A STUDY ON EPIDEMIOLOGY AND AETIOLOGY OF SUPPURATIVE CORNEAL ULCER IN SUB-HIMALAYAN PART OF WEST BENGAL

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ABSTRACT

BACKGROUND

Corneal ulcer is one of the leading causes of ocular morbidity in developing country. Early diagnosis and targeted therapy is indispensable. Sociodemographic variables along with predisposing factors plays a major role in its development and clinicopathological correlation in diagnosis is very much helpful in diagnosis and subsequent management.

The aim of the study is to identify the epidemiological factors and causative organism of the suppurative corneal ulcer.

MATERIALS AND METHODS

In this observational cross-sectional study, after taking proper history, patients with suppurative corneal ulcer are examined for clinical diagnosis. Applying sterile method of swab collection from the ulcer for standard microbiological examination (staining, culture) swabs are taken for predetermined laboratory investigations. Sociodemographic variables (age, gender, occupation) relevant injury history, microbiological data are tabulated for statistical calculations.

RESULTS

After application of inclusion and exclusion criteria wiling 81 patients, M:F=55:26 were assessed. Major number of patients (n=61, 75.30%) are middle aged between 33-62 years of age. Occupation played a major role as evidenced by 44.44% (n=36) contribution from agricultural workers (tea garden worker, pineapple farmer, other agricultural worker) followed by household worker (n=13, 16.05%). Positive history of prior corneal injury is common in fungal corneal ulcer (n=22, 51.16%) as well as in bacterial (n=8, 66.66%). Among the prior corneal injury associated fungal ulcer vegetative matter injury in 15 patients (32.60%), while in bacterial variety, it is 5 (10.86%) in number. In laboratory investigations, pure fungal growths are found in 37 patients (45.68%), while pure bacterial are 12 in number (14.81%). A good number (n=8, 9.81%) shows mixed infection. Culture negative ulcers are good in number (n=24, 29.63%) among which 6 (7.47%) are microscopically positive. The sensitivity and specificity of clinical diagnosis of fungal corneal ulcer are 84.61% and 72.41% respectively with a high correlation between clinical and microbiological diagnosis of fungal corneal ulcer (either smear positive or culture positive and a quiet high positive predictive value for clinical diagnosis (84.61%). But, in case of bacterial corneal ulcer, the positive predictive value is 41.37%, while negative predictive value is 84.61% in our study.

CONCLUSION

Middle-aged agricultural workers are more prone to develop corneal ulcer and fungal corneal ulcers are more prevalent in this region of India than bacterial. History of prior corneal injury is a major risk factor. Fungal corneal ulcers have high correlation between clinical and microbiological diagnosis than bacterial.

KEYWORDS

Corneal Ulcer (Fungal, Bacterial), Staining, Culture, Predictive Value.

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BACKGROUND

Corneal ulcer is one of the important ophthalmic conditions causing significant morbidity especially in the developing countries.[1] Scarring of the cornea developed as a result of suppurative corneal ulcer is the second commonest cause of preventable blindness after cataract among people in Asia, Africa and in the Middle East.[2] In India, there are approximately 6.8 million people who have corneal blindness with vision less than 20/200 in at least one eye, and amongst theses, about a million have bilateral corneal blindness.[3] Suppurative corneal ulcer maybe caused by bacteria, fungi

and/or protozoa.[4]Bacterial corneal ulcer is considered a leading cause of monocular blindness in the developing world.

Several studies have investigated the epidemiology and causative organism of suppurative corneal ulcer in Indian subcontinent. No such literature has included the vast population of the North East part of India. So, in North Bengal Medical College, an observational cross-sectional study of suppurative corneal ulcer was conducted amongst the patients to determine the risk factors, which predispose the development of suppurative corneal ulcer with the purpose to identify the epidemiological factors and causative organism of the suppurative corneal ulcer.

Aims and Objectives

The aim of this study is to determine the influence of risk factors, climate and geographical variation on the incidence of suppurative corneal ulcer and the pattern of microbial pathogens causing suppurative corneal ulcer in North Bengal.

Objectives- The objective of the present study is directed to-

a. Assess demographic profile and identify the risk factors of suppurative corneal ulcer in a tertiary care teaching hospital of North Bengal.
b. Find out the aetiological diagnosis of corneal ulcer.
c. Find out the rate of different types of suppurative corneal ulcer on the basis of aetiology.
d. Identify culture positive and culture negative cases of corneal ulcer.
e. Evaluate the correlation between clinical and microbiological diagnosis of suppurative corneal ulcer.

MATERIALS AND METHODS

Inclusion Criteria- Clinically diagnosed patients of suppurative corneal ulcers who attended the Outpatient Department (OPD) or admitted in the inpatient department during the study period were included in this study after taking proper informed consent from patient.

Exclusion Criteria

1. The children below the age of 6 yrs.
2. Patient with suspected viral keratitis.
3. Mooren's/marginal ulcer.
4. Disciform keratitis.
5. Neurotrophic corneal ulcer.
6. Unwilling patients.

A predesigned proforma containing the relevant questionnaires with a space for detail of ocular and systemic examination were constructed and included as study tool.

Visual acuity was recorded for each eye separately by Snellen's visual acuity chart for distant vision with standard method. A detailed ocular examination of both the diseased and healthy eye was done in diffuse light and under slit-lamp illumination. The size of the epithelial defect after staining with fluorescein was measured with the variable slit on the bi-microscope and recorded in millimetres. In similar fashion, the size and depth of the stromal infiltrate was also recorded. A sketch of each ulcer was also drawn on the form using standardised frontal and cross-sectional diagrams and the presence or absence of a hypopyon was recorded and the height of the same was measured in millimetres. Associated ocular conditions such as blepharitis, dacryocystitis, dry eyes, corneal anaesthesia or lagophthalmos were also noted.

After a detailed ocular examination and clinical diagnosis by the same experienced ophthalmologist (in each case), corneal scrapes were taken by applying proparacaine hydrochloride (0.5%) with a sterile Bard-Parker blade No. 15 using proper aseptic measure. The scrapes were taken from the base and edges of ulcer.

Scrapped material obtained from the ulcer was processed for direct 10% potassium hydroxide (KOH) mount examination and Gram stain for direct microscopic examination and a portion was inoculated in the enrichment media (Trypticase Soy Broth) and in Sabouraud Dextrose Agar (SDA). Inoculated Trypticase Soy Broth was kept overnight and was subcultured on plating media containing 5% sheep's blood agar. The blood agar plate for bacterial culture was kept at 37°C and observed for 3 days. The Sabouraud dextrose agar plate was kept at 22°C and observed regularly for 14 days. The plates were discarded after 2 weeks, if there was no growth.

When KOH smear was positive for amoebic cyst, further corneal scrapping was performed and the material was inoculated into non-nutrient agar overlaid with E. coli and observed regularly for 7 days. Bacteria were further identified using biochemical identification test and selective media. Filamentous fungi were identified according to macroscopic appearance of culture on SDA media.

Microbial cultures were considered to be significant if growth of the organism could be demonstrated in a solid phase culture or there was semi-confluent growth at the site of inoculation on one solid medium with identification of morphological characteristic of similar organism in Gram stain.

If, by microscopy, hyphae was observed in scrapped material from corneal tissue, but failed to grow in culture, the causative organism was also reported as fungal.

From the time of clinical diagnosis, treatment as per standard treatment protocol has been started, and if any modification needed after microbiological tests, it has been included in the treatment.

Ethical Approval- The protocol and both the patient information sheet and the consent form were submitted to the Institutional Ethics Committee of NBMCH for approval and the same was granted.

RESULTS AND ANALYSIS

During the study period, 129 patients presented with corneal ulcer and after applying exclusion and inclusion criteria, 39 patients were excluded from the study. As 9 patients later on refused to participate in the study, ultimately 81 patients were included into the study and analysed. After collection of data, it was entered in Microsoft excel sheet and statistical calculation done using SPSS version 20.

Characteristics	Number of Patients (n) (%)
Gender	
Male	55 (67.9%)
Female	26 (32.1%)
Total	**81 (100%)**
Age Group	
<18 years	4 (4.93%)
18-32 years	10 (12.34%)
33-47 years	40 (49.38%)
48-62 years	21 (25.92%)
More than 62 years	6 (7.40%)
Occupation	
Agricultural workers	36 (44.44%)
Teagarden workers	13 (16.05%)
Pineapple farmers	6 (7.40%)
Other agricultural workers	17 (20.99%)
Forest guards	2 (2.47%)
Labourer/sweepers	11 (13.58%)
Tradesman	11 (13.58%)
Households	13 (16.05%)
Carpenters	5 (6.17%)
Office workers	1 (1.23%)
Students	3 (3.70%)
Drivers/tailors/plumbers	5 (6.17%)
Unemployed	4 (4.94%)

Table 1. Demographic Profile

Predisposing Factor	Fungal Corneal Ulcer (n=43)	Bacterial Corneal Ulcer (n=12)	Mixed Corneal Ulcer (n=8)	Culture/Microscopy Negative Corneal Ulcer (n=18)	Total (n=81)
Corneal trauma	22 (51.16%)	8 (66.66%)	7 (87.5%)	9 (50%)	46 (56.79%)
Diabetes	5 (11.62%)	1 (8.33%)	0	1 (5.55%)	7 (8.64%)
Lagophthalmos	1 (2.32%)	0	0	4 (22.22%)	5 (6.17%)
NLD block	4 (9.30%)	3 (25%)	1 (12.5%)	2 (11.11%)	10 (12.34%)
Lid abnormalities	4 (9.30%)	0	0	4 (22.22%)	8 (9.87%)
Postoperative	0	0	0	3 (16.66%)	3 (3.7%)
Contact lens	0	1 (8.33%)	0	0	1 (1.23%)
Use of corticosteroid	2 (4.65%)	2 (16.66%)	0	0	4 (4.93%)
Use of topical antibiotic	14 (32.5%)	4 (33.33%)	1 (12.5%)	9 (50%)	28 (34.56%)
Use of traditional treatment/medication	5 (11.62%)	3 (25%)	2 (25%)	3 (16.66%)	13 (16.05%)

Table 2. Predisposing Factors for the Development of Corneal Ulcer

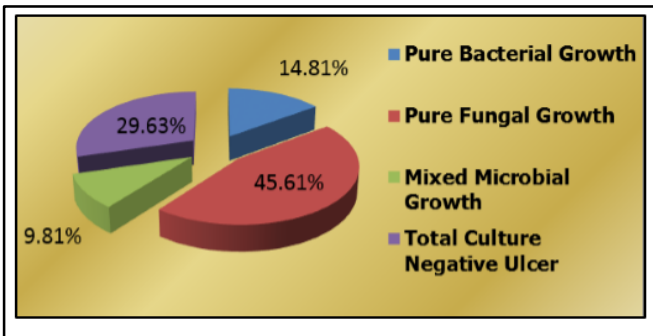
Traumatic Agents	Cases (n=46)	Percentage
Vegetative Agents		
Tea leaves	6	13.04
Pineapple branch or thorn	6	13.04
Insects	4	8.69
Cow tails	3	6.52
Finger nail	4	8.69
Bamboo/Broom stick	4	8.69
Grass/Paddy/Husk	6	13.04
Total	**33**	**71.71**
Non-vegetative agents		
Metallic objects	2	4.34
Dirty water	1	2.17

Dust, soil or stones	6	13.04
Wood	4	8.69
Total	**12**	**28.24**

Table 3. Nature of Traumatic Agents for the Development of Corneal Ulcer

Traumatic Agents (n=46)	Fungal Ulcer	Bacterial Ulcer	Mixed Ulcer	Culture and M/E Negative
Vegetative Agents	15 (32.60%)	5 (10.86%)	6 (13.04%)	3 (6.52%)
Non vegetative agents	7 (15.21%)	3 (6.52%)	1 (2.17%)	6 (13.04%)
Total	**22 (47.81%)**	**8 (17.38%)**	**7 (15.21%)**	**9 (19.56%)**

Table 4. Cross Table Showing Relationship between the Nature of Traumatic Agent and Causative Agent of Suppurative Corneal Ulcer



Growth Pattern	Cases (n=81)	%
Pure bacterial growth	12	14.81
Pure fungal growth	37	45.68
Mixed microbial growth (both fungal and bacterial)	8	9.81
Pure Acanthamoeba ulcer	0	0
Patients with (+)ve cultures (fungal, bacterial or both)	57	70.37
Culture (-)ve, microscopy (+)ve fungal ulcer	6	7.47
Culture/microscopy (-)ve ulcer	18	22.22
Total culture (-)ve ulcer	24	29.63

Diagram and Table 5. Culture Positivity of Suppurative Corneal Ulcer

Name of the Investigation	Result	No.	Presence of Fungal Growth in Culture/10% KOH Mount		Sensitivity	Specificity	Positive Predictive Value	Negative Predictive Value
			Positive	Negative				
Clinical Suspicion of Fungal Corneal Ulcer on Slit-Lamp Examination	Positive	52	44	8	84.61%	72.41%	84.61%	72.41%
	Negative	29	8	21				
	Total	**81**	**52**	**29**				

Table 6. Correlation between Clinical Diagnosis and Microbiological Diagnosis in Suppurative Fungal Ulcer

Name of the Investigation	Result	No.	Presence of Bacterial Growth in Culture		Sensitivity	Specificity	Positive Predictive Value	Negative Predictive Value
			Positive	Negative				
Clinical Suspicion of Bacterial Corneal Ulcer on Slit-Lamp Examination	Positive	29	12	17	24.69%	72.13%	41.37%	84.61%
	Negative	52	8	44				
	Total	**81**	**20**	**61**				

Table 7. Correlation between Clinical Diagnosis and Microbiological Diagnosis in Suppurative Bacterial Corneal Ulcer

DISCUSSION

The part of West Bengal, which was the catering region of our study population includes teagardens, dense forests, large area of cultivating lands and hills of Himalaya. A history of corneal injury was recorded in 46 (56.79%) patients in our study, which is less than that reported in the study done by Srinivasan M et al[4] where 65.4% patients had a history of corneal trauma. In their study, it was also found that corneal trauma was the major risk factor for development of fungal corneal ulcer (47.81%) when compared to that of bacterial corneal ulcer (17.38%). Similarly, fungal corneal ulcer was frequently reported among the patients with corneal injury in different studies done in Hyderabad (54.4%)[5] and Kolkata (72.2%).[6] But, in our study, corneal trauma was the most common risk factor for both fungal (22/43, 51.16%) as well as bacterial corneal ulceration (8/12, 66.66%).

Among the corneal ulcer with vegetative matter injury, paddy or husk (n=6, 13.04%) was one of the major vegetative matters responsible for trauma in our study along

with injuries with tea leaves and pineapple branches or thorn. In South India, paddy or rice stalks in the field was reported to be the most common (25%) cause of superficial corneal trauma in a study done by Srinivasan M et al.[4]

Vegetative matter as cause for corneal trauma resulting in fungal corneal ulcer was found in 32.60% cases (15/46) in our study, which was lower than that reported in the Bharathi et al study[1] (61.28%). But, the association of the same was higher in our study for bacterial corneal ulcer (10.86% vs. 2.5%).

In 57 (70.37%) cases, microorganisms could be isolated on culture of the scraping materials of 81 suppurative corneal ulcer patients in this present study. This figure compares favourably with the findings of the studies done by Srinivasan et al[4] in South India and by AK Leck et al in Ghana[7] where culture positivity rates were 68.4% and 57.3% respectively, but it does not approach the 80% isolation rate reported by Upadhyay et al[8] in Nepal or the isolation rate of 81.7% reported by Dunlop et al[9] in Bangladesh. In addition to these factors, the use of transporting media instead of direct inoculation for recovery of microbial pathogens is still in controversy.[10] When compared to the number of fungal isolates (n=37,45.68%), less bacterial pathogens (n=12,14.81%) were detected in the present study. This result can be correlated with the fact that, 28 (34.56%) patients enrolled in this study had history of introduction of topical antibiotics and as a consequence fewer bacteria were isolated.

In the current study, it was fond that in North Bengal, Aspergillus sp. (30/45, 66.66%) was the commonest fungal pathogen followed by Fusarium sp. (12 out of 45; 26.66%). Similar reports were documented by Basak SK et al[11] where the major isolates were Aspergillus sp. (59.8%) and Fusarium sp. (21.2%)[11] in Gangetic West Bengal. But, in another study done by Saha S et al,[12] which was performed over the urban population of West Bengal, Aspergillus was found to be the most common fungus (55.04%) followed by Candida albicans (18.91%). In contrast to the above studies, Narsani AK et al reported that Candida (69%) was the predominant isolated fungus in Hyderabad.[13] In our study, only two cases (4.44%) of Candida was diagnosed during one year study period.

In our study, most common bacteria isolated among the patients with bacterial corneal ulcer was Staphylococcus aureus similar to the findings reported in the study by Basak et al, though the proportion was higher in our study as compared to Basak's study (60% vs. 42.6%).[11] In the present study, Streptococcus pneumoniae was positive in only 10% (2/20) cases, which were also similar to the findings reported in the study done by Basak et al[11] where Streptococcus pneumoniae was detected in 9.4% cases. But, Srinivasan et al reported that major bacterial pathogen detected in their study was Streptococcus pneumonia (44.3% of all bacterial culture positive cases), whereas Staphylococcus sp. was positive in 15.6% cases.[4] In our study, Pseudomonas sp. was the next most common (15%) isolated bacterial pathogen following Staphylococcus aureus. Pseudomonas sp. had also been identified as an important cause of corneal ulceration in South India. Here, Srinivasan et al reported Pseudomonas sp. responsible for 14.4% cases of bacterial corneal ulcer. Pseudomonas sp. also had been identified as a frequent cause of corneal ulceration in some developing countries.[14] Mixed microbial growth (both fungal and bacterial) was detected in 9.81% (n=8) cases in our study.

In this present study, 33.33% (4/12) bacterial corneal ulcer patients had the history of use of some topical antibiotics. In addition to changes in resistance patterns, studies have also demonstrated changing patterns of causative organisms over time in a given geographical location. Varaprasathan et al[15] reported that the proportion of S. pneumoniae and P. aeruginosa ulcers in Northern California had decreased over a 50-year period.

Clinically suggestive fungal corneal ulcer were seen in 55 patients among the total 81 suppurative corneal ulcer patients. In our present study, the sensitivity and specificity of clinical diagnosis of fungal corneal ulcer made by an experienced ophthalmologist using slit-lamp biomicroscope was 84.61% and 72.41% respectively with a high correlation between clinical and microbiological diagnosis of fungal corneal ulcer (either smear positive or culture positive and a quiet high positive predictive value for clinical diagnosis (84.61%)). But, it was lower than sensitivity and specificity reported in the study by the Bharathi et al[1] where those were reported to be 94.1% and 94.58%, respectively for fungal corneal ulcer. But, in case of bacterial corneal ulcer, the positive predictive value is 41.37% while negative predictive value is 84.61% in our study.

CONCLUSION

The spectrum of the suppurative corneal ulcer varies with geographical location influenced by the local climate and occupational risk factors. From the current study, it is evident that like other parts of the world, climate and the environment in which the person lives have influence on the type of corneal infection that develops. Corneal injury was the principal risk factor for the development of suppurative corneal ulcer, but coexisting ocular diseases were also other important risk factors in our study. Incidence of fungal corneal was much higher than bacterial corneal ulcer in this region. Predominant fungus causing suppurative corneal ulcer is Aspergillus sp., whereas predominant bacteria isolated for causing corneal ulcer is Staphylococcus aureus.

Sensitivity and specificity for clinical diagnosis of fungal corneal ulcer is very much high when correlated with microbiological diagnosis. In contrast, the sensitivity of the same in cases of bacterial ulcer is low when compared to that of fungal corneal ulcer though it has similar specificity. As many eye clinics in the locality do not have microbiology facilities, the regional information are important with regard to empirical management. Despite advances in treatment, it still remains clinically challenging and although the outcome can be favourable with appropriate management. There is potential for significant and permanent visual impairment in addition to social and healthcare costs.

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