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Peripherally Inserted Central Catheters: Potential for Use in the ICU

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Central venous catheters (CVCs) are widely used in critically ill patients. They permit haemodynamic monitoring and allow access for the administration of fluids, blood products, medications, and, sometimes, total parenteral nutrition (TPN). Although CVCs have significant benefits in many clinical situations, the increase in their use over the last 20 years has been associated with at least a doubling of resultant nosocomial infections (Fraenkel et al. 2000). The average rate of CVC-associated blood stream infection (BSI) is 5.3 per 1,000 catheter days in the ICU. The attributable mortality for these BSIs is and their attributable costs are high. The documented infection rate for PICCs is 0.75 infections per 1000 catheter days, compared with shortterm (non-medicated) central venous catheters at 2.51 infections per 1000 catheter days (Carrico 2005), resulting in substantial savings.

Moreover, unsuccessful insertion of CVCs may occur in up to 20% of cases. The hazards associated with attempted CVC insertion (whether successful or not) include arterial puncture, haematoma, pneumothorax and hemothorax. In general, the rate of major CVC complications (e.g., pneumothorax or vessel laceration requiring repair) and minor complications (e.g., arterial puncture without significant haemorrhage) is between 0.5 and 10%. There are no risks of pneumothorax with the PICC insertion procedure.

PICCs first gained popularity in the 1970s, and their use has grown steadily since then. In a recent report, Centers for Disease Control and Prevention (CDC), in the US, recommends usage of peripherally inserted central catheters (PICCs) when the duration of IV therapy is likely to exceed 6 days. As a result of the CDC recommendation, PICCs have now become well recognised as reliable central venous access devices (VAD), with lower potential for complications than short-term central venous catheters.

PICC is a special long, soft, intravenous line. For a VAD to be termed a PICC it must be inserted into the peripheral vasculature and the distal tip of the catheter must terminate in the superior vena cava, the inferior vena cava, or the proximal right atrium. A vein in the arm is the most common point of insertion. Progress into the chest via the peripheral system follows the basilic or cephalic veins into the axillary, the subclavian, then the innominate veins that join to form the superior vena cava (SVC). Optimal central venous placement is the lower third, distal portion of the SVC, or as close to the right atrium as you can get without entering. A tip termination proximal to the superior vena cava is technically not a PICC but rather a peripheral catheter. After the PICC is inserted, confirmation of correct tip placement by X-ray requires that the PICC line material be visible on radiographs. Therefore, radiopaque substances (e.g., barium sulphate) are blended into the PICC-line material.

Many intravenous medications and solutions cause damage to the peripheral venous endothelium and should be administered centrally to avoid damage. With central tip termination of PICC, the blood flow around the catheter is high (2 L or more per minute) which provides immediate dilution of the infusate and helps protect the vessel walls from chemical irritation by the prescribed therapy. Thus, PICCs may be used for any infusate, regardless of osmolarity, pH, or other chemical properties of the solution or medication (Vesely et al. 2002).

Various articles have proven that central venous pressure can be checked reliably from PICCs (Alansari and Hijazi 2004; Black et al. 2000). More over, it has been shown that attempted bedside PICC placement in the ICU could be successful 97.8% of the time.

Although these facts, in addition to its' other features, make PICC an excellent option for usage with patients in the ICU, more studies need to be done to support its' use.

Pre-Insertion Assessment

An assessment should be done as early as possible during a patient's hospital/ICU admission, in order to determine the type of VAD that is most appropriate for the therapy type and duration, condition of veins, and diagnosis. The most appropriate device should be able to provide access throughout the course of therapy, minimise pain and venous damage, use nursing time efficiently, and be cost effective.

"Dwell time" is the maximum expected duration considered appropriate for a given type of device. However, many devices have no established dwell time. Nontunnelled percutaneous central venous catheters, such as internal jugular, subclavian, and femoral devices, are generally considered appropriate only for short-term use, due to the higher risk of infection compared with PICCs, implanted ports, and tunnelled catheters. It is well known that PICC lines can stay for a long time (more than a year) with good care (Fiore 2005).

Contraindications

Insertion of any central VAD must be performed judiciously, as every insertion increases the risk of vessel damage, thrombosis, and stenosis, and potentially creates difficulty in obtaining future access. PICC insertion often becomes difficult or impossible for patients who have had multiplePICCs previously. If a patient requires frequent intermittent access, an implanted venous port may be a preferred option.

PICCs should not be used for frequent intermittent access or for blood sampling. Because a PICC is very long and thin, it is not advisable to insert it solely for the purpose of obtaining blood for laboratory analysis. Each blood draw increases the risk of occluding the catheter. A risk-benefit analysis should be done to determine the value of using a PICC for drawing blood.

Several factors contraindicate PICC placement: lack of peripheral access, venous thrombosis, and end-stage renal disease. Patients with restricted peripheral access must be sent to the interventional radiology department to have PICC placement performed under fluoroscopy. The presence of upper extremity or subclavian thrombosis is another contraindication for bedside PICC insertion, regardless of whether or not ultrasound is used. These patients also may be referred to interventional radiology to have a PICC inserted under fluoroscopy.

Patients with chronic renal failure and end-stage renal disease are not appropriate candidates for PICC placement. The need to preserve peripheral veins for future dialysis fistulas is a critical issue for these patients. Insertion of any catheter in the upper extremity or the subclavian veins can cause thrombus formation and scarring that could reduce the probability for successful fistula development. The internal jugular vein, particularly the right jugular vein, is the preferred insertion site for these patients. Although this choice is not without risks, it provides shortest and most direct route to the superior vena cava and minimises potential venous damage (Saad and Vesely 2003).

Development of PICC Line Insertion Program

Hospitals are responsible for developing training curricula to certify staff in PICC line insertion. In accordance with Intravenous Nurses Society (INS) guidelines, these courses require only an 8-16 hour class including clinical training. Hospitals with well-developed PICC line insertion programs recommend separating the PICC line program from radiology if there is enough patient volume, as it will generate significant cost savings for the hospital. This is a result of lower procedure costs than those resulting from a radiologist who performs the insertion in the radiology department. In addition to the decreased costs, risk of infection is also lessened, as staff at the bedside closely monitor insertion.

Conclusion

PICCs are central catheters with all the benefits of centrally inserted catheters, without some of the disadvantages. A PICC line insertion should be the VAD of choice, due to its lower incidence of infection compared with subclavian and internal jugular percutaneous catheters. Advantages focus on the less serious nature of the complications that occur with PICCs as opposed to other central lines. Vein identification is easier with peripheral access than with more risky access into the chest. Peripheral access avoids the risk of pneumothorax, nerve damage to the nerves of the brachial plexus or those in the chest, and infection with lower heat and bacterial growth on the skin of the arms and legs. Disadvantages with PICC lines are frequent occlusions due to the small diameter, risk of breakage and frequency of phlebitis. When considering the risk benefit ratio with central lines including both PICCs and chest lines, PICC lines clearly have the greatest benefit with the least risk.

For more information on developing a PICC line program: Intravenous Nurses Society (INS), Cambridge, Massachusetts www.ins1.org

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