Oxygenators

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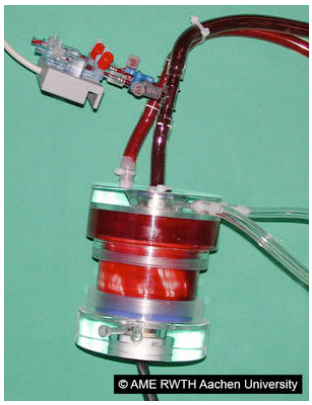
Oxygenators are medical devices used in incisions that require the interruption of blood flow in the body, such as a cardiopulmonary bypass surgery. Oxygenators are capable of exchanging gases from the human body, meaning they add oxygen and remove the waste product carbon dioxide.

Oxygenators are used in conjunction with a Heart-Lung machine, where the oxygenator replaces the work of the lungs in the body (systemic blood circulation). The part of the beating heart is replaced by a rotary pump (6).



The first oxygenator conceptualized was in the 17th century by Robert Hooke; however, he was not able to finalize his visions. It was not until the 19th century when German and French physiologists developed the first oxygenator. It was a disc oxygenator that consisted of blood flowing over a series of rotating discs (4). This system was open to the atmosphere and resulted in a high amount of blood clotting. In 1953 Dr. John Gibbon performed the first open heart surgery on a human using a disc oxygenator (6). In 1956 the first membrane oxygenator was developed. In this oxygenator blood no longer came in contact with the atmosphere, which substantially reduced the blood clotting; however, the membrane that was initially used (Teflon, polyethylene) was not very permeable to oxygen and carbon dioxide so it was later replaced by a silicone rubber membrane (4). Membrane oxygenators today are made of hollow fibers which allow maximal permeability (2).

Oxygenators are connected to the body by a series of tubes and cannulae that are placed into the right atrium or vena cava for venous blood, and the ascending aorta for oxygenated blood, respectively (6). The venous blood is pumped into the oxygenator, where it enters a chamber that contains a gas-permeable membrane made out of hollow fibers. Oxygen diffuses from the inside of the chamber through the fibers into the blood. Similarly carbon dioxide diffuses from the blood into the inside of the chamber. Since blood is considerably poorly diffusible in plasma, the blood must come in contact with a greater surface area (creating a thin film of blood) so that the diffusion rate is greater (2).

New innovations include an oxygenator with an integrated rotary blood pump thereby substantially reducing the blood contact surface. This reduces bleeding, hemolysis and thrombosis risks (1).

During surgery hypothermia is (28°-30°C) maintained to reduce the risk of tissue damage. Cold blood slows down the body's metabolic rate, decreasing the demand for oxygen (6).

In the future scientists will continue the search of an optimal membrane for maximal permeability of gases. Furthermore, machines are being developed, that are connected to the oxygenator, so that blood parameters are constantly being watched to see how much oxygen is required or how much carbon dioxide diffuses out of the blood (1).

Works Cited

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