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Brief report

Stickers used for identification of intravenous lines may be a source of contamination

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This study assessed in an in vitro model the effect of 2% alcohol clorhexidine for the disinfection of stickers used for intravenous line identification. Nonadhesive sticker sides were associated with higher numbers of colony-forming units when manipulation was performed without 2% alcohol clorhexidine disinfection. Future clinical studies are needed to validate these data and design policies for daily sticker disinfection.

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The World Health Organization (WHO) recommends identifying venous and arterial vascular access owing to serious errors that have occurred from mix-ups of venous and arterial lines.[1-7] For this reason, the use of colored plastic stickers attached to intravenous (IV) lines for proper line identification has been implemented in many institutions. However, in a recent in vitro study, our group demonstrated that the surfaces of these stickers were routinely colonized after 3-5 days of handling, and that the stickers could be a potential source of catheter colonization.[8] Thus, the need for firm recommendations from the WHO regarding a policy for decontaminating IV line stickers merits careful assessment.

In the present study, we used an in vitro model to assess the effect on microbial contamination of IV line stickers of disinfection with 2% alcohol chlorhexidine compared with no disinfection.

METHODS

This in vitro study was carried out in the laboratory of the Clinical Microbiology and Infectious Disease Department and in the Cardiac Surgery Postoperative Care Unit of Hospital General Universitario Gregorio Marañón. The study was approved by our local Ethics Committee.

The model consisted of a set of 60 stickers placed in a sterile surface in the Cardiac Surgery Postoperative Care Unit (simulating the patient care environment) and then exposed to 3 different contamination levels for up to 15 days while performing daily disinfection with 2% alcohol chlorhexidine, after (model 1; M1) or before (model 2; M2) obtaining surface cultures, or not performing disinfection. The 3 contamination levels were low: (stickers exposed only to air without handling as controls), medium (stickers exposed to manipulation by handling with clean gloves), and high (stickers exposed to manipulation by handling without gloves). Twice daily, a single manipulator (always the same person) vigorously touched (for 2 seconds) all surfaces of the stickers in the medium and high models. At 24 hours after this manipulation, surface cultures were obtained from all stickers using cotton swabs. The sticker surface cultures were immediately processed at the microbiology laboratory. The microorganisms recovered from the sticker surface cultures were counted and identified by phenotypic characteristics. Before the sticker surface manipulations in the medium and high models, daily base counts and phenotypic

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Table 1
Comparison of the time to first positive culture and number of cfu in the 3 models and between the sticker sides

Variable	Model						*P* value
	No disinfection		M1*		M2†		
Time to positivity, d, median (IQR)	5.0 (3.0-8.2)		4.5 (3.0-8.0)		4.5 (1.7-9.0)		.82
	NA side	3.0 (3.0-5.0)	NA side	5.0 (4.0-8.0)	NA side	3.0 (0.0-7.0)	.23
	A side	8.0 (3.0-10.0)	A side	4.0 (2.0-7.0)	A side	5.0 (3.0-11.0)	.38
Number of cfu, median (IQR)	15.0 (5.5-44.0)		4.5 (2.0-10.2)		2.5 (1.0-6.0)		<.001
	NA side	23.0 (15.0-130.0)	NA side	3.0 (1.0-11.0)	NA side	3.0 (0.0-6.0)	<.001
	A side	6.0 (3.0-16.0)	A side	5.0 (3.0-9.0)	A side	2.0 (1.0-6.0)	.06

A, adhesive; *NA*, nonadhesive.
*2% alcohol chlorhexidine disinfection after obtaining surface cultures.
†2% alcohol chlorhexidine disinfection before obtaining surface cultures.

identification of the microorganisms colonizing the manipulator's hands were performed during the study period.

We tested disinfection before and after obtaining cultures to evaluate whether the culture results were similar when disinfection was performed before sampling and after sampling. We tested only 2% alcohol chlorhexidine because this is the disinfectant used in our hospital. In addition, the tinting of 2% alcohol chlorhexidine helped us ensure that all stickers were properly disinfected on all surfaces.

We established 15 days as a reasonable period for testing our model, based on a previous study in which we demonstrated colonization of stickers for up to 5 days of use.[8] We tested each model 5 times and recorded the median value of the 5 experiments, to ensure similar disinfection in the models.

Statistical analysis

Nonnormally distributed continuous variables were compared using the Mann-Whitney *U* test and are expressed as median and interquartile range (IQR). Factors influencing survival were estimated by Kaplan-Meier survival analysis, and the distribution of survival in groups was compared using the log-rank test. In all analyses, a 2-sided *P* value $<.05$ was considered to indicate statistical significance. The statistical analysis was performed with SPSS 18.0 (SPSS, Chicago, IL).

RESULTS

Overall, most experimental models tended to have positive superficial cultures at the end of the study period. Tables 1 and 2 compares the 3 models in terms of time to the first positive culture and number of colony-forming units (cfu). Regarding time to the first positive culture, the median time to colonization of the sticker surfaces was similar in all models: M1, 4.5 days (IQR, 3.0-8.0 days); M2, 4.5 days (IQR, 1.7-9.0 days); no disinfection, 5.0 days (IQR, 3.0-8.2 days) ($P = .82$). However, there were statistically significant differences among the models in the median cfu count: M1, 4.5 (IQR, 2.0-10.2); M2, 2.5 (IQR, 1.0-6.0); no disinfection, 15.0 (IQR, 5.5-44.0) ($P < .001$). Moreover, in the analysis based on sticker side, the nonadhesive side in the no disinfection model was associated with higher cfu counts compared with that in the 2% alcohol chlorhexidine disinfection groups: M1, 3.0 (IQR, 1.0-11.0); M2, 3.0 (IQR, 0.0-6.0); no disinfection, 23.0 (IQR, 15.0-130.0) ($P < .001$) (Table 1).

Similar results were found when we compared the 3 groups in terms of level of contamination. The median numbers of cfu in the low, medium, and high models were as follows: M1: 3.0 (IQR, 1.7-5.0), 3.5 (IQR, 1.0-5.2), and 11.5 (IQR, 8.7-13.2); M2: 1.5 (IQR, 0.0-3.0), 4.5 (IQR, 1.7-7.2), and 2.5 (IQR, 1.5-8.2); no disinfection: 18.0 (IQR, 3.7-27.5), 7.0 (IQR, 3.5-13.0), and 104.0 (IQR, 13.5-136.5) (Table 2).

Table 2
Comparison of level of contamination in terms of time to first positive culture and number of cfu in the 3 models

Variable	Model			*P* value
	No disinfection	M1*	M2†	
Time to positivity, d, median (IQR)				
Low‡	5.0 (3.0-10.0)	6.5 (3.7-11.0)	2.5 (0.0-13.0)	.35
Medium§	5.5 (2.7-10.0)	4.5 (1.0-6.7)	4.5 (3.0-10.2)	.85
High¶	4.0 (3.0-7.2)	3.5 (2.0-6.2)	6.0 (2.2-7.0)	.66
Number of cfu, median (IQR)				
Low‡	18.0 (3.7-27.5)	3.0 (1.7-5.0)	1.5 (0.0-3.0)	<.001
Medium§	7.0 (3.5-13.0)	3.5 (1.0-5.2)	4.5 (1.7-7.2)	.11
High¶	104 (13.5-136.5)	11.5 (8.7-13.2)	2.3 (1.5-8.2)	<.001

*2% alcohol clorhexidine disinfection after obtaining surface cultures.
†2% alcohol clorhexidine disinfection before obtaining surface cultures.
‡Air exposure without manipulation.
§Manipulation with gloves.
¶Manipulation with hands.

The cfu counts of microorganisms recovered in the surface cultures of the stickers are presented in Table 3. All isolated microorganisms except fungi were the same as those recovered in the manipulators' hand microbiota.

DISCUSSION

The data from our in vitro study suggests that stickers used for IV line identification should be decolonized daily using 2% alcohol chlorhexidine, which was demonstrated to significantly reduce microorganism colonization.

Several medication errors owing to mixups of arterial and venous IV lines with severe consequences for patients have been reported.[1-4,9] To solve these problems, the WHO has recommended differentiating arterial and venous IV lines using such strategies as affixing colored plastic stickers to the lines.[5-7]

It has been demonstrated that colonization of hubs or skin surrounding the catheter exit site is the most common source of catheter tip colonization and catheter-related bloodstream infections.[10-13] For this reason, guidelines for the prevention of catheter-related bloodstream infections usually include periodic decontamination of the skin surrounding the catheter insertion site, as well as surfaces of the hub connectors.[14] Other surfaces close to the catheter insertion site should be carefully considered as potential sources of colonization and infection. In a recent study, our group demonstrated in an in vitro model that the surfaces of the stickers used for IV line identification were colonized after 3-5 days of handling and suggested that future studies should clarify the need for sticker decontamination and/or replacement.[8]

In the present study, we tested various sources of contamination to assess whether sticker contamination was produced by

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