

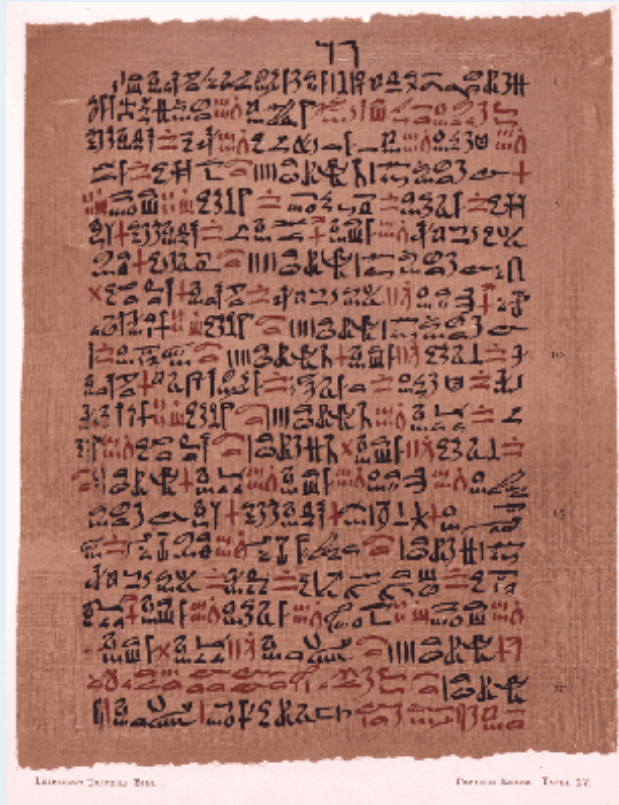
Total Endovascular Aortic Care; Are We There Yet?!

*Hosam F El Sayed, MBBCh, PhD, FACS
Associate Professor of Surgery,
Division of Vascular Surgery
Eastern Virginia Medical School
Norfolk, VA*

Disclosures

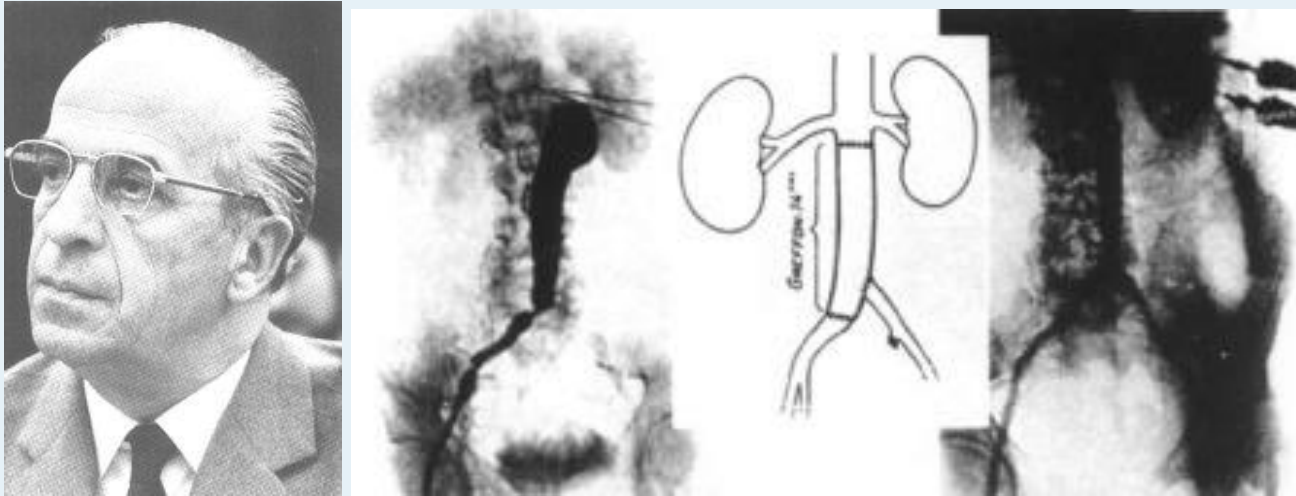
- None

Ebers Papyrus (1550, B.C.)



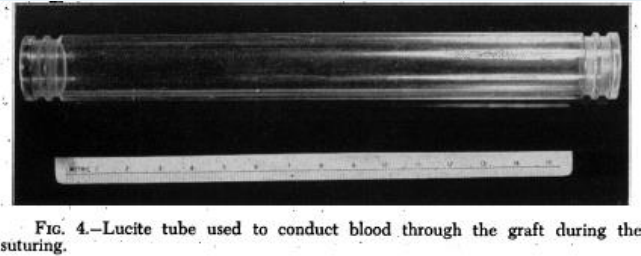
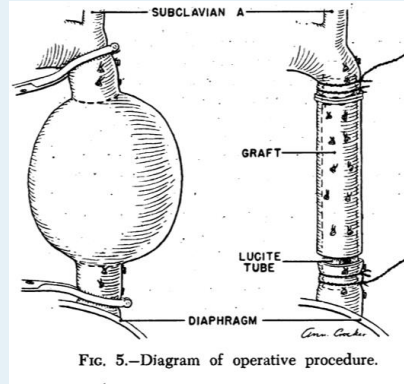
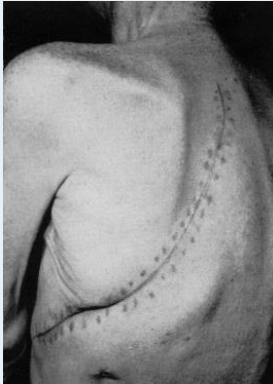
Within this script lies the first recorded mention of aortic aneurysms, quoted as “. . . only magic can cure tumors of the major arteries.”

Charles Dubost, March, 1951



The First Reported Open TAAA Repair

The **first successful** resection of a descending aortic aneurysm was performed by **Conrad and Hartley** in **1951**



Annals of Surgery 1951; 134 743-52

The New Era of Endovascular Repair



Nikolay Volodos, 1985



Juan Carlos Parodi, 1991

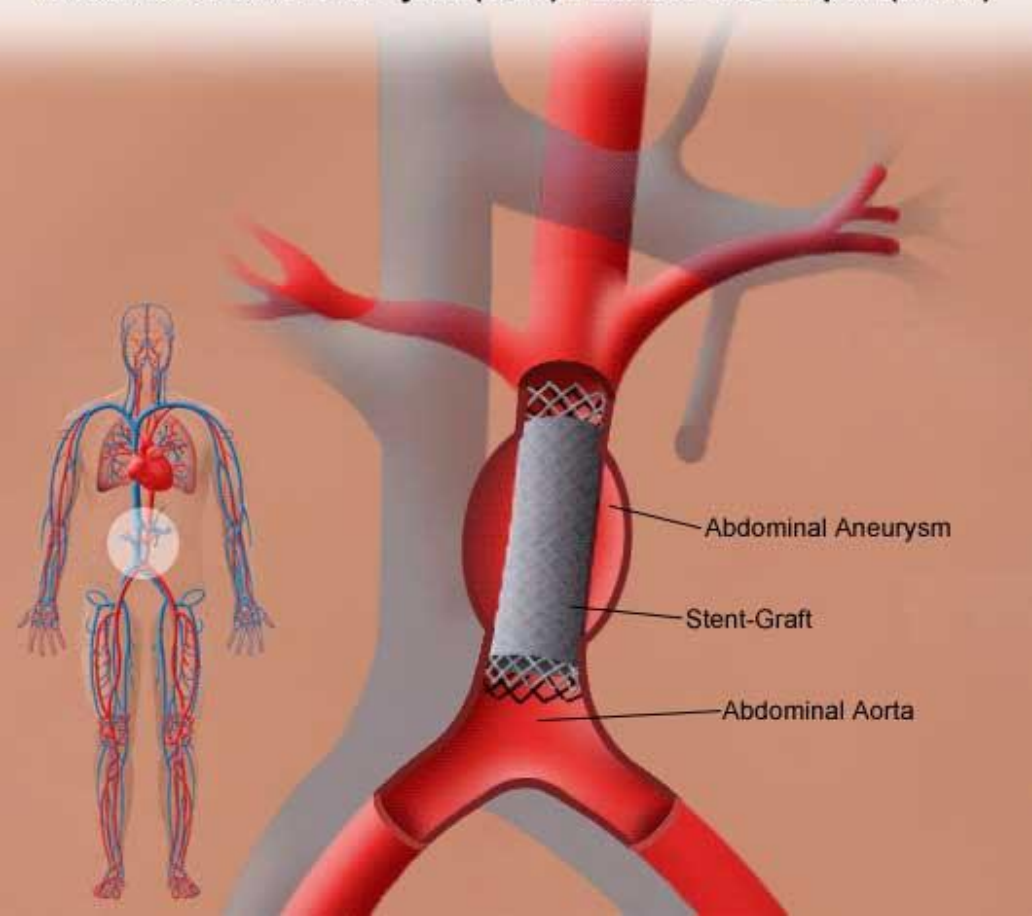
So, What Happened In The Past 33 years

- More and more cases are treated using ER than OR.
 - Push by the patients
 - Push by industry
 - Push by surgeons
 - Push by interventionalists
- In 2006, for the first time, ER exceeded the number of OR in the US.
- Currently, between 65-88% of elective Aortic Aneurysms are repaired using ER

EVAR Devices

- Started as custom made Dacron Grafts with balloon expanding Palmaz stents inside
- Started as Aorto-aortic tube grafts, then Aorto-Uni-Iliac devices then evolved into the bifurcated configuration
- Multiple generations and modifications over the years
 - Device profile reduction
 - Modification of fixation and seal
 - Increased flexibility

Abdominal Aortic Aneurysm (AAA) Endovascular Repair (EVAR)





Medtronic EVAR EndoGrafts



AneuRx



Talent



Endurant

APTUS, INC.

- Aptus²



COOK MEDICAL

- Zenith
- Zenith Flex
- Zenith LP³



CORDIS CORPORATION

- Incraft³



ENDOLOGIX

- Powerlink
- Nellix³



GORE & ASSOCIATES

- Excluder



LOMBARD

- Aorfix³



MEDTRONIC, INC.

- AneuRx
- Talent
- Endurant



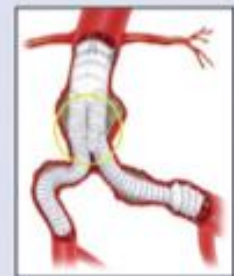
TRIVASCULAR

- Ovation³



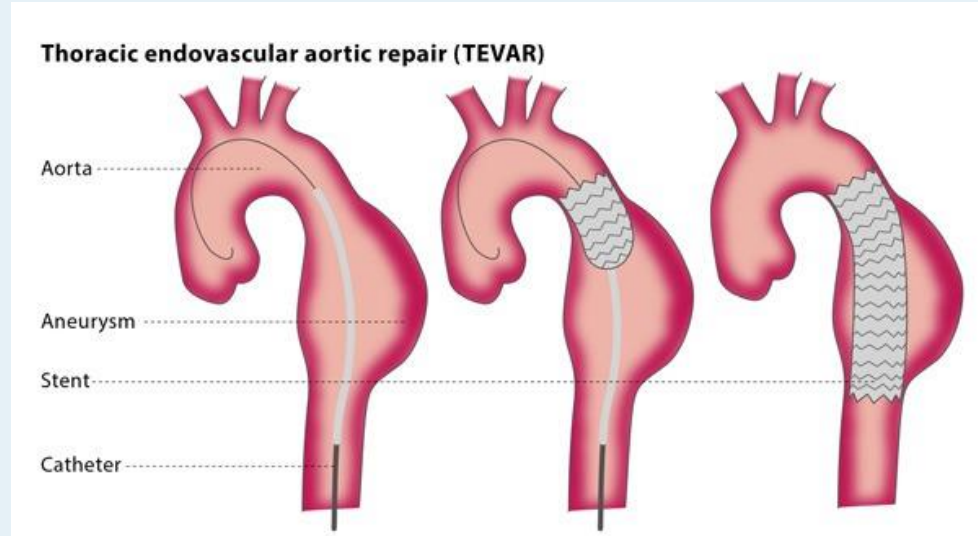
VASCUTEK

- Anaconda³



TEVAR

- First device was approved by the FDA in 2005 (Gore Tag Device) for the treatment of thoracic aortic aneurysm
- Similar improvements and generations of thoracic devices that mimicked the EVAR territory.



ZONES OF THE AORTA

Zone 0: ascending aorta (Ao) to innominate artery (innom.)

Zone 1: innominate artery to left common carotid (LCC)

Zone 2: LCC to left subclavian artery (LSA)

Zone 3: first 2 cm distal to LSA

Zone 4: Zone 3 to mid descending Ao (~T6)

Zone 5: mid descending Ao to celiac artery

Zone 6: celiac artery to superior mesenteric artery (SMA)

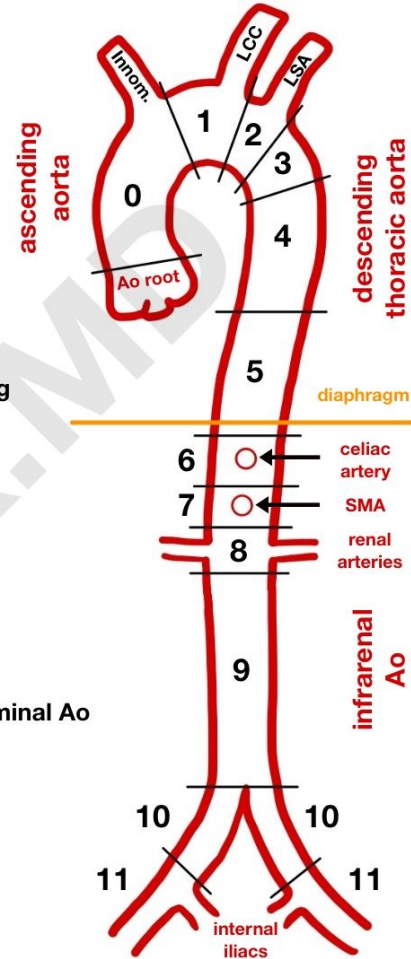
Zone 7: SMA to renal arteries

Zone 8: renal to infra-renal abdominal Ao

Zone 9: infrarenal abdominal Ao

Zone 10: common iliac arteries

Zone 11: external iliac arteries



ZONES OF THE AORTA

Zone 0: ascending aorta (Ao) to innominate artery (innom.)

Zone 1: innominate artery to left common carotid (LCC)

Zone 2: LCC to left subclavian artery (LSA)

Zone 3: first 2 cm distal to LSA

Zone 4: Zone 3 to mid descending Ao (~T6)

Zone 5: mid descending Ao to celiac artery

Zone 6: celiac artery to superior mesenteric artery (SMA)

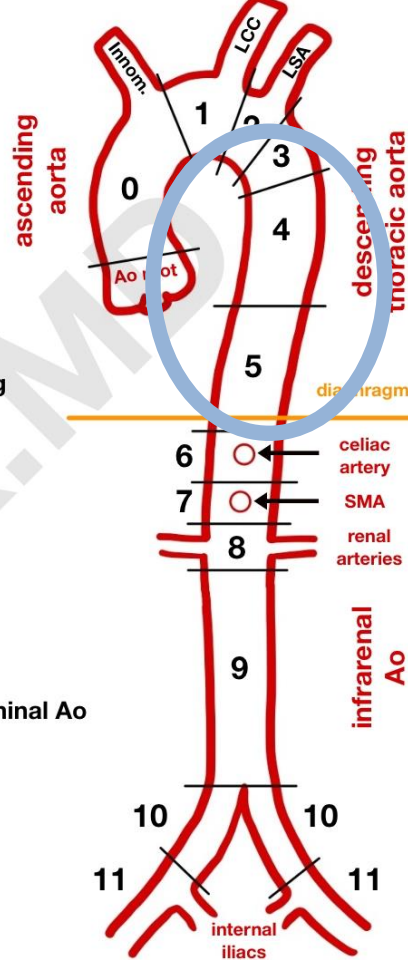
Zone 7: SMA to renal arteries

Zone 8: renal to infra-renal abdominal Ao

Zone 9: infrarenal abdominal Ao

Zone 10: common iliac arteries

Zone 11: external iliac arteries



ZONES OF THE AORTA

Zone 0: ascending aorta (Ao) to innominate artery (innom.)

Zone 1: innominate artery to left common carotid (LCC)

Zone 2: LCC to left subclavian artery (LSA)

Zone 3: first 2 cm distal to LSA

Zone 4: Zone 3 to mid descending Ao (~T6)

Zone 5: mid descending Ao to celiac artery

Zone 6: celiac artery to superior mesenteric artery (SMA)

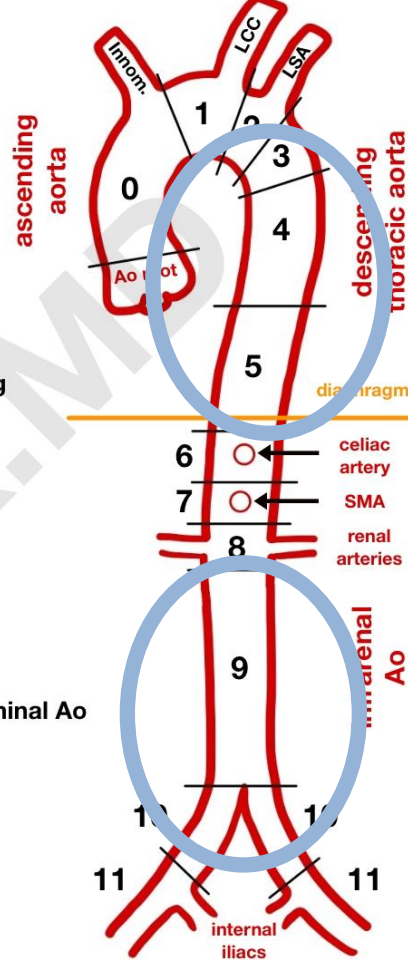
Zone 7: SMA to renal arteries

Zone 8: renal to infra-renal abdominal Ao

Zone 9: infrarenal abdominal Ao

Zone 10: common iliac arteries

Zone 11: external iliac arteries



How About The Other Segments

- Branches.
- Hostile environment
- Aortic elasticity.

How About The Other Segments

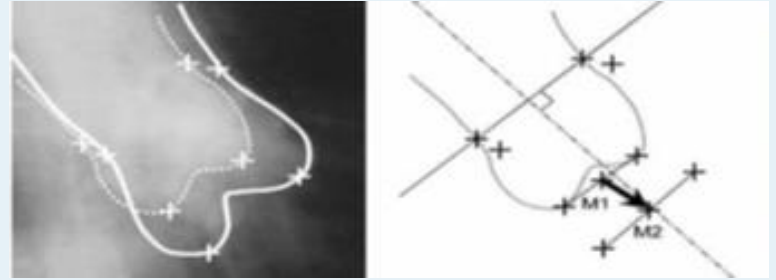
- **Branches.**
- Hostile environment
- Aortic elasticity.
- Ascending Aorta: **Coronaries**
- Aortic arch: **Arch vessels**
- Visceral Segment: **Mesenteric and renals**
- Iliac arteries: **Internal Iliac artery**

How About The Other Segments

- Branches.

- Hostile environment

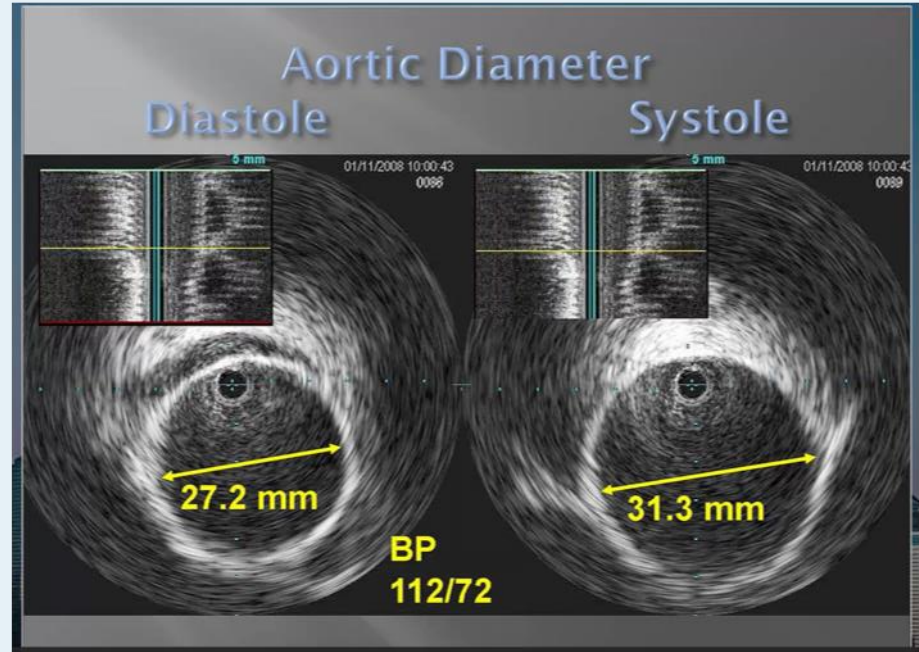
- Aortic elasticity.



- Ascending aorta and Arch
 - Movement at the aortic root of 4-7 mm
 - Movement at the BCA of 3-4 mm
 - Aortic diameter change of 8-10%
 - Torsion movement of 6 degrees

How About The Other Segments

- Branches.
- Hostile environment
- **Aortic elasticity.**

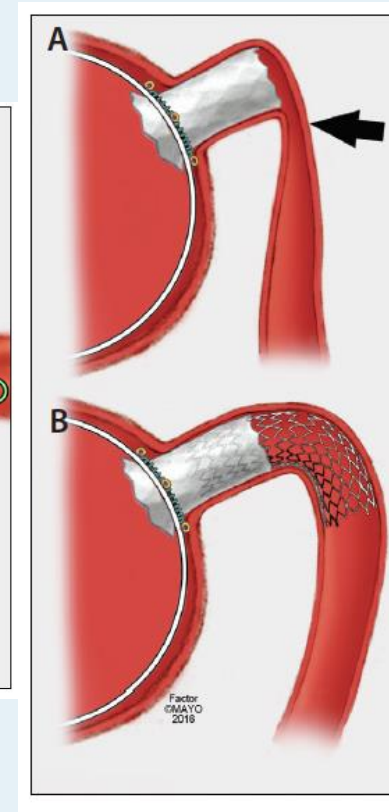
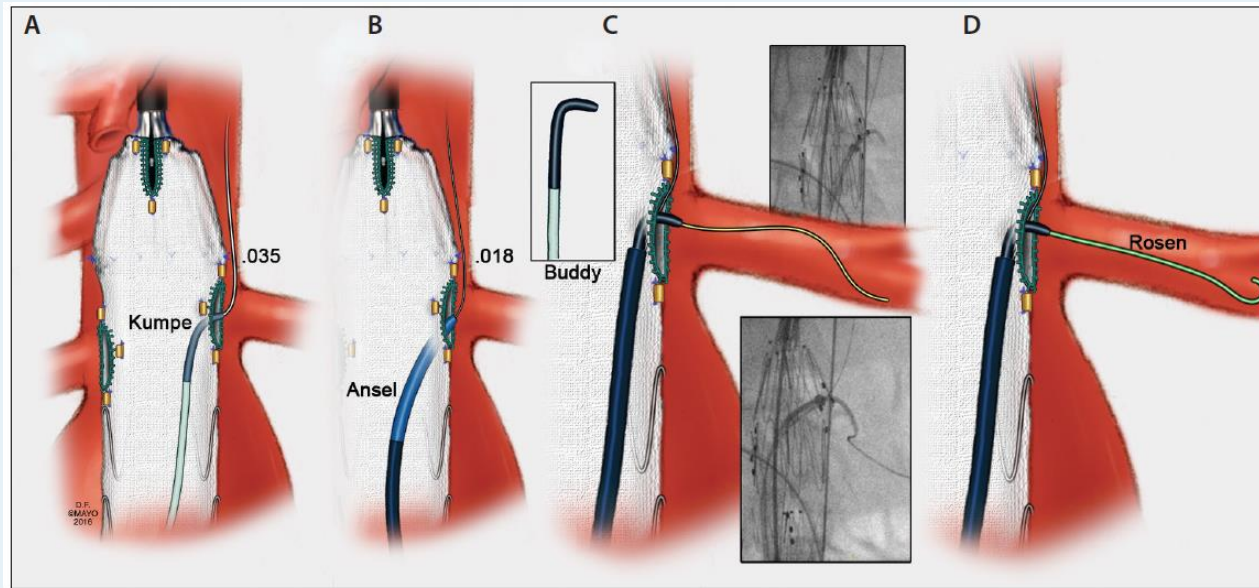


Branches

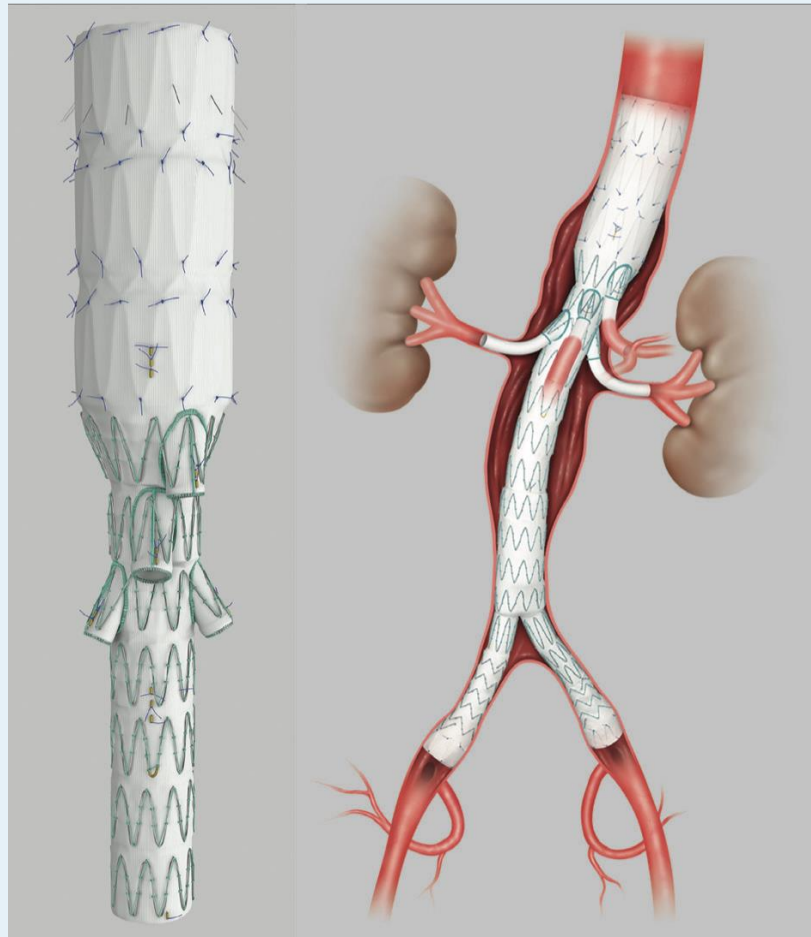
- Dedicated devices for the anatomy
- Parallel Grafts
- Physician modified endografts

Dedicated Devices

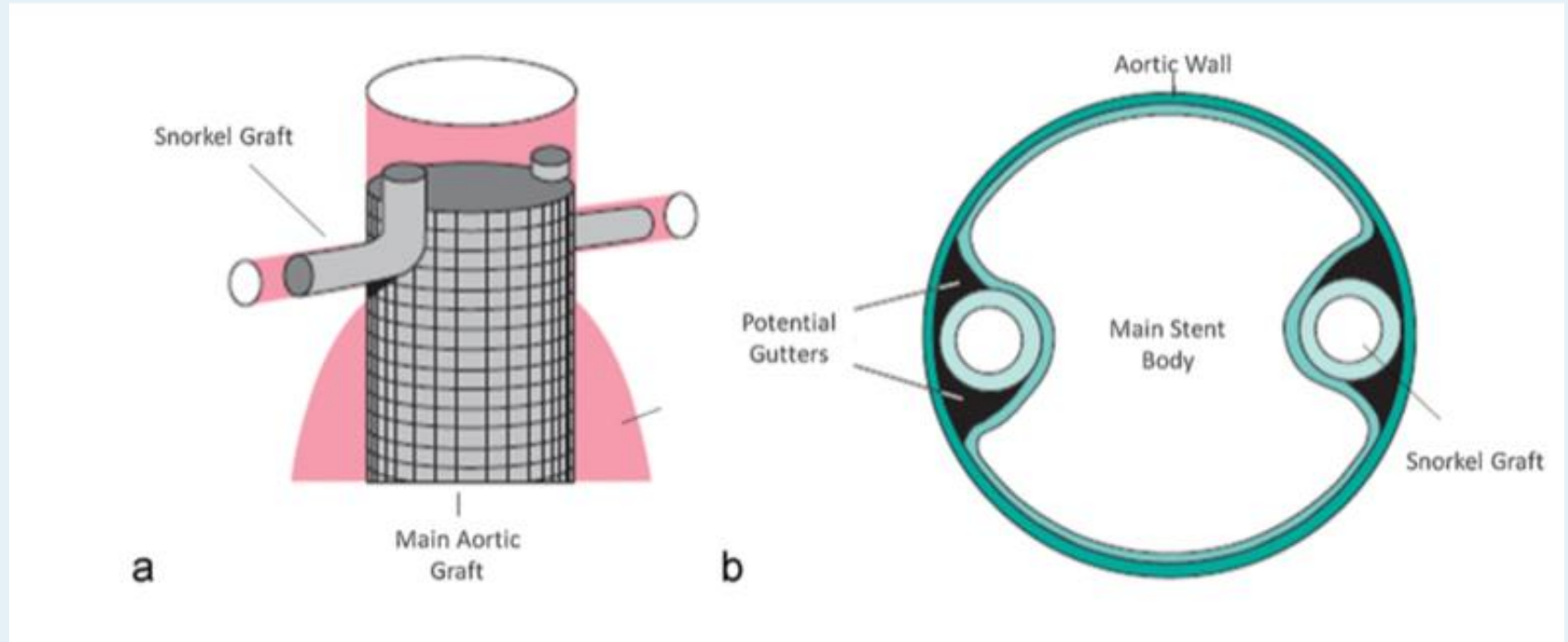
Fenestrated devices



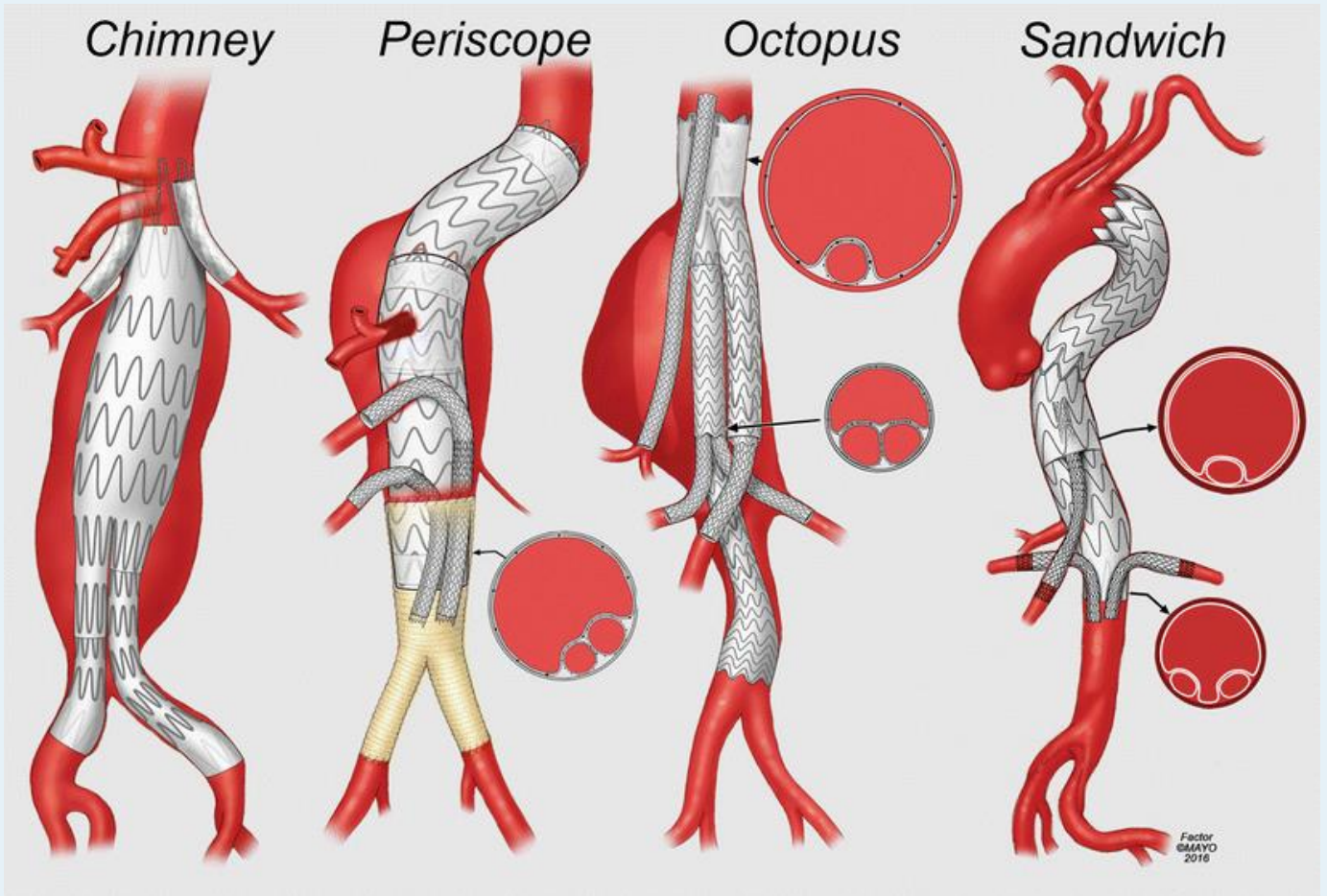
Dedicated Devices Branched Devices



Parallel Grafts



Parallel Grafts

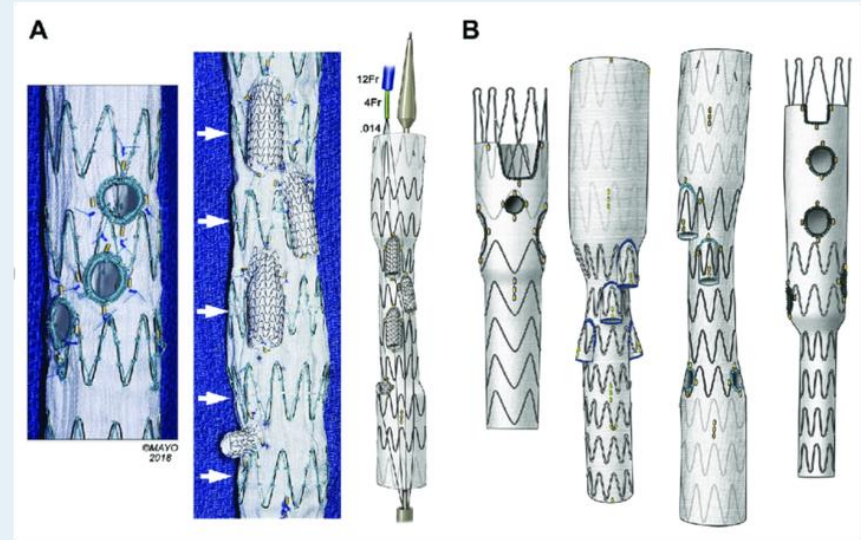


Physician Modified Endografts

- We create our own fenestrations and/or branches.
- Can be back table
- Can be In-Situ

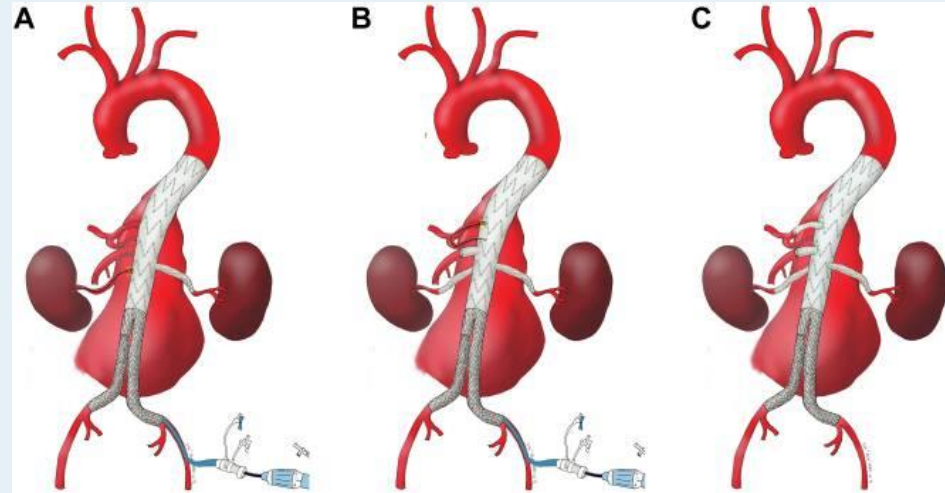
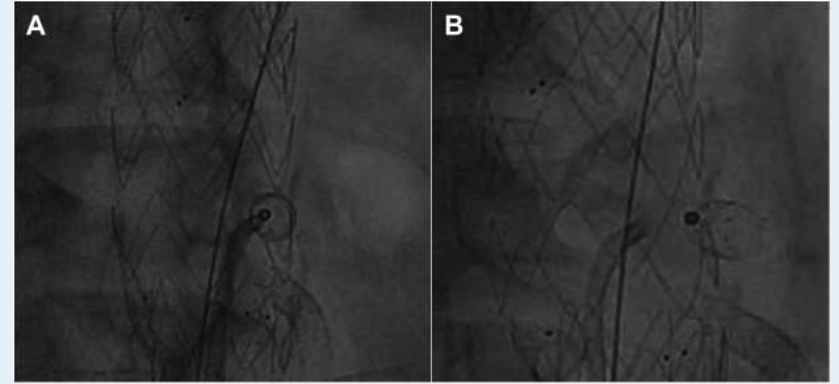
Physician Modified Endografts

- We create our own fenestrations and/or branches.
- Can be back table
- Can be In-Situ



Physician Modified Endografts

- We create our own fenestrations and/or branches.
- Can be back table
- Can be In-Situ



Physician Modified Endografts

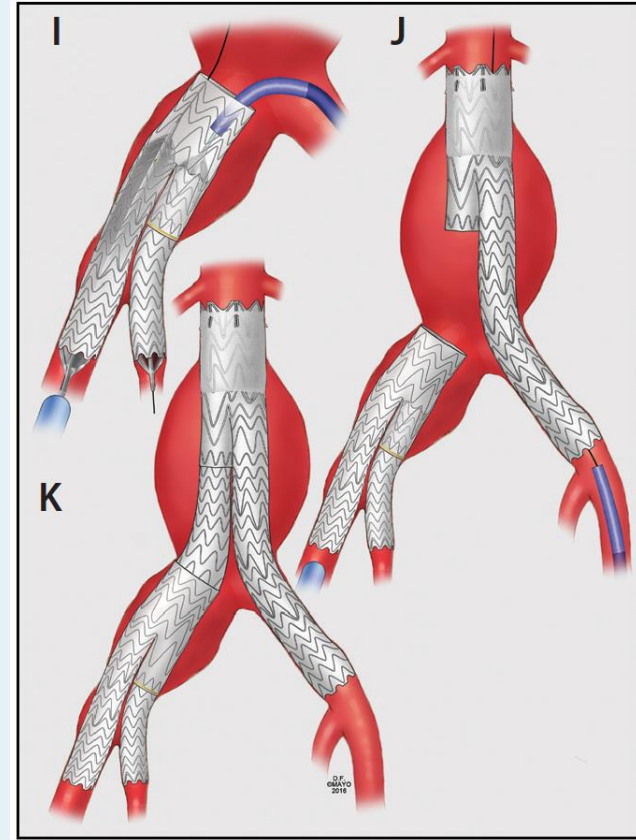
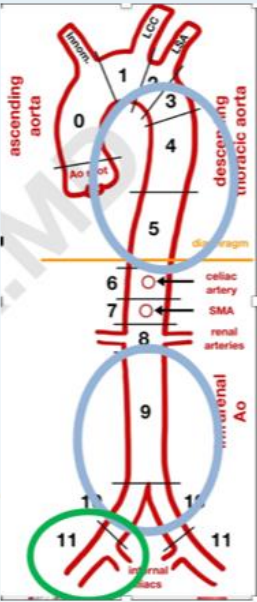
- We create our own fenestrations and/or branches.
- Can be back table
- Can be In-Situ
- Can be extremely complex procedures
- No quality control
- Significant regulatory and legal implications

Current Dedicated Devices

- Commercially available

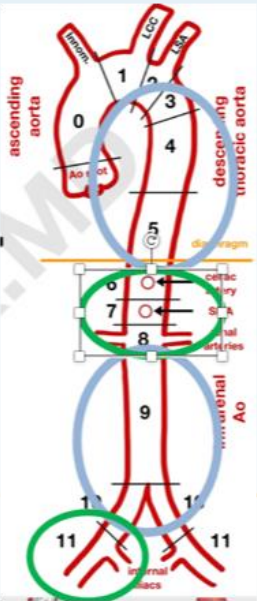
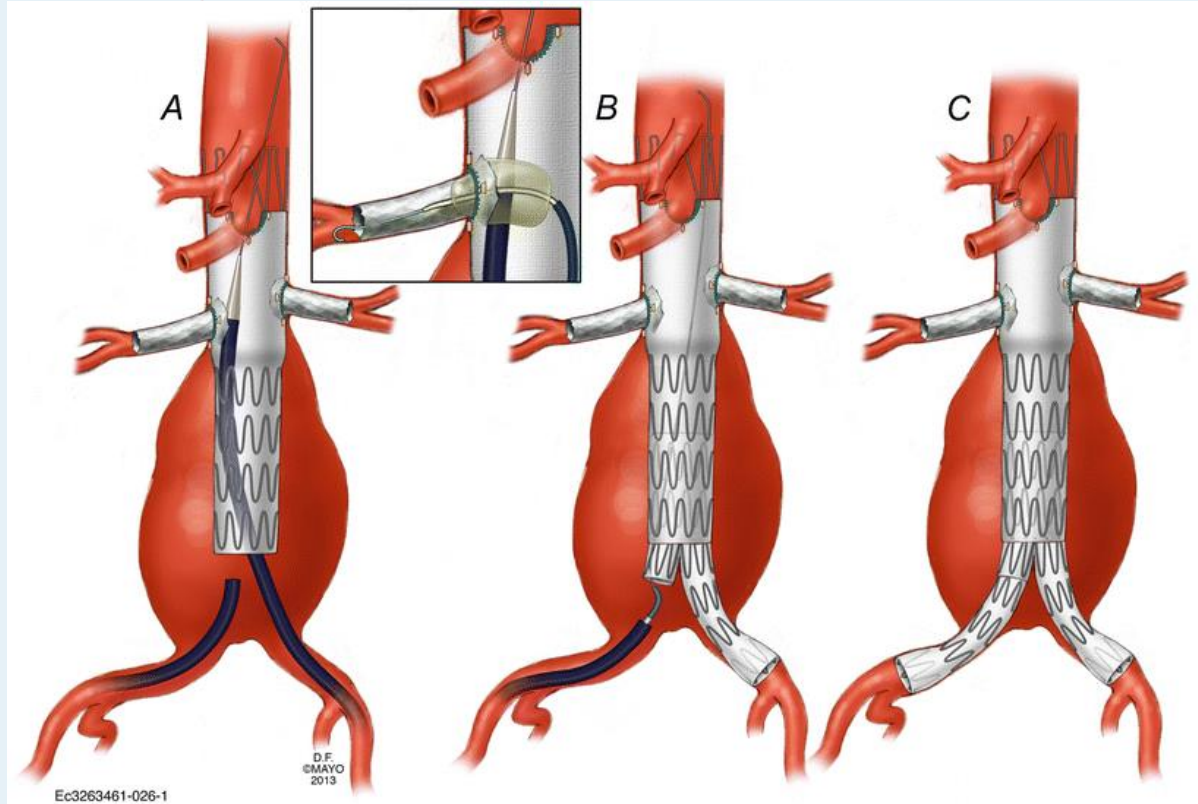
- Investigational
 - Under Clinical Trials
 - PSIDE (Physician Sponsored Investigational Device Exemption)

Commercially Available Devices IBE (Gore)



Commercially Available Devices

Z-fen (Cook Medical)

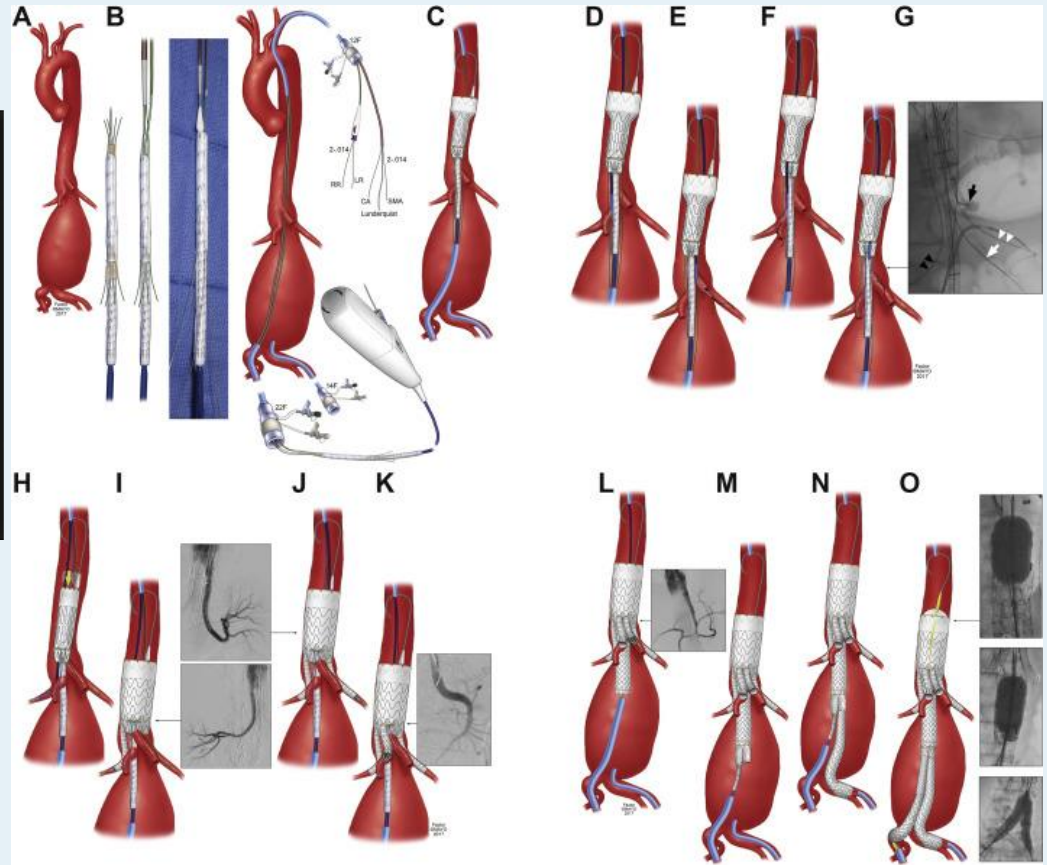
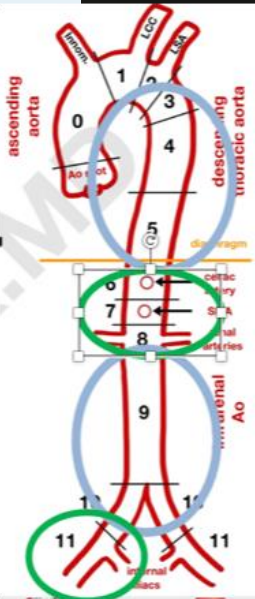


Commercially Available Devices

TAMBE (Gore)

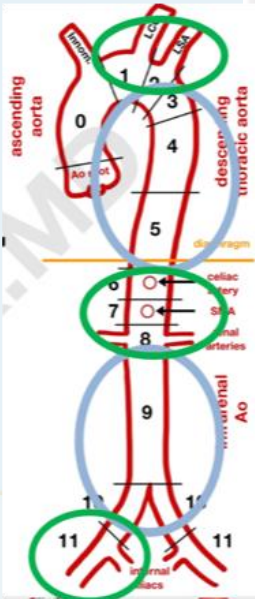
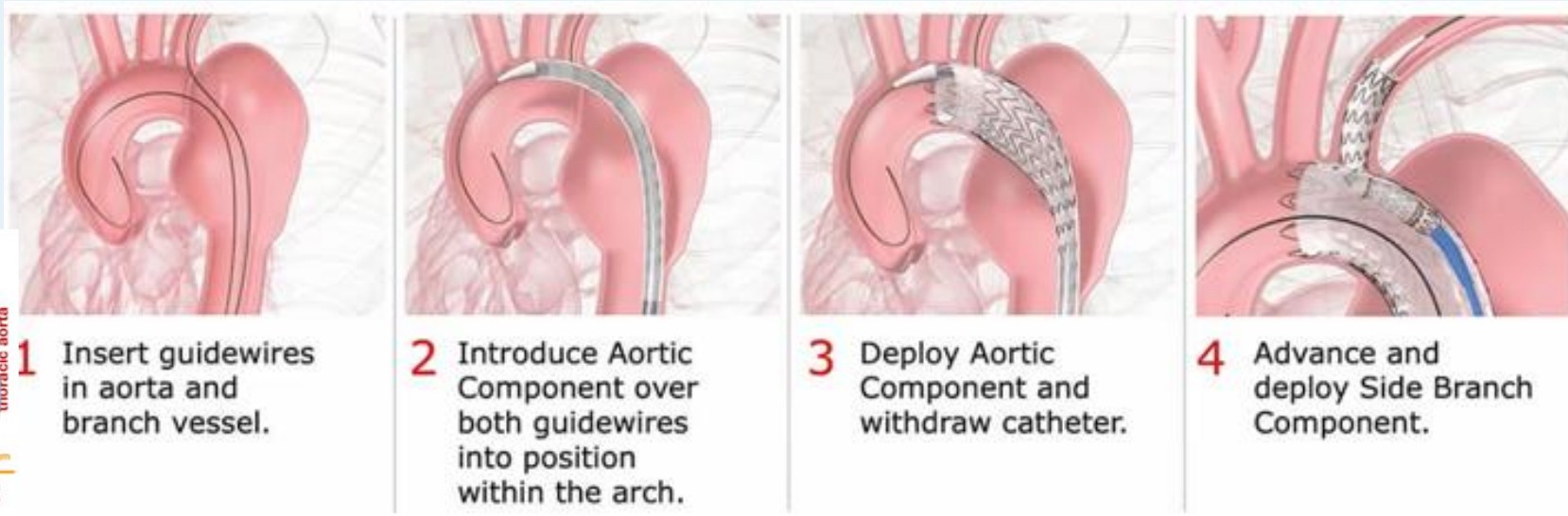


© 2015 W. L. Gore & Associates, Inc.



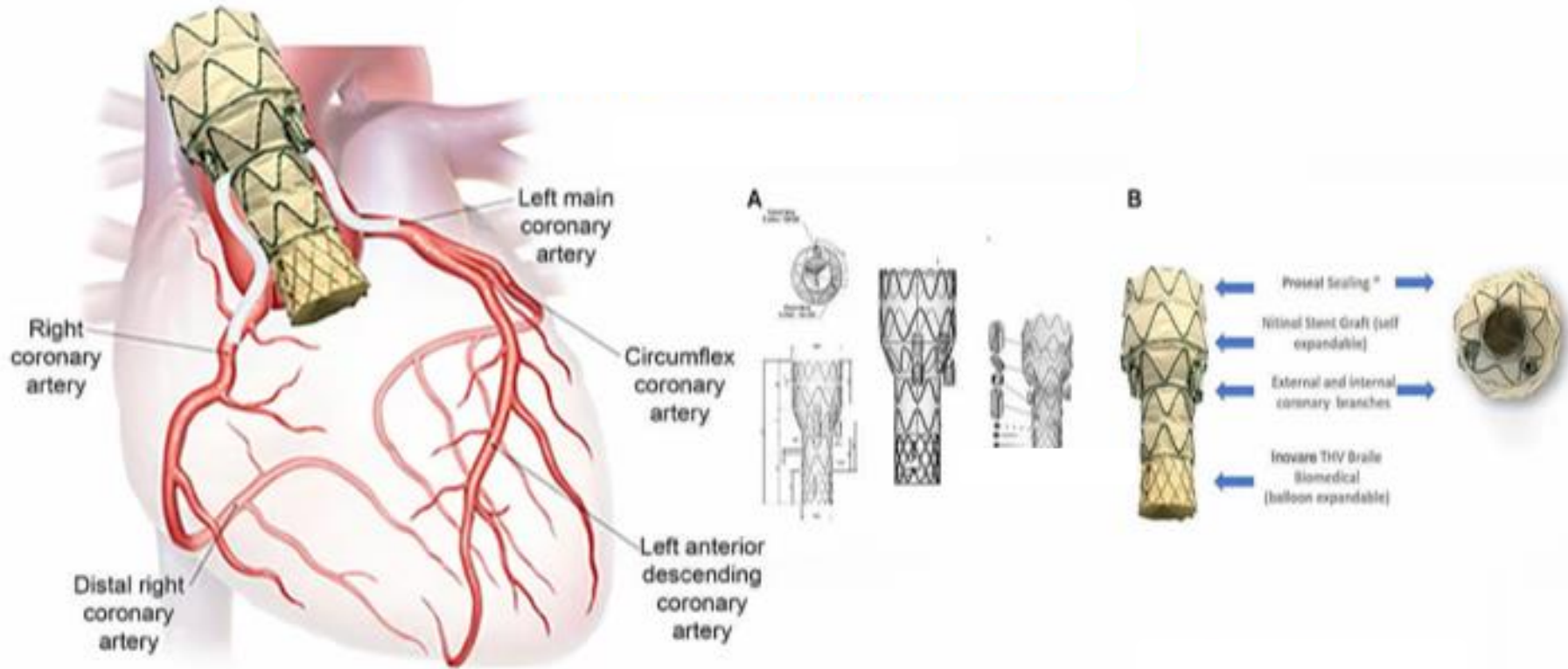
Commercially Available Devices

TBE (Gore)



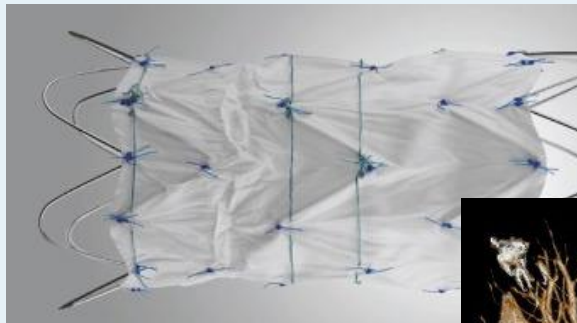
Investigational Devices

Aortic Root (Endo Bental)



Investigational Devices

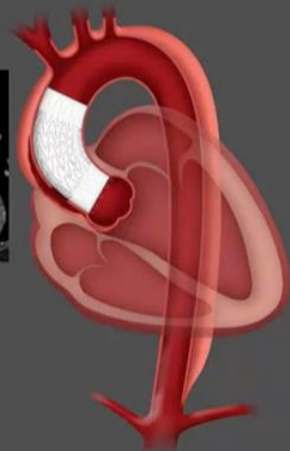
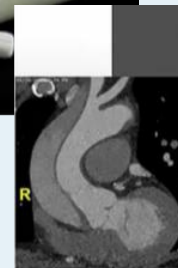
Ascending Aorta



Ascend Device (Cook Medical)



ASG Device (Gore)



Investigational Arch Devices

Single Branch Devices



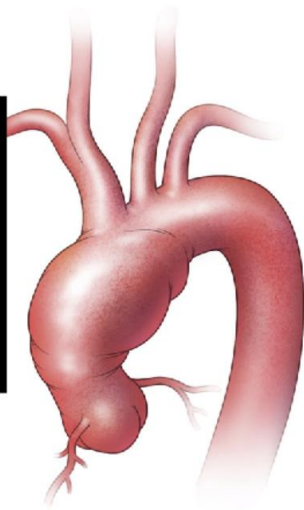
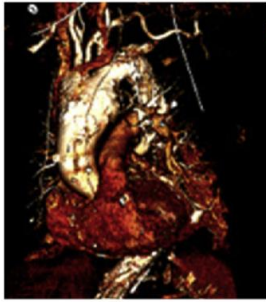
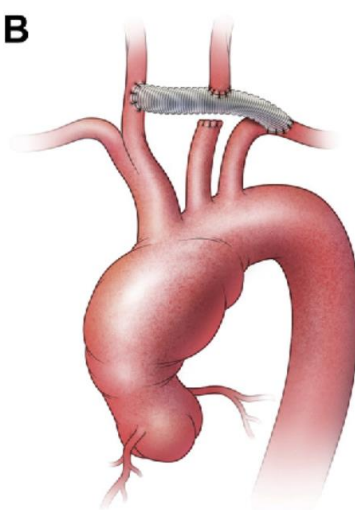
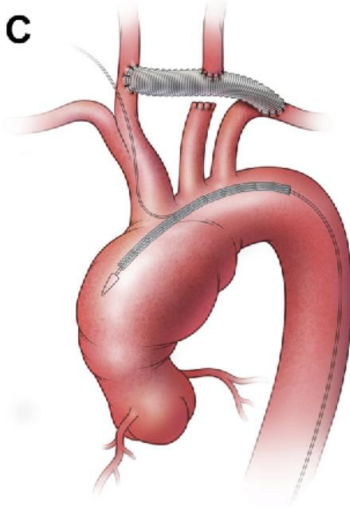
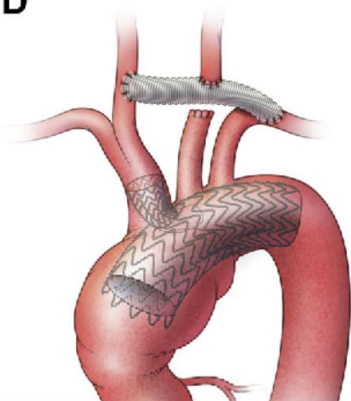
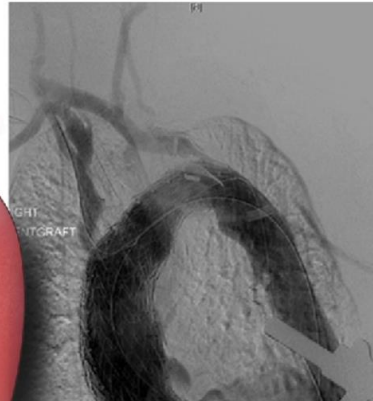
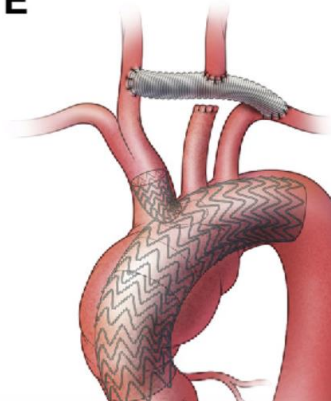
TBE (Gore)



Mona LSA (Medtronic)

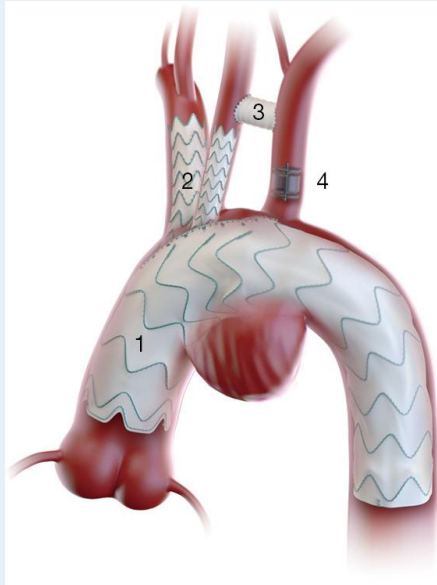


NEXUS (Endospan)

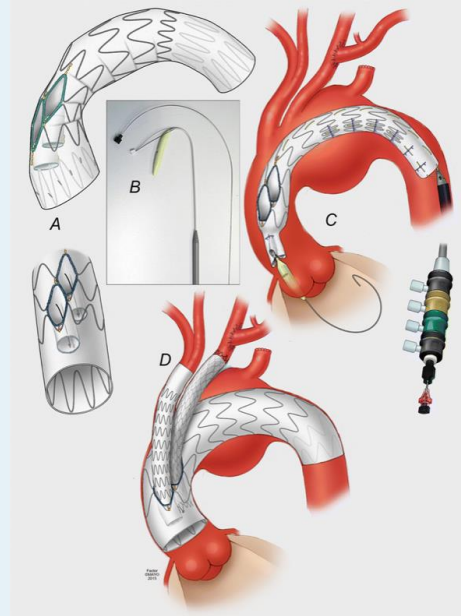
A**B****C****D****E**

Investigational Arch Devices

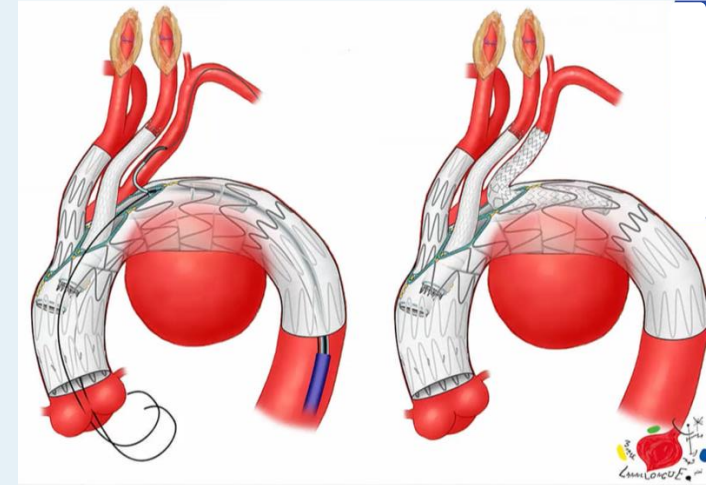
Dual and Triple Branch Devices



Relay Branch Device (Terumo)

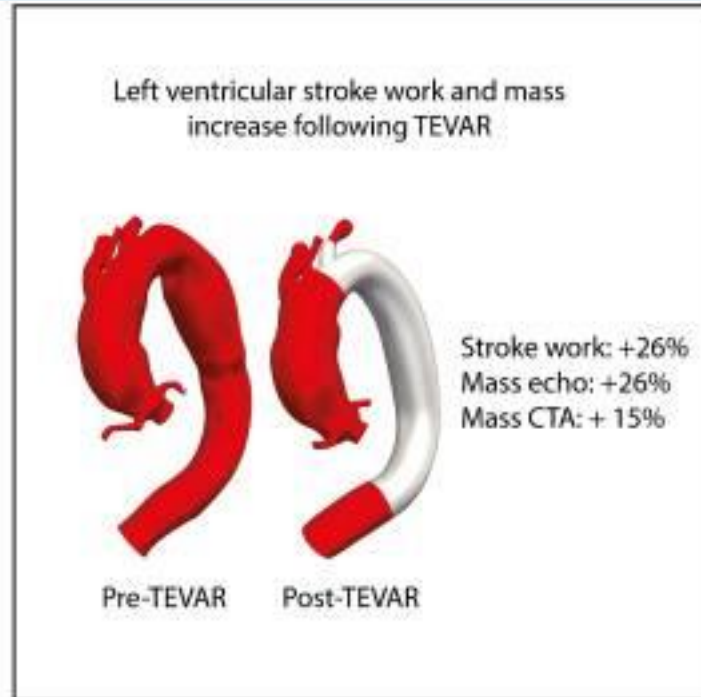
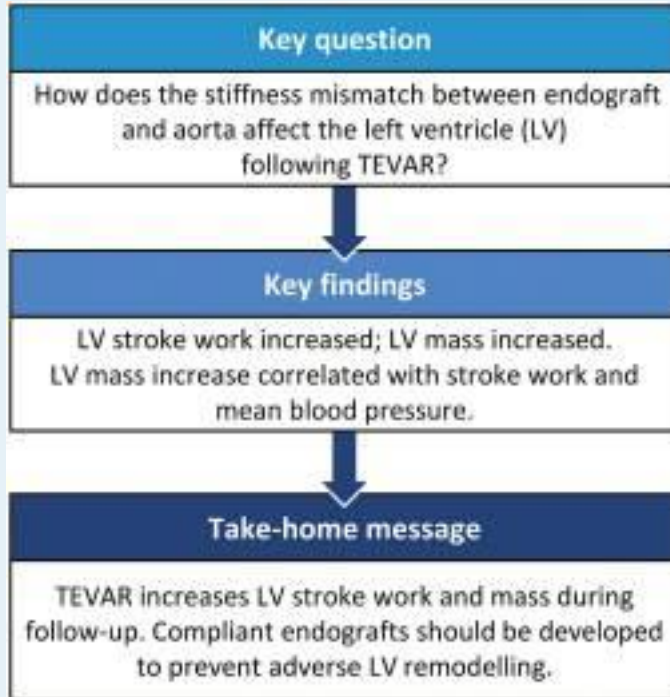


Dual Branch Device (Cook Medical)



Triple Branch Device (Cook Medical)

Aortic Compliance After TEVAR



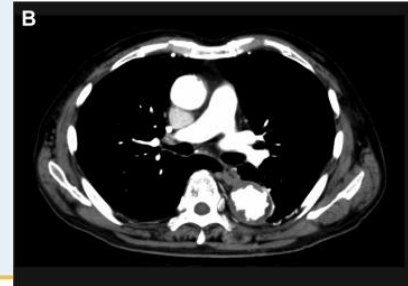
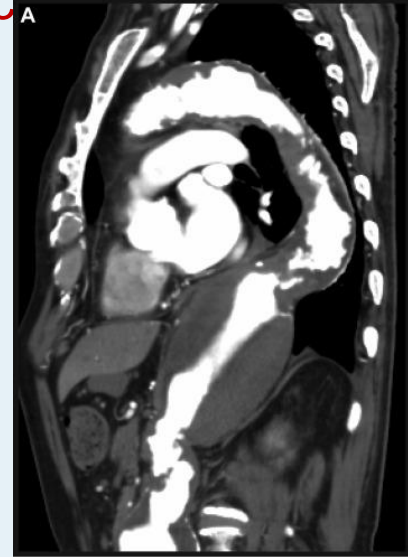
(van Bakel, et al; Eur J Cardiothorac Surg; 2019)

Currently Unsuitable Aortic Cases for Endovascular Repair

- Excessive tortuosity.

Currently Unsuitable Aortic Cases for Endovascular Repair

- Excessive tortuosity.
- Large clot burden



Currently Unsuitable Aortic Cases for Endovascular Repair

- Excessive tortuosity.
- Large clot burden
- **Connective tissue diseases**

Currently Unsuitable Aortic Cases for Endovascular Repair

- Excessive tortuosity.
- Large clot burden
- Connective tissue diseases
- **Infected aortic pathologies**

Current Barriers to Total Endovascular Aortic Care

- Availability of Devices for different anatomies and pathologies
- Complexity of implantation procedure
- Excessive radiation exposure
 - During implantation
 - Follow up
- Device durability
- Continued evolution of the aortic pathology
- Myocardial degeneration (hypertrophic cardiomyopathy)

The Future

- Device availability and improvement
- Newer technology
 - Device design
 - Navigation
 - Imaging
 - AI

Conclusions

- We have gone a long way in aortic surgery
- Endovascular repair of various aortic pathologies has improved dramatically and continues to over the years opening new frontiers in the management of aortic disease.
- Newer devices, newer imaging and navigation technologies, AI are all in progress

Total endovascular aortic care; are we there yet?!

Not really but we are on our way.



Thank You

