THE E-XL AORTIC STENT AS EXTENSION IN COMPLICATED DISSECTIONS AFTER FROZEN ELEPHANT TRUNK PROCEDURES

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Background - Chronic Type I Aortic Dissection

St.p. prox. ao. repair for acute Type I AD

Patent false lumen distally ~ 70 - 89%

- ***Aortic growth***
- ***Aortic rupture***
- ***Malperfusion***

Redo Surgery at 5 - 12 yrs: 16 – 39%

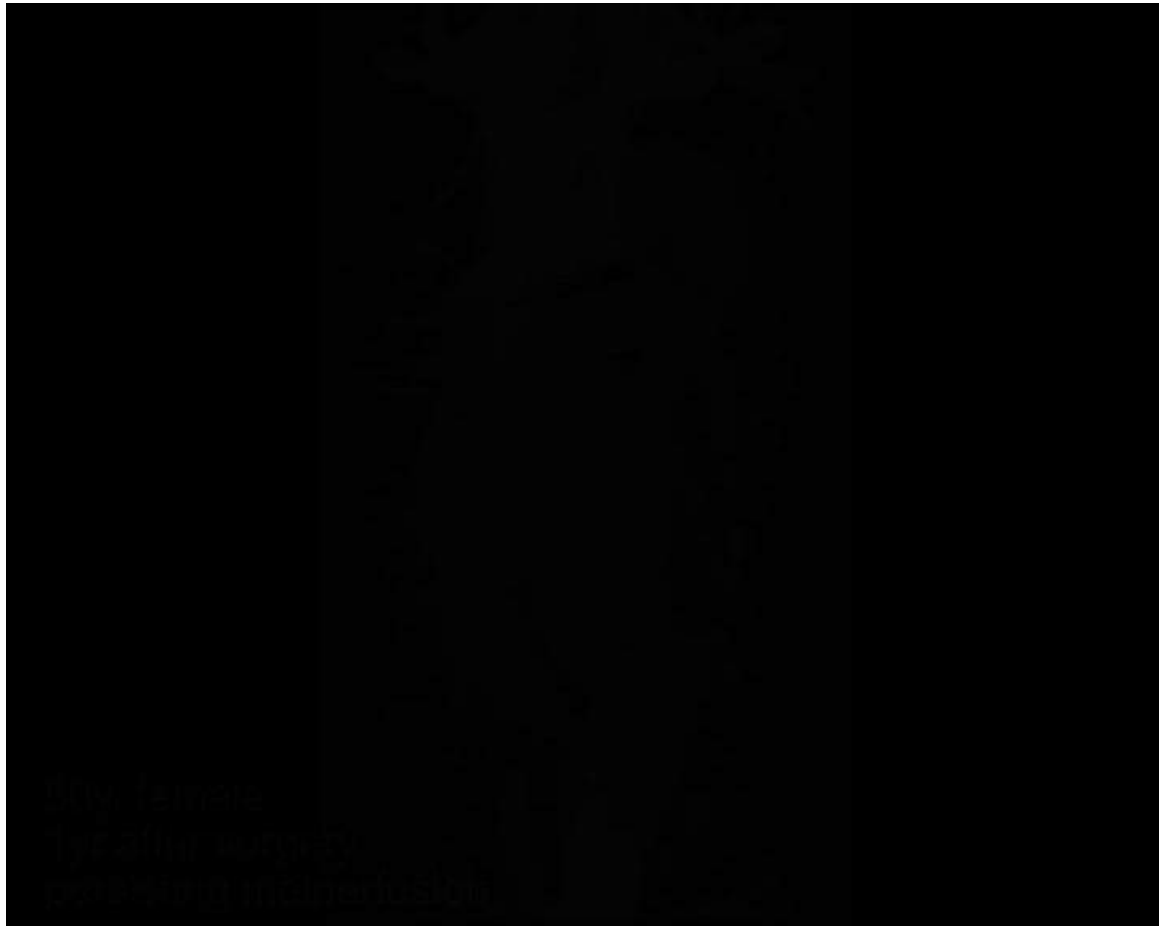
Glauber, Murzi 2010

Park 2009, Ishihara 2009

Zierer 2007

Geirsson, Bavaria 2007

Kirsch 2002

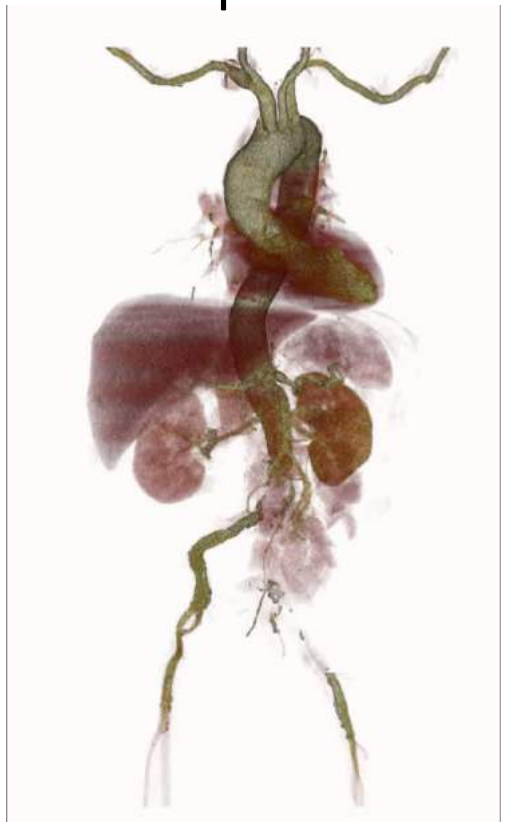


Malperfusion in acute Type A (AAD)

Malperfusion in Type I AD - Case Examples

Cerebral

Peripheral



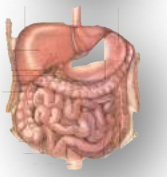
Type I

Potential End – Organ Ischemia

Cerebral

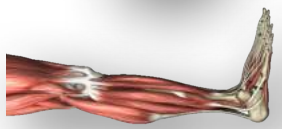
Heart

Spinal Cord



Visceral

Renal



Extremities

Malperfusion in AAD - Mortality

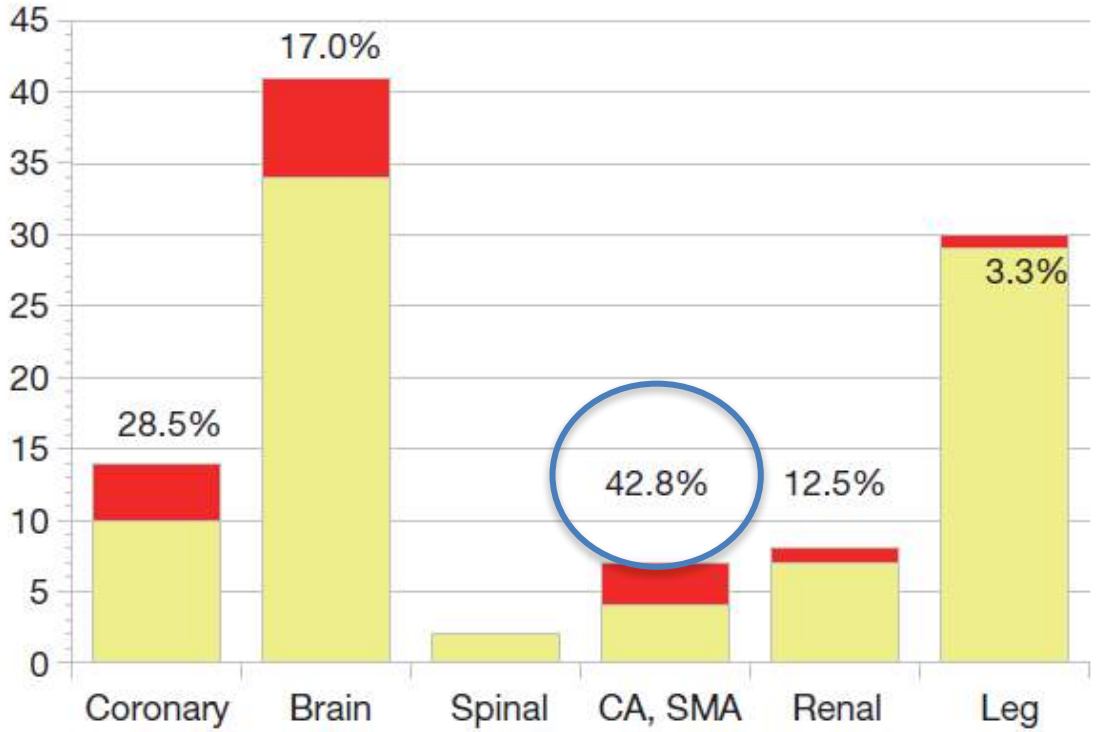
Outcome according to malperfusion extent in acute Type A AD

Malperfused system	Total N (%)	Mortality (%)
0	1420 (66.4)	12
1	494 (23.1)	21
2	139 (6.5)	31
3	53 (2.5)	43

Czerny et al, Am. Coll. Cardiol. 2015
GERAADA Results

Visceral Malperfusion

The major Killer among malperfusion sites



Okita et al, Ann Cardiothorac Surg 2016

Standard Treatment in acute AAD
does not consider visceral/peripheral Malperfusion

Delay to specific malperfusion treatment (standard approach)

Onset of symptom to diagnosis

Proximal aortic repair

Re-evaluation of malperfusion

Malperfusion treatment

>15 hours

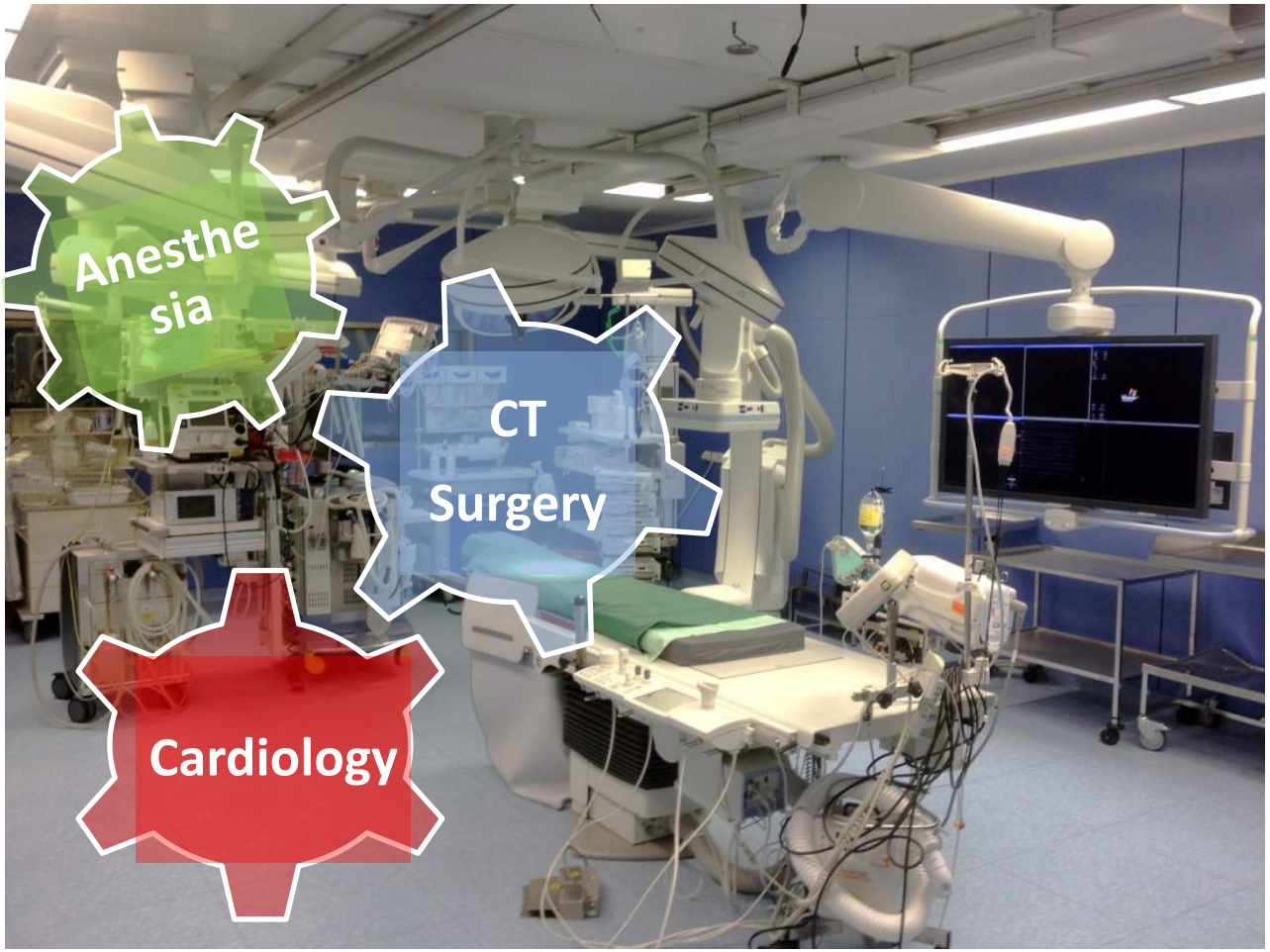
Classic approach (CT only) may

- result in delayed detection/treatment of visceral/peripheral malperfusion
- worsen ischemia severity and end-organ failure
- augment reperfusion injury (Delay+CPB+HCA)

Acute AD in Essen – Clinical Status at Presentation

%	Acute AD N =131
Penn A no circulatory collapse no malperfusion	33
Penn B malperfusion	40
Penn C circulatory collapse	9
Penn B+C circulatory collapse malperfusion	18

Hybrid Room Concept in Acute AD
Endovascular Diagnostics/Treatment + Ao. Surgery

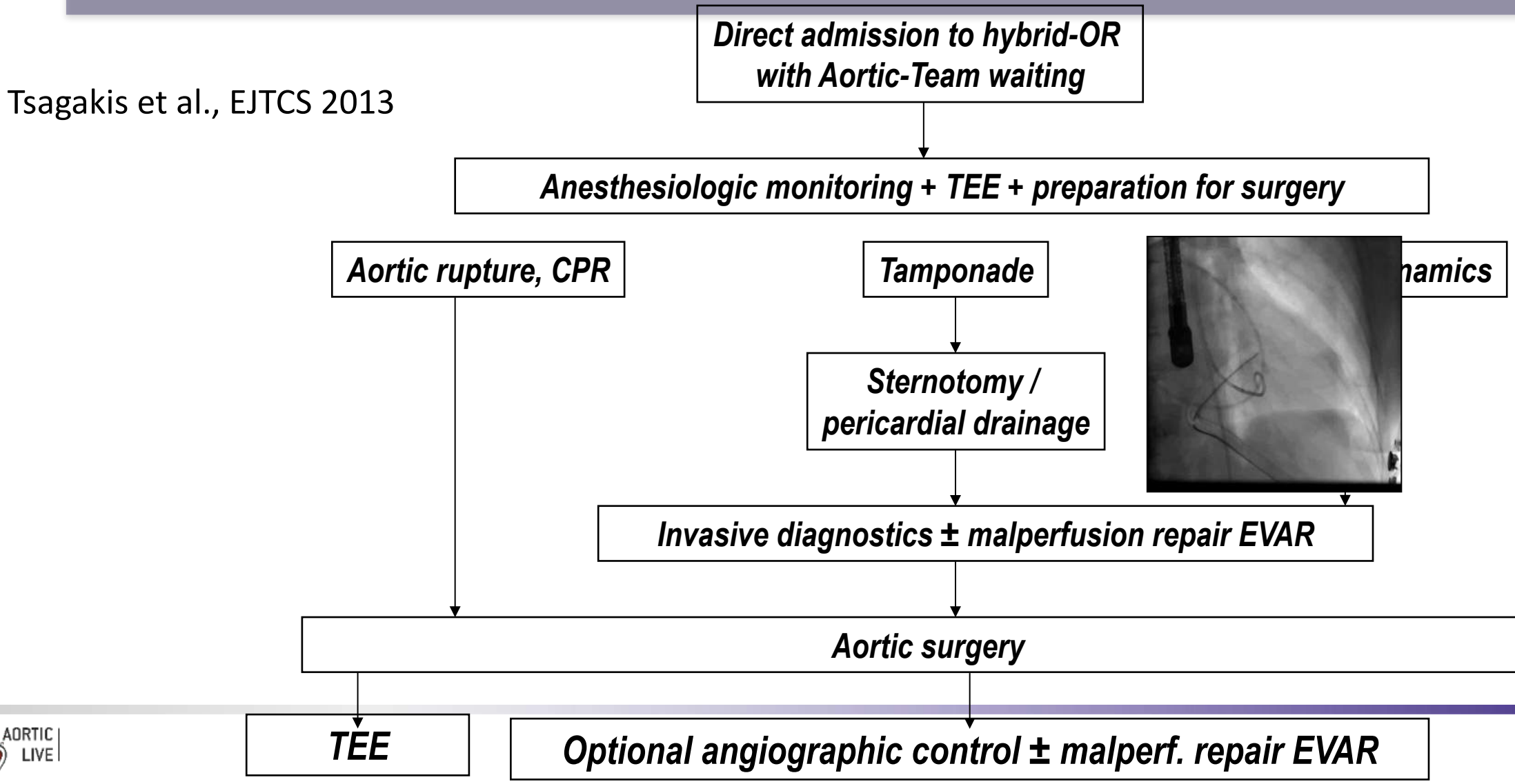


Equipment
RR Monitoring (3 peripheral arteries)
TEE
NIRS
Cell saver
Thromboelastometry
C-arm floor mounted
Angioscopy
Heart lung machine (2 arterial circuits)

Endo + Surg. on the same table – no patient transport

Essen Hybrid Concept Algorithm

Tsagakis et al., EJTCS 2013



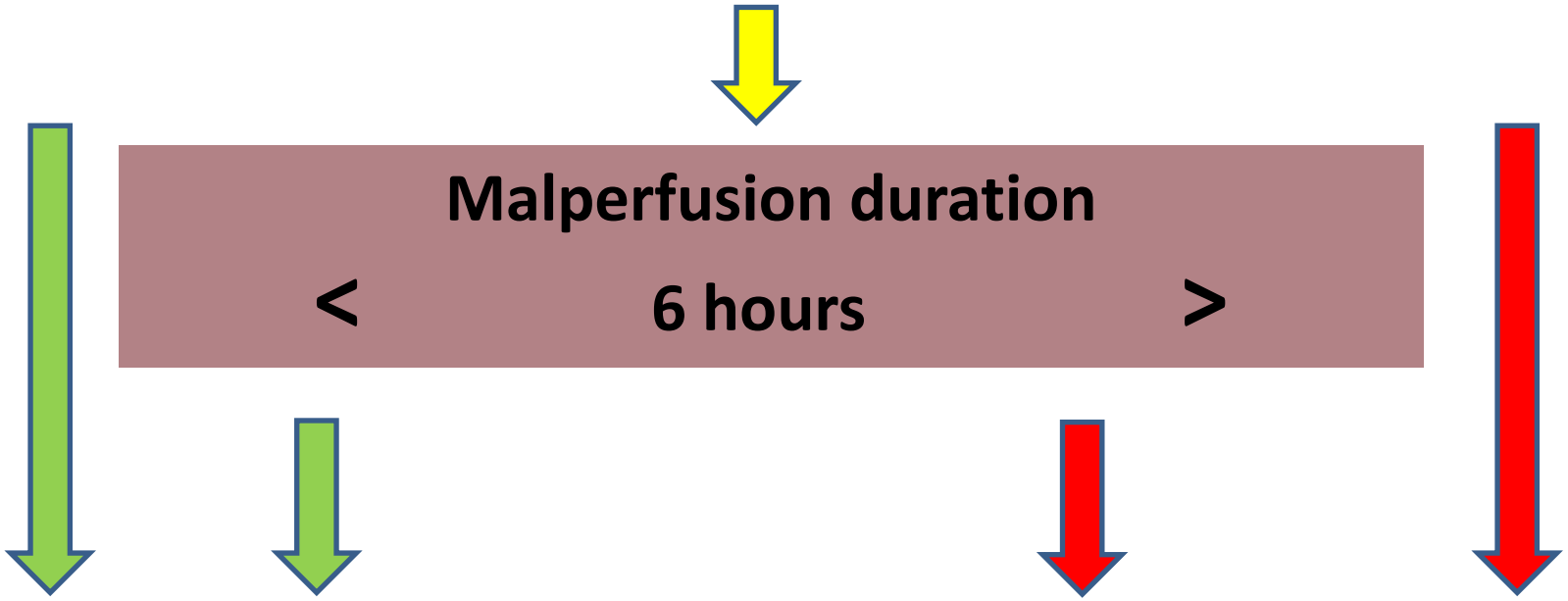
TL collapse ± visceral malperfusion symptoms

Decision Making

TL collapse
No symptoms

TL collapse
Dynamic malperfusion

TL collapse
Static malperfusion



Malperfusion duration

< 6 hours >

Proximal Surgery
± postop. angiography

1. EVAR to restore Perfusion
   ± ICU-Delay ± Laparotomy
2. Surgery

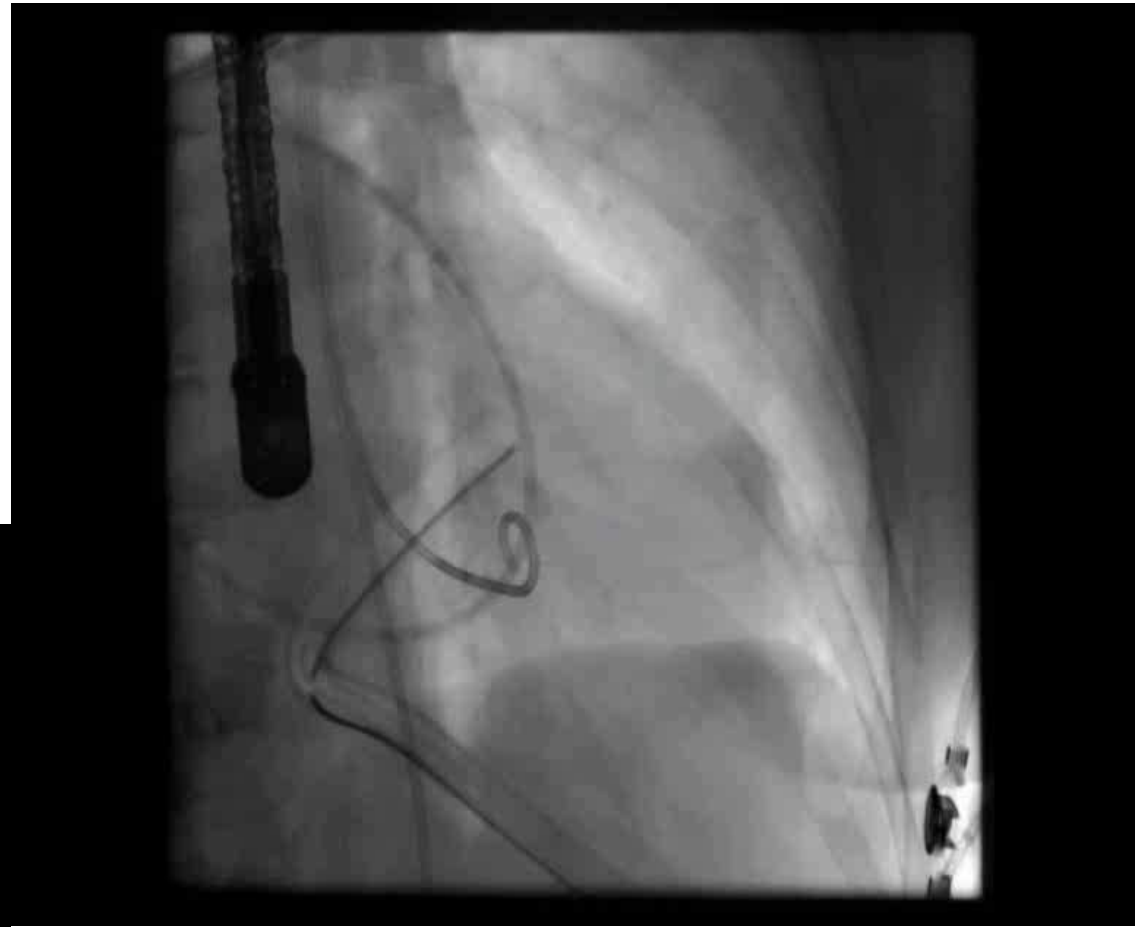
Case Example – Endovascular First

<u>Pericardial Drainage + EVAR prior to Surgery</u>

67yrs, female, Tamponade, TL collapse, Visceral + Peripheral Mal.

Strategy

1. Sternotomy for tamponade release
2. EVAR for restoration of the distal perfusion
3. Immediate surgery due to severe AV regurgitation
4. Bio-Conduit (bicuspid valve) and 2/3 arch replacement



5 years FU

Case Example - ICU-Controlled Delay

64 year old male, 24 h with abdominal pain, delayed CT

ICU Controlled Delay Concept

Arrival in Hybrid Room

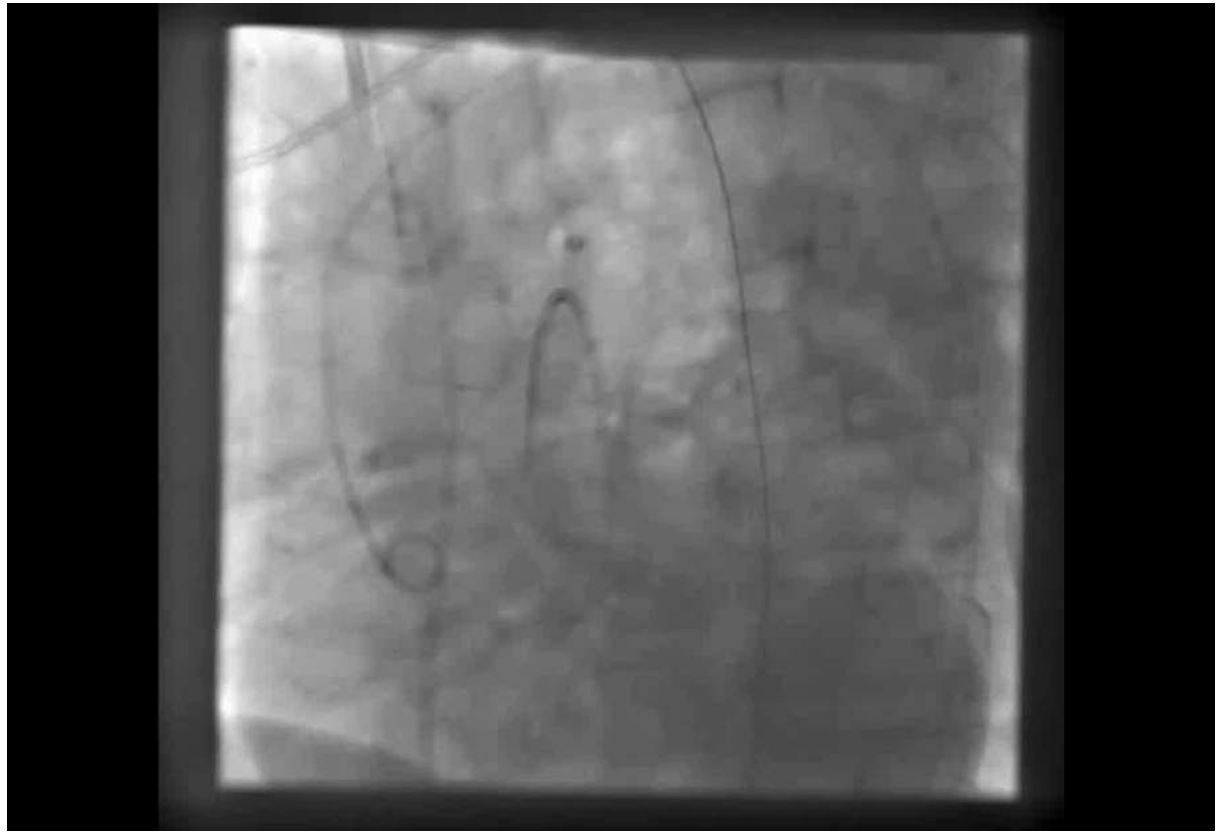
Intubated + sedated

TEE tube in place

3 sites RR-monitoring

RR<120mmHg

→ Angiography, EVAR with E-xL



Tsagakis et al, Thorac Cardiovasc Surg. 2008

Case Example - ICU-Controlled Delay

64 year old male, 24 h with abdominal pain, delayed CT

ICU Controlled Delay Concept

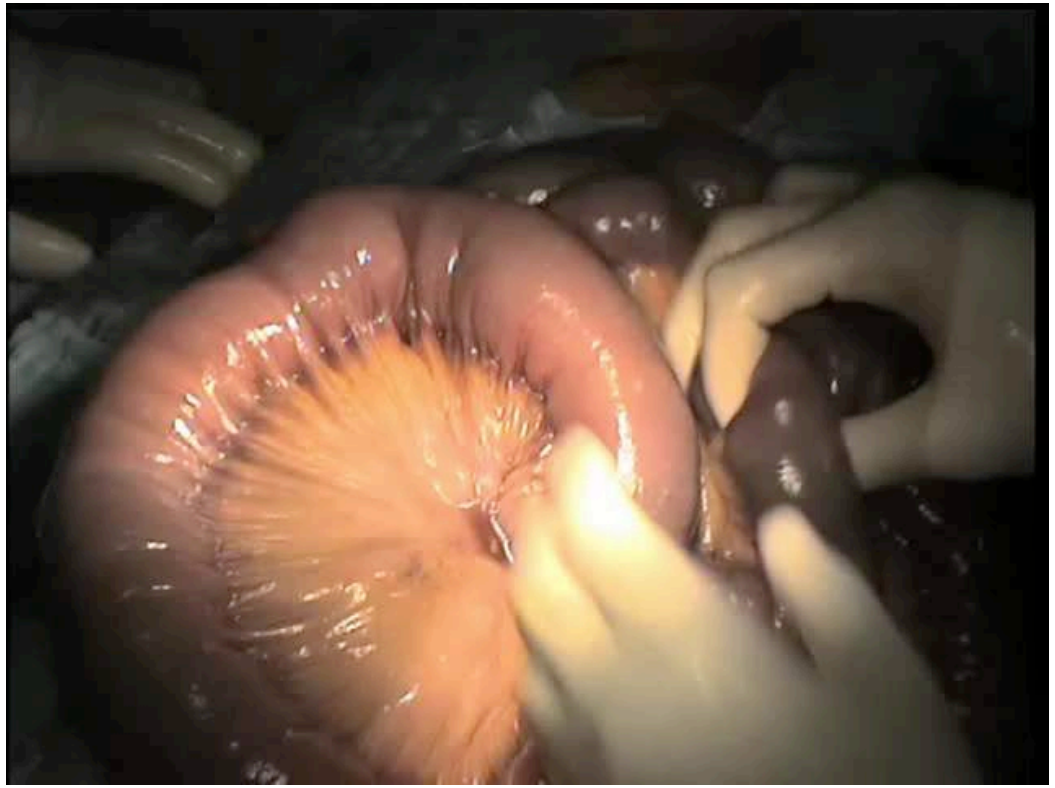
After restoration of mesenteric perfusion:

Transfer to ICU, stable

Intubated + sedated

TEE tube on place

After 24 h: Laparotomy, bowel resection



Tsagakis et al, Thorac Cardiovasc Surg. 2008

Case Example - ICU-Controlled Delay

64 year old male, 24 h with abdominal pain, delayed CT

Case Example - ICU-Controlled Delay

64 year old male, 24 h with abdominal pain, delayed CT

ICU Controlled Delay Concept

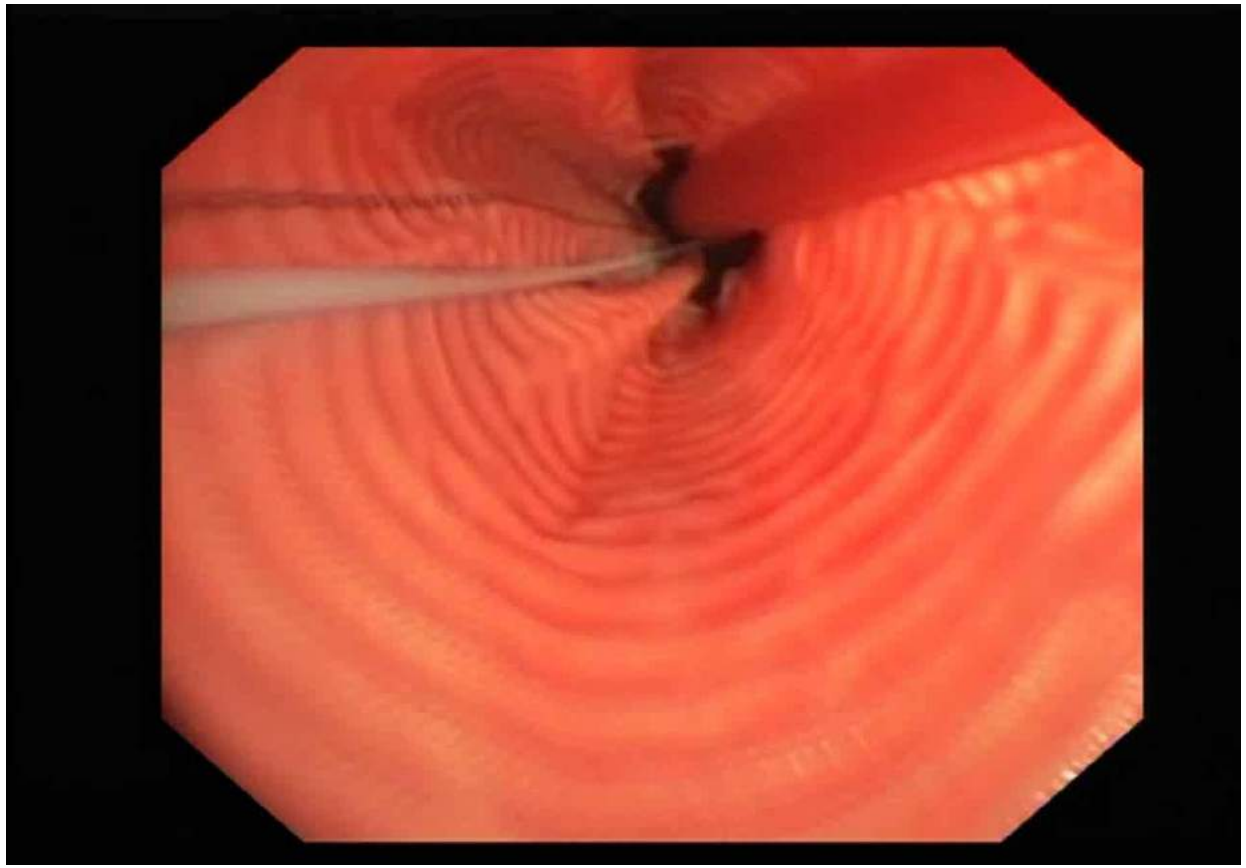
After bowel resection:

Transfer to ICU, stable

Intubated + sedated

TEE tube on place

After 48 h: Second look, additional bowel resection, immediately thereafter FET (hemodynamic instability)



Tsagakis et al, Thorac Cardiovasc Surg. 2008

Case Example - ICU-Controlled Delay

64 year old male, 24 h with abdominal pain, delayed CT

Result

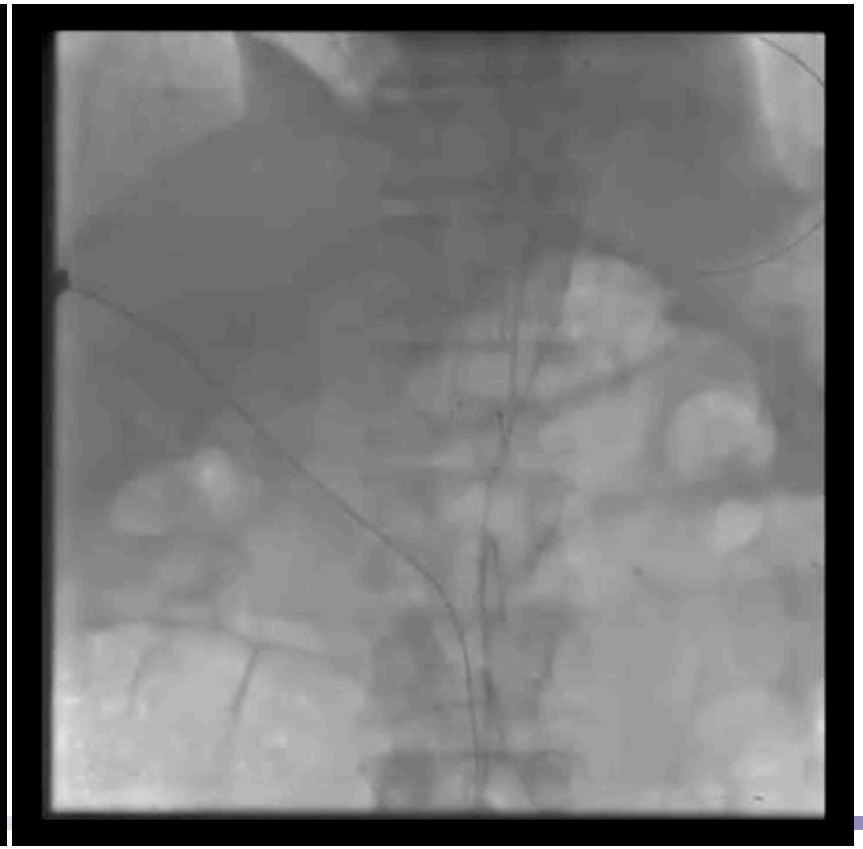
6 months postop

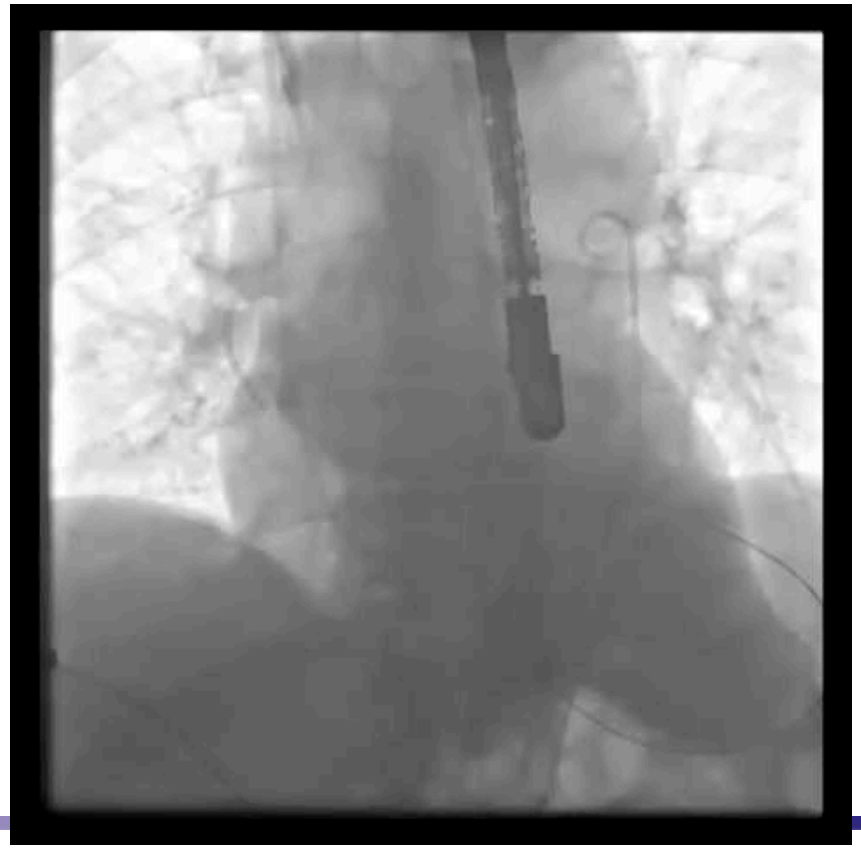
3 years FU

Persisting Visceral Malperfusion
Intraoperative Solution- Case Example

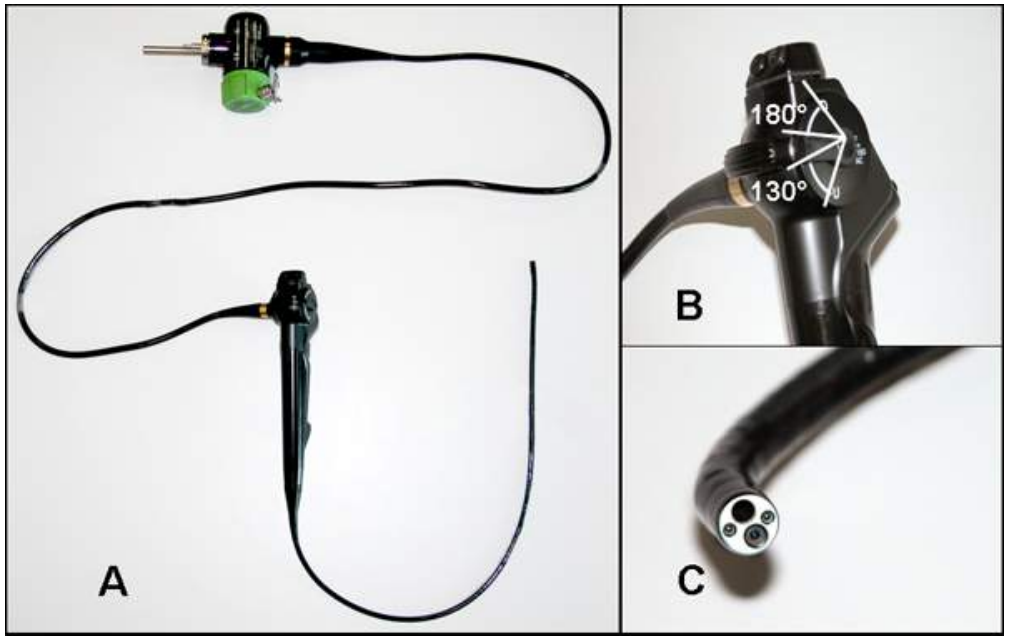
TL collapse - TC occlusion

Stent crossed Re-entry
Displacement into FL + SMA occlusion



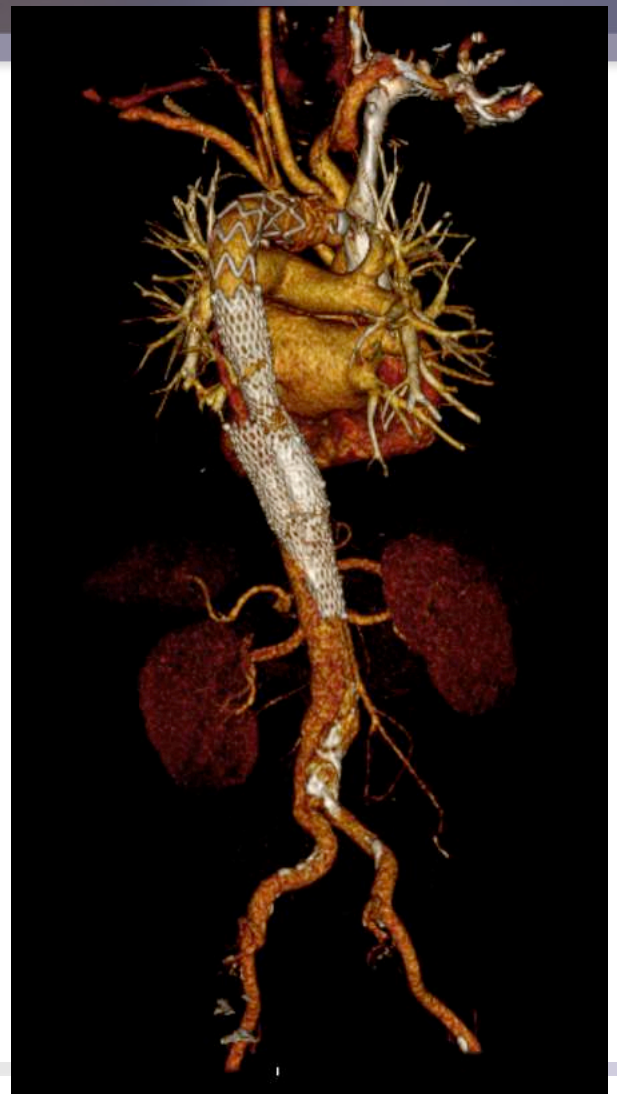


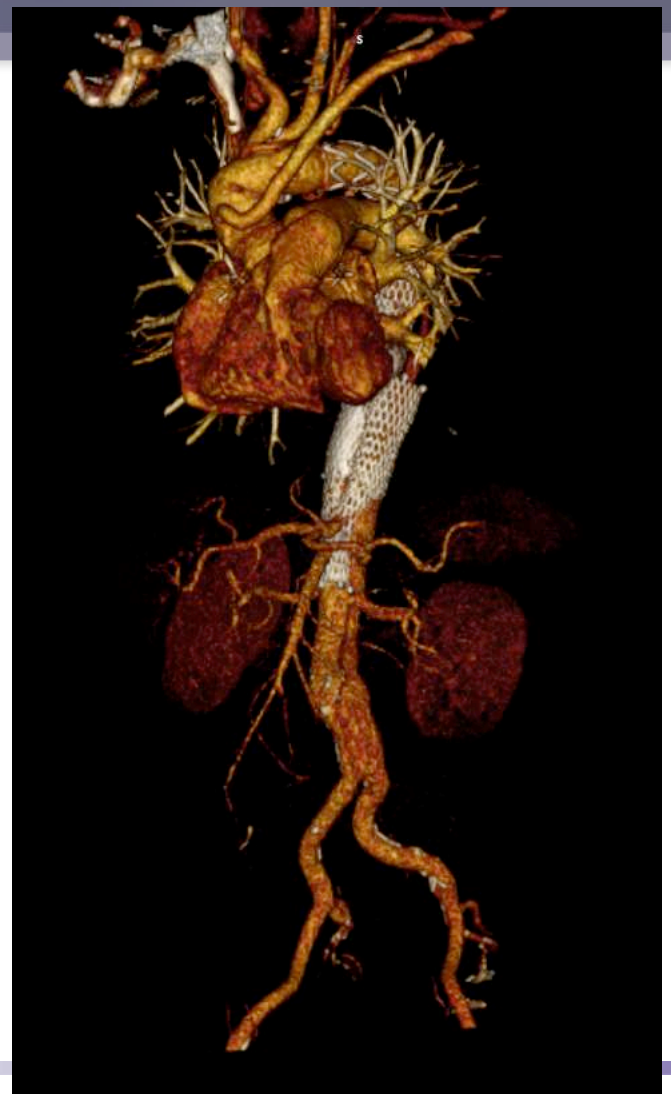
Persisting Visceral Malperfusion
Intraoperative Solution - Salvage by Angioscopy



Angioscope
Autoclavable videoscope

Antegrade stenting - Result





14 months FU

TL+FL stable

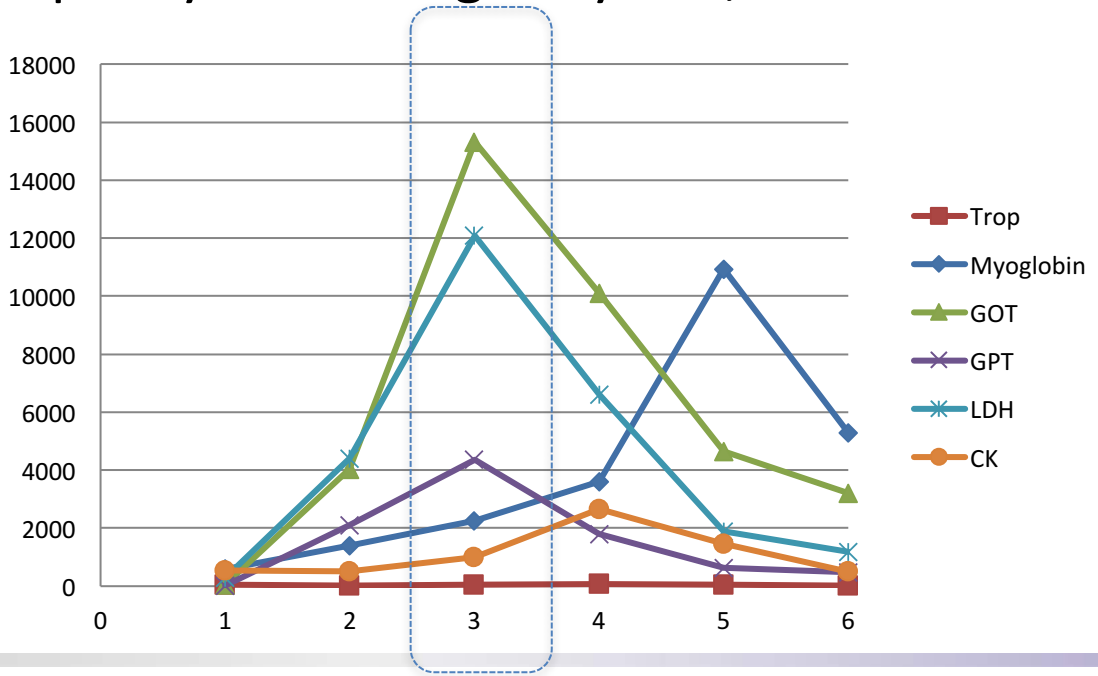
Postoperative Visceral Malperfusion

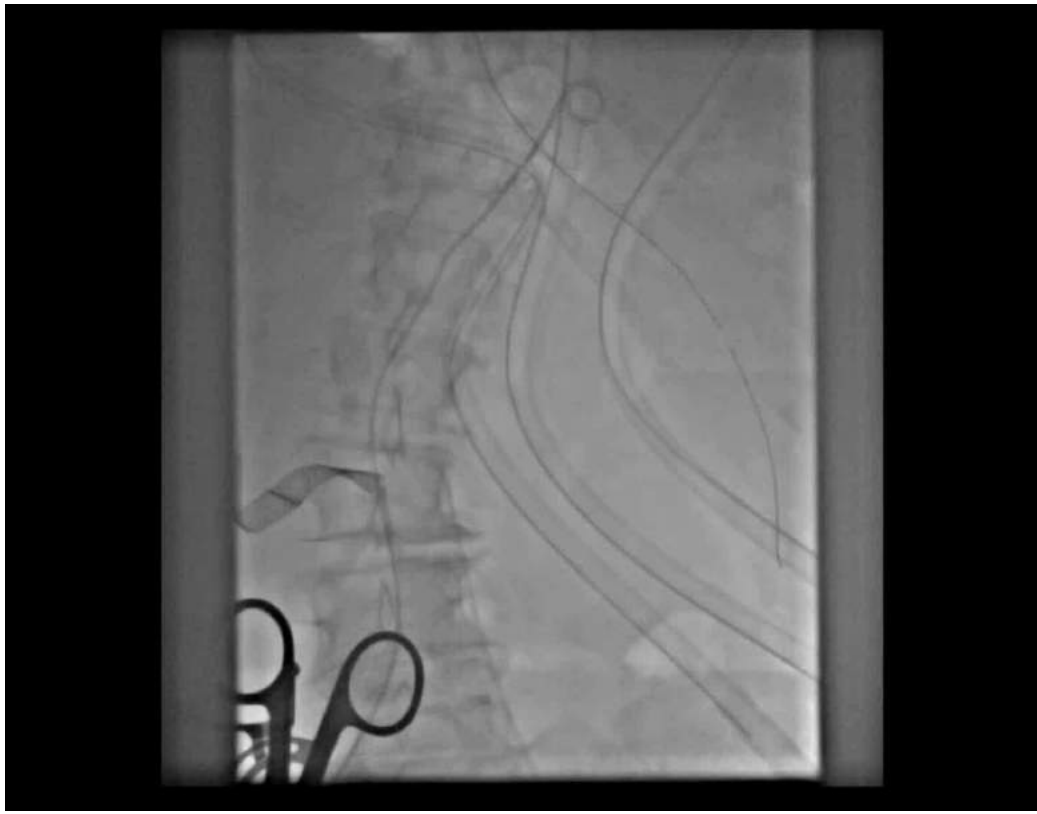
77yrs, female, Type I AAD - TL collapse thoracoabd. Level

Surg. FET + RCCA Revascularisation

1st postop. day . course uneventful

2nd postop. day increasing enzymes, distended abdomen





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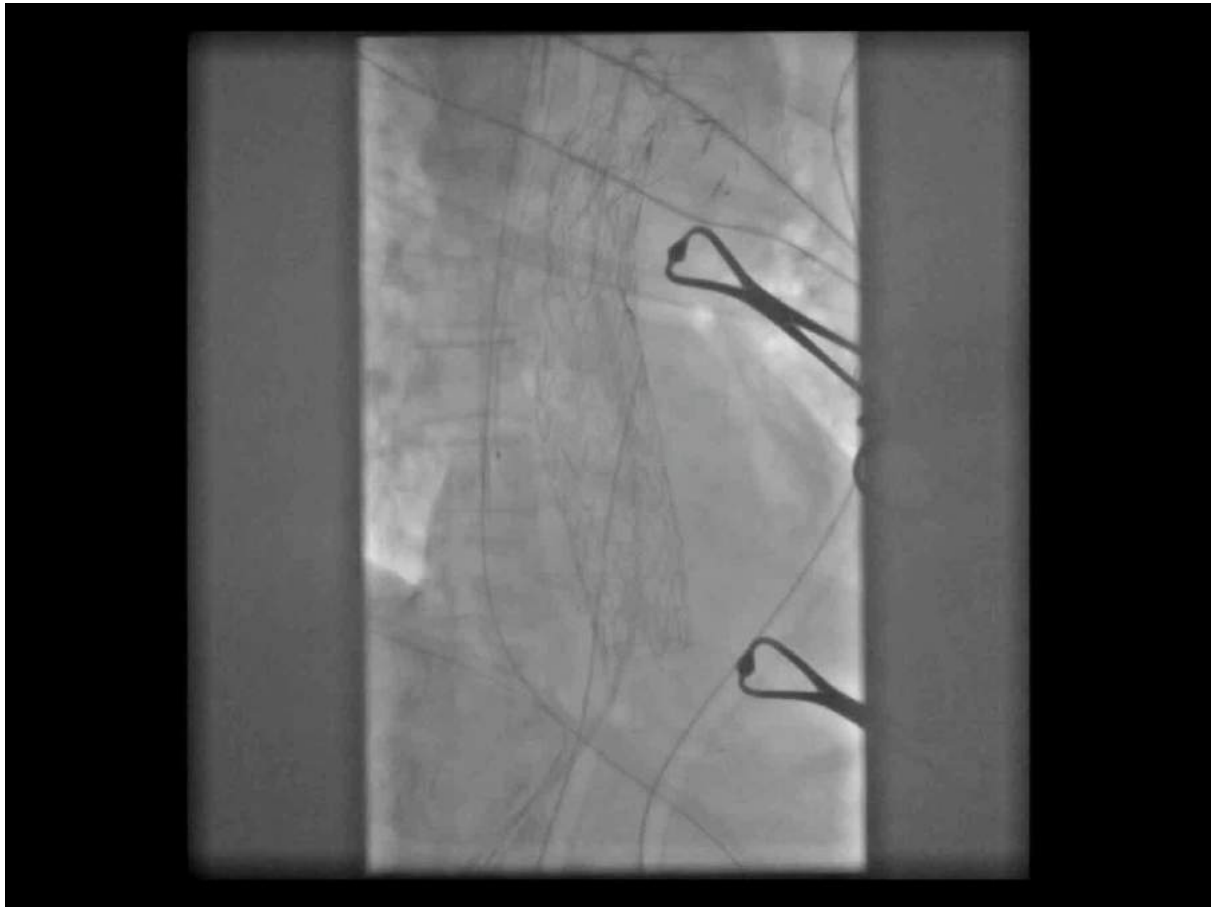
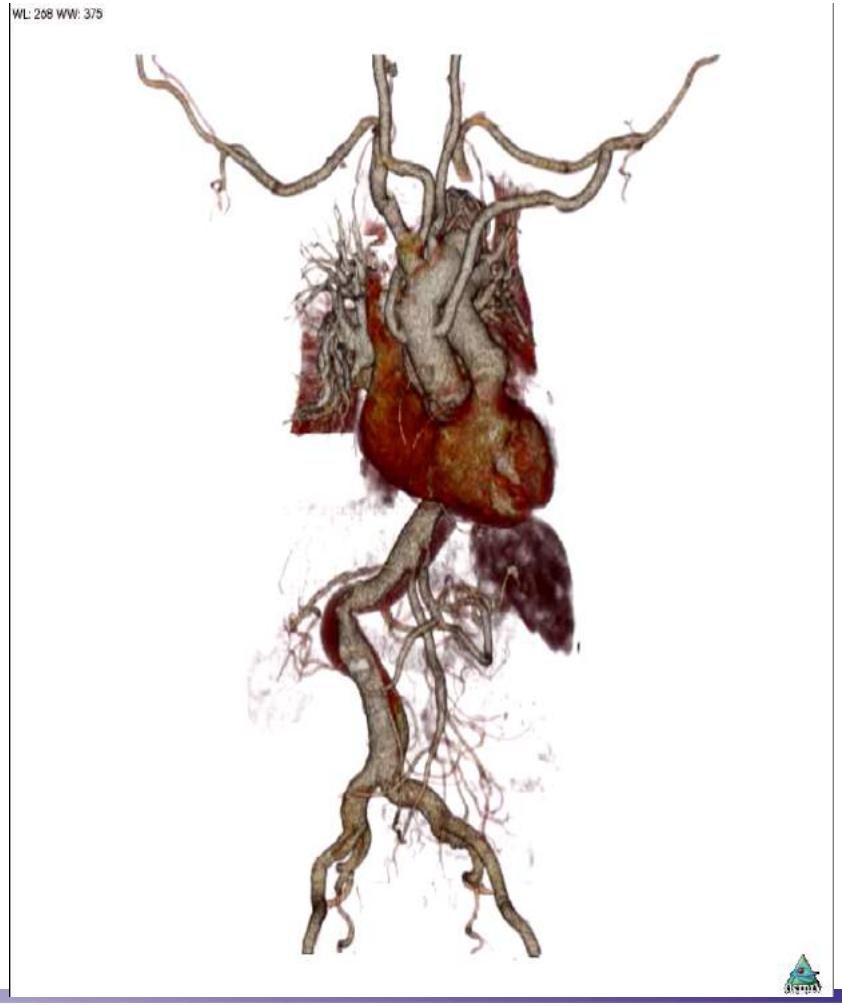




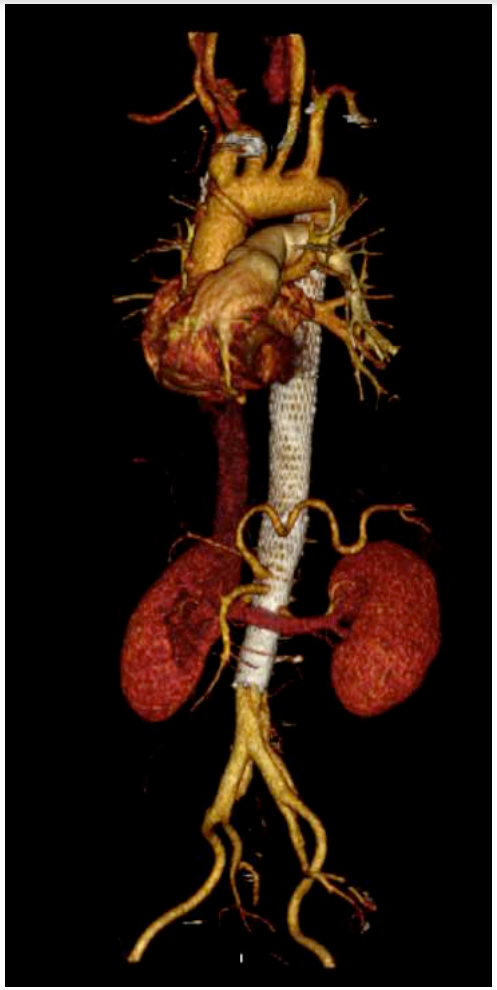
Longterm Follow up after 3 x E-xL for AAD with visceral malperfusion

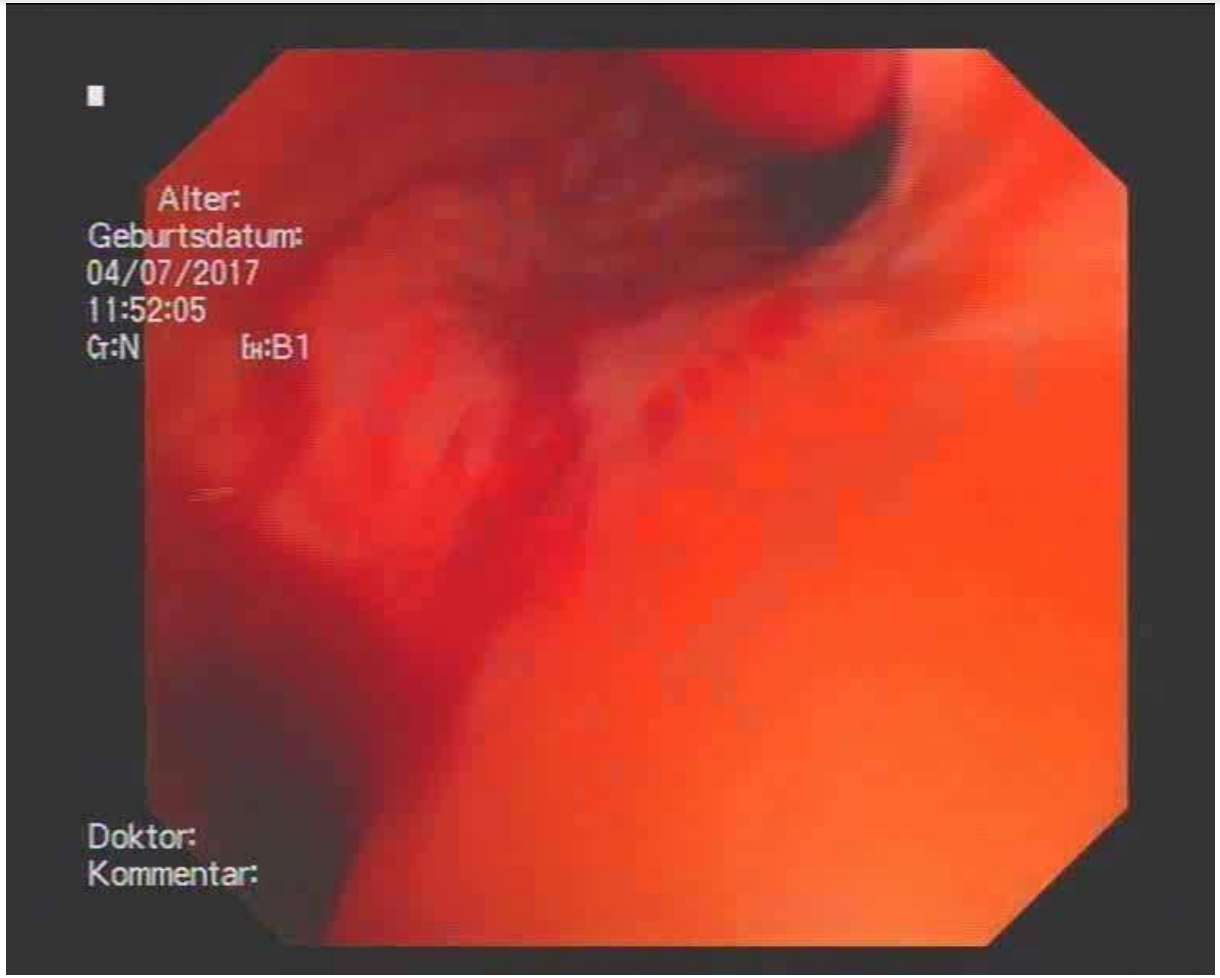
Indication for Re-do Surgery

Pseudoaneurysm Arch
6 years after prox. repair

-> prox. Arch replacement

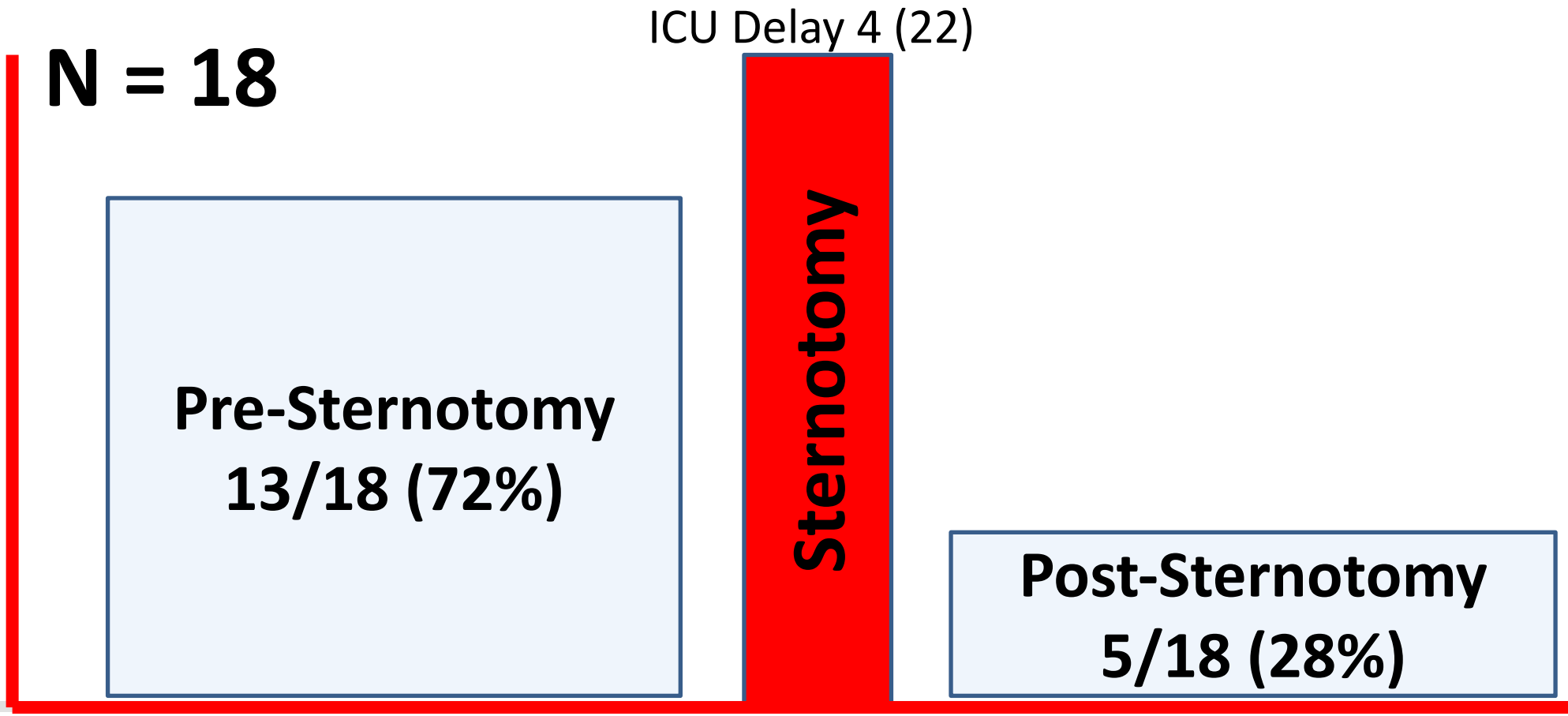
Angioscopy demonstrated endothelialization of the stents without involving artery orificies





TL-Stabilization by E-xL uncovered Stents to resolve Visceral/Peripheral Malperfusion

Midterm experience 2008-2017



TL-Stabilization by uncovered Stents to resolve Visceral/Peripheral Malperfusion

Midterm experience 2008-2017

Endovascular Treatment + Surgical Treatment

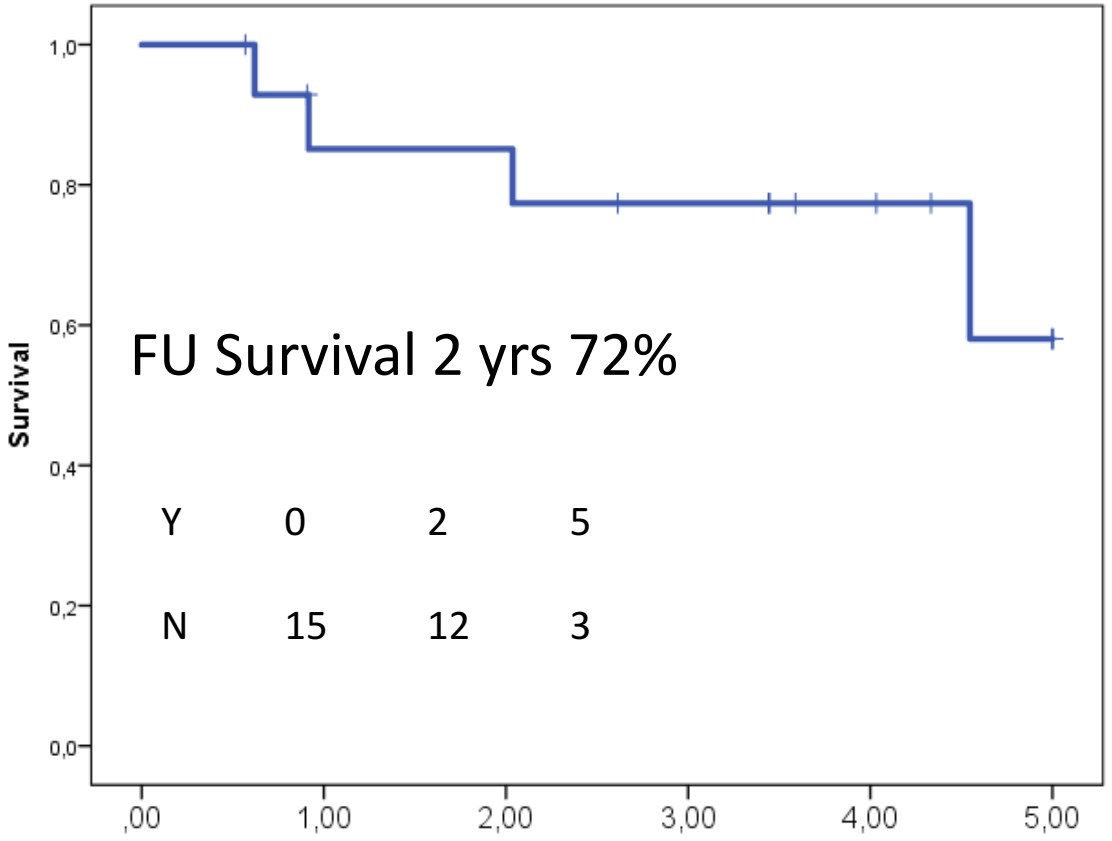
Number of uncovered stents	**35**
Stent coverage	
Thoracic aorta	5(28)
Thoracoabd.	14 (78)
Abdominal	15 (83)
Stent /Patient	1.9

Patients	**N = 18**
Ascending	3 (17)
Asc+Arch	3 (17)
Asc+FET	12 (67)
Total root	6 (33)
CABG	6 (33)

TL-Stabilization by uncovered Stents to resolve Visceral/Peripheral Malperfusion

Midterm experience 2008-2017

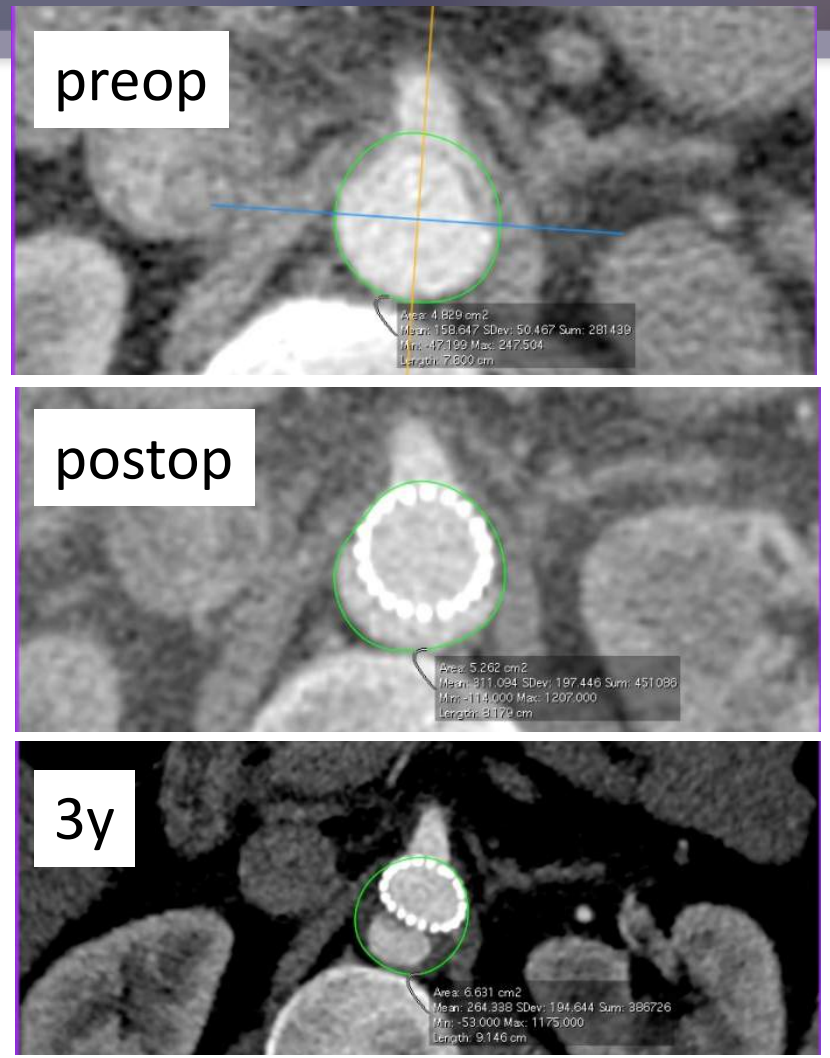
	N = 18
Mortality In-Hospital	3 (16.7)
Residual visceral ischemia	4 (22)
Residual peripheral ischemia	2 (11)
Follow-up	
Re surgery (prox. Aorta/Arch/AAA)	3
Re endo intervention	0



Fate of abdominal aorta after stenting

No occlusion of visceral arteries occurred

	Abdominal aorta (mean FU 3.2y)					
	Proximal			Distal		
	postop	FU	p	postop	FU	p
Diameter, cm	2.9±0.5	3.2±0.6	0.005	2.4±0.7	2.6±0.8	0.027
Ratio TL/AL, %	65±19	63±25	0.196	65±23	61±26	0.280



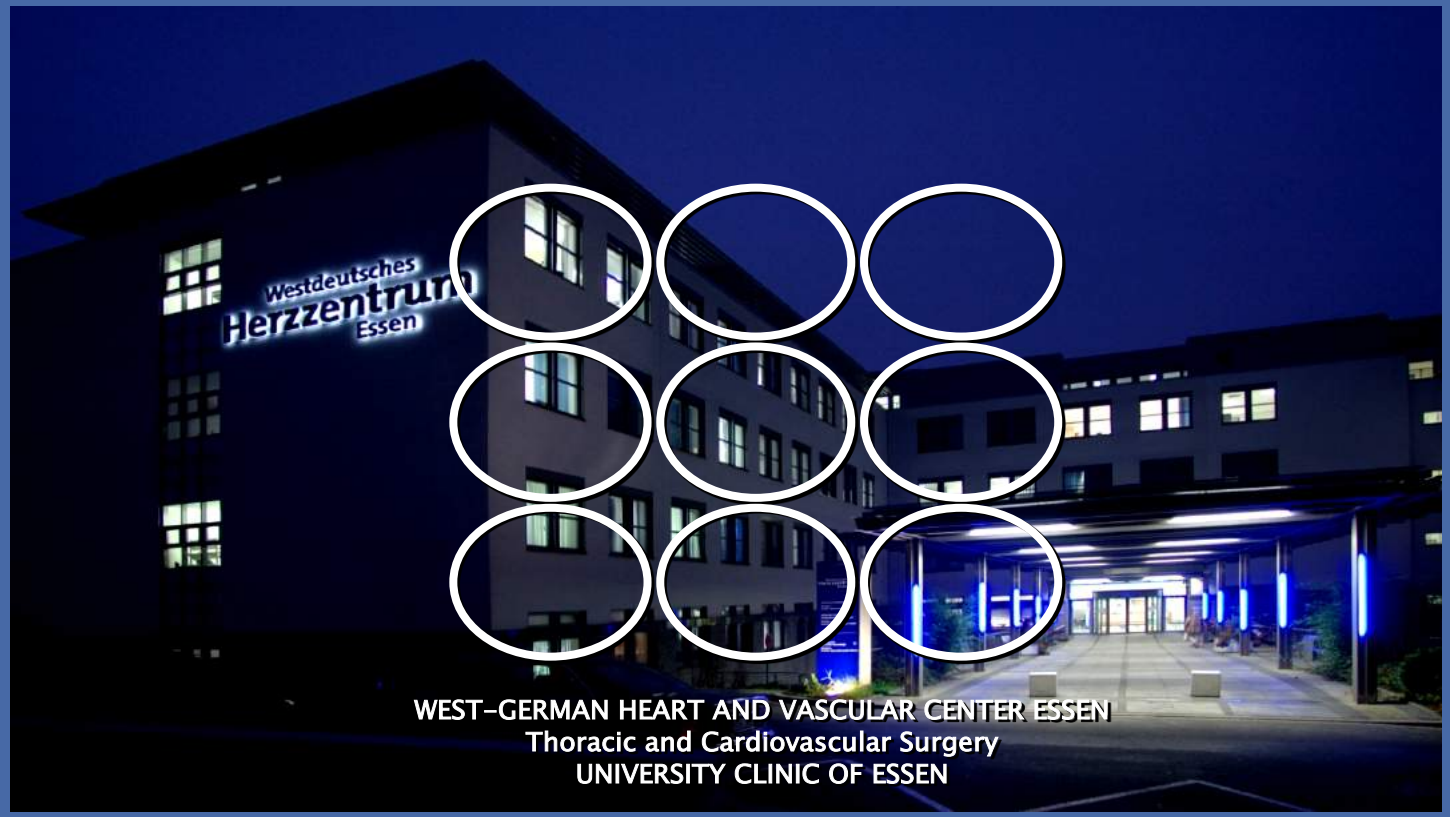
Conclusions I

- Angiography allows real time detection of malperfusion providing the option for a patient tailored treatment
- Endovascular treatment of severe visceral and/or peripheral malperfusion in acute type I AD is safe in a hybrid-OR setting
- After release of tamponade, it can be done safely in primary hemodynamically compromised patients

Conclusions II

- ICU-controlled treatment delay in case of prolonged visceral ischemia/necrosis is a prerequisite to overcome severe metabolic disorder and to increase the chance for survival
- Angioscopy supports decision making/control intraoperatively
- The E-xL uncovered stent allows tissue ingrowth (neo-endothelialization) without obstructing artery offsprings

west-german heart center essen



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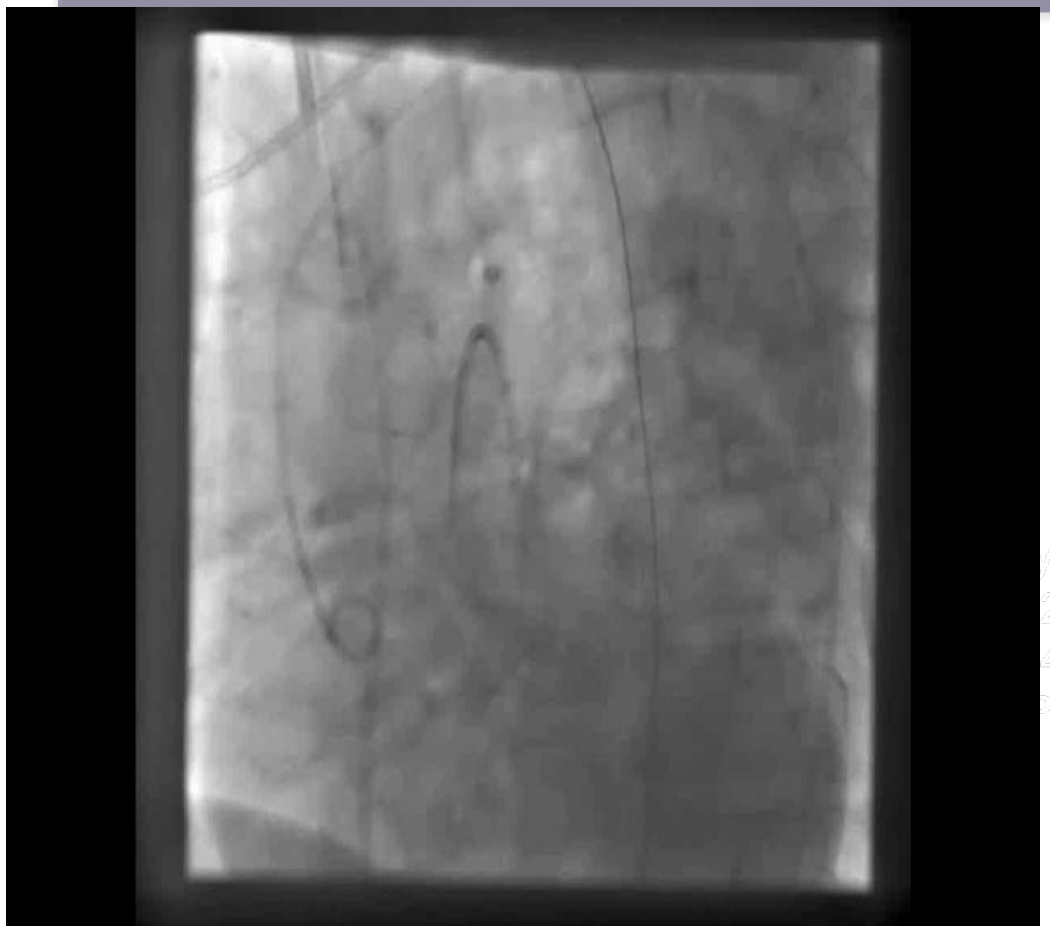
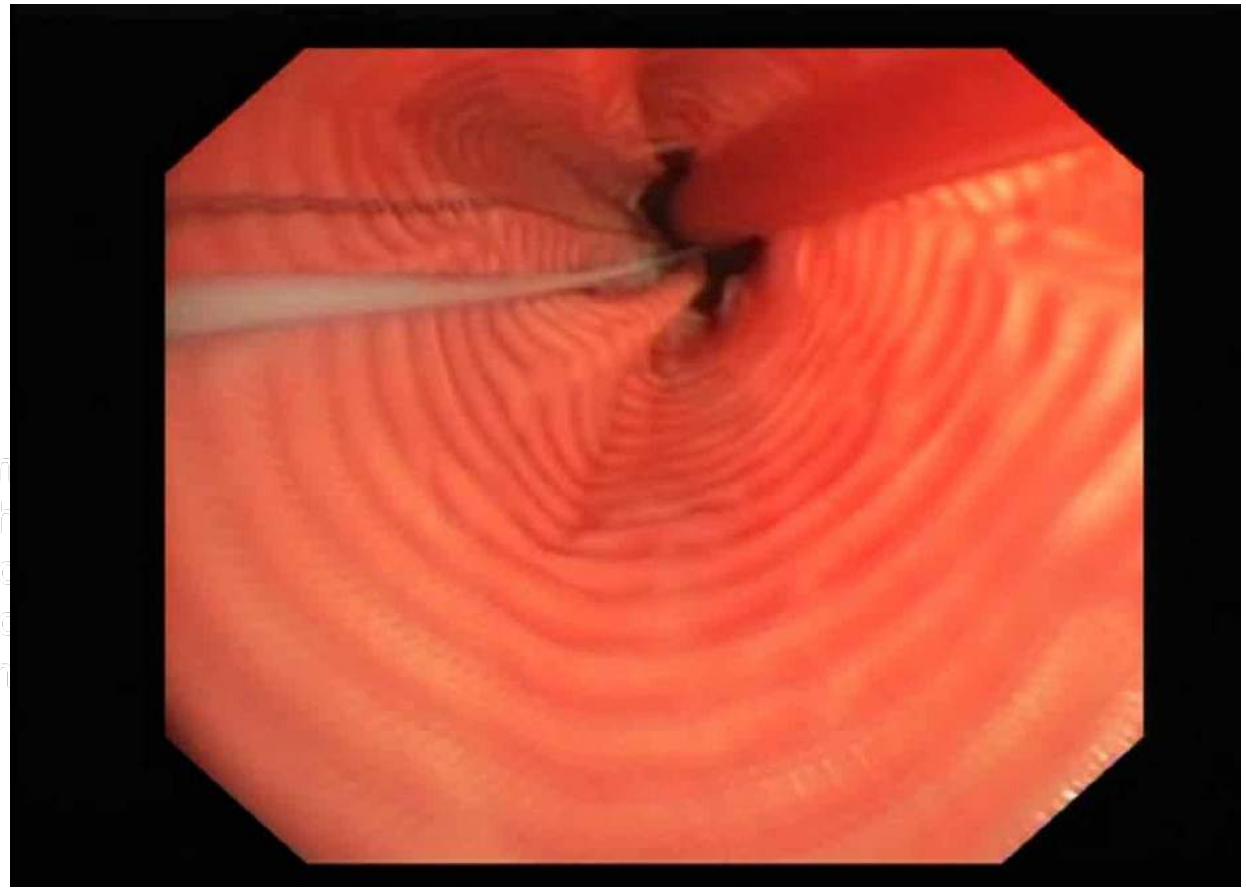
Hybrid Concept in AAD (Case 2) (64yrs, ♂)

Strategy

1. EVAR for restoration of mesenteric perfusion
2. *ICU controlled delay with TEE in place + surgical standby
3. 1. Laparotomy after 24 hours (partial bowel resection)
4. 2. Laparotomy after 48 hours (additional bowel resection)
5. and aortic surgery (Proximal repair + E-vita open)

*Tsagakis et al., Thorac Cardiovasc Surg. 2008





Optimed stent