

The Heart-Lung Machine

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BME 281 Second Presentation, November 20, 2012 <amandajunkins@my.uri.edu>

Abstract—The heart-lung machine is a crucial device that makes it possible for organs to function outside of the body, and puts ease on the surgeons who perform open-heart surgeries.

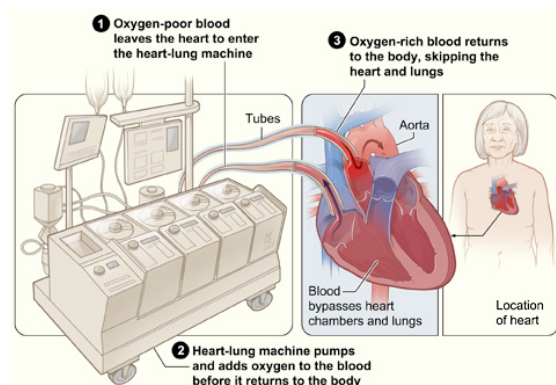
I. INTRODUCTION

THE heart-lung machine is a pumping device that makes it possible to take over the functions of the lungs and heart primarily during an open-heart surgery. It can be used during a cardiothoracic surgery, and most commonly used to perform a cardiopulmonary bypass. CPB is often used during heart surgeries, due to the difficulty in operating on a beating heart. The surgeon can operate in a blood-free area, which is easier and can allow for more precision and less complications. The heart-lung machine, first known as a perfusion pump, was created by Dr. Alexis Carrel and Charles Lindbergh in the 1930s. In 1953, Dr. John H. Gibbons, Jr. was credited with developing the first clinically successful heart-lung pump. The creation and advancement of the heart-lung pump is considered a big step in developing open-heart surgery, organ transplant, and the artificial heart.

II. METHODS

The heart-lung machine, or perfusion pump, is composed of a chamber that receives all the blood from the body, which is the responsibility of the right atrium of the heart. The machine then pumps the blood through an oxygenator, which is the function of the right ventricle. This oxygenator removes the carbon dioxide and adds oxygen to the blood, which is the typical function of the lungs.

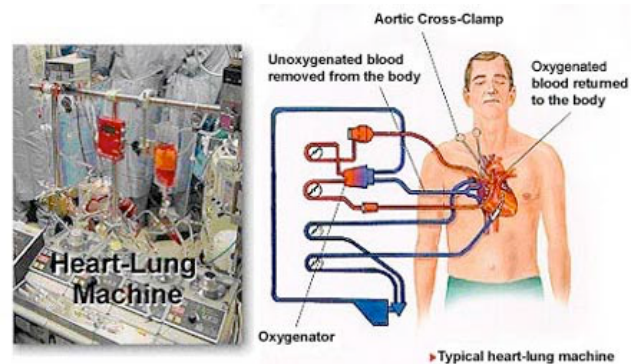
The machine then continues by pumping the oxygenated blood back to the body, which is the function of the left atrium and ventricle. This process is possible by a series of tubes that are connected to the patient by a team of surgeons. The heart-lung machine itself is operated by perfusionists during the surgery. To end an operation, the surgeon gradually lets the patient's heart resume its normal functions.



III. RESULTS

The result of the heart-lung pump is the ability of a surgeon

to perform an open-heart surgery in a blood-free zone while the heart is not beating. Such a procedure, called cardiopulmonary bypass, allows for supporting the circulation of the blood when operations require the opening of the heart's chambers. CPB can also be used to induce total body hypothermia, where the body can be maintained for up to 45 minutes without perfusion (blood flow). If blood flow were to be stopped at normal body temperature, permanent brain damage will occur in just a few minutes, followed by almost certain death shortly after. The heart-lung machine also allows for medications and anesthetics to be administered directly into the blood, simply by adding them to the blood in the heart-lung reservoir, arriving immediately to the patient.



IV. DISCUSSION

The clear advantage to the heart-lung machine is being able to allow doctors to operate in a blood-free area. This should contribute to less surgical error. The disadvantage is that brain damage can still occur, particularly a syndrome known as "pumphead". The effects can include defects to attention, concentration, short term memory, and fine motor function.

In the future, the heart-lung pump will hopefully become portable, allowing for paramedics to aid heart attack patients on the scene, for instance. Also, the device will be further developed to allow for less brain damage after the surgery.

REFERENCES

- [1] "Alexis Carrel - Wikipedia, the free encyclopedia." *Wikipedia, the free encyclopedia*. Web. <http://en.wikipedia.org/wiki/Alexis_Carrel>.
- [2] "Cardiopulmonary bypass - Wikipedia, the free encyclopedia." *Wikipedia, the free encyclopedia*. Web. 19 Nov. 2012. <http://en.wikipedia.org/wiki/Cardiopulmonary_bypass>.
- [3] DeBakey, Michael. "John Gibbon and the heart-lung machine: a personal encounter and his import for cardiovascular surgery -- DeBakey 76 (6): S2188 -- The Annals of Thoracic Surgery." *The Annals of Thoracic Surgery*. Web. <<http://ats.ctsnetjournals.org/cgi/content/full/76/6/S2188>>.
- [4] "Heart-Lung Machine." *Department of Cardiothoracic Surgery, University of Southern California, Los Angeles*. USC cardiothoracic Surgery, Web. <<http://www.cts.usc.edu/zglossary-heartlungmachine.html>>.

- [5] Levinson, Mark. "Leaning Ctr : The Heart-Lung Machine." *Heart Surgery Forum*. Web.
<[http://www.hsforum.com/stories/storyReader\\$1486](http://www.hsforum.com/stories/storyReader$1486)>.