OPIS PRZYPADKU CASE REPORT

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The role of prostaglandin analogues and minimally invasive glaucoma surgery in long-term disease control: a case based-review



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HIGHLIGHTS

Close monitoring of glaucoma helps in early detection of disease progression and in on-time proper intensification of pharmacological therapy and implementation of glaucoma surgery.

ABSTRACT

Purpose: To present a case of long-term primary open angle glaucoma management and discuss various therapeutical approaches.

Case: During a 11-year long follow-up period of a 58-year-old woman with primary open angle glaucoma we observed signs of disease progression despite intraocular pressure within normal range and triple anti-glaucomatous therapy. Proper switch of therapeutic agent together with implementation of minimally invasive glaucoma surgery helped to maintain a stable condition.

Conclusion: Regular monitoring of glaucoma patients is crucial for recognition of early signs of progression in order to properly amend the pharmacotherapy or implement adequate surgical treatment.

Key words: primary open-angle glaucoma, latanoprost, trabecular micro-bypass stent, trabeculectomy ab interno

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INTRODUCTION

Primary open-angle glaucoma is a chronic, progressive optic neuropathy characterized by irreversible damage to the retinal nerve fiber layer (RNFL) and degeneration of retinal ganglion cells, resulting in visual field loss. The pathogenesis of glaucoma is multifactorial, with intraocular pressure (IOP) being the only well-established and modifiable risk factor [1]. However, disease progression may occur even in patients with adequate control of IOP, particularly when additional risk factors such as older age or systemic comorbidities are present.

The management of glaucoma relies primarily on lowering IOP through pharmacological therapy, laser procedures, or surgical interventions. Among conservative treatments, prostaglandin analogues deserve special attention, as they provide the greatest IOP reduction while lacking significant systemic side effects. Furthermore, minimally invasive glaucoma surgery (MIGS), often combined with phacoemulsification, represents an effective alternative, particularly for patients with mild to moderate disease.

CASE PRESENTATION

Baseline

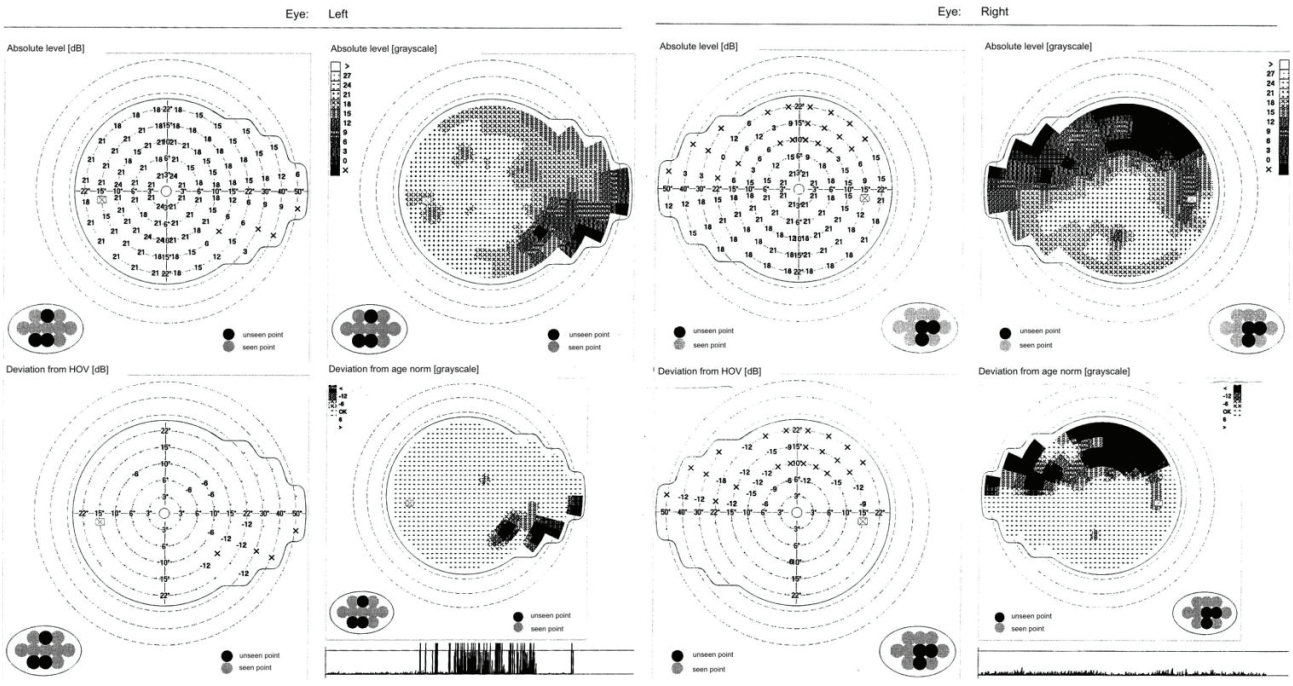
A 58-year-old female patient was referred to our outpatient clinic with a prior 14-year history of primary open-angle glaucoma. She had been treated with a fixed combination of dorzolamide and timolol eye drops twice a day together with brimonidine twice a day. The patient denied any ocular complaints or symptoms. On examination, her best-corrected visual acuity (BCVA) was 0.0 logMAR in both eyes. IOP was 17 mmHg and 18 mmHg in the right (OD) and left (OS) eye, respectively. Slit-lamp examination revealed bilateral lens opacities and enlarged optic disc cups with cup to disc ratio of 0,7 in both eyes. In gonioscopy the anterior chamber angles were classified as grade 3 in the Shaffer system. Angle measurement in the anterior segment optical coherence tomography presented 21° in the right eye and 29° in the left eye. Central corneal thickness was 539 µm in the right and 526 µm in the left eye. Both eyes were emmetropic. Baseline visual field testing showed early lesions presented in figure 1.

Baseline optic disc optical coherence tomography (OCT) demonstrated a RNFL thickness reduction in the inferior quadrant (49 µm) of the right eye and in the inferior quadrant (91 µm) of the left eye. Both eyes had enlarged optic nerve head cups, with vertical cup-to-disc ratio of 0.76 in the right eye and 0,86 in the left eye.

Based on these findings, glaucoma was classified as early in both eyes according to Glaucoma Staging System by Mills et al. [2]. Since no previous documentation was available concerning the baseline IOP, the current triple therapy was

FIGURE 1

Baseline visual field examination showing superior paracentral and peripheral defect with a nasal step in the right eye and inferior nasal step in the left eye. Statistical parameters indicate early stage of glaucoma: MD (mean deviation) = -0.034 dB, PSD (pattern standard deviation) = 2.2 dB in the right eye and MD = 0.0096 dB, PSD = 0.87 dB in the left eye.



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continued and the patient was scheduled for close follow-up every 3 months.

Follow-up

The patient has remained under observation for 11 years. During the initial period there was no significant disease progression. Follow-up examination in the fourth year of observation revealed gradual enlargement of the pre-existing right-eye defects (nasal step and paracentral defect extending toward the blind spot), despite numerical parameters of MD (mean deviation) = -0.034 dB and PSD (pattern standard deviation) = 2.1 dB. In the left eye enlargement of the nasal step and blind spot were noted, with MD = -0.034 dB and PSD = 1.4 dB. OCT demonstrated slight reduction in the RNFL thickness in the inferior quadrant (44 µm) of the right eye and in the superior (82 µm) and inferior (84 µm) quadrants in the left eye. Vertical cup-to-disc ratio was 0,81 in the right eye and 0,87 in the left eye. Throughout the 4 years of observation the visual acuity and IOP remained stable. Mean IOP was 16.62 (±1.34) mmHg in the right eye and 17.4 (±1.53) mmHg in the left eye. Given no significant progression and stable IOP, the existing therapy was continued.

In the sixth year of observation, visual acuity declined due to cataract progression, with slit-lamp findings of corticonuclear cataract, more advanced in the left eye. Since the BCVA decreased to 0.2 logMAR in the right eye and 0.4 logMAR in the left eye, the patient was qualified for surgical intervention. She underwent phacoemulsification combined with trabecular micro-bypass stent implantation in the left eye, without complications. Postoperatively the patient presented IOP reduction (15 mmHg) and visual acuity of 0.0 logMAR in the left eye. Antiglaucomatous therapy was continued as before. Initially, the patient was hesitant to undergo surgery in the fellow eye. Furthermore, in the following years, the patient did not attend medical appointments regularly due to the COVID-19 pandemic.

During the ninth year of follow-up, visual field testing revealed glaucomatous progression presented in figure 2, despite stable IOP values; mean IOP: OD = 16.2 (±1.64) mmHg, OS 15.2 (±1.10) mmHg. Concurrently, visual acuity dropped to 0.3 logMAR in the right eye due to further cataract progression. The patient agreed to proceed with phacoemulsification combined with trabeculectomy ab interno. Topical therapy was intensified to dorzolamide and timolol (both twice a day) and latanoprost once a day.

The latest examination revealed BCVA of 0,0 logMAR in both eyes and IOP of 11 mmHg in the right eye and 12 mmHg in the left eye. Optic disc OCT demonstrated a RNFL thickness reduction in the inferior quadrant (47 µm) of the right eye, in the superior (76 µm) and inferior quadrant (79 µm) of the left eye. Visual field is shown in figure 3. The patient has remained under further outpatient follow-up.

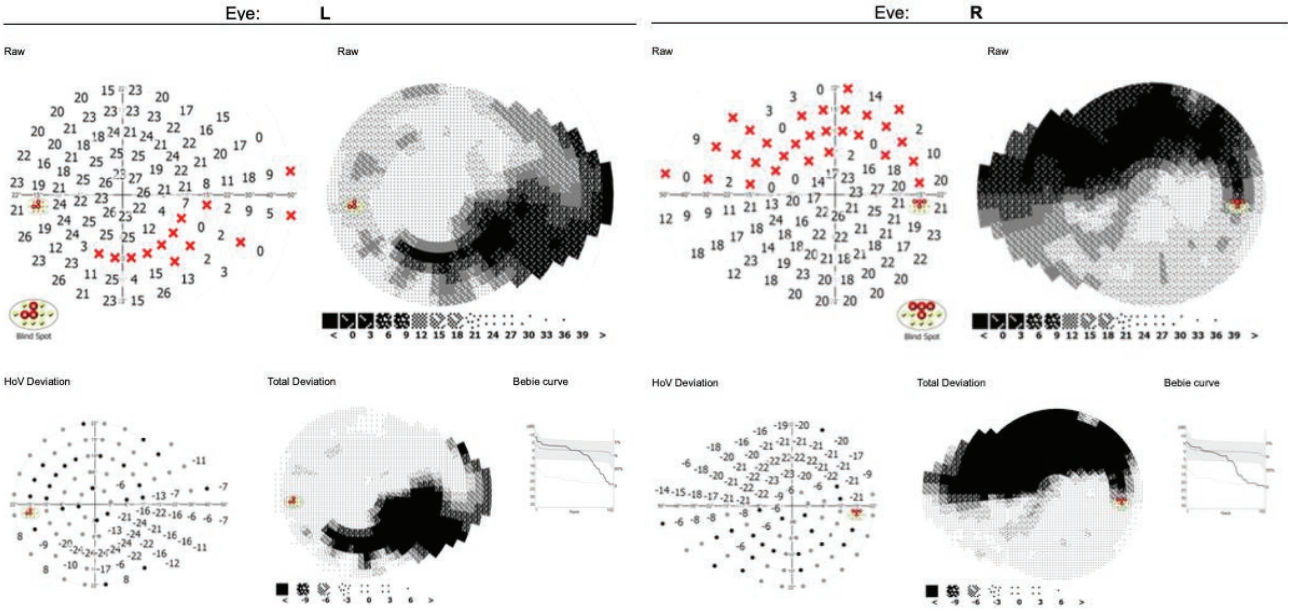
DISCUSSION

Risk factors for glaucoma progression

Faster progression of the glaucoma lesions in the further years of the follow-up despite IOP in the normal range in

FIGURE 2

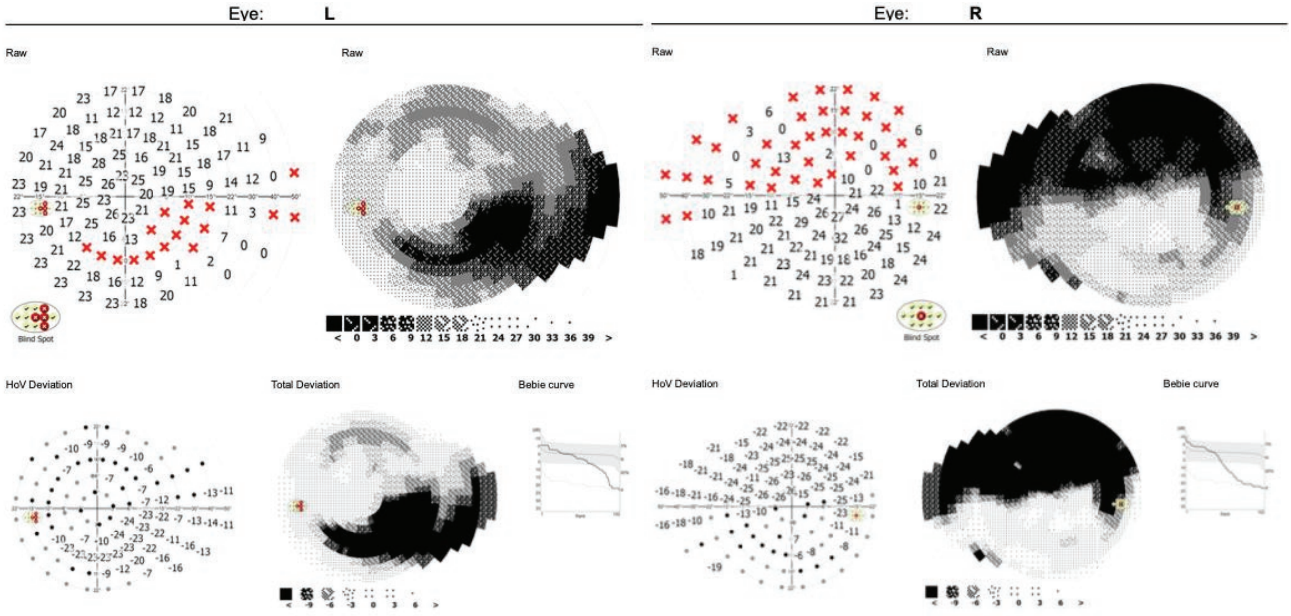
Visual field examination in the ninth year of observation showing progression of former scotoma. Exacerbation was also noted in the statistical values (OD MD = -7.48 dB, PSD = 10.20 dB; OS MD = -3.91 dB, PSD = 9.79 dB).



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FIGURE 3

Visual field examination in the eleventh year of observation showed a scotoma similar to that found in the previous examination. Statistical values were as follows: OD MD = -7.85 dB, PSD = 11.66 dB; OS MD = -5.68 dB, PSD = 9.50 dB. The progression of MD in the left eye was associated with the formation of posterior capsule opacification.



the described case have led us to search for plausible causes. Numerous studies have investigated factors associated with rapid glaucoma progression. Coleman et al. reported that baseline characteristics such as older age, higher IOP, and thinner central corneal thickness predict a faster rate of progression [3]. In our case, IOP remained stable throughout follow-up, suggesting other factors contributed to progression – most notably older age, which has been previously found to be also a risk factor for the development of open angle glaucoma [4, 5]. Jammal et al. demonstrated that, for the same IOP levels, older patients are more susceptible to glaucomatous damage [6]. Therefore, even in well-controlled cases, clinicians should remain alert as advancing age increases the risk of progression, particularly in patients older than 60–70 years [7–14].

Therapy intensification

Our patient initially presented with well-controlled IOP on triple therapy consisting of a non-selective β-blocker, a topical carbonic anhydrase inhibitor, and an α_2-adrenergic agonist. When glaucomatous progression was detected in the visual field examination the therapy must have been intensified. The α_2-agonist was replaced with a prostaglandin analogue, due to its superior IOP-lowering efficacy. Meta-analyses comparing monotherapy with brimonidine and latanoprost confirm greater IOP reduction with the latter [15–17]. Latanoprost is also preferred regarding side-effect profile [15–17], as prostaglandin analogues generally lack systemic adverse effects [18].

Microinvasive surgical alternatives

In this case, the patient underwent trabecular micro-bypass stent implantation in the left eye and and trabeculectomy ab interno in the right eye, both combined with phacoemulsification. Both these procedures belong to the category of minimally invasive glaucoma surgery and may be performed with cataract extraction to reduce medication burden in patients with mild-to-moderate glaucoma.

The trabecular micro-bypass stent is implanted into Schlemm's canal to enhance aqueous outflow from the anterior chamber. It has a safety profile comparable to phacoemulsification alone [19, 20]. Guedes et al. claim that patients who underwent combined phacoemulsification together with micro-bypass stent implantation experienced significant IOP reduction and could have reduced the number of used hypotensive eyedrops [21].

On the other hand, the principle of trabeculectomy ab interno is based on the selective removal and ablation of the trabecular meshwork and the inner wall of Schlemm's canal. This procedure appears to have a favorable safety profile compared to more invasive glaucoma surgeries such as trabeculectomy ab externo or implantation of drainage devices, as it carries a lower risk of post-interventional hypotony and spares patients from long-term filtration bleb complications [22]. It is also worth noting that trabeculectomy ab interno does not exclude the possibility of further glaucoma surgical interventions in the future [23]. Moreover, numerous studies have found it to produce a stronger and longer-lasting hypotensive effect compared to the

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above-discussed trabecular micro-bypass stent. Al Yousef et al. reported in a study comparing the effectiveness of phacoemulsification combined with micro-bypass stent implantation versus phacoemulsification combined with trabeculectomy ab interno that the latter achieved a stronger and more sustainable IOP reduction [24].

CONCLUSION

This case underscores that glaucoma progression may occur despite IOP within normal range, emphasizing that in certain cases in order to achieve good control over glaucomatous progression it is necessary to lower the IOP to the levels of lower limit of normal. While IOP is the single modifiable glaucoma risk factor, there are other determinants, that may lead to increased susceptibility to disease progression. Age-related cellular senescence, affecting trabecular meshwork and retinal ganglion cells, may further increase susceptibility to glaucomatous damage. The therapeutic switch to latanoprost resulted in satisfactory IOP control and disease stabilization. This highlights the importance of individualized treatment adjustment based on regular follow-up examinations and comprehensive patient evaluation. When medical therapy alone is insufficient, minimally invasive glaucoma surgery, including trabecular micro-bypass stent implantation or trabeculectomy ab interno, offers a safe and effective approach to further enhance IOP control while minimizing surgical risks.

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Analysis and interpretation of data: Jakub Gajdecki, Anna Michalska.
Drafting the article: Jakub Gajdecki.
Critical article revision: Anna Michalska, Paweł Stala.
Final approval: Jakub Gajdecki, Anna Michalska, Paweł Stala.

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