The fight against microbes is a constant battle. Increasingly, with regular reports on microbial resistance and 'superbugs', new treatments are being sought to reduce infections and their associated morbidity.

In the last year or two, we have seen the introduction of hypochlorous solution into the UK podiatry market. Its potential benefits have been long known as a topical antiseptic, but only recently has it been manufactured into a stabilised, usable form suitable for regular clinical use.

A product that has a bacterial killing power 80 times greater than bleach12 with limited toxic effects, and which does not delay wound healing sounds too good to be true.

**Ivan Bristow PhD**

Above: HOCl has been shown to be effective against a number of microorganisms.

**Hypochlorous Acid (HOCl)**

Hypochlorous acid (HOCl) (not to be confused with hydrochloric acid), is a naturally occurring weakly acidic molecule of chlorine in water used by the body as part of the innate immune system, particularly by neutrophils, eosinophils, macrophages and B cells.2 During infection and inflammation, immune cells ingest and kill microbes. Consuming quantities of oxygen, they are able to produce superoxide species, which in turn dismutates into hydrogen peroxide which then converts to HOCl under the influence of the enzyme myeloperoxidase.3 HOCl possesses strong antimicrobial properties being bactericidal, fungicidal, viricidal and sporicidal4 through depletion of microbial energy stores (ATP),5 oxidation of nucleotides and damage to microbial cell membranes,6 whilst having little effect on mammalian cells,7 probably as a result of its endogenous presence in the immune system. In addition, evidence suggests that bacterial toxins exposed to HOCl may undergo oxidative neutralisation.7

Despite the known advantages of HOCl, mass production of the chemical into a usable, stable form has been a challenge due to its chemistry. HOCl exists in an optimal pH of around 2.5–5.5. Below this level, chlorine gas is liberated. Above
Despite the known advantages of HOCI, mass production of the chemical into a usable, stable form has been a challenge due to its chemistry.
In podiatry, this has a great potential for use in treatment of foot wounds and ulcers, particularly because of its antimicrobial profile along with anti-biofilm activity.

ANTI-INFLAMMATORY ACTION OF HOCl

In addition to its antimicrobial properties, research has highlighted the effects of HOCl on moderating inflammation. Pelgrift & Friedman summarised the main anti-inflammatory effects as follows:

1. HOCl adds one or more Cl groups to the NH2 group of histamine, thereby decreasing its potency.
2. Oxidation by HOCl of thiol or thioether groups directly decreases the activity of leukotrienes and interleukin-6 (IL-6).
3. Oxidation by HOCl of thiol or thioether groups directly increases the activity of transforming growth factor-beta (TGF-beta), which is anti-inflammatory.
4. Oxidation by HOCl causes increased synthesis of growth factors.
5. At high concentrations, HOCl decreases the activities of matrix metalloproteinase-7 (MMP-7) and collagenases.
6. HOCl oxidation can ultimately neutralise pro-inflammatory cytokines, including tumour necrosis factor-alpha (TNF-alpha), IL-1, and IL-6.
7. HOCl chlorinates proteinaceous parts of antigens, which causes increased activity against gram-negative bacteria.

Anti-inflammatory effects can have positive benefits such as pain reduction and decreased healing times, and may be effective in the treatment of itch in conditions such as atopic dermatitis, as demonstrated in an animal model and in a paediatric population, performing equally as well as a potent topical steroid and other drugs.

HOCI, BIOFILMS AND WOUND HEALING

Biofilms are collections of different types of organisms that may reside on a surface or on the bed of a wound, encased in a scaffold of glycopolymers which act as a protective shell, making their elimination difficult through normal immune processes or chemotherapy. Additionally, they can contribute to antibiotic resistance. Hypochlorous acid has been shown to destroy biofilms,

control infection and to be more effective for decreasing bacteria versus saline or povidone-iodine in wound irrigation. In a review of the use of HOCl, led by Prof David Armstrong, the authors conclude that HOCl had comparable antimicrobial activity to other available agents but with much less cytotoxicity and more evidence on its safety and effectiveness. Strong evidence was found in favour of its use in diabetic foot wounds.

In podiatry, this has a great potential for use in treatment of foot wounds and ulcers, particularly because of its antimicrobial profile along with anti-biofilm activity. In addition, work has shown that, unlike other wound products, HOCl does not delay or inhibit the wound healing process, ultimately improving healing rates and outcomes.

SUMMARY

HOCl solution is a simple chemical with strong powers of oxidation and therefore antimicrobial activity across a very broad range of organisms, which emulates the body's own innate immune system. Modern manufacture processes have allowed for production of a pure form of the chemical stabilised for clinical use. Many of these properties make HOCl a valuable asset in podiatry as an antiseptic, anti-inflammatory and wound care agent, which does not delay wound healing and is entirely compatible with tissues, causing minimal irritation or sensitivity.

DECLARATION OF INTEREST

The author declares he has undertaken work for Canonbury Limited who carry hypochlorous products in their catalogue.

REFERENCES