

Can Peripheral Central Venous Lines be inserted safely and successfully where X-ray facilities are not available?

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Abstract

Background:

Primary care settings often lack facilities for radiological evaluation of the position of supra- and infra-clavicularly inserted central venous catheters. If peripherally inserted central venous lines could reliably be successfully inserted this would make the need for immediate confirmatory radiological studies less crucial. Previous studies with peripherally inserted catheters reported a low success rate. This study was performed to determine whether the placement of a more flexible peripherally inserted catheter, the Arrow PICC (Arrow PS-01651), would result in an improved and acceptable success rate.

Method:

Twenty-three patients in the casualty unit of the Mamelodi Hospital during 1997 and 1998, who required a central venous line and had this inserted via the peripheral venous route were evaluated after insertion of the catheter. The best basilic or median cubital vein in the cubital fossa was used for insertion following a standardized method. A number of 14 catheters were inserted in the right arm and 9 were inserted in the left arm. The position of the placement was assessed by an AP supine chest X-ray.

Results:

Successful placement was achieved in 91% of insertions (21 of 23 catheters).

In both of the unsuccessful placements the catheter tip was located in the ipsilateral internal jugular vein. (One on the left and one on the right.) No clinically significant complications resulted from these procedures.

Conclusions:

This study showed that central venous catheterisation with soft catheters (Arrow PICC - Arrow PS-01651), via visible palpable peripheral veins in the cubital fossa is easy to perform and is a safe procedure with a high success rate for correct catheter placement. This route warrants serious consideration when central venous catheterisation is desirable, especially in settings where X-ray facilities are not available to exclude complications or confirm placement.

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Introduction

Central venous lines are used for the accurate monitoring of fluid administration in various clinical settings¹. It is

extremely valuable², but correct placement is essential for accurate monitoring.

Insertion is usually effected via the

supraclavicular or infraclavicular routes. Complications, such as pneumothorax, hemothorax, catheter embolism, venous air embolism, nerve injury, arterial puncture and chylotho-

rax, have all been documented following catheter insertion via these routes³.

In an article discussing complications associated with central venous catheters, Scott states that a "Chest X-ray is mandatory to exclude immediate complications for e.g. a pneumothorax"⁴. Strong warnings appear in the package insert of these central venous catheters, advising that it should not be done without X-ray control. (e.g. ARROW product no AK-04650-E 8/92). Even standard textbooks make the point that this procedure is potentially dangerous and requires adequate assessment.

These guidelines and the weight of evidence concerning complications are a major deterrent to doctors inserting central venous lines when no X-ray facilities are available.

The insertion of supra- or infraclavicular central venous lines also requires special instruction and frequent use to maintain the skill and expertise to perform these procedures. Radiological control is often not available in primary care environments, especially after hours.

Rosen⁵ has shown that the insertion of central venous lines via the cubital fossa (peripherally inserted central catheters) is safe and has a low complication rate, similar to the insertion of a normal drip. However, previous studies with peripherally inserted catheters reported a low success rate – 77,7% correct placement with a Drum cartridge catheter, and 52,8% with the I-catheter (Bardic)⁶.

X-ray assessment following catheter insertion is performed to exclude the complications listed above and to ascertain whether the catheter tip is in the desired position.

Major complications needing X-ray assessment are unlikely to occur following peripheral venous insertion, so the major reason for X-ray assessment is to determine the correct placement of the catheter tip.

If peripherally inserted central venous lines can be successfully inserted (i.e. the catheter tip in the correct position to monitor central venous pressure), the necessity for radiological evaluation is far less critical.

This will be of tremendous help to primary health care doctors without radiological control facilities. Some authors have suggested that a medial cubital vein should be used in emergency conditions to reduce the number of complications⁷. Cannulation of the superficial veins of the arm require less skill than cannulation of the subclavian and internal jugular routes¹.

Peripherally inserted central venous pressure has been shown to reflect central venous pressure quite accurately under controlled circumstances⁸. Rosen¹ argues that for short-term use, central venous catheterisation through visible palpable peripheral arm veins is safe and remains the method of choice for those with little experience of sophisticated techniques. Primary care doctors are not always exposed to and therefore often have little experience with sophisticated techniques. This study was prompted by the fact that Mamelodi hospital has no X-ray facilities after 4 pm in the afternoon and practitioners working there have to deal with many patients who would benefit from the insertion of a central

venous line. We believe there are many such settings where primary care doctors have to work in less than ideal circumstances and also have not had exposure to training in the insertion of catheters via the supra- or infraclavicular routes.

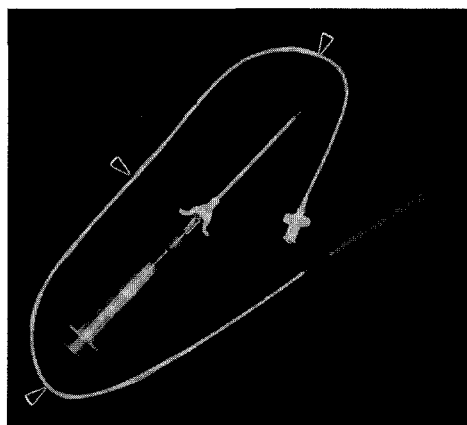
If we can find a method with the safety and the lack of major complications that peripheral vein cannulation offers but with an acceptable accuracy of placement of the catheter tip to ensure the benefits of central venous pressure monitoring, this would have obvious benefits.

The aim of this study was to determine whether the more flexible Arrow PICC (Arrow PS-01651 Peripherally Inserted Central Catheter) could be safely inserted via a peripheral vein with the catheter tip placed successfully in the desired position in the superior vena cava.

Materials and methods.

The Arrow PICC catheter was inserted in 23 patients needing a central venous line. The Arrow PICC (Arrow PS-01651) is a soft polyurethane radiopaque catheter, 55cm, 16Ga (Figure 1). The study was performed in the casualty unit of the Mamelodi hospital during 1997 to 1998. Informed consent was obtained from all patients or their family prior to insertion of the catheter and the study was approved by the Ethical

Figure 1: The Arrow PICC (Peripherally inserted central catheter) (Arrow PS-01651) with syringe, cannula and catheter (arrow heads).



show that the more rigid devices like the I-catheter⁶ do not demonstrate as high a success rate as the softer more flexible catheters¹². We used the Arrow PICC which is also a soft type of device. Our success rate supports this statement.

4. Reading of the central venous pressure should be done with the arm in 45° abduction. Further abduction or adduction of the arm can lead to movement of the catheter tip up to 2-3 cm. Adduction alone can result in the catheter being drawn into the thorax as much as 9 cm¹⁷.

There is a risk of air embolism after the syringe is removed and the cannula is situated in the lumen of the vein and the proximal end is open to the atmosphere. This is usually the case with most central venous lines irrespective of their place of insertion. The central veins are however prevented from collapsing because of connective tissue surrounding them. Air embolism is therefore more likely to occur in them than the peripheral veins¹⁸.

Authors have suggested that a medial

cubital vein should be used in emergency conditions to reduce the number of complications⁷. Cannulating the superficial veins of the arm require less skill than the subclavian and internal jugular routes¹.

The Arrow PICC is a safe catheter. It is a catheter-through-cannula device. The catheter is not inserted through a needle device. Therefore the catheter cannot shear if attempts are made to withdraw it while the needle is still in the vein. There is no flexible stylet wire stiffening the catheter throughout its length.

Three cases developed superficial inflammation at the site of insertion. None of these three developed thrombophlebitis. A superficial inflammation is not an indication to remove the catheter. However if signs and symptoms of severe local infection and systemic infection appear, the catheter should be removed¹⁹. An aseptic technique should be followed, and the catheter should be removed as soon as it is no longer needed. Using the PICC Catheter Set (Arrow PS-01651) proves to be cost-effective. The cost of the catheter pack is two

thirds of the price of a standard Central Venous Line Catheter Set.

Conclusion

We think that despite our small numbers this study confirms that central venous catheterisation with a soft peripherally inserted intravenous catheter (Arrow PS-01651) through visible palpable peripheral arm veins in the cubital fossa is safe and easy to perform.

It has a low complication rate and a high successful placement rate. Accordingly it merits serious consideration especially in situations where X-ray facilities are not immediately available and a central venous line is considered to be imperative. We would also hope that further studies could be conducted on a larger body of patients to better assess the promise of this technique.

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References

1. Rosen M, Latta P. Handbook of percutaneous central venous catheterisation. 2nd ed. London, Philadelphia, Toronto, Sydney, Tokyo: W.B Saunders Company; 1992.
2. Kalso E. A Short history of central venous catheterisation. *Acta Anaesthesiol Scand* 1985; 81:7.
3. Dawood MM, Trebbin WM. Complications associated with central venous cannulation. *Hosp Pract* 1991; 26:211-214,218-219.
4. Scott WL. Complications associated with central venous catheters. *Chest* 1988; 94:1221-122.
5. Rosen M, Latta P. Handbook of percutaneous central venous catheterisation. 2nd ed. London, Philadelphia, Toronto, Sydney, Tokyo: W.B Saunders Company; 1992:58.
6. Ng WS, Rosen M. Positioning central venous catheters through the basilic vein. A comparison of catheters. *Br J Anaesth* 1973; 45:1211.
7. Editorial. Central Vein Catheterisation. *Lancet* 1986; 2:669.
8. Joseph DM, Philip BK, Philip JH. Peripheral venous pressure can be an accurate estimate of central venous pressure. *Anesthesiology* 1985; 65:A166.
9. Webre DR, Arens JF. Use of cephalic and basilic veins for introduction of central venous catheters. *Anesthesiology* 1973; 38:389.
10. Blitt CD. Monitoring in Anesthesia and Critical Care Medicine. Central venous pressure monitoring. New York: Churchill Livingstone; 1985:121-165.
11. Burgess GE, Marino RJ, Peuler MJ. Effect of head position in the location of venous catheters inserted via basilic veins. *Anesthesiology* 1977; 46:212.
12. Bridges BB, Carden E, Tackacs FA. Introduction of central venous pressure catheters through arm veins with a high success rate. *Can Anaesth Soc J* 1979; 26:128.
13. Farman JV. Which central venous catheter? *Br J Clin Equipment* 1978; 32:210.
14. Woods DG, Lumley J, Russell WJ, Jacks RD. The position of central venous catheters inserted through arm veins: a preliminary report. *Anaesth Intensive Care* 1974; 2:43.
15. Deitel M, McIntyre JA. Radiographic confirmation of the site of central venous pressure catheters. *Can J Surg* 1971; 14:42.
16. Ragasa J, Shah N, Watson R, Bedford MD. Where antecubital CVP catheters go: a study under fluoroscopic control. *Anesthesiology* 1988; 69(Suppl.3A):A231.
17. Kalso E, Rosenberg PH, Vuorialho M, Pietila K. How much do arm movement displace cubital venous catheters? *Acta Anaesthesiol Scand* 1982; 26:354.
18. Cahill DR. Lachman's Case Studies in Anatomy. 4th ed. New York, Oxford: Oxford University Press; 1997: 94.
19. Maki DG, Goldmann DA, Rhame FS. Infection control in intravenous therapy. *Ann Intern Med* 1973;79:867.