Fully Implanted Central Venous Catheter in Oncological Patients: Multiple Case Report

Cateter Venoso Central Totalmente Implantado em Pacientes Oncológicos: Relato de Casos Múltiplos

Catéter Venoso Central Completamente Implantado en Pacientes Oncológicos: Reporte de Casos Múltiples

RESUMO

Objetivo: descrever as características dos pacientes oncológicos em uso de cateter venoso central totalmente implantado em um serviço de oncologia, ao longo de 14 anos de registro. **Método:** relato de casos múltiplos, a partir de dados secundários de um hospital de grande porte. Para análise foi utilizado o software Epi Data e o programa Statistical Package for the Social Sciences. **Resultados:** foram implantado 450 cateteres, 76,9% em pacientes do sexo feminino, idade média de 51,5 anos, diagnosticados com câncer de mama (43,3%), o principal motivo para implantação do cateter foi a administração de quimioterapia antineoplásica (63,5%), tempo médio de permanência de 502 dias e tempo máximo de uso de 2340 dias. Os eventos que motivaram a remoção do cateter foram: infecções (3,3%), trombose (1,8%) e embolizações (1,8%). **Conclusão:** os pacientes tiveram boa tolerância do cateter, poucas complicações, refletindo o comprometimento da equipe assistencial quanto à orientação e cuidado contínuo.

DESCRITORES: Cateteres Venosos Centrais; Oncologia; Enfermagem; Câncer; Câncer de mama.

ABSTRACT

Objective: to describe the characteristics of cancer patients using fully implanted central venous catheters in an oncology service over a 14-year period of records. **Method:** multiple case reports based on secondary data from a large hospital. Epi Data software and the Statistical Package for the Social Sciences were used for analysis. **Results:** 450 catheters were implanted, 76.9% in female patients, mean age of 51.5 years, diagnosed with breast cancer (43.3%), the main reason for catheter implantation was the administration of antineoplastic chemotherapy (63.5%), mean length of stay of 502 days and maximum length of use of 2340 days. The events that led to catheter removal were: infections (3.3%), thrombosis (1.8%) and embolizations (1.8%)**. Conclusion:** patients tolerated the catheter well, with few complications, reflecting the commitment of the care team regarding guidance and continuous care.

KEYWORDS: Central Venous Catheters; Oncology; Nursing; Cancer; Breast cancer.

RESUMEN

Objetivo: describir las características de los pacientes con cáncer usuarios de catéter venoso central totalmente implantado en un servicio de oncología, a lo largo de 14 años de registro. **Método:** informe de múltiples casos, basado en datos secundarios de un gran hospital. Para el análisis se utilizó el software Epi Data y el programa Paquete Estadístico para las Ciencias Sociales. **Resultados:** Se implantaron 450 catéteres, 76,9% en pacientes de sexo femenino, edad media de 51,5 años, con diagnóstico de cáncer de mama (43,3%), el principal motivo de implantación del catéter fue la administración de quimioterapia antineoplásica (63,5%), estancia media de 502 días y tiempo máximo de utilización de 2340 días. Los eventos que motivaron el retiro del catéter fueron: infecciones (3,3%), trombosis (1,8%) y embolizaciones (1,8%). **Conclusión:** los pacientes toleraron bien el catéter y tuvieron pocas complicaciones, lo que refleja el compromiso del equipo de salud con la orientación y el cuidado continuo.

DESCRIPTORES: Catéteres Venosos Centrales; ONCOLOGÍA; ENFERMERÍA; CÁNCER; CÁNCER DE MAMA.

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INTRODUCTION

Cancer is the main public health problem in the world. The incidence of this disease grows at a rate similar to that of population aging, which, together with changes in behavior and the environment, imply high rates of morbidity and mortality. It is believed that it will reach around 28.4 million new cases in 2040 worldwide. In Brazil, it is estimated that around 704 thousand new cases of cancer will occur each year in the three-year period 2023-2025, with the exception of non-melanoma skin neoplasms. [1,2]

Cancer treatment is complex. Among the existing modalities, the intravenous route is commonly used for the administration of antineoplastic chemotherapy. Therefore, due to the treatment time, the endothelial irritability caused by several of these drugs, in addition to the risk of tissue necrosis that can also occur in the event of extravasation into the subcutaneous region by some of them, the implantation of Central Venous Catheters (CVC) is generally indicated. [3,4]

For the adequate management and safety of cancer patients using antineoplastic chemotherapy, the availability of stable and safe venous access is necessary, and among the main catheters used for this purpose are the Totally Implantable Central Venous Catheters (CVC-TI) or Port-a-cath®, which are tunneled catheters, implanted under a subcutaneous path up to the atriocaval junction, a feature that allows the infusion of irritant and vesicant solutions with endothelial protection. [3,5]

The use of CVC-TI brings numerous benefits to cancer patients, such as less interference in daily activities, fewer venipunctures, reduced risk of peripheral infection, and savings to the oncology service. However, inconveniences such as risk of extravasation, deep vein thrombosis (DVT), obstruction, embolization, and rotation or extrusion of the reservoir may occur and may even lead to removal of the device. [5-7]

The use of CVC-TI is widespread in clinical practice, but the literature still lacks studies that explore its specific application in oncology patients. This device plays a crucial role in the management of cancer patients, allowing safe and efficient access for the administration of antineoplastic chemotherapy and other prolonged and complex therapies. In hospital practice, understanding the specific characteristics and demands of these patients goes beyond merely updating records; it is an essential step towards promoting specialized, patient-centered and safety-oriented care.

By analyzing the particularities of CVC-TI use in this group, it becomes possible to identify the factors that influence clinical stages and complications related to the device, thus allowing the implementation of practices that optimize the performance of the health team. This study seeks to fill this gap by describing the characteristics of cancer patients using CVC-TI based on 14 years of records from an oncology service. This approach provides support for improving care practices, directing strategies for improving cancer care.

METHOD

A multiple case report conducted using secondary data from a large hospital in Minas Gerais, certified as a High Complexity Oncology Care Unit (UNACON).

After each case was assessed by the multidisciplinary team, the referral physician in oncology or hematology was responsible for deciding whether to implant the CVC-TI, and a descriptive report of the indication was issued and sent to the surgeon on duty to proceed with the implan-

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tation of the venous access. All patients using the CVC-TI in this study had their devices implanted by one of the two thoracic surgeons on duty, both with more than five years of experience.

Prior to the CVC-TI insertion procedure, patients were assessed regarding their history, physical condition, bleeding time, clotting time and blood count. All patients were informed about the intervention to be performed and potential associated risk factors, and provided verbal and written consent for surgery.

The catheters were implanted in an operating room under local or general anesthesia using a standard technique. In some cases, CVC-TI implantation was combined with another surgical procedure, such as biopsy or excision of malignant neoplasm, according to the demands of each case. The choice of CVC-TI, implantation technique, site (subclavian, internal jugular vein or basilic vein) and side were decided by the surgeon on duty. It is important to note that the insertion site was analyzed in terms of infection, edema, mass and previous radiotherapy received.

After surgical insertion of the catheter, confirmation of adequate implantation was confirmed by perioperative radioscopy, postoperative lung radiography, or both techniques. Heparin was not used to prevent intraluminal thrombosis during and after the operation period, and no prophylactic anticoagulant or antibiotic was administered. All patients received AC in the study setting.

Data collection took place in May 2022, and came from institutional care forms containing information completed by the nursing team on patients using CVC-TI from April 2008 to May 2022. Forms from patients of all ages and sexes who had CVC-TI implanted from April 2008 to May 2022 were included in this collection, and those with incomplete information were excluded. A total of 463 forms were previously selected and of these, 450 comprised the final sample, since 13 patient records were excluded due to incomplete data. It is worth noting that the maintenance of the completion of these forms and respective monitoring of the patients was carried out by two of the researchers, and that the information was based on the time of permanence of the CVC-TI, that is, from its implementation until its removal or death of the patient.

The EpiData software, version 3.1b, was used to create the database, with double data entry to detect typing errors, containing the following variables: medical record number, age, sex, initial medical diagnosis, indication for CVC-TI insertion, device caliber, date, site and vessel of insertion, situation regarding surgical insertion, subsequent complications, date of last manipulation. The Statistical Package for the Social Sciences, version 18.0, was used to analyze the data. A descriptive analysis was performed and the respective exact Confidence Intervals (95% CI) were calculated for the point estimates of this sample.

It should be noted that the use of the Informed Consent Form for data collection was waived, since the data were collected from institutional records. In addition, there was no contact, intervention or influence on the routine, monitoring or treatment of the oncology patients being monitored.

This study was approved by the Research Ethics Committee involving human beings of the Federal University of São João del-Rei, opinion number: 2.010.532/2017 and by the co-participating institution, opinion number: 2.083.066/2017, CAAE: 65824617.2.0000.5545.

RESULTS

Between April 2008 and May 2022, 463 CVC-TIs were implanted and monitored in the study setting; of these, 450 individuals were monitored, of which 346 (76.88%) were female, with ages ranging from 14 to 82 years, with a mean of 51.5 years and a standard deviation of 15.9 years. From the CVC-TI insertion procedure to its last manipulation, the maximum time of use of the device was 2340 days and the shortest time of use was one day, due to the death of the patient. The average CVC-TI permanence was 502 days.

In this study, initial medical diagnoses for 15 different types of cancer were observed. Among them, the most frequent were female breast cancer (n=186; 41.3%) and bowel cancer (n=111; 24.7%), followed by lymphomas (n=31; 6.8%), lung (n=28; 6.3%), ovarian (n=19; 4.2%), esophagus/stomach (n=15; 3.3%), pancreas (n=12; 2.7%), acute lymphoblastic leukemia (n=10; 2.3%), cervix/endometrium (n=10; 2.3%), aoropharynx (n=8; 1.8%), sarcoma (n=6; 1.4%), central nervous system (n=6; 1.4%), bone (n=4; 0.8%), multiple myeloma (n=2; 0.4%) and bladder (n=21; 0.4%).

The main clinical indication for the use of CVC-TI in cancer patients was QA (286/63.5%). Another 160 (35.7%) patients used it due to difficulty in puncturing peripheral venous access and four (0.8%) due to bilateral lymph node dissection due to malignant breast neoplasia. The implanted devices belonged to three different manufacturers: 356 (79%) In-Port® (manufacturer: FB Medical); 47 (10.5%) Life-Port® (manufacturer: Guinez International); 25 (5.5%) Basic-Port® (manufacturer: Instituto de Bioengenharia Erasto Gaertner); and 22 (5.0%) were not registered. All of them are non-valved and have a mean positive pressure limit.

Most CVC-TIs were inserted into the right subclavian vein in 289 (64.3%) patients, the left subclavian vein in 113 (25.1%) patients, the right internal jugular vein in 46 (10.2%) patients, and the femoral vein in two accesses (0.4%). Regarding the caliber of the devices, it was found that 343 (76.3%) were 8.0 French (Fr), 54 (11.9%) were 9.0 Fr, 31 (6.8%) were 7.5 Fr, and 22 (5.0%) were not registered on the forms; 358 (79.5%) catheters were inserted without difficulty.

Table 1 shows the variables related to the indication for use of CVC-TI, the veins punctured for its insertion, the caliber of the catheter, and the situation regarding surgical insertion of the device during the 14 years of registration.

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Table 1- Characteristics of the use of fully implanted central venous catheter (n=450). Divinópolis, MG, Brazil, 2025

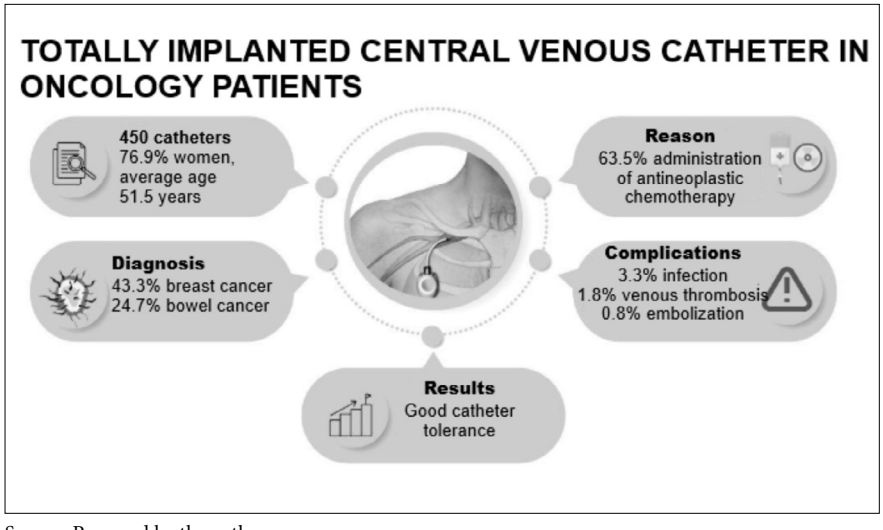
Variables	n (%)
Clinical indication	
Antineoplastic chemotherapy	286 (63,5)
Difficult peripheral venous access	160 (35,7)
Bilateral lymph node dissection	4 (0,8)
Access route	
Right subclavian vein	289 (64,3)
Left subclavian vein	113 (25,1)
Right internal jugular vein	46 (10,2)
Femoral vein	2 (0,4)
Catheter caliber	
7,5 french	31 (6,8)
8,0 french	343 (76,3)
9,0 french	54 (11,9)
Not reported	22 (5,0)
Difficulty in surgical insertion of the catheter	
Yes	92 (20,5)
No	358 (79,5)

Source: Prepared by the author

Of the 450 catheters inserted, the main reason for catheter removal was patient death (180/40.2%), followed by the end of the initially indicated treatment (88/19.6%) and complications described below (27/5.9%).

The summary and organization of the main information was represented by the infographic below (Figure 1).

Figura 1- Infográfico das principais características do uso do cateter venoso central totalmente implantado (n=450). Divinópolis, MG, Brasil, 2025



Source: Prepared by the authors

Regarding complications that led to CVC-TI removal, complications arose due to infection (15 cases; 3.3%), eight (1.8%) due to deep vein thrombosis (DVT) and four (0.8%) due to embolization.

No complications related to catheter malfunction, such as rotation, reservoir extrusion and material failures, were evidenced in the records (primary device defects are currently rare, however, they are still described in oncology centers with high demand). All complications were late and, therefore, associated with the use of the device and not with the surgical implantation procedure.

It is worth noting that, according to the institutional protocol in the study setting, in order to determine the removal of the CVC-TI, signs of infection were required, such as fever, chills, inflammation of the cavity, in addition to the result of positive central and peripheral microbiological analyses. In this investigation, a positive culture for Staphylococcus aureus and Staphylococcus non-aureus was found.

Overall, thrombotic, embolic and infectious complications were uncommon in the studied setting and were mainly observed during the first year after implantation. There were no deaths related to CVC-TI complications.

In order to maintain patency and prevent CVC-TI obstruction, the standard operating routines of the study setting indicated: salinizing all CVC-TIs that did not have an indication for fluid infusion for the next 30 days (effective washing of the device with saline solution using a positive pressure technique) and heparinizing CVC-TIs without an indication for infusion for a period longer than 30 days (filling the catheter lumen with 100 IU/mL heparin solution).

This study demonstrated the team's commitment to the ongoing process of caring for cancer patients, with all patients receiving guidance regarding the CVC-TI. Furthermore, valuing the completion and updating of the monitoring form contributes to improving the qual-

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ity of care and management in oncology. Continuity of records can support this investigation and future research, generating improvements in health practices related to the implantation, maintenance and evaluation of catheter use.

DISCUSSION

During cancer treatment, patients often undergo multiple painful venipunctures, whether for the administration of antineoplastic chemotherapy, antibiotics, blood products, or nutritional supplements. To overcome the problems of peripherally inserted catheters, CVCs, including the fully implanted type, have considerably improved the quality of life of these patients. [7,8]

Few studies were found in the literature specifically addressing the characterization or follow-up of patients using CVC-TI within oncology. [6,7,9-13] The results of this study were compared with the available literature, with specific findings from cancer patients using this device.

The predominance of female cancer patients was observed in other studies on the subject [6,11], as well as the age group, whose incidence of cancer increases from 50 years of age. [11,14] Regarding the average time of use of CVC-TI in the adult population, there are large variations, which is demonstrated by other researchers. [6]

This study observed a predominance of patients using CVC-TI with a diagnosis of malignant neoplasia of the breast and intestine, similarly to a study carried out in France, which sought to describe the acute and late complications and associated vulnerabilities in patients using CVC-TI during a period of one year, in an oncology service. [13]

In clinical practice, the main indications for insertion of CVC-TI refer to the need for frequent venous access, use of vesicant drugs and/or inadequacy of the peripheral venous system, so that its use is routinely associated with chemotherapy treatment. For intermittent infusion of fluids or other procedures with this device, percutaneous puncture of the reservoir is performed, sparing the skin during treatment intervals. [11,15]

The multidisciplinary team, especially the surgeon, should discuss the type of CVC to be used on a case-by-case basis, as this influences the risk of possible complications. CVCTIs have a reservoir made of titanium or plastic with a single or double chamber, and may or may not be valved. There are models in which the valve is positioned in the reservoir and, in others, at the tip of the catheter. [15,16]

Although it is observed that valved catheters have a lower occurrence of malfunction due to intracatheter thrombi, since inadvertent blood reflux is prevented, the superiority of valved catheters has not been proven. [15]

Another decision that falls to the oncology team is the access route for the CVC-TI. In addition to the excellent surgical technique, the patient's general health status, anatomy, location of the malignant neoplasm and indication must be taken into account. One of the main puncture sites is the subclavian vein [11], as verified in this study.

Subclavian vein access is usually successful and uncomplicated [11], There is agreement in studies that the subclavian access is more favorable than the others regarding the incidence of DVT [3], Furthermore, it is common in oncology services to choose the right subclavian vein. [7,15,17] The predominant selection of the right side in this study reflects what is described in the literature [6,17]; the rate of DVT associated with catheterization is lower on the right side than on the left, in addition to the anatomical ease of inserting the device, in the right body portion the venous path to the atrium is more rectilinear compared to the left side. [3] It is worth noting that, even in patients with malignant neoplasms in the thoracic region, such as breast cancer, there is no objection to implanting the CVC-TI on the same side, however, it is usually done on the opposite side. [6,15]

The definition of the CVC-TI caliber is a complementary characteristic to be observed by the team, and it is recommended to choose the largest French available by the service [18], number 9 Fr, as it allows the infusion of antineoplastic chemotherapy, blood collection and blood transfusion when necessary, without a high risk of obstruction of the device. [17,18] In this study, it was identified that most catheters were 8.0 Fr, different from what was found in the literature.

CVC-TI implantation is accompanied by complications of varying severity. In this study, it was observed that the complications that led to catheter removal were lower than those found in the literature. Infectious complications with CVC-TI ranging from 4.8 to 8.8% were reported in previously conducted follow-up studies. [14,15]

Even with low occurrence rates, cancer patients may experience immediate complications associated with CVC-TI insertion, which include pneumothorax, hemothorax, hemorrhage, infection, thromboembolism, among others. [3,15] Complications related to the catheter may be due to its malfunction, occlusion of the lumen, improper positioning, degradation of the catheter and fracture followed by migration of part of the catheter [3,17]; It was noted that these complications, nor others related to the insertion of the CVC-TI, were not identified at the location studied. This distinct evidence is most likely justified because, in the service in question, the surgical insertion of the devices is performed by thoracic surgeons experienced in the procedure, in addition to the practice of thorough investigation of the clinical conditions of the patients.

Infectious complications led to the removal of 15 catheters, five of which were identified by clinical skin examination (pain, hyperemia, increased local heat, drainage of purulent secretion) in the reservoir region and 10 with a positive blood microbiological analysis (culture) result for Staphylococcus aureus and Staphylococcus non-aureus. Infec-

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tious complications frequently related to long-term catheters are the main cause of early removal of the device. [6]

Bloodstream infections (BSIs) have multifactorial origins, which is why early identification and treatment are the goals of healthcare services. Included in the group of healthcare-associated infections (HAIs), they are the most frequent adverse event associated with healthcare, negatively impacting morbidity and mortality rates, patient safety and, consequently, the quality of services. [19]

To control and prevent the emergence of BSI associated with the use of CVC-TI, it is recommended that oncology services adopt bundles or "care packages" for insertion and handling of the device. Care such as hand hygiene and training of staff to do so before inserting, handling or inspecting the CVC-TI, skin preparation with 0.5% to 2% alcoholic chlorhexidine, use of aseptic technique to access and change needleless connectors and constant reassessment of the need for CVC-TI retention are strategies widely recommended for clinical practice. [8,19]

CVCTI is a safe and more comfortable vascular access for cancer patients. Catheter-related DVT is one of the low-incidence non-infectious complications, generally caused by the time of catheter implantation, material, caliber, access route and location of the distal end, appearance of infused substances, history of previous catheters, patient coagulation pattern and other associated diseases. During oncogenesis, cancer patients are prone to episodes of thrombosis, since, in addition to the characteristics of the disease itself, there is also the administration of different fluids and the presence of the catheter itself, considered another vulnerability factor. [3]

Another non-infectious complication found in this research was catheter embolization, which, according to the description, occurred due to fracture of the CVC-TI, and access for its insertion in these cases was performed through the right subclavian vein, as demonstrated in the literature, which states that such a complication is commonly found in patients in whom the device would be implanted via the subclavian route. [11,17]

According to the recommendations in the literature, after insertion of the CVC-TI, it is necessary to adopt a set of practices for its proper maintenance and operation, thus the multidisciplinary team must be constantly trained to minimize early removal of the catheter due to late complications and improve patient safety. [8,6,19]

In this context, it is worth mentioning that in the institution studied, an integrated system of CVC-TI care protocols was reviewed and updated. Through standard operational routines, the nursing team performs its puncture, manipulation and other catheter care actions based on scientific evidence. [18,20] The use of care protocols favors decision-making, aiming to reduce inappropriate practices and incidents during patient care. [21]

Regarding device maintenance, studies have shown that positive pressure of 0.9% saline solution (saline flush) is sufficient to maintain catheter permeability and prevents vulnerabilities associated with heparin administration [8], old practice carried out in the service. Furthermore, the gold standard in CVC-TI care is considered to be: hand hygiene; maximum barrier precautions; skin antisepsis with 2% chlorhexidine during catheter insertion and puncture; appropriate selection of the implantation site by the multidisciplinary team. [9,1019,22]

A limitation of the study is the sample size restricted to a single oncology service, which may limit the generalizability of the findings. In addition, the retrospective nature of the study may introduce selection bias, as data were extracted from clinical records that may not have been consistently documented. Complications associated with the use of CVC-TI were assessed only in a specific period, which may not reflect long-term incidence. Finally, the lack of control for external variables, such as comorbidities and different treatment protocols, may influence the results and make it difficult to determine causal relationships between the use of CVC-TI and the complications observed. These limitations highlight the need for future studies with larger and multicenter samples to validate and expand the findings of this work.

The contributions of this study to nursing practice refer to the evidence found on the good tolerance of patients to CVC-TI, which may encourage health professionals to adopt this approach in their clinical practices. In addition, the study emphasizes the importance of continuing education of the nursing team regarding best practices for insertion and maintenance of CVC-TI, promoting a culture of safety and quality in the care of cancer patients. The valorization of the recording of actions and interventions performed is also an important contribution, as it allows a more accurate assessment of the care provided and facilitates the identification of areas that require improvement. Finally, the strategies developed based on the information collected can serve as a guide to improve care protocols, contributing to patient safety and the effectiveness of cancer treatment.

CONCLUSION

This multiple case study demonstrated that cancer patients tolerated CVC-TI well, with few complications, the rates of which were lower than those found in the literature. This reflects the commitment of the healthcare team to provide guidance and ongoing care. It is essential that healthcare professionals prioritize care during catheter insertion and maintenance, in addition to knowing how to identify, prevent, and treat possible complications. These practices are essential to prolong the life of the device and improve the patient's quality of life.

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