Original Article

Rationale for Hickman catheter removal in patients undergoing hematopoietic stem cell transplantation*

Motivo de retirada do cateter de Hickman em pacientes submetidos ao transplante de células-tronco hematopoéticas

Motivo del retiro del catéter de Hickman en pacientes sometidos al transplante de células-tronco hematopoéticas

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ABSTRACT

Objective: To identify rationale for removal of the first Hickman catheter implanted in patients undergoing allogeneic hematopoietic stem cell transplantation, the micro-organisms involved in the occurrence of infection, and the length of time the catheter was in situ. **Methods:** A cross sectional, retrospective study was conducted. The sample consisted of 57 transplant recipients. To conduct chart review, an instrument was developed containing variables related to patient identification, time of catheter use, reason for withdrawal, and isolated micro-organisms. **Results:** Among the reasons for catheter removal, frequent infection (49%) was the most common; the Stenotrophomonas maltophilia microorganism (25%) was the most frequently isolated. **Conclusions:** Due to the high incidence of infectious complications leading to Hickman catheter removal, it is essential to standardize catheter care for the health care team, patients and their caregivers.
Keywords: Bone marrow transplantation; Hematopoietic stem cell transplantation; Central venous catheterization; Nursing care

RESUMO

Objetivo: Identificar os motivos da retirada do primeiro cateter de Hickman implantado em pacientes submetidos ao transplante de células-tronco hematopoéticas alogênico, os micro-organismos envolvidos na ocorrência de infecção e o tempo de permanência do cateter in situ. **Métodos:** Estudo transversal retrospectivo. A amostra foi constituída por 57 prontuários de pacientes transplantados. Para a obtenção dos dados, elaborou-se um instrumento contendo variáveis relativas à identificação do paciente, tempo de permanência do cateter, motivo de retirada e micro-organismo isolado. **Resultados:** Dentre os motivos de retirada do cateter, destacou-se como o mais frequente a infecção (49%). O Stenotrophomonas maltophilia (25%) foi o micro-organismo identificado com maior frequência. **Conclusões:** Diante da elevada incidência de complicações infecciosas que levam à retirada do cateter de Hickman, faz-se necessária uma padronização de cuidados relacionados a esse cateter, tanto para a equipe de saúde como ao paciente e seu cuidador.
Descritores: Transplante de medula óssea; Transplante de células-tronco hematopoéticas; Cateterismo venoso central; Cuidados de enfermagem

RESUMEN

Objetivo: Identificar los motivos del retiro del primer catéter de Hickman implantado en pacientes sometidos al transplante de células-tronco hematopoéticas alogénico, los microorganismos involucrados en la ocurrencia de infección y el tiempo de permanencia del catéter in situ. **Métodos:** Estudio transversal retrospectivo. La muestra estuvo constituída por 57 historias clínicas de pacientes transplantados. Para la obtención de los datos, se elaboró un instrumento conteniendo variables relativas a la identificación del paciente, tiempo de permanencia del catéter, motivo del retiro y microorganismo aislado. **Resultados:** Entre los motivos del retiro del catéter, se destacó como el más frecuente la infección (49%). El Stenotrophomonas maltophilia (25%) fue el microorganismo identificado con mayor frecuencia. **Conclusiones:** Frente a la elevada incidencia de complicaciones infecciosas que llevan al retiro del catéter de Hickman, se hace necesaria una patronización de cuidados relacionados a ese catéter, tanto para el equipo de salud como para el paciente y su cuidador.
Descriptores: Trasplante de médula ósea; Trasplante de células madre hematopoyéticas; Cateterismo venoso central; Atención de enfermería

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** Study accomplished at a specialized allogeneic stem cell transplantation unit of a general public hospital in the interior of São Paulo State.*

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INTRODUCTION

Today, hematopoietic stem cell transplantation (HSCT) is indicated to reestablish hematopoiesis or treat malign diseases through intravenous stem cell infusion[1].

Although this treatment mode represents a possibility to increase the patient's survival time, or even to cure the disease, it is considered a risky procedure due to the complications, whose frequency depends on the transplantation type, the patient's age and clinical condition[2].

HSCT can be allogeneic, when the graft donor is a relative or not, autologous when the donor is the patient him/herself, or syngeneic, when the donor is a monozygotic twin sibling. It is highlighted that allogeneic HSCT implies greater infection risk due to the presence of prolonged neutropenia, as a result of high doses of chemotherapy and/or full body radiotherapy, use of immunosuppressors to avoid graft rejection and graft-versus-host disease[1].

Independently of the type of HSCT that is indicated -, autologous, allogeneic or syngeneic, patients are submitted to the implantation of an indwelling catheter, generally a Hickman catheter, before the start of the conditioning regimen. This device is an adaptation of the single-lumen catheter[3], used for prolonged parenteral nutrition infusion, whose caliber and number of lumens were increased in response to the therapeutic needs of clients submitted to HSCT[4].

It is indicated because it dispenses percutaneous puncture, permits central venous pressure monitoring, simultaneous infusion of large fluid quantities, blood collection for laboratory tests, besides guaranteeing stem cell infusion without compromising the graft[5].

Despite different advantages, some post-implant complications can be described for this device, such as infection, occlusion, embolism and thrombosis, among others[6]. It is observed that about 30% of these complications can result in early catheter removal[7]. Besides, it is known that Hickman catheter-related infection can aggravate the condition of patients submitted to HSCT[5]. It is highlighted that, when this device is removed early, that is, before bone marrow grafting, a new catheter may be necessary.

It is extremely relevant for nurses responsible for daily Hickman catheter manipulation to know about the main reasons leading to the withdrawal of this device, so that they can plan and put in practice actions to guarantee its dwelling time and minimize patient risks.

Thus, the goal of this study was to identify the reasons for withdrawing the first Hickman catheter implanted in allogeneic HSCT patients and, in case of infection, to identify the microorganisms involved and the catheter dwelling time *in situ*.

METHODS

A retrospective cross-sectional study was carried out at a specialized allogeneic HSCT unit of a general public hospital in the interior of São Paulo State, with possesses the standard requirements the Unified Health System (SUS) suggests for the registration of HSCT services.

The study sample comprised the files of allogeneic HSCT patients who complied with the following inclusion criteria: age 18 years or older, submitted to allogeneic HSCT for the first time, between 2003 and 2007, and whose Hickman catheter was implanted under aseptic conditions at the surgical center. Five files with incomplete or unreadable information were excluded.

Between January 2003 and December 2007, 62 patients were submitted to allogeneic HSCT, 57 of whom complied with the inclusion criteria.

Approval for the study was obtained from the Institutional Review Board of the study hospital (Protocol No 3797/2007). To collect the data, by consulting the patient files, an instrument was used after validation by three HSCT expert nurses, with variables regarding patient identification, catheter dwelling time, reason for catheter withdrawal (exit site infection, tunnel infection, catheter-related bloodstream infection, persistent fever without infection focus, bad positioning, end of treatment, accident catheter traction and death) and isolated microorganism in case of catheter-related infection.

The database was structured and analyzed using Statistical Package for the Social Sciences (SPSS) software, version 10.0 for Windows. Descriptive data analysis was performed through absolute and relative frequencies, central trend (mean and median) and dispersion measures (standard deviation, minimum and maximum).

RESULTS

As presented in Table 1, the male gender predominated (63%). The mean age was 36 years (SD ± 12.36). The most frequent baseline pathology (30%) was acute myeloid leukemia (AML).

The shortest catheter dwelling time was 1 day and the longest 203 days. Most withdrawals (76%) of the first Hickman catheter occurred within 60 days after implantation, with a mean dwelling time of 45.16 days.

The most frequent reason for withdrawal was catheter-related infection (49%), 7% was related to exit site infection, 14% to tunnel infection and 28% to bloodstream infection.

Among the microorganisms identified through blood culture of patients whose Hickman catheter was removed due to catheter-related bloodstream infection (BSI), it was verified that 100% were gram-negative bacteria, with *Stenotrophomonas maltophilia* (25%) as the most frequent

(Table 2). All BSI cases were diagnosed within 90 days after the HSCT.

Table 1 – Sample (n=57) characteristics according to the study variables. Ribeirão Preto - SP, 2003-2007.

Variables	n	%
Gender		
Male	36	63
Female	21	37
Age (years)		
Variation	19-64	
Mean (SD)	36.18 (±12.36)	
Median	34	
Pathology		
Chronic myeloid leukemia	13	23
Acute myeloid leukemia	17	30
Chronic lymphocytic leukemia	1	2
Acute lymphocytic leukemia	4	7
Non-Hodgkin lymphoma	4	7
Severe aplastic anemia	9	16
Multiple myeloma	2	3
Myelodysplastic syndrome	3	5
Others	4	7
Time of stay (days)		
< 30	22	39
31 |—| 60	21	37
61 |—| 90	8	14
>91	6	10
Variation	1-203	
Mean (SD)	45.16 (±37.62)	
Median	40	
Reason for withdrawal		
Exit site infection	4	7
Tunnel infection	8	14
Bloodstream infection	16	28
Persistent fever without infectious focus	6	11
End of therapy	6	11
Death	8	14
Others (catheter traction and bad positioning)	9	15

Table 2 – Distribution of microorganisms isolated in blood culture of patients submitted to allogeneic HSCT. Ribeirão Preto - SP, 2003-2007.

Microorganism	n	%
Serratia marcescens	1	6.25
Stenotrophomonas maltophilia	4	25.00
Klebsiella oxytoca	1	6.25
Pseudomonas fluorescens	2	12.50
Acinetobacter baumannii	2	12.50
Enterobacter cloacae	2	12.50
Klebsiella pneumoniae	2	12.50
Pseudomonas aeruginosas	1	6.25
Acinetobacter lwoffi	1	6.25
Total	16	100.00

DISCUSSION

Nowadays, Acute Myeloid Leukemia (AML) is a baseline disease that is more indicated for allogeneic HSCT in adults. This treatment is the most effective to fight this disease[8]. This data is in line with the present study findings, in which the main indication for allogeneic HSCT was AML, whose catheter-related BSI rate is higher than that of patients with solid tumors as, in those patients, the central venous catheter involves the need for a larger number of catheter manipulations[9].

In the present study, infection was the main reason for catheter removal, with has also been evidenced in other studies involving onco-hematological patients or not[7,10-13].

Allogeneic HSCT, whose therapeutic procedure involves high chemotherapy doses, stands out among the factors contributing to Hickman catheter-related infection incidence levels[11]. Besides, manipulation of the device is appointed as an important risk factor for the development of catheter-related infection, mainly in patients with tunneled central venous catheters, like Hickman's catheter[12]. It should be highlighted that infections occurring at a late stage after the catheter insertion period cannot be solely associated with the surgery. Instead, catheter maintenance and handling by the multiprofessional team should also be taken into account[11-12]. This reveals the importance of training people who handle the catheter, in hospital an also at home, as well as the need to adopt meticulous care involving Hickman's catheter to prevent infections.

A literature review on catheter-related nursing care in patients submitted to HSCT evidenced infection control strategies, such as: the use of catheters infused in antimicrobials, intraluminal perviousness protocols to reduce the formation of blood clots and biofilms, and the use of aseptic techniques for handling[13].

Other studies[12-13] assessed the incidence of Hickman catheter-related infection (CRI) in patients submitted to high chemotherapy doses and allogeneic HSCT, identifying CRI rates of 9.7% and 3.1%, whose episodes were responsible for reducing the catheter dwelling time. The authors highlighted the importance of judicious care for Hickman catheter maintenance and manipulation with a view to infection control and prevention. The importance of team training through permanent education programs should be highlighted.

Although the efficacy of training professionals for catheter care is questioned as a preventive method[14], investments in the adoption of preventive measures that contribute to the reduction of CVC infection rates cannot be dispensed. In that sense, studies affirm that nursing interventions for infection prevention in cancer patients are not a constant among professional practices[13,15] and defend that education-based intervention among different professional groups involved in patient care can successfully be put in practice to reduce infection rates[15].

In an integrative literature review about Hickman's catheter in HSCT, a specific category was included about manipulation, handling, infection prevention and control related to Hickman's catheter in patients submitted to HSCT. Most (n=7) of the analyzed studies aimed to reduce the number of manipulations or lumen openings to the external environment, appointing health team training on catheter manipulation as an effective infection prevention measure[5].

Regarding the mean dwelling time of Hickman's catheter, in literature[6] a mean in situ dwelling time of 371 days is observed, excluding complications. In this study, on the opposite, the mean catheter dwelling time was 45.54 days, although complications were not excluded.

In a case-control study that involved 52 patients[16], the mean period from catheter insertion to the development of bacteremia by *S. Maltophilia* was 60 days, with 11 days as the shortest and 325 days as the longest in situ dwelling time. It should be highlighted that this was the most frequent microorganism, which could justify catheter dwelling times shorter than 60 days.

In the present study, it was also observed that the period between the first and thirtieth dwelling day of the device was predominant for the development of complications that implied catheter withdrawal, a risk that continues until the sixtieth day, with bloodstream infection (BSI) as the main reason. When comparing these outcomes with literature, it was observed that some researchers detected that the period for the appearance of BSI occurred within the first 30 days after the HSCT, which implied a mortality rate 20% higher than in patients who did not develop BSI, although the study did not intend to identify the origin of that infection[17]. On the other hand, other authors conclude that infections related to partially implanted CVC are rare within the first 30 days after insertion[18]. This level is a source of concern though, considering that a minimum dwelling time of 60 days is desirable after HSCT, as this is the main period when transplant-related complications occur.

When identifying the microorganisms isolated in blood culture in the present study, it was observed that, although literature appoints gram-positive bacteria as the main agents involved in CVC-related infections, in the collected data, this fact was not confirmed. Gram-positive bacteria figure among the most frequent isolated causes of these complications, particularly *Staphylococcus* strains, which are microorganisms from the patient's endogenous microbiota[13,18-19]. Another interesting data is that more than 80% of infections in immunocompromised patients are attributed to microbiota colonizing the patient him/herself[18].

As mentioned, these findings differ from the results obtained from the assessed patients, in whom the predominant microorganism was a gram-negative bacteria, *Stenotrophomonas maltophilia*, with peculiar characteristics that enable it to adhere and form biofilm in catheters, resulting in catheter infection[16]. A retrospective study that involved hematological patients in a non-neutropenic phase, aimed at investigating the frequency and microorganisms that caused Hickman catheter-related infections underlines the predominance of gram-negative bacteria (68%) in these clients, among which *Stenotrophomonas maltoplilia* was the most frequent[20].

CONCLUSIONS

In this study, infectious complications in 28 patients were responsible for short Hickman catheter dwelling times, and also the main reason for its withdrawal. It is highlighted that *Stenotrophomonas maltophilia* (25%) was the most frequent microorganism isolated in blood culture and that the mean dwelling time was 45.16 days.

These study results can help to understand the reasons for Hickman catheter withdrawal in patients submitted to allogeneic HSCT. This fact will grant nurses new elements for care planning. Thus, the proposed interventions will be specifically aimed at minimizing early catheter removal.

One possible study limitation is due to the fact that the place of study has three transplantation beds and one for rehospitalization, resulting in a small number of subjects during the study period. Besides, the fact that the transplantation unit is part of a large tertiary teaching hospital can limit comparisons between these results and those of other health institutions.

Despite the limitations, this study permitted the identification of reasons for catheter withdrawal and the most frequent microorganisms isolated in blood culture, which can contribute to the establishment of infection prevention measures.

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