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Effect of transfer status on outcomes for necrotizing soft tissue infections

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ABSTRACT

Background: Whether patients with necrotizing soft tissue infections (NSTI) who presented to under-resourced hospitals are best served by immediate debridement or expedited transfer is unknown. We examined whether interhospital transfer status impacts outcomes of patients requiring emergency debridement for NSTI.

Methods and materials: We conducted a retrospective review studying patients with an operative diagnosis of necrotizing fasciitis, Fournier's gangrene, or gas gangrene in the 2010-2015 American College of Surgeons National Surgical Quality Improvement Program Participant Use Data Files. Multivariable regression analyses determined if transfer status independently predicted 30-d mortality, major morbidity, minor morbidity, and length of stay.

Results: Among 1801 patients, 1243 (69.0%) were in the non-transfer group and 558 (31.0%) were in the transfer group. The transfer group experienced higher rates of 30-d mortality (14.5% *versus* 13.0%) and major morbidity (64.5% *versus* 60.1%) than the non-transfer group, which were not significant after risk adjustment (adjusted odds ratio [95% confidence interval]: 0.87 [0.62-1.22] and 1.00 [0.79-1.27], respectively). The transferred group experienced a longer median length of postoperative hospitalization (14 d [interquartile range 8-24] *versus* 11 d [6-20]), which maintained statistical significance after adjustment for other factors (adjusted beta coefficient [95% confidence interval]: 1.92 [0.48-3.37]; $P = 0.009$).

Conclusions: Our results suggest that interhospital transfer status is not an independent risk factor for mortality or morbidity after surgical management of NSTI. Although expedient debridement remains a basic tenet of NSTI management, our findings provide some reassurance that transfer before initial debridement will not significantly jeopardize patient outcomes should such transfer be deemed necessary.

Introduction

Necrotizing soft tissue infections (NSTI) are a family of rapidly progressive infections that are associated with significant morbidity and mortality.[1-4] Because of the strong association between death and time to definitive care among NSTI patients, the World Society of Emergency Surgery has proposed an ideal "time from diagnosis to initial surgical debridement" of 6 h for patients without, and 1-2 h for patients with, systemic signs of sepsis.[5,6]

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Complicating this recommendation is the reality that NSTI is a rare condition. Most physicians will treat only one case of NSTI over the course of their entire career.[3] In addition, the in-hospital management of NSTI patients is extremely resource intensive.[3] These patients often require multiple surgical debridements and complex wound management. Their hospital care will, by necessity, require time-intensive effort from numerous services, including critical care, nutrition, social work, and rehabilitation. Owing to the low prevalence of the disease and the extensive resources needed to treat it, NSTI is generally considered a condition best managed within tertiary medical centers.

Whether patients with NSTI who presented to under-resourced hospitals are best served by immediate surgical debridement at those hospitals or by expedited transfer to medical centers that are better equipped to manage such patients is unknown. Interhospital transfers have been shown to be beneficial for patient outcomes in other time-sensitive medical conditions that require high-level care such as severe injury, acute myocardial infarction, and stroke.[7-10] The objective of our study was to examine whether interhospital transfer status impacts the outcomes of patients who require emergency surgical debridement for NSTI.

Materials and methods

The 2010-2015 American College of Surgeons National Surgical Quality Improvement Program Participant Use Data Files (ACS NSQIP PUFs) were used for this study.[11] All patients from this data set who had an operative diagnosis of necrotizing fasciitis, Fournier's gangrene, or gas gangrene (as indicated by an International Classification of Diseases, Ninth Clinical Modification code of 728.86, 608.83, or 040.0), as is consistent with previous studies,[12,13] and who underwent an emergency operation were included for analysis. Only emergency procedures were included in our analysis. The ACS NSQIP defines an emergency procedure based upon the surgeon and anesthesiologist reporting the case as emergent. Before 2012, emergency cases were defined as those usually performed as soon as possible and no later than 12 h after the patient has been admitted to the hospital or after the onset of related preoperative symptomatology. The 12-h time frame was removed from the definition beginning in 2012. We only included emergency procedures in an effort to exclude those patients who may have been transferred from another hospital after having undergone initial emergency debridement, with subsequent interhospital transfer being primarily for the purposes of postoperative intensive care or significant wound care. It was assumed that such patients (those who undergo interhospital transfer after initial operative debridement of their NSTI) would be categorized as having an emergency operation only for management of uncontrolled infection not for operative management of routine wound care.

The primary predictor variable of our analysis was interhospital transfer status. Patients who were admitted directly from home comprised the "non-transfer" group, whereas patients who were admitted from an outside emergency room or who were transferred from an acute care facility comprised the "transfer" group. Patients who were transferred from a nursing home, chronic care facility, or intermediate care facility were classified as non-transfer group patients. Additional predictor variables included an array of patient- and procedure-related characteristics (Table 1).

The outcome variables for our study were 30-d mortality, major and minor morbidity, length of postoperative hospitalization, and hospital discharge destination.[14] A patient was considered to have sustained major morbidity if they experienced one or more of the following complications in the first 30 d after their index procedure: organ/space surgical site infection (SSI), wound dehiscence, unplanned reintubation, need for mechanical ventilation >48 h, pulmonary embolism, acute renal failure (with or without need for renal replacement therapy), pneumonia, myocardial infarction, cardiopulmonary arrest requiring cardiopulmonary resuscitation, systemic sepsis, septic shock, stroke, and/or bleeding. Patients were considered to have sustained minor morbidity if they experienced one or more of the following complications in the first 30 d after their index procedure: superficial incisional SSI, deep incisional SSI, urinary tract infection, and/or deep venous thrombosis. Patients who were discharged to a skilled nursing facility who were at such a facility before their hospitalization were considered to have been discharged to home.

The patient- and procedure-related characteristics of non-transfer and transfer patients were compared using Pearson's chi square tests for categorical variables and Wilcoxon rank sum tests for continuous variables. To determine the independent association between interhospital transfer status and outcomes, a multivariable logistic regression model was constructed for each of the three categorical outcomes, and a similar linear regression model was constructed for postoperative length of hospital stay. Those patient- and procedure-related factors (listed in Table 1), which demonstrated a univariate association with a particular outcome at the $P < 0.2$ level were included as potential predictor variables in that outcome's regression model. As the primary predictor of interest, interhospital transfer status was forced into each of the four regression models regardless of the strength of its univariate association with the particular outcome. Missing data were handled in two ways. For those variables missing <1% of observations, patients with missing data were excluded from analysis. For those variables missing ≥1% of observations, a missing indicator was created.[15] Information about hospital discharge status was made available by ACS NSQIP starting with its 2011 PUFs. Therefore, for our analysis of this outcome, only those patients with known discharge destination were included.

By including only emergency index operations for NSTI, we sought to confine our analysis to non-transfer and transfer patients who were undergoing initial operative debridement. Before and including 2013, ACS NSQIP included information about whether patients had undergone any type of operation within the 30 d preceding their index operation. We therefore performed a subgroup analysis of patients from our overall study population in whom the presence or absence of an operation in the preceding 30 d was known. For this subgroup analysis, univariate comparison of outcomes for