

Infection, local reaction and poor fixation of dressings for central venous catheter

Infecção, reação local e má fixação de curativos para cateter venoso central

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Keywords

Clinical nursing research; Nursing assessment; Chlorhexidine; Central venous catheterization/nursing; Infection; Bandage

Descritores

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Abstract

Objective: To identify factors related to the occurrence of infection, local reaction and poor fixation of dressings for central venous catheters.

Methods: Randomized clinical trial conducted with adult patients using central venous catheter for short periods, hospitalized in intensive and semi-intensive care units of a university hospital.

Results: 85 patients (43 chlorhexidine dressings; 42 gauze and tape). Use of blood component increases the chance of catheter-related infection; use of dressings for more than three days increases the chance of local reaction; catheter in the jugular vein increases the chance of poor fixation of the dressing. Catheter permanence for more than five days increases the chance of infection, local reaction and poor fixation.

Conclusion: Both dressings are effective to cover central venous catheters and can be used for this purpose.

Resumo

Objetivo: Identificar fatores relacionados à ocorrência de infecção, reação local e má fixação de curativos para cateter venoso central.

Métodos: Ensaio clínico randomizado realizado com pacientes adultos em uso de cateter venoso central de curta permanência, internados em centro de terapia intensiva e semi-intensiva de hospital universitário.

Resultados: 85 pacientes (43 curativo de clorexidina; 42 curativo de gaze e fita). Uso de hemocomponente aumenta a chance de infecção relacionada ao cateter; uso de curativo por mais de três dias aumenta a chance de reação local; uso de cateter em veia jugular aumenta a chance de má fixação do curativo. Tempo de permanência do cateter superior a cinco dias aumenta a chance de infecção, reação local e má fixação.

Conclusão: Ambos os curativos são efetivos para cobertura de cateter venoso central e podem ser utilizados com essa finalidade.

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Introduction

The use of central venous catheters in hospitals represents a breakthrough for clinical practice, being an indispensable tool in patient care, especially for those in critical condition. In these patients, the short-term catheter is the most commonly used, since it is recommended when central access is required for a short period of time (seven to ten days).⁽¹⁾

Despite its widespread use, central catheters expose patients to complications, among which are highlighted primary bloodstream infection, due to high rates of associated morbidity and mortality.^(1,2) This corresponds to the primary bloodstream infection in patients using central venous catheter for a period longer than 48 hours, and whose blood infection is not related to another site.

One way to prevent this complication is by occlusion of the ostium of the central catheter with sterile dressing, for which various technologies are available in the market. The objective of this study was to identify factors related to the occurrence of infection, local reaction and poor fixation of dressings for central venous catheters.

Methods

A randomized clinical trial was developed in the adult intensive and semi-intensive care units of a university hospital in Curitiba, state of Paraná, in southern Brazil. Data were collected between October 2011 and May 2012, during which the number of subjects stipulated in sample size calculation was reached. An instrument was used to record the data, which comprised socio-demographic, clinical and outcome (infection, local reaction and fixation of the dressing) variables, adapted through a pilot test.

Inclusion criteria were: aged 18 years or over; admitted to the adult intensive or semi-intensive care unit; using the first central catheter for less than 24 hours; absence of known sensitivity to materials of dressings. Exclusion criteria were: trichotomy by blade at the catheter insertion site prior to puncture; bleeding from the ostium of the catheter; temperature above 38° C prior to puncture; severe

allergic reaction to the material of the dressing; using hemodialysis or pulmonary artery catheter.

The patients included in the study were randomized using the block randomization technique for the dressings as described: Study group – chlorhexidine antimicrobial; Control group – gauze and microporous tape. The dressings were evaluated daily and patients were monitored to one of the end points: extra-hospital discharge, death, second catheter puncture or device removal.

The collected data were entered into a Microsoft Excel® spreadsheet, and analyzed using the BioStat® software, through descriptive statistics. In the analysis of response variables (infection, reaction site and fixation reaction), the following tests were used: chi-square, Fisher's exact, Williams G and Mann-Whitney U, all of them with significance level of 5%.

The development of the study complied with national and international ethical guidelines for studies involving human beings.

Results

Eighty-five patients were included in the study, of which 43 were included in the chlorhexidine group and 42 in the gauze group. There was no loss in follow-up of the patients included. In both groups, there was a predominance of men (55.81% chlorhexidine; 57.14% gauze), Caucasians (83.72% chlorhexidine; 92.85% gauze), diagnoses related to the digestive system (25.58% chlorhexidine; 38.09% gauze), hospitalization in the intensive care unit (93.02% chlorhexidine; 85.71% gauze), and use of polyurethane catheters (100% in both groups), most of which were double lumen (88.37% chlorhexidine; 88.09% gauze), variables that were not related to the occurrence of infection.

In the sample studied, 13.95% of patients in the chlorhexidine group developed infection, compared with 11.90% in the gauze group. It is noteworthy that there was a significant difference in the chlorhexidine group with respect to the use of blood components, which increases the risk of developing infection by 10.29 times ($p=0.0037$). In the gauze group, it was statistically confirmed that the cath-

eter permanence for more than five days increases the risk of developing infection by eight times ($p=0.0353$). Use of total parenteral nutrition, days of usage of the dressing and number of dressing changes were not significant for the occurrence of infection (Table 1).

The permanence of the dressing differed between the groups surveyed. In the gauze and tape group, the dressings remained for 1.63 ± 0.34 days, whereas in the chlorhexidine group the permanence was 2.39 ± 0.91 days. It is noteworthy that, within the groups, there was no significant difference of this variable between the catheters that developed infection or not.

With respect to the variable local reaction outcome, it was considered a reaction when the patient had at least one of the following signs and symptoms: maceration, redness, peeling or itching in the area of contact between the dressing and the skin. There was a high incidence of local reaction to the

dressings (39.53% chlorhexidine; 45.24% gauze), mostly characterized by redness and maceration of the skin.

In the chlorhexidine group, it was observed that the risk of local reaction is 4.48 times greater in patients who use the dressing for more than three days ($p=0.0003$); and three times greater in those requiring more than two dressing changes ($p=0.0193$) (Table 2). Furthermore, the development of local reactions was significantly greater in patients who had chlorhexidine dressings for longer periods (2.57 ± 1.09 versus 1.96 ± 1.04 days, $p=0.0404$). With regard to the variables: sex ($p=0.2635$); ethnicity ($p=0.5799$); medical diagnosis ($p=0.0734$); and anatomical site of insertion ($p=0.5628$), no significant relation was identified with the variable local reaction.

In patients with gauze and tape dressings, a significant relationship was identified between insertion of the catheter into the subclavian

Table 1. Variables associated with the occurrence of infection in patients using dressings of gauze and tape, and chlorhexidine

Variable	Experimental Group - chlorhexidine					Control Group – gauze and tape				
	Yes n(%)	No n(%)	p-value	RR	CI	Yes n(%)	No n(%)	p-value	RR	CI
Sector										
Clinical	0	1(2.70)	0.3387			0	1(2.70)	0.8980		
Surgical unit	5(83.33)	12(32.43)				1(20)	16(43.24)			
Semi-Intensive care unit	0	5(13.51)				1(20)	6(16.22)			
Intensive care unit	1(16.67)	15(40.54)				2(40)	11(29.73)			
First Aid	0	4(10.81)				1(20)	3(8.11)			
Insertion site										
Jugular vein	1(16.67)	11(29.73)	0.4552	0.52	(0.07; 3.98)	4(80)	14(37.84)	0.4044	0.45	(0.06; 3.67)
Subclavian vein	5(83.33)	26(70.27)		1			23(62.16)		1	
Permanence of central venous catheter (days)										
≤ 5	4(66.67)	26(70.27)	0.5921	1	(0.24; 5.53)	1(20)	27(72.97)	0.0353	1	(0.98; 65.02)
> 5	2(33.33)	11(29.73)		1.15		4(80)	10(27.03)		8.0	
Blood component										
Yes	4(66.67)	3(8.11)	0.0037	10.29	(2.31; 45.72)	0	9(24.32)	0.2790	1	
No	2(33.33)	34(91.89)		1		5(100)	28(75.68)			

RR – relative risk; CI – confidence interval of 95%

Table 2. Variables associated with the occurrence of local reaction in patients using dressings of gauze and tape, and chlorhexidine

Variable	Control group - chlorhexidine					Control group – gauze and tap				
	Yes	No	p-value	RR	CI	Yes	No	p-value	RR	CI
	n(%)	n(%)				n(%)	n(%)			
Insertion site										
Jugular vein	5(29.41)	7(26.92)	0.5628	1.08	(0.48; 2.40)	3(15.79)	12(52.17)	0.0143	3.75	(1.27; 11.10)
Subclavian vein	12(70.59)	19(73.08)		1		16(84.21)	11(47.83)		1	
Number of dressing changes										
≤ 2	13(76.47)	26(100)	0.0193	1	(1.92; 4.68)	10(52.63)	16(69.57)	0.2604	1	(0.76; 2.80)
> 2	4(23.53)	0		3.0		9(47.37)	7(30.43)		1.46	
Days of dressing use										
≤ 3	5(29.41)	23(88.46)	0.0003	1	(1.95; 10.31)	8(42.11)	16(69.57)	0.0735	1	(0.93; 3.6)
> 3	12(70.59)	3(11.54)		4.48		11(57.89)	7(30.43)		1.83	

RR – relative risk; CI – confidence interval of 95%

vein and increased risk of developing local reaction by 3.75 times, when compared to insertion into the jugular vein ($p=0.0143$) (Table 2). Sex ($p=0.5888$), ethnicity ($p=0.5730$), medical diagnosis ($p=0.5609$) and days of use of the dressing ($p=0.0735$) were not significant for the occurrence of local reaction.

Furthermore, when all cases of local reaction were considered, regardless of the type of dressing used, it was shown that catheters with permanence exceeding five days are 4.44 times more likely to develop a local reaction ($p=0.0042$).

In both groups surveyed, there was good fixation of the dressing (83.72% chlorhexidine; gauze 90.48%; $p=0.2739$). It is noteworthy that for the gauze group, all cases of poor fixation were identified in the catheters inserted via the jugular vein ($p=0.0035$). With respect to the chlorhexidine dressing, more than two changes were found to increase the risk of developing poor fixation by 9.75 times ($p=0.0061$). The variables sex, ethnicity and medical diagnosis had no significant relation with the occurrence of poor fixation in both groups.

When considering all cases of poor fixation, regardless the type of dressing used, the catheter permanence for more than five days increases the risk of poor fixation of the dressing by 5.73 times ($p=0.0036$).

Discussion

Catheter-associated infection is a complication with significant effect on the morbidity and mortality of individuals using central catheters. Thus, the unremitting efforts to promote evidence-based care to prevent infection are justified. The low rates of infection in the surveyed units, due to the massive adoption of preventive measures, are noteworthy. Moreover, the constant monitoring of patients is an important factor in the early removal of the device and identification of complications as early as possible, a positive factor for the patients, however limited the expected results.

The evidence presented by this study contribute to formulate strategies for the prevention of complications arising from the use of central catheters by nurses, since they are responsible for assessing and changing the dressings, as well as for the choice of technology to be used to cover the ostium of the catheter.

The technologies studied here are safe options for occlusion of the catheter ostium, a fact demonstrated by the low incidence of infection in both groups studied. Cases of infection occurred predominantly in male patients (63.64%), which is corroborated by another study whose results showed that 54% of the diagnoses of catheter-associated infection occurred in men.⁽³⁾ Nevertheless, in this study, the

variable sex was not identified as a significant variable for the occurrence of infection ($p=0.4301$).

The site of catheter insertion was not a determining factor for the occurrence of infection in this study ($p=0.2519$). Nevertheless, studies with strong scientific evidence reinforce the preference for the subclavian vein for insertion of short-term catheter in adults, so as to reduce the risk of infection associated with this device.⁽²⁾

Regarding the number of lumens, there was a predominance of dual lumen catheters in both groups surveyed, a factor that was not related to the occurrence of infection ($p=0.6181$). Nevertheless, there is evidence suggesting that the greater the number of lumens of the catheter, the greater the risk of infection.⁽⁴⁾

In the gauze and tape group, there was statistical proof that the permanence of the catheter for more than five days increased the risk of developing infection by eight times. One study reinforces this finding by indicating, with statistical significance, that the catheter permanence for more than five days increases the risk of developing infection by 15.97 times.⁽⁵⁾

Other statistical proof concerns the relation between the use of blood components and the occurrence of infection. This variable showed a significant relation with the occurrence of infection in the group that used chlorhexidine dressings ($p=0.0037$), yet it is suggested that this relation must be further investigated, as there are no reports on this in literature.

The dressings analyzed in this study frequently developed local reactions (39.53% chlorhexidine, gauze 45.24%). There was statistical evidence that gauze dressings are associated with a higher risk of local reaction when applied to the subclavian region ($p=0.0143$), which may be related to the presence of thin and sensitive skin in this region compared to the jugular region, due to less exposure to friction and sunlight, factors which contribute to increase skin thickness.

In this study, it was shown that the permanence time longer than five days increases the chances of occurrence of local reaction. This confirms that the longer the catheter permanence time, the longer

the permanence time of the dressing on the skin, a fact that is also associated with increased chance of local reaction. The relation between the permanence time of the dressing and the occurrence of local reaction is explained by the patients using chlorhexidine dressing, because in this group, the permanence time of the dressing on the patients who developed reactions were significantly longer (2.57 ± 1.09) than on those who did not develop this complication (1.96 ± 1.04 , $p = 0.0404$).

Other important variables in this context relate to the days of use and number of changes of the dressing. The chance of developing local reaction increases by 6.9 times when the dressing is used for more than three days ($p=0.0001$), and by 3.47 times when the number of dressing changes is greater than two ($p=0.0327$). This relationship between the variables days of use and number of changes of the dressing, and the outcome local reaction, is explained by the patients using chlorhexidine dressings. In these patients, the number of dressing changes greater than two ($p=0.0193$), and use of the dressing for more than three days ($p=0.0003$), were significant for the occurrence of local reaction.

The dressing aims to occlude the catheter ostium and prevent its colonization by microorganisms. For this purpose, the dressing needs to remain firmly attached to the patient's skin, preventing the catheter ostium from contact with ambient air. It is noteworthy that in both groups surveyed, there was good fixation of the dressing (83.72% chlorhexidine; 90.48% gauze), with no statistical difference ($p=0.2739$). Considering the cases of poor fixation, there was statistical evidence that poor fixation is related to the permanence of the catheter for more than five days (increasing the risk of poor fixation by 7.12 times – $p=0.0036$). Furthermore, in the chlorhexidine group, more than two dressing changes increased the chance of poor fixation ($p=0.0061$). These variables may be related to the catheter permanence time, since the longer the patient remains with the catheter *in situ*, the more dressing changes are required.

Moreover, in the gauze group those with catheters inserted via the jugular vein were 7.12 times more prone to the occurrence of poor fixation of

the dressing ($p=0.0036$). This relation may be associated with the fact that this is an area of great mobilization, with the presence of skin folds that hinder the correct fixation of the dressing.

In both groups, there was a difference with respect to the permanence time of the dressing. In the gauze group, the dressing remained for 1.63 ± 0.34 days, slightly lower than that stipulated by clinical protocol. For the chlorhexidine group, the permanence time of the dressing was well below that stipulated, averaging 2.39 ± 0.91 days. The expected permanence time was seven days, however, it is noteworthy that in most patients, the increase in the number of dressing changes due to poor fixation, as well as the catheter permanence for less than five days, may have contributed to this finding.

Conclusion

A significant association was evidenced between: catheter permanence time greater than five days, blood component infusion and the occurrence of primary bloodstream infection; catheter permanence time greater than five days, and permanence time, days of use and number of changes of the dressing, as well as the insertion site and occurrence of local reaction; and permanence time of the dressing, number of dressing changes, insertion site and permanence time of the catheter, and the occurrence of poor fixation.

Collaborations

Pedrolo E and Oliveira GLR contributed to the project design, analysis and interpretation of data, research execution, drafting of the article and final approval of the version to be published. Danski MTR collaborated with the project design, analysis and interpretation of data, critical review of the relevant intellectual content and final approval of the version to be published. Vayego AS participated in the analysis and interpretation of data, critical review of the relevant intellectual content, and final approval of the version to be published. Boostel R contributed to the analysis and interpretation of data, study execution, drafting of the article and final approval of the version to be published.

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