Editorial

Pseudobacteremia

Blood is a very special juice.
Goethe, *Faust*

Pseudobacteremia implies that bacteria isolated from blood culture media originated outside of the patient's bloodstream. Reports of pseudobacteremia have increased with the advent of instrumentation to detect blood borne bacteria;[1-3] in fact, the term pseudobacteremia[4,5] entered the literature just recently as preferable to terms such as pseudosepsis.[6] Since automated devices now process about one-half of all the blood cultures done in the US, reliability in these devices is mandatory. Three reports, the first in 1981, have already documented the problems of ineffective sterilization and contamination of radiometric devices (Table).[7-9] In this month's issue of *Infection Control,* two more outbreaks of pseudobacteremia are described associated with automated radiometric blood culture analyzers.[10,11] In the current description of *Bacillus sp.* pseudobacteremia, Gurevich et al deduced that spores were introduced into the blood culture bottle, possibly from dust settling on the floor of the machine.[11] They advised regular cleaning of this area of the machine and moving the machine away from ventilation ducts and windows. Though *Bacillus sp.* can usually be regarded as contaminants, more troublesome is the report of Craven et al of oxacillin-resistant *S. aureus* which was propagated in an automated radiometric system *during* a true outbreak of oxacillin-resistant *Staphylococcus aureus* at Boston City Hospital.[10] Retrospectively, there were good clues that the false-positive blood cultures were from uninfected patients, but the false positives took months to discover. Mock attempts to mimic cross-contamination revealed that media harboring bacterial growth foamed at the bottleneck, thus allowing the sampling needle to contact bacteria directly and to transmit a small inoculum to subsequent bottles.

At the Medical University Hospital, we have been using the Bactec 460 in our laboratory since 1977. Each month we process approximately 1,000 blood cultures of which about 15% are positive. The use of this instrument has improved the speed of detection of organisms in blood cultures and reduced the time our technologists have to spend in that area. During six years of Bactec 460 usage, we have never documented epidemic pseudobacteremia. We do adhere to the manufacturer's recommendations that the needle be changed daily and the needle sterilizer be changed (depending on the volume of blood cultures processed) on a routine basis. These recommendations are the minimal ones and other laboratories may opt more often for this prophylaxis against pseudobacteremia.

Cost looms as a major issue in pseudobacteremia. Neither of the present reports eliminates the cost of its pseudoepidemic although Craven et al indicate that 18% of their patients were treated for true bacteremia.[10] Potential expenditures for such cases could be extensive with these costs distributed among several hospital departments. We do not know if extra days of hospitalization or additional and unnecessary culturing resulted from the false-positive cultures, but they likely did. Earlier studies have shown that the extra hospital days incurred from nosocomial bloodstream infections average about 7.4 days, only slightly shorter than the 7.7 days for surgical wound infections.[12] There are over 6,000 general hospitals in the US, accounting for over 1,000,000 beds. If we assume from published data that each day one in every ten hospitalized patients has a blood culture and about 10% of these cultures are positive, then about 10,000 apparent bacteremias occur per day in the US alone. If we make a most conservative estimate that only 1% of the positive blood cultures are falsely positive, then at least 100 patients per day in the US have a false-positive episode. If we further assume that hospitalization is extended by only one day (instead of 7), and that the average daily cost of hospitalization is $600 (for our hospital currently), then the minimal cost incurred for false-positive blood cultures in the US would be $60,000 a day or about $22,000,000 a year. Studies to verify such assumptions are needed. Yet, even if it is shown that extra hospital days do not result, it is still likely that physicians generate unneeded expenditures with extra cultures and other diagnostic tests when faced with the report of a positive blood culture. For instance, if physicians order only one additional blood culture for each pseudobacteremic patient, at $50 per culture, a large annual expenditure results.

Who is responsible for these extra costs? In an age of prospective payment systems related to diagnosis related groups (DRGs), will such unnecessary costs be excluded from reimbursement for co-morbidity? More likely, under the pressure of DRG legislation, medical record departments will welcome another reimbursable diagnosis, sepsis, to cushion the DRG crunch. These issues need to be dealt with on a local and national level.

Clearly, the way to limit unnecessary expenditures—not

Address reprint requests to J.F. John, MD, 916 CSB, Medical University of South Carolina, Charleston, SC 29425.

TABLE
PSEUDOBACTEREMIA ASSOCIATED WITH RADIOMETRIC BLOOD CULTURE ANALYZERS

Authors	Organism(s)	No. Patients	Defect
1. Greenhood et al[7]	*K. pneumoniae*	13	Sampling needle
2. Griffin et al[8]	*K. pneumoniae*	2	Defective circuit
	S. pyogenes	1	board resulting in
	S. epidermidis	1	inadequate needle
			sterilization
3. Berger[9]	*Bacillus sp.*	15	Contaminated cotton swabs
4. Craven et al[10]	*S. aureus*	11	Needle sterilization
	S. epidermidis	10	
	Streptococcus sp.	1	
	E. coli	1	
5. Gurevich et al[11]	*Bacillus sp.*	26	"Dust" on machine surface

to mention possible morbidity—is to prevent or to detect false-positive blood cultures before clinicians pull their therapeutic and diagnostic triggers. Several published discussions have outlined systematic approaches to recognizing pseudobacteremia.[2,13] Quality control for automated devices certainly needs to be rigorous, but straightforward. Technicians need to scrutinize the machines under their charge to insure that they work properly. Clinical microbiologists need to create means to detect patterns suggesting false-positivity. For instance, clinical microbiology laboratories which do not routinely perform mock controls could perform mock runs with standard bacteria as an acid test to determine the sterility of crucial machine parts. Additionally, a "validity index" based on computer-generated variables could accompany each blood culture report, indicating the statistical likelihood of the culture being a true positive. Infection control personnel who could contribute to such an index also need to survey bacteremia data in a timely fashion and interact with the laboratories and the wards.[14] Clinicians need to realize that *Bacillus sp.* and coagulase-negative staphylococci are not the only bacteria that produce false-positive blood cultures particularly if an automated device is used.[7,8,10] Clinicians also need to depend on their bedside acumen to determine if bacteremia is likely. Yet the so-called "afebrile bacteremia" of the aged[15] and the very young[16] plus low-grade bacteremia detected in cancer patients[17] complicate such a determination. Hospital epidemiologists need to determine if physicians respond more appropriately to blood culture data than they do to antimicrobial susceptibility data.[18] Finally, we need to proceed with better methods of bacteremia detection, realizing that with every step added to the sequence of detection, we risk slipping further into technological traps.[19]

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Joseph F. John, Jr., MD
Edward R. Bannister, PhD
Departments of Medicine and
Laboratory Medicine
Medical University of South Carolina and
Veterans Administration Medical Center
Charleston, South Carolina