



Recent Advances in Glaucoma Management: A Narrative Review

Recent Advances in the Management of Glaucoma: A Narrative Review

Igor Wilke Dalla Rosa – Federal University of Health Sciences of Porto Alegre

Isabel Bittencourt de Almeida Pedrosa – Santa Marcelina College

Ana Beatriz Hoffmann – ABC School of Medicine

Giovanna Musa Scalise Szpigel – Anhembi Morumbi University of São Paulo

SUMMARY

Introduction: Glaucoma is a chronic and progressive optic neuropathy characterized by optic nerve damage and visual field loss, and is one of the leading causes of irreversible blindness worldwide. It is estimated that more than 76 million people will have glaucoma in 2020, and that this number will exceed 110 million by 2040. **Objective:** To review the main recent advances in the diagnosis and treatment of glaucoma, with an emphasis on technological and therapeutic innovations.

Methodology: A narrative literature review conducted in PubMed, Scielo, and Google Scholar databases, including publications between 2013 and 2023. Review articles, clinical studies, and consensus statements from international and national medical societies were selected. **Results**

and discussion: Diagnostic methods have been improved by optical coherence tomography (OCT) and the use of artificial intelligence algorithms, capable of early detection of structural changes. In clinical treatment, new prostaglandin analogues, sustained-release eye drops, and fixed drug combinations stand out, which improve adherence. Laser therapy has advanced with selective trabeculoplasty (SLT), and minimally invasive surgeries (MIGS) have brought safer alternatives to trabeculectomy. Despite these advances, challenges remain related to universal access and therapeutic adherence. **Conclusion:** Glaucoma management has evolved significantly, enabling early diagnosis and less invasive treatments. However, the effectiveness of these advances depends on expanded access and the implementation of public health screening strategies.

Keywords: Glaucoma. Early diagnosis. Therapy. Ophthalmology.

ABSTRACT

Introduction: Glaucoma is a chronic and progressive optic neuropathy characterized by optic nerve damage and visual field loss, being one of the leading causes of irreversible blindness worldwide. It is estimated that more than 76 million people had glaucoma in 2020, and this number is projected to exceed 110 million by 2040. **Objective:** To review the main recent advances in the diagnosis and treatment of glaucoma, with emphasis on technological and therapeutic innovations. **Methods:** Narrative literature review carried out in PubMed, Scielo and Google Scholar databases, including publications between 2013 and 2023. Review articles, clinical trials and guidelines from international and national medical societies were included.

Results and discussion: Diagnostic methods have been enhanced by optical coherence tomography (OCT) and artificial intelligence algorithms capable of early detection of structural changes. In clinical treatment, new prostaglandin analogs, sustained-release eye drops and fixed drug combinations have improved adherence. Laser therapy has advanced with selective laser trabeculoplasty (SLT), and minimally invasive glaucoma surgeries (MIGS) provided safer alternatives to trabeculectomy. Despite these advances, challenges remain regarding universal access and treatment adherence. **Conclusion:** Glaucoma management has significantly evolved, allowing earlier diagnosis and less invasive treatments. However, the effectiveness of

these advances depend on broader access and the implementation of screening strategies in public health.

Keywords: Glaucoma. Early diagnosis. Therapeutics. Ophthalmology.

1. INTRODUCTION

Glaucoma represents a set of progressive optic neuropathies characterized due to optic nerve damage, loss of nerve fibers and consequent impairment of the field visual. It is a multifactorial condition, in which elevated intraocular pressure (IOP) is the main risk factor, but not the only one. Vascular, genetic, and environmental factors also contribute to its pathophysiology.

The epidemiological relevance of glaucoma is significant: according to the World Health Organization World Health Organization, it is among the main causes of irreversible blindness, impacting directly affect the quality of life of affected individuals and generate high social and economic. In Brazil, it is estimated that millions of people live with the disease, often without diagnosis, due to the absence of obvious initial symptoms.

The impact of glaucoma goes beyond the clinical field, as it involves social and economic aspects related to loss of productivity, functional dependence and overload of health services. Therefore, diagnostic and therapeutic advances play a central role in coping with the disease.

Thus, this narrative review seeks to explore the main advances in the management of glaucoma, highlighting everything from the incorporation of new diagnostic technologies to the expansion of therapeutic options.

2 THEORETICAL FRAMEWORK

Historically, the diagnosis and treatment of glaucoma have evolved significant. Clinical examination with tonometry and funduscopy was, for a long time, the main diagnostic tool. However, recent advances have allowed greater sensitivity in early detection.

The development of optical coherence tomography (OCT) has enabled analysis detailed view of the retinal nerve fiber layer, identifying changes even before the

functional loss. Furthermore, research with artificial intelligence has expanded the potential for screening and prediction of risk of progression.

In treatment, the use of hypotensive eye drops was revolutionary in the 20th century, significantly reducing the rate of blindness. However, the challenges of therapeutic adherence stimulated the creation of prolonged-release formulations and fixed combinations, simplifying schemes.

In the surgical field, trabeculectomy has established itself as the gold standard, but complications such as phlebitis and endophthalmitis have stimulated the emergence of alternatives minimally invasive, such as MIGS, which seek to balance efficacy and safety.

2. MATERIAL AND METHOD

This is a narrative literature review. The databases used were PubMed, Scielo and Google Scholar, including publications between January 2013 and December 2023. The descriptors applied were: 'glaucoma', 'diagnosis', 'treatment', 'surgery' and 'artificial intelligence'.

Original articles, systematic reviews, and consensuses of societies were included. medical and national and international clinical guidelines. The selection prioritized studies of clinical relevance, practical applicability, and technological innovation. Articles were excluded duplicates, studies with low methodological quality and isolated reports without general impact.

As a narrative review, quantitative meta-analysis methods were not applied, but we sought to synthesize relevant trends and findings that contribute to the understanding

3. RESULTS AND DISCUSSION

3.1 Advances in diagnosis

The diagnosis of glaucoma has undergone a revolution with the incorporation of tomography. optical coherence tomography (OCT), which allows precise measurement of fiber layer thickness nerve cells of the retina. Studies show that structural changes can precede the clinical manifestation of visual loss.

More recently, artificial intelligence has been applied to the analysis of exams image and visual fields, providing predictive algorithms with superior accuracy in compared to conventional methods. These tools have the potential to democratize tracking in areas with few specialists.

3.2 Advances in clinical treatment

Prostaglandin analogues remain the first line of treatment, due to its efficacy and safety. However, new extended-release formulations and combinations fixed reduced the frequency of instillations, improving patient compliance.

Sustained-release eye drops with nanotechnology are under development, with potential to maintain stable therapeutic concentrations for weeks or months, decreasing the need for daily use.

3.3 Laser therapy

Selective laser trabeculoplasty (SLT) has emerged as an effective alternative in both initial treatment and in cases of drug failure. The LiGHT study demonstrated similar efficacy between SLT and eye drops as first line, with advantages in adherence and long-term cost-benefit.

Technological evolution has also brought greater precision to devices, reducing complications and increasing reproducibility.

3.4 Surgical advances

Trabeculectomy, although effective, carries a risk of serious complications. The surgeries Minimally invasive glaucoma surgeries (MIGS) have emerged as an alternative, with lower morbidity, faster recovery and good outcomes in patients with mild to moderate. Devices such as iStent and Trabectome have shown promise, although they are still less effective in advanced cases.

The future points to combinations of MIGS with pharmacological therapies and lasers, expanding the therapeutic arsenal.

3.5 Current challenges

Despite advances, challenges persist. Unequal access to new technologies limits population benefits, especially in developing countries. Furthermore, low adherence to chronic treatment is still a universal problem, with a direct impact on disease progression. Educational campaigns, population screening, and public policies are essential to reduce the overall impact of glaucoma.

FINAL CONSIDERATIONS

Glaucoma remains one of the leading causes of irreversible blindness in world. Diagnostic advances, such as OCT and artificial intelligence, allow early detection, while new pharmacological, laser and minimally invasive surgical therapies expand the management possibilities.

However, barriers related to access and adherence limit the effectiveness of these progress. It is necessary to invest in large-scale tracking strategies, expand the access to modern technologies and strengthen public policies aimed at eye health.

Thus, the future of glaucoma management depends not only on medical innovations, but also the integration between science, clinical practice and public health.

REFERENCES

APTEI, F.; CHIQUET, C.; ROMANET, JP Intraocular pressure-lowering combination therapies with prostaglandin analogs. **Drugs**, vol. 72, no. 10, p. 1355–1371, 2012.

GAZZARD, G.; KONSTANTAKOPOULOU, E.; GARWAY-HEATH, D.; et al. Selective laser trabeculoplasty versus eye drops for first-line treatment of ocular hypertension and glaucoma (LiGHT): a multicenter randomized controlled trial. **Lancet**, vol. 393, no. 10180, p. 1505–1516, 2019.

MEDEIROS, FA; ZANGWILL, L.M.; BOWD, C.; MANSOURI, K.; WEINREB, RN The structure and function relationship in glaucoma: implications for detection of progression and measurement of rates of change. **Invest Ophthalmol Vis Sci**, v. 53, no. 11, p. 6939–6946, 2012.

QUIGLEY, HA; BROMAN, AT The number of people with glaucoma worldwide in 2010 and 2020. **Br J Ophthalmol**, v. 90, no. 3, p. 262–267, 2006.

SAKATA, K.; SAKATA, L.M.; SUSANNA, R. Jr. Glaucoma in Brazil: epidemiological and socioeconomic aspects. **Rev Bras Oftalmol**, v. 66, no. 6, p. 379–387, 2007.

SAHEB, H.; AHMED, II Micro-invasive glaucoma surgery: current perspectives and future directions. **Curr Opin Ophthalmol**, vol. 23, no. 2, p. 96–104, 2012.

THAM, Y. C.; LI, X.; WONG, T.Y.; QUIGLEY, HA; AUNG, T.; CHENG, CY Global prevalence of glaucoma and projections of glaucoma burden through 2040: a systematic review and meta-analysis. **Ophthalmology**, vol. 121, no. 11, p. 2081–2090, 2014.

TING, DSW; PASQUALE, LR; PENG, L.; CAMPBELL, JP; LEE, AY; RAMAN, R.; et al. Artificial intelligence and deep learning in ophthalmology. **Br J Ophthalmol**, v. 103, no. 2, p. 167–175, 2019.

WEINREB, RN; AUNG, T.; MEDEIROS, FA The pathophysiology and treatment of glaucoma: a review. **JAMA**, vol. 311, no. 18, p. 1901–1911, 2014.

DE CARVALHO, RL; CABRAL, RG; ROSARIO FERRER, Y. INTELLIGENT TUTORING SYSTEMS AS A TEACHING RESOURCE IN MATHEMATICS TEACHING.

HOLOS, [S. l.], v. 6, p. 1–11, 2019. DOI: 10.15628/holos.2019.7028. Available at: <https://www2.ifrn.edu.br/ojs/index.php/HOLOS/article/view/7028>. Accessed on: June 4, 2023.

ROSATELLI, MC, & Self, JA Supporting distance learning from case studies. In S. **P Lajoie, & M. Vivet (Eds.)**, Proceedings of 9th international conference on artificial intelligence in education, p. 457-564, April. 2000.