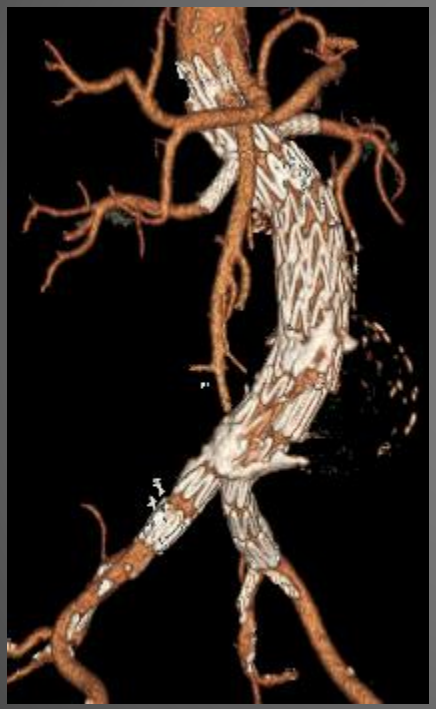
DEBATE?
3x-4x FEVAR is the Way to go



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Disclosures

- William Cook Europe/Cook Inc.
  - Research grants & Consulting
- Atrium Maquet
  - Consulting
- Bentley
  - Consulting

Lay-Out

- Sensible Arguments
- Practical Examples
- Scientific Evidence

Is there a Debate?

- We owe our patients the best possible treatment but also a durable treatment
  - Not a choice….
  - Far too many patients with long-term unsuitable necks treated with standard EVAR
- Extension of disease
- A Man has to do what a Man has to do……

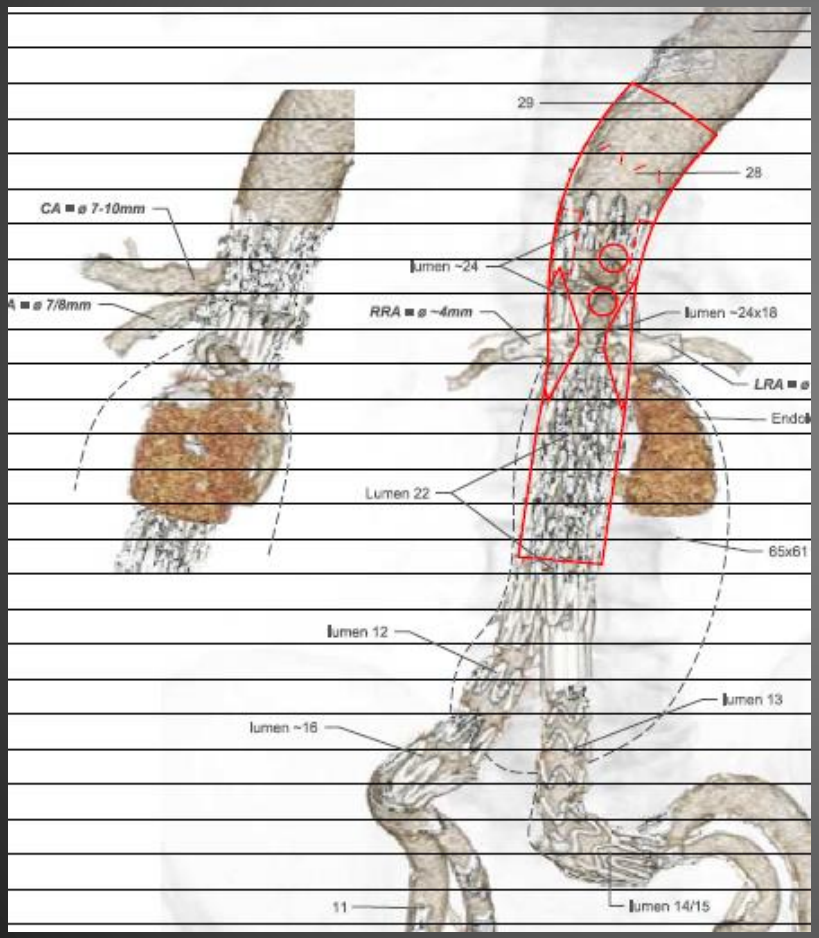
Key Issues

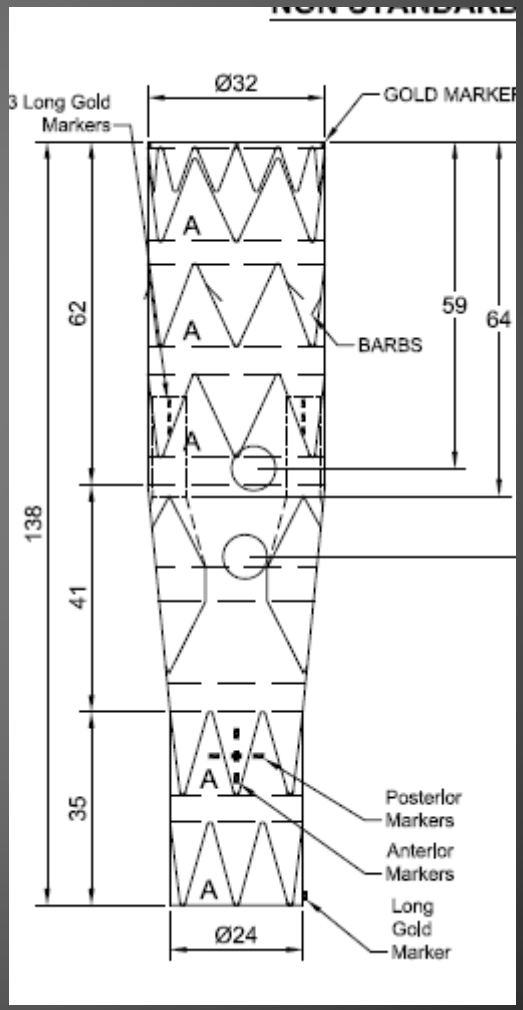
- Aortic Neck Dilatation (AND) after EVAR?
- Stability of suprarenal Aorta?

- M&M after 3-4xFEVAR higher than 2xFEVAR?

- Difficulty of repair of failed 2x-3xFEVAR

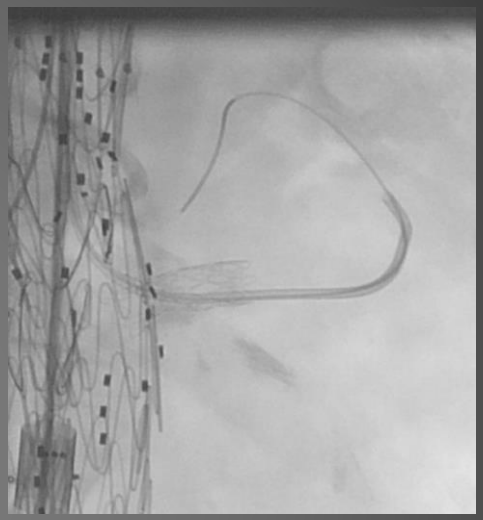
Case 1: Failed 2xFEVAR

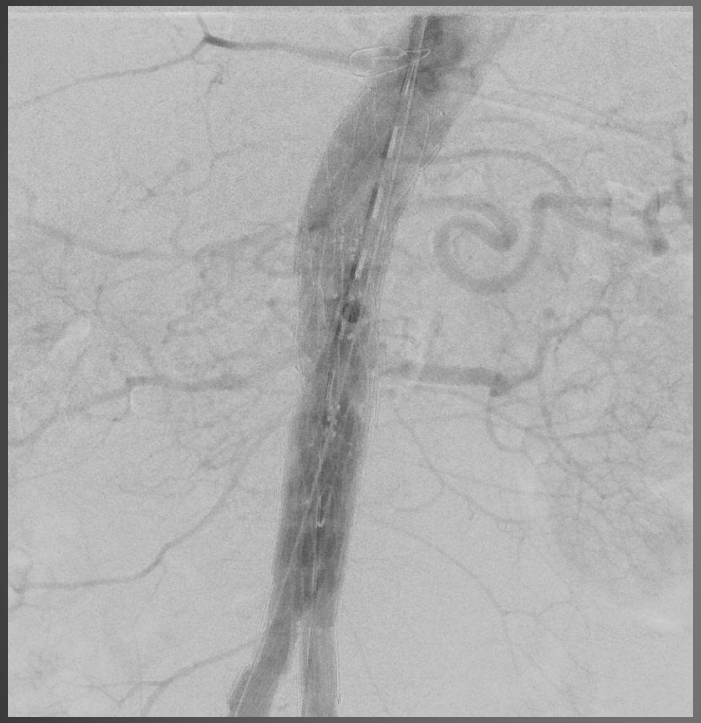


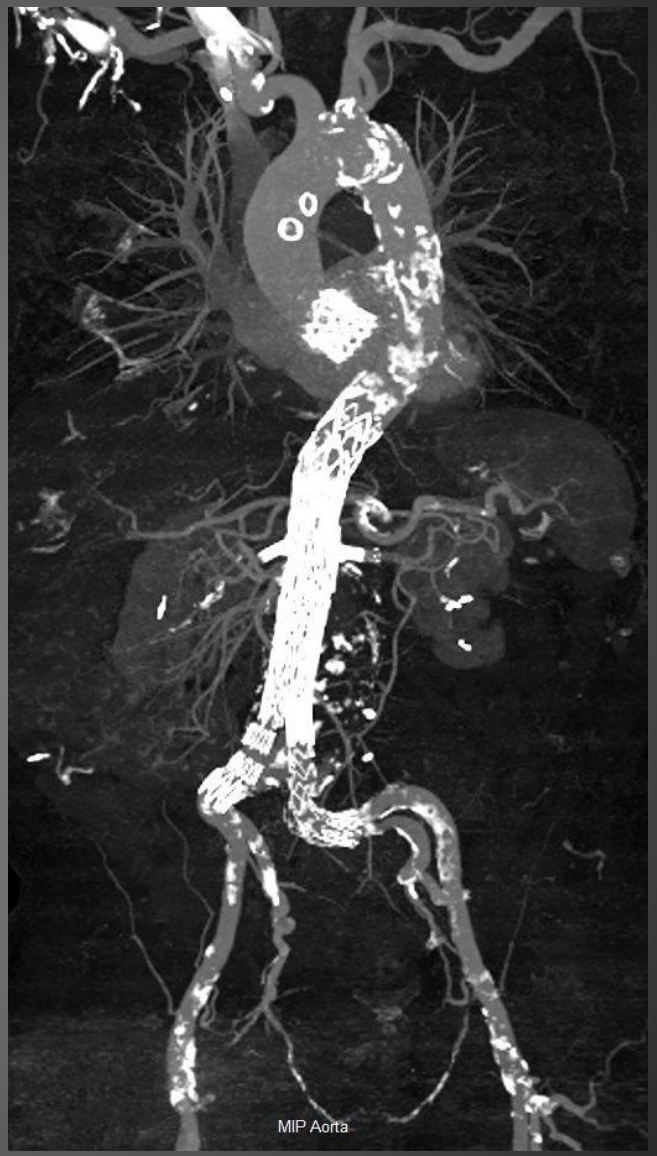


F372

Partial opening of graft…





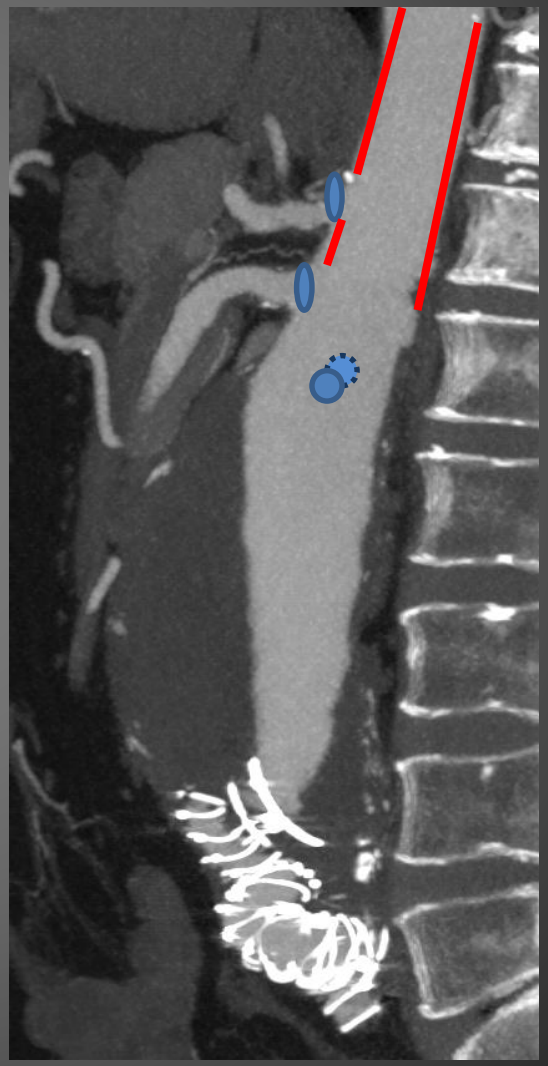

MIP Aorta

Case 2: 4xFEVAR

- 61 YO Male
- AAA 65mm
  - EVAR 4 yrs ago

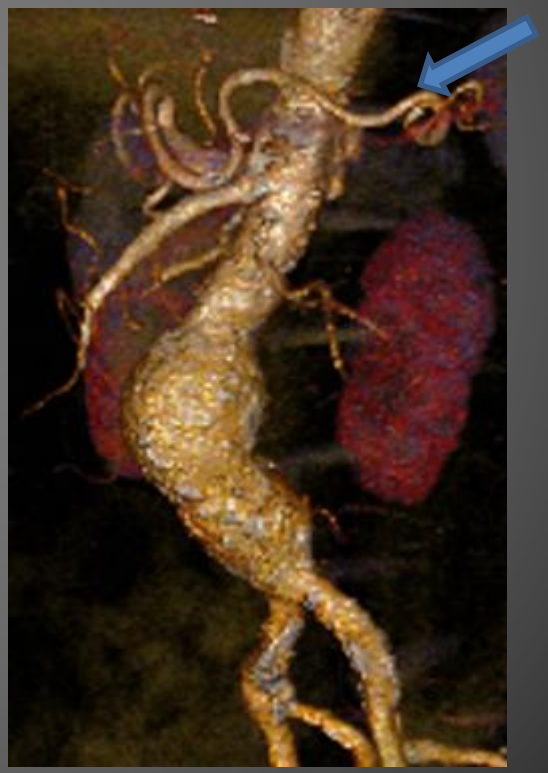
Plan

- 4x FEVAR
  - Easy CT and SMA
  - Adequate sealing zone
  - Proximal extension still possible

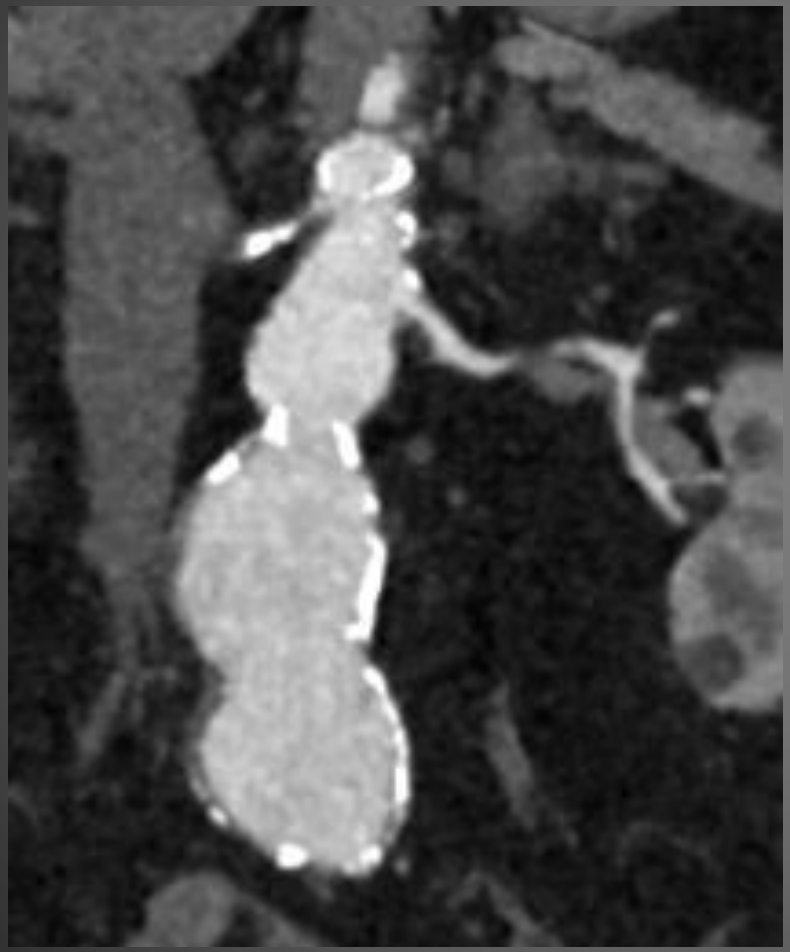


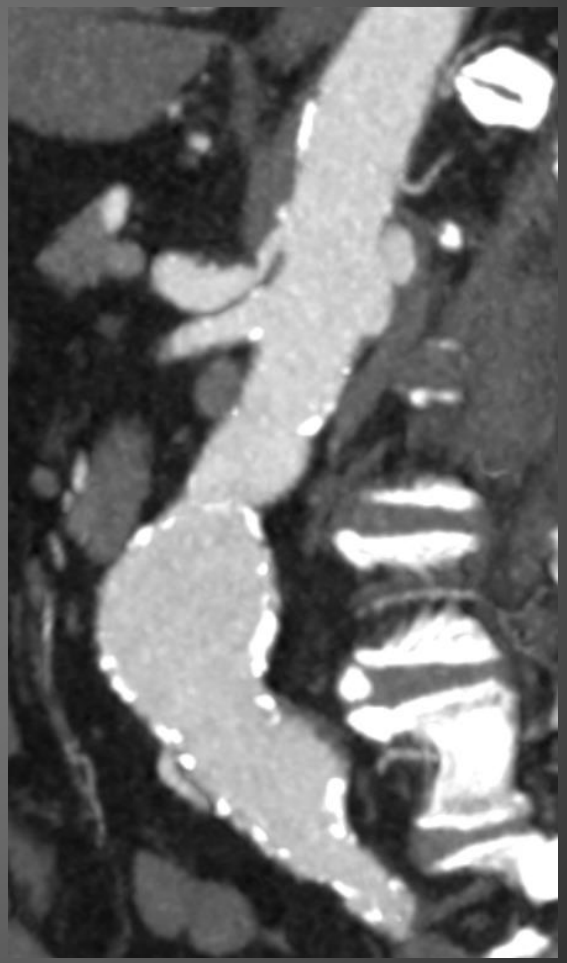
Case 3: 4xFEVAR
(without stenting the celiac artery)

- 69 YO Male
- Juxtarenal AAA 58mm
  - Ulcer supraceliac Aorta
- Comorbidity
  - CAD
  - COPD



Preoperative CTA

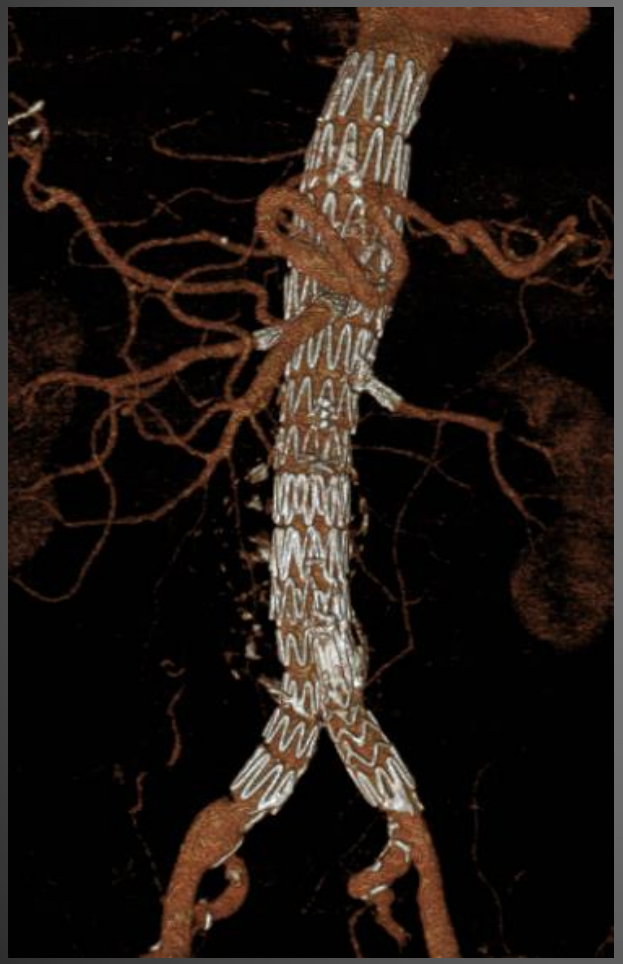


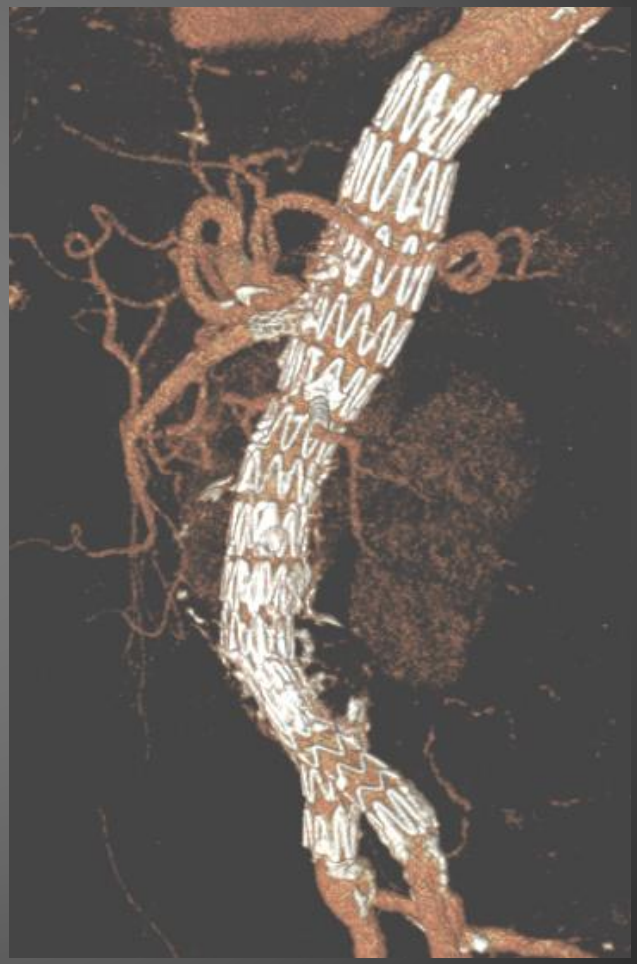


Plan

- 4x FEVAR
  - Adequate sealing zone
  - Unstented Celiac trunk

CTA 3 yrs Postop



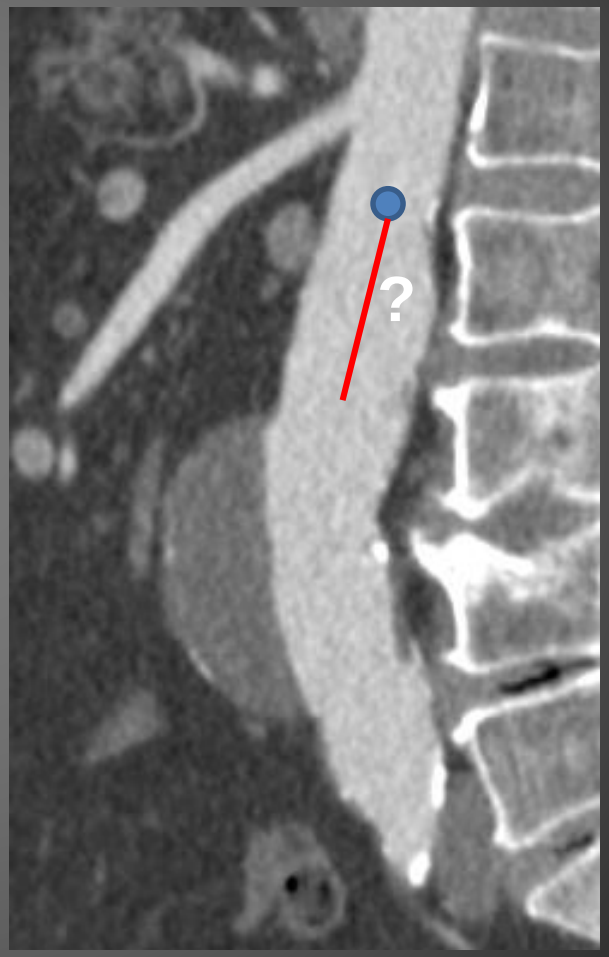


Case 4: 3xFEVAR

- 65 YO Male
- Juxtarenal AAA
  - Dmax: 53 mm
  - Saccular
- Co-morbidity
  - CAD
  - PAD

01.03.1952

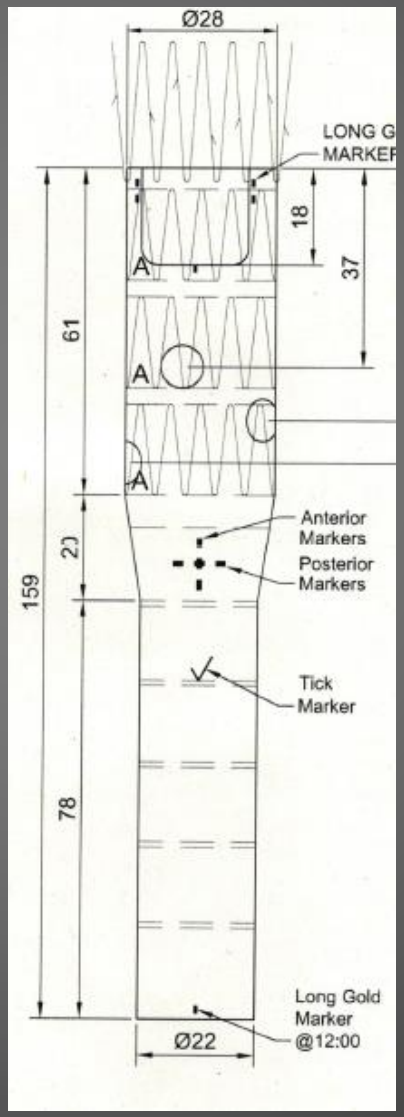
Proximal Neck

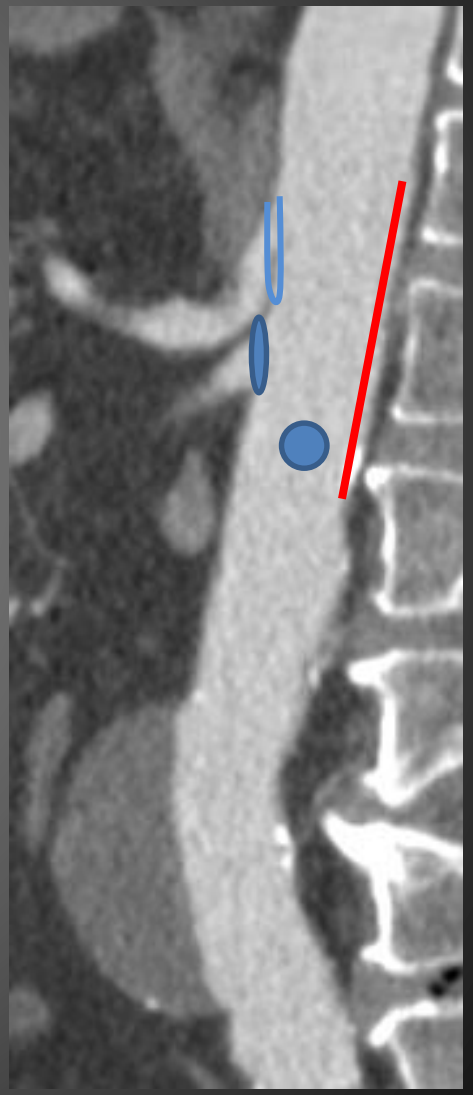


→ Proximal neck length: 0 or 40 mm?

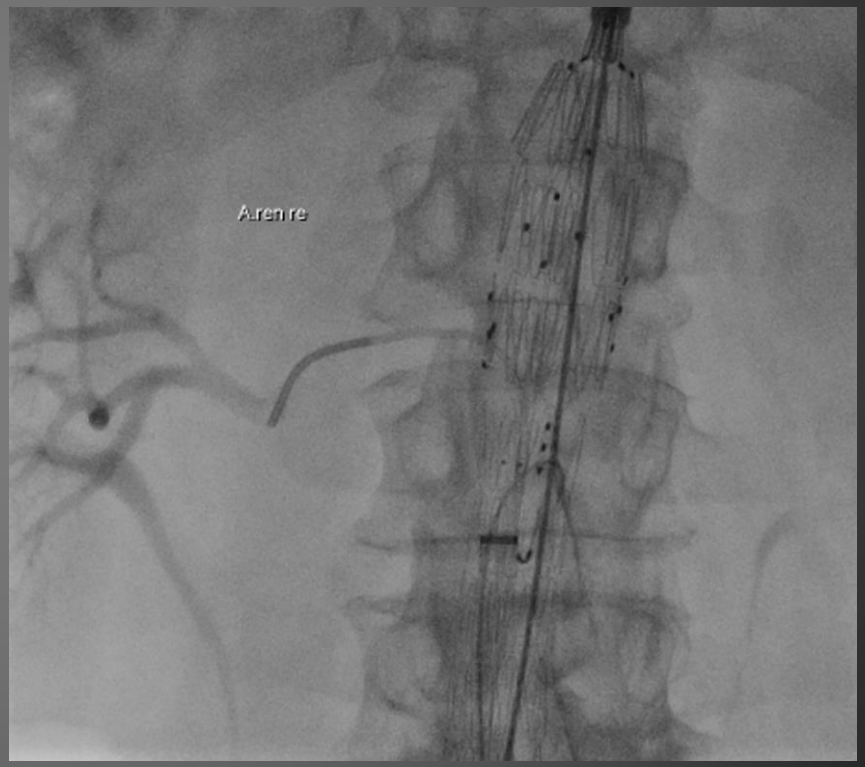
Plan

- 3x FEVAR

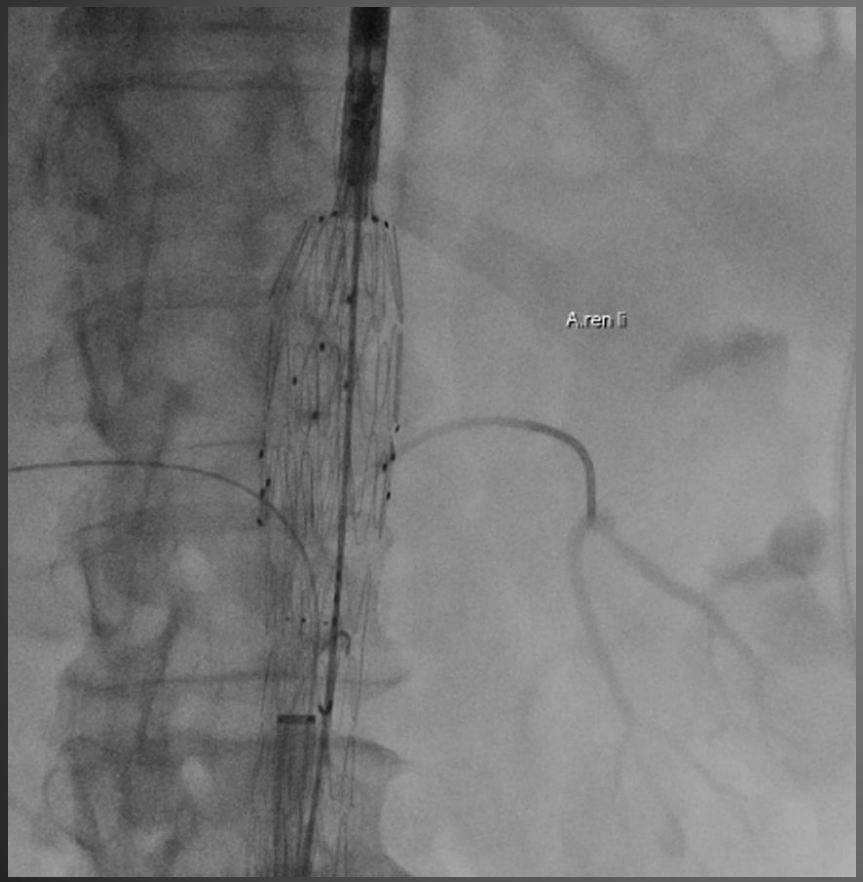


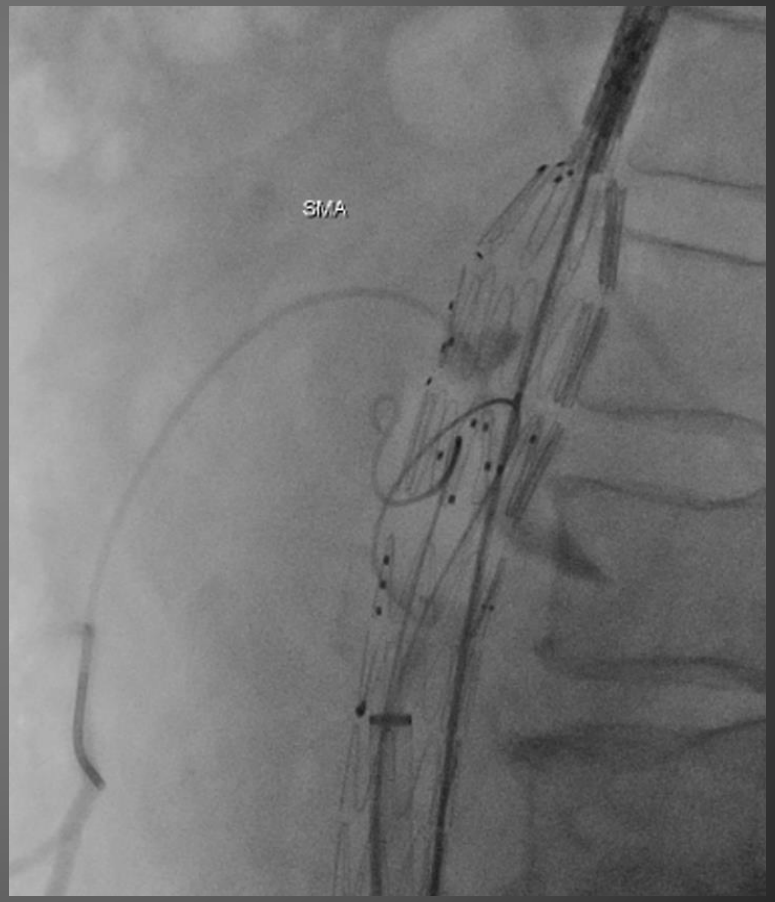


3x FEVAR

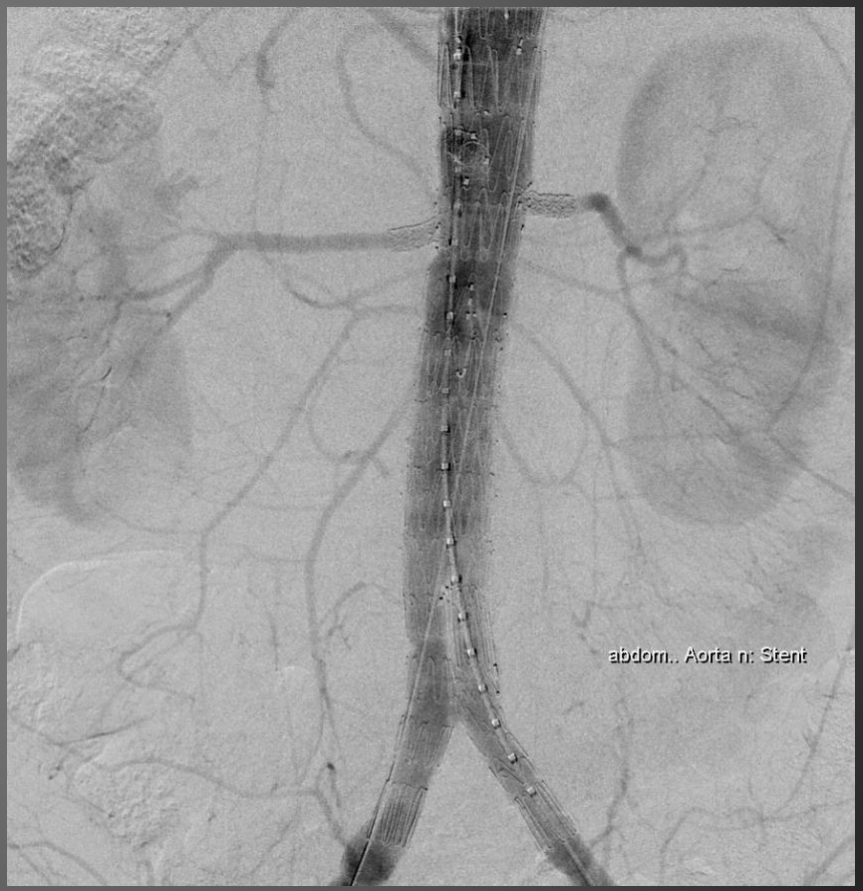


3x FEVAR

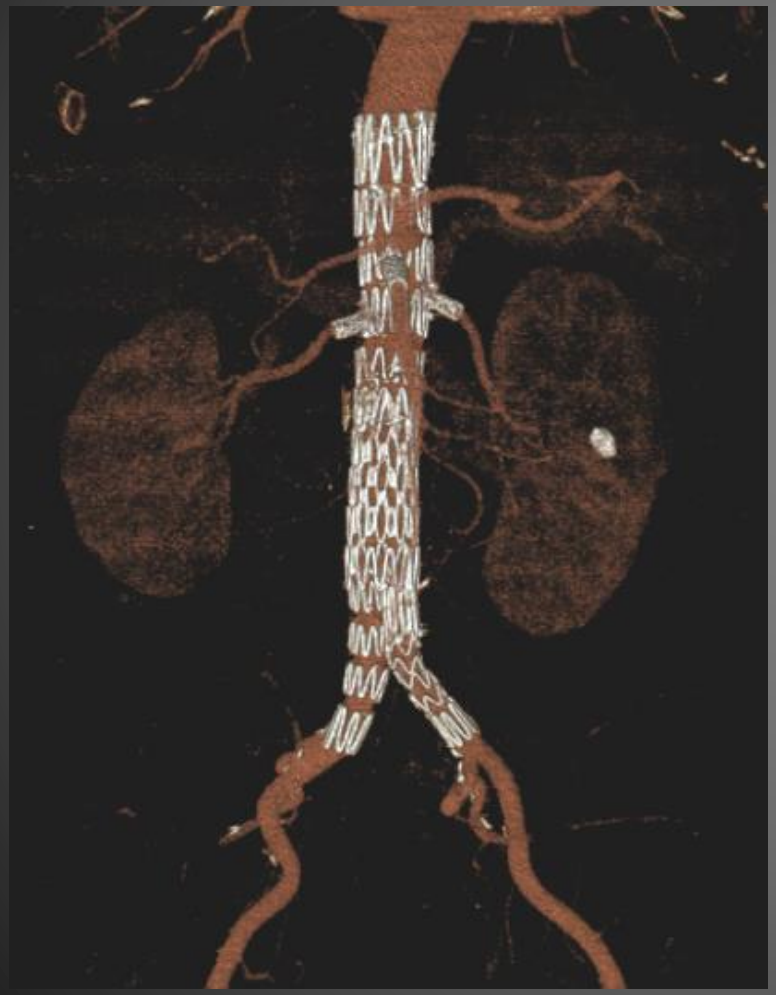




3x FEVAR



Postop CTA

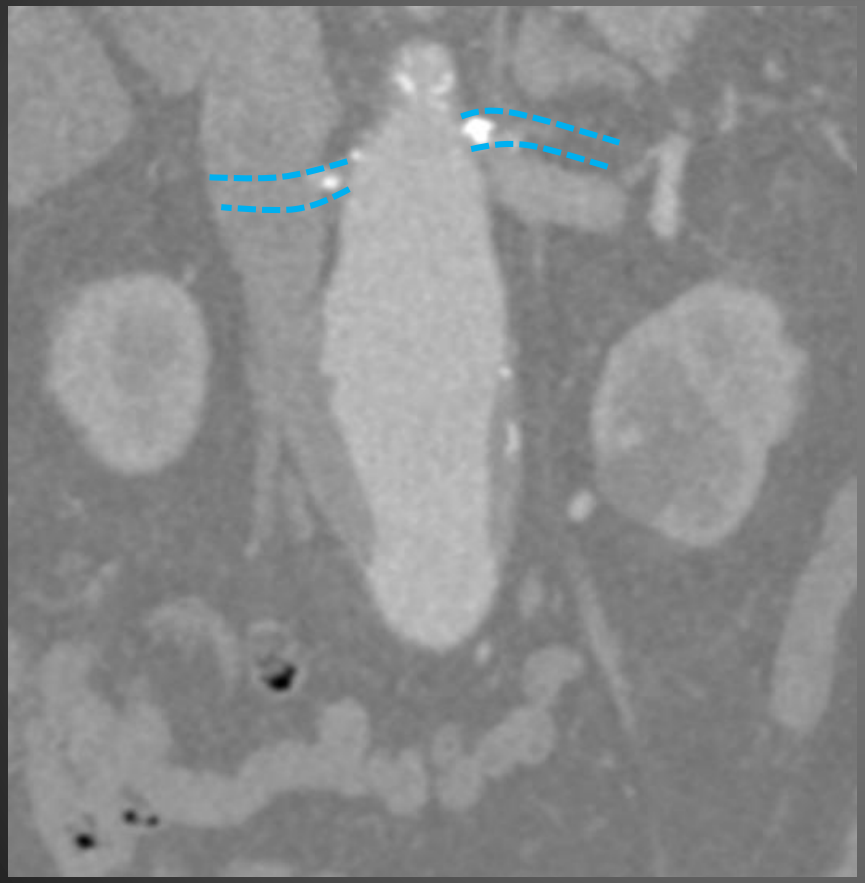


Case 5: 3xFEVAR
(wrong choice)

- 71 YO Male
- 2011
  - Juxtarenal AAA
    - Dmax: 54 mm
- Co-morbidity
  - CAD

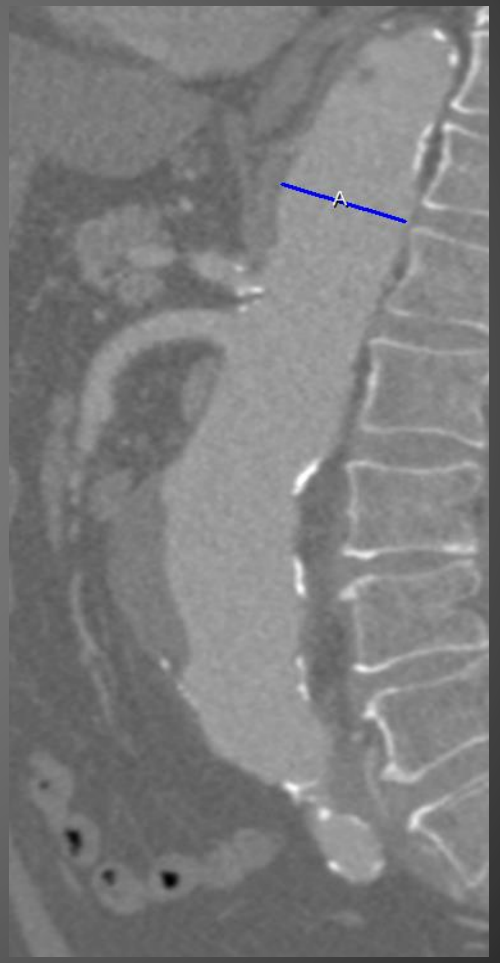
01.01.1940

Proximal Neck



→ Proximal neck length: 4-5mm, conical

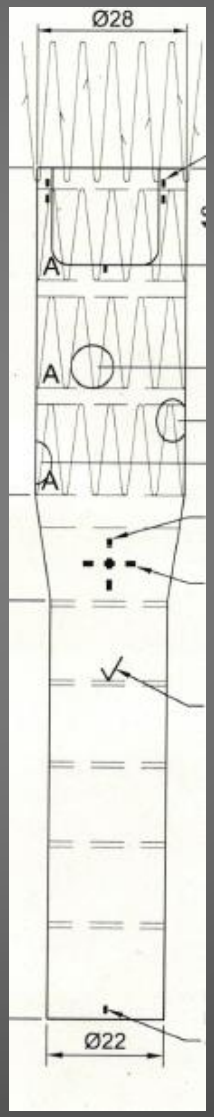
Problem: Dilated Thoracic Aorta

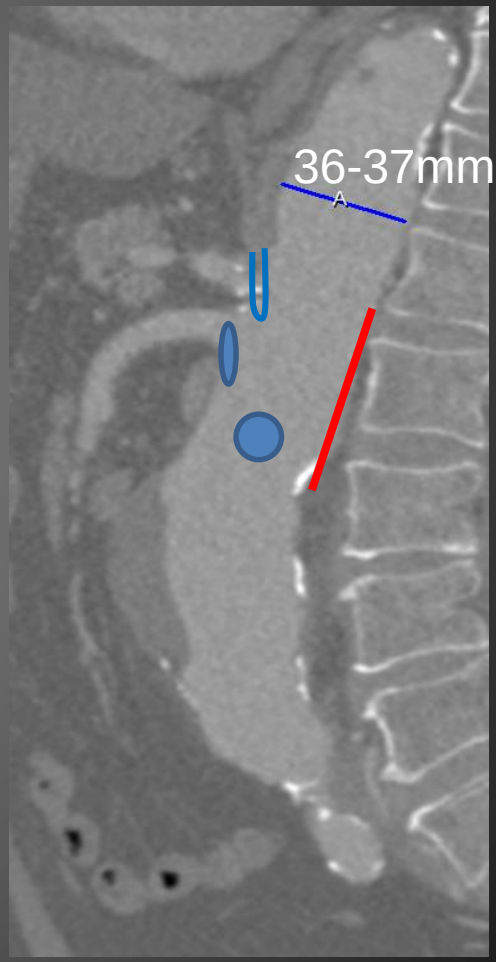


→ Dmax above Celiac trunk: 36-37mm…

Plan

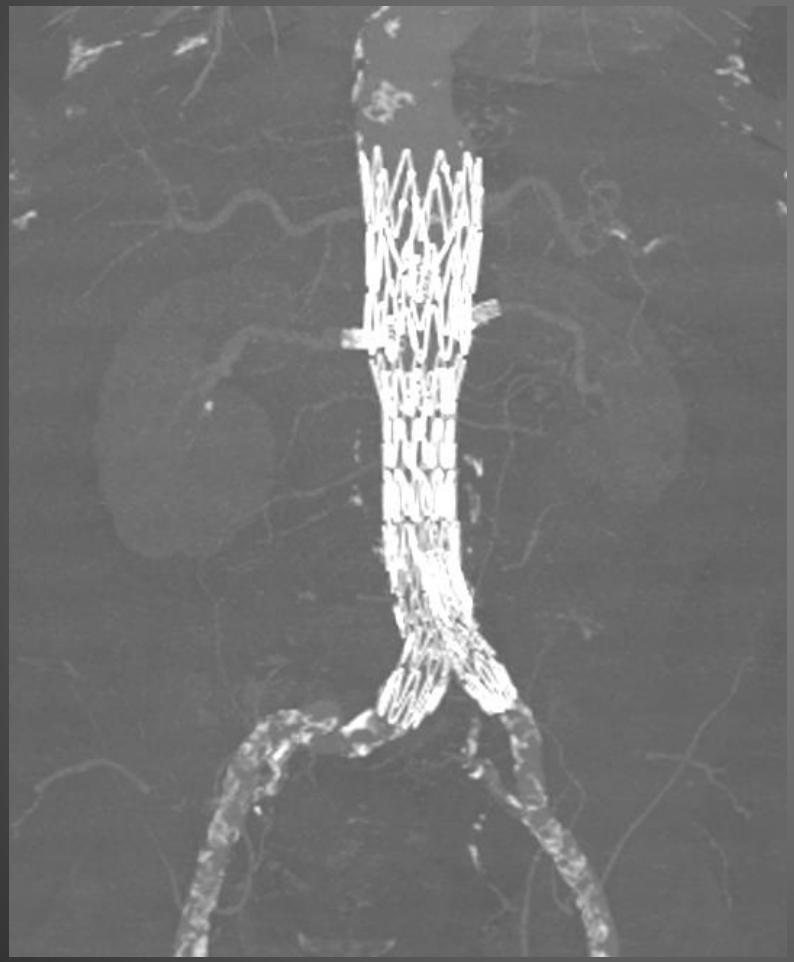
- 3x FEVAR



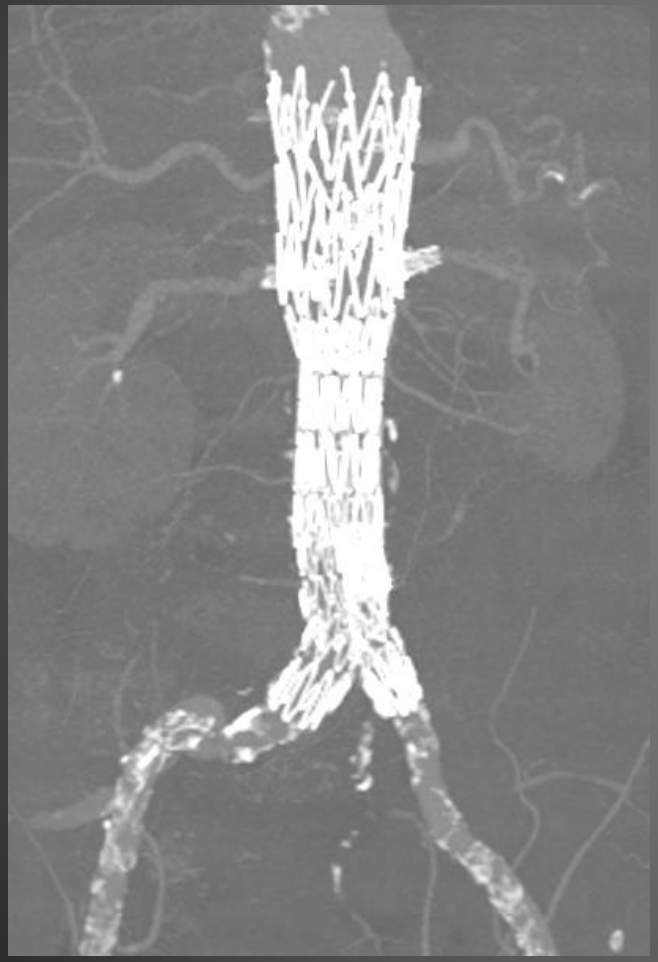


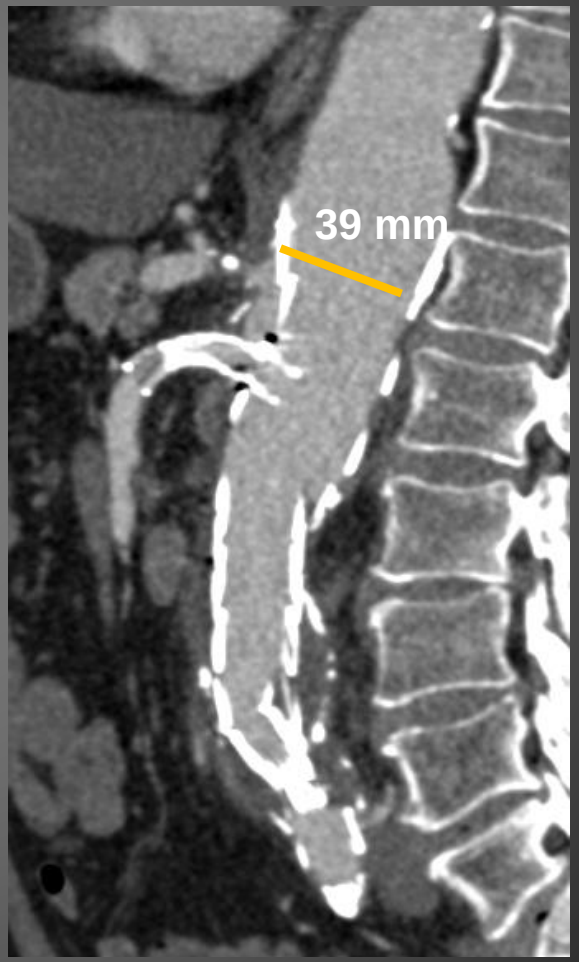
3x FEVAR

Postop CTA

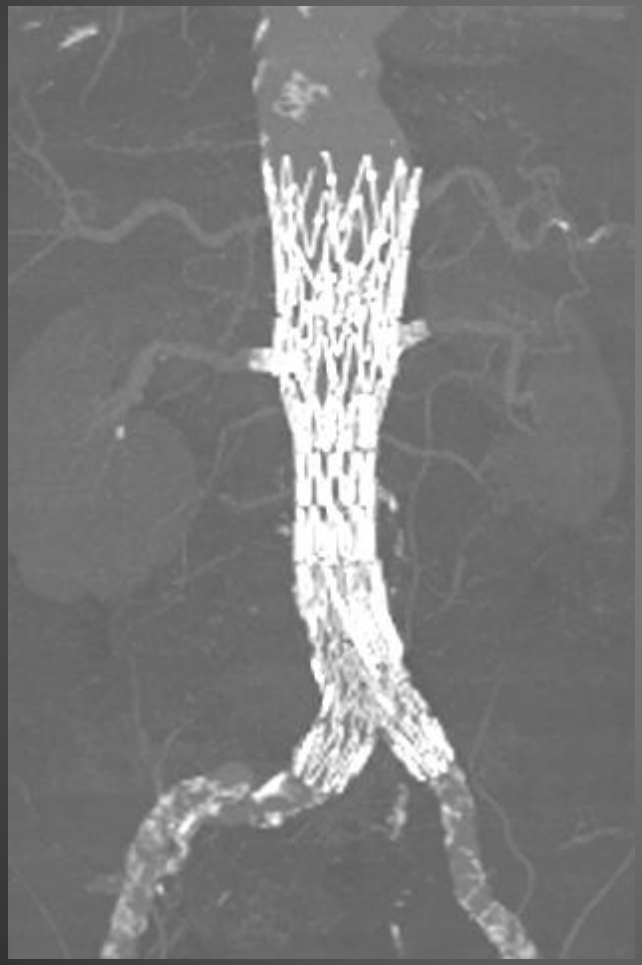


CTA @ 1 year



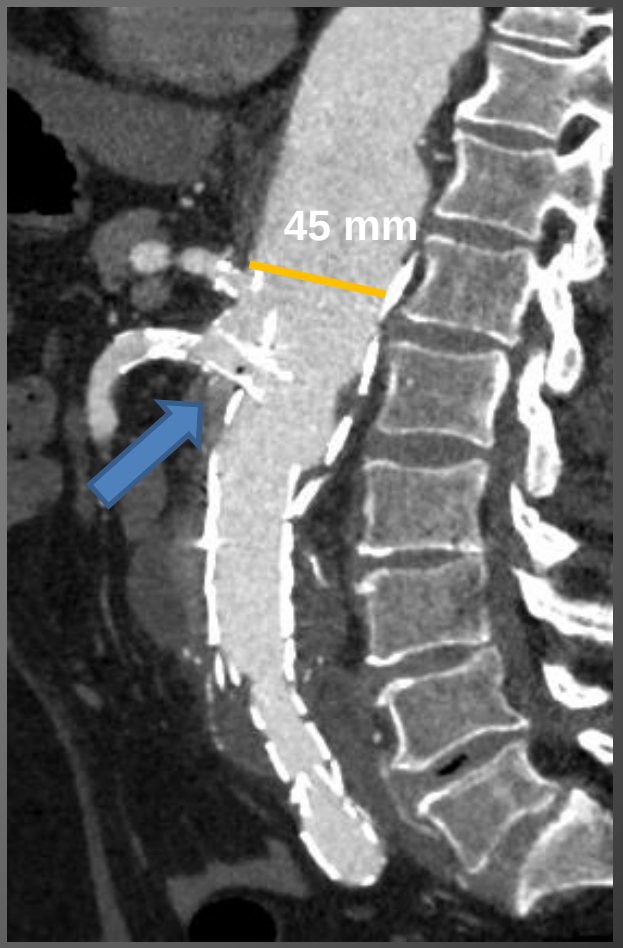


CTA @ 2 years



CTA @ 4 years

CTA @ 6 years

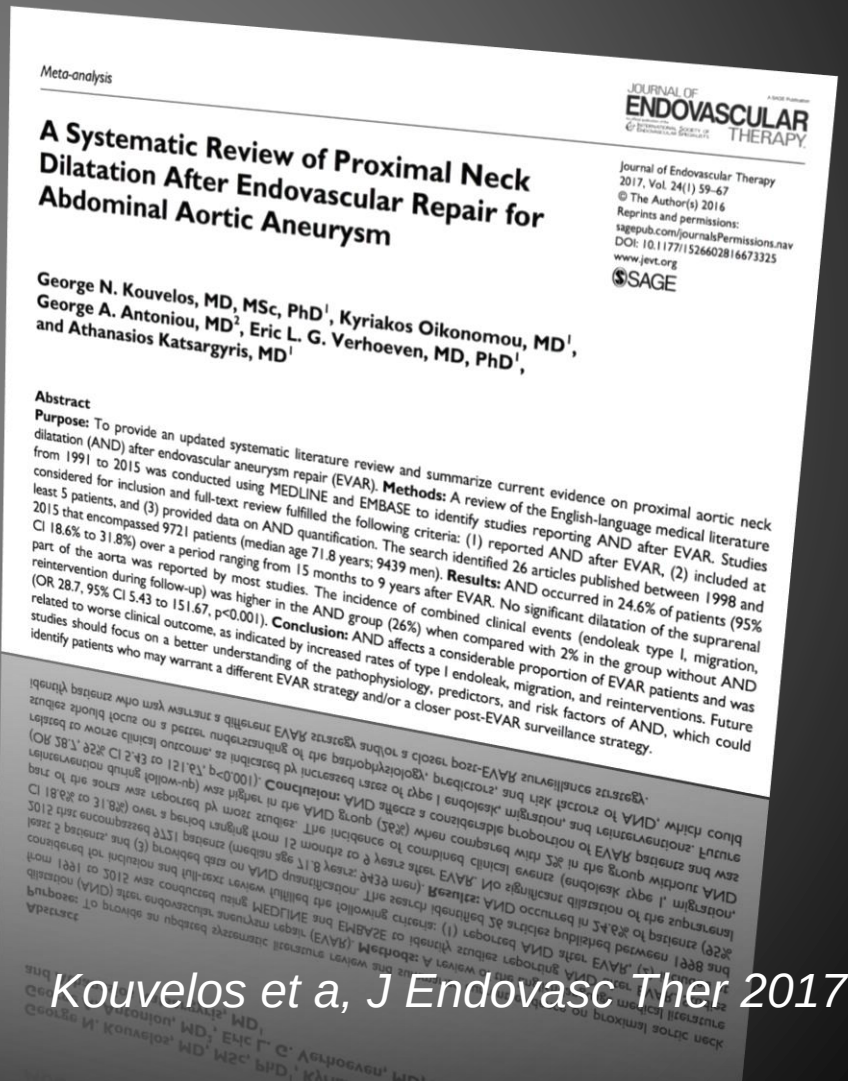


Treatment Plan

- Redo F/BEVAR
  - 1x ↓ Branch for CA
  - 3x Fenestrations

AND after EVAR

- ✓ Meta-analysis
- ✓ Inclusion criteria
  1. *To report AND after EVAR*
  2. *To include at least 5 patients*
  3. *To provided data on AND quantification*



Meta-analysis

JOURNAL OF ENDOVASCULAR THERAPY

A Systematic Review of Proximal Neck Dilatation After Endovascular Repair for Abdominal Aortic Aneurysm

Journal of Endovascular Therapy
2017, Vol. 24(1) 59–67

DOI: 10.1177/1526602816673325
www.jevt.org
SAGE

George N. Kouvelos, MD, MSc, PhD[1], Kyriakos Oikonomou, MD[1], George A. Antoniou, MD[2], Eric L. G. Verhoeven, MD, PhD[1], and Athanasios Katsargyris, MD[1]

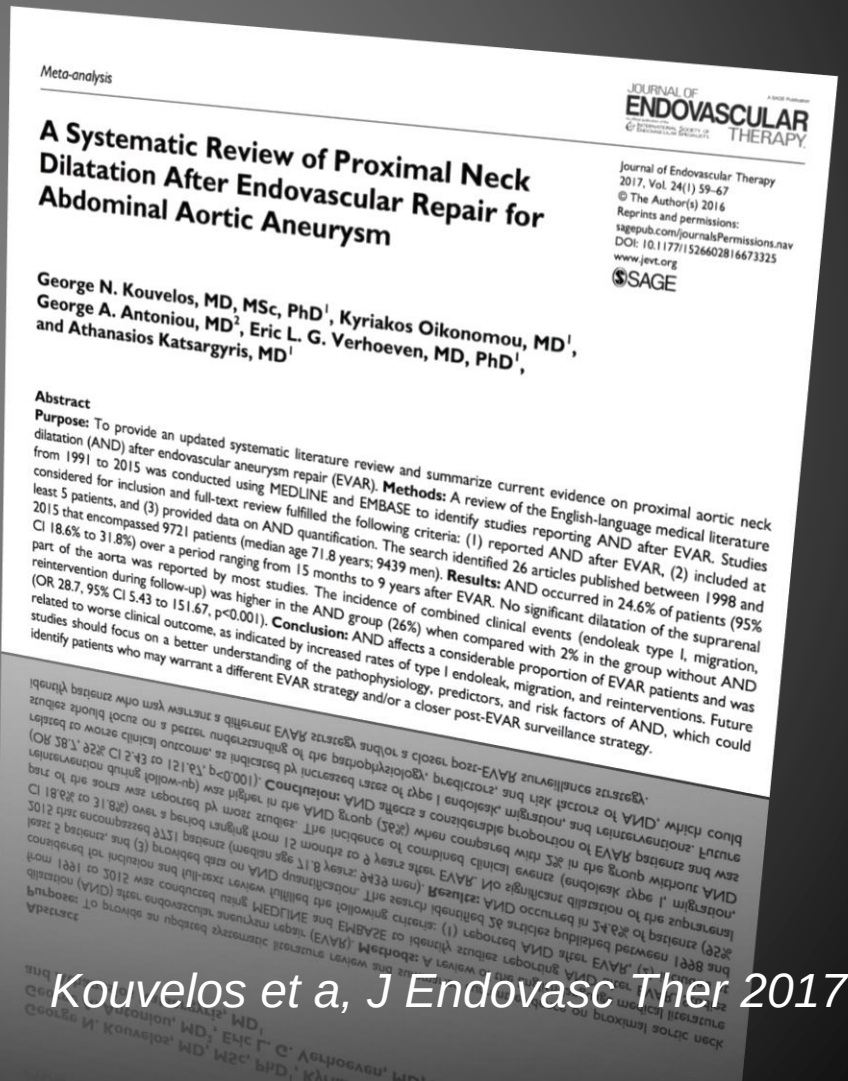
Abstract

Purpose: To provide an updated systematic literature review and summarize current evidence on proximal aortic neck dilatation (AND) after endovascular aneurysm repair (EVAR). **Methods:** A review of the English-language medical literature from 1991 to 2015 was conducted using MEDLINE and EMBASE to identify studies reporting AND after EVAR. Studies considered for inclusion and full-text review fulfilled the following criteria: (1) reported AND after EVAR, (2) included at least 5 patients, and (3) provided data on AND quantification. The search identified 26 articles published between 1998 and 2015 that encompassed 9721 patients (median age 71.8 years; 9439 men). **Results:** AND occurred in 24.6% of patients (95% CI 18.6% to 31.8%) over a period ranging from 15 months to 9 years after EVAR. No significant dilatation of the suprarenal part of the aorta was reported by most studies. The incidence of combined clinical events (endoleak type I, migration, reintervention during follow-up) was higher in the AND group (26%) when compared with 2% in the group without AND (OR 28.7, 95% CI 5.43 to 151.67, p<0.001). **Conclusion:** AND affects a considerable proportion of EVAR patients and was related to worse clinical outcome, as indicated by increased rates of type I endoleak, migration, and reinterventions. Future studies should focus on a better understanding of the pathophysiology, predictors, and risk factors of AND, which could identify patients who may warrant a different EVAR strategy and/or a closer post-EVAR surveillance strategy.

Kouvelos et a, J Endovasc Ther 2017

AND after EVAR

- ✓ 26 articles
- ✓published between 1998 and 2015
- ✓9721 patients



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Kouvelos et a, J Endovasc Ther 2017

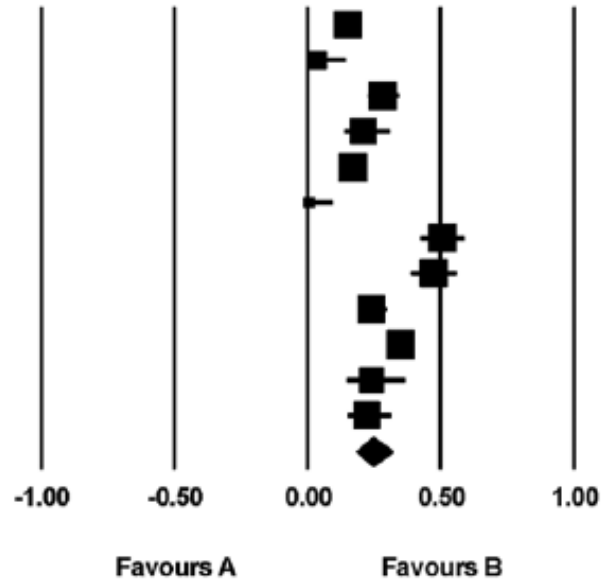
Incidence of AND

12 studies – 8550 pts

Study name	Time point	Event rate	Lower limit	Upper limit	Z-Value	p-Value	Relative weight	Relative weight
Makaroun	2001	0.153	0.117	0.197	-10.919	0.000	9.71	
May	2003	0.039	0.010	0.144	-4.434	0.000	3.98	
Cao	2003	0.283	0.228	0.344	-6.361	0.000	9.79	
Napoli	2003	0.211	0.139	0.307	-5.104	0.000	8.65	
Dillavou	2005	0.170	0.145	0.199	-16.078	0.000	10.14	
Malas	2005	0.006	0.000	0.094	-3.555	0.000	1.43	
Sampaio	2006	0.507	0.426	0.588	0.167	0.868	9.62	
Badger	2006	0.473	0.388	0.559	-0.616	0.538	9.53	
Dalainas	2007	0.240	0.190	0.297	-7.667	0.000	9.76	
Diehm	2007	0.351	0.339	0.363	-23.448	0.000	10.43	
Pintoux	2011	0.241	0.148	0.367	-3.732	0.000	8.07	
Oberhuber	2012	0.223	0.153	0.314	-5.269	0.000	8.89	
		0.246	0.186	0.318	-6.123	0.000		

Statistics for each study

Event rate and 95% CI



24.6% of the patients
(95% CI 18.6% to 31.8%)

Clinical Outcome during FU

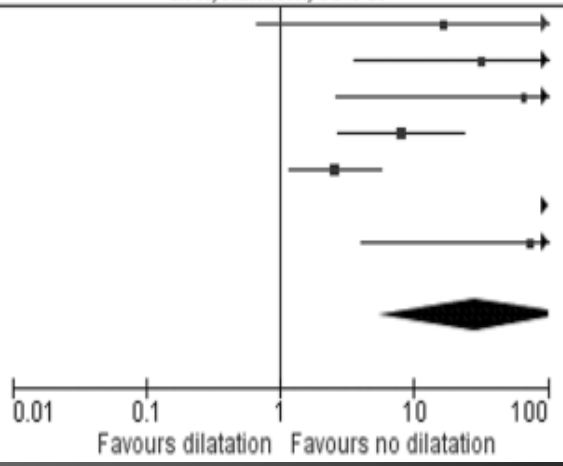
7 studies – 1759 pts

endoleak type I, migration, reintervention

Study or Subgroup	Aortic neck dilatation Events	Total	No aortic neck dilatation Events	Total	Weight	Odds Ratio M-H, Random, 95% CI	Year
Makaroun	1	48	0	266	11.4%	16.83 [0.68, 419.35]	2001
Napoli	6	19	1	71	14.8%	32.31 [3.59, 291.05]	2003
May	2	2	3	49	11.4%	66.43 [2.64, 1670.67]	2003
Cao	13	65	5	165	18.4%	8.00 [2.72, 23.51]	2003
Dillavou	10	124	20	605	19.1%	2.57 [1.17, 5.63]	2005
Dalainas	49	58	0	184	12.5%	1922.68 [109.99, 33608.86]	2007
Oberhuber	7	23	0	80	12.4%	73.18 [3.98, 1345.13]	2012
Total (95% CI)	26%	**339**	2%	**1420**	**100.0%**	**28.70 [5.43, 151.67]**	
Total events	88		29				

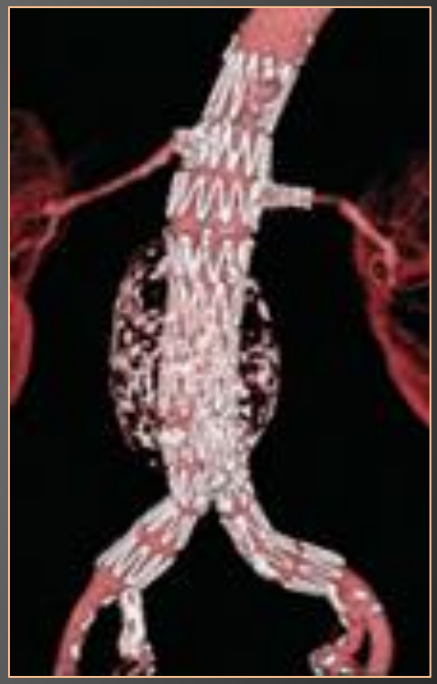
Heterogeneity: $Tau^2 = 3.62$; $Chi^2 = 34.03$, $df = 6$ ($P < 0.00001$); $I^2 = 82\%$

Test for overall effect: $Z = 3.95$ ($P < 0.0001$)



Suprarenal AND?

- Suprarenal aorta does not seem to dilate significantly over time (5 studies)
- Differences in stiffness, thickness between suprarenal and infrarenal aorta
- Fenestrated EVAR has shown low rates of migration and type I endoleak, although AND following fenestrated EVAR has not been investigated adequately.



Verhoeven et al. *Eur J Vasc Endovasc Surg*. 2016;51:775–781

Kouvelos et al. *J Endovasc Ther* 2016

Comparison of outcomes for double fenestrated endovascular aneurysm repair versus triple or quadruple fenestrated endovascular aneurysm repair in the treatment of complex abdominal aortic aneurysms

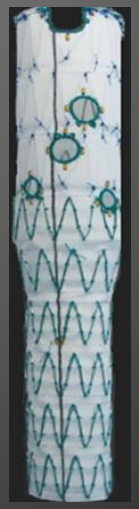
Athanasios Katsargyris, MD,[a] Kyriakos Oikonomou, MD,[a] George Kouvelos, MD,[a] Hozan Mufty, MD,[a] Wolfgang Ritter, MD,[b] *and* Eric L. G. Verhoeven, MD, PhD,[a] *Nuremberg, Germany*

(J Vasc Surg 2017;■:1-8.)

- Standard (2x) FEVAR

vs

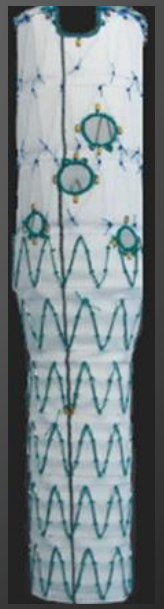
- Complex (3x-4x) FEVAR



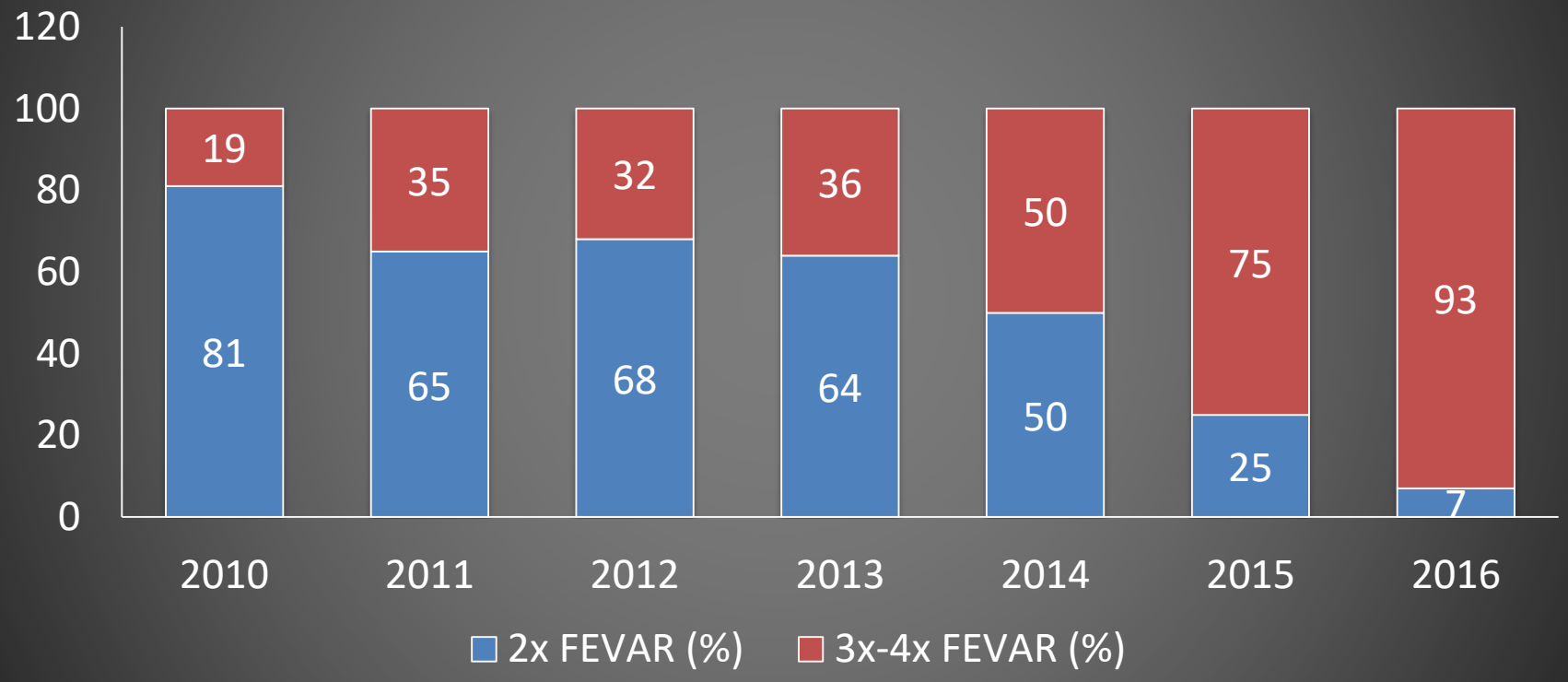
Stent-graft Design

- Standard (2x) FEVAR
  - N=202 (48.8%)

- Complex (3x-4x) FEVAR
  - N=212 (51.2%)

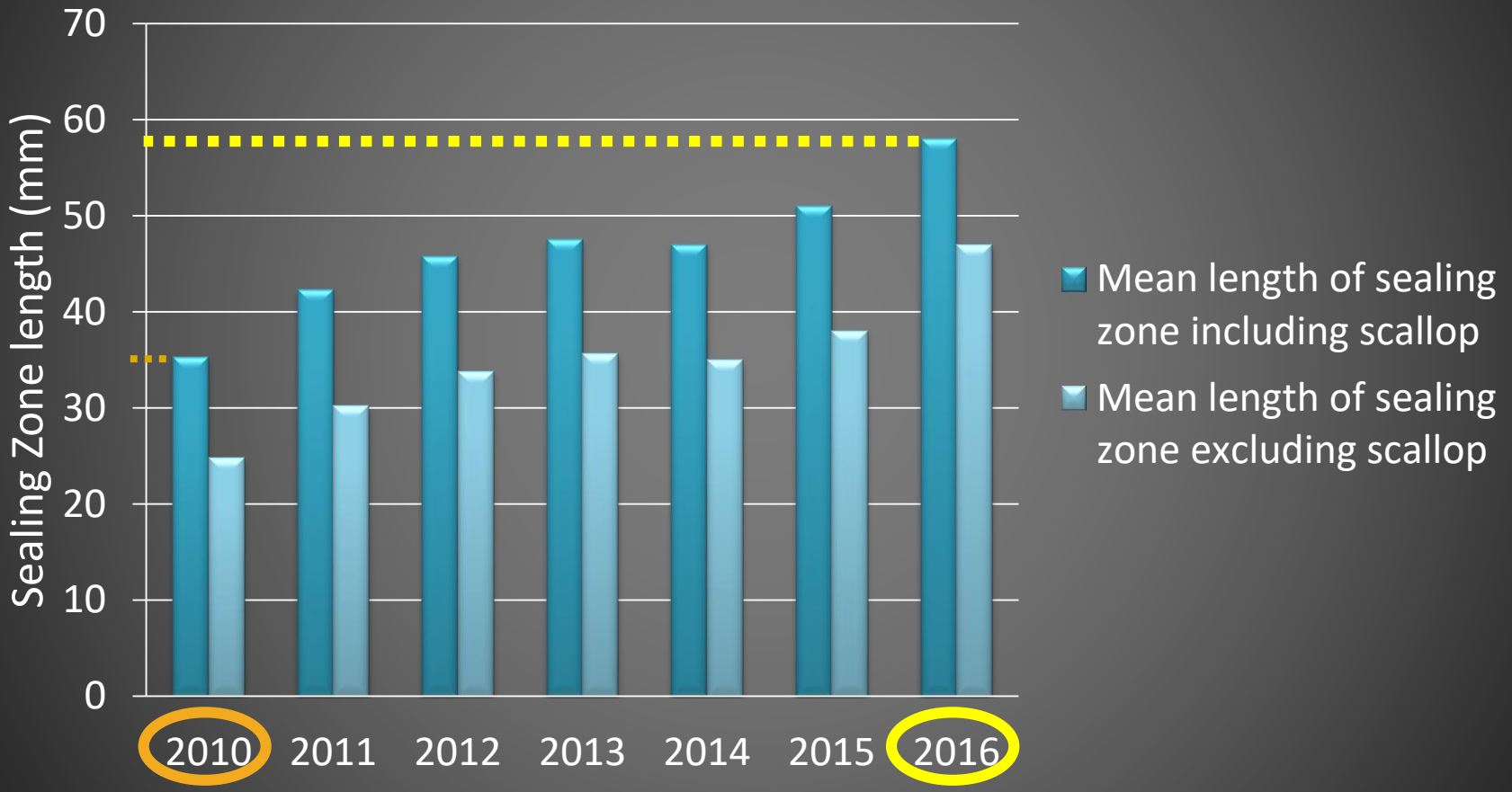


Evolution of Stent-graft Design



↑ Use of Complex FEVAR over the years…

Evolution of Sealing Zone



↑ Sealing zone length over the years…

Technical Success

Overall: N=403/414 (97.3%)

- Standard (2x) FEVAR
  - N=198/202 (98%)
- Complex (3x-4x) FEVAR
  - N=205/212 (96.7%)

(P=0.6, NS)

30-Day Mortality

Overall: N=2/414 (0.5%)

- Standard (2x) FEVAR
  - N=1/202 (0.5%)
- Complex (3x-4x) FEVAR
  - N=1/212 (0.5%)

(P=1.0, NS)

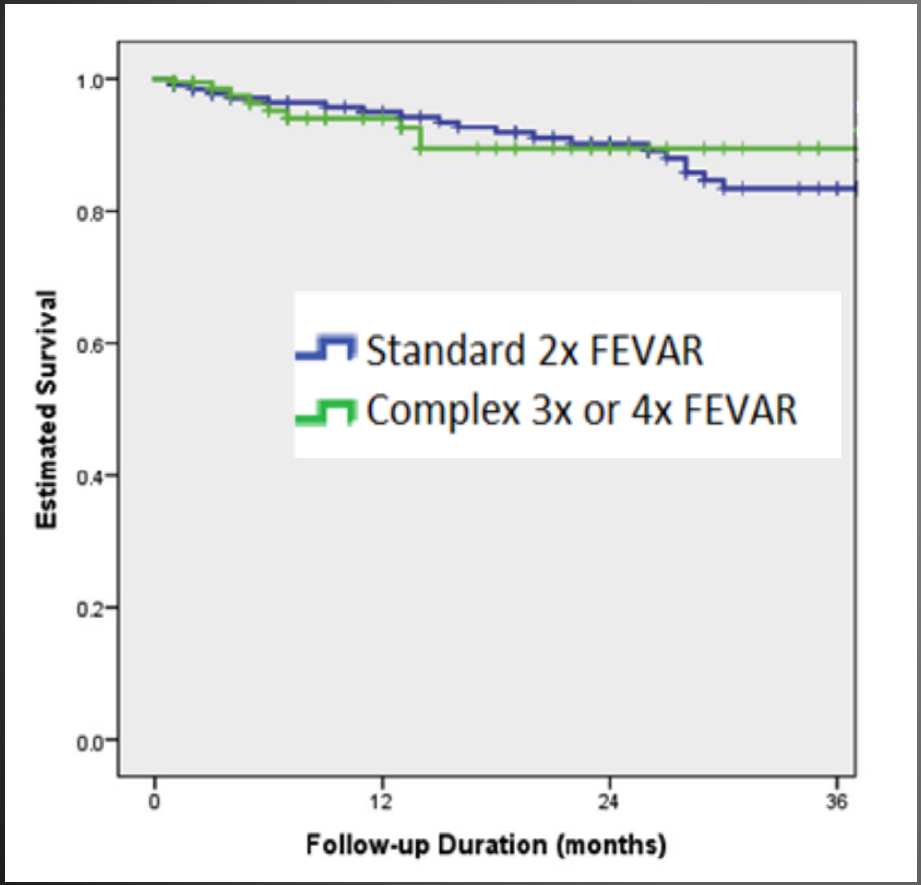
Major Complications

Overall: N=43/414 (10.4%)

- Standard (2x) FEVAR
  - N=19/202 (9.4%)
- Complex (3x-4x) FEVAR
  - N=24/212 (11.3%)

(P=0.63, NS)

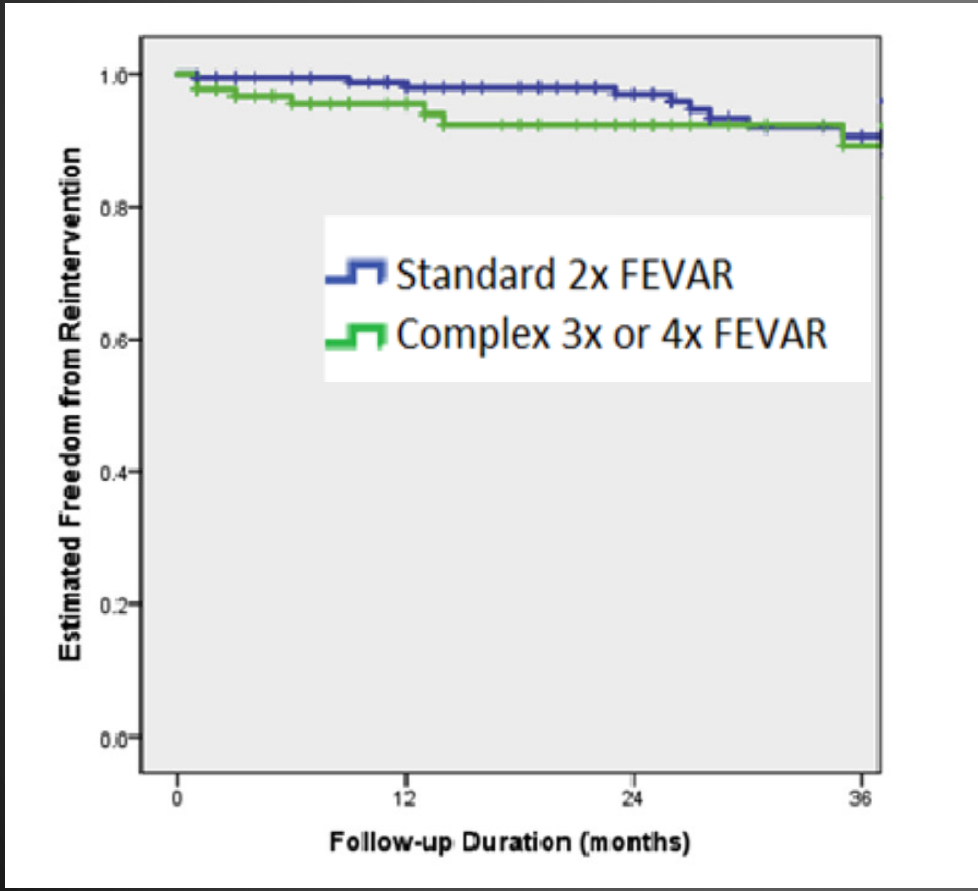
Estimated Survival



- Standard (2x) FEVAR
  - 95 ± 1.7% at 1 year
  - 83.4 ± 3.6% at 3 years
- Complex (3x-4x) FEVAR
  - 94 ± 2.4% at 1 year
  - 89.4 ± 3.5% at 3 years

P=0.96, NS

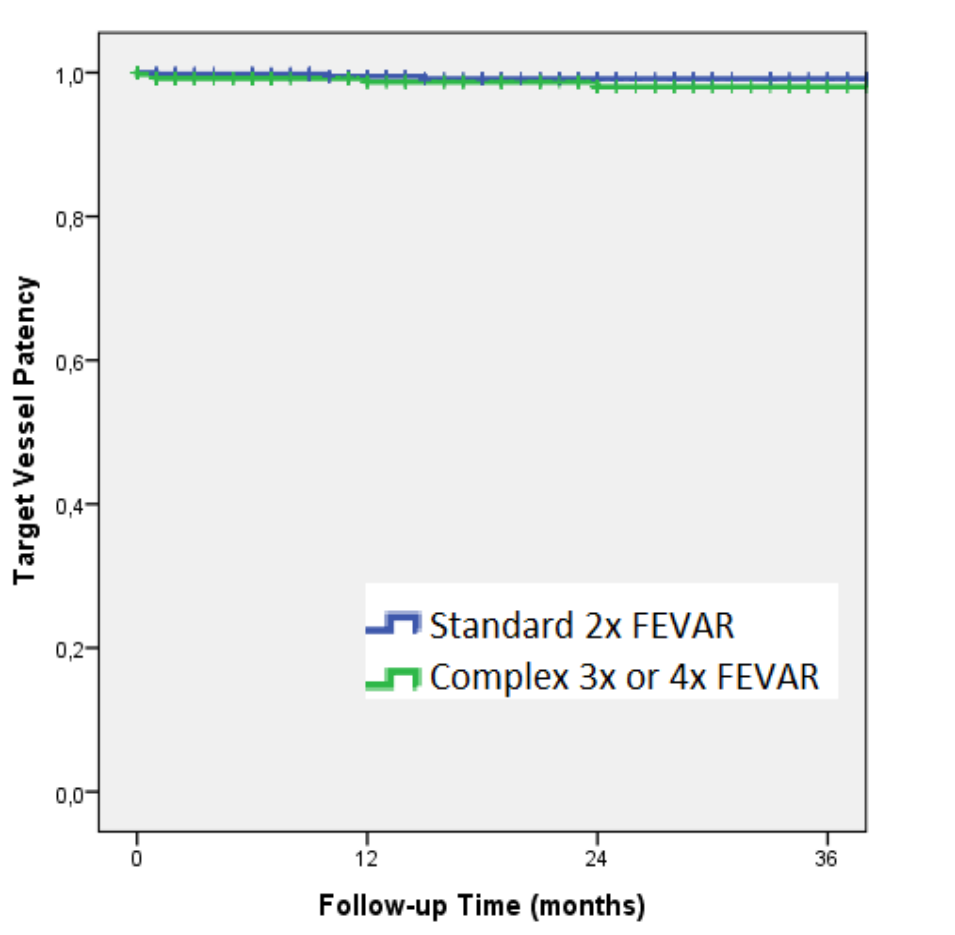
Freedom from Reintervention



- Standard (2x) FEVAR
  - 97.9 ± 1.2% at 1 year
  - 90.5 ± 3.1% at 3 years
- Complex (3x-4x) FEVAR
  - 95.4 ± 2.0% at 1 year
  - 90.1 ± 4.2% at 3 years

P=0.5, NS

Target Vessel Patency



- Standard (2x) FEVAR
  - 99.2 ± 0.4% at 1 year
  - 98.6 ± 0.6% at 3 years
- Complex (3x-4x) FEVAR
  - 98.7 ± 0.6% at 1 year
  - 98.0 ± 0.9% at 3 years

P=0.48, NS

Take Home Message

- Standard EVAR only in good neck anatomy
- 3xFEVAR has replaced 2xFEVAR
- In dilated thoracic aorta/bulging of suprarenal aorta in sagital view: 4x FEVAR

- GOAL
  - more durable results
  - easier repair in case of extension of disease….