



UNMASKING STREPTOCOCCUS PYOGENES: THE DEADLY FOE IN NECROTIZING SOFT TISSUE INFECTIONS

Microbiology

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ABSTRACT

Necrotizing soft tissue infections (NSTIs) that are caused by *Streptococcus pyogenes* are serious life-threatening illnesses, which can cause septic shock associated with the highest morbidity and mortality. This case series aims to study the clinical presentation, treatment outcomes, and factors affecting morbidity and mortality of patients with *S. pyogenes*-related NSTIs. A case series of 4 patients with *S. pyogenes*-related NSTIs were admitted from January 2022 to December 2022. Results were recorded and compared using descriptive statistical analysis. We included 4 patients (male to female ratio 3:1) of NSTI with a median age of 57 years (range 37 years to 82 years). Out of 4 cases, 3 cases showed NSTI in lower limbs. The mortality rate of NSTI due to *S. pyogenes* is (3/4) 75% in this study. The poor outcomes in those cases were mostly related to delay in presentation, underlying comorbidities, threshold of infection, total area of infection, metabolic conditions, involvement of multi-dysfunction (Hepatic and renal), delay in intervention and mostly the virulence of organism which can cause toxic shock syndrome.

KEYWORDS

Streptococcus pyogenes, NSTI, Necrotising, Soft Tissue, Infection

INTRODUCTION

Streptococcus pyogenes - Group A *Streptococcus* (GAS), a deadly infectious pathogen, which is linked to a wide range of illnesses, from minor infections to severe necrotizing soft tissue infections (NSTI) and the more fatal streptococcal toxic shock syndrome (STSS) (Bruun et al., 2021). The term "necrotizing skin and soft-tissue infections" (NSTI) describes infections that cause necrosis to develop in the skin, subcutaneous tissue, and superficial fascia. NSTIs are a group of infections that can arise from breaches in the skin's (or mucosa's) integrity and can happen in various anatomical locations. Patients with NSTIs frequently need to be admitted to an intensive care unit (ICU) due to these rare but potentially fatal infections (Kao, 2013).

Necrotizing soft tissue infections (NSTI) caused by GAS require prompt and thorough surgical debridement of the infection site. An infection with *Streptococcus pyogenes* has been a highly feared cause of NSTI. This pattern is largely confirmed by more recent surveillance studies (Cravez et al., 2020; Inaba et al., 2016; Peetermans et al., 2020; Uchikura et al., 2020). We herein present a case series related to *S. pyogenes* infected necrotizing soft tissue infection (NSTIs) to study the clinical presentation, treatment outcomes, factors affecting morbidity and mortality of patients with *S. pyogenes*-related NSTIs.

MATERIAL AND METHODS

A case series of patients with *S. pyogenes*-related NSTIs admitted during a period of January 2022 to December 2022. Data obtained from records on patients demographic profile, detailed history, general and systemic examinations, laboratory evaluation (figure 1) followed by management and outcome of patients. Results were recorded and compared using descriptive statistical analysis.

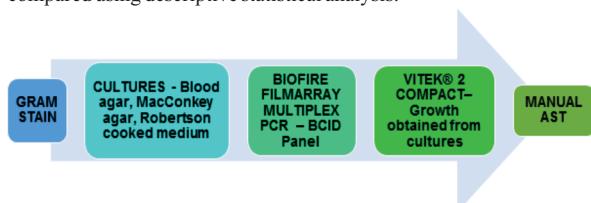


Fig 1. Flow Of Laboratory Evaluation

Case Summary

A 37 year-old previously healthy male (case 1) with no known comorbidities, sustained a blunt trauma to his right distal forearm without disruption of the overlying skin. He had mild pain focal to the

site, discolouration of the skin and swelling. Individual reported to local health care centre and managed with analgesics (Figure 2a). However, the swelling gradually increased and got infected by involving the whole limb. Patient presented to our centre with high grade fever, with swelling and blister like wound over distal end of right forearm one month after the injury. He was admitted and debridement (Fasciotomy) was done on emergency basis (Figure 2b). On initial investigations, he was found with low Hb%, and elevated levels of leukocytes, liver enzymes and metabolic acidosis on Arterial blood gas (ABG) analysis. Pus culture shown the growth of *S. pyogenes* as shown in Figure 2c, 2d, 2e). Despite of efforts patient succumbed to his illness due to delay in presentation followed by multiple organ dysfunction.

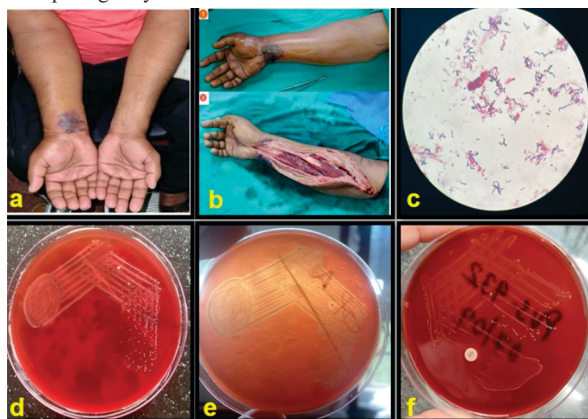


Fig 2. a) Initial presentation of case 1; b) Progression of trauma with cellulitis followed by Fasciotomy; c) Gram stain of the pus sample showing gram positive cocci in short and long chains; d) & e) Growth on Blood agar – Pinpoint α Hemolytic colonies of *Streptococcus pyogenes* as seen on transmitted light; f) Growth of organism showing susceptibility to bacitracin.

A 60 year-old female (case 2) known case of diabetes and hypertension, brought to hospital after one week of sign and symptoms with a non-healing ulcer over left lower limb with unknown aetiology. She underwent debridement immediately after admission. Laboratory investigations revealed that, she was mildly anaemic had leucocytosis, hyperglycaemic as well as elevated levels of serum creatinine. Due to the advance age, surface area of infection and comorbidities patient

succumbed to her illness within two days of admission despite early intervention.

A 54 year-old male (case 3) known case of Non-Healing Ulcer with lymphoedema, CVA, epilepsy, poly trauma, acute on CKD brought to hospital with a non-healing ulcer over lateral malleolus of left lower limb with unknown aetiology. He underwent debridement immediately after admission. Laboratory investigations revealed that, he was mildly anaemic with leucocytosis, as well as with elevated levels of serum creatinine. Despite of comorbidities, and involvement of entire surface area of infection due to early intervention patient recovered and discharged after four weeks of treatment.

Similarly, an 82 years old morbidly obese male (case 4) with history of Non Healing Ulcer (NHU) over Right foot which was previously operated presented with non-healing ulcer over right thigh, perineum, lateral and posterior wall of abdomen with unknown aetiology. Debridement was done immediately after admission. He was found hypoglycaemic and with elevated levels of leucocytes, serum creatinine and liver enzymes on laboratory investigations and metabolic acidosis on ABG analysis. However, patient succumbed to his illness with septic shock due to advance age, involvement of large surface area of infection and comorbidities.

The poor outcomes in these cases were mostly related to delay in presentation, underlying comorbidities, threshold of infection, total area of infection, metabolic conditions, involvement of multi organs dysfunction (Hepatic and renal), delay in intervention and mostly the virulence of organism which can cause toxic shock syndrome as shown in table 1 and 2.

Table 1. General Characteristics And Clinical Presentation Of Cases

Characteristics	Case 1	Case 2	Case 3	Case 4
Age	37	60	54	82
Gender	Male	Female	Male	Male
Areas involved	Left UL involving whole limb	Lt (LL) involving whole limb	Lt (LL) near Lateral malleolus	Rt (LL) involving Thigh, perineum and posterior and lateral abdominal wall
Etiology	Trauma	Unknown	Unknown	Unknown
Time between the onset of symptoms and presentation	1 month	1 week	2 weeks	2 days
Admission to first debridement days	1 day	1 day	1 day	0 days
Duration of hospital stay	1 week	2 days	4 weeks	8 days
Comorbidities	Nil	T2DM, HTN	K/C/O NHU with lymphoedema, CVA, epilepsy, poly trauma, acute on CKD	Morbidly obese K/C/O NSTI foot with NHU (Optd) SSG done
Outcome	Death	Death	Survived	Death

Table 2. Laboratory Parameters Of Cases

Characteristics	Case 1	Case 2	Case 3	Case 4
Haemoglobin (mg/mm ³)	8.9	10	9.9	11.1
Total WBC count (g/dl)	28900	26000	28000	18800
Random blood sugar (mg/dl)	72	225	128	65
Creatinine (g/dl)	1.1	3	2.2	4.4
Total protein	6.2	5.2	4.9	5.4
Albumin (g/dl)	2.19	1.6	1.7	1.8
Liver involvement	Yes Elevated levels of AST & Bilirubin Portal HTN	No	No	Yes Elevated levels of AST/ALT & Bilirubin

ABG analysis	Metabolic acidosis	Not done	Not done	Metabolic acidosis
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DISCUSSION

We included four patients (male to female ratio 3:1) of NSTI in our study with median age of 57 years (range 37 years to 82 years). A retrospective observational chart review of 93 patients in southern part of India also shown mean age of 56.7 years, 74% were males and 26% were females as similar to our study (Dhekane et al., 2023). Out of 4 cases, 3 cases presented with NSTI in lower limbs. The mortality rate of NSTI due to S. pyogenes is (3/4) 75% in this study. A retrospective study in two health care centres among 54 cases shown a fatality rate of 11.1% due to GAS infection which was lower as compared to our study (Haggar et al., 2012). In the previous literature (Bruun et al., 2021; Kao, 2013) illustrated that advanced age, peripheral vascular disease, diabetes mellitus, malnutrition, atherosclerosis, and obesity, deranged laboratory parameters due to multiple organ dysfunction, delay in intervention and mostly the virulence of organism which can cause toxic shock syndrome as risk factors for GAS infection in NSTI and further fatality which was similar in this study.

CONCLUSION

We concluded that diagnosing and treating NSTIs caused by S. pyogenes is difficult. Early detection and aggressive debridement, along with broad-spectrum antibiotics and supportive care, remains the time-tested treatment of choice and the only way to improve outcome. Further research with a larger sample size is needed.

REFERENCES

1. Bruun, T., Rath, E., Madsen, M. B., Oppegard, O., Nekudov, M., Arnell, P., Karlsson, Y., Babbar, A., Bergey, F., Itzek, A., Hyldegaard, O., Norrby-Teglund, A., Skrede, S., Nedrebo, T., Skuttlaberg, D. H., Hedetoft, M., Hansen, M. B., Polzik, P., Rosén, A., ... Martins Dos Santos, V. A. P. (2021). Risk Factors and Predictors of Mortality in Streptococcal Necrotizing Soft-tissue Infections: A Multicenter Prospective Study. *Clinical Infectious Diseases*, 72(2), 293–300. <https://doi.org/10.1093/cid/ciaa027>

2. Cravez, E. M., Nasreddine, A. Y., & Halim, A. (2020). Persistent Streptococcus pyogenes infection of the forearm following blunt trauma. *Case Reports in Plastic Surgery and Hand Surgery*, 7(1), 139–144. <https://doi.org/10.1080/23320885.2020.1858715>

3. Dhekane, P., Gopalakrishnan, R., Ramasubramanian, V., Sethuraman, N., Ramanathan, Y., Suresh Kumar, D., & Nambi, P. S. (2023). Not so uncommon, yet neglected 'Severe Streptococcus pyogenes infections at a tertiary care center in south India. *Indian Journal of Medical Microbiology*, 41, 55–58. <https://doi.org/10.1016/j.ijmm.2022.12.006>

4. Haggar, A., Nerlich, A., Kumar, R., Abraham, V. J., Brahmamathan, K. N., Ray, P., Dhandu, V., Joshua, J. M. J., Mehra, N., Bergmann, R., Chhatwal, G. S., & Norrby-Teglund, A. (2012). Clinical and microbiologic characteristics of invasive Streptococcus pyogenes infections in north and south India. *Journal of Clinical Microbiology*, 50(5), 1626–1631. https://doi.org/10.1128/JCM.06697-11/SUPPL_FILE/JCM-JCM06697-11-S01.PDF

5. Inaba, M., Nozaki, S., Fujiwara, T., Hongou, T., Uozumi, M., Nakahara, T., Akagi, Y., Kojima, T., Naito, H., & Nakao, A. (2016). Case of Necrotizing Fasciitis from Streptococcus pyogenes (Group A) Treated Successfully with Negative-Pressure Wound Therapy. *Surgical Infections Case Reports*, 1(1), 142–145. <https://doi.org/10.1089/crsi.2016.0044>

6. Kao, L. S. (2013). Necrotizing soft tissue infections. *Common Problems in Acute Care Surgery*, 451–461. https://doi.org/10.1007/978-1-4614-6123-4_37

7. Peetermans, M., de Prost, N., Eckmann, C., Norrby-Teglund, A., Skrede, S., & De Waele, J. J. (2020). Necrotizing skin and soft-tissue infections in the intensive care unit. *Clinical Microbiology and Infection*, 26(1), 8–17. <https://doi.org/10.1016/j.cmi.2019.06.031>

8. Uchikura, T., Mori, N., Kono, A., Arino, H., Takahashi, T., & Takeuchi, I. (2020). Early surgery for limb preservation in Group A Streptococcus-induced necrotizing soft tissue infection and subsequent soft tissue infection: A case report. *IDCases*, 22, e00980. <https://doi.org/10.1016/j.idcr.2020.e00980>