2006 Herbst Award Recipient Profile

Janet Pettit, MSN, RNC, NNP

Janet Pettit is the recipient of the Suzanne LaVere Herbst Award for Excellence in Vascular Access Practice, sponsored by Genentech, Inc., for 2006. The award was presented at the AVA Conference in Indianapolis, Indiana, in September 2006.

Ms. Pettit's background includes over 30 years of neonatal intensive care experience as a clinical nurse, manager, outreach educator, clinical nurse specialist and nurse practitioner. She is currently employed in the 45-bed neonatal intensive care unit (NICU) at Doctors Medical Center in Modesto, CA, as a neonatal nurse practitioner and clinical nurse specialist. An interest in vascular access devices has led to multiple publications, clinical research, and national and international speaking engagements.

Ms. Pettit's unique expertise makes her a sought-after consultant to the vascular access device industry. Through work with multiple NICUs across the United States and Canada, she has gathered a vast knowledge of care practices for infants with vascular access devices, particularly peripherally inserted central catheters (PICCs).

Ms. Pettit is the coauthor of the *PICC Guidelines* produced by the National Association of Neonatal Nurses and serves as a reviewer for the Infusion Nurses Society *Infusion Nursing Standards of Practice* and AVA's *Journal of the Association for Vascular Access*. She has served professional organizations in a variety of roles, including the Board of Directors for the National Association of Neonatal Nurses and the Association for Vascular Access.

On the basis of her outstanding performance as a nurse, her skill as a gifted educator and speaker, her contributions as a researcher, and her commitment and dedication to AVA, Janet Pettit earned the 2006 Suzanne LaVere Herbst Award for Excellence in Vascular Access Practice, sponsored by Genentech, Inc.

DOI: 10.2309/java.11-4-12

CE Test Material

Trimming of Peripherally Inserted Central Catheters: The End Result

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Abstract

A debate surfaced in the neonatal literature over two years ago questioning the safety and efficacy of trimming peripherally inserted central catheters (PICCs) prior to insertion. An investigation was undertaken to define the risks and benefits of doing so and evaluate the methods of trimming PICCs. When trimmed by 1 of 3 methods, conclusive evidence revealed that the method of catheter trimming affects the integrity of the catheter tip. Additional study is required to determine whether catheter tip alteration impacts patient outcomes.

Peripherally inserted central catheters (PICCs) are often used for administration of medications and nutritional solutions for premature and ill infants. Early reports of use, dating from the 1970s, described placement of a PICC using silicone tubing inserted into the peripheral venous system via a cannula style peripheral intravenous device.[1] After the tubing reached the vena cava, the intravenous cannula was withdrawn and a 25-gauge blunt butterfly needle attached to the distal end of the tubing to serve as the catheter hub. Two skin closure strips applied in an X configuration covered the coiled, external portion of the catheter to prevent dislodgement. A sterile transparent polyurethane dressing covered the catheter and insertion site. This "make your own" style of PICC, although crude based on today's standards, met the need for a central venous catheter (CVC) placed at the infant's bedside, thus preventing the additional expense and stress of movement to the operating room. The popularity of this method waned as commercially available products became available. Today's neonatal PICCs are available in polyurethane or silicone and come in a variety of sizes and lumen configurations, ranging from 1.1- to 3-Fr, with lengths typically 20–50 cm.

Despite over 30 years of successful use in neonates, debate surrounding techniques for catheter insertion, stabilization, and ongoing care regimes persists. Remnants of the early methods of neonatal PICC insertion persist today, particularly the method of preparing and securing the catheter. Of particular concern are the need for and the method chosen when tailoring the catheter length to that required by the infant.[1-5] The risks and benefits of trimming PICCs, as well as results of an investigation using three commonly known methods of catheter trimming, are detailed in this article.

Background

Concern regarding trimming PICCs was heightened in 2004 when a published report demonstrated the difference between the manufacturer-generated, bevel-cut catheter tip and one achieved by cutting with scissors.[2] In this report, only one silicone PICC was cut using scissors.[2] When viewed using electron microscopy, an irregular edge and a visible fragment were identified on the newly cut catheter. Speculation surrounded the safety and necessity of trimming what the author identified as a rounded, smooth, and beveled configuration of the tip engineered by the manufacturer.[2] Risks associated with trimming were believed to involve the potential for embolized fragments from the trimmed catheter tip and insertion-related trauma to the intimal lining of the vein secondary to catheter tip irregularity. In lieu of trimming, the author recommended leaving a portion of the catheter under a transparent dressing with the remaining catheter outside the dressing coiled and secured with tape and wrapped with roll gauze. Subsequent "Letters to the Editor" mirrored beliefs and expressed additional concerns related to the trimming of PICCs.[3-5] Questions surfaced as to whether the "guillotine" or a specially designed trimming device provided by one manufacturer would provide a cleaner tip than scissors.[5] A desire to maintain a rounded, smooth tip to facilitate catheter advancement and the coiling method of securement to avoid catheter trimming was reported by one clinician.[5] Another respondent expressed desire to change practice based on the limited and speculative nature of the information presented.[3]

Catheter Trimming

During manufacturing, the tip of each neonatal PICC is cut with a blade or blade-like instrument to produce a 90° angle or square, but not rounded, tip. Constructing a catheter with a beveled tip as identified in the article by Trotter,[2] although widely promoted in the past, has provoked concerns of vascular perforation and thrombosis and is currently contrary to published standards and guidelines for product use promulgated by the U.S. Food and Drug Administration (FDA), the Infusion Nurses Society (INS), and the National Association of Neonatal Nurses (NANN), as shown in Table 1.[6-8] In addition, clinicians who continue to create beveled catheter tips are practicing "off label" use of the product, exposing themselves along with their employer

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DOI: 10.2309/java.11-4-13

Table 1. Published standards and guidelines for catheter trimming.

Agency	Recommendations
FDA[7]	"Where device modification is offered to the practitioner (such as distal catheter tip trimming), a quality assurance mechanism must be provided such that the modification will not result in a product that alters the safety or efficacy of the device as presented by the manufacturer to the FDA as a final product. (This may require additional test data)."
	"Instructions for catheter trimming shall provide a reminder to maintain aseptic technique, cut the catheter squarely (no points), and in such a manner that produces a clean, smooth surface."
	"Provide instructions addressing catheter migration (forward, towards the heart and backward, toward the access site, or tributary vein)."
INS[6]	"The manufacturer's labeled use(s) and directions for product use should be considered in the preparation and placement of catheters, including modifications made to the catheter tip."
	"The length of the selected catheter should allow for appropriate placement without alteration of tip integrity; caution should be used and manufacturer's use(s) and directions should be strictly adhered to when tip alteration is required.
NANN[8]	"Trimming excess catheter may lessen the risk of catheter migration into the patient, decrease resistance within the catheter, and decrease potential damage to the external portion of the catheter. Some inserters prefer not to trim the catheter, and some manufacturers do not allow trimming."
	The manufacturer's directions for trimming and the FDA (1994) guidelines should be followed.
	Use sterile technique and manufacturer's equipment, as directed.

Table 2. Manufacturers' recommendations for trimming of catheters studied.

Brand	Catheter deemed trimmable?	Trimming method recommended
Bard	Yes	Scissors or blade
BD	Yes	Scissors or trim tool
HDC	Yes	Scissors or scalpel blade
Smith-Medical	Yes	Scissors
Tyco	Yes	Scissors
Vygon	Yes	Scissors

BD, Becton Dickinson.

to additional legal risk should the infant experience a complication related to this practice.

A catheter is deemed trimmable if the manufacturer supports this practice in their Instructions for Use (IFUs) and the trimming follows guidelines by the FDA.[7] Manufacturers recommending catheter trimming are required to provide clinicians with instructions for altering the length of their device.[7] Scissors, a surgical blade, or a specially designed trimming tool are among the instruments identified in the literature and by manufacturers for catheter trimming.[9] Those manufacturers of neonatal PICCs surveyed who support trimming and provide guidance to clinicians are identified in Table 2.

During a literature search, I did not locate any clinical studies that provided scientific evidence to support the practice of trimming or not trimming PICCs. However, one small study comparing trimming methods was located.[9] Clinicians have failed to prove one method of catheter trimming as clinically superior, or trimming as superior to nontrimming. Complications (eg, phlebitis, thrombosis, or infection) potentially arising from the creation of a rough or irregular catheter tip during trimming have not been causally linked.

Theoretical Benefits and Risks of Catheter Trimming

The benefits of trimming a PICC have not been scientifically defined; however, enhanced care makes this practice appealing and deserving of further scrutiny. Inward migration of a catheter evokes particular concern for contributing to the risk of catheter-associated pericardial effusion and tamponade in neonates, which may be arrested when the entire catheter length is indwelling. However, the imprecision of anthropometric measuring techniques makes estimating the exact length of catheter required difficult to achieve, often requiring a portion of the catheter to remain external. For safety purposes, the length of any external catheter segment should be routinely assessed in an attempt to promptly identify catheter migration and subsequent sequelae.[8] Multiple coils of catheter remaining on the skin hinder the ability to perform this critical assessment. Decreasing resistance to forward flow through the device is accomplished through removal of redundant catheter length; this outcome affords an additional benefit to trimming. Performing a dressing change is challenging even when the catheter is completely in situ. Practitioners can experience difficulty when performing adequate skin antisepsis if the site is littered with catheter material, particularly when the practitioner must take extreme caution to prevent catheter dislodgement.

Opposition to trimming catheters focuses on possible, yet unproven, complications related to the change in the manufacturer-achieved tip configuration. Catheter tips containing irregular edges or fragments pose concerns of inducing complications, such as thrombosis, phlebitis, infection, and embolism should a fragment become dislodged.[2,9] A trimmed catheter that is too short to successfully reach the desired termination point generates additional expense associated with PICC placement should the need for an additional catheter occur.

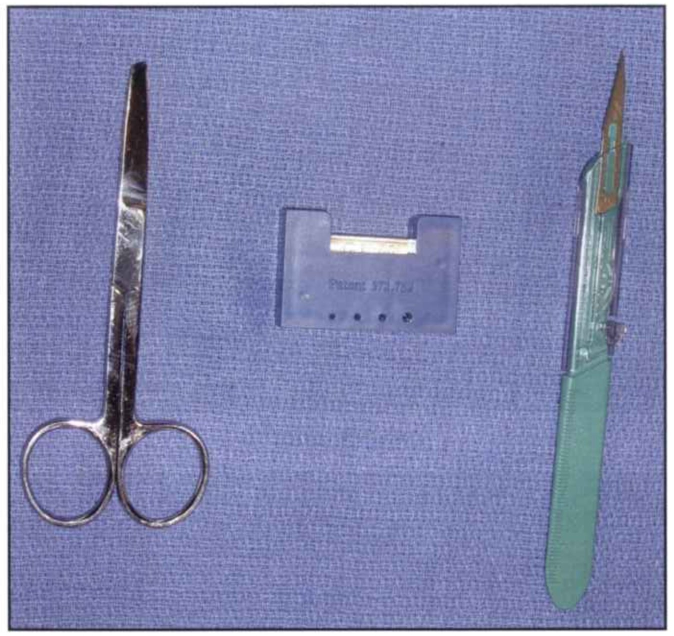

Figure 1. Instruments used to trim catheters, including scissors, a trimming tool, and scalpel blade.

One recent report has investigated the changes to the PICC tip following trimming.[9] This investigation compared trimming techniques using five different 2-Fr PICC catheters to determine whether postmarket alteration of the catheter tip produced a visible difference. Each catheter was subjected to three cuts using a new pair of scissors, a scalpel, and a guillotine (ie, a specially designed trimming instrument) (see Figure 1). Each cut tip was evaluated using a scanning electron microscope. The study concluded that cutting with a guillotine provided a smooth surface in all five catheters observed, whereas one in five catheter tips cut by a scalpel was irregular and all five of the catheters cut with scissors showed rough and irregular edges. The authors recommended not trimming catheters with scissors and speculated that the scissors-induced tip alteration could lead to an increase in thrombosis and infection. Replication of this study using a larger number of catheters was recommended by the authors. The ability to generalize these data to other brands of 2-Fr catheters and to catheters of different sizes and with additional lumens is necessary.

On the basis of the information provided in the Parvez[11] and Trotter[2] articles and subsequent concern expressed by respondents, an investigation to provide additional data to help support or invalidate the practice of catheter trimming was undertaken. The purpose of this study was to examine the difference between the manufacturer-trimmed PICCs and those trimmed using methods recommended in the literature and in manufacturer-supplied PICC "Instructions for Use." The objective was to demonstrate that the method of trimming, but not the process of trimming, altered the catheter tip. An additional prospective study will be conducted to establish a relationship between trimmed catheters and infant outcomes. However, a preliminary retrospective review of outcome data for a small group of infants is discussed in this article.

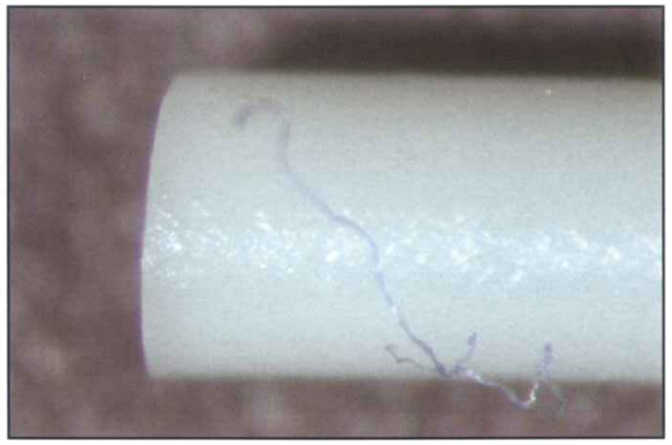

Figure 2. Fragments and lint fibers on trimmed catheter prior to removal. The irregular-appearing catheter tip with adherent fragments and lint fibers was cleaned by wiping with alcohol, allowing the fragments and fibers to be removed.

Table 3. Results of trimming methods and catheter tip appearance.

Tip configuration	Untrimmed		Scissors		Scalpel		Trimming Tool	
	S	P	S	P	S	P	S	P
Smooth	2	7	0	0	1	2	4	6
Irregular	2	1	4	8	3	6	0	2

S, silicone catheter; P, polyurethane catheter.

Method

Twelve 1.1- to 2-Fr PICCs representing six manufacturers of neonatal catheters were evaluated during the study. Catheters selected for study were those identified for placement in neonates. Two of the catheters evaluated were 1.1-Fr, single-lumen, polyurethane PICCs. The remaining 10 PICCs were sizes 1.9- to 2-Fr, with four composed of silicone and six of polyurethane. Two of the 2-Fr polyurethane catheters were dual-lumen devices.

After product "blinding," each catheter was labeled and three, 5-cm sections cut on a sterile barrier using each of three trimming methods: scissors, a #11 straight scalpel blade, and a specially designed trimming tool (Figure 1). The scissors used were those supplied in a manufacturer's procedure tray. The scalpel blade was pulled over the catheter while residing on a glass cutting block by using a cutting motion. Use of the trimming tool required placing the segment of catheter into one of the identi-

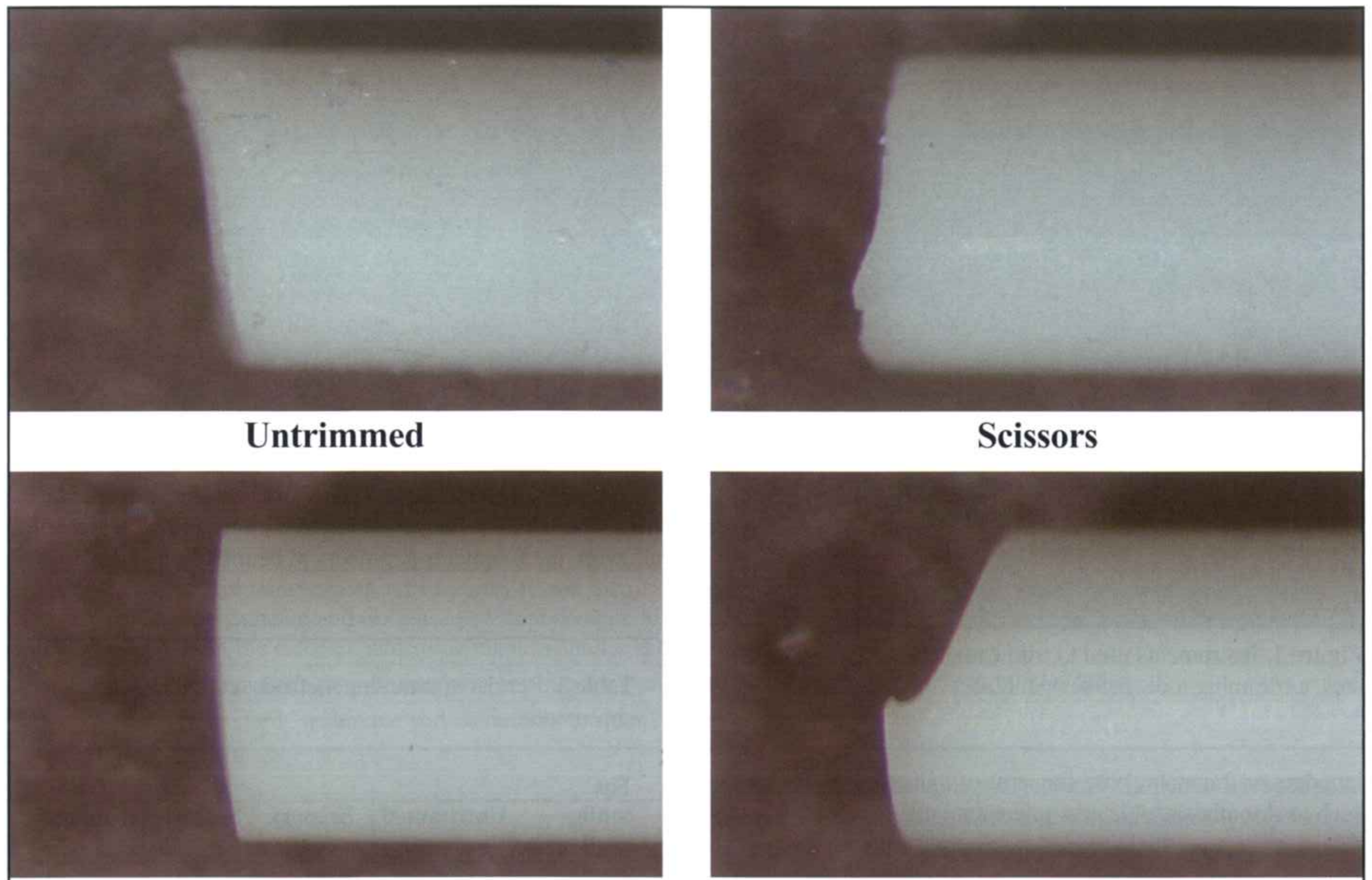

Figure 3. Differences among silicone catheters that were trimmed using three methods, compared with original untrimmed tip.

fied holes in the device and pushing the blade in one downward motion to initiate the cut.

Results

A total of 48 trimmed catheter tips were digitally photographed using high-powered magnification. A trial using higher magnification did not provide additional information when evaluating the cut surface pattern. Fragments or other debris (ie, lint fibers) were removed from each catheter by wiping with alcohol on initial evaluation to prevent misidentification of catheter tip irregularities (Figure 2). The entire cut surface of each catheter was viewed and the most irregular portion of the surface, if present, photographed.

Digital photographs were analyzed to compare the appearance of each cut surface. The three cut surfaces of each catheter were then compared with the tip of the catheter as supplied by the manufacturer. Surfaces were classified as irregular or smooth. Of the 12 catheters studied, three (25%) demonstrated moderate tip irregularities prior to trimming, and very mild irregularities were noted on an additional four catheters. All catheters trimmed with scissors exhibited irregularities, in addition to nine (75%) cut with the scalpel blade and two (17%) cut with the trimming tool. Silicone catheters possessed two irregular tips when received by the manufacturer, no irregular tips when cut with the trim tool, and three irregular tips when cut with the scalpel blade. Of the eight polyurethane catheters, one arrived from the manufacturer with an irregular tip, two demonstrated an irregular tip following the cut from the trimming tool, and six cut with the scalpel blade developed an irregular tip. A comparison of the manufacturer-supplied catheter tip versus the three trimmed tips from one silicone catheter is depicted in Figure 3 and from one polyurethane catheter in Figure 4.

Both 1.1-Fr, single-lumen and 2-Fr, dual-lumen polyurethane catheters appeared to possess similar tip surfaces with each trimming method, with the exception of one of the dual-lumen devices that demonstrated a smooth surface following cutting with a scalpel blade. The manufacturer and the trimming tool both provided smooth catheter tips, but the tips resulting from cutting with scissors and the scalpel blade were irregular.

Some irregularities were mild, whereas others were particularly rough and jagged. The cutting motion used with the scalpel created a very jagged appearance in many of the catheters. One polyurethane catheter was difficult to cut with the trimming tool, despite several attempts. A summary of the outcomes of the trimming methods is displayed in Table 3.

Clinical Outcome Data

Outcome data of infants having either trimmed or

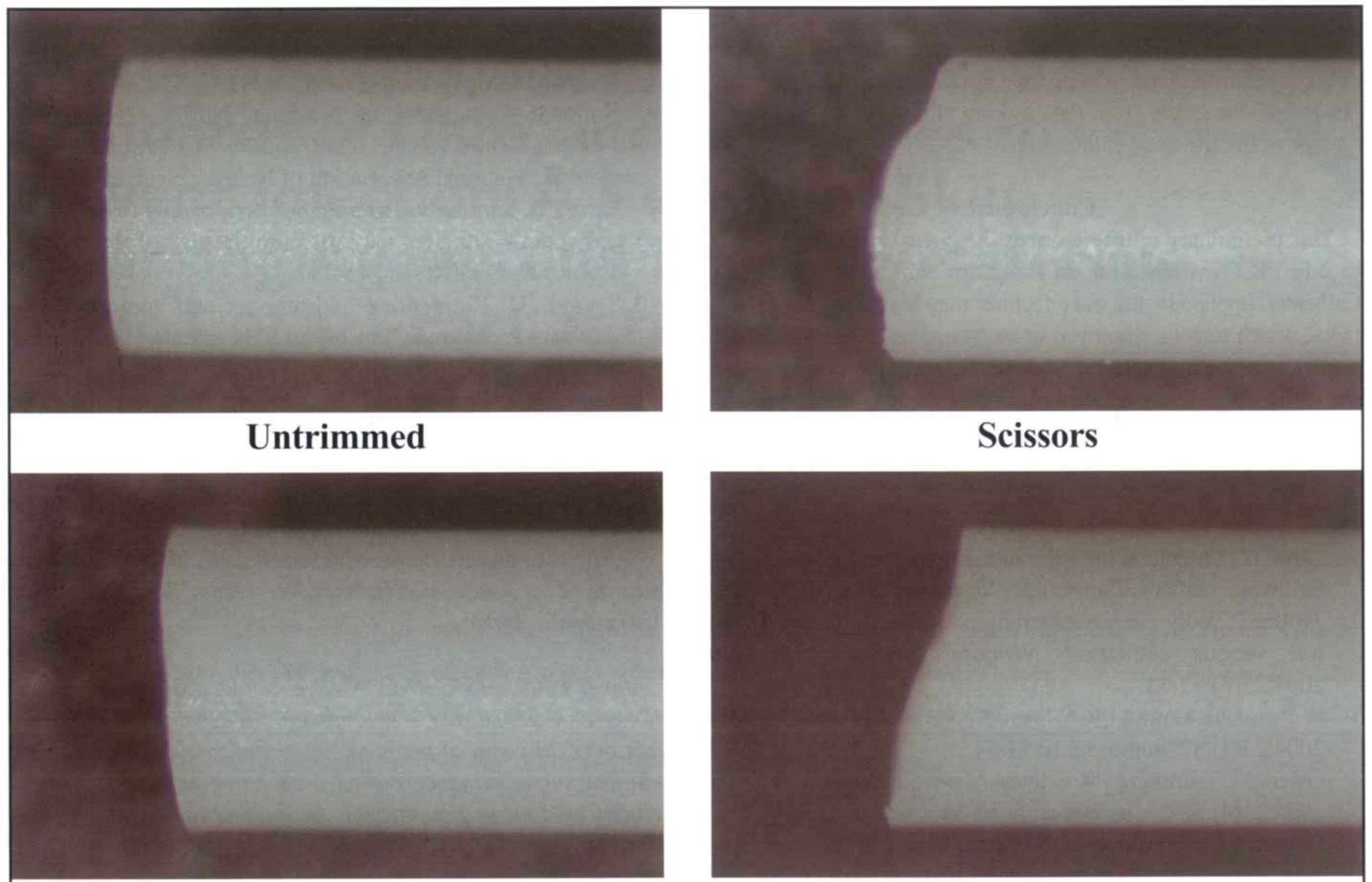

Figure 4. Differences among polyurethane catheters that were trimmed using three methods, compared with original untrimmed tip

nontrimmed PICCs during a 12-month period were reviewed to describe possible complications associated with catheter trimming. Infants received either a 1.1- or 2-Fr polyurethane PICC, both of which contained a flexible wire stylet. The decision to trim the catheter was at the discretion of the inserting nurse. In some cases, the entire supplied length of the catheter was required to reach the targeted tip location within the vena cava, negating the need to trim. Peripheral veins used for catheter insertion included the basilic, cephalic, axillary, temporal, posterior auricular, and greater saphenous veins. Peel-away sheath or needle-style introducers were used based on chosen catheter size. Skin antisepsis was achieved through use of povidone–iodine or a 2% chlorhexidine gluconate solution, determined by the birth weight and age of the infant. Maximum sterile barrier precautions, including use of latex-free and powder-free gloves, were maintained, although powder-free gloves were introduced during the last six months. Radiographic documentation of catheter location was performed at the conclusion of the procedure, and only outcomes of catheters having the tip within the superior or inferior vena cava were included. The transparent dressing covering the catheter was replaced only if nonadherent or soiled.

A total of 116 PICCs were placed in an equal number of infants. Outcome data were unavailable for eight catheters as the result of the infants being transferred to another facility with the catheter indwelling. All but 15 catheters were trimmed. Three cases of mechanical phlebitis were identified, all while catheters were indwelling within the greater saphenous vein. Two of the trimmed catheters (0.2%) and one (0.7%) of the untrimmed catheters were associated with phlebitis. Thrombosis was not clinically observed in any infants nor was radiographic assessment performed.

Discussion

Trimming the PICC clearly alters the tip as provided by the manufacturer. Two of the catheters possessed an improved and smoother tip posttrimming; however, the significance of this change remains unclear. Clinical data did not demonstrate an increase in phlebitis resulting from catheter trimming; however, the data represented small numbers and need expansion to also include outcome data representing silicone catheters. One critical benefit of trimming that impacts the safety of these vulnerable infants is the ability to readily observe the length of the external segment of catheter, thus allowing immediate recognition of migration and potentially reducing its risk.

Limitations of the Study

Only one catheter representing each brand was studied. A larger quantity of each catheter is warranted to ensure that the quality of the visualized tips is a representative sampling and not random chance. To detect catheter tip–induced patient complications, a randomized, prospective approach would allow conclusions to be drawn from data linking clinical outcomes to the quality of the trimmed catheter tip.

Conclusion

This preliminary effort describes the changes resulting to 1.1- to 2-Fr PICCs when trimmed using three different techniques. Catheters supplied by the manufacturer may have irregular tip surfaces, which may be improved or worsened in appearance as the result of the method selected to trim. Although the trimming tool may most consistently create the smoothest edge, the clinical significance, if any, is unclear. To recommend one method of trimming as superior to others warrants additional clinical evidence.

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Acknowledgment

Portions of this article were presented at the 20th Annual Conference of the Association for Vascular Access, September 2006, Indianapolis, Indiana.

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Submitted 10/5/2006; revision received 11/2/2006; accepted 11/3/2006.

CE Test Material

Vascular Access Nursing Practice, Standards of Care, and Strategies to Prevent Infection: A Review of Skin Cleansing Agents and Dressing Materials (Part I of a 3-Part Series)

Deborah Richardson, RN, MS, CNS

Abstract

This three-part series of articles (parts 2 and 3 will be published in the Spring and Summer 2007 journal issues, respectively) will include information appropriate for the novice and the expert vascular access nurse. The series will include primers on vascular access devices, along with review of skin cleansing agents, dressing materials, catheter flush solutions, and injection caps. The focus of the article series will be the issue of catheter-related bloodstream infection, practice, technologies developed to prevent or decrease infections, current standards, and guidelines and preventive strategies.

Appropriate and effective skin antisepsis is one of the select criteria in preventing catheter-related bloodstream infection (CRBSI). However, prior to discussing cleansing agents, it is important to have a basic understanding of the anatomy of the skin and what types of microflora exist on it, and discuss the role of biofilm.

The Skin

The skin is the largest organ of the human body. It is divided into two major sections: epidermis and dermis.[1] The epidermis is made up of five layers of cells in different stages of maturation.[1] The dermis is the thickest layer and is composed of elastin, collagen fibers, sebaceous ducts, sweat glands, and hair follicles.[1] There are three types of human skin: wet, dry, and oily. Wet skin normally exists in the axilla and groin areas, and larger numbers of microbes reside here. Dry skin, located on our extremities, has the fewest number of microbes. Oily skin typically exists around the neck, trunk, and forehead.

Transient and resistant microflora exist on everyone's skin. Transient flora, such as methicillin-resistant *Staphylococcus aureus* (MRSA) and *Candida species*, are found on the skin surface.[1] Resistant flora are found within the layers of the skin and glands.[1] *Coryneforms*, *Acinobacter*, and *Staphylococcus* are examples of resistant microflora.

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DOI: 10.2309/java.11-4-14

Normal skin flora vary from person to person. The skin of the antecubital space is dry and cool and houses approximately 10 colony-forming units (CFUs) per site.[2] In comparison, the skin of the neck and thorax is oily and houses approximately 1000–10,000 CFUs per site.[2]

The Skin and Central Venous Catheters

The insertion of a central venous catheter is one of the most common invasive procedures done today. The catheter must pass through the layers of the skin before entering the bloodstream. The belief has always been that the organisms from the skin or hub migrate along the length of the catheter and colonize it.[2] There is now new research supporting the idea that the skin organisms attach to the extraluminal wall of the catheter during insertions. Elliott et al found colonization and biofilm formation within 90 minutes of insertion despite skin disinfection and strict aseptic technique.[3]

After the catheter or device is inserted, the body or host responds to the presence of the foreign object through a series of organized, complex processes and interactions between the device and the bloodstream. Within seconds of contact with the device, plasma proteins strike the catheter material and quickly attach to the surface, reaching a critical level within about 5 minutes.[2] In very quick order, the coagulation cascade and complement system are activated and are directed to promote attachment of platelets to the catheter surface by the plasma proteins.[2] This platelet-to-protein adhesion stimulates platelet activation, degranulation, and further progression of the coagulation cascade and thrombus formation.[2] Simultaneously, other proteins