NOVELTIES IN VASCULAR SURGERY

XXX Giornate Cardiologiche Torinesi

Torino, 27 Ottobre 2018

Post dissection descending thoracic aortic aneurysms: the role of open and endovascular surgery

Gianfranco Varetto

Università di Torino - Dipartimento di Scienze Chirurgiche
Scuola di Specializzazione in Chirurgia Vascolare
S.C. Chirurgia Vascolare U (Direttore Prof. P. Rispoli)

AZIENDA OSPEDALIERO - UNIVERSITARIA
Città della Salute e della Scienza di Torino

CONFLICTS OF INTEREST

Disclosure

Speaker name: Gianfranco Varetto

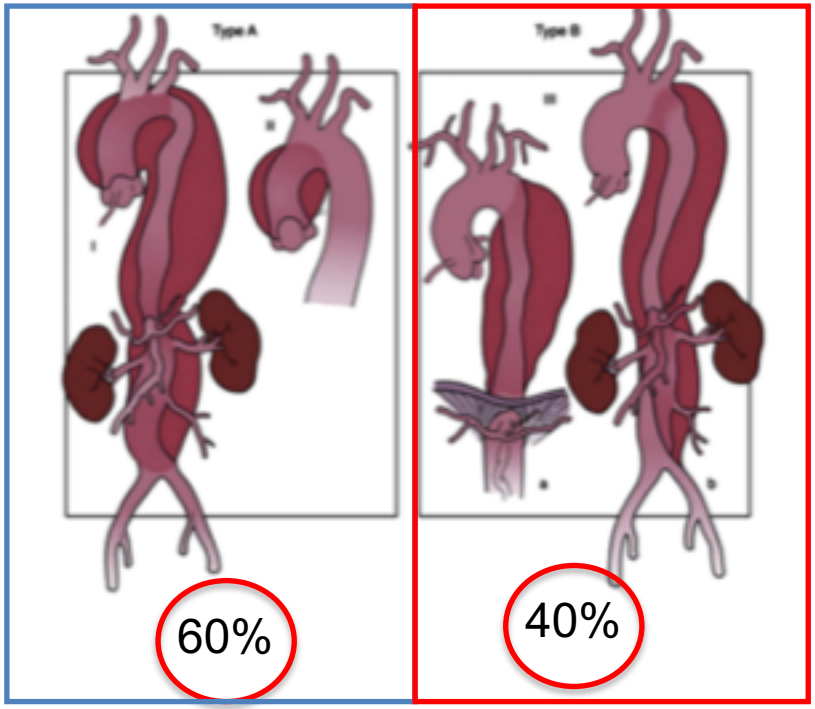
.....

❑I don‘t have any potential conflicts of interest

AORTIC DISSECTION

Although rare, aortic dissection is one of the most feared aortic diseases, associated with high mortality and morbidity.

OPEN SURGERY



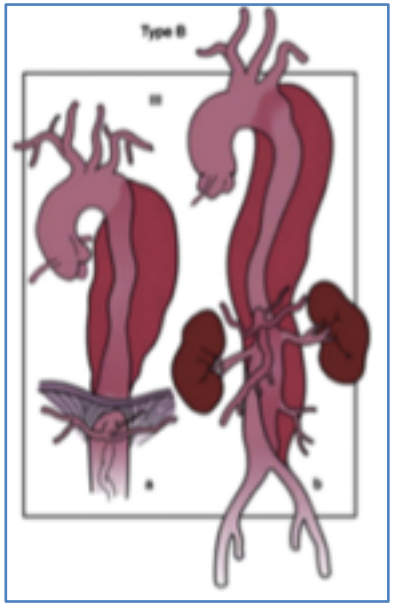
MEDICAL TREATMENT
ENDOVASCULAR SURGERY
OPEN SURGERY

Oikonomu K, Katsargyris A, Ritter W et al. Endovascular management of chronic post-dissection aneurysms. Ann Cardiothorac Surg 2014

Riambau V, Bockler D, Brunkwall J et al. Management of Descending Thoracic Aorta Diseases. Clinical PracticeGuidelines of the European Society fot Vascular Surgery (ESVS). Eur J Vasc Endovasc Surg (2017)

STANFORD B AORTIC DISSECTION (tBAD)

- ACUTE (AtBAD) → within 14 days of the onset of symptoms.
- SUBACUTE → between 14 days and 3 months
- CHRONIC (CtBAD) → after 3 months



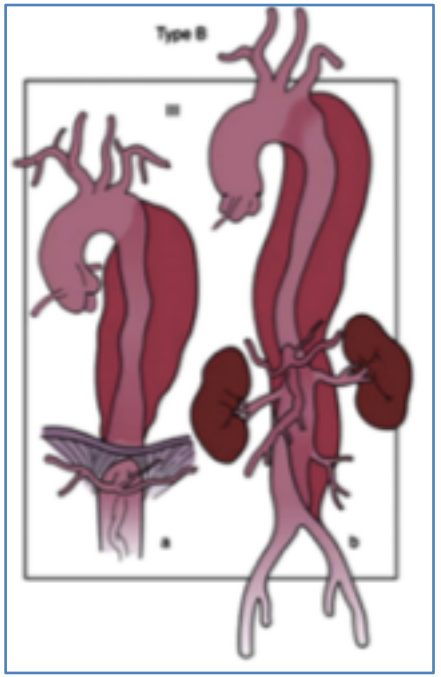
Oikonomu K, Katsargyris A, Ritter W et al. Endovascular management of chronic post-dissection aneurysms. Ann Cardiothorac Surg 2014;3(3):307-313

Schepens M. Type B aortic dissection: new perspectives. J Vis Surg 2018;4:75

Riambau V, Bockler D, Brunkwall J et al. Management of Descending Thoracic Aorta Diseases. Clinical PracticeGuidelines of the European Society fot Vascular Surgery (ESVS). Eur J Vasc Endovasc Surg (2017) 53, 4e52

International Registry of Aortic Dissection (IRAD)

- hyperACUTE (HAtBAD) → (symptom onset up to 24 hours)
- ACUTE → 2-7 days
- SUBACUTE → between 8-30 days
- CHRONIC (CtBAD) → > 30 days



Boher AM, Isselbacher EM, Nienaber et al. The IRAD classification system for characterizing survival after aortic dissection. Am J Med 2013

STANFORD B AORTIC DISSECTION (tBAD)

- UNCOMPLICATED → hospital mortality 10%
- COMPLICATED → frank rupture, impending rupture, refractory pain, persistent and uncontrollable hypertension despite adequate medical treatment, rapid growing of the diameter of the dissected aorta, occurrence of acute hoarseness, malperfusion of the viscera or limbs.

  → **<u>hospital mortality 50%</u>**

Oikonomu K, Katsargyris A, Ritter W et al. Endovascular management of chronic post-dissection aneurysms. Ann Cardiothorac Surg 2014

Schepens M. Type B aortic dissection: new perspectives. J Vis Surg 2018

Riambau V, Bockler D, Brunkwall J et al. Management of Descending Thoracic Aorta Diseases. Clinical PracticeGuidelines of the European Society fot Vascular Surgery (ESVS). Eur J Vasc Endovasc Surg (2017)

STANFORD B AORTIC DISSECTION (tBAD)

UNCOMPLICATED → hospital mortality 10%

COMPLICATED → frank rupture, impending rupture, refractory pain, persistent and uncontrollable hypertension despite adequate medical treatment, rapid growing of the diameter of the dissected aorta, occurrence of acute hoarseness, malperfusion of the viscera or limbs.

→ hospital mortality 50%

MEDICAL TREATMENT

ENDOVASCULAR SURGERY

OPEN SURGERY

Recommendation 16	Class	Level of evidence	References
In patients with complicated acute type B aortic dissection, endovascular repair with thoracic endografting should be the first line intervention	I	C	6,85–89,92–94,96–99, 103,109

Oikonomu K, Katsargyris A, Ritter W et al. Endovascular management of chronic post-dissection aneurysms. Ann Cardiothorac Surg 2014

Schepens M. Type B aortic dissection: new perspectives. J Vis Surg 2018

Riambau V, Bockler D, Brunkwall J et al. Management of Descending Thoracic Aorta Diseases. Clinical PracticeGuidelines of the European Society fot Vascular Surgery (ESVS). Eur J Vasc Endovasc Surg (2017)

ACUTE COMPLICATION TYPE B DISSECTION

Aortic rupture
Refractory pain
Uncontrollable hypertension
Rapid growth
Visceral malperfusion
Limb malperfusion
Spinal cord ischemia

POST DISSECTION TAA (pdTAA)

Post-dissection aortic aneurysms (PDAA) affect 20-40% of patients with aortic dissection.

Interventional management to prevent rupture required in 18% of cases.

Factors associated with secondary aneurysms formation:

- initial diameter of false lumen at the proximal descending aorta of > 2 cm (sensitivity 100% and specificity 76%)
- patency of false lumen or partial false lumen thrombosis
- large area (>70%) of false lumen
- hypertension
- aortic diameter > 40 mm

Oikonomu K, Katsargyris A, Ritter W et al. Endovascular management of chronic post-dissection aneurysms. Ann Cardiothorac Surg 2014;

Song JM, Kim SD, Kim JH, et al. Long-term predictors of descending aorta aneurysmal change in patients with aortic dissection. J Am Coll Cardiol 2007

Sueyoshi E, Sakamoto I, Hayashi K, et al. Growth rate of aortic diameter in patients with type B aortic dissection during the chronic phase. Circulation 2004;

Tsai TT, Trimarchi S, Nienaber CA. Acute aortic dissection: perspectives from the International Registry of Acute Aortic Dissection (IRAD). Eur J Vasc Endovasc Surg 2009;

POST DISSECTION TAA (pdTAA)

Aortic diameter growth after type B dissection ranges between 1 and 7 mm per year. The process often involves toracoabdominal aorta and is accompanied by extensive aortic remodeling leading to fibrotic stiffness of dissection flap.

Indications for repair:

- **onset of symptoms → lumbar pain, abdominal pain, hypotension, malperfusion**
- **in asymptomatic patients → maximum aneurysm diameter remains the most important indicator for treatment**

Oikonomu K, Katsargyris A, Ritter W et al. Endovascular management of chronic post-dissection aneurysms. Ann Cardiothorac Surg 2014;3(3):307-313

Blount KJ, Hagspiel KD. Aortic diameter, true lumen, and false lumen growth rates in chronic type B aortic dissection. AJR Am J Roentgenol 2009;192:W222-9.

GROWTH RATE

In medically managed patients with type B aortic dissection, the aortic diameter increased over time at mean rate 1.49 mm/year at proximal descending aorta with greater increased in size ofthe false lumen diameters than the true lumen diameter.

CONCLUSION:

In post-surgical repaired type A and post stent-grafting therapy type B aortic dissection, aortic diameter did not change over time.

Type B aortic dissection with **medical treatment had minimal increased** in aortic diameter over time.

The results suggested that uncomplicated type B aortic dissection requires on-going medical treatment.

J Med Assoc Thai. 2015 Sep;98(9):902-9.

Growth Rate of Aortic Diameter in Post Treatment of Aortic Dissection.

Wasinrat J, Lertkowit M, Siriapisith T.

2017 ESVS GUIDELINES

Editor's Choice – Management of Descending Thoracic Aorta Diseases

Clinical Practice Guidelines of the European Society for Vascular Surgery (ESVS)

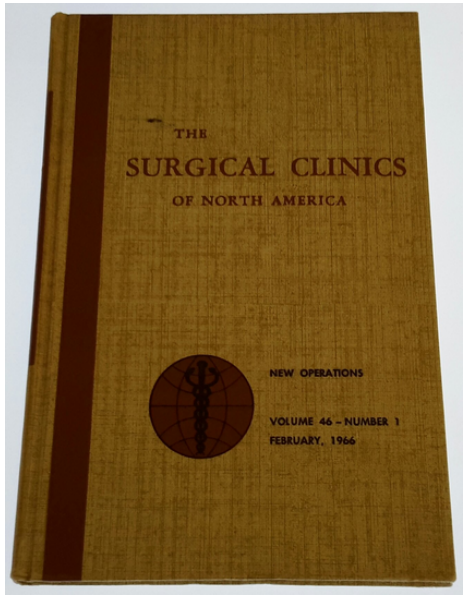
Writing Committee [a] V. Riambau, D. Böckler, J. Brunkwall, P. Cao, R. Chiesa, G. Coppi, M. Czerny, G. Fraedrich, S. Haulon, M.J. Jacobs, M.L. Lachat, F.L. Moll, C. Setacci, P.R. Taylor, M. Thompson, S. Trimarchi, H.J. Verhagen, E.L. Verhoeven,
ESVS Guidelines Committee [b] P. Kolh, G.J. de Borst, N. Chakfé, E.S. Debus, R.J. Hinchliffe, S. Kakkos, I. Koncar, J.S. Lindholt, M. Vega de Ceniga, F. Vermassen, F. Verzini,
Document Reviewers [c] P. Kolh, J.H. Black III, R. Busund, M. Björck, M. Dake, F. Dick, H. Eggebrecht, A. Evangelista, M. Grabenwöger, R. Milner, A.R. Naylor, J.-B. Ricco, H. Rousseau, J. Schmidli

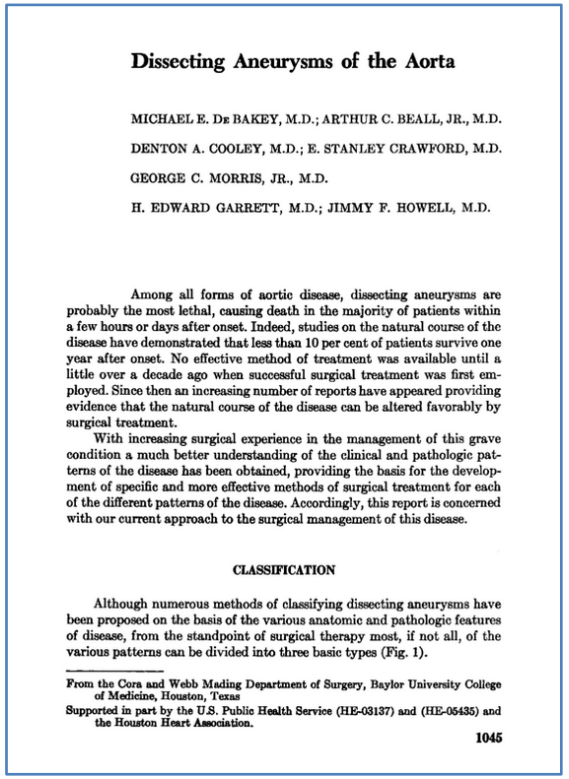
Recommendation 34a			
In patients with chronic aortic dissection, a descending thoracic aortic diameter between 56 and 59 mm may be considered as an indication for treatment in patients at reasonable surgical risk	IIb	C	167,176
Recommendation 34b			
In patients with chronic aortic dissection, a descending thoracic aortic diameter greater than 60 mm should be considered as an indication for treatment in patients at reasonable surgical risk	IIa	C	97,167,176
Recommendation 35			
In patients with chronic aortic dissection and thoraco-abdominal extension, an aortic diameter greater than 60 mm should be considered as an indication for treatment in patients at reasonable surgical risk	IIa	C	167,176

Riambau V, Bockler D, Brunkwall J et al. Management of Descending Thoracic Aorta Diseases. Clinical PracticeGuidelines of the European Society fot Vascular Surgery (ESVS). Eur J Vasc Endovasc Surg (2017)

OPEN SURGERY

Acute complicated tBAD's were initially treated with open surgery consisting of the replacement of a part of the dissected thoracic aorta with a vascular Dacron prosthesis. Dr. Cooley and DeBakey were pioneers in this intervention





Dissecting Aneurysms of the Aorta

MICHAEL E. DE BAKEY, M.D.; ARTHUR C. BEALL, JR., M.D.
DENTON A. COOLEY, M.D.; E. STANLEY CRAWFORD, M.D.
GEORGE C. MORRIS, JR., M.D.
H. EDWARD GARRETT, M.D.; JIMMY F. HOWELL, M.D.

Among all forms of aortic disease, dissecting aneurysms are probably the most lethal, causing death in the majority of patients within a few hours or days after onset. Indeed, studies on the natural course of the disease have demonstrated that less than 10 per cent of patients survive one year after onset. No effective method of treatment was available until a little over a decade ago when successful surgical treatment was first employed. Since then an increasing number of reports have appeared providing evidence that the natural course of the disease can be altered favorably by surgical treatment.

With increasing surgical experience in the management of this grave condition a much better understanding of the clinical and pathologic patterns of the disease has been obtained, providing the basis for the development of specific and more effective methods of surgical treatment for each of the different patterns of the disease. Accordingly, this report is concerned with our current approach to the surgical management of this disease.

CLASSIFICATION

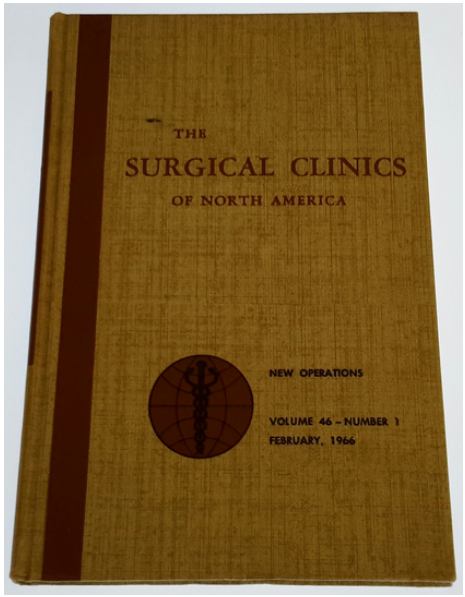
Although numerous methods of classifying dissecting aneurysms have been proposed on the basis of the various anatomic and pathologic features of disease, from the standpoint of surgical therapy most, if not all, of the various patterns can be divided into three basic types (Fig. 1).

From the Cora and Webb Mading Department of Surgery, Baylor University College of Medicine, Houston, Texas
Supported in part by the U.S. Public Health Service (HE-03137) and (HE-05435) and the Houston Heart Association.

OPEN SURGERY

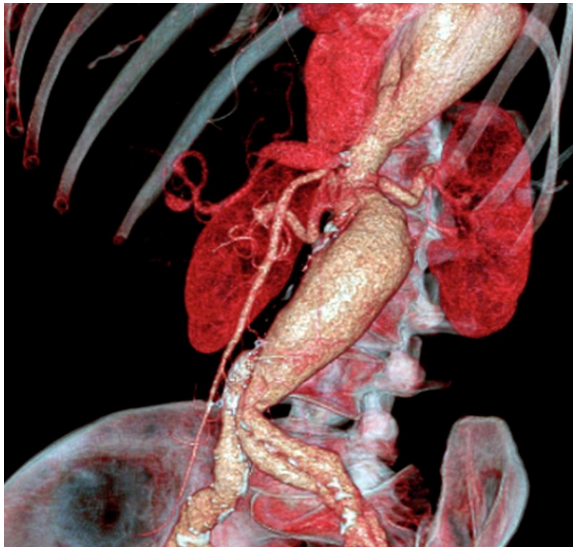
Open repair remains the first line therapy of PDAA, but is still associated with high mortality and morbidity rates.

In the chronic dissection with aneurysm formation of the descending thoracic and/or thoracoabdominal aorta,
especially in **connective tissue disorders**,
<u>open surgery offers nowadays the best immediate results with long durability</u>.



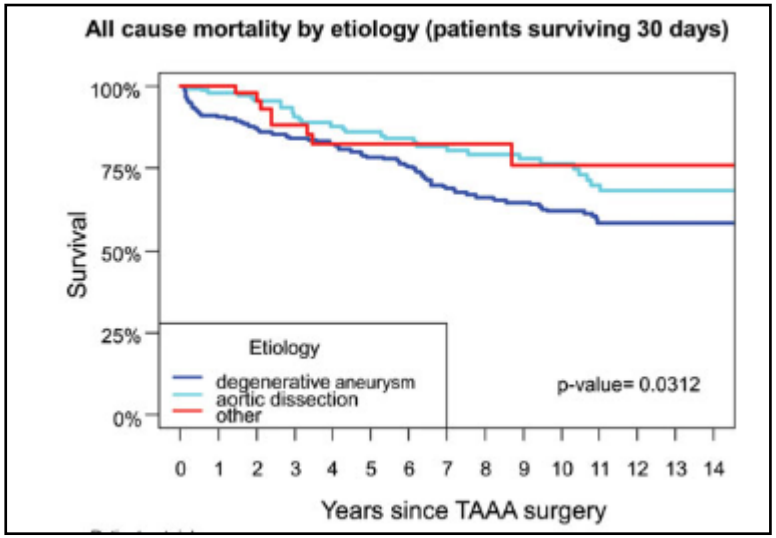
CONNECTIVE TISSUE DISORDERS

In patients with connective tissue disorders such as Marfan, Ehlers-Danlos, and Loeys-Dietz syndromes the aortic diameter will continue to dilate over time with higher reinterventions rates.



CONNECTIVE TISSUE DISORDERS

Previous arch intervention	117 (21.6)
Previous TAA intervention including ET	95 (17.5)
Previous AAA intervention	102 (18.8)
Emergent/urgent procedure	64 (12)
Rupture	48 (8.9)
Aortic disease	
Degenerative chronic aneurysm	325 (60)
Chronic dissection	160 (29.5)
Connective tissue disorder	37 (6.8)
Inflammatory	17 (3.1)
Infective	3 (0.6)



CONCLUSION

Outcomes of contemporary open TAAA repair using a multi-ADJ approach are very satisfactory. Long-term survival is largely determined by patient age and preoperative patient condition and not by the extent of the aortic repair. Post-dissection aneurysms are apparently protective for long-term survival compared with degenerative chronic aneurysms. Our contemporary results demonstrate that open surgical TAAA repair is an extremely effective option and is associated with a low need for aortic reinterventions.

Open thoracoabdominal aortic aneurysm repair in the modern era: results from a 20-year single-centre experience

Giacomo Murana[a,b,*], Sebastiano Castrovinci[a,b], Geoffrey Kloppenburg[a], Afram Yousif[a], Hans Kelder[c], Marc Schepens[d], Gijs de Maat[a], Uday Sonker[a], Wim Morshuis[a] and Robin Heijmen[a]

OPEN AORTIC REPAIR

3.2.2.2. Open repair. Despite the lack of data regarding comparison between open and endovascular repair, OR remains the standard treatment in low surgical risk patients with CTBAD because of an improvement in surgical results over the last 20 years.

Riambau V, Bockler D, Brunkwall J et al. Management of Descending Thoracic Aorta Diseases. Clinical PracticeGuidelines of the European Society fot Vascular Surgery (ESVS). Eur J Vasc Endovasc Surg (2017)

OPEN AORTIC REPAIR

Mainstays of surgical repair are similar to those of thoracic aortic aneurysms or TAA.

But pdTAA:

- require a more complex operative repair because of the intimal flap;
- are generally more extensive than degenerative aneurysms;
- develop in younger patients;
- develop in patients with connective tissue
- are more likely to present in emergency/u
- are Crawford type I and II

- longer operation times
- higher risk of bleeding
- higher risk of SCI
- higher risc of renal failure

Riambau V, Bockler D, Brunkwall J et al. Management of Descending Thoracic Aorta Diseases. Clinical PracticeGuidelines of the European Society fot Vascular Surgery (ESVS). Eur J Vasc Endovasc Surg (2017)

OPEN AORTIC REPAIR

In High Volume Centres

- Mortality rates → from 6% to 11%
- paraplegia/paraparesis rates → from 3.6% to 12%
- renal complications rates → from 17% to 25%,
  15% of patients requiring hemodialysis

But analyses of volume-related outcomes reveal a "real world":

- Mortality rates → reaching 22.3%
- post-operative complications (overall) → 55%

Zoli S, Etz CD, Roder F, Mueller CS, Brenner RM, Bodian CA, et al. Long-term survival after open repair of chronic distal aortic dissection. Ann Thorac Surg 2010

Conrad MF, Chung TK, Cambria MR, Parachuri V, Brady TJ, Cambria RP. Effect of chronic dissection on early and late outcomes after descending thoracic and thoracoabdominal aneurysm repair. J Vasc Surg 2011

Crawford ES, Crawford JL, Safi HJ, Coselli JS, Hess KR, Brooks B. Thoracoabdominal aortic aneurysms: pre-operative and intra-operative factors determining immediate and long-term results of operations in 605 patients. J Vasc Surg 1986;

Safi HJ, Miller 3rd CC, Estrera AL, Huynh TT, Porat EE, Hassoun HT, et al. Chronic aortic dissection not a risk factor for neurologic deficit in thoracoabdominal aortic aneurysm repair. Eur J Vasc Endovasc Surg 2002

Cowan JA Jr, Dimick JB, Henke PK, et al. Surgical treatment of intact thoracoabdominal aortic aneurysms in the United States: hospital and surgeon volume-related outcomes. J Vasc Surg 2003

OPEN AORTIC REPAIR

Recommendation 36	Class	Level of evidence	References
Open repair of aneurysmal or symptomatic chronic type B aortic dissection in patients with low surgical risk should be considered in dedicated centres with low complication rates	IIa	C	41,180

Recommendation 37			
In patients with chronic type B dissection undergoing operative repair, intra-procedural cerebrospinal fluid drainage, left heart bypass, and moderate hypothermia should be considered to reduce procedural mortality and spinal cord injury.	IIa	C	41,183

OPEN AORTIC REPAIR

Cerebrospinal fluid pressure increases with aortic cross-clamping, and could exceed the venous pressure, compromising venous outflow, leading to spinal cord malperfusion and secondary SCI.

CSF drainage has a role in the prevention of paraplegia and paraparesis, with a risk reduction up to 75% (OR 0.48, 95% CI 0.25-0.92).

Recommendation 6	Class	Level of evidence	References
Cerebrospinal fluid drainage has a role in the prevention of paraplegia and paraparesis and should be considered during extensive open repair of the descending thoracic aorta	IIa	B	29,37

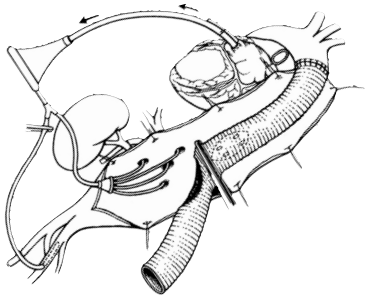
- mantain CSF pressure at 10 mmHg intra-operatively
- and for 48-72 hours after completion of the aneurysm repair
- associated with blood pressure control (MAP between 80 and 100 mmHg)

Riambau V, Bockler D, Brunkwall J et al. Management of Descending Thoracic Aorta Diseases. Clinical PracticeGuidelines of the European Society fot Vascular Surgery (ESVS). Eur J Vasc Endovasc Surg (2017)

OPEN AORTIC REPAIR

Left heart bypass (LHB):

- prevents heart failure
- mantains distal aortic perfusion
- mantains CDF pressure (SCI reduction from 11.2% to 4.5%)
- permits induction of systemic hypotermia.

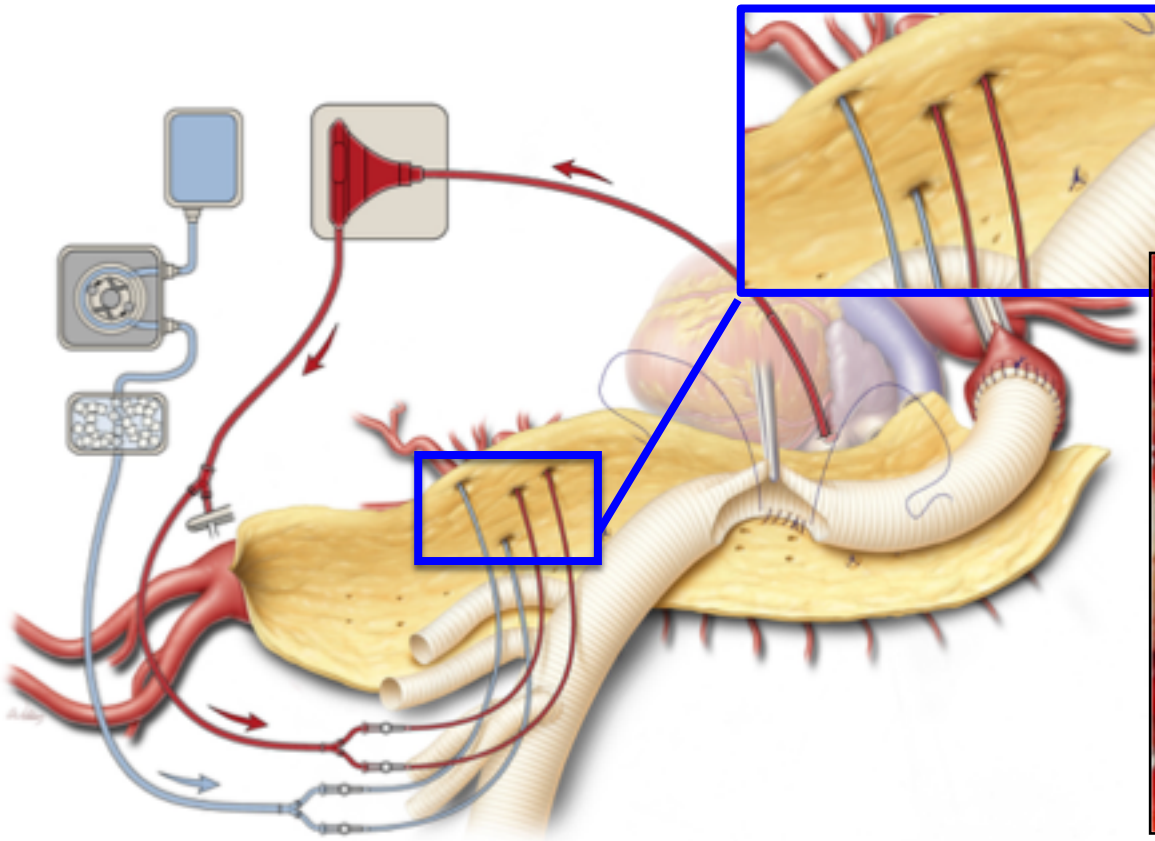


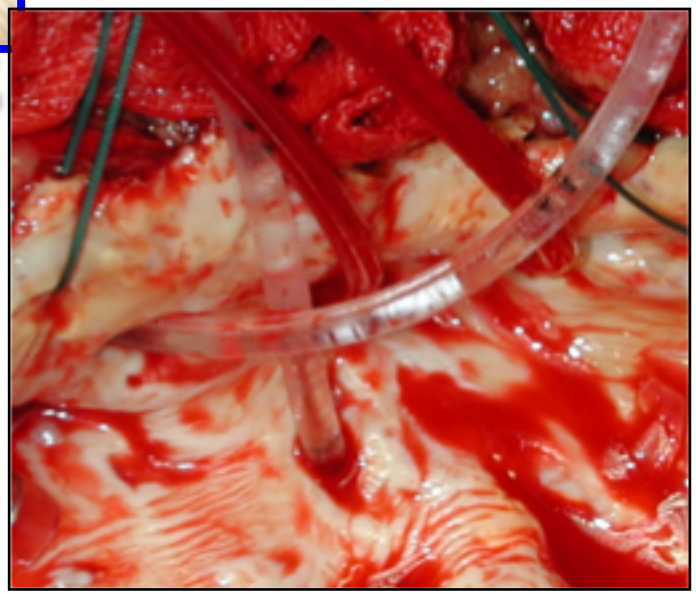
Recommendation 7			
To prevent spinal cord ischaemia, left heart bypass, allowing distal perfusion, during open type I and II thoraco-abdominal aortic aneurysm repair should be considered	IIa	C	40
Recommendation 8			
During extensive open descending thoracic aorta repair, moderate hypothermia around 32 °C may be considered to prevent spinal cord ischaemia	IIb	C	41,42
Recommendation 9			
Systemic cooling to less than 32 °C in combination with cerebrospinal fluid drainage is not recommended during open descending thoracic aortic repair as it can increase the risk of subdural bleeding	III	B	39,42

Riambau V, Bockler D, Brunkwall J et al. Management of Descending Thoracic Aorta Diseases. Clinical PracticeGuidelines of the European Society fot Vascular Surgery (ESVS). Eur J Vasc Endovasc Surg (2017)

OPEN AORTIC REPAIR

In addition to left heart bypass (LHB), selective vessel perfusion reduce ischemic damage.

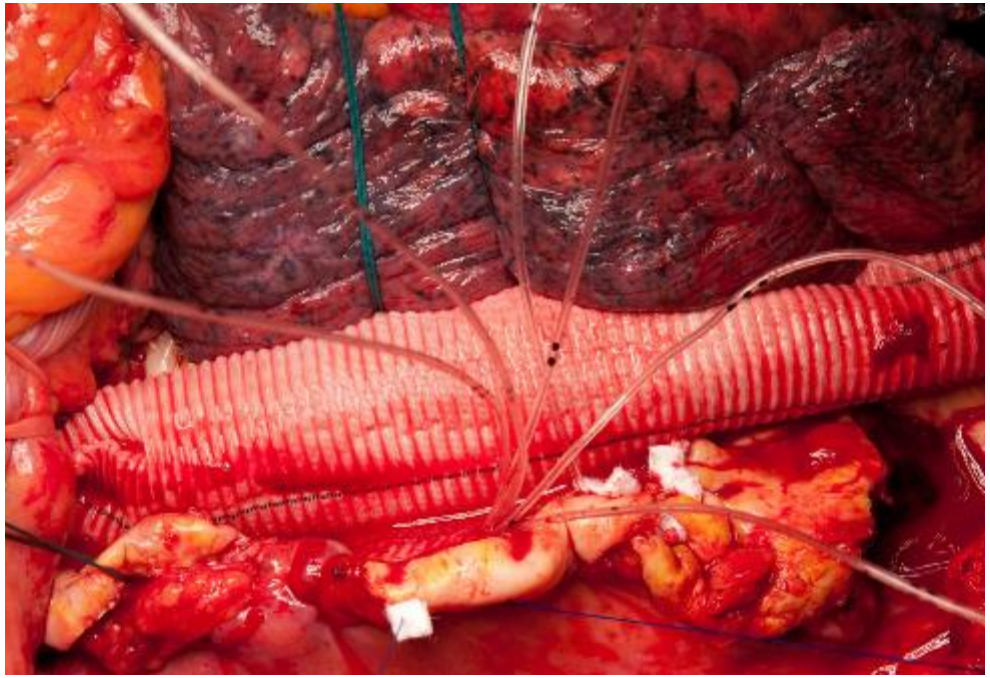




- Visceral arteries: Warm Blood
- Renal arteries: Custodiol

OPEN AORTIC REPAIR

Intercostal reattachment.



Avoid blood steal phenomenon

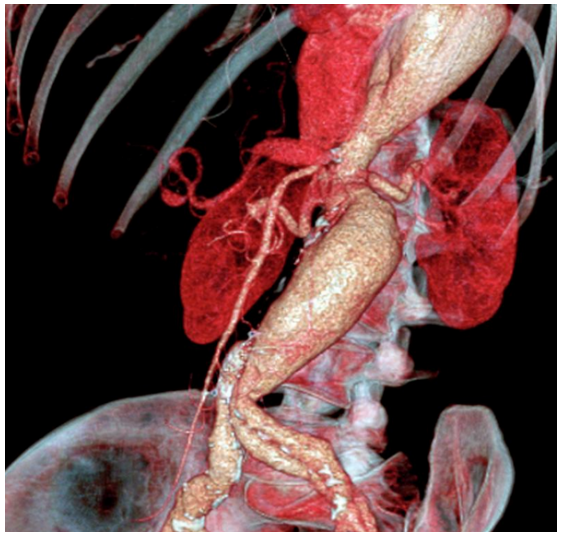
Aggressive critical i.c. reimplantation

Etz CD, et al. Eur J Cardiothor Surg 2007

CONNECTIVE TISSUE DISORDERS

TEVAR in patients with connective tissue disorders such as Marfan, Ehlers-Danlos, and Loeys-Dietz syndromes remains contra-indicated because the aortic diameter will continue to dilate over time with higher reinterventions rates and higher risks for stent-graft related complications such as retrograde aortic dissection.

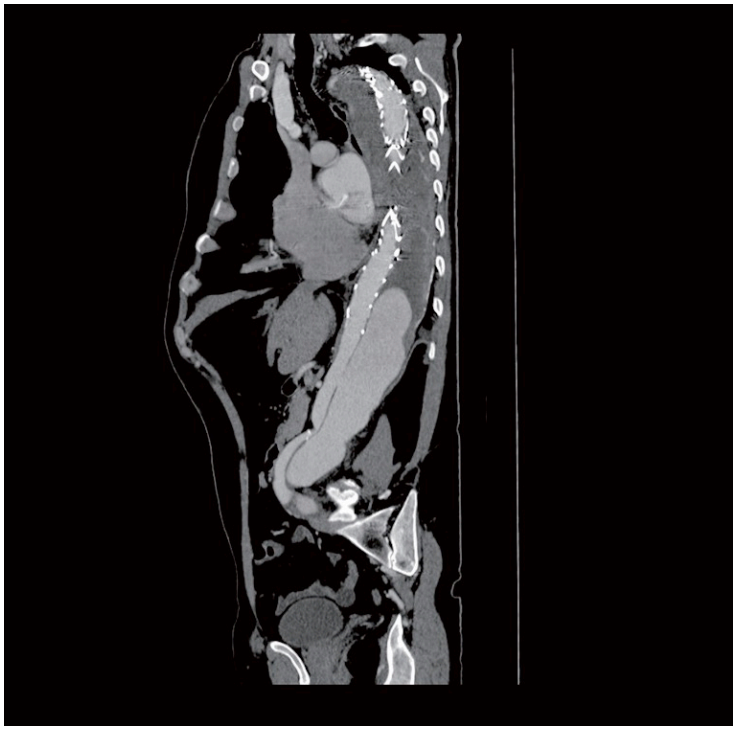
Only in emergency situations TEVAR can be accepted in these particular patients as a bridge to definitive surgery. The future progression of the disease with unavoidable dilatation leads to secondary endoleaks and high reintervention rates with uncertain long-term results.



Schepens M. Type B aortic dissection: new perspectives. J Vis Surg 2018

ACUTE UNCOMPLICATED TYPE B AORTIC DISSECTION

In acute uncomplicated situations the position of endografting is less clear and should be further delineated; however, on the long run also in these situations endografting might be protective for future aortic catastrophes in certain patient categories.

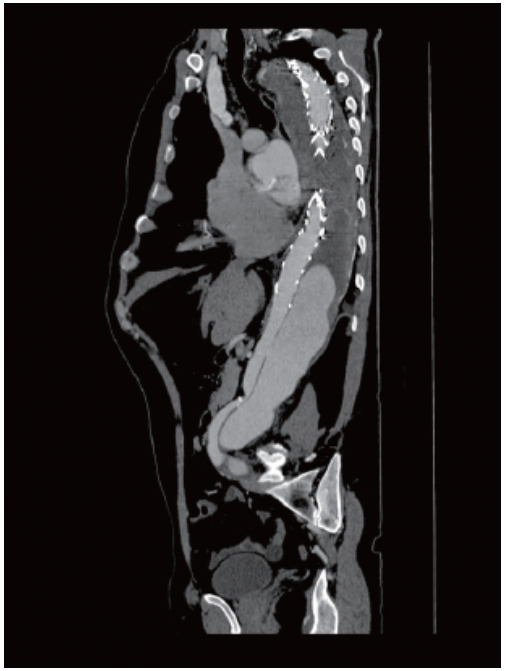


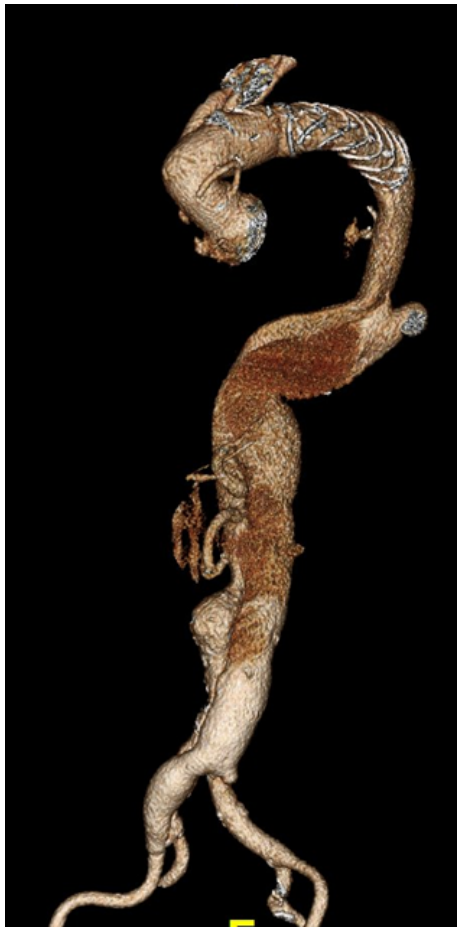
Type B aortic dissection: new perspectives

Marc A.A.M Schepens Journal of Visualized Surgery 2018

TEVAR

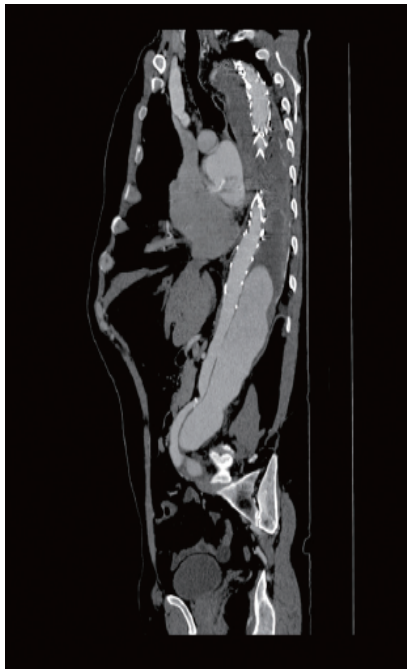
Thoracic endovascular aneurysm repair (TEVAR) covering only the proximal entry tear has proven to be insufficient in most patients with chronic PDAA and has a limited role only for PDAA with distal sealing zone in the thoracic aorta.





TEVAR

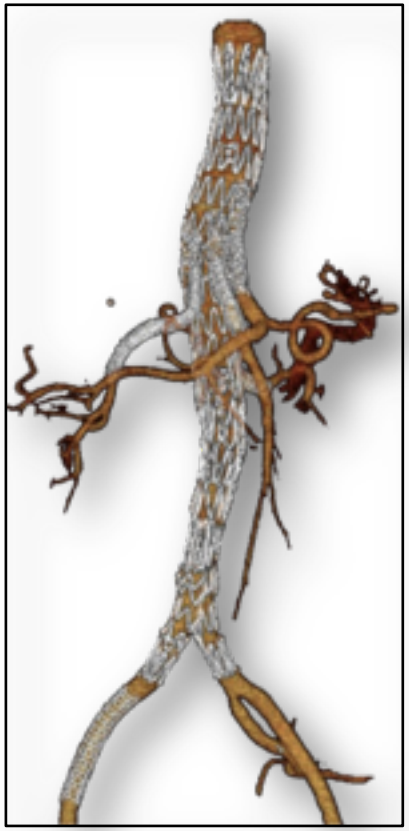
TEVAR covering only the proximal entry tear has proven to be insufficient in most patients with chronic PDAA and has a limited role only for PDAA with distal sealing zone in the thoracic aorta.

Marques De Marino P, Oikonomou K, Verhoeven E et al, Techniques and outcomes of secondary endovascular repair for post-dissection Thoracic/thoracoabdominal aortic aneurysms. J Cardiovsc Surg. 2018

FEVAR/BEVAR

Fenestrated and branched stent-grafts have been used lately in some expert centres to treat PDAA of the thoracoabdominal aorta with good preliminary results despite the technical difficulties in these patients (narrow true lumen, stiff chronic dissection flap, target vessels that originate from the false lumen (FL).



Marques De Marino P, Oikonomou K, Verhoeven E et al, Techniques and outcomes of secondary endovascular repair for post-dissection Thoracic/thoracoabdominal aortic aneurysms. J Cardiovsc Surg. 2018

Fenestrated and branched endovascular aortic repair for chronic type B aortic dissection with thoracoabdominal aneurysms

Atsushi Kitagawa, MD,[a] Roy K. Greenberg, MD,[a,b] Matthew J. Eagleton, MD,[a] Tara M. Mastracci, MD,[a] and Eric E. Roselli, MD,[b] *Cleveland, Ohio*

J Vasc Surg 2013;58:625-34.

Article in Press

Early Experience of Endovascular Repair of Post-dissection Aneurysms Involving the Thoraco-abdominal Aorta and the Arch

R. Spear, J. Sobocinski, N. Settembre, M.R. Tyrrell, S. Malikov, B. Maurel, S. Haulon

Eur J Vasc Endovasc Surg (2015) ■, 1—10

Outcomes of Fenestrated/Branched Endografting in Post-dissection Thoracoabdominal Aortic Aneurysms

K. Oikonomou [a,b], R. Kopp [a], A. Katsargyris [a], K. Pfister [a], E.L. Verhoeven [b], P. Kasprzak [a,*]

Eur J Vasc Endovasc Surg (2014) 48, 641—648

Placement of a branched stent graft into the false lumen of a chronic type B aortic dissection

Dominic Simring, FRACS (Vasc), Jowad Raja, MRCS, FRCR, Luke Morgan-Rowe, BS, MBBS, Julian Hague, BS, MBBS, MRCS, FRCR, Peter L. Harris, MD, and Krassi Ivancev, MD, PhD, *London, United Kingdom*

J Vasc Surg 2011;54:1784-7.

Editor's Choice — The Impact of Early Pelvic and Lower Limb Reperfusion and Attentive Peri-operative Management on the Incidence of Spinal Cord Ischemia During Thoracoabdominal Aortic Aneurysm Endovascular Repair

B. Maurel [a], N. Delclaux [a], J. Sobocinski [a], A. Hertault [a], T. Martin-Gonzalez [a], M. Moussa [a], R. Spear [a], M. Le Roux [a], R. Azzaoui [a], M. Tyrrell [b], S. Haulon [a,*]

[a] Aortic Centre, Hôpital Cardiologique, CHRU de Lille, INSERM U1008, Université Lille Nord de France, 59037 Lille Cedex, France
[b] King's Health Partners, London, UK

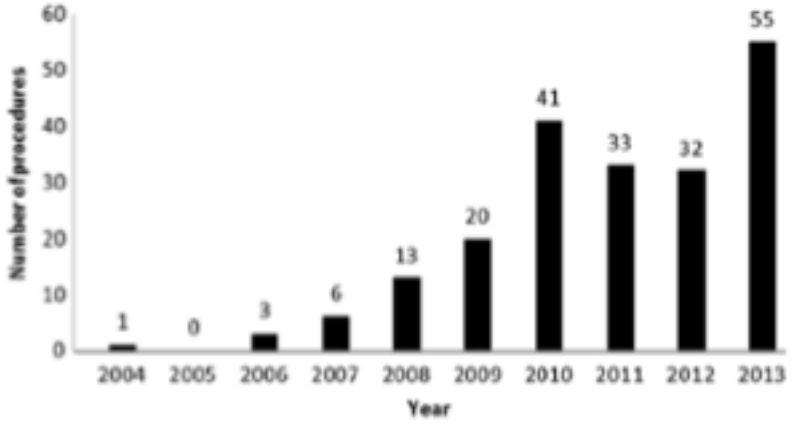


Figure 1. Number of patients treated annually.

Table 2. Thirty day complication rates.

	Total ($n = 204$)	Group 1 ($n = 43$)	Group 2 ($n = 161$)	RR (95% CI)	p
Major complications	54 (26.5)	15 (34.9)	39 (24.2)	1.1637 (0.9195–1.4728)	.11
Spinal cord ischemia	8 (3.9)	6 (14.0)	2 (1.2)	1.1477 (1.0163–1.2961)	<.01
30 day mortality	14 (6.9)	5 (11.6)	9 (5.6)	0.4807 (0.1699–1.3604)	.15
Minor complications	56 (27.5)	12 (27.9)	44 (27.3)	1.0080 (0.8181–1.2420)	.54

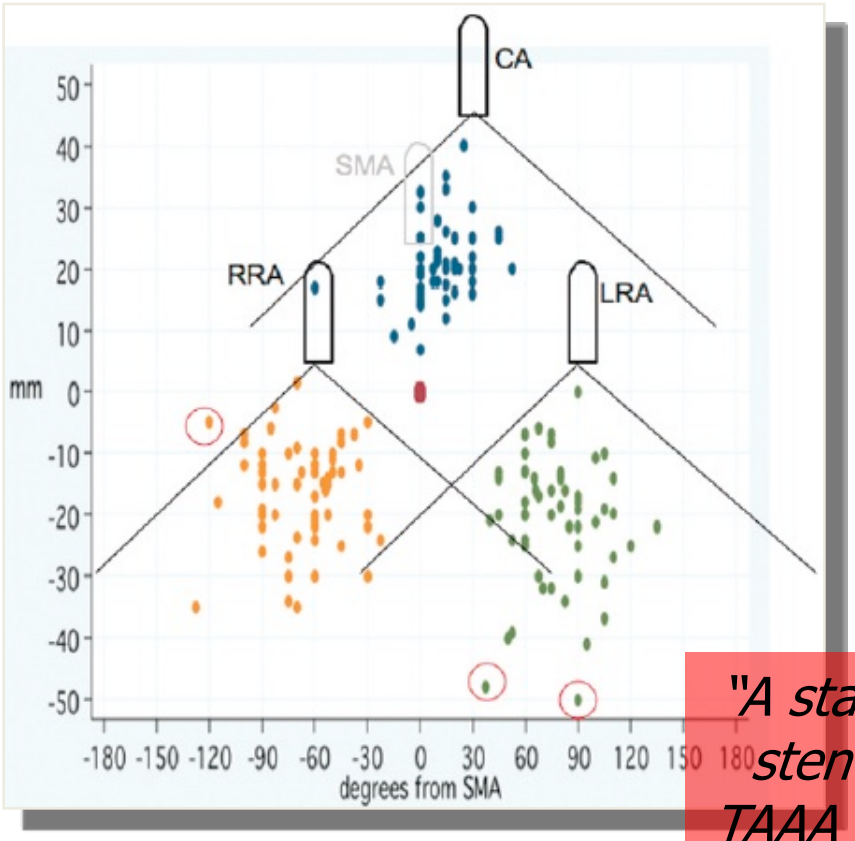
Note. Values are given as n (%). RR = relative risk; CI = confidence interval.

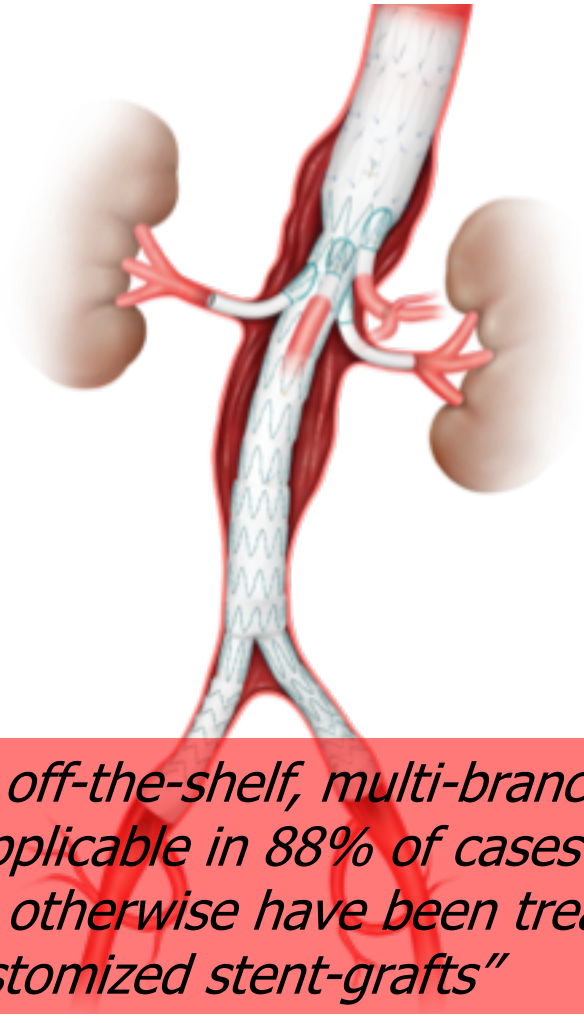
Eur J Vasc Endovasc Surg 2015

A Standardized Multi-Branched Thoracoabdominal Stent-Graft for Endovascular Aneurysm Repair

Matthew P. Sweet, MD, MS[1]; Jade S. Hiramoto, MD[1]; Ki-Hyuk Park, MD, PhD[2]; Linda M. Reilly, MD[1]; and Timothy A.M. Chuter, DM[1]

J ENDOVASC THER.
2009;16:359–364





"A standardized, off-the-shelf, multi-branched stent-graft is applicable in 88% of cases of TAAA that would otherwise have been treated using customized stent-grafts"

FEVAR/BEVAR

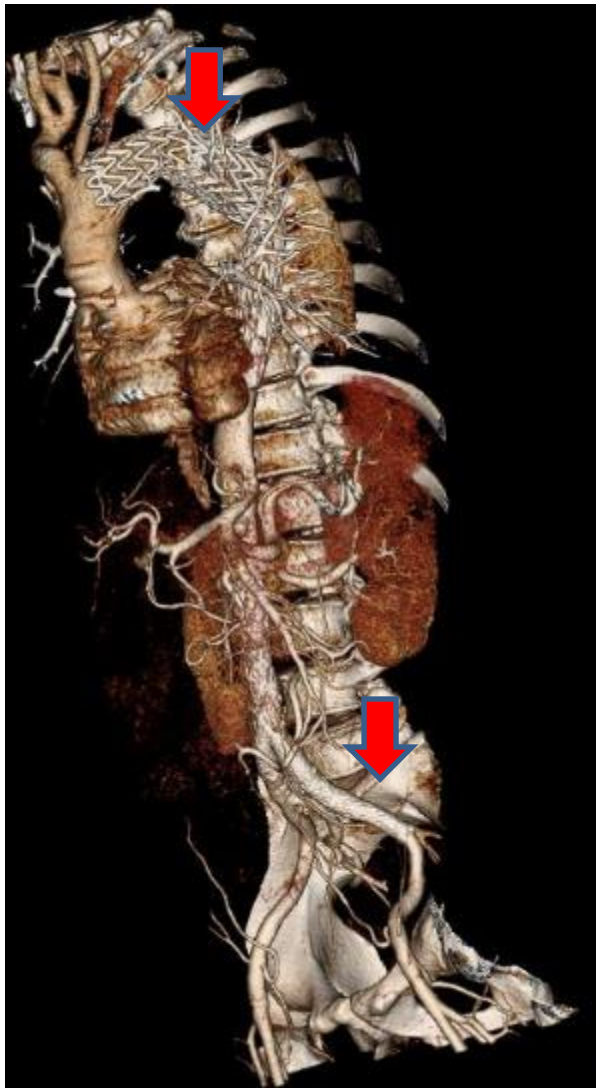
Technical Issues:

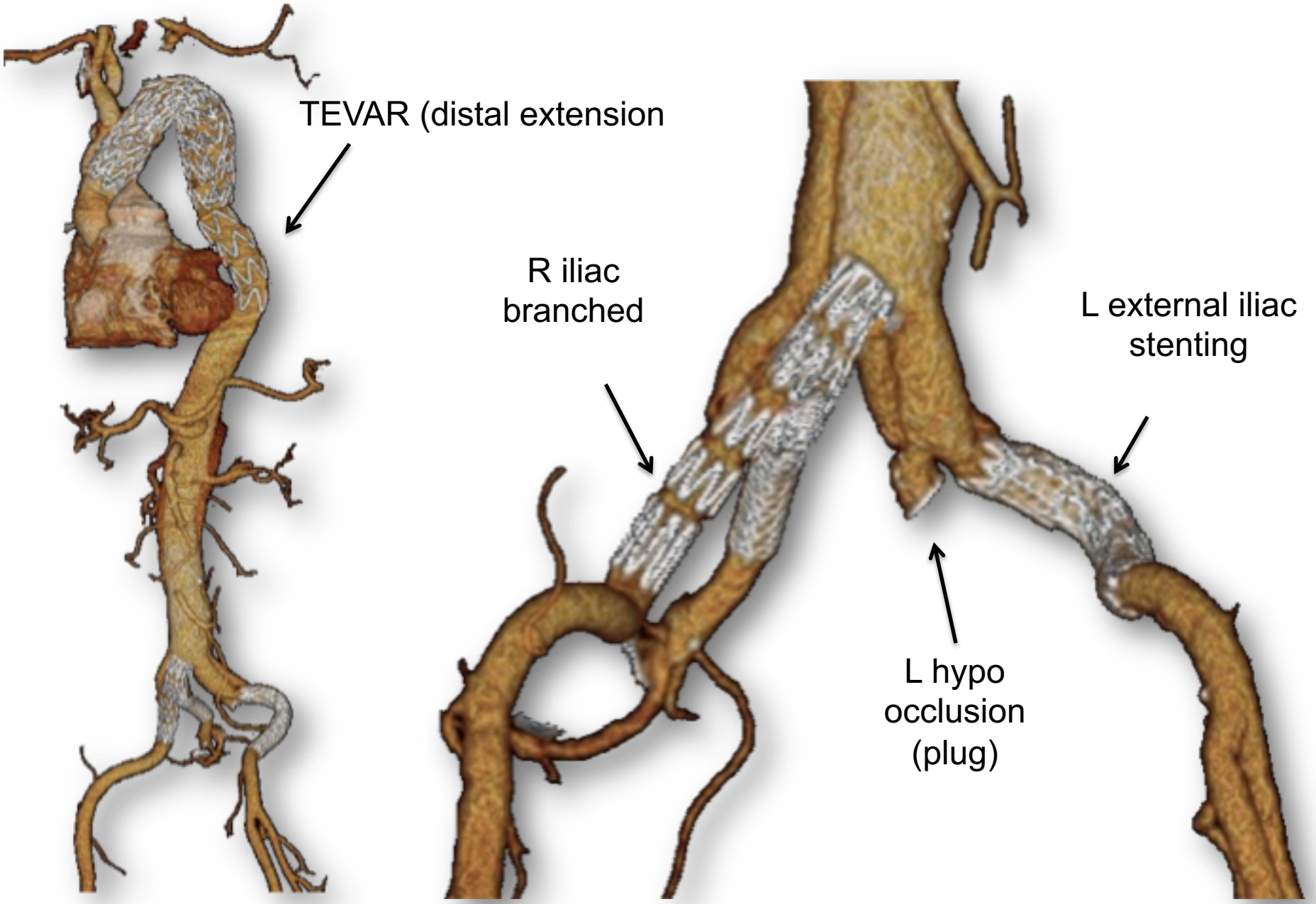
- Extensive disease
- Small true lumen
- Visceral vessels from the false lumen
- Dissected visceral vessels
- Occluded / dissected access arteries

FEVAR/BEVAR

Technical Issues:

- **Extensive disease**
- Small true lumen
- Visceral vessels from the false lumen
- Dissected visceral vessels
- Occluded / dissected access arteries




TEVAR (distal extension
R iliac branched
L external iliac stenting
L hypo occlusion (plug)

FEVAR/BEVAR

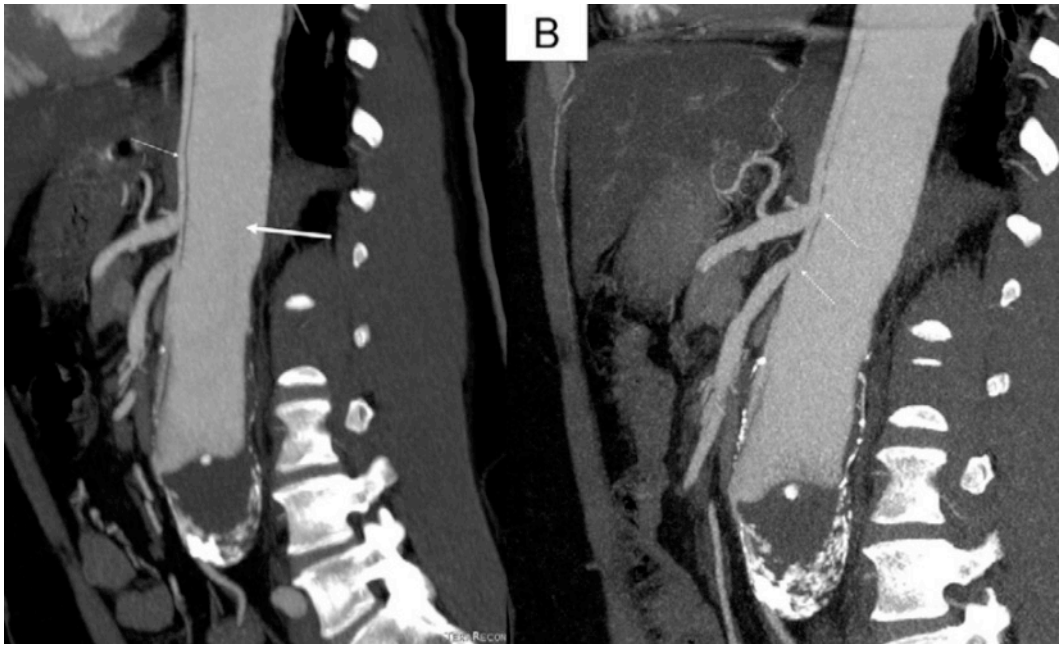
Technical Issues:

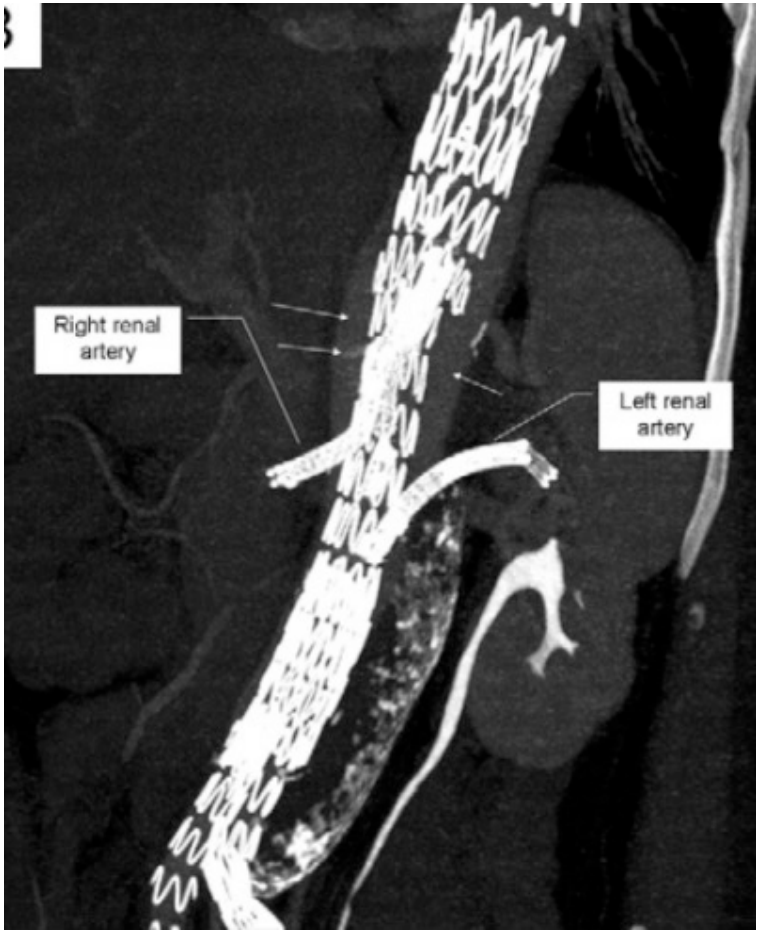
- Extensive disease
- **Small true lumen**
- Visceral vessels from the false lumen
- Dissected visceral vessels
- Occluded / dissected access arteries

Placement of a branched stent graft into the false lumen of a chronic type B aortic dissection

Dominic Simring, FRACS (Vasc), Jowad Raja, MRCS, FRCR, Luke Morgan-Rowe, BS, MBBS, Julian Hague, BS, MBBS, MRCS, FRCR, Peter L. Harris, MD, and Krassi Ivancev, MD, PhD, *London, United Kingdom*

J Vasc Surg 2011;54:1784-7.



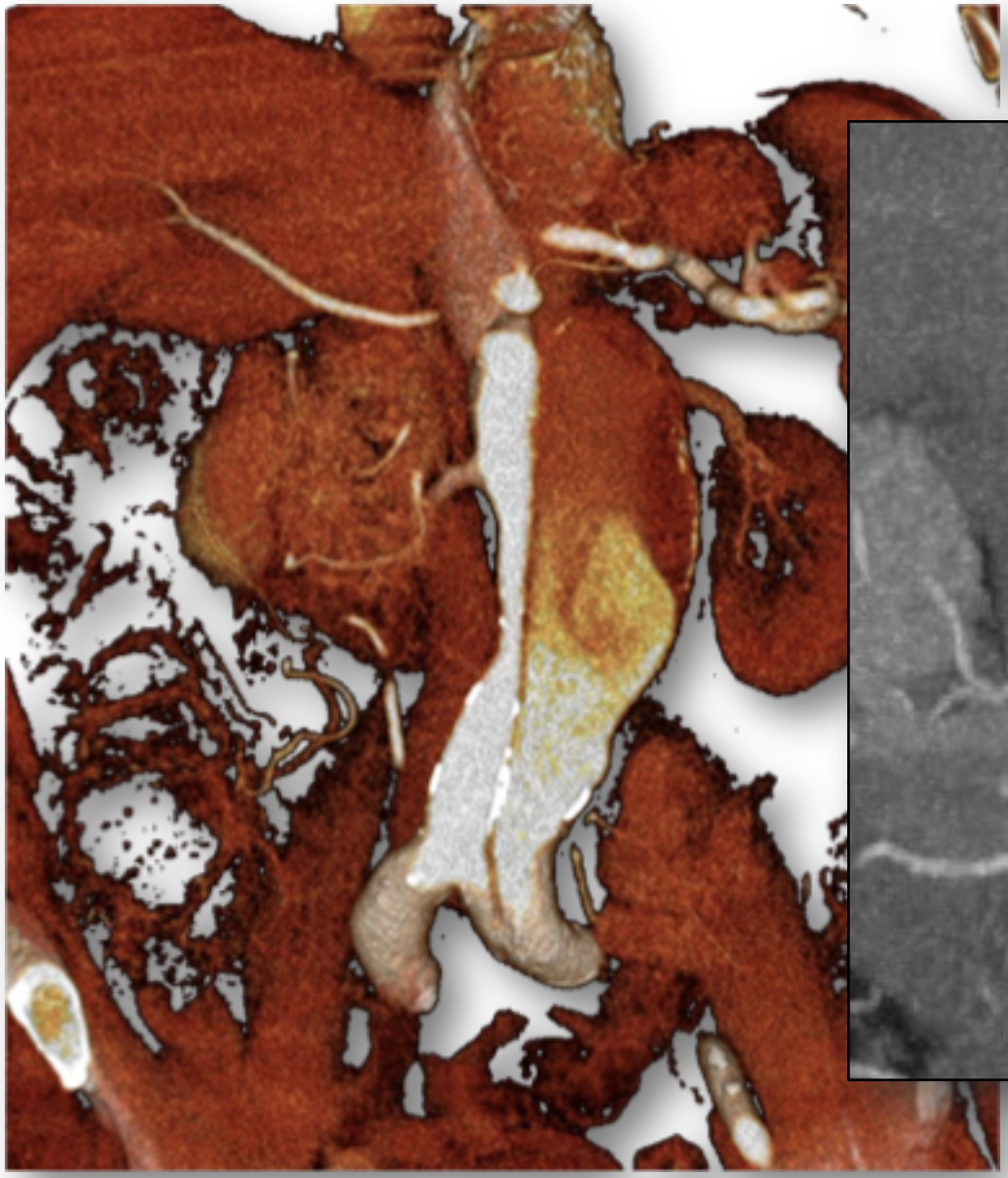


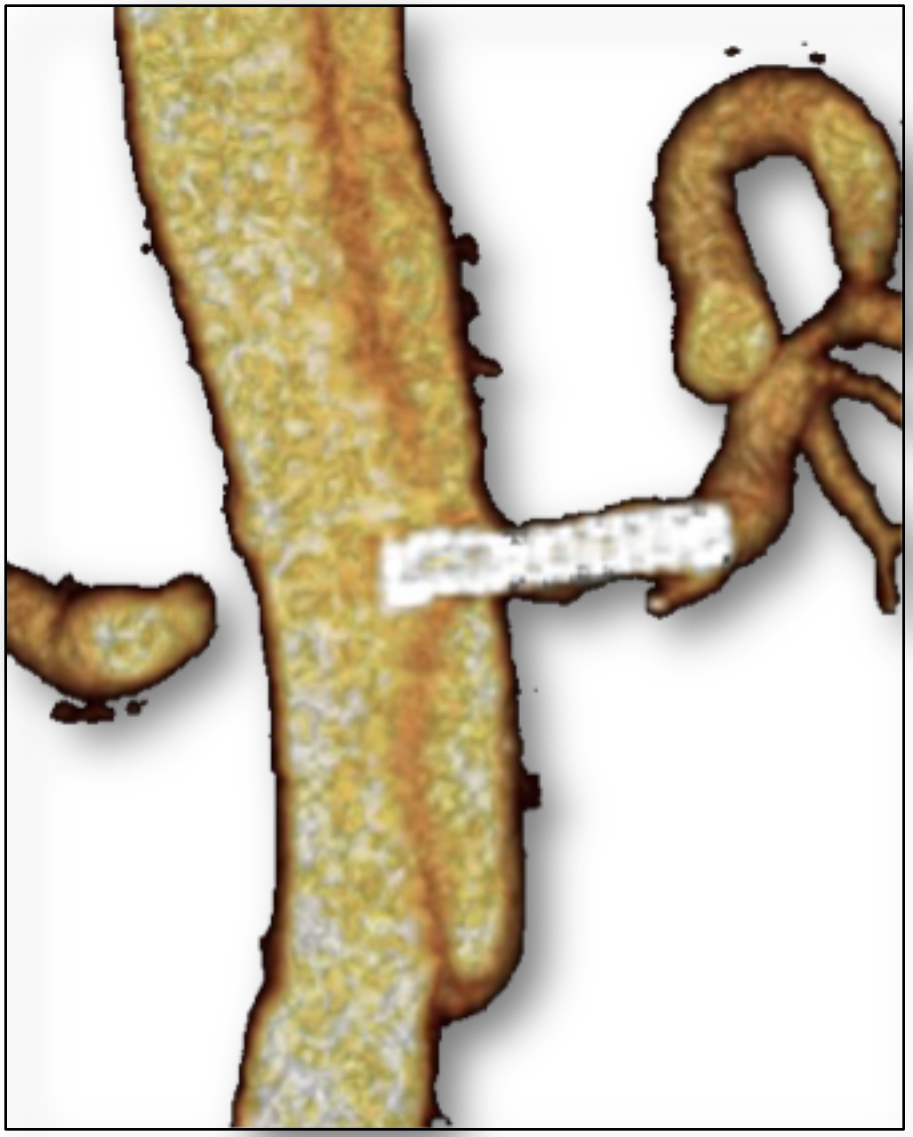
FEVAR/BEVAR

Technical Issues:

- Extensive disease
- Small true lumen
- **Visceral vessels from the false lumen**
- Dissected visceral vessels
- Occluded / dissected access arteries

Branch arising from the false lumen

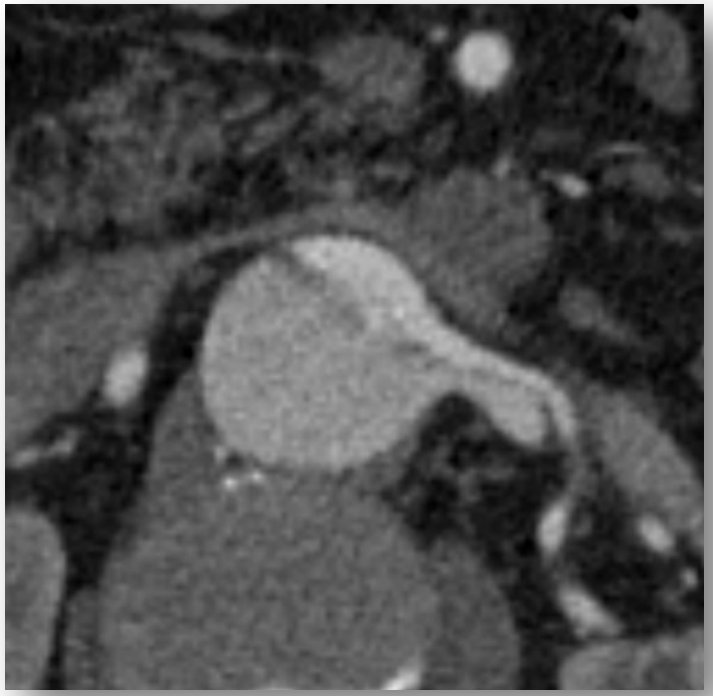


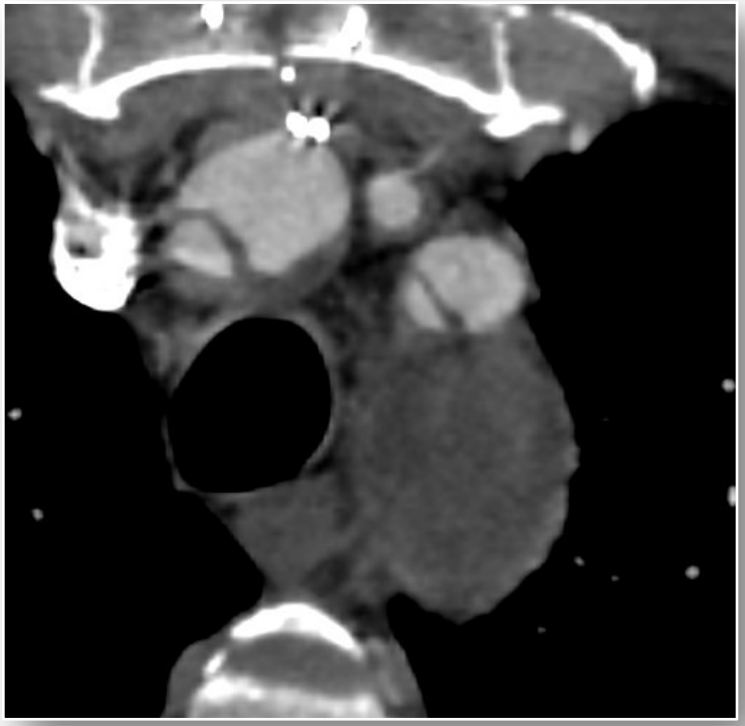


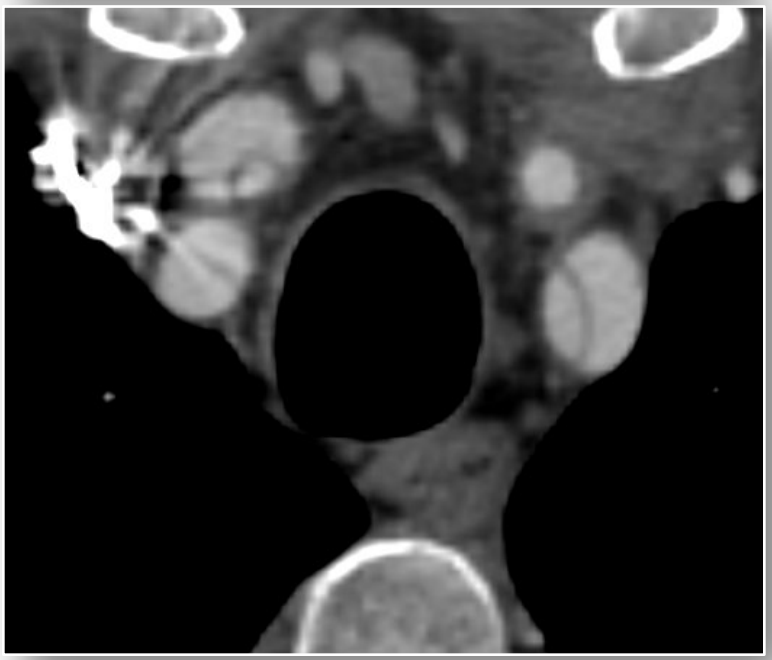
FEVAR/BEVAR

Technical Issues:

- Extensive disease
- Small true lumen
- Visceral vessels from the false lumen
- **Dissected visceral vessels**
- **Occluded / dissected access arteries**







PETTICOAT
(Provisional ExTension To Induce COmplete ATtachement)

This technique may be employed during endovascular treatment of type B aortic dissection (TBD) using self-expandable bare stents distal to the covered stent graft placed over the proximal entry tear

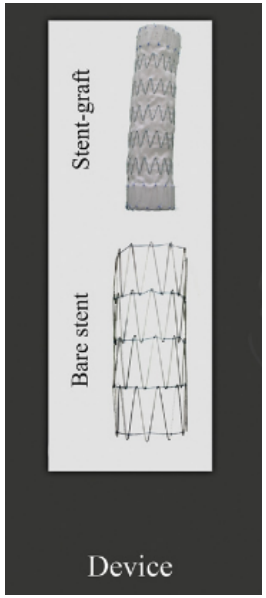
Conclusion
A significant immediate increase in TL could be achieved with resolution of all cases of dynamic malperfusion and TL collapse

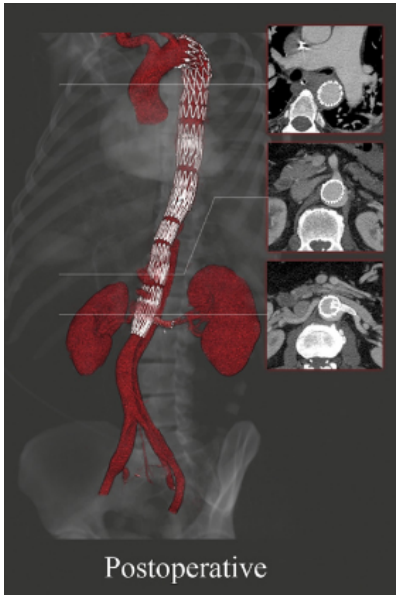
Volume changes in aortic true and false lumen after the "PETTICOAT" procedure for type B aortic dissection

Germano Melissano, MD,[a] Luca Bertoglio, MD,[a] Enrico Rinaldi, MD,[a] Efrem Civilini, MD,[a] Yamume Tshomba, MD,[a] Andrea Kahlberg, MD,[a] Eustachio Agricola, MD,[b] and Roberto Chiesa, MD,[a] *Milan, Italy*

JVS 2012

PETTICOAT
(Provisional ExTension To Induce COmplete ATtachement)



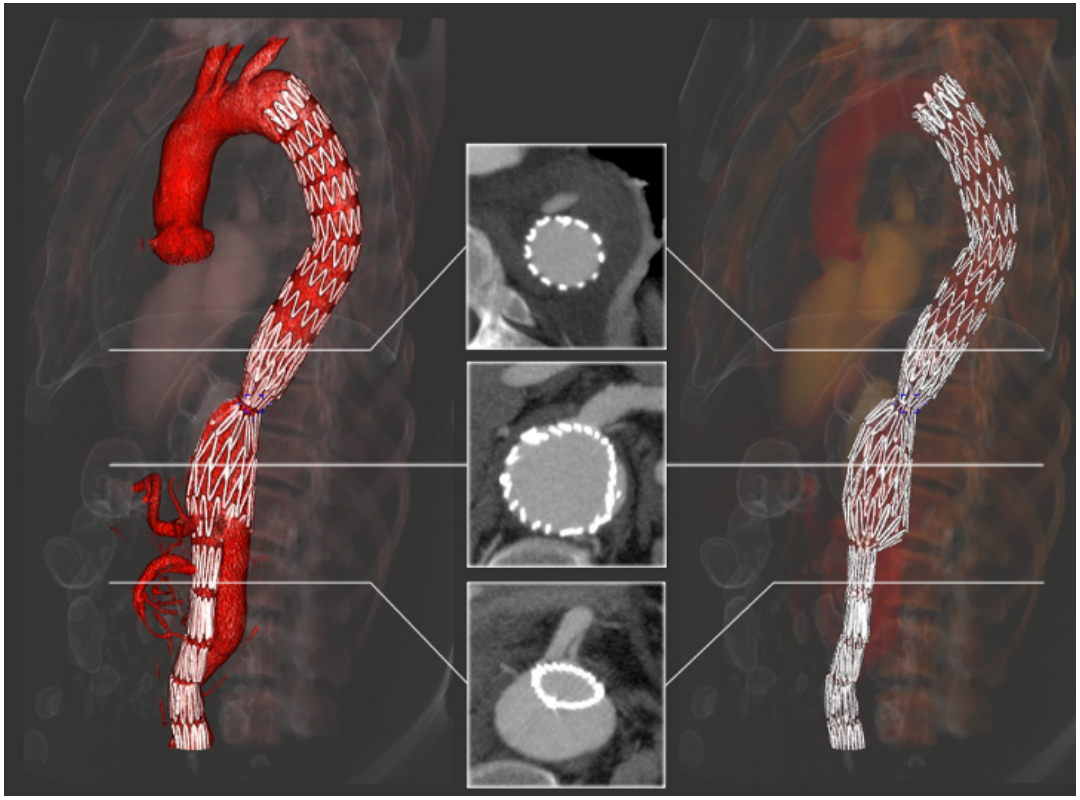


Volume changes in aortic true and false lumen after the "PETTICOAT" procedure for type B aortic dissection

Germano Melissano, MD,[a] Luca Bertoglio, MD,[a] Enrico Rinaldi, MD,[a] Efrem Civilini, MD,[a] Yamume Tshomba, MD,[a] Andrea Kahlberg, MD,[a] Eustachio Agricola, MD,[b] and Roberto Chiesa, MD,[a] *Milan, Italy*

JVS 2012

PETTICOAT
(Provisional ExTension To Induce COmplete ATtachement)



Volume changes in aortic true and false lumen after the "PETTICOAT" procedure for type B aortic dissection

Germano Melissano, MD,[a] Luca Bertoglio, MD,[a] Enrico Rinaldi, MD,[a] Efrem Civilini, MD,[a] Yamume Tshomba, MD,[a] Andrea Kahlberg, MD,[a] Eustachio Agricola, MD,[b] and Roberto Chiesa, MD,[a] *Milan, Italy*

JVS 2012

PETTICOAT
(provisional extension to induce complete attachement)

Analysis of the literature data, not only does it demonstrate that the PETTICOAT technique is safe and feasible but also that it is able to enhance the effect of the proximal TEVAR improving the re-expansion of the true lumen of the distal thoracoabdominal aorta possibly improving end-organ perfusion.

However, since there is no evidence of improved short and mid-term survival as well as positive remodelling of the false lumen in the distal aorta, when compared to a simple proximal stent-grafting, a widespread use of the PETTICOAT technique is not justified and it should be limited to cases complicated by dynamic malperfusion as a bailout adjunctive tool.

J Cardiovasc Surg (Torino) 2017 **The Petticoat concept for endovascular treatment of Type B aortic dissection.**
Bertoglio L, Rinaldi E, Melissano G et al

STABILISE

(Stent-Assisted Ballon-Induced Intimal Disruption and Relamination in Aortic Dissection Repair)

The STABILISE concept was first described in 2014 by Hof-ferberth et al. as Stent assisted Balloon induced intimal Disruption and relamination in aortic dissection repair"
This technique has been developed as an adjunct of the staged total aortic and branch vessel endovascular (STABLE) reconstruction technique (or PETTICOAT technique)
which consists of bare stent deployment distal to the stent graft to induce remodelling of the distal dissected aorta while preserving the visceral branch arteries and the Adamkiewicz artery.

Where the STABLE technique mid-term results showed a 75% false lumen perfusion rate despite extensive distal aortic repair, STABILISE aimed to achieve false lumen elimination and immediate restoration of uniluminal thoraco-abdominal aortic flow by balloon inflation of the bare aortic stent.

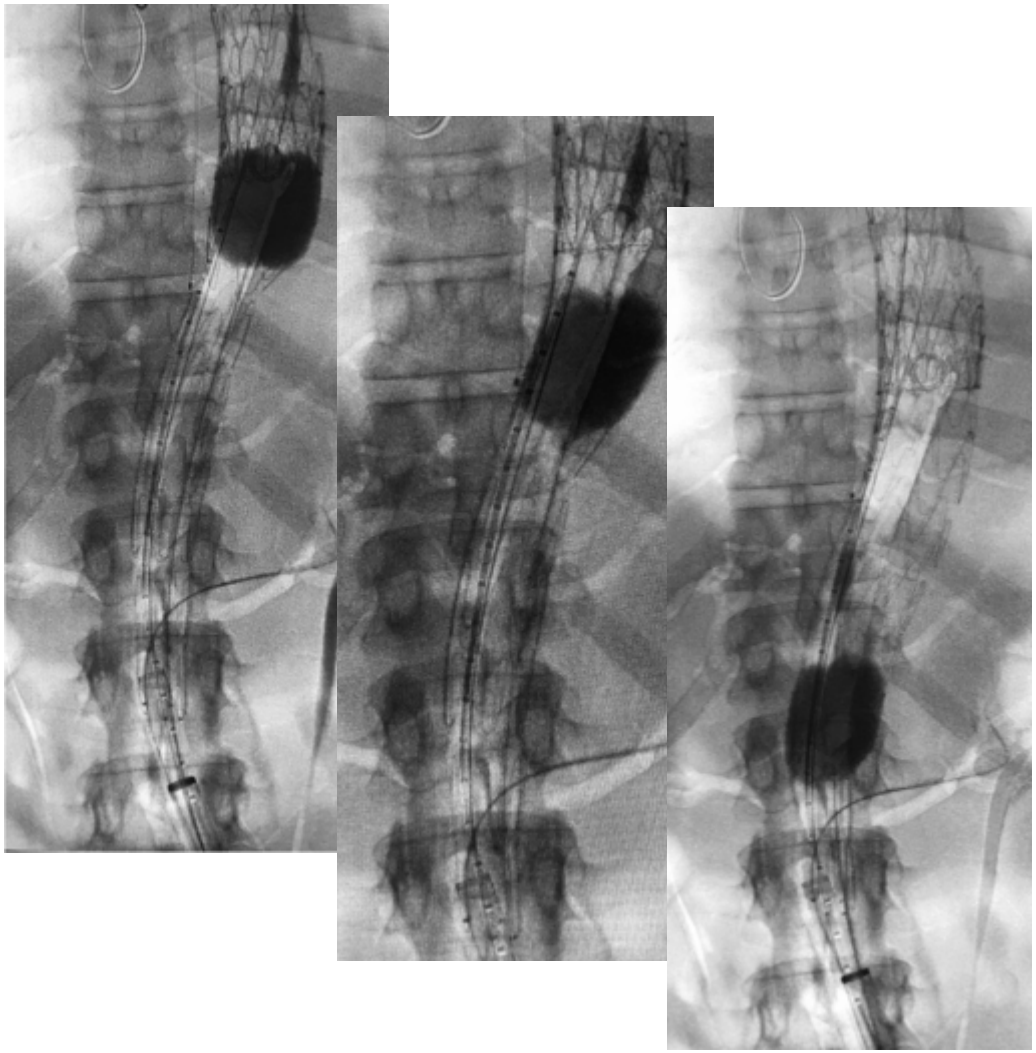
Elsa M. Faure [a,b,c,*], Salma El Batti [a,c], Marwan Abou Rjeili [a], Pierre Julia [a], Jean-Marc Alsac [a,c]

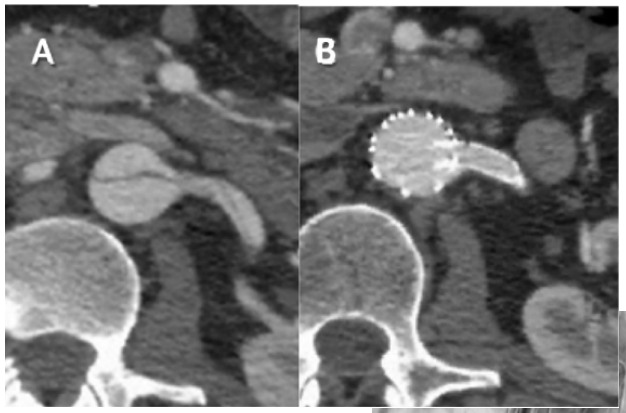
Mid-term Outcomes of Stent Assisted Balloon Induced Intimal Disruption and Relamination in Aortic Dissection Repair (STABILISE) in Acute Type B Aortic Dissection

Eur J Vasc Endovasc Surg (2018)

STABILISE

(Stent-Assisted Ballon-Induced Intimal Disruption and Relamination in Aortic Dissection Repair)





STABILISE

(Stent-Assisted Ballon-Induced Intimal Disruption and Relamination in Aortic Dissection Repair)

Complete false lumen obliteration and aortic remodelling was obtained in all patients at the thoraco-abdominal level, and in 39% (n = 16) at the unstented infrarenal aorto-iliac level.
The maximum aortic diameter increased in only two patients (5%) at the unstented infrarenal level.

CONCLUSION:
To obtain immediate and durable thoraco-abdominal aortic remodelling in acute type B dissections, the STABILISE technique is safe and reproducible while not compromising the patency of collateral branches

Elsa M. Faure [a,b,c,*], Salma El Batti [a,c], Marwan Abou Rjeili [a], Pierre Julia [a], Jean-Marc Alsac [a,c]

Mid-term Outcomes of Stent Assisted Balloon Induced Intimal Disruption and Relamination in Aortic Dissection Repair (STABILISE) in Acute Type B Aortic Dissection

Eur J Vasc Endovasc Surg (2018)

FALSE LUMEN EMBOLISATION

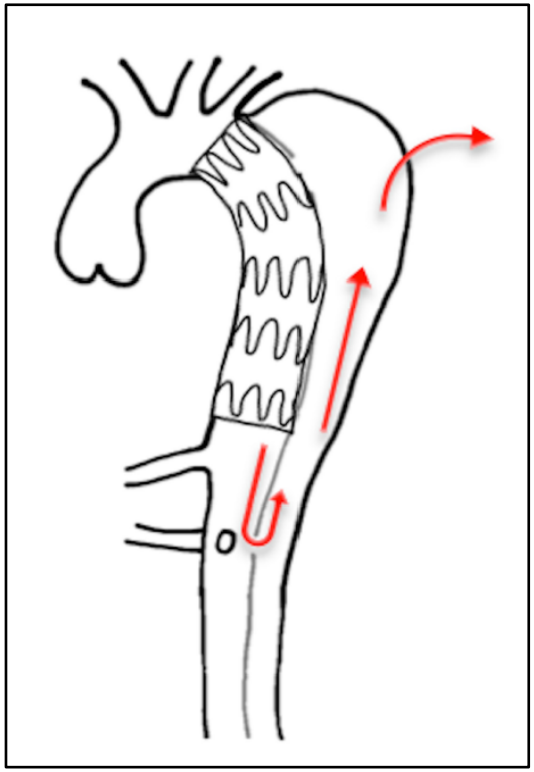
Endovascular strategies have been increasingly used for the treatment of chronic type B aortic dissection (cTBAD) offering better outcomes in terms of mortality and morbidity compared to open surgical repair.

Aortic remodeling after standard TEVAR is less likely in cTBAD due to rigidity of the dissection membrane.

Another limition of endovascular therapy is continued retrograde false lumen perfusion with back-flow from distal entry tears.

Treatment strategies in cTBAD should aim at false lumen thrombosis. There are many approaches to achieve this goal of false lumen thrombosis, but concepts as open surgery or fenestrated and branched endovascular repair are limited by either high technical and logistic demands to the surgeon or high rates of mortality and morbidity.

False lumen embolization techniques offer less invasive treatment strategies with promising early results.



Techniques and outcomes of false lumen embolization in chronic Type B aortic dissection
Fiona ROHLFFS, Konstantinos SPANOS, Nikolaos TSILIMPARIS, Eike Sebastian DEBUS, Tilo KöLBEL J Cardiovasc Surg 2018

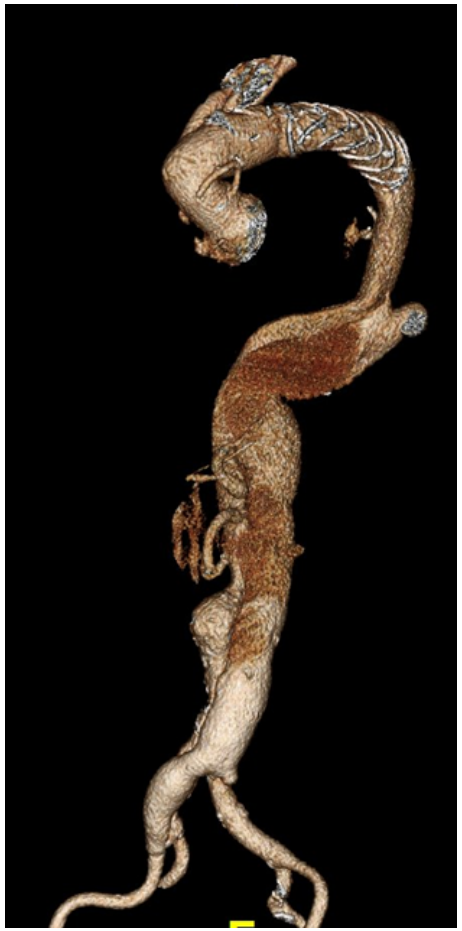
FALSE LUMEN EMBOLISATION

Techniques for direct false lumen embolisation:

- the “cork in the bottle neck” Technique

- the Candy-Plug Technique

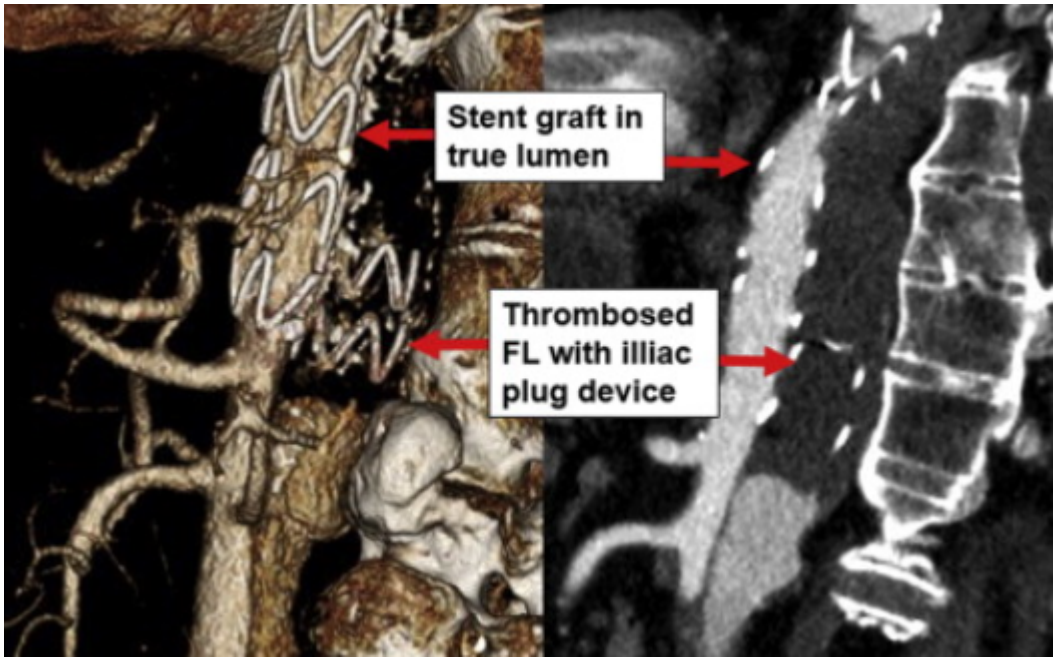
- the Knickerbocker Technique



Techniques and outcomes of false lumen embolization in chronic Type B aortic dissection
Fiona ROHLFFS, Konstantinos SPANOS, Nikolaos TSILIMPARIS, Eike Sebastian DEBUS, Tilo KöLBEL J Cardiovasc Surg 2018

FALSE LUMEN EMBOLISATION
"Cork in the bottle neck Technique"

The was first described by Loubert et al in 2003 as the "cork in the bottle neck" strategy, using cava filters, detachable balloons, thrombin and Talent occluders into the false lumen to interrupt back-flow at the level of the distal descending thoracic aorta.



Techniques and outcomes of false lumen embolization in chronic Type B aortic dissection
Fiona ROHLFFS, Konstantinos SPANOS, Nikolaos TSILIMPARIS, Eike Sebastian DEBUS, Tilo KöLBEL J Cardiovasc Surg 2018

FALSE LUMEN EMBOLISATION
"Cork in the bottle neck Technique"

To advance this strategy Hofferberth et al described the additional use of **coils and cyanoacrylate glue** followed by Idrees et al. who reported on 21 patients with chronic thoraco-abdominal aortic dissection using iliac occluders to embolize the false lumen. Idrees describes a 100% technical success rate and false lumen thrombosis in all patients at a median follow-up of 25 months.

Roselli et al. demonstrate **the use of a 24 mm iliac occluder,** which was first deployed into a18 F sheath to gain sufficient lengths of the delivery system as the standard delivery system was too short. Then the dilator tip of the sheath was cut so that it could be used as a pusher for deployment of the iliac occluder at the intended level into the false lumen. As the false lumen diameter was larger and back-flow not sufficiently sealed by the first device a second occluder was placed using the same technique.

Mendes et al**. used several plugs** with diameters of 18 – 22 mm to fill the false lumen and Wojtaszek et al. published sealing of a single distal entry tear with an Amplatzer Vascular Plug with good outcome in two patients.

However, all these techniques are limited to patients with smaller false lumen diameters at the level of the diaphragm since the described materials for arterial embolization are not available for large diameters.

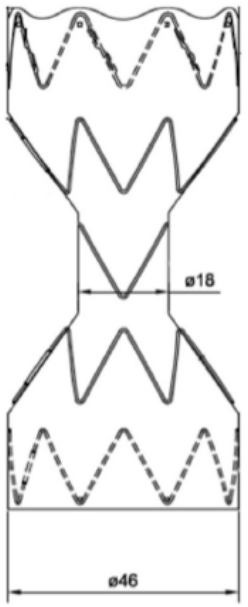
Techniques and outcomes of false lumen embolization in chronic Type B aortic dissection
Fiona ROHLFFS, Konstantinos SPANOS, Nikolaos TSILIMPARIS, Eike Sebastian DEBUS, Tilo KöLBEL J Cardiovasc Surg 2018

FALSE LUMEN EMBOLISATION
The Candy-Plug Technique

To overcome the problem of large false lumen diameters, the Candy-Plug Technique was first introduced by Kölbel et al. in 2013.

Back-table modification of a 42mm diameter Zenith TX2 ProForm thoracic stent-graft (Cook Medical, Bjaeverskov, Denmark) by placing a central diameter reducing suture in the middle of the graft **giving it a candy-wrapper shaped appearance was performed**. The Candy-Plug required a central opening to allow retrieval of the nose-cone of the introduction system, which could be closed using commercially available vascular plug devices. The initial back-table modified stent-graft has further been modified as a custom-made device (CMD), which is available in diameters up to 50 mm and a central midsection of 18 mm

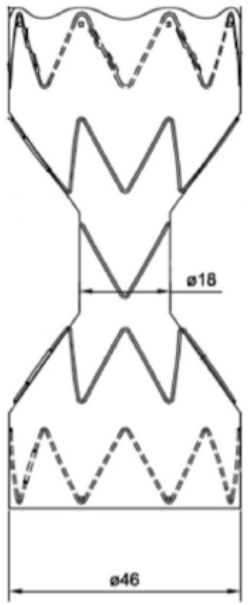
First generation Candy-Plug



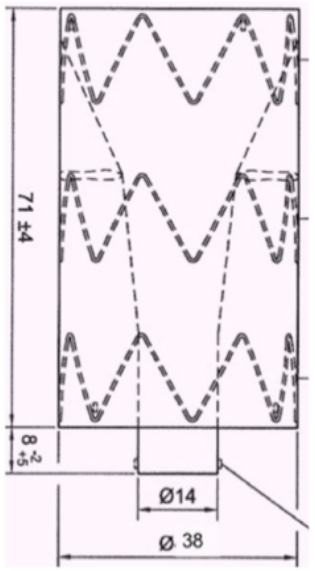
Techniques and outcomes of false lumen embolization in chronic Type B aortic dissection
Fiona ROHLFFS, Konstantinos SPANOS, Nikolaos TSILIMPARIS, Eike Sebastian DEBUS, Tilo KöLBEL J Cardiovasc Surg 2018

FALSE LUMEN EMBOLISATION
The Candy-Plug Technique

First generation Candy-Plug



Second generation Candy-Plug

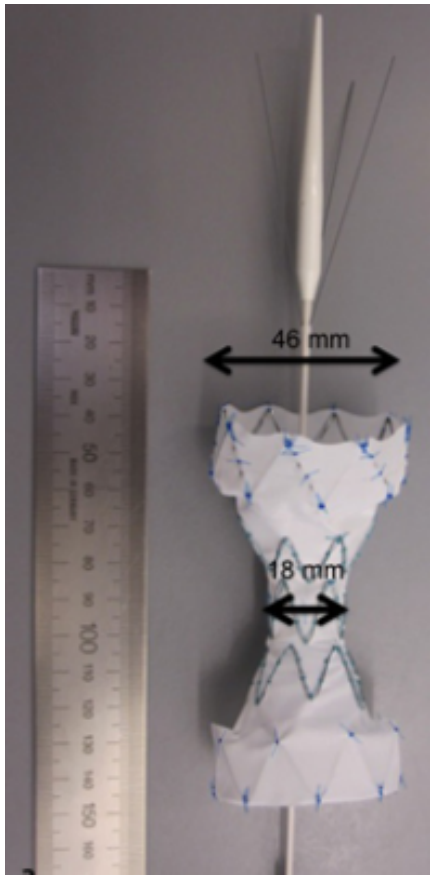


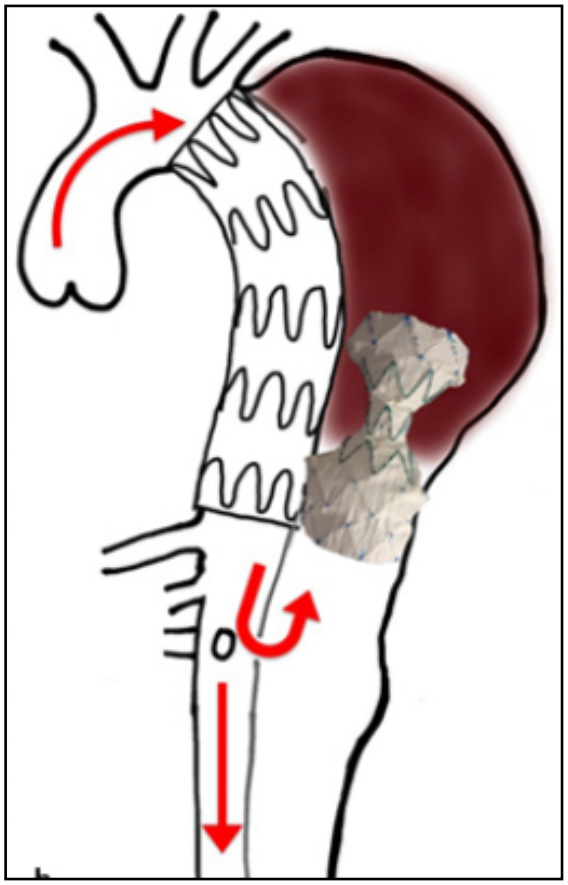
Different than the previous generation this Candy-Plug has a tubular appearance thereby increasing its sealing capability

Techniques and outcomes of false lumen embolization in chronic Type B aortic dissection
Fiona ROHLFFS, Konstantinos SPANOS, Nikolaos TSILIMPARIS, Eike Sebastian DEBUS, Tilo KöLBEL J Cardiovasc Surg 2018

FALSE LUMEN EMBOLISATION

The Candy-Plug Technique



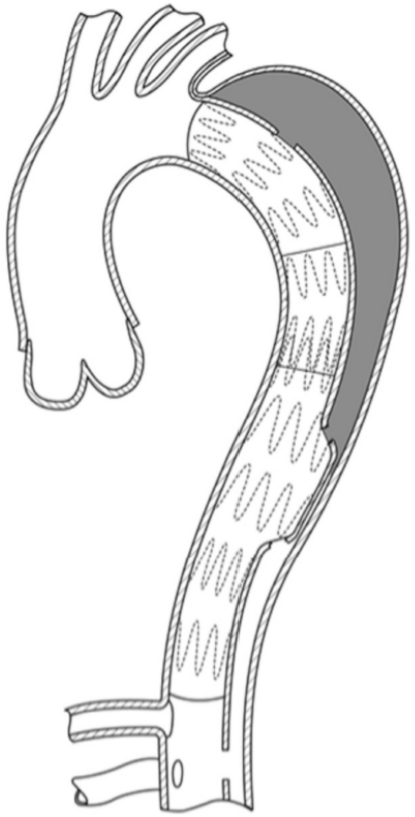


Techniques and outcomes of false lumen embolization in chronic Type B aortic dissection
Fiona ROHLFFS, Konstantinos SPANOS, Nikolaos TSILIMPARIS, Eike Sebastian DEBUS, Tilo KöLBEL J Cardiovasc Surg 2018

FALSE LUMEN EMBOLISATION
The Knickerbocker Technique

The Knickerbocker technique is an endovascular fenestration technique and does not require access to the false lumen nor additional materials to occlude the false lumen.

Its application consists of expanding a compliant balloon at the level of a large diameter stent-graft segment in the true lumen to rupture the dissection membrane into the false lumen at a limited segment of the aorta shortly above the celiac trunk.



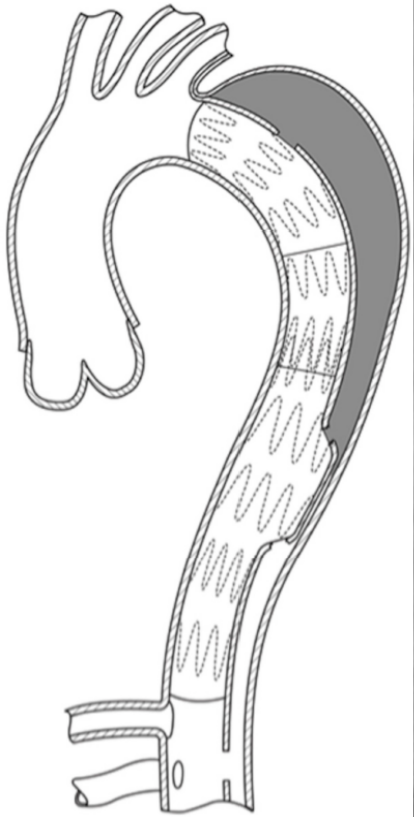
Techniques and outcomes of false lumen embolization in chronic Type B aortic dissection
Fiona ROHLFFS, Konstantinos SPANOS, Nikolaos TSILIMPARIS, Eike Sebastian DEBUS, Tilo KöLBEL J Cardiovasc Surg 2018

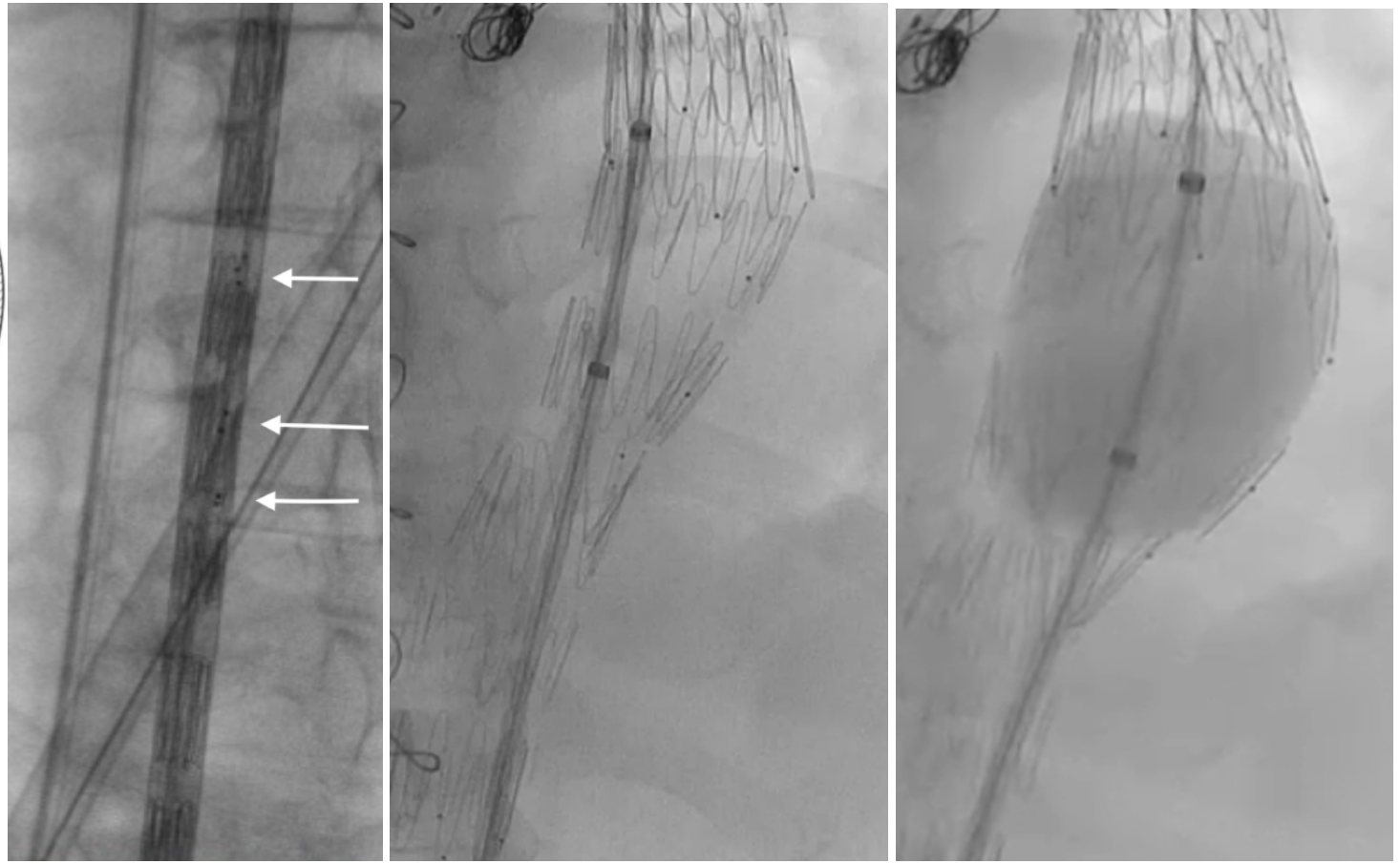
FALSE LUMEN EMBOLISATION
The Knickerbocker Technique

After an initial experience with using oversized standard tubular stent-grafts, the Knickerbocker-graft has been used as a custom-made unilateral double-tapered stent-grafts with a marked preformed bulbous section.
Gold-markers allow direction of the bulbous section towards the false lumen
The distal end of the Knickerbocker-graft is deployed just proximal to the celiac trunk. After orienting the bulbous section, which is marked with gold-markers, towards the false lumen the graft is deployed and a compliant balloon is used to dilate the bulbous section of the stent-graft until the dissection membrane ruptures at the targeted segment of the aorta. Now the oversized stent-graft expands into the false lumen sealing off false lumen backflow.
Proximally the graft should be positioned with sufficient overlap to a proximal stent-graft if required. The shape of the deployed stent-graft is similar to knickerbocker-trousers, which explains the denomination.

Techniques and outcomes of false lumen embolization in chronic Type B aortic dissection
Fiona ROHLFFS, Konstantinos SPANOS, Nikolaos TSILIMPARIS, Eike Sebastian DEBUS, Tilo KöLBEL J Cardiovasc Surg 2018

FALSE LUMEN EMBOLISATION
The Knickerbocker Technique





Techniques and outcomes of false lumen embolization in chronic Type B aortic dissection
Fiona ROHLFFS, Konstantinos SPANOS, Nikolaos TSILIMPARIS, Eike Sebastian DEBUS, Tilo KöLBEL J Cardiovasc Surg 2018

RUPTURE CASES

In treating post-dissection TAA, entry closure by TEVAR is sometimes insufficient, owing to persistent retrograde flow into the FL from abdominal or iliac re-entries.

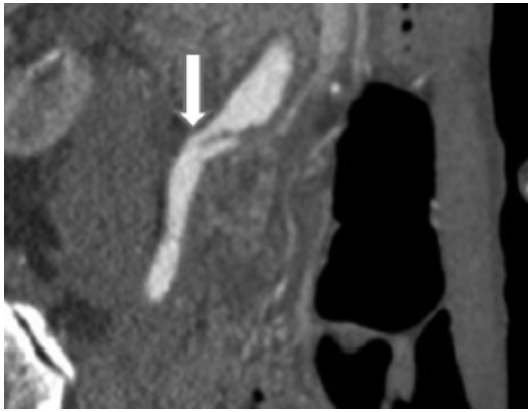
Adjunctive techniques are needed to close these distal re-entries to obtain complete FL exclusion, especially in rupture cases.

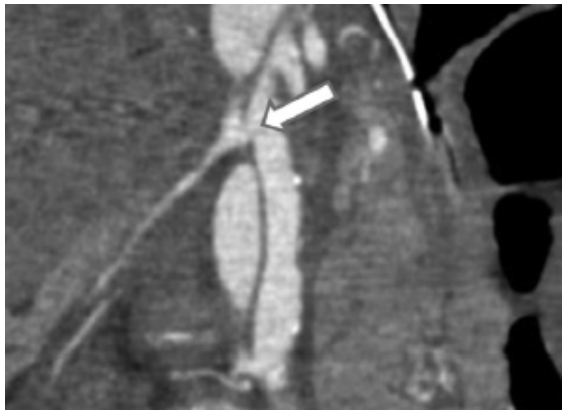
Recently, encouraging results of complete coverage of the thoraco-abdominal aorta with fenestrated or branched endografts have been reported.

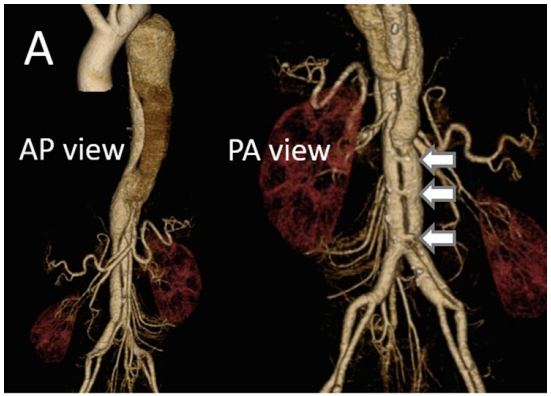
Multiple Re-entry Closures After TEVAR for Ruptured Chronic Post-dissection Thoraco-abdominal Aortic Aneurysm EJVES Short Reports (2018) 38, 15–18

R. Kinoshita [a], F. Ganaha [a,*], J. Ito [a], N. Ohyama [b], N. Abe [b], T. Yamazato [b], H. Munakata [b], K. Mabuni [b], T. Kugai [b]

Adjunctive techniques to close the distal re-entries to obtain complete FL exclusion in rupture cases





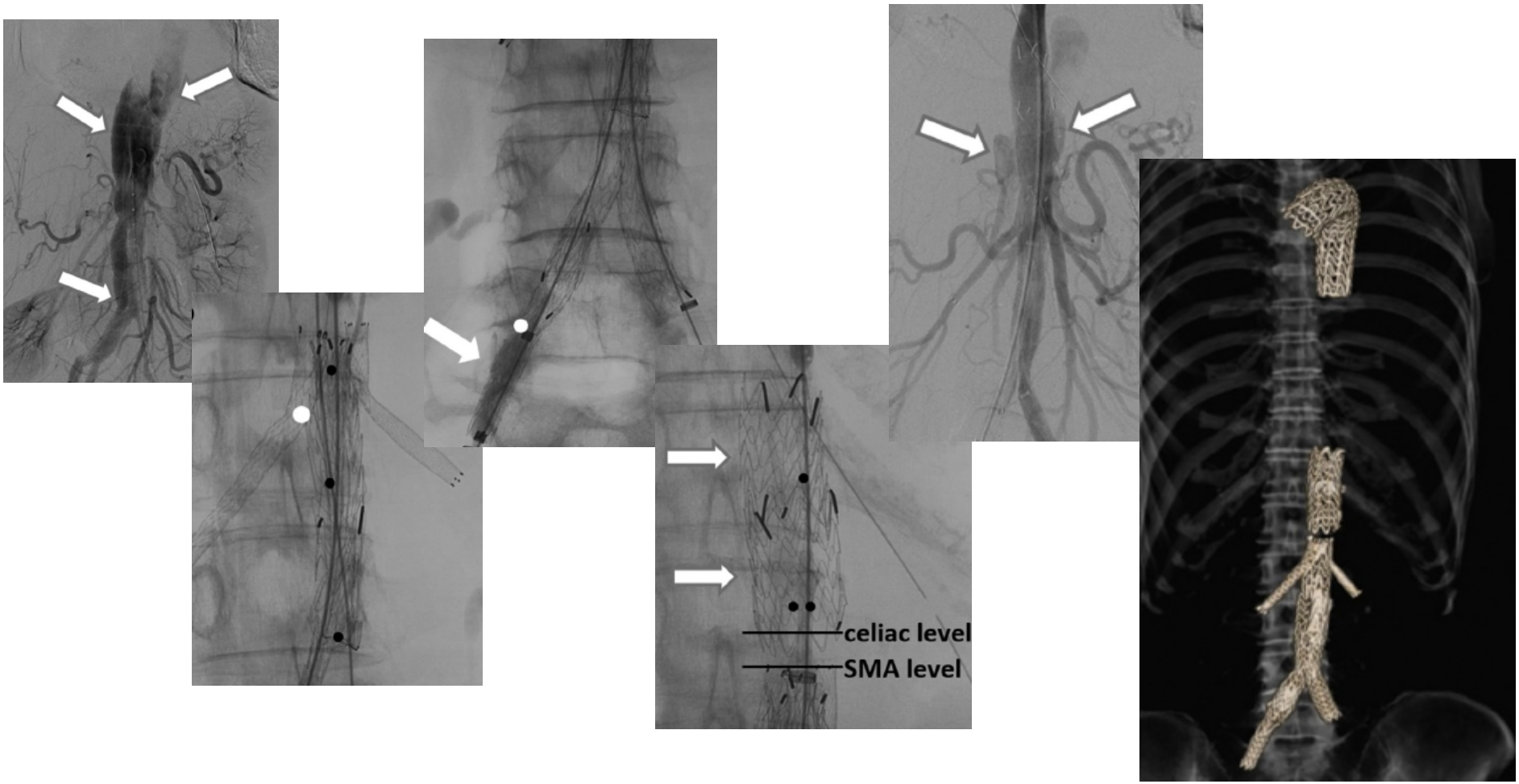


re-entry tears at the detached right lumbar arteries

Multiple Re-entry Closures After TEVAR for Ruptured Chronic Post-dissection Thoraco-abdominal Aortic Aneurysm EJVES Short Reports (2018) 38, 15–18

R. Kinoshita [a], F. Ganaha [a,*], J. Ito [a], N. Ohyama [b], N. Abe [b], T. Yamazato [b], H. Munakata [b], K. Mabuni [b], T. Kugai [b]

Adjunctive techniques to close the distal re-entries



Multiple Re-entry Closures After TEVAR for Ruptured Chronic Post-dissection Thoraco-abdominal Aortic Aneurysm EJVES Short Reports (2018) 38, 15–18

R. Kinoshita [a], F. Ganaha [a,*], J. Ito [a], N. Ohyama [b], N. Abe [b], T. Yamazato [b], H. Munakata [b], K. Mabuni [b], T. Kugai [b]

CONCLUSIONS

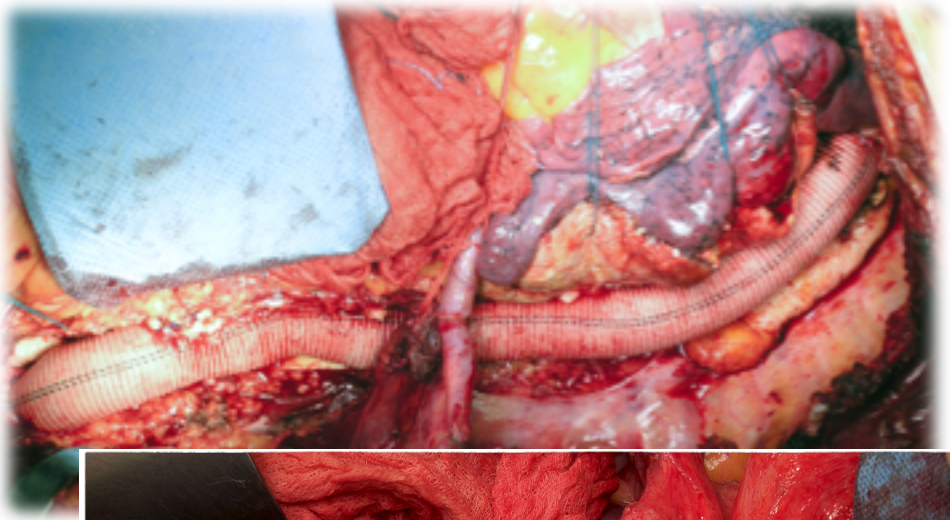
- Endovascular solutions for PDTAA/TAAA are widely applicable
- Sharp decrease in complications with experience & rigid protocols
- Open repair will remain, for very specific indications
- Extensive aneurysmal degeneration present specific challenges for endovascular treatment
- Early experiences with f/bTEVAR in dedicated centers show promising results

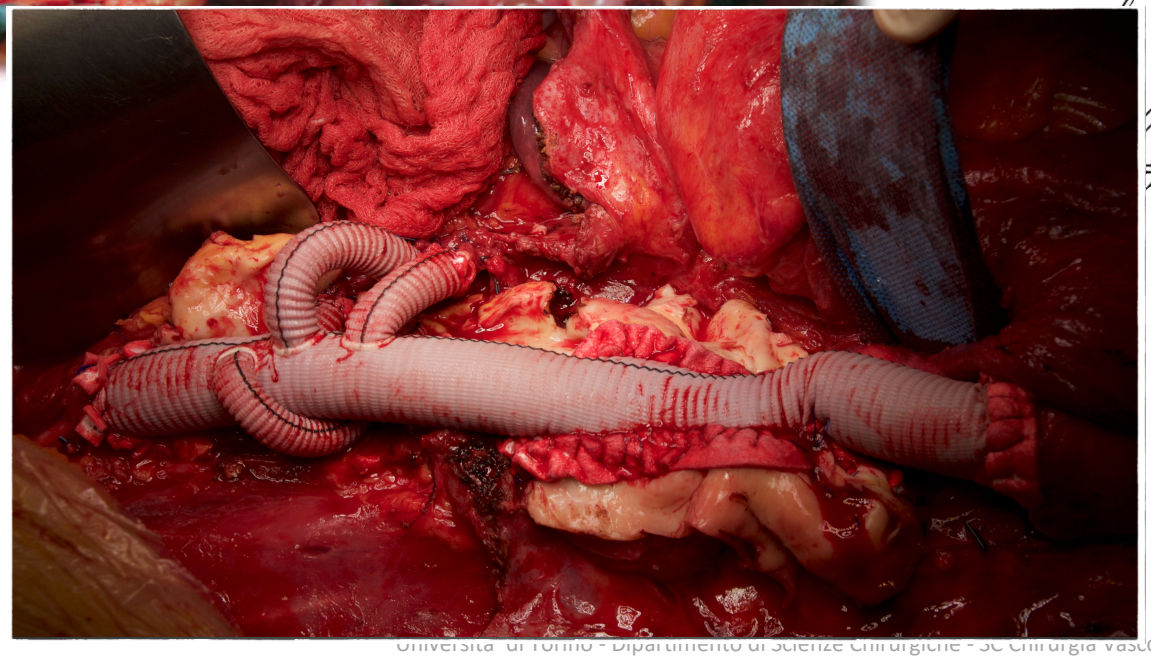
GRAZIE

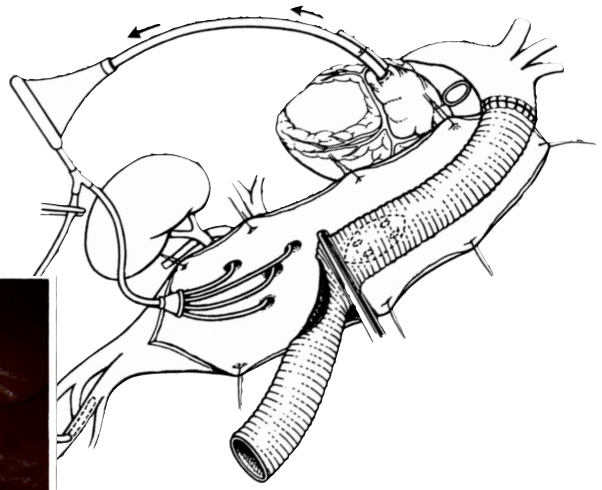
Conclusions

- Endovascular solutions for TAAA are widely applicable
- Sharp decrease in complications with experience & rigid protocols
- Open repair will remain, for very specific indications

OPEN AORTIC REPAIR







Several questions remain regarding the application of TEVAR to aneurysmal degeneration of chronic type B aortic

Circulation
Cardiovascular Interventions

American Heart Association.

Endovascular Repair of Type B Aortic Dissection: Long-term Results of the Randomized Investigation of Stent Grafts in Aortic Dissection Trial

Christoph A. Nienaber, Stephan Kische, Hervé Rousseau, Holger Eggebrecht, Tim C. Rehders, Guenther Kundt, Aenne Glass, Dierk Scheinert, Martin Czerny, Tilo Kleinfeldt, Burkhart Zipfel, Louis Labrousse, Rossella Fattori and Hüseyin Ince
for the INSTEAD-XL trial

Circ Cardiovasc Interv. 2013;6:407-416; originally published online August 6, 2013;
doi: 10.1161/CIRCINTERVENTIONS.113.000463
Circulation: Cardiovascular Interventions is published by the American Heart Association, 7272 Greenville Avenue, Dallas, TX 75231

Print ISSN: 1941-7640. Online ISSN: 1941-7632

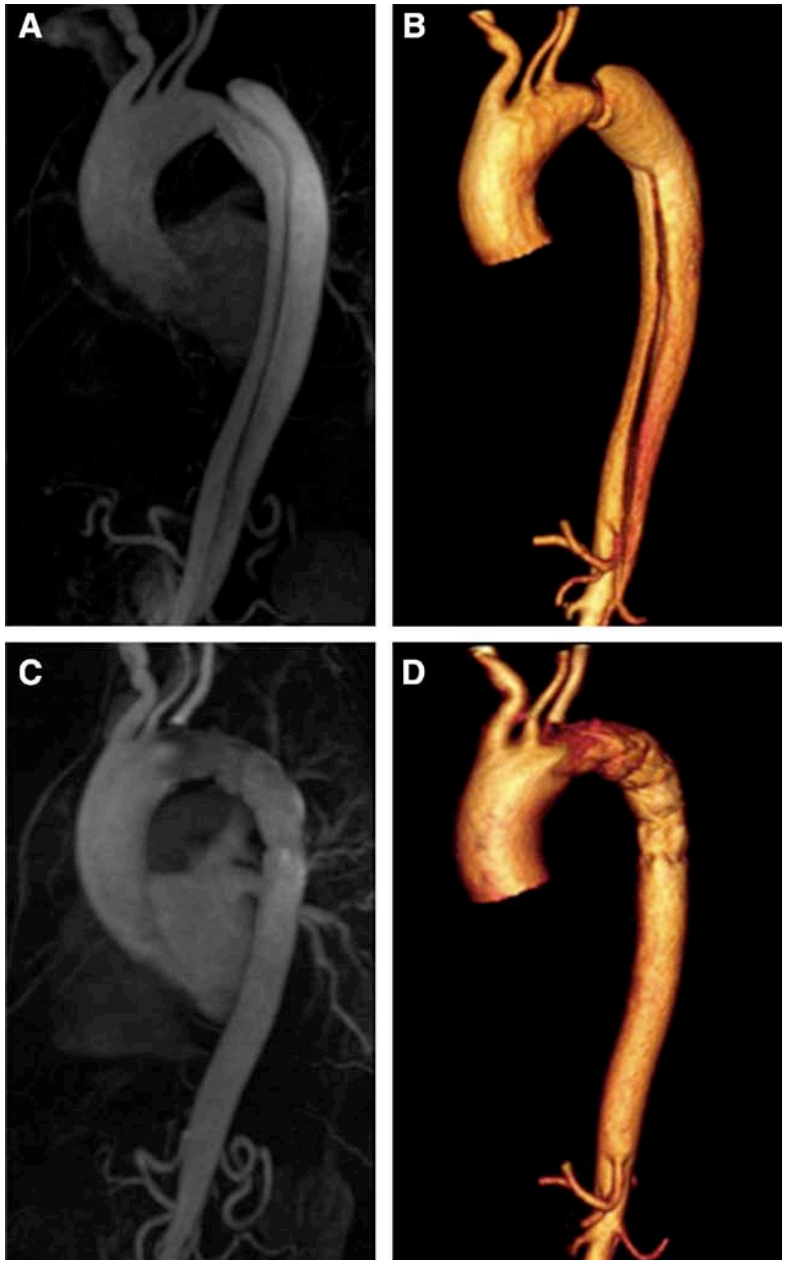
Table 5. Aortic Morphology at 5 Years

	OMT	OMT+TEVAR	*P* Value
FL thrombosis	11/50 (22.0%)	48/53 (90.6%)	<0.0001
Partial FL/no FL thrombosis	39/50 (78.0%)	5/53 (9.4%)	<0.0001
Remodeling of thoracic aorta*	5/50 (10.0%)	42/53 (79.2%)	<0.0001
Critical expansion of thoracic aorta†	33/50 (66.0%)	11/53 (20.8%)	<0.0001

FL indicates false lumen; OMT, optimal medical treatment; and TEVAR, thoracic endovascular aortic repair.

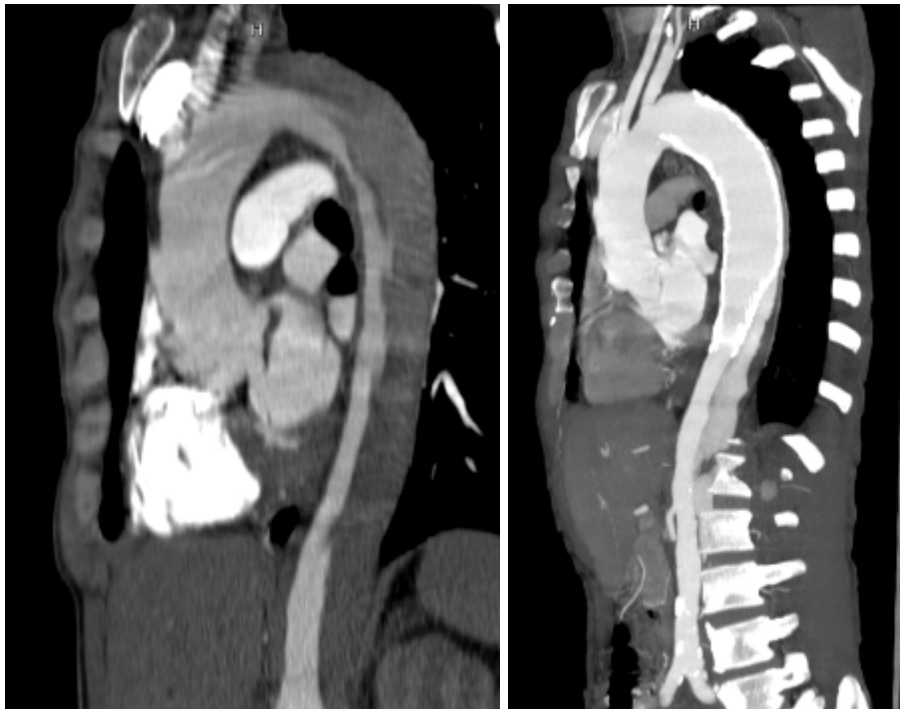
*Based on aortic morphology as assessed vs baseline.

†Occurring within long-term follow-up.



	Patients	30-day/in hospital deaths	SCI %	Follow up (months)	late related deaths	Reintervention %
Kitagawa 2013 Group A (extensive)	15	0		19	1	53
Kitagawa 2013 Group B (focal)	15	0		19	0	0
Oikonomou 2014	31	3 (9.6 %)	12.6 0 permanent	17	0	22.5
Spear 2016 Aortic arch aneurysm	7	1(14%)		18	0	28.5
Spear 2016 TAAA	16	1(6%)	6	6	0	8.7

Background



- The number of patients with unrepaired chronic aortic dissection (CTBAD) is increasing.
- Present studies are reporting heterogeneous TX & results

- Most commonly, post-dissection aneurysms involve the thoracoabdominal aorta.

The use of fenestrated/ branched stent-grafts to achieve complete exclusion is an appealing option