Risk stratification and outcome of cellulitis admitted to hospital

M. Figtree [a,*], P. Konecny [b], Z. Jennings [b], C. Goh [b], S.A. Krilis [b], S. Miyakis [c]

[a] *Royal North Shore Hospital, Pacific Highway, St Leonards NSW 2065, Australia*
[b] *Department of Immunology, Allergy and Infectious Disease, St George Hospital, 1st Floor, 2 South St, Kogarah NSW 2217, Australia*
[c] *3rd Dept of Medicine, Aristotle University of Thessaloniki, Papageorgiou Hospital, Ring Road Thessaloniki-Efkarpia, PC 56403, Salonica, Greece*

Summary *Objectives:* To identify risk factors associated with mortality and adverse outcome of community acquired cellulitis/erysipelas requiring hospital admission.
Methods: A retrospective analysis of 395 episodes of cellulitis/erysipelas admitted to a tertiary referral hospital between January 1999 and December 2006.
Results: Mortality was 2.5% (10/395). There were 112 complications (28.4%). Median hospitalisation was 5 days. Factors independently associated with mortality, adverse outcome and prolonged stay (>7 days) were bacteraemia and albumin <30 g/L. A risk stratification model was designed based on factors independently associated with adverse outcome: altered mental status, neutrophilia/paenia, discharge from the cellulitic area, hypoalbuminaemia and history of congestive cardiac failure. Adverse outcome risk among patients with scores <4, 6–9 and >9 was <20%, 55% and 100%, respectively. All patients who died had admission score ≥4. Factors independently associated with prolonged hospitalisation were: age >60, symptom duration >4 days, hypoalbuminaemia, bacteraemia, isolation of MRSA and time to effective antibiotics >8 h. MRSA was more frequent among patients admitted during 2003–2006 (OR 2.43, 95% CI: 1-12-5.27). Streptococci accounted for most bacteraemia (11/20). Infectious Disease physician input was independently associated with shorter hospitalisation.
Conclusions: Cellulitis/erysipelas requiring hospitalisation confers considerable morbidity and mortality. Clinical markers present on admission can be used to stratify patient risk of mortality and adverse outcome.
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* Corresponding author. Tel.: +61 2 9926 8478; fax: +61 2 9436 2870.
 E-mail address: melfigtree@yahoo.com.au (M. Figtree).

Introduction

Superficial soft-tissue infections that involve the skin (erysipelas) or spread to the subcutaneous tissue (cellulitis) are characterized by erythema, swelling, pain, and frequently systemic involvement.[1] The estimated incidence of cellulitis in developed countries is 16.4—24.6/1000 person-years.[2] Although cases are frequently managed as outpatients,[3] cellulitis ranks as the 11th most frequent diagnosis in Australian public hospitals with 73.6 patient days per 10,000 population.[4] Cellulitis and/or erysipelas are generally not considered severe infections.[1] The mortality of cellulitis/erysipelas in the pre-antibiotic era has been estimated to be 11%.[5] The all-cause mortality for patients requiring hospital admission for cellulitis today remains considerable, at 5—7.2%.[6] Complications occurring in patients hospitalised with cellulitis substantially increase health-care costs.[4,7] Factors predictive of mortality and morbidity are not well defined in the literature and the process of devising relevant treatment guidelines and designing appropriate clinical drug trials, in the era of increasing antimicrobial resistance, are impeded.[5]

The present study aimed to evaluate factors associated with mortality, complications and prolonged hospital stay in community-acquired cellulitis requiring hospitalisation. Differences in patient management between Infectious Disease (ID) physicians and other hospital specialities were also analysed.

Materials and methods

This retrospective cohort study was conducted in a 650-bed tertiary referral hospital in Sydney, Australia between January 1999 and December 2006. Ethics approval was obtained from the South Eastern Sydney Human Research Ethics Committee. Admissions with International Classification of Diseases (ICD-10-CM) codes L03.0, L03.1, L04, L08, L89, H00.0, K12.2 and J34.0, corresponding to cellulitis and/or erysipelas at the different anatomical sites, were selected by medical record database. Although there are clinical features differentiating erysipelas from cellulitis, accurate distinction can be difficult and the terms are often used interchangeably.[1,8] Therefore, for the purposes of this study, the term "cellulitis" is used invariably to denote infection involving the skin and/or the subcutaneous tissue. When infection extends beyond this depth to involve fascia and/or muscle, the prognosis and management differs;[1] hence patients presenting with myositis or necrotising fasciitis on admission were excluded. Additional strict exclusion criteria were applied: where cellulitis was not the only reason for admission, nor the primary diagnosis, local complications at presentation (i.e. abscess, bursitis), diabetic foot infections, cases with inadequate information, patients who completed antibiotic therapy through a parenteral antibiotic program and age <16 years.

Patient notes were reviewed by the study doctors and data collected on premorbid residency and function, co-morbidities, immunosuppression, systemic steroid use, previous cellulitis, tinea, duration of symptoms, preadmission antibiotics, multiorgan failure as previously defined,[9] ulceration or discharge from cellulitic area, laboratory results on admission (albumin, C-reactive protein, serum creatinine, neutrophil count), blood and swab cultures, time from triage to empiric antibiotic administration, treatment modalities, allergies, requirement for surgery, complications during admission, length of hospital stay, in-hospital consultation from another specialty, follow-up and discharge plan. Microbiological prevalence data was compared between the first and second 4-year periods. Data was analysed using SPSS v.11.0 for Windows. For categorical variables, Pearson's Chi Square or Fisher's exact test was used; for continuous variables, Student's t-test or one-way analysis of variance with Bonferroni correction. 2-tailed tests of significance and p values <0.05 were considered. Univariate analysis for each end-point (death, complication, hospital stay >7 days) identified significant factors which were then selected for inclusion in a logistic regression model, using a forward stepwise selection algorithm with entry and removal criteria of $p = 0.05$ and 0.10, respectively.

To predict adverse outcome (defined as the composite end-point of death or complication) the independent multivariate correlates were transformed into a scoring system. Each coefficient, rounded to the nearest integer, was used to assign the weight (number of points) of the respective predicting factor, the final score consisting of the sum of points for each patient. SPSS randomly selected 198 cases (evaluation group) to construct the model used for the scoring system, which was then applied to the remaining 197 cases (internal validation group). Receiver Operator Curve (ROC) analysis was applied and the score points with the optimal performance measures (sensitivity, specificity, positive and negative predictive value) were identified.

Results

During the study period 1241 cellulitis cases were admitted. Of these, 683 (55%) were randomly chosen (alphabetically) for further analysis, due to study duration limitations. Those selected were verified as being representative of the whole dataset in terms of age, sex, admission period and team, and ICD-10 major code (data not shown). Out of the 683 cases, 395 met the inclusion criteria. Of the 288 excluded, cellulitis was not the primary diagnosis in 143, was hospital-acquired in 52, was not the only reason for admission or complications were present on admission in 53, and 40 were excluded due to incomplete outcome data, health-care facility residence within the previous seven days, unresolved episode or age <16 years. Patient characteristics, co-morbidities and risk factors for cellulitis are shown in Table 1.

Clinical features

The lower limb was the affected site for 294 (74.4%) cases, followed by upper limb 56 (14.2%), face 19 (4.8%) and trunk 18 (4.6%). Cellulitis extended to >1 site (e.g. limb to trunk) in 8 (2.0%) cases. Lower limb cellulitis occurred in a significantly older age group (average 73y.o.) compared with cellulitis of the upper limb (63y.o.) and face (52y.o.) ($p < 0.01$).

Discharge from the cellulitic area was present in 109 (27.6%) episodes. For limb cellulitis, lymphangitis was