

## Bacterial Keratitis: Risk factors, clinical and microbiological study at a tertiary care hospital- A two year study

Sreelakshmi Kothapalli<sup>1</sup>, Gopala Krishna Ogirala<sup>2,\*</sup>, Jithendra Kandati<sup>3</sup>

<sup>1</sup>Associate Professor, <sup>2,3</sup>Professor, <sup>1,2</sup>Dept. of Ophthalmology, <sup>3</sup>Dept. of Microbiology, Narayan Medical College, Chinthareddypalem, Nellore

**\*Corresponding Author:**

Email: sujatha2481@gmail.com

### Abstract

**Aims:** The purpose of the present study was to identify the common predisposing factors in the region and to identify the common bacterial agents associated with bacterial keratitis and outcome of the condition with regard to individual pathogen.

**Settings & Design:** A prospective hospital based cross sectional study for a period of two years at a tertiary care hospital by the department of ophthalmology in association with department of Microbiology.

**Material & Methods:** 350 patients above >5 years attending the OP of dept. of ophthalmology with clinical signs and symptoms of Bacterial keratitis were enrolled. Demographic data, duration of illness, clinical signs and symptoms were noted. Corneal smears and scrapings were collected by following standard protocol, and were transported to microbiology laboratory for processing and isolation of pathogens. The isolated pathogens were identified by standard biochemical tests and microbiological procedures by following CLSI guidelines.

**Results:** 350 cases of bacterial keratitis with 200 males and 150 females were enrolled as cases, 26-45 years was the most common age group in the study. 31.1% were farmers, 52% belong to low socio economic status. 60.6% had a history of previous injury or surgery to the involved eye. History of corneal injury with paddy husk was noted in 60.57% of cases which was a major risk factor. 315 cases forming 90% of all cases were positive for growth. Staphylococcus aureus was the dominant isolate in the study. Aspergillus niger and Candida albicans were the fungal isolates in the study.

**Conclusion:** Bacterial keratitis is one of the serious ocular conditions which require emergency care and management. Corneal injury remains as the major risk factor and associated ocular disorders, contact lens usage are other risk factors. Old age, anterior chamber infiltration, long duration of illness was associated with significant risk of poor visual outcome in the study. Any programmes directed against this condition should focus on the above factors in prevention of bacterial keratitis and to prevent complications.

**Keywords:** Bacterial keratitis, Corneal smears, Staphylococcus aureus, Candida albicans.

### Introduction

Bacterial keratitis still remains as one of the serious ocular infectious pathologies which threaten the vision. The outcome depends upon the condition of the cornea and pathogenicity of the infecting bacteria. It is associated with poor clinical outcome if appropriate therapy is not properly initiated. Bacterial keratitis rarely occurs in normal eye, because of human cornea's natural resistance to infection.<sup>(1)</sup> Corneal infections mostly result from, failure of one of the protective mechanisms that maintain the ocular surface integrity. Passive and active host defense mechanisms protect corneal tissues from bacterial invasion. The natural host defense mechanisms include, complement activation and enzyme secretion within the lacrimal fluid and other factors like lysozymes, lactoferrin, betalysin and ceruloplasmin also add more protection to the corneal defense against bacterial invasion.<sup>(2)</sup>

Bacterial keratitis is rare without any predisposing factors that breach the natural active and passive defense mechanisms. Most of the studies earlier reported keratitis to be associated with ocular trauma or ocular surface disorders like dry eye syndrome, lid deformities, chronic usage of steroids and ocular surgeries. Increased and widespread usage of contact

lenses particularly hard contact lenses has now been associated with increased incidence of bacterial keratitis.<sup>(3)</sup> However the risk factors are variable depending upon the geographic region and climatic factors. The spectrum of pathogens which are responsible for bacterial keratitis varies from place to place and region. Most of the literature in the studies report gram positive pathogens as the most common etiological agents of bacterial keratitis, and Pseudomonas aeruginosa as the most common gram negative pathogen. Complications are rapid and more threatening in case of gram negative keratitis than gram positive keratitis.<sup>(4)</sup> Bacterial keratitis is associated with severe visual loss and corneal damage if therapy is not initiated immediately. The purpose of the present study was to identify the common predisposing factors in the region and to identify the common bacterial agents associated with bacterial keratitis and outcome of the condition with regard to individual pathogen.

### Materials & Methods

A prospective cross sectional hospital based study was conducted at Narayana Medical College and hospital, by Department of Ophthalmology for a period of 2 years from June 2014 to May 2016. All the patients

above 5 years of age, attending the outpatient section with signs and symptoms of bacterial keratitis were enrolled in the study. The study was presented to the institutional ethical committee and was accepted. All the procedures in the study were done as per the ethical committee guidelines. The study details were informed to the participants in the study and written consent was obtained from all the participants. The socio demographic data (Age, sex, occupation etc) was obtained by thorough interview of the cases in the study and noted. The predisposing factors, clinical history, slit lamp microscopic findings, other ocular conditions, systemic diseases, previous history of ocular surgery or medications, visual acuity at the time of presentation were noted in a separate proforma and documented. Patients not consenting for the study and who lost the follow up in the study period were excluded. Cases with signs and symptoms suggestive of viral keratitis, Acanthamoeba keratitis and fungal keratitis were excluded from the study.

**Collection of specimen:** Corneal smears and scrapings were collected from all the cases enrolled in the study by following a standard protocol. Before collection of corneal material topical anaesthetic agent tetracaine was installed into the eye. Two corneal swabs were collected by using thioglycollate broth moistened calcium alginate swab from the edges of the ulcer. One was used for smear preparation and other for culture. Grams' staining was performed and results were noted. Another swab was inoculated on blood agar, chocolate agar, Macconkey agar and Sabourad's dextrose agar for fungal and bacterial growth. Corneal scrapings collected by using a spatula were inoculated directly on the culture media. All the plates were incubated at 37°C overnight and examined everyday for growth until 3 days for bacterial and 7 days for fungal growth. The bacterial growth was identified using standard biochemical tests and microbial procedures. Fungal growth was identified by colony morphology, LPCB mount and slide culture. Germ tube test and chlamyospore formation on corn meal agar was done for identification of *Candida albicans*.<sup>(5)</sup>

## Results

A total of 350 cases of bacterial keratitis were diagnosed during the study period, with 200 males (57.1%) and 150 (42.9%) females. The most common age group in the study was 26-35 years (26.9%) and 36-45 years (26.6%) with minor difference and males were predominant in the study in all age groups. The age of the patients ranged from 6 years to 68 years and the mean age was 35 years. Male to female ratio in the study was 1.34:1. Among the 350 cases, 111 (31.7%) were already treated with topical self medications. 52% of cases in the study belong to low socioeconomic status, 31.4% and 16.6% to middle and upper economic class. Occupational history of the cases in the study revealed, 31.1% of cases were farmers, 20% were

housewives, 17.4% were labourers and 8.6% were professional salaried employees. 11.4% were students and another 11.4% were performing different occupations. 60.6% of cases (212/350) had a history of previous injury or surgery to the involved eye. 48.3% of cases had a history of > 2 weeks duration of illness, 29.1% of cases with 8 to 14 days old and 22.6% with ≤ 7 days old. (Table 1)

**Table1: Clinical and Demographic data of Cases Enrolled in the study**

Age	Male (No) (%)	Female (No) (%)	Total (No) (%)
5-15 Years	12	8	20 (5.7)
16-25 Years	32	26	58 (16.6)
26-35 Years	56	38	94 (26.9)
36-45 Years	54	39	93 (26.6)
46-55 Years	28	24	52 (14.9)
>55 Years	18	15	33 (9.4)
<b>Total</b>	<b>200 (57.1)</b>	<b>150 (42.9)</b>	<b>350</b>
<b>Socio economic status</b>			
Low	96	86	182 (52)
Middle	68	42	110 (31.4)
Upper	36	22	58 (16.6)
<b>Occupation</b>			
Farmer	98	11	109 (31.1)
Labourer	33	28	61 (17.4)
salaried	19	11	30 (8.6)
House wife	0	70	70 (20)
Student	22	18	40 (11.4)
Others	28	12	40 (11.4)
<b>H/O Previous Injury to eye</b>			
Yes	125	87	212 (60.6)
No	75	63	138 (39.4)
<b>H/O topical application</b>			
Yes	45	66	111 (31.7)
No	155	84	239 (68.3)
<b>Duration of illness</b>			
≤ 7 days	44	35	79 (22.6)
8 days-14th day	54	48	102 (29.1)
> 2 weeks	102	67	169 (48.3)

Data regarding the risk factors among the cases is summarized in Table 2. 9.71% of cases were using contact lens (34/350), 21 were using soft contact lens, 8 were using rigid gas permeable lens and 5 were using hard PMMA CL. History of corneal injury with organic matter, sand, pencil, glass were noted in 60.57% (212/350) cases, which was identified as a major risk factor in our study. Other ocular abnormalities

encountered in our study were, blepharitis in 34 cases, lid abnormality in 21, keratopathies (Postoperative, bullous etc.) in 22 cases, Past history of ocular surgery in 33 cases, Dry eye syndrome in 18 cases. Other Systemic conditions like diabetes etc were observed in 34 cases. Overlapping of risk factors was observed in few cases of our study.

Among the 350 cases, right eye involvement was noticed in 170 (48.57%) cases, left eye in 144 cases (41.14%) and bilateral involvement in 36 cases (10.29%). Corneal infiltrates were localized at central zone in 21.43%, nasal in 19.43%, temporal in 22.29%, inferior in 25.14% and superior in 11.43% of cases. However, overlapping of the zones was observed in few cases of our study. Lesions of the inferior zones were mostly associated with contact lens usage cases. In 47.14% of cases, the depth of ulceration was  $30 \pm 60\%$ , in 46.29% of cases the depth was  $<30\%$  and in 6.57% of cases it was  $>60\%$ . Anterior chamber inflammation was observed in 224 cases and absent in 126 cases. 34.82% presented with 2+, 29.02 with 1+, 19.20% with 3+ and 16.96% with 4+. 60.57% had vision between 6/36 and 6/60, 16.57% had vision between 3/60 to HM, 13.14% had vision between 6/12-6/24, and 3.43% had vision between 6/6 -6/9. (Table 2)

**Table 2: Risk factors & Clinical features of enrolled cases in the study**

Risk factors	No	%
Corneal injury	212	60.57
Contact lens usage	34	9.71
<b>Ocular abnormalities</b>		
Blepharitis	34	9.71
Lid abnormality	21	6.00
Keratopathies	22	6.29
Dry eye syndrome	18	5.14
Past H/O Ocular Surgery	33	9.43
Others	34	9.71
<b>Clinical parameters observed</b>		
<b>Position of Corneal infiltrate</b>		
Central	75	21.43
Nasal	68	19.43
Temporal	78	22.29
Inferior	88	25.14
Superior	40	11.43
<b>Depth of ulceration</b>		
$<30\%$	162	46.29
$30 \pm 60\%$	165	47.14
$>60\%$	23	6.57
<b>Anterior Chamber Inflammation</b>		
+1	65	29.02
+2	78	34.82
+3	43	19.20
+4	38	16.96
<b>Visual acuity at Presentation</b>		
PL-NPL	22	6.29
3/60-HM	58	16.57

6/36-6/60	212	60.57
6/12-6/24	46	13.14
6/6-6/9	12	3.43
<b>Involvement of Eye</b>		
Right eye	170	48.57
Left eye	144	41.14
Bilateral	36	10.29

**Microbial isolation:** A total of 350 specimens were processed for culture on appropriate culture media. 315 cases forming 90% of all cases were positive for growth. Pure growth was observed in 280 cases and Polymicrobial growth in 18 cases. Mixture of bacterial and fungal growth was seen in 17 cases. 335 bacterial isolates and 17 fungal isolates were isolated in the study. Among the bacterial isolates gram positive were 161, gram negative were 174 and fungal 17. *Staphylococcus aureus* was the most common bacterial isolate in the study (33.43%) followed in order by *Pseudomonas aeruginosa* (29.25%), *Escherichia coli* (19.10%). Other less commonly isolated bacteria were *Coagulase negative staphylococcus* 9.746%), *Streptococcus pneumoniae* (7.16%), *Hemophilus influenzae* (3.58%). *Candida albicans* was the predominant fungal pathogen (64.7%) followed by *Aspergillus niger* (35.3%). (Table3)

**Table 3: Bacterial & Fungal Isolates from the study**

Isolate	No	%
Streptococcus pneumoniae	24	7.16
Staphylococcus aureus	112	33.43
Pseudomonas aeruginosa	98	29.25
Escherichia coli	64	19.10
Hemophilus influenzae	12	3.58
CONS	25	7.46
Aspergillus niger	6	35.3
candida albicans	11	64.7

## Discussion

Bacterial keratitis is an emergency which demands early diagnosis and institution of treatment. In the absence of identification of causative agent the initial treatment is broad spectrum intensive treatment. Identification of the causative agent with antibiotic susceptibility provides specific therapy and prompt recovery. But various epidemiological factors determine the outcome of the condition and vary from one country to another and in different areas of the same country. Our study, describes the data of 350 cases of bacterial keratitis with different causative factors, risk factors and etiological agents with their antibiotic susceptibility.

A clear male preponderance was observed in our study with 57.1% and also in all age groups of our study. A significant male preponderance was also observed in many studies in all the age groups and consistent with the findings in our study.<sup>(6,7)</sup> The most

common age group presented with bacterial keratitis in both male and female was 26-45 years, which is a main age of occupational age among males and females. This finding was similar to the findings of M. Ahn et al, Bharathi et al in their studies.<sup>(8,9)</sup> Occupational trauma was most the common cause of bacterial keratitis in our study, and most commonly seen in farmers. Ocular injury with paddy stalk was the most common cause as mentioned in many south Indian studies, as paddy cultivation is an important life hood for many farmers in south India.<sup>(10)</sup> In our study a significant number of cases were observed in the harvesting seasons of November – January which is differing with some of the studies indicating more number of cases in dry, hot seasons in their study.<sup>(11)</sup> Contact lens usage was identified in 9.71% of cases in our study; most of the studies are reporting an increasing usage of contact lens as a significant risk factor in cases of Bacterial keratitis, which was not identified in our study. This can be explained as most of the cases who presented in our study were of farmers and labourers than students and belong to low socio economic status.

Coexisting ocular abnormalities accounted to 46.3% of cases in our study which was significantly higher than few studies in south India; however studies from the north have shown similar findings in their studies.<sup>(12)</sup> History of previous injury to the eye was found to be significant risk factor among cases in our study, and was found in studies of Schafer et al also.<sup>(13)</sup> No significant association was found in involvement of either right eye or left eye, right eye was involved in 48.57% of cases in our study.

In our study, the culture positive rate was 90% which is significantly higher than many other studies done previously. This rate is higher as in our study most of the cases (68.3%) had no history of any kind of topical installation of antibiotic solutions. The spectrums of pathogens isolated were variable and depend upon the nature of injury, pre existing ocular disorder and other factors. In cases of bacterial keratitis due to paddy stalk injury, a mixture of bacterial and fungi were isolated from 17 cases in our study. In cases of contact lens injury, most of them were pure bacterial growth and only 2 cases reported fungal growth along with bacterial pathogens. These findings of our study were almost similar to the findings in the study of Alexandrakis G et al.<sup>(14)</sup> The common bacterial pathogens were Staphylococcus aureus, Streptococcus pneumoniae, Pseudomonas aeruginosa, Escherichia coli, Hemophilus influenza and Coagulase negative staphylococcus. Fungal pathogens which were isolated include Candida albicans and Aspergillus niger in our study. However few studies also reported other fungal and bacterial pathogens in their study. Polymicrobial growth was identified mostly in cases with prolonged duration of illness and coexisting ocular conditions. Few studies reported the gradual increase of Coagulase negative staphylococcus in their studies while few

reported Pseudomonas aeruginosa as their dominant pathogen in their study. However type of isolate is mostly dependent upon the type of risk factor and type of injury associated in causation of corneal ulcer. Differences in the isolates could be due to variation of the population in the study, health of cornea, geographic location and climate which are all variable factors.

### Conclusion

To conclude, bacterial keratitis is one of the serious ocular conditions which require emergency care and management. Corneal injury remains as the major risk factor and associated ocular disorders, contact lens usage are other risk factors. Old age, anterior chamber infiltration, long duration of illness was associated with significant risk of poor visual outcome in the study. Staphylococcus aureus was the most common isolate in the study and Pseudomonas aeruginosa was the second most common. Aspergillus niger and Candida albicans were the fungi isolates in the study. Our study emphasizes the risk factors, causative pathogens and associated ocular conditions which are associated with bacterial keratitis. Any programmes directed against this condition should focus on the above factors in prevention of bacterial keratitis and to prevent complications.

**Acknowledgements:** Nil

**Conflict of interest:** Nil

### References

1. G. Amescua, D. Miller, and E. C. Alfonso, "What is causing corneal ulcer? Management strategies for unresponsive corneal ulceration," *Eye*, vol. 26, pp. 28–36, 2012.
2. Miedziak AI, Miller MR, Rapuano CJ, et al. Risk factors in microbial keratitis leading to penetrating keratoplasty. *Ophthalmology* 1999;106:1166-70; discussion 1171.
3. Matthews TD, Frazer DD, Minassian DC, et al. Risks of keratitis and patterns of use with disposable contact lenses. *Arch Ophthalmol* 1992;110:1559-62.
4. Parmar P., Salman A., Kalavathy C .M., Kaliampurthy J., Thomas P.A., Jesudasan C.A. Microbial Keratitis at extremes of age. *Cornea*. 2006;25:153-158.
5. Wilhelmus K, Liesegang TJ, Osato MS, Jones DB. Laboratory diagnosis of Ocular infections. Washington DC: American Society of Microbiology; 1994; Cumitech series#13A.
6. Balows A, Hausler WJ, Herman KL, Isenberg HD, Shadomy HJ (ed) Manual of Clinical Microbiology, 6th edn. Washington, DC: American Society for Microbiology, 1991.
7. Kunimoto DY, Sharma S, Reddy MK, Gopinathan U, Jyothi J, Miller D et al. Microbial keratitis in children. *Ophthalmology* 1998;105:252-7.
8. M.Ahn, K.C.Yoon, S.K.Ryu, N.C.Cho, and I.C.You, "Clinical aspects and prognosis of mixed microbial (bacterial and fungal) keratitis," *Cornea*, vol. 30, no. 4, pp. 409–413, 2011.
9. M. J. Bharathi, R. Ramakrishnan, R. Meenakshi, C. Shivakumar, and L. Lionel Raj, "Analysis of the risk

- factors predisposing to fungal, bacterial & Acanthamoeba keratitis in south India," *Indian Journal of Medical Research*, vol. 130, no. 6, pp. 749–757,2009.
10. Srinivasan M, Gonzales CA, George C, Cevallos V, Mascarenhas JM, Asokan B, et al. Epidemiology and aetiological diagnosis of corneal ulceration in Madurai, south India. *Br J Ophthalmol* 1997;8:965-71.
  11. Jeng BH, McLeod SD. Microbial keratitis (Editorial). *Br J Ophthalmol* 2003;87:805-06.
  12. Basak SK, Basak S, Mahanta a, Bhowmick a. epidemiological and microbiological diagnosis of suppurative keratitis in Gangetic West Bengal, eastern India. *Indian J Ophthalmol* 2005;53:17-22.
  13. Schaefer F, Bruttin O, Zografos L, et al. Bacterial keratitis: a prospective clinical and microbiological study. *Br J Ophthalmol* 2001;85:842-7.
  14. Alexandrakis G, Alfonso EC, Miller D. Shifting trends in bacterial keratitis in south Florida and emerging resistance to fluoroquinolones. *Ophthalmology* 2000;107:1497-502.