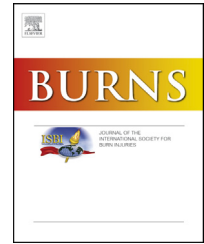


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Intermediate-level disinfection with accelerated hydrogen peroxide prevents accumulation of bacteria in Versajet™ tubing during repeated daily debridement using simulated-use testing with an inoculated pork hock

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ABSTRACT

Objective: This study assesses the feasibility of using the Versajet™ system (VJS) on an inoculated pork hock (PH) skin surface sequentially for 8 days with daily cleaning and intermediate-level disinfection (ILD).

Methods: Daily, PHs were inoculated with bacteria suspended in artificial test soil (ATS). An ILD protocol with accelerated hydrogen peroxide (AHP, Oxivir™[®]) was employed to clean and disinfect the VJS between debridements.

Results: PH skin contains $6.1\text{--}6.8 \times 10^6$ cfu/cm² bacteria. Bacterial counts in the handpiece and discharge hoses immediately after debridement of the PHs, and before cleaning, increased throughout the study period ($5.19\text{--}6.43 \log_{10}$ cfu/mL). Cleaning with the ILD protocol was reduced bacterial counts on the VJS by 6-log. Protein, a surrogate marker of organic contamination, was also reduced post-cleaning and ILD. Compared to a maximum post-debridement level of protein (57.9 µg/mL) obtained before ILD, VJS protein levels dropped to 9.8 (handpiece) and 13.8 µg/mL (discharge hose).

Conclusions: Disinfection of the handpiece and discharge hose after debridement with AHP resulted in a 6-log reduction in bacterial count and 4.2 fold reduction in protein. An ILD protocol with an AHP may be a feasible method for serial skin surface debridements with the VJS for up to eight days.

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1. Introduction

Debridement of necrotic tissue is essential for treatment and prevention of infection in burn injury. Optimal management

of contaminated wounds requires removal of necrotic and devitalized tissue without damaging viable structures [1]. Non-viable tissue may contribute to inflammation, stimulate bacterial growth and impede formation of granulation tissue, as well as delay re-epithelialization and promote wound

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contracture [2]. Bacterial colonization is a potentially life threatening complication of burn injury, that can lead to invasive infection and graft loss [3]. Among the potential barriers to clearing bacterial burden is the creation of pseudoeschar with use of antimicrobial dressings [4]. To remove this stubborn layer of protein coagulum mixed with bacteria, many burn units use hydrotherapy [5] despite evidence that the hydrotherapy itself can be a source of bacterial contamination [6]. Another contributor to surface contamination is biofilms. Biofilms are a layer consisting of exopolysaccharides, extracellular DNA, and protein that may foster microbial resistance to antibiotics or disinfectants [7]. The presence of protein can be used as a marker for biofilm [8]. Thus, removal of proteins associated with necrotic skin, pseudoeschar, and biofilm are important considerations for wound bed debridement.

In full thickness burn injury debridement takes place surgically under general anaesthesia in the operating room. However, the majority of burns are partial thickness, and debridement takes place in conscious patients at the bedside with removal of necrotic debris, pseudoeschar and biofilm occurring during multiple dressing changes. Debridement can be achieved through surgical, autolytic, enzymatic, biosurgical or mechanical methods. This may be painful and this pain may lead to other issues, such as post-traumatic stress disorder [9]. The Versajet™ hydrosurgery system (VJS) (Smith and Nephew Inc., St. Laurent, Quebec) is a single use product for surgical debridement of the burn wound in the operating room. The majority of fluid passes into a collection aperture, and by Venturi effect debris is removed with the fluid. The user can adjust the force of the stream of water whereby at the lowest setting the VJS is painless. The senior author on this paper used the VJS on his arm and suffered no ill effects on settings 1 and 2 (of 10).

Although marketed for single use surgical debridement theoretically use of VJS at the lowest setting may assist in cleansing of wounds by lifting pseudoeschar and debris during routine daily dressing changes at the bedside. Given the cost of the unit, it is not currently economical to use a new handpiece at each dressing change. If the handset could be cleaned sufficiently to permit reuse on the same patient with each dressing change, bedside use may become financially viable. However reuse of this device, even on the same patient, requires an effective cleaning protocol to prevent colonization of the hand piece and contamination of the burn wound from one day to the next. Thus, we wanted to explore the feasibility of disinfecting the VJS after successive debridements, thereby allowing potential reuse on the same individual.

The potential colonization of the handpiece with repeated use could have devastating results in the burn patient transferring bacteria from contaminated areas to clean areas. Therefore prior to embarking on a trial of VJS at the patients' bedside it is important to examine the efficacy of an intermediate-level disinfection (ILD) protocol on controlling bacterial contamination of the equipment. Oxivir-TB® (Johnson Diversey, Oakville, Ontario) is an accelerated hydrogen peroxide (AHP)-containing disinfectant (0.5% w/v) that is marketed for use in healthcare, medical, industrial and institutional facilities [10]. A protocol using Oxivir-TB® was evaluated on a VJS used daily to debride a pork hock freshly

inoculated with a known quantity of bacteria, for 8 days sequentially.

2. Objectives

1. To examine if ILD will prevent the accumulation of microbes on a VJS used repeatedly to debride microbially-contaminated pork hock skin.
2. To examine if ILD will prevent the accumulation of protein on a VJS used repeatedly to debride microbially-contaminated pork hock skin.

3. Methods

3.1. Bacterial culture and inoculation

Artificial test soil (ATS) was inoculated with a mix of *Enterococcus faecalis* ATCC 29212, *Pseudomonas aeruginosa* ATCC 27853, and *Candida albicans* ATCC 14053, each at a 10^8 cfu/mL concentration. This ATS-triple bacteria soil has been used previously to represent organic bioburden in trials involving the cleaning of medical devices [10,11] and includes three organisms associated with burn wound infection [12–14]. Under a biological safety cabinet, pork hock skins (36 cm² area) were inoculated with 200 µL of the inoculated soil and held overnight in the fridge to allow the bacteria to colonize the specimen.

3.2. Debridement process

Under a biological safety cabinet, the inoculated pork hocks were debrided using sterile 0.9% sodium chloride (saline), USP for injection (Baxter Corporation, Mississauga, Ontario). The VJS pump was turned to setting 2 (low speed) during debridement (approx. 45 s duration). Waste collected from the discharge hose was discarded. A single VJS hand piece was used for the entire study.

3.3. Sample collection

Samples were collected on days 1 through 5 with a final collection on day 8. The timeframe of one week was chosen as at our institution the majority of all acute burn wounds are debrided in this timeframe, and the gap between days 5 and 8 represented the possibility of a weekend break during

- i) Pre-debridement (positive control) and post-debridement pork hock skins were sampled using a dry Dacron™ polyester-tipped swab (Fisher Scientific, Ottawa, Ontario). After the initial swab of the inoculum site, the swab was dipped into 2 mL of sterile distilled water (SDW) and wrung out. The site was swabbed a second time (a third time for positive controls only). The swab was broken off into the same tube of SDW. All pork hock samples were collected in a biosafety cabinet according to biosafety level 2 containment procedures. On day 1 and day 8, an uninoculated (negative control) pork hock was sampled in a similar manner to evaluate the baseline levels of microorganisms on intact pork hock skin at the beginning and end of the

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