



Antibacterial effect of ultrasonic fogger machine on the environment of dental clinic

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Abstract

It is very important to obtain the maximum sterilization and antibacterial effect inside the dental clinic. This study aimed to explore the antibacterial effect of the ultrasonic fogger machine. The method is based on spraying an antibacterial agent inside the dental clinic and calculating the number of colony-forming units (that will appear on agar plates) before and after using the fogger machine. 10 samples were taken from the environment of the dental clinic (the operation room), these samples were streaked on blood agar and incubated. After 24 hours, the colony-forming units were calculated. Another sample was taken after using the fogger machine, and also streaked on blood agar and incubated. The colony-forming units were calculated again. The fogger machine showed good antibacterial effects with about 60% of the bacterial colonies were disappeared. Based on the results of this study, the fogger machine was a good choice in sterilizing the dental clinic environment.

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Introduction

The sterilization of the dental clinic environment is a very important thing since the air becomes loaded with multiple types of bacteria and viruses that came from the persons who visit the clinic for treatment. The dental devices and machines use compressed air to operate the high-speed turbines and this will facilitate the spreading of the pollutant all around. For sterilizing purposes, many procedures could be used, ventilation systems, air vacuums, air filters, ultraviolet lamps and fogger machines (Enrica *et al.*, 2019).

The medical ultrasonic fogger machine is a device that converts a liquid anti-bacterial agent to a dense vapor by using ultrasonic vibrations. This vapor consists of very small size droplets (in microns).

The small size of droplets will make it an airborne particle and this feature will facilitate their spreading in the air (Stefan Kooij *et al.* 2019). There are many liquids used as a sterilizer with the fogger machine, for example (chlorine dioxide, hydrogen peroxide, sodium hypochlorite, and hypochlorous acid).

The hypochlorous acid is an oxidizing agent, in an aqueous state it dissociates into H⁺ ions and OCl⁻ ions. It is also an endogenous material that is synthesized inside the human body and has a great role in responding to infections (Serhan Sakarya *et al.*, 2014). The hypochlorous acid can bind to the lipid layer of the bacterial cells and disturb cellular integrity. It has a broad-spectrum antimicrobial activity especially in pH level 3-6 (Dychdala *et al.*, 2001). The aim of this study is to clarify the ability of the ultrasonic fogger machine in sterilizing the environment of the dental clinic by using hypochlorous acid as an antibacterial agent, since it is widely available and have low cost.

Materials and methods

The environment inside the dental clinic has been examined 20 times, 10 times before the exposure to the hypochlorous acid and 10 times after the exposure.

10 persons were allowed to enter the operation room and stay for 5 minutes. Those persons have no dental issues and they were subjected to simple routine dental polishing. The purpose of getting them inside the clinic is only to make the clinic occupied by many persons to test the antibacterial effect of the hypochlorous acid. 10 agar media have been used (blood agar) to record the bacterial loading in the environment of the dental clinic operation room. Those agars were incubated for 18 hours at 28 degrees centigrade. After incubation, there was a massive bacterial growth in all the agar dishes with an average of 68 colony-forming units in each dish.

After the dental polishing procedure has been accomplished to all those 10 volunteers, the operation room has been sealed off and the ultrasonic fogger machine (Haoqi, China) was left to operate for up to 15 hours (Fig. 1). The fogger machine converts 600ml of fluid into the fog in each operation hour (Table 1). The concentration of hypochlorous acid was 200mg/L. Then, the environment has been examined again by using 10 blood agar plates. After the incubation of these plates, the colony-forming units has been calculated again. The number of colonies has been reduced up to 55% to 60% (Table 2 and Fig. 2). The average number of colonies was 30 colony-forming units on each plate.

The statistical analysis was done by using SPSS, the student version.

Results

The number of bacterial colonies has been reduced in all the 10 plates that incubated after using the fogger machine which indicates that the hypochlorous acid is a good antimicrobial agent and a fogger machine (Fig. 1, Table. 1) is a good tool for reducing the bacterial loading in the operating room environment. The colonies number has been diminished by 60% - 66% after spraying the hypochlorous acid by the fogger machine (Table. 2) and that represent a major reduction in the bacterial loading inside the clinic. The Mean values of the bacterial colonies also lowered from 92.9 to 30.4 as seen in (Fig. 2)

Table 1. Specification of the fogger machine.

No.	Property	Unit
1	Brand Name	HAOQI
2	Place of Origin	China
3	Power Source	Electric
4	Power	90 W
5	Voltage	110-220 V
6	Frequency	50 Hz
7	Capacity	13L
8	Mist Output (gallon / day)	1350ML/HOUR
9	Noise output	≤46 dB

Table 2. Number of bacterial colonies before and after HOCl spraying.

No.	Before spraying HOCl	After spraying HOCl
1	99	30
2	111	35
3	103	33
4	70	25
5	78	26
6	100	32
7	109	34
8	75	30
9	80	22
10	90	30
11	98	33
12	86	27
13	86	25
14	94	33
15	101	35
16	91	30
17	82	27
18	88	30
19	105	36
20	112	36

Discussion

One of the most important terms and conditions is the hygienic environment. Hypochlorous acid is an endogenous material in the human body that has an important immune role against a wide range of bacterial species. It is produced by WBCs, mononuclear cells and B-lymphocytes (Kettle *et al.*, 1997). HOCl adheres to the cell membrane and damages cellular integrity. The best antibacterial action can be obtained at pH level 3-6 (Dychdala *et al.*, 2001).

HOCl is a strong oxidizing agent that disintegrates into OCl ions and H ions which denature the proteins (Wang L *et al.*, 2007). Hakimullah Hakim *et al.* tested the effect of slightly acidic hypochlorous acid water on the bacterial cells and he was able to inactivate the bacteria by spraying the hypochlorous acid on the contaminated surfaces (Hakim H *et al.*, 2016).

Tomoko Ono *et al.* agreed with the results of this study, he tried to find out the bactericidal effect of weak acid hypochlorous solutions of pH 5.0 - 6.0 and

he found that the hypochlorous acid has very good antimicrobial activity against a wide range of bacteria (Ono T *et al.*, 2012).



Fig. 1. Ultrasonic fogger machine.

Li Ni *et al.* coincide with the result of this study, he investigates the antibacterial effect of hypochlorous acid by apply it on the contaminated stainless steel surfaces and the results showed very good efficiency of the hypochlorous acid in decontaminating and sterilizing the stainless steel surfaces (Ni L *et al.*, 2016).

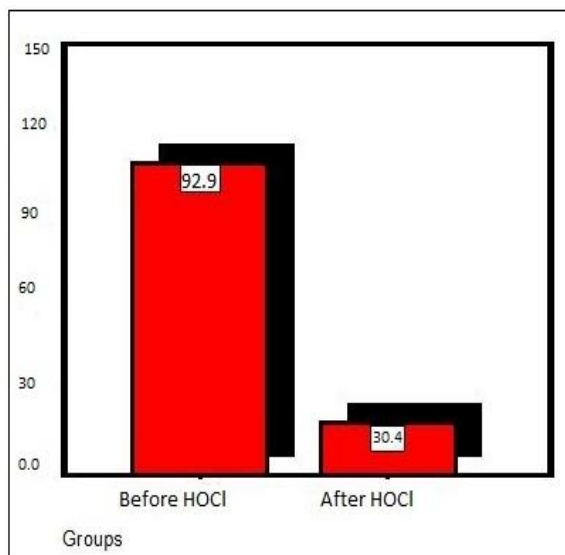


Fig. 2. Mean values of bacterial colonies before and after spraying HOCl.

Michael S. Block and Brian G. Rowan reviewed the evidence for using the hypochlorous acid in the office

on daily basis as an antimicrobial agent. The results indicate that the hypochlorous acid could be used with high expectation as a disinfectant material (Block and Rowan, 2020).

Chun-Ju Chen *et al.*, (2016) explored the effectiveness of HOCl in reducing the number of bacterial cells on the surface of titanium implants. He compared the antimicrobial effect of many chemical materials. The results showed the very good antibacterial effect of Hypochlorous acid on both gram-positive and gram-negative bacteria, especially when used in large amounts (Chen C-J *et al.*, 2016). R. Herruzo *et al.*, 2020 made a comparison between hypochlorous acid and other antiseptics used to treat and sterilize wounds. The findings referred to the good efficacy of the hypochlorous acid is used in large amounts for a long time (R.Herruzo and I.Herruzo, 2020).

Conclusion

The findings indicate that the hypochlorous acid is a low-cost, widely available, non-irritant antibacterial activity with increased antibacterial effect as the time and the concentration were increased.

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Author disclosure statement

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