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Editorial

Glaucoma in India: Epidemiological Insights, Therapeutic Evolution, and Strategic Imperatives for Vision Preservation

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Glaucoma, a progressive optic neuropathy characterized by retinal ganglion cell apoptosis, neuroretinal rim thinning, and irreversible visual field loss, represents a mounting public health crisis in India, exacerbated by rapid demographic aging and a population surpassing 1.4 billion [1]. Systematic reviews and meta-analyses over two decades report a pooled prevalence of 3.23% (95% CI: 2.49-4.06%) among adults aged ≥40 years, with primary open-angle glaucoma (POAG) at 2.07% (95% CI: 1.60-2.60%) and primary angle-closure glaucoma (PACG) at 0.81% (95% CI: 0.56-1.12%), projected to increase substantially by 2050, potentially exceeding 15 million cases [2,3]. Regional variations are pronounced: the Chennai Glaucoma Study documented POAG prevalence at 3.54% and PACG at 1.84% in urban southern India, while Northeast cohorts show PACG predominance tied to short axial length, hyperopic biometry, and shallow anterior chambers [2,4]. Pathophysiologically, elevated intraocular pressure (IOP) arises from trabecular meshwork (TM) extracellular matrix (ECM) accumulation—including plasminogen activator inhibitor-1 (PAI-1), fibronectin, and collagen type IV—induced by transforming growth factor-β2 (TGF-β2), impairing conventional outflow, as evidenced in perfused human anterior segments [5,6]. Pivotal randomized trials—the Early Manifest Glaucoma Trial (EMGT), Collaborative Initial Glaucoma Treatment Study (CIGTS), Advanced Glaucoma Intervention Study (AGIS), and Collaborative Normal Tension Glaucoma Study (CNTGS)—validate IOP reduction as the only proven surrogate for neuroprotection, with EMGT demonstrating 50% progression risk reduction at 25% IOP lowering and dose-dependent benefits in other studies, applicable even to normal-tension glaucoma [5]. Many patients present with moderate to advanced disease due to low awareness (6-10% view it as treatable), sparse rural screening (5-10% coverage where 70% reside), myopia/hyperopia surges, and genetic risks like MYOC mutations reported in Indian cohorts [1,2,7].

Therapeutic strategies center on IOP modulation: prostaglandin F2α analogs (PGAs; latanoprost, bimatoprost) boost uveoscleral outflow via FP-receptor-driven matrix metalloproteinase (MMP) expression and ciliary muscle relaxation, delivering 25-35% reductions irrespective of diurnal fluctuations; β-blockers (timolol) inhibit aqueous production through adenylyl cyclase blockade; α2-agonists (brimonidine) curb inflow with possible neuroprotective effects; and topical carbonic anhydrase inhibitors (dorzolamide) limit bicarbonate flux [5,8]. Fixed-dose combinations address polypharmacy nonadherence (40-70% dropout), though affordability challenges persist despite Ayushman Bharat generics [1]. For advanced presentations common in India, mitomycin-C trabeculectomy yields 70-85% 5-year success and remains the preferred surgical approach; microinvasive glaucoma surgeries (MIGS; iStent, Hydrus) and intracameral bimatoprost implants represent emerging options where available, limited by cost [7,8]. Urgent imperatives include: (i) tiered opportunistic screening (>40 years, family history, high myopia, diabetes) using portable tonometry, fundus imaging, and AI-OCT tele-triage targeting substantial rural referrals; (ii) primary-secondary integration via

ASHA workers and NPCBVI; (iii) national registries for genotype-phenotype analysis and neuroprotection trials (citicoline, memantine, BDNF); (iv) NDHM-subsidized MIGS/genomics; and (v) multimedia campaigns framing glaucoma as the "silent thief of sight" [1,3,4]. Coordinated efforts could substantially reduce the blindness burden, synchronizing India with WHO global targets [2].

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