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The Pattern of Microbial Keratitis in soft Contact Lens Wearers in a Tertiary Care Hospital in Eastern India

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Abstract
Background: *Soft contact lenses are increasing in trend since a decade and are being used for both cosmetic and therapeutic purposes. Lack of compliance and poor hygiene towards lens care is one of the main causes associated with microbial contamination and eye infections. Microbial keratitis (MK) is one of the serious vision threatening outcomes of inappropriate contact lens use and may even lead to permanent damage to the cornea. About 43% of the corneal ulcers are mainly due to soft contact lens use. Pseudomonus aeruginosa and Acanthamoeba spp. are associated more significantly with soft contact lens wearers apart from others like Staphylococcus aureus and Candida albicans. This study attempts to explore the risk of microbial contamination associated with inappropriate use and maintenance of contact lenses, type of microbial flora involved and their profile as regards ophthalmic infections in contact lens wearers.*
Methods: *The case control study consists of 68 subjects studied over a period of 6 months. One sample each was collected from the concave surface of contact lenses, lens case and tip of the solution bottles with the help of sterile cotton tipped swabs that were pre- moistened with sterile brain heart infusion (BHI) broth. Samples of lens care solution were directly cultured on solid media. All samples were inoculated onto 5% sheep blood agar, Chocolate agar, Mac Conkey's agar and Sabouraud's dextrose agar. The plates were incubated and the organisms grown identified using standard microbiological techniques. The statistical analysis was done using Chi square test.*

Results: *66.2% subjects showed growth of organisms in at least one of the samples. The overall rate of microbial contamination among the total samples was 73.53%. Lens case was the most contaminated sample (64.5%) followed by lenses (58.2%), tip of solution bottles (55.6%) and lens care solution (45.5%). 158 samples were positive on culture for bacteria and 42 for fungi. Pseudomonas species and Staphylococci were the main bacteria whereas all the fungal isolates were Candida albicans. Infection associated with the use of contact lens was more in occasional users (67.6%) than daily users (32.4%). The subjects using contact lens for more than 2 years showed less contamination (66.6%) than those using for less than 2 years (81.8%). The subjects using contact lens for cosmetic purpose (38.2%) had more contamination (84.6%) than subjects using for therapeutic purpose (73.8%).*

Conclusions: *Our results showed that the soft contact lens care practices amongst the subjects were not satisfactory which results in high level contamination. To avoid complications, it is necessary to avoid continuous use of contact lenses, change CL wearing schedules, lens material and care solutions.*

Keywords: *Contact lens, keratitis, Candida, Pseudomonas, Staphylococci.*

Introduction

Soft contact lenses are increasing in trend since a decade and are being used for both cosmetic and therapeutic purposes. Contact lenses are nowadays being used for optical reasons such as to correct irregular astigmatism or superficial corneal irregularities or anisometropia, for promotion of epithelial healing in persistent epithelial defects or recurrent corneal erosion, for pain relief in cases of bullous keratopathy or wet filamentary keratitis with blepharospasm, for preservation of corneal integrity by shielding a descemetocele or splinting the edges of a small corneal wound, in patients with ocular myopathies it acts like a ptosis props to support the upper eyelid, in patients with cicatrizing conjunctivitis it can prevent symblepharon formation and maintain the fornices and finally it can act as an effective drug delivery system. Recent reports reveal that around 140 million people wear contact lens and their numbers are on the rise globally.[1,2]

Lack of compliance and poor hygiene towards lens care is one of the main causes associated with microbial contamination and eye infections. Extended wearing of contact lenses, poor lens hygiene and inappropriate lens fit are particular risk factors for complications. Studies have shown that after long term contact lens use, the corneal epithelium becomes thinner and less sensitive to touch and it may also exacerbate pre existing diseases. [1, 2, 3] The complications associated with CL wear ranges from milder to severe conditions which cause a change in corneal physiology leading to epithelial, stromal, and endothelial compromise. The patient factors for developing complications are pre-existing allergic or autoimmune diseases like rosacea or thyroid disease, meibomian gland dysfunction, incomplete and abnormal blinking, smoking and drugs like diuretics, antihistaminics, anticholinergics, psychotropics and steroids which can decrease tear production and increase the risk of developing complications.[3,4]

Microbial keratitis (MK) is one of the serious vision threatening outcomes of inappropriate contact lens use and may even lead to permanent damage to the cornea eventually resulting in visual loss, if left untreated.[3, 4] The contact lens complications include mechanical, hypoxic, immunologic and hypersensitivity reactions which mimic infectious keratitis. [3, 4] The prevalence of microbial keratitis has been on an increase since the past five decades when soft contact lenses were first introduced and is gradually increasing over time. About 43% of the corneal ulcers are mainly due to soft contact lens use.[5] The incidence of contact lens associated keratitis has risen to 30 percent in the developed countries.[3] As compared to soft contact lenses, the risk of infection is much less with rigid contact lenses. The soft contact lens related microbial keratitis is mainly caused by bacteria & fungi, with the parasites and viruses playing a smaller role. *Pseudomonus aeruginosa* and *Acanthamoeba spp*. are associated more significantly with soft contact lens wearers. Also seen are *Staphylococcus aureus*, *Serratia*

marcescens and fungi like *Candida albicans* and *Fusarium solani.* Among the microbes causing the microbial keratitis, fungal keratitis accounts for about 50% of all cases of culture-proven microbial keratitis in developing countries. The soft contact lens associated keratitis is more significant in younger patients than the elderly. However the severity of the infection is more in elderly than the younger patients and the elderly patients are more prone to multiple and more diverse risk factors which makes prevention complicated.[6]

Our present study attempts to explore the risk of microbial contamination associated with inappropriate use and maintenance of contact lenses, type of microbial flora involved and their profile as regards ophthalmic infections in contact lens wearers in a tertiary care hospital in Eastern India.

Methodology & Patients

The study was carried out in the Departments of Ophthalmology & Microbiology, ICARE Institute of Medical Sciences and Research (IIMSAR), Haldia, India, and included a total of 68 subjects during a period of 6 months. The students, faculty, subjects visiting for routine check up etc. who were asymptomatic contact lens users were included in this study. The subjects were asked to fill a questionnaire containing details of lens use and its cleaning and storage protocol. The age of the subjects included in this study was between 18 to 50 years.

The study protocol was approved by the Institutional Ethics Committee which follows Helsinki guidelines. The written informed consent was given by each subject included in the study. One sample each was collected from the concave surface of contact lenses, lens case and tip of the solution bottles with the help of sterile cotton tipped swabs that were pre- moistened with sterile brain heart infusion (BHI) broth. Samples of lens care solution were directly cultured on solid media. All samples were inoculated onto 5 per cent sheep blood agar, Chocolate agar, Mac Conkey's agar and Sabouraud's dextrose agar. The blood agar, chocolate agar and Mac Conkey's agar plates were incubated at 37° C for 24-48 hours while Sabouraud's dextrose agar was incubated at 25° C and examined daily for growth of fungi and discarded at the end of three weeks. Organisms grown were identified using standard microbe-ological techniques. The statistical analysis was done in terms of percentage contamination obtained, type of microbial flora involved and its relation with the lens care practices followed by the users using Chi square test.

Results

Forty five subjects (66.2%) out of total 68 subjects showed growth of organisms in at least one of the samples. The overall rate of microbial contamination among the total samples was 73.53 percent (200/272). Lens case was the most contaminated sample (64.5%) followed by lenses (58.2%), tip of solution bottles (55.6%) and lens care solution (45.5%) [Figure 1].

Out of all 200 contaminated samples, 158 were positive on culture for bacteria and 42 were positive for fungi [Figure 2]. Of the bacterial isolates, *Pseudomonas* species and *Staphylococci* were the main organisms [Figure 3]. *Pseudomonas* predominated in lenses (34%), against *Staphylococcus* in lens cases (29%), bottles (22%) and lens care solutions (17%). Other bacteria isolated less frequently were *Streptococcus pneumoniae*, *Serratia marcescens*, gram positive bacilli, gram negative diplococci and in few cases, mixed bacterial flora. All the fungal isolates were identified as *Candida albicans*. We could not isolate any case of *Fusarium solani* and *Acanthameba spp.* in our study.

The frequency of infection associated with the use of contact lens was observed more in occasional users (67.6%) than in daily users (32.4%) while the contamination in sample were 90.9% in daily users as compared to 56.52% in occasional users [Table 1]. The subjects using contact lens for more than 2 years (35.3%) showed less

contamination (66.6%) while subjects using for less than 2 years (64.7%) were having more bacterial contamination (81.8%) as shown in Table 2. Further, the subjects using contact lens for cosmetic purpose (38.2%) have shown more contamination (84.6%) rather than subjects (61.8%) using for therapeutic purpose (73.8%) as depicted in Table 3. The isolated bacterial species were less resistant to ceftazidime (6%) and amikacin (6%).

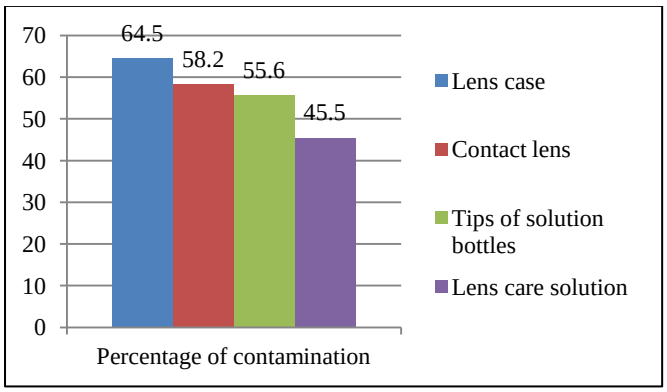

Figure 1

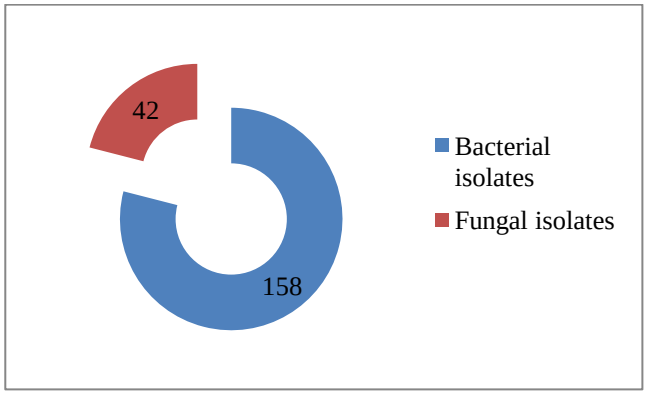

Figure 2

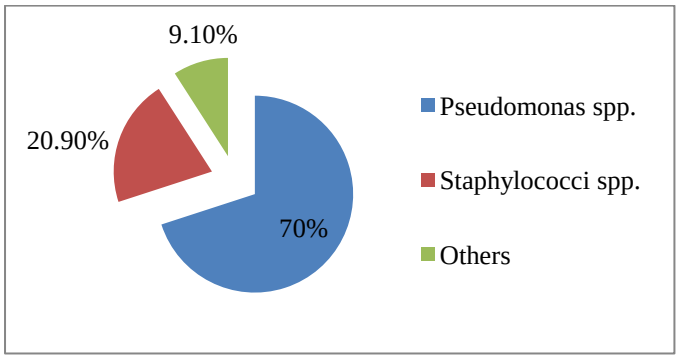

Figure 3

Table 1: Percentage distribution of contaminated microbiological samples according to frequency of contact lens use.

Frequency of use	Total subjects (n = 68)	Subjects with contaminated samples
Daily	22	20 (90.9%)
Occasional	46	26 (56.52%)

Table 2: Percentage distribution of contaminated microbiological sample according to duration of contact lens use.

Duration of use	Total subjects (n = 68)	Subjects with contaminated samples
≤ 2 years	44	36 (81.8%)
≥ 2 years	24	16 (66.6%)

Table 3: Percentage distribution of contaminated microbiological sample according to reason for contact lens use.

Reason of use	Total subjects (n = 68)	Subjects with contaminated samples
Cosmetic	26	22 (84.6%)
Therapeutic	42	31 (73.8%)

Discussion

The leading risk factor for MK is CL wear. The incidence of MK was significantly increased from 40% to 52% during 2008-2012.[7] The incidence of MK was found to be more than 20 per 10,000 person per year for soft CL wearers.[8] The common risk factors for CL related MK is poor storage case hygiene, infrequent storage case replacement, and overnight CL wear.[9, 10] In addition, the major risk factors for CL associated MK are overnight use of daily wear lenses, using lenses on extended wear schedule for longer duration, being of male gender, inadequate hygiene of the CLs, and poor CL storage case cleaning, use of tap water for storing lenses, failure to air-dry lens-storage cases or use of one step hydrogen peroxide disinfectant.[11, 12, 13-16] About quarter of the cases of MK are due to the contaminating organisms in the CL case and solution.[17] Microbial contamination of CL storage case was a great risk for gram-negative bacterial infection among soft CL-wearers.[18] Our study revealed that approx 66 percent of the subjects were prone to bacterial contamination which supports this fact.

The majority of contact lens wearers reported three unsafe practices, viz keeping their CL cases for longer than recommended (82%), topping off solution in the case (55%) or wearing their lenses while sleeping (50%). Various types of microorganisms are associated with MK in CL wearers. The clinical manifestation of MK can be related to the broad type of causative organisms. The MK in CL wearers varies by predisposing factors and climatic conditions. The most common bacterial pathogens associated with MK are *Staphylococcus* and *Pseudomonas* species. Our study shows that *Pseudomonas* species are more common than *Staphylococcus* in CL wearers which is similar with other studies. Bacterial keratitis in CL wearers is mostly associated with gram-negative bacteria such as *Pseudomonas, Serratia, Acinetobacter, Klebsiella spp* and other bacterial species. In our study, most of the bacterial species were isolated and identified from CL, CL storage case, CL solution and corneal scraping of CL wearers. The CL associated keratitis is also caused by gram-positive bacteria such as *Staphylococcus*, *Streptococcus spp.* and others.[19] Few isolates of *Streptococcus pneumoniae* were also found in our study, as also reported by Ormerod et al. who found that *Staphylococcus species, P. aeruginosa* and *S. pneumoniae* as major isolates in MK in North America whereas in Sweden, *S. aureus* and *S. epidermidis* were the most common gram-positive bacteria in central microbial keratitis while *P. aeruginosa* was the most common gram-negative bacteria.[20, 21] MK caused by gram-negative bacteria is more severe and associated with a worse visual prognosis than that of the most other common bacterial pathogens. *Pseudomonas* and *Staphylococci* are the most common bacterial pathogens implicated in CL associated bacterial keratitis which was also found in our study. *P. aeruginosa* accounts for 37-60% of CL related corneal bacterial infection.[22] Extended wear of soft contact lens are mostly associated with the increased incidence of *P. aeruginosa* infection.[23, 24] Enzymes like alkaline protease and gelatinase are produced by the *P. aeruginosa* during pseudomonas keratitis which play an important role in the invasion of corneal epithelium and pathogenesis of CL associated *Pseudomonas* keratitis.[25]

Amongst the fungi, *Candida albicans* and *Fusarium solani* and amongst the parasites, *Acanthameba spp.* have been frequently associated with microbial keratitis, as reported by several workers. [20-22] We also found *Candida albicans* as a predominant fungal isolate from contact lenses in our study. However, we could not report any case of *Fusarium solani* and *Acanthameba spp.* due to lack of proper facilities for their identification.

Our study also found an increased rate of contamination among daily users and those using lenses for purely cosmetic purposes reflecting carelessness and lack of compliance on the part of the users regarding lens care. Lens cases were the most frequently contaminated item followed by contact lenses as also found by other researchers.

The antibiogram report indicated that the isolated bacterial species were less resistant to ceftazidime (6%), and amikacin (6%).

All *P.aeruginosa* isolates were sensitive to ceftazidime and amikacin, and only 6.7% were resistant to Ciprofloxacin. Among the *S. pneumoniae* isolates, 2.6% were resistant to amikacin, and all were sensitive to cefazolin, ceftazidime, cefixime and cephalothin. Apart from MK, the other complications associated with CL wear include lens deposition, allergic conjunctivitis, giant papillary conjunctivitis, peripheral infiltrates and neovascularization.

Conclusion

In conclusion, our results showed that the soft contact lens care practices amongst the subjects were not satisfactory which results in high level contamination. To avoid complications, it is necessary to avoid continuous use of contact lenses, change CL wearing schedules, lens material and care solutions. The current trend in contact lens care is toward the use of multipurpose

and no rub solutions. Application of topical therapy and increasing awareness among the CL users are the other methods to minimise the risk of microbial keratitis.

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