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Editorial

The Department of Cardiovascular Anesthesia of The Texas Heart Institute: An Informal History

John. R. Cooper, Jr, MD[1]; N. Martin Giesecke, MD[2]

[1]Department of Cardiovascular Anesthesiology and Critical Care, The Texas Heart Institute, and Department of Anesthesiology, Baylor College of Medicine, Houston, Texas
[2]Department of Cardiovascular Anesthesiology and Critical Care, Methodist Hospital, Houston, Texas

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Introduction

This article describes the background, formation, composition, and accomplishments of the Department of Cardiovascular Anesthesiology at The Texas Heart Institute (THI)—one of the most significant medical institutions of the 20th and 21st centuries. As important as it is individually, this history cannot be separated from the history of CV anesthesia (CVA) and CV (CV) surgery at Baylor College of Medicine (BCM).

We describe this article as "an informal history" because few formal, standard, clear historical records (departmental or institutional) exist, save those about the history of BCM.[1] Much of the information reported here was obtained from oral sources, plus written histories of the Texas Medical Center (TMC), its hospitals and other institutions, and biographies and memoirs of individual physicians. We also include our own personal memories. We especially wish to show the contributions of physicians mentioned in the dedications (Fig. 1).

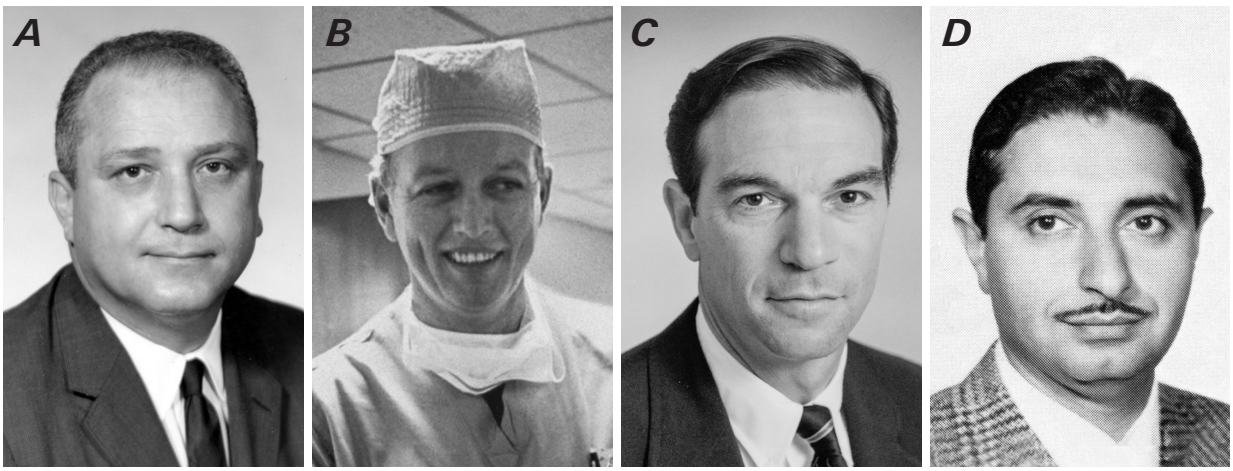

Fig. 1 Drs (**A**) Keats, (**B**) Cooley, (**C**) Slogoff, and (**D**) Girgis

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Corresponding author: John R. Cooper, Jr, MD, Department of Cardiovascular Anesthesia, The Texas Heart Institute at Baylor College of Medicine, 6720 Bertner Ave, MC 1 – 226, Room O520, Houston, Texas 77030 (john.cooperjr@bcm.edu)

We chose to write this history now while the resources we used to construct large parts of it remain available. Those resources included individuals' memories, which we wished to plumb while they were "yet green," to borrow a phrase from Isaac Asimov.[2] The more concrete sources consist mostly of scientific papers from the department, published personal histories of physicians or institutions, photographs from various sources, and documents from the BCM Archives Division and THI itself.

The origins of THI's Department of Cardiovascular Anesthesia are convoluted. This is because of the often-confusing relationships among the department's staff, THI itself, BCM, and to a lesser extent, St Luke's Episcopal Hospital (now Baylor St Luke's Medical Center), and Texas Children's Hospital (TCH).

The origin of the THI department cannot be separated from the beginnings of CVA at BCM. BCM and THI are intertwined, with each institution influencing the other. This is in part because both BCM and THI CVA largely originated with the relationship between 2 remarkable physicians: Arthur Stanley Keats and Denton Arthur Cooley.

The Texas Medical Center and Baylor College of Medicine: Denton A. Cooley and Michael E. DeBakey

Understanding the history of CVA at THI requires understanding what THI itself is as well as its relationship to BCM and other institutions in the TMC (eg, St Luke's, TCH). Although officially, THI was founded by Denton A. Cooley, MD, in 1962,[3] both THI and its Department of Cardiovascular Anesthesiology existed functionally before that time.

Houston in the 1940s was a vibrant port city whose local economy was largely based on the oil industry due to the large discoveries of oil deposits in Texas, starting with the Spindletop field in 1900. The industry continued to grow in Texas in subsequent decades and to some extent shielded the state from the severe economic effects of the Great Depression of the 1930s.

In the 1940s, forward-thinking leaders of Houston, led by local businessman and United States War Production Board Chair Jessie Jones, wanted to fundamentally change the direction of the city. Their goal was to transform it into a major metropolitan area with world-class institutions. One focus of that effort was on medical care. Setting aside an area for a medical center was proposed by prominent local physician Erenst Bertner, MD, and Dean of the University of Texas Dental Branch Frederick C. Elliott, DDS.[4] These individuals and other local leaders started with a designated location for medical institutions, which would include a medical school. A large tract of land southwest of downtown and adjoining Rice University was purchased for the new medical center. This parcel of land was already home to one major local institution: Hermann Hospital. Next came the medical school. It was proposed that Baylor University Medical School in Dallas, which was having difficulties at the time, could be persuaded to move to Houston. With funds provided in part by the MD Anderson Foundation and Texas oilman Hugh Roy Cullen, this was accomplished in 1943.

Abbreviations

ACGME, Accreditation Council for Graduate Medical Education
BCM, Baylor College of Medicine
CPB, cardiopulmonary bypass
CV, cardiovascular
CVA, cardiovascular anesthesia
LVAD, left ventricular assist device
OR, operating room
TCH, Texas Children's Hospital
THI, The Texas Heart Institute
TMC, Texas Medical Center
UTMB, University of Texas Medical Branch

Another specific wish of the local leaders was to recruit a nationally known physician to serve as chairman of the school's Department of Surgery. At first, they approached Alton Ochsner, MD, an internationally famous surgeon and one of the founders of the then newly organized Ochsner Clinic in New Orleans. Because of his New Orleans commitments, Dr Ochsner declined the invitation. Instead, he recommended Michael DeBakey, MD, one of his former surgical residents. Dr DeBakey, at that time an Ochsner surgical staff member, was already a well-known vascular surgical specialist. He agreed to assume the chairmanship and moved to Houston in 1948, when the first of the medical school's buildings was just being completed.

Other institutions in Houston planned to construct hospitals in the TMC area, including the Methodist and Episcopal churches. Additionally, a children's hospital was planned. Over the next few years, all these plans

were brought to completion with the construction of (or addition to) 5 major hospitals in the TMC: Hermann (preexisting), Houston Methodist, St Luke's, TCH, and the MD Anderson Hospital for Cancer Research.

In 1951, Denton A. Cooley, MD, appeared on the scene—or rather, returned to it. A Houston native whose family's roots in the city went back generations, Dr Cooley had left Houston to attend the University of Texas at Austin, where he was known for his basketball skill. He then attended medical school at the University of Texas Medical Branch (UTMB) in Galveston before transferring to Johns Hopkins in Baltimore. He finished a surgical residency there under department Chair Alfred Blalock, MD. In 1944, during his residency, Dr Cooley assisted Blalock with the first "blue baby" palliative operation, known as a Blalock-Taussig shunt. Cooley subsequently participated in and later performed many more congenital heart operations while at Johns Hopkins. He was particularly recognized for his exceptional technical skill. After finishing his residency, Dr Cooley contacted Dr DeBakey in Houston, stating that he intended to return to the city but first wished to complete more training overseas. Dr DeBakey gave his assent and offered Dr Cooley a BCM surgical appointment when he returned. Dr Cooley then became a fellow under Russell Brock, a prominent British thoracic surgeon at the Brompton Hospital in London, who was a pioneer in "closed" cardiac valvular procedures: operating on diseased cardiac valves with either an instrument or the surgeon's finger placed through a small, tightly controlled hole in the cardiac chamber walls. Thus, when Dr Cooley returned to Houston, he was as close to a fully trained CV surgeon as could be found in the early 1950s, when all the pioneering surgeons in that subspecialty were essentially self-taught.[3]

It should be noted that all the medical subspecialists involved in the care of CV surgical patients—surgeons, anesthesiologists, cardiologists, pulmonologists, and other important personnel such as perfusionists—had few or no established training programs in the 1950s. Essentially, everyone involved had on-the-job training, and at that time, most CV surgical procedures were experimental.

The subsequent association between Dr Cooley's and Dr DeBakey's practices at BCM was to have a worldwide impact on both cardiac and vascular surgery as a subspecialty. It also profoundly affected the growth of the TMC as a whole and especially the newly constructed Methodist, St Luke's, and TCH. Initially, the 2 surgeons collaborated on treatments for vascular pathologic conditions by developing and applying new concepts in surgical therapy. These included the use of the first human cadaver vascular grafts and later artificial grafts for abdominal aneurysms and ruptures, aorto-iliac occlusive disease, carotid artery occlusive disease, and thoracic aneurysms and dissections of the aorta. Their work together was truly pioneering and produced many scientific publications.

Other young staff surgeons joined the BCM surgical department, focusing first on vascular disease and later cardiac disease. These included Drs Oscar Creech, Stanley Crawford, Grady Hallman, Arthur Beall, and George Morris and later Drs George Reul, Jimmy Howell, and George Noon. They all became well known locally, nationally, or both. Surgical firsts at BCM included the first carotid endarterectomy, the first use of Dacron surgical grafts, and the first definitive repairs of thoracic aortic aneurysm. The department rapidly became nationally and internationally known not only for its original therapies but also for its impressive case volume.

However, Dr DeBakey both led the department and competed against his own staff. His patients were always given priority for admission over other surgeons' patients at Methodist, initially the primary location for BCM surgeons' activities in the CV arena.

This competition was especially fierce between Drs DeBakey and Cooley. Both were naturally therapeutically aggressive and driven individuals, and both were interested in the therapy of cardiac and vascular disease and therefore in the same types of surgical cases. Both generated many patient referrals. However, an additional factor came into play. Dr Cooley had extensive experience and was the acknowledged local leader in the surgical treatment of pediatric patients with congenital heart disease. These procedures were usually performed at TCH, which at that time shared a 6-room operating suite with St Luke's. Because he sometimes had difficulty having patients admitted to Methodist, Dr Cooley took the practical step of having pediatric patients admitted to TCH and having his adult patients admitted to St Luke's. These institutions (Fig. 2) became the center of his activities in the mid- to late 1950s, and most of his subsequent well-known cases took place in their combined surgical suites. The functional separation of Dr Cooley's practice from Methodist was open and sanctioned by Dr DeBakey.[5]

Fig. 2 Photograph of the Texas Medical Center in 1964, showing Texas Children's Hospital and St Luke's Hospital in the foreground and the section connecting them where the operating rooms were

Arthur Stanley Keats, MD

Into this setting of aggressive surgeons exploring new therapies for CV disease came another individual who would prove to be, in anesthesiology and specifically CV anesthesiology, a prime example of the right person in the right place at the right time. The term "CV anesthesiologist" was unknown at the time and would not be used generally until almost 25 years later, even though such subspecialty practices in both surgery and anesthesia were being developed by the early 1960s.

Arthur S. Keats, MD, was a native of New Jersey who graduated from the University of Pennsylvania Medical School and interned at the University of Chicago. He then trained in both research and clinical anesthesia at the Massachusetts General Hospital and Harvard Medical School under its professionally famous departmental chairman, Henry K. Beecher, MD. After completing his residency there in 1951, Dr Keats spent a year practicing anesthesia in Switzerland. Upon returning to the United States, he became the chief of Anesthesia at the Mary Imogene Bassett Hospital in Cooperstown, New York, and had an appointment as a clinical instructor at Columbia University in New York City.

In 1955, Dr DeBakey, as chair of BCM's Department of Surgery, needed a new chair of Anesthesiology, which had been made a division of the Department of Surgery (a common circumstance for academic anesthesiology departments in that era). Relationships between surgeons and anesthesiologists on a national level were not cordial at that time, even in academic circles. For several years after World War II, which generated many physicians trained in anesthesia, anesthesiologists— as opposed to nurse anesthetists—were often not welcomed by many surgeons in operating rooms (ORs), as the surgeons resented the presence of another physician in their domain. Anesthesiologists were not generally asked to speak at surgical meetings and seldom attended them. Dr Beecher was an exception to this rule, as he had a reputation for advocating cooperation with the surgeon. He was probably the only nationally prominent academic anesthesiologist with whom Dr DeBakey was acquainted.

In searching for a new Anesthesiology chair, Dr DeBakey asked Dr Beecher for a recommendation. Dr Beecher's immediate and only suggestion was Dr Keats. Dr DeBakey and BCM extended an offer to Dr Keats, and he accepted. Thus, at 33 years of age, Dr Keats was installed as the new chair of the Division of Anesthesiology on September 30, 1955. Before this, Anesthesiology had been a department in the medical school; the faculty were private practitioners with clinical appointments at the school. The inclusion of the Department of Anesthesiology as a division of the Department of Surgery came at the same time as the inclusion of several other surgical subspecialty departments as divisions of the main department. The Board of Directors of BCM made these organizational decisions.[1]

Dr Keats immediately started work, establishing the beginnings of an academic anesthesiology department in all aspects: clinical care, education of residents, and both clinical and laboratory research (Fig. 3). He was given offices in the BCM administration building and laboratory space elsewhere. He received a small salary from BCM for performing the abovementioned tasks and for the administration of the departments at Jefferson Davis Hospital, which treated indigent patients and which was the teaching hospital for BCM trainees. The salary was also for insuring the instruction of those trainees during rotations to the Houston Veteran's Administration Hospital and the private St Luke's/TCH and Methodist. Because his salary from BCM was small, approximately $5000 per year, Dr Keats was expected to earn compensation by providing anesthesia services to the patients of BCM surgeons at the private hospitals in the TMC (Arthur S. Keats, personal communication, 1996).

Fig. 3 Keats in the laboratory

The Beginnings of Open-Heart Surgery in Houston

Besides the aforementioned vascular procedures, one important area of surgical progress during this time was operations on the heart itself. As previously noted, procedures on cardiac lesions such as valvular stenosis and insufficiency were performed by "closed" techniques or by others such as "well" approaches, which allowed access to the atria. This changed forever in April 1953, when Dr John Gibbon of Jefferson Medical College in Philadelphia used extracorporeal circulation—specifically, cardiopulmonary bypass (CPB)—to successfully close a secundum atrial septal defect in a young woman. She went on to lead a normal life afterward.[6] He attempted other cases but had no success. Still believing that his successful case proved the validity of the concept, Dr Gibbon transferred his technology to a young surgeon, John Kirklin, MD, at the Mayo Clinic in Rochester, Minnesota.

The other primary site for CV surgical research using CPB at that time was only 90 miles away at the University of Minnesota, under the leadership of C. Walton Lillehei, MD. Dr Lillehei had already become known for repairing intracardiac defects in children by using "cross-circulation," whereby the child's parent served as a "pump oxygenator."[7] He had remarkable success with this approach with relatively few complications for the era. But at the same time, he and his associates were also researching mechanical extracorporeal circulation. In fact, an operation with CPB had been attempted at the university in 1952, but the patient died in the OR. Their techniques had become more refined by 1955 and were almost ready to be used again in patients.

Because Dr Cooley was extremely interested in repairing intracardiac defects and became aware of the research at both programs in Minnesota, he and Daniel McNamara, MD, the chief of Pediatric Cardiology at TCH, visited them in June 1955. (The visit was memorable for both and is well recounted in Dr Cooley's memoir.[3]) They visited Dr Lillehei first, observed a cross-circulation procedure and, more importantly, saw the pump oxygenator developed by Dr Lillehei's associate, Richard DeWall, MD. This device was much simpler than the Mayo-Gibbon pump that they would see the next day. That pump was much larger, was mechanically more complicated, had a much larger priming volume, and was quite expensive. The 2 devices also used very different physiologic approaches to extracorporeal perfusion. Dr Cooley left Minnesota realizing that he could not possibly acquire a Mayo-Gibbon pump because of its expense and complexity. Rather, he thought that a pump like the one developed at the

University of Minnesota might be more feasible for use in Houston.

After returning to BCM, Dr Cooley started a research program using this pump in animals. Unfortunately, these experiments were not very successful. Dr Keats was involved with this initial research effort, too.

In April 1956, Dr Cooley was contacted about a patient who had developed a ventricular septal defect after a myocardial infarction. The patient's cardiologist, Sydney Schnur, MD, believed that if nothing was done, the patient would die within 24 hours. Dr Cooley declared himself and his surgical team ready. The patient was transferred to Methodist, and the pump was brought from the surgical laboratory at BCM. When one of the authors (John R. Cooper) later asked Dr Cooley who had performed the anesthetic management for this first case with a pump oxygenator, Dr Cooley could not remember (Denton A. Cooley, personal communication, 2008). He said it might have been a nurse anesthetist, but more likely it was a prominent private-practice anesthesiologist, Presley Chalmers, MD, who was the chief of Anesthesia at Methodist.[8] Unfortunately, the medical records for that case and the other early cases have not been preserved.

The patient's chest was opened, and CPB was initiated. Dr Cooley repaired the ventricular septal defect in a remarkably short time, and the patient was successfully weaned from the pump oxygenator.[9] In a historical sense, this operation may well have been the first adult pump case in the world for acquired heart disease (as opposed to congenital heart disease) and certainly for acutely acquired heart disease.

The BCM and Houston medical communities were very impressed with Dr Cooley's skill and the fact that extracorporeal circulation had become possible in Houston. Dr Cooley began to have patients with cardiac defects referred to him by other cardiologists.[3] By the end of 1956, he had performed 95 more open heart operations at St Luke's/TCH—more than all other sites in the United States combined. As a result, patient referrals increased the next year and in subsequent years.

Interestingly, the perfusionist for Dr Cooley's early cases was another physician: a pediatric cardiologist and one of Dr McNamara's colleagues, Joseph Latson, MD, who had been involved with the Houston research and development of the pump. We do not know whether Latson's assistance was motivated by personal interest, or whether this was an "assignment" by Dr McNamara. A few other individuals were involved as perfusionists in the early cases, including medical students and surgical residents, but evidently most of the burden was borne by Dr Latson. Eventually, a nurse—Mary Martin, RN—was recruited to take over as a full-time perfusionist in the rapidly expanding service, allowing Dr Latson to resume his other clinical duties. Ms Martin noted during a personal conversation with Dr Cooper that once she took over, Dr Latson did not provide perfusion services for any more pump cases (Mary Martin, personal communication, 2008). Also, what may not be appreciated was that even before Dr Latson left, Dr Keats and, later, other anesthesiologists became involved with supervising perfusion in Dr Cooley's practice, which led to the shared supervision of CPB along with the attending surgeon; this practice remains ongoing at THI (Fig. 4).

The original pump oxygenator used in Houston was relatively easy to construct, but the individual components were sometimes hard to obtain, and Dr Cooley was interested in developing a more permanent device rather than one made for each case. So, at his direction, Dr Latson and his best friend, Robert Leachman, then a medical student and later an internationally prominent cardiologist, pursued the project in Dr Latson's home garage and in the surgical laboratory at BCM. Their final product was manufactured by a Houston business, Commercial Kitchens Company, which was one of the few manufacturers in the city that could weld stainless steel. This second device nicknamed the "Coffee Pot" because of its resemblance to a percolator coffee maker, worked well and was used by Dr Cooley for several years.[10] Presumably it was used by other surgeons at BCM, but when and to what extent is unclear, and the individuals involved are no longer living. The device was further reproduced by the Mark Company.[3] Multiple copies were made and were used in other hospitals in Texas, although to what extent is not known.

Ultimately, the Coffee Pot was retired in the early 1960s, when commercially manufactured disposable oxygenators became available. A surviving example, and perhaps the original oxygenator, was later found in a surgical laboratory closet at BCM. Its components are on display in the DeBakey Museum at BCM and the Wallace D. Wilson Museum at THI. Dr Keats was involved with both the experimental work in perfusion (including the development of the Coffee Pot) and personally provided anesthetic management for Dr Cooley's cases at St Luke's/TCH (Fig. 5). This was acknowledged by numerous individuals involved

in the operative and postoperative clinical care of those patients at the time. Several physicians have described Dr Keats's profound knowledge of pharmacology and his use of that knowledge to help manage Dr Cooley's and other physicians' patients.

Dr Keats began to publish his experiences with anesthesia at a time when there was relatively little in the anesthetic literature concerning CV subjects.[11] For example, what is generally regarded as the first textbook on cardiac anesthesia was published in 1956 by Kenneth Keown, MD.[12] Other texts followed, but slowly. The field of cardiac surgery, however, was expanding extremely rapidly, especially after Dr Cooley and later other surgeons at BCM showed that it could be accomplished with good clinical results for many patients and with an acceptable mortality rate, especially for the time. Dr Keats once remarked that things changed so quickly that the physicians involved thought that there needed to be an extra member of the operating team whose job was to just sit in a corner of the OR and think.[13]

Fig. 4 The Baylor/Texas Children's Hospital/St Luke's cardiac surgery group circa late 1957, with (left to right) Joseph Latson, MD; unknown; unknown; Denton Cooley, MD; Yoshi Takao, MD; James Harberg, MD; Mary Martin, RN; unknown; Luis Soltero, MD; unknown; Arthur Keats, MD; and Daniel McNamara, MD

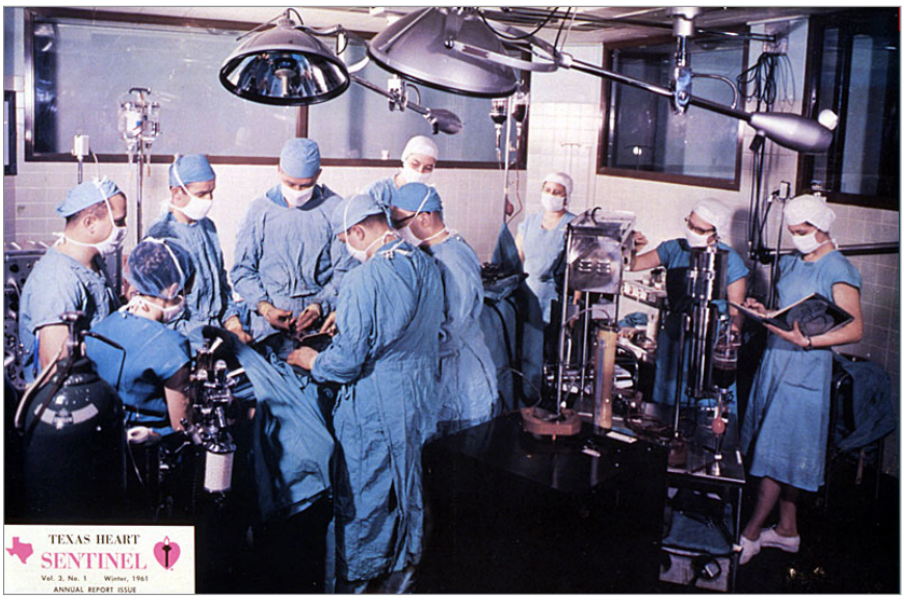

Fig. 5 Dr Cooley operating in old room 1 at St Luke's/Texas Children's Hospital in 1961. Dr Keats is the anesthesiologist. Mary Martin is the perfusionist using the "Coffee Pot" oxygenator. Note the nurse with Dr Cooley's ledger book of recorded cases.

Dr Keats's personal involvement with most of Dr Cooley's cases persisted from 1956 well into the early 1960s (Kamel Girgis, personal communication, 2020). This was a remarkable personal achievement, but as Dr Cooley became busier, it became impossible when combined with Dr Keats's other duties. His wife, Marilyn, once mentioned that it was common for him to return home at 9:00 PM after having left for work before 7:00 AM (Marlyn Keats, personal communication, 1985). Dr Keats would work with a resident, and his colleague, Jane Telford, MD, would come over from Ben Taub—a new public hospital—and relieve him for lunch (K. Girgis, personal communication, 2020).

During this time, Dr Keats also worked with Dr DeBakey, who operated primarily at Methodist. Exactly how involved Dr Keats was with Dr DeBakey's practice and those of the other BCM CV surgeons is now impossible to determine, but there was significant interaction. Dr Keats also was not just a clinician but the chairman of the department, with responsibilities in administration, educating trainees, and research. It seems that he moved forward in all these areas with deliberate speed. Unfortunately, departmental records do not exist for the earliest years of his leadership; the first annual report on the Division's activities was not made until 1959.[14]

Other anesthesia faculty began to be added to the BCM attending physicians who directed their primary efforts to CV patients both at St Luke's/TCH with Dr Cooley and at Methodist with Dr DeBakey and the other BCM CV surgeons. The surgeons, of course, demanded anesthesiologists who were familiar with the cardiac and vascular operations being done. The earliest of these was Dr Telford. Faculty members added later included Phiroze Sabawala, MD; Alexander Romagnoli, MD; Kamel Girgis, MD; Jerriann Hacker, MD; Alexander Goldstein, MD; and John Riquelme, MD, all of whom became part of the CVA faculty at BCM. Most were on staff at St Luke's, Methodist, or both. An additional physician, Beman Das, MD, stayed for a relatively short period of time. Another BCM CV Anesthesia staff member, who joined the department in the early 1960s, was M. Jerome "Jerry" Strong, MD. He worked mainly at St Luke's/THI. He was especially skilled in managing pediatric patients with congenital cardiac defects. He left BCM in the early 1970s and moved west to join the Department of Anesthesiology of the University of California San Francisco, where he had notable success.

Cardiovascular Anesthesia at The Texas Heart Institute and Baylor College of Medicine

When THI was founded by Dr Cooley in 1962, his pediatric cardiac surgical practice at TCH was well established, and he had begun to admit adult patients to the physically connected St Luke's and perform the surgical procedures in the shared ORs of the 2 hospitals. Thus, there was functionally no clinical change when the official founding occurred. So, as a practical matter, a department existed since Dr Cooley started cardiac surgery under the auspices of BCM. To be clear, THI was founded as an educational and research entity and had no clinical arm until 2021. However, what had started as Dr Cooley's personal practice caused THI to be widely regarded as a clinical entity, even though the clinical casework was performed in the ORs and cardiac catheterization laboratories of St Luke's/TCH. These clinical facilities remained combined from 1955 until TCH opened new CV ORs in the early 1990s.

Thus, CVA was performed as a perceived part of THI since it was founded. Before that, as stated above, the sole anesthesiologist providing CVA was Dr Keats, with help from Dr Telford. Later, all THI anesthesia staff members were full-time BCM faculty, but because Dr Cooley was a full-time BCM staff member also, this was just taken in stride with little thought given to specific CV designations, even though they had existed clinically from the beginning. This apparently changed in the late 1960s, when Dr Cooley sought more organizational structure for THI. A board of directors for THI was formed, and a medical director was appointed: Robert Hall, MD, well known nationally as President Eisenhower's cardiologist when he was in the US Army Medical Corps. Divisions of THI were formally established, including Surgery, Anesthesia, and Cardiology. A Research division with an animal laboratory and a section of Cardiovascular Pathology were added later. A process for appointments to THI's professional staff was also created. These appointments were separated from those to BCM and the 2 hospitals involved. At that time, St Luke's, TCH, and THI were all administered jointly as a single organization, although they each maintained separate boards of directors and were legally distinct entities.

From the mid-1950s forward, Cooley's surgical case load kept increasing. Anesthetic management for these

patients was now impossible for Dr Keats to handle personally after the early 1960s, so additional staff joined the BCM Department of Anesthesia. They were primarily based at St Luke's/TCH and thus were part of the THI group. These anesthesiologists, including the aforementioned Drs Strong, Sabawala, Girgis, Goldstein, Hacker, and Romagnoli, joined at various times throughout the 1960s. There was a separate group of BCM CV anesthesiologists at Methodist for Dr DeBakey and the other BCM CV surgeons. A few of the THI group members went back and forth to both hospitals. It was mentioned to us several times by various staff that because Dr Cooley was so much easier to work with, the St Luke's/TCH ORs were a much more pleasant place to practice than Methodist's Fondren-Brown CV unit. Additionally, Dr Cooley required other staff surgeons to interact with the anesthesiologists and other personnel as he did, which made THI's atmosphere even more welcoming.

Although the staff anesthesiologists and Dr Keats did not refer to themselves as CV anesthesiologists at the time, the exclusive nature of their practice in both institutions made them such. Thus, Dr Cooley's practice, Dr DeBakey's practice, and the other BCM and THI CV surgeons occupied all these anesthesiologists' clinical efforts. Dr Cooley's practice expanded as he added CV surgeons to the THI staff starting in the 1960s. Functionally, theirs was one of the first CV anesthesia departments and almost certainly the largest at the time. It was orchestrated in Houston under the overall leadership of Dr Keats. The increasing size of the department was a necessary response to the continuing expansion of THI's (St Luke's/TCH) and BCM's (Methodist Hospital/Fondren-Brown unit) CV surgical volume.

As surgeons and cardiologists became more accepting of advancements in cardiac care, which were being made on many fronts, the cardiac surgical practice at THI continued to increase. Artificial cardiac valves of many types were developed and were implanted with varying degrees of success at first. Early attempts were made at therapy for coronary artery disease, for example, with coronary endarterectomy. Experimentation began on mechanical devices to assist the heart, and the first of these left ventricular assist devices (LVADs) was implanted at Methodist by DeBakey's group in 1966.[15] Dr DeBakey, however, was personally more interested in developing an artificial heart, and he secured a National Institutes of Health (NIH) grant to fund the project. He recruited an Argentinian physician—Domingo Liotta, MD, who was developing a working model—to work in the BCM surgical laboratories. At the same time, transplantation of organs—first abdominal ones, the kidneys and the liver—was gaining acceptance. Cardiac transplantation followed, with the first being performed in South Africa. Dr Cooley performed the first successful US cardiac transplant on May 3, 1968, and then several more. Dr Goldstein was the anesthesiologist for Dr Cooley's first transplant, assisted by Dr Kamel Girgis, who managed the anesthesia for most of the subsequent transplants (Ann Goldstein, personal communication, 2020; K. Girgis, personal communication, 2020).[16] Unfortunately, this initial enthusiasm for cardiac transplants quickly waned as most of the initial patients succumbed to infection relatively shortly after their operations, and cardiac transplantation was suspended in the United States except at 2 institutions.

Cardiovascular Anesthesia Education

From an educational standpoint, another important event occurred in June 1965. Dr Keats took advantage of his clinical situation and started what was probably the first formal CVA fellowship in the world, defining the fellowship as involving cases with exclusively cardiac, vascular, or thoracic pathology and for a term of at least 1 year at an academic institution. The first fellow was Cornelia ("Nellie") Lukban, MD, who had previously done a residency at Boston City Hospital. After the cardiac fellowship, she joined the BCM faculty for a time as an instructor and then returned to her native Philippines (Fig. 6). The second fellow was Dr Girgis, who was accepted for fellowship in 1966 and subsequently joined the BCM anesthesia faculty. This fellowship was not approved by the Accreditation Council for Graduate Medical Education (ACGME), which did not yet recognize anesthesia fellowships. Nevertheless, it was the first documented fellowship that met the abovementioned criteria. Five years later, in 1970, this and other fellowships were accredited by the ACGME Anesthesiology Residency Review Committee for an extra year (CA4 year) of training beyond normal residency.

The Total Artificial Heart

In 1969, Dr Liotta approached Dr Cooley because he was frustrated and not getting encouragement from BCM or Dr DeBakey in his artificial heart research. Dr Cooley, in contrast, encouraged him and thought that his newest model with some modifications might be suitable for patient implant. Drs Cooley and Liotta implanted the world's first total artificial heart on April 4, 1969, after the patient, Haskell Karp, could not be successfully weaned from CPB.[17] Dr Keats directed the anesthetic management of the case with assistance from Dr Girgis (K. Girgis, personal communication, 2023). The device worked and led to a subsequent cardiac transplant 2 days later. Unfortunately, Mr Karp died 2 days after that from an overwhelming infection, again a result of the limited immunosuppression and antibiotic knowledge of the times.

The personal and institutional fallout from the total artificial heart implant was significant. Dr DeBakey was upset that the operation was carried out without his knowledge or permission. Ultimately, Dr Cooley resigned as a BCM faculty member. (The full story of this episode is well beyond the scope of this article; the authors refer readers to the various accounts of the controversy by Dr Cooley and others.) The result was a complete separation of Dr Cooley's practice from BCM. Because the practice was already located in a hospital other than Methodist, his resignation had little practical effect on his patients' care.

New Efforts at THI

Dr Cooley additionally worked to start a formal research arm for THI and recruited John "Jack" Norman, MD, to head it in 1972.[18] Dr Norman established an animal laboratory and began research into LVADs. He received grants from the NIH and other entities. After Dr Norman's departure a few years later, O. H. "Bud" Frazier, MD, assumed leadership of the THI Laboratories and remains in this position today. From time to time, THI anesthesiologists have participated in the laboratories' experimental work with LVADs and total artificial hearts.

Three years after Dr Cooley's split from BCM, in 1972, an important improvement was made to the clinical facilities at St Luke's/TCH. Prompted by Dr Cooley, the boards of the institutions had embarked on a building program that would address the chronic lack of available space in the face of a huge patient load, with many of these patients headed for surgery. The ORs were markedly expanded to include a suite or "Pod" of 8 designated CV surgical rooms surrounding a sterile core area from which supplies could be accessed easily. They were equipped with modern monitors and were large for the time. Uniquely, one of the rooms was built as a "double-ended" suite with anesthesia machines at each end and the room divided by an accordion partition if needed. Thus, in those days of local harvesting of donor hearts (as opposed to remote harvesting as is carried out nowadays), the donor and recipient could be cared for

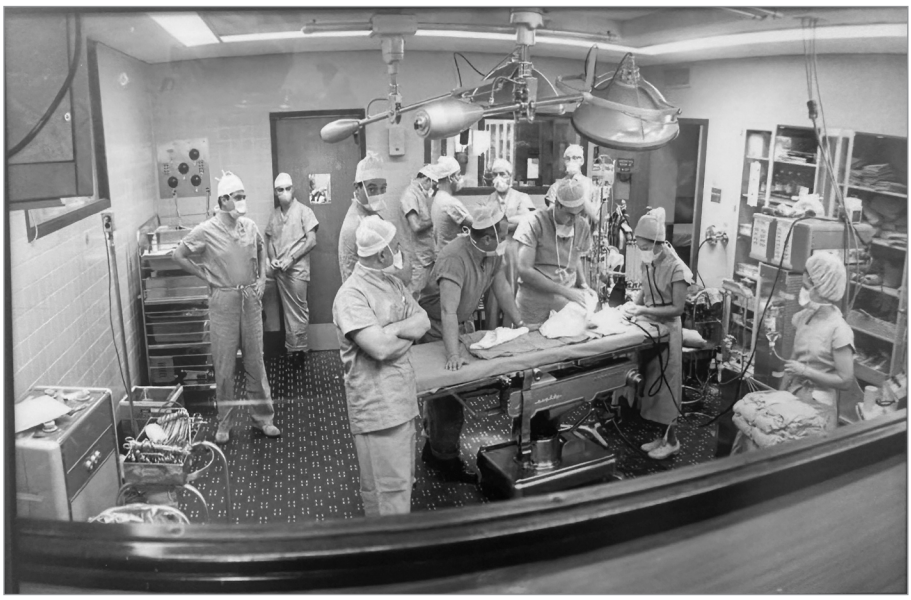

Fig. 6 Arthur Keats and Jerry Strong anesthetizing a patient in old room 1 at St Luke's/Texas Children's Hospital, circa 1965. The person at the head of the table is Cornelia Lukban, MD, Baylor College of Medicine's first Cardiovascular Anesthesia fellow.

in the same room. To our knowledge, this room was never used at both ends for a cardiac transplant patient and donor but was used (rarely) for kidney transplant recipients and donors some years later.

While there is no specific documented evidence of anesthesia input into the OR design, there are signs of subtle influences. Instead of an anesthesia supply cart in each room, there were multiple built-in drawers for supplies and drugs, which permitted easy access, and there was adequate space for plenty of needed equipment. Additionally, there was an entire cabinet for anesthesia supplies alone. The rooms had state-of-the-art monitors plus supplemental monitors easily seen by everyone in each room. All the rooms were equipped the same, with everything in the same place in all rooms, which dramatically improved efficiency and rapidity of access for the anesthesiologists.

This OR expansion markedly improved patient flow and efficiency. Additionally, and importantly, postoperative care was expanded from the original St Luke's Surgical Recovery Room, which functioned as an intensive care unit (ICU), to two 20-bed designated CV recovery rooms (CVRRs). Each of these units had 4 isolation rooms with an additional designated isolation room between the units that was intended for postoperative care of heart transplant patients. The CVRRs were placed next to the ORs on the same floor. This allowed quick transit times to and from the ORs, which saved numerous patients' lives over the years.

THI CV Anesthesia Separation From BCM

Because of Dr DeBakey's vigorous criticism and Dr Cooley's subsequent resignation from BCM, Drs Keats and Cooley knew that it was only a matter of time before Dr DeBakey would want complete separation of BCM anesthesiologists from THI. Thus, the 2 began to make plans for this situation.

The BCM CV anesthesiologists themselves continued to provide anesthesia services for Dr Cooley and his expanding group of surgeons, with no change in their day-to-day practice. However, the Methodist-based BCM CV surgical faculty and especially Dr DeBakey himself were increasingly resentful that BCM anesthesiologists were continuing to provide anesthetic care for THI when none of the surgeons there were BCM faculty any longer. There was the general impression that Dr Cooley and THI were receiving "better" CV anesthesia services. This came to a head when Dr DeBakey, as president of BCM, and after consulting with several BCM faculty (Kenneth Mattox, personal communication, 2023), removed Dr Keats as chair of Anesthesiology on July 1, 1974. While Dr Keats was a tenured professor, chairs at BCM were reappointed yearly. He had received his reappointment letter, but not personally, as he was out of the country at the time. Dr DeBakey had this letter removed from Dr Keats's office, and a letter documenting his removal was placed on his desk. This, although perhaps expected, was still particularly upsetting for Dr Keats as he had been on a long-postponed vacation overseas after completing his service as editor in chief of the journal *Anesthesiology*. He returned to hear the official announcement from his replacement, Lawrence Schumacher, MD, the former BCM Anesthesia chair who had been reappointed. In a particularly petty move, the locks on his office door had been changed while he was gone (Donald Donavan, personal communication, 2024).

Dr Keats discussed the situation with Dr Cooley, who had already promptly and expectantly asked him to move his practice to THI and St Luke's/TCH full time. Considering his options and goals, Dr Keats decided to move to THI and attempt something that had not been done before, which was to form a partially academic practice in a private-practice hospital while financially operating as a private-practice group.

Although he was a tenured professor, Dr Keats resigned from BCM. He was given office and laboratory space at St Luke's while he formalized his plans. He invited several BCM anesthesia faculty members to leave the medical school and join him, which they did. He established the department in such a fashion that he had controlling interest in the newly formed group and could function like an academic chair. Clinical academic appointments were later secured from the University of Texas Medical School at Houston. Trainee rotations were established with UTMB in Galveston, the University of Texas at Houston, and soon other institutions. Interestingly and uniquely, Dr Keats was allowed to convert the existing BCM CV Anesthesia Fellowship to one sponsored by THI. The THI program was the only one in the United States that was accredited for a year or less of fellowship training and that was free standing (ie, not an extension of a medical school department of anesthesiology residency training program). This was entirely due to the national regard

for Dr Keats in the scope of anesthesiology postgraduate education. The result was that after his removal as chair, he emerged with his practice, research group, and educational offerings in CVA intact and was able to move forward.

The removal of Dr Keats as chair had unintended consequences for the BCM Department of Anesthesiology. Although a new chair (Dr Schumacher) had been named, in those days, an anesthesia residency program was certified with the person who was chair at the time of certification. When Dr Keats was removed, the BCM anesthesia residency program was automatically placed on probation, and it took some time to regain normal certification. BCM Anesthesia's national prominence in education and research left with Dr Keats rather than remaining with the department. Also, several of the most skilled anesthesiology faculty moved to THI with Dr Keats (D. Donovan, personal communication, 2024).

Having good relations with the combined administrations of St Luke's/TCH/THI, Dr Keats and the group were able to secure a small laboratory with a gas chromatograph and an attached small office space. The laboratory and equipment allowed Drs Keats and Alex Romagnoli to continue to pursue the pharmacology research with which they were involved (Fig. 7).

Seven BCM staff members who were invited to join the new department, accepted, and ultimately resigned from BCM deserve special mention:

- **Kamel Girgis, MD.** A native of Egypt who trained in anesthesia there, then came to the United States to do a residency at the University of Texas MD Anderson's anesthesia program in Houston. (The University of Texas Medical School at Houston had not yet been founded.) He returned to Egypt in 1962 but came back in 1966 to join BCM as a CVA fellow. This fellowship appointment probably makes him the second CV anesthesia fellow in the world by modern standards (ie, associated with an accredited medical school, at least a 1-year term, and participating in anesthetic management of cardiac, vascular, and thoracic patients). He joined the BCM faculty after fellowship and remained primarily at THI before the separation (K. Girgis, personal communication, 2020).
- **Alexander Goldstein, MD.** A native of St Louis, Missouri, he was educated at Harvard, and then completed medical school at BCM. He did a BCM anesthesia residency after internship and then joined the BCM faculty. He split his time among Ben Taub Hospital (the county hospital) and the CV anesthesia departments at Methodist and THI (A. Goldstein, personal communication, 2020).

Fig. 7 Dr Keats and Phyllis Kolander, a longtime cardiovascular anesthesia laboratory technician, in Dr Keats's laboratory at The Texas Heart Institute

- **Jerriann Hacker, MD.** A Texas native, she attended medical school and partly completed a surgical residency at BCM before switching to an anesthesia residency, also at BCM. She joined the BCM faculty afterwards and had split her time between Ben Taub and THI (Jerriann Hacker, personal communication, 2023).
- **John Riquelme, MD.** A native of Chile, where he attended medical school, he did his anesthesia residency and CVA fellowship at BCM before joining the faculty. He divided his time between Methodist and THI (A. Goldstein, personal communication, 2020; John Riquelme, personal communication, 2020).
- **Alexander Romagnoli, MD.** A native of Italy, after medical school, he emigrated first to England, where he trained in anesthesia, and then to Canada. He joined the staff of McGill University and began to publish pharmacology research, which led him to meet Dr Keats at national meetings. He visited Houston and was so impressed that Dr Keats was able to recruit him to BCM. Dr Romagnoli divided his time between Methodist and THI before eventually moving to THI full time (Nancy Romagnoli, personal communication, 2020).
- **Phiroze B. Sabawala, MD.** He was a native of India, where he attended medical school and did residency in anesthesia. He was recruited to the Department of Anesthesia at the University of Washington, where he was productive in scientific publications, and from there he was recruited to BCM in 1963. He spent most of his time at THI.
- **Stephen Slogoff, MD.** A native of Pennsylvania, he received his medical education at Jefferson Medical School in Philadelphia and did his anesthesia residency there. Thereafter, he completed an ACGME-approved Postgraduate Year 3 (PGY3) CVA fellowship, which was the first one in the country. He enlisted in the US Army afterward and was posted to the Burn Unit at Brook Army Medical Center in San Antonio, Texas. Notably, he began publishing results of his clinical research at Brook. He was subsequently recruited to BCM and was initially on staff at Ben Taub Hospital before moving to THI (Stephen Slogoff, personal communication, 2025). Of note, his first day at BCM was July 1, 1974, the day Dr Keats was removed as chair.

The Late 1970s and the 1980s

During THI's especially busy years in the late 1970s and into the 1980s, the person primarily responsible for running the CV anesthesia and OR schedule was Dr Kamel Girgis. He was known for arriving in the ORs early, usually at 6:00 AM, to make any necessary last-minute schedule or staffing changes, handle problems with preoperative patients, and generally ensure that things ran smoothly. He was never officially recognized for this extraordinary, years-long effort—which today would be a job in itself—but did it anyway because he believed that it was the correct thing to do.

With this group, all committed to CVA at THI, the department became stable and clinically productive. The department continued to receive rotating residents and fellows, first from UTMB, later from UT Houston, and then from other programs such as the University of Mississippi. The department also continued to offer fellowship training in CVA as a PGY4 certified by the ACGME.

The first staff member to be recruited after the original group (4 years later, in 1978) was John Cooper, MD. A native Mississippian, he had attended medical school at Tulane University and did his residency at the University of Mississippi, along with a fellowship in cardiac anesthesia that was partially spent at THI. He was recruited from the Department of Anesthesia of the Ochsner Clinic in New Orleans.

Additional new staff were added in the 1980s for various periods of time, including Fredrick Koch, MD; Sarajavo "Frank" Kodali, MD; Samuel Metz, MD (all former THI CVA fellows); Nancy Nussmeier, MD; John P. Williams, MD; and later, Terry Vitez, MD. Drs Nussmeier and Williams departed after 1-year terms because of preplanned commitments. Dr Koch left in the early 1980s for academic practice in Virginia. Dr Vitez left for a new opportunity in Georgia.

As noted above, one of the BCM anesthesia faculty who asked to join the original THI department was Dr Stephen Slogoff (Fig. 8). This was fortunate because Dr Slogoff was interested and skilled in clinical research at a time (the mid-1970s) when CV anesthesiologists were just establishing the subspecialty. He and Dr Keats would, over the next several years, embark on research efforts that would dramatically affect both CV anesthesiology and anesthesiology in general and that earned the department a reputation for significant investigations. This research was enabled in part by the THI

department's access to a large clinical source of patient data because the highly skilled CV surgical services at THI were extremely busy. Importantly, Dr Keats had not given Dr Slogoff a "publish or perish" mandate, as many academic researchers encounter. Instead, Dr Keats encouraged him to do research in the areas that interested them both but did not demand it. Thus, these efforts were motivated purely by clinical scientific curiosity, plus the ability to collaborate with Dr Keats (Stephen Slogoff, personal communication, 2025). Of note, in the late 1980s, Dr Slogoff was appointed to the brand-new position of associate chief of the Service.

In 1980, results were published from the Coronary Artery Surgery Study,[19] an early, multi-institutional look at the results of bypass surgery. The study had found marked differences in operative mortality among institutions, and Drs Keats and Slogoff wanted to know the reason for it, assuming a reasonable similarity in surgical skills. They set out to study this difference in outcomes and, specifically, to determine whether differences in anesthetic management were among its causes. The results of their study,[20] which used independent observers to record data—then a novel approach—and rigorous noninvasive monitoring for ischemia in patients, were spectacular in identifying specific intraoperative determinants of myocardial ischemia associated with coronary surgery and showing, for one of the first times ever, that differences in anesthetic management affected the incidence of ischemia, plus its effect on outcomes. These same factors remain relevant today.

This study's publication highlighted THI as a center of significant CV anesthetic research promoted or carried out by Drs Slogoff and Keats, as did previous and subsequent papers focusing on other CV topics, including the origins of neurologic injury with CPB,[21] protection from neurologic injury in open-chamber procedures,[22] lack of differences in outcome with different anesthetic agents on coronary bypass cases,[23] and specific determinants of neurologic outcomes.[24] Other significant clinical research papers resulted from using the department's access to large numbers of patients and employment of 2 dedicated anesthesia research nurses, Carolee Arlund, RN, and Juliette Dean, RN, who markedly increased the department's researcher's ability to gather information and who followed up with patients. Notably, these nurses were funded by the department itself and did not derive their income from grants.

Fig. 8 Stephen Slogoff, MD, with trainees

1990s

The 1990s brought change to THI and the department. The number of cardiac procedures, which had reached a high point in the early 1980s, gradually fell through the decade as more coronary revascularization procedures were done via balloon catheters in the cardiac catheterization labs.

Additionally, several staff changes affected the department. Although Phiroze Sabawala had retired in the late 1980s, the membership of the department had remained largely unchanged since its founding. This changed, starting in the early 1990s when Martin Giesecke, MD, joined the THI department after residency at UTMB, a CV fellowship at THI, and just 2 years in solo private practice in Victoria, Texas. He had completed a residency at UTMB in 1989, including 6 months of CVA at THI and another 6 months at UTMB committed primarily to CV disease and CVA. Alan Alexander, MD, joined the department after training at Texas Tech University and a CV fellowship at THI. Samuel Metz moved to an academic position in Philadelphia, and Frank Kodali left for a private practice opportunity in East Texas. Significantly, Steve Slogoff

took the chair of Anesthesia at Loyola University in Chicago and left in 1993. John Cooper was appointed associate chief after Dr Slogoff left. Other additions in the 1990s included Byron Tsusaki, MD; Prashant "Pat" Lotlikar, MD; Bruce Puryear, MD; and Deborah Sandoval, MD (Drs Puryear and Sandoval being former THI fellows).

More members of the original group began to retire. Alexander Romagnoli retired in the mid-1990s, although he continued to work part-time. A few years later, both Alexander Goldstein and John Riquelme were forced to retire because of chronic health conditions, and Jerri Hacker retired electively.

The 1990s also brought significant changes to the department's educational efforts. In terms of residency positions, since the separation from BCM, THI had accepted rotating residents from various programs. The initial one, UTMB, started in 1974, and UT Houston followed. Others were added over the next 2 decades, including University of Mississippi, University of Florida, Tulane University, University of Chicago, Texas Tech University, and the US Air Force anesthesia residency at Wilford Hall Air Force Hospital.

THI offered fellowship positions in 2 categories. The first was the free-standing THI CV Anesthesia Fellowship, which was usually for a term of 1 year. The other position was an ACGME-certified fellowship with various terms ranging from 3 months to 1 year. This was taken advantage of by fellows from the University of Mississippi, UTMB, University of Florida, University of Chicago, and others.

This changed in 1994, when the ACGME decertified all previously accredited fellowships in any specialty training program that did not lead to subspecialty board certification. Because there was no board certification in CVA, the CVA fellowship at THI was decertified. However, the department was able to keep offering a certified program because the State of Texas Medical Board offered itself as the certification body. Previously, and further complicating training matters starting with the 1985 academic year, the ACGME and its Anesthesiology Residency Review Committee lengthened normal anesthesia residency from 3 years after medical school graduation to 4.

Anesthesiology as a specialty changed in the mid-1990s because of economic forces changing medicine. "Managed care" became a common term, and there was great concern among many experienced anesthesiologists, especially those in private practice models, that fewer personnel would be needed. Almost overnight, for this reason and others, anesthesia became an unpopular specialty. Anesthesia chairs went so far as to keep residents who had completed their training as junior faculty until jobs eventually became available. There was a resultant fall in the numbers of rotating residents and fellows. Having adequate staff for all the anesthetizing locations became a challenge. Because our department was then committed to providing all-physician anesthesia services, many faculty worked by themselves. This gradually improved in the late 1990s, but much of the decade had been difficult. Nonetheless, the quality of the anesthesia fellows in training at THI remained generally high.

Surgical facilities for adult and congenital heart operations were separated when TCH opened new ORs in 1993. Initially, the CV surgeons and anesthesiologists followed the pediatric patients to the new TCH facilities.

In 1995, Charles Fraser, MD, a son-in-law of Dr Cooley, became the TCH chief of Congenital Heart Surgery. Soon, THI CV surgeons turned over their congenital cardiac practice to him. The CVA department continued to perform anesthesia for congenital heart operations at TCH until 1998. While the collaboration with Dr Fraser was congenial, it became apparent that he desired anesthesiologists who were focused primarily on the care of congenital heart patients. The THI CVA departmental leadership saw that it was impossible to provide adequate staffing for a growing congenital service in a physically separate location. The attending staff levels at the time were too low to accommodate 2 call schedules (1 for adults and 1 for pediatrics), especially because not all staff participated in congenital heart operations.

The decision to cease involvement with congenital heart cases was not taken lightly as it obviously ran against the earliest traditions of the department. Nevertheless, the relationship was formally concluded and a separate TCH Division of CVA was started under Dean Andropoulos, MD, in fall 1997. Significantly, the new section of the Department of Anesthesia of TCH was named the Arthur S. Keats Division of Pediatric Cardiovascular Anesthesia because Dr Andropoulos recognized Dr Keats's contributions in this area and to TCH anesthesia.

Staff added late in the decade included the returning Nancy Nussmeier and, significantly, respected researcher David Collard, MD. Drs Nussmeier and Collard were hired to reinvigorate the research arm of the department, which had lagged since Dr Slogoff's departure. They responded with several studies.[25-30]

2000s

This decade brought many significant changes to the department and to THI.

In June 2001, Tropical Storm Allison brought devastating flooding to Houston, including the TMC, which was by then the largest medical complex in the world. The basement and subbasement of St Luke's were flooded, and much damage was done because of loss of electrical power and thus air conditioning. Most patients were discharged or moved to adjoining buildings that had emergency power. Interestingly, the new Denton A. Cooley Building was not affected because it had not yet been connected to the existing hospital complex. It took approximately 6 to 10 days for hospital services to return to normal. Other institutions in the TMC suffered much worse damage. Few surgical or cardiac catheterization lab cases were done during this time, although St Luke's and THI were able to return to full operations in a little over a week.

In late 2001, THI moved into the Cooley Building, which directly adjoined St Luke's. The Cooley Building contained a new CV surgical suite with 12 rooms, new patient care areas on the upper floors, and a planned renovated CVRR of 52 beds adjacent to the new ORs. However, for an entire year after the new ORs opened, postoperative patients were transported by elevator to postoperative ICU beds on the seventh and eighth floors of the new building, while the old CVRR space and other old ICUs were removed and the space renovated. This preserved the original THI principle of having the ORs and postoperative CVRRs/ICU beds next to one another on the same floor of the hospital. This intervening year was difficult but was managed without any major mishaps.

The new ORs were much larger and had even more modern monitors and a built-in ability to accommodate new electronic systems. As before, the ORs were constructed around a sterile central core, which facilitated the movement of personnel and supplies from room to room. Additionally, 2 of the rooms were designated for hybrid cases; imaging systems built into the rooms enabled more advanced cardiac and vascular cases to be carried out, and if cardiac or vascular interventions were needed, appropriate staff were readily available. In the new ORs' construction, 2 subtle but important principles were preserved from the old rooms: First, all monitors were easily seen by all staff present in the rooms; and second, a series of built-in drawers contained pharmacologic and anesthetic supplies and all the necessary routine equipment for performing cardiac anesthesia. Rolling carts were deliberately not used except in certain circumstances for cases done outside of the CV ORs.

Shortly after the CVA group moved into this new operating suite, a relative economic downturn precipitated some dissension within the group over its management. While there were perhaps valid arguments on both sides, the threat of instability of the service and concerns that it could cause problems delivering CV anesthesia services led the St Luke's administration to award a new contract for CVA coverage to BCM. St Luke's and BCM had been growing closer after the college broke off its longstanding relationship with Methodist. Refusing to work with BCM, Arthur Keats reluctantly retired and left the department that he had founded in early 2005, as did Kamel Girgis, its longest-serving staff member after Dr Keats. The rest of the attending faculty elected to remain with the new BCM department.

John Cooper was appointed acting chief of CV Anesthesia. The department, now under BCM, continued as before but still with some personnel instability. Partially because of this instability, Dr Cooper was removed as acting chief, and N. Martin Giesecke was appointed chief in 2007 by the St Luke's administration. Dr Cooper remained a staff member.

Two years later, Martin Giesecke had to move to Dallas, Texas, to be closer to his parents; there, he became vice chair of Anesthesia and Pain Management at Southwestern Medical School. Dr Collard was appointed chief of CVA by the St Luke's administration. Li Quan Chen, MD, was appointed associate chief.

Dr Keats died in 2007. Even after retirement, he had remained an advisor to some department members, so his counsel persisted to the end. His death was lamented by many.[31]

Surgical volume continued to be substantial, and the catheterization laboratory had a large interventional load also. The first metallic stents for peripheral vascular disease were used, including those for abdominal

aortic aneurysms and aorto-iliac occlusive disease. Importantly, transcatheter implantation of aortic valve prostheses began to be performed.

The most dramatic clinical event to take place during the decade was the first implantation of a new type of total artificial heart by O. H. Frazier in 2001. It was the first of several implants, but unfortunately, although these devices tended to be successful in the short term, the surviving patients often succumbed to strokes, and the program was eventually closed nationally.[32] The CV Anesthesiology department was, of course, directly involved in the management of these cases in the OR.

Also, the use of LVADs—of various types, but all using continuous-flow (nonpulsatile) technology—continued to expand. Because LVAD-supported patients were surviving for longer and longer periods of time, they needed other types of noncardiac surgery, and CV Anesthesia was consulted for their anesthesia services, which became a new facet of practice.

Educationally, the decade saw the accreditation of the THI/BCM fellowship in CV Anesthesia by the ACGME in 2006. THI was either the first or second fellowship (disputed) accredited under this new certification program in the nation. It was approved for 10 fellowship positions and remains so today. John Cooper was program director for the newly accredited fellowship, as he had been for the THI fellowship since taking over for Dr Keats in the early 1990s. James Anton, MD, became director in 2007.

2010s

In 2010, St Luke's returned the contract for CV Anesthesia to a physician-directed subsidiary of St Luke's. The professional members of the group were employed by that subsidiary while remaining members of the clinical staff of BCM's Department of Anesthesia. This arrangement persisted until 2015, when the hospital returned the contract for CVA to BCM. Functionally, this had no effect on clinical operations.

Critical Care of Postoperative Cardiovascular and Thoracic Surgery Patients

An official Division of CV Anesthesia Critical Care was formed in 2014 with Cesar Castillo, MD (a former THI cardiac anesthesia fellow and certified intensivist), as the first staff member.

In a more general sense, critical care medicine as practiced by anesthesiologists dates back at least to the arrival of Dr Keats in Houston in 1955. At that time, no postoperative critical care units existed anywhere in the United States. The large facilities for polio patients on negative-pressure respirators in the early 1950s certainly could be regarded as ICUs, but they faded away as polio epidemics became less frequent. Postoperative patients were cared for in a recovery room until they could return to their floor bed. Nursing on a postsurgical ward or floor was also more focused on immediate postsurgical care at that time. This began to change with the beginning of CV surgery, because the patients needed intensive care for longer.

One of the unique problems encountered in this new era was that many patients needed postoperative respiratory care. General anesthesia practice at the time was to extubate patients at the conclusion of surgery. If this was not possible, a tracheostomy was usually performed. An additional problem was that few, if any, mechanical ventilators were available. Most hospitals partially solved this problem by retaining patients who were not ready to go to a floor bed in the postsurgical recovery room. This solution was used at St Luke's/TCH, especially with small pediatric patients.

After Dr Keats arrived and began working with Dr Cooley's patients, he became more involved with care in the recovery room, including administration of vasoactive infusions and postoperative respiratory care. Exactly how much time he devoted to postoperative care is now impossible to determine. To address the shortage of mechanical ventilators, Dr Keats constructed a ventilator specifically for pediatric patients.[31] As the number of patients in Dr Cooley's practice increased, their immediate postoperative care became more of an issue. As previously noted, the CVRR at St Luke's/TCH was commonly used as a de facto ICU. Critical care practices at that time would be regarded as primitive now. A nurse who worked in the CVRR in the 1960s noted that there were only 2 monitors available in the unit that could invasively monitor arterial pressures.

When the expanded cardiac facilities at St Luke's/TCH opened in 1972, in addition to the 8 designated cardiac ORs, there were 2 designated CVRRs. Each was on the same floor as the cardiac ORs and literally 30 to 40 feet away. They were constructed as 20-bed units,

with 16 beds in an open space and 4 individual rooms for patients. Between the 2 units was an additional isolation bed that was to be used for cardiac transplant patients. The proximity of the CVRRs to the ORs was a deliberate choice.

Physician care for these postoperative patients traditionally rested with the surgical service. However, Dr Cooley stated that while he was interested in his patients' postoperative care, he did not believe that this was where his skills were best employed, so he left this care to others. Over time, "intensive care by committee" developed, with each involved service contributing to specific aspects of care. As more CVA personnel joined the staff, they became involved on at least an ad hoc basis.

By the 1970s, in the new CVRRs, there was an implicit division of labor among specialties. The anesthesiologists managed short-term respiratory care, with anesthesia trainees becoming involved after the attending staff left at the end of the operative schedule. The anesthesiologists and trainees managed extubations of ventilated postoperative patients. Surgical staff or trainees managed hemorrhage issues, chest tubes, transfusions, and so forth. The attending cardiologists usually would see their patients twice each day and managed pharmacologic interventions and the patient's cardiac rhythm, and they often made decisions about discharge from the CVRR. This de facto division of labor worked well in most cases. Pulmonologists were very few in the early days, and usually became involved if respirator weaning was problematic. Providing ventilator support for adult patients required establishing respiratory care departments, which grew from small organizations of a few individuals to the large entities that exist in major hospitals today.

Ventilators began to be used because cardiac surgery patients were often not ready for extubation at case end, particularly among the preponderance of pediatric patients who were operated on in the early days of cardiac surgery. The initial respirators were pressure cycled, and most were made by either the Bird corporation or the Puritan-Bennett (P-B) corporation. The initial Bird ventilator was released in 1955, and P-B ventilators were also introduced about this time. It is not clear when these ventilators were initially used at St Luke's/TCH. A volume-cycled ventilator made by P-B, the MA-1, was introduced in 1967 and was very popular as it expanded the care of acutely ill patients, permitting better ventilation of patients with more difficult conditions. Of note, in the new CVRRs opened in 1972, a mounting column was built into the wall for P-B PR II ventilators at every bed; these were commonly used in the 1970s and early 1980s for postoperative CV surgical patients.

In those early days, the anesthesiologists had an important role in postoperative care, which expanded as anesthesia trainees became available. Starting in the mid-1970s, those trainees were required to remain in the hospital when they were on call. While ventilator weaning in those days was largely done by nurses following a protocol, the anesthesia trainee would be consulted for the order to extubate. At St Lukes/TCH, there was no mandate for overnight ventilation of cardiac surgery patients as in many other programs, and ventilator weaning proceeded no matter what the hour, presuming that the patient was stable from a CV standpoint. This approach was adopted as the CV surgery service became increasingly busy; patients needed to be expeditiously moved through the system for their own well-being and to vacate the CVRRs for patients operated on later in the week. The system worked well for the most part. If a patient could not be weaned from the ventilator by the second or third day, a pulmonary consultation for long-term management would be made.

Equipment was updated as more advanced ventilators became available to replace the pressure-cycled ones, all of which were removed from the CVRRs by the late 1980s. These upgrades were needed because the patient population was aging and had more complex CV problems.

Although this system of employing input from all involved services was generally effective, it did not always work well. Therefore, in the initial years of the Department of Cardiovascular Anesthesia's Critical Care Division in the late 2010s, patient management became more formalized. Specifically, the CV units were "closed," meaning that the ICU physician was in direct control of most patients admitted to the CVRRs. This system, which had not been feasible in the early days of CV surgery, became practical as the number of critical care physicians continued to increase.

An ACGME fellowship in CV Anesthesia Critical Care was established in 2015, with John Cooper as the first program director. Since then, the program has accepted 2 fellows a year. Cesar Castillo assumed the directorship in 2016.

The number of CV surgical cases stabilized, while their acuity, severity, and complexity increased. The number of cases in the catheterization labs continued to grow, and it became common for 4 catheterization laboratory rooms to need anesthesia services simultaneously, especially as transcatheter valve implants and electrophysiologic studies became more frequent.

The Baylor Lung Institute was founded in the mid-2010s and had 3 thoracic surgeons initially. This immediately increased the number of major thoracic surgical cases in the Cooley Building ORs. Additionally, the BCM Department of Surgery formed a new Division of Vascular Surgery, whose surgeons contributed yet more patients.

In 2018, David Collard was forced to resign as chief of CV Anesthesia because of a debilitating illness. James Anton became the new chief. Li Quan Chen continued to serve as associate chief.

Soon afterward, Dr Anton was also named co-chair of the Department of Anesthesia of BCM. He continued as chief of CV Anesthesia at THI and at the newly renamed Baylor St Luke's Medical Center.

2020s

In 2021, Dr Anton became the permanent chair of the BCM Department of Anesthesia. He retained his THI/St Luke's post of chief of Cardiovascular Anesthesia and Critical Care. This returned the administrative situation to what preceded Arthur Keats's removal as chair of BCM Anesthesia 47 years earlier, with a single person as chair and chief of CV Anesthesia simultaneously.

The department continued to add staff members in both CV anesthesia and critical care, with some members dividing their time between both areas. At this writing, the total staff numbers 17 in CV Anesthesia and 10 in CVA Critical Care.

John Cooper stopped clinical practice in March 2020 but continues as a member of the department, concentrating on fellow education and research (primarily historical).

Today, the department/division continues to render care for all types of patients with CV and thoracic disease and critical care of those patients under the leadership of James Anton.

Summary

This report was written to capture details not recorded in many histories of CV surgery, even though the evolution of CV anesthesia is an important part of the story. An additional section of the history, centered on the more technical aspects of CV and thoracic care as it began, and then evolved in the succeeding years at THI, plus related figures, is available at the Baylor CV Anesthesia website. Two additional segments concerning the CVA "stat lab" and the pump team can also be found with the main section. All will be on the BCM Department of Anesthesia website later this year. Additional photographs can be found there also. We hope that this relatively brief summary has done the individuals involved justice and pays proper homage to the person who really began the story, Arthur S. Keats, MD.

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