TEVAR for Chronic Dissection Strategy for Long-term Durability

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Disclosure

- Research funds
  - *Cook*
  - *Medtronic*
  - *Boston scientific*
  - *Cordis*
  - *Otsuka*
  - *Korea United Pharm*
  - *Dong-A Pharmaceutical*

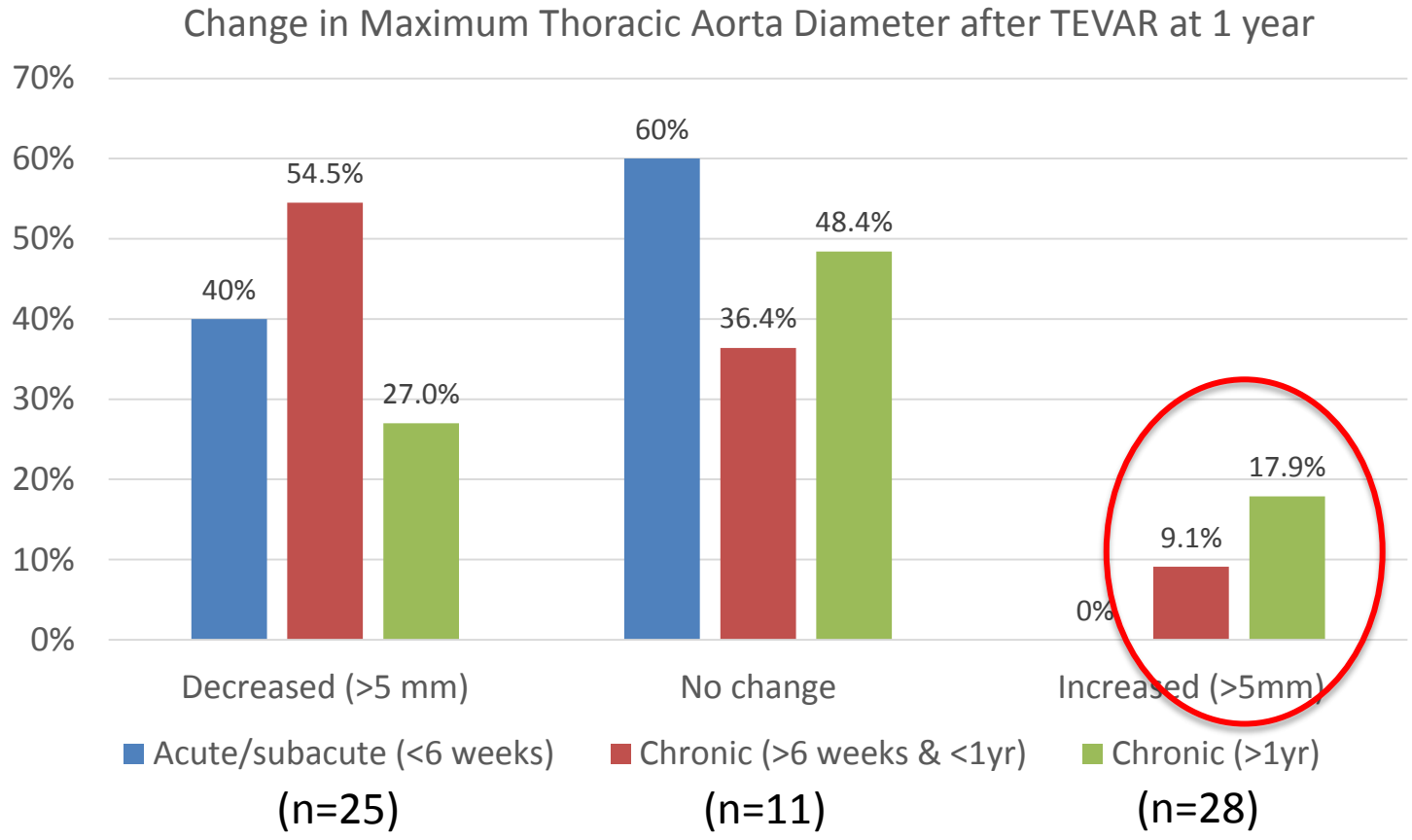
- *Severance Cardiovascular Intervention (SCI) Workshops in cooperation with Medtronic, Cordis, Abbott, Cook, Boston Scientific*

Potential Factors Affecting Long-term Durability of TEVAR in Chronic TBAD

- Timing of TEVAR
- Type Ia Endoleak:
  - Landing zones
  - Device selection
- Extent of stent graft coverage
- Retrograde aortic dissection
- Stent graft induced new entry (SINE)
- Retrograde reentry into false lumen

Severance Hospital Experience: Aorta Diameter Change after TEVAR in Type B AD

N=64



Predictor of Failed FL Volume Reduction

J ENDOVASC THER
2014;21:697–706

◆CLINICAL INVESTIGATION

Large False Lumen Area Is a Predictor of Failed False Lumen Volume Reduction After Stent-Graft Repair in Type B Aortic Dissection

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Purpose: To investigate the predictors of failed false lumen (FL) volume reduction at 12 months after stent-graft implantation in patients with type B aortic dissection.

Methods: The retrospective analysis comprised 38 patients (25 men; mean age 60±12 years) with double-barrel type B aortic dissection (9 acute) treated with thoracic endovascular aortic repair (TEVAR) and evaluated with serial computed tomography (CT) scans up to 12 months. Aortic volume changes were determined. Based on FL volume change at 1 year after stent-graft implantation, patients were dichotomized according to the presence or absence of FL volume reduction. Clinical and CT variables were compared between groups to determine risk factors of failed FL volume reduction. A major adverse event (MAE) was defined as death or reintervention.

Results: Patients were followed for 4.2±2.8 years. FL volume reduction (+FLVR) occurred in 27 (71%) patients, whereas 11 (29%) patients had no FL volume reduction (–FLVR). The MAE-free survival rate was significantly higher in the +FLVR patients than in the –FLVR group (88.9% vs. 27.3%, respectively; p<0.001). Chronicity of dissection, location of tear site, or the maximum total aortic lumen area was not associated with failure to achieve FL volume reduction. However, the maximum preprocedure FL area was significantly lower in the +FLVR group than in the –FLVR group (12.6±6.6 vs. 21.0±11.4 cm^2, respectively; p=0.041) and was an independent predictor for failed FL volume reduction (odds ratio 1.3, 95% confidence interval 1.02 to 1.70, p=0.031).

Conclusion: Failed FL volume reduction after TEVAR was associated with a significantly increased rate of mortality or reintervention during follow-up. A larger preprocedure maximum FL area was a predictor of failed FL volume reduction after TEVAR in type B dissection.

J Endovasc Ther. 2014;21:697–706

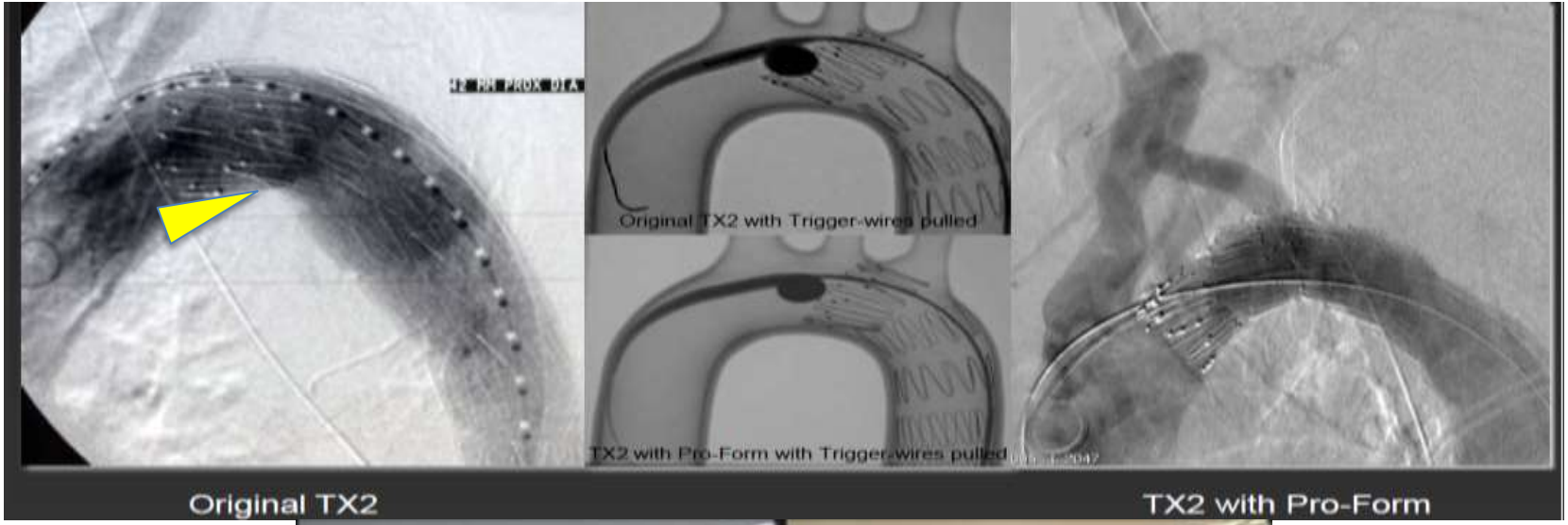
Univariate and Multivariate Logistic Regression Analysis for Failure of False Lumen Volume Reduction

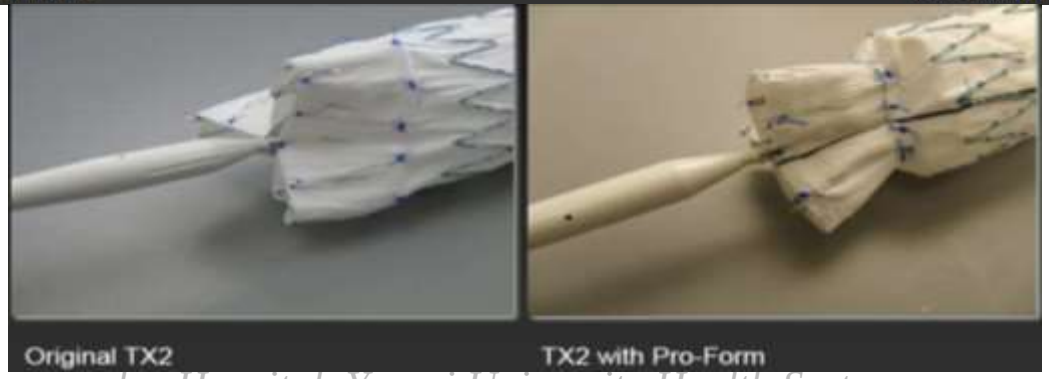
	Univariate Analysis		Multivariate Analysis	
	OR (95% CI)	p	OR (95% CI)	p
Age	1.0 (0.95 to 1.07)	0.611		
Male gender	0.8 (0.20 to 3.79)	0.858		
Acute dissection	1.5 (0.27 to 9.13)	0.612		
Hypertension	0.1 (0.01 to 2.14)	0.172		
Diabetes	5.7 (0.46 to 71.61)	0.172		
Smoking	0.3 (0.05 to 1.79)	0.196		
Distance of primary entry tear site from LSA (per cm)	1.0 (0.99 to 1.02)	0.116	1.0 (0.99 to 1.02)	0.160
Maximum aorta area (per cm^2)	1.0 (0.99 to 1.12)	0.096	0.8 (0.67 to 1.03)	0.100
Maximum FL area (per cm^2)	1.1 (1.01 to 1.21)	0.020	1.3 (1.02 to 1.70)	0.031
Maximum infrarenal aortic diameter (per cm)	1.0 (0.99 to 1.17)	0.078	1.0 (0.93 to 1.23)	0.340
Total aortic lumen volume (per mL)	1.0 (0.99 to 1.00)	0.132		
TL volume (per mL)	1.0 (0.99 to 1.01)	0.151		
FL volume (per mL)	1.0 (0.99 to 1.00)	0.390		
TL to FL volume ratio	1.0 (0.99 to 1.01)	0.222		
TL volume index	1.0 (0.98 to 1.06)	0.304		
Distance of maximum FL area from LSA (per cm)	1.0 (0.99 to 1.01)	0.254		

Proximal Landing Zones

- Proximal landing zone:
  - Generally within aortic arch
  - Ideally ≥20 mm between LSA and the primary entry tear
- If the LSA-primary entry tear distance <20 mm,
  - Coverage of LSA ostium by thoracic stent graft
  - Routine or selective revascularization of LSA

Bird Beak Phenomenon





Bird-Beak & Type Ia Endoleak

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ORIGINAL ARTICLE

Cite this article as: Kudo T, Kuratani T, Shimamura K, Sakamoto T, Kin K, Masada K et al. Type 1a endoleak following Zone 1 and Zone 2 thoracic endovascular aortic repair: effect of bird-beak configuration. Eur J Cardiothorac Surg 2017;52:718–24.

Type 1a endoleak following Zone 1 and Zone 2 thoracic endovascular aortic repair: effect of bird-beak configuration†

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Abstract

OBJECTIVES: Type 1a endoleak is one of the most severe complications after thoracic endovascular aortic repair (TEVAR), because it carries the risk of aortic rupture. The association between bird-beak configuration and Type 1a endoleak remains unclear. The purpose of this study was to analyse the predictors of Type 1a endoleak following Zone 1 and Zone 2 TEVAR, with a particular focus on the effect of bird-beak configuration.

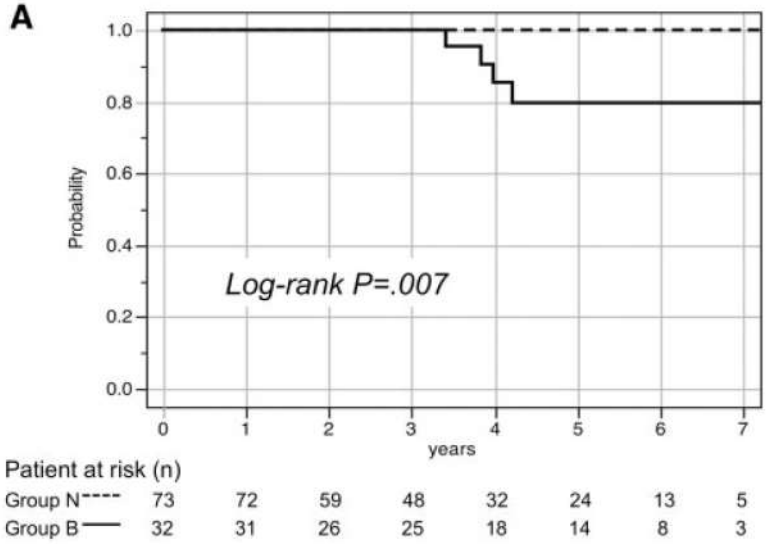
METHODS: From April 2008 to July 2015, 105 patients (mean age 68.6 years) who underwent Zone 1 and 2 landing TEVAR were enrolled, with a mean follow-up period of 4.3 years. The patients were categorized into 2 groups, according to the presence (Group B, n = 32) or the absence (Group N, n = 73) of bird-beak configuration on the first postoperative multidetector computed tomography.

RESULTS: The Kaplan–Meier event-free rate curve showed that Type 1a endoleak and bird-beak progression occurred less frequently in Group N than in Group B. Five-year freedom from Type 1a endoleak rates were 79.7% and 100% for Groups B and N, respectively ($P = 0.007$). Multivariable logistic regression analysis showed that dissecting aortic aneurysm (odds ratio 3.72, 95% confidence interval 1.30–11.0; $P = 0.014$) and shorter radius of inner curvature (odds ratio 1.09, 95% confidence interval 0.85–0.99; $P = 0.025$) were significant risk factors for bird-beak configuration. Multivariable Cox proportional hazard regression showed that Z-type stent graft (hazard ratio 2.69, 95% confidence interval 1.11–6.51; $P = 0.030$) was a significant risk factor for bird-beak progression.

CONCLUSIONS: Appropriate stent grafts need to be chosen carefully to prevent Type 1a endoleak and bird-beak configuration after landing Zone 1 and 2 TEVAR. Patients with bird-beak configuration on early postoperative multidetector computed tomography require closer follow-up to screen for Type 1a endoleak.

Keywords: TEVAR • Thoracic aortic aneurysm • Dissecting aortic aneurysm • Endoleak • Bird beak

Freedom from Type Ia Endoleak



Kudo T, Eur J Cardiothorac Surg. 2017;52:718

Extent of SG Coverage: Long or Short?

- Stent graft length:
  - should be long enough to cover proximal entry tears

- Long coverage:
  - may be advantageous for false lumen exclusion.
  - however, higher risk of spinal cord ischemia ?
    (Esp. covering distal DTA of T 8~12 levels)

Extent of Stent Graft Coverage for Chronic Type B AD

CLINICAL STUDY

Outcomes of Endovascular Management for Complicated Chronic Type B Aortic Dissection: Effect of the Extent of Stent Graft Coverage and Anatomic Properties of Aortic Dissection

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ABSTRACT

Purpose: To assess the effect of the extent of stent graft coverage and anatomic properties of aortic dissection on the outcomes of thoracic endovascular aortic repair (TEVAR) for complicated chronic type B aortic dissection (CCBAD) in terms of survival, reintervention, and false lumen thrombosis.

Materials and Methods: A retrospective analysis was performed of 71 patients who underwent TEVAR for CCBAD. Mean patient age was 58.7 years. Distal extent of stent graft coverage was categorized as short (≤ T8) or long (≥ T8) coverage. Indications of reintervention were categorized into three groups: proximal, elastogenic, and distal according to the anatomic relationship of the culprit lesion and the stent graft. Overall survival, reintervention-free survival, and extent of false lumen thrombosis were compared.

Results: The technical success rate was 97.2%. The 1-year, 3-year, and 5-year overall survival rates were 97.1%, 88.9%, and 88.9%, and 3-year, 5-year, and 5-year reintervention-free survival rates were 80.7%, 73.8%, and 60.4%. There were no differences in overall survival, reintervention-free survival rates, and extent of false lumen thrombosis between the groups. In the short coverage group, distal reintervention was more frequent in patients with an abdominal aortic diameter ≥ 37 mm compared with patients with an abdominal aortic diameter < 37 mm ($P = .005$).

Conclusions: TEVAR was effective for CCBAD with a high technical success rate and low mortality. The extent of stent graft coverage did not make a difference in terms of survival and false lumen thrombosis. Reinterventions were more frequently performed in patients with a large baseline abdominal aortic diameter who were treated with short stent graft coverage, and so longer coverage is recommended in such patients.

ABBREVIATIONS

CCBAD = complicated chronic type B aortic dissection, IQR = interquartile range, ROC = receiver operating characteristics, TEVAR = thoracic endovascular aortic repair

Most survivors of acute aortic dissection have a patent false lumen with a persistent weakened and diseased aortic wall. Reports indicate that in-hospital mortality after surgical repair of proximal aortic dissection and complicated distal aortic dissection is 15%–33% and 2%–39%, respectively (1). In-hospital mortality in cases of medically treated distal aortic dissection is reported to be 10% (2). Survivors of acute aortic dissection remain vulnerable to complications, such as aneurysmal degeneration, persistent pain, recurrent dissection, visceral or limb malperfusion, and rupture, which may need subsequent interventions (3–6). Although thoracic endovascular aortic repair (TEVAR) is a proven therapeutic option for acute type B aortic dissection with better

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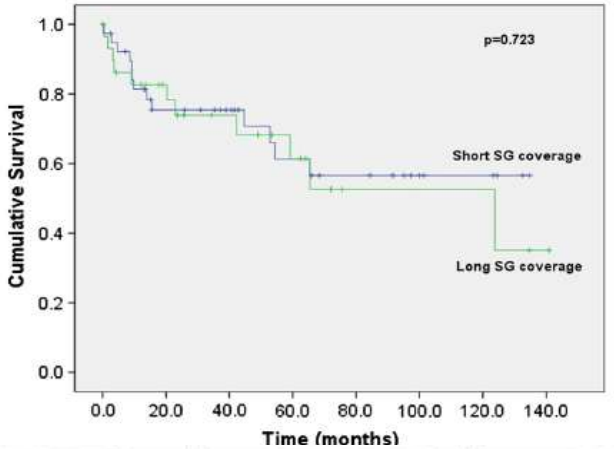
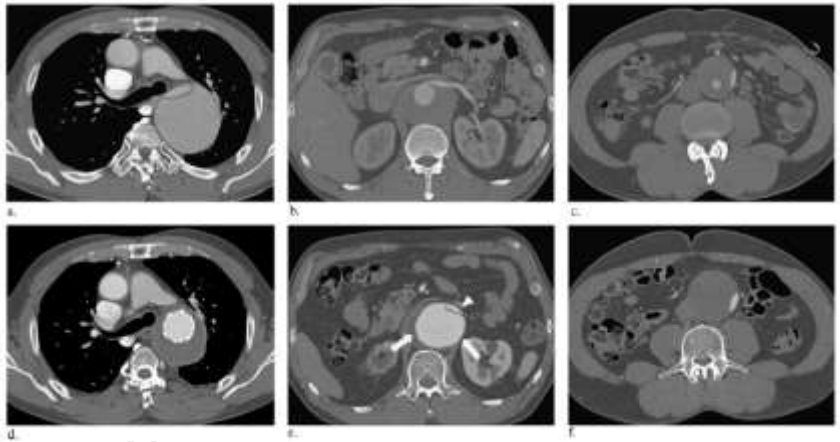
Reintervention-free survival





Extent of SG Coverage: Not Associated with Aneurysm Sac Shrinkage

CLINICAL RESEARCH STUDIES

From the Society for Clinical Vascular Surgery

Outcomes of thoracic endovascular aortic repair for chronic aortic dissections

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ABSTRACT

Background: Open surgical repair remains the "gold standard" treatment for chronic type B aortic dissection (cTBD) with aneurysm. Thoracic endovascular aortic repair (TEVAR) has gained popularity in recent years for the treatment of thoracic aortic diseases, including cTBD. We assessed the effectiveness of TEVAR in the treatment of cTBD using the Vascular Quality Initiative (VQI) database.

Methods: The VQI registry identified 4713 patients treated with TEVAR from July 2010 to November 2015, including 125 repairs for cTBD. We analyzed TEVAR outcomes in this cohort per the Society for Vascular Surgery reporting standards for TEVAR.

Results: Median age was 65.0 years (interquartile range [IQR], 56.0-72.0 years), and 85 (68.0%) were male. Median aneurysm diameter was 5.5 cm (IQR, 4.8-6.3 cm). Sixty-two (49.6%) patients were asymptomatic on presentation. 57 (45.6%) were symptomatic, and 6 (4.8%) presented with rupture. Median length of stay was 8.0 days (IQR, 4.0-11.0 days). Fluoroscopy time was 17.3 minutes (IQR, 10.5-25.6 minutes). The distal landing zone was aortic zone 4 in 27 (21.6%) and aortic zone 5 and distal in 98 (78.4%) patients. Successful device delivery occurred in 123 (98.4%) patients. Conversion to open repair occurred in one (0.8%) patient. A type IA endoleak was present in 2 (1.6%), type IB endoleak in 2 (1.6%), and type II endoleak in 2 (1.6%) patients. Perioperative complications included stroke in 1 (0.8%), respiratory complications in 6 (4.8%), and spinal cord ischemia symptoms present at discharge in 3 (2.4%) patients. In-hospital mortality occurred in three (2.4%) patients. Reintervention was required in two (1.6%) patients for false lumen perfusion and in two (1.6%) patients for extension of the dissection. Follow-up was available for 43 patients at a median time of 239 days (IQR, 38-377 days). Median change in sac diameter was −0.2 cm (IQR, −0.5 to 0.1 cm). Sac shrinkage of 0.5 cm was noted in 12 (27.9%), with sac growth >0.5 cm in four (9.3%) patients. Extent of stent graft coverage did not affect sac shrinkage ($P = .65$). Patients with aneurysms ≥5.5 cm compared with <5.5 cm were more likely to demonstrate shrinkage (−0.6 cm vs 0.0 cm; 95% confidence interval, 0.3-11.7; $P = .04$).

Conclusions: TEVAR for cTBD may be performed with acceptable rates of morbidity and mortality. Changes in sac diameter in the midterm are promising. Long-term data are needed to determine whether this approach is durable. (J Vasc Surg 2018;67:1345-52.)

ARTICLE HIGHLIGHTS

- **Type of Research:** Retrospective analysis of prospectively collected Vascular Quality Initiative (VQI) data
- **Take Home Message:** Thoracic endovascular aortic repair of chronic type B aortic dissections in 125 patients resulted in three deaths (2.4%). Technical success was 98.4%, with two cases of type IA endoleak (1.6%) and type IB endoleak (1.6%). Aneurysm sac shrinkage of at least 5 mm was observed in 12 patients (27.9%) with a median follow-up of 8 months, and extent of stent graft coverage was not associated with aneurysm sac shrinkage.
- **Recommendation:** This study suggests that thoracic endovascular aortic repair for chronic type B dissections can be performed safely with reasonable rates of aneurysm sac shrinkage at a median follow-up of 8 months.

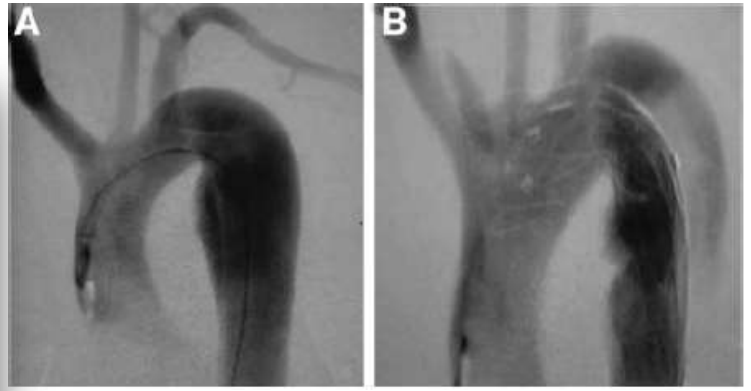
Spinal chord ischemia 2.4%

Sac shrinkage >0.5 cm in 28%
Sac expansion >0.5 cm in 9%

J Vasc Surg 2018;67:1345

Retrograde Dissection

Incidence 2.5% (11 of 443 patients)



Vascular Medicine

Retrograde Type A Aortic Dissection After Endovascular Stent Graft Placement for Treatment of Type B Dissection

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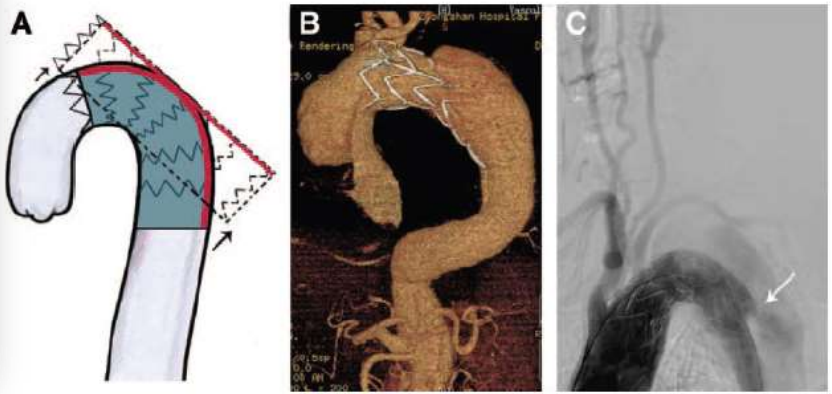
Background—Retrograde type A aortic dissection has been deemed a rare complication after endovascular stent graft placement for type B dissection. However, this life-threatening event appears to be underrecognized and is worth being investigated further.

Methods and Results—Eleven of 443 patients developed retrograde type A aortic dissection during or after stent grafting for type B dissection from August 2000 to June 2007. Of these 11 patients, 3 had Marfan syndrome. The Kaplan–Meier estimate of the rate of freedom from this event at 36 months is 97.4% (95% confidence interval, 0.95 to 0.99). The new entry was located at the tip of the proximal bare spring of the stent graft in 9 patients, was within the anchoring area of the proximal bare spring in 1, and remained unknown in 1 patient. Eight patients were converted to open surgery, and 2 received medical treatment. One patient suddenly died 2 hours after the primary stent grafting, and 2 died within 1 week after the surgical conversion, so mortality reached 27.3%. During the follow-up from 3 to 50 months, type I endoleak was identified in 1 patient 3 months after the surgical exploration and disappeared at 6 months.

Conclusions—Retrograde type A aortic dissection after stent grafting for type B dissection appears not to be rare and results from mixed causes. Fragility of the aortic wall and disease progression may predispose to it, whereas stent grafting–related factors make important and provocative contributions. Avoiding aortic arch stent grafting in Marfan patients, preferably selecting the endograft without the proximal bare spring for patients with a kinked aortic arch or with Marfan syndrome (if endografting is used), improving the device design, and standardizing endovascular manipulation might lessen its occurrence. (*Circulation*. 2009;119:735-741.)

Key Words: aortic dissection ■ endovascular surgery ■ grafting ■ stents



Dong ZH, Circulation. 2009;119:735-741

Retrograde Aortic Dissection after TEVAR

European Registry : Incidence 1.3%

Retrograde Ascending Aortic Dissection During or After Thoracic Aortic Stent Graft Placement

Insight From the European Registry on Endovascular Aortic Repair Complications

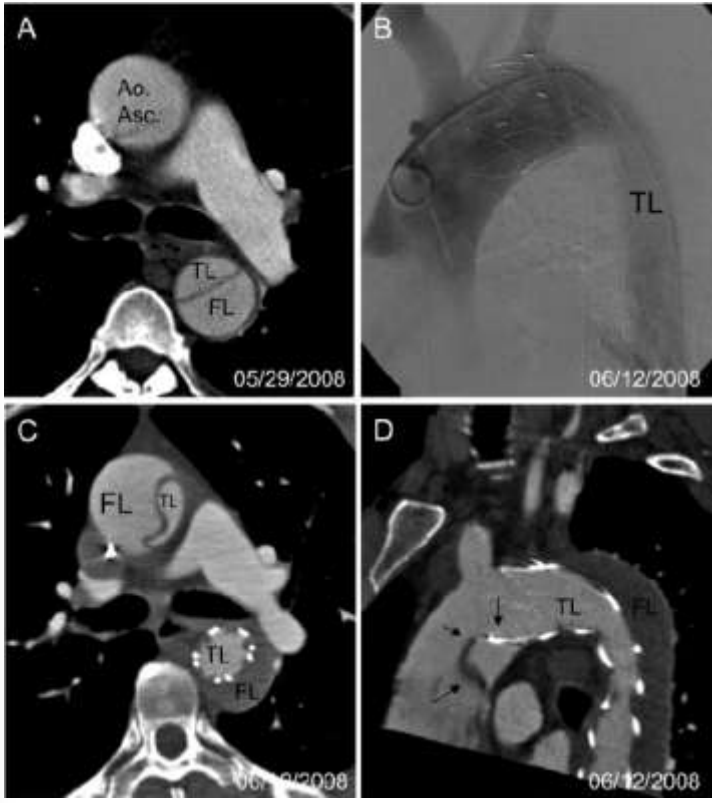
Holger Eggebrecht, MD; Matt Thompson, MD; Hervé Rousseau, MD; Martin Czerny, MD; Lars Lönn, MD; Rajendra H. Mehta, MD, MS; Raimund Erbel, MD; on behalf of the European Registry on Endovascular Aortic Repair Complications

Background—Single-center reports have identified retrograde ascending aortic dissection (rAAD) as a potentially lethal complication of thoracic endovascular aortic repair (TEVAR).

Methods and Results—Between 1995 and 2008, 28 centers participating in the European Registry on Endovascular Aortic Repair Complications reported a total of 63 rAAD cases (incidence, 1.33%; 95% CI, 0.75 to 2.40). Eighty-one percent of patients underwent TEVAR for acute (n=26, 54%) or chronic type B dissection (n=13, 27%). Stent grafts with proximal bare springs were used in majority of patients (83%). Only 7 (15%) patients had intraoperative rAAD, with the remaining occurring during the index hospitalization (n=10, 21%) and during follow-up (n=31, 64%). Presenting symptoms included acute chest pain (n=16, 33%), syncope (n=12, 25%), and sudden death (n=9, 19%) whereas one fourth of patients were asymptomatic (n=12, 25%). Most patients underwent emergency (n=25) or elective (n=5) surgical repair. Outcome was fatal in 20 of 48 patients (42%). Causes of rAAD included the stent graft itself (60%), manipulation of guide wires/sheaths (15%), and progression of underlying aortic disease (15%).

Conclusions—The incidence of rAAD was low (1.33%) in the present analysis with high mortality (42%). Patients undergoing TEVAR for type B dissection appeared to be most prone for the occurrence of rAAD. This complication occurred not only during the index hospitalization but after discharge up to 1050 days after TEVAR. Importantly, the majority of rAAD cases were associated with the use of proximal bare spring stent grafts with direct evidence of stent graft–induced injury at surgery or necropsy in half of the patients. (***Circulation***. **2009;120[suppl 1]:S276–S281.**)

Key Words: aorta ■ TEVAR ■ stent graft ■ complications ■ dissection



Eggebrecht H, Circulation 2009;120:S276

Retrograde Aortic Dissection after TEVAR

Table 1. Patient Characteristics

	All Patients (n=48)
Age	56.5 (32–80)
Men	31 (65)
Hypertension	40 (83)
Coronary artery disease	5 (10)
Previous aortic surgery	2 (4)
Underlying aortic disease	
Acute aortic dissection	26 (54)
Chronic aortic dissection	13 (27)
Thoracic aortic aneurysm	8 (17)
Penetrating aortic ulcer	1 (2)
Presumed etiology of aortic disease	
Atherosclerotic	26 (54)
Connective tissue disease (Marfan)	4 (8)
Traumatic	1 (2)

Data are presented as mean (range) or n (%).

Eggebrecht H, Circulation 2009;120:S276

Retrograde Aortic Dissection after TEVAR

Table 2. Procedural Data

	All Patients (n=48)
Emergency procedure	16 (33)
No. of stent grafts placed	1 (1–5)
Stent graft device used	
Talent (Medtronic)	29 (60)
Valiant (Medtronic)	9 (19)
GoreTAG (Gore)	6 (13)
Zenith TX2 (Cook)	1 (2)
Endofit (Le Maitre)	3 (6)
Relay (Bolton)	0
Design of most proximal stent spring	
Free-flow bare spring	40 (83)
Membrane-covered	8 (17)
Diameter of most proximal stent graft, mm	37 (28–46)
Diameter of ascending aorta, mm	37 (26–50)
Oversizing, mm	2.5 (0–8)
Oversizing, %	6 (0–24)
Landing zone within aortic arch	
Zone 0	1 (2)
Zone 1	5 (10)
Zone 2	26 (54)
Zone 3	16 (33)
Method for blood pressure–lowering during stent graft deployment	
Drug-induced hypotension (eg, nitroprusside)	42 (88)
Adenosine-induced cardiac arrest	2 (4)
Rapid right ventricular pacing	2 (4)
Overstenting of arch vessels	19 (40)
Retraction of stent graft during deployment	12 (25)
Additional balloon dilatation of the stent graft after deployment	11 (23)

Table 3. Occurrence and Management of Ascending Aortic Dissection After TEVAR

	All Patients (n=48)
Occurrence after TEVAR procedure, d	
Intraprocedural	7 (15)
During index hospitalization	10 (21)
After discharge during follow-up	31 (64)
Onset of ascending dissection after TEVAR, d	35 (0–1050)
Symptoms	
None	12 (25)
Chest pain	16 (33)
Syncope/collapse	12 (25)
Sudden death	9 (19)
Diagnostic modality for detection	
CT	35 (73)
MRI	1 (2)
TEE	7 (15)
Angiography	7 (15)
Necropsy	5 (10)
Treatment*	
None	9 (23)
Emergency surgery	25 (64)
Elective surgery	5 (13)
Death	20 (42)
Presumed etiology of ascending dissection after TEVAR	
Stent graft–induced	29 (60)
Procedure-related (eg, wire manipulation)	7 (15)
Underlying undiagnosed ascending disease/progression of aortic disease	7 (15)
Evidence of stent graft–induced injury by surgery/necropsy	24 (50)

Eggebrecht H, Circulation 2009;120:S276

Retrograde Aortic Dissection

SYSTEMATIC REVIEW AND META-ANALYSIS

American Heart Association | American Stroke Association

Retrograde Type A Aortic Dissection After Thoracic Endovascular Aortic Repair: A Systematic Review and Meta-Analysis

Yanqing Chen, MD;* Simeng Zhang, MD;* Lei Liu, MD;* Qingsheng Lu, MD; Tianyi Zhang, MD; Zaiping Jing, MD

Background—Retrograde type A aortic dissection (RTAD) is a potentially lethal complication after thoracic endovascular aortic repair (TEVAR). However, data are limited regarding the development of RTAD post-TEVAR. This systematic review aims to define the incidence, mortality, and potential risk factors of RTAD post-TEVAR.

Methods and Results—Multiple electronic searches were performed. Fifty publications with a total of 8969 patients were analyzed. Pooled estimates for incidence and mortality of RTAD were 2.5% (95% confidence interval [CI], 2.0–3.1) and 37.1% (95% CI, 23.7–51.6), respectively. Metaregression analysis evidenced that RTAD rate was associated with hypertension (P=0.043), history of vascular surgery (P=0.042), and American Surgical Association (P=0.044). The relative risk of RTAD was 1.81 (95% CI, 1.04–3.14) for acute dissection (relative to chronic dissection) and 5.33 (95% CI, 2.70–10.51) for aortic dissection (relative to a degenerative aneurysm). Incidence of RTAD was significantly different in patients with proximal bare stent and nonbare stent endografts (relative risk [RR]=2.06; 95% CI, 1.22–3.50). RTAD occurrence rate in zone 0 was higher than other landing zones.

Conclusions—The pooled RTAD rate after TEVAR was calculated at 2.5% with a high mortality rate (37.1%). Incidence of RTAD is significantly more frequent in patients treated for dissection than those with an aneurysm (especially for acute dissection), and when the proximal bare stent was used. Rate of RTAD after TEVAR varied significantly according to the proximal Ishimaru landing zone. The more-experienced centers tend to have lower RTAD incidences. (***J Am Heart Assoc.* 2017;6:e004649. DOI: 10.1161/JAHA.116.004649.**)

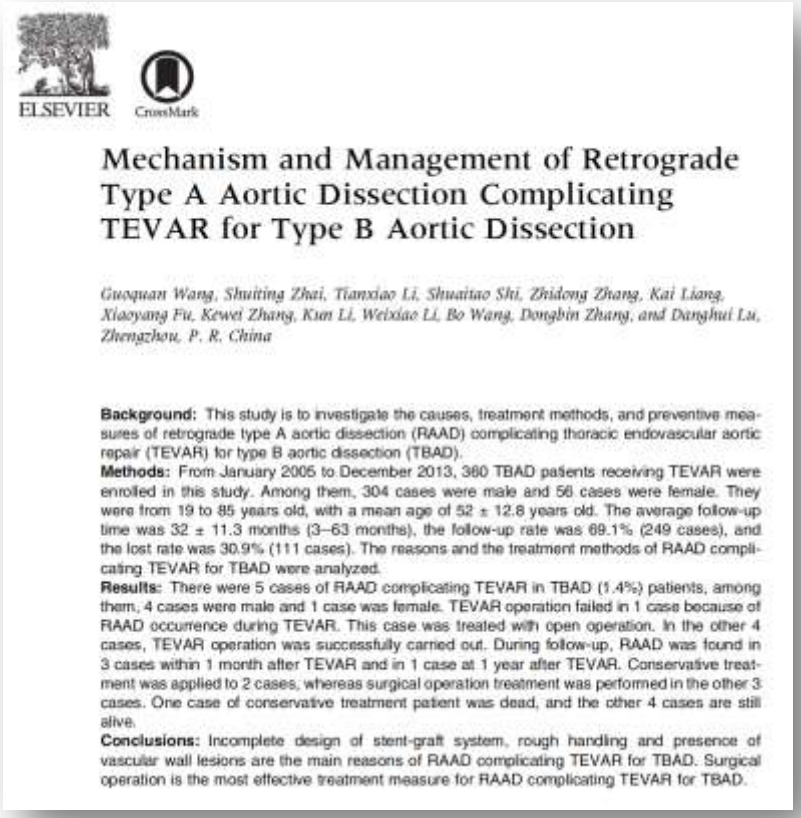
Key Words: complication • endograft • retrograde type A aortic dissection • TEVAR

Incidence: 2.5%
Mortality 37.1%

Risk factors:
- Proximal bare stent
- Proximal ishimaru landing zone
- Inexperience

J Am Heart Assoc. 2017;6:e004649

Mechanisms of Retrograde Type A AD Complicating TEVAR



ELSEVIER CrossMark

Mechanism and Management of Retrograde Type A Aortic Dissection Complicating TEVAR for Type B Aortic Dissection

Guoquan Wang, Shuiting Zhai, Tianxiao Li, Shuaitao Shi, Zhidong Zhang, Kai Liang, Xiaoyang Fu, Kewei Zhang, Kun Li, Weixiao Li, Bo Wang, Dongbin Zhang, and Danghui Lu, Zhengzhou, P. R. China

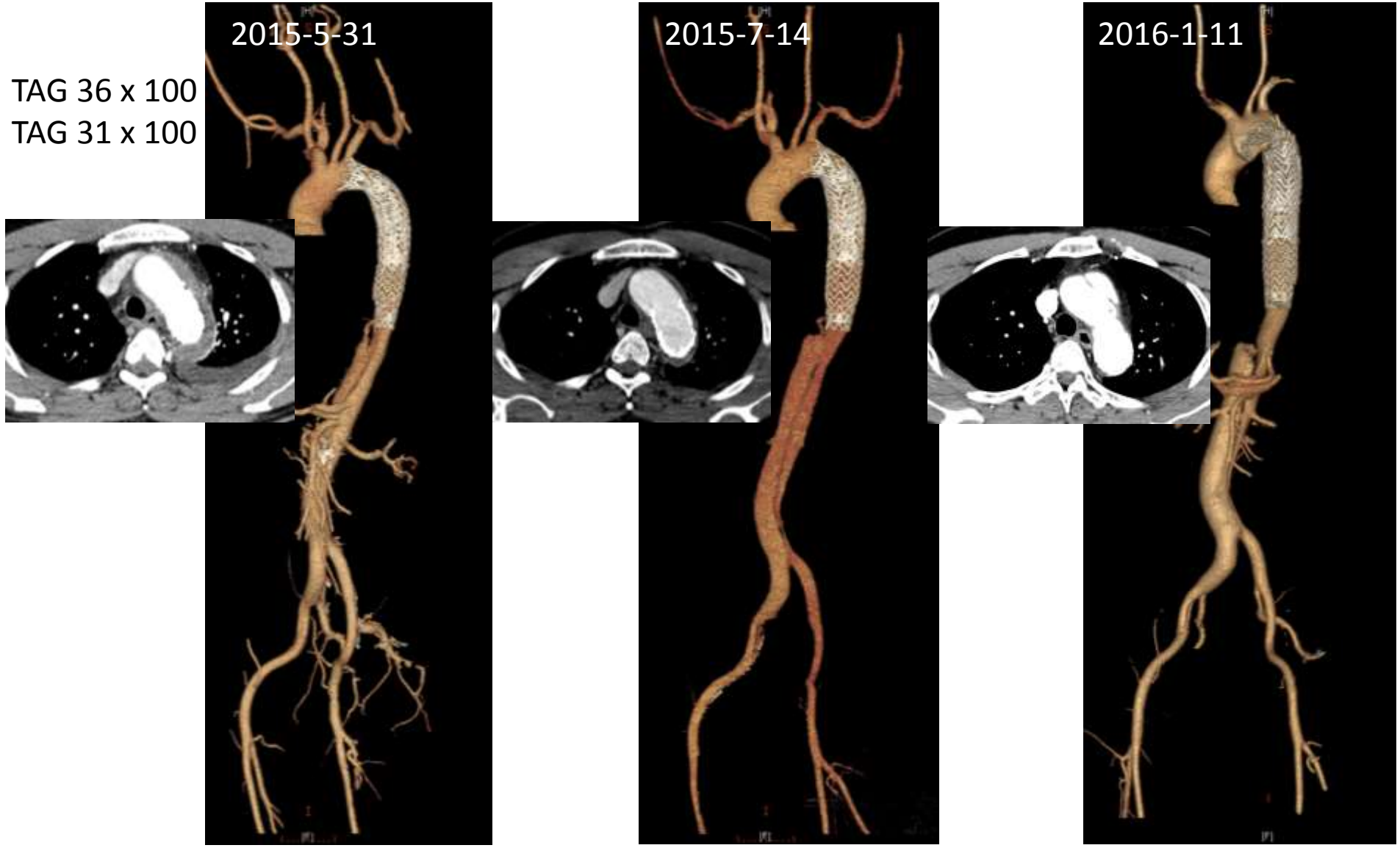
Background: This study is to investigate the causes, treatment methods, and preventive measures of retrograde type A aortic dissection (RAAD) complicating thoracic endovascular aortic repair (TEVAR) for type B aortic dissection (TBAD).
Methods: From January 2005 to December 2013, 360 TBAD patients receiving TEVAR were enrolled in this study. Among them, 304 cases were male and 56 cases were female. They were from 19 to 85 years old, with a mean age of 52 ± 12.8 years old. The average follow-up time was 32 ± 11.3 months (3–63 months), the follow-up rate was 69.1% (249 cases), and the lost rate was 30.9% (111 cases). The reasons and the treatment methods of RAAD complicating TEVAR for TBAD were analyzed.
Results: There were 5 cases of RAAD complicating TEVAR in TBAD (1.4%) patients, among them, 4 cases were male and 1 case was female. TEVAR operation failed in 1 case because of RAAD occurrence during TEVAR. This case was treated with open operation. In the other 4 cases, TEVAR operation was successfully carried out. During follow-up, RAAD was found in 3 cases within 1 month after TEVAR and in 1 case at 1 year after TEVAR. Conservative treatment was applied to 2 cases, whereas surgical operation treatment was performed in the other 3 cases. One case of conservative treatment patient was dead, and the other 4 cases are still alive.
Conclusions: Incomplete design of stent-graft system, rough handling and presence of vascular wall lesions are the main reasons of RAAD complicating TEVAR for TBAD. Surgical operation is the most effective treatment measure for RAAD complicating TEVAR for TBAD.

Table III. Reasons of RAAD complicating TEVAR for TBAD

Stent graft (device-related)	Bare frame design of the first section and head barbed design of the support
	Excessive oversize, resulting in too large radial force
	Elastic back stress after passive bending can damage the vascular wall and the head and tail bracket bonding site
Vascular disease (disease progression)	Marfan's syndrome
	Ascending aortic diameter greater than 40 mm
	Landing zone locates in 0–2 region
	AD is prone to occur than AAA
Operation (procedure-related)	Guide wire, catheter, delivery sheath, and stent graft
	Balloon dilatation
	Side wall clamp function

Wang G, Ann Vasc Surg 2016; 32: 111

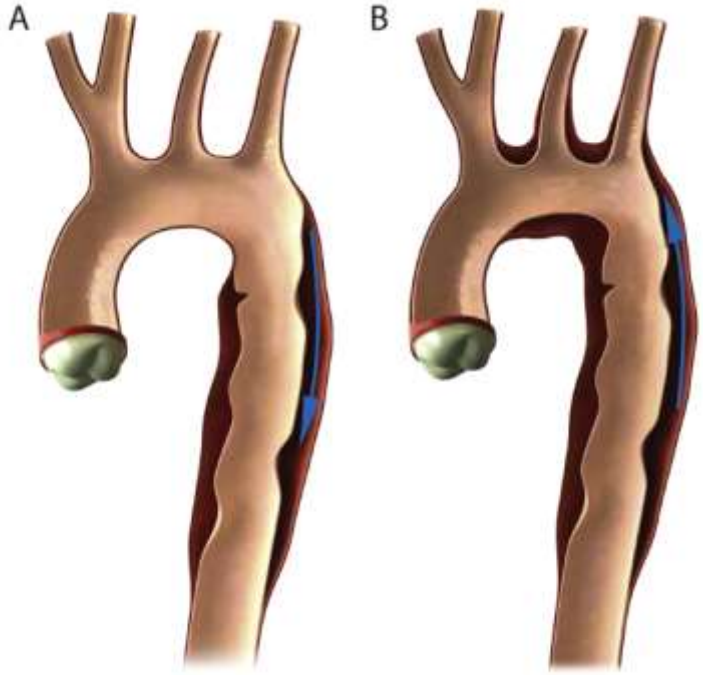
TAG 36 x 100
TAG 31 x 100



Impact of Retrograde Arch Extension in Acute TBAB on Management and Outcomes

IRAD data

Retrograde extension of hematoma



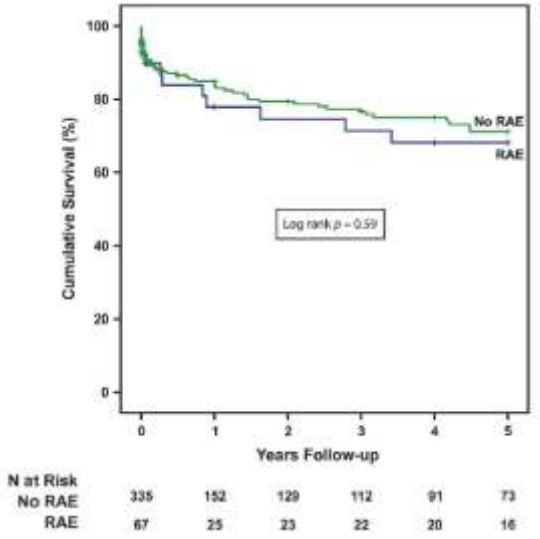


Table 4. Independent Predictors of Death at 5 Years in Patients With Type B Dissection: Effect of Multivariate Adjustment[a]

Variable	Hazard Ratio	95% CI	*p* Value
Acute type B dissection with RAE	1.1	0.5–2.3	0.85
Age ≥70 years	2.6	1.4–4.7	0.002
Coma	3.8	1.6–9.0	0.003
Aortic rupture	3.4	1.8–6.3	<0.001
Mesenteric ischemia	3.4	1.3–8.7	0.01
Acute renal failure	2.2	1.1–4.1	0.02
Shock	9.8	2.6–36.3	0.001

Nauta FJH, Ann Thorac Surg 2016;102:2036

Risk Factors for SG-induced New Entry

Incidence and risk factors for retrograde type A dissection and stent graft-induced new entry after thoracic endovascular aortic repair

Tao Ma, MD,[1] Zhi Hui Dong, MD,[1] Wei Guo Fu, MD,[1] Da Qiao Guo, MD,[1] Xin Xu, MD,[1] Bin Chen, MD,[1] Jun Hao Jiang, MD,[1] Jue Yang, MD,[1] Zhen Yu Shi, MD,[1] Ting Zhu, MD,[1] Yun Shi, MD,[1] Bao Hong Jiang, PhD,[1] and Xiao Yun Xu, MD,[1] *Shanghai, China and London, United Kingdom*

ABSTRACT

Objective: Stent graft (SG)-induced new entry (SINE) and retrograde type A dissection (RTAD) are serious device-related complications occurring after thoracic endovascular aortic repair (TEVAR) for Stanford type B aortic dissection (TBAD) and may lead to endograft-related complications including retrograde dissection and death. The purpose of this study was to investigate the incidence and risk factors for the development of RTAD and SINE after TEVAR for TBAD and to identify the complications associated with this.

Methods: From April 2005 to October 2013, there were 997 patients who underwent TEVAR for TBAD. 852 were followed up (0-6 years; mean, 2.6 years), and 59 SINEs developed in 53 patients. The oversizing ratio and incidence of RTAD and SINE were compared between proximal bare stent (PBS) and non-PBS groups and RTAD and SINE and non-RTAD and non-SINE groups. The baseline characteristics and SG configurational factors potentially affecting both RTAD and distal SINE were analyzed.

Results: There was no significant difference between PBS and non-PBS groups in the incidence of RTAD. A greater oversizing ratio was related to a higher distal SINE rate. SINE was seen more frequently in smokers and in patients with hypertension, Marfan syndrome, and TEVAR in the chronic phase and less frequently in complicated dissection cases. Device-related factors for SINE were SG with a connecting bar and SG length <165 mm. The SG length <165 mm increased the overall proximal and distal SINE incidence in multivariate analysis.

Conclusions: The presence of a PBS is not associated with a higher RTAD rate, whereas the use of an SG with a connecting bar and length <165 mm increases the risk of RTAD and SINE after TEVAR. (J Vasc Surg 2017;■:1-8.)

Variables	RTAD and SINE			RTAD			Distal SINE		
	OR	95% CI	*P* value	OR	95% CI	*P* value	OR	95% CI	*P* value
Male gender	—	—	—	—	—	—	—	—	—
Age >60 years	—	—	—	—	—	—	—	—	—
TEVAR in chronic phase	2.32	1.30-4.25	.01	—	—	—	2.63	1.22-5.68	.01
TEVAR for complicated dissection	0.55	0.31-1.00	.05	—	—	—	0.44	0.21-0.95	.03
Smoking	—	—	—	—	—	—	—	—	—
Hypertension	—	—	—	—	—	—	—	—	—
Marfan syndrome	3.72	1.09-12.75	.05	—	—	—	—	—	—
SG with connecting bar	2.51	1.38-4.54	<.01	—	—	—	3.28	1.54-7.00	<.01
SG <165 mm	4.17	2.31-7.53	<.01	2.99	1.35-6.64	.007	5.65	2.60-12.64	<.01
Two SGs implanted	—	—	—	—	—	—	—	—	—

CI, Confidence interval; *OR*, odds ratio; *TEVAR*, thoracic endovascular aortic repair.

Distal Stent Graft-Induced New Reentry

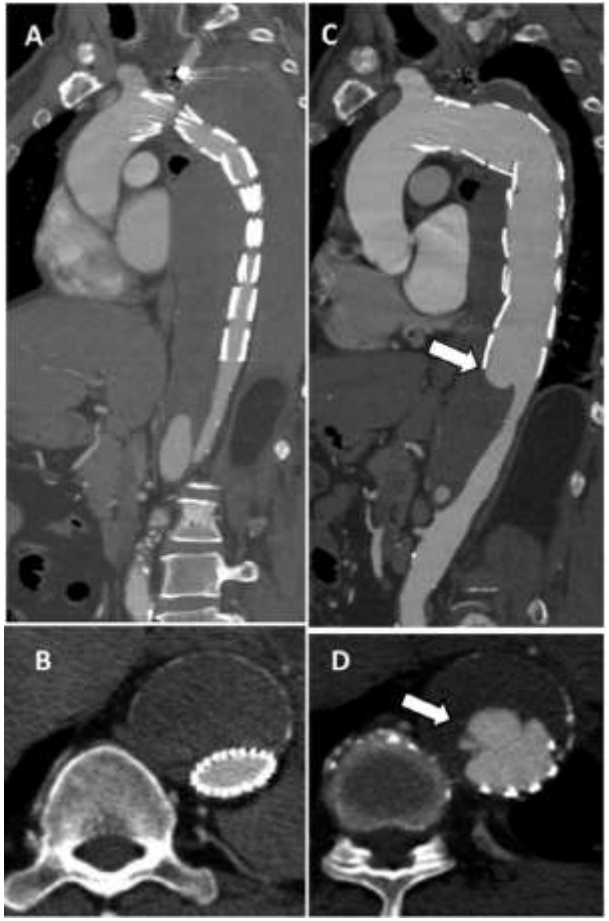


Table 3. Multivariate Analysis for Risk Factors of Stent-Induced New Entry Development

Characteristics	OR	95% CI	*p* Value
Female	3.140	0.893–9.524	0.076
Age	…	…	0.841
Body surface area	…	…	0.928
Systemic hypertension	…	…	0.783
Dyslipidemia	…	…	0.108
Diabetes mellitus	…	…	0.860
Chronic kidney injury	…	…	0.999
Marfan syndrome	…	…	0.969
Aortic kinking	…	…	0.236
Acute type B dissection	…	…	0.445
Residual type B dissection	…	…	0.325
Oversizing ratio maximum diameter	2.641	0.993–7.026	0.052
Oversizing rate A/B	…	…	0.631
Oversizing ratio area	1.843	1.109–3.064	0.018
Oversizing ratio mean diameter	0.034	0.001–0.802	0.036

CI = confidence interval; OR = odds ratio.

Ann Thorac Surg 2016;102:527

Stent Graft Induced New Entry (SINE)

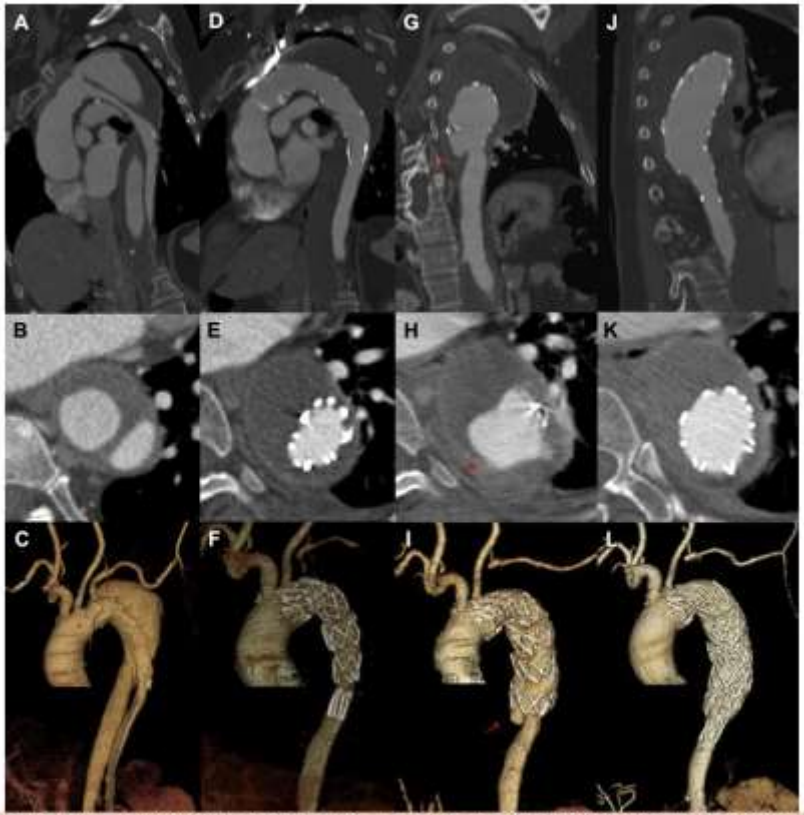
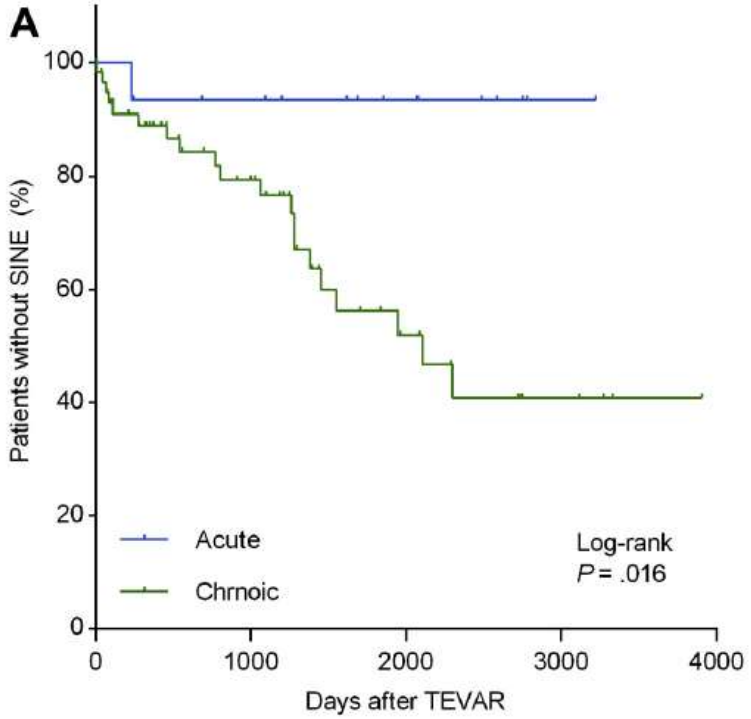


Fig 2. A, Multiplanar reconstruction image, **(B)** axial image, and **(C)** three-dimensional volume-rendered computed tomography (CT) image of a 53-year-old woman with a Stanford type B chronic descending thoracic aortic dissection. **D-F,** Thoracic endovascular aortic repair (TEVAR) is performed with a 38 × 150 SEAL stent graft (S&G Biotech Inc, Seongnam, Korea) and the false lumen is completely thrombosed. Distal oversizing ratios of the stent graft by maximal diameter, mean diameter, circumference, and area were 111%, 161%, 146%, and 580%, respectively. **G-I,** At follow-up 9 months later, small new intimal tear (*red arrow*) has developed at the distal margin of the stent graft. **J-L,** An additional 40 × 110 SEAL stent graft is inserted at the distal margin of the original stent graft, and the distal intimal tear is completely regressed.



Jang H, J Vasc Surg 2017;65:676

Taper & Oversizing Ratio

$$\text{Taper Ratio (\%)} = \left(1 - \frac{Xd}{Xp}\right) \times 100$$

$$\text{Oversizing Ratio (\%)} = \left(\frac{Xg}{Xd} - 1\right) \times 100$$

p: proximal aorta
d: distal aorta
G: stent graft

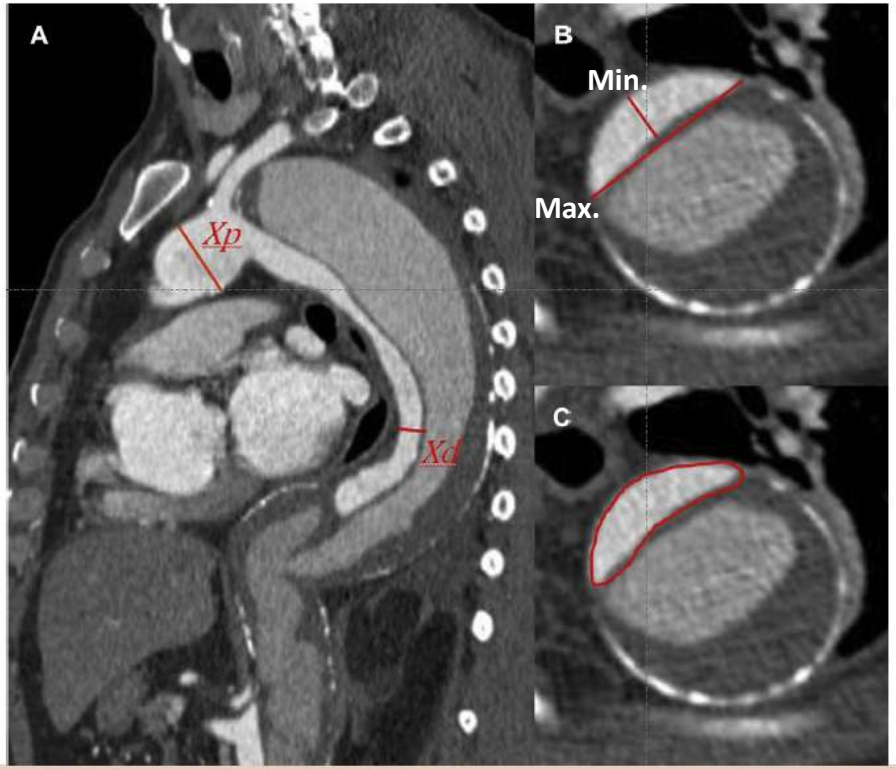


Fig 1. **A,** Saggital computed tomography (CT) view before thoracic endovascular aortic repair (TEVAR) shows the size of presumed proximal landing zone (*Xp*) and the size of the presumed distal landing zone (*Xd*). **B,** Maximal and minimal diameter and mean diameter of Xd. **C,** Area and circumference of Xd.

Predictors of SINE

Risk for SINE is increased, if SG diameter is larger than 2 x mean diameter of distal aorta

Variable[a]	Cutoff value	Sensitivity	Specificity	Predictive value	
				Positive	Negative
Taper ratio					
Maximal diameter	26.1	71	60	42	84
Mean diameter	48.0	71	66	45	85
Circumference	40.8	67	70	45	84
Area	72.9	71	66	45	85
Oversizing ratio					
Maximal diameter	43.8	55	85	58	83
Mean diameter	108.8	60	76	48	83
Circumference	87.0	50	89	63	82
Area	335.9	60	76	52	84

[a]Data are presented as percentages.

Jang H, J Vasc Surg 2017;65:676

Stent Graft Implantation

- Mismatch between the proximal and the distal landing zone diameters > 4 mm
  - **Tapered stent grafts**,
  - **Restrictive bare stent**
  - **Bottom-up technique** using two SGs of different diameters

  => The small endoprosthesis deployed distally first, and the larger device inserted proximally into the smaller to facilitate good sealing

Restrictive Bare Stent

Restrictive bare stent for prevention of stent graft-induced distal redissection after thoracic endovascular aortic repair for type B aortic dissection

Jiaxuan Feng, MD, Qingsheng Lu, MD, Zhiqing Zhao, MD, Junmin Bao, MD, Xiang Feng, MD, Lefeng Qu, MD, Jian Zhou, PhD, and Zaiping Jing, MD, *Shanghai, China*

Background: Stent graft-induced distal redissection (SIDR) is one of the major concerns in the durability of endovascular repair for complicated Stanford type B aortic dissection. The characteristics and means of prevention of this complication remain unknown.

Methods: From April 1997 to March 2010, 674 patients with type B aortic dissections were treated primarily by thoracic endovascular aortic repair (TEVAR) at our center. Criteria for inclusion in this study were treatment primarily with TEVAR and an estimated mismatch rate (ratio of distal diameter of stent graft to long diameter of true lumen) greater than 120%. By this protocol, 465 patients were included in this study and were retrospectively analyzed. Among them, 266 patients were treated in the acute phase, and 199 were treated in the chronic phase.

Results: A total of 311 patients were treated with standard TEVAR and 154 patients with TEVAR + restrictive bare stent (RBS). The preoperative mismatch rate (measured as the preoperative long diameter of the true lumen at the level of the intended distal end of the stent graft) of the SIDR was significantly higher than that of the non-SIDR (192.7 ± 54.9% vs 131.9 ± 10.4%; $P < .05$). The follow-up mismatch rate of the SIDR was significantly higher than that of the non-SIDR (145.4 ± 34.6 vs 120.3 ± 16.1; $P < .05$). Compared with the standard TEVAR, TEVAR + RBS was associated with a lower incidence of SIDR (0% vs 2.9%; $P = .033$) and less secondary intervention (3.9% vs 9.3%; $P = .040$). Placement of the RBS significantly expanded the true lumen at the level of the descending aorta with the narrowest true lumen and at the level of the distal end of the stent graft.

Conclusions: The mismatch between the distal diameter of the stent graft and the diameter of the compressed true lumen seems to be the major factor in the occurrence of SIDR. Placement of an RBS, as an adjunctive technique to TEVAR, could reduce the incidence of SIDR. On the basis of early- to midterm observations, RBSs may improve morphological remodeling of the dissected aorta at certain levels. (J Vasc Surg 2013;57:44S-52S.)

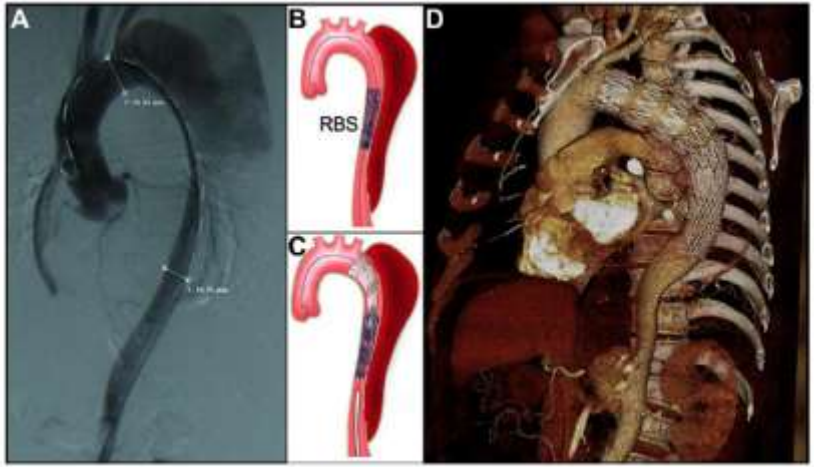


Table III. Comparison of patient outcomes between the TEVAR and the TEVAR + RBS groups

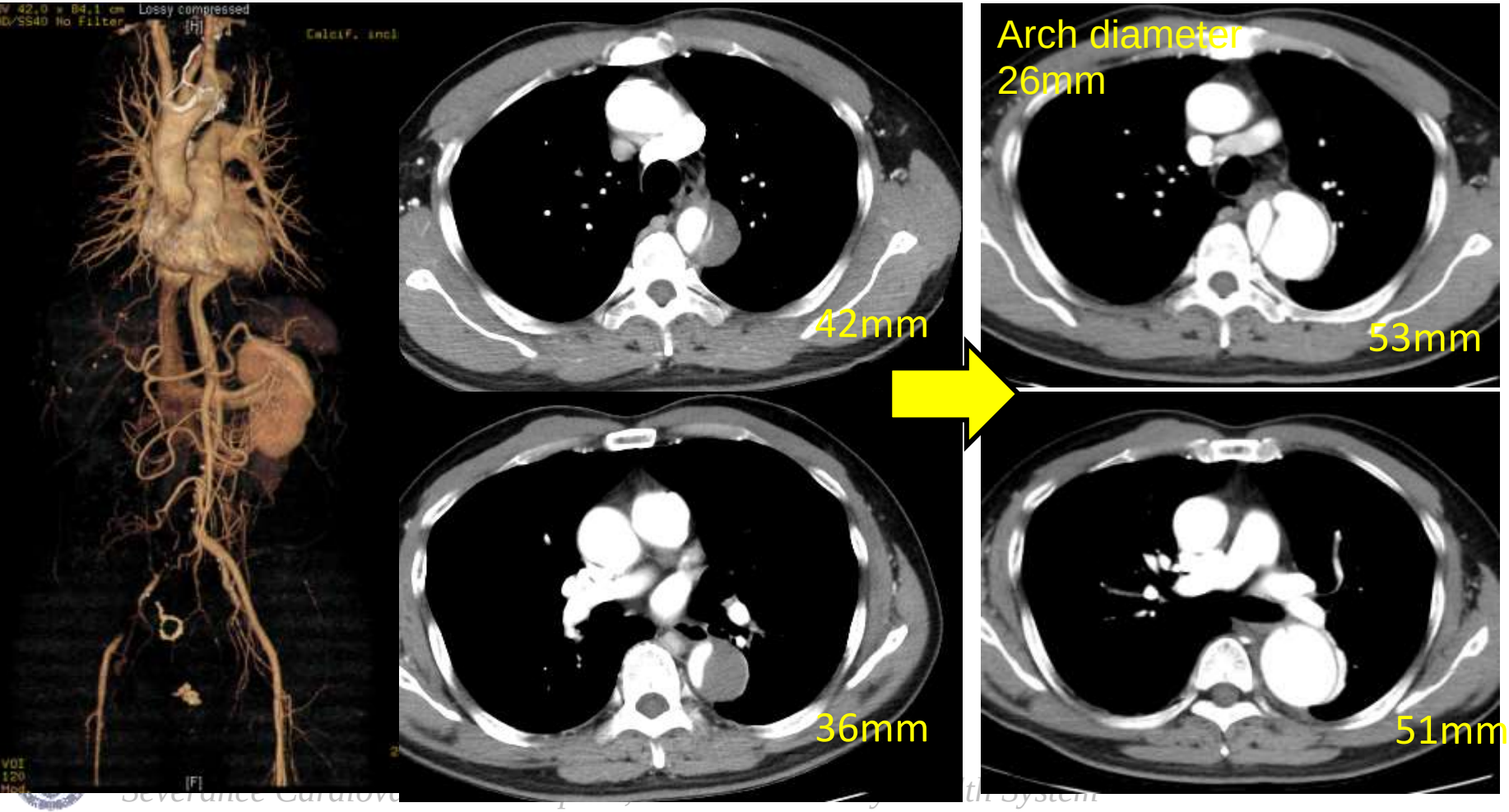
	TEVAR group (n = 311)	*TEVAR + RBS group (n = 154)*	P
Acute/chronic aortic dissection, n	180/131 (57.9%/42.1%)	86/68 (55.8%/44.2%)	.691
Preoperative mismatch rate, %	135.5 ± 13.6%	131.8 ± 10.7%	.172
Complications, n			
Access problem	6 (1.9%)	2 (1.3%)	.910
Paraparesis/paraplegia	3 (1.0%)	1 (0.6%)	.729
SIDR	9 (2.9%)	0	.033*
Secondary intervention for all causes	29 (9.3%)	6 (3.9%)	.040*
Conversion to surgery	2 (0.6%)	0	.807
Overall death	9 (2.9%)	2 (1.3%)	.352
Aorta-rated death	6 (1.9%)	1 (0.6%)	.434

RBS, Restrictive bare stent; *SIDR*, stent graft-induced distal redissection; *TEVAR*, thoracic endovascular aortic repair.
*Significant, $< .05$.

RBS dimeter = longest diameter of TL

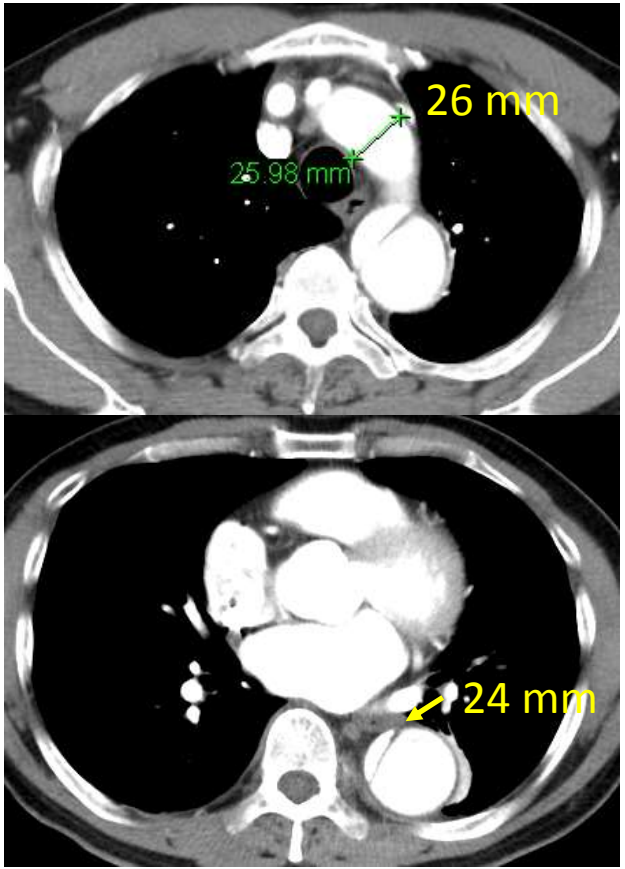
Feng J, J Vasc Surg 2013;57:44S

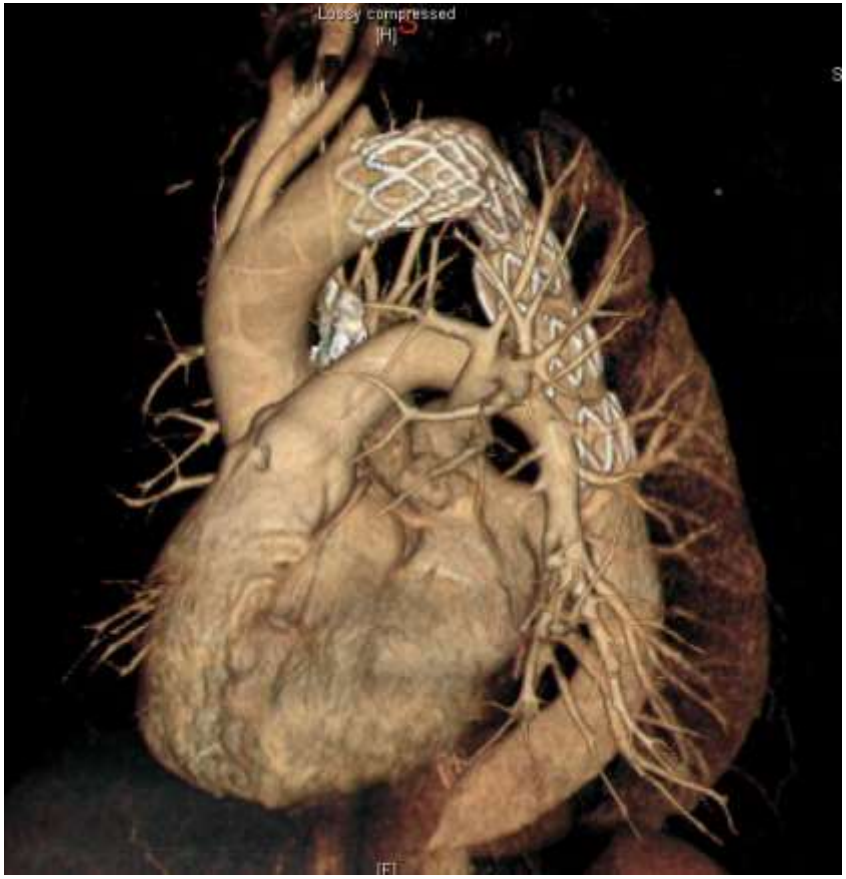
M/56, (AHK, #8159514) At 5 months after Acute TBAD



TEVAR

2014/6
TEVAR
S&G 30-130mm,

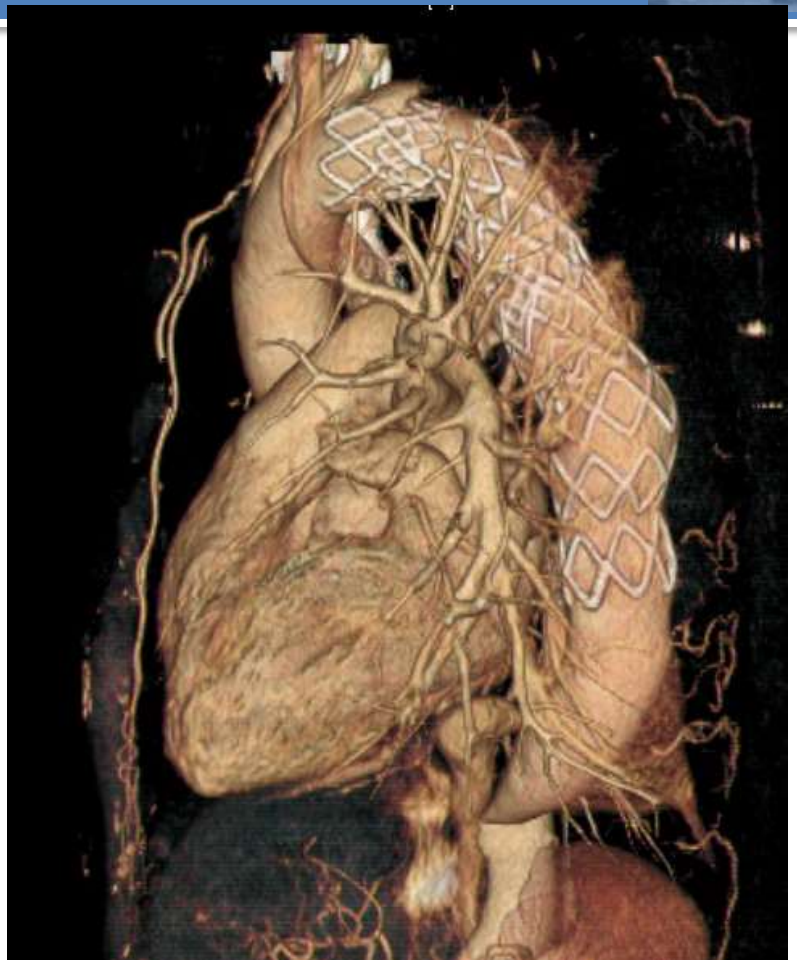




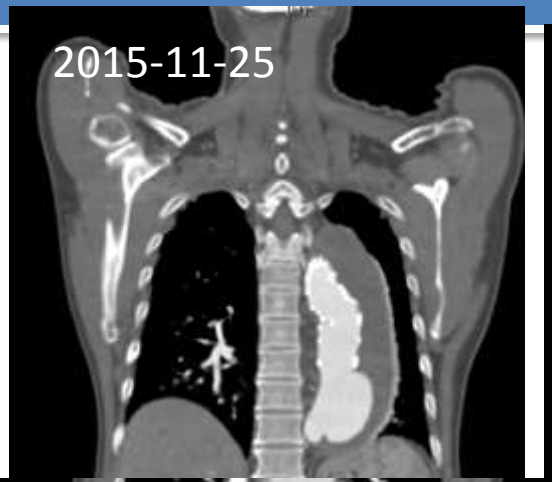
SINE occurred after 8 months

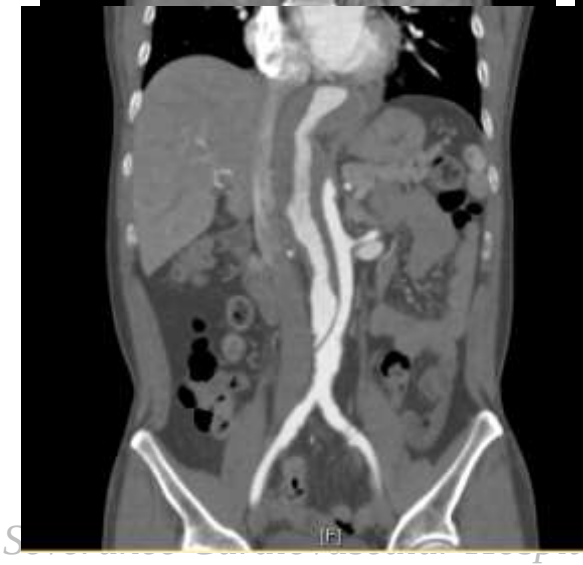
2nd TEVAR

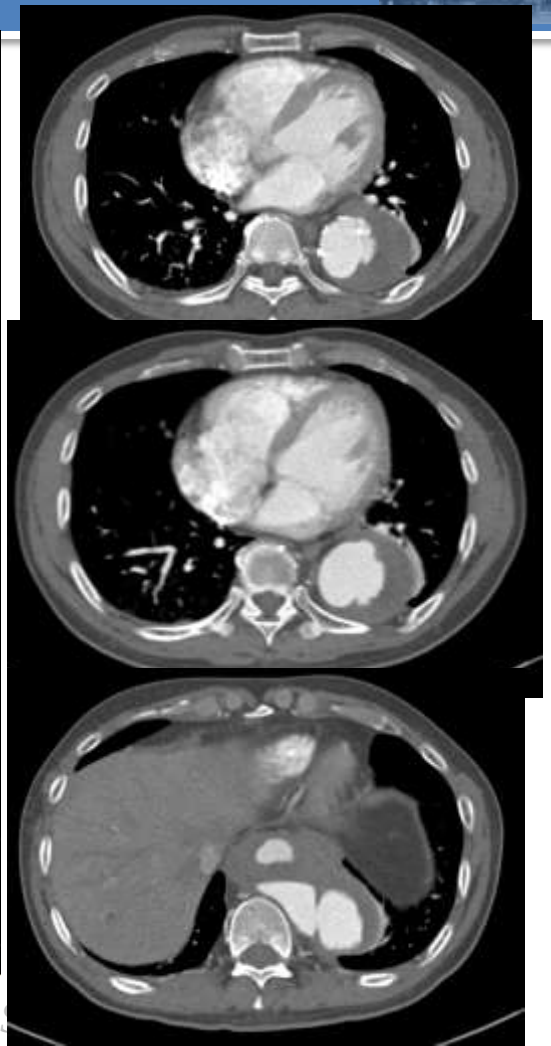
2015/2
S&G 36-32-110 mm,
tapered type



2nd SINE occurred after 8 months

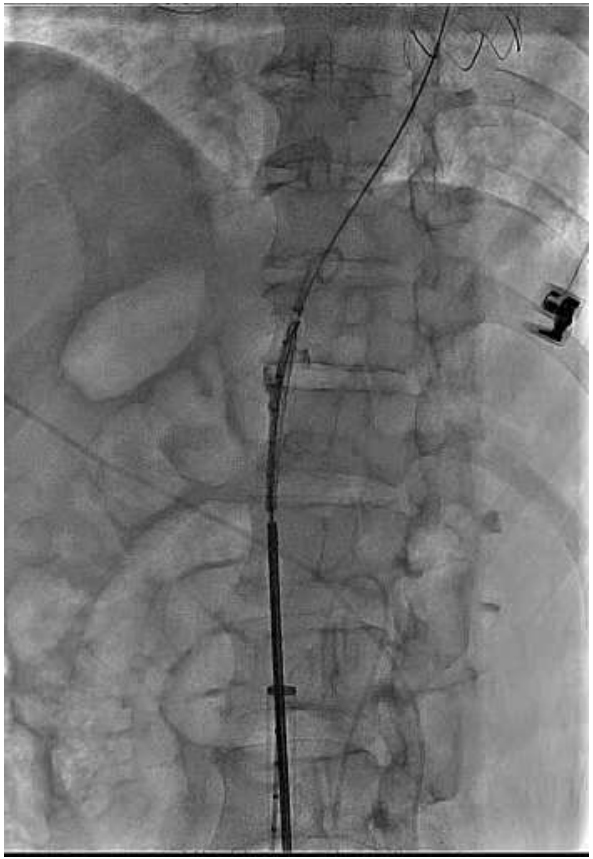


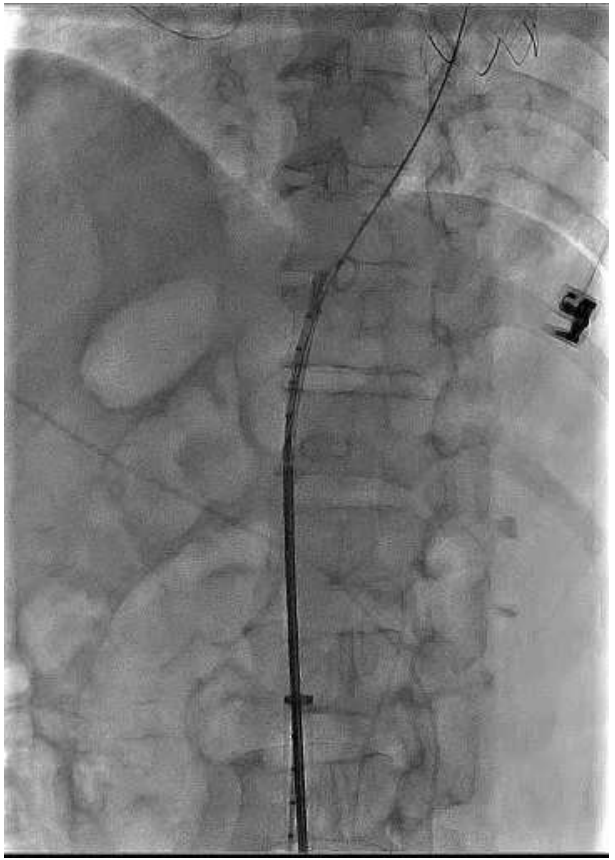




Restrictive Bare Stent

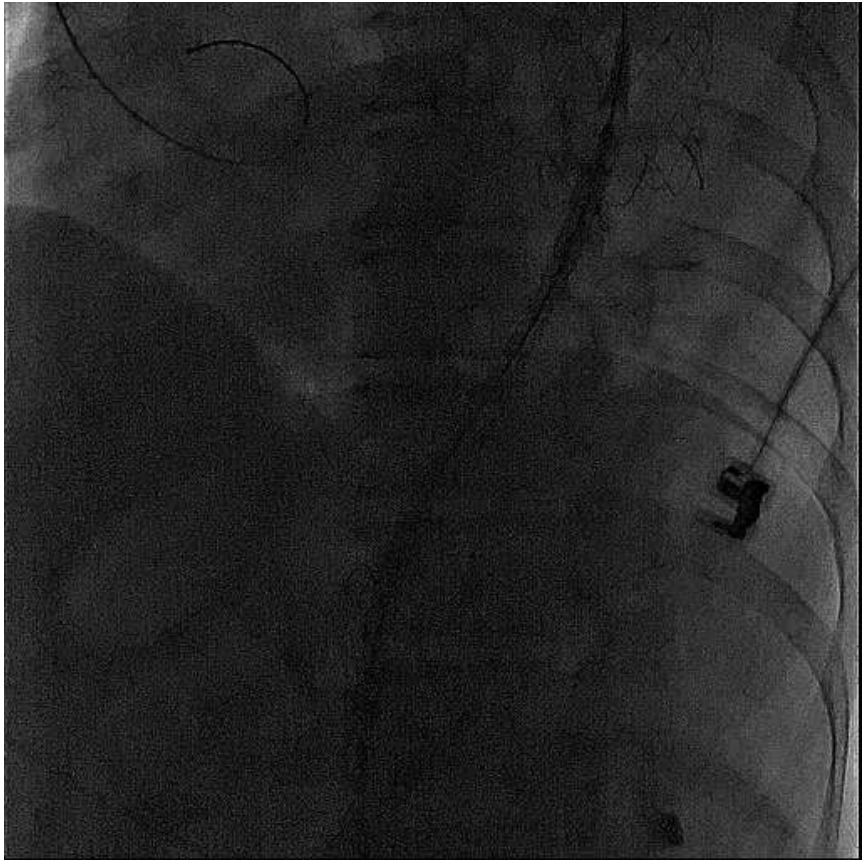
BMS 24X40 mm
Hercules Vascular



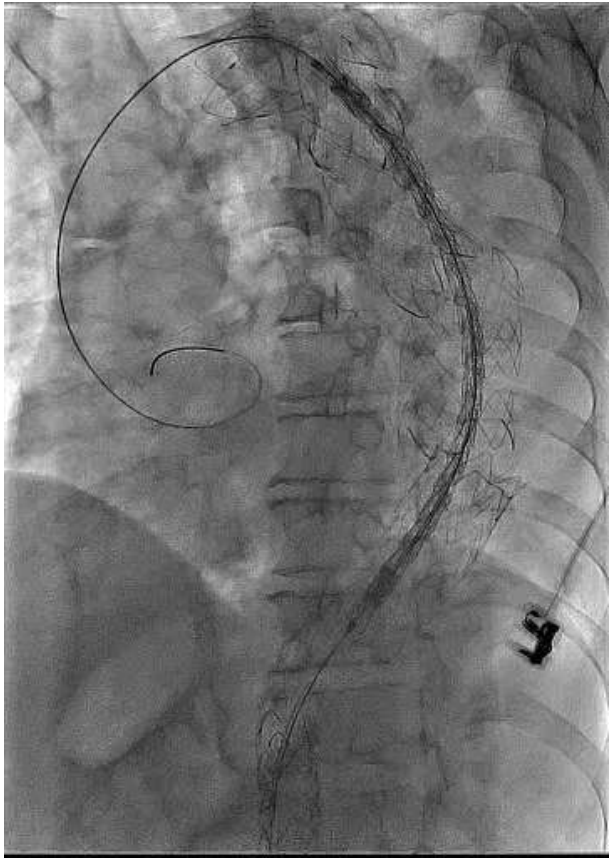


3rd TEVAR

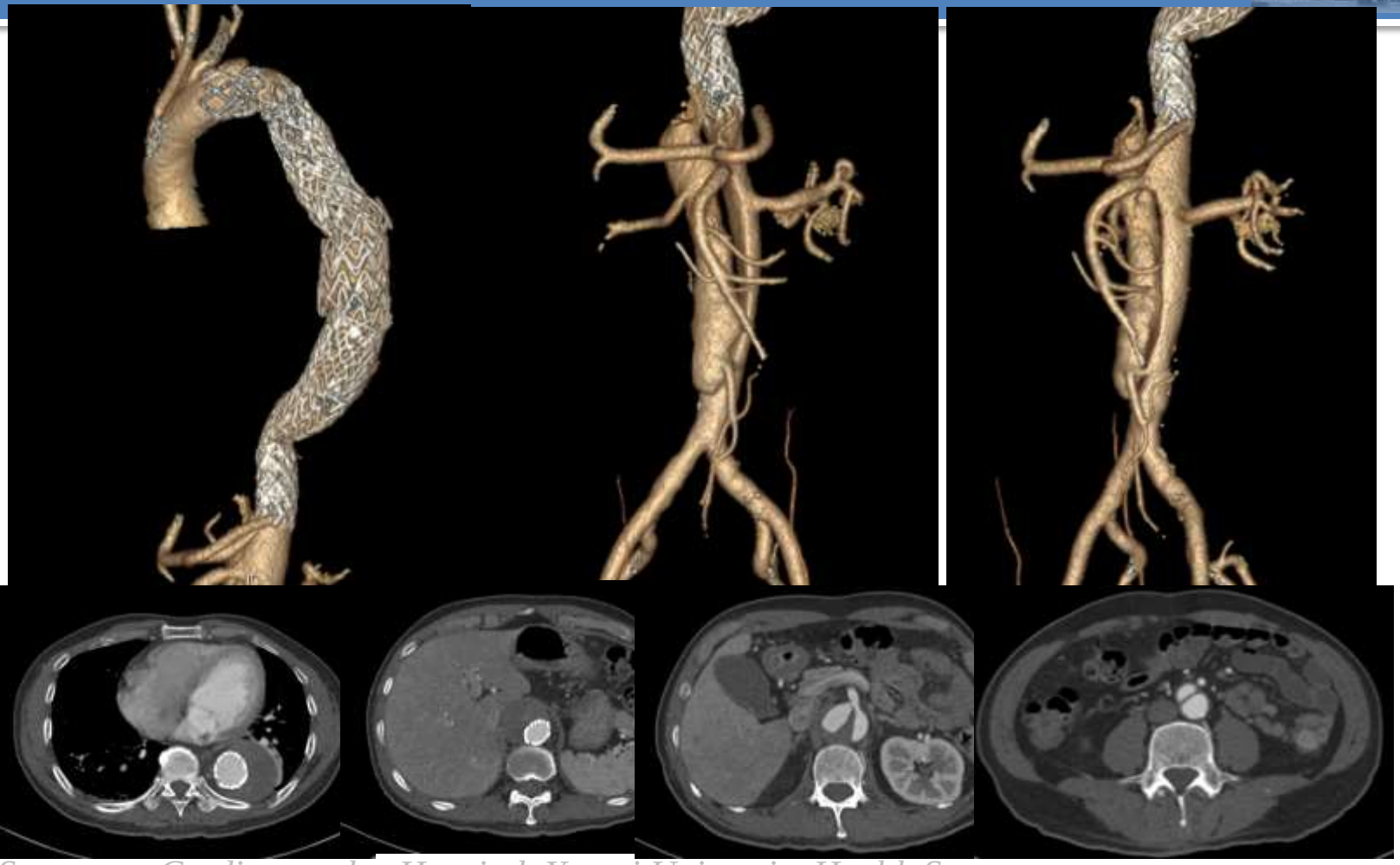
TAG 31 X 150 mm



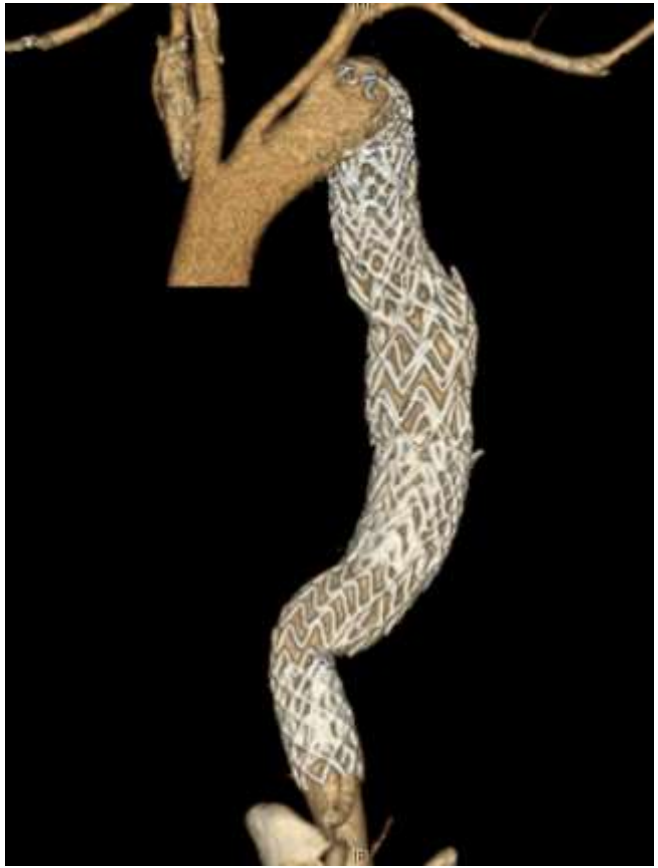
TAG 37X200mm



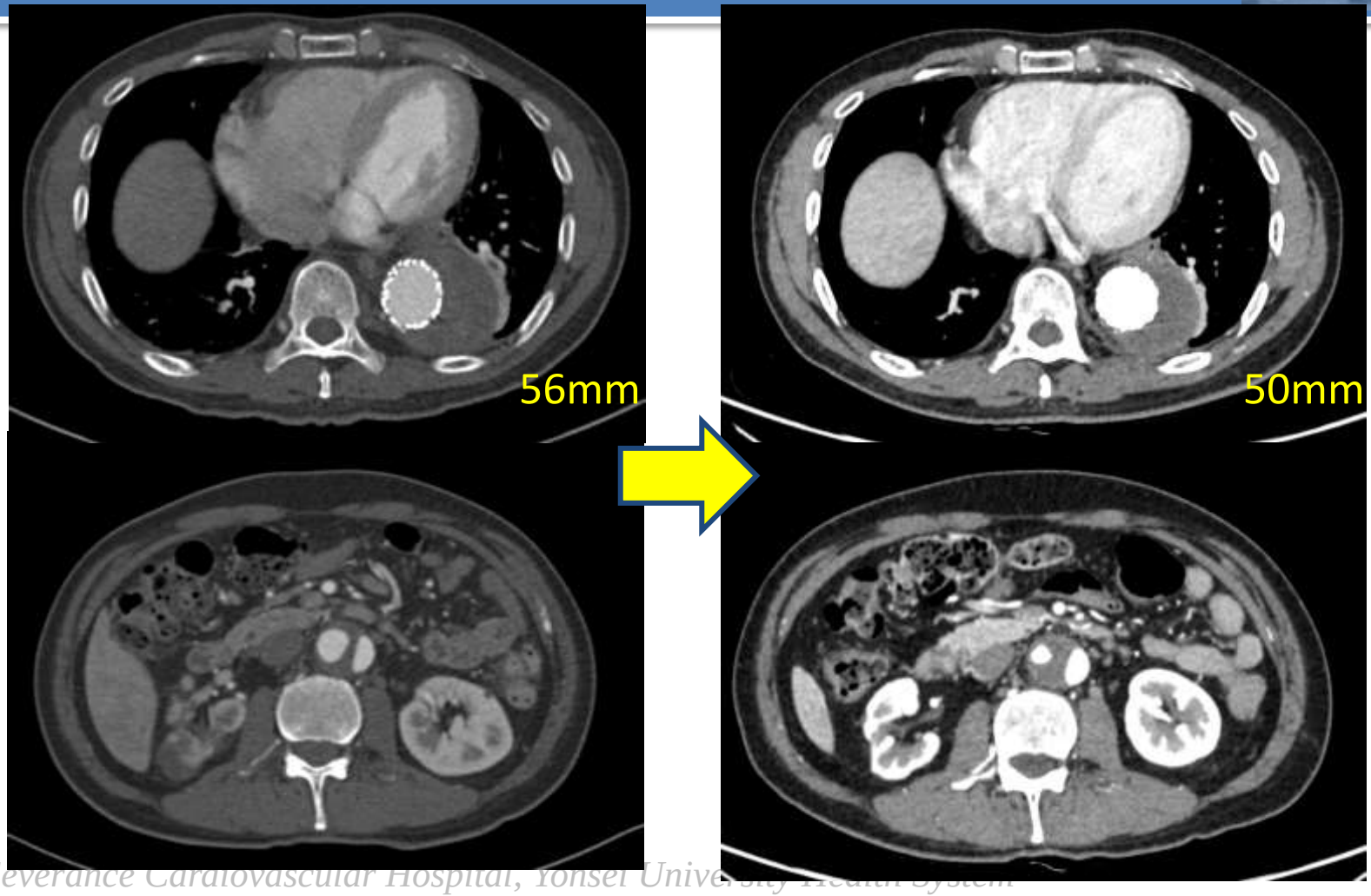
Post-procedural CT



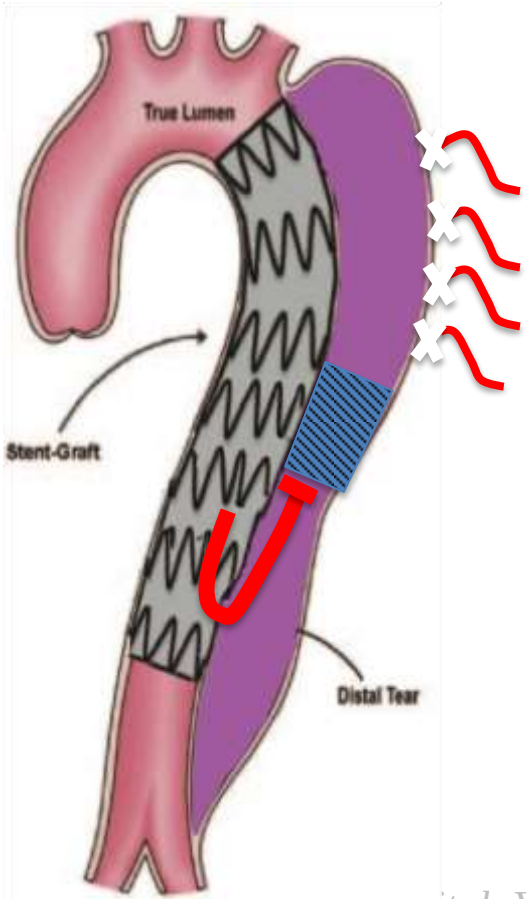
Follow-up CT (6 months later)



Follow-up CT (6 months later)



Strategies to prevent False Lumen Back Flow



- Extend aortic coverage distally
  - fEVAR
- Open surgery (Hybrid repair)
- Occlude False lumen
  - Open/Endovascular Fenestration
  - Plug, coils
  - Knickerbocker (double tapered)
- Occlude intercostals

Presentation by Tilo Kölbel
Modified by Ko

Take Home Messages

Key factors of optimal TEVAR for TBAD:

- Earlier intervention
- Detailed review of imaging studies prior to the procedure
- Selection of proper landing zones
- Proper device sizing
- Tapered configuration of stent grafts avoiding oversizing
- False lumen treatment may be required in patients with treatment failure