Surgical treatment of spinal cord diseases

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• Ethiology
• PDA
• Compression myelopathy

Atlantoaxial instability

Incidence
Dogs - toy breeds, usually younger than 1 year
Rarely in large breeds and cats (Siamese)

• AA instability

Ethiopathogenesis
➢ hereditary and/or developmental disturbance of C1-C2 articulation

spinal cord compression

Cause of instability:
1. fx, aplasia, hypoplasia or malformation of dens axis
2. laxity or rupture of ligaments

ligg. alare, apicale, transversum, atlantoaxiale dorsale

Minor trauma can cause clinical signs

• AA instability

Symptoms
✓ pain, reluctance to walk
✓ abnormal posture – lowered neck
✓ difficulties to raise head to bowl
✓ progressive tetraparesis and ataxia

• AA instability

➢ Diagnosis

Ddg.: fx of C vertebra, disc protrusion/extrusion, meningitis
- neurologic exam

**Watch too much neck flexion!**

- X-ray

**first LL view in non-sedated animal**

- Easier to evaluate in anaesthesia (LL view)

VD + „open mouth“ view
to diagnose aplasia or fx of *dens axis*

- AA instability

**T x**

**conservative**

- 3-4 weeks cage rest
- immobilisation of the neck in extension (brace - cast)
- first 24-48 hrs steroids

**Relapses often**

- AA instability

**T x surgical**

**tetraparesis + when conservative failed**

- reposition
  - decompression (hemilaminectomy or reposition of sublx)
  - stabilisation:

**dorsal – sling**

**ventral – AA arthrodesis**

+ *odontoidectomy in malformation of dens axis*

- methylprednisolon succinate-sodium 30 mg/kg
  - AA instability

**Post op care**

- Cage rest 10-14 days
- Limited activity till arthrodesis
- Elevated bowl, brace +/-
- No leash till the end of life
  - AA instability

**Prognosis**
- conservative

**relapses**
- ventral vertebral stabilisation - good
- Compression myelopathy

**Wobbler syndrome**

**Incidence**
- quite often
- young Great Danes + old Dobermans
- Wobbler syndrome

**Etiopathogenesis**

exact cause unknown
- it is a "syndrome" with multifactorial ethiology

Suggested
- hereditary cause + nutrition and trauma
- Wobbler syndrome

**5 nosologic conditions causing compression**

1. **chronic degenerative disc disease**

fibrinoid degeneration with Hansen protrusion type II
+ subsequent annular and ligament hyperthrophy
- C5-C7
- compression more severe in extension, minor in flexion
- elongation of *lig. longitudinale dorsale*

**adult male dobermans**
- Wobbler syndrome

disturbance of endochondral ossification
deformity of vertebral body, articular facets and lamina
stenosis of spinal canal – cranial vertebral body

- Spinal cord compressed laterally or dorsoventrally
- C3-C7

**young Great Danes (might be also in Dobermans)**

- Wobbler syndrome

instability of vertebral body secondary to chronic disc degeneration might be predisposing factor to malposition of vertebral body (and vice versa)

- ventral spinal cord compression by craniodorsal part of the body
  - C6 or C7

**mainly adult male Dobermans**

- Wobbler syndrome

hyperthrophy secondary to vertebral instability

- genetic or nutritional abnormality
  - vertebral arch and articular facets will hyperthrophy, and deform
  - compression from dorsal side

partly static (hyperthrophied arcus and facets)

partly dynamic (in extension - arcus vertebrae)

- minor in flexion
- C4-C7

**young Great Danes**

- Wobbler syndrome

  - dorsal (hyperthrophy/hyperplasia of ligamentum flavum)
  - ventral (hyperthrophy/hyperplasia of anulus fibrosus)
  - lateral (arthrosis of articular facets or their malformation/malarticulation)
  - dynamic compression
  - anywhere from C2 to C7

**young Grade Danes**

- Wobbler syndrome

**Symptoms**
➢ Slow worsening of co-ordination during months to years
hypermetry, ataxia

➢ in 40% cases also cervical pain
➢ all 4 limbs, first pelvic
➢ exacerbation can cause minor trauma
➢ in chronic atrophy \( m. \supraspinatus/m. \text{infraspinatus} \)
➢ patients hold neck in flexion
extension during exam can temporarily worsen motor deficit

• Wobbler syndrome

Diagnosis

Ddg.: IVDD, HD bil., CCL bil., AA sublx, generalised pain due to Addison disease, secondary nutritional hyperparathyroidism, tumours of cervical cord and canal, polyarthritis/polymyositis, discospondylitis, meningitis, fx/lx of C vertebrae

➢ history, neurologic and radiographic exam

Stress radiography (extension + linear traction) might temporarily worsen neurologic signs!

➢ Wobbler syndrome

Tx conservative
do not prevent progression

➢ medicamentous (NSAIDs/steroids)

➢ limited movement 3-4 weeks

➢ food from elevated bowl

temporary alleviation

color of spinal cord oedema -- remyelinisation

• Wobbler syndrome

1. „SLOT“ protrusion

2. vertebral traction, stabilisation using K-wires + PMMA

ventral dynamic compression

3. traction + stabilisation using polyvinylidine spinal plate

ventral dynamic compression

4. traction + stabilisation using Harrington rod
2 ventral compressions (C6 and C7)

5. dorsal laminectomy

in hyperthrophy of lig. flavum and malformation of arcus vertebrae

- Wobbler syndrome

**Perioperative care**

- methylprednisolone succinate-sodium 30 mg/kg
- 2-3 wks cage rest
- another 6-8 wks slow return to normal activity
- no leash till the end of life

**Results of Sx Tx = appropriate patient selection**

- only some of the cases have good long-term prognosis

- Wobbler syndrome

**Prognosis**

- conservative – progressive worsening
- sx

- relatively good

chronic disc disease

some with vertebral tipping

some with hyperthrophy of lig. flavum/malformation of the arch

- uncertain

„hourglass compression“

- unfavourable

inherited malformation of vertebrae

- Compression myelopathy

**Fx/lx of vertebrae**

**Incidence**

- low
- dogs and cats
- no breed, age and gender predisposition
• Vertebral Fx and Lx

Ethiopathogenesis

➤ pathologic

hereditary or congenital anomalies of ligaments

chronic imbalance of Ca and P, neoplasia

➤ traumatic

• Vertebral Fx and Lx

types of spinal injuries:

➤ 1. hyperextension

➤ 2. hyperflexion

➤ 3. compression

➤ 4. rotation + flexion

➤ 5. only vertebral processes

• Vertebral Fx and Lx

Symptoms

➤ from pain to plegia

➤ with possible disturbance of micturition

➤ crepitus

Diagnosis

Ddg.: acute traumatic extrusion, contusion/commotion of spinal cord

➤ cautious neurologic exam

➤ deep pain

➤ LL + DV view in non-anesthetised animal

20% of patients fx in 2 locations

➤ myelography

to rule out fragment dislocation + disc extrusion

if there is not correlation between clinical signs and plain radiography

• Vertebral Fx and Lx

Tx
conservative

fxs with minor dislocation

- cage rest minimum 2-3 wks
- neck – brace
- first 24-48 hrs steroids
- 3 times a day revision of micturition
- Vertebral Fx and Lx

Tx surgical

Fx/lx reposition + stabilisation

Consider:

1) localisation (neck, thoracic ....)
2) fragment(s) + disc(s) findings
3) body constitution + weight
4) age
5) equipment available
6) experience
7) owner compliance to co-operate

- Vertebral Fx and Lx

Methods of stabilization:

1. fixation of vertebral bodies using plate and screws – caudal thoracic and cranial lumbar
2. fixation using K-wires + PMMA
3. fixation of processus spinosi + processus articularis using „U“ pin + cerclage wires
4. plating of processus spinosi
5. crossed K-wires into vertebral bodies
6. transillial pin – L7

- Crossed pins + PMMA
- Vertebral Fx and Lx

Prognosis

- minimal dislocation even after conservative tx
good
  - unstable

guarded
  - older than 48 hrs + canal narrowed more than 80%

unfavourable
  - Vertebral Fx and Lx
  - Compression myelopathy

Cauda equina

Incidence
  - large breeds, German Shepherd
    - Cauda equina syndrome

Incidence: middle age dogs
  - Congenital stenosis of cauda equina

no breed and gender predisposition
  - Acquired syndrome of cauda equina

large breeds, especially German Shepherd
  - Cauda equina syndrome

Etiopathogenesis
  - compression of spinal cord and nerve roots

L7, S1-S3 and Cd1-Cd5 (cauda equina)

at the level of L5-L7, S1-S3 and Cd1-Cd5
  - Cauda equina syndrome

Causes:

2. acquired:

a) fx/lx of vertebrae

b) discospondylitis

c) osteomyelitis of vertebrae

d) spondylosis deformans

e) IVDD (acute disc extrusion)
f) vertebral neoplasia (L7-S1)

surrounding soft tissue and nerve root neoplasia

- Cauda equina syndrome

**Symptoms**

- chronic LS pain
- sometimes lameness
- reluctance to climb up the stairs, jump
- abnormal sitting
- during walking erode dorsal surface of claws
- progressive incontinentia alvi et urinae
- abnormal motor function of the tail
- atrophy of hind limb muscles
- Cauda equina syndrome

**Diagnosis**

Ddg.: HD, degenerative myelopathy

- history
- neurologic exam
- laboratory – blood + CSF
- Cauda equina syndrome

**Tx**

- fx/lx, discospondylitis, neoplasia

 treat the cause

- **conservative**  IVDD, LS stenosis

 limited movement 4-6 wks + NSAIDs

- **surgical**

1. dorsal laminectomy L7-S1

 sometimes with dorsal fenestration and foramenotomy

2. dorsal laminectomy L6-S1

 sometimes with facetectomy
in a case of lumbosacral stenosis
  • Cauda equina syndrome

**Prognosis**
  ➢ conservative
    good in back pain
    relapses are quite often
  ➢ surgical
    acute, no incontinence
    favourable
    chronic with incontinence and severe paraparesis
    guarded to poor

**Intervertebral disc disease**
  • Characteristics of TL-IVDD
  • common clinical problem encountered in practice
    usually dictates early surgical intervention
  • **Dg. requires ability to interpret:**
    neurological examination

**Knowledge of ancillary diagnostic tests**
  • IVDD - differences
    ➢ Men
    age
    gender
    ➢ anatomical differences

**Spinal cord length**

**Spinal canal**

**Forces on disc: column x longbow**
  • IVDD - differences
  ➢ men x dogs
clinical signs

- IVDD

Incidence

- mainly chondrodysphic breeds

3-6 years

Hansen type I

- non-chondrodystrophic

Hansen type II

8-10 years

- IVDD

Risc of extrusion

male dogs > ovariectomized females > bitches

influence of estrogens?

- IVDD

Ethiopathogenesis

Hansen – 2 typees of metaplasia

- between 8 months and 2 years \textit{chondroid metaplasia}
- between 3.-6. year \textit{fibroid metaplasia}

maybe too simplified concept

- IVDD

Symptoms

- \textbf{grade I}: first episode of back pain, no motor deficit
- \textbf{grade II}: repeated pain and/or mild paraparesis
- \textbf{grade III}: severe paraparesis
- \textbf{grade IV A}: paraplegia deep pain intact
- \textbf{grade IV B}: paraplegia, deep pain absent < 48 hodin
- \textbf{grade IV C}: paraplegia, deep pain absent > 48 hodin

- IVDD

Diagnosis


- IVDD

**Tx**

- trend is prompt surgical intervention

**Prognosis**

- based on lokalisation

grade
duration of clinical signs
method of tx

- IVDD

**WRONG !!!**

- immediately „put“ on steroids patients with grades I and II, duration 1 day

- „treating“ dog with grades III, IV for weeks!! With steroids
steroids x nonsteroidal      WHEN ?

  •  NeuroSx techniques
  •  Decompressive Sx
     ventral neck decompression (SLOT)
     hemilaminectomy
     minihemilaminectomy
     pediculotomy
     dorsal laminectomy
  •  Fenestration

prophylaxis
  •  Cervical IVDD

14-16% cases of IVDD

  •  Clinical signs
     neck pain
     hemi- to tetraparesis
  •  3 grades:  I concomitant x-ray finding
  II pain
  III motor deficit

Choice of Tx based on the grade!

  •  Cervical IVDD
  •  Disc fenestration
  •  Indikace

protruze (mineralizace)

s návratnou bolestivostí krku a svalovými spazmy

rutinně C2-3 až C6-7

  •  Postup
     ve hřbetní poloze
     identifikace meziobratlových prostorů
     fenestration
• SLOT
  • Dorsal cervical decompression

laminectomy

hemilaminectomy
  • Indications

lateral a intraforaminal extrusion
dorsal approach
occasionally
  • NeuroSx techniques
  • decompressive surgery
    ➢ hemilaminectomy
    ➢ minihemilaminectomy
    ➢ dorsal laminectomy
  • fenestration = prophylaxis
  • RF unit
  • Laser
  • Nucleolysis
  • Classification of dogs with TL-IVDD according to severity of clinical signs
  • Fenestration of TL discs
  • Dorzolateral
    from Th10-11 to L3-4
    ➢ dorsolateral muscle separation
  • Ventral
    ➢ thoracotomy in 10th IC space
    in combination with paracostal laparotomy

complicated
  • Hemilaminectomy
  & Durotomie
  • Hemilaminectomy
• Hemilaminectomy
• Dorsal laminectomy
• LS region

Only one method of decompression

➢ type A (Funkquist)
➢ type B (Funkquist)
➢ modification

• Method of choice in TL region
• Dorsal laminectomy
• Method of choice in TL region

Disadvantages!

➢ laminectomy scar tissue
➢ do not provide approach to the floor

• Factors of prognosis

➢ Correct dg + lesion localization
➢ Correct method of Tx
➢ Atraumatic approach
➢ Time factor

IV A 48 hrs!

• Perioperative care

➢ Corticoids

methylprednisolone (succinate-sodium)

20-30 mg/kg one dose slowly in infusion

➢ ATB in bacterial cystitis
➢ Monitoring of urination

3-4 times a day

➢ Rehab

ASAP

• Papiloma of choroidal plexus
• Surgical, myelographic, and laboratory aspects of neurosurgical treatment of thoracolumbar disc disease in dogs as an indicator of prognosis

• Habilitation thesis


• Alois Nečas

• Brno, 4.6.1999

• Cited in Slatter’s *Textbook of Small Animal Surgery, 3rd ed*


• Prognosis for neurological recovery after treatment

• **Dictated by the severity of injury to the spinal cord**

To provide a prognosis before intervention

history

and neurological examination are used.

• **We found additional and objective prognostic indicators**


• Goal of the clinical study

• **The purpose of this study was to find new and different prognostic indicators for neurological outcome in dogs with TL-IVDD.**

• **Four different aspects**

  laboratory = CSF enzyme activities

  myelographic = extent of spinal cord swelling

  surgical/clinical = recurrence of neurological deficits

  = progress and extent of recovery after decompressive procedure

• 1. CSF analysis
97 dogs with TL-IVDD (49 male + 48 female)
puncture: cisterna magna 97 lumbal 45

Goal: to find, if myelopathy due to TL disc extrusion can cause elevation of CK and LDH in CSF

• Significant differences in activities of these enzymes in CSF were found between healthy and TL-IVDD dogs:

Mann-Whitney U-test (p<0.01)

- Aspect 1: CSF analysis

- Normal values 23 healthy dogs (lumbar punctures)

CK = 0.41 ± 0.43 µkat/l
LDH = 0.40 ± 0.28 µkat/l

The highest normal activity (mean+2sd) was assessed.

CK > 1.27 µkat/l abnormal
LDH > 0.96 µkat/l

Affected dogs (45 lumbar samples)

CK = 2.47 ± 3.22 µkat/l
LDH = 1.45 ± 1.98 µkat/l

- 1. CSF analysis

- CK activity in samples taken on
day 1< day 2 > day 3-4 < day 7-17
LDH activity in samples taken on
day 1< day 2 > day 3-4 ~ day 7-17

- The enzymes activities are dependent on time of collection of CSF samples

- Aspect 1: Summary

97 dogs with TL-IVDD (49 M + 48 F)
cranial puncture 97 lumbal 45

Purpose: determine whether transverse myelopathy due to TL disc herniation may cause elevation of CSF CK and LDH

• Significant differences between activities of the two enzymes in the CSF of healthy dogs and dogs with TL-IVDD were found:

Mann-Whitney U-test (p<0.01) C O N F I R M E D

- Time of collection dependent enzyme activity (peaks) was found

- Aspect 1: CSF fluid analysis
Preliminary results of our recent investigation of CSF enzyme activity in samples obtained from deep pain absent paraplegic dogs suggest that concentrations of the enzymes are related to severity of the central nervous tissue damage. Might be helpful in establishing more reliable prognosis before surgery!

- Aspect 2: Myelographic study

Lateral myelographic view was examined for evidence of and extent of spinal cord edema

- The extent of the edema correlated with
  - severity of clinical signs IV A < IV B
  - duration of the neurological deficits

IV A (operated on within 48hrs) > IV A (later than 48 hrs)

- Aspect 2: Myelographic study

- The extent of edema is
  - very accurate prognostic indicator

in dogs with grade IV A involvement (< 48 hrs)

more than 3.17 ± 1.95 TL vertebrae = minimal chance of complete recovery

The outcome of surgery was assessed based on 9 to 51 months follow-up.

- Aspect 3: Recurrence of herniation

The probability of disc prolapse at another site after a dog had undergone hemilaminectomy is a question that owners commonly ask.

- We decided to assess recurrence rate 1-30 months; median = 9 14.59% 10.27 ± 7.25 months

Recurrences involving other discs

Prata (1981) 2.7%

Muir et al. (1995) 5%
Dhupa et al. (1999) 6.4% (early + late reoperation groups)

- Aspect 4: The course of recovery

Result of Tx classified as:

- **Excellent** = complete recovery of motor and urinary functions
- **Very good** = minimal motor deficit when walking on a slippery surface, and complete recovery of urinary bladder function
- **Good** = obvious remaining dysfunction, either motor or urinary, but animal retained independent function and usefulness
- **Fair** = not enough improvement to be returned to owner as an independent animal

- „Good“
- Aspect 4: The course of recovery
- The time taken until dogs regained the ability to walk without assistance + until complete recovery differed between the groups of patients

grade II < III < IV A < IV B

- The time at which a grade IV A dog regains the ability to walk unassisted is an objective prognostic indicator

- Outcome excellent very good or fair

  - IV A < 48 hrs 1.70 ± 1.14 weeks 2.90 ± 1.47 weeks
  - IV A > 48 hrs 2.15 ± 1.69 weeks 3.96 ± 2.29 weeks