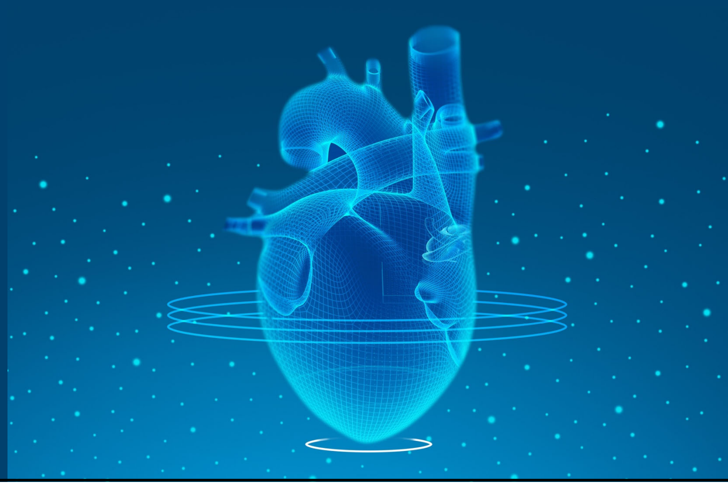
Minneapolis Heart Institute Foundation®

GRAND ROUNDS



1

INVENTIONS AND DISRUPTIVE INNOVATIONS IN VASCULAR SURGERY

Peter Gloviczki, MD, FACS

Roberts Emeritus Professor of Surgery and Chair,
Division of Vascular and Endovascular Surgery,
Director, Emeritus, Gonda Vascular Center,
Mayo Clinic, Rochester, MN,
Editor-In-Chief, Emeritus, Journal of Vascular Surgery

Minneapolis Heart Institute Foundation Cardiovascular Grand Rounds
March 9, 2026,
Minneapolis, MN

MAYO CLINIC

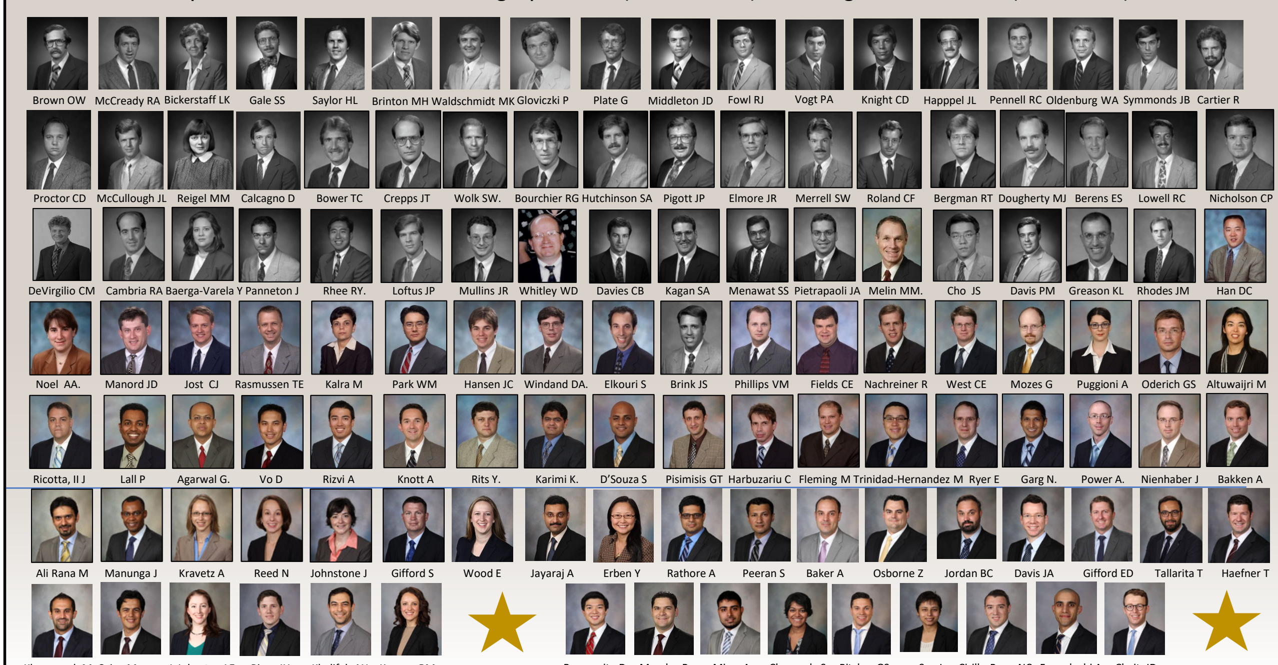
Minneapolis Heart Institute Foundation®

2

NO CONFLICT OF INTEREST

3

Mayo Clinic Rochester Vascular Surgery Fellows (1980 – 2020) and Integrated Residents (2012-2020)



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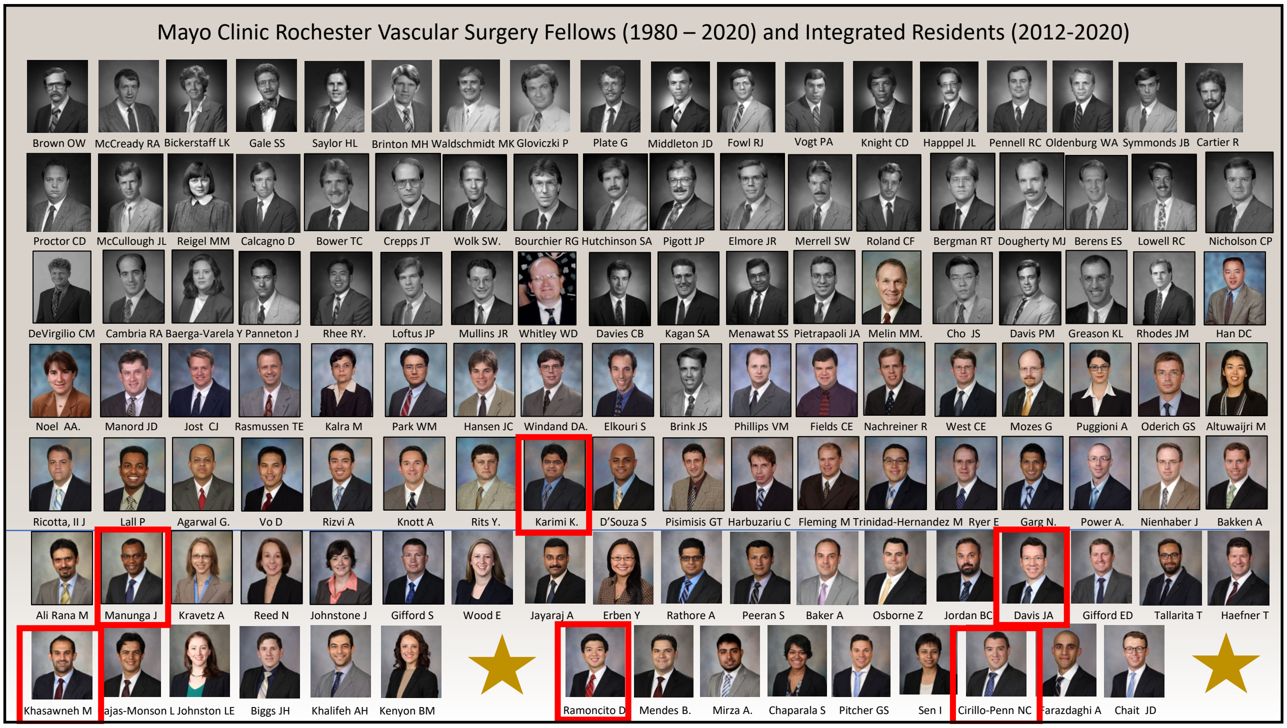
Mayo Clinic Rochester Vascular Surgery Fellows (1980 – 2020) and Integrated Residents (2012-2020)
Brown OW McCready RA Bickerstaff LK Gale SS Saylor HL Brinton MH Waldschmidt MK Gloviczki P Plate G Middleton JD Fowl RJ Vogt PA Knight CD Happpel JL Pennell RC Oldenburg WA Symmonds JB Cartier R
Proctor CD McCullough JL Reigel MM Calcagno D Bower TC Crepps JT Wolk SW. Bourchier RG Hutchinson SA Pigott JP Elmore JR Merrell SW Roland CF Bergman RT Dougherty MJ Berens ES Lowell RC Nicholson CP
DeVirgilio CM Cambria RA Baerga-Varela Y Panneton J Rhee RY. Loftus JP Mullins JR Whitley WD Davies CB Kagan SA Menawat SS Pietrapaoli JA Melin MM. Cho JS Davis PM Greason KL Rhodes JM Han DC
Noel AA. Manord JD Jost CJ Rasmussen TE Kalra M Park WM Hansen JC Windand DA. Elkouri S Brink JS Phillips VM Fields CE Nachreiner R West CE Mozes G Puggioni A Oderich GS Altuwaijri M
Ricotta, II J Lall P Agarwal G. Vo D Rizvi A Knott A Rits Y. Karimi K. D'Souza S Pisimisis GT Harbuzariu C Fleming M Trinidad-Hernandez M Ryer E Garg N. Power A. Nienhaber J Bakken A
Ali Rana M Manunga J Kravetz A Reed N Johnstone J Gifford S Wood E Jayaraj A Erben Y Rathore A Peeran S Baker A Osborne Z Jordan BC Davis JA Gifford ED Tallarita T Haefner T
Khasawneh M ajas-Monson L Johnston LE Biggs JH Khalifeh AH Kenyon BM Ramoncito D Mendes B. Mirza A. Chaparala S Pitcher GS Sen I Cirillo-Penn NC arazdaghi A Chait JD

5


Mayo Clinic Rochester Vascular Surgery Fellows (1980 – 2020) and Integrated Residents (2012-2020)
Brown OW McCready RA Bickerstaff LK Gale SS Saylor HL Brinton MH Waldschmidt MK Gloviczki P Plate G Middleton JD Fowl RJ Vogt PA Knight CD Happpel JL Pennell RC Oldenburg WA Symmonds JB Cartier R
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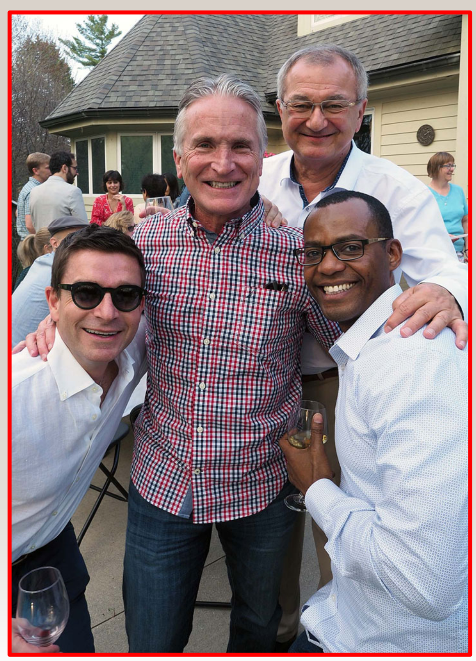
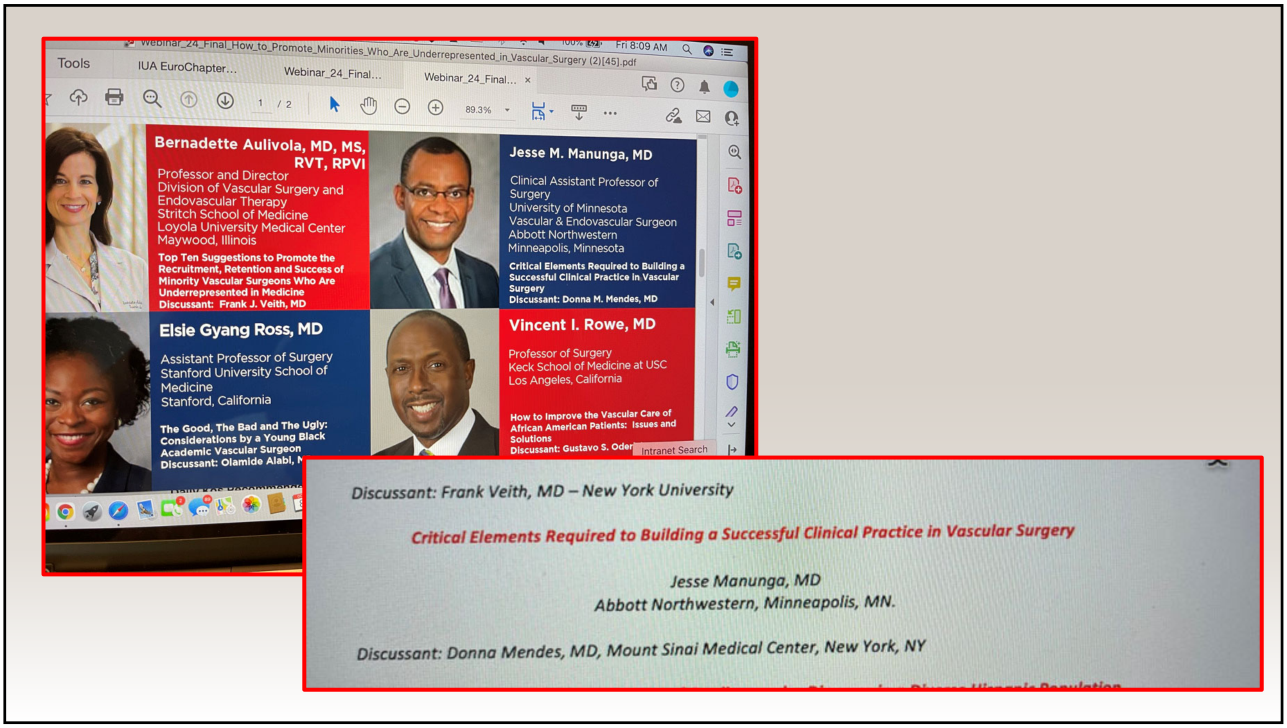


10


Bernadette Aulivola, MD, MS, RVT, RPVI
Professor and Director
Division of Vascular Surgery and Endovascular Therapy
Stritch School of Medicine
Loyola University Medical Center
Maywood, Illinois
Top Ten Suggestions to Promote the Recruitment, Retention and Success of Minority Vascular Surgeons Who Are Underrepresented in Medicine
Discussant: Frank J. Veith, MD
Jesse M. Manunga, MD
Clinical Assistant Professor of Surgery
University of Minnesota
Vascular & Endovascular Surgeon
Abbott Northwestern
Minneapolis, Minnesota
Critical Elements Required to Building a Successful Clinical Practice in Vascular Surgery
Discussant: Donna M. Mendes, MD
Elsie Gyang Ross, MD
Assistant Professor of Surgery
Stanford University School of Medicine
Stanford, California
The Good, The Bad and The Ugly: Considerations by a Young Black Academic Vascular Surgeon
Vincent I. Rowe, MD
Professor of Surgery
Keck School of Medicine at USC
Los Angeles, California
How to Improve the Vascular Care of African American Patients: Issues and Solutions
Discussant: Frank Veith, MD – New York University
Critical Elements Required to Building a Successful Clinical Practice in Vascular Surgery
Jesse Manunga, MD
Abbott Northwestern, Minneapolis, MN.
Discussant: Donna Mendes, MD, Mount Sinai Medical Center, New York, NY

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Volume 73, Number 1, January 2021
SVS Society for Vascular Surgery
JVS Journal of Vascular Surgery
Official Publication of the Society for Vascular Surgery
Anatomic Feasibility of TAMBE Stent Graft
AAA Screening in the United States
Deferred Carotid Revascularization After Stroke
Atherectomy in Superficial Femoral Artery
Six-Minute Walk Distance in PAD
Ergonomics of Vascular Surgeons
Late Mortality After Paclitaxel-Coated Stents
Spinal Cord Protection During Complex EVAR
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Karen Woo, Los Angeles, CA

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INVENTIONS AND DISRUPTIVE INNOVATIONS IN VASCULAR SURGERY

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LECTURE-SPECIFIC OBJECTIVES

1. Distinguish between inventions and innovations, and between sustaining and disruptive innovations
2. Describe major milestones in the evolution of vascular and endovascular surgery
3. Apply surgical innovations in clinical practice but preserve the integrity of ethical patient care
4. List major innovations that define the future of vascular surgery

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INVENTION

- A new idea or creation of a brand-new device or process
- Requires scientific skills
- A patent protects intellectual property

15

INNOVATION

- Application of an invention
- Adds value to a new device or idea
- Meets existing or unarticulated needs
- Requires scientific, technical and marketing skills

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"Innovation is the most powerful force for change in the world"

Bill Gates

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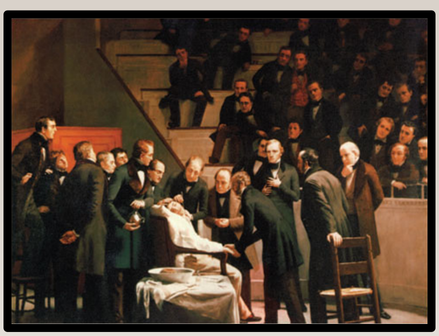
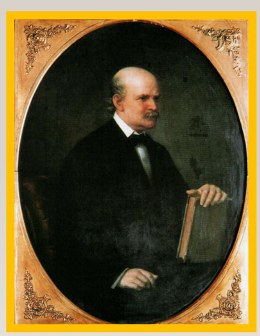
FUNDAMENTAL INNOVATIONS THAT CHANGED SURGICAL CARE

ANESTHESIA

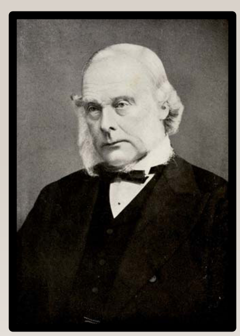
ASEPSIS - ANTISEPSIS



William T.G. Morton
1846



Ignaz Semmelweis
1847



Sir Joseph Lister
1867

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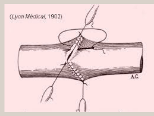
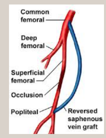
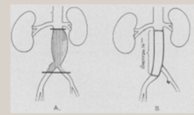
TOP 12 INNOVATIONS THAT CHANGED VASCULAR SURGERY

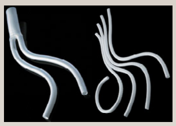

1. Vascular Anastomosis

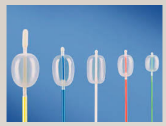

2. Endarterectomy



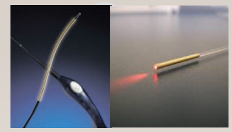
3. Vein bypass

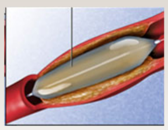

4. Homograft repair of AAA

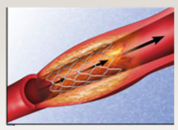

5. Prosthetic grafts


6. Fogarty balloon catheters


7. IVC Filters


8. RFA and Laser ablations


9. Balloon angioplasty


10. Stents


11. Stent grafts


12. Branched and fenestrated stent grafts

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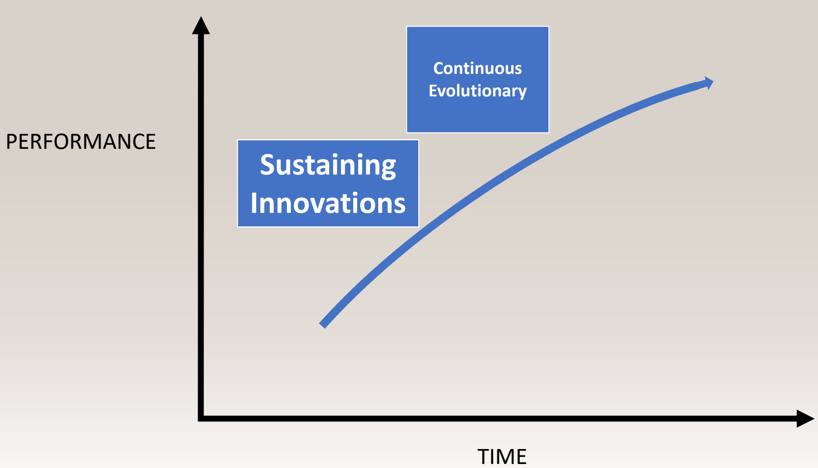
SUSTAINING INNOVATIONS



Source: "Digital Leadership"

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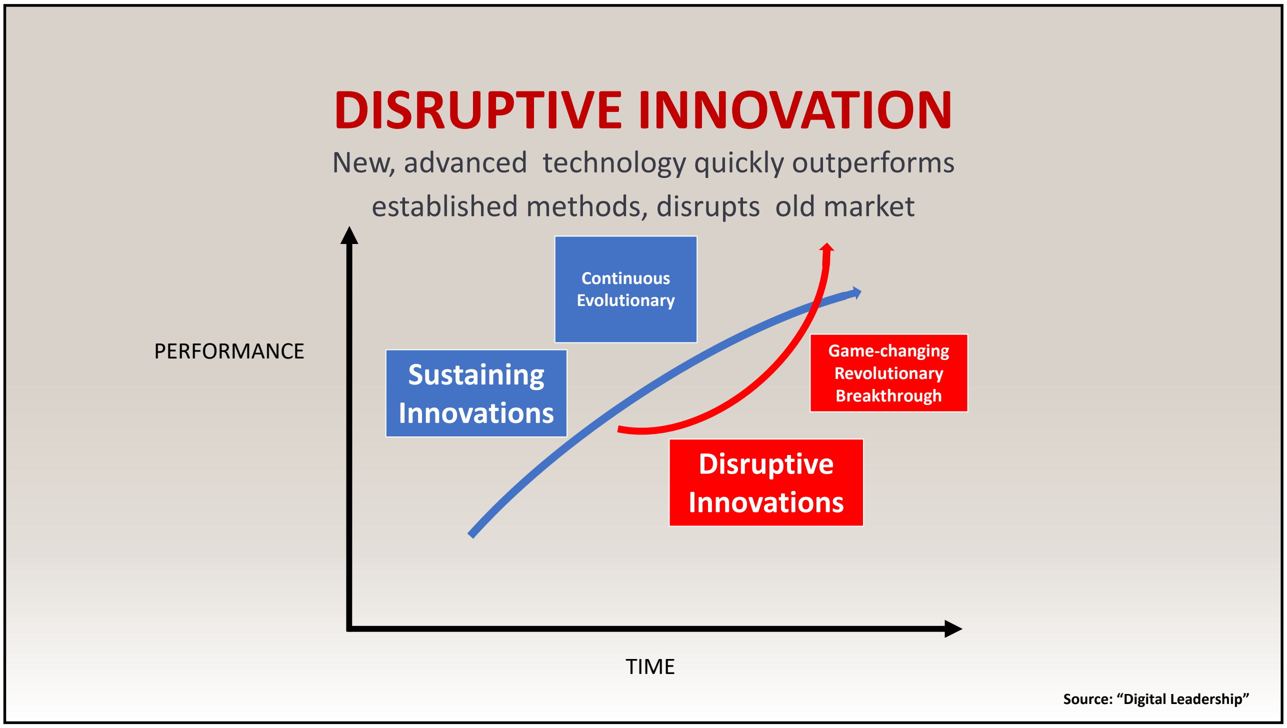
DISRUPTIVE INNOVATION
New, advanced technology quickly outperforms established methods, disrupts old market
PERFORMANCE
Continuous Evolutionary
Sustaining Innovations
Game-changing Revolutionary Breakthrough
Disruptive Innovations
TIME
Source: "Digital Leadership"

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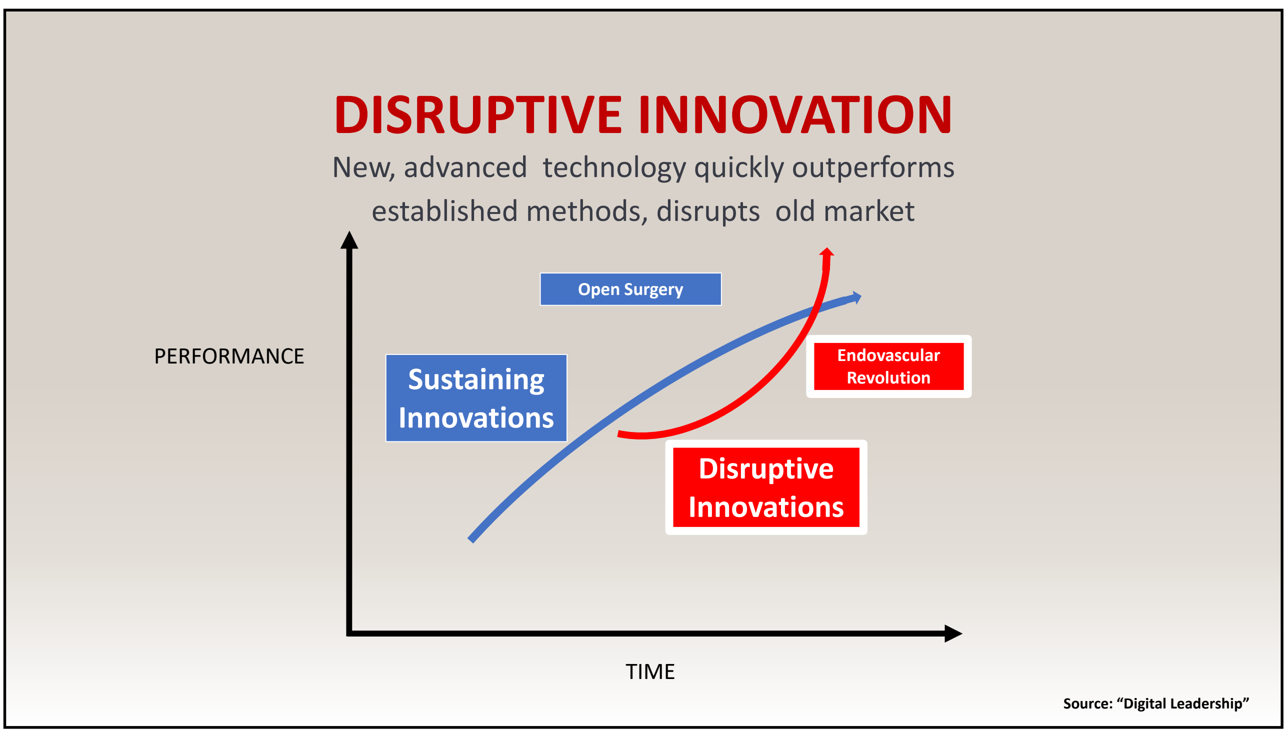
DISRUPTIVE INNOVATION
New, advanced technology quickly outperforms established methods, disrupts old market
PERFORMANCE
Open Surgery
Sustaining Innovations
Endovascular Revolution
Disruptive Innovations
TIME
Source: "Digital Leadership"

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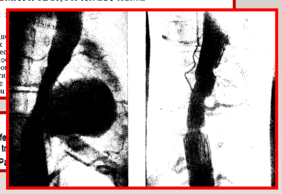
ENDOVASCULAR REVOLUTION

УДК 616.132-007.64-001.5-089.819.5

Н. Л. Володось, И. П. Карпович, В. Е. Шеханин, В. И. Троян, Л. Ф. Яковенко, Л. С. Керемет, А. С. Неонета, В. И. Кулеба, А. И. Санько, Г. И. Гавриков

СЛУЧАЙ ДИСТАНЦИОННОГО ЧРЕЗБЕДРЕННОГО ЭНДОПРОТЕЗИРОВАНИЯ ГРУДНОЙ АОРТЫ САМОФИКСИРУЮЩИМСЯ СИНТЕТИЧЕСКИМ ПРОТЕЗОМ ПРИ ТРАВМАТИЧЕСКОЙ АНЕВРИЗМЕ

Title: Grudnaâ khirurgiâ
Article Title: A case of distant transfe…
synthetic prosthesis in t…
Holdings: Vol: iss. 6 Date: 1988 P…



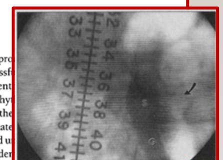
Nikolay L. Volodos et al.

Transfemoral Intraluminal Graft Implantation for Abdominal Aortic Aneurysms

J.C. Parodi, MD, J.C. Palmaz, MD, H.D. Barone, PhD

Transfemoral, Endovascular Stented Graft Repair of an Abdominal Aortic Aneurysm

Juan C. Parodi, MD; Michael L. Marin, MD; Frank J. Veith, MD



(Arch Surg. 1995;130:549-552)

March 24, 1987 **September 6, 1990** **November 23, 1992**

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ENDOVASCULAR REVOLUTION

ORIGINAL ARTICLES

From the Society for Vascular Surgery

Presidential address: Charles Darwin and vascular surgery

Frank J. Veith, MD, New York, N.Y.

Vascular surgeons must acquire endovascular skills

There are two clear reasons why vascular surgeons must become competent with the catheter-guidewire-imaging techniques that will enable them to perform endovascular treatments. The first is that some of these treatments will prove to be safe and effective and will replace standard open surgical techniques. This is already true for percutaneous balloon angioplasty (PTA) and caval filters. As stents, endovascular grafts, and other newer treatments become perfected, it is possible that 40% to 70% of current operations will be replaced with less-invasive endovascular treatments.[22,23] The survival of Vascular Surgery will depend on the ability of vascular surgeons to adapt and acquire the catheter-guidewire-imaging skills to perform some of the new endovascular procedures that replace vascular operations. If we do

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ENDOVASCULAR REVOLUTION

ORIGINAL ARTICLES

From the Society for Vascular Surgery

Presidential address: Charles Darwin and vascular surgery

Frank J. Veith, MD, *New York, N.Y.*

Selection as President of The Society for Vascular Surgery is for me a singular honor, especially because it comes on the 50th Anniversary of this esteemed Society. However, this is a time of enormous upheaval in American medicine, and holding this office has also forced me to focus on the future of Vascular Surgery and how well it will survive these turbulent times. The resulting concern I have for the future of our specialty has prompted me to select Charles Darwin as the topic of my Presidential Address. It is certainly reasonable to wonder what possible relevance Darwin, the famous English naturalist and the father of the theory of evolution, could have to Vascular Surgery. In fact, the theory and principles of Darwin are important to our specialty, and I will explain why.

The life and accomplishments of Charles Darwin

Charles Darwin was born in 1808 to a wealthy medical family in Shrewsbury, England. His father, a fashionable physician, entered his young son in Edinburgh Medical School. However, young Charles fled in horror at the sight of his first operation. Because the choice of alternative careers was limited and his aptitude for the classics minimal, his father enrolled Charles in Christs' College at Cambridge University with the intent that he become a clergyman. At Cambridge, Darwin obtained the rudiments of a scientific education and was able to pursue his boyhood interest in the natural history of plants, birds, and insects. Indeed, until the defining event in Darwin's life, it appeared that he was destined to become yet another botanizing Victorian clergyman. That seminal event was his appointment as Naturalist on the naval ship, *H.M.S. Beagle,* which had been commissioned to make a surveying voyage of the unexplored nether regions of South America, including Patagonia and Tierra del Fuego (Fig. 1). This 40,000 mile, 5-year voyage included many adventure-filled inland expeditions that gave Darwin a view of the natural world from the Brazilian jungle to the peaks of the Andes. His observations led him to speculate about the relationship between extinct and contemporary species and to question the then-current view that animal and plant species, having been created by God in His infinite wisdom, are permanently fixed and immutable. Concepts born in Darwin's mind on the voyage of the *Beagle,* together with supporting evidence gathered on that trip, ultimately led to his definitive formulation of the theory of evolution in *The Origin of Species By Means of Natural Selection,* published 23 years after the voyage.[1] Darwin was not one to rush prematurely into print and had spent the two decades between the formulation of his theory and its announcement in wrestling with potential objections and collecting supportive facts. This caution was based on Darwin's recognition that his theory would contradict religious thinking and would therefore elicit a storm of hostility and opposition. As Mark Twain would subsequently say: "Let a man proclaim a new principle and public sentiment will surely be on the other side." This statement certainly applied to Darwin's theory in his era. It is often applicable today, and it may apply to parts of this Presidential Address.

The theory of biologic evolution was not new. By Darwin's own count, evolutionary ideas had been put forth by more than 30 predecessors going back to the ancient Greeks. Others, including Diderot, Lamarck, and Darwin's own grandfather, had previ-

From the Division of Vascular Surgery, Department of Surgery, Montefiore Medical Center & Albert Einstein College of Medicine.

Presented at the Fiftieth Annual Meeting of the Society for Vascular Surgery, Chicago, Ill., June 11-12, 1996.

Reprint requests: Frank J. Veith, MD, Montefiore Medical Center/Albert Einstein College of Medicine, 111 East 210th St., New York, NY 10467.

J Vasc Surg 1997;25:8-18.

0741-5214/97/$5.00 + 0 **24/6/76004**

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Vascular surgeons must acquire endovascular skills

There are two clear reasons why vascular surgeons must become competent with the catheter-guidewire-imaging techniques that will enable them to perform endovascular treatments. The first is that some of these treatments will prove to be safe and effective and will replace standard open surgical techniques. This is already true for percutaneous balloon angioplasty (PTA) and caval filters. As stents, endovascular grafts, and other newer treatments become perfected, it is possible that 40% to 70% of current operations will be replaced with less-invasive endovascular treatments.[22,23] The survival of Vascular Surgery will depend on the ability of vascular surgeons to adapt and acquire the catheter-guidewire-imaging skills to perform some of the new endovascular procedures that replace vascular operations. If we do

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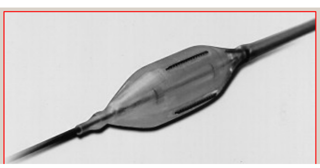
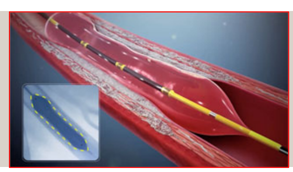
ENDOVASCULAR REVOLUTION

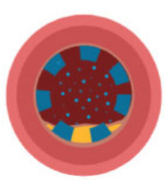
PLAIN, CUTTING , SCORING, DRUG ELUTING, SHOCKWAVE ANGIOPLASTY BALLOONS



DRUG-ELUTING, BIORESORBABLE AND INTEGRATED BIOSENSOR STENTS


Bare Metal Stent


Drug Eluting Stent


Bioresorbable Stent


Intergrated Sensor Stent

Advanced Science, Volume: 6, Issue: 20, First published: 19 August 2019, DOI: (10.1002/advs.201900856)

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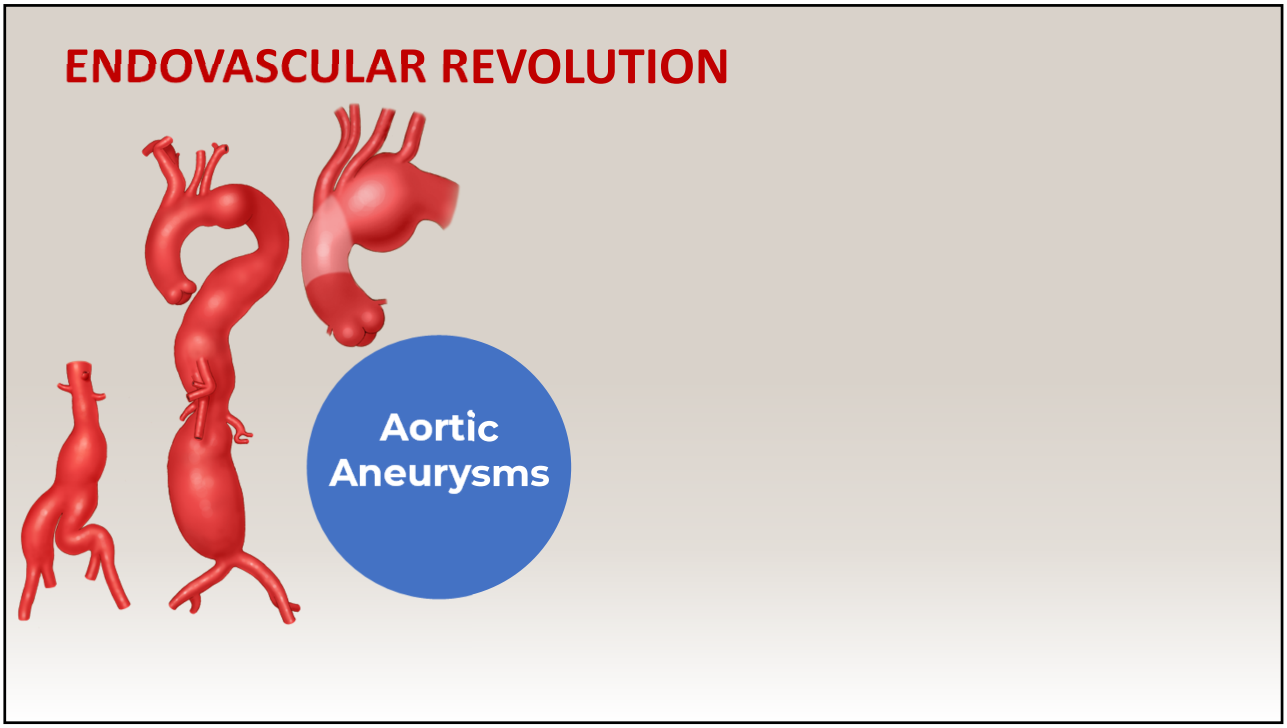
ENDOVASCULAR REVOLUTION
Aortic Aneurysms

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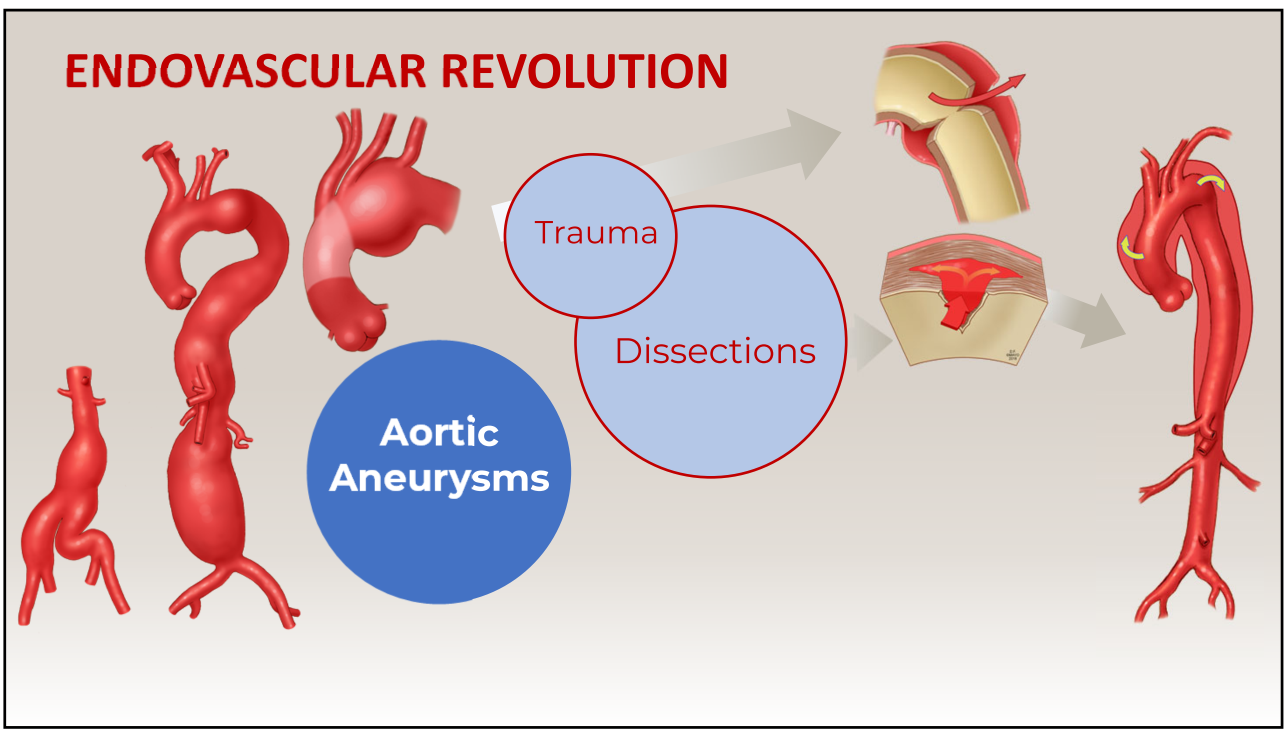
ENDOVASCULAR REVOLUTION
Trauma
Dissections
Aortic Aneurysms

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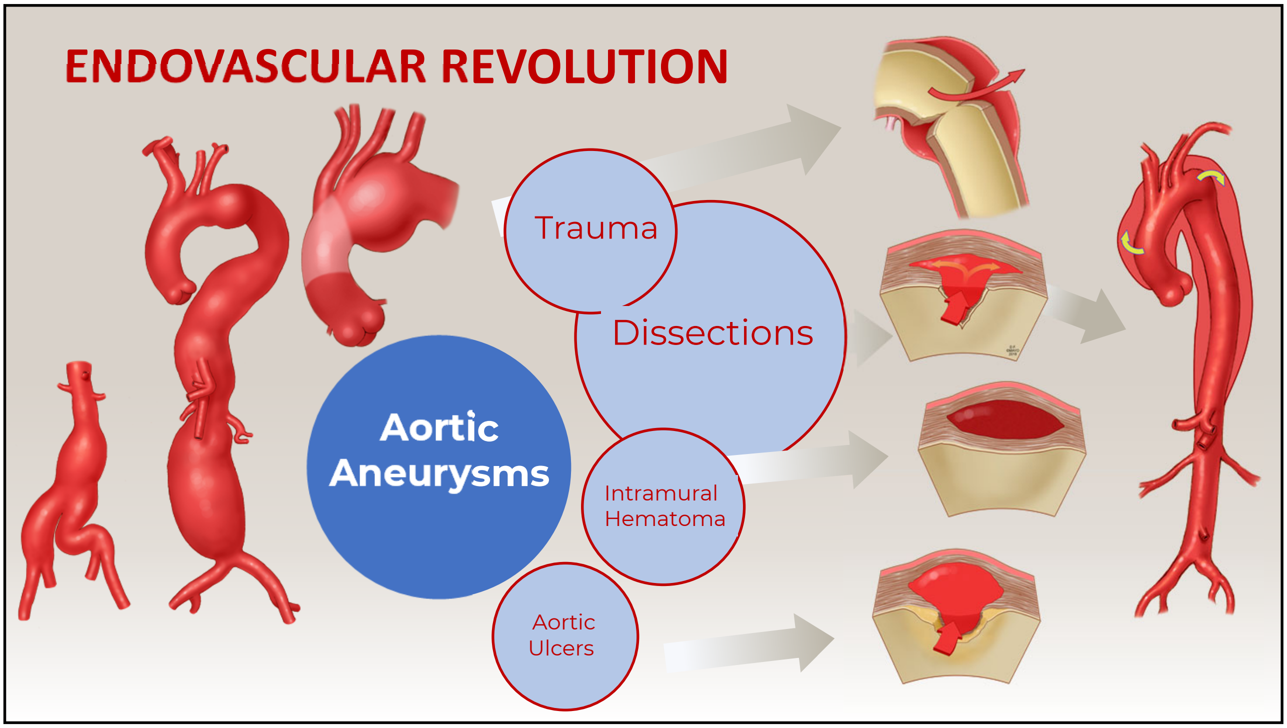
ENDOVASCULAR REVOLUTION
Trauma
Dissections
Aortic Aneurysms
Intramural Hematoma
Aortic Ulcers

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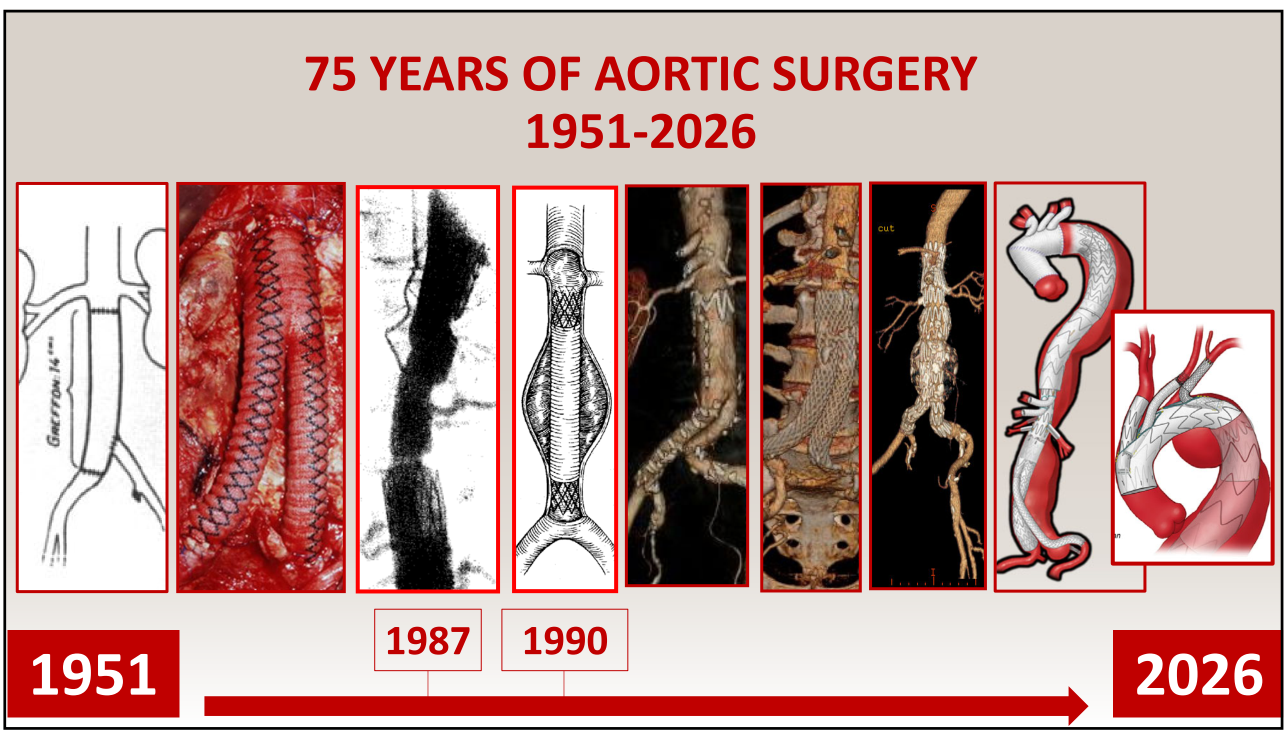
75 YEARS OF AORTIC SURGERY
1951-2026
1987
1990
1951
2026

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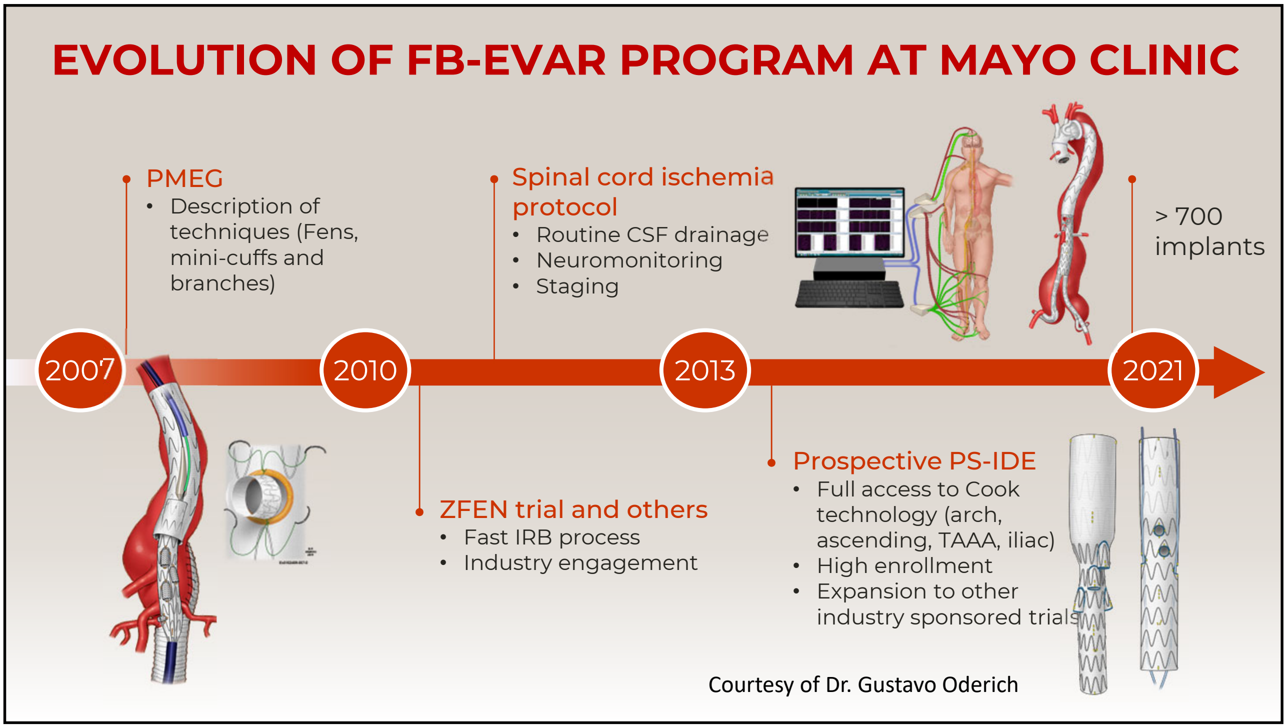
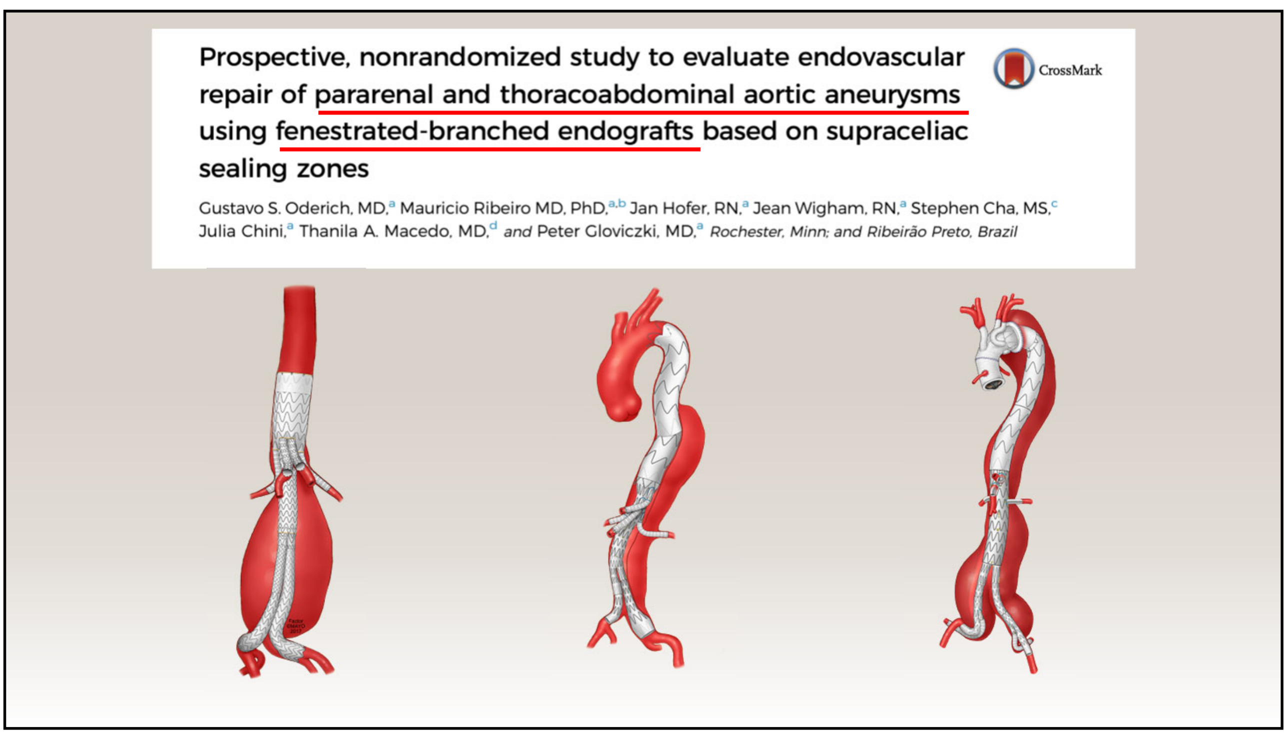
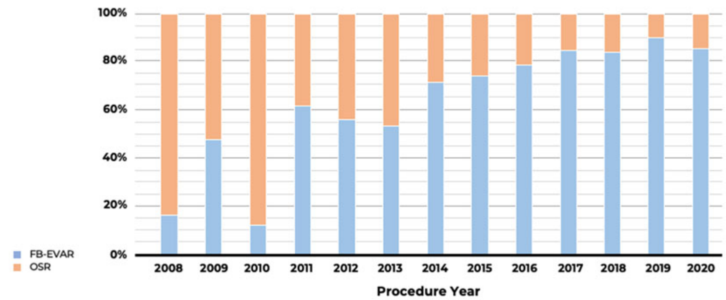

EVOLUTION OF FB-EVAR PROGRAM AT MAYO CLINIC
PMEG
• Description of techniques (Fens, mini-cuffs and branches)
Spinal cord ischemia protocol
• Routine CSF drainage
• Neuromonitoring
• Staging
> 700 implants
2007
2010
2013
2021
ZFEN trial and others
• Fast IRB process
• Industry engagement
Prospective PS-IDE
• Full access to Cook technology (arch, ascending, TAAA, iliac)
• High enrollment
• Expansion to other industry sponsored trials
Courtesy of Dr. Gustavo Oderich

31


Prospective, nonrandomized study to evaluate endovascular repair of pararenal and thoracoabdominal aortic aneurysms using fenestrated-branched endografts based on supraceliac sealing zones
CrossMark
Gustavo S. Oderich, MD,[a] Mauricio Ribeiro MD, PhD,[a,b] Jan Hofer, RN,[a] Jean Wigham, RN,[a] Stephen Cha, MS,[c] Julia Chini,[a] Thanila A. Macedo, MD,[d] and Peter Gloviczki, MD,[a] Rochester, Minn; and Ribeirão Preto, Brazil

32

• MAYO CLINIC EXPERIENCE WITH FB-EVAR AND OPEN REPAIR OF THORACOABDOMINAL AORTIC ANEURYSM (2008 – 2020)



Number of Cases

	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Overall	18	29	25	18	16	30	46	50	51	52	56	78	35
OSR	15	15	22	7	7	14	13	13	11	8	9	8	5
FBEVAR	3	14	3	11	9	16	33	37	40	44	47	70	30

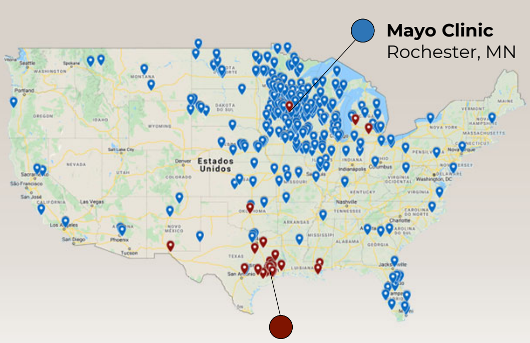
Figure S2. Percent of 504 cases with thoracoabdominal aortic aneurysm done by FB-EVAR (teal bar) or OSR (rose bar) over a 13-year period.
FB-EVAR indicates fenestrated-branched endovascular aortic repair; and OSR, open surgical repair.

33

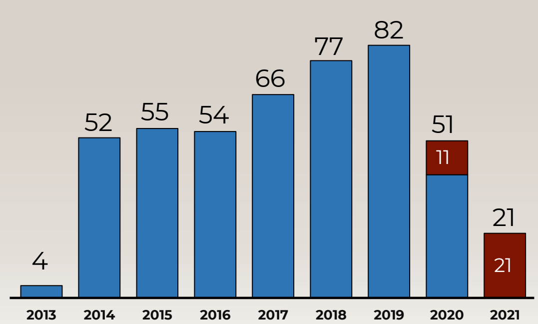
MAYO CLINIC - UTH HOUSTON EXPERIENCE WITH FB-EVAR

- Prospective, non-randomized study
- 462 FB-EVAR patients

30-day mortality
5/462 (1.1%)



Oderich et al. Ann Surg 2021



Courtesy of Dr. Gustavo Oderich

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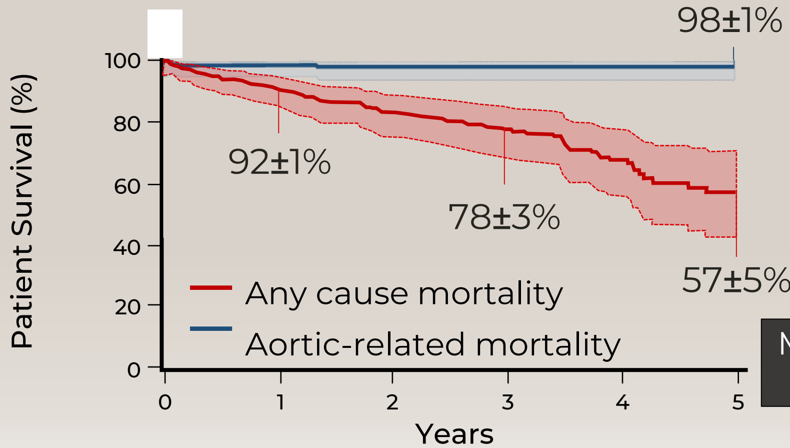
PATIENT SURVIVAL



Mean follow up, 26±20 months

Number at risk	430	295	195	131	70	34

Oderich et al. Ann Surg 2021

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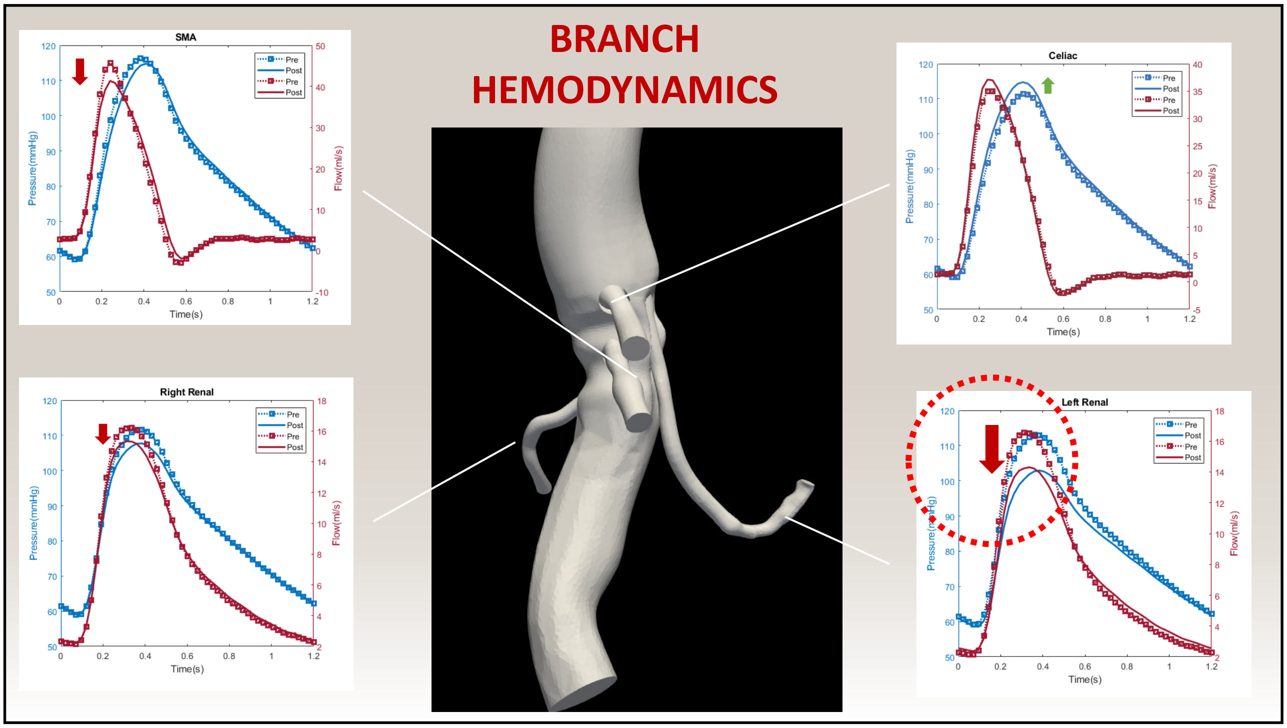
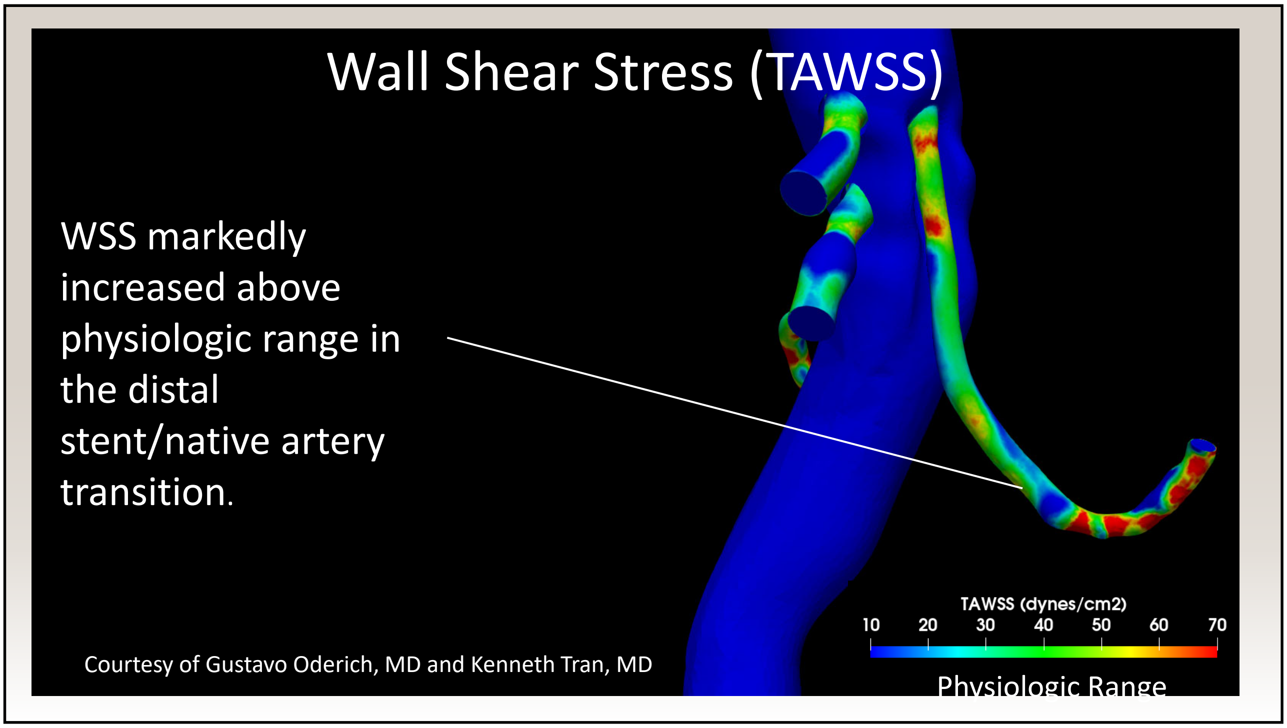
Computational Flow Modelling to Assess Hemodynamic Changes Following F-BEVAR

Courtesy of Gustavo Oderich, MD and Kenneth Tran, MD

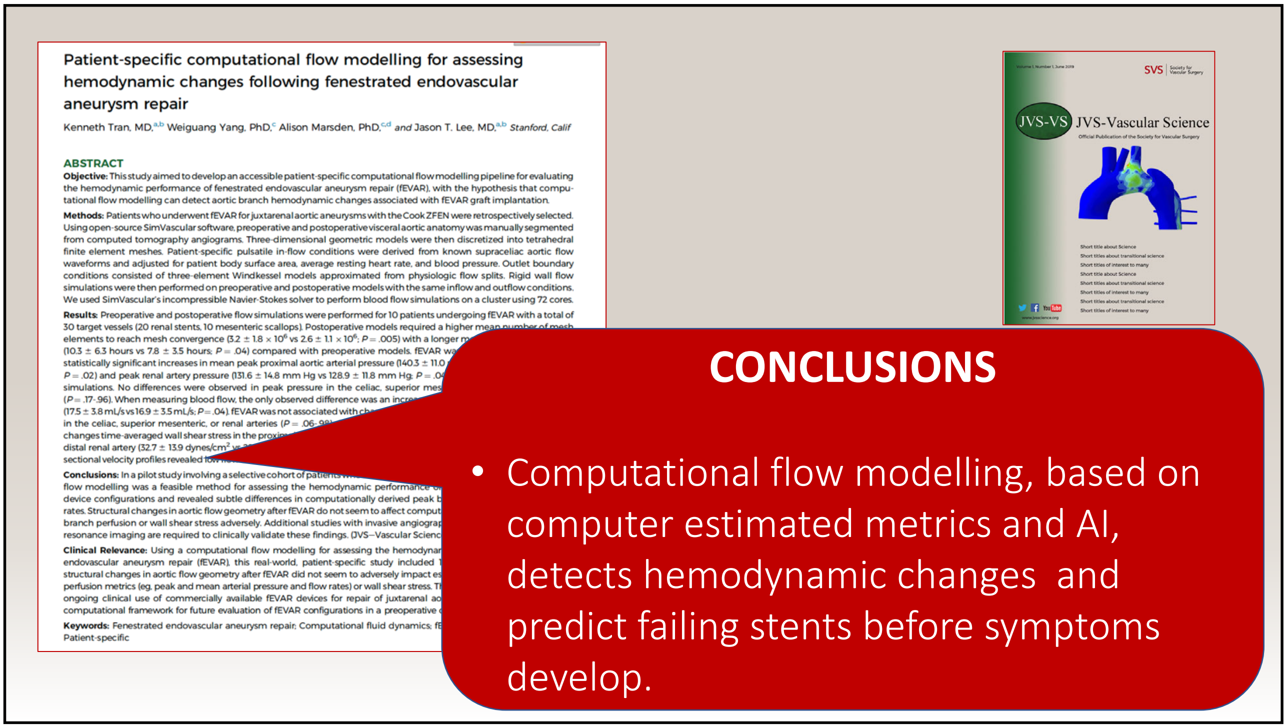
36


BRANCH HEMODYNAMICS
SMA
Right Renal
Celiac
Left Renal
Pre
Post
Pressure(mmHg)
Flow(ml/s)
Time(s)

37


Wall Shear Stress (TAWSS)
WSS markedly increased above physiologic range in the distal stent/native artery transition.
Courtesy of Gustavo Oderich, MD and Kenneth Tran, MD
TAWSS (dynes/cm2)
10 20 30 40 50 60 70
Physiologic Range

38


Patient-specific computational flow modelling for assessing hemodynamic changes following fenestrated endovascular aneurysm repair
Kenneth Tran, MD,[a,b] Weiguang Yang, PhD,[c] Alison Marsden, PhD,[c,d] and Jason T. Lee, MD,[a,b] Stanford, Calif
ABSTRACT
Objective: This study aimed to develop an accessible patient-specific computational flow modelling pipeline for evaluating the hemodynamic performance of fenestrated endovascular aneurysm repair (fEVAR), with the hypothesis that computational flow modelling can detect aortic branch hemodynamic changes associated with fEVAR graft implantation.
Methods: Patients who underwent fEVAR for juxtarenal aortic aneurysms with the Cook ZFEN were retrospectively selected. Using open-source SimVascular software, preoperative and postoperative visceral aortic anatomy was manually segmented from computed tomography angiograms. Three-dimensional geometric models were then discretized into tetrahedral finite element meshes. Patient-specific pulsatile in-flow conditions were derived from known supraceliac aortic flow waveforms and adjusted for patient body surface area, average resting heart rate, and blood pressure. Outlet boundary conditions consisted of three-element Windkessel models approximated from physiologic flow splits. Rigid wall flow simulations were then performed on preoperative and postoperative models with the same inflow and outflow conditions. We used SimVascular's incompressible Navier-Stokes solver to perform blood flow simulations on a cluster using 72 cores.
JVS-VS JVS-Vascular Science
SVS
CONCLUSIONS
• Computational flow modelling, based on computer estimated metrics and AI, detects hemodynamic changes and predict failing stents before symptoms develop.

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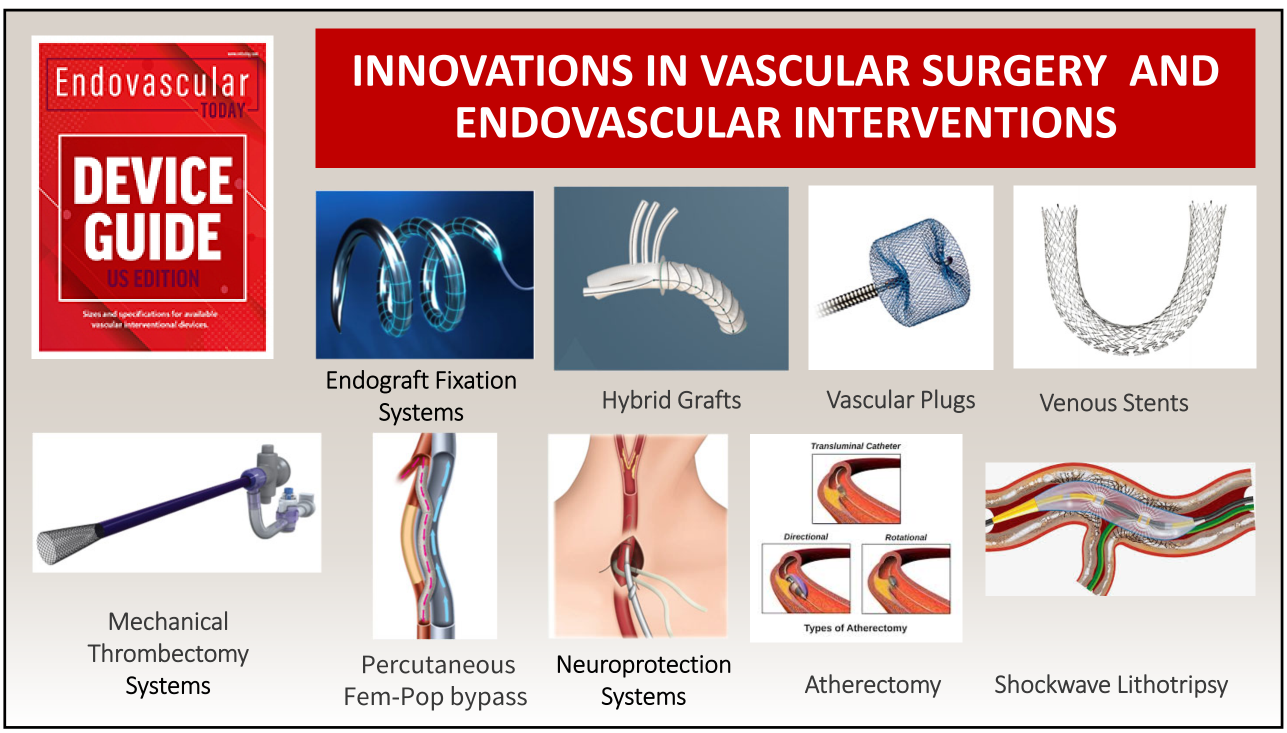
Endovascular TODAY
DEVICE GUIDE
US EDITION
INNOVATIONS IN VASCULAR SURGERY AND ENDOVASCULAR INTERVENTIONS
Endograft Fixation Systems
Hybrid Grafts
Vascular Plugs
Venous Stents
Mechanical Thrombectomy Systems
Percutaneous Fem-Pop bypass
Neuroprotection Systems
Transluminal Catheter
Directional
Rotational
Types of Atherectomy
Atherectomy
Shockwave Lithotripsy

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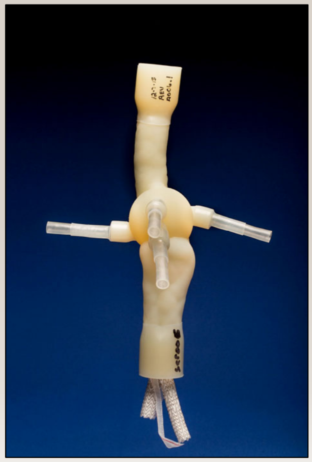
3D-PRINT AORTIC MODEL AND PULSATILE FLUID PUMP



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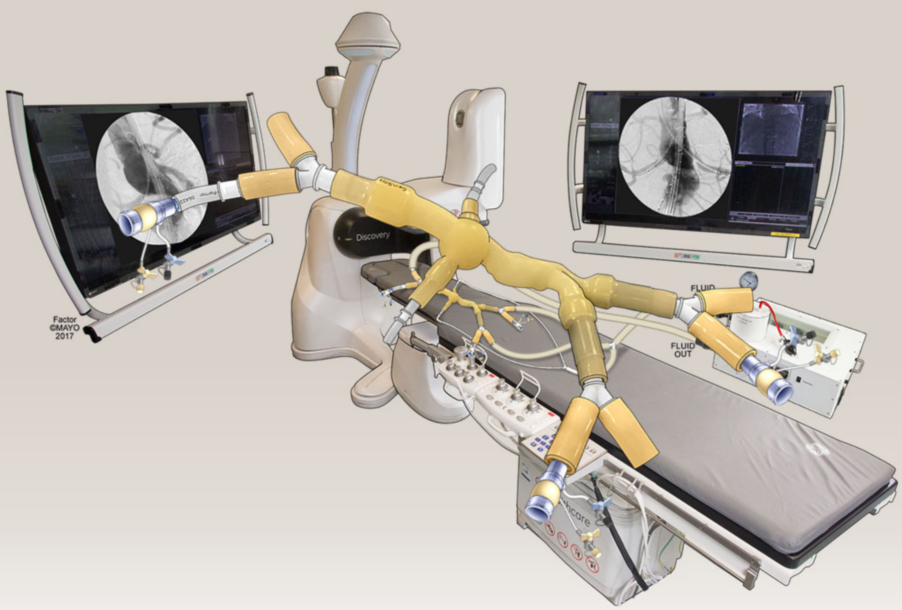

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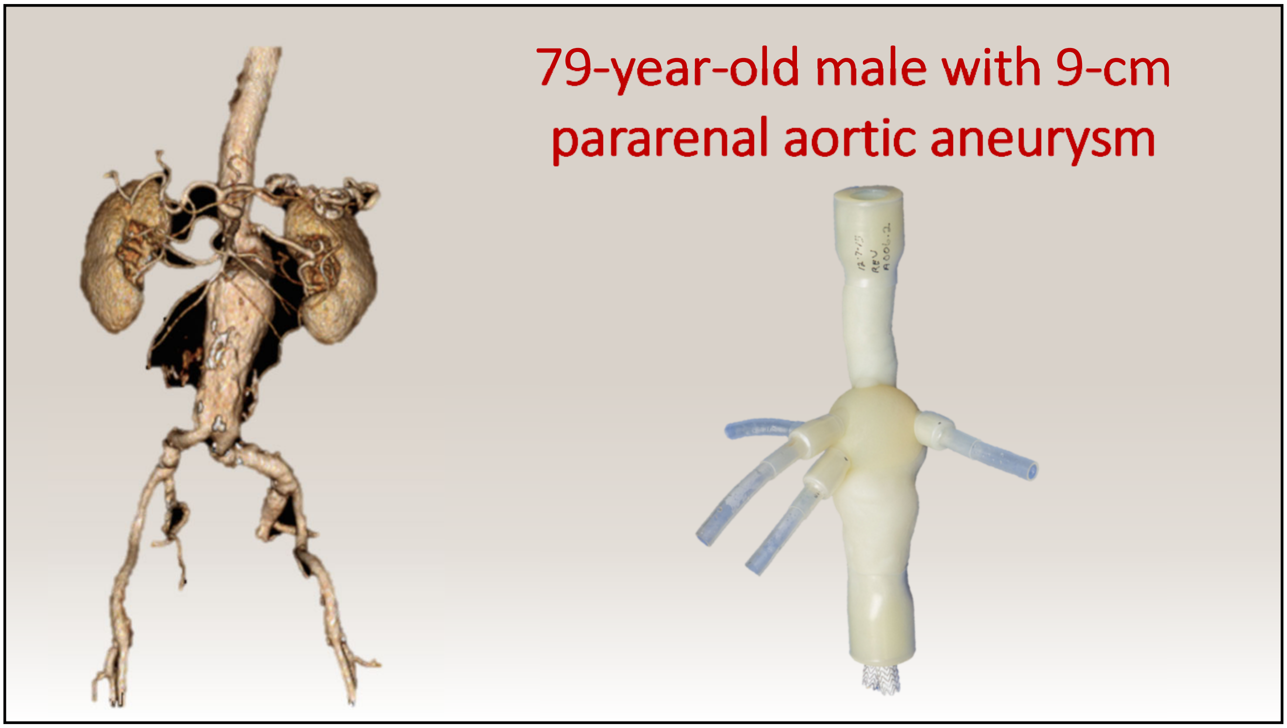

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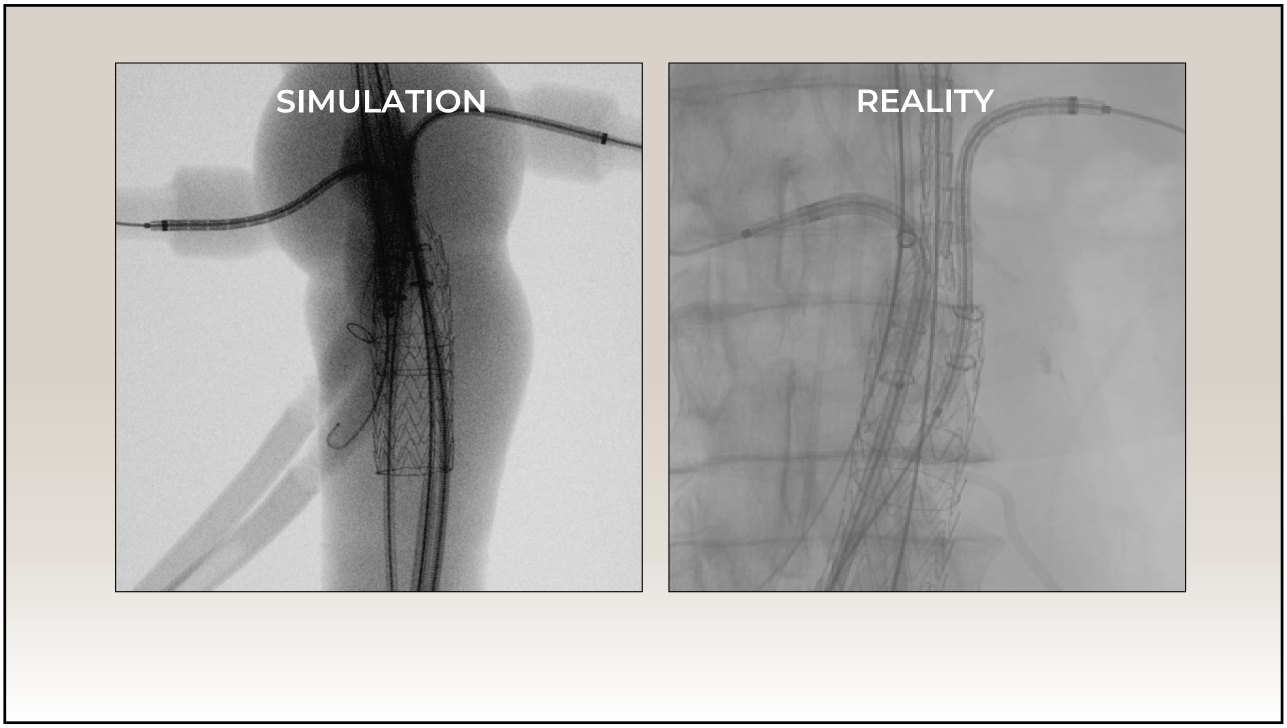

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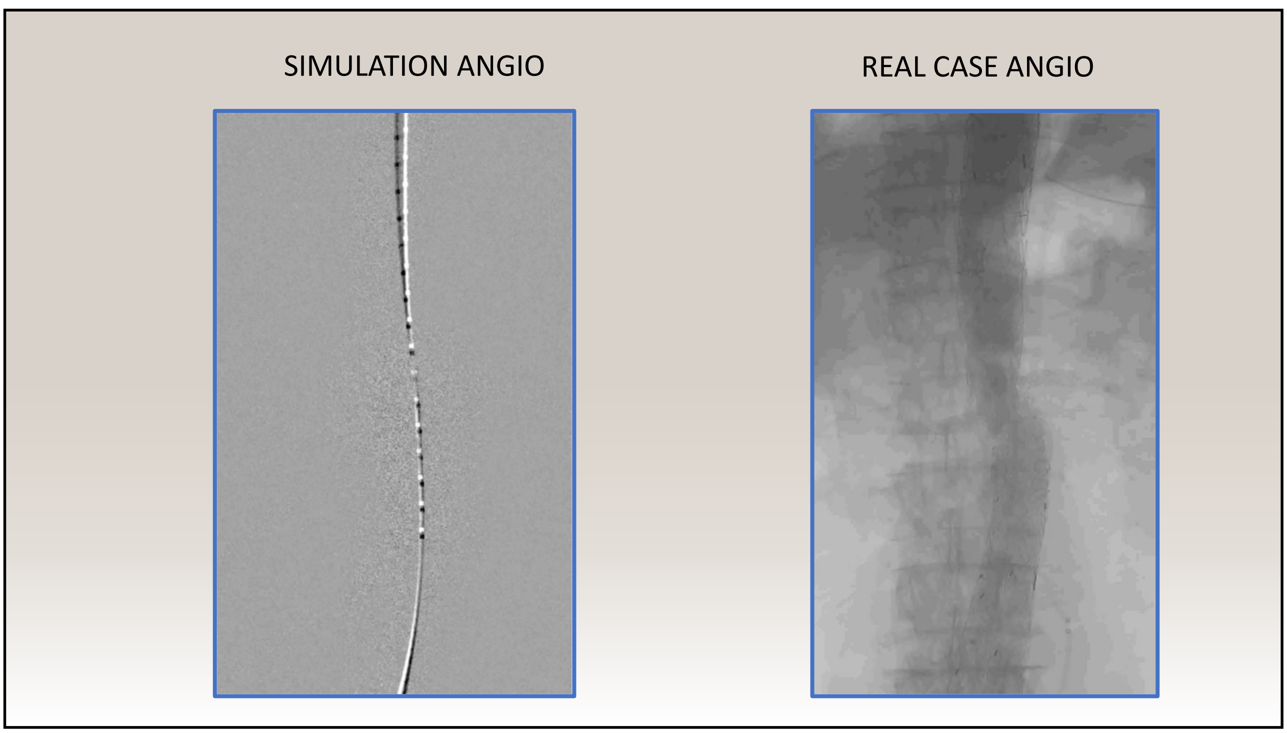

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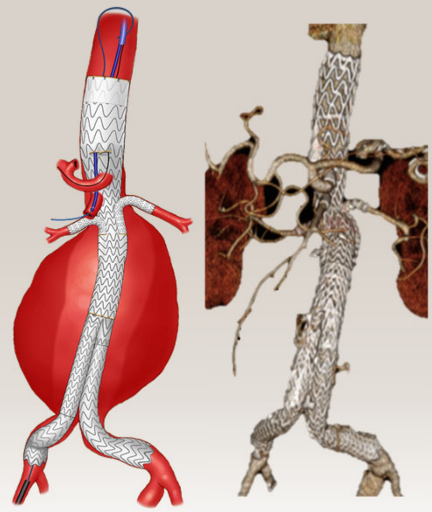
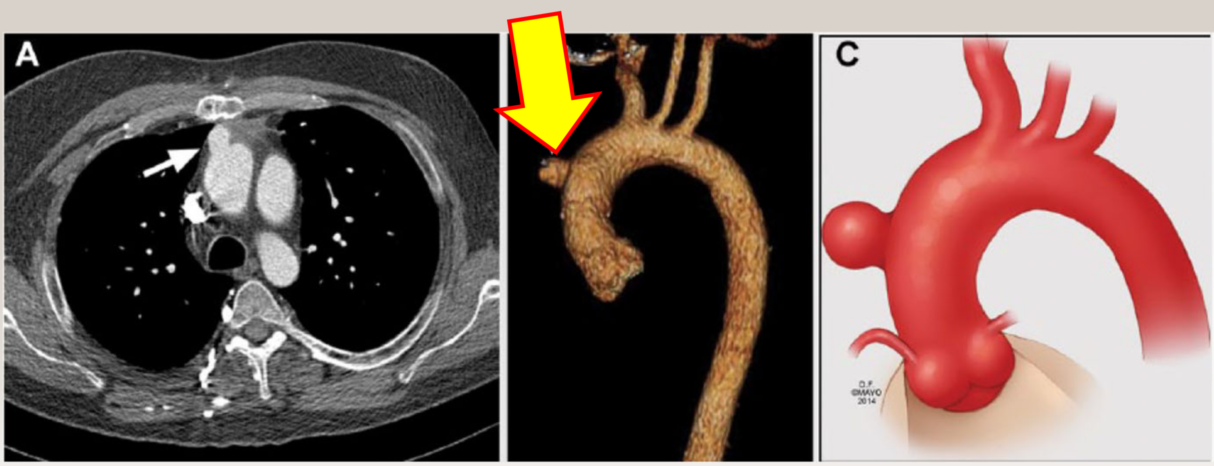
FIRST IN-MAN IMPLANT TEAM

GORE EXCLUDER Thoracoabdominal Branched Endoprosthesis (TAMBE)



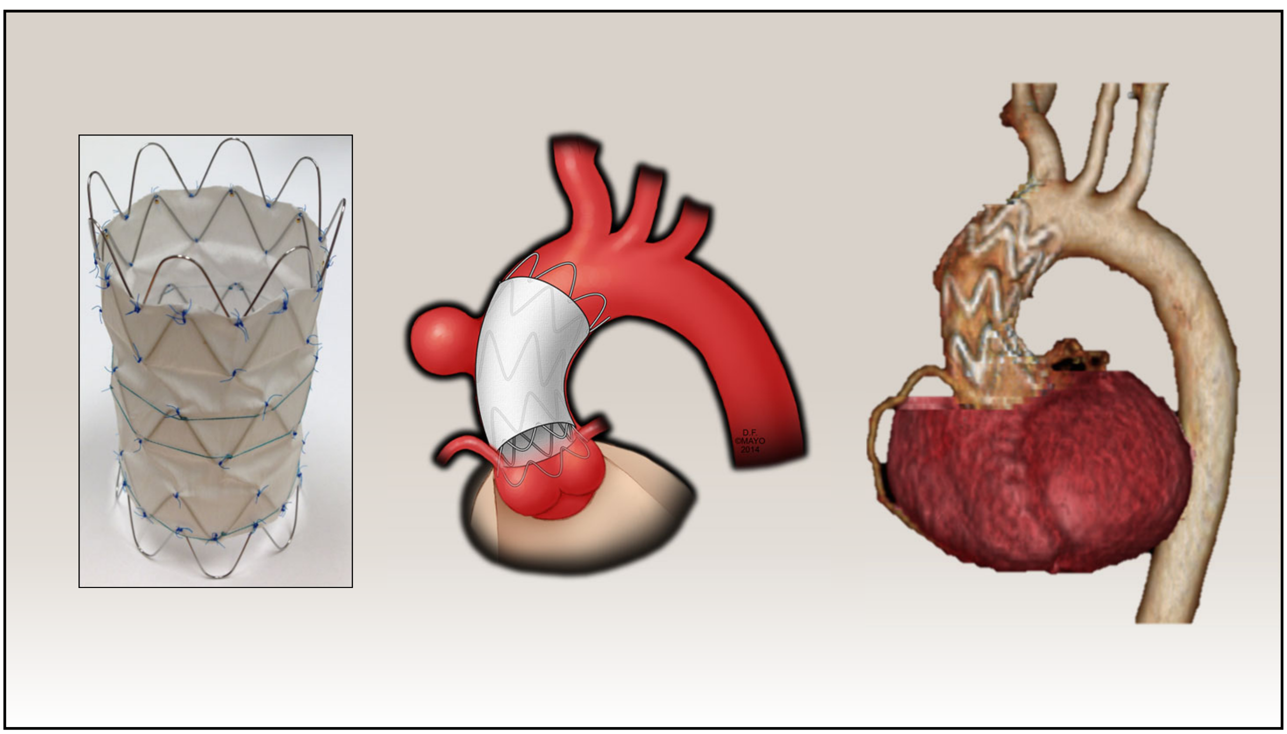
47

48 y/o Man with Pseudoaneurysm of the Ascending Aorta



48

49



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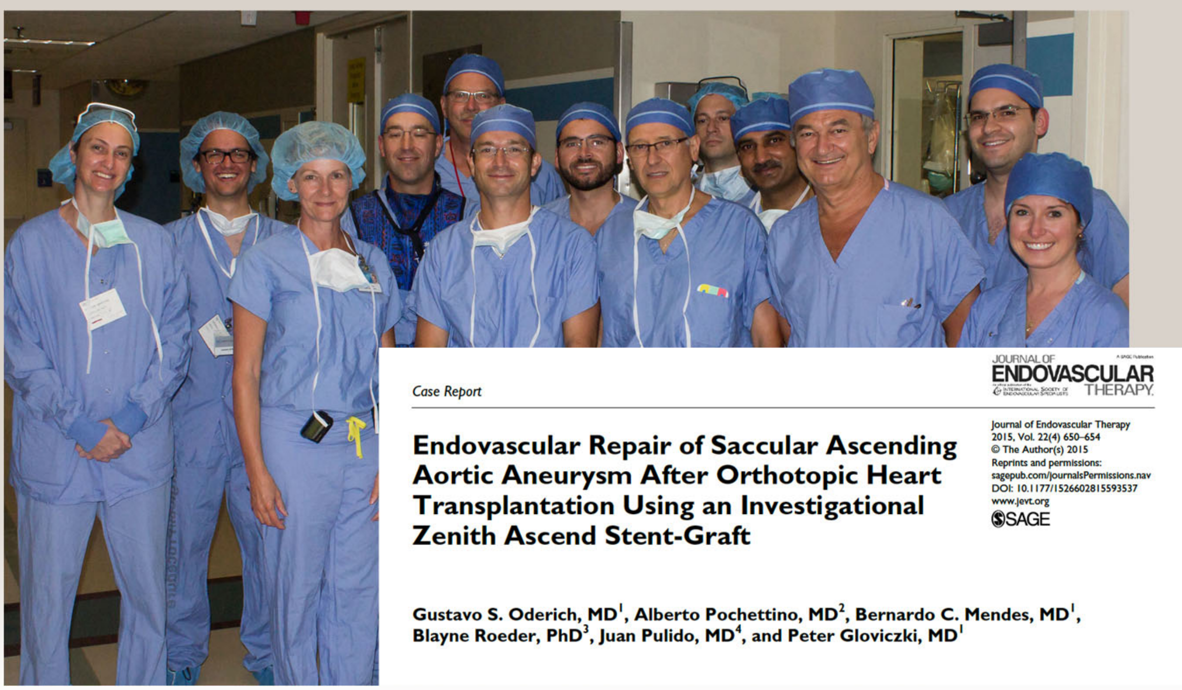
51



JOURNAL OF ENDOVASCULAR THERAPY

Case Report

Endovascular Repair of Saccular Ascending Aortic Aneurysm After Orthotopic Heart Transplantation Using an Investigational Zenith Ascend Stent-Graft

Journal of Endovascular Therapy
2015, Vol. 22(4) 650–654
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DOI: 10.1177/1526602815593537
www.jevt.org
SAGE

Gustavo S. Oderich, MD[1], Alberto Pochettino, MD[2], Bernardo C. Mendes, MD[1], Blayne Roeder, PhD[3], Juan Pulido, MD[4], and Peter Gloviczki, MD[1]

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SVS Society for Vascular Surgery

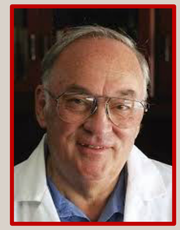
Recipients of the SVS Medal of Innovation

ESVS Honorary Member

2015 Nicolai Volodos

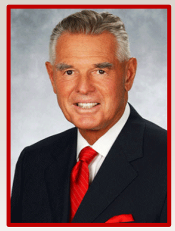
2006
Juan Parodi

2008
Timothy A.M. Chuter,



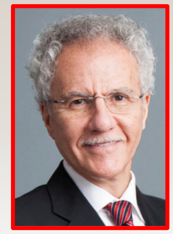
2010
Thomas Fogarty

2012
Roy Greenberg



2013
Edward Dietrich

2019
Robert L. Kistner



2025
Enrico Ascher

53

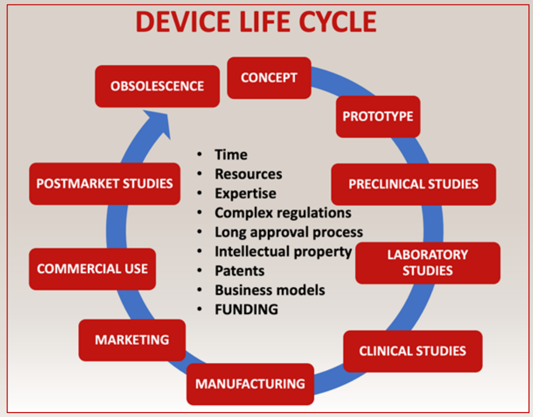
"When something is important enough, you do it even if the odds are against you."

Elon Musk

54

MAJOR CHALLENGES OF SURGICAL INNOVATIONS

- Skyrocketing costs
- Long approval process
- FUNDING!
- Complex regulations



55

ETHICAL CHALLENGES OF ADOPTERS OF INNOVATIONS

- Limited information on the new device
- Need training and mentor
- Learning curve
- Early experience only by the inventor
- Long term results are not available

56

ETHICAL CHALLENGES OF ADOPTERS OF INNOVATIONS

- Limited information on the new device
- Need training and mentor
- Learning curve
- Early experience only by the inventor
- Long term results are not available
- **Must make a shared decision with the patient**
- **MUST PROTECT THE INTEREST OF THE PATIENT!**

57

TAKE HOME MESSAGE

- Surgical innovation is essential to advance cost-effective care

58

TAKE HOME MESSAGE

- Surgical innovation is essential to advance cost-effective care
- Shared decision making by an ethical surgeon and a well informed patient is the cornerstone of ethical patient care

59

TAKE HOME MESSAGE

- Surgical innovation is essential to advance cost-effective care
- Shared decision making by an ethical surgeon and a well informed patient is the cornerstone of ethical patient care
- Continuous re-evaluation and improvement of a new procedure, performing comparative studies, cost analysis and long-term follow-up care are our responsibilities

60

"Never before in history has innovation offered promise of so much to so many in so short a time."

Bill Gates

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ARTIFICIAL INTELLIGENCE

THE FUTURE OF VASCULAR SURGERY?

*"T*echnological innovation, demographic change (aging populations with complex vascular disease), and the continued shift toward **minimally invasive, image-guided interventions**. The specialty is evolving into a **hybrid discipline combining surgery, endovascular intervention, advanced imaging, and data science**. *."*

CHAT-GPT

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THE FUTURE OF VASCULAR SURGERY

1. Percutaneous endovascular therapy first
2. Complex aortic endovascular repairs with off-the shelf multibranched devices
3. Reduced radiation exposure due to advanced Imaging and navigation
   - Intravascular ultrasound (IVUS)-guided interventions
   - Fusion imaging combining CT and fluoroscopy
   - 3-D navigation systems and electromagnetic catheter tracking.
   - Robotics and remote interventions
4. Hybrid operating rooms with high resolution imaging

   Seamless transition between open and endovascular techniques

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THE FUTURE OF VASCULAR SURGERY

5. Improved long-term results of infrainguinal procedures
   - lithotripsy, drug coated balloon and drug eluting, bioresorbable and biosensor stents, tissue-engineered vascular grafts, cell-based therapies
6. Improved venous and lymphatic Interventions
   - Dedicated venous stents, Iliocaval, Left Renal vein and SVC stents
   - Endovascular deep vein valve
   - Mechanical thrombectomy for deep vein thrombosis and pulmonary embolism
   - Supermicrosurgical and robotic lymphatic reconstructions for lymphedema
7. Open aortic and arterial surgery reserved for failed endovascular procedures, infections, malignant tumors and selected by-passes

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THE FUTURE OF VASCULAR SURGERY

8. Artificial Intelligence and Digital Planning
   - Automated aneurysm measurement and surveillance
   - Endograft sizing and procedural planning with simulation
   - Prediction of restenosis, thrombosis, or endoleaks.

9. Personalized and Data-Driven Vascular Care
   - Large clinical registries and machine-learning tools will help personalized treatment decisions and predict outcomes

65

THE OPERATING ROOM AT ST MARY'S HOSPITAL, ROCHESTER, MINNESOTA IN 1893

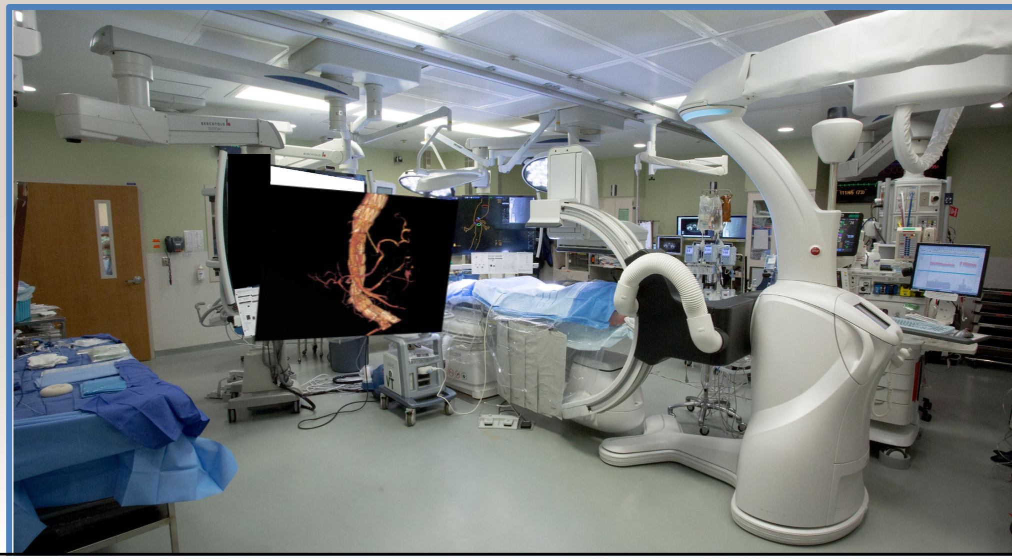
Dr William J. Mayo

.

Dr Charles H. Mayo

66

OPERATING ROOM 801
ST MARY'S HOSPITAL, MAYO CLINIC, ROCHESTER, MN



67

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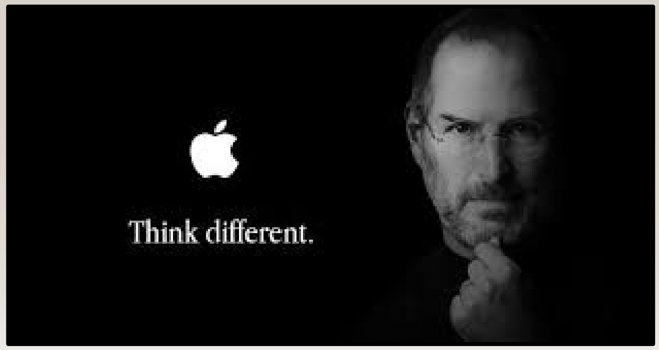
"Innovation distinguishes between a leader and a follower"



Steve Jobs

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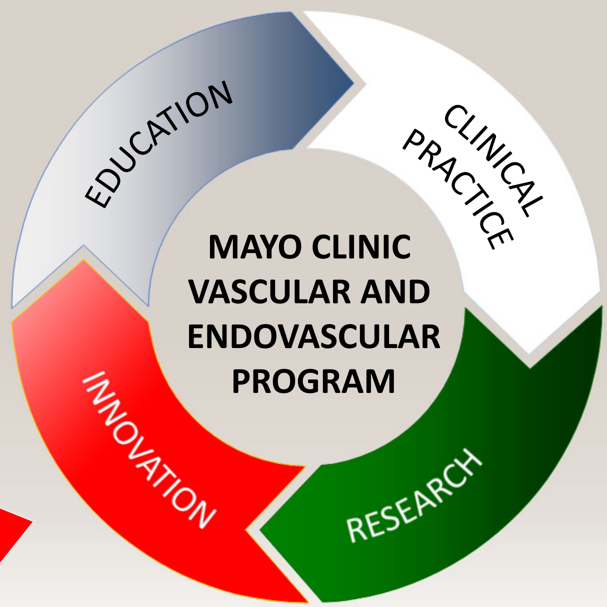
MAYO CLINIC



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THANK YOU!

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