



2018 Review:

1. Del Rosso and Bhatia (2018). "Status Report on Topical Hypochlorous Acid: Clinical Relevance of Specific Formulations, Potential Modes of Action, and Study Outcomes." *J Clin Aesthet Dermatol* **11**(11): 36-39.

- Hypochlorous acid (HOCl), a naturally occurring molecule that is a component of the human innate immune response.
- It has demonstrated antimicrobial properties supported by both *in-vitro* and *in-vivo* studies.
- Over time, a variety of anti-inflammatory and other biologic properties of HOCl have led to applications for;
 - wound healing,
 - pruritus,
 - diabetic ulcers,
 - seborrheic dermatitis
 - atopic dermatitis
 - acne vulgaris
- MANAGEMENT OF VARIOUS SKIN DISORDERS
 - HOCl has been incorporated into topical formulations due to antimicrobial, anti-inflammatory, immunomodulatory, and wound healing properties.



- 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 and their biofilms.
- Stabilized/pH-neutral HOCl is superior in terms of antimicrobial activity to nonstabilized HOCl and acidified bleach in vitro, including against hypochlorite-resistant strains.
- In a variety of laboratory studies, HOCl has been shown to decrease the activity of histamine, neutrophil-generated leukotrienes (i.e., LTB₄), interleukin (IL)-6 and IL-2, and, in high concentrations, to downregulate some matrix metalloproteinases (MMPs) (e.g., MMP-7, collagenases), diminish mast-cell degranulation and cytokine release induced by immunoglobulin E, and induce favorable effects on keratinocyte and fibroblast migration.
- Other clinical applications include promotion of wound healing and scar prevention.

Wound Healing:

1. Armstrong, Bohn et al. (2015). "Expert Recommendations for the Use of Hypochlorous Solution: Science and Clinical Application." *Ostomy Wound Manage* **61**(5): S2-s19.

"In the last 15 years, more advanced hypochlorous acid (HOCl) solutions, based on electrochemistry, have emerged as safe and viable wound-cleansing agents and infection



treatment adjunct therapies. Based on in vitro studies, the antimicrobial activity of HOCl appears to be comparable to other antiseptics but without cytotoxicity; there is more clinical evidence about its safety and effectiveness. With regard to the resolution of infection and improvement in wound healing by adjunct HOCl use, strong evidence was found for use in diabetic foot wounds; moderate evidence for use in septic surgical wounds; low evidence for venous leg ulcers, wounds of mixed etiology, or chronic wounds; and no evidence for burn wounds. The panel recommended HOCl should be used in addition to tissue management, infection, moisture imbalance, edge of the wound (the TIME algorithm) and aggressive debridement. The panel also recommended intralesional use of HOCl or other methods that ensure the wound is covered with the solution for 15 minutes after debridement”

2. Sakarya, Gunay et al. (2014). "Hypochlorous Acid: an ideal wound care agent with powerful microbicidal, antibiofilm, and wound healing potency." *Wounds* **26**(12): 342-350.

“The aim of this study was to investigate the effect of stabilized hypochlorous acid solution (HOCl) on killing rate, biofilm formation, antimicrobial activity within biofilm against frequently isolated microorganisms and migration rate of wounded fibroblasts and keratinocytes. Minimal bactericidal concentration of stabilized HOCl solution for all standard microorganisms was 1/64 dilution. All microorganisms were killed within 0 minutes and accurate killing time was 12 seconds. The stabilized HOCl solution had dose-dependent favorable effects on fibroblast and keratinocyte migration compared to povidone iodine and media alone. These features lead to a stabilized HOCl solution as an ideal wound care agent”



3. Totoraitis, Cohen et al. (2017). "Topical Approaches to Improve Surgical Outcomes and Wound Healing: A Review of Efficacy and Safety." J Drugs Dermatol **16**(3): 209-212.

“Surgical procedures are an important piece of a dermatologist's daily practice. Therefore, the optimization of post-surgical wound healing is an area of utmost importance and interest. In an attempt to mitigate this risk and improve surgical outcomes, multiple topical products continue to be used. Traditionally, this includes both topical antibiotics and antiseptics. Topical antiseptics, including chlorhexidine and povidone-iodine, can have a cytotoxic effect on keratinocytes and may actually impede wound healing as a result. In addition, **chlorhexidine in particular can produce both otologic and ocular toxic effects when used on the face.** Emerging products, such as hypochlorous acid, may be a potential alternative to the more commonly used agents, as it has effective antimicrobial actions and minimal adverse effects”

Venous Leg Ulcers

1. Bongiovanni (2014). "Effects of Hypochlorous Acid Solutions on Venous Leg Ulcers (VLU): Experience With 1249 VLUs in 897 Patients." J Am Coll Clin Wound Spec **6**(3): 32-37.

“897 patients with 1249 venous leg ulcers were treated with aqueous solutions of hypochlorous acid (HCA) rather than the standard normal saline. This protocol caused all ulcers to close completely. Venous leg ulcer care protocols that clean, debride, pack and dress with hypochlorous acid solutions can reduce the effects of some comorbidities while accelerating healing times”



2. Selkon, Cherry et al. (2006). "Evaluation of hypochlorous acid washes in the treatment of chronic venous leg ulcers." *J Wound Care* **15**(1): 33-37.

"Patients who failed to achieve a 44% reduction in wound size with standard treatment (compression bandaging) received HOCl washes. Of the 20 ulcers, nine (45%) healed and five (25%) reduced in size by over 60%, when treated with HOCL. All patients became free of pain. These findings confirm the clinical efficacy of treating venous leg ulcers with hypochlorous washes. Use of HOCl washes as an adjunctive therapy for recalcitrant venous leg ulcers appreciably increases healing and rapidly relieves pain"

3. Strohal, Mittlbock et al. (2018). "The Management of Critically Colonized and Locally Infected Leg Ulcers with an Acid-Oxidizing Solution: A Pilot Study." *Adv Skin Wound Care* **31**(4): 163-171.

"The study authors tested a new acid-oxidizing solution (AOS [Nexodyn]; APR Applied Pharma Research S.A., Balerna, Switzerland) to determine its ancillary antimicrobial properties and potential support for wound healing. In the study, 30 patients with critically colonized or locally infected chronic leg ulcers of any origin were included. Application of the solution was well tolerated, and no adverse events were recorded. In all patients, local infection was overcome, and wound bed pH and wound area decreased significantly. In addition, patient pain levels decreased to a level where interventions were not required after study day 7. In 37% of all patients, a complete resolution of chronic ulcers was achieved by the end of the study period.



According to these results, the AOS seems to be a valid and highly tolerable treatment to support wound healing in locally infected ulcers”

Treatment of Burns

1. Bunyan (1983). "The treatment of burns by hypochlorite solution." J Trop Pediatr **29**(2): 93-94.

“At the beginning of the Second World War it was reported that very dilute solutions of hypochlorite were effective in the treatment of wounds and burns. Rapid reduction of traumatic oedema and inflammation appeared to be the dominant factor in preventing infection, as well as the marked proteolytic effect, whereby burn sloughs were allowed to separate without putrefaction, resulting in healthy healing or healthy granulations on which grafts could be confidently expected to take completely. Hypochlorite, in its main constituent, hypochlorous acid, acts by combining with the proteins of the wound to form chloramines, which are powerfully bactericidal and bacteriostatic. Bacterial toxins are neutralized and infection is controlled or prevented. Acute surgical infections such as gas gangrene are quickly brought under control”

2. Gray, Foster et al. (2016). "Universal decolonization with hypochlorous solution in a burn intensive care unit in a tertiary care community hospital." Am J Infect Control **44**(9): 1044-1046.

“Infections are the leading cause of morbidity and mortality in burn patients. Patients colonized with methicillin-resistant Staphylococcus aureus (MRSA) are at higher risk of developing an invasive infection, and MRSA is endemic in many burn units. The typical decolonization regimen



of mupirocin and chlorhexidine bathing is not optimal in burn patients because of chlorhexidine limitations on nonintact skin. We studied the impact of universal decolonization using mupirocin and hypochlorous acid bathing on health care-associated MRSA infections in a burn intensive care unit. We show a significant decrease in total MRSA infections”

Hand Cleanser

1. Anagnostopoulos, Rong et al. (2018). "0.01% Hypochlorous Acid as an Alternative Skin Antiseptic: An In Vitro Comparison." *Dermatol Surg* **44**(12): 1489-1493.

“HOCL 0.01% were observed to have equal or more efficacious antiseptic properties compared with povidone iodine 5% (PI), chlorhexidine gluconate 4% (CHG), and isopropyl alcohol 70% (IPA) against common skin microorganisms, such as methicillin-susceptible *Staphylococcus aureus* (MSSA) and *Staphylococcus epidermidis* (MSSE), methicillin-resistant *S. aureus* (MRSA) and *S. epidermidis* (MRSE), *Candida albicans*, *Corynebacterium* species, *Propionibacterium acnes*, *Pseudomonas aeruginosa*, *Streptococcus pyogenes*, *Staphylococcus capitis* and *Staphylococcus xylosum*”

Acne, Eczema, Psoriasis, Allergic Dermatitis, Itching

1. Hypochlorous acid is effective in Atopic Dermatitis – Systematic Review

Vakharia and Silverberg (2018). "New therapies for atopic dermatitis: Additional treatment classes." *J Am Acad Dermatol* **78**(3 Suppl 1): S76-s83.



“HOCl has been shown to decrease numerous inflammatory cytokines, including tumor necrosis factor- α , interferon gamma, IL-2, and histamine, as well as nuclear factor kappa. In a recent case series, 7 days of treatment of patients with AD with topical hydrogel containing 0.008% HOCl and 0.002% NaOCl significantly reduced pruritus. PR022 is a topical formulation of HOCl that is being studied for the treatment of mild-to-moderate AD, with preclinical studies demonstrating lesional improvement with topical application”

2. Tirado-Sanchez, et.al. (2009). Efficacy and tolerance of superoxidized solution in the treatment of mild to moderate inflammatory acne. A double-blinded, placebocontrolled, parallel-group, randomized, clinical trial. *Journal of Dermatological Treatment*. **20**:289–292

A total of 89 patients were enrolled in this double blinded, clinical trial. Patients presented with 10–50 inflammatory lesions (papules and pustules) and an absence of nodulocystic lesions.

Results: Improvement was excellent in **nine** patients (23%) using HOCL, compared with **five** patients (21%) using benzoyl peroxide (BP) ($p = 0.378$); good in **21** patients (54%) using HOCL and **12** patients (50%) using BP ($p = 0.794$), compared with four patients (18%) taking placebo ($p = 0.001$); and fair in six patients (15%) using SOS and five patients (21%) using BP ($p = 0.415$), compared with 12 patients taking placebo (55%) ($p = 0.014$). In three patients using HOCL (8%) the response was poor, compared with two patients (8%) using BP ($p = 0.725$) and six patients (27%) taking placebo ($p = 0.075$). We did not need to change a dose during the study period and no systemic effect was observed. *Conclusions:* We found that HOCL is an important choice to treat inflammatory acne, comparable with benzoyl peroxide.



3. Fukuyama, Ehling et al. (2018). "Comparison of topical tofacitinib and 0.1% hypochlorous acid in a murine atopic dermatitis model." *BMC Pharmacol Toxicol* **19**(1): 37.

"When administered onto lesional skin of mice with atopic dermatitis, hypochlorous acid gel reduced lesions and scratching behaviour. The reduced inflammatory response was demonstrated by diminished inflammatory cytokines in affected skin tissue"

4. Fukuyama, Martel et al. (2018). "Hypochlorous acid is antipruritic and anti-inflammatory in a mouse model of atopic dermatitis." *Clin Exp Allergy* **48**(1): 78-88.

"When administered after full development of lesions, HOCl reduced lesions and scratching behaviour. The reduced inflammatory response by HOCl treatment was demonstrated by reduced secretion of inflammatory cytokines in affected skin tissue. In addition, HOCl significantly reduced IL-12 production in neuronal cells. The diminished scratching behaviour was confirmed by impaired response to several pruritogens in dorsal root ganglia neurons. These data indicate a direct reduction in sensory response by HOCl, leading to significantly reduced itch and inflammation in vivo.

5. Leung, Zhang et al. (2013). "Topical hypochlorite ameliorates NF-kappaB-mediated skin diseases in mice." *J Clin Invest* **123**(12): 5361-5370. "Nuclear factor-kappaB (NF-kappaB) regulates cellular responses to inflammation and aging. In cultured cells, HOCl inhibited the activity of inhibitor of NF-kappaB kinase (IKK), a key regulator of NF-kappaB activation, by oxidizing cysteine residues. For mice with acute radiation dermatitis, topical HOCl inhibited the expression of NF-kappaB-dependent genes, decreased disease severity, and prevented skin



ulceration. **Furthermore, these data suggest that topical HOCl reduces skin aging through IKK modulation”**

6. Microbicidal effect of weak acid hypochlorous solution on various microorganisms

Ono, Yamashita et al. (2012). "Microbicidal effect of weak acid hypochlorous solution on various microorganisms." *Biocontrol Sci* **17**(3): 129-133.

“We investigated the microbicidal effect of weak acid hypochlorous solutions of pH 5.0 - 6.0, produced by mixing NaClO and HCl in water, against various bacteria, fungi, and virus in vitro. The weak acid hypochlorous solution had excellent microbicidal effect against a broad microbicidal spectrum of standard strains and clinical isolates in a short time. The microbicidal effects of hypochlorous solutions did not depend on the available chlorine concentration but on the HClO concentration. These results show that the weak acid hypochlorous solution has practical applicability in such places as hospitals and establishments related to the food industry”

7. Mahamat, Brooker et al. (2011). "Impact of hypochlorite disinfection on meticillin-resistant *Staphylococcus aureus* rate." *J Hosp Infect* **78**(3): 243-245.

“MRSA rates in a hospital in the north east of Scotland were significantly declining due to a series of infection control interventions applied between February 2001 and January 2005. These included terminal disinfection of the environment in isolation rooms and cohort areas using sodium hypochlorite in place of detergent. Stopping the hypochlorite disinfection in February 2005 was associated with an increase in MRSA rates from 10% to 25% ($P \leq 0.03$) over a six-month



period, with rates approaching the pre-intervention levels. Other infection control measures remained unchanged. This work adds significantly to the meagre published evidence that environmental contamination is important in the transmission of MRSA”

8. Environmental control to reduce transmission of *Clostridium difficile*

Mayfield, Leet et al. (2000). "Environmental control to reduce transmission of *Clostridium difficile*." *Clin Infect Dis* **31**(4): 995-1000.

“Restrictive antibiotic policies and infection control measures have been shown to reduce the incidence of *Clostridium difficile*-associated diarrhea (CDAD) among hospitalized patients. To date, the role of environmental disinfectants in reducing nosocomial CDAD rates has not been well studied. In a before-and-after intervention study, patients in 3 units were evaluated to determine if unbuffered 1:10 hypochlorite solution is effective as an environmental disinfectant in reducing the incidence of CDAD. Among 4252 patients, the incidence rate of CDAD for bone marrow transplant patients decreased significantly, from 8.6 to 3.3 cases per 1000 patient-days, after the environmental disinfectant was switched from quaternary ammonium to 1:10 hypochlorite solution in the rooms of patients with CDAD. Reverting later to quaternary ammonium solution increased the CDAD rate to 8.1 cases per 1000 patient-days. Unbuffered 1:10 hypochlorite solution is effective in decreasing patients' risk of developing CDAD in areas where CDAD is highly endemic”

9. Reduction of faecal coliform, coliform and heterotrophic plate count bacteria in the household kitchen and bathroom by disinfection with hypochlorite cleaners



Rusin, Orosz-Coughlin et al. (1998). "Reduction of faecal coliform, coliform and heterotrophic plate count bacteria in the household kitchen and bathroom by disinfection with hypochlorite cleaners." J Appl Microbiol **85**(5): 819-828.

"Fourteen sites evenly divided between the household kitchen and bathroom were monitored on a weekly basis for numbers of faecal coliforms, total coliforms and heterotrophic plate count bacteria. The first 10 weeks comprised the control period, hypochlorite cleaning products were introduced into the household during the second 10 weeks, and a strict cleaning regimen using hypochlorite products was implemented during the last 10 weeks. The implementation of a cleaning regimen with common household hypochlorite products resulted in the significant reduction of all three classes of bacteria at these four sites and other household sites"

10. Methicillin-resistant Staphylococcus aureus (MRSA) contamination in bedside surfaces of a hospital ward and the potential effectiveness of enhanced disinfection with an antimicrobial polymer surfactant

Yuen, Chung et al. (2015). "Methicillin-resistant Staphylococcus aureus (MRSA) contamination in bedside surfaces of a hospital ward and the potential effectiveness of enhanced disinfection with an antimicrobial polymer surfactant." Int J Environ Res Public Health **12**(3): 3026-3041.

"A field experimental study was designed with the QAC plus daily hypochlorite cleaning as the experimental group and hypochlorite cleaning alone as the control group. In the experimental group, the mean staphylococcal concentration of bedside surfaces was significantly ($p < 0.0001$) reduced. The results of this study support the view that, in addition to hypochlorite wiping, the



tested QAC surfactant is a potential environmental decontamination strategy for preventing the transmission of clinically important pathogens in medical wards”

11. Inactivation of bacteria on surfaces by sprayed slightly acidic hypochlorous acid water: in vitro experiments

Hakim, Alam et al. (2016). "Inactivation of bacteria on surfaces by sprayed slightly acidic hypochlorous acid water: in vitro experiments." J Vet Med Sci **78**(7): 1123-1128.

The capacity of slightly acidic hypochlorous acid water (SAHW), in both liquid and spray form, to inactivate bacteria was evaluated. **SAHW was able to inactivate *Escherichia coli* and *Salmonella Infantis* to below detectable levels within 5 sec of exposure.** In addition, SAHW antibacterial capacity was evaluated by spraying it using a nebulizer into a box containing these bacteria. SAHW was able to inactivate both bacterial species on the glass plates (dry condition) and rayon sheets within 5 min spraying. Our findings demonstrate that SAHW is a good candidate for biosecurity enhancement. Spraying it on the surfaces of objects, eggshells, egg incubators and transport cages could reduce the chances of contamination and disease transmission”

12. Airborne fungi and bacteria in child daycare centers and the effectiveness of weak acid hypochlorous water on controlling microbes

Chen, Su et al. (2012). "Airborne fungi and bacteria in child daycare centers and the effectiveness of weak acid hypochlorous water on controlling microbes." J Environ Monit **14**(10): 2692-2697.



“A three-week-long biological sampling scheme was conducted in two child daycare centers (CDCCs) in order to investigate efficiency of weak acid hypochlorous water (WAHW) on disinfecting indoor microbes. This study clearly clarified the risky period during which children may be exposed to hazardous environments, and demonstrated the effectiveness of spraying WAHW the night before on decontaminating indoor airborne microbes on the following day, especially in the case of fungi”

13. Efficacy of liquid spray decontaminants (with HOCL) for inactivation of *Bacillus anthracis* spores on building and outdoor materials

Wood, Choi et al. (2011). "Efficacy of liquid spray decontaminants for inactivation of *Bacillus anthracis* spores on building and outdoor materials." *J Appl Microbiol* **110**(5): 1262-1273.

“Decontaminants utilizing hypochlorous acid chemistry was effective to inactivate *Bacillus anthracis* Ames and *Bacillus subtilis* spores on building and outdoor materials”

Effect on Micro-Organisms – Viruses

1. Studies on air-borne virus infections: III. The killing of aerial suspensions of influenza virus by hypochlorous acid

“Recently considerable interest has been taken in the possibility of combating air-borne infection by means of antiseptics dispersed in the air as fine particles. The effect of such bactericidal mists upon virus particles suspended in the air has therefore been studied. A brief reference has already been made to the results of these experiments which showed that aerosols of influenza



virus could be rendered non-infective. Preliminary tests suggested that influenza virus was susceptible to mists of hexyl resorcinol in propylene glycol, but only the action of hypochlorite was studied in detail as it appeared the more likely to be of practical value under wartime conditions”

Citation - Edward and Lidwell (1943). "Studies on air-borne virus infections: III. The killing of aerial suspensions of influenza virus by hypochlorous acid." J Hyg (Lond) **43**(3): 196-200.

2. Aerosol Disinfection Capacity of Slightly Acidic Hypochlorous Acid Water Towards Newcastle Disease Virus in the Air: An In Vivo Experiment

Hakim, Thammakarn et al. (2015). "Aerosol Disinfection Capacity of Slightly Acidic Hypochlorous Acid Water Towards Newcastle Disease Virus in the Air: An In Vivo Experiment." Avian Dis **59**(4): 486-491.

“Here we selected slightly acidic hypochlorous acid water (SAHW) as a candidate and evaluated its virucidal efficacy toward a virus in the air. Three-day-old conventional chicks were challenged with 25 doses of Newcastle disease live vaccine, while at the same time reverse osmosis water as the control and SAHW containing 50 or 100 parts per million (ppm) free available chlorine in pH 6 were sprayed on the treated chicks with other nebulizers. Subsequently, the virus was isolated from the control and 50 ppm treatment groups, while no clinical signs were observed in and no virus was isolated from the 100 ppm treatment group. The virulent Newcastle disease virus (NDV) strain Sato, too, was immediately inactivated by SAHW containing 50 ppm chlorine



in the aqueous phase. These data suggest that SAHW containing 100 ppm chlorine can be used for aerosol disinfection of NDV in farms”

3. The effect of a low concentration of hypochlorous acid on rhinovirus infection of nasal epithelial cells

Yu, Park et al. (2011). "The effect of a low concentration of hypochlorous acid on rhinovirus infection of nasal epithelial cells." *Am J Rhinol Allergy* **25**(1): 40-44. “Low concentrations of hypochlorous acid (HOCl) have been shown to exhibit both antibacterial and anti-influenza virus activity. To model the antiviral effect of nasal irrigation with low-level HOCl in patients with the common cold, we tested the effects of a low concentration of HOCl on HRV infection of primary human nasal epithelial cells (HNEC). HOCl treatment significantly inhibited HRV-induced secretion of IL-6 and IL-8 and significantly reduced viral titer. The effects of HOCl peaked at 1 minute after HOCl generation and decreased thereafter. These in vitro findings indicate that nasal irrigation with low-level HOCl solution may improve clinical symptoms in patients with the common cold”

4. Effects of a low concentration hypochlorous Acid nasal irrigation solution on bacteria, fungi, and virus

Kim, Lee et al. (2008). "Effects of a low concentration hypochlorous Acid nasal irrigation solution on bacteria, fungi, and virus." *Laryngoscope* **118**(10): 1862-1867.

“Low concentrations of hypochlorous acid may be used as a nasal irrigation solution. The study evaluated bactericidal, fungicidal, and virucidal effects by challenging the cells with the following



microorganisms *Aspergillus fumigatus*, *Haemophilus influenzae*, *Klebsiella pneumoniae*, *Rhizopus oryzae*, *Candida albicans*, *Methicillin-resistant Staphylococcus aureus*, *Streptococcus pneumoniae*, and *Streptococcus pyogenes*. To study the virucidal effects of HOCl, we used the human influenza A virus. More than 99% of bactericidal or fungicidal activity was noted for all species, except for *Candida albicans*”

Dental/Gum Disease, Mouth Sores and Halitosis

1. Safety of low-concentration hypochlorous acid as a mouthwash and antibacterial effect on oral bacteria

Kim et al. (2011). "The Safety of Low Concentration Hypochlorous Acid as an Oral Gargle Solution and Its Anti-Microbial Effects." *Korean Journal of Otorhinolaryngology-Head and Neck Surgery* **54**(6): 403-407. “The authors aimed to evaluate the safety of low concentration hypochlorous acid as an oral gargle solution. The authors treated oral mucosal epithelial cell with 3.5 ppm hypochlorous acid and evaluated cytotoxicity. For evaluation of efficacy, we performed oral gargle with normal saline, chlorhexidine and hypochlorous acid in 10 healthy volunteers. The throat cultures were performed before and after each gargling. *Staphylococcus aureus*, *Streptococcus pneumoniae*, *Streptococcus pyogenes*, *Haemophilus influenzae*, *Klebsiella pneumoniae*, *Aspergillus fumigatus*, *Rhizopus oryzae* were evaluated semi-quantitatively

There was no cellular toxicity in MTT assay and the morphological changes were not observed. Both chlorhexidine and hypochlorous acid showed significant decrease of microbes (chlorhexidine: $p=0.036$, hypochlorous acid: $p=0.031$). There was no significant differences



between them ($p=0.217$). Low concentration hypochlorous acid is safe for the oral mucosal epithelium and has antimicrobial efficacy similar to that of chlorhexidine”

2. Viability and Effects on Bacterial Proteins by Oral Rinses with Hypochlorous Acid as Active Ingredient

Castillo et al. (2015). "Viability and Effects on Bacterial Proteins by Oral Rinses with Hypochlorous Acid as Active Ingredient." *Braz Dent J* **26**(5): 519-524. “This study investigated the effect of hypochlorous acid (HOCl) rinses and chlorhexidine (CHX) on the bacterial viability of *S. mutans*, *A. israelii*, *P. gingivalis*, *A. actinomycetemcomitans*, *E. corrodens*, *C. rectus*, *K. oxytoca*, *K. pneumoniae* and *E. cloacae*. HOCl was more effective than CHX against *P. gingivalis*, *A. actinomycetemcomitans*, *C. rectus* and *K. oxytoca* ($p=0.001$). CHX and HOCl had similar efficacy against *K. pneumoniae*”

Allergy Symptoms Relief and Respiratory Diseases

1. Improved outcomes after low-concentration hypochlorous acid nasal irrigation in pediatric chronic sinusitis

Cho, Min et al. (2016). "Improved outcomes after low-concentration hypochlorous acid nasal irrigation in pediatric chronic sinusitis." *Laryngoscope* **126**(4): 791-795.

“We aimed to evaluate the effectiveness of low-concentration hypochlorous acid (HOCl) nasal irrigation compared to isotonic normal saline for pediatric chronic rhinosinusitis. Total symptom, X-ray scores significantly improved with HOCl. Nasal irrigation with HOCl is an effective adjuvant treatment compared to isotonic normal saline for pediatric sinusitis”



2. Super-oxidized solution inhibits IgE-antigen-induced degranulation and cytokine release in mast cells

Medina-Tamayo, et.al. Super-oxidized solution inhibits IgE-antigen-induced degranulation and cytokine release in mast cells. *International Immunopharmacology* 7 (2007) 1013–1024.

“In summary, our data suggest that HOCL is able to inhibit the cell machinery for granule secretion without altering the main signal transduction pathway induced by IgE-antigen receptor crosslinking. This is a relevant finding because the identification of the mechanism(s) of action of HOCL on mast cells could help to identify novel targets in the intricate pathways that control allergic and inflammatory reactions.”

Eyes

Reduction in bacterial load using hypochlorous acid hygiene solution on ocular skin

Stroman, Mintun et al. (2017). "Reduction in bacterial load using hypochlorous acid hygiene solution on ocular skin." *Clin Ophthalmol* **11**: 707-714.

“The application of a saline hygiene solution preserved with pure HOCl acid reduced the bacterial load significantly without altering the diversity of bacterial species remaining on the skin under the lower eyelid”

Exit-Site Care In Peritoneal Dialysis

Wadhwa and Reddy (2007). "Exit-site care in peritoneal dialysis." *Contrib Nephrol* **154**: 117-124.



“Exit-site infection (ESI), tunnel infection and associated peritonitis are major causes of morbidity and catheter loss in chronic peritoneal dialysis patients. Meticulous exit-site care is vital in preventing ESI. Avoiding trauma to the exit-site and daily cleaning of the exit-site with a dedicated antimicrobial soap is essential for the longevity of the peritoneal dialysis catheter. ESI rates in peritoneal dialysis patients treated with HOCL for the exit-site care are similar or lower compared to povidone-iodine or chlorhexidine.