

# Transhumeral Amputation for Treating Necrotizing Fasciitis Infection of the Upper Extremity: Report of Two Cases

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## Abstract

Necrotizing fasciitis, an infection of the skin and subcutaneous tissue, can spread rapidly. Studies have emphasized the importance of prompt surgical intervention with aggressive debridement of diseased tissue; however, mortality rates are high despite immediate treatment. We describe two men, aged 44 years (case 1) and 74 years (case 2), presenting with necrotizing fasciitis who underwent aggressive surgical intervention, multiple debridements, and eventual transhumeral amputation of the upper extremity. In each case, the patients were discharged from the hospital to their homes on amoxicillin-clavulanate at postoperative days 15 (case 1) and 32 (case 2). Findings of laboratory studies had normalized. Early diagnosis of necrotizing fasciitis is vital for successful treatment of the infection. We recommend limb amputation as a life-saving measure if aggressive debridement and antibiotic therapy are unsuccessful.

## Introduction

Necrotizing fasciitis is a life-threatening infection of the subcutaneous tissue and spreads rapidly.<sup>1</sup> The most common pathogen of this disease, group A streptococcus, is ubiquitous and present in normal human oral flora.<sup>2</sup> Early diagnosis and surgical debridement, in conjunction with antibiotic therapy, reduce the death rates associated with necrotizing fasciitis.<sup>1</sup> Even with appropriate treatment, mortality rates as high as 33% have been reported.<sup>3</sup>

Scores of the Laboratory Risk Indicator for Necrotizing Fasciitis have helped determine the presence of the infection based on component levels (C-reactive protein,  $\geq 150$  mg/L; total white blood cell count,  $> 15$  g/L; hemoglobin,  $< 13.5$  g/dL; sodium,  $< 135$  mmol/L; creatinine,  $> 1.41$  mg/dL; and glucose,  $> 10$  mmol/L).<sup>4</sup> The goal of this study was to reflect upon the importance of co-morbidity factors on the exacerbation of spread and severity of infection with respect to upper limb necrotizing fasciitis

associated with fight bite, as well as comment on the importance of limb amputation as a life saving treatment option. We describe two men who presented with clinical findings of necrotizing fasciitis of the upper extremity. After repeated unsuccessful and extensive debridements and fasciotomies, with continued hemodynamic instability, florid bacterial sepsis, and progression of necrotic muscular tissue in both patients, transhumeral amputation was performed. The patients were informed that the data concerning the case would be submitted for publication, and they provided verbal consent.

## Case 1

A 44-year-old man presented to our emergency department for evaluation of worsening pain and swelling in his left hand and forearm. The patient reported involvement in an altercation 48 hours earlier, in which he struck another individual in the mouth and sustained a laceration to the dorsal aspect of his small finger, near the metacarpophalangeal (MCP) joint. He did not seek care for 24 hours, when he woke up with pain and swelling in his left hand. The patient was seen at an outlying hospital and transferred to our tertiary care center for definitive treatment. Notably, he had a past medical history significant for type 2 diabetes, hypertension, and alcohol abuse.

On admission, he had a discolored hand and forearm. A 4-mm laceration was noted over the dorsal aspect of the MCP joint of the small finger, with purulent discharge. The hand was cool, entirely insensate, and compartments in the forearm were firm. The patient expressed pain with passive extension of the fingers and no active motion of the digits. Neither the radial nor ulnar pulses were palpable nor present on Doppler examination, although the brachial artery was. Radiographs revealed no bony abnormalities or gas in the soft tissues. Initial results of laboratory studies confirmed the suspected diagnosis of necrotizing fasciitis (white blood cell count, 20.5 g/L; hemoglobin, 14.6 g/L;

serum sodium, 123 mmol/L; lactate, 5.2 mmol/L; and creatinine, 1.09 mg/dL).

The patient was taken urgently to the operating room. Fasciotomies of the forearm were performed for treatment of his compartment syndrome. Operative evaluation indicated bulging muscle compartments of the forearm after fasciotomies (Figure 1). His small finger was necrotic, with a septic proximal interphalangeal joint; therefore, the small finger was amputated at the level of the mid-proximal phalanx. The muscle appeared to improve in color on release of the fascia but was not contractile.



**Figure 1.** Intraoperative, anterior view of left forearm and hand in case 1 shows bulging muscle compartments and temporary closure.

The forearm culture, obtained intraoperatively, was positive for *Streptococcus pyogenes*, and a blood culture was negative for bacterial growth. The patient remained critically ill, with labile blood pressures after the procedure, and was taken to the intensive care unit. Unasyn was administered on admission to the emergency department and continued in the intensive care unit. Clindamycin was also administered during his stay in the intensive care unit.

At 48 hours after the initial injury, repeated irrigation and debridement procedures were performed. Progression of the necrotic muscle was noted, and the flexor compartment was entirely devitalized and debrided (Figure 2). A thin, light-brown colored watery discharge was observed when the wound was opened (Figure 3). Based on the extent of infection, devitalized tissue, and persistent hypotension, transhumeral amputation was performed. The wound was left open to drain. In the subsequent week, serial debridements were performed in four additional operative procedures, in which necrotic muscle was excised.



**Figure 2.** Intraoperative, anterior view of left forearm in case 1 shows notable devitalization of flexor digitorum superficialis (black arrow) and carpi radialis (white arrow).



**Figure 3.** Intraoperative, anterior view of left elbow in case 1 indicates thin watery discharge encountered in wound.

After undergoing transhumeral amputation, the patient recovered and was discharged from the hospital on amoxicillin-clavulanate at postoperative day 15. At 1 week after the transhumeral amputation, the appearance of the arm improved and the open wound was definitively treated with delayed primary closure. At discharge, component values obtained from laboratory tests and vital signs had normalized (white blood cell count, 7.8 g/L; serum sodium, 136 mmol/L; and lactate, 0.9 mmol/L).

### Case 2

A 74-year-old man was transferred to our facility from a rehabilitation center. He had worsening pain and swelling in his right upper extremity and rapidly deteriorating mental status during a 24-hour period. Notably, the patient had past medical history significant for dementia, depression, type 2 diabetes, posttraumatic stress disorder, alcohol withdrawal with history of seizures, traumatic brain injury, ascitis, and alcoholic cirrhosis of the liver. On clinical examination, the patient had a superficial abrasion over the dorsum of the hand, with cellulitis extending to the antecubital fossa, and sloughing of the skin. Radiographic findings were of nonspecific soft tissue edema, with no evidence of subcutaneous air (Figures 4A and 4B). He was admitted to the intensive care unit after a diagnosis of sepsis (white blood cell count, 33.5 g/L; hemoglobin, 13.9 g/L; serum sodium, 139 mmol/L; lactate, 13.3 mmol/L; and creatinine, 2.45 mg/dL, ESR 8, CRP 12.5).



**Figure 4.** Preoperative radiograph of right forearm and hand in case 2. (A) Nonspecific swelling of the dorsal forearm. (B) Swelling of the hand dorsum.

The patient was taken urgently to the operating room where fasciotomies of the forearm were performed and devitalized tissue was aggressively debrided (Figure 5). Fascial tissues were surrounded by a thin dishwater-colored serous fluid, a known finding in patients with necrotizing fasciitis. Intraoperative cultures were positive for *Streptococcus pyogenes* or group A streptococcus. Postoperatively, he returned to the intensive care unit and remained critically ill. He was started on clindamycin.



**Figure 5.** Intraoperative view of the right forearm and hand in case 2 after fasciotomy and aggressive debridement, showing development of devitalized tissue over the palmar surface of the hand.

For 15 hours, the clinical status of the patient continued to deteriorate. Evidence of proximal progression of the infection was noted, and component values obtained from laboratory tests did not improve. The decision was made to proceed with transhumeral amputation, just above the elbow for source control, and delayed closure.

After undergoing transhumeral amputation, the patient recovered and was discharged from the hospital on amoxicillin-clavulanate at postoperative day 32. Component values had similarly normalized at discharge (white blood cell count, 6.6 g/L; hemoglobin, 11.1 g/L; serum sodium, 139 mmol/L; lactate, 1.0 mmol/L; and creatinine, 0.74 mg/dL).

## Discussion

The axiom “life before limb” is often cited in orthopaedics and trauma surgery in the face of devastating injury or infection. The current cases represent the severity of infection and risk to life in those afflicted with necrotizing fasciitis. Both involved overwhelming infection, rapidly deteriorating clinical status, and consensus that the limb had to be removed to save the patient’s life. Once amputation had occurred, both patients demonstrated improved blood pressures, improving kidney function and subsequent decrease in leukocytosis.

To our knowledge, case 1 is one of the first reports of necrotizing fasciitis resulting from a human bite to the hand. Wienert et al.<sup>5</sup> described a human bite to the lower extremity, which caused an infection with group A streptococcus that resulted in necrotizing fasciitis. The infection was successfully treated with repeated debridement and a limb salvage procedure. Additionally, Motsitsi<sup>6</sup> reported a fatal case of necrotizing fasciitis after a human bite to the upper extremity. Studies involving the presence of necrotizing fasciitis after human bites in the lower extremities,<sup>7,8</sup> and sexual organs<sup>8</sup> have also been noted.

Factors affecting the mortality rate of patient’s have varied significantly in the research (Table 1). However, we could find only one study that analyzed this for the upper limb only. Yeung et al<sup>9</sup> found that liver failure, thrombocytopenia, initial more proximal involvement, renal failure, and hypotension upon initial presentation were predictors of mortality in patients with necrotizing fasciitis of the upper limb. Jabbour et al<sup>10</sup> did a large scale review of the literature and found that delay in diagnosis, advanced age, existence of multiple medical comorbidities, polymicrobial infections, and bacteremia were associated with higher mortality. In contrast, earlier surgical debridement and early antibiotic therapy were associated with decreased mortality.<sup>11,12</sup> Hypertension, diabetes mellitus and renal impairment were found to be the comorbidities that were most associated with mortality, with diabetes being the most prevalent.<sup>10</sup>

For both of our patients, early diagnosis was based on intraoperative appearance of the wound and confirmed with findings of intraoperative cultures. Both patients presented to our emergency department in early decline. Quick clinical diagnosis of necrotizing fasciitis is critical but is often missed or delayed.<sup>13</sup> However, there are several clinical features that can act as risk indicators. Most importantly, these include a significantly elevated CRP of  $\geq 150$  mg/l as well as decreased hemoglobin and erythrocyte count.<sup>13</sup> Aggressive operative treatment, antibiotic therapy, and eventual amputation after notable

**Table 1.** Summary of recently published studies analyzing predictors of mortality and overall mortality associated with necrotizing fasciitis

Study	Year, country	Study type	No. patients	Mortality rate	Predictors of mortality
Yeung et al <sup>9</sup>	2011, Japan	Retrospective	29	28%	Decreased renal and liver function, thrombocytopenia, initial proximal involvement, hypotension on admission, ALERTS score of 3
Hadeed et al <sup>12</sup>	2016, US	Retrospective	87	12.5%	Surgical intervention by 6 h after presentation (17.5% in late group vs. 7.5% in early group)
Kao et al*	2011, US	Retrospective	296	9%-25%, six hospitals	Patient age, severity of disease (ie, presence of shock requiring pressor support and renal failure)
Wong et al <sup>11</sup>	2003, Singapore	Retrospective	89	21.3%	Advanced age, > two associated comorbidities, procedure delay > 24 h (P < 0.05; relative risk = 9.4)

US, United States; ALERTS, Abnormal Liver function, Extent of infection, Renal impairment, Thrombocytopenia, and Shock.

\* Kao LS, Lew DF, Arab SN, et al. Local variations in the epidemiology, microbiology, and outcome of necrotizing soft-tissue infections: a multicenter study. *Am J Surg* 2011;202(2):139-45. doi: 10.1016/j.amjsurg.2010.07.041.

effort to save the limb led to successful clinical recovery. Concerning initial time to first debridement and interval to subsequent debridements, the results of the current cases correspond with the mean time to intervention of a recently published study<sup>14</sup> in the United Kingdom. On average, the first debridement was performed within 12 hours of patient referral to the clinic; the median delay between the first and second debridement was 24 hours.

The outcomes of our study reinforce known principles in treating necrotizing fasciitis. Aggressive surgical debridements did not change the clinical status of either patient as demonstrated in the literature, therefore amputation of the infected extremity was necessary in saving the life of these two men.

## Funding

The authors received no financial support for the research, authorship, and publication of this article.

## Conflict of Interest

The authors report no conflicts of interest.

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