Contamination of Catheter-Drawn Blood Cultures

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Contamination of blood cultures causes diagnostic confusion and sometimes leads to unnecessary use of antimicrobial agents. Previous studies comparing contamination of blood drawn through an intravascular catheter with simultaneous direct venipuncture have shown mixed results and included small numbers of patients (1–5, 7–9). To conduct a more-comprehensive comparison of the frequencies of contamination for these two collection methods, we undertook a 2-year retrospective study at a tertiary-care medical center.

Using a computerized database, we identified retrospectively all samples submitted for blood culture from adult or pediatric patients at our hospital between January 1997 and December 1998. From these samples, we identified matched pairs of blood cultures, each consisting of one sample labeled as being taken through an intravascular catheter and the other labeled as being taken by direct venipuncture, both of which were collected from the same patient within a 20-min time span. The specific type of intravascular catheter used was determined from the clinical notes if the label did not contain this information. During the study period, blood culture collection had been undertaken by various nursing and medical staff without standardization of technique. Blood for culture was inoculated into media for processing in a BACTEC 9240 or BacT/ALERT automated blood culture system and incubated either until microbial growth was detected or for 5 days; isolates from positive bottles were identified by standard techniques.

Each positive blood culture isolate was categorized by either an adult or pediatric infectious diseases or medical microbiology physician as clinically significant, indeterminate, or a contaminant. This assessment of significance was based on the compatibility of the patient’s actual clinical features with typical features of infection with that microorganism as described previously by our group (10). An episode was defined as a period beginning with the first positive blood culture and ending when 7 days (2 days for coagulase-negative staphylococci) had passed without another positive blood culture with the same microorganism, regardless of whether negative cultures were drawn in the intervening days (6, 10). Blood cultures yielding one or more contaminants and one or more truly bacteremic organisms were counted under both categories. We calculated and compared true bloodstream infection rates and contamination rates for matched pairs of catheter-drawn and direct venipuncture samples. The background contamination rates from contemporaneous pediatric and adult studies at our hospital were 2.4% (L. B. Reller, P. O. Adholla, and S. Mirrett Abstr. 98th Gen. Mtg. Am. Soc. Microbiol., abstr. C341, 1998) to 3.5% (6).

From a total of 71,109 blood cultures submitted to the clinical microbiology laboratory during the 2-year period, we identified and analyzed 1,408 pairs of concurrent catheter-drawn and venipuncture samples. Overall true bloodstream infection and contamination rates are presented in Table 1; the higher rate of contamination of cultures collected by intravascular catheter was statistically significant (P = 0.001 by the chi-squared test). Contamination rates for individual intravascular catheter types were as follows: implantable ports (e.g., Port-a-cath), 7 of 166 (4.2%); subcutaneous tunneled and cuffed central venous catheters (e.g., Hickman), 21 of 767 (2.7%); nontunneled central venous catheters, 16 of 245 (6.5%); unspecified central venous catheters, 0 of 31; peripherally inserted central venous catheters, 3 of 57 (5.3%); and arterial catheters, 7 of 142 (4.9%). There was no statistically significant difference between these type-specific contamination rates (P = 0.99 by binomial data analysis). The contaminating microorganisms isolated from catheter-drawn samples were more diverse (included 33 coagulase-negative staphylococci, 6 diphtheroids, 5 viridans group and nonhemolytic streptococci, 4 enterococci, 2 Staphylococcus aureus isolates, and 1 isolate each of Micrococcus sp., Lactobacillus sp., Propionibacterium sp., Enterococcus sp., Escherichia coli, Clostridium perfringens, Veillonella sp., Bacteroides sp., mixed gram-positive bacteria, and Candida sp.) than those isolated from venipuncture samples (included 21 coagulase-negative staphylococci, 2 isolates of Micrococcus sp., and 1 isolate each of Propionibacterium sp., Bacillus sp., Peptostreptococcus sp., and Clostridium septicum).

Our data indicate that intravascular catheter-drawn blood cultures are more likely to be contaminated than direct venipuncture blood cultures. This comparison of the contamination-
tion rates by the two methods of blood collection is validated by concordance of the true-positive rates. However, the retrospective design of this study precluded standardization of collection technique and assurance of accurate labeling for all samples that may have been eligible for inclusion. Moreover, although the investigators were assiduous and experienced, their categorization of isolates was subjective and not blind, as are ultimately all clinical judgments. The comparison of contamination rates for individual intravascular catheter types is particularly problematic, because insertion technique for, use of, and care for the different catheter types were not standardized.

Several researchers previously have compared simultaneous catheter-drawn and direct venipuncture blood cultures to seek to answer the same question addressed in this study. All studies including preexisting intravascular catheters (1, 3, 4, 8, 9), including our study, have shown a higher rate of contamination for catheter-drawn samples; all studies including only newly inserted intravascular catheters (2, 5, 7) have shown no increase in contamination for catheter-drawn samples.

We do not believe that the increased risk of contamination contraindicates the use of intravascular catheters for blood culture collection, but our findings do support the recommendation to take a catheter-drawn sample only when direct venipuncture is not possible or safe. Moreover, if blood from a catheter after initial insertion is cultured, we recommend collecting a second and concurrent independent venipuncture sample to aid interpretation should contamination occur. Last and importantly, clinicians must be aware of the pitfalls in interpretation of positive catheter-drawn samples.

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REFERENCES


TABLE 1. Clinical significance of results of concurrent intravascular catheter-drawn and direct venipuncture blood cultures

<table>
<thead>
<tr>
<th>Clinical significance of blood culture results</th>
<th>No. of samples (%)</th>
<th>Catheter-drawn</th>
<th>Direct venipuncture</th>
</tr>
</thead>
<tbody>
<tr>
<td>True bloodstream infection</td>
<td>203 (14.4)</td>
<td>193 (13.7)</td>
<td></td>
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<tr>
<td>Contamination</td>
<td>54 (3.8)</td>
<td>26 (1.8)</td>
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<tr>
<td>Indeterminate</td>
<td>23 (1.6)</td>
<td>12 (0.9)</td>
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<tr>
<td>Negative</td>
<td>1,128 (80.1)</td>
<td>1,177 (83.6)</td>
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</tr>
<tr>
<td>Total</td>
<td>1,408 (100)</td>
<td>1,408 (100)</td>
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