Comparative Veterinary Ophthalmology

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Topics

- Veterinary ophthalmology
- Unique anatomy
- Vision
- Diagnostics
- Diseases
Veterinary Ophthalmologist

- A veterinarian that specializes in eye diseases
What does a veterinary ophthalmologist do?

- Examine animals with eye problems
- Medical and surgical treatment of disorders of the eye
- Evaluate breeding dogs for inherited eye diseases
  - CERF = Canine Eye Registry Foundation
Species

- Dogs
- Cats
- Horses
- Llamas, alpacas
- Cattle, sheep, goats, pigs
- Exotics
Ocular Anatomy of Critters
- sclera
- iris
- pupil
Eyelids/Nictitating Membrane

- Spread tear film & protect eye
- Lined with conjunctiva
- Nictitans
  - Fan-shaped structure
  - Serves as a “squeegie” to spread tear film
  - Passively elevates when globe retracts
Fibrous Tunic of Globe (Outer shell)

- Cornea
- Sclera
Cornea

- Transparent
- ~ 0.5-1 mm thick
- Functions:
  - Transmit light
  - Focus light
  - Protect internal contents
Cornea Anatomy

- 4 Layers of the Cornea
  - Epithelium
  - Stroma
  - Descemet’s membrane
  - Endothelium
Cornea Stroma

- Will absorb water (and swell) if there is a break in the epithelial or endothelial barriers.
Vascular Tunic - “Uvea”

- Middle tunic of the eye
- Comprised of three regions:
  - Iris
  - Ciliary body
  - Choroid
Iris/Pupil

- Regulates the amount of light entering the posterior portions of the eye

- Opposing muscles
  - Dilator
  - Sphincter
Feline vs Canine Iris

- Feline: pupil is a vertical slit
- Canine: pupil is round
- Color can vary
Lens

- Transparent
- Focuses light onto the retina to form an image
- Changes shape for accommodation (focuses vision)
- Any opacity is a cataract
The Crystalline Lens

Aqueous Humor

Vitreous Humor

Anterior Pole

Epithelium

Capsule

Cortex

Hexagonal Lens fibers (cross section)

Posterior Pole

Equatorial Lens Bow

Embryonic Nucleus

Zonules

Ciliary Processes

Nucleus

Vitreous Humor
Choroid, Retina & Optic Nerve
RETINA

Retinal Pigmented Epithelium

Choriocapillaris

CHOROID
Tapetum

- Most domestic species except:
  - Birds, pigs, camelids, rabbits
- Dorsal, triangular shape
- Reflective to increase vision in dim light
  - Light passes through retina a second time
  - Low light threshold 6X lower than human
  - May reduce resolution
Optic Nerve

- Collection of axons of ganglion cells of the retina
- Axons exit the eye at the optic disc
- Variable appearance between species and breeds
Various Vascular Patterns & Optic Nerve Shapes

- Holangiotic: cat and dog
Various Vascular Patterns

- Merangiotic: rabbit
Various Vascular Patterns

- Paurangiotic: horse
Various Vascular Patterns

- Anangiotic:
- birds
Human
Non-human primate
Canine - Color Dilute
Canine - Albinotic
Feline

Elliptical pupil
Equine

Horizontal oval pupil
Corpora nigra
Llama/Alpaca
Llama/Alpaca
Sheep
Ferret
Guinea Pig
Avian

pecten
Avian Globe - Size

- Often $\geq 50\%$ of cranial volume vs. $\leq 5\%$ in human

- Ostrich
  - Largest globe of land mammals $\sim 50$ mm
  - Dog $\sim 23$ mm
Globe - Size

- Globes so large, nearly touch at midline of skull
- BIG EYES, SMALL BRAIN!!!
Globe - Shape

- Cartilage, bone in sclera - rigidity
- Owls - tubular
- Diving, small raptors, pets - flat
Globe - Position

- Variable

- Raptors: more forward
  - ↑ binoc. vision & acuity

- Pet birds/poultry: more lateral
  - ↓ binoc. vision & acuity
Eyelids/Conjunctiva

- Very thin, delicate
- Few feathers (filoplumes)
Iridal Musculature
Constrictor & Dilator

- Striated muscle
  - Voluntary control
  - Rapid response

- Smooth muscle
  - Involuntary pupil movement
Lens/Accomodation

- Very pliable lens
  - Annular pad
- Large accommodative range
  - Especially raptors
- Brucke’s & Crampton’s muscles
Pecten

- Pleated, pigmented structure over ONH protruding into vitreous

**Functions:**
- Aqueous production
- Thermoregulation
- Navigation
- pH, oxygenation
Optic nerve

- ONH covered by the pecten
Orbit/Extraocular Muscles

- Tight fit of globe/orbit
- EOM thin/poorly developed
- Birds move head, not eyes
Vision Testing in Animals

- Menace reflex
  - Positive at 20/400
- Cottonball tracking
- Visual Placing
- Maze testing
- Retinoscopy for refractive error
- ERG, Pattern ERG
Menace Reflex
Cottonball Test
Visual Placing
Dazzle Reflex
Vision in Dogs

- Wider field of view
  - Less binocular vision
- Most are emmetropic (no refractive error)
- Myopia (near-sighted)
  - Labradors (24%), German Shepherds (53%), Rottweilers (64%), Miniature Poodles, Miniature Schnauzers
Vision in Dogs

- Poorly developed accommodative mechanisms and retina
  - Low #’s ganglion cells
  - Accomodative range only 2-3 diopters
  - Poor visual acuity
    - 7-12 cpd or Snellen 20/50 - 20/95
Rod Dominant Retina

- Excellent motion detection
  - 800-900m moving vs. 585m or less stationary
- Excellent night vision
- Yellow-blue color vision (dichromatic)
Bird’s eye view...

- Excellent visual acuity
- Color vision (tetrachromatic)
- Pattern recognition
- Dim and bright light vision
- Under water accommodation
- High resolving power for detection of motion
Bird’s eye view …

- Visual acuity/ability to resolve differs by species and behavior
- Raptors: can resolve small objects & rapid motion
- Raptor acuity: 2.5X greater than human!
  - Ex: Falcon: high visual acuity during 150 mph swoop
Bird’s eye view...

- Diving birds
  - Ability for high accommodation with sudden change in refractive index under water
- Poultry: lower acuity
  - “Lower visual field myopia”
    - Keep ground in focus during other tasks
- Some birds see UV radiation or polarized light
Retina

- Avascular
- High density of rods and cones
- Well-developed color vision
- Excellent visual acuity
Retina - Fovea

- Cone-rich, rod-free pit
- Dorsotemp. to pecten
- **Functions:**
  - High resolution
  - Binocular fixation
  - Depth perception
  - Color perception
Retina - Fovea

- Most domestic species are afoveate
- Some are monofoveate (owl)
- Some are bifoveate (diurnal raptors, hummingbirds, waterfowl)
Retina - Fovea

- Bifoveate Theory:
  - Temporal fovea for binoc. vision
  - More medial one for monoc. vision
- H/P: area of thinning of retina
Ophthalmic Diagnostic Tests in Animals
Schirmer Tear Testing

Normal STT: dog ≥ 15 mm, cat 0-17 mm, rabbit = 5 mm
Applanation Tonometry

Normal IOP ~ 10-25 mmHg
**No topical anesthetic used

**IOP range in cats 10-31 mmHg
Biomicroscopy/Slit Lamp Exam
Indirect Ophthalmoscopy
Direct Ophthalmoscopy
Culture and Cytology

Moistened culture swab

Kimura cytology spatula
Conjunctival Brush Cytology
Gonioscopy

Normal ICA

Abnormal ICA
Ocular Ultrasonography 20 MHz

Cataract, retinal detachment

Cataract

Retinal detachment
Ocular Ultrasonography 35 MHz

Iridocorneal angle

Ciliary processes
Electroretinography
Electroretinography

2 y.o. Siberian Husky
Fluorescein Angiography
Ocular Diseases in Animals
Cataracts

- Hereditary (dogs > other species)
- Diabetes mellitus (dogs)
- Inflammation
- Developmental/congenital
- Retinal degeneration
- Trauma
- Nutritional

Equine congenital nuclear cataract
Hereditary Cataract

Labrador, Golden retriever, Bichon Frise, Min. Schnauzer, Min. Poodle, Cocker Spaniel, Boston Terrier...
Canine Diabetic Cataract OU

Lens capsule rupture OD; Intumescent cataract OU
Feline Cataract 2° to Bartonellosis/Uveitis
Treatment of Cataracts

- Phacoemulsification
- Implantation of artificial intraocular lens implant
  - 41 Diopter
IOL immediately post-phaco
2 weeks post phacoemulsification + IOL

9 y.o. domestic shorthair cat

10 y.o. mixed breed dog
Lens Capsule Fibrosis/Mineralization
Uveitis = Inflammation inside the eye

- Aqueous humor
  - Flare, hyphema, fibrin

Anterior chamber fibrin, flare

Lipid aqueous flare
Lyme Disease Associated Uveitis
Feline Uveitis/Secondary Cataract
Feline Herpesvirus-1 Keratoconjunctivitis

Fluorescein positive dendritic ulcers
Feline Corneal Sequestration

Corneal sequestration; corneal vascularization

1 hour post keratectomy and conjunctival pedicle graft
Feline Eosinophilic Keratitis
Immune-mediated Keratitis
Corneal Infection

Collagenase ulcer in cat

Collagenase ulcer in horse
Fungal Keratitis

Satellite lesions in a horse

Fungal keratitis in an alpaca
Surgical Treatment of Fungal Keratitis
Penetrating Keratoplasty
Chronic Glaucoma
Retinal Dysplasia
Feline Hypertensive Retinopathy
Intraocular Tumors
Systemic Infectious Disease

Blastomycosis
Developmental/Congenital Anomalies

Persistant hyaloid vasculature in a llama

Optic nerve coloboma in a cria
Congenital Anomalies - Persistent Pupillary Membranes

Canine iris to cornea PPM’s

Feline iris to iris PPM’s
Entropion = inward turning of the eyelids
Ocular Trauma

Cat scratch laceration

2 wks post repair
Ocular Trauma

Globe proptosis

Globe rupture, foreign body
Summary

- Except for birds, visual acuity and color vision are poorly developed
- Significant differences in ocular anatomy, diseases, treatment among species
- Wide range of diagnostic and surgical procedures
- Many diseases are similar to human ophthalmology
  - Animal models for human disease
The End... Questions???