

DISEASE AND INTRAOCULAR PRESSURE: A STUDY TO EVALUATE THE RELATIONSHIP BETWEEN CHRONIC OBSTRUCTIVE PULMONARY DISEASESeema Channabasappa¹, Vittal Nayak Irvathur², Sathya J Kakade³, Maharshi Maitra⁴**HOW TO CITE THIS ARTICLE:**

Seema Channabasappa, Vittal Nayak Irvathur, Sathya J Kakade, Maharshi Maitra. "Disease and Intraocular Pressure: A Study to evaluate the relationship between Chronic Obstructive Pulmonary Disease". Journal of Evolution of Medical and Dental Sciences 2014; Vol. 3, Issue 07, February 17; Page: 1656-1663, DOI: 10.14260/jemds/2014/2039

ABSTRACT: BACKGROUND & OBJECTIVES: An elevation of intraocular pressure if left undiagnosed or untreated may progress to ocular hypertension and glaucoma or glaucomatous optic neuropathy with irreversible visual loss. Chronic obstructive pulmonary disease, being a leading cause of death in the world, is a major cause of chronic morbidity and mortality. Ocular co-morbidities found to be associated with chronic obstructive pulmonary disease were glaucoma and cataract. **METHODS:** This study has considered a hundred diagnosed cases of chronic obstructive pulmonary disease and tried to evaluate the relationship between intraocular pressure and the pulmonary arterial pressure and also to find if with a rise in pulmonary arterial pressure there was a simultaneous rise in the intraocular pressure. The intraocular pressure was measured in this study by Applanation Tonometry and the pulmonary arterial pressure was recorded using 2-D ECHO. **RESULTS:** There was found to be medium correlation between pulmonary arterial pressure and the intraocular pressure of both the right eye and the left eye and p values were found to be 0.003 and 0.000 respectively which were of strong significance ($p < 0.01$). There was also found to be a tendency of both the pulmonary arterial pressure and the intraocular pressure to rise with age in the study group. The intraocular pressure of the right eye was found to be higher than that of the left eye. **INTERPRETATION & CONCLUSION:** This study has shown that both intraocular pressure and pulmonary arterial pressure increase with age. Thus the patients who have been diagnosed to have chronic obstructive pulmonary disease, of which increased pulmonary arterial pressure is a common feature, must regularly be screened for the development of raised intraocular pressure as a timely detection in such patients would prevent them from developing ocular hypertension and glaucoma with irreversible visual loss.

KEYWORDS: Intraocular pressure; Ocular hypertension; Glaucoma; Hypertension, Pulmonary; Pulmonary Disease, Chronic Obstructive; Age Groups.

INTRODUCTION: Chronic obstructive pulmonary disease is a major cause of chronic morbidity and mortality. It is a chronic, progressive disease with pulmonary and extra-pulmonary manifestations and is a leading cause of death in the world.

An increase in its prevalence and mortality has been predicted in the coming decades.¹ It was ranked sixth as the cause of death in 1990 and is estimated to be the third major cause of death worldwide by 2020.²

Data from studies performed in the Netherlands show that 25% of the population with chronic obstructive pulmonary disease aged 65 years and above suffered from at least 2 co-morbidities. The ocular co-morbidities in these patients were glaucoma and cataract.³ Ocular

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manifestations of pulmonary hypertension secondary to chronic obstructive pulmonary disease develop as a result of reduced outflow due to increased systemic venous pressure.⁴

A study named "Patterns of Co-morbidities in Newly Diagnosed COPD & Asthma in Primary care" was performed on 2699 patients in the United Kingdom and the relative risks were estimated for the associated co-morbidities. The study found the relative risk of glaucoma to be 1.29 in patients with diagnosed chronic obstructive pulmonary disease.^{5,6}

Some chronic obstructive pulmonary disease cases may develop glaucoma due to the corticosteroids used in its treatment,⁷ especially the steroid responders.

An attempt is made in this study to evaluate the relationship between chronic obstructive pulmonary disease and intraocular pressure and if there is an increase in intraocular pressure in such cases. Elevated intraocular pressures may progress to glaucoma with significant irreversible visual loss if undetected. An effort is also made to determine if intraocular pressure is raised, whether it is related with the rise in pulmonary artery pressure in chronic obstructive pulmonary disease patients.

MATERIAL AND METHODS: The present study is a cross-sectional study among diagnosed cases of chronic obstructive pulmonary disease and was conducted in the department of Ophthalmology, VIMS & RC, Nallurahalli, Whitefield, Bangalore.

This was a duration based study in which the aim was to take at least a hundred cases as the sample size.

Cases of chronic obstructive pulmonary disease of age above 40 years of both genders who attended the outpatient departments or were admitted as inpatients in the departments of Ophthalmology, TB & Chest Diseases and General Medicine at VIMS & RC were considered for the study.

A pre-structured proforma was used to collect the baseline data and an informed written consent was obtained after explaining about the need of the study and the procedures that were to be performed for the collection of data. Detailed history was asked and examination performed as per the proforma for those who satisfied the inclusion and exclusion criteria.

Inclusion criteria:

1. Diagnosed cases of chronic obstructive pulmonary disease
2. Males and females of age above 40 years

Exclusion criteria:

1. Established cases of glaucoma/glaucoma suspect prior to the diagnosis of chronic obstructive pulmonary disease
2. Family history of glaucoma
3. Patients on steroids : Topical/oral/inhalational
4. Congenital abnormalities of the optic disc
5. History of Ocular Trauma/Surgeries

The intra ocular pressure was measured using Applanation Tonometry under topical corneal anesthesia using 0.5% proparacaine hydrochloride after tear film staining with the help of a moistened fluorescein strip. All the recordings were done between 10 AM to 1 PM.

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The right ventricular systolic pressure, as a mirror of the pulmonary arterial pressure, was measured by two-dimensional echo cardiography at VIMS & RC. All the recordings were done by the same echo cardiographer using Agilent Sonos 5500. For the purpose of considering members of the study with different pulmonary arterial pressure levels, into different groups required for the analysis of the data the recorded pulmonary arterial pressure was classified into mild, moderate and severe as follows:

Normal: Pulmonary arterial pressure < 30 mm of Hg.

Mild: 30 mm of Hg < Pulmonary arterial pressure ≤ 45 mm of Hg.

Moderate: 45 mm of Hg < Pulmonary arterial pressure ≤ 60 mm of Hg.

Severe: Pulmonary arterial pressure > 60 mm of Hg.^{8,9}

Statistical methods:

(a) Descriptive statistical analysis has been carried out in the present study. Results on continuous measurements are presented on Mean±Standard Deviation (Min-Max) and results on categorical measurements are presented in Number (%). Significance is assessed at 5% level of significance ($p < 0.05$).

(b) Significant figures:

+ Suggestive significance (P value: $0.05 < P < 0.10$).

* Moderately significant (P value: $0.01 < P \leq 0.05$).

** Strongly significant (P value: $P \leq 0.01$).

(c) Pearson's product-moment correlation coefficient:

Pearson's product-moment correlation coefficient, denoted by r , has been used in this study as a measure of the correlation between two variables x and y giving a value between +1 and -1 inclusive.

Correlation	Negative	Positive
None	-0.09 to 0.0	0.0 to 0.09
Small	-0.3 to -0.1	0.1 to 0.3
Medium	-0.5 to -0.3	0.3 to 0.5
Strong	-1.0 to -0.5	0.5 to 1.0

Table 1: Pearson's Correlation Co-efficient

RESULTS: A total of 100 patients were considered in the study. The mean intraocular pressure of all the subjects was found to be 15.01 ± 1.43 mm of Hg in the right eye and 14.92 ± 1.43 mm of Hg in the left eye. The mean intraocular pressure of the participating males was found to be 15.02 ± 1.39 mm of Hg and 14.90 ± 1.41 mm of Hg in the right and left eyes respectively. The mean intraocular pressure of the participating females was found to be 14.93 ± 1.69 mm of Hg and 15.07 ± 1.54 mm of Hg in the right and left eyes respectively.

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Gender IOP (mm Hg)		No. of Pts.	Mean	Std. Deviation
Male	OD	86	15.02	1.389
	OS	86	14.90	1.414
Female	OD	14	14.93	1.685
	OS	14	15.07	1.542

Table 2: Comparison of mean IOP with SD in males and females

Variation in mean intraocular pressure with age: The mean intraocular pressure of the right eye was found to be 14.66 ± 1.43 , 15.21 ± 1.46 and 15.73 ± 0.79 mm of Hg respectively in the age groups of 40 to 55 yrs., 55 to 70 yrs. and 70 to 85 yrs.

The mean intraocular pressure of the left eye was found to be 14.72 ± 1.60 , 15.07 ± 1.28 and 15.18 ± 1.17 mm of Hg respectively in the age groups of 40 to 55 yrs., 55 to 70 yrs. and 70 to 85 yrs.

The correlation coefficient between duration of chronic obstructive pulmonary disease and intraocular pressure of right eye was 0.041 and p value was 0.685. The correlation coefficient between duration of chronic obstructive pulmonary disease and intraocular pressure of left eye was 0.039 and p value was 0.699. Thus there was no correlation between the duration of chronic obstructive pulmonary disease and the intraocular pressure of the right and left eyes, which were checked for separately in this study.

The correlation coefficient between duration of chronic obstructive pulmonary disease and PAP was found to be 0.47 and the p value was found to 0.001. Thus there was medium correlation between duration of chronic obstructive pulmonary disease and PAP and the p value was found to be 0.001 ($p < 0.01$) which is strongly significant.

Statistical Analysis		IOP (OD)	IOP (OS)
PAP	Pearson Correlation	0.295	0.378
	P value	0.003**	0.000**

Table 3: Correlation between PAP and IOP right and left eye

The correlation coefficient between pulmonary arterial pressure and intraocular pressure of right eye was found to be 0.295 and p value was found to be 0.003. Thus there was medium correlation between pulmonary arterial pressure and the intraocular pressure of the right eye and the p value was strongly significant.

The correlation coefficient between pulmonary arterial pressure and intraocular pressure of left eye was found to be 0.378 and p value was found to be 0.000. Thus there was medium correlation between pulmonary arterial pressure and the intraocular pressure of the left eye and the p value was strongly significant.

The mean pulmonary arterial pressure of all the subjects was found to be 28.67 ± 8.73 mm of Hg. The mean pulmonary arterial pressure of the participating males was found to be 28.22 ± 8.69 mm of Hg. The mean pulmonary arterial pressure of the participating females was found to be 31.43 ± 8.80 mm of Hg.

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Gender Statistical Analysis			IOP (OD)	IOP (OS)
Hypertension Duration (yrs.)	Male	Pearson Correlation	0.216	0.244
		P value	0.046*	0.023*
	Female	Pearson Correlation	0.087	0.115
		P value	0.767	0.695

Table 4: Correlation between duration of hypertension and IOP, males and females

In the males participating in the study the correlation coefficient between duration of hypertension and intraocular pressure of right eye was found to be 0.216 which signifies a small correlation and the p value was found to be 0.046 which is of moderate significance. The correlation coefficient between duration of hypertension and intraocular pressure of left eye was found to be 0.244 which signifies a small correlation and the p value was found to be 0.023 which is of moderate significance.

No such correlation was found to exist among the female participants of the study.

The percentage of people having an increase in their pulmonary arterial pressure rose from 17% in the 40 to 55 years age group to 38.1% in the 56 to 70 years age group and to 72.7% in the 71 to 85 years age group thus showing the rise of pulmonary arterial pressure with age and increasing severity of the pulmonary hypertension among the participants of the study with age.

The mean intraocular pressure of both the right and left eyes were found to be rising with age among the male participants of the study, among the female participants of the study the mean intraocular pressure was seen to be rising with age in the right eye but the mean intraocular pressure of the left eye was observed to be falling with age.

In the present study group the intraocular pressure of the right eye was found to be higher than the intraocular pressure of the left eye.

Gender	Age (yrs.)	IOP (OD) (mm Hg)	IOP (OS) (mm Hg)
Male	40-55	14.66	14.66
	56-70	15.26	15.06
	71-85	15.70	15.30
	Total	15.02	14.90
Female	40-55	14.67	15.17
	56-70	15.00	15.14
	71-85	16.00	14.00
	Total	14.93	15.07

Table 5: IOP variations among different age groups

LIST OF ABBREVIATIONS USED

COPD = Chronic Obstructive pulmonary Disease

IOP = Intra Ocular Pressure

PAP = Pulmonary Arterial Pressure

OD = Oculus Dexter

OS = Oculus Sinister

DISCUSSION: Chronic obstructive pulmonary disease remains a major public health problem and is projected to rank fifth worldwide in burden of disease by the year 2020.¹⁰ It is a chronic and progressive disease with pulmonary and extra-pulmonary manifestations, whose incidence is expected to increase in the coming decades.¹

Some studies show that chronic obstructive pulmonary disease patients have a relative risk of 1.29 of developing glaucoma.^{5,6} Chronic obstructive pulmonary disease causing raised pulmonary arterial pressure can result in raised episcleral pressures, via raised systemic venous pressure, and that can in turn result in raised intraocular pressure, which is an important risk factor for the development of glaucoma.

Glaucoma is the second most common cause of blindness worldwide,¹¹ contributing to 12.3% of the world's blind population. If undetected or untreated it can lead to irreversible visual loss due to glaucomatous optic neuropathy.

The intraocular pressure is the most common ocular parameter associated with glaucoma. Thus it may be important to evaluate the systemic correlates like the relationship between systemic parameters and intraocular pressure which emphasize the interdependence of the eye with other organ systems.

A study reported that pulmonary arterial pressure though cannot be directly measured by Echocardiography, right ventricular systolic pressure, a surrogate for systolic pulmonary arterial pressure, can be estimated by Echocardiography. A moderate to high correlation (0.57–0.93) has been reported between trans-thoracic echocardiographic estimation of right ventricular systolic pressure and systolic pulmonary arterial pressure measured via right heart catheterization.^{12,13} A different study concluded that echocardiography is a reliable method for detecting pulmonary hypertension.¹⁴

In this study we have tried to evaluate whether an increase in pulmonary arterial pressure, which is a common feature in chronic obstructive pulmonary disease, is related to a concurrent rise in the intraocular pressure and, if there is such a concurrent rise in intraocular pressure, whether it is related to the rise in pulmonary arterial pressure.

This study took into consideration a hundred diagnosed cases of chronic obstructive pulmonary disease over a stipulated time period. It included patients of both sexes above the age of forty years and excluded patients with established glaucoma, glaucoma suspects, patients with history of trauma and previous ocular surgeries and patients on steroids. Their intraocular pressure was measured using Applanation Tonometry and pulmonary arterial pressure was recorded by two dimensional Echocardiography.

It was observed that there were no established cases of glaucoma found among the participants of the study but there was a significant correlation between the pulmonary arterial pressure and the intraocular pressure and that both pulmonary arterial pressure and intraocular

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pressure had a tendency to rise with age in chronic obstructive pulmonary disease. As increase in pulmonary arterial pressure is a common feature of chronic obstructive pulmonary disease, a concurrent rise in the intraocular pressure of such patients may be expected. Regular screening of these patients will help prevent them from developing ocular hypertension and glaucoma with visually devastating consequences.

In the present study group chronic obstructive pulmonary disease patients with systemic hypertension were found to have a significantly raised pulmonary arterial pressure ($p < 0.01$). Further studies will help to determine whether other respiratory disorders and systemic conditions, in which there is a chronic rise in the pulmonary arterial pressure, can give rise to an increase in the intraocular pressure and thus its consequences. Further follow up of the study group will be necessary to establish the relationship between chronic obstructive pulmonary disease and glaucoma.

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