  - CBC, glucose, electrolytes, calcium, magnesium, LFTs
- Lumbar puncture to r/o infection

Seizures - treatment

- Medications
  - Alcohol-withdrawal seizures treated with benzodiazepines
- Avoid triggers
- Avoid dangerous situations
  - Driving, operating machinery, roofing, etc.
  - Comply with state laws

Seizures - medication

- Generalized or focal
  - Classics
    - Valproic acid, phenytoin, carbamazepine, phenobarbital, topiramate, primidone, lamotrigine
  - Levetiracetam (Keppra)
  - Others
    - Zonisamide, pregabalin, gabapentin
- Lacosamide
  - Adjunct therapy for complex partial seizures only
- Absence
  - Ethosuximide, valproic acid, clonazepam

Seizure medication considerations

- Pregnancy
  - Valproic acid is significantly teratogenic
  - Topiramate, phenobarbital, topiramate, carbamazepine – cat. D
- Dosing frequency
- Side effects/interactions
- Monitoring
  - Serum levels for most drugs
    - Not levetiracetam
  - CBC (anemia, blood dyscrasia)
  - Hepatic function
- Discontinuation – wait at least 2 years seizure-free

Status epilepticus

- Medical emergency!
  - Repeated seizures without recovery between
  - Fixed epileptic condition lasting >30 minutes
- Maintain airway
- 50% dextrose IV for potential hypoglycemia
- Benzodiazepines initially
  - Phenytoin, fosphenytoin for maintenance
    - Precipitates in glucose-containing solutions
  - Phenobarbital, midazolam may be required
- Respiratory depression and hypotension possible
  - May require intubation

Syncope

- Transient loss of consciousness
  - Usually leads to fall if patient is standing
- May be cardiogenic (arrhythmias, aortic stenosis), orthostatic hypotension, or vasodepressor (common faint)
  - More likely in elderly
- Autonomic neuropathy/dysautonomia
  - Impaired regulation of BP, HR, etc. in response to stress, posture, heat, exercise (carotid mechanoreceptors)
  - May be central or peripheral
  - Diabetes mellitus II is a common cause
  - Carotid stenosis

Syncope

- Evaluate for head injury from fall
- Cardiac workup
- Carotid imaging
- Treatment
  - Midodrine (vasoconstrictor)
  - Fludrocortisone (volume expander)
    - maintain adequate hydration
  - Treat cardiac abnormalities
  - Caution with driving

Tourette Syndrome

- Full name: Gilles de la Tourette syndrome
- Frequent motor and/or phonic tics for at least one year
- Symptoms begin before age 21
- Etiology not completely understood
  - Likely chromosomal abnormality
- Chronic course, but may be relapsing/remitting
- Often associated with obsessive/compulsive behaviors

Tourette Syndrome

- Motor tics (80%) – face, head, shoulder
  - Sniffing, blinking, frowning, shrugging, head thrusting, etc.
  - Echopraxia (imitating movement of others)
- Phonic tics (20%)
  - Grunt, bark, hiss, throat-clearing, cough
    - Coprolalia (obscenities)
    - Echolalia (repetition of others)
    - Palilalia (repeating words or phrases)
- Tics may be self-mutilating
- Ultimately a combination of motor and phonic tics develops

Tourette Syndrome

- Treatment is symptomatic
  - Cognitive behavioral therapy
  - α-adrenergic agents (clonidine)
  - Typical antipsychotics are the only FDA-approved meds
    - Haloperidol
    - Unfavorable side-effect profile

A 45 year old man presents with episodes of left-sided retro orbital pain, tearing and rhinorrhea nightly x several weeks. What is the most appropriate treatment?

1. Sumatriptan and 100% O2
2. Ibuprofen and 100%O2
3. Amitriptyline
4. Verapamil

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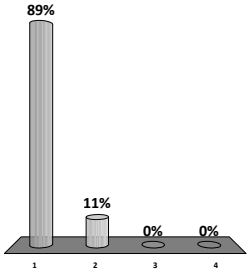

Which is the most appropriate initial medication for migraine prophylaxis?

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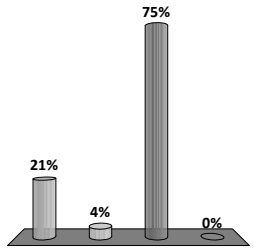

A woman presents at 24 weeks gestation for treatment of recurrent tonic-clonic seizures. What is the best treatment option?

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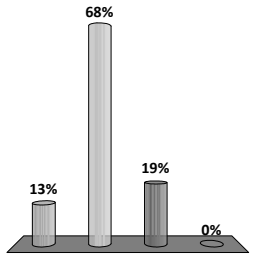

You suspect Alzheimer Disease in an 80 year old patient. What is the most appropriate initial medication?

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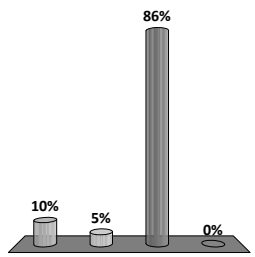

A patient with a history of AD presents with disorientation and visual hallucinations x 3 hours. What is the most appropriate treatment?

1. Stat alprazolam
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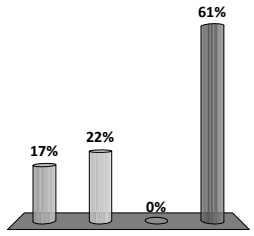

37 year old woman presents with intermittent weakness, paresthesias and fatigue. MRI brain reveals multifocal white matter disease. CSF shows oligoclonal bands. What is the diagnosis?

1. Guillian-Barre
2. Myasthenia Gravis
3. Huntington Disease
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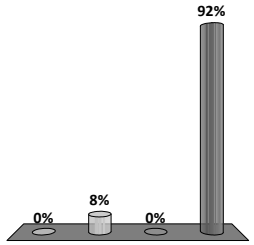

Patient presents with L-sided facial droop, expressive aphasia and LUE weakness. Where is the stroke?

1. Right MCA
2. Basilar artery
3. Right PCA
4. Left MCA

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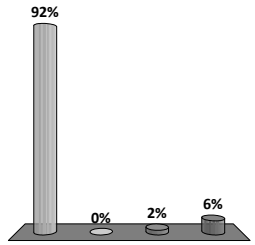

Patient presents with L-sided facial droop, expressive aphasia and LUE weakness x 2 hours. After the H&P, what is the best next step?

1. Administer t-PA
2. CT scan of head
3. Emergency coiling procedure
4. Administer ASA, Plavix and simvastatin

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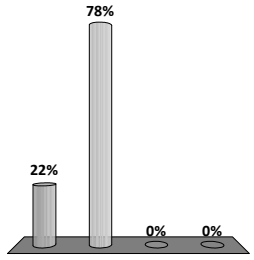

Which of the following is true regarding cerebral aneurysms?

1. Commonly found in posterior Circle of Willis
2. Typically present with headaches, blurred vision
3. CT is gold standard of diagnosis
4. SAH is a major complication

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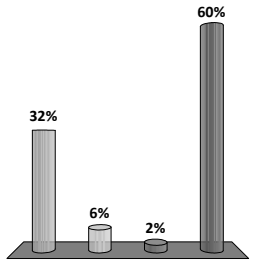

A 60 y/o man complaining of resting tremor of the hand has postural instability and cogwheel rigidity on exam. Which is the most appropriate initial medication?

1. Tetrabenazine
2. Propranolol
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4. Carbidopa-levodopa

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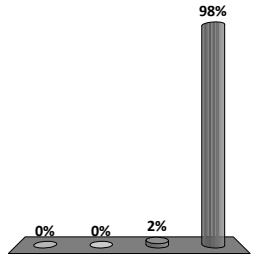

A 6 year old unvaccinated girl presents with acute onset high fever, malaise, N/V, confusion and stiff neck. Which is the most appropriate first step?

1. Administer IV dexamethasone
2. Lumbar puncture
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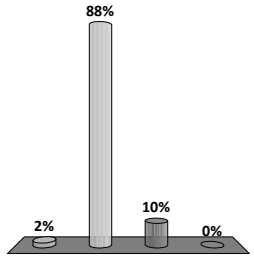

Thank you and good luck!

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