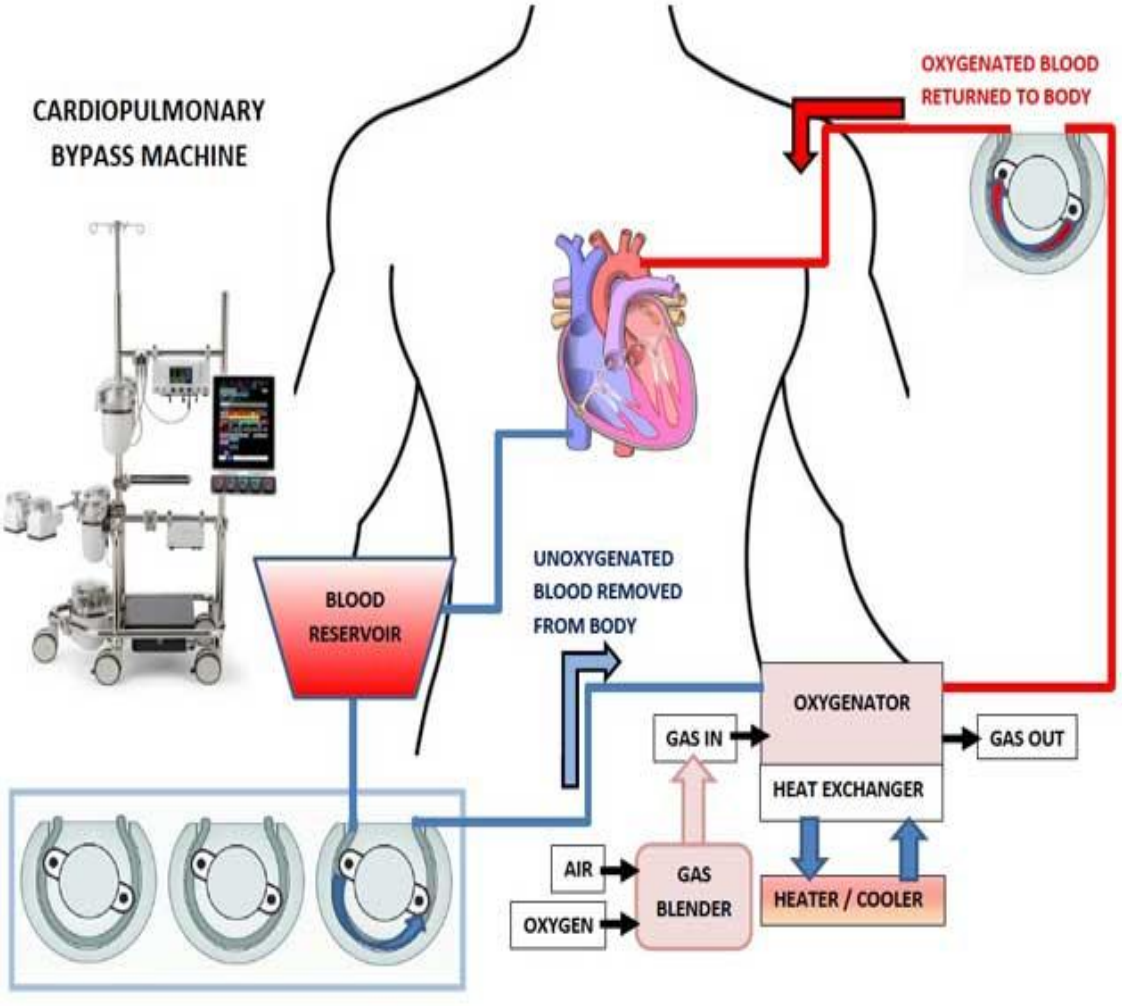
The Cardiopulmonary Bypass Circuit (heart-lung machine)



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The Cardiopulmonary Bypass Circuit (heart-lung machine)

- It is one of the truly revolutionary machines of medical equipment has been the invention and development of heart-lung machine.
- During an open-heart surgery, such a bypass surgery, the heart lung machine takes over the functions of heart and lung and allows the surgeon to carefully stop the heart while the rest of the patients' body continues to receive oxygen-rich blood.
- The surgeon can perform the work on heart without interference from bleeding or heart pumping motion. Once the procedure is over, the surgeon starts the heart and disconnects the heart lung machine.

- The principle of the heart-lung machine (also known as **pump-oxygenator or cardiopulmonary bypass**) is actually quite simple.

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- Deoxygenated blood withdrawn from the upper heart chambers is drained into a reservoir. From there, the blood is pumped through an artificial lung.
- This component is designed to expose the blood to oxygen. As the blood passes through the artificial lung (also known as an *oxygenator*), the blood comes into intimate contact with the fine surfaces of the device itself.
- Oxygen gas is delivered to the interface between the blood and the device, permitting the blood cells to absorb oxygen molecules directly.
- Now the blood becomes oxygenated blood.
- Finally, the heart-lung machine actively pumps the oxygenated blood back into the patient through a tube connected to the arterial circulation.
- The heart-lung circuit is a continuous loop, as the oxygenated blood goes into the body, deoxygenated blood returns from the body and is drained into the pump completing the circuit.
- Typically, blood is drained cannulas in the superior and inferior vena cavae (SVC, IVC) or IVC and right atrium (RA) to the heart–lung machine where it is

pumped through the artificial lung back into the body via an arterial cannula placed in the ascending aorta.

- The modern heart-lung machine is actually more sophisticated and versatile than the overview given above. In fact, *the pump oxygenator can do a number of other tasks necessary for safe completion of an open heart operation.* Firstly, any blood which escapes the circulation and spills into the operating field around the heart can be suctioned and returned to the pump. Returning shed blood into the heart-lung machine greatly preserves the patient's own blood stores throughout the operation.
- Secondly, the patient's body temperature can be controlled by selectively cooling or heating the blood as it moves through the heart-lung machine. Thus the surgeon can use low body temperatures as a tool to preserve the function of the heart and other vital organs during the period of artificial circulation.
- And the bypass pump has connectors into which medications and anesthetic drugs can be given. In this way, medications arrive to the patient almost instantly by simply adding them to the blood within the heart-lung reservoir.

- To initiate heart-lung bypass, the surgeon must first impair the body's own clotting system. Otherwise, the patient's blood would immediately clot upon exposure to the plastic tubing and artificial surfaces inside the heart-lung machine itself. Thinning of the blood (or anticoagulation) is done by first administering a powerful anticoagulant called heparin.
- Once clotting is impaired, a large drainage tube is placed in the upper chamber of the heart (called the right atrium). This tube drains the deoxygenated blood from the patient into the heart-lung machine. Then a smaller tube is placed into the arterial system so that red blood can be returned to the patient's body where it is needed. The most common site for this tube is in the aorta.

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- So the modern Heart-lung machine can perform the following tasks:
- 1- Oxygenation of blood
- 2- Controlling the patient body temperature.
- 3- Adding medication and anesthetic drugs to the blood through the machine during the surgery.
- In spite of these advantages, there are some substantial disadvantages in this machine, some of these are:
- 1- Formation of blood clots which may lead to a stroke, heart attack or kidney failure.
- 2- This machine can also trigger inflammatory process that can damage many body systems and organs.
- 3- In rare cases, memory loss may occur.

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