

Automatic Surgical Instrument Sterilizer

Noor S. Ali, Noor Ali Abdul Hussein, Haider Salah Hadi¹ and Rahman Hanoon Atiyah²

1 dept. of medical instrumentation technologies engineering, Hilla University College, Babylon, Iraq. hs2002638@gmail.com 2 MSc Biomedical engineering/University of azad south tehran. Rahmanha593@gmail.com

Abstract:

Introduction: The operational conditions for the sterilization process have been set, represented by a certain temperature, a specific amount of UV rays and a certain percentage of alcohol. **Purpose:** To make a sterilization device that performs a three-stage sterilization process on the same device in order to obtain excellent sterile surgical instruments in less time than usual. **Material and methods:** The process of sterilizing surgical instruments goes through several steps, which are in the following sequence: Wear sterilization uniform and hand gloves before carrying surgical tools, Conducting a laboratory examination of surgical instruments before performing the sterilization process. Place the surgical instrument on the conveyor belt of the sterilizer, Ensure that there is a source of ventilation inside the room in which the sterilization will take place, Turn on the device, Waiting until the sterilization process ends and the surgical instruments go through the three stages of sterilization, Preserve sterilized instruments in such condition by placing them in airtight containers until use, After that, perform the laboratory examination of the surgical instruments again. **Results:** The laboratory examination is carried out using a light microscope twice, once before the sterilization process and the second after the sterilization process to ensure that the sterilization process has been done well or not. **Conclusion:** The sterilization process was done very well with less time and the possibility of sterilizing many surgical instruments and relatively large sizes. Hazardous odors are emitted and should not be inhaled, so there must be good ventilation in the place and the way the device works is simple and easy and does not require training.

Keywords: Automatic sterilization, disinfection, surgical instruments, pasteurization, radioactive sterilization, ventilation, equipment

1.Introduction

The process of disinfection or sterilization is defined as the process of inhibiting or killing all micro-organisms, which includes (single-celled, eukaryotic organisms such as parasites, fungi, bacteria and viruses) as well as other contaminants on surfaces or biological fluids. Which can be in different ways, including sterilization by filtering, high pressure with moist heat, dry heat and finally chemical sterilization. This process differs from other processes called pasteurization, which are used to sterilize milk at different temperatures. These methods are makes to reduce the presence of contaminants in biological samples or liquids or to remove them permanently, as the surface or material on which this process is performed is later considered sterile [1].

The main objective of the sterilization process is to reduce as little as possible or remove all pathogens or pollutants, and heat is often used for this purpose at different temperatures and in different ways, including steam sterilization, which is at temperatures exceeding 100°C or dry heat that reach 200°C, in addition to chemical sterilization and radioactive sterilization [2,3]. In general, laboratory tools, including those used in surgical operations, are sterilized by dry heat, especially those that enter the body, such as laboratory needles for anesthesia, pacemakers, hypodermic needles, and scalpels [4]. Most of the surgical and medical devices that are used in surgical operations are made of galvanized iron or aluminum materials that can tolerate high temperatures, so it is possible to sterilize them using dry or wet heat, especially those that were used in previous years, but with the development of modern technology, these tools are now manufactured it is a plastic material that does not tolerate high temperatures, so it must be sterilized by radiation, while some materials were previously sterilized using low moist heat or using ethylene oxide gas. During the past years, specifically 16 years ago, many other advanced sterilization systems such as (ozone gas, immersion of parasitic acid, vaporized hydrogen peroxide, etc.) were used to sterilize medical devices and tools used in laboratory or surgical operations [5].

Disinfection, Sterilization and Cleaning

In general, there is no unified definition that includes all of the above terms, which is disinfection, sterilization and cleaning, but there are some basics on which the Clinical Laboratory Standards Institute was based, which is the removal or inhibition of the least possible contaminants from surfaces or biological materials, a term that includes all operations as indicated by the International Organization for Standardization [6,7].

1.Sterilization:

The sterilization process is defined as the removal of all contaminants or microbes and their elimination or destruction, whether these contaminants (vegetal, animal or germs) by various biological, chemical, and physical sterilization methods, as the inhibition or removal of bacterial or microbial colonies, which are estimated at $\geq 10^6$ colonies (CFU) of materials or surfaces that are sufficient to sterilize them

2- Sterilization with chemicals or chemical sterilization: It is defined as the use of chemical materials to remove all forms of microbes for a specific period of time (3-12 hours). The most important materials used in sterilization are hydrogen peroxide at concentration 7.5%, ortho-phthaldehyde (OPA), paracetic acid (PAA) at a concentration of (0.2%), and glutaraldehyde ($\geq 2.4\%$).

3- The disinfection process: It is defined as the removal or reduction of all types of pollutants, with the exception of bacterial spores from surfaces or non-living objects. As this method guarantees the removal of as much as $\geq 10^3$ bacterial colonies (CFU) that present on non-living surfaces.

4- Ultra disinfection or (HLD) High level disinfection: This process is defined as the use of some chemicals to remove or kill microbes and contaminants from surfaces in the shortest possible period of time, which is able to remove up to 10^6 bacterial colonies (CFU). The most important materials used for this purpose are (hypochlorous acid (400-450 ppm), hydrogen peroxide at concentration (7.5%), hypochlorite at (650-0%) 675 ppm, glutaraldehyde at ($\geq 2.0\%$), and ortho-phthaldehyde -OPA (0.55%))

5- Disinfection at the intermediate level (ILD): where it is characterized by This disinfection process is capable of removing pulmonary tuberculosis bacteria *Mycobacterium tuberculosis* and is also used to sterilize surfaces that are not contaminated with body fluids or blood.

6- Disinfection at Low level (LLD): This process is used to remove some types of fungi, encapsulated viruses and vegetative forms of bacteria whose walls or coverings are affected by chemicals. The most important materials used are dilute glutaraldehyde, hydrogen peroxide 3%, phenols, and quaternary ammonium compound.

7- Cleaning or disinfection: It is the process of removing pathogens, including microbes, as well as removing visible dust (inorganic and organic materials) from surfaces and places, as this process is able to remove as much as ≥ 1 bacterial colonies (CFU) as a minimum.

2.Methodology

The practical part includes the preparation and operation of the surgical instrument sterilizer, the installation and concentration of chemicals, devices and equipment, and the method of operation of the surgical instrument sterilizer.

Stages of making a sterilizer

The process of making a sterilizer goes through several stages, which are in sequence as follows:

The first stage:

this stage consists in preparing all the materials, devices and equipment that we will need to make the device, represented by aluminum pallets, electrical box, connecting wires etc.

The second stage:

At this stage, aluminum pallets, conveying tubes, and connecting wires are cut according to the measurements that were prepared to make the device.

The third stage

It is the stage in which the adrenal is programmed because it is considered to be in control of the entire sterilization process. It controls the conduct of the conveyor belt within a specific time during the transition of the surgical instrument from one stage to another. It also controls the alcohol pumping process and temperature control.

The fourth stage

It represents the stage in which the electrical circuit of the device, represented by the Arduino and Red Board, is connected with the connecting wires, and all of them are placed inside the electrical box. Also, at this stage, the motor that moves the conveyor belt, which is used to transport surgical tools from one place to another inside the device, is installed and connected, as well as the motor that pumps alcohol from the tank into the conveyor tubes.



Fig: The fourth stage of making the device

The fifth stage

It consists in making sure that all the pieces are installed tightly according to the measurements and standards that were prepared previously, that is, making sure that there are no technical or electrical defects.



Fig: The fifth stage of making the device

3.Results



a. before sterilization

b. after sterilization

Fig: Laboratory examination of the surgical instrument, a. before sterilization, b. after sterilization.

4. Discussion

The laboratory examination is carried out using a light microscope twice, once before the sterilization process and the second after the sterilization process to ensure that the sterilization process has been done well or not. The examination process is done by placing the surgical instrument under the microscope and then taking a picture of the examination process in order to clarify the difference to the surgical instrument before and after the sterilization process.

5. Conclusions

The sterilization process was done very well. The time required for the sterilization process was less than if the sterilization process was done separately, each stage alone. The possibility of sterilizing many surgical instruments and relatively large sizes. Hazardous odors are emitted and should not be inhaled, so there must be good ventilation in the place. The way the device works is simple and easy and does not require training the person performing the sterilization process.

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