

„Einmal alles neu? Oder nur das Wesentliche“

## Neue Aspekte in der Aorten Chirurgie

9. Patiententag Thorakale Aorten Chirurgie



Medizinische Hochschule  
Hannover

# Lebensader Aorta

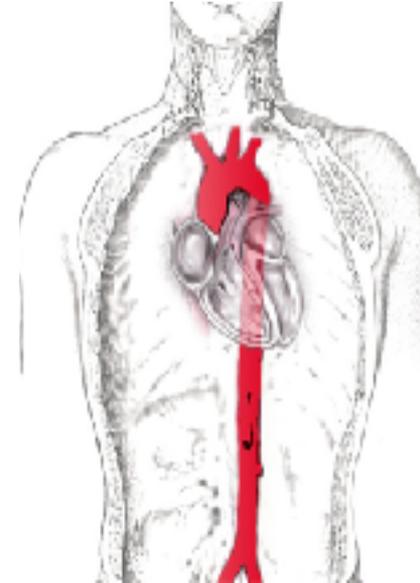
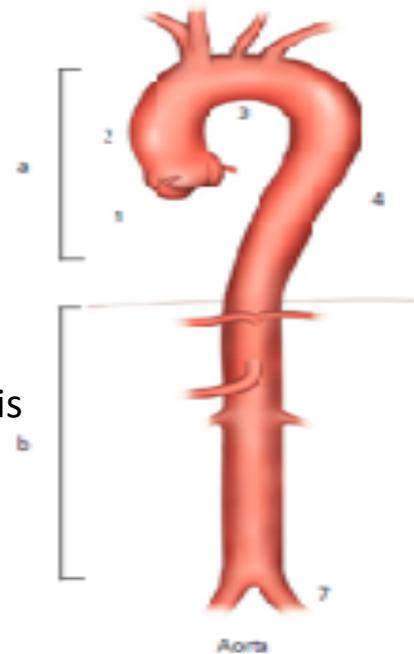
128-199n. Chr.



Galenus von Pergamon  
„4 Säfte Lehre“, „Gladiator-Arzt“

Aorta thoracalis

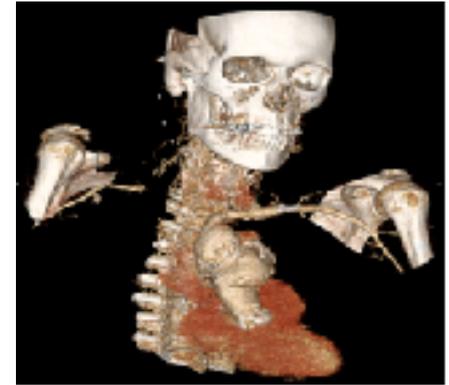
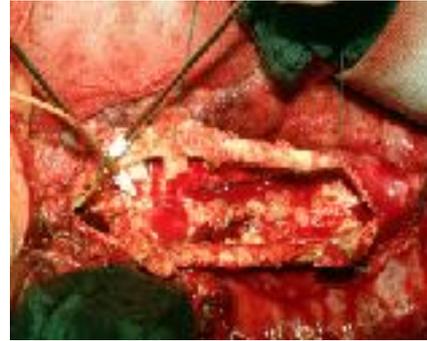
Aorta abdominalis



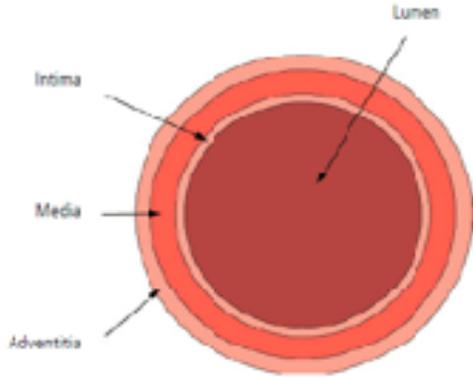
1: Aortenwurzel, 2: Aorta ascendens, 3: Aortenbogen, 4: Aorta descendens

# Genese der Aortenerkrankungen

- Atherosklerose
- Degeneration
- Bindegewebserkrankungen
- Trauma
- Aortitis



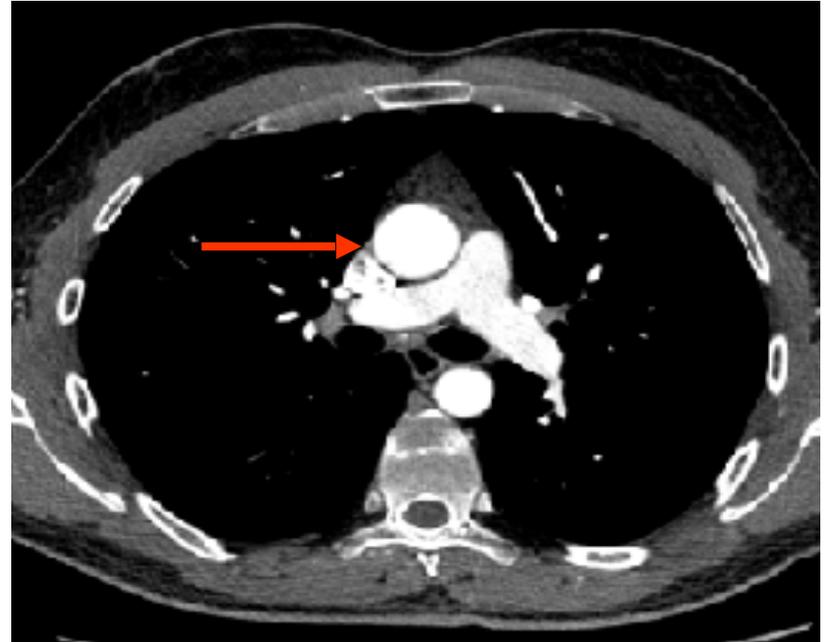
# Histologie der Aorta und Normgrößen



Normalwerte thorakale Aorta des Erwachsenen in der Computertomografie (CT) (in cm)

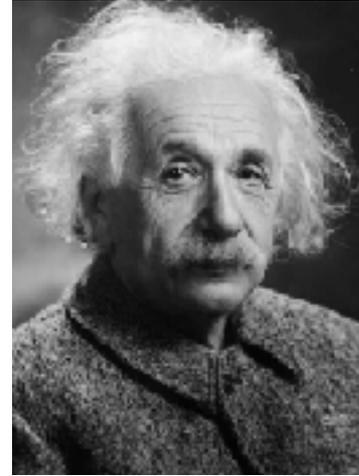
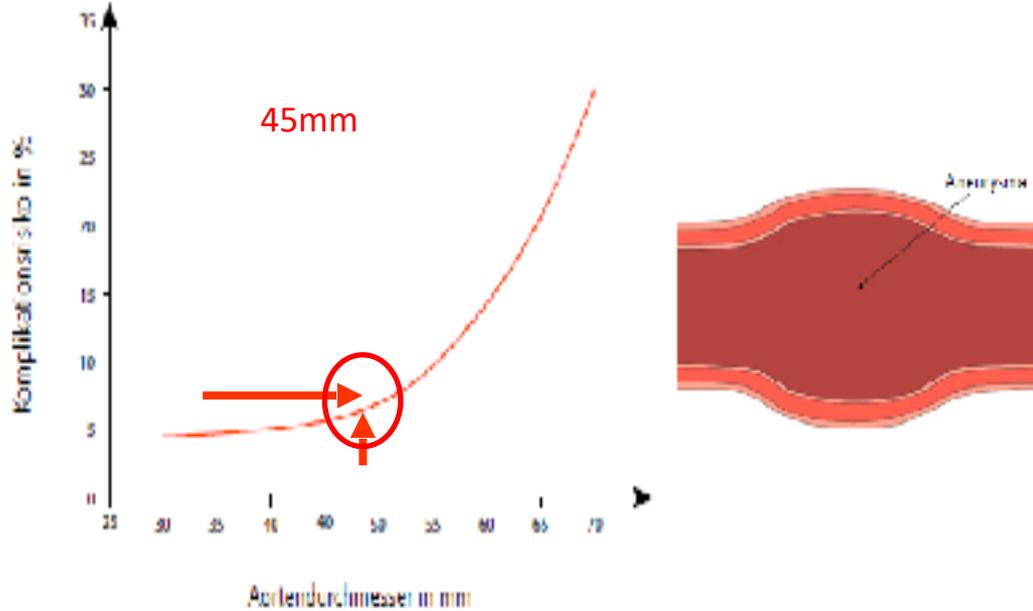
Lokalisation	Weiblich	Männlich
Aortenwurzel	3,5-3,7	3,6-3,9
Aorta ascendens	2,9	2,9
Aorta descendens	2,1-2,6	2,5-3,0
thorako-abdomineller Übergang	2,1	2,1-2,7

(nach Liefferades et al.)



CTA: Normalbefund

# Aortenaneurysmen – „Silent Killer“



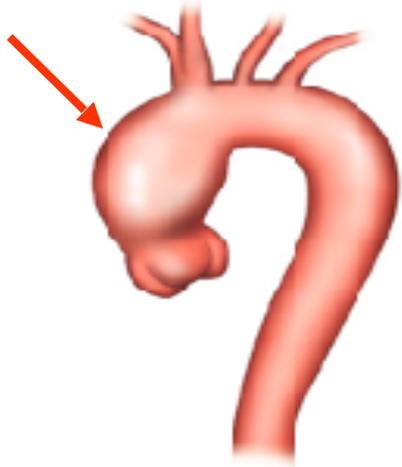
Albert Einstein



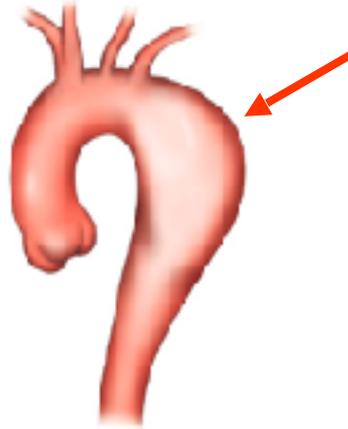
Mick Jagger

Komplikationswahrscheinlichkeit (Dissektion, Ruptur, Tod) in Abhängigkeit vom Aortendurchmesser  
Ab 50 mm Sterblichkeitsrisiko größer als Operationsrisiko

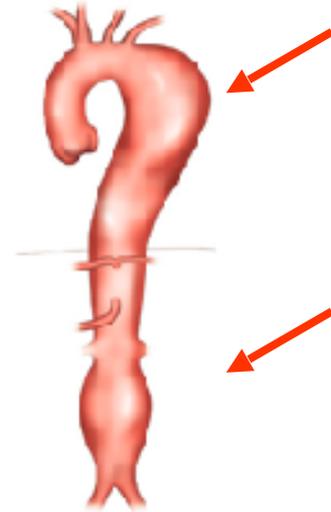
# Anatomische Varianten von Aortenaneurysmen



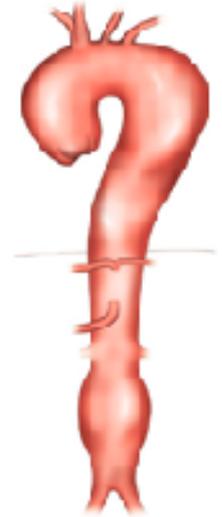
Ascendens-Aneurysma



Descendens-Aneurysma

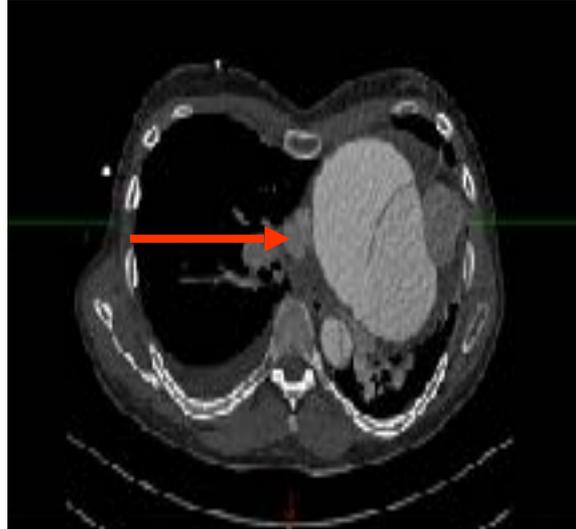


Thorakoabdominelles  
Aortenaneurysma (TAAA)



Megaaortensyndrom

# Aortenaneurysmen – „Silent Killer“

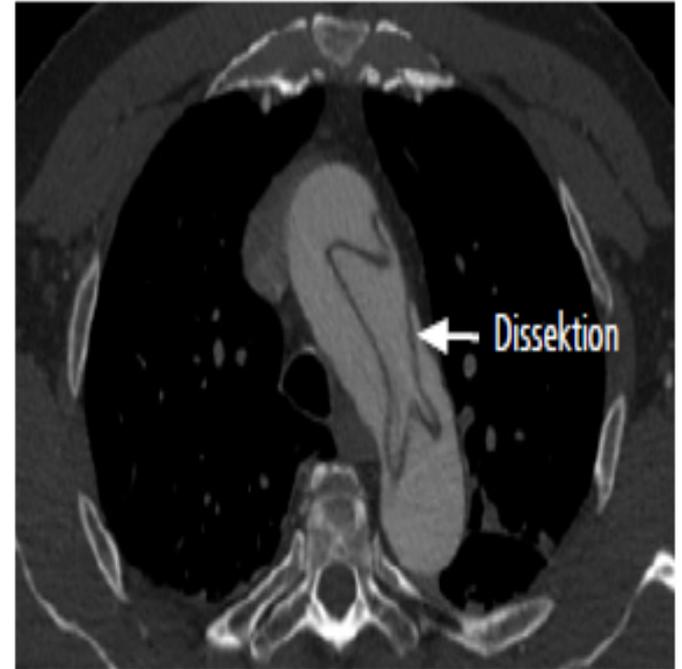
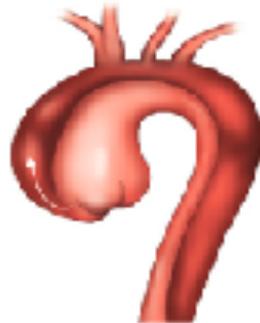
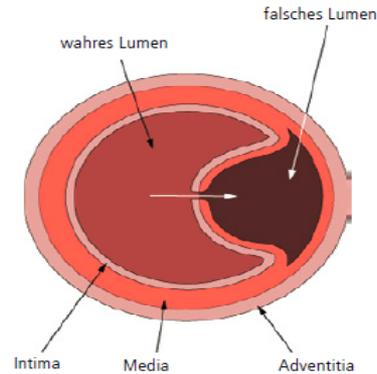


CT – Untersuchung mit Kontrastmittel bei thorakaler Schmerzsymptomatik seit einigen Monaten  
Aortenaneurysma 82mm mit akuter Typ A Dissektion

# Aortendisektion



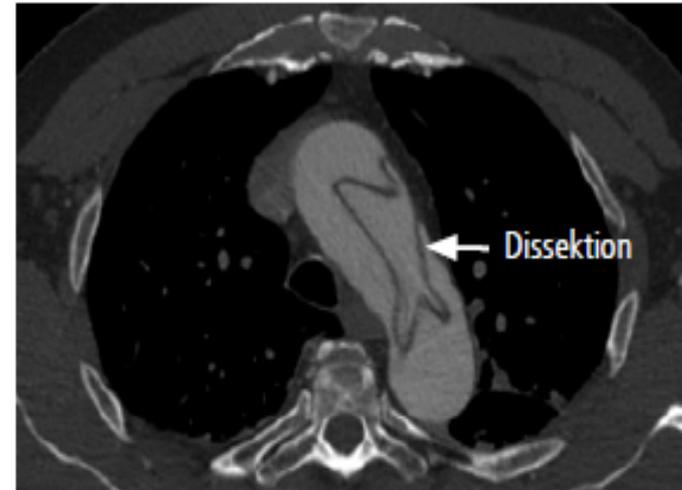
König George II Augustus 1683-1760  
(geb. Hannover/Herrenhausen)



# Aortendissektion

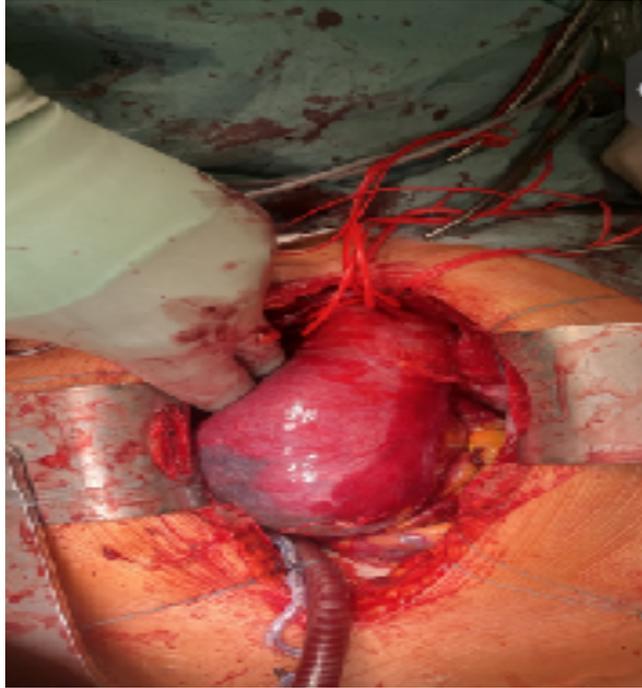
**Etiology of out-of-hospital cardiac arrest diagnosed via detailed examinations including perimortem computed tomography**

Yoshihiro Moriawaki<sup>1</sup>, Yoshio Tsubota, Takayuki Kurogaki, Noriyuki Suzuki

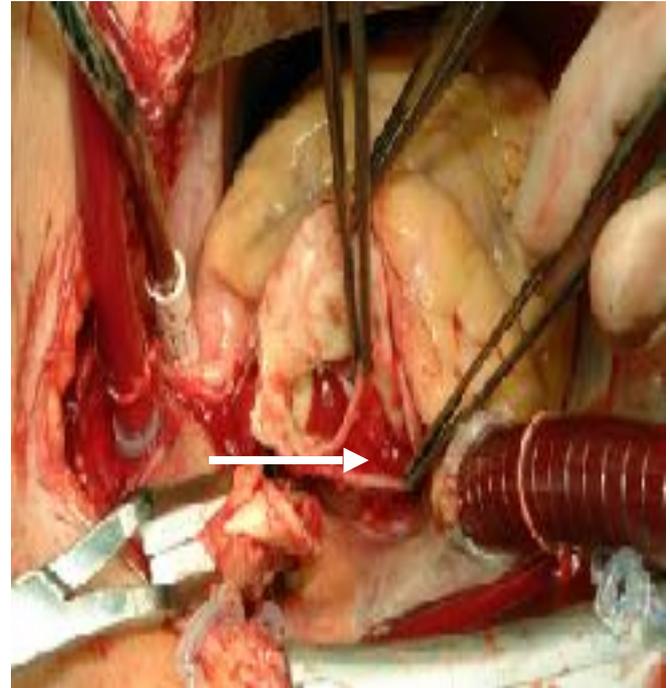


**Aortendissektion mit 8% Hauptursache für außerklinische Reanimation**

# Aortendisektion



Aortenwurzeleinriss mit Aneurysma



Dissektionsmembran in der Wurzel

# Chirurgische Ergebnisse

“Fastest knife in the West End”  
“Schnellstes Messer in London”

23 Sekunden für eine Beinamputation



Robert Liston 1794-1847



300% Sterblichkeit

Der Patient (1) und der Assistent (2) starben an Infektionen. Ein Zuschauer (3) an einem Herzinfarkt.

# Geschichte der Aortenchirurgie

## SURGICAL CONSIDERATIONS OF INTRATHORACIC ANEURYSMS OF THE AORTA AND GREAT VESSELS\*

DIXON A. COOLEY, M.D., AND MICHAEL E. DE BAKRY, M.D.

HOUSTON, TEXAS

FROM THE DEPARTMENT OF ANGERY, BAYLOR UNIVERSITY COLLEGE OF MEDICINE, AND THE VAULTS OF THE UNIVERSITY OF TEXAS MEDICAL BRANCH AT EL PASO, TEXAS, AND THE DEPARTMENT OF SURGERY, THE UNIVERSITY OF CHICAGO, CHICAGO, ILLINOIS

TABLE I

Case No.	Sex, Age, and Date Operated	Aneurysm Site	Operative Procedure	Result and Remarks
1. R.M.	C.M. 45 12/12/49	Distal thoracic	Proximal ligation with oblique plane visored ligature (ribbe catheter)	Apparently well for 2 months and then developed fatal hemorrhage
2. R.R.	W.M. 38 4/18/49	Distal thoracic	Proximal and distal ligation with cord sutures	Fatal
3. J.M.	C.M. 41 1/1/50	Ascending and adjacent aorta	Ligation of subclavian and carotid, aneurysmectomy, and arterioplasty	Cured
4. W.H.	M.M. 41 4/11	Ascending and transverse arch	Aneurysmectomy and arterioplasty	Died 24 hours after operation, diffuse cerebral damage, secondary complications
5. L.H.	C.M. 41 9/6/51	Terminal thoracic aorta	Aneurysmectomy and celophane wrapping, subsequent shunt	Died 18 days after operation, secondary hemorrhage
6. W.E.	W.M. 51 7/11	Transverse arch and descending	Celophane wrapping	Improved

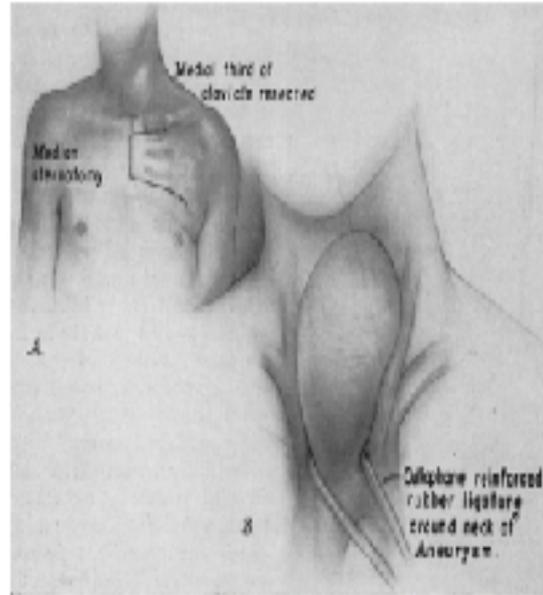
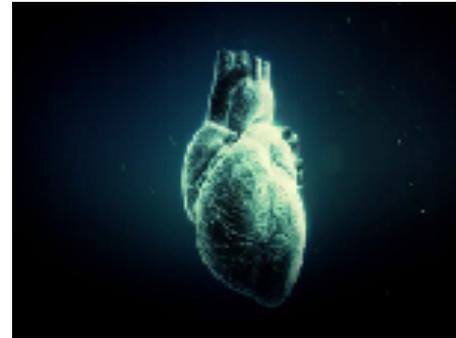


FIG. 2.—Drawing of operative procedure and findings in Case 1, showing approach in A and the aortic aneurysm in B, along with the aortic sac and both of the transverse arch and between the innominate and subclavian arteries, with placement of celophane reinforced ligature around its neck.

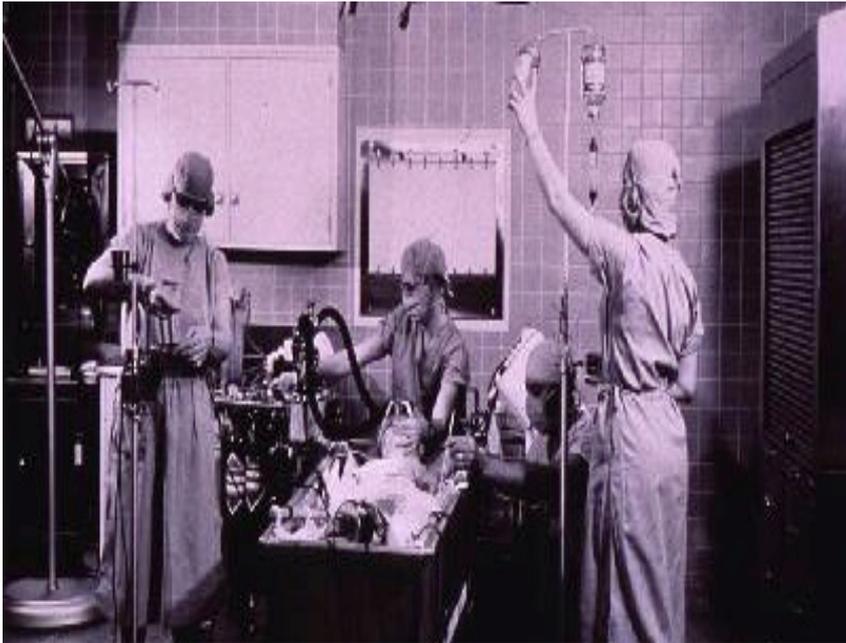


# Achillesferse der Aortenchirurgie



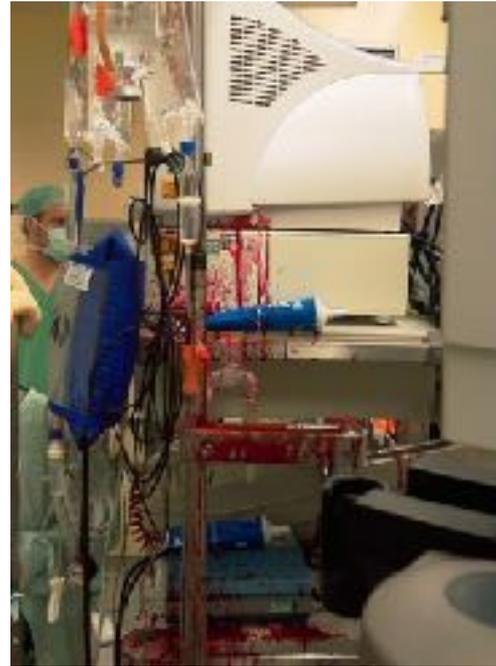
# Achillesverse der Aortenchirurgie

Hypothermie-Abkühlen des Patienten auf 19-28 Grad zur Organprotektion



# Achillesverse der Aortenchirurgie

Hypothermie-Abkühlen des Patienten auf 19-28 Grad zur Organprotektion



# Geschichte der Aorten Chirurgie

## SURGICAL CONSIDERATIONS OF INTRATHORACIC ANEURYSMS OF THE AORTA AND GREAT VESSELS\*

DIXON A. COOLEY, M.D., AND MICHAEL E. DE BAKRY, M.D.

HOUSTON, TEXAS

FROM THE DEPARTMENT OF ANGERY, BAYLOR UNIVERSITY COLLEGE OF MEDICINE, AND THE SURGICAL SERVICES OF THE LEFFERSIDE SAND HASTING AND THE VETERANS ADMINISTRATION HOSPITAL, HOUSTON

TABLE I

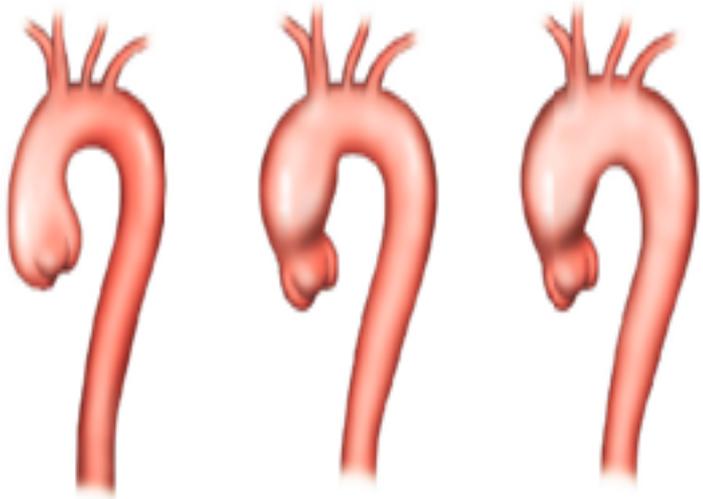
Case No.	Sex, and Age	Date Operated	Status	Aneurysm Location	Surgical Procedure	Result and Remarks
1. R.S.	C.M. 45	12/21/49	Bybilitic	Transverse arch	Proximal aortic resection, the place vessel ligation	Survived well for 2 months and then developed fatal hemorrhage
2. R.S.	W.M. 35	4/18/48	Spontaneous	Et aortic	Proximal aortic resection, Et aortic aneurysmectomy	Fatal
3. J.M.	C.M. 45	1/12/51	Bybilitic	Ascending aorta	Resection of aneurysm and aneurysmectomy, and aortic arch	Fatal
4. P.E.	W.M. 35	10/4/51	Spontaneous	Ascending aorta and transverse arch	Aneurysmectomy and aortic arch	Died 56 hours after operation, diffuse cerebral damage, secondary complications
5. L.H.	C.M. 35	1/1/51	Bybilitic	Terminal thoracic aorta	Aneurysmectomy and celophane wrapping, subsequent aortic	Died 18 days after operation, secondary hemorrhage
6. W.E.	W.M. 35	1/1/51	Bybilitic and aortic aneurysm	Transverse arch	Celophane wrapping	Improved



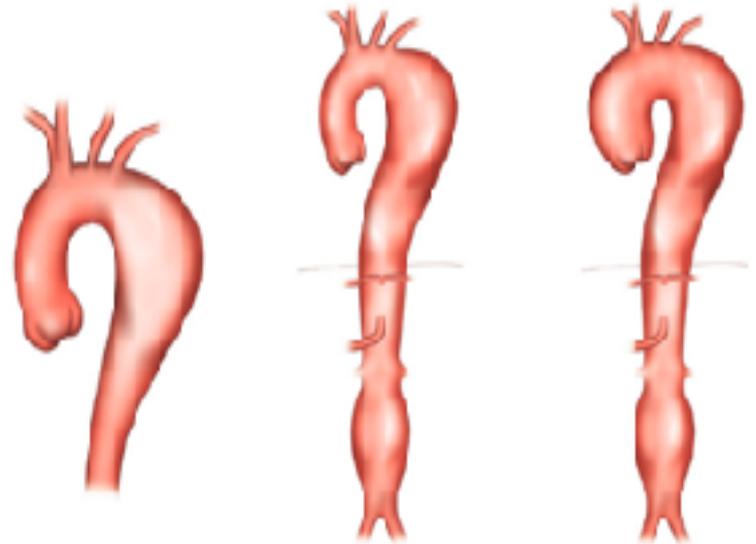
50% Sterblichkeit

12% Sterblichkeit

# Chirurgische Therapie in Abhängigkeit der Lokalisation



Aorta ascendens / Aortenbogen



Aorta descendens / thorakoabdominelle Aorta

# Geschichte der Aorten Chirurgie

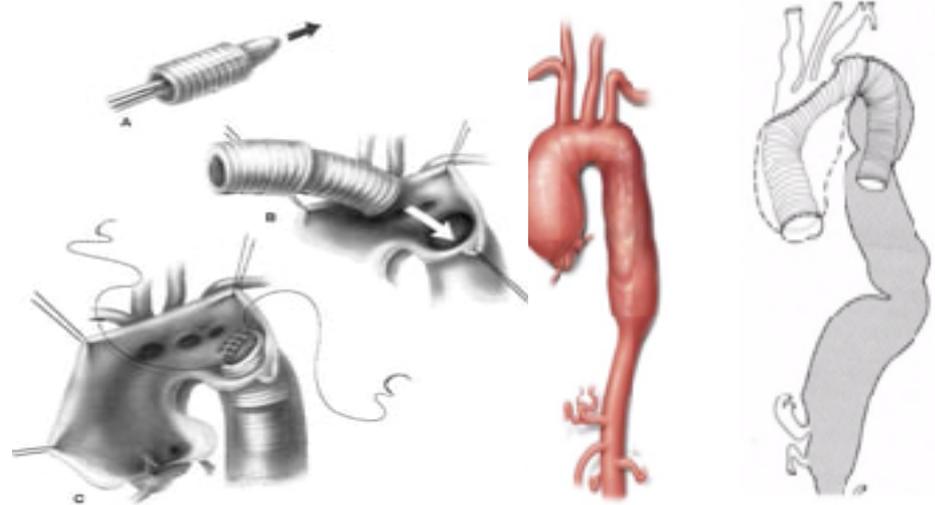
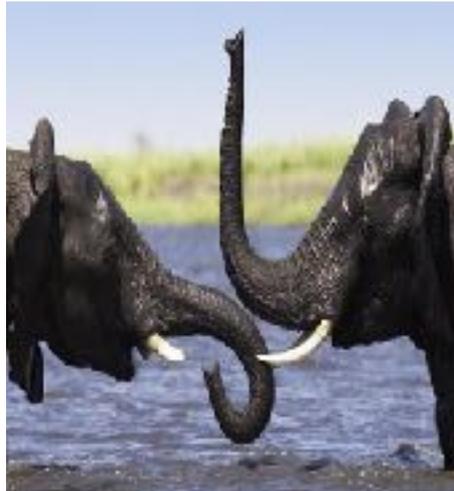
HOW TO DO IT

Thorac. cardiovasc. Surgeon 31 (1983) 37-40

## Extensive Aortic Replacement using "Elephant Trunk" Prosthesis\*

H.G. Borst, G. Welterbasch, and G. Schaps<sup>1</sup>

Division of Thoracic and Cardiovascular Surgery, Surgical Center, and  
<sup>1</sup>Institute of Anesthesiology, Hannover Medical School, Hannover, FRG



Hans-Georg Borst (MHH)

# Operative Technik Aortenbogensersatz

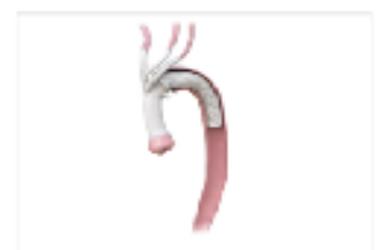
Frozen Elephant Technique (FET) Moderne Hybridprothese



STRAIGHT  
CONFIGURATION



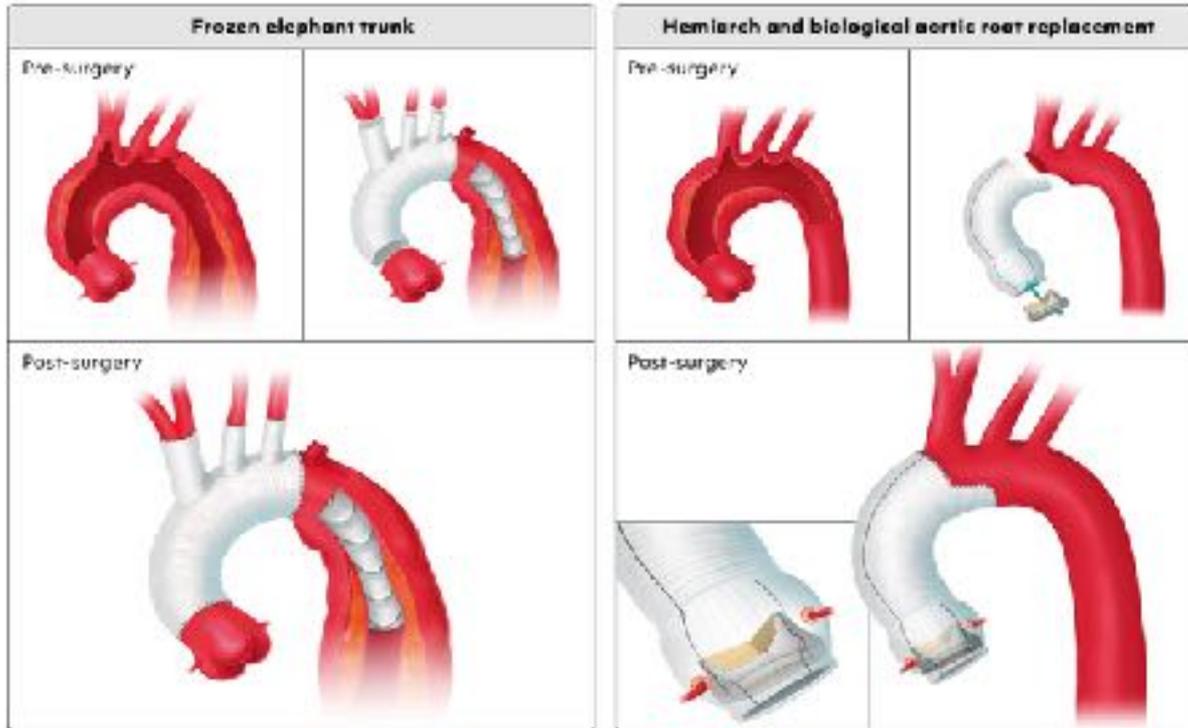
BRANCHED  
CONFIGURATION



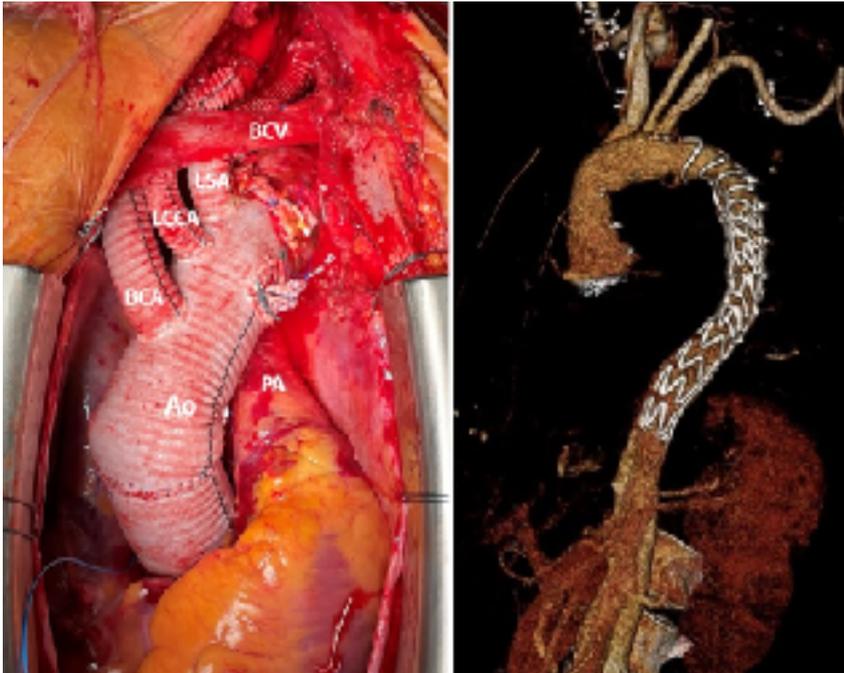
TRIFURCATED  
CONFIGURATION

ARTIVION

# Komplettersatz vs. Teilbogenersatz



# Aortenbogenchirurgie



# Aortenbogenchirurgie

European Journal of Cardio-Thoracic Surgery 2024, 97(3): waad266  
<https://doi.org/10.1093/ejcts/eaad266> Advance Access publication 2 June 2024

ORIGINAL ARTICLE

Cite this article as: Tsagakis K, Kempfert J, Zierer A, Martens A, Dohle D-S, Castiglioni A et al. E-vita OPEN NEO in the treatment of acute or chronic aortic pathologies: first interim results of the NEOS study. Eur J Cardiothorac Surg 2024; doi:10.1093/ejcts/eaad266.

## E-vita OPEN NEO in the treatment of acute or chronic aortic pathologies: first interim results of the NEOS study

Konstantinos Tsagakis<sup>1,2</sup>, Joerg Kempfert<sup>1,2</sup>, Andreas Zierer<sup>1,2</sup>, Andreas Martens<sup>3</sup>, Daniel-Sebastian Dohle<sup>4</sup>,  
Alessandro Castiglioni<sup>5</sup>, Randolph Hung-Leung Wong<sup>6</sup>, Kazimierz Widenka<sup>7</sup>, Oliver Liakopoulos<sup>8</sup>,  
Michael A. Berger<sup>9</sup>, Aung Ye Do<sup>10</sup>, Tomas Holubec<sup>11</sup>, Maximilian Luehr<sup>12</sup>, Juan José Legarra Calderón<sup>13</sup>  
and Martin Grabenwöger<sup>1,2,3\*</sup>

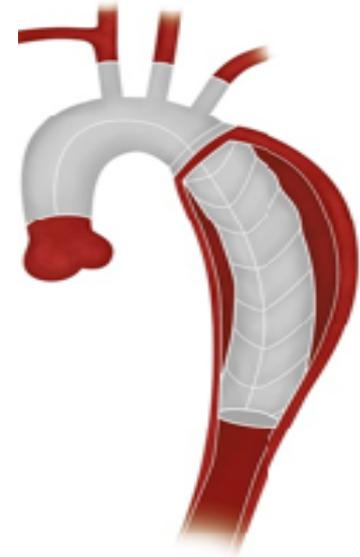
### Abstract

**OBJECTIVES:** The aim of this multicentre study was to demonstrate the safety and clinical performance of E-vita OPEN NEO Stent Graft System (Privia Inc.) in the treatment of aneurysm or dissection, both acute and chronic, in the ascending aorta, aortic arch and descending thoracic aorta.

**METHODS:** In this observational study of 12 centres performed in Europe and in Asia patients were enrolled between December 2020 and March 2022. All patients underwent frozen elephant trunk using E-vita OPEN NEO Stent Graft System. Primary end point was the rate of all-cause mortality at 30 days and secondary end points included future clinical and safety data, see reported up to 1–6 months postoperative.

**RESULTS:** A total of 160 patients (86.3% male; mean age 59.7 years) were enrolled at 12 sites. A total of 90 patients underwent surgery using the E-vita OPEN NEO for acute or subacute type A aortic dissection (n = 32), chronic type A aortic dissection (n = 10) or the acute or chronic aortic aneurysm (n = 29), while 1 patient did not undergo surgery. Device technical success at 24 h was achieved in 97.0%. All discharge, new discharging stroke occurred in 4.4%, while new paraplegia and new paraparesis was reported in 2.7% and 2.7%, respectively. Stroke/paralysis requiring permanent (>30 days) disability or hemiparesis at discharge was observed in 3.3% of patients. Between discharge and the 3–6 months visit, no patients experienced new discharging stroke, new paraplegia or new paraparesis. The 30-day mortality was 5.1% and the estimated 6-month survival rate was 71.6% (standard deviation 2.0).

**CONCLUSIONS:** Total arch replacement with the E-vita OPEN NEO can be performed with excellent results in both the acute and chronic setting. This indicates that E-vita OPEN NEO can be used safely, including in the setting of acute type A aortic dissection.



- Bogenersatz gute Ergebnisse
- 4.5% Schlaganfall
- 3% Sterblichkeit

# Aortenbogenchirurgie

European Journal of Cardio-Thoracic Surgery 56 (2019) 872–878  
doi:10.1093/ejcts/ezz037 Advance Access Publication 7 March 2019

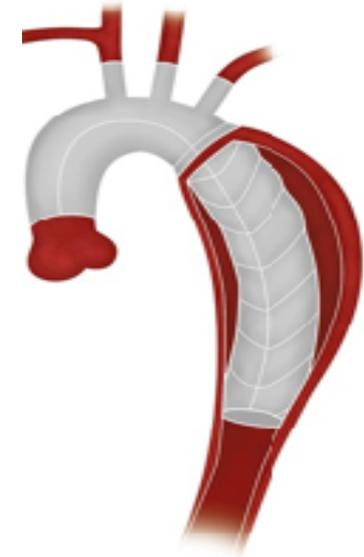
ORIGINAL ARTICLE

Use this article to cite: Berger T, Wels G, Voetsch A, Arnold Z, Krolsch M, Rylski B et al. Multicentre experience with two frozen elephant trunk prostheses in the treatment of acute aortic dissection. *Eur J Cardiothorac Surg* 2019;56:872–8.

## Multicentre experience with two frozen elephant trunk prostheses in the treatment of acute aortic dissection†

Tim Berger<sup>ab</sup>, Gabriel Wels<sup>c</sup>, Andreas Voetsch<sup>d</sup>, Zsuzsanna Arnold<sup>e</sup>, Maximilian Krolsch<sup>ab</sup>,  
Bartosz Rylski<sup>ab</sup>, Philipp Krombholz-Reindl<sup>e</sup>, Andreas Winkler<sup>d</sup>, Marius Mach<sup>f</sup>, Daniela Gabler<sup>f</sup>,  
Raimund Seitelberger<sup>d</sup>, Mathias Siepe<sup>ab</sup>, Friedhelm Beyersdorf<sup>ab</sup>, Martin Grabenwoeger<sup>f</sup>,  
Martin Czerny<sup>ab</sup> and Roman Gottardi<sup>ga</sup>

**RESULTS:** Preoperative characteristics did not differ significantly between groups. There was also no statistically significant difference in postoperative outcome: in-hospital mortality (11% vs 12%;  $P=0.99$ ), stroke (16% vs 6%;  $P=0.14$ ), and spinal cord injury (5% vs 6%;  $P=0.99$ ). While there was no statistically significant difference in the occurrence of distal stent graft-related new entries (16% vs 11%;  $P=0.77$ ), there was a significantly higher rate of secondary endovascular aortic interventions in the ThorFlow<sup>TM</sup> hybrid group (22% vs 0%;  $P=0.003$ ). There was a trend towards a higher rate of false lumen thrombosis at the level of the aortic trunk (74% vs 93%;  $P=0.085$ ) and was comparable at the thoraco-abdominal transition (53% vs 80%;  $P=0.33$ ) 1 year after implantation of the prostheses.



- 10% Sterblichkeit
- 11% Schlaganfall

# Aortenbogenchirurgie

## Single-centre experience with the frozen elephant trunk technique in 251 patients over 15 years†

Malaik Shrestha<sup>1\*</sup>, Andreas Martens<sup>2</sup>, Tim Kaschold<sup>3</sup>, Erik Beckmann<sup>3</sup>, Sebastian Borteke<sup>3</sup>, Heiko Krueger<sup>2</sup>, Julia Neuser<sup>2</sup>, Felix Fleiszer<sup>2</sup>, Fabio Ivo<sup>3</sup>, Firas AbdAlhadi<sup>3</sup>, Jaemin Harke<sup>3</sup>, Jun D. Schemitz<sup>3</sup>, Sorghol Cabetari<sup>3</sup>, Matthias Karck<sup>3</sup>, Axel Haverich<sup>1</sup> and Ajay Chavan<sup>1</sup>

<sup>1</sup> Department of Cardiothoracic, Transplantation and Vascular Surgery, Hannover Medical School, Hannover, Germany  
<sup>2</sup> Department of Cardiac Surgery, University Hospital Heidelberg, Heidelberg, Germany  
<sup>3</sup> Department of Diagnostic and Interventional Radiology, Wilhelms-Oberlinde, Göttingen, Germany

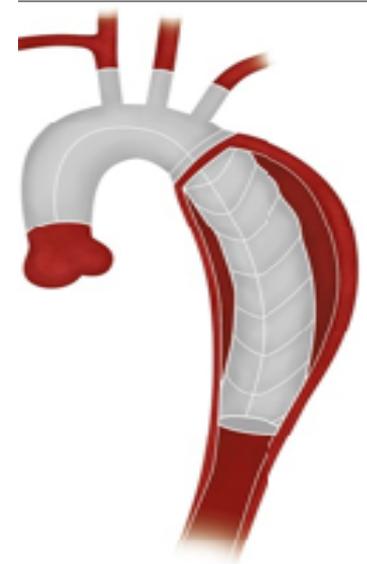
### Abstract

**OBJECTIVES:** Our goal was to present our 15-year experience (2001–2015) with the frozen elephant trunk (FET) technique.

**METHODS:** A total of 251 patients (82 with acute aneurysm, 96 with acute aortic dissection type A, 4 with acute type B dissection, 52 with chronic aortic dissection type A, 17 with chronic type B dissection and 67 redo cases) underwent FET implantation with either the custom-made Chavan-Haverich (n = 66), the Jone-Forte (n = 31) or the Vascutec Thoraflex hybrid (n = 154) prosthesis. The cases were assigned to an early period (2001–2011) and a contemporary period (2012–present).

**RESULTS:** Mean cardiopulmonary bypass time, aortic cross-clamp time, circulation arrest time and selective antegrade cerebral perfusion time were 241 ± 72, 125 ± 59, 56 ± 30 and 81 ± 24 min, respectively. Incidence of rethoracotomy for bleeding, stroke, spinal cord injury, prolonged ventilatory support (>96 h) and long-term dialysis were 10, 14, 2, 24 and 7%, respectively. The in-hospital mortality rate was 11% (n = acute aortic dissection type A, 12%). Of the 7 patients with graft infection, 1 died and the other had a protracted hospital stay. There were 49 second-stage procedures in the downstream aorta, either open surgical (n = 25) (thoraco-abdominal, n = 15; descending, n = 6; infrarenal, n = 4) or transcatheter endovascular (n = 24). Flexible thoracic endovascular aneurysm repair (TEVAR) implantation was successful in all 23 cases.

**CONCLUSIONS:** FET results are comparable with those of the published results of the conventional elephant trunk technique. FET is an ideal landing zone for subsequent transfemoral endovascular completion. Patients with graft infection may have dismal results.



- 20% Sterblichkeit
- 20% Rethorakotomie
- 20% Schlaganfall

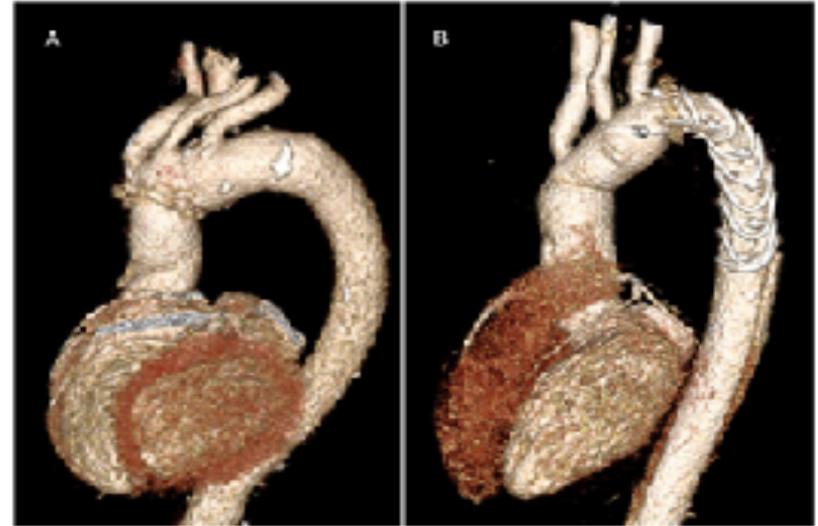
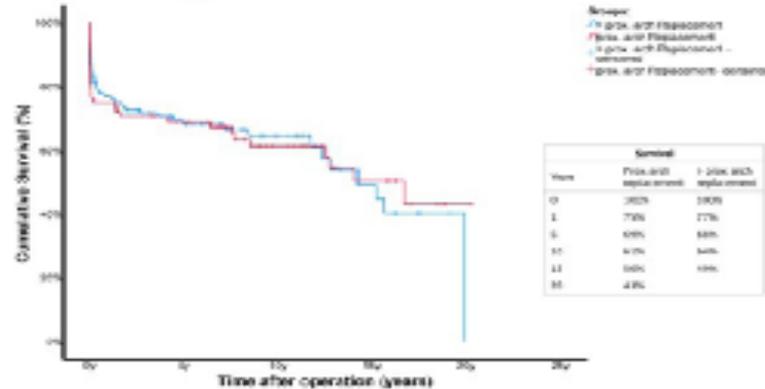
# Komplettersatz vs. Teilbogenersatz

ORIGINAL ARTICLE

Open Access <https://doi.org/10.1007/s00391-020-01811-3>

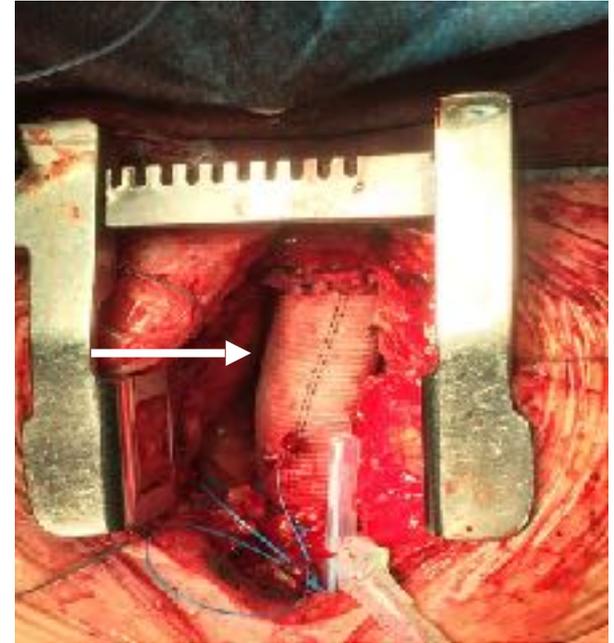
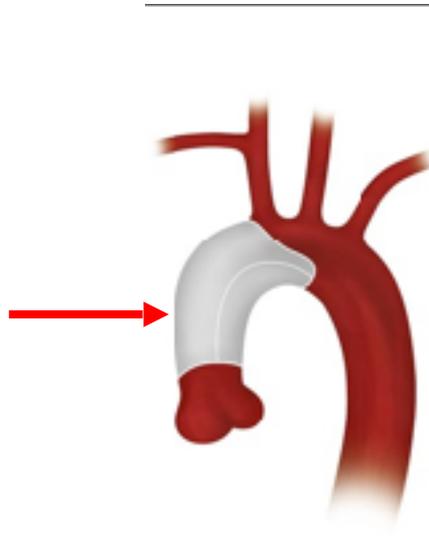
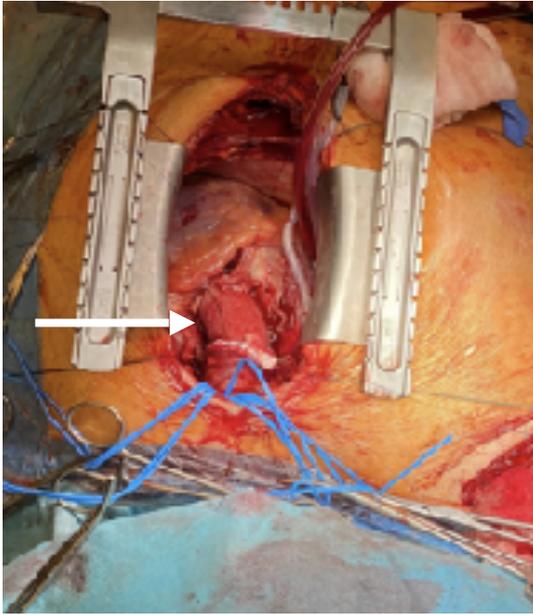
## Acute Aortic Dissection Type A in Younger Patients (< 60 Years Old) — Does Full Arch Replacement Provide Benefits Compared to Limited Approach?

Ruben Malenkov, MD; Naveeh Lal Shrivastha, MD; Anindya Mukherjee, MD; Erik Beckmann, MD; Holke Krueger, MD; Mariel Arar, MD; Linda Mudofin, MD; Stefan Reuter, MD; Raza Poyanmehr, MD; Wilhelm Korte, MD; Tobias Schilling, MD; Axel Haverich, MD; Tim Gatzfeld, MD



- Bessere Ergebnisse bei Teilbogenersatz
- 13% Schlaganfall
- 15% Sterblichkeit

# Teilbogenersatz bei Aortendissektion



# Teilbogenersatz bei Aortendissektion

European Journal of Cardio-Thoracic Surgery 49 (2016) 1392–1401  
doi:10.1093/ejcts/evz351 Advance Access publication 13 October 2015

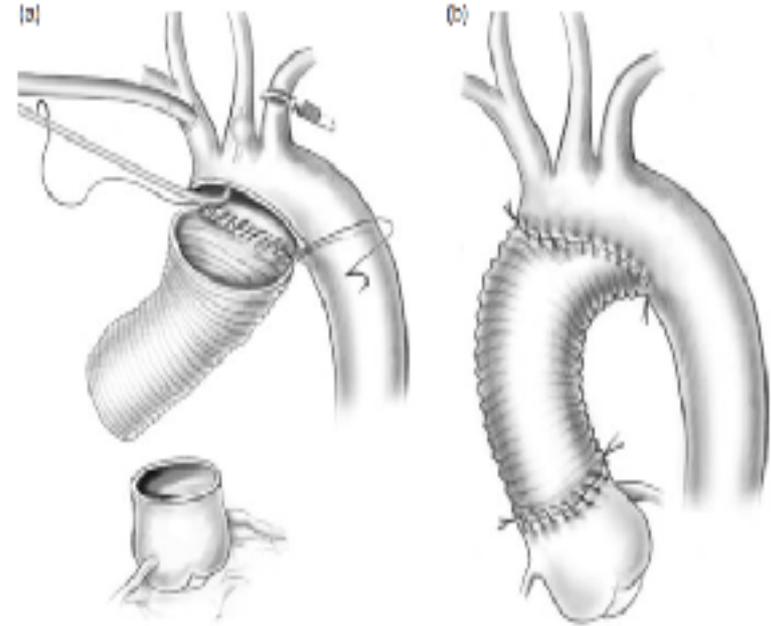
ORIGINAL ARTICLE

Cite this article as: Yan Y, Xu L, Zhang H, Xu Z-Y, Ding X-Y, Wang S-W, et al. Proximal aortic repair versus extensive aortic repair in the treatment of acute type A aortic dissection: a meta-analysis. Eur J Cardiothorac Surg 2016;49:1392–401.

## Proximal aortic repair versus extensive aortic repair in the treatment of acute type A aortic dissection: a meta-analysis

Yan Yan<sup>a</sup>, Li Xu<sup>a</sup>, Hao Zhang<sup>a</sup>, Zhi-Yun Xu<sup>a\*</sup>, Xue-Yan Ding<sup>b</sup>, Shu-Wei Wang<sup>c</sup>, Xiang Xue<sup>a</sup> and Meng-Wei Tan<sup>a\*</sup>

- Geringere Sterblichkeit
- Mehr Reoperationen im Verlauf



# Teilbogenersatz bei Aortendissektion



The Annals of Thoracic Surgery

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In Press, Journal Pre-proof [What's this?](#)

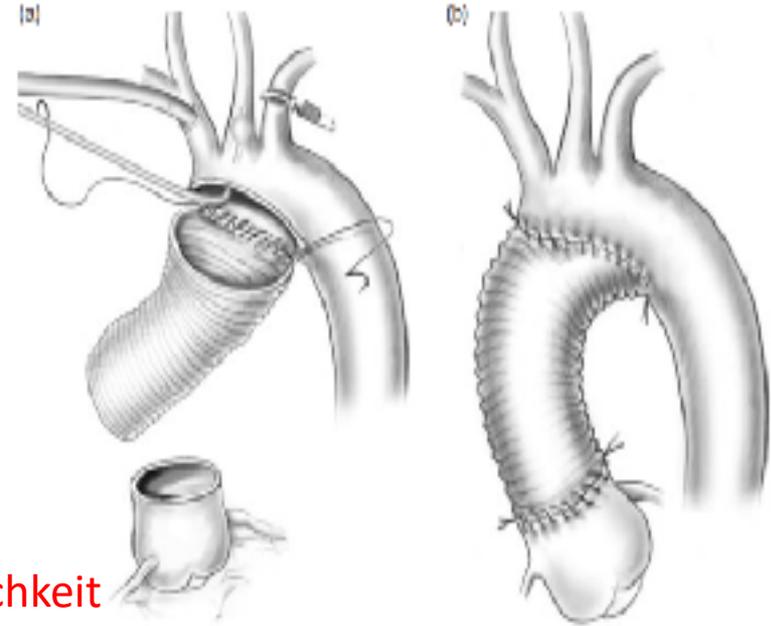


ORIGINAL ARTICLE

## Reinterventions After Repair of Acute Type A Aortic Dissection: Incidence, Outcomes, and Risk Factors

**Conclusions:** The cumulative incidence of acute reintervention after ATAAD repair was reasonably low (15% at 10 years); reinterventions were relatively safe (5% operative mortality), and reinterventions did not significantly impact long-term survival.

- 16 % in 10 Jahren
- 6% Sterblichkeit
- Re-Operationen haben keinen Einfluss auf Sterblichkeit



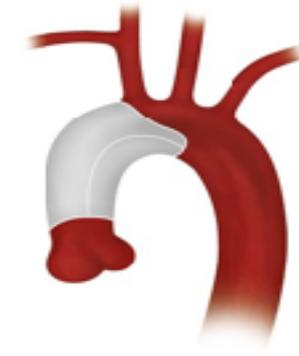
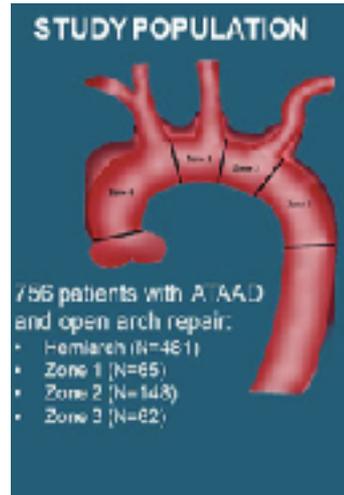
# Teilbogenersatz bei Aortendissektion

> *Ann Thorac Surg.* 2023 Apr;115(4):888-895. doi: 10.1016/j.athoracsur.2022.10.035.  
Epub 2022 Nov 8.

## Distal Aortic Progression After Hemiarch, Zones 1–3 Arch Replacement in Acute Type A Aortic Dissection

Nathan J Graham<sup>1</sup>, Marc Titsworth<sup>1</sup>, Pana-Arnaghan Ahmad<sup>1</sup>, Xiaoting Wu<sup>1</sup>, Arora Naeem<sup>1</sup>, Karen M Kim<sup>1</sup>, Shinichi Fukuhara<sup>1</sup>, Himanshu Patel<sup>1</sup>, G Michael Deeb<sup>1</sup>, Bo Yang<sup>2</sup>

**Conclusions:** There was no significant difference in long-term survival, distal aorta growth, or reoperation rate for distal aortic aneurysm after hemiarch or zones 1, 2, or 3 arch replacement. Patient-specific arch replacement strategies may be used rather than defaulting to aggressive arch replacement for all ATAAD patients.



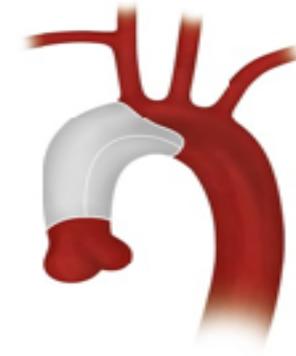
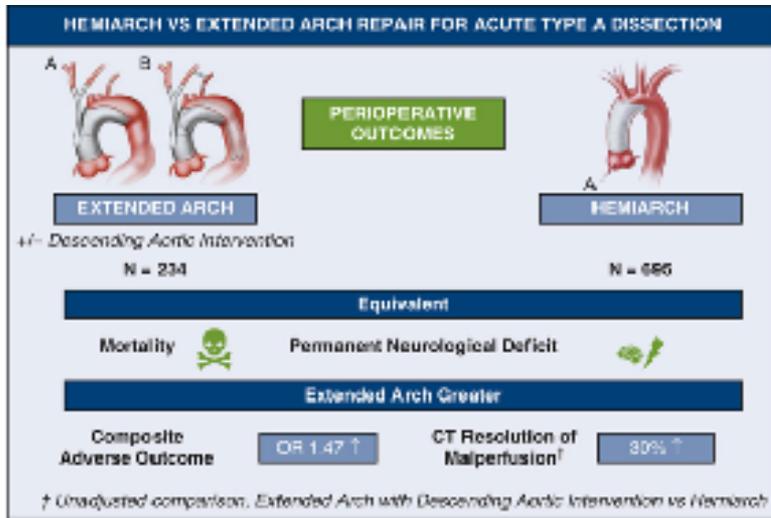
- Kein Unterschied im Verlauf

# Teilbogenersatz vs. Aortenbogenersatz

Multicenter Study | J Thorac Cardiovasc Surg. 2024 Mar;167(3):636-643.e5.

doi: 10.1016/j.jtcvs.2023.04.012. Epub 2023 Apr 20.

## Hemiarch versus extended arch repair for acute type A dissection A dissection: Results from a multicenter national registry



- Geringere Sterblichkeit bei Teilbogenersatz
- Kein Unterschied im Verlauf

# Aortic Guideline EACTS/STS 2024

## EACTS/STS Guidelines for diagnosing and treating acute and chronic syndromes of the aortic organ

Type A aortic dissection.

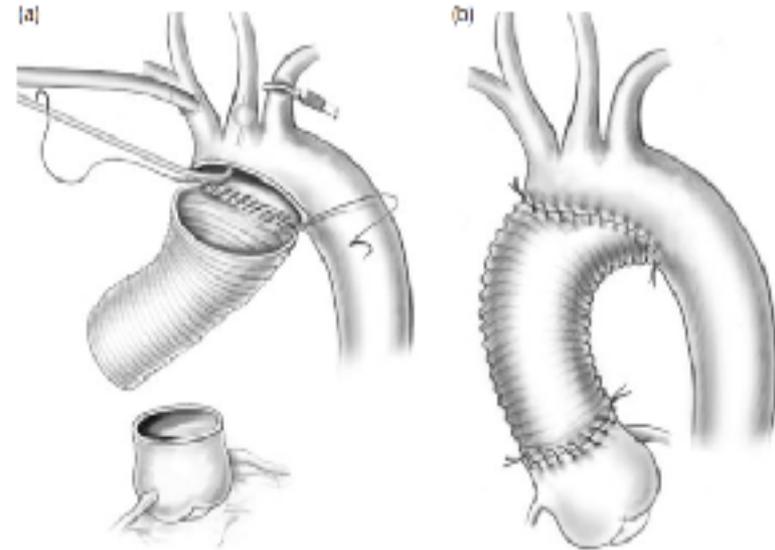
Recommendation Table 5: Acute aortic diseases: Type A aortic dissection

Recommendations	Class <sup>a</sup>	Level <sup>b</sup>	Ref <sup>c</sup>
Resection of emergency surgery is recommended in patients surviving with acute type A aortic dissection.	I	B	[213, 212]
A tear-oriented approach with exclusion or resection of the primary entry tear in the ascending aorta and arch is recommended.	I	B	[213, 214]
Inspection and coverage of communications between lamina in the proximal descending aorta may be considered in specialized centers for pregnant patients.	IIb	C	-
Despite preoperative neurologic dysfunction or non-traumatic stroke, open repair should be considered.	IIa	B	[215-217]
In cases of clinical and imaging evidence of cerebral malperfusion, revascularization may be considered prior to aortic repair.	IIb	C	-
Antegrade systemic perfusion via axillary or direct aortic cannulation should be considered.	IIa	B	[218, 219]
An open distal anastomosis during lower limb bypass or cross-clamp arrest is recommended.	I	B	[220, 221]

<sup>a</sup>Class of recommendation.

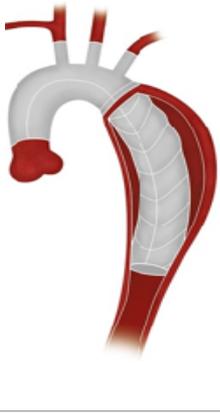
<sup>b</sup>Level of evidence.

<sup>c</sup>Reference.



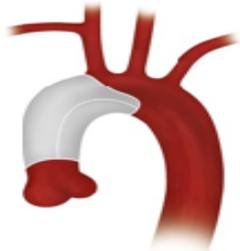
Offene Aortenbogenanastomose

# Teilbogenersatz vs. Aortenbogenersatz



- Komplettsanierung am Bogen
- Schutz der Kopfgefäße
- Vorbereitung zur TEVAR

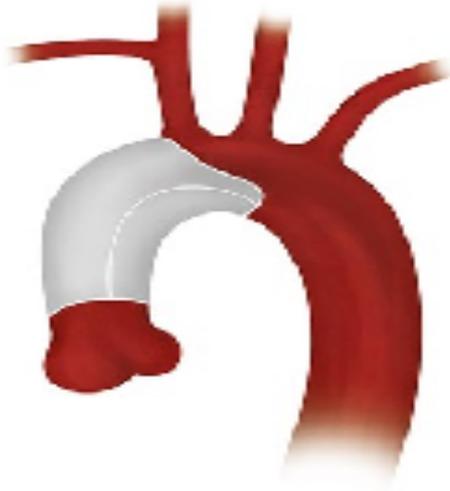
- Sehr komplexe Operation
- Hohes Risiko Schlaganfall
- Risiko Lähmung



- Kürzere Operation
- Weniger Kühlen
- Geringere Sterblichkeit

- Re-Operation Risiko
- Rest-Dissektion

# Teilbogenersatz bei Aortendissektion



- Kürzere Operation
- Weniger Kühlen
- Besseres Ergebnis



# Ende Gut, Alles Gut



Aorten-Patiententag in Hannover 2023

# Herzlichen Dank für Ihre Aufmerksamkeit



**Prof. Dr. med. Aron-Frederik Popov**