

Research Article

FACTORS ASSOCIATED WITH EARLY DIAGNOSIS AND PROGNOSIS OF NECROTISING SOFT TISSUE INFECTION: A PROSPECTIVE OBSERVATIONAL STUDY

Kuldip Pratap Patel¹, Satish Singh²

¹Associate Professor, Department of General Surgery, Birsa Munda Government Medical College, Shahdol, Madhya Pradesh, India

²Assistant Professor, Department of General Surgery, Birsa Munda Government Medical College, Shahdol, Madhya Pradesh, India

*Corresponding Author
Kuldip Pratap Patel

Article History

Received: 07.08.2026

Revised: 25.08.2026

Accepted: 05.09.2026

Published: 25.09.2026

Citations:

Patel KP, Singh S. Factors associated with early diagnosis and prognosis of necrotising soft tissue infection: a prospective observational study. *J Surg Radiol*, V5(7) 492-497.

Abstract: **Introduction:** Necrotizing soft tissue infection (NSTI) is a rapidly progressive, life-threatening surgical emergency characterized by fascial and soft-tissue necrosis, systemic toxicity and a substantial risk of organ failure. Early clinical findings may be nonspecific, whereas delay in definitive source control is associated with worse outcomes. This study evaluated clinical, laboratory, microbiological and selected radiological characteristics and outcomes among patients with NSTI at a tertiary-care surgical centre in central India. **Methods:** This prospective observational study included 100 patients with NSTI treated between May 2023 and August 2025. Demographic characteristics, symptom duration, comorbidities, local clinical findings, vital signs, laboratory parameters, microbiological findings, selected imaging findings, APACHE II score and treatment-related variables were assessed. Outcomes included number of operations, mechanical ventilation, ICU stay, amputation and in-hospital mortality. The available dataset supports descriptive analysis; patient-level data required for inferential and multivariable modelling were not available in the supplied manuscript. **Results:** Among 100 patients, 65 were male and 35 were female, with a mean age of 56.6 ± 11 years. Median symptom duration before surgery was 7 days (IQR 3–14), 66% had diabetes mellitus and 90% had lower-limb involvement. Type I NSTI accounted for 35% and type II for 37%; culture showed no growth in 28% of patients and multidrug-resistant infection was reported in 34%. Median APACHE II score was 17 (IQR 12–24); shock occurred in 76%, mechanical ventilation was required in 21%, and acute kidney injury occurred in 59%. Mean serum albumin was 2.4 ± 0.7 g/dL. Median number of surgeries was 1 (IQR 1–2), median ventilation duration was 2 days (IQR 1–3), median ICU stay was 3 days (IQR 2–5.25), and in-hospital mortality was 34%. **Conclusion:** NSTI remains a high-mortality surgical emergency. The cohort demonstrates a substantial burden of diabetes, shock, acute kidney injury and organ-support requirements. Early recognition, resuscitation, broad-spectrum antimicrobial therapy and urgent surgical source control remain central to management. Further analysis of the complete patient-level dataset is required to identify independent predictors of mortality.

Keywords: Necrotizing soft tissue infection; necrotizing fasciitis; early diagnosis; surgical debridement; mortality; prognosis; acute kidney injury; diabetes mellitus.

INTRODUCTION

Necrotizing soft tissue infections are severe, rapidly progressive infections involving the fascia and surrounding soft tissues. Their clinical spectrum ranges from pain, erythema and swelling to bullae, ecchymosis, skin necrosis, systemic toxicity, shock and multiorgan dysfunction. Early diagnosis is challenging because extensive deep tissue infection may be present despite relatively limited superficial skin findings.^{1,2}

Pain disproportionate to the apparent local findings, rapidly progressive swelling, systemic toxicity, bullae, ecchymosis, anesthesia and crepitus should increase clinical suspicion. Importantly, the absence of advanced cutaneous changes does not exclude NSTI. Current guidance emphasizes prompt surgical assessment and source control; imaging should be used selectively and should not delay operative management when clinical suspicion is high.^{2,5}

Timing of surgery is a major modifiable determinant of outcome. In a systematic review and meta-analysis of 109 studies involving 6,051 patients, overall mortality was 21.1%. Surgery within 6 hours of presentation was associated with lower mortality than surgery after 6 hours (19% versus 32%; OR 0.43, 95% CI 0.26–0.70), and surgery within 12 hours was also associated with lower mortality.¹

Diabetes and other comorbidities are common in NSTI and may contribute through impaired host defence, microvascular disease, neuropathy and delayed recognition. Renal dysfunction, hypotension, thrombocytopenia, bacteremia and other manifestations of organ dysfunction have been associated with mortality in contemporary prognostic literature.³

Indian prospective data are comparatively limited. A prospective South Indian ICU cohort of 100 patients reported 34% mortality and identified AKIN stage 3, shock, mechanical ventilation for more than 3 days and low serum albumin as factors associated with higher

mortality.⁴ These observations provide a clinically relevant benchmark for the present central Indian cohort.

The present study was undertaken to evaluate clinical, systemic, laboratory, microbiological and selected radiological factors associated with NSTI and to describe their relationship with clinically important outcomes, including repeated surgery, amputation, ICU stay and mortality.

2. Aim and Objectives

Aim: To assess clinical, pathological and radiological factors associated with early diagnosis of NSTI and their relationship with outcome and prognosis.

- To evaluate local clinical findings including bullae, skin colour, pulsation, neurological findings, compartment syndrome, anatomical site and extent.
- To evaluate pain, fever, heart rate, blood pressure and respiratory rate and their relationship with prognosis.
- To assess duration of symptoms as a potential determinant of disease severity and outcome.
- To evaluate CRP, hemoglobin, WBC count, platelet count, ESR, serum creatinine and blood glucose.
- To assess microbiological findings from pus culture and sensitivity.
- To evaluate diabetes mellitus, hypertension, ischemic heart disease and relevant medications.
- To assess plain radiography, colour Doppler and CT in selected patients.
- To relate these factors to mobilization, hospital stay, number of operations/debridements, amputation and mortality.

MATERIALS AND METHODS

Study design and setting: Prospective observational study conducted in the Department of General Surgery, Birsa Munda Government Medical College, Shahdol, Madhya Pradesh, India.

RESULTS

A total of 100 patients with NSTI were included. Sixty-five patients (65%) were male and 35 (35%) were female. Mean age was 56.6 ± 11 years. Median symptom duration before surgery was 7 days (IQR 3–14). Diabetes mellitus was present in 66% of patients, and lower-limb involvement was reported in 90%.

Type I NSTI accounted for 35% and type II NSTI for 37%. Microbiological assessment reported no growth in 28% of patients and multidrug-resistant infection in 34%. The manuscript does not provide organism-level distribution, antimicrobial susceptibility details, or the denominator used for the MDR estimate; these should be added if available. Median APACHE II score was 17 (IQR 12–24). Shock occurred in 76% of patients, acute kidney injury in 59%, and mechanical ventilation was required in 21%. Mean serum albumin was 2.4 ± 0.7 g/dL. Median number of surgeries was 1 (IQR 1–2), median duration of mechanical ventilation was 2 days (IQR 1–3), and median ICU stay was 3 days (IQR 2–5.25). In-hospital mortality was 34%.

The available manuscript provides aggregate cohort data but does not provide cross-tabulation of these variables by survival status. Accordingly, the present Results section reports descriptive cohort findings only and does not claim that any individual variable was independently associated with mortality.

Study period: May 2023 to August 2025.

Study population and sample size: The supplied manuscript reports 100 patients with NSTI. The analysis below therefore treats 100 as the final cohort size rather than a planned sample size.

Eligibility: The supplied synopsis states inclusion of patients admitted with soft-tissue infection and exclusion of arterial gangrene and thromboembolic gangrene. The exact inclusion and exclusion criteria should be reproduced from the approved institutional protocol in the final submission.

Variables: Local examination (bullae, colour, pulsation, neurological examination, compartment syndrome, site and extent); clinical features (pain, fever and symptom duration); vital signs; CRP, hemoglobin, WBC count, platelet count, ESR, serum creatinine, blood glucose and serum albumin; pus culture and sensitivity; diabetes, hypertension and ischemic heart disease; APACHE II score; and selected imaging findings.

Outcomes: Mobilization, hospital stay, number of operations/debridements, amputation, mechanical ventilation, ICU stay and in-hospital mortality.

Statistical analysis: Categorical variables are presented as frequency and percentage. Continuous variables are presented as mean $\pm$ SD or median with interquartile range according to the format available in the supplied dataset. Because individual patient-level data and mortality-stratified tables were not supplied, no new p values, odds ratios or multivariable regression estimates have been generated. For the complete dataset, chi-square/Fisher exact tests and Student t-test/Mann–Whitney U test may be used as appropriate, followed by multivariable logistic regression for independent predictors of mortality.

Table 1. Baseline characteristics and clinical outcomes of the study cohort (n=100)

Variable	Study cohort (n=100)
Age, mean $\pm$ SD	56.6 $\pm$ 11 years
Male sex	65 (65%)
Female sex	35 (35%)
Symptoms before surgery, median (IQR)	7 (3–14) days
Diabetes mellitus	66 (66%)
Lower-limb involvement	90 (90%)
Type I NSTI	35 (35%)
Type II NSTI	37 (37%)
No growth on culture	28 (28%)
Multidrug-resistant infection	34 (34%)
APACHE II, median (IQR)	17 (12–24)
Shock	76 (76%)
Mechanical ventilation	21 (21%)
Acute kidney injury	59 (59%)
Serum albumin, mean $\pm$ SD	2.4 $\pm$ 0.7 g/dL
Number of surgeries, median (IQR)	1 (1–2)
Ventilation duration, median (IQR)	2 (1–3) days
ICU stay, median (IQR)	3 (2–5.25) days
In-hospital mortality	34 (34%)

Note: Type I/II categories describe NSTI classification and are not microbiological categories. “No growth” refers to the culture result and therefore should not be interpreted as a third NSTI type. The MDR figure should be accompanied by the relevant microbiological denominator in the final submission.

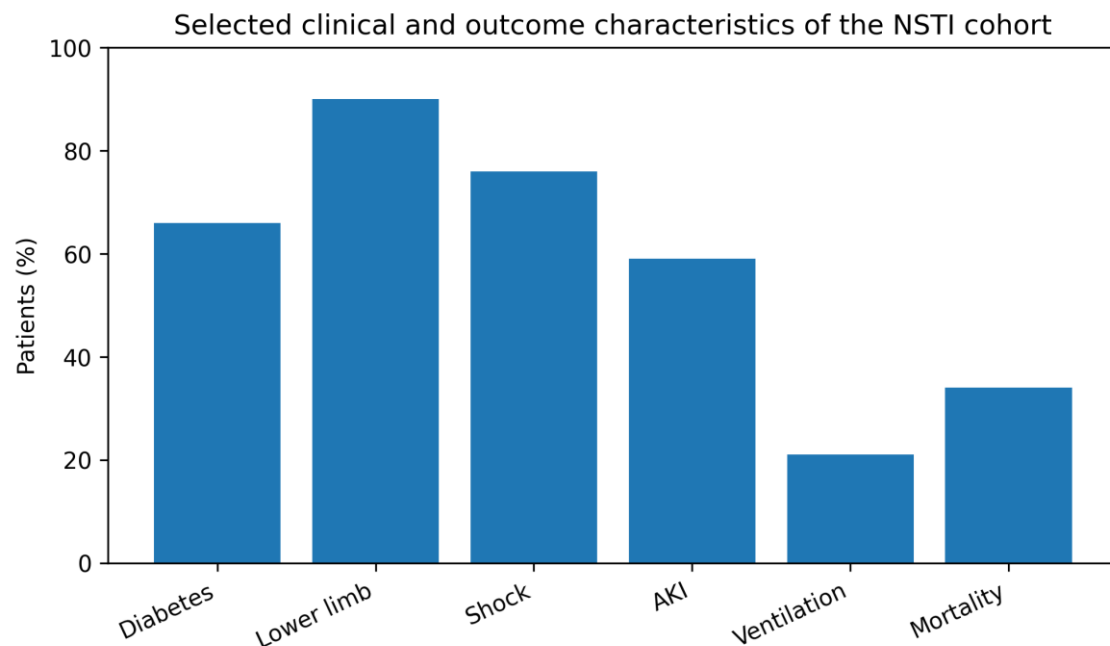


Figure 1. Selected clinical and outcome characteristics of the study cohort. Values are percentages based on the supplied aggregate data.

DISCUSSION

This prospective observational cohort describes 100 patients with NSTI treated at a tertiary-care surgical centre in central India. The cohort had substantial disease severity, reflected by the high prevalence of shock (76%), acute kidney injury (59%), mechanical ventilation requirement (21%) and an in-hospital mortality of 34%. Diabetes was present in 66% and lower-limb involvement in 90%. These findings emphasize the systemic nature of NSTI and the

importance of early recognition and definitive source control.

The 34% mortality observed in the present cohort is higher than the 21.1% pooled mortality reported by Nawijn et al. across 109 studies and 6,051 patients.¹ Differences in case mix, severity, referral patterns, comorbidity burden and healthcare setting can substantially influence mortality and should be considered when comparing cohorts. The present study

also had a high prevalence of shock and acute kidney injury, which may indicate a severely ill population.

Timing of surgery remains a clinically important and potentially modifiable factor. Nawijn et al. reported lower mortality when surgery was performed within 6 hours of presentation compared with later surgery, with mortality of 19% versus 32% and an odds ratio of 0.43 (95% CI 0.26–0.70).¹ The present manuscript records symptom duration before surgery but does not provide the precise interval from hospital presentation to first debridement. These two intervals should be distinguished in the final analysis because symptom duration reflects prehospital delay whereas presentation-to-operation time is more directly influenced by the treating system.

The findings are also consistent with the prospective South Indian ICU cohort reported by Kurian et al., in which 34% of patients died and AKIN stage 3, shock, mechanical ventilation for more than 3 days and low serum albumin were associated with mortality.⁴ The current cohort similarly demonstrates frequent shock, acute kidney injury, mechanical ventilation and hypoalbuminemia, with mean albumin of 2.4 ± 0.7 g/dL. However, because survival-stratified data are unavailable in the supplied manuscript, the present study should not state that these variables were statistically significant predictors in this cohort.

Contemporary evidence further supports assessment of systemic physiological derangement rather than reliance on individual local findings. A 2026 systematic review and meta-analysis of 41 observational cohorts involving 168,261 adults identified older age, chronic liver disease, chronic kidney disease, high comorbidity burden and immunosuppression, as well as hypotension, bacteremia, acute kidney injury, coagulopathy, thrombocytopenia and shock, as factors associated with mortality.³ These findings support a multivariable analytical framework for the present dataset.

The local examination variables specified in the protocol—including bullae, skin colour change, pulsation, neurological findings, compartment syndrome, anatomical site and extent—are clinically relevant markers of disease severity. Their prognostic value should, however, be demonstrated against predefined endpoints such as mortality, amputation and repeated debridement. Similarly, symptom duration should be analysed separately from time to operative source control.

Laboratory parameters such as CRP, WBC count, platelet count and creatinine can provide complementary information regarding inflammation and organ dysfunction. Nevertheless, laboratory scores should not be used to delay operative management in patients with convincing clinical evidence of NSTI. Imaging may help define the extent of infection in selected patients, but

guidelines emphasize prompt surgical consultation and treatment when NSTI is suspected.^{2,5}

Microbiological findings are important for targeted antimicrobial therapy and for describing local epidemiology. The present manuscript reports 28% no-growth cultures and 34% multidrug-resistant infection, but organism-level data are not provided. The final paper should report the number of cultures obtained, the number positive, organism distribution, polymicrobial infection, and the denominator and definition used for multidrug resistance. This will substantially improve the microbiological interpretation.

Repeated debridement is an important outcome in NSTI, but the number of operations should be interpreted in the context of disease extent and physiological severity. A greater number of procedures does not necessarily represent treatment failure; patients with more extensive infection may appropriately require serial source-control operations. Future analysis should therefore consider disease severity and timing between procedures.

Overall, the principal contribution of this study is the description of a central Indian cohort with a high burden of systemic complications and substantial mortality. The study would be strengthened considerably by reporting time from presentation to first debridement, organism-level microbiology, amputation rate, hospital length of stay, detailed complication rates, and survival-stratified analyses with adjusted effect estimates.

6. Strengths and Limitations

Strengths: (1) prospective observational design; (2) consecutive cohort size of 100 patients as reported in the manuscript; (3) multidomain assessment incorporating clinical, laboratory, microbiological and selected radiological variables; (4) clinically meaningful surgical and ICU outcomes; and (5) relevance to an Indian tertiary-care surgical population.

Limitations: (1) the supplied manuscript contains aggregate rather than patient-level data; (2) mortality-stratified comparisons and adjusted regression estimates cannot therefore be reproduced; (3) exact eligibility criteria and ethics approval details are not provided; (4) organism-level microbiology and the denominator for the MDR estimate are not reported; (5) exact time from presentation to first debridement is not provided; and (6) the single-centre design may limit generalizability.

CONCLUSION

NSTI is a time-critical surgical emergency associated with substantial mortality and organ dysfunction. In this 100-patient central Indian cohort, diabetes, lower-limb involvement, shock and acute kidney injury were frequent, and in-hospital mortality was 34%. The findings reinforce the importance of rapid recognition, resuscitation, appropriate broad-spectrum antimicrobial therapy and urgent surgical source control. Complete patient-level analysis is required before independent

prognostic associations can be claimed. In the final submission, the study should report ethics approval, exact eligibility criteria, microbiological details, time to surgery, amputation and hospital-stay data, and survival-stratified statistical analyses.

and meta-analysis with a focus on monomicrobial Gram-negative infections. *Int J Surg*. 2026;112(4):10523-10535. doi:10.1097/JS9.0000000000004744.

REFERENCES

1. 1. Nawijn F, Smeeing DPJ, Houwert RM, Leenen LPH, Hietbrink F. Time is of the essence when treating necrotizing soft tissue infections: a systematic review and meta-analysis. *World J Emerg Surg*. 2020;15:4. doi:10.1186/s13017-019-0286-6.
2. 2. Stevens DL, Bisno AL, Chambers HF, Dellinger EP, Goldstein EJC, Gorbach SL, et al. Practice guidelines for the diagnosis and management of skin and soft tissue infections: 2014 update by the Infectious Diseases Society of America. *Clin Infect Dis*. 2014;59(2):e10-e52. doi:10.1093/cid/ciu444.
3. 3. Kruger N, Durr K, Fernando SM, Rochwerg B, Inaba K, Kim D, et al. Prognostic Factors Associated With Mortality Among Patients With Necrotizing Soft-Tissue Infection: A Systematic Review and Meta-Analysis. *Crit Care Med*. 2026;54(7):1779-1787. doi:10.1097/CCM.0000000000007147.
4. 4. Kurian GP, Korula PJ, Jacob JM, Desha AMK, Karuppusami R, Kandasamy S. Patient Characteristics and Outcomes in Necrotizing Soft-tissue Infections: Results from a Prospective Cohort Study in a Tertiary Care Center Intensive Care Unit in South India. *Indian J Crit Care Med*. 2022;26(4):452-456. doi:10.5005/jp-journals-10071-24153.
5. 5. Bonne SL, Kadri SS. Evaluation and management of necrotizing soft tissue infections. *Infect Dis Clin North Am*. 2017;31(3):497-511. doi:10.1016/j.idc.2017.05.011.
6. 6. Anaya DA, Dellinger EP. Necrotizing soft-tissue infection: diagnosis and management. *Clin Infect Dis*. 2007;44(5):705-710. doi:10.1086/511638.
7. 7. Wong CH, Chang HC, Pasupathy S, Khin LW, Tan JL, Low CO. Necrotizing fasciitis: clinical presentation, microbiology, and determinants of mortality. *J Bone Joint Surg Am*. 2003;85(8):1454-1460. doi:10.2106/00004623-200308000-00004.
8. 8. Sugihara T, Yasunaga H, Horiguchi H, Fujimura T, Ohe K, Matsuda S, et al. Impact of surgical intervention timing on the case fatality rate for Fournier's gangrene: an analysis of 379 cases. *BJU Int*. 2012;110:E1096-E1100. doi:10.1111/j.1464-410X.2012.11291.x.
9. 9. Bucca K, Spencer R, Orford N, Cattigan C, Athan E, McDonald A. Early diagnosis and treatment of necrotizing fasciitis can improve survival: an observational intensive care unit cohort study. *ANZ J Surg*. 2013;83:365-370. doi:10.1111/j.1445-2197.2012.06251.x.
10. 10. Yeh YS, Chen PJ, Huang SC, Chang CH, Yang H, Lee TN, et al. Global epidemiology and mortality trends of necrotizing fasciitis: a systematic review