ORIGINAL ARTICLE

Primary Open-Angle Glaucoma And Serum Vitamin D Levels

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Abstract:

Objectives: To compare the levels of vitamin D of patients having primary open-angle glaucoma with controls

Methodology: This was an observational, cross-sectional study, carried out at the Department of Biochemistry & Department of Ophthalmology, Watim Medical College, Rawat, Rawalpindi. Medical records of 150 patients from the last 5 years were reviewed to categorize them into two groups, Group I diagnosed with POAG based on established criteria (specific optic nerve changes, open angle on gonioscopy and specific visual field defects) & Group II (Controls). Data collection from medical records included: age, gender & Serum vitamin D level in ng/ml. Data analysis was done using the Statistical Package for Social Sciences (SPSS) version 21. Descriptive statistics were used to review the demographic data (age & gender) and the vitamin D levels both for the POAG group and control. Independent t-test was used to compare serum vitamin D levels of the two groups while considering the p-value less than 0.05 as statistically significant.

Results: The mean vitamin D levels in Group I (POAG) was 39.75 ± 9.64 ng/ml vs vitamin D level in Group II (Controls) 38.22 ± 7.59 ng/ml with no statistically significant difference.

Conclusion: We found no role of serum vitamin D levels in primary open-angle glaucoma. *Al-Shifa Journal of Ophthalmology 2024; 20(2): 56-60.*

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Introduction:

Primary open-angle glaucoma (POAG), being among the common causes of permanent visual loss, is a serious concern all over the world.[1] It is estimated that millions suffer from this illness worldwide with the number expected to increase to a worrying figure of 112 million in 2040.[2] The reported worldwide prevalence of POAG is 2.4% which increases with age[3] and males are found to be more susceptible to POAG than females.[4] It is reported to be most prevalent in Africa (4.2%) whereas in Pakistan the situation appears particularly critical. Studies report the incidence of POAG between 2.2% to 4.2% in the age group of 40 and above.[5] This poses a significant public health burden to any community as vision loss impacts not only

the quality of life but also hinders the overall productivity of the individual and the community.

POAG is characterized by a gradual deterioration of the optic nerve leading to visual field defects. Increased intraocular pressure (IOP) is a key underlying factor. Despite significant research efforts, the precise mechanisms underlying optic nerve degeneration in POAG remain unclear. Several theories have been proposed which includes reduced blood flow to the optic nerve, oxidative stress and excitotoxicity (damage caused by excessive glutamate stimulation).

While the exact mechanisms leading to optic nerve damage in POAG remain under investigation, researchers increasingly suspect that oxidative stress has a noteworthy part in its etiology and progression.[6] Oxidative stress arises once the body's natural antioxidant defenses are overcome by free radicals leading to cellular damage. This incited attention to the potential protective effects of minerals, vitamins and antioxidants leading to the finding that vitamin C and E, act as free radical scavengers, having a shield effect on the optic nerve from oxidative damage.[7,8]

Researchers are increasingly interested in the potential role of vitamin D in eye health. This essential nutrient, well-known for its contributions to bone health and immune function, has two main sources: sunlight and food. Exposure to ultraviolet (UV) light from the sun triggers vitamin D synthesis in the skin while dietary sources contribute a smaller amount. Once absorbed in the intestines or synthesized in the skin, it is converted by the liver into its main storage form, 25(OH)D. This form, measured in the blood serum, is the primary indicator of a person's vitamin D status. Generally, when the serum 25(OH)D levels are below 30 ng/ml, it is considered to be a vitamin D deficiency.[9] While the literature has linked vitamin D to eye diseases like refractive errors, dry eyes, age-related macular degeneration, and cataracts, it also suggested a likely role of vitamin D in retinal ganglion cell function and optic nerve health, potentially leading to POAG.[10] We conducted this study to explore the association of vitamin D with POAG by comparing serum vitamin D levels of patients with POAG and control hoping this will help in future POAG prevention and management strategies.

Materials and Methods:

It was an observational (cross-sectional) study conducted adhering to the Declaration of Helsinki and after the approval of the hospital ethical committee. To determine sample size, we used previous study data (mean) for a two-mean comparison with $\alpha = 0.05$, $\beta = 0.05$, and power = 0.95. Non-probability convenient sampling method was used to review medical records of 150 patients (≥40 years old) from the last 5 years allowing us to categorize them into two groups: Group I (POAG): Adults (≥40 years old) diagnosed with POAG based on established criteria (specific optic nerve changes, open angle on gonioscopy and specific visual field defects) confirmed through medical record review. Group II (Controls): Age- and sex-matched adults without a history of glaucoma or any eye condition affecting optic nerve health.

Exclusion criteria were having angle closure or secondary glaucoma, history of ocular trauma, pregnancy, lactation, documented vitamin D supplementation within the past 6 months, and chronic illnesses affecting vitamin D metabolism (e.g., kidney disease, malabsorption syndromes).

Data collection from medical records included: Demographic data: age & sex and Serum vitamin D level in ng/mL (measurement done by radioimmunoassay technique with Diasorin SR® kit).

Data analysis was done using the Statistical Package for Social Sciences (SPSS) version 21. Descriptive statistics were used to review the demographic data (age & gender) and the vitamin D levels both for

the POAG group and controls. Categorical data i.e., gender was expressed as frequencies and percentages while continuous data i.e. age and levels of vitamin D were presented as means with standard deviation. Independent t-test was used to compare serum vitamin D levels of the two groups while considering the p-value less than 0.05 as statistically significant.

Results:

The medical records of 150 patients were reviewed in this study which were divided into two groups of 75 participants each group (n = 75 per group). The mean age of participants in Group I (POAG) was 52.0 ± 10.25 years, while the mean age in Group II (Control) was 54.0 ± 9.5 years. There was no statistically significant difference in age between the groups (p > 0.05). The gender distribution was Group I (POAG) 45.33% male, 54.67% female (Male: Female = 1:1.2) vs Group II 44.00% male, 56.00% female (Male: Female = 1:1.27). The mean vitamin D level for participants in Group I (POAG) was 39.75 ± 9.64 ng/ml vs mean vitamin D level in Group II (Control) 38.22 ± 7.59 ng/ml with no statistically significant difference. (Table I)

Table 1: Descriptive statistics of POAG and control group

		Group I (n = 75)	Group II n = (75)	p value
Mean age in years		52.0 ± 10.25	54.0 ± 9.5	>0.5
Gender	Male	45.33%	54.67%	
	Female	44%	56%%	
Mean vitamin D levels in ng/ml		39.75 ± 9.64	38.22 ± 7.59	

Discussion:

The potential role of vitamin D in eye health, particularly related to POAG (primary open-angle glaucoma), has appeared as a new research area. Similar to its established connections with systemic diseases affecting teeth, bones, and the cardiovascular system, the receptors of vitamin D have been identified in the aqueous humor and vitreous of the eye[11] suggesting a possible role in the regulation of intraocular pressure which is the most important risk factor in open-angle glaucoma

Endocrine Society defined deficiency of vitamin D having serum levels below 30 ng/dl.[9] 0ur study found vitamin D levels trending towards the lower limit, which aligns with reports from other researchers in our region.[9,11] This widespread deficiency is likely due to several factors, including reduced outdoor activities, increased screen time, and sun avoidance practices.[9]

While some studies haven't found any association between levels of vitamin D and IOP[12], others suggest vitamin D is negatively correlated with intraocular pressure.[13] Yoo et al [14] observed an inverse association between vitamin D levels and IOP in men with glaucoma. Ayyagari et al[15] also reported a similar trend in the African American population. Further investigation is needed to elucidate the possible mechanisms by which vitamin D might influence IOP and its subsequent impact on glaucoma development.

Several studies suggest a probable connection between low vitamin D levels and increased risk of POAG. Yoo et al[14] and Lv et al[16] reported low levels of vitamin D in glaucoma patients compared to controls. Additionally, Ayyagari et al[15] observed a connection between low vitamin D and increased POAG severity. These findings suggested a role for vitamin D in the occurrence of POAG, but our study, along with others like Carbone et al[17] and Dikci et al[18], did not reveal a difference in vitamin D levels in both groups. These conflicting

results necessitate further investigation with larger sample sizes, diverse populations, and standardized methodologies.

Researchers have found that low vitamin D levels can be a risk factor for glaucoma, but they are still unsure exactly how vitamin D is involved.[19] There may be a pathway involving oxidative stress, in addition to the already known increased IOP pathway. Vitamin D's antioxidant and anti-inflammatory properties might play a part in this. A study[19] showed that a specific form of vitamin D (1,25(OH)2D3) helped protect human retinal pigment epithelial cells from damage caused by oxidative stress. The vitamin seemed to work through antioxidant signaling pathways, lowering the level of harmful molecules and factors like ROS, cytokines, and VEGF.

Abouzeid H[20] suggested ethnicity may influence the association between vitamin D and glaucoma, potentially contributing to variations observed across studies. Our study contributes to the ongoing discussion by adding data on vitamin D levels in a specific population. However, future research with larger sample sizes and consideration of potential confounding factors is needed to definitively know the role of vitamin D in glaucoma.

Abouzeid H[20] also suggested gender-specific associations, with vitamin D playing a more significant role in males or females depending on the study population. Further research is needed to explore how ethnicity, genetics, and sex hormones interact with vitamin D in influencing glaucoma risk While investigating how gene polymorphisms of vitamin D receptors might interact with vitamin D levels and glaucoma risk, Lv et al[16] found an association between vitamin D absence and specific variations in the vitamin D receptor (VDR) gene, suggesting a potential genetic influence. Studies conducted in France, Croatia, US and Turkey further corroborated this trend.[20]

To the best of our knowledge, such data is lacking in Pakistan. It was not a prospective study a hospital based cross sectional retrospective study with a relatively small sample size with a specific ethnicity. Confounding factors like sunlight exposure and dairy intake were not considered, but we still believe that it has an impact on understanding the link of vitamin D with primary open angle glaucoma, especially in Pakistan.

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