Is TEVAR Safe and Durable in a Long-Term?

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What kind of issue is more related to durability of TEVAR ?

- **Patient related issues**

  Aging process, Aorta anatomy and angulation, SINE in AD, location of branch arteries etc.

- **Stent graft related issues**

  durability of graft, nitinol, stainless etc.

CASE 1 : Progress of Chronic AD

Chronic Type B Aortic Dissection with Huge Aneurysm Change

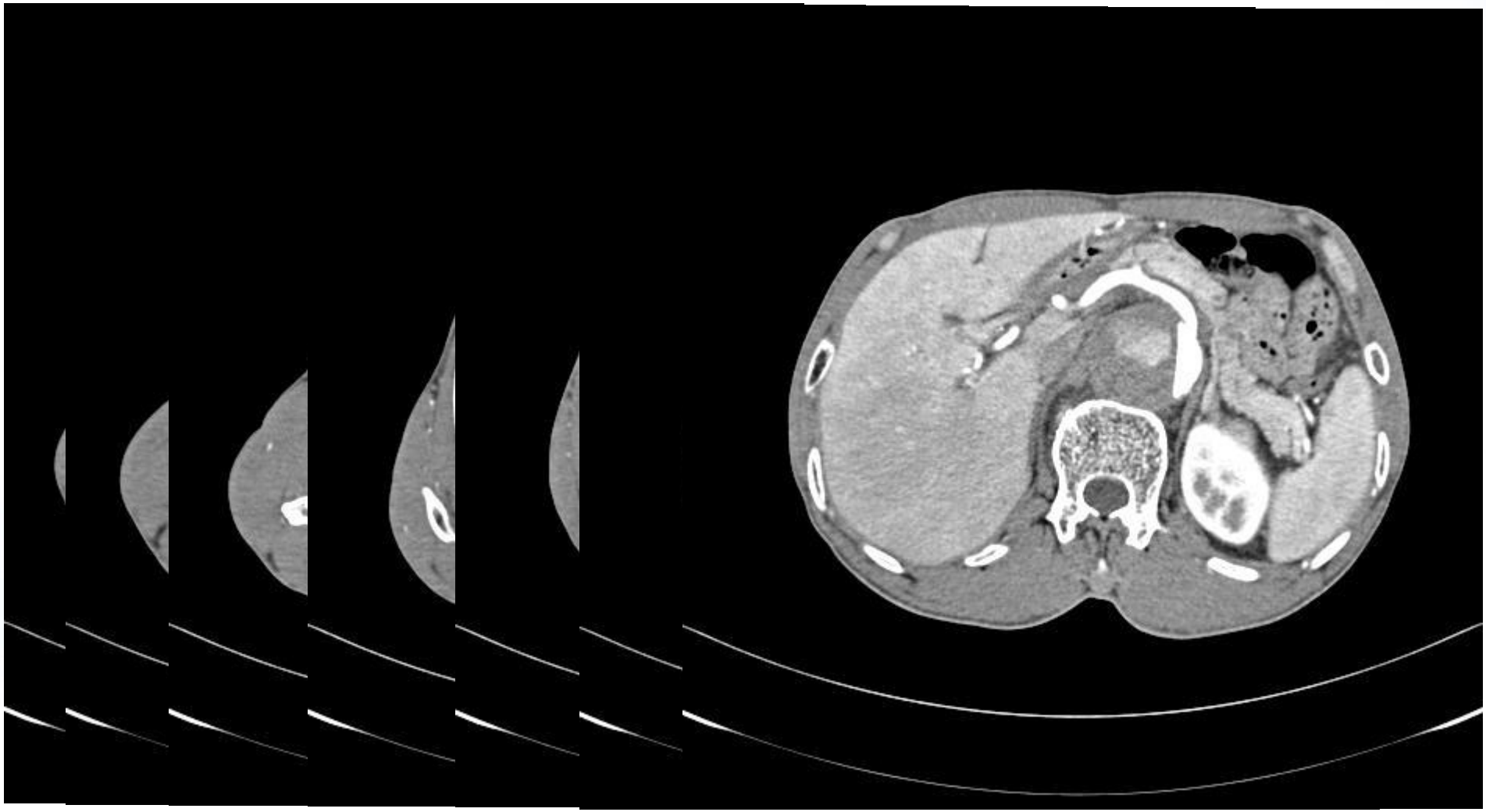
김OO M/69

- Chief Complaint : Widening of mediastinum

- Past History : HT(+), DM(+), Smoking (+)
  Hyperlipidemia(-), CVA(-),

- 48 Kg, 160cm

Case 1 : CT in 2008



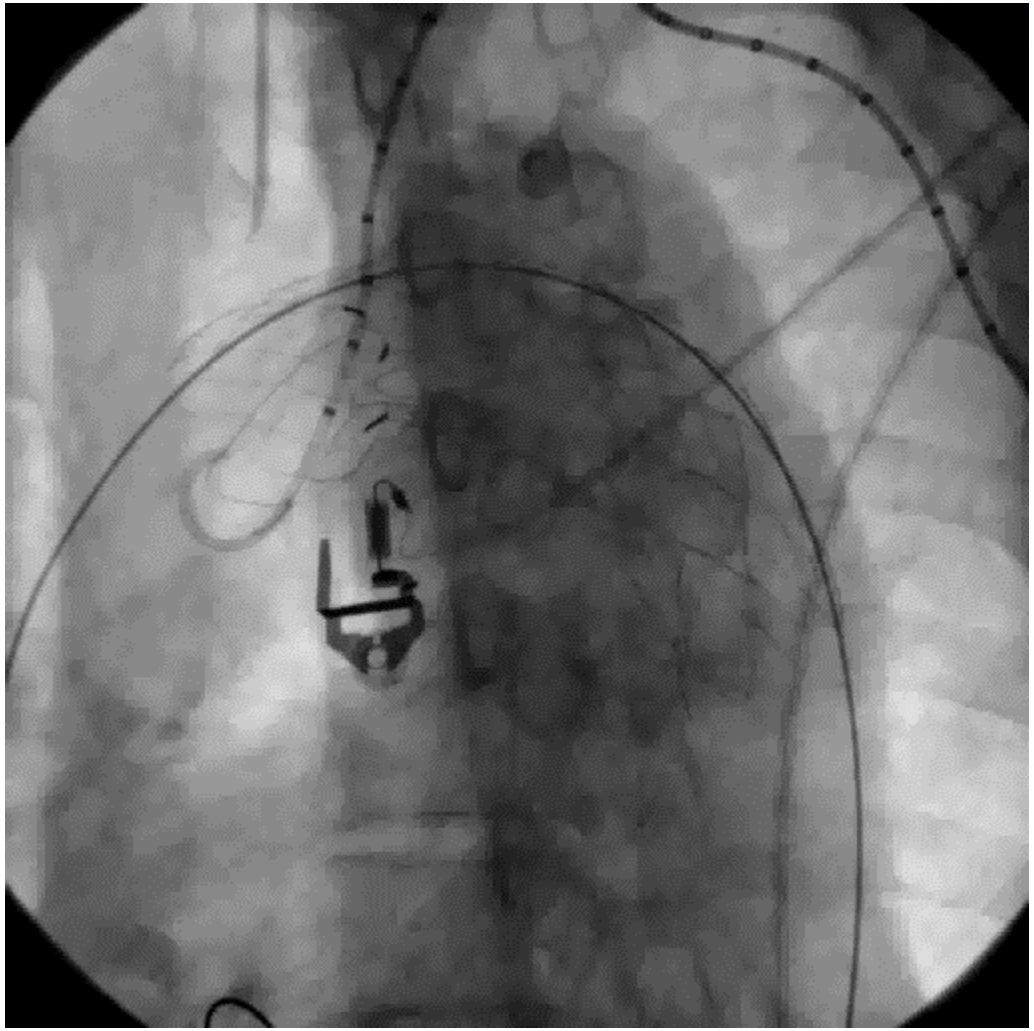
We always thought over…..

Endovascular vs Operation

Advantage of TEVAR : Effective

- Short procedure time. Easy
- Low early complication rate : stroke, paraplesia etc.
- Especially old age, patients with many co-morbidity

Case 1 : TEVAR in 2008



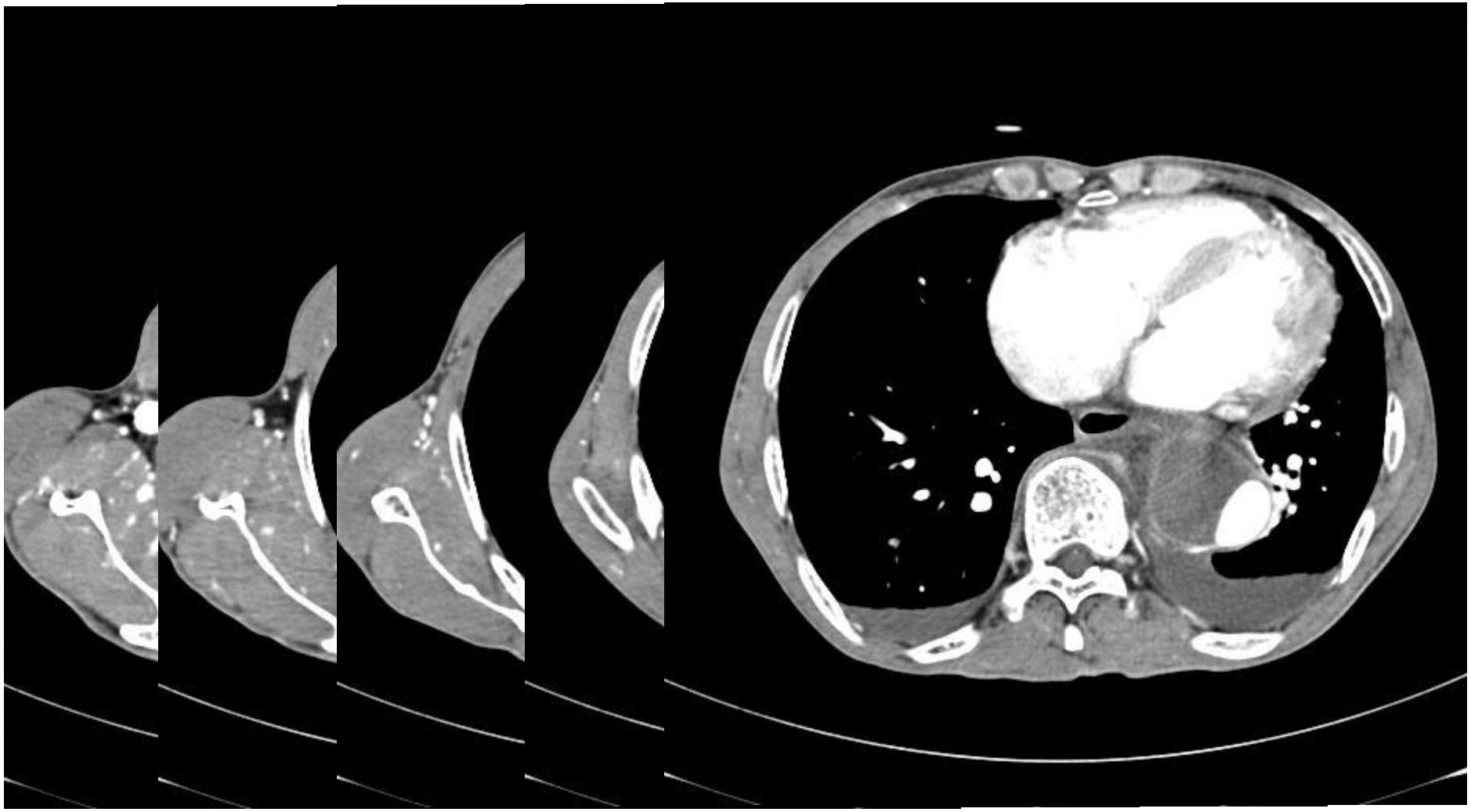
Nevertheless

Simple !

Easy !

Safe !

Case 1 : CT after TEVAR



Long-Term Clinical Outcome of TEVAR for Complicated Acute Type B AD

Author and Year (Ref. #)	n	Pathology	Early Mortality n (%)	Mean Follow-Up (months)	Survival Rate (%)
TEVAR vs. medical					
Chemelli-Steingruber TEVAR 2010 (15)	38	Acute complicated	5 (13.2)	33 (0–97)	Dissection-death survival: 1–5 yrs (82.6) Rupture free survival: 1–5 yrs (93.1)
Chemelli-Steingruber medical 2010 (15)	50	Acute	3 (6.0)	36 (0–122)	Dissection death free: 1 yr (88.0) 5 yrs (74.9) Rupture free survival: 1 yr (93.4) 5 yr (88.5)
Garbade TEVAR 2010 (17)	46	27 acute complicated 19 acute uncomplicated	9 (19.6)	1,107 days	1 yr (80) 3 yrs (73.3) 5 yrs (56.3)
Garbade medical 2010 (17)	84	63 acute uncomplicated 21 acute complicated	7 (8.3)	1,107 days	1 yr (86.2) 3 yrs (80.9) 5 yrs (72.1)
Fattori IRAD TEVAR 2008 (19,20)	43	Acute complicated	5 (11.6)	2.3 yrs median	on 27 patients 1 yr (88.9) 3 yrs (76.2)
Fattori IRAD medical 2008 (19)	390	Acute	34 (8.7)	2.3 yrs median	on 189 patients 1 yr (90.3) 3 yrs (77.6)

Rossella et. al, J Am Coll Cardiol 2013;61:1661–78

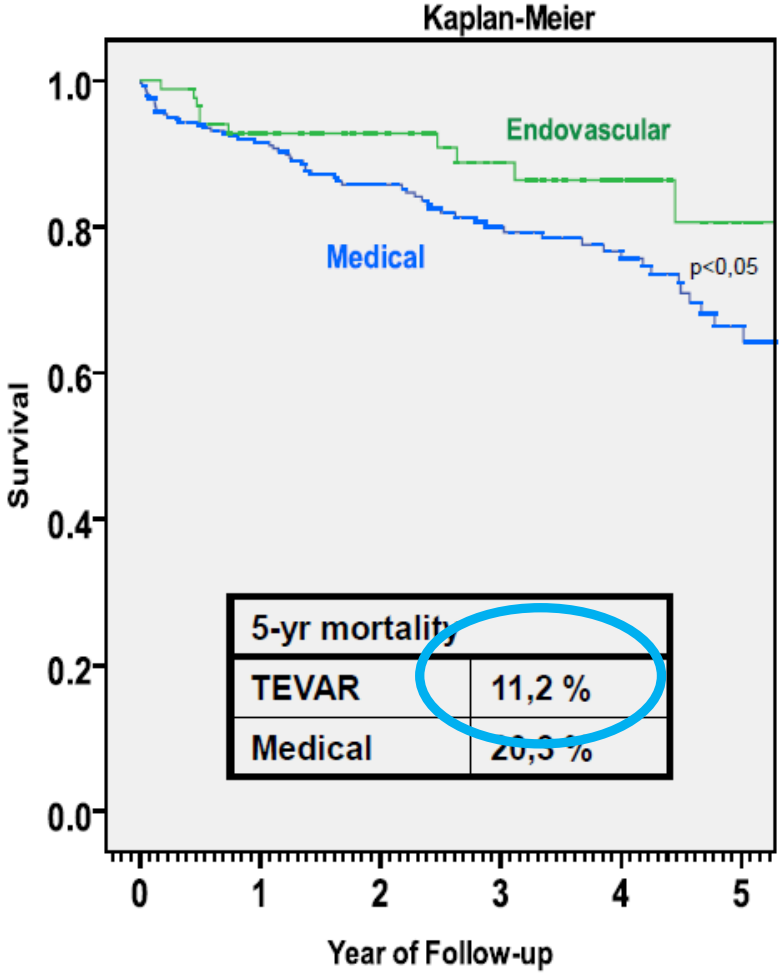
Long-Term Clinical Outcome of TEVAR for Complicated Acute Type B AD

5-year survival : 56.3%~ 87%

5-year freedom from aortic events : 45.0%~77.0%

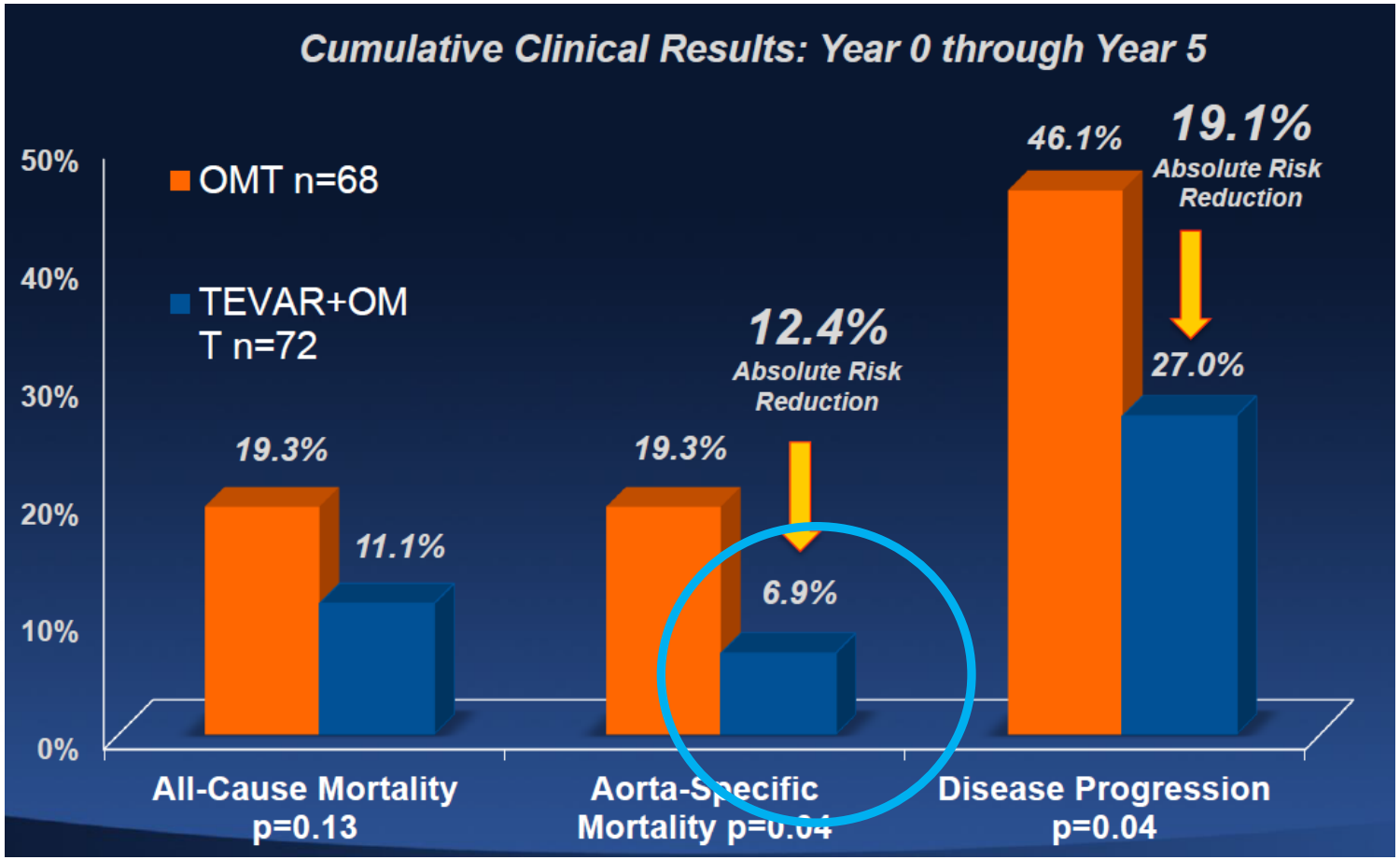
Rossella et. al, J Am Coll Cardiol 2013;61:1661–78

TEVAR in Uncomplicated Type B AD ? : Long-Term Outcomes in IRAD



Fattori et al, AHA 2010

INSTEAD-XR
: 5 yrs Outcomes after TEVAR in Uncomplicaed AD



Nienaber CA et al Circulation CV Inv 2013

Long-Term Clinical Outcome of TEVAR for Descending Thoracic Aortic Aneurysm

- **Observational study**
- **On label use, all descending TAAA including LCA to LSCA bypass**
- **12 years follow up, N=579, Mean age 71.1**

J Vasc Surg. 2018 February ; 67(2): 363–368.

Long-Term Clinical Outcome of TEVAR for Descending Thoracic Aortic Aneurysm

- **Aortic rupure :** 2 early events

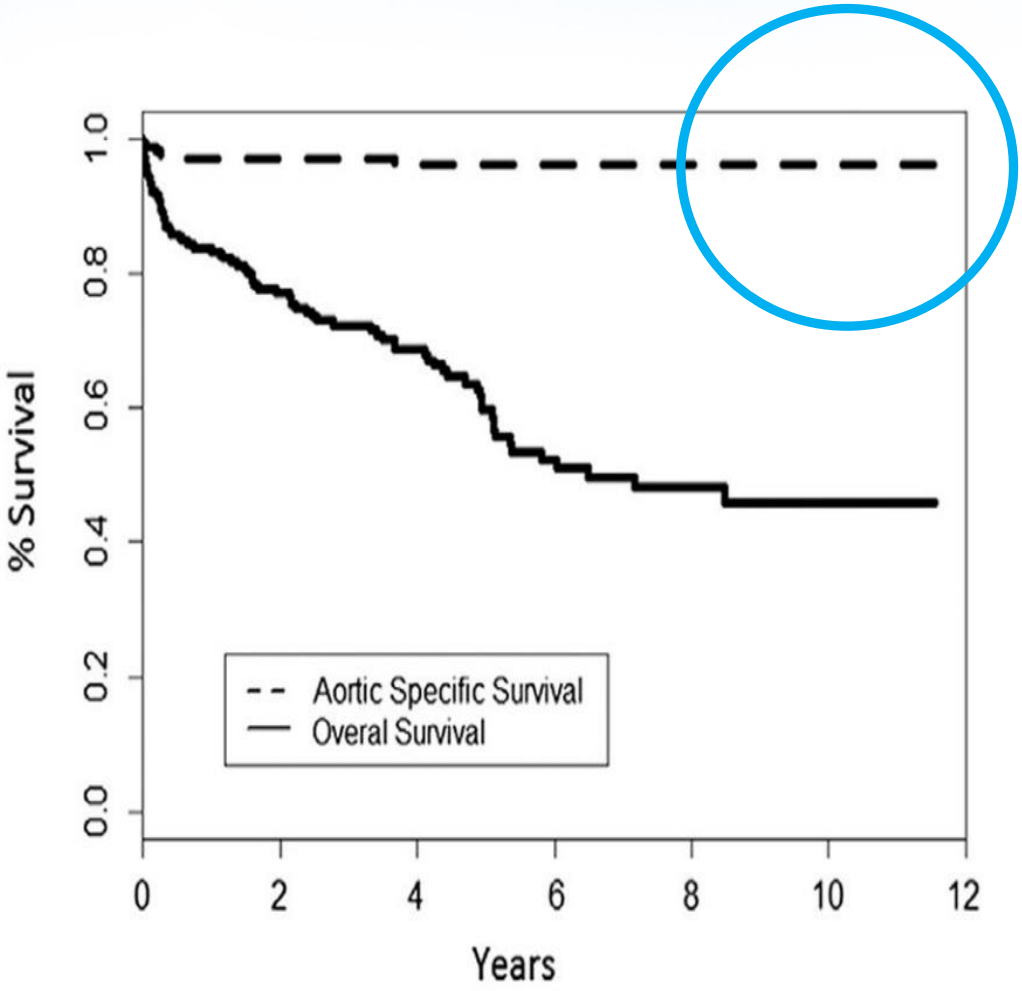
- **Endoleak :** 14 patients (7.3%)
  type I (n = 10)
  type II (n = 2)
  type III (n = 2)

- **Overall survivals : 45.7%**

- **Aorta-specific survivals : 96.2%**

J Vasc Surg. 2018 February ; 67(2): 363–368.

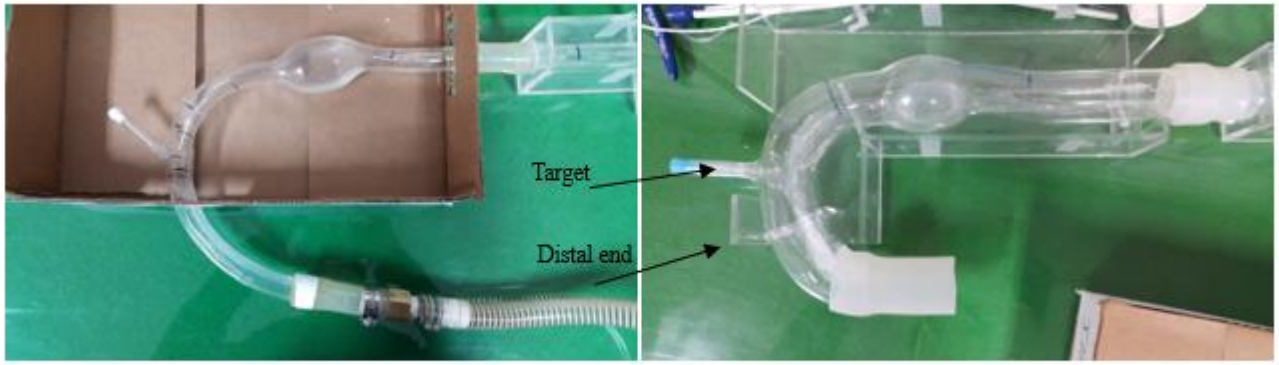
Long-Term Clinical Outcome of TEVAR for Descending Thoracic Aortic Aneurysm



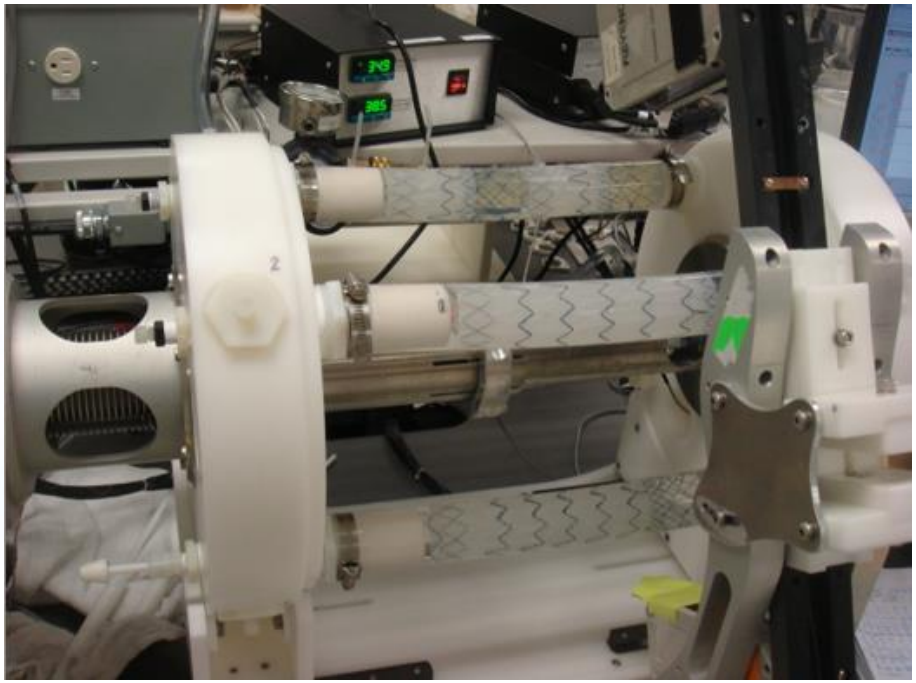
Type of endograft	
Gore TAG/C-TAG[a]	57.8 (111)
Medtronic Talent/Valiant[b]	24.0 (46)
Cook Zenith TX2/Alpha Thoracic[c]	16.1 (31)
Bolton Relay[d]	1.6 (3)
Medtronic Aneurx[b]	0.5 (1)

J Vasc Surg. 2018 February ; 67(2): 363–368.

Fatigue Test



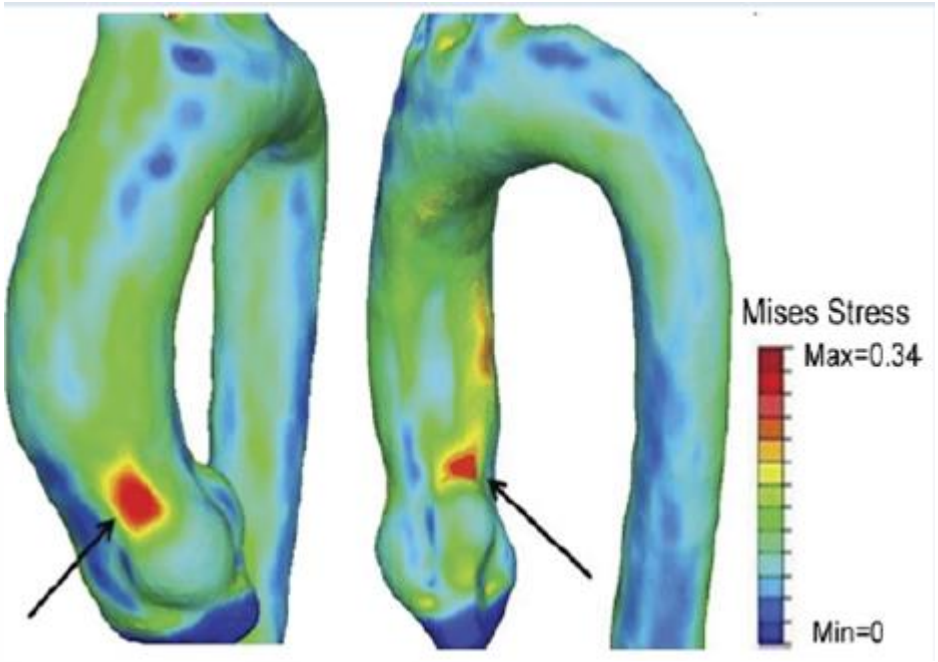
Phantom

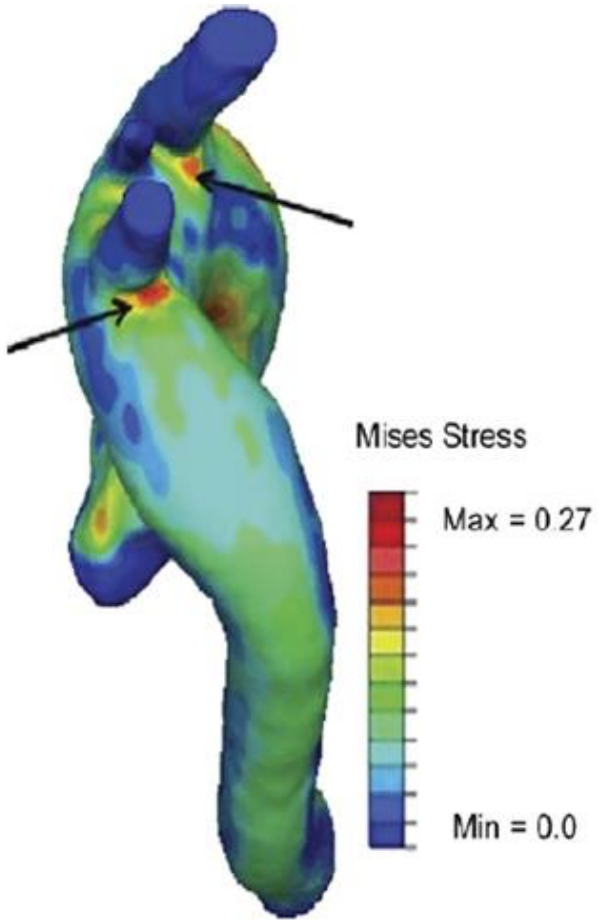


45,000,000 in the phantom = 10 years

Disadvantages of TEVAR

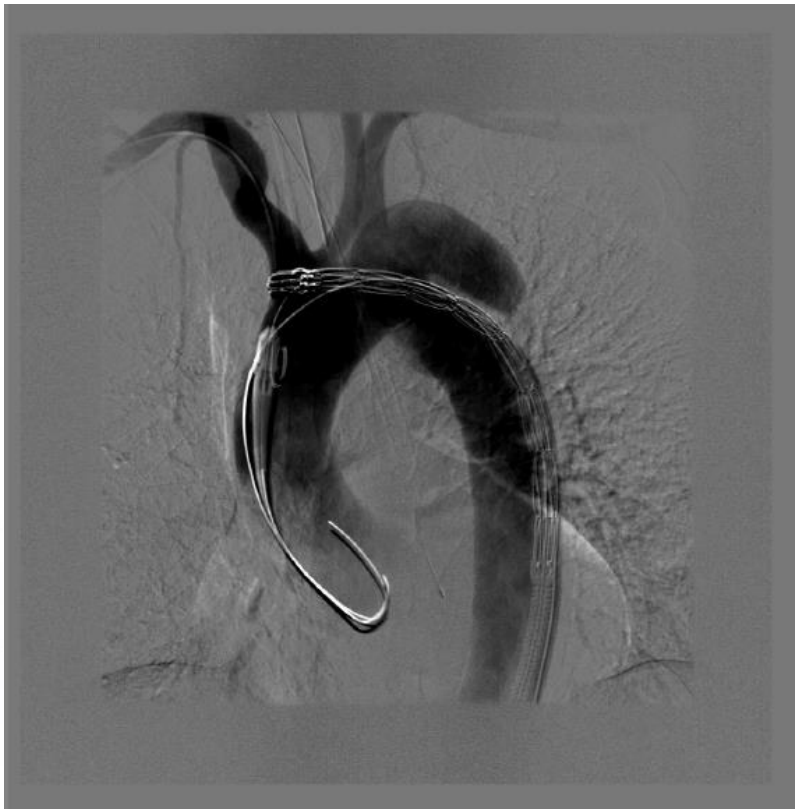
- Three dimensional anatomy is different from fluroscopic image : Aorta is not straight





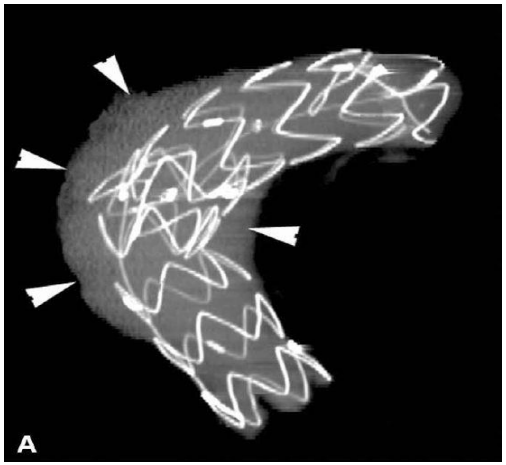
Disadvantages of TEVAR

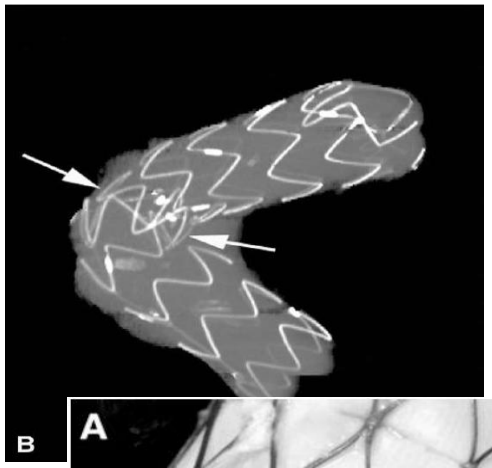
- **Birdbeak → Retrograde aortic dissection**

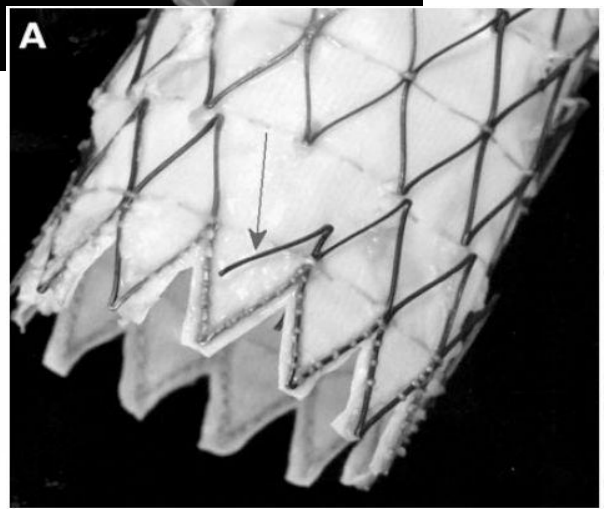


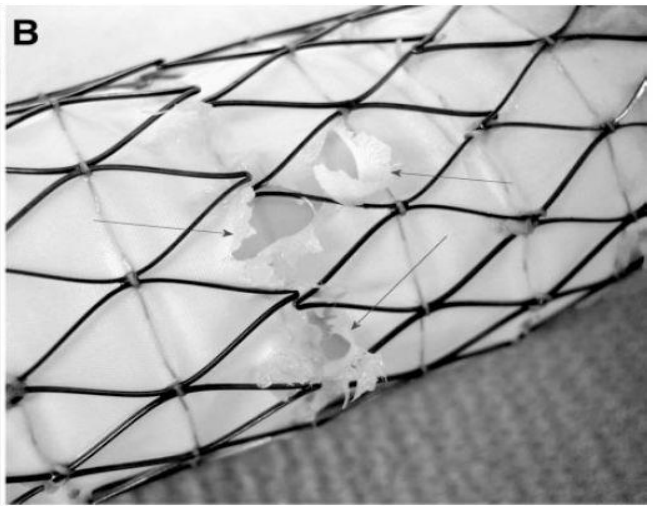
Disadvantages of TEVAR

- Stent graft migration, Stent fracture, Fabric tear during long term follow up



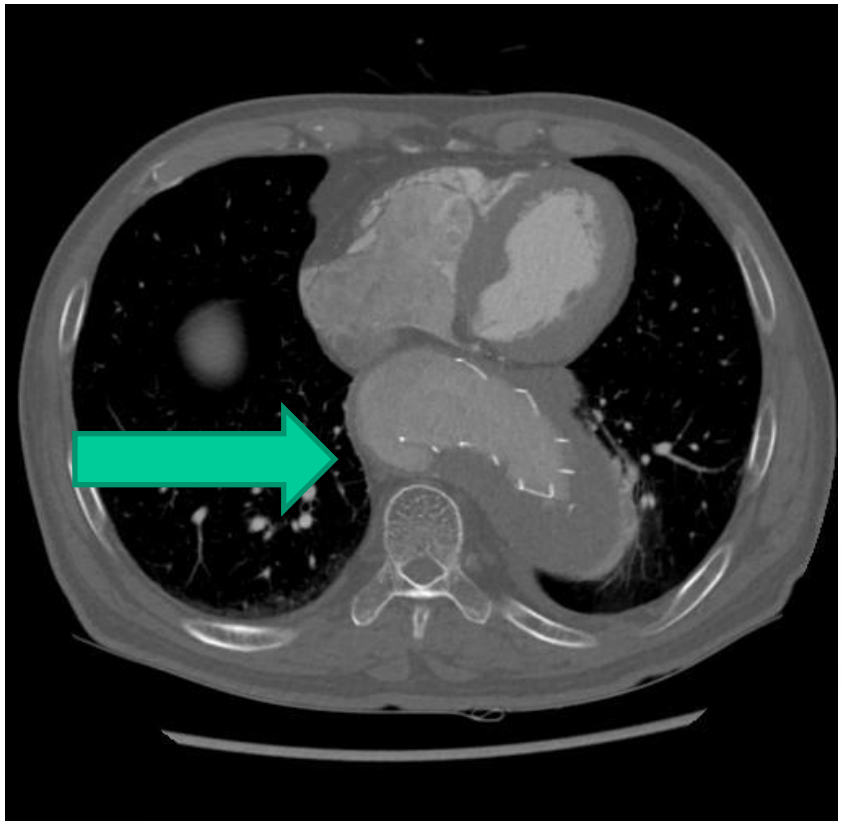






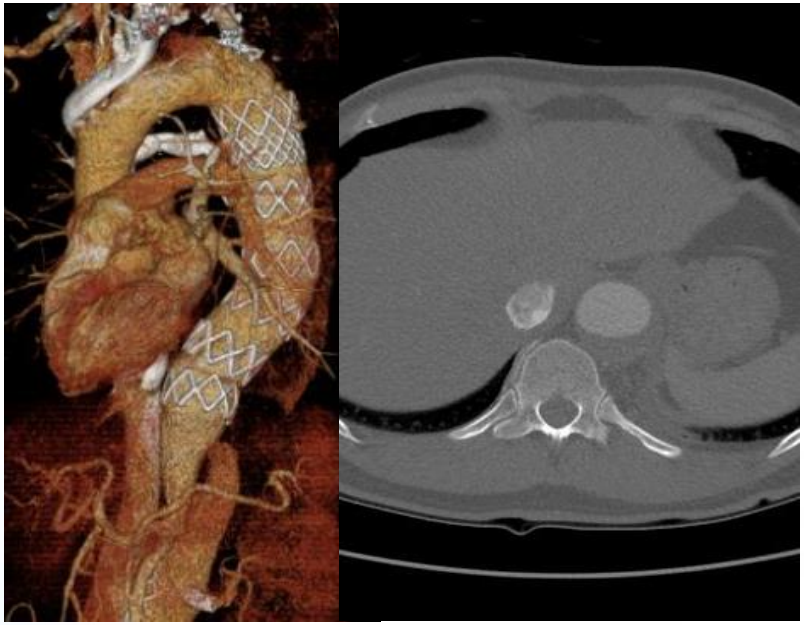
Benedikt et al Curr Prob Diag Rad 2004 Dec

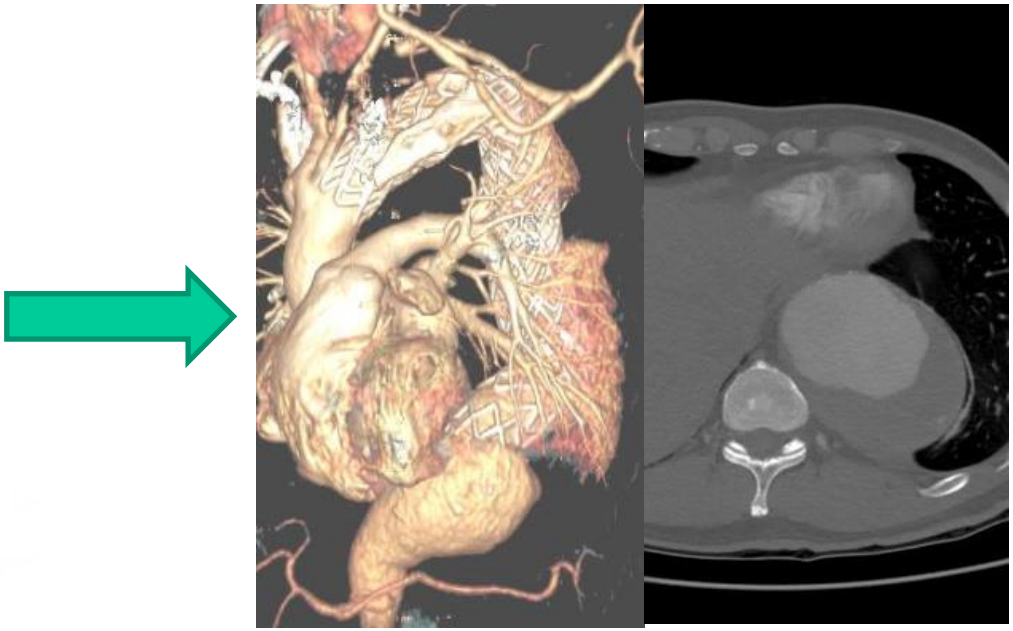
Stent Graft Induced Edge Dissection (SINE)



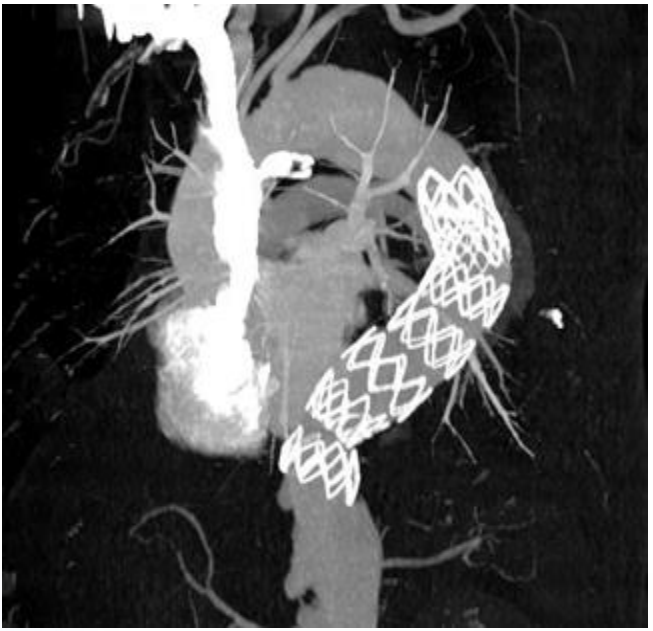
Aneurysmal Formation

After 7 yrs





Aortic angulation change on CT after 8 years

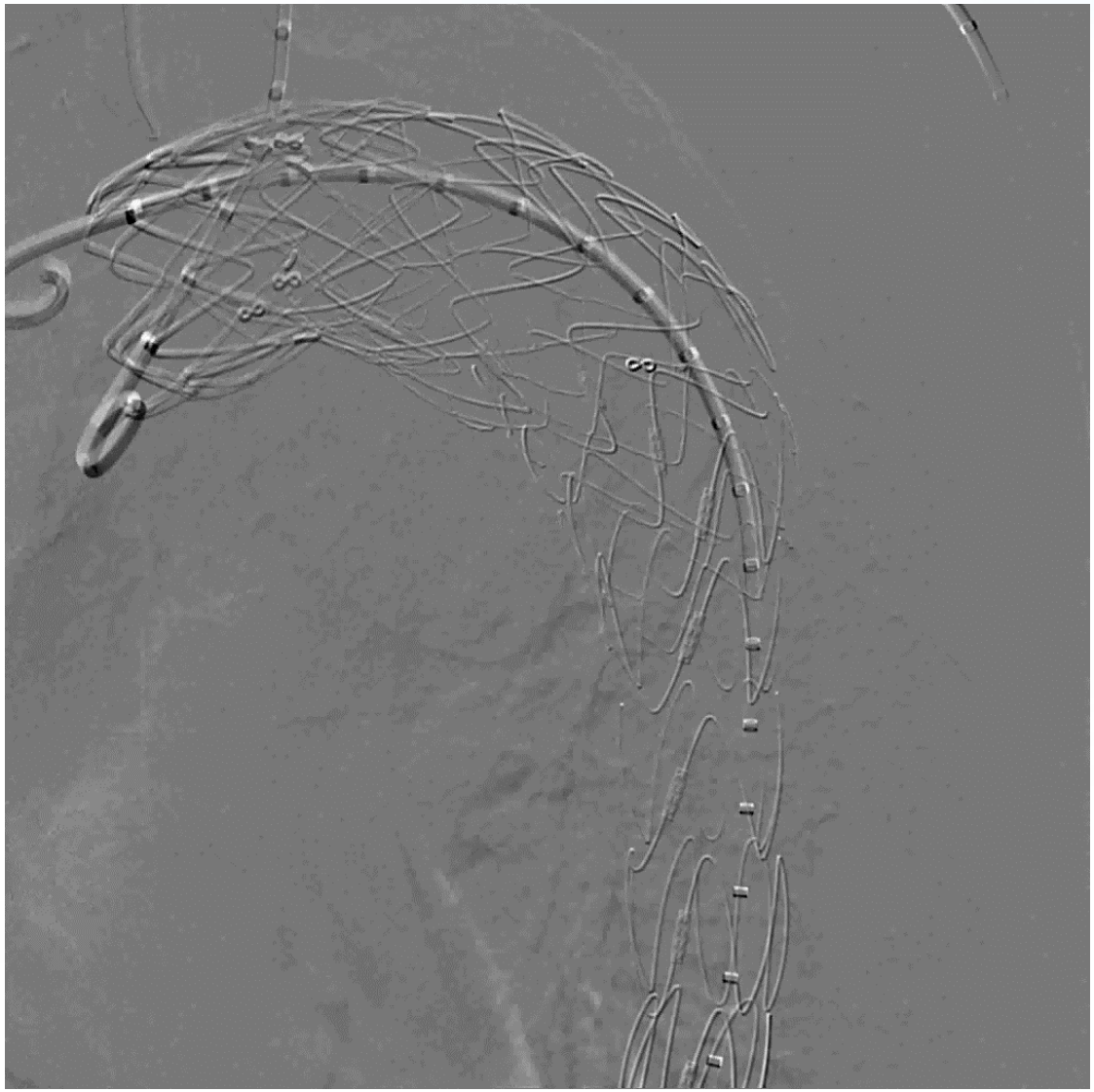


1 year

6 year

8 year

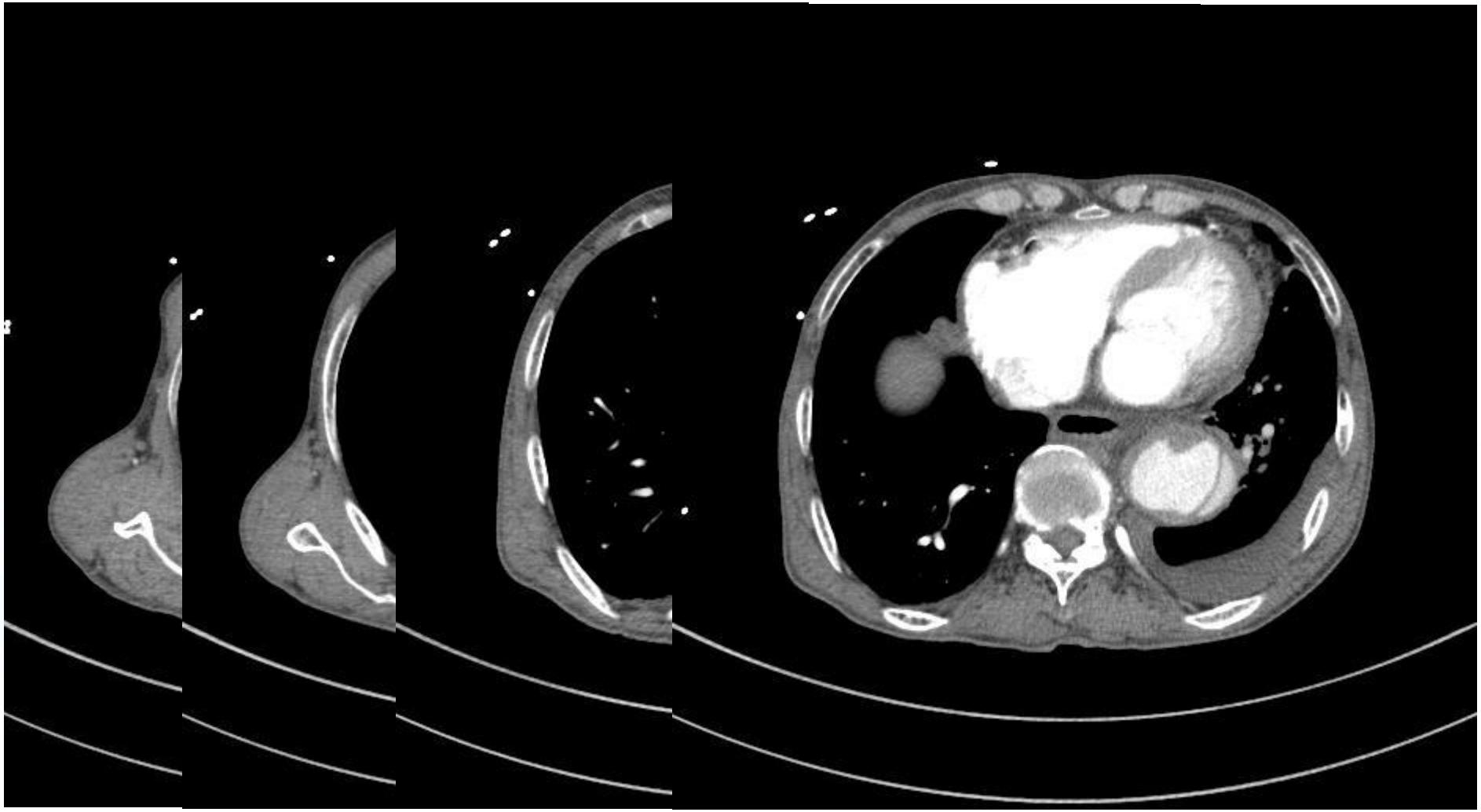
Case 1 : TEVAR in 2011



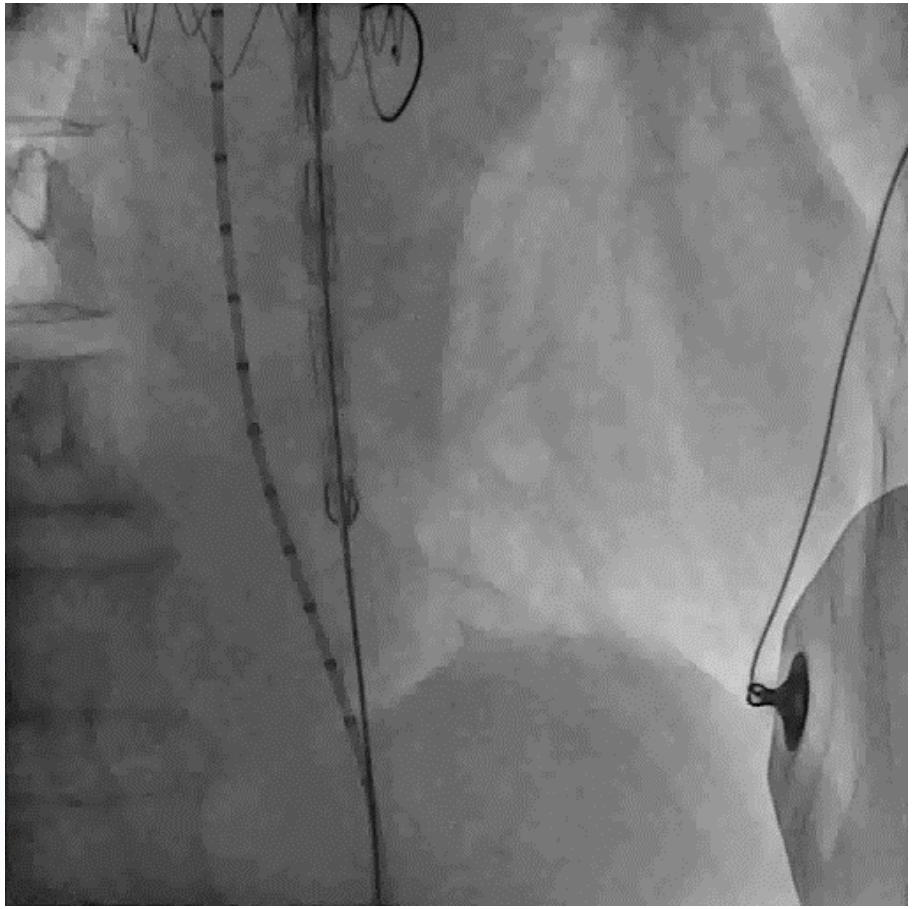
SINE develop…..

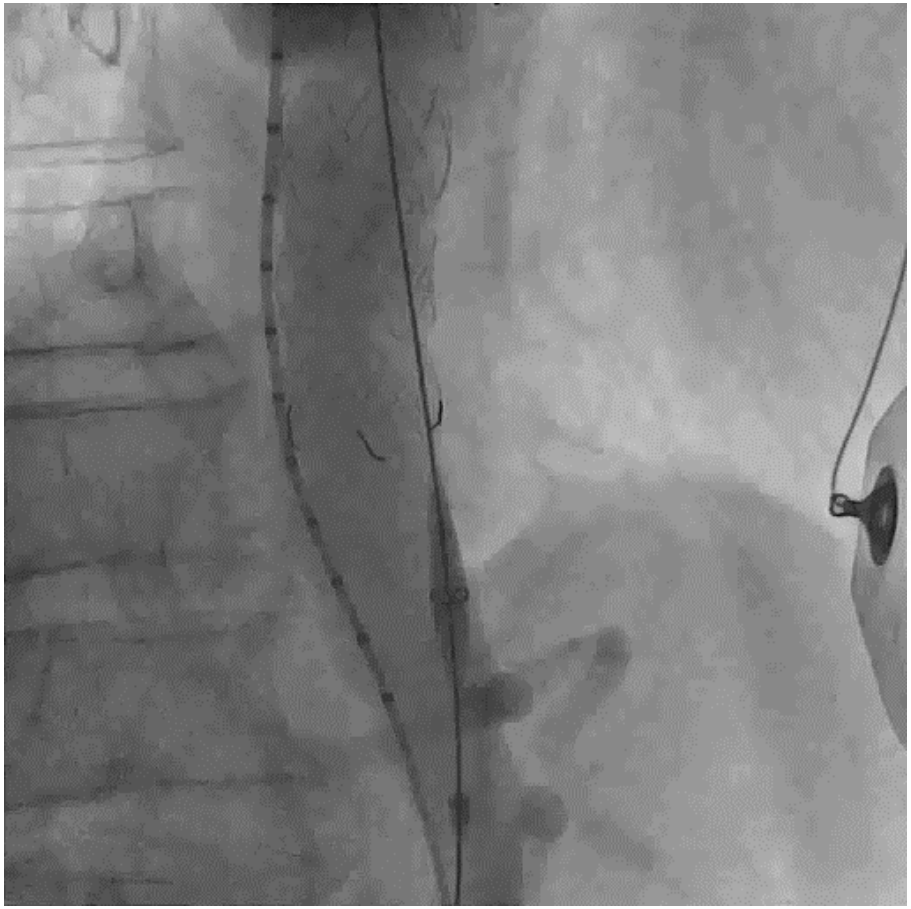
Re-TEVAR

Case 1 : CT in 2019, Age 80

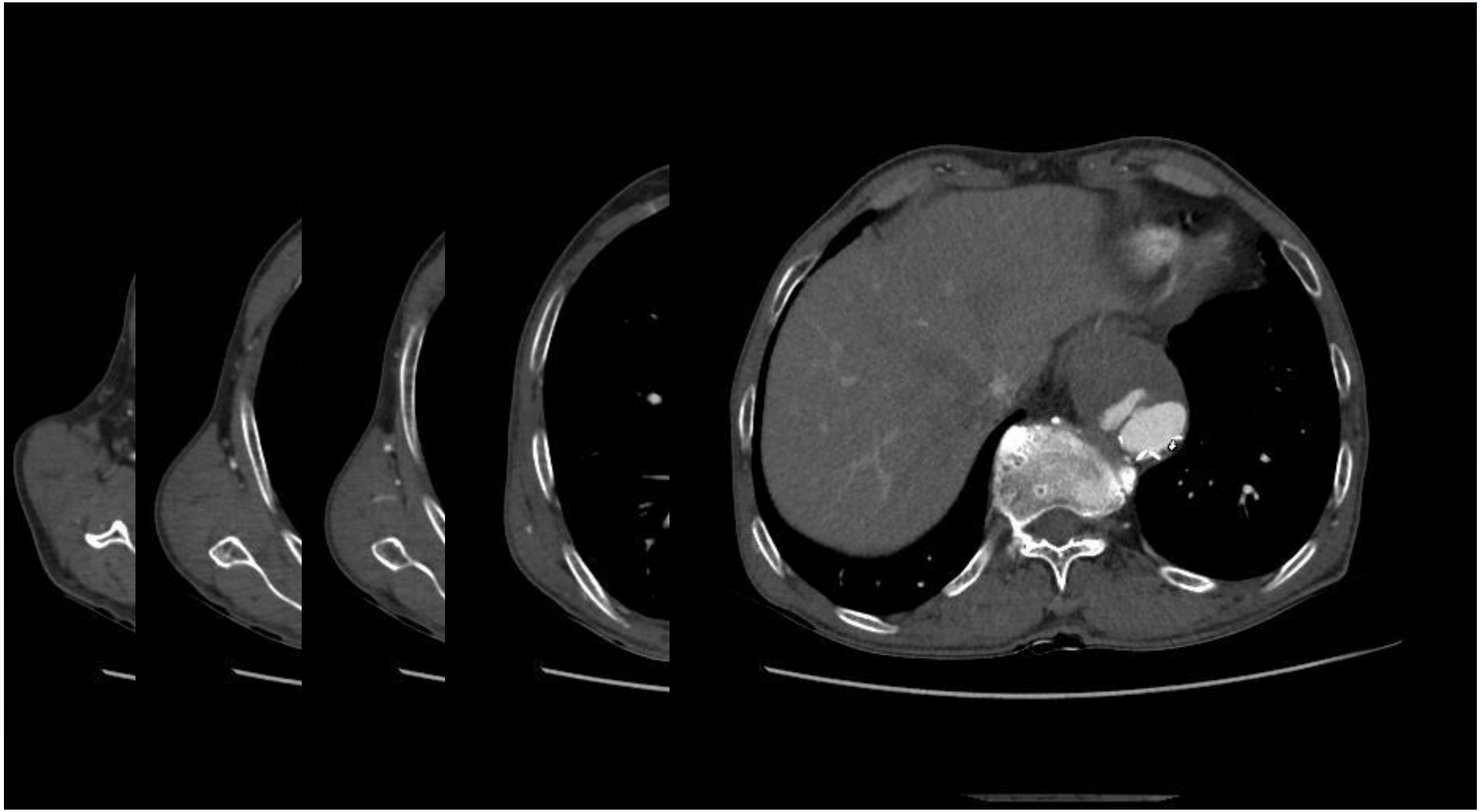


Case 1 : TEVAR in 2019





Case 1 : CT in 2021, Age 82



Mid-Term Clinical Outcome of Descending AD with Malperfusion : PNUH data

Table 2. Charateristics of acute TBAD with MS managed with endovascular procedures

Characteristics	Value (n=27)
Arteries of malperfusion	
Visceral	2(7.4%)
Renal	13(48.1%)
iliofemoral	7(25.9%)
Combined(more than 2)	6(22.2%)
Visceral+Renal	2(7.4%)
Renal+ Iliofermoral	2(7.4%)
Visceral + Renal + iliofemoral	2(7.4%)
Duration from admission to procedure (day)	5.5±7.9
Type of procedure	
TEVAR only	7(25.9%)
Selective stenting only	6(22.2%)
Combined procedure(TEVAR and selective stenting)	14(51.9%)
Anesthesia	
General	10(37.0%)
Local	17(63.0%)
Primary technical success	27(100%)

TBAD: type B aortic dissection, MS:malperfusion syndrome, TEVAR:thoracic endovascular repair

Under submission

Mid-Term Clinical Outcome of Descending AD with Malperfusion : PNUH data

Table 3. Clinical outcomes of endovascular treatment for acute TBAD with MS

In hospital clinical outcome	(n=27)	Follow up clinical outcome	(n=27)
Mean length of hospital stay (day)	19.6±11.1	Mean follow up duration (year)	4.3±3.1
Major adverse events		Major adverse events	
Death	0(0%)	Death	0(0%)
Stroke	2(7.4%)	Stroke	1(3.7%)
Minor	1(3.7%)		
Major	1(3.7%)		
AKI	7(25.9%)	Maintenance HD	2(7.4%)
Temporary RRT	3(11.1%)	Cardiac event	0(0%)
Paraplegia	0(0%)	Aneurysmal change	1(3.7%)
Cardiac event	0(0%)	Endoleak	0(0%)
Limb iscehmia	1(3.7%)	Reintervention rate	2(7.4%)
Endoleak	1(3.7%)		
Reintervention rate	1(3.7%)		

TBAD: type B aortic dissection, MS:malperfusion syndrome, AKI:acute kidney injury, RRT:renal replacement therapy, HD:hemodialysis

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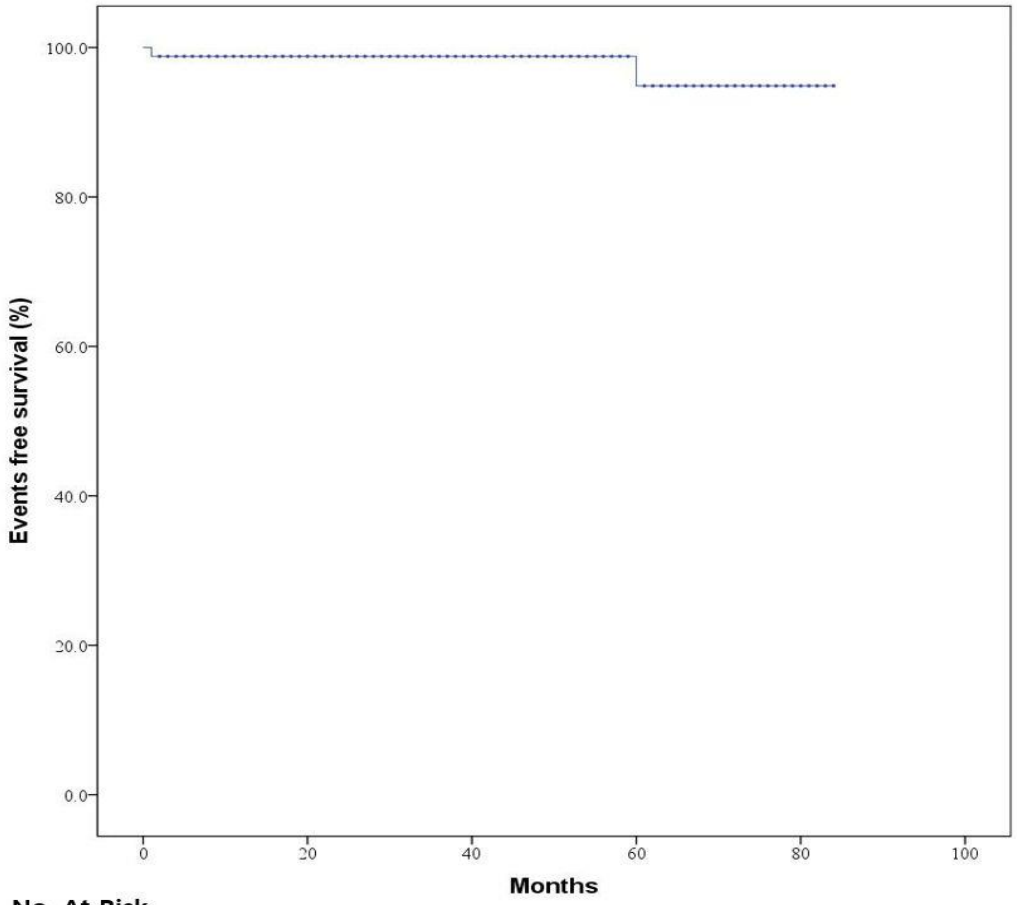
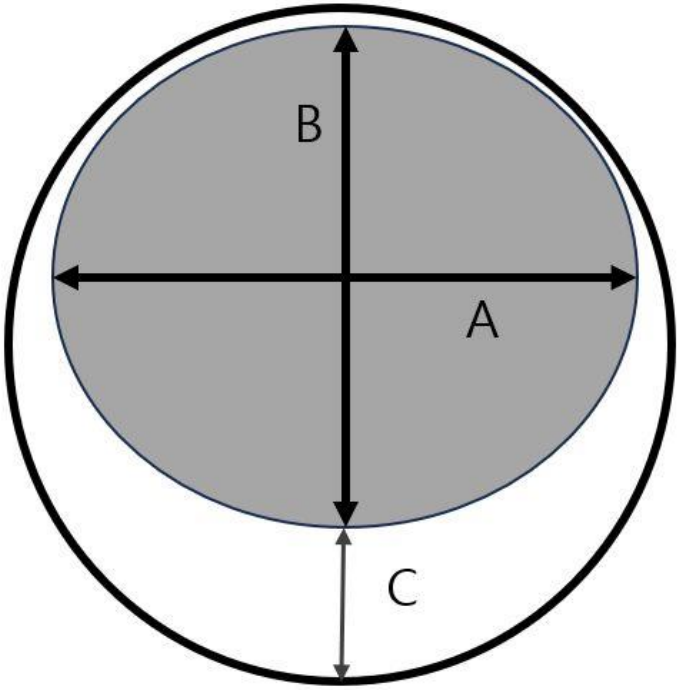
Mid-Term Clinical Outcome of Descending AD with Malperfusion : PNUH data



No. At Risk				
TEVAR group (N=21)	20	20	20	19
Selective stenting group (N=6)	6	6	6	6

TEVAR vs TEVAR+selective stent vs Selective stent
CT analysis : PNUH data



True lumen area(mm^2)
= A/2 X B/2 X π

False lumen diameter(mm)=C

TEVAR vs Selective stent
CT analysis : PNUH data

Table 4. CT parameters between TEVAR group and Selective stenting group

	TEVAR group(n=21)	Selective stenting group(n=6)	P value
Measurement at the middle of lesion			
Change of aortic area	188.4±543.9	878.9±436.3	0.037
Change of true lumen area	353.6±337.7	320.2±452.1	0.946
Change of false lumen diameter	-7.1±7.2	10.4±19.38	0.059
Measurement at the celiac trunk level			
Change of aortic area	22.8±179.7	303.7±45.1	0.025
Change of true lumen area	136.9±119.5	46.6±60.8	0.026
Change of false lumen diameter	-3.5±7.4	11.0±5.4	0.013
Measurement at the renal a level			
Change of aortic area	37.3±165.5	442.9±100.9	0.019
Change of true lumen area	57.2±50.1	75.1±17.0	0.545
Change of false lumen diameter	-1.0±5.7	5.3±5.4	0.122

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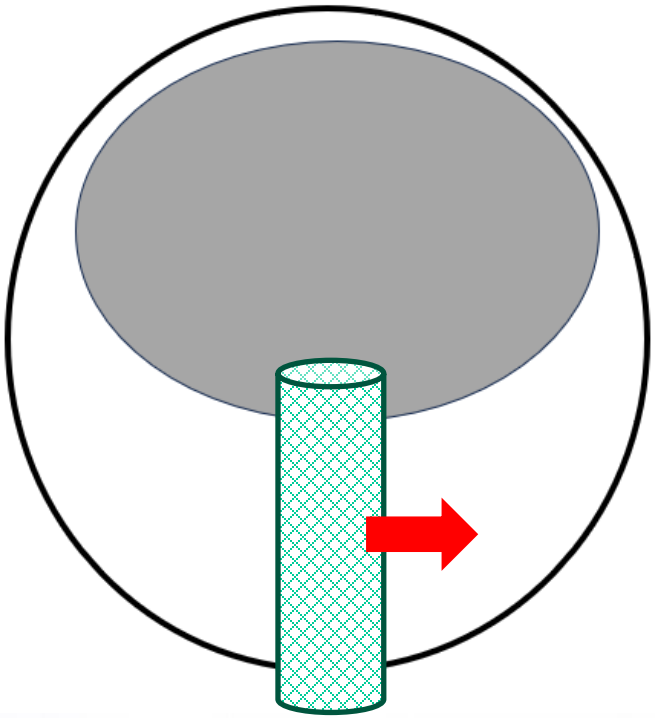
TEVAR vs TEVAR+selective stent vs Selective stent
CT analysis : PNUH data

Table 5. CT parameters among TEVAR group, Selective stenting group and Combined group

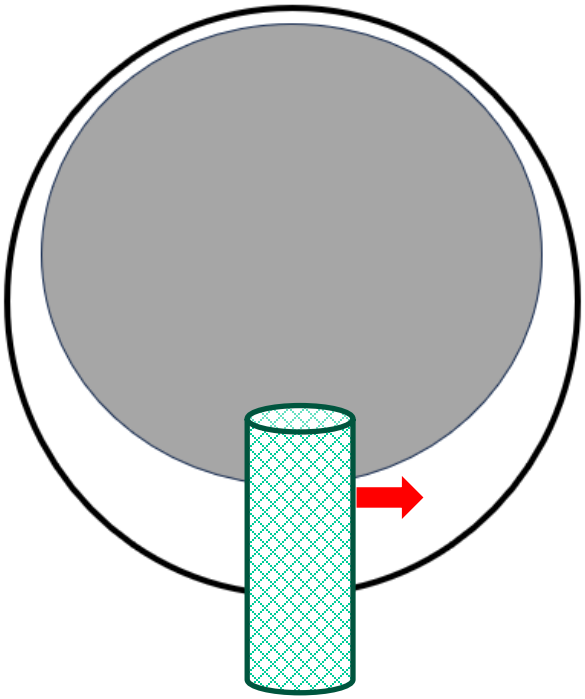
	TEVAR group(n=7)	Selective stenting group(n=6)	Combined group(n=14)	P valu
Measurement at the stent graft level				
Change of aortic area	121.4±708.1	878.9±436.3	245.8±406.6	0.171
Change of true lumen area	406.0±285.0	320.2±452.1	308.6±394.0	0.884
Change of false lumen diameter	-11.4±6.1	10.4±19.4	-3.3±6.0	0.020
Measurement at the celiac trunk level				
Change of aortic area	-14.9±204.1	303.7±45.1	55.1±165.0	0.057
Change of true lumen area	170.4±154.2	46.6±60.8	108.1±81.6	0.314
Change of false lumen diameter	-4.6±9.13	11.0±5.4	-2.7±6.2	0.026
Measurement at the renal a level				
Change of aortic area	-12.2±92.2	442.9±100.9	79.8±207.7	0.004
Change of true lumen area	34.9±56.1	75.1±17.0	76.3±38.5	0.235
Change of false lumen diameter	-3.2±6.0	5.3±5.4	0.9±5.3	0.131

Under submission

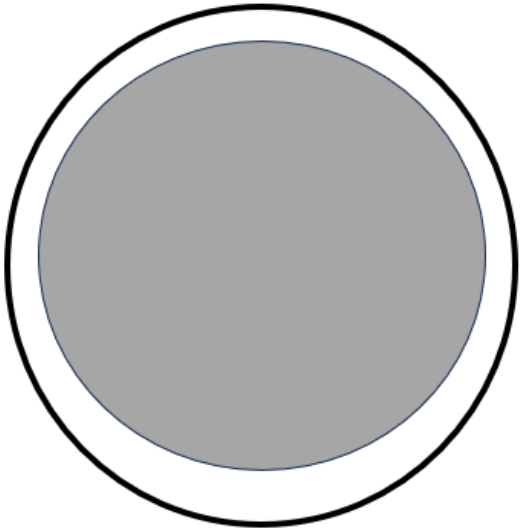
Illustration of CT analysis according to procedures



Selective stent only for compromised branch a.



TEVAR + selective stent

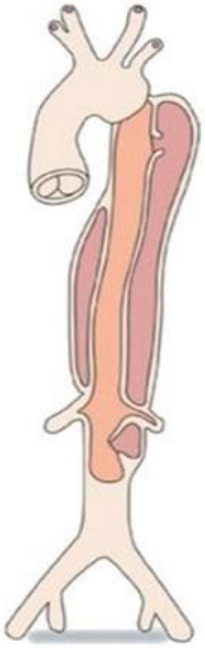


TEVAR only

Mid-Term Clinical Outcome of Descending AD with Malperfusion : PNUH data

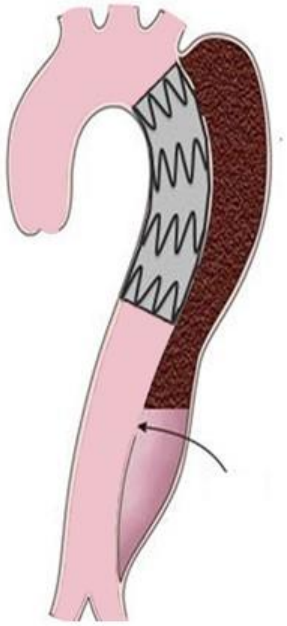
Midterm clinical outcomes of endovascular treatment for acute type B aortic dissection with malperfusion syndrome

Subjects



27 patients
Type B AD
with malperfusion

Management
TEVAR
Selective stenting



Clinical Outcomes

Mean follow up : 4.3 years

Technical success : 100%

Clinical outcomes

Death 0%
Reintervention 7.5%
Stroke 3.8%
Hemodialysis 7.5%

Conclusion Endovascular treatment for acute Type B AD with malperfusion had high technical success rate and good clinical outcomes

Summary
Long Term Durablity of TEVAR

- Short procedure time. Easy

- Low early complication rate : stroke, paraplesia etc.

- Long term aortic related mortality are relatively low
  TAAA <5%,
  uncomplicated AD <10%
  complicated AD 45-77%

- Re-intervention rate are more frequent.
- Most of TEVAR issues are related to patient factors
  (age, aortic anatomy etc.)

Summary
Long Term Durablity of TEVAR

- TEVAR is useful especially **old age, patients with many co-morbidity**

- More innovative devices will be developed

- **At this time, We should do Repair, Repair ….. !!**

upto average left expectancy