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5th International Meeting on Aortic Diseases

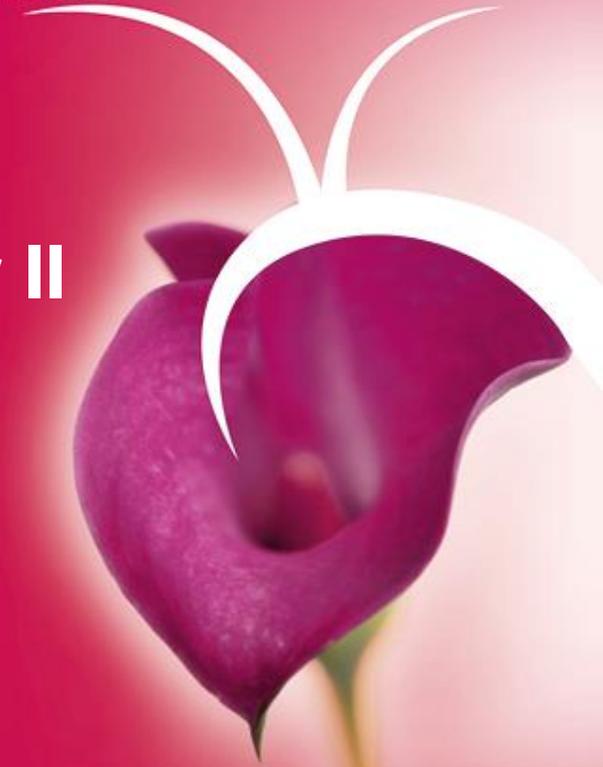
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Distal aortic reintervention after surgery for acute DeBakey type I or II aortic dissection: open versus endovascular repair

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Disclosure of Interest

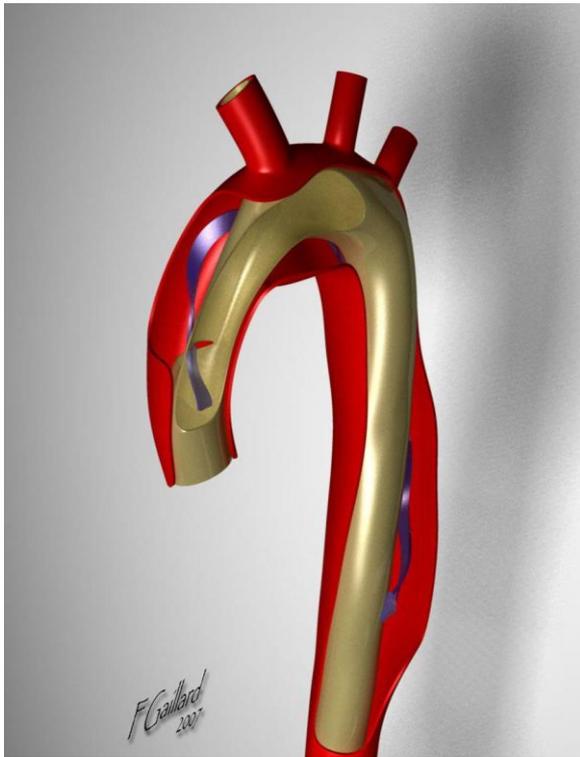
Rita Karianna Milewski, MD, PhD

I do not have any potential conflict of interest

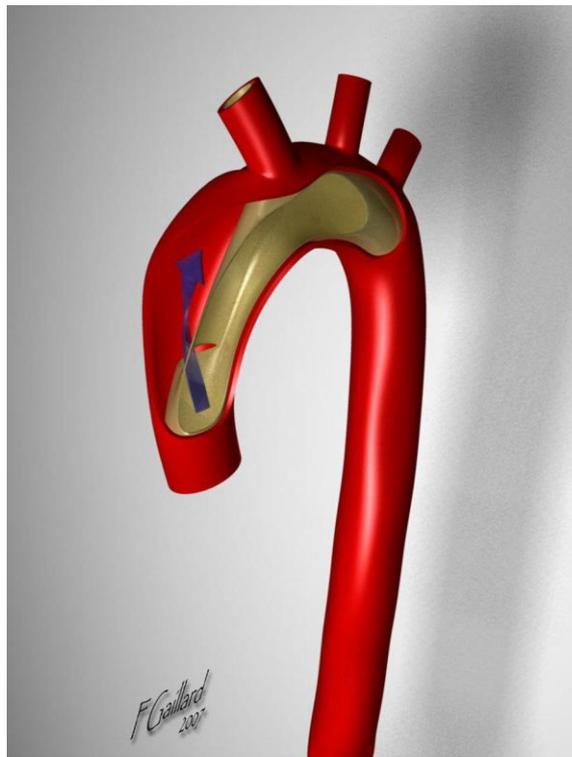


Aortic Dissections

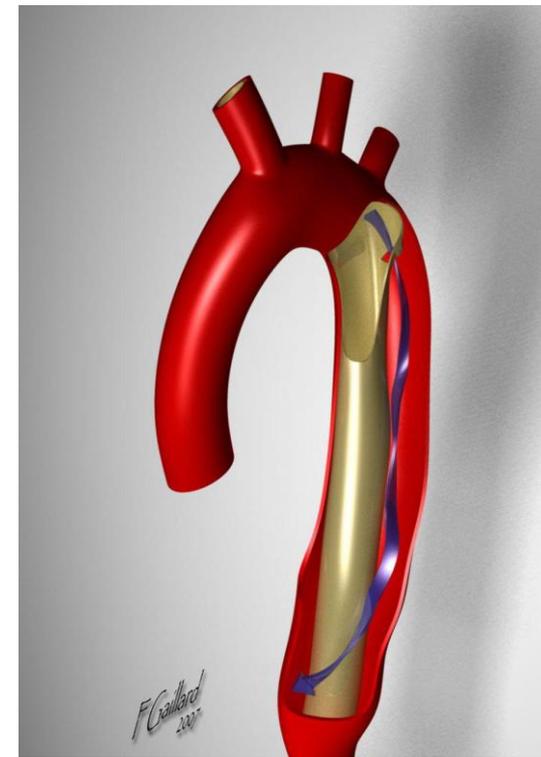
Risk of Late Distal Aortic Interventions



DeBakey I
Stanford A



DeBakey II
Stanford A



DeBakey III
Stanford B



DeBakey I and II Dissection

Over the last 20 years, diagnostic modalities, perioperative management and operative techniques for acute Type I or II aortic dissection have improved

More are surviving the acute phase

- Aortic centers mortality rates 5-15%

However, for many patients the initial operation is not a cure



Risk of Late Distal Arch and Descending Aorta Reintervention

Most acute ascending aortic dissection patients, the dissection process extends beyond the left subclavian artery

Both residual DeBakey I dissection and those with DeBakey II are at increased risk of late aortic events

For patients successfully operated on for acute ascending aortic dissection, the late risk of death is significantly increased over that of the healthy population



Risk of Distal Aortic Reintervention

Late dissection aneurysmal aorta or de novo dissections develop requiring distal reintervention

Residual distal dissected aorta segments grow at rate 1-7mm/y

Risk of late interventions following proximal repair of ascending dissection is 6-15%



Paradigm Shift

- Open surgical repair is the gold standard for treating aortic events following Type I or II dissection repair
- Paradigm shift in favor of endovascular therapy for distal aortic dissections



Comparative Open and Endovascular Study Design for Distal Aortic Reintervention

Comparative analysis of outcomes of open versus endovascular procedures in patients with distal aortic pathologies following proximal repair for acute DeBakey I or DeBakey II dissection



Inclusion and Exclusion Criteria

Inclusion

- All aortic pathologies that occurred after type I or II dissection repair distal to the replaced ascending aorta
- Comparison of reinterventions for the aortic arch and the descending aorta.

Exclusion

- Connective tissue disease



Goals of Interventional Approach

The goals of open and endovascular distal aortic intervention differ:

- Open – remove all aortic pathology
- Endovascular approach aims to prevent aortic dilatation by promoting false lumen thrombosis and stabilization



Reintervention Indications

Open aortic replacement or Endovascular remodeling

- maximum aortic diameter ≥ 5.5 cm,
- rapid aneurysmal degeneration with growth rate >1 cm/year,
- suture line aneurysm,
- malperfusion syndrome due to compression of the true aortic lumen
- penetrating atherosclerotic ulcers and
- large re-entries between false and true lumen in the descending aorta



Reintervention Cohorts

	All (n = 141)	Open group (n = 87)	Endovascular group (n = 54)	P-value
Age (years)	63 (55; 72)	63 (55; 72)	63 (56; 71)	0.89
Over 80 years old	8 (6)	5 (6)	3 (6)	1.00
Male gender	100 (71)	61 (71)	39 (72)	0.41
History of aortic dissection				
DeBakey type I	123 (87)	74 (85)	49 (91)	0.44
DeBakey type II	18 (13)	13 (15)	5 (9)	0.44
Proximal repair				
Aortic valve repair	110 (78)	66 (76)	44 (81)	0.53
Aortic root replacement	26 (18)	16 (18)	10 (19)	0.84
Wheat procedure	6 (4)	6 (7)	0	0.08
Distal repair				
No arch replacement	55 (39)	43 (49)	12 (22)	<0.01
Hemiarch replacement	76 (54)	42 (48)	34 (63)	0.13
Total arch replacement	10 (7)	2 (2)	8 (15)	<0.01
Antegrade TEVAR	14 (10)	2 (2)	12 (22)	<0.01
Current clinical presentation				
Hypertension	124 (88)	77 (89)	47 (87)	1.00
Diabetes mellitus	6 (4)	3 (3)	3 (6)	0.86
Hyperlipidaemia	31 (22)	20 (23)	11 (20)	0.88
Renal failure	10 (7)	3 (3)	7 (13)	0.07
COPD	16 (11)	11 (13)	5 (9)	0.73
Current smoker	12 (9)	7 (8)	5 (9)	0.95
Coronary artery disease	14 (10)	10 (12)	4 (7)	0.62
BAV	5 (4)	1 (1)	4 (7)	0.14
History of stroke	4 (3)	2 (2)	2 (4)	0.97
Current distal aortic pathology				
Aortic arch aneurysm	56 (40)	52 (58)	4 (7)	<0.01
Thoracoabdominal aneurysm				
Crawford I	47 (33)	24 (28)	23 (43)	0.10
Crawford II	15 (11)	9 (10)	6 (11)	0.89
Crawford III	5 (4)	3 (3)	2 (4)	0.70
Crawford IV	1 (1)	1 (1)	0	1.00
Abdominal aortic aneurysm	4 (3)	0	4 (7)	0.02
True lumen compression	13 (9)	3 (3)	10 (19)	<0.01
'De novo' type III dissection	2 (1)	0	2 (2)	0.15
PAU	2 (1)	0	2 (2)	0.15



Distal Reintervention Cohort Analysis

- Analysis of 141 patients (two centers)
 - University of Pennsylvania, Philadelphia, PA, USA
 - Heart Center Freiburg University, Freiburg, Germany
- Distal Reintervention
 - Aortic Arch 56
 - Descending Aorta 87
- Dissection pathology
 - DeBakey I (87%)
 - DeBakey II (13%)
- Average Age 63y
- Male 70%



Initial Acute Dissection Ascending Procedure Analysis

Hemiarch	54%
Total Arch	7%
No arch procedure	39%
Antegrade TEVAR	10%



Distal Aortic Arch Reinterventions

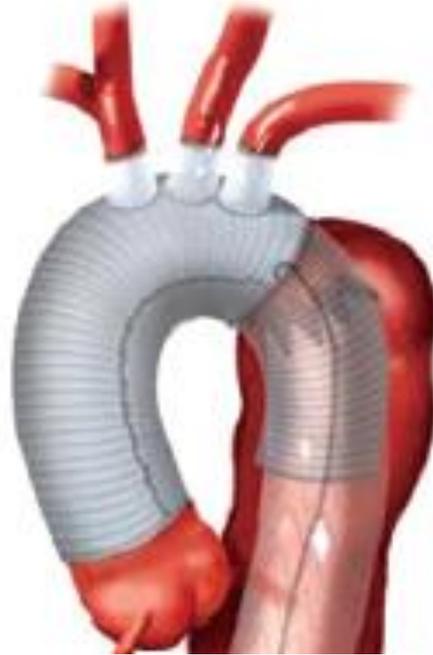
Open 52 (93%)

 Hemiarch 20

 Total arch 32

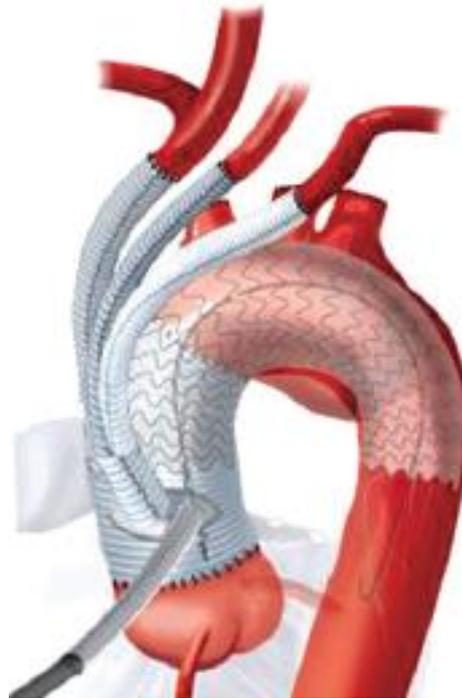
Hybrid 4 (7%)

Total Arch Procedure

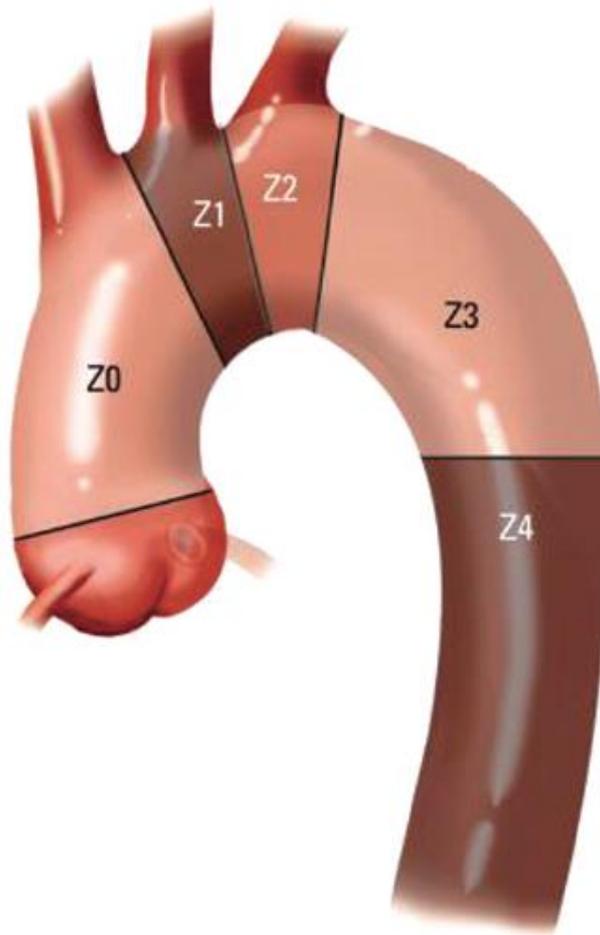


Hybrid Arch Procedure

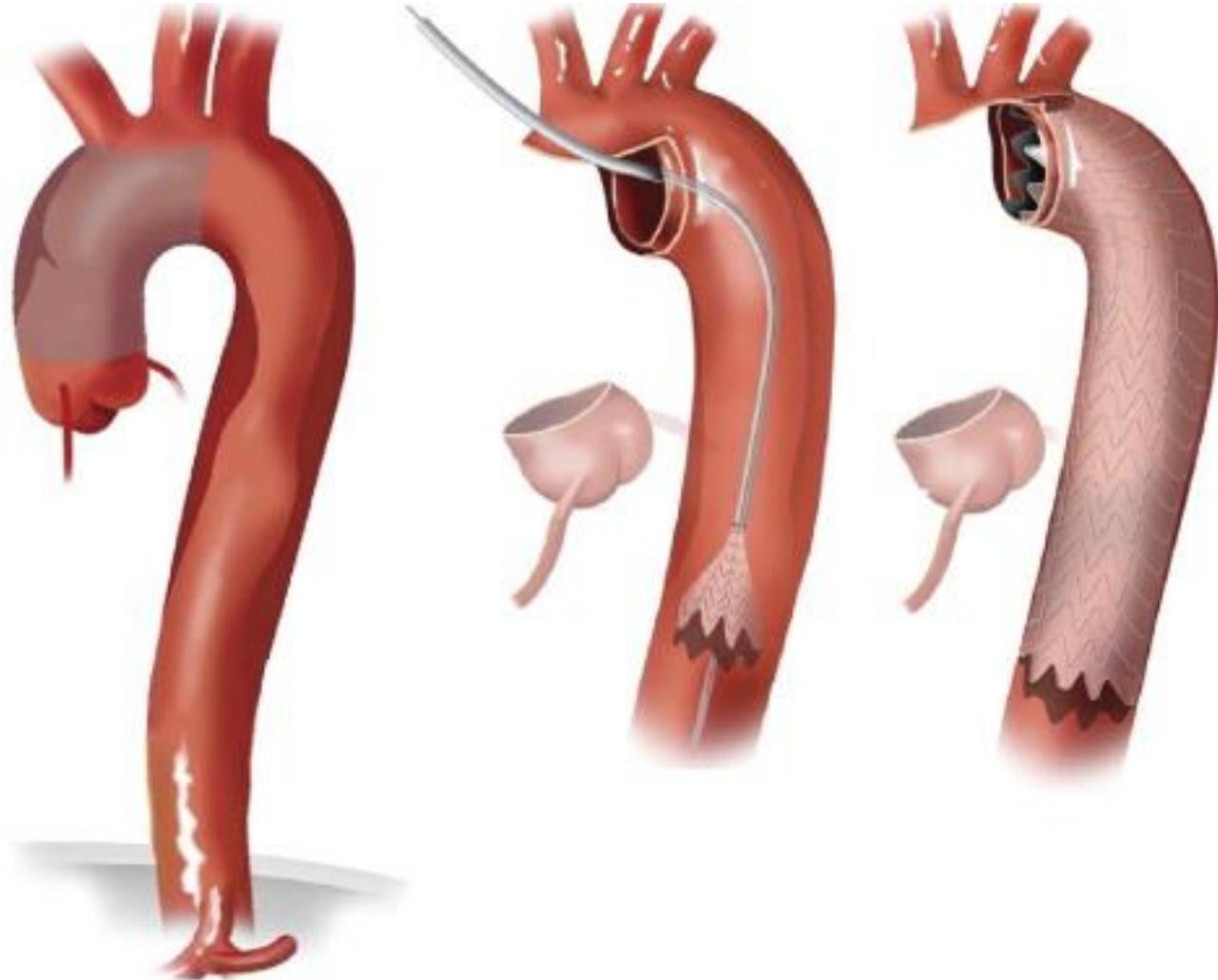
Type II



Zone 2 Arch Repair



Antegrade Stent Arch Repair





Distal Descending Aorta Reintervention Procedures

Open (35)

Hemiarch	48%
Antegrade stent	2%

Endovascular (50)

Hemiarch	63%
Antegrade stent	22%



Descending Aortic Pathology

- Open
 - Crawford extent I 24
 - Crawford extent II 9
 - Crawford extent III 3
 - Crawford extent IV 3
- Endovascular
 - Crawford extent I 23
 - Crawford extent II 6
 - Crawford extent III 2
 - Crawford extent IV 4
- Malperfusion 13
- De novo DeBakey III 3
- Re-entries 3
- PAU 2



Distal Aortic Arch Outcomes

No Re-Reinterventions

Mortality

Open	3/52 (5.8%)
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Hybrid	1/4 (25%)
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Descending Aortic Reintervention Outcomes

	All (n = 85)	Open group (n = 35)	Endovascular group (n = 50)	P-value
Time between primary surgery and distal reintervention (years)	1.3 (0.3; 4.1)	2.7 (0.8; 6.7)	0.6 (0.1; 3.5)	<0.01
Urgency of reintervention				
Immediate	7 (8)	3 (9)	4 (8)	1.00
Urgent (<24 h)	19 (22)	7 (20)	12 (24)	0.86
Elective	59 (69)	25 (71)	34 (68)	0.92
Reintervention time (min)	110 (100; 140)	250 (140; 260)	110 (90; 120)	<0.01
Outcome				
In-hospital mortality	8 (9)	8 (23)	0	<0.01
Stroke	1 (1)	0	1 (2)	1.00
Paraplegia	1 (1)	1 (3)	0	0.35
Respiratory failure	1 (1)	1 (3)	0	0.35
Renal failure	2 (2)	1 (3)	1 (2)	1.00
Chest re-exploration for bleeding	2 (2)	2 (6)	0	0.12
ICU time	2 (1; 3)	3 (2; 4)	2 (1; 2)	<0.01
In-hospital time	6 (5; 8)	6 (4; 8)	5 (5; 8)	0.89
Secondary reintervention	6 (7)	2 (6)	4 (8)	1.00



Analysis of Outcomes of Descending Aortic Reintervention

Open Procedure in hospital mortality 8 (23%)

- 7/8 (88%) thoracoabdominal replacements
- 2/7 (30%) non-elective reinterventions



Survival for Descending Aortic Reinterventions

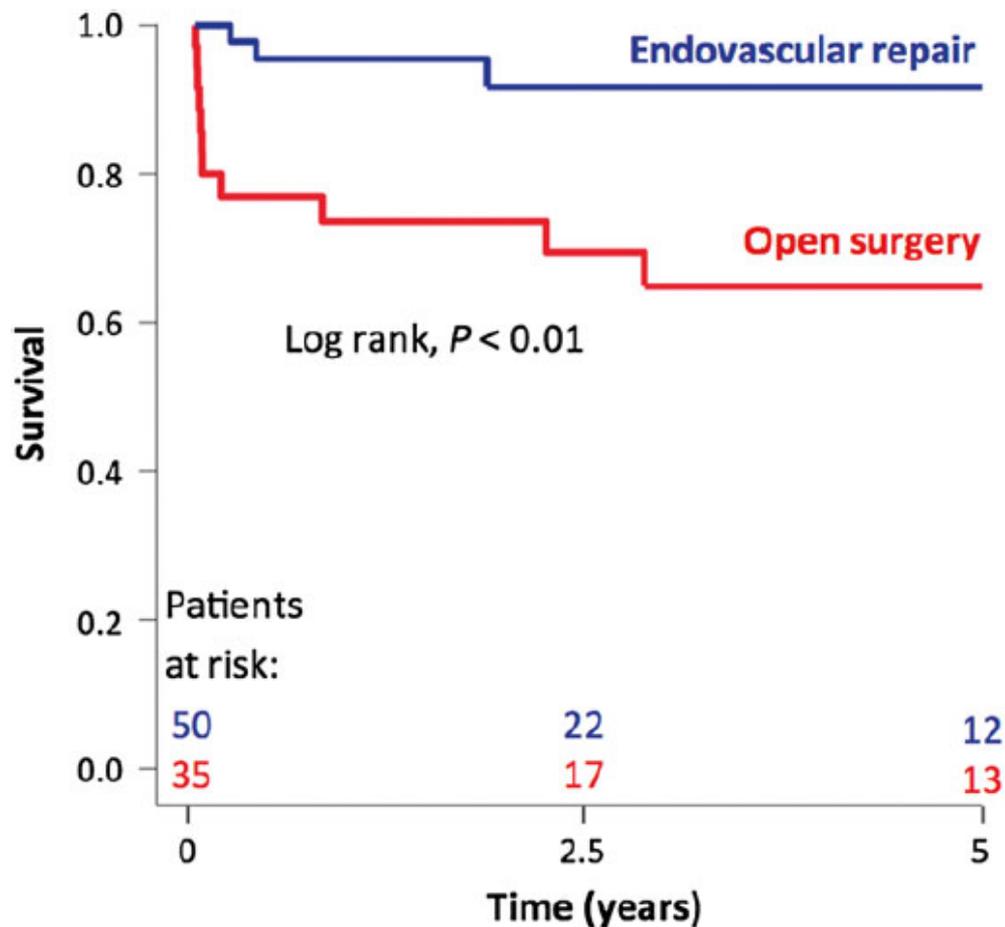
Open

1 year	74+/-8%
5 year	65+/-9%

Endovascular

1 year	96+/-3%
5 year	92+/-5%

Survival After Descending Aortic Reintervention





Freedom From Descending Aorta Distal Reintervention

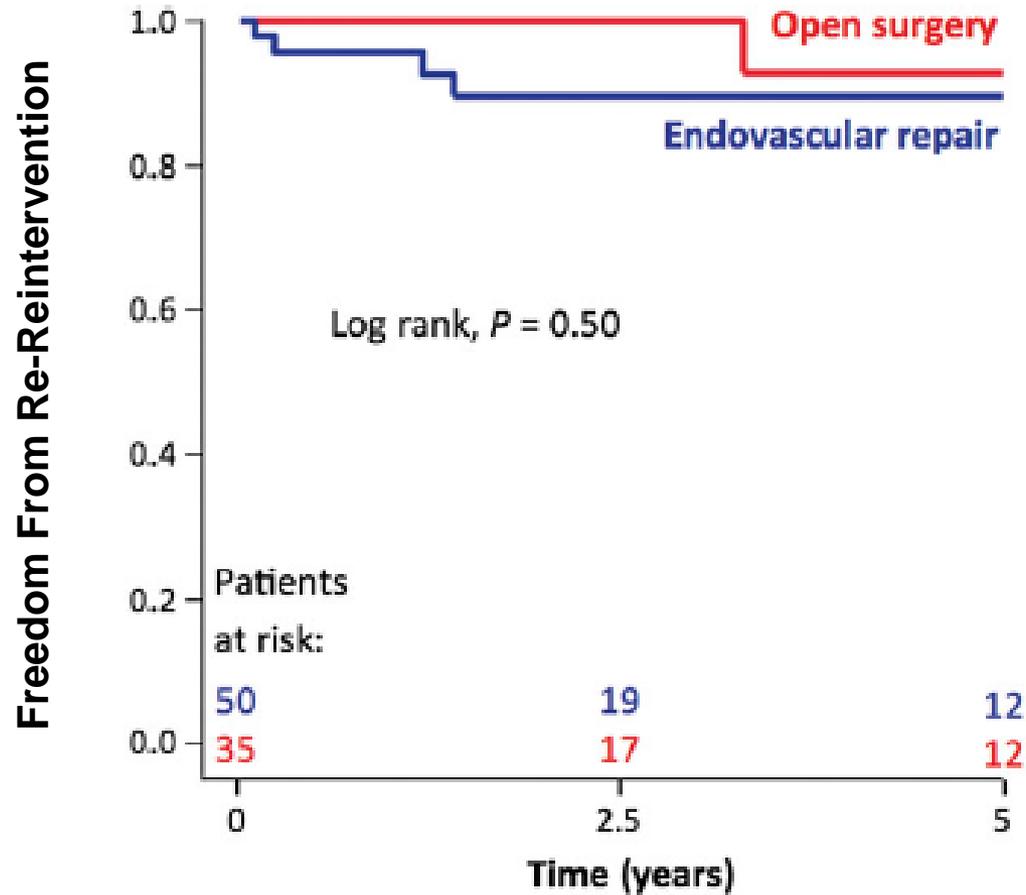
Open

1 year	100+/-0%
5 year	93+/-7%

Endovascular

1 year	96+/-3%
5 year	90+/-5%

Freedom From Distal Re-Reintervention





Distal Descending Aorta Stabilization

Endovascular Stabilization – 86%

- Growth – 14%
 - 5 patients had aorta > 5.5cm during follow-up
 - 2 continued growth at 0.5cm over 6mo
- Endovascular re-intervention
 - 4 → endovascular (no in hospital mortality)
- Medical management
 - 3

Open Stabilization – 98%

- 2 → endovascular (one 70d in hospital mortality)



Analysis of Open and Endovascular Outcomes

Current guidelines for managing aortic pathologies for open and endovascular have same thresholds

The average time between surgery for acute dissection and reintervention was shorter in patients undergoing endovascular descending aortic repair when compared with open surgery

Endovascular approach does not eliminate aortic disease; however it does slow its progression and may be a treatment option especially in older patients or those with comorbidities

Despite a technically successful endovascular reintervention, over 10% of patients attained threshold aortic diameter values for re-reintervention during this mid-term follow-up study

Overall survival was significantly better in patients undergoing descending aortic endovascular reintervention



Conclusions

In centers with low mortality and morbidity open surgical repair remains the gold standard, especially in younger patients

Endovascular intervention on the descending aorta in experienced hands offers a benefit when treating late aortic complications after type I or II aortic dissection repair.

It does not eliminate the aortic disease; however, as it does slow its progression, it is a sensible treatment option, especially in older patients

Endovascular repair is associated with lower in-hospital mortality and better survival.



Future Directions in Distal Arch and Descending Reintervention

Branched and fenestrated endografts are currently may being utilized as a treatment therapy for arch pathology

The use of a hybrid approach facilitates the treatment of extensive aortic pathology by combining the benefits of open proximal reconstruction with the minimally invasive nature of a second staged TEVAR treatment

Various procedures such as varying zoned arch procedures at the time of acute ascending dissection repair to build a platform for distal arch and descending procedures

With the rapid technologic advancements in endovascular designs and innovative therapeutic strategies technology can be utilized as a catalyst to develop procedures for patients for whom no other surgical options existed in the past



Thank you

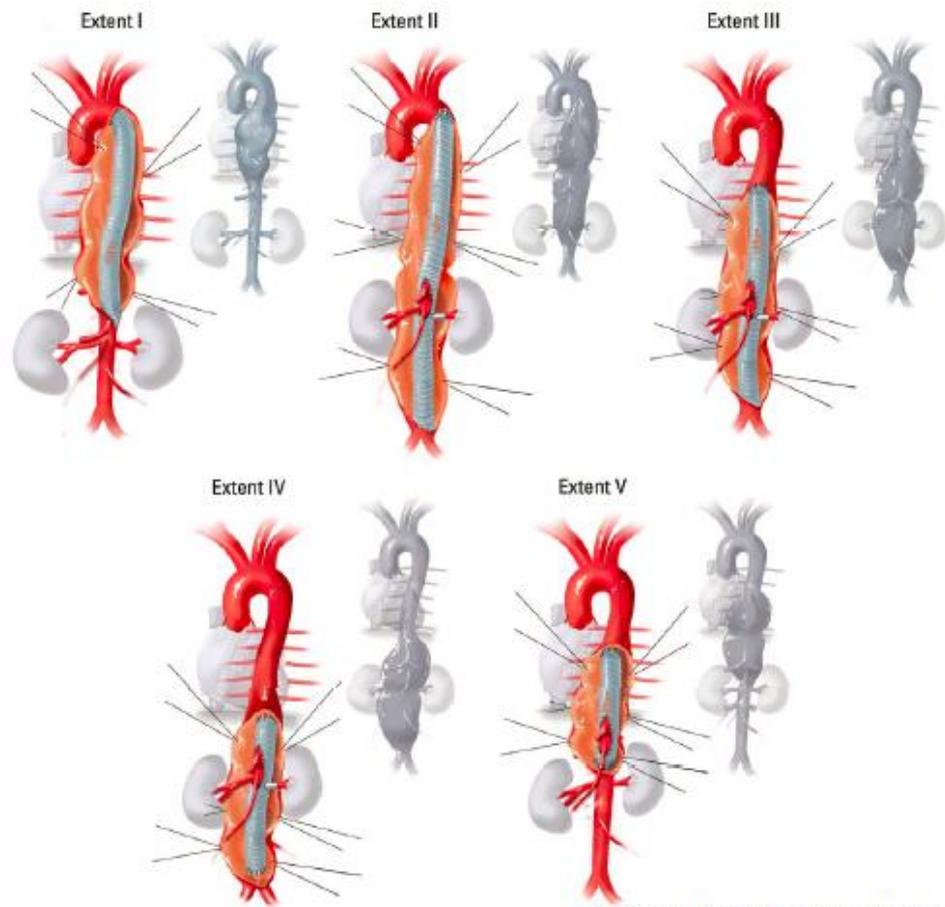




Paradigm Shift

- Paradigm shift for distal aortic dissections in favor of endovascular therapy





Frederick JR et al. Ann Cardiothorac Surg 2012



Cohort Demographic Analysis

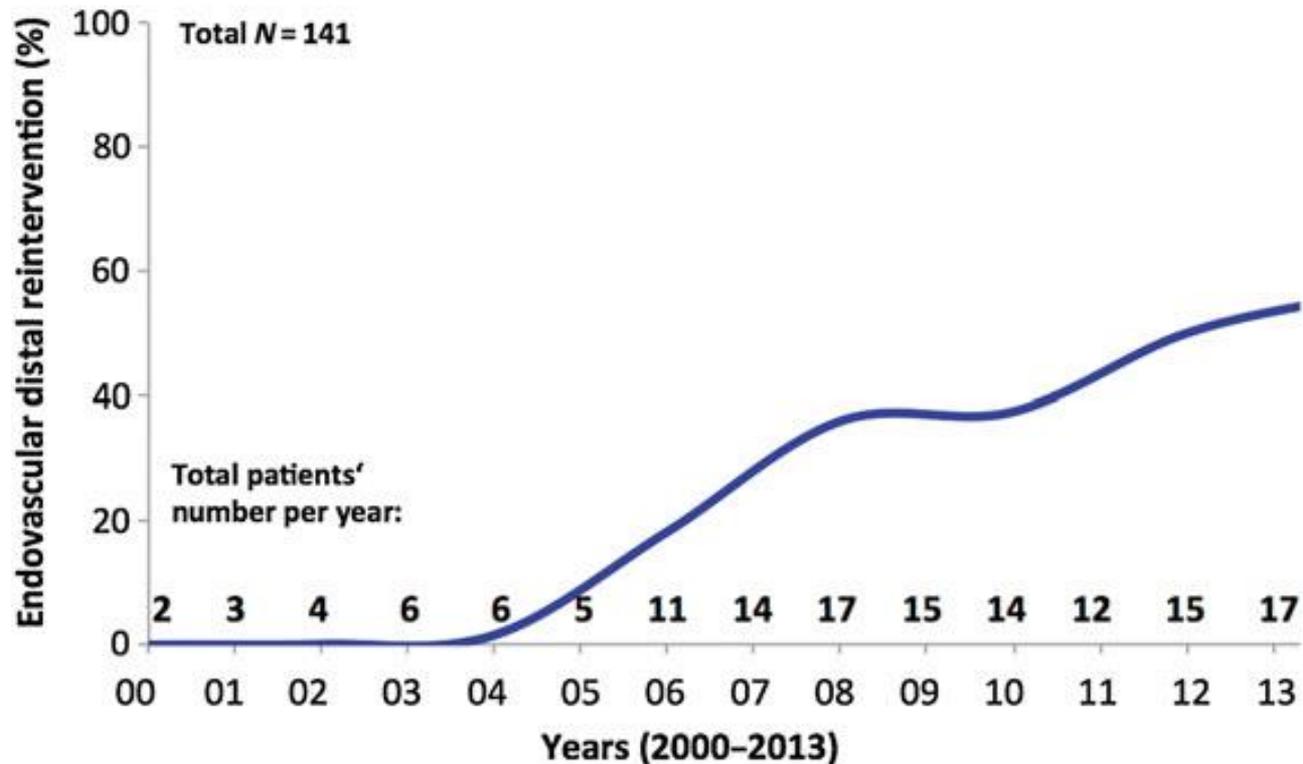
- Average Age 63y
- Male 70%



Descending Aortic Pathology

- Malperfusion 13
- De novo 3
- Re-entries 3
- PAU 2

The rate of endovascular distal aortic reinterventions per year throughout the study period





Analysis Summary

- The average time between surgery for acute dissection and reintervention was shorter in patients undergoing endovascular descending aortic repair when compared with open surgery.



Analysis Summary

- In-hospital mortality after descending aortic reintervention was lower in patients classified for endovascular treatment.
- Despite a technically successful endovascular reintervention, over 10% of patients attained threshold aortic diameter values for re-reintervention during this mid-term follow-up study.
- Overall survival was significantly better in patients undergoing descending aortic endovascular reintervention.



Limitations

- This study is limited by several factors. First, since most of the
- patients were operated on for acute dissection at regional hospitals,
- we were unable to provide all the details on their primary
- surgery and on their aortic dissection anatomy. Furthermore, this
- is a mid-term follow-up study; therefore, a definitive conclusion
- on the need for late re-reintervention after open or endovascular
- aortic repair cannot be drawn. Finally, we did not provide individual
- causes of death for the entire cohort, since none of our study
- patients were autopsied and, during interviews, family members
- or general practitioners could cite a plausible cause of death in
- only a few patients.



Hybrid Approaches

- The impetus for hybrid approaches in the treatment of complex aortic arch pathologies is exactly this synergistic effect of endovascular technique with open surgery.
- For the staged approach a significant number of patients who undergo the first stage do not progress to the second open stage
- The use of a hybrid approach facilitates the treatment of extensive aortic pathology by combining the benefits of open proximal reconstruction with the minimally invasive nature of a second staged TEVAR treatment.



Outcomes

- In hospital mortality
 - Open 20%
 - Endovascular 0%
- Spinal Ischemia
 - Open 1 patient



Distal Descending Aorta Reintervention Procedures

- Open (35)
- Endovascular (50)



> 1 Distal Reintervention

- Open

 - 2 ➡ endovascular (one in hospital mortality)

- Endovascular

 - 4 ➡ endovascular (no in hospital mortality)



Technology as a Catalyst

- With the rapid technologic advancements in TEVAR designs and innovative therapeutic strategies technology can be utilized as a catalyst to develop procedures for patients for whom no other surgical options existed in the past



Analysis of Open and Endovascular Intervention

- Current guidelines for managing aortic pathologies for open and endovascular have same thresholds
- Endovascular approach is generally earlier and in patients with multiple comorbidities or advanced age
- Endovascular therapy in patients with no aortic aneurysm, but with large re-entries between false and true lumen to initiate false lumen thrombosis and reduce the risk of later false lumen dilatation and true lumen collapse.
- Shorter interval between acute dissection repair and reintervention for endovascular versus open surgery.
 - less invasive endovascular approach
 - aortic remodelling



Analysis of Open and Endovascular Intervention

- Current guidelines for managing aortic pathologies for open and endovascular have same thresholds
- Endovascular approach is generally earlier and in patients with multiple comorbidities or advanced age
- Endovascular therapy in patients with no aortic aneurysm, but with large re-entries between false and true lumen to initiate false lumen thrombosis and reduce the risk of later false lumen dilatation and true lumen collapse.
- Shorter interval between acute dissection repair and reintervention for endovascular versus open surgery.
 - less invasive endovascular approach
 - aortic remodelling



Summary

- The average time between surgery for acute dissection and reintervention was shorter in patients undergoing endovascular descending aortic repair when compared with open surgery
- In-hospital mortality after descending aortic reintervention was lower in patients undergoing endovascular compared to open procedure
- Despite a technically successful endovascular reintervention, over 10% of patients attained threshold aortic diameter values for re-reintervention during this mid-term follow-up study
- Overall survival was significantly better in patients undergoing descending aortic endovascular reintervention.



Endovascular Stents

- Widely utilized for aortic aneurysms
- Controversial in aortic dissections

Hybrid Arch Procedures

Type II

