



Dr. Jill Narak received a Bachelor of Arts in English and Biology from Creighton University in 2001. She was awarded a Doctor of Veterinary Medicine degree from Iowa State University College of Veterinary Medicine in 2005. Dr. Narak continued her education with an internship in Small Animal Medicine and Surgery (2006) and a residency in Neurology/Neurosurgery (2009) at Auburn University College of Veterinary Medicine. During her time at Auburn, Dr. Narak also earned a Master of Science degree in Biomedical Sciences. After completion of her residency, Dr. Narak joined the faculty at the University of Tennessee College of Veterinary Medicine. In 2012, she moved back to Alabama to begin a family and served as an assistant professor in the Department of Clinical Sciences at Auburn University. She was then in private practice in the Atlanta area prior to moving her practice to North Alabama. She has taught and trained thousands of veterinary students, interns, and residents. She currently practices at Huntsville Veterinary Specialists & Emergency in Huntsville, Alabama. Her clinical interests include neurosurgery, and she has expertise in the management of Chiari-like malformation and neuropathic pain.

Neuro for Newbies



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Jill Narak, DVM, MS, DACVIM (Neurology)

Outline

- Review of neuroanatomic localization
- Nervous system trauma
- Seizures
- The down dog (or cat!)

Neuroanatomic Localization



- **Intracranial**

- Forebrain
- Brainstem
- Cerebellum
- Vestibular

- **Spinal cord segments**

- Upper and lower motor neuron

- **At the periphery**

- Nerves
- Neuromuscular junction
- Muscles

The Forebrain

- **Anatomic grouping of functional brain components**
 - Cerebrum, thalamus/hypothalamus, limbic system
- **Seat of intelligence, cognition/learning, behavior/personality, relay and integration of all senses, maintenance of homeostasis**
- **Deficits are contralateral to a lesion**
- **Seizures arise here**

Brainstem

- **Seat of mentation/consciousness/awareness**
 - Bright, alert, and responsive → obtunded → stuporous → comatose
 - Motor function
 - Upper motor neuron systems
- **Cranial nerve nuclei**
 - All except for I and II
- **Relay of sensory function**
 - Proprioceptive pathways, cranial nerve information
- **Cardiorespiratory control**
- **Deficits are primarily ipsilateral to a lesion**

Cerebellum

- **Regulates rate, range, and force of movement**
 - NOT the initiator
- **Plays a role with equilibrium**
- **Abnormalities are ipsilateral to a lesion**

Vestibular Syndrome

- **Peripheral**
 - No postural reaction abnormalities
 - Idiopathic or ear-related are common
- **Central**
 - Ipsilateral postural reaction abnormalities
- **Paradoxical**
 - Ipsilateral postural reaction abnormalities
 - Other signs are **OPPOSITE** what is expected
 - AKA, a **PARADOX**

Spinal Cord

- **Upper motor neuron sections**
 - C1-5 and T3-L3 segments
 - Normal to increased segmental reflexes and muscle tone
- **Lower motor neuron sections**
 - C6-T2 and L4-S3 segments
 - Decreased to absent reflexes and tone
- **Proprioceptive abnormalities expected for any location affected**
- **Deficits are often symmetric or will otherwise be ipsilateral to a lesion**

- Bring the lower motor information to the muscles
- Bring the peripheral sensory information to the spinal cord
- Dysfunction can be both motor and sensory in nature
 - Consider it can be many limbs, if not all
 - Diffuse lower motor neuron disease
 - Tick paralysis
 - Coonhound paralysis

Neuromuscular Junction

- The gap that acetylcholine must traverse in order for lower motor neurons to talk to muscles
- Dysfunction is motor only in nature
- Can be a category of diffuse lower motor neuron disease
 - Botulism

Muscles

- Perform the activities dictated by the brain (UMNs) and spinal cord (LMNs)
- Dysfunction will be of motor nature only
- Not an etiologic category for diffuse lower motor neuron disease

- Cervical ventroflexion is common

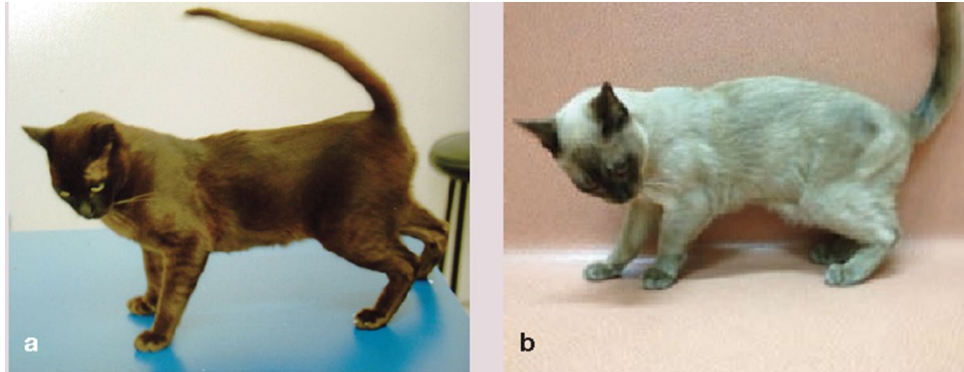


Figure 1. Cervical ventroflexion in cats

Common Clinical Syndromes



- Seizures
- Trauma
- Difficulty walking

Seizures

- The most common small animal neurology presenting complaint
- 3 major causes
 1. Idiopathic (primary) epilepsy
 2. Symptomatic (secondary) epilepsy
 3. Reactive seizures (not true epilepsy)
- 2 major types
 1. Generalized
 2. Partial (focal)
- Neuro exam ideally performed during interictal time

Seizures

- **Diagnostic work-up**
 - Minimum database
 - Toxic, metabolic etiologies
 - Radiographs, ultrasound
 - Primary or metastatic neoplasia
 - Infectious screening
 - Meningoencephalitis
 - Referral to specialty practice
 - MRI/CT, cerebrospinal fluid analysis, etc.

- **Maintenance treatment**

- Bromide
- Levetiracetam
- Phenobarbital
- Zonisamide

Seizures

- **Emergency treatment**
 - At home
 - Midazolam intranasal or per rectum
 - Clorazepate for cluster seizures
 - In-hospital
 - Diazepam/midazolam bolus(es)
 - Midazolam CRI
 - Phenobarbital loading
 - Levetiracetam bolus(es)
 - Propofol CRI

Nervous System Trauma



- Brain
- Spinal cord
- Periphery

Traumatic Brain Injury

- Oftentimes can be managed conservatively
- Consider referral for surgery:
 - Refractory seizures
 - Palpable skull fractures
 - In a location that could potentiate brain injury

Conservative Management of TBI



- **Osmotic diuretics**
 - Mannitol
 - Hypertonic saline
- **Pain medications**
 - Consider patient's mentation when choosing
- **Anticonvulsants**
 - As needed, in-hospital and to go home

- **The Cushing's response**

- Systemic hypertension
- Bradycardia
- Often seen alongside altered mentation, pupils, and/or respirations

- **Small animal coma scale**

- Also known as the modified Glasgow coma scale
- Monitors level of consciousness, motor function, and brainstem reflexes
 - Perform at least daily
- Serial monitoring associated with prognostic information

- **History**

- Blunt force trauma
- Consider pathologic fractures if history is inconsistent
 - Neoplasia, diskospondylitis, osteomyelitis, metabolic bone disease

- **Plain radiography**

- 3 compartment theory of stability
- Positioning considerations

- **Advanced imaging**

- Occasionally identifies lesions not noted on survey radiographs
- Surgical planning
- 3D printing

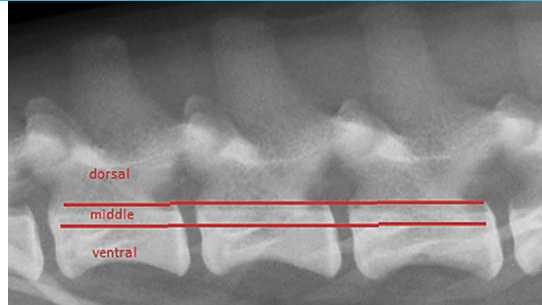


Figure 2. Three compartment theory of stability

Spinal Trauma Management



- **Conservative**

- Reasonable choice if < 2 compartments affected
- STRICT rest/confinement for at least 8 weeks
- Brace rarely needed

- **Surgical**

- Best option if 2 or more compartments affected
- Requires referral

- **Prognosis**

- Good prognosis (either option) if nociception intact

- Categories of nerve injury
 - Neuropraxia
 - Axonotmesis
 - Neurotmesis
- Prepare to treat for neuropathic pain before/after nerve amputation

Clinical Signs of Spinal Cord Injury

Loss



- Proprioception
- Ataxia
- Voluntary motor
- Voluntary urination
- Superficial pain
- Deep pain

Gain



The Down Dog

- Consider signalment

- Small
 - Intervertebral disk disease (especially if chondrodystrophic)
 - Meningomyelitis of unknown etiology
 - Anomalous (e.g., atlantoaxial instability, syringomyelia)
 - Trauma
- Large
 - Neoplasia
 - Degenerative myelopathy
 - Diskospondylitis
 - Fibrocartilagenous embolism

Conservative Treatment



- **STRICT rest/confinement for 6 weeks***
- **Medications**
 - Anti-inflammatory, muscle relaxer, analgesic(s)
- **Physiotherapy**
 - Bedside exercises (e.g., passive range of motion, assisted standing, etc.)
- **AVOID**
 - Chiropractic manipulation
 - Intensive physical therapy

The Down Cat

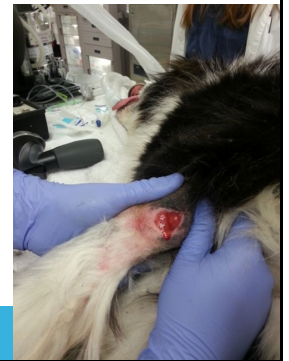
- Feline infectious peritonitis (dry form) = most common cause of proprioceptive ataxia, weakness, and/or paralysis
- Consider neoplasia (lymphoma, especially)
- Intervertebral disk disease, diskospondylitis, fibrocartilaginous embolism are RARE but possible
- Conservative therapy as for dogs

Care for the Recumbent Patient

- **Head elevation**
 - Prevent intracranial hypertension in traumatic brain injury
- **Frequent rotation and well-padded bedding**
 - Prevent decubital ulcers
- **Evacuation of the urinary bladder**
 - Prevent detrusor atony
- **Keep the patient clean and dry**
 - Prevent urine/fecal scald



Figures 3 and 4. Decubital ulcers over the elbow and ischiatic tuberosities, urine/fecal scalding of the rear end.



That is the Question!

- **To steroid or not to steroid**
- **Head trauma**
 - NO
- **Spinal dysfunction**
 - High dose protocols no benefit compared to placebo
 - Could be used instead of a NSAID for conservative management of IVDD
 - Anti-inflammatory dosing with weaning

'Shotgun Approach' for Neurologic Patients



- **Treat for many possibilities**
- **Hope something lands!**
- **Prednisone**
 - Anti-inflammatory dose
 - Consider dog vs. cat differences
 - Consider dexamethasone potency
- **Antibiotics**
 - Clindamycin
 - Doxycycline

To Sum Up



- Reminder of neuroanatomic localization
- Review of common neurologic syndromes in dogs and cats
- Reasonable approach for the general practitioner



Thank you for choosing Vetcetera!

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