Our Patient has High Eye Pressure: Is it a Problem? (Raised Intraocular Pressure - Glaucoma)

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Abstract

Raised intraocular pressure (IOP) causes or can progress to glaucoma which is a silent thief of sight, being leading cause of irreversible blindness worldwide. It can remain asymptomatic until a relatively late stage.[1] Most of the cases are detected on routine ophthalmological examination. As late detection of the disease is considered as one of the most significant poor prognostic factors in the course of the disease,[2] early detection and prompt management becomes an important step to fight with this potentially blinding disorder. Intraocular pressure is a key modifiable factor in the treatment of glaucoma. This review describes the significance of treating increased intraocular pressure as early as possible after its detection and a clinical approach towards its proper management.

Introduction

Intraocular pressure (IOP) is the fluid pressure inside an eye. Aqueous humour secreted by ciliary body circulates inside the eye to maintain this pressure. Any condition which causes excessive production or defective drainage of this fluid leads to raised IOP. It normally ranges from 11- 21 mm of Hg and two standard deviations either side of the average.

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Causes of raised IOP can be hereditary and genetic (primary open angle glaucoma, primary angle closure glaucoma), congenital, ocular hypertension (high IOP but no other signs of glaucoma), ocular trauma, postoperative cases of intraocular surgeries and few medications like steroids, sulpha drugs and few anti neoplastic medications.[3] The common risk factors are age > 50 years, black race, family history, high diastolic blood pressure, Diabetes mellitus, use of topical and systemic steroids, thinner central cornea, high myopia for POAG and hypermetropia and female preponderance for PACG, retinal vein occlusions, Retinitis Pigmentosa, vascular factors like migraine and vasospastic disorders like Raynaud's disease.

Raised IOP is generally referred to as "glaucoma". Worldwide, glaucoma is the second most common cause of blindness, after cataracts and leading cause of irreversible blindness.[1] Previous studies have shown that for every known case of glaucoma there is another case of occult disease.

By definition glaucoma is a chronic progressive optic neuropathy with visual field loss in a characteristic way, intraocular pressure being a key modifiable as well as an important risk factor.[4,5]

Why raised IOP is a problem and needs prompt management and proper evaluation?

When excess aqueous humour builds up in the eye either due to increased production or increased resistance to its outflow, it raises pressure inside eye (intraocular pressure) which in turn damages the optic nerve and causes characteristic visual field loss. It causes irreversible damage to the optic nerve and no known treatment has the potential to restore lost vision. The most effective way of preventing damage to the optic nerve is to reduce the intraocular pressure (IOP) by means of various pharmacological and surgical interventions.

Various studies have shown that risk of Open Angle Glaucoma is positively related to IOP levels at baseline. Although persons with baseline IOP of 25 mmHg had a 13-fold relative risk of developing OAG, most cases arose with lower baseline-IOP. It thus confirms the role of IOP as an influential risk factor.[6]

The results of Collaborative Initial Glaucoma Treatment Study (CIGTS) support considering more aggressive treatment when undue elevation or variation in IOP measures is observed.[7] Increased IOP fluctuation (SD or range of IOP) as well as high IOP (maximum IOP) are important predictors of progressive visual field loss. It is advocated to measure IOP by observing the inter visit range of IOP over time and to take required steps for its proper management.[8]

Adequate IOP control can markedly reduce progression of glaucomatous damage in POAG.[9]

Management

All the causes of high IOP can lead to either open angle or closed angle glaucoma which is confirmed on below mentioned clinical findings and investigations. Hence the treatment guidelines are given separately for them.

Clinical examination and investigative procedures include[10]

1. Tonometry: Measuring IOP - Goldmann applanation tonometry is the gold standard.
2. Clinical examination: anatomy of the pupil, iris, and anterior chamber angle depth on slit lamp examination
3. Gonioscopy: Gonioscopic anatomy of the pupil, iris, angle of the anterior chamber and its width, iris processes and ciliary body
4. Perimetry: visual field testing
5. Clinical evaluation of optic nerve head:
   Slit lamp fundoscopy: provides good stereoscopic view
   Non-contact Hruby lenses- 78D or 90D
   Contact lenses - for very small pupils
   Direct ophthalmoscope: monocular,

easy, hence can be used for glaucoma screening.

6. Optic nerve head imaging: Confocal scanning laser ophthalmoscopy (CSLO)
   Optical coherence tomography (OCT)
   Scanning laser polarimetry
7. Ultrasound biomicroscopy of the angle (UBM)
8. Other psychophysical tests: Colour vision
   Electroretinogram (ERG)
   Pattern electroretinogram (PERG)
   Multifocal visual evoked potential (mfVEP)

Treatment of Open Angle Glaucoma

Medical treatment of open angle glaucoma

Higher baseline IOP is considered as one of the strongest consistently predictive factors for worse mean deviations in visual field plotting. It is advocated to measure IOP by observing the inter visit range of IOP over time.[8]

Main goals of glaucoma treatment are slowing disease progression and preserving quality of life. Reduction of intraocular pressure is the only proven method to treat glaucoma.

Current management guidelines from the American Academy of Ophthalmology Preferred Practice Pattern recommend lowering the intraocular pressure toward a target level known as "Target IOP". Target IOP is an IOP range deemed unlikely to cause further optic nerve damage and to avoid functional impairment from glaucoma. Estimation of target pressure is based on a patient's risk factors for progression, the level of IOP that caused damage, the severity of disease, and longevity.[8]

General suggestions for medical treatment of glaucoma[10]

1. Establish a target pressure
2. Adjust the treatment programme to the patient and his/her lifestyle
3. Initiate or change therapy through a therapeutic trial in one eye
4. When therapy is ineffective, substitute rather than add drugs
5. Continually monitor the target pressure
6. Ask about and monitor systemic and ocular side effects
7. Simplify and reduce treatment when possible
8. Teach patients the proper technique to instil eye drops - simply closing the eyes for 3 minutes after instilling eye drops and apply digital pressure on lacrimal sac area - this will decrease the systemic absorption of drugs and will enhance eye drug contact.
9. Provide written instructions.
10. Attempt to maximise compliance by providing an explanation of the disease and rationale for the treatment.
11. Stop treatment periodically to determine continuing effectiveness
12. Measure IOP at the different times of the day and at different intervals after the last administration of the medication
13. Recommend comparison shopping for the medications

Antiglaucoma medications[1,4]

Class of Medication	Example	Usual Dosages	Mechanism of Action	Local Adverse Effects	Systemic Adverse Effects
Prostaglandin analogues (prostamide)	Latanoprost, Travoprost, tafluprost, Unoprostone, Bimatoprost	1/d at night	Increase in uveoscleral outflow of aqueous humour	Conjunctival hyperaemia, lengthening and darkening of eyelashes, brown discolouration of the iris, uveitis, macular oedema	Minimal systemic adverse effects; may be related to headaches
β-Adrenergic blockers	Timolol, levobunolol, Carteolol, Metipranolol, Betaxolol	1/d in the morning	Reduction of aqueous humour production	Ocular irritation and dry eyes	Contraindicated in patients with asthma, chronic pulmonary obstructive disease, and bradycardia
?-Adrenergic agonists	Brimonidine, Apraclonidine	3/d (Sometimes 2/d)	Initial reduction of aqueous humour production with subsequent effect of increase in outflow	Ocular irritation, dry eyes, allergic reaction is relatively common	Central nervous system effects and respiratory arrest in young children; caution in patients with cerebral or coronary insufficiency, postural hypotension, and renal or hepatic failure
Carbonic anhydrase inhibitors	Dorzolamide, Brinzolamide, Acetazolamide (oral)	3/d (Sometimes 2/d)	Reduction of aqueous humour production	Ocular irritation, dry eyes, burning sensation with topical agents	Topical form has minimal systemic adverse effects; oral form may be associated with paraesthesia, nausea, diarrhoea, loss of appetite and taste, lassitude, or renal stones
Cholinergic agonists	Pilocarpine, Carbachol	Usually 4/d, but may vary	Increase in aqueous humour outflow	Ocular irritation, induced myopia and decreased vision due to ciliary spasm	Ciliary spasm leading to headaches in young patients

Prostaglandin analogues

- They are considered as first line therapy nowadays.
- They exhibit very few systemic side effects as compared to beta blockers.

Beta blockers

They should not be prescribed: when patient is already on systemic beta blockers as the combination may involve the relative high risk of systemic side effects and at bedtime as they show risk of systemic hypotension but preferred in conditions like ocular inflammation, cystoids macular oedema, herpes simplex keratitis.

Alpha 2 agonists

They are believed to have neuroprotective effect.

Topical carbonic anhydrase inhibitors

They are slightly less effective than Beta blockers, relatively contraindicated in patients with sulpha drug allergy and can precipitate corneal decompensation in patients with corneal endothelial

dysfunction. They are thought to have additive neuroprotective effect.

Systemic carbonic anhydrase inhibitors

- Generally used in acute rise of IOP
- Short term use
- Sulpha drug allergy is a relative contraindication.

Miotics

- Now predominantly used in angle closure
- They were formerly the mainstay of treatment in open angle glaucoma.

Combined preparations

Combined preparations with similar ocular hypotensive effects to the sum of the individual components improve convenience and patient compliance.

They are cost effective.

Examples:

- Timolol and dorzolamide- twice daily
- Timolol and latanoprost- once daily
- Timolol and brimonidine- twice daily
- Timolol and Travoprost -once daily
- Timolol and brinzolamide- twice daily
- Brimonidine and brinzolamide- twice daily

Surgical treatment of open angle glaucoma[5]

Indications

1. When medical treatment fails to achieve desired reduction in intraocular pressure
2. When patient compliance is poor.

Laser surgery- Laser trabeculoplasty

It lowers IOP by introducing biological changes in trabecular meshwork and hence increasing aqueous outflow. It has an excellent safety profile and can be done in office visit. Though it achieves substantial decrease in IOP in majority of the cases, the effect decreases over years; failure rate being 10% per year.[1]

Trabeculectomy

It is most commonly performed surgery for open angle glaucoma. It involves excision of very small part of trabecular meshwork and corneoscleral tissue and thereby providing drainage route for aqueous humour inside eye beneath the conjunctiva.

Newer advances in trabeculectomy are

1. Use of antiscarring agents, e.g. Mitomycin -C
2. Use of Drainage devices.

Several alternatives to these procedures have been proposed and are being investigated. These so-called minimally invasive or non-penetrating glaucoma surgeries are -deep sclerectomy, viscoanalostomy and canaloplasty. Various metanalysis comparing these techniques with trabeculectomy concluded that trabeculectomy is more effective in lowering IOP but has more rate of complications.[1]

Treatment of Angle Closure Glaucoma[1,5]

Management of angle closure glaucoma depends upon the stage of the disease and correct identification of underlying pathology.

Acute angle closure attack

Patient presents with severe pain, redness, watering, photophobia, blurring of vision and associated ipsilateral headache, nausea and vomiting. This stage requires emergency management. Clinical examination shows mid-dilated very sluggishly reacting pupil, hazy cornea, circumciliary congestion, reduced visual acuity, raised IOP, gonioscopically

closed angle, shallow anterior chamber, iris bombe or peripheral anterior synechiae formation. (AAO)

First line treatment is **laser peripheral iridotomy** in which peripheral full thickness hole is created in iris to prevent papillary block. Mild attacks can be treated with topical miotics (pilocarpine 1-2%). But when IOP is markedly elevated (40-50 mm Hg), pupillary sphincter becomes irresponsive to miotics. Hence other **antiglaucoma medications** like prostaglandin analogues, carbonic anhydrase inhibitors, and beta blockers should be used. If medical management fails to abort the attack, conventional **laser iridoplasty** can also be done. Fellow eye which is at high risk of angle closure should also undergo prophylactic laser peripheral iridotomy.

If iridotomy is unsuccessful or difficult to perform because of a cloudy cornea, surgical iridectomy can be a useful alternative.

Angle closure suspects

Angle closure suspects are the patients who are suspected to have angle closure but no manifest glaucoma (anatomically narrow angles but normal IOP and no glaucomatous changes in optic nerve head evaluation).

Current treatment guidelines support prophylactic laser peripheral iridotomy in such patients especially in presence of risk factors like family history, patients with symptoms and signs of intermittent angle closure (prodromal or subacute stage), patients who require repeated dilated examinations for screening of diabetic retinopathy or in case of poor patient compliance limiting the follow up visits. **Lens extraction and IOL implantation** is good option in patients with visually significant cataracts as it widens the angle.[1] It can be combined with goniosynechiolysis to improve trabecular outflow.[5]

Chronic angle closure

It can occur in two forms:

1. After an acute attack in which synechial closure persists.
2. Angle closes gradually and IOP rise is very slow as a result of which angle functions slowly compromise. This is the most common form, also known as "creeping angle closure".

Though miotics and other IOP lowering agents can reduce IOP, iridotomy is must. Repeated periodic gonioscopy is imperative. Most of the patients are controlled with iridotomy followed by long term use of topical antiglaucoma medications. Rest may require filtering surgery and goniosynechiolysis.[5]

Take Home Message

We cannot turn a "blind eye" to this "silent loss of vision" as a result of untreated or undetected high intraocular pressure or else it would be like depriving elderly people of good quality of life associated with vision.[2]

There is, of course, no way to determine in advance which IOP will prevent or slow further damage. Some patients may even have an IOP-independent component of damage. Perhaps we should consider IOP modulation rather than IOP reduction as the most appropriate treatment. This may include not only robust IOP reduction in

patients at risk for visual loss, but also the goal of reducing IOP fluctuation, particularly in patients who progress at lower pressures.

Specific guidelines, however, must await a better understanding of the pathophysiologic consequences of long term IOP fluctuations in glaucoma.[8]

Closer co-operation between general Practitioners, Ophthalmologists and optometrists will be the practical way ahead for most practices.

Primary care physicians can play an important role in detection of high IOP and diagnosis of glaucoma by:[11]

- Referring patients with positive family history and suspicious optic nerve head findings to ophthalmologists for complete ocular examination.
- Identifying patients with symptoms and signs of acute rise of IOP, managing them primarily and then referring them to Ophthalmologist.
- Engaging in screening of patients with risk factor to develop glaucoma.
- Explaining and reassuring the patients
- Discussing the impact of visual loss with the patients
- Monitoring anti-glaucoma therapy and its side effects, if any
- Referring to Ophthalmologists in case of progression or side effects of treatment
- Educating patients regarding screening of family members and genetic factors
- Referring patients with previous history of glaucoma surgery (even years back) and red eye back to Ophthalmologist.
- Not prescribing topical steroids to every acute red eye patient without comprehensive ophthalmological examination by Ophthalmologist as 5% population can be high steroid responder.[3]

They can improve treatment outcomes by reinforcing the importance of treatment adherence and persistence and by recognising adverse effects of glaucoma medication and surgeries.[1]

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Fruits, vegetables, and legumes: sound prevention tools

Fruits and vegetables are inversely associated with cardiovascular disease and premature mortality.

Overall, risk reductions for total mortality in the order of 35%- and specifically of 27% to 39% for cardiovascular and non-cardiovascular death-were found for even three to four servings per day of fruits, vegetables, and legumes compared with fewer than one serving per day, indicating that optimal health benefit can be achieved with even a modest level of consumption.

For this consumption to be affordable, policies that lower prices of fruits and vegetables by establishing new alliances between governments and the private sector, consumer groups, the research community, and other non-governmental bodies, especially in low-income and middle-income countries, should be encouraged.

It seems logical to think that people with a higher consumption of plant-derived foods are more likely to have a lower consumption of animal-derived foods.

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Heart failure

Heart failure is common in adults, accounting for substantial morbidity and mortality worldwide. Its prevalence is increasing because of ageing of the population and improved treatment of acute cardiovascular events, despite the efficacy of many therapies for patients with heart failure with reduced ejection fraction, such as angiotensin converting enzyme (ACE) inhibitors, angiotensin receptor blockers (ARBs). β blockers, and mineralocorticoid receptor antagonists, and advanced device therapies. Combined angiotensin receptor blocker, neprilysin inhibitors (ARNIs) have been associated with improvements in hospital admissions and mortality from ARBs with ARNIs i appropriate patients. Improved safety of left ventricular assist devices means that these are becoming more commonly used in patients with severe symptoms.

Heart failure with preserved ejection fraction is a heterogeneous disorder that remains incompletely understood and will continue to increase in prevalence with the ageing population. Although some data suggest that spironolactone might improve outcomes in these patients, no therapy has conclusively shown a significant effect.

Marco Metra, John R Teerlink, The Lancet, 2017, Vol 390, 1981