RESEARCH ARTICLE

TUNNELED ADULT PERIPHERALLY INSERTED CENTRAL CATHETER (PICC) FOR CENTRAL VENOUS ACCESS IN PAEDIATRICS: A SINGLE CENTRE EXPERIENCE.

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ABSTRACT

Objective: Long term intravenous access in paediatrics is challenging in terms of ease of procedure, maintenance of catheter and complications. Small calibre of peripheral veins in children make insertion of peripheral long-term access difficult. Our centre adopted the use of tunneled adult Peripherally Inserted Central Catheter (PICC) for central venous access in paediatrics with the hope to improve these challenges. We describe a single institute 3-year experience of this technique. **Material & Methods:** Retrospective analysis of patients aged less than 12 years old who had tunneled PICC insertions from January 2018 till December 2020. The following data was recorded and studied: indication, reason for removal, duration of PICC, vessel inserted, device type and complications. **Results:** Eleven adult PICCs were inserted from this technique in 10 children. The average age was 35.7 months and weight was 13.2 kg. The youngest patient was 3 months old at 6.9 kg. Most common indication for insertion was for long term antibiotics (82%) and the remainder were for difficult intravenous access. The procedure was done under local anaesthetic with sedation in 90% of cases. Average duration of PICC was 26.8 days. Out of 11 PICCs only 1 had line related infection that required premature removal of the catheter. 55% completed the intended duration while 27% of PICCs had dislodged. **Conclusion:** Tunnelled adult PICC for central venous access in paediatrics is a feasible option for long term vascular access and has a lower risk of infection. However, almost a third of the catheters inserted still suffered premature dislodgement.

KEYWORDS

PICC, tunnelled peripheral inserted central catheter, children, paediatrics.

1. INTRODUCTION

Intravenous access for paediatric patients is a challenge for the treating physician, especially in severely ill cases. Common difficulties faced during such venous access device placement include troubles in venous cannulation, small calibre of vein for catheter placement, maintenance of catheter patency, thrombophlebitis and catheter dislodgement. Usage of a Peripherally inserted central catheter (PICC) is a long-term solution to ensure venous access is maintained for the duration needed.

A PICC is a catheter made of polyurethane or silicon with sizes ranging from 3 to 6 French (Fr) that is typically inserted at a peripheral vein in the arm and guided into a larger vein close to the heart. In the paediatric population, the peripheral vein maybe too small to accommodate a catheter and using a more central vein approach will help in ensuring success of venous access.

Tunnelled adult PICCs as central venous access in paediatrics offers several advantages compared to conventional PICC or central venous catheter. Tunnelled PICCs has reduced rate of infection, lower rate of dislodgement especially in special needs children, better comfort and easier catheter removal without the need for general anaesthesia (Maria et al., 2019; Lawson et al., 2018).

PICC insertion in paediatric is not without its complications. Side effects that may arise are superficial and deep venous thrombosis of the arm, infection, catheter fracture and embolization (Maria et al., 2019; Gnannt et al., 2018; Westergaard et al., 2013).

In the paediatric population, smaller peripheral vessel dimensions with sharper, more angulated routes of the subclavian and internal jugular veins make conventional peripherally inserted central venous catheter insertion more difficult (Janik et al., 2004).

Our centre adopted the use of tunneled adult Peripherally Inserted Central Catheter (PICC) for central venous access in paediatrics with the hope to overcome these challenges (Bernasconi et al., 2017). This study describes a single institute 3-year experience of this technique.

2. MATERIALS AND METHODS

2.1 Patient population

This retrospective study was conducted in Hospital Sungai Buloh. Patients were aged between 3 months to 12 years old (3- 144 months) who underwent successful tunnelled adult PICC as central venous catheter insertion in interventional radiology department over a 3- year period from January 2018 to December 2020.

2.2 Data collection

The data was collected from interventional radiology database, electronic patient charts and the picture archiving and communication system (PACS; Centricity Universal Viewer). The following data were recorded – patient demographics, age in months, weight, indication or intended use of the PICC, diagnosis at the time, PICC device type and size, vessel inserted, location of tip, duration of usage of PICC, reason for removal and

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line related infection.

2.3 Peripherally inserted central catheters (PICCs)

Three different types of polyurethane PICC were used in this study with majority being BARD Power PICC™ (Bard Access Systems, Salt Lake City, USA; Navilyst Medical, Marlborough, USA). The other two catheters used were Lifecath from Vygon™ Peripherally inserted polyurethane central venous catheter (Écouen, France) and another was Celsite® PICC-Cel by B- Braun™ (B.Braun, Melsungen AG, Germany). Single and double lumen was used in this study. PICC size ranges from 3Fr to 5Fr.

2.4 Ethical considerations

The study was registered in the National Medical Research Registry under the Institute for Clinical Research Malaysia. Informed consent was obtained from next of kin of all participants included in the study. Data were treated anonymously and confidentially according to national required standards.

3. PICC Placement Technique.

1. Cases are performed with conscious sedation given by the Paediatrics team or general anaesthesia.
2. Standard practice included US guidance, fluoroscopy and Seldinger technique.
3. The preferred site for access is one of the internal jugular veins (IJV), usually the right.
4. Local anaesthesia is given at the insertion site and along the tunnelled anterior chest wall exit site.
5. The IJV is puncture using 21G micropuncture needle under ultrasound guidance. The 0.018" wire is inserted through the needle and parked in the inferior vena cava. The needle is subsequently removed. (Figure 1)

Figure 1: Illustration showing position of guidewire within the micropuncture needle and the chest wall tunnelling site.

6. Next, track is tunneled at the anterior chest wall using previous 21G micropuncture needle. The exit site of the tract is the same as the entry site of the previous microwire in the IJV.
7. 0.018" PICC catheter wire is backloaded through the needle and exit to the tunnel entry site. (Figure 2A-D).
8. The needle is removed and PICC introducer peel away sheath is inserted over the wire from jugular insertion site to the chest exit site. Then the stylet of the peel way sheath is removed and the PICC catheter is backloaded from the sheath in the chest to the neck. The peel way is then completely removed, reloaded and used for entry into the jugular vein. (Figure 2E-I).
9. The PICC catheter is then measured and cut according to appropriate length using fluoroscopic guidance. (*NB some catheters have a minimum length beyond which they cannot be cut) (Figure 2I)

Figure 2: (A,B) Micropuncture needle inserted from the chest wall site to the insertion IJV site. (C, D) The 0.018" catheter wire is backloaded through the needle and exit to the tunnel insertion site. (E,F) The PICC introducer peel away sheath is inserted over the wire. (G,H) The PICC catheter is backloaded from the sheath in the chest to the neck. (I) The PICC catheter is measured and cut using fluoroscopic guidance.

10. Subsequently, the peel away sheath is introduced into the inferior vena cava from the jugular entry site over the existing 0.018" wire.
11. The wire is removed and the PICC is inserted into the peel away sheath. (Figure 3A).
12. The peel away sheath was then removed, and the central tip position (cavo-atrial junction) was recorded using on table chest radiograph. (Figure 3B).
13. Skin closure over the internal jugular vein incision site is achieved with sutures or sterile strips. The catheter is anchored at the anterior chest wall with sutures or a StatLock device. (Figure 3C-E).
14. PICCs were removed when no longer required or if a complication necessitating removal occurred (e.g. catheter fracture, infection). This could be done bedside in the ward, without the use of anaesthesia.

Figure 3: (A) The PICC is inserted over the peel way sheath (B) Chest radiograph to confirm tip position. (C,D,E) Post-operative photograph illustrating how the PICC device is secured using the proprietary adhesive dressing supplied with the device or sutures, applied to the right anterior chest wall. Skin incision closure is achieved with adhesive steristrips or suture.

4. RESULTS

Eleven adult PICCs were inserted with this technique in 10 children. The average age of our subjects was 35.7 months (range 3 months to 144 months) and average weight was 13.2kg (range 6.9 to 35kg). The youngest patient was 3 months old at 6.9kg.

Most common indication for insertion was for long term antibiotics (82%) and the remainder were for difficult intravenous access. Seven of the

patients were admitted due to infection (3 meningitis, 1 subdural empyema, 2 osteomyelitis, 1 pleural empyema) and the remainder 4 patients were admitted due to severe burn injuries. The procedure was done under local anaesthesia with sedation in 90% of cases while one was performed under general anaesthesia as patient was already intubated in ICU.

The average duration PICC was left in situ was 26.8 days. Out of 11 PICCs only 1 had line related infection that required premature removal of the catheter. Six patients completed the intended duration of use. Two PICCs had dislodged prematurely, one was leaking requiring early removal and one transferred hospital with PICC in situ.

Reason of removal	No of patient (percentage)
Completion of treatment / discharge	6 (55%)
Transfer hospital	1 (9%)
Infected	1 (9%)
Leaking	1 (9%)
Dislodged	2 (18%)

5. DISCUSSION

This retrospective study looks at the technique, advantages and problems faced from insertion of tunnelled adult PICC as central venous access in paediatrics. This method was first described by Lawson BT et al for long term intravenous access (Lawson et al., 2018). They described a low infection rate (4.8%) as well as a low rate of premature dislodgement (9.6%). Tunnelled PICC reduces the incidence of infection by having the exit site located in the chest (for jugular access) where there is low risk of micro bacterial colonization. When comparing tunnelled lines with typical PICCs in children, Jaffray J et al described a lower incidence of line related infection rate in tunnelled catheters (Jaffray et al., 2020).

Central line-associated bloodstream infection (CLABSI) can pose a serious problem that necessitate modification of antibiotic regimes and may potentially have adverse outcomes onto a child (Barrier et al., 2012). Our results as well as the literature clearly demonstrates that tunnelled central venous access have a low rate of such infections between 5-10%. To further reduce chances of infection it is recommended using antibiotic regimes whereby doses are less frequent in a day to reduce the manipulation of the catheter (Barrier et al., 2012).

Catheter dislodgement is also reduced in tunnelled PICC as the catheter is tucked away under the child's clothes away from their inquisitive hands. In our data, we saw almost double the percentage of premature dislodgement but this is likely due to our small sample size and relative inexperience. In addition to infection, frequent catheter manipulation also increases the risk of premature dislodgment and should be minimized.

Another added advantage for utilising this technique for insertion of long-term vascular access is the relatively easier puncture due to the large calibre neck vein available as oppose to a peripheral vein, especially in very small children (Bernasconi et al., 2017). Furthermore, in critical patients requiring long term access, there is a high likelihood that peripheral venous vascular access has been exhausted. When comparing femoral to jugular venous access, the neck site is favourable as there is less chance of catheter soiling and manipulation, especially for children using diapers. Studies have demonstrated an increased risk of catheter related infections with catheters placed at the groin (Tsai et al., 2009). The literature also shows that success rates for cannulation and catheter insertion improved amongst interventional radiologists (Hauser et al., 2020).

In our study population, there were 4 cases of severe burns that required venous access. When burns involve a large body surface area affecting the upper and lower limbs, venous access proves challenging (Austin et al., 2015). In such cases, we find that a jugular approach and if permissible a

tunnelled jugular approach would be ideal to secure short- and long-term access as well as reduced rates of infection. One problem to note in association with burn injuries is the increased incidence of thromboembolic events due to a hypercoagulable state especially in the first week after a burn injury (Van Haren et al., 2013). However, we did not encounter any cases of blocked PICC catheter in the burn patients of our study group.

Gnannt R et al reported the rate of thrombosis in first time PICC insertions of 3.9% (Gnannt et al., 2018). There was fewer incidence reported in single lumen as compared to double lumen PICC. A general rule in our practise is that the catheter should be no larger than two times the size of the internal jugular vein. In our institute, we favour a 4-5Fr catheter which should fit into a 2.4-3.0mm jugular vein. In the literature, the average time reported from the insertion of line to when symptomatic thrombosis is detected is 23.5 days. The risk of developing a symptomatic deep vein thrombosis is higher with every line insertion in the same vein/arm (Gnannt et al., 2018). In this study, there were no complication of thrombosis present, with an average catheter in-situ duration of 26.8 days. Only one of our patients had the PICC placement into the same vein twice, but no incidence of symptomatic thrombosis was detected.

Final catheter position is a major concern when performing central venous access in paediatrics. Racadio et al analysed a large dataset of almost 1200 cases studying central and non-central tip locations (Racadio et al., 2001). The conclusion was that centrally placed catheters at the correct location were associated with a lower risk of blockage as compared to non-central location. In our study, we placed all our catheters within the SVC vertically. This position ensures that the catheter is parallel to the wall of the vessel and not abutting it. If catheters are abutting a vessel wall, there is an increased risk of clot formation (Di Costanzo et al., 1984).

There has been reports of complications during removal of PICCs especially in paediatrics (Miall et al., 2001). In our institute, removal of PICCs were done bedside without complications. There was no documented exit site bleeding, skin bruising, chest wall cellulitis or other difficulties encountered during catheter removal in any of our cases. This makes for ease of care as oppose to some other types of central catheters with cuffs that require general anaesthesia for removal.

To the best of our knowledge, this is the first such observational study in Malaysia with several limitations identified. We acknowledge the limited study sample size with all cases either from burn injuries or pediatric neurosurgical unit. We also had no comparison of typical PICC placement versus central venous catheter data to analyse difference in the complications. A larger scale prospective study is needed in pediatric population to obtain more concise conclusion.

6. CONCLUSIONS

Tunnelled adult PICC for central venous access in the paediatric age group is a safe technique for long term venous access. There is a lower risk of infection but premature removal is still a problem. The use of a large central vein in the neck with ultrasound guidance makes venous access puncture easier as compared to peripheral venous route, especially in the ill patient where peripheral access has been exhausted.

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