The LENS

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Agenda

- During this session we will discuss the basic clinically important issues concerning the lens.
  - Embryology
  - Anatomy and Physiology
  - Diseases
    - Cataracts
    - Luxation
  - Surgery of the Lens
The lens is an optically clear malleable structure within the eye that functions to further focus incoming light rays clearly on the retina.
Lens Embryology

- First organ to develop in the eye.
- Invagination of surface ectoderm to form the lens vesicle.
- The invagination process results in the former surface epithelium to be facing inward with the basement membrane on the outside.
Lens Anatomy

- Zonules
Lens Anatomy

- Lens Sutures
Lens Anatomy

- Lens Nuclei
Lens Anatomy

- Lens Capsule, Cortex and Nucleus
Lens Physiology

- **Lens Protein**
  - Crystallins $\alpha \beta/\gamma$ (90% of lens proteins) = high refractive index

- **Nutrition**
  - Aqueous / Vitreous / Uvea
  - Glucose is the chief source of energy

- **Glucose Metabolism**
  - Hexokinase

- **Nuclear Sclerosis**
Lens Physiology

- Nuclear (Lenticular) Sclerosis
Lens Function

Accommodation
Common Diseases of the Lens

- **Loss of Accommodation**
  - Aging “Lenticular Sclerosis” and ciliary muscle weakness.
  - ‘After-Cataract’ or Lens Removal Surgery

- **Cataract**
  - Any opacity of the lens or its capsule.

- **Luxation**
  - Lens displacement due to rupture of zonules, lens shrinkage (resorbing cataract) or buphthalmia.
Classification of Cataracts

- **AGE OF ONSET**
- **CAUSE**
- **LOCATION**
- **STAGE**
Age of Onset

- **CONGENITAL** - CATARACTS PRESENT AT BIRTH
- **DEVELOPMENTAL** (JUVENILE) - BIRTH - 6 YEARS
- **SENILE** - GREATER THAN 6 YEARS OF AGE
Cause

- TRAUMA
- INFLAMMATION - UVEITIS
- METABOLIC - DIABETES MELLITUS
- GENETIC - MOST COMMON TYPE IN THE DOG
- NUTRITIONAL - i.e.: MILK REPLACER
Location

- **LENS CAPSULE**
  - ANTERIOR
  - POSTERIOR
  - EQUATORIAL

- **LENS CORTEX**
  - ANTERIOR
  - POSTERIOR
  - EQUATORIAL

- **LENS NUCLEUS**
  - EMBRYONAL
  - FETAL
  - ADULT
Stage

- INCIPIENT
- INCOMPLETE
- COMPLETE
- RESORBING
- INTUMESCENT
- MORGAGNIAN
AN INCIPIENT CATARACT IS A SMALL LENS OPACITY THAT DOES NOT AFFECT THE ANIMALS VISION NOR THE VIEW OF THE COMPLETE FUNDUS BY THE EXAMINER. A DILATED EXAMINATION IS OFTEN TIMES NECESSARY IN ORDER TO MAKE THE DIAGNOSIS.
Incomplete Cataract

INCOMPLETE CATARACTS ARE LARGER THAN INCPIENT BUT SMALLER THAN A COMPLETE OPACIFICATION OF THE LENS. THE OPACITIES PARTIALLY OBSCURE THE VIEW OF THE FUNDUS AND DO NOT USUALLY CAUSE COMPLETE BLINDESS IN THE AFFECTED EYE.
Incomplete Cataract Dog’s Eye View
Complete Cataract

COMPLETE CATARACT IS WHEN THE ENTIRE LENS IS OPACIFIED. THE EYE IS FUNCTIONALLY BLIND AND THE FUNDUS IS NOT VISIBLE WITH AN OPHTHALMOSCOPE.
Dog’s Eye View
Complete Cataract
RESORBING CATARACT IS ONE THAT IS GETTING SMALLER DUE TO LIQUIFACATION OF THE LENS FIBERS AND OFTEN TIMES LENS INDUCED UVEITIS IS OCCURRING AS WELL.
Intumescent Cataract

An intumescent cataract is one that is swollen due to a rapid accumulation of fluid within the lens. Many cataracts go through some degree of intumescence when they reach the complete stage. The classic intumescent cataract is the diabetic cataract.

Aldose reductase activates in Diabetes Mellitus and Sorbitol is produced which is an insoluble by-product that pulls water in lens.
Intumescent Cataract

Aldose reductase activates in Diabetes Mellitus and Sorbitol is produced which is an insoluble by-product that pulls water into the lens.
A Morgagnian cataract is a resorbing cataract with liquefied cortex and the solid nucleus sinks to the bottom.
Therapy of Cataracts

- Medical
  - Dissolution
  - Prevention
  - Palliative
    - mydriasis
  - Anti-inflammatory
- Surgical
  - Phacoemulsification
  - Planned Extracapsular
Lens Luxation

- **Causes**
  - Zonular Rupture
    - Breed Predisposition
      - Terriers
    - Trauma
    - Inflammation
  - Lens Shrinkage
    - Resorbing Lens
    - Micro and/or sphero-phacia
  - Buphthalmia
    - Chronic Glaucoma
Lens Luxation

● Aphakic Crescent
● Iridodenesis
  – quivering of iris = loss of stability of lens
● Change in depth of anterior chamber
  – irregular (shallow and deep
  – shallow
  – deep
Lens Luxation

- **Focal Corneal Edema**
  - secondary to the lens touching the corneal endothelium

- **Generalized Corneal Edema**
  - secondary to the lens filling the anterior chamber and ↑ IOP (secondary glaucoma).
Lens Luxation Therapy

- Accurate Diagnosis
- Immediate referral for lens extraction surgery.
Lens Luxation Complications

- Glaucoma
- Retinal Detachment
- Corneal Endothelial Damage and secondary persistent corneal edema.
- Fellow eye will likely luxate in the future.
Lens Induced Uveitis a.k.a. LIU

Intraocular inflammation secondary to an immune mediated attack on lens protein.

The immune system has an inherent tolerance to lens protein; however, when a cataract begins to resorb, an exceptional amount of lens protein leaks into the aqueous and overwhelms the immune tolerance.

A primary cataract that begins to resorb; or, a chronic uveitis that leads to a resorbing cataract, can confound the primary uveitis with an additional LIU.
Lens Induced Uveitis

You are presented with an 8-year-old female Cocker Spaniel who has had an incomplete cataract in the LEFT EYE diagnosed by you 1 year ago and a recent history of redness to the left with a serous ocular discharge for the past 2 months or so. She has been bumping into things occasionally on her left side.
Lens Induced Uveitis

Your examination revealed:

Menace = Positive OU
PLR = Normal OU
Anisocoria OS smaller than OD
Right eye: Normal
Left eye:
Serous ocular discharge
A few corneal blood vessels and a circum-limbal ciliary flush
No aqueous flare seen
Superficial and deep conjunctival hyperemia to a level of 2+

The ocular media was opaque and a slit beam examination showed that there was mild corneal edema and a deep anterior chamber.

In addition the contour of the iris was flat and the iris was mildly hyperemic and inflamed.
Lens Induced Uveitis

Schirmer Tear Test values were 18 mm/min OU and fluorescein was negative OU.
Intraocular pressure was 18 mm Hg OD and 7 mm Hg OS.
After 1% tropicamide mydriasis, examination of the OD remained normal; but the OS had a complete lens opacity with a wrinkled anterior lens capsule. The fundus was not visible OS.
She has been otherwise healthy and her physical examination today was normal, other than the findings above. A routine CBC, Chemistry Panel and Urinalysis were all normal.

Diagnosis = Lens Induced Uveitis
Lens Induced Uveitis

- **Therapy**
  - Topical Anti-inflammation drugs (can combine)
    - Topical Steroid
      - 0.1% dexamethasone or 1% prednisolone acetate
    - Topical Non-Steroid
      - flurbiprofen
  - Mydriatic - Cycloplegic
    - 1% Atropine or
    - 1% Tropicamide
  - Systemic Anti-inflammation drug (one)
    - Steroid
      - Prednisone
    - OR
    - Non-Steroid (one)
      - Aspirin (dogs and horses)
      - Rimadyl (dogs)
      - flunixin (1x only in dogs; not for cats; 5 - 10 days in horse)
      - phenylbutazone (horses only)