The Midline Intravenous Catheter: Meeting the Challenges of Patient Safety and Cost Control

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The last decade of evolution in the efforts to reduce healthcare-acquired infections (HAIs) has seen a multitude of new initiatives and requirements that address, among other issues, the elimination of central line-associated bloodstream infections (CLABSIs). Organizations such as the Institute for Healthcare Improvement (IHI),[1] the Centers for Disease Control and Prevention (CDC)[2] and the Joint Commission (JC) all have set standards or outlined specific recommendations that bundle scientifically-supported interventions aimed at reducing CLABSIs in critical care units in United States hospitals. Currently, more than 3,000 hospitals across the U.S. have responded to a call-to-action from the IHI and implemented extensive programs that involve continuous team-centered approaches to aseptic practice during insertion and care of intravascular central lines.

The Joint Commission (JC)'s proposed expansion of its National Patient Safety Goals for 2010 will require hospitals to extend prevention efforts to patients with central lines on non-critical care units.[3] Considering that a key CLABSI prevention intervention addresses the need for daily review of catheter necessity, this new JC requirement makes it imperative that novel strategies be considered for patients that may no longer require a multi-port central line but still need extended intravascular access. Such alternate approaches should include the use of an intravascular catheter that offers increased patient safety by reducing the risk of infection.

The heightened emphasis on eliminating CLABSI stems from some very sobering statistics. Although extensive inroads have been made in the prevention of healthcare-acquired bloodstream infection, recent estimates indicate that approximately 250,000 CLABSIs still occur in hospitals. [4] Of these, more than 80,000 occur in intensive care units with 30,000 patients dying as a result of acquiring such infections. The cost to the healthcare system is staggering: an average of $45,000 per infection with a total cost to U.S. hospitals of $2.3 billion.[5] The Centers for Medicare & Medicaid has since Oct. 1, 2008 instituted new reforms in which reimbursement for hospital-acquired CLABSI will not qualify for higher payment rates.[6] With shrinking third-party dollars and in light of the recent national debate on control of healthcare costs, the issue of infection control becomes imperative.

One answer to the complexity of cost and safety in intravenous delivery may be the midline catheter. Midline catheters are generally used to deliver many of the same medications or isotonic solutions used through a peripheral intravenous catheter (PIV) including a variety of antibiotics. Unlike PIVs which are recommended to be replaced every three to four days,[7] midline catheters are used in patients requiring more than five days of infusion therapy. A typical duration of use for a midline catheter is from two to four weeks. The extended period of use provides several benefits that positively impact current healthcare concerns: staff efficiency resulting from a reduction in clinician time expended during frequent catheter replacements; cost savings resultant from the reduction in the overall number of supplies; and improved patient satisfaction scores that stem from less frequent patient discomfort that occurs when multiple PIV replacement procedures are necessary.

The ability of a midline catheter to be used safely for extended periods of time is due in part to the location of the insertion site. The length of a typical midline catheter is approximately 3 inches (7.5 cm) and 8 inches (20 cm), longer than a peripheral catheter but shorter than the peripherally-inserted central catheter (PICC). The catheter is inserted near the antecubital fossa in the arm into either the basilica, cephalic, or brachial veins with the tip extending no further than the distal axillary vein in the upper arm,[8] which by definition, excludes the midline catheter from categorization as a central line. Catheter insertions placed in the arm pose less risk of infection due to the inherent number of skin bacteria found at the site. Estimates indicate that bacterial concentrations at femoral skin sites exceed 10,000 cfu/cm2. Jugular and subclavian skin sites harbor approximately 1,000 cfu/cm2 of bacteria. These sites are typically used during central line access. The average bacterial concentration at a typical arm insertion site is considerably lower, around 10 cfu/cm2.[9] In a major review of published studies on infection rates associated with intravascular devices, only two BSIs were identified during use of over 9250 midline catheters. The pooled mean rates in studies on midline catheters were significantly lower (0.2 BSIs per 1,000 device days) vs. PICCs (1.1) or short-term non-tunneled central venous catheters (2.7). In comparison, bacteremia rates associated

with PIVs were determined to be 0.5 BSIs per 1,000 device days.[10] Low infection rates are therefore a second critical advantage in using midline catheters.

A third important advantage for healthcare institutions in using a midline catheter is the availability of having large numbers of persons who can potentially perform the insertion. A typical triple-lumen non-tunneled central venous catheter requires insertion by a physician while a PICC is usually inserted either by an invasive radiologist or specially-trained nurse. The overall numbers of PICC nurses in hospitals are fairly limited, with services usually provided to larger medical/surgical patient units. The midline catheter may be inserted by specially trained registered nurses with PIV insertion experience. Large numbers of RNs trained in anatomy and physiology, aseptic technique, and monitoring methods for identification of complications, would vastly increase the capability of an institution to provide safer intravascular practice. Groups of patients that can be potentially targeted to receive midline catheters include those to be discharged from critical care units, patients on medical or surgical units, or OBGYN patients requiring longer term intravenous therapy. Another key area where midline-trained nurses would prove invaluable is the emergency department (ED). For many institutions, this is the primary area that accounts for a majority of their patient admissions to the hospital. Let's picture the following scenarios involving patients seen in the ED: a long-term care (LTC) patient with community-acquired pneumonia; a diabetic patient with leg cellulites; a patient identified with an acute abdomen. Whether admitted to the hospital or discharged home or back to the LTC facility, all these patients are ideal candidates for a midline catheter insertion since each requires standard antibiotic therapy. Several important outcomes may very well be avoided – hospitalizations, IV restarts, and confirmatory chest radiographs as would be needed with a central line.

Novel technologies have greatly improved the quality of how intravenous therapy has been provided in the last two decades. Shielded needles resulting in the avoidance of sharps injuries, cannulas made of synthetic polymers to reduce phlebitis, and antiseptic solutions with extended residual activity, are all examples of the leaps made in addressing negative outcomes seen in a widely diverse patient population. Perhaps the next major step in advancing the safety design of catheters is to incorporate a mechanism that would reduce touch contamination of the catheter itself. The first device to integrate a protective sheath over the catheter is the FirmGrip (Flexicath Ltd.) midline device. A flexible silicone sleeve covering the length of the catheter allows the clinician to advance the device without any direct contact of its surface. The benefit of this innovation becomes more evident when consideration is made of situations involving difficult insertions which extend the opportunity for contamination of catheter surfaces.

Understanding the pathogenesis of bacterial contamination of intravascular catheters provides substantial support for considering the incorporation of sheathed catheters. It has been well documented that one of the major routes of bacterial inoculation into the bloodstream occurs when organisms are transferred from the hands of clinicians to the surface of the device hub or onto the catheter itself that may occur during the insertion process. Bacterial organisms in this typical scenario adhere to the plastic material, replicate and subsequently advance on the extraluminal surface of the catheter, where over time, become integrated into developing biofilms resultant from the continuous buildup of protean-based substances secreted from protective immunological body cells. The biofilm provides the medium for substantial growth and proliferation, at which point large numbers of bacteria are released into the bloodstream, therefore signifying the start of a bloodstream infection.

The introduction of sheathed catheters, particularly an advanced design intravascular device such as a midline catheter, may prove to be of significant benefit in the present healthcare scene where patient safety dictates many key quality initiatives and where financial concerns, such as employee efficiency, supply costs, and even length of stay are prime concerns for healthcare workers and infection control preventionists alike.

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