

Hypochlorous Acid: Applications in Small Animal Dermatology

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Abstract

In small animal veterinary dermatology, there are many conditions in which bacterial complications are actually secondary to other processes. In these instances, microbial control with topical antiseptics is preferred to the use of systemic antibiotics. Hypochlorous acid represents a natural, gentle, and safe topical agent that is effective against the microbes most commonly associated with these conditions, and it also has anti-inflammatory properties. Despite being used in animals for over 100 years, it can still be considered a novel and innovative approach to managing some of the most common skin disorders seen today.

Keywords: Hypochlorous Acid; HOCl; Dermatology; Pyoderma; Atopic Dermatitis; Otitis Externa

Introduction

In veterinary medicine, there are many inflammatory conditions that result in bacterial overgrowth on the skin surface. In many of these cases, the bacteria involved may not be primary pathogens, but rather commensal organisms that proliferate because of hospitable circumstances that arise on the skin surface secondary to underlying conditions. Systemic antibiotics may be used to try to control these situations but would be considered inappropriate for this purpose and would risk the development of antibiotic resistance. A better solution is to consider safe and effective topical antiseptics that can accomplish the same results without the use of systemic antibiotics.

Hypochlorous acid (usually designated chemically as either HOCl or HClO) is produced naturally within white blood cells such as neutrophils, eosinophils, mononuclear phagocytes, and B-lymphocytes as a part of the innate immune response; it serves as a natural defense mechanism against infection [1]. The compound is released from activated leukocytes via a heme enzyme, myeloperoxidase (MPO), which generates hypochlorous acid from hydrogen peroxide and chloride [2]. HOCl is produced within these cells by the respiratory burst pathway [3].

Hypochlorous acid appears to have some notable advantages over other topical agents used in veterinary dermatology. It is a weak acid that is very gentle on the skin, and in human medicine, it is considered so gentle that it is even used in eye drops and eyelid cleansers. It is considered almost non-toxic, and has effects against a variety of microbes, including bacteria, yeasts, and viruses. The antimicrobial activity of HOCl is not that of a conventional antibiotic but rather an agent that is directly toxic to microbial cells, including many gram-positive

and gram-negative bacteria (e.g. *Staphylococcus spp.*, *Pseudomonas aeruginosa*) and their biofilms [4]. Its anti-inflammatory properties are thought to derive principally from its effects on histamine, leukotrienes (LTB₄), and cytokines (IL-2 and IL-6) [3]. HOCl can help reduce inflammation by inhibiting the production of inflammatory cytokines and chemokines, and this action can potentially help reduce redness, swelling, and discomfort associated with skin inflammation.

The physicochemical properties of HOCl after application to the skin are highly dependent on both pH and formulation stability [4]. The properties of HOCl in solution are strongly linked to the solution's pH because pH changes can cause HOCl to react, resulting in mixtures of HOCl in equilibrium with various reaction products [3]. HOCl stability is optimized over a pH range of 3.5 to 5.5 [2]. A concentration of 0.01% HOCl has been found to be effective for most dermatologic applications [5]. Natural HOCl is unstable; through technology, it can be stabilized into an effective topical antiseptic agent [6]. Stabilized solutions of hypochlorous acid have demonstrated profound antimicrobial and anti-inflammatory effects, and since hypochlorous acid is quite gentle on the skin, it has the potential for many uses in small animal dermatology.

Despite its powerful cleansing abilities, HOCl is known for being gentle on the skin, making it a popular choice for use in both prescription and non-prescription skincare products. This likely occurs for several reasons. Hypochlorous acid is a weak acid, its pH tending to be about 5.5, which is less acidic than many other products used in topical therapy, such as salicylic acid and glycolic acid (pH typically 3.0 - 3.5). This tends to make hypochlorous acid less likely to cause irritation or damage to the skin. Because HOCl is a naturally occurring substance in the body, it is also less likely to cause adverse reactions or sensitization than synthetic chemicals or harsher acids. Finally, by keeping the skin clean and free from harmful bacteria, HOCl can help to maintain a healthy skin barrier and reduce the risk of inflammation or damage.

While the benefits of hypochlorous acid are only now being rediscovered, it has a long history of use in veterinary medicine, with documentation in the veterinary literature going back at least until 1916 [7]. There was a long period in which its use in veterinary medicine went largely unreported, but it is now experiencing a resurgence.

Dermatologic applications

Atopic dermatitis

Atopic dermatitis is a very common skin condition, especially in dogs, and is an exaggerated immune response to natural allergens in the environment (pollens, molds, housemite, etc). In most cases, it represents an aberrant immune reaction in a genetically susceptible individual and is often associated with skin barrier function abnormalities [8].

Pruritus is a cardinal feature of atopic dermatitis, with many allergic dogs noted to lick and chew at their feet, rub their faces, experience pinnal erythema, and often develop rashes in the groin and axillary areas. Secondary bacterial and yeast overgrowth is commonplace. The disorder shares many commonalities with atopic dermatitis in humans (eczema).

The treatment of atopic dermatitis in dogs typically involves medications that help control pruritus, and this might include products targeting the cytokines associated with pruritus, or more broad-spectrum down-regulators of inflammation, such as calcineurin inhibitors and corticosteroids. Allergen-specific immunotherapy (ASIT) is the only therapy capable of making pets more tolerant to problematic allergens in their environment. Antimicrobial therapy is too often prescribed to treat recurrent bacterial overgrowth that is commonly associated with this condition.

Hypochlorous acid may be a useful adjunct for the management of atopic dermatitis. The specific antipruritic mechanism of action remains unclear [9], but might occur due to its effects on eliminating cutaneous microbes (specifically *Staphylococci* and *Malassezia pachydermatis*) which can exacerbate atopic dermatitis, or because of its anti-inflammatory effects through the reduction of activities of LTB₄,

IL-2, and histamine, which have been noted in humans [3]. By keeping the skin relatively free of harmful bacteria, it may actually promote a healthier skin barrier function, and reduce inflammation. Studies in mouse models suggest that topical hypochlorous acid on its own may significantly reduce scratching behavior [9].

Canine pyoderma

Canine pyoderma is commonly seen in veterinary practice, and it can become chronic and recurrent. This typically occurs because the pyoderma is most often secondary to underlying conditions, such as allergies, immune dysfunction, endocrinopathies, and other conditions. In the vast majority of cases, the pyoderma is a result of an overgrowth of commensal organisms on the skin surface, principally *Staphylococcus pseudintermedius*.

In many cases, veterinarians attempt to treat superficial canine pyoderma with systemic antibiotics, but this is often not a satisfactory endeavor, since the problem is likely to recur if the underlying problem has not been completely addressed. The need is not for stronger and stronger antibiotics, but to use strategies to control the surface bacterial overgrowth while addressing the underlying primary cause of the problem [10].

Topical therapies are important in the management of canine pyoderma because superficial bacterial infections often do not warrant the use of systemic antibiotics. In addition, the emergence of methicillin-resistant and multidrug-resistant microbes has heralded a change in perspective, where topical antibacterial therapy is not merely adjunctive, but it is often the primary and preferred method of treatment [11].

Hypochlorous acid should be considered as an option for the management of superficial canine pyoderma. It is gentle on the skin, can be used even in ulcerated areas, and it has documented antimicrobial properties against the surface organisms most likely to be involved [12]. By reducing microbial load, it lessens the need for systemic antibiotics, and thereby the prospect of bacterial resistance, dysbiosis, and adverse reactions.

Otitis externa

Otitis externa is a common problem in pets, especially dogs, and most cases are the result of underlying disease processes (such as allergies) that cause inflammation and the overgrowth of bacteria (such as *Staphylococcus pseudintermedius*, *Pseudomonas aeruginosa*, etc.) and yeasts (*Malassezia pachydermatis*) in the ear canal. While topical treatment is a frequent part of therapy, resolution of otitis externa requires successfully addressing the underlying issues [13].

Hypochlorous acid appears to be a suitable cleaning solution for canine otitis externa [14]. It has been shown to be effective *in vitro* against those microbes most commonly associated with otitis externa, and is able to disrupt biofilm [15]. Together with its anti-inflammatory properties, it is a logical consideration for the treatment of uncomplicated external ear diseases. Until more is known about its effects on the middle ear, hypochlorous acid, like most other topical solutions, should be used with caution when the eardrum is ruptured. As with pyoderma, most cases of otitis externa are secondary to underlying disease processes, especially allergy, and these conditions must be managed if the otitis externa is to truly resolve.

Other indications

Hypochlorous acid has been used for many other applications in human dermatology, including for wound healing, acne, rosacea, and even psoriasis [5]. For wound healing, it has been found to increase the production of collagen and other proteins that are essential for tissue repair [16] and it has also been used for burns, scar management, and diabetic ulcers as well [17].

The product has been used in a variety of inflammatory skin diseases such as acne, rosacea, and psoriasis, for the same reason that it is effective in atopic dermatitis - control of surface microbial load, and its anti-inflammatory effects. Potentially, it might have a role in the treatment of a variety of other dermatology conditions in pets, including canine and feline acne, wound management, and acral lick dermatitis, to name just a few. It is likely that it also has non-dermatologic applications as it does in humans, possibly for keratitis, blepharitis, periodontal disease, sinusitis, anal sacculitis, and other conditions.

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