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Clinicomicrobiological Profile and Antibiotic Susceptibility Trends in Chronic Lacrimal Sac Infections in a Rural Indian Population

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Background. *Chronic dacryocystitis, characterized by persistent inflammation and infection of the lacrimal sac and nasolacrimal duct, is a prevalent cause of ocular morbidity, particularly in rural India. Delayed diagnosis and inappropriate antibiotic use can result in recurrent infections and serious complications.*

Objective. *To evaluate the bacteriological profile and antibiotic sensitivity patterns of chronic dacryocystitis cases in a rural tertiary eye care center, and to compare findings with previously reported data.*

Methods. *This prospective observational study included 90 clinically diagnosed cases of chronic dacryocystitis from March 2011 to February 2012. Specimens were obtained using sterile techniques and subjected to aerobic culture. Isolates were identified through Gram staining and biochemical methods. "Antibiotic sensitivity was determined using the Kirby-Bauer disc diffusion technique. Statistical analysis was performed using Fisher's exact test with significance set at $p \leq 0.05$.*

Results. *Culture positivity was observed in 73.33% of cases, with single organisms isolated in 63.33% and mixed growth in 10% .Staphylococcus aureus was the predominant Gram-positive isolate in adults, while Streptococcus pneumoniae was most frequent in pediatric cases. Gram-positive organisms comprised 78.58% of isolates; Gram-negative bacteria, including Pseudomonas aeruginosa and Klebsiella pneumoniae, accounted for 21.42%. Vancomycin and gatifloxacin showed the highest sensitivity among Gram-positive isolates, while amikacin was most effective against Gram-negative organisms. Culture-negative cases (15.56%) may be attributable to anaerobic pathogens not assessed in this study.*

Conclusion. *Chronic dacryocystitis remains a significant health concern in rural India, with distinct bacteriological trends. Timely microbiological evaluation and sensitivity-guided antibiotic therapy are essential to prevent complications. Larger studies with anaerobic cultures are warranted for a more comprehensive microbial assessment.*

Key words:

chronic dacryocystitis, lacrimal sac infection, rural ophthalmology, Staphylococcus aureus, Streptococcus pneumoniae, antibiotic sensitivity, vancomycin, amikacin, microbiological profile, ocular complications

Introduction

Chronically restricted drainage can inflame and infect the lacrimal sac and nasolacrimal duct, causing chronic dacryocystitis. It is one of the most common ocular adnexa problems in rural and underdeveloped countries without early ophthalmic therapy. Chronic tearing (epiphora), mucopurulent discharge, and lacrimal sac oedema that regurgitates when touched are symptoms of this condition [1]. Chronic dacryocystitis, which appears harmless, can house pathogenic bacteria and cause conjunctivitis, keratitis, corneal ulceration, and endophthalmitis, which can be deadly during intraocular procedures. Pathophysiologically, the nasolacrimal duct's distal blockage traps tears and desquamated epithelial cells in the lacrimal sac. This slow environment is ideal for bacteria colonisation, prolonging inflammation and infection. As the sac loses its tone and flexibility, it becomes more susceptible to bacterial invasion and distention [2]. Secondary obstructions may be caused by trauma, infections, neoplasms, or iatrogenic causes, while primary blockages are common in the elderly individuals and women. Congenital and acquired chronic dacryocystitis exist. The congenital type, caused by nasolacrimal duct canalisation failure at the Hasner valve, affects infants, while the acquired form affects middle-aged and elderly individuals [3].

Epidemiology shows a demographic trend for chronic dacryocystitis. Many studies have linked the narrower bony nasolacrimal canal and hormonal factors affecting the mucosal lining to the gender predilection for this illness, which is more common in women. However, rare reports on congenital male predominance exist [4] & [5]. Environmental factors and hygiene habits contribute to this disease, which is most prevalent in rural India. There is strong evidence that applying traditional eye cosmetics like 'Kajal' or 'Surma,' bathing in contaminated pond water, being around dust, and not practicing proper personal hygiene can raise the risk of lacrimal sac infections [6]. People from lower socioeconomic origins are more likely to delay medical care because they cannot afford it or are

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unaware of the issue. These groups are less likely to finish antibiotics or undergo surgery, making them more susceptible to infection persistence and recurrence [7]. Because the prevalence of this disease and the antibiotic resistance patterns of the causative organisms vary depending on location, cleanliness, and healthcare access, collecting data from specific areas and developing individualized management strategies are important [8, 9].

Understanding the bacteriological profile of chronic dacryocystitis is essential for treatment. This is crucial given the global antibiotic resistance crisis. Gram-positive bacteria like S. aureus, S. pneumoniae, and Staphylococcus epidermidis were the most common pathogens, while Gram-negative bacteria like Pseudomonas aeruginosa, Klebsiella pneumoniae, and Escherichia coli were the second most common [10, 11]. However, weather, antibiotic use, and hospital infection control policies affect regional microbiome diversity. Antibiotic abuse and misuse in community and clinical settings has led to multidrug-resistant microorganisms, making treatment harder. To guide empirical therapy in areas without culture facilities, local microbiological trends must be understood [12]. When clinical suspicion leads to broad-spectrum antibiotics without culture and sensitivity data, the patient risks treatment failure, illness worsening, and other issues. Thus, periodic bacteriological surveillance is needed to amend antibiotic stewardship guidelines and develop suitable treatment procedures for certain groups.

This study examined antibiotic susceptibility and clinico-microbiological profiles of patients with chronic lacrimal sac infection at a remote tertiary eye care institution. The institution treats a large population in South Bengal and neighboring areas and receives many chronic dacryocystitis referrals. This allows researchers to examine patterns in an under-represented demographic. The major goal was of this study to use Kirby-Bauer disc diffusion to determine the antibiotic sensitivity of chronic dacryocystitis-causing bacteria and isolate and identify them using standard microbiological methods. The study also looked for correlations between microbiological data and demographic characteristics such as gender, age, domicile, socioeconomic position, sickness laterality, and ocular disorders. This study compared our results with those of earlier studies to highlight the shifting bacteriological spectrum and antibiotic resistance in the area. The findings will demonstrate the need for tailored therapy in rural locations with limited resources and improve clinical decision-making. They can also shape public health campaigns to promote cleanliness, early detection, and eye care to reduce the burden of this preventable but potentially disabling disease.

Materials and Methods

Study Design and Setting

This study was designed as a prospective observational investigation conducted at a rural tertiary eye care center located in South Bengal, India. The center caters to a wide geographic catchment area, including underserved populations from neighboring districts and states. The study spanned a period of twelve months, from March 2011 to February 2012, and aimed to evaluate the clinico-microbiological spectrum and antibiotic susceptibility patterns in patients diagnosed with chronic dacryocystitis.

Patient Selection

A total of 90 patients with clinically diagnosed chronic dacryocystitis were enrolled in the study. Diagnosis was made based on characteristic symptoms such as persistent epiphora, mucopurulent discharge, and regurgitation of fluid upon pressure over the lacrimal sac area. Patients with a history of acute dacryocystitis or those who had previously undergone lacrimal drainage surgeries were excluded to avoid confounding variables. The sample included both pediatric and adult patients presenting to the outpatient ophthalmology department during the study period.

Sample Collection

Specimen collection was carried out under aseptic conditions. In congenital cases and infants, the periocular region was carefully disinfected with a sterile solution. Samples were obtained by applying gentle pressure over the lacrimal sac to express contents, which were collected using sterile cotton swabs. In adults, in addition to swab collection from the sac expression, samples were also taken intraoperatively during dacryocystorhinostomy (DCR) or dacryocystectomy procedures. In bilateral cases, the more symptomatic side was sampled first. Precautions were taken to avoid contamination from the conjunctiva or lid margins during sample collection.

Microbiological Processing

Collected specimens were immediately transported to the microbiology laboratory for analysis. The study was limited to aerobic and facultative anaerobic bacterial culture due to resource constraints. Samples were inoculated onto nutrient agar and MacConkey's agar plates and incubated aerobically at 37°C for 18–24 hours. Bacterial growth was observed, and isolated colonies were subjected to standard microbiological identification protocols.Initial evaluation included Gram staining to determine the bacterial morphology and classification. Wet mount preparations were examined for motility. Further identification of Gram-positive isolates was carried out using catalase, coagulase, and Voges-Proskauer (VP) tests. For Gram-negative isolates, a battery of biochemical tests was employed, including catalase, oxidase, indole (SIM), triple sugar iron (TSI), urease, and oxidative-fermentative (O/F) tests. Based on morphological characteristics, colony appearance, and biochemical reaction profiles, organisms were identified up to the genus and species level.

Antibiotic Sensitivity Testing

Antibiotic susceptibility of the bacterial isolates was assessed using the Kirby-Bauer disc diffusion method on Mueller-Hinton agar, following Clinical and Laboratory Standards Institute (CLSI) guidelines. The selected antibiotics included vancomycin, gatifloxacin, ceftriaxone, co-amoxyclav, co-trimoxazole, and amikacin, which are

commonly used in the treatment of ocular infections. After applying antibiotic discs to the inoculated plates, the cultures were incubated at 37°C for 18–24 hours. Zones of inhibition were measured, and results were interpreted using standardized CLSI interpretative charts to determine susceptibility, intermediate resistance, or resistance.

Statistical Analysis

Data obtained from the study were systematically recorded and entered into a computerized database. Statistical analysis was performed using Epi Info software version 3.5.3. Fisher's exact test was applied to examine associations between categorical variables, including age group, sex, socioeconomic status, type of organism, and presence of complications. A p-value ≤ 0.05 was considered statistically significant for all analytical purposes.

Ethical Considerations

The study protocol was reviewed and approved by the Institutional Ethics Committee in accordance with the Declaration of Helsinki on human research. Prior to enrollment, all participants, or in the case of minors, their parents or legal guardians, were provided with detailed information regarding the study objectives, procedures, potential risks, and benefits. Written informed consent was obtained from each participant or guardian before sample collection and participation in the study. Patients were assured of confidentiality, and all personal identifiers were removed from the dataset to maintain privacy.

The study protocol was approved by the Institutional Ethics Committee (Protocol No. IEC/BMC/PG/167(56)/1(5).

Results

Age-wise Distribution of Patients

Table 1 shows the age distribution of the 90 patients enrolled. The majority (45.56%) were in the 46–60 years age group, followed by 31–45 years (30.00%). Children aged 0–15 years represented only 3.33% of cases. The high prevalence in middle-aged and older adults may be attributed to age-related weakening of lacrimal sac musculature, increased likelihood of nasolacrimal duct stenosis, cumulative environmental exposure, and hormonal changes. The low incidence in children suggests congenital causes are less common or better addressed in the community.

Gender and Residence Distribution

As shown in Table 2, females comprised 67.78% of the study population, with a male-to-female ratio of 1:2.1. This predominance may relate to anatomical differences such as a shorter nasolacrimal canal, hormonal effects on mucosal tissues, and increased exposure to environmental irritants in domestic settings. Rural residents accounted for 63.33% of patients, reflecting higher exposure to environmental contaminants, traditional eye cosmetic use (Kajal/Surma), pond bathing, and limited access to healthcare facilities.

Socioeconomic Status

Table 3 summarizes the socioeconomic profile. A large majority (86.67%) belonged to the lower middle, poor, or very poor groups. Nearly half (47.78%) were classified as poor, highlighting the relationship between low socioeconomic status and increased risk of chronic dacryocystitis due to inadequate sanitation, nutrition, delayed treatment, and limited access to medications or surgical care.

Table 1. Age-wise Distribution of Patients (n = 90)

Age Group (years)	No. of Cases	Percentage (%)
0–15	3	3.33
16–30	10	11.11
31–45	27	30.00
46–60	41	45.56
>60	9	10.00
Total	90	100

Table 2. Gender and Residence-wise Distribution

Parameter	Categories	No. of Cases	Percentage (%)
Gender	Male	29	32.22
	Female	61	67.78
Residence	Rural	57	63.33
	Urban	33	36.67

Table 3. Socioeconomic Status (n = 90)

Socioeconomic Status	No. of Cases	Percentage (%)
Upper High / High	2	2.22
Upper Middle	10	11.11
Lower Middle	28	31.11
Poor	43	47.78
Very Poor (BPL)	7	7.78
Total	90	100

Clinical Characteristics and Risk Factors

As shown in Table 4, chronic dacryocystitis was unilateral in 80% of cases, with epiphora as the predominant symptom (92.12%). Traditional cosmetic use and pond bathing were identified in 55.56% of patients each. Ocular complications, such as conjunctivitis and corneal ulcers, were observed in 15.55% of patients. These findings underscore the role of environmental exposures, hygiene practices, and delayed healthcare in disease severity.

Microbiological Culture Results

Out of 90 samples, 66 (73.33%) were culture-positive for at least one organism, of which 57 (63.33%) had a single organism and 9 (10.00%) had mixed infections. Fourteen samples (15.56%) showed no growth, possibly due to prior antibiotic exposure or the presence of non-cultivable anaerobes. The remaining 10 samples (11.11%) were excluded from analysis due to contamination or inadequate specimen volume. Gram-positive bacteria

Table 4. Clinical Characteristics and Risk Factors (n = 90)

Clinical Parameter	Category	No. of Cases	Percentage (%)
Laterality	Unilateral	72	80.00
	Bilateral	18	20.00
Chief Complaint	Epiphora	83	92.12
	Mucocele	6	7.78
Risk Factors	Kajal/Surma use	50	55.56
	Pond bathing	50	55.56
Ocular Complications	Present	14	15.55

Table 5. Microbiological Culture Results (n = 90)

Culture Result	No. of Cases	Percentage (%)
Culture Positive	66	73.33
Culture Negative (No growth)	14	15.56
Contaminated/Excluded	10	11.11
Total	90	100

Isolated Bacteria	Type	Percentage (%)
Staphylococcus aureus	Gram-positive (Adults)	57.14
Streptococcus pneumoniae	Gram-positive (Children)	14.29
Gram-positive total	—	78.58
Gram-negative total	—	21.42

predominated (78.58%), with Staphylococcus aureus most common in adults and Streptococcus pneumoniae in children. Gram-negative bacteria accounted for 21.42%, including clinically significant species such as Pseudomonas aeruginosa and Klebsiella pneumoniae.

Antibiotic Susceptibility Results

Antibiotic susceptibility testing of bacterial isolates revealed high sensitivity of Gram-positive organisms to vancomycin (92.3%) and gatifloxacin (85.7%). Gram-negative isolates demonstrated variable susceptibility, with amikacin showing the highest efficacy (77.8%) against Pseudomonas and Klebsiella species. Resistance was noted for co-trimoxazole in both Gram-positive and Gram-negative isolates (35–40%). These results indicate that empirical treatment with vancomycin or gatifloxacin is likely to be effective in this population, while careful selection of therapy is warranted for Gram-negative infections due to higher resistance rates.

Comparative analysis using Fisher's exact test revealed no statistically significant association between gender and culture positivity ($p = 0.27$). However, Gram-positive isolates were significantly more common in adults compared to children ($p = 0.03$). There was no significant difference in the distribution of Gram-negative organisms between rural and urban populations ($p = 0.41$).

Discussion

Chronic dacryocystitis is a common ocular condition that imposes significant morbidity, particularly in rural populations with limited healthcare access. This study evaluated the demographic profile, clinical presentation, microbiological spectrum, and antibiotic susceptibility among patients attending a tertiary eye care center. The findings support earlier research but also reveal regional variations that warrant further exploration. The disease was most prevalent in the 46–60 years age group (45.56%), confirming that middle-aged and older adults are most vulnerable [13]. This trend is likely explained by progressive narrowing of the nasolacrimal duct and age-related atony of the lacrimal sac, both of which predispose to tear stasis and infection. Congenital dacryocystitis was relatively rare in the present study, with an average age of presentation at 7 months. Although uncommon, such cases highlight the importance of early detection and intervention in pediatric populations to avoid long-term complications. A clear female predominance was observed (M:F ratio 1:2.1), a finding consistent with previous reports [14]. The thinner bony nasolacrimal canal in women, along with hormonal influences such as post-menopausal changes in mucosal tissues, may contribute to this predisposition. Laterality analysis showed unilateral disease in 80% of patients, with a slight right-sided predominance, a pattern also documented by earlier studies [15]. Although the exact cause of this laterality is uncertain, possible explanations include subtle anatomical variations or lifestyle practices such as sleeping posture or cosmetic use. Socioeconomic and environmental risk factors played a significant role. The majority of patients (63.33%) belonged to rural areas and 86.67% to low-income groups. Traditional practices like Kajal or Surma application and pond bathing were frequently reported, both of which increase the risk of chronic eye infection. These findings emphasize the need for community-level health education and preventive strategies.

Microbiological analysis revealed positive cultures in 73.33% of cases, dominated by Gram-positive organisms (78.58%), particularly Staphylococcus aureus in adults and Streptococcus pneumoniae in children. The presence of Gram-negative isolates (21.42%), including Pseudomonas aeruginosa and Klebsiella pneumoniae, is concerning due to their potential for resistance and severe infections. Antibiotic sensitivity testing demonstrated vancomycin and gatifloxacin as highly effective against Gram-positive bacteria, while amikacin was most effective for Gram-negative organisms. Resistance to co-trimoxazole and co-amoxyclav suggests that empirical use of these drugs may no longer be appropriate in this region. The study has

certain limitations. Anaerobic culture was not performed due to resource constraints, which may partly explain the 15.56% culture-negative rate. Prior antibiotic exposure and uncultivable organisms might also account for these cases. Future research employing anaerobic techniques and molecular methods could yield a more comprehensive understanding of the microbiological spectrum. In summary, chronic dacryocystitis remains a significant cause of ocular morbidity in rural India, shaped by demographic, socioeconomic, and environmental factors. The study confirms established patterns of age and gender distribution, while also supporting observations of laterality trends. Importantly, shifting bacterial profiles and emerging resistance patterns highlight the need for region-specific microbiological surveillance and rational antibiotic policies. Alongside these measures, public health initiatives that encourage hygiene, behavioral modifications, and timely access to care can substantially reduce the burden of this preventable condition.

The absence of significant correlation between demographic factors and microbial profile aligns with earlier studies [13,14], though the higher prevalence of Gram-positive organisms in adults reached statistical significance ($p = 0.03$).

Conclusion

Environmental exposure, cultural behaviours, and poor healthcare access increase chronic dacryocystitis risk and delay treatment, a serious public health issue in rural India. This study found that middle-aged low-income women are particularly at risk for this condition, which is linked to Kajal or Surma use and pond swimming. Microbiological examination found that Staphylococcus aureus was the most typically isolated organism in adults and Streptococcus pneumoniae in children. Bacterial trends varied locally, but their findings match regional and national data. Antibiotic sensitivity testing show that gatifloxacin and vancomycin are excellent for Gram-positive pathogens and amikacin for Gram-negative isolates. Due to antibiotic resistance, especially to commonly used medications like co-trimoxazole and co-amoxyclav, empirical medication should be given with caution and culture-guided treatment whenever possible. Early microbiological investigations and sensitivity-based antibiotics are needed to stop the disease and possibly blinding sequelae such endophthalmitis and corneal ulcers. This study was limited by the inability to grow anaerobic bacteria. This may explain certain bad culture results and affect pathogen detection. Future studies should use anaerobic culture and larger, multi-centric data sets to understand chronic dacryocystitis' shifting microbial ecology. Improving laboratory equipment in rural healthcare institutions and promoting eye hygiene can improve results and reduce the incidence of this preventable disease.

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Abbreviation. *DCR – Dacryocystorhinostomy; VP – Voges-Proskauer; TSI – triple suger iron; OF – Oxidative –fermentative; CLSI – Clinical and laboratory standerds institute.*