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Research Paper

A Study on Raised Intraocular Pressure and Its Correlation With Visual Function in Patients With Diabetes Mellitus

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Abstract
Background : *Diabetes mellitus is the most common lifestyle disorder and the leading cause of irreversible blindness in the working age group. Diabetic patients are reported to have a higher incidence of intraocular pressure elevation and glaucoma. Early and periodic ocular screening tests are needed to protect visual function.*
Aim and objective: *Assesssment of different types of glaucoma in patients with diabetes mellitus. The correlation of normal and raised intraocular pressure with visual acuity, visual fields in glaucoma patients.To create awareness about avoidable blindness in diabetic patients and to direct the patient towards further evaluation and follow up.*
Materials and Methods: *The study is a hospital- based , non- interventional, cross-sectional prospective study. Visual function is evaluated in 500 patients attending Ophthalmology out patient department of Kanyakumari govt medical college hospital. Estimation of visual acuity, anterior segment examination, slit lamp examination, intraocular pressure, retinoscopy & fundus examination, visual field analysis , gonioscopy are done to detail the defective vision.*
Results analysis: *Data is analysed using SPSS. Among 500 diabetic patients, 466 had normal intraocular pressure and 34 were diagnosed to have glaucoma (6.8%) -- Primary open angle glaucoma (5.8%),Primary angle closure glaucoma (0.2%), Neovascular glaucoma(0.2%), Phacomorphic glaucoma (0.2%) & Phacolytic glaucoma(0.4%). 22 patients had visually impairment and 12 of them were blind. Subjects with glaucoma had optic nerve head changes with cupping, retinal nerve fiber loss and visual field defects.*
Conclusion: *Diabetes is the systemic risk factor associated with various types of glaucoma causing irreversible blindness. The therapeutic maneuver of reducing intraocular pressure seems to slow the progression of disease in majority of them. Early diagnosis is the best way to maximize the number of years of sight for patients who have glaucoma.*
Keywords: *Diabetes Mellitus, Intraocular pressure, Glaucoma, Visual function.*

I. INTRODUCTION

Diabetes mellitus, one of the worlds most important public health problem, is expected to rise from the current estimate of 150 million to 300 million in 2025. Data relating to the alarming increase in the prevalence of Type 2 diabetes in younger people including children and adolescents has recently been reviewed. There is a strong relationship between glycemia and the risk of development and progression of microvascular complications as glaucoma.

Glaucoma is the leading cause of irreversible blindness throughout the world. The common denominator of glaucoma is a characteristic optic neuropathy, which derives from various risk factors including increased intraocular pressure. Once the blindness of glaucoma has occurred, there is no known treatment that will restore the lost vision. In nearly all cases, however blindness from glaucoma is preventable. From the perspective of those whose visual function has been severely affected by glaucoma, the impact of the disease can be profound and includes difficulty with employment, mobility, ability to

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drive and social isolation. The impact of glaucoma can be quantified by visual function measurement & health related quality of life measures.

With the launch of 'Vision 2020' global initiative, the focus has shifted to all causes of avoidable blindness. Efforts should be made to recognize and treat those affected, at an early stage, for the benefit of the individual and the society. With this view, this study has been undertaken.

II. MATERIALS AND METHODS

Study design - The present study is a hospital-based, non-interventional, cross- sectional prospective study. The study population consists of 500 diabetic patients (age group 30–70 years) attending Ophthamology out patient department in Kanyakumari Govt Medical College Hospital. Informed consent is obtained and by way of providing proforma, the required data is collected.

Ophthalmic examination:

(1) Visual acuity testing – The presenting distant visual acuity for both eyes is measured seperately using a standard Snellen's chart properly illuminated at a distance of 6m. (2) Each participant had an anterior segment examination, using a torch, to detect the signs of conjunctival and corneal diseases. (3) Slit lamp examination of cornea was done to determine the position, depth and site of corneal abnormality and lens opacities. (4) Recording of intraocular pressure– Schiotz indentation tonometer was used to record the intraocular pressure of the anaesthetized cornea.

(5) Visual field analysis-- done using automated static perimeter (for selected cases).

(6) Retinoscopy was performed after pupillary dilatation to elicit the refractive status of the eye. (7) Fundus examination was carried out using direct ophthalmoscope. (8) Gonioscopy – to determine the type of angle in the anterior chamber of the eye (selected cases).

The following definitions are used for the study :

1.Visual impairment – WHO Definitions

Category of visual impairment	Visual acuity with best possible correction	
	Maximum less than	Minimum equal to or better than
Low Vision		
1	6/18	6 /60
2	6 /60	3 /60
3	3 /60	1 /60
Blindness		
4	1 /60	Light perception (PL)
5	No perception of light (NPL)	

1. Glaucoma: An intraocular pressure of more than 21 mm Hg associated with optic disc cupping and / or visual field defects.

2. Glaucomatous visual field defects are paracentral scotomas, nasal step, siedel's scotoma, arcuate scotomas, double arcuate or ring scotoma, tubular vision, end stage or total field defect.

3. Glaucomatous optic nerve head changes include pallor of the disc, splinter hemorrhages, irregularity of neuro retinal rim which are early changes and cupping of the optic disc (>0.7), bayonetting sign, glaucomatous optic atrophy which are late changes. All the participants of this study had the following tests done. Estimation of blood sugar and serum cholesterol- blood samples are collected and sent to the Biochemical laboratory, Kanyakumari Govt Medical College Hospital and the reports collected.

III. RESULTS ANALYSIS

Table – 1: Distribution of diabetic subjects by age and sex

Age group (years)	Male	Female	Total
30- 40	15	30	45
41-50	53	42	95
51-60	86	84	170
61-70	112	78	190
Total	266	234	500

Among 500 diabetic patients examined, 266 are men and 234 are women.

Table – 2: Distribution of various types of glaucoma in diabetic subjects

Type of glaucoma	Total no: of cases	Prevalence %
Primary open angle glaucoma (POAG)	29	5.8
Primary angle closure glaucoma (PACG)	1	0.2
Neovascular glaucoma	1	0.2
Phacomorphic glaucoma	1	0.2
Phacolytic glaucoma	2	0.4

Total	34	6.8

Primary open angle glaucoma is found to be the most common type of glaucoma with a prevalence of 5.8%

Table – 3 : Distribution based on mechanics of glaucoma – by age & sex

Age group	Open angle (POAG, Phacolytic)	Angle closure (PACG, Neovascular, Phacomorphic)	Developmental anomalies of angle	Total
30-40	-	-	-	-
41-50	2	1	-	3
51-60	20	1	-	21
61-70	9	1	-	10
Total	**31**	**3**	**-**	**34**
Female	20	2	-	22
Male	11	1	-	12
Total	**31**	**3**	**-**	**34**

Among 34 subjects with glaucoma (22 females and 12 males), open angle glaucoma was diagnosed in 31 of them and 4 subjects had closed angle glaucoma

Table – 4: Distribution of IOP in eyes with glaucoma

Age group	No: of eyes with glaucoma	Eyes with normal IOP	Eyes with raised IOP
30-40	-	-	-
41-50	6	2	4
51-60	42	4	38
61-70	10	4	6
Total	58	10	48

48 eyes had elevated IOP & 10 eyes had normal IOP among patients with glaucoma

Table – 5: Visual function in eyes with normal & elevated IOP

Visual function tests	Ocular functional changes	Eyes with normal IOP (total=10)		Eyes with elevated IOP (total=48)	
		Number	Percentage	Number	Percentage
Fundus changes	Optic nerve head change	10	100	41	85
	Normal ONH	-		2	4
	No fundus view	-		5	10
Visual acuity	Visual impairment (VA 6/18 – 3/60)	8	80	30	62
	Blindness (VA < 3/60 in better eye)	2	20	18	37
Visual fields	Visual field normal	4	40	7	14
	Visual field loss	6	60	39	81

IV. DISCUSSION

The 500 diabetic patients with the complaints of difficulty in vision selected for this study were examined thoroughly for the visual defects.

34 diabetic patients were found to have elevated intraocular pressure (IOP) & were diagnosed to have **glaucoma**. In the healthy eye, flow of aqueous humor against resistance generates an IOP of approximately 15 mm of Hg, which is necessary for the proper shape and optical properties of the globe[1].Glaucoma is characterized by an "elevated" intraocular pressure that share either the common feature of progressive optic neuropathy or the common feature of occludable drainage angles in the anterior chamber. Optic neuropathy causes optic nerve head changes leading to diminished visual acuity and field loss. Persons with diabetes mellitus appear to have a slightly higher IOP and reported to have a higher incidence of IOP elevation[2].

Primary open angle glaucoma (POAG) diagnosed in 29 subjects was the common type noted in our study. The pathophysiological mechanism of intraocular pressure elevation is because of resistance to aqueous humor outflow in the juxtacanalicular portion of trabecular meshwork due to glycation and crosslinking of meshwork glycoprotein as suggested by Chihara E et al.[3] There is compromise of microvasculature of retinal axons & direct mechanical damage to retinal nerve fibers leading to optic nerve head cupping and visual field defects. Optineurin protein functions to protect the optic nerve from TNF-alpha mediated apoptosis and loss of function of this protein decreases the threshold for ganglion cell apoptosis in patients with glaucoma. Among 29 subjects with POAG , it was found to be common among female patients and the same reported by Pasquale LR et al.[4] 20 subjects were in the age group 51-60 suggesting that the incidence of POAG increases substantially with age (Gordon MO et al).[5] The higher prevalence of POAG 5.8% among diabetics in our

study coincides with that reported by Mitchell P et al.[6] Management is to lower IOP, the only risk factor amenable to management, to a safe target level of IOP.

One case of **Primary angle closure glaucoma** (PACG) that is bilateral, asymmetrical, presenting in a 60 year female subject (Salmon JF et al).[7] It is characterized by apposition of the peripheral iris against the trabecular meshwork resulting in obstruction of aqueous outflow (Mapstone R).[8] Diabetes is associated with angle closure glaucoma due to an increase in lens thickness and autonomic dysfunction which may lead to a more dilated pupil (Schertzer).[9] Medical treatment with topical antiglaucoma medication and laser surgical treatment is given to lower IOP and preserve vision. It is important to manage prophylactically (with iridectomy) the fellow eye of patients who have angle closure glaucoma with a pupillary block component. The prevalence percentage 0.2% among diabetics is similar to that reported by Quingley HA et al.[10]

Rubeosis iridis and the incidence of **neovascular glaucoma** is more common in diabetic subjects and is a complication of proliferative diabetic retinopathy (Brown GC et al).[11] Under conditions of retinal ischaemia, the Muller cells being the primary source synthesize a diffusible angiogenic peptide factor,VEGF(Vascular endothelial growt factor), that stimulates new vessel proliferation (Aieillo LP,et al).[12] Growth of a fibrovascular membrane on the iris surface and in the anterior chamber angle initially obstructs aqueous outflow in an open angle form and later contracts to produce secondary synechial angle closure glaucoma(John T et al).[13] The key to successful management is to detect neovasclarisation of iris early and laser treatment with panretinal photocoagulation is done which reduces the stimulus for ocular neovascularisation.

Phacolytic glaucoma is a form of open angle glaucoma associated with hypermature cataractous lens. The glaucoma inducing mechanism is a macrophagic response to lens protein. There is release of high molecular weight lens proteins from hypermature cataractous lens, macrophages engulf these proteins & obstruct the trabecular meshwork leading to increase in IOP (Epstein DL).[14] This condition should be handled as an emergency, ultimately by removal of the lens after IOP control. In **Phacomorphic glaucoma** an intumescent lens through pupillary block and iris bombe, leads to peripheral anterior synechiae and secondary angle closure. Treatment is cataract extraction after lowering IOP.

Regarding the **cupping of optic nerve head**, among patients with normal intraocular pressure, all of them had glaucomatous optic nerve head changes of which 20% of eyes had early ONH changes, and 80% had late optic nerve head changes. Also on evaluation, cupping > 70% and optic atrophy was found to be common in patients with normal intraocular pressure (Foster P).[15] Among patients with raised intraocular pressure, 31% of eyes had early & 54% had late glaucomatous optic nerve head changes. As regards the **visual field defects**, among patients with normal intraocular pressure, 60% of them had glaucomatous field defect and among patients with raised intraocular pressure, 81% of had field defects on evaluation. Thus Glaucomatous visual field defect was found to be common among patients with raised intraocular pressure (Goldberg).[16]

In eyes with normal IOP, **visual impairment** with VA 6/18 - 3/60, was present in 6 eyes (60%) & blindness in 4 eyes (40%). Among eyes with elevated IOP, 30 eyes (62%) had visual impairment and 18 eyes (37%) were blind. The above findings suggest that visual field defect and vision loss is more common in diabetic subjects with raised intraocular pressure present along with late disc changes (Sivakumar N).[17] Visual field defects with late optic disk changes & visual impairment is more common in patients with normal intraocular pressure. The overall **incidence of glaucoma among diabetics 6.8% in our study** is similar to that reported in Maharastra by Sheetal Dharmadhikari et al. Succesful management aims to lower IOP either by laser therapy, medical or surgical intervention to a 'target pressure' below which further optic nerve damage is unlikely.

V. CONCLUSION

The prevalence of various types of glaucoma is found to be higher among diabetics in our study. Raised intraocular pressure is one of the major risk factor leading to visual field defects and complete vision loss in our society. Visual field loss has got a remarkable impact on the vision related quality of life- i.e., the ability to perform important visual tasks, such as reading or driving, and the individuals satisfaction with life style.

Comprehensive eye examination as recommended by The American Academy of Ophthalmology can detect glaucoma even before it causes significant loss of visual function. Optical coherence tomography – optic disk scan & retinal nerve fiber layer thickness measurement helps for the recognition of early damage in diabetic patients at risk for glaucoma. Therefore screening tests for glaucoma should necessarily be combined with the annual diabetic retinopathy screening procedure by specialists in patients with diabetes mellitus.

Diabetes mellitus is a stress-related, modern, lifestyle disease which can be prevented by suitable stress-relaxation techniques, healthy diet and exercise. Affected persons should be made aware of glaucoma and its

impact on visual function , benefits of early detection , follow-up and proper treatment. Thus deterioration of visual function can be avoided & vision can be preserved for a better living condition.

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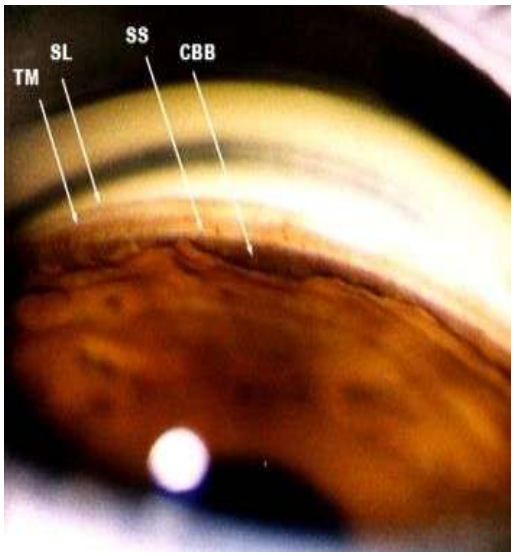
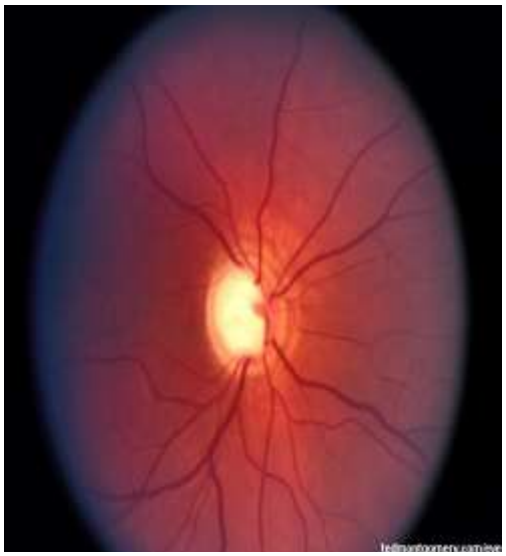
1.Applanation tonometry

2. Optical Coherence Tomography

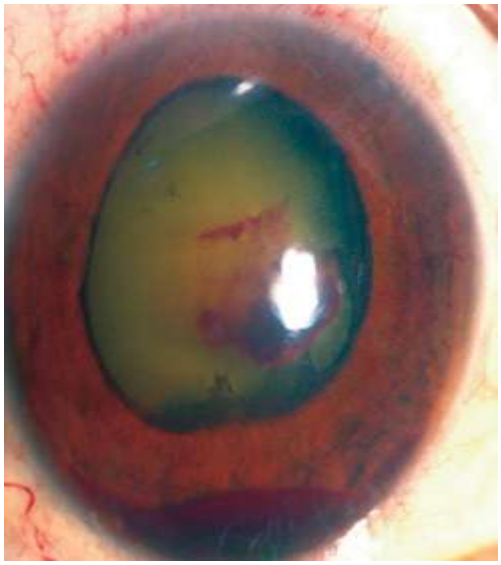


3. Gonioscopy–anterior chamber angle



4. Fundoscopy – Cupping of optic disc

5. Phacomorphic glaucoma



6. Neovascular glaucoma