Relationship between Diabetes and Intraocular Pressure

Mohammad Khalaj, Sajjad Fereydooni, and Ameneh Barikani

Children Growth Research Center, Qazvin University of Medical Sciences, Qazvin, Iran

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Abstract- The ophthalmologic outcomes of diabetes were important. This research is conducted to assess the relation between diabetes and intraocular pressure changes in the patients of Avicenna Hospital, compared with healthy persons referring to the facility. With cross-sectional research, 400 persons including 200 diabetics and non-diabetics were selected on a random basis over one year in 2012. Research data were collected by examination and checklists, and then analyzed by SPSS 16 statistical software. Descriptive results were extracted, and the relation between the variables were analyzed by Chi2 test, t-test, Fisher's exact test, Pearson's correlation coefficient, with *P*. value less than 0.05 ($P<0.05$). In the group of diabetics, 37% and 63%were male and female respectively, while in non-diabetics group 47% and 53% were male and female. The mean age of diabetics patients were 54.17 ± 8.25 and non-diabetics 49.06 ± 7.26 years. Mean vision acuity of the right eye was 9.035 in the diabetics and 9.56 in the witness group. Mean intraocular pressure was 16.71 ± 1.96 mm/Hg in diabetics, and 12.86 ± 1.45 mm/Hg in non-diabetics, which showed a significant difference (t = 22.337, $P=0.001$). It is advisable that the intraocular pressure of diabetics be measured and recorded on a regular basis.

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Keywords: Intraocular pressure; Diabetes; Age; Sex; Glaucoma; Presbyopia; Amblyopia

Introduction

Diabetes is a relatively prevalent and serious disease caused by the inability of the body to produce insulin or consume sugar. In diabetics, either pancreas is not capable of producing sufficient insulin, or cells might not be able to appropriately respond to insulin. In the basis of World Health Organization (WHO) definition, 2-hour glucose of over 200 is called "problematic", and 2-hour glucose of 140-200 is called "impaired glucose tolerance". Also, fasting glucose of over 100 mg/dl is called "problematic", and that of 100-126 is called "impaired fasting glucose tolerance" (1,18).

Chronic high blood sugar causes changes in all blood vessels which in turn engage sensitive bodily organs in minor and major complications such as stroke, myocardial infarction, cardiac failure, renal failure, as well as ophthalmological disorders. Diabetic ophthalmological disorders are among the major causes of blindness and low vision worldwide, annually engaging hundreds of thousands of patients in severe ophthalmological conditions. Possible ophthalmological disorders caused by diabetes include cataract, double vision, vision reduction, vitreous hemorrhage, macular edema, retinal vascular changes and diabetic retinopathy (2).

Ocular hypertension and glaucoma variants have not been yet proven as direct ophthalmological consequences of diabetes, yet they are being studied for their possible role in visual impairment caused by chronic blood sugar increase (3,6,7).

Glaucoma is caused by the increasing intraocular pressure, and may cause permanent damage to the optic nerve, low vision and even blindness (4,5).

Glaucoma is identified by the increasing intraocular pressure accompanied by optic disc cupping and impairment of the visual field. The most frequent cause of preventable blindness in the USA, glaucoma takes place by two general mechanisms: either the disorderly outflow of vitreous fluid as a result of defective drainage system of anterior chamber (open-angle glaucoma), or disorderly access of vitreous fluid to drainage system of anterior chamber (angle-closure glaucoma) (9).

Glaucoma variants include primary open-angle glaucoma, primary angle-closure glaucoma, glaucoma with normal pressure, acute angle-closure glaucoma, hereditary glaucoma, glaucoma secondary to lens

Corresponding Author: A. Barikani
Children Growth and Development Research Center, Qazvin University of Medical Sciences, Qazvin, Iran
Tel: +98 28 33360904, Fax: +98 28 33360904, E-mail address: barikani.a@gmail.com

modifications, glaucoma secondary to uvea changes, glaucoma secondary to trauma, neovascular glaucoma, and glaucoma caused by steroids. The most frequent glaucoma is the primary open-angle one which has engaged almost 1.29-2% of people of over 40 years of age and 4.7% of people of over 70 years of age. The disease is more prevalent in colored people by fourfold.

There is a strong familial tendency toward infection by this variant; therefore, close relatives of patients should also be examined. Juvenile onset primary glaucoma which includes 5% of familial cases of primary open-angle variant and 3% of non-familial cases is companied by a genetic mutation in the chromosome (1). In case of failure of medical treatment, surgery will be resorted to.

Rubeosisiridis and neovascularization of the angle of anterior chamber take place as a result of extensive retinal ischemia caused by advanced diabetic retinopathy or the blockage of the central retinal vein (9).

Although the exact role of diabetes and high blood sugar in the patients with glaucoma is not yet identified, the formation of new vessels in iris as a result of chronic high blood sugar in diabetics may be accounted for as the main reason for glaucoma and ocular hypertension. To diagnose this disorder, ophthalmoscopy to observe the optic nerve cupping, and tonometry to measure the intraocular pressure should be part of the routine ophthalmological examination in all patients of over 35 years of age. This is especially important in cases of patients with familial glaucoma history and colored patients. High-risk persons should be screened once in every two years from the age of 30, and annually from the age of 50 (1).

Regarding what has been presented so far about glaucoma in diabetic people, which seriously threatens the eyesight, and also high level of glaucoma prevalence all over the world as well as in Iran, specifically its 14-per-cent prevalence in Qazvin Province identification, control and decreasing ophthalmological diseases, especially glaucoma in diabetics, and factors contributing to it is regarded as extremely necessary (18).

Materials and Methods

This comparative cross-sectional study was conducted over one year, 20 March 2002 to 20 March 2003. Eyes of 200 diabetic and 200 non-diabetic patients with ophthalmology section of Ultra-specialized Clinic of Qazvin Avicenna Hospital were studied.

Patients were 35-70 years of age examined by referring to the ophthalmological clinic. They were entered into the research, which took one year, randomly and with their own consent. Upon their arrival at the clinic, ophthalmological examinations, vision acuity, visual field condition, and intraocular pressure and diabetic test (FBS>126) was determined, they were provided with a questionnaire of 14 questions, prepared in advance and about personal details, diabetes history of the patient and his relatives, history of general diseases and glucose related ophthalmological disorders, as well as questions based on their vision examination. Subjects personally cooperated with the research agents when filling out the questionnaires and, when needed, after that.

In this study which took place with an optometrist's help, in line with analyzing the visual field, vision acuity was measured using projector chart or LCD chart. The chart was set 6 meters away from the patient so that a patient with good vision acuity would distinguish the smallest (10/10) letters. For patients who previously used spectacles, vision with and without spectacles was measured and recorded next to their present vision acuity measure.

The intraocular pressure of all participant patients, disregarding any basement disease especially diabetes, was measured and recorded by optometrist doctors using an Airplus digital tonometer.

In addition, retinas were examined in terms of possible alterations and optic disc cupping as diagnostic symptoms of glaucoma.

Finally, all results including those of ophthalmological examinations and questionnaires were collected and analyzed, using SPSS 16 software. Also, the relationships between the variables were analyzed by Chi2 method, Fisher's exact test, t-test, and Pearson's correlation coefficient with $P<0.05$.

Results

Four hundred persons consisting of 200 diabetics and 200 non-diabetics were studied regarding the effect of diabetes on the intraocular pressure.

In the diabetic group, there were 74 men (37%) and 126 women (63%). The mean intraocular pressure difference between diabetics and non-diabetics patients was significant ($P=0.001$) (Table1).

Mean age of male subjects was 54.4±7.97, and that of female was 54.05±8.49 in patient group, which had no significant difference (Table 2).

Table 1. The frequency distribution of diabetics and non-diabetics patients with sex, mean age, mean vision of the left &right eye, abundance of presbyopia, mean intraocular pressure, abundance of amblyopia, and ocular conditions(n=400)

		Diabetes(n=200)	Non-Diabetes(n=200)	*P*
Sex	**Male**	37	47	0.054
	Female	63	53	
Mean age (±SD)		54.1±8.25	49±7.26	0.001
Mean vision acuity	**Left eye**	9.02±2.13	9.56±1.84	0.001
	Right eye	9.035±2	9.56±1.39	0.002
Presbyopia	**Exists**	50.5	40	0.044
	Does not exist	49.5	60	
Mean intraocular pressure		16.71±1.96	12.86±1.45	0.001
Amblyopia	**Exists**	16.5	7.5	0.008
	Does not exist	83.5	92.5	
Ocular conditions	**Aphakia**	0.5	0	
	Cataract	3	0	0.01
	Does not exist	95.5	100	

Table 2. The frequency distribution of mean age, visual acuity, presbyopia, intraocular pressure with sex (n=400)

		Diabetes(n=200)		Non Diabetes(n=200)	
		Male (n=74)	**Female (n=126)**	**Male (n=94)**	**Female (n=106)**
Mean age±SD		54.4±7.97	54.05±8.49	49.62±7.82	48.58±6.74
P		0.6		0.8	
Visual acuity	**Left**	9.02±2.04	9±2.18	9.47±1.4	9.65±0.9
	Right	9.08±1.74	9±2.15	9.52±1.5	9.5±1.3
P		0.8		0.7	
Presbyopia		2.09±0.39	1.86±0.48	1.94±0.45	1.78±0.5
P		0.01		0.1	
Intraocular pressure		16.45±1.79	16.86±2.04	12.69±1.37	13±1.51
P		0.1		0.1	

In diabetic patients' group, the relationship between age and intraocular pressure was analyzed using Pearson's correlation coefficient. Frequency of intraocular pressure (IOP)=>20 in diabetics patient was more than non-diabetics (Table 3).

Table 3. Frequency of intraocular pressure (IOP)based on age in male and female diabetic and non-diabetic patients (n=400)

IOP / Age	Diabetes (n=200)						Non-Diabetes (n=200)					
	Female (126)			Male (74)			Female (106)			Male (94)		
	10-14.9	15-19.9	=>20	10-14.9	15-19.9	=>20	10-14.9	15-19.9	=>20	10-14.9	15-19.9	=>20
20-39	2	4	-	1	4	-	12	1	-	11	-	-
40-59	24	57	4	12	41	-	82	5	-	75	3	-
60-79	4	29	1	4	12	-	4	2	-	5	-	-
=>80	-	1	-	-	-	-	-	-	-	-	-	-

The correlation (r) was 0.025 in diabetic and 0.109 in the non-diabetic group, which showed a lack of relationship between age and intraocular pressure in both groups. Mean intraocular pressure difference within diabetics and non-diabetic patients with sex were not significant (Table 4).

Table 4. Mean±SD of IOP in diabetics and non-diabetic patients with sex and age

Age \ IOP	Diabetes(n=200)		*P*	Non-Diabetes(n=200)		*P*
	Female(126)	Male(74)		Female(106)	Male(94)	
	Mean±SD	Mean±SD		Mean±SD	Mean±SD	
20-39	16.8±1.8	17.6±2.6	0.5	13.6±1.4	13.5±1.2	0.8
40-59	16.6±2	16.4±1.7	0.4	12.8±1.4	12.6±1.3	0.3
60-79	17.3±2.1	16.1±1.5	0.04	13.5±2.3	12.2±1	0.2
=>80	16±0	-	-	-	-	-

Discussion

Results of our research indicate the mean intraocular pressure in diabetes (16.71±1.96) was more than in non-diabetes (12.86±1.45). However, the mean intraocular pressure among both sexes of both groups did not show a significant statistical difference.

It may be therefore concluded that diabetes as a dangerous, prevalent disease which annually increases, may be regarded as a factor effective in, and a basis for the increase of glaucoma. This fact necessitates more research on the relationship between diabetes and intraocular pressure changes. It should be noted that ocular outcomes often develop without showing any symptoms.

Some infected people even continue with their normal course of life without paying attention to the disease and referring to the physician, not seeking treatment until the disease has hindered the every-day life or weakened the eyesight. It may be accordingly concluded that preventive measures and better blood glucose control in healthy, pre-diabetics and even diabetic persons, may prevent the increase in prevalence of diabetes, and even the occurrence of intraocular pressure and glaucoma in the society. In this respect, it is advisable to start with education and then with prevention and treatment.

As regards factors contributing to glaucoma, it has become evident that glaucoma and intraocular pressure are influenced by a variety of factors. This factor includes genetics and hereditary backgrounds so that glaucoma cases are more prevalent and observed more frequently in close relatives of the patients. In this respect, it is advisable that close relatives of the patients be paid special attention to and be subject to more specialized study over the course of prevention, treatment, and screening.

The race is another factor contributing to glaucoma, to the point that it is more prevalent in some races such as colored. Other factors including prolonged consumption of corticosteroids, endophthalmitis, trauma, intraocular hemorrhage are effective in the infection with and prevalence of glaucoma. Age is a much discussed factor in relation to prevalence of glaucoma. With the increase in age, prevalence of glaucoma also increases (8,16,17).

In our research, the relationship between age and intraocular pressure in the diabetic group was studied with Pearson's correlation coefficient, which showed the correlations (r) of 0.025 in diabetics and -0.109 in non-diabetics. This indicated that there was no relationship between age and intraocular pressure in both groups. The intraocular pressure was even reduced to some extent in diabetics as the age increased.

In a research, factors such as higher bodily mass index, prolonged diabetes and cataract surgery history were found related to glaucoma prevalence.(8). In other study cataract prevalence was estimated 33.1% among 3,888 diabetic persons in Esfahan research (12), 28% among 567 diabetic persons in China (13), 10.4% among 3,606 diabetic persons in England (14), and 50% among 850 diabetic persons in Korea (15).

In our research, 6 subjects (3%) of diabetics had cataract and 3 subjects (1.5%) aphakia. which showed a significant difference (P=0.01).

Other highlights of ocular conditions caused by diabetes include refractory errors, presbyopia, and amblyopia. According to the statistics, they are more prevalent in diabetics than in non-diabetics (2,17). In our research, presbyopia was more prevalent in the diabetic group (50.5%), compared to the 40% ratio in non-diabetics. Also amblyopia was more prevalent in the

diabetic group (16.5%), compared to the 7.5% ratio in non-diabetics.

As stated in various sources, diabetes is one of the most important factors contributing to the reduction of vision acuity of both eyes in short- and long-term, via various mechanisms and by causing damage to different parts of the eyes (2,17).

In our research was showed that the eyesight of diabetics reduces compared to non-diabetics, so that mean vision acuity of the right eye was 9.035±2 in diabetics and 9.56±1.39 in non-diabetics. Also, mean vision acuity of the left eye was 9.02±2.13 in diabetics and 9.56±1.84 in non-diabetics. Presently, around 60 million persons have glaucoma, of which 50% are not diagnosed, and around 6 million are totally blinded as a result of glaucoma. Moreover, data indicate that glaucoma as the most preventable cause of blindness in the USA, which in turn, indicates the necessity of more attention to the screening of glaucoma-infected persons (10).

Intraocular pressure may be reduced by reducing the production or increasing the outflow of vitreous fluid, using medical treatment, laser therapy or surgery. There are topical medicines for reducing the production or increasing the outflow of vitreous fluid. If the medical treatment is not favorably responded to, the bypass surgery of the drainage system is useful in many glaucoma variants.

In complicated cases, cryotherapy or diathermy may be used to destroy the ciliary body to reduce the production of vitreous fluid (11).

With respect to all researches and analyses conducted, material quoting these researches, and also findings of our research, diabetes should be more focused on and paid more attention to, as a basis for glaucoma and intraocular pressure changes. Also, the relationship between the two diseases should be studied more, to control and reduce glaucoma cases.

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