The Glaucomas of Dogs and Cats
July 18th 2009
Richard R Dubielzig
Definition of Glaucoma

Intraocular pressure too high for the normal functioning of the retina and optic nerve head
Selected Canine Glaucoma Diseases

- Goniodysgenesis (Primary Glaucoma)
- Thin-walled Iridociliary Cysts (Pigmentary Uveitis)
- Melanosis
Canine Primary Glaucoma

Synonyms

• Goniodysgenesis
• Pectinate ligament dysplasia
• Mesodermal dysgenesis
• Open-angle closed-cleft glaucoma (Peiffer)
• Acute angle-closure glaucoma (Miller)
What is Goniodysgenesis?

- The normal Canine Iridocorneal Angle and the Drainage System
- Goniodysgenesis: A solid sheet of iris-like uveal tissue extending from the iris base to the distorted terminus of Descemet’s membrane
Primary Glaucoma in Dogs

- 28% of Cocker Spaniels in the COPLOW collection are affected
- 35% of Bassett Hounds
- 62% Female

Goniodysgenesis N=1428
Total COPLOW Canine N=17,436
The Normal Canine Iridocorneal Angle
Goniodygenesis
Normal
Pressure

Normotensive Basset Hound with Goniodygenesis
Goniodysgenesis with Glaucoma
Why Do Dogs With Goniodysgenesis Get Glaucoma?

- Only a small % of dogs with goniodysgenesis will develop glaucoma.
- More extensive goniodysgenisis increases the risk of glaucoma during the life of the dog.


- Once the first eye has glaucoma, the second eye is very likely to develop disease.
- But, but, but: These facts do not contribute much to answer the question.
Faulty Thinking?

• The obvious mechanism to explain the development of glaucoma in goniodysgenesis has been a gradual closure of the iridocorneal angle, because of progressive growth of the angle abnormality.
  – This has never been demonstrated!
What is Canine Primary Glaucoma?

- Sudden onset of painful, red, often blind eye with very high pressures
- The response to treatment is variable, but severe cases are blind from the start
- Very poor success rate with any treatment protocols tried
- Females affected more than males
- Enucleation is a common outcome
  - When dealing with the second eye, enucleation is often chosen very early (24 hours from the first signs of disease)
Human Primary Angle Closure Glaucoma as a Potential Model for Canine Primary Glaucoma

- Affects Eskimos and Asians with greater frequency
- Hyperopic eyes, smaller eyes
- Large lens
- Shallow anterior chamber
- Women affected 3x more than men
- Pathophysiology
  - Contact of the pupillary margins with the lens (pupillary block)
  - Pressure gradient between the anterior and posterior chambers
  - Forward bowing of the peripheral iris closes the angle
  - Treated successfully by laser iridotomy
The Relationship of Canine Primary Glaucoma to Pupillary Block

Thanks to Dr Paul Miller
Miosis and the Iris Profile

A
Before Latanoprost

B
After Latanoprost
What can pathology say about the early changes leading to outflow obstruction in canine primary glaucoma?

- Evidence supports the idea that the pupillary margins of the iris rub against the lens
- Evidence that pigment dispersion may play a role
- Acute inflammation is seen in the iridocorneal angle and the limbus soon after the start of clinical signs
- Evidence of gradual atrophy of the corneoscleral trabecular meshwork
Evidence of Pupillary Iris Rubbing against the Lens Leading to Pigment Dispersion and Evidence of Acute Inflammation Playing a Role in the Iridocorneal Angle and the Limbus

Work done by Chris Reilly
Pigment Dispersion

Upper Angle

Lower Angle
30 hour Glaucoma
Suppurative Inflammation
Pigment Dispersion in Primary Glaucoma

- Distinguish superior from inferior angle by pigment alone
  - 1 to 3 Days: 92%
  - 4 to 7 Days: 95%
  - Chronic: 79%

- Cells Stripped from Iris
  - 1 to 3 Days: 43%
  - 4 to 7 Days: 75%
  - Chronic: 55%

- Pigmented Cells in the Angle
  - 1 to 3 Days: 64%
  - 4 to 7 Days: 95%
  - Chronic: 50%
Neutrophilic Inflammation

- 1 to 3 Days: 86%
- 4 to 7 Days: 50%
- Chronic: 15%
Evidence of gradual atrophy of the corneoscleral trabecular meshwork

Cocker Spaniel: Normotensive Goniodysgenesis

One Day Trabecular Meshwork Atrophied
What can pathology say about the progression of neuroretinal disease in glaucoma?

Retinal and optic nerve degeneration in canine primary glaucoma occurs rapidly after the onset of clinical signs and progresses according to a regular schedule.
Effects of Canine Primary Glaucoma on the Optic Nerve and the Retina

Two day glaucoma, Canine
Early and Later Optic Nerve and Retina

Kerry Ketring images
The Retina in Primary Glaucoma

One Day Glaucoma
“Red Dead” Ganglion Cells
Ganglion Cell Counts

- Controls: N=10
- Pre-Glaucoma: N=2
- 1 Day: N=5
- 2 Day: N=7
- 3 Day: N=5
- 4-5 Days: N=7
- 7 Days: N=7

Legend:
- GC Up
- GC Down
“Red Dead” Ganglion Cells

Read/Dead GC

Controls N=10  Pre-Glaucoma N=2
1 Day N= 5  2 Day N= 7  3 Day N= 5  4-5 Days N= 7
Retinal Thickness

![Graph showing retinal thickness measurements over time for different conditions: Controls, Pre-Glaucoma, 1 Day, 2 Day, 3 Day, 4-5 Days, and 7 Days. The graph compares Superior Retina (blue) and Inferior Retina (red) thickness values.](image-url)
Retinal CD 18+ Phagocytes
Retinal MHC2+ Phagocytes
2 to 4 day Glaucoma (Canine)

Four Day Glaucoma
2 to 4 day Glaucoma
TUNEL+ not seen before day 2/3
2 to 4 day Glaucoma
The Optic Nerve in Primary Glaucoma

30 hour Glaucoma
3 day Glaucoma
Optic Nerve 2 to 4 Days
4 day Optic Nerve Head
Phagocytosis/Malacia
5 day Canine Glaucoma
5 day Canine Glaucoma
Chronic Glaucoma
Optic Nerve CD18+ Phagocytes
CD18 on 4-5 day Glaucoma Optic Nerve
Optic Nerve MHC2+ Phagocytes
Schnabel's Cavernous Optic Atrophy
Pre-Glaucoma: The Second Eye

The Up Side

The Down Side
The Second Eye

Atrophy of the Corneoscleral Trabecular Meshwork
A New Paradigm in the Pathogenesis of Canine Primary Glaucoma associated with Goniodysgenesis:

1. The angle abnormality, along with growth of the lens, causes contact between the lens capsule and the pupillary margin of the iris.

2. Pigment epithelial cells rub off the pupillary margin of the iris.

3. Pigment in the angle causes atrophy/necrosis of trabecular-lining cells in the corneoscleral trabecular meshwork.
A New Paradigm, continued

4. This leads to increased pressure in the anterior chamber, pushing the iris against the lens.

5. Now there is a vicious cycle, which leads to an explosive pressure rise that stops perfusion of the optic nerve and retina.
The Canine Glaucoma Diseases

- Goniodysgenesis (Primary Glaucoma)
- Thin-walled Iridociliary Cysts (Pigmentary Uveitis)
- Melanosis

Thin-walled Iridociliary Cysts (Pigmentary uveitis)

- 108 cases in Golden Retriever dogs
- Clinically considered inflammatory
- Histologic features
  - Thin-walled cysts
  - Posterior synechia
  - Retrocorneal membrane
  - PIFM
  - Minimal inflammation
  - Pigmented cyst fragments
  - Pigment dispersion
Thin-walled Cysts in Golden Retriever
Thin-walled Cysts
Thin-walled Cysts (Pigmentary Uveitis)
Epithelial Cyst Walls
The Canine Glaucoma Diseases

- Goniodysgenesis (Primary Glaucoma)
- Thin-walled Iridociliary Cysts (Pigmentary Uveitis)
- Melanosis

Canine Ocular Melanosis
Ocular Melanosis
Canine Ocular Melanosis
195 Cases

- Cairn Terrier…48
- Labrador retriever…26
- Boxer…19
- Golden Retriever…. 9
- Boston Terrier …8
- Dachshund….6
Ocular Melanosis
Ocular Melanosis
Selected Glaucoma Diseases in Cats

- Lymphoplasmacytic Uveitis
- Angle Recession (Contusion)
- Aqueous Misdirect Syndrome
- Open Angle Glaucoma
Feline Lymphoplasmacytic Uveitis
Feline Lymphoplasmacytic Uveitis
Feline Lymphoplasmacytic Uveitis
Select Glaucoma Diseases in Cats

- Lymphoplasmacytic Uveitis
- Angle Recession (Contusion)
- Aqueous Misdirect Syndrome
- Open Angle Glaucoma
Angle Recession
Angle Recession
Normal Feline Iridocorneal Angle
Angle Recession Canine
Mechanism of Angle Recession

Cornea and lens displaced posteriorly

Cornea recovers

Lens still displaced

Angle tears

Angle Recession
Select Glaucoma Diseases in Cats

- Lymphoplasmacytic Uveitis
- Angle Recession (Contusion)
- **Aqueous Misdirect Syndrome**
- Open Angle Glaucoma

Aqueous Mis-direct Syndrome
Aqueous Mis-direct Syndrome
Select Glaucoma Diseases in Cats

• Lymphoplasmacytic Uveitis
• Angle Recession (Contusion)
• Aqueous Misdirect Syndrome
• **Open Angle Glaucoma**

Feline Open Angle Glaucoma
12 cases