



Vein Diameter for Peripherally Inserted Catheter Insertion: A Scoping Review

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Abstract

Background: *The risk of venous thromboembolism (VTE) may be reduced if a vein of appropriate diameter is used for peripherally inserted central catheter (PICC) insertion. However, clinicians may have predilections to cannulate certain vein types and use particular insertion sites (eg, right or left arm) and therefore do not necessarily assess all veins available to determine the most optimal vessel to introduce a catheter. It is important that clinicians have an understanding of the diameter of veins used for PICC insertion and the effect of patient factors such as hand dominance on vein size to determine whether their clinical practice is appropriate.*

Methods: *A scoping review of published literature was performed to determine existing knowledge regarding the diameters of veins used for PICC insertion and the influence of patient factors such as hand dominance and laterality (left or right arm) on vein size.*

Results: *There was limited published research about the diameters of the basilic, brachial, and cephalic veins at the midupper arm, with only 6 studies identified. Three of the 6 selected articles focused on vein diameter measurement to inform arteriovenous fistula development. Only 1 study included participants undergoing PICC insertion. Scant research examined the effect of laterality on vein diameter and 1 study was identified that reported the influence of hand dominance or vein type on the diameter of veins used for PICC insertion.*

Conclusions: *This review found that there is a paucity of studies that have examined the veins used for PICC insertion. Nevertheless, it appears that the basilic vein has the largest diameter (with smaller brachial and cephalic veins), although this is not always the case. Laterality and hand dominance does not seem to influence vein diameter. Further research about the vasculature used for PICC insertion is needed to inform clinical practice.*

Keywords: *basilic vein, brachial vein, cephalic vein, peripherally inserted central catheter, ultrasound, vein measurement, venous thromboembolism*

Introduction

Peripherally inserted central catheters (PICCs) are commonly used in a range of patient groups in contemporary health care.^{1,2} PICCs may be associated with venous thromboembolism (VTE), an adverse event that incorporates upper extremity thrombus (affecting both the deep and superficial vasculature) and pulmonary embolism.^{1,3,4} Symptomatic VTE is uncomfortable for the patient, interrupts

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treatment, may result in permanent vasculature damage, and is associated with increased risk of mortality.¹ There is a strong relationship between larger PICC diameter and increased rates of VTE in patients with a PICC.⁴⁻¹¹ This may be explained by Virchow's triad,¹² which indicates that interruption of blood flow (ie, stasis) is an important factor in the risk of thrombus. Although this concept has not been tested in vivo, mechanical models do support the concept that larger diameter PICCs markedly increase the degree of stasis.¹³ Further, although there is limited clinical research in this area, previous research suggests an association between the degree of stasis (catheter-to-vein-diameter ratio) and risk of VTE in patients with cancer.¹¹

However, larger-diameter devices are often clinically necessary because lumen number largely determines PICC diameter. Multiple lumens are required for the delivery of incompatible infusions, so the number of lumens required and thus the diameter of the PICC is governed by the treatment needs of the patient. For example, in the oncology/hematology setting where simultaneous chemotherapy agents, blood products, and intravenous antibiotics may be required, larger PICCs containing multiple lumens are necessary.¹⁴

Site selection for PICC insertion necessitates a thorough patient assessment. Skin integrity, comorbidities, history of previous vascular access devices, and vasculature health are important considerations in the decision-making process.¹⁵ Vasculature assessment using 2-dimensional ultrasound imaging guidance before insertion is recommended.¹⁵ One element of vasculature assessment is the measurement of vein diameter to ensure the target vein is appropriate for the diameter of the PICC. The diameter of the PICC is determined by clinical need and is difficult to modify; hence, vasculature assessment and the selection of a vein of appropriate diameter is important to reduce stasis, which may reduce the risk of VTE.

Although the basilic, brachial, and cephalic veins on both arms are suitable for PICC insertion, each of these veins may not be assessed in clinical practice. A number of factors may guide insertion-site decisions, and 1 element is vein size perceptions, which may influence some clinicians to favor specific veins. For instance, the basilic vein may be preferred for PICC insertion and the cephalic vein avoided due to perceived differences in vein size.^{15,16} Further, whilst both arms are potentially suitable for PICC insertion, clinicians may favor a particular side. Some clinicians prefer a right-sided approach due to an easier anatomic pathway to the superior vena cava.^{17,18} Alternatively, others may insert on the left side in most patients because they perceive the nondominant arm enables easier patient self-care.⁴

Here we report a review of the literature on the diameter of veins used for PICC insertion as well as the effect of vein type, hand dominance, and laterality on these measurements to provide clinicians with information to guide site selection for PICC insertion.

Method

This review is in the form of a scoping review, following the framework proposed by Arksey and O'Malley.¹⁹ First, the research question was identified. Second, the literature was

reviewed and appropriate studies were selected and data were charted in a table. Finally, the results were collated, summarized, and reported. The scoping review method is systematic, but also allows rapid summation of research and identification of gaps in knowledge. The scoping review process differs from a systematic review in that it does not necessarily seek to evaluate the quality of the study design, and is suitable where a wide range of study designs have been undertaken.^{19,20}

Identifying the Question and Relevant Literature

The following research questions were used to guide the search for this scoping review.

1. What is known about the diameter of veins (basilic, brachial, or cephalic) most commonly used for PICC insertion?
2. Can vein diameter be predicted by vein type?
3. What is the influence of hand dominance and laterality (arm side) on the diameter of veins used for PICC insertion?

Articles were included that reported the measurement of the diameter of the basilic, brachial, or cephalic veins at the mid-humerus level. There is scant research documenting the anatomic location of PICC insertions, so it was difficult to define a usual PICC insertion zone. The defined measurement area (7-14 cm proximal to the cubital fossa) was determined based on previous research and after consultation with an experienced PICC inserter (> 10,000 insertions) who has witnessed that most PICC insertions occur approximately 10 cm proximal to the cubital fossa.¹⁶ Nonetheless, articles were only excluded if they reported vein diameter measurement well outside of the usual PICC insertion locations in the upper arm (eg, forearm, cubital fossa, or axillary).

The search was conducted in October 2015. Keywords were based on previous research and exploration of medical subject headings. Search tools such as Boolean operators were used to widen, narrow, or combine search results. Inclusion and exclusion criteria were developed to ensure that relevant research was identified. Six databases were searched, including the Cumulative Index to Nursing and Allied Health Literature, the Cochrane Library, Embase, the Johanna Briggs Institute database, Medline, and Scopus. Further, the reference lists of identified studies were hand searched to determine studies not identified in the database searches.

Selecting the Literature

The title and abstract of search results were reviewed to determine whether studies met the inclusion criteria (see Figure 1). Where this was not evident, the full-text article was accessed and reviewed to determine relevance. The authors reviewed these results and consensus was reached after discussion. Results were limited to the year 2000 onward to ensure more contemporary literature was scoped. Research that reported vein diameter measurement from human cadavers was excluded because the effect of formaldehyde on vein size is not clear.²¹ Hence, it would be problematic to determine

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