UNIVERSITEIT GENT

FACULTY OF MEDICINE AND HEALTH SCIENCES

THE 26TH INTERNATIONAL EXPERTS SYMPOSIUM
CRITICAL ISSUES
IN AORTIC ENDOGRAFTING

Planning of rAAA: How do sealing zone diameter changes affect graft choice and design

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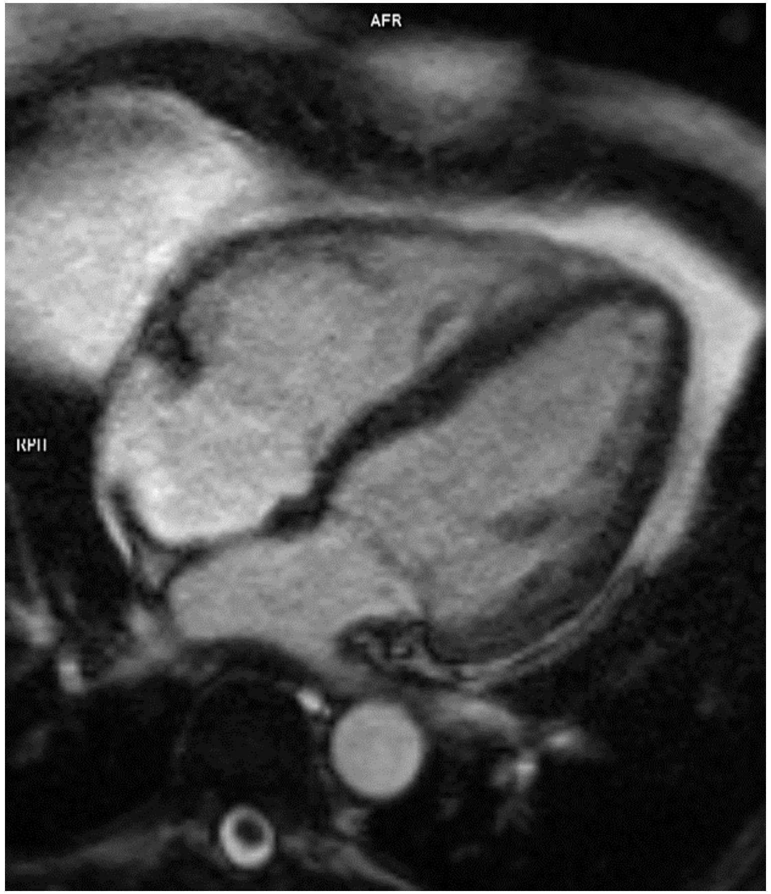
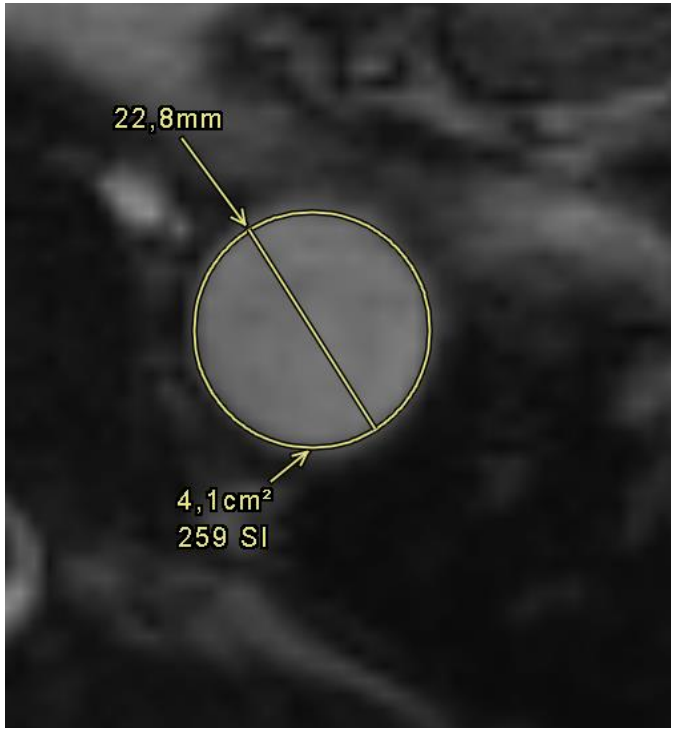
Disclosures

- ❑ I have the following potential conflicts of interest to report:
  - ❑ Receipt of grants/research support
  - ❑ Receipt of honoraria and travel support
  - ❑ Participation in a company sponsored speakers‘ bureau
  - ❑ Employment in industry
  - ❑ Shareholder in a healthcare company
  - ❑ Owner of a healthcare company

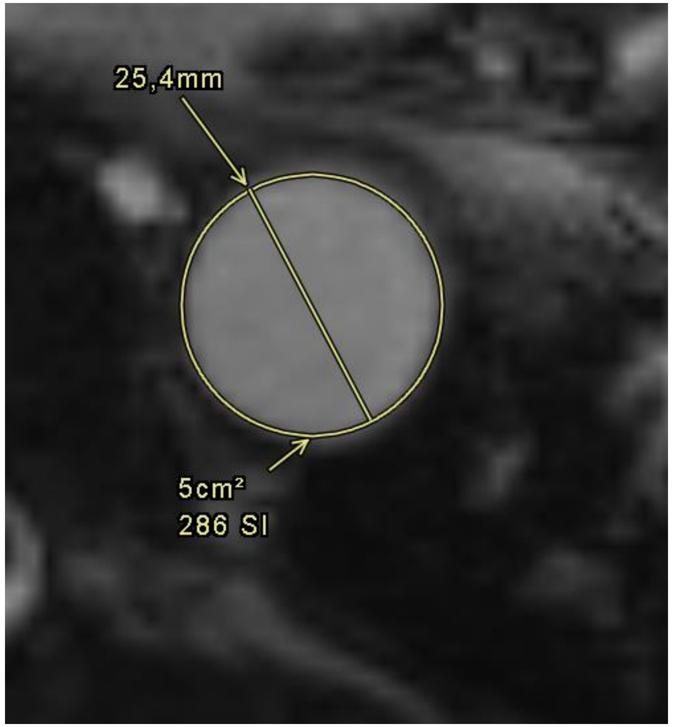
- ✓ I do not have any potential conflict of interest

Changing diameters of the aorta



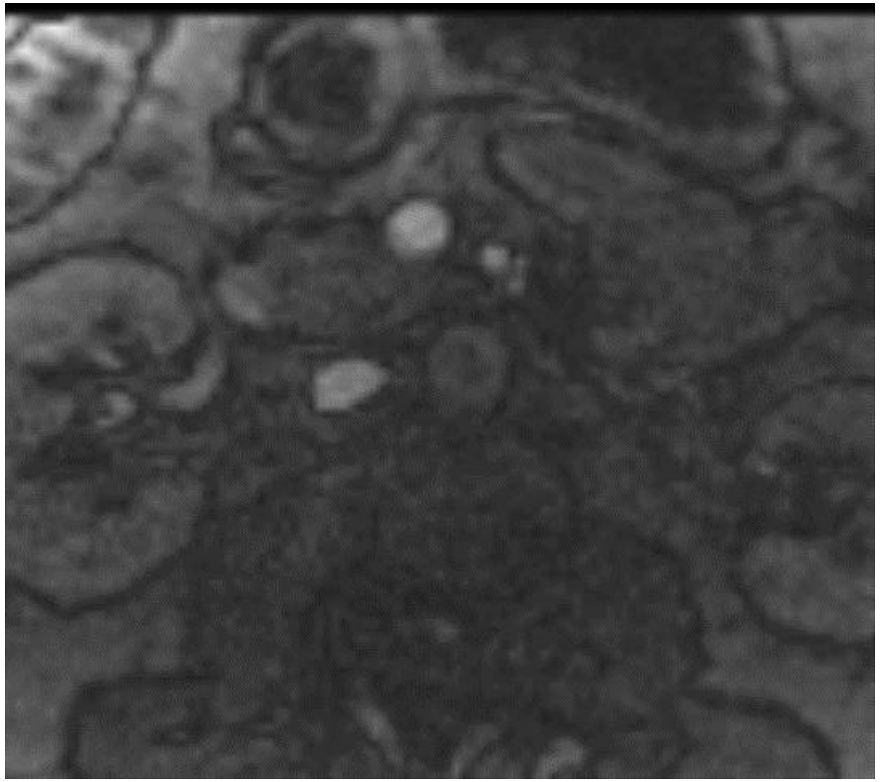


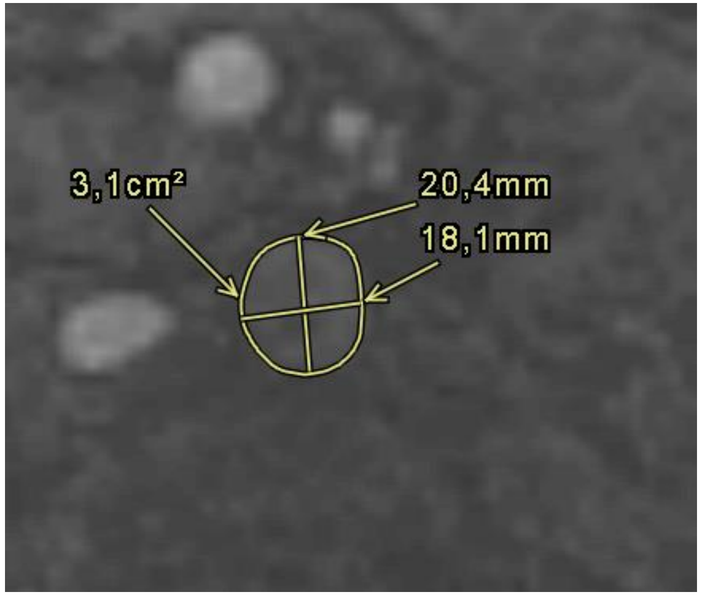
Diameter during diastole



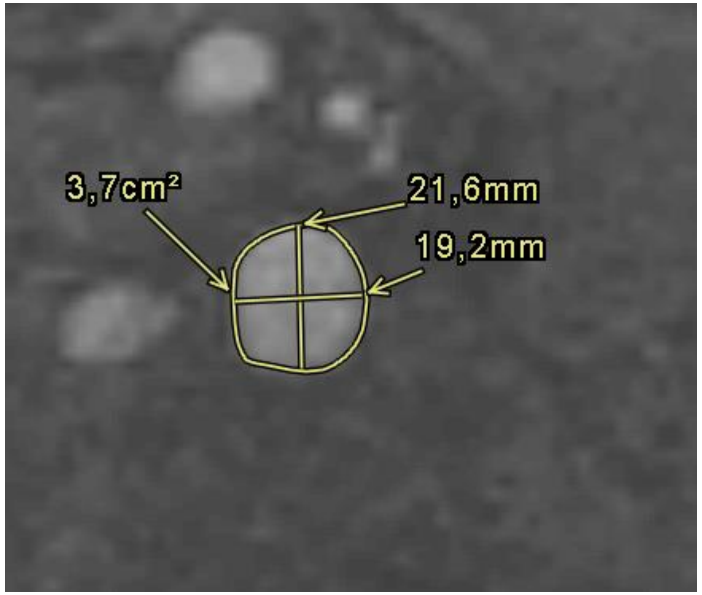
Diameter during systole

Changing diameters of the aorta





Diameter during diastole



Diameter during systole

Difficulties with endograft sizing in a patient with traumatic rupture of the thoracic aorta: The possible influence of hypovolemic shock

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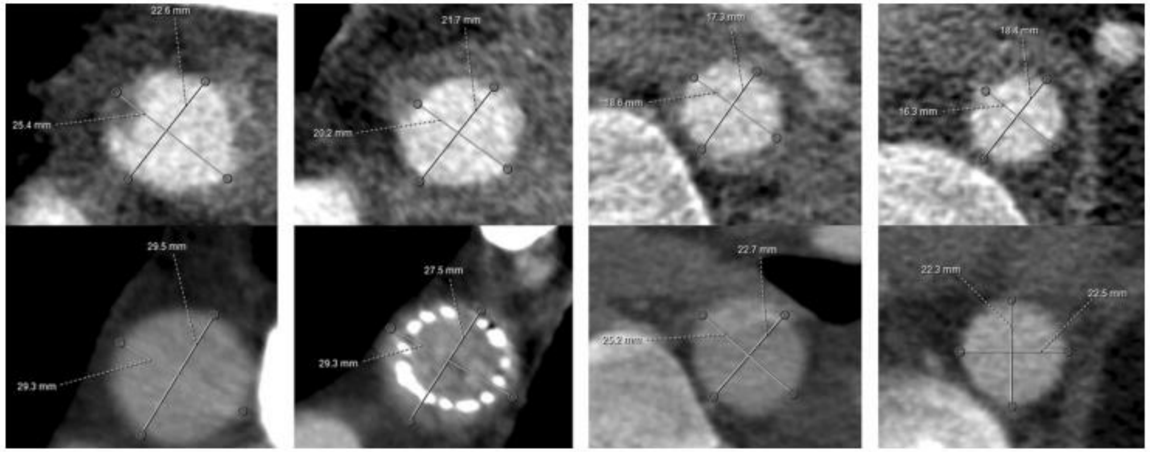

Fig 3. Perpendicular computed tomography angiography reconstructions at different levels along the center luminal line are shown **(top row)** before and **(bottom row)** after thoracic endovascular aneurysm repair. **A,** The ascending aorta 25 mm proximal to proximal sealing zone, **(B)** the proximal sealing zone between the left carotid and subclavian artery, **(C)** the descending aorta 80 mm distal to proximal sealing zone, and **(D)** and the abdominal aorta 210 mm distal to the proximal sealing zone.

Table. Diameter measurements before and after thoracic endovascular aneurysm repair

	Observer 1				*Observer 1, 2nd measurement*				*Observer 2*			
	Mean TEVAR diameter, mm		*Difference*		*Mean TEVAR diameter, mm*		*Difference*		*Mean TEVAR diameter, mm*		*Difference*	
Location	*Pre*	*Post*	*mm*	*%*	*Pre*	*Post*	*mm*	*%*	*Pre*	*Post*	*mm*	*%*
Ascending aorta	24	29.5	5.5	23	24.5	30	5.5	22	23.5	30	6.5	28
Proximal sealing zone	21	28.5; stent 22	7.5	36	21	28	7	33	21	29; stent 22	8	38
Descending aorta	18	24	6	33	17.5	24	6.5	37	19	25	6	32
Abdominal aorta	17.5	22.5	5	29	17	22	5	29	18	22.5	6.5	36

(J Vasc Surg 2008;47:1333-6.)

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The Impact of Hypovolaemic Shock on the Aortic Diameter in a Porcine Model

F.H.W. Jonker [a], H. Mojibian [a], F.J.V. Schlösser [a], D.M. Botta [b], J.E. Indes [a], F.L. Moll [c], B.E. Muhs [a,*]

Diameter reduction due to hypovolemia

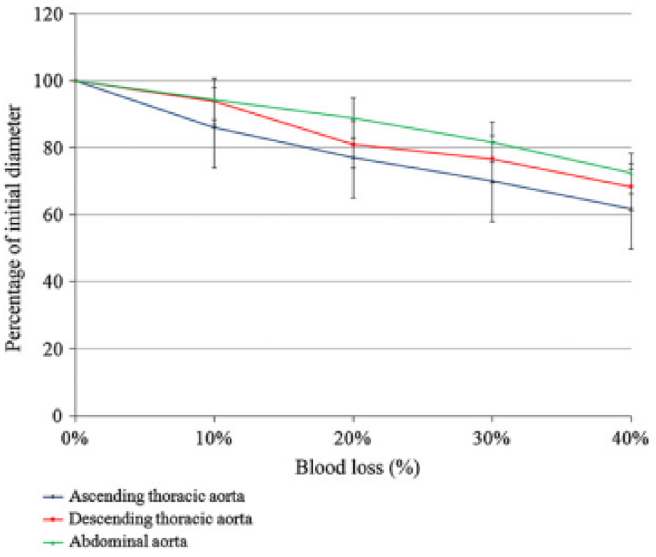

Figure 1 Aortic diameters during lowering of the blood volume. Error bars represent the 95% confidence interval of the mean.

Diameter increase during resuscitation

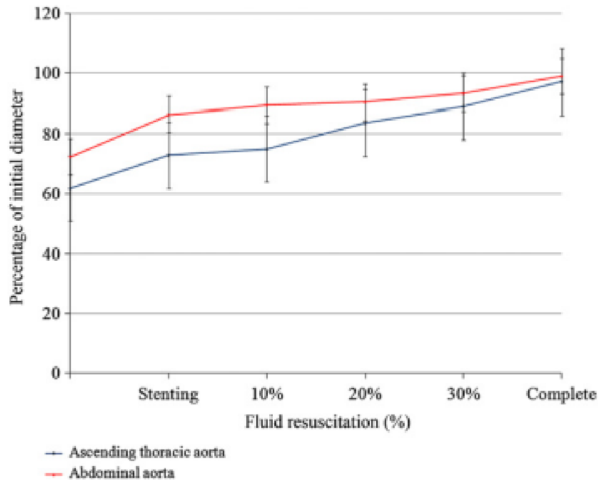

Figure 3 Increase of the ascending and abdominal aortic diameter during resuscitation. The descending thoracic aorta was not included in this figure because the stent graft was deployed in the descending thoracic aorta, and from that moment the diameter measured by IVUS actually represents the stent lumen. Error bars represent the 95% confidence interval of the mean.

Oversizing needed for adequate sealing

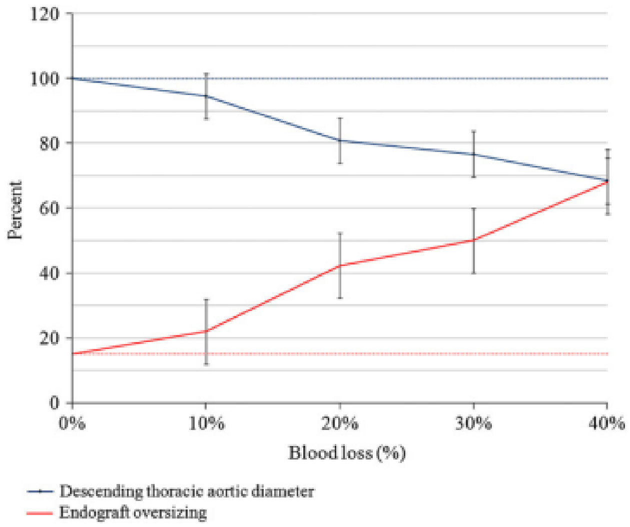

Figure 6 Descending thoracic aortic diameter and theoretic oversizing of the endograft-related to circulating blood volume The red line represents the theoretic percentage of oversizing of the aortic diameter to obtain a 15% oversizing of the normal aortic diameter, which is recommended by most endograft manufacturers. Error bars represent the 95% confidence interval of the mean.

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Aortic endograft sizing in trauma patients with hemodynamic instability

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43 trauma patients

- ➢ CT on admission
- ➢ CT in stable situation

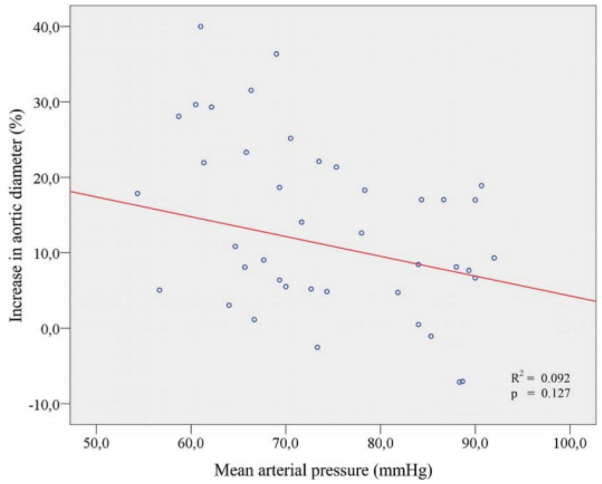

Fig 1. MAP of trauma patients while hemodynamically unstable and increase in aortic diameter at the level of the mid DTA on the control CT. *CT,* Computed tomography; *DTA,* descending thoracic aorta; *MAP,* mean arterial pressure.

Table II. Mean diameter changes of the aorta and IVC (N = 43)

Level	*HD unstable (mm)*	*Control (mm)*	*Diff (mm)*	*Increase (%)*	*Range (%)*	*P value*
Aorta						
Ascending	27.4	28.3	0.9	3.3	−10.8-19.8	.012
Arch	22.2	23.6	1.4	6.3	−7.5-26.1	.011
Proximal DTA	21.9	23.1	1.2	5.5	−6.7-38.8	.010
Mid DTA	19.2	21.1	1.8	9.4	−8.0-40.0	<.001
Distal DTA	18.1	19.4	1.3	7.2	−7.9-54.3	<.001
Infrarenal	14.3	15.9	1.6	11.2	−5.9-44.9	<.001
Inferior vena cava						
Max diameter	19.9	21.6	1.7	8.5	−8.3-49.1	.002
Min diameter	11.6	15.8	4.2	36.2	−12.8-203.1	<.001

Diff, Difference in mm; *DTA,* descending thoracic aorta; *HD unstable,* hemodynamically unstable; *IVC,* inferior vena cava.

Table III. Mean diameter changes of the aorta and IVC in patients with a pulse ≥130/min (N = 12)

Level	*HD unstable (mm)*	*Control (mm)*	*Diff (mm)*	*Increase (%)*	*Range (%)*	*P value*
Aorta						
Ascending	26.2	27.3	1.1	4.2	−1.3-17.6	.184
Arch	21.1	22.8	1.7	8.1	−7.5-16.3	.382
Proximal DTA	20.3	22.9	2.6	12.8	−3.2-38.8	.068
Mid DTA	18.3	20.6	2.3	12.6	6.7-36.4	.003
Distal DTA	18.2	19.4	1.2	6.6	−7.3-25.7	.133
Infrarenal	14.3	16.1	1.8	12.6	3.0-33.9	.004
Inferior vena cava						
Max diameter	19.3	22.2	2.9	15.0	−6.4-48.7	.028
Min diameter	11.5	16.1	4.6	40.0	−12.8-170.0	.016

Diff, Difference in mm; *DTA,* descending thoracic aorta; *HD unstable,* hemodynamically unstable; *IVC,* inferior vena cava.

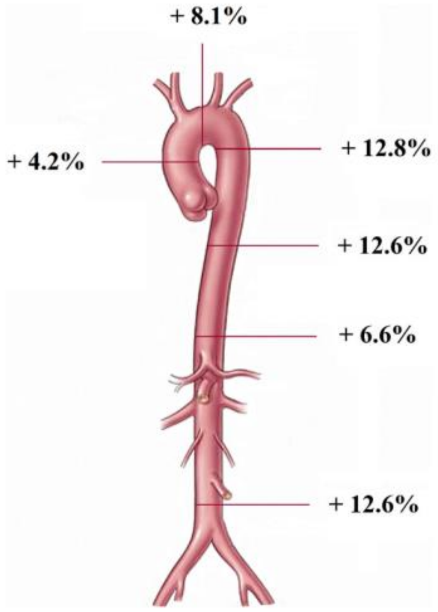

Fig 2. Mean increase in aortic diameter in patients with a pulse ≥130/min. The mean increase in aortic diameter was most consistent at the level of the mid descending thoracic aorta (P = .003), and at the level of the infrarenal aorta (P = .004), the mean increase in aortic diameter failed to reach statistical significance at the remaining levels.

Supra- and Infra-Renal Aortic Neck Diameter Increase after Endovascular Repair of a Ruptured Abdominal Aortic Aneurysm

Claire van der Riet [1,*], Richte C. L. Schuurmann [1], Angelos Karelis [2,3], Mehmet A. Suludere [1], Meike J. van Harten [1], Björn Sonesson [2,3], Nuno V. Dias [2,3], Jean-Paul P. M. de Vries [1] and Martijn L. Dijkstra [1]

74 patients with rAAA treated with EVAR

Table 3. Aortic neck diameters and oversizing measured on the preoperative and first postoperative computed tomography scans.

Level Relative to Lowest Renal Artery	PreOperative Diameter (mm)	Post-Operative Diameter (mm)	*p*-Value	Planned Pre-EVAR Oversizing (%)	Achieved Post-EVAR Oversizing (%)	*p*-Value
+40 mm	24.9 ± 2.7	26.3 ± 2.6	<0.001			
+10 mm	22.9 ± 2.8	24.9 ± 2.8	<0.001			
Baseline	22.0 ± 3.2	24.3 ± 3.1	<0.001	31 (22–40)	20 (10–26)	<0.001
−10 mm	22.7 ± 3.9	25.4 ± 3.7	<0.001	27 (19–36)	14 (7–23)	<0.001
−20 mm	24.4 ± 6.0	27.7 ± 6.3	<0.001	22 (11–28)	10 (1–16)	<0.001

EVAR = endovascular aneurysm repair.

Table 5. Spearman correlation between shortest apposition length and shortest apposition length/neck length ratio with neck diameter increase and the intended oversizing at 10 mm distal from the lowest renal artery baseline.

	Aortic Neck Diameter Increase		Intended Oversizing	
	Correlation (ρ)	*p*-Value	Correlation (ρ)	*p*-Value
Shortest apposition length	−0.256	0.031	−0.157	0.192
Shortest apposition length/neck length ratio	−0.244	0.040	−0.183	0.126

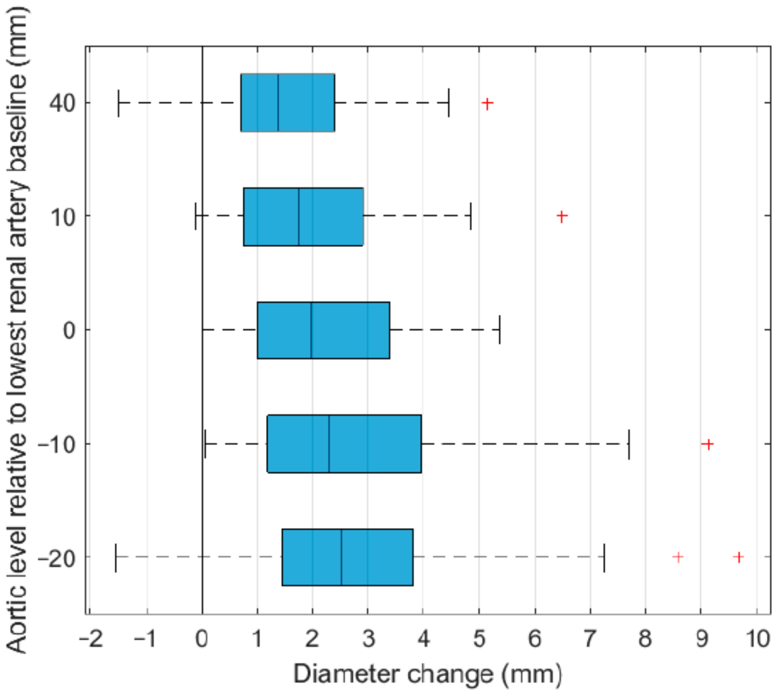

Figure 2. Diameter change at five aortic levels on the first computed tomography angiography scan after endovascular aneurysm repair.

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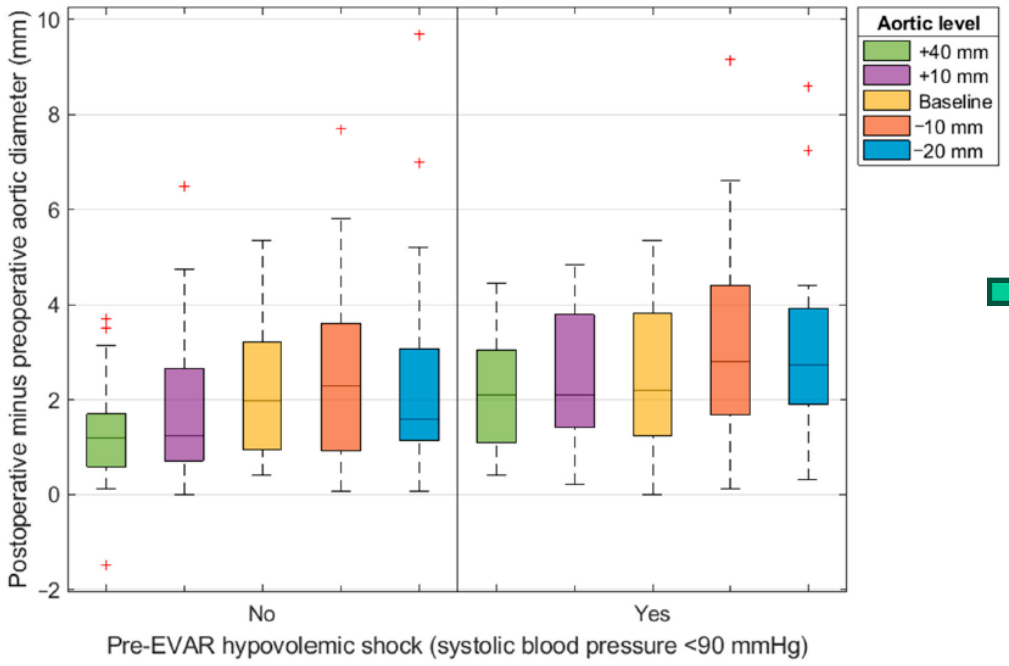

Figure 3. EVAR = endovascular aneurysm repair; diameter change at various levels of the aorta relative to the renal artery baseline for patients with and without preoperative hypovolemic shock (systolic blood pressure of <90 mmHg).

Increased risc of Type 1A endoleak

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Oversizing Consideration of Proximal Stent Graft in Hemodynamically Stable and Unstable Patients Undergoing Emergent Endovascular Aortic Repair

Yuhan Qi [1,2,†], Chengxin Weng [1,†], Ding Yuan [1], Tiehao Wang [1], Yukui Ma [1], Yi Yang [1], Jichun Zhao [1,*] and Bin Huang [1,*]

134 patients with rAAA

Table 2. Univariate and multivariate regression analyses of risk factors of type IA endoleak.

	Univariate Analysis		Multivariate Analysis *	
Statistics	**HR (95%CI)**	***p*-Value**	**HR (95%CI)**	***p*-Value**
Gender	2.76 (0.61, 12.40)	0.19		
Age	1.03 (0.94, 1.13)	0.53		
HD unstable	1.87 (0.42, 8.45)	0.41		
MAP	0.97 (0.91, 1.04)	0.39		
HR	1.01 (0.96, 1.06)	0.78		
Anesthesia	0.46 (0.05, 3.83)	0.47		
α angle	0.99 (0.97, 1.01)	0.42		
β angle	1.01 (0.99, 1.03)	0.32		
SNA	2.24 (0.43, 11.67)	0.34		
Neck diameter	1.27 (1.03, 1.56)	0.028	0.92 (0.63, 1.35)	0.67
OSR >30% vs. ≤30%	0.57 (0.06, 5.07)	0.62		
OSR >20% vs. ≤20%	0.06 (0.01, 0.31)	0.001	0.06 (0.01, 0.72)	0.026
Neck length	0.83 (0.72, 0.95)	0.009	0.74 (0.56, 0.98)	0.033
Maximum diameter	1.03 (0.98, 1.09)	0.24		
CIAA	0.63 (0.13, 3.18)	0.58		

HD = Hemodynamically, MAP = mean artery pressure, HR = heart rate, OSR = oversizing ratio, CIAA = common iliac artery aneurysm. * Adjusted for gender, age, hemodynamic instability, maximum diameter, neck angulation.

J. Clin. Med. **2023**, *12*, 7500

Oversizing Consideration of Proximal Stent Graft in Hemodynamically Stable and Unstable Patients Undergoing Emergent Endovascular Aortic Repair

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Table 3. Rates of adverse outcomes after emergent endovascular repair of patients with ruptured or impending rupture abdominal aortic aneurysm.

	Hemodynamically Unstable			Hemodynamically Stable		
OSR	**≤30% (*n* = 30)**	**>30% (*n* = 14)**	***p***	**≤20% (*n* = 24)**	**>20% (*n* = 66)**	***p***
Survival FU time-m	24.50 (16.00–49.25)	25.00 (9.75–53.00)	0.99	30.50 (15.00–60.50)	33.50 (11.50–69.25)	0.57
Imaging FU time-m	10.00 (1.00–39.50)	1.50 (1.25–32.50)	0.87	16.50 (5.00–29.00)	15.00 (5.25–34.50)	0.71
30-day mortality	4 (13.33%)	0 (.00%)	0.15	1 (4.17%)	1 (1.52%)	0.45
Overall survival	11 (36.67%)	6 (42.86%)	0.69	7 (29.17%)	15 (22.73%)	0.53
Reintervention	2 (6.67%)	1 (7.14%)	0.95	4 (16.67%)	6 (9.09%)	0.31
T1AEL	3 (11.11%)	0 (0.00%)	0.19	4 (16.67%)	1 (1.52%)	0.006
T1BEL	2 (7.41%)	0 (0.00%)	0.30	3 (12.50%)	4 (6.06%)	0.31
T2EL	5 (18.52%)	2 (14.29%)	0.73	6 (25.00%)	14 (21.21%)	0.70

OSR = oversizing ratio, FU = follow-up, T1AEL = type IA endoleak, T1BEL = type IB endoleak, T2EL = type II endoleak.

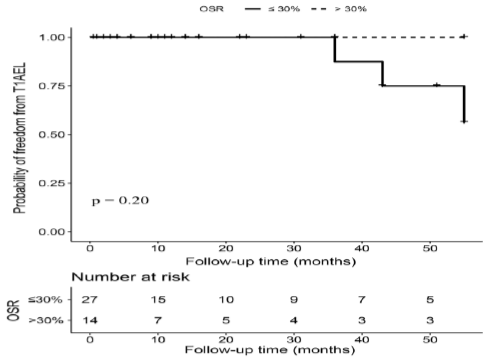

Figure 2. Kaplan–Meier curves of freedom from T1AEL in hemodynamically unstable patients with OSR > 30% versus OSR ≤ 30%. Footnote: T1AEL = type IA endoleak, OSR = oversizing ratio.

Hemodynamically unstable
Oversizing > vs < 30%

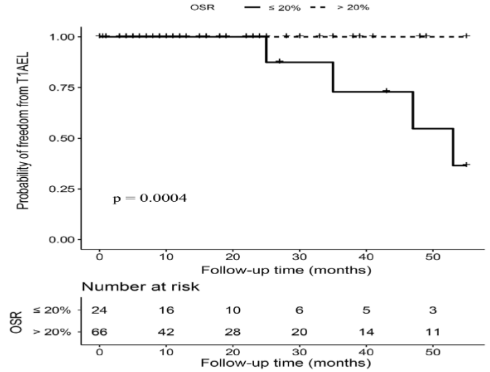

Figure 3. Kaplan–Meier curves of freedom from type IA endoleak (T1AEL) in hemodynamically stable patients with OSR > 20% versus OSR ≤ 20%. Footnote: T1AEL = type IA endoleak, OSR = oversizing ratio.

Hemodynamically stable
Oversizing > vs < 20%

J. Clin. Med. **2023**, *12*, 7500

CLINICAL PRACTICE GUIDELINE DOCUMENT

Editor's Choice – European Society for Vascular Surgery (ESVS) 2024 Clinical Practice Guidelines on the Management of Abdominal Aorto-Iliac Artery Aneurysms☆

- An important technical aspect of emergency EVAR is the degree of stent graft oversizing in the presence of existing hypovolaemia. The haemodynamic condition of the patient on presentation may influence this and, to avoid an intraoperative or late Type Ia or Ib endoleak, 30% oversizing is preferable when treating a rAAA assessed by CTA performed during permissive hypotension
- It is also advised that the devices used for rAAAs should be the ones that the operator and the team routinely use in elective EVAR and with which the team has significant experience.

Conclusions

- The aorta is not just a tube, but a working organ
- The diameters are influenced by the hemodynamic status of the patient and oversizing should be adapted to it.
- In hemodynamically stable patients with rAAA an oversing of ≥ 20% is indicated
- In hypotensive patients with rAAA an oversizing of +/- 30% is indicated
- The endografts shuld be compliant and comformable enough to accomodate for these changes in diameter