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# Hemostatic discs exhibit broad-spectrum antimicrobial activity against pathogens linked to vascular access device infections

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## PURPOSE and DESIGN

To evaluate the *in vitro* **physical efficacy** of a **hemostatic disc** comprised of a non-eluting polymer with potassium ferrate against known opportunistic pathogens of **vascular access device related infections** including Gram-positive and Gram-negative bacteria, and the yeast *Candida albicans*.

The efficacy of the hemostatic disc was evaluated alongside the chemical control chlorhexidine gluconate discs.

## BACKGROUND

Vascular access devices are frequently linked to healthcare-associated infections, including post-insertion bleeding and infection-related sequelae [1, 2].

Skin and dressing integrity is compromised at the access site due to creation of a new portal of entry and hemo-serous fluid loss at the access site leading to risks for local and systemic infection, including central-line-associated bloodstream infections [3, 4].

Endogenous infections originate from migration of patient commensal skin microbiota along the access device or represent exogenous pathogens from the healthcare environment [5] (Figure 1).

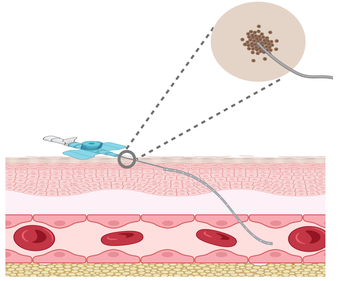

**Figure 1. Endogenous microbiota at vascular the access site.** The endogenous microbiota from the skin recolonizes around the vascular access site within a short timespan creating a potential reservoir for pathogens associated with extraluminal vascular access infection.

## LIMITATIONS

The instability of potassium ferrate in aqueous solution and the non-eluting nature of the compressed powder potassium ferrate disc were limitations in testing the antimicrobial impact of the product using traditional microbiology tests including minimum inhibitory concentrations and disc diffusion tests.

## METHODS

The inhibitory effect of the hemostatic disc and the chlorhexidine gluconate impregnated disc was confirmed using *in-vitro* disc diffusion tests. Disc diffusion tests were selected to represent a surrogate marker of antimicrobial toxicity, demonstrating a zone of clearance at the site of disc contact with a lawn inoculum of each microbial strain tested.

Disc diffusion tests were conducted using individual fresh overnight cultures of *Pseudomonas aeruginosa* (ATCC 47085), *Staphylococcus aureus* (ATCC TCH1516) and *Candida albicans* (ATCC 1023) with a standardised 0.5 McFarland inoculum density (Figure 2).

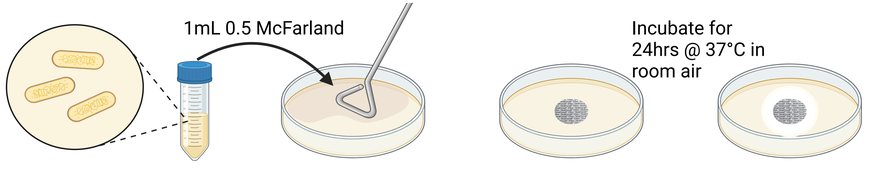


**Figure 2. Preparation of disc diffusion tests.**

Disc diffusion tests were performed for dry discs and in the presence of high and low levels of anticoagulated blood, to evaluate the impact of organic material on the potential antimicrobial effect.

The annular radius used to determine the zone of inhibition for each test (Figure 3).

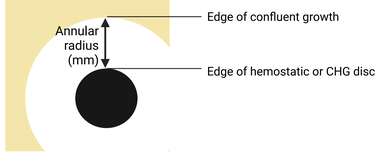


**Figure 3. Measuring the zone of inhibition.** Zones of inhibition were determined by measuring the annular radius in mm from the edge of the disc to the edge of the zone of clearance.

## RESULTS

Zones of inhibition measured from 0 mm - 5 mm at 24-hours post-inoculation. The hemostatic disc components did not diffuse through the bacteriological agar, therefore no zones of inhibition were visible and annular radii were recorded as 0 mm (Figure 4A-C). The area under the disc was absent of bacterial growth for *Staphylococcus aureus* and *Pseudomonas aeruginosa* confirming a broad-spectrum inhibitory effect (Figure 4A outset).

CHG was more effective when discs were wet due to solubilization of the CHG in the foam disc. The zones of inhibition were larger when the CHG disc was saturated with anticoagulated blood prior to incubation (Figure 4H and I).The largest zones of inhibition were observed for CHG against *S. aureus* and *Candida albicans* (Figure 4F and I). The CHG was ineffective against *P. aeruginosa* when dry (Figure 4D outset).

## DISCLOSURES

This project was funded by an Unrestricted Educational Grant awarded by Biolife, LLC.

## CONCLUSIONS

An inhibitory effect on microbial growth was observed for the discs with both physical (hemostatic disc) and chemical (CHG) modes of action for microbial strains commonly associated with vascular access device related infections.

**Hemostatic discs** (compressed hydrophilic polymer and potassium ferrate powder) **inhibit** the growth of Gram-positive and Gram-negative **bacteria**, and the **yeast** *Candida albicans*.

Hemostatic discs **inhibit physical growth** of Gram-positive and Gram-negative microbial strains **in the presence and absence of anticoagulated blood** and organic material.

Hemostatic discs **outperform CHG** discs **for Gram-negative bacteria** including *Pseudomonas aeruginosa*.

Compressed hydrophilic polymer and potassium ferrate powder discs show promise for inclusion in hemostatic bundles with antimicrobial benefits [6,7].

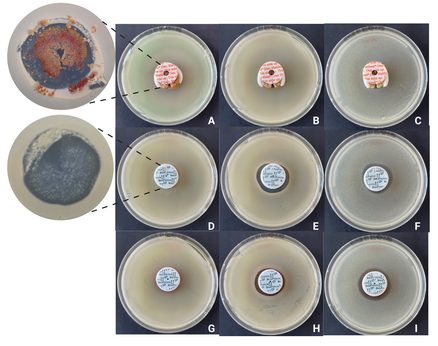


**Figure 4. Zones of inhibition.** Top row (4A-C): compressed hydrophilic polymer and compressed potassium ferrate discs incubated with *Pseudomonas aeruginosa*, *Staphylococcus aureus*, or *Candida albicans*. Zones of inhibition based on annular radius all equal 0 mm. Hemostatic discs inhibited the growth of the organism directly beneath the disc (see outset 4A) confirming that the non-eluting product was inhibitory to bacterial growth, but not yeast (growth beneath the disc). *P. aeruginosa* growing closest to the disc did not show evidence of characteristic pyocyanin production (green pigment) further supporting an inhibitory effect. Middle row (4D-F) dry chlorhexidine gluconate discs incubated with each of the three organisms (PA, SA, CA). Annular radii measured 0 mm, 4 mm, and 3 mm respectively.Growth was noted under the disc for *P. aeruginosa* (see outset 4D). Bottom row: (4G-I) chlorhexidine gluconate disc pre-saturated with anticoagulated blood. Annular radii were increased compared to the dry disc, measuring 2 mm, 4 mm, and 5 mm respectively.

## REFERENCES

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