American Journal of Infection Control 42 (2014) 1161-4

Contents lists available at ScienceDirect

American Journal of Infection Control

journal homepage: www.ajicjournal.org

Major article

Colonization of stickers used for the identification of intravenous lines: Results from an in vitro study

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Key Words:
Microbial colonization
Stickers
In vitro contamination
Microbial reservoir
Central venous catheters
Intravenous lines
Intravenous therapy

Background: Clear differentiation of arterial and intravenous (IV) lines is a safety strategy recommended by the World Health Organization, and signaling stickers attached to IV lines are implemented in many institutions. However, the risk of colonization of the stickers' surface has not been evaluated. Our objective was to assess the colonization rate of stickers used for IV lines identification in an in vitro model using 3 different contamination degrees.

Methods: A set of 30 stickers used for IV lines identification were exposed to low, medium, and high contamination degrees for up to 15 days. Twice a day, a single manipulator vigorously touched the surface of the stickers simulating the daily handling. Surface cultures of all stickers were performed daily. The microorganisms recovered were counted and identified by phenotypic characteristics.

Results: Colonization occurred after 5 days in low and medium manipulation models and after 3 days in the high manipulation model. Nonadhesive sticker sides were associated with greater significant numbers of colony forming units when manipulation was performed without gloves.

Conclusion: Stickers used for the identification of IV lines may become potential reservoirs of catheter colonization. Clinical studies to validate these data and design policies of stickers' changes are required.

Severe errors because of mix-up venous and arterial lines have prompted the World Health Organization (WHO) to recommend differentiating venous and arterial vascular access.[1-6] Color paper or plastic stickers attached to intravenous (IV) lines are implemented in many institutions, and they are usually located close to the portal of entry of the catheters. However, the risk of colonization on the surface of those stickers as a potential source for catheter colonization has, to the best of our knowledge, not been assessed. Moreover, the WHO does not give recommendations regarding a policy of change or decontamination of those stickers, but it is well-known that bacteria and fungi may adhere to inert surfaces acting as reservoirs for infection.[7-11]

Our study consisted of an in vitro model to assess the colonization rate of stickers used for IV lines identification as a first step to evaluate convenience of substitution or decontamination.

MATERIALS AND METHODS

Setting

This in vitro study has being carried out in the Laboratory of the Clinical Microbiology and Infectious Disease Department and the Cardiac Surgery Postoperative Care Unit at the Hospital General Universitario Gregorio Marañón.

Study design

The model consisted of a set of 30 stickers placed on a sterile surface in the Cardiac Surgery Postoperative Care Unit (simulating the environment of patient care), which were exposed to 3 different contamination procedures: low contamination, which was performed on 10 stickers (5 with the adhesive side up, 5 with the

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Financial support: M. Guembe was supported by the Fondo de Investigación Sanitaria (grant no. CP13/00268).
Conflict of interest: None to report.

http://dx.doi.org/10.1016/j.ajic.2014.07.023

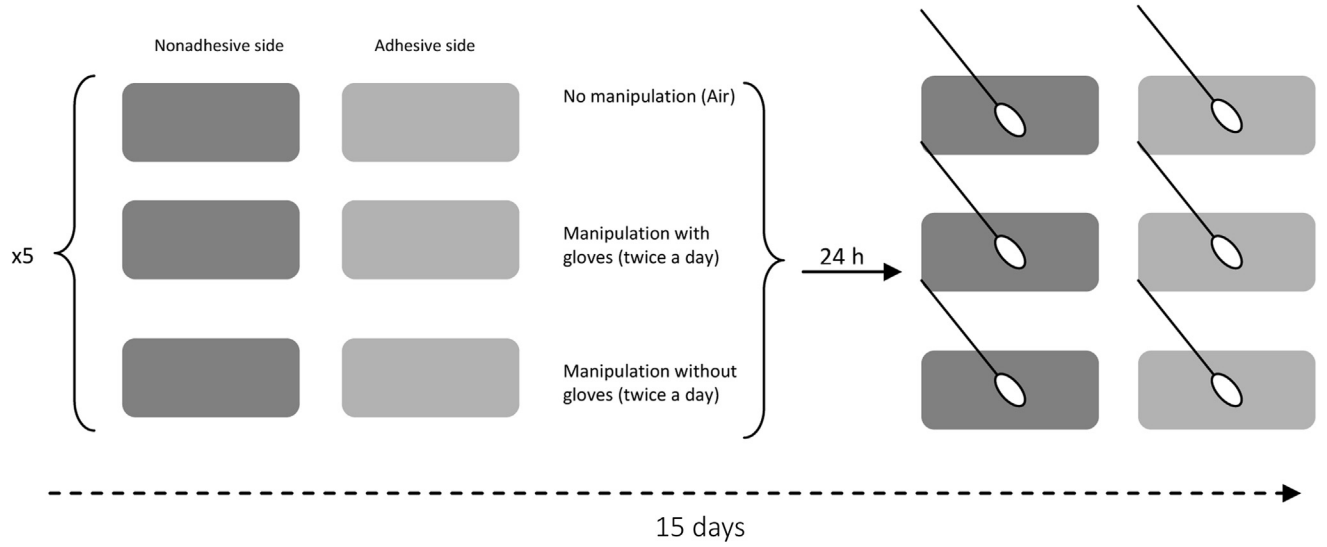

Fig 1. Experimental model.

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

Variable	Model						*P* value
	Low*		Medium†		High‡		
Median time to positivity (IQR), days	5.0 (3.0-10.0)		5.5 (2.7-10.0)		4.0 (3.0-7.2)		.70
	NA side	A side	NA side	A side	NA side	A side	
	5.0 (3.0-5-0)	10.0 (3.5-11.5)	5.0 (3.0-7.0)	10.0 (2.0-11.0)	3.0 (2.5-4.5)	7.0 (4.0-8.5)	.32
Median number of cfu (IQR)	18.0 (3.7-27.5)		7.0 (3.5-13.0)		104.0 (13.5-136.5)		.01
	NA side	A side	NA side	A side	NA side	A side	
	23.0 (18.0-38.0)	4.0 (2.5-23.5)	12.0 (5.5-16.0)	6.0 (1.5-8.5)	136.0 (83.0-140.0)	16.0 (5.0-104.0)	.004

A, adhesive; *cfu*, colony forming units; *IQR*, interquartile range; *NA*, nonadhesive.
*Air exposure with no manipulation.
†Manipulation with gloves.
‡Manipulation without gloves.

nonadhesive side up) exposed only to air and with no handling; medium contamination, which was performed on 10 stickers (5 with the adhesive side up, 5 with the nonadhesive side up) exposed to handling with clean gloves; and high contamination, which was performed on 10 stickers (5 with the adhesive side up, 5 with the nonadhesive side up) exposed to handling without gloves (Fig 1).

Laboratory procedure

Twice a day, a single manipulator vigorously touched the surface of the stickers belonging to medium and high models, and surface cultures of all stickers were performed daily using cotton swabs. The experiment was followed for up to 15 days. Stickers' surface cultures were immediately processed at the microbiology laboratory by streaking the entire surface on an agar plate supplemented with 5% sheep's blood. All cultures were incubated for 48 hours at 37°C under aerobic conditions. The microorganisms recovered from stickers' surface cultures were counted and identified by phenotypic characteristics.

Before touching the surface of the stickers in medium and high models, a base count and phenotypic identification of the manipulator hands' colonizing microorganisms was performed daily during the study period.

The use of clean gloves in the medium model was determined because the guidelines for the prevention of catheter-related infections recommend the use of either clean or sterile gloves while manipulating IV lines.[12]

The different study variables were annotated in a data collection form.

Statistical analysis

Nonnormally distributed continuous variables were compared using the Mann-Whitney *U* test and expressed as median and interquartile range.

Factors influencing survival were estimated by Kaplan-Meier survival analysis, and the log-rank test was used to compare the distribution of survival between groups. In all analyses, a 2-sided *P* value $<.05$ was considered to be statistically significant. Statistical analysis was performed with SPSS version 18.0 (SPSS Inc, Chicago, IL).

RESULTS

Overall, all experimental models ended up having positive superficial cultures at the end of the study period. Table 1 summarizes the time to the appearance of colonization (number of colony forming units [cfu] per plate). The time to colonization was shorter for high manipulation models ($\geq$3 days) but longer for low and medium manipulation models ($\geq$5 days). Moreover, high manipulation models performed in the nonadhesive side of the stickers recovered significantly greater numbers of cfu compared with the rest of the experiments.

The number of cfu of microorganisms recovered in the surface cultures of the stickers had the following distribution: coagulase-