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RISK FACTORS, MICROBIOLOGICAL PROFILE, AND ANTIBIOTIC SUSCEPTIBILITY PATTERNS OF LOWER LIMB CELLULITIS IN NON-DIABETIC PATIENTS: A TERTIARY CARE HOSPITAL STUDY

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ABSTRACT
Introduction: Cellulitis is a common acute bacterial infection of the skin and subcutaneous tissue. While diabetes mellitus is a well-established risk factor, a significant proportion of cellulitis cases occur in non-diabetic individuals. In these patients, local factors such as trauma and venous insufficiency may play a pivotal role, yet this population remains under-evaluated compared to diabetic cohorts.
Aim: To identify the risk factors, clinical presentation, microbiological profile, and antibiotic susceptibility patterns in non-diabetic patients presenting with lower limb cellulitis.
Materials and Methods: This observational, hospital-based cross-sectional study was conducted at the Department of General Surgery, Sree Balaji Medical College and Hospital, Chennai, India, from July 2024 to May 2026. The study included 110 non-diabetic patients aged 20–75 years diagnosed with lower limb cellulitis. Data regarding clinical history, local examination, and wound cultures were collected. Statistical analysis was performed using SPSS version 25.0.
Results: The mean age of the study population was 49.6 ± 12.8 years, with a male predominance (65.5%). The most common risk factors were minor trauma (38.2%), skin fissures (32.7%), and chronic edema (30.9%). Wound culture was positive in 69.1% of cases. Staphylococcus aureus was the predominant isolate (39.5%), followed by Streptococcus species (21.1%). Methicillin-resistant S. aureus (MRSA) was isolated in 10.5% of patients. High sensitivity was observed for Vancomycin (97.4%) and Linezolid (94.7%), while resistance to Ciprofloxacin was noted in 42.1% of isolates.
Conclusion: Lower limb cellulitis in non-diabetic patients is primarily driven by local predisposing factors rather than systemic metabolic abnormalities. Gram-positive organisms remain the primary etiological agents, with a notable prevalence of MRSA. Early identification of local risk factors and culture-guided antibiotic therapy are essential for optimal outcomes.

KEYWORDS: Staphylococcus aureus, MRSA, Venous insufficiency, Soft tissue infection.

INTRODUCTION

Cellulitis is an acute, diffuse, spreading bacterial infection involving the skin and subcutaneous tissues, characterized clinically by erythema, warmth, swelling, and pain. It represents a significant healthcare burden worldwide. While diabetes mellitus is traditionally recognized as a major predisposing factor due to associated neuropathy and immunological dysfunction, cellulitis in non-diabetic individuals constitutes a significant proportion of surgical practice.
In non-diabetic patients, the pathogenesis is often driven by alternative risk factors such as minor trauma, tinea pedis, chronic venous insufficiency, obesity, and lymphedema. However, the majority of existing literature focuses on diabetic foot infections, leading to a potential gap in understanding the specific clinical and microbiological profile of the non-diabetic population. Furthermore, empirical antibiotic therapy is often extrapolated from diabetic protocols, which may not address the specific microbial spectrum or resistance patterns of non-diabetic patients.
Understanding the distinct risk factors and antibiotic susceptibility patterns in this group is crucial for reducing recurrence and antimicrobial resistance. Therefore, this study aimed to analyze the clinical and microbiological profile of lower limb cellulitis exclusively in non-diabetic patients in a tertiary care setting.

MATERIALS AND METHODS

Study Design and Setting
This observational, hospital-based cross-sectional study was conducted in the Department of General Surgery at Sree Balaji Medical College and Hospital, Chennai, a tertiary care teaching hospital. The study duration was from July 2024 to May 2026.

Participants
The study population consisted of patients admitted to surgical wards with a diagnosis of lower limb cellulitis.
Sample Size: Based on a hypothesized frequency of 0.81, 95% confidence interval, and 5% confidence limits, the calculated sample size was 107. A total of 110 patients were enrolled to account for dropouts.
Inclusion Criteria: Patients aged 20 to 75 years with clinically diagnosed lower limb cellulitis who were confirmed to be non-diabetic via biochemical parameters (Fasting Blood Sugar, Post-Prandial Blood Sugar, and HbA1c).
Exclusion Criteria: Patients under 18 years, those with chronic liver disease, and those who did not provide informed consent.

Data Collection
Data were collected using a structured proforma. Clinical evaluation included detailed history (trauma, occupation), local examination (signs of inflammation, entry portals), and grading of cellulitis.
Laboratory Analysis: Included Complete Blood Count (CBC), Renal Function Tests (RFT), and blood sugar profiles to confirm non-diabetic status.
Microbiological Analysis: Wound swabs or tissue samples were obtained under aseptic precautions for culture and sensitivity testing to identify causative organisms and their antibiograms.

Statistical Analysis
Data were analyzed using the Statistical Package for the Social Sciences (SPSS) version 25. Continuous variables were expressed as mean \pm standard deviation (SD). Categorical variables were expressed as frequencies and percentages. The Student's t-test was used for comparing means, and the Chi-square test or Fisher's exact test was used for categorical variables. A p-value \le 0.05 was considered statistically significant.

Ethical Considerations
The study was approved by the Institutional Ethics Committee. Written informed consent was obtained from all participants.

RESULTS
Demographic and Clinical Profile
A total of 110 non-diabetic patients were studied. The mean age was 49.6 \pm 12.8 years. The highest incidence was in the 51–60 years age group (27.3%), followed by 41–50 years (25.5%). Males constituted 65.5% (n=72) and females 34.5% (n=38), with a male-to-female ratio of 1.9:1.
The cardinal clinical features were swelling (92.7%), erythema (90.9%), and pain (89.1%). A skin breach or ulcer was visible at presentation in 52.7% of cases. Regarding severity, 47.3% presented with Grade II (moderate) cellulitis, while 18.2% had Grade III (severe) disease.
Risk Factors
Local predisposing factors were highly prevalent. A history of minor trauma was the most common risk factor (38.2%), followed by skin fissures (32.7%) and chronic edema (30.9%). Fungal infections (tinea pedis) were identified in 25.5% of patients.

Table 1: Risk Factors Associated with Lower Limb Cellulitis (n = 110)

Risk Factor	Number of Patients (n)	Percentage (%)
History of minor trauma	42	38.2
Skin fissures / cracks	36	32.7
Tinea pedis / intertrigo	28	25.5
Chronic edema of lower limb	34	30.9
Venous insufficiency	26	23.6
Obesity (BMI ≥ 30 kg/m²)	22	20.0
Previous episode of cellulitis	18	16.4
Poor foot hygiene	30	27.3
Prolonged standing / occupational risk	24	21.8
No identifiable risk factor	14	12.7

Microbiological Profile
Wound culture was positive in 76 patients (69.1%) and negative in 34 (30.9%). Gram-positive organisms constituted 71.1% of the positive cultures. Staphylococcus aureus was the most common isolate (39.5%), followed by Streptococcus species (21.1%). MRSA was isolated in 8 patients (10.5%).

Table 2: Microbiological Profile of Isolates (n = 76)

Organism Isolated	Number of Isolates (n)	Percentage (%)
Staphylococcus aureus	30	39.5
Methicillin-resistant *Staphylococcus aureus* (MRSA)	8	10.5
Streptococcus species	16	21.1

Escherichia coli	6	7.9
Klebsiella species	4	5.3
Pseudomonas aeruginosa	2	2.6
Polymicrobial growth	10	13.1
Total	**76**	**100**

Antibiotic Susceptibility

Among the isolates, sensitivity was highest for Vancomycin (97.4%) and Linezolid (94.7%), followed by Imipenem (92.1%). Commonly used antibiotics showed variable resistance: Ciprofloxacin (42.1% resistant) and Doxycycline (39.5% resistant).

Treatment and Outcome

Conservative management (antibiotics and limb elevation) was sufficient for 43.6% of patients. Surgical interventions included wound debridement (36.4%) and debridement with fasciotomy (14.5%). The majority of patients (74.5%) had an uneventful recovery. Complications included post-procedure wound issues (16.4%) and disability (7.3%). Mortality was 1.8%.

DISCUSSION

This study highlights that lower limb cellulitis in non-diabetic patients is a distinct clinical entity driven largely by local anatomical and physiological factors. The mean age of 49.6 years and male predominance (65.5%) observed in our study align with findings by McNamara et al. and Dupuy et al., who identified male sex and advancing age as independent risk factors due to occupational exposure and venous compromise.

Role of Local Risk Factors

Unlike diabetic cellulitis, which is heavily influenced by systemic metabolic derangement, our study confirms that non-diabetic cellulitis is triggered by breaches in the skin barrier. Minor trauma (38.2%) and skin fissures (32.7%) were the leading risk factors. This supports the systematic review by Quirke et al., which concluded that local skin conditions and venous disease are more strongly associated with non-purulent leg cellulitis than systemic factors. The presence of tinea pedis in 25.5% of our cohort reinforces the importance of examining the interdigital spaces, as these fungal infections often serve as the "portal of entry" for bacteria.

Microbiological Trends

The microbiological profile revealed a predominance of gram-positive cocci (71.1%), consistent with global literature. Staphylococcus aureus was the primary pathogen. Notably, 10.5% of isolates were MRSA. This mirrors the trend reported by Liu et al. regarding the rise of community-acquired MRSA in skin and soft tissue infections. The high sensitivity to Vancomycin and Linezolid suggests these should remain the reserve drugs for resistant cases, while the high resistance to Ciprofloxacin (42.1%) indicates that fluoroquinolones may no longer be suitable for empirical therapy in this region.

Outcomes

The treatment outcomes were largely favorable, with 74.5% of patients recovering uneventfully. However, the fact that 14.5% required fasciotomy and 5.5% underwent amputation highlights that cellulitis in non-diabetics can still progress to limb-threatening severity if not graded and managed early.

Limitations

The study was limited to a single tertiary center, potentially introducing referral bias. The culture negativity rate of 30.9% is a known challenge in cellulitis diagnostics, often due to low bacterial load in non-purulent presentations.

CONCLUSION

Lower limb cellulitis in non-diabetic patients is predominantly a consequence of local barrier disruption and circulatory compromise rather than systemic illness. Staphylococcus aureus, including MRSA strains, remains the most common causative organism. Management strategies must prioritize the identification of local portals of entry (such as fungal infections or trauma) and utilize culture-guided antibiotic therapy to mitigate emerging resistance. Public health education focusing on foot hygiene and early care of minor skin injuries could significantly reduce the burden of this disease in the non-diabetic population.

Next Step for Research: Future multicentric studies comparing diabetic and non-diabetic cohorts with long-term follow-up for recurrence would provide deeper insights into preventative strategies.

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