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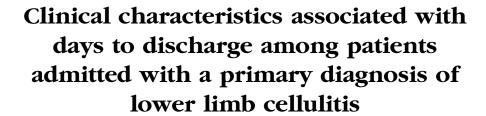# Clinical characteristics associated with days to discharge among patients admitted with a primary diagnosis of lower limb cellulitis

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Background: Clinicians have limited ability to classify risk of prolonged hospitalization among patients with lower limb cellulitis.

Objective: We sought to identify characteristics associated with days to discharge and prolonged stay.

Methods: We conducted retrospective cohort analysis including patients admitted with a primary diagnosis of lower limb cellulitis at community and tertiary hospitals.

Results: There were 4224 admissions for lower limb cellulitis among 3692 patients. Mean age of the cohort was 64.4 years. Frequencies of tobacco smoking, obesity, and diabetes mellitus were 25.1%, 44.9%, and 19.3%, respectively. Patients having decreased likelihood of discharge included those with the following: 10-year age increments 0.90 (95% confidence interval [CI] 0.88-0.92), obesity 0.90 (95% CI 0.83-0.97), diabetes mellitus 0.90 (95% CI 0.82-0.98), tachycardia 0.76 (95% CI 0.67-0.85), hypotension 0.77 (95% CI 0.65-0.90), leukocytosis 0.86 (95% CI 0.79-0.93), neutrophilia 0.80 (95% CI 0.73-0.87), elevated serum creatinine 0.74 (95% CI 0.68-0.81), and low serum bicarbonate 0.84 (95% CI 0.75-0.95).

Limitations: This analysis is retrospective and based on coded data. Unknown confounding variables may also influence prolonged stay.

Conclusions: Patients with lower limb cellulitis and prolonged stay have a number of clinical characteristics which may be used to classify risk for prolonged stay. (J Am Acad Dermatol http://dx.doi.org/10.1016/j.jaad.2016.11.063.)

Key words: cellulitis; discharge; length; limb; lower; prolonged; stay.

Cellulitis and cutaneous abscess represent the second most common infection leading to over 680,000 admissions annually in the United States,[1,2] with a substantial allocation of resources directed toward these admissions.[3] In 2011, Medicare reimbursed over $1 billion for total hospital charges in the cellulitis diagnosis-related group.[4] The Affordable Care Act incentivizes hospitals to optimize the quality and cost ratio by

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Abbreviations used:

LOS: length of stay
SSSI: skin and skin structure infection

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decreasing length of stay (LOS) and enhancing coordination of care upon discharge. However, little is known about factors contributing to LOS for

patients admitted with cellulitis of the lower limb, the anatomic site[5-7] accounting for the majority of diagnoses. The ability to risk stratify these patients for the purpose of resource allocation and coordination of care is limited. The purpose of this study was to characterize patients admitted for lower limb cellulitis, and to investigate whether patient demographics, comorbidities, admission vital signs, and laboratory markers of infection were associated with greater days to discharge and LOS.

METHODS

This retrospective cohort study was approved by the institutional review board of the Feinstein Institute for Medical Research at Northwell Health. Patients aged 18 years or older admitted with a primary diagnosis of lower limb cellulitis between January 2009 and July 2014 were included in the analysis. Patients admitted with cellulitis of the toe, foot, finger, hand, arm, buttock, or the head and neck along with any cellulitis complicated with abscess, myositis, or fasciitis were excluded. Patient data were obtained from 3 of the 21 networked hospitals at Northwell Health, a regional integrated health care system with over 276,000 recorded discharges in 2015.

The following explanatory variables were explored: demographic and baseline characteristics (age, gender, race, insurance type, tobacco smoking, body mass index, body mass index classification), comorbidities (obesity, diabetes mellitus, hypertension), admission vital signs (temperature, heart rate, systolic blood pressure), and laboratory markers of infection (white blood cell count, neutrophil percent, serum creatinine, serum bicarbonate). Data elements were selected with the intent of evaluating variables based on what is known about the biology of the disease and on hypothesized relationships with LOS. The first vital signs and laboratory results recorded upon admission were used in the analysis.

STATISTICAL ANALYSIS

There were 4224 primary admissions for lower limb cellulitis among 3692 patients. The 4209 admissions for which information on LOS were available were used for the analysis. Some variables were

CAPSULE SUMMARY

- Patients admitted for lower limb cellulitis frequently experience prolonged hospital stays.

- Increasing age, obesity, diabetes mellitus, tachycardia, hypotension, leukocytosis, neutrophilia, elevated serum creatinine, and low serum bicarbonate are associated with prolonged stay.

- Identification of risk factors for prolonged hospitalization may impact risk stratification and management recommendations.

dichotomized to facilitate comparison and clinical interpretation of results. The χ^2 test was used to examine associations between categorical variables. Univariable comparisons for continuous variables were performed using the Mann-Whitney test. A multivariable Cox (proportional hazards) regression with a robust variance estimator was used to model days to discharge, the primary outcome. The robust sandwich estimate of the covariance matrix was used to account for the hierarchical structure of the data (ie, multiple admissions for the same patient). All candidate variables were entered into the multivariable model to assess aggregate effect on days to discharge. A backward selection algorithm was then applied to remove those factors that did not contribute significantly to the model.

In a secondary analysis, we dichotomized LOS into 5 days or less versus more than 5 days, the latter category being indicative of prolonged hospitalization. This dichotomization was chosen a priori based on average length of admission for cellulitis without complication reported by Medicare.[4] A generalized linear mixed models approach for clustered data (multivariable logistic regression) was used to model LOS using the same set of data elements used in the Cox regression. Generalized linear mixed model was used to account for the hierarchical structure of the data, and a backward selection algorithm was then applied to remove factors that did not contribute significantly to the model. The final regression models used 60% (2550/4224) of the data because of the combination of all missing data among the 15 variables of interest. All analyses were carried out using software (SAS 9.3, SAS Institute Inc, Cary, NC).

RESULTS

Prolonged stay was observed among 38.3% (1413 of 3692) of patients and among 39.5% (1662/4209) of total admissions. Frequency characteristics of patients admitted for lower limb cellulitis and for patients with prolonged stay are listed in Table I.

Results of the multivariable proportional hazards analysis for days to discharge are listed in Table II. The adjusted hazard ratio estimate for age indicates that for every unit increase in age, the likelihood of discharge decreased by 1%. Calculations for 5-year