

REPRINTED

JOURNAL OF VASCULAR ACCESS DEVICES

JVAD

The Official Publication of the National Association of Vascular Access Networks

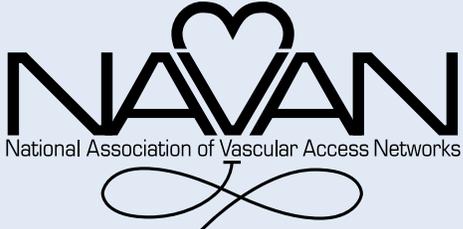
S U M M E R 1 9 9 8

Tip Location

of Peripherally
Inserted
Central
Catheters

- ♥ **New Valved Catheters**
- ♥ **Improving Patient Care**
- ♥ **Device-Related Complications**

NAVAN
National Association of Vascular Access Networks

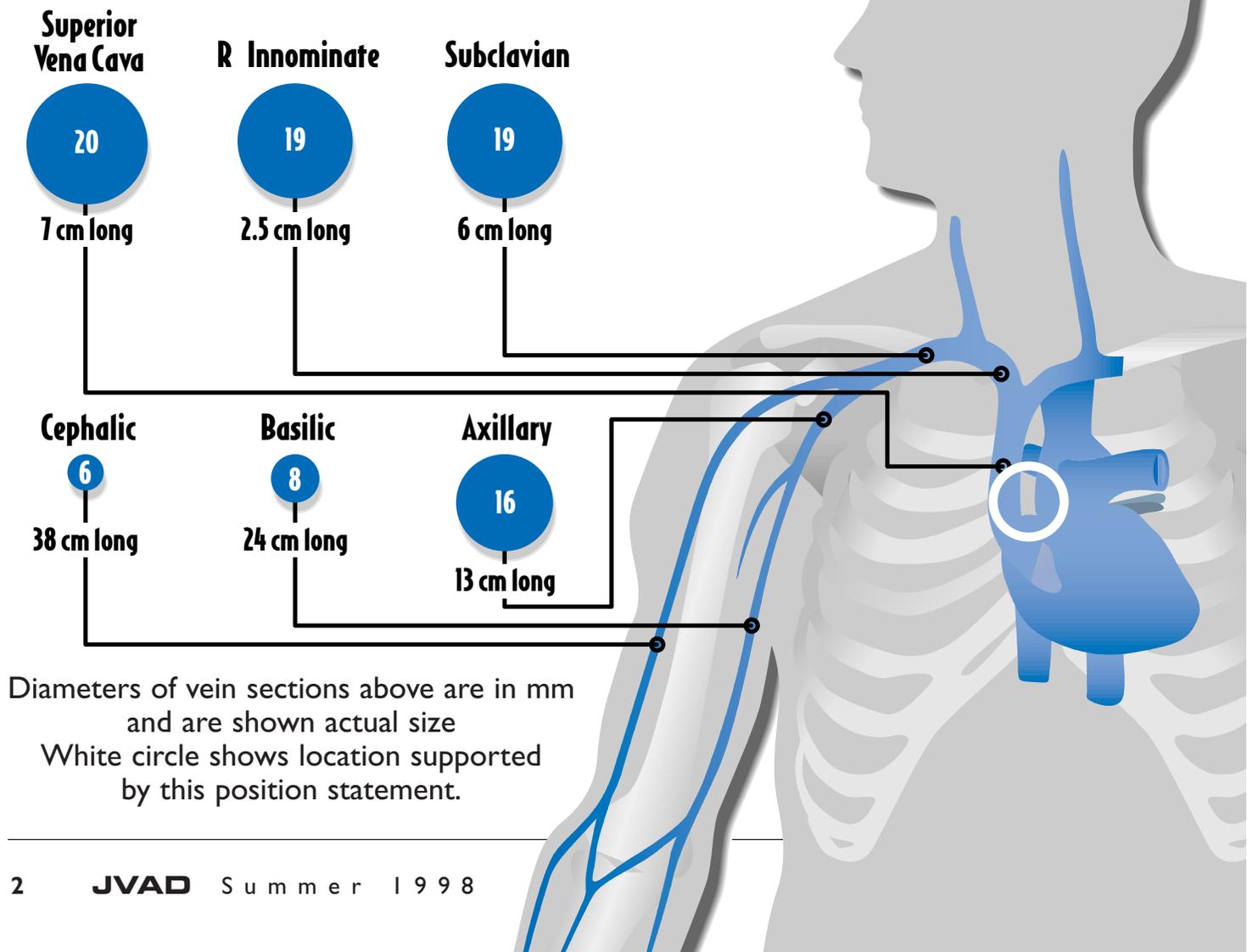


TIP LOCATION

OF PERIPHERALLY INSERTED CENTRAL CATHETERS

During the past decade, the use of peripherally inserted central catheters (PICCs) has increased significantly. This increase in clinical use and importance has prompted deviation from the original concept of the PICC being a central venous catheter. After careful consideration of clinical research, the Board of Directors of the National Association of Vascular Access Networks (NAVAN) feels there is sufficient information to support the following position statement.

Vasculature Vein Measurements



NAVAN POSITION STATEMENT

NAVAN recommends that the most appropriate location for the tip of peripherally inserted central catheters (PICCs) is the lower one-third of the superior vena cava (SVC), close to the junction of the SVC and the right atrium. This tip location allows the catheter to float freely within the vein lumen and lie parallel to the vessel wall, resulting in a considerable reduction in such complications as thrombosis and infection. The catheter tip should not extend into the right atrium, as cardiac complications may develop with such a placement. Insertion sites in the lower extremity of pediatric and neonatal patients should result in a tip location in the inferior vena cava above the level of the hemidiaphragm.

Anatomical or pathophysiological reasons prohibiting tip advancement into the SVC may indicate a need for tip location in veins distal to the SVC (e.g., innominate or brachiocephalic, subclavian, and axillary veins) also referred to as a midclavicular catheter. Reasons include, but are not limited to, SVC syndrome, chest tumors encroaching on the SVC, and surgically

created changes to the internal anatomy. Careful assessment of all factors, such as solution pH, osmolality, coagulation anomalies, primary and chronic diseases, and length of therapy, is required to weigh the risks versus the benefits of choosing these non-central (non-SVC) tip locations.

After insertion, confirmation of PICC tip position is necessary and can be obtained by a chest radiograph or other imaging modality. PICC tips found to be in an aberrant location should be repositioned prior to infusion of any solution through the catheter.

PICC tip location is influenced by (1) the original effective catheter length; (2) anthropometric measurements; (3) catheter trimming or cutting to a specific length; (4) patient's height, arm length, and chest width; (5) venipuncture site; and (6) anatomical pathway of the vein used for insertion and advancement of the PICC. All such factors must be considered when selecting product(s), writing policies and procedures, and assessing individual patients.

BACKGROUND

A PICC is defined as a central venous catheter inserted at a peripheral location and advanced into the SVC. For adults, the veins of the antecubital fossa or the proximal portion of the upper extremity are the preferred insertion site. In neonatal patients, scalp veins, such as the posterior auricular and temporal veins, may be used. For pediatric patients, the saphenous, popliteal, and femoral veins of the leg may serve as the insertion site, with the tip location in the inferior vena cava.¹

Abbreviations used for catheters inserted from peripheral veins have created confusion, rather than clarity, of the catheter type. For this reason, the use of "PICC" is considered the appropriate acronym. The term "peripherally inserted catheter" or "PIC" should be avoided because this can be interpreted to include several types of catheters and is not completely indicative of a peripherally inserted central catheter.

Use of veins in the upper extremity to gain access to the central venous system was first attempted in 1912.² PICCs gained attention in the middle 1970s, primarily for the infusion of antineoplastic agents and parenteral nutrition.³⁻⁶ The first study of nurse-inserted PICCs was published in 1979.⁷ In the 1980s,

PICC use increased as the expansion of intravenous therapy into home health care increased the need for reliable venous access.⁸ PICCs continue to provide a successful alternative to repeated peripheral venipuncture and insertion of other central venous catheters in all health care settings.

Numerous published studies examine the clinical performance of PICCs.⁹⁻²⁷ These studies all report successful clinical use of PICCs with low complication rates. In some studies, the preferred site for tip location is only the SVC while others include innominate or brachiocephalic, subclavian, and axillary veins as acceptable. Subsequently, the challenge is correlating clinical outcomes to specific tip location.

The SVC was defined as the acceptable tip location for central venous catheters in the 1950s.² In this location, the catheter is more likely to lie parallel to the vein wall without impinging on the wall. Solutions infused through the SVC will be diluted by rapid blood flow. When the catheter tip lies outside the SVC, vein curvatures, junctions, and venous valves, and vein diameter increase the possibility of tip contact with the vein wall. This contact disrupts the endothelial cell layer of the tunica intima, exposes the basement membrane, and triggers the clotting process.

Smaller vein diameters indicate smaller amounts of blood flow, leading to irritation of a chemical nature.² Thus the mechanical irritation of the vessel at the catheter tip is compounded by the chemical irritation from the solution being infused. Thrombosis, thrombophlebitis, and possible subsequent catheter-related infection can result from this vessel wall irritation.²⁸

Deep vein thrombosis of the upper extremities is estimated to occur at a rate of more than 50,000 cases per year, with 30% to 40% of these cases being associated with central venous catheters. While only 3% of central venous catheters develop clinically significant thromboses, subclinical (i.e., clinically silent) thromboses can be found radiographically in 30% to 60% of all central catheters.²⁹ Others report that the incidence of catheter-related venous thrombosis is as high as 68%, with only 1% to 5% demonstrating clinical evidence of thrombosis.²

A study of tunneled catheters followed groups of patients with different flush regimens, chemotherapy infusion volumes, and tip locations.³⁰ In 107 catheters, optimal tip location (defined as the SVC, right atrium, or their junction) resulted in a 16% incidence of thrombosis, while those in suboptimal tip locations (defined as any other vein) had a 62% incidence of thrombosis. All

thrombi were confirmed by venogram or at autopsy.

In a randomized clinical trial, Kearns compared PICCs whose tips were placed in the SVC to PICCs whose tips were placed in the axillosubclavian-innominate vein.³¹ Solution osmolalities infused through both tip locations ranged from 160 and 455 mOsm/kg. Venograms were performed to assess vein condition at the catheter tip. The

axillosubclavian-innominate group had a 60% thrombosis rate; the SVC group a 21% thrombosis rate.

Many factors are involved in the formation of thromboses associated with venous catheters. Patient-related factors include alterations in clotting processes related to chronic diseases and genetic abnormalities, hydration and nutritional status, and alterations in blood flow related to movement and vessel stenosis.

Infusate-related factors include final solution osmolality and pH.

While it may not prevent the problem completely, catheter tip location is a critical factor in the development of thromboses and is a conscious choice made by health care professionals based on knowledge of patient-related risk factors, published research on venous thromboses, and catheter characteristics. ♥

REFERENCES

1. Frey AM. Pediatric peripherally inserted central catheter program report. *Journal of Intravenous Nursing*. 1995;18:280-291.
2. Ryder MA. Peripherally inserted central venous catheters. *Nursing Clinics of North America*. 1993;28:937-971.
3. Hoshal VL. Total intravenous nutrition with peripherally inserted silicone elastomer central venous catheters. *Archives of Surgery*. 1975;110:644-646.
4. Bottino J, McCredie KB, Groschel DHM, Lawson M. Long-term intravenous therapy with peripherally inserted silicone elastomer central venous catheters in patients with malignant diseases. *Cancer*. 1978;43:1937-1943.
5. Prian GW, Way CWV. The long arm silastic catheter: A critical look at complications. *Journal of Parenteral and Enteral Nutrition*. 1978;2:124-128.
6. MacDonald AL, Master SKP, Moffitt EA. A comparative study of peripherally inserted silicone catheters for parenteral nutrition. *Canadian Anesthesia Society Journal*. 1977;24:263-269.
7. Lawson M, Bottino JC, McCredie KB. Long term I.V. therapy: A new approach. *American Journal of Nursing*. 1979;79:110-103.
8. Brown JM. Peripherally inserted central catheters: Use in home care. *Journal of Intravenous Nursing*. 1989;12:144-150.
9. Rutherford C. A study of single lumen peripherally inserted central line catheter dwelling time and complications. *Journal of Intravenous Nursing*. 1988;11:169-173.
10. Ragasa J, Shah N, Watson R. Where antecubital catheters go: A study under fluoroscopic control. *Anesthesiology*. 1989;71:378-380.
11. Goodwin M. The Seldinger method for PICC insertion. *Journal of Intravenous Nursing*. 1989;12:356-365.
12. Markel S, Reynen K. Impact on patient care: 2652 PIC catheter days in the alternative setting. *Journal of Intravenous Nursing*. 1990;13:347-351.
13. Graham DR, Keldermans MM, Klemm LW, Semenza NJ, Shafer ML. Infectious complications among patients receiving home intravenous therapy with peripheral, central, and peripherally placed central venous catheters. *American Journal of Medicine*. 1991;91:95S-100S.
14. James L, Bledsoe L, Hadaway LC. A retrospective look at tip location and complications of peripherally inserted central catheter lines. *Journal of Intravenous Nursing*. 1993;16:104-109.
15. Goodwin ML, Carlson I. The peripherally inserted central catheter: A retrospective look at three years of insertions. *Journal of Intravenous Nursing*. 1993;16:92-103.
16. Tice AD, Bonstell RP, Marsh PK, Craven PC, McEniry DW, Harding S. Peripherally inserted central venous catheters for outpatient intravenous antibiotic therapy. *Infectious Diseases in Clinical Practice*. 1993;2:186-190.
17. Abi-Nader JA. Peripherally inserted central venous catheters in critical care patients. *Heart & Lung*. 1993;22:428-434.
18. Lam S, Scannell R, Roessler D, Smith MA. Peripherally inserted central catheters in an acute care hospital. *Archives of Internal Medicine*. 1994;154:1833-1837.
19. Merrell SW, Peatross BG, Grossman MD, Sullivan JJ, Harker WG. Peripherally inserted central venous catheters: Low-risk alternatives for ongoing venous access. *Western Journal of Medicine*. 1994;160:25-30.
20. Loughran SC, Borzatta M. Peripherally inserted central catheters: A report of 2506 catheter days. *Journal of Parenteral and Enteral Nutrition*. 1995;19:133.
21. Chait PG, Ingram J, Kuhn C. Peripherally inserted central catheters in children. *Radiology*. 1995;197:775.
22. Donaldson JS, Morello FP, Lim-Dunham J. Peripherally inserted central venous catheters: US-guided vascular access in pediatric patients. *Radiology*. 1995;197:542.
23. Donovan M, Thomas K, Harris D. Peripherally inserted central catheters: Placement and use in a family practice hospital. *Journal of American Board of Family Practice*. 1996;9:235.
24. Alhimyary A, Fernandez C, Picard M, et al. Safety and efficacy of total parenteral nutrition delivered via a peripherally inserted central venous catheter. *Nutrition in Clinical Practice*. 1996;11:199-203.
25. Ng PK, Ault MJ, Maldonado LS. Peripherally inserted central catheters in the intensive care unit. *Journal of intensive care medicine*. 1996;11:49.
26. Ng PK, Ault MJ, Ellrodt AG, Maldonado L. Peripherally inserted central catheters in general medicine. *Mayo Clinical Protocol*. 1997;72:225-233.
27. Dubois J, Garel L, Tapiero B, Dube J, Laframboise S, David M. Peripherally inserted central catheters in infants and children. *Radiology*. 1997;204:622-626.
28. Ryder M. Peripheral access options. *Surgical Oncology Clinics of North America*. 1995;4:395-427.
29. Stephens MB. Deep venous thrombosis of the upper extremity. *American Family Physician*. 1997;55:533-539.
30. Brown-Smith JK, Stoner MH, Barley ZA. Tunneled catheter thrombosis: Factors related to incidence. *Oncology Nursing Forum*. 1990;17:543-549.
31. Kearns PJ, Coleman S, Wehner JH. Complications of long arm catheters: A randomized trial of central vs peripheral tip location. *Journal of Parenteral and Enteral Nutrition*. 1996;20:20-24.