"La vita è un dono che ciascuno di noi deve saper spendere virtuosamente e intensamente.
Le opportunità scientifiche ci stanno mettendo a disposizione più tempo: spetterà a noi renderlo più fecondo e più ricco di significati".

Silvio Berlusconi, Presidente del Consiglio dei Ministri

La Politica: vivere a lungo per gli altri
"Kos" - Anno XXV n. 267 settembre-ottobre 2008
Editrice San Raffaele

"Life is a gift that each one of us must know how to spend virtuously and intensely.
Scientific advancements are providing us with more time: it is our responsibility to make it as fecund and meaningful as we can"

Silvio Berlusconi,
President of the Council of Ministers

La Politica: vivere a lungo per gli altri
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R. Chiesa, G. Melissano, J.S. Coselli, A. Zangrillo, O. Alfieri

AORTIC SURGERY AND ANESTHESIA "HOW TO DO IT" III

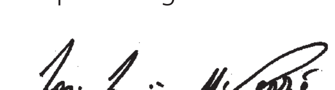
Istituto Scientifico Universitario San Raffaele
Università Vita-Salute San Raffaele

Prof. Roberto Chiesa's intellectual and operational efforts, like those of all the best teacher-clinicians and researchers at San Raffaele, as are Prof. Ottavio Alfieri, Prof. Alberto Zangrillo, Dr. Germano Melissano, are not merely professional and scientific. In fact, the aim of the San Raffaele clinical-scientific-university complex is to treat people, whatever their colour and creed, from all walks of life, from all corners of the globe. A person, therefore: not only for "what he is" physically speaking, but for "who he is" both intellectually and spiritually.
A consideration not simply somatic, psychiatric, spiritual nor even merely ethical, but a global consideration of the individual, encompassing three ontologically harmonized components: the "conditio sine qua non" without which man does not exist.
It is the task of a dedicated professional – in this case, one focusing his efforts upon blood circulation – to "make sure" that these three components are in perfect harmony and eucrasy in order to guarantee man's well-being.
In other words, no clinician-scientist can ignore the aforementioned trilogy, just like the artist searching for the perfect balance between materials, whether canvas, wood, marble or the environment, and mind to create the message he wishes to transmit with his masterpiece.
I consider, and thank for this our Principal Associate, Jesus Christ, Professor Chiesa to be a great Teacher, Researcher and Operator of the San Raffaele philosophy: our patients are the embodiment of three intertwined components, a concept that is passionately reflected by the words contained in this volume.

sac. prof. Luigi Maria Verzé

La tensione intellettuale e operativa del prof. Roberto Chiesa, come di quella dei migliori didattico-clinici e ricercatori del San Raffaele, quali il prof. Ottavio Alfieri, il prof. Alberto Zangrillo, il dott. Germano Melissano, non è semplicemente di rigore professionale e scientifico.
Infatti, l'obiettivo del Complesso clinico-scientifico-universitario San Raffaele è quello di occuparsi dell'uomo, qualsiasi uomo, di qualsiasi religione, di qualsiasi colore sia il suo sangue o il suo ceto, in qualsiasi regione del mondo.
L'uomo, quindi, non solo per "quello che egli è" come corpo, ma per "chi egli è" come intelletto e come spirito.
Non, quindi, una visione soltanto somatica, né soltanto psichiatrica, né soltanto spirituale e nemmeno soltanto etica, ma una visione globale di persona con tre componenti ontologicamente armonizzate una "conditio sine qua non", senza la quale non c'è persona. Tocca al professionista, a ciò dedicatosi – qui è il caso della circolazione sanguigna –, "curare" che le tre componenti siano eucrasicamente armonizzate per il miglior ben-essere dell'uomo stesso.
In altre parole nessun medico-scienziato può prescindere dalla predetta trilogia, come ogni artista cerca l'armonia tra il materiale – tela, o legno, o marmo, o ambiente – e, il suo cervello d'arte, e l'anima che lo spettatore deve leggere nel suo capolavoro.
Debbo riconoscere e ringraziarne il nostro Socio di Maggioranza – Cristo Gesù – che il prof. Chiesa è grande Maestro, Ricercatore e Operatore in linea con l'obiettivo San Raffaele: l'ammalato è persona con tre componenti tra loro integrate, come anche dice la passione che sta nelle righe di questo volume.

sac. prof. Luigi Maria Verzé



FOREWORD

Our generation have had the privilege of witnessing some of the most dramatic advancements and transformations in the history of medicine. The success of minimally invasive techniques in cardiovascular surgery is changing in an unparalleled way our approach to aortic disease. One equally great and not unexpected change has taken place in the new millennium: the realm of surgical excellence, dynamic ideas, innovation and progress has now broadened to the five continents.

In a world of global challenges, healthcare is no exception, however it does have its unique features: the technological breakthroughs that only profit-driven multinational companies seem able to provide, can't replace integrity, commitment, and compassion as the driving force of our profession.

This third edition of our "How to do it" meeting on aortic disease will bring together vascular, endovascular and cardiothoracic specialists with the anesthesiologists that make our effort possible every day. Moreover, experts from the four corners of the globe will share their experiences in the Special Symposium Global Thinking in Cardiovascular Surgery: "East meets West" for a better understanding of how the challenge of cardiovascular disease is met regardless of the boundaries of cultural, socioeconomic and geographical differences.

In this year's edition of the companion book we have the privilege of hosting a very informative historical article written by Prof. Joseph S. Coselli regarding the development of aortic surgery in Houston, the cradle of this discipline; we are very honoured that Prof. Coselli accepted to join us as guest Editor of this publication. Special thanks to Dr. Raffaella Voltolini for her friendship, ongoing support and the documentation on the new "Vita–Salute San Raffaele University" facilities and to Dr. Gianna Zoppei and AISPO for providing us the text and the touching pictures of "San Raffaele in the world". Our gratitude also goes to Prof. Antonio E. Scala, dean of the School of Medicine of our University, for providing us with an outstanding cultural milieu. Our great friend Prof. Angelo Argenteri is the much appreciated author of the fascinating historical article that concludes this book.

Last but not least our special thanks to sac. prof. Luigi Maria Verzé, founder and president of our Institution, for being our never ending source of inspiration with his visionary worlds that lead us every day in our effort to accomplish the mission of the San Raffaele.

Roberto Chiesa, Germano Melissano, Alberto Zangrillo, Ottavio Alfieri

The International Congress
Aortic Surgery and Anesthesia "How to do it" III
is organised under the auspices of

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SIAARTI

Associazione italiana per la solidarietà tra i popoli

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SAN RAFFAELE IN THE WORLD

The San Raffaele Foundation operates internationally by means of AISPO (Italian Association for Solidarity among People), a non-profit Organization founded in 1984 by the operators of the San Raffaele Scientific Institute of Milano to implement cooperation activities in Developing Countries, mainly in the field of health care. The NGO is headquartered within the premises of the Milano Institute.

AISPO is formally recognised by the Italian Ministry of Foreign Affairs and operates in close collaboration with the Directorate for Development Cooperation (D.G.C.S.) of the Italian Ministry of Foreign Affairs and with the Civil Protection Department of the Italian Government.

AISPO is called upon to aid local Authorities and the population of Developing Countries to improve health conditions and strengthen/create local health care systems.

MAIN AREAS OF ACTIVITY

A) Emergency projects

AISPO operates to meet population needs during emergencies and post-emergency situations such as:

- natural disasters: the tsunami in Sri-Lanka, the earthquake in north Afghanistan, floodings in Colombia, Mozambique;
- conflicts: post-war period in Afghanistan and Iraq, internal conflicts in north Uganda, Colombia and Palestine;
- public health emergencies: Ebola epidemic in Uganda, SARS in Vietnam.

In the aftermath of such events AISPO activities are tailored to meet the most urgent needs of the population, distributing food and water, providing building material for houses or temporary shelters, installing and managing infrastructures such as tent-hospitals, implementing water and sanitation projects. In long-term emergencies AISPO is often called upon to give general and medical support (such as in Uganda where thousands of night commuters found hospitality inside the hospital compound).

AISPO is one of the 33 Italian NGOs which are official partners of ECHO - the Humanitarian Aid Office - and has collaborated with such United Nations Agencies as UNOHAC, UNOMOZ, UNDP WHO and UNICEF.

Whenever possible AISPO interventions shift from emergency to development aid, supporting indigenous capacities to enhance reconstruction and development.

B) Development cooperation

AISPO runs cooperation projects in different countries with the aim of fostering the participation of local governmental (local Ministry of Health, Universities) or non-governmental (local NGOs, Dioceses) partners.
The projects being implemented always fall within the framework of local health policies and/or WHO strategies (ex. application of WHO policies for TB control).

Cooperation projects in the health field are aimed at improving access to at least basic services through the set-up of dispensaries, the organization of immunization campaigns, the implementation of health education campaigns and the provision of material goods and drugs.

Where and when feasible AISPO supports local partners in designing, building and starting-up tertiary level hospitals and specialised health institutions, as in Brazil (500-bed University Hospital) and India (150-bed Spinal Centre). AISPO also supports various hospitals in implementing best practices, protocols and process improvement.

C) Training activities

Training activities and know-how transfer play a key-role in the development of local capacities, in both clinical and management/administration areas.

Training activities can be either on-the-field, with special courses held by foreign experts in short or long-term missions (courses in emergency medicine, orthopaedics, etc.) or via day-by-day activities performed along with the local staff. These programmes are organized with the involvement of local institutions.

AISPO also supports local partners in organizing international conferences and training courses in highly specialised medical fields (TB, HIV/AIDS and other infectious diseases, Emergency Medicine).

Training activities for professional operators coming from Developing Countries are also organized in Italy in cooperation with both the San Raffaele Scientific Institute and other Italian health care institutions.

In specific cases AISPO has provided scholarships to health care professionals to attend high-level courses such as Masters in Public Administration or specific training programmes such as the "Advanced Training Courses on TB management" promoted by the World Health Organization and "STOP TB Italia".

D) Specialised medical & Scientific Cooperation projects

Thanks to the linkage with the San Raffaele Scientific Institute, the Vita-Salute San Raffaele University and the San Raffaele Science Park, AISPO develops and runs a series of highly specialised medical cooperation projects which can, in some cases, head towards the implementation of scientific research cooperation programmes. Specific projects focus on the treatment and prevention of HIV/AIDS, HPV, TB and SARS. Scientific collaboration is now starting also in the biomedical field (ex. stem-cells research in India and in Brazil).

AISPO – in partnership with the European Space Agency, the San Raffaele Scientific Institute, the General Defence Staff and the company Telbios – is also implementing telemedicine activities in the field of counselling and e-learning (past experiences in Bosnia, Albania, and Palestinian Territories).

OFFICIAL DONORS

Directorate for Development Cooperation (D.G.C.S.) of the Italian Ministry of Foreign Affairs, Civil Protection Department of the Italian Government, ECHO – the Humanitarian Aid Office, United Nations Agencies as UNOHAC, UNOMOZ and UNDP WHO, UNICEF, WHO, Lombardy Region Cooperation Office, Chamber of Commerce of Milano, Cariplo Foundation, Province of Bolzano, Province of Milano.
AISPO projects are always co-financed with funds raised by the NGO.

MAJOR RECENT AISPO PROJECTS

Afghanistan

- Reconstruction of the District Hospital and schools destroyed by the Narhin District earthquake
- Post-war reconstruction of Health Centres, dispensaries and schools in the Baghlan Province
- Construction of houses and shelters for returnees in the Baghlan Province
- Restoration of the Baghlan Regional Hospital
- Construction and start-up of the new Surgical Hospital in Kabul

Albania

- Strengthening of the operational capacities of the Dr. Xhaferr Kongoli Regional Hospital in Elbasan, with a special focus on cardiology services
- Strengthening of the Emergency Medical System in the Scutari Province

Brazil

- Cooperation with the São Rafael de Bahia Hospital
- Construction of ambulatories and basic-health facilities in the rural region of Barra
- Strengthening of professional centres addressed to young people living in favelas of Salvador de Bahia
- Support to children living in the favela of Nova Esperança in Salvador de Bahia

China

- Set-up, organization and upgrading of an Emergency Medical Service in the Municipality of Taiyuan

Colombia

- Health assistance to the local population living along the Pacific Coast and in the pluvial forest
- Set-up of the San Rafael Boat Hospital which will provide permanent high-level medical services to the local population

India

New Delhi

- Set-up of the Indian Spinal Injuries Center in New Delhi for the acute treatment and rehabilitation of patients affected by loco-motor disabilities
- Upgrading of local Emergency Medical Services mainly by means of specialised staff

Dharamsala

- Set-up of the New Tibetan Delek Hospital in Dharamsala and cooperation projects in the health field addressed to the Tibetan population in exile (vaccination campaigns, water and sanitation projects, set-up of dispensaries in remote settlements, training courses)
- For the next three years: strengthening of the TB control programme among the Tibetan communities exhiled in India. The project will implement and expand the DOTS strategy in all its components

Mozambique

- AISPO presence in Mozambique dates back to 1993: the NGO has always been committed to help the local Health Ministry to improve services offered to the population. During these years AISPO activities have shifted from emergency to development cooperation. Local partners are the Caia, Chemba and Maringue health districts in the Sofala Province and the Mavalane Hospital in Maputo

Palestinian Territories

- Quality enhancement of Palestinian Rehabilitation Services with a special focus on disabled children, through the upgrading of Bethlehem Arab Society for Rehabilitation Centre in a Referral Hospital for Rehabilitative Medicine for the whole Region
- Community Based Rehabilitation Programmes in the West Bank area
- Development of Bedouin activities, above all women's employment and forage management

Sri Lanka

- In the aftermath of the tsunami AISPO managed a camp hospital in tents built by the Italian Association of Alpine Troops in Kinniya (Trincomallee). AISPO and the San Raffaele Hospital assured the presence of medical and technical staff for about 4 months. After the acute emergency phase AISPO concentrated its efforts on the rehabilitation of other local health facilities along with PHC activities, training of local staff and water and sanitation projects
- In March 2007 a permanent hospital was built by the Italian Civil Protection Department in Kinniya and AISPO was entrusted to support the start-up phase
- Rehabilitation and assistance to the Mutur Hospital

Uganda

- Support to the St. Raphael of St. Francis Hospital in Kampala
- Cooperation with the St. Mary Hospital Lacor in Gulu and support in emergencies due to health epidemics (ebola virus) or internal conflicts
- Strengthening of the National TB Programme
- ICC prevention in Kampala and Gulu areas

Vietnam

- Organisation of the Carlo Urbani Centre for training, research and reference for the control of respiratory infections in central Vietnam

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SAN RAFFAELE:
PROGRESS IN BUILDING
THE "CITY FOR MAN"

SAN RAFFAELE: PROGRESS IN BUILDING THE "CITY FOR MAN"

Fig 1
Works in progress in the area of the second Biotechnology Department (DIBIT2)
[2006]

Fig 2 – 3
DIBIT2 starts up
[2008]

Fig 4
The image of the Archangel St. Raphael has been placed on the "Basilica"
[2008]

Fig 5
San Raffaele Scientific Institute: building site of the new departments
[2006]

Fig 6
The new departments work is nearing completion
[2008]

Fig 1

Fig 2

Fig 3

Fig 4

Fig 5

Fig 6

Fig 7
First building of DIBIT2 for Laboratory Medicine (Laboraf)
[2006]

Fig 8 – 9
DIBIT2 and Vita-Salute San Raffaele University complex
[2008]

Fig 10
San Raffaele Hotel Residence in course of construction
[2006]

Fig 11
San Raffaele Hotel Residence starts up
[2008]

Fig 9

Fig 7

Fig 8

Fig 10

Fig 11

????????

Basilica is the name of the structure upon which has been placed the image of the Archangel St. Raphael, whose name in Hebrew means "Health-life regenerated in God".

?????????? for the Greeks and Romans was a regal and public place of cultural exchange: philosophy, theodicy, physics, mathematics, metaphysics etc. This *Basilica*, in the same way, will be a place of exchange, not only between teacher and student: Medicine is the crossroads of universal culture, in both the longitudinal and vertical sense.

At its base stands the "Ciborium", or a place of substantial nutrition based on a powerfully regenerative ideas matrix such as stem cells, with roots deep-set in ancient olives and vines that produce oil and wine, which are symbols of Raphael medicine.

On the Sea of Galilee there is a boat, lent symbolically by the fisherman Peter, as a post from which to transmit all that Jesus Christ said and all that he did and continues to be and to do so man might be a real man, meaning a model of God or his authentic *imago*.

From the Sea of Galilee, flows the word, or *Verbum*, symbolized in the water by azure marble, below the vertex of the Dome, which is open towards infinity.

The water flows around a large spiral shell, which symbolizes man and his components "?????????????????? " (body – mind – spirit), as written in gold letters carved into the precious floor.

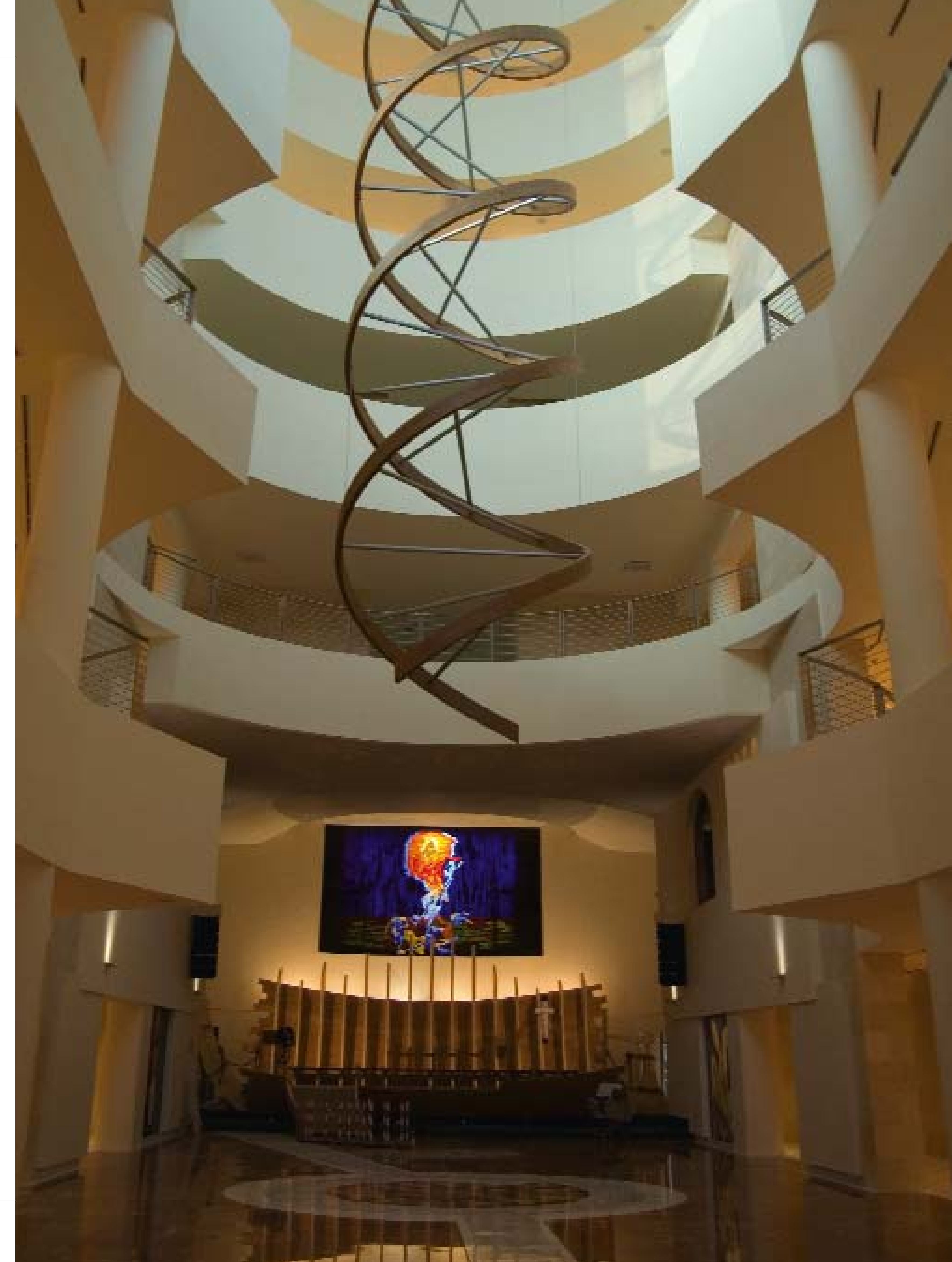
From the spiral shell springs the DNA double helix, suspended between limited earth and infinite sky, between gradual research and "absolute truth". This precious helix rises straight up into the sky. The web of the Dome is open, permitting free flight.

The rear stained-glass window is a reproduction of "The Resurrection" painted by the great Bavarian artist Matthias Grünewald, while the remaining precious windows show a pelican, again representing Christ as nourishment for men of every skin colour, and the oil and wine of the Good Samaritan.

Jesus, incarnate λογος, the living eucharistic Verbum, from the Galilean fishing boat pours protein upon the eternal, human spiral

σωμα-νους-ψυχη

to drive the double-helix of evolution in search of the "absolute truth" mediated by research, beyond the transparency of the earthly web upon the Angel's wings towards godliness propagating the values of Mankind.



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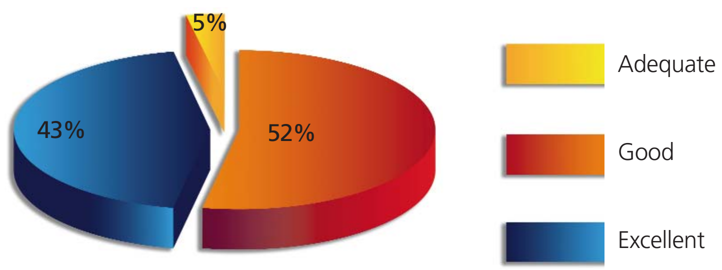
THE SECOND EDITION

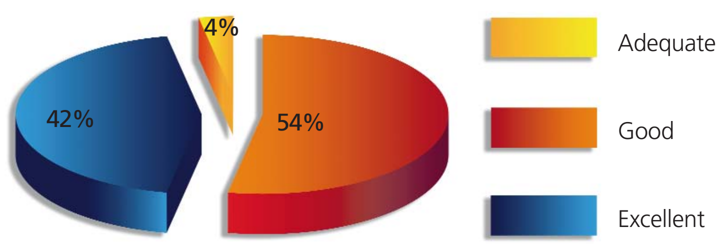
THE SECOND EDITION

INTERNATIONAL CONGRESS
AORTIC SURGERY “HOW TO DO IT” II
MILANO, DECEMBER 15TH – 16TH, 2006

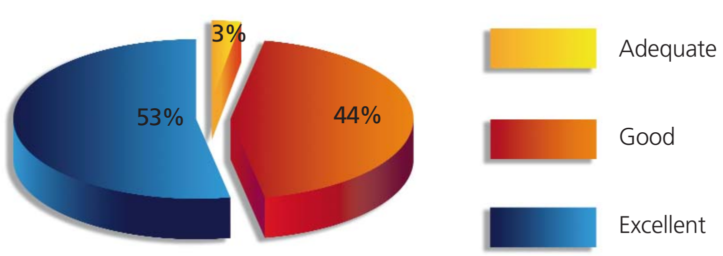
Relevance of the topics discussed



Efficacy of the congress for the Continuing Medical Education



Educational quality of the congress



Delegate countries breakdown

Non European Countries	
Saudi Arabia	3
Brasil	15
China	6
Indonesia	3
Iraq	4
Libya	2
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USA	20

European Countries	
Albania	8
Austria	9
Belgium	7
Esthonia	5
France	30
Germany	17
Greece	20
Lithuania	10
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Principality of Monaco	5
Russia	9
Spain	15
Sweden	8
The Netherlands	9
UK	15

Italy	
Local participation	184
Regional participation	82
National participation	219


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TEAM
PORSCHE
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2007

’08

HISTORY OF AORTIC SURGERY IN HOUSTON

Susan Y. Green, Scott A. LeMaire, Joseph S. Coselli
The Texas Heart Institute at St. Luke’s Episcopal Hospital and Baylor College of Medicine, Houston - Texas - USA

HISTORY OF AORTIC SURGERY IN HOUSTON

That Houston could play an enormous role in the development of treatment for aortic disease seems improbable. Houston is a relatively new city, formed in 1836 on the mosquito-laden banks of Buffalo Bayou, shortly after the Republic of Texas gained independence from Mexico.[1] It is a low, flat city and only about 50 feet above sea level in most places. It is also hot and humid, and summers there can seem endless. Nonetheless, with the discovery of oil in the nearby Spindletop and Humble oil fields in the early 1900s, the development of the Houston Ship Channel in the 1910s, and the greater availability of air conditioning in the 1950s, Houston became a key business center, amassing great wealth and becoming a more appealing place to live. Houston's population rose from a mere 44,633 in 1900 to 596,163 in 1950 to 2.14 million in 2006, making it the fourth largest city in the United States.[2, 3]

ORIGIN OF THE TEXAS MEDICAL CENTER

As Houston has grown, so has the Texas Medical Center (TMC). Extraordinary acts of philanthropy have fueled this growth. In 1914, real estate broker George H. Hermann left the bulk of his $2.6-million estate to build a hospital for Houston's poor. Constructed next to the late millionaire's namesake Hermann Park, Hermann Hospital opened in 1925 on a 10-acre campus surrounded by a pinewood forest [Fig. 1]. Known as the Parker tract, 133.5 acres of these piney woods that were directly south of the Hermann Hospital site were purchased by Will C. Hogg and sold to the city for cost in 1924. The Parker/Hogg tract formed the basis of what would become the TMC.[4, 5]

In 1936, the immensely wealthy cotton baron Monroe Dunaway Anderson created a charitable foundation with an initial grant of $300,000. The goals of the M. D. Anderson Foundation were somewhat vaguely stated and gave foundation members considerable freedom of interpretation. The foundation also served to protect his wealth from estate taxes, and when Anderson died in 1939, he bequeathed his vast remaining fortune ($19 million) to the M. D. Anderson Foundation.[6, 7]

Foundation trustees pursued the creation of the TMC, and in December 1943, the voters of Houston approved this initiative and supported the sale of the 133.5 Hogg/Parker land to the M.D. Anderson Foundation (at a low price in keeping with the original sale to the city). The TMC was officially chartered in 1945. Promising land and construction funds, the TMC convinced universities in other Texas cities to take part in this fledgling medical community. The Baylor University College of Medicine [which later became Baylor College of Medicine (BCM)] moved to Houston from Dallas and opened in its temporary home—a converted department store building. In 1947, the college moved to its present site in the Roy and Lillie Cullen Building, which was the first building completed in the newly expanded TMC [Fig. 2]. That year, the Cullens established the Cullen Foundation to promote medical research and education with an initial endowment of $160 million.[4, 5]

Fig 1

Fig 1
Site of the future Texas Medical Center: Hermann Hospital in 1926. South of the hospital, Fannin Street is still a dirt road.
John P. McGovern Collection.

Fig 2

Fig 2
Baylor College of Medicine's Cullen Building, which was the first building to open in the newly incorporated Texas Medical Center (1947).
Baylor College of Medicine (BCM) Archives.

ATMOSPHERE OF EXCELLENCE

In 1948, shortly after BCM opened in its new location, the highly skilled surgeon and inventor, Michael E. DeBakey, joined the college as Chair of the Department of Surgery [Fig. 3]. By the time he had moved to Houston, Dr. DeBakey had already had a phenomenal career. In 1932, as a medical student at Tulane University, he had invented the roller pump (later incorporated into the heart-lung machines used in open-heart surgery). He had also trained in Europe with vascular specialists such as René Leriche and Martin Kirschner, and held a military commission during World War II in the Office of the Surgeon General, inventing the mobile medical unit (the Mobile Auxiliary Surgical Hospital, or MASH unit), assisting in the development of the Veterans Administration Hospitals, and advocating for the Army Medical Library (which evolved into the National Library of Medicine, home of PubMed). DeBakey came to Houston after initially refusing the offer at least twice; perhaps he was troubled by Baylor's lack of affiliation with any hospital—and the resulting lack of patients to treat—or by the college's deep insolvency. Promised that hospital affiliation would be arranged, and on the advice of his mentor, Dr. Alton Ochsner, DeBakey left his beloved Tulane University and moved to Houston, where, at least, the climate was similar to that of New Orleans.[8-13]

As early as the late 1940s, Houston's reputation for surgical excellence was growing as the TMC pushed for board certification for all practicing surgeons. The influential Houston Surgical Society, founded in 1947, required board certification for members and increased their exposure to new concepts by regularly hosting expert guest speakers. Additionally, DeBakey and others fought to ensure that only board-certified surgeons were granted operating privileges in TMC hospitals.[14] DeBakey also established a rigorous residency program by affiliating with the nearby Naval Hospital after it was decommissioned into a Veterans Affairs Hospital in 1949 [15] (renamed the Michael E. DeBakey Veterans Affairs Medical Center in 2003), as well as the county hospital (Jefferson Davis), and established a premier relationship with the Methodist Hospital when it opened its TMC location in 1951 [Fig. 4]. Methodist Hospital, built in its new location thanks to a $1 million donation from the Cullens, would serve as BCM's primary teaching hospital and, of the 3 affiliated hospitals, was the only one built in the TMC and was only a 10-minute walk from BCM. Opportunities existed to serve numerous and highly varied patients throughout Houston. Thus, an atmosphere that supported, or perhaps demanded, excellence was being cultivated, and large numbers of patients were suddenly available to BCM's clinicians.[16]

Native Houstonian Denton A. Cooley was recruited to the Baylor faculty and joined DeBakey in the Department of Surgery in 1951 to start a cardiac program [Fig. 5]. Dr. Cooley had earned his undergraduate degree from the University of Texas in 1941, where he was also privileged to be a member of the school's championship basketball team (in the Wallace D. Wilson Museum honoring Dr. Cooley, Cooley's basketball conference championship ring is prominently displayed beside medals of honor from throughout the world), and his medical degree from Johns Hopkins University Medical School in 1944, to which he had transferred from the University of Texas Medical School. After graduating, he entered a residency program under the direction of Dr. Alfred Blalock and assisted him in the first "blue baby" cardiac operation. Because

Fig 3

Fig 3
Dr. DeBakey in front of the Cullen Building in a vintage automobile (1950s).
BCM Archives.

Fig 4

Fig 4
Primary source of patients. The Methodist Hospital shortly after it opened in the Texas Medical Center (1951).
John P. McGovern Collection.

part of Cooley's medical education had been funded by the Army Specialty Training Program, he served in the Army Medical Corps from 1946 to 1948 and was the Chief of Surgery for the 124th Station Hospital in Austria. Afterwards, he returned to Johns Hopkins to complete his residency and remained as an instructor. He had many surgical opportunities at Johns Hopkins and had developed a unique insight into the repair of the aorta and its branch vessels, having laterally clamped and oversewn the aorta to repair an aortic pseudoaneurysm in one patient, and extirpated an aneurysm of the right subclavian artery (with proximal and distal ligation) in a second patient with a recent coarctation repair. Cooley later supplemented his cardiac training in London under the tutelage of Lord Russell Brock before returning to Houston.[13, 17, 18]

Ernest Stanley Crawford was born and raised in rural Alabama. Although his father could have used his help on the family farm, young Stanley's education came first. Crawford's childhood dream was to become a doctor, and in high school, he worked at the local pharmacy. He attended the University of Alabama as part of the class of 1943, and worked odd jobs to earn his way. Feeling patriotic after the attack on Pearl Harbor in 1941, he attempted to join the Army Air Corps as a commissioned officer but was rejected for being too skinny. However, Navy recruiters who came to his college accepted him as a commissioned officer. In 1942, he was accepted into the Navy's V-12 program to train doctors. This was a windfall for Crawford: the program paid his tuition, bought his books, and paid him $30 per month. He graduated with high honors in 1943, completed his first 2 years of medical school in Alabama, and then became 1 of 13 transfer students accepted to Harvard Medical School. He graduated from Harvard with highest honors in 1946 and started his residency at Massachusetts General Hospital. He left to serve for 2 years at the U.S. Naval Hospital, then returned to Boston and completed his residency in 1954 as chief resident under Drs. Edward Churchill and Arthur Allen. Because of the rigid hierarchy in Boston, Crawford had few opportunities to quickly advance past a junior position. That, coupled with the misdiagnosis of a terminal health condition (he was diagnosed with chronic Bright's disease [nephritis] and told his life expectancy was 3 to 10 years), led Crawford to seek better opportunities. Crawford did not wish to die and leave his young wife and children in debt. Dr. Churchill was a friend of DeBakey's from their work in the Surgeon General's office. DeBakey and Crawford coauthored their first paper together in 1952.[19] Crawford was hired as junior faculty and moved to Houston in the summer of 1954 [Fig. 5]. Fortunately, while at Baylor, he befriended the nephrologist who was able to find and identify bacteria in his urine. Another friend, an infectious disease specialist, was testing a new drug shown to be effective against this bacterial strain. Crawford was told to drink a gallon of the drug and was pleasantly surprised to be completely cured 2 weeks later.[13, 20]

Other aortic pioneers in Houston included Oscar Creech, Jr, George Morris, Jr, and Arthur Beall, Jr. Creech was an alumnus of Tulane's residency program and joined DeBakey at Baylor in 1949, shortly after the Cullen building opened. Creech developed many of the early perfusion and aortic graft techniques and coauthored many of the early aortic dissection papers. He returned to Tulane in 1956.[21] Morris began his residency at Baylor in 1950, spending a significant amount of time at Jefferson Davis Hospital, and although he coauthored many of the earliest articles describing aortic repair in Houston, he was most famous for his 1963 report on

Fig 5a

Fig 5b

Fig 5
Drs. Cooley (a) and Crawford (b) in their offices at Baylor in 1957. *BCM Archives.*

the first successful repair of an acute aortic dissection.[22] Beall began his residency at Baylor in 1954, with a brief period of separation for military service (which involved helping Stanford's Frank Gerbode to develop aortic valve homografts); he returned and completed his residency in 1959. He is most famous for his Beall cardiac valve, widely used in the 1960s and 70s, but he also coauthored many of the papers detailing Houston's near-dominance of aortic surgery in the 1950s and 60s.[23] Other authors in the early days of aortic surgery in Houston included Daniel E. Mahaffey, Walter S. Henly, H. Edward Garrett, Jimmy F. Howell, Edward B. Diethrich, Bela Halpert, and Grady L. Hallman [Figs. 6 and 7].

The first collaboration between Drs. DeBakey and Cooley resulted in their landmark 1952 paper detailing their widely varying experience with aneurysm repairs in 6 patients from 1948 to 1951 [Fig. 8].[17] The unflappable DeBakey had been surprised by young Cooley's suggestion to directly repair an aortic aneurysm in a patient presenting at Jefferson Davis. It should be noted that this suggestion marked Cooley and DeBakey's formal introduction, as Cooley had just joined Baylor and was participating in his first departmental rounds. Cooley was confident it could be done, as this patient's aneurysm was similar to the one he had repaired at Johns Hopkins. DeBakey supported Cooley's adventurous side and stated that the operation should be performed the next day.[13] Cooley borrowed a Lebsche chisel from the Veterans Hospital and rapidly performed the operation the next morning; by the time DeBakey scrubbed in, Cooley was making his closing sutures.[24] This degree of adventurousness on Cooley's part was typical of what was increasingly being expected and supported in Houston.

In the early 1950s, syphilis-induced saccular aneurysms were common. These were discrete, localized aneurysms with an affinity for the aortic arch and brachiocephalic vessels. At this time, documented techniques for aortic repair—used with varying success—included inserting wire or other material to stimulate fibrosis (introduced by Charles H. Moore[25] in 1864); proximal ligation of the aneurysm (as first reported by Tuffier[26] in 1902); endoaneurysmorrhaphy, or opening and narrowing an aneurysm with sutures while maintaining blood flow (Matas[27], 1903); cellophane wrapping to induce periarterial fibrosis by irritation (as popularized by Poppe[28] in 1946); aortorrhaphy, or removal of an aneurysmal section of the aorta, followed by lateral suturing (as described in case studies by Blakemore in 1947[29] and Monod et al [30] in 1950); and homograft replacement (as described in 1951 by Lam[31], who, during an aortic aneurysm repair, placed a Lucite tube within the homograft as a shunt).

THE FIRST AORTIC PAPER FROM HOUSTON

Cooley and DeBakey used or considered all these techniques in their first reported series of 6 very different repairs—3 of which were successful—of aortic and great vessel aneurysms [Fig. 8]. The abovementioned aortorrhaphy was described, as well as a second, ultimately unsuccessful case (death seemed related to cerebral damage). The paper described the complexities of surgical exposure, as well as the limitations of current surgical instruments and adjuncts.[17] Clearly, the authors were intrigued by the aorta and intended to master its repair.

Fig 6

Fig 6
DeBakey and his colleagues from the Baylor College of Medicine Department of Surgery, including Drs. Soltero, Lau, Crawford, Henly, and Cooley, in front of Jefferson Davis County Hospital (1950s). *BCM Archives.*

Fig 7

Fig 7
The Baylor College of Medicine Department of Surgery (1958), whose members included Drs. DeBakey, Lau, Morris, Crawford, Henly, Beall, Cooley, J. Ochsner, McDonald, and Allende. *BCM Archives.*

RISE OF THE HOMOGRAFT

Although their 1952 paper[17] showed that aortic repair was feasible, it was clear that, in some cases, successful repair would require sectional aortic replacement. The question that remained was with what to replace the aorta. Gross' studies of coarctation in both human and animal models showed that an aortic homograft could be used to replace small sections of the aorta.[32] But, as Lam pointed out, aortic coarctation differs significantly from aortic aneurysm, in that extensive collateral blood supply develops in patients with coarctation but not in patients with aneurysms. How could blood flow be maintained during aortic aneurysm resection and replacement? Lam and Aram placed a Lucite tube within the homograft and connected it to either end of the aorta, which provided adequate blood flow but made suturing difficult.[31] Several authors [33-37] reported their experience with elective resection and homograft replacement of abdominal aortic aneurysms in the early 1950s. At that time, complete resection of such aneurysms was generally considered desirable, because Lam and Aram had opined that resecting their patient's aneurysm could have prevented the patient's death. Dubost, in 1951, also endorsed complete resection.[34]

DeBakey had generously offered to perform autopsies when meeting with the local Houston coroner, who readily accepted. This arrangement provided access to homograft material from young, healthy donors and allowed his surgeons to explore aortic resection and homograft replacement.[38] They initially used Gross' method of preserving homografts at 4°C but eventually shifted to using freeze-dried homografts.[39]

EARLY ABDOMINAL AORTIC ANEURYSM REPAIR

In their collaboration on abdominal aneurysm resection and replacement with homograft, Drs. DeBakey and Cooley reported on their experience with 7 patients operated on at the Methodist and Jefferson Davis Hospitals from November 1952 to March 1953 [Fig. 9]. The series was remarkable because it was the largest of its type and because 6 of 7 patients had recovered from the operation. These cases were straightforward in that all the aneurysms began distal to the renal arteries. Two of these cases involved reoperation of previously cellophane-wrapped aneurysms that were nonetheless expanding.

In their report on abdominal aneurysms, DeBakey and Cooley provided tips on homograft selection, measurement, and anastomosis; approaching lumbar arteries; and using heparin to prevent distal thrombosis. Aortic occlusion times ranged from 48 to 102 minutes, and 60 minutes of ischemia appeared to be well tolerated. Because of this, shunts for redirecting blood flow were not used.[40]

Of interest, only 1 of the 7 patients described in this paper had a syphilitic aneurysm; 6 of 7 the patients had atherosclerotic aneurysms. Early in the history of aortic repair, it was thought that the use of penicillin would eradicate syphilis, and that all the innovative surgical

Fig 8a

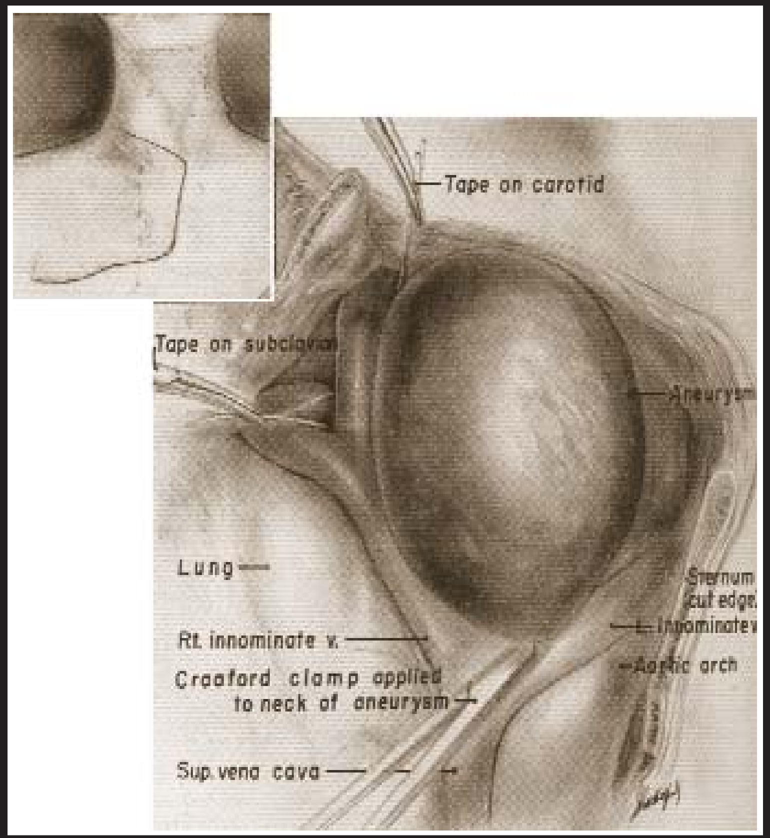


Fig 8b

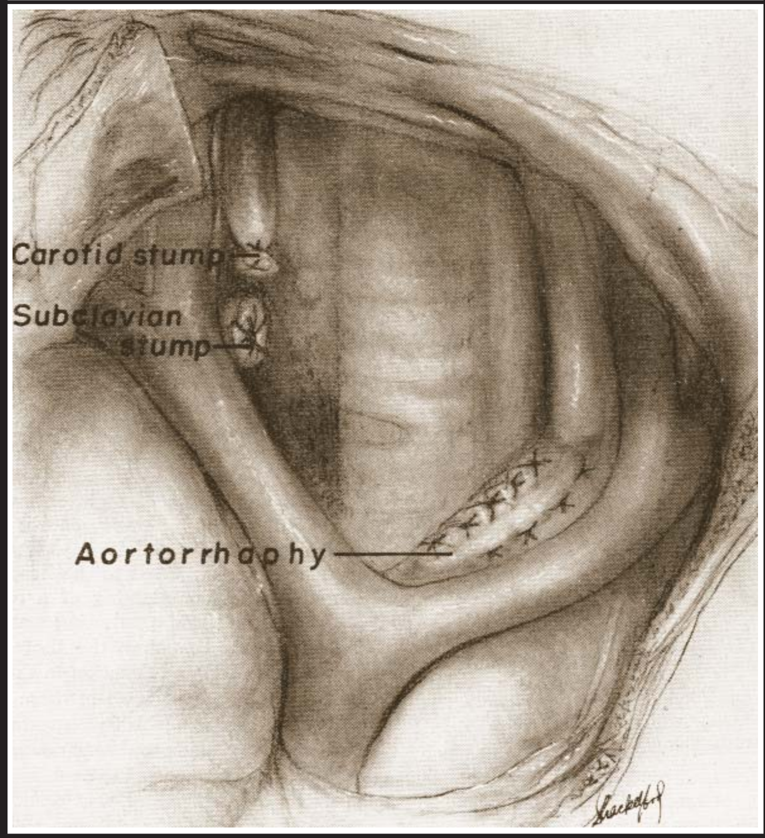


Fig 8
Images from DeBakey and Cooley's first collaboration (presented in 1951 and published in 1952).[17]
a. Preoperative image of a saccular aortic arch aneurysm.
b. Postoperative image of the aorta after resection of the aneurysm and lateral suturing.

approaches being developed to treat aortic aneurysms would probably be abandoned as unsuitable for atherosclerotic aneurysm repair.[24] The addendum mentions 5 more successful cases of abdominal aortic aneurysm resection with homograft replacement. All of these aneurysms were atherosclerotic, and 3 had been repaired previously with cellophane. These results shifted treatment away from the use of cellophane wrapping in such cases.

EARLY DESCENDING THORACIC AORTIC REPAIR

Soon, the experience with homograft replacement of abdominal aortic aneurysms was translated into homograft replacement of descending thoracic aortic aneurysms. Although Lam and Aram[31] had attempted such a repair in 1951, they were ultimately unsuccessful. In this era, descending aneurysms continued to be treated with intrasaccular wiring [Fig. 10].[41] However, this would soon change.[42] The first successful homograft replacement of a descending thoracic aortic fusiform aneurysm was performed at Methodist Hospital on January 5, 1953, and was subsequently reported by DeBakey and Cooley [Fig. 10]. More difficult than their previously documented abdominal repairs, this case involved a much larger (20×20-cm) aneurysm that had eroded through several vertebral bodies. Was there increased risk of paraplegia in this type of repair? Would a shunt to redirect blood flow be necessary? Lam and Aram's Lucite shunt seemed cumbersome, because it was placed within the homograft and held in place with sutures, and it had to be readjusted to allow room for suturing during the operation. Despite the use of the Lucite shunt, temporary weakness of the lower limbs had developed in their patient. Ultimately, DeBakey and Cooley used the "clamp-and-sew" approach and did not employ a shunt. The aorta was occluded for 45 minutes, and the patient survived without any ischemic damage. They hastened the return of blood flow by fully resecting the aneurysm after the homograft was anastomosed in place. DeBakey and Cooley theorized that the repair's success was due to the formation of collateral blood supply when the aneurysm was developing or to the administration of small amounts of heparin before clamping.[42]

In their 1954 discourse on aortic disease, DeBakey and Cooley discussed acquired aneurysmal disease. Their approach was either 1) lateral suturing along the clamped section of the aorta after removal of saccular aneurysms (primarily syphilitic), or 2) resection and replacement for fusiform aneurysms (primarily degenerative and atherosclerotic). Saccular aneurysms are usually small and easily resected at their "neck," and their leathery texture is well suited to holding sutures. They are fairly simple to repair, because blood flow through the remaining circumferential section of normal aorta is not impeded. Fusiform aneurysms are much harder to repair, because the aneurysm expands circumferentially from the diseased aortic section, and correction requires removing an entire aortic section and somehow replacing it. Additionally, blood flow to sensitive organs like the spinal cord and kidneys is interrupted.

DeBakey and Cooley reported on 3 new cases of descending thoracic aneurysm replacement using homografts, in addition to the abovementioned report of their first case. Al-

Fig 9

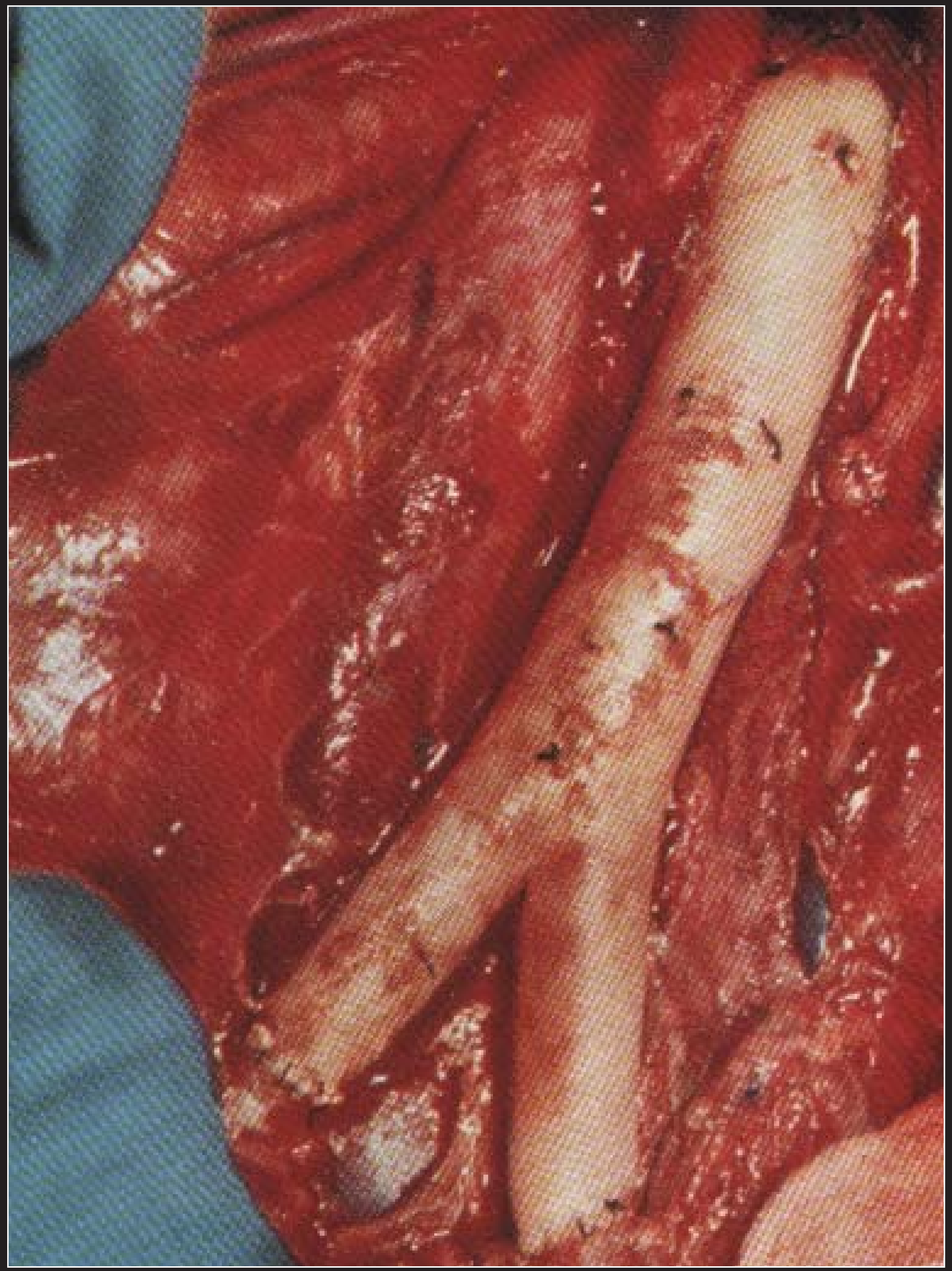


Fig 9
Photo of the Houston group's first surgical repair of an abdominal aortic aneurysm.
A homograft was used to replace the aneurysmal aortic segment (1953).[40]

though 3 of 4 patients showed no ill effect of temporary aortic occlusion (45, 48, 77, and 37 minutes), 1 patient had delayed-onset paraparesis, which lasted for several months. Again, DeBakey and Cooley proposed that individual tolerance of aortic occlusion is multifactorial, and they stated that aortic clamping should be strictly limited to no more than 60 minutes, and even less for repairs affecting spinal cord perfusion. Furthermore, to reduce the impact of distal organ ischemia during temporary aortic occlusion, they recommended rerouting aortic circulation with a shunt (or bypass) or reducing oxygen demand in tissues (by means of hypothermia) in at least some cases.[43]

USE OF HYPOTHERMIA

Houston clinicians began exploring the benefits of hypothermia for aortic surgery, building on the groundbreaking work by Bigelow[44] in Canada (much of which was done in dogs). At this time, hypothermia was induced by ice water baths or cooling blankets (filled with coils of refrigerant), sometimes supplemented with a small injection of chlorpromazine. The application of hypothermia was typically stopped at 90°F (32.2°C), but the patient's temperature would tend to drift a few degrees lower. Hypothermia was slowly reversed with warm water baths.[45]

Using 50 dogs undergoing simulated aortic surgery, Houston researchers studied hypothermia as a means of reducing paraplegia. The results suggested that hypothermia was amazingly effective.[46] In 1954, DeBakey reported using hypothermia successfully in a single case of distal arch aortic aneurysm repair.[47] In typical Houston fashion, the following year, the results of 240 cases of aortic repair using hypothermia were reported.[48] Houston's surgeons believed that hypothermia simplified operative repair (as compared to using shunts), and was generally safe and useful in operations on the upper sections of the aorta, but DeBakey was keenly aware of the risk of ventricular fibrillation that was associated with deeper levels of hypothermia.[45]

EARLY AORTIC ARCH REPAIR

The aortic arch was a particularly challenging aortic segment to repair. Arch repair had been first attempted by Schafer and Hardin in 1951. They placed the proximal ends of four 3-mm polythene shunts just distal to the aortic valve and placed the distal ends in the innominate, left common carotid, and left subclavian arteries and the descending thoracic aorta. Upon placement of the final shunt, and before aortic clamping began, the patient's heart went into fibrillation. Efforts to restore normal rhythm failed, but the operation was carried out nonetheless, and the patient died shortly afterward.[33]

Fig 10a

Fig 10b

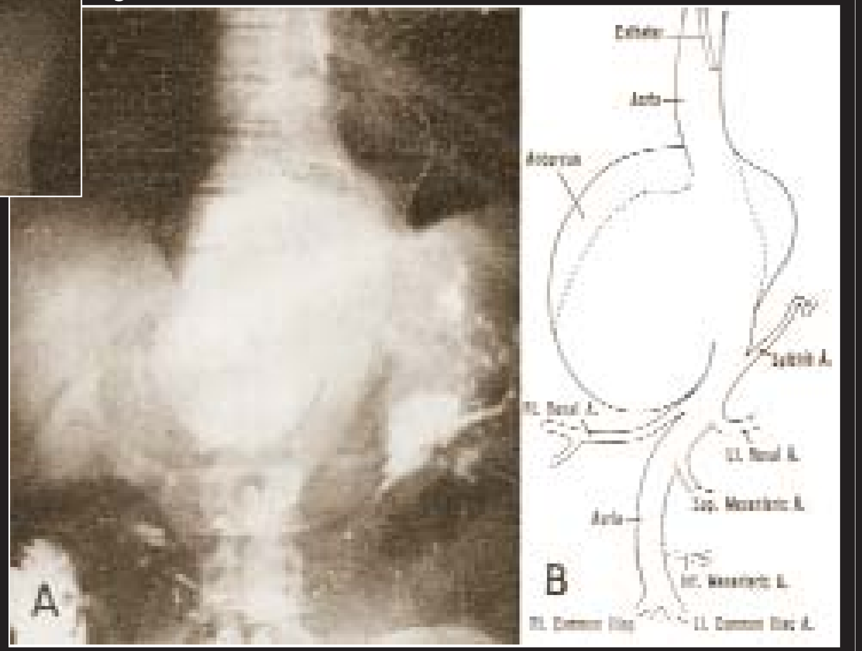


Fig 10c

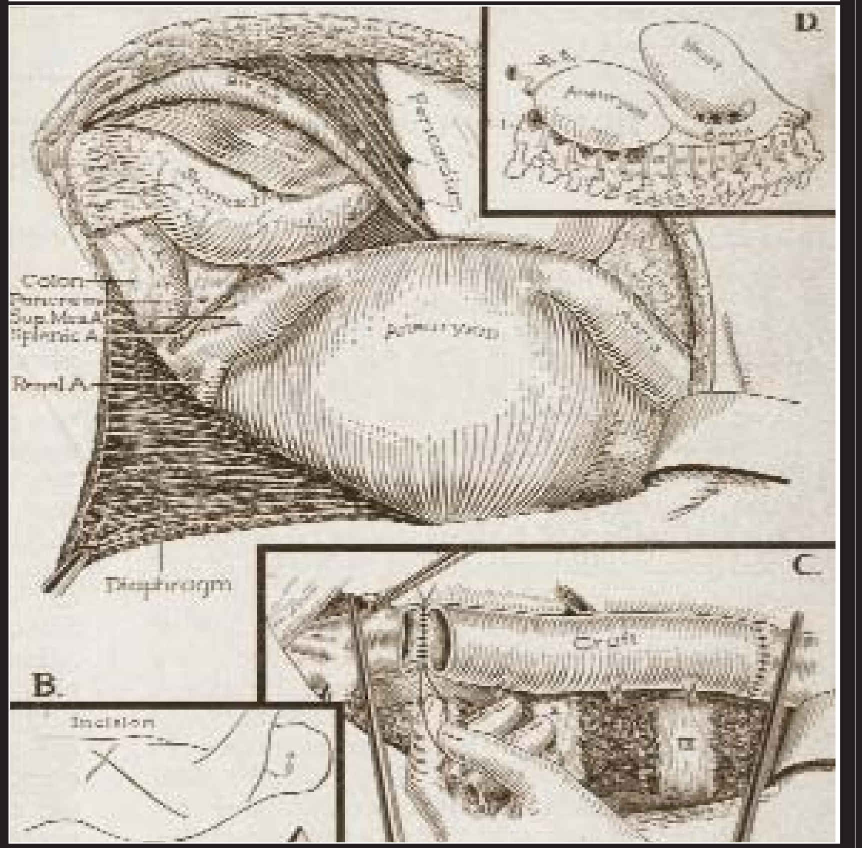


Fig 10
Differing approaches to aortic aneurysms within the same era (1953).
a. Intrasaccular wiring to induce fibrosis in an aortic aneurysm.[41]
b. Preoperative imaging of DeBakey and Cooley's patient with a descending thoracic aortic aneurysm.
c. Aneurysm resection and replacement with a homograft.[42]

In 1955, Cooley, Mahaffey, and DeBakey reported on what was only this era's third attempt to surgically replace the entire aortic arch [Fig. 11]. Unlike previous attempts, this one involved using mild hypothermia (93°F or 33.8°C) in an attempt to reduce strain on the left ventricle of the heart. Bypass shunts were also used to minimize brain and spinal cord ischemia. A circular, temporary bypass shunt was used that was made of 14-mm synthetic compressed polyvinyl sponge (Invalon©). The shunt had branches to the proximal right and left common carotid arteries. Cardiac arrhythmia developed shortly after the ascending aorta was clamped, but regular heart rhythm returned spontaneously after several minutes. The reconstruction was successfully completed, but the patient did not regain consciousness and died 6 days postoperatively.[49]

In 1956, Houston surgeons (Creech, DeBakey, and Mahaffey) made 2 additional unsuccessful attempts to replace the aortic arch. In one case, the approach was quite similar to the one used in the 1955 case (14-mm shunt and hypothermia), but in the other case, the surgeons used a very large 20-mm shunt and no hypothermia. Although both patients died, neither patient suffered ischemic damage to the brain or spinal cord.[50] Later, in a 1956 article entitled "Resection of Aneurysms of the Thoracic Aorta," Cooley, Creech, and DeBakey suggested using hypothermia during aortic arch aneurysm repair and emphasized the need to maintain blood flow to the brachiocephalic vessels, stating that "the use of a temporary shunt to bypass the arch and its tributaries is essential," although none of their cases to date had been successful.[51]

In 1957, DeBakey, Crawford, Cooley, and Morris reported the first successful total aortic arch replacement.[52] The authors now recognized that left ventricular strain could quickly result in patient death and that even a few minutes of ischemia could severely damage the central nervous system. They also recognized that shunts could be cumbersome and prolong repair. To address these issues, they used an artificial heart-lung machine (a modified DeWall-Lillehei pump oxygenator) to provide cardiopulmonary circulation. (Commercial Kitchens of Houston built and donated this machine—one of only 3 or 4 in the entire country—in 1956[53]. Legend has it that it was frequently wheeled back and forth between various institutions through the TMC's interconnecting tunnels.) Cooley was quite familiar with this machine, having used it dozens of times in his pediatric patients. Additionally, this technique had recently been used by Cooley and DeBakey in the first successful ascending aortic aneurysm homograft replacement, and at that time, the authors had predicted its future use in arch replacement.[54] In the ascending repair, venous blood was withdrawn through catheters in the venae cavae, while oxygenated blood was delivered through cannulas in the right femoral artery and the right common carotid artery, and a short period of cardiac arrest was tolerated.

In the arch repair, delivery was expanded to include the left common carotid artery (similar to the antegrade cerebral perfusion used today) [Fig. 12]. The aorta was clamped proximally, just past the coronary arteries, and distally, just past the left subclavian artery; no cardiac arrest occurred. Distally to proximally, the arch was resected and replaced with a homograft without complication. Perfusion time was 43 minutes, and the patient recovered fully and was discharged on postoperative day 16. At the time of the report, the patient had survived for 5

Fig 11

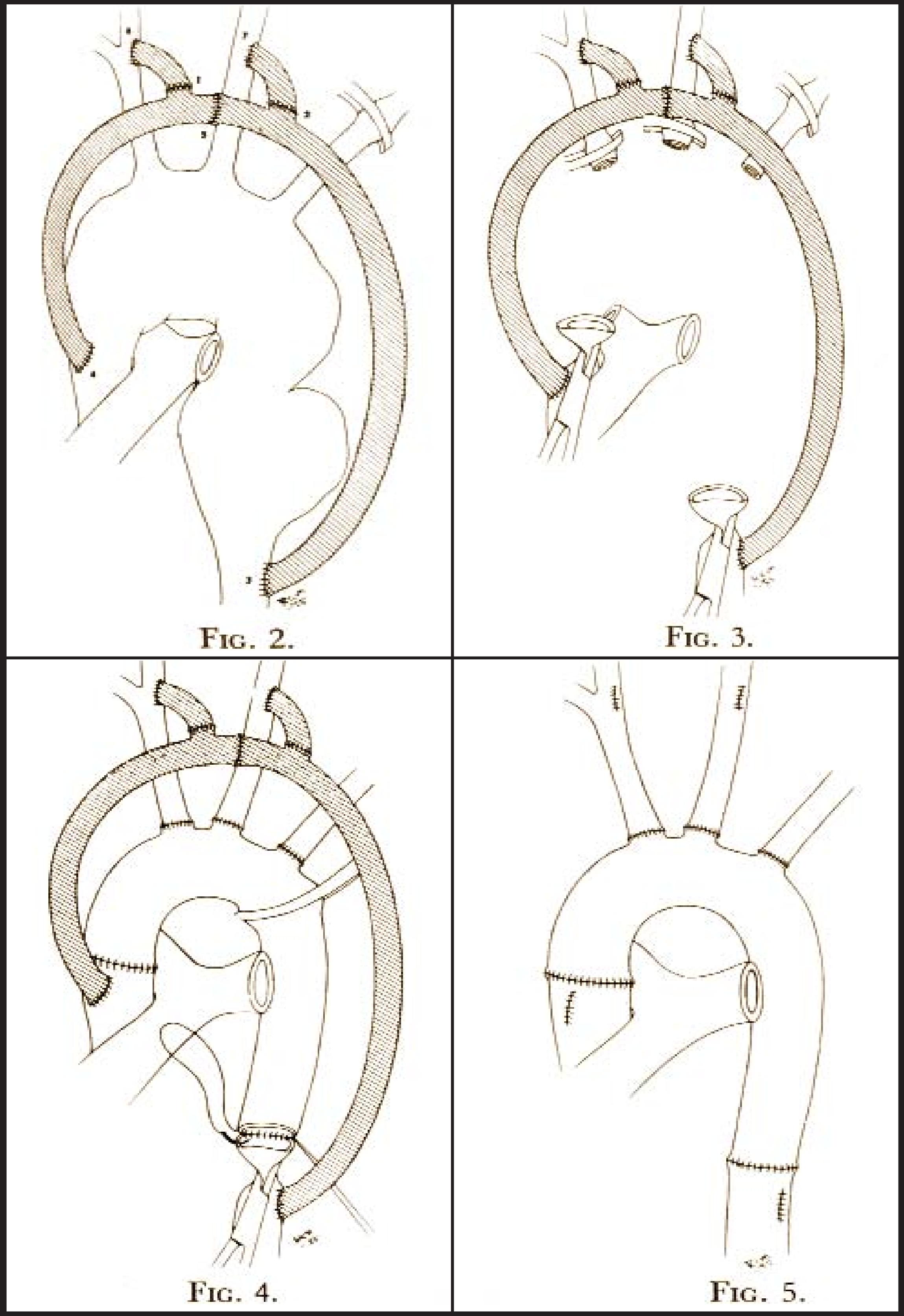


Fig 11
Series of drawings detailing the Houston group's first attempt at total aortic arch replacement with an Invalon© graft. Bypass shunts were used to conduct blood from the ascending to the descending aorta and into the brachiocephalic vessels (1955).[49]

months.[52] In a 1962 discourse on 138 cases of saccular or fusiform aortic arch aneurysm repair, DeBakey and colleagues indicated that they had largely abandoned hypothermia but continued to use several methods of temporary bypass (including the heart-lung machine) chosen according to the location of aortic repair. The concept of bypass to permanent graft conversion was also discussed.[55]

THORACOABDOMINAL AORTIC ANEURYSM REPAIR

Thoracoabdominal aortic aneurysm (TAAA) repair by homograft replacement was also accomplished quite early in Houston. Open surgical repair of TAAAs had lagged behind other types of aortic repair, largely because of the complexity of maintaining spinal cord and visceral circulation.

In 1956, DeBakey, Creech, and Morris reported the results of 4 such repairs, which all involved aneurysm resection and homograft replacement, as well as reattachment of the celiac axis, superior mesenteric artery, and one or more renal arteries [Fig. 13]. Hypothermia was used in the first patient (who did not survive), and 14-mm Invalon© shunts were used in the other 3 patients. The aneurysm was partly or fully excised to make room for the anastomosis to the homograft. The reattachment of vessels to the homograft generally began with the left renal artery, followed by the distal aortic anastomosis, which allowed the occluding clamp to be moved up, restoring blood flow to the left kidney. This was in keeping with the authors' idea that, of the visceral organs, the kidneys were the most sensitive to ischemia. Next, the right renal artery, the superior mesenteric artery, the celiac axis, and lastly the proximal aorta were reattached. If the aneurysm was not yet fully resected, it was now completely extirpated. In this homograft replacement approach, the intercostal arteries were not reattached, because the aneurysm was entirely removed. Two of the 4 patients died, one due to pulmonary complications and one due to a bleeding gastrointestinal ulcer.

When this work was presented at the 1956 American Surgical Association conference, it was met with extraordinary enthusiasm. Dr. John Gibbon, inventor of the heart-lung machine, called DeBakey "one of the world's greatest surgeons" and the work "one of the most brilliant technical achievements that to my mind has been accomplished in the last few years in the field of vascular surgery." In less than 8 years since DeBakey joined BCM (and only 5 years since its primary teaching hospital was built), Houston had achieved great stature in this field; as Dr. Henry Bahnson jokingly put it, "To hear a monumental and simply thrilling feat in surgical treatment emanating from Houston is certainly not unusual and hardly remarkable."[56]

Nine years later, DeBakey, Crawford, Garrett, Beall, and Howell presented their experience in 42 patients, including the 4 from their original report. With experience, mortality had improved from 50% (in 1956) to 26% (11 of 42 deaths in the current series). The desire to limit ischemic damage guided their surgical approach. The Dacron graft was first used as a bypass and was placed adjacent to the aneurysm [Fig. 14]. At this time, the aneurysm was resected just

Fig 12

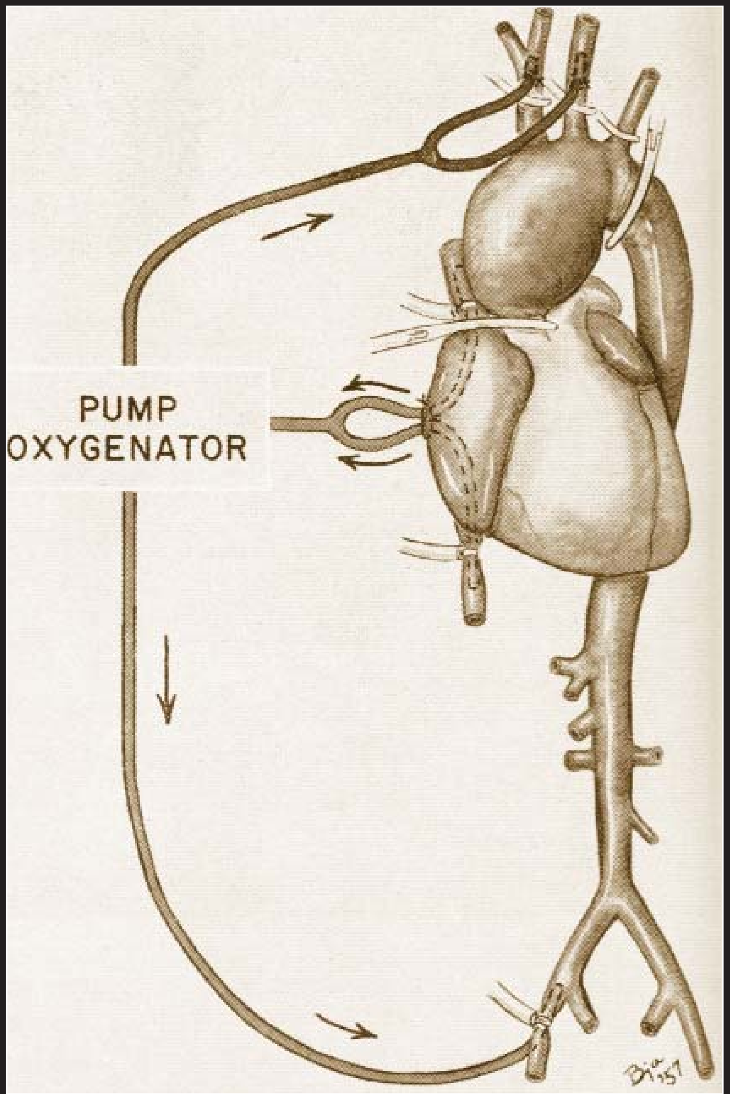


Fig 12
An early cardiopulmonary bypass circuit as used in a successful total aortic arch replacement with a homograft.
Early antegrade cerebral perfusion is shown (1957).[52]

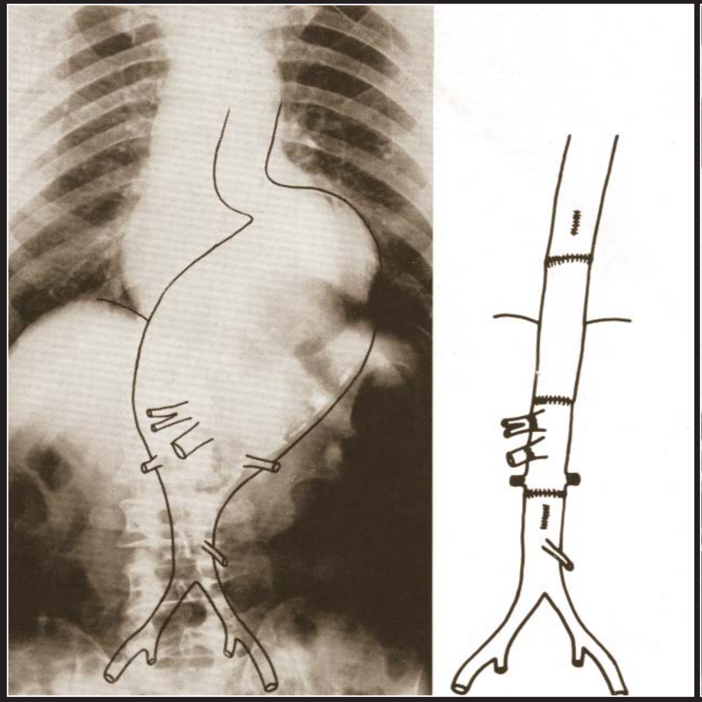


Fig 13a

Fig 13b

Fig 13
a. Preoperative imaging and superimposed drawing of a thoracoabdominal aortic aneurysm with postoperative sketch of completed repair.
b. Postoperative photo of the homograft used to complete the repair and image of intravenous pyelogram that shows normal kidney function (1956).[56]

enough to make room for the graft to hasten repair. The graft was then anastomosed end-to-side in this displaced, extra-anatomical position, and blood flow was restored through the bypass graft. The visceral arteries were reattached sequentially, starting with the left renal artery and working up to the celiac axis. Often, small Dacron grafts were used to facilitate the reattachment of visceral arteries. As each visceral artery was anastomosed, clamps would be repositioned and blood flow restored. However, with this approach, it was still not yet feasible to reattach intercostal arteries of the spinal cord.[57]

Although the rates of paraplegia were not specifically mentioned in DeBakey et al's report, paraplegia was not an insignificant complication during this era. Blaisdell and Cooley had demonstrated, in a canine model, the importance of reattaching at least 2 spinal cord arteries to prevent paraplegia.[58] During this time, and largely in abdominal aneurysms, Crawford began to experiment with a more anatomically directed, top-to-bottom, aortic graft replacement technique that did not have the stilted qualities of the bypass-turned-graft aortic repairs. Crawford repaired the aneurysm from within, following its natural course and later wrapping the aneurysm around the graft. He described how one can anastomose a renal artery, preserved with a small button of aortic tissue, to a small hole incised in the graft.[59] Later, he would more fully apply this approach to thoracoabdominal aortic repair.

DEVELOPMENT OF SYNTHETIC ARTERIAL SUBSTITUTES

DeBakey was intrigued by Voorhees and colleagues' report[60] of using a synthetic Vinyon graft to replace a section of the aorta. Homografts were not the ideal aortic replacement; the donor tissue was difficult to obtain, preparing the tissue to enhance its durability was time-consuming and expensive, and the storage requirements were stringent.[51]

In a 1966 paper looking back on their 15-year experience with aortic graft replacements, Jordan, DeBakey, O'Neal, and Halbert discussed the longevity and durability of homografts. Over time, the elastic fibers in homografts break down and are primarily replaced with dense, hyalinizing fibrous connective tissue. Although this "filled in" tissue allows the homograft to retain its original shape, flexibility is lost. In most cases, this process is quite slow; however, Jordan et al noted that, sometimes, homografts would rapidly deteriorate. Rarely, homografts would undergo atherosclerotic changes and become aneurysmal.[61] Ultimately, the use of homografts decreased, perhaps because of the increasing success of aortic replacement surgery; supply could not keep up with demand.

The choice of Dacron as a graft material was somewhat serendipitous. Dr. DeBakey originally requested nylon from the local department store, but they had none in stock, so the salesperson suggested a new fabric, Dacron. DeBakey found this substitution suitable and soon created the first Dacron artificial artery on his wife's sewing machine [Fig. 15].[13] In a 1954 repair, his bifurcated Dacron graft was used to replace a section of the abdominal

Fig 14

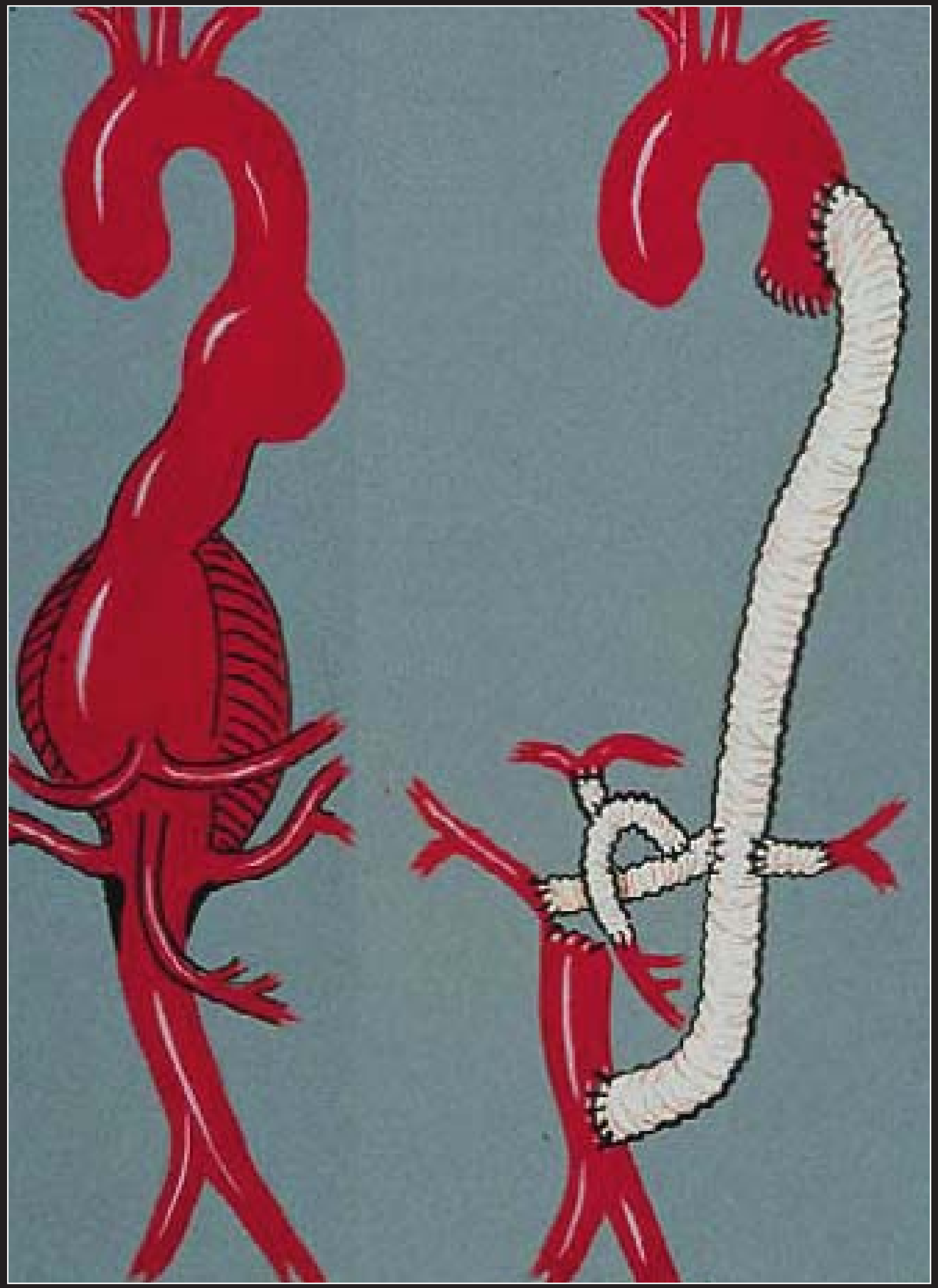


Fig 14
An early thoracoabdominal aortic aneurysm repair. The Dacron graft is anastomosed around the aneurysm, which is then entirely resected (1965). *BCM Archives.*

aorta. He continued to experiment with Dacron and other fabric graft materials. A textile manufacturer he had treated invited him to Philadelphia; while there, DeBakey met with Professor Thomas Edman, of the Philadelphia Textile Institute, and together they developed an improved knitted and pleated Dacron graft.[62] The advantages of this knitted graft were flexibility, elasticity, amenability to autoclaving and clamping, and its ability to accommodate changes, such as openings sculpted to a branch or to reattach a branch artery, without losing integrity [Fig. 16].[63]

Crawford, DeBakey, and Cooley also explored other synthetic graft materials—Invalon© (compressed polyvinyl sponge), woven Orlon (taffeta), knitted Orlon, a mixture of knitted Orlon and Dacron, and chemically treated nylon (Edwards-Tapp tube)—and compared them to their first-generation knitted Dacron grafts in their 1957 report of 317 patients.[64] The preparation of some of these grafts was quite complex. Most grafts were preclotted in the patient's blood or plasma (allowing the blood to fill the interstitial spaces in the graft) before insertion to reduce the porosity of the graft. Of concern was the general impression that twice as much blood was seeping through synthetic grafts as through homografts, and that synthetic grafts posed a greater risk of infection. Although used less frequently than the other grafts because of its more recent development, the knitted Dacron graft seemed the most promising synthetic graft.[64]

The first Dacron grafts were somewhat coarsely knitted, but by adding more needles to the knitting machines and by using thinner and more elastic yarn, it was possible to develop a Dacron graft capable of expanding, much like the native aorta. Yarn could also be textured somewhat, such that a uniform surface, with uniform porosity, could be achieved. Pleats (or corrugations) were made by placing the graft over a tight mandrel template and winding a strong thread around it. Both woven and knitted grafts were available; each type had distinct advantages. Woven grafts were less porous because of the tight packing of the yarn by the loom. Thus, woven grafts were better for replacing large-diameter vessels, like the aorta, or for reducing blood loss in repairs requiring heparinized blood and cardiopulmonary bypass. However, flexibility was sacrificed in the woven grafts, limiting their use. Knitted grafts were more commonly used, as they were more flexible and easier to cut during repair.[61, 63]

The impression that aortic disease was largely localized was a key concept in the development of aortic replacement grafts; segments of diseased aorta were usually surrounded by healthy aortic tissue. This healthy tissue could accommodate a graft.[65] In a 1966 paper, Houston surgeons stated that the ideal aortic replacement would be nontoxic, hypoallergenic, durable, elastic, pliable, and available in multiple sizes and shapes. Graft porosity had to be low enough to prevent excessive blood loss but high enough to allow healing. He added that while his current graft (in 1966, as manufactured by the United States Catheter and Instrumentation Corporation) was not perfect, it was much better than grafts of earlier generations.[61] Of note, Dacron remains the fabric of choice for aortic replacement grafts today.

Fig 15

Fig 16

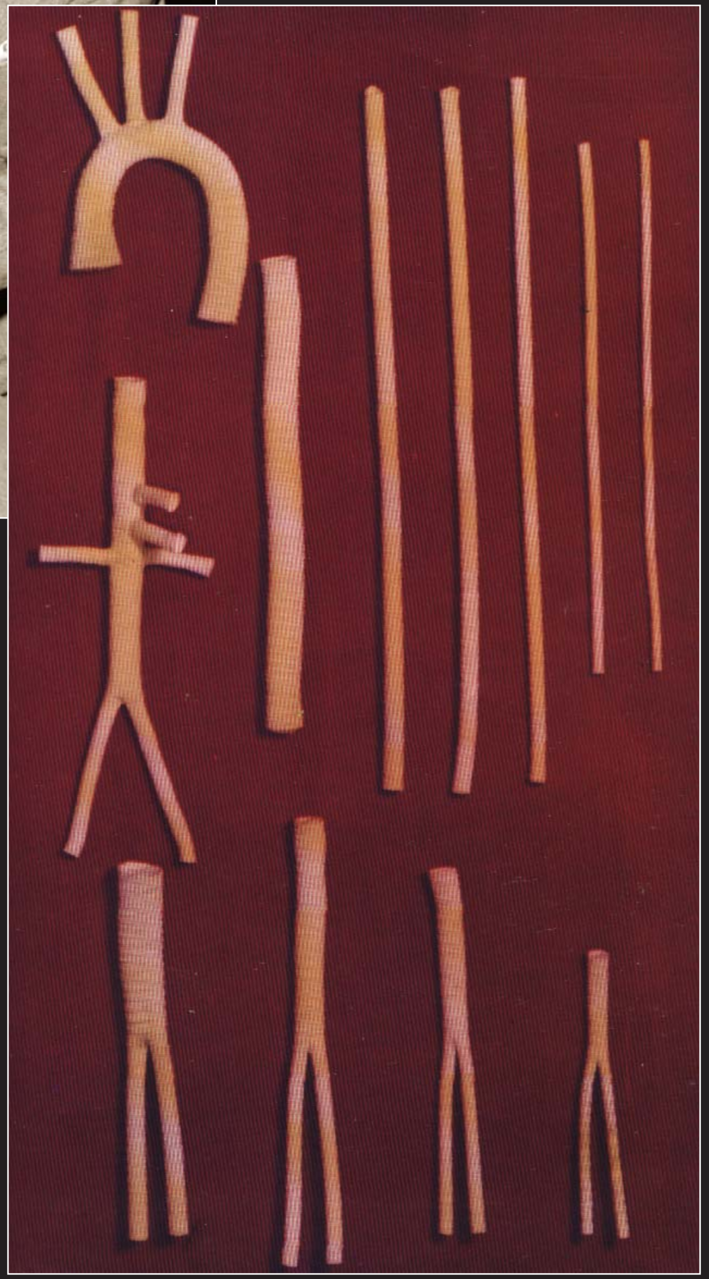


Fig 15
DeBakey sewing the first Dacron graft on his wife's sewing machine (early 1950s).
DeBakey had been taught to sew by his mother.
BCM Archives.

Fig 16
Photo of knitted Dacron aortic grafts. The grafts were presented at the 107th Annual Meeting of the American Medical Association (1958).[63]

AORTIC DISSECTION

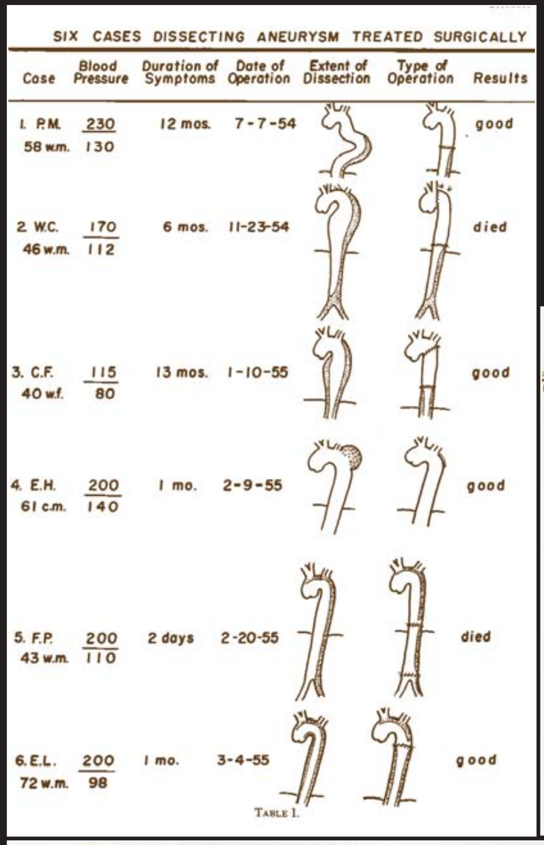
Although the high lethality of aortic dissection had been discussed since the early 19th century, and although Shennan[66] had published his astute observations from large numbers of aortic dissection cases in 1934, this familiarity had not led to improved prognosis for persons with aortic dissection, and surgical treatment for aortic dissection still seemed untenable in the early 1950s. However, in 1955, the Houston group revived interest in the surgical management of aortic dissection with the publication of the landmark paper, "Surgical Considerations of Dissecting Aneurysms of the Aorta."[67] The paper, presented at the 1955 American Surgical Association conference, detailed the surgeons' experience in 6 cases of aortic dissection, with 4 survivors. Most of these patients had hypertension and chronic dissection involving the descending thoracic aorta [Fig. 17].

The Houston surgeons' approach to repairing chronic dissection was based on a natural phenomenon in which another tear creates a re-entry site into the main aortic channel. Repair centered on cross-clamping the descending aorta, dividing the aorta in two, and then obliterating the false aneurysm of the lower aortic section by circumferentially suturing the "double-barreled" aorta closed, thus creating a single, true lumen in the lower section of the aorta. In the upper section, a small wedge of the innermost layer (which lay between the 2 channels) was excised, creating a re-entry site (fenestration). Thus, when the 2 sections of aorta were rejoined with an end-to-end anastomosis, blood from both channels would flow downward in a single channel. Additionally, a homograft replacement could be incorporated into the repair [Fig.18].

The following year, Houston authors published 4 additional articles on dissection[68-71] that displayed an early understanding of the large role that the location of an aortic dissection (proximal versus distal) plays in both treatment and prognosis. Additionally, it was recognized that completely eliminating the false lumen was not practical. Hemodynamic factors that might contribute to the development of aortic dissection were described, as was the value of conducting imaging studies to simplify diagnosis. Their technique was widely presented and well received throughout the United States and Europe as DeBakey and Cooley attended academic conferences and toured European surgical facilities.[13] At the American Surgical Association meeting in 1956, Cooley commented on their total experience of 14 patients[72] and stressed the importance of maintaining normal blood pressure postoperatively. Presciently, he also mentioned some unusual histologic findings in 2 patients with Marfan syndrome who had dissection without hypertension. These patients had normal medial tissue instead of the abnormal, "cystic medial necrosis," described in most such patients.

In the August 1961 issue of *Circulation*, the Houston experience with 72 cases of aortic dissection was presented.[73] The patients' symptoms varied greatly, and 3 of 10 patients whose only symptom had been substernal or epigastric pain "had been treated for myocardial infarction before the correct diagnosis was obvious." The role that the location of aortic dissection played in treatment was further emphasized with an early, 4-category classification schema (Types I, II, III, and IV) [Fig. 19]. Mortality was 26% overall and 20% for those with dissection limited to the descending or thoracoabdominal aorta. Two cases of paraplegia occurred.

Fig 17

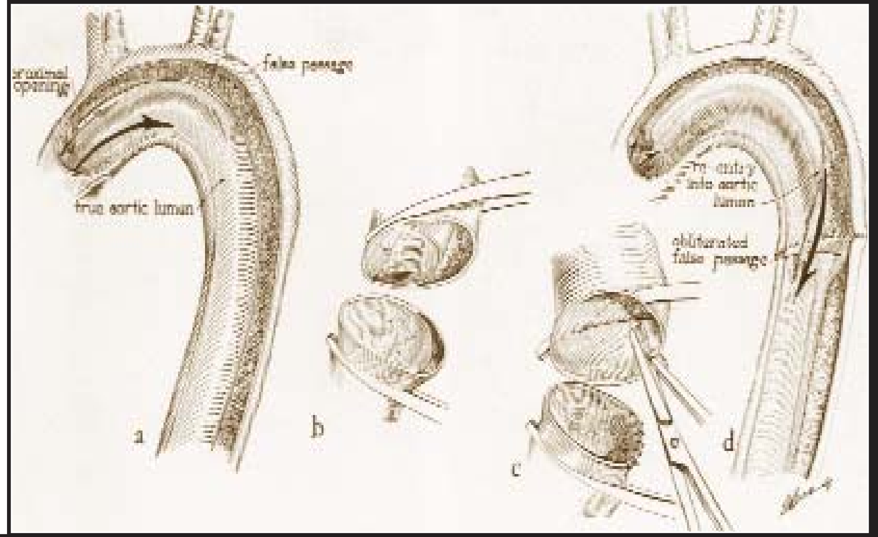


SIX CASES DISSECTING ANEURYSM TREATED SURGICALLY

Case	Blood Pressure	Duration of Symptoms	Date of Operation	Extent of Dissection	Type of Operation	Results
1. P.M. 58 w.m.	230/130	12 mos.	7-7-54			good
2. W.C. 46 w.m.	170/112	6 mos.	11-23-54			died
3. C.F. 40 w.f.	115/80	13 mos.	1-10-55			good
4. E.H. 61 c.m.	200/140	1 mo.	2-9-55			good
5. F.P. 43 w.m.	200/110	2 days	2-20-55			died
6. E.L. 72 w.m.	200/98	1 mo.	3-4-55			good

TABLE I.

Fig 18



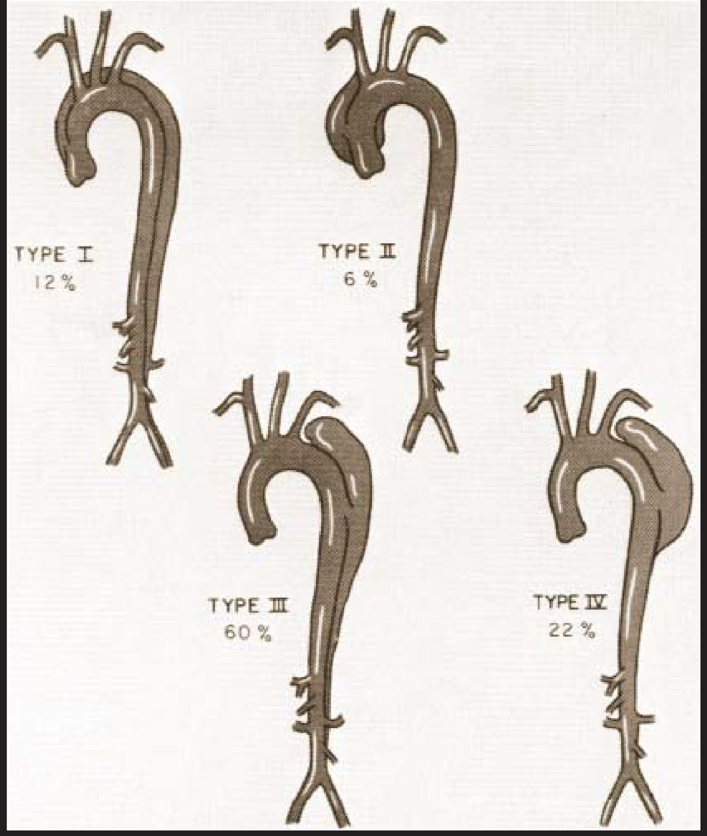


Fig 19

Fig 17
The Houston group's first report on aortic dissection (1955), which described the results of 6 surgical repairs of aortic dissection. Repair included homograft replacement in cases 2, 3, and 5.[67]

Fig 18
Series of drawings detailing the Houston group's approach to aortic dissection (1955).[67]

Fig 19
Early DeBakey classification system for aortic dissection and the frequency of each type of dissection in 72 patients (1961).[73]

In 1963, Houston's George Morris reported the first successful emergency repair of an acute aortic dissection.[74] The patient, a 32-year-old physician, was admitted to Methodist Hospital within 6 hours of experiencing incapacitating chest pain. He had substantially different blood pressure in his left and right arms (70/10 and 110/10 mm Hg) and classic signs of aortic valve insufficiency. Within an hour of admittance, the patient was in surgery, hastened by the newly developed disposable plastic bubble oxygenator. The tear in the ascending aorta was repaired, and the aortic valve was resuspended. Despite some initial pulmonary complications, the patient eventually made a full recovery.

In 1966, DeBakey was the guest editor of an entire volume of *Surgical Clinics of North America*. This volume largely focused on the aorta and included 21 articles. In his article "Dissecting Aneurysms of the Aorta," based on the Houston experience in 250 cases of aortic dissection, DeBakey presented his revised classification system for aortic dissection (Types I, II, and III), based on presentation and treatment, which has survived to the present day [Fig.20].[75] Unto his final days, DeBakey never appreciated the Stanford modification of his dissection classification.[38]

THE CRAWFORD ERA

Although Crawford had coauthored many of the earliest papers on aortic surgery, much of his finest work was published after his second decade at Baylor [Fig. 21]. Twenty years after joining DeBakey in Houston, Crawford [76] reported, in his first of many landmark papers, his evolving experience with 23 TAAA repairs. He reported on techniques he had begun to experiment with in the mid-1960s (see the section on thoracoabdominal aortic repair, above). Crawford drew from techniques used in other surgical applications, including anatomic endovascular graft inclusion, inspired by the technique used by Javid and colleagues [77] to repair infrarenal aortic aneurysms; reimplantation of lumbar or intercostal arteries, as demonstrated by Spencer [78] in a canine model; and the reattachment of the celiac axis and the superior mesenteric and renal arteries by directly suturing the vessel orifice to openings made in the graft, as suggested experimentally by Carrel and Guthrie in 1906.[79] Using these techniques, Crawford achieved a 96% survival rate, essentially setting a gold standard for all future comparisons [Fig 22].

Allowing prognosis and treatment to be based on anatomic features, Crawford's namesake classification system for TAAAs first appeared in 1978 [80], and, with minor revisions, it remains a useful method to identify, communicate, and compare aspects of aortic disease. Crawford's continued efforts in thoracoabdominal aortic repair were presented in his two landmark publications describing his experience with 605 patients [81] (regarded by the *Journal of Vascular Surgery* as its most important article of the decade [82]) and 1509 patients (authored after his death by Svensson et al).[83] Crawford had achieved consistently low mortality rates, but he was concerned about the damage caused by even temporary spinal cord ischemia and the attendant high rates of paraplegia; for the repairs he classified as most complex (Type II), the rate of paraplegia was more than 20% in his 605-patient series. With his protégés (Svens-

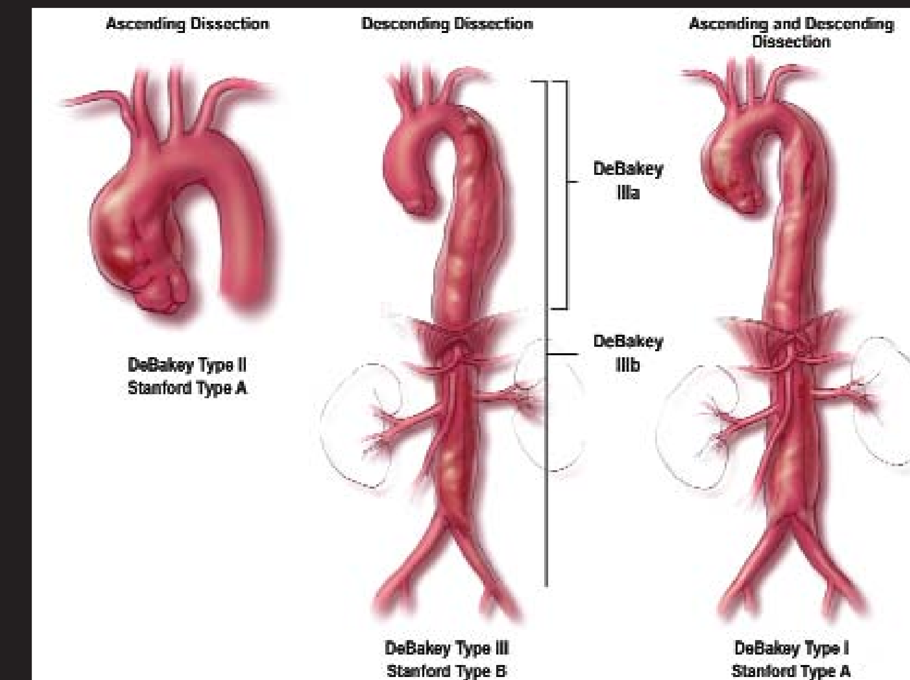


Fig 20

Fig 21

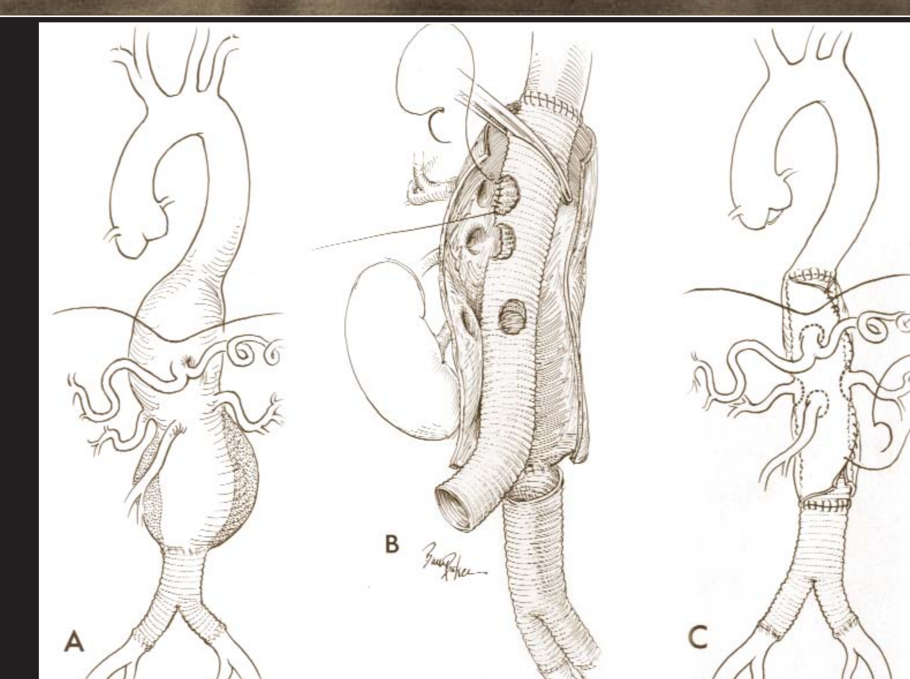


Fig 22

Fig 20
DeBakey and Stanford classifications of aortic dissection.
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Fig 21
The Baylor College of Medicine Department of Surgery (late 1960s or early 1970s). Front (left to right): Morris, Beall, DeBakey, and George and Paul Jordan. Back (left to right): Crawford, Noon, Shumaker, Guinn, Mattox, and unidentified persons.
BCM Archives.

Fig 22
Illustration of the Crawford technique of thoracoabdominal aortic repair, showing reattachment of the visceral arteries. This partly resected section of the aorta is wrapped around the graft (1979).[110] *Copyright Elsevier.*

son, Safi, and Coselli), he tested cerebrospinal fluid (CSF) drainage as a means of ameliorating spinal cord damage. The experiment was unsuccessful, but only because too little CSF had been drained.[84] As several years passed, evidence was found that supported the use of CSF drainage, and a randomized trial conducted by Coselli and LeMaire associated this technique with a significant decrease in paraplegia rates.[85] Today, CSF drainage is widely used, even in some endovascular repairs.

Crawford dominated the field of aortic surgery, especially in the 1970s and 1980s, and continued this work until his untimely death in 1992. His monumental work was the collaboration between him and his son, *Diseases of the Aorta: Including an Atlas of Angiographic Pathology and Surgical Technique*, published in 1984 [Fig. 23].[86] Aortic surgery is forever indebted to Dr. Crawford.

THE TEXAS MEDICAL CENTER TODAY

The TMC is the largest medical center in the world [Fig. 24] and covers about 4 square kilometers, with almost 20 kilometers of streets and 2.6 million gross square meters of office space—nearly as much space as all of downtown Los Angeles. The TMC has been the single largest employer in Houston since the 1980s and is credited with pulling the city out of that decade's "oil bust." Currently, 73,000 people are employed by the TMC's 46 institutions. The economic impact of the TMC on the City of Houston nears $150 million US dollars each year.

More than $7 billion US dollars in additional building and infrastructure projects are scheduled through 2014, including 17 projects that have already begun. A significant portion of this new construction (26%) is specifically designated for research purposes. Once this construction is completed, the TMC will be seventh largest "downtown" area in the United States.

Baylor College of Medicine is building a large complex that includes its first hospital, focused on personalized medicine, as well as additional research facilities. Research is enhanced by frequent collaboration with nearby institutions, and more than $573 million US dollars' worth was conducted in 2000 alone.[87]

STATE OF CURRENT AORTIC RESEARCH

Today, the focus of aortic repair in Houston merges continued surgical innovation with genetic, tissue, and cellular discoveries. Collaborative efforts by the University of Texas Health Science Center at Houston, BCM , and the University of Texas Medical Branch in nearby Galveston have led to tremendous insight into recently discovered genetic mutations [88-95] and molecular pathways related to thoracic aortic aneurysms [96-104] and dissections. Surgical techniques have been expanded to incorporate endovascular approaches as well as hybrid aor-

Fig 23

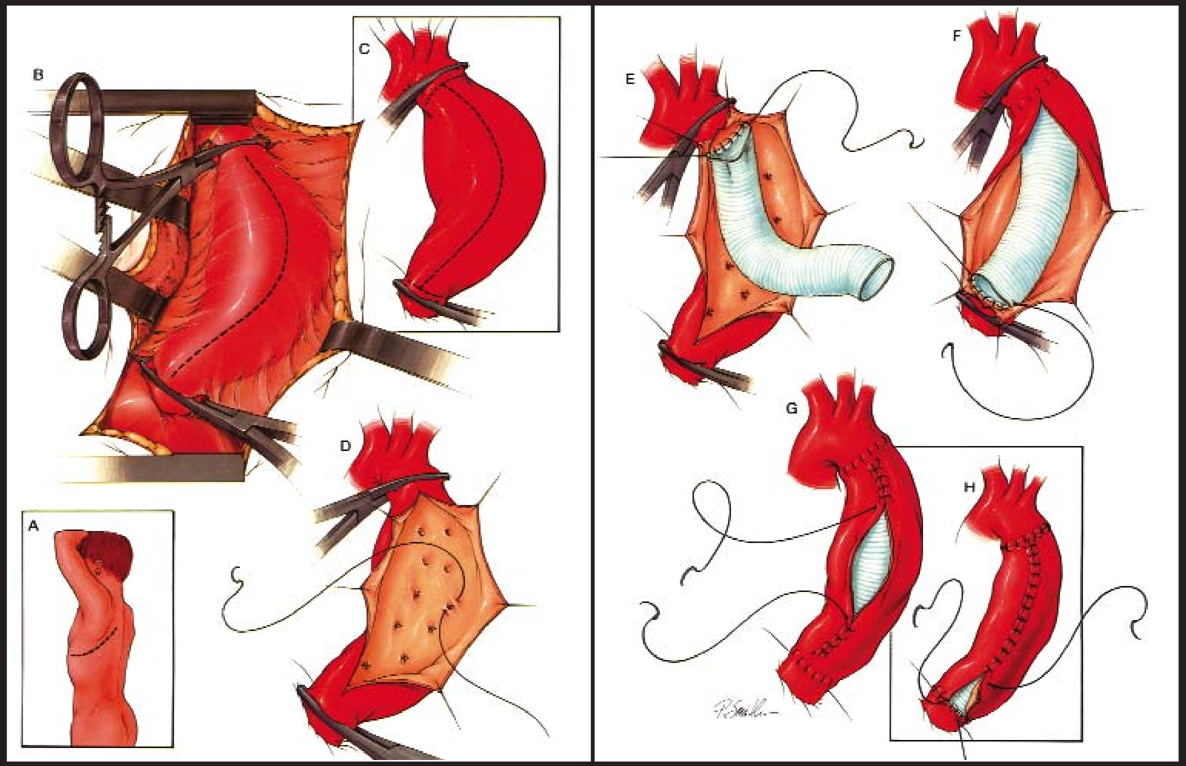

Fig 23
Excerpt from the Crawford & Crawford book showing surgical repair of a descending thoracic aortic aneurysm (1985).[86]
Copyright Lippincott Williams & Wilkins.

Fig 24

Fig 24
Aerial photo of the Texas Medical Center (2007).
Texas Medical Center.

tic repairs [105-109]. Efforts are currently underway to better identify at-risk phenotypes and correlate them to as-yet-undiscovered genes. The analysis of extensively detailed tissue collections is deepening our understanding of the cellular responses to aortic dissection. For all that has been accomplished in Houston, there is still more that is being and can be achieved.

MEMORANDUM

Although DeBakey and Cooley were famous for their differences, together they advanced the field of aortic surgery like no other partnership has. Before the recent death of Dr. DeBakey, whose accomplishments were truly without bounds, DeBakey presented Cooley with a copy of their first paper, "Surgical Considerations of Intrathoracic Aneurysms of the Aorta and Great Vessels" [Fig. 25].[17] This paper is prominently displayed in the museum honoring Cooley, above his copy of DeBakey's Congressional Medal of Honor. In an accompanying note, DeBakey shares this recognition with Cooley in honor of their early work. Cooley was present for DeBakey's memorial service, as The Young Tuxedo Brass Band of New Orleans triumphantly led the recessional in homage to DeBakey's love for music and his native Louisiana.

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Fig 25

Fig 25
Photo of Drs. DeBakey and Cooley taken at the 2008 Joint Session of the 6th Current Trends in Cardiothoracic Surgery Conference and the 17th Congress of the Michael E. DeBakey International Surgical Society. Cooley receiving a framed copy of their first collaborative paper, "Surgical Considerations of Intrathoracic Aneurysms of the Aorta and Great Vessels."[17]
Agapito Sanchez, Baylor College of Medicine.

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SCIENTIFIC ABSTRACTS

OPENING LECTURE

Leonardo da Vinci and the aortic valve

Francis Robicsek

LEONARDO DA VINCI AND THE AORTIC VALVE

Francis Robicsek
Carolinas Medical Center, Charlotte - NC - USA

A brief description of Leonardo's activity as an artist, scientist, mechanical and military engineer as well as anatomist is given. Graphic material from the collection of the Windsor Castle Collection is presented to document Leonardo's interest in three particular issues of aortic (valve) physiology:

1) The role of the sinuses of Valsalva and generated eddy-currents by them upon the function of the aortic valve leaflets;
2) The role of aortic wall compliance at different levels of the ascending aorta;
3) The inherent stenotic nature of the bicuspid valve and its physiological consequences.

The relevance of Leonardo's observations and conclusions to modern day pathophysiological research of the aortic root are shown.

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SCIENTIFIC ABSTRACTS

OPENING LECTURE

Aortic surgery in the new millennium

Joseph S. Coselli

AORTIC SURGERY IN THE NEW MILLENNIUM

Joseph S. Coselli

The Texas Heart Institute at St. Luke's Episcopal Hospital and Baylor College of Medicine, Houston - TX - USA

J.S. Coselli, S.Y. Green, S.A. LeMaire

Tremendous innovations have been introduced in the last half-century to improve care for patients with aortic disease. Conditions that were essentially untreatable in the early 1950s can now be repaired with a greater likelihood of survival than ever imagined. Aortic repair has grown to encompass adjuncts designed to ameliorate specific surgical morbidities, such as spinal cord ischemia and renal dysfunction, while embracing endovascular technologies to enable less invasive approaches, including hybrid procedures. Other recent technical advances include the use of prefabricated branched aortic grafts to minimize residual native aortic tissue and, thus, to reduce the late formation of patch aneurysms; surgical adhesives to improve the strength of fragile anastomoses; and valve-sparing aortic root replacement surgery to preserve the native aortic valve, improve hemodynamics, and reduce the need for anticoagulation.

The future of aortic surgery will undoubtedly be heavily influenced by advancements in multiple disciplines – genetics, cellular biology, biochemistry, engineering, and bioinformatics – as well as by innovations in imaging and in surgical and endovascular technology. Personalized medicine will require surgeons to tailor treatments to the needs of individual patients and to be equally facile with both surgical and endovascular approaches. Enhanced understanding of the biology of aortic tissue – particularly the complex relationships among the cellular, genetic, and environmental factors that control its structure and function – will benefit patients by enabling the development of more sophisticated treatment approaches, including the use of medications to prevent or slow aneurysm growth. The analysis of genetic profiles will dictate the selection of therapeutic measures, and specific biomarkers will be used to predict and minimize potential complications. Hospital administrators will partner with surgeons to provide sufficient resources and dedicated support teams to enhance operative outcomes. Surgical societies will continue to serve to advance and enlighten members to the benefit of patients. Treatment outcomes will be reported in a standard fashion to better assess patient risk and identify late events. Each of these areas presents tremendous opportunities to improve treatment and quality of life for patients with aortic disease.

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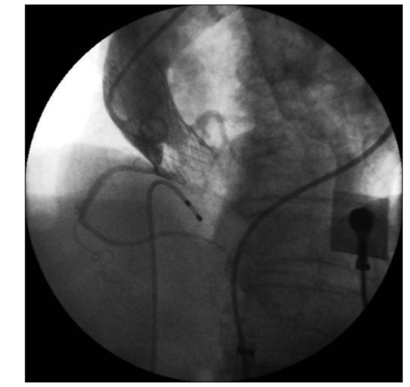
SCIENTIFIC ABSTRACTS

ENDOVASCULAR TREATMENT I

Chairmen: Maurizio Cotrufo, Edouard Kieffer, Francesco Musumeci, George Silvay

SELECTING PATIENTS FOR TRANS-FEMORAL AORTIC VALVE IMPLANTATION	Antonio M. Calafiore Discussant: Iassen Michev
SELF EXPANDABLE TRANS-CATHETER AORTIC VALVE IMPLANTATION	Corrado Tamburino Discussant: Francesco Musumeci
THE ROLE OF TRANS ESOPHAGEAL ECHOCARDIOGRAPHY IN ENDOVASCULAR TREATMENT OF THE THORACIC AORTA	Madhav Swaminathan Discussant: Giuseppe Crescenzi
PERIOPERATIVE ANESTHESIOLOGICAL CHALLENGES OF THE UNFIT PATIENT "IDEAL CANDIDATE" OF TRANSFEMORAL AORTIC VALVE IMPLANTATION	Remo Daniel Covello Discussant: Luigi Tritapepe
ENDOVASCULAR TREATMENT OF TYPE B DISSECTION. GOALS, OUTCOMES, DISEASE SPECIFIC DEVICES	Germano Melissano Discussant: Giovanni Lorenzi
LEFT SUBCLAVIAN ARTERY AND CELIAC TRUNK SALVAGE BY STENT-GRAFT BRANCHING OR FENESTRATION: IS IT WORTH IT?	Timothy Resch Discussant: Massimo Porcellini
REDO ENDOVASCULAR TREATMENT (RELINING) AFTER FAILED SURGICAL OR ENDOVASCULAR AORTIC PROCEDURE	Armando C. Lobato Discussant: Stefano Bonardelli
TREATMENT OF ENDOLEAKS AFTER EVAR	Wei Zhou Discussant: Francesco Speziale

SELF EXPANDABLE TRANS-CATHETER AORTIC VALVE IMPLANTATION



Corrado Tamburino
Università degli Studi di Catania - Italy

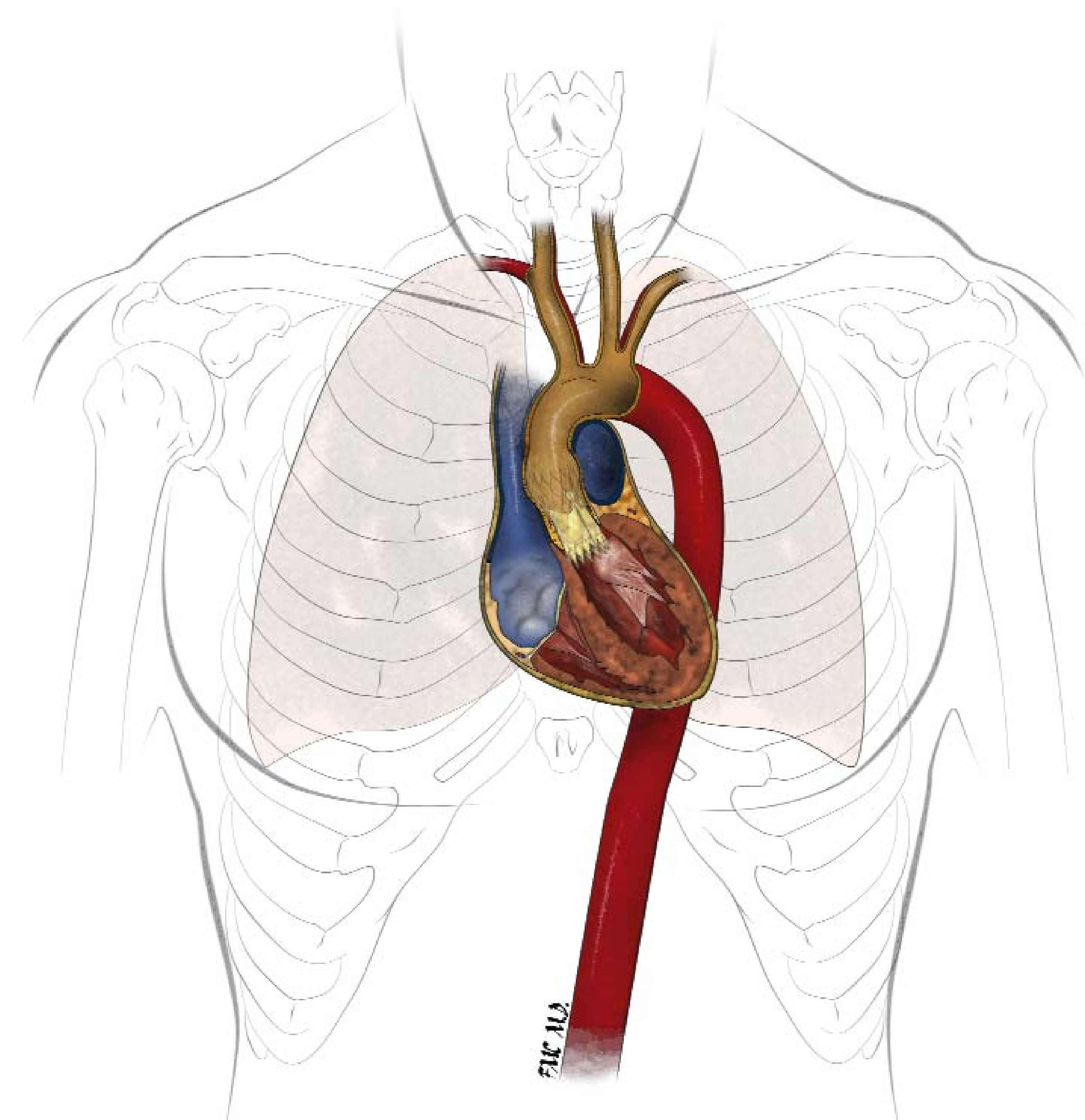
Background: Degenerative aortic stenosis (AS) is the most common valvular heart disease in the elderly. Surgical aortic valve replacement (AVR) is a time-honoured technique which has produced excellent results in many patients over the last forty years. In spite of all that, a recent survey, which investigated the adherence to the current guidelines on the management of severe AS, showed that more than 30% of patients directed towards surgical AVR did not undergo intervention due the age and the co-morbid conditions. On the basis of that, in the last three years percutaneous aortic valve replacement (PAVR) claims everyone's attention as a safe and effective alternative technique to surgery for the treatment of severe AS in patients felt to be unsuitable for surgical management due to high procedural risk.

Device description: Two PAVR systems are currently in advanced stage of clinical evaluation: the balloon-expandable Cribier-Edwards aortic valve and the third 18-Fr generation of self-expandable CoreValve™ prosthesis (CoreValve Inc., Irvine, California). Since the first implantation in 2005, self-expandable CoreValve™ prosthesis has shown excellent results in terms of device reliability and incidence of procedural complications. The prosthesis (currently in commerce in two sizes of 26 and 29 mm) consists in a frame and a biological valve: The self-expanding frame is a three device frame made from laser cut Nitinol tubing. Each level completes a particular function: The upper part (aortic level) of the frame increases the prosthesis fixation to the aorta wall and axes the system parallel to the blood flow; the middle part (commissural level) carries the valve and the convex shape of this level is opposed to the concavity of the coronary sinus to preserve their natural hemodynamic flow; the lower part (annulus level) anchors firmly the prosthesis to the aortic annulus preventing any migration and paravalvular leaks by creating a high radial force.

Procedure: The procedure is performed under fluoroscopic and angiographic guidance, in local anesthesia and mild sedation. Is possible to perform the procedure also in total anesthesia and with the aid of the transesophageal guidance. A temporary pace-maker (PM) is placed in right ventricle through the left femoral vein; an 18-F introducer is inserted, after the placement of vascular suture-mediated system (Prostar® XL 10-F Abbott), in a femoral artery, a pig-tail catheter is positioned in ascending aorta through the controlateral femoral artery. After heparin 5000 IU i.v., aortic valvuloplasty is performed under rapid ventricular pacing (180 bpm) to enlarge the aortic orifice before prosthesis placement; then the self-expandable prosthesis is positioned across the native valve and deployed. Once the final release is obtained, an aortography is performed to assess the good functionality and the competence of the biological valve. The arterial accesses are closed with percutaneous suture systems, the PM catheter left for 48 hours. In the post procedure period vital parameters, haemoglobin, renal function, cardiac rhythm need to be monitored for at least 5 days.

Institutional experience: We performed PAVR successfully in 22 patients: 13 female, mean age 80±5 y.o., NYHA class 2.8±0.6; 6 patients had prior coronary artery by-pass; 11 patients had porcelain aorta; 10 underwent previous percutaneous coronary angioplasty. The logistic EuroScore was 24.7±7%. 18-Fr Self-expandable CoreValve™ prosthesis was implanted in all patients; procedure time was 65±17 minutes, fluoroscopy time 14±4 minutes. The valve used was the 26 mm in 17 patients, and the 29 mm in the others. The peak-to-peak aortic gradient decreased from 65±22 mmHg to 3±4 mmHg (p<0,001). The neo-aortic valve was competent in all; 12 patients had mild paravalvular leaks; in one patient a second prosthesis was implanted for high position of the first one; 1 had late cardiac tamponade caused by PM temporary wire, treated with pericardiocentesis and 1 had a transient ischemic cerebral episode after the procedure. 5 patients received permanent pacemaker for third degree atrio-ventricular block. In-hospital stay was 9.2±4.5 days. There was one death after 21 days for emorragic stroke and one cerebral ischemia at 27 days. The mean follow-up is 5±4 months (1-12), 20 patients are in NYHA class 1,5±0.5 with good prosthetic valve function.

Conclusion: Currently surgical AVR remains the gold standard technique for patients with a mild-to-moderate surgical risk, but percutaneous aortic replacement with the Revalving™ self-expanding prosthesis is feasible and provides immediate hemodynamics and clinical improvement in patients at high risk for surgical intervention. Questions remain mainly concerning safety and long-term durability, which have to be assessed.



THE ROLE OF TRANS ESOPHAGEAL ECHOCARDIOGRAPHY IN ENDOVASCULAR TREATMENT OF THE THORACIC AORTA

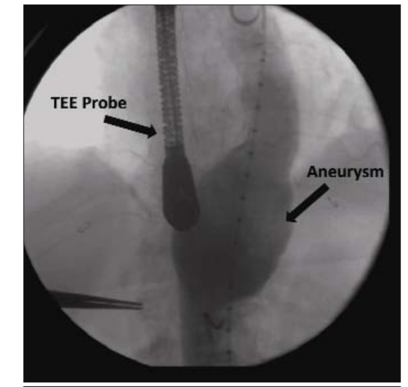
Madhav Swaminathan
Duke University Medical Center, Durham - NC - USA

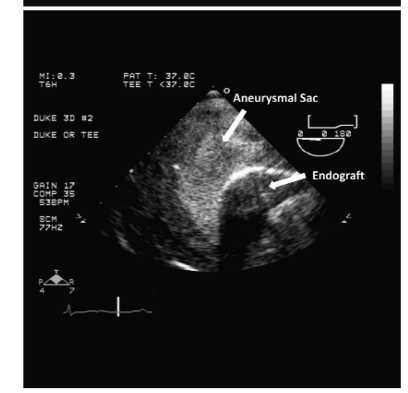
Endovascular repair of the aorta (EVAR) has steadily gained popularity as a reliable alternative to conventional surgical repair of thoracic aortic aneurysms (TAA). Endograft repair of the thoracic aorta can also be associated with significant perioperative morbidity, including endoleaks and paraplegia. The success of EVAR is critically dependent on demonstration of satisfactory graft deployment by various imaging modalities. The proximity of the esophagus to the thoracic aorta makes transesophageal echocardiography (TEE) a valuable imaging tool for aortic diseases.

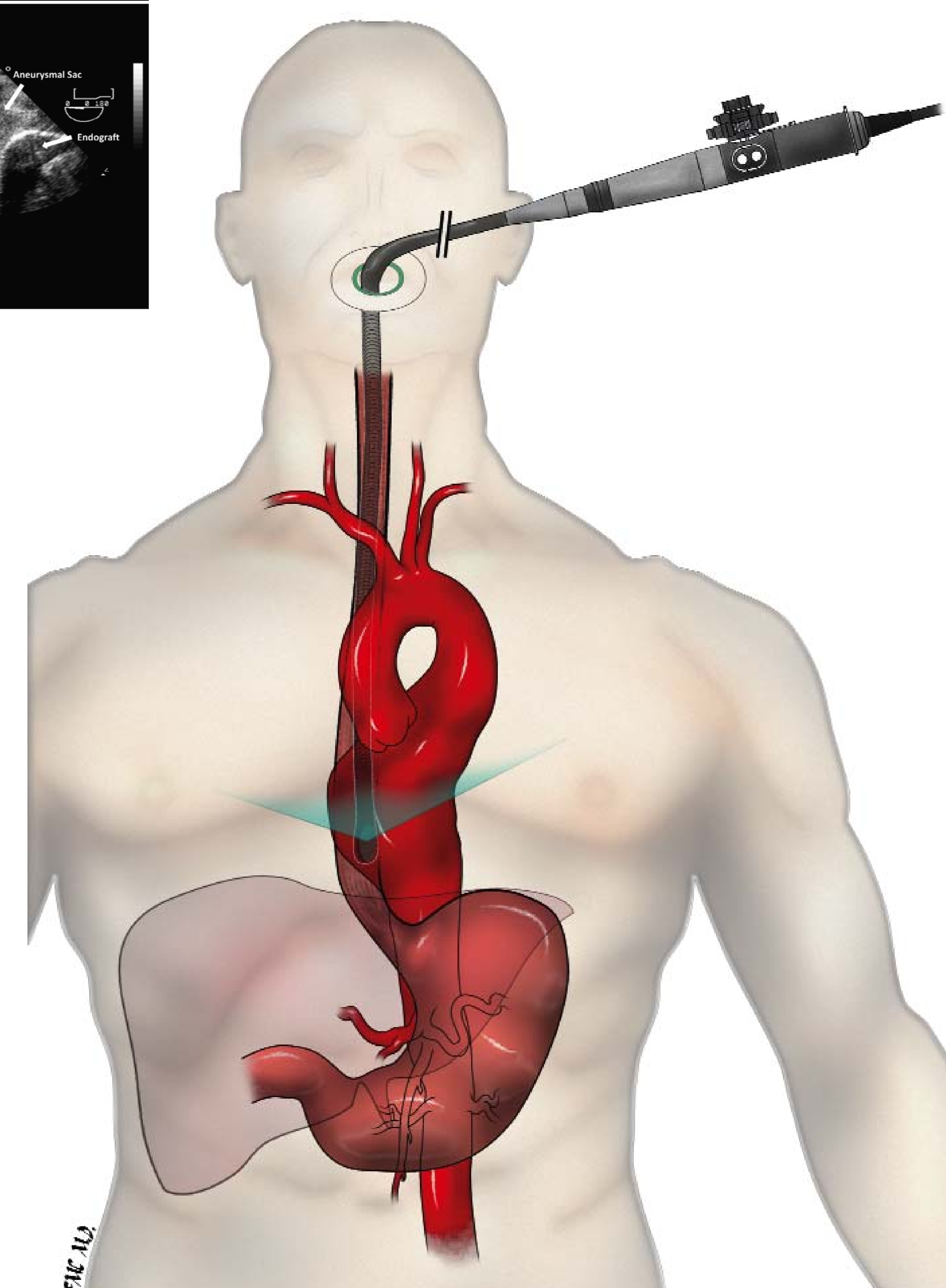
The timely detection of endoleaks may be one of the most valuable features of TEE, especially during EVAR. Color flow Doppler (CFD) is a sensitive technique for assessment of blood flow in any area. Even small endoleaks may be identified by CFD. In many instances, it may be possible to detect an endoleak with TEE that angiography has not be able to confirm. The disadvantage of angiography is that it relies on a fixed volume of radio-opaque contrast to circulate within the endoleak. Therefore, small leaks may escape detection because the volume of contrast within the leak may not be detectable by fluoroscopy or the imaging angle may not be accurate enough to detect the leak. TEE has been shown to be more sensitive than angiography in detecting endoleaks after endovascular TAA repairs. Endoleak may also be indicated by the development of spontaneous echo contrast, or 'smoke' within the aneurysmal sac after deployment of the endograft. The sudden development of 'smoke' in an aneurysmal sac should alert the echocardiographer to the possibility of an endoleak. A distinction should be made between swirling echo contrast in an aneurysmal sac and static smoke. Contrast that swirls around the sac may indicate an endoleak, while static contrast implies no movement or flow within the sac, suggesting the absence of any endoleak. Type 2 endoleaks (branch vessel flow) are less common, but may also be detected by intraoperative TEE.

However, TEE also has certain disadvantages. When the aorta is tortuous along its length, imaging may be difficult and interpretation inaccurate since the aorta may disappear from view at crucial locations. The introduction of endograft into the aorta may make imaging of the aneurysm difficult due to the high echodensity of the graft material. The ultrasound 'dropout' due to the echodensity may not permit CFD evaluation and detection of endoleak may therefore be difficult.

Transesophageal echocardiography is an ideal imaging tool for the thoracic and upper abdominal aorta and can supplement angiography in guiding placement of the endograft. The principal advantage of TEE is that it enables the echocardiographer to identify aortic pathology, detect endoleaks and monitor cardiac performance with a single imaging tool. Indications of EVAR are expanding to include complex aortic diseases. The future appears to be brighter for patients with severe thoracic aortic disease who would otherwise have been poor candidates for open repair.







PERIOPERATIVE ANESTHESIOLOGICAL CHALLENGES OF THE UNFIT PATIENT "IDEAL CANDIDATE" OF TRANSFEMORAL AORTIC VALVE IMPLANTATION

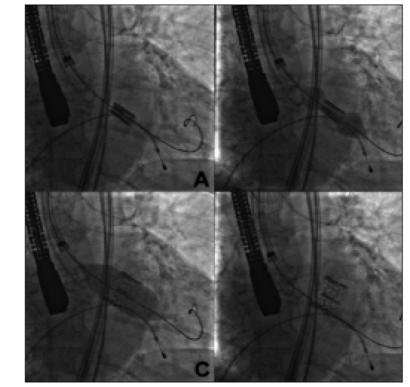
Remo Daniel Covello
San Raffaele Scientific Institute, Milano - Italy

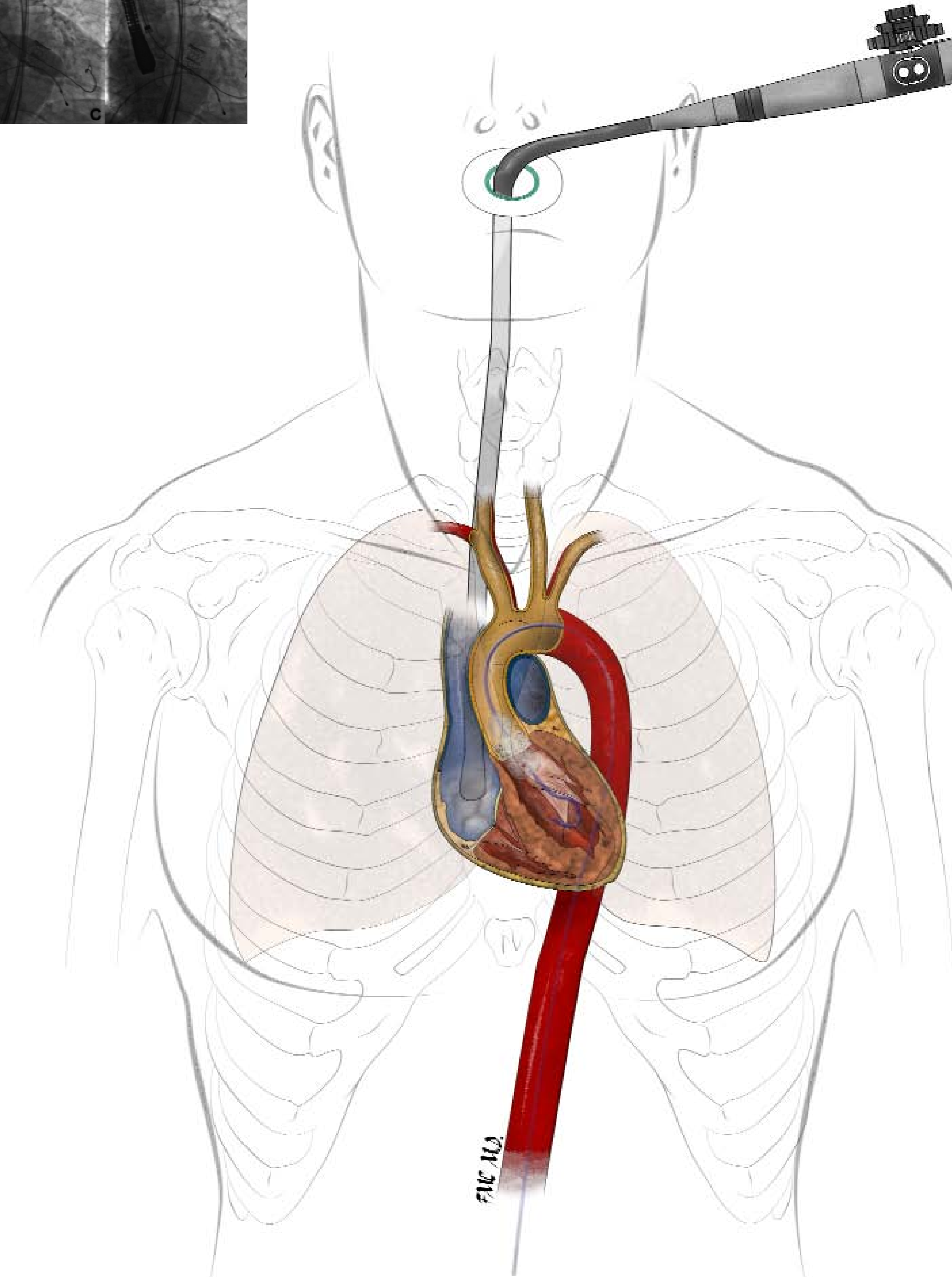
Rapid progress in interventional cardiology has recently seen the rate of percutaneous coronary intervention overtake that of coronary artery bypass surgery. Attention is now directed towards the treatment of valvular diseases, with exciting development in balloon and stent technology having the potential to transform the management of many common heart conditions.

Percutaneous aortic valve implantation is an emerging alternative to surgical replacement, at present reserved for inoperable patients with severe aortic stenosis. As this new procedure is on its way towards clinical practice, a multidisciplinary approach is required, and the "valve team" should include a cardiac surgeon, an interventional cardiologist and a cardiac anesthesiologist.

Anesthesiologists must be aware of current technology in order to take a participative role in risk stratification and patient selection, develop monitoring and standards of care for "off-site" anesthesia in the cardiac catheterization laboratory and plan postoperative management for the early phase of recovery from the procedure.

We present a focus on challenges encountered in the anesthesiological management of percutaneous aortic valve implantation and a proposal of solutions.





ENDOVASCULAR TREATMENT OF TYPE B DISSECTION. GOALS, OUTCOMES, DISEASE SPECIFIC DEVICES

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G. Melissano, L. Bertoglio, E. Civilini, A. Campos Moraes Amato, G. Crescenzi, Y. Tshomba, R. Chiesa

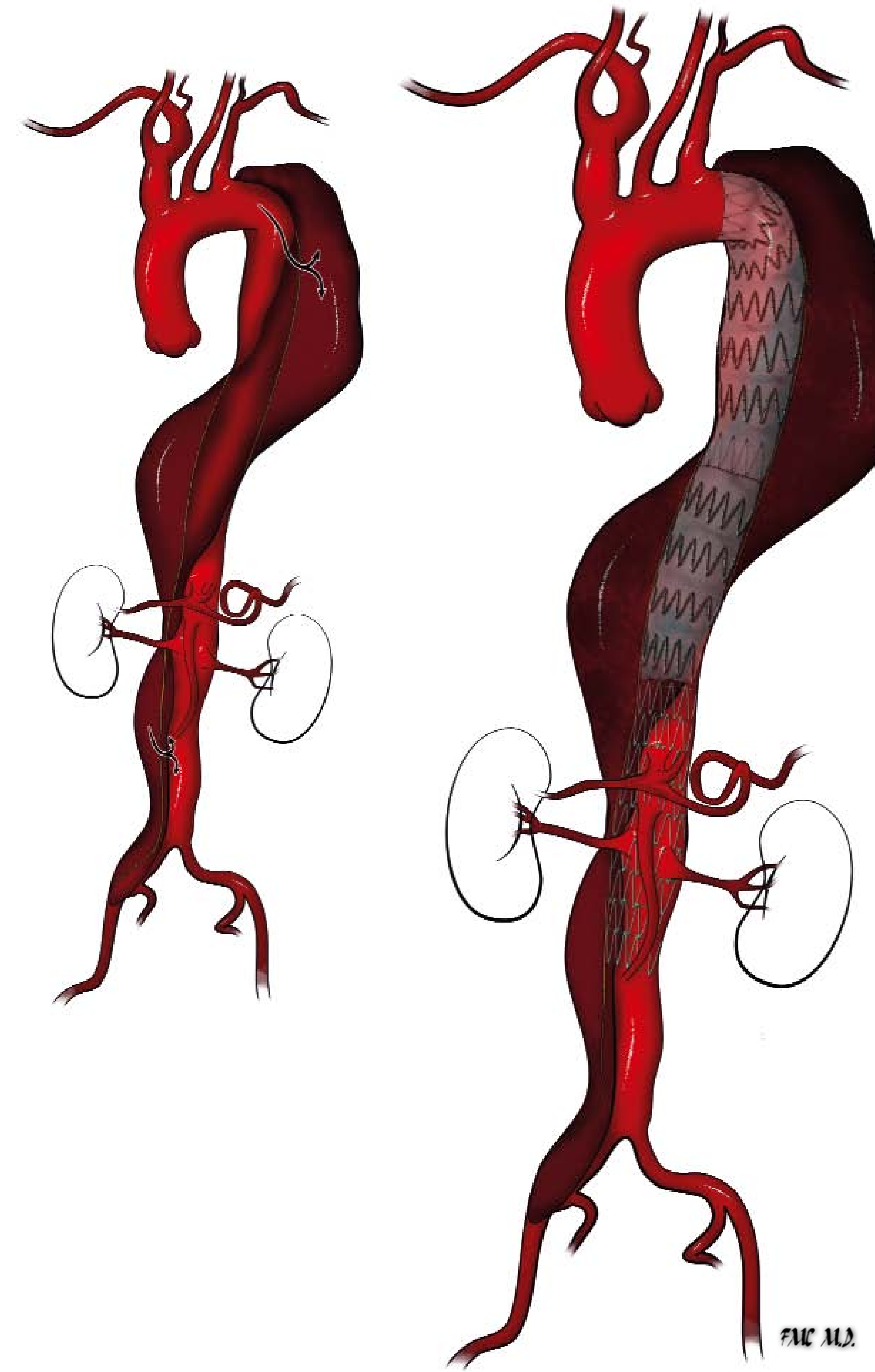
The objective of this study is to evaluate the feasibility and safety of a new endovascular device specifically designed for aortic dissection, that recently become available in Europe.

The Zenith® Dissection Endovascular System is a modular system that consists of a proximal component, the Zenith TX2-P® TAA Stent-Graft, and a distal component, the Zenith® Dissection Endovascular stent that employs a series of low radial force bare stents positioned in the aorta distal to the standard stent-graft that covers the primary tear.

From June 2005 to present, this device was employed in 17 cases (all men, median age of 64 yrs (range: 45 – 76) of type B aortic dissection with a compression or collapse of the true lumen. All procedures were performed under general anesthesia with TEE monitoring in all cases and cerebrospinal fluid drainage in 6 patients. One step open surgical supra-aortic vessels re-routing was performed in 7 cases to obtain an adequate proximal landing zone: six cases of left carotid-subclavian artery bypass and one case of right to left common carotid artery bypass and left subclavian to common carotid artery transposition. Clinical follow-up visit and CT scan were obtained at 1, 6 and 12 months, and yearly thereafter.

A secondary technical success was obtained in all cases (100%) and 30-day clinical success was achieved in 16 cases (94%). In one case a type IA entry flow was observed. No mortality was recorded. Occlusion of visceral/renal arteries, retrograde dissections or device-induced tears in the intimal lamellae was not observed. Peri-procedural morbidity included temporary renal failure in 1 case and post-implantation syndrome with fever and leukocytosis for 23 days in 1 case. No cases of paraplegia were recorded. At a median follow-up of 16 months (R. 2 – 37 months), we observed a clinical success rate of 94%. No migration of the device was observed. No late occlusion of visceral or renal arteries was recorded at follow-up.

Our peri-operative and short term follow-up results showed that the Zenith® Dissection Endovascular System for the treatment of aortic dissection can be safely used without affecting patency of the branches covered by the bare stent. These results need to be validated on a larger group of patients with a mid-term follow-up. An international multicenter trial is currently enrolling patient in Europe and US to evaluate the device in a subacute setting.



LEFT SUBCLAVIAN ARTERY AND CELIAC TRUNK SALVAGE BY STENT-GRAFT BRANCHING OR FENESTRATION: IS IT WORTH IT?

Timothy Resch
Vascular Center Malmö-Lund - Sweden
M. Malina, T. Resch, B. Sonesson

Most patients tolerate sacrifice of the left subclavian artery. The indications for preserving it include the presence of a dominant left vertebral artery, LIMA coronary bypass and a Lussoria aneurysm. Patients who require very long stent grafts or who have had previous aortic surgery are at particular risk for developing spinal ischemia and may benefit from collateral spinal perfusion via branches of the subclavian artery.

The left subclavian artery can readily be revascularized before or after implantation of an aortic stent graft by adding a carotidosubclavian bypass or transposition. It may, therefore, be argued that endovascular revascularization is not really necessary.

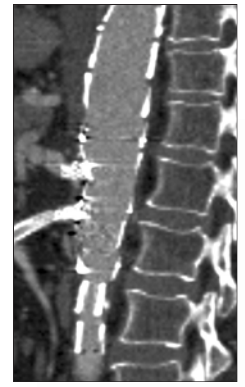
Branched or fenestrated thoracic stent grafts are, however, much needed to preserve the brachiocephalic trunk or left carotid artery during endovascular repair of more proximal aortic arch lesions. A technical failure in the arch is usually disastrous and the arch does not lend itself readily to the development of novel stent grafts. The left subclavian artery seems more suitable due to the fact that a potential failure is rarely lethal.
Several strategies are pursued in the development of endografts that preserve the subclavian artery:

- Fenestrations are simple to manufacture but difficult to implant with sufficient accuracy. Furthermore, the durability of a covered stent that passes through a thoracic fenestration is unproven.
- Cuffs, particularly "inner sleeves", improve the seal but accurate orientation remains difficult and some techniques require antegrade direction of the cuff and hence questionable flow haemodynamics.
- In situ fenestration does not require accurate positioning or customisation but durability of the seal is unknown.
- Chimney grafts are readily implanted with currently available devices, but there is concern that the branch may get compressed. "Gutters" alongside the chimney cause a proximal type I endoleak in some patients.
- Branches reaching all the way into the subclavian artery are notoriously difficult to insert and usually require complex indwelling catheters and "body-floss-wires". Such devices need to be custom made and may be prone to kinking.

The coeliac trunk can be sacrificed safely only in patients with a hepatic artery that originates from the SMA. Sacrificing the coeliac trunk is also tolerated by most other patients but lethal complications from hepatic or gastric ischemia have occurred. Unprovoked planned sacrifice of the coeliac trunk should, therefore, be avoided.
The technical aspects on creating a coeliac branch are somewhat different from the subclavian artery:

- Retrograde approach to the vessel as well as open bypass are less readily achieved.
- The diaphragmal crura and coeliac tortuousity offer significant mechanical challenge to any type of covered stent. The risk for material fatigue and stent collapse is obvious.
- Branches that are directed caudally can be achieved from a brachial approach.
- Accidental obliteration of the vessel is asymptomatic in most patients.

In conclusion: Preservation of the left subclavian artery and the coeliac trunk may not be required in most patients but represent important steps in the technical development of advanced stent grafts and are necessary in some cases.



REDO ENDOVASCULAR TREATMENT (RELINING) AFTER FAILED SURGICAL OR ENDOVASCULAR AORTIC PROCEDURE

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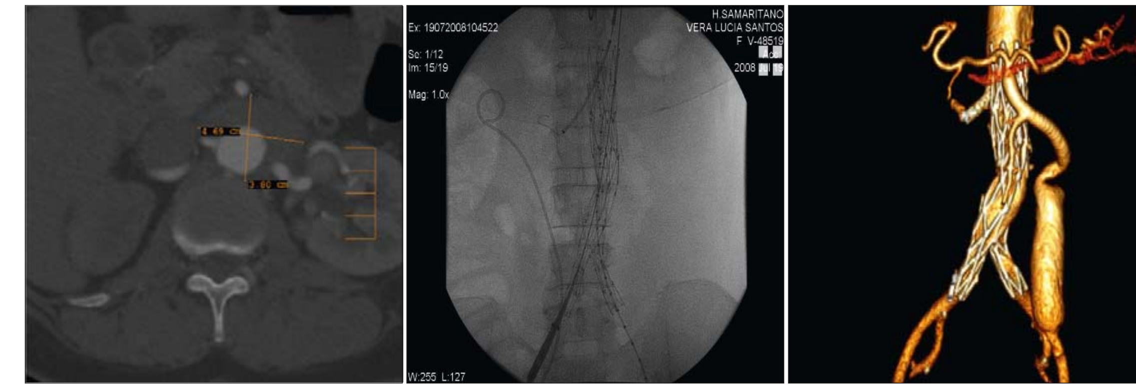
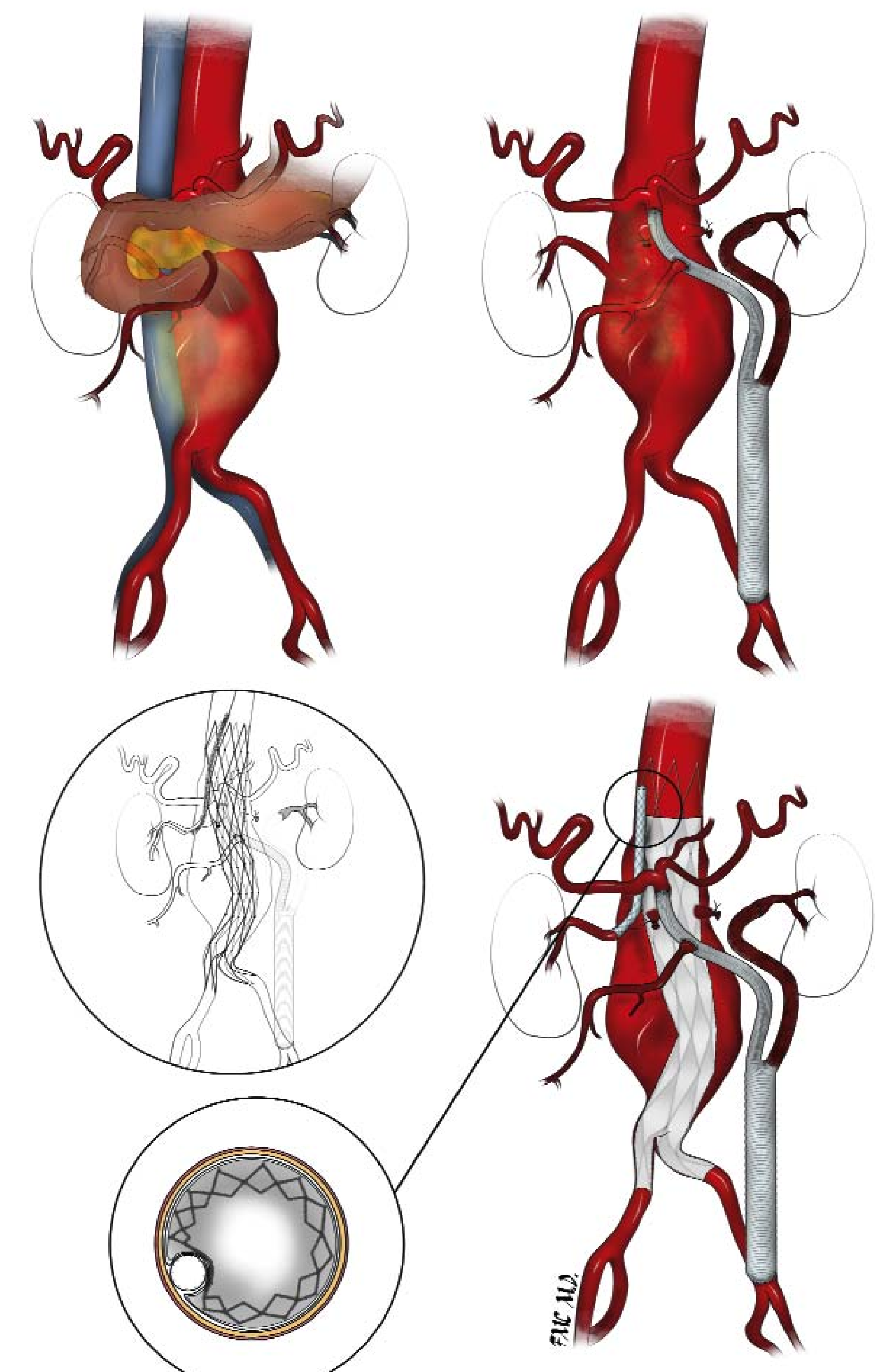
Introduction: Endovascular aneurysm repair (EVAR) and thoracic endovascular aortic repair (TEVAR) have had a great impact on the treatment of abdominal as well as thoracic aortic aneurysms (AAA/TAA). The introduction of the side-branched stent-graft has made it possible to offer endovascular treatment to patients with thoracoabdominal aneurysms without proximal and/or distal sealing zones. Side-branched stent-grafts, however, are costly and time-consuming to manufacture, which limits their applicability, especially in the emergency setting. The chimney graft (CG) technique can be used to restore the flow in aortic branches accidentally or intentionally covered during EVAR or TEVAR, in patients with juxtarenal AAAs and in some urgent cases of thoracoabdominal aortic aneurysms when off-label devices need to be employed.

Technique: The CG is a covered stent placed parallel to the aortic stent-graft to preserve flow to a vital aortic branch that was overstented in order to achieve adequate seal. Covered stents are usually used to minimize the risk of endoleak. The technique has already been used in the renal arteries, superior mesenteric artery (SMA), left subclavian artery (LSA), left common carotid artery (CCA), and innominate artery (IA).

Case Report: A 59 years old female complaining of continuous severe back pain had a 58 mm type IV thoracoabdominal aortic aneurysm (TAA) diagnosed on a CT scan. She was submitted to a laparotomy as an attempt to perform an open repair of the TAA. This was of the inflammatory type and involved also the inferior vena cava, duodenum and right renal artery making it impossible to repair it completely with this approach. During the open surgery the debranching of the celiac trunk, SMA and left renal artery was undertaken leaving behind only the right renal artery for posterior (after 7 days) occlusion with a bifurcated stent-graft. A post operative (PO) Angio CT scan demonstrated left renal artery bypass occlusion making it absolutely imperative to revascularize the right renal artery. A CG was planned to preserve the only renal artery with blood flow as it would be covered by the aortic stent-graft. The right renal artery was cannulated in an antegrade fashion with a Terumo wire from a left brachial approach. This wire was exchanged for an Amplatz Super Stiff (Boston Scientific), over an 11cm 8F sheath (Cordis). Afterwards, the self-expandable covered stent (Fluency, Bard) was inserted into the right renal artery. The Powerlink stent-graft (Endologix) was then released, and the covered stent Fluency (Bard) was deployed in the right renal artery as a CG. Accomplished angiogram showed complete exclusion of the aneurysm sac and patency of the right renal artery. A 2 months PO Angio CT scan showed no endoleak and patent right renal artery.

Conclusion: The use of chimney grafts is feasible in the renal artery and can facilitate stent-graft repair of thoracoabdominal aortic aneurysms.





TREATMENT OF ENDOLEAKS AFTER EVAR

Wei Zhou
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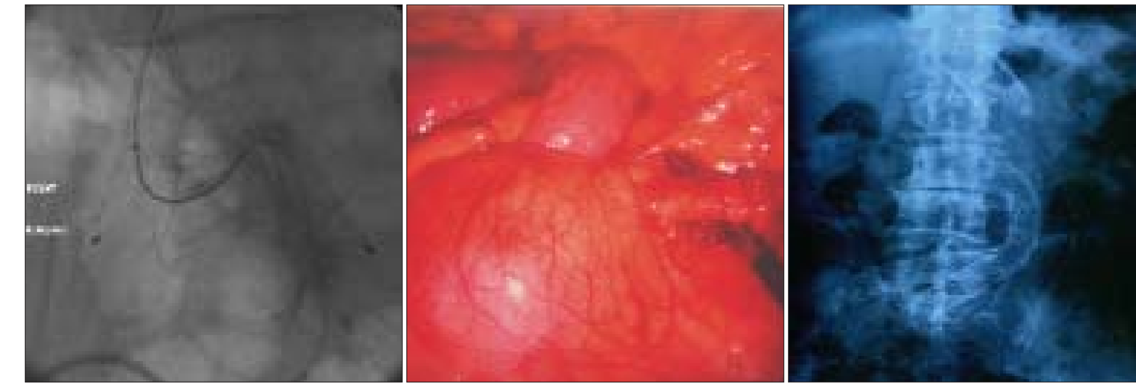
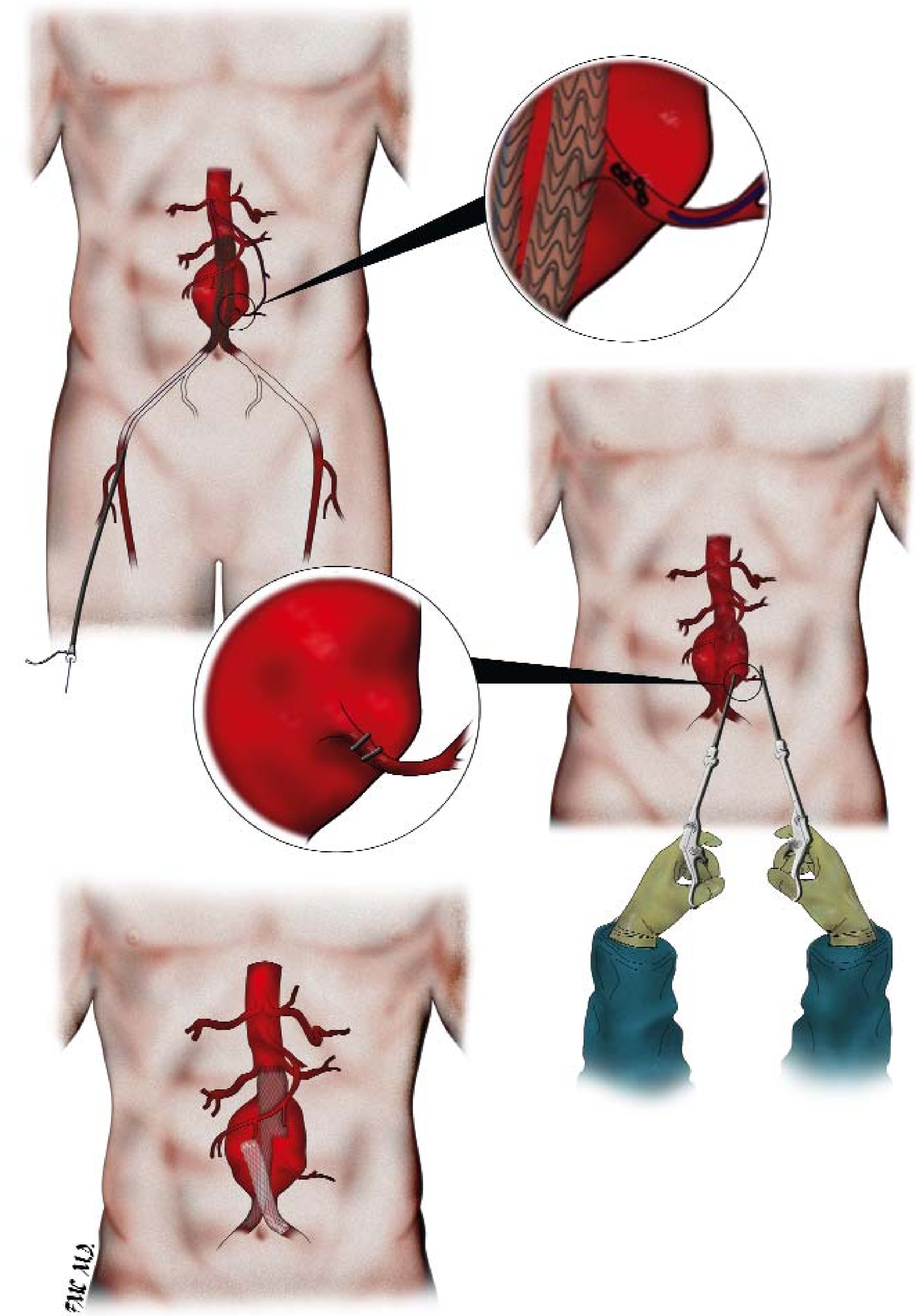
Introduction: Since its inception, endovascular intervention has evolved into a valid alternative in treating patients with abdominal aortic aneurysms. However, endoleak, a novel complication associated with EVAR, can potentially lead to an aneurysm expansion and subsequent rupture. Treatment indications, management strategies, and interventional techniques for endoleaks will be discussed.

Methods and Results: Clinical records of 452 patients who underwent EVAR from 11/2000 through 12/2007 at two affiliated institutions of Stanford University were retrospectively reviewed. Patients with documented endoleaks on follow-up CT scans were evaluated, particularly those who received secondary interventions. Among the most recent 220 patients, thirteen (7.8%) patients received treatments for endoleaks that were associated with aneurysm expansion including three patients required multiple interventions. Various management approaches and interventional techniques were used. Among them, type I endoleaks (n=5) were aggressive treated with stentgraft extension placement, aortouniliac stentgraft conversion, external surgical wrap of aortic neck, or open surgical conversion with graft explantation. Conversely, type II endoleaks were routinely managed conservatively except in patients with aneurysm expansion. The commonly employed techniques included coil embolization of IMA or lumbar arteries through SMA or hypogastric branches respectively, tranlumbar embolization through direct sac puncture, and laparoscopic ligation of IMA. Type III and Type IV endoleaks were rare. Type III enleaks were treated with additional stentgraft and type IV with re-lining, while surgical conversion was limited to patients who failed secondary endovascular interventions or those who were not candidate for endovascular management. Despite initial technical success rate of 92.3%, two patients developed recurrent endoleaks on follow-up CT scans with sac enlargement. One patient required open surgical intervention six months after failed endovascular approach.

Conclusion: Endoleak is not a benign complication of EVAR and has increased incidence in patients with marginal anatomy for EVAR. Various surgical and percutaneous techniques are complimentary of each other in treating endoleaks. Proficiency in both open and endovascular techniques and understanding the nature of this complication are essential to provide optimal care for patients with post-EVAR endoleaks. Importantly, long-term follow-up is mandatory.





’08

SCIENTIFIC ABSTRACTS

OPEN SURGERY I

Chairmen: Luciano Gattinoni, Claudio Muneretto, Carlo Setacci

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AORTIC VALVE SPARING PROCEDURES AND AORTIC VALVE REPAIR	H. Joachim Schäfers Discussant: Alessandro Castiglioni
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EPIDURAL ANALGESIA AND OUTCOME IN CARDIAC SURGERY	Jane C. Ballantyne Discussant: Erminio Sisillo
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ASSESSMENT OF THE AORTIC VALVE FOR REPAIR

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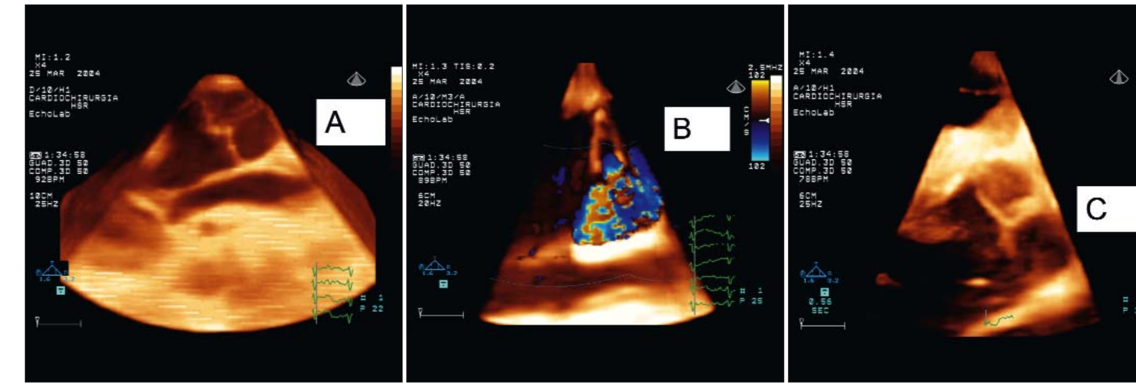
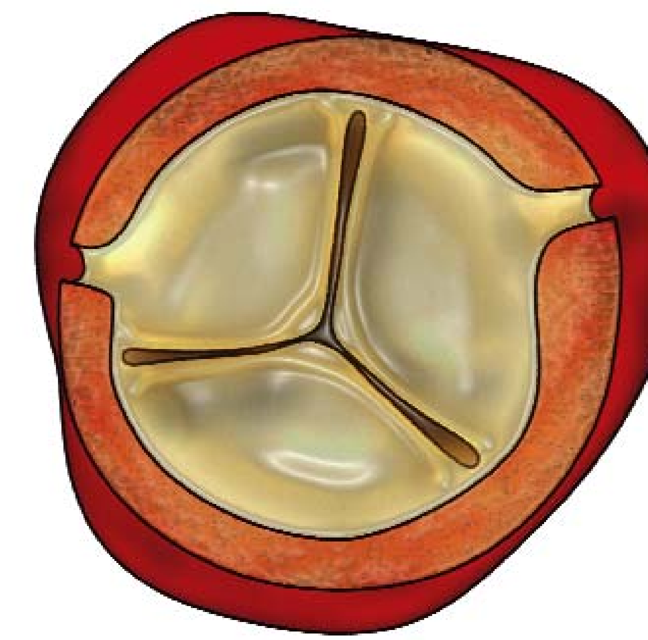
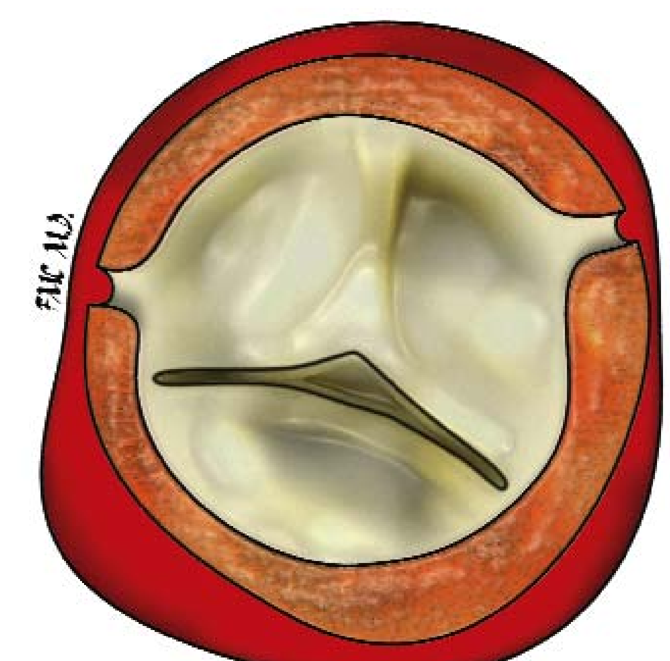
San Raffaele Scientific Institute, Milano - Italy



Aortic valve repair (AVRep) is an attractive procedure to attempt the correction of valve regurgitation (AR) therefore avoiding prosthesis replacement. However, the uncertainties regarding evaluation of the AR mechanism at arrested heart and limited surgical strategy due to a scarcity of valve tissue makes surgeons reluctant to perform AVRep. Intraoperative Doppler Echocardiography using the Transesophageal and Epicardial approaches provides useful information on the functional anatomy, severity and site mapping of AR in order to plan the surgical strategy of AVRep.

To assess AR suitability for repair, Doppler Echocardiography should depict the valve morphology (number and tissue characterization of valve leaflets), mechanism(s) (restricted motion, prolapse, functional tethering of the leaflets), site (interleaflet, commissural, intraleaflet), direction (central, eccentric) and severity of AR. In addition, Doppler Echocardiography permits the intraoperative evaluation of AVRep efficacy before closure of the chest, thus overcoming the unreliable check at arrested heart. Recently, the introduction of 3D reconstruction has enhanced the use of echocardiographic imaging for aortic valve assessment. According to echocardiographic findings we can differentiate the optimal anatomy for repair (monoleaflet prolapse of bicuspid valve, anulus/sino-tubular junction mismatch, commissural unrestricted lesions, leaflet perforation) from the valve lesion at risk of suboptimal or unsuccessful repair (fibrotic-calcific leaflet retraction, combined lesions, multileaflet prolapse, quadricuspid valve).





AORTIC VALVE SPARING PROCEDURES AND AORTIC VALVE REPAIR

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H. J. Schäfers, D. Aicher

Background: Surgery involving the aortic valve is commonly required either for aortic diseases or aortic valve regurgitation. Preservation and/or reconstruction of the native valve avoids the disadvantages of implantation of a heart valve prosthesis.

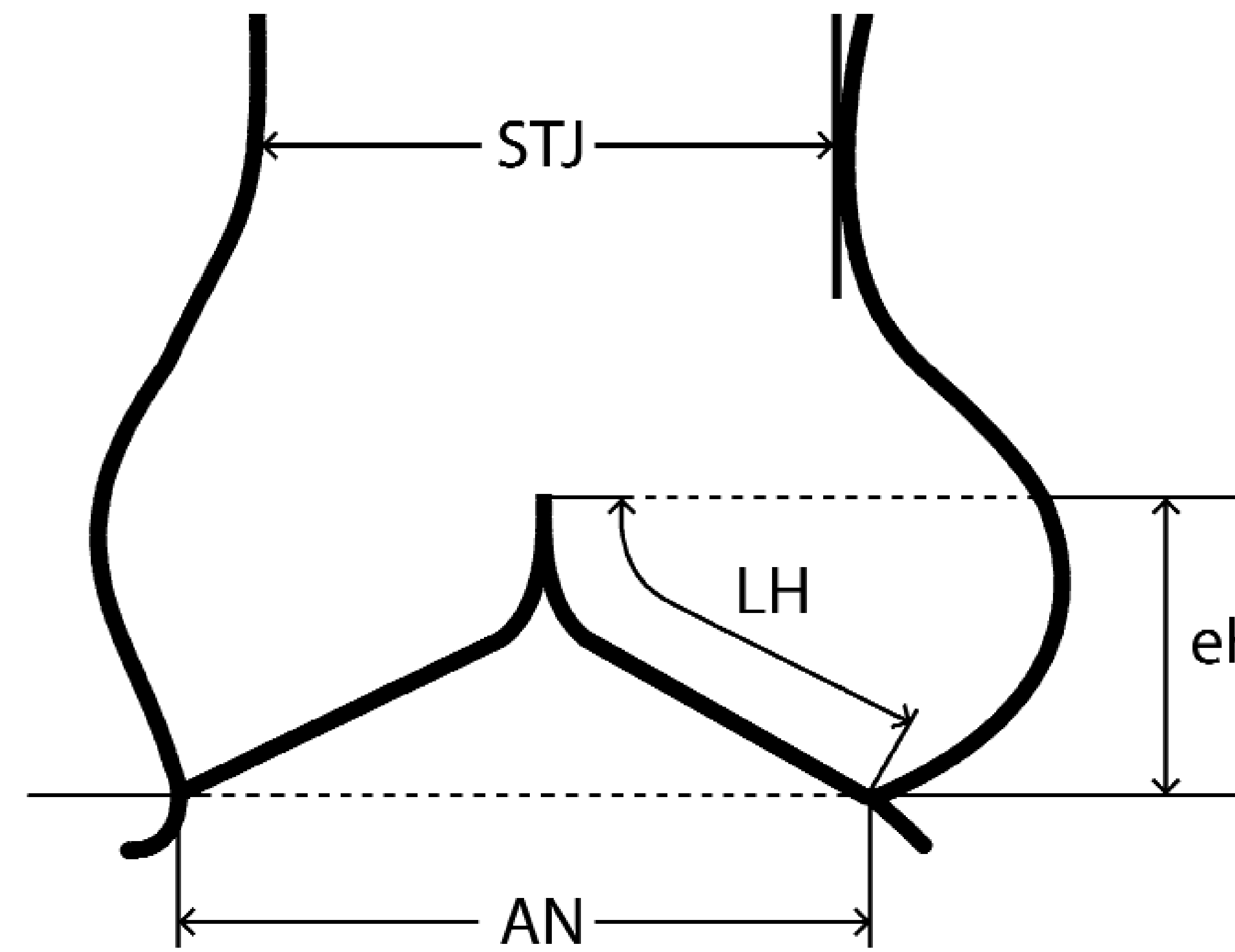
Methods: Between 10/97 and 3/08, 826 patients were treated by preservation or reconstruction of the native aortic valve. Aortic aneurysm was present in 536, acute dissection in 66 individuals. The mean preoperative degree of aortic regurgitation was 2.5±0.8.

The primary aortic valve/root procedure was root remodeling (Remod: n=350), aortic valve reimplantation (Reimp: n=29), separate aortic replacement and valve repair (AscRep: n=164), or aortic valve reconstruction (Rep: n=283). Concomitant procedures were CABG (n=159), aortic arch replacement (partial 180, total 39), mitral repair (n=75), and other procedures (72).

Results: Hospital mortality was 3.4% after remodelling, 3.7% after valve repair and aortic replacement, and 1.8% after aortic valve repair, all patients survived after valve reimplantation. 5 and year survival was good in all groups (87 – 100%; 10 yrs 77 – 89%).

Freedom from AI ≥ II did not differ markedly between the groups (Remod 89%, Reimp 84%, AscRep 94%, Rep 77%). Freedom from reoperation at 5 years was similar in all groups (89 – 96%), at 10 years Remod showed the best stability (95% vs. 85% or 78%). Many of the failing valves could be re-repaired, freedom from valve replacement at 5 years was > 92% and >85% at 10 years. Other valve-related complications were rare.

Conclusion: Preservation or reconstruction of the native aortic valve is feasible in a large proportion of patients with aortic disease or aortic valve regurgitation. The stability of these procedures is excellent for most of the patients, and the incidence of valve-related complications is low.



EPIDURAL ANALGESIA AND OUTCOME IN CARDIAC SURGERY

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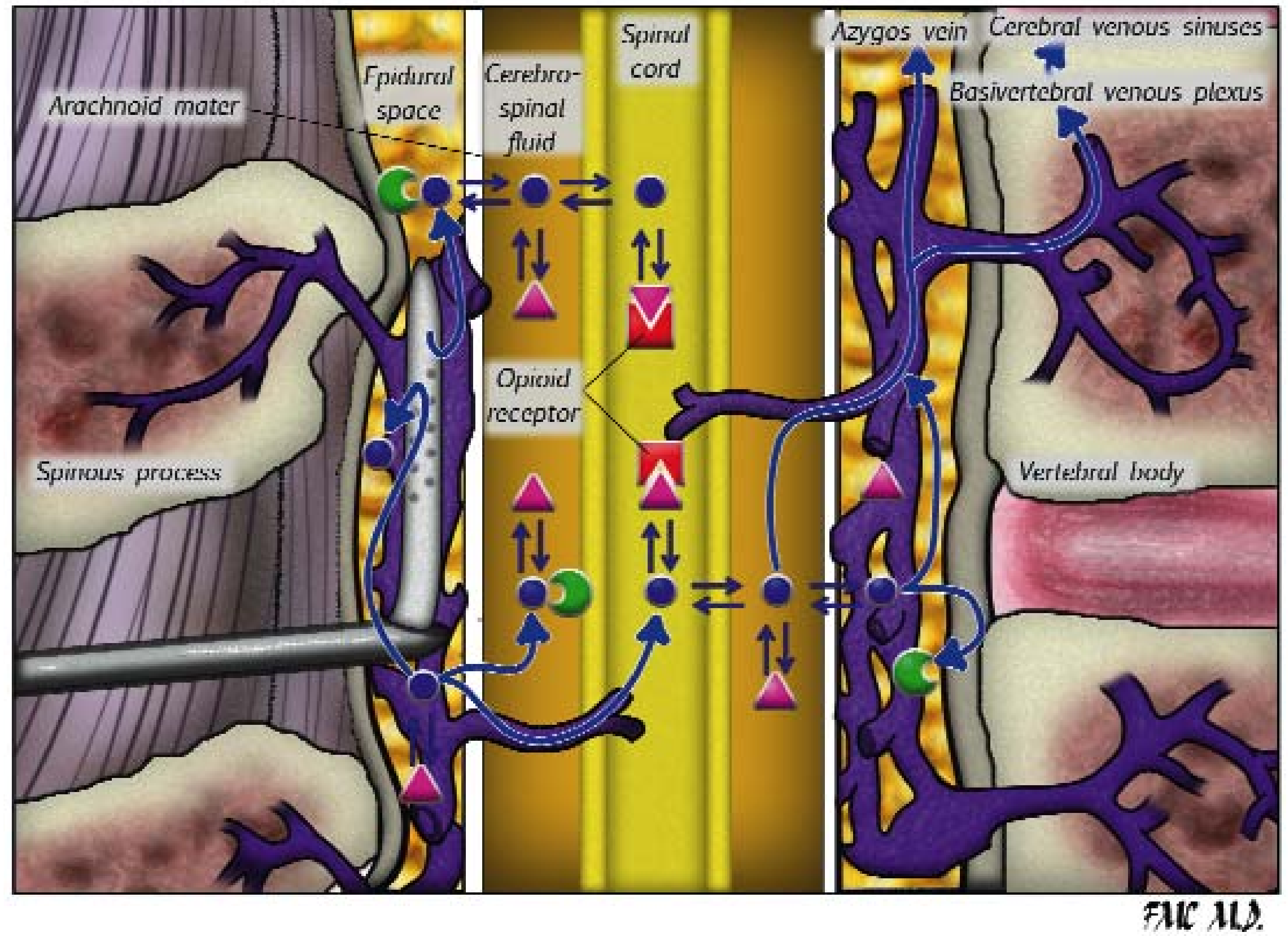
Background: Epidural analgesia offers greater pain relief compared to systemic opioid-based medications, but its effect on morbidity and mortality is unclear. We therefore undertook a systematic review of the available trials to assess evidence for benefit other than or secondary to the known superior pain relief.

Objectives: To assess the benefits and complications of postoperative epidural analgesia in comparison with postoperative systemic opioid-based pain relief for adult patients who underwent elective abdominal aortic surgery.

Data collection & analysis: We retrieved and analysed all available randomized controlled trials comparing postoperative epidural analgesia and postoperative systemic opioid-based analgesia for adult patients who underwent elective open abdominal aortic surgery. Two authors independently assessed trial quality and extracted data. We contacted study authors for additional information and data.

Main results: Thirteen studies involving 1224 patients met our inclusion criteria; 597 patients received epidural analgesia and 627 received systemic opioid analgesia. The epidural analgesia group showed significantly lower visual analogue scale for pain on movement (up to postoperative day three), regardless of the site of epidural catheter and epidural formulation. Postoperative duration of tracheal intubation and mechanical ventilation was significantly shorter by about 20% in the epidural analgesia group. The overall incidence of cardiovascular complication; myocardial infarction; acute respiratory failure (defined as an extended need for mechanical ventilation); gastrointestinal complication; and renal insufficiency was significantly lower in the epidural analgesia group, especially in trials that used thoracic epidural analgesia.

Conclusions: Epidural analgesia provides better pain relief (especially during movement) for up to three postoperative days. It reduces the duration of postoperative tracheal intubation by roughly 20%. The occurrence of prolonged postoperative mechanical ventilation, overall cardiac complication, myocardial infarction, gastric complication and renal complication was also reduced by epidural analgesia, especially thoracic. However, current evidence does not show an overall benefit on mortality.



AORTIC ARCH ANEURYSMS: OPEN SURGERY

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R. Di Bartolomeo, D. Pacini, L. Di Marco

During the last decade, surgery of the thoracic aorta has increased substantially because of a growing incidence of aortic pathologies, mainly due to more accurate diagnoses and, also because of a wider spectrum of surgical indications. Even if patient outcome has improved considerably, this surgery is still associated with significant morbidity and mortality especially due to neurological complications. Neurologic injuries are the most feared complications resulting from suspension of cerebral circulation. To prevent these complications, various methods have been widely used.

Antegrade selective cerebral perfusion (ASCP), as demonstrated by various authors [1-4], represents the best method of protection against brain ischemia during aortic arch surgery.

Since November 1996, we have been using Selective Cerebral Perfusion (SCP), as described by Kazui, with very encouraging results. This technique provides moderate hypothermia (26°C), which, at the same time, reduces the problems due to deep hypothermia and prevents ischemic injuries of the abdominal viscera and of the spinal cord.

ASCP has considerably prolonged the "safe time" of circulatory arrest allowing more complex and time-consuming aortic arch reconstruction.

In our experience we have seen that with this technique it is possible to treat also diffuse aneurysmal disease of the thoracic aorta (arch, ascending and descending aorta) using only an anterior approach (median sternotomy)[5]. Occasionally an additional left anterior thoracotomy at the fourth intercostal space may be necessary to improve the exposure in case of a particular thorax conformation; involvement of the aorta until the diaphragmatic iatus or in case of reoperation with firm pleuric adhesions.

During the last year we started with hybrid repair of the complex aortic pathologies involving the entire thoracic aorta with the aid of the ASCP. This technique is the most recent development of the classic elephant trunk technique, the "Frozen elephant trunk" technique[6,7], and it represents the combination of an endovascular with a conventional surgical treatment for an hybrid approach. The early results are very encouraging even if long term follow up is required[8].

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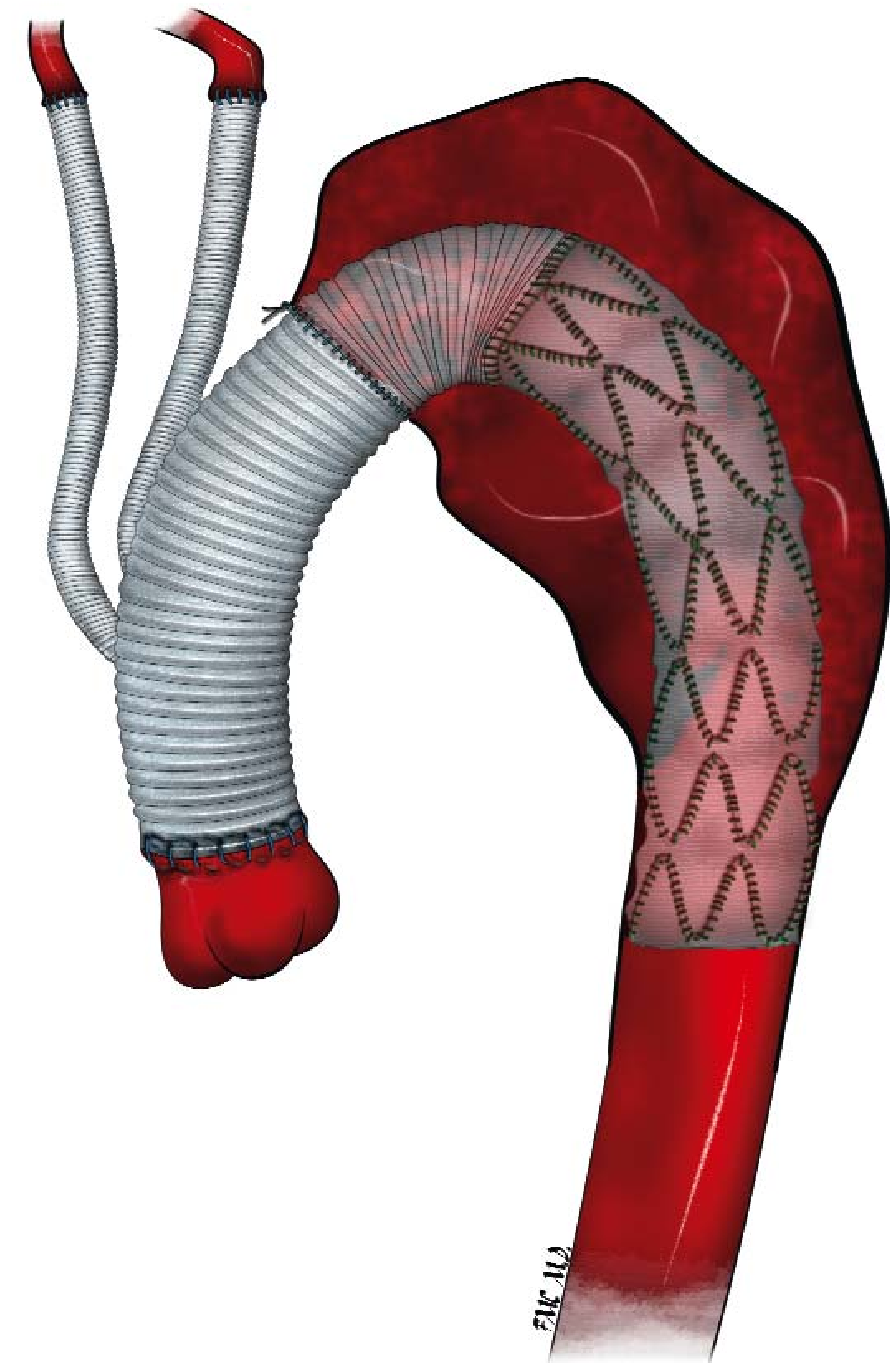

MINIMALLY INVASIVE ABDOMINAL AORTIC SURGERY (MINILAPAROTOMY AND LAPAROSCOPIC APPROACHES)

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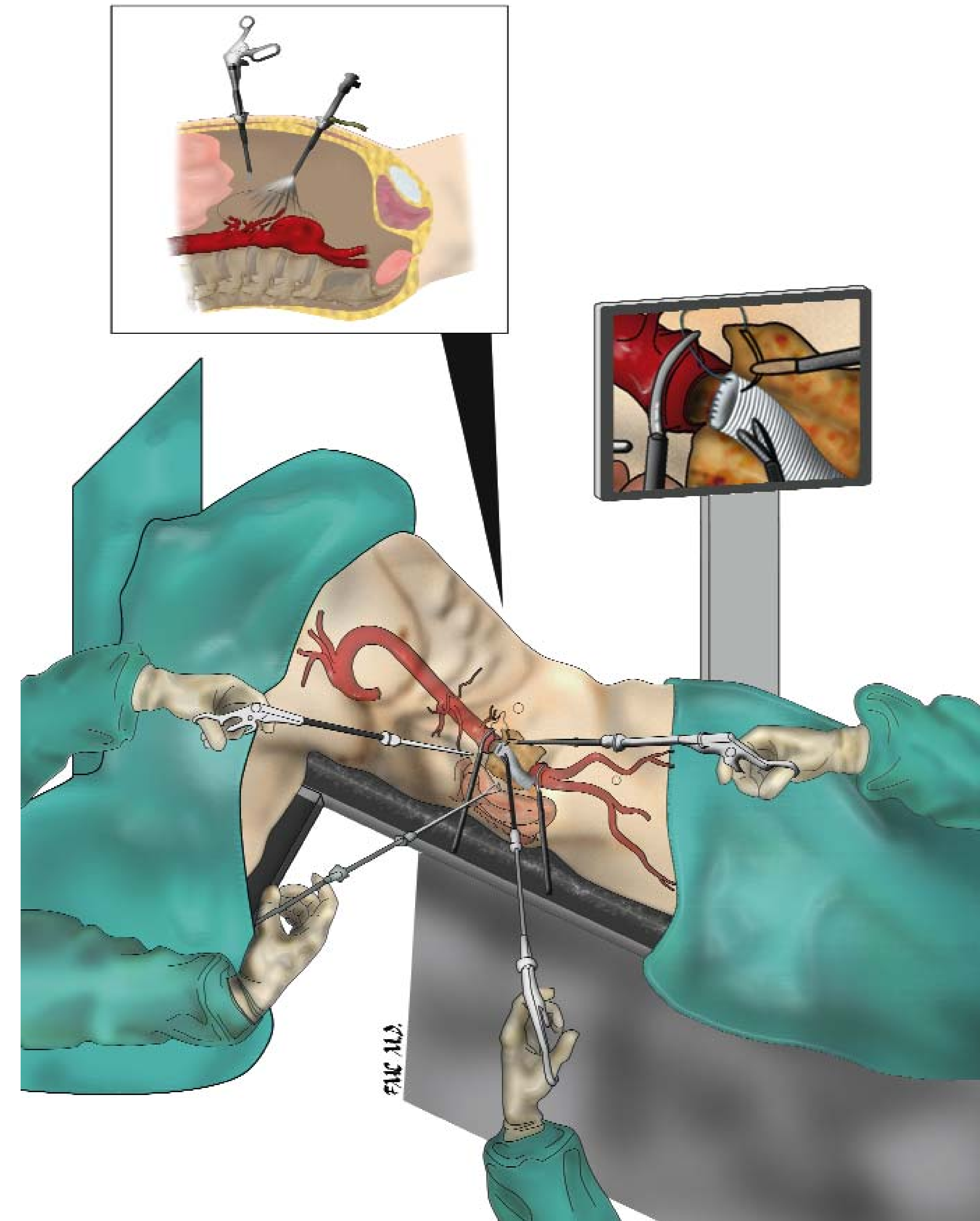
L. Chiche, F. Lefèbvre, J. Gaudric, S. El Batti, E. Kieffer

Adoption of minimal access surgical techniques by the general surgical community has not been paralleled in the vascular arena. Concerns regarding aortic exposure, control of hemorrhage and technical difficulties with vascular anastomoses have led to hesitant embraces of these methods. However, in experienced hands, many advantages of minilaparotomy and laparoscopic approaches, including reduced postoperative pain, early rehabilitation and reduced risk of abdominal dehiscence have been well established.

Since approximately 6 years, we decided to offer a totally laparoscopic approach of abdominal aortic diseases to more than 50 selected patients. Non-heavily calcified aortoiliac occlusive lesions were first treated, in order to get enough surgical skills regarding aortic exposure and intracorporeal anastomoses. Then juxtarenal aortic occlusions were treated, prior performing totally laparoscopic abdominal aortic aneurysms repair at the end of the learning curve-period. In all cases, we used a transperitoneal left retrocolic or more frequently left retrorenal laparoscopic approach in a patient placed in a dorsal decubitus position transformable into a quite lateral decubitus position. By this way, operative field remained free from intrusion of intra-abdominal organs, precluding the use of any specific visceral retractor. Side-to-end or end-to-end anastomoses were performed using Coggia's technique, with hemicirconferential running sutures previously knotted on Teflon pledgets. Operative and aortic clamping times were significantly reduced after the first step learning curve.

Encouraging perioperative results were observed and complications specifically related to the technique were quite solved with growing experience. Following-up the first treated patients confirmed our expectations regarding mid-term anatomical results. We now consider the totally laparoscopic approach as a safe and efficient alternative method to open abdominal aortic surgery for occlusive and aneurysmal diseases. Lessons learned from our initial experience, including specific tips and tricks of laparoscopic approach, will be presented at the meeting.



INFLAMMATORY AAA: PHYSIOPATHOLOGY AND THERAPEUTIC OPTIONS

Andrea Stella
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Inflammatory abdominal aortic aneurysms (IAAA) are a challenging problem for the vascular surgeon. Although there is much debate about the etiology of inflammatory AAAs and wheter they are a separate and distinct disease, recent immunohistologic data document a sprectum of inflammation even in routine AAAs. Inflammation in AAAs appears to be localized to the adventitia. The inciting event initiating the inflammatory response is unknown: however it appears to be a systemic response with elevated erytrocyte sedimentation rates (ESRs) and markers of chronic inflammation.

IAAAs is a well-defined clinical and pathologic entity with an incidence ranging from 2% to 18.1% of all cases of AAA. The triad of abdominal or back pain, weight loss and elevated erythrocyte sedimentation rate in a patient with AAA is highly suggestive of a IAAA. These variants of aneurysm have a predilection to occur in males with a mean age 5-10 years younger than the patients with atherosclerotic aneurysms. Macroscopically the lesion presents a whitish, thickened aortic wall (> 0.5 cm thick) adhering to adjacent tissues and organs (duodenum, sigmoid colon, ureters, inferior vena cava, left renal vein, left gonadal vein, small bowel, pancreas). Thickening of the vessel wall is caused by centrifugal development of a parietal fibro-inflammatory process whose etiology and mechanisms of onset remain unsettled (there is evidence for the role of genetic factors in the development of IAAA).

The abdominal CT scan is the most reliable radiographic study to detect aneurismal wall thickening, peri-aneurysmal soft tissue changes and entrapment of adjoining structures; the accuracy of high-resolution ultrasound is reported to be less than that of abdominal CT scan while the urography is of historical interest only. Magnetic resonance imaging may be preferred as it avoids ionizing radiations and is less nephrotoxic. Nuclear medicine techniques can delineate increased uptake in the inflammatory processes in the aortic wall and surrounding tissues and can monitor the activity in the follow up.

Thickening of the aortic wall does not seem to reduce the risk of aneurysm rupture so that surgery remains the treatment of choice. Surgical management of IAAA is technically difficult due to the presence of the parietal inflammatory process. The relations between the aorta and proximal structures are impaired, hampering isolation of the aneurysm and increasing the risk of iatrogenic damage to periaortic structures with a consequent rise in morbidity and mortality. Despite the technical difficulties associated with IAAA, data from the literature supports an operative approach to management whenever possible with modified operative techniques (limited dissection of the aneurysm wall, above renal arteries aortic clamp, left antero-lateral approach to the sac). Controversy exists regarding abdominal approach (trans-peritoneal or retro-peritoneal) and ureterolysis during repair of IAAA. We do trans-peritoneal route and rarely do ureterolysis. With these surgical approaches, the operative mortality-morbidity and late survival of IAAAs were comparable to the non-inflammatory AAA.

The post-operative evolution of the periaortic fibro-inflammatory process can be monitored with CT angiography. A review of the literature revealed that complete postoperative regression of periaortic fibrosis was observed in 23-84.5% of the IAAA studied, partial regression in 6.2%-66.7%, no regression in 0-38% and progression in 3.1-4% of the patients. The use of endovascular stent graft repair may negate the technical difficulties encountered with open repair. This technique can effectively exclude an aneurysm from the circulation and prevent the rupture. A number of case reports and series in the literature show good early results in terms of patient survival, early morbidity and aneurysm exclusion but infrequently longer-term regression of perianeurysmal fibrosis. Than open repair remains the treatment of choice of IAAA with entrapment of perianeurysmal structures.