Glaucoma-Induced Blindness

University of Florida
• Aqueous produced in Ciliary Body with carbonic anhydrase enzyme.
• It moves to AC and exits at ICA.
 OPERATIONAL DEFINITION OF GLAUCOMA

- “Elevation of IOP causes RGC and optic nerve damage and results in blindness.”

- At every level of IOP there is a risk of damage, although this increases with increasing IOP.

- Damage can occur with extreme rapidity in dogs!!
  - Sensitivity of the optic nerve to a particular level of IOP may change with time.
Retinal Ganglion Cells

- RGC and their optic nerve axons are the sole connecting link between the retina and the central visual system.
- Little functional redundancy.
- The optic nerve is a vulnerable area of the visual system due to the concentration of RGC axons into a single nerve.
Canine Glaucomas

- Over 42 breeds affected. Up to 5.5% affected.
- Canine glaucoma appears to exist as a group of glaucoma subtypes (breeds) based on factors other than IOP level.
- All of these diseases are associated with increased IOP.
  - May be associated with elevated myocilin levels in the aqueous and TM
  - Myocilin is elevated prior to increased IOP.
- The ocular circulation may also be inherently abnormal in some breeds.
- All glaucomas are secondary to some cause. Primary glaucoma has a bilateral potential.
■ Classic clinical signs
  – a. Increased IOP
  – b. Mydriasis- fixed and dilated pupil.
  – This may be the only early sign in cats or Chows with glaucoma
  – c. Corneal edema
  – d. Engorged and congested episcleral vessels
  – e. Ocular pain
  – f. Vision loss and blindness
Chronic clinical signs
a. Buphthalmia
b. Visual deficits
c. Striate keratopathy (Haab's Striae)
d. Lens subluxation or luxation
e. Cupping of the optic disc
f. Retinal degeneration
Equine Glaucoma: Apps and Warmbloods
Recognition

Which of these have glaucoma?
Recognition of Glaucoma

Which of these has glaucoma?
SPCA infarct
Which of these has glaucoma?
POAG in Beagles

1 year

5 years

8 years

11 years
“Cupping”
NFA indicates NFL loss
NFL can be decreased by 33% and still have vision
Pressures of the Posterior Segment

- IOP 12-18 mmHg
- Arterial Pressure ~70-80 mmHg
- Venous Pressure ~30-40 mmHg
- Translaminar Tissue Pressure 3.1± 0.3 mmHg/100µm
- Retrolaminar Tissue Pressure 7 mmHg
- Optic Nerve Subarachnoid Spinal Pressure ~0-10 mmHg
TONOMETRY

- The normal canine and feline IOP is 15 to 25 mm Hg.

- It is possible to crudely evaluate IOP digitally if the IOP is very high or low, but this is not satisfactory to evaluate clinical response to therapy.
- Single time-point IOP measurement cannot be used by itself as a determinant of whether glaucoma is or is not present,
- or whether optic nerve damage will occur or progress in humans or dogs.
– The Schiotz indentation tonometer.
– The human Schiotz table is accurate for the dog.
Applanation tonometers - TonoPen: work by flattening small area of cornea with known force.
Gonioscopy

Dogs with narrow angles seem to be at risk of glaucoma.

Angles narrow and close in dogs.
Narrow angles are involved in the pathogenesis of some types of canine glaucoma.

Dogs with glaucoma are more closely related to dogs with narrow angles.
The iridocorneal angle gradually closes in most types of glaucoma and the initially effective treatment becomes inadequate.

Surgery is the only option available when vision continues to diminish in spite of maximum medical therapy.
Feline Glaucomas

- POAG in Siamese and Burmese
- Secondary glaucomas from uveitis and tumors are most common.
Treatment or Cure?

- Treatment is not more than a tradition based on obsolete ideas with little justification by any positive effect.
- Prophylactic therapy with IOP reducing drugs can delay the onset of IOP elevation from 8 to 30 months!
- There is presently no cure for the glaucomas. To treat the optic nerve damage in the glaucomas we would have to reverse the visual field defects.
This is the Key!!

- How do we protect the remaining sighted eye in a dog that has already lost one eye to glaucoma?
- The one-eyed dog!!
Glaucoma Therapy

- The objectives of therapy:
- (1) increase aqueous outflow
- (2) decrease aqueous production
- (3) preventing or delaying glaucoma in the other eye.
Maximum Medical Therapy
Classes: six beta blockers, 3 miotics, 4 systemic or topical CAIs, two alpha-2 agonists, and four PGs.

With three drugs at one time, there are 60 possible combinations of these five glaucoma drug classes.

If you switch treatment every four weeks it would take five years to use all the possible combinations!!
“Is 30 or 20 mmHg a Safe IOP?”

- In an eye which has suffered a glaucomatous attack 30 mmHg is too high.
- It may be a reasonable goal for pain relief.
- Lowering the IOP to less than normal levels may be most protective of the ONH.
Hyperosmotics (acute glaucoma)
- a. 20% mannitol: 1 to 2 gm/kg IV; repeat in 6 hours if necessary
- b. 50% glycerol: 1 to 2 ml/kg PO; repeat in 8 hours if necessary
- c. TOPICAL Latanoprost (PG)
Parasympathomimetics (topical)

- a. 1 to 2% pilocarpine every 6 hours
- b. 0.125 to 0.25% demecarium bromide: BID
- c. 0.125 to 0.25% echothiophate iodide: BID
- **Beta-adrenergic antagonists** (topical)
  - a. 0.5% timolol maleate: BID
  - b. 0.25% betaxolol: BID
- **Topical CAIs**
  - a. Dorzolamide (2% Trusopt): TID
  - b. Brinzolamide (1% Azopt): BID

- **Topical Prostaglandins**
  - a. Uniprostone (0.12%, Rescula): TID
  - b. Latanoprost (0.005%, Xalatan): BID
  - c. Travoprost (0.004%, Travatan): BID or SID in the pm
  - d. Bimatoprost (0.03%, Lumigan): SID

- **Calcium Channel Blockers**
  - Norvasc, amlodipine. 0.625 mg/10 lbs PO SID
Carbonic-anhydrase inhibitors (oral)
- a. Acetazolamide (Diamox, Lederle): 10 to 25 mg/kg divided TID
- b. Dichlorphenamide (Daranide, Merck): 2 to 3 mg/kg TID (GONE)
- c. Methazolamide (Neptazane, Lederle): 5 mg/kg divided TID
- **Alpha-2 agonists**
  - Apraclonidine 0.5% BID
  - Brimonidine 0.2% TID, (Alphagan): neuroprotective as well
- **Glutamate Inhibitors:** Namenda (Memantine) 1 mg/lb PO twice a week
- **NOS Inhibitors**
- **Oxygen-free radical scavengers**
- **Systemic corticosteroids**
- **Neuropeptides- very soon!!!**
Surgical Therapy

- Cyclodestructive procedures- lasers, cryodestruction
- Fistulization procedures- shunts
- Ciliary Body Ablation- cheap but effective??
- Intraocular Prosthesis- for the owner
- Enucleation- removes source of pain
Cook et al, 1997:
- 5.6% visual at 1 year with diode laser.

Garcia et al, 1998:
- 18% visual at 1 year with Ahmad valves.