REVIEW

The classification and management of skin and soft tissue infections

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Abstract

Skin and soft tissue infections (SSTIs) are a common problem in patients presenting to the emergency department, varying from mild local inflammation to necrotizing fasciitis. SSTI were the 2nd most common indication for antibiotic use in Europe in 2006. Currently, the National Institute of Clinical Excellence (a UK based independent organization responsible for providing national guidance on the promotion of good health and the prevention and treatment of ill health) has not published any guidelines for the classification and management of these patients. This is a review of the evidence around attempts at developing classification systems for SSTI and their management. It also considers the financial implications for both the patient and the healthcare system and the personal ramifications for patients.

Introduction

The skin is the largest organ of the body and with the underlying fat layers, fascia and muscle, represents the majority of the tissue in the body (Dryden, 2010). Skin and soft tissue infections (SSTIs) are clinical entities of variable presentation, aetiology and severity that involve microbial invasion of the layers of the skin and underlying soft tissues (Koerner and Johnson, 2011). Presentation can vary enormously from mild local inflammation to life threatening necrotizing fasciitis (Koerner and Johnson, 2011). The clinical presentation of the different levels of SSTIs is beyond the scope of this paper. SSTIs are a common problem in patients presenting to the emergency department (ED). In the UK alone, 87,749 admissions with a diagnosis of cellulitis were recorded in 2009/2010 (Health and Social Care Information Centre, 2011).

Skin and soft tissue infections

SSTIs lead to considerable morbidity (Stevens et al., 2005) and result in a significant proportion of antibiotics prescribed in hospitals. Ansari et al. (2009) found that SSTI was the second commonest indication for antibiotic use across Europe in 2006 after lower respiratory tract infection (LRTI). Taking this into consideration, it is surprising to find...
that there is a paucity of evidence about the use of clinical scores to assess the severity of SSTIs and to predict outcome and guide therapy (Marwick et al., 2011).

At the time of writing, the National Institute for Clinical Excellence (NICE) has not issued any guidelines for the classification and management of patients with SSTIs. Over the last decade, there have been two attempts to establish classification systems for SSTIs and their management although neither has been validated in retrospective or prospective clinical studies (Koerner and Johnson, 2011).

**Classification systems**

The first of these attempts was by Eron et al. (2003) who proposed a classification system for SSTIs dividing them into four classes according to the severity of local and systemic signs and symptoms of infection, and the presence and stability of any co-morbidities (see Table 1, Fig. 1). Each class then has a plan for the management of these patients. The authors note that due to a lack of high level evidence available from randomized clinical trials, their recommendations are based on expert opinion.

Ki and Rotstein (2008) argue that this classification is overly simplified and the descriptions of patient presentations are ambiguous. Support for this comes from Marwick et al. (2011) who suggest that this could make classification of a patients’ illness severity unclear and subjective. It is also argued that the clinical features of classes 2 and 3 overlap which leaves the decision regarding management to the physicians’ discretion which provides little support for those lacking experience (Campbell et al., 2009). A further criticism of this study comes from Marwick et al. (2011) who found no evidence to support the use of intravenous (IV) antibiotics in patients with certain specified co-morbidities such as obesity or peripheral vascular disease. In class 4, Eron et al. (2003) use the term "sepsis syndrome" which Marwick et al. (2011) argues is poorly defined and out dated.

Despite all of these criticisms, the Eron classification has been adopted by the Clinical Resource Efficiency Support Team (CREST), and translated into the "Guidelines on the Management of Cellulitis in Adults" (Fulton, 2005). These UK guidelines advise on appropriate site of care, choice of antibiotics and route of administration depending on the clinical severity as stratified by Eron et al. (2003). However, the validity of these guidelines has never been proven by a clinical study (Koerner and Johnson, 2011). Marwick et al. (2011) also note that despite the number of hospital admissions due to SSTIs, it is surprising that there is very little evidence to inform practice guidelines and that currently the guidelines are based on expert consensus.

The second attempt to classify SSTIs and their management was made by Ki and Rotstein (2008) who proposed an algorithm based on clinical presentation, co-morbidity and the anatomical region and size of the affected body area leading to a classification of either mild or moderate to severe. They have used the "rule of nines" (Wallace, 1951) previously applied to burns patients to estimate the size of the lesion. Whilst this algorithm may prove to be useful, at present there is a lack of clinical evidence to support it. Marwick et al. (2011) also argue that it requires further study and validation.

A study by Marwick et al. (2011) in Dundee aimed to modify the Eron classification and apply it to a cohort of hospitalized patients with SSTIs. Their objectives were to compare the patients’ antibiotic therapy with the recommendations in the UK (CREST) guidelines and also assess the relationship between severity, management and outcomes. The CREST guidelines and classification criteria were modified in order to make them more objective and the four classes mutually exclusive. An internationally recognized definition of sepsis was used to replace poorly defined descriptions such as "sepsis syndrome" used by Eron (see Tables 2 and 3). A standardized early warning score (SEWS) of ≥4 was used to identify the most severely unwell

<table>
<thead>
<tr>
<th>Class</th>
<th>Patient criteria</th>
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<tbody>
<tr>
<td>1</td>
<td>Afebrile and healthy, other than cellulitis</td>
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<tr>
<td>2</td>
<td>Febrile and ill appearing, but no unstable co-morbidities</td>
</tr>
<tr>
<td>3</td>
<td>Toxic appearance, or at least one unstable co-morbidity, or a limb-threatening infection</td>
</tr>
<tr>
<td>4</td>
<td>Sepsis syndrome or life threatening infection, e.g. necrotizing fasciitis</td>
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Co-morbidities: peripheral vascular disease, diabetes mellitus, chronic venous insufficiency, morbid obesity.

Toxic appearance; changes in mental status, tachycardia, tachypnoea, hypotension.

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patients. This score was chosen as it has been demonstrated to predict in-hospital mortality and length of stay for medical patients (Marwick et al., 2011). The antibiotic therapy initiated for each patient was benchmarked against the recommendations in the CREST guidelines. In each case, the treatment was classified as: appropriate, under-treatment or over-treatment.

The retrospective study conducted by Marwick et al. (2011) looked at 205 patients admitted to hospital with SSTIs and assessed the appropriateness of the prescribed antibiotic therapy for each patient. Three key aspects were addressed in the management of SSTIs (Koerner and Johnson, 2011) firstly investigating the co-morbidities that may complicate or delay the resolution of SSTIs. The Eron and CREST guidelines recommend intravenous antibiotics for patients with certain co-morbidities such as obesity or peripheral vascular disease; however, as discussed previously, there is no evidence to support this assumption (Marwick et al., 2011; Jorup-Ronstrom et al., 1984). This led to the conclusion that groups 1 and 2 could actually be merged into one group and that the majority of these patients could be managed in the community with oral antibiotics (Marwick et al., 2011). The second key aspect of this investigation was the impact of sepsis as a complication of a primary SSTI. It was found that even in the absence of more severe physiological manifestations, patients in severity class 3 (sepsis but SEWS <4) had worse clinical outcomes than patients without sepsis (classes 1 and 2) which supports existing evidence.

Thirdly, Marwick et al. (2011) looked at the importance of using a SEWS and found it to be a powerful means of identifying high risk patients presenting with SSTIs. This supports previous evidence which showed that a SEWS of ≥4 on admission predicted in-hospital mortality and length of stay for general medical patients (Paterson et al., 2006).

Within this study of 205 patients, Marwick et al. (2011) found that there were 35 different antibiotic regimes prescribed, some of which were not appropriate for the condition. A similar outcome was found in the USA by Edelsberg et al. (2008). The study evaluated the appropriateness of antibiotic therapy prescribed according to the CREST guidelines. It demonstrated that only 26% of patients were treated appropriately with 43% of patients being over treated and 31% of patients being under treated.

Marwick et al. (2011) also note that defining appropriate antibiotic therapy in a clinical situation can be very difficult partly due to the constantly changing clinical climate. For example, since this study took place, the antibiotic protocol locally within the region has changed due to increasing concerns about clostridium difficile. This issue raises important clinical safety concerns when looking at the number of patients who were over treated with antibiotic therapy.

One possible explanation for the under treatment was that patients in class 2 were coded as under treated when they were given oral antibiotics when this may actually be as effective as IV antibiotics for this cohort of patients. The authors conclude that the choice of antibiotic therapy was not evidence based with significant under treatment of severely ill patients. This has obvious implications for patient mortality and morbidity.

This study has illustrated a notable uncertainty amongst doctors regarding appropriate antibiotic therapy for SSTIs. It is unclear if this is due to a lack of evidence based guidance or a lack of adherence to available guidance. This disturbing observation highlights the urgent need for training particularly in light of the rapidly increasing resistance to antimicrobial agents (Koerner and Johnson, 2011).

One weakness of this study is that it did not consider the effects of time to antibiotic administration or antibiotic dosing on patient outcome. This can influence outcome in
severely ill septic patients. Support for this comes from the National Patient Safety Agency (NPSA) 2010, who found that delays in administering antibiotics can lead to patient harm with serious and even fatal consequences.

A further study conducted by Campbell et al. (2009) aimed to discover if there were any differences in outcomes amongst patients with SSTIs treated according to the recommendations of a clinical guideline similar to that of Eron et al. (2003) and those treated otherwise and also to see if there was a difference in the cost of treatment in these two groups. Despite a number of limitations of this study identified by the authors themselves, they concluded that patients treated in accordance with the guidelines had similar outcomes to those treated differently with a significantly lower cost. They go onto recommend encouragement to comply with the guideline.

The majority of SSTIs are caused by *Staphylococcus aureus* and β-haemolytic streptococci (Dryden, 2010). Clinically, the microbial aetiology can often be predicted accurately in uncomplicated SSTIs with localized pus producing lesions and localized wound sepsis from Staphylococcal and rapidly spreading infections usually caused by β-haemolytic streptococci (Dryden, 2010). The treatment for Staphylococcal infections is generally antibiotics and surgical drainage, however, the choice of empirical therapy has been complicated by the emergence of strains with resistance to multiple agents (Dryden, 2010; Tenover, 2006). This illustrates the importance of local knowledge of epidemiology and susceptibility of pathogens in guiding the development of antibiotic guidelines. There are many other considerations in the choice of antibiotic therapy such as MRSA for example; however, discussion of this is beyond the scope of this paper.

**Discussion**

All of these factors discussed highlight several issues. Firstly, it has been suggested that the Eron classification upon which the UK guidelines are based is outdated, ambiguous, poorly defined and is open to interpretation offering little support to inexperienced staff. It is also based on expert opinion rather than clinical evidence. Adaptations to this guideline made by Marwick et al. (2011) appear to have provided an effective and easily applicable guideline for the treatment of patients with SSTIs but require further validation. The algorithm proposed by Ki and Rotstein (2008) again requires validation in clinical studies.

The study by Marwick et al. (2011) has also illustrated an uncertainty amongst prescribers regarding appropriate antibiotic therapy and highlighted the need for clear treatment guidelines. Campbell et al. (2009) have demonstrated the possible cost implications of failing to comply with antibiotic guidelines. This does not only relate to the actual cost of the antibiotics but also to the cost of admitting patients to hospital for IV antibiotics when they could be treated as effectively in the community with either oral or IV antibiotics. One should also consider the implications for the patient who is admitted to hospital unnecessarily which may have financial ramifications for them in terms of loss of earnings, as well as theoretically increasing the risk of iatrogenic effects for the patient.

**Conclusion**

This review of the literature highlights a need to look at national and international guidelines for the classification and management of SSTIs, adherence to them and patient outcomes. One approach to this could be to conduct a retrospective study similar to Marwick et al. (2011) in order to review current performance in the management of these patients. It may also be worth looking at the treatment of this cohort of patients within their own home rather than admitting patients requiring IV antibiotics in order to prevent hospital admissions. This is in line with the new UK emergency department clinical quality indicators aimed at reducing avoidable hospital admissions by improving the provision of ambulatory care for emergency conditions such as cellulitis (Department of Health, 2011). This review has highlighted the need for further research into the classification of SSTIs to develop an internationally agreed, evidence based classification and management system to inform practice guidelines for this cohort of patients. As demonstrated above, all of these factors have implications for patient safety and satisfaction as well as financial implications, both of which are constantly scrutinized in today’s financial climate in order to help healthcare professionals to deliver the highest standard of evidence based care.

**References**


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