NEPHROLOGY

Nephrology **23** (2018) 863–866

Original Article

Disinfection of the peritoneal dialysis bag medication port: Comparison of disinfectant agent and disinfection time

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KEY WORDS:
antisepsis, chronic renal failure, disinfection, nursing, peritoneal dialysis.

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Accepted for publication 26 June 2017.
Accepted manuscript online 13 July 2017.

doi: 10.1111/nep.13101

SUMMARY AT A GLANCE

This is an in vitro study looking at the effectiveness of the types and duration of application of disinfectants in eliminating several micro-organisms at the medication port of peritoneal dialysis bags. The authors found that disinfecting with 2% chlorhexidine for at least 5 s was effective.

ABSTRACT:

Aim: **The aim of the present study was to compare different disinfection techniques for the peritoneal dialysis bag medication port (MP).**
Methods: **An experimental study was conducted testing different cleaning agents (70% alcohol vs 2% chlorhexidine) and time periods (5, 10 and 60 s) for disinfection of the MP. Five microorganisms (*S. aureus, E. coli, A. baumannii and C. parapsilosis,* CNS) were prepared for use as contaminants of the MP. MP were incubated in Tryptic soy broth at 36°C for 24 h, after which, they were seeded on a Biomérieux blood agar plate and incubated for 24 h at 36°C.**
Results: **Three hundred peritoneal dialysis bags were analyzed regarding the time expose to the disinfectant showed a statistically significant difference in the number of culture positive (7/100) $P = 0.001$; Gram positive (6/100) $P = 0.006$ for 5 s, one positive culture and turbid bag with 10 s, while friction for 60 s showed all negative results. The comparison between disinfectant, alcohol or chlorhexidine, 150 bag in each group, showed that the ones disinfected with alcohol had five turbid bags, eight positive cultures and seven germs identified, while all bags disinfected with chlorhexidine were negative for all parameters, with a difference statistically significant ($P = 0.004$).**
Conclusion: **Our results suggest that the MP should be scrubbed with 2% chlorhexidine for at least 5 s; if alcohol 70% is used the length of friction should not be inferior to 10 s.**

Peritonitis continues to be the most common cause of catheter withdrawal, patient transfer to haemodialysis and antibiotic use, usually occurring due to inadequate technique during bag exchange or catheter connection.[1,2] There is no specific pattern for the distribution of peritonitis microorganisms around the world.[3–6]

Clinical signs and symptoms of peritonitis are well known; a positive dialysate culture will guide management and its treatment consists of the intraperitoneal (IP) administration of antibiotics.[5] Also there is the risk of catheter obstruction due to formation of fibrin clots in the peritoneal fluid, requiring IP heparin use in the dialysate solution.[7–9] The dialysis bag, which is sterile and protected by an outer packaging, has a medication port (MP) that is used to administer antibiotics and other medications, made of latex, which must be cleaned before use. Recommendations regarding the cleaning process for the MP, 5 min cleaning with 70% alcohol, povidone iodine-alcohol or chlorhexidine-alcohol, date back to the 1980s, when the dialysis system was not disposable.[10,11] Nowadays, it is common sense among nurses and other health professionals to follow the same recommendations used for intravenous medication ports[12,13] before use. Nevertheless, there is no publication validating the procedure for MP of peritoneal dialysis bags, and 5 min is a long interval that is difficult to adhere to.

Therefore, the objective of this study was to compare the disinfection technique for the peritoneal dialysis bag MP in relation to the disinfectant type used and the length of time friction was applied.

MATERIALS AND METHODS

An experimental study was conducted testing different cleaning agents (70% alcohol vs 2% chlorhexidine) and time periods (5, 10 and 60 s) for disinfection of the MP using 300 MPs of sterile peritoneal dialysis bags, divided into five groups, with each group being contaminated with a different germ *Staphylococcus aureus* (*S. aureus* ATCC 29213), *Escherichia coli* (*E. coli*), *Acinetobacter baumanni* (*A. baumanni*), and *Candida parapsilosis* (*C. parapsilosis*) Coagulase negative Staphylococcus (CNS) and subsequently seeded in blood agar. Each group had 60 MP, where half was disinfected with 70% alcohol and half with 2% chlorhexidine. Regarding the exposure time, the groups were further divided into three; 10 MP for each time period (5,10 and 60 s). The primary aim of the study was to evaluate the duration of friction to avoid contamination of MPs of sterile peritoneal dialysis bags.

The germs were obtained from the microbiology sector of the Laboratory of Clinical Pathology. A 3 mL sterile saline solution was dispensed in a test tube. A 1 μL-calibrated loop was touched in an *S. aureus* colony and inoculated in the saline solution. The solution was then shaken in a tube agitator and its turbidity measured to a McFarland 0.5 standard. The process was repeated in the same manner for each different germ. The solution containing the germ to be used was transferred to a Petri dish.

The following steps were performed for contaminating the MP: the workbench was cleaned with 70% alcohol; external dialysis bag packaging was cleaned with 70% alcohol and placed on the workbench; hands were cleaned with alcohol gel; followed by the use of sterile gloves, the procedure was repeated for each bag before removing it from the external packaging; the bag was held and the MP dipped in the Petri dish with the suspension containing the germ. It was then submitted to the cleaning technique with sterile gauze, in accordance with the cleaning product and time protocol; the MP was held with forceps and cut using sterile scissors; after cleaning, each MP was placed in a glass tube containing Tryptic Soy Broth (TSB) and incubated in an oven at 36°C for 24 h. It was then seeded by depletion on a Biomérieux blood agar plate. This plate was incubated for 24 h in an oven at 36°C. It was examined after 24 h to check for any growth. Plates without growth after 48 h were considered negative. Plates with a positive result after 24 or 48 h were analyzed through identification tests, in accordance with the protocol of the microbiology laboratory.

Four peritoneal dialysis bags were used for the positive control group, in which the MP was placed in the Petri dish suspension containing the germ and then placed in a glass tube with TSB, with the same procedure performed as previously described.

Descriptive statistics with absolute and relative distribution (*n* - %) were used, and Fisher's exact test was for comparisons. Data were analyzed using the Windows software *Statistical Package for Social Sciences*, version 20.0 (SPSS Inc., Chicago, IL, USA, 2008). The statistical level of significance was set at 5%.

RESULTS

The results of the 300 bags of dialysate analyzed are presented in Table 1. A statistically significant difference ($P = 0.001$) was found between 5 s of friction with alcohol and other groups, with seven (14%) positive cultures. Besides, there were six (12%) Gram-positive cultures when friction for only 5 s was used, a statistically significant difference (0.006) compared with other groups.

Table 2 presents the data stratified according to disinfectant alcohol or chlorhexidine, and a statistically significant difference favouring Chlorhexidine ($P = 0.004$) with all results negatives for the different times of exposure.

In Table 3 are presented the distribution of the three microorganisms that had positive results when disinfected with alcohol 70% in the different times. When comparing microorganism, CNS had a statistically significant difference

Table 1 Triptyc Soy Broth (TSB), Culture and Gram absolute and relative distribution according to time and disinfectant

Time (s) Evaluations	Alcohol (*n* = 150)			Chlorhexidine (*n* = 150)			p€
	5 (*n* = 50) *n*	10 (*n* = 50) *n*	60 (*n* = 50) *n*	5 (*n* = 50) *n*	10 (*n* = 50) *n*	60 (*n* = 50) *n*	
TSB							0.12
Not Turbid	45	50	50	50	50	50	—
Turbid	5	—	—	—	—	—	—
Culture							0.001
Negative	43	49	50	50	50	50	—
Positive	7	1	—	—	—	—	—
Gram-stain							0.006
Absent	44	49	50	50	50	50	—
Gram negative	—	1	—	—	—	—	—
Gram positive	6	—	—	—	—	—	—

€, Fisher's exact test; TSB, Tryptic Soy Broth.

Table 2 Tryptic Soy Broth, Culture and Gram absolute and relative distribution stratified by disinfectant agent

Evaluations	Disinfectant				
	Alcohol (n = 150)		Chlorhexidine (n = 150)		p€
	n	%	n	%	
TSB					
Not turbid	145	96.6	150	100.0	0.30
Turbid	5	3.4	—	—	—
Culture					
Negative	142	94.6	150	100.0	0.004
Positive	8	5.4	—	—	—
Gram-stain					
Absent	143	95.3	150	100.0	0.15
Gram negative	1	0.7	—	—	—
Gram positive coccus	6	4.0	—	—	—

€, Fisher's exact test; TSB, Tryptic Soy Broth.

for positivity at 5 s with *P*-values of 0.01; 0.005; 0.01 for TSB, culture, and Gram stain, respectively.

DISCUSSION

Scrubbing with chlorhexidine for 5 s was effective against the different germs tested. Chlorhexidene has been previously reported as effective with 15 s by Kaler *et al.*[14] On the other hand Ruschman and Fulton disclosed that a minute of alcohol 70% or povidone iodine were applicable for eliminating bacteria growth in the latex tubing of intravenous devices.[12]

Bailie *et al.*,[10] based on a lack of standardization, recommended the use of 30 s of friction as 5 min was considered a lengthy and demanding technique, although they did not specify the disinfectant product used. However, in 1992 Holmes *et al.*[11] questioned this suggestion due to their concern about the possibility of peritonitis caused by *Mycobacteria chelonea (M. chelonea)*. This concern was based on a previous study conducted by Carson *et al.*[15] involving the cleaning procedures of hospital material, in which *M. chelonea* showed to be more resistant and was only eliminated with the use of povidone iodine for 5 min. Since then, no further studies related to this topic have been performed and the 5 min practice has continued to be recommended as a result. The occurrence of peritonitis by *M. chelonea* is rare, and when present it is difficult to resolve. A recent scientific literature review of peritonitis caused by this germ revealed the occurrence of only 10 cases in the English literature.[16]

There is currently a gap in the knowledge related to the MP cleaning process, which perpetuates the recommendation for 5 min cleaning by friction, although not always followed by staff, either with alcohol or povidone iodine. Nonetheless, there are several studies regarding the cleaning of intravenous medication entrance ports that demonstrate both alcohol and chlorhexidine to be effective for disinfection involving friction.[13,14] A similar study with disinfection of needleless catheter connectors and access ports with alcohol found that after cleaning 20 (67%) showed transmission of microorganisms.[17]

There is no evidence to link contamination through the MP with the development of peritonitis, however, there is a need to perform this disinfection, since contamination may happen following handling. Other than antibiotics,[18] the most commonly used intraperitoneal medications are heparin[7] and insulin,[19] however, reports linking the association between peritonitis and MP manipulation are contradictory. Selgas *et al.*[20] reported the occurrence of 4 times more

Table 3 Tryptic Soy Broth (TSB), Culture and Gram absolute distribution according to germ type and 70% alcohol

Evaluations	*Staphylococcus aureus* (n = 30)			*E. coli* (n = 30)			CNS (n = 30)		
	Time (s)								
	5	10	60	5	10	60	5	10	60
	n = 10	n = 10	n = 10	n = 10	n = 10	n = 10	n = 10	n = 10	n = 10
TSB									
Not turbid	9	10	10	10	10	10	4	10	10
Turbid	1	—	—	—	—	—	6	—	—
Culture									
Negative	9	10	10	10	9	10	5	10	10
Positive	1	—	—	—	1	—	5	—	—
Gram-stain									
Absent	9	10	10	10	—	10	5	10	10
Gram negative	—	—	—	—	—	—	—	—	—
Gram positive	1	—	—	—	—	—	5	—	—
Identification									
Absent	—	10	10	10	9	10	5	10	10
Gram negative	—	—	—	—	1	—	—	—	—
Gram positive	1	—	—	—	—	—	5	—	—

CNS, Coagulase negative *Staphylococcus*; TSB, Tryptic Soy Broth. No positive culture was detected for *Acinetobacter baumanni* or *Candida parapsilosis*.

peritonitis cases in patients receiving intraperitoneal (IP) insulin, while Quellohorst[21] when analyzing the pros and cons of IP insulin found no significant difference in the number of patients with peritonitis who underwent peritoneal dialysis and received subcutaneous or IP insulin.

It is time to revise our procedure and practice according to evidence, lengthy time spent in the technique of transfer set change was revisited by Firanek *et al*.[22] their results suggested the cleaning stage of submersion for 5 min in povidone iodine could be eliminated, as it is a lengthy procedure and presents no benefit in the reduction of contaminants, the same consideration should be given to cleaning the MP.

The main limitation of this study is perhaps the small number of germs tested. Nonetheless, the findings obtained indicate the importance of the cleaning procedure, despite the dialysate bag being removed in a sterile state from the packaging, as the handling process can increase the risk of contamination.

Our results suggest that in cases where the MP is used for medication administration, the cleaning procedure should be performed through friction using 2% chlorhexidine for at least 5 s; if 70% alcohol is used the length of friction should not be inferior to 10 s.

DISCLOSURE

All authors report no conflicts of interest relevant to this article.

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