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Original Research Paper

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EVALUATION OF INTRAOCULAR PRESSURE CHANGES IN COPD PATIENTS USING INHALED ANTICHOLINERGICS: A SAFETY ASSESSMENT

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ABSTRACT

Introduction: The potential impact of inhaled anticholinergic medications used in Chronic Obstructive Pulmonary Disease (COPD) on intraocular pressure (IOP) is unclear. **Aim:** This study aimed to evaluate the safety of these medications by assessing their effect on IOP **Materials & Methods:** A prospective observational study was conducted on 152 patients diagnosed with Chronic Obstructive Pulmonary Disease (COPD). Following the exclusion of 23 patients with cataracts and 29 patients who failed to complete follow-up, a total of 100 patients were enrolled. The study group (n=70) received Tiotropium Bromide in combination with Formoterol Fumarate and Fluticasone Propionate, while the control group (n=30) was administered only Formoterol Fumarate and Fluticasone Propionate via metered-dose inhaler (pMDI). All participants underwent comprehensive baseline ophthalmic evaluation, including gonioscopy and intraocular pressure (IOP) measurement. IOP was subsequently monitored at baseline, 2 hours post-dose, and weekly for four weeks. Both groups demonstrated minimal IOP variation throughout the study duration. **Results:** Slight increases in IOP were observed by the 3rd week in both groups. **Conclusion:** Inhaled anticholinergics, administered via MDI didn't cause significant changes in IOP over the study period, supporting their safety in COPD management.

KEYWORDS : intraocular pressure, inhaled anticholinergics, glaucoma

INTRODUCTION:

Chronic Obstructive Pulmonary Disease (COPD) is a progressive, debilitating respiratory disorder characterized by persistent airflow limitation and chronic symptoms such as dyspnea, cough, and sputum production. Structural abnormalities in the airways and alveoli contribute significantly to its pathophysiology, leading to high morbidity and mortality.[3] Globally, COPD affects approximately 12.64% of individuals aged 40 years and above,[1] and in India, it is the second leading cause of death.[2]

Pharmacologic management typically involves long-acting bronchodilators such as long-acting muscarinic antagonists (LAMAs) and long-acting beta-agonists (LABAs), with anticholinergics like tiotropium and ipratropium commonly used for symptom control.[56] However, concerns have emerged regarding potential systemic anticholinergic effects, particularly on intraocular pressure (IOP), due to possible pupil dilation and anterior chamber angle narrowing—factors relevant to glaucoma risk.[8] This study was conducted to assess the impact of inhaled anticholinergic agents on IOP in COPD patients.

MATERIALS & METHODS:

The study was carried out in the Department of Respiratory Medicine at Saraswathi Institute of Medical Sciences from March 2023 to February 2025. Based on the prevalence of anticholinergic use (93.4%), a sample size of 152 was estimated. After excluding 23 patients with cataracts and 29 who failed follow-up, 100 patients were enrolled. Seventy patients received Tiotropium with Formoterol and Fluticasone, while 30 patients received only Formoterol and Fluticasone via metered-dose inhaler (pMDI). Ophthalmic evaluations, including gonioscopy and IOP measurements, were performed at baseline, 2 hours post-dose, and weekly for four weeks. Statistical analysis using IBM SPSS v29 applied paired t-tests with $p < 0.05$ as the threshold for significance.

RESULTS:

This hospital-based prospective study was conducted among 100 patients diagnosed with Chronic Obstructive Pulmonary Disease (COPD). The patients, aged between 40 and 80 years, were categorized into stages 1 to 4 COPD based on the GOLD 2023 criteria. The study group consisted of 70 participants, with a predominance of males (58 males, 12 females). The control group included 30 participants, with 18 males and 12 females[Table-1]. There were no patients in GOLD Stage1. In Stage 2, there were 12 patients in the control group and 24 in the study group. In Stage 3, 13 patients were in the control group and 38 in the study group. In Stage 4, there were 5 patients in the control group and 8 in the study group. The distribution was not statistically significant ($p = 0.892$). In both groups, 60% of patients had Angle III, while 40% had Angle IV. No significant difference seen. [Table 3]

Table 1: Age and gender distribution of patients in study and control group

Age Group (years)	Control Group (Male/Female)	Study Group (Male/Female)	Total
40-50	4 M / 2 F	8 M / 2 F	16
51-60	5 M / 2 F	14 M / 2 F	23
61-70	6 M / 4 F	26 M / 6 F	42
71-80	3 M / 4 F	10 M / 2 F	19
Total	18 M / 12 F	58 M / 12 F	100

Table 2: Distribution according to GOLD Stage 2023 in the patients of study and control group

GOLD Stage	Control Group	Study Group	Total (%)	Control Group (%)	Study Group (%)
1	0	0	0	0%	0%
2	12	24	36	33.33%	66.67%
3	13	38	51	25.49%	74.51%
4	5	8	13	38.46%	61.54%
Total	30	70	100	30%	70%

Table 3: Distribution of angle of chamber of eye in study and control group

Group	Angle III (%)	Angle IV (%)

Control	60%	40%
Study	60%	40%
Total	60%	40%

Table 4: Intraocular Pressure Before Starting Medication in study and control group.

IOP Range (mmHg)	Right Eye (%)	Left Eye (%)	Total (%)
11-13	9%	12%	9%
13-15	54%	54%	54%
15-17	26%	29%	26%
17-19	11%	5%	11%
>20	0%	0%	0%

Table 5: Intraocular Pressure After 2 Hours of Medication in study and control group.

IOP Range (mmHg)	Study Group (R)	Study Group (L)	Control Group (R)	Control Group (L)
11-13	10	10	5	5
13-15	25	25	10	10
15-17	20	20	10	10
17-19	15	15	5	5
>20	0	0	0	0

Table 6: Representation of Mean IOP Over Population.

Time Point	Left Eye (Mean ± SD)	Right Eye (Mean ± SD)
Baseline	13.99 ± 1.94	13.99 ± 1.94
After 2 hrs	14.01 ± 1.94	14.03 ± 1.94
After 1 week	14.02 ± 1.94	14.02 ± 1.94
After 2 weeks	14.03 ± 1.94	14.03 ± 1.94
After 3 weeks	18.42 ± 8.29	14.23 ± 1.94
After 4 weeks	19.41 ± 2.92	15.23 ± 2.94

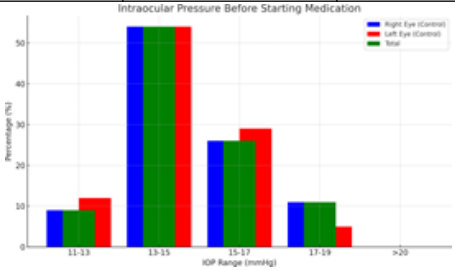

Fig. 1: Intraocular Pressure Before Starting Medication.

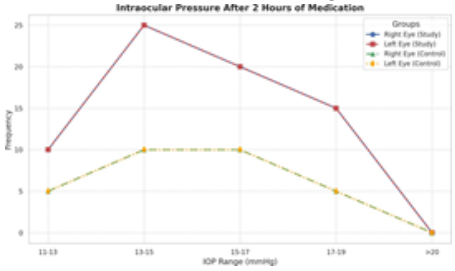

Fig.-2 Intraocular pressure after 2 hours of medication.

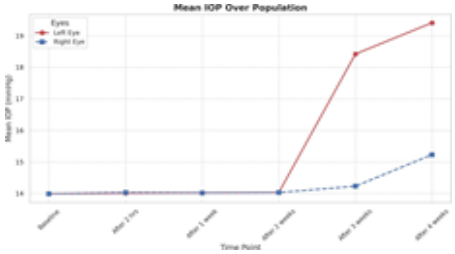

Fig. 3: Mean IOP Over Population.

The anterior chamber angle distribution was comparable between the study and control groups, with no statistically significant differences noted. Intraocular pressure (IOP) was assessed at baseline and at multiple intervals following initiation of therapy. Baseline IOP values were within normal limits, with a mean of 14.605 ± 1.32 mmHg in the right eye and 14.535 ± 1.36 mmHg in the left eye [Table 4]. Two hours post-medication, IOP values remained stable and similar between groups. Over the first two weeks of treatment, no notable changes were observed. However, by the third and fourth weeks, a progressive rise in IOP was detected in the study group receiving anticholinergic therapy, with the increase reaching statistical significance compared to the control group [Table 5]. This trend suggests a potential cumulative effect of anticholinergic agents on IOP. Importantly, no clinically significant ocular symptoms or complications were reported in either group during the study period [Table 6].

DISCUSSION:

This study comprehensively examined the effects of anticholinergic inhalers on intraocular pressure (IOP) in patients diagnosed with chronic obstructive pulmonary disease (COPD), with a particular emphasis on demographic characteristics, ocular biometric parameters, and disease severity. The sample population was predominantly male (76%), with the majority falling within the 61–70-year age group (42%), a distribution that reflects global epidemiological patterns of COPD prevalence. Such trends have been attributed to prolonged exposure to risk factors—particularly tobacco smoke—among older males, as supported by Verma[9].

The disease severity of participants was classified using GOLD staging, with the bulk of patients falling into moderate (Stage 2) and severe (Stage 3) categories. This distribution echoes findings from Yadav et al.[10], who reported similar stage predominance in clinical cohorts. Initial IOP assessments showed mean values of 14.6 mmHg in the right eye and 14.5 mmHg in the left eye—both within physiologic limits and exhibiting no statistically significant intergroup differences. These findings parallel baseline observations reported by Kumar and Bhushan[11]. Additionally, gonioscopic evaluation revealed anterior chamber angles predominantly classified as Grade III or IV, suggesting no inherent predisposition to angle-closure pathology, consistent with previous observations by Aksoy[12].

Short-term follow-up (within one week) did not reveal significant alterations in IOP, corroborating previous studies by Yadav et al.[10] and Francis[13] that found negligible acute effects of anticholinergic bronchodilators on ocular pressure. However, by the second to third week, a subset of patients exhibited a gradual IOP rise, occasionally surpassing 20 mmHg—a pattern also noted by Pandey and Tripathi[14].

By the fourth week, a clinically relevant elevation in IOP (>20 mmHg) was observed in 21.4% of the treatment group compared to only 7.1% in controls. These findings align with Kumar and Bhushan[15], suggesting a stage-dependent, delayed IOP increase, potentially influenced by cumulative drug exposure, inhaler type, dosage, and individual susceptibility.

Clinical Implications And Recommendations:

The findings of this study highlight the importance of routine intraocular pressure (IOP) monitoring in COPD patients prescribed anticholinergic inhalers, especially those with predisposing ocular conditions such as glaucoma or ocular hypertension. The potential for cumulative IOP elevation with prolonged use necessitates careful consideration of alternative bronchodilator therapies in high-risk individuals. Clinicians should adopt a vigilant approach, incorporating regular ophthalmologic assessments as part of long-term COPD management. Further large-scale studies with extended follow-up are recommended to confirm these findings and refine therapeutic strategies.

CONCLUSION:

Prolonged use of anticholinergic inhalers may be associated with increased IOP, whereas short-term use appears to have minimal impact. No significant IOP changes were observed in the control group receiving Formoterol and Fluticasone via metered-dose inhalers (MDIs), supporting their ocular safety. MDIs may thus present a safer delivery method than nebulization. Ongoing research is essential to evaluate long-term ocular risks.

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