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THE EFFECT OF DIABETES MELLITUS AND RETINAL LASER PHOTOCOAGULATION ON CORNEAL PARAMETERS: A SPECULAR MICROSCOPIC STUDY

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ABSTRACT

Objectives: The aims of this study were to compare the endotelial structure and central corneal thickness in diabetic and non-diabetic subjects, and to evaluate the effect of retinal laser photocoagulation in patients with diabetic retinopathy on endotelial structure and central corneal thickness.

Methods: Subjects were recruited from Al-Naser Eye Hospital, 110 eyes were examined and classified into three groups: diabetic, non-diabetic and diabetic retinopathy treated with laser photocoagulation. The endotelial structure was examined for cell density, coefficient of variation of cell área, percentage of hexagonal cells and central corneal thickness. Images were obtained and analyzed by specular microscope.

Results: The mean central corneal thickness was statically thinner in diabetic than in non-diabetic subjects (498 mm versus 505 mm, $p=0.029$), no differences were observed between diabetic and non-diabetic groups with regard to the mean of coefficient of variation of cell size ($p=0.410$), mean hexagonality percentage ($p=0.076$), average cell size ($p=0.214$) and endotelial cell count ($p=0.268$). There were no statistically significant differences observed between diabetic and diabetic retinopathy subjects treated with laser photocoagulation in regard with specular microscopy parameters ($p= 0.512$).

Conclusion: Diabetes mellitus has no clinical effects on corneal parameters; besides retinal laser photocoagulation is a relatively safe procedure without a pathological effect on corneal endothelium.

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INTRODUCTION

Diabetes mellitus is a very frequent disease worldwide that have a large important impact on social and psychological behaviors of affected patients, not only due to its prevalence and poor patient's compliance but also because of its chronic complications and high mortality rate (Goday, 2002; Aljarousha *et al*., 2016). The disease entity is characterized by hyperglycemia, chronic development, presentation of microvascular and macrovascular disorders that may lead to catastrophic healthy situations (Fowler, Michael 2008; Group, UK Prospective Diabetes Study, 1998). Many studies have proved that functional damage or change, on the level of cell, occurs very early in the disease without visibly prominent effect on the anatomical structures of an organ (Kothari *et al*., 2002; Mariya Memon *et al*., 2010). Diabetic retinopathy being the most frequent cause of blindness for the working age individuals and is considered as an essential leading cause of blindness in the modern societies (Alves *et al*., 2008). The currently available and most commonly performed procedure for the management of diabetic retinopathy, one of the microvascular complications of diabetes mellitus, is by laser photocoagulation that uses the heat emitted from the laser to seal or destroy abnormal leaking blood vessels in the retina either by focal photocoagulation or scatter (panretinal) photocoagulation (Hoshi and Takimoto, 1994). And it's well known that application of laser photocoagulation on the retina will start at a healthy and transparent central corneal surface so that laser waves cross the cornea to reach the retinal surface of area of interest to treat hypoxic and neovacularized areas of the retina. Similar to vascular endothelium, the function of the corneal endothelium is to act as a cellular barrier. If corneal endothelium function is compromised and affected due to diabetes mellitus, then corneal physiological functions and anatomical properties may change as proved by other studies (Schultz *et al*., 1984; Shenoy *et al*., 2009; Ultrasónica, 2006). For this reason, we found it worthy to investigate both the effect of diabetes mellitus and retinal laser photocoagulation separately on corneal parameters (endothelial cell count, hexagonality, coefficient of variation, size and central corneal thickness) as measured by specular microscope. And to compare these parameters in diabetic and non-diabetic corneas of closely similar age-matched group. To our best knowledge, this is the first study to investigate the effect of diabetes mellitus and retinal laser photocoagulation on corneas of Palestinian subjects in Gaza strip.

MATERIALS AND METHODS

The study was performed on 110 eyes of 55 subjects (23 males, 32 females) aged between 41 to 72 years old (mean age=56.5 ± 7.13 years). The appropriate sample size was determined according to previous studies (Mohd-Ali *et al*., 2011; Awad and Aljarousha, 2017). Subjects were recruited among patients attended Al-Naser Eye Hospital between 21 February. 2016 and 20 March 2016. Subjects were classified into three groups. The first group included 18 diabetic patients (mean age= 59.33 ± 7.33) with proliferative diabetic retinopathy who had a history of at least on session of retinal laser photocoagulation. The second group included 18 diabetic patients (mean age= 59.33 ± 4.52 years) with no diabetic retinopathy and no history of retinal laser photocoagulation. The third group is the control group included 19 non-diabetic controls (mean age= 53.11 ± 7.72 years). The subjects included in the first and second group were of type I and type II diabetes mellitus. The diagnosis of diabetes mellitus was based on medical records and the medical history, and all subjects were on oral or parenteral antibiotic medication. Criteria of exclusion were any corneal pathology, axial myopia, high refractive errors, pseudoexfoliation, glaucoma, history of ocular trauma, intraocular surgery, intraocular inflammation, contact lens wear and age younger than 40 years. All patients had a slit lamp and fundus examination. A retinal evaluation performed, best corrected visual acuity and intraocular pressure (IOP) were measured. Central endothelial cell density (cell/mm), variation in size of endothelial cell (CV), the percentage of hexagonal cells, and central corneal thickness (CCT) were analyzed using a non-contact specular microscope (SP3000P; Topcon, Tokyo, Japan) with the large-Net imaging system (version 2.1; Topcon). Specular microscopy of the central endothelium was performed on both eyes by using a specular microscope. This device autotracts the cornea and autofocuses on the endothelium without touching the cornea. It also provides high magnification, good image quality and the capability for semi-automated, computer-assisted cell density determination, and morphometric analysis. Using the 'dot' method, we then digitized 50 cells by touching the cell apices with a graphic tablet pen, and we analyzed the cell sizes according to a variety of factors including cell density, the CV of cell area, and the percentage of hexagonal cells. All statistical tests and analyses were based on parameters values obtained from all three groups.

Statistical analysis

Data analysis was conducted using IBM SPSS (Version 21.0, SPSS Inc, Chicago, Illinois, USA).Categorical variables were compared with the independent sample t-test for normally

Table 1. Demographic and clinical status of subjects

Variables	DRP (n=18)	Diabetic (n=18)	Non-diabetic (n=19)	Total (n=55)
Mean age	59.33±7.33	59.33±4.51	53.11±7.72	57.18±7.22
Gender & Mean age				
Male	57.63±7.37 (n=8)	59.57±5.12 (n=7)	53.25±8.55 (n=8)	56.7±7.41 (n=23)
Female	60.7±7.4 (n=10)	59.18±4.36 (n=11)	53.00±7.50 (n=11)	57.53±7.18 (n=32)

n= number of subjects.
DRP= subjects with proliferative diabetic retinopathy who were treated with retinal laser photocoagulation.
Diabetic= subjects with a history of diabetes mellitus who had no diabetic retinopathy

Table 2. Comparison study of variables differences between non-diabetic and diabetic groups

Variables	Non-diabetic (n=38)	Diabetic (n=36)	P (sig.)
Hexagonality, %	53.15± 10.55	55.32 ± 10.74	.076
Cell density, /mm^2	2442.93 ± 434.36	2493.96 ± 368.33	.268
Central corneal thickness, mm	.505 ± .028	.498 ± .026	.029 *
CV of size, %	35.66 ± 5.04	35.15 ± 5.73	.410
Average size	432.14 ± 93.57	416 ±85.07	.214

*Indicates statistically significant P-values.

Table 3. Comparison study of variables differences between diabetic group and proliferative diabetic retinopathy group that received retinal laser photocoagulation

Variables	Diabetic (n=36)	DRP(n=36)	P (sig.)
Hexagonality, %	52.72 ± 10.47	50.86 ± 15.03	.103
Cell density, /mm^2	2458.96 ± 368.33	2389.07 ± 425.51	.155
Central corneal thickness, mm	.511 ± .026	.512 ± .380	.749
CV of size,%	35.53 ± 5.73	36.19 ± 5.81	.336
Average size	415.4 ± 85.07	430.69 ± 111.58	.123

distributed and Mann-Whitney U test for abnormality distributed data. With significance was calculated at $p<0.05$.

RESULTS

Fifty five subjects were enrolled in this study. Subjects were classified into three groups each of a similar number of subjects; the first group included eighteen diabetic subjects with proliferative diabetic retinopathy and who were treated with retinal laser photocoagulation, the second group included eighteen diabetic subjects without detected retinopathy, while the third group included nineteen non-diabetic subjects treated as a control group. Demographic and clinical status of all subjects are clearly shown in Table 1. Table 2 summarizes the significance of variable differences between non-diabetic and diabetic subjects who had no diabetic retinopathy (second group versus third group); the effect of diabetes mellitus on different corneal parameters. The mean central corneal thickness was statistically thinner in diabetic than in non-diabetic subjects (0.498 ± 0.026 mm versus 0.505 ± 0.028 mm, p=0.029). No differences were observed between diabetic and non-diabetic groups with regards to the mean coefficient of variation of cell size, mean hexagonality percentage, average cell size and endothelial cell count. Table 3 illustrates the effect of laser photocoagulation on diabetic corneas by comparing the outcome measures of diabetic subjects and those with proliferative diabetic retinopathy who treated with retinal laser photocoagulation. Our results showed that there were no significant differences observed between the two groups in regard with all corneal parameters mentioned previously.

DISCUSSION

Central corneal endothelial morphology evaluation not only reflects the quantitative corneal properties, but also provides a qualitative description of the functional status in terms of variation in cell area and cell shape. A reduction of cells that is not detectable by cell density measurements alone may be detected by quantization of the coefficient of variation of cell area, the percentage of hexagonal cells and CCT. There are many reports about corneal endothelial structure in diabetic patients (Schultz *et al*., 1984; Keoleian *et al*., 1992; Shetlar *et al*., 1989). Schultz *et al*. (1984) reported that in diabetic patients endothelial cell density was similar, coefficient of variation of cell area was increased, and percentage of hexagonal cells was decreased compared with non-diabetic patients. Larsson *et al*. (1996) reported that the endothelial cell density, coefficient of variation of cell area and percentage of hexagonal cells, all were not significantly different between type II diabetic and non-diabetic subjects. Roszkowska *et al*. (1999), however, reported in diabetic patients a decreased endothelial cell density, an increased coefficient of variation of cell area (polymeatheism), and a decreased percentage of hexagonal cells (pleomorphism). In Japanese diabetic patients, Itoi *et al*. (1989) and Matsuda *et al*. (1990s) have reported a similar endothelial cell density, an increased coefficient of variation of cell area, and a decreased percentage of hexagonal cells. In the present study, similar cell density, hexagonality and coefficient of variation of cell area were observed in the two groups of diabetic and non-diabetic subjects; but mean CCT was higher in the non-diabetic subjects (0.505 versus 0.498 mm) ; thinner in diabetic subjects. Although statistically significant, this difference in CCT might be of no clinical relevance as no corneal oedema was observed in any of the non-diabetic subjects, which is not in agreement with some previous studies with larger sample sizen>1000) (Ultrasónica, Diabéticos Mediante Paquimetría, 2006; Sudhir *et al*., 2012), that have reported a significant increase in central pachymetry in diabetic patients compared with non-diabetic subjects. In addition, the difference observed in our study, although statistically significant, is extremely small, and what supports this theory is similar studies with smallersample size (n~200) (Choo *et al*., 2010; Inoue, Kenji *et al*., 2002), that did not report any significant difference of CCT between the two groups, which may support the theory that the difference observed in our study might be attributed to the small sample size. Several articles have paid attention to the corneal morphology and central corneal thickness in diabetic and normal subjects, but the results are inconsistent. Thus, the morphology of the corneal endothelium in conditions with diabetes mellitus remains to be fully elucidated. Laser photocoagulation is a commonly used intervention to treat diabetic retinopathy (Evans *et al*., 2014) and previous studies indicate that corneal endothelial cell loss may occurs with retinal laser photocoagulation (Pardos and Krachmer, 1981; Menchini *et al*., 1990; Hiroshi Murata *et al*., 2006). Pardos and Krachmer (1981) demonstrated a correlation between argon laser photocoagulation energy and decreased corneal endothelial cells after 6 weeks in 22 diabetic eyes.

On the contrary, Makitie *et al*. (1985) found no statistically significant decrease in corneal endothelial cell density following retinal photocoagulation. We evaluated endothelial cell parameters of 36 eyes of diabetic patients treated with retinal laser photocoagulation, by using specular microscopy and compared them with the same values gathered from 36 eyes of diabetic patientswithout retinal laser photocoagulation. The results of our study suggested that there were no statistically significant difference in the endothelial cell parameters between the two groups. Our patients had no documented endothelial cell pathology, and retinal laser photocoagulation has shown to be a safe procedure.

Conclusion

Diabetes mellitus is an important cause of blindness that affects many ocular structures. However, based on our investigation, diabetes mellitus has no clinical effects on corneal parameters. Our study, as well, showed that retinal laser photocoagulation is a relatively safe procedure without a pathological effect on corneal endothelium.

REFERENCES

Aljarousha, M., Badarudin, N.E., Che Azemin, M.Z. 2016. Comparison of dry eye parameters between diabetics and non-diabetics in district of Kuantan, Pahang. *Malays J Med Sci*., 23:72–77.

Alves, M. D. C., Carvalheira, J. B., Módulo, C. M., and Rocha, E. M. 2008. Tear film and ocular surface changes in diabetes mellitus. Arquivos Brasileiros de Oftalmologia, 71(6), 96–103.

Awad, K. S., and Aljarousha, M. A. 2011. Comparison of Dry Eye Parameters between Keratoconus Patients and Control Subjects in Gaza Strip, *Palestine*, 325–328.

Choo, M. M. *et al*. 2010. "Corneal changes in type II diabetes mellitus in Malaysia. "*International Journal of Ophthalmology*, 3.3:234.

Evans, J.R., Michelessi, M., Virgili, G. 2014. Laser photocoagulation for proliferative diabetic retinopathy. *Cochrane Database Syst Rev*.,24; 11: CD011234.

Fowler, Michael J. 2008. "Microvascular and macrovascular complications of diabetes." *Clinical diabetes,* 26.2:77-82.

Goday, A. 2002. Epidemiology of diabetes and its non-coronary complications. *Rev EspCardiol*., 55: 657-670.

Group, U.K. Prospective Diabetes Study. "Tight blood pressure control and risk of macrovascular and microvascular complications in type 2 diabetes: UKPDS 38." *BMJ*: *British Medical Journal*, 1998, 703-713.

Hiroshi Murata, *et al*. 2006. Corneal endothelial cell density reduction: a complication of retinal photocoagulation with an indirect ophthalmoscopy contact lens. *ActaOphthalmol. Scand*., 85: 407–408.

Hoshi, M., and T. Takimoto. 1994. "Treatment of Diabetic Retinopathy Photocoagulation-When to Start and How to Follow. Viewpoint from Physician." *Journal-Japan Diabetes Society*, 37: 791-791.

Inoue, Kenji, *et al*. 2002. "The corneal endothelium and thickness in type II diabetes mellitus." *Japanese Journal of Ophthalmology*, 46.1:65-69.

Itoi M, Nakamura T, Mizobe K, Kodama Y, Nakagawa N, Itoi M. 1989. Specular microscopic studies of the corneal endothelia of Japanese diabetics. Cornea, 8:2–6.

Keoleian GM, Pach JM, Hodge DO, Trocme SD, Bourne WM. 1992. Structural and functional studies of the corneal endothelium in diabetes mellitus. *Am J Ophthalmol*., 113: 64– 70.

Kothari, V., Stevens, R.J., Adler, A.I., Stratton, I.M., Manley, S.E., Neil, H.A., *et al*. 2002. UKPDS 60: risk of stroke in type 2 diabetes estimated by the UK Prospective Diabetes Study risk engine. *Stroke*, 33: 1776-1781.

Larsson LI, Bourne WM, Pach JM, Brubaker RF. 1996. Structure and function of the corneal endothelium in diabetes mellitus type I and type II. *Arch Ophthalmol*., 114: 9–14.

Makitie, J., Koskenvuo, M., Vannas, A., Jarvinen, E. and Ahonen R 1985. Corneal endothelium after photocoagulation in diabetic patients. *ActaOphthalmologic*., 63: 355–360.

Mariya Memon, Khalid Iqbal Talpur, Arsalan Rajpur, Mohammad Memon. 2010. Correlation between Intra Ocular Pressure, Central Corneal Thickness and Glaucoma Stage in Patients with Primary Open Angle Glaucoma. *Pak J Ophthalmol*., 26: 26-34.

Matsuda, M., Ohguro, N., Ishimoto, I., Fukuda, M. 1990s. Relationship of corneal endothelial morphology to diabetic retinopathy, duration of diabetes and glycemic control. *Jpn J Ophthalmol*., 34:53–6.

Menchini, U., Scialdone, A., Pietroni, C., Carones, F. and Brancato, R. 1990. Argon versus krypton panretinal photocoagulation side effects on the anterior segment. *Ophthalmologica*, 201: 66–70.

Mohd-Ali, B., Liew, L. Y., Tai, H. J., and Wong, Y. Y. 2011. Tears evaluation of one sample of keratoconus patients in kuala lumpur. *Medical Journal of Malaysia*, 66(1), 53–55.

Pardos, G.J. and Krachmer, J.H.. 1981. Photocoagulation. Its effect on the corneal endothelial cell density of diabetics. *Arch Ophthalmol.*, 99: 84–86.

Roszkowska, A.M., Tringali, C.G., Colosi, P., Squeri, C.A., Ferreri G. 1999. Corneal endothelium evaluation in type I and type II diabetes mellitus. *Ophthalmologica*., 213:258–61.

Schultz, R.O., Matsuda, M., Yee, R.W., *et al*. 1984. Corneal endothelial changes in type I and type II diabetes mellitus. *Am J Ophthalmol*., 98: 401–410.

Shenoy, R., Khandekar, R., Bialasiewicz, A., *et al*. 2009. Corneal endothelium in patients with diabetes mellitus: a historical cohort study. *Eur J Ophthalmol*., 19:369–375.

Shetlar, D.J., Bourne, W.M., Campbell, R.J. 1989. Morphologic evaluation of Descemet’s membrane and corneal endothelium in diabetes mellitus. *Ophthalmology*, 96: 247–50.

Sudhir, Rachapalle, R., Rajiv Raman, and Tarun Sharma. 2012. "Changes in the corneal endothelial cell density and morphology in patients with type 2 diabetes mellitus: a population-based study, Sankara Nethralaya Diabetic Retinopathy and Molecular Genetics Study (SN-DREAMS, Report 23)." Cornea 31.10: 1119-1122.

Ultrasónica, Diabéticos Mediante Paquimetría. 2006. "Variation of central corneal thickness in diabetic patients as detected by ultrasonic pachymetry." *Arch Soc Esp Oftalmol*., 81:523-526.

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