Bacterial Flora - A Potential Source of Endophthalmitis after Cataract Surgery

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Objectives : *To study bacteria from eye lids and conjunctival sac of patients undergoing cataract surgery before and after the application of antiseptics.*
Material and Method : *Patients undergoing elective cataract extraction in one university hospital were randomly enrolled. Cultures for bacteria and candida were done by swabbing the eye lids before and after cleaning with 4% chlorhexidine gluconate. Subsequently 7% povidone iodine was applied on eye lids and conjunctival sacs. Cultures of specimens from eye lids and conjunctival sac were taken after the application of 7% povidone iodine and at the end of the operation.*
Results : *Fifty-one patients were enrolled. Positive cultures were found in 90.2% and 82.4% before and after cleaning the face with 4% chlorhexidine. After topical application of 10% povidone iodine, only 19.6% had positive cultures from eye lids and conjunctival sac; a significant reduction (p=0.001).At the end of the operation, positive cultures were found from eye lids in 10 patients and from the conjunctival sac in 4 patients. Isolates were skin flora and candida species in 2 patients. None of the patients had endophthalmitis.*
Conclusion *: Cleaning eye lids with 4% chlorhexidine followed by applying 10% povidone iodine was effective in decreasing skin flora in cataract surgery. The organisms were not completely eliminated. Post-operative follow-up to detect infectious complications is warranted.*

Keywords *: Bacterial Flora, Endophthalmitis, Cataract surgery*

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Infective endophthalmitis following intraocular surgery is one of the most serious post-operative ocular infections which may result in visual loss[1-6]. Cataract surgery by means of extracapsular lens extraction and phacoemulsification is a widely performed intraocular operation. Prevalence of post-operative intraocular infections following the surgery has been extremely low, ranging from 0.1 to 0.7% of total procedures[7]. Common etiologic agents of post-operative endophthalmitis include *Staphylococcus epidermidis, Staphylococcus aureus,* streptococci and less frequently Gram negative bacteria. These organisms are periorbital flora, less common are from contaminated surgical devices, fluids and topical medications. Reduction of periorbital flora has been associated with a lower incidence of post-operative ocular infections. Common ophthalmological practices to prevent post-operative endophthalmitis include topical application of antiseptics eg., 5-10% povidone iodine or 4% chlorhexidine gluconate and topical antimicrobial agents eg., chloramphenicol, gentamicin, etc.

Povidone iodine 5 to 10% concentration is an antiseptic widely used in surgical procedures. Povidone iodine is an intermediate level antiseptic with higher microbicidal activity against Gram negative than Gram positive bacteria. Irritative effects of povidone iodine on skin and mucosa are mild, therefore, it is safe, well-tolerated for both pre-operative skin and mucosal

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application. Chlorhexidine gluconate is an effective, safe, commonly used skin antiseptic in surgical procedures. Chlorhexidine gluconate of 4% w/w scrub/wash preparation is recommended as a skin antiseptic for patients in the pre-operative period eg., shower on the night before operation in order to reduce surgical infections. Microbicidal activity on Gram-positive is higher than Gram-negative bacteria, therefore, combined use of chlorhexidine gluconate with povidone iodine may increase efficacy in the reduction of periorbital flora and post-operative endophthalmitis. In Thailand, there has been limited data on periorbital flora in pre-operative cataract patients and on intervention to prevent post-operative eye infections. The authors' primary objective of the present study was to determine efficacy of chlorhexidine gluconate combined with povidone iodine in reduction of periorbital flora during the pre-and post-operative period in cataract surgery. Secondary objective was to characterize microbiology, including type, colony count and susceptibility of periorbital flora in these populations.

Material and Method

The authors conducted a prospective, descriptive study in the Ophthalmology Unit, in a large, teaching, tertiary-care facility. Patients undergoing cataract extraction during 2002-2003 were enrolled. An informed written consent form was presented to and signed by every patient studied. Cataract extraction was performed by phacoemulsification or extracapsular extraction. Criteria to exclude a patient from the study were non-intact periorbital skin, presence of periorbital infections, history of allergy or contraindication to any antiseptics used in the present study. Before surgery patients were instructed to scrub their faces with 4% w/w chlorhexidine gluconate and rinse with tap water. Swabs were taken from both periorbital and eyelid/lid margin and sent for culture before and after application of chlorhexidine gluconate. Following chlorhexidine gluconate, 10% povidone iodine was applied by an assigned investigator to the patient's periorbital area, eyelid/lid margin and also conjunctival sacs. Thereafter, those three sites were swabbed for culture during the pre-and post-operative period. Semi-quantitative bacterial culture was performed using standard manual plating in blood and McConkey agar, 4 quadrant/plate, incubated at 37 C for 24 hours prior to plate reading. Colony counts were rated as heavy, moderate and scanty growth of organisms. Qualitative susceptibility testing to selected antimicrobial agents was done using disc diffusion method plating on Kirby-Bauer agar. Susceptibility results were interpreted as susceptible or resistant. The patients' demographic and microbiologic data were recorded in standardized case record forms, subsequently analyzed and reported.

The study had been approved by The Ethical Reviewer Board on Human Experiment of Faculty of Medicine Siriraj Hospital, Mahidol University prior to the beginning of the study.

Statistical analysis was performed with the use of statistical program SPSS 11.5 for Windows . Continuous and categorical variables were expressed as mean and percentages respectively. Comparison of variables was done with Chi-square or Fisher's exact test. A p-value of 0.05 or less is considered statistically significant.

Results

From November 2002 to January 2003, fifty-one patients (male 26, female 25) were enrolled into the present study. The mean age was 64.7 years (range 37-80 years). Forty-seven (92.2%) of the total patients underwent phacoemulsification, extracapsular extractions was done for the rest of them. Twelve patients (23.5% of total patients) were diabetics. None received systemic antimicrobial therapy, one patient was on systemic corticosteroid during 30 days prior to operation. Four patients were on topical antibiotic eye drop (chloramphenicol 1, polymyxin/gramicidin 1 and quinolones 2) during the pre-operative period.

The organisms isolated in the present study are shown in Table 1. Prior to application of antiseptics, 81 bacterial strains were isolated from periorbital skin of 46 patients (90.2%). Following topical application with 4% chlorhexidine gluconate to the periorbital area, 64 strains were isolated from slightly fewer patients (42 patients, 82.4%). There was no statistically

Table 1. Organisms isolated from eyelid/lid margin and conjunctival sac (N=51)

Time	No of patients (%)
Before CHG (EM)	46 (90.2)
After CHG (EM)	42* (82.4*)
After CHG + PID (EM+CS)	10* (19.6*)
After operation (EM+CS)	14 (27.4)

*p = 0.001, OR = 21.8 (95 % CI = 7.1 -70.0)
CHG = 4% chlorhexidine gluconate
PID = 10% povidone iodine
EM = eyelid/lid margin
CS = conjunctival sac

significant difference of the isolation rate between before and after 4% chlorhexidine gluconate application. Following application on periorbital skin and conjunctival sac with 10% povidone iodine, fewer patients had positive cultures, (10 patients from eyelids, lid margins of 9 patients and from the conjunctival sac of 1 patient). Reduction of periorbital bacterial flora by 10% povidone iodine was statistically significant ($p = 0.001$).

However, the number of patients with positive culture rose from 10 at the beginning to 14 at the end of the operation (Table 1). Organisms were isolated from the conjunctival sac from 1 and 4 patients at the beginning and at the end of the operation respectively.

There were 81 strains of organisms isolated (Table 2); 74 were gram-positive bacteria. Co-agulase-negative staphylococci was the most common organism found before and after the application of antiseptics and at the end of the operation. Gram-negative bacilli were isolated from 7 patients (13.7%), comprising non-fermentative bacilli in 3, *Citrobacter* spp, *Klebsiella pneumoniae*, *Proteus mirabilis* and *Escherichia coli* in 1 each. *Candida* spp. were found in 2 patients. After the application of chlordexidine and povidone iodine, the number of patients with co-agulase-negative *Staphylococci* and diphtheroids were reduced from 40 to 7 and 14 to 2 respectively. Other organisms were not found after povidone iodine except *Citrobacter spp.* in 1 patient.

The number of colonies decreased substantially by antiseptics, only scanty colonies were found after the application of antiseptics.

As shown in Table 3, coagulase - negative staphylococci, the most common isolates in the present study (136 strains), were moderately sensitive to antimicrobial agents tested. From 71 to 92% of isolates were sensitive to oxacillin, amoxicillin/clavulanate and ampicillin/sulbactam. Similar to other Gram positive organisms, coagulase - negative staphylococci was highly sensitive to vancomycin and teicoplanin.

Both antiseptics were well-tolerated in all patients. No adverse effects were found in any subjects. No intraocular infection was found up to 30 days after operation.

Table 2. Number of patients and organisms isolated (N=51)

Type of organisms	No (%)
Coagulase-negative *Staphylococci*	43 (84.3)
Diphtheroids	20 (39.2)
Micrococci	9 (17.6
Gram-negative bacilli	7 (13.7)
Candida spp.	2 (3.9)

Table 3. Antimicrobial susceptibility of coagulase-negative staphylococci (N=136)

Antimicrobial	Sensitive (%)
Oxacillin	71
Erythromycin	73
Cotrimoxazole	77
Cefazolin	91
Amoxicillin/clavulanate	92
Ampicillin/sulbactam	92
Vancomycin	100
Teicoplanin	100

Discussion

Etiologic agents of endophthalmitis following cataract surgery has been associated with periorbital skin flora. Speaker MG., et al found that 82% of periorbital flora was associated with organisms isolated by vitrectomy from patients with post-operative endophthalmitis following cataract surgery[8]. Common isolates in their study included *S. epidermidis* 70% of all isolates, *S. Aureus*, 10%, *Streptococcus* spp., 9%, *Enterococcus* spp. 2% and Gram negative bacilli, 6%[9].

Reduction of periorbital flora has been achieved with topical application of antiseptics. Apt L. found 5% povidone iodine effective to reduce periorbital flora in pre-operative cataract patients[10]. Additionally, some studies showed that microbial inhibition of 5% povidone iodine may last 24 hours or longer post-operatively[11]. Reduction of this flora may be associated with reduced incidence of post-operative endophthalmitis following cataract surgery. Speaker MG, et al demonstrated the efficacy of 5% povidone iodine in the prevention of culture-positive endophthalmitis[12].

Demographic characteristics of the present study patients were comparable to those of general cataract patients, eg., age, gender, underlying disorders, topical antimicrobial agents. The present results may represent common periorbital flora in general cataract patients in Thailand. Compared to studies from other countries, periorbital flora isolated from eyelid, lid margin and conjunctival sac in the study were comparable regarding type of organisms and prevalence. Gram-positive bacteria were more common than Gram-

negative bacteria, coagulase-negative staphylococci were the most frequent isolates followed by diphtheroids. The authors did not find any post-operative endophthalmitis in the present study. The presented patients had some risk factors for post-operative ocular infections[13], eg., one fourth of them with diabetes mellitus and one patient with prior corticosteroid therapy. These data demonstrated preventive benefit of periorbital antisepsis on post-operative endophthalmitis.

Reduction of bacterial isolates with 10% povidone iodine following 4% chlorhexidine gluconate were significantly higher than 4% chlorhexidine gluconate alone. This combination might have synergistic or additive effects on antimicrobial activity. In the present study 4% chlorhexidine gluconate followed by 10% povidone iodine reduced periorbital flora by 78.3%. As shown in Table 1, more patients had positive culture at the end of the operation. Increased periorbital flora during the post-operative period has been reported and thought to be peri-operative contamination[14].

Different levels of flora reduction were found in the present study, probably related to type of organisms and antiseptics. Inhibition of coagulase-negative staphylococci and diphtheroids with the study antiseptics was less than Gram-negative organisms and *Candida* spp.. Scanty colony count of organisms was associated with more reduction by antiseptics than moderate to heavy colony count. This suggests that the inhibitory effect on coagulase-negative staphylococci and diphtheroids by 10% povidone-iodine was lower than on other organisms. Chlorhexidine gluconate wash failed to eliminate organisms, this might be due to insufficient contact time.

Coagulase-negative staphylococci in the present study were moderately susceptible to antimicrobial agents tested. A few of the study patients were on topical antimicrobial therapy prior to enrollment, as a result, selective pressure associated with antimicrobial therapy was unlikely. These data should be taken into account when considering empirical antimicrobial therapy or prophylaxis for post-operative ocular infections.

No patient in the present study experienced adverse effects associated with 4% chlorhexidine gluconate or 10% povidone iodine. This demonstrates the safety of the study antiseptics on periorbital skin (eyelid, lid margin) and ocular mucosa (conjunctival sac).

Conclusion

Periorbital flora in cataract patients are mainly Gram-positive bacteria, mainly coagulase-negative staphylococci and diptheroids. Chlorhexidine gluconate combined with 10% povidone iodine applied on periorbital skin and ocular mucosa were effective in flora reduction and were well-tolerated.

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แบคทีเรียประจำถิ่น-แหล่งของการติดเชื้อหลังผ่าตัดต้อกระจก

ยงค์ รงค์รุ่งเรือง, จุฑาไล ตัณฑเทอดธรรม, ยุวดี ตันติวัฒนาไพบูลย์, ศิริพร ศรีพลากิจ, สมหวัง ด่านชัยวิจิตร

วัตถุประสงค์ : *ศึกษาแบคทีเรียบนหนังตาและเยื่อบุตาในผู้ป่วยผ่าตัดต้อกระจกก่อนและหลังทายาฆ่าเชื้อ*

วัสดุและวิธีการ : *ศึกษาในผู้ป่วยผ่าตัดต้อกระจกตาในโรงพยาบาลแห่งหนึ่ง เพาะเชื้อโดยการป้ายหนังตาก่อนและหลังการฟอกหน้าด้วย 4% คลอเฮกซิดีน กลูโคเนท หลังจากนั้นทาหนังตาและเยื่อบุตาด้วย 10% โปวิโคน ไอโอดีน ป้ายหนังตาและเยื่อบุตาส่งเพาะเชื้อ ทำซ้ำอีกครั้งหลังผ่าตัดเสร็จ*

ผลการศึกษา : *ศึกษาในผู้ป่วย 51 ราย เพาะเชื้อได้ใน 90.2% และ 82.4% ของผู้ป่วยก่อนและหลังฟอกหน้าด้วย 4% คลอเฮกซิดีน กลูโคเนท หลังจากทาหนังตาด้วย 10% โปวิโคน ไอโอดีน พบเชื้อเพียง 19.6% ของผู้ป่วย เชื้อลดลงอย่างมีนัยสำคัญทางสถิติ (p=0.001) เมื่อผ่าตัดเสร็จ พบเชื้อบนหนังตาและเยื่อบุตา 10 และ 4 รายตามลำดับ เชื้อที่พบเป็นเชื้อประจำถิ่น และพบเชื้อราแคนดิดา 2 ราย ไม่มีผู้ป่วยติดเชื้อหลังผ่าตัดต้อกระจก*

สรุป : *การฟอกหน้าด้วย 4% คลอเฮกซิดีน กลูโคเนท และทาทับด้วย 10% โปวิโคน ไอโอดีน มีประสิทธิผลในการลดเชื้อประจำถิ่นบนหนังตาในผู้ป่วยผ่าตัดต้อกระจก แต่ไม่สามารถทำให้เชื้อหมดไปในทุกราย จึงมีความจำเป็นต้องติดตามผู้ป่วยหลังผ่าตัดเพื่อตรวจว่ามีการติดเชื้อหรือไม่*