ORIGINAL ARTICLE

# Epidemiology of Ocular Infection Due to Bacteria and Fungus – A Prospective Study

**B L Sherwal, AK Verma**

**Abstract**

A total number of 400 cases of eye infection were studied. Among them, 250 were conjunctivitis (59.2%),120 were keratitis (53.34%) 15 were endophthalmitis (26.67%) and 15 were suffering from other infections (40%). The corneal scrapping, conjunctival swab and biopsy material ( endophthalmitis cases) was collected asceptically. The material was examined using 10% Potassium hydroxide, Gram staining and Giemsa staining. The specimens were cultured on sheeps' blood agar, chocolate agar and sabourauds' dextrose agar. In the bacterial cause of eye infection Staphylococcus aureus (19.13%) was the most commonly isolated organism and other pathogens isolated were Streptococcus pneumoniae (10.93%), Streptococcus pyogens (0.55%), Pseudomonas aeruginosa (4.92%), Klebsiella species(2.74%), Escherichia colli (1.10%) and Proteus mirabilis (0.55%). Among the opportunistic pathogens, Staphylococcus epidermidis, (19.13%) were the most common isolate followed by Acinetobacter species(2.74%). Alkaligenes faecalis (1.10%), Staphylococcus saprophyticus (0.55%), Staphylococcus cohnii (0.55%), Staphylococcus haemolyticus (0.55%). In the endopthalmitis patients only Pseudomonas aeruginosa (20%) and Staphylococcus epidermidis (6.67%) were isolated. In the fungal keratitis, the total fungal isolates were 32.50%. Among them Aspergillus species (56.42%) was the most common fungus isolated followed by Curvurlaria (17.95%), Cladosporium (7.70%), Candida species (5.13%), Fusarium (5.13%), Alternaria (5.13%), Penicillium (2.57%). Fungal infection is a life threatening condition, which needs early diagnosis and treatment to save the patients' eye. Staphylococcus aureus and Staphylococcus epidermidis are still the most common isolates among the known and opportunistic pathogens in ocular infection. Pseudomonas is the most common cause of endophthalmitis. Aspergillus remains most common cause for fungal keratitis.

**Key Words**

Ocular Infection, Opportunistic Patogen, Keratitis

## Introduction

Infection of the eye leads to conjunctivitis, keratitis, endopthalmitis and other infections which are responsible for increased incidence of morbidity and blindness worldwide (1,2). Suppurative keratitis can cause corneal opacity and perforation, which leads to severe visual loss and is the second most common cause for blindness in developing countries (3,4). The etiological cause for suppurative keratitis may vary at different geographical locations (5). Different types of fungi that are one of the important etiological agents also affect cornea orbit and other ocular structures. Fungal infection is a life threatening condition which needs early diagnosis and treatment to save the patients' eye. In some cases when medical treatment fails early surgical debridment is resorted (6). The study has been conducted to detect various types of eye infections and the different trends of bacterial as well as its fungal etiology.

**From the Department of Microbiology Lady Hardinge Medical College New Delhi & HIMS,Dehradun, Uttaranchal, India**
**Correspondence to :** Dr.BL Sherwal, Department of Microbiology, Lady Hardinge Medical College New Delhi- India

## Material & Methods

The study was conducted in the Department of Microbiology, Lady Hardinge Medical College, New Delhi. A total number of 400 cases of eye infection were studied. All the patients were examined in the eye OPD and ward by a specialist. The corneal scrapping sample has been taken using slit lamp biomicroscope in an asceptic manner. Scrapping was done with the help of 4% Lignocaine and sterile bard parker blade (No.15). Scrapping material was taken from edge and base of ulcer. Conjectival swab has been taken from conjunctivitis patients. Biopsy material has been taken from endopthalmitis patients. The material was examined using 10% Potassium Hydroxide, Gram staining, Giemsa staining and cultured in blood agar, chocolate agar and sabouraud dextrose agar. Kinyouns staining and non-nutrient agar culture has been used in suspected cases of actinomycetes and acanthamoeba infections respectively ( 3,7,8).

Bacteria were identified by using routine biochemical tests. Filmantous fungi were identified on the basis of growth rate, colony characteristic, fruiting structure and microscopy.

## Result

A total of 400 patients of eye infection were studied which included patients suffering from conjunctivitis (250), keratitis (120), endopthalmitis (15) and other infections (15) (Table-I). The isolation rate was 59.2% in conjunctivitis , 53.34% in keratitis, 26.67% in endopthalmitis and 40% in others. In the bacterial cause of eye infection Staphylococcus aureus (19.13%) was the most commonly isolated organisms among the known pathogen.Other known pathogens isolated were Streptococcus pneumoniae (10.93%), Streptococcus pyogens (0.55%), Pseudomonas aeruginosa (4.92%), Klebsiella species (2.74%), Escherichia coli (1.10%) and Proteus mirabilis (0.55%). Among the opportunistic

***Table-1 Suspected Eye Infections with Etiological Agent***

| SNo. | Infection | Total Cases | Bacterial | Fungal | Total Postive % age |
|---|---|---|---|---|---|
| 1. | Conjunctivitis | 250 | 148 | - | 59.20 |
| 2. | Keratitis | 120 | 25 | 39 | 53.34 |
| 3. | Endopthalmitis | 15 | 4 | - | 26.67 |
| 4. | Others | 15 | 6 | - | 40.00 |
| | **Total** | **400** | **183** | **39** | **45.75** |

***Table-2 Bacterial Isolatesin Eye Infecctions***

| SNo. | Microorganism | Conj (250) | Ker(120) | Endo(15) | Oth(15) | Total % age |
|---|---|---|---|---|---|---|
| **A)** | **Known Pathogens** | | | | | |
| 1. | S aureus | 27 | 5 | 0 | 3 | 35(19.13) |
| 2. | Str pneumo | 15 | 5 | 0 | 0 | 20(10.93) |
| 3. | Str pyogenes | 1 | 0 | 0 | 0 | 1(0.55) |
| 4. | Ps. aeruginosa | 1 | 4 | 3 | 1 | 9(4.92) |
| 5. | Klebeiella sps. | 4 | 1 | 0 | 0 | 5(2.74) |
| 6. | E. coli | 1 | 0 | 0 | 1 | 2(1.10) |
| 7. | Pr. mirabilis | 1 | 0 | 0 | 0 | 1(0.55) |
| **B)** | **Opportunistic Pathogens** | | | | | |
| 8. | S epidermidis | 31 | 3 | 1 | 0 | 35(19.13) |
| 9. | S saprophyticus | 1 | 0 | 0 | 0 | 1(0.55) |
| 10. | S cohnii | 1 | 0 | 0 | 0 | 1(0.55) |
| 11. | S haemolyticus | 1 | 0 | 0 | 0 | 1(0.55) |
| 12. | Acinetobacter sps. | 5 | 0 | 0 | 0 | 5(2.74) |
| 13. | Alk. feacalis | 0 | 1 | 0 | 1 | 2(1.10) |
| **C** | **Normal Flora** | | | | | |
| 14 | Micrococci | 59 | 6 | 0 | 0 | 65(35.52) |
| | **Total (%)** | 148 (59.20) | 25(20.84) | 4(26.66) | 6(40) | 183(53.19) |

*Ps. aeruginosa : Pseudomonas aeruginosa; E. coli : Escherichia coli;*
*Pr. mirabilis : Proteus mirabilis*

*Table 3. Fungal Isolates In Keratitis Patients*

| S. No | Funngus | Number | % Age |
|---|---|---|---|
| 1. | Apergillus fumigatus | 9 | 23.08 |
| 2. | Aspergillus flavus | 8 | 20.52 |
| 3. | Aspergillus niger | 5 | 12.83 |
| 4. | Candida sps. | 2 | 5.13 |
| 5. | Fusarium sps. | 2 | 5.13 |
| 6. | Cladosporium | 3 | 7.70 |
| 7. | Curvularia | 7 | 17.95 |
| 8. | Alternaria | 2 | 5.13 |
| 9. | Penicillium | 1 | 2.57 |
| | **Total** | **39** | **32.50** |

pathogens, Staphylococcus epidermidis (19.13%) were the commonest isolates followed by Acinetobacter species (2.74%), Alkaligenes faecalis (1.10%), Staphylococcus saprophyticus (0.55%), Staphylococcus cohnii (0.55%), Staphylococcus haemolyticus (0.55%)(Table2). In conjunctivitis patients Staphylococcus aureus (18.24%) and Staphylococcus epidermidis (20.95%) was the most common isolate among known and opportunistic pathogens respectively. In the keratitis patients most common among known and opportunistic bacterial isolates were Staphylococcus aureus (7.15%), Staphylococcus epidermidis (4.29%). Other pathogens isolated were Pseudomonas aeruginosa (5.72%), Klebsiella species (1.43%), Alkaligenes faecalis (1.43%) and normal flora i.e. Micrococcus (8.58%). In the endopthalmitis patients the only organisms isolated among known and opportunistic pathogens were Pseudomonas aeruginosa (20%) and Staphylococcus epidermidis (6.67%) respectively. From the keratitis patients the fungal isolates were isolated in 32.50% cases(Table3). Among them Aspergilus species (56.42%) was the most common fungus isolated followed by Curvurlaria (17.95%), Cladosporium (7.70%), Candida (5.13%), Fusarium (5.13%), Alternaria (5.13%), Penicillium (2.57%). In the various Aspergilus species Aspergilus fumigatus (23.08%) were the most common species followed by Aspergilus flavus (20.52%) and Aspergilus niger (12.83%).

## Discussion

Various studies in this direction are available in past (3,5,7,9-17). In this study, Gram positive cocci are still the most common isolates among known and opportunistic

*Fig 1. Showing Distribution of Cases*

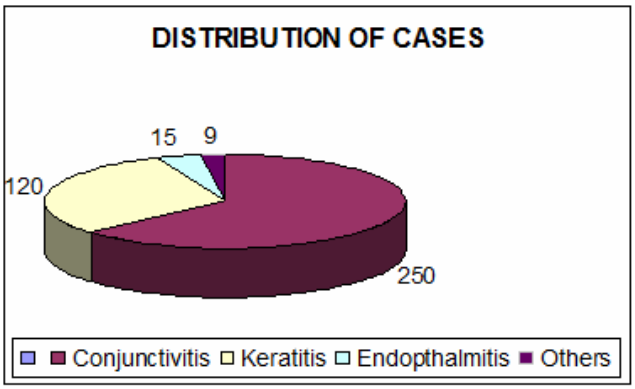
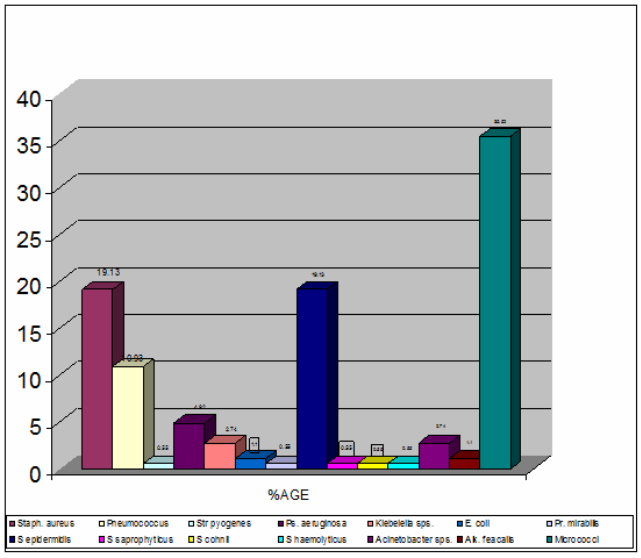



*Fig 2. Showing %Age of Cases*




pathogens. Several other studies in India, Nepal and other parts of world have shown similar results inferring Gram positive cocci as a primary cause of bacterial keratitis (7,3,10). A comparative analysis of the different studies by various authors has been shown in Table 4. The positivity rate of bacterial keratitis in our study was 20.84% in which 52% was caused by Gram positive cocci and 24% by Gram negative bacilli. This is well correlated with other studies in India by Garg *et al* where they showed Gram positive organism (82.4%) and Gram negative (16.1%) (11). Among the Gram positive organisms in bacterial keratits Staphylococcus aureus and Streptococcus pneumonia constituted (40%) and in Gram negative bacteria Pseudomonas aeruginosa (16%) of total positive isolates. Among corneal ulcer cases Leck *et al* reported Streptococcus species (20%) and Staphylococcus species

**Table-4 Comparative Studies of Keratitis Positive Patient**

| Place | Authors | Year | % age of isolates | | M/C organisms | |
|---|---|---|---|---|---|---|
| | | | Bacteria | Fungi | Bacteria | Fungus |
| Nepal | Upadhyay *et al* (3) | 1991 | 63.2% | 6.7% | Str pneumo<br>S epider<br>S aureus | Candida<br>Fusarium<br>Aspergillus |
| Bangladesh | Dunlop *et al* (17) | 1994 | 53.50% | 35.90% | Pseudo spp<br>Str pneumo | Fusarium<br>Asperg.spp |
| India | Srinivasan *et al* (7) | 1997 | 47.1% | 46.8% | Str pneumo<br>Pseudo spp | Madurai,<br>Aspergilus<br>Fusarium |
| India | Garg *et al* (11) | 2000 | 63.62% | 33.64% | S epider<br>S aureus | Fusarium<br>Aspergilus |
| Hyderabad | Kunimoto *et al* (12) | 2000 | 74% | 25.7% | S epider<br>Str pneumo | Fusarium<br>Aspergillus |
| Ghana | Leck *et al* (5) | 2002 | 12.4% | 36.2% | Pseudo spp<br>Str pneumo | Aspergilus<br>Fusarium |
| India | Leck *et al* (5) | 2002 | 23.9% | 38.6% | Str pneumo<br>Coagulase -ve staph | Aspergilus<br>Fusarium |
| Kolkata, India | Das A *et al* (9) | 2003 | 29% | | S aureus<br>S.epider | LHMC N. |
| Delhi, India | Sherwal *et al* -present study | 2004 | 20.84% | 32.50% | S.aureus<br>S.epider | Curvularia<br>Aspergillus |

*Str pneumo: Streptococcus pneumoniae, S epider : Staphylococcus epidermidis,Pseudo.spp : Pseudomonas species*

(10%) in Ghana and from India he reported Streptococcus species (46.8%), Staphylococcus species (26.8%) and Pseudomonas species (14.9%) (5). Das *et al* found Staphylococcus aureus, Staphylococcus epidermidis, Pseudomonas aeruginosa as most frequent bacteria in nosocomial ocular infection (9).

The common cause of fungal keratitis in our study was Aspergilus species 56.42% followed by Curvularia 17.95%. Kunimoto *et al* has also reported from Hyderabad, Aspergilus species (37%) and Curvularia (16%) are common pathogens (12). Several other reports from Nepal, Bangladesh and India have also shown Aspergilus species as most common isolate in fungal keratitis (10,13,14,17). Aspergilus fumigatus (23.08%) was the most common isolate in our study followed by Aspergilus flavus (20.52%) and Aspergilus niger (12.83%). Leck *et al* reported Aspergilus flavus (16.7%) as most common sps. followed by Aspergilus fumigatus (4.2%), Aspergilus niger (0.3%) from India and from Ghana they reported Aspergilus flavus (8.3%), Aspergilus fumigatus (6.4%), Aspergilus niger (0.9%), Aspergilus nidulans (0.9%) and other Apsergilus species (0.9%) (5). The Aspergilus species is most common pathogen for fungal keratitis, probably because it is resistant to hot and dry conditions (5).

In the case of endopthalmitis Pseudomonas aeruginosa (75%) and Staphylococcus epidermidis (25%) were isolated. The total isolation rate was 26.66%. Ahmed N *et al* (16) isolated Pseudomonas aeruginosa while Kaul S *et al* (15) isolated Staphylococcus aureus and Staphylococcus epidermidis in endopthalmitis patients. Various bacteria and fungus associated infections like conjunctivitis, keratitis, endopthalmitis and other eye infections are a common problem in India. Different etiological agents are identified in our study. Staphylococcus aureus and Staphylococcus epidermidis were the common isolates. It is observed that the normal commensals of the eye has also led to serious ocular infections in many cases. Pseudomonas species and Staphylococcus epidermidis are the common cause of endopthalmitis. Aspergilus species is found to be a major cause for fungal keratitis.

## Conclusion

Persistent efforts should be put for continuous surveillance and epidemiological characterization which are imperative to treat and prevent morbidity and blindness of population at risk in India.

**References**


1. Chirambo MC, Tielsch JM, West KP, Katz J. Blindness and visual impairment in Southern Malawi. *Bull WHO* 1986; 64:567-72.
2. Juarez-Verdayes MA, Reyes-Lopez MA, Cancino-Diaz ME, *et al*. Isolation, vancomycin resistance and biofilm production of Staphylococcus epidermidis from patients with conjunctivitis, corneal ulcers, and endophthalmitis. *Rev Latinoam Microbiol* 2006;48(3-4):238-46.
3. Upadhyay MP, Karmacharya PC, Koirala S,T *et al*. Epidemiological characteristics pre-disposing factors and etiological diagnosis of corneal ulceration in Nepal. *Am J Opthalmol* 1991;111:92-99.
4. Ashaye A, Aimola A. Keratitis in children as seen in a tertiary hospital in Africa. *J Natl Med Assoc* 2008;100 (4):386-90.
5. Leck AK, Thomas PA, Hagan M, *et al*. Etiology of suppurative corneal ulcers in Ghana and south-India, and epidemiology of fungal keratitis. *Br J Opthalm* 2002;86:1211-15.
6. Thomas PA. Current perspectives on ophthalmic micosis. *Clin Microb Rev* 2003;16:730-97.
7. Srinivasan M, Gonzales CA, George C, *et al*. Epidemiology and etiological diagnosis of corneal ulceration in Madurai, south Iinda. *Br J Ophthalm* 1997;81:965-71.
8. Jones BD. Initial therapy of suspected microbial corneal ulcers. II. Specific antibiotic therapy based on corneal smears. *Surv Ophthalmol* 1979;24:97, 105-61.
9. Das A, Dey AK, Agarwal PK, Mazumdar AK, Mazumdar S, Chatterjee SS. Nosocomial cular infection – a prospective study. *J Indian Med Assoc* 2003;101:490-92.
10. Yeh DL, Stinnett SS, Afshari NA. Analysis of Bacterial culture in infectious keritits 1997-2000. *Am J Opthalmol* 2006;142;1066-68.
11. Garg P, Rao GN. Corneal ulcer : Diagnosis and management. *Community Eye Health* 2000;12:21-24.
12. Kuniomoto DY, Sharma S, Garg P, *et al*. Corneal ulceration in the elderly in Hyderabad, south India. *Br J Ophthalmol* 2000;84:54-59.
13. Dunlop AAS, Wright ED, Howlader SA *et al*. Suppurative corneal ulceration in Bangladesh. *Aus NZ J Ophthalmol* 1994;22:105-10.
14. Mahajan VM. Ulcerative keratitis: An analysis of laboratory data in 674 cases. *J Ocul Ther Surg* 1985;4:138-41.
15. Koul S, Philipson A, Philipson BT. Incidence of endophthalmitis in Sweden. *Acta Ophthalmol (Copenh)*. 1989 Oct;67(5):499-503.
16. Ahmed N, Bal A, Khan AA, *et al*. Whole genome fingerprinting and genotyping of multiple drug resistant (MDR) isolates of Pseudomonas aeruginosa from endophthalmitis patients in India. *Infect Genet Evol* 2002 ;1(3):237-42.
17. Dunlop AA, Wright ED, Holader SA, Nazrul I, Jussain R, McClellan K, Billson FA. Suppurative corneal ulceration in Bangladsh. A study of 142 cases examining the microbiological diagnoses, clinical and epidermological feature of bacterial and fungal keratitis. *Aust NA J Opthalmol* 1994;22:105-10.