MEDICAL INSTRUMENTATION
SECOND YEAR
2021-2022
LECTURE NO.(6 PART A)
AUTOCLAVE

DR. SAIF AL-SABTI

1. Introduction

It is always a danger to health working in a microbiology or pathology lab. In such laboratories where lots of work goes on with bacteria and virus, or possibly infected materials, the need for sterilization is paramount. The slightest chance of contamination from a 'dirty' apparatus can shut down a whole lab, and – let's hope not – get someone deadly sick. This is where an autoclave comes in very handy. Bacteria and viruses and living or semi-living things and as such, they can live within very specific boundaries only in specific environments. Unlike the glass beaker that held some bacteria culture, they won't survive at high temperatures and pressure. And that is the environment you can create within an Autoclave – very unfriendly to any kind of microorganism. Autoclaves are also known as steam sterilizers, and are typically used for healthcare or industrial applications. An autoclave is a machine that uses steam under pressure to kill harmful bacteria, viruses, fungi, and spores on items that are placed inside a pressure vessel. The items are heated to an appropriate sterilization temperature for a given amount of time. The moisture in the steam efficiently transfers heat to the items to destroy the protein structure of the bacteria and spores.

Figure 1: Autoclaves

The steam digester, a prototype of the autoclave that is better known now as a pressure cooker, was invented by French-born physicist Denis Papin in 1679.1 It wasn't until 1879 that the French microbiologist Charles Chamberland created a new version called the autoclave to be used in medical applications. The science of disinfection and sterilization began in 1881 with the research of Robert Koch on the disinfecting properties of steam and hot air. He demonstrated the greater power of penetration exhibited by moist heat (steam) compared to dry heat. Finally, in 1933 modern autoclave technology was introduced with the first pressure steam sterilizer that controlled performance by measuring the temperature in the chamber drain line (thermostatic trap). Prior to this date, pressure was the sole indication of control with no means to verify temperature or air elimination. Over time, new autoclave technology has been developed including pre-vacuum cycles in 1958, and steam-flush pressure-pulse in 1987 allowing the science to evolve into the autoclaves, or steam sterilizers, used in hospitals today.

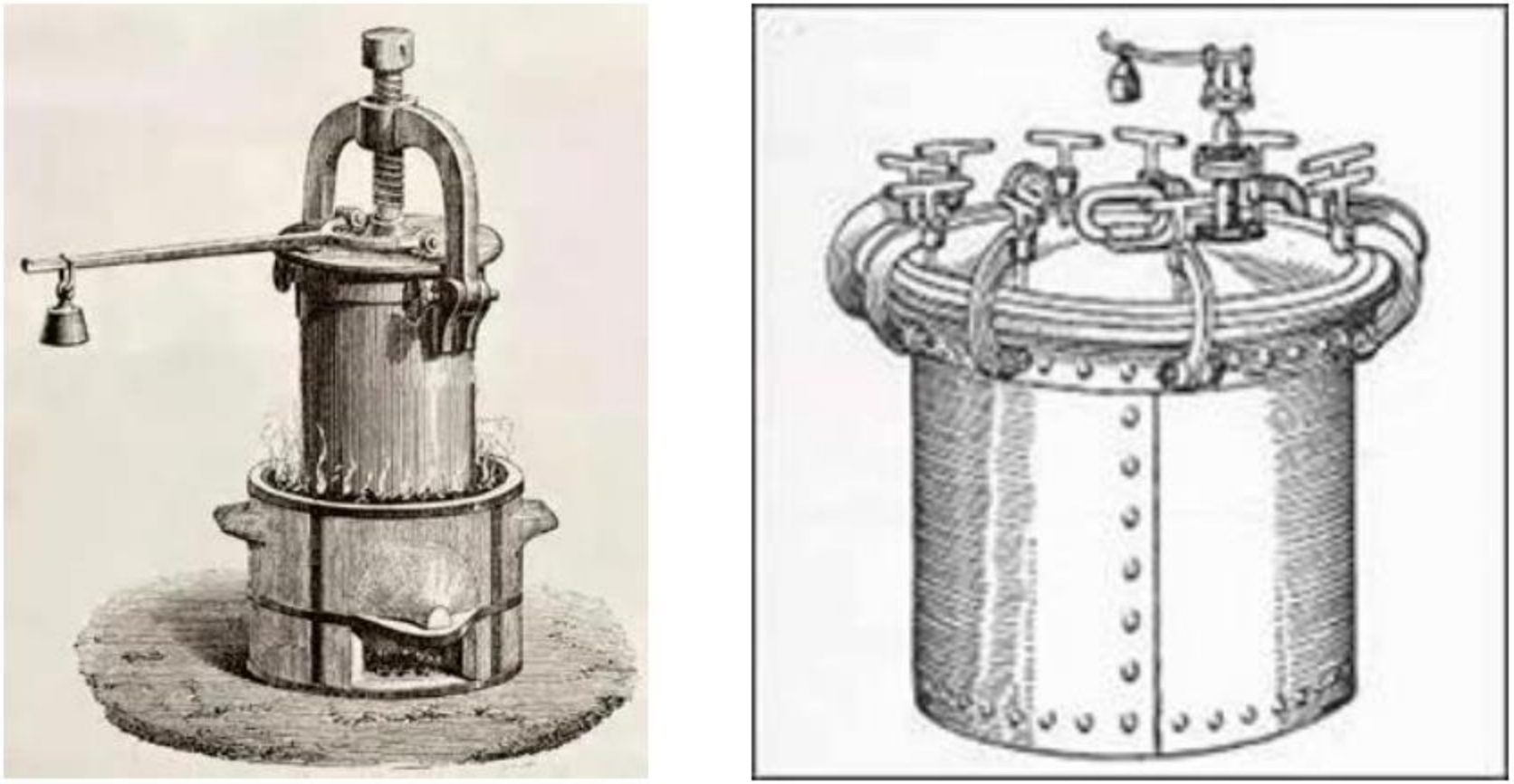

Figure 2: The first steam sterilizer built in 1880 by Charles Chamberland

2. The principle of an autoclave

The autoclave works on the principle of moist heat sterilization where steam under pressure is used to sterilize the material present inside the chamber. The high pressure increases the boiling point of water and thus helps achieve a higher temperature for sterilization. Water usually boils at 100°C under normal atmospheric pressure (760 mm of Hg); however,
the boiling point of water increases if the pressure is to be increased. Similarly, the high pressure also facilitates the rapid penetration of heat into deeper parts of the material, and moisture present in the steam causes the coagulation of proteins causing an irreversible loss of function and activity of microbes. This principle is employed in an autoclave where the water boils at 121°C at the pressure of 15 psi or 775 mm of Hg. When this steam comes in contact with the surface, it kills the microbes by giving off latent heat. The condensed liquid ensures the moist killing of the microbes. Once the sterilization phase is completed (which depends on the level of contamination of material inside), the pressure is released from the inside of the chamber through the whistle. The pressure inside the chamber is then restored back to the ambient pressure while the components inside remain hot for some time.

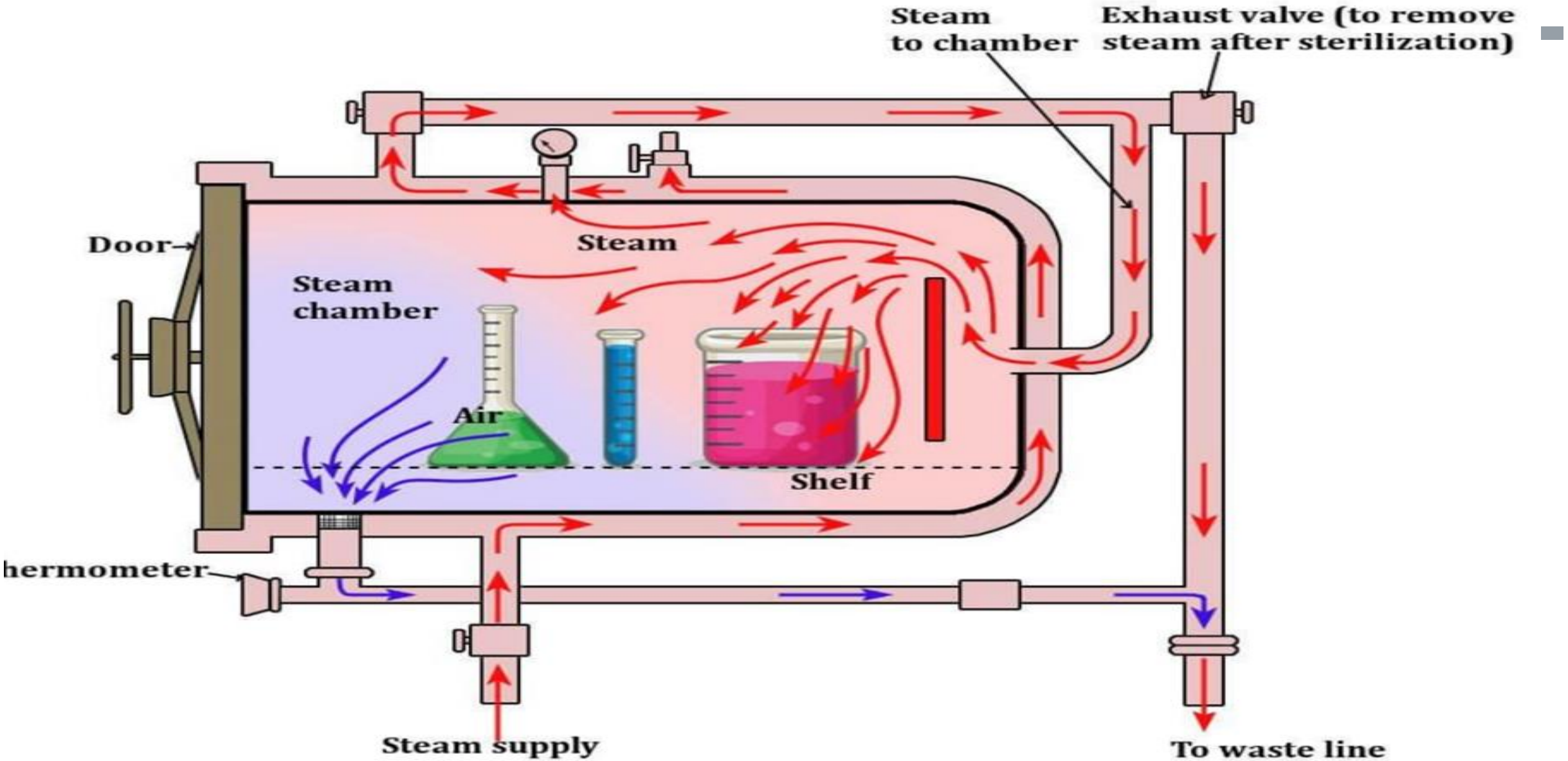

Figure 3: The principle of an autoclave