Septicemia from Disposable Pressure-Monitoring Chamber Domes
"Beware of Greeks Bearing Gifts"

"I fear the Greeks even when bringing gifts," heeded Laocoön, vainly, in regard to the Trojan horse. Seemingly innocuous on external appearance, the hollow figure contained the seeds of Troy's destruction. There is an analogy between Virgil's tale and the epidemic experience reported by Buxton and his co-workers in this issue of Chest (see page 508).

Nosocomial (or hospital-acquired) infections are now recognized as one of the major problems of infectious disease in the developed countries; between 5 and 15 percent of the 40 million patients admitted to hospitals in this country every year develop an infection during hospitalization that they did not have when they entered the hospital. Most of these infections, especially those occurring in immunologically competent patients, are related causally to surgical operations or exposure to invasive devices such as urethral catheters, endotracheal tubes, or vascular cannulas. Rates of nosocomial infection have, not surprisingly, been highest (exceeding 50 percent) in patients confined to intensive care units for treatment of multiorgan failure. While far from optimal, the techniques of asepsis with regard to the use of invasive devices are sufficiently advanced so as to assure relative freedom from infection with limited exposures.

Infusion-related sepsis (bacteremia deriving from infection of the cannula wound or from contaminated infusate) is probably the most insidious and least frequently recognized nosocomial infection, in great measure due to the commonplace role of infusion therapy in modern hospitals. Over one-half of the 40 million Americans who are hospitalized each year receive some form of infusion, i.e., for administration of fluid and electrolytes, blood, or drugs, or, increasingly, for hemodynamic monitoring. The infectious complications with infusion therapy, which are estimated to exceed 25,000 cases of bacteremia each year in this country alone, have been appreciated only in the past decade; the risks of sepsis from intra-arterial monitoring systems have been recognized only in the past five years. Widespread recognition of these iatrogenic hazards has been frustratingly slow but has been abetted by the occurrence of major epidemics, such as the one reported by Buxton et al.

Most infusion-related septicemias appear to be of extrinsic origin, i.e., derive from microorganisms introduced into an infusion or the cannula wound after the infusion has been set up for use in the hospital. The ritual of asepsis during insertion of a catheter and the protocol advocated for management of infusions in general are specifically designed to reduce the risks of infection from extrinsic contamination. A quantum advance for further reducing the hazards of extrinsically introduced microorganisms has been the availability of commercially manufactured items for clinical use that are disposable; these items, in theory, obviate the problems of nonstandardized and poorly monitored procedures for sterilization within hospitals and the disastrous consequences of failure of sterilization of reusable materials that come into direct contact with the patient. Extending far beyond inexpensive disposable syringes and needles that have significantly reduced the risks of nosocomial hepatitis, the vast list of disposable items now available includes drapes and sheets, urethral catheters, dressing and procedure trays of all types, ventilator circuits which come into direct contact with the patient, and, most recently, disposable transducer chamber domes for use in intra-arterial pressure monitoring systems.

The use of invasive hemodynamic monitoring systems in critically ill patients has exploded in the past decade. Arterial pressure monitoring, usually through radial or femoral arterial catheters, and the use of flow-directed pulmonary arterial (Swan-Ganz) catheters are now considered almost routine for critically ill patients in most large medical centers. While the quantitative hemodynamic data so derived are often of considerable value for the optimal management of these patients, the potential for misuse of invasive monitoring is also considerable and, it would appear, has not been adequately explored. Eight prior outbreaks of bacteremic infection or hepatitis deriving from contamination of intra-arterial monitoring systems bear this out. In all of these outbreaks, infection was produced by extrinsically contaminated infusate within the system; contamination stemmed from heparin-containing flushing solutions prepared from multidose vials, from contaminated ice used to chill syringes for obtaining specimens of arterial blood, and, in six outbreaks, from lack of an optimal protocol for cleaning and sterilizing reusable transducer cham-
ber domes,\textsuperscript{4,5} \textit{ie}, using chemical methods of disinfection with agents (such as aqueous solutions of benzalkonium) that are not reliably effective against many gram-negative bacilli.

Disposable domes for transducers, which are now available, seemingly should obviate the problems of resterilization of the components of the transducer within hospitals; however, the outbreak reported by Buxton et al, another epidemic to reinforce in the minds of physicians the iatrogenic hazards of invasive monitoring, points out most convincingly that even if commercial items are truly sterile when they arrive in the hospital, as they fortunately usually are, they can readily become contaminated during clinical use. Moreover, seemingly insignificant practices in the use of such items, such as using a solution of dextrose in water rather than saline solution as the infusate in monitoring systems, can have portentous consequences. The use of disposable sterile items must not inculcate a sense of false security and relax attention to good aseptic practices or diminish vigilance for related iatrogenic disease.

Unfortunately, the initial source of contamination of permanent components of transducers in the epidemic at Hartford Hospital was not identified. Most likely, a single transducer became contaminated during use; this contamination was perpetuated and spread by the failure of personnel to routinely decontaminate transducers after use in each patient. Personnel were apparently deluded that the use of sterile disposable domes provided a fail-safe barrier against any contamination reaching the patient. All reusable components of transducers should be cleansed and sterilized, ideally with ethylene oxide gas, between use with different patients.\textsuperscript{4}

Relatively few studies have examined the infectious hazards of intra-arterial catheters \textit{per se} when used for hemodynamic monitoring. In a recent prospective study of 130 intra-arterial catheters used in patients with prolonged respiratory and other multiorgan failure, we found that 18 percent of the catheters produced local infection, and 4 percent produced sepsis;\textsuperscript{9} overall, 12 percent of all nosocomial bacteremias identified in these patients during the study originated from an arterial catheter. All catheter-related septicemias occurred with arterial cannulations exceeding four days ($P < 0.001$), and placements of catheters by cutdown (rather than percutaneously) were associated with an increased risk of infection. Intercurrent systemic antimicrobial therapy did not protect against catheter-related septicemia but may have been responsible for the predominance of enterococci, gram-negative bacilli, and Candida in these infections.

It is now clear that all types of invasive monitor-

\textbf{REFERENCES}


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