"Aortic Arch and Thoraco-Abdominal Aortic Disease

Side branch stent-grafts: materials and results

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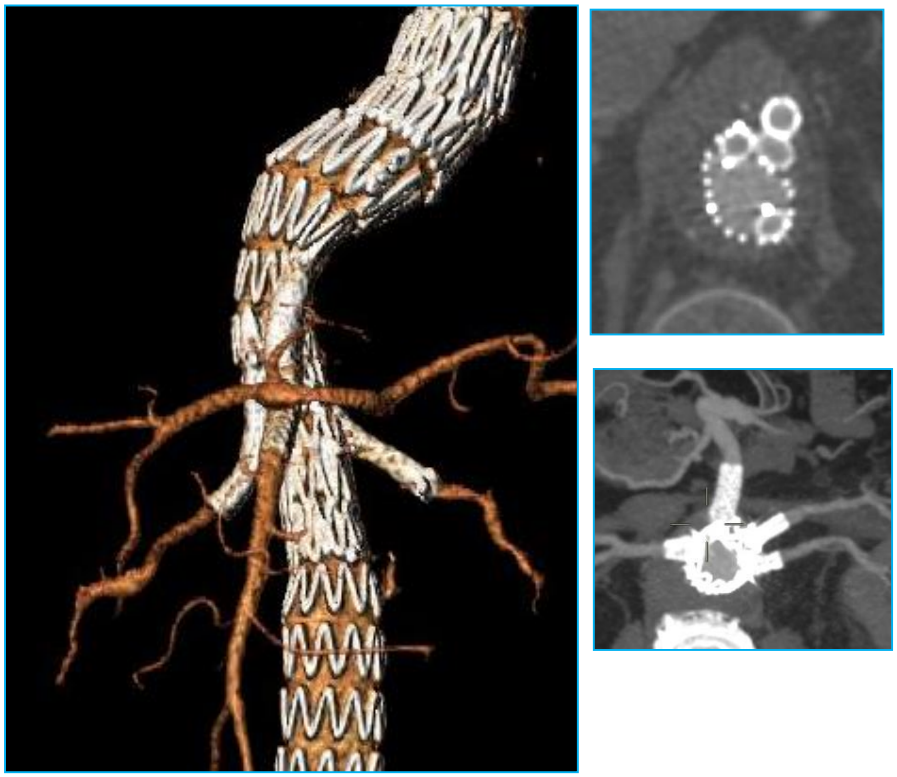


Side branch stent-grafts: materials and results

Disclosure

Speaker name: ***Prof. Mauro Gargiulo***

I have the following potential conflicts of interest to report:

X Consulting: Cook Medical

X PI Expand Registry

Employment in industry

Stockholder of a healthcare company

Owner of a healthcare company

Other(s)

Branched endografts for thoracoabdominal aneurysms

R Greenberg. J Thorac Cardiovasc Surg 2010

Endovascular repair of **406** TAAA

	Endo* (%)	Open (%)	p
SCI	4.3	7.5	0.08
30-d Mortality	5.7	8.3	0.2
1-yr Mortality	15.6	15.9	0.9

*: 9 yrs older and sicker patients

Ten-year experience with endovascular repair of thoracoabdominal aortic aneurysm repair Results from 166 consecutive patients

E Verhoeven, European Journal of Vascular Surgery 2015

	n	%
Technical Success	157	95
SCI	15	9
30-d Mortality	13	8
In hospital Mortality	15	9
	mean	**SD**
F-up (months)	29	21

The impact of Early Pelvic-Lower Limb Reperfusion & attentive peri-operative management on incidence of SCI during TAAA Endovascular Repair

	G1*	G2	Tot
TAAA	43	161	204
	%	%	p
30-d mortality	11.6	5.6	0.09
SCI	14	**1.2**	**<0.01**
SCI (TAAA I,II,III)	25	**2.1**	**<0.01**

* : patients treated before the protocol

B Maurel, European Journal of Vascular Surgery 2015

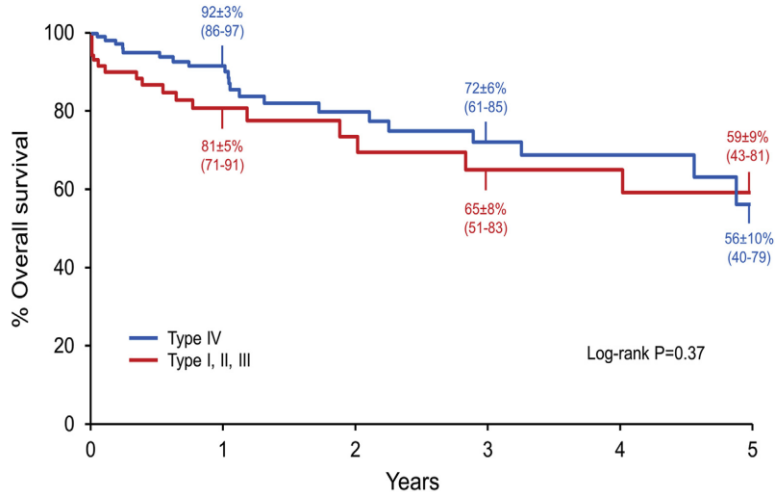
Endovascular Repair of TAAA using fenestrated and branched endograft

G Oderich, J Thorac Cardiovasular Surg 2017

185 cases	%
30-day Mortality	4
Paraplegia	3
Permanent Dialysis	1
Myocardial Infarction	5
Respiratory Failure	5
Renal Failure	11

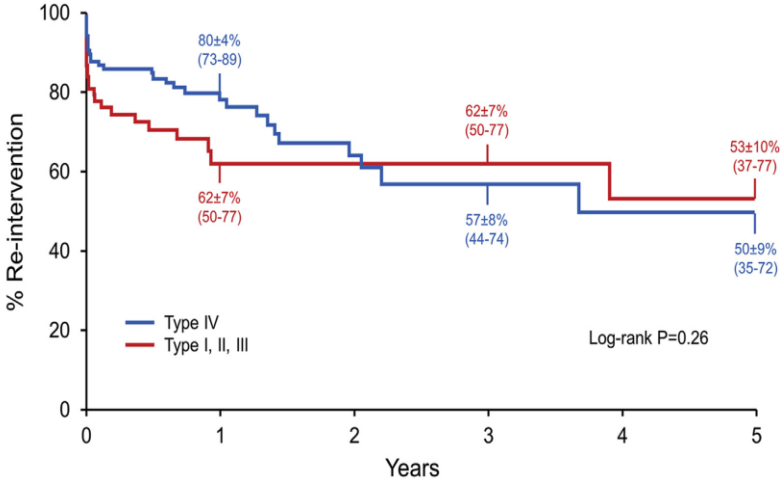
Endovascular Repair of TAAA using fenestrated and branched endograft

G Oderich et al.
J Thorac Cardiovascular Surg 2017



Survival

@ 1-yr	92% (type IV)	vs 81% (type I-III)
@ 3-yr	72%	vs 65%
@ 5-yr	59%	vs 56%



Freedom from Re-interventions

@ 1-yr	80% (type IV)	vs 62% (type I-III)
@ 3-yr	54%	vs 62%
@ 5-yr	50%	vs 53%

Endovascular repair of thoraco-abdominal aortic aneurysms by fenestrated and branched endografts†

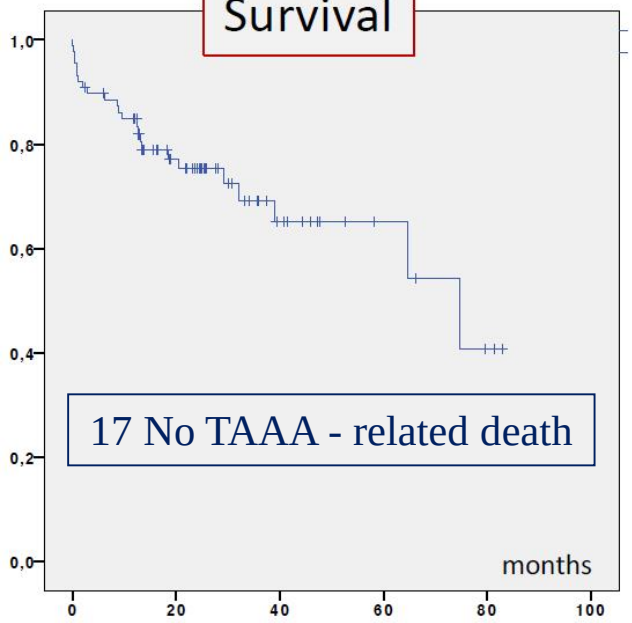
Enrico Gallitto*, Gianluca Faggioli, Rodolfo Pini, Chiara Mascoli, Stefano Ancetti, Cecilia Fenelli, Andrea Stella and Mauro Gargiulo

European Journal of Cardio-Thoracic Surgery 56 (2019) 993–1000

TAAA 88

Mean Follow – up 36 ± 22 months

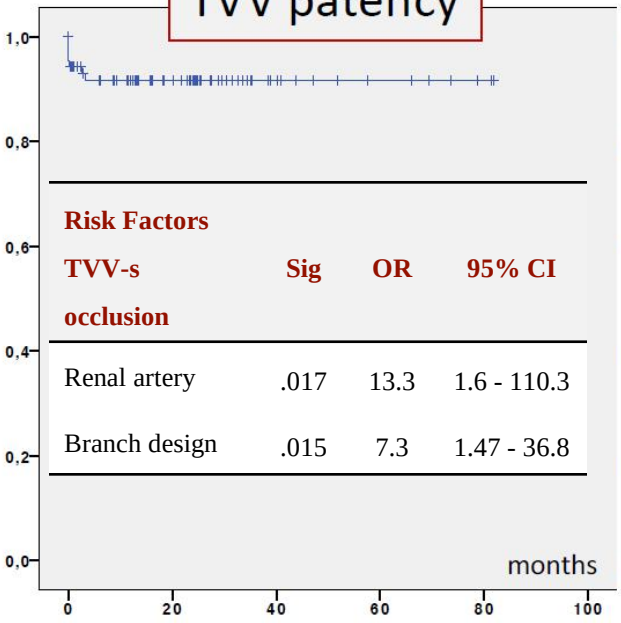
Survival



17 No TAAA - related death

time	1 year	2 year	3 years
%	89	75	70
n	69	41	22
SE	03	04	05

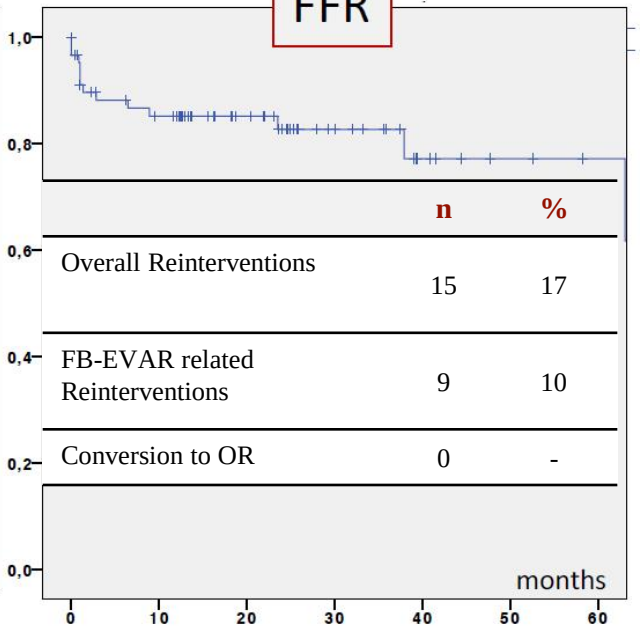
TVV patency



Risk Factors TVV-s occlusion	Sig	OR	95% CI
Renal artery	.017	13.3	1.6 - 110.3
Branch design	.015	7.3	1.47 - 36.8

time	1 year	2 year	3 years
%	92	92	92
n	72	34	22
SE	02	03	05

FFR



	n	%
Overall Reinterventions	15	17
FB-EVAR related Reinterventions	9	10
Conversion to OR	0	-

time	1 year	2 year	3 years
%	85	83	83
n	57	33	16
SE	03	04	05

Fenestrated or branched endovascular aortic repair for postdissection thoracoabdominal aortic aneurysm

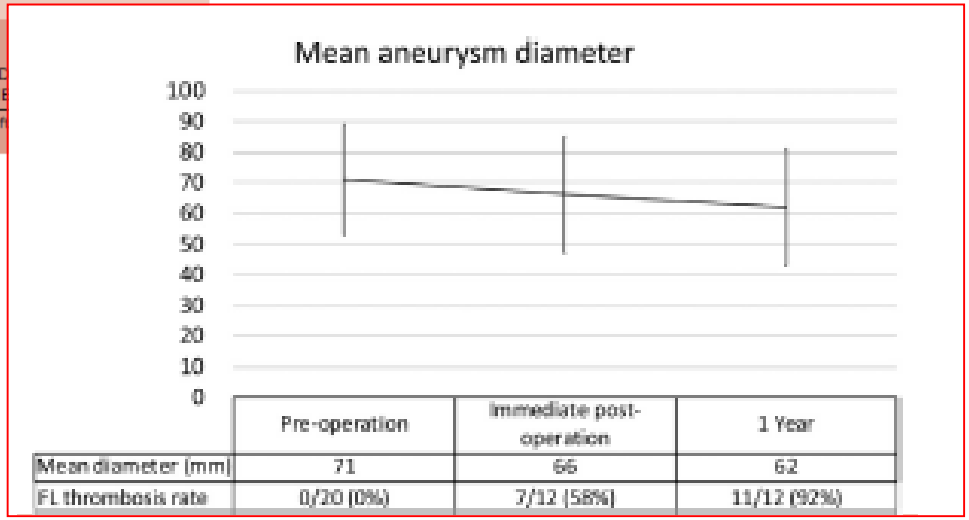
Yuk Law, FRCS,[a,b] Nikolaos Tsilimparis, MD,[a] Fiona Rohlffs, MD,[a] Vladimir Makaloski, MD,[a] Christian-Alexander Behrendt, MD,[a] Franziska Heidemann, MD,[a] Sabine Helena Wipper, MD,[a] Eike Sebastian Debus, PhD,[a] *and* Tilo Kölbel, PhD,[a] *Hamburg, Germany; and Hong Kong, People's Republic of China*

(J Vasc Surg 2019;■:1-9.)

Table II. Dissection characteristics with corresponding endograft designs

Patient	Aneurysm diameter, mm	TL diameter, mm	CA	TL/FL	SMA	TL/FL	RRA	TL/FL	LRA	TL/FL	Distal graft	Additional embolization
1	61	35 × 25	Fen	Both	Fen	Both	Fen	TL	Fen	TL	IBD/Bifurc	
2	67	23 × 18	Fen	TL	Fen	TL	Fen	TL	Fen	FL	Bifurc	
3	70	34 × 11	Br	FL	Fen	TL	Fen	TL	Fen	FL	Bifurc	Bilateral iliac FL
4	97	30 × 13	Fen	TL	Fen	TL	Fen	TL	uBr	FL	Bifurc	
5	71	47 × 36	Occ	Occ	Br	TL	Br	TL	Br	TL	IBD	
6	103	36 × 15	Br	FL	Fen	Both	Fen	TL	uBr	FL	Bifurc	SMA & right iliac FL
7	50	28 × 23	Fen	TL	Fen	TL	Fen	TL	Fen	Both	Bifurc	Right iliac FL
8	75	35 × 20	Fen	TL	Fen	TL	Fen	FL	Fen	TL	Bifurc	
9	73	27 × 9	Fen	TL	Fen	TL	Fen	Both	Fen	TL	Bifurc	Right iliac FL
10	87	39 × 38	Fen	TL	Fen	TL	Fen	TL	Fen	TL	Tube	
11	60	37 × 24	Fen	TL	Fen	TL	Fen	Both	Fen	TL	Bifurc/IBD	
12	61	22 × 13	Fen	TL	Fen	TL	Fen	TL	Fen	FL	Bifurc	
13	42	29 × 15	Fen	TL	Fen	TL	Fen	TL	Fen	FL	IBD/Bifurc	
14	60	33 × 13	Br	FL	Br	Both	Fen	TL	Fen	FL	Tube	
15	70	35 × 9	Fen	TL	Fen	TL	Fen	TL	Fen	FL	Bifurc	Right iliac FL
16	62	30 × 15	Fen	Both	Fen	Both	Fen	TL	Fen	TL	Bifurc/IBD	
17	58	35 × 20	Br	TL	Br	TL	Br	FL	Br	TL	Bifurc/IBD	
18	66	34 × 14	Fen	TL	Fen	TL	Occ	Occ	Fen	TL	Bifurc	
19	58	37 × 32	Br	TL	Br	TL	Br	TL	Br	TL	Bifurc	
20	64	23 × 14	Fen	FL	Fen	TL	Fen	TL	Fen	TL	Bifurc/IBD	
Overall	68	32 × 19									2 Tube 11 Bifurc 6 Bifurc/IBD 1 Bilateral IE	

Bifurc, Bifurcated graft; *Br*, branch; *CA*, celiac artery; *Fen*, fenestration; *FL*, false lumen; *IBD*, iliac branched device; *LRA*, left
RRA, right renal artery; *SMA*, superior mesenteric artery; *TL*, true lumen; *uBr*, upward branch.



	Pre-operation	Immediate post-operation	1 Year
Mean diameter (mm)	71	66	62
FL thrombosis rate	0/20 (0%)	7/12 (58%)	11/12 (92%)

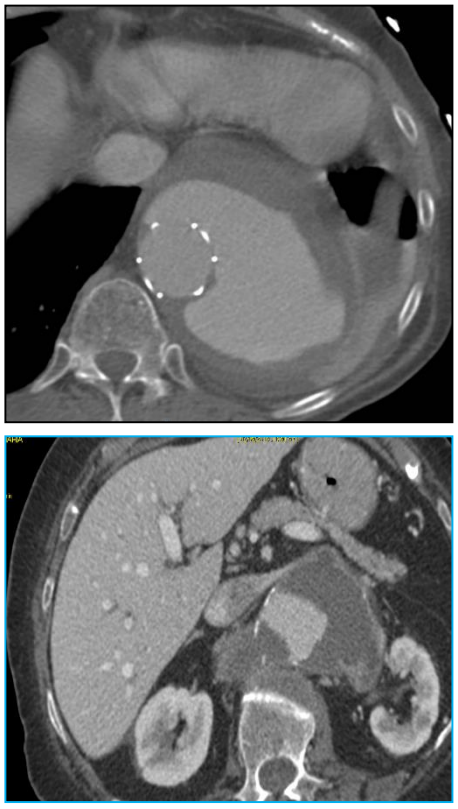
Total Endovascular Repair of Contained Ruptured Thoracoabdominal Aortic Aneurysms

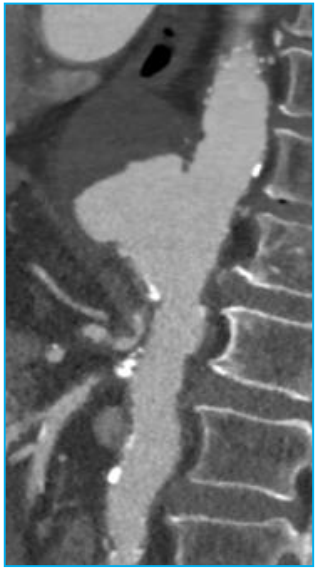
Enrico Gallitto,[1] Gianluca Faggioli,[1] Rodolfo Pini,[1] Chiara Mascoli,[1] Antonio Freyrie,[2] Vincenzo Vento,[1] Stefano Ancetti,[1] Andrea Stella,[1] and Mauro Gargiulo,[1] Bologna and

Ann Vasc Surg 2019; 58:211-21

Table III. Intraoperative and Perioperative data

Features	n (%)
Technical success	11 (92)
TVV patency at completion angiography	33/34 (97)
SCI	2 (17)
Cardiac morbidity	1 (8)
Pulmonary morbidity	3 (25)
New onset of dialysis	1 (8)
Minor stroke (parallel graft)	1 (8)
Cerebral hemorrhage (custom-made FB-EVAR)/no postoperative sequelae	1 (8)
30-Day mortality	2 (17)
respiratory failure (T-branch)	
cardiac failure (parallel graft)	
In-hospital mortality (included 30-day mortality)	3 (25)





Impact of previous open aortic repair on the outcome of thoracoabdominal fenestrated and branched endografts

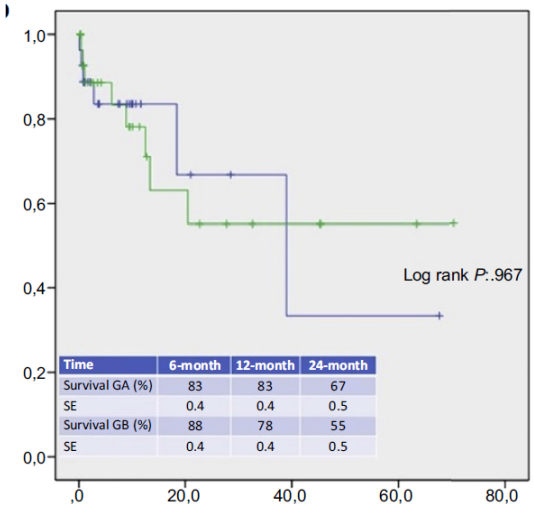
Enrico Gallitto, MD, PhD, Gianluca Faggioli, MD, PhD, Chiara Mascoli, MD, Rodolfo Pini, MD, Stefano Ancetti, MD, Andrea Vacirca, MD, Andrea Stella, MD, PhD, *and* Mauro Gargiulo, MD, PhD, *Bologna, Italy*

(J Vasc Surg 2018;68:1667-75.)

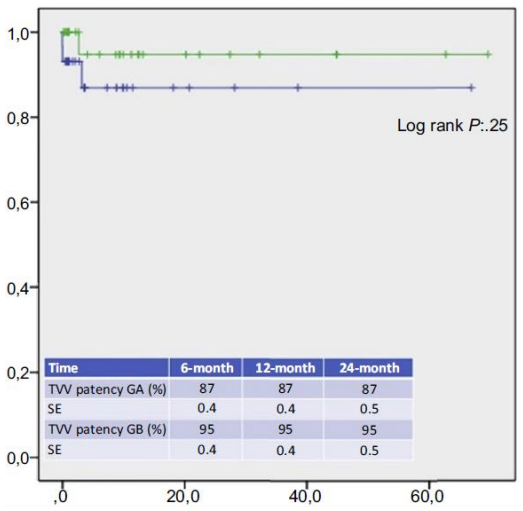
Table II. Thoracoabdominal aortic aneurysms (TAAAs) Crawford's distribution in group A and B

Crawford's type	Overall	Group A	Group B
I	1	1	–
II	14	7	7
III	24	12	12
IV	23	10	13
Total	62	30	32

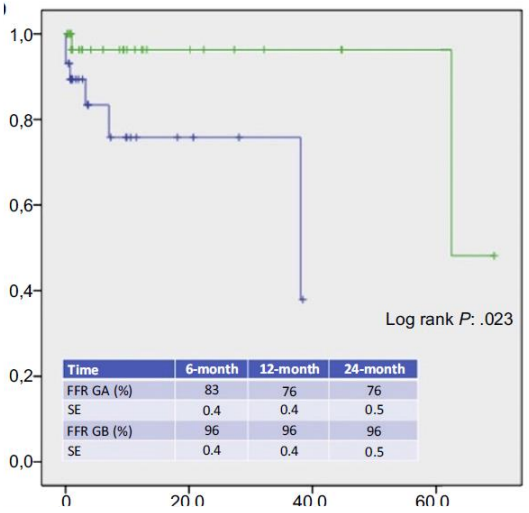
- **Take Home Message**: Fenestrated and branched endovascular repair of thoracoabdominal aortic aneurysms in 62 patients resulted in similar rates of technical success (92%), 30-day mortality (5%), 2-year visceral artery patency (91%), and 2-year survival (60%) in patients with and without previous open aortic repair.
- **Recommendation**: This study suggests that previous open surgical repair does not negatively impact outcomes following fenestrated and branched endovascular repair of thoracoabdominal aortic aneurysms.



Survival



Patency of TVVs



FFR

Endovascular repair of thoraco-abdominal aortic aneurysms by fenestrated and branched endografts†

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TAAA 88

Key question

Is endovascular repair of thoracoabdominal aneurysms (TAAAs) by fenestrated/branched endograft (FB-EVAR) safe and effective in high-risk patients?

Key finding(s)

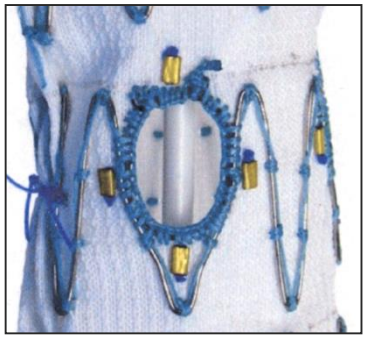
30-Day hospital mortality rate: 5%–8%; Paraplegia: 3%; Cardiopulmonary morbidity: 8%–14%; Dialysis: 2%; Survival rate at 3 years: 70%.

Take-home message

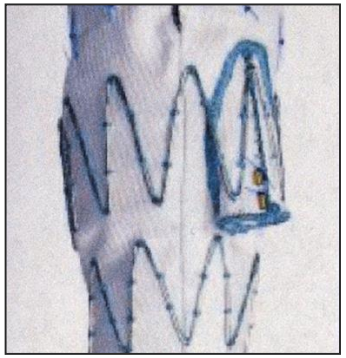
FB-EVAR for TAAAs is safe and effective. It could be the first therapeutic option in high-risk patients with anatomical feasibility.

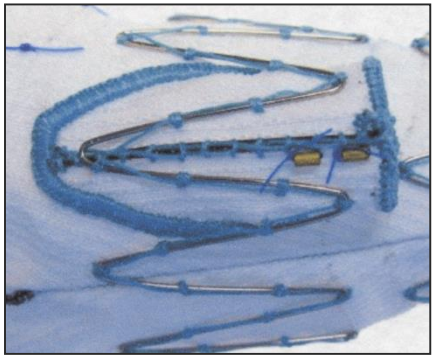
TAAA Endovascular Repair

- **Reinforced Fenestration**
  - J/P-AAA
  - Type IV TAAA
  - Renal arteries



- **Side-Arm branches**
  - Type I, II, III TAAA
  - Aortic Ø > 35 mm



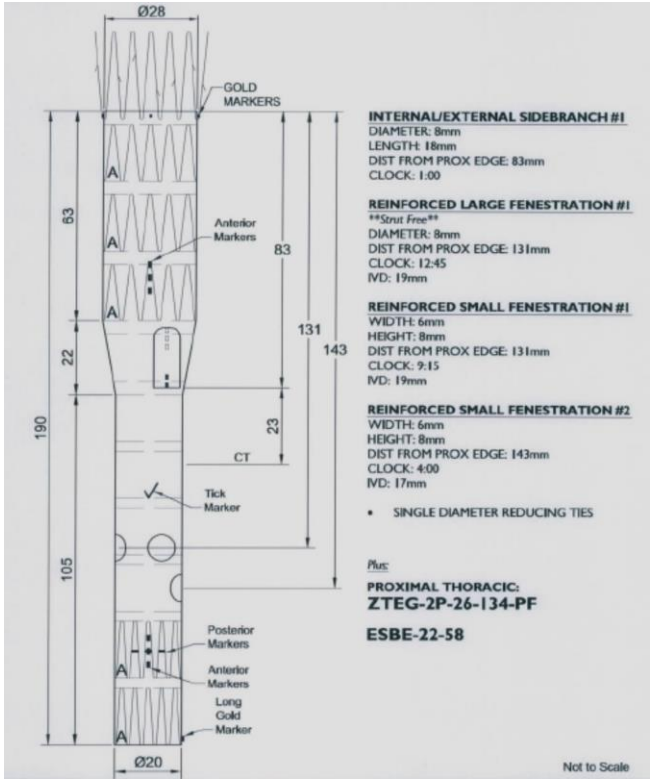


Greenberg R. et al.
J Thorac Cardiovasc Surg 2010

TAAA Endovascular Repair

Endograft

- Custom-Made
- Off-the-shelf



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- **TVV 317**

- **Fenestrations vs branched Endograft**

  - Endograft with branches 35%
  - Endograft with fenestration 51%
  - Endograft with branched and fenestration 14%

- **Endograft Configuration**

  - Custom made endograft 68%
  - Off the shelf endograft 32%

The different effect of branches and fenestrations on early and long-term visceral vessel patency in complex aortic endovascular repair

Rodolfo Pini, MD, Gianluca Faggioli, MD, Enrico Gallitto, MD, Chiara Mascoli, MD, Cecilia Fenelli, MD, Stefano Ancetti, MD, Andrea Vacirca, MD, *and* Mauro Gargiulo, MD, *Bologna, Italy*

(J Vasc Surg 2019;■:1-7.)

Our approach was:

- fenestration or side branches according to the aortic anatomy and not the type of vessel

- if the aortic lumen diameter is < 30 mm, we have generally preferred **fenestration,** because the bridging stent will usually be relatively short and this type of configuration allows for shorter coverage of the proximal healthy aorta

- in the case of a larger aortic lumen diameter, **side branches** will lead to easier vessels cannulation.

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(J Vasc Surg 2018;68:1667-75.)

Table IV. Literature experiences (with >150 cases) reported in the last years by high-volume centers for fenestrated and branched endovascular repair (FB-EVAR) repair: Perioperative results

Authors	Patients, No.	Technical success, %	30-day mortality, %	SCI, %
Greenberg et al[17]	406	–	5.7	4.3
Maurel et al[18]	204	92.6	6.9	3.9
Verhoeven et al[19]	166	95.0	8.0	9.0
Eagleton et al[20]	354	94.0	4.8	8.8
Oderich et al[21]	185	94.0	4.3	3.0

SCI, Spinal cord ischemia.

Table V. Literature experiences (with >150 cases) reported in the last years by high-volume centers for fenestrated and branched endovascular repair (FB-EVAR) repair: Follow-up results

Authors	Months of follow-up, mean ± SD	Survival, % at 24-month	TTV-patency, % at 24 months	FFR, % at 24 months
Greenberg et al[17]	–	–	–	–
Maurel et al[18]	–	–	–	–
Verhoeven et al[19]	29 ± 19	78	97	98
Eagleton et al[20]	23 ± 19	68	92, 98, 97[a]	64
Oderich et al[21]	21 ± 20	68 ± 5/72 ± 6[b]	95	62

FFR, Freedom from reinterventions; *TTV*, target visceral vessels.
[a]Percentages referred to renal artery, superior mesenteric artery, and celiac trunk, respectively.
[b]Percentages referred to type I-III and type IV thoracoabdominal aortic aneurysms (TAAAs), respectively.

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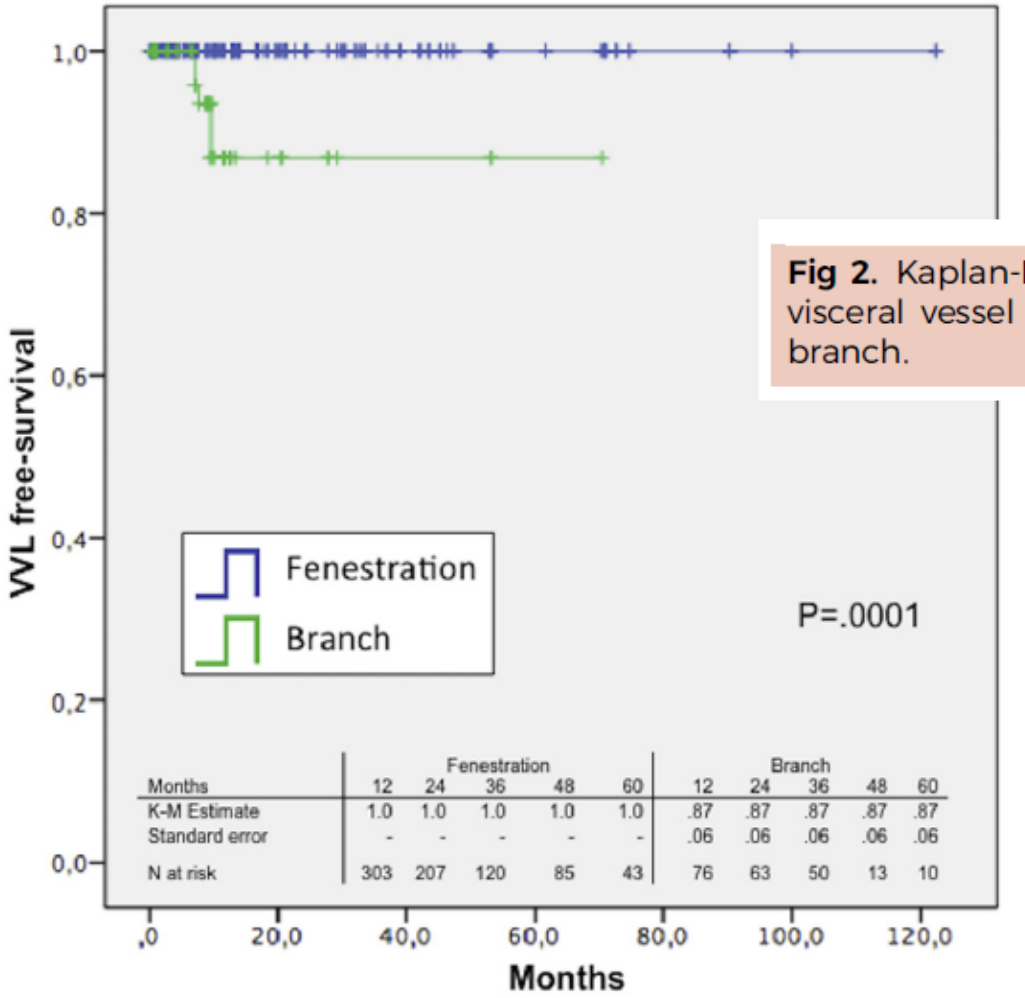

	Fenestration					Branch				
Months	12	24	36	48	60	12	24	36	48	60
K-M Estimate	1.0	1.0	1.0	1.0	1.0	.87	.87	.87	.87	.87
Standard error	-	-	-	-	-	.06	.06	.06	.06	.06
N at risk	303	207	120	85	43	76	63	50	13	10

Fig 2. Kaplan-Meier (*K-M*) curve with log-rank analysis of visceral vessel loss (*VVL*)-free survival in fenestration and branch.

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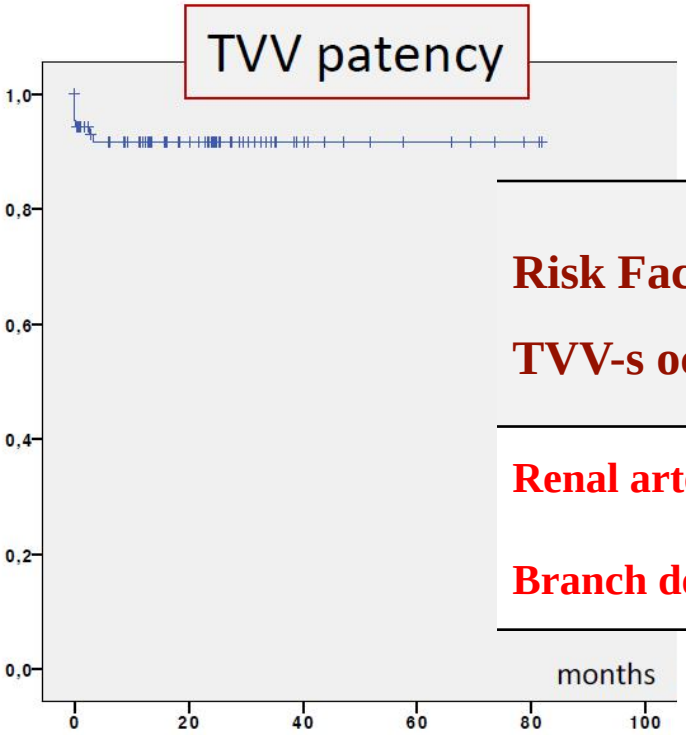

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Branch design	.015	7.3	1.47 - 36.8

Eur J Vasc Endovasc Surg (2018) 56, 382–390

Renal Artery Orientation Influences the Renal Outcome in Endovascular Thoraco-abdominal Aortic Aneurysm Repair☆

Enrico Gallitto *, **Gianluca Faggioli, Rodolfo Pini, Chiara Mascoli, Stefano Ancetti, Mohammad Abualhin, Andrea Stella, Mauro Gargiulo**

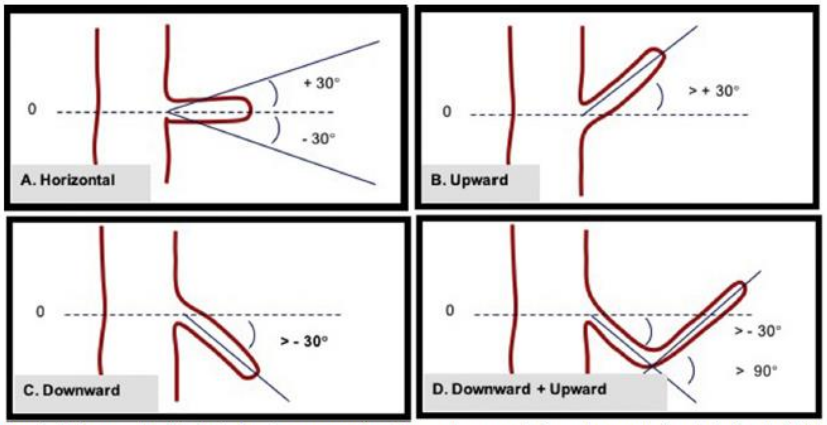

Figure 1. RA orientation was classified into four types according to the volume rendering and coronal view: A (horizontal), B (upward), (downward), D (downward + upward).

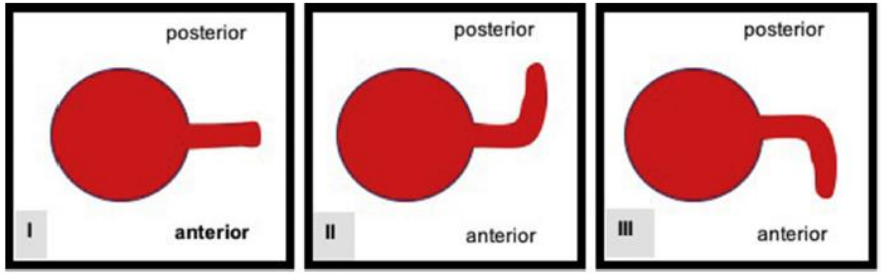

Figure 2. RA orientation was classified into three types according to axial view: I (lateral), II (posterior), III (anterior).

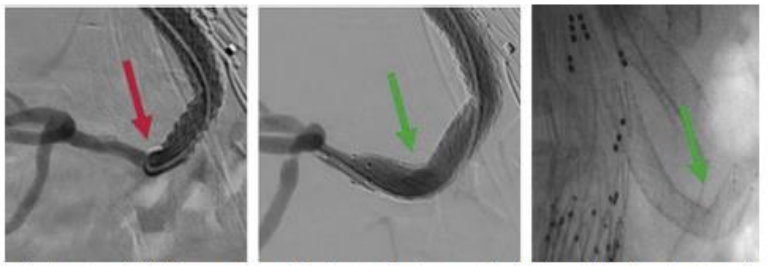

Figure 3. For any doubts, stenosis, kinking, or acute angles in the transition between the distal end of the visceral stent graft and renal artery, relining by a self expandable stent graft was performed.

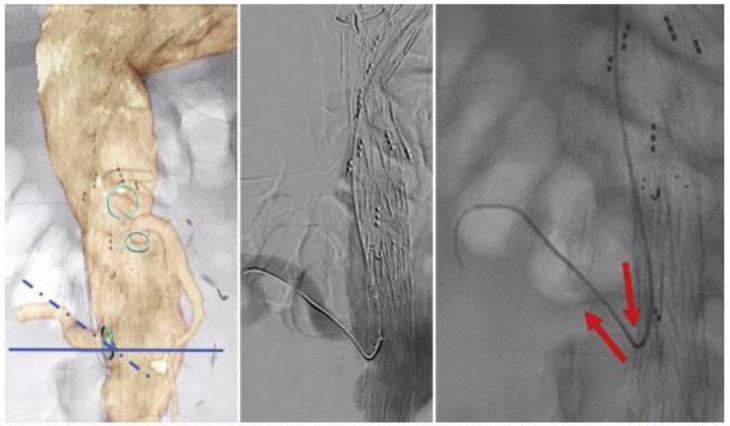

Figure 4. Intra-operative images of thoraco-abdominal endovascular repair by branched endograft. Multiple attempts to advance materials (stiff guidewire and introducer) inside an upward right renal artery. Upward renal artery orientation was an independent risk factor for intra-operative RA loss.

Eur J Vasc Endovasc Surg (2018) 56, 382–390

Renal Artery Orientation Influences the Renal Outcome in Endovascular Thoraco-abdominal Aortic Aneurysm Repair☆

Enrico Gallitto *, **Gianluca Faggioli, Rodolfo Pini, Chiara Mascoli, Stefano Ancetti, Mohammad Abualhin, Andrea Stella, Mauro Gargiulo**

Table 9. Overall composite renal artery events.

	n
Intra-operative RA lesion	4
RA loss	10
RA related re-interventions	5
RA occlusion	4

Type B ($p = .05$; OR 3.9; 95% CI 1.1–15.7) or D ($p = .006$; OR 10.9; 95% CI 2.3–50.8) RA orientations and branches ($p = .006$; OR 5.7; 95% CI 1.6–20.3) were independent predictors of composite RA events on multivariable analysis.

On multivariable analysis, type B RA orientation ($p = .03$; OR 5.9; 95% CI 1.1–31.1) and branches ($p = .03$; OR 7.3; 95% CI 1.1–47.9) were independent risk factors for intra-operative RA loss

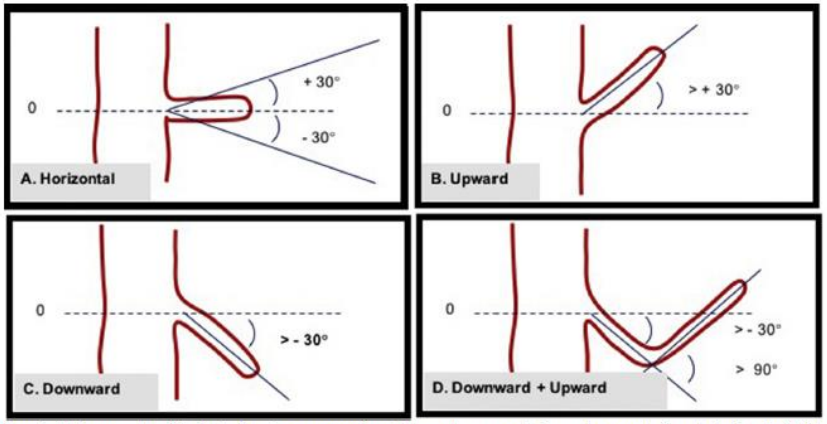

Figure 1. RA orientation was classified into four types according to the volume rendering and coronal view: A (horizontal), B (upward), C (downward), D (downward + upward).

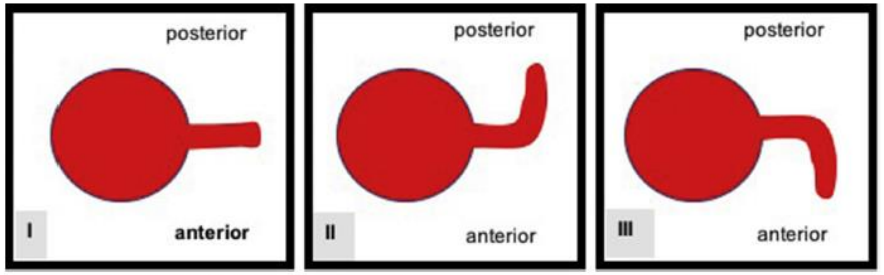

Figure 2. RA orientation was classified into three types according to axial view: I (lateral), II (posterior), III (anterior).

First/Preliminary Experience of Gore Viabahn Balloon-Expandable Endoprosthesis as Bridging Stent in Fenestrated and Branched Endovascular Aortic Repair

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Ann Vasc Surg 2019; epub

Table IV. Anatomical distribution of the aortic lesion

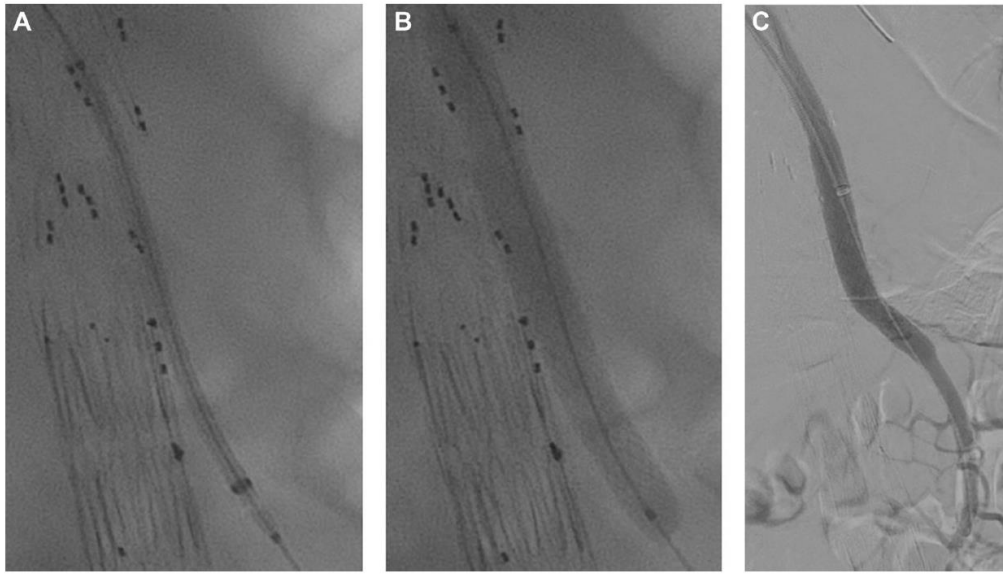
Aortic lesion	*n*	%
J/p-AAA	10	66
TAAA	3	20
EL Ia post standard EVAR	1	7
AAA + IAA	1	7

AAA + IAA, infrarenal abdominal and iliac aneurysms; EL Ia post standard EVAR, proximal type I endoleak after a standard EVAR.

Table V. Details of TVV accommodation by branch, fenestration, or scallop.

	CT	SMA	RA	HA	Total
Branches	1	1	2	3	7
Fenestrations	11	12	28	0	51
Scallops	2	0	0	0	2
Total TVVs	14	13	30	3	60

CT, celiac trunk; HA, hypogastric artery; RA, renal artery.



The hybrid stentgraft technique in bridging hostile renal arteries in Thoracoabdominal branched endograft.

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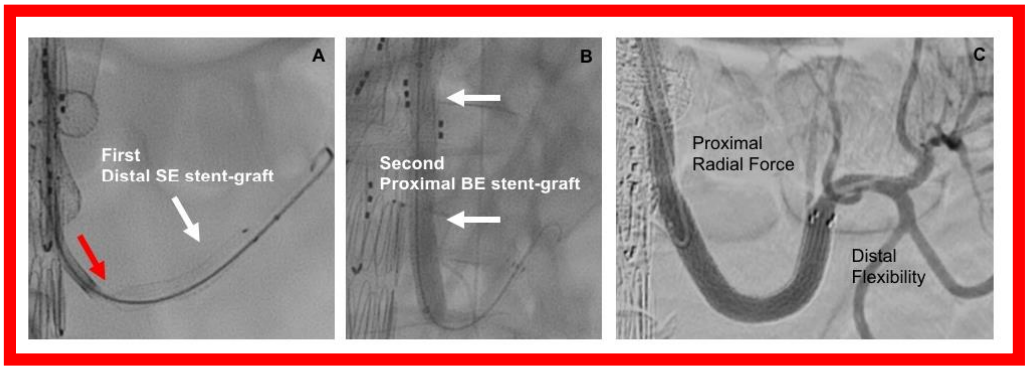
Methods.
Between 2010 and 2019, all TAAAs undergoing FB-EVAR were prospectively collected. Pre-operative, procedural and post-operative data of RAs accommodated by branch design and patent at the completion angiography, were retrospectively analyzed. Hostile renal artery anatomy included upward (typeB) and downward + upward (typeD) orientations.
Type B and D RAs treated by the combination of SE+BE stent-graft as bridging stent (BE+SE group), were compared with RAs treated by balloon expandable stent-graft only (BE-group). Renal artery occlusion, reinterventions and branch instability were assessed.

Table 1. Bridging stent-grafts used in SE+BE and BE groups.

	BE - group	SE+BE - group	Overall
Atrium Advanta	19*	27	46
Gore VBX	2	13	15
Gore Viabahn	-	40	40
Overall	21	80	101



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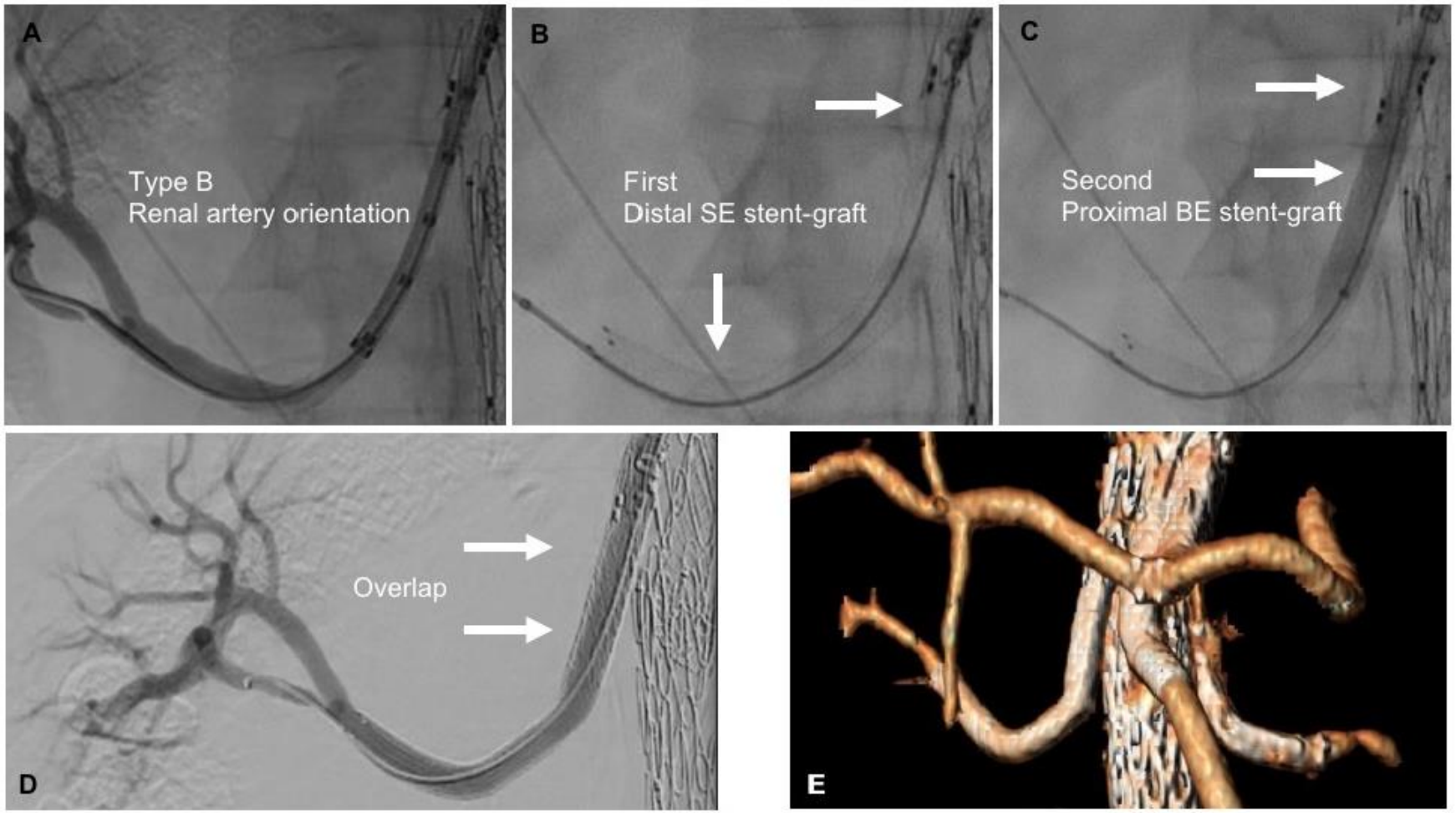

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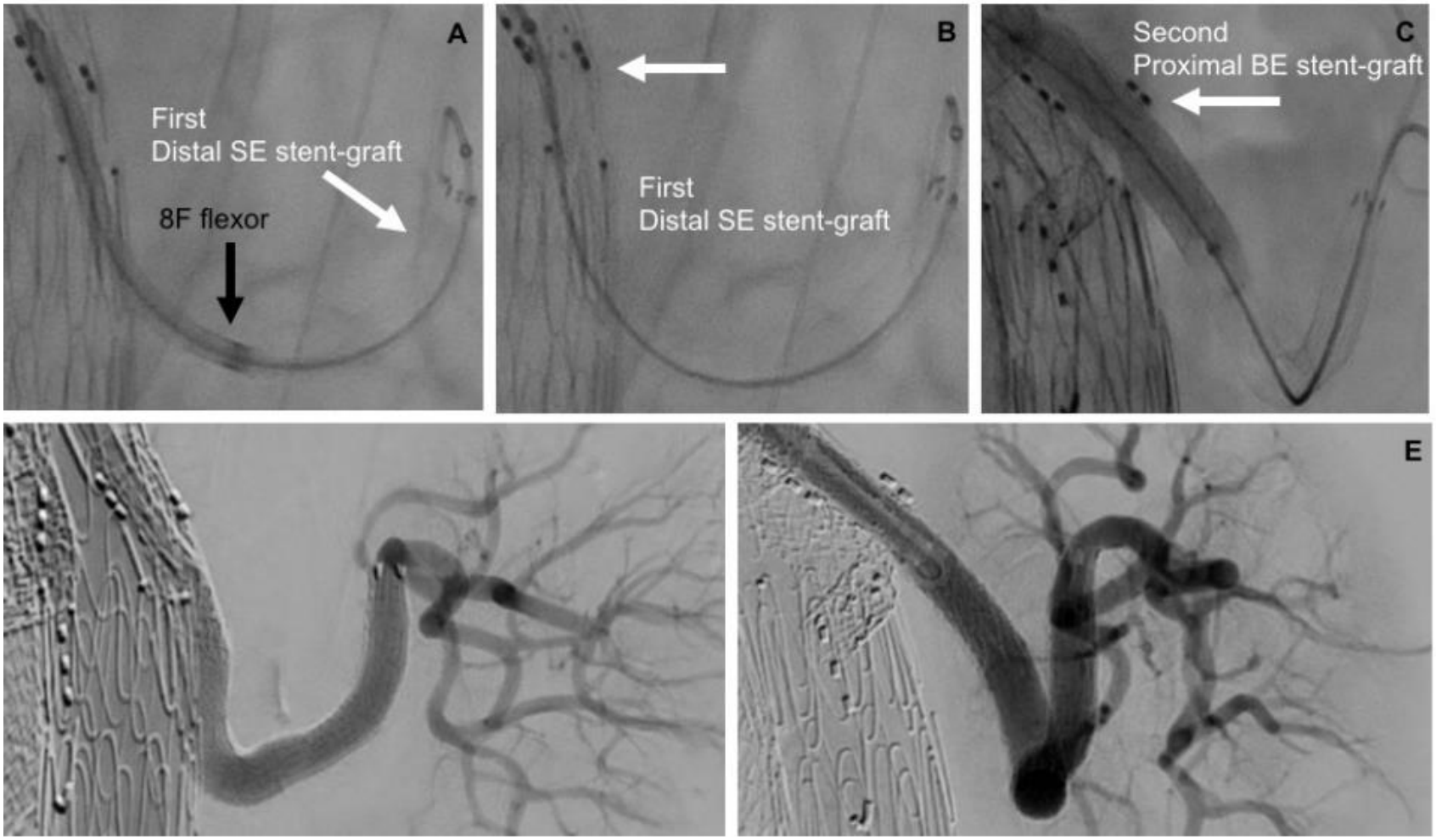

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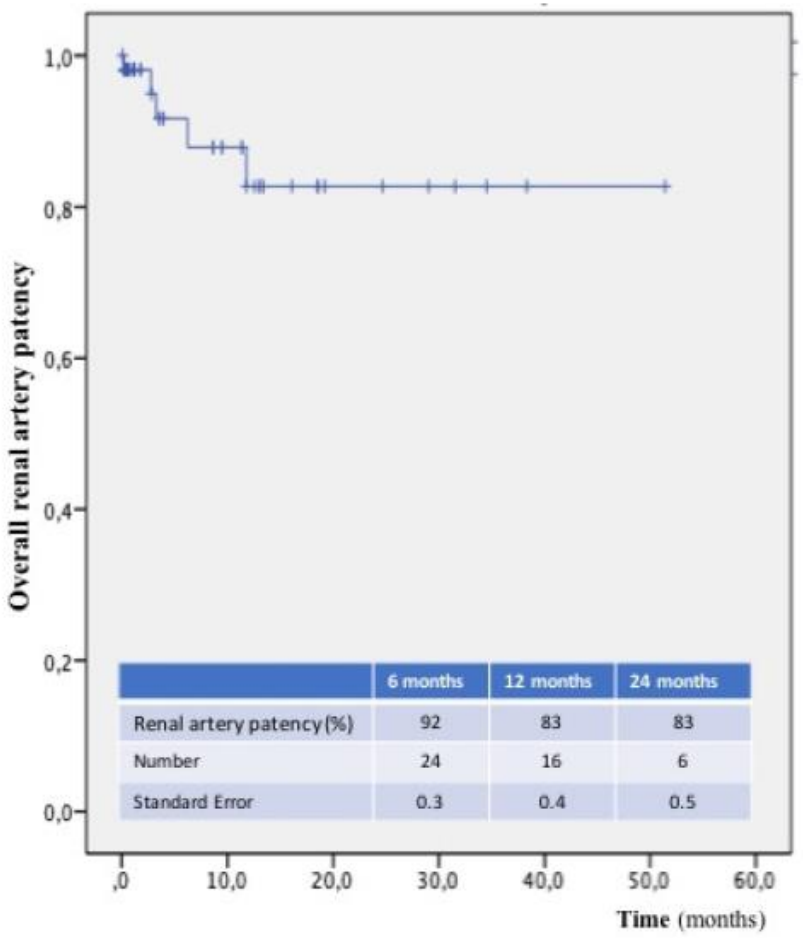
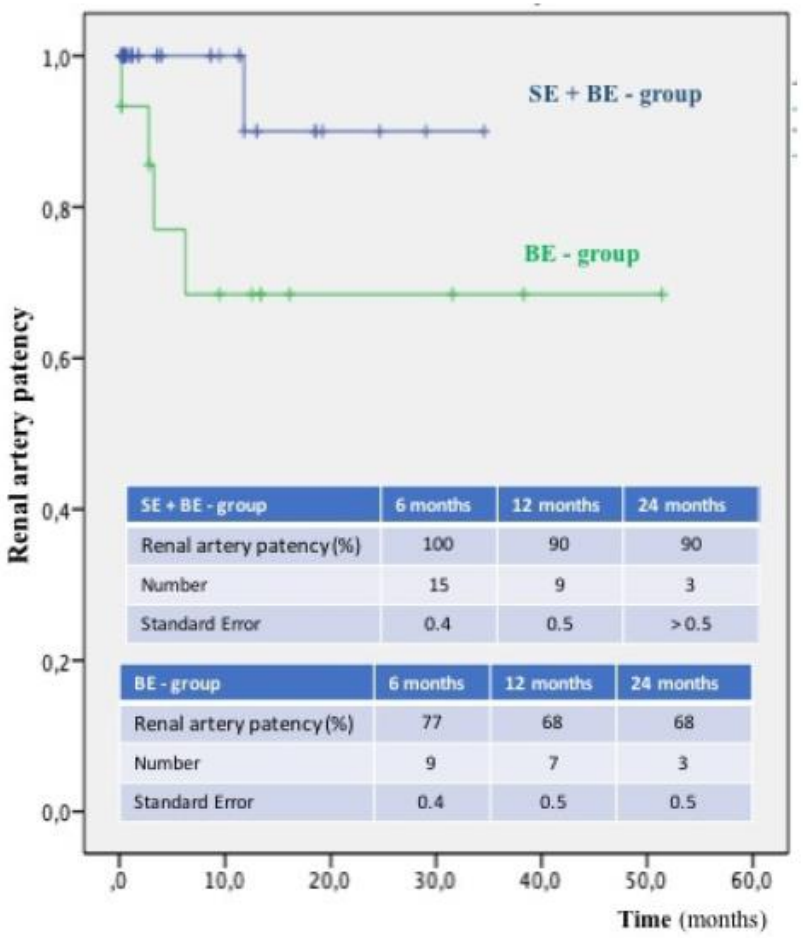


	6 months	12 months	24 months
Renal artery patency (%)	92	83	83
Number	24	16	6
Standard Error	0.3	0.4	0.5



SE + BE - group	6 months	12 months	24 months
Renal artery patency (%)	100	90	90
Number	15	9	3
Standard Error	0.4	0.5	>0.5

BE - group	6 months	12 months	24 months
Renal artery patency (%)	77	68	68
Number	9	7	3
Standard Error	0.4	0.5	0.5

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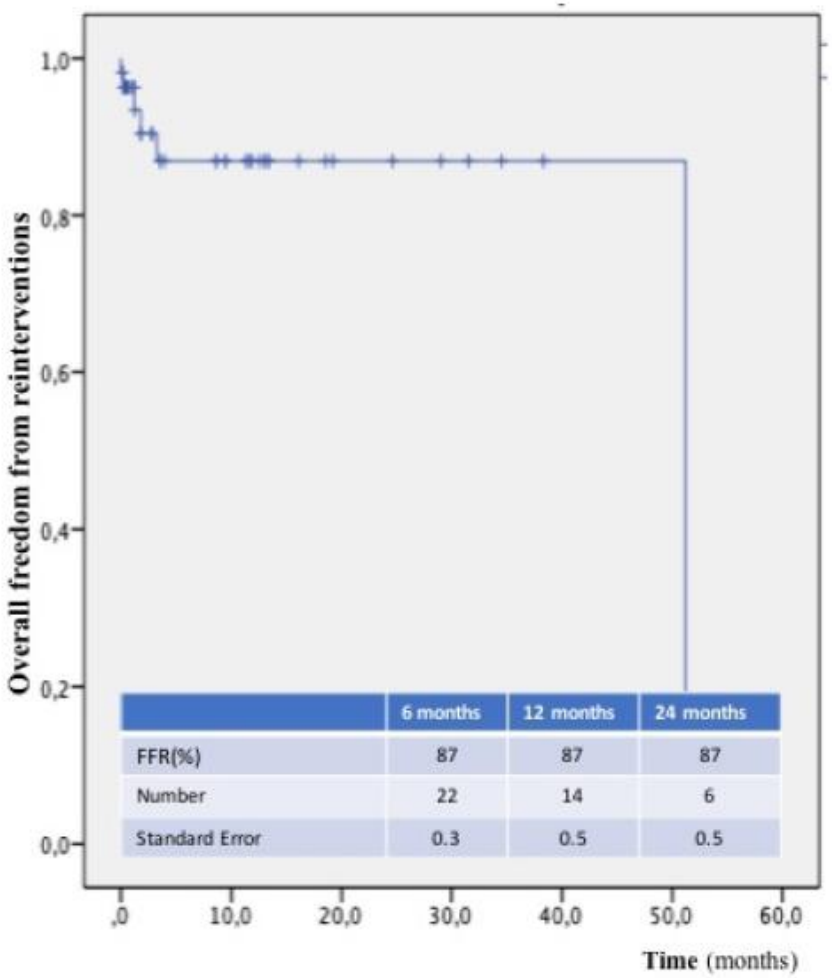
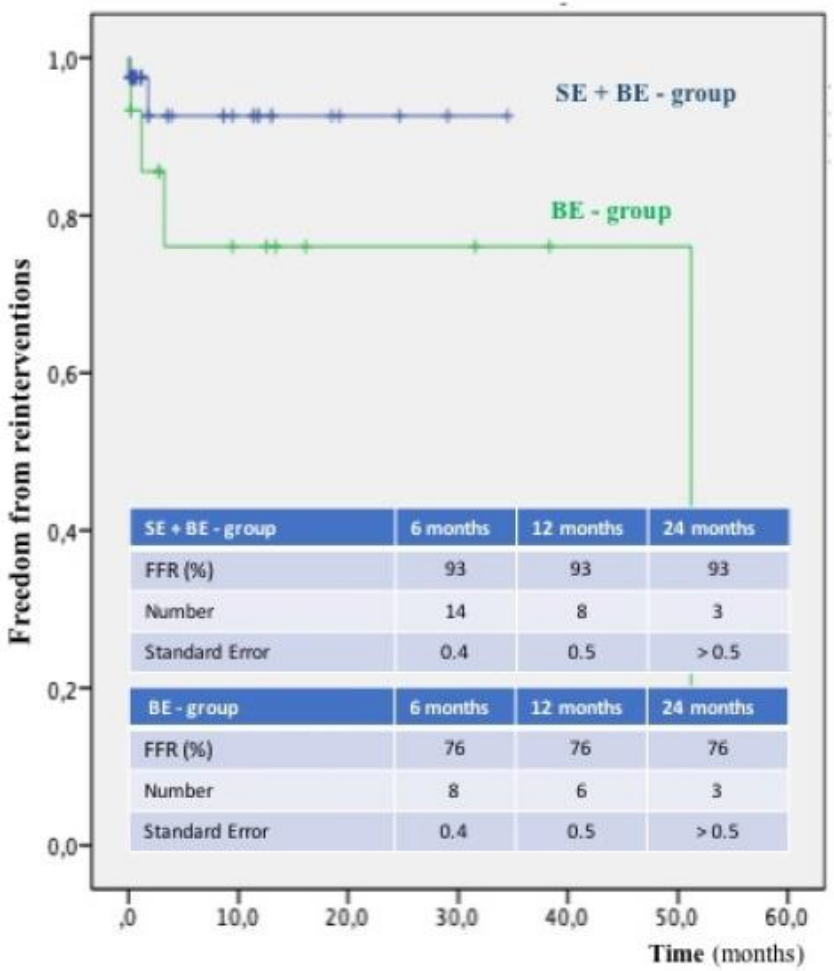


	6 months	12 months	24 months
FFR(%)	87	87	87
Number	22	14	6
Standard Error	0.3	0.5	0.5



SE + BE - group	6 months	12 months	24 months
FFR (%)	93	93	93
Number	14	8	3
Standard Error	0.4	0.5	>0.5

BE - group	6 months	12 months	24 months
FFR (%)	76	76	76
Number	8	6	3
Standard Error	0.4	0.5	>0.5

Side branch stent-grafts: materials and results

Take-Home Message

- The total endovascular treatment of TAAA is evolving
- Short-mid term results seem encouraging endovascular treatment of TAAA
- Side-Branch stent-grafts:
  - in case of a larger aortic lumen diameter at the level of visceral vessels
  - renal arteries revascularization with BE in type A-C renal arteries anatomy and with BE+SE in type B-D renal artery anatomy.