

Central Catheter of Peripheral Insertion in Pediatric Oncology: a Retrospective Study

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Cateter Central de Inserção Periférica em Oncologia Pediátrica: um Estudo Retrospectivo

Catéter Central de Inserción Periférica en Oncología Pediátrica: un Estudio Retrospectivo

Fabriciana Gonçalves Santana¹; Patrícia Luciana Moreira-Dias²

Abstract

Introduction: Obtaining venous access in children and adolescents with cancer is a challenge for nurses. Central peripheral insertion catheter (PICC) has been used as an alternative to long-term venous access, reliable and safe in Pediatric Oncology. **Objectives:** Identify the profile of children and adolescents with indication of PICC use, list the reasons for removal and the length of time the catheter is present during cancer treatment. **Method:** Quantitative study, descriptive and retrospective, which used documentary analysis as a research technique, through medical and institutional records. The sample consisted of 51 records of PICC-type catheters inserted between 2012 and 2016. **Results:** Male patients corresponded to 66,6% of PICC insertions and the age group being prevalent between 4 and 9 years (30,7%). The most frequent diagnoses were leukemias (41%) and lymphomas (25,6%), with diagnostic time at the time of insertion of the PICC less than one month (51,9%). The reasons for removal of PICC were termination of treatment (45%), infections (17,6%), traction of the accidental (15,6%), obstruction (11,7%), death of the patient (5,8%), and catheter rupture (3,9%). The mean length of stay was 145 days. **Conclusion:** The data indicate that most of the removals of the PICC were elective reasons, that is, due to the end of the intravenous therapy, in addition to a high rate of catheter permanence. PICC has been shown to be an important option for intravenous therapy in Pediatric Oncology.

Key words: Nursing Care; Catheterization, Central Venous; Neoplasms; Child; Adolescent.

Resumo

Introdução: A obtenção de um acesso venoso em crianças e adolescentes com câncer é um desafio para os enfermeiros. O cateter central de inserção periférica (PICC) tem sido utilizado como uma alternativa para obtenção de um acesso venoso duradouro, confiável e seguro na Oncologia Pediátrica. **Objetivos:** Identificar o perfil das crianças e adolescentes com indicação do uso de PICC, elencar os motivos de remoção e o tempo de permanência do cateter durante o tratamento oncológico. **Método:** Estudo quantitativo, descritivo e retrospectivo, que utilizou como técnica de pesquisa a análise documental, por meio de prontuários e registros institucionais. A amostra foi constituída por 51 prontuários nos quais constam registros de cateteres inseridos no período de 2012 a 2016. **Resultados:** Pacientes do sexo masculino corresponderam a 66,6% dos registros, sendo a faixa etária prevalente entre 4 e 9 anos (30,7%). Os diagnósticos mais frequentes foram de leucemias (41%) e linfomas (25,6%), com tempo de diagnóstico no momento da inserção do PICC menor que um mês (51,9%). Os motivos de remoção do PICC foram o término do tratamento (45%), infecções (17,6%), tração do acidental (15,6%), obstrução (11,7%) óbito do paciente (5,8%) e ruptura do cateter (3,9%). O tempo médio de permanência foi de 145 dias. **Conclusão:** Os dados apontam que a maior parte das remoções do PICC foi por motivos eletivos; ou seja, decorrentes do término da terapêutica intravenosa, além de uma alta taxa de permanência do cateter. O PICC mostrou ser uma importante opção para terapia intravenosa em Oncologia Pediátrica.

Palavras-chave: Cuidados de Enfermagem; Cateterismo Venoso Central; Neoplasias; Criança; Adolescente.

Resumen

Introducción: La obtención de un acceso venoso en niños y adolescentes con cáncer es un desafío para los enfermeros. El catéter central de inserción periférica (PICC) ha sido utilizado como una alternativa para obtener un acceso venoso duradero, confiable y seguro en la Oncología Pediátrica. **Objetivos:** Identificar el perfil de los niños y adolescentes con indicación del uso de PICC, elencar los motivos de remoción y el tiempo de permanencia del catéter durante el tratamiento oncológico. **Método:** Estudio cuantitativo, descriptivo y retrospectivo, que utilizó como técnica de investigación el análisis documental, a través de prontuarios y registros institucionales. La muestra fue constituída por 51 prontuarios en los que constaban registros de catéteres insertados en el período de 2012 a 2016. **Resultados:** Los pacientes del sexo masculino correspondieron al 66,6% de los registros, siendo el rango de edad prevalente entre 4 y 9 años (30,7%). Los diagnósticos más frecuentes fueron de leucemias (41%) y linfomas (25,6%), con tiempo de diagnóstico en el momento de la inserción del PICC menor de un mes (51,9%). Los motivos de retiro del PICC fueron el término del tratamiento (45%), infecciones (17,6%), tracción del accidental (15,6%), obstrucción (11,7%) óbito del paciente (5,8%) y la ruptura del catéter (3,9%). El tiempo promedio de permanencia fue de 145 días. **Conclusión:** Los datos apuntan que la mayor parte de las remociones del PICC fueron motivos electivos, o sea, resultantes de la terminación del tratamiento intravenoso, además de una alta tasa de permanencia del catéter. El PICC mostró ser una importante opción para terapia intravenosa en Oncología Pediátrica.

Palabras clave: Atención de Enfermería; Cateterismo Venoso Central; Neoplasias; Niño; Adolescente.

¹ Universidade Paulista (Unip). Jundiaí (SP), Brazil. Orcid iD: <https://orcid.org/0000-0002-3384-9954>

² Unip. Jundiaí (SP), Brazil. Orcid iD: <https://orcid.org/0000-0002-3153-5302>

Corresponding author: Patrícia Luciana Moreira Dias. Avenida Armando Giasseti, 577 – Vila Hortolândia - Trevo Itu/Itatiba. Jundiaí (SP), Brazil. CEP 13214-525. E-mail: fabricianasantana@yahoo.com.br.



INTRODUCTION

Obtaining and maintaining peripheral intravenous access involves procedures performed by the nursing team in patient care. Central venous catheters are known to be an essential element in current cancer treatment, significantly decreasing the need for multiple peripheral venipunctures. The three types of central venous catheters most commonly used in pediatric oncology are totally implantable catheters, tunneled external central venous catheters, and peripherally inserted central catheters (PICC)¹⁻².

Oncology services vary significantly in their choice of the appropriate catheter for treatment of pediatric cancer. This choice usually depends on a combination of factors, including the treatment plan, predicted time of use, patient's preference and skill in self-care, institutional capacities, and predominant ideas concerning the benefits and limitations of each type of catheter. In pediatric oncology, the loss of a venous line can compromise the treatment's efficacy, with extravasation of vesicant antineoplastic drugs as one of the main concerns, potentially leading to adverse outcomes and compromising the affected limb and delaying treatment¹⁻³.

The U.S. Centers for Disease Control (CDC), which sets standards for the prevention of catheter-related infections, recommends avoiding the application of vesicant drugs using devices with metallic needles. According to the CDC, one way to avoiding the extravasation of vesicant antineoplastic agents is to not apply them in prolonged continuous infusion (more than 30 minutes) via peripheral venous access. In this case, a central venous catheter is indicated³.

The use of a PICC is an advanced, specialized, high-complexity procedure whose success depends on the nurse's technical skills, adequate choice of the vein to be punctured, and methods for visualization of the venous system. The implementation of a systematic approach in nursing care has been identified as a fundamental element in managing patient care in all phases in the use of the PICC, especially in its maintenance. Early removal of a PICC has direct implications for the patient's care and for the nursing staff's work process⁴.

The main reasons for non-elective removal of PICC are mechanical causes, such as obstruction, rupture, and spontaneous or accidental dislodgement, as well as non-mechanical causes such as infections and thrombosis. Proper training of the individual nurse and nursing staff in handling the device is essential for catheter management, since complications such as infiltrations and infections are related to practices in maintenance of the PICC. In addition to inadequate management, complications may

be related to the quality of the material and/or patient's characteristics, limiting or reducing the indwelling time for PICC before the conclusion of the scheduled intravenous therapy⁵⁻⁷.

Despite the possible complications from the catheter's prolonged or inadequate use, PICC is suggested due to the numerous benefits, thus often making it the first choice for a central venous line. PICC ensures greater satisfaction for patients, families, physicians, and especially the nursing team, who experience anxiety together with the patient due to the need for countless venipunctures for the therapy^{2,8,9}.

Intravenous access is the most common route for treatment of hematological cancer in pediatrics. Treatment of pediatric cancer is prolonged, lasting from six months to two years or even longer in case of relapse. Thus, cancer treatment in children and adolescents, with intravenous access as the most common route for administering the antineoplastic drugs, leads to progressive strain on the venous system. In addition, installing a venous line in children and adolescents leads to behavioral and physiological reactions conditioned by pain or anxiety. Therefore, central venous catheters for pediatric cancer treatment have been widely recommended, with valved PICC as an option for central access, mainly by allowing not only the administration of drugs but also transfusions and blood draws. Other benefits include preservation of the patient's self-image, avoiding fear and reducing stress associated with venipunctures¹⁰.

The existing evidence and daily observation of the increase in indication of PICC lines in various areas of pediatrics suggest the following questions: *What are the main indications for PICC in children and adolescents with cancer? What is the indwelling time, considering that PICC is currently intended for long-term use? What are the main complications resulting from the use of PICC in pediatric oncology? Which of these complications are implicated in the non-elective removal of a PICC?*

The answers to these questions can orient measures to make this practice increasingly safe, resulting in numerous benefits for pediatric cancer patients. In light of the above, the current study aimed to identify the profile of children and adolescents with indication for the use of PICC, list the reasons for removal, and determine the catheter's indwelling time during cancer treatment.

METHOD

This was a descriptive retrospective study with a quantitative approach that used document analysis as the technique, based on patient charts and other hospital records.

The study was performed in a hospital providing care in various pediatric specialties, including Oncology, Hematology, Neurology, Nephrology, Endocrinology, and Cardiology. The hospital is a non-profit charitable institution in a city in the interior of São Paulo State, Brazil. Patient care covers children and adolescents from birth to 19 years of age. The hospital has 11 beds in the wards and five ICU beds, a surgical center, and two post-anesthesia recovery beds.

The hospital's medical and multidisciplinary staff provides broad, comprehensive care for cancer patients, accompanying them throughout treatment and follow-up. The institution has an outpatient chemotherapy unit with eight day beds and a procedures room. The nursing staff in the outpatient unit is trained and prepared to care for children and adolescents, performing various procedures, including management of PICC in patients for whom it has been indicated. The institution began using PICC in 2012.

Our sample consisted of 51 patient records on the use of PICC successfully installed in 39 children and adolescents in cancer treatment (the difference in the number is due to some cases in which a patient underwent more than one insertion due to non-elective removal of the catheter). The sample included records for all the children and adolescents that underwent insertion, maintenance, and removal of PICC-type lines.

The inclusion criteria were children and adolescents (birth to 19 years of age) in cancer treatment involving the use of PICC, independently of sex, age, diagnosis, and type of treatment; patients whose PICC had been inserted and removed in the institution, independently of the reason for removal; and patients whose PICC had been inserted and removed elsewhere, but who maintained their care with the catheter at our institution, as long as the data on the insertion and removal were recorded on the patient's chart.

Exclusion criteria were catheters that were not successfully installed and patients with no records of the insertion or removal of the PICC on their charts and hospital records.

Data collection used document search and analysis by review of the patient charts and other hospital records on the insertion, maintenance, and removal of the PICC-type lines. The study complied with all the ethical guidelines in Resolution 466 of December 12, 2012, by the Brazilian National Health Council¹¹.

The project was first submitted to the study's host institution. After approval by the institution, it was then submitted to the Institutional Review Board of Universidade Paulista (CEP-UNIP), where it was approved under protocol number CEP 1.583.491, after which the data collection began.

The researchers committed to use the data collected from the patient charts and hospital records exclusively for the purposes of this study, as well as to maintain the data's confidentiality and the patients' anonymity.

Data collection involved analysis of the charts of children and adolescents submitted to use of PICC and hospital records aimed at documenting the insertion, maintenance, and removal of the catheters. Data on the children/adolescents included sex, age, diagnosis, and time since diagnosis at the time of installation of the PICC, as well as details on insertion of the catheter (vein punctured, caliber and brand of the catheter, and complications), indwelling time, complications, and reasons for removal.

Data collection lasted eight months, from October 2016 to May 2017.

The data were keyed in and organized electronically in a database built by the researchers on an Excel 2010® spreadsheet. The collected data were computed in tables and later submitted to descriptive statistical analysis.

RESULTS

The study sample consisted of 51 patient records with information on PICC installed in 39 children and adolescents in cancer treatment. The majority of the children and adolescents were males. The predominant age bracket was 4 to 9 years, and infants (under 1 year) were the least frequent age bracket for catheter insertion. The most frequent diagnoses were leukemia (41%) and lymphoma (25%). Table 1 shows the profile of children and adolescents undergoing PICC use during their cancer treatment.

Table 1. Profile of children and adolescents in cancer treatment submitted to PICC. Jundiaí - SP, Brazil, 2017

Variable	n	%
Sex		
Male	26	66.7
Female	13	33.3
Age at time of insertion		
< 1 year	01	2.56
1 to 3 years	06	15.3
4 to 9 years	12	30.7
10 to 14 years	10	25.6
> 15 years	10	25.6
Diagnosis		
Leukemias	16	41.0
Lymphomas	10	25.6
Bone and soft tissue tumors	06	15.3
Tumors of the central nervous system	04	10.2
Abdominal tumors	03	7.6

Time since diagnosis at the time of insertion was predominantly less than one month (51.9%), followed by one to three months (27.4%). Table 2 shows this variable. In the 51.9% of cases in which time since diagnosis was less than one month until insertion of the PICC, the diagnosis was leukemia in 25.4% and lymphoma in 13.7%. The basilic vein was punctured for insertion of the catheter in 75% of the cases.

Table 2. Time since diagnosis in children and adolescents in cancer treatment at insertion of PICC. Jundiaí - SP, Brazil, 2017

Variable	n	%
< 1 month	27	51.9
1 to 3 months	14	27.4
4 to 6 months	6	11.7
7 to 11 months	4	7.8
12 to 18 months	0	0
> 18 months	0	0

As for reasons for removal of the catheter, 50.8% of cases were elective, that is, conclusion of treatment (45%) or death (5.8%). Removals due to catheter-related complications accounted for 48.8% of cases. The most frequent complication was infection (17.6%), followed by accidental dislodgement (15.6%), obstruction (11.7%), and rupture (3.9%). Infection was a presumptive reason for removal of catheters, since none of these cases were confirmed by culture. Non-elective removal was more frequent in males and in the 4 to 9-year age bracket. Table 3 shows the data on reasons for removal of catheters.

Table 3. Reason for removal of the PICC in children and adolescents in cancer treatment. Jundiaí - SP, Brazil, 2017

Reason for removal	n=51	%
PICC-related complications		
Infections (not confirmed by culture)	09	17.6
Accidental dislodgement	08	15.6
Obstruction	06	11.7
Rupture	02	3.9
Total	25	48.8
Reasons not related to the PICC		
Conclusion of treatment	23	45.0
Death	03	5.8
Total	26	50.8

As for PICC indwelling time, mean duration with the device was 145.48 days (maximum 796; minimum 15 days). The age bracket with the longest indwelling time was 4 to 9 years (34%), followed by adolescents over 15 years (30%). These data specifically were calculated for

50 catheters, since one catheter lacked information on indwelling time.

DISCUSSION

Obtaining intravenous access in children and adolescents with cancer is a major challenge for nurses, since it is an extremely complex and difficult procedure. PICC has been used as an alternative for obtaining a lasting, reliable, and safe venous line in pediatric oncology. Despite the reliability and safety of using this type of catheter, various complications can occur during its use¹⁻³.

Leukemia and lymphoma were the most frequent diagnoses in the study sample. Time between diagnosis and insertion of the catheter was less than one month in 51.9% of the cases. The most frequent age bracket at time of insertion of the PICC was 4 to 9 years (n=12; 30.7%), followed by 10 to 14 years (n=10; 25.6%), and 15 to 19 years (n=10; 25.6%). The age brackets with the least use of PICC were 1 to 3 years (n=6; 15.3%) and under 1 year (n=1; 2.5%). These data are similar to other studies on the use of PICC in pediatric oncology¹²⁻¹⁸.

The study showed that the user population of tunneled central venous catheter was significantly younger than the patient population that used PICC, since the latter is more difficult to insert and its accidental dislodgement is more common in small children¹². A study in Brazil with a sample of 15 children using PICC showed the highest prevalence in the 11-16-year age bracket, and also showed leukemia as the main diagnosis¹⁷.

The mean age of children participating in a 15-years retrospective study performed in Canada with insertion of PICC was 9.7 years, and 48% of the patients that received a PICC were under 10 years of age. Leukemia and lymphoma were the most common diagnoses in the study sample, accounting for 37% and 18.4%, respectively¹⁴. In another study, the majority of the patients were males and the mean age at catheter insertion was 10.28 years¹⁵. In the current study, children and adolescents over 10 years of age represented 51.2% of the sample, and leukemias and lymphomas were the most common diagnoses.

Importantly, the fact that use of PICC is more frequent after 4 years of age and rare in children under 1 year can be explained by the fact that infants are still undergoing full neurodevelopment and maturing skills that are still uncontrolled and misunderstood. Infants are still beginning to develop their cognition, intelligence, and knowledge concerning their body and the relationship to their surroundings. Around 3 to 4 years of age, children begin to improve their acquired skills and understand the environment's dynamics¹⁶. From then on, the child begins to understand instructions like "don't pull on the

catheter”, and whenever possible an age-appropriate and targeted approach is possible for care of the PICC.

As for PICC indwelling time, the mean duration in this study was 145.5 days (minimum 15 days, maximum 796 days). Two previous studies had shown maximum indwelling time of 398 days¹⁷ and 365 days¹⁸. A study of 36 children with cancer showed a mean time of 69 days (minimum 24 days, maximum 247 days)¹⁵. Mean PICC duration in a study with 15 children was 55 days, ranging from 9 to 154 days¹³.

In the current study, the main reasons for removal of the PICC were not related to the catheter in 50.8% of cases, 23 of which (45%) were conclusion of treatment and three (5.8%) were death. Catheter-related reasons for removal were infections (n=9; 17.6%), accidental dislodgement (n=8; 15.6%), obstruction (n=6; 11%), and rupture (n=2; 3.9%).

The reasons for catheter removal not related to the PICC were similar to the results of a study in Italy, in which removal due to conclusion of treatment accounted for 64% and removal due to death for 21% of cases¹⁸.

In one study, the most common reasons for removal were conclusion of chemotherapy and obstruction, with 20% each (n=3)¹³. Obstruction was also the most common complication in another study, followed by infections and accidental dislodgement. The infections were treated, maintaining the catheter and resolving the infection without any adverse event¹⁵.

Some authors have reported evidence that peripherally inserted central catheters display higher rates of infections and venous thromboembolism than central venous catheters in pediatric inpatients¹⁹.

It is important to repeat that in our sample there was no laboratory confirmation of infections, but that infection was recorded on the charts of some patients as the cause for removal of the device.

The rate of infections as reason for removal of the catheter in the current study was considerably lower (17.6%) than in another Brazilian study, in which infections occurred in 38% of the cases¹⁷. This may be due to the fact that in the study group, the children are treated in the outpatient setting by a dedicated team. Other authors have reported higher infection rates with PICC in inpatient cancer treatment when compared to outpatient treatment of these children²⁰. In addition, sutureless fixation can also be related to higher odds of infection²¹. A study performed in a developed country showed an infection rate of 4.8%¹⁸.

A prospective study in a cancer hospital reported that the main complications associated with PICC were infections (12.5%), thrombosis (4.82%), obstruction (4.82%), arrhythmias (4%), early removal of the catheter

(3%), bleeding (2.55%), and pneumothorax (2.55%)²².

Further in relation to infection, data from a study of children with neutropenic cancers showed that those with totally implantable catheters had a decrease of approximately 50% in length of hospital stay, need for admission to the ICU, bacterial infections, and days on antibiotics when compared to children using tunneled central catheters and PICC, although no differences were seen between the groups in relation to mortality. The authors highlight the need for more information on mortality from catheter-related infections, but emphasize that the outcomes with totally implantable catheters were superior to those with tunneled central catheters and PICC²³.

The current study did not identify any cases of deep venous thrombosis (DVT), while other studies report this event in 4.1% of cases¹⁸. Several studies have associated PICC with higher odds of developing DVT, compared to other central catheters¹⁰⁻²⁴. In addition, a study that compared the risk of thrombosis associated with PICC and tunneled central venous catheter in patients under 18 years with leukemia pointed to higher risk of catheter-associated thrombosis in children that used PICC, with an incidence of 10.2%, compared to tunneled central venous catheter, with only 1.5%¹².

Another factor potentially related to non-occurrence of thrombosis in this study is that the basilic vein was the first option as the puncture site. According to the literature, this vein should be the first option because of its larger diameter, whereas the cephalic vein is associated with difficulty in advancing the catheter and increased incidence of superficial and deep venous thrombosis^{25,26}. In the current study, 75% of the catheters were inserted in the basilic vein.

The study's limitations include the small sample size, since the use of PICC is still recent at our institution, and there is difficulty in identifying the annotations needed to collect data from patient charts and records, thus hindering confirmation of some data.

CONCLUSION

PICC is a safe and durable option to obtain intravenous access in care for children and adolescents with cancer, since it provides a route for safe infusion of chemotherapy drugs, benefiting the children and adolescents and their families and thus decreasing the emotional stress and physical and psychological pain from numerous attempts at venipuncture during treatment.

PICC proved flexible in use, applicable to various age brackets. In this study the most frequent use was in children over 4 years and adolescents, usually the

first choice for intravenous access following the cancer diagnosis.

Despite numerous advantages in the use of PICC, it can also present complications over the course of treatment. It thus requires specific and qualified care managed by highly trained professionals for this responsibility. The development of institutional protocols can orient the management of this device, besides ensuring continuity of care between teams and departments in the institution where the patient is treated.

The study identified low rates of infections as the reason for removal of the catheter when compared to other studies in Brazil, similar to the results from international studies. Thrombosis is the complication that has been most questioned and associated with the use of PICC; however, the current study found no cases of catheter-associated thrombosis. Importantly, the catheter was removed whenever any sign of possible complication appeared. Knowing the profile of children and adolescents with an indication for use of PICC during cancer treatment and its possible complications can orient preventive measures aimed at maintenance of the device according to demand.

Indwelling time was a relevant finding in this study's sample, with maximum time exceeding two years. The majority of reasons for removal were not related to complications with the catheter itself, thereby demonstrating promising durability in situations in which PICC is managed correctly. Adjusting the patient's needs in intravenous therapy to the child's and family's possibilities for care of the device, the institutional reality, and the best evidence on the use of PICC can be a path to advanced practice in pediatric oncology.

CONTRIBUTIONS

Fabriciana Gonçalves Santana participated in the data collection, analysis, and interpretation and writing of the manuscript. Patrícia Luciana Moreira-Dias participated in the study design and planning and writing and critical revision of the manuscript.

CONFLICT OF INTEREST

None.

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