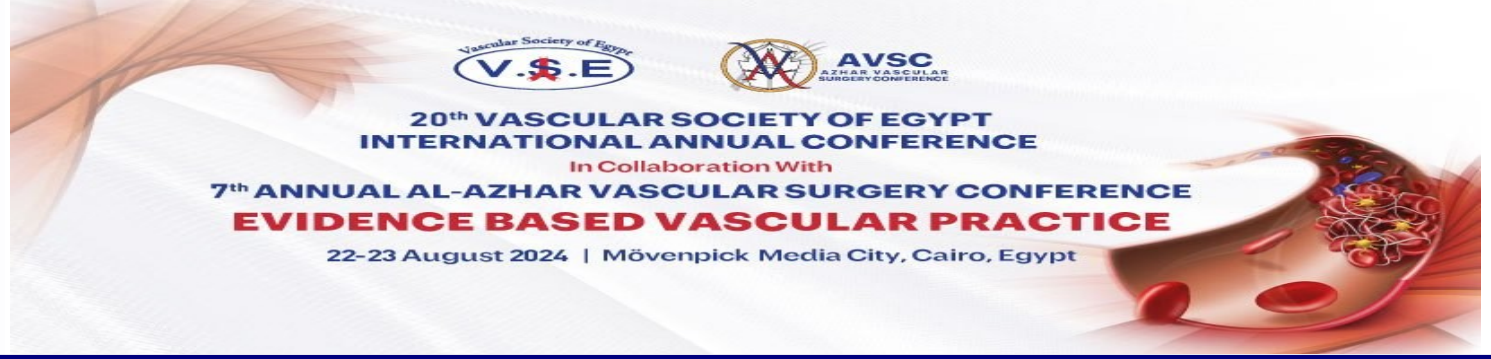
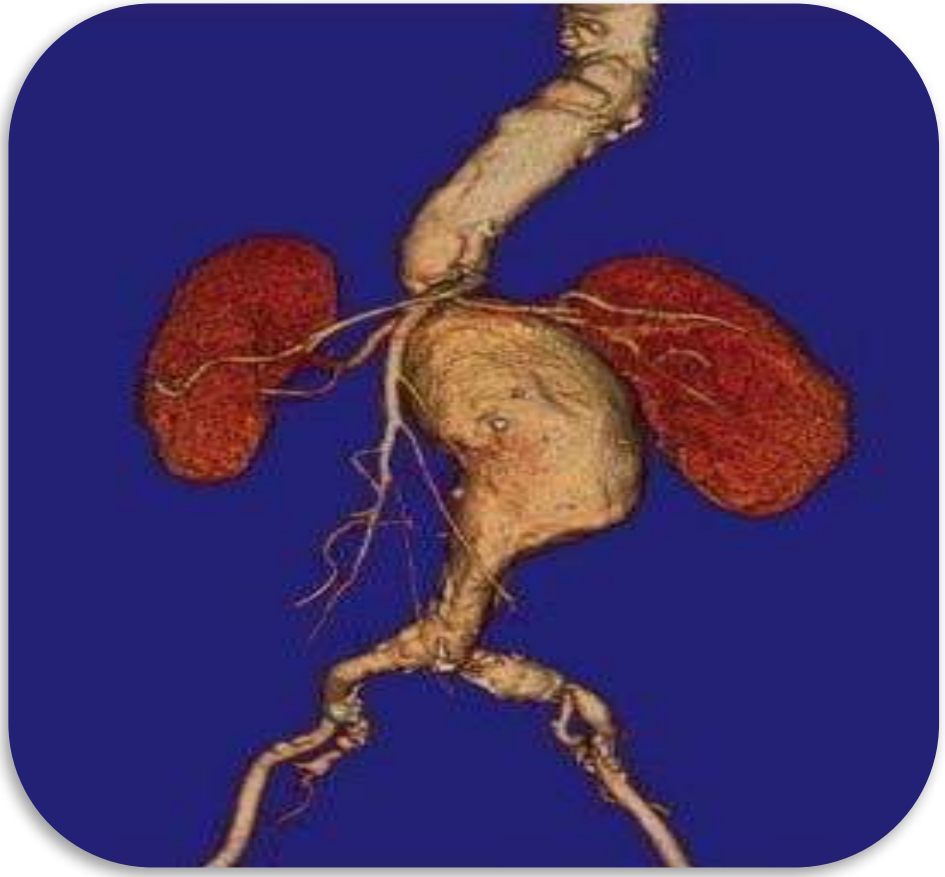


Contemporary Options For Treating Juxtarenal Aneurysm

Samer Koussayer, MD, FACS, RVT

Assoc. Professor , Al Faisal University
Consultant Vascular & Endovascular Surgery
Director of Fellowship Program
King Faisal Specialist Hospital & Research Center
Riyadh, KSA

Juxtarenal AAA : Neck <10mm



Treatment options

- EXTEND PROXIMALLY TO CREATE A NEW SEALING ZONE

FEVAR

"Chimney"

- CREATE AN ENDOVASCULAR SUTURE LINE

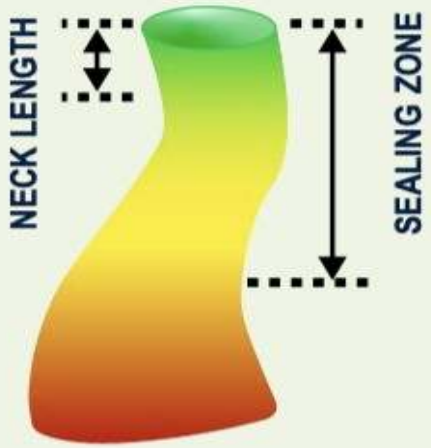
- EXPERIMENTAL

Physician-modified endovascular grafts

Not All Short Neck Are The Same

INFRARENAL SEALING ZONE

NEEDS



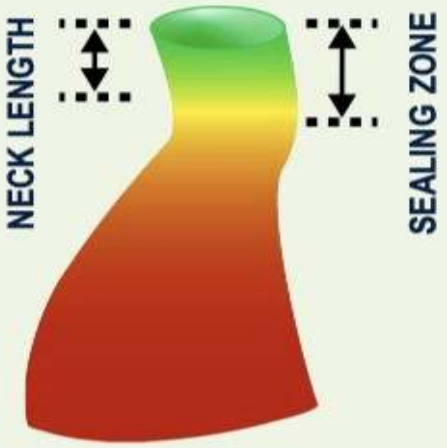
HOSTILE

SEAL

+

STRENGTH

Use all the existing seal and maintain the seal over time



INADEQUATE

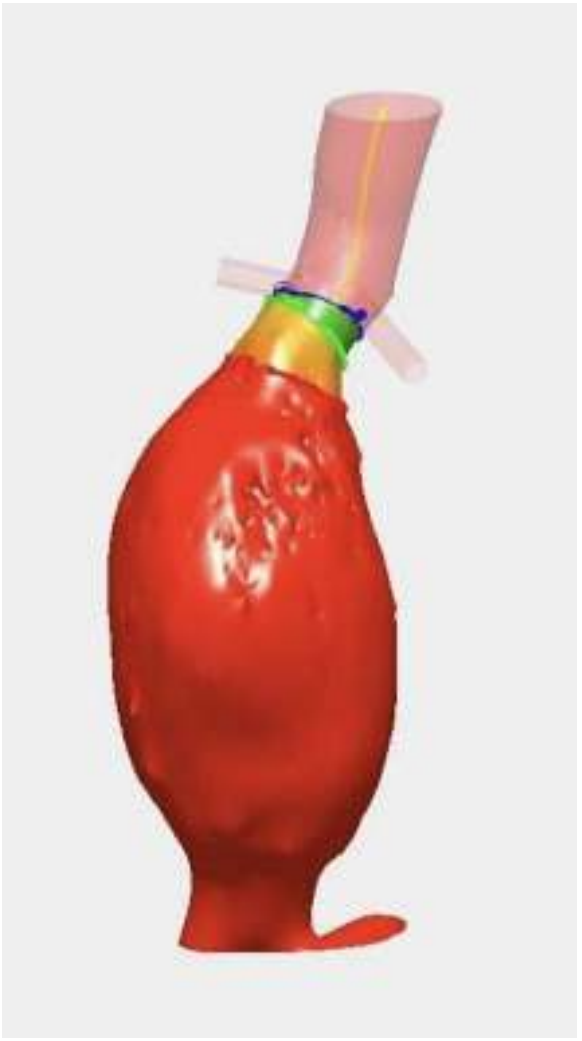
SEAL

+

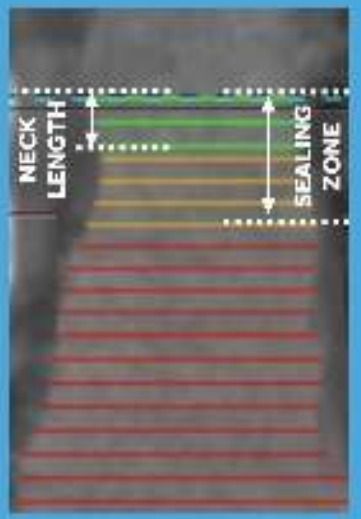
LENGTH

Extend the seal above the renals

1- Hostile Sealing Zones – Protect The Seal

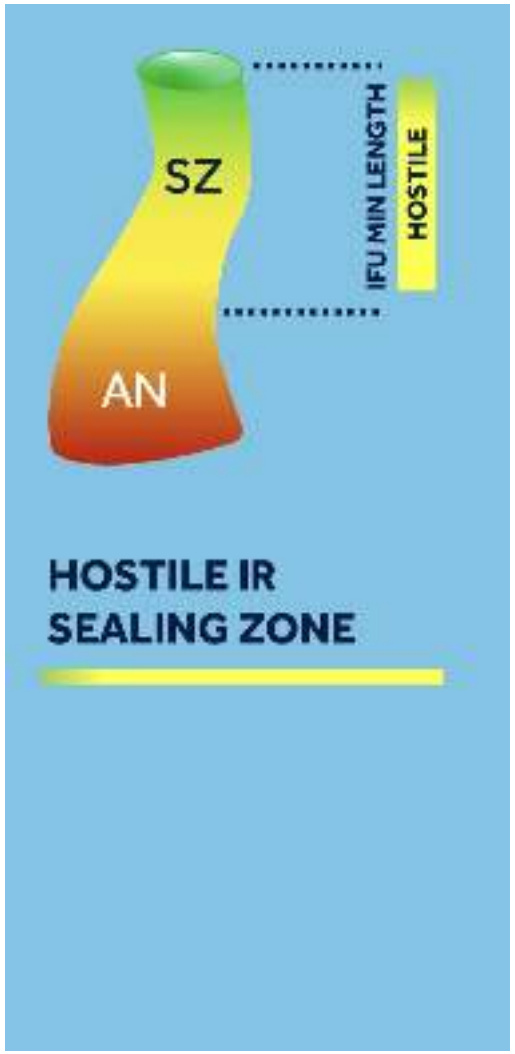


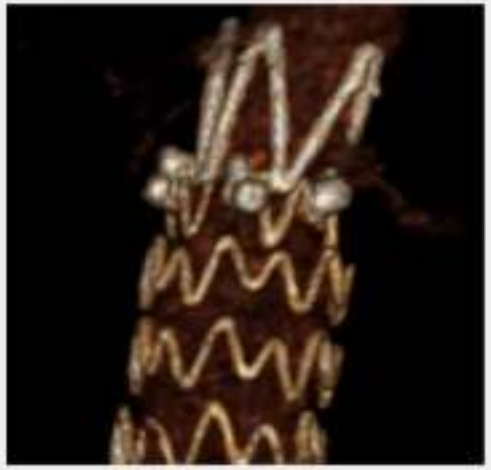
NECK LENGTH	SEALING ZONE	NECK DIAMETER	ANGULATION INFRARENAL	ANGULATION SUPRARENAL	%THROMBUS	% CALCIUM
4 mm	10 mm	24 mm	20°	10°	0%	0%



- ✓ The graft is expected to have **circumferential apposition** along the min IFU length
- ✓ Infrarenal sealing zone is sufficient (longer than min neck recommended per IFU of the standard graft alone) to seal infrarenally
- ✗ Infrarenal sealing zone is considered hostile (conical)

HOSTILE SEALING ZONES – ADD STRENGTH TO SEAL

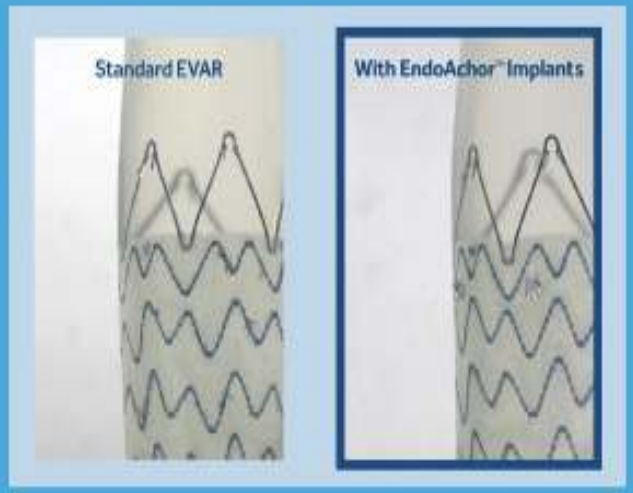




NECK LENGTH	SEALING ZONE	NECK DIAMETER	ANGULATION INFRARENAL	ANGULATION SUPRARENAL	%THROMBUS	% CALCIUM
4 mm	10 mm	24 mm	20°	10°	0%	0%

ESAR
(ENDURANT + HELI-FX)

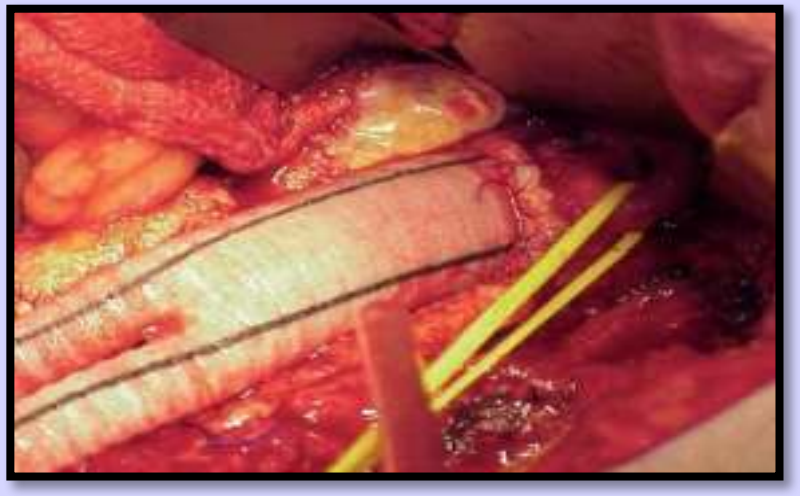
- STRENGTHEN THE SEAL
- AVOID RENAL CANNULATION

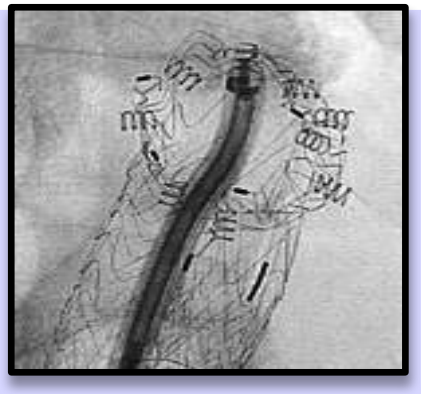


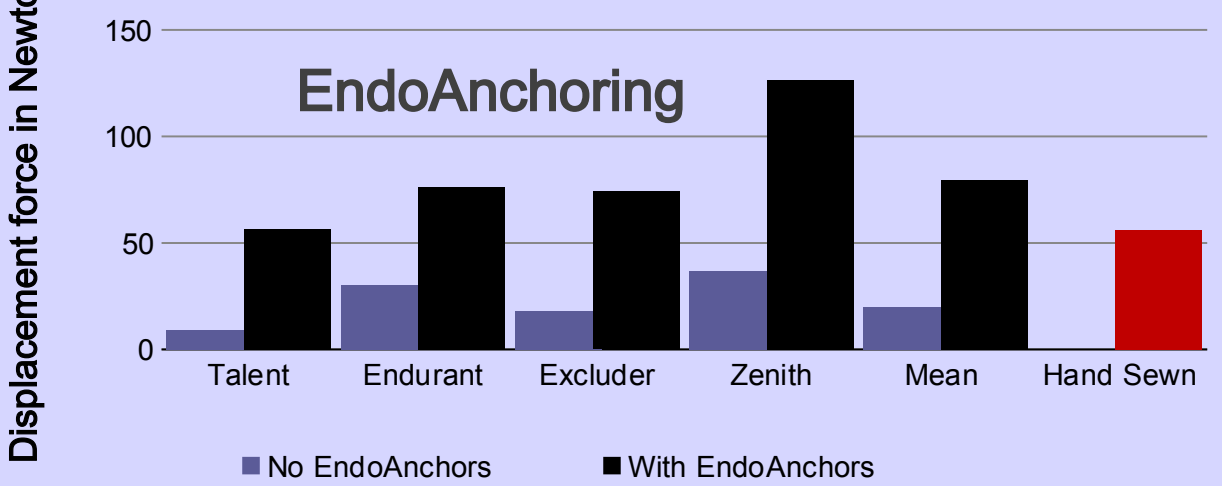
Less is better, no need for renal cannulation
if infrarenal seal zone can be strengthened

How Does The Endoanchores Work..

IT Create the stability of a surgical anastomosis by providing transmural fixation of endografts to the aortic wall



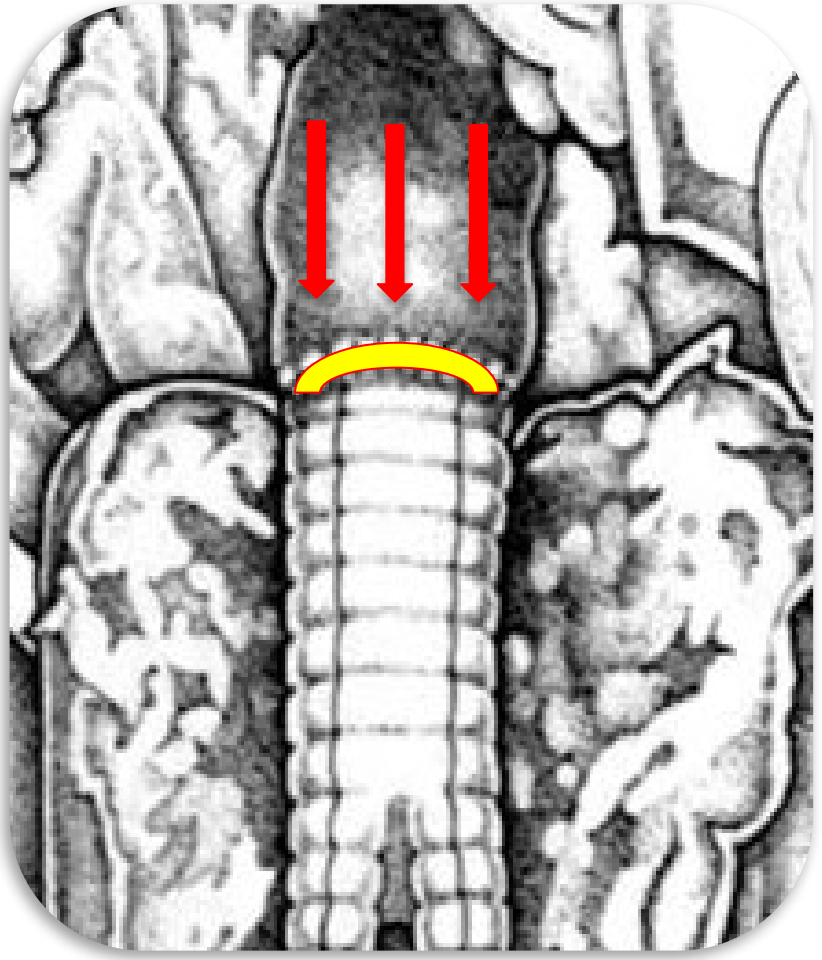




Case images from John Aruny MD, Bart Edward Muhs, MD, PhD.

Melas et al. *JVS* 2012;55(6):1726-33

WHAT WE KNOW ABOUT OPEN REPAIR



In Open Repair, suture line provides:

- ***Longitudinal fixation***
  - **Preventing downward displacement of the graft from the aorta**
- ***Radial fixation***
  - **Preventing dilation and separation of the aorta from graft**

Image adapted from Kaza AK et al. JVS. 2001;34:367-8

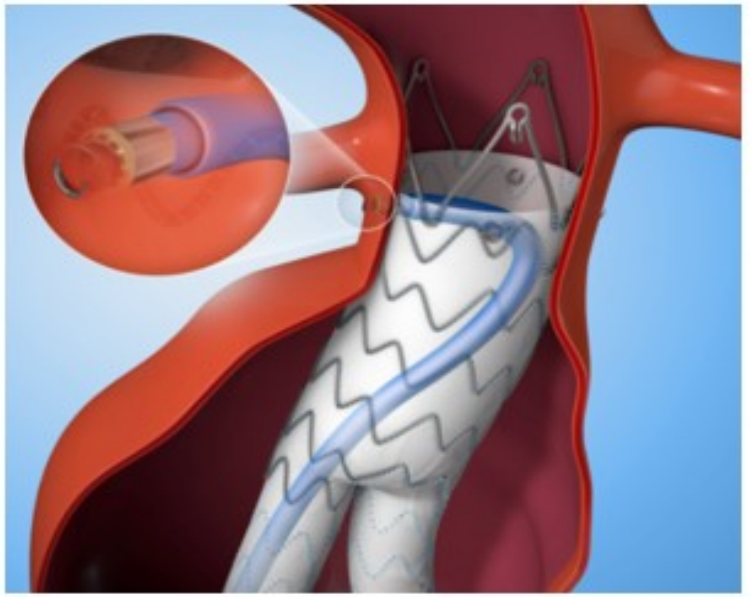
OVERCOMING THESE IN VIVO AND DURABILITY CHALLENGES

Unlike Open Repair, NO endo grafts offer techniques for *radial fixation*
- *Yet, AAA is a dilating disease*

Adaptability to long-term disease process will improve outcomes
- *Don't fight the disease but adapt to it*

Heli-FX™ EndoAnchor™ Implant System:

- Provide Longitudinal & Radial Fixation[1,2]
- Increases Aorta-Graft Apposition[3,4]



1: Melas et al. J Vasc Surg. 2012; 55(6):1726-33 3: Tassiopoulos AK et al. J Vasc Surg. 2017; 66(1):45-52
2: Perdikides et al. J Endo Ther 2012; 19:707-715 4: Deaton, Semin Vasc Surg 25:187-192

ANCHOR Registry

- **Treat hostile necks off-the-shelf with Heli-FX™ EndoAnchor™ system**

Reinforced seal

Transmural radial fixation of aorta to endograft, similar to sutured anastomosis

Durable Long-term Results in Challenging Patients

Early 5-Year Results ANCHOR Primary Arm[1]

89.0% FF Type Ia

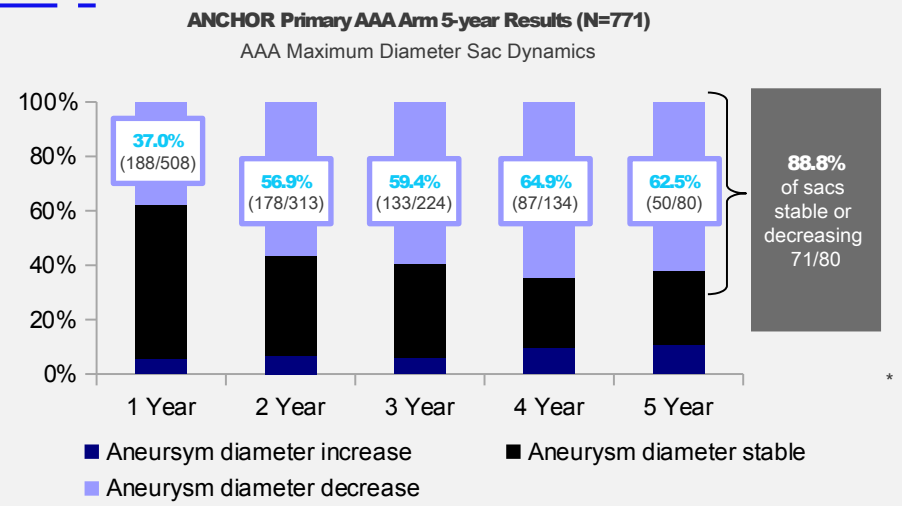
96.0% FF Reinterventions for Type Ia

0 Migrations at any time through 5 years

98.4% FF ARM^

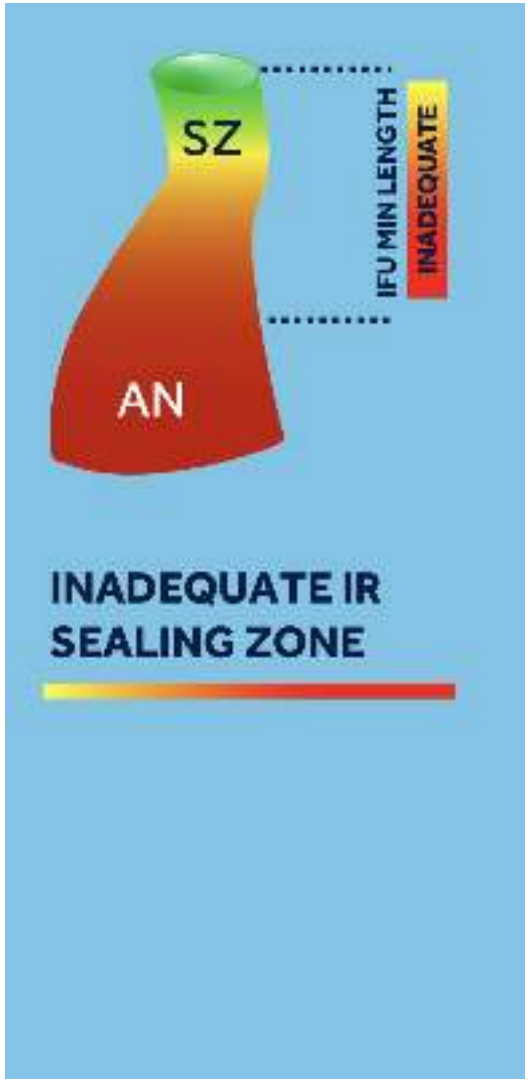
97.7% FF Rupture

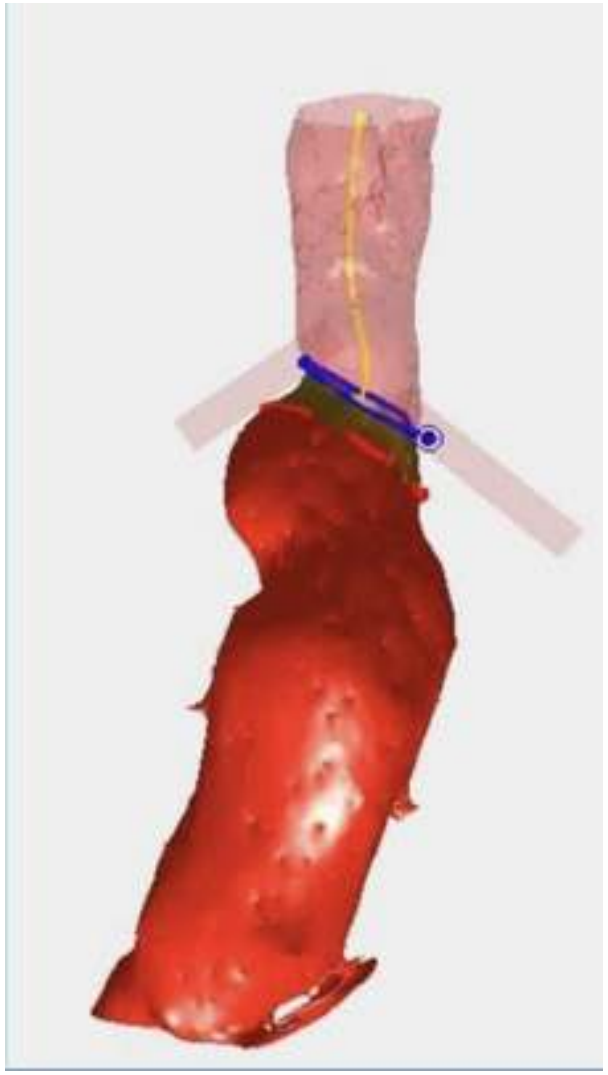
88.8% Stable or Regressing Sac



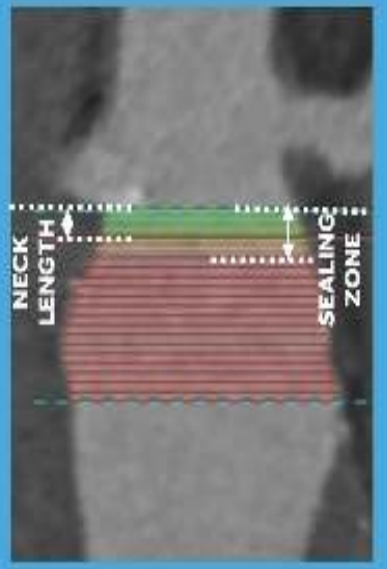
1 ANCHOR Registry Primary AAA Arm, October 2020 data cut. Data on file at Medtronic.
^ARM: Aneurysm-related mortality
* AAA diameter increase defined as ≥ 5 mm increase in maximum diameter. AAA diameter decrease defined as ≥ 5 mm decrease in maximum diameter

2- Inadequate Sealing Zones – Add Length To Seal



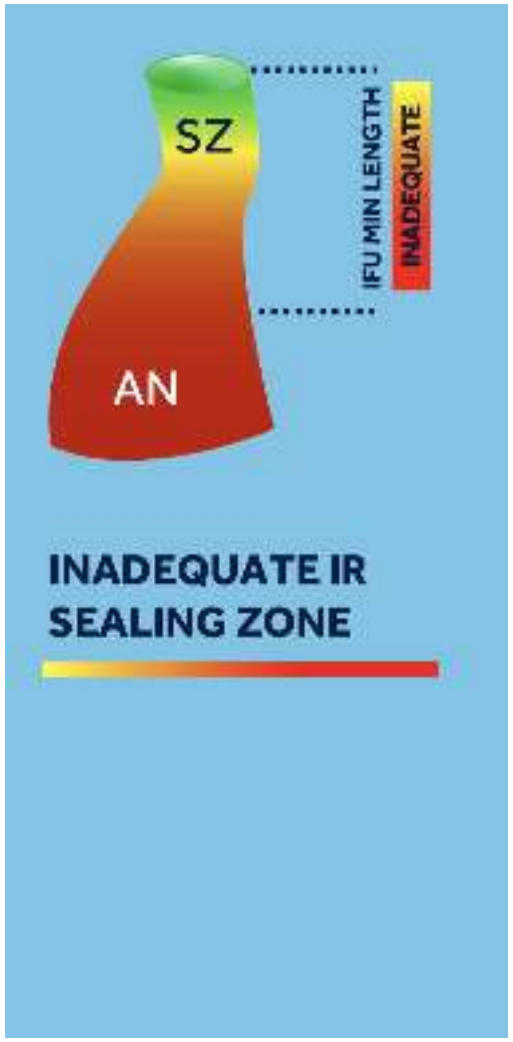


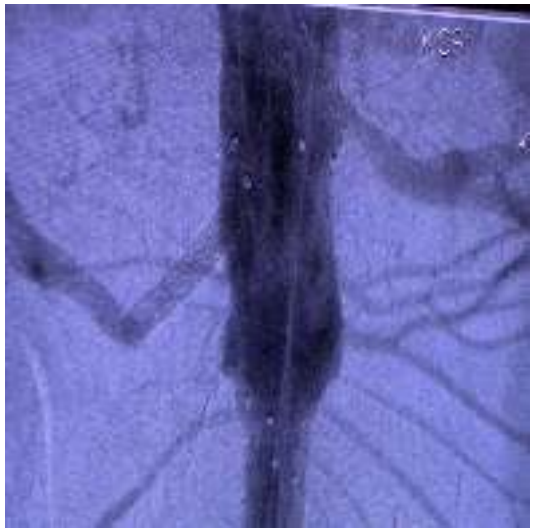
NECK LENGTH	SEALING ZONE	NECK DIAMETER	ANGULATION INFRARENAL	ANGULATION SUPRARENAL	%THROMBUS	% CALCIUM
3 mm	5 mm	26 mm	15°	10°	0%	0%



- The graft is expected to have **limited/no circumferential apposition**
- **Infrarenal sealing zone is not sufficient** (shorter than min neck recommended per IFU of the standard graft alone) to seal infrarenally

Inadequate Sealing Zones – Add Length To Seal

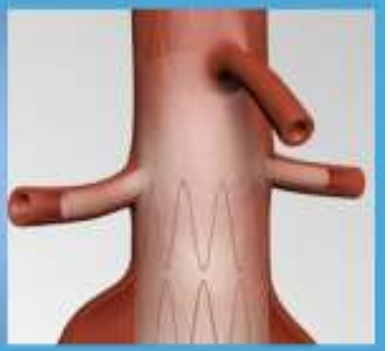




NECK LENGTH	NEW SEALING ZONE	NECK DIAMETER	ANGULATION INFRARENAL	ANGULATION SUPRARENAL	%THROMBUS	% CALCIUM
3 mm	15 mm	26 mm	15°	10°	0%	0%

ChEVAR-FEVAR

- EXTEND THE SEAL IN HEALTY AORTA
- ADD LENGTH

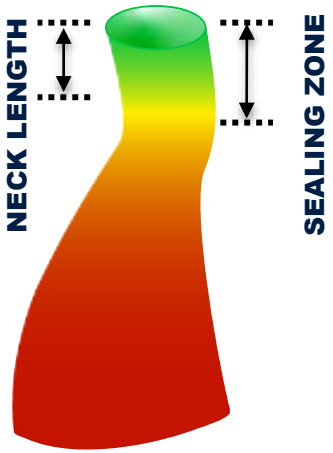


ChEVR

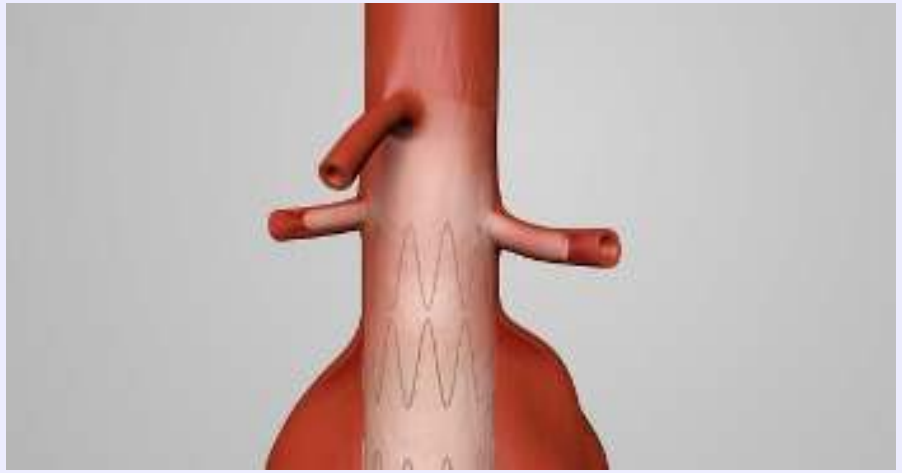
FEVR

If the infrarenal sealing zone is inadequate, an healthier one should be found above the renals

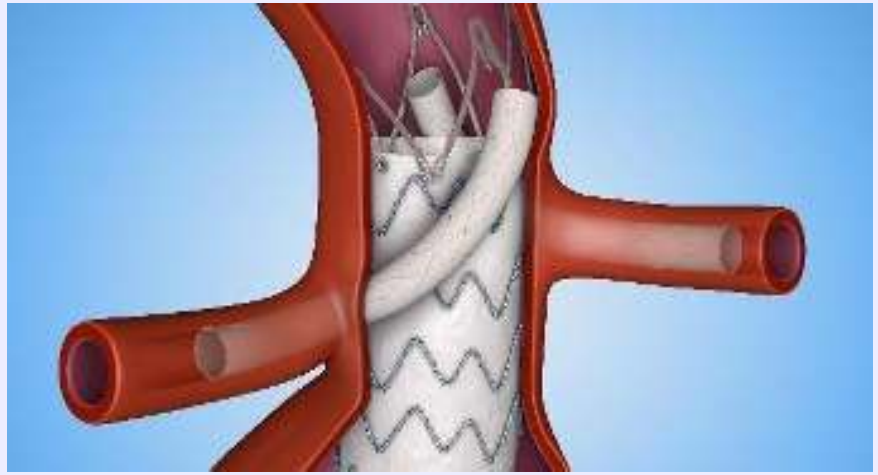
Inadequate sealing zone needs seal + length



INADEQUATE



F-EVAR



Ch-EVAR

Empower physicians to be confident with ChEVAR in the right patients!

PROS

- Custom made
- Consolidated Technology

CONS

- More accurate planning
- Technical skills demanding procedure
- Long design and production time

VS

- Off the shelf
- Emergency setting availability
- Cheaper
- Technically easier ??

- Less wall apposition (Gutters)
- Grafts conflict

The Algorithm

Low medical risk

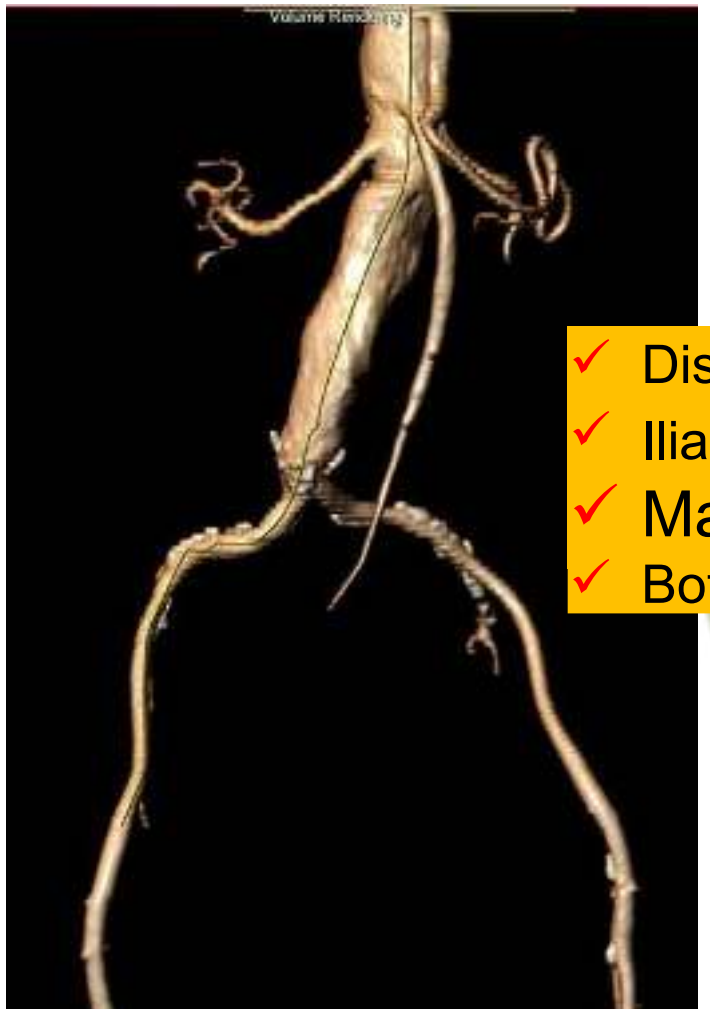
High medical risk

Unfit for any intervention

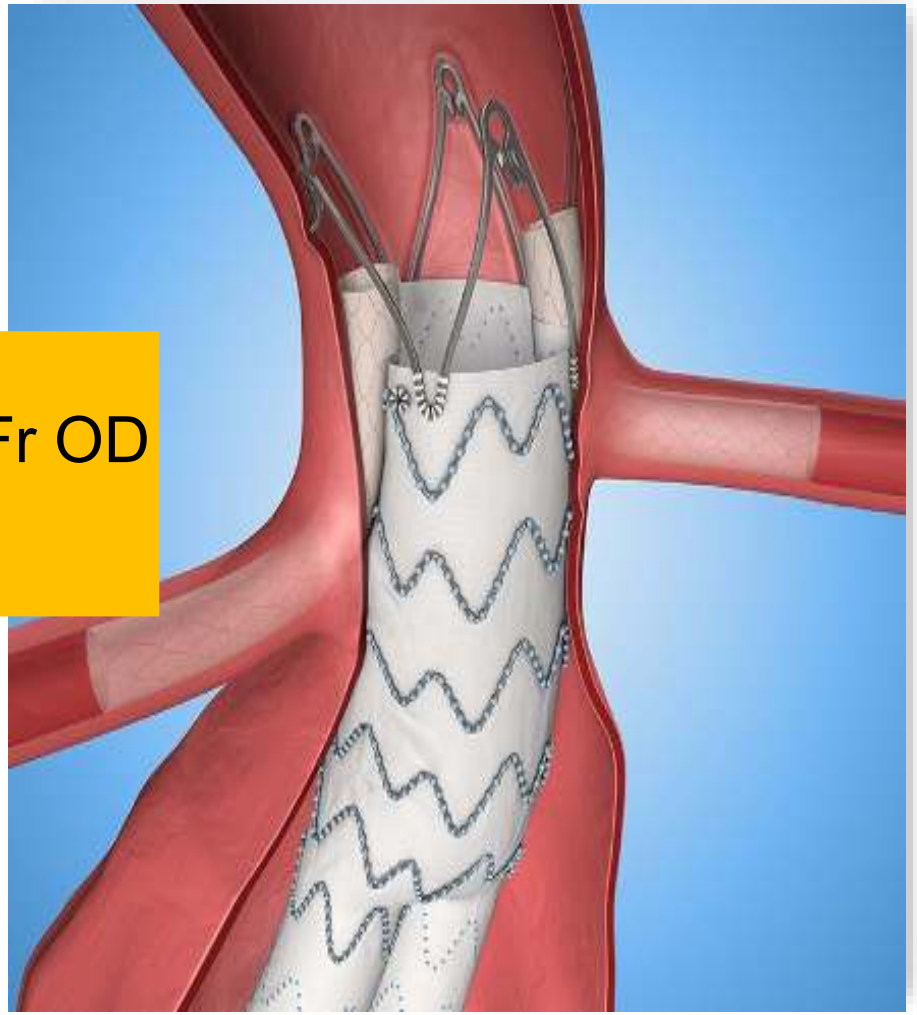
Relevant evidence: FEVAR Clinical Data

Author Reference	n of pts (branches)	Technical success	Mortality 30-day	Dialysis	Branch Patency	Freedom 2ry Reintervention
Anderson J et al J Vasc Surg 2001	13 (33)	100%	0	0	0	0
Halak et al J Vasc Surg 2007	17 (42)	98%	0	0	95%	88%@2y
Muhs et al J Vasc Surg 2006	38 (87)	94%	2.6%	0	92%	88%@4y
O'Neil et al Eur JVES 2006	119 (302)	91%	1%	3%	97%	-
Semmens et al J Vasc Surg 2006	58 (143)	91%	3.4%	0	-	-
Ziegler et al J Vasc Surg 2007	63 (132)	97%	1.6%	1%	92%	75%@6y
Scurr Br J Surg 2008	45 (127)	100%	2.2%	0	97%	-
Bicknell et al Eur JVES 2008	15 (40)	98%	0	0	-	-
Kristnundsoon et J End Ther 2008	54 (134)	-	3.7%	0	96%	-
Greenberg et al J Vasc Surg 2010	30 (77)	100%	0	0	98%	89%@2y
Verhoeven et al Eur JVES 2010	100 (275)	100%	1%	2%	93%	91%@2y
Haulon et al Ann Surg 2010	80 (237)	100%	2.5%	1.5%	98%	85%@1y
Total	503/1629	98%	1.3%	0.3%	97%	83%

Unsuitable for FEVAR



- ✓ Distal neck diameter 13mm
- ✓ Iliac Access: 5mm, profile 23.4 Fr OD
- ✓ Maximum neck angle 45°
- ✓ Both renals down oriented



ChEVAR Clinical Data

Pericles study- MAIN OUTCOMES

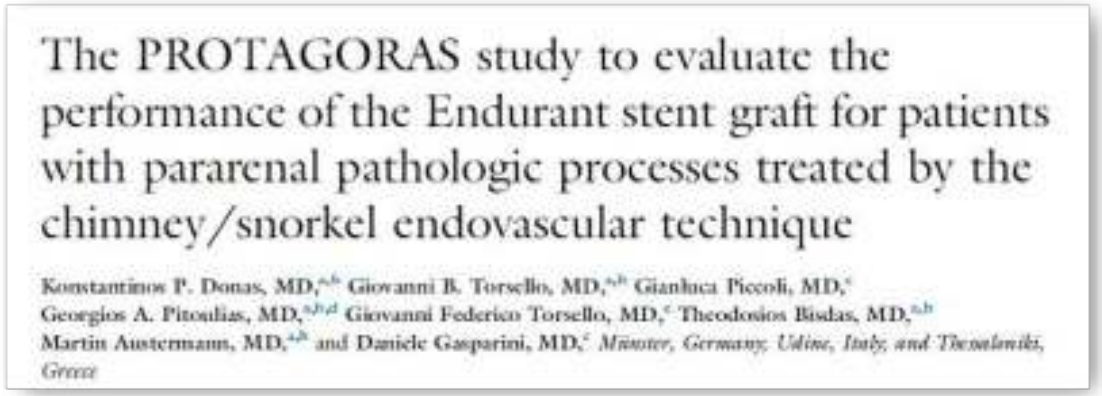
517 patients from 13 international centres

	Mean follow up 17.1 months
Intra-op type Ia endoleak:	7.9%
Persistent intra-op type Ia endoleak	2.9%
Technical Success	97.1%
Chimney-graft patency	94.1%

Donas K et. al; *Ann Surg*. 2015 Sep;262(3):546-53

ChEVAR clinical Data

PROTAGORAS study: ChEVAR with the Endurant Stent Graft



The PROTAGORAS study to evaluate the performance of the Endurant stent graft for patients with pararenal pathologic processes treated by the chimney/snorkel endovascular technique

Konstantinos P. Donas, MD,[a,b] Giovanni B. Torsello, MD,[a,b] Gianluca Piccoli, MD,[c] Georgios A. Pitoulias, MD,[a,b,d] Giovanni Federico Torsello, MD,[c] Theodosios Bisdas, MD,[a,b] Martin Austermann, MD,[a,b] and Daniele Gasparini, MD,[c] *Münster, Germany; Udine, Italy; and Thessaloniki, Greece*

128 patients with pararenal pathologies and the intention to treat by Endurant and Atrium V12 as chimney graft .

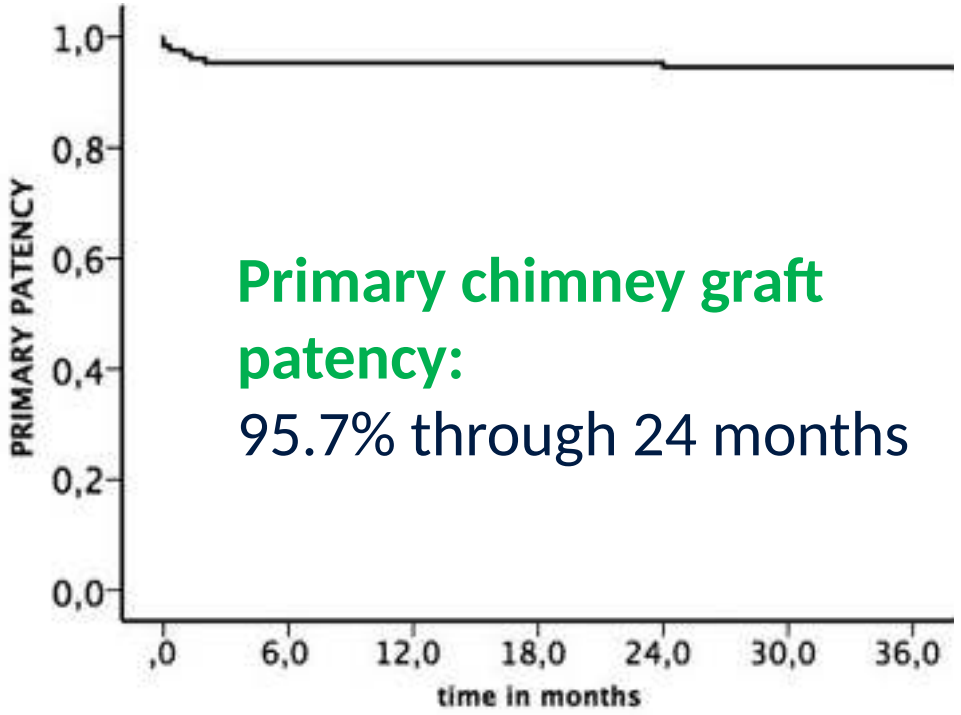
	Mean
Preoperative proximal neck diameter	24.9 ± 3.7 mm
Preoperative suprarenal neck angulation	22.8 ± 22.6°
Preoperative proximal neck length	4.7 ± 3.2 mm
Postoperative new neck length after use of chimney grafts	18.7 ± 6.3 mm

TV per patient	1.5
Technical success	100%
30 day mortality	0.8%

Donas K et. al, *J Vasc Surg*. 2016 Jan;63(1):1-7

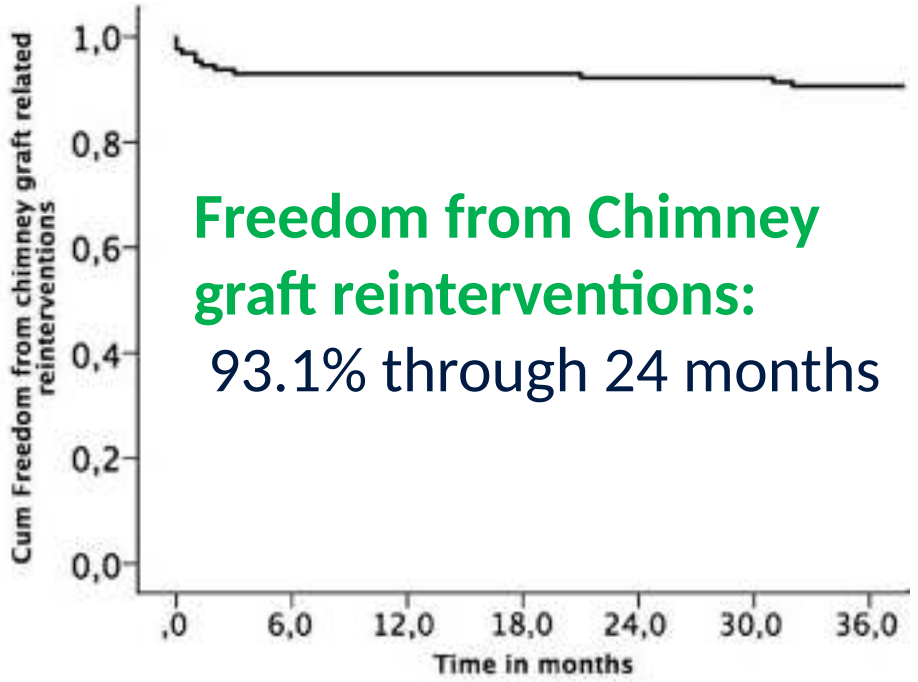
The PROTAGORAS study

NEW ONSET TYPE IA ENDOLEAK 1.6 %



Primary chimney graft patency:
95.7% through 24 months

patients at risk:	128	105	92	84	64	52	38
chimney's at risk:	187	152	138	125	93	75	52
standard errors:	0,04	0,04	0,04	0,04	0,04	0,04	0,03



Freedom from Chimney graft reinterventions:
93.1% through 24 months

patients at risk:	128	105	92	84	64	52	38
chimney's at risk:	187	152	138	125	93	75	52
standard errors:	0,04	0,04	0,04	0,04	0,04	0,04	0,03

Donas K et. al, *J Vasc Surg*. 2016 Jan;63(1):1-7

Anatomical Condition For ChEVAR

- Insignificant calcification and thrombus at the level of proximal neck
- Adequate axillary or brachial artery access
- Limited Thrombus or calcification in the arch and DTA

Short Neck	Angulated Neck	Renal Angulation
• Infrarenal neck length ≥2mm (2-9mm) • *New neck* seal zone length >15 mm • *New neck* diameter 19 to 30 mm • 1 or 2 Chimneys	• Infrarenal neck angulation ≤ 60° • Suprarenal neck angulation ≤ 45° • Supra SMA angulation ≤ 45°	• Maximum renal angulation < 90° (Measured from the direction of the renal stent)
		

fEVAR vs ChEVAR

Original Article

Vascular

Treatment of complex aortic aneurysms with fenestrated endografts and chimney stent repair: Systematic review and meta-analysis

Yang Yaoguo[1,2], Chen Zhong[1,2], Kou Lei[1,2] and Xiao Yaowen[1,2]

Vascular
2017, Vol. 25(1) 92–100
© The Author(s) 2016
Reprints and permissions:
sagepub.co.uk/journalsPermissions.nav
DOI: 10.1177/1708538116627718
journals.sagepub.com/home/vas
SAGE

- ✓ No significant differences were seen between F-EVAR and Ch-EVAR in 30-day mortality, target organ dysfunction, target vessel occlusion or development of aneurysms
- ✓ A higher aneurysm related mortality in Ch-EVAR was observed.
- ✓ F-EVAR was associated with a higher re-intervention rate than Ch-EVAR

(20/380), respectively ($p = 0.905$). Approximately, 1.1% and 1.6% increase in aneurysm was observed following fenestrated endovascular aneurysm repair and chimney stent repair, respectively ($p = 0.437$). The re-intervention frequency was 205 and 19 cases after fenestrated endovascular aneurysm repair and chimney stent repair, respectively (11.7%, 5.6%, $p = 0.001$).

Conclusions: Fenestrated endovascular aneurysm repair and chimney stent repair are safe and effective in treating patients with complex aortic aneurysm. A higher aneurysm-related mortality was observed in chimney stent repair while fenestrated endovascular aneurysm repair was associated with a higher re-intervention rate.

Table 4. Outcomes of patients in each groups.

	F-EVAR	Ch-EVAR	*P* value
Technical success	98% (3810/3878)	99.5% (623/626)	0.028
30-day mortality	(47/1884)	3.2% (12/380)	0.459
Aneurysm-related mortality	1.4% (27/1884)	3.2% (12/380)	0.018
Type I endoleak	2.0% (38/1884)	3.4% (13/380)	0.092
Type II endoleak	5.4% (102/1884)	5.3% (20/380)	0.905
Target organ function impaired	5.0% (185/3658)	4.0% (25/626)	0.27
Vessels restenosis/ occluded	3.6% (135/3787)	(21/339)	0.792
Aneurysm growth	1.1% (20/1811)	(6/380)	0.437
Re-intervention	11.7% (205/1746)	5.6% (19/380)	0.001

Guidelines say

Editor's Choice — European Society for Vascular Surgery (ESVS) 2019 Clinical Practice Guidelines on the Management of Abdominal Aorto-iliac Artery Aneurysms

Recommendation 96	Class	Level
In complex endovascular repair of juxtarenal abdominal aortic aneurysm, endovascular repair with fenestrated stent grafts should be considered the preferred treatment option when feasible.	IIa	C

Recommendation 97	Class	Level
In complex endovascular repair for juxtarenal abdominal aortic aneurysm, using parallel graft techniques may be considered as an alternative in the emergency setting or when fenestrated stent grafts are not indicated or available, or as a bailout, ideally restricted to <2 chimneys.	IIb	C

Guidelines say

Recommendation 98	Class	Level
In patients with juxtarenal abdominal aortic aneurysm, new techniques/concepts, including endovascular aneurysm seal, endostaples, and in situ laser fenestration, are not recommended as first line treatment, but should be limited to studies approved by research ethics committees, until adequately evaluated.	III	C

Recommendation 99	Class	Level
In patients with ruptured juxta/pararenal abdominal aortic aneurysm open repair or complex endovascular repair (with a physician modified fenestrated stent graft, off the shelf branched stent graft, or parallel graft) may be considered based on patient status, anatomy, local routines, team experience, and patient preference.	IIb	C

Conclusions

- Juxtarenal aneurysms need a tailored approach considering all the options available, both as open or endovascular repair.
- FEVAR has been worldwide adopted with good results and allows for treatment of patients unfit for open repair .
- Ch-EVAR, if a standardized approach is followed, can provide good results and can help to save some costs .
- Open Repair remains the gold standard in fit patients and should always be taken into consideration.
- Continuous reporting is mandatory for new and oncoming technical options.


Thank You For Your
Attention