INTRAOCULAR PRESSURE (IOP)

Dr : AHMAD ABUELEINI
MD
Dr : Hassan Eisa Swify
FRCS Ed (Ophthalmology)
Definition of Glaucoma

- Glaucoma is a disease characterized by functional or structural anomalies of the eye in which at least one characteristic change in the optic disc or visual field is present and in which the progression of optic nerve damage can ordinarily be **alleviated or halted by lowering intraocular pressure**.

**INTRODUCTION**

Table 1-1 Risk factors for primary open-angle glaucoma

<table>
<thead>
<tr>
<th>Factor</th>
<th>Quality of evidence</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Ocular risk factors</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Intraocular pressure</td>
<td>Excellent</td>
<td>Most important</td>
</tr>
<tr>
<td>Thinner central corneal thickness</td>
<td>Excellent</td>
<td>Related to IOP and to optic nerve?</td>
</tr>
<tr>
<td>Myopia</td>
<td>Excellent</td>
<td>Related to IOP and to optic nerve?</td>
</tr>
<tr>
<td>Disc hemorrhage</td>
<td>Good</td>
<td>Prognostically important</td>
</tr>
<tr>
<td>Increased cup/disc ratio</td>
<td>Equivocal</td>
<td>May represent early POAG</td>
</tr>
<tr>
<td>Asymmetric cupping</td>
<td>Equivocal</td>
<td>May represent early POAG</td>
</tr>
<tr>
<td><strong>Non-ocular risk factors</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Age</td>
<td>Excellent</td>
<td>Causal mechanisms unknown</td>
</tr>
<tr>
<td>Race (e.g. African or Hispanic descent)</td>
<td>Excellent</td>
<td>Causal mechanisms unknown</td>
</tr>
<tr>
<td>Family history</td>
<td>Excellent</td>
<td>Multifactoral genetic factors</td>
</tr>
<tr>
<td>Adult onset diabetes</td>
<td>Equivocal</td>
<td>Elevated IOPs, but protective of ganglion cells?</td>
</tr>
<tr>
<td>Diastolic perfusion pressure</td>
<td>Excellent</td>
<td>Biologically plausible</td>
</tr>
<tr>
<td>Migraine and peripheral vasospasm</td>
<td>Equivocal</td>
<td>More relevant in 'low-tension disease'?</td>
</tr>
<tr>
<td>Gender</td>
<td>Inadequate</td>
<td>Contradictory reports</td>
</tr>
<tr>
<td>Alcohol consumption</td>
<td>Inadequate</td>
<td>Requires confirmation</td>
</tr>
<tr>
<td>Cigarette smoking</td>
<td>Inadequate</td>
<td>Requires confirmation</td>
</tr>
</tbody>
</table>
RELATIONSHIP BETWEEN IOP & VF LOSS

The Australian Blue Mountain study found the odds ratio of developing glaucoma was 4.7 times higher in patients with a screening IOP of greater than 21 mmHg than in patients with lower IOP.


RELATIONSHIP BETWEEN IOP & VF LOSS

According to the AGIS study, reducing IOP in glaucoma patients limits disease progression and slows visual field loss.

According to the EMGT study, for every 1 mm drop in IOP, a 10% reduction in risk of glaucomatous progression was observed.
IOP

- Majority of cases with OH do not develop glaucoma (OHTT)

- Some cases with glaucoma never progress without Rx (EMGT)

- Some cases with glaucoma develop VF loss despite adequate control of IOP (AGIS)

NORMAL IOP

**In children:**
6–8 mmHg at birth
increase by 1 mmHg /2 years till 12 ys

**Healthy adult:**
10 - 21 mmHg (16 +/- 2.5)
i mmHg per decade
Goldmann tonometry for reproducibility

**Recommendation**

GAT tonometer is the most reproducible, it is recommended for IOP measurement in patients with healthy corneas.

Precision figures reported for GAT

Under ideal circumstances for measurement, **Intraobserver variability**: 2.5 mmHg
two readings by the same observer will be within this figure for 95% of subjects.

**Interobserver variability**: ± 4 mmHg
(95% confidence limits either side of mean difference between observers)
Prevalence of Calibration Errors in GAT

- Approximately 90% and 30% of tonometers were outside the tolerance ranges of ±0.5 and ±2.5 mmHg, respectively.

- For achieving more accurate IOP measurement regular checking of GAT tonometers for calibration

How to test calibration of a GAT
How to test calibration of a GAT

Periodic calibration check recommended: at least twice yearly

1. Set the tonometer in position on the slit-lamp stand, with the biprism head in place and the tension on the circular dial on the right side set at 5 mm Hg. The head should lean slightly forwards (away from the examiner).

2. Slowly twirl the circular dial counter-clockwise until the head rocks back towards you. The tension should read 0 to 2 mm Hg below zero.

Tonometry — role for finger tonometry for special circumstances

Consideration can be given to finger tonometry to estimate IOP as very low, normal, or very high

in certain situations (e.g., eyes with flat anterior chambers, eyes with keratoprosthesis)

To check IOP after LA
**Circadian Cycle**

Diurnal variation 3-5 mmHg more in untreated glaucoma
Maximum IOP between 8-11am
Minimum between midnight & 2am
This is dependent on sleep cycle than daylight cycle

**IOP**

- The semicircles should be clear with distinct margins.
- Wider, blurred semicircles result in false-high readings as does vertical misalignment.
- Measurements without the use of fluorescein underestimate the true IOP
IOP & Cataract Surgery

IOP was lower after speculum placement.

Interestingly, supine positioning & autoregulatory mechanisms seemed to have the greatest effect on IOP changes.

Viscoelastics

Steroids

IOP : decrease by 3mmHg

Transient increase in IOP

- IOP increases temporarily because of wearing tight neckties, caffeine intake, yoga positions and isometric exercises.
- Valsalva maneuvers, or breath holding by the patient, must be avoided.
- The unanswered question is whether these intermittent bursts of elevated IOP lead to pathological problems?

Neurol Res. 1999;21:243-6
Corneal Edema

- Large amounts of corneal edema produce an underestimation of IOP when measured by applanation tonometry.

- Small amounts of corneal edema (as induced by CL wear) probably cause an overestimation of IOP.

- Remove CL 2 hrs before tonometry.

Natural History of Intraocular Pressure During Pregnancy.

- Metabolic and physiologic changes during pregnancy cause a mild decrease in IOP.

1. The episcleral venous pressure decreases.
2. A metabolic acidosis occurs, which affects aqueous production and IOP.

- IOP show an average decrease of 1.5mmHg during pregnancy.
Natural History of Intraocular Pressure During Pregnancy.

- In one study, the majority of eyes required treatment with glaucoma medications and maintained stable visual fields. The course of glaucoma was variable, with 18% developing visual field loss and another 18% developing increased IOP without visual field loss.

INTERFACE FLUID SYNDROME

- **Post-LASIK:**
  stromal edema or interface fluid on slit lamp exam, increase in pachymetry measurements, steepening of corneal topography, or inappropriately low IOP measurements
INTERFACE FLUID SYNDROME

Pathophysiology:

- High intraocular pressure → diffusion of aqueous humor across the corneal endothelium into the stromal interface created by the flap → pocket of fluid accumulates at the lamellar interface

IOP

Physiological variations
Measurement errors
Corneal thickness, Hysteresis
Individual susceptibility
State & rate of progression
THE TARGET IOP CONCEPT

The goal of the clinician while treating patients with glaucoma should be to lower the IOP to a level that is "safe" for that particular eye.

Ref: Surveys of Ophthalmology 2003; 48 (suppl 1): 53-57

THE TARGET IOP CONCEPT

A "target" pressure should be set as a goal of long term therapy: it should be chosen on an individual basis, weighing potential benefits and risks of treatment for each patient.

Ref: Surveys of Ophthalmology 2003; 48 (suppl 1): 53-57
**SETTING TARGET IOP**

**FACTORS TO BE CONSIDERED**

- IOP level at which optic nerve damage occurred
- Extent and rate of progression of glaucomatous damage,
- Presence of other risk factors
- Patient’s age
- Expected life span & Medical history

Ref: *Surveys of Ophthalmology* 2003; 48 (suppl 1); 53-57
AAO GUIDELINES: TARGET IOP

- **Ocular hypertension**
  → Reduction of 20% from baseline

- **Glaucoma patients with mild damage** (optic disc cupping but no visual field loss)
  → Reduction of 20-30% from baseline

- **Glaucoma patients with advance damage**
  → Reduction of 40% or more from baseline

- **Normal pressure glaucoma**
  → Reduction of 30% from baseline

HOW TO CALCULATE TARGET IOP

Target IOP = “Maximum IOP – Maximum IOP% - Z”

Z is an optic nerve damage severity factor.

- 0 → Normal disc and Normal VF
- 1 → Abnormal Disc and Normal VF
- 2 → VF loss not threatening
- 3 → VF loss threatening or involving fixation

HOW TO CALCULATE TARGET IOP

An eye with a maximum IOP of 30 mmHg, optic nerve damage and visual field loss not threatening fixation would have a target set at 19 mmHg (30-30%-2)


HOW TO USE A TARGET IOP

- Recommended to record and highlight the target pressure in the chart of a patient
- Draw an IOP curve for each glaucomatous patient and to highlight the target pressure on the curve

THANK YOU FOR YOUR TIME