Original Article

Comparative Study of Bacteriological Profile of Cellulitis in Diabetic versus Non-Diabetic Patient

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Abstract

Introduction: Comparative study of bacteriological profile of cellulitis - in diabetic versus non diabetic patient.

Materials and Methods: During a period of June 2018–May 2019 in Sanjay Gandhi Memorial Hospital surgical wards, approximately 100 cases including both diabetic and non-diabetic getting admitted through surgery out patient department, casualty, or transferred from other departments diagnosed as cellulitis based on clinical suspicion. Samples were collected from the deeper portion of the ulcers, among these samples, one swab was used for Gram staining and the other was used for culture. A direct Gram stained smear of the specimen was examined. The organisms were identified on the basis of their Gram staining properties, their biochemical reactions, and the culture identified.

Results: According to pus culture sensitivity is was found that among Gram-negative isolates, *Pseudomonas aeruginosa* (25.19% in D and 28.06 in ND) is most common in both diabetic and non-diabetic followed by *Escherichia coli* (16.12% in D and 17.39% in ND) and *Klebsiella pneumoniae* (12.9% in D and 8.6% in ND). Among Gram-positive isolates, *Staphylococcus aureus* is most commonly isolated followed by *Enterococcus* in diabetics, as in non-diabetics, *S. aureus* (32. 25% in D and 30.43% in ND) is most commonly isolated followed by *Enterococcus* (9.6% in D and 4.3% in ND) and methicillin-sensitive *S. aureus* (1.6% in D and 2.17% in ND) (D – diabetics and ND – non-diabetics).

Conclusion: Microbiological evaluation of the ulcers revealed that the prevalence of Gram-negative organisms 47 (57.75%) was found to be more than Gram-positive organisms 14 (17.5%), *Candida albicans* 3 (3.75%), and polymicrobial species 17 (21.25%). Among Gram-negative isolates, *P. aeruginosa* is most common in both diabetic and non-diabetic followed by *E. coli* and *K. pneumoniae*. Among Gram-positive isolates, *S. aureus* is most commonly isolated followed by *Enterococcus* in diabetics, as in non-diabetics, *S. aureus* is most commonly isolated followed by *Enterococcus* and methicillin-sensitive *S. aureus*.

Key words: Cellulitis, Comparative study, Culture study of pus discharge from cellulitic ulcer, Diabetic versus non-diabetics

INTRODUCTION

Cellulitis is a bacterial infection involving the inner layers of the skin. It specifically affects the dermis and subcutaneous fat. It affects patients of all age groups. The presence and the stability of comorbid conditions like diabetes that may complicate or delay the resolution of the infection influence the clinical management of the disease.

Numerous microorganisms can cause cellulitis. The most commonly isolated organisms are Gram-positive beta-hemolytic streptococci and *Staphylococcus aureus*. Unusual organisms like clostridium may cause infections in circumstances such as in animal bites, fresh/saltwater exposure, and certain occupational exposures.

Diabetes is a prevalent disease worldwide and wound infection is a major complication in diabetic patients. Patients with diabetes having impaired wound healing associated with multitude of factors, including neuropathy, vascular disease, and foot deformities, Gadepalli *et al*.[1] Metabolic abnormalities of diabetes lead to impaired leukocyte function, inadequate migration of neutrophils, and macrophages to the wound, along with reduced chemotaxis, predispose individuals to an increased risk of wound infection.

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Studies have revealed that diabetic wounds showed significantly higher bacterial counts compared with non-diabetic wounds. Natural skin flora itself induced sustained bacterial infections in the wound tissue in diabetic wounds, whereas non-diabetic organisms were able to cope with endogenous bacterial contamination.[2] It is a fact that diabetic patients are not only more susceptible to infection but also when infection occurs they are more severe as the diabetic is a compromised host while certain types of infection do have predilection for the diabetic.

The predominantly isolated organisms are *S. aureus*, Gram-negative Bacilli such as Pseudomonas aeruginosa, Escherichia coli, Klebsiella species, Proteus species, and anaerobic organisms. The remainders are due to Streptococcus species, Candida, etc. The infection may be polymicrobial also and mixed organisms are frequently encountered.[3]

However, the spectrum of microorganisms depends mainly on microbial flora of particular area, metabolic factors, hygiene, and the use of antibiotics. Management of these infections requires isolation and identification of the microbial flora, appropriate antibiotic therapy according to the sensitivity patterns.[4] Emergence of resistance among organisms against the commonly used antibiotics has been clearly outlined in various studies as being largely due to their indiscriminate use.

Early diagnosis of microbial infections is aimed to institute the appropriate antibacterial therapy and to avoid further complications in view of the above facts, a cross-sectional study was done to compare the microbial profile of diabetic wound infections with non-diabetic wound infections, to assess their *in vitro* susceptibility to antibiotics and detection of methicillin-resistant *S. aureus* and extended-spectrum beta-lactamase producers in Gram-negative *Bacilli*.

Aims and Objectives

The study entitled "*Comparative study of bacteriological profile of cellulitis – in Diabetic versus Non-Diabetic patient*" will be carried out on patients admitted in surgical wards of Sanjay Gandhi Memorial Hospital (SGMH) associated with Shyam Shah Medical College, Rewa (Madhya Pradesh), during the period of June 1, 2018,–May 31, 2019, with following aims and objectives:
1. To study the incidence of cellulitis in surgical wards SGMH
2. To study the pattern of bacterial profile in wounds in case of cellulitis
3. To compare the bacteriological profile.

Inclusion Criteria

The following criteria were included in the study:
1. All cases of cellulitis
2. Age group of 10–60 years.

Exclusion Criteria

The following criteria were excluded from the study:
1. Patient already on antibiotic therapy
2. Patient on immunosuppressant drugs
3. Patient having chronic disease such as tuberculosis and cancer.

MATERIALS AND METHODS

During a period of June 2018–May 2019 in SGMH surgical wards, approximately 100 cases including both diabetic and non-diabetic getting admitted through SOPD, casualty, or transferred from other departments diagnosed as cellulitis based on clinical suspicion, during the period of study will be included in the study.

Samples were collected from the deeper portion of the ulcers using two sterile swabs which were dipped in sterile glucose broth. The samples were collected by making a firm, rotatory movement with the swabs. One swab was used for Gram staining and the other was used for culture. A direct Gram-stained smear of the specimen was examined. The specimens were inoculated onto blood agar, chocolate agar, MacConkey's agar, and thioglycolate medium.

The inoculated plates were incubated at 370°C overnight and the plates were examined for growth, the next day. The further processing was done according to the nature of the isolate, as was determined by Gram staining and the colony morphology. The organisms were identified on the basis of their Gram staining properties and their biochemical reactions.

OBSERVATION AND RESULTS

Distribution of Bacteria Isolated from Study Population

Rani and Nithyalakshmi[6] microbiological evaluation of the ulcers revealed that the prevalence of Gram-negative organisms 47 (57.75%) was found to be more than Gram-positive organisms 14 (17.5%), *Candida albicans* 3 (3.75%), and polymicrobial species 17 (21.25%).

Among the organisms isolated, *P. aeruginosa* was the most frequent pathogen isolated from 19 (23.75%) subjects followed by *E. coli* isolated from 12 (15%) subjects. Different types of Gram-negative and Gram-positive bacteria isolated from ulcers are summarized in Tables 1-3.

Table 1: Proportion of bacteria isolates in specific age groups

Age (in years)	Total number of cellulitis patient both diabetic and non-diabetic	Proportion of bacteria isolated in specific age groups							
		Staphylococcus aureus	*Pseudomonas aeruginosa*	*Escherichia coli*	*Klebsiella pneumoniae*	E	Methicillin-sensitive *S. aureus*	Beta-hemolytic streptococci	A.s
1–10	7	3	2	1	-	-	-	2	-
10–20	4	1	1	2	1	-	-	-	-
20–30	7	4	1		1	1	-	-	-
30–40	25	8	7	3	4	2	1	1	-
40–50	25	10	7	4	2	2	1	1	-
50–60	21	6	7	5	4	1	-	-	1
60–70	11	2	3	3	-	2	1	-	-
70 and above	-	-	-	-	-	-	-	-	-

Table 2: Number of patients based on Gram-negative culture isolates

Gram-negative isolates	Cellulitis	
	Diabetic (%)	Non-diabetic (%)
Pseudomonas aeruginosa	15 (24.19)	13 (28.06)
Escherichia coli	10 (16.25)	8 (17.39)
Klebsiella pneumoniae	8 (12.09)	4 (8.6)
Proteus mirabilis	-	-
Proteus vulgaris	-	-
Citrobacter species	-	-
Acinetobacter species	1 (1.6)	-

Table 3: Number of patients based on Gram-positive isolates

Gram-positive isolates	Cellulitis	
	Diabetic (%)	Non-diabetic (%)
Staphylococcus aureus	20 (32.25)	14 (30.43)
Enterococcus species	6 (9.6)	2 (4.3)
Methicillin-sensitive *Staphylococcus aureus*	1 (1.6)	2 (4.3)
Beta-hemolytic streptococci	1 (1.6)	1 (2.1)

Comparison of Empirical Therapy and Therapy Given After Swab Report in Cellulitis Subjects

Considering antibiotic prescribing patterns in the cellulitis subjects, penicillin combinations 23 (28.75%) in normal patients followed by clindamycin 7 (8.13%) and amikacin 8 (9.30%) in intensive care patients were preferred as an empirical therapy in foot ulcer subjects.

In cellulitis subjects, penicillin 12 (22.22%) (Amoxicillin +Clavulanic acid) and cephalosporin's 10 (12.5%) are mostly prescribed drugs as empirical treatment. Amoxicillin + Clavulanic acid (U; 25 [33.78%] and C; 13 [33.33%]) is mostly prescribed drug after swab report due to its sensitivity against Gram-positive and Gram-negative activity in cellulitis subjects.

DISCUSSION

The present study observed types of microbial infections and patterns of antibiotics prescribed to subjects diagnosed with foot cellulitis. In the present study, male predominance was noted over females. This may be due to the fact that males tend to be more active in the outdoor activities, leading to injuries and prone to the development of ulcers. In the current study, we found that patients with an age range of 30–50 years constituted the majority with cellulitis. The mean age of patients in the present study is 38.78 ± 10.09 years which is on the line of study by Sundresh *et al.*[7] In our study, among social habits, both smoking and alcohol were important risk factors for the

COMPARISION OF EMPIRICAL THERAPY AND THERAPY AFTER SWAB REPORT IN CELLULITIS
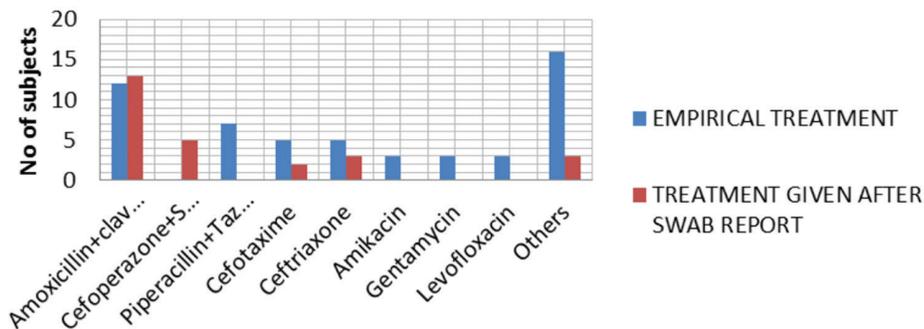
development of diabetic and non-diabetic cellulitis. Multiple wounds were the most common symptom identified among diabetic and non-diabetic cellulitis. Swelling with skin color change was most predominant symptom identified among diabetic and non-diabetic cellulitis, during the study period. These findings are consistent with the earlier published literature, Tiwari *et al.*[8]

Microbiological evaluation of diabetic cellulitis showed that the prevalence of Gram-negative organisms was found to be more than Gram-positive organisms, Rani and Nithyalakshmi.[6] *P. aeruginosa* was the most frequent followed by *E. coli.* These findings correlated well with those of studies carried out in India which showed that Gram-negative *Bacilli* as the most common organism and pseudomonas being the predominant pathogen, Manisha *et al.*[9]

The present study also adds to the literature by providing a detailed comparison of antibiotic utilization patterns among diabetics and non-diabetics. We demonstrated that diabetics were more likely to have significant exposure to antibiotics with broad Gram-negative activity, particularly antipseudomonal agents (the broad-spectrum antibiotics). Since the initiation of broad Gram-negative therapy in the emergency department or urgent care was not more common among diabetics, the increased use of these agents among diabetics appeared to be driven by inpatient providers. It is also notable that of patients who received any antibiotic with broad Gram-negative activity, these agents accounted for similar proportions of the total days of therapy in both diabetics and non-diabetics. In aggregate, our findings demonstrate that diabetics are more likely to be started on antibiotics with broad Gram-negative activity by inpatient providers, diabetics are not necessarily continued on longer durations of broad Gram-negative therapy once started, and the total amount of exposure to broad Gram-negative agents is substantial.

Overall, our findings suggest that inpatient providers perceive diabetics with cellulitis or abscess to be at increased risk for Gram-negative pathogens. This perhaps reflects an extrapolation of recommendations to use broad-spectrum empiric therapy in diabetics with certain complicated skin infections. However, for patients with cellulitis or cutaneous abscess, IDSA guidelines recommend antibiotic therapy targeted toward *S. aureus* and streptococcal species; there is no suggestion to use a broad spectrum of therapy in diabetics, Stevens *et al.*[10]

Our findings, therefore, highlight an important opportunity to improve antibiotic selection for all patients hospitalized with cellulitis, but particularly diabetics. It is also noteworthy that by linear regression, diabetes mellitus was independently associated with longer treatment durations. Although the average increase in treatment duration was small (1 day), this finding adds to the evidence that the presence of diabetes mellitus alters providers' treatment approach to cellulitis.

We found that despite more frequent treatment with broad Gram-negative therapy, diabetics were more likely than non-diabetics to be classified as clinical failure. It is important to point out that diabetics were also more likely than non-diabetics to have post-discharge outpatient follow-up visits raising the possibility of biased ascertainment of clinical failure events in this group. However, we also demonstrated that diabetics with cellulitis were more likely to be rehospitalized than non-diabetics. One could hypothesize that the increased frequency of clinical failure events among diabetics was due to their older age, hyperglycemia, or vascular insufficiency; however, other factors may have contributed.

Amoxicillin+Clavulanic acid along with metronidazole is commonly prescribed drugs irrespective of diabetes mellitus in this study, Dong *et al.*[11] These findings support current ISDA guidelines that recommend antibiotic therapy targeted toward Gram-negative isolates irrespective of diabetes mellitus.

Our results shown that relaxing incision followed by debridement was the most common surgical procedure among diabetic and non-diabetic ulcer which was significant to Tian *et al.*[12] study.

The present study demonstrates that a variety of organisms can be isolated from these ulcers. Knowledge of the microbes that cause infection and their susceptibility toward the antibiotics will allow physicians to make best out their choice. Considering the nature of the organism and the type of isolate, appropriate empirical antibiotic therapy should be initiated, especially for the patients who are at risk categories. Once the nature of the organism and the probable pathogens are isolated, de-escalation of empiric therapy with a single drug or combination therapy can be guided by relevant culture results.

CONCLUSION

The present study entitled "*Comparative study of bacteriological profile of cellulitis – in Diabetic versus Non-Diabetic patient*" was carried out on 100 patients admitted in surgical wards of Sanjay Gandhi Hospital associated with Shyam Shah Medical College, Rewa (M.P), during the period of June 1, 2018,–May 31, 2019.

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Amoxicillin+Clavulanic acid is mostly prescribed drug after swab report due to its sensitivity against Gram-positive and Gram-negative activity in both cellulitis subjects.

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