Michael E. DeBakey and Denton A. Cooley (Part I)

Mike, the master assembler, and Denton, the courageous fighter: A personal overview

Unforgettable past remembrances in the 1960s

After over 50 years, the reflections of the events, which touched the life shield, concerning our work on the creation of Cardiocirculatory assistance and the clinical use of the Total Artificial Heart at Baylor University College of Medicine (the name it had in those times) in Houston are well worth revisiting.

The outstanding advocacy of Mike DeBakey in the outbreak of this unique experience, and later on, the strong clinical conviction of Denton A. Cooley: '*no patient should die on the operating table*' were remarkable.

Unquestionably, *Mike went far toward realizing the universality he preached*.

The Science of Life in our Times

Michael E. DeBakey and Denton A. Cooley and their dreamy legends.

Medicine is the '**science of life';** definitely, it is not the **'science of death'**, and ´**in our times'**, because all science is historic; humanity has its own science throughout the centuries; it is a perpetual circle of scientific knowledge (1; page 132). We really don't know what will happen with the prolonged mechanical circulation that we have created in, for example, two or more centuries (1) (page 171).

And indeed, under these basic principles, two giants in the 20th century, Michael E. DeBakey and Denton A. Cooley, and each one with his own dreamy legend, developed advances in cardiovascular surgery**.**

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In the book, to some extent autobiographical, which I published in March 2007 (1), I stated that the most important letter I ever received was in May 1961 while I was in the Cleveland Clinic. It was signed by Michael E. DeBakey. He invited me to attend a fellowship program in his service of Cardiovascular Surgery in Houston for a year.

I think that the invitation was related to our presentation in Atlantic City during the annual meeting of the American Society for Artificial Organs (ASAIO) in March 1961. I say, "*I think it was related*" because really I could never know whether actually Mike DeBakey was in the audience at the ASAIO meeting, or was simply informed of our participation.

Indeed, I must necessarily return to the essentials of our presentation in the 1961 ASAIO and nothing better to refer to it than the concepts I published in my book (1; pages 225-227). "*Dr. Willem J. Kolff invited me to the United States in March 1961 to attend the Atlantic City meeting of the recently founded ASAIO. I presented to the Atlantic City meeting our now classic work on the theory and practice of artificial heart development. Today's line of work about drivers, electric motors, and mechanical and air-driven systems was presented along with the original prototypes and the animal results of experimental implantation*" (2, 3).

Engineer Tomasso Taliani

Yet incredibly, engineer Taliani and I accomplished in only one year (1960) the first step of the three models of the giant artificial heart research in Córdoba. When opening Taliani's latest manuscript -I was living in the United States when I received it- I came upon one of the gems of engineering thought. Taliani gave up everything for artificial heart research. When I had the good fortune to meet him initially in Córdoba, Argentina, during the holiday season in 1959, he was a "young "seventy-six-year-old man. The unforgettable engineer Taliani died at eighty-eight in Italy.

I can clearly see in my memory our old and dear Taliani with a cap, bending over his working table while he joined piece by piece, with his old hands, the Dacron tissue cusps of the heart valves for the artificial heart. The perfection of the valves was the astonishing work of C. William Hall. Bill went to Córdoba in 1965 just to shake hands with Taliani.

At that time, Bill Hall asked how difficult it was for me to teach engineer Taliani on cardiovascular anatomy and physiology. I answered very quickly that I was always prepared for him by virtue of the faithfulness to our own scientific powers, but that engineer Taliani was attracted by simplicity, perfect views, and clear glimpses; he preferred being given flashes.

Taliani read the prolific bibliography that I continuously brought to him just to gain a larger, clearer comprehension. However, I suddenly got the impression that to acquire juster and brighter

perceptions Taliani mostly relied on my own simplification of the problems and remarkable points encountered; he loved, above all, new ideas.

I now feel that the idea of his importance as an individual that was exploring with authority a totally new scientific field, determined Taliani mind's dignity; he respected the quality of knowledge instead of the quantity of it and I sincerely believe that was the main consequence of our rapid progress. It was not uncommon to teach drawings to mechanics, so that Taliani might have a quick eye and impart, with a sure hand, the perfection to his work.

After receiving the letter I already mentioned from Mike DeBakey in May 1961, I went to see Willem Kolff in the laboratory; after reading it, he advised me to accept the Mike DeBakey´s proposal for my own improvement in cardiovascular surgery. Certainly, Houston was the main attraction in cardiovascular surgery training at the time. The news spread quickly in the laboratory and then, I heard the funny words, that I have not forgotten, of my friend Spyridon Moulopoulos, professor of internal medicine at the University of Athens.

At that time, Moulopoulos, Kolff, and the engineer Steve Topaz had started the research on the now -famous counter-pulsation circulatory assistance with an intra- aortic balloon pump. Spyridon seriously asked me, *"Domingo, stay with us here in Cleveland. What will you do in Texas: will you be riding horses?"*

As soon as I arrived in Houston, on 10 July 1961, I went to say hello to Dr. DeBakey in the Methodist Hospital and he asked me if, in addition to my training in cardiovascular surgery, I wanted to devote myself to work -as part of my training- on the artificial heart in the Laboratories at Baylor University; I immediately nodded in agreement.

At that time, I received a very unfavorable impression of the Methodist Hospital; it looked like a fifth class hospital. Although DeBakey had come to Baylor University and the Methodist Hospital in 1948 -12 years earlier- yet he had not been able to realize his incredible, extraordinary work of transformation; however, we started seeing its early transforming results very shortly thereafter, in 1962.

In Baylor University laboratories there was absolutely nothing to start a work of the magnitude of that we had undertaken in the National University of Córdoba with engineer Taliani.

In fact, in July 1961 I only found a machine shop run by Mr. Louis Feldman, a diffident technician [(4)]. However, at that time I did not imagine the tremendous future enthusiasm of Lou Feldman, perhaps to some minor extent, but the attraction towards the research of the artificial heart that had seduced engineer Taliani in Córdoba was not less intense. At that singular moment in Baylor I myself had the valuable experience gathered with the three models of artificial heart developed in our experimental work in the National University of Córdoba.

The Crucial Conception: The Discovery of Prolonged Assisted Circulation

I will try to make a brief review of this medical discovery for caring, henceforward, those patients in advanced heart failure [(1; pages 171-180)].

In briefly, those days the cases of lethal postcardiotomy cardiogenic shock -acute failing heart at the end of cardiac surgery- with potentially viable myocardial tissue were not uncommon. The usual procedure, at that time, was to support the circulation for several hours postoperatively by means of either the extracorporeal machine or a left ventricular bypass from the left atrium to the femoral artery, with the aid of a roller pump and with the patient, in both cases, fully heparinized. The consequence of this short period of assistance was, as a general rule, to prolong a deadly outcome.

However, we were able to do a quite important observation during the unsuccessful procedure, that is, at the beginning -with solely a partial bypass of only 1-2 liters of blood- the myocardium regained for a short period of time (2-3 hours) an acceptable contractility before falling in a progressive deterioration leading to death.

Then, it suddenly occurred to me, while I was unhurriedly walking back to Baylor one evening that fall -immediately after the death of a patient in postcardiotomy cardiogenic shock- that prolonged use (for several days or weeks) of mechanical circulatory support of the left ventricle with a small implantable pump (similar to the little pumps developed in Córdoba to be implanted in dogs) and without systemic heparinization, might be the answer to support those dying patients.

What is the mystery of ideas suddenly emerging from the dark subconscious? In fact, unexpectedly we were struck at once by a new conception and intellectual power to solve the problem. For a fraction of a second, the solution of

the unresolved problem had finally appeared with great clarity from our innermost imagination. Whatever might be the result, the *lighting flash* was dictating us the path to follow in order to resolve the question; in the end, it was a singular contrast between unconsciousness and scientific knowledge.

During late 1961 and early 1962, I developed at Baylor a small intrathoracic air-driven pump — the latest system used by Taliani and me in Córdoba- that partially bypassed the left ventricle from the left atrium to the thoracic aorta. The pump housing was made of Silastic reinforced with Dacron fabric and inlet and outlet ball type valves were selected, instead of the three-leaflet Dacron fabric used in Córdoba.

In May 1962, during the annual meeting in Denver the American College of Cardiology selected our work on Assisted Circulation as the best finalist of the Young Investigator Award.

I vehemently presented the conception of prolonged Assisted Circulation at that unforgettable testimony in Denver [5].

On July 18, 1963, one of E. Stanley Crawford's patients, George Washington-which was, in fact, his real name- underwent an aortic valve replacement. The aortic valve was heavily calcified and was replaced with a Starr-Edwards mechanical valve. Early next morning, the patient had a cardiac arrest and was resuscitated by means of the open-chest technique. After the chest was closed, it was evident that severe brain damage had occurred. The patient remained in a coma, with low cardiac output and anuria. Without a proper pumping action the production of urine was nil. Subsequently, a rather severe pulmonary edema developed and he was refractory to standard treatment.

Crawford and I implanted the first clinical LVAD in the history of medicine in this patient on the evening of July 19, 1963, by bypassing the left ventricle from the left atrium to the descending thoracic aorta through a left thoracotomy incision. The pump was regulated to bypass with 1,800 to 2,500 mL of blood per minute. Although the anuria that had been present since cardiac arrest persisted, the pulmonary edema cleared, as indicated by plain chest X-ray and auscultation of the lungs. We discontinued mechanical support after four days of continuous use, but the patient remained in a coma and died.

On April 21 1966 the Liotta-DeBakey Paracorporeal Left Ventricular Assist Device (LVAD) was implanted for the first time in medicine in Mr. DeRudder, a patient in cardiogenic shock postcardiotomy. The Liotta-DeBakey was the first clinical paracorporeal pump.

Paracorporeal LVAS. Dr. DeBakey and Dr. Liotta (April 21 1966) (Picture appearing at www.arlingtoncemetery.net/medebakey.htm)

On August 6 1966 a patient from Mexico, Ms. Esperanza del Valle V., underwent a double valve replacement but couldn't be weaned from extracorporeal circulation. Then, we implanted a paracorporeal left ventricular assist device from the left atrium to the right axillary artery. After support by the ventricular assist device for ten days at a flow rate of 1,200 mL/min, the patient recovered, which made this the *first successful use of a Left ventricular assist device for postcardiotomy shock.*

In my autobiographical book, I acknowledged, Michael E. DeBakey, who played an important role in the surgical design of the paracorporeal pump implantation in this patient [1 ; page 177]. For example, the choice of longer percutaneous connectors to bypass the left ventricle from the left atrium to the right axillary artery was his suggestion.

In DeRudder´s surgery we had used short intrathoracic connectors, with the body of the pump sutured to the patient's skin. In this patient, the outlet connector was sutured to the right axillary artery, a decision made by DeBakey to avoid an ascending aorta implantation. It helped the removal of the pump without reentering the

chest, and the left atrial connector was left in the chest cavity undisturbed.

Sadly, about ten years later, Ms. Esperanza del Valle died in Mexico in a car accident.

Around 1998, at the School of Medicine of the University of Morón, we restarted the design, the making, and the animal implantation of a new system, the novel LVAS [6]. Novel LVAS may be a bridge to cardiac transplantation. However, the main indications are both Functional Heart Recovery and Destination Therapy. Several basic considerations were taken into account in the design of this new system:

1. We did not want to cannulate the heart chamber.

2. In particular, we rejected the use of left ventricular apical cannula -for the pump's inflow- for myocardial recovery patients or destination therapy, because it contributes to destroy the already severely damaged myocardium helical anatomy of the left ventricle.

3. We chose the atriostomy method (pump inflow). A large opening in the left atrial wall for blood inflow to the implantable pump is made; a 25- or 30 mm-diameter atrial prosthesis is sutured to the epicardial side of the left atrial wall (at the atriostomy opening). The atrial prosthesis is fitted with a titanium frame, which keeps the atriostomy permanently open.

4. In the latest model, anatomically tested in human cadavers, we have employed a small continuous flow pump with the atriostomy method for pump's inflow and the higher segment of the left axillary artery for the pump's outflow. The continuous flow pump, in an intrathoracic or extrathoracic position, is fixed at the level of the thoracotomy, at the 5th intercostal space.

Mike DeBakey, a unique personality

Meanwhile, what went through Mike's mind from May 1962 - our presentation in Denver- to 19 July 1963, when he put pressure on Stanley Crawford for the implantation of Assisted Circulation to a patient in a deep coma?

The analysis of this temporary halt in the personality of Mike DeBakey has a special significance. Firstly, it is clear that before requesting a definitive and great program for Baylor University, with unrestricted funds from the federal Government, Mike wanted a minimal clinical trial. And, that basic and minimum test was the result of the chest X- ray films of Stanley Crawford's patient. Before the circulatory assistance, the films showed an advanced lung edema and during the Assistance the chest X-Ray films showed a total disappearance of the pulmonary edema. The presentation of these chest X-ray films was the key to his celebrated strategy in Washington. In addition, no strategy has surpassed Mike's strategy [7]. Apparently, Mike was always hesitating, but his reliable advance was strong and safe and, from the simple chest X-ray clinical observations, he established the great program of circulatory assistance extended in Baylor University.

Truly, the commitment I made to Mike DeBakey would be for a year and that was what I had transmitted to the authorities of the National University of Córdoba; i.e. after a year I should return to Córdoba. They were impatiently waiting for me, because I had recently contested and been elected to the Chair of Anatomy in the School of Medicine and I was a member of the teaching staff in surgery in said School of Medicine. I was the Surgeon-in-Chief in a province Hospital (N.S. del Valle Hospital) and I was pressed to define my situation urgently; engineer Taliani wrote me as he was eager to continue with our work.

But Mike´s resources were infinite; it reminds me a bit of the critical and unchangeable mind of Willem Kolff. In the first opportunity, I told Mike that I had to return urgently to Córdoba in July 1962. His answer was: "*why?*" "*Firstly*, I said, *my wife Olga and two of my sons should return because they have a tourist Visa*". "*Don't worry*!" was his quick answer and left. In a few minutes, he sought me out; "tomorrow-he said- *you will be waited at the Central Immigration Office; go to see this gentleman*" - and he handed me a piece of paper with a name on it; the man was the executive chief of the immigration unit in Houston. Well, that kind man made arrangements for solving the problem with the visas in just five minutes, and my entire family received the well-known green card.

In a few days, Mike called me to go to his office to tell me that I had received from the American Heart Association the appointment of Advanced Research Fellow in cardiovascular surgery (62 F 92), which, incidentally, doubled by far my income. At the same time, he wrote the Dean of the School of Medicine of the National University of Córdoba, Professor Juan Martin Allende. Mike explained Dr. Allende -a well-known general and thoracic surgeon- about my work and that I needed remain

some more time in his Service of Cardiovascular Surgery in Houston.

Such, in broad terms, was Mike DeBakey´s unique personality; a testimony of his quicker intellect and his passion for prolonged circulation research. In truth, Mike's interests extended from pure science to culture, and into many adjoining fields such as those in humanitarian medical education.

C. William Hall, an Oklahoma native and a graduated medical doctor from the University of Kansas, came to Michael E. DeBakey Residency in cardiovascular surgery in July 1963. However, after a few months he, inexplicably, resigned and formally requested to be transferred to Baylor in my artificial heart program.

The resignation of Bill Hall –as a Resident- from the Department of Cardiovascular Surgery under the supervision of Mike DeBakey proved to be right from the start a serious mistake on his part. Mike systematically left him out of any clinical activity, including the clinical implantations of circulatory assistance; finally, throughout the time Bill quit the hospital. Bill Hall was considered by Mike to be an excellent collaborator to keep papers and records regarding the budget in order, and of help as a proof-reader for checking grammar mistakes in our papers.

Contrarily to the Mike's vision, Bill Hall was for us an outstanding collaborator and researcher at Baylor. Bill played a fundamental role when Mike established the Rice-Baylor artificial heart research program; his amicable manners immediately gained the affection of the engineers working at Rice, who were of great help for us regarding driver design and biomaterials. Bill Hall's help was invaluable when we periodically received the 'on-site visits' from the NIH officers concerning the progress of the Rice-Baylor research program.

In the fall of 1966, I was requested by the National University of Córdoba to be in Argentina for the obligatory contest to the Chair of Surgery. When I returned to Houston I found Bill Hall furious and disheartened. Apparently, Dr. DeBakey had called for a meeting -following our successful implantation of LVAS to the patient E. del Valle (August 6, 1966)- in his office at Methodist Hospital to discuss future steps on the Circulatory Assistance research. Certainly, Bill Hall was the first to be there. Mike's secretary, standing under the door frame, did not allow Bill to go in, with the argument that she had instructions from Dr. DeBakey to have a meeting only with the engineers.

To my humble opinion, from that very moment Bill decided to leave Baylor and lost his devotion to our own research work. Fortunately, he went to the Southwest Research Institute in San Antonio to manage artificial organ research in the Department of Bioengineering, a center of excellence, dedicated exclusively to biomaterials, and in few years Bill Hall was internationally recognized as a leader in biomaterials.

Why did a man with the intelligence and strong personality of Michael E. DeBakey have such abrupt reactions to the point of forbidding Bill to attend a meeting directly related to his task at Baylor? It is almost a mystery to me.

The eccentricity of great personalities shows itself particularly at crucial moments. Shakespeare exemplified this most skillfully on various occasions; a sort of art just appropriate in its own way. The human imagination always seems to be floating between the contrasts of things and is looking for a resting place to stay; unfortunately, it may be found peculiarly in the negative contrast of special events.

Lastly, let us to return to the lines regarding my association with Bill Hall; and I must say that C. William Hall was a dear friend; he was my close associate for five years in the artificial heart research at Baylor. He bitterly regretted the relationship with his children from his first marriage and, perhaps, that was the reason why he and his wife, Shirley, were so close to our kids. He was a heavy smoker and died prematurely of coronary disease in September 1992.

On my return to Argentina (July 1971) we kept writing each other in an extremely friendly way, even during the period of the extended controversies of Mike DeBakey, Denton A. Cooley and several medical scientists, following the clinical implantation of the total artificial heart (April 4, 1969).

Contrary to my opinion concerning the inexplicable circumstance of Mike's meeting in 1966 -apparently with engineers only- which I think frustrated Bill Hall, and was the main cause of his final decision of leaving Baylor sometime in 1967, Bill kept a respectful friendship with Dr. DeBakey and he remained at his side during the mentioned controversies after April 4, 1969.

Just before his death, he sent me a letter in which he wrote "*Whenever I need a little sunshine in my heart, I return to the unforgettable memories of those*

days working together in the artificial heart project in Baylor". On another occasion, he told a journalist in San Antonio, "*Domingo Liotta is a man, a friend that you cannot easily forget*".

The fundamental purpose of Thesaurus editions is to contribute to our medical students´ cultural education. Anyway, Thesaurus 37 (the first one of a set of three) has an additional subject-matter determination because it is dedicated to two outstanding personalities, as they are pictured in my mind, Michael E. DeBakey and Denton A. Cooley, who touched the higher problems of the 'Science of Life', with their technical skills and their continual strong advocacy to research in the cardiovascular field.

In the next Thesaurus I will write about the Rice-Baylor Artificial Heart Program -a true outstanding accomplishment of Mike DeBakey- and my historical encounter with Mike in Buenos Aires (April 1996).

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