Evaluation of the effect of Duration of Diabetes Mellitus type II and glycemic control on corneal endothelium using specular microscopy

Thesis

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By

Pavly Moawad Hanna Moawad

M.B.B.Ch

Under supervision of

Prof. Omar Mohamed El Fawahry

Professor of Ophthalmology

Faculty of Medicine - Cairo University

Prof. Waleed Hazem Attya

Professor of Ophthalmology

Faculty of Medicine - Cairo University

A.Prof.Dr. Marwa Metwaly Salama

Assistant Professor of Ophthalmology

Faculty of Medicine Cairo University

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Abstract

The human corneal endothelial cell is a non-regenerating predominantly hexagonal cell which covers the posterior surface of decrement's membrane, it is metabolically active and plays an imperative role in maintaining the corneal transparency by pumping water from stroma to the aqueous humor.

We used specular microscopy to assess corneal endothelium density , size, and shape in addition to central corneal thickness.

Our study was conducted on 90 eyes divided into 3 groups; control group , diabetic controlled , and diabetic uncontrolled.

Our study reported that glycaemic control significantly affect endothelial cell density , size, and shape, with no effect on central corneal thickness.

Meanwhile our study showed no correlation between diabetes mellitus duration and endothelial cell parameters.

Keywords:

Corneal endothelial cells , Diabetes mellitus , glycaemic control , duration of diabetes, Specular microscopy.

Contents

List of Abbreviations

A

ARI	=	Aldose Reductase Inhibitor
AGEs	=	Advanced Glycosylated End products
ATPase	=	Adenosine TriPhosphatase
AVE	=	Average cell size

B

BDVA	=	Best Corrected Visual Acuity

C

CCM	=	Corneal Confocal Microscopy
CCT	=	Central Corneal Thickness
CD	=	corneal endothelial density
CV	=	Coefficient of Variation

D

DM	=	Diabetes Mellitus

E

ECD	=	Endothelial Cell Density

F

FBG	=	Fasting Blood Glucose

G

G6PDH	=	Glucose-6-Phosphate Dehydrogenase

H

HBA1c	=	Glycated Hemoglobin

I

IGF-1	=	Insulin-like Growth Factor-1
IOP	=	IntraOcular Pressure

M

MAX	=	Maximum cell size
MIN	=	Minimum cell size
mRNA	=	messenger RiboNucleic Acid
MUC1	=	Mucin 1

N

NUM	=	Number of cells

P

6A	**=**	Percentage of hexagonal cells
PRPH	=	Percent Recovery Per Hour
PXF	=	Pseudoexfoliation syndrome

R

R	=	pearson product-moment correlation coefficient
RBG	=	Random Blood Glucose

S

SD	=	Standard Deviation
SPSS	=	Statistical Package for the Social Science

U

UCVA	=	Uncorrected Distant Visual Acuity

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Introduction

The human corneal endothelial cell is a non-regenerating predominantly hexagonal cell which covers the posterior surface of descement's membrane and faces the anterior chamber of the eye. Corneal endothelium is metabolically active and plays an imperative role in maintaining the corneal transparency by pumping water from stroma to the aqueous humor and keeping the stroma in the dehydrated level of 70% of water. Corneal endothelial cell density and morphology can be analyzed using specular microscope. The specular microscope has been shown to be reliable and reproducible.[1-3]

Worldwide, the incidence of type II diabetes mellitus is increasing, reaching epidemic proportions in developing countries. The disease entity is characterized by hyperglycemia and the development of micro- and macrovascular disorders, leading to functional and morphological disorders in several organs.[4-5] Diabetes mellitus is associated also with structural changes in corneal endothelial cells and their thickness.[6-10]

Many clinical evidences have shown that patients with diabetes have functional abnormalities such as a higher corneal autofluorescence, lower corneal sensitivity, greater baseline corneal thickness, less endothelial cell density, and increased endothelial permeability to fluorescein after intraocular surgery.[11-13]

Hypothetically, these phenomena could be caused by chronic metabolic changes at cellular level that primarily affect the single layer of the coherent endothelial cells.[14]

Thus, we performed our study to evaluate the differences of central corneal thickness and corneal endothelial cell morphology between diabetics and age matched healthy normal subjects with respect to duration and glycemic control of diabetes mellitus.

Aim of work

To evaluate the effect of duration of diabetes mellitus type 2 and glycemic control on corneal endothelium as regards endothelial cell density ,cells size, shape, and central corneal thickness using specular microscopy.

Corneal endothelium ultrastructure

A typical human endothelial cell measures 5 µm in height, and between 18 and 20 µm in width and has a rounded nucleus 7 µm in diameter. There is a variable number of microvilli on the posterior surface that project between 0.5 and 0.6 µm into the anterior chamber [15]. Oligocilia, projecting 2 to 7 µm from a pair of centrioles in the posterior cytoplasm, are present on some cells, particularly toward the corneal periphery[16] [17].

Transmission electron microscopy has shown that cells are separated laterally by a gap of about 30 µm, which is reduced to 3 µm at the site of a gap junction toward the anterior chamber [18]. Focal tight junctions join the cells at the apical third of the cell, but there are no desmosomal junctions[19].There is an overall hexagonal pattern with fine marginal folds when the cells are viewed from the posterior surface, but surface parallel histological sections reveal that there are extensive and irregular interdigitations between cells[20].

The anterior cell membrane of each cell is in direct contact with Descemet's membrane and,because no junctional complexes are present, endothelial cells are readily dislodged by mechanical injury[21]. The endothelial cell cytoplasm is rich in organelles, suggesting active transport and protein synthesis, with large numbers of mitochondria, both rough and smooth endoplasmic reticulum, and a well developed perinuclear Golgi apparatus. Pinocytotic vesicles are presumably concerned with the active transport of water and metabolites,they pass from the posterior cell membrane to be released either into the lateral cell space or through the anterior cell membrane,their formation is temperature dependent.