

Chlorine Dioxide Complex Cleanser: A New Agent With Rapid Efficacy for Keratosis Pilaris

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ABSTRACT

Chlorine dioxide complex™ is a new molecule to dermatology that is a unique, non-toxic, broad spectrum anti-microbial and keratolytic compound. Chlorine dioxide has been used as an antiseptic in industrial settings for decades, primarily in water treatment facilities for municipal water supplies and food preparation. The compound has exceptional antiseptic properties with no known potential for development of resistance. It is a true keratolytic and anti-inflammatory, but is non-toxic to human tissue due to its unique mechanism of action. Chlorine dioxide's use in consumer products was previously limited because it is inherently an unstable molecule that had to be used quickly after it was produced. However, the recent development of a complexed form of chlorine dioxide that retains its antimicrobial and keratolytic activity has allowed the development of products (AsepticMD, Aseptic Plus, Nashville, TN) that take advantage of the properties of this unique molecule. Here we report a case series demonstrating its efficacy as a cleanser in keratosis pilaris.

J Drugs Dermatol. 2018;17(5):554-556.

INTRODUCTION

Chlorine dioxide (ClO2) is a volatile, reactive gas at room temperature that was first synthesized in 1811. Early uses included as a pulp bleaching agent for paper making and as a disinfectant, but it was too expensive for routine industrial use until the 1940s. It has since been used in 5-10% of municipal water treatment facilities for water disinfection and deodorizing and is widely used as a food disinfectant.[1, 2] Although ClO2 gas is toxic at high concentrations by inhalation, when it is solubilized in water and applied to human tissue there is an absence of toxicity due to deactivation by intracellular defenses and the unique mechanism of action.[3]

When tested for antibacterial effectiveness against other antiseptics, such as bleach, hydrogen peroxide, iodophors, chlorhexidine, quaternary ammonium compounds, and others, ClO2 is the most effective agent, both against typical organisms and against multidrug resistant Staph and Pseudomonas.[4-6] It also has excellent activity against viruses, yeast and mycobacteria, as well as bacterial spores and biofilms.[6-17] In addition, it is anti-inflammatory by neutralizing reactive oxygen molecules and cytokines and also acts as a true keratolytic, degrading both the inter- and intramolecular disulfide bonds that stabilize keratin.[18-20]

While ClO2 complex™ has numerous potential applications in dermatology, early experience has demonstrated exceptional efficacy in keratosis pilaris, primarily related to its keratolytic effects.

Report of Cases

Table 1 outlines the demographics, clinical findings, and response to therapy of patients treated with chlorine dioxide complex wash (AsepticMD, Nashville, TN) in the authors' practice. All patients used the foaming facial cleanser and were instructed to wash once daily, gently rubbing the affected area for 5-10 seconds with a soft cotton cloth. No additional moisturizers, abrasion, or other interventions were used.

DISCUSSION

Keratosis Pilaris (KP) is a common complaint, affecting between 10% and 30% of the population. Onset is typically in childhood and although it frequently improves with age it does commonly persist into adulthood. Typical therapies include moisturizers containing keratolytics such as salicylic acid, lactic acid (or ammonium lactate) or urea. These treatments typically take several weeks to have an effect and must be used on an ongoing basis.[21, 22] Additionally, more aggressive therapy with topical retinoids has been attempted, but can be limited by irritation and cost.[23] Finally, several lasers have been reported to be effective, but treatment is again limited by cost.[24-29]

Chlorine dioxide complex wash led to rapid, nearly complete resolution of keratosis pilaris in the reported patients. It presents several benefits over existing treatments, including low cost and ease of use – essentially all individuals use soap on a daily basis, while daily application of moisturizer is much less likely, especially in adolescents who have notoriously low compliance.

Unlike other keratolytics, ClO2 is a highly specific oxidizer – it reacts with several specific amino acids in proteins, but does not react with or oxidize lipids, carbohydrates, or other organic

TABLE 1.

Clinical Findings and Result of Therapy with Chlorine Dioxide Complex Wash

Demographics	Involved area	Response to therapy
12 y/o female	Cheeks	Papules resolved in 3 days, minimal effect on erythema (Figure 1)
11 y/o female	Anterior Thighs	Papules resolved in 2 days, minimal effect on erythema (Figure 2)
13 y/o female	Posterior arms	Papules resolved in 2 weeks, minimal effect on erythema (Figure 3)
28 y/o female	Posterior arms	Papules 90% resolved in 1 month, minimal effect on erythema
20 y/o female	Cheeks	Papules resolved in 2 weeks, minimal effect on erythema

molecules.[3] Specifically, it reacts with cysteine, tyrosine, tryptophan, methionine, proline, hydroxyproline, and histidine, with most of its biologic activity coming from the reactions with cysteine, methionine, tyrosine, and tryptophan. [30-34]

This mechanism of action explains chlorine dioxide complex's rapid efficacy compared to traditional treatments for keratosis pilaris. Agents called "keratolytic", such as lactic acid, salicylic acid, benzoyl peroxide, ammonium lactate, and urea at concentrations less than 40%, do not have any direct effect on keratin – instead they hydrate the stratum corneum, allowing proteases to resume normal function and desquamation to proceed more normally than in dry conditions.[35] This has the obvious drawback of being slow, as it does not actually accelerate the rate of keratin removal compared to normal skin – it only returns it to being closer to a normal rate. ClO2, on the other hand, directly attacks the cysteine residues in keratin as well as the inter- and intramolecular disulfide bonds between and within keratin chains, thus acting as a true keratolytic that directly softens keratin and reduces its cohesiveness.[18, 19]

Chlorine dioxide's specificity for certain amino acids also explains its lack of toxicity. Non-specific oxidizers damage cells both internally by oxidizing proteins and externally by oxidizing lipids in cell membranes. ClO2 does not damage cell membranes because it does not oxidize lipids. Then, when ClO2 does enter cells, it rapidly reacts with the cysteine residues in glutathione, a key intracellular antioxidant peptide in both bacteria and mammalian cells. Because the reaction with cysteine is the most rapid chemical activity of ClO2, as long as a cell has reserves of active glutathione with unreacted cysteine, the ClO2 will not damage other cellular components.[3,30] Obviously there is potential for ClO2 toxicity to mammalian cells if the concentration is high enough, and while this exact concentration has not been defined, it is much higher than the concentration of ClO2 in use, giving ClO2 a very wide

FIGURE 1. Facial keratosis pilaris at baseline (A) and after 2 days (B) of using only chlorine dioxide complex wash once daily.

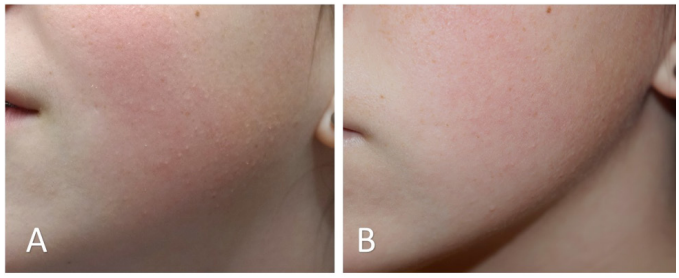


FIGURE 2. Keratosis pilaris of the thigh at baseline (A) and after 2 days (B) of using chlorine dioxide complex wash once daily.

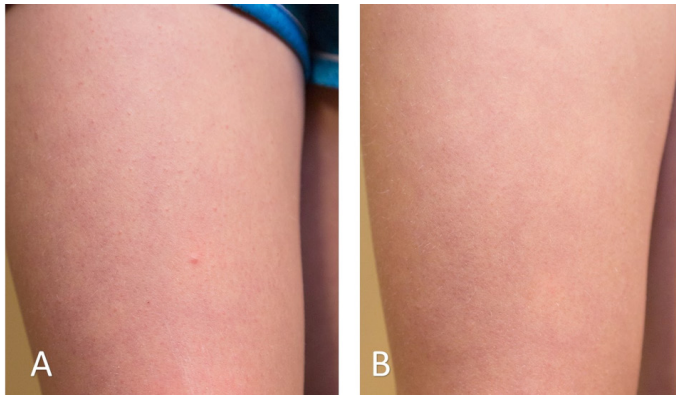
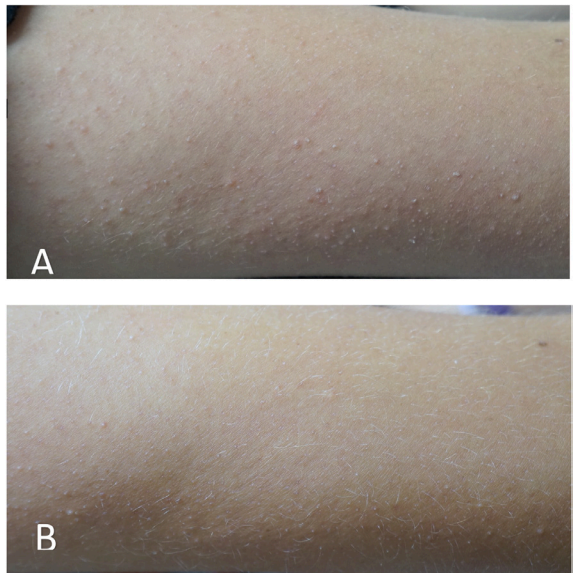


FIGURE 3. Keratosis pilaris of the upper arm before (A) and after (B) two weeks of once daily use of chlorine dioxide complex wash.



therapeutic window.[3] Alternatively, bacteria have a substantially lower intracellular reserve of glutathione that is easily depleted, allowing chlorine dioxide to become cytotoxic.

Given its unique properties, there are a number of obvious uses for chlorine dioxide in dermatology, so one must wonder why it is has not already been used in dermatology. The answer lies in the practical problem of low stability – ClO2 degrades long before any product would reach the end user. One attempt to overcome this involved two bottle systems, in which two solutions that reacted to form ClO2 were mixed together just before use – while these products have existed, especially as mouth rinses and wound care agents, the formulations possible were severely limited and they were quite inconvenient. This practical problem has been overcome by a unique process that complexes the chlorine dioxide into a stable compound that retains all of the useful properties of ClO2. This chlorine dioxide complex, while giving significant flexibility in formulation, still must be formulated carefully to ensure it does not react with other components of the formulation.

DISCLOSURES

Dr. Zirwas has served as a consultant for Valeant, Sun Products, Medimetricks, Promius, Anacor, Exeltis, Genentech, fitbit, and Smart Practice. He has been involved in the development of chlorine dioxide complex and is a part owner for AsepticMD.

Dr. Fichtel has an ownership stake in Strathspey Crown and Alphaeon, neither of which have any relationship with AsepticMD.

Chlorine dioxide complex was developed by Frontier Pharmaceutical and is patent pending.

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