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Hypertension and cerebrovascular diseases are related to corneal endothelial insufficiency — a retrospective study

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ABSTRACT

BACKGROUND: Corneal endothelium has an important role on the clarity of the cornea. Cataract surgery may cause corneal endothelial damages and serious vision problems. In this study, we aimed to investigate hypertension, cerebrovascular diseases, and trauma in patients who developed corneal endothelial insufficiency (CEI) after cataract surgery.

MATERIAL AND METHODS: The study was performed in the Department of Ophthalmology in Adana Ortadogu Hospital between October 2017 and October 2018. 24 patients who developed CEI after cataract surgery and 24 patients who did not develop CEI after cataract surgery were included to the study. Eye trauma, systemic hypertension, cerebrovascular diseases were investigated in the patients' own history. The findings were compared statistically.

RESULTS: The percent of cerebrovascular diseases was 54.2% in patients with CEI and 16.6% in patients without CEI. 58.3% of the patients with CEI had a systemic hypertension history. Hypertension was presented in 25% of the patients who did not develop CEI. The rate of trauma history in patients with CEI was 29.2% and 12.5% in those without CEI. The history of cerebrovascular disease and hypertension were significantly higher in patients with CEI.

CONCLUSION: Hypertension and cerebrovascular diseases appeared to be linked with CEI.

KEY WORDS: hypertension; cerebrovascular disease; trauma; cataract; corneal endothelial insufficiency

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INTRODUCTION

Corneal endothelium is the most important layer of corneal transparency. Therefore, the protection of this layer during surgical procedures is very important. The endothelium maintains the corneal stroma in a steady state of hydration by maintaining the active fluid pump and barrier function. This has a direct effect on the clarity of the cornea. Cataract treatment with phacoemulsification is one of the most common surgical methods used today. It is known by everyone that corneal endothelium may be damaged during phacoemulsification operation [1]. The corneal endothelial cell layer has no ability to regenerate itself after trauma. The repair process is provided by the expansion of the remaining cells, amitotic nucleus division, migration, and the phenomenon of badge formation. As a result, the cellular density decreases, the average cell area grows proportionally, and the hexagonal cell pattern deteriorates [2, 3]. Endothelial cell count is also known to decrease with age [4]. Most people with phacoemulsification are older. The increase in life expectancy in these patients makes endothelial damage an important factor during surgery. The endothelial functions may decrease in various corneal diseases such as trauma, previous intraocular operation, inflammation, metabolic disorders (diabetes mellitus) or Fuch's distrophy, congenital hereditary

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endothelial dystrophy, and posterior polymorphic dystrophy. Thus, the endothelial cell function deteriorates and the transparency of cornea is impaired [5]. Corneal endothelial insufficiency (CEI) causes irreversible serious vision problems. Treatment of this condition is difficult and can only be possible surgically.

The aim of our study was to investigate hypertension, cerebrovascular factors, and trauma in patients who developed CEI after cataract surgery (Phacoemulsification + IOL implantation). Another aim is to determine whether systemic hypertension, cerebrovascular diseases, and trauma may be related to an endothelial insufficiency, or not.

MATERIAL AND METHODS

The study was performed in the Department of Ophthalmology in Adana Ortadogu Hospital between October 2017 and October 2018. The ethics committee approval was obtained from Adana City Hospital in Adana in Turkey. The nature and purpose of the study explained to all patients and informant consent was obtained from all patients.

24 patients who developed CEI after cataract surgery and 24 patients who did not develop CEI after cataract surgery were included to the study. 48 patients who underwent lensectomy and intraocular IOL implantation with phacoemulsification technique were included to the study. The same phacoemulsification equipment was used in all operations. These operations were made by the same specialist.

At the beginning of the operation, tropicamide 0.5% and phenylephrine HCL 2.5% were instilled 3 times 5 minutes apart to the planned eye. Each patient was operated 45 minutes after the last drop. Proparakain HCL 0.5% was instilled to both eyes before the operation. The planned eye and surrounding area were wiped out with a 10% batikon. Patient covered with a drape. Eyelash bottoms and ocular surface were washed with 5% batikon and waited for 3 minutes. Peribulbar anaesthesia was performed by administering 3 ml jetocaine to the subtenon area. The sideports were opened with a 20 Gauge knife. Viscoelastic substance (VEM) was administered to the anterior camera. A corneal tunnel was opened with a 2.8 knife. Capsulorhexis and + hydrodissection were performed. The nucleus was phacoemulsified. Cortex residues were aspirated by bimanual irrigation and aspiration (I/A). The collapsible acrylic hydrophilic intraocular lens (IOL) was implanted into the capsule bag. The anterior camera was purged with I/A. 1 cc of 5.45 mg moxifloxacin was given to the anterior camera of patients. All operations were finished without complications.

The files and records of patients with CEI were retrospectively reviewed. Eye trauma, systemic hypertension, and cerebrovascular diseases were investigated in the patients' own history. Patients with a positive history of these conditions were noted. Patients with glaucoma, glaucoma surgery, history of previous vitrectomy, corneal transplantation, and those with intravitreal injection history were excluded from the study. Those with systemic diseases other than hypertension and cerebrovascular diseases and those with systemic steroid treatment for any reason were excluded.

STATISTICAL METHOD

In the descriptive statistics of the data, mean, standard deviation, median lowest, highest, frequency and ratio values were used. The Chi-Square Test was used for the analysis of qualitative independent data. SPSS 21.0 program was used in the analysis.

RESULTS

The mean age of patients with corneal endothelial failure was 75.2 ± 5.71. The mean age of patients with no corneal endothelial failure was 76.1 ± 5.50. 54.2% (N = 13) of the patients with corneal endothelial failure were male and 50.0% (N = 12) of the patients with no corneal endothelial failure were male.

The percent of cerebrovascular diseases was 54.2% (N = 13) in patients with CEI and 16.6% (N = 4) in patients without CEI. When these two groups were compared statistically, p-value was found to be 0.007. The history of cerebrovascular disease was significantly higher in patients with CEI ($p < 0.05$).

Among the patients with CEI, 58.3% (N = 14) had a systemic hypertension history. Hypertension was presented in 25% (N = 6) of the patients who did not develop CEI. When the two groups were compared in terms of hypertension, p-value was determined as 0.019. The history of hypertension was significantly higher in patients with CEI ($p < 0.05$).

The rate of trauma history in patients with CEI was 29.2% (N = 7) and 12.5% (N = 3) in those without CEI. When the two groups were compared in terms of trauma, p-value was found to be

Table 1. Demographic variables and clinical characteristics of the patients

		Corneal endothelial failure		No corneal endothelial failure	
		Mean	SD	Mean	SD
Age		75.2	5.71	76.1	5.50
		N	%	N	%
Gender	Male	13	54.2	12	50.0
Eye side	Right	12	50.0	13	54.2
CVD		13	54.2	4	16.6
HT		14	58.3	6	25.0
Trauma		7	29.2	3	12.5

CVD — cerebrovascular diseases; HT — hypertension; SD — standard deviation

Table 2. The comparison of cerebrovascular diseases (CVD), hypertension (HT), and trauma between the groups

	Corneal endothelial failure N (%)	No corneal endothelial failure N (%)	p
CVD	13 (54.2)	4 (16.6)	0.007
HT	14 (58.3)	6 (25.0)	0.019
Trauma	7 (29.2)	3 (12.5)	0.155

0.155. Although the rate of trauma was higher in patients with CEI, this was not statistically significant ($p < 0.05$).

Demographic variables and clinical characteristics of the patients are shown in Table 1.

The comparison of cerebrovascular diseases (CVD), hypertension (HT), and trauma between the groups is presented in Table 2.

DISCUSSION

Cataract surgery is performed with various techniques such as conventional extracapsular cataract extraction, small incision cataract surgery, and phacoemulsification. Several studies have been conducted to examine the effects of all these surgical methods on the corneal endothelium. These studies showed dysfunctions and a decrease in the number of endothelial cells after surgery. However, the aetiology of these dysfunctions and a decrease in the number of corneal endothelial cells has not been fully elucidated. The cause of CEI is mostly due to endothelial damage during phacoemulsification surgery; the heat released by the phaco tip, micro-air bubbles and the formation of free radicals, surgical instruments and mechanical deformation of the cornea have been held responsible [6–8]. On the other hand, the operative risks of CEI were determined as the duration of operation time, inexperienced surgeon, ultrasonic vibrations, and heat. However, a limited number of studies were performed to determine the risk factors before the operation [8–11].

Lundberg B et al. investigated the causes of CEI in a study. In this study, postoperative corneal oedema was clinically demonstrated to be strongly associated with loss of corneal endothelial cells [9]. Pramod K. Sahu et al. reported that the patients with diabetes mellitus had significantly higher corneal endothelial density after phacoemulsification compared to non-diabetic patients. In addition, patients with diabetes showed a slower and weaker recovery response [12]. In one study, it was shown that the number of corneal endothelial cells decreased in smokers and in patients with diabetes mellitus [13].

There is limited literature about the relationship between corneal endothelial failure and vascular pathologies. A study conducted by Olsen reported that the frequency of cardiovascular disease was significantly higher in the group of Fuchs' endothelial dystrophy than in the control group [14]. In this study, it was reported that the corneal endothelial cells develop in intimate relationship with vascular mesenchymal cells and the corneal and vascular endothelium share biological properties. In this context, it was suggested that there might be a relationship between vascular pathologies and endothelial dystrophy. In the present study, we hypothesized

that hypertension and vascular diseases might be associated with corneal endothelial failure due to a decreased blood supply resulted in a decreased aqueous flow. A decreased aqueous flow might negatively affect the feeding of the cornea.

The above-mentioned studies evaluated the preoperative, perioperative, and postoperative possible causes of CEI after cataract surgery. However, there is no consensus about this subject. In this context, we thought that our study contributed significantly to the literature. In the present study, we showed that CEI after phacoemulsification surgery might be associated with systemic hypertension and cerebrovascular diseases. Future longitudinal studies with large samples are needed to clarify these findings.

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STATEMENT OF COMPETING INTERESTS

The authors report no competing interests.

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