Blood Culture Accuracy: Discards From Central Venous Catheters in Pediatric Oncology Patients in the Emergency Department

Authors: Elizabeth J. Winokur, PhD, RN, CEN, Debra Pai, BSN, RN, CEN, Dana N. Rutledge, PhD, RN, Kate Vogel, MA, CLS, MT (ASCP), Sadeeka Al-Majid, PhD, RN, Christine Marshall, MSN, RN, CEN, CPEN, and Paul Sheikewitz, MD, Fullerton and Orange, CA

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Introduction: Lack of specific guidelines regarding collection of blood for culture from central venous catheters (CVCs) has led to inconsistencies in policies among hospitals. Currently, no specific professional or regulatory recommendations exist in relation to using, reinfusing, or discarding blood drawn from CVCs before drawing blood for a culture. Repeated wasting of blood may harm immunocompromised pediatric oncology patients. The purpose of this comparative study was to determine whether differences exist between blood cultures obtained from the first 5 mL of blood drawn from a CVC line when compared with the second 5 mL drawn.

Methods: During 2009-2011, 62 pediatric oncology patients with CVCs and orders for blood cultures to determine potential sepsis were enrolled during ED visits. Trained study nurses aseptically drew blood and injected the normally discarded first 5 mL and the second specimen (usual care) into separate culture bottles. Specimens were processed in the microbiology laboratory per hospital policy.

Results: Positive cultures were evaluated to assess agreement between specimen results and to determine that the identified pathogen was not a contaminant. Out of 186 blood culture pairs, 4.8% demonstrated positive results. In all positive-positive matches, the normal discard specimen contained the same organism as the usual care specimen. In 4 matches, the normally discarded specimen demonstrated notably earlier time to positivity (4 to 31 hours) compared with the usual care specimen, which resulted in earlier initiation of definitive antibiotics.

Discussion: These findings support the accuracy of the specimen that is normally discarded and suggest the need to reconsider its use for blood culture testing.

Key words: Research; Blood culture; Blood discards; Central venous catheter (CVC); Oncology

Inconsistencies exist in collection procedures for blood cultures from central venous catheters (CVCs). In our hospital emergency department, the first 5 mL of blood drawn from CVCs is discarded before a culture sample is obtained. Repeated discarding of blood in patients can cause potential harm, particularly when children have oncologic or

Elizabeth J. Winokur, *Member, Orange Coast Chapter*, is Clinical Educator, Emergency Department & Behavioral Health Services, St. Joseph Hospital, Orange, CA.
Debra Pai, *Member, Orange Coast Chapter*, is Clinical Nurse III, St. Joseph Hospital, Orange, CA.
Dana N. Rutledge is Professor, California State University, Fullerton, CA.
Kate Vogel is Supervisor, Microbiology and Immunology, St. Joseph Hospital, Orange, CA.
Sadeeka Al-Majid is Associate Professor, California State University, Fullerton, CA.
Christine Marshall, *Member, Orange Coast Chapter*, is Clinical Nurse IV, St. Joseph Hospital, Orange, CA.
Paul Sheikewitz is ED Physician, St. Joseph Hospital, Orange, CA.

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For correspondence, write: Elizabeth J. Winokur, PhD, RN, CEN, Clinical Education, St. Joseph Hospital, 1100 W Stewart Dr, Orange, CA 92863-5600; E-mail: beth.winokur@stjoe.org.
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hematologic conditions. Currently, evidence is lacking to support the practice of discarding the first 5 mL of blood obtained from a CVC. Therefore the purpose of this study was to determine whether differences exist between blood cultures obtained from the first and second 5 mL samples of blood obtained from CVC lines.

Background and Literature Review

Current practice guidelines do not include recommendations about whether to discard, use, or reinfuse blood drawn prior to obtaining blood for cultures.[1-3] In fact, policies and practices vary regarding CVC line insertion, access, and maintenance for both children and adults.[4-8] Penwarden and Montgomery[5] developed a protocol for blood cultures in patients with CVCs based on the little available evidence and expert opinion. This protocol requires a peripheral blood draw along with the CVC draw; blood samples for cultures are drawn from all central line lumens with no discarding of blood. No outcomes have been reported from use of this protocol.

In practice, methods that involve discarding the first sample of blood obtained from a CVC are common.[9] The rationale behind discarding a first sample is to remove potential contaminants such as heparin or saline. This practice assumes that blood immediately beyond the catheter hub is diluted by flush solutions that can inhibit microbial growth or increase contamination rates.[10] Policies that recommend not discarding blood aim to minimize blood loss.[9]

Research supports the accuracy of laboratory results obtained from CVCs for specific assays, including hematology and chemistry panels,[11] antibiotic levels,[12] cyclosporine,[13] fibrinogen,[14] and blood cultures.[14,15] In a prospective cohort study of critically ill medical patients, Beutz et al[16] concluded that the negative predictive value (negative results that are correctly interpreted) of blood specimens from CVC lines is good; however, sensitivity may not be adequate (the gold standard is peripheral blood). In a systematic review with pooled data, cultures obtained from blood drawn from CVCs in hospitalized patients with cancer had 89% sensitivity and 95% specificity compared with peripheral blood.[15] The authors reported similar issues with sensitivity in a systematic review of 2677 patients: 63% sensitivity from specimens drawn from CVCs, and 79% with peripheral blood specimens. DesJardin et al.[17] found a low positive predictive value (PPV) of cultures drawn from CVCs and concluded that "a positive result from a catheter needs clinical interpretation and may require confirmation" (p. 647). No researchers in any of these studies indicated whether the protocol required blood to be discarded. In a systematic review comparing performance characteristics of blood cultures obtained using vascular devices compared with peripheral needle sticks, Falagas and colleagues[15] found that in half of studies, blood was discarded before culture specimens were obtained.

We found little research regarding the amount of blood that should be discarded to obtain accurate samples for hematology, chemistry, or coagulation studies.[11,14,18] Shulman and colleagues[12] studied 96 pediatric inpatients with CVCs to determine the amount of blood withdrawal necessary to obtain accurate results. Based on data [findings not provided], they reported that "the results from the first aliquot discarded did not compare favorably with those from the second or third" [12, p. 178]; however, they failed to include the data analysis on which this conclusion was based. These authors concluded that the amount of blood discarded should be determined by the size of the CVC; discards of 0.3 mL in infants and 1.0 mL in children prior to blood culture specimen withdrawal from CVCs were deemed adequate.[12] This study has not been replicated. No studies were found in which drawing of blood for cultures in community hospital emergency departments was investigated.

Preliminary Investigation

Subsequent to a literature review using Medline to determine whether a national standard of care existed for blood withdrawal from CVCs for cultures, telephone calls were made to emergency personnel in major pediatric and oncology medical centers in the United States. Concurrently, an E-mail request was sent to a list of pediatric emergency managers. Responses showed divergent policies: most hospitals discard 3 to 5 mL before drawing blood for a blood culture specimen; some hospitals changed catheter hubs before drawing blood and did not discard any blood; and some hospitals used the initial specimen and did not discard any blood.

Significance

Given significant variability among emergency departments regarding whether the first withdrawn CVC specimen for blood cultures is used, evidence is needed to establish practice recommendations.

Research Questions

The following research questions were formulated to address these issues and relate to blood drawn from CVCs