Reflections on the Revolution at Baylor College of Medicine in the 60s. Foundations of Cardiovascular Science and Research.

Artificers of Assisted Circulation and Total Artificial Heart:
Domingo S. Liotta, Michael E. DeBakey, Denton A. Cooley and E. Stanley Crawford




In September 2010

Almost 50 years have passed since our initial work (1961) on Assisted Circulation at Baylor College of Medicine (BCM) in Houston. Thus, a review of that historical period is justified.

Above all, I am dedicating this essay in sincere remembrance to the great talents of Michael DeBakey, Denton Cooley and Stanley Crawford, founders of the 20th Century Cardiovascular Science at BCM. The cardiovascular teaching of DeBakey, Cooley and Crawford ***-a teaching of permanence-*** has not been confined to physicians in the United States and it may be stated, without any fear of being wrong, that in the 20th Century no cardiovascular surgeon in the world exerted an intellectual influence comparable to that of these giants of cardiovascular surgery.

They have been the *'bread of life'* for thousands of cardiovascular patients and certainly they have guided and passed on knowledge to thousands of cardiovascular surgeons all over the world to accomplish the same mission.

I would like to render a special tribute to Dr Michael E. DeBakey, a man of character and a man of genius, the founder of the Cardiothoracic Department at Baylor College of Medicine in Houston and, I repeat, a beloved teacher of numerous generations of cardiac surgeons all over the world.

The eminence of Michael DeBakey, his bold determination to investigate the unknown, his making of modern cardiovascular surgery, his monumental dream regarding the Texas Medical Center, which came true in the 21st Century, his worthy contribution to the clinical research of Mechanical Assisted Circulation are all values regarded with respect worldwide.

Every great man is unique, and Dr DeBakey was a highly determined man; the largest part of his power was in constant effervescence and emerged directly from his own presence through his powerful will; his reserved force was almost boiling.

Dr DeBakey, needing to be logical, was a man who took the prophecy of excellence upon himself. **The fact of becoming a successful cardiovascular surgeon lies in the power of our will, thus reaching either a brilliant or an opaque future.**

However, I must say, with my deepest respect to our beloved master, that Dr DeBakey -as a good commander- was under the greatest obligation to purify all the emotions accumulated in Residents and Fellows who wanted to be humble cardiovascular surgeons and he, according to his theory of 'spiritual catharsis' -the purging of the emotional effect of heart surgery stress- urged his surgical team, without any mercy, to look into their willpower and the hidden inner forces of their human souls so as to be able to excel every surgeon in the world.

Above all, this reconstruction of the great personality of Dr DeBakey needs not be taken too

earnestly; his fervor showed his constant reverence for medical excellence in pursuing a continuous ideal of perfection; he imperatively demanded -*exigently pressing*- superiority of this surgical team and collaborators.

Michael DeBakey, having raised himself to the highest rank, -'*he embarked on his amazing career without being lifted from above*'- was a brave man who, through his action, took the hopes of the future upon himself.

He confided in the unsearched part of the medical science -'***sure that the future would be worthy of the past***'.

Dr DeBakey, with articulated actions and **faith in real facts**, had his practical empirical formula to move forward: -*Never will you know if something will work, at least you have tried it*'- that is, you cannot foresee the action of something until it is done.

Dr Denton A. Cooley is one of the most brilliant and original cardiovascular surgeons in the 20th Century. He is probably the most technically gifted cardiovascular surgeon who has ever lived.

Certainly, I greatly admire Dr Cooley because of his well-known surgical dexterity, his technical skill to make surgery simple, his achievement to improve science, and the solemnity of heart surgeries, which was proverbial among Residents and Fellows. However, what is more important, I really admire Dr Cooley for his moral tenacity and his tremendous courage to fight for the life of his patients. Dr Cooley is, above all, a fighter -'*a giant fighter to defend human existence';* he has become a legend in his own lifetime.

In the evening of July 19, 1963 Dr Stanley Crawford and I implanted the first Assisted Circulation in medical history. A patient of Stanley had a cardiac arrest after an aortic valve replacement; the patient remained in coma and anuria and severe pulmonary edema progressively developed. An intrathoracic LVAS was implanted and regulated to bypass with 1800 to 2500 mL of blood per minute. The mechanical support was discontinued after 4 days of continuous use. The patient remained in coma and died.

In the 60s, DeBakey, Cooley, Crawford and I planted the seed of Assisted Circulation and the Total Artificial Heart at Baylor College of Medicine in Houston and ´an exciting journey began.´

Buddhists say, '*No seed will die, every seed will grow*'. However, in the scientific field this old and noble saying is not always a real fact.

The outstanding development of today -***the spring from the deep root of the 60s***- and the endless horizon of mechanical circulatory devices surprise the scientific world, and even us.

However, we must recognize that the late effect of every human action already blooms in the cause -*the end preexists in the means*-; the valuable fruit of today's mechanical circulation cannot be severed from its early seed planted by us.

Thus, in our case Buddhists are right, even a feeble seed blooms rightly in a fertile garden.

The most prominent findings of these seminal studies at Baylor were the demonstration that functional permanent recovery of the failing myocardium is possible by means of a prolonged unloading of the left ventricular chamber, with the use of an implanted artificial ventricle; that is, when the overload volume of the left ventricular chamber is decompressed. The unloading of the overload heart volume entails an interaction between mechanical shortening and overstretched myocardial fibers.

Cardiac metabolism was shown to decrease according to myocardial oxygen consumption and coronary circulation was increased during the period of assistance.

The physiological principles for regulation of contractile performance -*the Frank-Starling mechanism*- were restored with the implanted Assisted Circulation.

On August 6, 1966 a paracorporeal left ventricular Assist device was implanted in a patient in postcardiotomy cardiogenic shock. After 10 days of assisted circulation the patient's myocardium recovered, making this the ***first successful use of assisted circulation for postcardiotomy shock.***

Drs DeBakey and Liotta.
Historical cardiac surgery*: implantation of the Liotta-DeBakey Left Ventricular Assist Device (LVAD) in a paracorporeal position at the Methodist Hospital, Houston (April 21, 1966).*

On April 4, 1969 the heart of a dying man was replaced with a Total Artificial Heart following the removal of the badly diseased natural heart. The patient regained normal state of conscience within one hour after the operation.

The device worked well and the patient was extubated the day after surgery -an achievement that remains unique in the history of Total Artificial Heart devices.

Historical Operation. The first Clinical Total Heart Replacement with an Artificial Heart *(orthotopic position).*

On the left, Dr. Liotta; in the center of the picture, the empty pericardial sac of the patient, Mr. H. Karp. On the right, the hands of Dr. Cooley holding Mr. Karp's heart and the artificial heart just before implantation. Texas Heart Institute, Houston (April 4, 1969). Lower right corner of the picture: Dr. Cooley is holding both the removed artificial heart and the donor heart. (April 7, 1969).

Today, thinking in retrospect, I do not hesitate to confess that the most important letter I have received in my life was in May 1961, almost half a century ago.

The letter was signed by Michael DeBakey; he offered me the possibility to work one year into his Fellowship Program. Truly, at that time, after few months spent at the Cleveland Clinic mostly working with a noble man, Willem Kolff, I was extremely eager to return to Argentina to regain my position of Associate Professor of Surgery and Professor of Anatomy and continuing my clinical and research work at the National University of Cordoba.

Nowadays I thank God and my wife Olga. She advised me to stay in the United States and to accept the opportunity to be one year with Dr DeBakey.

The Liottas and their 6 kids-3 boys and 3 girls-Houston, 1969

She encouraged me and was ready to join me in the amazing adventure that finally lasted more than one decade; incidentally, four of our kids were born in the United States.

From my point of view -after almost half a century- I may conclude that the intellectual and authentic scientific revolution in the treatment of cardiovascular diseases including the discoveries of Mechanical Circulation at Baylor College of

Medicine *could have never happened* without men of an uncommonly strong and incisive intellect, Michael E. DeBakey, Denton A. Cooley and E. Stanley Crawford.

The Cooleys and their 5 girls at the Texas countryside, ca. 1969

Indeed, Dr DeBakey was the artificer of the Rice-Baylor Artificial Heart Program that went into action in 1964, and I was his proud Director at Baylor. In later years, Dr George D. Noon, a gifted cardiac surgeon, directed the Artificial Heart Program at BCM.

In Buenos Aires, in April 1996, Dr. DeBakey told me:

"Domingo, we created the Conception of Assisted Circulation at Baylor."

In addition, we can be sure that steady perseverance and faith in our 'dream' were key factors. Therefore, there is no doubt in my mind that **DeBakey and Cooley** were the intellectual cement that bonded the bricks of our work on ***Assisted Circulation in 1962 and the Total Artificial Heart in 1969*** at Baylor College of Medicine**.**

Unquestionably, we must be indebted for the tenacity, effort and courage of cardiovascular scientists in the five continents, who over the past 40 years have improved and developed modern mechanical circulatory devices to be successfully employed worldwide today.

Particularly through their continuous activity I am foreseeing a bright future for mechanical circulatory clinical research. Finally, I don't have any doubt in my mind that the persistent efforts to develop mechanical circulation have been a long but highly valuable journey. *In fact, it has been hard work but a healthy fight for life. Furthermore, the journey has just started; the future is widely open to improved devices for* ***Permanent Mechanical Circulation*** *and this must be our goal from now on.* Professor Alain F. Carpentier in Paris is actively engaged in developing a pulsatile TAH with highly refined technology.

Dr Friedrich W. Mohr, Director of *Herzzentrum* in Leipzig, attended a highly emotional ceremony at the Italian Hospital in Buenos Aires, on September 23 2010. It was on the occasion that the Hospital named the Service of Cardiovascular Surgery after me.

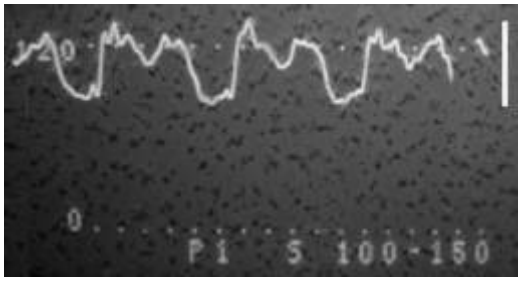
The event was organized by the hospital authorities, Dr Roberto Battellini, the new Chief of Service, an outstanding gifted cardiac surgeon, and Dr Daniel Bracco, former chief of the cardiovascular service.

Drs Battellini, Liotta and Mohr, September 23, 2010

In the academic ceremony that followed, we proposed to the audience to explore the THI Cooley and 'Bud' Frazier laboratory line using continuous-flow pump for the Total Artificial Heart (TAH). We hope to make the enthusiastic Professor Mohr take this line of work at Leipzig.

In the meantime, at the School of Medicine of the University of Morón we are concerned in developing a simple device to change continuous flow into a pulsatile-like flow.

In vitro preliminary studies, School of Medicine, University of Morón, Buenos Aires, 2010:



At the outflow of a continuous flow pump, a simple "gadget" changes the flow into pulsatile (60 beats per minute; vertical bar, 40 mmHg)

Bibliography:

Bibliography on Assisted Circulation is available at **www.fdliotta.org**; including the first Dr.Cooley´s publications on TAH.

This Thesaurus issue is the first part of a total of three of the **"50-year Review on Mechanical Circulation at BCM"**.

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