

ADVANCE FOR NURSES

Promoting Progressive Healing

Nurse examines a new form of pure hypochlorous acid researchers say may prevent MRSA and other infections in chronic wounds.

Hypochlorous acid is a very potent broad-spectrum antimicrobial agent.

By Randell Varilla, MSN, RN

Chronic nonhealing wounds, such as venous stasis ulcers, diabetic ulcers, and pressure ulcers are serious unmet medical needs that effect a patient's morbidity and mortality.

Factors that inhibit wound closure and healing are bacterial load, biofilm, presence of dead tissue or foreign bodies, deficiency of growth factors, tissue maceration, venous stasis, diabetes, malnutrition, renal disease, and advanced age.

Infection of chronic wounds by *staphylococcus*, including MRSA, *Pseudomonas*, *Peptoniphilus*, *Enterobacter*, *Stenotrophomonas*, *Finegoldia* and *Serratia* spp. is problematic because these pathogens can form a biofilm that can become a major obstacle for wound closure and the healing process.

Losing Control

Controlling the bacterial bioburden in wounds has been very difficult.

If the physician cannot control the infection in these chronic wounds, the patient may become further compromised by additional tissue damage, bacteremia, sepsis or deeper wound infections.

Systemically administered antibiotics do not effectively decrease the level of bacteria or the associated biofilm in a chronic granulating wound. Topical antiseptics have been the method of choice but still do not fully provide effective alternatives or significant improvement.

The search for a safe and effective alternative remains a healthcare worker's biggest challenge.

Pure Hypochlorous Acid

Topical antiseptics have a long history of use, and many, such as sodium hypochlorite (Dakin's solution), hydrogen peroxide, acetic acid and povidone-iodine, remain in widespread use.

At typical concentrations, these disinfectants can actually impede wound healing and are discouraged for use on chronic ulcers. Therefore, the standard of care for chronic ulcers is debridement and moisture-retentive dressings.

Hypochlorous acid (HOCl) is a very potent broad-spectrum antimicrobial agent. It is produced by the body's white blood cells as part of the innate defense against microbial pathogens through phagocytosis and oxidative burst with no-to-low potential for resistance.

In the past, companies and compounding pharmacies have attempted to prepare various forms of pure HOCl unsuccessfully and have unfortunately had to settle with mixtures such as Dakin's solution, which is a mixture of sodium hypochlorite (bleach) and HOCl (innate immune molecule). Pure HOCl in solution has been described as being 80-100 times more potent as a germicide than the hypochlorite anion (high pH).

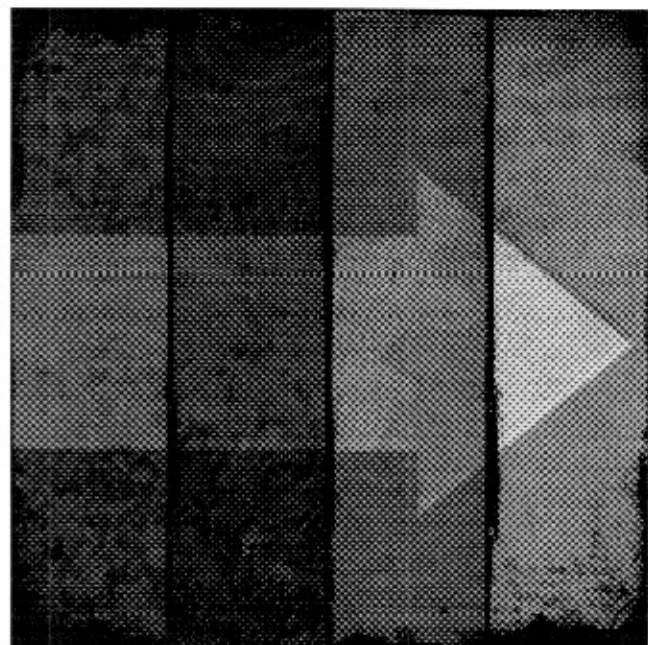
This is because pure HOCl in solution as a neutral/uncharged species can penetrate microbial

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cells and spore walls while the charged hypochlorite anion cannot penetrate cell walls. Pure HOCl is protonated and neutral in solution at acidic pH's. An understanding of chlorine chemistry is important in order to appreciate both the active form and the long-term stability in glass or plastic containers.

Chlorine species in aqueous solution transforms into two active forms: hypochlorous acid (HOCl) and the hypochlorite anion (OCl⁻). The pH range where the ratio of the two species (HOCl/OCl⁻) in 0.9 percent saline gives pure HOCl (i.e. >97 percent relative molar distribution of active chlorine species as HOCl) is at pH 4-6. One finds mixtures of hypochlorous acid and hypochlorite anion at neutral (pH 7) and hypochlorite anion at basic pH ranges (pH >8).

Recent *in vitro* research studies showed hypochlorous acid was effective against both planktonic and biofilm forms of *S. aureus*. The researchers concluded the

compound was equally effective *in vitro* against various antibiotic-sensitive and resistant *S. aureus* isolates when tested in minimum bactericidal concentration and time-kill assays.

This new form of broad-spectrum antimicrobial has recently garnered much attention within the wound care research community. A series of studies indicate that it is a safe, effective, broad-spectrum antimicrobial agent against: Gram-positive bacteria including: MRSA, VRE, and *Bacillus anthrax*; Gram-negative bacteria; yeast; fungi; and *Acanthamoeba*.

Clinical Case Studies

Clinical case studies using 0.01 percent HOCl in 0.9 percent saline solution at pH 4-5 have shown we can use a variety of wound mesh dressings, with (or without) negative pressure wound therapy (NPWT).

Wound mesh dressings are designed to aid in the reduction of tissue maceration of the adjacent skin next to the wound. Clinical case studies have shown a marked increased speed of wound healing without being toxic to living tissues.

In our studies we used 0.01 percent HOCl in 0.9 percent saline solution at pH 4-5 with a variety of wound mesh dressing, with (and without) NPWT with many severe chronic nonhealing wounds showing good wound closure and accelerated wound healing.

The 0.01 percent HOCl in 0.9 percent saline solution was used with a simplified and streamlined NPWT clinical protocol that involves moistening the wound with a moist compress wetting with 0.01 percent HOCl in 0.9 percent saline solution on standard cotton gauze prior to physical cleaning, debridement and drying of the affected wounds.

Thin film dressings were used to cover the wound and hold a hydrophobic mesh in the wound, a pre-cut silicone tube (instillation port) positioned at the wound bed, and a Trac-Pad (exit port) in place for negative pressure wound therapy (NPWT).

The wound area was then wrapped in cotton gauze and a secondary dressing as ordered by the physician. Wound care specialists or informed patients can instill pure 0.01 percent hypochlorous acid in a saline solution with vacuum removal as instructed by the attending surgeon or wound care nurse.

The results revealed use of 0.01 percent HOCl in 0.9 percent saline solution and NPWT in many severe chronic non-healing wounds (e.g. below-the-knee amputation, chronic venous girdle ankle ulcer, cancer patient with a radical excision of a squamous cell cancer exposing cranial bone) resulted in marked accelerated wound repair in patients.

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(A 0.01 percent HOCl in 0.9 percent saline solution at pH 4-5 should be available in the first half of 2012 in a glass 40 mL bottles with an optional finger actuated spray pump for wound care.) Hence, there is a clear potential for the use of 0.01 percent HOCl in 0.9 percent saline solution as a key agent in promoting progressive healing for a wide variety of wound types.

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