ORIGINAL ARTICLE

Comparison of The Efficacy of Starting Antibiotic Medications with Debridement of Ulcer Versus Antibiotics Alone in Cases of Bacterial Corneal Ulcer - A Randomized Control Trial

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Abstract:

Objective: To compare the efficacy of antibiotic therapy combined with mechanical ulcer debridement versus antibiotic therapy alone in the treatment of bacterial corneal ulcers.

Methods: A randomized controlled trial was conducted at the Institute of Ophthalmology, Mayo Hospital, Lahore, over 12 months from January 2022 to &December 2022. Treatment-naïve patients (n=92) with culture-positive bacterial keratitis and ulcer sizes of 2–5 mm were randomized into two groups. Group A (n=46) underwent mechanical debridement followed by topical moxifloxacin 0.5%, while Group B (n=46) received topical moxifloxacin 0.5% alone. The primary outcome was the change in ulcer size (mm) measured on days 3, 7, 14, and 21. Treatment success was defined as a ≥25% reduction in ulcer size by day 21.

Results: The adjunctive debridement group (Group A) demonstrated a statistically significant improvement in healing outcomes. By the final assessment on day 21, the mean ulcer size in Group A was reduced to 1.08 ± 1.07 mm, which was nearly half that of Group B (2.05 ± 1.33 mm; p = 0.004). Treatment response was significantly better in Group A, with 91.3% of patients achieving treatment success compared to only 71.7% in the antibiotic-only group (p = 0.001).

Conclusion: Debridement with antibiotics expedites ulcer healing compared to antibiotics alone, reducing economic burden in resource-limited settings. *Al-Shifa Journal of Ophthalmology 2025; 21(3): 168-173. © Al-Shifa Trust Eye Hospital, Rawalpindi, Pakistan.*

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Introduction:

The epithelial corneal defect having underlying inflammation owing to microbial infection attack is called corneal ulcer. Cornea is a highly exposed surface of eye and its vulnerability towards increased risk of infection and external trauma is very high. In developing countries, a major cause of corneal blindness is infectious corneal ulcer .[1] Annual rate of fresh corneal blindness cases is 1.5-2 million due to corneal ulceration and that is why various reports of WHO rate it as a major problem for public health.[2] Transparency, surface and shape are changed by many corneal ulcers that results in reduced vision.[3]

Nutritional deficiency and trauma are predisposing factors for corneal ulcer. Its symptoms include foreign body sensation,

lacrimation, progressive redness, photophobia and ache. It can be diagnosed by microbial studies, fluorescein staining and slit-lamp examination. It is an ocular emergency needing immediate treatment. Microbial keratitis is a significant cause of visual impairment leading to blindness[4].

In bacterial corneal ulcer, infection is usually eradicated successfully by using suitable antibiotic treatments[5]. In prediction of clinical outcome, an important role is played by vulnerability of causative organisms to antibiotics. Bacteria account for up to 44.5% of all cases of infectious keratitis; this varies by geographical area[6]. For treating bacterial ulcer, topical antibiotics are the medicines of choice and effectiveness of topical antibiotics has been reported for preventing corneal damage. Broad spectrum empiric therapy is helpful in resolving most of the community-acquired bacterial ulcers.

Mechanical debridement of loosely adhered epithelium and necrotic tissue containing debris, microbes and inflammatory cells offers smooth basement membrane that can be covered by healthy epithelium[7,8]. This procedure is comparatively noninvasive and safe.[8] In both the eyes, insulating topical anesthetics are used for preparing patients.[9] For removal of loose epithelium, different instruments can be used by a practitioner.[10] An effective and safe option is methylcellulose spear-shaped surgical sponge.[8] Keeping in view the safety for Bowman's membrane, a Kimura spatula can also be used because it is blunt endives.[8] However, on some occasions, use of sharp instruments like scalpel blades have also been advocated while other authors have contentions that it is inappropriate to use sharp instruments on such places.[9] While, removing epithelium aggressively near limbus may result into damaging of stem cells; that's why from the 1-2 mm of limbus, a proactive band of epithelium should be maintained.[11] For removing epithelial basement membrane, there is slight debridement of Bowman's layer.[12,13] However, with epithelium debridement, complications such as severe postoperative pain, delayed healing, superficial punctate keratopathy, severe bacterial keratitis and central stromal scarring have been reported.[11]

There are studies showing better outcome of keratitis with ulcer debridement[14,15]. But randomized control trial comparing the traditional, topical administration of antibiotic medications only and antibiotics with debridement in bacterial keratitis is lacking. In order to look for this comparison, this study was carried.

Methodology:

This single-center, parallel-group RCT (1:1 allocation) was carried out at Institute of Ophthalmology Unit-III, KEMU, Mayo Hospital Lahore from January 2022 to December 2022. Ethical approval was obtained from the Institutional Review Board of KEMU. After taking informed

$$n = \frac{\left\{ z_{1-\alpha}\sqrt{2\bar{P}(1-\bar{P})} + z_{1-\beta}\sqrt{P_1(1-P_1)+P_2(1-P_2)} \right\}^2}{(P_1-P_2)^2}$$

consent from adult patients having age >15 years with culture-positive bacterial keratitis, ulcer size 2–5 mm, and no prior treatment were included in the study. Patients having corneal ulcer of any other etiology were excluded. Patients with perforation of cornea, involvement of limbus, prior treatment, infection of the vitreous cavity confirmed or having systemic disease were excluded from the study.

Sample size of 92 patients (46 patients in each group) was estimated by using 5% level of significance, 90% power of test with expected percentage of antibiotics with debridement as 93.3%[14] and antibiotics without debridement as 70.20%[15]. Non-probability consecutive sampling was used. Using Lottery method all patients included in the study were divided into two groups; Group A i.e., Experimental group, receiving antibiotics in addition to debridement of the ulcer & Group B i.e., Control group, receiving

antibiotics alone in the treatment of corneal ulcer.

All patients in both groups received topical antibiotic i.e., Moxifloxacin 0.5% as an empirical regimen. Patients of Group A further underwent debridement to achieve maximal corneal infiltrate clearance without endangering perforation. After instilling topical proparacaine eye drops to anesthetize the surface of eye, Bard-Parker® surgical blade number 15 was used to remove all the loose epithelium and necrotic tissue from the base and edges of ulcer viewing through operating microscope Leica® M220 F12.

All patients being treated were followed for changes in size of corneal ulcer at 3, 7, 14, and 21-day intervals by the consultant ophthalmologist who was blinded about the treatment given. The efficacy of treatment was determined by measuring ulcer size using slit lamp with a calibrated graticule. Treatment regimen showing reduction in size of corneal ulcer by 25% in 3 weeks was considered effective. All procedures were performed under the supervision of a Professor in Ophthalmology having minimum 20 years post fellow ship experience & a trained staff nurse.

Our demographic variables were the patient's age (in years) and gender (men or women) while the presence of bacterial corneal ulcer was our research variable. Data was analyzed using SPSS 26. Quantitative variables like age & size of ulcer are presented as mean ±SD while Qualitative variables like gender are presented as frequency and percentages. To compare the efficacy of treatment of two groups Chi-square test of independence was utilized.

Results:

The mean age of cases in group-A was 42.34 ± 10.36 years and in group-B the mean age of cases was 41.92 ± 9.68 years. There were 50(54.3%) male and 42(45.7%) female cases. In group-A there were 24(52.2%) male and 22(47.8%) female cases .In group-B there were 26(56.5%) male and 20(43.5%) female cases.

Table 1: Comparison of mean ulcer size (mm) between the two study groups over the follow-up period.

Study Group	Day3(Mean±SD)	Day7(Mean±SD)	Day14(Mean±SD)	Day21(Mean±SD)
Group A (n=46)	3.47 ± 0.71	2.54 ± 0.75	1.90 ± 0.89	1.08 ± 1.07
Group B (n=46)	3.50 ± 0.70	3.01 ± 0.77	2.63 ± 1.01	2.05 ± 1.33
p-value	0.85	0.05	0.04	0.004

Mean size of corneal ulcer at day 3 in Group-A was 3.47 ± 0.71 mm and in Group-B was 3.50 ± 0.70 mm, p-value 0.85 . At day 7 the mean size of corneal ulcer in Group-A was 2.54 ± 0.75 mm and in Group-B was 3.01 ± 0.77 mm , p-value 0.05 while at day 14 the mean size of ulcer in Group-A was 1.90±89 mm and in Group-B was 2.63 ± 1.01 mm respectively, p-value 0.04 .At day 21 the mean size was 1.08 ± 1.07 mm in Group-A and in group-B was 2.05± 1.33 mm, p-value 0.004 .

Table 2: Comparison of Efficacy of Treatment in both study groups by using Chi Square test.

		Study Group		Total	Chi Square test	P value
		Group-A	Group-B			
Patients treated	Yes	42(91.3%)	33(71.7%)	75(81.5%)	11.121	0.001
	No	4(8.7%)	13(28.3%)	17(18.5%)		
Total		46(100.0%)	46(100.0%)	92(100.0%)		

In group-A 42(91.3%) cases of bacterial corneal ulcer were treated and in group-B 33(71.7%) cases treated . The efficacy of treatment in group-A was statically higher as compared to group-B, as p-value < 0.05.

Discussion:

Bacterial keratitis is one of the important causes of blindness in underdeveloped and developing countries, which is also difficult to treat. As microorganisms change and resistance develops, more advanced and newer antibiotics and techniques are needed to be utilized to provide adequate coverage. Debridement of the ulcer thoroughly cleans the corneal ulcer by removing the infected and nonviable necrotic tissue, any foreign debris and residual material from medications/ dressings. It also reduces the bacterial and toxin load thus improving penetration of the antibiotic medications[16].

In our study it was seen that debridement combined with antibiotic medications had better efficacy than when antibiotic medications were used alone. Group-A (patients treated with antibiotics with debridement) 42(91.3%) cases improved with treatment and in group-B (patients only receiving antibiotics) 33(71.7%) cases improved with treatment. The efficacy of treatment in group-A was statically higher as compared to group-B, as p-value < 0.05. Erasmus Darwin is the first person in literature who proposed debridement of cornea for treatment purposes [17]. In 1898, Ranvier first discovered that in an eroded area of cornea, surface cells migrate from adjacent intact epithelium to cover the ulcerated area [18] . Franke, in 1907, suggested that removing superficial epithelium of cornea can be used therapeutically for corneal diseases. In 1983, Trokel found the ability of excimer laser to ablate the surface of cornea in a more controlled way and thus its properties to change the shape of corneal tissue[19]. Now, a combination of the techniques for corneal debridement discovered and proposed during the past are deployed for the treatment and diagnosis of diseases of cornea including corneal ulcers.

Saeed N et al at Pakistan are of the view that Surgical intervention in the form of simple epithelial debridement of the ulcer may at time become necessary with antimicrobial medications[20]. Completely removing the diseased epithelium along with basement membrane allows the corneal epithelium to regenerate [21]. Wang et al at Shandong Eye Institute studied 209 patients (209 eyes) with corneal ulcer not responding to antimicrobial agents for 2 weeks. When these patients were subjected to modified ulcer debridement combined with antimicrobial medications, healing rates improved and healing duration reduced[14]. In a study conducted by Fan NW et al corneal ulcer debridement was done using sclerotome removing the loose epithelium and necrotic tissue. Debridement promoted healing from the healthy margins of the ulcer by the removal of loosely adherent nonviable epithelium [22].

Sridhar et al are also of the view that debridement tends to be beneficial in the resolution of corneal ulcer caused by microsporidia [16]. Also Kerr et al in their study found the efficacy of debridement and using medications subsequently, of

bacterial corneal ulcers associated with vernal keratoconjunctivitis to be very effective [23].

Zloty P et al during their study in results also showed that aggressive debridement and debulking of keratitis lesions leads to a morefaster clinical resolution with much less adverse effect and better visual potential. The mean duration (in days) of treatment in patients not undergoing surgical debridement was 17.1 ± 4.2 days, which was statistically longer than the patients 9.4 ± 2.7 days who underwent surgical debridement ($P < 0.001$)[24].

The results of our study are in line with the studies mentioned before. However, Das et al in a randomized control trial of 120 eyes concluded that in cases of corneal ulcer debridement has no significant role in the resolution of the corneal lesions and thus no beneficial effects on final visual outcome[25] . This study differs from the results of our study where we found statistical difference between the effects of debridement with antibiotic medications than when medications are used alone. There is the risk of irregular astigmatism induction and localized corneal thinning and even corneal perforation while debriding the ulcers. But unresolved and progressive keratitis has the worst visual prognosis.

With evidence being available to the contrary, it is imperative that policies be devised and subsequently adopted as per indigenous data as the bacterial strains, antibiotic formulations and patient factors may vary geographically and a treatment plan tailor made taking into account these differences is better than an empirical treatment.

Single-center design and small sample size may limit generalizability. Potential variability in debridement technique necessitates multicenter trials with larger sample size assessing standardized debridement protocols and their outcomes.

Conclusion:

Mechanical debridement combined with antibiotic therapy demonstrates significant superiority over antibiotic treatment alone in the management of bacterial corneal ulcers. This combined approach results in substantially faster healing rates, reduced ulcer size, and higher treatment success, particularly evident within the first week of therapy. The procedure enhances antibiotic penetration by removing necrotic tissue and biofilm, thereby accelerating recovery. This simple, cost-effective intervention is especially valuable in resource-limited settings, where it can reduce treatment duration, minimize complications, and alleviate economic burden

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