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Original Article

The Change in Intraocular Pressure After Intravitreal Injection of Anti-VEGF

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Author`s Contribution
[1,2,6]Drafting the work or revising it critically for important intellectual content, analysis, or interpretation of data for the work, [4]Final approval of the study to be published, [5,6]Substantial contributions to the conception or design of the work; or the acquisition, [3]analysis, drafting,

Conflict of interest: None
Funding source: None

Article received: 18-02-26
Article accepted: 04-04-26

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A B S T R A C T

Objective: To determine the alteration in intraocular pressure (IOP) following intravitreal injection of anti-VEGF.

Methods: A prospective observational study was conducted at Sindh Institute of Ophthalmology and Visual Sciences, Hyderabad, from August 2025 to January 2026, on 49 patients who received intravitreal anti-VEGF injection for various retinal conditions. IOP was measured using Goldmann applanation tonometry at baseline, and at defined intervals post-injection including 30 minutes, 24 hours, one week, and at one month following the procedure. Cases with pre-existing glaucoma or ocular hypertension were noted individually. All the relevant data were analyzed using SPSS version 23 at significance level of $p<0.05$.

Results: Overall average age of participants was 60.29±8.67 years, with a male predominance of 73%. Baseline IOP mean was 14.2 mmHg, which raised significantly to 22.6+8.4 mmHg at 30 minutes post-injection ($p<0.001$), demonstrating an average acute rise, while returned toward baseline in most of the cases within 24 hours, recording a mean value of 15.8 ± 3.1 mmHg ($p>0.05$). Subsequently by 24 hours to 1 week, IOP returned to baseline with no clinically meaningful changes ($p>0.05$), indicating that the acute post-injection IOP elevation is short-lived and self-resolving in most of the patients.

Conclusion: The anti-VEGF intravitreal injections noted to be the safe regardless of causing acute, transient IOP elevation that peaks immediately post-injection and declines sharply within one hour in most cases, subsequently fully normalizing by 24 hours without prolong effects.

Keywords: IOP, anti-VEGF, intravitreal injection, ocular hypertension

Introduction

Intravitreal drug administration provides targeted therapeutic effects and minimal systemic exposure, while overcoming the limitations associated with other topical/systemic therapies. Treatment durability and patient compliance have also enhanced with advancements in drug formulations and drug delivery via sustained-release.[4,5] Despite potential advantages of anti-VEGF agents, complications associated with the procedure and frequency of intravitreal injections may not be neglected. These complications include, but not limited to, intraocular pressure elevation, cataract formation, vitreous hemorrhage, retinal detachment, and endophthalmitis.[6,7]

Intraocular pressure (IOP) plays a critical role in maintaining ocular structure and function by balancing production and outflow of aqueous humor. Disruption in IOP can affect optic nerve and ocular perfusion, leading to ocular glaucoma, hypertension, or hypotony.[6] Changes in intraocular pressure (IOP) is one of the most commonly reported complication that has been linked to compromised optic nerve health and glaucoma progression.[7,8] Intravitreal injections, especially Anti-VEGF, have been found to disrupt

production-outflow balance of aqueous humor, where the injected fluid increases intraocular volume. This volume-related mechanical effect leads to transient elevations in IOP. The short-term IOP elevation is usually well tolerated and normalizes in less than 60 minutes.[9,10] Although, the transient spikes in IOP that arise within minutes after injection are self-limiting, in some cases these spikes may exceed 50 mmHg before returning to normal. The magnitude and duration of IOP elevation may vary depending on baseline IOP, axial length and ocular rigidity, presence of glaucoma, and volume of injected drug.[10,11] The recurrent intravitreal injections may lead to sustained elevation in IOP through obstruction of the trabecular meshwork, subclinical inflammation, and structural damage to outflow pathways, with secondary glaucoma development have also been documented. These repeated fluctuations in IOP may contribute to optic nerve damage over time, emphasizing the need for cautious use of anti-VEGF injections and long-term monitoring of these patients. [12,13] Moreover, variations in injection technique, syringe design, and drug formulation may further complicating the IOP behavior after intravitreal injection.[14] In spite of the high frequency of this procedure worldwide, the evidence base remains limited specifically at local level along with short follow-up, and the inconsistent methodology. However present conducted to systematically measuring IOP changes before and after injection at different time points, and categorizing at-risk patients ultimately enabling safer, more informed clinical practice.

Methodology

A prospective observational study was conducted on 51 patients to assess the changes in IOP following intravitreal injection of anti-VEGF agents, at Sindh Institute of Ophthalmology and Visual Sciences. All the patients with confirmed diagnosis of the retinal conditions requiring intravitreal anti-VEGF therapy, aged 18 years or older, both genders, scheduled to receive at least three intravitreal injections as part of their planned treatment and attend all the scheduled follow-up visits were included, while patients with pre-existing diagnosis of glaucoma or ocular hypertension (baseline IOP exceeding 21 mmHg) with history of currently using IOP-lowering treatment, patients undergone intraocular surgery within the preceding six months, patients contraindicated to use of any anti-VEGF agent and patients with active intraocular inflammation or the infection were excluded.

Anti-VEGF agents who used during study, their selection was made by the treating ophthalmologist based on the clinical diagnosis and indication of the patients, independent of the study, and patients remained in the same agent group throughout the study period. Anti-VEGF agent (Bevacizumab) was performed under standardized aseptic conditions. The topical anaesthesia was administered using proxymetacaine 0.5% eye drops, and povidone-iodine 5% was used to the conjunctival sac and periocular skin and allowed a minimum contact time of three minutes. Following sterile draping and placement of a lid speculum, the injection was delivered at 3.5 to 4.0 mm posterior to the limbus in the inferotemporal or superotemporal quadrant using a 30-gauge needle. Optic disc perfusion and light perception were assessed immediately following injection, and topical chloramphenicol 0.5% was instilled at the conclusion of the procedure. Intraocular pressure was measured using Goldmann applanation tonometry, the internationally accepted gold standard for IOP evaluation.

Subsequently the IOP was recorded at four standardized time points: immediately before injection and prior to any topical medication administration (baseline), at thirty minutes post-injection to assess near-peak elevation and early resolution; at twenty-four hours post-injection to evaluate short-term pressure changes; at one week post-injection to confirm resolution of the acute response and immediately before the subsequent injection cycle to detect any cumulative IOP change between treatment sessions. Each measurement was recorded as the mean of two consecutive readings; with a third reading taken if the first two differed by more than 2 mmHg. All the patients were assessed for mean change in IOP from baseline to each post-injection time points. All the data was recorded by study proforma. Data was entered and analyzed using by the SPSS version 26.

Results

According to the baseline characteristics of 51 patients undergoing ocular treatment, the patient's mean age was 60.3±8.7 years, male predominance (73%) and left treated eye more often (57%). Preoperative intraocular pressure (IOP) was 17.4±2.3 mmHg, average central corneal thickness was 511±30 µm, and mean cup-to-disc ratio was 0.54±0.20. According to comorbidities diabetes was highly prevalent among (84%) cases, followed by hypertension in 33%, and known glaucoma patients were 12%. Table I.

Table I: Baseline and clinical analysis of the patients. (n=51)

Baseline Variables	Statistics	
Age (mean)	60.29±8.67	
IOP pre-injection	17.35±2.30	
Central corneal thickness	511.17±30.04	
Cup-to-disc ration	0.54±.19	
Gender		
Male	37	72.5%
Female	14	27.5%
Eye treated		
Right eye	22	43.1%
Left eye	29	56.9%
Hypertension		
Yes	17	33.3%
No	34	66.7%
Known glaucoma		
Yes	6	11.8%
No	45	88.2%
Diabetes mellitus		
Yes	43	84.3%
No	8	15.7%

In this study mean baseline IOP was 14.2 mmHg, swelling to 35.8+21.6 mmHg, (p=0.001) at 5 minutes, then declining gradually: 27.5+13.3 mmHg at 10 minutes, to 22.6+8.4 mmHg at 30 minutes and 16.1+1.9 mmHg at 1 hour (p=0.001). Additionally, by 24 hours to 1 week, IOP returned to baseline with no clinically meaningful changes (p=>0.05), indicating that the acute post-injection IOP elevation is short-lived and self-resolving in most of the patients. Table II & figure 1.

Table II: Change in intraocular pressure after intravitreal injection of anti VEGF.

Timepoint	Mean IOP (mmHg)	Mean Δ (mmHg)	SD	p-value
Baseline (T0)	14.2	—	2.1	—
5 min	35.8	+21.6	6.2	0.0001
1 hour	16.1	+1.9	2.6	0.0001
24 hours	14.3	+0.14	2.6	0.351
1 week	14.2	+0.06	2.3	0.602
1 month	14.0	-0.14	2.2	0.224

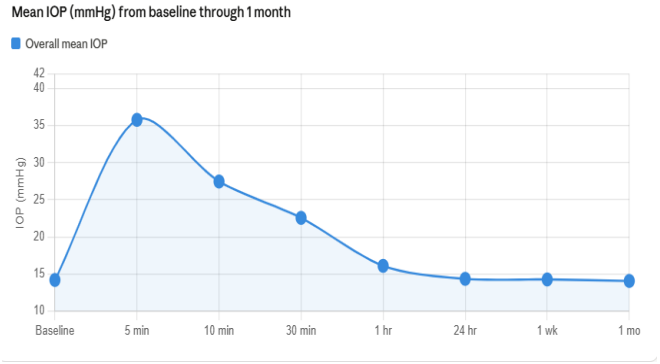

Figure I. IOP trajectory over time. (n=51)

Out of all, sustained IOP elevation (>25 mmHg) occurred among 5(9.8%) of the patients, ocular hypertension needing treatment was rarer around 5.9%, while subconjunctival hemorrhage affected the 7 cases, and endophthalmitis was 3.9%; however no retinal detachment, vitreous hemorrhage, or central retinal artery occlusion found in any case. Table III

Table III: Complications occurrence among patients. (n=51)

Complications		N	%
Sustained IOP elevation (>25 mmHg)	Yes	5	9.8
	No	46	90.2
Ocular hypertension requiring treatment	Yes	03	05.9
	No	48	94.1
Subconjunctival hemorrhage	Yes	7	13.7
	No	44	86.3
Endophthalmitis	Yes	2	3.9
	No	49	96.1
Retinal detachment	Yes	--	--
	No	51	100%
Vitreous hemorrhage	Yes	--	--
	No	51	100%
Central retinal artery occlusion	Yes	--	--
	No	51	100%

Discussion

The changes in IOP following intravitreal anti-VEGF injections has emerged as an imperative safety concern, assumed the widespread and recurrent usage of these agents in the disease of retina. Even temporary IOP spikes may have implications clinically, specifically in the cases with pre-existing glaucoma or the other optic nerve susceptibilities. Present study was conducted to assess the pattern and magnitude of IOP alteration after intravitreal anti-VEGF injection to better understand their potential

impact on the ocular health. In this study, mean age of the patients undergoing ocular treatment was 60.3±8.7 years, with male predominance (73%), left eye was more often treated (57%). Consistent baseline statistics were documented in the study of Omay E et al[15] who reported mean age of 63.58 ± 11.04 years, with majority of males (51.4%). Similarly, in the study of Liu Y et al[9] mean age of patients was 63.1±13.1 years, while majority of their participants comprised female patients (51%).

In this series, diabetes (84%) was the most prevalent comorbidity, followed by hypertension (33%), and known glaucoma patients were 12%. Comparably, in the study of Owusu-Afriyie B et al[16] found significantly high rates of hypertension (57.0%) and diabetes (52.6%) among patient seeking ophthalmic services, Similarly, in the study conducted by Zafar S et al[17] all of the participants had diabetes, majority of patients had diabetic retinopathy (27.5%), and only 0.8% of the patients received intravitreal anti-VEGF injections. These findings suggest that hypertension and diabetes represent a major systemic background among patients seeking medical and surgical care for eye diseases, supporting high pro patients requiring anti-VEGF therapy. Consistently, in the study carried out by Shah SM et al[18] prevalence of glaucoma was 6.9% in those receiving intravitreal anti-VEGF for neovascular age-related macular degeneration (nAMD), while in non-exudative AMD controls and in non-AMD controls, glaucoma was noted in 9.7% and 8.5% respectively.

In this study, mean baseline IOP was 14.2 mmHg, which significantly increased to 35.8+21.6 mmHg at 5 minutes after intravitreal therapy (p=0.001). Moreover, significant gradual decline in IOP occurred to 27.5+13.3 mmHg at 10 minutes, to 22.6+8.4 mmHg at 30 minutes, and normalized (16.1+1.9 mmHg) at 1 hour (p=0.001). Aligning with these findings, in the study of Mahar PS et al[19] mean IOP at baseline was 12.12 ± 2.11 mmHg, which significantly increased to 30.44 ± 6.53 mmHg at 5 minutes of intravitreal injection. Subsequently, IOP (mmHg) declined to 26.3 ± 4.6 at 30 minutes, to 26.1 ± 3.3 at 1 hour, to 25.6 ± 3.0 at 2 hour, and returned to baseline (12.1 ± 2.1) at 3 hour post- intravitreal injection (p < 0.001). Correspondingly, the study by Abbasi KZ et al[20] reported baseline IOP was 13.3+2.8 mmHg, which showed statistically significant rise to 30.89+5.65 mmHg immediately after injection, with gradual reduction at 30 minute (23.08+4.51 mmHg) and 60 minutes (18.14+2.62 mmHg); p < 0.001.

In our study cohort, IOP returned to baseline by 24 hours and showed no clinically meaningful change up till 1 week (p=>0.05), indicating that the acute post-injection IOP elevation is short-lived and self-resolving in most of the patients. In agreement, a study conducted by Zafar R et al[21] found a significant immediate increase in IOP from 16.16 to 44 mmHg to after intravitreal bevacizumab injection, which spontaneous declined to normal at 30 minutes, suggesting usually self-limiting nature of IOP spikes.

Consistently, the study conducted by Frenkel MP et al[22] concluded that IOP spikes following intravitreal anti-VEGF injections mostly short-lived and self-resolving. Furthermore, in current study, sustained IOP elevation (>25 mmHg) occurred among 9.8% of the patients, ocular hypertension needing treatment was rarer around 5.9%, while subconjunctival hemorrhage affected the 13.7% cases, and endophthalmitis was 3.9%; however no retinal detachment, vitreous hemorrhage, or central retinal artery occlusion found in any case. In line with these findings, the study conducted by Good TJ et al[23] found that sustained IOP elevation occurred in 6% of eyes, requiring intervention.

Moreover, sustained IOP elevation risk was markedly higher in eyes with pre-existing glaucoma (33%) compared to those without (3.1%); p<0.001. Similarly, in the study carried out by Bergamo VC et al[24] endophthalmitis occurred in 0.20% cases after intravitreal injections. Another study conducted by Sachdeva MM et al[25] reported subconjunctival hemorrhage in approximately 10% of cases following intravitreal anti-VEGF injections.

Overall findings of this study mostly consistent with the present literature, which approximately approves that intravitreal anti-VEGF injection produces a significant acute elevation in intraocular pressure, with cumulative sustained elevation reported in a subset of patients receiving long-term repeated treatment.

Though, numerous limitations must be acknowledged, as well as very limited sample size which may limited the statistical power for subgroup analyses, the inability to draw agent-specific conclusions across due to unequal group distribution, and the heterogeneity of patient indications and comorbidities including diabetes mellitus, hypertension, variable lens status, and differing baseline optic nerve characteristics which introduced confounding variables not fully controlled for in the current design and specifically lack of control group. Such significant limitations may reduce the generalizability of the findings, and further large-scale randomized studies are recommended to confirm the findings and establish the clear IOP monitoring guidelines for the cases on long-term anti-VEGF therapy.

The anti-VEGF intravitreal injections observed to be the safe regardless of causing acute, transient IOP elevation that peaks immediately post-injection and declines sharply within one hour in most cases, subsequently fully normalizing by 24 hours without long-term effects. Overall, findings indicate an excellent IOP safety profile, supporting their routine uses without the need for mandatory paracentesis, except in high-risk diabetes and glaucoma cases. However due to several limitations specifically very limited sample of study, further, multicenter prospective large-scale studies should be done to validate the findings and confirm the long-term IOP safety of anti-VEGF intravitreal injections.

Conclusion

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