Hydroclave - A newer method of sterilisation - Review

Karishma Desai¹, Geetha R. V.*², Leslie Rani S.³
¹Saveetha Dental College, Saveetha Institute of Medical and Technical Sciences, Saveetha University, Chennai, Tamil Nadu, India
²Department of Microbiology, Saveetha Dental College, Saveetha Institute of Medical and Technical Sciences, Saveetha University, Chennai, Tamil Nadu, India
³Department of General Pathology, Saveetha Dental College, Saveetha Institute of Medical and Technical Sciences, Saveetha University, Chennai, Tamil Nadu, India

ABSTRACT

Hydroclave is a recently introduced technique in the methods of sterilisation. It is a simple method that is affordable by most. This system uses steam to indirectly heat the vessel and dehydrate the waste that is fed into it. It has a variety of features. It has a higher and better degree of sterilisation. The holding time of this vessel is 15 minutes for a cycle. The advantages of using this Hydroclave is that it reduces waste by volume and size. The waste is reduced easily and hence it facilitates easy disposal. A systematic search strategy was employed and articles were found using keywords. Literature was taken from databases like PubMed and Google Scholar. Articles that discussed the newer techniques of sterilisation were included. Other articles which had data regarding Hydroclave, its benefits, structure and its applications were also included. A total of about 70 articles were collected initially. Multiple articles were added later from other sources. After eliminating articles that did not meet the inclusion criteria, more than 30 studies were finally obtained to carry out the research. This review summarized the use of Hydroclave for sterilisation. Other techniques, uses of Hydroclave, Process of sterilisation were also discussed in detail in this review article.
ducted using Hydroclave. It has been studied as an alternative treatment for infectious waste management. (Rafiee, 2016) Its use is also seen in the treatment of healthcare waste management. (Ciplak, 2016) The safety of such non-incineration based waste disposal devices have also been analyzed in a study. Hydroclave method of sterilization plays an important role when it comes to the management of medical and hospital wastes. (Dastpak et al., 2017; Farzadkia et al., 2015)

There are a few drawbacks of using this method of sterilizing wastes. Initially, the system requires more steam to heat up. Since the blades are used in fragmenting the wastes, they may get clogged. The end product of using this method is shrunken dry waste because of highly fragmented waste; it is difficult to recycle this type of waste. The waste hence produced goes to the landfills in the end. The use of hydroclave also leads to release of certain emissions into the air. This review is done to understand the various fields in which hydroclaves are used. It can sterilize a wide range of objects like needles, plastics, metals, etc. It has a high level of sterility. One plus point of this method is that it is not dependent on the operator; it is an automatic machine. It is low maintenance and a low-cost alternative to conventional methods. It ensures a low odour because the waste at the end is a dry product. Hydroclave has various advantages over conventional Autoclave. This review was done to analyze in detail the Hydroclave method of sterilization.

**General Sterilisation**

Sterilization is best defined as the complete destroying of microorganisms, endospores and pathogens. (Yoo, 2018) An object that is completely free of these organisms can be called sterile. (Lan eve, 2019) The technique of sterilisation should be chosen carefully. It should not cause any changes in structural or the biochemical properties of the object that has to be sterilised. (Dai et al., 2016) Sterilisation is a basic necessity for instruments. This is because if not sterilised, the instruments may lead to spread of infection. Sterilization is necessary to prevent transmission of infection. (Rutala and Weber, 2004) Some pathogens if not removed may bring about serious infection. They may even cause severe complications (like periodontal destruction) if instruments are not sterilised. (Shahana and Muralidharan, 2016) Newer pathogens are emerging in recent times that can pose as a threat and bring about infections. It is necessary to sterilise to completely erase the pathogens. (Ashwin and Muralidharan, 2015) Some bacteria like *A. baumannii* have even gained multi-step resistance and hence can cause serious nosocomial infections. (Girija, 2019; Girija et al., 2018). These organisms gain resistance through different mechanisms. These mechanisms include alterations in membrane permeability and chromosomal mutations (Smiline et al., 2018; J V Priyadarsini, 2018) Bacteria like these gain high resistance and enter the oral cavity and cause infections. (Priyadarsini, 2018; Girija and Priyadarsini, 2019) Newer sterilisation techniques have to be searched and developed since bacteria and other microorganisms develop resistance and hence cannot be eliminated. (Shahzan et al., 2019) Sometimes this resistance of organisms is attributed to the post-transcriptional changes that it undergoes. (Paramasivam et al., 2020).

Disinfection, Cleaning and sterilisation are all important to control disease spread and cross infections. (Hovius, 1992) In a dental set-up, infections can spread through multiple modes like aerosols, droplets, etc. Hence, it is necessary to disinfect even surfaces that are possibly contaminated. (Pratha and Geetha, 2017) Antimicrobials are substances that inhibit the growth of microorganisms. These substances are also used on inanimate objects as disinfectants. (Vaishali and Geetha, 2018) In a dental clinic, even extracted teeth have to be sterilised to prevent the spread of infection if any. They are sterilised using sodium hypochlorite, formalin, glutaraldehyde, etc. (Sandhu, 2012). Various chemical solutions like Chlorhexidine, Metronidazole gel, etc., are also proven to be effective against microorganisms. (Marickar et al., 2014) Herbal extracts are also used in certain conditions to kill selected pathogens. (Selvakumar and Np, 2017) These extracts may have good medicinal properties that may be helpful in selective situations. (Geetha et al., 2019) Sterilization usually includes incineration, boiling, etc. But now these present a lot of harm to the environment and to health status. Hence, newer approaches are being used to sterilise objects. (Laroussi, 1996) These new approaches include the usage of different liquids to sterilise and disinfect objects and surfaces.

**Newer Techniques of Sterilisation**

Since the time conventional methods have been used, there have been certain drawbacks with many of the methods used. Over the years, extensive development has taken place regarding newer techniques of sterilization. Ultrasonic cleaners are a new method in which high-frequency electrical energy is converted into mechanical energy during the process. (Mensudar and Amudha, 2014) Endoclns is another new development which is used in the sterilization process of endoscopes. Pulse light sterilization involves deactivation of microorganisms by
pulses of light focused on the object. The targeted object is illuminated using this light and aids in sterilization. New endoscopes such as flexible ureteroscopes, chip on tip endoscopes etc. are sensitive to heat. Hence gamma irradiation is used to sterilise these instruments. (Sabnis et al., 2014)

**Structure of Hydroclave**

The hydroclave is a double jacketed, cylindrical shredding system. (Farshad, 2014) The Hydroclave functions in four stages. In stage one; the waste is introduced into the apparatus. The waste can be bagged waste, sharps, liquids, cardboard or even metals. Then it moves to the second stage, wherein; the waste is fragmented. The sturdy paddles inside are rotated to facilitate the mixing process. (Hossain, 2011) High-temperature steam is introduced into the outer jacket of the vessel. This steam indirectly facilitates heating of the waste. The liquids present in the vessel turn to steam. It takes about 20 minutes to completely sterilize the waste. In stage three, the vessel is opened and de-pressurised. Stage four involved the unloading of the waste. The door is opened and the waste is removed from the vessel. The weight of the waste is reduced to a great extent. (Lavanya and Majhi, 2018)

**Features of Hydroclave**

Hydroclave presents a wide range of exclusive features. It can take 15 kg of waste in a single cycle. The entire cycle takes about 50 minutes to complete. This includes the initial heat up, start-up, sterilization, de-pressurising, and dehydration. The major sterilization takes place within 20 minutes at a temperature of 126 degrees. (Mathew, 2017) The hydroclave can treat all the materials that can be treated by autoclave treatment. In addition, hydroclave can also treat sharps.

**Uses of Hydroclave**

As already discussed, hydroclave has a variety of uses in various fields. It is useful in fragmenting sharps and also the conventional types of wastes. It is useful in treating a range of infectious wastes, very efficiently. Its application is also seen in treating hospital wastes, which need proper care, treatment and disposal to avoid any accidents, contamination, etc. (Ferdosi et al., 2016) The working takes place in four stages, they are Stage 1- Loading of Waste, Stage 2- Fragmentation of the Waste, Stage 3- Vessel venting and dehydration, Stage 4- Unloading of the waste.

**Advantages of Hydroclave**

Hydroclave is adaptable to future situations and also meets the capacity requirements. When it is compared to autoclave, the hydroclave has lesser cost and maintenance requirements. (Maamari, 2016) It creates steam pressure and a vacuum, and this process makes the sterilization more effective. It reduces the end waste product by weight and by volume to a great extent.

**Disadvantages of Hydroclave**

There are very few disadvantages to hydroclave sterilization. Initially, it takes a long time for the steam to heat up and build pressure inside the vessel. Next, the shredder blades may get clogged due to excess fragmenting of wastes. When the cycle is running for longer periods, there may be a lack of moisture. Hence, additional steam has to be injected into the outer jacket of the vessel. (Rao, 2004; Clark, 2018)

**CONCLUSION**

From this review, we can understand the role of Hydroclave. It is a newly introduced method of sterilisation. This method uses steam to heat up the vessel and dehydrate the waste. The Hydroclave sterilisation presents a low operating cost. It does not require any specific technique to operate this apparatus. The entire process takes 50 minutes, whereas the core sterilisation time takes only about 20 minutes at a temperature of 126°. It can sterilise metals, plastics, sharps, cardboard, etc. Hydroclave is known to be widely used because of its advantages over the conventional autoclave.

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**Conflict of Interest**

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