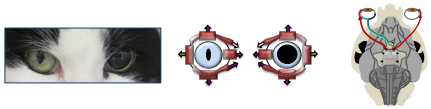
Anisocoria from a neurologist point of view



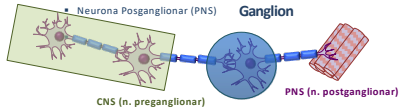
Royal Veterinary College University of London

Elsa Beltran, Ldo Vet, PGDipVet Ed, FHEA, DipECVN
Associate Professor in Veterinary Neurology-Neurosurgery
Royal Veterinary College, University of London

1

What do we know about autonomous innervation of the eye?

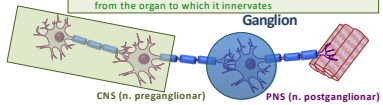
- CENTRAL component and PERIPHERAL component
- Centers in the hypothalamus and brainstem
- EFFERENT Components
  - Preganglionic neuron - CNS cell body
  - Neurona Posganglionar (PNS)



2

What do we know about autonomous innervation of the eye?

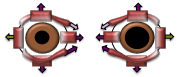
- Componente **EFERENTE**
  - Neurona **Preganglionar** - cuerpo celular CNS
    - **Parasympathetic – "craniosacral system"** – ganglion near the organ to which it innervates
    - **Sympathetic – "thoracolumbar system"** – ganglion away from the organ to which it innervates



3

What are we going to do?

- **Sympathetic** innervation and **parasympathetic** innervation to the eye



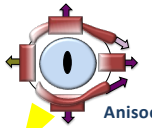
- Clinical Cases

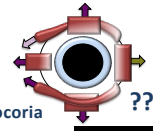
4

Pupillary size and response

parasympathetic

sympathetic

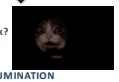




Anisocoria

???

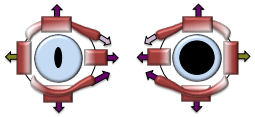
What is the pupil that does not work?



Let's go to the dark room..... RETROILUMINATION

5

Terminology

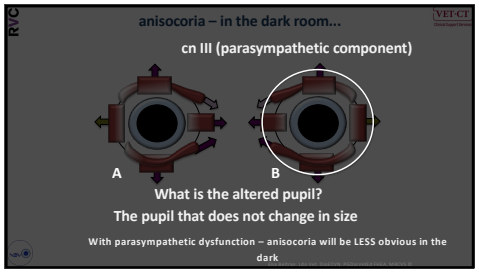


Isocoria (iso-; -cor-; ia)

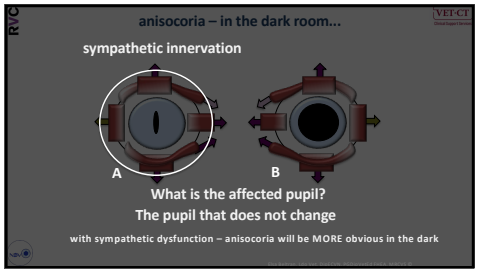
Anisocoria (an-; -iso-; -cor-; ia)

Dyscoria (dys-; -cor-; ia)

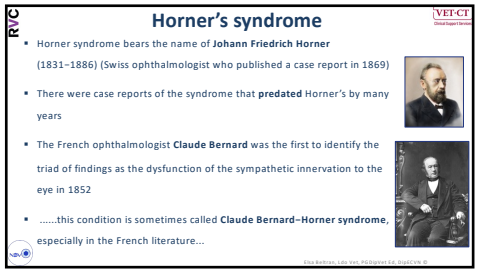
6


RVC
VET-CT
anisocoria – in the dark room...
cn III (parasympathetic component)
A
B
What is the altered pupil?
The pupil that does not change in size
With parasympathetic dysfunction – anisocoria will be LESS obvious in the dark

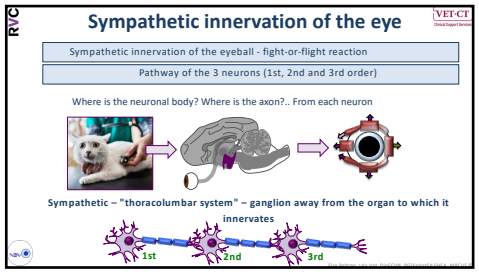
7


RVC
VET-CT
anisocoria – in the dark room...
sympathetic innervation
A
B
What is the affected pupil?
The pupil that does not change
with sympathetic dysfunction – anisocoria will be MORE obvious in the dark

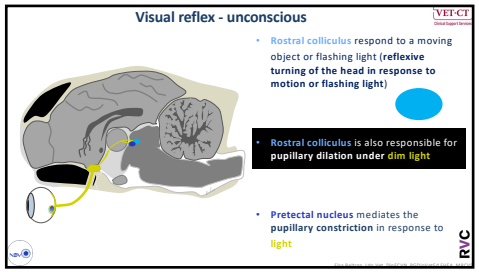
8


RVC
VET-CT
Horner's syndrome
Horner syndrome bears the name of Johann Friedrich Horner (1831–1886) (Swiss ophthalmologist who published a case report in 1869)
There were case reports of the syndrome that predated Horner's by many years
The French ophthalmologist Claude Bernard was the first to identify the triad of findings as the dysfunction of the sympathetic innervation to the eye in 1852
.....this condition is sometimes called Claude Bernard–Horner syndrome, especially in the French literature...

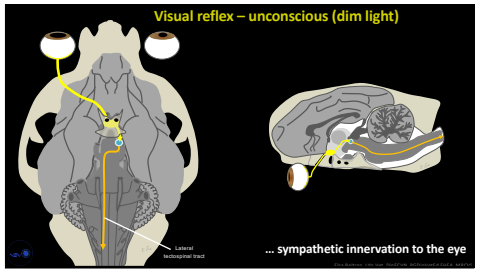
9


Sympathetic innervation of the eye
RVC
VET-CT
Sympathetic innervation of the eyeball - fight-or-flight reaction
Pathway of the 3 neurons (1st, 2nd and 3rd order)
Where is the neuronal body? Where is the axon?.. From each neuron
Sympathetic – "thoracolumbar system" – ganglion away from the organ to which it innervates
1st
2nd
3rd

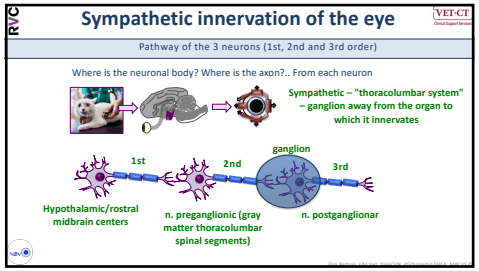
10


Visual reflex - unconscious
VET-CT
Rostral colliculus respond to a moving object or flashing light (reflexive turning of the head in response to motion or flashing light)
Rostral colliculus is also responsible for pupillary dilation under dim light
Pretectal nucleus mediates the pupillary constriction in response to light
RVC

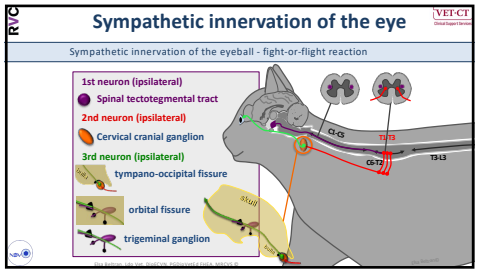
11


Visual reflex – unconscious (dim light)
Lateral tectospinal tract
... sympathetic innervation to the eye

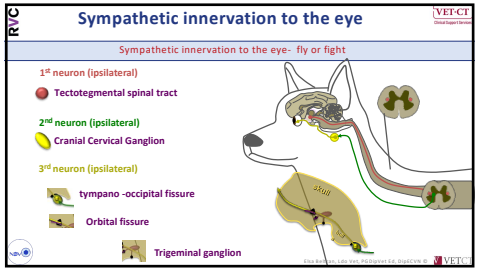
12


RVC
Sympathetic innervation of the eye
VET-CT
Pathway of the 3 neurons (1st, 2nd and 3rd order)
Where is the neuronal body? Where is the axon?.. From each neuron
Sympathetic – "thoracolumbar system" – ganglion away from the organ to which it innervates
1st
2nd
ganglion
3rd
Hypothalamic/rostral midbrain centers
n. preganglionic (gray matter thoracolumbar spinal segments)
n. postganglionar

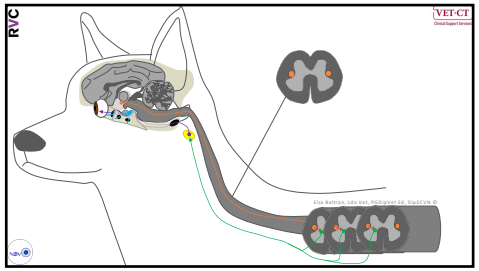
13


RVC
Sympathetic innervation of the eye
VET-CT
Sympathetic innervation of the eyeball - fight-or-flight reaction
1st neuron (ipsilateral)
Spinal tectotegmental tract
2nd neuron (ipsilateral)
Cervical cranial ganglion
3rd neuron (ipsilateral)
tympano-occipital fissure
orbital fissure
trigeminal ganglion
C1-C5
T1-T3
C6-T2
T3-L3
skull

14


RVC
Sympathetic innervation to the eye
VET-CT
Sympathetic innervation to the eye- fly or fight
1st neuron (ipsilateral)
Tectotegmental spinal tract
2nd neuron (ipsilateral)
Cranial Cervical Ganglion
3rd neuron (ipsilateral)
tympano -occipital fissure
Orbital fissure
Trigeminal ganglion
skull

15



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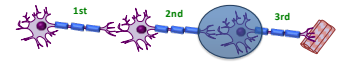
Sympathetic innervation of the eye

Pathway of the 3 neurons (1st, 2nd and 3rd order)



- smooth muscles of the periorbita
- ms Müller (upper and lower periods)

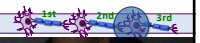
- iris dilator muscle – constriction
- antagonist muscle (iris sphincter muscle) - relaxation

reciprocal innervation

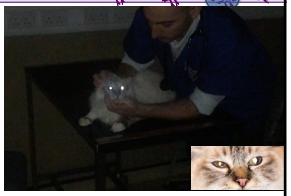
17

Dysfunction of sympathetic innervation

Horner's Syndrome – Clinical Signs



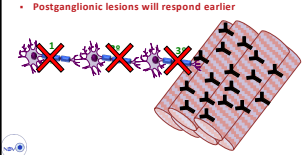
- Miosis
- Protrusion of the 3rd eyelid
- Enophthalmia
- Reduction of palpebral cleft
- Vasodilation (conjunctival hyperemia)
- **Miotic pupil is most noticeable in the dark**

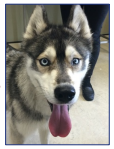


18

Pharmacological test – Horner's syndrome

- Do not use this test as the only way to neurolocalise
- Denervation hypersensitivity – new receptors have to be "created" and this will take 7 to 10 days
- **Postganglionic lesions will respond earlier**





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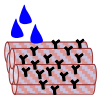
Pharmacological test – Horner's syndrome

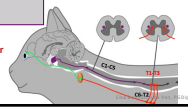
- **Denervation hypersensitivity**
- **Postganglionic lesions respond quicker**

1% Phenylephrine- sympathomimetic

1st order - dilatation 60-90 min
2nd order - dilatation 20-45 min
3rd order - dilatation < 20 min

Never use this test as the sole test for neurolocalisation





20

Dysfunction of the Sympathetic innervation to the eye

1st order Horner's syndrome

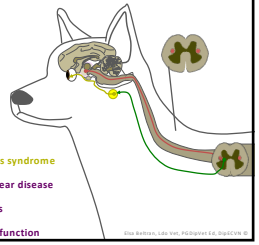
- **intracranial signs**
- **spinal cord dysfunction**

2nd order Horner's syndrome

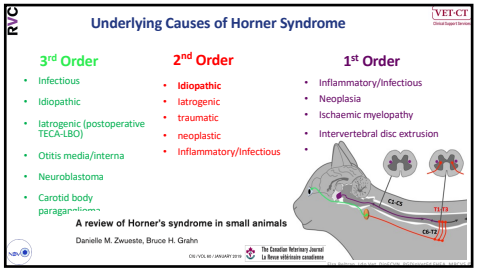
- **brachial plexus**
- **cervical trauma, mass…**

3rd order Horner's syndrome

- **middle/inner ear disease**
- **facial paralysis**
- **vestibular dysfunction**



21


RVC
VET-CT
Underlying Causes of Horner Syndrome
3rd Order
Infectious
Idiopathic
Iatrogenic (postoperative TECA-LBO)
Otitis media/interna
Neuroblastoma
Carotid body
2nd Order
Idiopathic
Iatrogenic
traumatic
neoplastic
Inflammatory/Infectious
1st Order
Inflammatory/Infectious
Neoplasia
Ischaemic myelopathy
Intervertebral disc extrusion
C1-C3
T1-T3
C6-T2
A review of Horner's syndrome in small animals
Danielle M. Zwueste, Bruce H. Grahn

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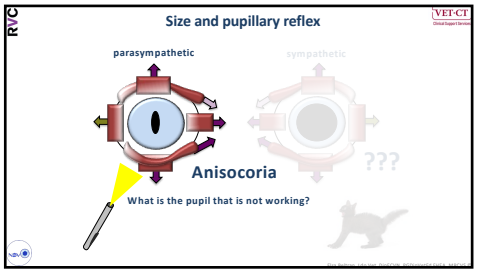
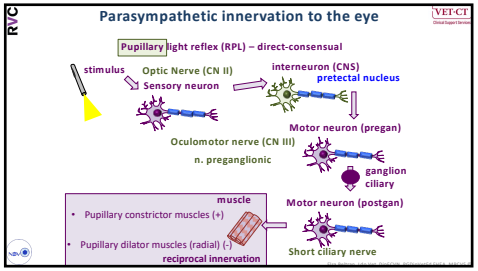

RVC
VET-CT
Size and pupillary reflex
parasympathetic
sympathetic
???
Anisocoria
What is the pupil that is not working?

23


RVC
VET-CT
Parasympathetic innervation to the eye
Pupillary light reflex (RPL) – direct-consensual
stimulus
Optic Nerve (CN II)
Sensory neuron
interneuron (CNS)
pretectal nucleus
Motor neuron (pregan)
Oculomotor nerve (CN III)
n. preganglionic
ganglion ciliary
muscle
Pupillary constrictor muscles (+)
Pupillary dilator muscles (radial) (-)
reciprocal innervation
Motor neuron (postgan)
Short ciliary nerve

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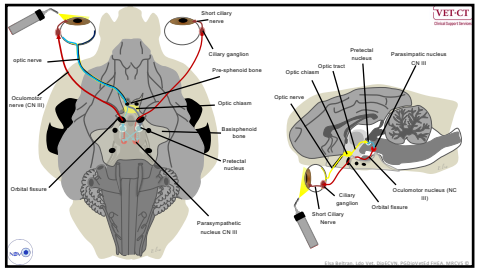
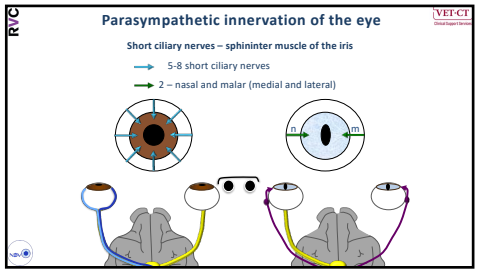
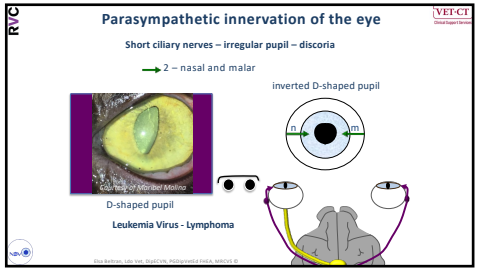

VET-CT
Short ciliary nerve
Ciliary ganglion
optic nerve
Pre-sphenoid bone
Oculomotor nerve (CN III)
Optic chiasm
Basisphenoid bone
Pretectal nucleus
Orbital fissure
Parasympathetic nucleus CN III
Pretectal nucleus
Parasympatic nucleus CN III
Optic chiasm
Optic tract
Optic nerve
Ciliary ganglion
Oculomotor nucleus (NC III)
Orbital fissure
Short Ciliary Nerve

25


RVC
VET-CT
Parasympathetic innervation of the eye
Short ciliary nerves – sphininter muscle of the iris
5-8 short ciliary nerves
2 – nasal and malar (medial and lateral)
n
m

26


RVC
VET-CT
Parasympathetic innervation of the eye
Short ciliary nerves – irregular pupil – discoria
2 – nasal and malar
inverted D-shaped pupil
n
m
Courtesy of Maribel Molina
D-shaped pupil
Leukemia Virus - Lymphoma

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CLINICAL AND MAGNETIC RESONANCE IMAGING FEATURES OF IDIOPATHIC OCULOMOTOR NEUROPATHY IN 14 DOGS

ROSER TETAS PONT, COURTENAY FREEMAN, RUTH DENNIS, CLAUDIA HARTLEY, ELSA BELTRAN

Vet Radiol Ultrasound, Vol. 58, No. 3, 2017, pp 334–343.

- Idiopathic oculomotor neuropathy
- Clinical signs ONLY of oculomotor dysfunction
- MRI only changes in this area
- Good prognosis
- Clinical signs do not progress, and some dogs can improve without any treatment

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CLINICAL AND MAGNETIC RESONANCE IMAGING FEATURES OF IDIOPATHIC OCULOMOTOR NEUROPATHY IN 14 DOGS

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Vet Radiol Ultrasound, Vol. 58, No. 3, 2017, pp 334–343.

Veterinary Ophthalmology (2017) 1–9

Clinical signs, imaging findings, and outcome in twelve cats with internal ophthalmoparesis/ophthalmoplegia

Negar Hamzainpour, Richard Lam, Roser Tetas and Elsa Beltran

Department of Clinical Science and Services, Royal Veterinary College, University of London, Hawkshead Lane, North Mymms AL9 7TA, Hatfield, UK

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Veterinary Ophthalmology (2017) 1–9 DOI:10.1111/vop.12523

Clinical signs, imaging findings, and outcome in twelve cats with internal ophthalmoparesis/ophthalmoplegia

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Department of Clinical Science and Services, Royal Veterinary College, University of London, Hawkshead Lane, North Mymms AL9 7TA, Hatfield, UK

- Ophthalmoparesis/plegia rarely present as the sole clinical signs in cats
- Advanced images might help for the diagnosis
- Abdominal ultrasound could be useful in cats with internal ophthalmoparesis/plegia and systemic signs
- Cats with internal ophthalmoparesis/plegia and other intracranial signs, guarded prognosis

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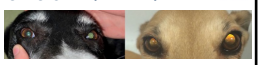
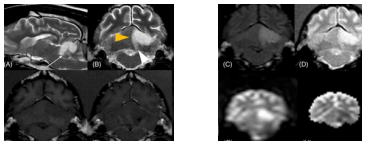
CLINICAL CASE 8 yo, FS, Greyhound



Mydriasis associated with ischemic cerebrovascular infarct affecting the ipsilateral cerebellar interposital nucleus in 2 dogs



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Thank you so much

ebeltran@rvc.ac.uk

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