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Low yield of blood and wound cultures in patients with skin and soft-tissue infections

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ABSTRACT

Background: Current guidelines recommend blood cultures in skin and soft-tissue infection (SSTI) patients only with signs of systemic toxicity and wound cultures for severe purulent infections. Our objectives were to determine: 1) blood and wound culture yields in patients admitted with SSTIs; 2) whether injection drug users (IDUs) and febrile patients had higher blood culture yields; and 3) whether blood and wound cultures grew organisms sensitive to typical SSTI empiric antibiotics.

Methods: We prospectively enrolled adult patients admitted from the ED with SSTIs at an urban hospital. We recorded patient characteristics, including IDU, comorbidities and temperatures, and followed admitted patients throughout their hospital course.

Results: Of 734 SSTI patients enrolled, 246 (33.5%) were admitted. Of 86 (35.0%) patients who had blood cultures, six had positive cultures (yield = 7.0%; 95% confidence intervals [CIs] 3.2–14.4); 4 were methicillin sensitive *Staphylococcus aureus* (MSSA) and 2 were methicillin resistant (MRSA). Of 29 febrile patients, 1 had a positive culture (yield = 3.5%; 95% CI 0.6–17.2). Of 101 admitted IDU patients, 46 (46%) received blood cultures, and 4 had positive cultures (yield = 8.7%; 95% CI 3.4–20.3).

Of 89 patients with purulent wounds, 44 (49.4%) patients had ED wound cultures. Thirteen had positive cultures (yield = 29.6%; 95% CI 18.2–44.2%). Most were MRSA, MSSA, and group A *Streptococcus* species – all sensitive to Vancomycin.

Conclusions: Febrile and IDU patients had low yields of blood cultures similar to yields in non-IDU and afebrile patients. All blood and wound culture species were adequately covered by currently recommended empiric antibiotic regimens.

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1. Introduction

In the era of highly prevalent community-acquired methicillin-resistant *Staphylococcus aureus* (MRSA), skin and soft tissues infections (SSTIs) are a common reason for hospital admission from the emergency department (ED) [1–4]. When working up patients with SSTIs for hospital admission, traditional teachings were to obtain cultures (blood and wound), as clinicians would do with most other types of infections. However, several studies of blood cultures for cellulitis have concluded that they offer no utility, and similar research has questioned the utility of wound cultures as well [5–10]. In response to these investigations, the current Infectious Diseases Society of America (IDSA)

guidelines recommend blood cultures only for patients with signs and symptoms of systemic toxicity (especially fever) and wound cultures only for moderate and severe purulent infections [11].

Most of the studies that formed the basis of the IDSA guidelines for SSTIs were performed in low risk patient populations and did not risk stratify patients according to the presence or absence of fever. Because they are at risk for endocarditis and occult, deep-seeded infections like epidural abscesses, the evaluation and admission decisions for injection drug users (IDUs) are often considerably different than those for other populations. For example, the standard practice for IDUs who present with a fever and no clear source is to obtain multiple blood cultures and admit to the hospital for observation. With these principles in mind, the objectives of this study were to determine the yields and utility of blood and wound cultures in patients admitted to the hospital from the ED with SSTIs in a population with a high percentage of IDUs and stratified according to fever. Specifically, we sought to determine

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1) the yields of blood cultures stratified according to the presence or absence of fever; 2) whether IDUs admitted with SSTIs had higher yields of blood cultures; 3) the yields of wound cultures; and 3) whether blood and wound cultures grew organisms that were resistant to typical SSTI empiric antibiotics.

2. Methods

2.1. Setting and participants

We conducted a pre-planned analysis of a prospectively enrolled cohort of patients who presented to the ED with SSTIs at an urban, county Level 1 trauma center from June 2010 to January 2013. On weekdays from 11:00 to 23:00, we screened and prospectively enrolled all adult patients (age >17 years) who presented to the ED and were admitted to the hospital with SSTIs. We identified patients by their triage complaints and confirmed SSTI by their final ED diagnoses. We excluded patients who were transferred from other hospitals or were sent to the ED from other clinics to wait for admission. At the time of this study, our hospital had a wound care clinic in operation three days per week from 09:00 to 17:00 – patients seen primarily in this clinic were not analyzed.

Research staff recorded all temperatures during the initial 6 h after ED presentation, and provided data collection forms to treating clinicians, who recorded elements of history (injection drug use, diabetes mellitus, and HIV), physical exam findings (location of infection, area of erythema, presence or absence of purulence, bullae, adenopathy, streaks, and necrosis), as well as results of complete blood counts and imaging (when performed).

Adhering to the principles of chart abstraction set forth by Gilbert et al., we followed admitted patients throughout their hospital course to determine culture results, antibiotic sensitivities, hospital interventions, survival and other outcomes [12].

2.2. Definitions, outcomes and analyses

We defined fever as any temperature ≥ 38 °C during the first 6 h of ED stay. A positive blood culture was defined as one or more cultures that grew bacterial organisms (per microbiology lab reports), and a positive wound culture was defined similarly per lab reports. Endocarditis was defined according to discharge diagnoses, which were primarily based on Modified Duke Criteria.

We primarily analyzed data using standard descriptive statistics [frequency percentages and differences in proportions with 95% confidence intervals (CIs) surrounding these calculations]. Our primary outcomes were yields of positive blood cultures and positive wound cultures, in which yield was defined as # positive cultures/total patients

who had that culture performed. Our research protocol was approved by the institutional review board.

3. Results

Of 734 patients enrolled, 246 (33.5%) were admitted to the hospital. Their median age was 45 (IQR 33–53) years, and 185 (75%) patients were male. See Table 1 for characteristics of admitted patients.

Of the 86 (35.0%) patients who had blood cultures, six had positive cultures (yield 7.0%; 95% CI 3.2–14.4%). All blood culture organisms were sensitive to the vancomycin used in these patients; 4 were methicillin sensitive *Staphylococcus aureus* (MSSA) and 2 were MRSA. Most patients 56 (65%) who had blood cultures did not have fever; 5 of these afebrile patients had positive cultures (yield 8.9%; 95% CI 3.9–19.3%). Of 29 patients with fever, only 1 patient had a positive culture (yield 3.4%; 95% CI 0.6–17.2%). Of the 101 admitted IDU patients, 46 (46%) received blood cultures, and 4 had positive cultures (yield 8.7%; 95% CI 3.4–20.3%). Of 145 admitted non-IDU patients, 40 (28%) received blood cultures, and 2 had positive cultures (yield 5.0% CI 1.4–16.5%). The 1 patient (1.2%; 95% CI 0.2–6.3%) in this cohort who was diagnosed with endocarditis was not an IDU and did not have fever.

Of 89 patients with purulent wounds, 44 (49.4%) patients had wound cultures performed in the ED; 13 had positive cultures for a yield of 29.6% (95% CI 18.2–44.2%). Fourteen (32%) of patients who had cultures had fever and 21 (48%) also had blood cultures in the ED. The predominant bacteria grown from these wounds were four MRSA, four MSSA, three group A *Streptococcus* species, and two poly-microbial species (*Corynebacteria*, *Enterococcus*, *Escherichia coli*, and *Streptococcus viridans*). All of the Staph species were sensitive to Vancomycin and one was resistant to Clindamycin. Only 1 patient (5%) also had a positive blood culture, which grew the same MSSA species that was seen in that patient's wound culture. None of the patients with positive blood or wound cultures had a change in their antibiotic regimens after results of cultures.

4. Discussion

Although blood culture results are the gold standard for the determination of bacteremia and endocarditis, in several clinical scenarios they have failed to significantly alter patient management and are no longer routinely recommended. The treatment of patients with pyelonephritis is largely empiric with urine culture serving as the only useful microbiologic test [13–14]. Although current IDSA guidelines recommend against routine blood cultures in patients with SSTI, they still suggest that they may be indicated in IDUs and in patients with fever. In this study we found that blood cultures had low yields of organisms in febrile patients and in IDUs that was not significantly different than the yields in afebrile, non-IDU patients. Furthermore, all organisms from the blood cultures were susceptible to standard, empiric SSTI antibiotics.

Although wound cultures of purulent SSTIs had a higher yield for organisms than blood cultures, only one culture yielded an organism that is not covered by standard empiric SSTI antibiotics (*E. coli*). This patient had a hand abscess that resolved with standard incision and drainage and vancomycin. The need for antibiotics in the treatment of small, appropriately drained abscesses is suspect [15].

Several other investigators have noted low yields and little utility of blood cultures in patients with SSTIs [5,16,17]. In a large retrospective study, Perl et al. found that blood culture yield is low with little impact in patient management, and this practice may be resource consuming and costly [5]. Similarly for wound cultures, other investigators have found predictable isolated microorganisms (typically Staph species), with sensitivity patterns that are adequately by standard empiric SSTI antibiotics. Given our similar findings in higher-risk, febrile and IDU patient populations, it is reasonable to restrict blood and wound cultures even further in these groups.

Table 1

Admitted patient characteristics (N = 246).

Characteristic	Median (IQR)
Age in years	49 (39,56)
	Number (%)
Male	185 (75.2%)
Injection drug use (IDU)	101 (41.1%)
HIV positive status	23 (9.3%)
Diabetes	53 (21.5%)
Main infections ^a	Number (%)
Cellulitis	164 (66.7%)
Abscess	62 (25.2%)
Leg/foot ulcer	27 (11.0%)

IQR = interquartile ratio; HIV = Human Immunodeficiency Virus.

^a Can have >1 type of infection.

4.1. Limitations

Although we enrolled a large number of patients, few had cultures performed and therefore the confidence intervals surrounding our point estimates of yields were wide. We did not record or control for administration of antipyretics – this may have falsely decreased our sample population with measured fever. Although we recorded temperatures, we did not record other vital signs. Clinicians may have ordered cultures in response to other clinical or laboratory markers of systemic illness, such as tachycardia, tachypnea, hypotension, and elevated lactate levels.

This was a single site study at a teaching hospital where resident physicians are commonly the primary providers – the ordering of blood and wound cultures at non-teaching institutions may differ substantially. Likewise, our yields and other findings may not reflect those that might be obtained in dissimilar patient populations, but examining yields in a high IDU prevalence ED was precisely one of our aims in this study.

Albeit with small numbers, we did note as a secondary finding that all of our positive blood cultures yielded *Staphylococcus aureus* species. The IDSA guidelines recognize that although *S. aureus* is an uncommon cause of cellulitis, its prevalence increases in patients who experience penetrating trauma, including injection drug use. Our findings provide further support to the IDSA guideline recommending that antibiotic treatment in IDUs should cover *S. aureus*.

5. Conclusions

Contrary to published guidelines, ED clinicians still commonly obtain blood cultures in afebrile, non-IDU patients. Febrile and IDU patients had low yields of blood cultures similar to the yield in non-IDU and afebrile patients. All positive cultures were *Staphylococcus* species (MSSA and MRSA) that would be adequately covered by currently recommended empiric antibiotic regimens. Although wound cultures of abscesses and NSI produce a moderate yield of organisms, their utility in changing patient management is also limited. Most cultures were *Staphylococcus* and *Streptococcus* species that were adequately covered by currently recommended empiric antibiotic regimens.

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Author contributions

All authors formulated the study design and contributed to the article composition. RMR takes responsibility for the paper as a whole.

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