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Contemporary Management of Type A Aortic Dissection: Is Hybrid the Future?

Erik Beckmann, MD
MHI Grand Rounds
April 27, 2026

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Objectives and Learning Goals

- Pathology and classification of aortic dissection
- Summarize current guideline-based management
- Review open-surgical and hybrid approaches
- Evaluate evidence of hybrid strategies
- Identify future directions of therapy

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Circulation

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Endorsed by the Society of Interventional Radiology and Society for Vascular Medicine

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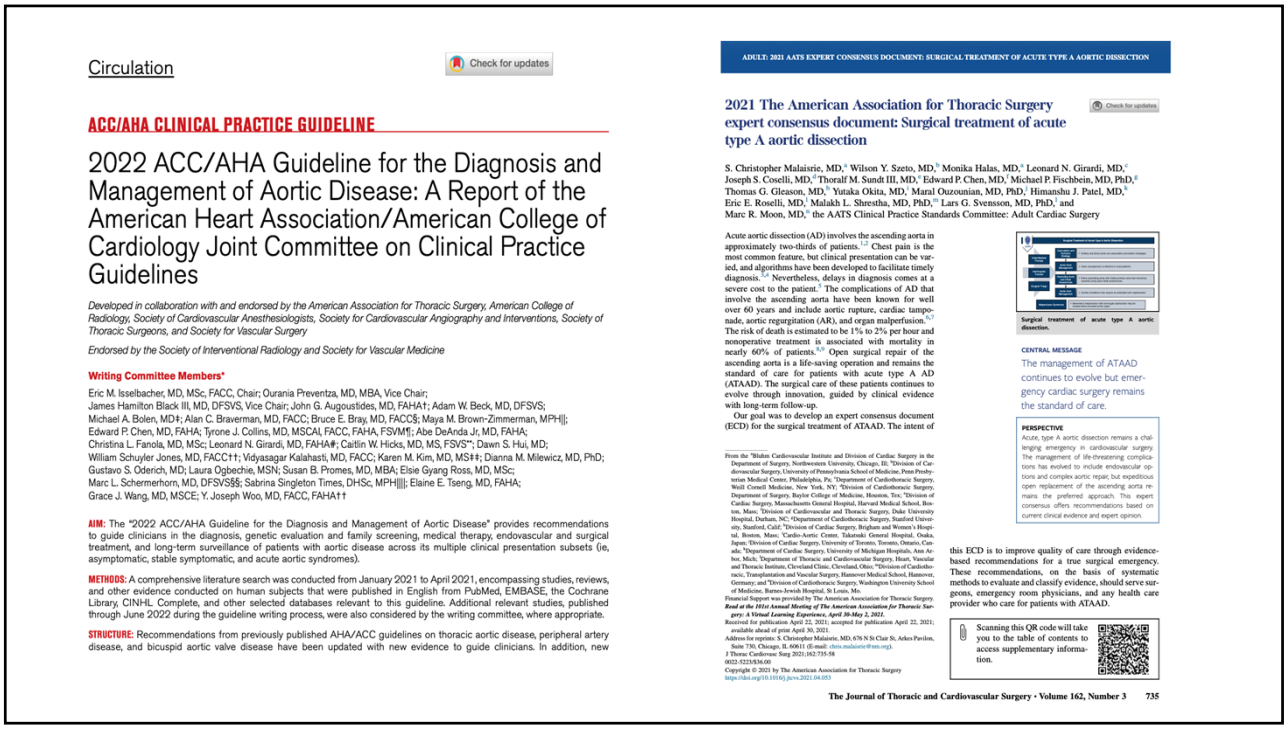

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Acute aortic dissection (AD) involves the ascending aorta in approximately two-thirds of patients.[1,2] Chest pain is the most common feature, but clinical presentation can be varied, and algorithms have been developed to facilitate timely diagnosis.[3,4] Nevertheless, delays in diagnosis comes at a severe cost to the patient.[5] The complications of AD that involve the ascending aorta have been known for well over 60 years and include aortic rupture, cardiac tamponade, aortic regurgitation (AR), and organ malperfusion.[6,7] The risk of death is estimated to be 1% to 2% per hour and nonoperative treatment is associated with mortality in nearly 60% of patients.[8,9] Open surgical repair of the ascending aorta is a life-saving operation and remains the standard of care for patients with acute type A AD (ATAAD). The surgical care of these patients continues to evolve through innovation, guided by clinical evidence with long-term follow-up.

Our goal was to develop an expert consensus document (ECD) for the surgical treatment of ATAAD. The intent of this ECD is to improve quality of care through evidence-based recommendations for a true surgical emergency. These recommendations, on the basis of systematic methods to evaluate and classify evidence, should serve surgeons, emergency room physicians, and any health care provider who care for patients with ATAAD.

From the *Bluhm Cardiovascular Institute and Division of Cardiac Surgery in the Department of Surgery, Northwestern University, Chicago, Ill; †Division of Cardiovascular Surgery, University of Pennsylvania School of Medicine, Penn Presbyterian Medical Center, Philadelphia, Pa; ‡Department of Cardiothoracic Surgery, Weill Cornell Medicine, New York, NY; §Division of Cardiothoracic Surgery, Department of Surgery, Baylor College of Medicine, Houston, Tex; ‖Division of Cardiac Surgery, Massachusetts General Hospital, Harvard Medical School, Boston, Mass; ¶Division of Cardiovascular and Thoracic Surgery, Duke University Hospital, Durham, NC; #Department of Cardiothoracic Surgery, Stanford University, Stanford, Calif; **Division of Cardiac Surgery, Brigham and Women's Hospital, Boston, Mass; ††Cardio-Aortic Center, Takanaki General Hospital, Osaka, Japan; ‡‡Division of Cardiac Surgery, University of Toronto, Toronto, Ontario, Canada; §§Department of Cardiac Surgery, University of Michigan Hospitals, Ann Arbor, Mich; ‖‖Department of Thoracic and Cardiovascular Surgery, Heart, Vascular and Thoracic Institute, Cleveland Clinic, Cleveland, Ohio; ##Division of Cardiothoracic, Transplantation and Vascular Surgery, Hannover Medical School, Hannover, Germany; and ***Division of Cardiothoracic Surgery, Washington University School of Medicine, Barnes-Jewish Hospital, St Louis, Mo.

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Address for reprints: S. Christopher Malaisrie, MD, 676 N St Clair St, Arkes Pavilion, Suite 730, Chicago, IL 60611 (E-mail: chris.malaisrie@nm.org).

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Surgical treatment of acute type A aortic dissection.

CENTRAL MESSAGE

The management of ATAAD continues to evolve but emergency cardiac surgery remains the standard of care.

PERSPECTIVE

Acute, type A aortic dissection remains a challenging emergency in cardiovascular surgery. The management of life-threatening complications has evolved to include endovascular options and complex aortic repair, but expeditious open replacement of the ascending aorta remains the preferred approach. This expert consensus offers recommendations based on current clinical evidence and expert opinion.

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GUIDELINES

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

Authors/Task Force Members: Martin Czerny [a,b,c*] (Co-Chairperson) (Germany), Martin Grabenwöger [a,d,e*] (Co-Chairperson) (Austria), Tim Berger [a,f] (Task Force Coordinator), Victor Aboyans [e,f] (France), Alessandro Della Corte [g] (Italy), Edward P. Chen [h] (USA), Nimesh D. Desai [i] (USA), Julia Dumfarth [j] (Austria), John A. Elefteriades [k] (USA), Christian D. Etz [l,m] (Germany), Karen M. Kim [n] (USA), Maximilian Kreibich [o,p] (Germany), Mario Lescan [q] (Germany), Luca Di Marco [r] (Italy), Andreas Martens [q,s] (Germany), Carlos A. Mestres [t] (South Africa), Milan Milojevic [u] (Serbia), Christoph A. Nienaber [v,w] (UK), Gabriele Piffaretti [x] (Italy), Ourania Preventza [y] (USA), Eduard Quintana [z] (Spain), Bartosz Rylski [a,b] (Germany), Christopher L. Schlett [a,c] (Germany), Florian Schoenhoff [aa] (Switzerland), Santi Trimarchi [ab] (Italy) and Konstantinos Tsagakis [a] (Germany), EACTS/STS Scientific Document Group

* Clinic for Cardiovascular Surgery, Department University Heart Center Freiburg Bad Krozingen, University Clinic Freiburg, Freiburg, Germany
† Faculty of Medicine, Albert-Ludwigs-University Freiburg, Freiburg, Germany
‡ Department of Cardiothoracic Surgery, Klinikum Stuttgart, Stuttgart, Germany
§ Medical Faculty, Sigmund Freud Private University, Vienna, Austria
¶ Department of Cardiology, Dupuytren-2 University Hospital, Limoges, France
EpiNaCT, Inserm 1094 & IRD 270, Limoges University, Limoges, France
Department of Translational Medical Sciences, University of Campania "L. Vanvitelli", Naples, Italy
** Clinic for Cardiac Surgery, University Hospital Zurich, Zurich, Switzerland
†† Cardiac Surgery, Cardiovascular and Thoracic Surgery, Duke University Medical Center, Durham, NC, USA
‡‡ Division of Cardiovascular Surgery, University of Pennsylvania, Philadelphia, PA, USA
§§ University Clinic for Cardiac Surgery, Medical University Innsbruck, Innsbruck, Austria
‖‖ Aortic Institute at Yale New Haven Hospital, Yale University School of Medicine, New Haven, CT, USA
Department of Cardiac Surgery, University Medicine Rostock, University of Rostock, Rostock, Germany
*** Division of Cardiovascular and Thoracic Surgery, The University of Texas at Austin/Dell Medical School, Austin, TX, USA
††† Department of Cardiac Surgery, University Hospital Tübingen, Eberhard Karls University Tübingen, Tübingen, Germany
‡‡‡ Cardiac Surgery Unit, IRCCS Azienda Ospedaliero-Universitaria di Bologna, Bologna, Italy
§§§ Department of Cardiac Surgery, Klinikum Oldenburg, Oldenburg, Germany
‖‖‖ The Carl von Ossietzky University Oldenburg, Oldenburg, Germany
Department of Cardiothoracic Surgery and the Robert Wirh Frater Cardiovascular Research Centre, The University of the Free State, Bloemfontein, South Africa
**** Department of Cardiac Surgery and Cardiovascular Research, Dedinje Cardiovascular Institute, Belgrade, Serbia
†††† Division of Cardiology at the Royal Brompton & Harefield Hospitals, Guy's and St. Thomas' NHS Foundation Trust, London, UK
‡‡‡‡ Department of Cardiac Surgery, Royal Brompton & Harefield Hospitals, London, UK
§§§§ Vascular Surgery Department of Medicine and Surgery, University of Insubria School of Medicine, Varese, Italy
‖‖‖‖ Division of Cardiothoracic Surgery, Department of Surgery, University of Virginia, Charlottesville, VA, USA
Department of Cardiovascular Surgery, Hospital Clínic de Barcelona, University of Barcelona, Barcelona, Spain
***** Department of Diagnostic and Interventional Radiology, University Hospital Freiburg, Freiburg, Germany
****** Department of Cardiac Surgery, University Hospital Bern, Inselspital, University of Bern, Bern, Switzerland
††††† Department of Cardiac Thoracic and Vascular Diseases, Fondazione IRCCS Ca Granda Ospedale Maggiore Policlinico, Milan, Italy
‡‡‡‡‡ Department of Thoracic and Cardiovascular Surgery, West German Heart and Vascular Center, University Medicine Essen, Essen, Germany

*Corresponding authors. Albert Ludwigs University Freiburg-Faculty of Medicine, University Heart Center Freiburg-Bad Krozingen, Südring 15, 79189 Bad Krozingen, Germany. Tel: +49 7633 2600; E-mail: martin.czerny@universitaets-herzzentrum.de (M. Czerny); Department of Cardiovascular Surgery, Clinic Floridsdorf, Brünnerstrasse 68, 1210 Vienna, Austria. Tel: +43 1 27700 43008; E-mail: martin.grabenwoeger@gesundheitvereinland.at (M. Grabenwöger)

EACTS/STS Committee Reviewers: Matthias Siepe[a], Anthony L. Estrera[b], Joseph S. Bavaria[c], Davide Pacini[d], Yutaka Okita[e], Arturo Evangelista[f], Katherine B. Harrington[g], Puja Kachroo[h], G. Chad Hughes[i]

*EACTS Review Coordinator: Department of Cardiac Surgery, University Hospital Bern, Inselspital, University of Bern, Bern, Switzerland
†Division of Cardiothoracic Surgery, University of Utah School of Medicine, Utah Medical School at UTHealth Houston, Houston, TX, USA
‡Department of Cardiovascular Surgery, Hospital of the University of Pennsylvania, Philadelphia, PA, USA
§Division of Cardiac Surgery, S. Orsola University Hospital, IRCCS Bologna, Bologna, Italy

The first two authors contributed equally to this work.

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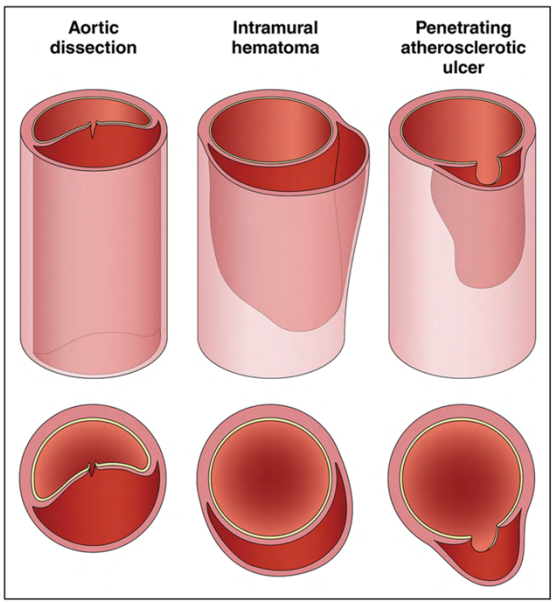

Figure 6. Acute Aortic Syndromes.
In aortic dissection, a tear in the aortic intima allows blood to penetrate the aortic media, pushing the dissection flap into the middle of the aorta, separating the true from the false lumen. In intramural hematoma, blood leaks into the aortic media at low pressure, forming a thrombus that pushes the outer wall of the aorta outward, leaving a relatively normal appearing aortic lumen. A penetrating atherosclerotic ulcer allows blood to enter the aortic media, but atherosclerotic scarring of the aorta typically confines the blood collection, often resulting in a localized dissection or pseudoaneurysm. Adapted with permission from Springer Nature Customer Service Centre GmbH: Springer Nature, Clough et al,[1] Copyright 2015.

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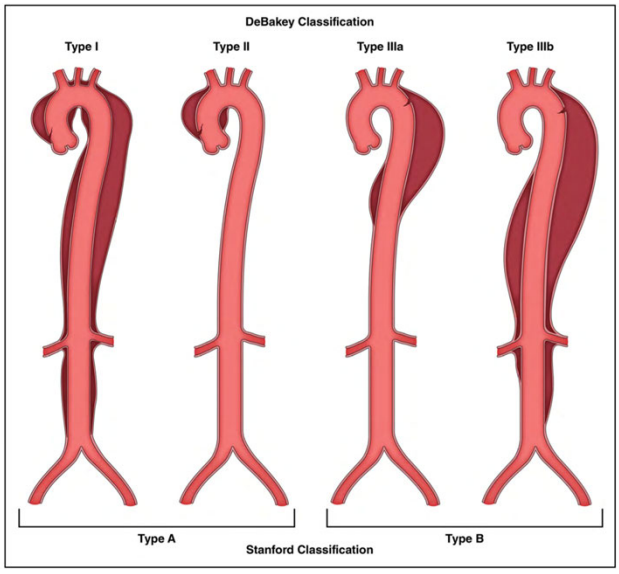

Figure 7. Classification of Acute Aortic Dissection.
The DeBakey and Stanford classification systems are used most commonly. The DeBakey system offers greater anatomic detail, whereas the Stanford system is simpler, essentially distinguishing those dissections that involve the ascending thoracic aorta from those that do not.

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Epidemiology

- Incidence: ~3-5 per 100,000 / year
- Peak age: 50-70 years
- Risk factors:
  - hypertension
  - connective tissue disease
  - bicuspid aortic valve
  - aortic aneurysm

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Presentation

- Sudden sharp, stabbing back / chest pain
- Additional signs depend on extent of dissection

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Presentation

- Sudden sharp, stabbing back / chest pain
- Additional signs depend on extent of dissection
- Mortality: 1-2% per hour
- Life-threatening emergency!

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Table 22. Signs and Symptoms of AAS

Clinical Signs and Symptoms	Cause
Asymmetric blood pressure (>20 mm Hg) between limbs	Compromise of branch artery flow
Bowel ischemia or gastrointestinal bleed	Malperfusion of the celiac or superior mesenteric artery
Dysphagia	Compression of the esophagus
Dyspnea	Compression of trachea or bronchus, congestive heart failure from aortic regurgitation, or cardiac tamponade
Hemoptysis	Vascular rupture into lung parenchyma
Hoarseness	Compression recurrent laryngeal nerve
Horner's syndrome	Compression of sympathetic chain
Myocardial ischemia or myocardial infarction	Coronary artery involvement by dissection or compression by aneurysm
New murmur of aortic regurgitation	Incomplete aortic valve closure secondary to leaflet tethering by the dilated aorta or cusp prolapse because of dissection into the aortic root
Oliguria or hematuria (gross)	Malperfusion of 1 or both renal arteries
Paraplegia	Spinal malperfusion attributable intercostal artery involvement
Lower extremity ischemia	Malperfusion of iliac artery
Shock	Cardiac tamponade, hemothorax, frank aortic rupture, acute severe aortic regurgitation, severe myocardial ischemia
Shortness of breath	Pericardial effusion, congestive heart failure from acute severe aortic regurgitation, or hemothorax
Stroke symptoms	Carotid or vertebral artery involved
Superior vena cava syndrome	Compression of the superior vena cava
Syncope	Carotid artery involvement or cardiac tamponade

AAS indicates acute aortic syndrome.

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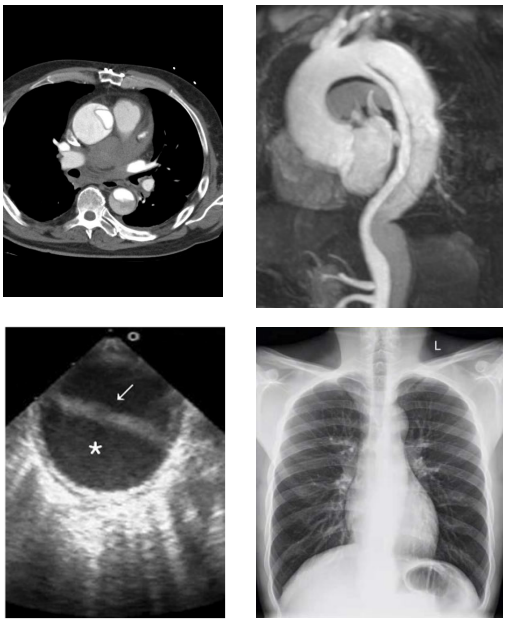
Diagnosis

- Recommended test: CT
- TEE and MRI reasonable
- Chest X-ray not sufficient



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Medical Therapy

7.3.1. Acute Medical Management of AAS

Recommendations for Acute Medical Management of AAS
Referenced studies that support the recommendations are summarized in the Online Data Supplement.

COR	LOE	Recommendations
1	B-NR	1. In patients presenting to the hospital with AAS, prompt treatment with anti-impulse therapy with invasive monitoring of BP with an arterial line in an ICU setting is recommended as initial treatment to decrease aortic wall stress.[1-5]
1	C-LD	2. Patients with AAS should be treated to an SBP <120 mm Hg or to lowest BP that maintains adequate end-organ perfusion, as well as to a target heart rate of 60 to 80 bpm.[3,6]
1	B-NR	3. In patients with AAS, initial management should include intravenous beta blockers, except in patients with contraindications.[2,5,7]
2a	B-NR	In those with contraindications or intolerance to beta blockers, initial management with an intravenous non-dihydropyridine calcium channel blocker is reasonable for heart rate control.[1,2,5]
1	C-LD	4. In patients with AAS, initial management should include intravenous vasodilators if the BP is not well controlled after initiation of intravenous beta-blocker therapy.[8]
1	C-EO	5. Patients with AAS should be treated with pain control, as needed, to help with hemodynamic management.

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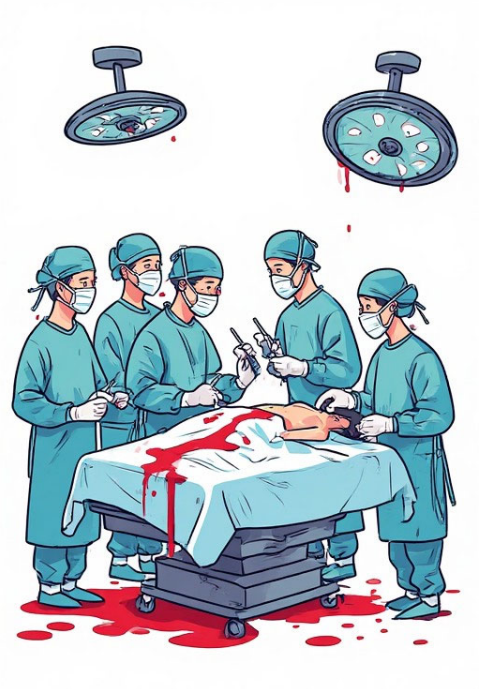
Goals of Surgical Therapy

- Prevent rupture
- Resect entry tear
- Restore true lumen flow
- Treat aortic root/ regurgitation
- Prevent future complications



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Conventional Surgery

- Ascending aortic replacement (“hemi-arch”)
- Total aortic arch replacement
- Total arch replacement w/ conventional elephant trunk

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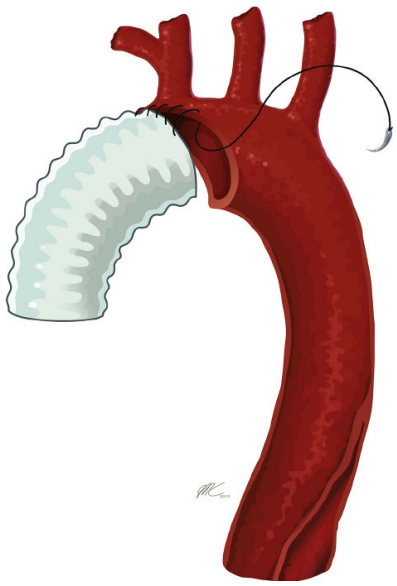
Ascending repair

- Minimal approach
- Open anastomosis (“hemi-arch”)
- Pros: - fast
  - less circulatory arrest time
- Cons: - residual distal dissection
  - higher late intervention rate



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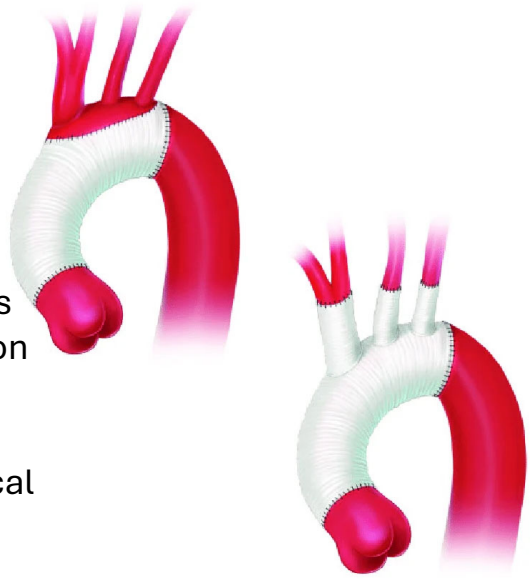
Total arch repair

- Supra-aortic vessels:
  - Island technique
  - selective re-insertion
- Pros: - treats arch-based entry tears
  - reduces risk for reintervention
- Cons: - longer operative times
  - potentially higher neurological risk (spine, brain)



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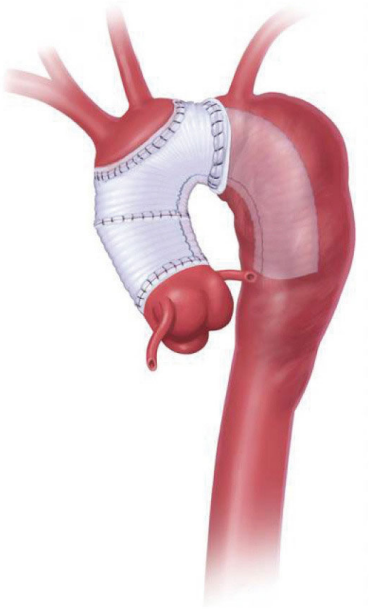
Total Arch with Elephant Trunk

- Pros:
  - treats arch-based entry tears
  - reduces risk for reintervention
  - facilitates future operations
- Cons:
  - longer operative times
  - potentially higher neurological risk (spine, brain)



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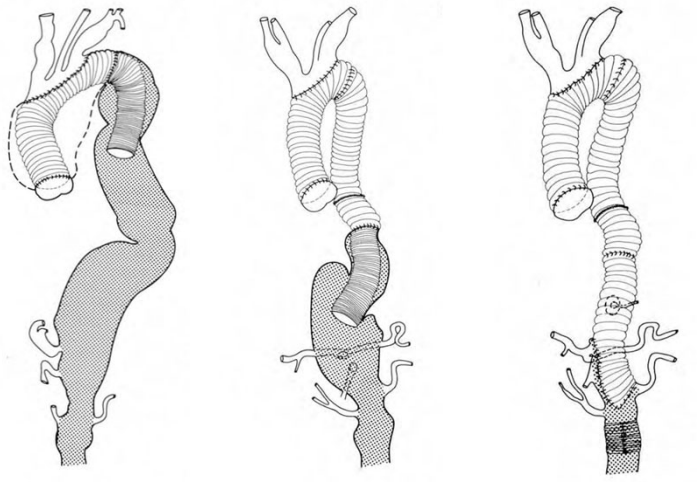
Extensive Aortic Replacement using "Elephant Trunk" Prosthesis*

H.G. Borst, G. Walterbusch, and D. Schaps[1]

Division of Thoracic and Cardiovascular Surgery, Surgical Center, and
[1]Institute of Anesthesiology, Hannover Medical School, Hannover, FRG

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



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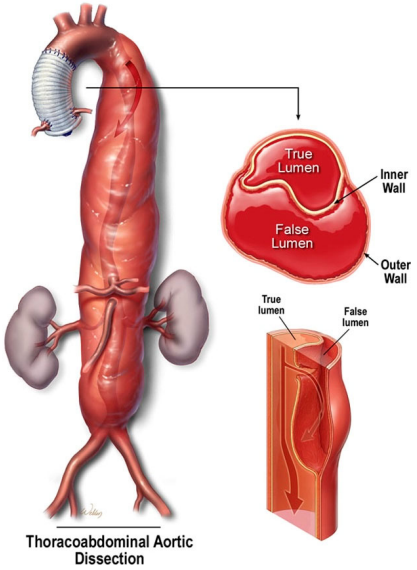
Limitations of Conventional Surgery

- Residual dissection (type I)
- Patent false lumen
- Aneurysmal degeneration
- No landing zone for stenting



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What is Hybrid Aortic Surgery?

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What is Hybrid Aortic Surgery?

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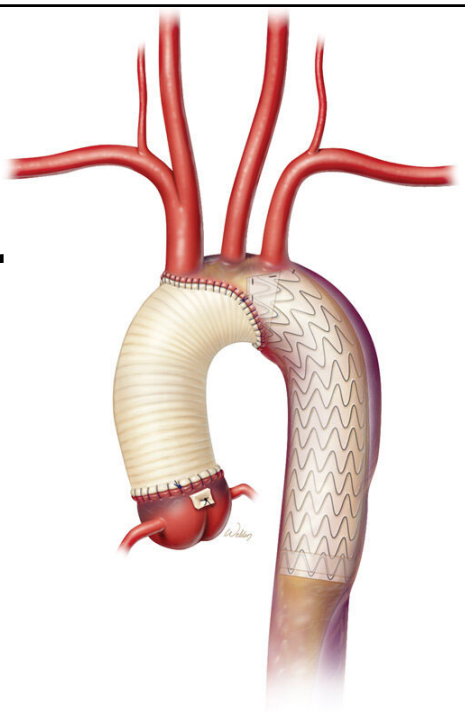
Ascending repair + TEVAR



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Combined Surgical and Endovascular Treatment of Acute Aortic Dissection Type A: Preliminary Results

Tatjana Fleck, MD, Doris Hutschala, MD, Martin Czerny, MD, Marek P. Ehrlich, MD, Marie-Theres Kasimir, MD, Manfred Cejna, MD, Ernst Wolner, MD, and Martin Grabenwoger, MD

Departments of Cardiothoracic Surgery and Interventional Radiology and Angiography, University of Vienna, Vienna, Austria

Background. The established treatment modality of acute Stanford type A dissection includes repair of the ascending aorta and various portions of the aortic arch, whereas the descending aorta is left untreated. We report a simultaneous approach of open repair of the ascending aorta with transluminal stent grafting of the descending aorta to minimize the consequences of an untreated descending aorta.

Methods. From April 2001 to February 2002, 8 consecutive patients (3 women [37.5%] and 5 men [62.5%]) with a mean age of 55.7 years (range, 45 to 70 years) were intended to be treated with the combined method of surgical repair of the ascending aorta and transluminal stent grafting into the descending aorta during the period of deep hypothermic circulatory arrest. Circulatory arrest time ranged between 30 and 67 minutes (average, 38.8 minutes). Specially designed Talent stent grafts (32 to 40 mm in diameter, length 13 cm) were inserted under direct vision and deployed with the proximal end at the origin of the left subclavian artery.

Results. Intraoperative stent graft placement was successful in 7 patients (87.5%). Because of severe kinking of the distal arch, stent insertion failed in 1 patient (12.5%). One patient with a history of preoperative stroke in the middle cerebral artery died because of intracerebral bleeding on postoperative day 2, resulting in an in-hospital mortality of 12.5%. Mean intensive care unit stay was 6.4 days (range, 2 to 21 days) and overall hospital stay was 18.2 days (range, 7 to 33 days). Completion computed tomographic scans revealed complete thrombosis of the false lumen in 2 patients and partial thrombosis in 4 patients. Follow-up was complete and ranged from 1 to 9 months (mean, 5.4 months).

Conclusions. This preliminary study shows that combined surgical and endovascular treatment of acute type A dissection is feasible, and at least partial thrombosis of the false lumen can be achieved, potentially minimizing the risk of further dilatation or rupture. Additionally, the stent graft expands the otherwise sickle-shaped true lumen, thereby ameliorating distal aortic perfusion. Long-term results are warranted to demonstrate the effectiveness of this new combined treatment modality.

(Ann Thorac Surg 2002;74:761–6)

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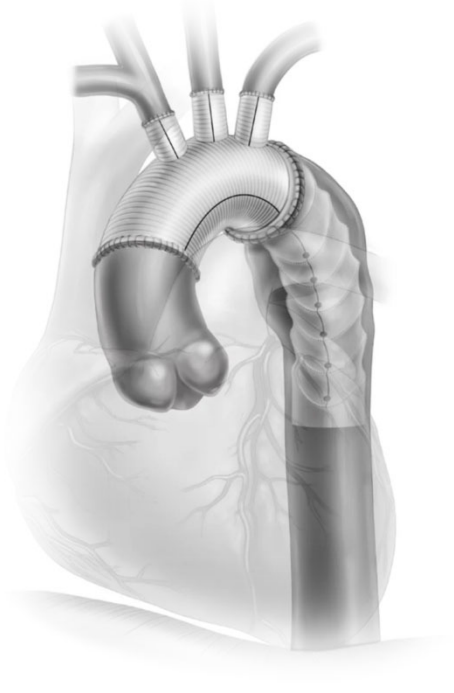
Frozen Elephant Trunk



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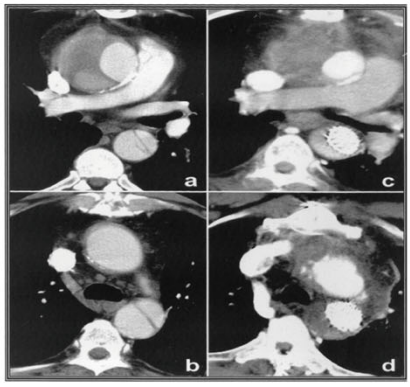
The frozen elephant trunk technique: A new treatment for thoracic aortic aneurysms

Brief Communications

The Journal of Thoracic and Cardiovascular Surgery • June 2003

Matthias Karck, MD,[a] Ajay Chavan, MD,[b] Christian Hagl, MD,[a] Holger Friedrich, MD,[a] Michael Galanski, MD,[b] and Axel Haverich, MD,[a] Hannover, Germany



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The frozen elephant trunk technique for the treatment of extensive thoracic aortic aneurysms: operative results and follow-up☆

Matthias Karck[a,*], Ajay Chavan[b], Nawid Khaladj[a], Holger Friedrich[c], Christian Hagl[a], Axel Haverich[a]

[a]*Division of Thoracic and Cardiovascular Surgery, Hannover Medical School, 30623 Hannover, Germany*
[b]*Division of Radiology, Hannover Medical School, Hannover, Germany*
[c]*Curative AG, Dresden, Germany*

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Abstract

Objective: The 'frozen' elephant trunk technique allows for single-stage repair of combined aortic arch and descending aortic aneurysms using a 'hybridprosthesis' with a stented and a non-stented end. This report summarizes the operative- and follow-up data (mean follow-up 14 months) with this new treatment. **Methods**: Between 09/01 and 4/04, 22 patients (62±9 years; 9 female) with different aortic pathologies (15 aortic dissections, 7 aneurysms) were operated on after approval from the local institutional review board. The stented end of the hybridprosthesis was deployed in the descending aorta through the opened aortic arch during hypothermic circulatory arrest and selective antegrade cerebral perfusion. **Results**: All patients survived the procedure but one patient died of acute hemorrhage due to rupture of the false lumen in the descending aorta on the second postoperative day. Two patients required reexploration of the chest for bleeding complications. In 2 of 4 patients who developed neurological dysfunction, symptoms resolved completely. In one of them, the descending aorta was perforated intraoperatively due to misplacement of the stented end of the hybridprosthesis. In all follow-up CT-scans thrombus formation in the descending aortic aneurysm excluded by the stented end of the hybridprosthesis has been observed. **Conclusions**: This procedure is performed through median sternotomy and combines the concepts of the elephant trunk operation and endovascular stenting of descending aortic aneurysms. Favourable intraoperative and postoperative results during follow-up with regard to thrombus formation around the stented descending aortic segment encourage us to evaluate all patients with thoracic aneurysms extending to proximal and distal of the left subclavian artery for this treatment.

Keywords: Elephant trunk technique; Aortic arch replacement

EUROPEAN JOURNAL OF CARDIO-THORACIC SURGERY

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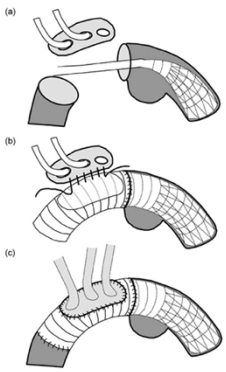

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Midterm results of extensive primary repair of the thoracic aorta by means of total arch replacement with open stent graft placement for an acute type A aortic dissection

Naomichi Uchida, MD, Hiroshi Ishihara, MD, Hidenori Shibamura, MD, Yoshiki Kyo, MD, and Masamiti Ozawa, MD

Objectives: We sought to describe the midterm results of extensive primary repair of the thoracic aorta by means of the modified elephant trunk technique with a stent graft for acute type A aortic dissection, particularly the changes of the false lumen shown by enhanced computed tomographic scanning.

Methods: The subjects were 35 consecutive patients who received arch replacement with open stent grafting for type A acute aortic dissection between December 1997 and April 2002. The mean follow-up period was 55 months (range, 30-83 months). Computed tomographic scanning was performed at 1, 3, 12, and 36 months postoperatively to detect thrombosis and obliteration of the false lumen after its exclusion by the stent graft. The diameter of the aorta was measured at 3 levels: the distal edge of the stent graft, the diaphragm, and the origin of the superior mesenteric artery.

Results: Two patients died in the initial operation, but no patients required additional surgical treatment of the thoracic aorta. The mean diameter of the stent grafts was 26.2 mm, and the mean length was 8.9 cm. Thrombus formation in the false lumen was recognized at the distal edge of the graft in all patients, at the diaphragmatic level in 26 patients, and at the superior mesenteric artery level in 15 patients. Obliteration of the false lumen was recognized at the distal edge of the graft in all patients, at the diaphragmatic level in 20 patients, and at the superior mesenteric artery level in 15 patients. The aorta distal to the stent graft showed minimal changes.

Conclusions: In patients with acute type A aortic dissections, it is possible to perform extensive primary repair of the thoracic aorta with relative safety by using a synthetic graft with a self-expanding stent, and this method might reduce the necessity of further operations not only for the distal descending aorta but also for the thoracoabdominal aorta.

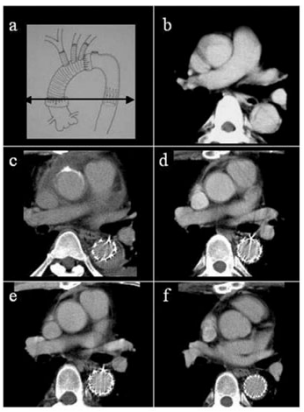

TABLE 2. Postoperative data

Postoperative data	
Early results	
Early mortality	2
Early morbidity	4
Cerebral accident	0
Paraplegia	0
Pulmonary failure	2
Renal failure	1
Low output syndrome	1
Intestinal ischemia	0
Late results	
Follow-up period, mo (mean)	30-83 (55)
Late mortality	0
Late morbidity	1
Cerebral accident	1
Paraplegia	0
Pulmonary failure	0
Additional surgical procedure	1
Thoracic aorta	0
Infrarenal abdominal aorta	1

The Journal of Thoracic and Cardiovascular Surgery • April 2006

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Surgery for acute type A dissection using total arch replacement combined with stented elephant trunk implantation: Experience with 107 patients

Li-Zhong Sun, MD,[a] Rui-Dong Qi, MD,[b] Qian Chang, MD,[a] Jun-Ming Zhu, MD,[a] Yong-Min Liu, MD,[a] Cun-Tao Yu, MD,[a] Bin Lv, MD,[c] Jun Zheng, MD,[a] Liang-Xin Tian, MD,[a] and Jin-Guo Lu, MD[c]

Objective: In patients with acute type A dissection, it is controversial whether to use a more aggressive strategy with extended aortic replacement to improve long-term outcome or to use a conventional strategy with limited ascending aortic or hemiarch replacement to circumvent a life-threatening situation.

Methods: Between April 2003 and June 2007, 107 patients (17 women, 90 men; mean age, 45 ± 11 years; range, 17–78 years) with acute type A dissection underwent total arch replacement combined with stented elephant trunk implantation under hypothermic cardiopulmonary bypass and selective cerebral perfusion. Computed tomography was performed to evaluate the residual false lumen in the descending aorta during follow-up.

Results: Thirty-day mortality was 3.74% (4/107 patients), and in-hospital mortality was 4.67% (5/107 patients). Spinal cord injury was observed in 3 patients (1 patient with left lower-extremity paraparesis and 2 patients with paraplegia). Cerebral infarction was observed in 3 patients, ventilator support exceeding 5 days was required in 9 patients, and rebleeding was observed in 4 patients. During a mean follow-up of 35 ± 14 months, 3 patients died and 3 patients were lost to follow-up. On postoperative computed tomography, complete thrombus formation was observed around the stented elephant trunk in 95% of patients (95/100) and at the diaphragmatic level in 69% of patients (69/100).

Conclusion: Low morbidity and mortality were achieved using total arch replacement combined with stented elephant trunk implantation. These encouraging surgical results and postoperative outcomes favor this more aggressive procedure for acute type A dissection. (J Thorac Cardiovasc Surg 2009;138:1358-62)

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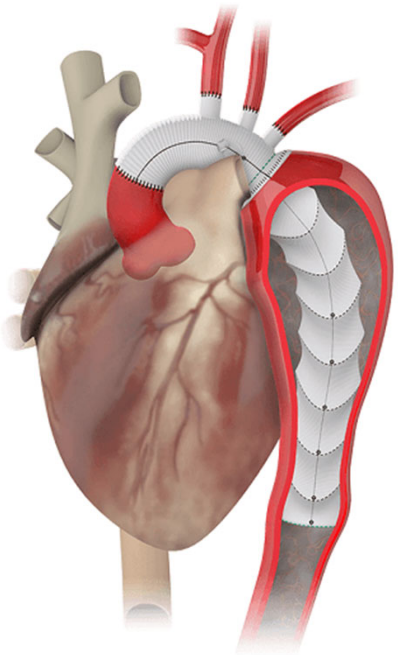
Terumo Aortic Thoraflex Hybrid™



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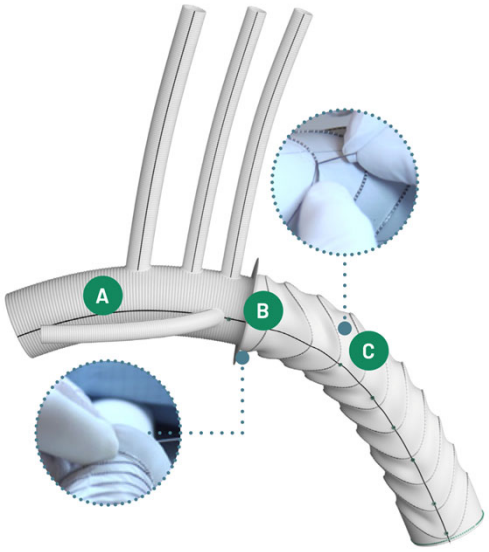
Terumo Aortic Thoraflex Hybrid™



- **A** 100% gelatin sealed Gelweave™ surgical graft and polyester stent graft
- **B** Suture collar facilitates hemostatic distal anastomosis to the aorta
- **C** "The unique nitinol ring stent design allows the graft to sit well within the native aortic arch, through most angulations"[1]

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ACQUIRED: AORTA

Total aortic arch replacement with a novel 4-branched frozen elephant trunk prosthesis: Single-center results of the first 100 patients

Malakh Shrestha, MBBS, Tim Kaufeld, MD, Erik Beckmann, MD, Felix Fleissner, MD, Julia Umminger, MD, Firas Abd Alhadi, MD, Dietmar Boethig, MD, Heike Krueger, RN, Axel Haverich, MD, and Andreas Martens, MD

TABLE 1. Pre-, intra-, and postoperative data

	All	Acute dissection	Chronic dissection	Aneurysm	*P* value
Preoperative data					
Patients	100	37	31	32	
Male sex	65 (65%)	28 (76%)	20 (65%)	17 (53%)	.15
Age, y	62 (49-70)	55 (47-68)	53 (43-67)	68 (61-75)	.0001
Marfan syndrome	12 (12%)	5 (14%)	7 (23%)	0 (0%)	.021
Previous surgery	28 (28%)	1 (3%)	23 (74%)	4 (13%)	<.0001
Renal insufficiency	17 (17%)	5 (14%)	6 (19%)	6 (19%)	.77
Malperfusion	11 (11%)	10 (27%)	1 (3%)	0 (0%)	.0004
Postoperative data					
Ventilation, d	1.0 (0.6-3.7)	2.8 (0.8-6.0)	0.9 (0.5-3.7)	0.7 (0.5-1.1)	.0014
Prolonged ventilation	29 (29%)	16 (43%)	9 (29%)	4 (13%)	.020
Rethoracotomy for bleeding	10 (10%)	6 (16%)	3 (10%)	1 (3%)	.19
Stroke	9 (9%)	5 (14%)	3 (10%)	1 (3%)	.32
Paraparesis	7 (7%)	3 (8%)	2 (7%)	2 (6%)	.96
Recurrent nerve palsy	25 (25%)	8 (22%)	12 (39%)	5 (14%)	.049
Acute kidney injury	30 (30%)	12 (32%)	12 (39%)	6 (20%)	.27
Dialysis	14 (14%)	4 (11%)	7 (23%)	3 (9%)	.25
Dialysis at discharge	8 (8%)	3 (8%)	3 (10%)	2 (6%)	.88
Hospital stay, d	17 (12-27)	16 (11-27)	20 (15-31)	15 (11-22)	.13
Perioperative mortality	7 (7%)	3 (8%)	1 (3%)	3 (9%)	.60

The Journal of Thoracic and Cardiovascular Surgery • July 2016

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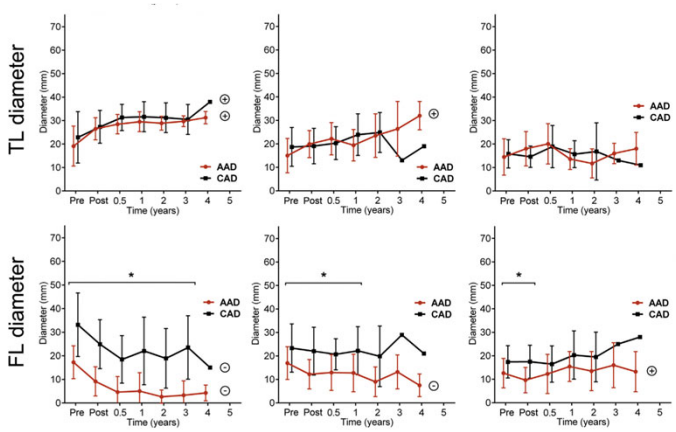
ACQUIRED: AORTA

Total aortic arch replacement with a novel 4-branched frozen elephant trunk prosthesis: Single-center results of the first 100 patients

Malakh Shrestha, MBBS, Tim Kaufeld, MD, Erik Beckmann, MD, Felix Fleissner, MD, Julia Umminger, MD, Firas Abd Alhadi, MD, Dietmar Boethig, MD, Heike Krueger, RN, Axel Haverich, MD, and Andreas Martens, MD



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The elephant trunk is freezing: The Hannover experience

Malakh Shrestha, MBBS, Erik Beckmann, MD, Heike Krueger, RN, Felix Fleissner, MD, Tim Kaufeld, MD, Nurbol Koigeldiyev, MD, Julia Umminger, MD, Fabio Ius, MD, Axel Haverich, MD, and Andreas Martens, MD

Background: The "elephant trunk" (ET) technique traditionally has been performed to treat complex aortic diseases involving the aortic arch and the descending aorta. Despite the fact that, in recent years, the "frozen elephant trunk" (FET) technique has been used increasingly for such pathologies, discussion is still ongoing in the surgical community regarding which of the 2 techniques is better. We compared our results using the classic ET versus the FET technique.

Methods: From August 2001 to March 2013, a total of 277 patients underwent total aortic arch replacement and either ET (group A) or FET (group B) implantation. In group A, 97 patients (59 men; age 59.7 ± 12.7 years; 44.3% with aneurysm; 55.6% with dissection [48.45% acute]) underwent an ET procedure; 21.64% were re-operations. In group B, 180 patients underwent an FET procedure (126 men; age 59.8 ± 13.2 years; 34.4% with aneurysm; 63.3% with dissection [35% acute]); 30% were reoperations.

Results: In group A, in-hospital mortality was 24.7%; postoperative stroke rate was 12.4%. During follow-up, 27.8% underwent a second-stage procedure. In group B, in-hospital mortality was 12.2%; postoperative stroke rate was 13.3%. During follow-up, 27.7% patients underwent further interventions in the downstream aorta.

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https://doi.org/10.1093/ejcts/ezac051 Advance Access publication 4 February 2022

ORIGINAL ARTICLE

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Frozen elephant trunk in acute aortic type a dissection: risk analysis of concomitant root replacement

Erik Beckmann *, Andreas Martens , Tim Kaufeld , Ruslan Natanov , Heike Krueger, Linda Rudolph, Axel Haverich and Malakh Shrestha

Department of Cardiothoracic, Transplantation and Vascular Surgery, Hannover Medical School, Hannover, Germany

* Corresponding author. Department of Cardiothoracic, Transplantation and Vascular Surgery, Hannover Medical School, Carl-Neuberg-Strasse 1, 30625 Hannover, Germany. Tel: +49-511-532-6581; fax: +49-511-532-5404; e-mail: beckmann.erik@mh-hannover.de (E. Beckmann).

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ORIGINAL ARTICLE

Total aortic arch replacement with frozen elephant trunk in acute type A aortic dissections: are we pushing the limits too far?†

Malakh Shrestha*, Felix Fleissner, Fabio Ius, Nurbol Koigeldiyev, Tim Kaufeld, Erik Beckmann, Andreas Martens and Axel Haverich

Department of Cardiothoracic, Transplantation and Vascular Surgery, Hannover Medical School, Hannover, Germany

* Corresponding author. Department of Cardiothoracic, Transplantation and Vascular Surgery, Hannover Medical School, Carl-Neuberg Strasse 1, 30625 Hannover, Germany. Tel: +49-511-5326238; fax: +49- 511-5328156; e-mail: shrestha.malakh.lal@mh-hannover.de (M. Shrestha).

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Featured Article

Open total arch replacement with trifurcated graft and frozen elephant trunk

Erik Beckmann#, Andreas Martens#, Wilhelm Korte, Tim Kaufeld, Heike Krueger, Axel Haverich, Malakh Shrestha

ORIGINAL ARTICLE

-Thoracic, Transplantation and Vascular Surgery, Hannover Medical School, Hannover, Germany
buted equally to this work.
akh Shrestha, MD. Department of Cardiothoracic, Transplantation and Vascular Surgery, Hannover Medical School, Carl-
625 Hannover, Germany. Email: shrestha.malakh.lal@mh-hannover.de.

kground: The frozen elephant trunk (FET) technique was introduced in Hannover Medical School
01 to treat patients with complex aortic arch pathologies. Since 2012, we primarily use the trifurcated
aflex Hybrid FET graft. In this article, we report our experience with the trifurcated FET graft.
hods: Between November 2012 and September 2018, 211 patients underwent FET implantation with
rifurcated Vascutek Thoraflex Hybrid graft. The indications for surgery were: degenerative aneurysms
patients, acute aortic dissections (AD) in 96 patients, and chronic ADs in 47 patients. And, 18% of cases
sternal re-operations.
ults: Mean cardiopulmonary bypass time, aortic cross-clamp time, and myocardial ischemia time were
84, 115±71, 50±26 minutes, respectively. Incidence of re-thoracotomy for bleeding, stroke, permanent
legia/paraparesis, prolonged ventilatory support (>96 h), and long-term dialysis were 13%, 18%, 2%,
, and 5%, respectively. In-hospital mortality was 12%. Follow-up was complete for 100% of patients
comprised a total of 513 patient years. The mean follow-up time was 2.2 [0–6] years. During follow-up,
were 32 aortic re-interventions distal to the FET. The survival rate at 1 and 5 years was 84% and 81%,
ctively.
clusions: Total aortic arch replacements with trifurcated FET can be performed with positive results.
trifurcated graft allows selective anastomosis of the supra-aortic vessels, which might result in improved
ostasis.

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Benefits of FET

- Treats tears in arch & prox. descending aorta
- Stabilizes the true lumen
- Treats malperfusion by re-expansion of the true lumen
- Promotes false lumen thrombosis
- Creates landing zone for future TEVAR

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Risks of FET

- Longer operative time
- Longer circulatory arrest time
- Spinal cord ischemia
- Technically more complex

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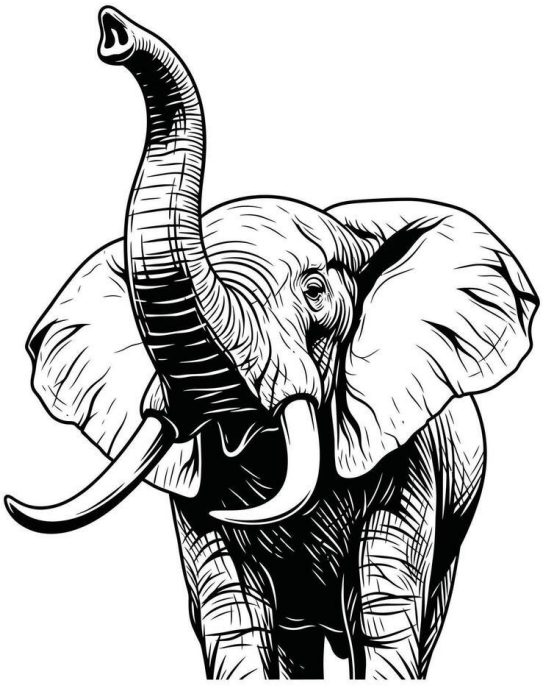
Ideal patients for FET

- Young(er) patients
- Distal malperfusion
- Arch or descending tear
- Extensive (type I) dissection



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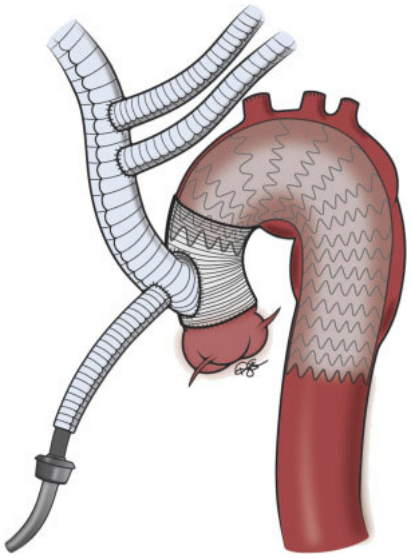
Debranching



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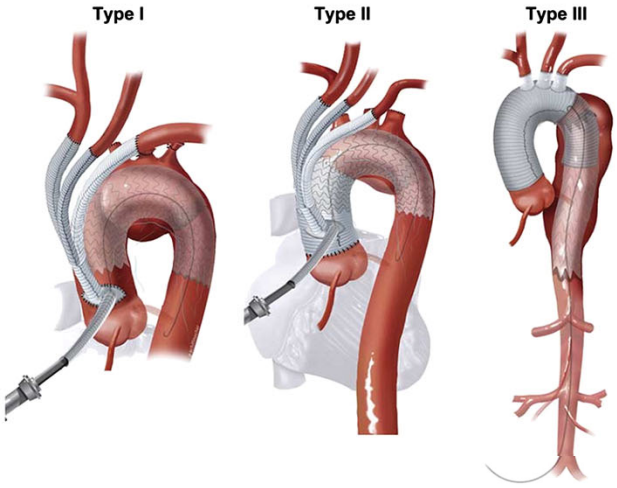
Have hybrid procedures replaced open aortic arch reconstruction in high-risk patients? A comparative study of elective open arch debranching with endovascular stent graft placement and conventional elective open total and distal aortic arch reconstruction

ACQUIRED CARDIOVASCULAR DISEASE

The Journal of Thoracic and Cardiovascular Surgery · September 2010

Rita Karianna Milewski, MD, PhD, Wilson Y. Szeto, MD, Alberto Pochettino, MD, G. William Moser, CRNP, Patrick Moeller, BS, and Joseph E. Bavaria, MD



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Have hybrid procedures replaced open aortic arch reconstruction in high-risk patients? A comparative study of elective open arch debranching with endovascular stent graft placement and conventional elective open total and distal aortic arch reconstruction

ACQUIRED CARDIOVASCULAR DISEASE

The Journal of Thoracic and Cardiovascular Surgery · September 2010

Rita Karianna Milewski, MD, PhD, Wilson Y. Szeto, MD, Alberto Pochettino, MD, G. William Moser, CRNP, Patrick Moeller, BS, and Joseph E. Bavaria, MD

TABLE 1. Preoperative characteristics and comorbidities

	Hybrid		Open total arch		
N	27		45		*P* values
Age, y	71.3	± 9.6	62.8	± 13.5	.008
Gender (N male)	16	62%	24	52%	.63
Prior CVA	3	12%	6	13%	1.00
Prior MI	5	19%	5	11%	.26
CRF	3	12%	2	4%	.344
Moderate/severe COPD	12	44%	5	11%	.003
Smoker	18	67%	23	51%	.077
Surgical history					
Redo sternotomy	6	22%	15	33%	.424
CABG	1	4%	5	11%	.40
Root replace	0		4	9%	.29
AVR/root	1	4%	3	7%	1.00
Asc aneurysm	0	0%	3	7%	.287
Type A dissection repair	2	7%	9	20%	.191
AAA	5	19%			.006
Pathology					
Atherosclerotic aneurysm	26	96%	26	58%	<.001
Fusiform	9	33%	18	40%	.623
Saccular	17	63%	8	18%	<.001
High-grade/mobile atheroma	13	48.1%	3	6.7%	<.001
Chronic dissection	1	4%	16	36%	<.001
Prior trauma			1	2%	
Other			2	4%	

TABLE 3. Outcomes

	Hybrid		Open total arch		*P*
	N = 27		N = 45		value
In-hospital mortality	3	11%	7	16%	.739
Stroke	1	4%	4	9%	.644
Transient neurologic deficit	0		5	11%	.15
Permanent paraplegia	2	7%	0		.137
Reversed spinal cord ischemia	3	11%	0		.049
renal failure	5	19%	5	11%	.486
Renal failure requiring new hemodialysis	3	11%	3	7%	.665
Reoperation for bleeding	0		1	2%	1.00
Afibrillation	9	33%	13	29%	.793
Mean hospital stay (d)	20.1	15.9	17.5	16.2	

Age stratification and mortality

	In-hospital mortality			
	Hybrid arch		Open total arch	
<75 y	2	14%	3	9%
>75 y	1	8%	4	36%

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Benefits of Debranching

- Eliminates circulatory arrest
- Type I: eliminates need for CPB
- Type II: reduces CPB time

Limitations of Debranching

- Limited role in type A dissection

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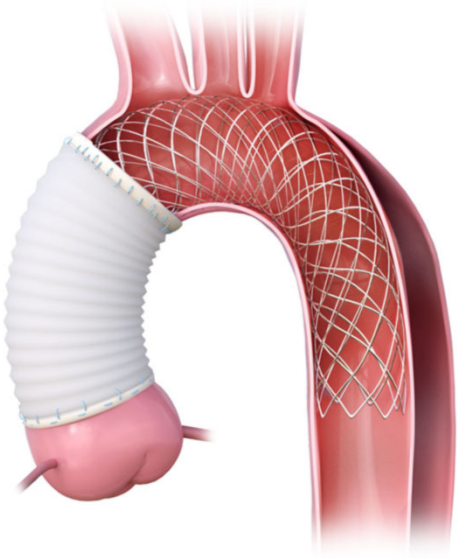
Artivion AMDS™ Hybrid



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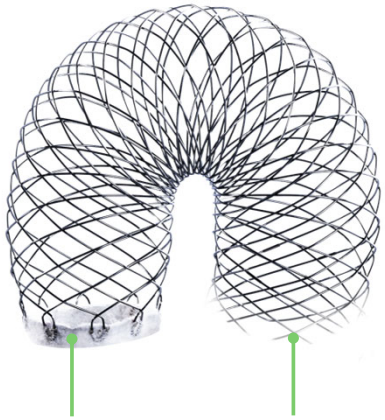
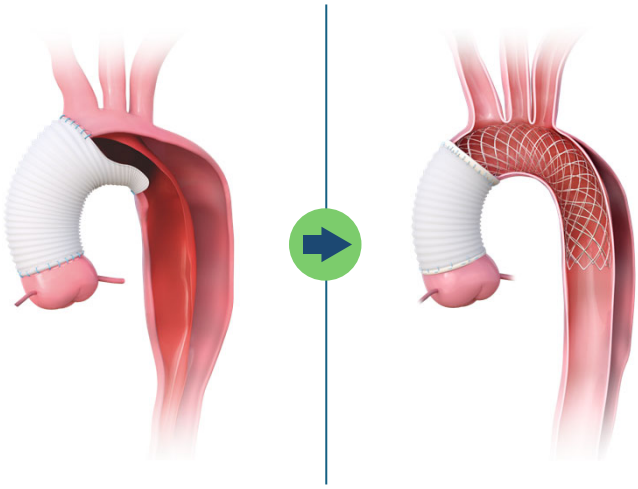
Artivion AMDS™





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A novel hybrid prosthesis for open repair of acute DeBakey type I dissection with malperfusion: Early results from the PERSEVERE trial

Wilson Y. Szeto, MD,[a] Shinichi Fukuhara, MD,[b] Fernando Fleischman, MD,[c] Ibrahim Sultan, MD,[d] William Brinkman, MD,[e] George Arnaoutakis, MD,[f] Hiroo Takayama, MD, PhD,[g] Kyle Eudailey, MD,[h] Derek Brinster, MD,[i] Arminder Jassar, MBBS,[j] Joseph DeRose, MD,[k] Chase Brown, MD,[a] Woodrow Farrington, MD,[l] and Michael C. Moon, MD[m]

ADULT: AORTA

The Journal of Thoracic and Cardiovascular Surgery • July 2025

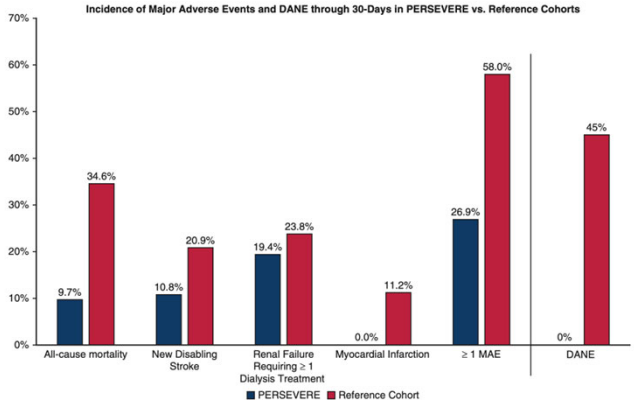

FIGURE 3. 30-day MAE and DANE rates compared with reference cohorts. *MAE*, Major adverse event; *DANE*, distal anastomotic new entry.

FIGURE 6. Example of positive aortic remodeling at 1-year, post-procedure at 1-year, post-procedure.

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What drives Strategy?

- Location of entry tear
- Extent of dissection
- Patient age
- Patient's condition
- Malperfusion
- Surgical expertise

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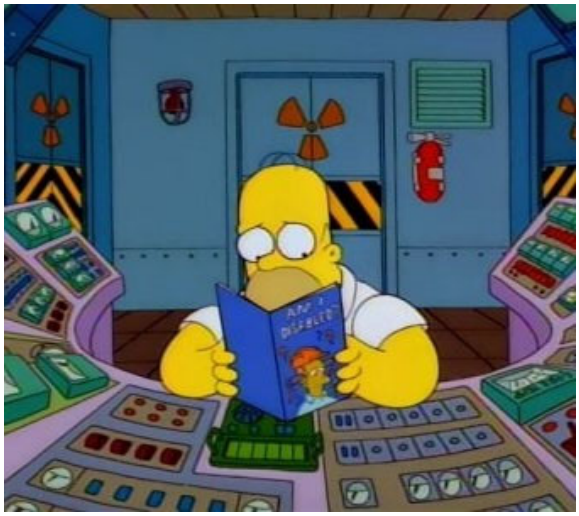
Practical Algorithm

- Type II dissection → Hemi-arch
- Type I dissection → Hemi-arch
  Entry in asc. Aorta
  Old / unstable pt.
- Type I dissection → Total arch + FET
  Young, stable pt.
- Tear in arch → Total arch ± FET
- Malperfusion → Total arch + FET
  or AMDS



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Therapy has to be tailored to the individual patient !

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Case Presentation

- **HPI:**
  - 75 y.o. male with acute chest pain
  - EKG showed STE, hence underwent coronay angiogram showing no relevant blockages
  - TTE was done the following day and showed „echodensity“ in the arch promtping CTA
  - CTA showed acute type A aortic dissection
- **PMH:**
  - hypertension
  - hyperlipidemia
  - tremor

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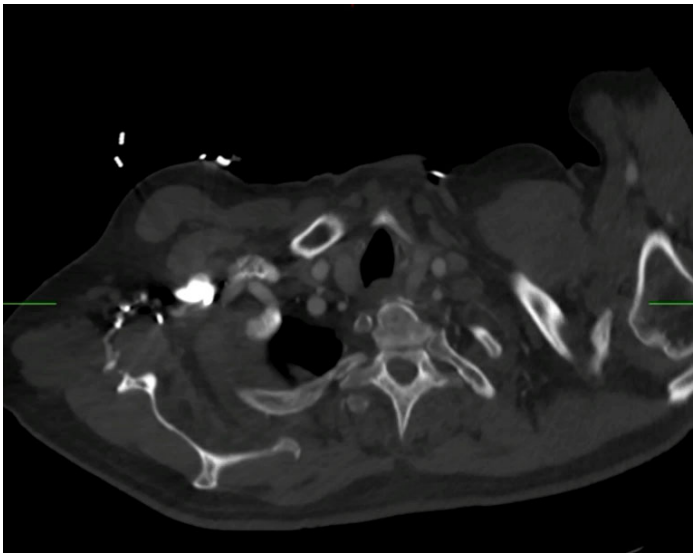
Case: Preoperative CT-A



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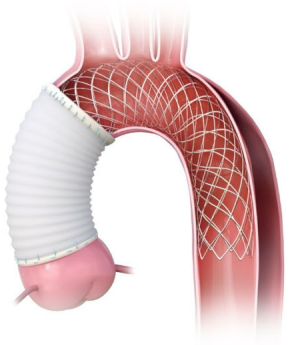
Artivion AMDS™ Hybrid Prosthesis

Minneapolis Heart Institute

Allina Health
ABBOTT NORTHWESTERN HOSPITAL



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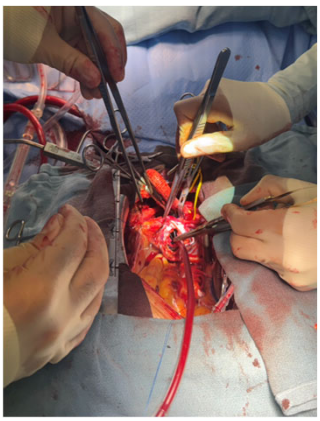
Case Presentation

Hospital Course:

- Return to OR for hemorrhage
- Extubated on POD 1
- Postop: afib, delirium
- Discharged on POD 14



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Surgical Outcome of AADA Repair at MHI

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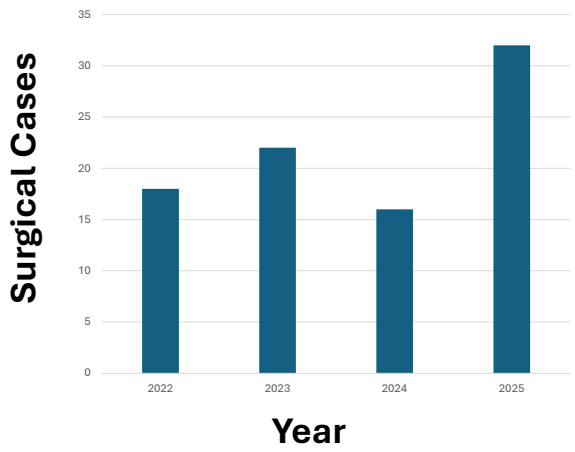
Annual case volume at MHI



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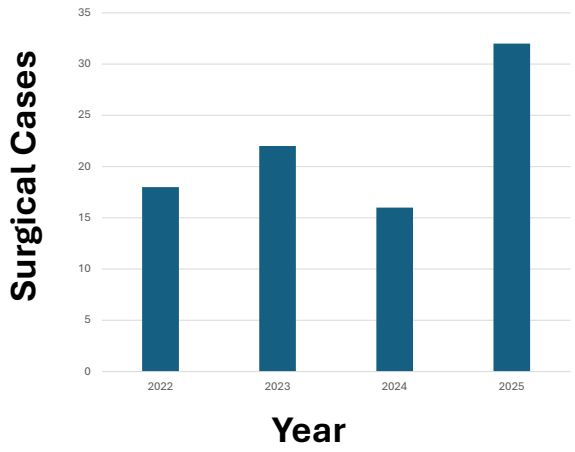
Annual case volume at MHI



Patient characteristic	n=88
Age (years)	62 ± 16
Male (n, %)	59 (67%)
Previous cardiac surgery (n, %)	5 (6%)

55

Intraoperative data

Proximal aortic repair	n=88
Ascending replacement (n, %)	59 (67%)
Full root replacement (n, %)	29 (33%)
Distal aortic repair	**n=88**
Hemiarch repair (n, %)	52 (59%)
Hemiarch with antegrade hybrid-stent placement (n, %)	1 (1%)
Subtotal arch (n, %)	4 (5%)
Total arch with endovascular stent (FET)	27 (31%)
Total arch without FET (n, %)	1 (1%)
No circulatory arrest (n, %)	3 (3%)
Concomitant cardiac procedures	**n=19**
Coronary artery bypass grafting (n, %)	5 (6%)
Aortic valve replacement (n, %)	10 (11%)
Mitral valve surgery (n, %)	1 (1%)
Tricuspid valve surgery (n, %)	3 (3%)

56

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Postoperative outcome

Characteristic	n=88
ICU stay (days)	6 (0-33)
Stroke (n, %)	15 (17%)
Rethoracotomy for bleeding (n, %)	12 (14%)
Dialysis (n, %)	11 (12%)
ECMO (n, %)	5 (6%)
In-hospital mortality (n, %)	8 (9%)

58

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Prognosis after Surgery?

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Is Compliance With Guideline Recommended Follow-Up After Aortic Dissection Associated With Survival?

Amit Sharma, MD, Jesse M. Manunga, MD, Larissa Stanberry, PhD, Matthew P. Pavlovec, RN, Darlington Nwaudo, BA, Craig Strauss, MD, MBA, Ross F. Garberich, MS, Benjamin Sun, MD, Domenico Calcaterra, MD, Karol Mudy, MD, Jessica M. Titus, MD, and Kevin M. Harris, MD

Minneapolis Heart Institute Foundation at Abbott Northwestern Hospital, Minneapolis, Minnesota

ABSTRACT

BACKGROUND Patients with acute aortic dissection (AD) remain at risk for long-term complications and thus are recommended to adhere closely to American College of Cardiology and American Heart Association aorta guideline-based follow-up imaging and clinic visits. The long-term outcomes of compliance with such a model are not well understood.

METHODS This was a retrospective cohort study of patients at a regional AD center who survived hospital discharge for AD and who were analyzed by compliance with initial follow-up at 3 months and long term after AD. The primary end point was death.

RESULTS A total of 172 (66% type A; 33% type B) patients survived hospitalization and were followed up over 48 months (interquartile range [IQR], 21, 88 months). Of these patients, 122 (71%) attended the first follow-up appointment, and 90 (52%) attended more than two-thirds of recommended appointments. Patients who attended the first follow-up visit had improved long-term follow-up compliance (75% [IQR, 50%, 91%]) compared with patients who did not attend the first visit (18% [IQR, 0%, 57%]). Noncompliance with the scheduled long-term follow-up was associated with a 50% increase in the risk of death (hazard ratio, 1.6; 95% confidence interval, 1.2, 2.1; $P < .001$). Furthermore, in patients with low compliance (consistently attending less than one-third of follow-up appointments), the lifetime risk of death after AD was more than double that of patients with high compliance (consistently attending more than two-thirds of appointments) (hazard ratio, 2.2; 95% confidence interval, 1.5, 3.1; $P < .001$).

CONCLUSIONS Nearly one-third of patients with AD do not attend the first recommended follow-up visit, and such failure was associated with later noncompliance with subsequent follow-up. Low-compliant patients have double the lifetime risk of death after AD than do high-compliant patients.

(Ann Thorac Surg 2022;113:846-52)

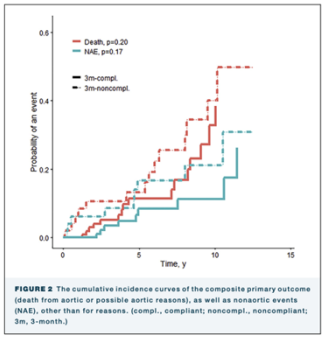

FIGURE 2 The cumulative incidence curves of the composite primary outcome (death from aortic or possible aortic reasons), as well as nonaortic events (NAE), other than for reasons. (compl., compliant; noncompl., noncompliant; 3m, 3-month.)

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Future Directions?

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Future Directions?

Terumo Aortic Rapidlink

Gore TAG TBE

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Is Hybrid the Future?

YES, for selected patients
- FET improves aortic remodeling
- Reduction of future interventions

NO, as a universal strategy
- Surgery remains standard of care
- Not all pts require aggressive repair

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Is Hybrid the Future?

YES, for selected patients
- FET improves aortic remodeling
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NO, as a universal strategy
- Surgery remains standard of care
- Not all pts require aggressive repair

THE FUTURE IS TAILORED AORTIC SURGERY !

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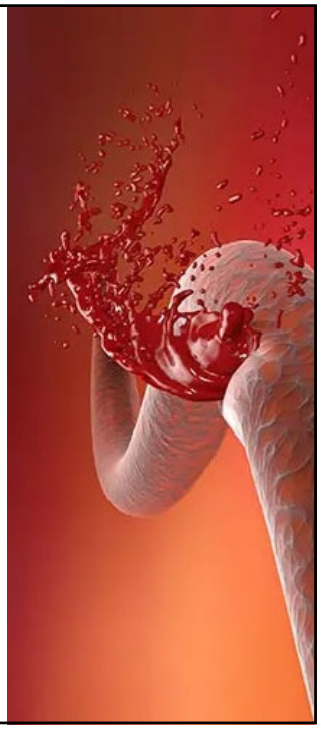
Conclusions

- Type A dissection requires emergent surgery
- Patient's condition and disease impact extent of repair
- Hybrid strategies are expanding, but not universal
- Hybrid repair may improve future prognosis
- Balance: risk now vs. benefit later
- Primary goal is always to keep patient!



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Abbott Northwestern Intensivist Service

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Teamwork !

Allina Health
COURAGE KENNY REHABILITATION INSTITUTE

MINNEAPOLIS ANESTHESIA PARTNERS

Minneapolis Heart Institute Foundation

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ABBOTT NORTHWESTERN

Thank you for your attention!

Erik Beckmann, MD
Minneapolis Heart Institute
erik.beckmann@allina.com

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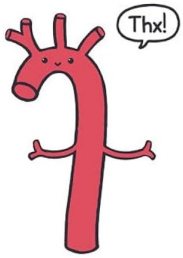

Aorta say Thank You!

Erik Beckmann, MD
Minneapolis Heart Institute
erik.beckmann@allina.com

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