The Bovine Neurologic Exam: Demystifying the Workup

Katie Simpson, DVM, MS, DACVIM
Assistant Professor, Livestock Medicine and Surgery
Colorado State University

Is the problem neurologic?

Purpose of a Neuro Exam

• Is neurologic disease present? If so...
• LOCALIZE, LOCALIZE, LOCALIZE
  • And remember...
  • Often can’t perform ‘complete’ neuro exam as in SA – not safe or realistic
• Observation becomes very important
• Be methodical
• Neurologic lesions will be repeatable
• Then....differential list is much easier
• Drives diagnostics and treatment
Neuroanatomic Lesion Localization Simplified

- Central nervous system
  - Brain: 3 regions
    - Forebrain
    - Brainstem
    - Cerebellum
  - Spinal cord: 5 regions
    - C1-C5
    - C6-T2
    - T3-L3
    - L4-S1
    - S1-Cd

- Peripheral nervous system
  - Cranial nerves
  - Spinal nerves

History

- Onset/duration/progression/symmetry
  - Mentation and behavior
  - Interactions w/ other animals, people

- Nutrition & water sources

- Location

- Vaccines/deworming/topicals?

- Previous dz history
  - Previous tx and response

- Other cattle affected?
  - If so, likely nutritional, toxic, metabolic, or infectious

- Other species affected?

- Owner expectations

I haven't seen her since last week, doc!!
Distance Exam: In the field or clinic, enclosed area

- Mentation
  - Responding appropriately to environmental stimuli?
  - Stupor, depression, excitement, mania...
  - Separate from temperament
  - Localization: forebrain or brainstem

- Behavior
  - Interaction with environment, other animals, people?
  - Aggression, yawning, vocalizing, pacing?
  - Localization: forebrain

Has a change been noticed?

Systemic disease?
Distance Exam: In the field or clinic, enclosed area

- Posture
  - Position of head, trunk, limbs when standing and ambulating
Distance Exam: In the field or clinic, enclosed area

- **Gait:** evaluate coordination and strength
  - Observe front and hind limbs, as moves toward and away from you
  - Look at foot placement during turns, change of direction, etc. – abduct? Knuckling?
  - Ataxia: abnormal gait w/ incoordination?
  - Hypermetria: exaggerated movements of limbs during locomotion?
  - Weakness?
  - Which limbs affected?

- **Muscle atrophy?**
  - Neurogenic vs. disuse
Close Up Exam?

- Location
  - Good footing; not slick concrete, ideally
  - If you have a chute that a recumbent animal can't be easily moved out of, pick a different spot
  - Evaluating in an alleyway prior to restraint helps make the determination of whether they can remain standing or not

- Baby calves
  - Postural reactions as in SA: wheelbarrowing, hopping, hemiwalking, CP, etc.
  - Determine asymmetry between each side and front and rear limbs

- Adult cattle
  - Halterbroken
  - Circling, up and down gradients, over curbs, etc.
  - Tail pull
    - Depends on patient temperament!
    - Weakness and symmetry
    - Normal adult bovine should be able to maintain course
  - Postural reaction: conscious proprioception only one, in receptive animals
    - Proprioception: awareness of limb position in space
    - Place limb in abnormal position; should be corrected immediately
Close Up Exam

- Adult cattle
  - Halterbroken
    - Circling, up and down gradients, over curbs, etc.
    - Tail pull
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  - Proprioception: awareness of limb position in space
  - Place limb in abnormal position; should be corrected immediately

Video courtesy Dr. Ray Whalen
Hands On Exam

- Full physical exam
  - Check tail and anal tone when taking the temperature
- Cranial nerve exam

<table>
<thead>
<tr>
<th>Cranial N. Number</th>
<th>Cranial N. Name</th>
<th>Name Mnemonic</th>
<th>Function</th>
<th>Function Mnemonic</th>
<th>Origin (Location of nucleus)</th>
</tr>
</thead>
<tbody>
<tr>
<td>I</td>
<td>Olfactory</td>
<td>On</td>
<td>Sensory</td>
<td>Some</td>
<td>Forebrain</td>
</tr>
<tr>
<td>II</td>
<td>Optic</td>
<td>Occasion</td>
<td>Sensory</td>
<td>Say</td>
<td>Forebrain</td>
</tr>
<tr>
<td>III</td>
<td>Oculomotor</td>
<td>Our</td>
<td>Motor + parasymp</td>
<td>Marry</td>
<td>Midbrain</td>
</tr>
<tr>
<td>IV</td>
<td>Trochlear</td>
<td>Trusty</td>
<td>Motor</td>
<td>Money</td>
<td>Midbrain</td>
</tr>
<tr>
<td>V</td>
<td>Trigeminal</td>
<td>Truck</td>
<td>Both</td>
<td>Rat</td>
<td>Pons + Medulla</td>
</tr>
<tr>
<td>VI</td>
<td>Abducens</td>
<td>Acts</td>
<td>Motor</td>
<td>My</td>
<td>Medulla</td>
</tr>
<tr>
<td>VII</td>
<td>Facial</td>
<td>Funny</td>
<td>Both + parasymp</td>
<td>Brother</td>
<td>Medulla</td>
</tr>
<tr>
<td>VIII</td>
<td>Vestibulocochlear</td>
<td>Very</td>
<td>Sensory</td>
<td>Says</td>
<td>Medulla</td>
</tr>
<tr>
<td>IX</td>
<td>Glossopharyngeal</td>
<td>Good</td>
<td>Both + parasymp</td>
<td>Big</td>
<td>Medulla</td>
</tr>
<tr>
<td>X</td>
<td>Vagus</td>
<td>Vehicle</td>
<td>Both + parasymp</td>
<td>Brains</td>
<td>Medulla</td>
</tr>
<tr>
<td>XI</td>
<td>Accessory</td>
<td>Any</td>
<td>Motor</td>
<td>More</td>
<td>Medulla</td>
</tr>
<tr>
<td>XII</td>
<td>Hypoglossal</td>
<td>How</td>
<td>Motor</td>
<td>More</td>
<td>Medulla</td>
</tr>
</tbody>
</table>
Cranial Nerve Abnormalities

Peripheral
• Unilateral
• In most cases, sole neurologic abnormality

Central: in the nuclei
• Unilateral or bilateral deficits
• Multiple cranial nerves affected
• Other nearby nuclei on same side (ipsilateral) or other side (contralateral)
• UMN signs: paresis, ataxia
• CAVEAT: CN VIII

<table>
<thead>
<tr>
<th>Cranial Nerve Test</th>
<th>Afferent</th>
<th>Reflex</th>
<th>Efferent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Menace RESPONSE</td>
<td>Retina, II</td>
<td>OPPOSITE Cortex, Cerebellum</td>
<td>VII</td>
</tr>
<tr>
<td>Pupillary light reflex</td>
<td>Retina, II</td>
<td>Brainstem</td>
<td>III</td>
</tr>
<tr>
<td>Oculocephalic reflex (positions of globes in orbits)</td>
<td>VIII</td>
<td>Brainstem</td>
<td>III, IV, VI</td>
</tr>
<tr>
<td>Palpebral reflexes (+ facial sensation and symmetry)</td>
<td>V</td>
<td>Brainstem</td>
<td>VII</td>
</tr>
<tr>
<td>Sorellowing or gag reflex</td>
<td>IX and X, often V and XI</td>
<td>Brainstem</td>
<td>IX and X, often V and XI</td>
</tr>
</tbody>
</table>

2/3/2019
Signs of Cranial Nerve Dysfunction

• I, Olfactory: sense of smell
  • Won’t eat?? Hard/impossible to test in depressed or anorectic ruminant!

• II, Optic: vision & light
  • Apparent blindness
  • Decreased/absent menace
  • Decreased/absent PLR

• CN III, IV, and VI: Oculomotor, trochlear, and abducent; normal position & symmetry of globes, parasymp to iris (III)
  • Strabismus (III, IV, VI, OR VIII)
  • Ptosis of upper eyelid (III)
  • Dilated pupil (III)
  • Lack of physiologic nystagmus
Signs of Cranial Nerve Dysfunction

- CN V: Trigeminal; facial sensation & muscles of mastication
  - Sensory: decreased/absent facial sensation, loss of corneal/palpebral
  - Motor:
    - Unilateral: asymmetrical mm of mastication, weak jaw tone
    - Bilateral: dropped jaw, salivation, poor prehension & mastication

- CN VII: Facial; motor to facial expression & parasymp to lacrimal glands
  - Drooped ear/eyelid/lip?
  - "Dry eye": can lead to corneal ulceration
  - NO MUZZLE DEVIATION

- CN VIII: Vestibulocochlear; balance & hearing
  - Head tilt
  - Leaning/circling
  - Nystagmus
### Clinical Signs

<table>
<thead>
<tr>
<th>Signs</th>
<th>Peripheral (in CN VIII)</th>
<th>Central (in CN VIII based on symptoms)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Paresis</td>
<td>-</td>
<td>+</td>
</tr>
<tr>
<td>Sensation</td>
<td>-</td>
<td>+</td>
</tr>
<tr>
<td>Spontaneous nystagmus</td>
<td>-</td>
<td>+</td>
</tr>
<tr>
<td>Spontaneous vertical nystagmus</td>
<td>-</td>
<td>+</td>
</tr>
<tr>
<td>Normal (prolonged) nystagmus</td>
<td>Decreased††</td>
<td>Decreased††</td>
</tr>
<tr>
<td>Strabismus</td>
<td>-</td>
<td>+</td>
</tr>
<tr>
<td>Spontaneous nystagmus</td>
<td>-</td>
<td>+</td>
</tr>
<tr>
<td>Strabismus present that changes direction when head position changes</td>
<td>-</td>
<td>+</td>
</tr>
<tr>
<td>Bilateral strabismus present with globes oriented in different directions</td>
<td>-</td>
<td>+</td>
</tr>
</tbody>
</table>

### Signs of Cranial Nerve Dysfunction

- IX & X, Glossopharyngeal & vagus; sensory & motor to pharynx & larynx
- Inability to swallow (dysphagia) & drooling
- Feed present in nares
- Loss of gag reflex
- Abnormal (stertorous) respirations from laryngeal dysfunction*
- Vagus: decreased rumen contractions**

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**Signs of Cranial Nerve Dysfunction**

- XI: Accessory: don’t bother

- XII: Hypoglossal: motor to tongue
  - Tongue paresis/paralysis/deviation/protrusion
Spinal Reflexes

- Withdrawal or flexor reflex
  - Both sides, front and rear limbs
  - Weak/absent: LMN, peripheral nn. or MS
  - Exaggerated or crossed extensor: UMN
- Patellar reflex
  - Recumbent adults
  - Calves
  - Hyper vs. hyporeflexia: UMN or LMN
- Perineal reflex
  - Weak tail or anal tone: S1-Cd5 lesion
- Cutaneous trunci or panniculus reflex
  - Hypalgesia cranial to lesion, anesthesiain at and caudal

Localizing the Lesion
Normal Forebrain Function: Cerebrum + Diencephalon

- Behavior
- Cognitive function
- Initiates voluntary motor activity (locomotion, etc.)
- Vision in occipital cortex: OPPOSITE FROM SIDE MENACED
- Nuclei of cranial nn. I and II (olfactory and optic)

Forebrain Disease

- Abnormal mentation
- Behavior changes
  - Aggression, frequent yawning, abnormal vocalization, compulsive pacing
  - "Head pressing" (compulsive walking into immovable barriers)
- Cortical blindness*
  - OPPOSITE from side menaced, if unilateral
- Circling or head TURN toward affected side
- Mild proprioceptive deficits
  - OPPOSITE side, if unilateral
- Opisthotonus
- Seizures
Differential Dx for Diffuse Forebrain Dz

- Polioencephalomalacia
  - Thiamine deficiency, sulfur toxicity, lead toxicity, salt toxicity
  - Bacterial meningoencephalitis (usually neonates)
  - Thromboembolic meningoencephalitis
  - Hepatic encephalopathy
  - Nervous ketosis
  - Rabies: CAN LOOK LIKE ANYTHING
    - Reovirus, herpesvirus (1 or 5)
    - Pseudorabies
  - Unilateral disease
    - Abscess, granuloma, neoplasia

Normal Brainstem Function

- Nuclei of CN III – XII
- Ascending reticular activating system: level of consciousness
- Respiratory center: medulla
Brainstem Disease

- Cranial nerve deficits
  - One or more cranial nerves (III – XII)
  - Either same or opposite sides
- Mentation changes possible (severe depression, obtundation, coma)
  - If ARAS involved
- Ipsilateral hemiparesis OR tetraparesis
- Altered respiratory pattern; usually terminal

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Differential Dx for Brainstem Dz

- Listeriosis
- Otitis media/interna
- Pituitary abscess
- Brainstem abscess
- Rabies
Normal Cerebellar Function

- Coordinates voluntary motor function (skeletal mm movements)
- Posture
- Muscle tone
- Smoothness/synergy of mm activity
- Does not initiate motor activity

Cerebellar Disease

- Normal mentation
- Abnormal gait: Ataxia, hypermetria
  - Truncal sway: side to side motion
- NO LOSS OF STRENGTH
- Wide-based stance
- Tremors, esp intention tremors
- Absent menace response BUT VISUAL
- +/- Spontaneous nystagmus

Video courtesy of Dr. Kevin Washburn, Texas A&M University
Differential Dx for Cerebellar Dz

- Congenital/hereditary
  - Cerebellar hypoplasia
  - Cerebellar abiotrophy
  - Other malformations
  - Lysosomal storage diseases (mannosidosis)

- Acquired
  - Grass stingers
  - Space occupying mass: abscess, granuloma

Spinal Cord Lesions: C1-C5

UMN signs: normal to increased mm. tone/spasticity, normo to hyperreflexia, decreased proprioception/pain, malnutrition disease mm. atrophy

LMN signs: decreased mm. tone/flaccidity, hype to anaesthesia, hype to analgesia of innervated regions, acute neurogenic mm. atrophy
Spinal Cord Lesions: C6-T2

UMN signs: normal to increased mm. tone/spasticity, normo to hyperreflexia, decreased proprioception/pain, minimal/no disuse mm. atrophy

LMN signs: decreased mm. tone/flaccidity, hype to anestesia, hype to analgesia of innervated regions, acute neurogenic mm. atrophy

Spinal Cord Lesions: T3-L3

UMN signs: normal to increased mm. tone/spasticity, normo to hyperreflexia, decreased proprioception/pain, minimal/no disuse mm. atrophy

LMN signs: decreased mm. tone/flaccidity, hype to anestesia, hype to analgesia of innervated regions, acute neurogenic mm. atrophy
Spinal Cord Lesions: L4-S1 (or S2)

UMN signs: normal to increased mm. tone/spasticity, normo to hyperreflexia, decreased proprioception/pain, minimal/no disuse mm. atrophy

LMN signs: decreased mm. tone/flaccidity, hype to areflexia, hype to analgesia of innervated regions, acute neurogenic mm. atrophy

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Spinal Cord Lesions: S1-Cd5

UMN signs: normal to increased mm. tone/spasticity, normo to hyperreflexia, decreased proprioception/pain, minimal/no disuse mm. atrophy

LMN signs: decreased mm. tone/flaccidity, hype to areflexia, hype to analgesia of innervated regions, acute neurogenic mm. atrophy
Spinal Cord Lesion Localization

<table>
<thead>
<tr>
<th>Region</th>
<th>C1-C5</th>
<th>C6-T2</th>
<th>T3-L3</th>
<th>L4-S1</th>
<th>L5-S5</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sym.</td>
<td>Ataxia, Paresis/Paralysis UMN signs</td>
<td>Normal</td>
<td>Normal</td>
<td>Normal</td>
<td>Normal</td>
</tr>
<tr>
<td>Asym.</td>
<td>Ataxia, Paresis/Paralysis UMN signs</td>
<td>Ataxia, Paresis/Paralysis UMN signs</td>
<td>Ataxia, Paresis/Paralysis UMN signs</td>
<td>Normal</td>
<td>Normal</td>
</tr>
</tbody>
</table>

UMN signs: normal to increased mm. tone/spasticity, normo to hyperreflexia, decreased proprioception/pain, minimal/no disuse mm. atrophy

LMN signs: decreased mm. tone/flaccidity, hypo to areflexia, hypo to analgesia of innervated regions, acute neurogenic mm. atrophy

Differential Dx for SC Dz

- Trauma
  - Fractures, luxations, subluxations
- Epidural lymphosarcoma (BLV associated)
- Vertebral body abscesses/osteomyelitis
  - May have pathologic fracture
- Discospondylitis
- Parasite migration
  - Hypoderma bovis (Setaria, Parelaphostrongylus tenuis rarely reported)
- Rabies
Diagnostic and Treatment Plan

• Ancillary diagnostics
  • CBC/Chem?
  • CSF aspirate and analysis
  • Radiographs

• “Shotgun” treatment
  • Thiamine: neuroprotective
  • +/- Antibiotic
  • Antiinflammatory: flunixin meglumine, meloxicam
  • +/- Dewormer
  • Consider w/d times!

Questions?