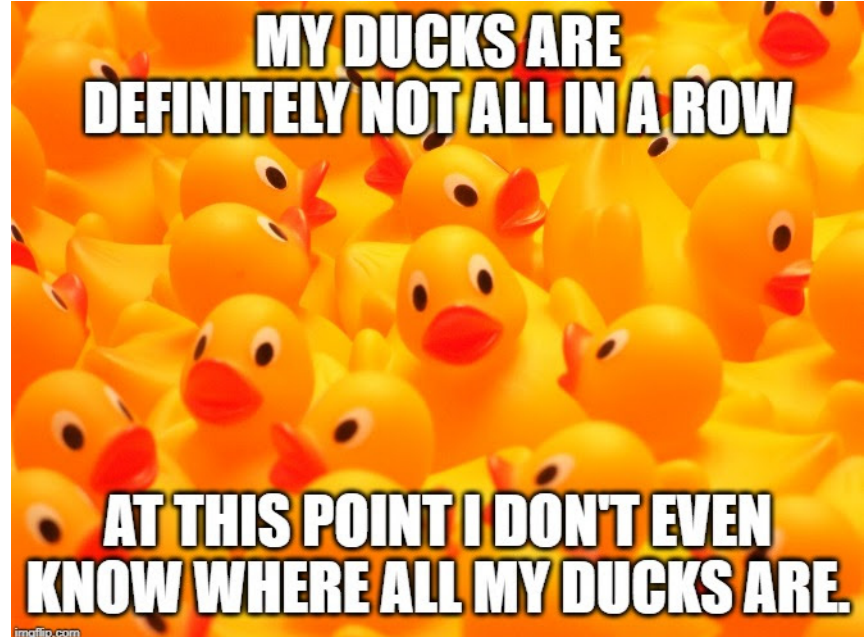


# Everything You Need to Know About the Tilt: Vestibular Disease in Dogs and Cats

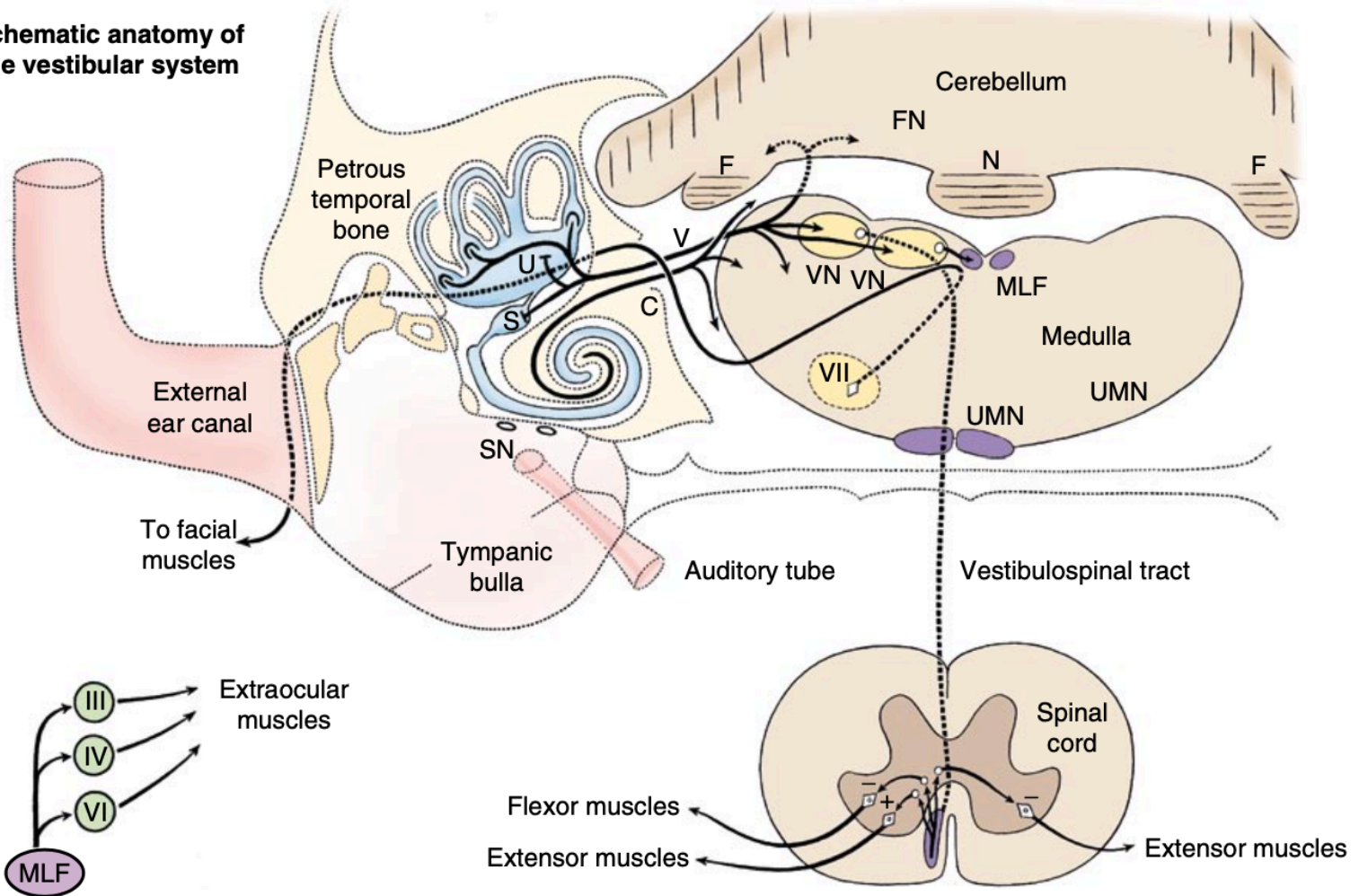
Rebecca McBride, DVM, MS, Diplomate, ACVIM (Neurology)

# Outline

- Anatomy and physiology of the vestibular system
- Neurolocalization
  - Peripheral
  - Central
- Differential diagnoses
- Diagnostics
- Treatment
- Case examples

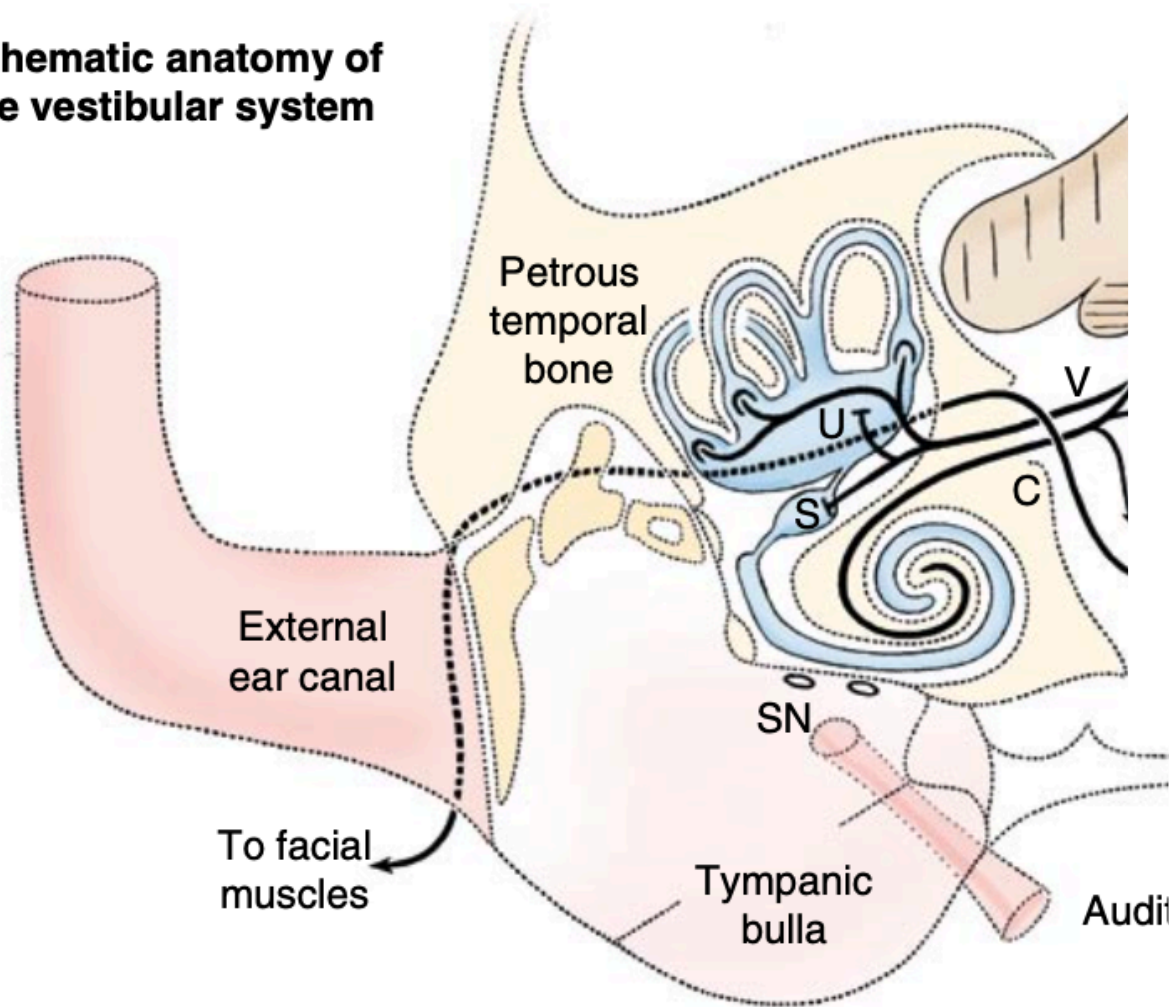


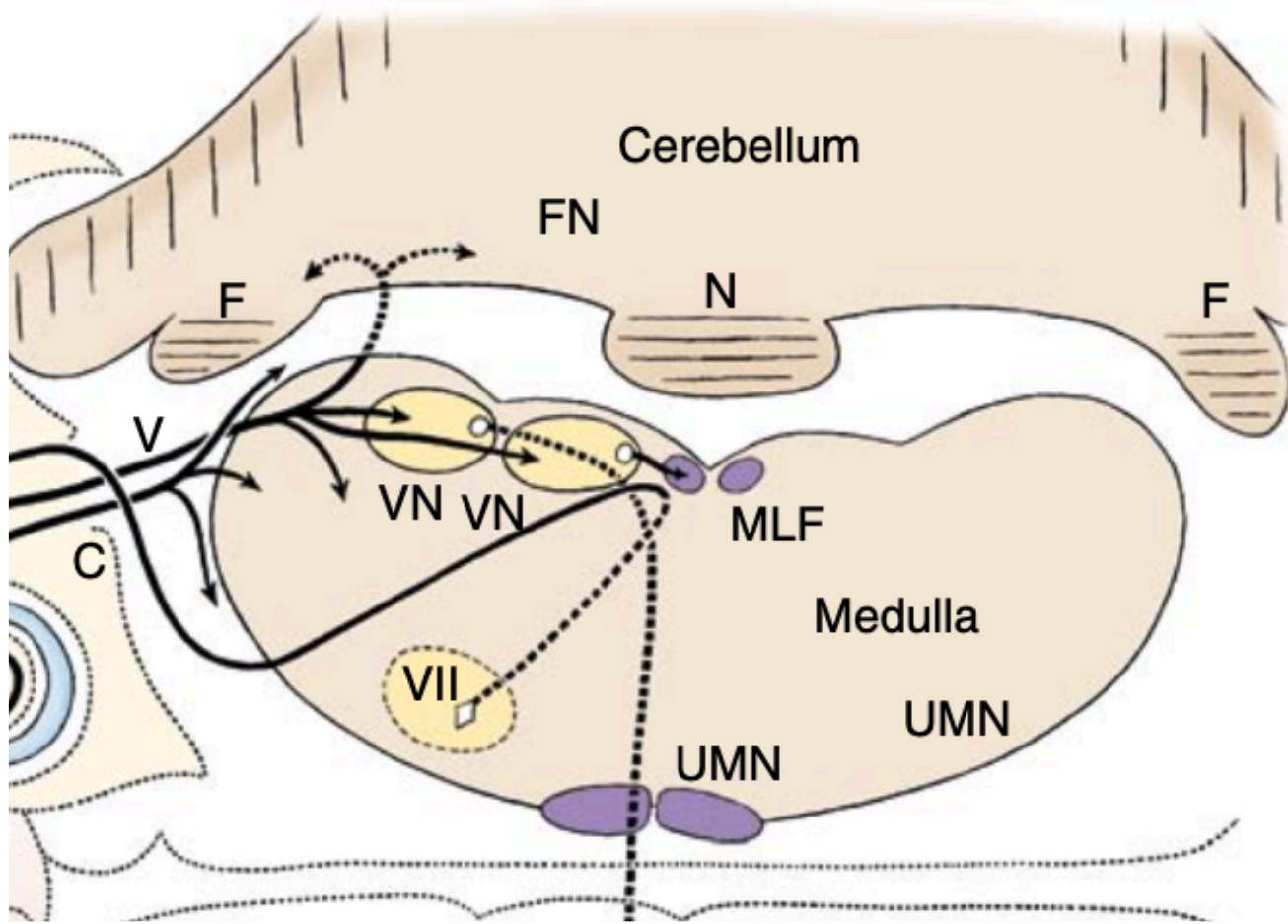
**Schematic anatomy of the vestibular system**

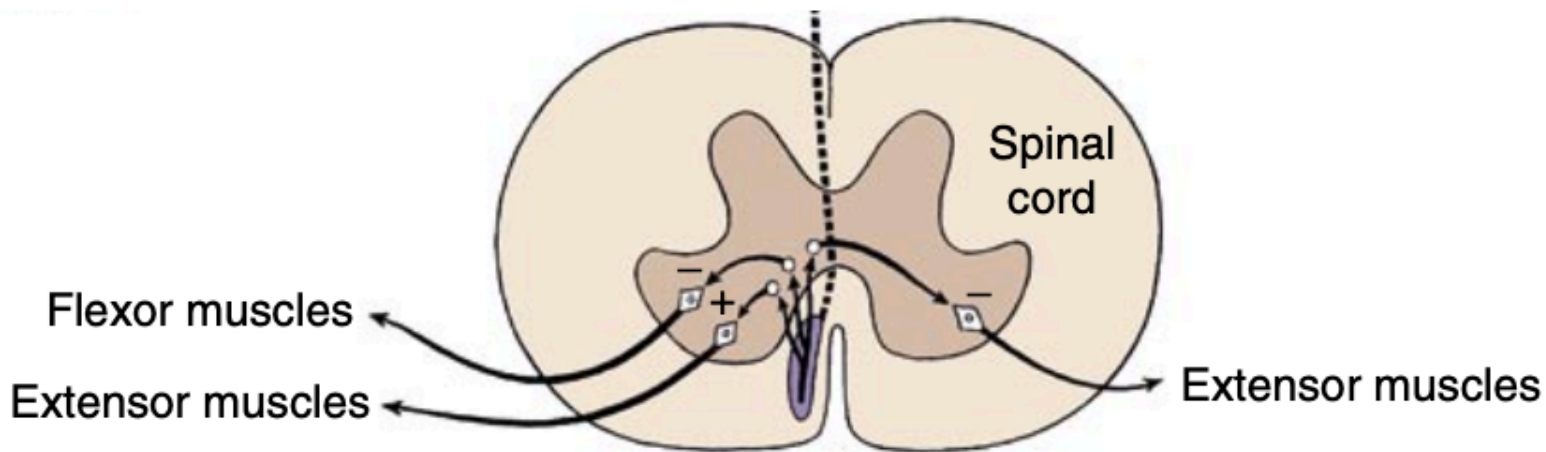
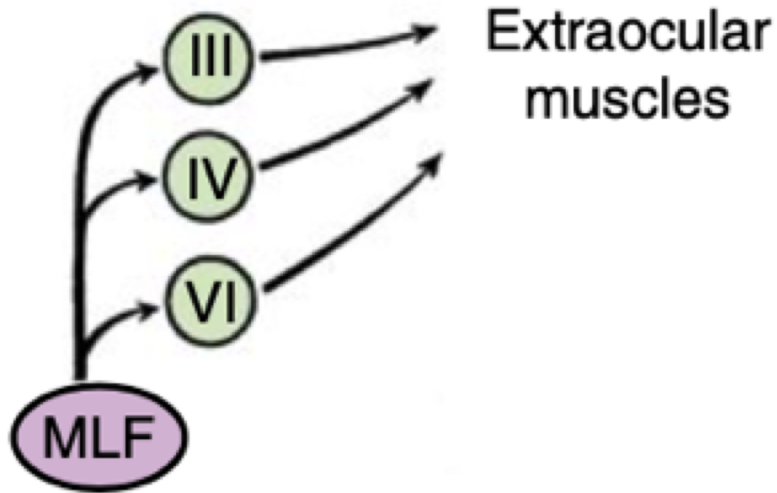


**FIGURE 12-2** Schematic anatomy of the vestibular system. *III*, Oculomotor nucleus; *IV*, trochlear nucleus; *VI*, abducent nucleus; *VII*, facial nucleus; *C*, cranial nerve VIII—cochlear portion; *V*, cranial nerve VIII—vestibular portion; *F*, flocculus; *FN*, fastigial nucleus; *MLF*, medial longitudinal fasciculus; *N*, nodulus; *S*, saccule; *SN*, sympathetic neurons; *U*, utricle; *UMN*, upper motor neuron; *VN*, vestibular nucleus.

# Schematic anatomy of the vestibular system

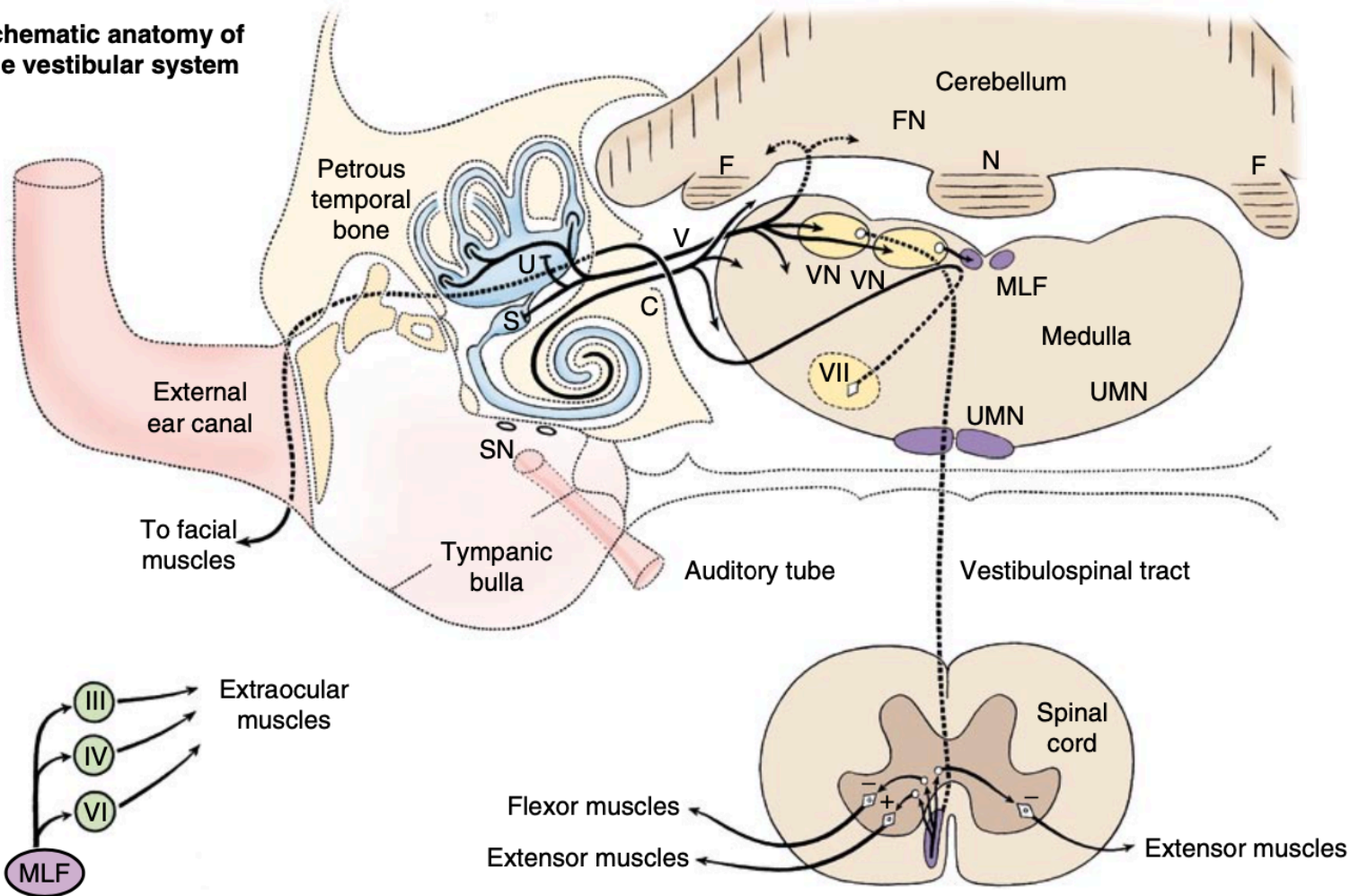






ocular system. *III*, Oculomotor nucleus; *IV*, trochlear nucleus; *VI*, abducent nucleus; portion; *V*, cranial nerve VIII—vestibular portion; *F*, flocculus; *FN*, fastigial nucleus; *MLF*, medial longitudinal fasciculus; *SN*, sympathetic neurons; *U*, utricle; *UMN*, upper motor neuron; *VN*, vestibular nucleus.

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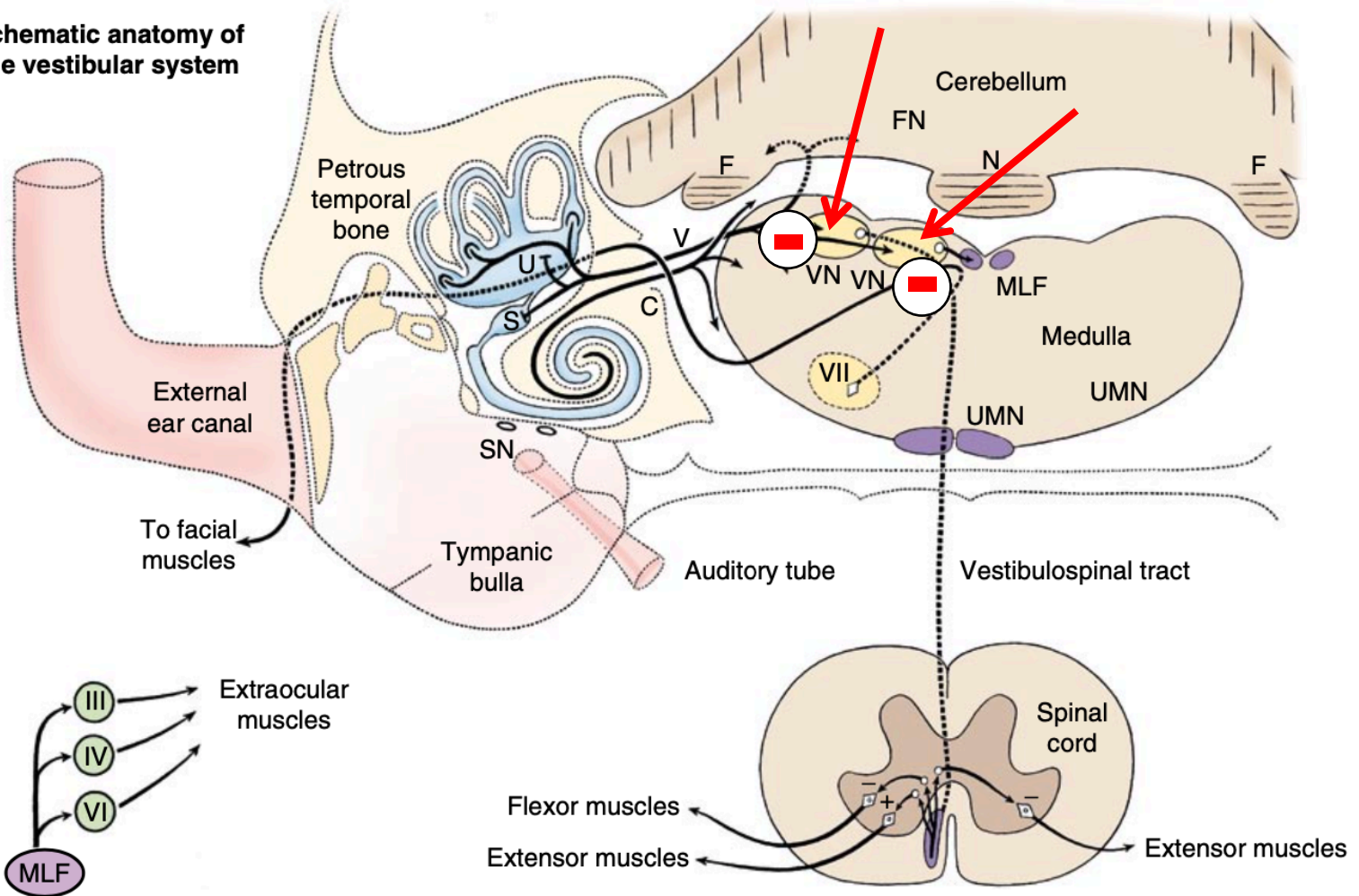
# Vestibular System and Cerebellum



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**Schematic anatomy of the vestibular system**



**FIGURE 12-2** Schematic anatomy of the vestibular system. *III*, Oculomotor nucleus; *IV*, trochlear nucleus; *VI*, abducent nucleus; *VII*, facial nucleus; *C*, cranial nerve VIII—cochlear portion; *V*, cranial nerve VIII—vestibular portion; *F*, flocculus; *FN*, fastigial nucleus; *MLF*, medial longitudinal fasciculus; *N*, nodulus; *S*, saccule; *SN*, sympathetic neurons; *U*, utricle; *UMN*, upper motor neuron; *VN*, vestibular nucleus.

What are some clinical signs we can see associated with vestibular disease?



# Neurolocalization

Clinical Signs	Peripheral	Central (brainstem)	Central (cerebellum)
Head tilt			
Nystagmus			
Other Cranial Nerves			
Postural Reactions*			
Mentation			
Gait			
Horner syndrome			

# Neurolocalization

Clinical Signs	Peripheral	Central (brainstem)	Central (cerebellum)
Head tilt	Towards the lesion	Towards the lesion	Away from lesion
Nystagmus			
Other Cranial Nerves			
Postural Reactions*			
Mentation			
Gait			
Horner syndrome			

# Neurolocalization

Clinical Signs	Peripheral	Central (brainstem)	Central (cerebellum)
Head tilt	Towards the lesion	Towards the lesion	Away from lesion
Nystagmus	Horizontal (away from the lesion), Rotary	Horizontal (away from lesion), Rotary, Vertical, Dysconjugate	Horizontal (towards lesion), Rotary, Vertical, Dysconjugate
Other Cranial Nerves			
Postural Reactions*			
Mentation			
Gait			
Horner syndrome			

# Nystagmus



Dysconjugate

# Nystagmus



Vertical

# Neurolocalization

Clinical Signs	Peripheral	Central (brainstem)	Central (cerebellum)
Head tilt	Towards the lesion	Towards the lesion	Away from lesion
Nystagmus	Horizontal (away from the lesion), Rotary	Horizontal (away from lesion), Rotary, Vertical, Dysconjugate	Horizontal (towards lesion), Rotary, Vertical, Dysconjugate
Other Cranial Nerves			
Postural Reactions*			
Mentation			
Gait			
Horner syndrome			



# Neurolocalization

Clinical Signs	Peripheral	Central (brainstem)	Central (cerebellum)
Head tilt	Towards the lesion	Towards the lesion	Away from lesion
Nystagmus	Horizontal (away from the lesion), Rotary	Horizontal (away from lesion), Rotary, Vertical, Dysconjugate	Horizontal (towards lesion), Rotary, Vertical, Dysconjugate
Other Cranial Nerves	+/- VII	+/- III-XII	+/- menace deficit
Postural Reactions*			
Mentation			
Gait			
Horner syndrome			

# Other Cranial Nerves



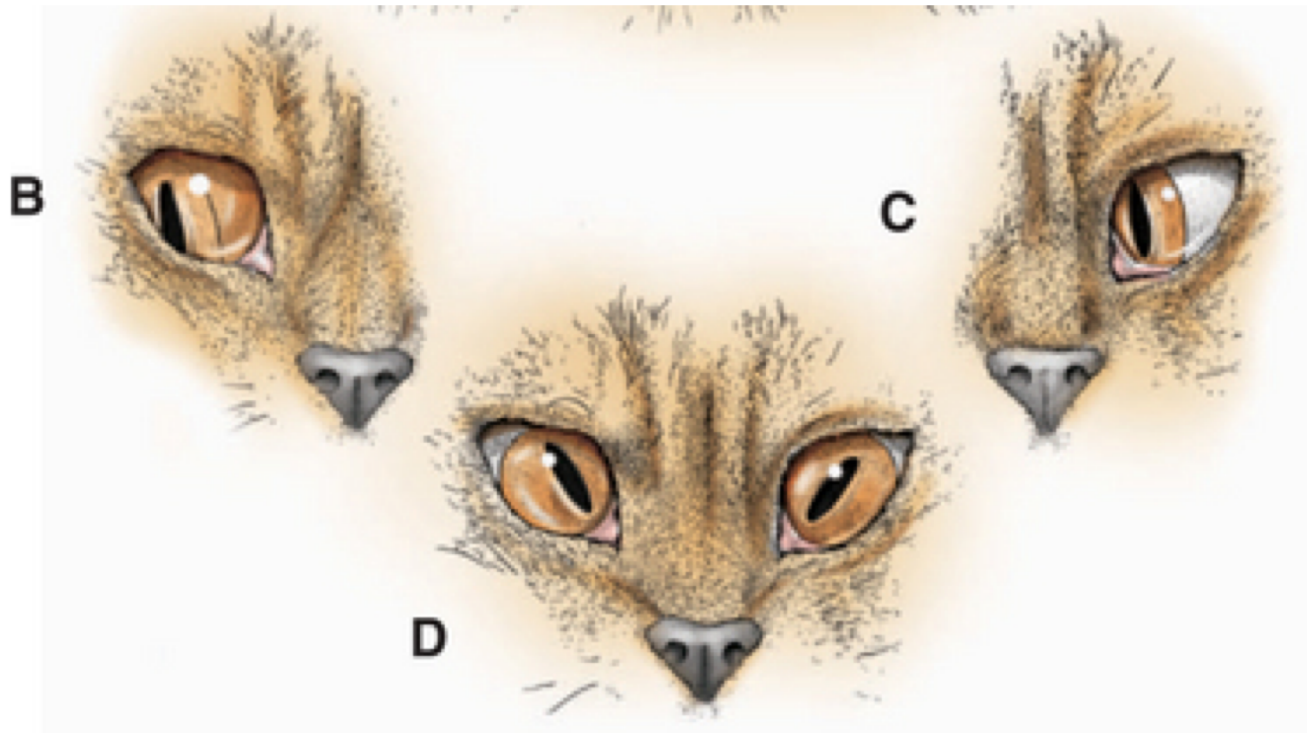
CN VII: Facial Nerve

# Other Cranial Nerves



CN III: Oculomotor

# Other Cranial Nerves



B: CN III: Oculomotor

C: CN VI: Abducens

D: CN IV: Trochlear

# Other Cranial Nerves



CN V: Trigeminal



CN VII: Facial Nerve

# Other Cranial Nerves



CN VI: Abducens

# Other Cranial Nerves



CN XII: Hypoglossal



# Neurolocalization

Clinical Signs	Peripheral	Central (brainstem)	Central (cerebellum)
Head tilt	Towards the lesion	Towards the lesion	Away from lesion
Nystagmus	Horizontal (away from the lesion), Rotary	Horizontal (away from lesion), Rotary, Vertical, Dysconjugate	Horizontal (towards lesion), Rotary, Vertical, Dysconjugate
Other Cranial Nerves	+/- VII	+/- III-XII	+/- menace deficit
Postural Reactions*			
Mentation			
Gait			
Horner syndrome			

# Neurolocalization

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Postural Reactions*	Normal	Decreased ipsilateral to head tilt	Decreased contralateral to head tilt
Mentation			
Gait			
Horner syndrome			

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Mentation	Normal	+/- Abnormal	Normal
Gait			
Horner syndrome			

# Neurolocalization

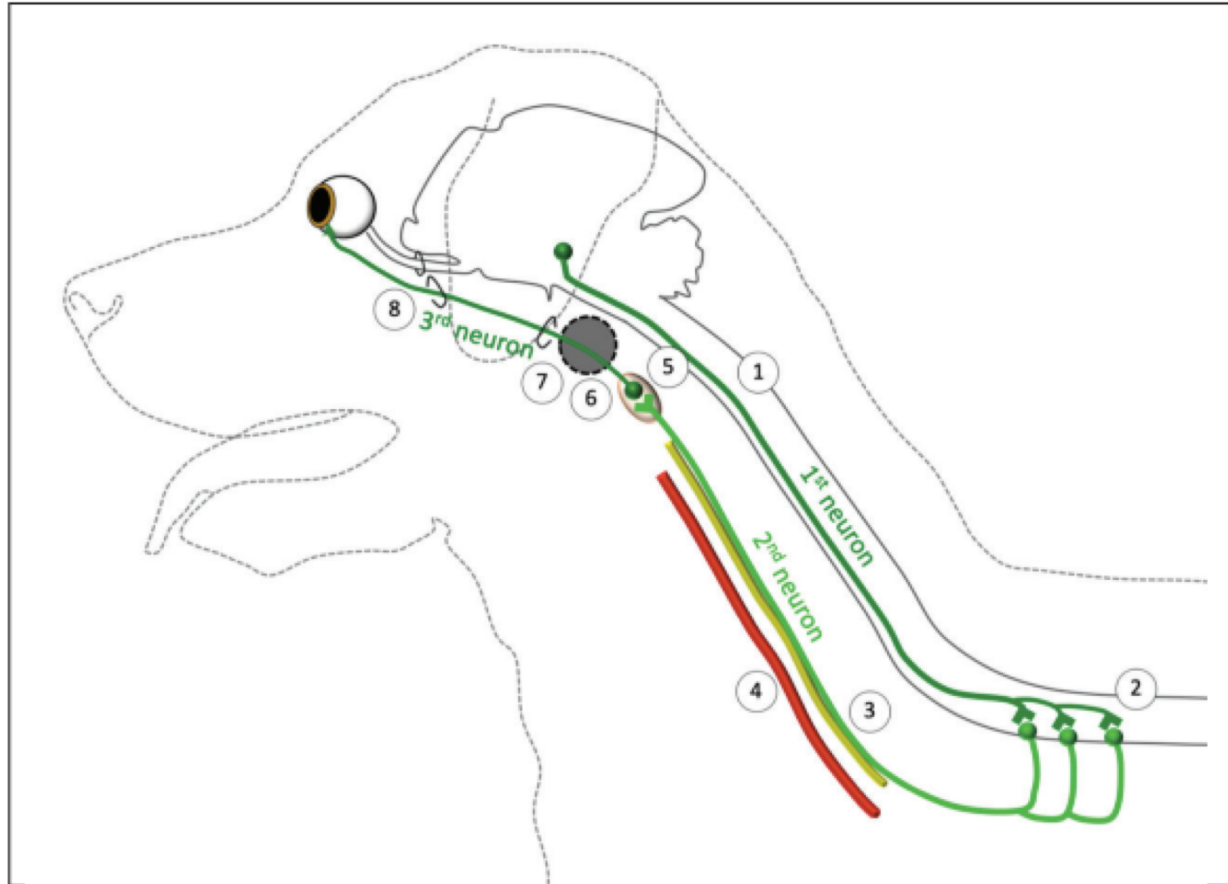
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Other Cranial Nerves	+/- VII	+/- III-XII	+/- menace deficit
Postural Reactions*	Normal	Decreased ipsilateral to head tilt	Decreased contralateral to head tilt
Mentation	Normal	+/- Abnormal	Normal
Gait	Vestibular ataxia	Vestibular ataxia, +/- general proprioceptive ataxia	Vestibular ataxia, +/- cerebellar ataxia (hypermetria, titubation, intention tremors)
Horner syndrome			

# Horner Syndrome

- Ptosis (eyelid drooping)
- Enophthalmos
- Miosis (smaller pupil)
- Elevated third eye-lid



# Sympathetic Innervation to the Eye



**Figure 1:** Neuroanatomic pathway for sympathetic innervation to the eye. (1) lateral tectotegmentospinal tract; (2) T1 to T3 spinal cord segments; (3) vagosympathetic trunk; (4) carotid sheath; (5) cranial cervical ganglion; (6) tympanic bulla; (7) tympano-occipital fissure; (8) orbital fissure

# Neurolocalization

Clinical Signs	Peripheral	Central (brainstem)	Central (cerebellum)
Head tilt	Towards the lesion	Towards the lesion	Away from lesion
Nystagmus	Horizontal (away from the lesion), Rotary	Horizontal (away from lesion), Rotary, Vertical, Dysconjugate	Horizontal (towards lesion), Rotary, Vertical, Dysconjugate
Other Cranial Nerves	+/- VII	+/- III-XII	+/- menace deficit
Postural Reactions*	Normal	Decreased ipsilateral to head tilt	Decreased contralateral to head tilt
Mentation	Normal	+/- Abnormal	Normal
Gait	Vestibular ataxia	Vestibular ataxia, +/- general proprioceptive ataxia	Vestibular ataxia, +/- cerebellar ataxia (hypermetria, titubation, intention tremors)
Horner syndrome	Possible!	No (rarely yes, sorry)	No

# Neurolocalization: Simplified

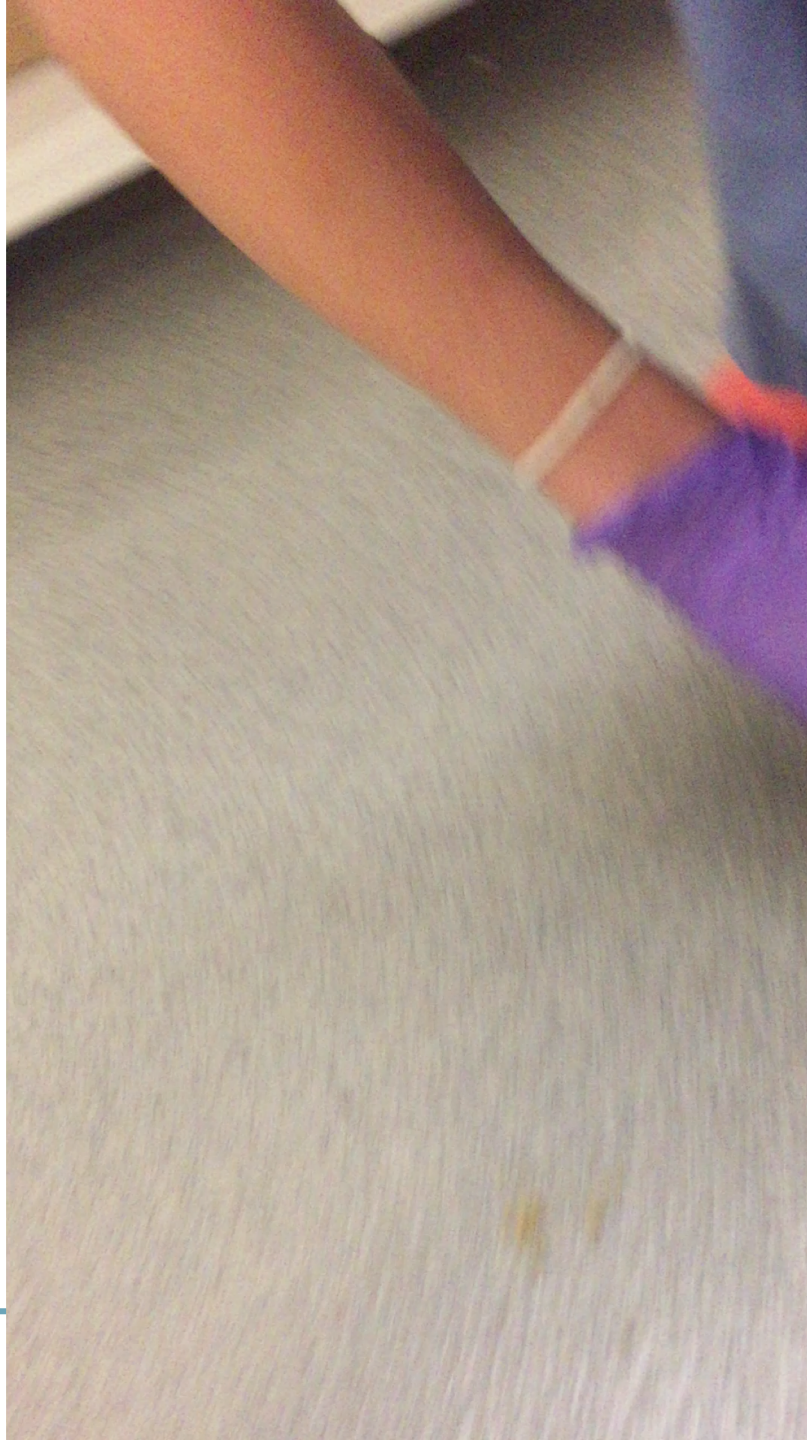
Clinical Signs	Peripheral	Central
Nystagmus	Horizontal (away from the lesion), Rotary	Horizontal (away from lesion), Rotary, Vertical, Dysconjugate
Other Cranial Nerves	+/- VII	+/- III-XII
Postural Reactions*	Normal	Decreased; worse on one side
Mentation	Normal	+/- Abnormal
Gait	Vestibular ataxia	Vestibular ataxia, +/-general proprioceptive ataxia +/- cerebellar ataxia (hypermetria, titubation, intention tremors)
Horner syndrome	Possible!	No (rarely yes, sorry)



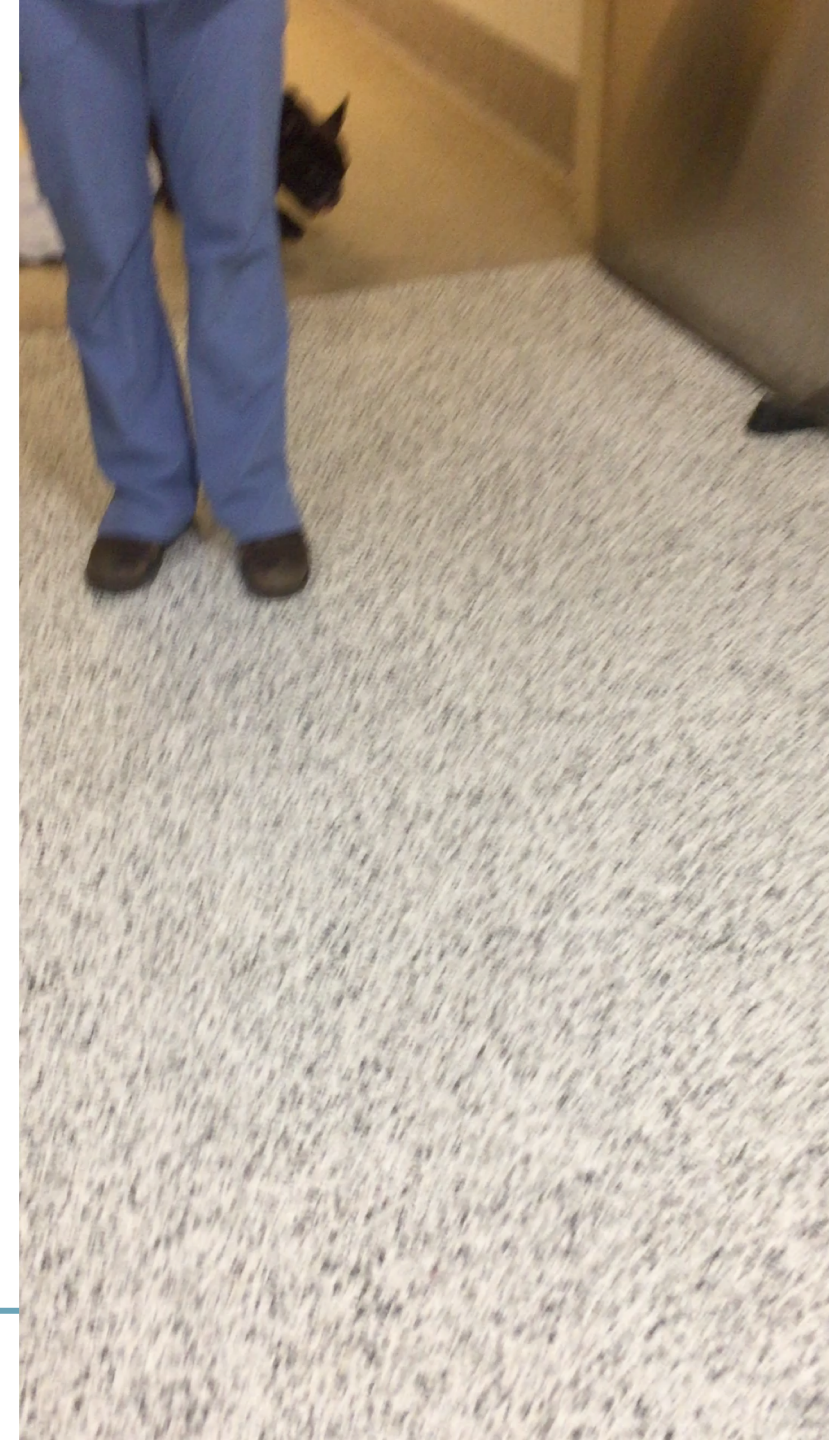
**Let's practice!**

<http://www.neurovideos.vet.cornell.edu/Video.aspx?vid=12-03#>





<http://www.neurovideos.vet.cornell.edu/Video.aspx?vid=12-05#>



# Differential Diagnoses: Central

- **Degenerative:** Storage diseases
- **Anomaly:** congenital malformation, Chiari-like malformation
- **Metabolic:** thiamine deficiency (cats primarily), hypothyroidism, portosystemic shunt
- **Neoplasia:** meningioma, glioma, lymphoma, etc.
- **Infectious/Inflammatory/Idiopathic:** autoimmune (MUE), infectious (FIP, FeLV, FIV, distemper, toxoplasmosis/neospora,
- **Trauma/Toxin:** metronidazole toxicity (>50mg/kg/day)
- **Vascular:** stroke (especially cerebellar)

# Differential Diagnoses: Peripheral

- **Degenerative:** No
- **Anomaly:** Congenital (GSD, English Cocker, Doberman, Fox terrier, Siamese, Burmese, Tonkinese)
- **Metabolic:** Hypothyroidism
- **Neoplasia:** Yes
- **Infectious/Inflammatory/Idiopathic:** otitis media/interna, idiopathic (Old dog vestibular)
- **Trauma/Toxin:** ototoxic drugs (aminoglycosides), tympanic membrane rupture
- **Vascular:** No



# Diagnostics

- **CBC:** thrombocytosis, thrombocytopenia, microcytic anemia (PSS)
- **Chem:** liver values, kidney values, liver synthetic function (PSS), ALP
- **UA:** proteinuria, USG
- **T4:** hypothyroidism vs hyperthyroidism leading to vascular event
  - \*\*\*If low, follow up with MSU panel to r/o sick euthyroid\*\*\*
- **Blood pressure:** hypertension leading to vascular event
- **Fundic exam:** retinal hemorrhages

# Diagnostics

- **Chest radiographs:** look for evidence of pulmonary metastases
- **Otoscopic exam:** check integrity of the tympanic membrane
- **Skull radiographs:** not useful
- **Thiamine levels:** history dependent
- **Toxoplasmosis/Neospora titers:** toxo (dogs, cats), neospora (dogs only)

# Treatments

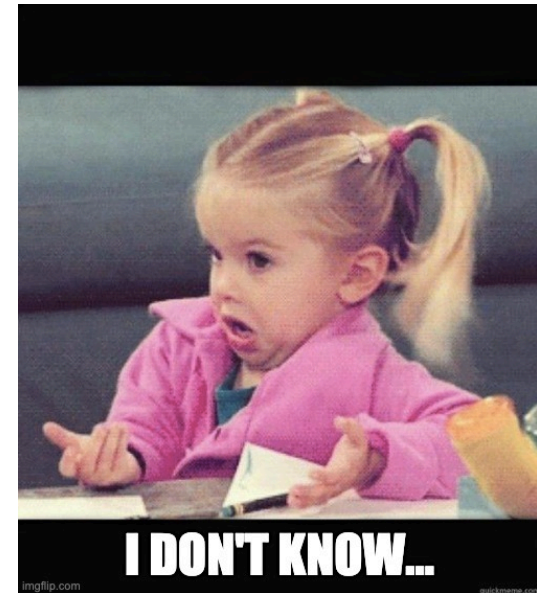
- Treat any **co-morbidities** that could lead to **vascular event**
  - Cushings, hypertension, CKD/PLN, PLE, hyperthyroidism, heart disease, etc
- **Otitis media/interna:**
  - **Antibiotics:** clavamox, cephalixin for at least 8 WEEKS
  - **Anti-inflammatory:** NSAIDs or low dose prednisone
  - Clindamycin does not penetrate bone well / treat *Pasturella multocida*
  - Potentially VBO
- **Hypothyroidism:** levothyroxine (if confirmed via MSU panel)

# Treatments

- **Thiamine supplement:** 100mg SQ for 3-5 days
- **Dizziness / symptoms:**
  - Meclizine (4mg/kg PO q24)
  - Ondanestron (0.5-1mg/kg q 12 PO or IV)
  - Cerenia (1mg/kg q24 IV; 2-4mg/kg PO q24)

# When to Refer:

- Central vestibular disease
- Rapidly progressive worsening of vestibular signs
- Not improving with medical management

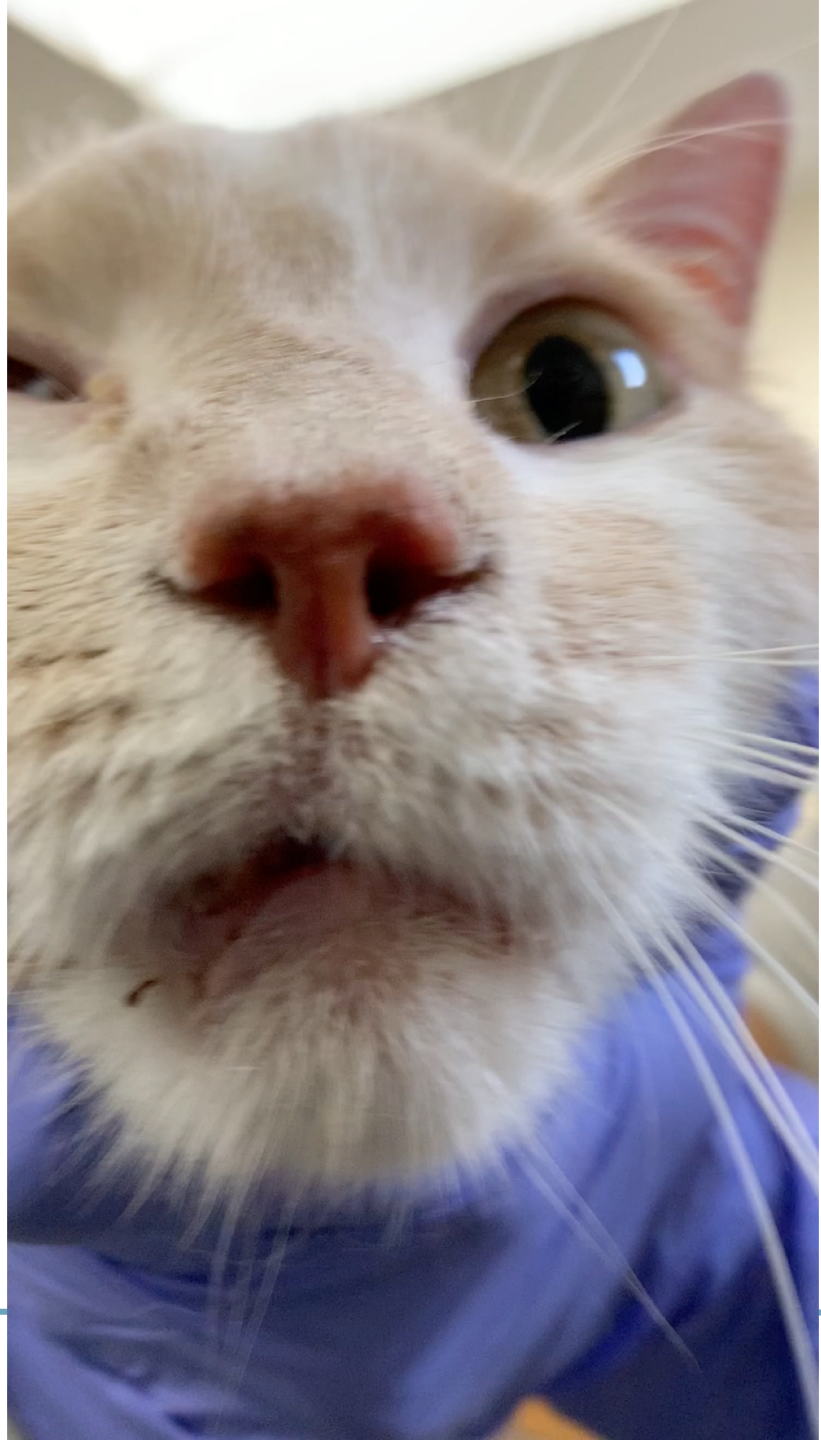


# Case Examples

# Case 1

- 12 yo MC DSH
- 1 month hx of vestibular signs and discharge AD
- Treated with clavamox and prednisone by rDVM and no improvement
- Otoscopic exam showed ruptured ear drum AD and purulent material
- Stertorous





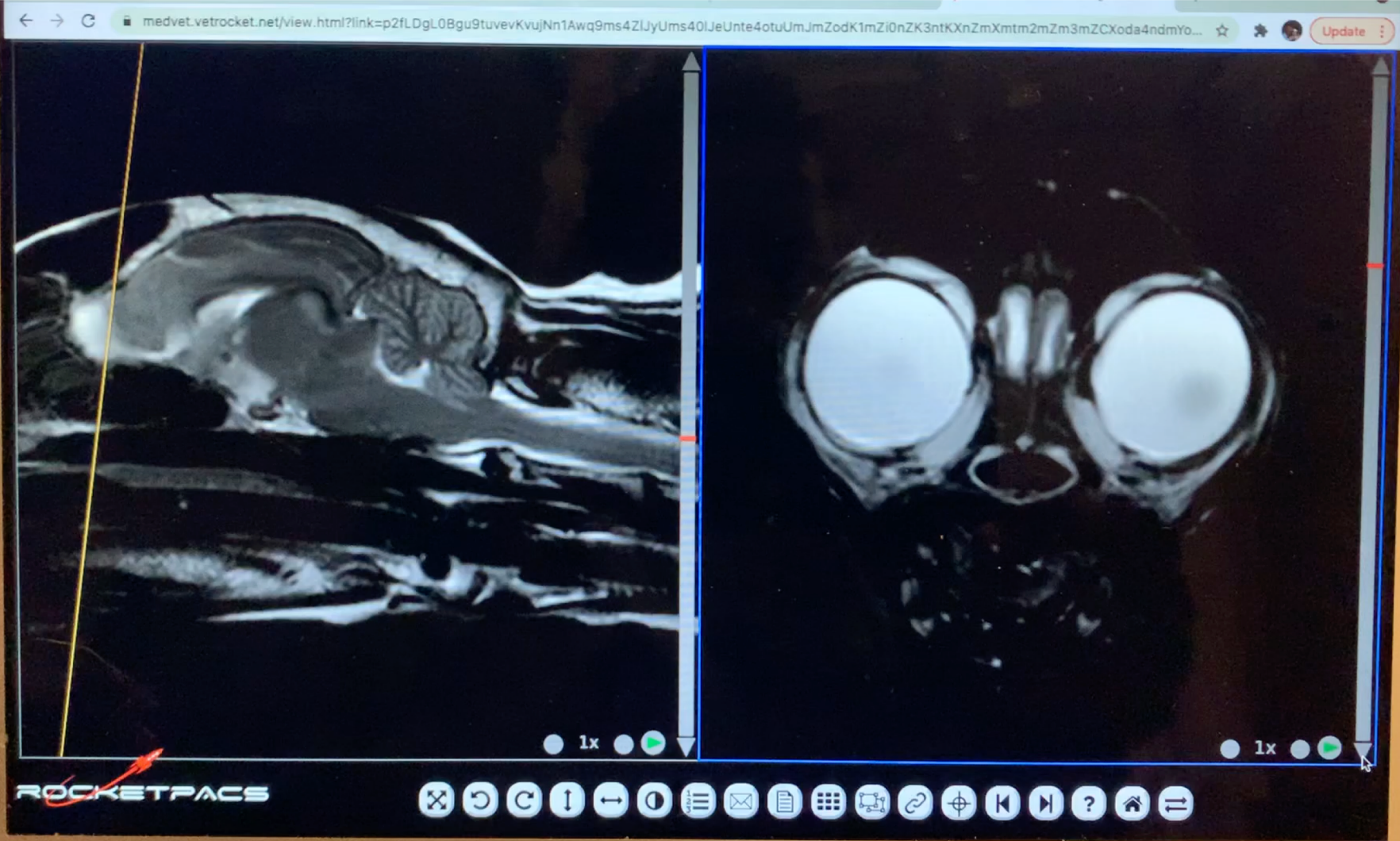


# Neuro Exam Summarized:

- **Mentation:** normal
- **Cranial nerves:** Circling to the right, right sided head tilt, Horner syndrome OD, facial nerve paralysis on the right
- **Posture:** Right head tilt and right sided head turn
- **Gait:** Circling to the right, vestibular ataxia
- **Postural reactions:** Decreased extensor postural thrust on the right, delayed hopping in the right thoracic

# Case 1

- Neurolocalization?
  - Central vestibular
- Differentials?
  - Otitis media/interna with intracranial extension
  - Other infectious (e.g. FIP, toxoplasmosis)
  - Neoplasia
- Plan?
  - CBC/Chem
  - CXR
  - MRI +/- CSF tap



# Outcome

- True cut biopsy of the mass was taken
- Sent home on prednisone and clavamox while awaiting cytology
- Unfortunately, Dash declined two days later and was completely non-ambulatory and non-responsive; owners elected euthanasia
- Cytology revealed an aggressive sarcoma

## Case 2

- 4 yo FS DSH
- “Doing a weird head bobbing thing”



# Case 2

- Neurolocalization?
  - Bilateral peripheral vestibular disease
- Differentials?
  - Otitis media/interna\*
  - Ototoxic drugs
  - Trauma?
  - Neoplasia
- Plan?
  - CBC/Chem
  - MRI +/- CSF tap or CT



# Outcome

- Treated with clavamox for 8 weeks and anti-inflammatory prednisolone
- Clinical signs resolved
- Owners elected not to pursue repeat imaging



# Case 3

- 9 yo FS DSH
- New onset vestibular signs
- Fed only sardines and goats milk (ew...)



**Lu**  
**DSH**  
**FS**  
**9 yrs**  
**#491936**

# Neurologic Exam Summarized:

- **Gait:**

- Ambulatory
- Vestibular and cerebellar ataxia
- Intermittent truncal swaying
- Falling to the left
- Tight circling in both directions
- Crouched gait

- **Mentation:** Obtunded

- **Posture:** Left and right sided head tilt

- **Cranial Nerves:**

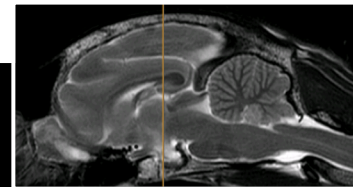
- Absent menace OU
- Vertical positional nystagmus with extension of the head and on dorsal recumbency
- Decreased nasal sensation bilaterally

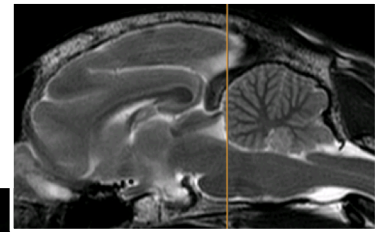
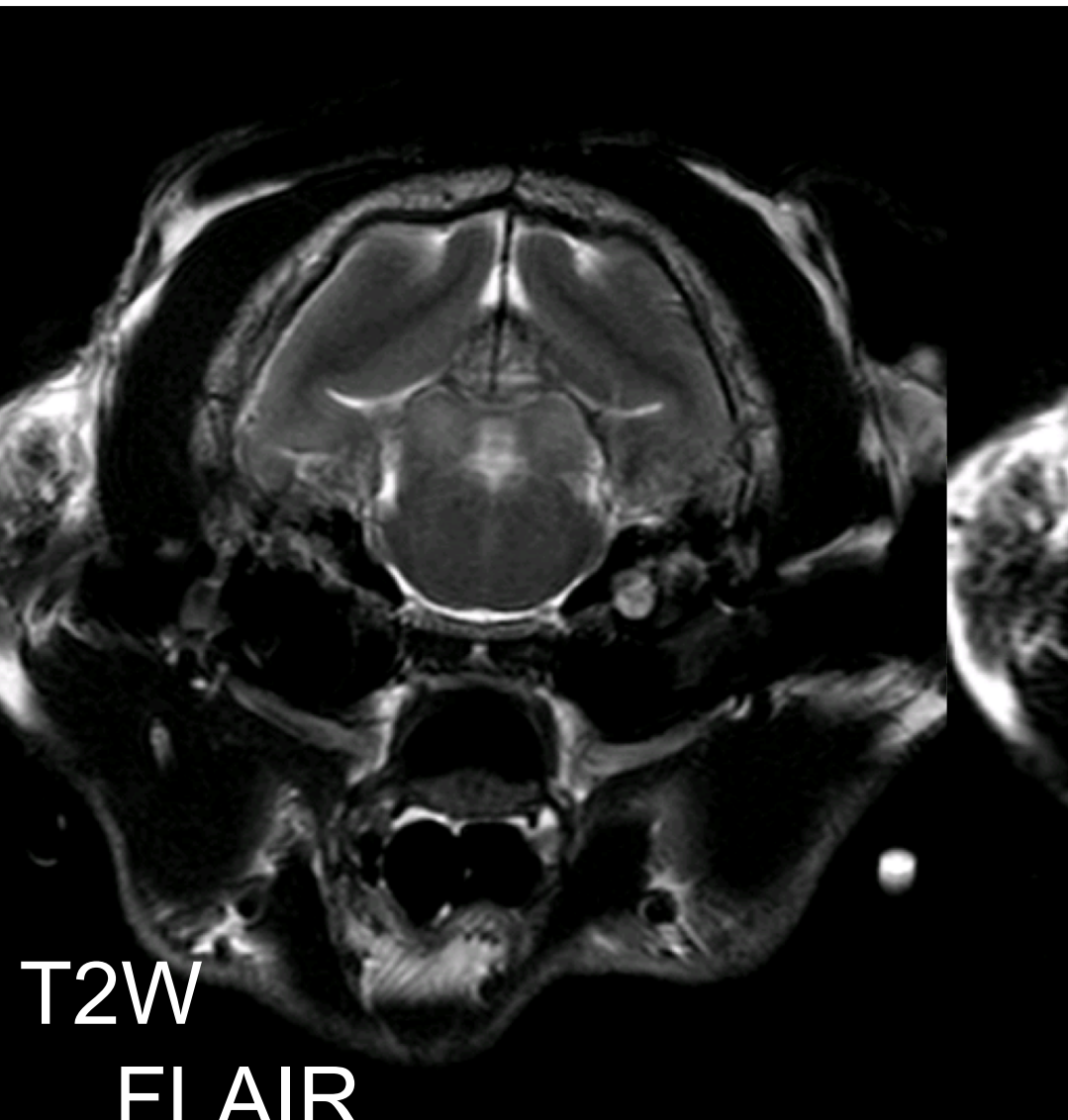
- **Postural Reactions:** delayed on the left

- **Where do you neurolocalize?**

# Case 3

- Neurolocalization?
  - Central vestibular
- Differentials?
  - Otitis media/interna with intracranial extension
  - Thiamine deficiency
  - Other infectious (e.g. FIP, toxoplasmosis)
  - Neoplasia
- Plan?
  - CBC/Chem
  - CXR
  - MRI +/- CSF tap
  - Thiamine B1 level







# Outcome

- Thiamine at 100mg SC q 24hrs x 3 days
- A complete and balanced diet
- No more sardines!!!!

**Lu**  
**Recheck**





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248-960-7200 (work)