GLAUCOMA AND BOUVIERS

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GLAUCOMA: A diverse group of diseases united only by the fact that IOP is too high for the optic nerve to work properly and some or all of the dog’s vision is lost
Intraocular Pressure

What flows in = What flows out
Causes

Outflow is #1 Problem

“Primary”  No obvious association with another ocular or systemic disorder – both eyes, genetic
  Open angle – open/closed cleft
  Closed angle – open/closed cleft

“Secondary”  Another ocular or systemic disorder is present one or both eyes, +/- genetic
  Lens associated
  Inflammatory
  Blood
  Tumors
  Others
How do we look at the outflow path?

“Open” angle

“Closed” angle
New ways of looking at the outflow: The cleft

Open

Closed ciliary cleft
Glaucoma overview:
Primary Open Angle Glaucoma

IOP (mm Hg)
TIME (Months)
Glaucoma overview:
Primary Angle Closure Glaucoma

- Marked IOP↑
- Pain
- Red eye/Hazy cornea
- Fixed semi-dilated pupil
- Rapid vision loss
PACG Risk Factors

- Mid/older age
- Dim light/night
- Mid-range pupil

- Females 2:1
- Stress
- Genetic

http://www.aacca.net/newsletterimages/old116.jpg
Genetics: The Angle

- PACG is polygenic in humans and undoubtedly dogs.
- Heritability of angle is 56% (Samoyed).
- So ½ of PACG is NOT simply angle genetics but other factors.
  - Shape of the front portion of the eye, sex, age, stress etc.
- Almost every dog with PACG has bad angles but only 1.5% with bad angles gets PACG.
- “Bad” angles are just the first “hit”.
Genetics of the Angle

Ruthless selection vs PLD can ↓ frequency of PLD in a line

*But:* - PLD came from selecting *for* something else in many breeds
  - What new problems will be unintentionally selected for?
  - What cost to the breed?

**STUDY:** Can we better ID dogs at risk of PACG by looking for other potentially genetic factors?
### Other Potential Genetic “Hits”

<table>
<thead>
<tr>
<th><strong>Humans</strong></th>
<th><strong>Dogs</strong></th>
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</thead>
<tbody>
<tr>
<td>• Shallow AC</td>
<td>• Shallow AC</td>
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<tr>
<td>• Thick/forward lens</td>
<td>• Thick/forward lens</td>
</tr>
<tr>
<td>• Far-sighted</td>
<td>• Far-sighted?</td>
</tr>
<tr>
<td>• Mid-range pupil</td>
<td>• Mid-range pupil</td>
</tr>
<tr>
<td>• Abnormal iris position</td>
<td>• Abnormal iris position</td>
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![Diagram of eye structures](image.png)
Other Non-genetic Factors

- PACG is probably not all genetic
- Short-term increases in blood pressure?
- Things that put the pupil in the middle
- Things that “crowd” the front of the eye
  - Lens growth, drugs etc
How PACG Develops

Normal

PACG

PLD is only first “hit”
Selecting by Angles:
Currently the only game in town
Angle Scoring

Grade by Width and by extent of Pectinate Ligament Dysplasia

Ekesten AJVR 1991
Other scoring schemes

• % of normal
• Mild, moderate, severe
• “Good” or “Bad”
PACG – It's not only sudden onset

- **Latent** - “at risk” fellow eye
- **Intermittent** – attacks that spontaneously resolve
- **Acute congestive** – sudden attacks that don’t resolve
- **Post congestive** – had an attack but now normal IOP
- **Chronic** – gradual increase
- **Absolute** – end stage
Latent Form

- “Normal” fellow eye
- At high risk – 50% in 8 months
- Abnormal angle/S-shaped iris
- Cleft open initially – may close later
- Preventative drops lower risk to 50% in 30+ months
Intermittent Form

- 8-yr-old FS Cocker Spaniel
- Vague Hx transient red eye at night or with child crying
- Has PLD both eyes

<table>
<thead>
<tr>
<th>Time</th>
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<tr>
<td>8AM</td>
<td>15</td>
<td>17</td>
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<tr>
<td>9AM</td>
<td>13</td>
<td>21</td>
</tr>
<tr>
<td>11AM</td>
<td>16</td>
<td>23</td>
</tr>
<tr>
<td>1PM</td>
<td>17</td>
<td>41</td>
</tr>
<tr>
<td>2PM (latano)</td>
<td>16</td>
<td>12</td>
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- Cleft Closed on HRUS
Intermittent PACG - Course

- **Remain normal** – rare
- **Develop acute PACG** – most common
- **Develop chronic PACG** - occurs

![Graph showing intermittent PACG course](image_url)
Absolute Glaucoma
BHF Study: Better Prediction

- PLD is common in Bouviers
- Only 1-2% with PLD develop PACG
- Therefore other factors may trigger an attack
- What are these factors?
- Can we use them to better identify “at-risk” dogs so we can target preventative therapy better and improve breeding advice?
Better Prediction

- Prospective
  98 “normal” eyes, 50 Bouviers
  2 one-eyed from PACG
  Mean age: 63.3 mo range 10-140 months
  17 males, 33 females

- Slit-lamp/Indirect
- IOP pre/post-pupil dilation
- Gonioscopy
- Streak retinoscopy
- A-, B-, and 20 MHz high resolution ultrasonography (HRUS)
- Especially ± 2 sd from mean

Ekesten AJVR 1991
Prediction - Gonioscopy

- 76% had some PLD (75% in Europe)
- Only 10% were “open” or “wide open” 360°
- Only severe PLD associated with PACG
- But few (15%) with severe PLD had PACG
- Two forms of glaucoma occur in Bouviers
  - “Typical PACG” with PLD
  - Pigment in TM/Cleft – PLD not required
Prediction - Tonometry

- IOP Pre/Post dilation did not identify at-risk dogs
- IOP only useful in dogs who had an attack in one eye, had a red eye, or were being treated
- Increased IOP may be one of the last events
Prediction - Retinoscopy

- Younger dogs more far sighted
- 50% $\geq 0.5$D far-sighted
- Every dog $>2$ sd had severe PLD, often closed cleft
- A shift to near-sightedness suggests intermittent spikes
Prediction – A-Scan

- Shallow AC associated with PACG and TM pigment
- Lens gets bigger with age
- Need more dogs to see if explains female predisposition
Closed cleft associated with PACG and TM pigment

Does closed cleft signal intermittent or impending glaucoma?
BHF Study Summary

Refractive errors, shallow anterior chamber, long axial length, and cleft closure also occur in addition to PLD in Bouviers and these factors may also contribute to PACG.
Summary

1) Stress can trigger glaucoma in dogs
2) You might need to start to care about the ciliary cleft
3) Dog glaucoma is sort of like glaucoma in people
4) Bitches more likely to have glaucoma than dogs
5) Angles are not just something from geometry class
Some Remaining Questions

- Tonometric screening in dogs? NO
- Is ultrasound plus gonioscopy better than gonioscopy alone?
- Can refractive errors aid in prediction?
- Provocative tests?
- Genetic testing?
- New treatment options
Questions?