Definitions – Neurologic System (2 parts)

Autonomic Nervous System (2 parts)
- Sympathetic
- Parasympathetic

Somatic Nervous System (2 parts)
- Central Nervous System (2 parts)
  - Brain (3 parts)
    - Forebrain, Brain Stem, Cerebellum
  - Spinal Cord (5 parts)
    - Cervical, Thoracic Limb, ThoracoLumbar, Pelvic Limb, SaccoCoccygeal
- Peripheral Nerve (2 kinds)
  - Cranial Nerve, Spinal Nerve
  UMN and LMN??

Definitions – Motor Nerves

UMN – upper motor neuron (nerve cell)
- Originate from the brain
- Stimulate or inhibit the nerves (LMN) that directly control motor activity
  - Initiate movement
  - Maintain muscle tone
  - Regulate posture
- Divided into 2 kinds:
  - Pyramidal – originate from motor area of cerebral cortex
  - Extrapyramidal – originate from the brain stem
  - Extrapyramidal is the predominant UMN system in dogs and cats

LMN – lower motor neuron
- Originate from the spinal cord
- Directly innervate the muscles

BOTTOM LINE:
UMN tell LMN what to do
LMN tell muscles what to do

Definitions – Motor Nerves

What is a reflex??
- Sensory nerve stimulated
- Synapse at brain stem or spinal cord
- Motor nerve (LMN) response
- Muscle contraction

UMN moderate the reflex
LMN make up the reflex arc

Definitions – Motor Nerves

UMN Abnormalities
Lesion in the CNS above tested nerve reflex
- Increased stiffness of muscles, spastic paresis
- Brisk spinal reflexes (3-4)
- Increased stride length
- Conscious Proprioception (CP) deficits

LMN Abnormalities
Lesion in the CNS at tested nerve reflex
- Flaccid weakness
- Weak or absent spinal reflexes (0-1)
- Shortened stride length
- CP deficits
Definitions – Neuroanatomy

CNS Part 1 – Forebrain (job?)
Controls behavior, consciousness and proprioception – lots of CNS cerebral stuff (2 parts?)
• Cerebrum and Diencephalon
Which Cranial Nerves originate here?
• CN 1-3
  – 1 - O – Olfactory (smell)
  – 2 - O – Optic (sight)
  – 3 - O – Oculomotor (pupil)
• Indirect effects on CN 5
  – 5 - T – Trigeminal (facial sensation)

Definitions – Neuroanatomy

Diencephalon (2 parts?)
Thalamus and Hypothalamus

Hypothalamus
Controls pituitary and other hormones
Appetite and water intake
Thalamus
Pain sensation
Temperature regulation

Definitions – Neuroanatomy

CNS Part 2 - Brain Stem (job?)
Level of Consciousness and involuntary vital functions (breathing, etc.) (3 parts?)
• Midbrain, Pons, Medulla
Which Cranial Nerves?
• CN 3-12
Level of Consciousness, Posture & Cranial Nerves (except vision & smell) assess the brain stem

Definitions – Neuroanatomy

Cranial Nerves (Pnemonic)
O - On
O - Old
O - Olympus’s
T - Towering
T - Top
A - A
F - Fat
V - Vicous
G - Goat
V - Vandalized
A - A
H - Hat
1 - Olfactory
2 - Optic
3 - Oculomotor
4 - Trochlear
5 - Trigeminal
6 - Abducens
7 - Facial
8 - Vestibulocochlear
9 - Glossohypoglossal
10 - Vagus
11 - Accessory
12 - Hypoglossal

Definitions – Neuroanatomy

CNS Part 3 – Cerebellum (job?)
Controls muscle coordination
Unconscious proprioception
• Rate and range of movement
Cerebellar Lesion
• Hypermetric gait – goose stepping
• Intention tremor
• Side to side head movement
• Broad based stance

Definitions – Neuroanatomy

CNS Part 4 – Spinal Cord
5 parts?
• Cervical
• Thoracic Limb (Brachial Plexus)
• ThoracoLumbar
• Pelvic Limb
• Sacro-Coccygeal
Tested by doing spinal nerve reflexes
• LMN findings at the SC lesion
• UMN findings below the SC lesion
• Normal reflexes above the SC lesion
Definitions – Neuro Terms

Opisthotonus ("star gazing")
Dorsiflexion of the head and neck

Root Signature
Pain in a limb due to nerve pain
 Experienced as shooting pains by people
 (causes?)
• Intervertebral disc disease
• Spinal arthritis
  – Nerve pinched as it exits IV foramen
• Nerve sheath tumor (most common?)
  – Schwannoma
  – Hemangiopericytoma

Definitions – Neuro Terms

Conscious Proprioreception
Sensing limb and body position
Does the pet know where its body parts are?
• Controlled by multiple neurons in the central and peripheral nervous system
• UMN and LMN Lesions can affect CP

Unconscious Proprioreception
Regulation of rate and range of movement
• Controlled by the cerebellum

Definitions – Neuro Terms

Ataxia
Inability to perform normal, coordinated motor activity that is not caused by:
• Weakness
• Musculoskeletal problems
• Abnormal movements such as tremors or spasms
Stumbling around due to poor neuro coordination
(3 kinds of ataxia?)
  – sensory, cerebellar, vestibular

Dysmetria
Difficult movement
Hypermetria
Overreaching, exaggerated movement

Definitions – Neuro Terms

Behaviors
• Behavior
• Seizures
• Tremor
• Hearing Loss
• Vision Loss
• Dysphagia

Neuro History

Behavior
• Wandering, vocalizing, stuck in corners, inappropriate elimination
  – forebrain
• Increased or decreased appetite
  – diencephalon
• Increased water intake
  – diencephalon
• Any other abnormal behavior
### Neuro History

#### Seizures
- **Onset**
- **Frequency**
  - Single or clusters?
- **Progression**
- **Description**
  - Generalized, partial or behavioral
  - Duration and character of pre-ictal, seizure and post-ictal phases
- **Medications and drug monitoring**

#### Tremor
- **Intention tremor, postural tremor, myotonia, myoclonus**

**Intention Tremor**
- Bobble-head type movement
- Intensifies when reaching the end of a goal-oriented movement (lesion?)
- Cerebellar lesion – lack of unconscious proprioception (rate and range of movement)

The more the pet tries to consciously control an intentional movement, the less unconscious proprioception there is.

---

#### Postural Tremor
- In head or limb when weight supported (cause?)
- Due to pain or weakness
- Not necessarily caused by neuro dz
- But it can be due to neurologic weakness or pain

---

#### Myoclonus
- Brief, jerking muscle contraction (cause?)
- Neurologic cause (examples?)
  - Demyelination (CDV, Rottweilers)
  - Partial seizure

---

#### Myotonia
- Inability of muscles to relax after contraction (symptoms?)
  - Muscle dimpling after percussion
  - Extensor rigidity if severe (lesion?)
- Myopathy or metabolic disease (examples?)
  - Scotty cramp
  - Congenital myotonia

---

#### Hearing Loss
- Startles easily
- Very deep sleep
- Failure to respond to commands (lesion?)
- Lesion – brain stem, CN8, ear

#### Vision Loss
- Bumps in to things, especially in unfamiliar surroundings
- Low light or bright light (lesion?)
- Lesion – retina, CN2, forebrain
Neuro History

Dysphagia (symptoms?)
- Trouble swallowing (gulping)
- Coughing, gagging or regurgitation
  - Especially after eating or drinking
- Voice change
- Inspiratory stridor
  - Worse in heat or with exercise
  - Laryngeal paralysis (lesion?)

Neuro History

Dysphagia (symptoms?)
- Lesion
  - caudal brainstem
  - peripheral neuropathy
    - CN IX, X, XI (examples?)
  - Hypothyroidism
  - Idiopathic, breed associated
  - Junctionopathy (MNJ)
    - Myasthenia gravis
  - Myopathy – primary or secondary
    - Addison’s Disease (2ndary)

Neuro Exam

There is much more to a neurologic exam than flipping the toes and thumping the knees
- Takes 10-15 minutes
- Do things first that are least likely to upset the patient
- Omit steps that might cause injury
- Complete the entire exam
  - Don’t zero in on obvious abnormalities and miss others

Neuro Exam

Assess 6 Things:
- Mental Status and Behavior
- Eye & Ear Exam
- Gait, Attitude and Posture
- Cranial Nerves
- Spinal Reflexes
- Palpation and Pain Perception

Neuro Exam

Tools:
- Plexor
- Hemostat
- Strong light source
- Cotton tipped applicator, saline
- Cotton balls
- Blindfold – muzzle, handkerchief, 8x10 piece of paper
- Slip free surface
- Drops to dilate eyes (tonometer)
- Hand Lens or ophthalmoscope
- Otoscope

Neuro Exam

Mental Status and Behavior
- Abnormal Behavior most often revealed in the history
- Observe while taking a history, prior to handling
- Let the patient have run of the exam room
- Level of consciousness (0-4)
  - Excited (3-4)
  - Alert – Normal (2)
  - Depressed/obtunded – drowsy but arousable (1)
  - Stuporous – sleeps if left alone, arousable (1)
  - Comatose – no response to pain (0)
- Quality of Consciousness
  - Normal
  - Demented – responds inappropriately
<table>
<thead>
<tr>
<th>Neuro Exam</th>
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<tbody>
<tr>
<td>Mental Status and Behavior</td>
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<tr>
<td>Lesion Localization</td>
</tr>
<tr>
<td>- dull, wandering, vocalizing</td>
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<tr>
<td>- Cerebral lesion</td>
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<tr>
<td>- Stupor, obtunded</td>
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<tr>
<td>- Cerebral lesion</td>
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<tr>
<td>- Can be more severe with brain stem lesions</td>
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<tr>
<td>- Demented</td>
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<tr>
<td>- Cerebral lesion</td>
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<tbody>
<tr>
<td>Eye &amp; Ear Exam</td>
</tr>
<tr>
<td>Iris and Pupil</td>
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<tr>
<td>Check for Horner’s Syndrome</td>
</tr>
<tr>
<td>Evaluate Nystagmus</td>
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<tr>
<td>Evaluate Vision</td>
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<tr>
<td>Menace Response, Corneal Reflex, Dazzle Reflex</td>
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<tr>
<td>Tear Production</td>
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<tr>
<td>Fundic (retinal) exam</td>
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<tr>
<td>Ear exam</td>
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<td>Eye &amp; Ear – Iris &amp; Pupil</td>
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<tr>
<td>Hiccup</td>
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<tr>
<td>- Alternating pupil sizes (cause?)</td>
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<td>- FeLV infected cats (CN3 PMN)</td>
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<td>- Active/changing forebrain edema</td>
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<td>Anisocoria</td>
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<tr>
<td>- Forebrain</td>
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<tr>
<td>- Brainstem</td>
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<tr>
<td>- Horner’s syndrome</td>
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<tr>
<td>- FeLV</td>
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<td>Eye &amp; Ear – Iris &amp; Pupil</td>
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<tr>
<td>Pupillary Light Reflex (PLR)</td>
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<tr>
<td>- CN 2 &amp; 3</td>
</tr>
<tr>
<td>- Slowed – forebrain &gt; brainstem lesion</td>
</tr>
<tr>
<td>- Not present – blindness</td>
</tr>
<tr>
<td>- Slowed – iris atrophy, coloboma</td>
</tr>
<tr>
<td>- Direct &amp; consensual (define)</td>
</tr>
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Can a pet be blind with intact PLR?
- PLR intact with cortical blindness
- PLR slow at onset of SARDs
If no PLR, does that mean the pet is blind?
- High sympathetic tone can block PLR
- As can anesthesia or coma
Neuro Exam

Eye & Ear – Horner’s Syndrome
- Miosis
- Ptosis
- Enophthalmos
- Prolapsed nictitans
Loss of Sympathetic tone to the eye
Lesion localization:
- Brain stem – CN3 SMN
- Spinal Cord – cervical, thoracic
- Thoracic cavity, neck
- Middle ear, inner ear
- Periorbital structures

Neuro Exam

Eye & Ear – Nystagmus
Normal Nystagmus
- Physiologic Nystagmus
  - Move patient’s head L, R, up, down
  - Fast phase toward the movement
- Siamese nystagmus
Abnormal Nystagmus
- Abnormal Physiologic nystagmus
- Spontaneous Nystagmus
  - Horizontal, vertical, rotary
- Positional nystagmus
  - In dorsal recumbency
- Usually indicates vestibular disease

Neuro Exam

Eye & Ear – Vision
- Tracking objects
  - In full light first
  - If in doubt, check in low light
  - I like to use cotton balls (no sound)
  - Or step back and move fingers
  - Check each eye separately
  - Block other eye with 8x10 paper
- Exam room obstacle course
  - Full light first
  - Then low light if in doubt

Neuro Exam

Eye & Ear – Reflexes & Responses
PLR – already done
Menace Response
- Check medial and lateral each eye
- Check each eye separately (paper)
- Be careful not to touch the whiskers or cause a breeze
- Not a reflex – processed in forebrain & cerebellum
- Lesion localization:
  - CN 2 – optic – vision
  - CN 7 – facial – blinking
  - Cerebellum, cerebrum
  - May not be present if < 12 weeks old
Neuro Exam
Eye & Ear – Reflexes & Responses
Dazzle Reflex
• Shine bright light in the eye
• Normal response – squint
• Processed at the diencephalon
• Intact dazzle reflex means:
  – Retina, optic nerves, diencephalon nuclei, facial nerve work fine
  – Intact dazzle/PLR + blindness = cortical blindness

Neuro Exam
Eye & Ear – Reflexes & Responses
Corneal Reflex
• Touch cornea gently with finger or moistened cotton tip applicator
  – CN 5
• Retraction of globe, and squint
  – CN 6, CN 7
• Lesion localization
  – Brain stem
  – Anesthesia or coma
HINT – do this BEFORE applying ophthalmic anesthetic for IOP

Neuro Exam
Eye & Ear – Tear Production
• Signs of dry eye
  – Mucopurulent ocular discharge, red eye
  – Pigmentary keratitis, corneal ulcer
• STT prior to any drops in the eyes
• Unilateral dry eye and nose
  – Neurogenic KCS
  – Brainstem, CN3P
  – Tx oral pilocarpine, not cyclosporine

Neuro Exam
Eye & Ear – Tear Production
• Ipsilateral lip droop, ear droop, ectropion and dry eye
  – Neuroparalytic keratitis
  – CN 7
  – Difficult to manage
  – Following TECA or ear infection
Neuro Exam
Eye & Ear – Fundic Exam
• Drops to dilate eyes, after ruling out glaucoma
• Optic disk - Physically observe CN2
  – Papilledema (causes?)
  – GME, orbital neoplasia, CDV
• Vessels (DDx hemorrhage?)
  – Hemorrhage – hypertension, vasculitis, coagulopathy
  – Tortuosity (causes?)
  • Hyperviscosity, hypertension

Eye & Ear – Fundic Exam
• Retina & Tapetum (DDx chorioretinitis?)
  – Chorioretinitis – hyporeflective infiltrates
    • Fungal, FIP, LSA, Leishmania
  – Hyperreflective – old lesions
  – Medallion lesions – CDV
  – Retinal detachments (DDx?)
    • Hemorrhage, infiltration, trauma
  – Retinal degeneration/atrophy (DDx?)
    • Old SARDs
    • PRA
Neuro Exam

Eye & Ear – Ear Exam

- Otitis externa
  - Exudate, redness
- Otitis media
  - Ear drum – red, opaque, bulging
  - Deficits in:
    - CN3S – Horner’s Syndrome
    - CN 7 – facial paralysis
    - CN 8 – vestibular signs

Attitude, Posture and Gait

Attitude
- position of the eyes and head with respect to the body

Posture
- position of the body with respect to gravity

Gait
- Movements when walking or running
Neuro Exam

Attitude – Lesion Localization

• Head tilt (one ear lower)
  – Unilateral vestibular lesion
• Head turn (yaw)
  – Ipsilateral forebrain lesion
• Head Press
  – Or gets stuck in corners (behavior)
  – Forebrain lesion
• Dropped eye

Neuro Exam

Posture

Wide based stance
• Common in neurologic disease
• Especially cerebellum and vestibular
• CP deficits as well

Schiff Sherrington posture
• Best appreciated in lateral recumbency
• Extension of the thoracic limbs
• Paralysis of pelvic limbs
• Lesion – TL spinal cord

Neuro Exam

Postures

Decerebrate Rigidity
• Extension of all limbs
• Sometimes opisthotonus
• Often stupor or coma
• Lesion – brainstem

Decerebellate Rigidity
• Opisthotonus
• Extension of thoracic limbs
• Flexion of the hips
• Consciousness not impaired
• Lesion – acute cerebellar (herniation)

Neuro Exam

Postural Reactions

Proprioreceptive Positioning
Tests Conscious Proprioreception
• Sense of limb and body position
• Does the animal know where it’s body parts are???

Gait Signs of CP Deficits:
• Clumsiness and incoordination
• May drag or scuff the toes
• Wide based stance and swaying gait
• Increased stride length

Neuro Exam

Postural Reactions

Proprioreceptive Positioning
Performing the test well
• Support to avoid body tilt, but not too much to allow weight shift from pain
• Turn one paw over so dorsum contacts floor
• Foot should immediately return to normal pad-down position
• Those with orthopedic disease should have normal CP if properly supported
• CP is often the first neurologic abnormality – sensitive for neuro disease
Neuro Exam

CP Deficits Lesion Localization:
NOT REALLY!! Unless one limb…
• UMN or LMN or both
• Forebrain, brain stem
• Spinal cord
• Peripheral nerves

CP deficits with normal or near normal
gait - HALLMARK
  - Cerebrum

Neuro Exam

Postural Reactions

Placing
1. Non-visual (tactile) first
   • Cover the eyes – muzzle and cloth
   • Pick pet up and move toward exam table
   • When touched with dorsum of paw, the pet
     should immediately place the paw pad down
     on the exam table
2. Then visual
   • pet should reach for the table before touched
   • Tests postural reaction and vision

Neuro Exam

Postural Reactions

Hopping
• Hold patient so all weight supported on
  one limb
• Move pet laterally
• Normal reaction is to hop to keep foot
  under body for support
• UMN lesions cause wider hopping
• All 4 limbs compared
• Sensitive test for subtle weakness or
  assymetry
Neuro Exam

Postural Reactions
Hemiwalking and Wheelbarrowing
• Do if CP, placing and hopping are equivocal
  – May be easier than hopping for very large dogs
• Hemiwalk by holding front and rear legs up on one side, and push laterally
• Wheelbarrow forward
  – Many dogs can not or will not wheelbarrow backward
  – May need to gently support the nose up for front wheelbarrowing
  – Good or comparing L and R stride length

Neuro Exam

Gait (4 parts)
• Lameness & Stride Length
• Ataxia
• Paresis/paralysis
• Abnormal movements

Neuro Exam

Gait – Lameness & Stride Length
Grading system
• Grade 1 – barely noticeable
• Grade 2 – weight bearing, noticeable
• Grade 3 – sometimes skips
• Grade 4 – often carries
• Grade 5 – always carries

Neuro Exam

Gait – Lameness & Stride Length
Short Strides:
• Limb pain
  – Musculoskeletal pain
  – Root signature
  • IVDDz, spinal arthritis, nerve sheath tumor
• LMN lesions
Long Strides:
• UMN lesions
Neuro Exam
Gait – Lameness & Stride Length

Painful Limbs are carried
Weak limbs are dragged

Neuro Exam
Gait – Ataxia (review)
Inability to perform normal, coordinated motor activity NOT caused by:
• Weakness
• Musculoskeletal problem
• Abnormal movement such as tremor

There are 3 types of ataxia
• Sensory ataxia
• Cerebellar ataxia
• Vestibular ataxia

Neuro Exam
Gait – Ataxia
Sensory Ataxia (cause?)
• Caused by loss of CP
• Signs of CP loss & Sensory Ataxia:
  – Clumsiness and incoordination
  – Wide based stance & swaying gait
  – Increased stride length
  – Dragging/knuckling the toes
• Lesion Localization:
  – UMN or LMN – BOTH or EITHER
  – Forebrain, Brainstem, Spinal Cord, Peripheral Nerve
  – 1, 2 (front, back, L, R) or all 4 limbs

Neuro Exam
Gait – Ataxia
Sensory Ataxia
Identifying generalized Sensory Ataxia
Doesn’t help much with lesion localization, unless only one limb
But it tells you that there is indeed neurologic disease present

Neuro Exam
Gait – Ataxia
Cerebellar Ataxia
• Inability to regulate unconscious proprioception
  – Rate and range of movement
  – Dysmetria, hypermetria
  – Hypermetria – exaggerated goose-step type gait
  – Broad based stance
• Lesion localization
  – Cerebellum
  – Rare - spinocerebellar tracts
    • Lateral spinal cord

Neuro Exam
Gait – Ataxia
Vestibular Ataxia
• Inability to tell up from down (assess and respond to gravity)
• Signs of unilateral vestibular ataxia:
  – Head tilt (ipsilateral or contralateral)
  – Abnormal nystagmus
• Signs of bilateral vestibular ataxia:
  – Crouched position
  – Reluctant to move
  – Side to side head movement
  – Can look very much like cerebellar disease, but not hypermetric & no intention tremor
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<tr>
<td>Abnormal Nystagmus</td>
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</tr>
<tr>
<td>• Horizontal fast phase contralateral</td>
<td>• Horizontal fast phase contralateral</td>
</tr>
<tr>
<td>- “fast away”</td>
<td>- “fast away”</td>
</tr>
<tr>
<td>• Rotary or vertical nystagmus</td>
<td>• Rotary or vertical nystagmus</td>
</tr>
<tr>
<td>- Central vestibular disease</td>
<td>- Central vestibular disease</td>
</tr>
<tr>
<td><strong>Peripheral Vestibular Disease</strong></td>
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</tr>
<tr>
<td>• Outside the brain stem</td>
<td>• Outside the brain stem</td>
</tr>
<tr>
<td>• Inner ear, middle ear, CN8</td>
<td>• Inner ear, middle ear, CN8</td>
</tr>
<tr>
<td><strong>Central Vestibular Disease</strong></td>
<td><strong>Central Vestibular Disease</strong></td>
</tr>
<tr>
<td>• Inside the brain stem</td>
<td>• Inside the brain stem</td>
</tr>
<tr>
<td>• More likely to show other CN deficits</td>
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<tr>
<td>Bilateral musculoskeletal disease can mimic neurologic weakness</td>
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<tr>
<td>- Bilateral cruciates</td>
<td>- Bilateral cruciates</td>
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<tr>
<td>- Bilateral coxofemoral luxations</td>
<td>- Bilateral coxofemoral luxations</td>
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<tr>
<td>- Bilateral severe hip dysplasia</td>
<td>- Bilateral severe hip dysplasia</td>
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<tr>
<td>- Severe spinal arthritis</td>
<td>- Severe spinal arthritis</td>
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<tr>
<td><strong>Paresis</strong></td>
<td><strong>Paresis</strong></td>
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<tr>
<td>• Partial loss of voluntary movement</td>
<td>• Partial loss of voluntary movement</td>
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<tr>
<td><strong>Paralysis (plegia)</strong></td>
<td><strong>Paralysis (plegia)</strong></td>
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<tr>
<td>• Total loss of voluntary movement</td>
<td>• Total loss of voluntary movement</td>
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<tr>
<td><strong>Paresis/Paralysis can be UMN or LMN</strong></td>
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<td><strong>Gait – Abnormal Movements</strong></td>
<td><strong>Cranial Nerves</strong></td>
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<tr>
<td>Intention Tremor (terminal tremor)</td>
<td>CN 1 – olfactory</td>
</tr>
<tr>
<td>- Worsens as the target is reached during goal oriented movement</td>
<td>- Not usually assessed</td>
</tr>
<tr>
<td>- Cerebellar lesion</td>
<td>- If they can’t smell, they often won’t eat</td>
</tr>
<tr>
<td>Postural Tremor</td>
<td>- Help localize forebrain lesions</td>
</tr>
<tr>
<td>- In limb or head when weight supported</td>
<td>- Blindfold and offer food</td>
</tr>
<tr>
<td>Myotonia – delayed muscle relaxation</td>
<td>- Check for sniffing</td>
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<td>- Muscle dimpling on percussion</td>
<td>- Don’t use irritating substances such as alcohol, ammonia, formalin</td>
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<tr>
<td>- Can progress to lateral rigidity</td>
<td>- Stimulate trigeminal N. producing false positive response</td>
</tr>
<tr>
<td>Myoclonus – jerking brief movements</td>
<td>- Ipsilateral forebrain</td>
</tr>
<tr>
<td>Wide circles, hugging the walls</td>
<td>- Ipsilateral forebrain</td>
</tr>
</tbody>
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<table>
<thead>
<tr>
<th>Neuro Exam</th>
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</thead>
<tbody>
<tr>
<td><strong>Cranial Nerves</strong></td>
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</tr>
<tr>
<td>CN 1 – olfactory</td>
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</tr>
<tr>
<td>- Not usually assessed</td>
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<tr>
<td>- If they can’t smell, they often won’t eat</td>
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<tr>
<td>- Help localize forebrain lesions</td>
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<tr>
<td>- Blindfold and offer food</td>
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<tr>
<td>- Check for sniffing</td>
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<td><em>Don’t use irritating substances such as alcohol, ammonia, formalin</em></td>
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Cranial Nerves
CN 2 – optic
CN 3 – oculomotor
CN 4 – trochlear
CN 6 - abducens
• Already assessed during Eye Exam
• Also look for strabismus
  - Normal strabismus
    • Convergent (esotropia)
      – Siamese, Himalayan
    • Divergent – brachycephalic dogs
  - Abnormal strabismus
    • Brainstem lesion, CN 3, 4, 6
    • Subtle changes seen by shining a bright light, reflection is normally symmetrical

Cranial Nerves
CN 5 – trigeminal
• Motor portion
  - Palpate temporals & masseter mm.
  - Atrophy, asymmetry
  - Mouth hangs open with bilateral weakness
    • Trigeminal neuritis
• Sensory portion
  - Ophthalmic branch
    • Corneal reflex produces a blink
  - Medial palpebral reflex
  - CN 5 in, CN 7 out

Cranial Nerves
CN 5 – trigeminal
• Sensory portion
  - Maxillary branch
    • Tactile sensation to upper lips
    • Response - grimace and blink
    • Insert hemostat into the nostril
    • Response – withdraw the head
    • CN 5 in, CN 7 out
  - Mandibular branch
    • Tactile sensation to lower lips
    • Behavioral response

Cranial Nerves
CN 6 - abducens
• Corneal reflex
• strabismus
Neuro Exam
Cranial Nerves
CN 7 – facial
• Tactile sensation already evaluated
  – Corneal reflex
  – Palpebral reflex medial and lateral
  – Nostril mucosal sensation
  – Upper lip sensation
  – Lower lip sensation
  – CN 5 in, CN 7 out
• Palpebral reflex that fatigues
  – Myasthenia gravis

Neuro Exam
Cranial Nerves
CN 7 – facial
• Facial asymmetry
  – Facial paralysis
  – Enlarged palpebral fissure
  – Ectropion
  – Drooping lip commissure
  – Drooping ear
  – Dry eye
  – Lesion localization
    – Brainstem
    – Ear
    – Peripheral nerve
    – Forebrain

Neuro Exam
Cranial Nerves
CN 7 – facial
• Facial asymmetry
  – Hemifacial spasm
    – Grimacing and squinting
    – Irritation of the facial nerve - spasms
  – Peripheral nerve disease
  – Often middle ear disease
  – Nasopharyngeal polyps in cats

Neuro Exam
Cranial Nerves
CN 7 – facial
• How do you tell the difference between facial paralysis and hemifacial spasm?
• Asymmetry – which side is abnormal?
  – Puckering of the muscles – spasm
  – Dry eye – paralysis
  – Can’t feel their face – paralysis
  – Ear disease – either (***)
  – Know the dog’s normal appearance
  – Ask the owner
Neuro Exam

Cranial Nerves
CN 8 – vestibulocochlear

- Cochlear portion – hearing
  - Bilateral deafness
  - No response to loud noise that produces no palpable vibration
  - History – startles from a sleep
  - Squeaky toys, whistle, beeper
  - Unilateral deafness
  - Looks away to the far wall in response to squeak, beep or whistle

- Vestibular portion - balance

- Ipsilateral head tilt
- Vestibular ataxia – ipsilateral lean
- Abnormal nystagmus
- Broad based stance
- Positional nystagmus
- Dorsal recumbency produces spontaneous nystagmus
  - “bed spins”
- Lesion localization – vestibular disease
  - Brain stem, inner ear, middle ear, peripheral nerve

Cranial Nerves
CN IX, X, XI – glossopharyngeal, vagus, accessory

- History
  - Dysphagia, regurgitation, voice change, inspiratory stridor
- Gag reflex
  - Touch left and right caudal pharynx with cotton swab
  - Response – palate elevates, pharyngeal muscles contract
  - Asymmetry more important than absence
  - If fractious, can externally palpate the area dorsal to the larynx

Cranial & Spinal Nerve Reflexes

What is a reflex??

- Sensory nerve stimulated
- Synapse at brain stem or spinal cord
- Motor nerve response
- Muscle contraction

LMN effect on cranial or spinal nerve reflex?

- Weak or absent reflex (0-1), flaccid paresis
- Lesion within the reflex pathway
- Sensory nerve, CNS, motor nerve, MNJ or muscle (generalized weakness)

UMN effect on spinal reflex?

- Exaggerated reflex (3-4), spastic paresis
- Lesion is above the reflex in the CNS

Spinal Reflexes
Things other than LMN that can suppress reflexes

- Severe muscle or joint rigidity
  - Fibrosis of muscles or joints
  - Ankylosis of joints
- Extreme excitation or myotonia
  - Absent muscle stretch response
- Severe metabolic disease causing weakness
  - Hypokalemia, acidosis
- Spinal shock
  - Reflex suppression caudal to acute SC injury
  - Reflexes return within 30-60 minutes
Neuro Exam

Spinal Reflexes
Things other than UMN that can exaggerate reflexes
• Extreme excitement
  – Normal gait postural reactions
  – Postural reactions abnormal with UMN
• Pseudohyperreflexia
  – Patellar reflex is exaggerated
  – But reflexes caudal to that are suppressed
  – Caudal muscle thigh tone normally dampens the patellar reflex
  – Lack of tone to the caudal thigh muscles allows seemingly exaggerated patellar reflex

Neuro Exam

Spinal Reflexes
• Sternal Recumbency
  – Cutaneous trunci (panniculus)
• Right Lateral Recumbency
  – Thoracic Limbs – biceps, triceps, withdrawal (flexor), crossed extensor
  – Pelvic Limbs – patellar, gastrocnemius, withdrawal (flexor), crossed extensor
  – Perineal
• Left Lateral Recumbency
  – Same as for right lateral

Neuro Exam

Biceps Reflex
• Lateral recumbency
• Grasp the antebrachium
• Extend the elbow & pull limb caudally
• Place index finger on biceps insertion
  – If testing up leg, use the thumb
• Lightly tap finger/thumb with plexor
• Response – contraction of biceps m (lesion?)
• LMN Lesion – C6-C8 Spinal Cord, musculocutaneous n.
• UMN Lesion above C6

Neuro Exam

Triceps Reflex
• Lateral recumbency
• First Method
  – Grasp the antebrachium of the up leg
  – Flex elbow and rotate shoulder medially, to abduct the elbow
  – Strike the Triceps insertion medially
• Second Method
  – Support the up leg & Allow animal to relax
  – Strike the Triceps tendon of insertion
• Response – contraction of triceps m., extension of elbow (lesion?)
• LMN Lesion – C7-T2 Spinal Cord, upper radial n.
• UMN Lesion above C7
Neuro Exam

Extensor Carpi Radialis Reflex
- Lateral recumbency
- Support the up leg
- Allow animal to relax
- Lightly tap the muscle belly of the ECR muscle
- Response – extension of the carpus (lesion?)
- LMN Lesion – C7-T2 Spinal Cord, upper & lower radial n.
- UMN Lesion above C7

Neuro Exam

Withdrawal (Flexor) Reflex
- Lateral recumbency
- Up limb relaxed and extended
- Pinch interdigital skin with fingers
- Response
  - Flexion of the shoulder, elbow and carpus in thoracic limb
  - Flexion of hip, stifle and hock in pelvic limb
  - Observe down limb for extension (crossed extensor reflex)
  - (lesions?)

Neuro Exam

Withdrawal (Flexor) Reflex
- Lesions
  - LMN Thoracic Limb
    - C6-T2 Spinal cord
    - Brachial plexus nerves
  - UMN (crossed extensor) Thoracic Limb
    - Lesion in CNS above C6
  - LMN Pelvic Limb
    - L6-S2 Spinal Cord
    - sciatic nerve
  - UMN (crossed extensor) Pelvic Limb
    - Lesion in CNS above L6

Neuro Exam

Withdrawal (Flexor) Reflex

Does Withdrawal reflex assess sensation?
NO!!
Withdrawal is a true reflex and is intact as long as the LMN at that SC segment are intact, regardless of ability to feel pain
Pain is assessed at the end of the neuro exam, by looking for conscious response to superficial or deep pain

JUST BECAUSE THEY PULL THEIR FOOT BACK DOESN'T MEAN THEY FEEL IT!!

Neuro Exam

Cutaneous Trunci (Panniculus) Reflex
- Standing or sternal recumbency
- Lightly pinch or poke skin just lateral to spine
  - Start at LS and proceed cranially
  - A ballpoint pen works well
- Response – bilateral contraction of cutaneous trunci, resulting in twitch of skin over thorax and abdomen
  - Normally absent in cervical and sacral areas
  - Note cranial and caudal extent L and R
  - (lesion?)
Neuro Exam

Cutaneous Trunci (Panniculus) Reflex
LMN Lesions
  • Normal one side, absent other side
    – Unilateral SC C8-T1 (rare)
    – brachial plexus injury
    – lateral thoracic n.
  • Ends further cranially than usual
    – SC Lesion 1-4 segments cranially
    – Can help lateralize disc protrusion or FCE
      • Fibrocartilagenous Embolism

Schiff-Sherrington Posture
Spastic Thoracic Limbs
Flaccid Pelvic Limbs (Lesion?)
Lesion L2-L4 > (L1-L7)

“Border Cells” in lumbar spinal cord
  • UMN project to cervical intumescence
    that gives rise to brachial plexus
  • Inhibit muscles of the thoracic limbs

Patellar Reflex
  • Lateral recumbency
  • Support the uppermost thigh with stifle
    partially flexed
  • Wait for patient to relax supported leg
  • Palpate patellar ligament between the
    patella and the tibial crest
  • Briskly strike patellar ligament with
    plexor
  • Response – single, quick extension of
    the stifle (lesion?)
  • LMN Lesion – L4-L6 Spinal Cord,
    femoral n.

Gastrocnemius Reflex
  • Lateral recumbency
  • Grasp the metatarsus of up leg
  • Extend the stifle and flex the hock
  • Briskly strike achilles tendon with
    plexor
  • Response – contraction of caudal thigh
    muscles (lesion?)
  • LMN Lesion – L6-S2 Spinal Cord,
    sciatic n.
  • UMN Lesion – in CNS above L6
Neuro Exam

Perineal (anal) Reflex
- Lateral or sternal recumbency, or standing
- Touch or lightly pinch the perineum R and L of anus
- Response – contraction of anal sphincter and tail flexion
- Open anus indicates LMN (lesion?)
- LMN Lesion – S1-S3 Spinal Cord, perineal nerve, pudendal nerve.

Neuro Exam

UMN Bladder
- Large bladder difficult to express
- Spastic urethral sphincter
- Lesion above the sacrum

LMN Bladder
- Large bladder easy to express
- Detrussor atony
- Lesion at the sacrum, cauda equina

Both UMN and LMN Bladders can dribble urine

Neuro Exam

Palpation & Pain
- End of the neuro exam
- Once pain is elicited, anticipation of pain can affect subsequent responses

Head
Neck
Back
Limbs and Tail

Neuro Exam

Palpation & Pain
Head
- Open fontanelle
- Muscles of mastication
  - Atrophy, masses, swelling
  - Open mouth – pain & limited range of motion
    - Neck pain
    - Fibrosing or painful myositis
    - Denervation muscle fibrosis
    - Bony proliferation – HOD
    - Deep ear disease
    - May require sedation to determine if they can’t or won’t open their mouth
### Neuro Exam

#### Palpation & Pain

**Head**
- Retropulse eyes via closed eyelids
  - Pain can indicate retrobulbar mass
- Tactile sensation
  - Superficial and deep pain
    - Superficial pain – poke with ballpoint or pinch lightly with hemostat
    - Deep pain (slow pain) – full compression with a hemostat
  - Evaluate deep pain only if deficits in superficial pain
- Look for behavioral response (lesion?)
  - Lesion – Cerebrum, Brain stem

**Neck**
- Evaluate for curvature, displacement, atrophy, masses, swelling
- Palpate dorsally (paralumbar muscles) for pain
  - Palpate spinous and transverse processes separately
  - Ears twitch and neck tenses with pain
- Palpate ventrally for pain
  - Often the only way to detect caudal neck pain (dorsal muscles massive)
  - Can also gently rock the large transverse processes of C6

**Back**
- Evaluate for curvature, displacement, atrophy, masses, swelling
- Palpate dorsally (paralumbar muscles) for pain
  - Spinous and transverse processes palpated separately (Lesion?)
  - TL Spinal or spinal cord lesion
  - Muscle pain
- Assess strength with pressure over shoulders and pelvis
  - LS disease often shows pelvic limb weakness or pain on downward pressure
  - Paresis can be UMN or LMN

**Limbs & Tail**
- Evaluate musculature of limbs & tail
  - Atrophy, masses, swelling, tone
  - Attention to symmetry
- LS Palpation for pain
  - Lift the pelvis and put downward pressure on LS
  - Lift the tail
  - Extending the hips often also extends the LS

**Tactile sensation of limbs and tail**
- Superficial and deep pain
  - Look for conscious response
  - Withdrawal reflex an unconscious reflex
Neuro Exam

Palpation & Pain

Limbs & Tail
- Loss of pain & motor in one limb – think peripheral nerve disease
- Limp tail
  - S-Cd luxation causes limp tail without sensation (tethered tail)
  - Limp tail with sensation may be “Limber Tail” or fracture
    - Limber tail – myopathy of the coccygeal muscles
    - Compartment syndrome that resolves with time

Neuro Exam

Palpation & Pain

• Localized muscle atrophy
  - Neuro lesion at or above that Segment
  - MSK pain causing disuse

• Generalized muscle atrophy/tony
  - Metabolic disease - Addison’s, insulinoma
  - Generalized disease
    - Myopathy
    - Junctionopathy - myasthenia gravis
    - Peripheral neuropathy

Neuro Exam

Palpation & Pain

• Generalized pain
  - Muscular pain • myositis
    - Infectious of inflammatory
    - CK (CPK) can help distinguish muscle pain from joint or neurologic pain
    - Muscle and nerve biopsy to confirm
  - Neurologic pain
    - Thalamus – Thalamic Pain Syndrome

If any lameness or pain, perform complete musculoskeletal exam to rule out orthopedic disease

Neuro Exam

Palpation & Pain

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