Vestibular Disease

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Goals

• Review the anatomy and function of the vestibular system
• Discuss clinical signs and differential diagnoses for peripheral and central vestibular patients
• Review case videos, recommended diagnostics, treatments, and prognostic guidelines
Function of the Vestibular System

• Maintain balance (body position) and normal head and eye position
Vestibular Dysfunction

Results from a lesion affecting the peripheral or central component

- Peripheral component
  - Inner Ear - receptors, ganglion and peripheral axons of the vestibular division of cranial nerve VIII

- Central component
  - Vestibular nuclei in the medulla
  - Cerebellum
Peripheral Vestibular System Anatomy

• Inner ear
  - Semicircular canals within petrous temporal bone
• CN VIII
Central Vestibular System Anatomy

- Vestibular nuclei in medulla of brainstem
- Cerebellum
Central Vestibular System Projections from Vestibular Nuclei

- Rostral via MLF to CN III, IV, VI (eye position)
- Dorsal to cerebellum
- Caudal to vestibulospinal spinal tract (head/body position)
- To CRTZ in medulla (nausea)
Neuroanatomical structures near the Vestibular System

• Horner’s Pathway
  ▪ Sympathetic innervation to eye
  ▪ Passes through middle ear
  ▪ Signs of dysfunction include miosis, ptosis, enophthalmus
  ▪ More common in peripheral disease
Neuroanatomical structures near the Vestibular System

- **Facial nerve**
  - Nucleus in brainstem
  - Nerve passes through middle ear
  - Signs of dysfunction include eye/lip droop, inability to blink (ipsilateral facial palsy)
  - May be seen with central or peripheral vestibular disease

Lowrie. *Compendium* July 2012
Vestibular Disease - Neurolocalization

- Identify patients that localize to the vestibular system
- Decide if peripheral vs. central disease is most likely based on neurological exam findings
  - This guides recommended diagnostics, treatment plan, and prognosis
## Signs of Vestibular Dysfunction

Distinguishing Central from Peripheral

<table>
<thead>
<tr>
<th></th>
<th>CVD</th>
<th>PVD</th>
</tr>
</thead>
<tbody>
<tr>
<td>Loss of balance (ataxia)</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Listing to one side</td>
<td>Yes</td>
<td>Yes</td>
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<tr>
<td>Head tilt</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Falling/rolling/Circling tightly</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Nystagmus</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Horizontal</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Rotary</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Vertical</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>Positional ventral strabismus</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Cranial nerve deficits</td>
<td>Possible V – XII</td>
<td>Possible VII</td>
</tr>
<tr>
<td>Horner’s syndrome</td>
<td>Rare</td>
<td>Possible</td>
</tr>
<tr>
<td>Cerebellar signs</td>
<td>Possible</td>
<td>No</td>
</tr>
<tr>
<td>Altered consciousness</td>
<td>Possible</td>
<td>No</td>
</tr>
<tr>
<td>Postural reaction deficits</td>
<td>Ipsilateral to lesion</td>
<td>No</td>
</tr>
</tbody>
</table>
Vestibular Dysfunction

**Typical vestibular patients**
- Nystagmus fast phase away from lesion
- Head tilt, circling, falling towards lesion

**Exceptions:**
1. Paradoxic vestibular disease
   - Nystagmus, circling, head tilt change direction
   - **Postural deficits always ipsilateral to lesion**
   - Lesion location: Cerebellum or caudal cerebellar peduncle ipsilateral to postural deficits

2. Bilateral peripheral vestibular
   - Often no head tilt or nystagmus
   - Crouched gait, side-to-side head movements
Vestibular ataxia
Vestibular ataxia
Vestibular circling
Nystagmus

Two types of involuntary rhythmic eye movement
1. Physiologic = oculocephalalic reflex
2. Pathologic (resting or induced)
Frequency of Nystagmus

Troxel. Signs of neurologic dysfunction in dogs with central versus peripheral disease JAVMA. 2005
Horizontal Nystagmus

Fast phase “runs away” from the side of lesion

- Fast phase right
- Rate = 160 beats/min
- Diagnosis=Left otitis media
- Peripheral disease
Vertical nystagmus

• Induced
• Rate: 58 beats/min
• Diagnosis: MUE/GME
• Central disease
Peripheral Vestibular Disease

Differential Diagnoses

- Idiopathic vestibular disease
- Otitis media/interna
- Neoplasia
  - Otic neoplasia, Nasopharyngeal polyps
- Toxic (aminoglycoside ototoxicity)
- Traumatic
- Degenerative/anomalous
  - Congenital disease
Idiopathic Peripheral Vestibular Disease

Gus - 9yr MN Poodle
- Horizontal nystagmus, fast phase right
- Left ventral strabismus
- Left head tilt
- Mild ataxia
- Normal brain MRI exam, CSF analysis, bloodwork, BP, T4
Idiopathic vestibular disease

• Geriatric dogs
• Cats any age
• Diagnosis of exclusion
  ▪ Rule out other causes
• Treatment:
  ▪ Supportive care
  ▪ Anti emetics (meclizine in dogs)
  ▪ Nursing care
• Prognosis
  ▪ Good, progressive improvement over 2-3 weeks, residual head tilt common
Meclizine is an H1 receptor antagonist.
Otitis media/interna

- Common
  - ~40% of cases of peripheral disease
- Diagnosis
  - Otoscopic examination (often requires sedation/general anesthesia)
  - CT / MRI
  - Myringotomy
    - Cytology, Microbiology, Histopathology
- Therapy:
  - Long term systemic antibiotics after culture/sensitivity
  - +/- Surgery (VBO)
Intracranial extension of otic infection

- Rare (cats>dogs)...but brainstem abscess and bacterial meningitis/encephalitis can occur.
Central Vestibular Disease
Differential Diagnoses

• Neoplasia
• Inflammatory brain disease (MUE/GME)
• Infectious
  ▪ Cats: Toxoplasmosis, FIP, Bacterial
  ▪ Dogs: Bacterial, Fungal, protozoal, rickettsial, viral
• Vascular (infarction)
Central Vestibular Disease
Differential Diagnoses

• Metabolic
  ▪ Hypothyroidism, Hypertension
  ▪ T4 and BP are part of minimum database

• Anomalous
  ▪ Intracranial intra-arachnoid quadrigmenal cyst

• Degenerative
  ▪ Cerebellar abiotrophy, Lysosomal storage disease

• Toxic
  ▪ Metronidazole
Neoplasia

“Oprah” 4yr FS Greyhound
• 5 days progressive ataxia, obtundation
• Nonambulatory tetraparesis, right head tilt, vertical nystagmus, absent CPs x 4
• MRI: Left cerebellar mass
• PNET (Primitive Neuroectodermal Tumor) on histopathology
Neoplasia

- Primary neoplasia vs. metastatic disease
- Prognosis is guarded longterm
- At minimum, corticosteroids (0.5mg/kg/day prednisone) to reduce peri-tumoral edema
- Additional treatment options:
  - Surgical excision
  - Radiation therapy
  - Chemotherapy
Inflammatory Brain Disease (MUE)

• Etiology unknown
  ▪ Immune-mediated and genetic factors contribute
• Typical signalment
  ▪ Young to middle age, small/toy breed dogs
  ▪ Females>males
• Neurological signs are often acute and progress rapidly
• Brainstem is a common site for lesions = central vestibular signs
“Shoonig” 7yr FS Coton De Tulear

- One week history of neck pain, dull mentation, ataxic gait, right head tilt
- Rapid progression within 24 hours to comatose mentation, nonambulatory tetraparesis, absent menace and facial sensation, nystagmus
Shoonig’s MRI Exam
“Cora” 4yr FS Min Aussie

- One week progressive history of pain, ataxic gait, nausea, dull mentation
Cora’s MRI Exam
Inflammatory brain disease (MUE)

- Perivascular cuffs of inflammatory cells in whorled pattern around vessels
- CSF: Mixed pleocytosis
Inflammatory brain disease (MUE)

- **Prognosis**
  - Ultimately depends on patient response to aggressive immunosuppressive therapy
  - ~70% show improvement, ~30% decline
- **Considered a treatable, not curable condition**
  - Relapses are common
- **Regarded as neurological emergency**
  - Patients rapidly progress and may die without treatment
Metronidazole toxicity

• Sabbia 4yr FS Rottweiler
• Acute onset nonambulatory tetraparesis, ataxia, abnormal eye movements
• Had been on metronidazole for 2 weeks at 50mg/kg/day
Metronidazole toxicity

• Most often seen in dogs on >60mg/kg/day but can occur at lower dosages
• Recovery is 1-2 weeks with time alone
• Oral diazepam therapy speeds recovery to 2-3 days
• Video: Sabbia post treatment
Cerebellum

- Brainstem (UMN system) initiates movement and regulates muscle tone to preserve normal body position while at rest or in motion
- Cerebellum regulates and fine tunes this motor activity
- All output is inhibitory
### Signs of Cerebellar Disease

#### Cerebellum

<table>
<thead>
<tr>
<th>Signs</th>
<th>Description</th>
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<tbody>
<tr>
<td>Spastic, goose-stepping gait</td>
<td>in all limbs, especially thoracic, with preservation of strength</td>
</tr>
<tr>
<td>Truncal ataxia</td>
<td></td>
</tr>
<tr>
<td>Intention tremors of head, eyes</td>
<td></td>
</tr>
<tr>
<td>Broad-based stance</td>
<td></td>
</tr>
<tr>
<td>Postural reactions</td>
<td>delayed with exaggerated responses</td>
</tr>
<tr>
<td>Ipsilateral menace deficit</td>
<td>with normal vision &amp; PLR</td>
</tr>
<tr>
<td>Opisthotonus /decerebellate posture</td>
<td>(rare)</td>
</tr>
<tr>
<td>Vestibular signs</td>
<td>(may be paradoxical)</td>
</tr>
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Adapted from “Clinical Syndromes in Veterinary Neurology” by Kyle G. Braund, 2nd ed.
Body Posture

- **Decerebellate rigidity**
  - Rigid extension of thoracic limbs, flexion of pelvic limbs, ± opisthotonus
  - DDX: Cerebellum

- **Decerebrate rigidity**
  - Rigid extension of all 4 limbs ± opisthotonus
  - DDX: Brainstem
Cerebellar Ataxia

- Hypermetria
- Intention Tremors
- Truncal ataxia
- Diagnosis: Cerebellar Cortical degeneration (abiotrophy)
Vascular disease

- Cerebellum is most common location in the brain for infarction
- Acute onset cerebellovestibular (central) signs
- May be paradoxical
Paradoxical Vestibular

- Left cerebellar caudal peduncle lesion
- Left-side postural reaction delay, increased tone, and hypermetria
- Paradoxical right head tilt
- Lesion is ALWAYS on side of postural deficits
Barney 10.5 MN Lab

- Ataxia (falling left)
- Left-sided hypermetria
- Right head tilt
- Left-sided proprioceptive abnormalities

Diagnosis: Left cerebellar infarct
Vascular Disease

- Clinical signs are focal, acute, non-progressive
- Diagnosis
  - Look for an underlying cause!
  - MRI is modality of choice for imaging diagnosis
- Idiopathic (>50%) vs. Underlying Cause
  - Endocrine disease, hypertension, neoplasia, renal failure, coagulopathy, sepsis, etc.
- Treatment
  - Time and supportive care
- Prognosis is good with no underlying cause
Take Home Points

• Recognize vestibular signs on neuro examination
• Memorize characteristics of central vs. peripheral vestibular disease
• Carefully consider the most likely differential diagnoses and associated prognoses
• Remember...
  ▪ T4, blood pressure, and otoscopic exam are part of minimum database
  ▪ Use meclizine for anti-motion sickness therapy in dogs
A young toy breed dog with acute onset of central vestibular signs should be considered a neurological emergency.
Questions