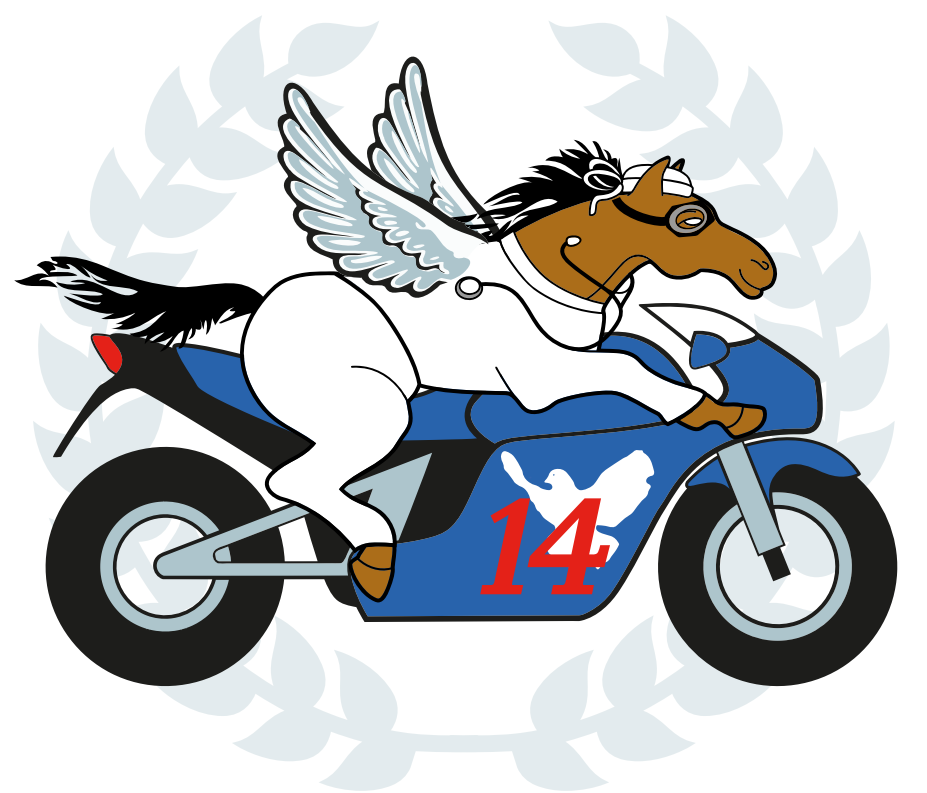




***THANK YOU
FOR YOUR SUPPORT***

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The Germany, Poland & Baltics Run.*



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ENDOQUINO
equine endocrinology - diagnosis & advice



GPM

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Zur Vorbeugung und Behandlung
von Magengeschwüren bei Pferden.



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1

Therapeutic problems

Wisdom is the power to see the truth without attempting to fit it into any mold.

- Low success rates overall
- Lack of knowledge
 - Lack of “understanding”
 - Failure to recognise as “cancer”
- **Late presentation**
- Lack of availability of treatments
 - Different countries have different problems
 - Logistic
 - Regulatory
 - Costs

Can we realistically EVER give a 100% prognosis

2

Treatment Options

1. Surgery / Cryo / Laser/Diathermy/Ligation
2. ‘Immune’ therapy
 - BCG Injections
 - Vaccines (autogenous / viral)
 - Cytokine / immunotherapy
3. Chemotherapy / Electrochemotherapy
 - Cytotoxics (topical & injection)
 - Antimetabolites (topical)
4. Photodynamic therapy
5. Radiation
6. Homeopathy / Natural medicine / Phytotherapy

Why so many treatments?

3

Treatment selection criteria

1. **SARCOID TYPE**
2. **SARCOID EXTENT**
3. **SARCOID LOCATION**
4. **SARCOID DURATION**
5. **PREVIOUS INTERFERENCE?**
6. **PROGNOSIS**

- a) LOGISTICS OF TREATMENT
- b) VALUE OF HORSE
- c) COST OF TREATMENT
- d) DURATION OF TREATMENT
 - Time to return to work
- e) ANIMAL COMPLIANCE
- f) OWNER COMPLIANCE

4

Note however:

- Some lesions remain static
 - Often for many years (or even for life)
 - Unpredictable exacerbation
 - Time scale very variable
- Some lesions / cases spontaneously resolve (completely)
 - These cases are solidly “immune”

• **Communication with owner is CRITICAL BEFORE YOU START ANYTHING**

5

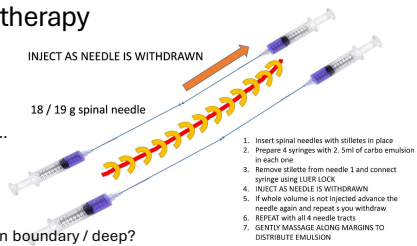
SHARP Surgery (conventional)

- Careful thought / preparation paramount
- Anatomic considerations
- Cosmesis
- Technical aspects / adjunctive chemotherapy
- Time / Hemostasis
- Closure – LAYERS / TENSION RELIEF/ SUTURES or STAPLES?

6

Adjunctive chemotherapy

- Topical
 - Closed wound
 - Open wound – laser +...
- Peri-surgical
 - Open wound infiltration boundary / deep?
 - Closed wound



7



8

RISK OF SEEDING / RESIDUAL TUMOUR

- **MARGIN DEFINITION**
 - Fear of closure challenges
 - Skin damage
- **SEEDING RISKS**
 - Instruments
 - Swabs
 - Gloves
 - Suture needles



9

Post Surgical Recurrence

- [Very] high rates for SARCOIDS (Jackson, 1996)
- Reasons for recurrence
 - **INADEQUATE MARGIN** → residual tumour
 - **SEEDING OF TUMOUR CELLS**
- **ALWAYS CONFIRM MARGIN SAFETY!**
 - **Do not economise!**



10

Is sarcoid still present?



11

Multiple surgical failures

- EASY surgery on Day 0
- Not so easy on day 65
- **HIDEOUS** on DAY 250
- A bit of a problem on DAY 550

- **NO HISTOLOGY EVER**
- - "I know it's a sarcoid, why should I waste time and money on histology!"



12

Improving the outcome in TUMOR SURGERY

• “SMART” SURGERY

- Minimal contamination surgical tumour reduction
- Avoids seeding of tumour cells into the site
- Improves surgical prognosis by 5- 10% overall

- NO 100% success rate ANYWHERE IN THE WORLD!
 - Unless you read the Internet and practice pages!

- SELECT YOUR CASES CAREFULLY!

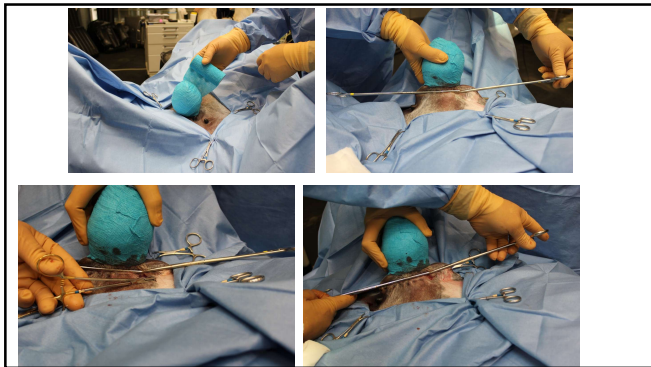
- Define the likely margin!



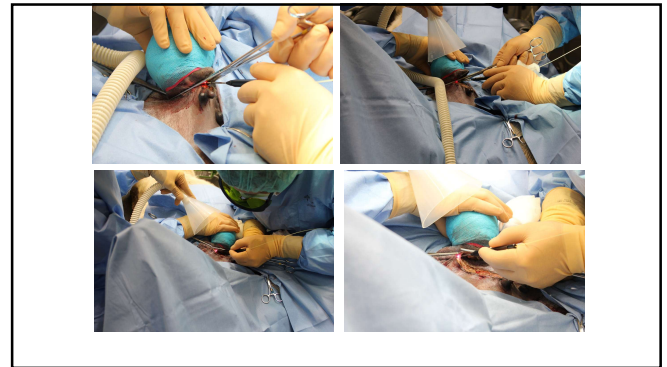
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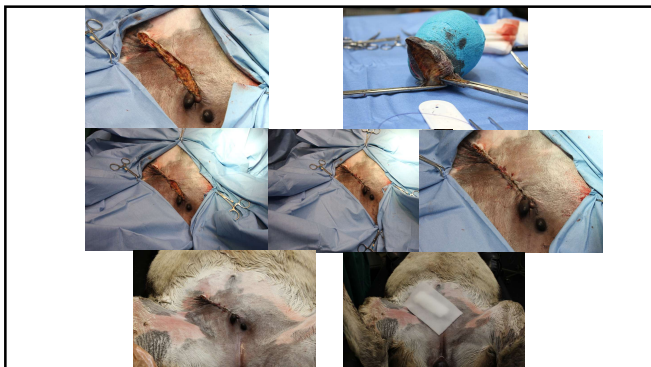
14



15



16



17

Cryosurgery

- Time consuming
- Experience helps!
- Cryo-antigen effects?
- ‘Crude-pour’ techniques?

• COMBINATIONS BETTER!

- Chemotherapy
- Surgery



18

Cryosurgery combined with 5-Fluorouracil



19

Slow release local chemotherapy

• Stable emulsions using medical grade oils / stabilisers

1. Cisplatin
2. Carboplatin
3. 5 Fluorouracil
4. Mitomycin C



20

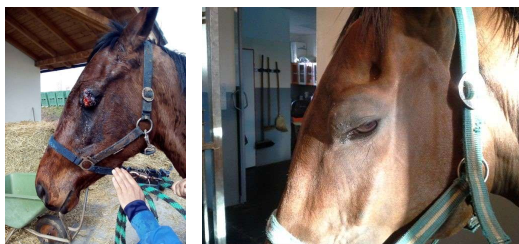


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22

Carboplatin s-r x 5 at 2 week intervals



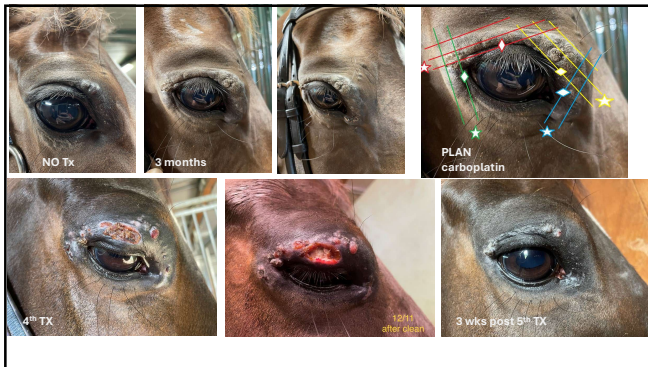
23

Slow release carboplatin emulsion



Is it getting WORSE?

24



25

Mitomycin C

- Aqueous MMC is washed out within 30 – 60 seconds
 - VERY high doses required
 - Repeat injections at short intervals
 - One paper presented at ECEIM (McKane S, 2016)
- MMC POLYMER
 - Thermolabile (multiple methods of administration)
 - Preliminary results encouraging
- MMC Implants (4mg)
- SECONDARY CHANGES
 - pigment loss over cutaneous lymphatics

26

Electrochemotherapy

- Electrically induced ↑ in cell uptake of chemo agents
 - Electroporation → increased drug concentration
- Reported cisplatin only
- Repeated GA required – up to 6 times
 - Do horse 'get used to anaesthesia'?
- New systems developed requiring sedation only
- Good results reported
- Limited personal experience of it
- Does it do any more than a slow-release form of the drugs?
- Better with slow-release chemotherapeutics (carboplatin/bleomycin/ MMC)?
 - More sensible / practical procedure
 - Fewer procedures

Mazbères S et al., Non-invasive contact electrodes for in vivo localized cutaneous electropulsation and associated drug and nucleic acid delivery. J Control Release. 2009 Mar 4;134(2):125-31. doi: 10.1016/j.jconrel.2008.11.003. Epub 2008 Nov 19.

27

Electrochemotherapy

- Non-responsive to repeated surgical / cryosurgical treatment
- 6 procedures

Courtesy Youssef Tamzali

Tozon N et al, Electrochemotherapy as a single or adjuvant treatment to surgery of cutaneous sarcoid tumours in horses: a 31-case retrospective study. Vet Rec 2016 Dec 17;179(24):627. doi: 10.1136/vr.103867. Epub 2016 Oct 7

28

IMMUNOTHERAPY

- Vaccines (BPV / mRNA vaccine)
 - BCG
 - AUTOGENOUS VACCINES
 - ESPY AUTOGENOUS TISSUE IMPLANTS
- PHYTOTHERAPY (Iscador P)

Grossarth-Maticek R et al., Use of Iscador, an extract of European mistletoe (*Viscum album*), in cancer treatment: prospective nonrandomized and randomized matched-pair studies nested within a cohort study. *Altern Ther Health Med*. 2001 May-Jun;7(3):57-66, 68-72.

- HEMOTHERAPY
- MEDIATOR THERAPY

29

Immunocidin® (novaVive USA)

- PPD of non-tuberculous mycobacterium
- Aqueous solution/ suspension (5ml vials)
- Tumor-volume-related treatment
- INTRATUMORAL INJECTION
 - Orthogonal planes essential
 - NOT FANS
- 4-6 doses q 14-28 days
- STRONG SWELLING (usually)

30

What about 'vaccination'?

- Widely practiced worldwide
 - NO JUSTIFICATION AT ALL**
 - Affected horses have no seroconversion to BPV... so why is it done at all?
 - Vaccination with BPV fails to protect horses from sarcoid
 - Post "vaccinal" BPV titres are NIL!
- FREQUENTLY MAKES MATTERS WORSE!**
- DELAYS PROPER TREATMENT**

"Lesion was present for many years but extended and got malignant in the last year. Owner applied XX Terra. Horse was vaccinated with Sarcoid Vaccine in November 2024 which was produced after of (from other lesion (Pneumotum, Prampit))"



31

ESPY AUTO TUMOR IMPLANT

- Autologous grafting after liquid nitrogen freezing of tumor tissue blocks
- Reports of success but also failures (of course, as for all other treatments)
- Mechanism is uncertain and rationality is not easy to understand!
 - Tumour derived antigens?
 - Remote effects reported
- High efficacy reported but also failures
- Different outcomes from different users
- 3 partial 'successes' out of 16 cases

Espy BMK How to treat Equine sarcoids by autologous implants. Autologous grafting treatment for equine sarcoid. Proceedings of the American Association of Equine Practitioners AAEP 2008, San Antonio. 68-73



32

ESPY TECHNIQUE



33

STELFONTA® (Virbac)

- Tigilanol tiglate
- Tumor / tissue agnostic
- Vascular destruction → rapid pain/ necrosis
 - Premed with FLUNIXIN
 - Hospitalise?
- Moderate T-cell stimulus locally
- ALARMING in many cases
- Rapid and impressive healing.... Success
- New – no real evidence yet
- Some bad failures!



34

Phytotherapy

- Iscador P**
 - Repeated injection locally
 - Long course / painful injections
- Bloodroot**
 - Commercially prepared
 - 15-30% zinc chloride**
 - Topical applications
 - Owner applied



Christen-Clottu Q et al. Treatment of clinically diagnosed equine sarcoid with a mistletoe extract (*Viscum album austriacus*). J Vet Intern Med. 2010 Nov-Dec;24(6):1453-9.

Wilford Set al., Owners' perception of the efficacy of Newmarket bloodroot ointment in treating equine sarcoids. Can Vet J. 2014 Jul;55(7):683-6.

35

Zinc Chloride (+/- "other stuff"!)

Dermequin 28,5 g

Description
Cosmetic ointment for horses

Instructions

Apply daily 4-6, follow veterinarian's advice use gloves - Do not apply close to the eyes.

Active ingredient:

Sanguinaria Canadensis, zinc, water



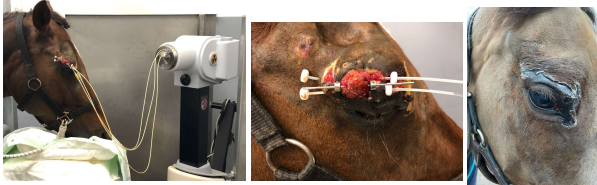
Find us in the Horse magazine!



36

HDR

- Highly effective
- Usually standing patient
- SHORT duration HIGH dose
- Accurate planning / calculation



37

“Equinox HEALTHCARE”

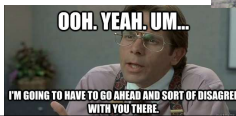
- High-end radiation facility
- Experience
- EVIDENCE



38

What other new treatment options are there?

- Photodynamic therapy
 - Photoactive agents (Hypericin / ALA)
- Hyperthermia
 - Repeated elevation of temp to 60° - 62°C
- Microwave poration-chemotherapy
- HIFU



Courtesy Jeremy Kemp Symonds

39

Immune “stimulants”

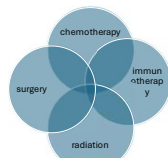
- ‘Sarc-ex’ / Echinacea etc.!
- Irrational choice
 - Would you ask for this therapy for yourself?
- If it was as easy as this, we need nothing else!



40

Therapeutic optionschoose carefully

- **Combination therapy is a really good option**
 - Responses may vary even when the lesions look the same and are situated in broadly the same anatomic region
- Limitations to choices are inevitable
 - Facilities / regulatory
 - Cost
 - Logistics



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When to consider the newest modalities:

- Periocular or sensitive-site sarcoids
 - RADIATION
 - IMMUNOTHERAPY (immunocidin / BCG)
 - S-R CHEMOTHERAPY
 - TIGILANOL TIGLATE
- Large, deep, or high-risk anatomical locations
 - MULTIMODAL THERAPY
- Resource-limited settings → BCG still has a role
- Mixed or aggressive lesions → Multimodal therapy (debulking + ECT/TSE)

42

What's on the horizon

- Viral-targeted gene editing (CRISPR)
- Immune checkpoint modulation
- Nanoparticle-enhanced drug delivery

Standardised, evidence-based protocols (currently lacking)

43

Implications of failure?

- Exacerbation
 - Transition to fibroblastic / malignant
- Regrowth at site
 - Recurrence / new lesions
- Reduced prognosis for next treatment
 - 40% for each failure
 - Biopsy counts as failure?



First treatment attempt **MUST** be the best available option
Economy seldom pays!

44

Its not the successes that matter..
...its the failures!

If you always
do what you
always did, you
will always get
what you
always got.
- Albert Einstein

**"If your treatment works – use it!
But IF IT DOESN'T, then CHANGE IT QUICKLY!"**



45



2020 VETswith HORSEPOWER
The Quarterly Journal of Equine Health

EQUINE MEDICAL SOLUTIONS

Knowledge is Power

I'M HERE TO GIVE YOU REASSURANCE.. EVERYTHING IS ALL RIGHT...

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EQUINE MEDICAL SOLUTIONS

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Oral Neoplastic Disease – Diagnosis & Treatment Options

Jenny Croft BVMS CertEP MRCVS
RCVS Advanced Practitioner in Equine Practice

1

Definition

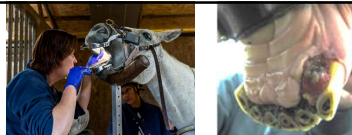
- **Tumour:** An abnormal mass of tissue (not necessarily cancer!)
- **Neoplasm:** An accumulation of abnormal cells (usually cancer!)
- **Mass:** An abnormal tissue with obvious “size”
- **Malignant:** A tumour with aggressive local or metastatic spread
- **Benign:** A tumour with no local or metastatic spread



2

Introduction

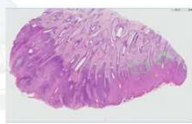
- Oral neoplasia is uncommon in horses - <1.1% of equine neoplasms develop directly in the mouth (Cotchin. 1977; Pascoe. 1981)
- Common for practitioners not to see any during a career (Pirie and Dixon. 1993)
- Few reported series of equine oral neoplastic disease (Dixon. 2024)
- Can look like non-neoplastic growths
 - Histology required for diagnosis
- Most oral neoplasms are malignant
 - SCC most common
- Small numbers of benign lesions have been reported (Bienert-Zeit et al. 2022)
- Increasing dental specialisation → more recognition



3

Introduction

- Rostral mandible most likely affected
- Use specialist pathologist in oral neoplasia
 - Lesions uncommon,
 - Experience → more accurate diagnosis
- Always provide:
 1. Representative sample
 2. Images & clinical description
 3. History & clinical signs

4

Structures

Soft Tissue	
Perioral skin / cheeks	
Buccal mucosa	
Gingiva	
Tongue	
Teeth	Bones
Enamel	Maxilla
Cement	Mandible
Dentine	

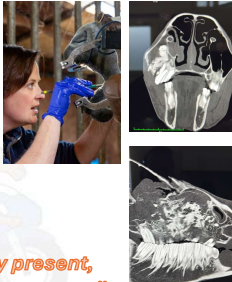


5

Categories of Oral Tumours

- Non-neoplastic growths
- Odontogenic tumours
- Soft tissue tumours
- Bone tumours

“If you know the cells that are normally present, you will know the primary tumours that can occur”



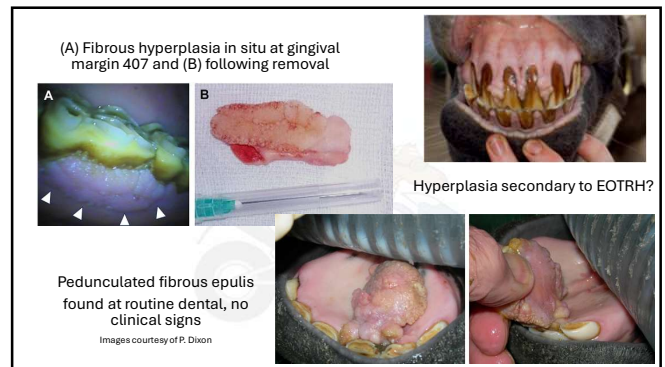
(Courtesy Christian Czech)

6

Oral non-neoplastic growths

- **Nodular hypercementosis ("cement pearls")**
 - Most commonly occur following periapical infection
 - <20mm.
 - Generally, **non-pathological**
 - Curette to remove if readily accessible, otherwise leave alone
- **Fibrous and gingival hyperplasia** – hyperplastic fibrous tissue at the gingival margins.
 - Non-pathological
 - Treat underlying condition? Surgically remove. Can also find **fibrous epulis** – growth/mass-like

7



8

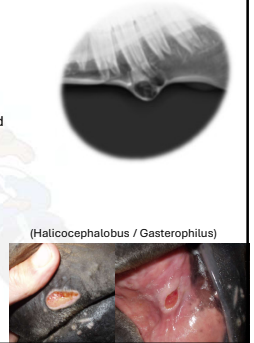
Oral non-neoplastic growths

- **Destructive and solitary bone cysts**
 - Benign, intraosseous fluid-filled structure surrounded by thin bone
 - Characteristic imaging appearances
 - Uncommon, but mostly found - paranasal sinuses (Van Delft 2017)
 - Clinical signs related to location
 - Treatment: Sx, curettage of cyst lining
- **Hamartoma**
 - Benign, disorganised collection of cells normally found in that anatomical location
 - Can resemble a neoplasm
 - Clinical signs related to location
 - Diagnosis: Histology
 - Treatment: Surgical removal is curative if the location allows

9

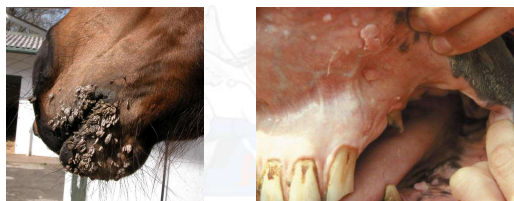
Oral non-neoplastic growths

- **Eruption "cyst"**
 - Pressure changes and remodeling of the alveolar and supporting bones beneath roots of erupting teeth
 - Painless. Bilateral. Not actually a cyst!
 - Ventral aspect of mandible – 3-5yrs of age. Usually resolve with age
- **Foreign Body reactions, parasitic lesions, viral lesions**



10

Oral non-neoplastic growths



11

Odontogenic (dental) tumours

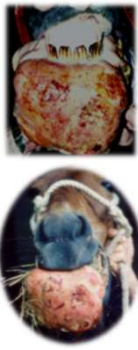
- Equine dental tumours are rare, but more common in horses than in other domestic species. (Knottenbelt et al. 2015)
- **Classified by their tissue of origin**

- Ameloblasts	Produce	Enamel	Ameloblastoma
- Cementoblasts:	Produce	Cementum	Cementoma
- Odontoblasts	Produce	Dentine	Compound odontoma
			Complex odontoma

12

Ameloblastoma

- Benign, rare – But most common **odontogenic** tumour (Morgan et al. 2019)
- Originates from alveoli - firm, non-painful jaw swelling
- Differentiate from SCC, fibrosarcoma that **OVERLIE** bone
- **Intraosseous dental tumour – imaging: Expansile mass within the jaw**
- **Diagnosis:** Histology
- **Treatment:** Surgical excision, +/- resection of supporting bone. Intralesional chemo? Radiotherapy. Prognosis good if completely resected



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Ameloblastoma



14

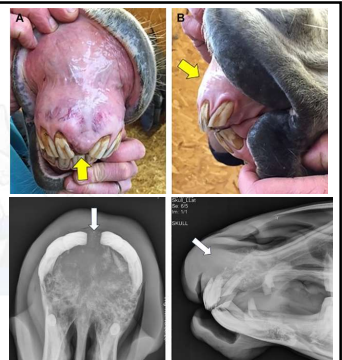
Ameloblastoma



15

Ameloblastoma

- 12yr old Connemara with incisor displacement
- Images show an irregularly calcified growth in the incisive and rostral maxillary area with incisor separation and local bone destruction
- Surgery: bilateral hemimaxillectomy – no regrowth after 7yrs



16

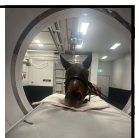
Compound and Complex Odontoma

- Calcified tumour containing dental tissue
- Formation of calcified enamel & dentine
- Most differentiated dental tumours
- **Compound odontoma:** A tumour of dental tissues in a more orderly pattern, containing tooth-like structures
- **Complex odontoma:** Disorganised tumour of tooth-forming tissue without distinct tooth morphology
- Commonly **affects younger horses**

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Compound and Complex Odontoma

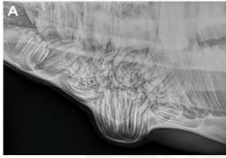
- **Clinical signs:** Firm, painless facial swellings of the affected jaw
- If they develop in the maxillary cheek teeth alveoli, they can expand into the sinuses or nasal cavity
- **Diagnosis:**
 - Imaging: well-defined, calcified growth **within jaw** (maxilla > mandible)
 - Histology if needed
 - Denticles allow DDx
- **Treatment:** Surgical removal



Complex odontoma – species?

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Compound Odontoma



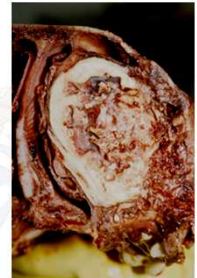
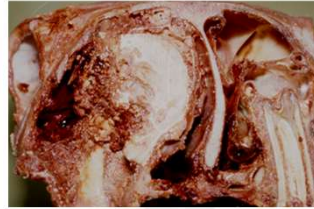
(A) Radiograph of a 2yo horse with a mandibular swelling of 12 months' duration show multiple denticles within the mandible



(B) More than 200 small, well-formed denticles were surgically resected. (Images Courtesy Jack Easley.)

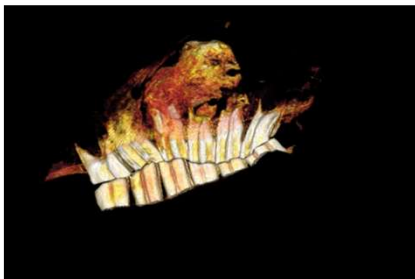
19

Complex Odontoma



20

Complex Odontoma



21

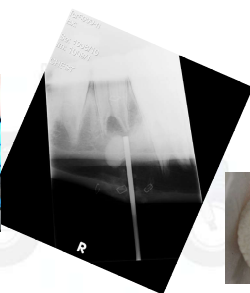
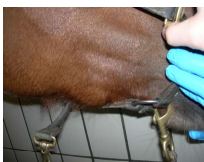
Cementoma

- Benign
- Slow-growing neoplasm of cementum-producing cells of **periodontal tissue**
- Large solitary lesions, not generally associated with periapical infections (distinguish from nodular hypercementosis)
- Diagnosis: Well-demarcated, generally spherical, dense radiopacities associated with the tooth apex
- Treatment: Excision, tooth removal of associated tooth, curettage of surgical sites
- Good prognosis



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Cementoma



23

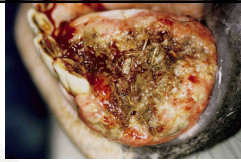
Soft Tissue Tumours

- **Primary Tumours:**
 - **Squamous Cell Carcinoma (SCC)**
 - Fibroma/Fibrosarcoma
 - Juvenile Ossifying fibroma
- **Secondary tumours:**
 - Melanoma
 - Sarcoid
 - Lymphosarcoma
 - Haemangiosarcoma

24

Oral SCC

- **SCC: most common equine oral neoplasia**
- More commonly occurs at other sites
 - Third eyelid
 - Genitalia
 - Pharynx
- Highly invasive
- Squamous epithelium neoplasm
- Oral mucosa or gingiva, rarely tongue epithelium
- Predilection site at mucosal junctions



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Oral SCC

Clinical signs: +/-

- Oral malodour
- Facial swelling
- Dysphagia, weight loss
- Ipsilateral, unilateral nasal discharge if sinus involvement
- Submandibular lymphadenopathy
- Incidental finding on dental exam

Oral examination:

- Large, fleshy mass protruding from mucosa
- Extensive invasion usually
- +/- displaced or loose teeth

Diagnosis:

- Histology – easy to biopsy
- +/- Radiography
- +/- CT – allows determination of tumour expansion

Generally, caudal oral cavity > rostral > tongue



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Oral SCC

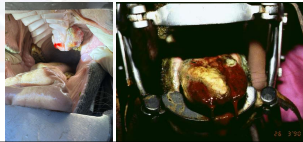
Treatment:

- Often impossible (size, location, extent at Dx)
- Complete surgical excision - rarely possible
- Intraleisional slow-release carboplatin or 5FU
- Stelfonta?
- Radiotherapy?
- Often not contemplated
- Euthanasia due to complications/prognosis

Courtesy Christian Czech

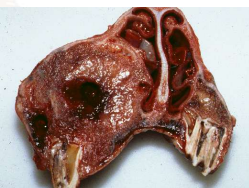
Prognosis:

- Insufficient data → reliable answer. Generally, highly malignant, locally invasive, rapid course → **guarded/poor long-term prognosis**



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Oral SCC



28

Fibroma/Fibrosarcoma

- **Fibroma**: Slow-growing, benign fibrous tissue neoplasm
- **Fibrosarcoma**: Malignant variant (still generally slow-growing)
- Develop from fibrous cells in the subcutaneous tissues, gingival margins, or periosteum
- Considered **rare**
- Red fleshy, **locally protruding growths** on the oral mucosa or the gingival margins
- No change in underlying bone, unless periosteal fibrosarcoma
- Diagnosis: Histology (**similar appearance to other oral tumours**)



Fibroma/Fibrosarcoma

Treatment options:

- Small lesions surgically resected
 - **PAY ATTENTION TO MARGINS!**
- High rate of recurrence
- Radiotherapy?
- Radical surgery – hemi-mandibulectomy, hemi-maxillectomy (Kawcak et al. 1996)



29

30

Juvenile Ossifying Fibroma

- Benign, fast-growing, locally aggressive fibro-osseous neoplasia of young horses (usually <1yr old)
- Typically develop in the rostral mandible
- Can cause significant local damage
- Do not metastasise
- Near-pathognomonic appearance
- Rapidly develop over a period of a few weeks within the rostral mandible or incisive bones



31

Juvenile Ossifying Fibroma

- Thickening / local disruption of the affected area +/- loosening of the adjacent incisor teeth.
- Golf ball-sized mass or larger protrudes from the bone
- Mostly foal remains healthy
- **Diagnosis:** Radiography, histology (Post op? Check margins)
- **Treatment:** Full surgical excision

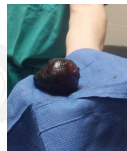


A 6-month-old foal under GA for resection juvenile ossifying fibroma involving its rostral mandible.

32

Oral Melanoma

- Grey horses mostly
- Lips, occasionally buccal mucosa
- Slow-growing, firm, painless masses
- Generally dark in colour
- Usually also lesions at predilection sites:
 - Perineal
 - Parotid salivary gland
 - Guttural pouch



33

Oral Melanoma

- Mostly found at dental exam as an incidental finding
- **Diagnosis:**
 - Clinical appearance mostly
 - Histology FNA
 - Homogeneous black mass
 - Malignant melanoma can be pink in colour – DANGER
- **Treatment:**
 - Surgical excision to margins
 - MMC Implants?



34

Oral Sarcoid

- Fibroblastic tumour of the skin, but can extend into the oral mucosa if severe
 - Rarely find oral lesions without a corresponding external lesion
- **Diagnosis:**
 - Typical appearance
 - Histology is characteristic if needed



35

Oral Sarcoid

- **Treatment:** Options are limited
 - Radiation: Brachytherapy (HDR)
 - Intralésional slow-release chemotherapy:
 - Carboplatin, 5FU
 - Surgical resection, rarely successful
 - BCG, Stelfonta? – Side effects!



36

Osteogenic (Bone) Neoplasia

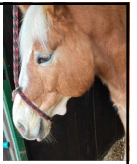
- Osteoma
- Osteosarcoma



37

Osteoma

- Slow-growing, solitary, benign bone tumour
- Congenital - may remain undetected if small or lie within the maxilla/ sinuses unless they grow further
- Incidental finding on head imaging
- Rounded, dense, calcified bony growths +/- pedunculated attachment
- Ventrolateral aspect of the mandible is a common predilection site
- Can suffer accidental trauma



38

Osteoma

- May be asymptomatic, within sinuses, or firm swellings of facial bones
- **Diagnosis:**
 - Radiography, CT if needed
 - → Calcified, well-demarcated lesions
- **Treatment**
 - Surgery only if indicated
 - Beware of bony attachments and location
 - Removal can → collateral damage to the reserve crown, infraorbital canal, facial bones, etc.
 - Caution essential



39

Osteoma

- A**
-
- A: Painless hard mass on left mandible – radiography resembled osteoma
- B**
-
- B: Lesion resected under standing sedation and local anaesthesia using bone saw
- BUT....Not always as straightforward as this!**

40

Osteosarcoma

- **VERY RARE!**
- Rapidly spreading, aggressive, malignant bone tumour
- Characterised by the presence of osteoid and immature new bone formation created by malignant osteoblasts
- **Clinical features:**
 - Hot / painful progressive facial swellings
 - Non-specific; similar to other Dzs causing bone swelling
 - Bone and dental disruption
 - Sinonasal and airway obstruction



41

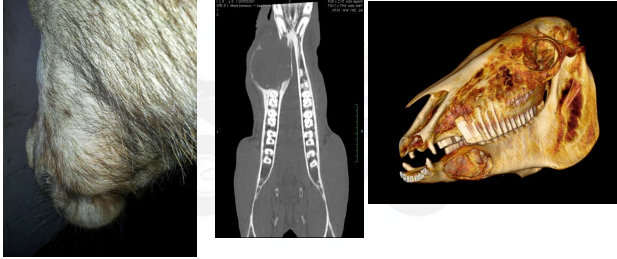
Osteosarcoma

- **Diagnosis:**
 - Imaging → Bone destruction with periosteal new bone formation
 - CT may help with surgical planning if relevant
 - Histology: takes time: decalcify sample, results not always definitive
- **Treatment options:** Depends on location and stage at presentation
 - Resection if possible? – Not if maxillary or if malignant/metastasised
 - Radiotherapy – poor success
 - Prognosis v poor
 - Euthanasia normally

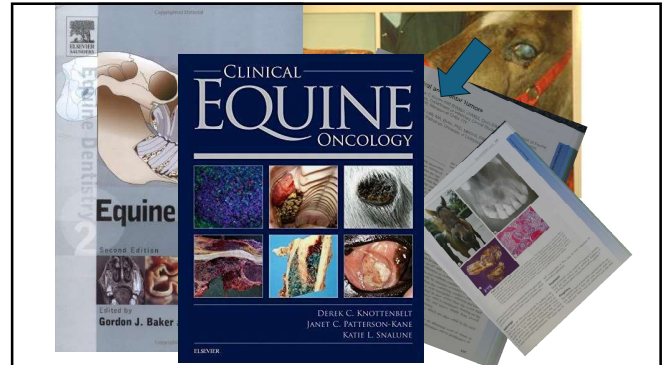


42

Osteosarcoma



43



44

To conclude: General Signs of Oral Neoplasia

- Swellings (cold / hot)
- PAIN?
- Tumours (visible/palpable)
- Oral bleeding
- Halitosis
- Unexpected loose teeth
- Nasal discharges – unilateral generally
- Excessive Salivation
- Dysphagia



45

Remember

- If you recognise an oral mass:
 - DO NOT MAKE AN IMMEDIATE DIAGNOSIS
 - DO NOT "Nip it off"!
 - DO NOT delay further investigation - **Never advise "wait and see"!**
 - DO NOT OFFER A PROGNOSIS!
- Advise further veterinary investigation immediately
 - Even some that look and are benign are very dangerous
- **Successful treatment needs early diagnosis**



46

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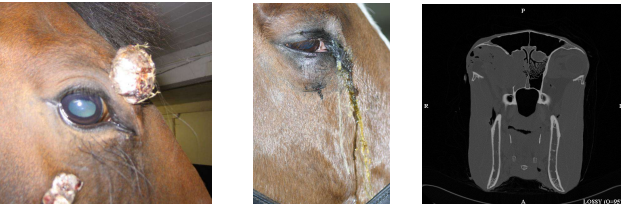
THANK YOU

- Professor Derek Knottenbelt – for advice, support, encouragement and providing images and videos
- Christian Czech - Images
- Deon Van Tonder - Images
- Paddy Dixon – allowing images to be used



48

Periocular & Ocular Neoplasia



Derek C Knottenbelt

EQUINE MEDICAL SOLUTIONS

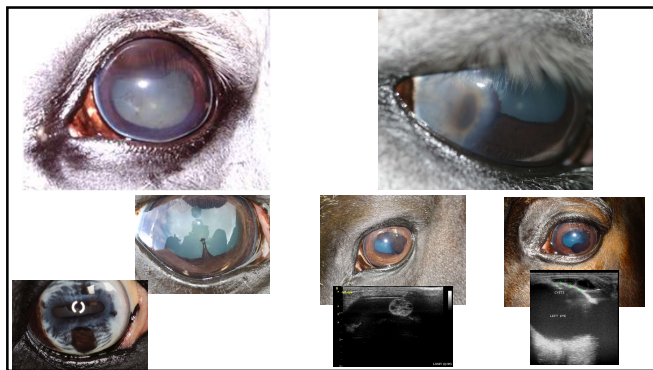
1

Not every lump is a "tumour"!

- Non-neoplastic masses are common!
 - EYELIDS
 - Collagen granuloma / Eosinophilic granuloma
 - Meibowmianitis
 - Calcinosis cutis
 - HABRONEMIASIS
 - CONJUNCTIVA
 - Dermoid
 - Lymphoid hyperplasia
 - Habronemiasis
 - GLOBE
 - Iris cysts
 - Iris naevus
 - Eosinophilic keratitis



2



3

Basic premise....

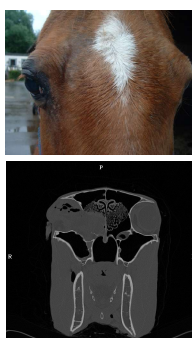
- 'If you know what cells an organ or structure has you will know what primary tumours it can get! (Stannard, 1992)
- Some tumours are more common than others, but any tumour CAN occur!
 - Primary – benign or malignant
 - Secondary / metastatic



4

Identify the primary problem ... if you can!

- Not always easy
 - Non-specific signs
 - Examine all structures
 - Detailed eye (s) examination
- Use all available aids
 - **Biopsies**
 - Radiography / CT
 - MRI
 - **U/S**
- Collect samples



5



Orbital mast cell tumour

Malignant lacrimal gland carcinoma

Palpebral/Conjunctival squamous cell carcinoma

Undifferentiated conjunctival myxocarcinoma with orbital destruction

- Initial presentation for ocular / periocular / orbital neoplasia can be misleading
- Eyelid swelling, conjunctival edema / exophthalmos and haemolacrimation (top 3 pictures from left to right respectively) can commonly be mistaken for trauma
- Characteristic discharge associated with conjunctival SCC (bottom middle) can be easily (and commonly is) mistaken for "infection"

6

Major Considerations

1. Tumour type... in full!
 - Implications for prognosis
2. Anatomical location
 - Feasibility of therapy
3. Patient / Owner compliance
 - Cost / logistics/treatment requirements
4. Facilities / expertise available
 - Stable yard
 - Practice
 - Hospital
 - Specialist centre



7

Tumour Types Periorbital Skin

- Papilloma
 - Viral
 - ECPV1
 - ECPV2
 - Squamous papilloma - precarcinomatous
- Melanoma
- Sarcoid / Fibroma / Neurofibroma
- Squamous Cell Carcinoma
- Lymphoma
- Mast cell tumour
- Myxoma



8

Tumour Types Adnexal Structures

1. Eyelids & Conjunctiva

- Papilloma
 - Viral
 - Squamous papilloma
- Melanoma
- Sarcoid
- Squamous Cell Carcinoma
- Lymphoma
- Mast cell tumour
- Myxoma
- Haemangiosarcoma

2 Orbital structures

- Squamous cell carcinoma
 - Not primary lesions
- Melanoma
 - Exophthalmos
- Lymphoma
 - Primary / secondary
- Sinus adenocarcinoma
 - Extension from sinus / ethmoid region
 - Exophthalmos / Strabismus
- Neuroendocrine tumour (EAPG)
- Lacrimal adenocarcinoma
 - Exophthalmos

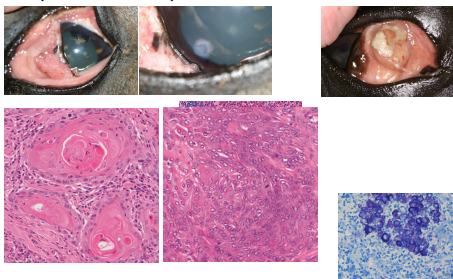
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Know your enemy



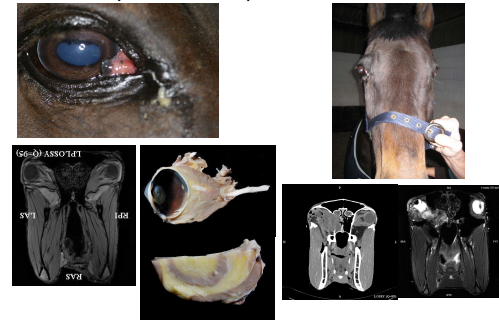
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Know your enemy!



11

Know your enemy!



12

Rare tumours are "just rare" ...
They are not impossible!

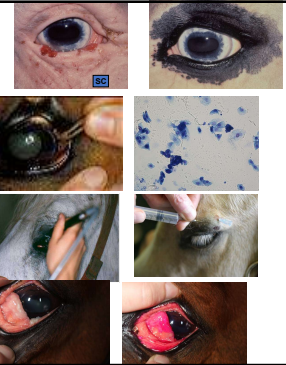


EVIDENCE is proportional to prevalence/incidence!
We know a lot more about common tumour types!

13

Diagnostic Methods

- Intuitive supposition!
 - Common things occur commonly
- Cytology
 - Scrapes / swabs
 - Brush
- Biopsy
 - Partial
 - Fine needle aspiration
 - Only for melanoma?
 - Excisional biopsy
 - Anatomical considerations
- Ultrasonography
- Radiography / CT
- MRI

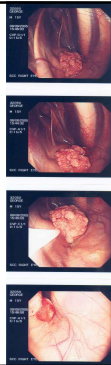


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Use your aids!



When you **KNOW** what you are dealing with the prognosis and management decisions become easier



15

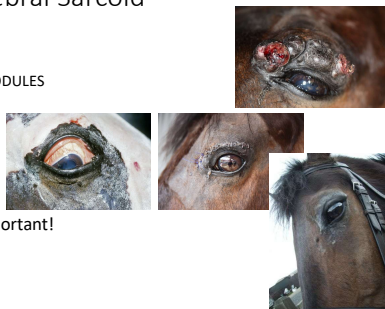
Ophthalmic Neoplasia Considerations

- Anatomical location
 - Periorbital skin
 - Eyelids
 - Lacrimal / tarsal glands
 - Conjunctiva
 - Nasolacrimal duct
 - Globe
 - Cornea
 - Iris
 - Fundus
 - Orbit
- Tumour prevalence
 1. Sarcoid
 2. Squamous Papilloma
 3. Melanoma
 4. SCC
 5. Lymphoma
 6. Mast cell tumour
 7. Haemangioma ~sarcoma
 8. Myxoma
 9. Medulloepithelioma
 10. Astrocytoma

16

Periocular & Palpebral Sarcoid

- All 6 forms possible
 - Many are mixed forms
 - BEWARE OF LOCALISED NODULES
- Therapeutic limitations
 - Anatomy
 - Sensitivity of structures
- Prognostic difficulties
 - Implications for failure
- Differential Diagnoses important!



17



18



19

Management

- Benign neglect
- Surgical removal
 - Can be problematical
 - Invasive locally
 - Wide excision required?
- Cryosurgery
- BCG immunotherapy
- Cytotoxic / antimitotics
- Radiation
- Others!

Think before you ACT!

20



21



22

Other Treatments

- **Intralesional cytotoxic / antimitotics**
 - Cisplatin s-r intralesional & Electrochemotherapy
 - 5-Fluorouracil s-r 1% intralesional injection
 - q 24h x 7; q 72h x 5
 - Mitomycin C slow release—poor efficacy
 - 5-Fluorouracil 5% topical [EFUDIX™]
 - q 12h x 7; q 24h x 7
 - Tazarotene (0.1% gel; Zorac™ : Topical)
 - Imiquimod (Aldara™)
- STELFONTA
- IMMUNOCIDIN / BCG
- Blood root - XTERRA™
- AWS
- Aciclovir
- Homeopathy / 'Natural medicine'/Acupuncture
- RUBBISH IN A JAR- BEWARE!!!!

23

Squamous Cell Carcinoma

1. Pre-carcinomatous changes
2. Proliferative
3. Ulcerative / destructive

Squamous Papilloma

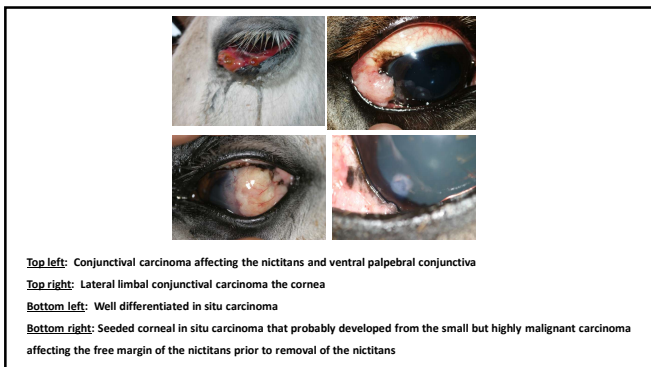
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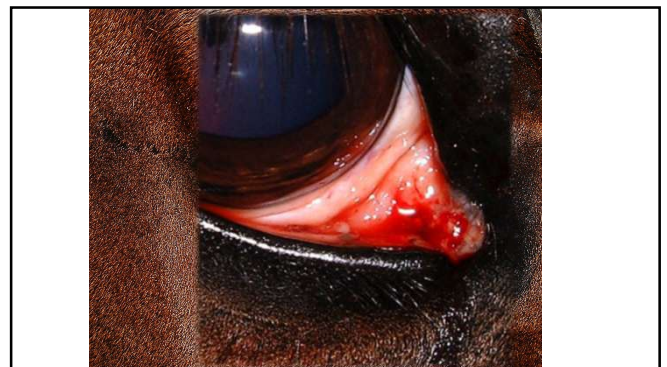
Top left: Conjunctival carcinoma affecting the nictitans and ventral palpebral conjunctiva

Top right: Lateral limbal conjunctival carcinoma the cornea

Bottom left: Well differentiated in situ carcinoma

Bottom right: Seeded corneal in situ carcinoma that probably developed from the small but highly malignant carcinoma affecting the free margin of the nictitans prior to removal of the nictitans

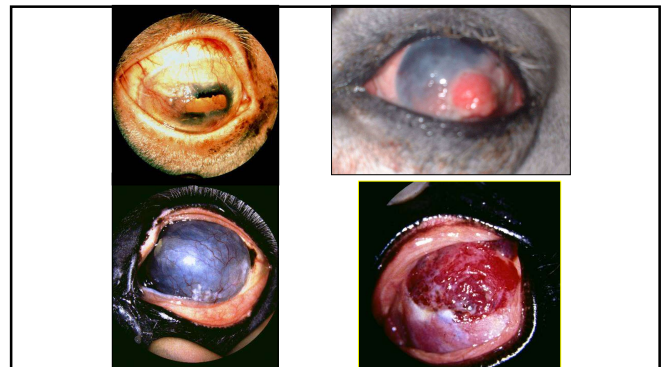
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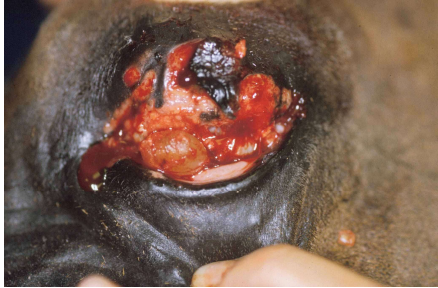
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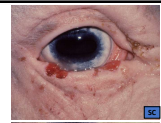
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31

Diagnostic Methods

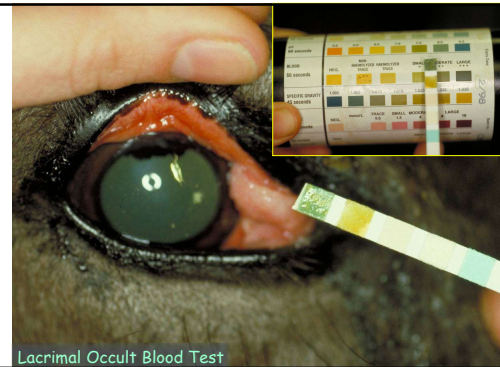
- Intuitive supposition!
 - Common things occur commonly
- Rose Bengal stain
- Lacrimal occult blood test
- Cytology
 - Scrapes / swabs
- Biopsy
 - Partial
 - Fine needle aspiration
 - Only for melanoma?
 - Excisional biopsy
 - Anatomical considerations
- Ultrasonography



32



33

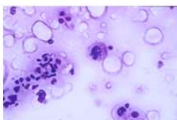


Lacrimal Occult Blood Test

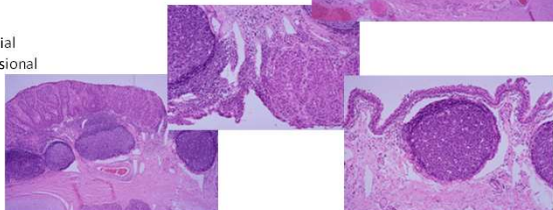
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Diagnosis

- 'Scrapes'



- Biopsy
 - Partial
 - Excisional



35

Treatment Options

- Benign neglect.....VERY DANGEROUS!
- Surgical excision
 - Feasibility
- Cryosurgery?
- Chemotherapy (topical)
 - 5 Fluorouracil (1% drops / 5% ointment)
 - Prednisolone
- Radiation
 - Interstitial Iridium-192 brachytherapy
 - Topical Staphylococcus aureus brachytherapy
- COMBINATION VS BETTER!



Multimodality treatment is the best way forward!

BCG DOES NOT WORK!

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Local Therapy

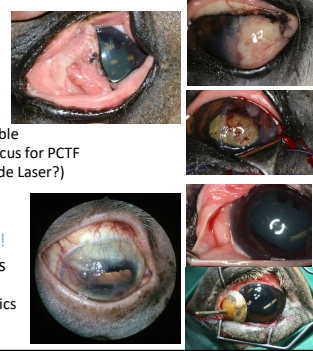
- 5-Fluorouracil
 - Ointment
 - Ophthalmic drops (1%)
 - Intralesional s-r
- Mitomycin C
 - Topical (.05%)
 - Intralesional slow-release
 - R-t-I-Polymer
- Carboplatin
 - Intralesional s-r injections
- Imiquimod
- Corticosteroids
 - Slow / mild / adjunctive
- STELFONTA (tigilanol tiglate)?



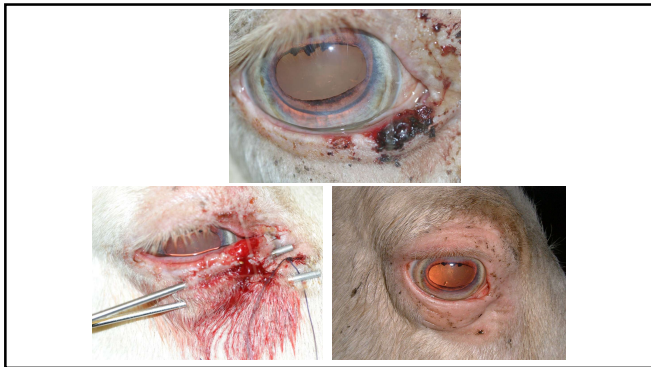
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Surgical Excision

- Careful case selection
 - Microscope definition
 - Preserve 3EL cartilage if possible
 - Gland of the 3rd eyelid → mucus for PCTF
 - Meticulous surgery (CO₂ / diode Laser?)
 - LOWER LID v UPPER LID?
- Send all tissue to pathologist!
- Combine with other methods
 - Radiation
 - Topical anti-mitotics / cytotoxics



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Adjunctive Therapy

- Prednisolone / Betamethasone
- Avoid sunshine!
- Protect face/eyes with masks
- Eyelash support
- ALWAYS check at PPE for non-pigmented eyelids/margins and lateral limbus



40

Ocular & Periocular Melanoma

- Common in grey horses
 - Can be encountered in others
- Slow growing
- Non-malignant at start?
- Intraocular melanoma is usually more benign?
 - Usually primary
- Often others at other sites (NOT ALWAYS!)
- Locations variable

Adnexal

- Periocular skin
- Palpebrum
- Caruncle

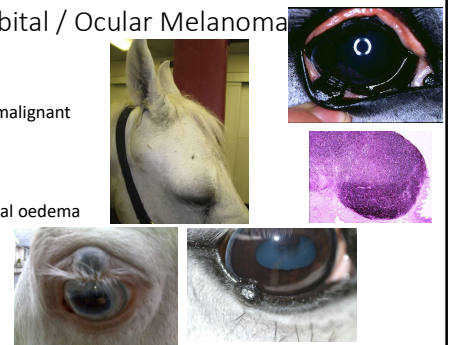
Ocular

- Sclera
- Iris
- Fundic
- Retinal

41

Palpebral / Orbital / Ocular Melanoma

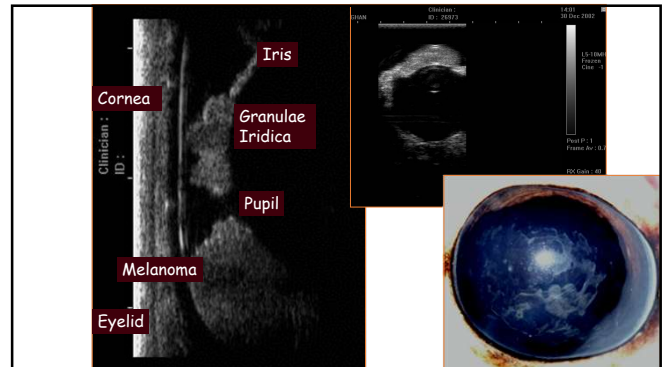
- Usually benign
- Rarely can be highly malignant
- Secondary effects
 - Eyelid distortion
 - Localised KCS
 - Ulceration / corneal oedema
 - Uveitis?
 - Blindness



42



43



44

Management

- Benign neglect
- Cimetidine
 - DOES IT WORK?.... No!
- Surgical excision
 - Best approach
 - Can be difficult to define margins
 - Localised iris lesions (partial iridectomy?)
- Cryosurgery
- Carboplatin

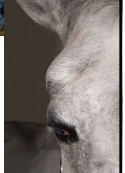



45

Lymphoma

- Different forms with different prognoses
 - EYELID NODULES
 - CONJUNCTIVAL NODULAR LYMPHOMA
 - ORBITAL LYMPHOMA
 - OCULAR LYMPHOMA
 - Conjunctival
 - Intraocular
- MULTICENTRIC LYMPHOMA
 - Most localised forms can be removed effectively!





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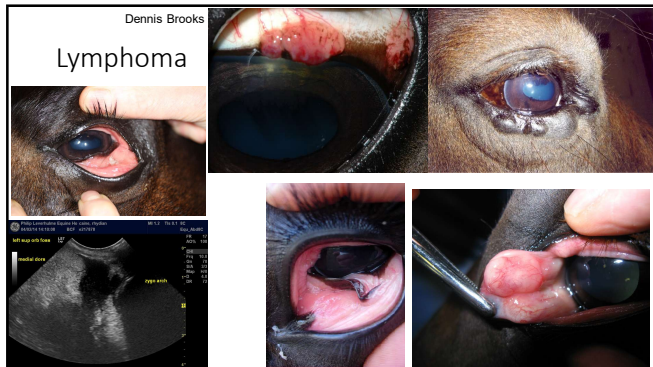


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Orbital Lymphoma



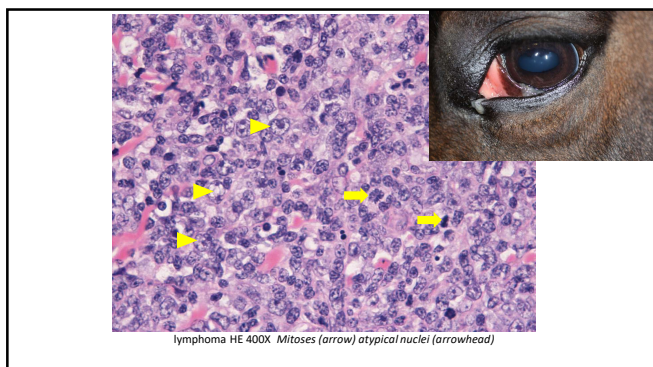
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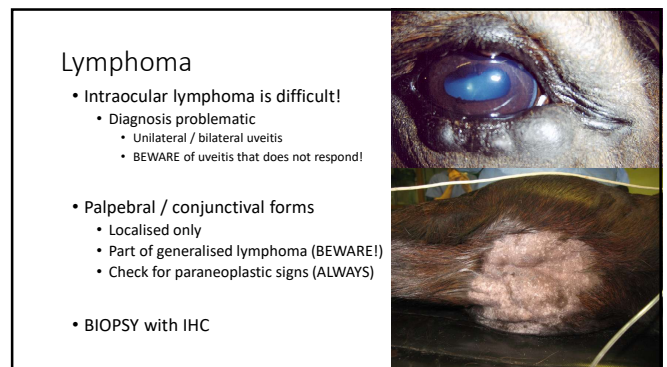
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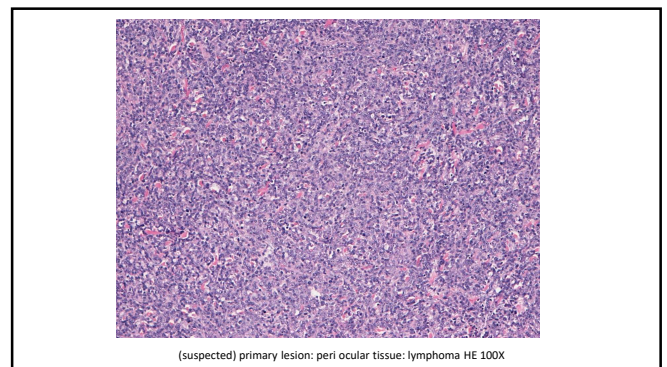
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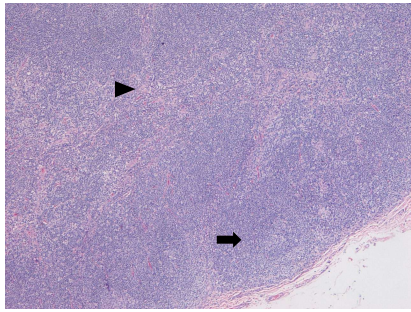
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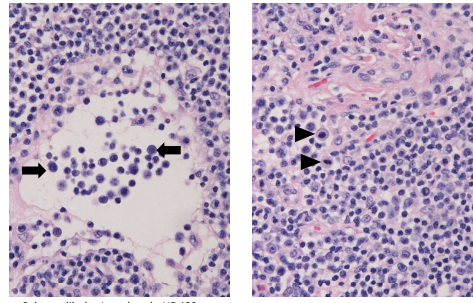


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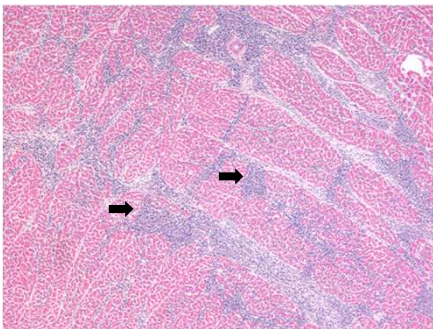
Submandibular Lymph node HE 100x
Structure preserved with cortical follicles (arrow) and sinuses (arrowhead)

55



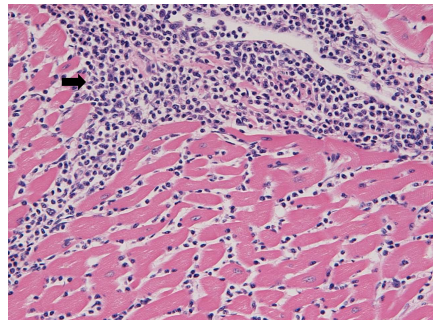
Submandibular Lymphnode HE 400x
Neoplastic cells are scattered within the lymphatics of the lymph node (arrow) but not colonizing the parenchyma. Some in mitoses (arrowhead)

56



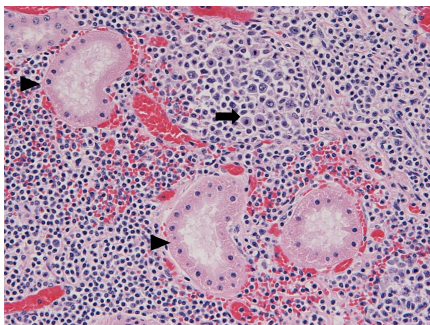
Heart, left ventricle. Multifocal infiltration (arrow) of neoplastic lymphocytes HE 100X

57



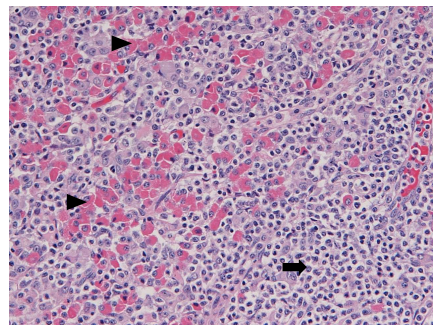
Heart, left ventricle. Multifocal infiltration (arrow) of neoplastic lymphocytes HE 400X

58



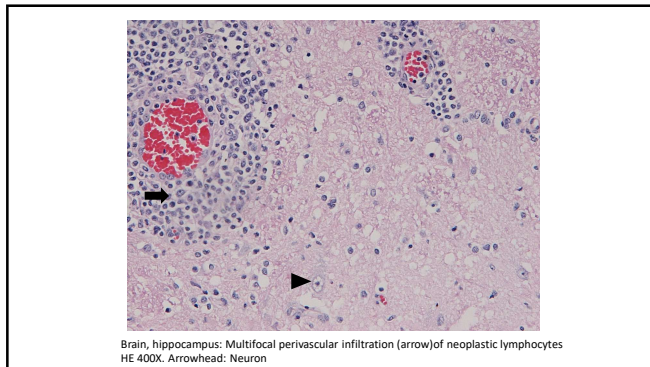
Kidney. Multifocal infiltration (arrow) of neoplastic lymphocytes HE 400X
Arrowhead: remaining tubules

59



Pituitary. Multifocal infiltration (arrow) of neoplastic lymphocytes HE 400X
Arrowhead: remaining acidophil cells

60



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62

Expectations / Prognosis

- Early biopsy is essential
 - "Usually" a horse is attached to the eye(s)!
 - Definitive diagnosis can be achieved
- Prognosis for localised conjunctival lesions may be fair – good
- Prognosis for all other forms is hopeless
- **BE VERY CAREFUL OF NON-RESPONSIVE UVEITIS – examine the horse!**

63

MAST CELL TUMOUR

- Periocular / face is commonest site
 - Defined / non-defined forms
- Genuine Mast Cell Tumour?
 - Possibly Habronema nodules
 - Summer condition
 - Surgical removal / Water / c-steroids?

64

Undifferentiated 'Myxoma'

- More often malignant
- Invasive
- DANGEROUS

65

Haemangiosarcoma / Angiosarcoma

- Rare malignant tumor
- Can be isolated/restricted
- More often disseminated

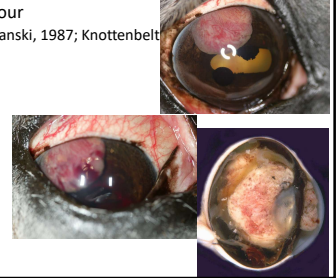
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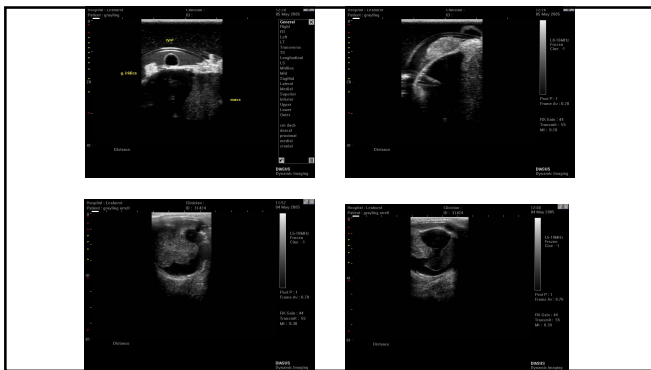
67

Medulloepithelioma / (Retinoblastoma)

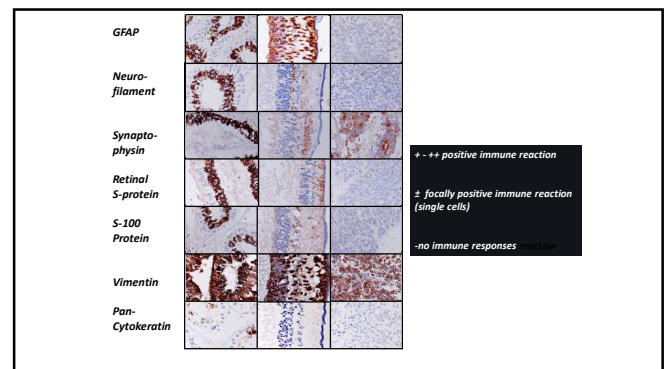
- Rare intraocular neuroepithelial tumour
 - Eagle, et al, 1978; Riis et al, 1990; Szymanski, 1987; Knottenbelt
- Congenital / Early onset?
- Highly vascular
- Not supposed to be metastatic!
 - Rebhun, 1998
- Locally invasive / aggressive
 - Knottenbelt, 2007



68



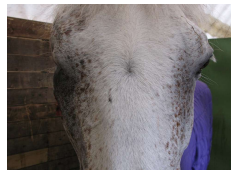
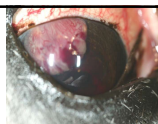
69



70

Expectations / Prognosis

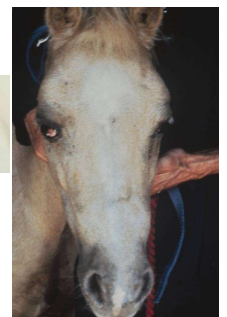
- NO treatment
- Prognosis for eye is poor
 - Early enucleation / ? Exenteration
- Possible malignancy?
 - Invasive rather than metastatic?



71

Orbital Masses

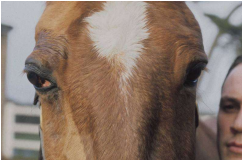
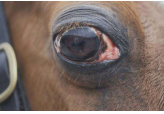
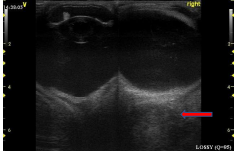
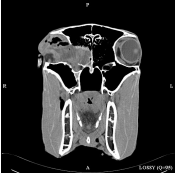
- Commonest cause of exophthalmos!
- Abscess
- Hydatid cyst
- Melanoma
- Lymphoma
- Extra-adrenal paraganglioma
- Lacrimal gland adeno[carcin]oma
- Extensions from sinus / ethmoidal masses (adenocarcinoma / SCC)
- Primary effects
- Secondary effects



72

Diagnosis

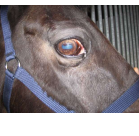
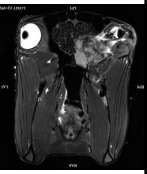
- Physical examination
 - FULL
 - Haematology
- Ultrasonography
- Endoscopy
 - Proximity to nasal cavity / sinuses
- Radiography / CT
- MRI

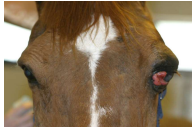
73

Can be "symptom free"



... but can be severely compromising or very painful or both!





74

WARNING Extra-adrenal paraganglioma

- Neuroendocrine tumour
- Orbit is predominate site
- Exophthalmos
- EXTREME DANGER**
 - Early intervention is essential but almost never diagnosed early enough
- VERY DESTRUCTIVE** (bone etc)
- EXTREMELY HAEMORRHAGIC**

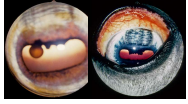
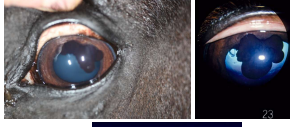
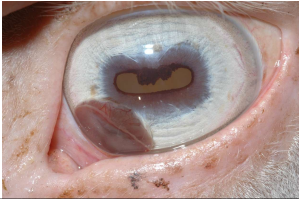
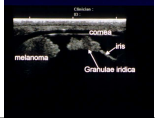


Miesner T¹, Wilkie D, Gemensky-Metzler A, Weisbrode S, Colitz C. Extra-adrenal paraganglioma of the equine orbit: six cases. *Vet Ophthalmol*. 2009 Jul-Aug;12(4):263-8. doi: 10.1111/j.1463-5224.2009.00706.x.

75

Differential Diagnosis

- Melanoma / melanotic naevus
- Amelanotic melanoma
- Retinoblastoma V Medulloepithelioma
- Iris stromal 'cyst' etc...,

76

Management

- TIME IS CRITICAL – early detection?
- Diagnosis is critical
 - Consider welfare of horse
 - Cosmesis is an incidental issue
- Differentiate from GLAUCOMA
- Therapeutic options for orbital / intraocular masses are limited
- Intraocular surgery is very specialised
- Chemotherapy is not great!



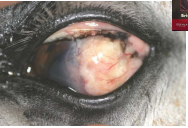

DO NOT remove a non-painful, functional exophthalmic eye unless there are definite reasons that justify this approach!

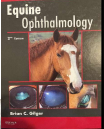
77

REMEMBER....

- 'If you know what cells an organ or structure has you will know what primary tumours it can get! (Stannard, 1992)
- Some tumours are more common than others but any tumour CAN occur!
- LOCATION AND BEHAVIOUR ARE IMPORTANT
- WE DON'T HAVE MUCH EVIDENCE!
- EVIDENCE?... let's GET IT..... together!







78





Interpreting the functional significance of equine eye abnormalities

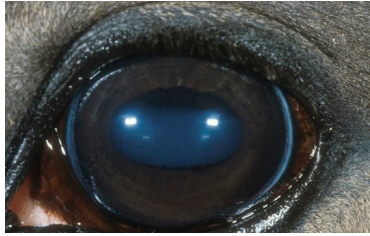
Josh Slater BVM&S PhD DipECEIM MRCVS
School of Veterinary Science
University of Liverpool

UNIVERSITY OF LIVERPOOL

2026 VETS with HORSEPOWER
The University, Poulton & Dalton Hall

1

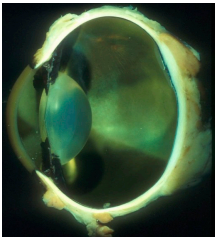
Anatomy of the eye



2

Anatomy of the eye

- Outer support layer
 - sclera and cornea
- Middle vascular layer
 - iris, ciliary body, choroid
- Inner neural layer
 - neurosensory retina
 - retinal pigment epithelium

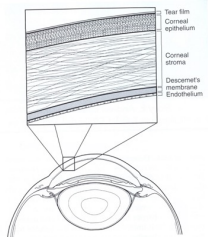


From: Equine Ophthalmology, Ed. B Gilger

3

Corneal anatomy

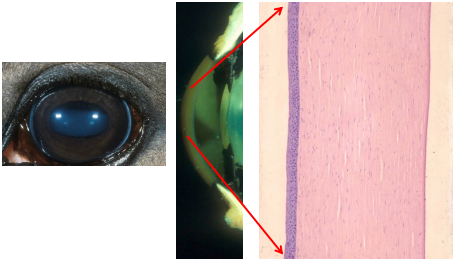
- Tear film
 - resident microbes
- Corneal epithelium
 - 8-10 cells thick
 - basement membrane
- Stroma
 - avascular
 - dehydrated by endothelium and tear film
- Descemet's membrane
- Endothelium



From: Equine Ophthalmology, Ed. B Gilger

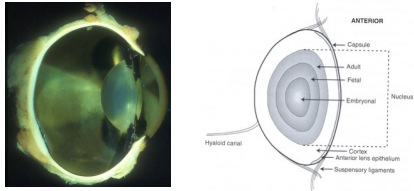
4

Corneal anatomy



5

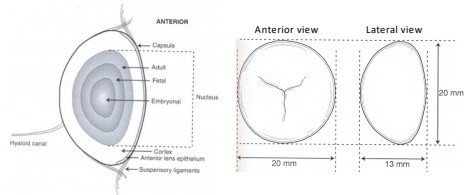
Lens



From: Equine Ophthalmology, Ed. B Gilger

6

Lens suture lines



From: Equine Ophthalmology, Ed. B Gilger

7

Fundus

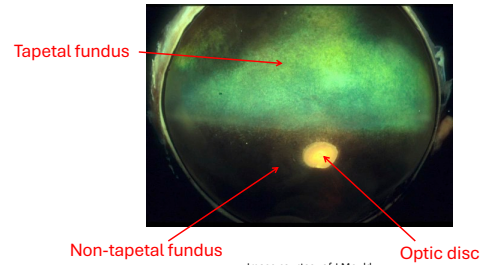
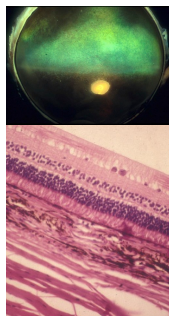


Image courtesy of J Mould

8

Tapetal fundus

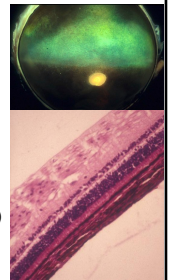
- Dorsal 2/3rds of the fundus
- Coloured and reflective because light reaches choroid and is reflected back onto NSR
- Colour of TF relates to pigmentation in RPE and choroid as well as thickness of tapetum
- Tapetum is dense layer of collagen in mid choroid
- Ophthalmoscopic view is of choroid and tapetum through NSR and RPE
 - NSR is transparent
 - RPE is lightly pigmented and transmits light
 - superficial choroidal capillaries visible right across TF



9

Non-tapetal fundus

- Ventral 1/3rd of the fundus
- Appears dark brown or black because of dense pigmentation in the RPE
- Light does not reach the choroid
- Pigmentation of NTF varies, esp dorsal to the disc
- There is no tapetum in this part of the fundus
- Ophthalmoscopic view is of RPE (choroid not visible)
 - NSR is transparent
 - RPE is heavily pigmented and does not transmit light
 - superficial choroidal capillaries not visible in the TF



10

Ophthalmoscopy

- Examination of the fundus
- Direct ophthalmoscopy
 - transillumination
 - direct ophthalmoscope
- Indirect ophthalmoscopy
 - light source and condensing lens
 - indirect ophthalmoscope



Direct ophthalmoscope

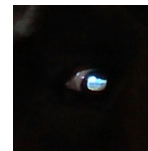


Indirect ophthalmoscopy

11

Distant direct ophthalmoscopy

- Hold ophthalmoscope (or transilluminating light source) at arm's length
- Quick screening method
- Pupil symmetry
- Identify opacities
- All opacities appear as silhouettes against fundus reflex



12

Close direct ophthalmoscopy

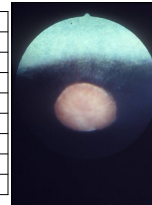
- Can be used to examine adnexa and globe
- For iris and posterior structures hold close to horse's eye
- Rotate lens dial to position different powered (diopter) lens between your eye and the horse's eye
- Positive numbers are black or **green**
- Negative numbers are **red**



13

Lens settings

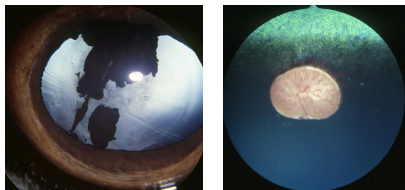
Lens wheel (diopter)	Focusses on
0	Fundus
+1 to +7	Vitreous
+8	Posterior lens capsule
+8 to +11	Lens
+12	Anterior lens capsule
+13 to +15	Iris
+15 to +19	Anterior chamber
+20	Cornea



- Image is magnified
- Peripheral fundus difficult to visualise

14

Interpreting the functional significance of abnormalities



15

Golden rules

- Adult horses with apparently normal vision and congenital abnormalities will have adapted
- Any horse with active ocular disease is not suitable for purchase, whatever the problem
- Any large opacity in visual axis will impair vision, but not necessarily **functional vision**
- Most cataracts are not progressive (unless uveitis is the underlying disease)
- Focal chorioretinal lesions usually do not impair functional vision and are not progressive
- Diffuse chorioretinal lesions often do impair vision (peripapillary retinal vessels help assess)

16

We need to answer the following questions...

- Does this eye have visual function (menace, dazzle responses)
- Do the eye's optical media have clarity (distant direct ophthalmoscopy)
- Is there evidence of pathology (check all parts of the eye)

17

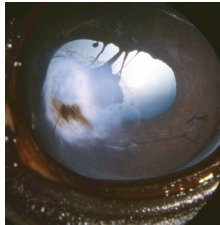
Clinical examination check list

- Stand back and count to 30: Facial symmetry, gross appearance, blink rate, discharge
- Palpate periorbital region
- Check palpebral (blink) reflex
- Conjunctival surface of eyelids, inc 3rd eyelid
- Bulbar surface
- Cornea & anterior chamber
- Iris, granula iridica and pupil shape
- Lens
- Vitreous
- Fundus



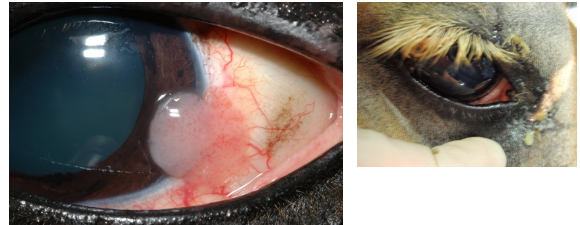
18

Corneal fibrosis and pigmentation



19

Squamous cell carcinoma



20

Iris cyst



21

Iris cysts right eye (left eye normal)



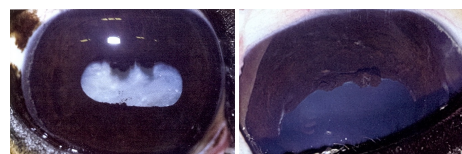
22

Cataract with posterior synechiae



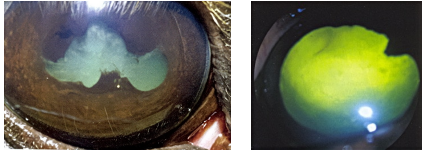
23

Recurrent uveitis



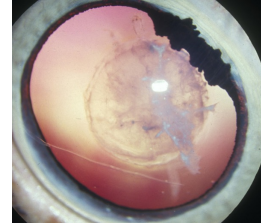
24

Recurrent uveitis



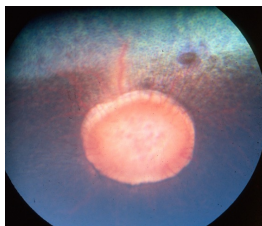
25

Nuclear cataract



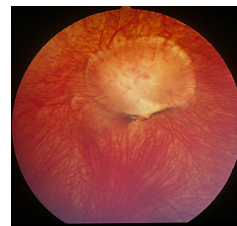
26

Normal fundus (suprapapillary depigmentation)



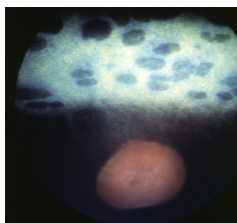
27

Normal fundus (pigment depleted)



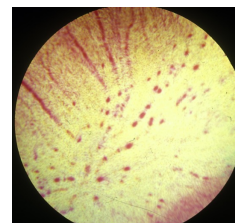
28

Normal fundus (choroidal naevi)



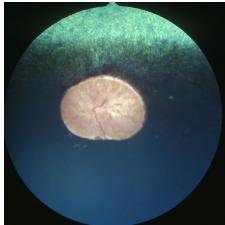
29

Normal fundus (choroidal vessels)



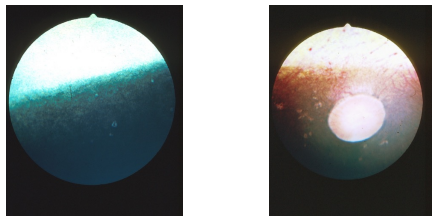
30

Optic nerve atrophy



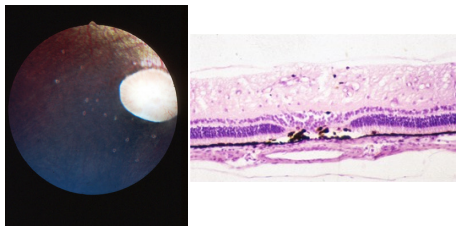
31

Multifocal chorioretinopathy



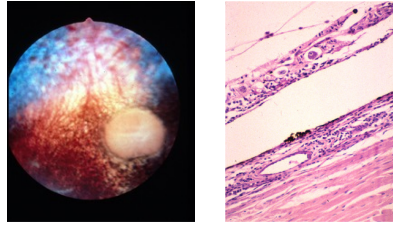
32

Multifocal chorioretinopathy



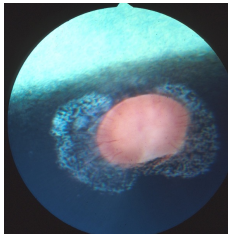
33

Diffuse chorioretinopathy



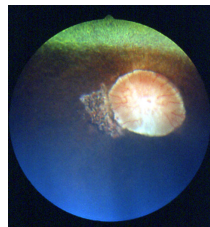
34

Peripapillary chorioretinopathy (butterfly lesion)

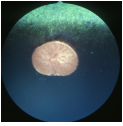


35

Peripapillary chorioretinopathy (butterfly lesion)



36



Interpreting the functional significance of equine eye abnormalities

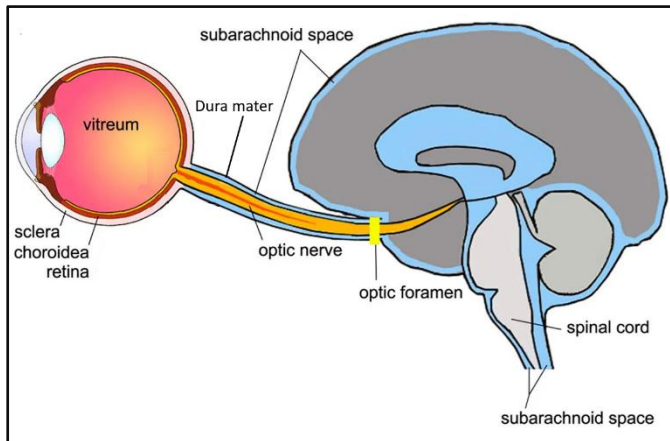
Josh Slater BVM&S PhD DipECEIM MRCVS
School of Veterinary Science
University of Liverpool



Equine Neuroophthalmology

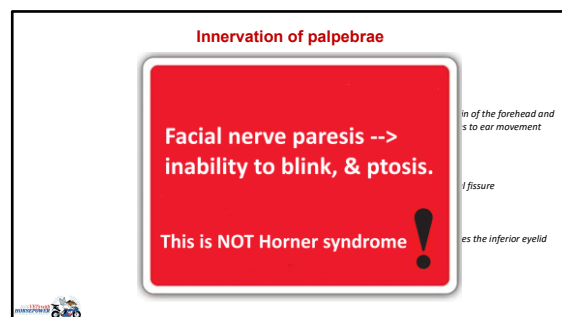
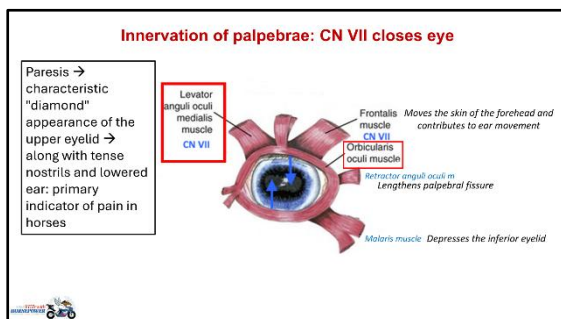
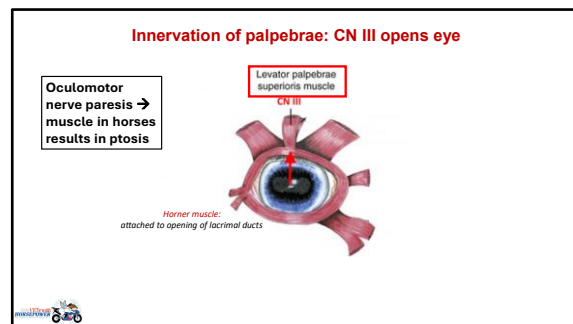
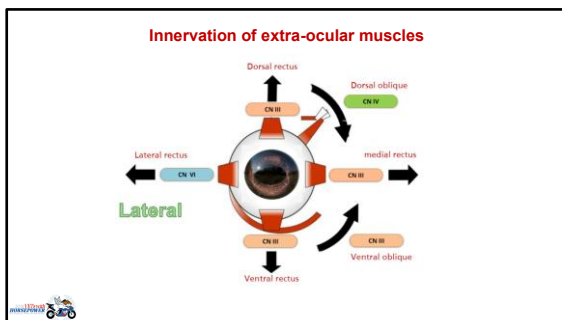
Dr Caroline Hahn ECVN ECEIM MRCVS

Neuroophthalmology is a subspecialty combining ophthalmology and neurology, focusing on complex diseases of the eye-brain connection. Lesion localisation requires understanding of the visual pathways and their related structures which involve motor, sensory, and autonomic functions from the central and peripheral nervous system.

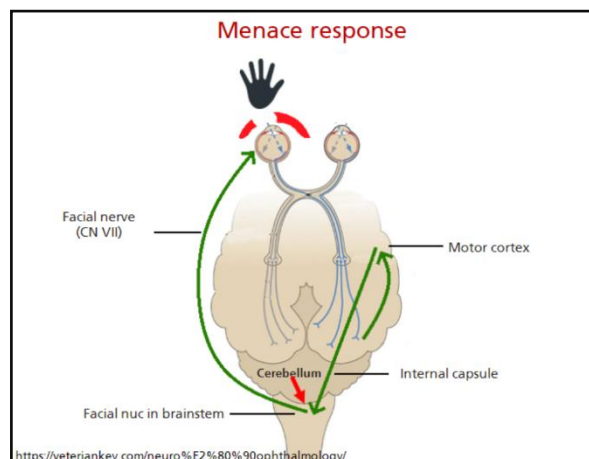
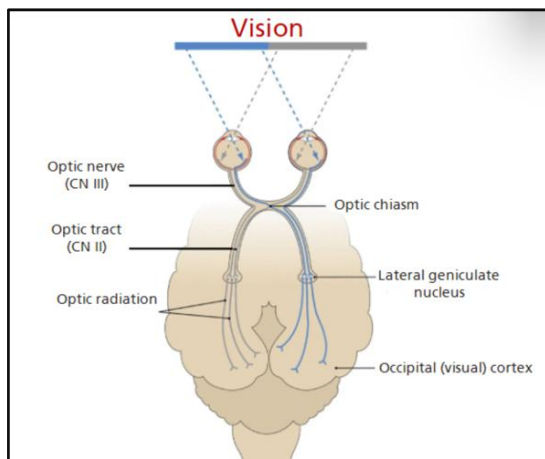


The retina is brain tissue that develops from the embryonic diencephalon (which becomes the thalamus). The optic nerve (a tract of the CNS and is myelinated by oligodendrocytes) is a white matter tract of the diencephalon, formed by retinal ganglion axons and glial cells. The optic nerve is surrounded by meninges (dura mater, arachnoid membrane, and pia mater) with a subarachnoid space and cerebrospinal fluid.

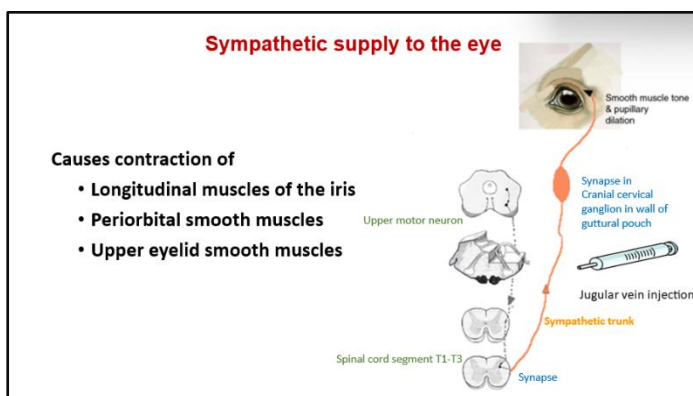
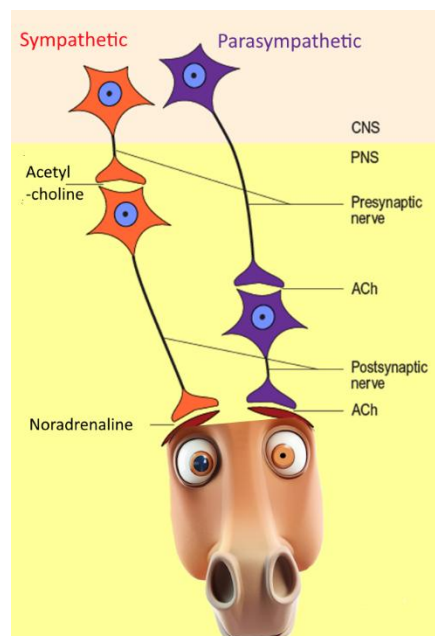
Innervation of the extraocular muscles & palpebrae:



Vision:

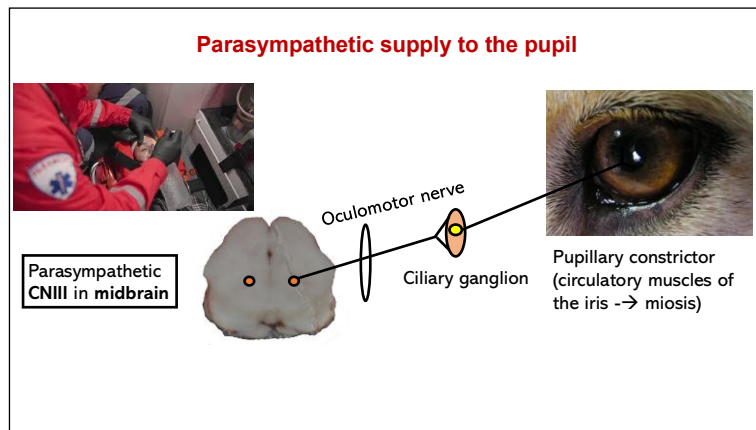


Autonomic nervous system innervation of eye:

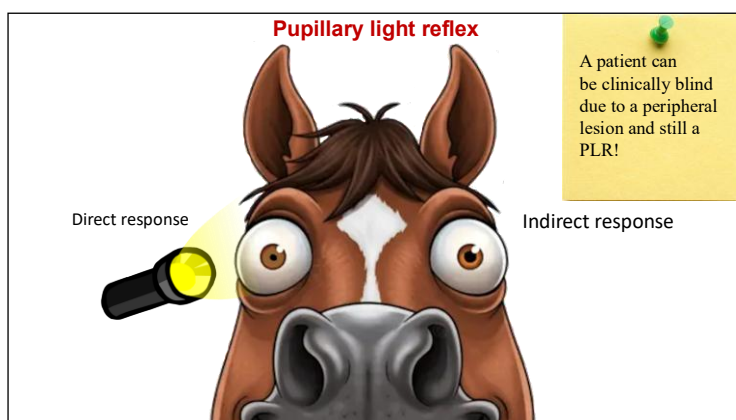
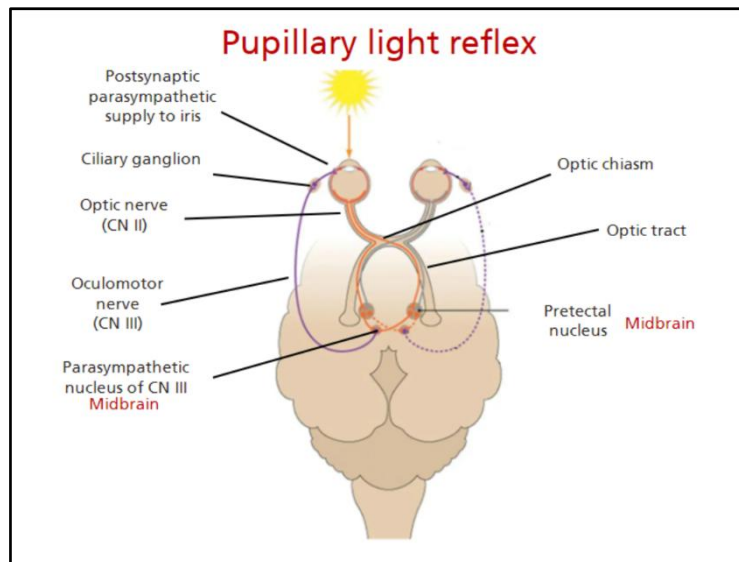


Sympathetic innervation to the eye is a 3-neuron pathway.

The central neuron begins within the hypothalamus → the brainstem → spinal cord white matter to synapse with the presynaptic LMNs in the grey matter of T1-3 → ventral nerve root, → spinal nerve → thoracic sympathetic trunk → cranial cervical ganglion in the guttural pouch → iris dilator muscle and smooth muscles of the periorbita and the eyelids.

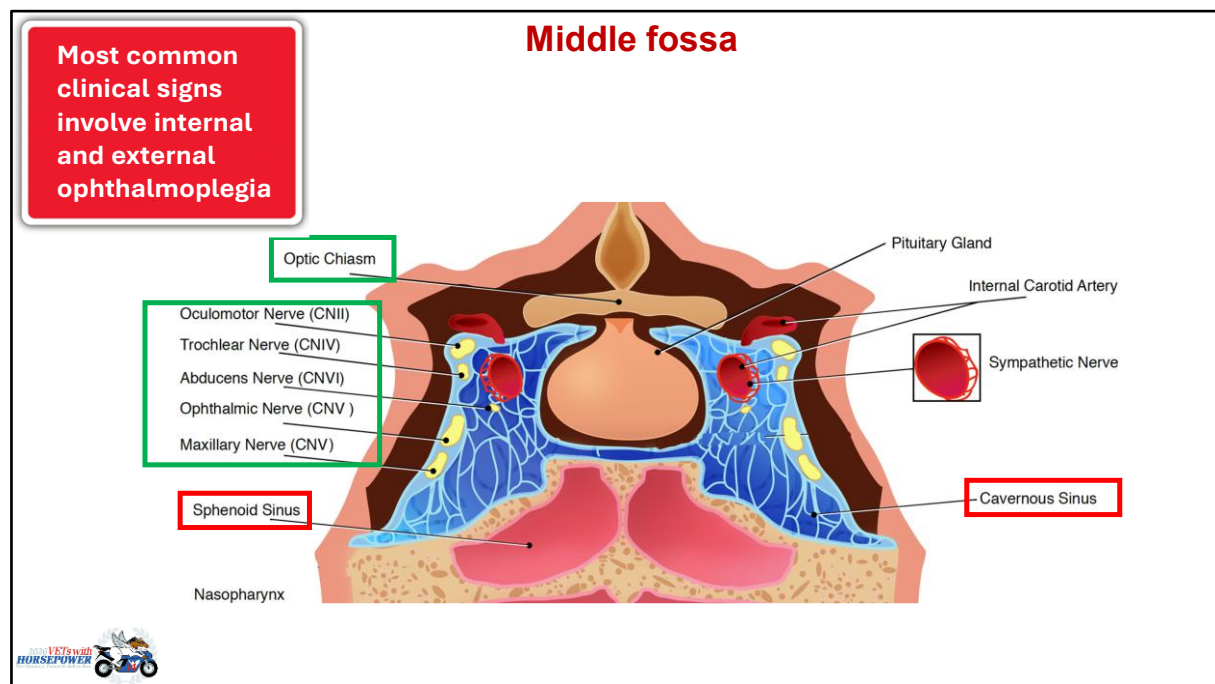
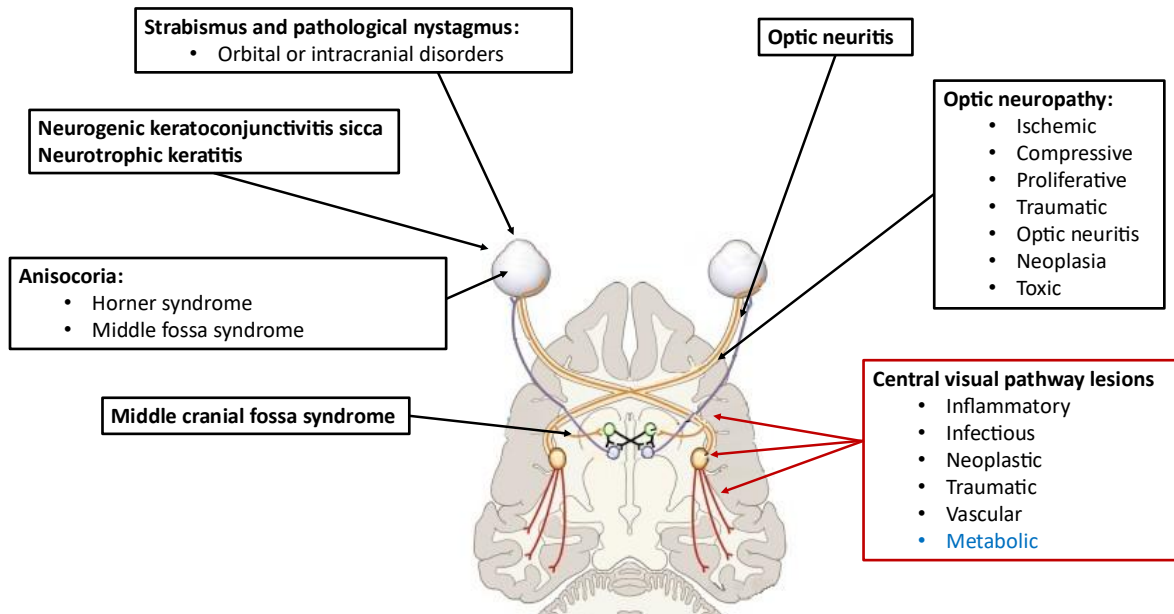


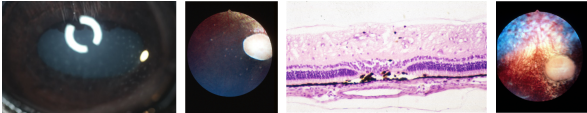
Pupillary light reflex:



If you cannot assess the PLR in a damaged eye look for the indirect response to assess if eye should be saved!

Equine Neuro-ophthalmological diseases





Herpesviruses and equine ocular disease – what can we learn from other species?

Josh Slater BVM&S PhD DipECEIM MRCVS
School of Veterinary Science
University of Liverpool




1

Herpesviruses and equine ocular disease

1. Comparative view of herpesvirus ocular disease
 - Herpesvirus lifecycle, pathogenesis and tropism
 - Ocular disease and herpesviruses in humans
 - Herpesvirus ocular disease in animals
2. Equine herpesviruses and the anterior segment
 - The case for and against EHV's as causal agents of keratoconjunctivitis
 - Features of (suspected equine) herpesvirus keratoconjunctivitis
 - Features of Immune Mediated Keratoconjunctivitis
3. Summary
 - Contrasting features of herpesvirus disease in horses compared to humans and other veterinary species: anterior segment vs posterior segment disease

2

1. Herpesvirus ocular disease: a comparative view

- Herpesvirus lifecycle, pathogenesis and tropism
- Ocular disease and herpesviruses in humans
- Herpesvirus ocular disease in animals



3

Immune privilege and the eye



4

The ups and downs of immune privilege

- Immune privilege protects the eye from damaging inflammation
 - limiting local immune and inflammatory responses preserve vision

Ocular immune privilege

Physical barriers

Blood-retina barrier
No efferent lymphatics

Immune inhibition

Cytokines and signal molecules (TGF- β , α -MSH); T cell inhibitors released by resident cells (Muller cells, RPE, IPE); surface bound inhibitors of T cells (e.g. CD 86, FasL)

Immune regulation

Regulation of systemic immune responses by APC's from the eye inducing systemic CD4+ & CD8+ Treg cells (ACAID in transplants)

(Taylor, 2009; Zhou & Caspi, 2010; Matthews, 2008)

5

The ups and downs of immune privilege

- Ocular tissues have limited ability to regenerate
 - immune suppressing mechanisms ('immune privilege') help protect ocular tissues from damage and maintain integrity
 - tolerance of foreign antigens helps reduce damaging inflammatory and immune responses to 'everyday' antigenic challenges
- Immune privilege limits local tissue destruction but also makes the eye more susceptible to viral infections (Dartt, 2011)
- Disruption of immune privilege mechanisms is central to some ocular diseases (e.g. IMMK and uveitis)
 - immune mechanisms involved only partially elucidated
 - mechanisms by which viruses affect ocular immunity not understood
 - immune privilege mechanisms may vary in different ocular locations

6

Key features of herpesvirus lifecycles

- Sophisticated and successful pathogens with complex lifecycles
- Global distribution across all mammals
- Invasive pathogens infecting multiple cell types
- Large genomes coding a wide range of virus functions
- Lytic and latent cycles of infection
 - virus replication, antigen expression, release of progeny, cell death (**lytic cycle**)
 - no virus replication or antigen expression, limited transcription, virus DNA persists in near-silent state, host cell survives, lifelong infection (**latent cycle**)
- Reactivation from latency triggers new lytic cycles of infection, virus shedding and new rounds of clinical disease

7

Herpesvirus ocular disease

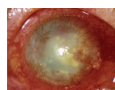
- Herpesviruses are common causes of ocular disease in mammals
- Herpes simplex virus-1 is the most common cause of infectious keratitis in humans and is a major cause of blindness worldwide (Karsten et al, 2012)
 - estimated annual prevalence in the USA of 500,000 people with 40,000 patients having severe visual impairment (Lairson et al, 2003; Farooq et al, 2012)
 - worldwide seroprevalence 80-90%, less in developed countries (Bradley et al, 2014)
- Herpesviruses cause ocular disease in veterinary species, notably dogs, cats and cattle (Styles, 2013; Ledbetter et al, 2009)
- Across these species, herpesviruses are mainly associated with anterior segment disease, especially keratoconjunctivitis and keratitis
- In horses, herpesviruses play a minor role in anterior segment disease but they are important causes of posterior segment disease

8

Human herpesviruses and ocular disease

- Herpes simplex virus-1 (HSV-1), varicella zoster virus (VZV) and cytomegalovirus (CMV)

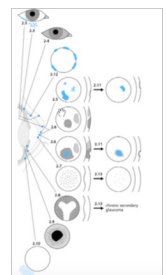
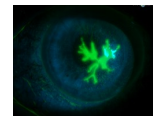
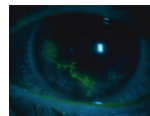
HSV-1	Conjunctivitis (blepharitis, ulceration and vesicles)
	Epithelial keratitis (punctate and dendritic keratopathy)
	Stromal keratitis (necrotising and immune mediated keratitis)
	Endotheliitis
	Neurotropic keratopathy
VZV	Conjunctivitis
	Keratitis (phlyctenule, epithelial, stromal keratitis)
	Herpes zoster ophthalmicus
CMV	Keratitis, endotheliitis, retinitis and acute retinal necrosis (disease mainly in immunocompromised patients)



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HSV-1 ocular disease

- Principally causes keratoconjunctivitis; other manifestations (iridocyclitis, uveitis and ARN) rare
 - all three corneal layers may be affected: epithelial, stromal and endothelial
 - mainly causes epithelial keratitis (Green et al, 2006)
 - dendritic or punctate ulcers are typical
 - pain, photophobia, lacrimation, blurred vision

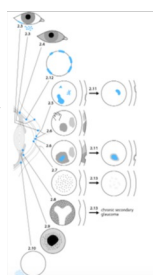
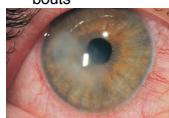


From: Sundmacher, Colour Atlas of Herpetic Eye Diseases, Springer.

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HSV-1 ocular disease

- Stromal keratitis (Gimenez et al, 2013)
 - immune mediated stromal keratitis: opacity, oedema and corneal neovascularisation
 - necrotising stromal keratitis: dense infiltration, stromal necrosis, ulceration
 - stromal scarring and impaired vision with recurrent bouts

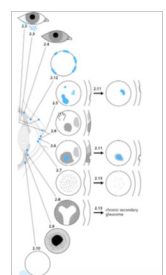
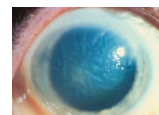
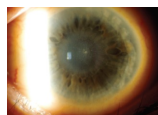


From: Sundmacher, Colour Atlas of Herpetic Eye Diseases, Springer.

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HSV-1 ocular disease

- Endotheliitis (Suzuki et al, 2008)
 - virus/immune pathology of endothelial layer
 - endothelial aqueous pump disruption
 - stromal oedema (various geographic distributions)
 - keratic precipitates overlying regional oedema

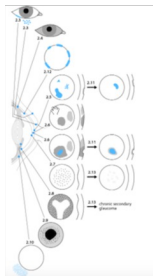
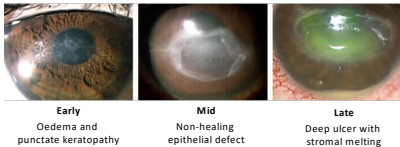


From: Sundmacher, Colour Atlas of Herpetic Eye Diseases, Springer.

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HSV-1 ocular disease

- Neurotrophic keratopathy (Suzuki et al, 2008)
 - denervation disease (trigeminal neuropathy) with epithelial defects, stromal opacification and corneal neovascularisation
 - progresses to corneal ulceration and melting ulcer

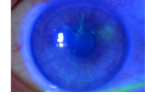


Sacchetti & Lambiase, 2013

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VZV ocular disease

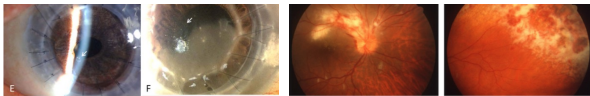
- Primary infection (varicella/chickenpox) and reactivation (zoster/shingles)
- Both stages associated with ocular disease (Tyring, 2006; Liesegang, 2008)
- Varicella disease most commonly conjunctivitis
 - phlyctenule-like (vesicular) lesions
 - corneal disease resembles HSV keratitis
 - punctate or dendritic keratitis
 - stromal keratitis also occurs
- Zoster disease
 - herpes zoster ophthalmicus is second most common complication of zoster
 - trigeminal neuropathy with skin lesions and immune mediated injury to multiple ocular structures following virus reactivation from V1
 - keratitis > uveitis > conjunctivitis



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CMV (HHV-5) ocular disease

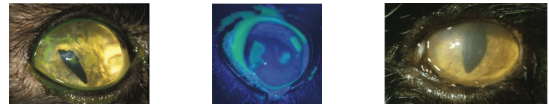
- Widely distributed virus with up to 100% prevalence (Fulop et al, 2013)
- Causes disease in immunocompromised patients
 - disease in immunocompetent individuals unusual (Radwan et al, 2013)
 - CMV ocular disease part of multi-organ virus pathology
- Main ocular disease is retinitis (Anderson et al, 2013)
 - less commonly endophthalmitis (Koizumi et al, 2015), anterior uveitis and ARN
 - often causes extensive retinal destruction with haemorrhages, oedema, necrosis, retinal detachment and vision loss



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Herpesvirus ocular disease in animals

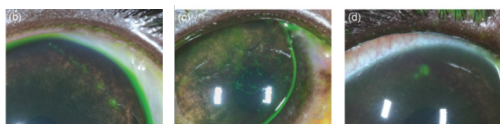
- FHV-1, CHV-1 & BHV-1 as causes of keratoconjunctivitis
- Many similarities to HSV-1 and VZV keratitis
- FHV-1 (Gould, 2011; Maes, 2012)
 - epithelial keratitis with both primary disease and reactivation
 - punctate and dendritic ulcers (fine and branching defects)
 - also geographic ulcers and immune mediated stromal keratitis



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Herpesvirus ocular disease in animals

- CHV-1 (Ledbetter et al, 2009; Gervais et al, 2012)
 - disease with primary infection and also reactivation
 - punctate, dendritic and geographic ulcers in naturally occurring disease
 - experimental primary infection induces conjunctivitis without keratitis
 - posterior segment disease not reported, except in neonates



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2. Equine herpesviruses and the anterior segment

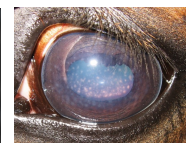
- The case for and against EHV-1 as causal agents of keratitis and possible initiating factors in Immune Mediated Keratoconjunctivitis



Sagi et al, 2020



Rushton et al, 2013



Richter, 2014

18

EHV's as causal agents of keratitis

- Little evidence in the literature for EHV-1 or EHV-4 as causal agents of keratitis/keratoconjunctivitis: single case report of EHV-1 punctate keratitis in a mule (Sagi et al, 2020)
- EHV-2 and EHV-5 are ubiquitous viruses with >90% prevalence
 - wide distribution complicates assessment of role in pathogenesis
 - demonstrating causality is therefore difficult
 - limited experimental data available, mainly clinical reports
- Clinical surveys of EHV-2 and EHV-5 prevalence in diseased and healthy eyes is contradictory
 - Both viruses commonly detected in diseased and healthy eyes
 - No correlation between EHV-2 or EHV-5 status and clinical appearance (Hollingsworth et al, 2015)
 - But clinical reports of antiviral treatment (1% trifluridine) responsive keratoconjunctivitis (Rushton et al, 2013)

19

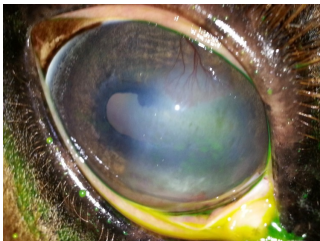
EHV's as aetiological agents in IMMCK?



Disruption of immune privilege mechanisms exposes corneal antigens to the immune system resulting in persistent immune-mediated pathology

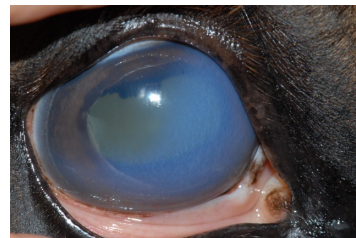
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Immune mediated keratoconjunctivitis: Epithelial disease



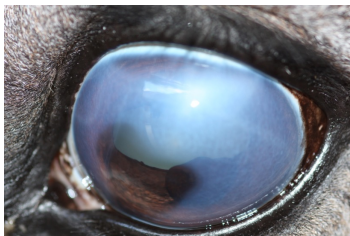
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Immune mediated keratoconjunctivitis: Stromal disease



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Immune mediated keratoconjunctivitis: Endothelial disease



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EHV keratopathy vs IMMCK



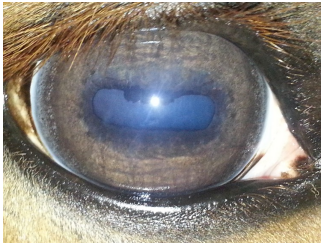
- EHV keratopathy**
- Mild pain, blepharospasm
 - Usually conjunctivitis
 - Punctate or dendritic lesions + oedema
 - Responsive to antivirals (trifluridine)
 - May be recurrent (reactivation?)
 - Possible initiating trigger for IMMCK?



- IMMCK**
- Usually not painful
 - Usually no conjunctivitis
 - Punctate lesions, oedema, possible mineral deposition in chronic disease
 - Neovascularisation in epithelial disease
 - Responsive to immunosuppression
 - Usually recurrent

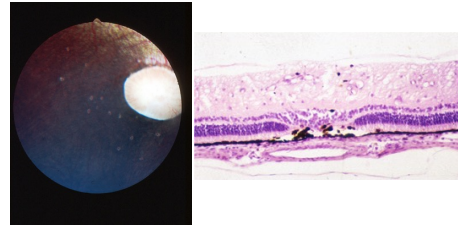
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After 4 weeks treatment with topical prednisolone (1%)
and cyclosporin (0.2%)



25

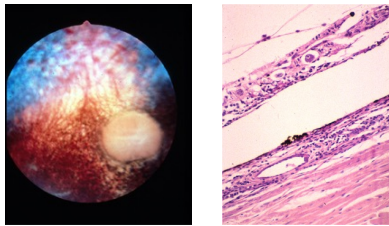
Posterior segment disease: EHV chorioretinopathy



Multifocal chorioretinopathy

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Posterior segment disease: EHV chorioretinopathy



Diffuse chorioretinopathy

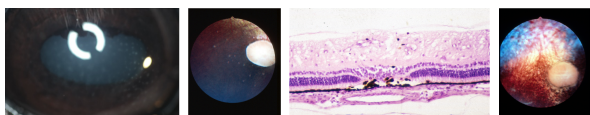
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Summary

- Herpesviruses are common causes of ocular disease in all mammals, especially humans
- Immune privilege is a key protective mechanism but decreases immune control of virus infections and disruption can result in persistent immune mediated ocular pathology
- In humans and most veterinary species, herpesviruses are mainly associated with anterior segment disease
- In horses, herpesviruses are mainly associated with posterior segment disease and their role in keratitis and IMM is unclear



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Herpesviruses and equine ocular disease – what can we learn from other species?

Josh Slater BVM&S PhD DipECEIM MRCVS
School of Veterinary Science
University of Liverpool



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Equine Cardioteam Ghent







Veins, vessels & WTF-Is-That?

A Practical Guide to Vascular Ultrasound



Prof. dr. Gunther van Loon
 DVM, PhD, Dip ECEIM, Assoc. Member ECVDI
 Equine Cardioteam Ghent
 Dept. of Internal Medicine, Reproduction and Population Medicine
 Faculty of Veterinary Medicine
 Ghent University , Belgium

G. van Loon – Equine Cardioteam Ghent
1

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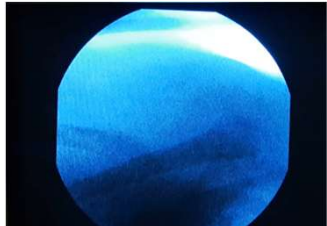


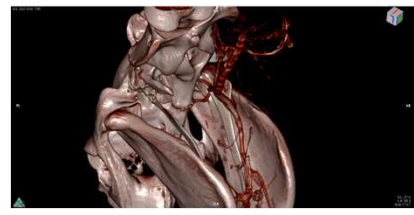

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Vascular examination

Peripheral versus central vessels!

- Palpation
- Auscultation
- **ULTRASOUND**
 - B-mode
 - Doppler: types!!
- Angiography
 - RX
 - Fluoroscopy
 - Angio-CT, (Angio-MRI)



Technique

Jugular

Aorta

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Jugular vein



Left side

- Jugular vein
- Carotid artery
- Esophagus

Right side

Long axis

Collapsibility!! → compression by probe

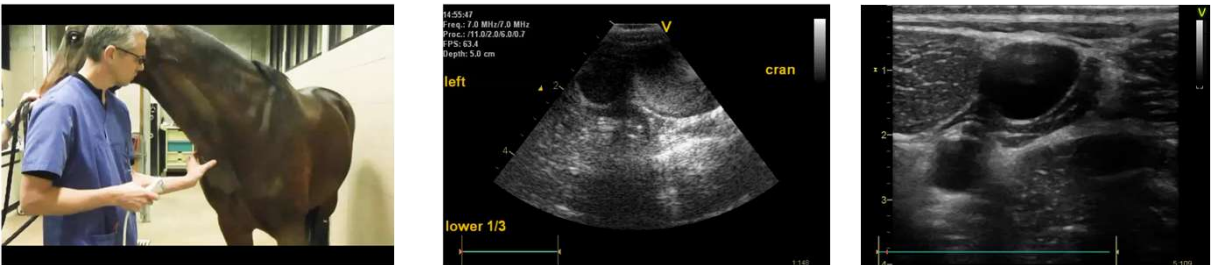
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Jugular vein



Caudal occlusion

Cranial occlusion

Caudal occlusion → filling, size, wall, content

Stop occlusion → emptying, flow?

Cranial occlusion → collapse, flow

Flow	→ anechoic
Stasis	→ echogenic
Thrombus	→ echogenic - hypoechoic

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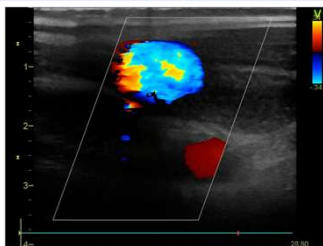


Thoracic inlet: caudal occlusion no longer possible

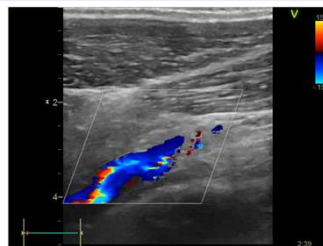
Slight sedation

→ lower head to assess size, wall, content

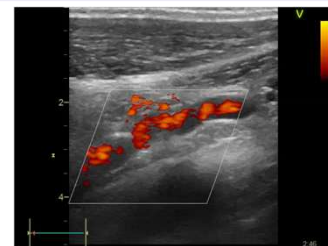
→ lift head for flow, collapse



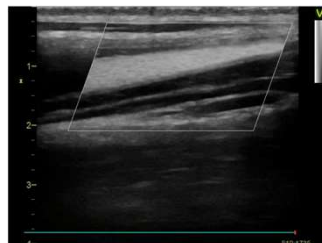
Color flow doppler
(angle dependent)



Color flow doppler
(angle dependent)



Power doppler
(less angle dependent)



B-flow
(not angle dependent!)

Jugular thrombosis – (peri) phlebitis

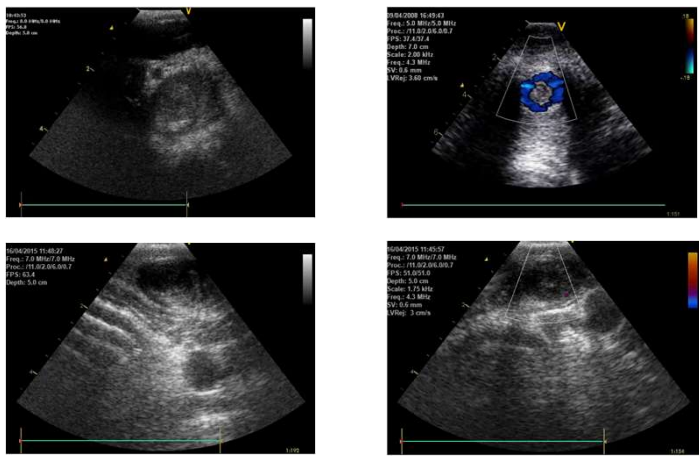


- ▶ Check in the vein and wall for
 - Thrombus
 - Echogenic spots (abscedation), (micro) air bubbles, necrosis
- ▶ Differentiate from oesophagus!

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Jugular thrombosis – (peri) phlebitis



- ▶ Check for residual flow – recanalization → prognosis

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Jugular thrombosis – (peri) phlebitis



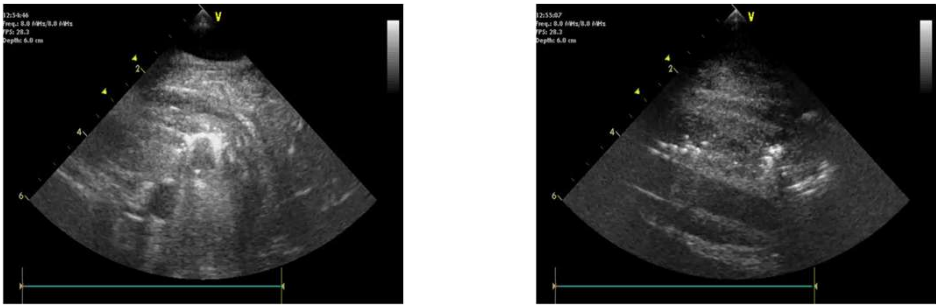
- ▶ Check in the vein and wall for
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 - Echogenic spots (abscedation), (micro) air bubbles, necrosis
- ▶ Differentiate from oesophagus!

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Jugular thrombosis – (peri) phlebitis



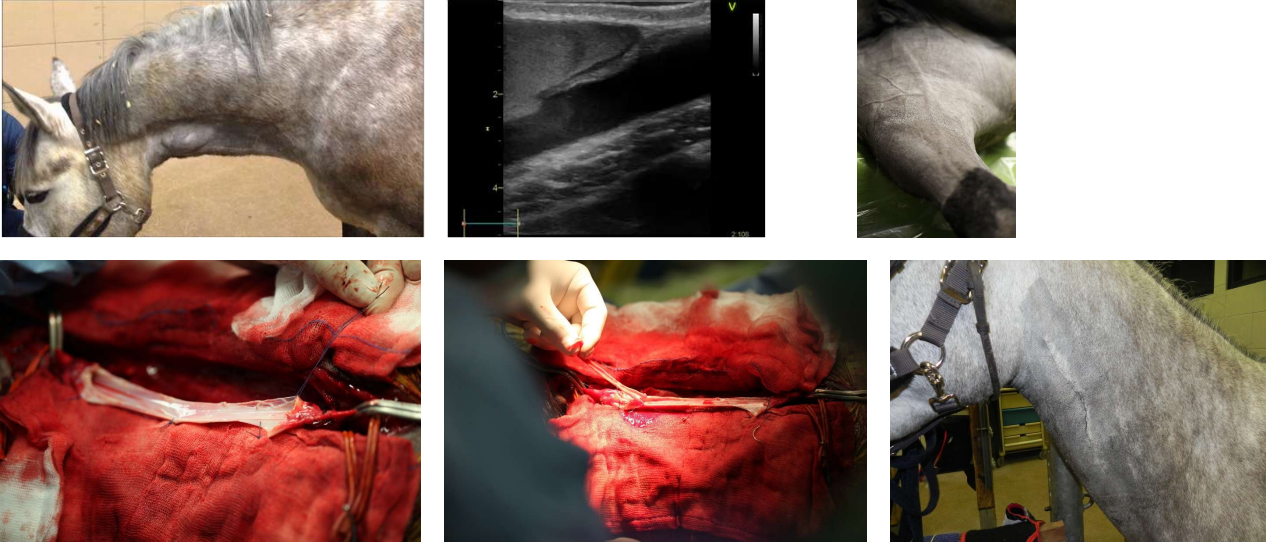
- ▶ Check around the vein for
 - Pus
 - Gas, hyperechoic spots (emphysema?)
 - Necrosis
- ▶ Differentiate from oesophagus!

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Surgery



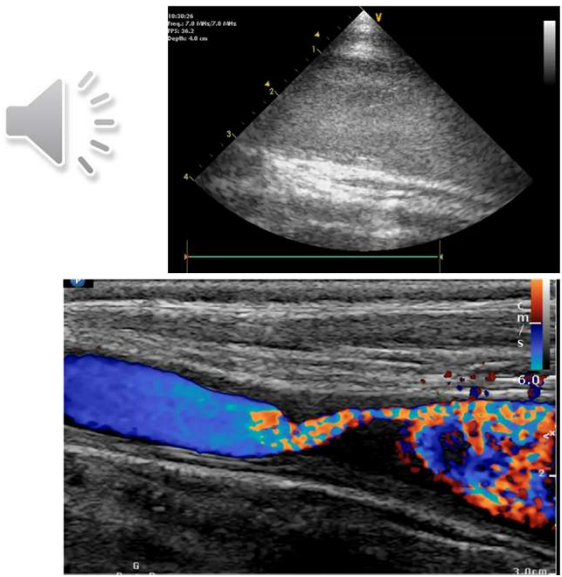
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Jugular vein stenosis

Stenosis:

- at thoracic inlet
- probably external trauma
- iatrogenic

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Jugular vein stenosis

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► Tx:

- Wait for collateral circulation
- Surgery
- PTA: percutaneous transluminal angioplasty: 9-12 bar



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Other peripheral vein abnormalities

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Arteriovenous fistula

► Causes

- Congenital
- Traumatic
- Iatrogenic

► Diagnosis

- Auscultation
- Palpation
- pO₂ measurement
- Ultrasound
- Angiography

(pseudo)Aneurysm, congenital vein abnormalities

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Aortic rupture

- Relatively rare condition
- Mainly during exercise, breeding
- More in males
- Sudden death

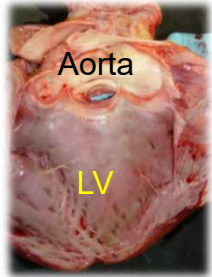
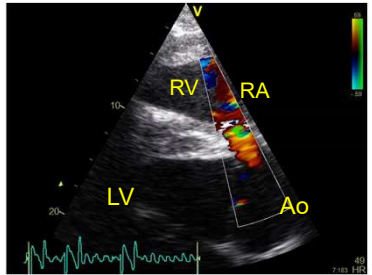


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Aortocardiac fistula

- Aorta ruptures into another cardiac chamber
 - (RA, RV, LV)
- Signs
 - More in males
 - Often loud systolic + diastolic murmur RIGHT
 - COLIC, pawing
 - Often ventricular tachycardia


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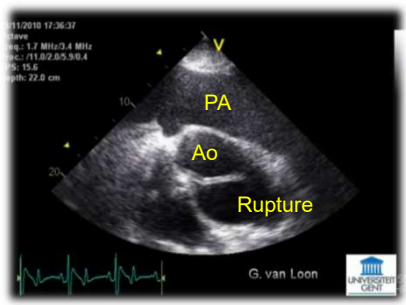




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Aortopulmonary fistula

- ▶ Aorta ruptures into the pulmonary artery!
- ▶ (Young) adult Friesian horses
- ▶ Acute signs:
 - (Soft or loud systolic/diastolic murmur left)
 - **Colic, pawing, tachycardia**
 - Usually sinus tachycardia
 - Hyperkinetic arterial pulse
- ▶ 'Chronic signs:
 - Exercise intolerance
 - Increased heart rates (often around 60/min)
 - Hyperkinetic arterial pulse
 - Ventral edema, right heart failure,...

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Aorta and iliac arteries



Treatment:

- Surgery?
- Catheter removal?
- Local r-TPA?
- (Anticoagulants?)

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Take home

- Good dynamic examination
- Jugular
 - Thrombosis: check residual flow or recanalization
 - (peri)phlebitis: sign of infection, necrosis → drainage if needed
 - Jugular stenosis → balloon dilatation?
- Peripheral vein: arteriovenous fistula, aneurysm, congenital
- Aortic rupture
 - In thorax: sudden death
 - Aortocardiac fistula: colic, ventricular tachycardia
 - Aortopulmonary fistula: Friesian, colic, sinus tachycardia

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Veins, vessels & WTF-Is-That?

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Prof. dr. Gunther van Loon

DVM, PhD, Dip ECEIM, Assoc. Member ECVDI

Equine Cardioteam Ghent

Dept. of Internal Medicine, Reproduction and Population Medicine

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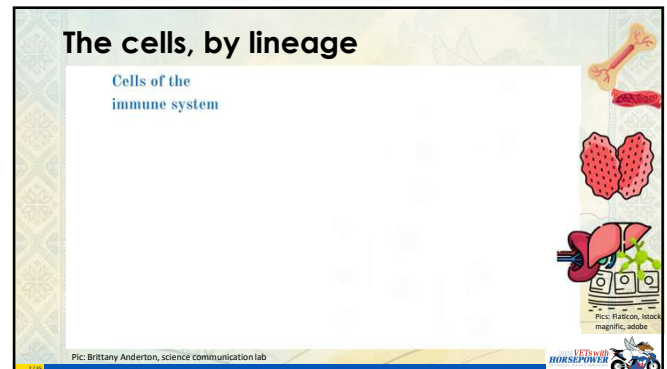
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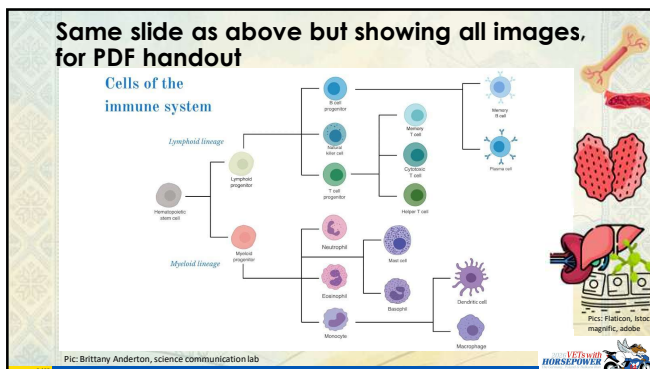
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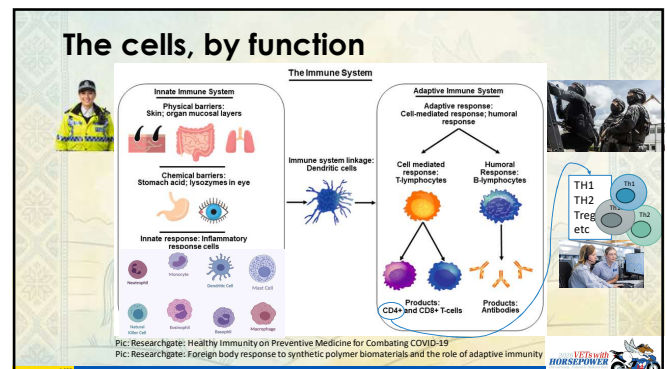
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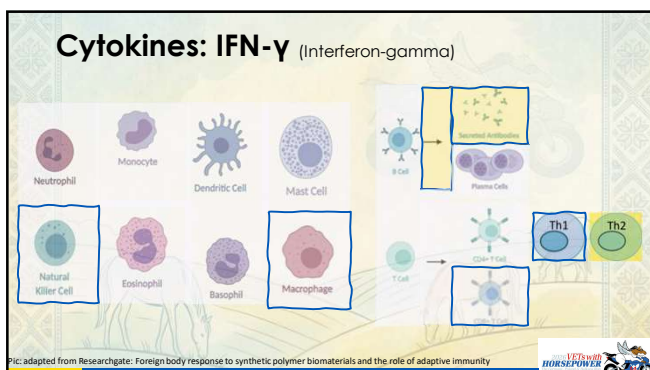
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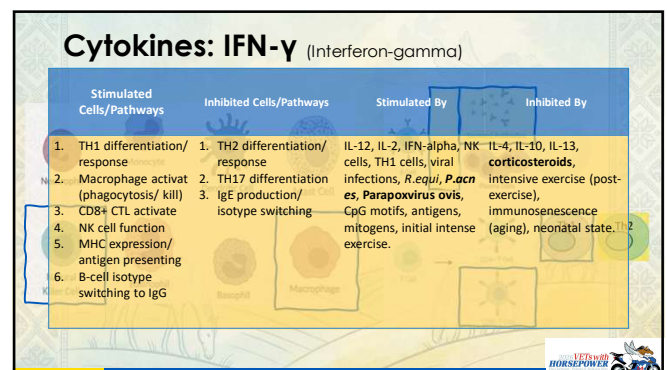
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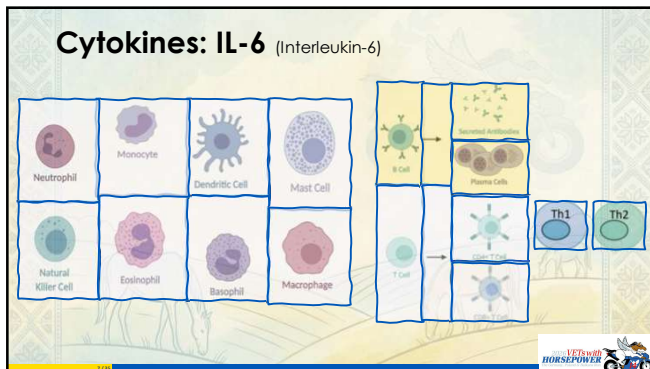
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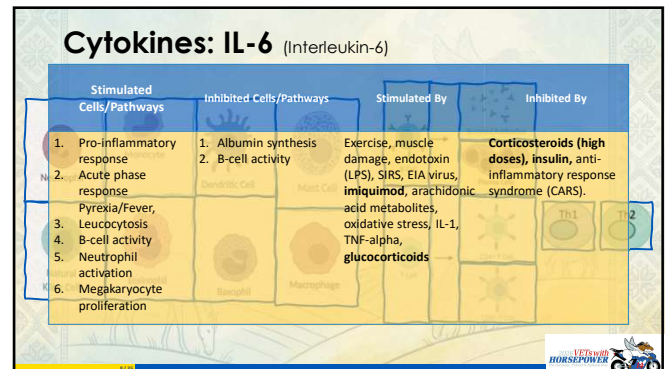
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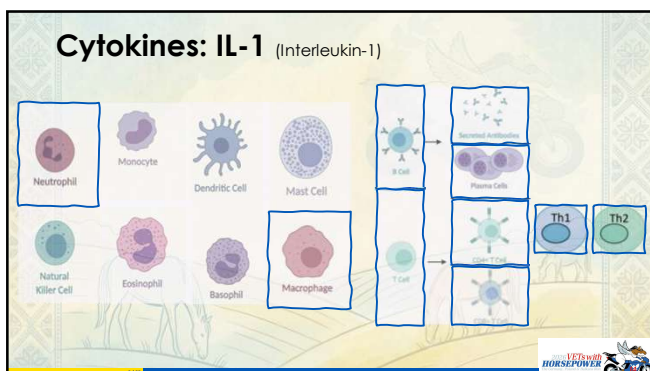
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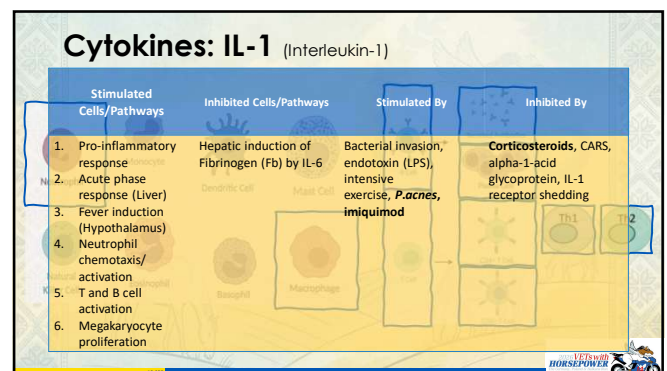
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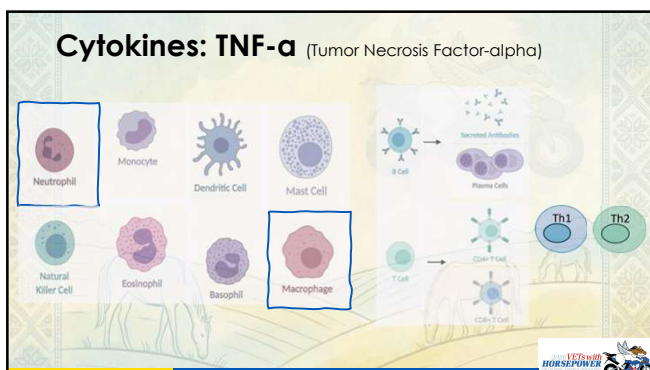
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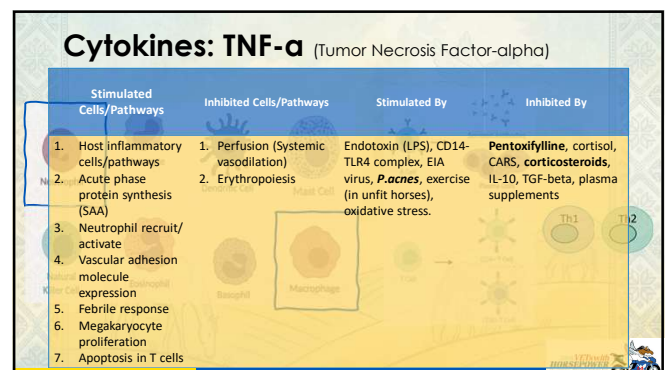
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Corticosteroids

- e.g., Dexamethasone, Prednisolone, Triamcinolone, Methylprednisolone
- Mechanism: bind to cytoplasmic glucocorticoid receptors, regulating up to 20% of genes in leukocytes.
 - Reduce the synthesis of proinflammatory cytokines like IL-1 and TNF- α
- Widely used on- and off license – systemic, topical, inhaled, IA



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Vaccination

- Mechanism: Vaccines introduce antigens that stimulate B-cell antibody production and T-cell memory
 - Attenuated live vaccines – less reliant on adjuvant
 - Inactivated/killed vaccine - no risk of causing disease or reversion to virulence
 - Equilis Prequenza (+ISCOM-Matrix)
 - Equip F (+ISCOM)
 - Recombinant viral vector vaccines - intracellular expression of antigens without the risk of causing disease or reversion to virulence
 - ProteqFlu (+carrier)



14

Vaccination schedules

- FEI – most recent vaccine within 6m 21d of competition
- BHA – every 6 months
- Wait until 6m age
 - Characterisation of immune responses in healthy foals when a multivalent vaccine protocol was initiated at age 90 or 180 days
- Not competing within 7 days of vaccination
 - Potentially poorer exercise performance
 - Potentially poorer immune performance



15

Passive immunisation

- Plasma, tetanus antitoxin
- Mechanism: administering preformed antibodies



16

Nutrition

- BALANCED NUTRITION**
 - Vit A, C and E, Se, Zn, Cu, Omega 3/6
- Beta-Glucans (Yeast Cell Wall Extract)
- Omega-3 Fatty Acids
 - ALA (Alpha-Linolenic Acid)
 - EPA (Eicosapentaenoic Acid)
 - DHA (Docosahexaenoic Acid)
- Boswellic acid, MSM
 - Dampen, for joint comfort
- Echinacea
 - Stimulate immune



17

Pentoxifylline

- Primarily human drug, oral bioavailability issue in horses
- Some evaluations in endotoxaemia and laminitis
 - Anti-inflammatory effects, eg suppresses pro-inflamm TNF- α , IL-1 β , IL-4, IL-6, IL-12
 - Makes RBC more flexible, blood less viscous



18

Azathioprine

- Strong immunosuppressant
 - Stops rapidly dividing of activated lymphocytes
- Used in humans for serious immune diseases, and in dogs too
 - But.... Very poor bioavailability in horse, and limited pharmaco data
- Potential is steroids not an option??



19

Zylexis® (Inactivated Parapoxvirus Ovis)

- 2 phased response
 - rapid Th1 immune response
 - destroying intracellular threats -> resp viruses
 - But limited benefit in EHV-1
 - milder, self-regulating Th2 phase
 - stabilizes the immune system
- Licensed use: reduction of clinical signs of stress/crowding-associated equine respiratory disease
 - from 10 months of age



Reproductive Control Trial > Van Meirvenne, 2014 Oct 16;17(3):4232-43.
doi:10.1186/s12917-014-0247-015. Epub 2014 Jul 27.

Efficacy of a Parapoxvirus ovis-based immunomodulator against equine herpesvirus type 1 and Streptococcus equi equi infections in horses
Elise Orie¹, Leen Van Brussel¹, Stephen Lave¹, Václav Krátek¹, Ann Collinane¹, Rachel Kenna¹, Norbert Lippert¹, Tania Anna Horrocks¹, Jeremy Salt¹, Rudiger Rapp¹

Updated ACVIM consensus statement on equine herpesvirus-1
David P. Lunn¹, Brandy A. Burgess, David C. Dorman, Lutz S. Goefting, Peggy Gross, Klaus Osterrieder, Nicola Pusterla, Gisela Soboll-Hussey
Journal of Veterinary Internal Medicine, Volume 38, Issue 3, May-June 2024, Pages 1290-1299, <https://doi.org/10.1111/jvim.17047>
Published: 03 May 2024 Article History



20

EqStim®

(Inactivated *Propionibacterium acnes*)

- Broad immune stimulant, especially macrophages
- FDA: indicated in the horse as an *adjunct* to conventional therapy in the treatment of Equine Respiratory Disease Complex (ERDC)



Intratumoral injection of *Propionibacterium acnes* suppresses malignant melanoma by enhancing Th1 immune responses
Kenshiro Tsuda¹, Katsuki Yamashita, Wang Linan, Yoshitomo Miyahara, Tomoko Akada, Takafusa Nakamura, Hiroshi Kitagawa, Masato Kakeida, Ichiro Kurakawa, Hiroshi Shiba, Etsuko C. Gabezawa, Hiroshi Mizutani



21

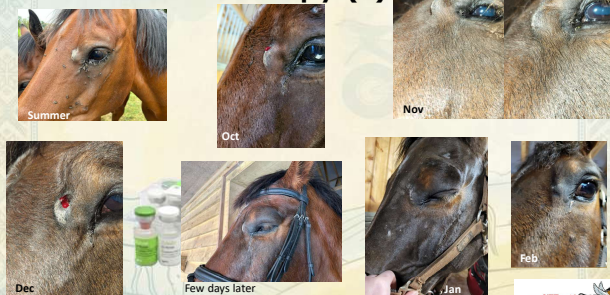
BIOLOGICS

- Mesenchymal Stem Cells (MSCs)
 - Emerging, most studies are small/uncontrolled
 - Monocytes/macrophages anti-inflammatory, Inhibit Th1 and Th2 proliferation, Suppress NK cells, reduced proliferation B-cells
 - Orthopaedics, ERU?, Asthma?
- Alpha-2-Macroglobulin (A2M)
 - no published large RCTs specifically in horses
 - Traps proteases incl MMPs
 - Mostly orthopaedic use, does not inhibit repair like corticosteroids



22

BCG Immunotherapy (+)



23

Imiquimod®

- Sarcoid
 - Especially nodular, also flat/verrucous
 - NOT fibroblastic
- Predominantly stimulates innate immune and Th1
 - Reduces tumour immune evasion
- Off license, long course, sore, wear gloves

Equine Veterinary Journal BEVA

EVIDENCE REVIEW Open Access

Treatment of equine sarcoids: A systematic review
Saskia S. Otter¹, Claire E. Davies¹, David G. M. Sutton
First published: 14 March 2023 | <https://doi.org/10.1111/evj.13935> | VIEW METRICS
Accessibility issue? Request accessibility updates.



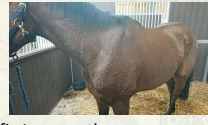
24

30

Type I Hypersensitivity (Immediate / IgE-Mediated / 'allergic')

IgE triggers mast cell release, histamines & prostaglandins & cytokines, eosinophils drawn in

- Insect Bite Hypersensitivity (Sweet Itch / IBH) (also type IV)
- Urticaria (Hives)
- Atopic Dermatitis
- Anaphylaxis
- Asthma
 - Type I/IV

- Steroids
- NSAIDs
- Allergen-Specific Immunotherapy
 - From Th2 (IgE) to Th1 (IgG)/Treg
 - Not 100% and 1-2 years
- Omega 3? Adjunct, cream?
- Antihistamines? Adjunct
- Se, VitE, Zn
- IL-5, IL-31 vaccine
- Ringworm vaccine??
 - Stim cell mediated, no sign benefit

VETechnic HORSEPOWER

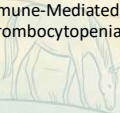
31

Type II Hypersensitivity (Cytotoxic)

Antigen on cell, IgG or IgM coating, NK and other immune kill own cells

- Neonatal Isoerythrolysis (NI)
- Immune-Mediated Hemolytic Anemia (IMHA)
 - Penicillin (rare)
- Immune-Mediated Thrombocytopenia

- Corticosteroids
- 2nd line – Azathioprine
- Plasma transfusion if NI – stop from drinking
 - Commercial or matched
- Pentoxifylline as adjunct if vasculitis?




VETechnic HORSEPOWER

32

Type III Hypersensitivity (Immune-Complex Mediated)

Excess soluble antigen, complex with IgG/IgA, deposits capillaries and tissues, Th1, recruit leukocytes

- Vasculitis
- Purpura Hemorrhagica
 - post-*Streptococcus equi* (rare)
- Glomerulonephritis




- Steroids
- Pentoxifylline
- (NSAIDs)

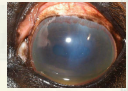
VETechnic HORSEPOWER

33

Type IV Hypersensitivity (T-Cell-Mediated / Delayed)

- Type IVa (Th1-mediated)
 - Equine Recurrent Uveitis (ERU / "Moon Blindness" via leptospira)
 - Sarcoidosis
- Type IVb (Th2/eosinophil)
 - Late-phase component of IBH
 - Allergic contact dermatitis
- Type IVc (cytotoxic T-cell)
 - Viral infections

- Corticosteroids
- Cyclosporin
- NSAIDs
- Stem cells?
- Azathioprine



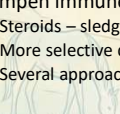
Pic: Merck vet manual

VETechnic HORSEPOWER

34

Take-home messages

- We deal with immune system in some way on most visits
 - But I at least never thought about it enough!
- "Can I boost his immunity?"
 - Vaccines, passive immunity if needed, Zylexis/EqStim
 - Look at nutrition, environment, stress.
- Dampen immune response
 - Steroids – sledgehammer approach but will work
 - More selective drugs – which matches pathway to suppress
 - Several approaches off-label, and almost all prohibited in sports



VETechnic HORSEPOWER

35

Stringhalt and Shivering

Dr Caroline Hahn ECVN ECEIM MRCVS
Royal (Dick) School of Veterinary Studies
The University of Edinburgh
Caroline.Hahn@ed.ac.uk

Definition:

- Pelvic limb movement disorders unrelated to lameness or ataxia are known as Stringhalt and Shivering ('Shivers' USA)
- They are defined by a specific abnormal pattern of hindlimb movement that is only apparent in specific gaits and is not the result of pain, paresis, or proprioceptive deficits
- The two conditions are not always easy to differentiate

Clinical signs

- Consistent excessive and prolonged flexion of one or both pelvic limbs while walking forward
- Hyperflexion varies from mild to severe, most obvious when the horse is turning sharply, backing, going down a slope & after standing still
- Stringhalt is divided into idiopathic, trauma associated and pasture associated groups

Idiopathic stringhalt:



- No pathologic changes on post-mortem examination
- Sudden onset clinical signs
- Not progressive
- Most improve
- Thoracic limb signs?
- Aetiology unknown

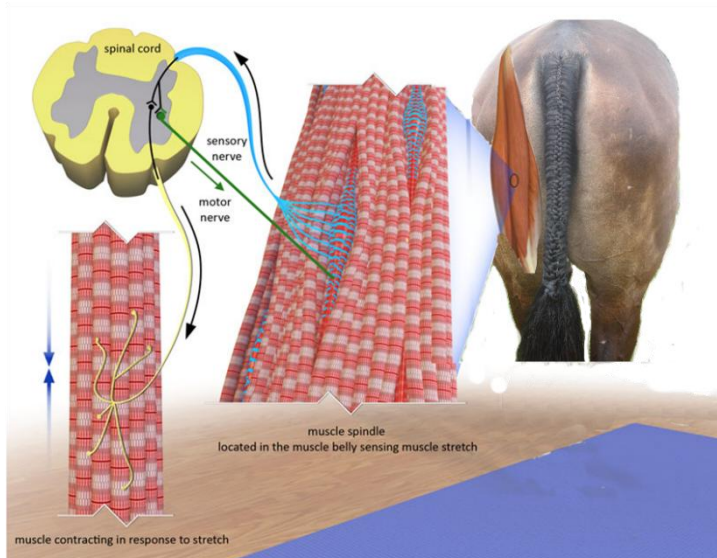
Stringhalt – clinical signs:

- Hyperflexion of one or both pelvic limbs evident at walk, particularly circling and trotting
- Hyperflexed limb is held in the adducted state; in early stages it may be intermittent with exercise and worse on hard ground
- Hyperflexion is present at a walk and trot, and variable when horses are asked to back up or when manually lifting the limb

- Rarely, the forelimbs may show knuckling and hypermetria

Stringhalt – aetiology:

Proposed to be disruption of the afferent or efferent fibres supplying muscle spindles and Golgi tendon organs



Trauma associated stringhalt:

- Often unipedal
- ? Trauma interferes with muscle's ability to gauge the number of motor units required for a normal smooth muscle contraction, →hypertonicity and hyperreflexia.
- Examine the horse! Orthopaedic pain, especially foot soreness, can cause a stringhalt-like gait
- Additionally, polyneuropathies can cause a Stringhalt-like gait

Pasture associated ('Australian') Stringhalt

- Muscle atrophy develops in most affected horses
- Tall adult horses particularly predisposed
- Not all horses grazing pasture with *H. radicata* develop clinical signs
- Most severely atrophied muscles are the long and lateral digital extensor muscles, also laryngeal hemiplegia
- Reported in horses grazing drought-affected, poor-quality pastures that contain the plant *Hypochoeris radicata* ('False Dandelion'), ? *Lathyrus species* (sweet peas), *Taraxacum officiale* (dandelion), *Malva parviflora*
- *Hypochoeris radicata* and sporadic cases found in Australia, Europe, parts of Asia, South America, and the US
-



Management of Stringhalt cases:

- Some horses may recover spontaneously
- In cases of plant poisoning or intoxication, horses should be removed that pasture
- Surgical resection of part of the muscle and tendon (myotectomy) of the lateral digital extensor at the level of the hock → variable success rate
- Administration of muscle relaxants, anticonvulsants (phenytoin), tranquilizers (acepromazine), and other medications can be helpful in some cases, but the effects are often temporary
- Recent study reported fewer stringhalt-like steps after repeated injections of Botox (EVJ January 2010, Wijnberg et al (<https://doi.org/10.2746/042516409X397361>))
- ***Response to injection of long-acting local anaesthesia into musculotendinous junction***

Shivering

- When Draught and Warmblood horses were the main means of transportation and farm work shivering was very common. The incidence declined following World War II, scant coverage in veterinary textbooks from the mid-twentieth century.
- A 2014 study found that Belgian Draft Horses had prevalence of 19% , predilection in Warmblood, Draught, and Thoroughbred geldings at least 16.3 hands tall (PMID: 24802303)
- Onset 5-10 years old, usually gradually progressive, chronic neuromuscular disease characterised by clonic-tonic muscle contractions ('shivering) when backing up. Other typical signs include trembling of the tail while held erect, trembling of the thigh muscles and a flexed and trembling pelvic limbs (*sole sign of hyperflexion of the hindlimb when it is lifted manually insufficient for a diagnosis of shivering*).
- There is no cure or definitive treatment but some horses with Shivers can continue to work or perform athletically, others will require retirement / euthanasia.
- A 2015 study detected abnormalities of the distal axons of cerebellar Purkinje cells in deep cerebellar nuclei, which could result in the hypermetria and myoclonus by causing abnormally elevated muscle recruitment in the biceps femoris and vastus lateralis muscles during backward walking.

Differentiating Shivering from Stringhalt

Shivering:

- Chronic difficulty in backing up
- Muscle hypertonicity → either excessive hindlimb hyperflexion, or excessive hindlimb rigidity and extension.
- Advanced cases → intermittent hyperflexion and abduction of the hindlimbs at the initiation of forward walking or when turning.

Stringhalt:

- Backward walking can be very similar to shivering

- Stringhalt hyperflexion during forward walking and has an acute onset consistent, rapidly ascending, hyperflexed, adducted pelvic limb gait at a walk
- Forward walking consistently affected, limb in adducted position (PMID: 24612176)

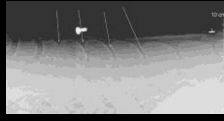
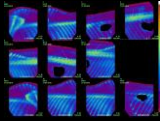


Shivering

Stringhalt

Back conditions of the horse: Diagnosis and Treatment

Dr Jessica Kidd
kiddvet@gmail.com



1

THE BACK



2



3

OFTEN, HORSES ARE SIMPLY PRESENTED FOR POOR PERFORMANCE



4

HISTORY AND CLINICAL SIGNS

- ◆ Back pain in horses can be divided into primary and secondary issues
- ◆ The clinical history is very important because the signs can be so varied and so vague.
- ◆ There is a very broad spectrum of clinical signs pertaining to back pain in horses.

5

Clinical examination



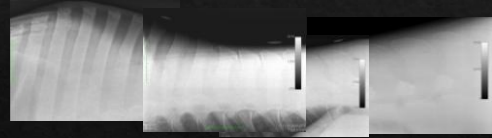
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MOST COMMON CONDITIONS WHICH AFFECT THE BACK OF THE HORSE

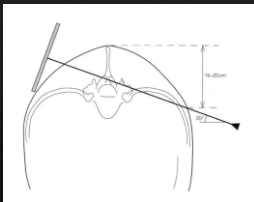
- ❖ Secondary back pain: muscular or osseous
- ❖ Osteoarthritis of the facet joints of the thoracic and lumbar spine
- ❖ Fractures
- ❖ Supraspinous ligament desmitis
- ❖ "Overriding Dorsal Spinous Processes": also called "Impinging Dorsal Spinous Processes" or "kissing spines"
- ❖ Soft tissue injuries

7

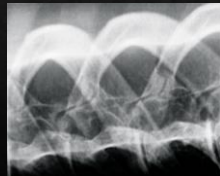
IMAGING: RADIOGRAPHY



8



From Butler et al. Clinical Radiology of the Horse

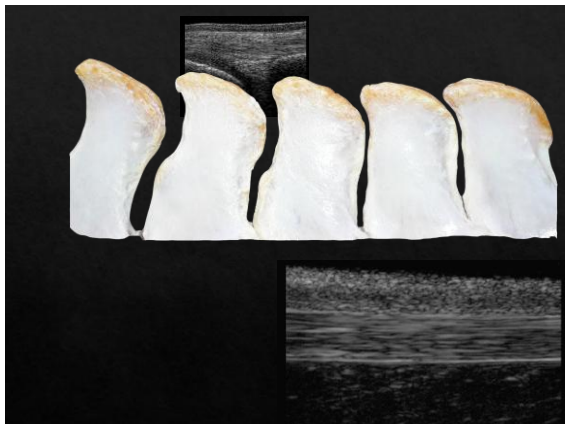


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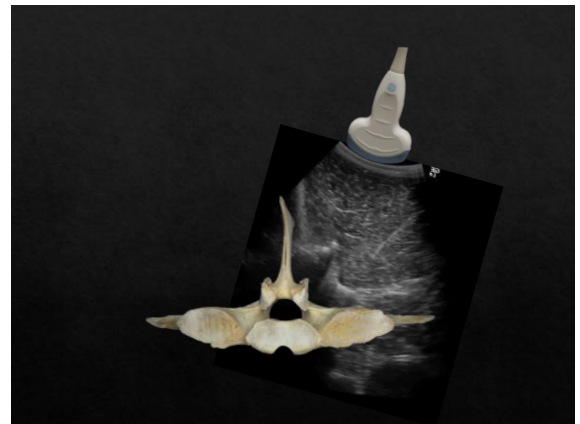
IMAGING: ULTRASONOGRAPHY



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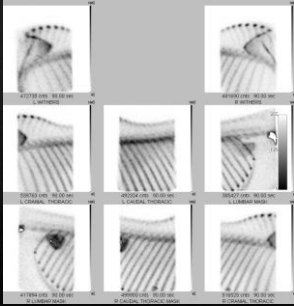


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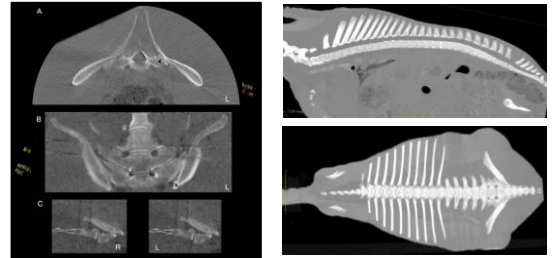


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IMAGING: SCINTIGRAPHY



13



14

soft tissue injuries



likely to be under diagnosed
size of the patient
limitations of the clinical examination
role of the physiotherapist

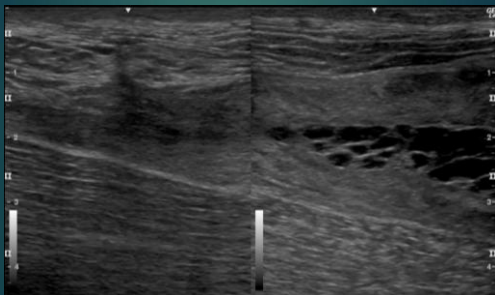
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soft tissue injuries

diagnostic options are severely limited
frequently impossible to rationalise
the findings of the clinical
examination

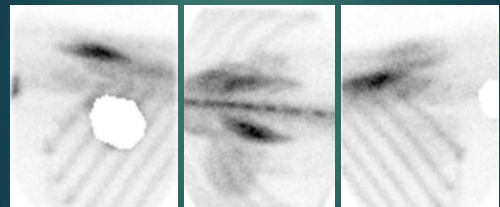
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soft tissue injuries

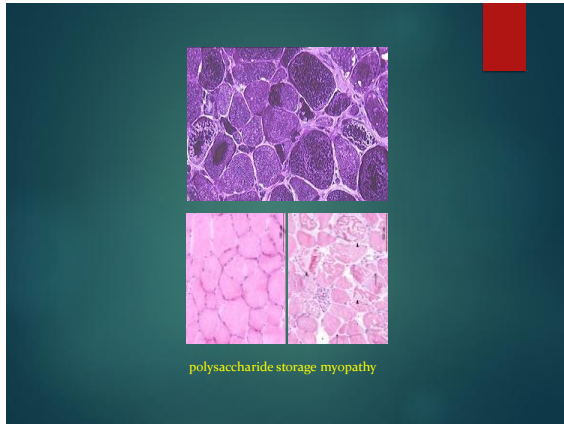


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soft tissue injuries



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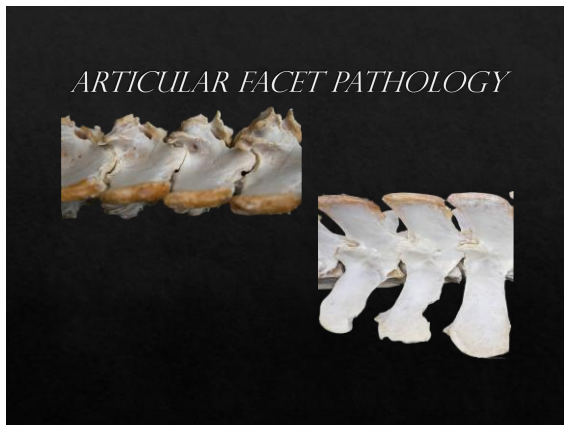


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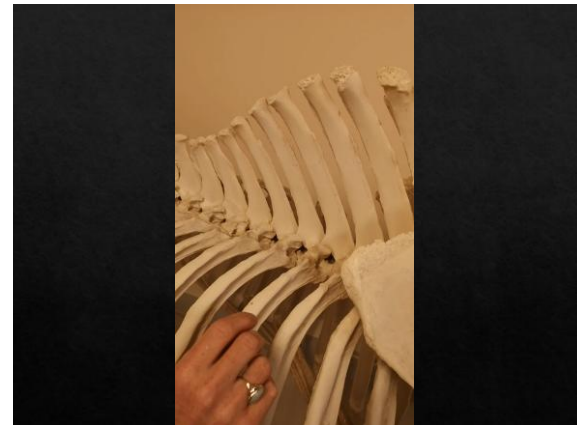
soft tissue injuries

the most common presentation of soft tissue abnormality in the back is muscle soreness/spasm secondary to hindlimb lameness

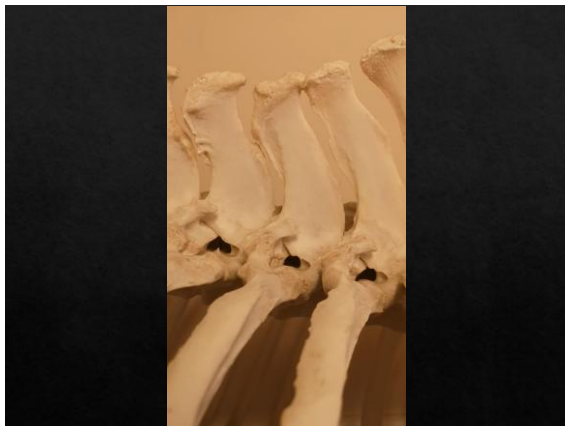
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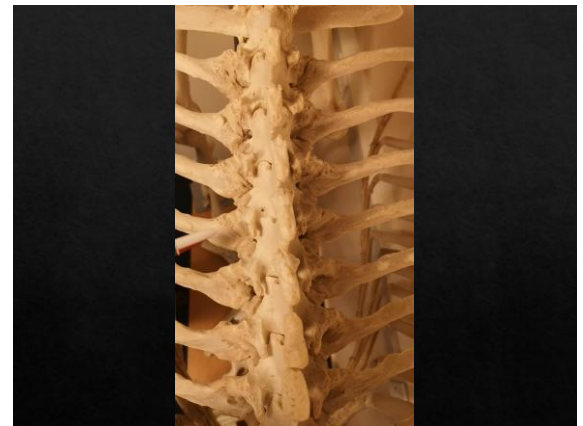
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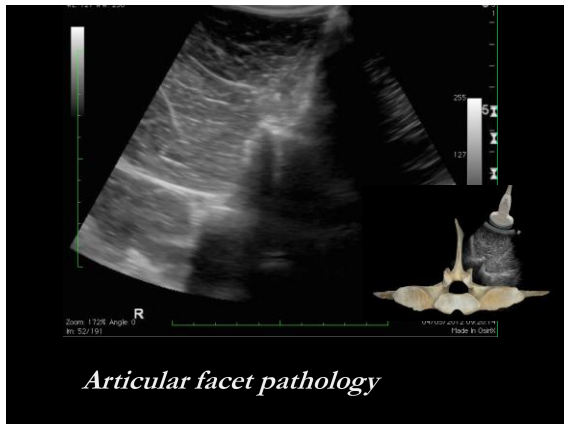
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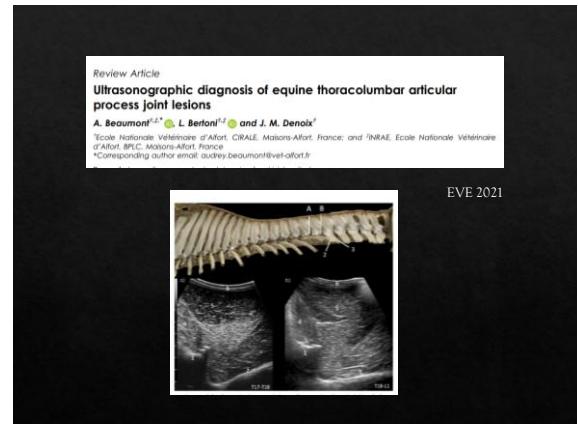
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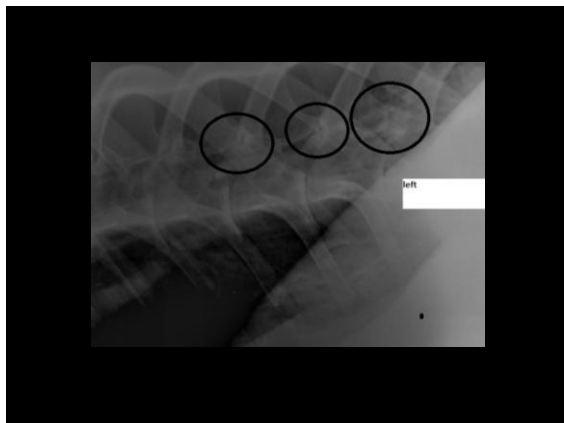
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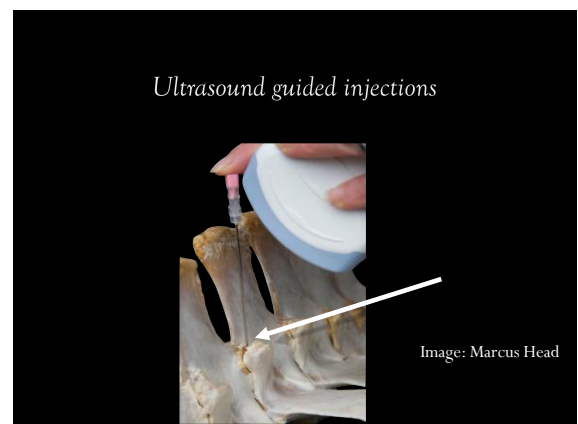
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Ultrasound guided injections

place the probe close
to midline and
approach from
laterallyOR

place the probe
laterally and direct the
needle vertically, close
to midline

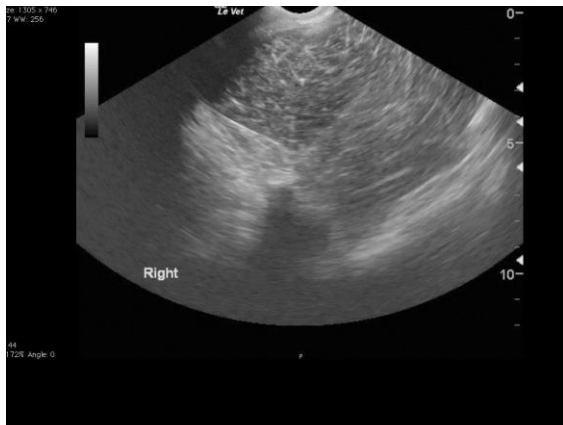


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Don't do it like this!



32

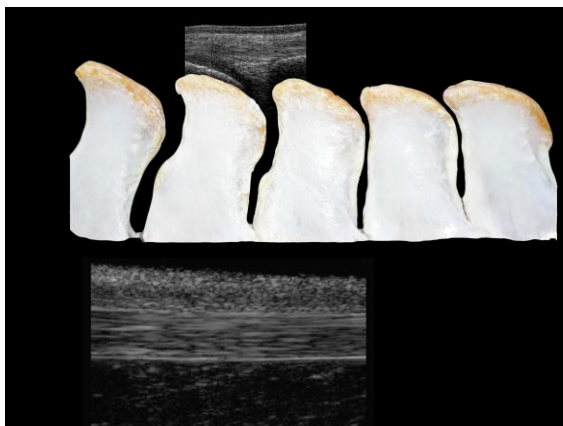


33

Supraspinous ligament injuries

- ◊ Not a common injury- overdiagnosed? Underdiagnosed?
- ◊ The ultrasonographic appearance changes from front to back so interpret with care
- ◊ Suspect areas can be infiltrated with local and the horse assessed
- ◊ Shockwave may help but not for use in acute cases

34

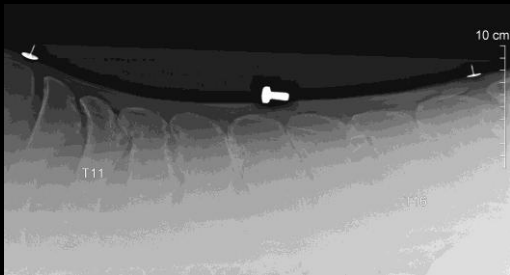


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Impinging dorsal spinous processes: "Kissing spines"



37

Lameness examination

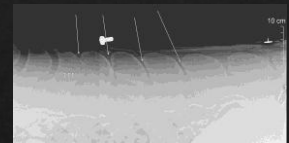


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DSP block



- ◆ A dorsal approach is very difficult in these cases!
- ◆ 5 ml local placed obliquely adjacent to supraspinous ligament triangulated to reach depth of pathology: ASSESS ASAP

40



41

However, the result can be striking...



42



43



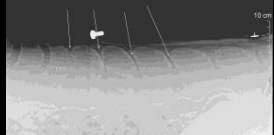
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45

Can I get away with just radiographing the horse?

- ✧ "Princess", a 4 yo TB in training
- ✧ Presented by the trainer for "moving badly"
- ✧ Trainer had experience with IDSP and requested back radiographs

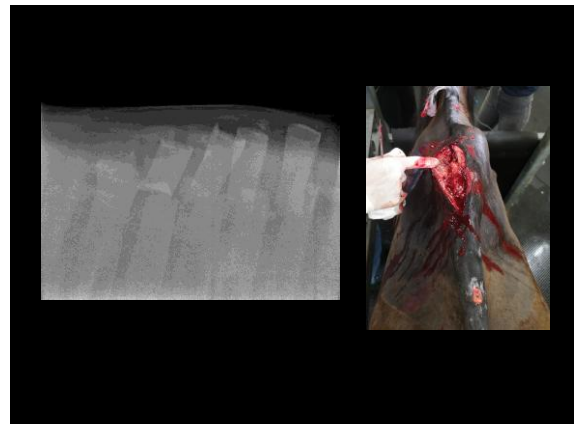


✧ But a negative response to a DSP block

46



47



48

Medical treatment options

- ◆ Regional infiltration
- ◆ Steroids:
 - ◆ Depomedrone: most effective
 - ◆ Triamcinolone
 - ◆ Dexamethasone



49

- ◆ Sarapin
 - ◆ Unlicensed
 - ◆ Extract of pitcher plant: form of chemical neurectomy
- ◆ Physiotherapy
- ◆ Shockwave
 - ◆ Cumulative analgesic effect
 - ◆ Now a racing withdrawal time

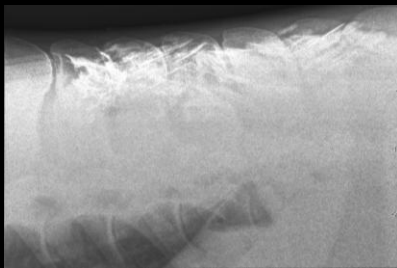
Extracorporeal shockwave therapy raises mechanical nociceptive threshold in horses with thoracolumbar pain

L. R. Truger, R. A. Funk, K. S. Clapp, L. A. Dahlgren, S. R. Werre, D. R. Hodgson, R. S. Pleasant
First published: 08 August 2019 | <https://doi.org/10.1111/evj.13159> | Citations: 4

50

kissing spines regional medication

Lovely image: Marcus Head



51

BLOOD ALERT!!

52

Surgical options: DSP resections

- ◆ Open approach under GA
- ◆ Standing resection
- ◆ Endoscopic resection



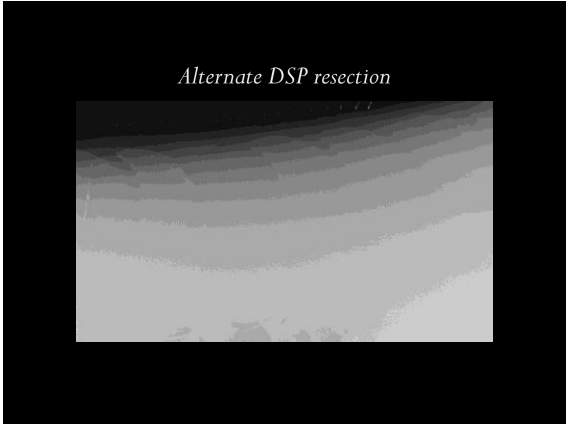
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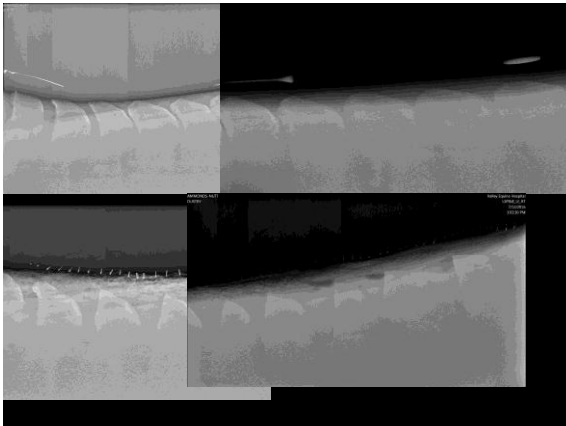
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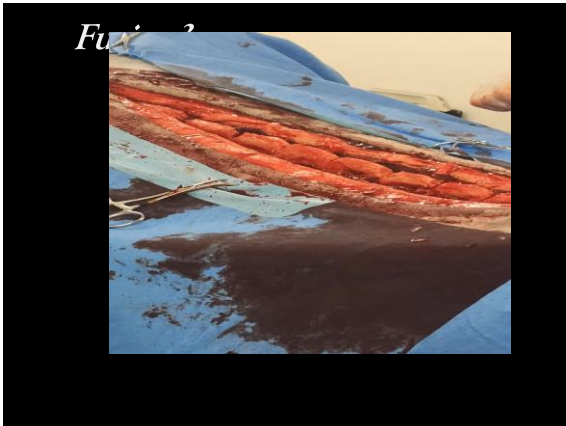
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Interspinous Ligament Desmotomy

Advantages:

- ◊ Less invasive
- ◊ Less expensive

Disadvantages:

- not applicable for all cases
- may not have sufficient effect

Most likely functions as a neurectomy

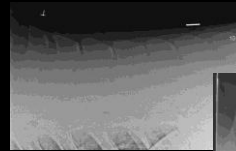
"The dense sensory innervation within the SSL and ISL could explain the severe pain experienced by some horses with impinging dorsal spinous processes."



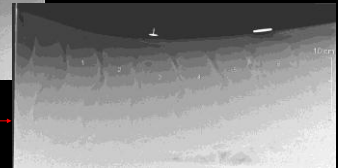
In Vivo *Neurobiology*, 2017, 104, 1022-1031. doi: 10.1111/ivb.12201. Open 2017 Jan 23.
Structure and Innervation of the Equine Supraspinous and Interspinous Ligaments
A. M. Derham¹, J. M. Schumacher², J. M. O'Leary³, G. Kelly³ |
Affiliations: 1. Hospital
PMID: 28224806. DOI: 10.1111/ivb.12201

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When can I use an ISLD?



Here!



NOT HERE!

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REVIEW ARTICLE

Equine Veterinary Journal WILEY

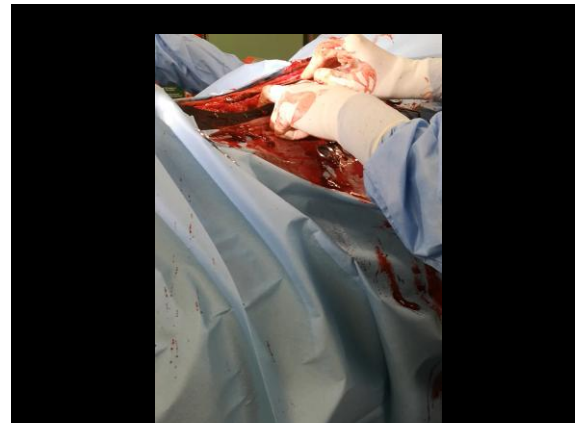
Implications of the neuroanatomy of the equine thoracolumbar vertebral column with regional anaesthesia and complications following desmotomy of the interspinous ligament

Ann M. Derham¹ | Jin Schumacher² | John M. O'Leary³ | Ger Kelly³ |
Caroline N. Hahn⁴

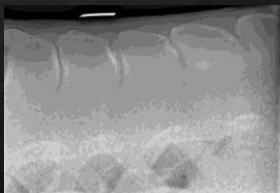
Sept 2020 EVJ

The authors hypothesised that this was because of a more lateral approach than previously described, resulting in the scissors being too far across midline and transecting a nerve in the region.

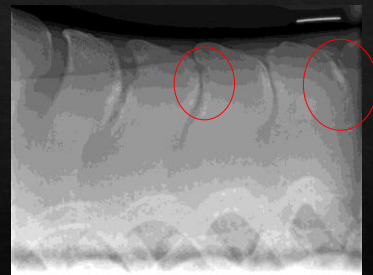
63



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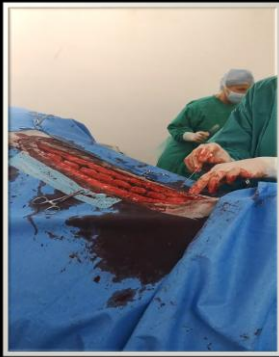


Can one combine subtotal osteotomy and ISLD – performing osteotomy at sites of over-riding spinous processes and ISLD at less affected sites?



65

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67

The bloody bits are over!

68

Needle guidance



69

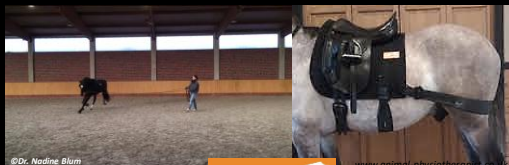
Aftercare

- ❖ 1. two weeks box rest till skin staples removed
- ❖ 2. Two weeks ascending walking exercise
- ❖ 3. Two weeks lunging (+/- Pessoa)
- ❖ 4. Six weeks turnout
- ❖ Check saddle fit before ridden work resumes
- ❖ Physio

70

Rehab: Biomechanics

- ❖ Equiband (Physiotherapeutical Therabands)



©Dr. Nadine Blum



www.animal-physiotherapie.de

Dr. Marc Koene- Tierklinik Lüsche GmbH

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Complications of back surgery

- ◆ 1. Anaesthetic complications
 - ◆ Blood loss
 - ◆ Prolonged recumbency → neuropathy/myopathy
- ◆ Incisional infections

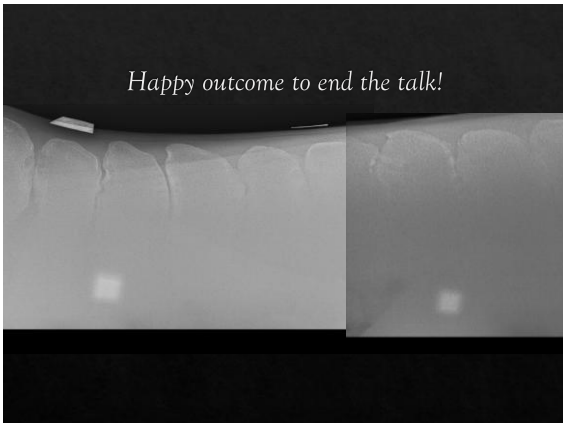


73



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Happy outcome to end the talk!



75



76

Thank you for joining us!



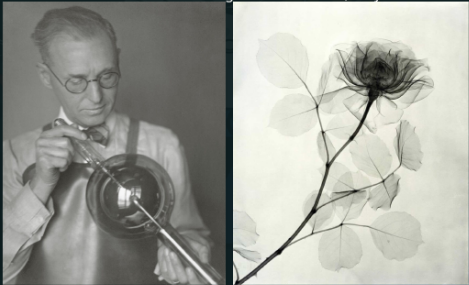
77

2026 VETs with HORSEPOWER
The University of Padova & Padova Zoo

UNBROKEN Kids

Overview of Contrast Radiography in Equine Practice: Making the Invisible Visible

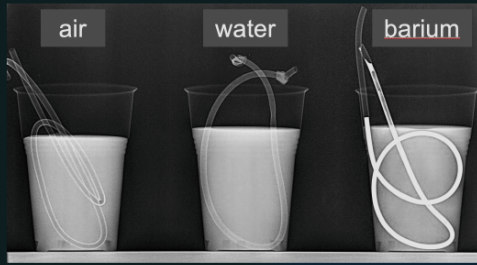
Davide Zani
Department of Veterinary Medicine and Animal Sciences
Università degli Studi di Milano, Italy



"Flowers are the expression of the love life of plants." — Dain L. Tasker

1

Contrast radiography uses radiopaque or radiolucent contrast agents to enhance the visualization of anatomical structures poorly or not visible on plain radiographs.



Positive contrast agents

- Radiopaque (white)
- Iodinated contrast media, barium sulfate

Negative contrast agents

- Radiolucent (black)
- Air, CO₂

Double-contrast studies

- Combination of positive and negative contrast
- Improved delineation of anatomical surfaces

2

Iodinated contrast media

- Water-soluble
- Safe for synovial, vascular and urinary studies
- Used in most procedures presented today



Barium sulfate

- Excellent mucosal coating
- Reserved for selected gastrointestinal studies
- Not indicated for cystography
- Useful as a radiographic marker (e.g., dorsal hoof wall profile)
- Contraindicated when perforation is suspected
- Low cost



In the vast majority of equine contrast studies, iodinated contrast media are the agent of choice.

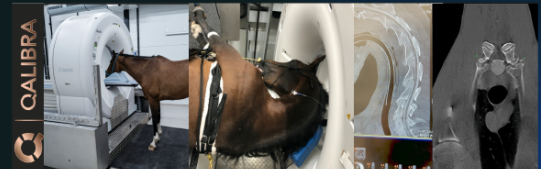
3

In the era of CT and MRI, contrast radiography may appear "vintage"...
...yet it still provides practical and accessible allowing:

1. Assess synovial involvement in cases of trauma and/or wounds
2. Evaluate intrathecal lesions of the DDFT and manica flexoria (tenography)
3. Perform fistulography
4. Assess digital perfusion abnormalities associated with laminitis
5. Demonstrate the presence of keratomas and keratoma-like lesions
6. Delineate esophageal abnormalities (e.g., strictures or diverticula)
7. Identify urine leakage from the urinary bladder and/or urethra in foals
8. Assessment of meconium impaction and intestinal atresia in foals

EASY

To evaluate spinal cord compression (myelography)
Maybe next time... Equine neurodiagnostics is a complex and rapidly evolving field that deserves a dedicated presentation.



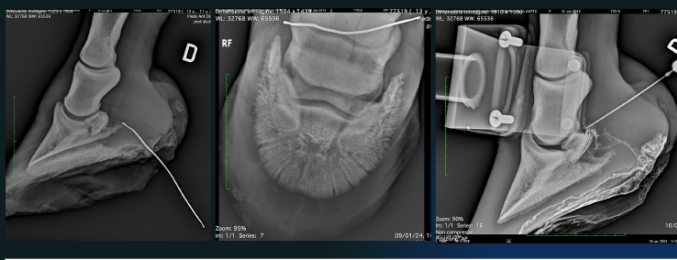
4

1. To assess the synovial involvement in cases of trauma and/or wounds

Data esame: 10 gennaio 2024
Data refertazione: 10 gennaio 2024
Responsabile di referto: Prof. Davide Zani
Specie: Equino Razza: F Sesso: F
Nome Proprietario: Az. Agr. Ranieri Giovanni
Veterinario Referente: Dott. Corbelli
Anamnesi: zoppia 4/5 arti Dx. Pododermite cronica (perforata su tutti gli arti in particolare a scario dell'articolazione distale di caviglia) presenza di un gonfiore superiore a tutto della lussazione laterale del tendine associato a deformazione/funzionalità del giorno laterale. Singola sepsi della borsa del carpo.
Esame effettuato: esame radiografico del piede, bursografia della borsa del navicolare

Chronic hypertrophic pododermatitis of the right forelimb, associated with swelling of the lateral heel bulb and suspected involvement of the foot synovial structures.

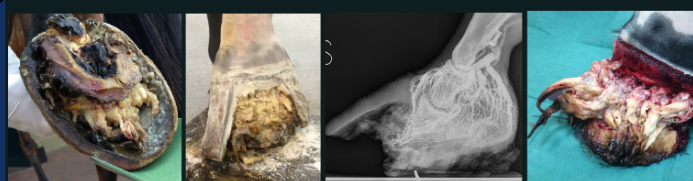
DIPJ sinovial tap
- TP 5.3
- 3200 NC



- Probe radiography → tract identified, synovial involvement not confirmed
- DIPJ synovial fluid analysis → equivocal findings
- Navicular bursa fluid → often insufficient for reliable analysis
- Contrast bursography → definitive confirmation of navicular bursa involvement

5

Not all chronic hoof diseases involve synovial structures, but contrast studies can help define the true extent of the lesion.



Foot Canker (Chronic Hypertrophic Pododermatitis)
4-year-old Standardbred mare with a single foot affected.

- CHP is a rare but severe chronic disease of the equine hoof characterized by abnormal proliferation and degeneration of the horn tissue
- Horses commonly show pain, lameness, and bleeding when the tissue is manipulated
- Usually affects the frog, rarely may extend to adjacent structures
- Etiology is unclear poor hygiene and wet environments are considered predisposing factors. Bovine papillomavirus types 1 and 2 (BPV 1-2) have been proposed as possible contributors to foot canker pathogenesis.

Contrast angiography defined lesion extent beyond what was apparent clinically or radiographically

6

2. Evaluate intrathecal abnormalities of DDFT and MF (Tenography)

BEVA Equine Veterinary Journal

Improved diagnostic criteria for digital flexor tendon sheath pathology using contrast tenography

A. V. KENT*, M. J. CHESWORTH*, E. WELLS*, C. GERDES*, B. M. BLADON*, R. K. W. SMITH* and A. R. FROST-JACKSON*

Article

Comparison of Ultrasonography, Contrast Radiographic Tenography, Cine-Beam Computed Tomographic Tenography, and Tenoscopy for Lesion Detection Within the Digital Flexor Tendon Sheath of Horses—A Prospective Clinical Trial

Camarena B. Supper¹, Christoph Koch^{1,2}, Daniela Schwitzer^{1,3}, Laura Cunha Silva¹, Frederik E. Penedo¹, Michael D. Kleihschmidt¹, Mathieu de Preux¹ and Elise Van der Velde^{1,4}

- Better agreement with **tenoscopy** than ultrasonography
- Practical pre-tenoscopic technique
- Particularly useful for **manica flexoria tears** **92% sensitivity**
- CT tenography showed the highest diagnostic accuracy for DDFT lesions (**83%**)
- Contrast tenography outperformed ultrasonography for DDFT (**72% vs 61%**) and MF lesions (**72% vs 56%**)
- Valuable alternative when CT is unavailable

Tenography improves diagnostic confidence and lesion detection compared with ultrasonography alone and remains a valuable pre-tenoscopic tool.

7

Tenography

How to Inject the Synovial Cavities of the Digit

John Schumacher, DVM, MS, Diplomate ACVIM*; and Ray Wilhite, PhD 2012 / Vol. 58 / AAEP PROCEEDINGS

- 1- Proximal Lateral Pouch Approach** Injection through a palpable lateral synovial pouch in the proximal portion of the sheath.
- 2- Palmar Pastern Approach** Needle inserted between the proximal and distal digital annular ligaments, remaining superficial to the deep digital flexor tendon.
- 3- Distal Axial Sesamoidean Approach** The axial sesamoidean approach is performed between the annular and proximal digital annular ligaments, the needle is inserted in a distal to proximal direction at approximately a 45° angle to the sagittal plane.
- 4- Palmar Axial Sesamoidean Approach** Needle placed axial to the lateral proximal sesamoid bone and directed toward the central intersesamoidean region. Reported 100% accuracy in non-distended sheaths

- Horse sedated
- Aseptic preparation of the distal limb; injection into the distal palmar/plantar recess of the DFTS (2) using a 20G x 38 mm needle (butterfly better).
- Administration of 10 mL of non-ionic iodinated contrast medium (Iohexol 300 mg/mL), diluted in 10mL of saline.
- Passive flexion and extension of the limb to facilitate contrast distribution.
- RX acquisition of a weight-bearing lateromedial (LM)

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Tenography

Manica Flexoria (MF) Tear

- Loss of the 2 parallel MF contrast lines
- MF line does not extend to proximal sesamoid level
- Focal contrast pocket over dorsal DDFT

DDFT Tear

- Thin oblique contrast line extending proximally within the DDFT outline

PAL Constriction

- Uneven contrast distribution through the fetlock canal
- Abnormal palmar/plantar soft tissue contour

Radiographic Quality Requirements

- Adequate intrathecal contrast filling
- Correct exposure and positioning
- Weight-bearing lateromedial projection

Courtesy of Dr. Marcattili – Pool House Equine Hospital

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Tenography

SJ, 7-year-old horse, developed a 2–3/5 right forelimb lameness after competition

- Digital sheath effusion
- Painful palpation of the retropastern region, with a palpable firm elastic mass
- Lameness abolished after intrathecal anesthesia of the digital sheath
- Ultrasound findings: 19 x 7 x 19 mm heterogeneous intrathecal mass, located distal to the proximal digital annular ligament
- Mass adherent to the palmar aspect of the DDFT
- Tenography confirmed a well-defined intrathecal mass with no adhesion to the sheath wall and no additional lesions detected

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Tenography

Treatment

- Surgical excision performed tenoscopically
- Return to (very) high-level athletic activity after surgery

Histopathology

- Bland spindle fibrocytic proliferation within dense collagenous stroma
- Marked fibrovascular component with neovascularization
- Multifocal thrombosis, hemorrhage and vascular necrosis
- Lesion closely associated with damaged/necrotic tendon tissue
- No significant cytologic atypia or evidence of malignancy

Immunohistochemistry

- FVIIIa positive in endothelial cells of proliferating vessels

Interpretation

Histologic findings and clinical behavior were most consistent with: **A benign post-traumatic fibrovascular reparative proliferation** ("pseudotumoral" lesion).

The lesion showed morphologic overlap with **human fibroma of tendon sheath (FTS)**, although the prominent vascular/thrombotic component and tendon association favored a reactive reparative process rather than a true neoplasm that are more consistent with a **traumatic DDFT fibrovascular proliferative lesion**

Fibroma of Tendon Sheath Revisited

In Vivo 25: 613-620 (2013)
doi: 10.1177/107755391350966

Histological features of fibroma of tendon sheath. The tumor is composed of bland spindle cells in a dense collagenous stroma. Slit-like vessels can be seen

- FTS is a distinctive benign fibroblastic/myofibroblastic tumor with a low risk for local recurrence and no metastatic risk.
- Surgery is the mainstay of treatment for FTS, and local recurrence can usually be managed with re-excision.
- The characteristic histological finding of FTS is the presence of slit-like thin-walled vessels or clefts

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3-Fistulography A probe tells us where we can go; contrast tells us where the tract actually goes

Fistulography findings

- Delineated the entire fistulous tract
- Demonstrated a **superficial subcutaneous origin**
- Excluded communication with deeper cervical or pharyngeal structures
- Findings subsequently confirmed by CT

Cytology

- Sebaceous differentiation (sebocytes and basaloid cells)
- DDX: sebaceous cyst, reactive sebaceous proliferation, sebaceoma

Outcome

- Medical management only
- Complete clinical resolution (cleaning drainage and antimicrobial therapy)

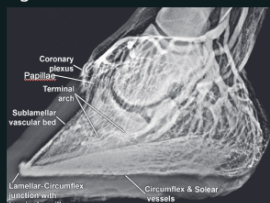
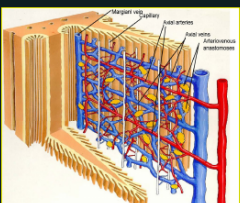
The larger cells with clear/pale cytoplasm are sebocytes (black arrow), while the smaller, more basophilic cells correspond to the basaloid germinative cell population (red arrow).

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4. Assess digital perfusion abnormalities associated with laminitis
Digital venography

Digital venography uses contrast radiography to assess the vascular status of the equine foot.

The technique was developed by Redden and Pollitt in the early 1990s and remains the most practical method for evaluating digital perfusion in standing horses.

Redden RF. The use of venograms as a diagnostic tool. Proc. 7th Bluegrass Laminitis Symp. 1993:1-6.

Courtesy of Prof. C. Pollitt

A simple standing technique that provides unique information on digital blood supply

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4. Assess alterations in digital perfusion associated with laminitis
Digital venography

How to Perform the Digital Venogram

526 2006 / Vol. 52 / AAEP PROCEEDINGS

Amy Rucker, DVM; Ric F. Redden, DVM; Elizabeth G. Arthur, DVM; Shannon K. Reed, DVM; Bradley W. Hill, DVM; Elaine M. Dziuban, DVM; and Daniel C. Renfro, DVM

Veterinary Clinics of North America: Equine Practice
Volume 20, Issue 1, April 2006, Pages 507-517

Equine Venography and Its Clinical Application in North America





Key materials

- 21G butterfly catheter (30.5 cm tubing)
- 2x12 ml syringes with iohexol 300 I/mg + injectable cap
- 1 clamp
- Rubber tourniquet (2.5 x 90 cm), Coesive bandage
- Radiograph blocks, radiopaque dorsal wall marker (barium paste)

Key steps

- Sedation and palmar digital nerve block
- Tourniquet applied at the fetlock
- Place the 21G butterfly into the lateral palmar digital vein
- Rapid injection of non-ionic iodinated contrast medium
- Radiographs obtained within 45 seconds (I-LM, II-DPa, III-Conedown, IV-LM)

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4. Assess alterations in digital perfusion associated with laminitis
Digital venography

Equine Venography and Its Clinical Application in North America

Vet Clin Equine 26 (2010) 167-177
doi:10.1016/j.cveq.2009.12.008
Amy Rucker, DVM

How to Perform the Digital Venogram

526 2006 / Vol. 52 / AAEP PROCEEDINGS

Amy Rucker, DVM; Ric F. Redden, DVM; Elizabeth G. Arthur, DVM; Shannon K. Reed, DVM; Bradley W. Hill, DVM; Elaine M. Dziuban, DVM; and Daniel C. Renfro, DVM



A - Early acute laminitis: Sole papillae compression, Mild vascular distortion
B - Progressive laminitis: Loss of distal perfusion, Coronary plexus distortion
C - Mild chronic laminitis: Coronary plexus compression, Laminar instability ("feathering")
D - Recrudescence chronic laminitis: Severe vascular instability
E - Severe acute laminitis: Marked P3 displacement, Absent solar perfusion
F - Post-treatment: Improved perfusion, Partial vascular restoration

Venography provides functional information that cannot be obtained from standard radiographs alone.

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4. Assess alterations in digital perfusion associated with laminitis
Digital venography
QH, stallion 6yo

6 August 2009
Colic surgery colon displacement

15 August 2009
Obel grade 2, laminitis of both forefeet.
Venography: preserved digital perfusion
Conservative management (palmar-support, FANS...)

28 August 2009
Progression to Obel grade
Bilateral P3 sinking.
Venography: Severe subcoronary perfusion deficits
Bilateral coronary grooving and dorsal toe resection.






Treatment decisions were guided by perfusion deficits rather than radiographic changes alone

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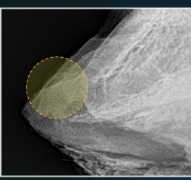
4. Assess alterations in digital perfusion associated with laminitis
Digital venography
QH, stallion 6yo

11 September 2009
Obel grade 4 laminitis Bilateral DDFT tenotomy performed to facilitate P3 derotation

24 September 2009
Clinical improvement (Obel grade 3).

29 September 2009
Relapse to Obel grade 4.

30 September 2009
Bilateral venography revealed severe loss of perfusion at the apex of P3
Concurrent radiographic evidence of early osteolysis of the distal phalanx
Dorsal toe wall resection and «lamellar wedge» ablation


Clinical improvement did not reflect vascular recovery. Venography revealed persistent ischemia of the distal phalanx.

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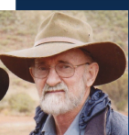
4. Assess alterations in digital perfusion associated with laminitis
Digital venography
QH, stallion 6yo

10 October 2009
Obel grade 4 despite improved digital perfusion. Despite every effort, the horse failed to show meaningful clinical improvement, and the decision was made to humanely euthanize him.



Good morning Davide - I have just viewed the pics and rads. The RF does indeed look bad. The DP is very low in the hoof capsule telling us that lamellar connections at the toe are weak or do not exist. This will never change. The large amount of exposed corium now looks like exuberant granulation tissue that will be difficult to remove without compromising healing of the sole. The rapid lysis of the dorsal margin of the DP will continue and the loss of bone will be exposing the inner contents of the bone and the nerve and vessel trauma is always painful. You may achieve better pain control using Gabapentin but at this stage this will only be palliative. It will give your client time to prepare for the inevitable (and adjust his bank account). The best of surgeons around the world lose horses like this despite world standard care. You have given this horse the best of treatment and every chance but sometimes there are cases where laminitis wins in the end. We have all learned from this case.

Dr. Chris Pollitt



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5-keratomas and keratoma-like lesions
Digital venography – Hoof space-occupying masses

EQUINE VETERINARY EDUCATION
Equine vet Educ. (2022) 34 (10) e431-e437
doi: 10.1111/evve.13523

Neoplasia within the equine foot: A retrospective case series of four horses
C. Osborne^{a,*}, Y. A. Elce^b, L. Meehan^c, A. J. Davern^a and T. B. Lescun^a

What is a keratoma?

- Hyperplastic keratin mass, not a true neoplasm
- Usually originates from the hoof wall, sole, or coronary band
- Associated with chronic inflammation or focal trauma

Why should we be cautious?

- Not every hoof mass is a keratoma
- Differential diagnoses include:
 - Melanoma
 - SCC
 - Fibroma
 - Bone cyst
 - Chronic encapsulated abscess

Why venography?

- Assesses displacement/compression of the vascular bed
- Helps define lesion extent
- Useful when radiographic findings are equivocal
- Complements CT/MRI and guides biopsy planning

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5-keratomas and keratoma-like lesions
Digital venography – Hoof space-occupying masses

Vet Surg. 2011 Aug 40(3):739-14. doi: 10.1111/j.1532-950X.2011.00664.x. Epub 2011 Jul 18.

Computed tomography or magnetic resonance imaging-assisted partial hoof wall resection for keratoma removal.
Getman LM¹, Davidson EJ¹, Ross MW, Leitch M, Richardson DW

VETERINARY SURGERY

Hoof wall masses removal in 30 standing sedated horses: Surgical technique, postoperative complications and long-term outcome
Catherine Ross BVMSc, MRCVS, Jonathan M. White BVMSc, MRCVS, Carl S. Davidson BVMSc, MRCVS, Marka Hübner BScBSc, MRCVS, Richard S. Stephenson BVMSc, CertSB, MRCVS – See all authors –
https://doi.org/10.1111/j.1532-950X.2011.00664.x

While CT and MRI remain the reference techniques for lesion mapping, venography can represent a practical first-line alternative, helping identify space-occupying lesions and guiding further diagnostic or surgical decisions.

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5-keratomas and keratoma-like lesions
Digital venography – Hoof space-occupying masses

Small lesions may be difficult to detect by RX when no clear P3 osteolysis is present

MRI-confirmed keratoma

- Marked lameness despite a very small lesion
- Minimal or equivocal radiographic changes
- No obvious P3 osteolysis
- MRI clearly identified the lesion and its relationship with the lamellar tissues

Venography highlighted focal vascular displacement and facilitated lesion localization

Venography-guided diagnosis

- Small lesion located at the toe region
- Venography demonstrated focal distortion/displacement of the vascular pattern
- Guided surgical exploration and lesion localization

Even small hoof masses may cause severe lameness, and subtle changes in the vascular pattern can sometimes be more informative than conventional radiographs.

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5-keratomas and keratoma-like lesions
Digital venography – Hoof space-occupying masses

Use of venography including the dorsal 60° proximal-palmaro-/plantaro-distal oblique to improve the evaluation of nonlaminitic digital disease of the horse
K. Trolinger-Meadows^a, A. Marlon^{b,c}, T. McCarrel^d, E. Porter^e and V. Dryden^f

Key message

- Standard venographic views were designed for laminitis assessment
- Focal hoof masses may be overlooked on routine projections
- Dorsal 60° conedown view improves visualization of the toe region
- Better identification of vascular displacement associated with keratomas and keratoma-like lesions

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5-keratomas and keratoma-like lesions
Digital venography – Hoof space-occupying masses

Large solear keratoma

- Extensive space-occupying lesion within the toe region
- Conedown projection clearly defined lesion location and extent
- Guided a targeted hoof wall resection
- No excessive removal of healthy lamellar tissue required
- No need for aggressive curettage of granulation tissue
- Histopathology confirmed keratoma

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5-keratomas and keratoma-like lesions
Digital venography – Hoof space-occupying masses

1y later...

2y later... sound at pasture

24

24

5-keratomas and keratoma-like lesions
Digital venography – Hoof space-occupying masses



Chronic solar abscess mimicking a keratoma

- Persistent foot lameness localized to the medial heel region
- MRI identified a small, rounded STIR-hyperintense lesion within the solar corium
- Venography demonstrated a corresponding focal perfusion defect
- No associated distal phalanx osteolysis
- Surgical curettage performed by the referring veterinarian
- Complete resolution of lameness

Differential diagnoses

- Chronic/organized solar abscess
- Solar keratoma
- Keratoma-like lesion
- Focal chronic pododermatitis

Not all focal perfusion defects represent neoplasia. Venography may identify clinically important lesions that range from keratomas to chronic organized solar abscesses, helping direct surgical exploration even when radiographic changes are absent.

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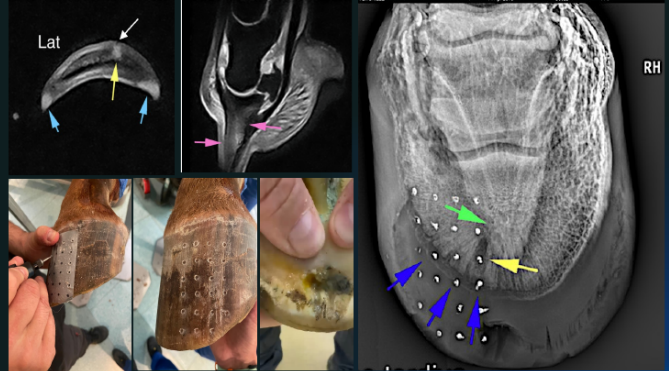
5-keratomas and keratoma-like lesions
Digital venography – Hoof space-occupying masses

Don't let its size fool you.



7-year-old Italian Sport Horse mare

- 4/5 left hindlimb lameness
- Positive abaxial sesamoid nerve block
- Suspected subsolar abscess, previous drainage attempt performed



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6. Delineate esophageal abnormalities (e.g., strictures or diverticula)
Esophagography – Choosing the appropriate contrast agent



BARIUM PASTE

- Use only when organ perforation or rupture is not suspected and there is no risk of aspiration.
- Reconstitute with 20 mL of water per 100 g of powder.
- Administer 100 mL boluses using a 150 mL oral syringe before each radiographic exposure.
- The double-contrast technique provides excellent visualization of mucosal abnormalities. Requires air insufflation through a catheter/tube.

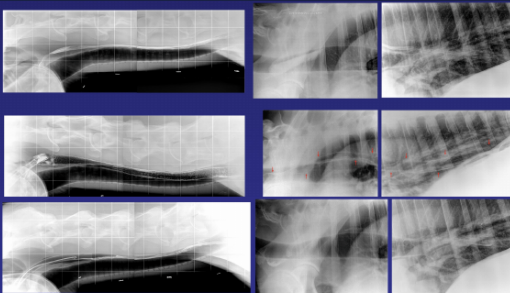
WATER-SOLUBLE CONTRAST AGENT (IOHEXOL)

- Preferred when organ perforation cannot be excluded.
- Provides lower radiographic contrast than barium.
- Safe for use in cases with suspected gastrointestinal leakage or perforation.
- Administration is best performed using an IV giving set (drip set) connected to an esophageal tube/catheter (100 ml bolus).
- Often used as the first-line contrast agent in high-risk patients before considering barium studies.

Barium provides superior mucosal detail, whereas iodinated contrast is preferred whenever perforation or leakage is a concern.

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6. Delineate esophageal abnormalities (e.g., strictures or diverticula)
Esophagography



Barium paste by os

Double contrastography:
Barium paste by os and insufflated air by NG tube

Iohexol (100 mL) administered via esophageal tube using a standard drip set.

Case example

- Horse with recurrent episodes of esophageal obstruction (choke)
- Contrast study demonstrated marked dilation cranial to the thoracic inlet followed by focal luminal stenosis
- A pulsion diverticulum was identified adjacent to the stenotic segment
- Endoscopy confirmed both the diverticular ostium and the esophageal stricture

Barium for detail, iodinated contrast for safety, double contrast for wall definition

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7. Identify urine leakage from the urinary bladder and/or urethra in foals
Cistography

Case Report

Urethral and bladder rupture in a neonatal colt
with urogenital sepsis

Technique

- Urinary catheter: sterile 8–12 Fr Foley
- Contrast medium: water-soluble iodinated contrast agent (Iohexol 300–350 mg I/mL)
- Dilution: 1:1 with sterile saline
- Volume: approximately 5–10 mL/kg or until moderate bladder distension is achieved
- Views: lateral ± VD projections during bladder filling
- Positive finding: contrast extravasation from the bladder or urethra

Courtesy of Equine Reproduction Centre Dott. Livini Zamboni

Contrast cystography may reveal small urinary leaks and provide precise anatomical localization of the defect.

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8. Assessment of meconium impaction and intestinal atresia in foals
Contrast enema

A simple contrast study can distinguish between medical and surgical causes of distal intestinal obstruction in foals.

Technique

- Rectal placement of a Foley catheter
- Administration of barium suspension (or water-soluble contrast if perforation is suspected)
- Gentle retrograde filling of the distal bowel
- Immediate lateral radiographs following contrast administration
- Evaluate contrast progression and identify the site of obstruction

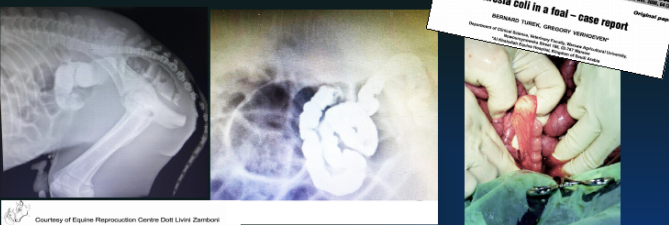
Clinical applications

- Meconium impaction
- Atresia coli / atresia ani
- Distal intestinal obstruction
- Assessment of colonic patency before surgery

Diagnostic Assessment of Foals with Colic
M. Keith Chaffin, DVM, MS and Noah D. Collier PhD, PhD

Atresia coli in the foal: a review of six cases
R. L. YOUNG, R. L. LINFORD and J. CLANES

Atresia coli in a foal – case report
ROBERT TUREK, GREGORY BRIDGEMAN



A simple contrast study can distinguish between medical and surgical causes of distal intestinal obstruction in foals

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VETS WITH HORSEPOWER
14 04/17 2025

DIVAS
Dipartimento di Medicina Veterinaria e Scienze Animali
LA STATALE

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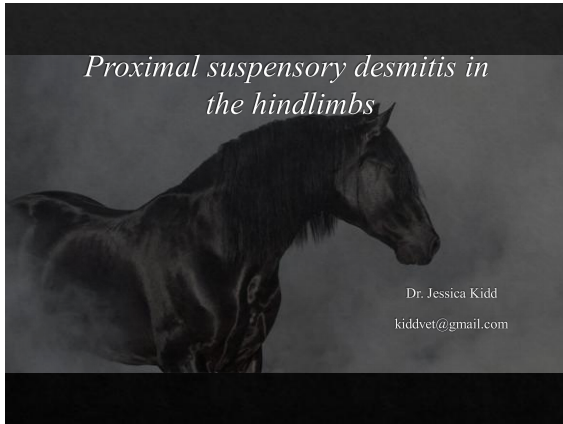
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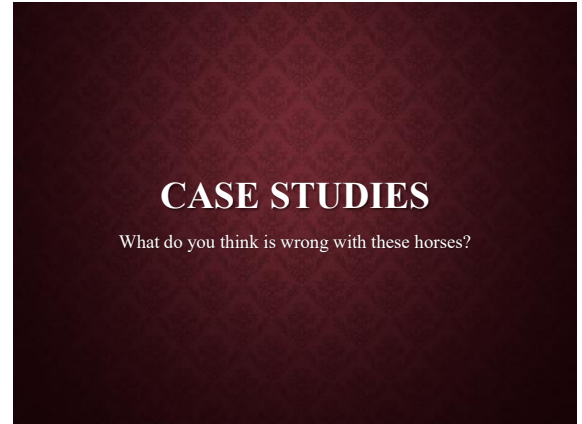


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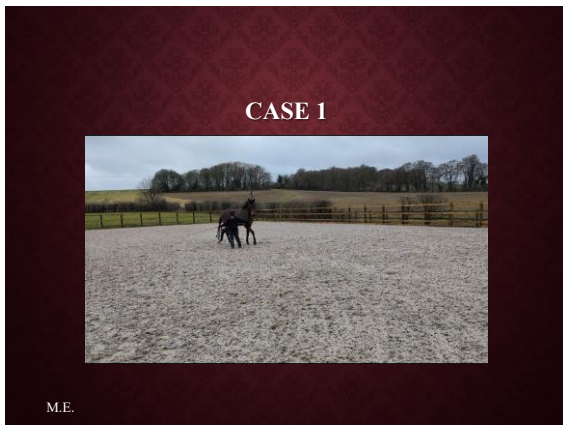
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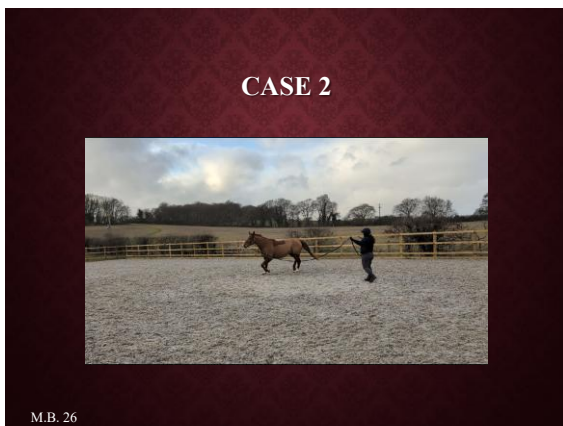
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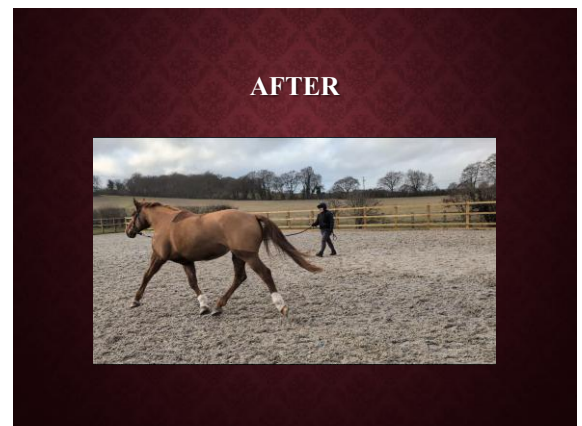
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Before

After

CASE 3

7



Video: Sue Dyson

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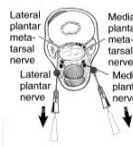
Video: Sue Dyson

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ANATOMY



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CLINICAL PRESENTATION

- Can be a hindlimb lameness or poor performance
 - Lameness may only appear when ridden
 - Poor HLI or difficulty with certain manoeuvres
 - Reluctance to go forward/bolting
- This is generally a condition which does not respond to rest
- These horses can also have secondary pelvic injuries
- bone spavin is main differential

- Generally a repetitive strain injury
- BUT there is a presentation in younger horses who are "low mileage"- these cases don't do as well
 - Genetic component?
- Often respond poorly to treatment



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RISK FACTORS

- Prolonged periods of medium and extended trot
- Dressage
- Straight hocks are a risk factor- but are they cause or effect?
- Lack of varied exercise

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DRESSAGE HORSES

- Repetitious work regime
- Single surface
- Diagonal work
- Overload of hind limbs
- Also, the gait of a dressage horse is scrutinized more and considered more important than in other disciplines.



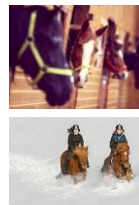
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THE ARENA

Why are more non-dressage horses developing this condition?

Cross training is important

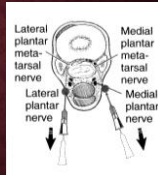
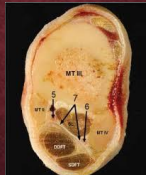
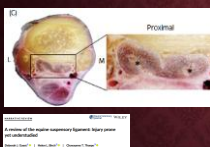
don't over-train on hard, high-traction surfaces



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WHY IS THIS MORE PROBLEMATIC IN HINDLIMBS?

- Compartmental syndrome

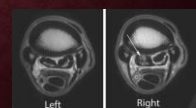


90% of forelimb cases respond to non-surgical management but only about 15% in hindlimbs

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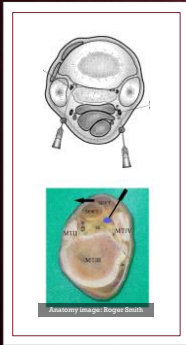
HOW DO WE DIAGNOSE PSD IN THE HINDLIMBS?

1. Note the clinical signs for the specific horse **
2. Blocks
3. Radiography
4. Ultrasonography
5. MRI (Is MRI better?)



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PROXIMAL METATARSAL BLOCKS

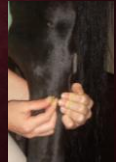


- Deep branch of the lateral plantar nerve block (DBLPN)
 - Replaced the sub tarsal block as it eliminates the risk of entering the tarsometatarsal joint
 - Small risk of entering the tarsal sheath
 - Can diffuse to distal hock
 - Very close to lateral plantar nerve (hence low 6)
- Local analgesia - positive to DBLPN but ideally negative to TMT and low 4/6 pt

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HOW TO PERFORM A DBLPN BLOCK

- deep branch of the lateral plantar nerve
 - Limb semiflexed in farrier's grip
 - 23g 1" needle with 3ml local
 - 1.5 cm distal to the head of the lateral splint bone
 - Displace SDFT axially and insert needle perpendicular to the skin
- Prepare sterily



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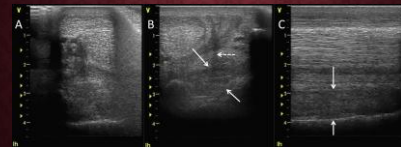
RADIOGRAPHY

Radiography for bone avulsions or change in trabecular pattern

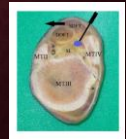


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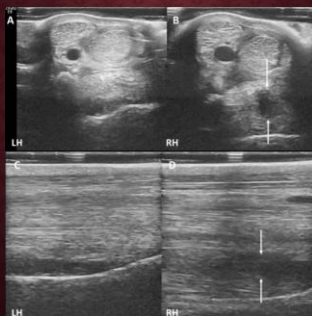
ULTRASONOGRAPHY



- Hindlimb PSL are best imaged on ultrasonography from a plantaro medial aspect.



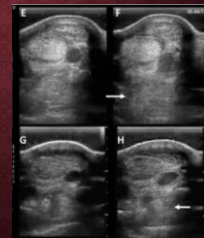
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OFF INCIDENCE SCANNING

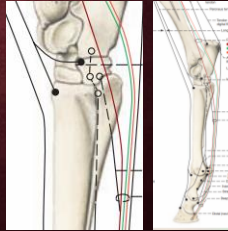
- The PSL has components of fat and muscle
- Off incidence scanning can help determine which is which and allows scar tissue to be visualised
- Adhesions?



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ACCESSORY LIGAMENT OF THE SUSPENSORY LIGAMENT

- Extends proximally from the SL to the calcaneus and T4
- Why some SL cases respond to hock flexion?
- Why some horses have distal hock pain and SL pain?
- Why diagnostic analgesic techniques can be confusing?



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Treatment options: hindlimbs

Rest and controlled exercise: about 15% respond

Which means 85% don't

Shock wave therapy: give a short lived analgesic effect

Intralesional corticosteroids: brief effect

PRP: does not work

Stem cells: does not work

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PLANTAR NEURECTOMY AND FASCIOTOMY

Two part surgery

Three categories of cases:

1. PSD alone: 78%
2. PSD plus another orthopaedic condition: 45%
3. PSD associated with poor conformation: poor outcomes



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POST-OPERATIVE CARE

- Farriery
- Six weeks of walking
- Physio
- Check the saddle
- Avoid deep surfaces and repetitious exercise
- Treat SI region pain if present



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CAN WE PREVENT PSD?



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CAN HORSES HAVE BOTH PSL PAIN AND HOCK PAIN?

- Yes! Minefield!
- Can also develop hock pain post-op



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ASSOCIATED LUMBOSACRAL PAIN

Probably due to compensatory reduction in the range of motion in the pelvis



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LUMBO-SACROILIAC PAIN

- Signs
 - Reduced performance
 - Loss of impulsion, ability to work in an outline, cadence or resistant behaviour
 - Bucking/kicking
 - Often minimal response to PBZ
 - May stand with kyphotic back
 - Clinical signs may only be evident when horse is ridden



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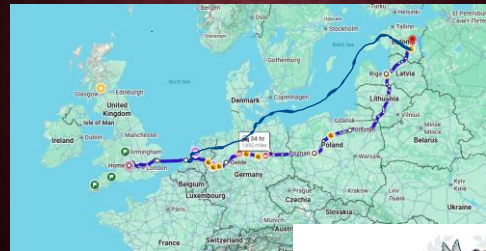
PROGNOSIS

- Younger horses tend to have a worse outlook
- Horses which also have sacroiliac pain don't do as well
- Horses with dropped fetlocks → significant structural damage → NOT surgical candidates
- Hock angles greater than 165 degrees
- Avulsion fractures and associated bone pain?
- Tuber sacrale higher than withers is a risk factor



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Thank you



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