Spinal disorder?

Transversal myelopathy:
Alteration caudal to the lesion:
► Postural deficits
► Ataxia
► Paresis
► Abnormal spinal reflexes (Hypo-, hyperreflexia)
► Micturation abnormalities (UMN and LMN bladder)
► (Pain)

Severity – Grading

1-5 scale
► Grade 1: only hyperaesthesia
► Grade 2: mild paraparesis and ataxia
► Grade 3: severe paraparesis and ataxia
► Grade 4: non-ambulatory paraparesis with intact deep pain perception
► Grade 5: paraplegia without deep pain perception

This scoring is used in most of the neurological textbooks.

Severity – Grading
Modified Frankel Score (MFS)
► 0: non-ambulatory para/tetraplegia, lack of superficial and deep nociception
► 1: non-ambulatory para/tetraplegia, lack of superficial but retained deep nociception
► 2: non-ambulatory para/tetraplegia, retained superficial and deep nociception
► 3: non-ambulatory para/tetraparesis
► 4: ambulatory para/tetraparesis (ataxia)
► 5: segmental hyperaesthesia

This is the preferred scoring in some surgery literature.

Diagnostic work up in suspected spinal diseases
► Signalment
► History
► Neurologic examination
  ▪ Localization
  ▪ Assessment of severity - grading
► Ancillary tests
  ▪ Blood work, urine analysis
  ▪ Radiography
  ▪ Advanced imaging: MRI, CT
  ▪ CSF analysis
► Differential diagnosis, diagnosis
► Prognosis
► Therapeutic plan
Anatomical diagnosis

**Localisation**

- CL-Cl cranocervical
- C6-T2 caudocervical
- T3-L2 thoracolumbar
- L4-S lumbosacral

**CSF analysis**
- Cytology, PCR, etc.

**Hemivertebra**
- Stenosis
- Anomaly

**Vascular**
- Diagnosis

**Ischaemic**
- Myelopathy

Chiari-like malformation

**Ancillary diagnostics**
- Fore limb: LMN, Reflexes

**Compression?**
- MRI, Myelography, CT

**Gait**
- Postural reactions

**Differential diagnosis – VITAMIN D**
- V = vascular
- I = immunomediimated, inflammatory/infectious
- T = trauma, toxic
- A = anomaly (malformation)
- M = metabolic
- I = idiopathic
- N = neoplasm, nutritional
- D = degenerative, developmental

**Imaging**

- Trauma? – CT, (RTG)
- Compression? – MRI, (myelography, CT, CT-myelo)
- Developmental abnormality? – RTG, CT, CT-myelo
- Vascular? – MRI

**The position of the lesion relative to the spinal cord**

- **Extradural:** Disc herniation, Trauma, Neoplasia, Discospondylitis
- **Intradural, extramedullary:** Neoplasia, Cyst
- **Intradu medullary:** Neoplasia, Inflammatory, Ischaemic, Haematoma

**Occipital puncture can be seen.**
### Degenerative diseases

**Intervertebral disc disease, Degenerative myelopathy, Degenerative lumbosacral stenosis, Osteoarthritis, Extravascular synovial cyst, Spondylosis deformans, Spinal stenosis**

### The Intervertebral Disc

**Annulus fibrosus**
- Concentric rings of fibrocartilagenous lamellae

**Nucleus pulposus**
- 80 – 88% water bound by proteoglycans
- Type II collagen
- Chondrocytes, fibrocytes and notochordal cells

**Cartilagenous endplates of the vertebrae**
- Thin layer of hyaline cartilage

### Disc Degeneration

- **Chondrodytophoid breeds**
  - Chondroid metaplasia of the nucleus – *Hansen type-I*
- **Nonchondrodytophoid breeds**
  - Fibroid metaplasia – *Hansen type-II*

### Hansen Type-I. disc herniation (extrusion)

- Described in chondrodytophoid dogs
- Peak incidence: 3 – 6 y
- 75% TL herniations between T11/12 and L1/2

### Type-II. disk herniations

- Often multiple
- Occur at points of greatest mobility
- Dehydration and fibrosis of the nucleus results in transference of load to the annulus
- Annulus bulges and fragments
- Generally large breeds
- >8 y

### „Other Acute Disc Herniations”

- Low volume, high velocity; missile; „type 3”
  - Can be traumatic
- Large breed acute annular disc herniations
- Acute herniation of dehydrated, fibrotic nucleus: old dachshund, large breeds
  - Undergone chondroid metaplasia but not degeneration and calcification
- Acute herniation of hydrated nucleus
  - Most common in the cervical spine
Breed predisposition

<table>
<thead>
<tr>
<th>Breed</th>
<th>Incidence</th>
<th>% of Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dachshund</td>
<td>308</td>
<td>41.2%</td>
</tr>
<tr>
<td>Poodle</td>
<td>67</td>
<td>8.8%</td>
</tr>
<tr>
<td>German shepherd</td>
<td>22</td>
<td>2.8%</td>
</tr>
<tr>
<td>Beagle</td>
<td>16</td>
<td>2.1%</td>
</tr>
<tr>
<td>German shepherd</td>
<td>16</td>
<td>2.1%</td>
</tr>
<tr>
<td>Italian grey</td>
<td>15</td>
<td>1.9%</td>
</tr>
<tr>
<td>Dalmatian</td>
<td>12</td>
<td>1.6%</td>
</tr>
<tr>
<td>Beagle</td>
<td>11</td>
<td>1.5%</td>
</tr>
<tr>
<td>Chihuahua</td>
<td>6</td>
<td>0.8%</td>
</tr>
<tr>
<td>Maltese</td>
<td>5</td>
<td>0.7%</td>
</tr>
<tr>
<td>Poodle</td>
<td>6</td>
<td>0.8%</td>
</tr>
<tr>
<td>Italian grey</td>
<td>5</td>
<td>0.7%</td>
</tr>
<tr>
<td>Pug</td>
<td>3</td>
<td>0.4%</td>
</tr>
<tr>
<td>Mixed breeds</td>
<td>104</td>
<td>13.8%</td>
</tr>
<tr>
<td>Giant breeds (20)</td>
<td>20</td>
<td>2.7%</td>
</tr>
<tr>
<td>Total</td>
<td>763</td>
<td>100%</td>
</tr>
</tbody>
</table>

*Data from Purdue University's computer files for the period January 1980 through June 1981.

The Dachshund

- Occurrence of 19% across dachshunds, some families as high as 75% (Ball et al., 1982)
- Complex trait, environmental factors important

Imaging

Survey radiography:

- Disk disease

Myelography:

- Disk extrusion
  - (Occipital puncture)
  - (Lumbar puncture)
CT: discus hernia

Myelo-CT: discus hernia

Simon Platt: Small Animal Spinal MRI Hansen I discus hernia

MR image of dehydrated & protruded disk in multiple region

**Therapy**

- **Conservative:**
  - Cage rest for at least 2 weeks after clinical signs have resolved!
  - Medication: NSAIDs or steroids, tramadol, gabapentin, gastric protection
- **Surgical:**
  - Decompression, fenestration
  - Severe neurologic signs
  - Failure of nonsurgical therapy
- + Physiotherapy

**Decision making in therapy**

- Acute or chronic?
- Severity?
- Grading!
  - Grade 5: surgical
  - Grade 4: surgical, may be conservative
  - Grade 2, 3: surgical or conservative
  - Grade 5: conservative
Success of conservative vs. surgical treatment

<table>
<thead>
<tr>
<th>Grade</th>
<th>Chance</th>
<th>Recovery</th>
</tr>
</thead>
<tbody>
<tr>
<td>1, 2, 3</td>
<td>82%-88%</td>
<td>100%</td>
</tr>
<tr>
<td>4</td>
<td>43%-51%</td>
<td>80-100%</td>
</tr>
<tr>
<td>5</td>
<td>0-7%</td>
<td>0-75%*</td>
</tr>
</tbody>
</table>

*It mainly depends on the time of the surgical decompression!

Chance of relapse in case of conservative management

- Thoracolumbar: 30.9%
- Cervical: 33%

Levin et al. Evaluation of the Success of Medical Management for Presumptive Thoracolumbar Intervertebral Disk Herniation in Dogs. Veterinary Surgery. 2007


When should be performed the surgical decompression?

- As soon as possible!
- Prevent secondary damage caused by the prolonged compression and loss of circulation
- What if there is no more deep pain sensation?
  - Does it make sense to do surgery in 12-24-48 hours or even later?

What is the prognosis in general?

- Intact deep pain s.: favourable
- No deep pain s.: grave – poor
- If deep pain s. regains in 2 weeks: favourable

Current surgical treatment of IVDD

Aim is to decompress the spinal cord

- Hemilaminectomy
- Pediculectomy
- Foramenectomy
- Lateral corpectomy
- Fenestration
- Laminectomy
- Ventral slot (cervical)
- Dorsal laminectomy (cervical)
Which surgical approach?

Hemilaminectomy

- Great access laterally and ventrally
- Minimal laminectomy membrane problems
- Access to contralateral side limited
- Access ventrally is limited if disc is firm, adherent
- Can cause instability if performed bilaterally

Mini-Hemilaminectomy (Pediculectomy, Foramenotomy)

- Preserves articular facets
- Dorsal limit – dorsal aspect of accessory process
- Can be performed bilaterally
- Less access to the vertebral canal and therefore the disc material
- Can cause instability

Ventral slot

- Cervical disc disease
- Wobbler syndrome

Possible complications:
- Severe bleeding
- Respiratory failure

Other surgical approaches

- LS spine – dorsal or sometimes a dorso-lateral approach
- Cervical spine – dorsal or hemi
- TL spine: lateral corpectomy in case of chronic disc protrusion
Other surgical approaches

- Fenestration
  - Fenestrate calcified disks, fenestrate higher risk disks T11/12 - L2/3
  - Decreased recurrence of the disease
  - Longer surgical procedure
  - Can cause instability
  - Extensive muscle dissection

What can go wrong?

- Cut the wrong site
- Recurrence
- Iatrogenic damage of the spinal cord
- Failure to remove disk material
- Hemorrhage
- Arrhythmias
- Damage to local soft tissue
- Instability
- Laminectomy membrane
- Seroma
- Infection

Treatment doesn`t end with surgery!

- Management of pain
- Management of incision
- Prevention of decubital ulcers
- Rehabilitation exercises, hydrotherapy
- Bladder care (evacuation 3 times daily!)
- Mental stimulation

Take home messages

- Most commonly the Th11-L2 sites are involved in T-L disk extrusion
- It is extremely important that deep pain be properly assessed. The withdrawal reflex does not verify the presence of deep pain. The animal should vocalize or otherwise indicate that pain was felt.
- Control of adequate bladder function is very important

The most common mistake made in managing animals with disk extrusions is administration of corticosteroids and analgesics without appropriate concurrent confinement. Strict cage rest is mandatory in these patients.

- It is generally accepted that patients with paresis should be treated by early decompression.
- Patients without deep pain s, should be operated on within 24 (~ 48) hours of disk extrusion.
- It is not sufficient to remove lamina, facets and pedicules alone without the compressive disk material.
- The role of prophylactic fenestration remains unclear.
Degenerative diseases

| Degenerative diseases | Intervertebral disc disease, Degenerative myelopathy, Degenerative lumbosacral stenosis, Osteoarthritis, Extradural synovial cyst, Spondylosis deformans, Spinal stenosis |

Degenerative lumbosacral stenosis (Cauda Equina Compression)

Cauda Equina Compression = compression of the terminal nerve filaments

Clinical signs

(LMN signs + pain)
- Lumbo-sacral pain!
- Difficult to stand up or jump
- Dragging the toes on the ground
- Hind limb paresis
- Muscle atrophy except m. quadriceps
- Low carriage of the tail
- Fecal and urinary incontinence
- Decreased anal reflex
- Hyperaesthesia, pruritus, automutilation is possible

Ancillary tests

- Radiography
- Myelography
- Epidurography
- Discography
- CT
- MRI
- Electrophysiology

The most common causes of LS stenosis

- Hansen Type-II. disc protrusion
- Lumbosacral instability
- Neoplasia
- Fracture
- Discospondylitis
- Spondylosis deformans
- Compressing L7 nerve root
- OCD of the sacrum

Myelography

Disk protusion - CEC

C.E.C. epidurography
CT
Sacrum OCD és CEC
MRI

Therapy

► Conservative
- In mild cases (only pain)
- Exercise restriction (4-6 w)
- NSAIDs, corticosteroids
- Physiotherapy

► Surgical
- In case of gait abnormalities
- In case of failure of the cons. treatment
- Dorsal laminectomy
  - (foramenotomy)
  - (stabilisation)

L7-S1 dorsal laminectomy
**Developmental or degenerative disease**

**Caudocervical spondylomyelopathy (Wobbler-syndrome)**

- Cervical vertebral malformation or malarticulation results in compression of the cervical spinal cord segments
- Most common in middle aged Dobermans (3-9 y) and young Great Danes (2)
- C5-6 and C6-7 is the most common
- Chronic, slowly progradiating disease

**Clinical signs**

**chronic compression of the cervical spinal cord**

- Stiff neck
- Ataxia
- Paresis
- „Two engine dog”
- LMN signs on the front limbs
- UMN signs on the hind limbs
- First signs on the hind limbs

**Wobbler therapy**

**Conservative**
- In mild cases
- Exercise restriction
- NSAIDs, corticosteroids
- Physiotherapy

**Surgical**
- High potential for morbidity and postop. complications!
- In case of gait abnormalities
- In case of failure of the cons. treatment
  - Dorsal laminectomy
  - Ventral slot
  - Ventral slot + stabilisation

**The most common causes of Wobbler-syndrome**

- Narrowing of the vertebral canal because of osseus malformation (Great Danes)
- Hypertrophy of the lig. flavum and joint capsules
- Annulus hypertrophy and dorsal longitudinal ligament pathology
<table>
<thead>
<tr>
<th>Degenerative diseases</th>
<th>Intervertebral disc disease, Degenerative myelopathy, Degenerative lumbosacral stenosis, Osteoarthritis, Extradural synovial cyst, Spondylosis deformans, Spinal stenosis</th>
</tr>
</thead>
</table>
| **Degenerative myelopathy** | ▶ Slowly progressive axonal degeneration and demyelination  
▶ Older German shepherd (>8 y) and mixes, boxer etc., rarely in cats  
▶ Hind limb ataxia and paresis, nonpainful!  
▶ Imaging: spinal cord atrophy  
▶ Genetic test is available  
▶ No curative treatment, poor prognosis  
▶ Physiotherapy |

<table>
<thead>
<tr>
<th>Trauma</th>
<th>Fracture, Luxation, Traumatic disc herniation, Traumatic A-L lux.</th>
</tr>
</thead>
</table>
| **Fracture, luxation** | ▶ Direct trauma to the spinal cord results primary and secondary injuries (See in closed mechanical injuries lecture!)  
▶ Emergency initial examination and stabilization  
  ▶ Immobilize the spine to prevent further damage!  
▶ Detailed neurological examination  
▶ Radiography, CT  
▶ Surgical or conservative treatment |

- **Decompression**:  
  ▶ Laminectomy  
  ▶ Durotomy (in case of severe swelling)  

- **Stabilization**:  
  ▶ Pins, screws and polymethylmethacrylate  
  ▶ Vertebral body plates  

C5 fracture
Clinical signs

- Pain!
- Transversal myelopathy
- Any breed, most common in older large breed dogs
- Cats: lymphoma, meningioma, osteosarcoma!

Imaging

Extradural?
Intradural-extradural?
Intramedullary?

Vertebral tumors:
Osteolysis – osteoproliferation on radiographs
- Ventral part of the vertebral body or proc. spinosus

Osteosarcoma of the sacrum

Neoplasia

<table>
<thead>
<tr>
<th>Primary or secondary tumors</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tumors can affect the vertebrae, meninges and spinal cord</td>
</tr>
<tr>
<td>Neoplasia can be classified as extradural, intradural-extradural, or intramedullary</td>
</tr>
<tr>
<td>Extramedullary tumors can be primary or secondary.</td>
</tr>
<tr>
<td>Primary vertebral tumors: fibrosarcoma, osteosarcoma, chondrosarcoma, hemangiosarcoma, myeloma</td>
</tr>
<tr>
<td>Secondary vertebral tumors: mammary, prostatic, thyroid carcinomas, malignant melanoma, metastatic osteosarcoma</td>
</tr>
<tr>
<td>Epidural tumors: lymphoma, metastatic tumors</td>
</tr>
<tr>
<td>Intramedullary-extradural: meningioma, peripheral nerve sheath tumor, lymphoma, nephroblastoma</td>
</tr>
<tr>
<td>Intramedullary: astrocytoma, oligodendroglioma, ependymoma, metastatic</td>
</tr>
</tbody>
</table>

Extradural tumors can be primary or secondary.

Intradural-extradural tumors can affect the vertebrae, meninges and spinal cord.
Lymphoma
Located intradural-extradural

Fibrosarcoma

Multiplex myeloma

Treatment

► Long-term prognosis is poor
► Medical therapy consists:
  ▪ Prednisone palliatively
  ▪ Chemotherapy (lymphoma, solitary plasmacytoma)
  ▪ Radiation therapy
► Surgical therapy
  ▪ Decompression + surgical resection or debulking
**Inflammatory/infectious**

<table>
<thead>
<tr>
<th>Discospondylitis</th>
<th>Meningitis, Meningomyelitis, Empyema, Osteomyelitis, GME</th>
</tr>
</thead>
<tbody>
<tr>
<td>► Septic infection of the disc and adjacent vertebrae</td>
<td>► Most common form is the immune-mediated („beagle-pain“, „steroid responsive meningitis“)</td>
</tr>
<tr>
<td>► Common: Staph. intermedius, Streptococcus, E. coli, Actinomyces, Aspergilllus, Brucella canis, Pasteurella</td>
<td>► Typically in young (7-18 month) dogs</td>
</tr>
<tr>
<td>► Mainly in middle-aged large breed dogs</td>
<td>► Most common in beagle, bernese, boxer, vizsla</td>
</tr>
<tr>
<td>► Clinical signs reflect the location, pain is the most common!</td>
<td>► Severe neck pain and fever</td>
</tr>
<tr>
<td>► Other infection or systemic disease can be in the background!</td>
<td>► CSF cytology is the definitive diagnostic test</td>
</tr>
<tr>
<td>► Therapy: long term antibiotic treatment (6-8 weeks), NSAID’s</td>
<td>► Treatment is long-term (min. 6 month) immunosuppression with tapering dosage of prednisolon</td>
</tr>
</tbody>
</table>

**Osteomyelitis**

- Common: Staph. intermedius, Streptococcus, E. coli, E. Epidural bleeding
- Typically in young (7-18 month) dogs
- Often systemic signs too

**Meningitis**

- Vascular compromise of the spinal cord that often progresses to local infarction
- Fibrocartilaginous embolic myelopathy (FCEM) or spinal cord infarct or ischemic myelopathy
- Peracute onset, nonprogressive, nonpainful, often asymmetrical
- Transverse myelopathy (ataxia, paresis)
- Most common in large breed dogs, miniature schnauzers and cats
- Imaging: MRI is definitive
- Treatment: physiotherapy

**Discospondylitis**

- X-ray: osteolysis surrounded by sclerosis on the vertebral endplates
- Cave: radiographic signs only after the first 2 weeks

**Infectious meningomyelitis**

- Viral, bacterial, protozoal or fungal
  - Cats: FIP, FeLV, toxoplasmosis etc.
  - Dogs: distemper, toxoplasmosis, neosporosis, cryptococcosis etc.
- Multifocal neurological signs, can include paresis and ataxia
- Often systemic signs too
- CSF test is the basis of the diagnostics

**Vascular**

- FCE, Epidural bleeding
A-Luxation, Chiari-like malformation and Syringomyelia, Hemivertebra, Arachnoid cyst, Spina bifida, Dysraphismus, Multiple cartilaginous exostoses

### Atlanto-axial luxation
- Instability or malformation of the atlantoaxial joint allows excessive flexion of the cervical 1-2 joint
- Subsequent ventral cord compression occurs from the cranial aspect of the body of the axis
- Most common in young toy breeds
- Neck pain, ataxia, tetraparesis
- X-ray, CT, MRI is definitive
- Treatment:
  - Conservative: neck splinting for 8-10 weeks (long term efficacy?)
  - Surgical: Fusion of the C1-C2

### Chiari-like malformation and syringomyelia and hydromyelia
- Hydromyelia is a fluid dilatation of the central canal
- Syringomyelia is a fluid dilatation in the spinal cord that may communicate with the central canal
- Any condition that causes obstruction of normal CSF flow along the spinal cord can cause it
- Most common in cervical region
- Cervical syringohydromyelia occurs as a component of congenital anomalies associated with caudal occipital malformation syndrome (Chiari), which is most common in Cavalier King Charles spaniel
- Neck pain, persistant scratching, ataxia, paresis

### Treatment (in case of clinical signs)
- Prednisolon 0,5 mg/kg/SID
- Gabapentin 5-10 mg/kg/TID
- Pregabalin 3-4 mg/kg/TID
- Omeprazol 0,5 mg/kg/SID
- NSAID (Meloxicam, Carprofen, Coxib)
- Other painkillers (pl. Fentanyl patch)
- Furosemid
- Surgical decompression + titanium mash?
### Hemivertebrae

- Wedge shaped malformation, with the apex dorsally, ventrally, or medially across the midline which often results in angulation of the v. column
- Spinal cord compression can occur
- Most common: bulldog, pug, yorkie, boston terrier, german shorthair pointer
- Clinical signs: slowly progressive ataxia, paresis, (pain)
- Imaging: X-ray, Myelography, CT, MRI
- Treatment
  - Conservative: physiotherapy, NSAIDs, steroids?
  - Surgical for progressive clinical signs: stabilisation + decompression

### Arachnoid cyst

- CSF filled diverticuli of the arachnoid membrane
- Most common in young adult rottweilers, cervically
- Chronic progressive
- Clinical signs: ataxia, paresis, (pain), incontinence
- Imaging: Myelography, MRI
- Treatment:
  - Conservative in mild cases: NSAIDs, steroids
  - In severe cases surgical decompression, partial excision and marsupilisation of the dura is recommended

### Thank you for your attention!

**Literature**
- **BVA Manual of Canine and Feline Neurology**
- **Handbook of Veterinary Neurology**
- **Small Animal Spinal Disorders**
- **Veterinary Neuroanatomy and Clinical Neurology**
- **Small Animal Surgery**