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Antibacterial effect of povidone iodine disinfectant and antibiotic eye drops before cataract surgery

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ABSTRACT

Objective: Investigate the distribution of bacteria in the conjunctival sac of two groups of cataract patients with different preoperative aseptic treatments, and compare the clinical effects of 0.5% povidone-iodine (PI) and antibiotic eye drops on killing conjunctival sac bacteria.

Methods: 400 cases of patients (400 eyes) who underwent cataract surgery in the Department of Ophthalmology of Baogang Hospital in Inner Mongolia from October 2019 to October 2020 were selected in a randomized controlled study. They were randomly divided into the experimental group (group A) and the control group (group B), with 200 cases in each group. Group A: the patients were given Gatifloxacin Eye Gel (3 times/day, 1 drop/time) combined with Diclofenac Sodium Eye Drops (4 times/day, 1 drop/time) before the operation; 0.5% PI was administered to irrigate the conjunctival sac, with 0.9% Sodium Chloride Injection washing after 3 min; 0.5% PI was administered to irrigate the conjunctival sac after operation. The corneal epithelium was observed after each irrigation. Group B: the patients were given Gatifloxacin Eye Gel (3 times/day, 1 drop/time) combined with Diclofenac Sodium Eye Drops (4 times/day, 1 drop/time) 2 days and 1 day before the operation; 0.9% Sodium Chloride Injection was administered to irrigate the conjunctival sac before and after surgical disinfection. Conjunctival sac specimens were collected for bacterial culture 2 hours before the operation, after irrigation, and after the procedure. The positive rate and the distribution of bacteria were compared between the two groups.

Results: The difference in the positive rate of bacteria in the conjunctival sac between the two groups at different time points had a statistical significance (χ^2 = 11.498, p < .022). Conjunctival sac specimens were collected on admission and 2 hours before the operation. There was no significant difference in the pathogens with positive results between the two groups (p = .955; p = .073); there was a substantial difference in the distribution of positive pathogens between the two groups before and after surgical disinfection (p < .001); there was a significant difference in the distribution of pathogens between the two groups after the operation (p = .005). For Staphylococcus epidermidis, Corynebacterium, Enterococcus faecalis, Streptococcus, and other Gram-positive bacteria, there was a significant difference in the disinfection methods between the two groups at different time points (p < .001); for Staphylococcus aureus, Gram-positive cocci, and Gram-negative bacteria, there was no significant difference in the disinfection methods between the two groups at different time points (p = .113; p = .224; p = .146). There was no significant difference between the two groups with 0-10 and 101-1000 bacterial colonies at different time points (p = .370 and .071, respectively). When there were 11-100 bacterial colonies, there was a significant difference between the two groups at different time points (p < .001). There was no significant difference in corneal epithelial injury between the two groups at other time points (χ^2 = 4.133, p = .127).

Conclusions: The combination of 0.5% PI disinfectant and antibiotic eye drops can effectively reduce the bacterial load of the conjunctival sac before operation. At the same time, it is safe and effective to irrigate the conjunctival sac with 0.5% PI disinfectant before the procedure.

Key Words: Cataract extraction, Povidone-iodine, Conjunctival sac irrigation, Bacterial culture, Corneal epithelium

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1. INTRODUCTION

With the development of modern ophthalmology, phacoemulsification combined with intraocular lens implantation has become the most commonly used surgical method in cataract treatment in China. Infectious endophthalmitis is a severe ocular emergency that occurs after cataract surgery, usually involving the vitreous, retina, and choroid. Progressing rapidly, it is difficult to be well-treated and seriously affects the recovery of visual function, even leading to enucleation. Because the ocular surface is continuously exposed to the air and contacts directly with the outside, under physiological condition, the microbial community can act as a normal flora that naturally colonizes the conjunctival sac. In contrast, the ocular surface provides a micro-environment with suitable temperature conditions and sufficient nutrition for microorganisms. Due to immune dysfunction in the elderly, tear film stability is reduced accordingly. Meanwhile, various antibodies, lactoferrin, and lysozyme deficiency in tears lead to the poor defense capability of the ocular surface, which will change the microbial community of the ocular surface and lead to an increased positive rate of bacteria in the conjunctival sac.[1] The most commonly-seen pathogens of infectious endophthalmitis are mainly gram-positive bacteria from the conjunctival sac and the skin of the eyelids and eyelid margin, with coagulase-negative staphylococci observed the most, which will produce harmful substances under the inflammatory effect and cause severe damage to the retina and vascular tissues. According to a retrospective analysis of 106 cases of infectious endophthalmitis in China, intraocular surgery accounted for the majority, including 68 cases of postoperative cataract infection, accounting for 64.15%.[2] Therefore, understanding the perioperative aseptic management of the cataract is a critical step in preventing infectious endophthalmitis.

The most commonly used method to reduce the flora on the ocular surface is to treat the ocular surface with topical antibiotics or instill 5% PI into the conjunctival sac before surgery. Fluoroquinolones are one of the commonly-used preoperative prophylactic topical antibiotics. They have an extensive range of activities against gram-positive and gram-negative bacteria, with low resistance rates, good solubility, and low toxicity. They can enter the eye well through the cornea. PI provides a broad spectrum of bactericidal activity for up to 1 hour in response to the release of free iodine molecules. Numerous data have shown that PI irrigation of the conjunctival sac effectively reduces bacterial growth in the eyelids and conjunctiva, thereby reducing the incidence of postoperative endophthalmitis.[3] Current guidelines recommend conjunctival sac disinfection with 5% PI for at least 3 minutes prior to intraocular surgery.[4] The study aimed to assess the efficacy of 0.5% PI combined with antibiotic eye drops on reducing bacterial colonization of the conjunctival sac before cataract surgery.[5] Meanwhile, the safety of 0.5% PI for irrigation of the conjunctival sac was assessed.

2. OBJECTS AND METHODS

2.1 Objects

A prospective study was conducted in this research. The research was approved by Ethics Committee of Baogang Hospital. All patients and their families were informed and had signed informed contents. Four hundred cases of patients (400 eyes) who underwent cataract surgery in the Department of Ophthalmology of Baogang Hospital in Inner Mongolia from October 2019 to October 2020 were selected in this study, including 214 female patients and 186 male patients, aged (70.51 ± 10.6). In addition, there were 186 patients with hypertension, 85 patients with coronary heart disease, and 26 patients with cerebral infarction. All patients underwent routine cataract preoperative examination, and conjunctival sac specimens were collected for culture on admission (before aseptic preparation). They were randomly divided into the experimental group (group A) and the control group (group B), with 200 cases in each group.

2.1.1 *Inclusion criteria*

(1) patients with no history of ocular injuries; (2) patients aged from 46 to 89; (3) patients with good corneal condition; (4) Patients with no ocular infection;(5) patients without antibiotics three weeks prior to surgery; (6) patients with essentially normal blood and urine routine test results.

2.1.2 *Exclusion criteria*

(1) patients with a history of iodine allergy;(2) patients with immune disorders; (3) patients with blood disorder;(4) chronic contact lens wearers; (5) patients with chronic blepharitis, conjunctivitis, dacryocystitis, and other local inflammatory diseases; (6) patients with diabetes.

2.2 Methods

2.2.1 *Surgical methods*

All of our patients underwent phacoemulsification combined with intraocular lens implantation, which was performed by the same skilled physician. At the end of the surgery, Tobramycin and Dexamethasone Ophthalmic Ointment were applied to the conjunctival sac, with sterile gauze covered.

2.2.2 *The collection of conjunctival sac specimens*

None of the subjects had recently instilled eye drops, and conjunctival sac scraping specimens were collected for bacteriological examination, by using sterile cotton swabs to quickly dip the lower eyelid fornix at the following five designated times in both groups: (1) T1, both groups were

admitted before preparation for asepsis; (2) T2, the patients in Group A were given Gatifloxacin Eye Gel (3 times/day, 1 drop/time) combined with Diclofenac Sodium Eye Drops (4 times/day, 1 drop/time) before the operation, and the patients in Group B were given Gatifloxacin Eye Gel (3 times/day, 1 drop/time) combined with Diclofenac Sodium Eye Drops (4 times/day, 1 drop/time) 2 days and 1 day before the operation; 0.9% Sodium Chloride Injection was administered to irrigate the conjunctival sac before and after surgical disinfection; (3) T3, 0.5% PI was administered to irrigate the conjunctival sac, with 0.9% Sodium Chloride Injection washing in Group A after 3min; 0.5% PI was administered to irrigate the conjunctival sac after operation; (4) T4, in the operating room, 10% iodophor was used to scrub the eyebrows, upper and lower eyelids, eyelashes and adjacent forehead, nose, cheeks and temporo-orbital region before surgery in both groups, and surgical disinfection was performed to exclude confounding factors. 0.5% PI was given to group A, and 0.9% sodium chloride injection was given to irrigate the conjunctival sac of the operation eye, and the irrigated conjunctival sac specimens were collected subsequently; (5) T5, the representatives from both groups were collected at the end of surgery. The conjunctival sac specimens were sent to the clinical laboratory of our hospital as soon as possible and inoculated on a blood plate medium in a timely manner, and the swabs were placed in the thioglycollate culture tubes, and the orifices were disinfected by alcohol lamp flame to seal the orifices.

2.2.3 *Bacteriological examination*

The collected specimens were cultured in 37∘C incubator in the microbiology laboratory of Baogang Hospital, in which the blood culture medium was cultured for three days. The colony growth indicated positive results; if there was no colony growth, it indicated negative results, and the number of bacterial colonies was also counted and recorded. The specimens were cultured in the thioglycollate agar culture medium for seven days to stimulate the growth of aerobic and anaerobic bacteria. If the culture liquid was clear and had no discoloration, it indicated negative results and no bacterial growth; if the culture medium showed turbid discoloration, it indicated positive results. Additionally, bacterial identification was performed with the automatic microorganism identification instrument.

2.2.4 *Examination of corneal epithelium*

Corneal conditions were routinely examined before surgery, and the corneas of the operated eyes were observed at 1 day, 3 days, and 1 week after surgery for corneal fluorescein sodium staining. The corneal epithelial injury was classified into mild, moderate, and severe according to the examination results.[7] The superficial punctate corneal epithelial injury was mild; massive loss of corneal epithelium erosion fused into a patch was classified as moderate; and the extensive corneal epithelial defect or formation of the stromal corneal ulcer was identified as severe.

2.2.5 *Statistical methods*

SPSS 20.0 statistical software was used to analyze the data. The measurement data were analyzed by t-test. The categorical data were compared by use of the chi-square test. The difference was statistically significant ($p < .05$).

3. RESULTS

3.1 General information

In studies of different preoperative antibacterial modalities that met the inclusion criteria, 400 patients had no preoperative inflammatory responses. There was no statistically significant difference in general information such as mean age, gender, and previous diseases between the two groups (see Table 1).

Table 1. Comparison of general information between the two groups

Item	Group A (n = 200)	Group B (n = 200)	*p*
Gender, n (%)			
Male	103 (25.8)	83 (20.8)	.057
Female	97 (24.3)	117 (29.3)	
Age	69.67±11.52	71.34±9.67	.106
Hypertension, n (%)	86 (21.5)	100 (25.0)	.160
Coronary Atherosclerotic Heart Disease, n (%)	39 (9.8)	46 (11.5)	.392
Cerebral Infarction, n (%)	10 (2.5)	16 (4.0)	.224

Note. The statistical analysis of age was made by *t*-test, and represented by $\chi \pm \sigma$. The difference was of statistical significance ($p < .05$). The statistical analysis of gender and the past medical history was made by χ^2, and represented by %. The difference was statistically significant ($p < .05$).

3.2 Bacterial culture of the conjunctival sac

3.2.1 *Bacterial culture of conjunctival sac specimens in the thioglycollate culture tubes*

In the thioglycollate culture tubes, there was a significant difference in the positive rate of bacterial culture in the conjunctival sac at different time points before and after treatment with povidone-iodine disinfectant combined with antibiotic eye drops and normal saline mixed with antibiotic eye drops (χ^2 = 11.498, p < .022) (see Table 2).

3.2.2 *Pathogen distribution of positive conjunctival sac specimens in the thioglycollate culture tubes*

Bacterial species were cultured and identified in the thioglycollate culture tubes, and various bacteria were cultured at different time points in both groups of patients. Conjunctival sac specimens were collected on admission and 2 hours before the operation and culture in the thioglycollate culture tubes in groups A and B. There was no significant difference in the pathogens with positive results between the two groups (p = .955; p = .073); there was a substantial difference in the distribution of positive pathogens between the two groups before and after surgical disinfection (p < .001); there was a significant difference in the distribution of pathogens between the two groups after the operation (p = .005). The two disinfection methods showed different results at different times for different strains. For Staphylococcus epidermidis, Corynebacterium, Enterococcus faecalis, Streptococcus, and other Gram-positive bacteria, there was a significant difference in the disinfection methods between the two groups at different time points (p < .001); for Staphylococcus aureus, Gram-positive cocci, and Gram-negative bacteria, there was no significant difference in the disinfection methods between the two groups at different time points (p = .113; p = .224; p = .146) (see Table 3).

Table 2. The comparison in positive rate of bacterial culture in conjunctival sac in different disinfection methods at different time points (the number of strains, %)

Group	Eye(s)	T1	T2	T3	T4	T5	χ^2	*p*
Group A	200	466 (26.2)	451 (25.4)	337 (19.0)	225 (12.7)	297 (16.7)	11.498	.022
Group B	200	488 (28.3)	355 (20.6)	350 (20.3)	233 (13.5)	296 (17.2)		

Table 3. Composition ratio of detected pathogens in different disinfection methods in different time groups (the number of strains, %)

Group and Time	Eye (s)	Staphylococcus Epidermidis	Corynebacterium	Enterococcus Faecalis	Streptococcus	Staphylococcus Aureus	Gram-positive Cocci	Other Gram-positive Bacteria	Gram-negative Bacteria	Total	*p*
T1 Group A	200	81 (17.4)	117 (25.1)	104 (22.3)	41 (8.8)	12 (2.6)	26 (5.6)	73 (15.7)	12 (2.6)	466 (100)	.955
Group B	200	94 (19.3)	120 (20.5)	100 (20.5)	40 (8.2)	18 (3.7)	30 (6.1)	74 (15.2)	12 (2.5)	488 (100)	
T2 Group A	200	75 (16.6)	69 (15.3)	165 (36.6)	41 (9.1)	9 (2.0)	19 (4.2)	64 (14.2)	9 (2.0)	451 (100)	.073
Group B	200	66 (18.6)	76 (21.4)	92 (25.9)	35 (9.9)	9 (2.5)	20 (5.6)	49 (13.8)	8 (2.3)	355 (100)	
T3 Group A	200	42 (12.5)	0 (0.0)	194 (57.6)	46 (13.6)	0 (0.0)	0 (0.0)	55 (16.3)	0 (0.0)	337 (100)	.000
Group B	200	109 (31.1)	21 (6.0)	187 (53.4)	4 (1.1)	4 (1.1)	0 (0.0)	25 (7.1)	0 (0.0)	350 (100)	
T4 Group A	200	25 (11.1)	0 (0.0)	125 (55.6)	25 (11.1)	0 (0.0)	0 (0.0)	50 (22.2)	0 (0.0)	225 (100)	.000
Group B	200	66 (28.3)	0 (0.0)	167 (71.7)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	233 (100)	
T5 Group A	200	60 (20.2)	46 (15.5)	111 (37.4)	5 (1.7)	14 (4.7)	2 (0.7)	56 (18.9)	3 (1.0)	297 (100)	.050
Group B	200	66 (22.3)	28 (9.5)	137 (46.3)	3 (1.0)	9 (3.0)	0 (0.0)	53 (17.9)	0 (0.0)	296 (100)	
p		< .0001	< .0001	< .0001	< .0001	.113	.224	< .0001	.146		

3.2.3 *Comparison in the number of positive conjunctival sac specimens and bacterial colonies in blood plate culture medium*

In the blood culture medium, the number of bacterial colonies in the conjunctival sac specimens with positive results was classified into three grades according to the number (0-10, 11-100, and 101-1000), in which 0 represented negative results, indicating that there was no growth of bacterial colonies. The conjunctival sac specimens were collected from 200 eyes in each group, 170 positive samples were cultured, and the culture success rate was 85%. Conjunctival sac specimens were collected on admission and 2 hours before surgery and cultured in blood plate medium in groups A and B. There was no significant difference in the number of positive conjunctival sac specimens and bacterial colonies between the two groups (χ^2 = 1.322, p = .516; χ^2 = 2.032, p = .362);

before surgery, conjunctival sac specimens were collected from patients in Group A and B for blood culture after different treatments, and there were significant differences in the number of positive conjunctival sac specimens and bacterial colonies between the two groups (χ^2 = 46.610, p < .001); there was a difference in the number of positive colonies in blood culture medium between group A and group B after surgical disinfection (χ^2 = 4.126, p = .042); there was a significant difference in the number of bacterial colonies between the two groups after surgery (p < .001). Conjunctival sac specimens were cultured in a blood plate medium. There was no significant difference between the two groups with 0-10 and 101-1000 bacterial colonies at different time points (p = .370 and .071, respectively). When there were 11-100 bacterial colonies, there was a significant difference between the two groups at different time points (p < .001) (see Table 4).

3.3 Examination of corneal epithelium

Preoperative routine examination showed no corneal epithelial injury in the two groups of patients, and the epithelial conditions of the operated eyes were observed at 1 day, 3 days and 1 week after the operation. The corneal injury was mild in both groups, showing superficial punctate corneal epithelial damage without apparent massive loss of corneal epithelium and corneal stromal layer ulcer formation. One day after surgery, 34.5% of patients showed external punctate corneal epithelial injury in Group A and 16.5% in Group B. 3 days after surgery, 15.0% of patients showed superficial punctate corneal epithelial damage Group A and 3.0% in Group B. One week after the operation, only 1 case of mild corneal epithelial injury was observed in Group A. Only two needle-like punctate staining spots were observed through corneal fluorescence staining. Deproteinized Calf blood Extract Eye Gel was administered, and the symptom disappeared when reexamined after 3 days. There was no significant difference in corneal epithelial injury between the two groups at different time points after surgery (χ^2 = 4.133, p = .127). It was safe and effective to irrigate the conjunctival sac with 0.5% PI disinfectant before surgery (see Table 5).

Table 4. Distribution of bacterial colonies in conjunctival sac specimens in different disinfection methods in different time groups (n)

Group and Time	Eye(s)	n	The number of positive specimens with different colony counts			χ^2	*p*
			0-10	11-100	101-1000		
T1 Group A	200	170	109	51	10	1.322	.516
Group B	200	170	99	58	13		
T2 Group A	200	170	117	46	7	2.032	.362
Group B	200	170	102	55	9		
T3 Group A	200	170	160	10	0	46.610	< .001
Group B	200	170	112	52	5		
T4 Group A	200	170	167	3	0	4.126	.042
Group B	200	170	160	10	0		
T5 Group A	200	170	170	0	0	18.539	< .001
Group B	200	170	157	13	0		
χ^2			4.273	33.762	5.282		
p			.370	< .001	.071		

Table 5. The comparison of corneal epithelial injury in different disinfection methods in different time groups (n, %)

Group	Eye(s)	Corneal epithelial injury at different time points (n, %)		
		1d	3d	1w
Group A	200	69 (34.5)	30 (15.0)	1 (0.5)
Group B	200	33 (16.5)	6 (3.0)	0 (0.0)
χ^2			4.133	
p			.127	

4. DISCUSSION

Endophthalmitis is a serious intraocular infectious disease that can lead to severe ocular structural and functional impairment. Large meta-analyses of endophthalmitis after cataract surgery have found that the incidence in developed countries ranges from 0.012% to 0.076%,[6] while the incidence in China is about 0.033%-0.11%.[7] Regular conjunctival sac contacts the outside and easily carries bacteria causing postoperative infection. Some studies have shown that the pathogens cultured from endophthalmitis after cataract surgery are consistent with the bacterial spectrum of the normal ocular surface.[8] Therefore, it is speculated that during surgical procedures, ocular surface pathogens enter the ocular structure through surgical incisions or intraocular lens implantation and cause infectious endophthalmitis.[9] In this study, patients with local and systemic risk factors, such as inflammatory diseases (e.g., chronic blepharitis, conjunctivitis, and dacryocystitis) and systemic diseases (e.g., diabetes), were excluded, thus increasing the reliability of the study results.

Normal conjunctival flora is dominated by bacteria, Staphylococcus epidermidis, Staphylococcus aureus, Streptococcus, Streptococcus pneumoniae, diphtheroid, Haemophilus and Pseudomonas aeruginosa are the most common pathogens of postoperative endophthalmitis.[10] According to Slean's study, it was found that coagulase-negative staphylococci, a member of gram-positive bacteria, was one of the most common pathogens cultured from endophthalmitis after cataract surgery. In contrast, gram-negative bacteria and rare fungi were less commonly-seen.[11] In this study, before aseptic preparation on admission, the distribution of positive pathogens in conjunctival sac specimens was dominated by Staphylococcus epidermidis (17.4%-19.3%), Corynebacterium (20.5%-25.1%), Enterococcus faecalis (20.5%-22.3%) and other Gram-positive bacteria (5.6%-6.1%), and Gram-negative bacteria accounted for only 2.5%-2.6%, without fungi observed T result was approximately similar to the results of most studies.

The best way to prevent postoperative endophthalmitis is to reduce ocular surface flora. The two most commonly-used methods are preoperative topical antibiotic therapy of the ocular surface and preoperative irrigation of the conjunctival sac with 0.5% PI. Optimal topical antibiotics should be broad spectrum, have a high concentration in the tear film, and have low corneal toxicity, with significant bactericidal effect and efficacy. Fluoroquinolones play their roles by inhibiting bacterial deoxyribonucleic acid gyrase, resulting in irreversible damage to deoxyribonucleic acid in Gram-positive and Gram-negative bacteria, thereby achieving bactericidal effects. Therefore, they are one of the most commonly-used local antibiotics to prevent endophthalmitis. However, antibiotics tend to produce resistant bacteria. The researchers from Pinna et al.[12] reported that 29% of coagulase-negative Staphylococcus isolates colonizing the ocular surface were multidrug-resistant organisms. Ta et al.[13] found that 15% and 16% of cultured coagulase-negative staphylococcal strains were resistant to ciprofloxacin and ofloxacin, respectively, and 29% of S. aureus were found to be resistant to fluoroquinolones. Therefore, we used a combination of Gatifloxacin eye gel and diclofenac sodium eye drops in this study. Some studies have shown that topical ofloxacin for three days is more effective in removing bacteria from the conjunctiva than topical ofloxacin for 1 hour.[14] In this study, the patients were given Gatifloxacin Eye Gel (3 times/day, 1 drop/time) combined with Diclofenac Sodium Eye Drops (4 times/day, 1 drop/time) 2 days and 1 day before the operation. There was no significant difference in bactericidal effect between the two groups ($p = .073$).

PI, also known as polyvinylpyrrolidone, is a water-soluble polymer of high molecular weight that destroys cell membranes when in contact with microorganisms. Free iodine denatures amino acids of bacterial proteins, thus playing a bactericidal role. PI comes into play rapidly, with most bacteria killed within 30 seconds. It is effective against bacteria, viruses, fungi, and spores.[15,16] A multicenter study from European Society for Cataract and Refractive Surgery (ESCRS) has shown that 5% PI takes at least 3 minutes to be instilled into the conjunctival sac, cornea, and periocular skin, and it is effective in reducing bacteria.[4] Some scholars recommend it is applicable to use diluted povidone-iodine solution continuously during surgery, but frequent use can cause corneal epithelial damage [17]. Therefore, we used the secondary iodine method for iodine disinfection in our study, and 0.5% povidone-iodine disinfectant was given twice to rinse the conjunctival sac of the operated eye 2 hours before surgery and after surgical disinfection, followed by 0.9% sodium chloride injection 3 minutes later.

The results showed that the positive rate of bacterial culture in a conjunctival sac in the thioglycollate culture tubes was significantly decreased from 25.4% to 19.0% after 0.5% PI was irrigated 2 hours before the operation and decreased from 19.0% to 12.7% after PI was irrigated again after surgical disinfection. There was a significant difference in the positive rate of bacterial culture in the conjunctival sac at different time points before and after treatment with 0.5% PI combined with antibiotic eye drops and normal saline mixed with antibiotic eye drops ($\chi^2 = 11.498$, $p < .022$). For Staphylococcus epidermidis, Corynebacterium, Enterococcus faecalis, Streptococcus, and other Gram-positive bacteria,

there was a significant difference in the disinfection methods between the two groups at different time points ($p < .001$); for Staphylococcus aureus, Gram-positive cocci, and Gram-negative bacteria, there was no significant difference in the disinfection methods between the two groups at different time points ($p = .113$; $p = .224$; $p = .146$). Two hours before the operation, conjunctival sac specimens were collected from the PI and regular saline groups for blood culture. There were significant differences in the number of conjunctival sac specimens and bacterial colonies between the two groups ($\chi^2 = 46.610$, $p < .001$); there was a difference in the number of positive colonies in the blood culture medium between the PI group and regular saline group after surgical disinfection ($\chi^2 = 4.126$, $p = .042$); there was a significant difference in the number of bacterial colonies between the two groups after surgery ($p < .001$). Conjunctival sac specimens were cultured in a blood plate medium. There was no significant difference between the two groups with 0-10 and 101-1000 bacterial colonies at different time points ($p = .370$ and .071, respectively). When there were 11-100 bacterial colonies, there was a significant difference between the two groups at different time points ($p < .001$). The above study results showed that the combination of 0.5% PI disinfectant and antibiotic eye drops could effectively reduce the bacterial load of the conjunctival sac before operation. At the end of surgery (T5), the positive rate of bacterial culture in the conjunctival sac was increased compared to T4, and the number of strains increased from 12.7% to 16.7% in the experimental from 13.5% to 17.2% in the control group. This finding may have affected the microbiological outcome due to the dilution of PI by irrigating the conjunctival sac with large amounts of saline during surgery. At the same time, our results showed that bacteria not found at T1 were found at T5. Still, an aseptic operation was used in our experiments, considering that these bacteria may enter the conjunctival surface during surgery. Other factors (such as the duration of the procedure and incision exposure time, and pathogens present in the air) could affect the number of ocular surface pathogens.

Tang Jing believes that 0.025% povidone-iodine solution is safe and effective for disinfecting the conjunctival sac before cataract surgery with an action time of 30 seconds.[18] It was found in the research from Shuai Tong that low concentrations of povidone-iodine solution caused discomfort and a low degree of corneal fluorescein staining at 1d, 3d, and 1W after surgery.[19] In this study, the epithelial conditions of the operated eyes were observed at 1 day, 3 days and 1 week after the operation. The corneal injury was mild in both groups, showing superficial punctate corneal epithelial damage without apparent massive loss of corneal epithelium and corneal stromal layer ulcer formation. One day after surgery, 34.5% of patients in the PI group showed superficial punctate corneal epithelial injury, and 16.5% in the regular saline group. At 3 day after surgery, 15.0% of patients showed external punctate corneal epithelial damage in the PI group and 3.0% in the joint salty group. At 1 week after operation, only 1 case of mild corneal epithelial injury was observed in the PI group, and only 2 needle-like punctate staining spots were observed through corneal fluorescence staining. Deproteinized Calf blood Extract Eye Gel was administered, and the symptom disappeared when reexamined after 3 days. There was no significant difference in corneal epithelial injury between the two groups at different time points ($\chi^2 = 4.133$, $p = .127$).

5. Conclusion

The combination of 0.5 PI disinfectant and antibiotic eye drops can effectively reduce the bacterial load of the conjunctival sac before operation. At the same time, it is safe and effective to irrigate the conjunctival sac with 0.5% PI disinfectant before the procedure.

Conflicts of Interest Disclosure

The authors declare they have no conflicts of interest.

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