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SHORT COMMUNICATION

John Heysham Gibbon: The Father of Heart – Lung Machine

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ABSTRACT

Dr. John Heysham Gibbon was a pioneering American surgeon & researcher renowned for his groundbreaking work in developing the Heart Lung machine, which revolutionized cardiac surgery by making open-heart procedures possible. His work transformed the field of open-heart surgery by enabling procedures that required stopping the heart while maintaining circulation through mechanical means. His invention of Heart–Lung machine stands as a monumental contribution to both medical science and clinical practice.

KEYWORDS

• Heart lung machine • Cardiopulmonary bypass • John Gibbon

INTRODUCTION AND BACKGROUND

John. Gibbon was born on September 29, 1903 in Philadelphia, Pennsylvania to Majorie Young and John H. Gibbon Sr. Gibbon came from a family with a strong medical lineage. From a young age, Gibbon had the ambition to pursue poetry and writing. His father, John H. Gibbon Sr. was a renowned surgeon and co-chairman of surgical department at Jefferson Medical College, he convinced Gibbon that a medical degree would do no harm and would not make him write less well, and this legacy heavily influenced the younger Gibbon's career path.

Gibbon commenced his undergraduate studies at Princeton University in 1919 and graduated in 1923 at the age of 20. Subsequently he earned his medical degree from Jefferson Medical College in Philadelphia in 1927. In 1929, he completed his residency at the Pennsylvania Hospital and later he was assigned his first clinical research project

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at Harvard. Following his medical school, Gibbon embarked on his surgical training at Massachusetts General Hospital in Boston, one of the most prestigious institutions in the US, under the mentorship of Dr. Edward Delos Churchill, one of the leading surgeons of his time. It was here that Gibbon developed his interests in both surgery and research.[1]

The origin of heart-lung machine concept:

The idea for Heart-Lung machine took root in Gibbon's mind during a pivotal event in 1930. On October 3, 1930, while working with Dr. Churchill at Massachusetts General Hospital in Boston, a 53 year old female patient, following uncomplicated cholecystectomy, suddenly developed discomfort in her chest and was diagnosed to have pulmonary embolism. Gibbon was given the task to monitor the vitals of the patients. The complication ended fatally. But this tragic incident gave birth to an idea in development of Heart lung machine, that could take over the function of heart and lungs during surgery, to remove deoxygenated blood from patient, add oxygen into that blood, allow carbon dioxide to escape from it and then inject oxygenated blood into patient's arteries, and thus allowing surgeons to operate on heart while maintaining blood circulation without causing irreversible damage to the body. He embarked on a long and arduous journey of research and development.

This challenge required overcoming major engineering, biological and medical hurdles, especially given the complexity of keeping blood from clotting or damaging tissues while outside the body.

Gibbon's early research began in the early 1930's in Churchill's animal laboratory where he conducted animal experiments to test whether it was possible to keep blood circulating outside the body. His initial results were disappointing. Keeping blood flowing outside the body posed enormous challenges; the blood coagulated, clotting within the machine and various mechanical failures occurred in the prototypes Gibbon designed. However, during these times, his wife, Mary Hopkinson, a laboratory technician in Churchill's research laboratory, played a significant role in his work. She assisted with laboratory experiments, including animal trials and supported him through the many challenges of perfecting the device. Together, they made critical refinement to Heart–lung machine, experimenting on cats and eventually achieving some success in temporarily maintaining circulation. In 1935, he was the first to carry out cardiopulmonary bypass in cat, while occluding pulmonary artery for 25 minutes while shunting the cardiac output through an assembly of pumps and oxygenators, his aim being able to make pulmonary embolectomy possible. Gibbon arrived back to Philadelphia in 1936, along with his wife Mary Hopkinson and continued his research in extracorporeal circulation.[2,3]

THE SECOND WORLD WAR

In 1942, World War II interrupted his research as Gibbon was called to serve as US army surgeon. Despite the interruption, the war years helped him reflect on and refine his ideas. Gibbon was honorably discharged from the army, holding the title of Lieutenant Colonel. However, after the war in 1945, he resumed his research with renewed vigor, and was offered the position of professor of surgery at Jefferson Medical college.

A COLLABORATIVE EFFORT: IBM & TECHNOLOGICAL ADVANCES

By the late 1940's, Gibbon's Heart-Lung machine had become more sophisticated, thanks in part to his collaboration with International Business machines (IBM). A student studying medicine at Jefferson, named EJ Clark, had ties to Mr. Thomas J. Watson, chairman of boards of IBM, and a meeting was scheduled through the help of this student. Mr. Thomas Watson showed interest in Gibbon's project and assured him of the help that he needed, both engineering and financial support. The IBM engineers arrived at Jefferson and helped Gibbon build a machine that could effectively oxygenate blood while keeping it circulating. One of the key breakthroughs was the use of a rotating disk system, which allowed blood to be exposed to oxygen without damaging blood cells, an earlier challenge that had been a major obstacle in his experiments. Use of screen for oxygenators produced turbulence which increased oxygenating capacity as much as eight times.

In 1949, they were able to construct the machine model-I, which was tried out on the first patient, 15 year old girl who had a

severe heart failure. She did not survive the procedure, but autopsy showed an unknown congenital heart defect, then; now the patent ductus arteriosus.[4]

Key a breakthrough: the 1st functional heart-lung machine:

However, it was not until 1953 after nearly 20 years of research- that Gibbon's work would culminate in a historic medical a breakthrough. Gibbon, along with IBM engineers, made improvements in the machine and developed the Model-II. The decisive moment came on May 6, 1953, when Gibbon successfully used his machine, Model II, to perform open heart surgery to repair a congenital atrial septal defect in an 18 year old patient, Cecilia Bavolek. She was connected to the machine for 45 minutes, of which 26 minutes she was completely depended on machine function for cardiopulmonary support. This was a momentous achievement, as it marked the first time in history that a machine successfully maintained circulation and oxygenation in a human patient during cardiac surgery. Model II consisted 3 roller pumps, screen oxygenator in which blood was allowed to flow on both sides of screen mesh to interface with oxygen. By 1954, they developed Model-III.

Gibbon's Heart Lung machine was a relatively primitive device compared to today's cardiopulmonary bypass machines, but it proved that the concept of extracorporeal circulation could work in humans. Subsequent improvements to the machine's design and function were made after Gibbon's initial success particularly in 1960's and 1970's as cardiac surgery became more widespread and new materials, technologies and drugs were developed to minimize risk of clotting. It enabled the surgeons to perform longer and more intricate procedures on the heart, including valve replacements, coronary artery bypass grafting, repairs of congenital heart defects.[5]

LATER LIFE AND LEGACY

John Gibbon retired from active surgical practice in 1967, dedicating the rest of his life to teaching and mentoring at Jefferson Medical College. For his contributions to medicine, Gibbon received numerous accolades and honors including the prestigious American heart association research achievement award in 1965 and Albert Lasker award for clinical medical research in 1968. John Gibbon passed away on February 5, 1973 at Philadelphia, Pennsylvania at the age of 69 due to massive myocardial infarction during a tennis match.

PERSONAL LIFE

When working in Churchills laboratory, Gibbon met his future wife, Mary Hopkinson, then Churchills surgical research assistant. Gibbon married her in 1932 and the couple had 4 children; Mary, John, Alice, Majorie. During world war II, he served as an Army surgeon and was given the rank of Lieutenant Colonel. When Gibbon passed away, Jefferson Medical college was renamed after him.

CONCLUSION

Through his perseverance and dedication, he left an indelible mark on medical science, improving lives of countless individuals. His legacy continues to inspire cardiac surgeons and medical researchers today.[6]

DISCLOSURES

Conflict of Interest: Nil

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