Spray or Pour? Why Spraying Hypochlorous Acid (HOCl) Cleansers May Degrade the Key Preservative Molecule, HOCl

Svetlana Panicheva, Ph.D., Debashish Chakravarthy, Ph.D., Rose Yaghi, DHA, M.S.

BACKGROUND

Wound cleansing is a critical first step in wound bed preparation, and multiple guidelines now recommend the use of pure hypochlorous acid (HOCl) as a preservative in wound cleansers. Specially formulated shelf-stable solutions are made available by some manufacturers. Yet the product's delivery system during cleansing can have a major impact on its stability within seconds of leaving the container on its way to the wound surface, potentially even before reaching the wound. This is because hypochlorous acid is highly volatile, and atomization into a mist may allow HOCl to disperse into the atmosphere before reaching the wound. We investigated whether atomizing the solution into a spray delivery leads to the rapid depletion of the key preservative molecule, hypochlorous acid.

METHODS

We tested two products: one available only as a poured product today, and one available as a spray (finger sprayer), like an atomized perfume spray system. We tested the available free chlorine (AFC) in these two products, as commercially available from bona fide manufacturers/distributors, under pouring-and-spraying scenarios.

To measure and estimate "post-delivery", the concentration of the hypochlorous acid measured as available free chlorine in the fluid reaching the wound, the contents were poured or sprayed onto an inert glass surface, forming a thin, approximately uniform layer to mimic what the scenario would be if the liquids were made available, via the two delivery systems, to the wound surface. For both product AFC measurement, the glass surface was laid flat on a surface six inches from the pour bottle's delivery orifice, or, in the case of the spray bottle, the spray nozzle.

RESULTS

The residual AFC, in ppm, for the pour product A (250 mL flip-top) and the spray product B (250 mL finger sprayer) was evaluated on a glass surface using AFC test strips (Monitor for Chlorine (0 – 300ppm) Serim Research Corporation). AFC test results are shown in increments of 25 ppm within the range of 0 to 100ppm, and 100ppm within the range of 100 to 300ppm.

First, the AFC measurements were performed directly from the bottle before pouring product A and spraying product B, yielding ~300 ppm for product A and ~100 ppm for product B. Table 1 summarizes the AFC values in the bottles for products A and B and the delivery mode.

*Vashe Wound Solution, ** Finger Pump Spray HOCl is available in the US for wound care
Urgo Medical North America Fort Worth, TX
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RESULTS CONT

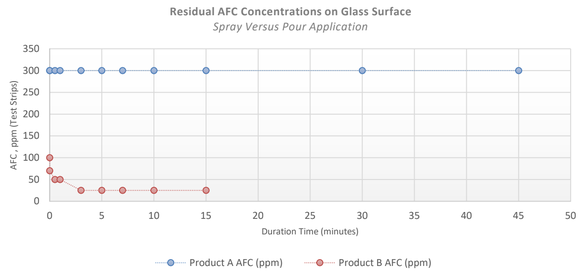
Table 1: Product A & B AFC Values in the Bottle & Delivery Method

Wound Cleanser	AFC Values in the Bottle, T=0 min (ppm)	Delivery Methods
Product A	~300	Pour
Product B	~100	Spray

Then, for product A (the package that allows only pouring), 25 mL was poured to cover the entire surface of the glass. The AFC measurement at T=0 min was consistent with the bottle content of ~300 ppm. This AFC value remains constant throughout the test. No major decline in the AFC was observed during the pour testing experiment for product A between 0 and 45 minutes of initiation of delivery to the target surface. Those results confirmed previous findings that correlated the applied volume of product A with the residual AFC value, demonstrating that the product should be applied in excess to achieve an efficient cleansing effect and reduce infection risk.

However, for product B (the package that allows only finger spray), the total number of strokes to cover the whole surface of the glass was 60, corresponding to 5.7 g of the dispensed sample. This quantity was used to test the AFC values for product B, where it was visible that spraying the product atomizes the fluid into droplets that coalesce on the target surface. Therefore, the target glass surface shows a lower AFC (~70 ppm) at T=0 min immediately after spraying. This should be compared to the delivery via pouring results for product A (~300 ppm) at the target surface. The AFC loss for product B was observed immediately after spraying, with a drop in AFC to between 40 and 60 ppm (40-60% loss) within the first 2 minutes of spraying on the target surface. The AFC loss for product B continues, where between 3 minutes and 15 minutes of testing, the AFC level decreases and stabilizes from 100 ppm at T-0 minutes to ~ 25 ppm (~75% loss). Figure 1: Shows the difference in the fate of the HOCl concentration during delivery, graphically, and the contrast is quite remarkable.

Figure 1: Spray versus Pour AFC Results for Products A & B Wound Cleansers



CONCLUSION

We believe that atomizing the liquid via a spray nozzle will enable rapid evaporation of HOCl from the cleanser as it travels from the spray nozzle tip to the wound. On the other hand, pouring a liquid onto gauze to soak it in excess is likely to keep the cleanser as close to its original state as possible until it reaches the wound surface, where we expect hypochlorous acid to be consumed rapidly. However, in our glass surface test, we observed dispersion differences in AFC stability over time, which we attribute to the superior HOCl-stabilizing technology likely present in Product A.

In addition, spraying causes the liquid to "run off" the wound, limiting the contact time, which should ideally be between 2 and 5 minutes based on studies of the effect of hypochlorous acid cleansers on microbial colonies. As opposed to the spray, pouring the cleanser onto gauze, as recommended for product A, provides a more controlled method, allowing for longer, more effective contact time needed to manage both slough and microbial colonies.

However, spray-type systems may be useful when it is not possible to apply a product to a wound with gauze, in cases where a controlled, pressurized flow is needed to eliminate microbial colonies from targeted areas by initial mechanical disruption of the surface organic load. However, clinicians should be aware of their pros and cons. When time permits, a pour-soak method is likely the best way to treat wounds. In the management of skin conditions or of clean or acute wounds, where the bioburden quantity, phenotypes, and general nature differ markedly from those in a chronic wound, a spray-type method may be more suitable. However, further research is indicated in this area to design a stable, sprayable formulation, with the critical parameter to optimize being the priming volume of the spraying nozzle before use for skin management.

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