

**Bone marrow transplant: prevention of central catheter infection***Trasplante de médula ósea: prevención de la infección del catéter central**Transplante de medula óssea: prevenção de infecção de cateter central***Mayara Raquel Silva<sup>1</sup>**

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Armada de Oliveira**Submission:** 03-15-2021**Approval:** 04-25-2021**Abstract**

The aim was to identify in the literature the nursing actions performed to prevent CVC infections in patients undergoing HSCT. This is an integrative literature review, in which quantitative data were used to answer the research problem. As a result, for the construction of the project, articles identified in the BDNF, LILACS, MEDLINE and SciELO literature bases were analyzed. We obtained 15 articles that answer the guiding question. To prevent complications associated with central venous catheters in patients undergoing hematopoietic stem cell transplantation, it is necessary to implement clinical protocols, provide guidance on hand washing technique for health professionals and caregivers, the use of chlorhexidine, and exchange dressing, among others. It is concluded that HSCT is a highly complex alternative treatment that requires specific care with the handling of the central venous catheter to maintain catheter patency and provide safe treatment for patients.

**Descriptors:** Stem Cells; Bone Marrow; Catheter-Related Infections; Nursing Care; Nursing.**Resumén**

El objetivo fue identificar en la literatura las acciones de enfermería realizadas para prevenir infecciones CVC en pacientes sometidos a TCMH. Se trata de una revisión integradora de la literatura, en la que se utilizaron datos cuantitativos para responder al problema de investigación. Como resultado para la construcción del proyecto, se analizaron los artículos identificados en las bases bibliográficas BDNF, LILACS, MEDLINE y SciELO. Obtuvimos 15 artículos que responden a la pregunta orientadora. Para prevenir las complicaciones asociadas a los catéteres venosos centrales en pacientes sometidos a trasplante de células madre hematopoyéticas, es necesario implementar protocolos clínicos, orientar sobre la técnica del lavado de manos a los profesionales de la salud y cuidadores, el uso de clorhexidina, cambio de apósito, entre otros. Se concluye que el TCMH es un tratamiento alternativo de alta complejidad que requiere cuidados específicos con el manejo del catéter venoso central con el fin de mantener la permeabilidad del catéter y brindar un tratamiento seguro a los pacientes.

**Descriptorios:** Células Madre; Médula Ósea; Infecciones Relacionadas con Catéteres; Atención de Enfermería; Enfermería.**Resumo**

Objetivou-se identificar na literatura as ações de enfermagem realizadas na prevenção de infecções de CVC em pacientes submetidos ao TCTH. Trata-se de uma revisão integrativa da literatura, na qual foram utilizados dados quantitativos para responder o problema de pesquisa. Como resultado para a construção do projeto foram analisados artigos identificados nas bases de literatura BDNF, LILACS, MEDLINE e SciELO. Obteve-se 15 artigos que respondem à pergunta norteadora. Para prevenir complicações associadas ao cateter venoso central em pacientes submetidos ao transplante de células-tronco hematopoiéticas, é necessário à implementação de protocolos clínicos, orientar sobre a técnica de lavagens das mãos para os profissionais de saúde e cuidadores, o uso de clorexidina, realizar troca de curativo, entre outras. Conclui-se que o TCTH é um tratamento alternativo de alta complexidade que exige cuidados específicos com o manuseamento do cateter venoso central a fim de manter a permeabilidade do cateter e proporcionar tratamento seguro para os pacientes.

**Descritores:** Células-Tronco; Medula Óssea; Infecções Relacionadas a Cateter; Cuidados de Enfermagem; Enfermagem.

Silva MR, Cavalcanti APS, Kimura CSFG, Vieira ECB, Amaral JG, Ferreira RS vein. The most used catheters for this procedure are Hickman, Double Lumen, Shilley and Permicath. They point to the main complications caused by catheter insertion: permanent loss of this access, thrombotic obstruction, bacteremia (presence of bacteria in the bloodstream), hemorrhage, subcutaneous extravasation, embolism, hyperemia (increase in circulating blood volume in a certain tissue or organ, with predominance in patients with aplastic anemia), accidental removal and infection<sup>2</sup>.

Infection is the main occurrence in patients undergoing HSCT, its incidence rate varies from 9 to 80%, it is caused by several factors, they are: the choice of vein for insertion of the central venous catheter, catheter caliber, care when handling the catheter by the team, surgical technique applied, type and stage of cancer, immunocompromised patient, hand washing technique, chemotherapy protocol, patient age, among others. In autologous post-transplantation, in most cases the infection is related to bacteremias of enteric organisms, caused by Graft Against Host Disease (GVHD) which occurs when the body's defense cells react against the patient's body, it can manifest itself as acute or chronic form. Suspicion of infection is the main cause of early withdrawal of CVC, this preventive measure can result in delay in treatment, anxiety, discomfort, and increased length of hospital stay, consequently, increased costs<sup>1,2,6</sup>.

In summary, HSCT is a treatment indicated as an alternative therapy for malignant and non-malignant diseases. This treatment in Brazil during the year 2018, 2,877 hematopoietic stem cell transplants were performed, with the highest prevalence rate in the southeast region with 1,528, later 700 in the south region, 482 in the northeast region, 167 in the center-west region and lastly 0 in the northern region<sup>7</sup>.

Given the specificity of nursing care in hematopoietic stem cell transplantation, the question that guided this study was: what nursing actions are performed to prevent CVC infection in patients undergoing HSCT?

The project is justified because it identifies specific nursing actions, related to the prevention of CVC infection, of patients undergoing HSCT, which is the main cause of morbidity and mortality in this public, especially in the post-HSCT phase. HSCT consists of the infusion of stem cells obtained from a donor and infused through a CVC, inserted in the pre-HSCT phase. It is of great importance to investigate complications and influencing factors related to its use during treatment. The infection is cited as one of the most presented ones, requiring an adequate planning of safe and effective nursing care to reduce the number of cases by preventing them<sup>8</sup>.

## Methodology

It is an integrative review of descriptive character and qualitative approach. In this study, electronic databases were used to collect articles: BDNF, LILACS, MEDLINE and SciELO. Articles available in full in Portuguese, between 2016 and 2020, the descriptors used were: stem cells, bone marrow, catheter-related infections and nursing care. The

## Introduction

The bone marrow (BM) popularly known as "marrow", is located inside the bones and is responsible for producing the blood elements that are: white blood cells (leucocytes - responsible for the body's defense), red blood cells (RBCs - responsible for the transport of oxygen and carbon dioxide) and platelets (which are responsible for clotting)<sup>1</sup>.

The term Bone Marrow Transplantation (BMT) is substituted in the literature for Hematopoietic Stem Cell Transplantation (HSCT) and is an alternative treatment indicated for patients with failure in the production of cells derived from BM and deficiencies in the immune system. The main diseases for which this treatment is intended are leukemia, severe anemia, myelodysplasia, genetic diseases, and immune system diseases<sup>1</sup>.

For HSCT, there is a specific preparation that involves three phases, namely: pre-HSCT, trans-HSCT and post-HSCT<sup>2</sup>.

In the pre-HSCT phase, it is necessary to carry out the preparation of the recipient and donor, which includes compatibility tests, which are specific, performed through blood samples collected and analyzed between recipient and donor, called histocompatibility test<sup>3</sup>. At this stage, a Central Venous Catheter (CVC) is also placed in the recipient, who will use it for a long period of time for drug administration (including chemotherapy), stem cell infusion, blood sample collection, nutrition parenteral and electrolyte supplements, with the aim of restoring the hematopoietic and immune systems<sup>2</sup>.

After the selection of the donor, the recipient is referred to carry out the protocol relevant to their case. On the scheduled day, the donor undergoes a procedure for removing the stem cells, using a technique selected for this purpose, which can be intraosseous puncture for aspiration of posterior iliac crest OM, performed in a Surgical Center or leukapheresis, which is the removal of the cells through the peripheral blood, a procedure performed in a specific Blood Bank for these cases. Once the cells are collected, the infusion is done through CVC, previously introduced<sup>4</sup>.

In the first post-HSCT months, recipients are more likely to experience side effects and adverse effects caused by drug ingestion from the start of the conditioning regimen. This implies an increase in symptoms. The most common symptoms are cough or dyspnea, fever, nausea, and emesis, algesia, chills, itching, edema, lack of appetite, colds, headache, among others. During the first year after HSCT, the immune system is still recovering, so the recipient is more susceptible to getting infections<sup>5</sup>.

Currently, we find different situations that allow this procedure to be performed, being classified into three types: syngeneic (the cells come from an identical twin); allogeneic (cells donated by another individual, whether or not related to the recipient) and autologous (the recipient itself is a donor for itself)<sup>2</sup>.

The nursing team has an essential role in the maintenance of the CVC, therefore, they must intervene in the prevention or aggravation of complications. The CVC is inserted into the internal jugular, subclavian, or femoral



selection of articles took place between July and August 2020. The articles selected to compose this study were exported to Microsoft Excel software and prepared with the aid of Microsoft Word software. The following variations were selected to build the chart: year of publication of the author, author, title, source, and samples. Afterwards, the content was analyzed using Bardin's analysis<sup>9</sup> with the structuring of the steps: analysis prior to the first step in which the collected material is subjected to further study; analytical description, which is the classification of each study and its relevant topics that intersect with its objectives; inferential interpretation, which refers to the act of relating the results obtained with the reality studied<sup>10</sup>.

An exploratory reading of the material was carried out, first 401,241 articles were collected with full disposition, after applying the inclusion and exclusion criteria and reading the titles, 114 articles were selected, after a thorough reading of the abstracts, 25 articles were selected, of these 7 were excluded for not answering the inclusion criteria, leaving 15 that answer the problem question. After a thorough reading of the selected articles, they were organized and tabulated in the chart below, containing relevant data from the selected articles to develop the research project, such as: year of publication (newest to oldest article), authors, title, bibliographic source, and samples (which filter from the article the main factors that meet the specific objectives).

**Results**

**Chart 1.** Listing of selected articles. São Paulo, SP, Brazil, 2021

Year of publication	Authors	Title	Source	Sample
2020	Castanho LEC, et al.	Curativo gel de clorexidina no transplante de células-tronco hematopoéticas <sup>11</sup>	Acta Paulista de Enfermagem	Hickman Catheter. Double lumen. Skin irritation. Bloodstream Infection.
2019	Fernandes DR, Braga FTMM, Silveira RC de CP, Garbin LM.	Higiene das mãos: conhecimento e habilidade de cuidadores no transplante de células-tronco hematopoéticas <sup>12</sup>	Revista Brasileira de Enfermagem	Infection.
2019	Rodrigues JAP, Lacerda MR, Gomes IM, Paes MR, Ribeiro RP, Bonfim CMS.	Perfil clínico de crianças submetidas a transplante de células-tronco hematopoéticas <sup>13</sup>	Cogitare Enfermagem	Ache. Cough. Coryza. Fever. Infection. Graft Disease vs. Host.
2019	Figueiredo TWB, Mercês NNA das, Silva LAA da, Machado CAM.	Protocolo de cuidados de enfermagem no dia zero do transplante de células-tronco hematopoéticas: construção coletiva <sup>14</sup>	Texto & Contexto-Enfermagem	Adverse reactions. Acute kidney failure.
2019	Danski MTR; Silva SR da, Pontes L, Pedrolo E.	Ação educativa para a padronização no manejo do cateter de hickman <sup>15</sup>	Cogitare Enfermagem	Hickman Catheter. Occlusion. Infection.
2018	Figueiredo TWB, Mercês NNA das, Nunes MBM, Wall ML.	Reações adversas no dia zero do transplante de células-tronco hematopoéticas: revisão integrativa <sup>16</sup>	Revista Gaúcha de Enfermagem	Bradycardia. Abdominal pain. Dyspnea. Emesis. Hypoxia.
2018	Marques A da CB, Szczepanik AP, Machado CAM, Santos PND, Guimarães PRB, Kalinke LP.	Transplante de células-tronco hematopoéticas e qualidade de vida durante o primeiro ano de tratamento <sup>17</sup>	Revista Latino-Americana de Enfermagem	Ache. Loss of appetite. DECEMBER Fatigue. Nausea.
2018	Silva AG da, Oliveira AC de.	Conhecimento autorreferido das equipes médica e de enfermagem quanto às medidas de prevenção de infecção da corrente sanguínea <sup>18</sup>	Texto & Contexto-enfermagem	Bloodstream infection.



2018	Pontes L, Silva SR da, Lima AP, Sandri LCS, Batistela AP, Danski MTR.	Incidentes relacionados ao cateter Hickman <sup>®</sup> : identificação de danos <sup>19</sup>	Revista Brasileira de Enfermagem	Hickman Catheter. Obstruction. Fracture. Infection.
2017	Fortunsti CFP.	Impacto de dois bundles na infecção relacionada a cateter central em pacientes críticos <sup>20</sup>	Revista Latino-Americana de Enfermagem	Double Lumens. Bloodstream Infection (ICS).
2017	Marques A da CB, Proença S de FFS, Machado CAM, Guimarães PRB, Maftum MA, Kalinke LP.	Qualidade de vida nos primeiros seis meses pós-transplante de células-tronco hematopoéticas <sup>21</sup>	Texto & Contexto-Enfermagem	Fatigue. Ache. Loss of appetite.
2017	Figueiredo TWB, Mercês NNA das.	Dia zero do transplante de células tronco hematopoéticas: cuidados do enfermeiro <sup>22</sup>	Revista Mineira de Enfermagem	Systemic Arterial Hypertension. Oxygen saturation drop. Tremors. Nausea and emesis. Skin rash.
2017	Figueiredo TWB.	Protocolo de cuidados de enfermagem no dia zero do transplante de células-tronco hematopoéticas <sup>23</sup>	Universidade Federal do Paraná	Hickman Catheter. Double Lumen Catheter. PICC catheter. Adverse reactions. DECH.
2016	Perin DC, Erdmann AL, Higashi GDC, Sasso GTMD.	Evidências de cuidado para prevenção de infecção de corrente sanguínea relacionada a cateter venoso central: revisão sistemática <sup>24</sup>	Revista Latino-Americana de Enfermagem	PICC catheter. ICSRC. Death.
2016	Oliveira VB de.	Fatores associados a infecção, readmissão hospitalar e recuperação medular entre pacientes oncohematológicos submetidos à transplante de células tronco hematopoéticas <sup>25</sup>	Fundação Oswaldo Cruz	Intense immunosuppression. DECH.

## Discussion

The most discussed prevention actions in the selected articles are: health education with 66.67%. Followed by hand washing with 46.67%. Successive catheter maintenance with 40%. Subsequently, protective barriers and clinical protocols correspond to 33.33%. Consecutive of asepsis with chlorhexidine and monitoring and measurement of vital signs corresponding to 26.67%. Followed by daily assessment of the catheter device insertion site with 20%. Continuing antibiotic prophylaxis, avoiding catheter insertion into the femoral vein, changing the dressing and immediately removing the catheter in cases of suspected infection represents 13.33%. And finally, chlorhexidine gel dressing, stimulating physical activity between the bed to help with circulation, social isolation, as the patient has low immunity and the use of a mask by the professional corresponds to 6.67%.

The use of chlorhexidine gel dressing in patients undergoing HSCT has proven to be an efficient measure in reducing catheter-related infections as it demonstrates a decrease in skin colonization by bacteria, associated with the importance of protocols in the health institution on the use of the dressing safely. Other preventive measures for CVC-related infections are identified, such as: avoiding access to the VF, sanitizing hands before handling the catheter, using maximum protective barrier during catheter insertion, performing skin antiseptic with chlorhexidine, changing dressings daily as recommended, assess the catheter insertion site and remove the catheter when its use is no longer necessary<sup>11</sup>.

It is important to emphasize the use of antibiotic prophylaxis from the beginning of conditioning, together with the development of preventive actions in the surgical environment and on the technical scientific knowledge of



caregivers on the correct technique of hand washing in HSCT for infection prevention and control<sup>12</sup>.

The use of hand washing, mask use and social isolation are recommended. These precautions aim to reduce the post-transplant morbidity and mortality rate, especially in the first 100 days of spinal cord recovery<sup>13</sup>.

Care in the preparation of the material, it is important to carry out cardiac monitoring and fluid balance, in addition, it is recommended to measure the vital signs pre, trans and post infusion of CTH at 15-minute intervals in the recipient, permanence of the health professional (nurse) beside the patient throughout the infusion of CTH, and construction of clinical protocols. The need to measure vital signs and monitor the patient to prevent persistent adverse reactions in health facilities<sup>14</sup>.

According to a study<sup>15</sup>, it is worth emphasizing the importance of continuing education among professionals to understand the steps of the procedure and handling of the catheter to standardize care and provide more safety to the patient. Furthermore, the use of specific protocols and a care plan for each phase of HSCT, pre-established according to the patient's clinical condition. Whose, the nursing team needs to be close to the patient to resolve doubts and offer support to the patient/family<sup>16</sup>.

To avoid this aggravating condition in the patient, health education, training/training of professionals to handle the catheter and daily assess the insertion site of the central venous catheter is necessary. In addition to these measures, hand washing, skin asepsis with chlorhexidine, use of a protective barrier, dressing change, catheter maintenance, and evaluation of the catheter insertion site are recommended. In addition, the importance of developing specific protocols to handle the CVC safely is highlighted to reduce the occurrence of obstruction<sup>17,18</sup>.

It is worth emphasizing the importance of the simultaneous use of bundles in the insertion and maintenance of the catheter to prevent ICS. Bundles are defined as an application of systematization of processes consisting of three to five interventions, based on clinical evidence of the patient, which is carried out collectively by the multidisciplinary team, aiming to improve patient outcomes. The bundles include hand washing practices, skin asepsis with chlorhexidine, use of a protective barrier, dressing change within 48 hours and daily assessment of the catheter insertion site<sup>19</sup>.

The importance of providing quality of life for the patient is highlighted, especially during the hospitalization phase, it needs to encourage the practice of exercises under nursing supervision, for example, getting out of bed frequently. To improve the patient's fitness and decrease symptoms. In addition to health education<sup>20</sup>.

According to study<sup>21</sup>, the authors address the dimensioning and cooperation between multidisciplinary teams during the phases of the procedure, and highlight nursing as the professional with more access to the patient to provide care, in addition to performing other functions such as: supervising activities and health education. For this,

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Silva MR, Cavalcanti APS, Kimura CSFG, Vieira ECB, Amaral JG, Ferreira RS they require from nurses technical scientific knowledge, skills and abilities to detect and intervene in adverse reactions. And it specifies the main care that the professional needs to have on day zero of HSCT, such as: catheter maintenance, vital signs measurement (SSVV), patient monitoring (pulse oximetry and fluid balance), catheter washing and nursing record. Because documenting the data in an organized way helps in decision making.

In the dissertation<sup>22</sup>, there is an emphasis on clinical protocols, as it improves care decision-making and directs care by professionals, provides positive results, rational use of available materials and equipment, consequently cost control.

According to study<sup>23</sup>, standardized care with specific guidelines to provide safe patient care. Among other preventive measures such as: the use of bundles with five components (hand washing, maximum protection barrier, asepsis with 2% chlorhexidine, avoiding the femoral insertion site, removing unnecessary catheters), catheter maintenance, permanent education, and use of closed infusion system.

Finally, the study<sup>24</sup> reinforces hand hygiene practices, equipment disinfection and the use of antibiotic prophylaxis, protective barriers, and patient monitoring.

#### **Conclusion**

Hematopoietic stem cell transplantation (HSCT) comprises three phases: pre-HSCT, trans-HSCT and post-HSCT. It is an alternative treatment indicated for patients with autoimmune, oncological, hereditary and hematological diseases with a high probability of cure, due to the correct return of spinal function. It can be autologous, syngenic and allogeneic.

To promote safe access for drug infusion and management of patients undergoing HSCT, it is necessary to use a permanent or temporary central venous catheter (CVC), inserted after the conditioning regimen. However, its insertion breaks the skin integrity, favoring the entry of biological agents, resulting in high rates of infection and mortality. In this research project, the following catheters were presented: Hickman, double lumen, shiley, hemodialysis/permicath and portocath.

HSCT is a complex procedure, with numerous restrictions and susceptible to adverse events in the short and long periods, with the patient's cooperation during treatment being essential, with the integral assistance of the multidisciplinary team. Dialogue between the team and the patient is essential for the patient to feel at ease and comfortable to express their feelings and symptoms, aiming for the best direction of the case.

Several lines of research are underway to make HSCT a safer and more applicable therapy for patients. Advances in understanding the immunological and hematological mechanisms involved in each step of the process have allowed the creation and development of new conditioning regimens with a low toxicity index.





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