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Ocular Complications in Children with Type 1 Diabetes Mellitus in Al-Diwaniyah Province: Case Control Study

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Abstract

Background: Ocular manifestations are common complications seen in children with type 1 diabetes several years after the onset of diabetes mellitus. Disturbed visual acuity, visual field defects, corneal dryness, raised intraocular pressure, cataract and retinal complications have been recognized in patients with type 1 diabetes; however, the exact frequency of these complications in Al-Diwaniyah province is still not very well established.

Aim of the study: To assess the ocular manifestation in patient with type 1 diabetes mellitus in Al-Diwaniyah province, in comparison with non-diabetic children.

Patients and methods: Data used in this study was collected using a case control study on 75 patients with type 1 DM who attended the diabetes specialist center. They were examined by an ophthalmologist in the Ophthalmology clinic department in Al-Diwaniyah teaching hospital. Those are compared with 75 apparently healthy children who attended the consultation clinic and emergency unit of Maternity and Children Teaching Hospital. The study has started from the 1st of September 2018 till the end of September 2019.

Results: Assessment visual acuity in patients with type 1 diabetes mellitus and control subjects revealed that 58 (77.3 %) of patients had normal visual acuity and that 59 (78.7 %) of control subjects had normal visual acuity. Abnormal visual acuity were identified in 17 (22.7 %) of patients and in 16 (21.3 %) of control subjects and the difference was statistically insignificant (P = 0.844). Abnormal Schirmer's test with dry eye was seen in 11 (14.7 %) of patients and in 3 (4.0 %) of control subjects (P = 0.025). Abnormal findings upon fundoscopic examination were identified in 2 (2.7 %) of patients in comparison with none of control subjects (P = 0.499). Intraocular pressure (IOP) was abnormally high in 8 (10.7 %) of patients in comparison with 1 (1.3 %) of control subjects; the difference was significant (P = 0.034). Visual field defect were identified in 2(2.7) of patients in comparison with 1 (1.3 %) of control subjects with no statistical significant difference (P = 1.000).

Conclusion: eye dryness and raised intraocular pressure were the main ocular complications in type 1 diabetes mellitus and long standing diabetes with poor control are the main risk factors for development of retinopathy in diabetic children.

Key words: Ocular Complications, Type 1 Diabetes Mellitus

Introduction

"Diabetes mellitus is not a single entity but rather a heterogeneous group of disorders in which there are distinct genetic patterns as well as other etiologic and pathophysiologic mechanisms that lead to impairment of glucose tolerance" (Alemzadeh and Wyatt, 2019). It is classified into several types including type 1, type 2 and other forms (Kahanovitz*et al*., 2017; Olokoba*et al*., 2012). Regarding type 1, indeed, this form of diabetes mellitus is the most commonly recognized from in daily pediatric clinical practice. Most of

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these cases, approximately 95 %, are autoimmune in nature and a few cases are idiopathic. It is basically characterized by near total beta cell destruction (Kahanovitz*et al*., 2017).

Remote clinical consequences of the disease included two major classes, small vessel and large vessels disorders. Peripheral nerves involvement, damage to kidney and damage to retina are the small vessel disease consequences. Large vessel complications are mainly attributable to accelerated atherosclerosis with eventual increase in the risk of ischemic heart disease and cerebrovascular accidents (Chawla*et al*., 2016)**.**

A number of consequences have been seen in the eye such as eye surface disorders, damage to retina, raised intra-ocular pressure and opacity of lens (Threatt *et al*., 2013). Eye consequences in association with hyperglycemia are common health issues among community, therefore, efforts must be spent to highlights the prevalence, the pathology and the approach to treat these consequences (Sayin*et al*., 2016).

In our present work, the goal was to assess the ocular manifestations in diabetic patient (type 1) in Al-Diwaniyah province, in comparison with non-diabetic children.

Patients and methods

Data used in this study was collected using a case control study on 75 children with type 1 DM, 32 males and 43 females, with varying age and who attended the diabetes mellitus specialist center. They were examined by an ophthalmologist in the Ophthalmology clinic department in Al-Diwaniyah teaching hospital .Those are compared with 75 apparently healthy children who attended the consultation clinic and emergency unit of Maternity and Children Teaching Hospital, they were examined in the same specialized center for diabetes. The study has started from the 1st of September 2018 till the end of September 2019.

The list of factors included in the data sheet was: Demographic features: age and gender and Laboratory investigations. Visual acuity was measured by Snellen Eye chart (E CHART) and Tumbling E" Visual Acuity Chart. Visual field was tested by Confrontation visual field testing and automated perimetry. Schirmer's test was used to measure eye moisture. Slit lamp was used to examine anterior eye segment. Fundoscopic examination was used to examine retina. Intraocular pressure is measured with a tonometer as part of a comprehensive eye examination.

Ethical consideration was based on approval that was issued by "Ethical Approval Committee" of the institute. The formal agreement was given by "the directorate of Health in Al-Diwaniyah province, the formal representative of Iraqi Ministry of health". Consent form each the care givers of enrolled children was obtained verbally.

The analysis of data statistically was done using the statistical package for social science (SPSS) version 16 and the Office Excel 2007. The presentation of qualitative data was based on number and %. The presentation of quantitative data was based on giving the mean, the range and the standard deviation. The student *t*-test was utilized to compare mean values between 2 groups. The association between qualitative data was based on the use of chi-square test. The p of less than or equal 0.05 was the cutoff for significance.

Results

The demographic characteristics of patients and control subjects are in table 1. The morbid characteristics of patients with type 1 diabetes are shown in table 2. Assessment visual acuity in patients with

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type 1 diabetes mellitus and control subjects revealed that 58 (77.3 %) of patients had normal visual acuity and that 59 (78.7 %) of control subjects had normal visual acuity. Abnormal visual acuity in the range of 6/9 to 6/60 were identified and compared in both groups and were presented in table **3**. Overall abnormal visual acuity were identified in 17 (22.7 %) of patients and in 16 (21.3 %) of control subjects and the difference was statistically insignificant (P = 0.844), as shown in table **4.**

Regarding other ocular abnormalities, they were shown in table.5. Abnormal Schirmer's test with dry eye was seen in 11 (14.7 %) of patients and in 3 (4.0 %) of control subjects, therefore the difference was statistically significant (P = 0.025).Abnormal findings upon fundoscopic examination were identified in 2 (2.7 %) of patients in comparison with none of control subjects; the difference was insignificant (*P* = 0.499). Intraocular pressure (IOP) was abnormally high in 8 (10.7 %) of patients in comparison with 1 (1.3 %) of control subjects; the difference was significant (*P* = 0.034). Visual field defectwere identified in 2 (2.7 %) of patients in comparison with 1(1.3 %) of control subjects with no statistical significant difference (*P* = 1.000). Cataract was seen in a single patient (1.3 %) and in none of control subjects without statistical significant difference (*P* = 1.000).

Table 1: Demographic characteristics

Characteristic	**Study group** ***n*** **= 75**	**Control group** ***n*** **= 75**	***P***
Age (years)			
< 10, *n* (%)	17 (22.7 %)	17 (22.7 %)	0.460 ¥ NS
10-15, *n* (%)	39 (52.0 %)	45 (60.0 %)	
> 15, *n* (%)	19 (25.3 %)	13 (17.3 %)	
Mean ±SD	12.54±3.60	12.13 ±3.11	0.460 † NS
Range	6 -18	5 -18	
Gender			
Male, *n* (%)	32 (42.7 %)	37 (49.3 %)	0.413 ¥ NS
Female, *n* (%)	43 (57.3 %)	38 (50.7 %)	
Education Level			
0	14 (18.7 %)	7 (9.3 %)	
1	11 (14.7 %)	16 (21.3 %)	
2	20 (26.7 %)	14 (18.7 %)	
3	18 (24.0 %)	22 (29.3 %)	
4	8 (10.7 %)	10 (13.3 %)	
5	4 (5.3 %)	6 (8.0 %)	
Mean ±SD	2.09 ±1.43	2.40 ±1.41	0.189† NS
Family's education level			
0	30 (40.0 %)	26 (34.7 %)	
1	5 (6.7 %)	8 (10.7 %)	
2	7 (9.3 %)	10 (13.3 %)	

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3	8 (10.7 %)	9 (12.0 %)	
4	6 (8.0 %)	10 (13.3 %)	
5	8 (10.7 %)	5 (6.7 %)	
6	7(9.3 %)	4 (5.3 %)	
7	2 (2.7 %)	2 (2.7 %)	
8	2 (2.7 %)	1 (1.3 %)	
Mean ±SD	2.39 ±2.47	2.21 ±2.18	0.650 † NS

n: number of cases; SD: standard deviation; ¥: Chi-square test; †: Independent samples t-test; NS: not significant at *P*> 0.05

Table 2: Disease characteristics of patients with type 1 diabetes mellitus

Characteristic	**Value**
Age at time of diagnosis (years)	
< 5, *n* (%)	28 (37.3 %)
5-10, *n* (%)	45 (60.0 %)
> 10, *n* (%)	2 (2.7 %)
Mean ±SD	5.58 ±2.80
Range	9 months - 11 years
Familial history of diabetes	19 (25.3 %)
Compliance	
Poor, *n* (%)	42 (56.0 %)
Good, *n* (%)	33 (44.0 %)
Daily insulin dosage	
Yes, *n* (%)	61 (81.3 %)
No, *n* (%)	14 (18.7 %)
Type of insulin administration	
Mixtard	32 (42.7 %)
Mixtard + soluble	35 (46.7 %)
Lenti+soluble	8 (10.6 %)
Incidents of Ketoacidosis (Times)	
0, *n* (%)	22 (29.3 %)
1, *n* (%)	12 (16.0 %)
2, *n* (%)	23 (30.7 %)
3, *n* (%)	14 (18.7 %)
4, *n* (%)	2 (2.7 %)
5, *n* (%)	2 (2.7 %)
Median (IQR)	2 (2)
Range	0 – 5
Admission to hospital	
0, *n* (%)	38 (50.7 %)
1, *n* (%)	33 (44.0 %)
2, *n* (%)	2 (2.7 %)

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3, *n* (%)	2 (2.7 %)
Follow up	
Irregular, *n* (%)	62 (82.7 %)
Regular, *n* (%)	13 (17.3 %)
HbA1C	
< 7, *n* (%)	15 (20.0 %)
> 7, *n* (%)	60 (80.0 %)
Mean ±SD	9.44 ± 2.84
Range	6 - 15

Table 3: Visual acuity in patients and control groups in right and left eye

Visual acuity	**Right eye**				**Left eye**			
	Study *n* = 75		**Control *n* = 75**		**Study *n* = 75**		**Control *n* = 75**	
	n	**%**	***n***	**%**	***n***	**%**	***N***	**%**
Normal	59	78.7	59	78.7	58	77.3	61	81.3
6/9	6	8.0	9	12.0	6	8.0	9	12.0
6/12	2	2.7	4	5.3	1	1.3	2	2.7
6/18	4	5.3	3	4.0	3	4.0	0	0.0
6/24	0	0.0	0	0.0	0	0.0	3	4.0
6/36	4	5.3	0	0.0	6	8.0	0	0.0
6/60	0	0.0	0	0.0	1	1.3	0	0.0

Table 4: Visual acuity abnormality in patients with type 1 diabetes mellitus and control subjects

Visual acuity	**Study *n* = 75**		**Control *n* = 75**		***P***
	N	**%**	***N***	**%**	
Abnormal	17	22.7	16	21.3	0.844 ¥ NS
Normal	58	77.3	59	78.7	

n: number of cases; ¥: Chi-square test; NS: not significant at *P*> 0.05

Table 5: Other ocular abnormalities

Abnormality	**Study *n* = 75**		**Control *n* = 75**		***P***
	N	**%**	***n***	**%**	
Schirmer's test (dry eye)	11	14.7	3	4.0	0.025 ¥ S
Fundoscopy	2	2.7	0	0.0	0.499 f NS
Intra ocular pressure	8	10.7	1	1.3	0.034 f S
Visual field defect	2	2.7	1	1.3	1.000 f

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					NS
Cataract	1	1.3	0	0.0	1.000 f NS

n: number of cases; ¥: Chi-square test; f: Fischer exact test; NS: not significant at $P > 0.05$; S: significant at $P \leq 0.05$

Discussion

In the current study, visual acuity was not significantly different between diabetic patients and control subjects. This finding was similar to the finding of (Akil*et al*., 2016), who studied ocular manifestation in children with diabetes in comparison with apparently healthy children and found no significant difference in visual acuity between both groups. Indeed, the visual acuity is affected by macular changes (Serban*et al*., 2014) and since there was no significant difference in retinal changes between diabetics and non-diabetics in the current study as evidenced from fundoscopic examination, this explains the lack of significance difference in visual acuity between both groups. These retinal changes actually need prolong time in addition to poor glycemic control to produce significant maculopathy that significantly affects visual acuity (Lövestam-Adrian *et al*., 2001). In the current study, abnormal Schirmer's test with dry eye was seen in 11 (14.7 %) of patients and in 3 (4.0 %) of control subjects, therefore the difference was statistically significant ($P = 0.025$).Eye drynessmay the result of either disruption of the pathway of tearing reflex or from anything that alters the capacity of the lacrimal gland to produce tears. Loss of lacrimal gland function may occur due to damage to small vessels of the gland in addition to damage to autonomic nerves controlling its function as a result of chronic hyperglycemia.

Reduction in tear secretion may be explained by damage to sensory nerves of the cornea due to diabetes. Some previous reports have linked the risk of dry eye to diabetes, but others, have denied such an association among insulin requiring diabetic children (Kaisermanet *al*., 2005).

In the current study, abnormal findings upon fundoscopic examination were identified in 2 (2.7 %) of patients in comparison with none of control subjects; the difference was insignificant ($P = 0.499$). The result of diabetic retinopathy was approximately similar to that reported by (Akil*et al*., 2016) (2.4 %); however, this is low contrasted to that given in previous published articles (Massin*et al*., 2007; Olsen *et al*., 1999; Kernell*et al*., 1997) that are in the range (5 to 50) %. The variation may result from a number of factors, including the wayutilized to search for retinopathy, the kind of population examined, the patients' age, poor glycemic control and the duration of diabetes. Early detection of dry eye is of great importance in order for early intervention that may delay further progression of eye damage.

In the current study, intraocular pressure (IOP) was abnormally high in 8 (10.7 %) of patients in comparison with 1 (1.3 %) of control subjects; the difference was significant ($P = 0.034$). This finding is consistent with the findings of other authors (Akil*et al*., 2016; Schele*et al*., 2012). This observationmay be attributed to the changes of the biomechanical characteristics of the cornea associated with diabetes disturbing the intraocular pressureestimation. This increasedresistance of corneal mayresult inwrongly high intraocular

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pressure estimation. Moreover, Last *et al* suggested that an increasedresistance of cornea attributed to diabetes is associated with alterations of the trabecular meshwork causing rise in intraocular pressure (Last*et al*., 2011).

In the present study, there was also no significant difference in visual field defects between diabetics and non diabetics. Indeed our findings are supported by the findings of Trick *et al*., in 1990, who found that visual field defects are more commonly seen in type 2 diabetes than in type 1 diabetes patients. However, our findings are inconsistent with the findings of Ozates*et al*., (2019) who found significantly more frequent visual field defects in patients with type 1 diabetes mellitus than control subjects.

Conclusion: eye dryness and raised intraocular pressure were the main ocular complications in type 1 diabetes mellitus and long standing diabetes with poor control are the main risk factors for development of retinopathy in diabetic children.

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