

PowerPoint 3:

Slide 1:

The items on this localization slide have been part of the extended matching section on the shelf exam in the past. Who knows how often they repeat the extended matching sections, but as a general rule of thumb, if you know this stuff, it won't be on there, but if you don't go over it, it will show up on the shelf exam.

- If you have a lesion involving the caudate nucleus, you have to think about something like Huntington's disease or Wilson's disease.
- If they have a lesion in the cerebellar hemisphere, the patient could have ataxia or dyscoordination of the limbs.
- If you have a cerebellar vermis lesion it can cause truncal ataxia.
- Cerebral peduncle can cause hemiplegia.
- Medial lemniscus can cause contralateral decreased vibration and proprioception.
- Medial longitudinal fasciculus can cause internuclear ophthalmoplegia, where the patient has difficulty adducting their eye, so if they have internuclear ophthalmoplegia on the right they are able to abduct their right eye but when they try to adduct their right eye it is slower in adduction compared to the unaffected eye.
- Medullary pyramid lesions can call hemiparesis.
- A pontine lesion can have a pontine lacunar infarct syndrome such as hemiparesis, ataxia, or dysarthria-clumsy hand syndrome, and you can also see 1 ½ syndrome.
- Subthalamic nucleus is associated with hemiballismus.
- With a thalamic lesion, we often think about sensory involvement, like thalamic pain syndrome, but you can also get a whole host of other neurological symptoms including weakness, memory loss, and visuospatial difficulty.

Slide 2:

The information on this slide has been a part of the extended matching section on the shelf exam in the past as well. They may ask you where neurotransmitter systems originate in which part of the brain.

- Acetylcholine originates in the nucleus basalis of Meynert.
- Dopamine originates in the substantia nigra.
- GABA is associated with the nucleus accumbens, and the way I remember this is that you accumulate A's in GABA, so nucleus accumbens.
- Norepinephrine is associated with locus coeruleus.
- Serotonin is associated with the raphe nucleus. So R and S go together, raphe and serotonin.

Slide 3:

I would familiarize yourself with herniation syndromes as you are preparing for the shelf exam. The shelf exam often asks a number of head injury and herniation syndrome-type questions. These are the 6 different types of herniation that are possible. I would suspect that the uncocal

and central herniation would be the most commonly referred to herniation syndromes on the shelf exam.

Slide 4:

We will talk about the individual herniation syndromes here.

- Uncal herniations are a common type of transtentorial herniation. This is where we saw on the slide before where you get the lateral displacement of the brain, so something like an epidural hematoma, when they herniate that is a transtentorial or uncal herniation. First you get contralateral hemiparesis, and then because there is a midline shift you get diminished consciousness from the effects on the reticular activating system. They get an ipsilateral third nerve palsy with a dilated pupil, and continued lateral displacement of the midbrain so you would get contralateral cortical spinal tract compression and ipsilateral hemiplegia. I would familiarize with transtentorial/uncal herniation because those are frequently asked about on the shelf exam.
- So cerebellar tonsillar herniations are probably less likely to be asked about on the exam, but this is where the cerebellar tonsils get pushed into and eventually through the foramen magnum, causing compression of the medulla and apnea.
- The central herniation is where there is diffuse brain swelling maybe from anoxic brain injury or whatever, and they get initially small reactive pupils and they get decorticate (flexor) posture, particularly of the arms, and then with midbrain failure and continued herniation, that's when they start losing the doll's eyes and cold calorics and other cranial nerve reflexes. You'll eventually get decerebrate posturing.
- Subfalcine herniation is another herniation syndrome, but I expect that it will not be asked about on the shelf exam. This would be most important for someone going into radiology because it is more likely to be a radiology pimp question than it would be to show up on the neurology shelf exam, but there is herniation in the frontal lobe beneath the falx, with signs related to the mass itself rather than to the herniation.
- Other herniation syndrome questions: if you have someone who has a head injury, and then they began to herniate, this is because of the acute cerebral edema rather than obstruction of the CSF. It is the edema that is contributing primarily to the herniation syndrome. If you have someone with a head injury and then they become hypertensive and bradycardic, with diminished respiratory response this is the Cushing's response.

Slide 5:

If you have a patient with numbness and tingling in the hands and feet, you certainly have to consider neuropathy as one of the most common causes. You have to look for treatable causes of neuropathy like fasting blood sugar, because diabetes is the most common cause of neuropathy in developed countries. You can also check hgbA1c for diabetes. You can also check vitamin B12 level because vitamin B12 deficiency can cause neuropathy symptoms as well as hypothyroidism. I would also recommend checking RPR (or syphilis antibody) for syphilis. Although it would be unlikely, you would hate to miss a treatable cause of peripheral neuropathy, particularly if they are having cognitive symptoms. You can also consider other testing such as SPEP, immunofixation electrophoresis, copper levels, and other testing.

Different people have different takes on neuropathy evaluation. Some people do step-wise approach and some people do a shotgun approach, and there are certainly arguments to be made for either one. EMG and nerve conduction studies can be helpful in the evaluation of a patient with numbness and tingling or really for many other neurologic symptoms.

The EMG is actually the needle test which looks at the spontaneous and activated activity of the muscle, and nerve conduction studies looks at the amplitude and conduction velocity and latency of the response to a series of shocks. An EMG and NCS work together even though they are separate tests but work very well in conjunction with each other. It is important to remember when somebody says they are going to order an EMG on this patient; it's implied they are going to get an EMG as well as an NCS because the EMG looks at the muscles and the muscle-nerve interaction, and the NCS looks at the health of the nerves. The EMG/NCS can be helpful anywhere in the neuro axis, from the motor neuron distal, so it can be helpful in the diagnosis of ALS or motor neuron disease or roots, plexus lesions, peripheral nerve, neuromuscular junction and muscle lesion. A lot of times students recommend EMG/NCS after they have ruled everything else out, but actually EMG/NCS can be very helpful early on in the evaluation of somebody with neuropathy because you can look and see if it's an axonal process or a demyelinating process. You can also look to see if it's mild, moderate, or severe. You can look and see if they have carpal tunnel syndrome. Do they look like they could be a good surgical candidate for treatment of carpal tunnel syndrome, so EMG/NCS really can be a pretty helpful test.

Slide 6:

The shelf exam likes to include other neuropathy syndromes. They may ask about lead poisoning, and what would draw your attention to that diagnosis would be the basophilic stippling in a patient with neuropathy.

They may also present a patient with Guillain-Barre, and in this patient you would see rapidly progressive weakness and areflexia, classically in an ascending distribution. You can certainly have patients present with Guillain-Barre with facial diplegia, so it doesn't necessarily have to be ascending, but I would expect on the shelf exam it probably would be ascending. The diagnostic test of choice for Guillain-Barre would be a lumbar puncture looking for what is called albuminocytologic dissociation - high protein with normal cells. The albuminocytologic dissociation with the high protein is from demyelination of the motor nerves.

Another Guillain-Barre-like presentation would be acute intermittent porphyria or AIP. These patients typically have recurrent abdominal pain, global weakness, and areflexia, with sensory loss and diminished vibration in the feet. Typically this is drug-induced, and maybe they took a sulfa drug. The recurrent abdominal pain with onset after the administration of a medication, you would certainly have to think about AIP.

Another type of porphyria is porphyria variegata. This is a type of porphyria where they have skin changes. They can have the abdominal pain just like AIP and they can have Guillain-Barre-

like presentation with weakness and areflexia, and what distinguishes them from AIP is the skin changes and skin photosensitivity. So if they work out in their garden, and they develop a rash on their exposed skin because of the sunlight exposure, one of the things you have to think of, especially if they have neurologic deficits would be porphyria variegata. This is different from porphyria cutanea tarda because cutanea tarda does not have the neurologic symptoms.

Another neuropathy syndrome that may show up on the shelf exam is diphtheria. In diphtheria, you would also have the Guillain-Barre-like presentation with the rapidly progressive weakness and areflexia, but they would have some significant upper respiratory symptoms. You can have prodromal upper respiratory or GI symptoms before Guillain-Barre, but with diphtheria they would be more significant. You would also often find the gray pseudomembrane. Diagnostic testing, you would also see the albuminocytologic dissociation with diphtheria just like in Guillain-Barre because of the demyelinating process.

You can also see vitamin B12 deficiency, and in vitamin B12 deficiency you would see absent ankle jerks with upgoing toes, decreased vibration and proprioception, and cognitive symptoms. The absent ankle jerks and upgoing toes are the classic presentation of B12 deficiency although we check B12 on everyone who walks in the door. Rarely do we see this classic presentation, but because there is an associated decreased vibration and proprioception, they can have an abnormal Romberg test. The Romberg test is a proprioceptive test rather than a cerebellar test. So if the vignette is that of a patient with an overly restricted diet, and they only eat carbohydrates, and they have an abnormal Romberg, then you have to consider B12 deficiency. The differential for absent reflexes and upgoing toes other than B12 deficiency you can also consider a diagnosis of Friedreich's ataxia. This would have a completely different presentation. You wouldn't have the diet changes, and this would be autosomal recessive, with onset at the age of 5-15 initially with gait changes and then the progressing into a debilitating progressive ataxia syndrome.

Last is diabetic amyotrophy, so if you have a patient who comes in with acute onset of pain in the hips and the thighs, often the pain is excruciating, followed by the weakness and atrophy of those proximal muscles, you'd have to think about diabetic amyotrophy. This primarily affects elderly diabetic patients, and it generally occurs unilaterally but the patients can be unfortunate enough to develop it on the opposite side in the future.

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I'm anticipating that somewhere along the way someone will be discussing with you obstructive sleep apneas or central sleep apneas, and in this section we will really only be going over neurologic causes of sleep disorders. Right now we will talk about narcolepsy. Narcolepsy presents with excessive daytime sleepiness, cataplexy, hypnagogic and hypnopompic hallucinations, and sleep paralysis. With excessive daytime sleepiness they often fall asleep in dangerous or socially inappropriate situations. With the cataplexy, that is really just loss of motor tone. They can have head drop or arm drop or full body drop where they completely drop to the floor, but it is not associated with loss of consciousness. So cataplexy should not be included in the differential for a syncopal event. So, in cataplexy they lose muscle tone in response to strong emotional response.

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The next sleep disorder we will talk about is restless leg syndrome. This is actually a very common cause of particularly initial insomnia, where the patient has trouble falling asleep because of a restless, antsy sensation in their legs. You want to evaluate treatable causes of restless leg syndrome such as iron deficiency. If you check their ferritin level and the level is less than 50, this would be consistent with iron deficiency and you would need to initiate iron replacement for this patient.

You also want to look for other treatable causes of restless leg-like syndromes. If you have a patient who has peripheral neuropathy, then sometimes during the day they won't notice their neuropathy symptoms, but when they lay down to go to sleep at night that is when they notice their paresthesias and the burning and tingling. So they may describe it as a restless legs-like syndrome when in actuality it is actually peripheral neuropathy. So it's important you look for treatable causes of neuropathy like diabetes, vitamin B12 deficiency, thyroid levels, etc.

As far as treatment for restless leg syndrome, we often use dopaminergic medications. This could be something like carbidopa/levodopa (Sinemet) or any of the dopamine agonists. Iron is a cofactor for dopamine synthesis so that is how the iron and the dopamine fit together.

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In the evaluation of a patient with memory loss, you have to keep the three D's in mind: Those three D's would be depression, delirium, and dementia. Depression can be very frustrating for patients and can certainly cause memory symptoms. Often patients who have depression and anxiety and other psychiatric symptoms, they have troubles concentrating, and they may appear forgetful, but in actuality it is really their difficulty concentrating. Depression certainly needs to be considered in the evaluation of memory loss. Unfortunately memory loss can be the early manifestations of Alzheimer's disease, so it is important to take a patient's depression seriously.

You have to think about delirium in the evaluation of memory loss, and the duration of the symptoms should help you figure out does this look acute like delirium or is this a more subacute or chronic condition such as in a dementing illness. There are a whole variety of metabolic and medication and other factors that can contribute to a patient's development of delirium. It is critical that you evaluate the patient's metabolic panel. You want to evaluate at their blood sugar, sodium levels, and other electrolytes. You want to look at their medication lists - Is there anything new, is there any anticholinergic medications, is there any signs of infections, whether it be a UTI or pneumonia or decubitus ulcer, or any other type of infection. So it's really important to find out what has changed in this patients health and their medications.

Lastly, you have to consider dementia. So when considering dementia in a patient it is really important to think about whether this patient has dementia or not. To determine whether or not they have dementia, you have to figure out if the cognitive symptoms affect the patient's ability to carry out their activities of daily life. If it is interfering with their daily life it is dementia, if it is not interfering, then they don't have dementia. If their cognitive symptoms are not inferring with

their daily life it is probably something like normal aging. Normal aging can be the tip of the iceberg syndrome like having trouble coming up with a person's name or they may have trouble remembering why they went into another room. Those connections may be slower to be made but eventually the connections will be made. So this is just normal aging.

Then there is Mild Cognitive Impairment, where the patient is having some mild memory symptoms, not significant to interfere with their daily life, but they appear to be greater than just normal aging, and this is what we call Mild Cognitive Impairment. Patients with MCI are at an increased risk to develop dementia. There are also different things that can cause MCI. MCI of the Alzheimer's type is the most common cause but you can also have vascular-related MCI, and drug induced, and other causes of MCI as well but if their cognitive symptoms are interfering with their everyday life then you have to conclude that this patient has dementia and consider what type of dementia.

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If you have diagnosed a patient with dementia, that the cognitive symptoms are interfering with their daily life, now you have to think about the different causes of dementia. So when you are in talking with a patient in the evaluation of dementia, you need to ask about any other associated factors. Are they having any associated neurologic events? Have they ever had a stroke? Have they ever had any weakness or any other neurologic symptoms? You want to find out the duration of these symptoms. How long has this been going on? Has this been a rapidly progressive thing over the last 6 months or has this been gradually progressive over the last few years? Has there been a step-wise progression? If you are thinking Alzheimer's disease you would expect this to be a gradual onset and gradual progression of cognitive decline, typically in an older patient. The initial symptoms are often memory loss and executive dysfunction. Your typical Alzheimer's patient would gradually have more difficult planning activities and participating in community activities like having difficulty driving and getting to where they need to go. They will start to repeating themselves and will start having more difficulty around the home, doing chores, etc.

In a patient with vascular dementia, you would expect to see a step-wise progression perhaps after a stroke before onset of the cognitive problems. If they have a lot of cardiac disease history, like they have had several heart attacks or have had bypass surgery, diabetes, hypertension, hyperlipidemia, or smoking, particularly if they have history of step-wise progression, you have to think about vascular dementia.

In frontotemporal dementia you want to ask if there has been any personality or behavioral change from the frontal lobe, but the frontal and temporal lobes also supply language function, so you want to find out if they are having any troubles expressing themselves or any receptive aphasia. So, it is not just the personality and behavior change but they often have associated language dysfunction. These patients are often typically younger than your typical Alzheimer's patients, so if someone presents in their 50s, and if they are starting to have dementia symptoms you have to think about frontotemporal dementia.

Another consideration is a Parkinson's syndrome like dementia with Lewy bodies. If you have a patient with cogwheel rigidity, masked face, gait instability, shuffling or festinating gait, resting tremor, bradykinesia, or any of the other classic symptoms of Parkinson's, and they are having more cognitive symptoms than you would expect, perhaps this is dementia with Lewy bodies. Also with dementia with Lewy bodies you will frequently see visual hallucinations. These are often small people or animals, and they are often formed hallucinations. Often in dementia with Lewy bodies you will also see fluctuations in cognitive function, so if there are big swings in their cognitive function, particularly in a patient with parkinsonian symptoms and exam findings then you need to consider dementia with Lewy bodies. You also want to ask the patient and loved one if there are any gait, tremor or other motor symptom issues which would make you believe it is a Parkinson's syndrome like dementia with Lewy bodies.

If they have a rapidly progressive cognitive decline then you have to think about a prion disease like CJD. CJD doesn't only have the rapidly progressive cognitive decline, but they also have associated exaggerated startle response, myoclonic jerks, EEG changes with periodic complexes on EEG which would be suggestive of CJD. The most commonly recognized symptom of CJD would be the rapid progression where within months the patient is getting lost within their own home and perhaps not recognizing family members and things we wouldn't expect until much later in the disease process like in Alzheimer's disease.

The last dementia syndrome causes would be normal pressure hydrocephalus which was discussed earlier in this review, and these patients are typically wet, wobbly, and wacky. They have the urinary incontinence, gait issues, and cognitive symptoms. It is important to remember that not all patients who have gait issues, gait instability, and incontinence and cognitive problems have normal pressure hydrocephalus, and so it's really important to examine your patients and look at their imaging to make that diagnosis. The treatment of choice for NPH is VP shunt placement and typically neurosurgeons want to know if the patient will be shunt responsive, so you can do a short-term shunt where you do a high volume lumbar puncture and take off at least 25 or 30 cc of CSF. You want to do a gait evaluation prior to and immediately following the lumbar puncture. You don't want to have the patient lying there for a couple hours recovering from their LP because you are looking for a symptomatic improvement, particularly in the gait, with the high volume lumbar puncture. So what you would expect to see immediately following the LP there would be improvement in the gait because reduction in the size of the ventricles would reduce the pressure on the leg fibers when you think of the homunculus and later that evening you would expect to see slightly worsening of their gait as they reaccumulate their CSF, and by the next day often the gait is back to normal. We often recommend getting a physical therapy evaluation for formal documentation of gait changes prior to and immediately following the LP. We don't generally see the changes in urinary incontinence in that short period of time, it's typically the gait changes. So if there is documented improvement in the gait then you can refer them to neurosurgery for possible shunt placement.

When considering others causes of memory loss you have to think about thiamine deficiency. So if you have a patient who has an acute onset of confusional state with ophthalmoplegia and ataxia then you have to think about Wernicke's encephalopathy. If they go on to develop

memory loss and confabulation, then that is Korsakoff's. The use of thiamine prevents anterograde amnesia and prevents the Korsakoff's.

Other cognitive symptoms can be seen in an AIDS patient with progressive memory loss. This patient with non-enhancing white matter lesions on MRI scan from PML. Other AIDS neuroradiology findings would be if you have ring-enhancing lesions in an AIDS patient - You have to think about toxo. Typically they treat patients for toxo, and then repeat for imaging and if there is no response to therapy then think about tumor like lymphoma.

Sometimes they present a vignette on the shelf exam where they give you a patient presentation and then you have to go through step-by-step with the choices to figure out what the patient has. So if you have a patient with a history of 5-6 month of falling and progressive lethargy and headache and on the exam they are found to have left sided weakness, hyperreflexia and upgoing toes on the left we would not expect this to be a stroke because you would not expect to see progressive changes in their exam over time. You would expect to be acute onset and stabilization of perhaps improvement. You would not expect this to be hydrocephalus because of the unilateral nature of the findings. You would not expect this to be infratentorial because they don't have particularly cerebellar exam findings, so the answer would be supratentorial in this particular situation.

Sometimes they give you patient like a 20 year old woman who comes in with acute onset of mental status change, hallucinations, and she is disheveled. Certainly some students, rightfully so, would consider the possibility of something like intoxication and check drug screen or alcohol level to make sure they aren't missing something, but this also could also be something like schizophrenia but I would ask you to first check the neuroimaging of the brain to make sure it is not vasculitis. You would need to make sure there are not multiple small strokes as you would expect to see in vasculitis.

As we discussed earlier, depression can certainly cause memory loss issues like in pseudodementia. Actually a patient can have cognitive symptoms and MMSE down to 25 with depression, so you really have to look at the rest of the symptoms and decide if it is really just depression or if it something else as well. You would expect bereavement to last less than or equal to 2 months.

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As I alluded to earlier, if you have a patient who has relatively acute onset of cognitive changes, and it looks like delirium or encephalopathy, then you have to consider metabolic changes like hyponatremia and hypoglycemia but you also have to consider overdose. Maybe the patient has overdosed on opioids or any other medications. You would want to do drug screening, alcohol level, and get a careful medication history. You also want to consider anticholinergic use particularly in an elderly patient or infection like a urinary tract infection, pneumonia, or decubitus ulcer, or any other cause of infection. Also in the right setting you have to think about a herniation syndrome. If they are progressively declining, becoming more and more somnolent, particularly if they have dilated pupil or pupils then you certainly have to consider herniation and check imaging to evaluate that. It could be a seizure. They could be having

complex partial seizures that is mental status change. You also have to consider hypoxia and check the oxygen levels and make sure the oxygen level is appropriate. You might have a patient who gets admitted to the hospital for a routine surgical procedure, and a couple days post operatively the incision is clean, dry, and intact, and there is no infection or fever, but the patient becomes nauseated, tremulousness, anxious, and irritable, one of the things you have to consider is benzodiazepine withdrawal.