Guided imagery in the form of ultrasound is quickly becoming a common practice in the insertion of central venous catheters (CVCs) and peripherally inserted central catheters (PICCs). Current literature illustrates the value of ultrasound in the enhancement of the assessment of upper extremity vascular systems for determining the optimal path and site of entry into the vein for the safe and successful advancement of PICC catheters. Ultrasound in conjunction with use of the modified Seldinger technique, typically called a micro-introducer, is proving to positively affect the success rate of PICC insertions and is proving to be an economical alternative to a PICC placed by an interventional radiologist in the Interventional Radiology Suite. By using ultrasound imaging, the vessel’s characteristics and its surrounding structures can be viewed prior to cannulation. Ultrasound usage seems to be linked with reduced rates of common complications associated with the “traditional” over-the-needle PICC insertion methods.

The use of ultrasound has broadened the band of opportunity for infusion nurses. The “traditional” PICC insertion included the use of large bore needles introduced at or near the antecubital fossa. This approach lends itself to movement with each bend of the patient’s arm. This movement allows the catheter to piston within the insertion site causing intima irritation and possible infection. With the use of ultrasound and micro-introducers, PICCs may now be placed above the antecubital fossa affording less catheter movement and in turn less sterile mechanical phlebitis and possibly less bacterial contamination. Ultrasound guided upper arm PICC placements also may reduce the rate of accidental removal. Some may conclude that PICCs placed above the antecubital fossa are: 1) farther out of the reach of the patient, 2) less irritating at the entrance site decreasing the chance of patient manipulation of the PICC catheter, and 3) less likely to be caught during normal activities by staff and patients.

Tampa General Hospital is an 877 bed level-one trauma center in Florida. The hospital has progressive trauma, cardiac, and burn intensive care units and is among the busiest solid organ transplant facilities in the country. In March of 1999, a one-person vascular access team was developed at this institution. Utilizing palpation and the over-the-needle introduction techniques, 40 to 50 four and five French PICCs were placed in patients with a success rate of 50% to 80%. In October of 1999, after a 3-day tutorial by Interventional Radiology, the PICC Nurse initiated a 30-day trial using a micro introducer in conjunction with ultrasound. The trial resulted in 55 PICCs placed at a 91% success rate (Figure 1). During that trial it was quickly noted that not only was the accuracy of the placements improved, but the efficiency was superior as well. One-attempt insertions are obviously quicker than multiple attempt insertions. The results of that trial were compelling enough to pursue the purchase of the hospital’s first portable bedside ultrasound unit (Figure 1).

At the VA Puget Sound Health Care System in Seattle, Washington, PICCs...
placed by infusion nurses generally are more cost effective than PICCs placed by an interventional radiologist. In 1999, prior to use of the modified Seldinger technique and a portable ultrasound unit, the IV Team placed 389 of 489 PICCs (76%) ordered, while the other 100 PICCs were placed by Interventional Radiology. The following year the IV Team became proficient with the use of the ultrasound unit and while 530 PICCs were ordered, the IV Team placed all but 36 of them. By 2002, of the 805 PICCs ordered, the IV Team placed 98% of them successfully (Figure 2). Once it became known that the IV Team could safely place PICCs at the bedside of even acutely ill patients in the ICUs, PICC referrals almost doubled.

There is a huge cost savings with IV nurses placing PICCs at the bedside as opposed to having them sent to the interventional radiology (IR) department. As noted in a previous study, the cost of placement by an IR staff member at the VA Puget Sound Health Care System (Seattle, Washington) was $978.00 while the cost of an IV nurse placing a PICC at the bedside using ultrasound was only $155.00. Combine that information with the fact that the time a radiologist spends placing a PICC takes the radiologist away from more advanced and higher-reimbursed procedures and it makes fiscal sense to utilize a designated infusion nurse or nurses to place PICCs. The use of ultrasound is also more cost effective within a facility by the very nature of a more accurate, efficient insertion - one kit, one needle, and one attempt. There is less waste or unaccountable disposable equipment. The advent of portable, affordable ultrasound and the micro-introducer has empowered nursing with the tools for cost effective, precise PICC insertions. PICCs placed with one attempt, with good technique, in the location of little movement will likely have favorable clinical outcomes. With favorable outcomes comes the reward of increased consultations and therefore an environment of quality infusion therapy. In hospital-based case studies, consultations for PICC insertion exponentially increased immediately after the introduction of ultrasound into the service. This increase serves to empower the infusion nurses and make them an integral part of the care provided.

There are few venous ultrasound machines that are very applicable to our practice. Even though it has never been the case for nursing to have large equipment budgets, ultrasound guided imagery has paid for itself in a very short period of time by reducing cost of insertion. Ultrasound units such as Dymax SiteRite™ II or III (Bard Access Systems), the SonoSite iLook™ and the PunctSure™ (Inceptio Medical Technologies) seem to attract the most interest by vascular access nurses.

The Agency for Healthcare Research and Quality (AHRQ) published a report in 2001 showing that of the 79 safety practices reviewed, 11 were identified as highly effective yet not performed routinely in the healthcare setting. The utilization of ultrasound to help guide the insertion of vascular access devices was mentioned as one of the top 11 practices in this list. Chapter 21 of this document will be of particular interest, as it is titled, “Ultrasound Guidance of Central Vein Catheterization.” The American College of Emergency Physicians (ACEP) has embraced the AHRQ’s recommendations released in July 2001 (“Making Health Care Safer: A Clinical Analysis of Patient Safety Practice”) to use ultrasound to place central lines in the Emergency Room because it prevents the incidence of punctured arteries and other complications. The ACEP
also recently issued guidelines that require all central venous catheters be placed with ultrasound monitoring. Even though the main thrust of Chapter 21 of the AHRQ’s report is toward the clinician placing central catheters via the internal jugular or subclavian vein routes, the authors believe that we must apply it to those accessing the central vascular system peripherally as well. It is our belief that every infusion therapist is obligated to employ the safest and most effective practices.

Technology affords us the advantage of visualizing a proposed vessel for cannulation and its surrounding structures including arteries. If we choose not to use it, the question is “are we doing a disservice to our clients and our practice?” As vascular access nurses, adopting these guidelines on our own will not only strengthen our practice but also provide the highest quality of care available at a reasonable cost.

This is the tip of the ultrasound iceberg and just the beginning in the use of bedside imagery for PICC placement. Ultrasound imaging may be utilized not only for the guidance of an introducer into a vessel (Figures 3 and 4), but it also may serve to visualize an internal / external jugular malpositioned PICC (Figures 5 and 6). This advancement in practice will save costly and time-consuming repeat chest x-rays, and spares the patient additional exposure to ionizing radiation. Consider also the time factor from insertion to final release of the PICC. For instance, a recent French study reported that the time required for ultrasound assessment is considerably less than assessment by traditional chest x-ray imaging. 15 We are doing these jugular checks with the same $11,000 to $15,000 ultrasounds that we used to access the veins.

The impact of ultrasonic imaging for PICC placement is tremendous. As higher resolution ultrasound machines become more accessible to nurses, the possibilities of dramatic improvements in patient and facility outcomes become more accessible as well. Nursing as a profession should embrace this evolution in vascular access and allow this tool to be the standard and not just an option.

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Figure 5. Needle within vessel (transverse)

Figure 6. PICC within vessel (sagittal)

REFERENCES

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