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Extension Lines of Antimicrobial Central Venous Catheters: An In-Vitro Comparative Assessment of Antimicrobial Activity.

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Extension Lines of Antimicrobial Central Venous Catheters: An In-Vitro Comparative Assessment of Antimicrobial Activity.

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INTRODUCTION:

The role of catheter extension line hubs as portals of entry and colonization by microorganisms is widely accepted (1). Various clinical studies indicate that the longer catheters are in place the more likely they are to become contaminated luminally (2). Microorganisms can contaminate the catheter hub (and lumen) at the time of catheter insertion over a percutaneous guidewire, or during later catheter manipulation (3). The catheter hub represents a transition point from the relatively aseptic lumen of the extension line and catheter to the relatively uncontrolled non-aseptic environment of the patient's skin, healthcare workers' hands, and non-sterile environmental air and surfaces. Contaminated catheter hubs lead to microbial adherence and biofilm formation in lumens of extension lines and catheters, which is a significant pathogenic route for catheter related bloodstream infection (CRBSI). Hub-related bacteremias with negative catheter-tip cultures have been reported (4). Antimicrobial catheters include those treated with chlorhexidine/silver sulfadiazine (CSS), minocycline/rifampin (MR), and silver/carbon/platinum (SCP). The purpose of this study was to evaluate microbial adherence to inner lumens of antimicrobial catheter extension lines.

MATERIALS AND METHODS:

CATHETERS

All test extension lines utilized in this study were obtained from sterile triple-lumen 7-French antimicrobial central venous catheters (CVCs), marketed product within current expiration dating. Extension lines of Minocycline/ Rifampin (MR), Silver/ Carbon/Platinum (SCP), and Chlorhexidine/Silver Sulfadiazine (CSS) [ARROWgard Blue PLUS[®]] catheters were aseptically removed. Extension lines from CVCs without antimicrobial treatment were utilized as untreated controls.

IN-VITRO ANTIMICROBIAL ACTIVITY OF CATHETER EXTENSION LINES

Challenge organisms: *Staphylococcus epidermidis* ATCC 35983, *Pseudomonas aeruginosa* ATCC 27853, *Candida albicans* ATCC 10231, *Enterococcus faecalis* ATCC 51299, and *Staphylococcus aureus* ATCC 33591.

Extension lines, including untreated controls, were flushed with 3 mL phosphate buffered saline (PBS), locked and extracted with PBS for 24 hours at 37° C, and rinsed again with 3 mL PBS. Lines were then inoculated with challenge organisms diluted in trypticase soy broth: Inoculum concentration for bacteria was 10³ colony forming units (CFU)/ml and for *C. albicans* was 10⁵ CFU/mL, as verified by Miles and Misra plate count.

After incubation for 24 hours at 37° C, lines were flushed with 3 mL of DE neutralizing broth, locked with neutralizing broth, and sonicated. Dilution plating was performed on sonication broth utilizing DE neutralizing agar.

RESULTS:

Catheter Extension Line Source	<i>S. aureus</i>	<i>P. aeruginosa</i>	<i>E. faecalis</i>	<i>S. epidermidis</i>	<i>C. albicans</i>
	cfu/mL	cfu/mL	cfu/mL	cfu/mL	cfu/mL
CSS	0	0	0	0	0
	0	0	0	0	0
	0	0	0	0	0
MR	0	1.10E+08	5.00E+03	7.00E+02	1.00E+04
	1.60E+05	3.00E+07	1.90E+04	0	8.00E+03
	3.20E+03	1.10E+08	1.60E+05	2.40E+06	3.00E+04
SCP	1.20E+07	4.00E+07	5.00E+06	1.40E+07	1.60E+03
	3.00E+07	1.10E+07	4.00E+06	4.10E+06	7.00E+02
	4.70E+07	1.50E+07	3.60E+06	5.00E+06	7.00E+03
Untreated Control	9.00E+06	1.01E+08	6.00E+05	9.00E+06	1.30E+04
	5.00E+07	9.00E+07	7.00E+04	2.60E+06	1.00E+04
	2.10E+06	5.00E+07	5.00E+05	2.10E+06	6.00E+03

Table 1. Adherence of challenge microorganisms to extension lines of antimicrobial catheters as compared to untreated controls.

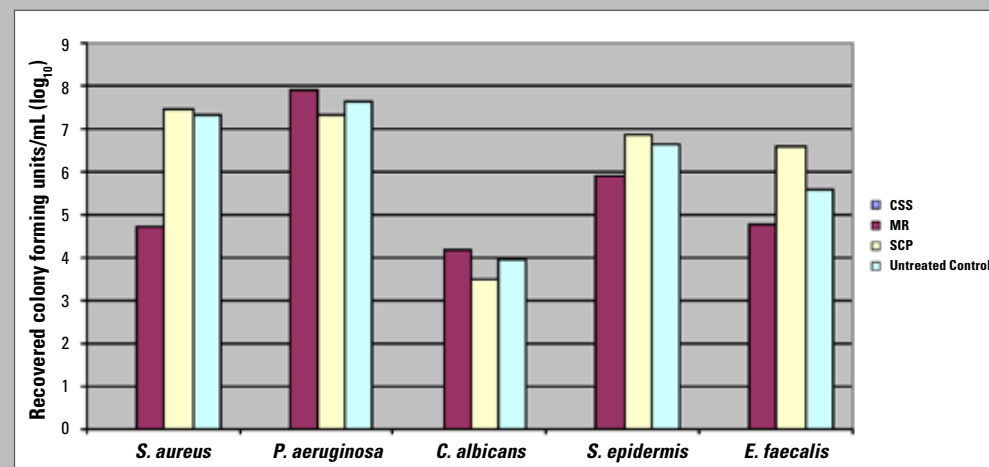


Fig. 1. Average colony forming units/mL (log₁₀) adherence of challenge microorganisms to extension lines of antimicrobial catheters as compared to untreated controls.

DISCUSSION:

CSS catheter extension lines consistently reduced adherence of all challenge organisms. Log₁₀ reductions with CSS as compared to untreated controls were as follows: *C. albicans* 4, *E. faecalis* >5, *S. epidermidis* >6, and *S. aureus* and *P. aeruginosa* >7. MR extension lines were ineffective at preventing adherence of *C. albicans*, *E. faecalis*, and *P. aeruginosa*. Some anti-adherent activity was seen with MR lines against *S. epidermidis* and *S. aureus*, but results were quite variable, indicating an inconsistent effect. SCP extension lines were not effective at preventing adherence of any of the five challenge organisms.

CONCLUSIONS:

Extension lines from the CSS catheter were the only lines included in this study that showed broad spectrum efficacy in preventing the adherence of all 5 test organisms.

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