

Neuro-Ophthalmic Pharmacology In Retinopathy Management

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Abstract

Objective: This study aims to evaluate the use of pharmacological therapy in the management of neuro-ophthalmic disorders, specifically diabetic and hypertensive retinopathy and optic neuritis, by analyzing prevalence, therapeutic differences, and their statistical significance.

Methods: A retrospective-analytic study was conducted at the Clinic of Ophthalmology and the Clinic of Neurology, University Clinical Center of Kosovo, during the period January 2024 – January 2025. A total of 200 patients were included: 80 with diabetic retinopathy, 40 with hypertensive retinopathy, and 80 with optic neuritis. Data were collected from medical records and analyzed regarding the use of pharmacological treatments (anti-VEGF agents, intravitreal corticosteroids, systemic antidiabetics, and antihypertensives), with comparisons made across diagnostic groups.

Results: Diabetic retinopathy and optic neuritis were the most prevalent conditions (40% each), followed by hypertensive retinopathy (20%). Anti-VEGF agents were the most frequently used therapy in diabetic retinopathy (81.2%), antihypertensives in hypertensive retinopathy (87.5%), and intravitreal corticosteroids in optic neuritis (75%). Statistical analysis showed significant differences in drug utilization across diagnoses: the difference in anti-VEGF use between diabetic retinopathy and optic neuritis was highly significant ($p < 0.001$); corticosteroids were used significantly more often in optic neuritis ($p < 0.01$); while antihypertensives were predominantly used in hypertensive retinopathy ($p < 0.001$).

Conclusion: This study provides evidence on the rational and effective use of pharmacological therapies in neuro-ophthalmic conditions, demonstrating that treatment choice is strongly associated with the underlying pathology. The findings contribute to improving clinical guidelines for the management of retinopathies and optic neuritis in hospital practice in Kosovo.

Keywords: Neuro-ophthalmology; Retinopathy; Optic neuritis; Pharmacological therapy; Anti-VEGF; Corticosteroids

Introduction

Retinopathy particularly diabetic retinopathy (DR) and hypertensive retinopathy (HR) remains one of the leading causes of visual impairment worldwide. Globally, an estimated 537 million adults live with diabetes, and the burden is projected to rise significantly in the coming decades, with direct implications for DR incidence, especially in low- and middle-income countries where access to screening and treatment is limited (International Diabetes Federation & IAPB, 2023). Approximately 22% of individuals with diabetes are affected by some form of DR, although prevalence varies by region. For example, in the United States, an estimated 9.6 million adults (26.4% of people with diabetes) were living with DR in 2021, and 1.84 million had vision-threatening disease (Lundeen et al., 2023).

Hypertensive retinopathy is also highly prevalent among patients with chronic hypertension. Depending on population characteristics and blood pressure control, prevalence estimates range from about 28% to over 70%, reflecting both diagnostic variability and the strong impact of cardiovascular risk factors (Modi & Arsiwalla, 2023). Studies from Eastern Europe and the

Balkans report similarly high levels; for example, recent data from Sarajevo showed that nearly 40% of diabetic patients attending hospital clinics had some form of DR, aligning with global clinic-based prevalence estimates (Begić et al., 2025).

The neuro-ophthalmic dimension of these conditions has become increasingly relevant, as the retina is considered an extension of the brain. Both retinopathies and optic neuritis share underlying mechanisms, such as inflammation, oxidative stress, and neurovascular damage, which not only impair vision but also affect ganglion cell survival and visual pathways (Mollan et al., 2024). Pharmacological advances, particularly the introduction of intravitreal anti-VEGF agents and corticosteroids, have significantly improved outcomes in DR and HR and may also offer neuroprotective effects (Wang et al., 2024). Optic neuritis, although less common, remains clinically important, with prevalence estimates in the tens per 100,000 population, and requires rapid recognition and timely corticosteroid therapy to reduce long-term morbidity (Abbass et al., 2025).

In Kosovo, there is a paucity of epidemiological data on ocular and neuro-ophthalmic diseases. National reports have noted gaps in systematic eye care, and ophthalmic health is often described as a “blind spot” in the strengthening of healthcare systems (World Health Organization, 2024). Recent local research has highlighted the burden of ocular complications in diabetic patients: a 2024 study reported that nearly 70% of patients with type 2 diabetes had dry eye disease, while about 3% had DR (Zekaj et al., 2024). These findings underscore the need for more comprehensive studies on retinal and neuro-ophthalmic conditions in the Kosovar population.

Against this background, the present study aims to evaluate prevalence, pharmacological treatment patterns, and statistically significant therapeutic differences among patients with diabetic retinopathy, hypertensive retinopathy, and optic neuritis treated at the Clinic of Ophthalmology and the Clinic of Neurology at the University Clinical Center of Kosovo (UCCCK) between January 2024 and January 2025. By integrating international evidence with local data, this study seeks to provide novel insights that can inform context-specific clinical guidelines for neuro-ophthalmic care in Kosovo.

Materials and Methods

This research was designed as a retrospective-analytic observational study, focusing on the evaluation of pharmacological therapies in neuro-ophthalmic conditions. It was conducted at the Clinic of Ophthalmology and the Clinic of Neurology within the University Clinical Center of Kosovo (UCCCK) in Pristina, during the period from January 2024 to January 2025.

A total of 200 patients were included in the analysis, divided into three diagnostic groups: 80 patients with diabetic retinopathy, 40 patients with hypertensive retinopathy, and 80 patients with optic neuritis. Inclusion criteria required patients to be over 18 years of age, have a clinically confirmed diagnosis, and to have received specific pharmacological treatment at UCCCK. Exclusion criteria comprised patients with other ocular pathologies affecting vision (such as glaucoma, age-related macular degeneration, or ocular trauma), incomplete medical records, or patients under the age of 18.

Data were collected from both electronic and paper-based medical records, including demographic information (age, sex), type of pathology, duration of the underlying systemic disease (diabetes or hypertension), therapies administered (anti-VEGF agents, intravitreal corticosteroids, systemic antidiabetics, and antihypertensives), as well as documented clinical outcomes, such as changes in visual acuity and reported adverse effects.

Statistical analysis was performed using SPSS (Statistical Package for the Social Sciences), version 26. Descriptive statistics were applied to determine the prevalence of pathologies and therapies, while comparisons between groups were assessed using the Chi-square test. Statistical significance was defined as $p < 0.05$.

The study was conducted in accordance with the principles of the Declaration of Helsinki and was approved by the Ethics Committee of UCCCK. The use of patient data was permitted only after obtaining informed consent for their inclusion in scientific research.

Results

A total of 200 patients were analyzed in this study, distributed across three diagnostic groups: diabetic retinopathy, hypertensive retinopathy, and optic neuritis. The mean age of the participants was 55.3 ± 11.2 years, with 52% females and 48% males. Diabetic retinopathy and optic neuritis were the most frequent conditions, each accounting for 40% of cases, while hypertensive retinopathy represented 20%. Regarding therapies, anti-VEGF agents were predominantly prescribed for diabetic retinopathy, antihypertensives for hypertensive retinopathy, and corticosteroids for optic neuritis. Statistical analysis confirmed significant differences in the use of anti-VEGF and corticosteroids between groups, while systemic drugs were strongly associated with the underlying systemic condition. Adverse effects were generally mild and manageable, with transient ocular pain and increased intraocular pressure being the most common.

Table 1. Demographic characteristics of the study population

Variable	Diabetic Retinopathy (n=80)	Hypertensive Retinopathy (n=40)	Optic Neuritis (n=80)	Total (N=200)
Mean age (years)	57.8 ± 10.4	60.2 ± 9.8	49.6 ± 12.3	55.3 ± 11.2
Female (%)	44 (55.0%)	18 (45.0%)	42 (52.5%)	104 (52.0%)
Male (%)	36 (45.0%)	22 (55.0%)	38 (47.5%)	96 (48.0%)

Patients with hypertensive retinopathy were slightly older on average, while optic neuritis patients tended to be younger. The gender distribution was balanced across groups.

Table 2. Prevalence of diagnoses in the study population

Diagnosis	n	%
Diabetic retinopathy	80	40.0%
Hypertensive retinopathy	40	20.0%
Optic neuritis	80	40.0%

Diabetic retinopathy and optic neuritis each accounted for 40% of cases, whereas hypertensive retinopathy was less prevalent (20%).

Table 3. Pharmacological therapies by diagnosis (prevalence of drug use)

Therapy type	Diabetic Retinopathy (n=80)	Hypertensive Retinopathy (n=40)	Optic Neuritis (n=80)	Total (%)
Anti-VEGF	65 (81.2%)	25 (62.5%)	5 (6.2%)	95 (47.5%)
Intravitreal corticosteroids	10 (12.5%)	5 (12.5%)	60 (75.0%)	75 (37.5%)
Systemic antidiabetics	70 (87.5%)	5 (12.5%)	10 (12.5%)	85 (42.5%)
Antihypertensives	20 (25.0%)	35 (87.5%)	15 (18.7%)	70 (35.0%)

Anti-VEGF therapy was dominant in diabetic retinopathy, while antihypertensives were almost exclusively used in hypertensive retinopathy. Corticosteroids were the mainstay of treatment in optic neuritis.

Table 4. Comparison of anti-VEGF use between groups (Chi-square test)

Comparison	χ^2	p-value
Diabetic retinopathy vs. Optic neuritis	85.2	<0.001*
Hypertensive retinopathy vs. Optic neuritis	56.7	<0.001*
Diabetic vs. Hypertensive retinopathy	3.4	0.064

Anti-VEGF therapy use differed significantly between retinopathy groups and optic neuritis ($p < 0.001$). The difference between diabetic and hypertensive retinopathy was not statistically significant.

Table 5. Comparison of corticosteroid use between groups (Chi-square test)

Comparison	χ^2	p-value
Optic neuritis vs. Diabetic retinopathy	72.1	<0.001*
Optic neuritis vs. Hypertensive retinopathy	54.3	<0.001*
Diabetic vs. Hypertensive retinopathy	0.02	0.880

Corticosteroid use was significantly higher in optic neuritis compared to both types of retinopathy ($p < 0.001$). No significant difference was observed between diabetic and hypertensive retinopathy.

Table 6. Documented adverse effects of pharmacological therapies

Adverse effect	Anti-VEGF (n=95)	Corticosteroids (n=75)	Antihypertensives (n=70)	Antidiabetics (n=85)
Transient ocular pain (%)	10 (10.5%)	8 (10.7%)	0	0
Intraocular pressure rise (%)	2 (2.1%)	12 (16.0%)	0	0
Systemic side effects (%)	0	0	9 (12.9%)	11 (12.9%)

The most frequent adverse effects were transient ocular pain and increased intraocular pressure, especially with corticosteroid use. Systemic side effects were mainly noted with antihypertensives and antidiabetics.

Discussion

The findings of this study demonstrated that diabetic retinopathy and optic neuritis were the most frequent conditions, each accounting for 40% of the study population, while hypertensive retinopathy was less prevalent (20%). These results are consistent with international data, where diabetic retinopathy (DR) is considered one of the most common complications of diabetes mellitus, with a global prevalence of approximately 22% among patients with diabetes (Lundeen et al., 2023; International Diabetes Federation & IAPB, 2023).

As expected, anti-VEGF therapy was the predominant treatment for diabetic retinopathy in this cohort, reflecting its well-established role in the management of diabetic macular edema and proliferative retinopathy. The extensive use of intravitreal corticosteroids in optic neuritis patients also aligns with current neuro-ophthalmological evidence that emphasizes corticosteroids as the standard of

care in reducing inflammation and accelerating recovery of visual function (Mollan et al., 2024). These findings confirm that our clinical practice follows international therapeutic trends (Wang et al., 2024).

Antihypertensive agents were reported primarily among patients with hypertensive retinopathy, underscoring the fact that strict blood pressure control remains the cornerstone of management for this condition. The lower prevalence of hypertensive retinopathy in this study compared to diabetic retinopathy may reflect local demographic factors, disease awareness, or differences in the duration and severity of systemic diseases (Modi & Arsiwalla, 2023).

Adverse effects were generally mild and manageable. The most common ocular complication was an increase in intraocular pressure following corticosteroid administration, consistent with previous reports (Mollan et al., 2024). Systemic side effects were reported with antidiabetic and antihypertensive medications, at levels comparable to international literature (Zekaj et al., 2024).

This study provides one of the first systematic insights into the burden of neuro-ophthalmic conditions in Kosovo. Nevertheless, the retrospective design and the single-center nature of the study limit the generalizability of the findings. Future prospective studies with larger, multicenter cohorts will be necessary to validate these results and to provide a stronger evidence base for updating local clinical guidelines.

Conclusion

This retrospective-analytic study provides an important contribution to understanding the prevalence, therapeutic approaches, and clinical outcomes of neuro-ophthalmic conditions in Kosovo. Among the 200 patients analyzed, diabetic retinopathy and optic neuritis emerged as the most frequent pathologies, each accounting for 40% of the cases, while hypertensive retinopathy was less common at 20%. These findings align with international evidence, highlighting the growing burden of diabetic retinopathy as a major complication of diabetes mellitus worldwide, and confirming the clinical relevance of optic neuritis as a common neuro-ophthalmic disorder requiring timely intervention.

Pharmacological treatment patterns in this cohort were consistent with international therapeutic standards. Anti-VEGF agents were confirmed as the cornerstone therapy in diabetic retinopathy, intravitreal corticosteroids were predominantly used in optic neuritis, and antihypertensive agents were essential in hypertensive retinopathy. Statistically significant differences between groups in the use of anti-VEGF and corticosteroids emphasize the role of personalized treatment approaches tailored to the underlying pathology. Furthermore, the recorded adverse effects were generally mild and manageable, supporting the overall safety and effectiveness of these therapeutic regimens in real-world clinical practice.

The study also underscores the importance of contextualizing global therapeutic strategies within the local healthcare setting. In Kosovo, where epidemiological data on ocular and neuro-ophthalmic diseases are scarce, these results serve as baseline evidence that can inform both clinical decision-making and healthcare policy. Despite the retrospective and single-center design representing limitations, the findings provide an essential foundation for future prospective and multicenter studies. Ultimately, improving early detection, treatment, and prevention of these conditions is crucial to reducing vision loss and enhancing patient quality of life in Kosovo and similar healthcare systems.

Recommendations

1. **Early Screening and Prevention:** Establish systematic screening programs for diabetic and hypertensive patients at the primary care level to ensure early detection of retinopathy and timely referral to specialized care.
2. **Standardized Clinical Guidelines:** Develop and implement national protocols harmonized with international standards for the diagnosis and management of diabetic retinopathy, hypertensive retinopathy, and optic neuritis, emphasizing evidence-based use of anti-VEGF agents and corticosteroids.

3. **Strengthening Healthcare Infrastructure:**Improve access to modern diagnostic tools (OCT, fundus photography) and ensure the availability of essential pharmacological agents (anti-VEGF and intravitreal corticosteroids) in all tertiary centers in Kosovo.
4. **Capacity Building and Training:**Provide continuous medical education and training programs for ophthalmologists, neurologists, and general practitioners to enhance their ability to recognize, diagnose, and treat neuro-ophthalmic diseases effectively.
5. **Multicenter and Prospective Research:**Encourage multicenter collaboration across Kosovo and the region to conduct prospective studies with larger cohorts, enabling stronger evidence generation and cross-country comparisons.
6. **Integration into National Health Policy:**Integrate neuro-ophthalmic diseases into national health strategies, focusing on reducing preventable vision loss, lowering the burden of systemic diseases such as diabetes and hypertension, and improving patient quality of life.

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