

Use of Antibiotic Lock Therapy with Long-Term Central Venous Catheters

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Abstract

Long-term central venous catheters are indicated for patients undergoing hematopoietic stem cell transplantation (HSCT). Antibiotic lock therapy (ALT) is used to prevent infection in patients with indwelling catheters. However, to date, there is no consensus on the use of ALT. The objective of this cross-sectional study was to assess the use of central venous catheters for ALT by nursing teams from HSCT centres in Brazil. Twenty-two centres were included. The results indicated that 73% of the centres were aware of ALT and 87% used it. ALT had been used for more than 5 years by 43% of the centres. Moreover, 43% of the centres used antibiotics plus heparin and 43% used vancomycin only. These results provide an overview of the use of ALT in care services by nurses from HSCT centres as a strategy for preventing the early removal of central venous catheters.

Keywords: Nursing care; Antibiotic prophylaxis; Hematopoietic stem cell transplantation; Central venous catheterization; Oncology.

1. Introduction

Long-term central venous catheters (LTCVCs) maintain their function for a long period after implantation in the patient. LTCVCs are usually made of silicone, are surgically implanted, and may be tunnelled in some sections. These catheters are indicated for patients who undergo hematopoietic stem cell transplantation (HSCT) because the treatment is extensive and requires multiple intravenous infusions and blood collections (Bonassa & Gato, 2012). The operation of LTCVCs requires specialized skills because these catheters may cause complications, especially infections (Zeroti et al., 2016; Morano et al., 2014). Therefore, the proper operation of LTCVCs by the nursing team should be supported by professional training courses and institutional protocols. Antibiotic lock therapy (ALT) can be used to prevent catheter-related dissemination of intraluminal infection into the bloodstream, favour the use of LTCVCs until the end of the proposed treatment, and ensure patient safety (Fernández-Hidalgo & Almirante, 2014). ALT is defined as the complete filling of the lumen of the catheter with an antimicrobial solution, which should remain for a specific period in the catheter, to achieve sterilization.

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The high concentration of the antimicrobial agent (doses 100 to 1000-fold higher than those used in systemic therapy) can be used to prevent catheter-related infection and has therapeutic action when associated with systemic antibiotic therapy (Fernández-Hidalgo & Almirante, 2014).

The suspicion or occurrence of catheter-related infection is common and is the main reason for early catheter removal (Pereira et al., 2013), which may lead to therapeutic complications in patients who have undergone HSCT. Therefore, ALT is considered a good strategy for preventing infection in patients with LTCVCs. However, to date, there is no consensus on the use of ALT. The objective of this study was to assess the use of ALT by nursing teams from HSCT centres in Brazil, registered in the Brazilian Society of Bone Marrow Transplantation (Sociedade Brasileira de Transplante de Medula Óssea – SBTMO).

2. Methods

This cross-sectional survey-type study was conducted from August 6 to November 7, 2014. In this type of study, information is collected at a single time point (Hulley, Cummings & Newman, 2015) using a questionnaire developed by researchers to identify the actions, knowledge, opinions, attitudes, and values of the study participants (Grey, 2001). The SBTMO website was searched to select centres eligible to participate in the study. The search allowed the recovery of the registry of 52 centres that met the selection criteria proposed for the study. The eligibility criteria were 1. being registered in the SBTMO since 2013 and 2. having a nurse responsible for the HSCT unit with at least one year of experience in this area of knowledge. The centres that did not respond to the questionnaire within 15 days were excluded. After identifying the transplant centres, one of the researchers invited the centres to participate in the study. Of the 52 eligible centres, 46 were contacted because five centres no longer performed HSCT (Figure 1).

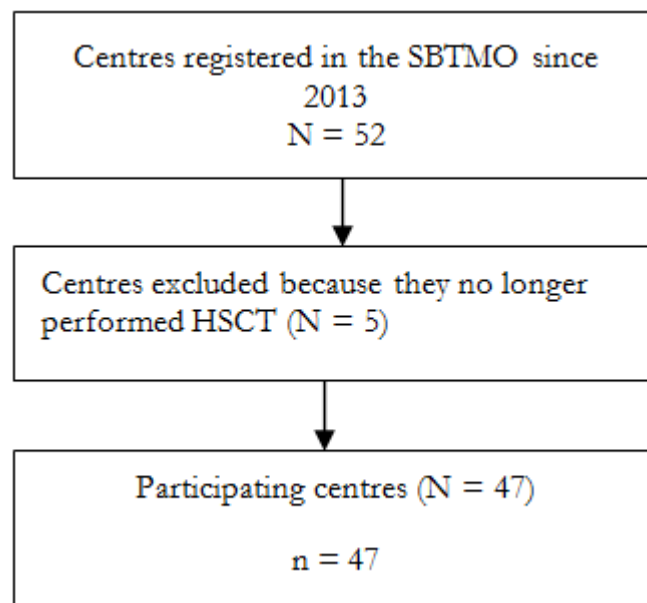


Figure 1. Selection of the centres participating in the study. Source: Brazilian Society of Bone Marrow Transplantation (Sociedade Brasileira de Transplante de Medula Óssea–SBTMO). Available at <http://www.sbtmo.org.br/centros-tmo.php>. Last accessed on November 19, 2013.

The questionnaire was sent to nurses from each participating centre. The questionnaire consisted of eight multiple-choice questions, which could be answered within 15 days. The informed consent form was accessed through an electronic link. After agreeing to participate in the study, the link directed the participant to the questionnaire. The pilot questionnaire used for validating the study was developed by five experts, in which the content of the questions was validated and the suggestions made by the experts were incorporated in the final questionnaire. The information extracted from the questionnaire was transferred to Microsoft® Excel 2010 spreadsheets, validated by double typing and, after correction of inconsistencies, was transferred to software SPSS® version 20.0 for Windows® for data analysis. The data were analysed using descriptive statistics, with measurements of frequency for nominal variables, and measurements of the means, standard deviations, and minimum and maximum values for numerical variables.

The study was approved by the Research Ethics Committee of the Hospital Câncer de Barretos Fundação Pio XII on March 13, 2014, and was registered under CAAE No. 26547814.4.0000.5437.

3. Results

The study population included 47 transplant centres, and 22 centres answered the online questionnaire. Sample loss corresponded to centres that did not return the questionnaire within the proposed period. Most respondents were located in the southeast region of Brazil (Table 1).

Table 1 – Regional distribution of haematopoietic stem cell transplantation centres registered in the Brazilian Society of Bone Marrow Transplantation that answered the online questionnaire. Brazil, 2014.

Region of Brazil	Registered centre		Responding centre	
	%	N	%	N
Southeast	64	30	82	18
South	21	10	14	3
Northeast	13	6	4	1
Midwest	2	1	0	0
Total	100	47	100	22

Among the 22 Brazilian HSTC centres, 16 (73%) reported being aware of ALT. Of these 16 centres, 13 (81%) were currently using the technique, one (6%) had used the technique in the past, and two (12%) knew about the technique but did not adopt it in care services (Table 2).

Table 2 - Distribution of hematopoietic stem cell transplantation centres according to the use of the antibiotic lock technique, Brazil, 2014.

Use of the antibiotic lock technique	%	N
Never used	13	2
Used in the past	6	1
Use currently	81	13
Total	100	16

Among the responding centres, 43% used this technique for more than 5 years, 15% used it for less than 1 year, 21% used it for 1–2 years, and 21% used it for 2–5 years (Table 3).

Table 3 - Distribution of hematopoietic stem cell transplantation centres in Brazil (N = 14) according to the period of use and conditions of use of long-term central venous catheters for ALT, decrease in infection rate, evaluation of the infection rate according to the ALT used, and type of central venous catheter and antimicrobial solutions used. Brazil, 2014.

Variables	%	N
Period of use (years)		
< 1	15	2
1 – 2	21	3
2 – 5	21	3
≥ 5	43	6
Reason for use		
Prevention of CRBSI	64	9
Treatment of CRBSI	36	5
Decrease in infection rate		
Yes, it decreased	57	8
No, it did not decrease	22	3
The decrease was not noticeable	14	2
Others	7	1
Decrease in the infection rate according to the		

lock technique used		
Partially favourable	43	6
Indifferent	36	5
Totally favourable	21	3
Partially unfavourable	0	0
Totally unfavourable	0	0
Type of antibiotic lock used in the CVC		
Antibiotic only	7	1
Heparin only	29	4
Antibiotic and heparin	43	6
Antibiotic and saline	21	3
Antimicrobials used		
Vancomycin	43	6
Gentamicin	14	2
Ethanol	7	1
Ciprofloxacin	0	0
Minocycline	0	0
Amikacin	14	2
Cefazolin	0	0
Ceftazidime	0	0
Others	22	3

CRBSI – catheter-related bloodstream infection; CVC – central venous catheter.

With regard to the application of ALT, 64% of the centres used the therapy for preventing Catheter-Related Bloodstream Infection (CRBSI) and 36% used it for treating CRBSI. Among the Brazilian HSCT centres that used ALT, 57% reported a decrease in the rate of catheter-related infection, 22% reported no decrease in the rate of infection, 14% failed to observe a decrease in the rate of catheter-related infection and 7% responded that the infection rates were negligible (Table 3). The most common antibiotic lock solutions were antibiotics (43%), heparin (29%), antibiotics combined with saline solution (21%), and antibiotics alone (7%).

Among the six (43%) HSCT centres that used antimicrobial agents combined with heparin, six (43%) used vancomycin, two (14%) used gentamicin, and one (7%) used ethanol. In the three centres that used antibiotics and saline, the antibiotics used were vancomycin or amikacin.

It is of note that three (22%) centres reported using more than one antimicrobial agent, and the agent used depended on the infectious agent isolated from blood culture.

4. Discussion

Oncohaematological patients who undergo HSCT receive chemotherapeutic drugs, immunosuppressants, parenteral nutrition, blood products, and other infusions through LTCVCs during treatment. In the present study, a questionnaire was sent to nursing professionals from different HSCT centres in Brazil to evaluate the use of ALT for preventing and controlling infection related to LTCVCs in patients who had undergone HSCT. The instrument used in this study was an online questionnaire consisting of eight questions. The questionnaire was sent via e-mail to nurses from HSCT centres registered in the Brazilian Society of Bone Marrow Transplantation, and 22 (47.8%) registered centres answered the questionnaire. The response rate was similar to that obtained in a survey conducted by the European Society of Bone Marrow Transplantation in 2007, in which 100 centres were invited to participate in the study by Stone et al., and 46 centres agreed to participate. The questionnaire was answered by nurses and evaluated the effect of mucositis in patients subjected to HSCT.

In our study, of the 22 responding centres, 18 (82%) were located in the southeast of Brazil, and this result was expected because most centres are concentrated in this region. With respect to ALT, 73% of the responding centres were aware of this procedure, indicating that it is well-known among HSCT centres in Brazil. Of the responding centres, 13 (81%) reported using ALT in the service.

Among the 14 responding centres using ALT, six (43%) used it for more than 5 years and eight (57%) used it for less than 5 years. Schoot et al. (2013) reported that this technique has been available for more than 10 years, which justifies its frequent use. One of the items of the questionnaire assessed whether ALT was used for preventing catheter-related infections. Eight (57%) responding centres used this technique for preventing infections and five (36%) used it for treating infections.

Regardless of the indication of the use of ALT, 57% of the centres reported a decrease in the rate of catheter-related infection after using this therapy. However, only 21% of the centres were totally in favour of using ALT, suggesting that this therapy does not have an immediate benefit. Therefore, more studies are necessary to determine the effectiveness of ALT in preventing or treating intravascular catheter-related infections.

Tan, Lau & Guglielmo (2014) conducted a review study to evaluate the effectiveness of ethanol locks in preventing CRBSI. and found that, among the 13 prevention studies, 11 reported a decrease in the rate of this type of infection (from 9.11 to 1.92 per 1000 catheters/day). This review included nine studies that used ethanol locks for treating CRBSI and found that the clinical cure rate was 90%.

With respect to the use of ALT after identifying and isolating the microorganisms, Fortún et al. (2006) evaluated 48 cases of CRBSI. Nineteen cases were treated with systemic antibiotic therapy and ALT (experimental group) whereas 29 cases were treated with systemic antibiotic therapy alone (control group). The ALT group had only one case of infection that required catheter removal whereas the control group had seven cases of infection that required catheter removal. Therefore, ALT appears to be a conservative and effective strategy in treating infections, particularly those caused by coagulase-negative staphylococci.

The Cochrane Collaboration systematic review and meta-analysis of ALT using LTCVCs in children with cancer reported that ALT together with systemic antibiotic therapy was recommended. Therefore, LTCVCs should be maintained despite the diagnosis of infections and should not be removed early or replaced to avoid risks to children (Schoot et al., 2013).

LTCVC-related infections occurs within 100 days after catheter placement. In the first 45 days, the infections are often caused by pathogens that colonize the catheter. Systemic antibiotic therapy is recommended for all types of LTCVCs. Catheter removal is indicated in cases of catheter-related infection complications, including severe sepsis, thrombophlebitis, endocarditis, bloodstream infection for more than 72 hours of antimicrobial therapy, or infections with *Staphylococcus aureus* (Schoot et al., 2013).

Among the 22 responding centres in Brazil, 14 used ALT and, of these, 71% used antibiotics alone or in combination. The antimicrobials used were vancomycin (six centres, 43%), gentamicin (two centres, 14%), amikacin (two centres, 14%), ethanol (one centre, 7%). Moreover, three (22%) centres selected the antibiotics on the basis of the infectious agent identified.

Worth et al. (2014) prospectively compared the effectiveness of heparin locks (43 patients) and ethanol locks (42 patients) in preventing infection related to central venous catheter and observed that ethanol locks did not significantly decrease the rate of infections in patients with LTCVCs.

None of the participating centres used a combination containing more than one antibiotic in ALT. However, the results of a comparative study indicated that the association of antibiotics, such as cefazolin and gentamicin, and heparin in ALT might help reduce bacteraemia caused by the use of tunnelled catheters. The rate of catheter-related bacteraemia in the ALT group was significantly lower than that in the control group, which did not use antibiotics (13.1% versus 32.4%, $p=0.0001$). Catheter-related bacteraemia was treated with intravenous antibiotics. The rate of cure in cases of catheter-related bacteraemia was lower in the control group than in the the ALT group (61.4% versus 95%, $p=0.015$). The overall rate of catheter removal was comparatively higher in the control group (79.8% versus 59.2%, $p = 0.002$). Moreover, the rate of catheter removal was higher in the control group (12.32 versus 2.22%, $p=0.0001$) considering catheter-related bacteraemia but was higher in the ALT group (28.26 vs 37.78%, $p=0.0001$) considering mechanical causes (Silva et al., 2013).

Different antibiotics are used in ALT. The efficacy of each antibiotic varies with the microorganism identified in the culture surveillance performed during treatment, regardless of the type of antibiotic used. Culture surveillance was performed in most of evaluated centres. The findings of this study can be used to optimize ALT and encourage nursing professionals to reassess this technique, which can improve care services and patient safety.

5. Conclusion

ALT in central venous catheters was acknowledged by nursing teams from 22 Brazilian HSCT centres registered in the Brazilian Society of Bone Marrow Transplantation. In most of the responding centres, ALT was used to prevent CRBSI. The rate of infection was decreased in eight centres. The antibiotic most commonly used in ALT was vancomycin. The results of this study increased the knowledge about the use of ALT in HSCT centres in Brazil to prevent the early removal of LTCVCs.

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