

MEDICAL DEVICES

MEDICAL INNOVATION: HEART LUNG BYPASS MACHINE (MEDICAL DEVICE: THERAPEUTIC)

Physician: Dr. John Gibbon

Industry: IBM, Thomas Watson, Chairman

Situation

No way to operate on the heart itself

Cardiovascular disease is the leading cause of death in the U.S. In the first half of the twentieth century, cardiovascular medicine had many triumphs, thanks in large measure to effective anesthesia and antibiotics that made surgery safer. Also, blood-typing, anti-clotting agents, and blood preservatives made blood transfusion practical for the first time. Cardiac catheterization (feeding a tube into the heart), electrocardiography, and fluoroscopy (visualizing living tissues with an X-ray machine) made the nonsurgical diagnosis of cardiovascular problems possible.

As of 1950, however, there was no safe way to treat damage or defects within the heart, since such surgery would require stopping the heart itself, and that would result in death. There would be no way to get oxygenated blood to circulate through the body, and keep the body's tissues alive during the surgery. While some surgeons practiced so-called blind surgery, in which they inserted a finger into the heart through a small incision without observing what they were attempting to correct, others tried to reduce the body's need for circulation by slowly chilling the patient until the heart stopped. Still other surgeons used "cross-circulation," in which the patient's circulation was connected to a donor's circulation. All of these approaches carried profound risks of hemorrhage, tissue damage, and death.

Physician-Industry Collaboration

An experiment with cats leads to collaboration with industry

In 1930, after witnessing the death of a patient from a pulmonary embolectomy, a young physician named John Gibbon conceived the idea of a machine that could support cardiac and respiratory functions during surgical procedures to repair defects in the heart and lungs. Over the next decade, Gibbon and his wife Mary developed experimental devices that allowed them to maintain complete pulmonary cardiac bypass in cats successfully for 25 minutes. With this initial success, Gibbon persuaded IBM Chairman Thomas J. Watson in the late 1940s to provide him with the technical expertise needed to produce a more sophisticated device. Watson provided the services of IBM's experimental physics laboratory and model machine shop as well as the assistance of staff engineers.

Gibbon began a new series of experiments with dogs in the 1950s, using the IBM-built machines. The next step involved using the machine on humans, and in 1953 Cecelia Bavolek became the first to undergo open heart bypass surgery successfully, with the machine totally supporting her heart and lung functions for more than half the duration, while the surgical team headed by Gibbon was able to close an opening between her atria and establish normal heart function. Two months later, an examination of the defect revealed that it was fully closed; Bavolek resumed a normal life. The age of open-heart surgery had begun.

Innovation Benefits

Millions of lives saved each year

Today, thousands of people worldwide undergo open heart surgery each day, all made possible by Gibbon's heart-lung machine and its successors. The procedures vary from cardiac valve replacement, coronary bypass surgery, heart transplant, and installing ventricular assist devices -- each of these surgeries requiring stopping the heart safely through the use of a heart-lung machine. Millions of lives are saved each year by these procedures, and the annual financial savings from them easily runs into the hundreds of billions of dollars.

Patient Benefits

A senior senator gets back on his feet

In 1998, Arlen Specter was a three-term U.S. Senator running for re-election in Pennsylvania when one weekend he felt pain in his chest. A vigorous squash player in good overall health, he didn't know exactly what the source of the pain could be, so he went for a medical test.

An angiogram revealed Senator Specter suffered from the number-one killer in America – coronary artery disease. In fact, Senator Specter had five serious blockages in his heart, any one of which could cause an immediate heart attack and sudden death.

After learning the news, he agreed to undergo coronary artery bypass surgery, in which veins from his leg and an artery from his chest wall would be grafted onto his coronary arteries to provide a pathway around the blockages.

The next morning, he went into surgery, and was placed on a heart bypass machine while the doctors stopped his heart and began delicately sewing the grafts in place. When their work was complete, the surgeons shocked his heart back into rhythm and finished the procedure.

Some six weeks later, Senator Specter was back in Washington, chairing hearings and representing his constituents. He resumed playing his daily game of squash soon thereafter, won re-election that fall and went on to serve another two terms in the Senate.

