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ASSOCIATION BETWEEN POAG AND METABOLIC SYNDROME AMONG PATIENTS ATTENDING A TERTIARY CARE CENTRE IN CENTRAL INDIA

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ABSTRACT

Objectives: To evaluate the association between Primary Open-Angle Glaucoma (POAG) and Metabolic Syndrome (MetS), and to assess the prevalence of MetS components among POAG patients in a tertiary care setting in central India. **Methods:** A case-controlled study was conducted over 12 months at a tertiary care centre. Patients diagnosed with POAG were assessed for the presence of MetS using the modified NCEP ATP III criteria. Demographic data, clinical parameters including intraocular pressure, central corneal thickness, cup-to-disc ratio, and systemic parameters like BMI, waist circumference, fasting blood glucose, triglyceride levels, and blood pressure were recorded and analysed. **Findings:** Out of 200 samples, 100 cases of POAG were selected and 100 controls which is age and gender matched. A statistically significant association was found between POAG and the presence of Metabolic syndrome ($p < 0.05$), suggesting a possible shared pathophysiological mechanism. There was also a significant relationship between BMI and metabolic syndrome. **Novelty:** This study highlights a significant correlation between POAG and Metabolic syndrome in a central Indian population, suggesting the need for integrated screening approaches to improve early detection and management of both conditions.

INTRODUCTION

Glaucoma is one of the leading causes of irreversible visual loss and disability in the world. [1] POAG is a multifactorial, chronic optic neuropathy, characterised by progressive loss of RGC with subsequent visual field defect [2], [3]. IOP is the only modifiable risk factor for POAG. [4] Bilateral blindness from glaucoma was estimated to be in 4.5 million people with open-angle glaucoma in 2010, rising to 5.9 million in 2020[2][5].

Previous cross-sectional and longitudinal epidemiological studies have shown associations of glaucoma or elevated IOP with elevated blood pressure (BP), elevated fasting plasma glucose (FPG) levels, atherosclerotic disease, and obesity. [7–11] These findings suggest a common mechanism linking elevated IOP or glaucoma to various components of metabolic syndrome. [7]

Metabolic syndrome is a cluster of metabolic abnormalities that includes central obesity, Hypertension, Hypertriglyceridemia and low levels of HDL Cholesterol [8]. It is found that about one-third of urban population in India have metabolic syndrome [9]. As much studies are not conducted about association of POAG and metabolic syndrome, this study may help ophthalmologist and physicians for better screening of glaucoma patients

The aim of this study was to find association between POAG and Metabolic syndrome among patients attending ophthalmology outpatient department at a tertiary care hospital in Bhopal which caters to the victims of Bhopal gas tragedy.

Aims and Objectives

To find an association between metabolic syndrome and open-angle glaucoma among patients attending the OPD.

Primary objective: To find whether metabolic syndrome is a risk factor among the patients of POAG.

Secondary objective:

1. To find the prevalence of metabolic syndrome among the study population
2. To find the prevalence of POAG among the study population
3. To find gender-related association in metabolic syndrome among the study population
4. To find gender related association in POAG among the study population.

MATERIALS AND METHODS

Type of Study: case-control study

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Name of institute: Bhopal Memorial Hospital and Research Centre

Conflict of interest: Nothing to disclose

Ethnic Clearance: Institutional Ethical Committee clearance will be obtained

Study population: Cases for the study include all the diagnosed cases of POAG as per the International Society of Geographic and Epidemiological Ophthalmology (ISGEO) criteria.

Inclusion Criteria for POAG:

- Intra-ocular pressure >21mmHg with non-contact tonometry
- Open anterior chamber angle
- Glaucoma optic disc changes (increased cup-disc ratio, thin neuro-retinal rim notching)
- Visual field defect by Humphry perimeter.
- Exclusion Criteria for the POAG Group:
- History of ocular trauma
- History of ocular surgery
- Systemic/ local condition causing secondary glaucoma.
- Persons on statins excluded.
- Inclusion criteria for control group:
- IOP <21mmhg
- No glaucomatous changes in optic disc
- No visual field loss
- No pseudo exfoliation materials in lens capsule / near pupil.

Exclusion criteria for control group:

- High Myopia >6D
- History of intra ocular surgery
- Subluxated lens
- Traumatic, complicated cataract

Study duration: 12 months

Observation protocol:

A detailed history of the following ophthalmological tests, anthropometric tests, blood pressure measurement, and laboratory investigations was conducted after obtaining informed written consent from the patient.

Ophthalmological tests

- Visual acuity testing using Snellen's chart
- IOP measurement with applanation tonometry
- Optic cup disc ratio and neuroretina rim features with an indirect ophthalmoscope
- Visual field test with Humphreys perimetry.

The definition of Metabolic Syndrome in this study was based on the National Cholesterol Education Program Adult Treatment Panel III (NCEP ATP III) criteria. ATP III criteria (the presence of three or more of the following five symptoms).

1. Abdominal obesity: waist circumference >102 cm (men) and >88 cm (women)
2. Hypertriglyceridemia: serum triglycerides level ≥ 150 mg/dl or drug treatment for elevated TG 3- Low HDL-cholesterol
3. Low HDL-cholesterol: <40mg/dl in men and <50mg/dl in women or drug treatment for low HDL-C.
4. High blood pressure: SBP >130mmHg and/or DBP>85mmHg or drug treatment for elevated blood pressure (high BP)
5. High fasting glucose (FBS): serum glucose level >110mg/dl or on treatment for diabetes.

Arthrometric measurement and blood pressure

- Waist circumference (WC) with flexible measuring tape
- Height by a stadiometer using centimetre scale and weight by a clinical scale.
- Blood pressure was measured twice after 5 min rest from right hand in a seated position using standard mercury manometer

Laboratory measurements

Laboratory Measurements Blood samples were drawn after 10-12 hours of fasting through the antecubital vein. Fasting blood glucose (FBG), triglycerides (TG), total cholesterol (TC), low- and high-density lipoprotein cholesterol (LDL-C, HDL-C) were measured on fresh sample. Serum TG concentrations were assayed using commercially available enzymatic reagents with glycerol phosphate oxidase.

RESULTS

The results of the case-control study were .the study population is classified into group -P cases and Group C, the Control group each are of 100 individuals.

Table 1. Comparison of age between the two groups

Age	Group-P		Group-C	
	No.	%	No.	%
45-50 years	5	5.0	7	7.0
51-60 years	30	30.0	28	28.0
61-70 years	43	43.0	49	49.0
71-80 years	18	18.0	15	15.0
>80 years	4	4.0	1	1.0
Total	100	100.0	100	100.0
Mean ± SD	63.69 ± 8.46		63.69 ± 8.19	
't' value, df	0.000, df=198			
P value	1.000, NS			

The mean age in Group-P was 63.69 ± 8.46 years; and in Group-C was 63.69 ± 8.19 years. The difference was found to be statistically not significant (P=1.000), which shows that the mean age of patients in both the groups was comparable.

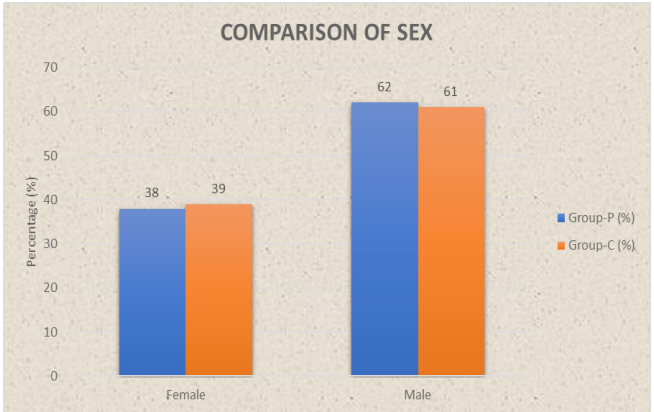

Figure 1. Bar diagram shows the comparison of sex between the two groups.

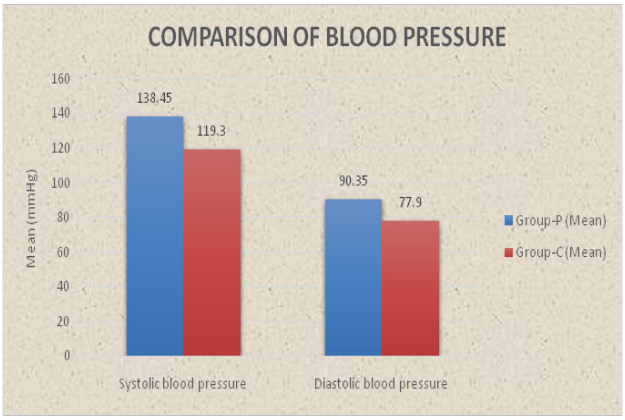

Figure 2. Bar diagram shows the comparison of blood pressure between the two groups.

Systolic blood pressure: The mean systolic blood pressure in Group-P was 138.45 ± 15.75 mmHg; while in Group-C, it was 119.30 ± 11.42 mmHg. The mean systolic blood pressure was significantly raised in Group-P compared to Group-C (P=0.001).

Diastolic blood pressure: The mean diastolic blood pressure in Group-P was 90.35 ± 13.03 mmHg; while in Group-C, it was 77.90 ± 10.15 mmHg. The mean diastolic blood pressure was significantly raised in Group-P compared to Group-C (P=0.001).

BMI.

A higher prevalence of metabolic syndrome was seen in over-weight and obese patients.

The mean fasting blood sugar in Group-P was 193.16 ± 71.44 mg/dL; while in Group-C, it was 133.43 ± 52.29 mg/dL.

Table. 3 Comparison of fasting blood sugar between the two groups

Parameter	Group-P [Mean±SD]	Group-C [Mean±SD]	't' value, df	P value
Fasting blood sugar	193.16 ± 71.44	133.43 ± 52.29	6.747, df=198	0.001*

DISCUSSION

POAG is a multifactorial, chronic optic neuropathy characterized by progressive loss of Retinal ganglion cells with subsequent visual field defect. (2)(3). It is one of the most common causes of irreversible vision loss among the population. (1) Hence, finding the risk factors or any associated factors plays a crucial role in early screening and detection of the disease, for which we can't prevent the incidence of blindness due to Glaucoma.

The main aim of this study was to find out whether metabolic syndrome is a risk factor for patients with POAG as well as to find out the prevalence of metabolic syndrome among the study population, prevalence of POAG among the study population

Table 2. Comparison of lipid profile between the two groups.

Parameter	Group-P [Mean±SD]	Group-C [Mean±SD]	't' value, df	P value
Triglycerides	196.04 ± 60.87	138.11 ± 57.03	6.945, df=198	0.001*
Total cholesterol	213.60 ± 44.09	151.08 ± 44.81	9.946, df=198	0.001*
LDL cholesterol	152.51 ± 34.82	108.96 ± 32.71	9.116, df=198	0.001*
HDL cholesterol	37.49 ± 7.94	47.37 ± 10.94	-7.309, df=198	0.001*

The mean triglycerides, total cholesterol and LDL cholesterol were significantly higher in Group-P, while the mean HDL cholesterol was significantly lower in Group-P compared to Group-C.

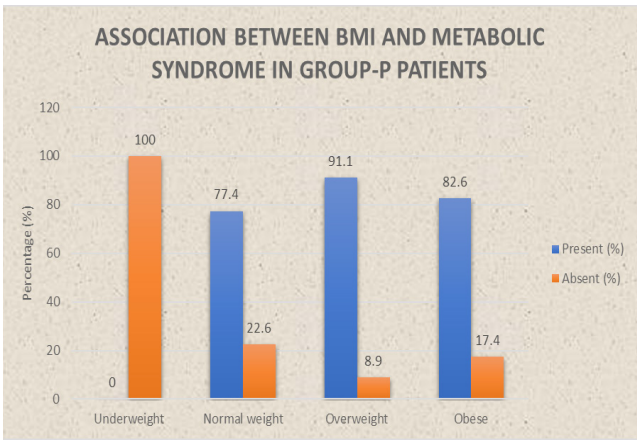

Figure 3. Bar diagram shows the association between metabolic syndrome and the BMI in Group-P patients.

There was a statistically significant association between BMI and the metabolic syndrome in Group-P patients (P=0.047), showing that metabolic syndrome depends on the patients'

also to find out gender related association with metabolic syndrome and glaucoma among the study population.

The results of this study showed a statistically significant association between the groups and the metabolic syndrome (P=0.001), and metabolic syndrome was dependent on the groups.

Metabolic syndrome was significantly higher in Group-P(case group) compared to Group-C. (Control Group).

A transition in disease pattern is noted recently from infectious disease to lifestyle diseases mainly clubbed under the title of metabolic syndrome [10,11]. Metabolic syndrome is a constellation of interconnected physiological, biochemical, clinical and metabolic risk factors which includes hypertension, dyslipidaemia, glucose intolerance, central obesity, pro inflammatory and pro-thrombotic states[12], [11]. As there a rise in incidence of metabolic syndrome in India, it is important to find its associations with disease like POAG as it's a cause of irreversible vision loss.

In a study conducted by Park et al.[13] it was found that the participants with a greater number of components of metabolic syndrome is found to have raised IOP which is significant risk factor for glaucoma, also an interesting finding noted in the

study was systolic and diastolic blood pressure was having a statistically significant relationship of IOP among the female participants of Study.

A prospective cohort study conducted by Zhang et al ([7]) found that increased age and high triglyceride level are an independent risk factors for glaucoma

A similar study conducted by Gupta et al[(1)] which is a case control study found that there is a positive association between POAG and dyslipidemia and this case control study conducted in 200 north Indian subjects were supported by similar study conducted by Devari et al where hyperlipidemia and POAG was found to have a positive association and was concluded hyperlipidemia to a positive risk factor for progression of glaucoma.

Our study analyzed the prevalence of Metabolic Syndrome among the cases which are diagnosed cases of POAG with controls which are age matched subjects without POAG. The results are compared with other available literatures and our analysis is as follows-

On exploring the age of participants ,30% of the cases were in the age group of 51-60 years and 49% of control was in age group of 61-70 years which is comparable to various other studies i.e. Gupta et al [(1)] , Rasoulinejad et al[(6),] Actis et al[(3).]

In our study among Group-P, there were 38 (38%) females and 62 (62%) males, among Group-C, there were 39 (39%) females and 61 (61%) males.

There was no statistically significant association between sex and the groups (P=0.884), which shows that the groups are independent of the sex this was contradictory with several studies Gupta et al [(1),] Rasoulinejad et al [(6),] Actis et al [(3).]

In our study the mean triglycerides, total cholesterol and LDL cholesterol were found to be significantly higher in Group-P (cases), while the mean HDL cholesterol was significantly lower in Group-P compared to Group-C (controls) this finding was similar to the observations conducted by various studies such as Tan et al[(14)] where a positive association was found with total cholesterol and triglyceride level and raised IOP. Gupta et al also found to have cases with a higher level of triglyceride, LDL, total cholesterol and low level of HDL, which is comparable to various other studies Gupta et al [(1),] Rasoulinejad et al [(6),] Actis et al[(3).]

The mean fasting blood sugar in Group-P was 193.16 ± 71.44 mg/dL; while in Group-C, it was 133.43 ± 52.29 mg/dL. The mean fasting blood sugar was significantly higher in Group-P compared to Group-C (P=0.001). this observation was similar to study conducted by Rasoulinejad et al [(6),] various mechanism explaining these were presented one of the mostly accepted mechanisms is hyperglycemia could induce apoptosis in retinal neuronal cells through the hexosamine biosynthetic pathway. Nakamura M;[(15)] also there is evidence that shows that the risk of neuronal injury from stress may increase with the presence of long-standing elevated blood glucose alongside dyslipidaemia. Kong GY[(16).]

Hypertension is found to be an independent risk factor affecting IOP which is found in various studies[(17)] Bonomi et al, similar findings were seen in our study The mean systolic blood pressure was significantly raised in Group-P compared to Group-C (P=0.001). The mean diastolic blood pressure was significantly raised in Group-P compared to Group-C (P=0.001).Both the systolic as well as diastolic blood pressures were found to be raised in Group-P compared to Group-C.

The comparison of mean BMI between the two groups was found to be statistically not significant (P=0.110) in our studies which was supported by Lee et al.(18),(19)

Among the 100 patients in Group-P, metabolic syndrome was present in 84 (84%) patients, and it was absent in 16 (16%) patients. Among the 100 patients in Group-C, metabolic syndrome was present in 22 (22%) patients, and it was absent in 78 (78%) patients.

There was a statistically significant association between the groups and the metabolic syndrome (P=0.001), and metabolic syndrome was dependent on the groups. Metabolic syndrome was significantly higher in Group-P compared to Group-C. Which was supported in various several other studies Yi et al(8), Tan et al (14), Rasoulinejad et al (6),Park et al(13).

CONCLUSION

Metabolic syndrome is a risk factor for POAG ang hence the prevalence of metabolic syndrome is significant in our country, the patients can be considered for screening for glaucoma.

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