ON SPECIALTY

History and Origins of the Left Ventricular Vent: A Tribute to Dr. Frank F. Allbritten, Jr.

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Frank F. Allbritten, Jr. was born onto the plains of south central Kansas in 1914. That same year, Germany declared war on Russia, France, and Belgium, igniting World War I. The rich soil that surrounded Frank's hometown of Cunningham produced luscious fields of corn, wheat, and milo. Though not himself a landowner, Frank's father worked for and later purchased a grain elevator in town. As a youngster, Frank excelled in the classroom and graduated from Cunningham High School in 1931 at the age of 16. Four years later, he went on to receive a Bachelor of Arts degree from the University of Kansas. Frank aspired to be a lawyer, but found the coursework too difficult. He settled on becoming a doctor and was accepted into the University of Kansas School of Medicine where he studied for two years. He then transferred to the University of Pennsylvania School of Medicine and graduated with a Doctor of Medicine degree in 1938. Following a two-year internship at the University of Pennsylvania Hospital, Frank served three years as a surgical resident at Pennsylvania Hospital in Philadelphia. His stipend as a surgical resident was $100 a month.

During his internship, Frank met two people that would change his life forever. The first, Marjorie Clarkson Bately, was a nurse that cared for him while he was briefly hospitalized with a hand infection. Within a few months of their first encounter, Frank asked Marjorie to marry him. She accepted. The second person to change Frank's life was a surgical research fellow at the University of Pennsylvania School of Medicine's Harrison Research Laboratory named Dr. John H. Gibbon, Jr.

". . . HE IS A DIRECT LINK, A LIVING, BREATHING LINK, TO THAT INCREDIBLE DAY IN PHILADELPHIA IN MAY OF 1953 WHEN THE HEART - LUNG MACHINE WAS BORN AND TRUE HISTORY WAS MADE."

The Gibbon Years

Gibbon was at home in Philadelphia, having been born, raised, and schooled there. Though his undergraduate degree was from Princeton in New Jersey, he attended high school (Penn Charter) and medical school (Jefferson Medical College) in Philadelphia. Following a two-year internship at Pennsylvania Hospital from 1927-1929, Gibbon left for Boston to spend a year as a research fellow at Massachusetts General Hospital with Dr. Edward D. Churchill.

A few months into his fellowship, Gibbon was called to the bedside of a middle-aged, slightly obese female patient who was lethargic, pale, and short of breath. Only moments earlier, the woman had been recovering uneventfully from gall bladder surgery performed several days prior. Now she exhibited the grave signs of an acute, massive pulmonary embolus. Dr. Churchill ordered the woman to be moved to the operating room immediately. Gibbon was assigned the task of recording the woman's pulse, blood pressure, and respirations every fifteen minutes.

A surgical operation, the Trendelenburg procedure, would be performed to extract the clot only as a last resort. During the night, Gibbon pondered the possibility of removing venous blood from the woman's body, oxygenating it, and then returning it to the systemic circulation. If such a machine existed, surely this woman could be saved! Surely a machine could be built that could temporarily replace the heart and lungs! Gibbon pondered his idea well into the wee hours of the night. At eight o'clock the next morning, the woman lost consciousness. Dr. Churchill immediately opened her chest and removed several large blood clots from the pulmonary artery. The patient died moments later despite all efforts to resuscitate her.

As Gibbon's fellowship year in Boston came to a close, his thoughts repeatedly returned to the dead woman, and to the possibility of developing a machine to artificially replace the heart and lungs. Upon returning to Philadelphia in 1931, Gibbon spent three years as an Assistant Surgeon at Pennsylvania Hospital, as well as a Fellow in Medicine at the University of Pennsylvania School of Medicine. Few, if any, of his colleagues believed that a machine could ever oxygenate blood outside the body.

Gibbon's academic and surgical responsibilities left him little time to pursue research. As such, with Dr. Churchill's permission, he returned to Massachusetts General Hospital in early 1934 intent on fulfilling his dream of building a heart-lung machine. Within a year, he and wife Maly had built a crude device (which included a rotating cylinder-type oxygenator) that successfully supported the circulation of cats for over two hours. Recognizing that extracorporeal circulation might indeed be possible, the University of Pennsylvania Hospital quickly offered Gibbon a position as Surgical Research Fellow in the

Harrison Research Laboratory. Gibbon returned to his hometown of Philadelphia, and over the next several years tweaked, modified, and improved his machine bit by bit, little by little. By 1939, Gibbon was able to report to the American Association for Thoracic Surgery meeting in Los Angeles that he had achieved indefinite survival of cats after they had undergone a brief period of total cardiopulmonary bypass.

Frank had been introduced to Gibbon in 1938 during his first year as an intern at the University of Pennsylvania Hospital. In the coming years, their relationship would go well beyond a simple acquaintance.

The War Years

From 1939 to 1941, further refinements were made to Gibbon's pump-oxygenator. As the machine's efficiency improved, dogs were used in place of cats as the experimental animal of choice. The war in Europe, however, had reached a feverish pitch. Gibbon, like millions of Americans, felt that the United States should intervene. Despite having four children ranging in age from one to ten, Gibbon volunteered as a reserve officer in the Medical Corps and was sent to the South Pacific in January of 1942. He would be away for four years. With a workable heart-lung machine literally in sight, Gibbon's dream was temporarily put on hold.

Following completion of his surgical residency at Pennsylvania Hospital in 1943, Frank too entered the United States Army Medical Corps, and quickly rose in rank to Lieutenant Colonel. Like Gibbon, Frank said goodbye to a wife and children while he fulfilled what he considered to be his patriotic duty.

Gibbon returned to Philadelphia in December of 1945 and resumed his position as Assistant Professor of Surgery at the University of Pennsylvania Hospital. A month later, he was offered the position of Professor of Surgery and Director of Surgical Research at Jefferson Medical College. At last, Gibbon felt he had finally secured an appointment where he could dedicate all of his time to his heart-lung machine. His first order of business, however, was to fill the vacancies in the surgical residency program which he helped oversee. Secondly, he desperately needed an assistant to carry out the various departmental duties so he could focus on his research. As coincidence would have it, Frank was on his way home to Philadelphia having served three years in the Army. When Gibbon learned of Frank's availability, he immediately hired him as an assistant surgeon.

Within a year, Frank was promoted to Chief of Surgery at Jefferson Medical College. He also served as Director of Surgery at Jefferson College Hospital's Barton Memorial Division. A few years later, Jefferson Medical College promoted Frank to Associate Professor of Surgery. While most of the surgical residents who worked along side Gibbon in the research lab stayed a year, perhaps two at the most, Frank remained on staff from 1946 to 1954. Indeed, he became the go-to guy within the Department of Surgery. He operated. He lectured. He published. He oversaw the various units and wards where surgical patients convalesced. While Frank so capably carried out the day-to-day duties and responsibilities of the Department of Surgery, Gibbon concentrated on perfecting his heart-lung machine in the research lab. Gibbon trusted Frank. And as such, it was Frank who was called upon one day to solve one of the more baffling problems associated with open-chambered cardiac procedures.

Allbriten (left) attending a surgical conference in Quebec in 1952 with fellow Philadelphia surgeons Bernard J. Miller (center) and John Y. Templeton, III

Deadly Air Bubbles

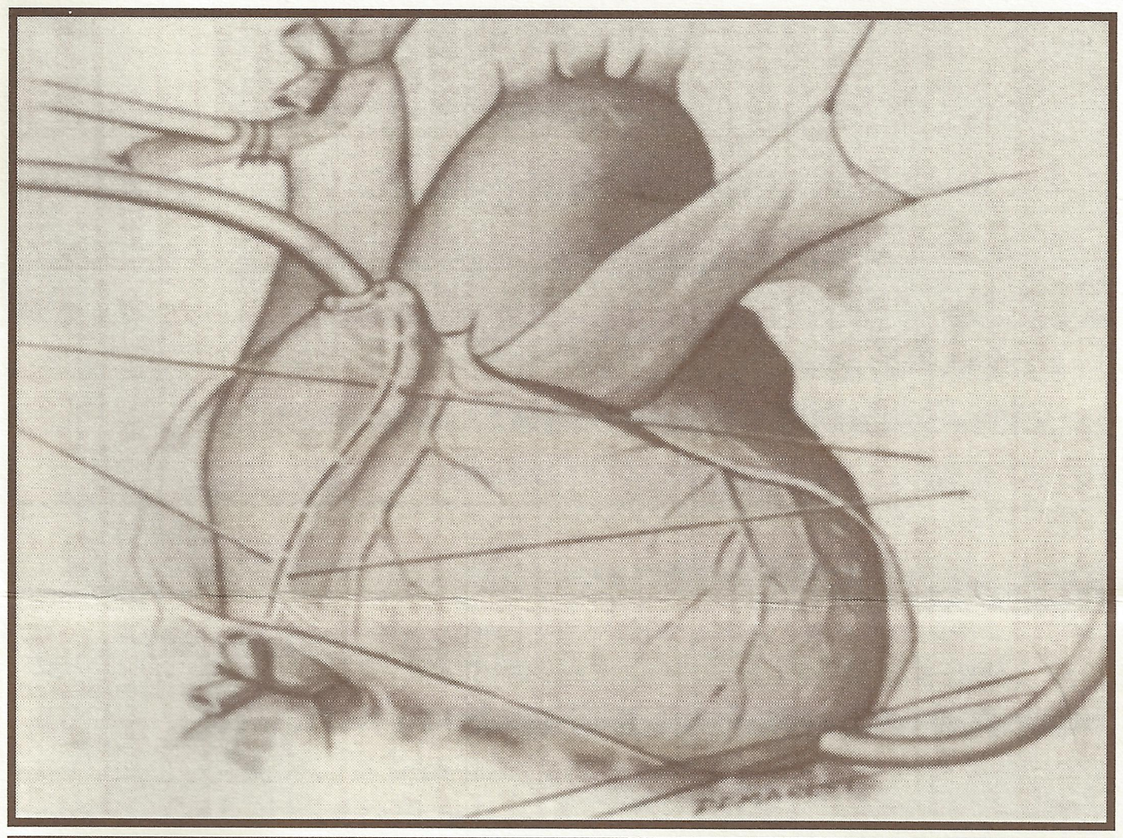
Over the years, Gibbon and his team identified and solved many problems associated with the heart-lung machine. Blood clotting, low oxygenation, hemolysis, and all sorts of equipment failures were but a few of the obstacles that had to be overcome. One particular problem that seemed to rear its ugly head time and time again was the unexpected presence of air in the dog's coronary and cerebral circulation at the time of autopsy. Were these deadly air bubbles being passed into the animal's bloodstream by the heart-lung machine itself?

Further observation and study revealed that the air was in fact being trapped beneath the leaflets of the mitral valve during open-chambered experiments (i.e., closure of inter-atrial or inter-ventricular defects). This air would then slowly escape into the animal's aorta, coronary arteries, and cerebral circulation during the postoperative period, resulting in certain death. Gibbon's residents suggested various approaches to solving the problem (flooding the operative field with carbon dioxide, filling the cardiac chambers with saline just prior to closure, etc.) but nothing seemed to work consistently or reliably. Frustrated, Gibbon invited Frank to join the effort.

After observing several experiments and gathering input from the residents, Frank retreated to his office to devise a solution. When he emerged several days later, he shared his idea, complete with drawings, with Gibbon and the team. His proposed remedy was to create a vent by which the air could be evacuated and removed during the surgical procedure. Specifically, a small tube would be placed in the left ventricle by means of a stab wound in the heart's apex. Gentle suction would be

applied to the vent tube throughout the course of the operation. Air that inadvertently collected in the heart's left atrium or left ventricle could now be "vented" safely to the outside.

Gibbon, a true researcher and scientist, held his excitement in reserve until further experimentation could prove Frank's ventricular vent a success. In a series of 17 dogs operated on for inter-atrial or inter-ventricular defects prior to the use of Frank's vent, 5 had succumbed to air emboli present in the coronary or cerebral circulation. Conversely, in 27 consecutive dogs operated on with the vent tube in place, none exhibited the devastating signs or symptoms of air embolism. Furthermore, no air could be found in any of the animals during post-mortem examination. Frank's ventricular vent worked!



Drawing which depicts venous cannulation and Allbritten's vent which is placed in the left ventricle by means of a stab wound in the heart's apex.

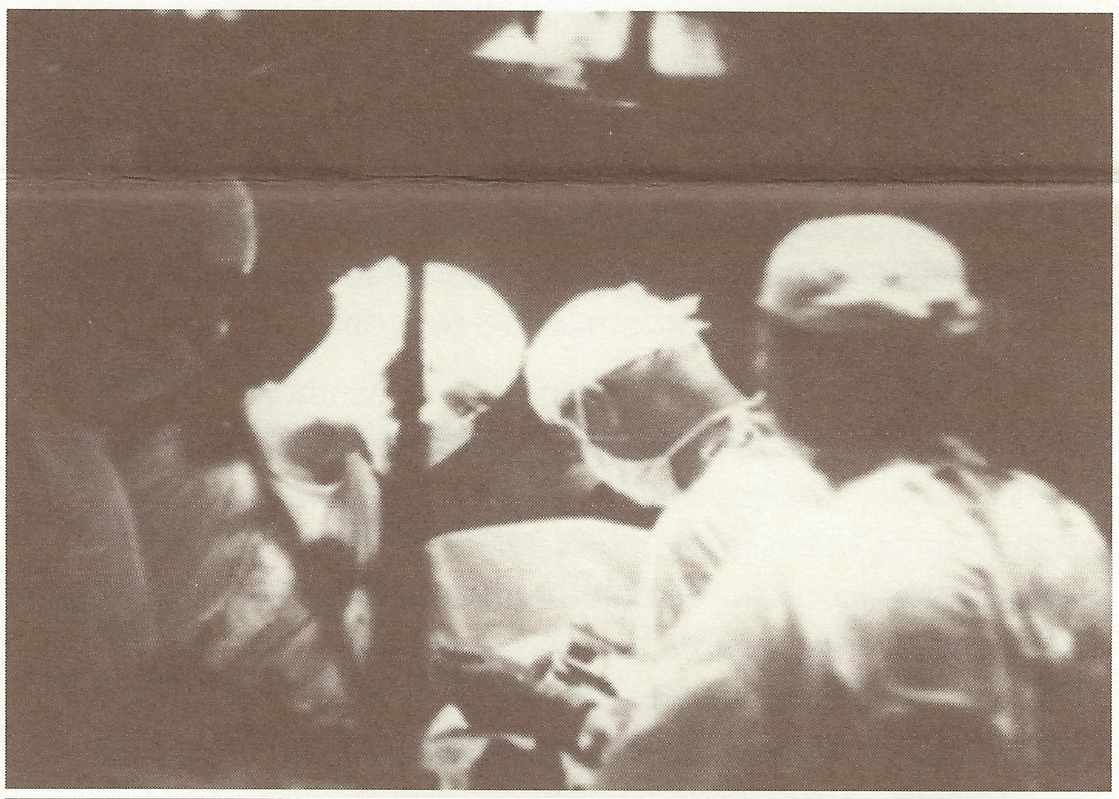
By early 1953, Gibbon felt the time had come to use his machine in humans. His success rate using medium-sized dogs had risen markedly, due in large part to Frank's ingenious ventricular vent. Furthermore, his confidence in his heart-lung machine and his surgical team was at an all-time high. Gibbon's dream was about to be reached.

The Day Comes

Cecelia Bavolek, an eighteen year-old college freshman, entered Jefferson College Hospital on January 19, 1953 complaining of fatigue, shortness of breath, and an irregular heart beat. Physical examination, including X-rays, revealed cardiac enlargement and a loud systolic murmur. Not entirely sure of the diagnosis, the attending cardiologists treated her for rheumatic heart disease. Following her initial discharge, she was scheduled to return in two months for further evaluation. Readmitted on March 29th, her symptoms had worsened to include fever, chills, and hemoptosis. A cardiac catheterization was performed, revealing an atrial septal defect with a large left-to-right shunt. Her surgery date was scheduled for May 6th. Gibbon and his team had just over a month to prepare.

On the morning of surgery, a mixture of excitement and nervousness filled the air at Jefferson College Hospital. The heart-lung machine, roughly the same size as a grand piano, was primed with heparinized blood obtained from donors the night before. Frank, whose efforts and dedication over the years had helped bring Gibbon and his team to this point, first assisted during the procedure. According to operative records, it was Frank who inserted the left ventricular vent, *his* left ventricular vent, which would prevent air from reaching Cecelia's brain and bringing about a most certain postoperative death. According to operative records, it was Frank, the boy from Kansas, who suggested to Gibbon that a primary closure of the septal defect would be faster than using a pericardial patch, yet equally effective. And it was Frank, the son of a grain elevator worker, who would stand up to the numerous critics that repeatedly labeled Gibbon's work as fruitless in the coming years.

Cecelia was discharged from the hospital on May 19th. A subsequent cardiac catheterization performed two months later revealed that no residual shunt or septal defect existed.



Gibbon (right center) and Allbritten (left center) during historic first successful open-heart surgery with the heart-lung machine in Philadelphia on May 6, 1953.

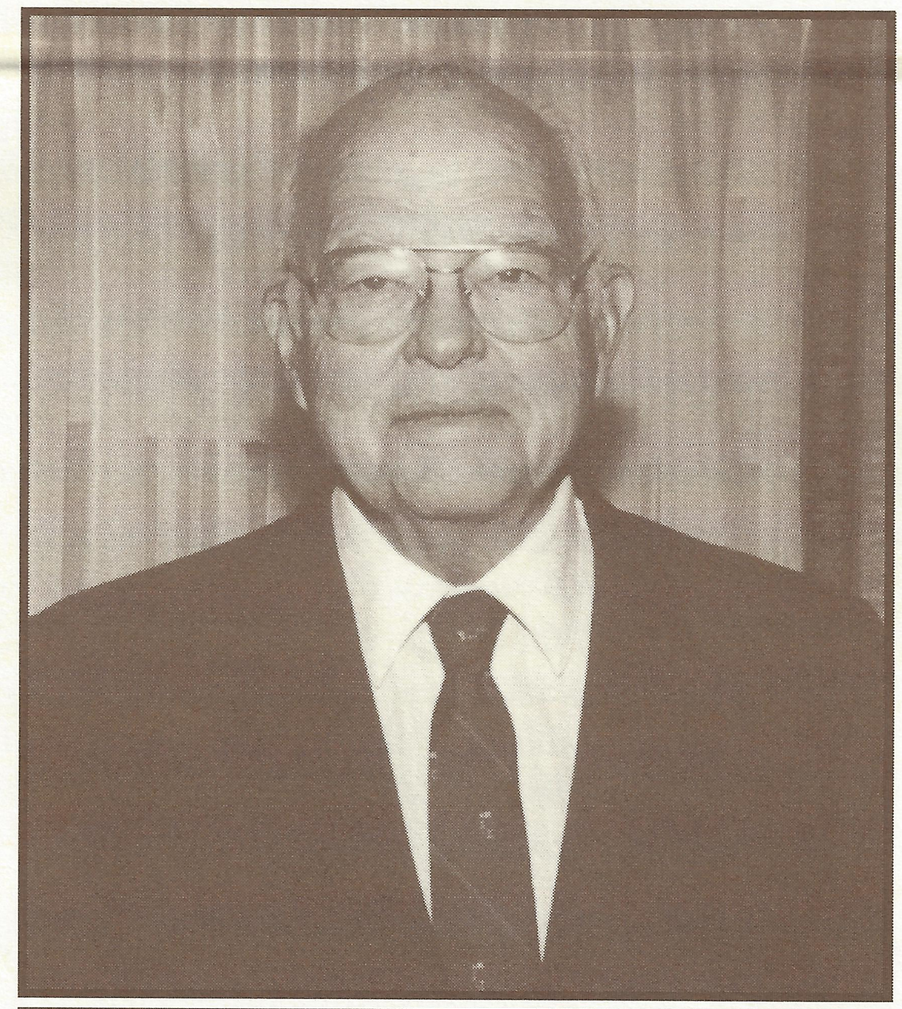
Afterword

In 1954, Frank was duly appointed Professor of Surgery at the University of Kansas School of Medicine and Chairman of the Department of Surgery at the University of Kansas Medical Center. Though his departure from Philadelphia was admittedly sad, his position at KU allowed him the opportunity to pursue his true interest- diseases of the lung and chest. From 1954 to 1971, Frank published over 100 scientific articles on thoracic, pulmonary, and esophageal disorders. In 1962, he co-authored a chapter on lung diseases for Gibbon's classic textbook, *Surgery of the Chest*. In 1972, Frank retired from KU and quietly returned home to Cunningham. He now resides in the very house in which he was born some eighty-six years ago.

The drive from Hays to Cunningham would take about two hours. When I arrived, Frank was busy in his yard pruning bushes and raking pine needles that had fallen during the winter months. He grinned when I introduced myself and told him what I did for a living. In his day, the term *perfusionist* didn't exist, although he thought it had a nice ring to it and was certainly appropriate given what we do.

He offered me a seat in his study while he washed up. The walls were adorned with framed letters, black and white photos, and numerous plaques and accolades. Gibbon's picture was there. So was DeBakey's, and Cooley's, and Dennis', and Lillehei's. I felt an inch tall.

Though nearly fifty years had passed, Frank seemed delighted to tell me about his idea for the left ventricular vent. He admitted to not being able to sleep the night before he and Gibbon and the many residents, fellows, and staff members who worked at Jefferson College Hospital in Philadelphia in the spring of 1953 performed the very first successful open-heart surgery using a heart-lung machine. He spoke of his remorse for the many patients who must have died waiting for extracorporeal circulation to be perfected. I could barely take a breath when he spoke of his own fears in having to undergo coronary artery bypass surgery at the age of eighty.



Dr. Frank F. Allbritten, Jr.
at home in Cunningham, Kansas

My drive back to Hays was a quiet one. Dr. Frank F. Allbritten, Jr., the once tall, handsome surgeon who served his country during war, the man who worked so diligently along side Gibbon for over eight years, the man who devised a vent catheter to rid the heart of air, was now wrinkled, bent, and hard of hearing. That got to me just a little bit. As a Kansan, perhaps I owed him more than just an occasional visit or phone call. As a perfusionist, perhaps my profession as a whole owed him something. After all, he is a direct link, a living, breathing link, to that incredible day in Philadelphia in May of 1953 when the heart-lung machine was born and true history was made. Only a handful of those remarkable individuals are left. Whoever and wherever they are, we ought to seek them out and listen to their stories. I guess I'm lucky to have met Frank at all. Nevertheless, whatever amount of time I spend with him, it simply won't be enough.

Author's Note

Statements contained in this article are from direct testimony by Dr. Frank F. Allbritten, Jr., or by members of his immediate family. The following additional sources were used to verify the accuracy of names, places, and dates.

References

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[This article will be posted on the Internet Services site under the History of Perfusion section. The Academy is very grateful to Kelly for helping to preserve the history of the profession and would like to solicit the help of all perfusionists in such efforts.]