Original Article

The Effect of Povidone–Iodine on Normal Bacteria Conjunctival Flora in Adult Patients in Onitsha Nigeria

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Abstract

Objectives: To determine the normal conjunctival flora and the effect of povidone–iodine on the flora in adult patients at the Guinness Eye Centre Onitsha Nigeria. **Materials and Methods**: Each randomly recruited new adult patient had conjunctival swab taken from one eye; then a drop of 5% povidone–iodine solution was instilled on the conjunctiva. Conjunctival swabs were taken at 1, 5, and 10 min after povidone–iodine instillation. The swabs were smeared on glass slides and also inoculated unto MacConkey, chocolate, and nutrient agar. Microbial study of the specimens was undertaken. **Results**: Of the 250 eyes of the 250 patients, 164 (65.6%) were culture-positive. A total of 225 organisms were isolated from the 164 culture-positive specimens as follows: *Pseudomonas aeruginosa* was isolated in 142 (63.1%), *Staphylococcus epidermidis* in 79 (35.1%), and *Staphylococcus aureus* in four (1.8%). Among the 61 specimens that grew more than one organism, 59 (96.7%) had a mixed growth of *P. aeruginosa* and *S. epidermidis* and 2 (3.3%) grew both *S. epidermidis* and *S. aureus.* Povidone–iodine significantly reduced the mean bacterial colony count in all bacterial isolates 10 min after instillation, that is: 114.4 to 35.7 for *P. aeruginosa* ($P < 0.05$), 71.7 to 15.8 for *S. epidermidis* ($P < 0.05$), and 45.5 to 3.0 for *S. aureus* ($P < 0.05$). Bacterial colonies persisted in seven (2.8%) eyes 10 min after instillation of 5% povidone–iodine. **Conclusion:** The normal conjunctiva of some patients harbor virulent bacteria, which load 5% povidone–iodine greatly reduced. These facts should be taken into consideration when planning intraocular surgery as part of the efforts to prevent endophthalmitis.

Keywords: Conjunctival bacteria flora, Nigeria, povidone–iodine

Introduction

The conjunctiva is the mucous membrane overlying the sclera and also lining the inner surface of the eyelids.[1] The conjunctiva and the cornea form the first line of defense of the globe. But injury, including surgical trauma, can breach this defense thus allowing microorganisms into the eye where they could cause serious infections.[2]

Some microbes do infect the conjunctiva leading to conjunctivitis. The infection could also affect adjacent structures. However, the conjunctiva harbors some bacteria, such as *Staphylococcus epidermidis* (coagulase-negative *Staphylococcus*), which under normal circumstances do not cause any infection. These are known as commensals or normal conjunctival flora.[3] Nevertheless, some of the conjunctival commensals had been implicated in postoperative intraocular infections.[4] Speaker *et al.*[4] in a hospital-based study in Germany reported that *S. epidermidis* was responsible for 70% of intraocular infections.

Efforts to minimize surgical infections include eyelash trimming, lacrimal sac syringing, conjunctival swab microscopy, culture and sensitivity, prophylactic antibiotics,[5] facial, and eyelid cleaning with antiseptics such as chlorhexidine or povidone–iodine.[6] Application of povidone–iodine on the conjunctiva has been reported to reduce the chance of postoperative infection by a factor of three.[7]

Povidone–iodine is a chemical complex of polyvinylpyrrolidone and elemental iodine.[8] It has a lower concentration of free iodine and also less toxic than other iodine formulations.[9] A bactericide, povidone–iodine has been found to be effective

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Access this article online

Quick Response Code:

Website: www.nigerianjournalofophthalmology.com

DOI: 10.4103/njo.njo_38_16

How to cite this article: Mbakigwe FC, Nwosu SN, Emele FE. The effect of povidone–iodine on normal bacteria conjunctival flora in adult patients in Onitsha Nigeria. Niger J Ophthalmol 2017;25:86-9.

against bacteria, fungi, protozoa, and viruses. It is thus useful in the prophylaxis against ophthalmia neonatorum.[9,10]

The Guinness Eye Center, Onitsha, is the only publicly-owned tertiary eye hospital in Anambra State, Nigeria. It has facilities for out-patient and in-patient care including specialized intraocular ophthalmic surgeries. The hospital attends to patients from different parts of Nigeria and beyond though its immediate catchment is Anambra State and its environs. We prospectively studied the normal conjunctival flora of adult patients in the hospital. This report is on the effect of 5% povidone–iodine on the flora. The antibiotics susceptibility of the conjunctival flora is the subject of another report.

Materials and Methods

This study which was conducted between March and April 2011 was approved by the Ethical Committee of the Nnamdi Azikiwe University Hospital. The laboratory could only handle 10 patients' specimen in a day and so this determined the number of patients recruited in a clinic day.

The patients were randomly selected as follows: all who met the inclusion criteria for the sampling frame for the day. After health talks, during which the objectives and procedures of the study were explained to the patients, the names of each new adult patient who met inclusion criteria were written on a 2-by-2-cm piece of paper. This paper was folded and put in a bag. The bag was churned and an assistant who was not involved in writing the names and folding the papers picked out 10-folded papers. To maintain the randomization, churning of the bag was repeated after each pick. Each paper was unfolded and the patient whose names were on the paper was taken for the study. The patient selection was done before the commencement of the clinic services.

Excluded from the study were patients with external ocular infections, ocular trauma, and red eye. Also excluded were patients who had used topical antibiotics or traditional eye medicine within 2 weeks of the study.

After explaining what was to be done and reassuring each patient of the safety of the procedure, a sterile swab was used to obtain specimen from the lower conjunctival fornix of the right eye. This was immediately followed by instilling a drop of 5% povidone–iodine on the lower conjunctival fornix of the same eye and specimens taken 1, 5, and 10 min after the instillation. During each specimen collection care was taken to ensure that the swab does not touch the eyelids. The specimens were smeared on glass slides and also inoculated unto chocolate, MacConkey, and nutrient agar. These specimens were immediately transported to the Medical Microbiology Research Laboratory of the Nnamdi Azikiwe University, Nnewi where they were incubated at 37°C for 24 h and examined.

Microbial growth on the culture media was identified by standard microbiological techniques including microscopic examination for bacterial colony morphology, size, color, shape, and pigmentation. The bacterial isolates were identified using the criteria of Cowman[11] which included catalase, oxidase, coagulase, and sugar fermentation reactions. Descriptive and inferential statistics were used to analyze the results.

Results

A total of 250 eyes of 250 patients were studied. There were 121 (48.4%) males and 129 (51.6%) females. The age range was 18 to 88 years; mean – 43.2 ± 16.7 years. One hundred and sixty-four (65.6%) eyes were culture-positive. Some specimens grew more than one organism. Thus, a total of 225 organisms were isolated from the 164 culture-positive specimens as follows: *Pseudomonas aeruginosa* was isolated in 142 (63.1%), *S. epidermidis* in 79 (35.1%), and *Staphylococcus aureus* in four (1.8%). Among the 61 specimens that grew more than one organism, 59 (96.7%) had a mixed growth of *P. aeruginosa* and *S. epidermidis* and two (3.3%) grew both *S. epidermidis* and *S. aureus.*

Table 1 shows the mean colony count for *P. aeruginosa* decreased from 114.4 before the instillation of 5% povidone–iodine to 35.7 by 10 min after the instillation. This was statistically significant (analysis of variance, ANOVA; $F = 49$; $P < 0.05$). Similarly, Table 2 shows that the mean colony count of *S. epidermidis* significantly decreased from 71.7 prior to the instillation of 5% povidone–iodine to 15.8 by 10 min after the instillation (ANOVA; $F = 94.85$; $P < 0.05$). As shown in Table 3, there was a statistically significant reduction in mean bacterial colony count of *S. aureus* from 45.5 before 5% povidone–iodine instillation to 3.0 by 10 min after the instillation (ANOVA; $F = 8.99$; $P < 0.05$). For all the positive cultures, the colonies persisted after 10 min of 5% povidone–iodine instillation in seven (2.8%) eyes of seven patients that is: two women, two artisans, and three other participants aged above 50 years. This persistence needs be further investigated.

Table 1: Colony count of *Pseudomonas aeruginosa* before and after instillation of 5% povidone–iodine

Colony count	Minimum	Maximum	Mean
Before povidone–iodine	18	309	114.4
1 min after povidone–iodine	5	265	86.5
5 min after povidone–iodine	0	227	60.0
10 min after povidone–iodine	0	197	35.7

Analysis of variance, ANOVA; $F = 49.00$; $P < 0.05$

Table 2: Colony count of *Staphylococcus epidermidis* before and after instillation of 5% povidone–iodine

Colony count	Minimum	Maximum	Mean
Before povidone–iodine	13	428	71.7
1 min after povidone–iodine	0	362	49.4
5 min after povidone–iodine	0	279	30.6
10 min after povidone–iodine	0	199	15.8

Analysis of variance, ANOVA; $F = 94.85$; $P < 0.05$

Table 3: Colony count of *Staphylococcus aureus* before and after instillation of 5% povidone–iodine

Colony count	Minimum	Maximum	Mean
Before povidone–iodine	8	82	45.5
1 min after povidone–iodine	5	42	21.5
5 min after povidone–iodine	0	18	3.5
10 min after povidone–iodine	0	7	3.0

Analysis of variance, ANOVA; $F = 8.99$; $P < 0.05$

Discussion

The results of this study indicate that up to 65.6% of the apparently normal conjunctivae of our patients overt harbor pathogenic bacteria. Our results further suggest that the most common bacteria that inhabit the conjunctiva of patients without obvious ocular surface infection in our hospital is *P. aeruginosa* which constitutes 56.8%. This is surprising and indeed differs from the findings in other studies which reported coagulase negative *Staphylococcus* as the most common organism.[12,13] Bekibele *et al.*[14] in a study of the upper eyelid bacteria count of ophthalmic surgery patients in Ibadan, reported that coagulase-negative *Staphylococcus* constituted 65%, whereas *S. aureus* accounted for 30%. However, coagulate-negative *Staphylococcus* accounted for 35.1% of the conjunctival flora and *S. aureus* was only 1.7% in our study. Although coagulase-negative *Staphylococcus* may not cause infection in an eye with intact epithelium, it can be a cause of trauma-related preseptal cellulitis as well as postoperative endophthalmitis.[4] On the other hand, both *P. aeruginosa* and *S. aureus* are pathogens which cause severe ocular infections that run aggressive course leading to sight loss.[15]

P. aeruginosa is a pathogen that could cause difficult-to-treat ocular infections, including infective corneal ulcers and endophthalmitis. It is, therefore, worrisome that this is the most common bacterial isolate in the apparently normal conjunctiva of our patients. Some factors, including topical antibiotics abuse, may be responsible for this. In Nigeria, antibiotics are easily purchased without the doctor's prescription. A previous study in our hospital showed that most corneal ulcer patients had used topical antibiotics and steroids, not prescribed by medical personnel, before presenting to the hospital.[14] Many patients present to our hospital as a last resort when other efforts, including self-medication have failed. Thus, in spite of excluding patients with a recent history of topical antibiotics use in this study, it is likely that indiscriminate antibiotics use by some patients may have eliminated susceptible commensals and leaving only the resistant organisms to continue to inhabit the conjunctiva. Specimen contamination may be another factor. But the methodological rigor adopted in this study made this unlikely. Very sterile swabs were used; microbial studies were conducted in a special laboratory and not in routine service laboratory, and there was no other similar study in the laboratory during the study period.

Nonetheless, our study demonstrated that 5% povidone–iodine significantly reduced the bacterial load for each bacterial isolate within 10 min of its instillation on the conjunctiva. This reduction was noticeable for all the organisms within 1 min of instillation of povidone–iodine [Tables 1–3]. This makes povidone–iodine a favorable preoperative ocular antiseptic for eye surgeries. However, it should be cautioned that though effective and safe, 5% povidone–iodine did completely eliminate all the organisms by 10 min after instillation [Tables 1–3]. The finding of persistence of bacterial colonies 10 min after instillation of 5% povidone iodine in some women, artisans, and persons older than 50 years is surprising, as we could not immediately pinpoint the risk factors.

Further studies are, therefore, required to determine the alternative modes of application of povidone–iodine that will help achieve the ultimate goal of completely eliminating the conjunctival flora, especially before surgery. Questions which such studies should answer include: could multiple instillation of the same concentration or changing the concentration or allowing a longer time to elapse after instillation of povidone–iodine completely eliminate the conjunctival bacterial flora? It is also important to determine the reasons for the persistence of the bacterial colonies in some patients 10 min after instillation of 5% povidone–iodine. Although awaiting answers to these questions, it is hereby recommended that preoperatively topical 5% povidone–iodine should be instilled into the conjunctival sac to reduce the ocular surface bacterial load before eye surgery.

In conclusion, the normal conjunctiva of 65.6% new adult patients at the Guinness Eye Center Onitsha, Nigeria harbor virulent bacteria, which, on instillation of 5% povidone–iodine drop, is greatly reduced within 10 min of instillation. These facts should be taken into consideration when planning intraocular surgery.

Financial support and sponsorship

Nil.

Conflicts of interest

There are no conflicts of interest.

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