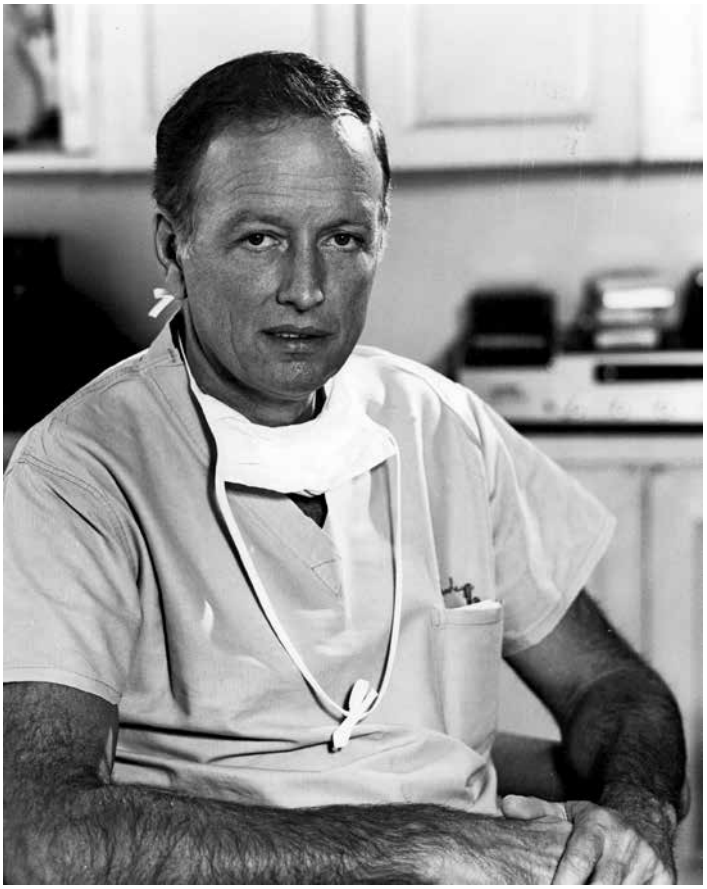
Making a Miracle – The Story of Denton Cooley and the First Total Artificial Heart

By Kenan Nerad

The world awoke on April 8, 1969, to find history had been made a day earlier in Houston, Texas — Haskell Karp, a forty-seven-year-old man emerged from surgery to find his failing heart had been replaced by an artificial heart made entirely of plastic. Such an operation had never been done before and was inconceivable to many, but Dr. Denton Cooley and his team at the Texas Heart Institute relied on decades of advances in cardiovascular surgery to save the life of a dying patient.[1]

The second of two sons, Denton Cooley was born to Ralph and Mary Cooley on August 22, 1920, at Houston's Memorial Baptist Hospital. The son of a prominent Houston dentist and grandson to one of the founders of the Heights, Denton Cooley spent his childhood in a Montrose home off West Alabama Street. He attended local public schools throughout his education at Montrose Elementary School, Sidney Lanier Junior High School, and San Jacinto High School. As a budding basketball player, Cooley was recruited to play for The University of Texas (UT), which found success during his years there, winning the 1939 Southwest Conference Championship and playing in the first NCAA competition. Cooley always thought highly of the lessons basketball taught him, particularly "endurance and competitiveness, with perhaps an emphasis on endurance."[2]



Renowned heart surgeon Dr. Denton Cooley founded the Texas Heart Institute at St. Luke's Hospital in Houston.
Photo courtesy of John P. McGovern Historical Research Center, Houston Academy of Medicine—Texas Medical Center Library, ICC 077 MWN, 13602.

Cooley entered UT in 1937 as a freshman in the predental program, with plans to work in his father's practice, but a fateful trip to San Antonio soon altered his career path. Cooley had a friend interning at Santa Rosa Hospital who gave Cooley the opportunity to assist in sewing a knife wound. Enthralled by the experience, Cooley immediately changed his major to premedical upon returning to UT.[3]

In 1941, Cooley graduated with honors and began medical school at UT Medical Branch at Galveston (UTMB). The scholastic environment that Cooley found at UTMB was a product of medical understanding of the time. Surgery was still in a rudimentary state, with a focus on excising problems instead of repairing or replacing when addressing issues found in the body. Thus, many at UTMB did not consider advancements in heart surgery possible. "We did not even think about surgery of the heart," said Cooley, adding, "It was beyond thought at the time that surgery or manipulation of the heart could be successful. In fact, we were even taught that if you suddenly stopped the heart's action or anything, for any purpose, you would never get it started again."[4] Misconceptions such as these led to cardiovascular surgery being nigh absent from Cooley's surgical training at UTMB.

Although UTMB was Cooley's first choice for medical school, he transferred in 1943 due to a developing political issue involving faculty that could threaten his career prospects. Following the bombing of Pearl Harbor and entry of the United States into World War II, the social climate within the country changed drastically. Concerns over un-American activities and paranoia ran rampant, and when the dean of medicine at UTMB began to have reported conflicts with his colleagues over political issues, he was investigated by the Texas Rangers. These investigations led to UTMB being placed on scholastic probation, temporarily negating any value of a degree from its medical school and causing Cooley to transfer to Johns Hopkins University School of Medicine in February of 1943, which propelled him into the world of cardiovascular surgery.[5]

At Johns Hopkins, Cooley found a mentor in Dr. Alfred Blalock who was on the cusp of a major circulatory breakthrough during the 1940s. His research hoped to treat "blue

Dr. Denton Cooley, right, performing the artificial heart operation.
Photo courtesy of John P. McGovern Historical Research Center, Houston Academy of Medicine—Texas Medical Center Library, ICC 077 MWN, 7465.

babies," or congenital pulmonic stenosis, primarily caused by an unusually small pulmonary artery, which prevented the artery's normal function. The pulmonary artery carries deoxygenated blood from the right ventricle of the heart to the lungs for oxygen exchange before returning it to the left ventricle and pumping it into the body for cellular respiration. Vivien Thomas, an African Amercian lab technician working for Dr. Blalock, discovered a solution for the condition that involved inducing pulmonary hypertension by rerouting blood through a neighboring vessel into the pulmonary artery, forcing the artery to pump the required volumes of blood to the lungs for normal human function. Thomas advised Blalock, as Cooley and others assisted the doctor, during the first operation in November of 1944. The operation saw immediate success. Cooley explained, "Before you opened this connection, they [the patients] were intensely cyanotic or blue, and then you opened the connection and suddenly, they become pink." Upon reflection he added, "I have always thought that that was the dawn of modern heart surgery and I was privileged to be present to witness it."[6]

During Cooley's postgraduate education, he spent two years serving as chief of surgery at a hospital in Linz, Austria, through his service in the Army Medical Corps. He achieved the rank of captain before spending a year in London studying under Russell Brock, London's top heart surgeon. Cooley returned to the United States in 1950 and began a series of medical advances, which helped propel the efficacy and effectiveness of cardiovascular surgery. One of his first stops upon returning to the United States was to observe the work of Dr. John Kirkland who had spent the last thirty years researching and developing an artificial circulator, allowing blood to be mechanically oxygenated outside of a patient's body. Kirkland's machines circulated blood through a column of bubbled oxygen to imitate oxygen exchange in the lungs. Some open-heart surgeries required compromising normal cardiovascular function, and Kirkland's invention sought to make these surgeries safer by providing a way to replicate lung functionality in the absence of a functioning heart-lung system. These early machines failed to oxygenate blood to a high concentration and were therefore only suitable for operations on children due to their reduced blood volume.[7]

Inspired by the inventions he saw, Cooley returned to Houston in 1951 and created his own artificial circulator at Baylor College of Medicine. In 1956 Cooley performed his first open heart surgery with his bubble oxygenator. His machine was still subject to several limitations despite the improvements made. Operations were on a timer, as the machine was unable to properly oxygenate blood if used longer than thirty to forty-five minutes. If used much longer, inadequate blood flow to varied organs could cause long-term complications for the patient. Patient size remained a major factor, as the machine's efficiency was still less than desirable. Despite the shortcomings, Cooley's machine proved what his former colleagues at UTMB thought was impossible: doctors could stop and restart the human heart and expect the patient to survive.[8]

During this time, the use of potassium ions was becoming a mainstream practice, which enabled the heart to be stopped during surgery. Such practices allowed surgeons to "operate in a completely quiet and bloodless field," as Cooley described, allowing for more precise operations to be performed with a lower mortality rate. In 1960, the use of an electrolyte solution instead of blood to prime bypass machines became a mainstay for Cooley and his team. In years prior, large quantities of blood drawn from either the patient or taken from the blood bank were utilized. This causes potential strain on patients due to blood loss and potential exposure to blood-borne pathogens and infections. Such developments showed that surgery could be practical, reproducible, and performed with disposable equipment.[9]

The artificial heart implanted in 1969 as seen on exhibit in 2013.
Photo courtesy of Karon Flage, Flickr.*

During his time at Baylor College of Medicine, Cooley partnered with another leading cardiovascular surgeon: Dr. Michael DeBakey. DeBakey had been instrumental to the development of the first heart-lung bypass machines, developing some of the components utilized in the 1932 models. The development of the heart-lung bypass machine was imperative to open-heart surgery, as it allowed for the complete immobilization of the heart during surgery and led to drastically safer operations. Another critical invention of DeBakey's was the use of Dacron grafts for repairing and replacing damaged blood vessels. Dacron was later used to construct the first total artificial hearts. Cooley, recruited by DeBakey in 1950, saw historic firsts as early as 1953 when the pair reported successful operations to treat aortic aneurysms, pulmonary embolisms, and carotoid endarterectomy. Such procedures were not possible without the progress DeBakey and Cooley made with heart-lung bypass machines, as pulmonary embolisms were cured by squeezing the lungs flat to remove inaccessible blood clots.[10]

Cooley's partnership with DeBakey was short lived, largely ending in 1962 due to what Cooley described as incompatible personalities. Upon leaving DeBakey's team Cooley established Texas Heart Institute. The two constantly sought to outperform the other, leading to incredible progress in cardiovascular surgery. From 1962 to 1967, the mortality rate for heart valve transplant patients fell from seventy percent to a mere eight percent. Their rivalry, however, was temporarily overshadowed when Dr. Christiaan Barnard performed the first heart transplant in South Africa on December 2, 1967. Fueled by competition, Cooley wrote to Barnard after his procedure, "Congratulations on your first transplant, Chris. I will be reporting my first hundred soon." Indeed, Cooley was not far behind, performing his first heart transplant six months later on May 3, 1968. Although the world's first, Barnard's patient survived only eighteen days, while Cooley's survived 204.[11] Cooley performed another twenty-one heart transplants by the end of 1968, keeping true to his promise to reach one hundred transplants.

Dr. Christiaan Bernard, a cardiac surgeon from South Africa, performed the world's first successful human heart transplant.

Photo courtesy of Nationaal Archief, the Dutch National Archives,and Spaarnestad Photo, Wikicommons.*

Dr. Michael DeBakey (center) was with Baylor College of Medicine for six decades, serving on the faculty, as chairman of the Department of Surgery, president, chancellor, and chancellor emeritus. Photo courtesy of John P. McGovern Historical Research Center, Houston Academy of Medicine—Texas Medical Center Library, ICC 077 MWN, 5597B.

On April 7, 1969, what began as a routine procedure to repair the lower chamber of a patient's heart quickly developed into an international story. Haskell Karp, a forty-seven-year-old man who suffered his first heart attack ten years prior, was suffering from severe heart failure and needed a surgical miracle. An hour into surgery, however, Dr. Cooley found Karp's heart beyond repair and concluded Karp was certain to die without an immediate transplant, a transplant they did not have. What was available to Dr. Cooley was an experimental, totally artificial heart still in the early stages of its development and testing. Made completely out of plastic, the eight-ounce pump had shown it could replicate all cardiac function of a normal heart for several days, and Dr. Cooley hoped it would be enough to buy time for a transplant heart to be secured. The operation was unprecedented, not just because the heart was still in the pre-clinical stage of testing but because it was the first time a totally artificial heart was implanted into a human.[12]

The operation, despite being a major trek into the unknown, was successful. Karp was described as "awake and alert" by attending physicians during the sixty-five hours until a human heart transplant was made available. Dr. Cooley found success, replacing the artificial heart with the donor heart, but Karp's luck ran out. Karp received immunosuppressant drugs to mitigate organ rejection, leaving his body prone to post-surgical infections. He quickly succumbed to pneumonia and died a short thirty-two hours after surgery, not an uncommon story for transplant patients due to the limited immunosuppressant drugs available during this time.[13]

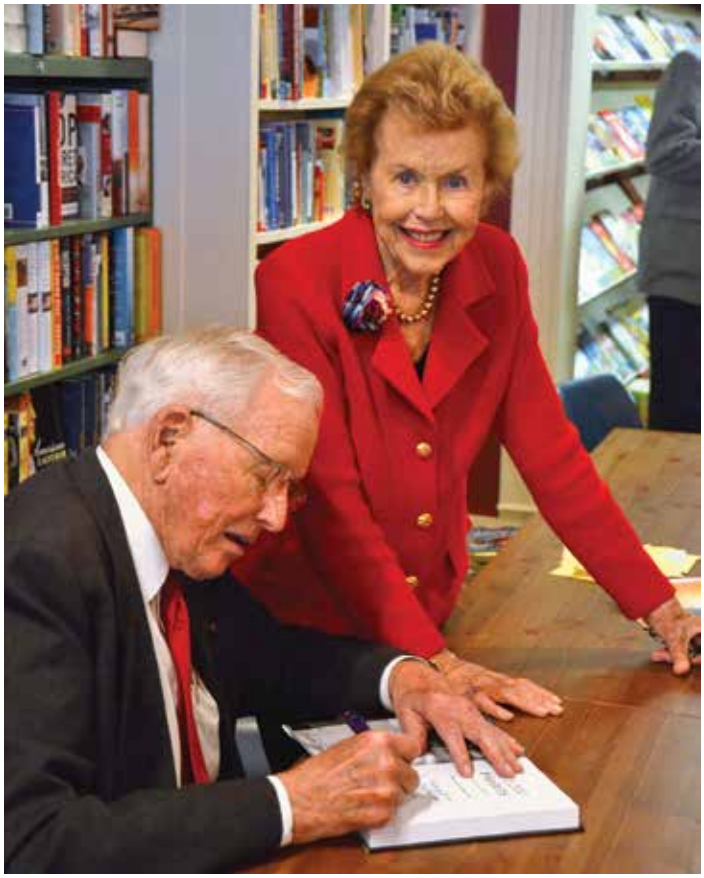
Furious upon hearing the news of this development, DeBakey believed Cooley had appropriated DeBakey's

research and failed to receive federal approval for the procedure. One of the physicians working with Cooley, Dr. Domingo S. Liotta, had recently parted ways with DeBakey and his research team, citing a conflict of interest over the future of cardiovascular surgery. With Liotta came a design for an artificial heart nearly identical to one DeBakey was testing in his own laboratory. DeBakey felt the model was not ready for implementation in a human and could lead to a defunding of research grants for artificial hearts. In 1965 DeBakey stated that with $50 million, "an artificial heart could be ready for permanent implementation within three to five years," and he was rightfully scared to see his project's funding jeopardized due to the actions of a colleague.[14]

Cooley's reputation suffered a major setback. The American College of Surgeons voted to censure him, Cooley ended his nineteen-year association with Baylor College of Medicine, and he faced a multimillion-dollar malpractice suit from Karp's widow. Cooley held fast by his decision, arguing that "if you are a ship out in the ocean and someone throws you a life preserver, you don't look at it to see if it has been approved by the federal government." Although Cooley proved a patient could survive on an artificial heart, the first total artificial heart to see FDA approval for human implementation, the Jarvik 7, would not surface until 1982.[15]

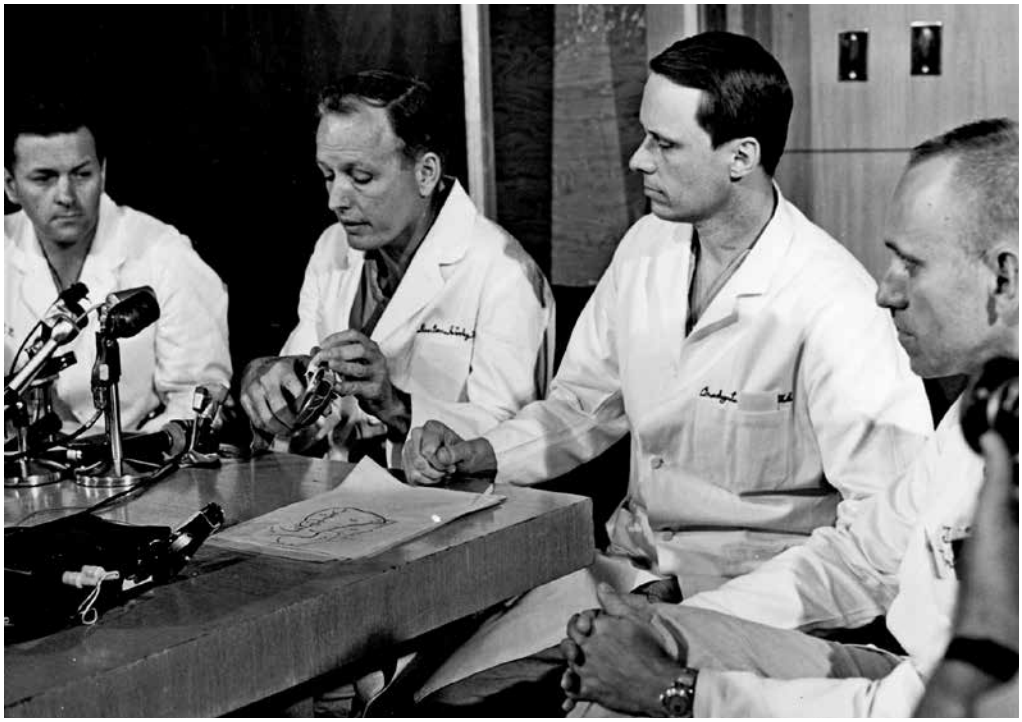
This development did not deter Cooley, as he continued to practice and improve cardiovascular surgery for the rest of his career. By 1972 Cooley had performed over 10,000 open-heart surgeries; and in 2001 he performed his 100,000th, performing as many as twenty-five surgeries a day. Many of his peers marveled as his dexterous hands, fully aware no one could ever match his speed and precision. Russell Brock once mused that "it stands to reason that the world will not produce a second Denton Cooley." Christiaan Barnard, upon viewing Cooley's technique observed, "It was the most beautiful surgery I had ever seen in my life...No one in the world, I knew, could equal it."[16] Cooley remained active at Texas Heart Institute until his passing on November 18, 2016. Although the last operation he performed was in 2007, he remained an omnipresent face throughout the hospital.

Kenan Nerad graduated from the University of Houston in 2019 with degrees in biotechnology and history. As an undergraduate he worked as a laboratory technician at Texas Heart Institute's Cardiovascular Surgery Research Laboratory. Kenan currently works for the Texas commission on Environmental Quality as a project manager of state and federal Superfund sites.



Dr. Denton Cooley and his wife of sixty-seven years, Louise Goldsborough Thomas Cooley, greet visitors in 2011 at a book signing for Dr. Cooley's book 100,000 Hearts.

Photo courtesy of the Texas Heart Institute.



Dr. Cooley, second from left, and the surgical team participate in a press conference following the artificial heart surgery.

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