



## Original Research Article

## Prevalence of steroid-induced glaucoma among patients suffering from vernal kerato-conjunctivitis in central India

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## ABSTRACT

**Background:** The present study is aimed to assess the prevalence of steroid-induced glaucoma in vernal kerato-conjunctivitis patients treated with topical steroids and to determine the association between different types of topical steroids and the presence of steroid-induced glaucoma.

**Methodology:** This study was conducted as a hospital-based cross-sectional study on patients belonging to the age range of 8 years to 18 years who were already diagnosed with vernal kerato-conjunctivitis and were using topical steroids as treatment. Detailed clinical history and ophthalmologic examination were done. Depending upon the potency of steroids and their intra-ocular pressure raising potential, patients were categorized into one of the 4 groups (A, B, C, D).

**Results:** Intra-ocular pressure levels were raised in 32.9% of the patients managed with topical corticosteroids. Steroid-induced glaucoma was observed in 15 (6.1%) of the patients with vernal kerato-conjunctivitis. Steroid-induced glaucoma was significantly associated with prolonged duration of corticosteroids and high potency corticosteroid use ( $p < 0.05$ ).

**Conclusion:** Steroid-induced glaucoma is one of the common complications of injudicious and long-term use of topical corticosteroids particularly high potency steroids. Approximately one-third of the patients on treatment for vernal kerato-conjunctivitis are corticosteroid responders. High potency steroids and prolonged use of steroids are factors associated with steroid-induced glaucoma.

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## 1. Introduction

Vernal keratoconjunctivitis (VKC) is a chronic, usually bilateral, and sometimes asymmetrical condition of the eye, which is characterized by seasonal exacerbations, or allergic inflammation involving the ocular surface. The disease may involve bulbar as well as tarsal conjunctiva and has been reported to be more common in warmer climates, among children and young adults, and those with other atopic conditions.<sup>1</sup> The underlying etiology of VKC is multifactorial and is attributed to multiple factors including climate, environmental allergens, and

genetic predisposition.<sup>2</sup> The condition is described as an IgE- and T cell-mediated allergic reaction which may be associated with non-specific hypersensitivity reactions. Apart from this, cytologic, immunohistologic, biohumoral, and molecular studies have suggested VKC as Th2 lymphocyte-mediated disease and the role of Th1-type cytokines, mast cells and eosinophils, chemokines, growth factors, and enzymes have also been suggested in the etiopathogenesis of VKC.<sup>3</sup>

The management of VKC depends upon the severity of the symptoms. Antihistamines, mast cell stabilizers, and antiallergic eye drops are most commonly prescribed whereas decongestants are added as adjunctive therapy

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to the antihistaminics/ antiallergics in cases with mild to moderate disease. Topical steroids are indicated in moderate to severe VKC which act by downregulating conjunctival inflammation.<sup>2</sup> Topical steroids are prescribed for a prolonged duration in the management of VKC. Though initially the topical steroids reduce the ocular inflammation and alleviate inflammatory features, injudicious use of topical corticosteroids may lead to sight-threatening complications, of which steroid-induced glaucoma (SIG) is the most serious one which may lead to permanent visual disability.<sup>4,5</sup>

The requirement for topical corticosteroids is higher in severe VKC and thus, severe VKC and a higher need for TCS may lead to more symptomatically devastating complications. In our clinical practice, we observed increased intraocular pressure in follow-up cases of VKC, this could be attributed to the injudicious use of topical corticosteroids due to their over-the-counter availability and prescription in wrong doses and for the wrong duration by the pharmacist, general physicians, and quacks.<sup>5</sup> The present study aimed to assess the prevalence of SIG in VKC patients treated with topical steroids and to determine the association between different types of topical steroids and the presence of SIG.

## 2. Methodology

This study was conducted as a hospital-based cross-sectional study in the Department of Ophthalmology attending a tertiary care center. All the patients belonging to the age range of 8 years to 18 years who were already diagnosed with VKC and were using topical steroids as treatment were included whereas patients with eye trauma, previous ocular surgeries, developmental or congenital glaucoma, or any angle anomalies were excluded.

After obtaining ethical clearance from Institute's ethical committee, all the cases fulfilling inclusion criteria were enrolled and consent was obtained from their guardians or relatives. Using a questionnaire, basic demographic data was obtained. Detailed clinical history including the drug name, dosage, frequency, and duration of topical steroids was noted. A detailed ophthalmologic examination was done which included visual acuity testing using Snellen's chart, and a slit-lamp examination of the anterior segment of the eye to re-confirm the presence of VKC. Intra-ocular pressure (IOP) was measured using Goldman's Applanation tonometer, 3-mirror Gonioscopy was also done to rule out any pre-existing angle anomalies, and visual field analysis using Humphrey's field analyzer (24-2), and the findings were documented.

A detailed fundus examination with optic nerve head evaluation using a +90 D Volk lens to look for vertical cup-disc ratio, neuro-retinal rim, and cup-asymmetry was done, and the findings were documented. Depending upon the potency of steroids and their IOP raising potential, patients

were categorized into one of the 4 groups (A,B,C,D).<sup>6</sup>

1. Group A- High potency- Dexamethasone and Betamethasone.
2. Group B- Moderate potency- Prednisolone.
3. Group C- weak potency- Loteprednol and Fluorometholone.
4. Group D- unknown drug group.

Patients with intraocular pressure >21 mmHg in two consecutive follow up were given topical anti-glaucoma medications and were monitored for optic nerve head changes and visual field changes were analyzed using a Humphrey field analyzer. Patients with a low IOP range < 40 mmHg were managed with topical Brimonidine and Timolol combination twice a day. Patients with IOP of more than 40 mmHg were managed with intravenous mannitol and systemic acetazolamide 250 mg thrice a day. Patients were asked to follow up every 3 months for monitoring.

### 2.1. Statistical analysis

Data compilation was done with the help of MsExcel and analysis was done using IBM SPSS software version 20. Categorical variables were expressed as frequency and proportion whereas continuous variables were expressed as mean and standard deviation. Association between different types of topical steroids and the severity of SIG was done using a chi-square test. A p-value of less than 0.05 was considered statistically significant.

## 3. Results

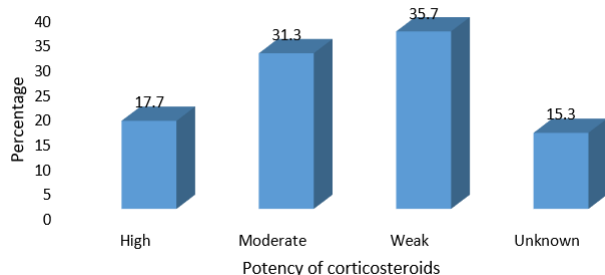
The present study was conducted on a total of 249 cases of VKC managed using topical corticosteroids.(Table 1)

**Table 1:** Distribution according to baseline variables

Baseline variables	Frequency (n=249)	Percentage
Age (years)	8-12	40.9
	13-15	39.4
	16-18	19.7
Sex	Male	62.7
	Female	37.3
Mean age at onset	12.2±3.6 years	
Mean Duration of TCS	17.23±2.5 months	
Past history	Asthma	18.1
	Eczema	21.7
	Allergic rhinitis	12.8
	Family history of atopy	12.0
		30

In the present study, the mean age of the children with VKC was 13.8±3.2 years and the majority i.e. 62.7% of the patients with VKC on steroids were males. The mean age at

onset of VKC was  $12.2 \pm 3.6$  years and the mean duration of use of TCS was  $17.23 \pm 2.5$  months. The majority of children had a history of eczema (21.7%), whereas asthma and allergic rhinitis were observed in 18.1% and 12.8% of the cases respectively.



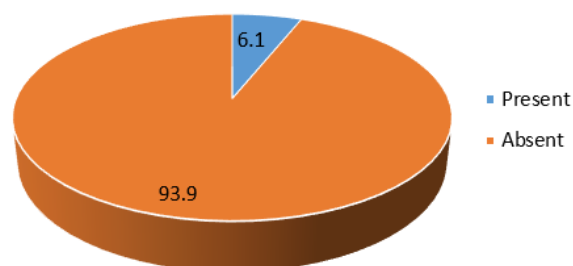
**Fig. 1:** Distribution according to potency of corticosteroids

The majority of children were taking weak potency of corticosteroids (35.7%), whereas 31.3% of patients were using moderate potency corticosteroids. Only 17.7% of the patients with VKC were using high-potency corticosteroids. (Figure 1)

**Table 2:** Distribution according to IOP levels

IOP	Frequency (n=249)	Percentage
Normal	167	67.1
Raised	82	32.9

IOP levels were raised in 32.9% of the patients managed with topical corticosteroids. (Table 2)



**Fig. 2:** Prevalence of steroid induced glaucoma

Steroid-induced glaucoma was observed in 15 (6.1%) of the patients with VKC. (Figure 2)

Steroid-induced glaucoma was significantly associated with prolonged duration of corticosteroids and high potency corticosteroid use ( $p < 0.05$ ). (Table 3)

The majority of patients had intraocular pressure in the range of 30–40 mmHg. The mean IOP was  $35.53 \pm 7.1$

mmHg. The majority of patients were having cupping in the range of 0.5 to 0.7 with mean cupping of  $0.56 \pm 0.13$ . On gonioscopy, all patients had open angles in all four quadrants in both eyes. (Table 4)

#### 4. Discussions

Corticosteroids are the mainstay of management of moderate to severe VKC in children, but these should be used judiciously and long-term use is not recommended as they have the potential to develop ocular complications such as raised intra-ocular pressure, steroid-induced glaucoma, exacerbation of glaucoma, steroid-induced cataract, increased susceptibility to infection, and delayed wound healing. Overall, the complications depend upon the dose, duration, potency of the steroid, and severity of VKC.<sup>7</sup> Steroid-induced glaucoma is one of the common complications associated with topical corticosteroids. Literature suggests that continuous administration of topical corticosteroids for 4–6 weeks may make approximately one-third of the patients as high to moderate steroid responders.<sup>6</sup> The present study is an attempt to identify the prevalence of steroid-induced glaucoma and its associated factors in patients of VKC receiving topical corticosteroids. In our study, IOP was raised in 32.9% of the patients and the prevalence of steroid-induced glaucoma was 6.1%. This could be attributed to a low level of awareness regarding the use and complication of topical corticosteroids, poor compliance to the medicine advised, over-the-counter availability of topical corticosteroids, and prescription by non-ophthalmologist in suboptimal doses.<sup>5</sup>

Our study findings were supported by the findings of Ang et al in which the authors documented the prevalence of steroid-induced glaucoma as 5.5%.<sup>4</sup> Our study findings were also supported by similar findings where corticosteroid responses have been reported to range from 6% to 56% in Chinese children even without the presence of VKC.<sup>8–10</sup> Senthil et al reported the prevalence of steroid-induced glaucoma as 2.24%.<sup>11</sup> Corticosteroid-induced glaucoma is an iatrogenic cause of open-angle glaucoma, which results from decreased trabecular outflow.<sup>12</sup> The majority of patients had Intraocular Pressure in the range of 30–40 mmHg. The majority of patients were having cupping in the range of 0.5 to 0.7. High potency corticosteroids were significantly associated with advanced cupping as well as a high range of IOP. These findings were similar to the study conducted by Saadia Farooq et al.<sup>13</sup>

We also aimed to assess the risk factors associated with steroid-induced glaucoma in patients of VKC. In our study, highly potent steroids and prolonged duration of steroids were associated with steroid-induced glaucoma ( $p < 0.05$ ). Various risk factors have been suggested in previous literature for steroid-induced glaucoma, these include the type of steroid, the potency of the corticosteroid, and preexistent ocular conditions such as ocular hypertension

**Table 3:** Association of baseline characteristics with steroid-induced glaucoma

Baseline variables	Steroid-induced glaucoma		P value	
	Present (n=15)	Absent (n=234)		
Age (years)	8-12	8 (53.3)	94 (40.2)	0.15
	13-15	4 (26.7)	94 (40.2)	
	16-18	3 (20)	46 (19.7)	
Sex	Male	9 (60)	147 (62.8)	0.31
	Female	6 (40)	87 (37.2)	
Mean age at onset (years)		11.9±3.1	12.8±3.8	0.37
Mean Duration of TCS (months)		22.8±8.9	4.1±0.4	0.001
Potency of corticosteroids	High	8 (53.3)	36 (15.4)	0.03
	Moderate	4 (26.7)	74 (31.6)	
	Weak	2 (13.3)	87 (37.2)	
	Unknown	1 (5.8)	37 (15.8)	

**Table 4:** Assessment of various glaucomatous parameters with relation to potency of topical corticosteroids

Parameters	The potency of topical Corticosteroids				P-value	
	High (n=8)	Moderate (n=4)	Low (n=2)	Unknown (n=1)		
Best corrected Visual Acuity	>20/40	2	1	1	0	0.21
	20/40-20/200	3	2	1	1	
	<20/200	3	1	0	0	
Intraocular Pressure	<30 mmHg	2	0	1	0	0.03
	30-40 mmHg	4	2	1	1	
	> 40 mmHg	2	2	0	0	
Optic nerve head changes	<0.5 cupping	3	1	2	0	0.02
	0.5- 0.7 cupping	3	2	0	1	
	>0.7 cupping	2	1	0	0	
Visual Field changes	Early	5	2	2	1	0.32
	Advanced	3	2	0	0	

or primary open-angle glaucoma.<sup>14</sup> Similarly, Ang et al reported prolonged duration of corticosteroid use, topical dexamethasone, mixed VKC, limbal neovascularization, and corneal involvement to be significant factors associated with corticosteroid response.<sup>4</sup> Literature suggests that the type and duration of steroids may be associated with the corticosteroid response and steroid-induced glaucoma, also the potential role of corneal inflammatory mechanisms has been suggested.<sup>4</sup> High potency steroids are low-cost steroids as compared to moderate and weak potency steroids and thus are prescribed in higher proportions of cases with VKC. Senthil et al. reported high presenting IOP and increased duration of steroid usage as significant factors requiring glaucoma surgery.<sup>11</sup> Sen et al. also divided patients into 4 groups based upon the potency of steroids used and reported the use of higher potency and prolonged duration of corticosteroids to be significantly associated with more severe glaucoma.<sup>5</sup>

Steroids are the mainstay of treatment of VKC, and the use of high potency significantly increases the risk of steroid-induced glaucoma in these patients.

## 5. Conclusion

Steroid-induced glaucoma is one of the common complications of injudicious and long-term use of topical corticosteroids particularly high potency steroids. Approximately one-third of the patients on treatment for VKC are corticosteroid responders. There should be a provision of periodic screening of vision and intraocular pressure along with counseling of guardians of patients with VKC for early detection, appropriate management and to prevent progression into glaucoma.

## 6. Study Limitations

The possible limitation of the study could be a small sample size. Obtained results in the present study could be utilized in future studies to assess the pattern of progression into steroid-induced glaucoma in VKC patients and for necessary awareness campaigns to educate the general population.

## 7. Ethics Committee Approval

The study protocol was reviewed and approved by the institutional ethics committee(IEC). This study was conducted as per the Declaration of Helsinki.

## 8. Conflict of Interest


None declared.

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