

1 **"Oh, The Pressure!"**

Melissa Vitek, OD
Anne-Marie Mader, OD

2 **Today: IOP and BP**

- ✓ *What they are*
- ✓ *How they're measured*
- ✓ *Factors influencing accuracy*
- ✓ *Causes of abnormal readings*

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4 **What is Intraocular Pressure??**

- IOP is the pressure exerted by the aqueous humor within the eye

- And what exactly is the *aqueous humor??*

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- The **aqueous** is the thin, watery fluid that fills the space between the cornea and the iris (anterior chamber)
- It is continually produced by the ciliary body, the part of the eye that lies just behind the iris
- This fluid nourishes the cornea and the lens and gives the front of the eye its form and shape

6 **More "Humorous" Facts:**

- Aqueous humor is formed in the ciliary processes of the ciliary body by secretion and ultrafiltration
- From the posterior chamber, the fluid passes between the iris and the lens and through the pupil, towards the anterior chamber

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- In the anterior chamber, aqueous flows toward the filtering elements of the trabecular meshwork, and into Schlemm's canal
- From this canal, fluid is conducted by way of small collector channels and larger aqueous veins into the venous system

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- The normal production and outflow of aqueous humor accounts for the maintenance of

the shape of the anterior chamber and can be expressed by means of the intraocular pressure, whose usual values range from 10mm Hg to 20mm Hg

10 **Measuring IOP**

11 **Tonometry**

- General definition: the measurement of tension or pressure
- Several different instruments available for measuring eye pressure

12 How it Works: based on boring law of physics, the *IMBERT-FICK LAW*
"AN EXTERNAL FORCE AGAINST A FLUID-FILLED SPHERE EQUALS THE INTERNAL PRESSURE MULTIPLIED BY THE AREA FLATTENED BY THE EXTERNAL FORCE, IF THE SPHERE IS PERFECTLY SPHERICAL, DRY, FLEXIBLE, AND INFINITELY THIN"

13 **2 Questions:**

1. Uh, What the HECK does THAT mean??
2. Is the front surface of the eye perfectly spherical, dry, flexible and infinitely thin?
 - No!
 - Eye doesn't really fit these conditions, BUT the statement is approximately accurate under certain conditions*

*Remember this when we talk about corneal thickness

14 **What the...????**

- if you know the force applied and area to which it is applied, you can calculate the pressure
- To understand it, think of 2 water balloons

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16 **2 balloons**

- One filled very full of water, the other with just enough water to give it shape
- If you poked each balloon with your finger (fixed area) and applied the same amount of force (push), which one would have the higher pressure?

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- Non-Contact Tonometer
- Tonopen
- Goldmann Applanation Tonometry

18 **Non-Contact Tonometry**

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- Applanation tonometer
- Works on the principle of a time interval
- Measures the time it takes from the initial generation of the puff of air to when the cornea is exactly flattened (in milliseconds) to the point when the timing device stops
- Takes less time for the puff of air to flatten a soft eye than it does a hard eye

19 **The Non-Contact Tonometer**

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21 **Advantages of NCT**

- User friendly
- Objective endpoint (no examiner error)
- No drops required
- Can be done as part of technician's pre-examination

22 **Disadvantages of NCT**

- Patient aversion
 - "You're not gonna puff me with air thing, are you?"
- Not consistent with "gold standard"
 - NCT gives higher measurements than Goldmann
 - NCT readings less accurate on thin corneas
- Large initial investment

23 **Tonopen**

24 **Tonopen**

- Hand held instrument
- Provides fast and accurate IOP readings
- comparable to Goldmann Applanation Tonometer

25 **Advantages of Tonopen**

- Smaller applanation area - better for irregular corneas
- Portable
- Can be used for bedridden patients
- Useful for patients that cannot fit comfortably behind the slit lamp
- Good for patients that are allergic to dyes
- Displays reading accuracy - no subjective endpoint

26 **Using the Tonopen:**

- Sterile cover must be over the tip of the instrument
- Must be calibrated before use

27 **Calibration of Tonopen**

- Press activation button until "CAL" appears in the window
- Hold Tonopen with the tip straight down toward the floor
- When instrument beeps and "UP" appears in the window, rotate the instrument so the tip is straight up.
- If "GOOD" appears, press the button again until a double line ==== appears

28 **Preparing the Tonopen**

29 **Using the Tonopen:**

- Instill topical anesthetic
- Instruct patient to look straight ahead
- Gently tap the Tonopen against the cornea
 - It should beep with every contact and show the pressure reading
 - When enough readings have been obtained (usually 4 - 6) it will beep again and display the final averaged reading
 - 5%, 10% 20% or >20% level: indicates the confidence of the reading

30 **Goldmann Applanation Tonometry**

"Gold standard" of IOP measurement

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32 **Specific Procedure**

- Anesthetic and fluorescein dye instilled
 - Can use combination (e.g., Fluress)
 - Can use strip and proparacaine

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- Using Cobalt Blue Filter, Probe is placed on patient's eye
- Examiner adjusts target to appropriate endpoint

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36 Examiner must align **mires** so that the half-circles are centered and equal

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38 **"GAT"**

39 **Disadvantages of GAT**

- Requires topical anesthetic
- Poor results with edematous corneas

- Some patients can be positioned in slit lamp
- Calibration done at factory
- Hard to delegate
- Influenced by external pressure
- Corneal abrasions possible

40 **Factors Influencing Accuracy**

- Corneal Center Thickness
- Repeated Measurements
- External Factors

41 **Corneal Thickness**

The **cornea** is the curved, transparent layer that covers the front part of the eye and protects its inner structures

42 **Corneal Thickness**

- Cornea thinnest at apex
- CCT does not change with age
- Avg CCT is 535 to 565
- Range: from about 410 to 725
- Ethnic differences likely
- CCT highest upon awakening
- Measured with pachometer

43 **Pachymetry**

44 **Corneal Center Thickness**

45 **Think of 2 balloons, each filled with the same amount of water
1 balloon is made of very thick rubber; the other is made of very thin rubber**

Which one has "higher pressure?"

46 **Effect of CCT on IOP**

A thick cornea will cause the IOP to be...
HIGHER

A thin cornea will cause the IOP to be...
LOWER

Charts are available to adjust pressure based on measured CCT

47 **Repeated Measurements/**

Other procedures

- Effect of repeated measurements
- Pachymetry / Gonioscopy
- Pressures may be falsely low because aqueous is being "squished out" of anterior chamber

48 External Factors

Influencing Accuracy

- Many studies in the literature
- Investigate effect of various factors on IOP accuracy
- "Statistics are the greatest liars of them all." * - just because one study says it doesn't make it true!

*Thomas Carlyle, Scottish writer and philosopher

49 Some Recent Findings:

- Wearing a necktie - IOP
- Nasal Steroids - IOP
- Regular Exercise - IOP
- Obesity / Difficult to position in slit lamp - IOP

50 Causes of Abnormal Readings

- HUGE topic!
- In general:
 - Most common cause of increased IOP: Primary Open Angle Glaucoma
 - Many different disease processes can increase - or decrease - IOP

51 VERY IMPORTANT POINT:

- Be careful when sharing info with patients!!
- Tonometry is NOT a glaucoma test
- Tonometry is only ONE PIECE of information that must be considered when making a diagnosis

52 Here's the way I think of it:

- Glaucoma is present when the pressure of the fluid inside the eye is too high for THAT PARTICULAR EYE to withstand

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- It's not accurate to tell a patient that his/her pressure is "OK" or normal
- Many factors must be considered when determining Dx of glaucoma

54 Summary of IOP Measurement

- Several methods available
- Various Factors may Affect Accuracy
- Be Careful about info shared with Pt

55 ***And now – another kind of “pressure”***