What is Really Going on in Glaucoma?

25 years of experience

Richard R Dubielzig
Canine Primary Glaucoma

- Goniodysgenesis
- Pectinate ligament dysplasia
- Mesodermal dysgenesis
- Open-angle, closed-cleft glaucoma (Peiffer)
- Acute angle-closure glaucoma (Miller)
- Who knows what else
Primary Glaucoma in Dogs

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

Dr Kerry Ketring
The Normal Canine Angle

Primary Pectinate Ligament
The Normal Canine Angle

Ciliary Cleft

Corneoscleral Trabecular Meshwork
Goniodysgenesis
Normal Pressure

Normotensive Basset Hound with Goniodysgenesis

Dr Kerry Ketting
What is Canine Primary Glaucoma?

• Sudden onset of painful, red, often blind eye with very high pressures
  – In this study the time of disease is measured from when the owner first notices a painful red eye (Hour 0)
• The response to treatment is variable, but severe cases are blind from the start

• 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)
Pigment Dispersion
and
Neutrophilic Inflammation

Chris Reilly
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%
Pigment Dispersion

Upper Angle

Lower Angle
Early Changes in the Iridocorneal Angle

30 hour Glaucoma

Neutrophils and Spindle Cell Proliferation
Evidence of Gradual Atrophy of the Corneoscleral Trabecular Meshwork
Pre-Glaucoma: The Second Eye

The Up Side

The Down Side
The Second Eye
Atrophy of the trabecular meshwork

Up

Down
Case Study

34 hour glaucoma

5 year-old spayed Laborador
Case Study

34 hour glaucoma
5 year-old spayed Laborador

Radiating bands of retinal necrosis
Case Study
34 hour glaucoma

Goniodygenesis
Case Study
34 hour glaucoma
Case Study
34 hour glaucoma

“Red-Dead” Ganglion Cells
Effects of Primary Glaucoma on the Optic Nerve and the Retina

Two Day Glaucoma, Canine

24 Hour Glaucoma, Canine
30 hour Glaucoma
Optic Nerve 2 to 4 Days

Necrosis of the neuropil
Three day Glaucoma
4 Day Optic Nerve Head
Phagocytosis/Malacia
Five day Canine Glaucoma

Stained for phagocytes
5 day Canine Glaucoma

Gitter cell macrophages
By seven days the optic nerve head is end-stage with deep cupping and gliosis
Schnabel's cavernous optic atrophy

Entrapped vitreous
Early Progression of Retinal Disease

Kerry Ketring images
2 to 4 Day Glaucoma (Canine)

Four Day Glaucoma
2 to 4 Day Glaucoma (Canine)

Sampled for Histopathology

Four Day Glaucoma
One Day Glaucoma
Red-Dead Ganglion Cells
Proptosis, 3 days

Glaucoma 2 Days after Laser Ablation of Melanocytoma
Electronmicrograph of 4-Day Glaucoma Apoptosis
Buphthalmos
Scleral Thickness

4 Day Glaucoma

7 Day Glaucoma

Normal Canine
Buphthalmos
Scleral Thickness

4 Day Glaucoma

Normal Canine

7 Day Glaucoma
Average Ganglion Cell Counts

This count includes “Red Dead” cells
“Red Dead” Ganglion Cells

Average number of Red/Dead GC

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Average Retinal Thickness, $\mu$
Average Scleral Thickness, $\mu$
Phagocytes in the Retina and Optic Nerve

![Graph showing phagocytes in different conditions](image)
Retinal MHC-2 Phagocytes
Optic Nerve MHC-2 Phagocytes
MHC-2 on 4-5 Day Glaucoma Optic Nerve
Suggested Timeline
Before the Owner Detects Pain

1. Young normotensive dog with goniodysgenesis
   a) Ciliary cleft open at first
2. Gradual loss of ganglion cells
   a) Likely bouts of pressure spikes
   b) Pigment dispersion?
3. Gradual atrophy of the corneoscleral trabecular meshwork
4. Collapse of the ciliary cleft
   a) Detected with ultrasound biomicroscopy
Suggested Timeline
After the Owner Detects Pain

1. Sudden painful crisis
   a) Pathology suggests an event 2-3 days before owner detects
2. Stepwise rapid necrosis of the optic nerve and retina
   a) Neutrophils, dead ganglion cells, apoptosis, and finally phagocytosis
3. The second eye progresses through the same cycle