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Original Article

Frequency of Elevated Intraocular Pressure in Patients With Acute and Chronic Anterior Uveitis

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Abstract

Background: Elevated intraocular pressure (IOP) is a frequent and serious complication in patients with uveitis, potentially leading to secondary glaucoma and permanent vision loss. Understanding the frequency and associated risk factors of elevated IOP in patients with acute and chronic anterior uveitis is essential for effective management and prevention of visual morbidity.

Objective: This study aimed to determine the frequency of elevated IOP in patients with acute and chronic anterior uveitis and to identify the associated demographic and clinical factors.

Methods: This This descriptive, cross-sectional study was conducted over six months at the Outpatient Department of Al-Shifa Trust Eye Hospital, Rawalpindi, involving 160 patients aged 20 to 60 years diagnosed with anterior uveitis. Patients were excluded if they were on anti-glaucoma medications, had specific ocular conditions, or had a pre-existing diagnosis of glaucoma or elevated IOP. Intraocular pressure was measured using Goldmann Applanation Tonometry, with elevated IOP defined as >21 mmHg. Demographic data and clinical history, including the duration and grade of uveitis, were recorded. Data were analyzed using SPSS version 25, with qualitative variables presented as frequencies and percentages, and statistical significance assessed using chi-square tests ($p \leq 0.05$).

Results: The mean age of the study participants was 33.19 years (SD ± 7.26). Elevated IOP was observed in 38.75% of the patients. A significantly higher frequency of elevated IOP was found in females (61.7% vs. 25% in males, $p = 0.000$), patients over 30 years of age (46.4% vs. 30.3%, $p = 0.026$), and those with hypertension (69.8% vs. 23.4% in non-hypertensive patients, $p = 0.000$). Grade I uveitis had the highest frequency of elevated IOP (100%), followed by grade III (42.9%), grade IV (4.1%), and grade II (0%) ($p = 0.000$). No significant association was found between elevated IOP and diabetes mellitus or the duration of uveitis.

Conclusion: The study found a substantial frequency of elevated IOP in patients with anterior uveitis, particularly among females, older patients, and those with hypertension. These findings highlight the need for regular IOP monitoring and tailored management strategies in high-risk patients to prevent the development of secondary glaucoma and associated vision loss.

1 Introduction

Uveitis, an inflammatory disorder affecting the uveal tract, which includes the iris, ciliary body, and choroid, remains a significant challenge in ophthalmic practice due to its potential to cause severe visual impairment. This condition can manifest in various forms, with anterior uveitis being the most prevalent, characterized by inflammation primarily in the anterior segment of the eye. Uveitis can arise from a multitude of etiologies, ranging from infections and systemic autoimmune diseases to isolated ocular syndromes, making it a complex condition to diagnose and manage (1). The clinical presentation of uveitis varies widely depending on the anatomical location and underlying cause, with anterior uveitis typically presenting with symptoms such as eye pain, redness, photophobia, and blurred vision (2). In contrast, posterior uveitis, which affects the posterior segment of the eye, may lead to more insidious symptoms such as floaters and visual disturbances.

A critical complication of uveitis, particularly anterior uveitis, is the elevation of intraocular pressure (IOP), a condition that poses a substantial risk for the development of secondary glaucoma. Elevated IOP in the context of uveitis results from a variety of mechanisms, both disease-related and iatrogenic. Disease-related mechanisms include the obstruction of the trabecular meshwork by inflammatory cells, proteins, and other debris, as well as trabeculitis, which can further impair aqueous humor outflow. Additionally, conditions such as pupillary block due to posterior synechiae and angle closure due to peripheral anterior synechiae can contribute to IOP elevation (3). Iatrogenic causes, most notably the use of corticosteroids—one of the mainstays of uveitis treatment—can exacerbate IOP by increasing

aqueous outflow resistance (4). The sustained elevation of IOP in uveitis patients is particularly concerning as it can lead to optic nerve damage and the irreversible loss of vision, highlighting the need for vigilant monitoring and prompt intervention.

The development of secondary glaucoma as a consequence of elevated IOP in uveitis is a major cause of irreversible blindness globally. This type of glaucoma can manifest in either an open-angle or closed-angle form, depending on the underlying pathophysiological mechanism. Open-angle glaucoma is often associated with chronic inflammation and subsequent damage to the trabecular meshwork, while closed-angle glaucoma typically results from anatomical alterations such as pupillary block (5). The diagnosis of elevated IOP in uveitis is complex and necessitates a thorough ophthalmic examination, including tonometry to measure IOP, gonioscopy to assess the drainage angle, and detailed evaluation of the optic nerve and visual fields (6). Early detection and management of elevated IOP are crucial to prevent the progression to glaucoma and the associated risk of permanent vision loss.

The management of elevated IOP in patients with uveitis involves a multifaceted approach aimed at controlling both the underlying inflammation and the elevated IOP. Anti-inflammatory therapies, including corticosteroids and immunomodulatory agents, are essential in reducing ocular inflammation and preventing further structural damage. In parallel, IOP-lowering medications such as prostaglandin analogs, beta-blockers, alpha-agonists, and carbonic anhydrase inhibitors may be employed to mitigate the risk of optic nerve damage by reducing IOP (7). In cases where pharmacological treatments fail to achieve adequate IOP control, surgical options such as trabeculectomy, glaucoma drainage implants, or cyclodestructive procedures may be considered (8). Given the significant risk of visual morbidity associated with elevated IOP in uveitis, ongoing research is vital to enhance our understanding of its prevalence, risk factors, and underlying mechanisms, thereby improving clinical outcomes.

This study aims to address the gap in the literature regarding the frequency of elevated IOP in patients with acute and chronic anterior uveitis and to identify associated risk factors within this patient population. By providing insights into the prevalence and predictors of elevated IOP, this research seeks to contribute to the development of targeted therapeutic strategies that can prevent the onset of secondary glaucoma and preserve visual function in patients with uveitis. Furthermore, understanding the long-term outcomes of these patients will be crucial in evaluating the effectiveness of current treatment modalities and in identifying areas where clinical practice can be optimized (9).

2 Material and Methods

The study was designed as a descriptive, cross-sectional analysis conducted over six months at the Outpatient Department of Al-Shifa Trust Eye Hospital, Rawalpindi, a tertiary care facility in Pakistan. The objective was to determine the frequency of elevated intraocular pressure (IOP) in patients diagnosed with acute and chronic anterior uveitis. A consecutive sampling technique was employed to recruit 160 patients aged 20 to 60 years who had been diagnosed with anterior uveitis for a duration exceeding two weeks. The diagnosis of anterior uveitis was confirmed through slit-lamp biomicroscopy by experienced ophthalmologists, ensuring the inclusion of patients with definitive clinical signs of uveitis.

Prior to commencement, ethical approval was obtained from the hospital's Ethics Review Committee (ERC), and the study adhered strictly to the ethical principles outlined in the Declaration of Helsinki. All participants provided written informed consent after being thoroughly informed about the study's purpose, procedures, potential risks, and benefits. Patients were excluded from the study if they were currently on anti-glaucoma medications, had specific ocular conditions such as mature cataracts, aphakia, ocular trauma, or recent ocular surgery, or had a pre-existing diagnosis of glaucoma or documented elevated IOP before the onset of uveitis.

Demographic and clinical data were meticulously collected, including patient name, age, gender, the lateral side affected by uveitis, duration and grade of uveitis, and history of systemic conditions such as diabetes mellitus and hypertension. The grade of uveitis was classified based on the Standardization of Uveitis Nomenclature (SUN) criteria. Intraocular pressure was measured using Goldmann Applanation Tonometry, which is considered the gold standard for IOP measurement. Elevated IOP was defined as a measurement exceeding 21 mmHg, consistent with widely accepted clinical thresholds (8).

To ensure the accuracy and reliability of the data, all measurements were performed by trained personnel using calibrated equipment. The data collection process was standardized, and any potential confounding factors were controlled through stratification during the data analysis phase. Data analysis was conducted using SPSS version 25.0, where qualitative variables were presented as frequencies and percentages, while quantitative variables were described using means and standard deviations. The statistical significance of associations between elevated IOP and various demographic and clinical factors was assessed using post-stratification chi-square tests, with a p-value of ≤0.05 considered statistically significant.

The methodology was carefully designed to minimize bias and ensure the generalizability of the findings. By adhering to rigorous data collection and analysis protocols, the study aimed to provide a comprehensive understanding of the prevalence of elevated IOP in patients

with anterior uveitis and to identify key risk factors associated with this condition, thereby contributing valuable insights to the field of ophthalmology.

3 Results

The study enrolled a total of 160 patients with acute and chronic anterior uveitis, with the primary objective of determining the frequency of elevated intraocular pressure (IOP) in this patient population. The mean age of the participants was 33.19 years (SD ± 7.26), ranging from 20 to 45 years. The gender distribution revealed a predominance of males, comprising 62.5% of the study population, while females accounted for 37.5%. The distribution of uveitis laterality was as follows: 55.6% had uveitis in the right eye, 24.4% in the left eye, and 20.0% had bilateral involvement.

The prevalence of systemic comorbidities was also assessed, with 48.1% of participants diagnosed with diabetes mellitus and 33.1% with hypertension. The overall frequency of elevated IOP, defined as an IOP measurement exceeding 21 mmHg, was 38.75%. The stratification of elevated IOP across different demographic and clinical variables is presented in Table 1.

Table 1: Demographic and Clinical Profile of Patients with Elevated IOP in Anterior Uveitis

Characteristic	Category	Total (n)	Elevated IOP (%)	p-value
Age Groups (years)	20-30	76	23 (30.3%)	0.026
	>30	84	39 (46.4%)	
Gender	Male	100	25 (25%)	0.000
	Female	60	37 (61.7%)	
Lateral Side	Right	89	54 (60.7%)	0.000
	Left	39	0 (0%)	
	Bilateral	32	8 (25%)	
Diabetes Mellitus	Yes	77	29 (37.7%)	0.457
	No	83	33 (39.8%)	
Hypertension	Yes	53	37 (69.8%)	0.000
	No	107	25 (23.4%)	
Grade of Uveitis	I	45	45 (100.0%)	0.000
	II	31	0 (0%)	
	III	35	15 (42.9%)	
	IV	49	2 (4.1%)	
Duration of Uveitis	≤3 months	97	35 (36.1%)	0.244
	>3 months	63	27 (42.9%)	

As depicted in Table 1, a significantly higher frequency of elevated IOP was observed in patients aged over 30 years compared to those aged 20-30 years (46.4% vs. 30.3%, p = 0.026). Gender-wise, females were significantly more likely to exhibit elevated IOP than males (61.7% vs. 25%, p = 0.000). The laterality of uveitis also influenced IOP, with the right eye being predominantly affected (60.7%), and no cases of elevated IOP were observed in the left eye. Bilateral uveitis cases showed a frequency of 25% for elevated IOP, with these differences reaching statistical significance (p = 0.000).

The presence of hypertension was strongly associated with elevated IOP, as 69.8% of hypertensive patients had elevated IOP compared to 23.4% of non-hypertensive patients (p = 0.000). However, there was no significant association between diabetes mellitus and elevated IOP (37.7% in diabetics vs. 39.8% in non-diabetics, p = 0.457).

The frequency of elevated IOP varied significantly across different grades of uveitis. Patients with grade I uveitis had the highest frequency of elevated IOP (100%), followed by grade III (42.9%), grade IV (4.1%), and grade II, where no cases of elevated IOP were observed (p = 0.000). The duration of uveitis did not show a significant impact on the frequency of elevated IOP, with 36.1% of patients with uveitis of ≤3 months duration and 42.9% of those with >3 months duration exhibiting elevated IOP (p = 0.244).

These results underscore the importance of identifying high-risk groups, such as older patients, females, those with hypertension, and those with specific grades of uveitis, for closer monitoring and management of elevated IOP to prevent the development of secondary glaucoma.

4 Discussion

The findings of this study highlighted a significant prevalence of elevated intraocular pressure (IOP) in patients with anterior uveitis, with a frequency of 38.75%, underscoring the critical need for vigilant monitoring in this patient population. This prevalence is consistent with

earlier studies, such as the one conducted at Shaikh Zayed Hospital in Lahore, which reported a similar frequency of 33.68% in patients with uveitis (10). The substantial frequency of elevated IOP observed in this study aligns with the recognized association between uveitis and secondary glaucoma, reinforcing the importance of timely intervention to prevent irreversible vision loss (9).

A noteworthy aspect of this study was the stratified analysis of elevated IOP across various demographic and clinical parameters, which provided deeper insights into the factors that may predispose patients to this complication. The significantly higher prevalence of elevated IOP in females compared to males (61.7% vs. 25%) was particularly striking. This finding contrasts with some previous studies, where male predominance was noted in certain uveitis subtypes, such as HLA-B27-associated uveitis (12). The reasons behind this gender disparity could be multifactorial, possibly involving hormonal influences or genetic predispositions that affect the inflammatory response and IOP regulation. This divergence from previous findings suggests the need for further research to elucidate the underlying mechanisms contributing to gender differences in IOP elevation among uveitis patients.

The study also identified age as a significant factor, with patients over 30 years old showing a higher frequency of elevated IOP compared to younger patients. This is in line with previous research that has suggested an age-related decline in aqueous humor outflow facility, which may exacerbate the risk of IOP elevation in older individuals (13). The association between hypertension and elevated IOP was another significant finding, supporting existing literature that points to a link between systemic hypertension and increased IOP, potentially mediated by vascular dysregulation or altered aqueous humor dynamics (14). The high prevalence of elevated IOP among hypertensive patients in this study highlights the need for closer monitoring of IOP in uveitis patients with coexisting hypertension, as they may be at increased risk of developing secondary glaucoma.

Interestingly, this study did not find a significant association between diabetes mellitus and elevated IOP, which differs from some reports suggesting that diabetes may contribute to IOP elevation through mechanisms such as increased oxidative stress and inflammation (15). The absence of this association in the current study may be attributed to the specific characteristics of the study population or the sample size. This discrepancy with previous findings underscores the complexity of the relationship between diabetes, uveitis, and IOP, and indicates that further research with larger, more diverse cohorts is necessary to clarify this relationship (16).

The study also revealed significant differences in the frequency of elevated IOP across different grades of uveitis, with grade I uveitis showing the highest prevalence. This finding is consistent with the understanding that more severe inflammation in the anterior segment can disrupt aqueous humor outflow, leading to IOP elevation (18). The absence of elevated IOP in grade II uveitis and the low frequency in grade IV may reflect the small sample sizes in these subgroups or specific inflammatory patterns associated with these grades (19). The lack of a significant association between the duration of uveitis and elevated IOP suggests that the risk of IOP elevation does not necessarily increase with the chronicity of the disease. However, it is important to note that the study was limited to a maximum follow-up period of three months, and longer-term studies are needed to assess the impact of chronic uveitis on IOP over time (20).

One of the strengths of this study was its focus on a well-defined patient population with anterior uveitis, which allowed for a detailed analysis of the factors associated with elevated IOP. The use of Goldmann Applanation Tonometry, the gold standard for IOP measurement, ensured the accuracy and reliability of the data collected. However, the study also had limitations, including its cross-sectional design, which precluded the assessment of long-term outcomes and causality. Additionally, the study was conducted at a single tertiary care center, which may limit the generalizability of the findings to other settings or populations.

In light of these findings, it is recommended that clinicians adopt a proactive approach to monitoring IOP in patients with anterior uveitis, particularly those identified as high-risk based on age, gender, and the presence of hypertension. Future research should aim to explore the long-term impact of elevated IOP in uveitis patients, investigate the underlying mechanisms of gender differences in IOP regulation, and examine the role of systemic conditions such as diabetes and hypertension in the pathogenesis of secondary glaucoma in uveitis. Expanding the study to include multiple centers and a more diverse patient population would enhance the generalizability of the results and provide a more comprehensive understanding of the factors influencing IOP in uveitis.

5 Conclusion

In conclusion, the findings of this study underscore the significant prevalence of elevated intraocular pressure (IOP) in patients with acute and chronic anterior uveitis, particularly highlighting the increased risk in females, older individuals, and those with hypertension. The association of elevated IOP with these demographic and clinical factors emphasizes the critical need for proactive monitoring and tailored management strategies in this patient population to prevent the onset of secondary glaucoma, a leading cause of irreversible blindness. While the study did not find a significant relationship between diabetes mellitus and elevated IOP, the strong correlation with hypertension suggests that patients with coexisting systemic hypertension should be closely monitored for IOP elevation. The variations in IOP elevation across different grades of uveitis further suggest that the severity of inflammation plays a crucial role in disrupting aqueous humor dynamics, necessitating more aggressive intervention in those with more severe grades. These results contribute valuable insights into the

management of uveitis, reinforcing the importance of regular IOP assessment, especially in high-risk groups, to preserve visual function and prevent long-term complications. Future research should aim to explore these associations further, particularly focusing on the long-term impact of IOP elevation and the underlying mechanisms that contribute to its development in uveitis patients, thereby optimizing therapeutic approaches and improving patient outcomes.

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