Ocular Microbial Flora and Diabetes in Patients Undergoing Cataract Surgery

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ABSTRACT

BACKGROUND

Diabetes, having an impact on the immune system, will cause changes in the microbial flora of different organs. The aim of this study was to compare the ocular microbial flora of diabetic and non-diabetic patients as candidates for cataract surgery.

METHODS

In this cross-sectional study, 380 diabetic and non-diabetic patients undergoing cataract surgery were selected by convenience sampling method. After informed consent, fasting blood sugar (FBS) and HbA_1c were measured. Then, microbial culture of the conjunctiva was performed before surgery. Data were analyzed by independent T-test and fisher's exact test.

RESULTS

Frequency of *Staphylococcus* coagulase-positive in diabetic/non-diabetic patients was 0/6. The difference was significant ($p=0.030$). In addition, the frequency of funguses in diabetic/non-diabetic patients was 17/1 ($p<0.001$). *Klebsiella*, *Staphylococcus* coagulase-negative and *Staphylococcus epidermidis* in diabetic patients were higher than non-diabetics ($p>0.05$).

CONCLUSIONS

The results of this study showed that, the rate of *Klebsiella*, *Staphylococcus* coagulase-negative, *Staphylococcus epidermidis* and Fungal species in conjunctival of diabetic patients was higher than non-diabetic. Therefore, ophthalmologists need to consider the immunology points in diabetic patients undergoing cataract surgery.

KEY WORDS

Bacterial Infection, Conjunctivitis, Diabetes, Cataract

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BACKGROUND

The major population of microorganisms that reside in the eyes of healthy people are bacterial normal flora. These microorganisms play a significant and specific role in preserving health and normal function of conjunctiva. These bacteria, when disturbed, can promptly re-establish themselves. These organisms generally aren't cause of eye infection, but they have potential to become pathogenic in the specific condition such as immune deficiency.[1] It was accepted that gram-positive bacteria, particularly coagulase-negative Staphylococci, are the main inhabitants of healthy eye. They are the main reason of postoperative infections.[2] The conjunctival flora may be changed in special conditions, in newborn, immune deficient patients, contact lens wearers, and patients using immunosuppressive medications.[3] Diabetes mellitus is one of the diseases that affects the immune system and reduces the effective function against infections. Diabetes may cause metabolic disorders can facilitate infection.[4,5] Diabetes has negative effects on the eyes, including delayed cornea damage, the formation of various types of glaucoma, cataracts and, retinopathy. It has been reported postoperative endophthalmitis was higher in diabetic patients in comparison with Non-diabetic patients.[6] Fernández-Rubio et al. planed a Study to assess the microbial pattern of diabetic patients who candidate for cataract surgery. They were chosen 5922 patients and showed 274 people had renal dysfunction. Diabetic patients have higher levels of *Staphylococcus aureus*, *Enterococci*, *Streptococci* and *Klebsiella* than non-diabetics also their result showed prevalence of conjunctival bacteria was higher in older patients than younger.[7] Kawata, demonstrated a correlation between the diabetes and conjunctival infection. Result of his study showed elder diabetic patients have a higher frequency of positive bacterial culture in the conjunctiva before cataract surgery.[8] The main goal of this study was to evaluate the conjunctival bacterial and fungal flora of diabetic patients and compare it to the Non-diabetic patients, in patients before cataract surgery.

METHODS

The population of this cross-sectional study consists of all patients referred to our hospital candidate for cataract surgery over a 12-month period from September 2017 to September 2018. Based on Moreno et al.[9] (Distribution of *Staphylococcus aureus* in diabetic patients was 14% and in Non-diabetics 4.2%, therefore, p1=0.14, p2=0.042, with consideration α=0.05, β=0.2,

$$n = \frac{(Z_{1-\frac{\alpha}{2}} + Z_{1-\beta})^2 P_1(1-P_1) + P_2(1-P_2)}{(P_1-P_2)^2}) = 175.62)$$

For more certainty, 190 patients selected by a convenience sampling method. This study approved by the Ethics Committee of Rafsanjan University of medical sciences (IR.RUMS.REC.1395.93). Patients with anatomical and functional defects such as corneal and conjunctival disorders and conjunctival secretions, known immunosuppressive diseases and ophthalmic medicine therapy were excluded from the study. Informed consent was obtained from all individuals. Before cataract surgery, fasting blood sugar (FBS) and HbA1c was measured. Also, the conjunctival swabs obtained by moistened sterile cotton tipped applicators in aseptic condition and appropriate light source, from both eyes of all the patients separately and sent to the microbiology laboratory of medical college. In the laboratory, the swabs were inoculated in Tryptic Soy Broth (TSB) at 37ºC for 6 hours to exclude infection and gram staining was done from the broth and also cultured in blood agar and Eosin methylene blue and thioglycollate broth. All media incubated at 37 ºC for 24 hours. After 48 hours, all the creatures were recognized by normal microbiological techniques i.e. colony morphology, Gram staining, pigment creation.

Statistical Analysis

The clinical and laboratory records of all patients were coded, and data analyzed by SPSS-20. The results were presented as mean ± standard deviation (SD). Independent t-test and fisher's exact test were used for analysis of data and p-value ≤ 0.05 was considered statistically significant.

Ethical Considerations

All procedures performed in studies involving human participants were in accordance with the Ethics Committee of our University of medical sciences, Iran, and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards.

RESULTS

In this study, microbial culture was taken from the conjunctival cul-de-sac of both eyes, but only we analyzed and reported the cultures results of the eye under cataract surgery. A total data from 380 people were analyzed in this study. The mean age of patients with positive and negative microbial culture (p=0.220) and diabetic and non-diabetic patients was not significantly different (0.052). There was no significance relation between gender and the result of microbial culture (p=0.257) but the relation between gender and diabetes was significant (p=0.022) (Table 1). The result of Fisher's Exact Test showed that the relation between diabetes and the outcome of microbial culture was significant (0.032) (Table 2). The frequency of microorganisms in diabetic/non-diabetics patients were as follows: *Klebsiella* 3/0 (p=0.123), *Staphylococcus* coagulase-negative 40/26 (p=0.059), *Staphylococcus epidermidis* 9/6 (p=0.600), *Enterobacter* 0/3 (p=0.248), *Staphylococcus* coagulase-positive 0/6 (p=0.030) and Funguses 17/1 (p<0.001) (Table 3). The frequency of the fungal species obtained showed in Table 4.

	Microbial Culture		p-Value	Diabetes		p-Value
	Positive (n=62)	Negative (n=268)		Yes (n=190)	No (n=190)	
*Age (years)	69.28±10.12	67.45±12.60	†0.220	66.69±8.67	69.13±14.65	†0.052
**Gender						
Male(n=161)	42(37.8)	119(44.2)	††0.257	92(48.4)	69(36.3)	††0.022
Female(n=219)	69(62.2)	150(55.8)		98(51.6)	121(63.7)	

Table 1. Comparison of Age and Gender in Patients with Conjunctival Cul-De-Sac Positive and Negative Culture

*: Mean±SD, **: No (%), †: Independent t-test, ††: Fisher's Exact Test used.

Microbial Culture	Diabetic	Non-diabetic	Total	p-value
Positive	69(36.3)	42(22.1)	111(29.2)	
Negative	121(63.7)	148(77.9)	269(70.8)	†† 0.032
Total	**190(100)**	**190(100)**	**380(100)**	

Table 2. Result of Microbial Culture in Diabetic and Non-diabetic Patients with Cataract

No (%), ††: Fisher's Exact Test was used.

Isolated Microorganism	Diabetic (N=190)	Non-Diabetic (N=190)	††p-Value
Klebsiella	3(1.6)	0(0)	0.123
Staphylococcus coagulase-negative	40(21.1)	26(39.4)	0.059
Staphylococcus epidermidis	9(4.7)	6(3.2)	0.600
Enterobacter	0(0)	3(1.2)	0.248
Staphylococcus coagulase-positive	0(0)	6(3.2)	0.030
Fungi	17(8.9)	1(0.5)	<0.000

Table 3. Bacterial and Fungal Pattern Isolated from Conjunctival Cul-De-Sac

No (%), ††: Fisher's Exact Test was used.

Fungi	Diabetic	Non-Diabetic
Aspergillus fumigatus	2(11.76%)	0
Aspergillus niger	2(11.76%)	0
Aspergillus flavus	2(11.76%)	0
Candida albicans	2(11.76%)	0
Candida glabrata	1(5.88%)	0
Candida parapsilosis	2(11.76)	0
penicillium	3(17.65%)	0
Mucormycosis	3(17.65%)	0
Cryptococcus neoformans	0	1(100%)
Total	**17(100%)**	**1(100%)**

Table 4. Frequency of Fungal Pattern Isolated from Conjunctival Cul-De-Sac

DISCUSSION

In this study, we assessed the conjunctival bacterial flora in diabetic and non-diabetic patients who referred for cataract surgery. It was accepted diabetes can lead to a decrease in immune system activity and this condition increase the risk of infection. On the other hand, patients with diabetes are susceptible to infection.[10] Recently, Ansari et al. planned a retrospective cohort study and assessed 938,440 patients without diabetes and 48,584 diabetic patients. Their result showed the diabetic patients had a significantly increased of conjunctivitis.[11] Based on our result, there was not statistically difference in the prevalence of microorganisms, including *Klebsiella*, *Staphylococcus* coagulase negative, *Staphylococcus epidermidis*, and *Enterobacter* in the diabetic and non-diabetic patients. In this study, *Staphylococcus* coagulase negative was higher in the diabetic patients in comparison with Non-diabetic group. (14.5% Vs. 10.6%). *Staphylococcus epidermidis* was also higher in the diabetic group.[12] Some studies have shown in many people, *Staphylococcus epidermidis* is the normal conjunctival flora.[12,13]

Many studies showed *Staphylococcus* coagulase negative is an important factor in endophthalmitis after ocular surgery.[3,14,15] Similar to our finding, Karimsab et al showed positive cultures in diabetic patients were higher in comparison to non-diabetic patients and *Staphylococcus* coagulase negative had a higher incidence in diabetic patients.[16] In another study Martins found *Staphylococcus* coagulase-negative was a common microorganism in diabetic patients with retinopathy.[17] Moreover Walker and colleagues also found similar results in their study.[18] Similar to the results of these studies, Johnson et al. found positive relation between the conjunctival flora in diabetic patients and higher rate of gram-positive cocci, *Staphylococcus* coagulase negative and *Staphylococcus aureus*.[19] The conjunctival fungal pattern of our diabetic patients showed an increased frequency in comparison to the non-diabetics. This difference was statistically significant (Table 2). Klotz et al. was reported that fungi can isolate from Conjunctival cul-de-sac of 6-25 percent of the normal population.[20] Similar to our findings, Andrade reported that positive fungi isolated from Conjunctival cul-de-sac of diabetic patients.[21] We find a significant difference in *Staphylococcus* coagulase-positive rate among the diabetic and non-diabetic patients. Based on our result frequency of *Staphylococcus* coagulase-positive in Non-diabetic patients was higher than diabetic patients. Our result was in contrast of reports in many studies. Karimsab and Suto et.al in two separated reports were shown in diabetic patients' rate of *Staphylococcus* coagulase-positive were higher in comparison of non-diabetic patients.[16,22] Similar to our result Adam reported in 2015 *Staphylococcus* coagulase-positive was identified in 53% of non-diabetic patients and 30 percent in diabetic patients. This difference was statistically significant. They concluded *Staphylococcus* coagulase-positive the most common bacterial flora in non-diabetic patients.[23] We did not find any relation between age and positive bacterial culture. In contrast of our study, some studies concluded that the elderly people were at high risk of positive conjunctival bacterial culture before cataract surgeries. Moreover, De Kaspar et al. showed patients with diabetes mellitus had a higher chance to have a positive conjunctival bacterial culture before ophthalmic surgeries.[24]

Limitations

The limitations of this study were the lack of examination of the functions of other organs of the body, including the kidneys, and the evaluation of serum creatinine levels. Also, in this study, occupation, place of residence and history of infectious diseases, the duration of diabetes diagnosis and treatment, and the way diabetes was treated was not investigated.

CONCLUSIONS

The results of this study showed that the rate of isolated Gram-negative bacteria, *Klebsiella* and *Staphylococcus epidermidis* were higher in the conjunctival flora in diabetic patients. Since these microorganisms possibly will be a main factor in conjunctival infections, treatment is necessary before cataract surgery to prevent postoperative endophthalmitis especially in diabetic patients who are relatively susceptible to infections.

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