

Do the Data Support Endovascular Therapy for Descending Thoracic AD?

Woong Chol Kang, M.D.

Gil Hospital, Gachon University

Incheon, Korea

Classification of AD

Acute vs. Chronic (2weeks)

Debaquey system: TYPE I



TYPE II



TYPE III (IIIa, b)



Stanford system: TYPE A. (Proximal)

TYPE B. (Distal)

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type B dissections account for about 40% of all dissections.

Stable patient with
systolic BP ≥ 100 mm Hg

Initial investigations:

- Blood tests
- ECG
- Chest radiography
- Titrate BP to 100–120 mm Hg with intravenous β blockers, nitroprusside, or calcium-channel blockers
- Analgesia

Aorta dissection confirmed

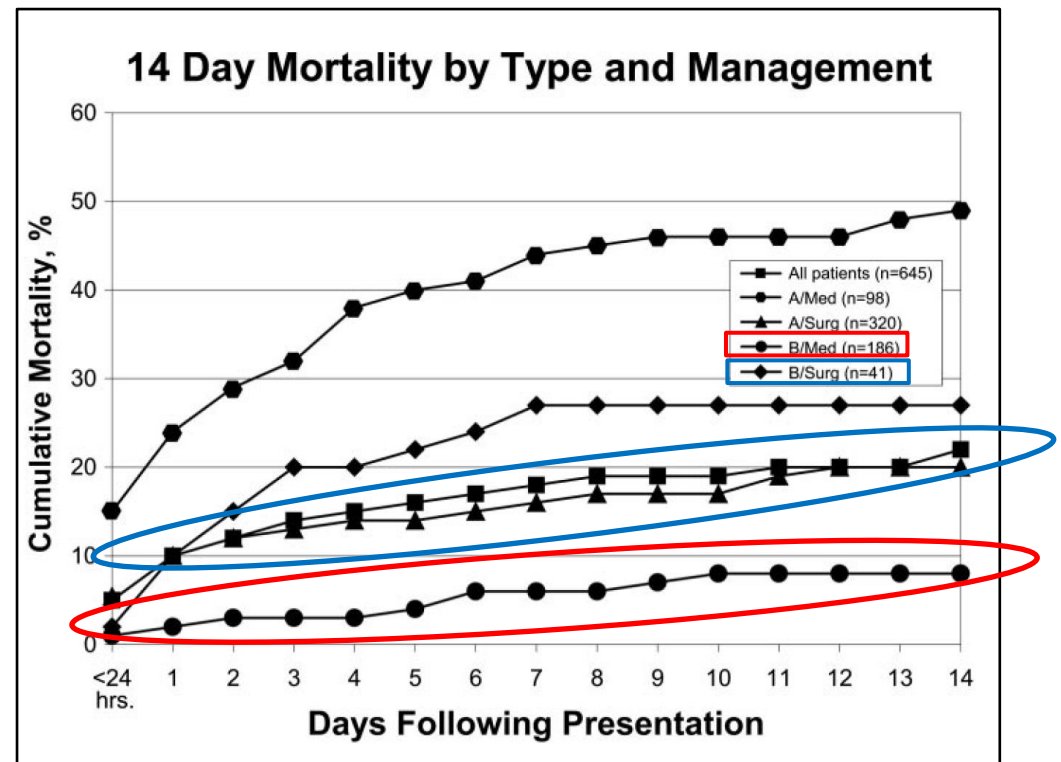
Type A

Surgery

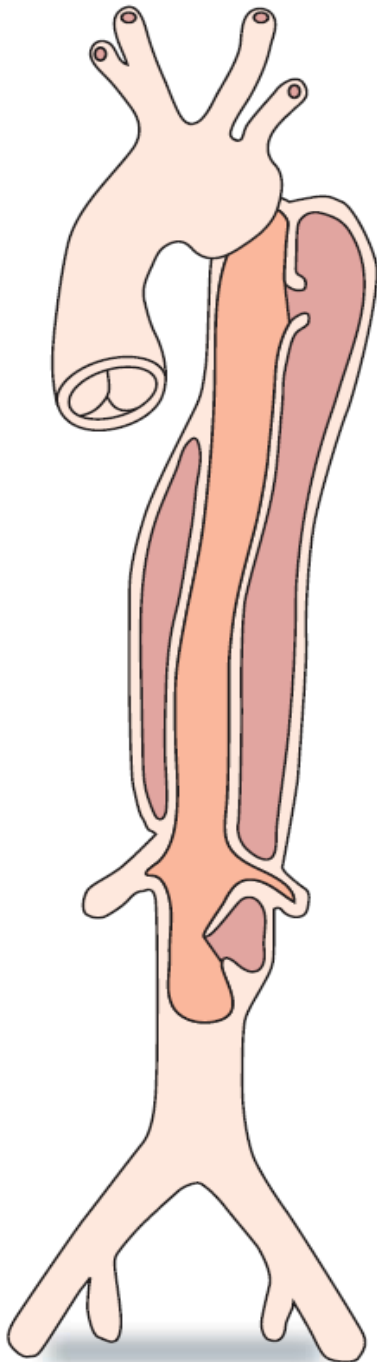
Type B

Continue
medical
treatment

Management of type B AD



Complication to acute type B Dissection



Malperfusion

Refractory hypertension

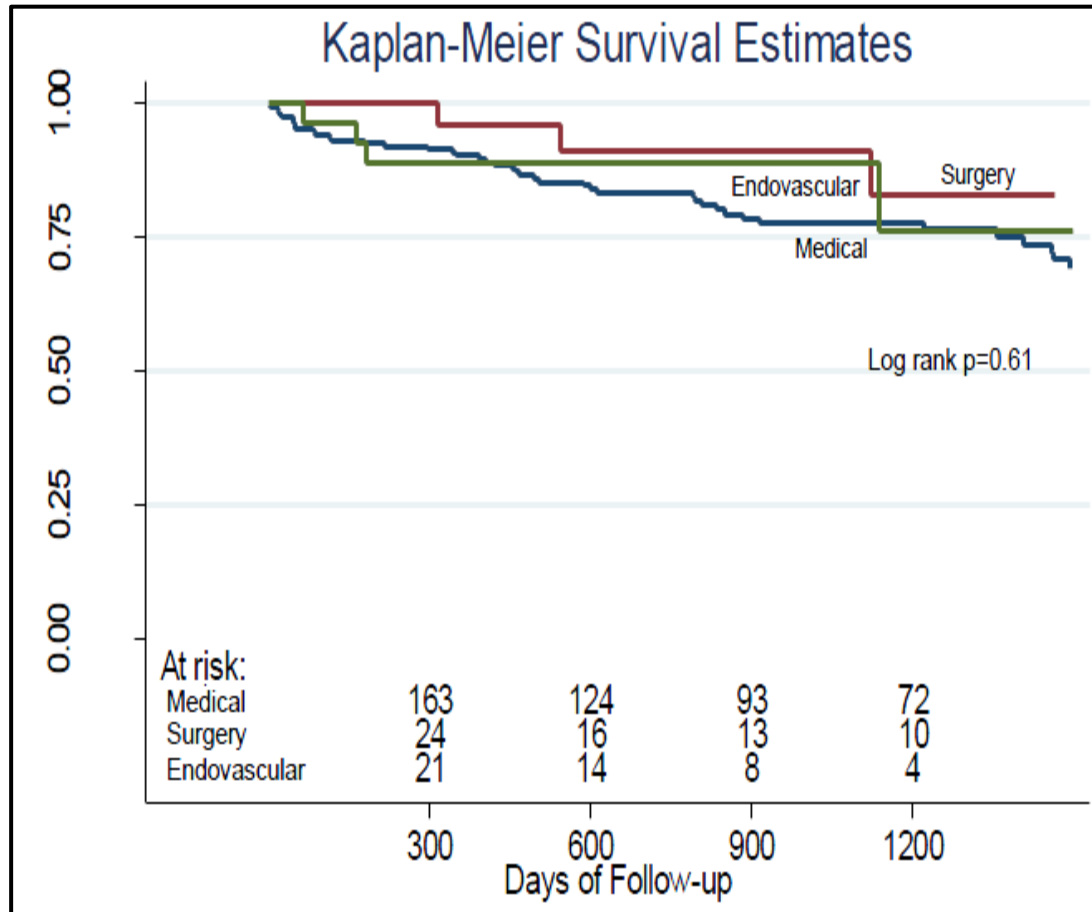
Continued pain



30%

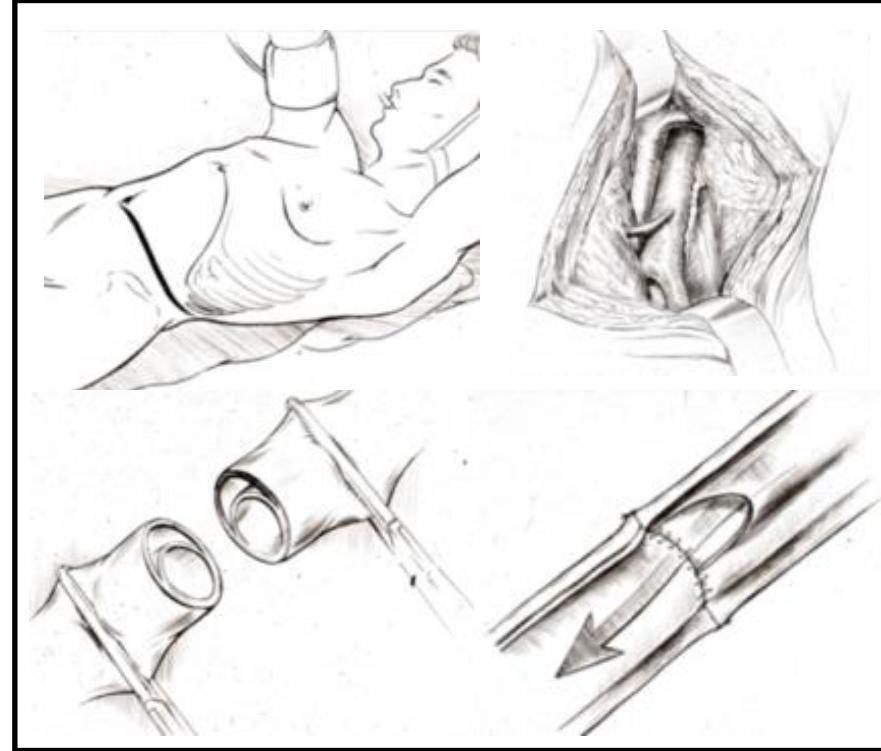
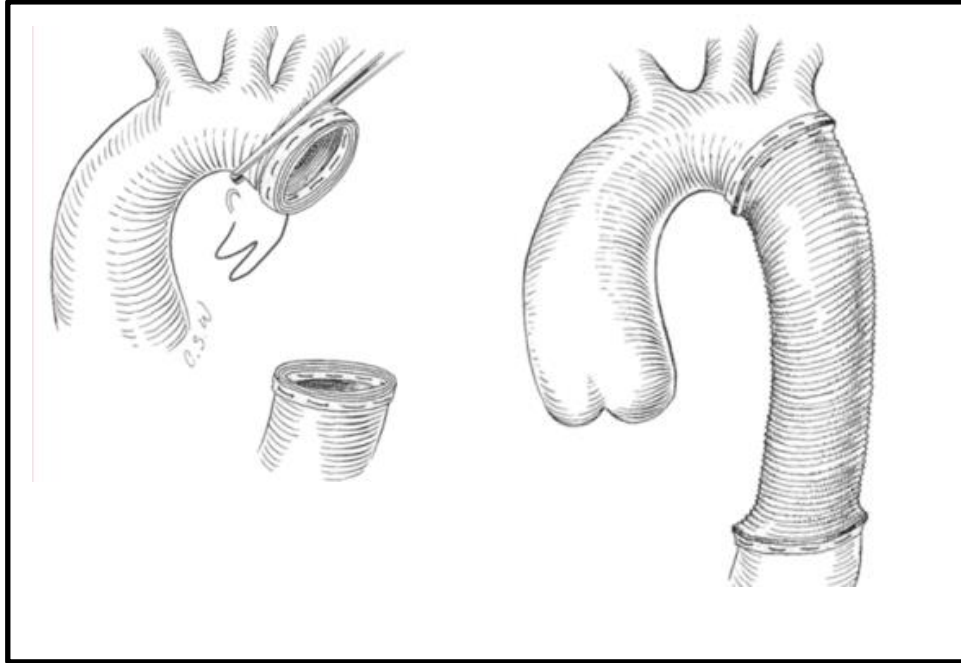
Mortality : 20% at day 2, 25-50% at 1 M

Survival of type B uncomplicated AD



- Dilatation/Aneurysm
20-50%/1-5yr
- Rupture or impending rupture
- Mortality : **25%/3yrs**
- **Intervention**
 - ✓ Open surgical repair
 - ✓ Endovascular therapy

Open Surgical Repair

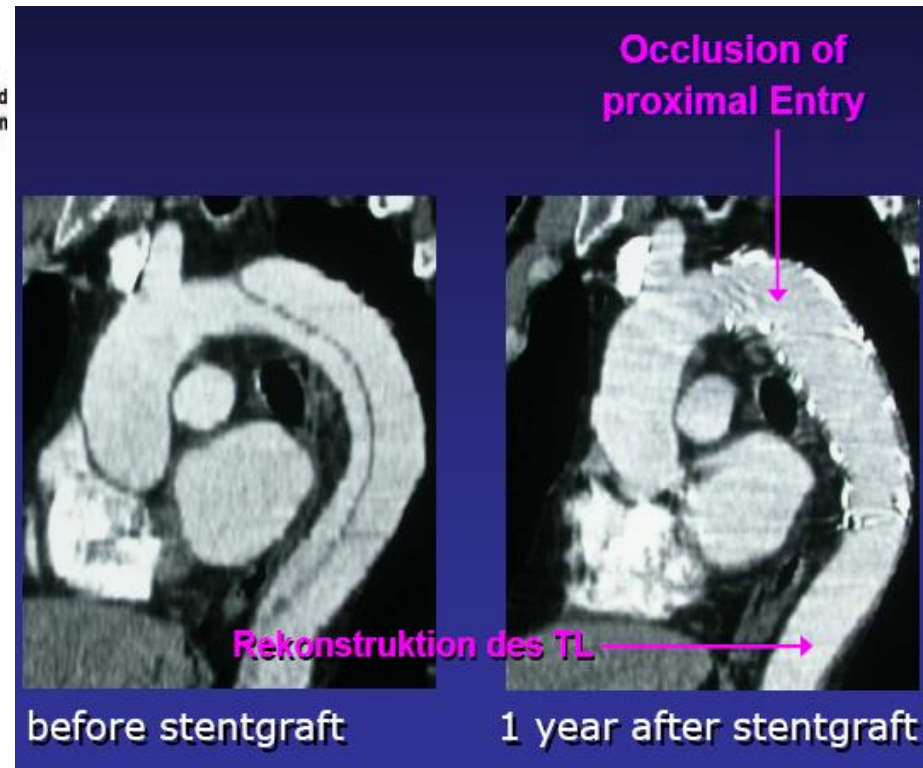
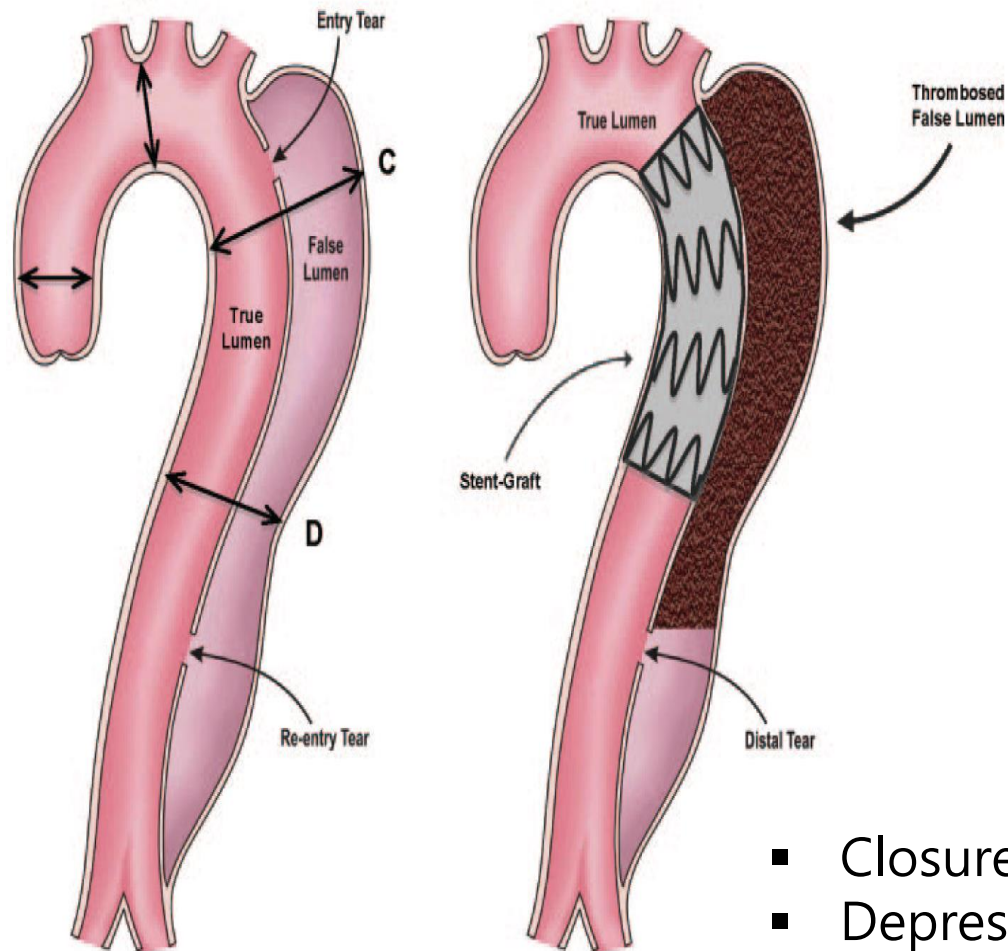


- Rupture : Graft replacement
- Expansion : Graft replacement
- Ischemia : Fenestration

- High in-hospital mortality (29%)
- New neurologic deficit (23%)
- Stroke (9%)
- Sustained paraplegia (5%)

from IRAD registry (Circulation 2006)

Concept of Endovascular therapy in AD



- Closure of the Proximal Entry tear
- Depressurization of the False Lumen
- Redirection of blood flow towards the TL
- Thrombosis of the FL
- Induction of aortic remodeling

Classification of AD for treatment strategy

Acute vs. Chronic

Complicated vs. Uncomplicated

Classification of AD for treatment modality

Acute vs. Chronic

Complicated vs. Uncomplicated

Open vs. Endovascular repair



Complicated Acute Type B AD: Is Surgery Still the Best Option? - Demographics

Variable	Medical Treatment (n = 390)	Emergency Treatment (n = 125)		p Value*
		Endovascular (Stent-Graft or Fenestration) (n = 66)	Surgery (Interposition Grafting or Fenestration) (n = 59)	
n (%)	390 (75.7)	66 (12.8)	59 (11.5)	
Demographics				
Age, mean (± SD), yrs	65.5 (13.2)	58.8 (11.1)	61.9 (14.7)	<0.001
Gender, male (%)	254 (65.1)	47 (71.2)	46 (78.0)	0.11
Etiology and patients' history				
Marfan syndrome (%)	6 (1.6)	3 (4.6)	6 (10.5)	—
Hypertension (%)	295 (76.6)	54 (81.8)	41 (70.7)	0.34
Atherosclerosis (%)	150 (39.6)	17 (26.2)	17 (30.4)	0.07
Bicuspid aortic valve (%)	5 (2.1)	0 (0.0)	0 (0.0)	—
Iatrogenic dissection (%)	16 (4.5)	1 (1.5)	0 (0.0)	—
Prior aortic dissection (%)	23 (6.1)	4 (6.2)	10 (17.9)	—
Prior aortic aneurysm (%)	69 (18.2)	8 (12.3)	16 (28.6)	0.07
Diabetes (%)	21 (5.6)	4 (6.2)	6 (10.9)	—
Prior cardiac surgery (%)	67 (18.4)	11 (17.2)	14 (25.0)	0.47

- IRAD represents 21 large centers in 11 countries which between 1996 and 2003 collected **571 type B AD**.
- Patients with symptoms of **ischemia or refractory pain** underwent an intervention (N=125, surgery or endovascular therapy).

Patients submitted to **surgery** presented with a **wider aortic diameter** than patients treated by endovascular therapy (5.36±1.7 vs. 4.62±1.4 cm, p=0.003).



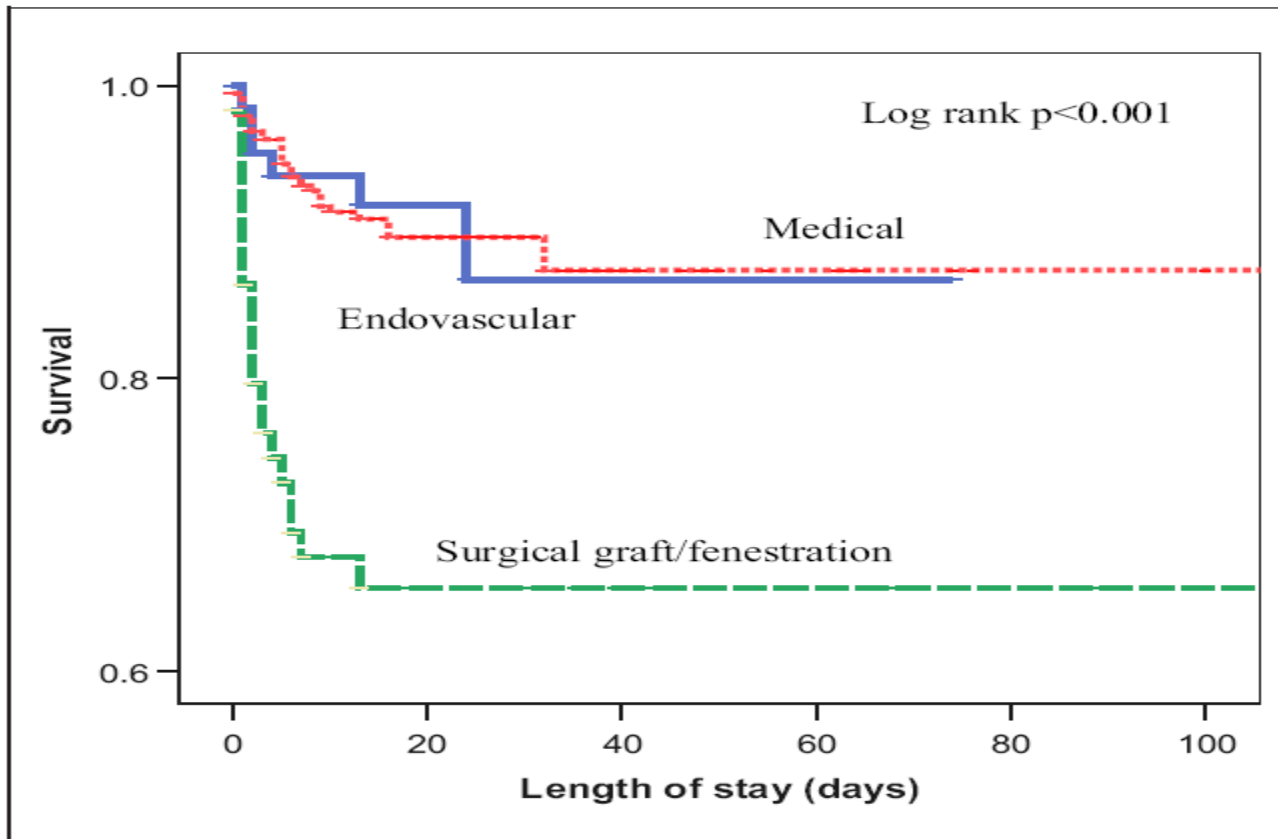
Complicated Acute Type B Dissection : Is Surgery Still the Best Option?

-IH complication & mortality

Variable	Endovascular (66 Patients) With Stent-Graft Placement in Aorta or Fenestration	Surgical (59 Patients) With Interposition Grafting or Fenestration	p Value
In-hospital complications (post-treatment) (%)			
CVA	2 (3.4)	4 (9.1)	0.40
Coma	1 (1.7)	2 (4.5)	0.58
Spinal cord ischemia	2 (3.4)	3 (6.8)	0.65
Myocardial infarction	1 (1.8)	1 (2.6)	>0.99
Mesenteric ischemia/infarction	4 (7.4)	2 (4.9)	0.70
Acute renal failure	4 (7.4)	8 (19.0)	0.09
Limb ischemia	2 (3.6)	2 (5.0)	>0.99
Any of the above complications	11 (20.8)	16 (40.0)	0.04
Mortality (%)	7 (10.6)	20 (33.9)	0.002



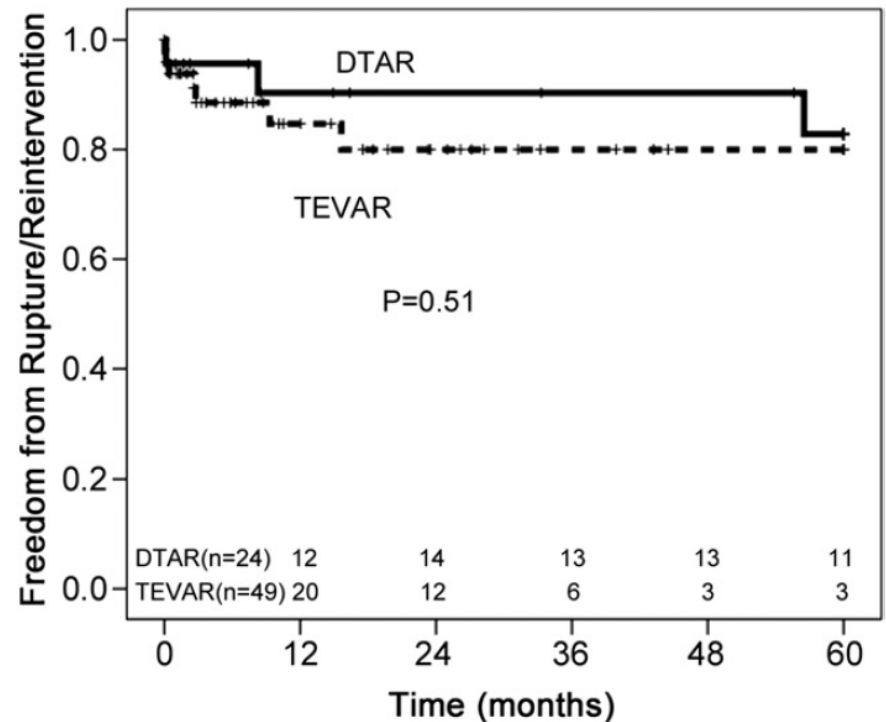
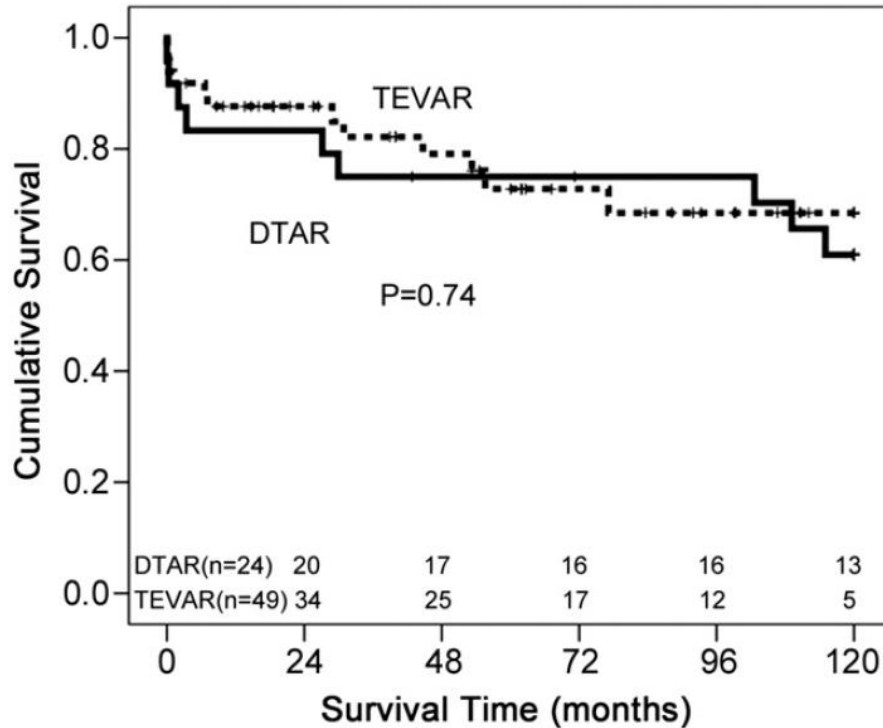
Complicated Acute Type B AD: Is Surgery Still the Best Option? - IH Cx & mortality



The less invasive nature of endovascular treatment seems to provide better in-hospital survival in patients with acute type B dissection.

Early Open and Endovascular Thoracic Aortic Repair for Complicated Type B AD

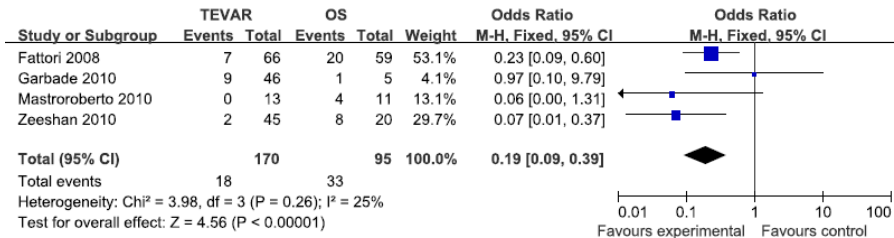
Seventy-three patients (mean age 66.3 yrs) with type B AD underwent early open descending aortic repair (n=24) or TEVAR (n=49).



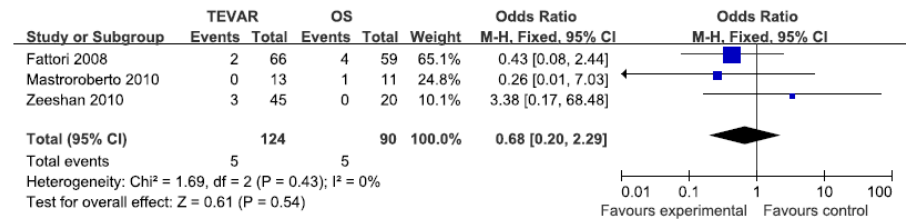
Patients undergoing TEVAR were **older** and had an **increased incidence of coronary artery disease and renal impairment** (all $p < 0.05$).

Endovascular Stent-Graft Placement or Open Surgery for the Treatment of Acute Type B Aortic Dissection: A Meta-Analysis

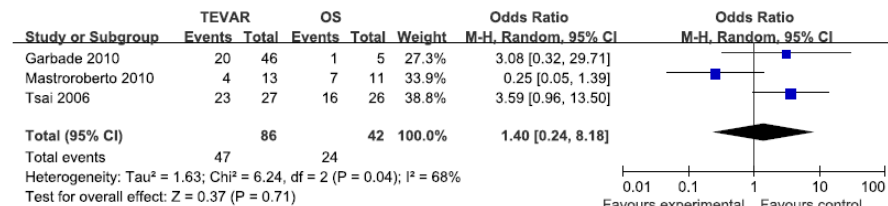
Thirty-day mortality



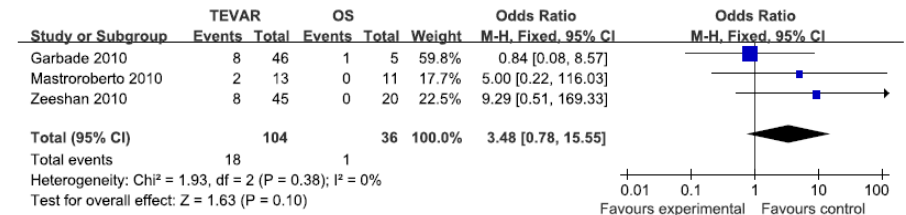
Stroke



Long-term mortality



Reintervention

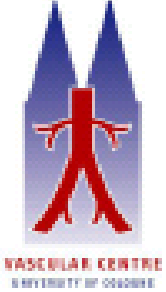


Classification of AD for treatment modality

Acute vs. Chronic

Complicated vs. **Uncomplicated**

OMT vs. Endovascular repair



ADSORB Trial

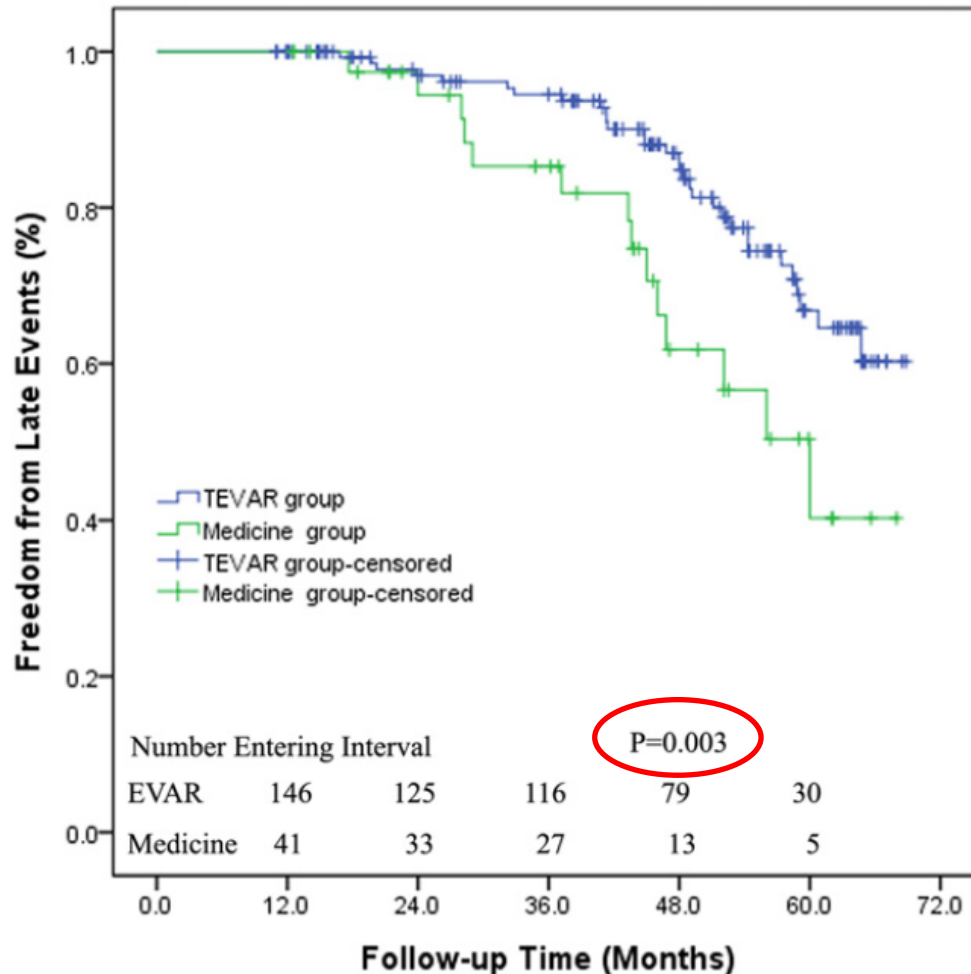
Prospective, Randomized, Multicentric, European study in **A**cute Uncomplicated Aortic **D**issection Type B Evaluating **S**tent-Graft Placement **OR** **B**est Medical Treatment (BMT) Alone

Number of Patients	250 (125 stent-graft, 125 BMT)
Number of Sites	30 centres, Europe
Total Study Duration	4 years (2007) <ul style="list-style-type: none">• 1 year recruitment• 3 year follow-up



Thoracic Endovascular Aortic Repair or Medical Management Alone?-Late events

- **193** consecutive patients in 2 hospitals (**Nanjing and Cleveland Clinic**) were enrolled.
- TEVAR group—**TEVAR and medications (n=152)** vs. **Medicine group-medically alone (n=41)**.
- All TEVAR procedures were performed in the **acute phase**.

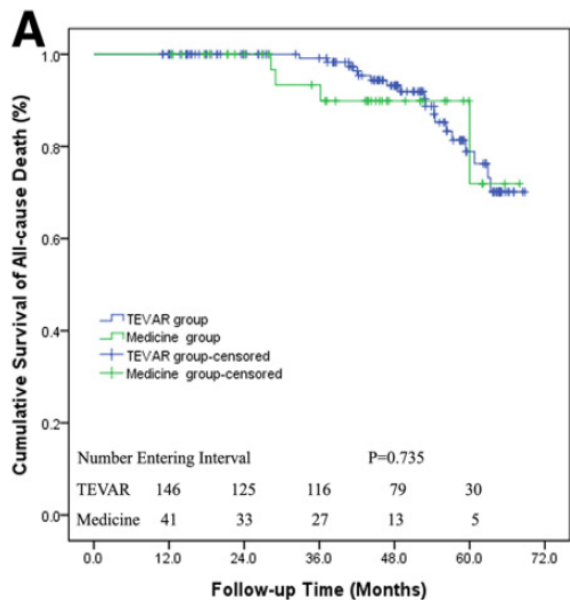


Late events

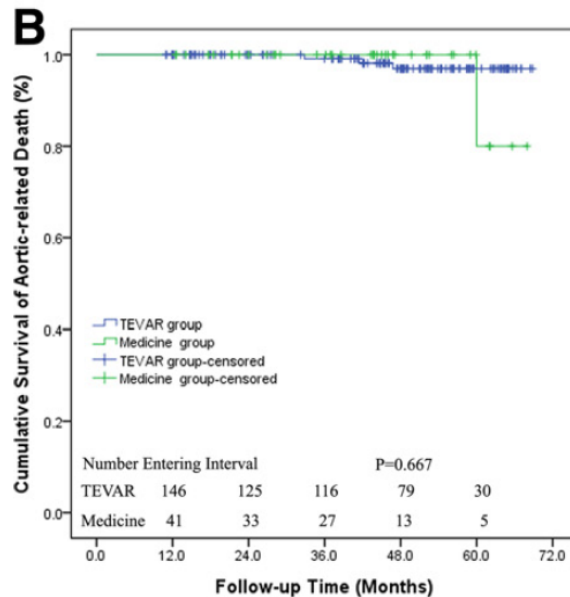
- Aortic rupture
- Retrograde Dissection
- Aortic enlargement
- Type-I and -II endoleaks
- Ulcerlike projection
- Late death

	1Y	3Y	5Y
TEVAR	97%	89%	67%
Medicine	97%	63%	34%

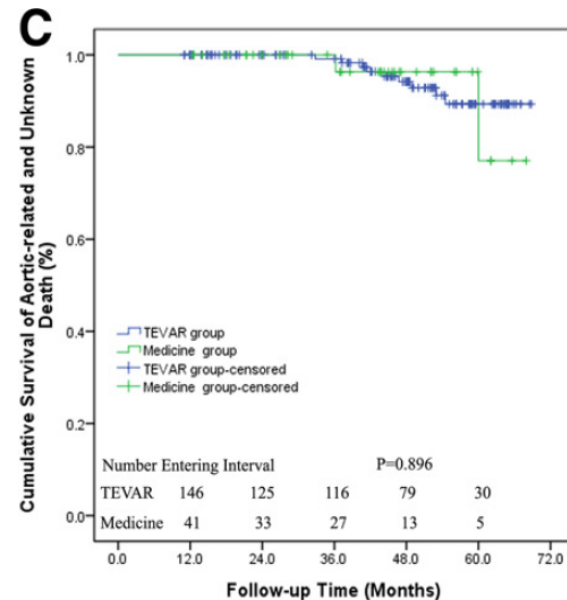
Thoracic Endovascular Aortic Repair or Medical Management Alone?-Death



All-cause Death



Aortic related Death



Aortic related Death & Unknown Death

Patients with type-B AAD treated with TEVAR experienced **fewer late adverse events** than those treated with medical management, but there was **no** significant difference among the groups in **5-year mortality** rates.

Classification of AD for treatment modality

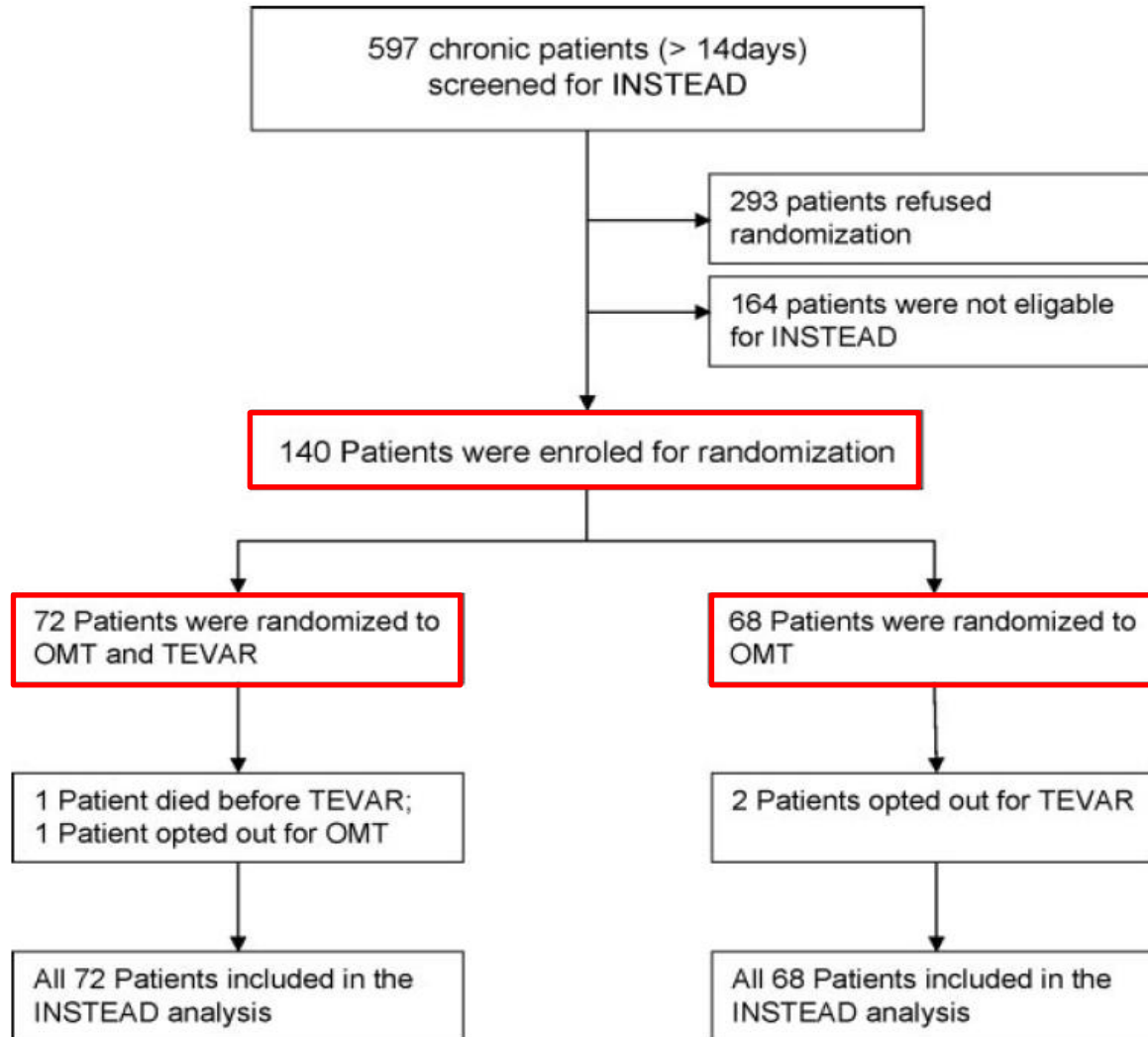
Acute vs. **Chronic**

Complicated vs. **Uncomplicated**

OMT vs. Endovascular repair

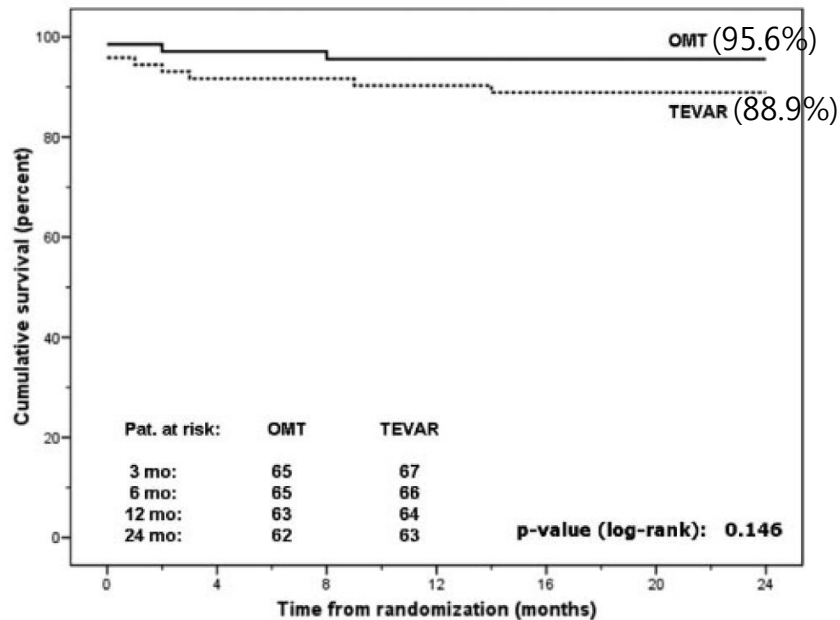
Randomized Comparison of Strategies for Uncomplicated Chronic Type B AD

The INvestigation of STEnt Grafts in Aortic Dissection (INSTEAD) Trial

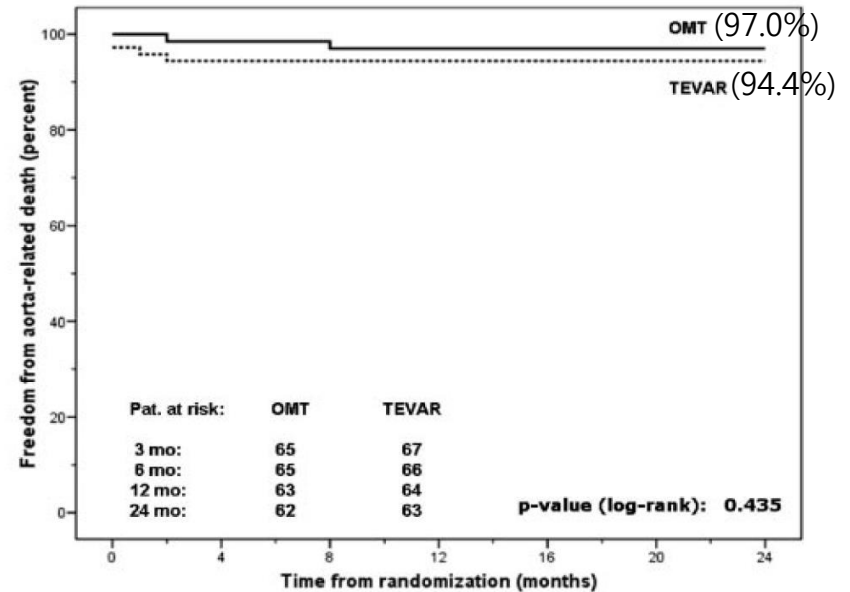


- **Primary EP**
 - all-cause death at 2yrs
- **Secondary EP**
 - aorta-related death
 - AD progression
 - aortic remodeling
- The study achieved 100% technical success in all TEVAR group.

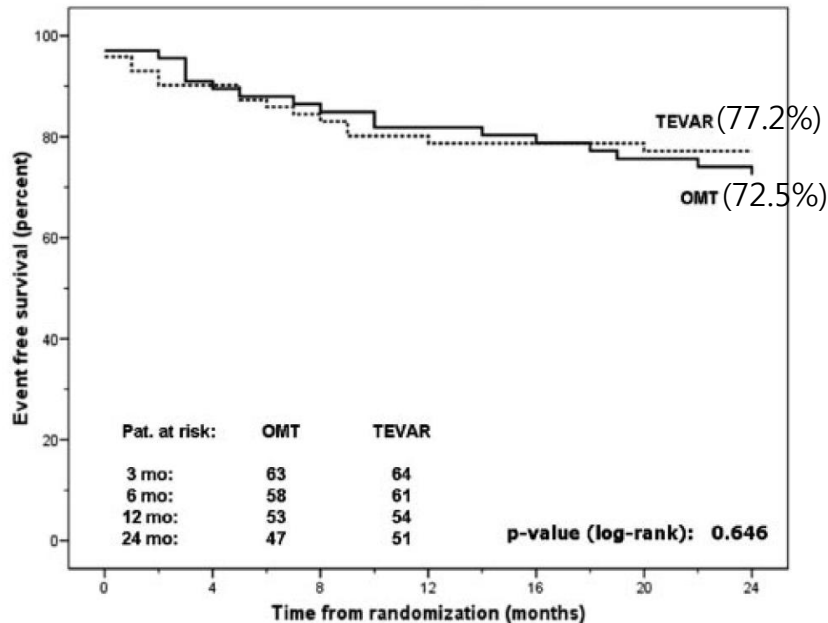
Cumulative survival



Aorta-related mortality

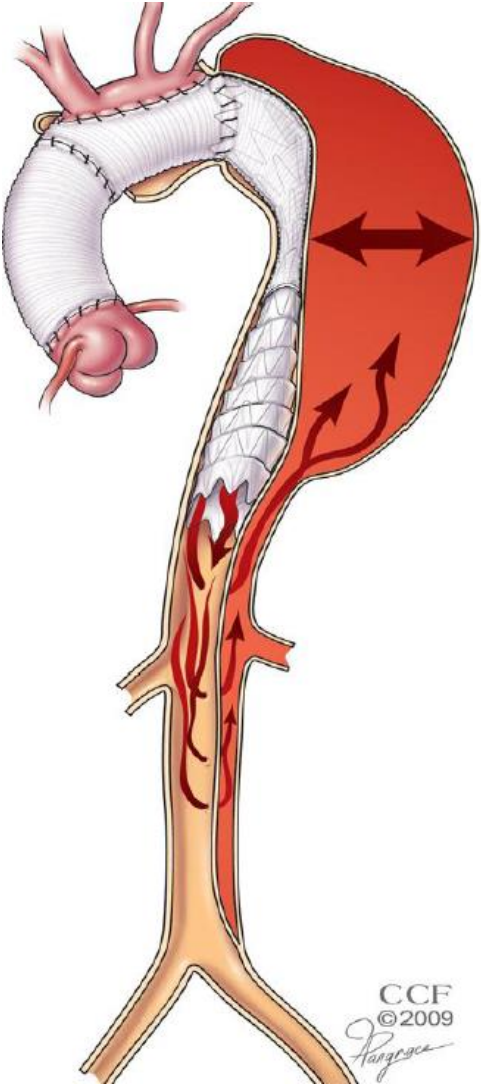
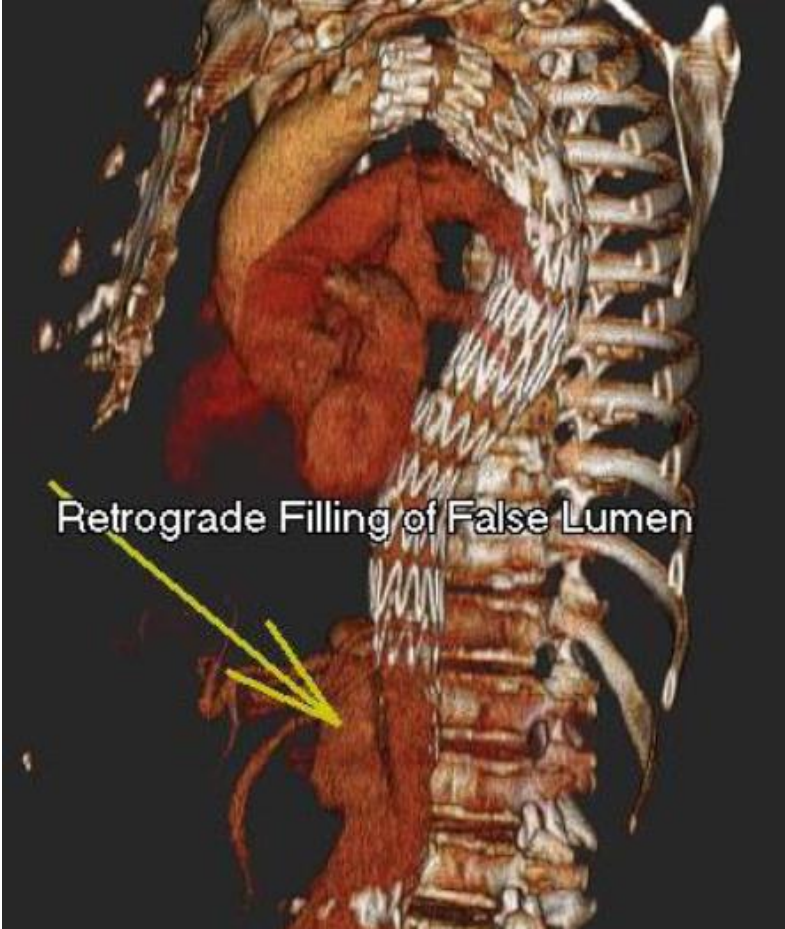


Combined end point of progression and adverse events



- Three neurological adverse events occurred in the TEVAR group (1 paraplegia, 1 stroke, and 1 transient paraparesis), versus 1 case of paraparesis with medical treatment.

Persistent perfusion of the false lumen



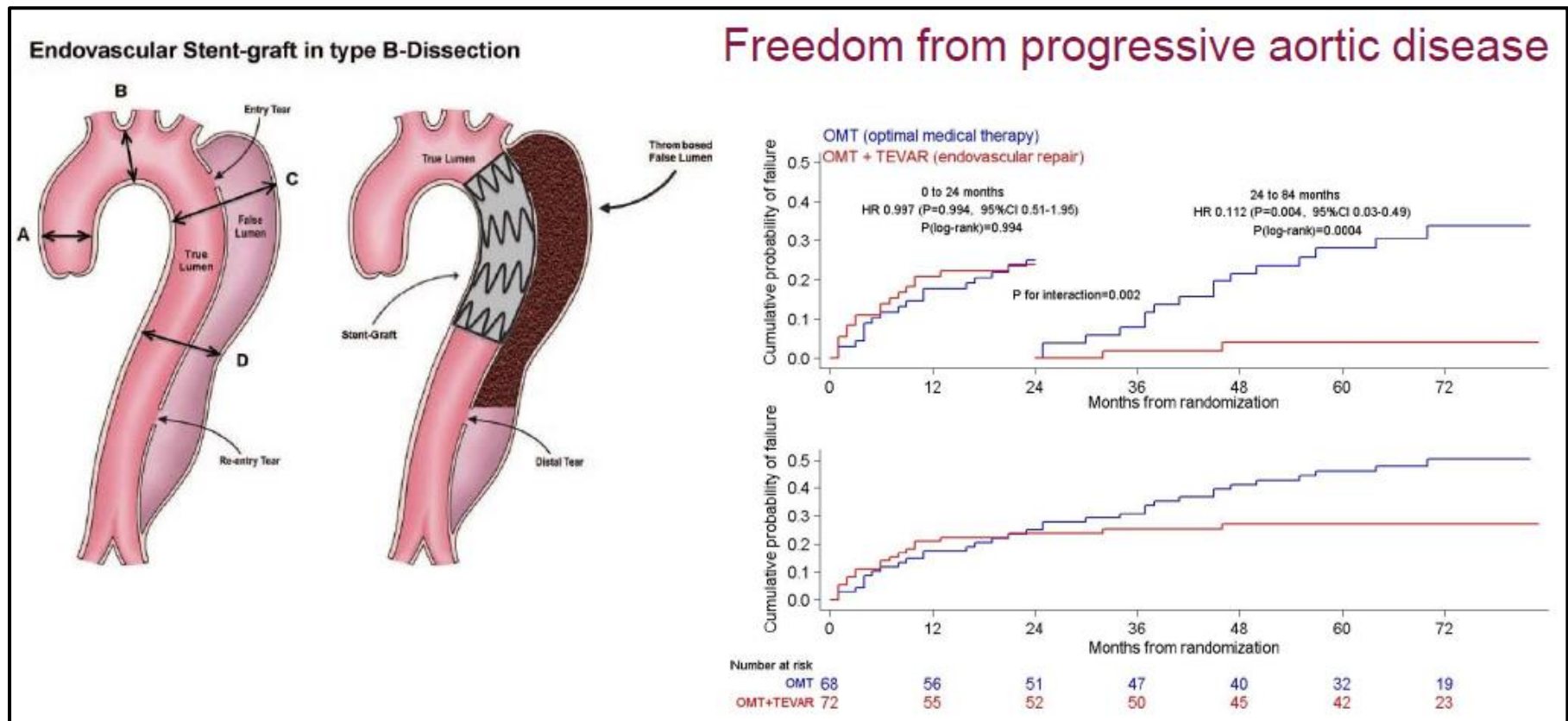
Characteristics	OMT (n=68)	OMT+TEVAR (n=72)	P
Baseline type B dissection			
Maximum aortic diameter	43.6±9.2*	44.1±9.6	0.65
True-lumen diameter at level C	20.3±9.3	19.4±8.0*	0.55
False-lumen diameter at level C	27.7±11.6	29.3±12.4*	0.65
True-lumen diameter at level D	17.3±8.7	17.4±10.7*	0.91
False-lumen diameter at level D	24.0±10.4	26.9±10.9*	0.13
3-Month follow-up			
Maximum aortic diameter	46.2±11.1	44.7±8.3	0.75
True-lumen diameter at level C	21.9±8.8	30.6±6.0	<0.001
False-lumen diameter at level C	29.4±15.0	14.0±14.2†	<0.001
True-lumen diameter at level D	17.1±8.8	25.7±6.7	<0.001
False-lumen diameter at level D	27.4±12.9	17.2±13.7†	<0.001
1-Year follow-up			
Maximum aortic diameter	45.5±7.9	44.7±11.9	0.37
True-lumen diameter at level C	23.9±9.9	31.8±5.9	<0.001
False-lumen diameter at level C	24.7±15.5	13.1±18.9	<0.001
True-lumen diameter at level D	19.3±9.0	27.1±7.0	<0.001
False-lumen diameter at level D	24.8±11.5	14.6±14.7	<0.001
2-Year follow-up			
Maximum aortic diameter	48.3±13.1	43.8±12.5	0.31
True-lumen diameter at level C	22.7±10.9	32.3±6.4	<0.001
False-lumen diameter at level C	26.8±9.4	12.5±16.7	<0.001
True-lumen diameter at level D	18.3±7.8	27.0±7.3	<0.001
False-lumen diameter at level D	26.9±10.3	13.8±14.9	<0.001
False-lumen thrombosis at 2 y, n (%)‡			
Complete	13 (19.4)	63 (91.3)	<0.001
Incomplete	6 (9.1)	6 (8.7)	0.79

Aortic remodeling

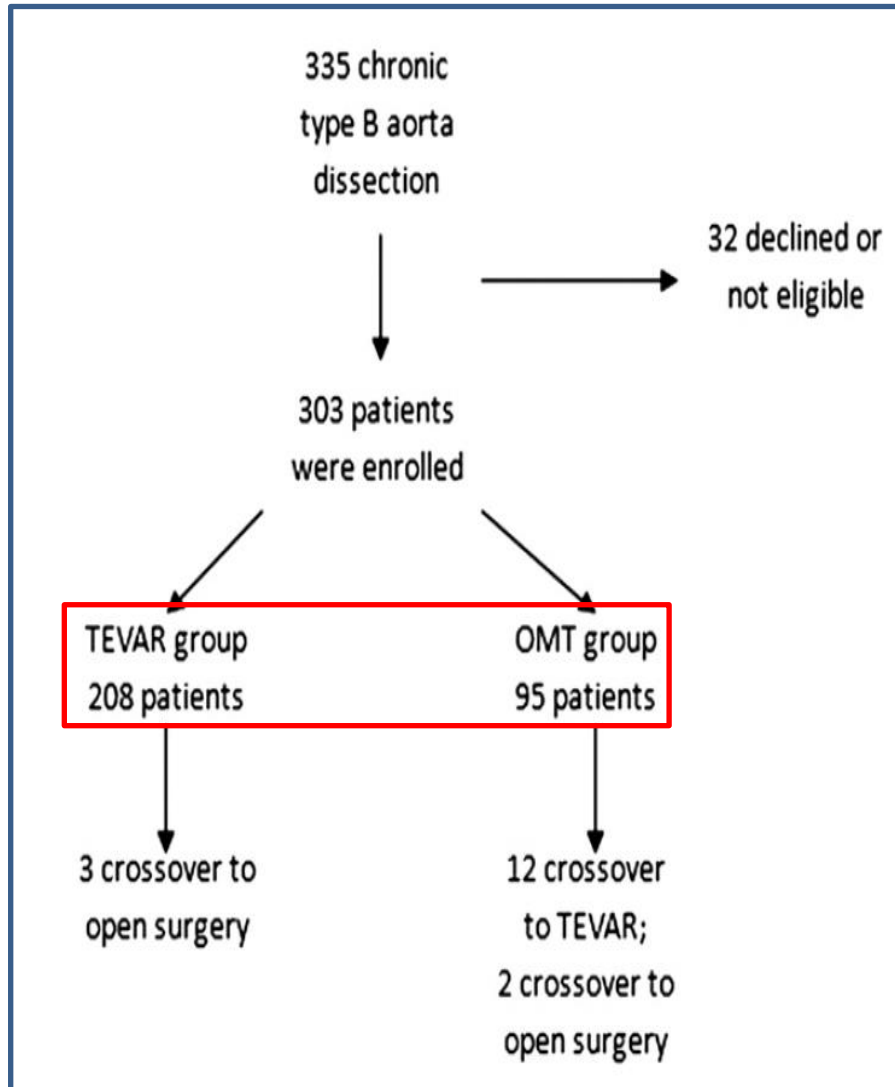
- Aortic remodeling** (with true-lumen recovery and thoracic false-lumen thrombosis) occurred in **91.3% of patients with TEVAR** vs. **19.4%** of those who received **medical treatment (P<0.001)**, which suggests ongoing aortic remodeling.

Conclusion : INSTEAD Trial

- No difference in mortality endpoint (Underpowered)
- Significant crossover to TEVAR
- Remodeling Benefit (91.3% with TEVAR vs. 19.4% with medical treatment alone ($p < 0.001$))

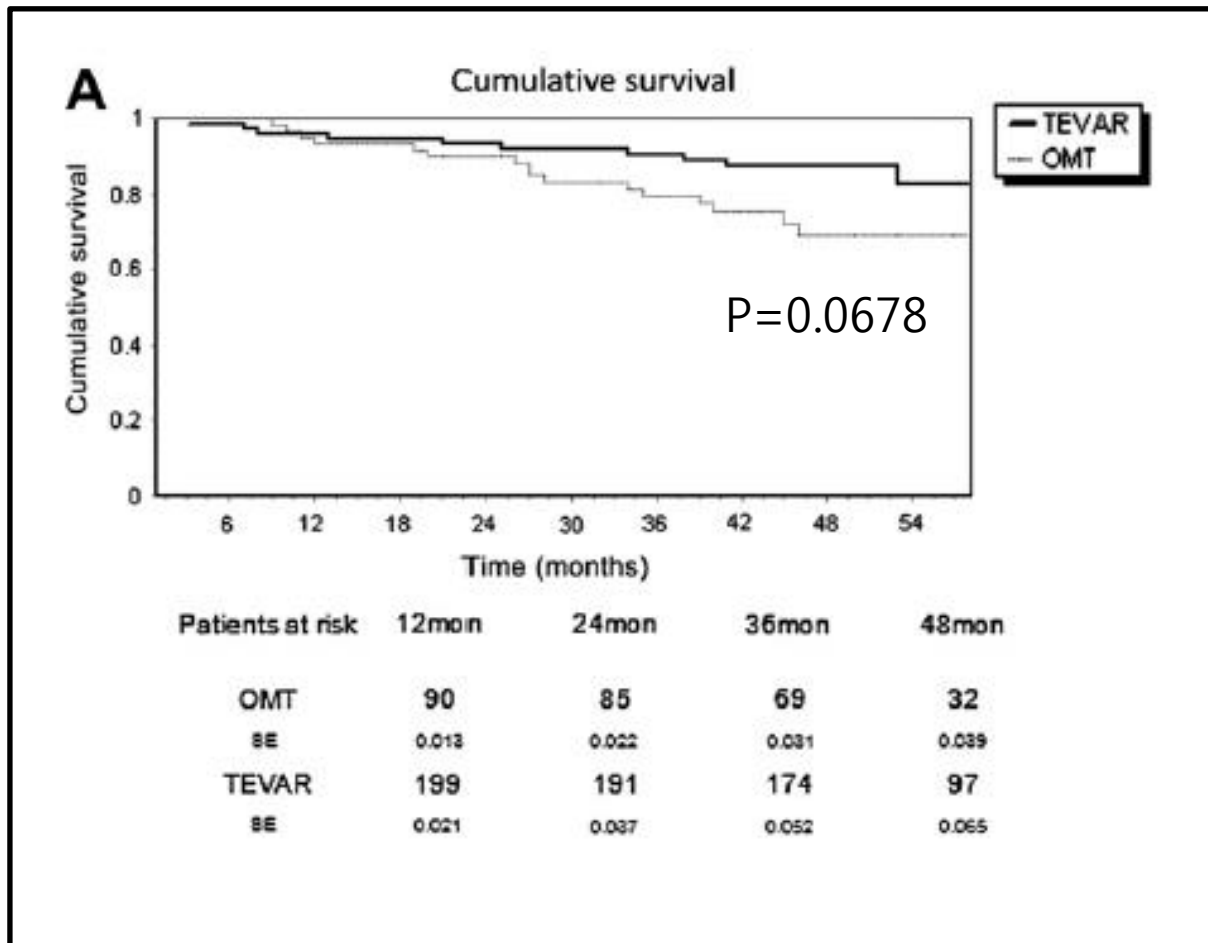


The results of stent graft vs. medication for chronic type B AD



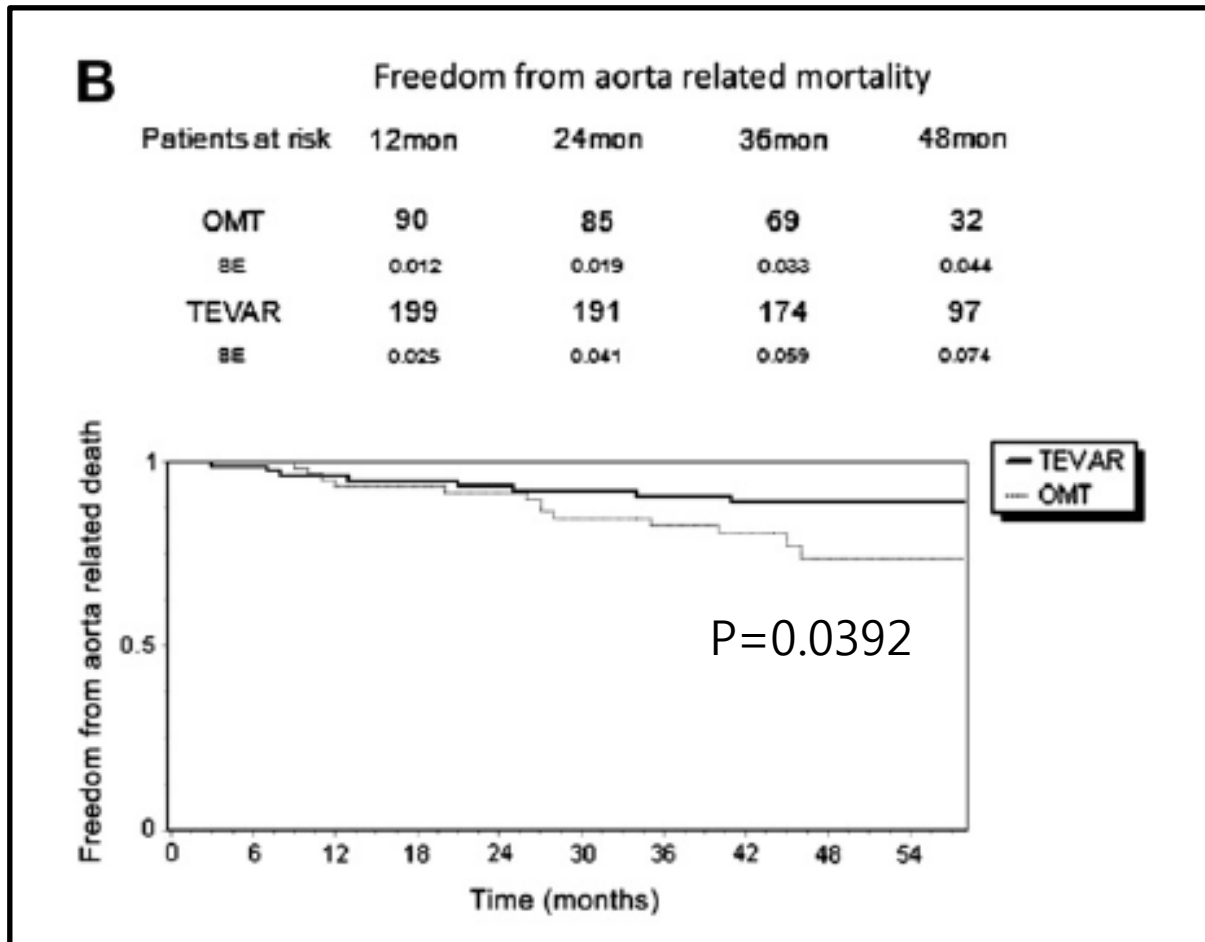
- **Prospective multicenter comparative study.**
- **303 consecutive patients with chronic type B AD** who were prospectively enrolled and treated by either **OMT or TEVAR.**
- Baseline diameter of the thoracic aorta was 41.2 (19.1) mm and dissection extended beyond the celiac axis in 87.1% of cases.

The results of stent graft vs. medication for chronic type B-Cumulative survival



	2Y	4Y
TEVAR	87.5%	82.7%
Medicine	77.5%	69.1%

The results of stent graft vs. medication for chronic type B-Aorta related mortality



	2Y	4Y
TEVAR	91.6%	88.1%
Medicine	82.8%	73.9%

The results of stent graft vs. medication for chronic type B-Aortic remodeling

	<i>OMT</i>	<i>TEVAR</i>
Maximum diameter of thoracic aorta, mean (SD), mm		
Baseline	40.7 (18.6)	42.4 (23.1)
Final	48.1 (17.3)	37.3 (12.8) ^a
Maximum diameter of abdominal aorta, mean (SD), mm		
Baseline	28.5 (17.4)	27.3 (14.7)
Final	31.8 (15.9)	32.7 (12.7)
Stable or decreased size of aorta	39.7% (27/68)	94.9% (151/159) ^a
Thoracic aorta remodeling	11.8% (8/68)	88.7% (141/159) ^a

Classification of AD for treatment modality

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NONSURGICAL RECONSTRUCTION OF THORACIC AD BY STENT-GRAFT PLACEMENT

TABLE 3. PROCEDURAL DATA AND INTRAOPERATIVE AND LONGER-TERM OUTCOMES.*

VARIABLE	SURGERY GROUP (N = 12)	STENT-GRAFT GROUP (N = 12)	P VALUE
Procedural measures			
Use of general anesthesia — no.	12	12	1
Duration — hr			<0.001
Mean	8.0±2.0	1.6±0.4	
Range	5–11	1.1–2.6	
Size of prosthesis — mm			<0.001
Length			<0.001
Mean	220±74	84±40	
Range	100–340	43–150	
Diameter			<0.001
Mean	27±2	38±3	
Range	22–28	30–40	
Duration of intensive care — hr	92±45	36±12	<0.001
Hospital stay — days			<0.001
Mean	40±24	7±3	
Range	14–96	4–15	
Body temperature >38°C — no. (%)	6 (50)	10 (83)	0.19
Mortality — no. (%)			
Perioperative	1 (8)	0	>0.99
After 30 days	1 (8)	0	>0.99
After 1 yr	4 (33; 95% CI, 10–65)	0 (0; 95% CI, 0–22)	0.09
Cumulative morbidity — no. (%)	5 (42; 95% CI, 15–72)	0 (0; 95% CI, 0–22)	0.04
Paraplegia	2 (17)	0	0.48
Neurologic defect	3 (25)	0	0.22
Respiratory complication	5 (42)	0	0.04
Renal failure	3 (25)	0	0.22
Physical recovery — no. (%)	7 (58; 95% CI, 28–85)	12 (100; 95% CI, 78–100)	0.04

Endovascular repair of complicated chronic distal AD: Intermediate outcomes and complications

Baseline clinical characteristics

Total population (no.)	76 (100%)
Male (no.)	49 (64%)
Age at diagnosis (y, mean \pm SD)	59.8 \pm 12.4
Age at intervention (y, mean \pm SD)	61.5 \pm 12.5
Time between diagnosis and intervention (mo, mean \pm SD)	25.0 \pm 31.0

Comorbidities (no.)

Hypertension	75 (99%)
Smoking	32 (42%)
Hyperlipidemia	26 (34%)
Diabetes mellitus	8 (11%)
Renal insufficiency (>1.5 mg/dL)	14 (18%)
Coronary artery disease	29 (38%)
Peripheral artery disease	7 (9%)
Chronic obstructive pulmonary disease	17 (22%)
Previous stroke	9 (12%)
Marfan syndrome	2 (3%)

Previous aortic surgery (no.)

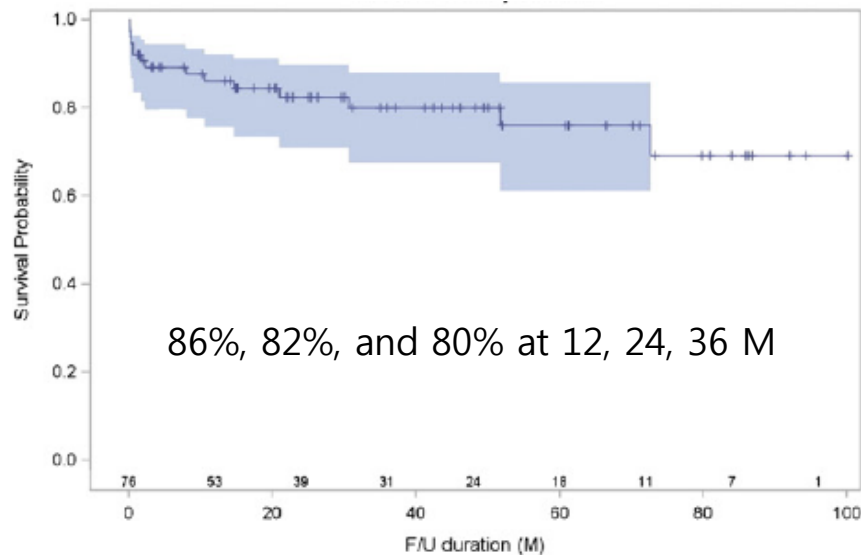
Ascending aortic repair for type A dissection	17 (22%)
Ascending aorta without arch	11
Ascending aorta and hemiarch	3
Elephant trunk repair	3
Infrarenal aneurysm repair	12 (16%)

- All cases (N=76) of TEVAR for complicated (aortic growth, malperfusion, intractable pain) CDAD were retrospectively reviewed.
- Aortic morphology (aneurysm size, false lumen thrombosis) was assessed at multiple levels with 3-dimensional image analysis techniques.

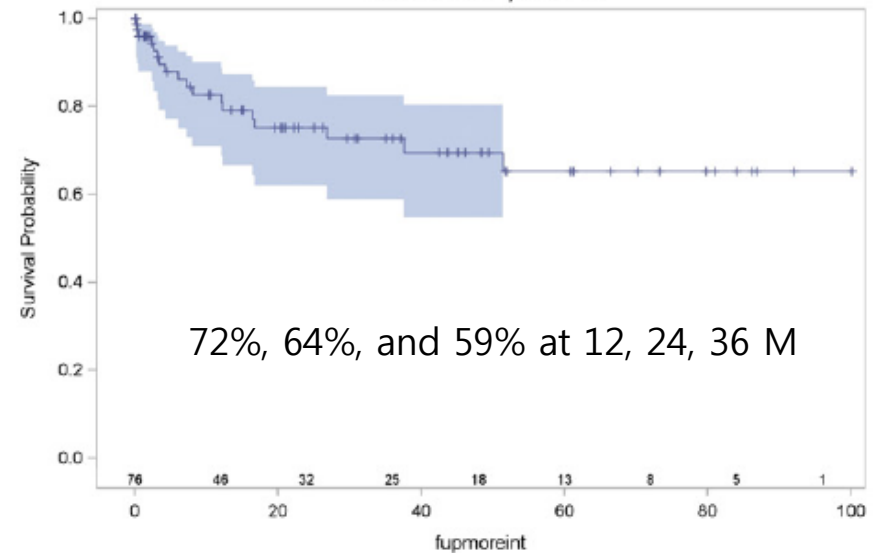
Endovascular repair of complicated chronic distal AD: Intermediate outcomes and complications

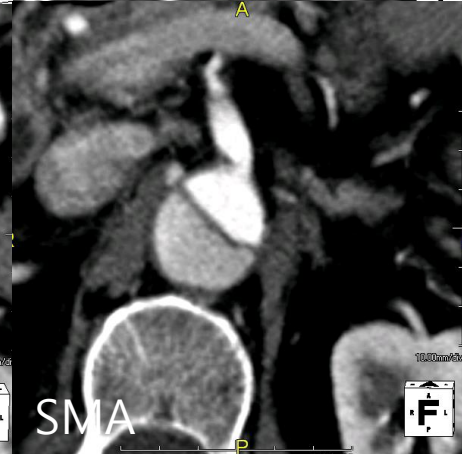
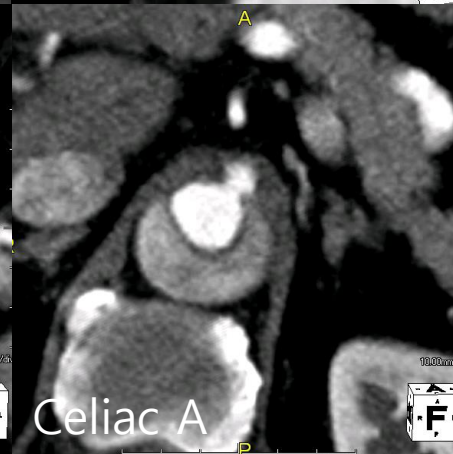
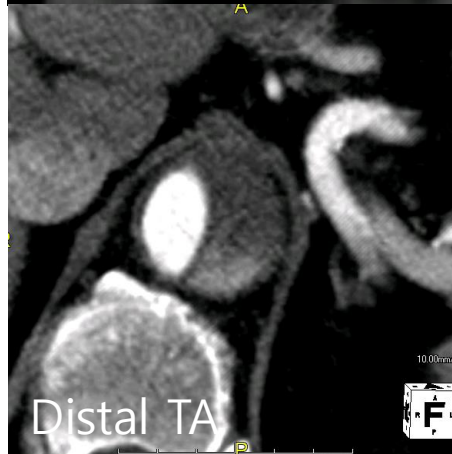
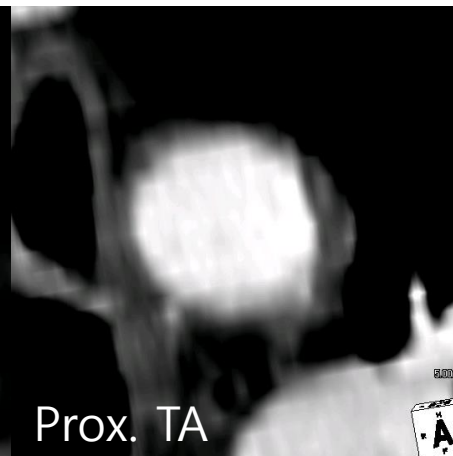
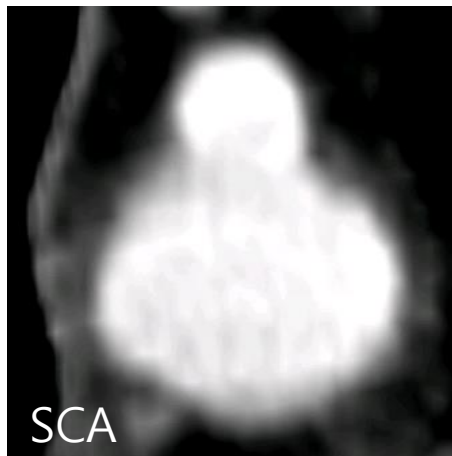
- Mean clinical FU : 34 months (all)
- Mean imaging FU : 24 months (67pts)
- Early (<30 postoperative days) mortality was 5% (4 patients).
- No paraplegia, and 1 patient died of stroke.

Overall survival



Freedom free reintervention



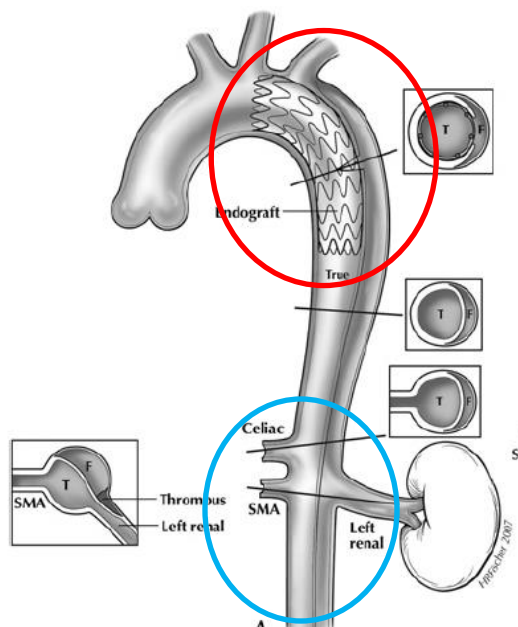


Arterial diameter changes

Location	All patients (n = 67)		Extensive dissection (n = 40)		Limited dissection (n = 27)	
	Baseline (mm)	Growth (mm/y)	Baseline (mm)	Growth (mm/y)	Baseline (mm)	Growth (mm/y)
MAD	52.3 ± 11.2	-3.87 ± 6.0*	53.6 ± 10.8	-5.24 ± 8.0*	50.3 ± 11.7	-2.42 ± 3.7*
PTA	41.2 ± 10.2	-1.56 ± 4.8*	42.7 ± 9.8	-2.74 ± 5.3*	38.9 ± 10.5	0.04 ± 3.1
MTA	45.0 ± 12.6	-1.90 ± 7.2†	45.2 ± 12.4	-2.29 ± 8.4	44.6 ± 13.0	-0.84 ± 2.8
DTA	36.5 ± 8.5	0.34 ± 3.2	39.3 ± 7.8	0.49 ± 3.4	32.5 ± 7.8	-0.30 ± 3.1
CA	33.1 ± 7.7	0.10 ± 3.2	36.5 ± 7.5	-0.10 ± 3.9	NA	NA
SMA	29.7 ± 6.6	0.40 ± 2.0	32.5 ± 6.4	0.58 ± 2.4	NA	NA
LRA	26.7 ± 6.4	0.40 ± 1.3†	29.2 ± 6.3	0.58 ± 2.1†	NA	NA
RRA	27.4 ± 6.8	0.59 ± 1.9†	30.1 ± 6.7	0.91 ± 2.3†	NA	NA
AA	25.4 ± 7.0	0.30 ± 1.1†	28.1 ± 7.1	0.40 ± 1.5†	NA	NA

MAD, Maximum aortic diameter; PTA, proximal thoracic aorta; MTA, midthoracic aorta; DTA, distal thoracic aorta; CA, celiac artery; NA, not available; SMA, superior mesenteric artery; LRA, left renal artery; RRA, right renal artery; AA, abdominal aorta. * $P < .01$. † $P < .05$.

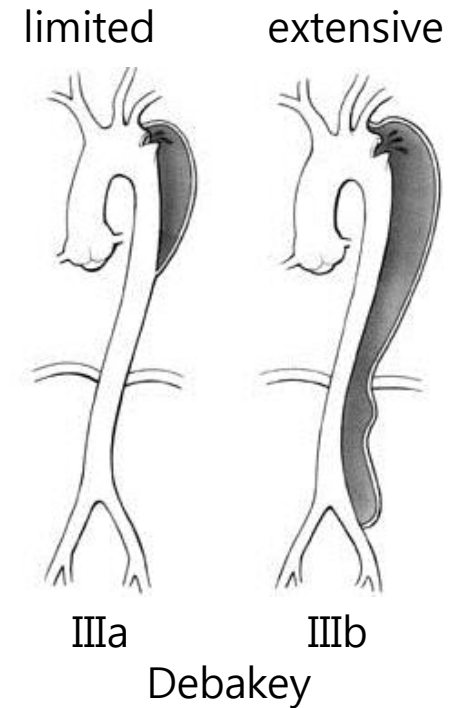
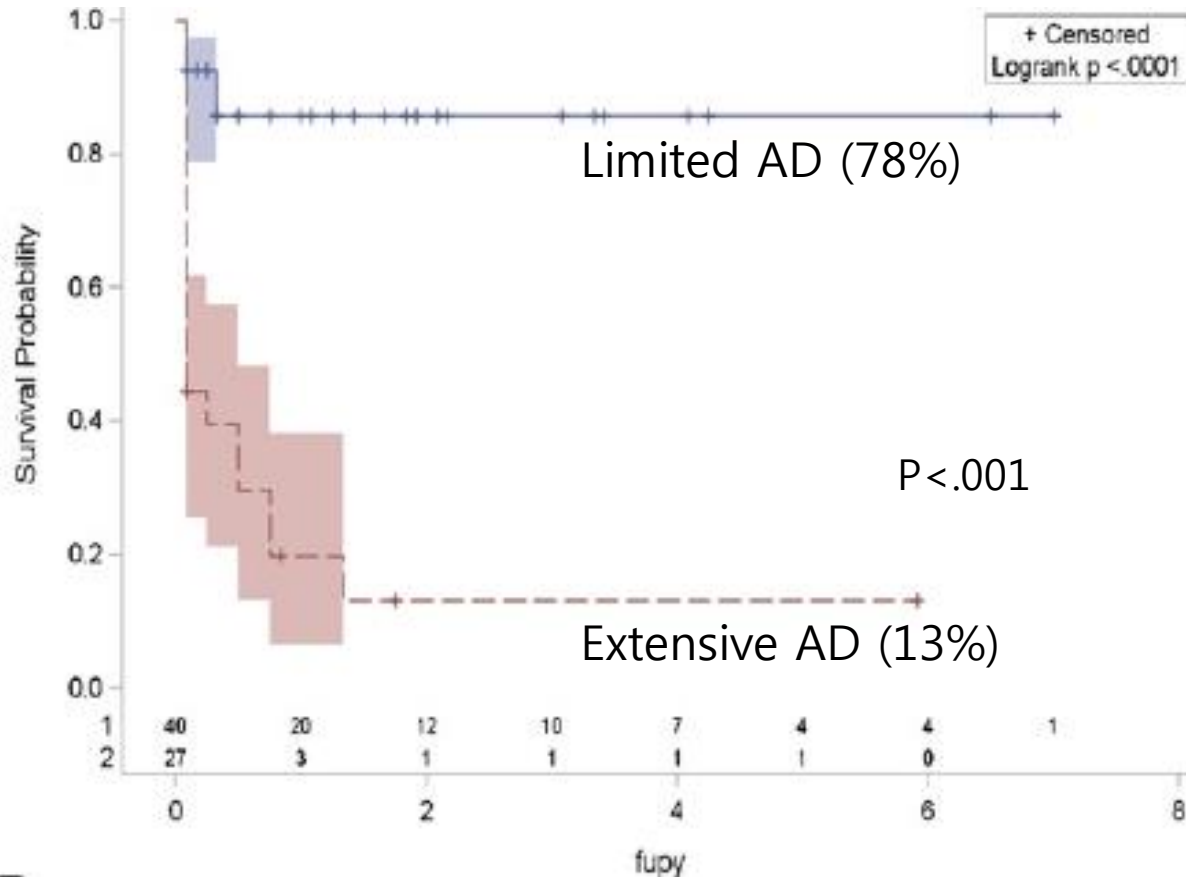
- TEVAR resulted in significantly decreased aortic diameter through the stent-grafted segment but not untreated segments.



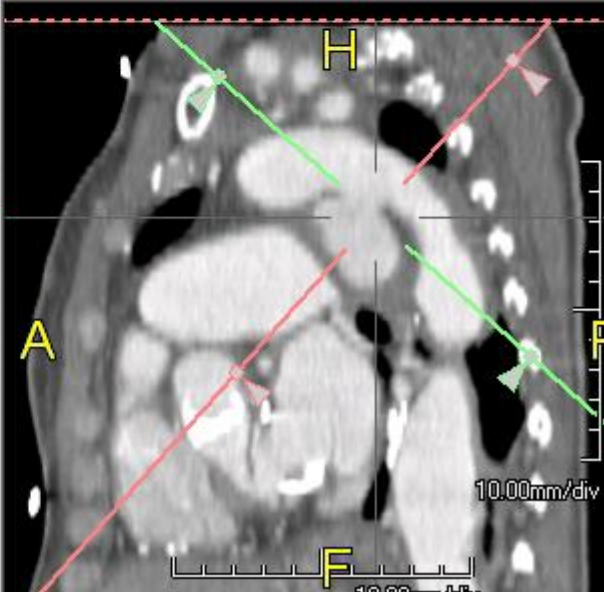
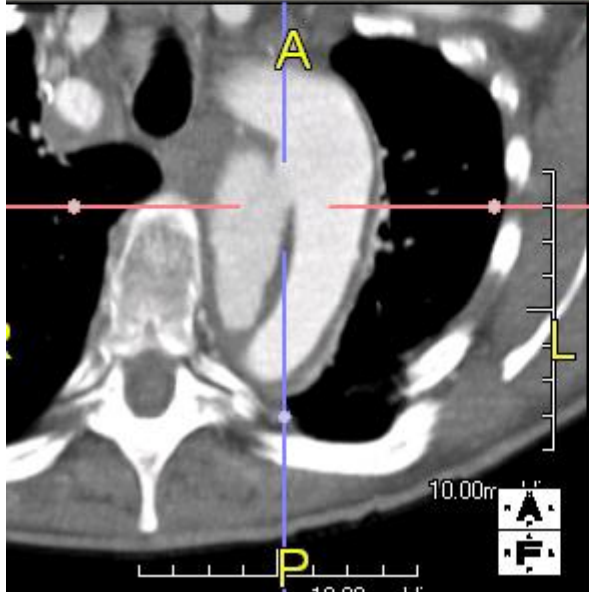
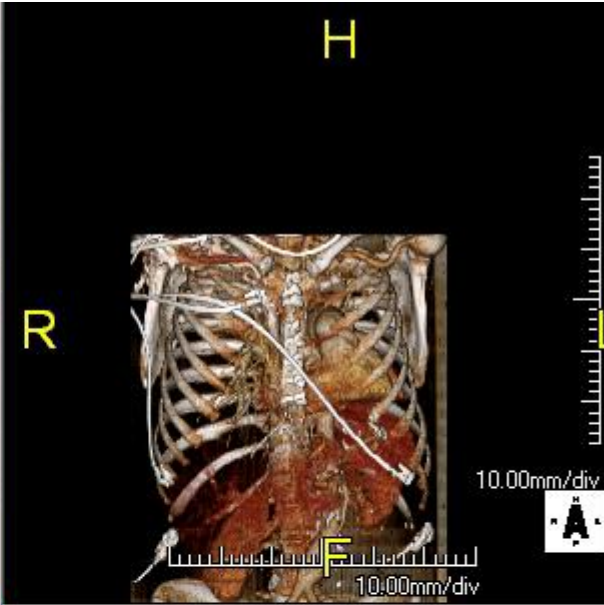
Complete false lumen thrombosis

	%
Proximal thoracic aorta	91
Midthoracic aorta	84
Distal thoracic aorta	55
Celiac artery	49
Superior mesenteric artery	35
Left renal artery	17
Right renal artery	21
Infrarenal aorta	19

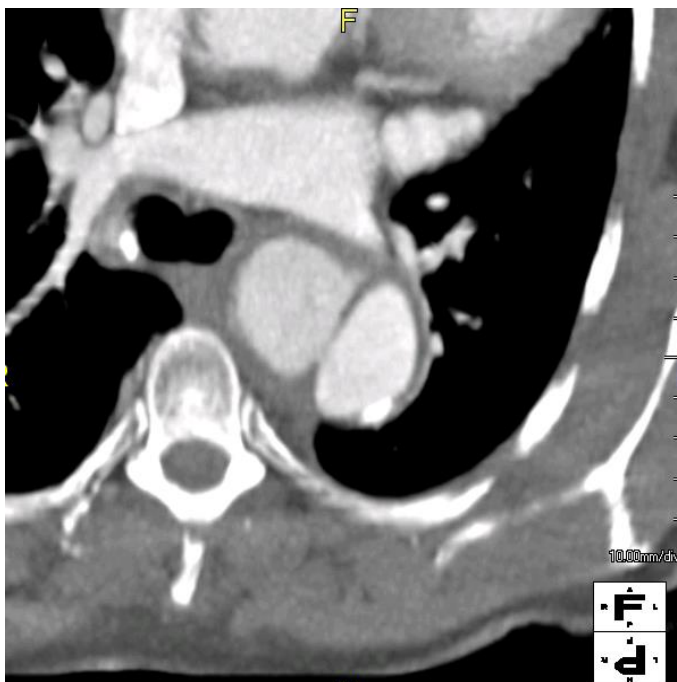
Complete thrombosis of FL



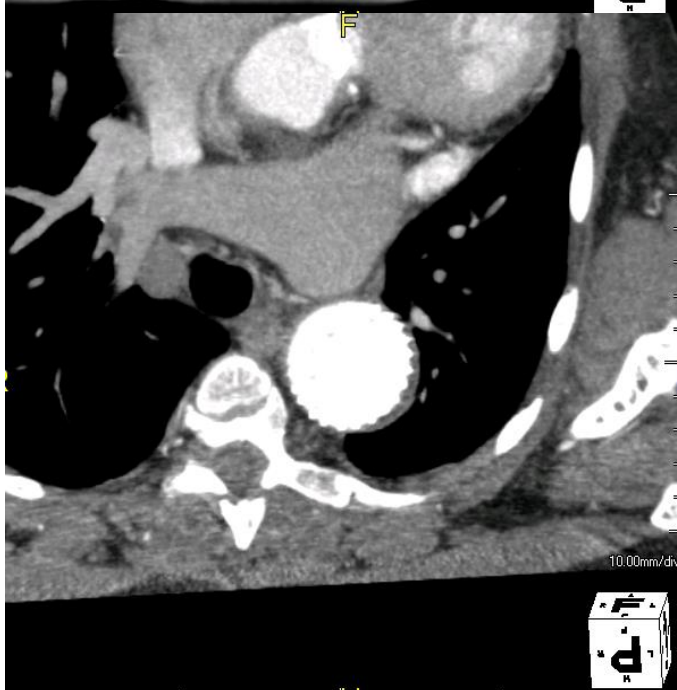
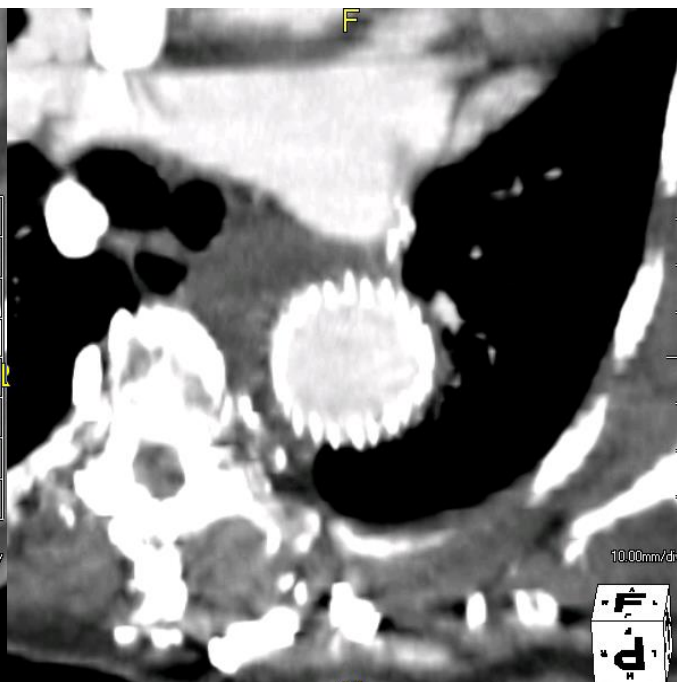
Limited AD



baseline



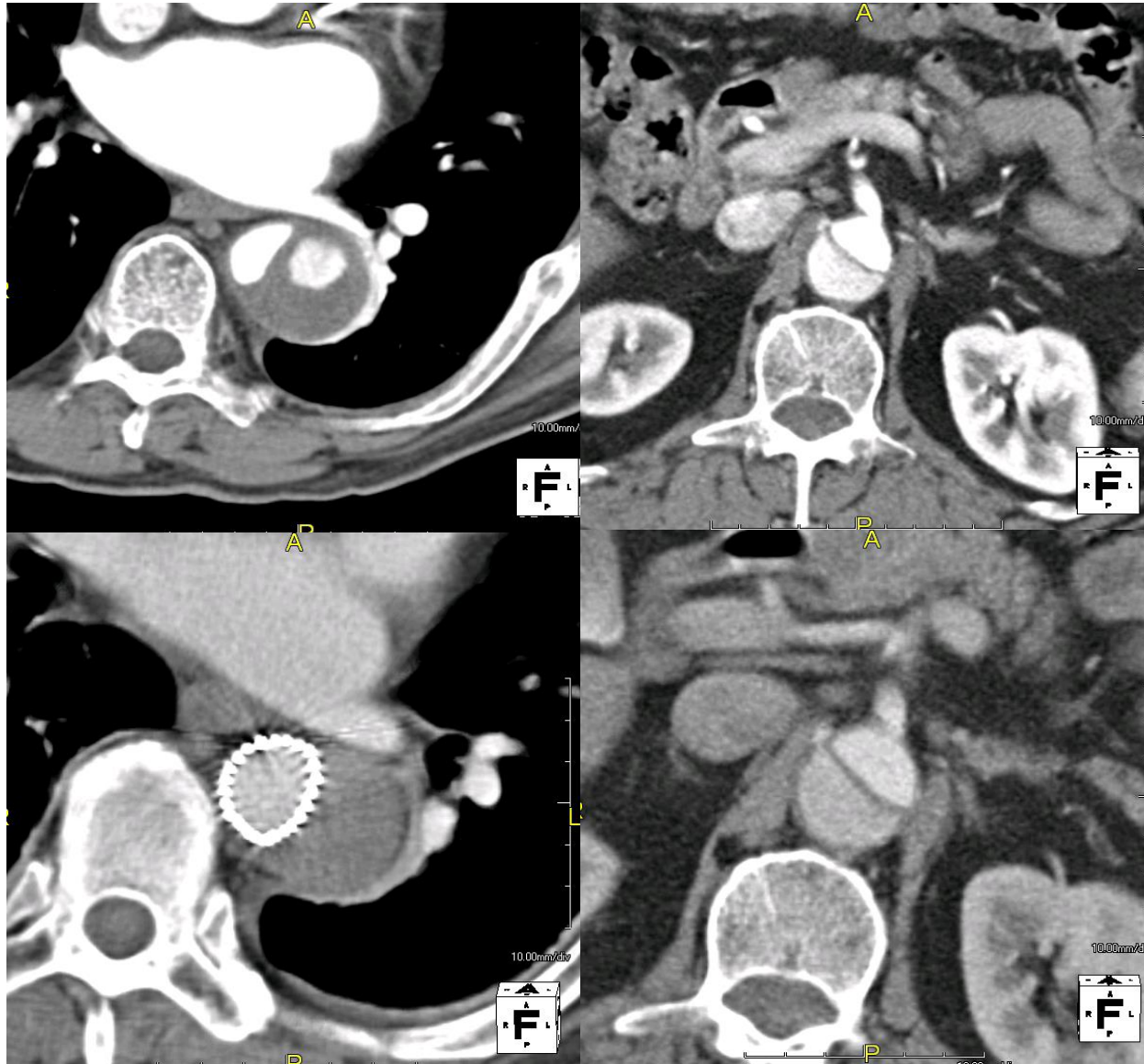
Post 4M



Post 4Y

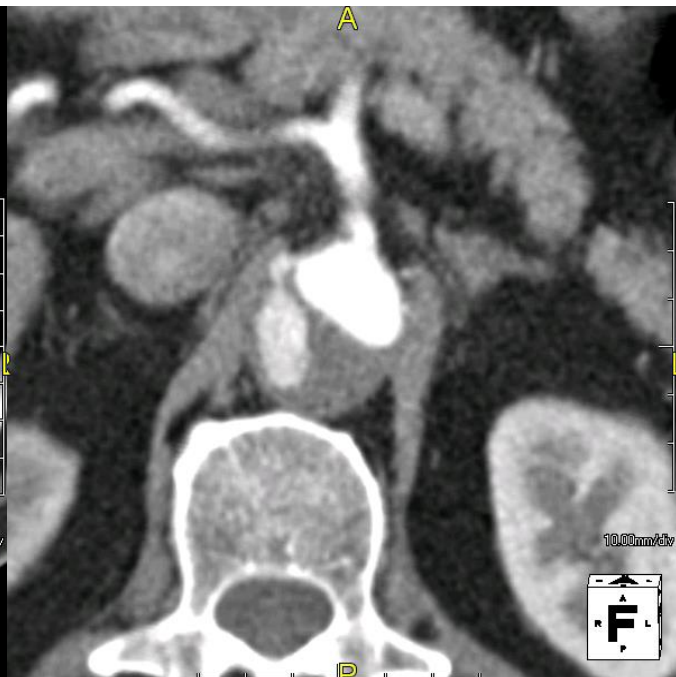
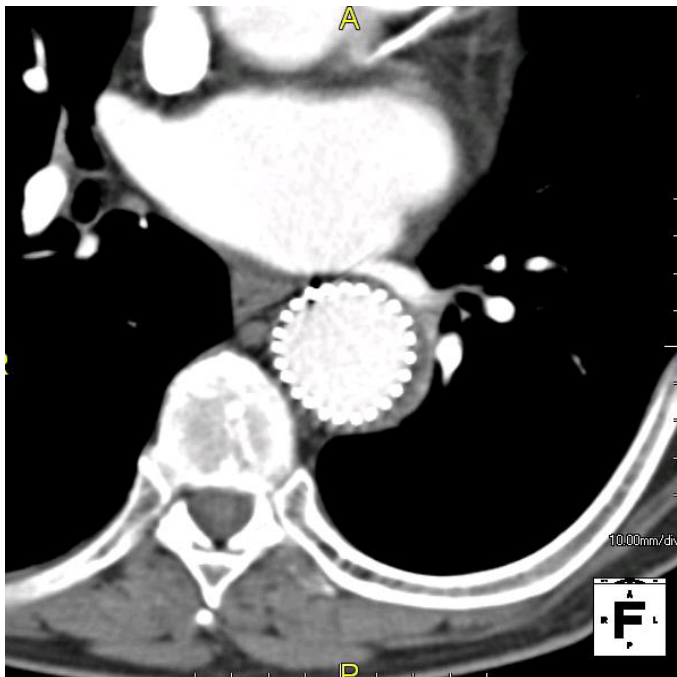
limited, complete resolution

Extensive AD



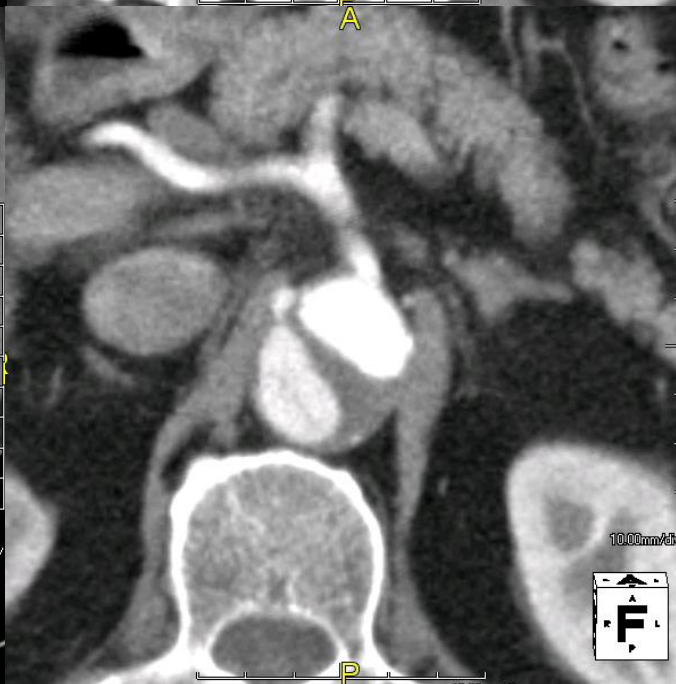
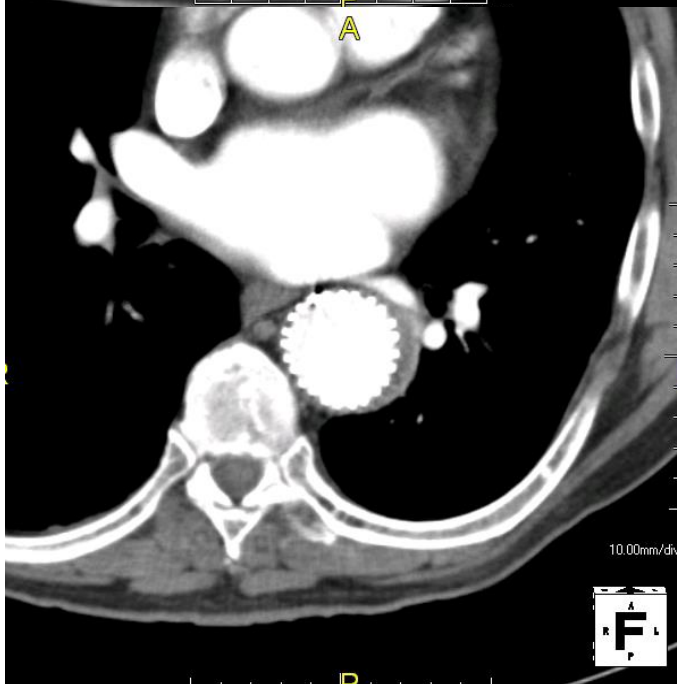
baseline

immediate
post S-G



S-G decrease,
below S-G no
change

Post 2yrs



Post 4yrs

Unanswered question for Endovascular therapy in AD

▪ **When** : Acute vs. Chronic

– Retrograde dissection

- Acute << Chronic

– Aortic remodeling

- Acute >> Chronic



Unanswered question for Endovascular therapy in AD

▪ How extent ?

Entry tear (aortic remodeling ↓) vs. As possible as long (neurologic Cx ↑)



Summary

- **Acute complicated**

IRAD : OP < S-G (mortality)

- **Acute uncomplicated**

OMT < S-G (no mortality), ADSORB (?)

- **Chronic uncomplicated**

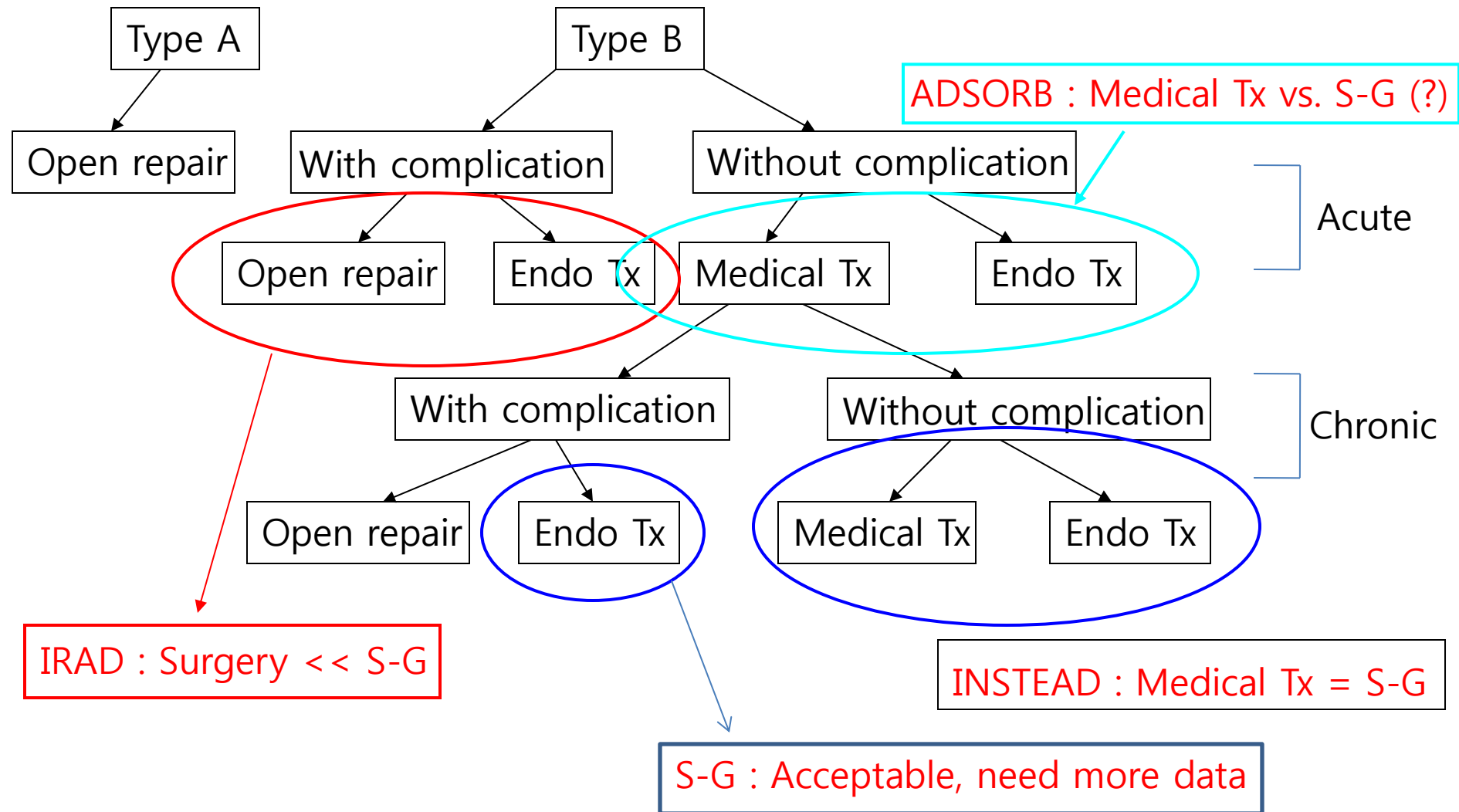
OMT < S-G (aortic remodeling), INSTEAD (-)

- **Chronic complicated**

S-G : Acceptable, limitation in extensive AD

Thank you for your attention!

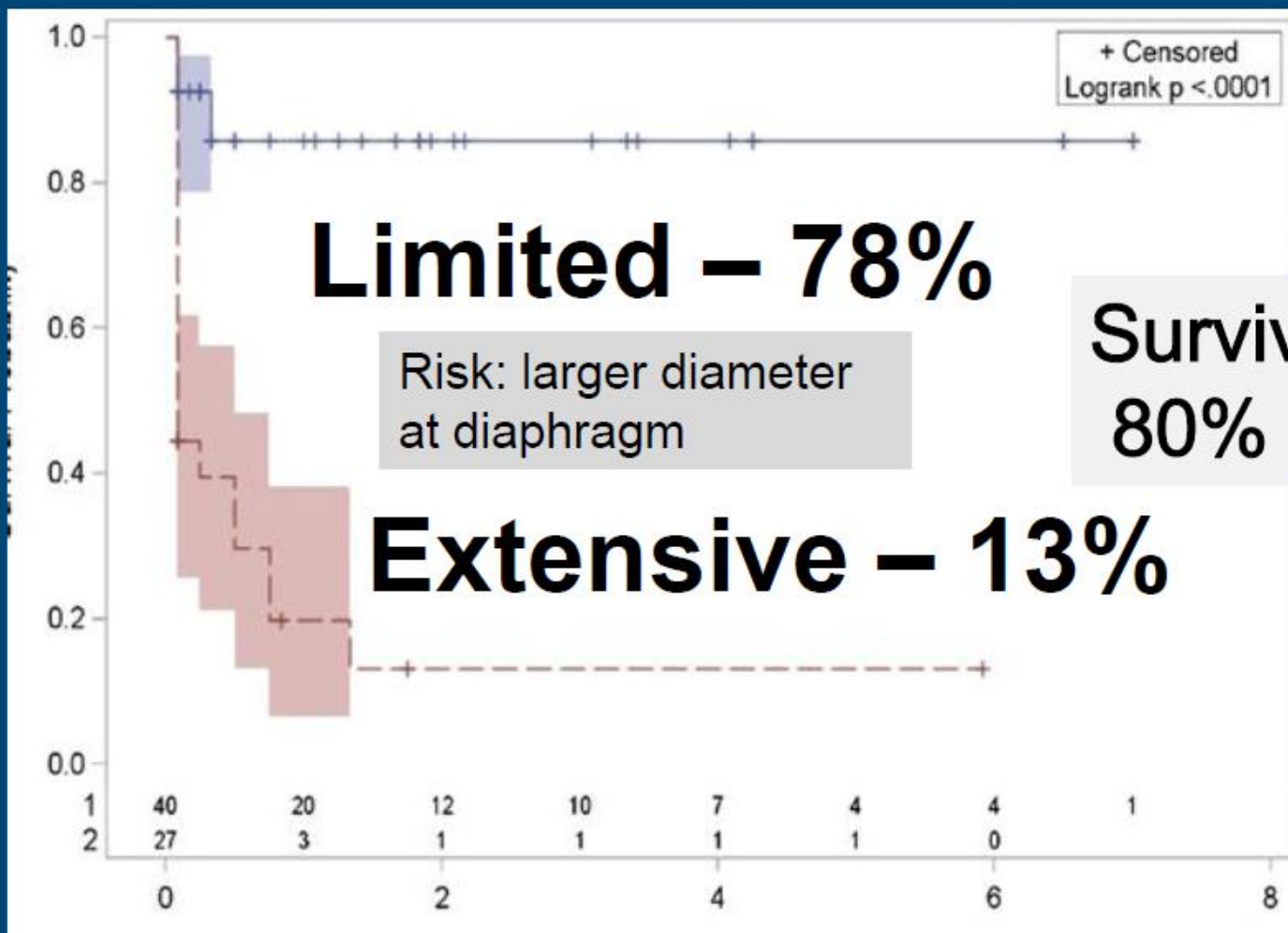
Aortic Dissection : endovascular Tx vs. other Tx



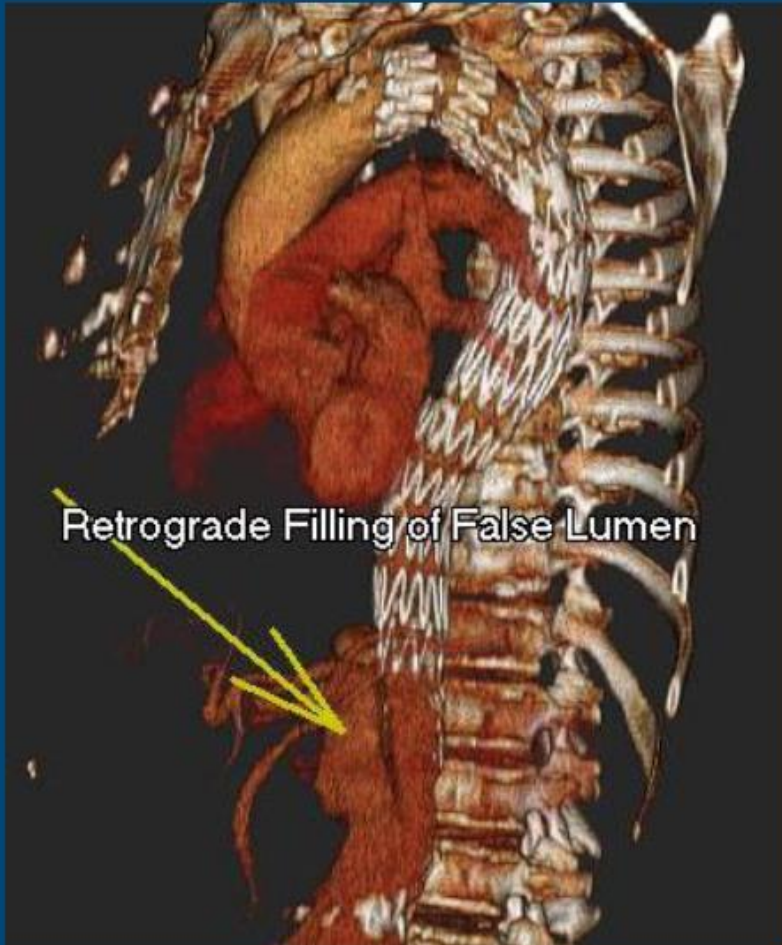
Summary

- Acute complicated distal dissections
→ TEVAR
- Acute high-risk uncomplicated
→ Delayed TEVAR
- Acute extensive (DeBakey type 1)
→ Surgery plus TEVAR
- Chronic with limited aneurysmal degeneration
→ TEVAR
- Chronic w/ aneurysm extensive → surgery
- Acute uncomplicated, low-risk for late comps → expectant medical

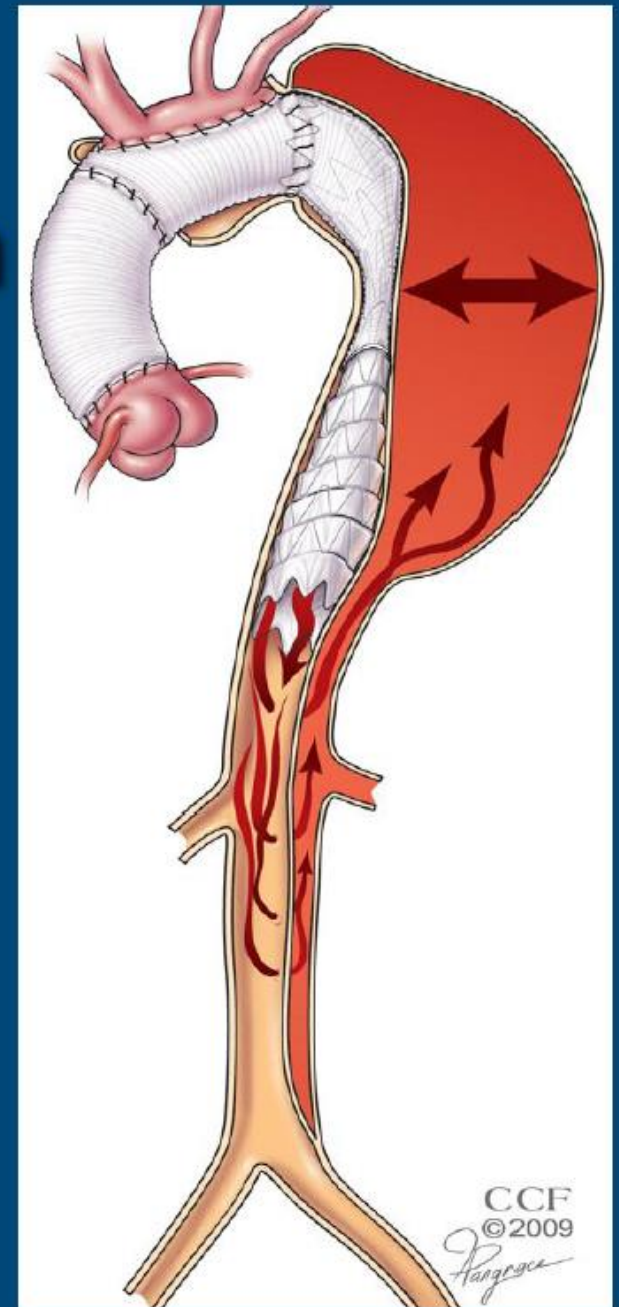
FL Complete Thrombosis is Predictable Based on Extent



Chronic Dissection False Lumen Perfusion



Failed Thromboexclusion



Risk for Late Reoperation

- **Aorta > 4cm**

Onitsuka, et al. ATS 2004 (Japan)

Winnerkvist, et al. EurJEVS 2006 (Sweden)

- **False Lumen > 22mm**

Song, et al. JACC 2007

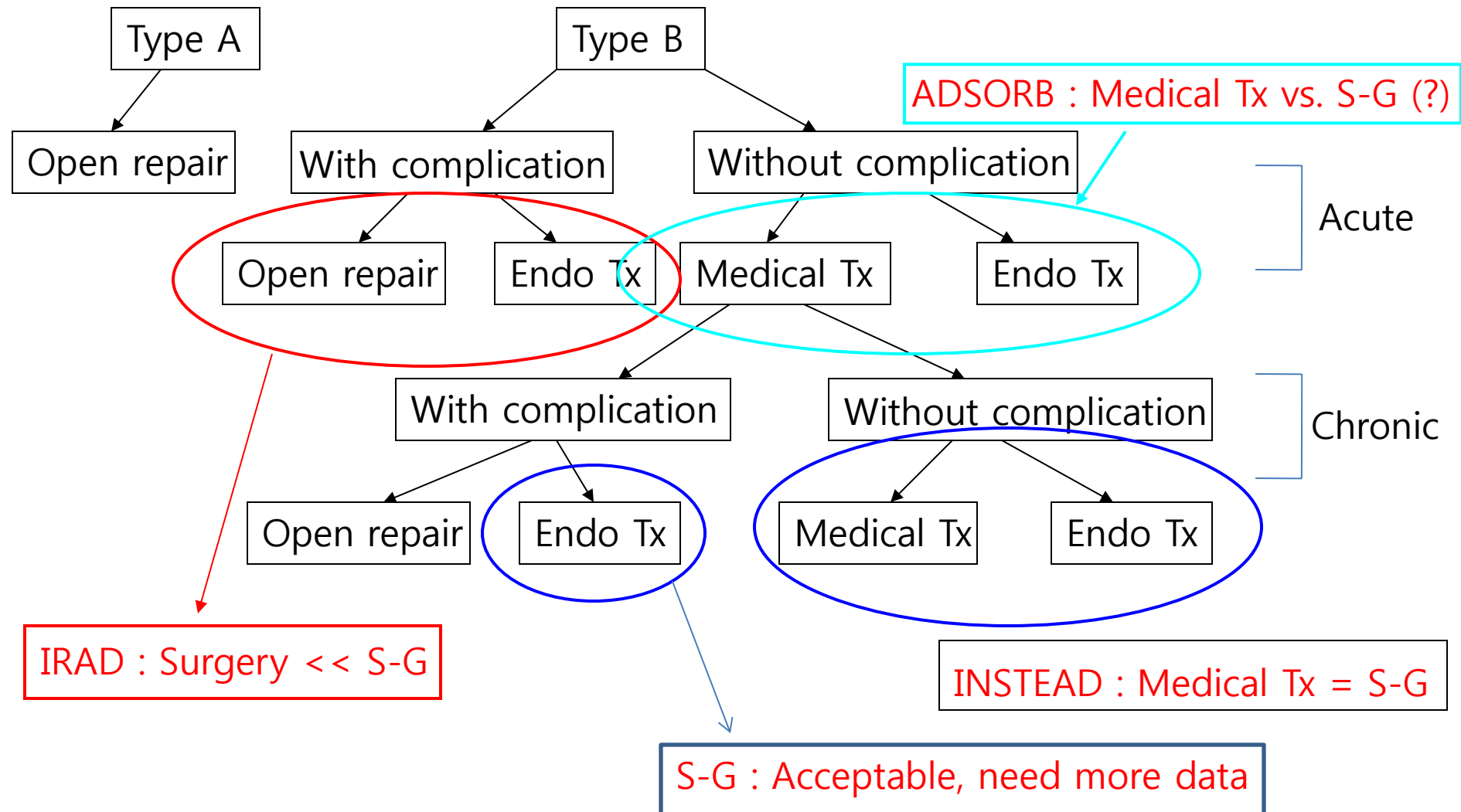
- **Partially Thrombosed False Lumen**

Tsai, et al. NEJM 2007

Our data showed...

- Management of complicated CDAD remains challenging for clinicians.
- TEVAR is a reasonable treatment modality for dissections limited to the thoracic aorta and for prevention of focal aortic growth in extensive dissections.
- Late complications and the need for secondary interventions emphasize the complexity of this patient population and the need for long-term follow-up.

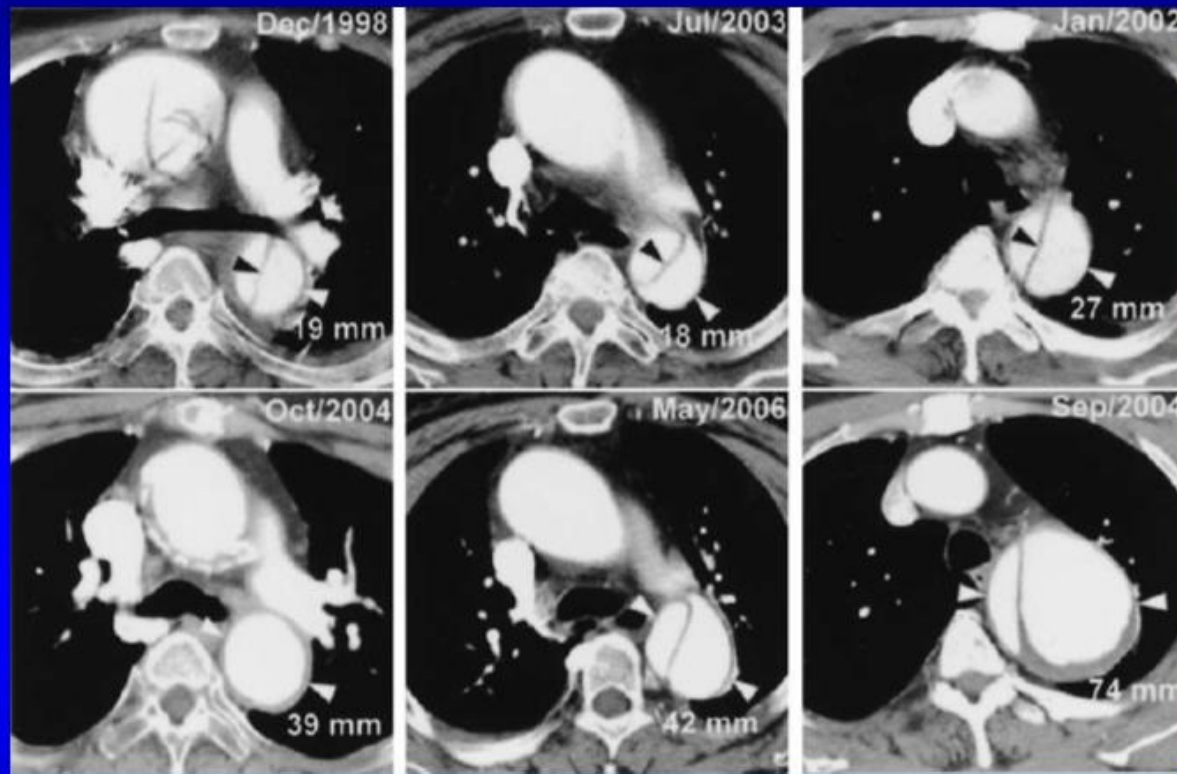
Aortic Dissection : endovascular Tx vs. other Tx



Conclusions

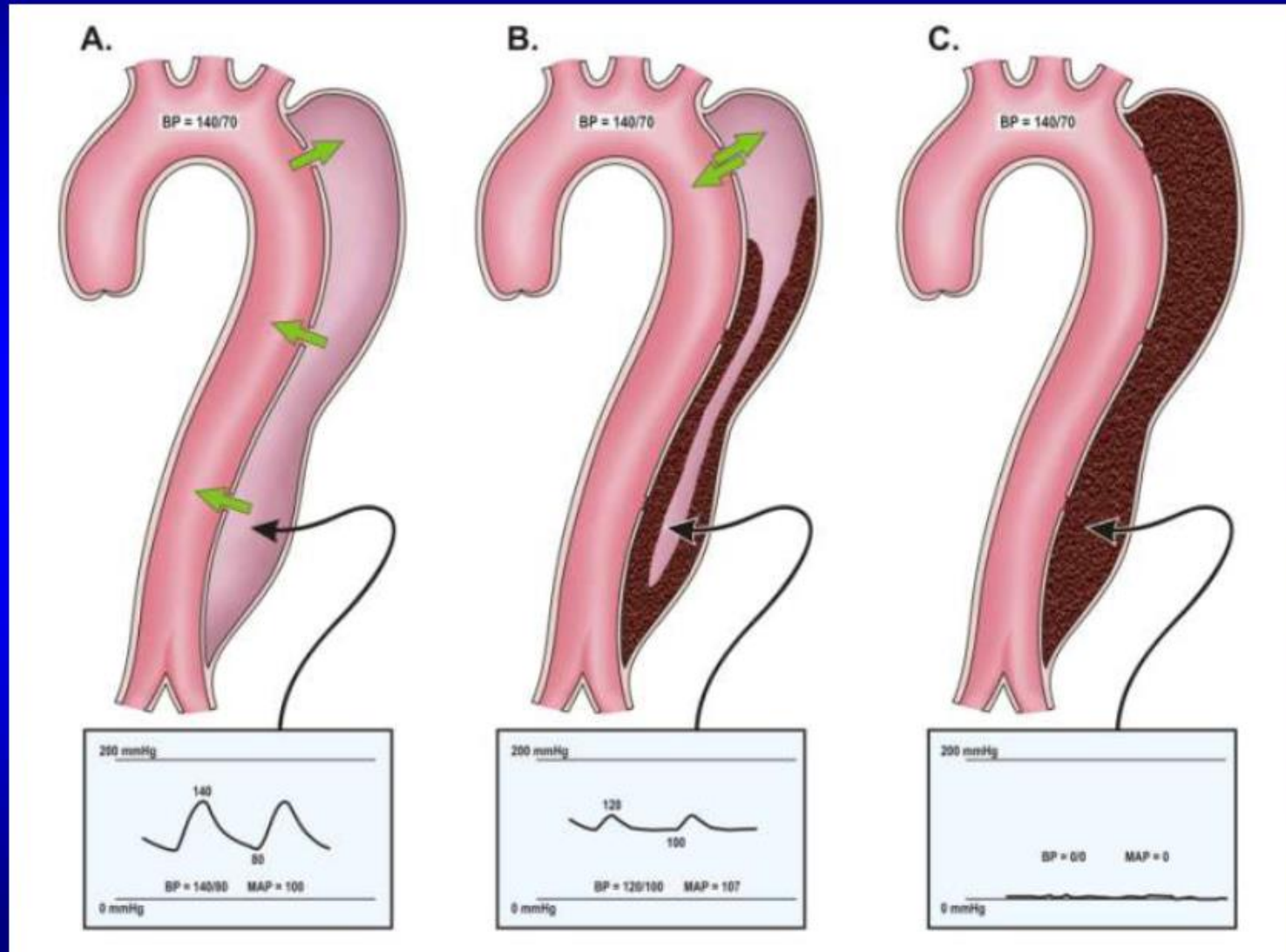
- The optimal treatment of AD remains a challenging clinical dilemma.
- Open aortic repair carries a high mortality rate, in addition to a high stroke and paraplegia rate.
- For uncomplicated type B AD a primary strategy of tailored antihypertensive medical treatment and serial imaging is justified, with deferred intervention.
- The concept of using aortic stent-graft to treat type B AD is relatively new and continues to evolve, as experience with this technique grows and technology improves.
- TEVAR is a reasonable alternative for patient with complicated type B AD and provides satisfactory mid-term clinical outcomes.
- TEVAR stabilizes the descending aorta in most patients and promotes aortic remodeling.
- However, careful attention should be given to the dissected aorta situated below the level of the stent-graft to detect late aneurysmal degeneration.

New risk group: Large false lumen (≥ 22 mm)

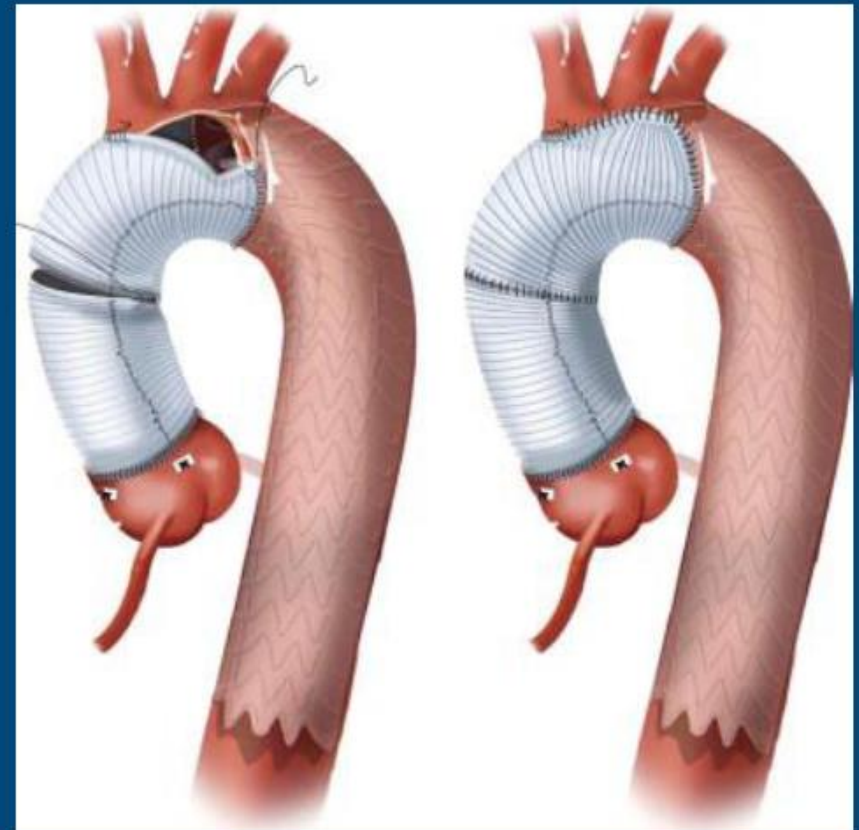
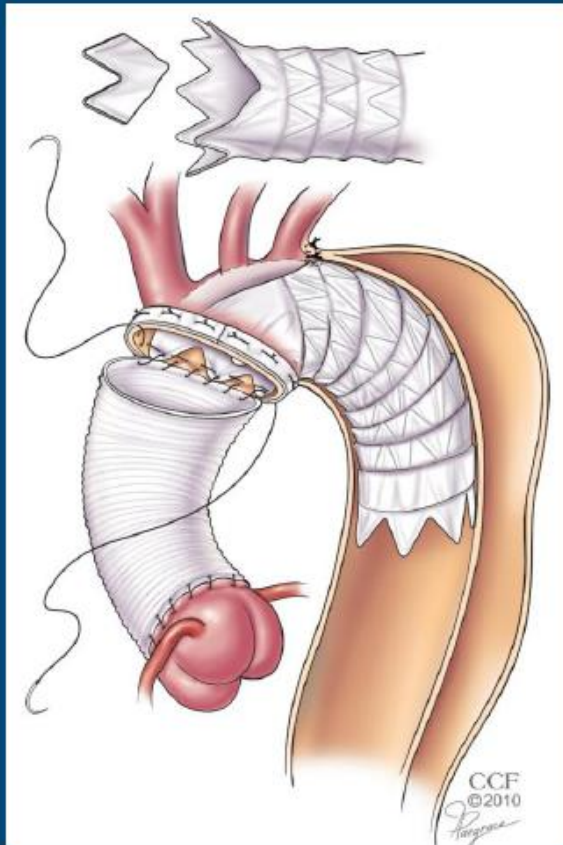


Two patients with a small initial false lumen diameter at the upper descending thoracic aorta showed a complete resorption of the false lumen (left) or did not show an aneurysm for approximately 3 years (middle), while another patient with a large initial false lumen diameter developed an aorta aneurysm after approximately 2.5 years (right).

New risk group: Partial false lumen thrombosis ?



Extended Hybrid Repair – Type A



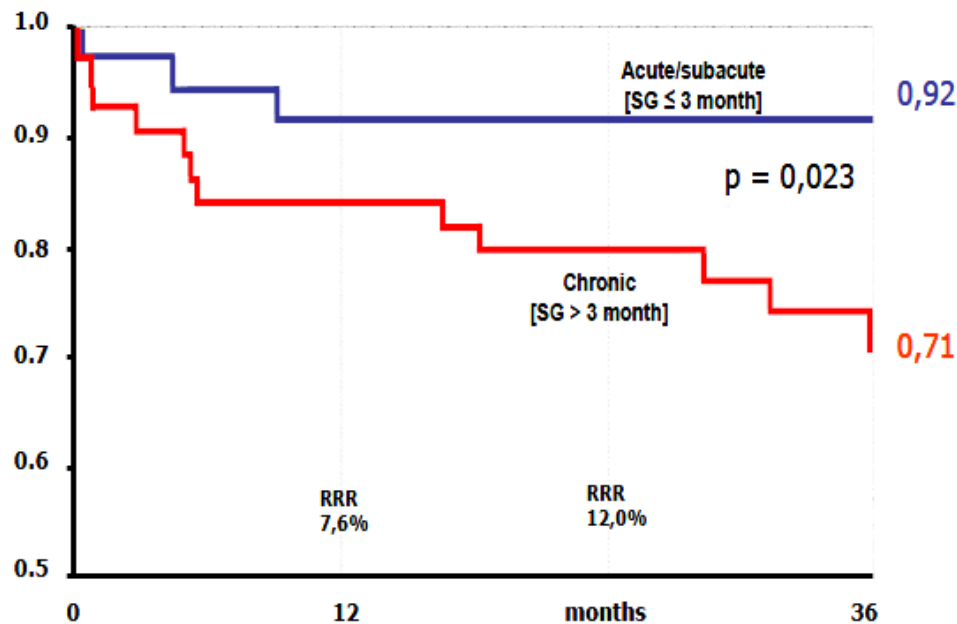
Roselli E, et al.
Cleveland Clinic. JTCVS 2012, in press.

Pocchettino A, BAVARIA, et al.
U Penn. ATS 2009.

Impact of treatment timing on event (MAVE) free survival in patients with type B aortic dissection (own results)

Chronic type B dissection

Nienaber (39)	1999	12	100	0	0	12
Kato (40)	2001	15	100	0	0	24
Eggebrecht (41)	2005	28	100	0	13,6	12
Chen (29)	2006	19	100	0	11	27



n = 84

High technical success rate

Earlier intervention ($\leq 3m$):
less MAVE

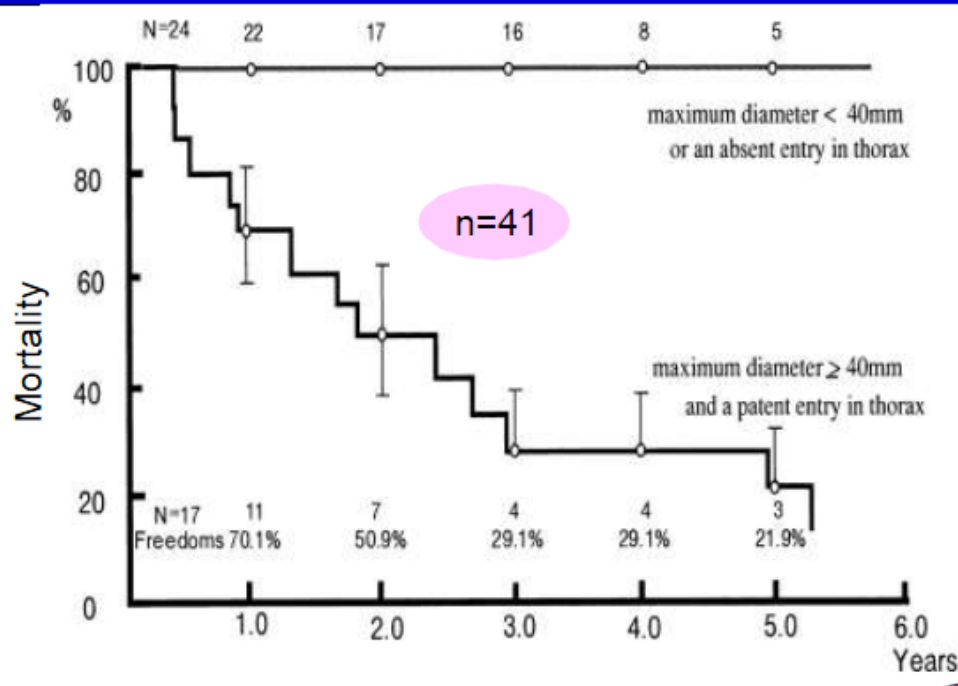
Late intervention ($> 3m$):
less remodeling

Mortality 0 - 13%

MAVE:

Major adverse vascular
events

Prognostic Predictors during long-term F/U in Type B



Univariate predictors:

Entry tear in thoracic aorta $p < 0.001$

Perfused false lumen $p < 0.018$

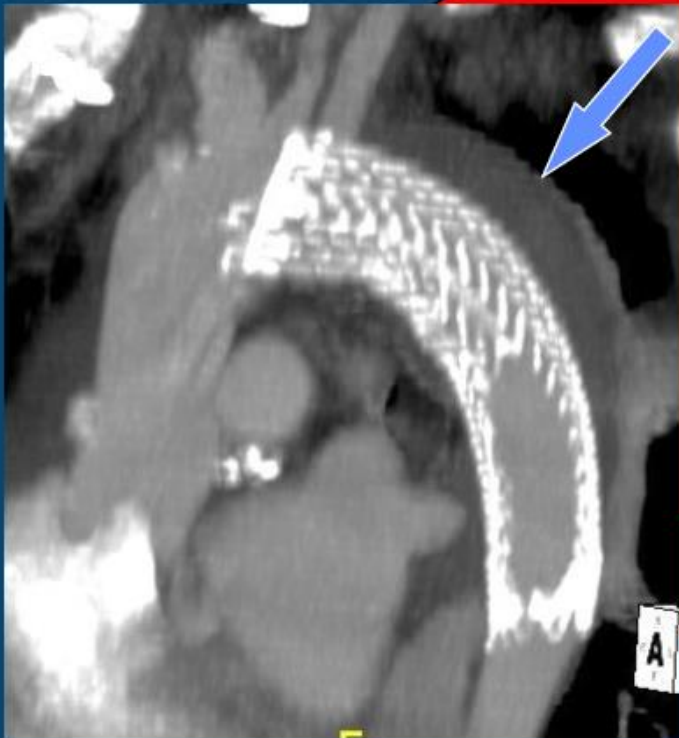
Maximal diameter ≥ 40 mm $p < 0.001$

**Chronic Dissection –
a new indication for SG?**

Status of False Lumen

Median follow-up = 154 days

Thrombosed



88%

Patent

12%

To date, no late deaths

Risk for Late Reoperation

- **Aorta > 4cm**

Onitsuka, et al. ATS 2004 (Japan)

Winnerkvist, et al. EurJEVS 2006 (Sweden)

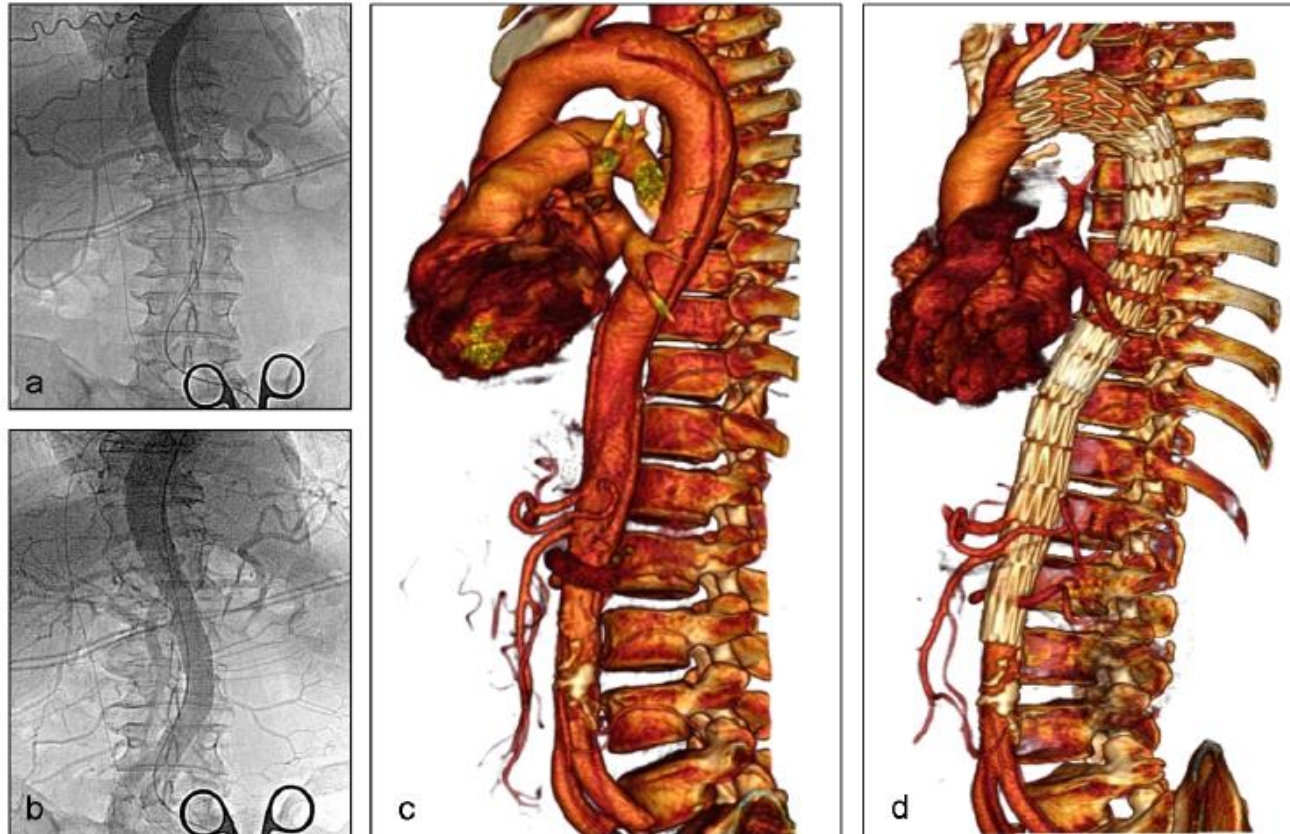
- **False Lumen > 22mm**

Song, et al. JACC 2007

- **Partially Thrombosed False Lumen**

Tsai, et al. NEJM 2007

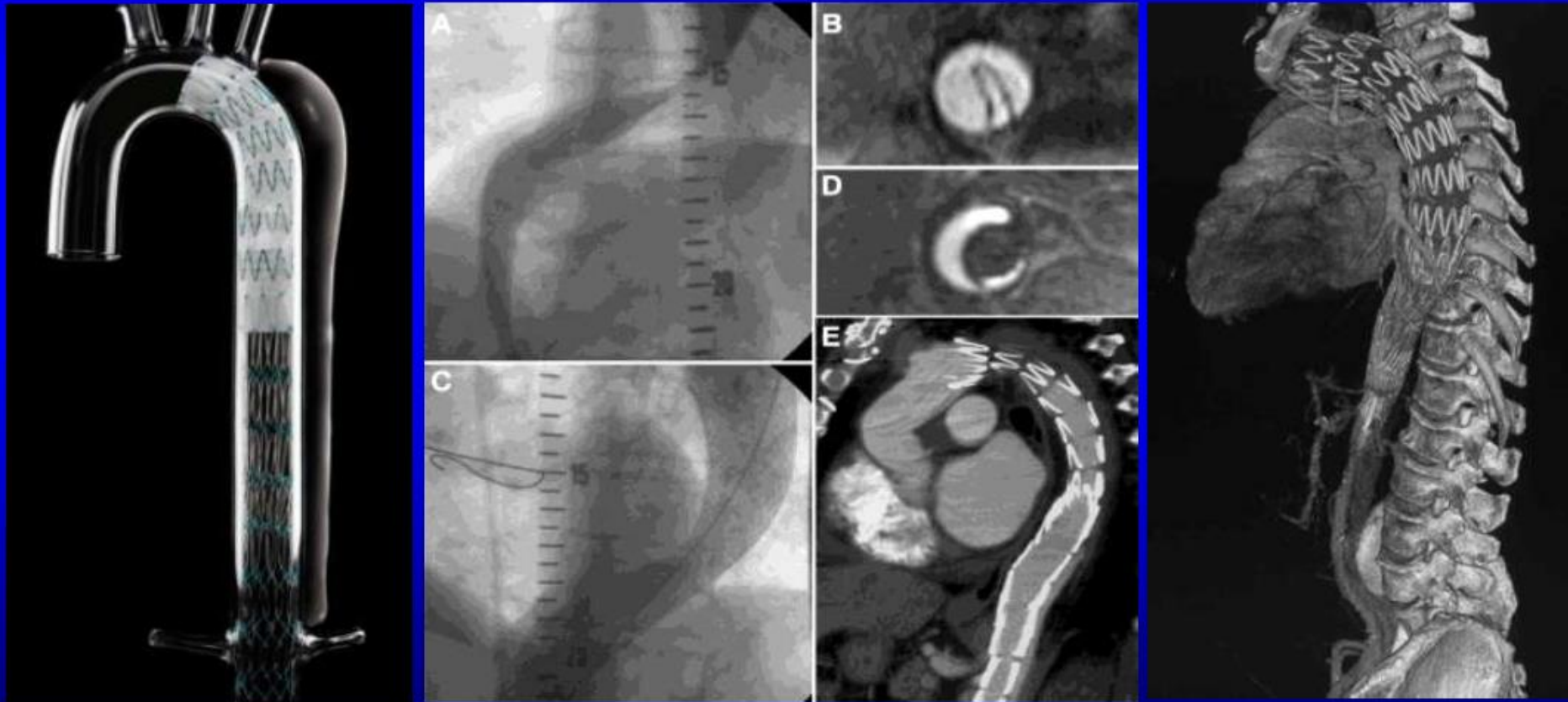
Complex complicated type B dissection



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

The PETTICOAT Concept

Provisional Extension To Induce Complete Attachment After Stent Graft Placement in type B aortic dissection



REPORT FROM THE SOCIETY OF THORACIC SURGEONS ENDOVASCULAR SURGERY TASK FORCE

Expert Consensus Document on the Treatment of Descending Thoracic Aortic Disease Using Endovascular Stent-Grafts*

Editors: Lars G. Svensson, MD, PhD, Nicholas T. Kouchoukos, MD, and D. Craig Miller, MD

Section Authors: Joseph E. Bavaria, MD, Joseph S. Coselli, MD, Michael A. Curi, MD, MPA, Holger Eggebrecht, MD, John A. Elefteriades, MD, Raimund Erbel, MD, Thomas G. Gleason, MD, Bruce W. Lytle, MD, R. Scott Mitchell, MD, Christoph A. Nienaber, MD, Eric E. Roselli, MD, Hazim J. Safi, MD, Richard J. Shemin, MD, Gregorio A. Sicard, MD, Thoralf M. Sundt III, MD, Wilson Y. Szeto, MD, and Grayson H. Wheatley III, MD

Longterm F/U data encourage stent-graft induced remodeling in any type B aortic dissection

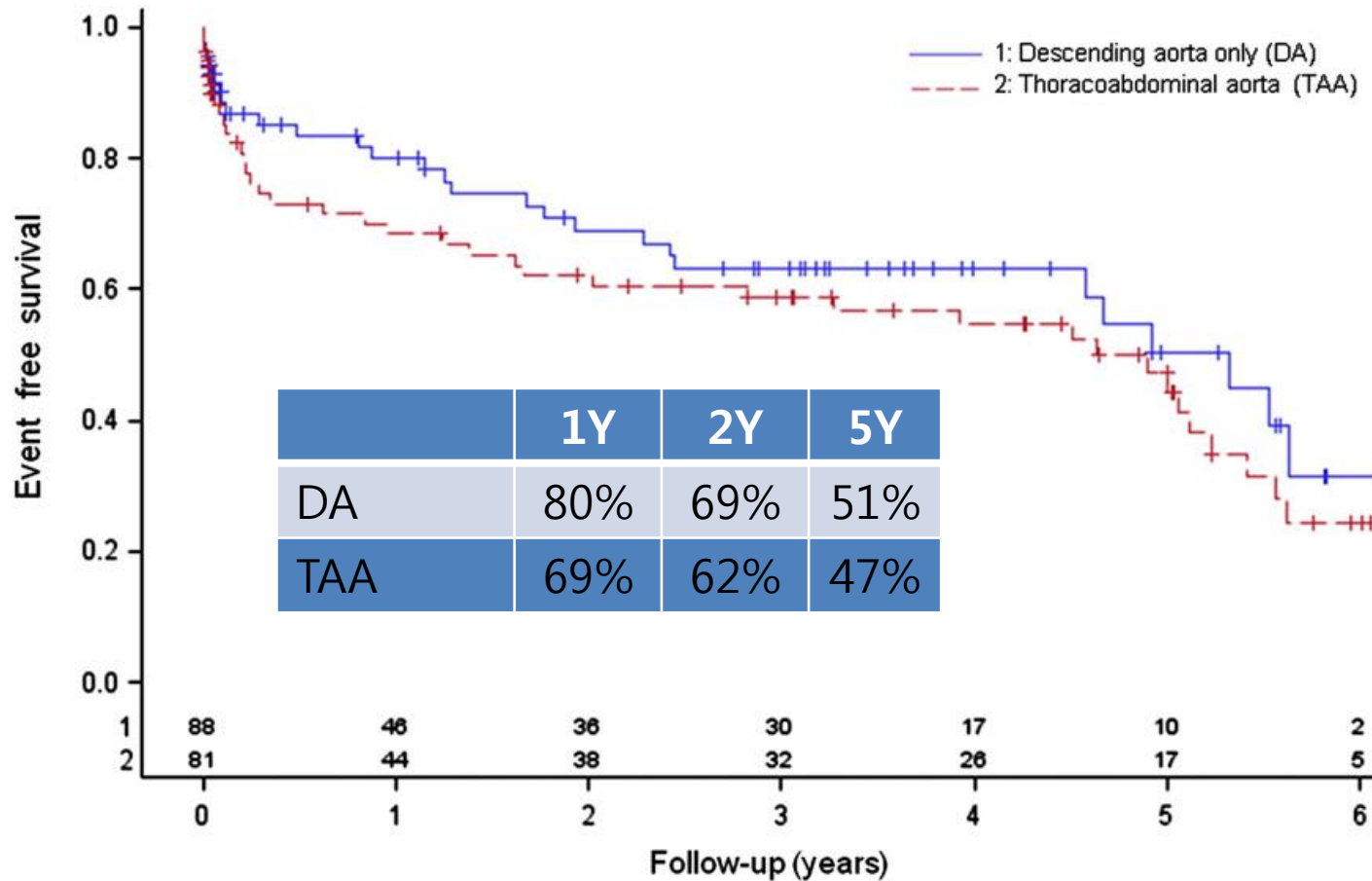
Conclusion: TEVAR in Type B Dissection

- Endovascular interventions are emerging to replace open surgery for type B dissection
- For **complicated type B aortic dissection** undelayed TEVAR is accepted and can be life-saving.
- For **uncomplicated type B dissection** a primary strategy of tailored antihypertensive medical treatment and serial imaging is justified, with **deferred stent-graft implantation** (within 3 months) for patients failing to respond to medical management or developing late complications.

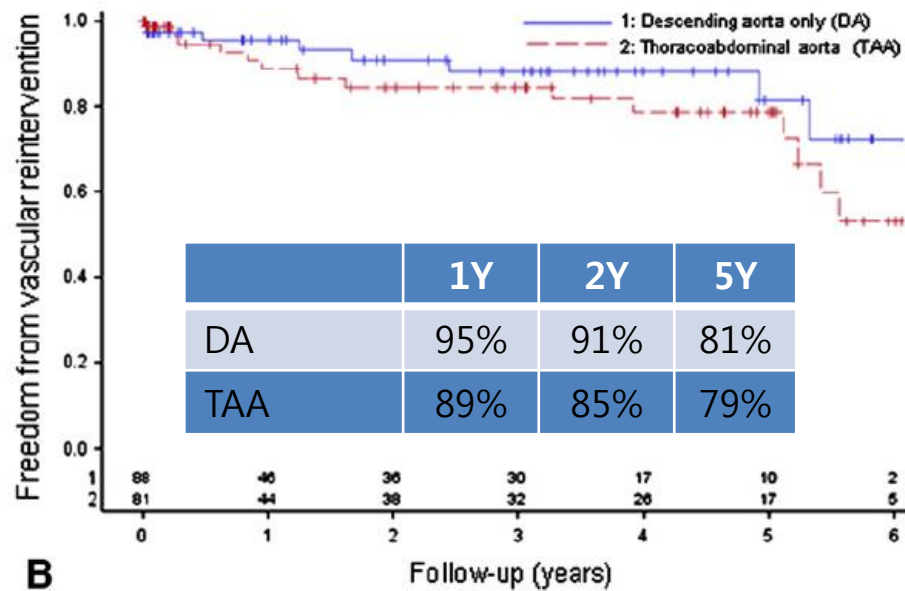
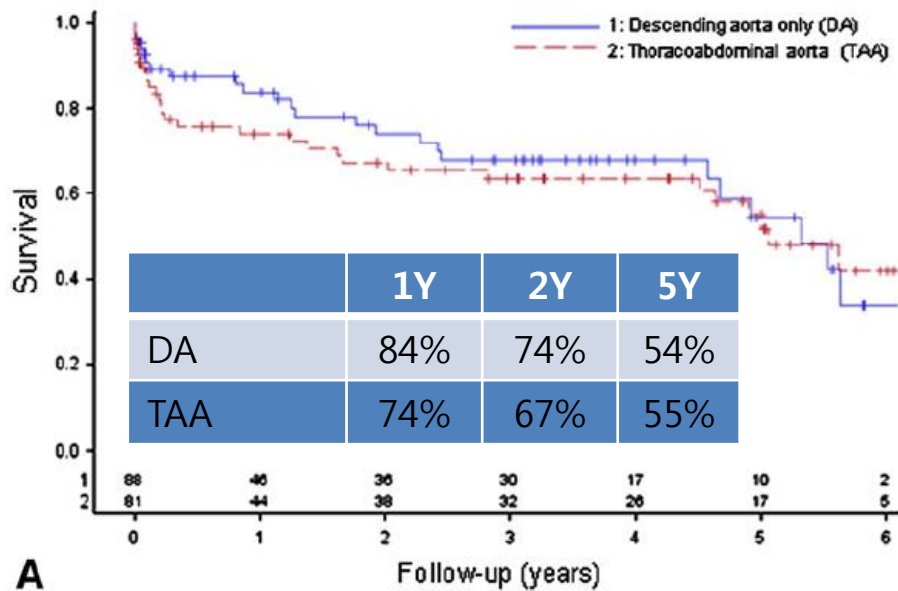
Open repair of chronic distal AD in the endovascular era: Implications for disease management

- From 2000 to 2008, 169 patients underwent open repair of the descending thoracic artery only (n=88) or thoracoabdominal (n=81) chronic aortic dissection (elective in 98, urgent/emergency in 71).
- Chart review and 3-dimensional assessment of computed tomography were performed.
- Poor outcome included all cause mortality or vascular reintervention.

Open repair of chronic distal AD in the endovascular era-Event-free survival



Open repair of chronic distal AD in the endovascular era-**Freedom free** reintervention



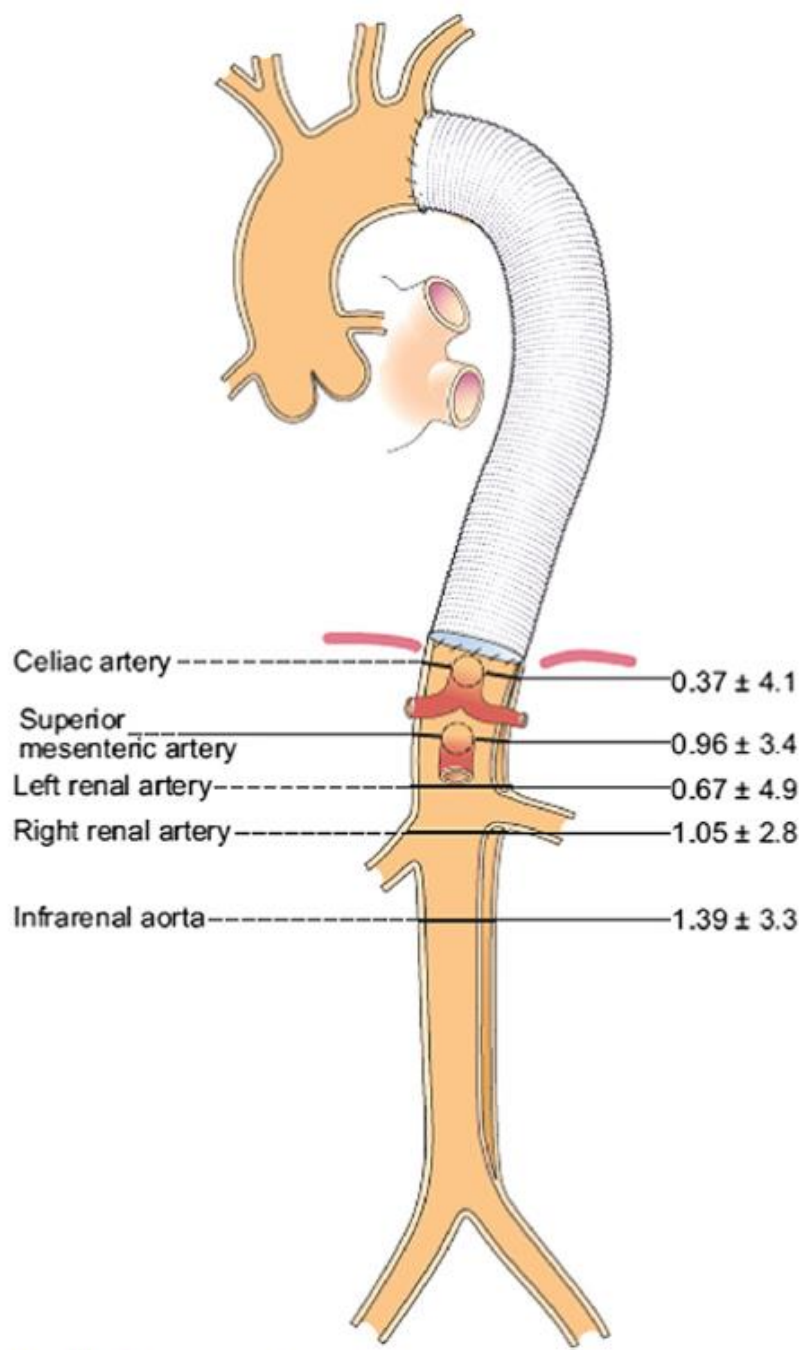


FIGURE 4. Aortic growth distal to repair (mm, mean \pm standard deviation).

Complication to type B Acute Dissection

- Type B dissections are commonly stratified as **acute onset complicated, acute onset uncomplicated, and chronic.**
- About **20%** of cases are complicated at the time of diagnosis, requiring either endovascular or surgical repair.

▪ Rupture	10 %
▪ Organ Ischemia (malperfusion)	5-10 %
▪ Refractory Hypertension	5-10 %
▪ Dilatation/Aneurysm	25 %/4yr

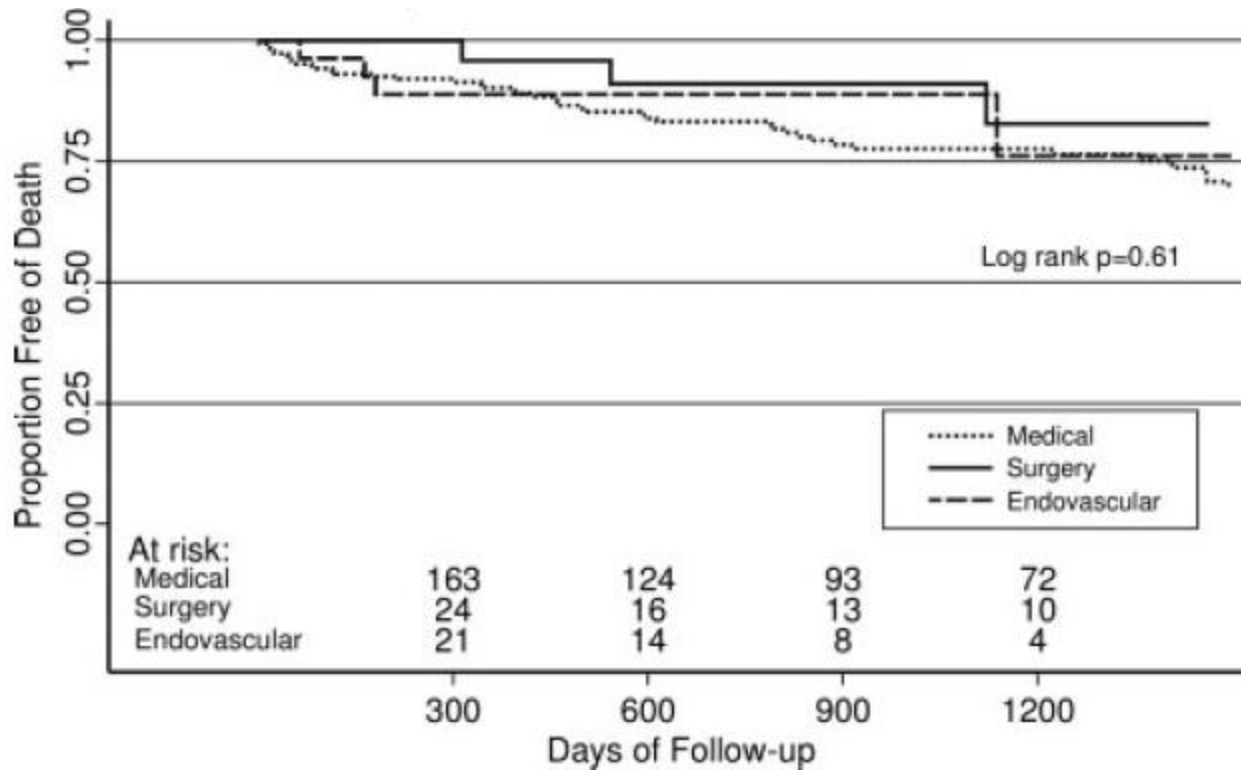


IRAD : International Registry of Aortic Dissection

- The **International Registry of Aortic Dissection (IRAD)** represents 21 large centers in 11 countries which between 1996 and 2003 collected **532 type B AD**.
- Patients with symptoms of ischemia or refractory pain underwent an intervention.
- In-hospital mortality was 29% for open traditional surgery, 11% for endovascular therapies, and 10% for medical therapy alone.

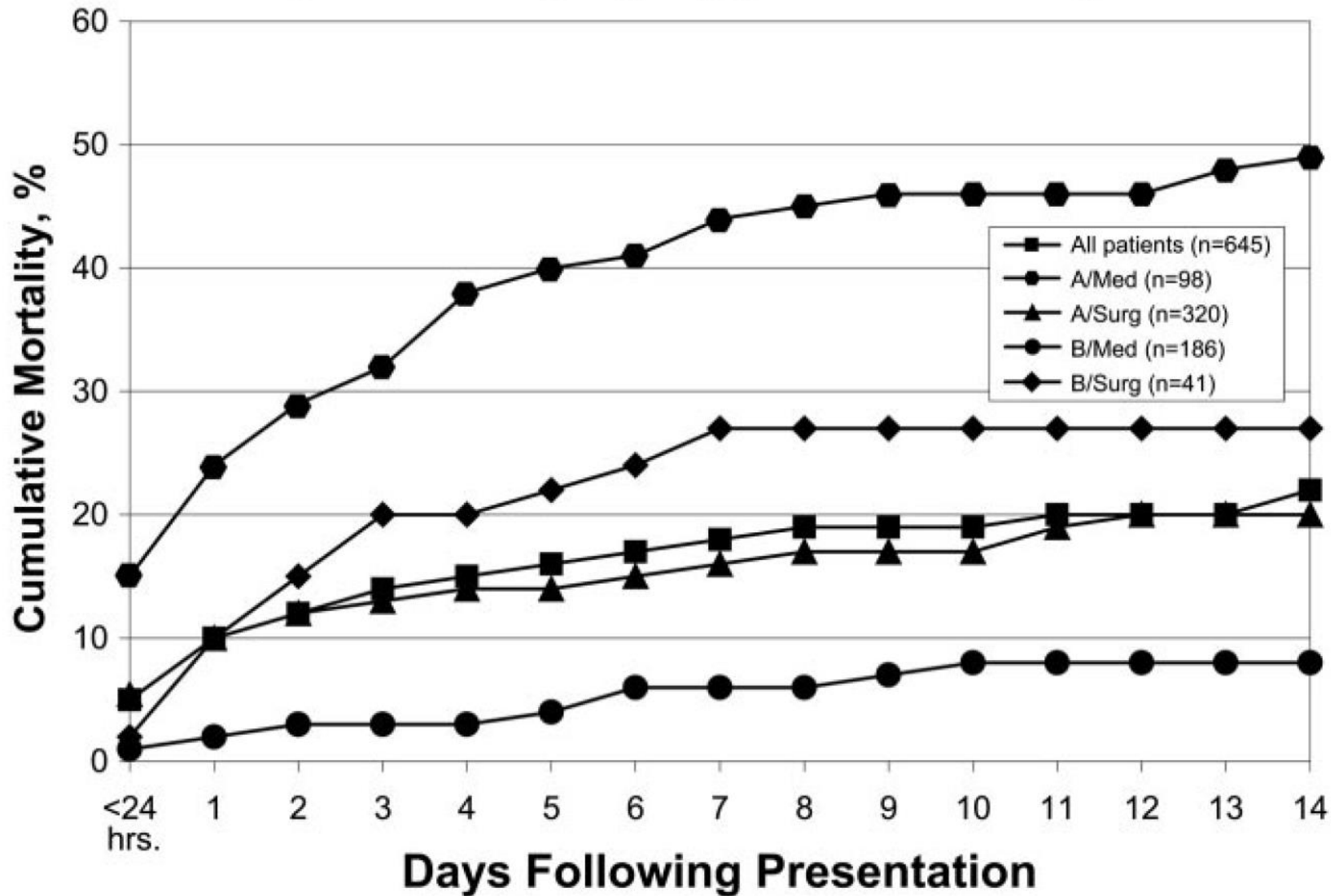


Kaplan-Meier Survival Estimates



- Those patients who survived discharge from the hospital, 96% were alive 1 year after surgery, 89% 1 year after endovascular therapy and 90% with medical therapy alone.
- At 3 years, 83% of the surgical group was alive, 76% of the endovascular group and 78% of the medical treatment only group.

14 Day Mortality by Type and Management



Classification

- **Acute vs. Chronic** (2weeks)
- **Disease extension** (anatomic consideration)

Stanford or DeBakey, Svensson (ESC)

- **Complicated vs. Uncomplicated**
 - ✓ Expansion/ imminent **rupture**
 - ✓ Persistent thoracic pain
 - ✓ Drug-resistant hypertension
 - ✓ Development of **malperfusion syndrome**
 - ✓ Development of **aneurysm** of the false lumen

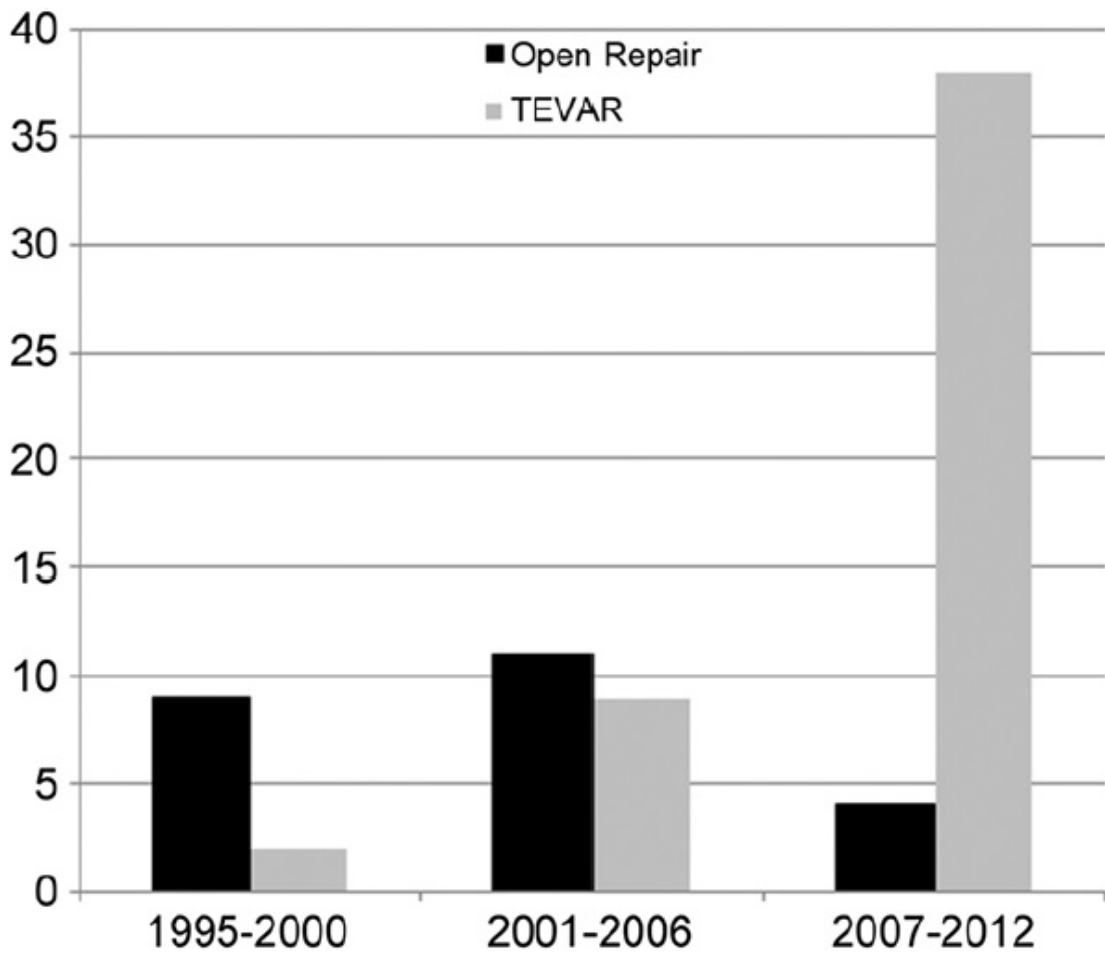


Fig 1. Evolution of management of complicated acute and subacute type B dissections at the University of Michigan from 1995 to 2012. These periods correlate with commercial availability of endografts. In addition to a trend toward increased use of thoracic aortic endovascular repair (TEVAR), the overall volume of intervention has increased, likely with inclusion of otherwise inoperable patients, as well as those presenting with malperfusion in the thoracic aortic endovascular repair treatment paradigm.

Conclusion : INSTEAD

- This is the **first randomized study** on elective stent-graft placement in survivors of uncomplicated type B aortic dissection.
- TEVAR **failed** to improve 2-year survival and adverse event rates despite favorable aortic remodeling.
- The INSTEAD trial with 3 year data did not show a statistically significant difference between medical management and endovascular therapy.
- This trial was **underpowered** to reach statistical significance.
- Also of note, the medical group did include 16% of patients who eventually had to go for repair of the aorta due to degenerative aneurysmal disease with aortic diameter > 6 cm.
- This trial with long-term follow-up may find a survival advantage for stent-grafting over medical management especially when late aneurysmal degeneration is considered.

Background

- Patients with distal chronic aortic dissections (DCAD) remain at high-risk for secondary aortic-related events and subsequent reinterventions.
- However, the ideal strategy to manage complicated DCAD is not defined yet: open surgical strategies are fraught with high rates of morbidity and mortality, while the results of the endovascular aortic repair (EVAR) are poorly known in this indication.

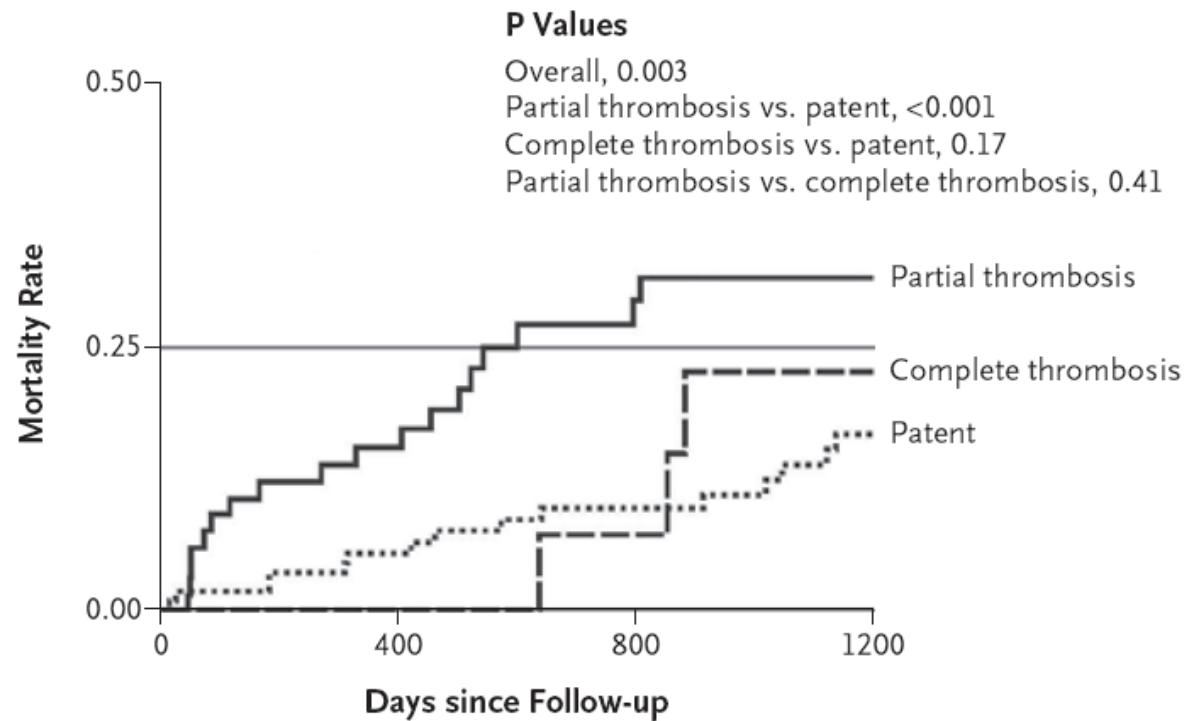
Methods

- .
- Data regarding the demographics, the indication for repair, the complications, and the morphologic changes of the aorta during follow-up was collected using medical records and CT-scan analysis.
- Statistical analysis was performed to evaluate the evolution of the aortic wall (aneurysm size, false lumen thrombosis) according to the aortic level.

Indication for DCAD repair

- (1) Maximum aortic diameter ≥ 55 mm;
- (2) Rapid aortic enlargement (≥ 10 mm per year);
- (3) Clinical or radiographic evidence of rupture or impending rupture;
- (4) Intractable chest pain, despite maximal medical therapy;
- (5) Symptomatic branch vessel stenosis/occlusion with subsequent visceral ischemia.

RESULTS

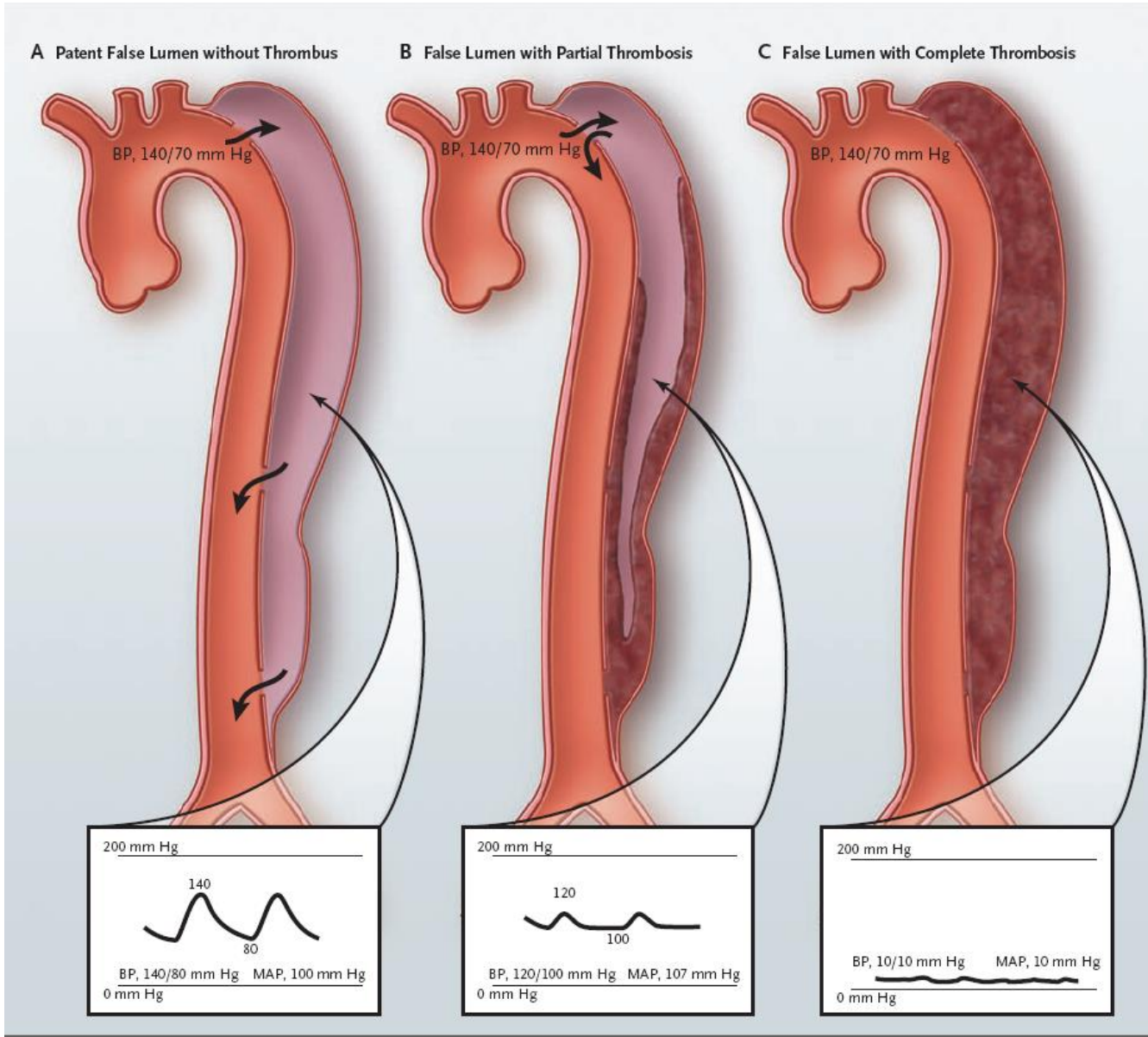


No. at Risk

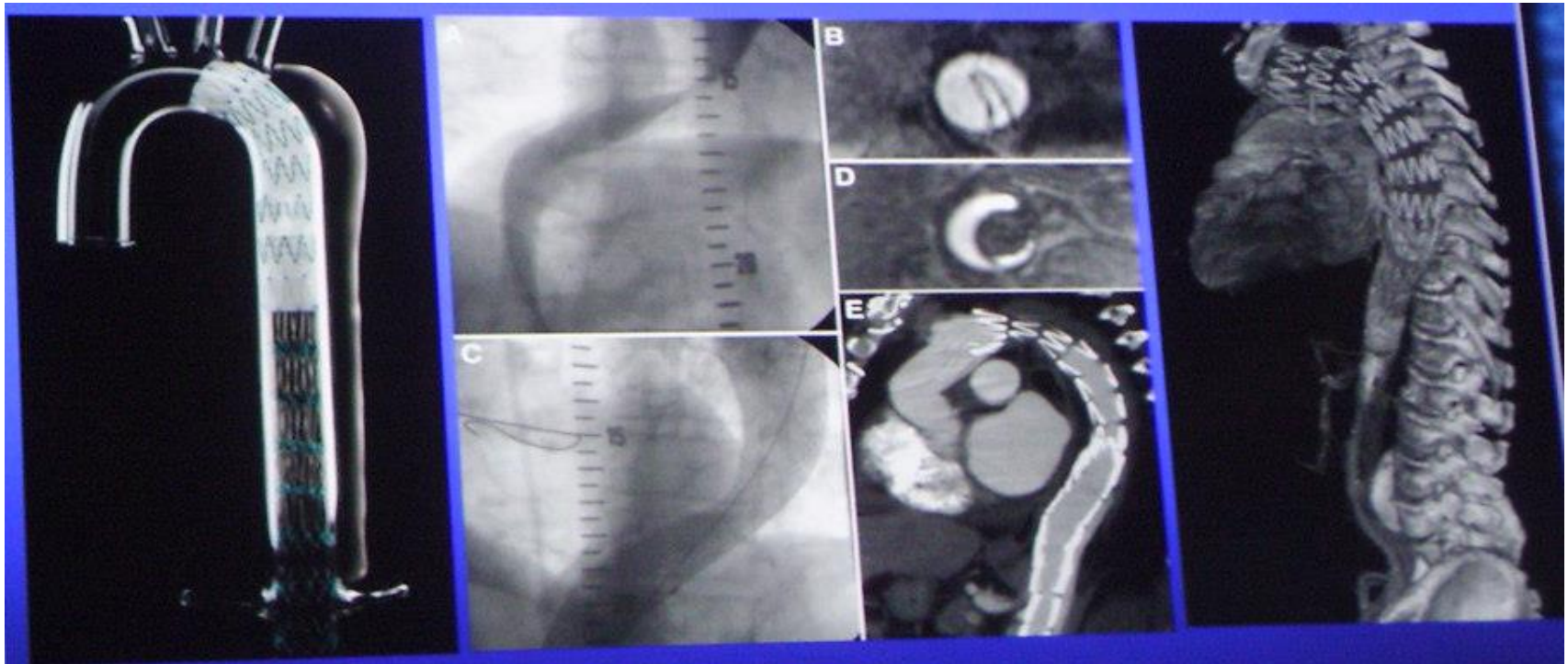
Patent	111	96	75	56
Partial thrombosis	67	48	32	24
Complete thrombosis	19	17	12	4

Figure 1. Kaplan–Meier Mortality Curve Stratified According to the Status of the False Lumen.

P values were calculated by the log-rank test. Overall denotes comparison of all three curves.



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



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

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

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

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

Conclusions

- EVAR is a reasonable alternative for patient with complicated DCA D and provides satisfactory mid-term clinical outcomes.
- EVAR stabilizes the descending aorta in most patients and promotes aortic remodeling.
- However, careful attention should be given to the dissected aorta situated below the level of the SG to detect late aneurysmal degeneration.

Timing of Endovascular Repair

- The optimal timing for endovascular intervention in type B dissections remains controversial.
- Acute : fragile dissecting membrane, inflammation, greater potential for stent-graft induced complete remodelling of the entire aorta.
- Chronic : more fibrotic and seemingly stable membrane in the chronic phase, progressive thickening of the intimal flap due to fibrosis and frequently possess multiple natural fenestrations in the septum which may not be sufficient to obliterate flow in the false lumen

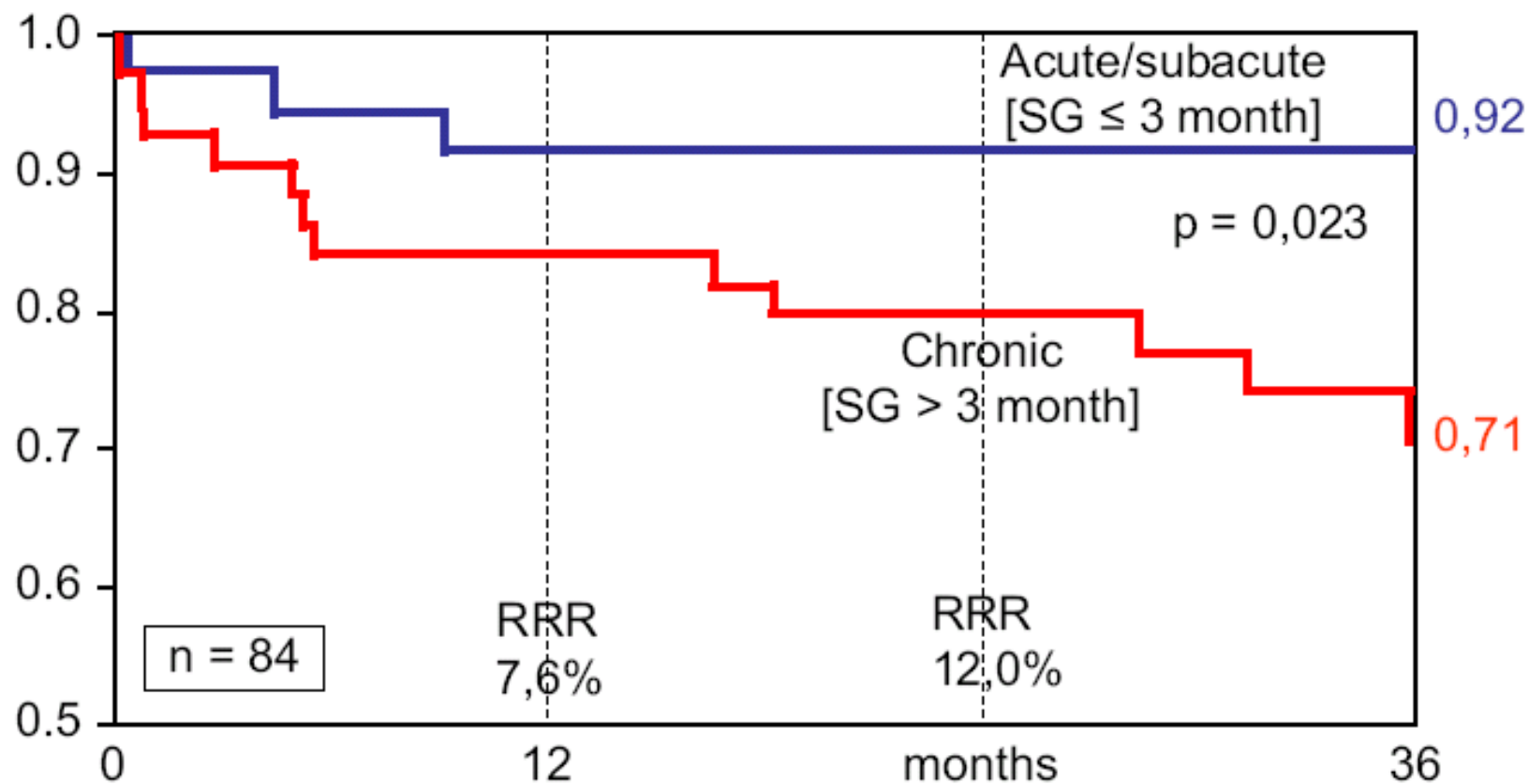


Figure 5 Impact of treatment timing on event (MAVE) free survival in patients with acute aortic dissection (own results).

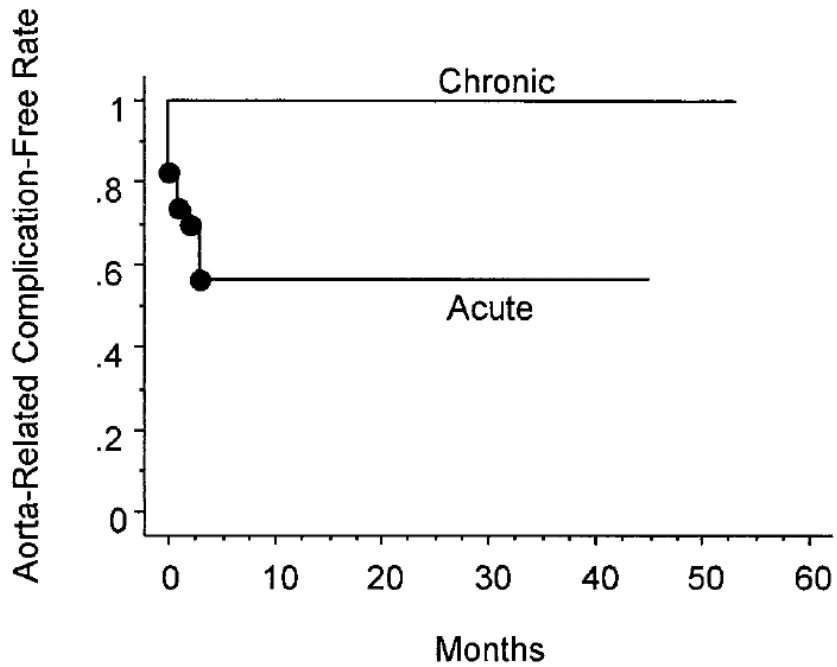


Figure 1. Actuarial aorta-related complication-free rate.

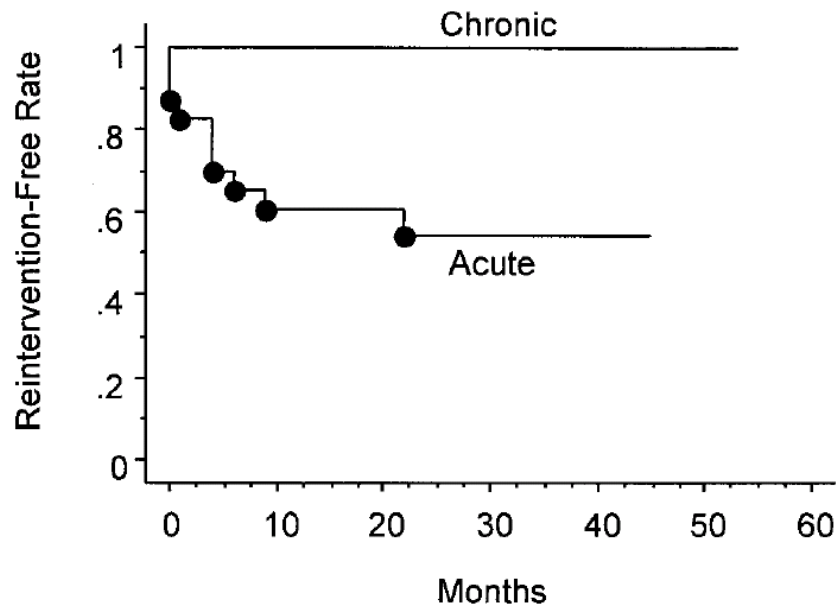


Figure 2. Actuarial reintervention-free rate curve.

Timing of Endovascular Repair

- In fact, due to lack of prospective randomised data comparing immediate and delayed intervention in various clinical and anatomical constellations, no general recommendation has been issued with respect to timing of endovascular treatment so far; observational evidence, however, may favour an early intervention, when justified by complications.

Endovascular Repair for distal Aortic Dissection

Woong Chol Kang, M.D.

Gil Hospital, Gachon University, Incheon, Korea



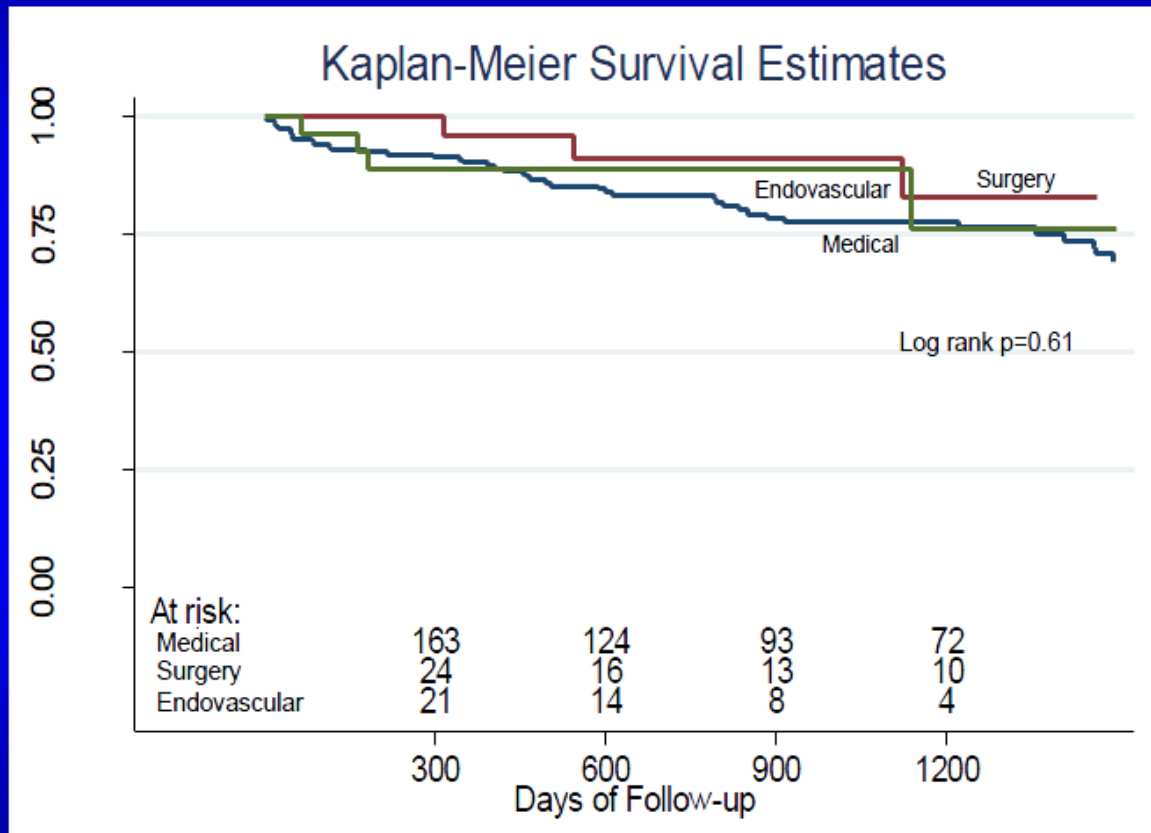
Do the Data Support Endovascular Therapy for Descending Thoracic Aortic Dissections?

Woong Chol Kang, M.D.

Gil Hospital, Gachon University, Incheon, Korea



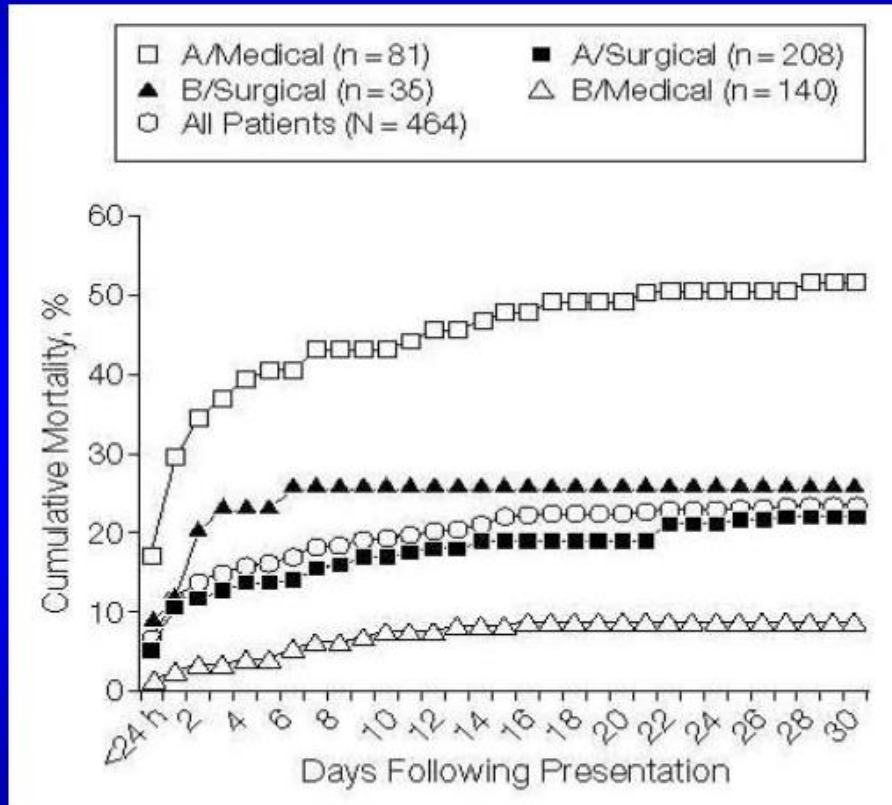
Survival of type B dissection by treatment in IRAD



- Mortality of type B dissection 25% in 3 years
- Need for improved treatment

Natural History: Thoracic Aortic Dissection

Aortic Dissection



Mortality

- 1 - 3% per hour (Shennan 1934)
- 1/3 within 24 hours (Lindsay 1967)
- 38% within 15 days (IRAD 2000)



Data from International Registry of Acute Aortic Dissection (IRAD)

Aortic Dissection

- Uncommon but highly lethal
- Tear in the **intimal layer**.
- Blood passes into the aortic media through the tear : creating **a false lumen**.
- Propagation of the dissection causes complications : **tamponade, AI, malperfusion syndromes, aneurysm, rupture.**



Classification

- **Acute vs. Chronic** (2weeks)
- **Disease extension** (anatomic consideration)
 - Stanford or Debakey, Svensson (ESC)**
- **Complicated vs. Uncomplicated**

ESC Classification

Stanford	Type A	Dissection involving ascending aorta, may extend distally
	Type B	Dissection involving only the descending aorta
De Bakey	Type 1	Dissection of the ascending and descending aorta
	Type 2	Dissection of ascending aorta only
	Type 3	Dissection of descending aorta only
European Society of Cardiology (ESC)	Class 1	Classic aortic dissection with intimal flap
	Class 2	Intramural haematoma
	Class 3	Discrete dissection- no haematoma
	Class 4	Penetrating atherosclerotic ulcer
	Class 5	Iatrogenic / traumatic dissection

Complication to type B Dissection

- Malperfusion
 - Refractory hypertension
 - Continued pain
 - Dilatation/Aneurysm 20-50%/1-5yr
 - Rupture or impending rupture
-
- About 30% of cases are complicated at the time of diagnosis, requiring either endovascular or surgical repair. (mortality : 20% at day 2, 25-50% at 1 M)
 - Acute vs. Chronic and Complicated vs. Uncomplicated.

Unanswered question for Endovascular therapy in AD

- **When**

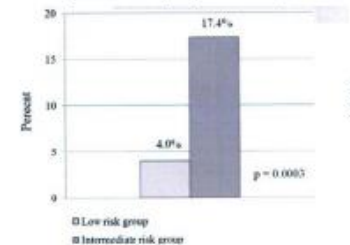
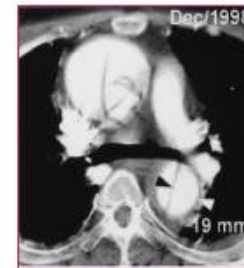
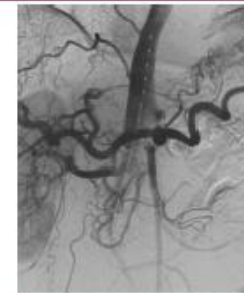
Acute vs. Chronic

Complicated dissection:

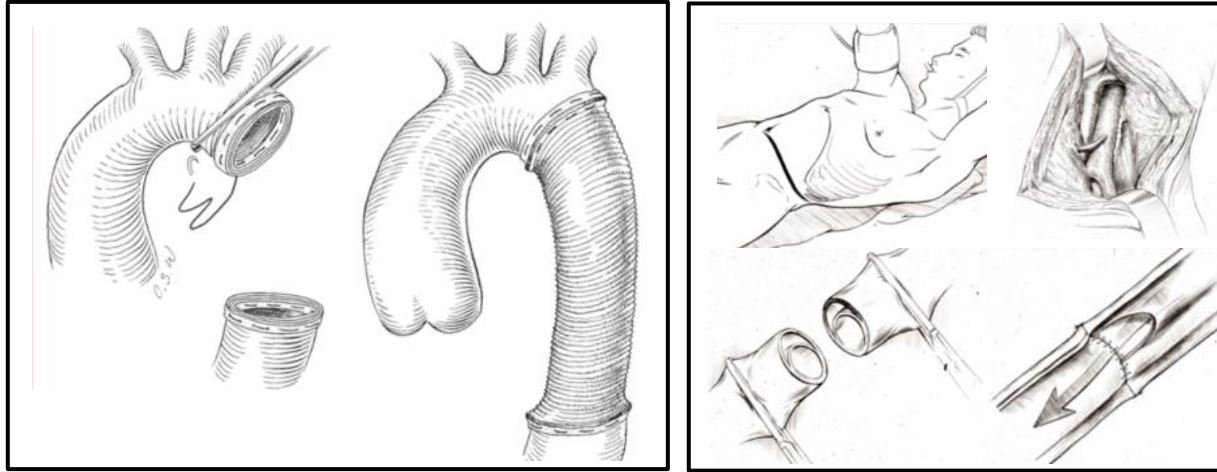
- Malperfusion syndromes
- Rupture / impending rupture
- Early false lumen expansion
- Resistant hypertension
- Partial FL thrombosis / FDG-uptake
- Ongoing pain

Uncomplicated dissection:

- None of the above
- Total aortic diameter ≤ 5.5 cm



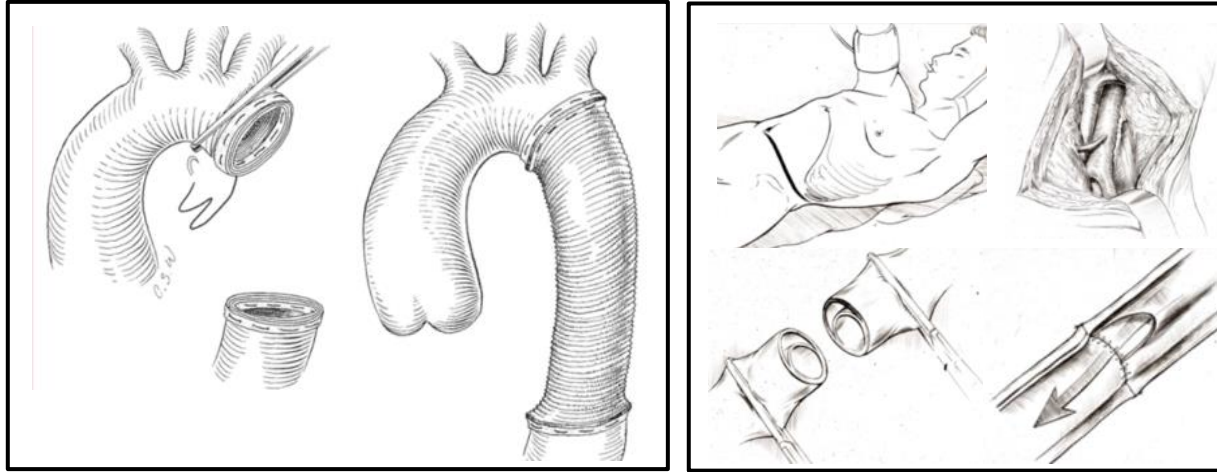
Open Surgical Repair



- Rupture : Graft replacement
- Expansion : Graft replacement
- Ischemia : Fenestration
- high in-hospital mortality (29%)
- new neurologic deficit (23%)
- stroke (9%)
- sustained paraplegia (5%)

from IRAD registry (Circulation 2006)

Open Surgical Repair



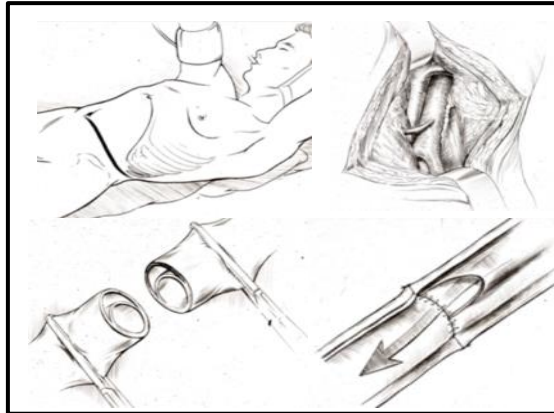
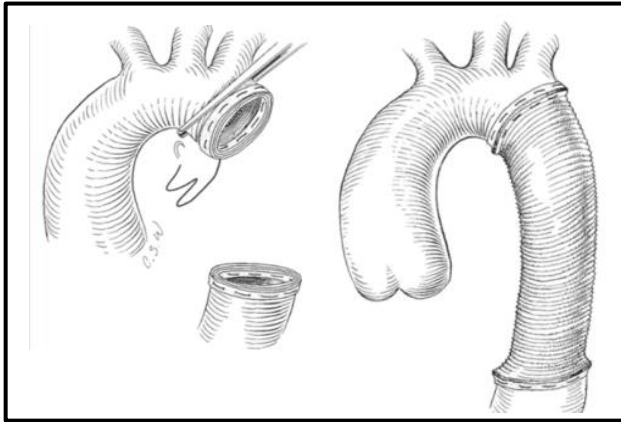
- Rupture : Graft replacement
- Expansion : Graft replacement
- Ischemia : Fenestration
- high in-hospital mortality (29%)
- new neurologic deficit (23%)
- stroke (9%)
- sustained paraplegia (5%)

from IRAD registry (Circulation 2006)

Current treatment of type B AD

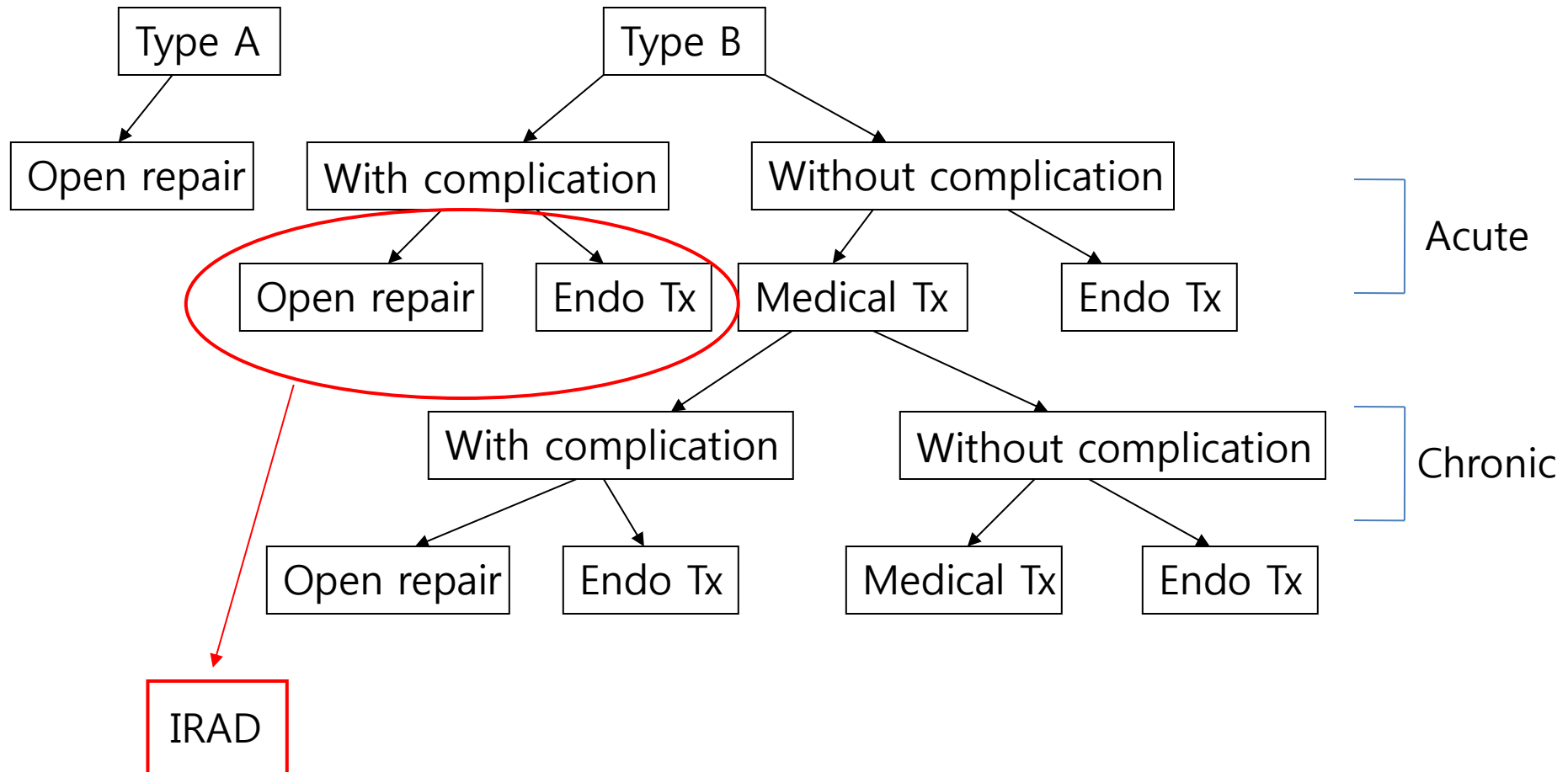
Optimal Medical Treatment

Open Surgical Repair



- High in-hospital mortality (29%)
- New neurologic deficit (23%)
- Stroke (9%)
- Sustained paraplegia (5%)

Aortic Dissection : Endovascular Tx vs. Other Tx





Association Between **Surgery** and **IH Mortality** in Patients With Acute Complicated Type B AD: Effect of Multivariate Adjustment

Model	Odds Ratio	95% CI	p Value
Unadjusted	4.25	1.64–11.00	0.003
Multivariate adjustment*	3.89	1.27–11.91	0.02
Propensity†	3.46	1.25–9.62	0.02
Propensity and multivariate adjustment	3.41	1.00–11.67	0.05

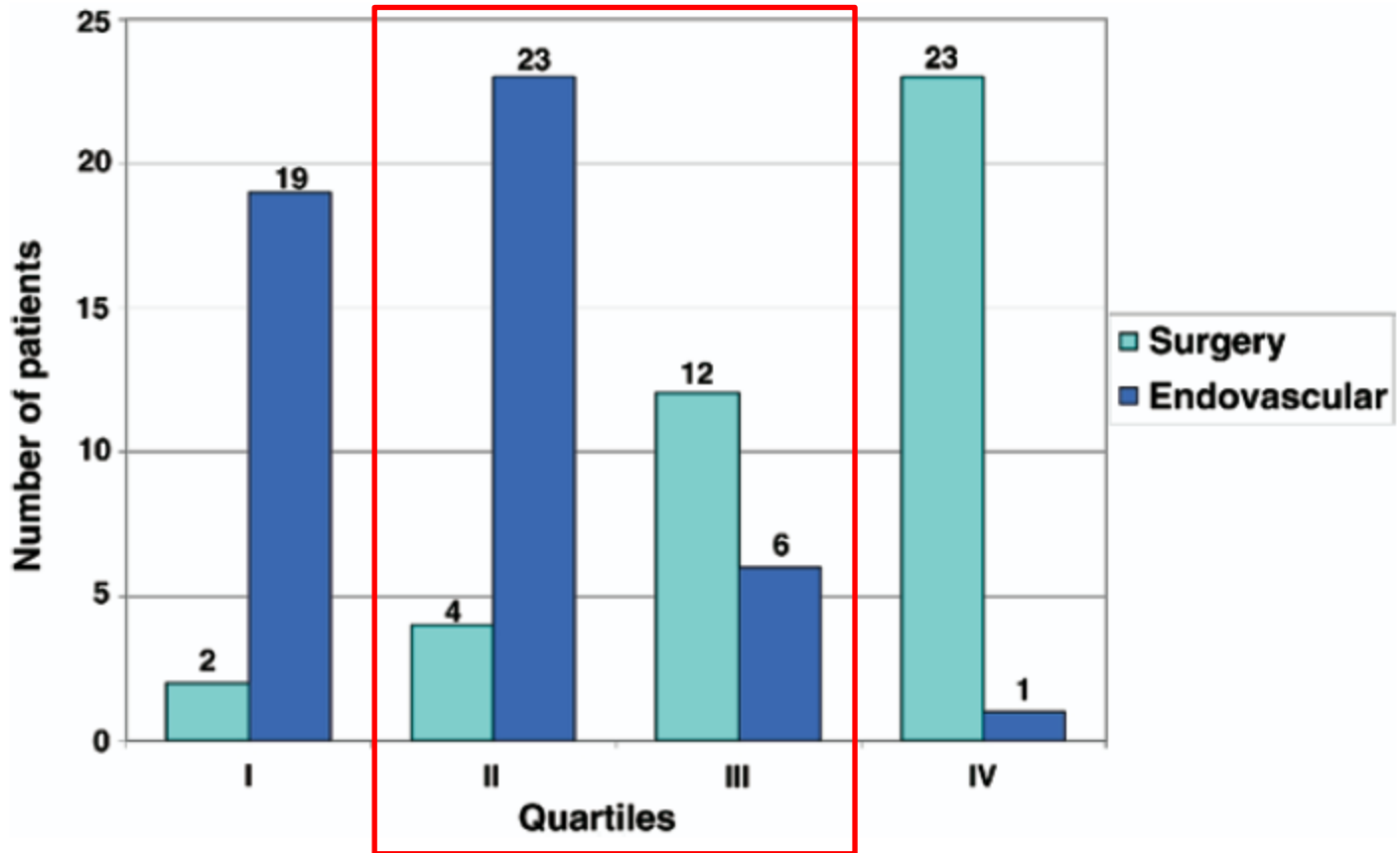
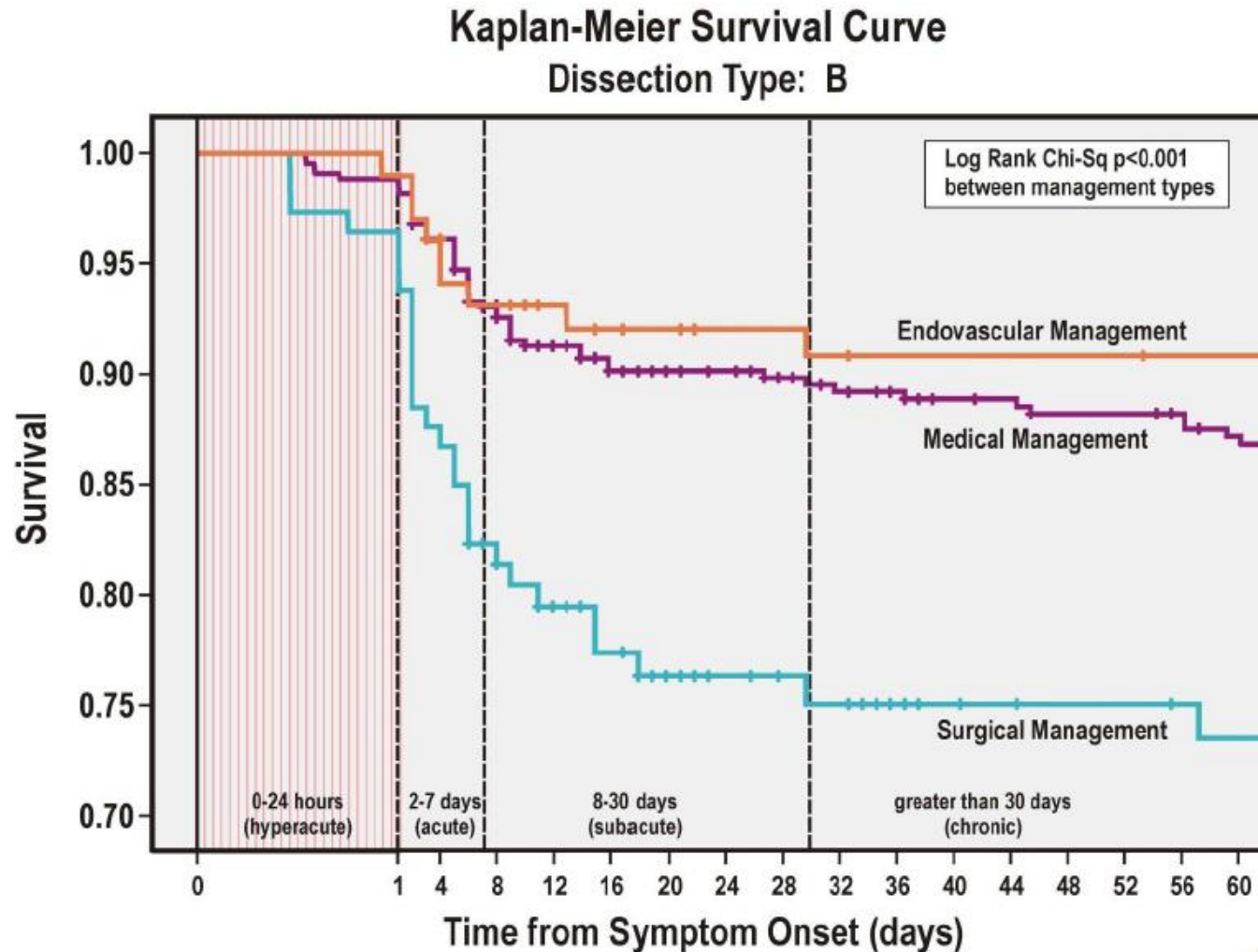


Table 6. Mortality for Combined Quartile 2 and Quartile 3

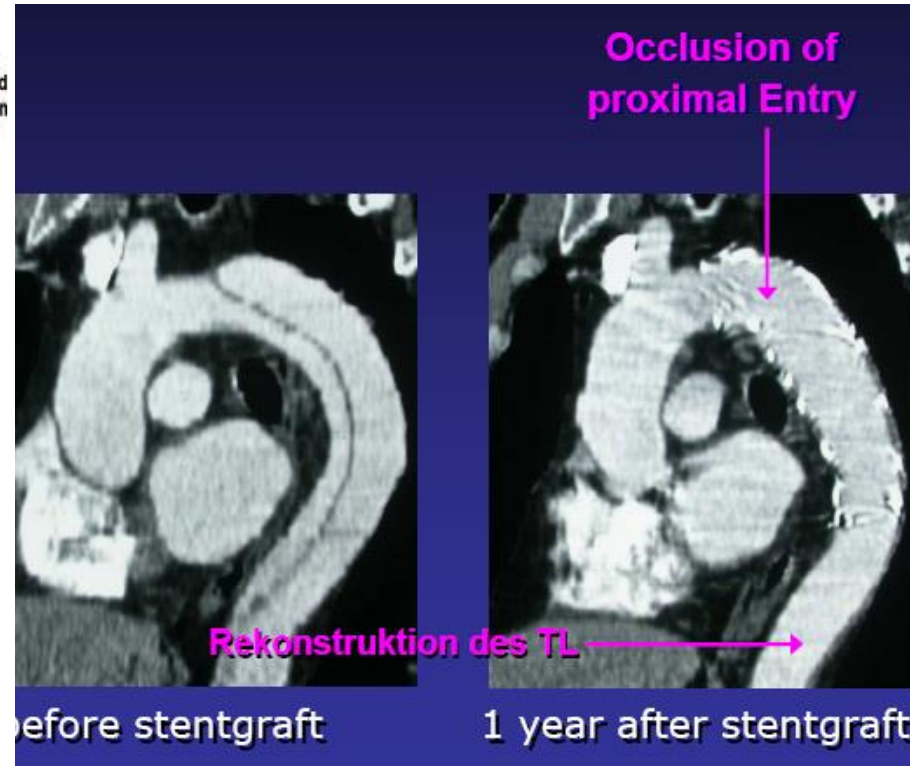
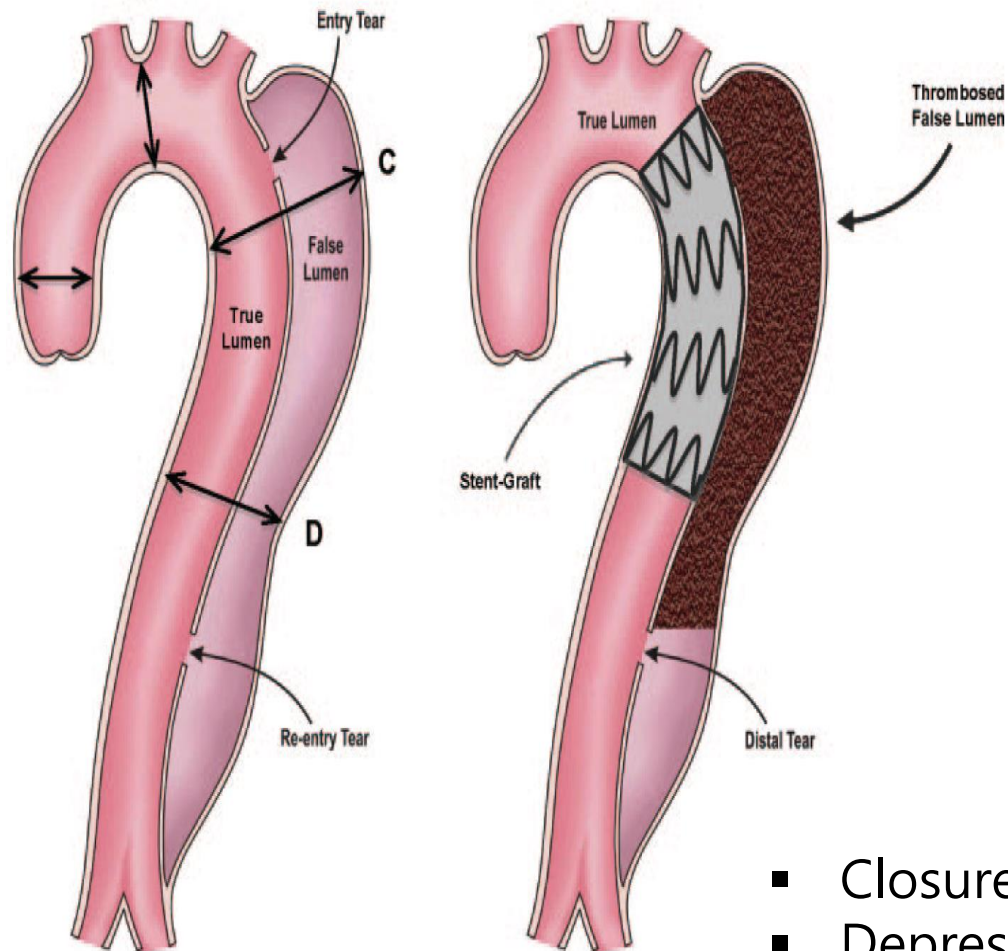
Models	Surgery 16 (35.6%)	Endovascular 29 (64.4%)	p Value
Mortality	7 43.8%	2 6.9%	0.006

Short-term Outcomes in type B dissection in IRAD



IRAD unpublished

Concept of Endovascular Repair in AD



- Closure of the Proximal Entry tear
- Depressurization of the False Lumen
- Redirection of blood flow towards the TL
- Thrombosis of the FL
- Induction of aortic remodeling



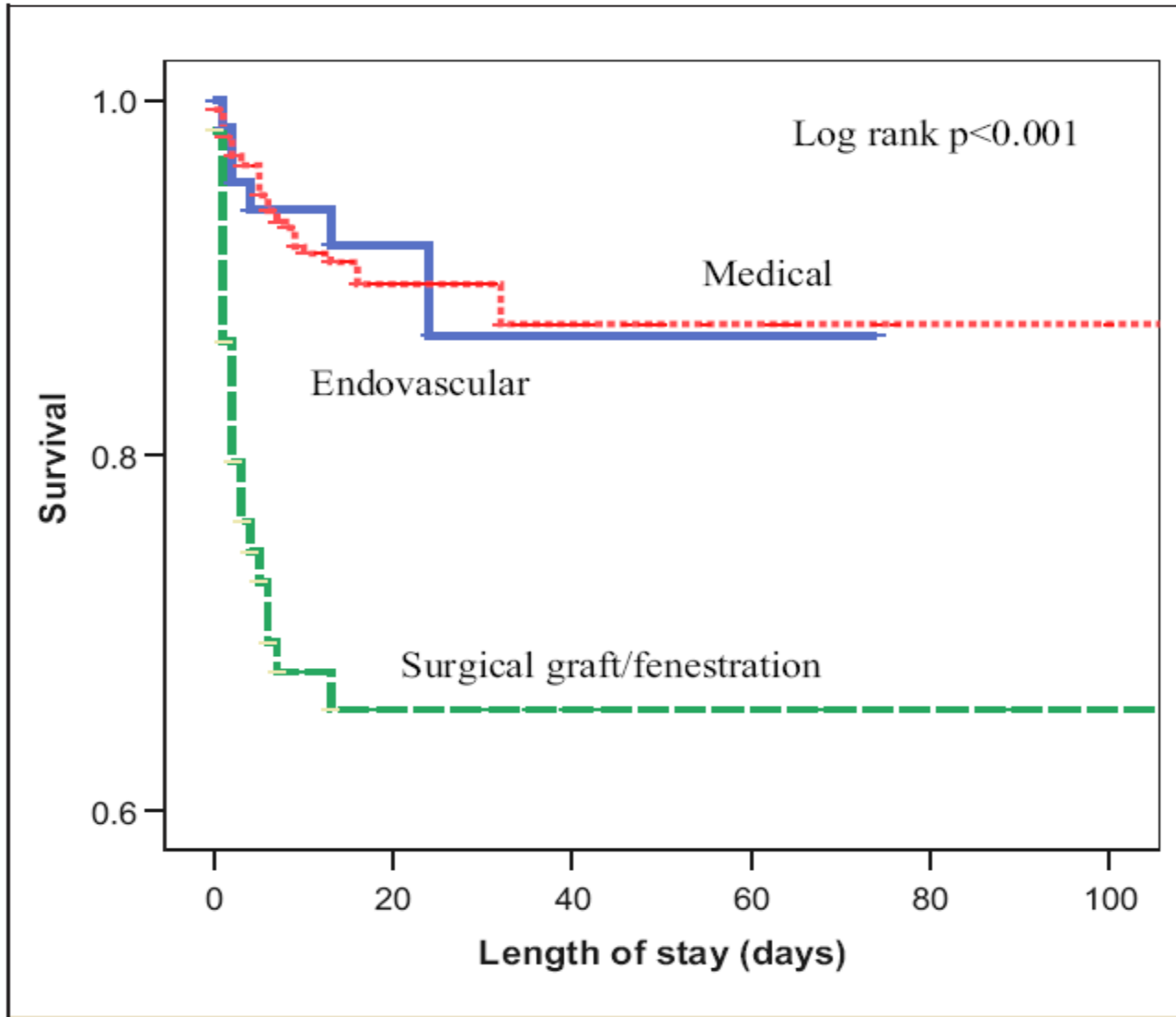


IRAD : International Registry of Aortic Dissection

- The **International Registry of Aortic Dissection (IRAD)** represents 21 large centers in 11 countries which between 1996 and 2003 collected **571 type B AD**.
- Patients with symptoms of ischemia or refractory pain underwent an intervention (surgery or endovascular therapy).



Kaplan-Meier overall in-hospital survival estimates

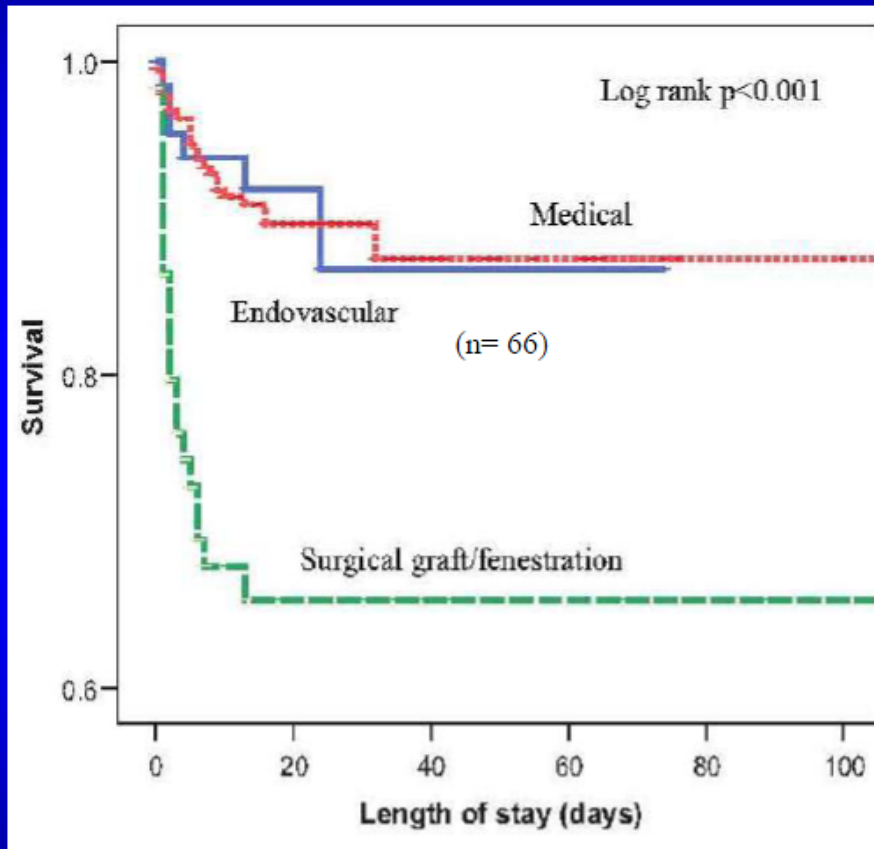




Conclusion : IRAD

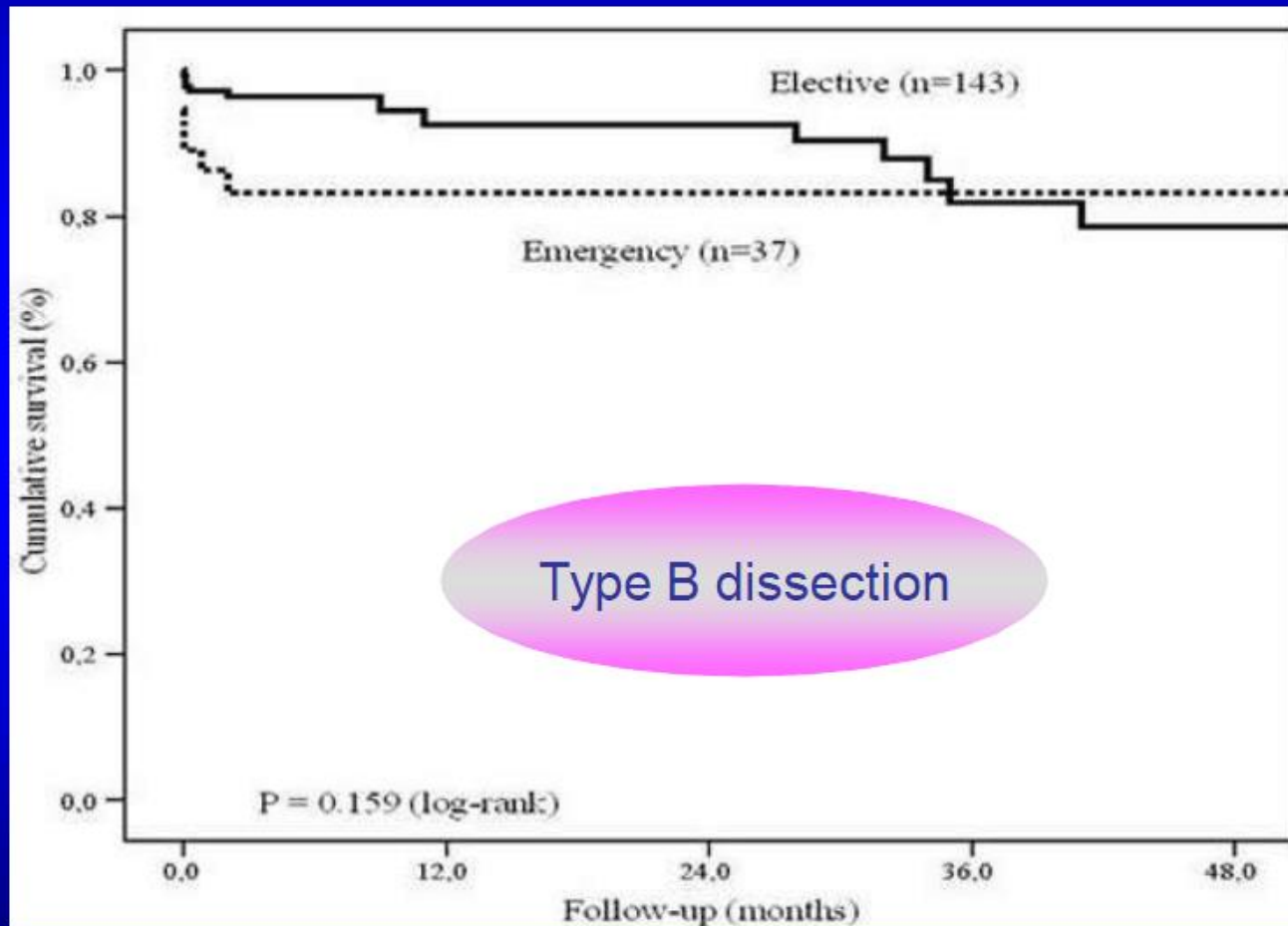
- The less invasive nature of endovascular treatment seems to provide better in-hospital survival in patients with acute type B dissection.
- Larger randomized trials or comprehensive registries are needed to assess impact on outcomes.

Outcomes: Survival of acute complicated type B dissection



- In the IRAD registry TEVAR improves survival in acute (<14 days) complicated type B dissection
- Randomized data are needed for support this notion !
- However, randomization is conceptually difficult in unstable scenarios !

Outcomes: TTR registry data in type B dissections



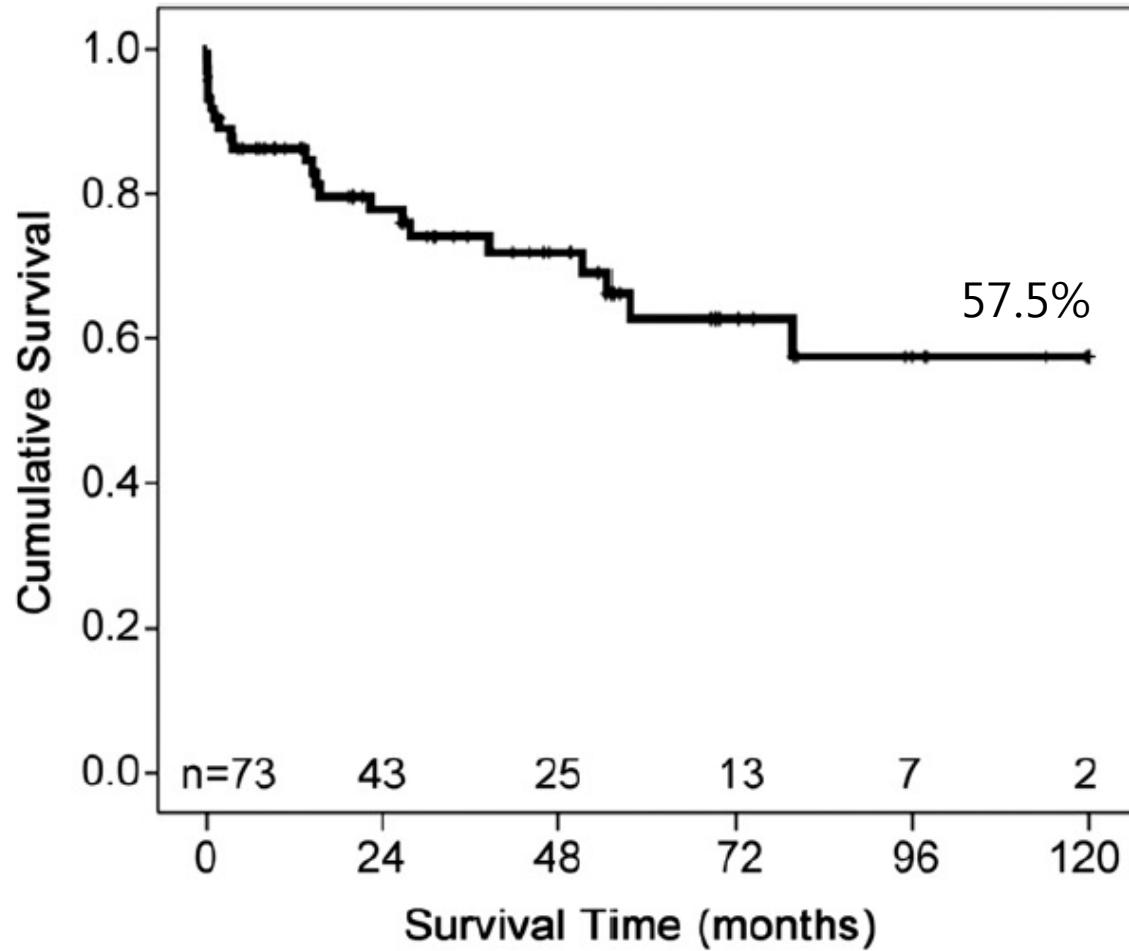
Early Open and Endovascular Thoracic Aortic Repair for Complicated Type B AD

- **Seventy-three** patients (mean age 66.3 yrs) with type B dissection (1995 to 2012) underwent early open descending aortic repair (n=24) or TEVAR (n=49).
- Intervention occurred in the acute (n=53) or subacute (n=20) period.
- Patients undergoing TEVAR were older and had an increased incidence of coronary artery disease and renal impairment (all $p < 0.05$).

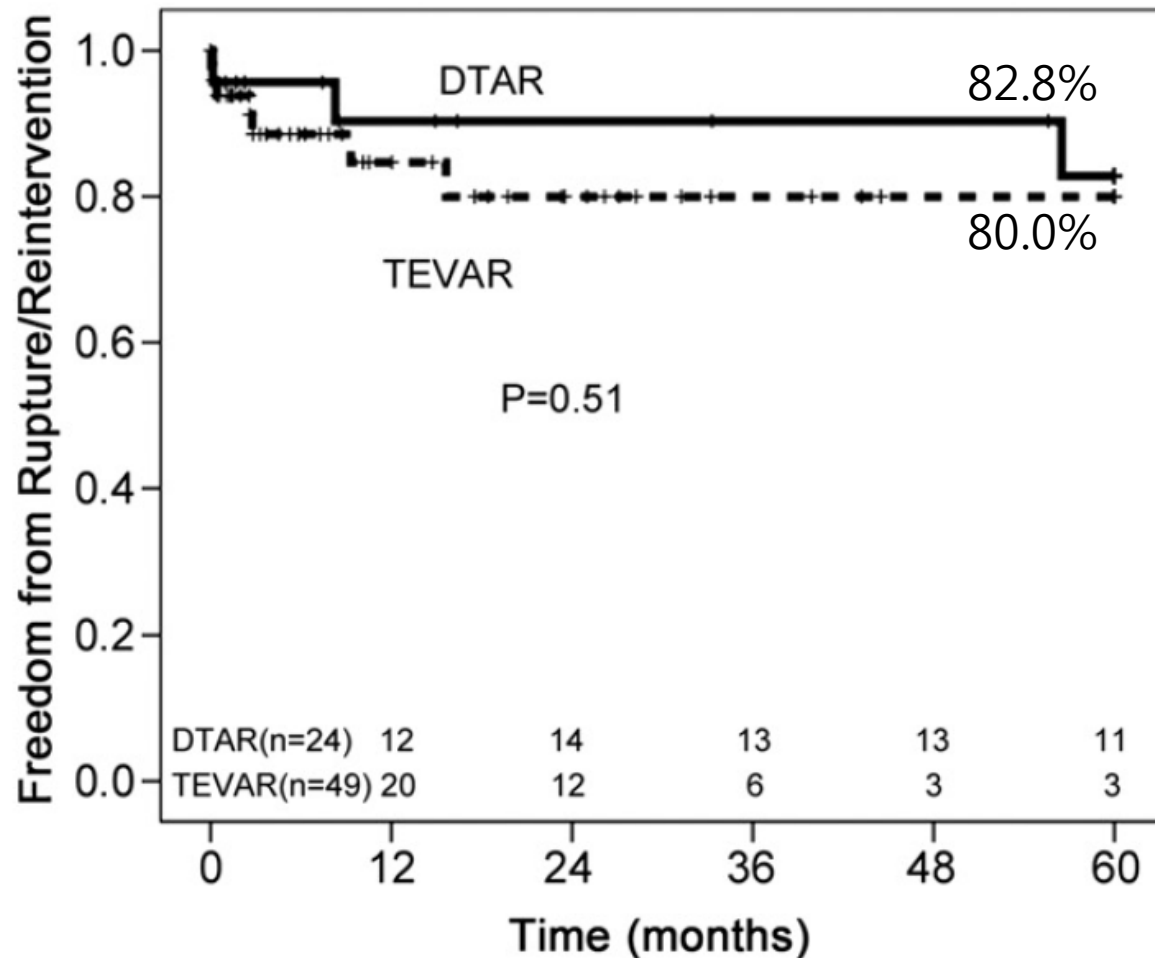
Early Outcomes for Open vs. TEVAR

Variable	Open Repair (n = 24)	TEVAR (n = 49)	<i>p</i> Value
In-hospital or 30-day mortality	4 (16.7%)	5 (10.2%)	0.46
Stroke	3 (12.5%)	3 (6.1%)	0.38
Need for dialysis	4 (16.7%)	2 (4.1%)	0.08
Spinal cord ischemia	1 (4.2%)	3 (6.1%)	1.0
Need for tracheostomy	4 (16.7%)	3 (6.1%)	0.21
Composite early outcome	7 (29.2%)	9 (18.4%)	0.30
Median length of stay (days)	28.1	17.5	0.05
Median duration of mechanical ventilation (h)	27	5	<0.001
Median blood product use (units of red cells, fresh-frozen plasma, or platelets)	6	0	<0.001

Early Open and Endovascular Thoracic Aortic Repair for Complicated Type B AD



Early Open and Endovascular Thoracic Aortic Repair for Complicated Type B AD



Early Open and Endovascular Thoracic Aortic Repair for Complicated Type B AD

- Early aortic repair for complicated type B dissection is associated with high rates of morbidity, late mortality, and reintervention.
- Despite its use in a higher risk group, outcomes seen with TEVAR were similar to open repair, thus supporting the recent paradigm shift toward an endovascular approach.

Endovascular Stent-Graft Placement or Open Surgery for the Treatment of Acute Type B Aortic Dissection: A Meta-Analysis

Zhang Hao, Wang Zhi-Wei, Zhou Zhen, Hu Xiao-Ping, Wu Hong-Bing, and Guo Yi, Wuhan, People's Republic of China

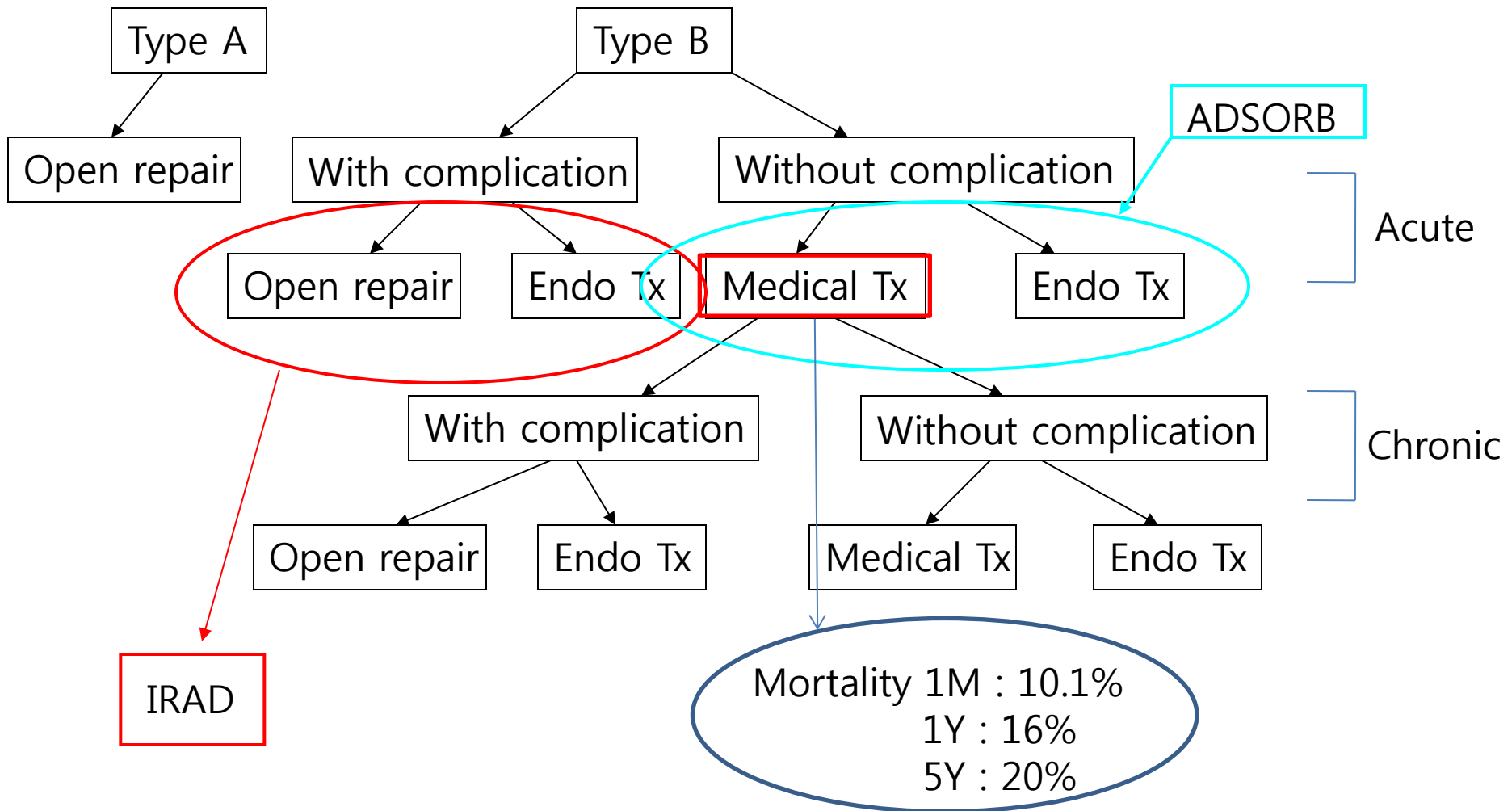
Background: Acute type B aortic dissection (ATBAD) is a life-threatening condition. Open chest surgical repair using a prosthetic graft has been a conventional treatment for ATBAD. During the past decade, thoracic endovascular aortic repair (TEVAR), which is considered as a less invasive and potentially safer technique, has been increasingly used to treat this condition. Evidence is needed to support the use of TEVAR for these patients. The aim of this review was to assess the efficacy of TEVAR versus conventional open surgery in patients with ATBAD.

Methods: For this review, we searched the Cochrane Central Register of Controlled Trials (CENTRAL) in The Cochrane Library (last searched: 2010, issue 4), MEDLINE, EMBASE, CINAHL, Web of Science, and the Chinese Biomedicine Database for clinical trials until January 18, 2011. Controlled trials in which patients with ATBAD were assigned to TEVAR or open surgical repair were included. For each outcome, we evaluated the quality of the evidence with reference to the Grading of Recommendations Assessments, Development, and Evaluation criteria. At the end, we used RevMan 5.0 software to analyze the datum.

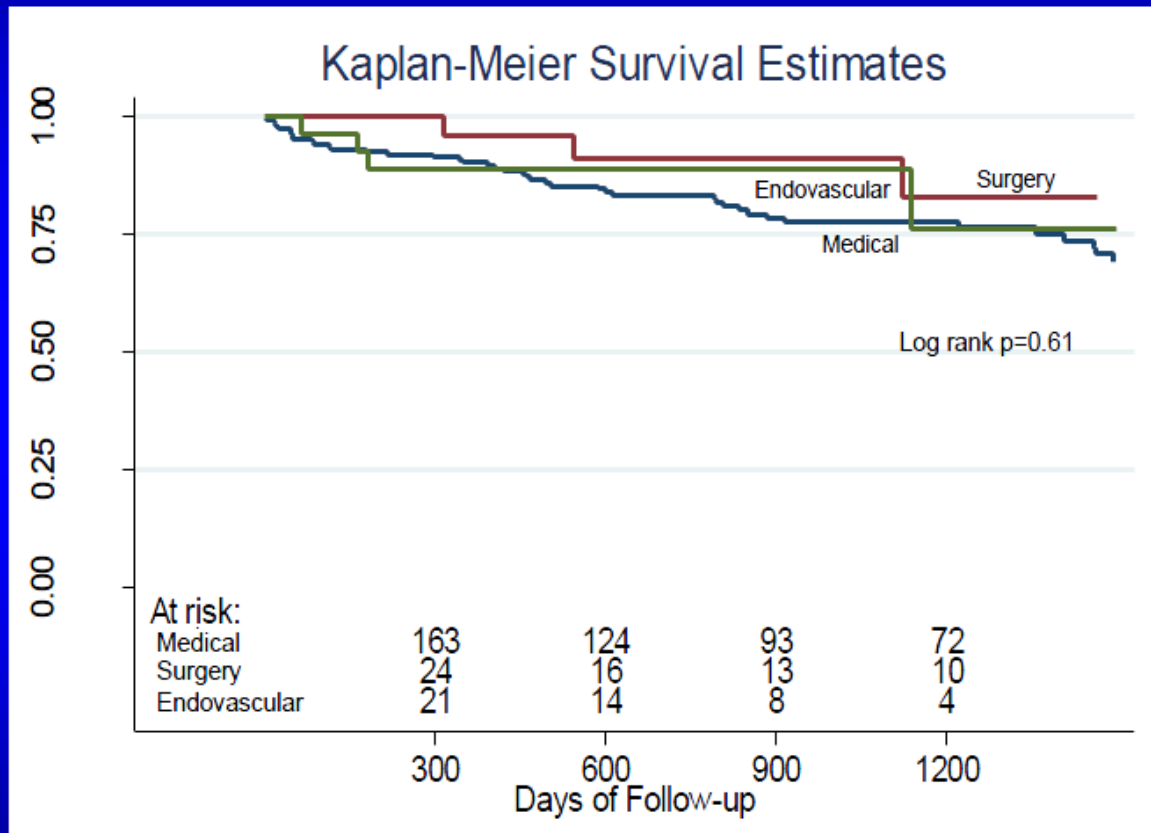
Results: Five trials (318 participants) are included in this review. As determined by the Grading of Recommendations Assessments, Development, and Evaluation approach, the result quality was low for 30-day mortality and very low for other variables. TEVAR can significantly reduce the short-term mortality for ATBAD (Mantel–Haenszel fixed odds ratio [95% confidence interval]: 0.19 [0.09–0.39], $P < 0.001$). TEVAR cannot significantly improve postoperative complications or long-term mortality.

Conclusions: TEVAR can be weakly recommended as an alternative for the selective treatment of ATBAD but cannot always be used in case of surgery.

Aortic Dissection : Endovascular Tx vs. Other Tx



Survival of type B dissection by treatment in IRAD



- Mortality of type B dissection 25% in 3 years
- Need for improved treatment

Treatment of Acute Type-B AD

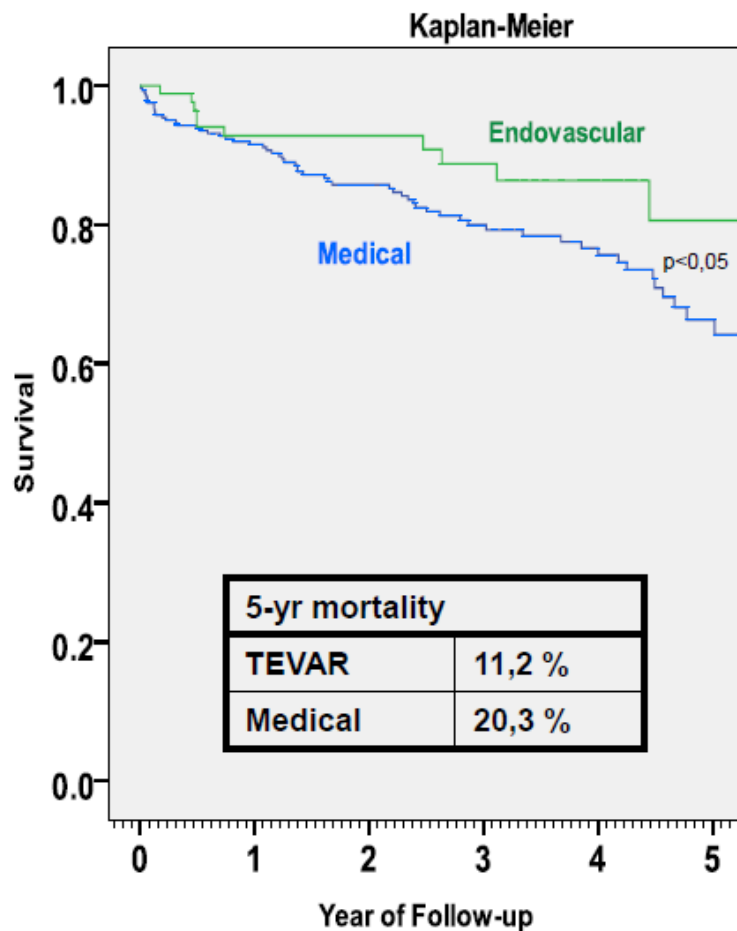
Thoracic Endovascular Aortic Repair or Medical Management Alone?

- From January 2004 to May 2008, 193 consecutive patients in 2 hospitals (Nanjing and Cleveland Clinic) were treated and retrospectively placed into 1 of 2 groups
- TEVAR group—TEVAR and antihypertensive medications (n=152) vs. Medicine group-medically alone (n=41).
- All TEVAR procedures were performed in the acute phase.

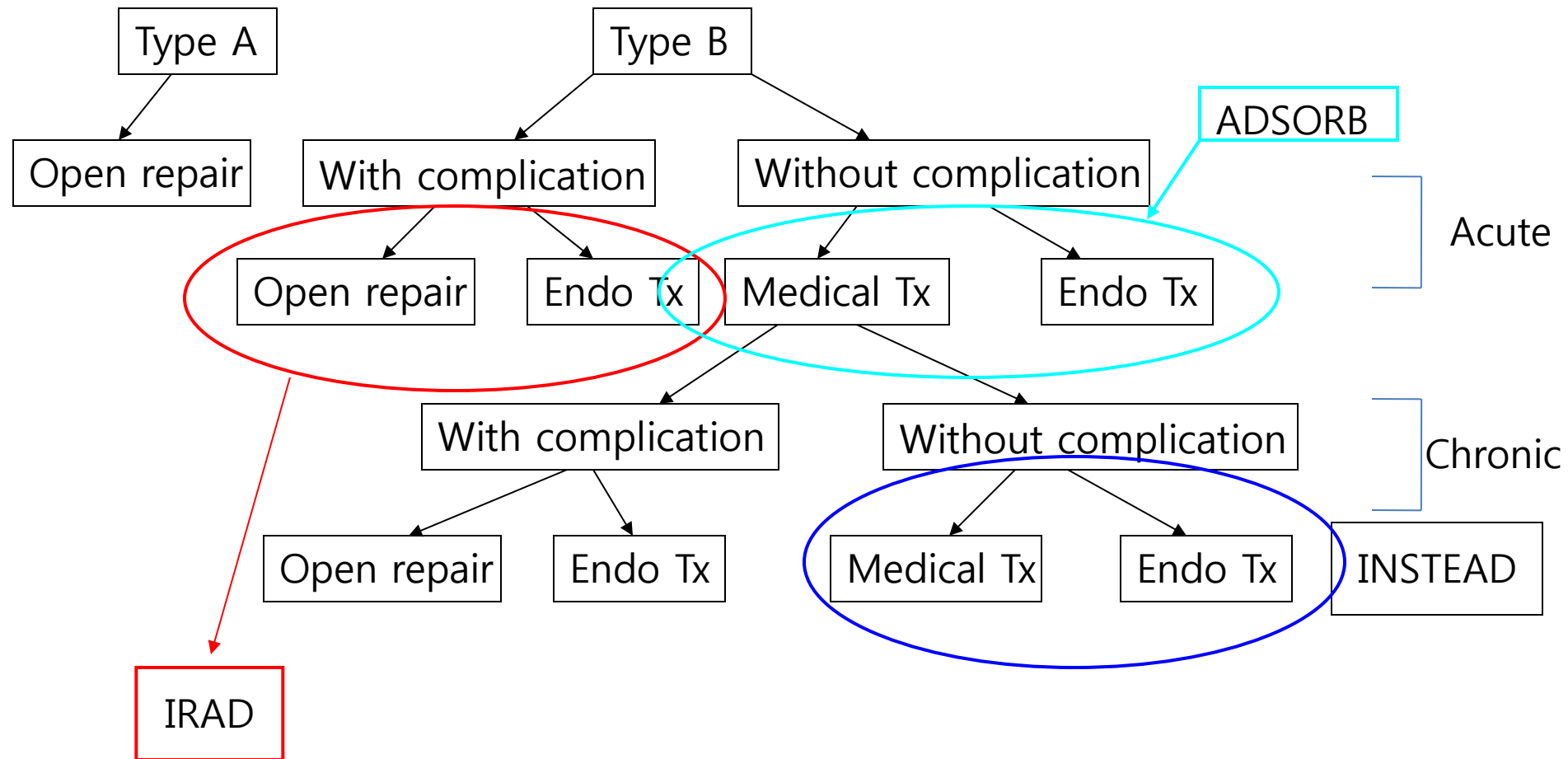
Thoracic Endovascular Aortic Repair or Medical Management Alone? - Demographics

	TEVAR Group (n = 152)	Medicine Group (n = 41)	p Value
Demographics			
Age at intervention, yrs	63.61 ± 9.61	66.93 ± 12.35	0.067
Male	137 (90.1)	37 (90.2)	0.624
Comorbidities			
Peripheral arterial disease	78 (51.3)	22 (53.7)	0.465
Hypertension	108 (71.1)	26 (63.4)	0.225
Smoking	49 (32.2)	17 (41.5)	0.178
Diabetes mellitus	16 (10.5)	7 (17.1)	0.188
Renal insufficiency	5 (3.3)	4 (9.8)	0.098
Coronary arterial disease	50 (32.9)	11 (26.8)	0.294
Extent of dissection			0.006
Confined in thoracic aorta	25 (16.4)	15 (36.6)	
Extended to abdominal aorta	127 (83.6)	26 (63.4)	
False lumen patency			0.294
Patent false lumen	102 (67.1)	30 (73.2)	
Partial thrombosis in false lumen	50 (32.9)	11 (26.8)	

Longterm outcomes: Endovascular treatment of uncomplicated acute type B dissection



Aortic Dissection : Endovascular Tx vs. Other Tx



INSTEAD Trial

- **No difference in mortality endpoint (Underpowered)**
- **Significant crossover to TEVAR**
- **Remodeling Benefit**
 - **91.3% with TEVAR**
 - **19.4% with medical tx alone (p<.001)**

The results of stent graft vs. medication for chronic type B AD

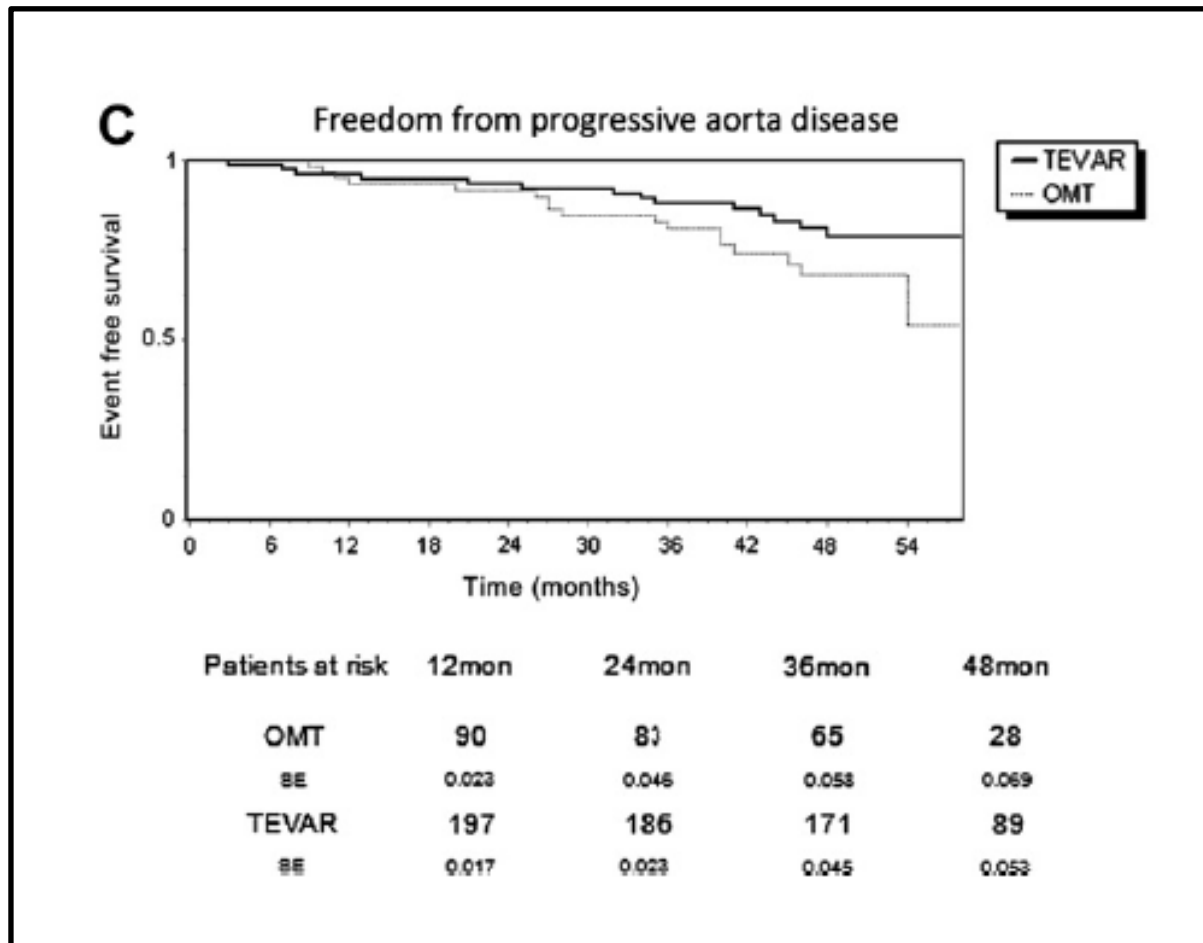
- This prospective multicenter comparative study.
- The study consisted of 303 consecutive patients with chronic type B AD from January 2007 to December 2010 who were prospectively enrolled and treated by either OMT or TEVAR.
- Of the patients, 219 were male and 84 were female (average age, 53.6 ± 20.3 years; range, 29-81 years).
- Baseline diameter of the thoracic aorta was 41.2 (19.1) mm and dissection extended beyond the celiac axis in 87.1% of cases.

The results of stent graft vs. medication for chronic type B AD-Midterm outcomes

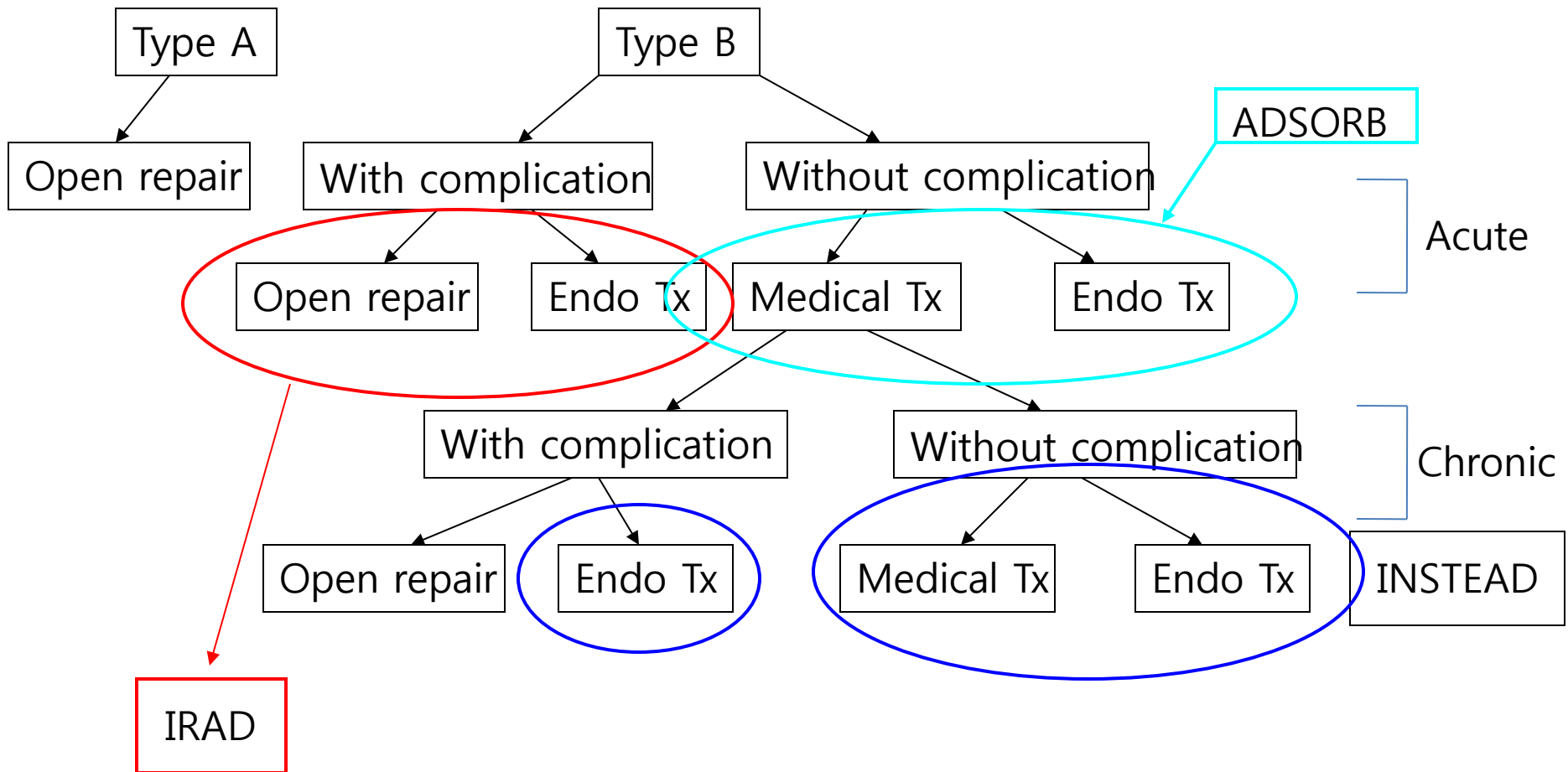
	<i>TEVAR</i>	<i>OMT</i>
Overall deaths, n	14	16
Aorta-related deaths	6 (4 unknown reasons)	14 (6 unknown reasons)
Other causes	Car accident 1, stroke 1, acute myocardial infarction 2, cancer 4	Acute myocardial infarction 1, cancer 1, stroke 1
Secondary interventions		
Crossover	N/A	12
Conversion to surgery	3	2
Extension	6	N/A

OMT, Optimal medical therapy; *N/A*, not available; *TEVAR*, thoracic endovascular aorta repair.

The results of stent graft vs. medication therapy for chronic type B-Progressive aorta disease



Aortic Dissection : endovascular Tx vs. other Tx



Endovascular repair of complicated chronic distal aortic dissections: Intermediate outcomes and complications

Woong Chol Kang, MD, PhD,^{a,d} Roy K. Greenberg, MD,^{a,b} Tara M. Mastracci, MD,^a
Matthew J. Eagleton, MD,^a Adrian V. Hernandez, MD, PhD,^c Akshat C. Pujara, BA,^b and
Eric E. Roselli, MD^b

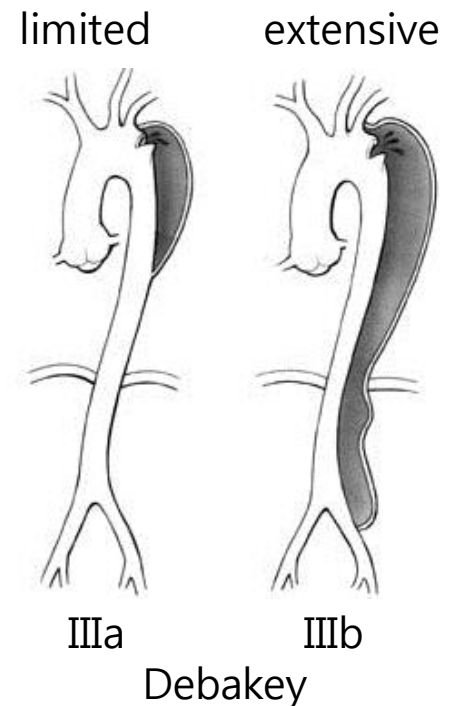
Methods

- All cases of TEVAR for complicated (aortic growth, malperfusion, intractable pain) CDAD at our institution between 2000 and 2007 were retrospectively reviewed.
- Aortic morphology (aneurysm size, false lumen thrombosis) was assessed at multiple levels with 3-dimensional image analysis techniques.

Clinical data

Baseline clinical characteristics	
Total population (no.)	76 (100%)
Male (no.)	49 (64%)
Age at diagnosis (y, mean \pm SD)	59.8 \pm 12.4
Age at intervention (y, mean \pm SD)	61.5 \pm 12.5
Time between diagnosis and intervention (mo, mean \pm SD)	25.0 \pm 31.0
Comorbidities (no.)	
Hypertension	75 (99%)
Smoking	32 (42%)
Hyperlipidemia	26 (34%)
Diabetes mellitus	8 (11%)
Renal insufficiency (>1.5 mg/dL)	14 (18%)
Coronary artery disease	29 (38%)
Peripheral artery disease	7 (9%)
Chronic obstructive pulmonary disease	17 (22%)
Previous stroke	9 (12%)
Marfan syndrome	2 (3%)
Previous aortic surgery (no.)	
Ascending aortic repair for type A dissection	17 (22%)
Ascending aorta without arch	11
Ascending aorta and hemiarch	3
Elephant trunk repair	3
Infrarenal aneurysm repair	12 (16%)

- Thirty patients (39%) were considered to have a limited dissection, and the remainder (61%) had extensive dissections.



Procedural data

Indication

Aneurysmal degeneration (>55 mm)	47 (62%)
Intractable pain	15 (20%)
Rapid growth (>10 mm/y)	9 (12%)
Lower limb claudication	2 (3%)
Visceral ischemia	2 (3%)
Rupture	1 (1%)

Stent-graft type

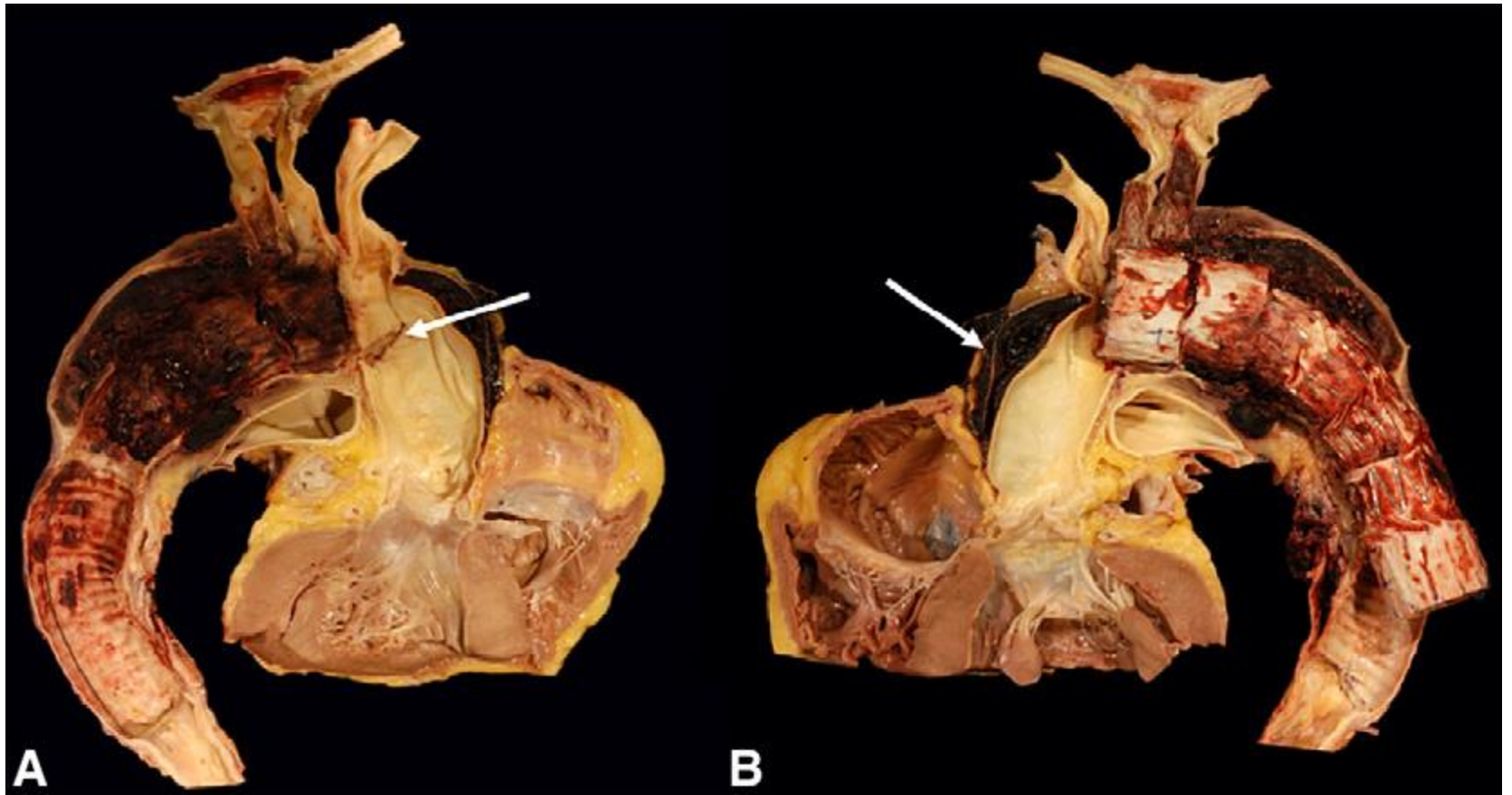
Gore TAG*	32 (42%)
Cook Zenith†	27 (35%)
Homemade	10 (13%)
Medtronic Talent‡	3 (4%)
Multiple types	4 (5%)

Procedure details

General anesthesia	43 (57%)
Cerebrospinal fluid drainage	46 (63%)
<u>Coverage of the left subclavian artery</u>	29 (39%)
Carotid-subclavian bypass	8 (10%)

- Technical success:73pts(96%).
- A total of 144 stent-grafts were implanted.

All data represent numbers and percentages of patients. *W. L. Gore & Associates, Inc, Flagstaff, Ariz. †Cook Medical Inc, Bloomington, Ind. ‡Medtronic, Inc, Minneapolis, Minn.



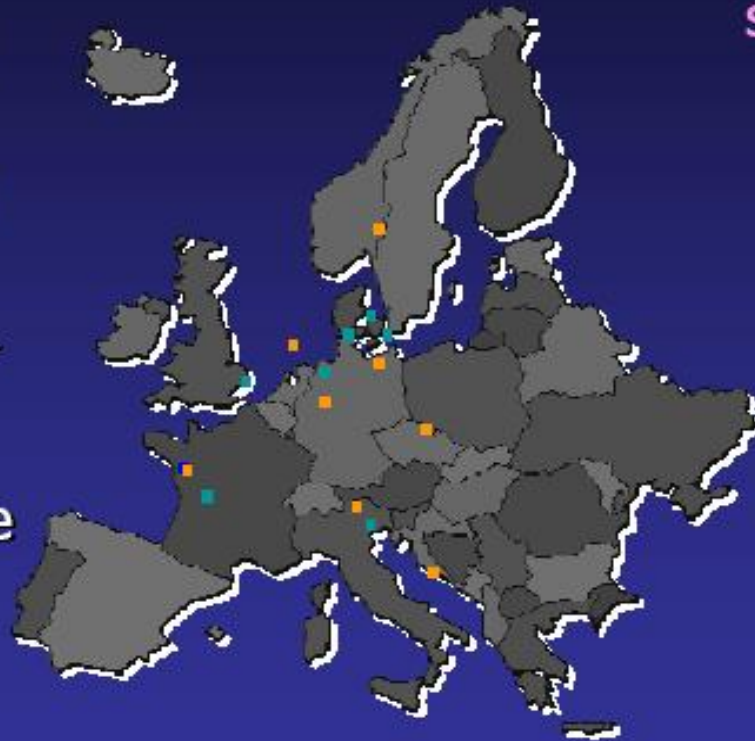
Patient who died on postoperative day 17 of a ruptured retrograde proximal dissection (identified at autopsy).

Randomized Comparison of Strategies for Uncomplicated Chronic Type B AD

The INvestigation of STEnt Grafts in Aortic Dissection (INSTEAD) Trial

- Initially 7 centers

- Rostock
- Berlin
- Bologna
- Essen
- Hanover
- Lille
- Toulouse

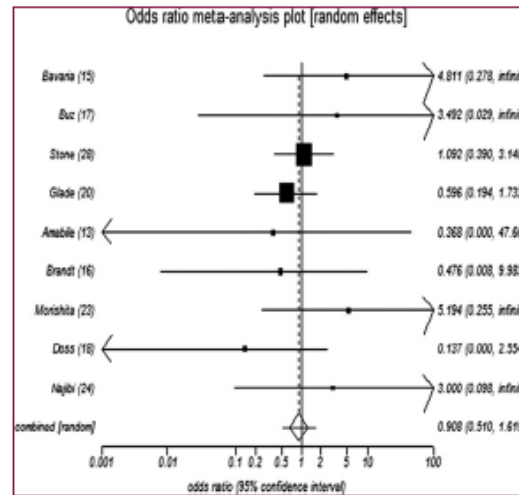
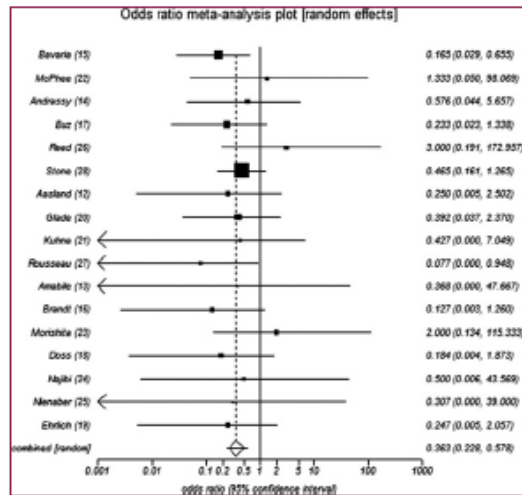


- 8 additional centers to speed up enrolment

- Bari
- Bordeaux
- Gothenburg ¹⁾
- Leipzig
- Ludwigsafen
- Modena ¹⁾
- Nieuwegein ¹⁾
- Vienna

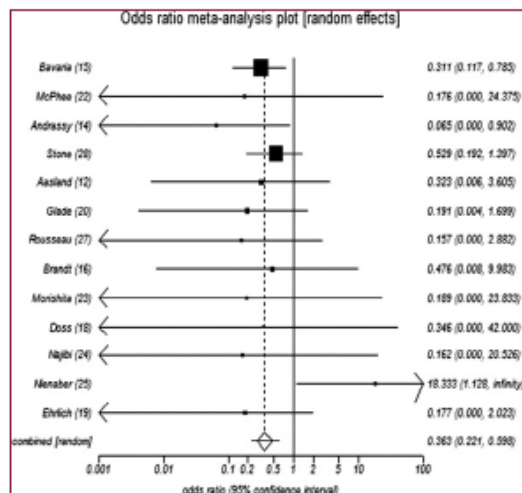
Metaanalysis: TEVAR vs. open surgery for complicated type AD

Perioperative mortality



Major
reintervention
rate

Major
neurological
injury



Metaanalysis:

30/538 events with TEVAR

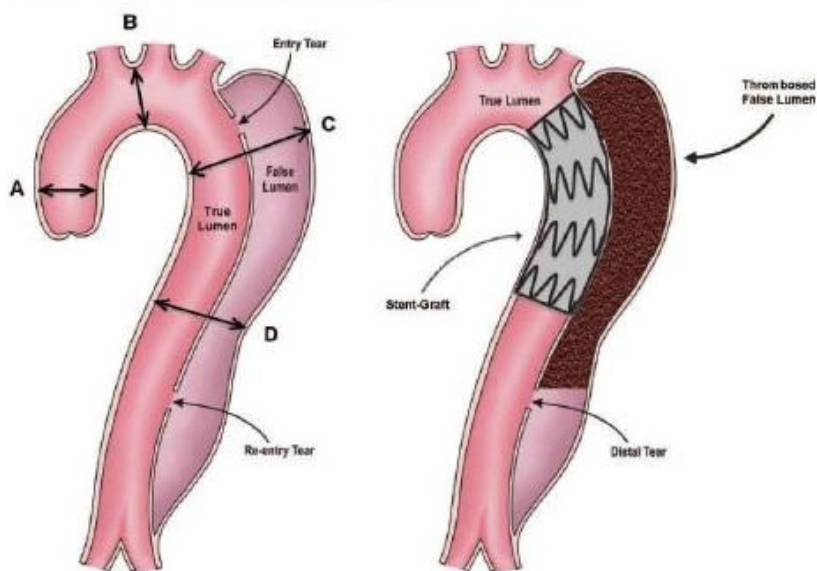
94/571 events with open surgery

Conclusion : **INSTEAD**

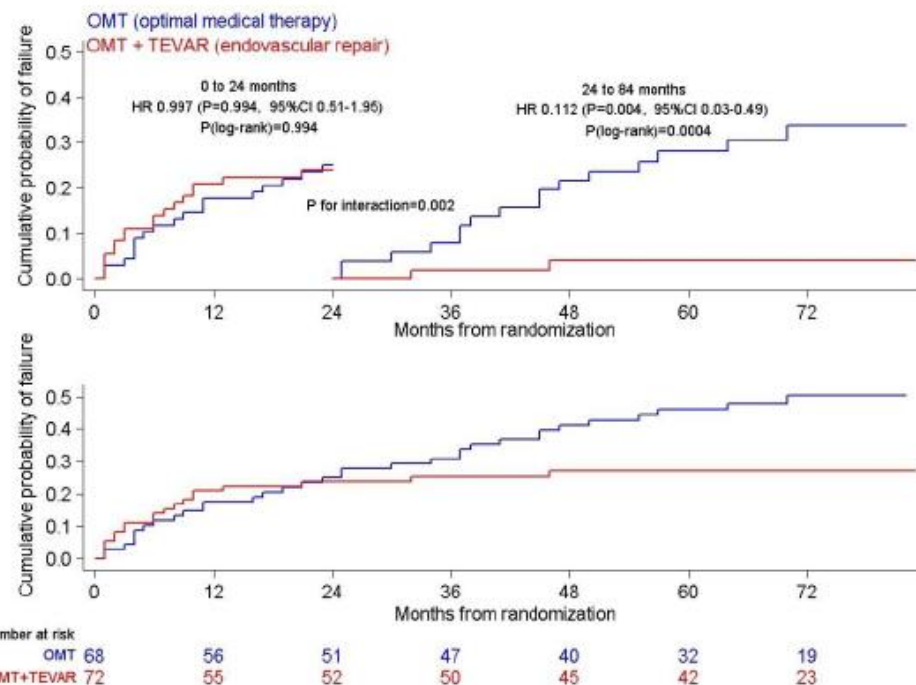
- This is the **first randomized study** on elective stent-graft placement in survivors of uncomplicated type B aortic dissection.
- In the setting of clinically stable, so-called uncomplicated type B aortic dissection, elective stent-graft placement on top of optimized medical management fails to improve survival and adverse events within an observation period of 2 years, despite favorable aortic remodeling.
- This trial was **underpowered** to reach statistical significance.
- This trial with long-term follow-up may find a survival advantage for stent-grafting over medical management especially when late aneurismal degeneration is considered.

INSTEAD-XL: 5 years outcomes after TEVAR in chronic dissection

Endovascular Stent-graft in type B-Dissection



Freedom from progressive aortic disease



Patient who died on postoperative day 17 of a ruptured retrograde proximal dissection (identified at autopsy).

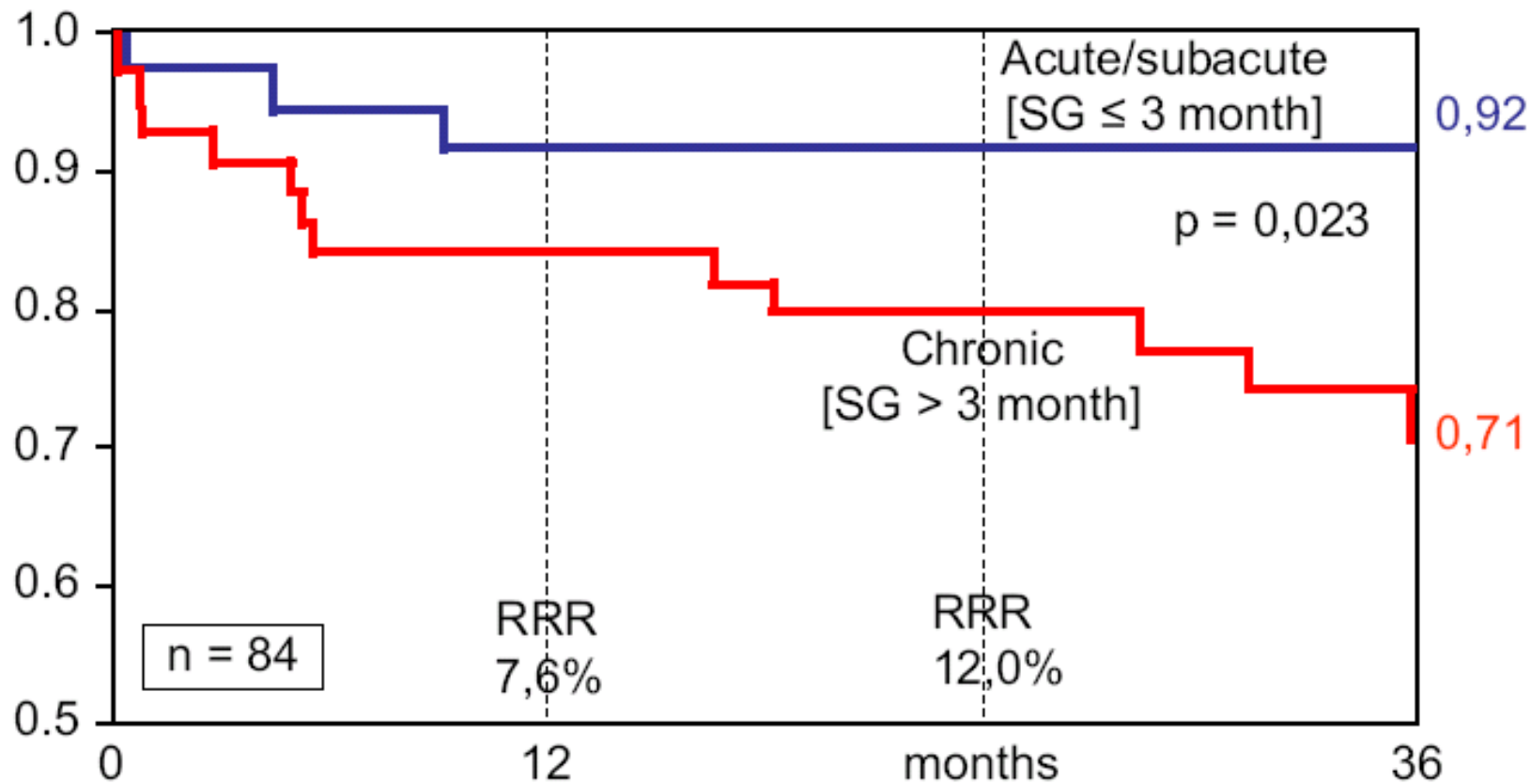
Timing of Endovascular Repair

- **Acute**

- ✓ **Fragile** dissecting membrane
- ✓ **Inflammation**
- ✓ Greater potential for stent-graft induced complete remodeling of the entire aorta.

- **Chronic**

- ✓ More fibrotic and seemingly stable membrane
- ✓ Progressive thickening of the intimal flap due to fibrosis and frequently possess multiple natural fenestrations in the septum which **may not be sufficient to obliterate flow in the false lumen**



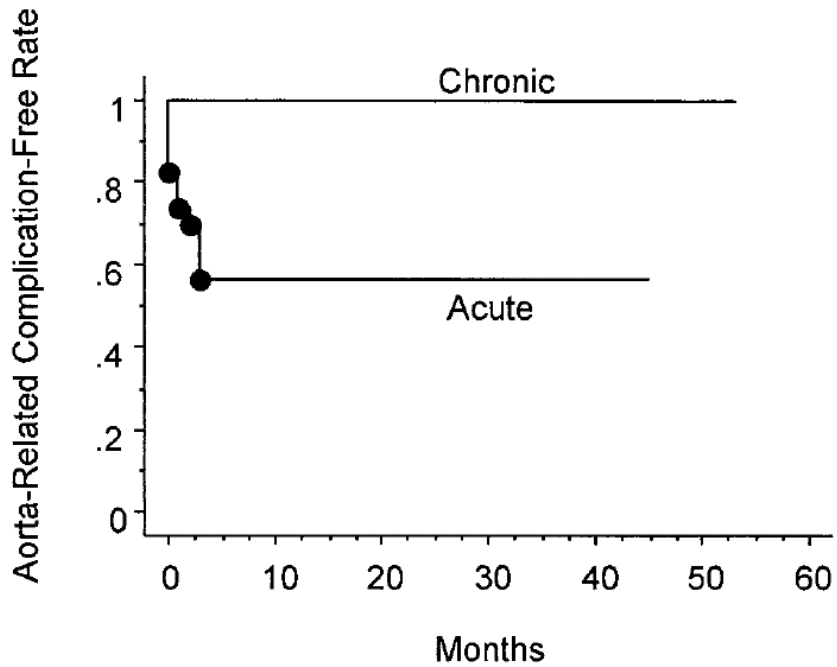


Figure 1. Actuarial aorta-related complication-free rate.

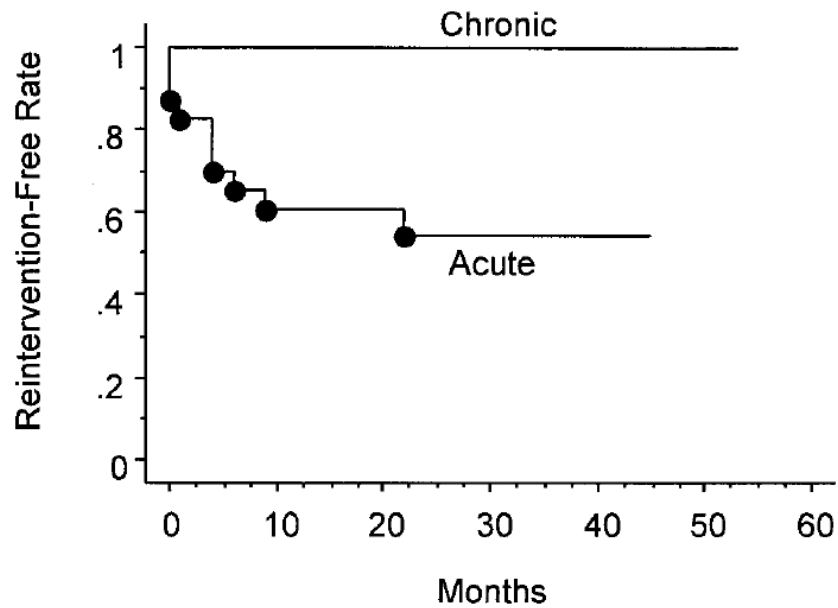
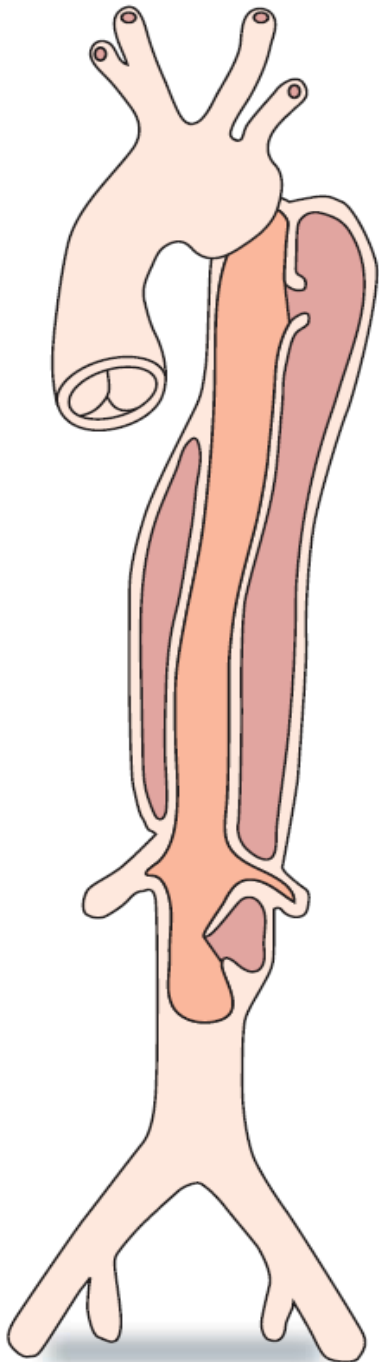


Figure 2. Actuarial reintervention-free rate curve.

Complication to type B Dissection



Malperfusion

Refractory hypertension

Continued pain

Dilatation/Aneurysm

Rupture or impending rupture

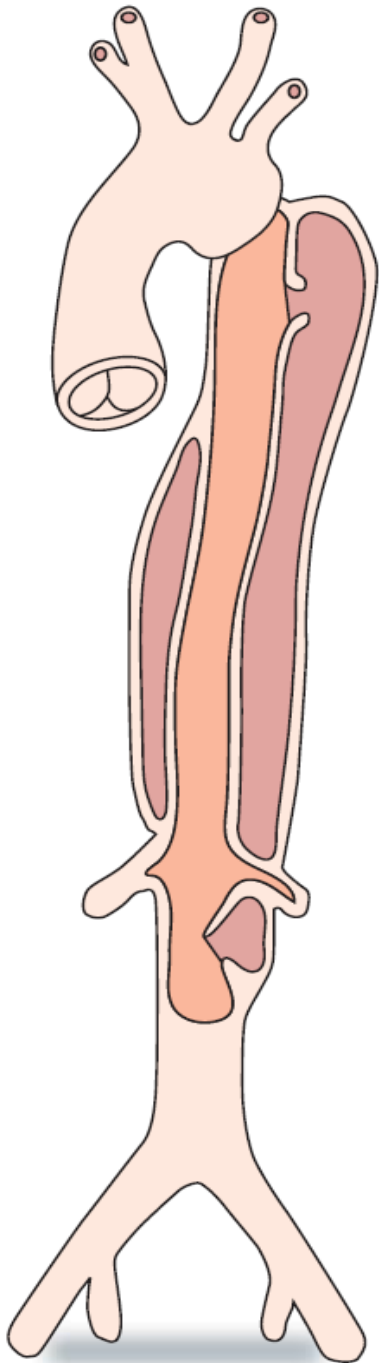
30%

20-50%/1-5yr

■ Intervention

- ✓ Open surgical repair
- ✓ Endovascular therapy

Complication to type B Dissection



Malperfusion

Refractory hypertension

Continued pain

Dilatation/Aneurysm

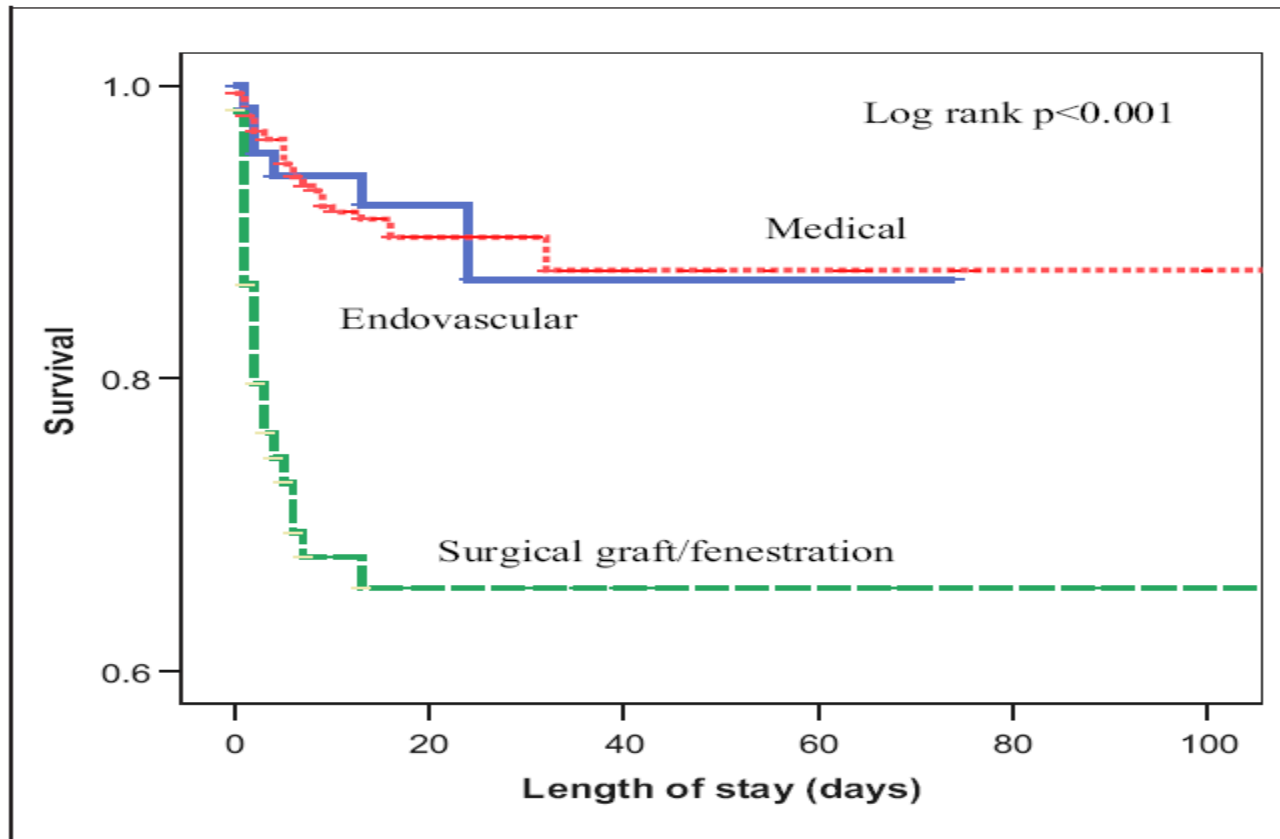
Rupture or impending rupture

20-50%/1-5yr

30%



Kaplan-Meier overall in-hospital survival estimates

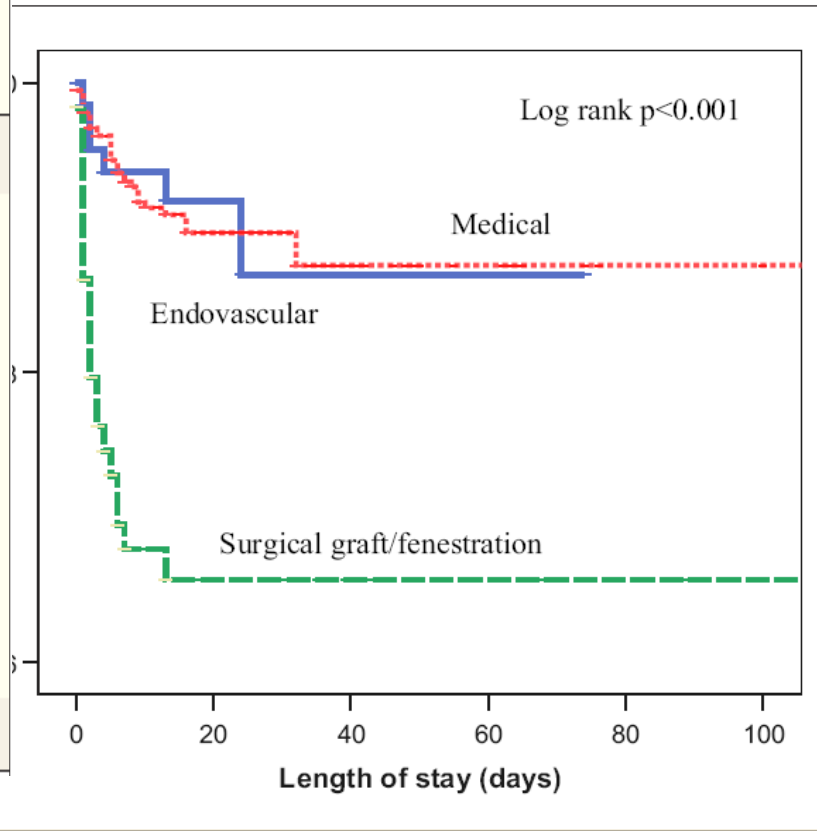


The less invasive nature of endovascular treatment seems to provide better in-hospital survival in patients with acute type B dissection.



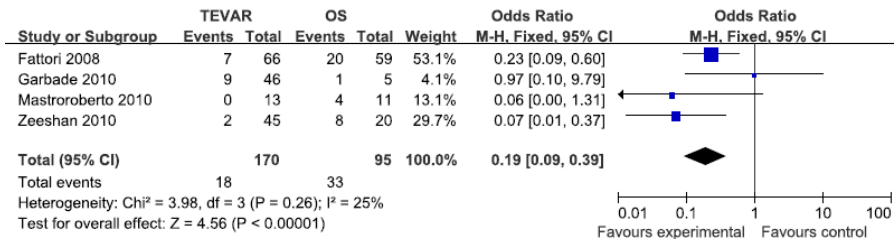
Complicated Acute Type B AD: Is Surgery Still the Best Option? - IH Cx & mortality

Variable	Endovascular (66 Patients) With Stent-Graft Placement in Aorta or Fenestration	Surgical (59 Patients) With Interposition Grafting or Fenestration	p Value
complications (post-treatment) (%)			
	2 (3.4)	4 (9.1)	0.40
	1 (1.7)	2 (4.5)	0.58
card ischemia	2 (3.4)	3 (6.8)	0.65
myocardial infarction	1 (1.8)	1 (2.6)	>0.99
cerebral ischemia/infarction	4 (7.4)	2 (4.9)	0.70
renal failure	4 (7.4)	8 (19.0)	0.09
hemiparesis	2 (3.6)	2 (5.0)	>0.99
any of the above complications	11 (20.8)	16 (40.0)	0.04
mortality (%)	7 (10.6)	20 (33.9)	0.002

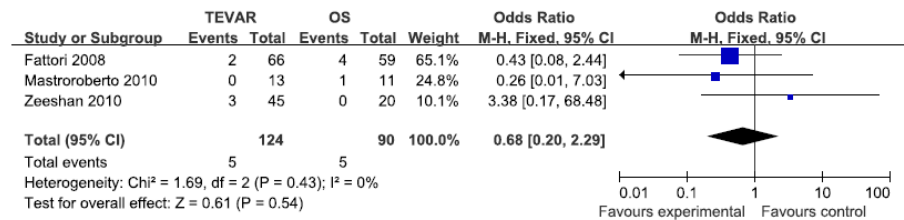


Endovascular Stent-Graft Placement or Open Surgery for the Treatment of Acute Type B Aortic Dissection: A Meta-Analysis

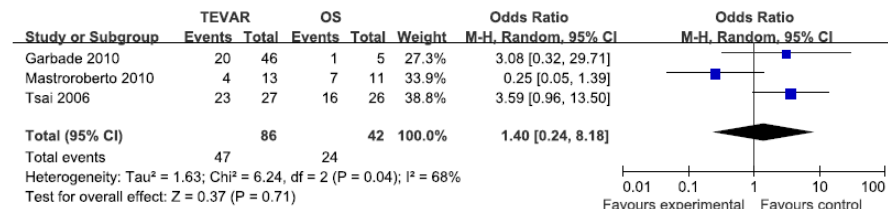
Thirty-day mortality



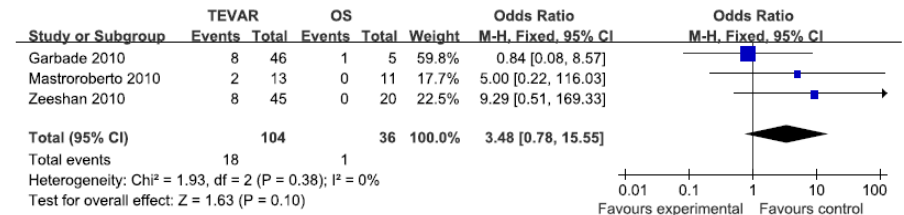
Stroke



Long-term mortality

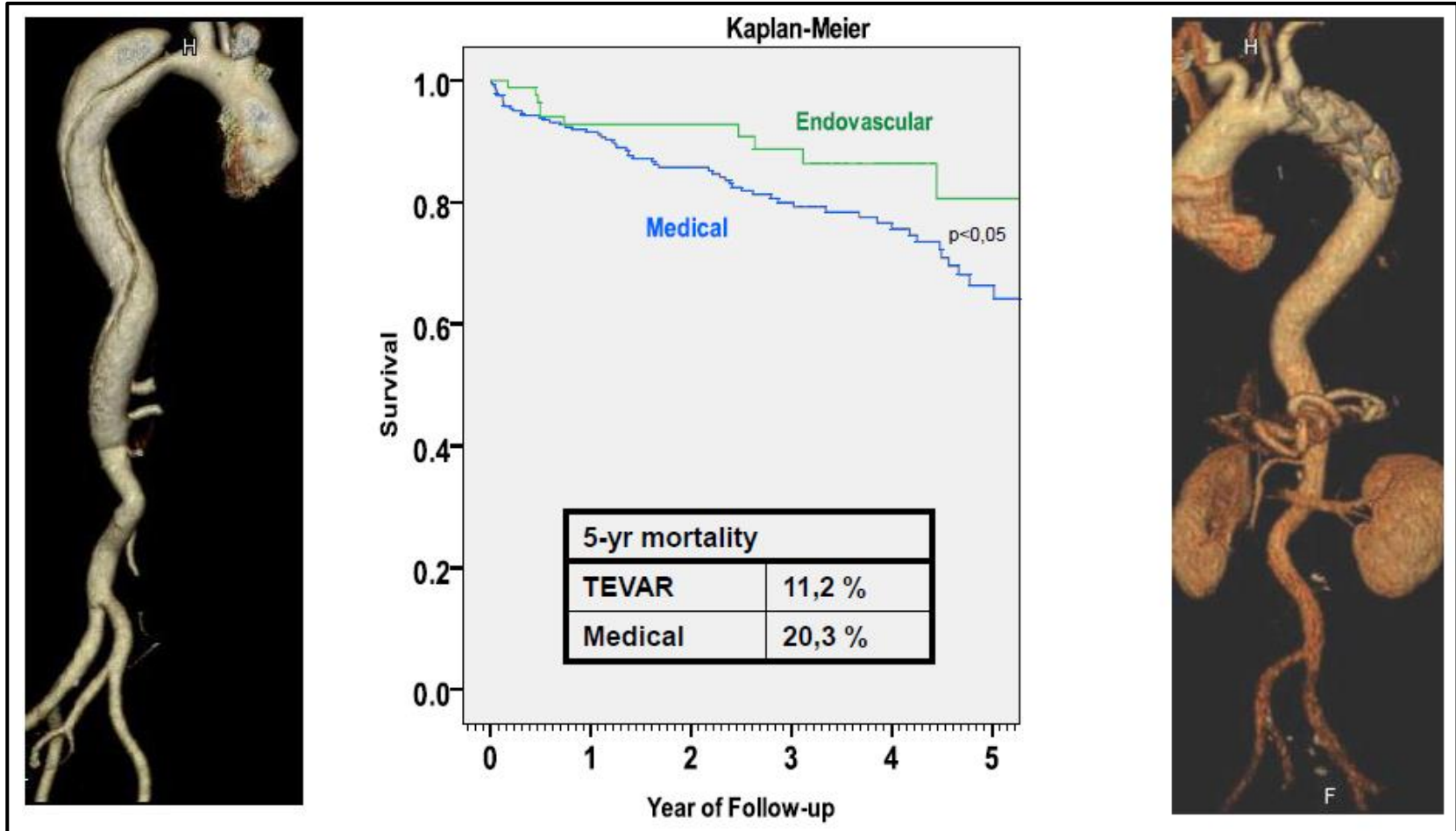


Reintervention



TEVAR can be weakly recommended as an alternative for the selective treatment of ATBAD but cannot always be used in case of surgery.

Endovascular treatment of uncomplicated acute type B AD-long term outcomes



The results of stent graft vs. medication for chronic type B-Aortic remodeling

	<i>OMT</i>	<i>TEVAR</i>
Maximum diameter of thoracic aorta, mean (SD), mm		
Baseline	40.7 (18.6)	42.4 (23.1)
Final	48.1 (17.3)	37.3 (12.8) ^a
Maximum diameter of abdominal aorta, mean (SD), mm		
Baseline	28.5 (17.4)	27.3 (14.7)
Final	31.8 (15.9)	32.7 (12.7)
Stable or decreased size of aorta	39.7% (27/68)	94.9% (151/159) ^a
Thoracic aorta remodeling	11.8% (8/68)	88.7% (141/159) ^a

- This was the first prospective multicenter comparative study on the treatment of type B aortic dissection in China.
- TEVAR had a significantly lower aorta-related mortality compared with OMT but failed to improve overall survival rate or lower the aorta-related adverse event rate.