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RESEARCH ARTICLE

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A single-centre experience of an anesthesia-led pediatric peripherally inserted central catheter service at a specialized cancer institute

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ABSTRACT

Introduction: To report our experience of establishing a pediatric peripherally inserted central catheter (PICC) line procedure led by the anesthesia department of a tertiary care cancer center.

Materials / Patients and Methods: A retrospective review was conducted over a period of 28 months. Variables such as demographic data, indications, the number of days the line remained in situ, and the frequency of adverse events were considered.

Results: A total of 112 patients between the ages of 1 and 14 years who had PICC lines inserted were included. All procedures were done under general anesthesia by two separate anesthesia teams with established protocols. Insertion was guided by ultrasonography through the basilic (*n* = 84, 75%), median cubital (*n* = 12, 10.7%), femoral (*n* = 1, 0.9%), or cephalic (*n* = 15, 13.39%) veins in the nondominant arm. The insertion success rate was 97.3% while the unsuccessful in 2.7%. The 4Fr (French number) PICC line was used in 95 (84.82%) patients and 5F in 17 (15.17%) patients. The PICC line was used for an average of 85.47 days (ranging from 0 to 350 days). Chemotherapy (*n* = 89, 78.47%), difficult Intravenous access (*n* = 15, 13.39%), and palliative care (*n* = 8 7.14%) patients require long-term venous access. 38 (33.92%) patients had completed treatment with a PICC line while 4 (3.57%) patients lost follow-up.

Conclusion: PICC—lines are an essential element of cancer treatment in children. Anesthesia-led PICC line service is a reliable option. They maintain the operating room, PICC line sterility during insertion, and complications comparable to following the recommended precautions.

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Introduction

Peripherally Inserted Central Catheters are fairly common in pediatric patients who require long-term intravenous (IV) therapy. These therapies include cancer chemotherapy, total parenteral nutrition, antibiotics for an extended duration, and frequent blood product transfusions [1,2]. The catheters are placed in a peripheral vein with the tip in the superior vena cava or right atrium. It is a specialized procedure that requires training and the use of ultrasound (USG) and fluoroscopy to guide placement is routine. The procedures are usually done by radiologists, pediatricians, anesthetists, or specialized nurses. In addition, pediatric patients require sedation or general anesthesia for these procedures which necessitates the presence of trained anesthetists during insertion.

Kamata et al [3] published a peripherally inserted central catheter in 133 patients as an alternative to tunneled central venous catheters for chemotherapy in oncological pediatric patients. While, in another retrospective cohort by YU Z, the nurse-inserted PICC line program was introduced in general pediatrics with favorable outcomes and a low complication rate [4].

The data are scarce from the developing world about the subject and our institution caters to a large pediatric population with cancer who frequently require central access. Traditionally, PICC lines at our institute were done by Interventional Radiologists [1]. However, due to logistical issues

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of arranging anesthetic service in radiology suites and procedure rooms and to cater for workload and patient satisfaction, an anesthetist-led service for PICC lines was established. To the best of our knowledge, this is one of the first such services in Pakistan, this study describes our initial experience of anesthetic-led pediatric PICC line insertion. Our research fills a vacuum in the literature by concentrating on setting up a PICC line service under anesthesia in a hospital that treats a lot of young patients. This effort sought to enhance workload, patient satisfaction, and logistical issues.

Objectives

The objective of the study was to document our experience of PICC line insertion in the pediatric population over a period of the first 28 months.

Equipment and Methods

Two anesthetists who were trained in the use of USG and line insertions were nominated for line insertions. A dedicated procedure room in the OR with an anesthetic machine, USG, and facilities for fluoroscopy were arranged. PICC lines of sizes 4 Fr, 5 Fr, and 6 Fr were arranged by operation room (OR) store. A standard operating procedure (SOP) was established for the care of lines where all patients would come to the OR holding bay area the next day for dressing change and heparin-lock the next day. Subsequently, they would undergo once-weekly dressings and heparin locks under the care of the primary team. We set a cut-off of 10 Kg for eligibility for PICC line insertion as the smallest catheter size available to us was 4 Fr. Children less than 10 Kg were dealt with on a case-by-case basis with the majority being referred for tunneled central line insertion. On the day of the procedure, a pre-procedural assessment and anesthetic preoperative assessment were done. Written informed consent for the PICC line procedure and general anesthesia was signed before the procedure. Established protocols for the operating room, standard monitoring, aseptic precautions, and postoperative anesthesia care observation were followed.

Patients were anesthetized under general anesthesia and the arm veins were visualized with a high-frequency linear probe of USG Mindray dp-10 to detect the puncture site setting an axillary tourniquet. The basilic, median cubital, or cephalic veins were punctured above the cubital fold after local asepsis and local anesthesia with 2cc of 1% lidocaine, and a 22-gauge USG guided blue catheter if the vein was thought to be too superficial for the puncture needle included in the kit. A 0.018 nitinol guide wire was catheterized into the vein to the superior vena cava and confirmed with fluoroscopy. To insert the PICC line, a peel-away introduction device was first placed after the insertion site had been incised. Under fluoroscopy, the catheter position was confirmed at the junction of the right atrium and the superior vena cava using fluoroscopy. With the use of a 2.0 silk suture and Tagaderm CHC Chlorhexidine Gluconate I.V.securement colloid dressing from 3M International (Maplewood, Minnesota, USA), the PICC line was secured to the skin. 4F and 5Fcook catheters (POWER PICC, Becton Dickinson Company) were readily accessible. The procedure was documented in the Hospital Information System. Post-procedure chest X-ray was performed to confirm catheter's tip location. The patients were discharged from the OR after confirmation of discharge criteria, as per established protocols, a dressing change was performed 24 hours after the procedure and then a weekly dressing change and flushing of the catheter lumen with heparin was performed. A trained resident evaluated any complication related to the procedure the next day. The patient was referred back from the primary team if the patient developed any late complications and at the end of treatment for removal. To assess and appropriately handle any immediate post-removal complications, the removal was performed under anesthesia in an aseptic setting with post-procedure monitoring during recovery.

Statistical Analysis

All the data regarding patients and procedures was retrieved from the Hospital Information System and analyzed with Microsoft MS Excel. The analysis considered the indication, the patient's sex, the treatment's success or failure, the patient's age at the time of insertion, the vein used for insertion, the type of PICC line, the average period of use, and the emergence of problems such as unintentional removal, dislodgment, venous thrombosis, obstruction, or infection, complete treatment, and long-term venous access for palliative reasons.

Results

One hundred and twelve PICC lines were inserted in an equal number of patients over a period of 28 months. 78 (69.6%) patients were males and 34 (30.4%) were females. The indications for catheter insertion were initiation of chemotherapy in 89

(79.47%) patients and 15 (13.39%) patients who had difficult IV access. While 8 patients (7.14%) long long-term venous access for palliative treatment was the primary indication.

The insertion success rate was 97.3%. The patients' ages ranged from 01 year to 18 years old, with an average age of 7.5 years at the time of insertion. The median age was 7 years old. The procedure was performed under general anesthesia in all patients of the pediatric age group. In the nondominant arm, the insertion was guided by USG into the basilic (n = 84, 75%), cephalic (n = 15, 13.39%), femoral (n = 1, 0.9%), and median cubital (n = 12, 10.71%). The 4F PICC line was utilized in 95 patients (84.82%) and the 5F line in 17 (15.17%).

The line was inserted in the right arm in 82 (69%) cases while in the left arm in 30 (31%) patients. The PICC line was used for an average of 85.47 days (1 to 300 days). The reasons for removing the catheter were the completion of treatment in 38 (33.92%) patients, and infection in 21(18.75%). In all suspected infection instances, the distal tip of the PICC line was cultured when it was removed. Accidental removal in 21 (18.75%) patients, blocking in 12 (10.71%) patients (The patients were thrombolysed with heparin, which was ineffective in two cases, and the catheter was subsequently replaced over a guide wire). Two patients died 2(1.7%) while the line was in place during the study. The misplacement was in 5 (4.46%) patients, deep venous thrombosis (DVT) in 1 (0.9%), and unsuccessful in 3 (2.67%) patients out of which two patients 2(1.7%) developed swelling of the arm so PICC line was removed, while 5 (4.46%) patients in our study still had a catheter *in situ* at the end of the study. 04 (3.6%) patients were lost to follow-up (Table 1).

There was no significant increase in the likelihood of problems based on the period of usage or catheter diameter. Complications occurred at an average of 11.7 months after the start of our study and 48 days (about 1.5 months) after the catheter was inserted.

Table 1. Features of the peripherally inserted central catheter (PICC) lines inserted during the study. PICC lines n = 112.

Gender

Gender	Number	Percentage
F	34	30.4
M	78	69.6
Total	112	100.0

Site

Site	Number	Percentage
Left median	1	0.9
Right femoral	1	0.9
Left cephalic	5	4.5
Right cephalic	10	8.9
Right median	11	9.8
Left basilic	24	21.4
Right basilic	60	53.6
Total	112	100.0

- Basilic vein 84 (75%)
- Femoral vein 1(0.9%)
- Cephalic vein 15 (13.39%)
- Median cubital 12(10.71%)
- Arm
- Right 82 (73.21%)
- Left 30 (26.78%)

Single Lumen

Size (Fr)	Number	Percentage
5	17	15.17
4	95	84.84
Total	112	100.0

- 3F 0 (0%)
- 4F 95 (84.82%)
- 5F 17 (15.2%)

Indication

Indications	Number	Percentage
Difficult IV	15	13.39
Long term venous access for Palliative treatment	8	7.14
Chemo	89	78.47
Total	112	100

Length of use 1–350 days (about 11 and half months) (Mean 85 days approximately)

Reasons for Removal

Reasons	Number	Percentage
Unsuccessful	3	2.7
DVT	1	0.9
(Loss of follow up)	4	3.57
Misplacement	5	4.46
Death	2	1.7
Occlusion	12	10.71
Infection	21	18.75
Accidental removal	21	18.75
Complete treatment	38	33.92
Still in use	5	4.46
Total	112	100

Discussion

Obtaining vascular access in the Pediatric population can be challenging. When it comes to cancer patients this becomes long-term as they require frequent blood sampling, multiple sessions of chemotherapy, transfusions of blood products, and occasionally total parenteral nutrition TPN. When vascular access is required for more than 2 weeks' preference should be given to long-term lines like tunneled catheters or PICC lines [1,3]. PICC lines are becoming more popular as they are a less invasive procedure as compared to central lines and risks of hemothorax, pneumothorax, and major vascular injury are reduced markedly though there are case reports of such complications in literature [5]. In our assessment parents were more likely to opt for PICC line insertion rather than the tunneled line when both were explained due to the less invasive nature of the procedure of PICC insertion. These lines carry no extra risks in the pediatric population; however, a standardized approach for insertion is recommended under aseptic measures to decrease the risk of infection [6]. We developed an SOP for insertion before starting our service which included parent education and consent, procedural conduct, and post-procedure care. The success rate of the procedure in our opinion depends upon the weight and age of the child, the visualization of good-sized veins with USG, and easy passage of guide wire. The failure in our population was due to aberrant anatomy and post-procedure complications such as swelling of the arm, redness, and venous thrombosis. Our failure rate was comparable to other studies [7,8]. Younger children require some sort of sedation or anesthetic for the procedure [7], as we were dealing with a majority population of less than 7-year-olds we preceded with General Anesthetic for them.

The mean duration of usage of the catheter was 85.47 days. The major complications were central line-associated bloodstream infection (CLABSI), Occlusion, and accidental removal [9]. We did not have an increased incidence of line-related DVT in our population, one of the reasons for this could be that we did not do follow-up Doppler's of any patients unless clinically indicated. The prevalence of venous thrombosis was 0.9%, but published rates in the literature ranged from 3.9% to 10% [5,10,11]. Our CLABSI rate was much higher than what other studies have found, [12,8]. The primary reason we suspect this is a lack of education among families and care providers. Based on our findings we instituted a plan to improve post-procedure care and education of our patients.

Regular care of all lines and patient follow-up are advised to avoid problems. Care staff members must get the appropriate training and information, and each patient must receive a follow-up document. Incidents can be avoided with the use of occlusive garments and education for care staff. We advise wearing waterproof clothing when showering and changing your dressing once a week [13,7] Blockages in the PICC line can be prevented by placing a bidirectional valve, carefully maintaining the catheter, and performing pulsed rinses with regular saline solution once a week. To avoid line thrombosis, a heparinized flush is equally vital.

Although the recommendations only show clinical monitoring in the department for arm discomfort, redness, or edema [11], routine ultrasonography monitoring of the catheter insertion site might be considered.

Conclusion

PICC lines are a growing solution for pediatric oncologists. They have many benefits such as reducing hospital stay, the lack of scarring, and quick removal by the care team under medical supervision. The most common problems are mechanical and infectious, and they may be prevented by carefully maintaining the catheter. The anesthesia-led PICC line services are a practical option with comparable complication rates

Conflict of interest

The authors declare that they have no conflicts of interest concerning this article.

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