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PERIPHERALLY INSERTED CENTRAL VENOUS CATHETER IN AUTOLOGOUS HEMATOPOIETIC STEM CELL TRANSPLANTATION PATIENTS: FEASIBILITY AND OUTCOME

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ABSTRACT

Objectives: This study describes our experience using PICC in patients submitted to autologous stem cell transplant (ASCT) regarding the time of use, withdrawal reasons, and complications. **Methods:** A retrospective cohort of 143 patients from 2017 and 2019, with a PICC inserted before the ASCT. **Results:** Regarding baseline disease, 104 (73%) of patients had multiple myeloma. The median days of use was 15 (1 – 37) per catheter. More than 80% of PICC remained in place after D+15, and 112 (78%) patients had the PICC removed at discharge. Only 13 (9%) patients had replacement of the PICC. The rates of central line associate bloodstream infection and thrombosis were 1.36 and 1.36 events per 1,000 PICC days, respectively. **Conclusions:** PICCs were successfully remained until discharge, with manageable rates of complications. All procedures were executed by nurses at the bedside. We concluded that PICC is a safe and feasible alternative to CVC for ASCT.

Keywords: Nursing; Catheterization, Peripheral; Hematopoietic stem cell transplantation; Catheter-Associated Infections; assessment, outcomes

INTRODUCTION

The use of peripherally inserted central venous catheters (PICC) in hematological patients has been growing, and reports in different scenarios have been published.[1-5] Patients with hematological diseases need safe and prolonged vascular access since they undergo intense treatments, high demand for blood products, and long and frequent hospitalizations.[6,7] Central venous catheters (CVC) are essential for treating patients with hematological malignancies and stem-cell transplant recipients. There is a variety of CVCs used in daily practices. Still, the most used long-term devices include surgically implanted cuffed tunneled central venous catheters, peripherally inserted CVCs (PICCs), and percutaneous non-cuffed or tunneled catheters.[6,8] The best type of vascular access selection should be based on the patient's and treatment's characteristics and the patient's preferences and safety. Factors to be analyzed are expected time of use, ease and security in the implantation, maintenance routines, comfort for the patient, and cost.[9]

PICC has advantages over other long-term vascular devices: lower risk of complications related to insertion, allows local compression in patients with coagulation disorders or thrombocytopenia and can be easily inserted and removed in an outpatient setting without the need for surgical intervention. However, there are some reports of thrombosis in the same population.[10]

OBJECTIVE

To describe our experience using PICC in patients with hematological diseases submitted to autologous hematopoietic stem cell transplantation concerning the time of use, reasons for exchange or withdrawal, and complications.

METHODS

This study was performed at a tertiary care hospital with 300 beds, including hematology and autologous and allogeneic stem cell transplant unit with 26 single-bed rooms with high-efficiency particulate air (HEPA) filters and positive pressure. Our center has a dedicated nurse team for the insertion and maintenance of PICC since 2015. The PICC catheter has been the primary central venous access (CVC) option in newly diagnosed acute leukemia patients and an alternative to short-term CVC for ASCT.

For this study, we reviewed the data regarding all consecutive PICCs inserted from 2016 and 2019 in patients submitted to ASCT.

This research was conducted following the Declaration of Helsinki and was approved by the Institution's Ethical Committee (CAAE no.54941216.0.3001.5455 – Comite de ëtica em Pesquisa – Hospital Nove de Julho).

PICC INSERTION AND REMOVAL

A group of trained nurses performed the PICC insertion under ultrasound-guided visualization. According to the manufacturer's instructions, the insertion occurred using the modified Seldinger technique and maximum precautionary barrier. The professional chooses the insertion site following the preferred sequence: basilica, cephalic, braquial, cubital, and jugular veins. The final position of the PICC tip (lower third of the superior vena cava) was confirmed by chest radiography before its use. PICC insertion occurs before the conditioning regime or stem cell infusion (D zero) and aims to be maintained until discharge after hematopoietic recovery. In 2018, the nurse team modified the fixation methods, PICC-cover, and shorted the length of lines connected to PICC due to some accidental CVC removal.

Formal indications for immediate PICC removal are suspected or documented infection, suspected or documented thrombosis in the PICC site, and discontinuity of a need for vascular access. The study also captured cases of catheter loss due to other causes.

PICC-RELATED OUTCOMES

The following outcomes were described: exit site and central line-related bloodstream infections (CLABSI), time in place, clinical or documented thrombosis, needs for replacement by accidental extraction, and removal by medical request.

The rate of CLABSI was reported as the number of events per 1,000 catheter-days.

CLABSI were defined by the BSI criteria of the Centers for Disease Control and Prevention (CDC).[11] All events were classified as complicated or uncomplicated CLABSI (regarding a resolution of fever in < 72h and no evidence of endocarditis or suppurative thrombophlebitis.[12]

The criteria to suspect clinical thrombosis was the evidence of pain, hyperemia, edema, or an increase in the brachial circumference of the punctured limb. If there was a suspicion of thrombosis, confirmation by venous doppler from the CVC site was necessary. There was no systematic investigation of thrombosis in individuals without clinical suspicion.

Data were reported as frequencies, medians, and intervals. Time to event was calculated by Kaplan and Meier. All data were analyzed using the SPSS program.

RESULTS

A total of 143 autologous recipients (58% of the sum of ASCT performed in the study period) had a PICC inserted per protocol before stem cell infusion. The most frequent baseline disease was multiple myeloma (n = 104; 73%), and the cohort's median age was 58 years. (Table 1)

The median day of PICC insertion was D-3 (ranging from D -10 and D zero) before ASCT infusion. The median time of the first PICC in use was 15 (1 – 37) days of use per catheter. In Figure 1, we showed the overall PICC survival after ASCT infusion. More than 80% of PICC remained in place after D+15.

Regarding catheter removal, 112 (78%) patients had the PICC removed only at discharge. Causes of early PICC removal were persistent fever (n=11), accidental removal (n=7), mechanical failure (n=5), documented exit-site or CLABSI infection (n=4), documented thrombosis (n=3), and intensive care unit transference by physician description (n=1).

The accidental removal occurred days before stem cell infusion in 6 of 7 events. Six events occurred before and one after 2018. Regarding mechanical failure/lumen obstruction, 4 of 5 events occurred in the first three days of PICC insertion and all four before stem cell infusion.

During the hospitalization, 13 (9%) patients had replacement of the first PICC. The reasons for replacement were accidental removal by patient (n=6), fever protocol (n=3), mechanical failure (n=2), infection (n=1) and local thrombosis (n=1).

CLABSI was documented in 3 (2.1%), with 1.36 infections per 1,000 PICC days. The events occurred 12, 13, and 15 days after PICC insertion, all during neutropenia (D+4, D+5, and D+7 after ASCT). The microbiological etiologies were *Staphylococcus epidermides* in all three events. All events were treated with antibiotics and the removal of CVC. All cases were classified as uncomplicated CLABSI. In one patient, there was an exit-site infection, and the patient had the catheter removed. The discharge occurred in D+14 in two and D+7 in the other, similar to the other patients who did not develop CLABSI (median for discharge D+13, p=0.97).

Thrombosis occurred in 3 (2%), resulting in a rate of 1.36 per 1,000 PICC days. Two of three cases occurred in myeloma patients. The event was documented after 6, 7, and 14 days in use and on Days -1, +3, and +10 of ASCT. The discharge occurred in D+12 in two and D+14 in the other, similar to the other patients who did not develop thrombosis (median for discharge D+13, p=0.99). All catheters were removed, and the event was considered mild (non-complicated) by a doppler scan.

DISCUSSION

In our experience, PICC was a feasible and safe central venous access for hematological patients submitted to ASCT. About 80% of the cohort experienced only one CVC during the ASCT hospitalization. Nurses inserted and removed all PICCs at the bedside, with a low incidence of complications. The replacement rate was less than 10%, and the early losses were more related to mechanical or accidental events. There were few cases of infection and thrombosis. They occurred more lately and were managed with no severe complications.

PICC has been an alternative central venous catheter to hematopoietic patients. [5, 13, 14] Bellesi and collaborators had already evaluated PICC as alternative venous access in individuals undergoing ASCT [1]. The authors concluded that PICC was a safe alternative for their population. After their results, several other centers started this approach, mainly because PICC has a low risk of complications related to insertion and removal, it can be inserted and managed by nurses, and it is related to comfort for the patient. Benvenuti et al., in a small number of pediatric patients, suggested that PICCs were a safe and effective alternative to conventional central venous catheters in pediatric patients receiving stem-cell transplantation.[15] The same was noted in the present cohort. Nurses inserted all PICCs in a bedside local, and most patients (80%) completed the ASCT hospitalization without needing PICC early removal until discharge.

The American Society of Clinical Oncology (ASCO) guideline for venous catheters during cancer care states: "There is insufficient evidence to recommend one type of CVC routinely for all patients with cancer. The choice of the catheter should be influenced by the expected duration of use, the chemotherapy regimen, and the patient's ability to provide care. The minimum number of lumens essential for managing the patient is recommended. These issues should be discussed with the patient". In its guideline, PICC was an alternative.[6]

In our cohort, most events of PICC replacement were due to accidental losses and occurred within a few days after insertion. Other studies also reported dislodgement of PICCs, resulting in early losses (varied from 5 - 15%).[1, 16, 17] After our preliminary results, the team modified the fixation methods, PICC-cover, and shorted the length of lines connected to PICC, with a significant event reduction.

The recommendations for CVC placement in cancer patients have been performed as an elective procedure, guided by ultrasound, by well-trained providers who regularly use the landmark method. A CVC care clinical bundle is recommended for the placement and maintenance of all CVCs to prevent infections. These recommendations may have a high success rate and low incidence of acute and chronic complications.[6, 12, 18]

CLABSI is a significant concern in all patients with CVC inserted, and previous reports of PICCs used in patients with hematologic diseases, who are compromised hosts, have indicated that the incidence of CLABSI is approximately 1-6 cases per 1,000 catheter days, and use of a PICC did not increase the occurrence of CLABSI compared with a conventional CVC. [17]

Although we had PICC-CLABSI events, the frequency was acceptable compared to other types of CVC

CLABSI in our center. Important that none was classified as complicated or increased hospitalization. The frequency of CLABSI in cancer patients is estimated at 0.5–10 per 1000 CVC-days, and it varies by baseline disease, disease phase, neutropenia, and other factors.[5,14] Morano et al. addressed specific PICC-CLABSI in a hematological cohort, and their results showed that the main risk for CLABSI was the underline disease. In their cohort, acute leukemia patients had more risk for PICC-BSI.[13] In our cohort, infection events were not related to baseline disease, but our patients mainly were multiple myeloma and lymphoma patients, non-neutropenic at CVC- insertion. A multicenter cohort with a large number of hematopoietic patients studied if PICC indwelling time contributes to increased CLABSI. They noted that the rates of PICC-CLABSI remained constant, regardless of PICC indwelling time.[14]

Another concerning complication is CVC-related thrombosis. The incidence of CVC-associated thrombosis in patients with cancer varies in different series, from 27% to 66% when routine screening with venography is performed. Most patients with CVC thrombosis are asymptomatic. Reported rates of symptomatic thrombi vary widely, from 0.3% to 28%.[6, 19] Symptomatic venous thrombosis rates associated with PICC lines range from 1 to 4%. PICC – side location and catheter diameter have been associated with this complication.[13, 17, 20, 21] We documented three cases (1.36 per 1,000 PICC days). Even though multiple myeloma patients have increased thrombosis rates, no association between thrombosis and baseline disease was observed. In our cohort, all insertions were made by eco-guided techniques, and we could not associate the event with time after transplant or thrombocytopenia.

Our study is subject to the general limitations of an observational design, which means that information bias may have been introduced: although most of our database was kept prospectively. Other limitations are the sample size and the single center location. As strengths, we assessed the occurrence of CLABSI based on CDC definitions, which is a rigorous method and therefore adds to generalizability.

The use of peripherally inserted central venous catheters (PICC) has been growing in different scenarios, but more data needs to be reported on transplant patients. This study shows the experienced of PICC in more than 100 consecutive autologous patients.

ASCT patients should be cared for with the right competence at all levels, and multidisciplinary teamwork is necessary. The engagement of a nurse team in transplant programs is essential, and our data reinforce that the nurse team can be responsible for venous catheter insertion, manutention, and removal. Early losses and late complication rates were manageable and did not increase hospitalization or outcome. Unlike other types of CVC, PICC care can be managed by nurses at the bedside, bringing commodity to the patient and team.

In summary, our study showed that PICCs was successfully inserted and remained without indication of replacement in 80% of our patients until discharge from ASCT. Early losses and late complication rates were manageable and did not increase hospitalization or outcome. All procedures were managed by nurses at the bedside, bringing commodity for patient and team. We concluded that PICC is a safe and feasible alternative to CVC for Autologous stem cell transplant recipients.

DATA AVAILABILITY STATEMENT

The data that support the findings of this study are available from the corresponding author upon reasonable request.

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