Answer to Ophthaproblem *continued from page 33*

3. Ocular hypertension

Ocular hypertension (OHT) is an asymptomatic condition characterized by an elevated intraocular pressure (IOP) with no detectable visual field or optic disk abnormalities on standard clinical tests. It is estimated that 4% to 7% of those older than 40 years of age in the United States and likely a similar number in Canada have OHT and many are unaware of it.[1] The unifying and most important risk factor for developing primary open-angle glaucoma (POAG), a disease of the optic nerve and a leading cause of irreversible blindness worldwide,[2] is an elevated IOP; therefore, patients with OHT are considered glaucoma suspects. However, POAG is a heterogeneous disease that requires specific changes in the optic disk and visual field for diagnosis. Not everyone with OHT will develop these features, and many patients diagnosed with POAG will have IOPs in the normal range when first measured, suggesting that various factors contribute to the pathogenesis of this heterogeneous condition.

It is still unknown how elevated pressure in the eye contributes to the development of POAG. Proponents of the mechanical theory suggest that an elevated IOP has a direct effect on the lamina cribrosa and retinal ganglion cell axons, leading to deformation, mechanical stress, and ultimately cell death.[3] Independently or together with the elevated IOP, dysfunction of blood flow autoregulation can play a pathogenic role and lead to ischemic hypoxia from the mismatch of perfusion and metabolic demand.[4] Interestingly, patients with OHT that progresses to POAG have been reported to have increased arteriolar narrowing compared with those who remain asymptomatic.[5]

The risk of progression from OHT to POAG can be quantified using a validated risk calculator,[6] which considers the patient's age, mean IOP, central corneal thickness (CCT), vertical cup-to-disk ratio, and visual field defects. As shown in **Table 1**,[6] each parameter is assigned a value, which can then be summed to estimate POAG risk. The prevalence of POAG increases with age and is 4 to 5 times greater among black Americans than among white Americans.[7] As increased CCT can overestimate IOP measurements, those with high IOP and decreased CCT are at greater risk than those with the same pressure but greater CCT. Although a corrective formula can adjust for this variable (subtract 4 mm Hg for CCT ≥ 600 µm; add 4 mm Hg for CCT ≤ 500 µm), decreased corneal thickness is also considered an independent risk factor for POAG.[8] Moreover, the hollowed-out appearance or "cupping" that is associated with the loss of retinal ganglion cells in glaucoma is incorporated into the risk calculator by the vertical cup-to-disk ratio. Generally, a value greater than 0.5 or considerable asymmetry between the 2 eyes is highly suggestive of glaucomatous atrophy. Finally, peripheral vision is the first to be affected by glaucoma and can be assessed using automated perimetry, although visual field defects cannot usually be detected until about 40% of the retinal ganglion cells are lost.[9]

Table 1. A calculator to estimate the risk of developing POAG: *A) Risk factors and the value of points for each variable; B) Total score of points to estimate the 5-year risk of developing POAG.*

A) RISK FACTORS	POINTS FOR RISK FACTOR VARIABLES				
	0	1	2	3	4
Age, y	≤ 44	45-54	55-64	65-74	≥ 75
Mean intraocular pressure, mm Hg (3 measurements per eye and average of 2 eyes)	≤ 21	22-23	24-25	26-27	≥ 28
Mean central corneal thickness, µm (3 measurements per eye and average of 2 eyes)	≥ 600	576-599	551-575	526-550	≤ 525
Vertical cup-to-disk ratio (1 measurement per eye and average of 2 eyes)	< 0.3	0.3 to < 0.4	0.4 to < 0.5	0.5 to < 0.6	≥ 0.6
Visual field, pattern standard deviation, dB (2 measurements per eye and average of 2 eyes)	< 1.8	1.8 to < 2.0	2.0 to < 2.4	2.4 to < 2.8	≥ 2.8

B) TOTAL SCORE OF POINTS	ESTIMATED 5-YEAR RISK OF DEVELOPING POAG, %
0-6	≤ 4
7-8	10
9-10	15
11-12	20
> 12	≥ 33

POAG—primary open-angle glaucoma.
Adapted from Gordon et al.[6]

Management

This patient's risk of progression to POAG can be used to guide treatment decisions. Considering this patient's age of 58 years (2 points), mean IOP of 30 mm Hg (4 points), CCT of 616 µm (no points), vertical cup-to-disk ratio between 0.4 and 0.5 (2 points), and normal visual field (no points), the estimated 5-year risk of progression is about 10% (**Table 1**[6]). Usually a 5-year risk of 15% or more is cause to initiate IOP-targeted treatment, unless the IOP is unusually high, which would call for immediate attention. Consequently, treatment was not initiated for this patient, but she continues to be monitored closely by her ophthalmologist.

There are 5 main classes of drugs that can be used to diminish IOP: prostaglandin analogues, β-adrenergic antagonists, α_2-adrenergic agonists, carbonic anhydrase inhibitors, and cholinergic agonists.[10] They act by either reducing the production of aqueous humour by the ciliary body (β-adrenergic antagonists, carbonic anhydrase inhibitors, and α_2-adrenergic agonists), increasing uveoscleral outflow of aqueous humour (prostaglandin analogues and α_2-adrenergic agonists), or by increasing aqueous outflow through the trabecular meshwork (cholinergic agonists). Although these agents are administered topically, there are still a number of systemic side effects that might manifest in patients using these therapies. The prostaglandin analogues, including latanoprost, are the standard first line of defence for reducing IOP owing to their effectiveness, minimal side effects, and once-daily dosing.[11]

Recommendations

A regular eye examination is critical for avoiding irreversible vision loss from POAG, as this condition causes no symptoms until the disease is at a late stage. Approximately 50% of cases of POAG go unnoticed and untreated,[7] emphasizing the importance of the family physician in identifying at-risk patients (particularly those older than 50 years of age, black patients, and those with a family history of glaucoma) for referral to an ophthalmologist. For those who have OHT and are being followed closely for the development of POAG, annual eye examinations are important to monitor for changes so that treatment can be promptly initiated to prevent irreversible vision loss.

Mr Micieli is a medical student at McGill University in Montreal, Que. **Mr Surkont** is a medical student at Queen's University in Kingston, Ont. **Dr Cohen** is a glaucoma specialist and Assistant Professor of Ophthalmology in the Faculty of Medicine at McGill University.

Competing interests
None declared

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