Use of HOCl by the Human Body…. THE HUMAN BODY CONNECTION

Born to Fight Infection

Micro-organisms are found in the air we breathe and on the food we eat.

As soon as a baby is born, innate defense mechanisms immediately protect the body and prevent infection by invading pathogens\ … microorganisms that are capable of causing diseases. The first line of defense is an external mechanical resistance that blocks entry into the human body. The skin acts as a wall that keeps pathogens out of the body.

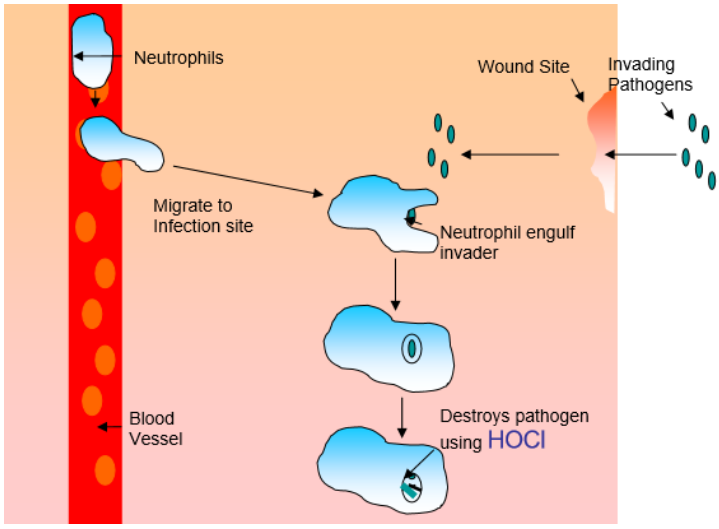
This nearly impermeable barrier is reinforced with chemical weapons such as lysozyme in the mouth which destroys bacterial cell walls and the acid pH of the stomach which inhibits microbial growth.

Internal surfaces of the body secrete a sticky substance called mucus, which lines the surfaces of the respiratory, digestive, excretory and reproductive systems. This barrier coats and traps invading pathogens, which can then be can be swept away by cilia or destroyed by stomach acid.

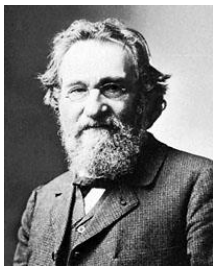
Protection Against Unwanted Invaders

The second line of defense is the inflammatory response (Fig 1). White blood cells such as neutrophils respond to any tissue invasion by migrating to the site of infection.

Neutrophils, seek out pathogens such as bacteria or viruses, surround and destroy them using **hypochlorous acid** (**HOCl**).
This process is known as phagocytosis (1)



Phagocytosis (Hunting for Food)

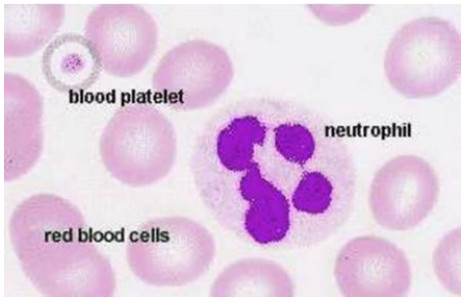


In the 1880s, the Nobel Prize-winning Russian microbiologist **Metchnikoff** (Fig 2) first reported the process of Phagocytosis. Metchnikoff observed that mobile white blood cells responded to the site of an infection and engulfed and destroyed the invading bacteria (2).

Metchnikoff called these hunting cells phagocytes, Greek for "eating cells," and published his findings in 1883. The most common type of Phagocyte is the neutrophil, with 50 to 70 percent of the White Blood Cells in the body consist of neutrophils white blood cells. (Fig 3):

Humans Advanced Radar Warning System

The human body senses damage to tissue and, as part of the inflammation response sends out biochemical messengers called histamines in response to microbial invasion. These messengers act as warning signals to the body, increasing blood flow at the site of infection, causing the capillaries to become porous allowing neutrophil white blood cells to leave the capillaries and migrate to the site of infection (1).



Seeking Out and Engaging the Enemy

The neutrophils hunt down the 'bad guys' … following the chemical trails left by invading micro-organisms through the process of chemotaxis. Once the neutrophils have identified their target they bind to outer surfaces and devour them (Fig 4).

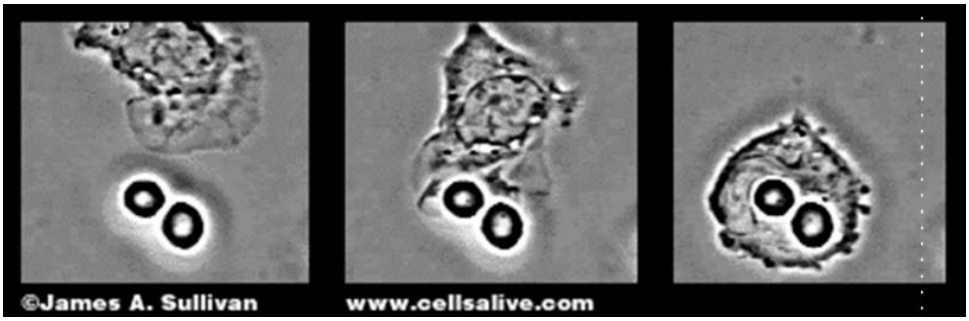
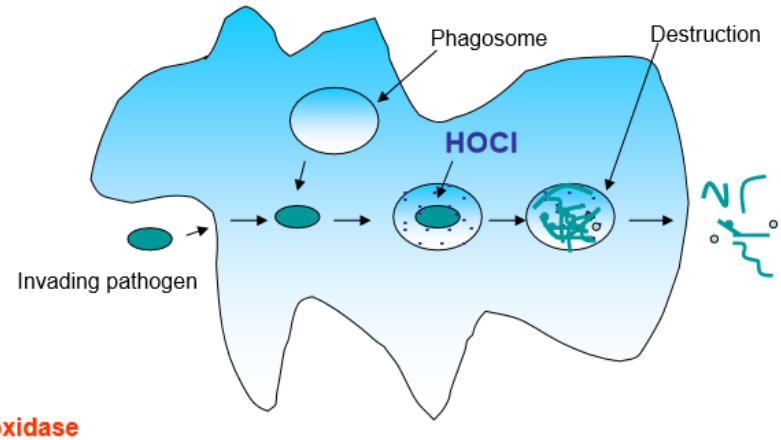


Fig 4 The process of Phagocytosis

Finishing off the Bad Guy

Once engulfed inside the neutrophil cell, the pathogen is encapsulated by a phagosome. The phagosome generates **HOCL** as the final step of the Oxidative Burst pathway, the centerpiece of the phagocytic killing mechanism. Large quantities of HOCl are released into the phagocytic vesicle to destroy the invading pathogen (Fig 5) (3).

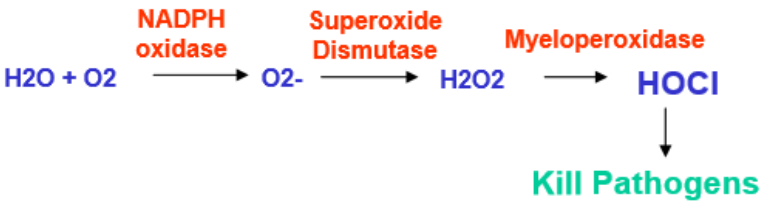
Fig 5 The destruction of invading pathogens



Chemistry of Neutrophil HOCL Production

During the oxidative burst pathway (Fig 6), neutrophils utilize the NADP oxidase enzyme complex which catalyzes the conversion of oxygen into superoxide anion (O^{2-}) (Fig 6).

Fig 6 The oxidative burst pathway

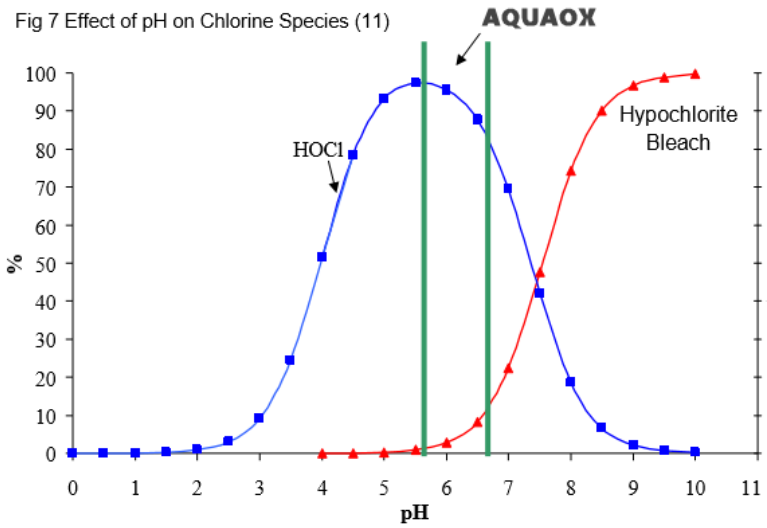


Superoxide dismutase then converts superoxide and water dismutase to form hydrogen peroxide (H_2O_2) and hydroxyl (OH) radicals (Fig 3). In the case of neutrophils, the hydrogen peroxide then combines with chloride (Cl^{2-}) ions by the action of the enzyme myeloperoxidase (MPO) to form **hypochlorous acid** (**HOCL**) (4).

The Beauty of AQUAOX

AQUAOX simply takes salt, water, and electricity and makes HOCL. AQUAOX is produced when required to kill harmful microorganisms at the same concentration and at the same pH range as HOCl produced by the human body. AQUAOX is made on site on demand and replaces harmful and dangerous chemical.

Fig 7 Effect of pH on Chlorine Species (11)



HOCl is many times more effective at killing harmful pathogens than hypochlorite, the major constituent of bleach (5). The AQUAOX process generates HOCl at near neutral pH using patented technology which generates the solution at the optimum pH to generate the maximum levels of hypochlorous acid (Fig 7).

Historical Use of Chlorine and HOCl

The laws of electrolysis were discovered by the English chemist Michael Faraday in 1832 (Fig 8). Electrolysis is the passing of an electrical current through a salt electrolyte, which then breaks up into a positive and negatively charged solution (6). By the latter part of the 19th century chlorine and hypochlorite were being produced by the electrolysis of aqueous sodium chloride solutions.

Fig 8 Michael Faraday

The antimicrobial activity of **HOCl** was demonstrated over 120 years ago by Koch (7). It has found application in the treatment of recreational and industrial water systems, sanitary applications and surface disinfection in the food industry and the disposal of hospital waste (8,9) Granum & Magnussen, 1987; Tsai & Lin, 1999). Heuter first used **HOCl as a wound disinfectant** in 1831 and Semmelweis utilised its bactericidal properties as a hand wash in 1847, this form of uncombined chlorine has been widely used for the control of microbial activity.

HOCl First World War Life Saver

During The First World War many allied soldiers lives were saved by a wound treatment process developed by Alexis Carrel, a Nobel Prize winning French surgeon and Drysdale Dakin a British biochemist. The treatment involved a combination of removal of dead cells known as debridement, using specialized surgical technique and continuous irrigation with HOCl antiseptic fluid (10). As HOCl is not stable, the fluid was produced by adding boric acid to hypochlorite and delivered using a complex system of rubber tubing delivered HOCl known as Dakin solution to nearly every inner surface of the wound. Patients who received the Carrel treatment typically recovered in less than half the time of patients treated by other methods and was widely adopted in the middle of 1915, saving lives and reduced the suffering of millions of allied soldiers.

Fig 9 Carrel Dakin Wound Treatment

Mimicking the Human Body

AQUAOX takes simple elements [salt and water] and generates HOCl, a natural biocide made by the human body's white blood cells that fight infection.

References

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