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# Clinico-Pathological and Microbiological Evaluation of Chronic Non-Healing Cutaneous Ulcers: A Prospective Observational Study

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## ABSTRACT

**Background:** Chronic non-healing cutaneous ulcers are associated with significant morbidity due to delayed healing, recurrent infection, and prolonged treatment. Clinicopathological assessment, along with microbiological evaluation, plays a crucial role in accurate diagnosis and effective management. The present study aimed to evaluate the clinical characteristics, histopathological findings, and microbiological profile of chronic non-healing cutaneous ulcers.

**Methods:** This prospective observational study included 120 patients with chronic non-healing cutaneous ulcers of more than six weeks' duration. Detailed clinical evaluation, histopathological examination of ulcer-edge biopsy specimens, and aerobic bacterial culture with antimicrobial susceptibility testing were performed. Data were analyzed using SPSS version 26.0, and a p-value <0.05 was considered statistically significant.

**Results:** Diabetic foot ulcer was the most common clinical presentation. Histopathology predominantly showed chronic inflammatory changes with granulation tissue. Positive bacterial growth was observed in most cases, with Staphylococcus aureus and Pseudomonas aeruginosa being the most frequently isolated organisms.

**Conclusion:** Combined clinicopathological and microbiological evaluation provides valuable information for accurate diagnosis and targeted management of chronic non-healing cutaneous ulcers. This integrated approach facilitates timely treatment, improves wound healing, minimizes complications, and ultimately enhances overall patient outcomes.

**Key-words:** Chronic cutaneous ulcer, Histopathology, Microbiology, Wound infection, Diabetic foot ulcer, Bacterial culture

## INTRODUCTION

Chronic non-healing cutaneous ulcers are defined as wounds that fail to progress through the normal phases of healing within an expected period, generally exceeding six weeks. These ulcers represent a significant public health challenge because of prolonged treatment, recurrent infection, disability, reduced quality of life, and increased healthcare expenditure. Diabetes mellitus, chronic venous insufficiency, peripheral arterial disease, pressure injury, trauma, vasculitis, and malignant transformation are among the leading etiological factors responsible for delayed wound healing [1,2].

Accurate diagnosis requires careful integration of clinical examination with histopathological and microbiological investigations. Histopathological examination helps identify chronic inflammatory changes, granulomatous disorders, vasculitic lesions, atypical infections, and malignant transformation that may not be clinically apparent. Simultaneously, microbiological culture identifies causative organisms and their antimicrobial

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susceptibility patterns, enabling targeted antibiotic therapy while minimizing antimicrobial resistance [3,4].

The microbial spectrum of chronic ulcers varies across geographical regions and healthcare settings. Although *Staphylococcus aureus* and *Pseudomonas aeruginosa* remain the predominant pathogens worldwide, increasing antimicrobial resistance and polymicrobial infections continue to complicate clinical management. Early identification of infecting organisms, combined with clinicopathological evaluation, plays an important role in optimizing wound care and improving healing outcomes [5].

Despite advances in wound care and antimicrobial therapy, the management of chronic non-healing cutaneous ulcers remains challenging because of delayed diagnosis, recurrent infections, and the emergence of antimicrobial-resistant organisms. Histopathological examination is valuable in identifying specific inflammatory, infectious, and neoplastic conditions, whereas microbiological evaluation facilitates the detection of causative pathogens and their antimicrobial susceptibility patterns, enabling targeted treatment. An integrated clinicopathological and microbiological approach may therefore improve diagnostic accuracy, guide appropriate therapeutic interventions, and contribute to better healing outcomes while reducing disease-related morbidity and healthcare burden.

Chronic non-healing cutaneous ulcers are defined as wounds that fail to progress through the normal phases of healing within an expected period, generally exceeding six weeks. These ulcers are associated with prolonged treatment, recurrent infection, disability, reduced quality of life, and increased healthcare expenditure. Accurate diagnosis requires an integrated clinicopathological and microbiological approach to identify the underlying etiology, infecting organisms, and appropriate treatment strategies. Therefore, this study evaluated the clinical profile, histopathological features, and microbiological characteristics of chronic non-healing cutaneous ulcers in patients attending a tertiary care hospital.

## MATERIALS AND METHODS

**Study Design and Setting**- This prospective observational study was conducted in the Departments of Dermatology, Pathology, and Microbiology at a tertiary care teaching hospital over a period of 18 months. A total of 120 patients with chronic non-healing cutaneous ulcers of more than six weeks' duration were enrolled.

**Study Population**- The study included patients presenting with chronic non-healing cutaneous ulcers attending the Dermatology outpatient and inpatient departments. Clinical details were recorded using a predesigned proforma after obtaining written informed consent.

**Inclusion Criteria**

- ✓ Patients aged ≥18 years.
- ✓ Patients with cutaneous ulcers persisting for more than six weeks.
- ✓ Patients willing to participate in the study.

**Exclusion Criteria**

- ✓ Acute ulcers of less than six weeks' duration.
- ✓ Patients receiving systemic antibiotics within the previous seven days.
- ✓ Patients with bleeding disorders or contraindications to biopsy.
- ✓ Patients who declined to provide informed consent.

**Clinical Evaluation and Sample Collection**- Detailed clinical history and physical examination were performed for all patients. Tissue biopsy was obtained from the edge of the ulcer for histopathological examination. Wound specimens were collected under aseptic precautions for aerobic bacterial culture and antimicrobial susceptibility testing using standard microbiological techniques.

**Histopathological Examination**- Biopsy specimens were fixed in 10% neutral buffered formalin, processed by routine paraffin-embedding techniques, sectioned, and stained with hematoxylin and eosin (H&E). Histopathological findings were evaluated by experienced pathologists.

**Microbiological Analysis**- Wound specimens were subjected to aerobic bacterial culture using standard microbiological methods. Isolated organisms were identified by conventional biochemical methods, and antimicrobial susceptibility testing was performed according to standard laboratory guidelines.

 

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**Statistical Analysis**- Data were analyzed using SPSS version 26.0 (IBM Corp., Armonk, NY, USA). Continuous variables were expressed as mean ± SD, and categorical variables as frequencies and percentages. Comparisons were performed using the independent *t*-test and Chi-square or Fisher's exact test, as appropriate. A *p*-value <0.05 was considered statistically significant.

**Ethical Approval-** The study was approved by the Institutional Ethics Committee. Written informed consent was obtained from all participants before enrollment, and patient confidentiality was maintained throughout the study.

## RESULTS

Table 1 presents the demographic characteristics of the study population. Among the 120 patients included in the study, the majority were males (61.7%), while females constituted 38.3%. The highest proportion of patients belonged to the 51–70 years age group (43.3%), followed by 31–50 years (28.3%), >70 years (18.4%), and 18–30 years (10.0%), indicating that chronic non-healing cutaneous ulcers were more frequently observed in older adults, particularly males.

**Table 1:** Demographic Characteristics of the Study Population (n = 120)

| Variable | | Frequency (n) | Percentage (%) |
|---|---|---|---|
| Age Group (years) | 18–30 | 12 | 10 |
| | 31–50 | 34 | 28.3 |
| | 51–70 | 52 | 43.3 |
| | >70 | 22 | 18.4 |
| Gender | Male | 74 | 61.7 |
| | Female | 46 | 38.3 |

Table 2 summarizes the clinical profile of patients with chronic non-healing cutaneous ulcers. Diabetic foot ulcer was the most common clinical diagnosis, accounting for 38.3% of cases, followed by venous ulcers (20.0%), traumatic ulcers (15.0%), pressure ulcers (13.3%), arterial ulcers (8.3%), and malignant ulcers (5.0%). These findings indicate that diabetic foot ulcer was the predominant clinical presentation among the study population.

**Table 2:** Clinical Profile of Chronic Non-Healing Cutaneous Ulcers (n = 120)

| Clinical Diagnosis | Frequency (n) | Percentage (%) |
|---|---|---|
| Diabetic foot ulcer | 46 | 38.3 |
| Venous ulcer | 24 | 20 |
| Traumatic ulcer | 18 | 15 |
| Pressure ulcer | 16 | 13.3 |
| Arterial ulcer | 10 | 8.3 |
| Malignant ulcer | 6 | 5 |

Fig. 1 illustrates the anatomical distribution of chronic non-healing cutaneous ulcers among the study population. The foot was the most frequently affected site (40.0%), followed by the leg (28.3%), ankle (13.3%), sacral region (10.0%), upper limb (5.0%), and other sites (3.4%). The findings demonstrate that lower-limb ulcers constituted the majority of cases in the present study.

Table 3 presents the histopathological findings observed in chronic non-healing cutaneous ulcers. Chronic inflammation with granulation tissue was the most common histopathological finding, accounting for 45.0% of cases, followed by chronic inflammatory ulcers (23.3%) and necrosis with acute inflammatory infiltrate (13.3%). Less frequent findings included vasculitis (6.7%), dysplastic changes (5.0%), squamous cell carcinoma (Marjolin's ulcer) (4.2%), and tuberculous granulomatous inflammation (2.5%).

 

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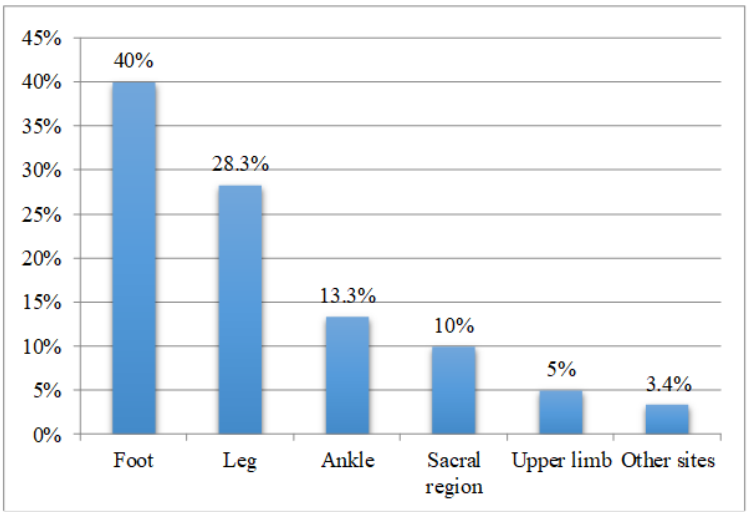


**Fig. 1:** Anatomical Distribution of Chronic Non-Healing Cutaneous Ulcers

**Table 3:** Histopathological Findings in Chronic Non-Healing Cutaneous Ulcers (n = 120)

| Histopathological Finding | Frequency (n) | Percentage (%) |
|---|---|---|
| Chronic inflammation with granulation tissue | 54 | 45 |
| Chronic inflammatory ulcer | 28 | 23.3 |
| Necrosis with acute inflammatory infiltrate | 16 | 13.3 |
| Vasculitis | 8 | 6.7 |
| Dysplastic changes | 6 | 5 |
| Squamous cell carcinoma (Marjolin's ulcer) | 5 | 4.2 |
| Tuberculous granulomatous inflammation | 3 | 2.5 |

Table 4 summarizes the microbiological profile of chronic non-healing cutaneous ulcers. *S. aureus* was the most frequently isolated organism (31.7%), followed by *P. aeruginosa* (21.7%), *Escherichia coli* (15.0%), *Klebsiella pneumoniae* (11.7%), *Proteus mirabilis* (8.3%), and *Enterococcus* spp. (5.0%). No bacterial growth was observed in 6.6% of cases, indicating that the majority of ulcers yielded positive bacterial cultures.

**Table 4:** Microbiological Profile of Chronic Non-Healing Cutaneous Ulcers (n = 120)

| Organism Isolated | Frequency (n) | Percentage (%) |
|---|---|---|
| *Staphylococcus aureus* | 38 | 31.7 |
| *Pseudomonas aeruginosa* | 26 | 21.7 |
| *Escherichia coli* | 18 | 15 |
| *Klebsiella pneumoniae* | 14 | 11.7 |
| *Proteus mirabilis* | 10 | 8.3 |
| Enterococcus spp. | 6 | 5 |
| No bacterial growth | 8 | 6.6 |

Fig. 2 illustrates the culture positivity among patients with chronic non-healing cutaneous ulcers. A large majority of cases (93.3%) showed positive bacterial culture, whereas only 6.7% of ulcers demonstrated no bacterial growth. These findings indicate a high prevalence of bacterial infection among chronic non-healing cutaneous ulcers in the study population.

 

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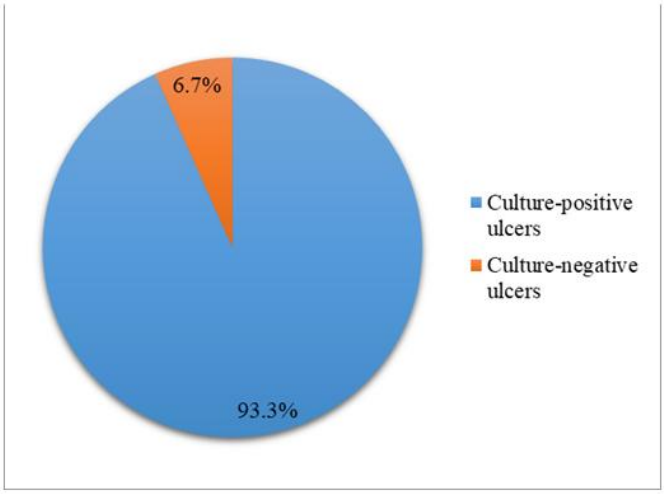


**Fig. 2:** Culture Positivity among Patients with Chronic Non-Healing Cutaneous Ulcers

## DISCUSSION

The present study evaluated the clinical, histopathological, and microbiological characteristics of chronic non-healing cutaneous ulcers in 120 patients. Most patients were males, with the highest prevalence observed in the 51–70-year age group. Similar demographic trends have been reported in previous studies, where advancing age and male predominance were attributed to a higher prevalence of diabetes mellitus, peripheral vascular disease, occupational trauma, and impaired wound healing [6,7].

Diabetic foot ulcer was the most common clinical diagnosis in the present study, followed by venous and traumatic ulcers. Diabetes contributes to ulcer chronicity through peripheral neuropathy, vascular insufficiency, and impaired immune function, thereby increasing susceptibility to infection and delayed tissue repair. Comparable observations have been reported by contemporary studies evaluating chronic wound epidemiology and management [8,9].

Histopathological examination predominantly demonstrated chronic inflammation with granulation tissue, whereas a smaller proportion of cases showed vasculitis, dysplastic changes, granulomatous inflammation, and squamous cell carcinoma. These findings emphasize the importance of tissue biopsy in chronic ulcers that fail to heal despite appropriate treatment, as histopathology helps identify specific inflammatory, infectious, and neoplastic conditions requiring different therapeutic approaches [10].

Microbiological analysis revealed positive bacterial growth in the majority of ulcers, with *S. aureus* being the most frequently isolated organism, followed by *P. aeruginosa*. This microbial pattern is consistent with published literature describing these organisms as the predominant pathogens in chronic wound infections. Accurate microbiological identification and antimicrobial susceptibility testing facilitate appropriate antibiotic selection, reduce unnecessary empirical therapy, and improve wound healing outcomes [11,12].

Overall, the findings of the present study highlight that an integrated clinicopathological and microbiological approach provides comprehensive information regarding the underlying etiology and infective profile of chronic non-healing cutaneous ulcers. Early diagnosis supported by histopathological examination and microbiological culture enables timely, targeted management, minimizes complications, and contributes to improved patient outcomes [13].

The findings of the present study reinforce the importance of a multidisciplinary approach in the evaluation and management of chronic non-healing cutaneous ulcers. Comprehensive clinicopathological assessment, combined with microbiological identification and antimicrobial susceptibility testing, facilitates accurate diagnosis, timely institution of targeted therapy, and improved wound healing outcomes. These observations are consistent with previous studies emphasizing that early diagnosis, evidence-based wound care, and appropriate infection control strategies play a crucial role in reducing complications, preventing disease progression, and improving the overall quality of patient care in individuals with chronic wounds [12,13]. Furthermore, recent studies have highlighted that an integrated multidisciplinary approach involving clinicians, pathologists, and microbiologists, together with

 

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individualized wound care and targeted antimicrobial therapy, significantly improves healing rates, minimizes recurrence, and reduces the socioeconomic burden associated with chronic wounds. These findings further support the need for comprehensive clinicopathological and microbiological evaluation in the routine management of chronic non-healing cutaneous ulcers [14].

## CONCLUSIONS

Chronic non-healing cutaneous ulcers demonstrate diverse clinical, histopathological, and microbiological characteristics. In the present study, diabetic foot ulcer was the most common clinical presentation, while chronic inflammation with granulation tissue was the predominant histopathological finding. *S. aureus* and *P. aeruginosa* were the most frequently isolated microorganisms. A combined clinicopathological and microbiological evaluation facilitates accurate diagnosis, guides appropriate antimicrobial therapy, and supports effective management of chronic non-healing cutaneous ulcers, thereby improving patient outcomes. Future multicenter studies with larger sample sizes and longer follow-up are warranted to validate these findings, evaluate antimicrobial resistance patterns, and develop evidence-based strategies for the early diagnosis and effective management of chronic non-healing cutaneous ulcers.

## CONTRIBUTION OF AUTHORS

**Research concept-** Mrigank Sinha, Aayushi Mehra
**Research design-** Mrigank Sinha, Aayushi Mehra
**Supervision-** Bipin Chandra Pandey
**Materials-** Mrigank Sinha, Aayushi Mehra
**Data collection-** Mrigank Sinha, Aayushi Mehra
**Data analysis and Interpretation-** Bipin Chandra Pandey
**Literature search-** Mrigank Sinha, Aayushi Mehra
**Writing article-** Mrigank Sinha, Aayushi Mehra
**Critical review-** Bipin Chandra Pandey
**Article editing-** Mrigank Sinha, Aayushi Mehra
**Final approval-** Bipin Chandra Pandey

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