



A lifetime of specialist care

Royal Brompton & Harefield **NHS**
NHS Foundation Trust

The changing Landscape in acute Type B Aortic Dissection

Professor Christoph A. Nienaber

The Royal Brompton and Harefield NHS Trust

Cardiology and Aortic Centre

C.Nienaber@rbht.nhs.uk

Acute type B dissection - in midair !



You have options:

Watch and wait ?

Carry on flying ?

You got enough gas !

Fuel delivery intact !

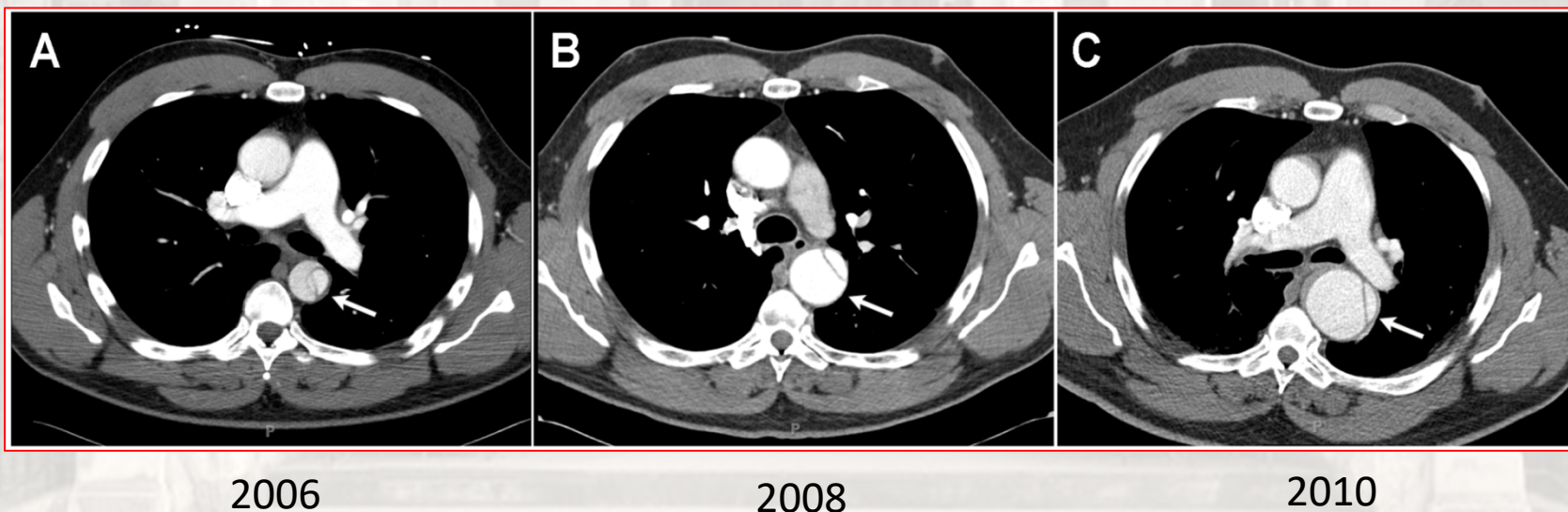
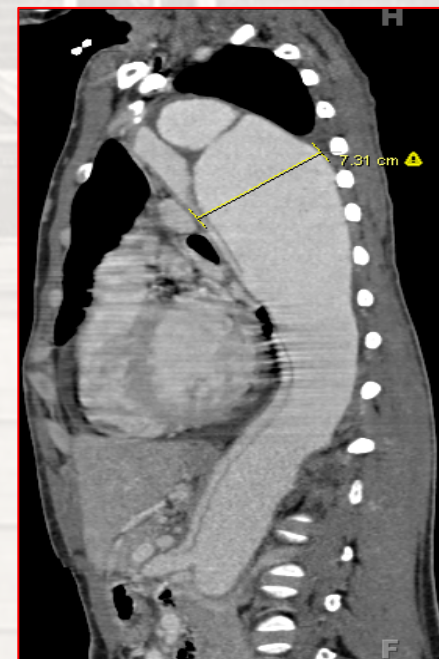
No malperfusion issues !

*Lowering the speed ...like
medical management ?*

...or do something actively?

This is type B dissection on drugs!

***Medical management** is expected to prevent ...
rupture, aneurysm, aortic repair...but does it really ?
4 Years of medical management results in aneurysmal
Degeneration!*

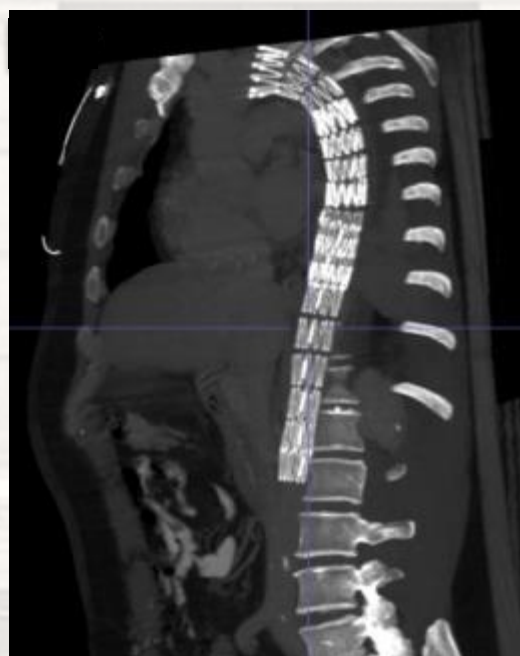


Remodeling with TEVAR...excellent long term outcome!

Complete FL thrombosis and
remodeling of the
descending thoracic aorta



Pre-procedure



Post-procedure



24 months

Survival after TEVAR in **complicated** type B dissection

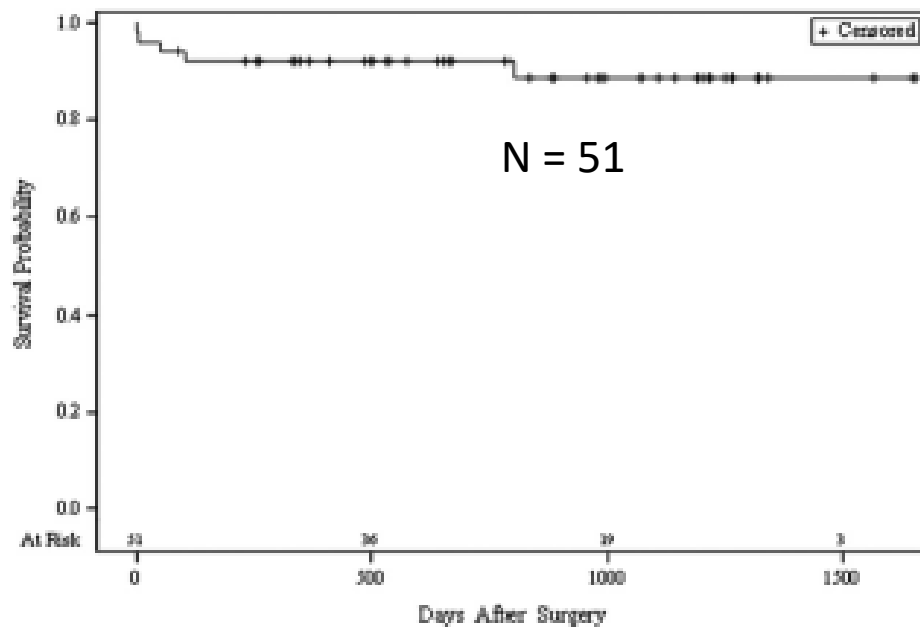
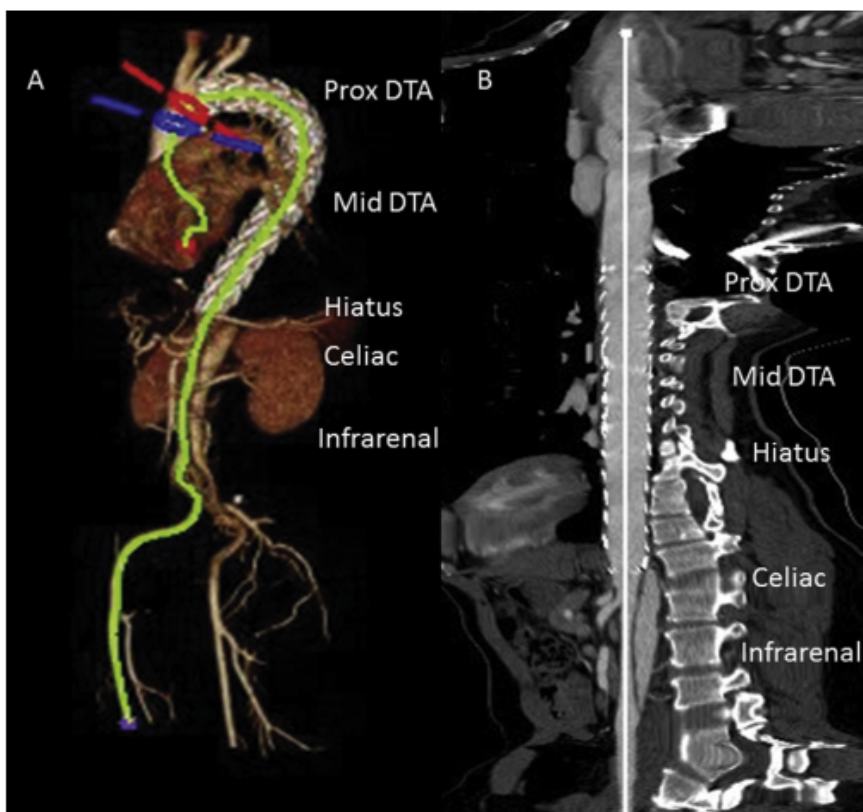
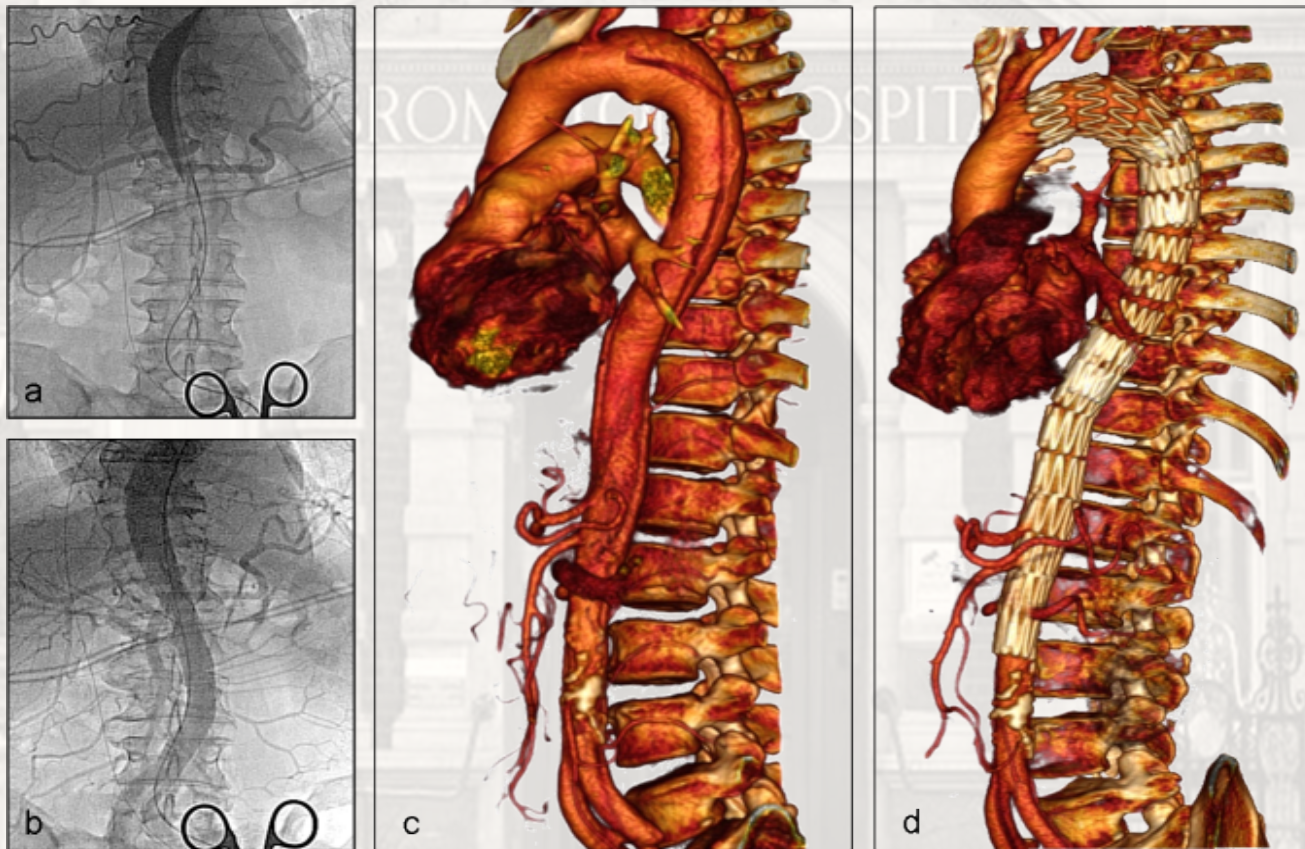


Fig 3. Kaplan-Meier survival curve in patients with acute type B aortic dissection who were treated with thoracic endovascular aortic repair.

Remodelling is key to success; long-term surveillance still recommended!

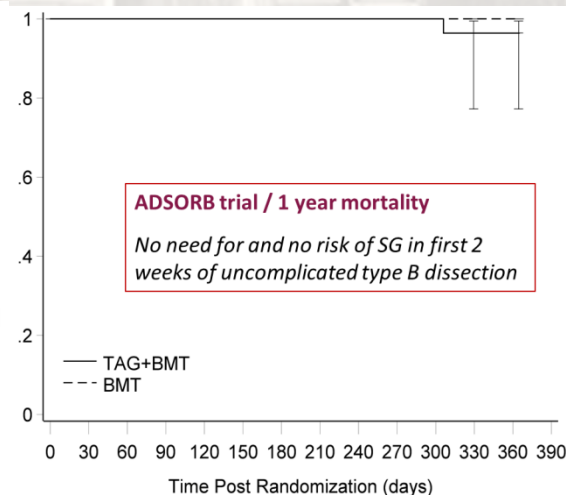
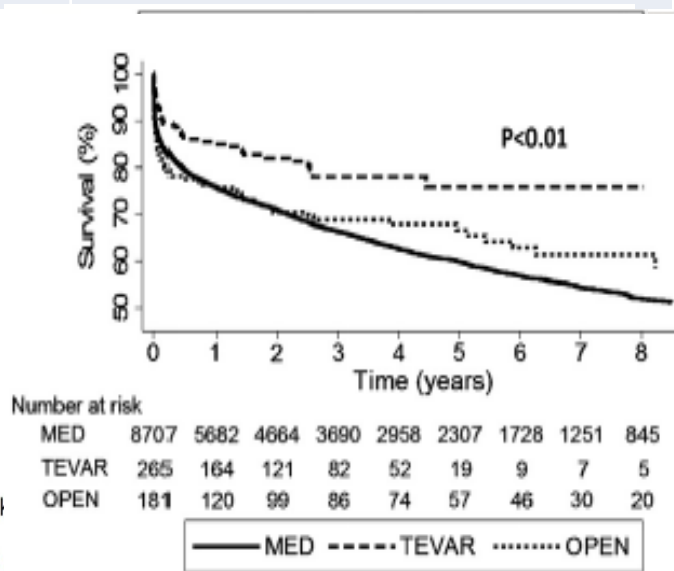
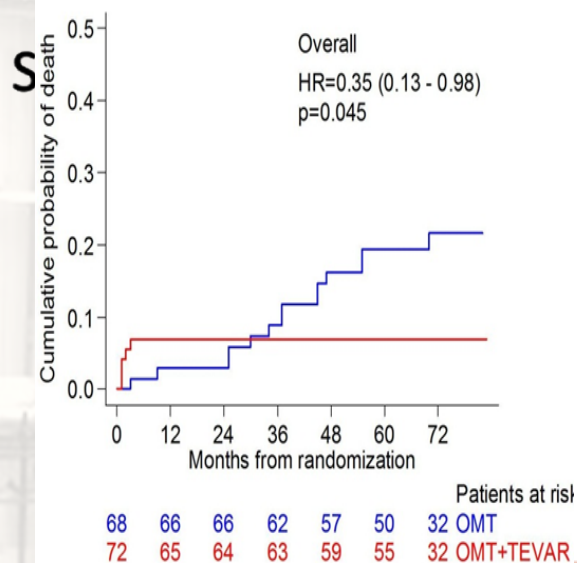
TEVAR in complex complicated type B dissection (IC)



Malperfusion syndrome treated with endovascular stent-graft and PETTICOAT; a) angiography of lower body malperfusion; b) reperfusion after proximal stent-graft; c) 3D CT reconstruction of acute complicated dissection with malperfusion; d) reconstructed aorta and abolished malperfusion after stent-graft and PETTICOAT.

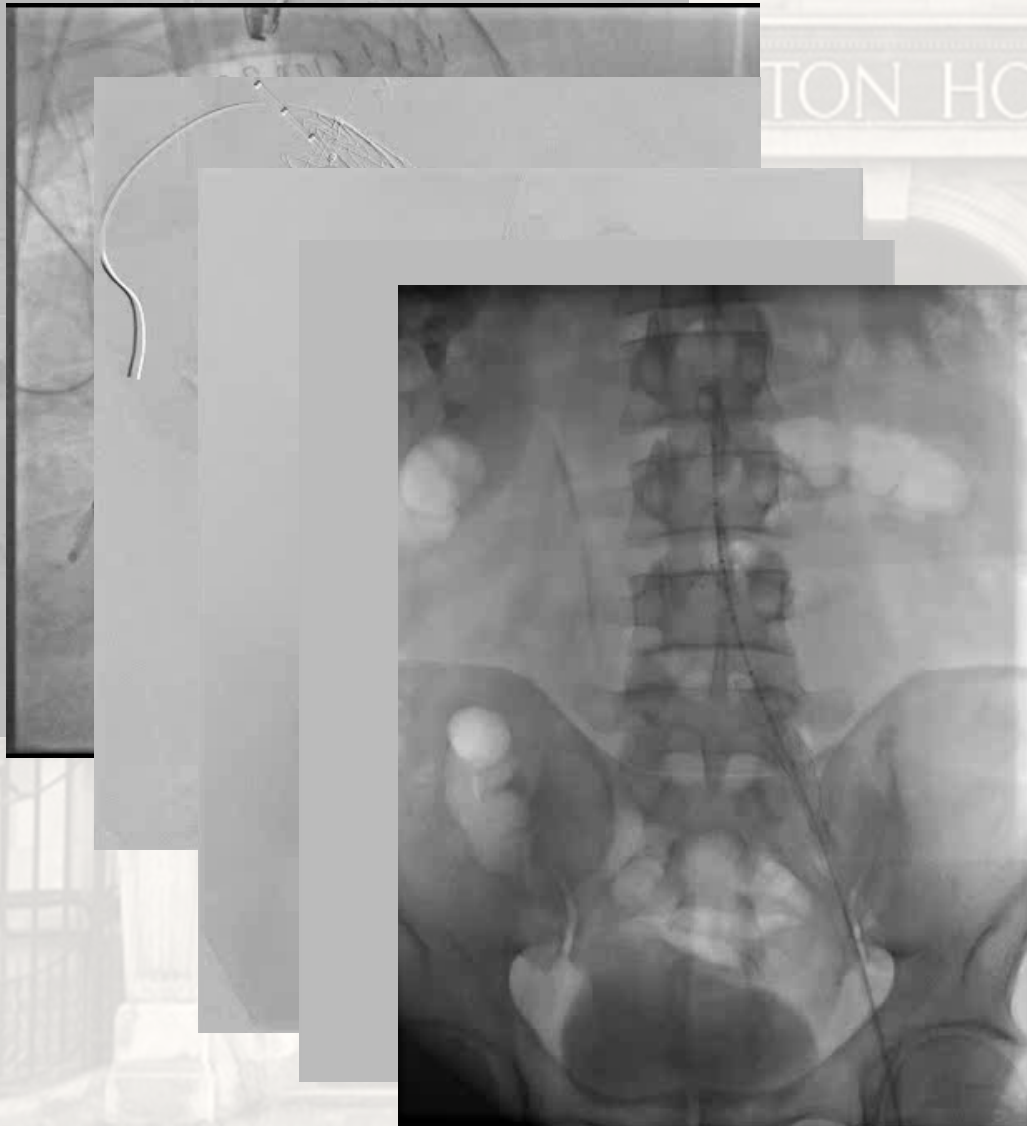
Survival after TEVAR in **uncomplicated** type B dissection (RCTs and registry)

RCT	REGISTRY	RCT
INSTEAD-XL (n=140)	COSHPD database (n=9165)	ADSORB (n=61)
Circulation CV 2013; 6:407	Iannuzzi JC et al. JVS 2018	Eur J Vasc Endovasc Surg 2014;48:285



The initial RCT showed a long-term advantage of an intervention (stent-grafting the TL), with two large registry-based analyses confirming the signal from the RCT; findings are supported by short-term F/U of an independent RCT. **On aggregate, all data are consistent! Very strong signal!**

Pictorial case of **optimal management** of type B aortic dissection



*Optimal management in
A recent case of distal (type B)
aortic dissection:*

Blood pressure management.

LSA bypass/single branch

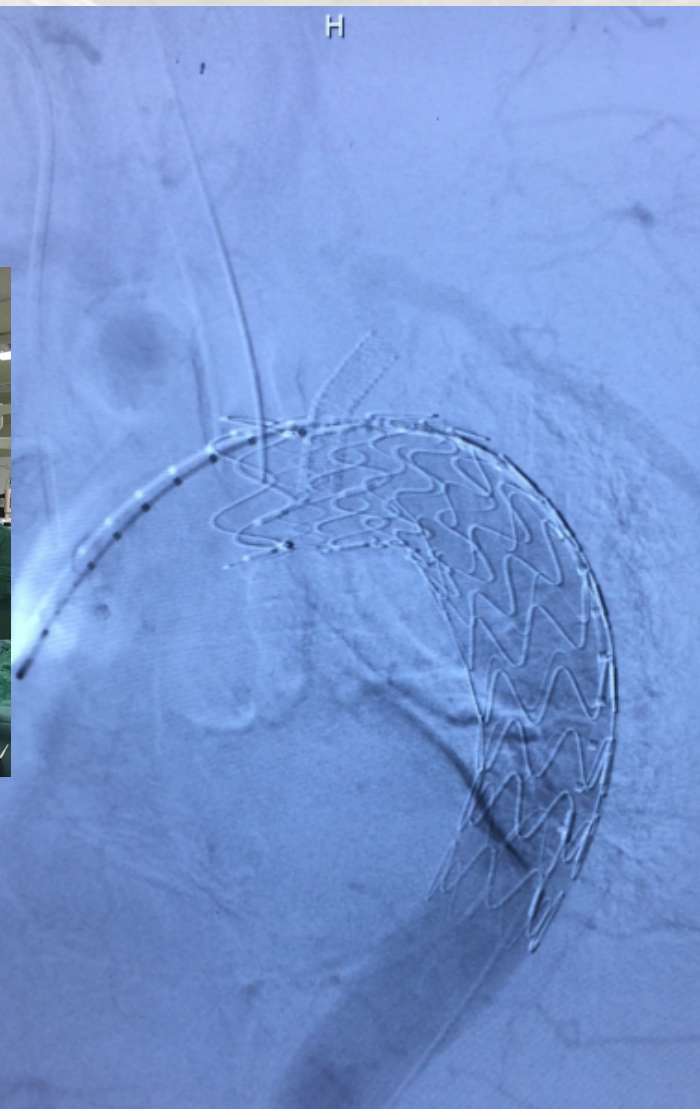
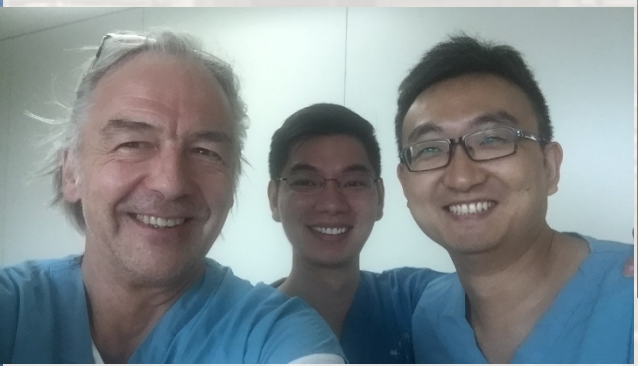
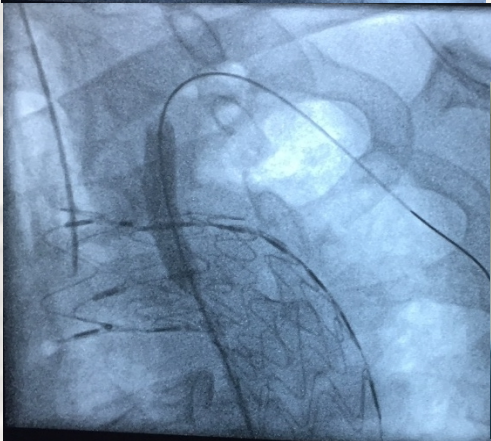
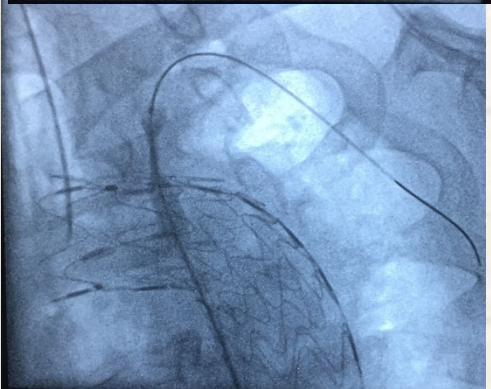
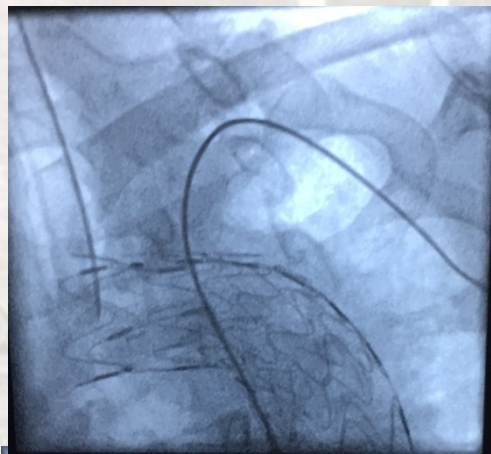
LSA occluder

Proximal Stentgraft

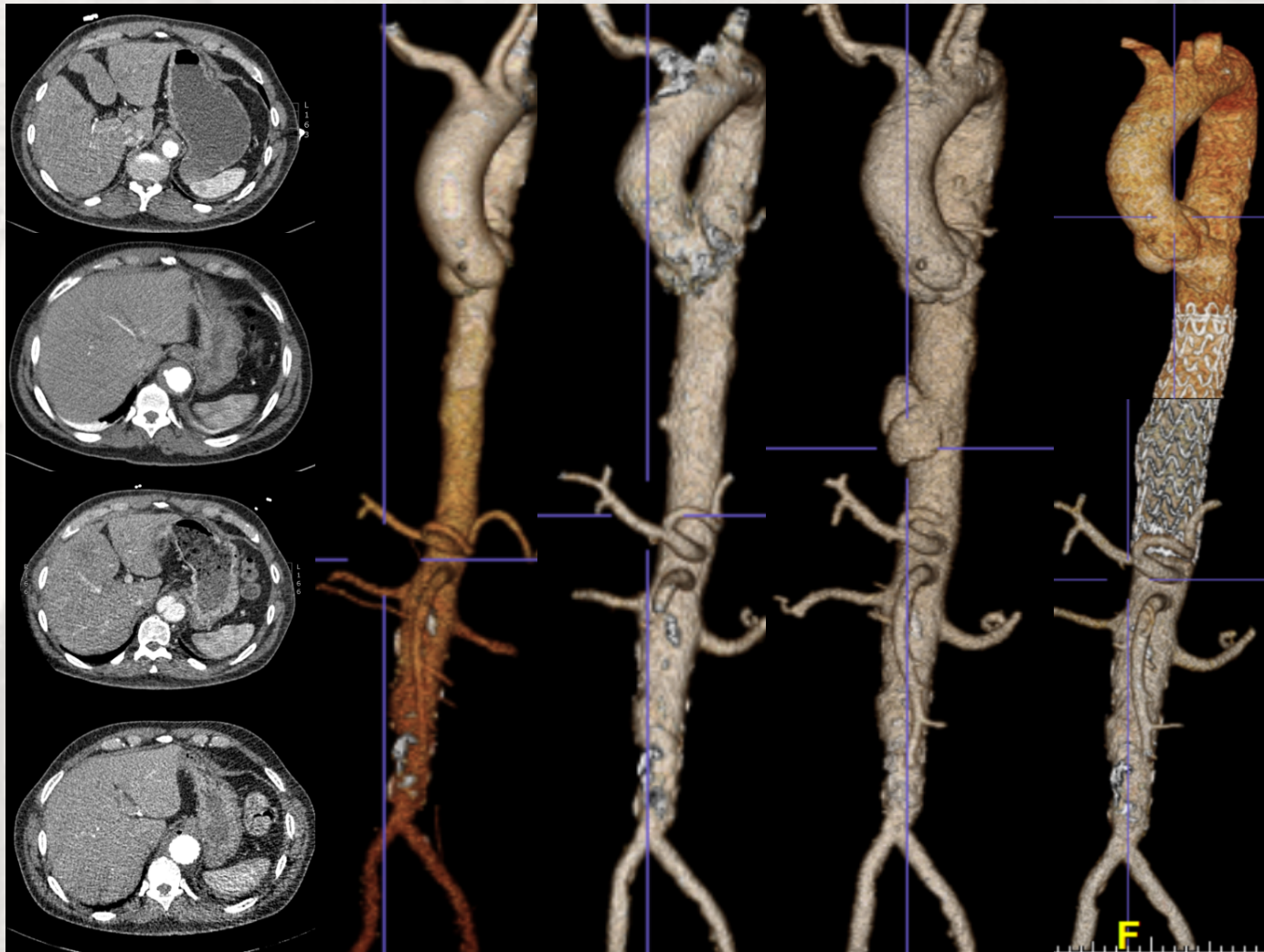
Open extension (PETTICOAT)

Distal management with SG

Individualised In situ Fenestration to revascularise LSA



Evolution of IMH/FID to full dissection within 3 weeks



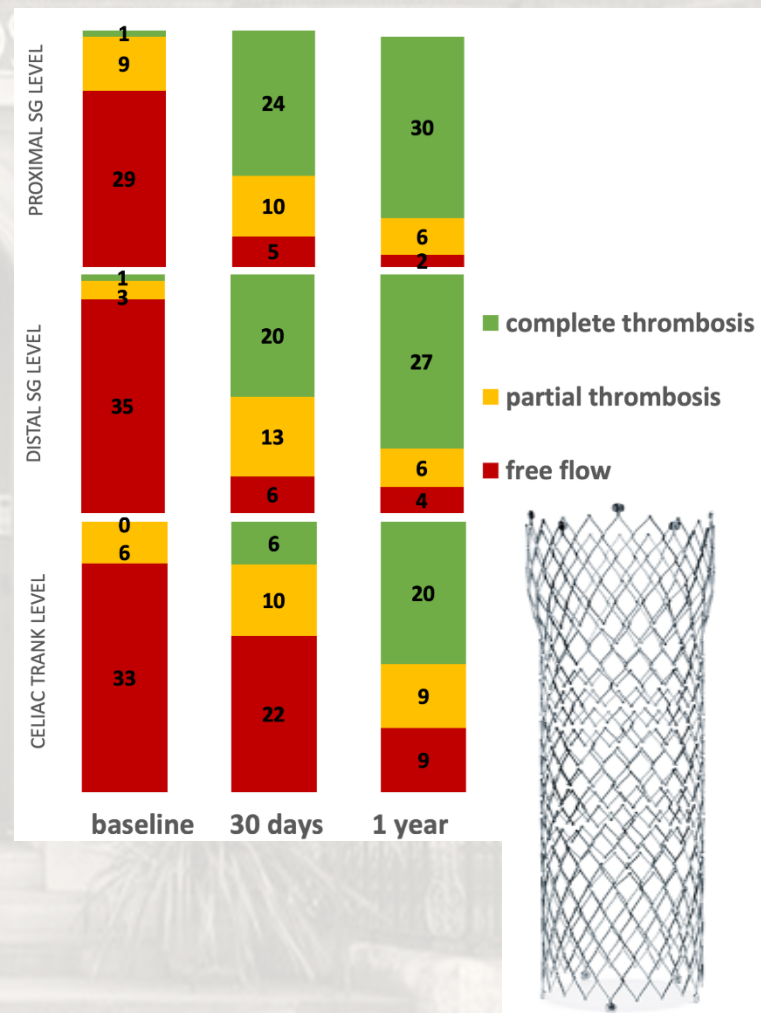
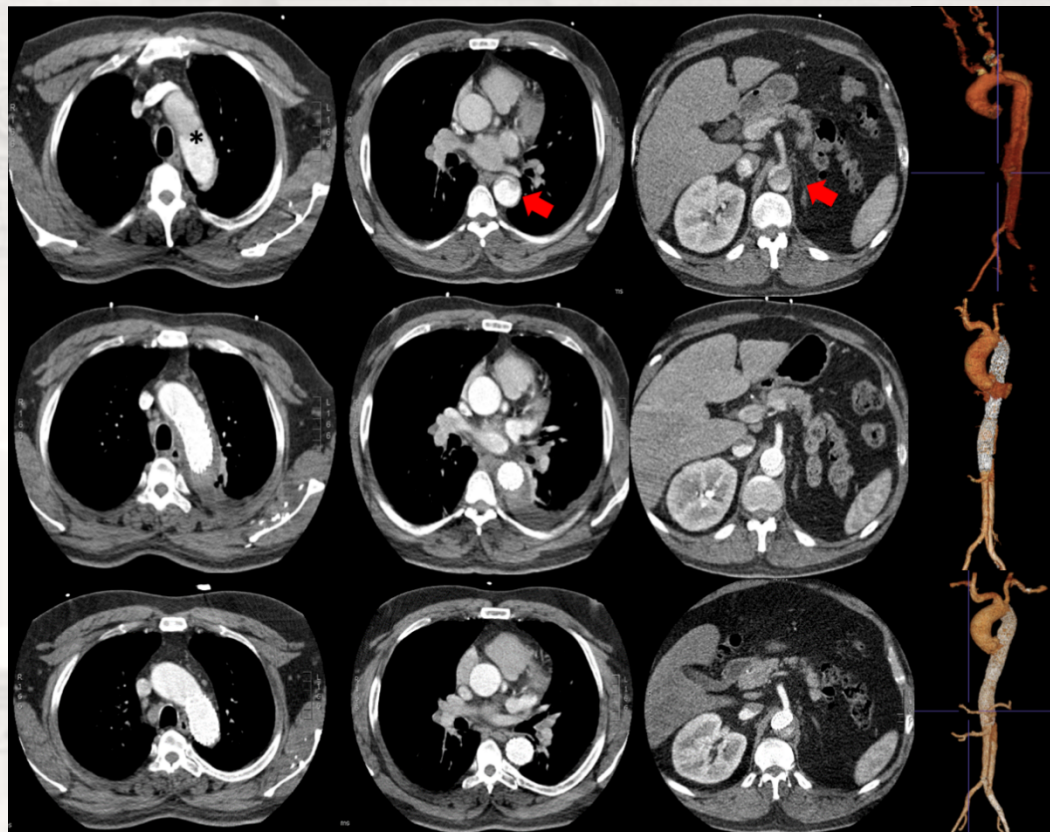
Asymptomatic !

Serial imaging and
active mgmt.

Problem sorted !

Yuan X, et al. JACC cr
2019; 1: 560-63

ASSIST study – enhanced remodelling with autoSTABILISE



Making sense of minor changes...

Graphical Abstract

Moderate Aortic Enlargement (MAE) in 2 Weeks

Methods

Type B
Acute Aortic
Syndrome
n=183

On admission

2 weeks later

1 year later



Commentary: Making sense of minor changes: Type B aortic dissection in a new light!

Christoph A. Nienaber, MD, PhD,^{a,b}
Ibrahim Akin, MD, PhD,^c and
Xun Yuan, MBBS, MMED^{a,b}

The clinical research group around Miyoshi and colleagues¹ from Kobe City Hospital in Japan have provided an important piece in the puzzle of identifying patients with uncomplicated aortic dissection and an untoward clinical outcome. Aortic enlargement within 2 weeks of acute type B aortic dissection or intramural hematoma of greater between 2 and 5 mm portends powerful prognostic information.

MAE(-)	147	112	89	70
MAE(+)	36	17	11	10

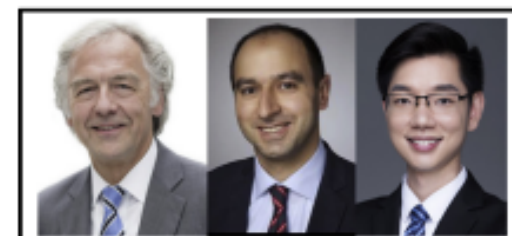
Results

Aorta-related adverse events

Implications

Aortic enlargement in 2 weeks is associated with subsequent aorta-related adverse events in patients with uncomplicated type B acute aortic syndrome.

Miyoshi Y et al. JTCVS 2021



Christoph A. Nienaber, MD, PhD, Ibrahim Akin, MD, PhD, and Xun Yuan, MBBS, MMED

CENTRAL MESSAGE

Early minor (≤ 5 mm) expansion of dissected aorta is a new piece in the puzzle to identify patients with type B dissection at high risk.

Nienaber CA, Akin I, Yuan X. J Thorac Cardiovasc Surg. 2021 Oct

Calculator: Estimation of risk in type B aortic dissection

Stanford Aortic Dissection Risk Calculator

Patient Data

- Connective tissue disease: ☒ No ☐ Yes
- Maximum aortic diameter in the area of the dissected aorta: 40 mm
- Circumference of false lumen: 240 degr.
- Identifiable aortic intercostal arteries in the area of the dissected aorta: 7
- False lumen outflow: 700 mL

Please tick supplying lumina (true lumen (TL) or false lumen (FL), or none) for every artery.

Artery	TL	FL
Left subclavian artery (375)	<input checked="" type="checkbox"/>	<input type="checkbox"/>
Celiac trunk (550)	<input checked="" type="checkbox"/>	<input type="checkbox"/>
Superior mesenteric artery (550)	<input checked="" type="checkbox"/>	<input type="checkbox"/>
Left renal artery (500)	<input checked="" type="checkbox"/>	<input type="checkbox"/>
Right renal artery (500)	<input checked="" type="checkbox"/>	<input type="checkbox"/>
Inferior mesenteric artery (190)	<input checked="" type="checkbox"/>	<input type="checkbox"/>
Left common iliac artery (400)	<input checked="" type="checkbox"/>	<input type="checkbox"/>
Right common iliac artery (400)	<input checked="" type="checkbox"/>	<input type="checkbox"/>

Risk Score

Result

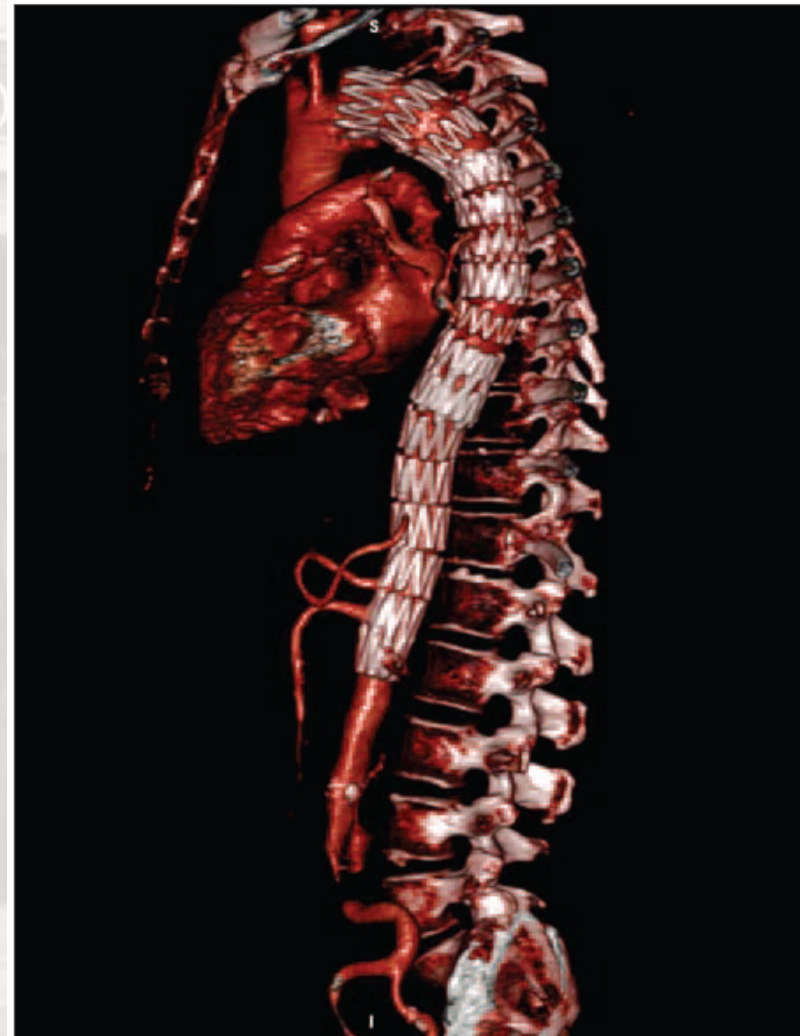
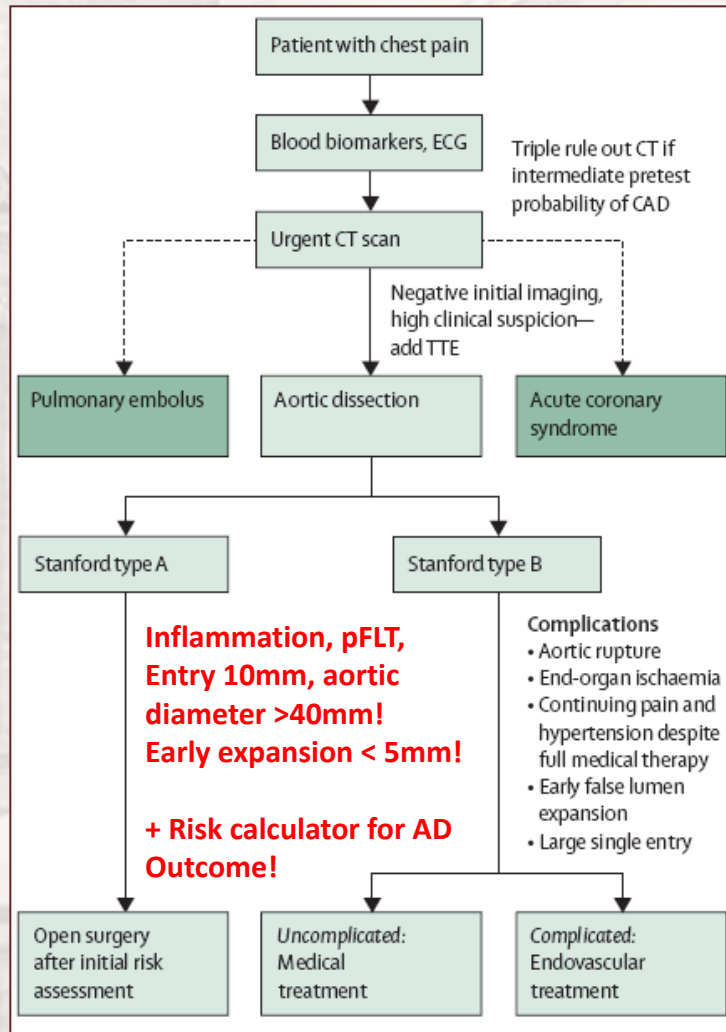
Linear predictor (LP): 6.522

Risk of adverse event before 2 years: 20.6 %

Low risk (LP < 6.05)
Intermediate risk (LP 6.06 to 7.00)
High risk (LP > 7.00)



Management 2022: Every patient should receive medical management and the option of endoluminal scaffolding to enable long term remodeling

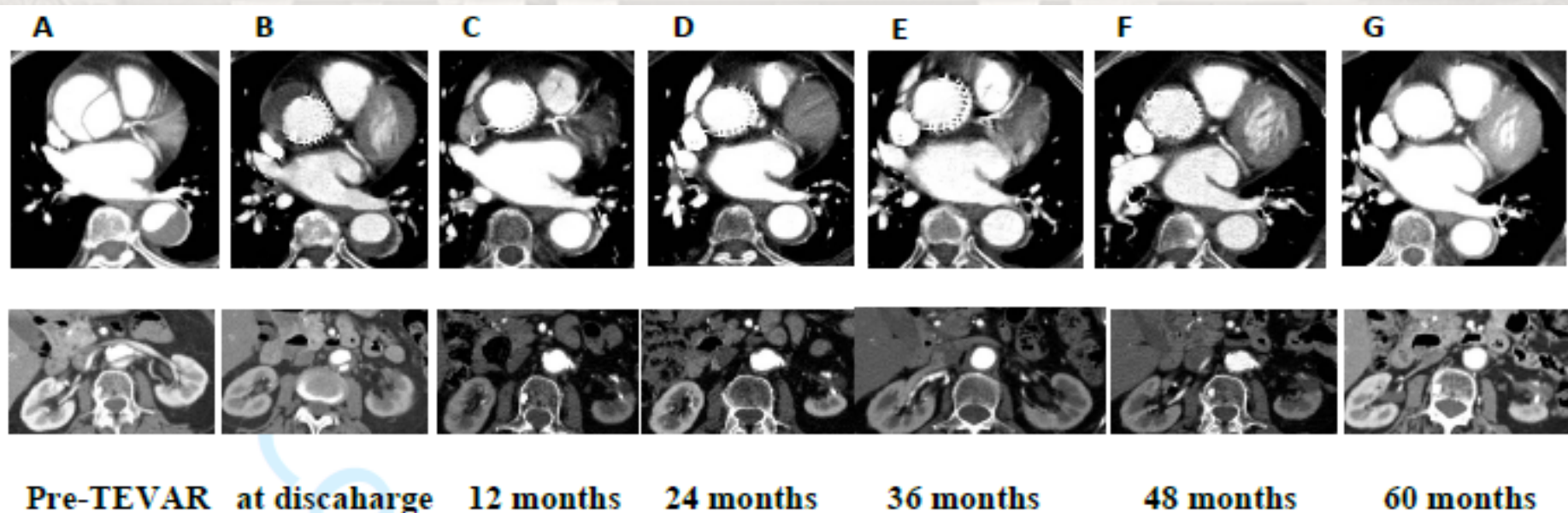


PETTICOAT for improved realignment ?



Endoluminal scaffolds can induce longterm remodelling – nothing else !

TEVAR in type A dissection



The ultimate goal in treating any dissection is mending the layers and healing of the aorta which requires stent-graft induced FL thrombosis and remodelling

◆ CLINICAL INVESTIGATION ◆

Provisional Extension to Induce Complete Attachment After Stent-Graft Placement in Type B Aortic Dissection: The PETTICOAT Concept

Christoph A. Nienaber, MD¹; Stephan Kische, MD¹; Thomas Zeller, MD²;
Tim C. Rehders, MD¹; Henrik Schneider, MD¹; Björn Lorenzen, MD¹;
Carsten Büniger, MD¹; and Hüseyin Ince, MD¹

¹Department of Cardiology, University Hospital Rostock, Germany.

²Herz-Zentrum Bad Krozingen, Germany.

◆ ◆ ◆
Purpose: To report the use of a technique (PETTICOAT: provisional extension to induce complete attachment) to obliterate sustained abdominal false lumen flow and pressurization despite successful stent-graft sealing of the thoracic entry tear in patients with complicated type B aortic dissection.

Methods: Of 100 initial patients subjected to stent-graft repair for complex type B aortic dissection with thoracoabdominal extension, 12 patients (10 men; mean age 58.7 years, range 44–76) demonstrated distal true lumen collapse and a perfused abdominal false lumen despite successful sealing of the proximal tears. As an adjunctive or staged procedure, a scaffolding stent was placed for distal extension of the previously implanted stent-graft. In each case, a Sinus aortic stent, Fortress stent, or a Z-stent system was customized with maximum 2-mm oversizing versus the original stent-graft diameter. Magnetic resonance or computed tomographic angiography was performed at discharge, at 3 months, and then annually to determine false channel thrombosis, true and false lumen dimensions, and re-entry flow.

Results: Delivery was successful in all cases (100%). The compressed distal true lumen (mean 4 ± 3 mm) was reconstructed to a mean width of 21 ± 3 mm, and malperfusion was abolished without any obstruction of the abdominal side branches. At up to 1-year follow-up, there were no signs of expansion or distal progression of the scaffolded dissected aorta. All patients with complete thoracic thrombosis showed evidence of improved aortic remodeling; 1 patient with no false lumen thrombosis died at 11 months from thoracoabdominal aortic rupture.

Conclusion: The PETTICOAT technique may offer a safe and promising adjunctive endovascular maneuver for patients with distal malapposition of the dissecting membrane and false lumen flow. The technique can both abolish distal true lumen collapse and enhance the remodeling process of the entire dissected aorta.

1st of our PETTICOAT cases



Figure 1 ♦ The PETTICOAT concept as an adjunctive procedure after primary placement of a stent-graft in a case of complicated type B dissection (A, B). (C, D) A bare metal scaffolding extension was added to the primary stent-graft to prevent distal true lumen collapse and ensure normalized true lumen runoff and distal aortic flow. (E) A MIP projection of the final result in a complex type B dissection (after previous surgery for proximal dissection); a staged PETTICOAT procedure after initial stent-graft placement resulted in complete reconstitution of the distal false lumen.

Staged PETTICOAT to avoid SINE

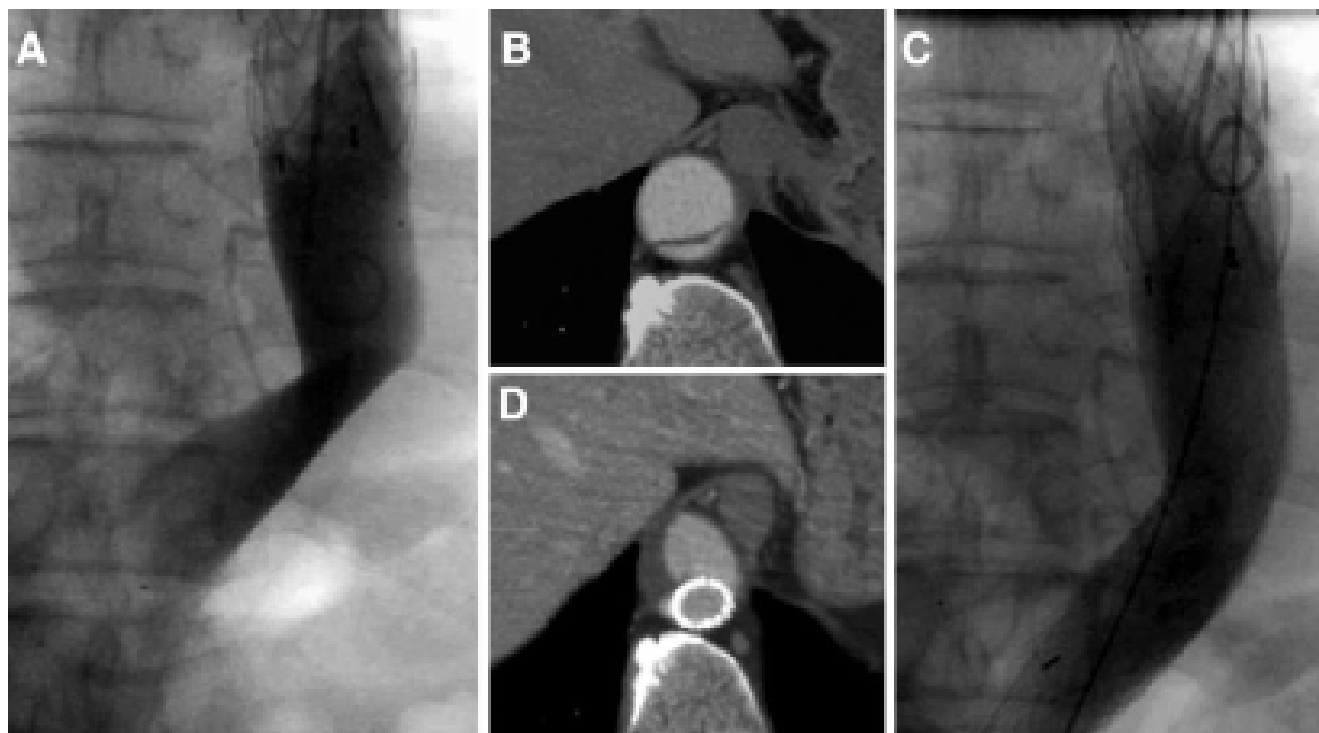
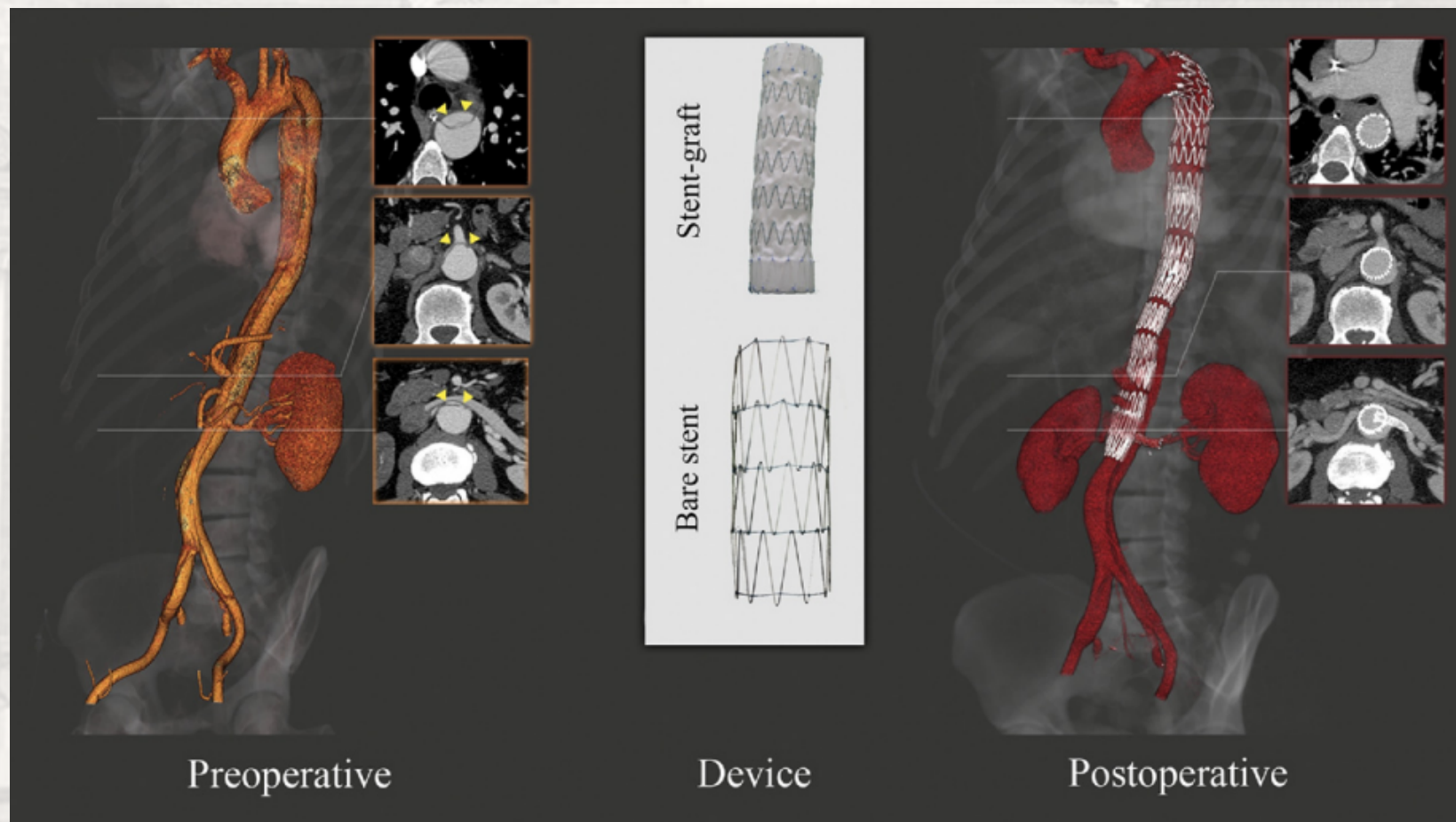
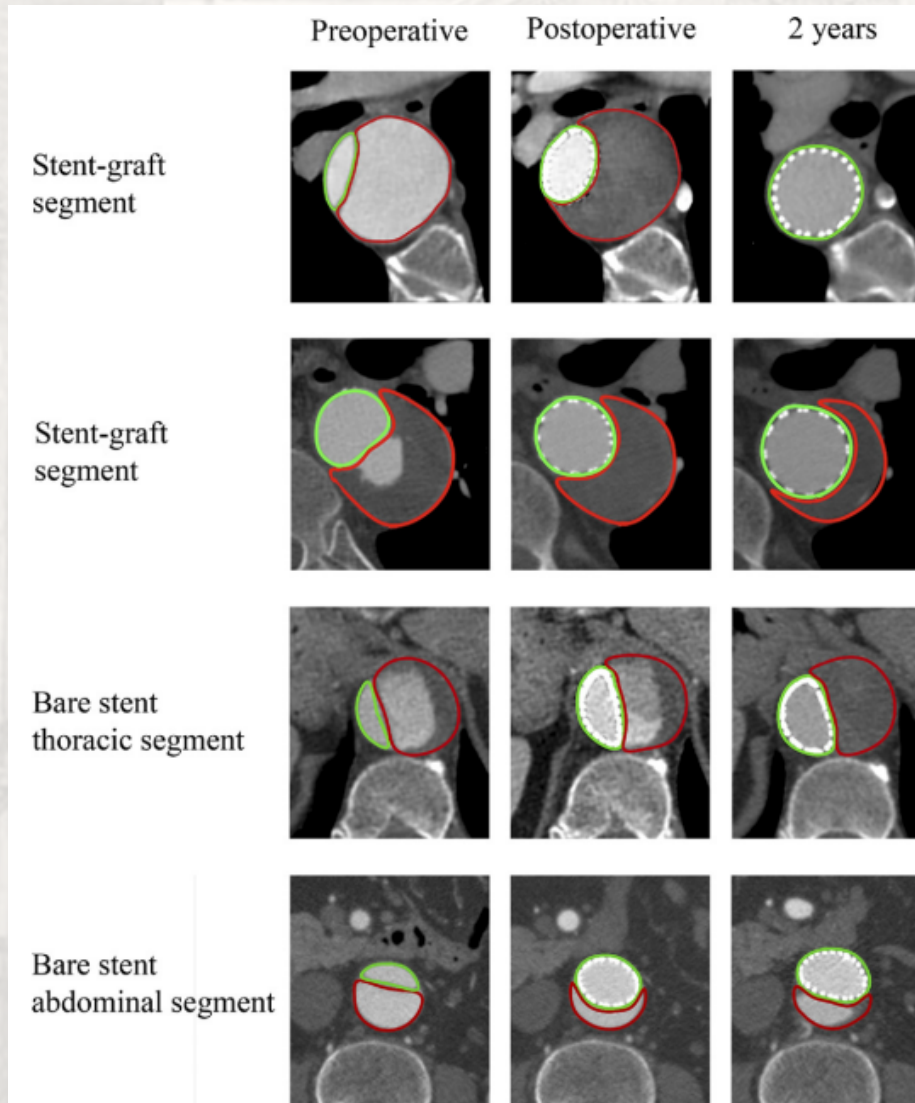


Figure 2 ♦ The PETTICOAT concept as a staged procedure 21 weeks after initial placement of a stent-graft alone (A) in the attempt to fully reconstitute the entire aorta in type B dissection (B). With persistent false lumen perfusion from communication sites distal to the initially placed stent-graft, the bare metal scaffold was inserted as a staged procedure (C); there was no compromise to any abdominal aortic side branch, and the true lumen diameter was improved (D).

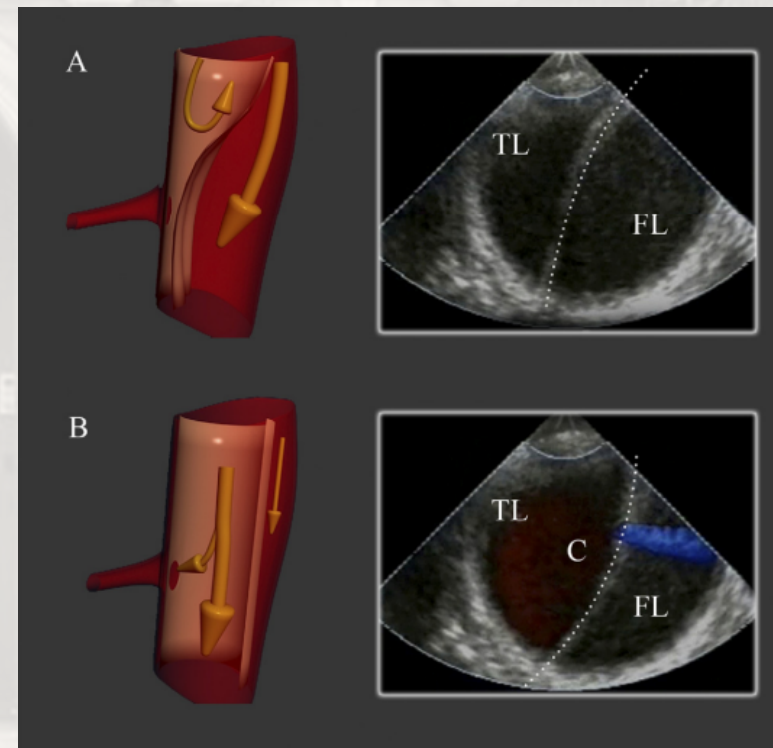
Volume Changes after PETTICOAT over 2 yrs



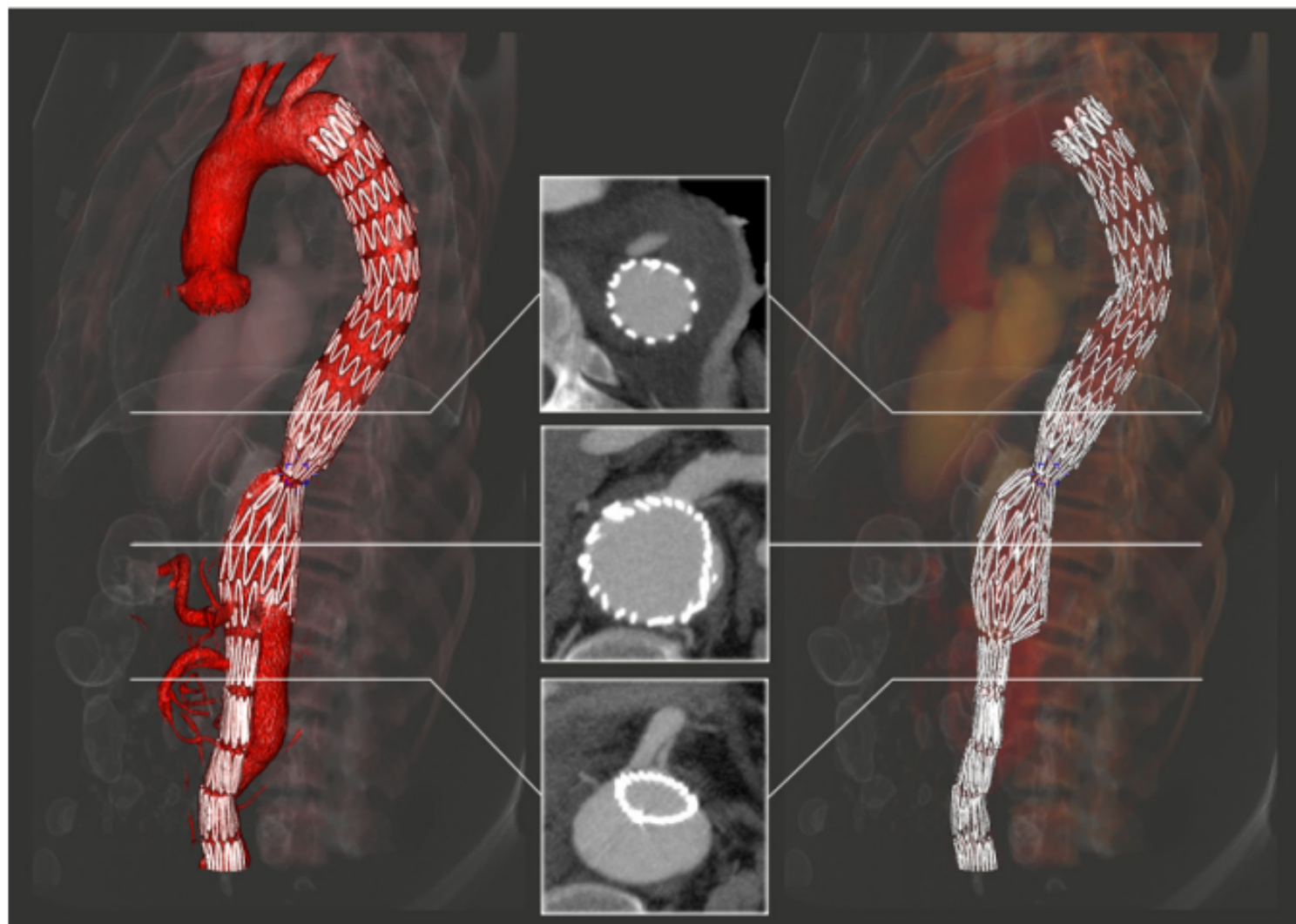
Volume Changes after PETTICOAT in 2 yrs



Arresting the flapping motion of lamella promotes thrombosis in FL



Post-interventional CT scan (single case with ruptured lamella)



Implications for practice

We identified no randomised controlled trials, so can draw no definite conclusion on this topic. Despite the lack of evidence from randomised controlled trials, evidence from non-randomised studies appears to suggest that the PETTICOAT technique can be used with close follow-up, and would potentially achieve favourable aortic remodeling in a short-term follow-up. With the accumulation of participants, evidence from non-randomised studies with large sample sizes may also be helpful in guiding clinical practice.

Implications for research

SOUTH BROMPTON HOSPITAL BLOCK

There are currently no randomised controlled trials from which we can draw conclusions about this review question. Evidence from non-randomised studies appears to be favourable for the PETTICOAT technique to solve the problem of unfavourable distal aortic remodeling. Randomised controlled trials are needed because new devices for the PETTICOAT technique, such as the Zenith endovascular aortic dissection system from COOK Medical, are launching to the market while a definite conclusion has not been drawn.

PETTICOAT experience

TABLE 1
Individual Demographics and Clinical Characteristics

Sex/Age, y	Dissection	Comorbidity	ASA Class	Stent-Graft/Size, cm
1. M/45	Postsurgical type A	HTN,	3	1 Talent/16
2. M/76	Subacute type B	HTN, RI	3	1 Talent/20
3. F/44	Subacute type B	HTN, stroke, aFib	3	1 Talent/18
4. F/46	Acute type B	HTN,	3	1 Excluder/22
5. M/71	Chronic type B	HTN, CAD, TIA, AAA, RI, dyslipidemia	3	1 Talent/16
6. M/53	Chronic type B	HTN, dyslipidemia	3	1 Talent/16
7. M/66	Chronic type B	HTN, RI	3	1 Talent/17
8. M/71	Subacute type B	HTN	3	1 Talent/15
9. M/58	Subacute type B	HTN, dyslipidemia, RI	3	1 Talent/16
10. M/55	Chronic type B	HTN, RI	3	1 Zenith/20
11. M/64	Subacute type B	HTN, RI, aFib	3	2 Valiant/20+15
12. M/55	Postsurgical type A	HTN,	5	1 Excluder/20

ASA: American Society of Anesthesiologists, HTN: hypertension, aFib: atrial fibrillation, AAA: abdominal aortic aneurysm, CAD: coronary artery disease, RI: renal insufficiency, TIA: transient ischemic attack.

PETTICOAT experience

TABLE 2
Procedural Characteristics of Individual PETTICOAT Patients

Days From Initial SG	Indication	Extension Device/ Length×Width, mm	Procedural Outcome			
			TL Diameter, mm	TL Open	Distal Runoff	Side Branch Compromise
1. 0	sTLC	Sinus/140×24	20	+	+	—
2. 0	sTLC	Sinus/125×24	19	+	+	—
3. 0	sTLC	Fortress/140×26	23	+	+	—
4. 0	Large reentry, sTLC	Sinus/140×28	24	+	+	—
5. 531	Persistent distal reentry, sTLC, claudication	Fortress/160×30	26	+	+	—
6. 150	New distal reentry, sTLC, claudication	Sinus/150×26	21	+	+	—
7. 181	Late sTLC, claudication	Sinus/150×26	23	+	+	—
8. 7	FL reperfusion via reentry, sTLC, claudication	Fortress/145×30	24	+	+	—
9. 1110	FL reperfusion via reentry, sTLC	Fortress/155×26	19	+	+	—
10. 151	FL reperfusion via reentry, bowel malperfusion	2 Z stents/140×26	19	+	+	—
11. 197	sTLC, femoral malperfusion	Fortress/140×28	23	+	+	—
12. 112	sTLC, femoral malperfusion	Fortress/140×24	19	+	+	—

FL: false lumen; TL: true lumen; SG: stent-graft; sTLC: symptomatic true lumen collapse.

All type B dissection subject to SG ?

- Complicated !
- Asymptomatic ?
- ~~Uncomplicated ?~~
- ~~High risk uncomplicated ?~~

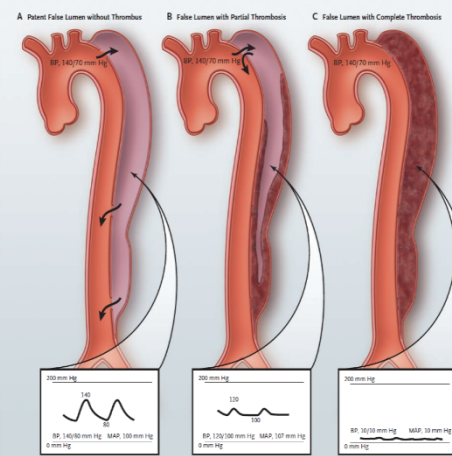


The NEW ENGLAND JOURNAL of MEDICINE

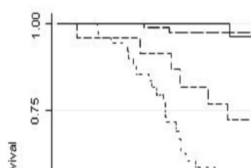
ORIGINAL ARTICLE

Partial Thrombosis of the False Lumen in Patients with Acute Type B Aortic Dissection

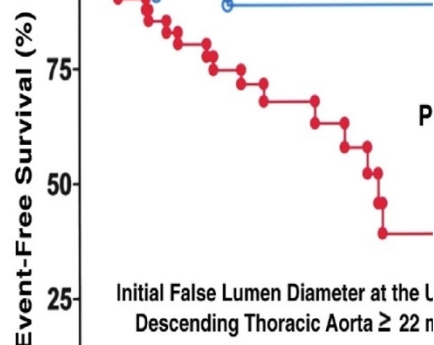
Thomas T. Tsai, M.D., M.Sc., Arturo Evangelista, M.D., Christoph A. Nienaber, M.D., Truls Myrnes, M.D., Gabriel Meinhardt, M.D., Jeanna V. Cooper, M.S., Dean E. Smith, Ph.D., Toru Suzuki, M.D., Rossella Fattori, M.D., Alfredo Llovet, M.D., James Froehlich, M.D., Stuart Hutchison, M.D., Alessandro Distante, M.D., Thoralf Sundt, M.D., Joshua Beckman, M.D., James L. Januzzi, Jr., M.D., Eric M. Isselbacher, M.D., and Kim A. Eagle, M.D., for the International Registry of Acute Aortic Dissection*



3140 Circulation June 26, 2012



Initial False Lumen Diameter :
Descending Thoracic Aorta



Initial False Lumen Diameter at the L
Descending Thoracic Aorta ≥ 22 mm

Follow-Up period (yr)

Patients at Risk

Initial False Lumen Diameter

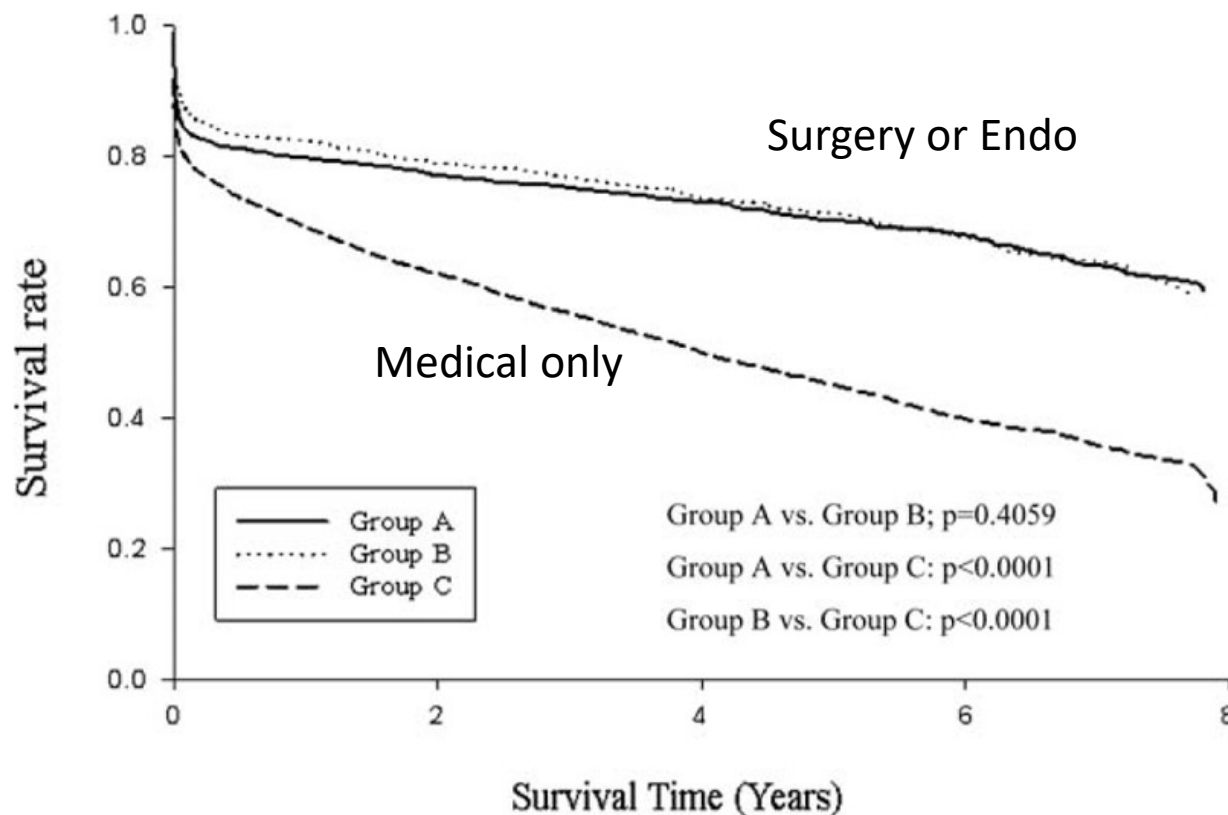
< 22 mm

≥ 22 mm

Follow-Up period (yr)	0	1	2	3	4	5	6	7	8	9	10
Initial False Lumen Diameter < 22 mm	58	48	30	11							
Initial False Lumen Diameter ≥ 22 mm	42	32	17	8							

B

Survival pattern of any Aortic Dissection



Overall survival rates of the three study groups in 9092 patients with aortic dissection in Taiwan.

Group A included 2340 patients (25.74%) treated surgically for type A AD

Group B included 1144 patients (12.58%) treated endo/surgically for type B AD

Group C included 5608 patients (61.68%) with any type of AD treated with medical therapy only.

Medical management only may never be enough !

Ting-Yu Yeh, et al. Epidemiology and Medication Utilization Pattern of Aortic Dissection in Taiwan: A Population-Based Study. Medicine (Baltimore). 2016 Feb;95(8):e200b

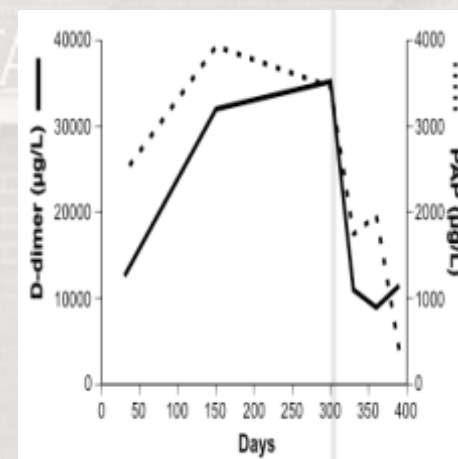
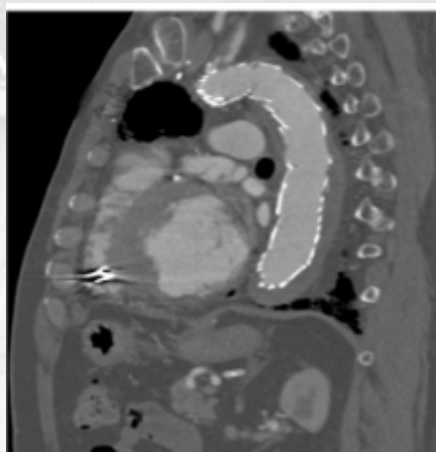
Pictorial example: High risk type B dissection with inflammation

Baseline

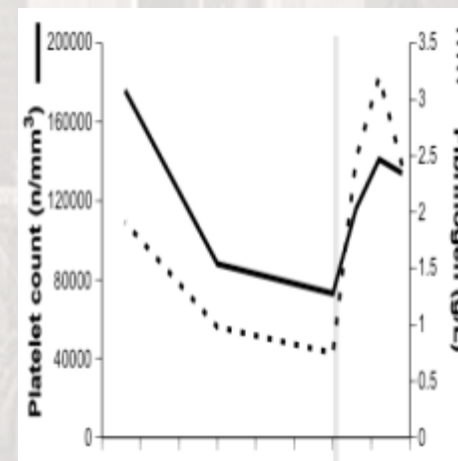
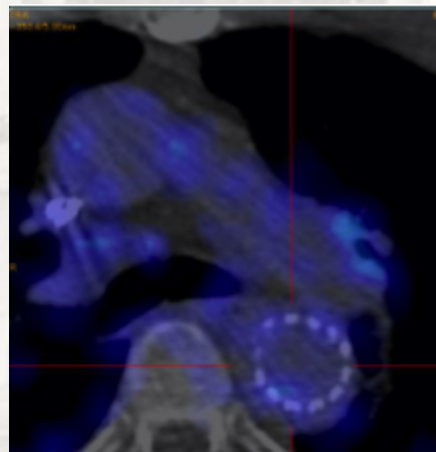
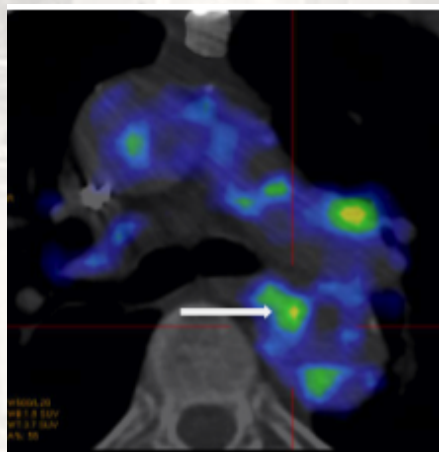
After TEVAR

Biology

CT

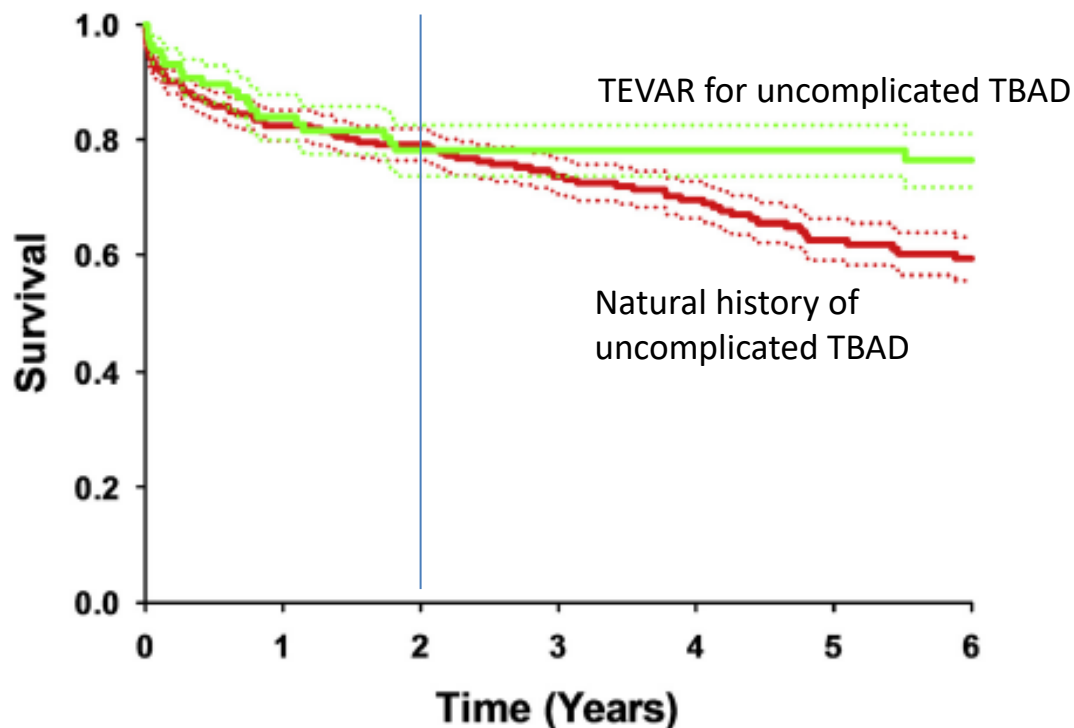


PET-CT



TEVAR

Late survival benefit after TEVAR in **uncomplicated** type B dissection

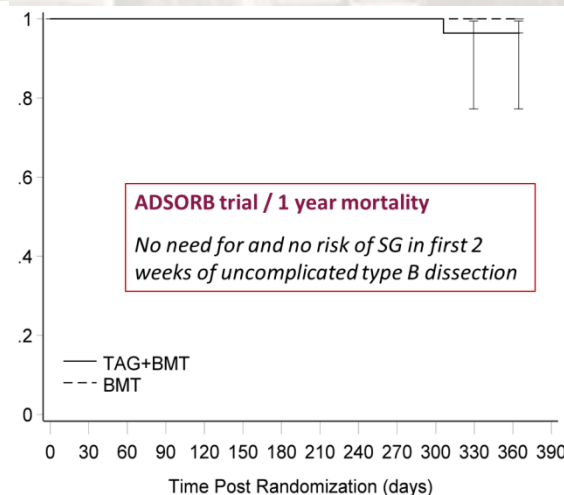
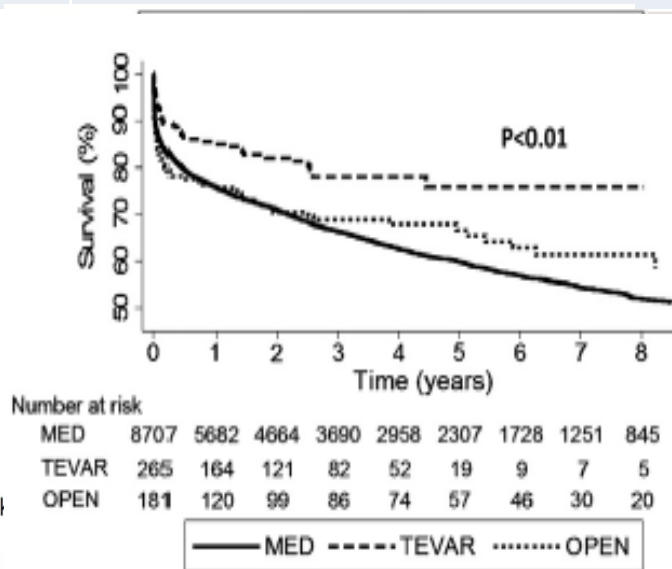
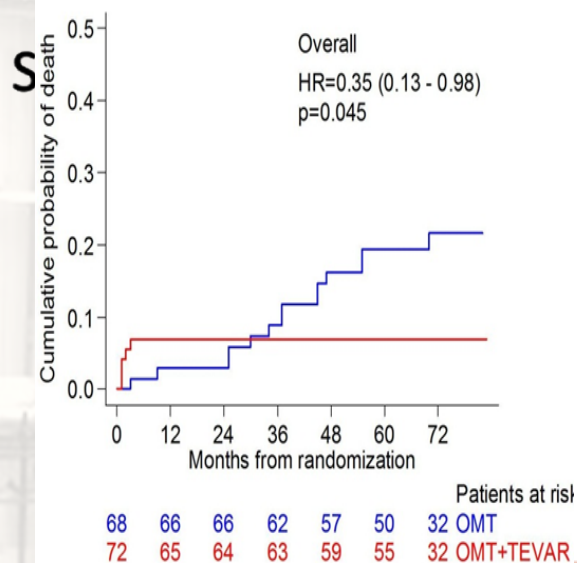


<u>Intervention:</u>							
At risk:	87	73	68	65	59	53	43
Survival:	100.0	83.9	78.2	78.2	78.2	78.2	76.4
SE (+/-):	0.0	3.9	4.4	4.4	4.4	4.4	4.7
<u>Medically Managed:</u>							
At risk:	211	174	167	136	108	82	65
Survival:	100.0	82.5	79.2	73.6	68.9	62.6	59.3
SE (+/-):	0.0	2.6	2.8	3.1	3.3	3.6	3.8

Fig 3. Kaplan-Meier curve for survival of 298 patients with uncomplicated, acute type B dissection, from the time of presentation, stratified by those undergoing intervention (*green*) and those remaining medically managed throughout the operative period (*red*) ($P = .018$). SE, Standard error.

Survival after TEVAR in **uncomplicated** type B dissection (RCTs and registry)

RCT	REGISTRY	RCT
INSTEAD-XL (n=140)	COSHPD database (n=9165)	ADSORB (n=61)
Circulation CV 2013; 6:407	Iannuzzi JC et al. JVS 2018	Eur J Vasc Endovasc Surg 2014;48:285



The initial RCT showed a long-term advantage of an intervention (stent-grafting the TL), with two large registry-based analyses confirming the signal from the RCT; findings are supported by short-term F/U of an independent RCT. **On aggregate, all data are consistent! Very strong signal!**



Shouldn't we stratify patients with type B dissection...?

JOURNAL OF THE AMERICAN COLLEGE OF CARDIOLOGY
© 2016 BY THE AMERICAN COLLEGE OF CARDIOLOGY FOUNDATION
PUBLISHED BY ELSEVIER

VOL. 67, NO. 24, 2016
ISSN 0735-1097/\$36.00
<http://dx.doi.org/10.1016/j.jacc.2016.04.016>

EDITORIAL COMMENT

The Art of Stratifying Patients With Type B Aortic Dissection*

Christoph A. Nienaber, MD, PhD



The management strategy for patients with "uncomplicated" type B aortic dissection has been the subject of ongoing debate since the advent of modern endovascular options to reconstruct a dissected aorta, and thereby, induce vascular remodeling (1,2). Patient management for complicated type B dissection enjoys greater agreement; in this setting, a primary endovascular therapeutic approach is recommended in current European Society of Cardiology guidelines with a Class I, Level of Evidence: C recommendation (3). For "uncomplicated" cases of dissection, the cardiovascular community continues to struggle with whether to embrace thoracic endovascular aortic repair (TEVAR) or any endovascular concept as first-line therapy absent well-recognized complications, such as malperfusion or impending rupture (4-6).

SEE PAGE 2835

The current paper by Qin et al. (7) in this issue of the *Journal* offers some insight, although bear in mind the study is based on a chart review and retrospective analysis of data from 3 Chinese cardiovascular centers across a period of 11 years. They concluded that TEVAR is feasible for "uncomplicated" type B aortic dissection in the acute setting (<14 days after dissection onset) with a lower adverse event rate and lower mortality than best medical management, the current standard of care. In their analysis, 71.0% of patients had late aortic events under medical management versus 46.7% after early

TEVAR on top of similar medication during follow-up. Thus, if a patient was expected to survive at least 5 years, the evidence suggested that early TEVAR offered an advantage over medical management alone. It should be noted that reported event rates in both groups appear high and underline the need for structured follow-up/surveillance of all patients with previous dissection.

The work by Qin et al. (7) would seem to confirm the recent swing to dismiss the term "uncomplicated dissection" and consider most, if not all, cases of type B dissection as "potentially complicated," because these patients' outcomes seem to improve long term as previously suggested from registries and the randomized INSTEAD-XL (Investigation of Stent Grafts in Aortic Dissection with extended follow-up) trial (8,9).

However, important aspects of this report are controversial. First, the degree of heterogeneity of TEVAR treatment is high considering the different protocols used in the 3 centers evaluated, including utilization of 5 different stent grafts in 184 patients over 11 years (averaging 5 to 6 patients per year per center). Second, why should a patient with "uncomplicated" type B aortic dissection receive TEVAR treatment in the acute phase when delayed TEVAR (>14 days from onset) has a lower rate of retrograde proximal dissection as a serious complication (10)? Postponing TEVAR to the subacute phase could have avoided their 1 case of retrograde dissection while still allowing ample time for TEVAR-induced remodeling before the window of plasticity/opportunity starts closing about day 100 (11). Why rush when the strategy allows for a fully elective TEVAR including neck vessel debranching, if necessary, for an optimal landing zone?

Third, whereas the overall observations favored TEVAR in "uncomplicated" dissection with long-term benefit (8,9), and seemed to support prophylactic

JOURNAL OF THE AMERICAN COLLEGE OF CARDIOLOGY
© 2016 BY THE AMERICAN COLLEGE OF CARDIOLOGY FOUNDATION
PUBLISHED BY ELSEVIER

VOL. 67, NO. 24, 2016
ISSN 0735-1097/\$36.00
<http://dx.doi.org/10.1016/j.jacc.2016.05.578>

Endovascular Repair Compared With Medical Management of Patients With Uncomplicated Type B Acute Aortic Dissection



Yong-Lin Qin, MD,^a Feng Wang, MD,^b Tian-Xiao Li, MD,^c Wei Ding, MD,^a Gang Deng, MD,^a Bo Xie, MD,^a Gao-Jun Teng, MD^a

ABSTRACT

BACKGROUND Thoracic endovascular aortic repair (TEVAR) has been used in patients with uncomplicated type B acute aortic dissection (B-AAD) to reduce late morbidity and mortality. The outcomes of comparisons between TEVAR and best medical treatment (BMT) on patients with uncomplicated type B-AAD are inconsistent in the published reports.

OBJECTIVES This study sought to further clarify the early and long-term (11-year) outcomes of TEVAR in patients with uncomplicated type B-AAD compared with those with BMT treatment.

METHODS Between February 2003 and August 2014, 338 patients with uncomplicated type B-AAD were retrospectively identified in 3 tertiary medical centers. Information about baseline characteristics was collected from medical records. Images were retrieved from the imaging archiving system, and the thrombosis status of the false lumen and extent of the dissection were evaluated via computed tomography angiography. Early and late outcomes were recorded and analyzed.

RESULTS TEVAR procedures were performed on 184 patients (TEVAR group) and BMT for 154 patients (BMT group). Early events and 30-day mortality were not significantly different between the 2 groups. Patients receiving BMT had significantly higher aortic-related adverse events compared with those in the TEVAR group ($p = 0.025$). All-cause mortality with TEVAR was significantly lower than that of BMT ($p = 0.01$).

CONCLUSIONS This study confirmed the feasibility of TEVAR for uncomplicated type B aortic dissection in the acute setting with fewer aortic-related adverse events and a lower mortality rate compared with BMT. (*J Am Coll Cardiol* 2016;67:2835-42) © 2016 by the American College of Cardiology Foundation.

The morbidity and mortality rate in type B acute aortic dissections (B-AAD) is highest within 10 to 14 days after acute onset (1,2). Current consensus holds that patients with complicated type B-AAD could be treated with thoracic endovascular aortic repair (TEVAR) (3), leading to better in-hospital survival than open surgery (4).

Patients with uncomplicated type B-AAD are commonly treated with conservative therapy (best medical treatment [BMT]) although the long-term outcome of medical therapy alone is suboptimal (5), with a reported 30% to 50% mortality rate at 5 years and a delayed expansion of the false lumen in 20% to 50% of patients at 4 years (6).

*Editorials published in the *Journal of the American College of Cardiology* reflect the views of the authors and do not necessarily represent the views of JACC or the American College of Cardiology.

From the NHR Cardiovascular BRU and Imperial College, Department of Cardiology & Aortic Centre, The Royal Brompton and Harefield NHS Trust, London, United Kingdom. Dr. Nienaber has reported that he has no

