Peripherally inserted central catheter ports: A vascular access specialist's systematic approach

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Implanted ports are an important vascular access device for patients with malignancies requiring long-term chemotherapy. Peripherally placed ports are increasing in use as they are a safe, cost-effective alternative to chest-placed ports. Most peripheral ports can be placed bedside by specialist nurses in designated clinical areas rather than costly operating rooms or interventional radiology suites. Peripheral ports are considered less invasive compared with chest port placement because of reduced procedural risk. To enhance the success rate of peripheral port placement and minimize risks, we provide vascular access specialists with a systematic approach along with some technical advice tips and tricks to help avoid mechanical complications such as repeated puncture of the vein, excessive bleeding, thrombosis or skin dehiscence, as well as latent complications such as catheter migration and catheter-related blood stream infection. (J Vasc Nurs 2019;■:1-4)

INTRODUCTION

Since the 1980s, the implanted port has played a significant role in the treatment of malignant diseases where repeated intermittent doses of chemotherapy are required. While implanted ports are considered to be safe and reliable, they can lead to major complications including catheter fracture from pinch-off syndrome, infection, and thrombosis.[1] The evolution of lower profile port designs and smaller diameter catheter material has allowed for the development of peripherally inserted central catheter (PICC) ports.[2] The prevalence of PICC port placement has increased in recent years and is considered a safe alternative to chest-placed port.[2,3] A number of studies have compared outcomes between PICC ports and chest ports. A recent meta-analysis reviewing 3,524 patients with malignancies found that PICC ports were significantly safer with no difference in infection or thrombosis rates.[2,4] PICC ports also have the advantage of being placed in a similar fashion to a traditional PICC (with an added incision and short tunnel to implant the port subcutaneously). PICC port placement is considered minimally invasive and devices are routinely placed by specialist vascular access nurses bedside in designated areas using intravascular electrocardiographic (ECG) guidance reducing the burden on specialist suites such as operating or fluoroscopy rooms.[5]

PICC ports and PICCs are the preferred venous access devices in many hospitalized patient cohorts. It is well established that these devices are a major advantage to oncological patients, enabling effective and proper delivery of chemotherapy and other therapies for protracted periods. They can also be used effectively for blood sampling to avoid unnecessary venesection. Central venous access devices (CVADs) such as PICCs and PICC ports have facilitated administration of vesicant and peripherally toxic chemotherapy agents such as FOLFOX (5-FU, oxaliplatin, and leucovorin), FOLFIRI (irinotecan, 5-FU, and leucovorin), and ECF (epirubicin, cisplatin, and 5-FU), which has improved patient safety and significantly minimized the risk of possible extravasation.

In some hospitals of Greece, PICC ports are placed in oncology patients because they can be accessed to collect blood

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samples and to administer medications, fluids, and blood products. Complications with PICC ports are uncommon but, as with other vascular access devices, they carry an infection risk, but rates have been observed to be comparatively lower than other CVADs.[4] When studies specifically evaluated the PICC ports, we noted that PICC port placement to the upper arm group had a significantly lower rate of complications in comparison to the subclavian group.[6]

To enhance the success rate during PICC port placement and to reduce mechanical complication rates, we present this article to provide technical advice on the procedure. This article has been written by academics in the field of vascular access who routinely place CVADs that include PICC ports.

INSERTION PROCEDURE

Blood vessel puncture point can differ to actual anatomical port pocket placement. PICC port placement is only undertaken after thorough patient and vessel assessment; this includes past medical history or previous surgery that may impact procedure and a physical assessment that includes cognitive assessment as well as assessment of blood pathology.[7,8] Blood vessels are comprehensively assessed by ultrasound for optimal characteristics such as diameter, depth from skin, and pathway from the puncture point toward the central veins. The rapid assessment of the peripheral veins protocol is used to systematically assess the most appropriate vessel to puncture and to identify any abnormalities of the vessel itself and surrounding structures such as nerve bundles and arteries.[9] Typically, the vein puncture point and vessel pathway should be large enough to ensure adequate blood flow around the catheter to reduce risk of thrombosis (known as catheter-to-vein ratio).[10]

Maximal barrier precautions are an essential element. The upper limb, axilla, and chest wall are thoroughly disinfected using alcoholic chlorhexidine before application of the sterile maximal barrier. Vessel puncture occurs with a 21-gauge needle using real-time ultrasound guidance, after confirmation that the needle tip is in the center of the vessel a guidewire is advanced through the needle toward the axillary and subclavian veins. Asking the patient to turn their head toward the insertion side and place their chin on their shoulder where possible can avoid the guidewire entering the internal jugular vein.[10,11]

A small incision is made at the initial puncture site (either prior or after the catheterization of the vein depending on the practitioner's experience) and using forceps, the point of entrance is enlarged. At this point, the catheter introducer is inserted through the skin and the catheter is then passed through the introducer. During catheter advancement, a clinical assistant may scan and, if required, compress the internal jugular vein to ensure the catheter does not enter this aberrant pathway. Once the catheter is inserted to approximately 20 cm–25 cm, it is connected to an ECG read out device to get an intravascular electrocardiograph (IV-ECG). The IV-ECG is a dynamic waveform that changes as the catheter travels toward the right atrium and the amplitude of the P wave increases and becomes largest when it is close to sinoatrial nodal tissue.[11] Anatomically, this is the cavoatrial junction, the preferred position for catheter tip termination. After catheter tip confirmation, the patient is consulted for preference of port pocket, which is typically the medial aspect of the upper arm. The proximal end of the catheter is then tunneled in a retrograde fashion (back down the arm) to the preferred port pocket site.

The PICC port pocket is prepared initially with subcutaneous local anesthesia (lidocaine 2%) followed by 0.9% sodium chloride. A small incision is then made (approximately 1.5 cm) with a number 11 scalpel, and the pocket is made using a combination forceps using inserter's gloved finger, this method helps separate the subcutaneous. A further 10–15 cc of 0.9% sodium chloride is injected above the bicep muscle to reduce the risk of bleeding and to assist with further dissection of subcutaneous tissue. The pocket is always made by keeping in mind that the port must not force any pressure on the skin to avoid skin dehiscence. It is better to make the pocket using small forceps by pointing them toward the lower limb and removing them open. The port can now be connected to the appropriately measured and trimmed catheter. Because the port does not require suturing to the bicep muscle to avoid it twisting in the future, placing three to four subcutaneous sutures using a burying knot technique to secure the port in place is sufficient. Tissue adhesive glue or intradermal sutures can be used. Catheter tip is once again confirmed using the IV-ECG method via a port access needle.

The simple measures discussed previously can assist in reducing mechanical complications such as repeated puncture of the vein, hemorrhage, thrombosis, skin dehiscence, port hub rotation, accidental aspiration of the catheter, and infection (Figures 1–3).

DISCUSSION

One of the main complications of PICC ports is infection; however, the incidence does not increase with these devices compared with chest ports and, as they are completely subcutaneous, are also superior to devices such as PICCs and Hickman catheters for patients requiring long-term intravenous therapy.[12] PICC ports may also be advantageous in some specific cohorts such as patients with head and neck cancer. The meta-analysis undertaken by Wu et al, (2018) found that patients with head and neck cancer had lower rates of thrombosis compared with centrally placed ports because of the insertion and pocket being away from the tumor site.[2]

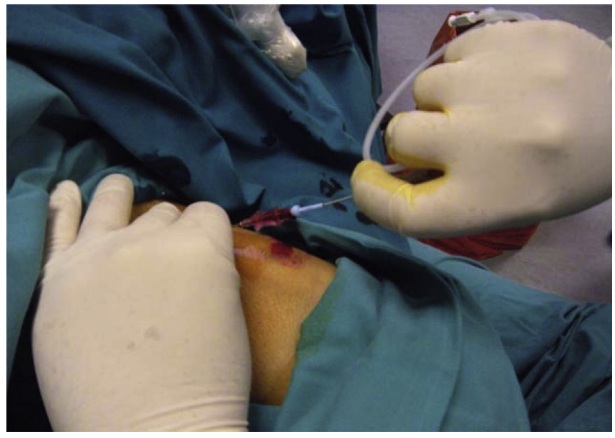

Figure 1. *The guidewire is inserted through the needle toward the axillary and subclavian veins.*

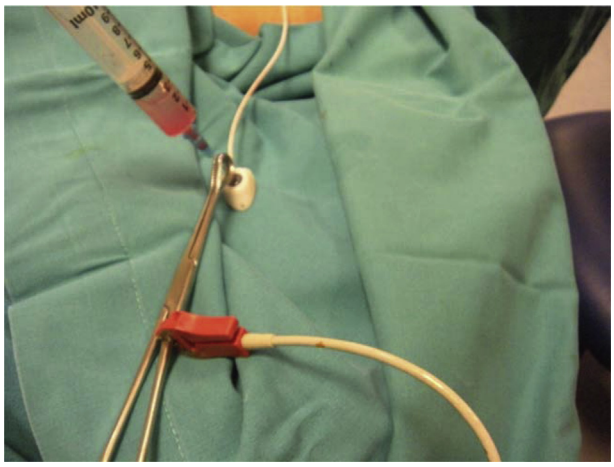

Figure 2. *The preferred position for catheter tip termination through the connection to an ECG read out device to get an intravascular electrocardiograph. ECG = electrocardiographic.*

Previous studies have found the incidence of venous thrombosis after PICC or port placement to be quite varied from 3% to 38%.[13] In addition, intravascular thrombosis is typically caused by endothelial damage because of local trauma, inflammation of vessel wall or stasis of blood flow, and hypercoagulable status (such as in some cancers). These mechanisms of acute thrombosis are explained by Virchow's theory of thrombotic pathogenesis.[14]

Research by Li et al (2018) found PICC-related venous thromboembolism (VTE) to be a common complication in patients with nasopharyngeal carcinoma, with an incidence of 5.6% and patients with a history of VTE and lower BMI to be more susceptible and symptomatic with PICC-related VTE, likely requiring anticoagulation.[15] Paje et al (2018) reported no relationship between catheter size and venous abnormalities, whereas the complications, which were reported, were catheter occlusion (4%) and tip migration (2.2%).[13] A study by Zochios et al (2014) reported that catheter size affects the risk of intravascular thrombosis; they observed that small-bore catheters were less likely to cause thrombosis than larger catheters in critically ill patients.[16] This is also supported by Australian research that found that a 45% or less catheter-to-vein ratio was optimal to reduce risk of catheter-related VTE.[10]

Figure 3. *The pocket which is made using combination forceps using inserter's gloved finger.*

A prospective study of Patel et al (2014) assessed complication rate of PICCs and ports in patients with nonmalignancies, for the first time, demonstrating less overall complications in patients with port devices compared with those with PICC lines (hazard ratio: 0.25), particularly with latent complications such as infection and thrombosis.[4] Moreover, Klogses et al (2015) reported 67 early or late complications from 248 PICC port implementations and, in 10 cases, the port system was explanted because of skin dehiscence and thrombosis.[1]

It is important to mention that mechanical and latent complications are not the only considerations for the placement of a PICC port but also the cosmetic benefits; a study by Marcy et al (2005) observed that in females with PICC ports, satisfaction was higher in terms of cosmetic appearance with the absence of a neck scar, and greater patient satisfaction was noted with no need to expose the chest. This study added to evidence that PICC port implantation could benefit patients with breast or head and neck cancer because imaging results after radiation therapy are better and there is less local skin irritation.[17] In Greece, PICC ports are implanted less frequently than chest ports and thus are less known to health professionals, such as nurses.

CONCLUSION

PICC port placement is a well-established procedure with many benefits that include reduced mechanical complications during insertion, are well tolerated by patients, and are comparable to chest ports for latent complications such as thrombosis and infection. A systematic approach with proper assessment before the PICC port procedure is always required to reduce complications and increase success and patient satisfaction.

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