

Hypochlorous acid: harnessing nature's germ killer

OptometryTimes.com

December 20, 2019

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Hypochlorous acid (HOCl) is the perfect weapon to fight germs. It hits hard against pathogens like Methicillin-Resistant Staphylococcus Aureus and Pseudomonas Aeruginosa. Yet this powerful weapon is 100 percent safe for humans, chemical free, non-toxic and all-natural. That's an impressive combination. It has been used in the medical field for over a century. Before antibiotics were available, HOCl was used to irrigate and disinfect wounds in World War I. It is now used in everyday settings including daycare centers, hospitals, and even produce sections in grocery stores.

HOCl is a weak acid that occurs naturally in our body. Neutrophils are white blood cells that are the first to arrive on site when an invading pathogen is detected. Neutrophils will chase down and engulf the pathogen through phagocytosis. Upon contact, neutrophils release a burst of bactericidal chemicals including its most powerful oxidizing agent, HOCl. This kills the pathogen by tearing down the cell membranes and proteins.

Killing germs

As you are aware, we have other strong disinfectant agents at our disposal. Bleach is widely used in hospitals and medical practices and shares the same chlorine family as HOCl. Research shows that they both kill bacteria, fungus, spores, and viruses. Yet bleach is highly irritating to the eyes, skin, and lungs- and inhalation over long periods could be carcinogenic. In contrast, HOCl has a temporary and mild chlorine smell that dissipates quickly, it is non-irritating, and it does not have poisonous side effects.

Alcohol is a popular disinfectant to use in clinic for wiping down instruments, furniture, and is a key ingredient in hand sanitizers. Ethyl alcohol (70%) is considered more effective compared to isopropyl alcohol. Both are bactericidal, fungicidal, and viricidal but are not effective against bacterial spores.³

Hand sanitizers with alcohol are used daily in many medical offices, but over time repeated use may lead to hand dermatitis. I became allergic to hand sanitizers after using it for many months in clinic. It was extremely irritating and embarrassing to have a rash on my hands. After discontinuing hand sanitizers and using latex free gloves, it still took months for my hand dermatitis to resolve. In one study, the prevalence of contact dermatitis related to hand hygiene ranged from 25 to 55 percent. Fortunately, HOCl acid can also be used in place of hand sanitizer with no irritating side effects. Moreover, punch HOCl delivers to pathogens is more powerful than the one delivered by alcohol.

Manufacturing HOCl

If hypochlorous acid is such a powerful weapon against germs, why isn't it more widely used? There are a couple of reasons, one being the cost to manufacturers. HOCl was very cost prohibitive until recently. Also, HOCl is stable for only a very short time before it became saltwater. Technology has corrected this problem over the years and now, HOCl can remain stable for years and it is less costly to create.

There are currently three different ways to synthesize HOCl. It is highly unstable when isolated in pure form and therefore can only exist in solution. One method to create HOCl is to electrolyze water and sodium chloride. However, this method can be tricky to manufacture. The easiest method is the acidification of hypochlorite (HClO), a chemical also used in manufacturing bleach and is readily commercially available. The most difficult method is to add gaseous chlorine to induce hydrolysis. It requires the use of chlorine gas, a highly toxic chemical that is problematic to manipulate.

Hypochlorous acid's Kryptonite

The pH level of HOCl is its Kryptonite. The pH of the solution must be maintained between a range of 3 to 6 in order to maintain a proper concentration of HOCl. When the pH is outside of this range, dissociation occurs. A higher pH will have more hypochlorite (OCl⁻) in the solution, whereas a lower pH will produce a higher concentration of chlorine (Cl₂). The powerful effect against pathogens is concentration dependent on HOCl. To prevent its dissociation, the optimal pH range must be maintained.

Another study found HOCl lost its stability when exposed to ultraviolet light, sunshine, air, and higher temperatures ($\geq 77^{\circ}\text{F}$). Some HOCl products last for a month once the bottle is opened. Some need to be stored in a glass opaque bottle to ensure stability. Therefore, it is important to read the manufacturer's instructions on whether an open bottle affects the expiration date.

Hypochlorous acid's role in optometry

Avenova was the first company to recognize HOCl's potential in fighting germs. Since then, other companies have jumped on the bandwagon and are available without a prescription: Bruder Hygienic Eyelid Solution, Heyedrate Lid and Lash Cleanser, Ocusoft Hypochlor, Pure & Clean Lid Prep Vision Source, Theratears Sterilid Antimicrobial Eyelid Cleanser & Facial Wash, and We Love Eyes Hypochlorous Eyelid & Eyelash Cleansing Spray.

A recent study tested HOCl's effect on decreasing the bacterial load on the periocular skin. After 20 minutes, a single application of 0.01% HOCl decreased staphylococci by 99.6 percent on 71 eyes. Repeated applications are important because recolonization of bacteria occurs rapidly.

HOCl has also been shown to be effective against epidemic keratoconjunctivitis (EKC) in a small case study. There were 14 cases of EKC treated with 0.008 percent HOCl four times a day. Patients showed improvement in signs and symptoms.⁹ In contrast, HOCl was not shown to be effective against demodex in Kabat's study published this past July.¹⁰

HOCl is a powerful force of nature against pathogens. It has multiple uses as an effective disinfectant both inside and outside of optometry. Yet, the fact that it is non-toxic and safe in application is a powerful combination that deserves consideration in patient care as well as in disinfection protocols in office.

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