

# Surgery for Acute Aortic Dissection

Thoralf M. Sundt, MD  
Director, Cardiac Clinical Service MGB  
Chief, Division of Cardiac Surgery MGH  
Co-Director Corrigan-Minehan Heart Center  
Edward D. Churchill Professor of Surgery, Harvard Medical School

Dec 2, 2022

## Disclosures

**None relevant**

### 3 Questions

- 1) Is an operation indicated?
- 2) What operation do we do?
- 3) Where should the operation be done?

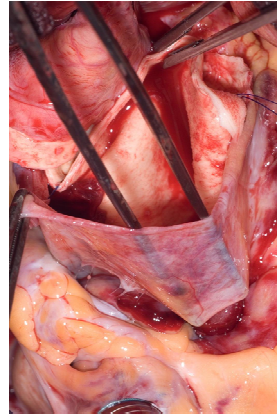
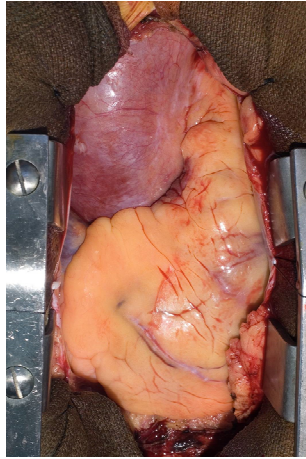


### 3 Questions

- 1) Is an operation indicated?
  - 1) Type A vs B etc
  - 2) timing
- 2) What operation do we do?
  - 1) Hemi
  - 2) Total
  - 3) Frozen Elephant Trunk
- 3) Where should the operation be done?
  - 1) Dedicated team
  - 2) Malperfusion



## What we are treating



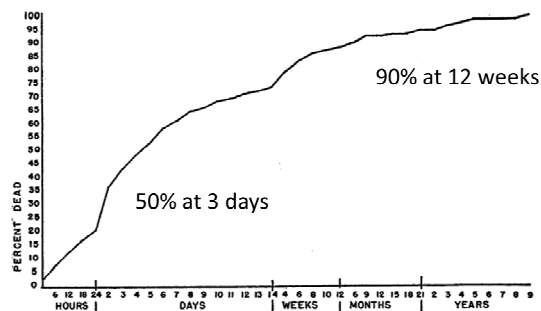
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## Dissection is Highly Lethal: “1%/hr”

### DISSECTING ANEURYSM OF THE AORTA: A REVIEW OF 505 CASES

ALBERT E. HIRST, JR., M.D., VARNER J. JOHNS, JR., M.D.,  
and S. WESLEY KIME, JR., M.D.

(From the Departments of Pathology and Medicine of the College of  
Medical Evangelists, Los Angeles, California)



Note these are autopsy  
data from the 1950's –  
“of those who died....”



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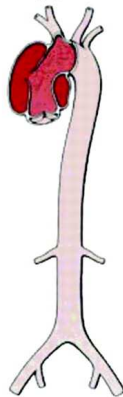
## A Closer Look: Distinguishing Subsets of Dissection

**De Baakey Type I**



**Stanford**

**Type II**



**Type A**

**Type III**



**Type B**

**Type A** = involves **A**scending

**Type B** = involved the aorta around **B**ack (the descending aorta is next to the spine!)

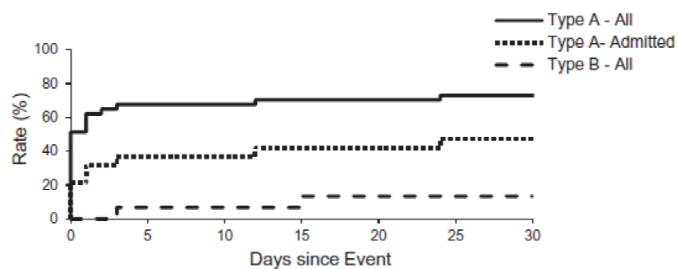
And "B" rhymes with "3" so Type B is the same as Type 3



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## Dissection is Highly Lethal: UK Data

50% pre-hospital mortality for Type A



Numbers at risk	Type - A	37	13	13	12	12	11	11
	Type - B	15	14	14	14	14	14	14

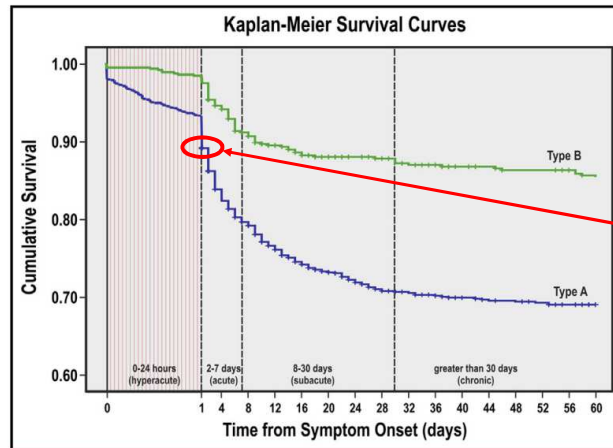
30 day mortality rate



*Circulation. 2013;127:2031-2037.*

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## What is the Rate of Death?



**Figure 1** Kaplan-Meier survival curve for Type A and Type B aortic dissection.

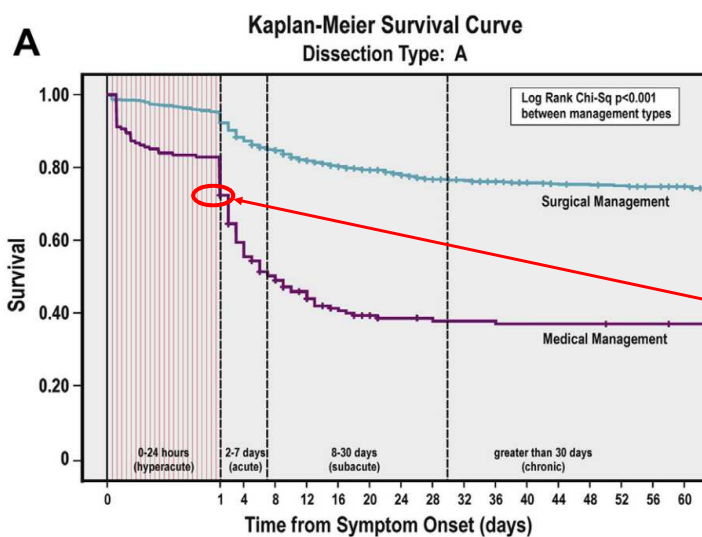
IRAD:

The risk of death is significantly higher for type A than type B

10% mortality in 24 hours for Type A



## What is the Rate of Death?



IRAD

30% mortality in 24 hrs if not operated (1%/hr)



# How should we treat them Surgically?

ADULT: 2021 AATS EXPERT CONSENSUS DOCUMENT: SURGICAL TREATMENT OF ACUTE TYPE A AORTIC DISSECTION

## 2021 The American Association for Thoracic Surgery expert consensus document: Surgical treatment of acute type A aortic dissection

Check for updates

S. Christopher Malaisrie, MD,<sup>a</sup> Wilson Y. Szeto, MD,<sup>b</sup> Monika Halas, MD,<sup>a</sup> Leonard N. Girardi, MD,<sup>c</sup> Joseph S. Coselli, MD,<sup>d</sup> Thoralf M. Sundt III, MD,<sup>e</sup> Edward P. Chen, MD,<sup>f</sup> Michael P. Fischbein, MD, PhD,<sup>g</sup> Thomas G. Gleason, MD,<sup>h</sup> Yutaka Okita, MD,<sup>i</sup> Maral Ouzounian, MD, PhD,<sup>j</sup> Himanshu J. Patel, MD,<sup>k</sup> Eric E. Roselli, MD,<sup>l</sup> Malakh L. Shrestha, MD, PhD,<sup>m</sup> Lars G. Svensson, MD, PhD,<sup>l</sup> and Marc R. Moon, MD,<sup>n</sup> the AATS Clinical Practice Standards Committee: Adult Cardiac Surgery

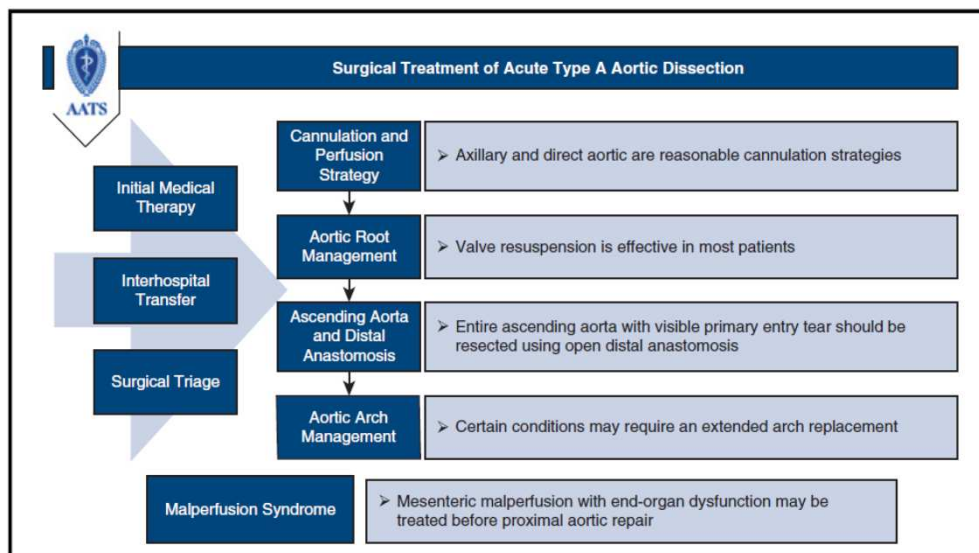
ADULT



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## Surgical Overview



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## Surgical Overview

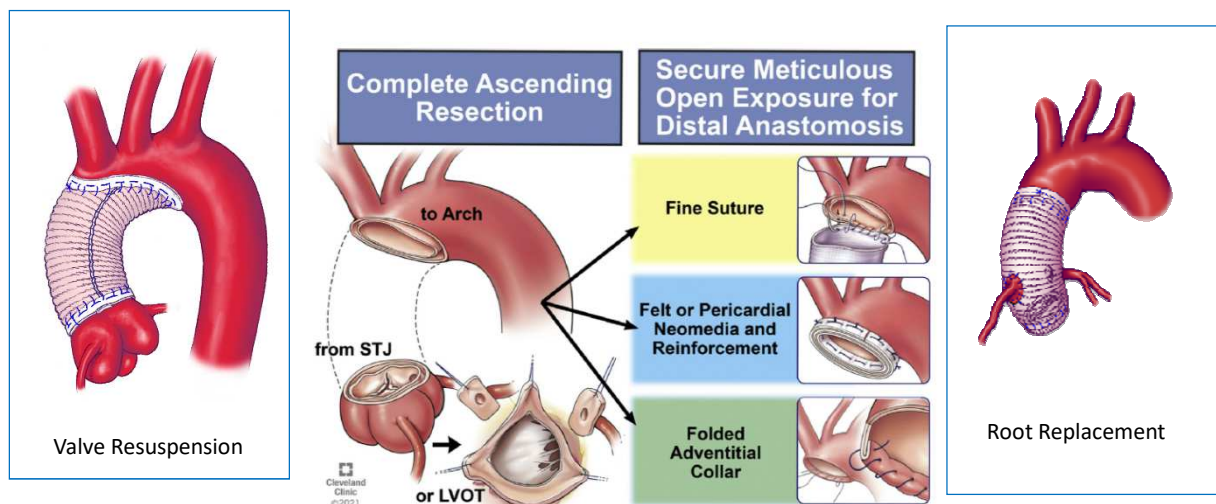
Recommendations	COR	LOE	References
<b>Surgical Triage</b>			
1. Emergency surgery is recommended for patients with acute type A aortic dissection.	I	B	1-4
2. Surgery is recommended in patients with type A IMH and one or more high-risk features*.	I	C	7,8
3. Expectant management may be reasonable for type A IMH patients with significant comorbidities in the absence of high-risk features*.	IIb	C	9-13
4. Surgery can be effective in patients with ATAAD and brain malperfusion.	IIa	B	14-20
5. Nonoperative management is reasonable in catheter induced ATAAD, if limited to the aortic root.	IIa	B	21-23
6. Descending TEVAR alone may be reasonable in selected patients with retrograde ATAAD.	IIb	C	24,25

*COR*, Class of recommendation; *LOE*, level of evidence; *ATAAD*, acute type A aortic dissection; *IMH*, intramural hematoma; *TEVAR*, thoracic endovascular aortic repair. \*Aortic diameter >50 mm, hematoma thickness >11 mm, pericardial effusion, aortic regurgitation, ulcer-like projection.



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## The Standard Operation: Replacement of Ascending Aorta with Hemi-Arch, Valve Resuspension or Root Replacement



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## Resuspension Generally Preferred, but ...

### Limited root repair in acute type A aortic dissection is safe but results in increased risk of reoperation

Peter Chiu, MD, MS,<sup>a,b</sup> Jeffrey Trojan, BA,<sup>a</sup> Sarah Tsou, BA,<sup>a</sup> Andrew B. Goldstone, MD, PhD,<sup>a,b</sup> Y. Joseph Woo, MD,<sup>a</sup> and Michael P. Fischbein, MD, PhD<sup>a</sup>

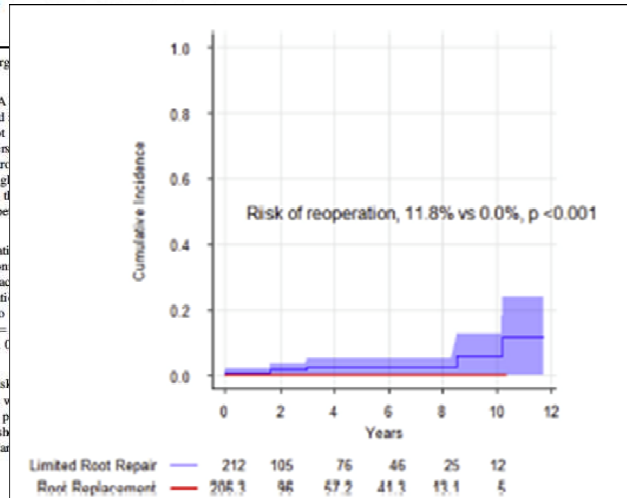
#### ABSTRACT

**Objective:** Management of the aortic root is a challenge for surgeons in acute type A aortic dissection.

**Methods:** We performed a retrospective review of the acute type A aortic dissection experience at Stanford Hospital between 2005 and 2015 and patients who underwent either limited root repair or aortic root replacement. Differences in baseline characteristics were balanced with inverse probability weighting to estimate the average treatment effect on the outcome of in-hospital mortality. We used multivariable logistic regression to evaluate in-hospital mortality. We used proportional hazards regression to evaluate differences in time to death. Reoperation was evaluated with death as a competing event in the Fine-Gray subdistribution hazard model.

**Results:** After we excluded patients managed either nonoperatively or with definitive endovascular repair, there were 293 patients without competing events who underwent either limited root repair or aortic root replacement. There was no difference in weighted perioperative mortality, odds ratio [confidence interval], 0.44-1.76,  $P = .7$ , and there was no difference in weighted survival, hazard ratio [95% CI], 0.54-2.31,  $P = .5$ . Reoperation was greater in limited root repair (11.8%, 95% CI, 0.0-25.0%) than for root replacement (0%),  $P < .001$ .

**Conclusions:** Limited root repair was associated with increased risk of reoperation after repair of acute type A aortic dissection. Surgeons with experience may consider aortic root replacement in well-selected patients. However, given good outcomes after limited root repair, surgeons should be encouraged to perform this more-complex operation. (J Thorac Cardiovasc Surg 2017; ■:1-7)



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## Management of the Aortic Arch

TABLE 7. Management of the aortic arch

Recommendations	COR	LOE	References
<b>Aortic Arch Management</b>			
1. Extended aortic arch replacement is reasonable in patients with ATAAD and: - primary entry tear in the arch or proximal descending thoracic aorta, - brain or peripheral malperfusion, - arch or descending thoracic aortic aneurysm or rupture.	IIa	B	1-9
2. Extended aortic arch replacement with frozen elephant trunk may be reasonable in ATAAD to promote favorable aortic remodeling.	IIb	B	10-23
3. Extended aortic arch replacement may be considered in young patients with Marfan syndrome or hereditary thoracic aortic disorders.	IIb	C	24-30

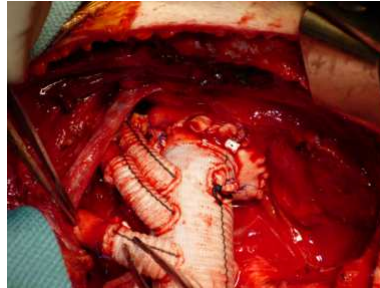
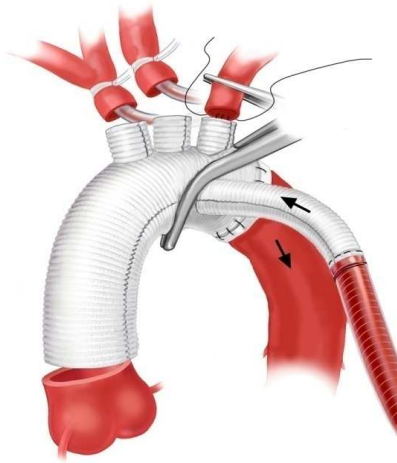
COR, Class of recommendation; LOE, level of evidence; ATAAD, acute type A aortic dissection.



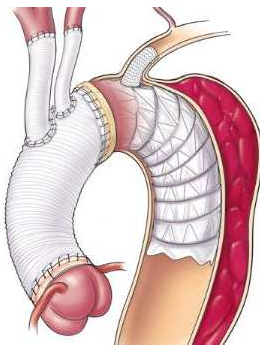
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## Zone 3 Total Arch Replacement



## Add TEVAR: “Frozen Elephant Trunk”



- Improves flow into true lumen, promotes false lumen thrombosis, and may address malperfusion
- Can favorably affect distal aortic remodeling
- Small risk of paraplegia
- Probably best restricted to patients at risk for patent false lumen (large proximal fenestration in DTA) or compressed true lumen



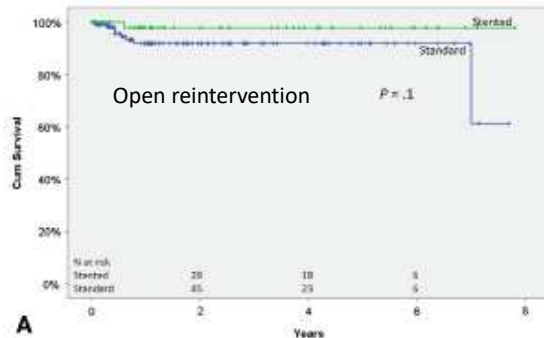
## The impact of frozen elephant trunk is unclear

Acquired Cardiovascular Disease

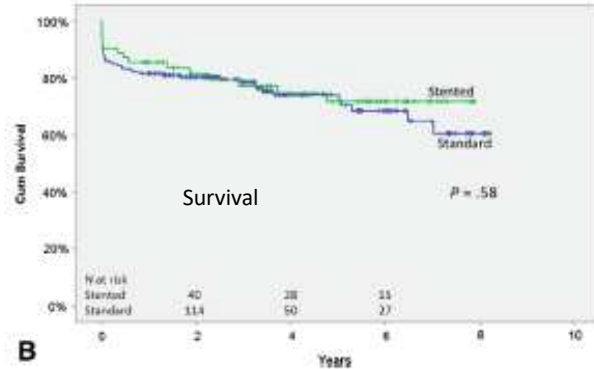
Vallabhajosyula et al

### Antegrade thoracic stent grafting during repair of acute DeBakey type I dissection promotes distal aortic remodeling and reduces late open distal reoperation rate

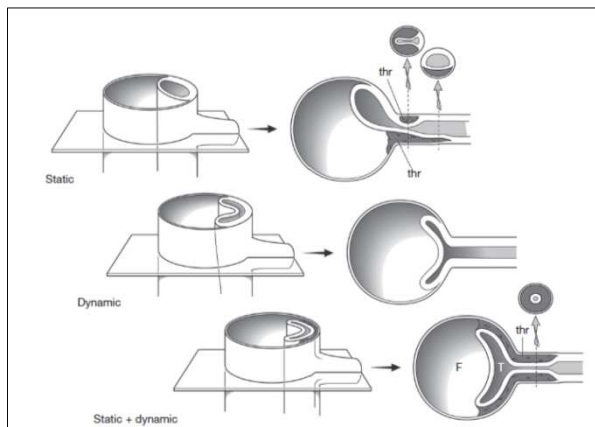
Prashanth Vallabhajosyula, MD, MS,<sup>a</sup> Wilson Y. Szeto, MD,<sup>a</sup> Aaron Pulsipher, BS,<sup>a</sup> Nimesh Desai, MD, PhD,<sup>a</sup> Rohan Menon, BS,<sup>a</sup> Patrick Moeller, BS,<sup>a</sup> Shenara Musthaq,<sup>a</sup> Alberto Pochettino, MD,<sup>b</sup> and Joseph E. Bavaria, MD<sup>a</sup>



Cardiovasc Surg 2014;147:942-50)



## What do we mean by Malperfusion?



### Impact on Mortality:

Pacini et al for the Emilia-Romagna AAD Registry (2011) N=502

- 43.7% mortality with Malperfusion vs
- 15% without ( $p < .001$ )

Geirsson et al U Penn (2007) N=244

- 30.5% mortality with Malperfusion vs
- 6.2% without ( $p < .001$ )

IRAD Registry

- Surgical mortality for patients with visceral malperfusion = 41.7%

*Greater than 2x increase in mortality*



# Management of Malperfusion

TABLE 8. Management of malperfusion

Recommendations	COR	LOE	References
<b>Malperfusion Management</b>			
1. It is reasonable to delay proximal aortic repair until after definitive treatment of mesenteric malperfusion.	Ila	B	6-11
2. Descending TEVAR, aortic fenestration, and branch vessel stenting are reasonable treatment options for mesenteric malperfusion.	Ila	C	9,12
3. It may be reasonable to perform revascularization for leg ischemia with sensory/motor deficits before proximal aortic repair.	Ilb	C	13-15

COR, Class of recommendation; LOE, level of evidence; TEVAR, thoracic endovascular aortic repair.



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## U Penn – Concomitant TEVAR

**Central Repair With Antegrade TEVAR for Malperfusion Syndromes in Acute DeBakey I Aortic Dissection**

Prashanth Vallabhajosyula, MD, MS, Jean Paul Gottfert, MD, Rohan Menon, BS, Ibrahim Sultan, MD, Zara Abbas, MS, Mary Siki, BS, Matthew Kramer, BS, Aaron Pulipher, MD, Suveeksha Naidu, Alberto Pochettino, MD, Karana Milewski, MD, PhD, Wilson Y. Szeto, MD, and Joseph E. Ravaria, MD

Division of Cardiovascular Surgery, University of Pennsylvania

**Background:** In acute DeBakey I aortic dissection, whether standard open repair with concomitant stent grafting (thoracic endovascular repair TEVAR) of the descending thoracic aorta or standard open repair with TEVAR of the descending thoracic aorta is superior remains unclear.

**Methods:** From 2005 to 2012, 277 patients with acute DeBakey I aortic dissection underwent emergent aortic repair. The patients were divided into those who had standard open repair (standard group, n = 43) versus those who had concomitant TEVAR during open repair (TEVAR group, n = 38). Prospectively maintained database was retrospectively reviewed.

**Results:** Demographic characteristics and comorbidities were similar. Circulatory arrest was 14 ± 14 minutes, p = 0.001 and cross-clamp time 10 ± 10 minutes, p = 0.001 times were longer in the TEVAR group.

**Patients presenting with acute DeBakey I aortic dissection with malperfusion syndrome are one of the highest surgical risk cohorts that need surgical treatment (1-3). Surgical outcomes in a subset of patients remain poor, especially in coronary and cerebral malperfusion, and in malperfusion syndromes. There is consensus on the management of this complex patients, although most centers believe that type A dissection repair, which confers a central true lumen flow, is the optimal prior platform. Some centers advocate for emergent surgical treatment of the malperfusion of embolizing, on an open-heart operation.**

Accepted for publication June 4, 2016.  
Presented at the Sixty-second Annual Meeting of the Society of Thoracic Surgeons, Philadelphia, PA, Nov 4-7, 2015.  
Address correspondence to Dr. Vallabhajosyula, Division of Cardiovascular Surgery, University of Pennsylvania, 3401 Locust Walk, Philadelphia, PA 19104-6218; e-mail: vallabhajosyula@upenn.edu.

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Some impact by adding TEVAR

Ann Thorac Surg  
2017;103:748-55

VALLABHAJOSYULA ET AL  
ACUTE AORTIC DISSECTION WITH MALPERFUSION 751

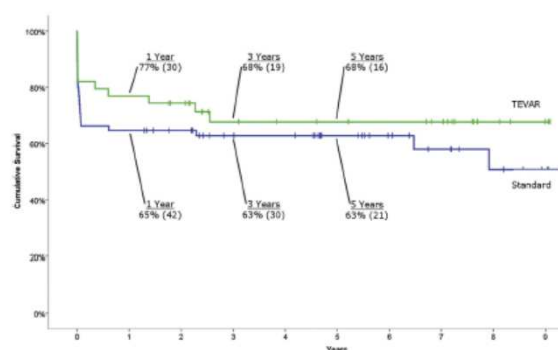


Fig 1. Cumulative survival in Standard versus thoracic endovascular aneurysm repair (TEVAR) group patients presenting with malperfusion.



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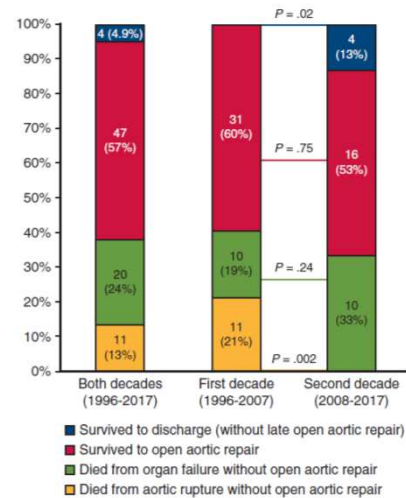
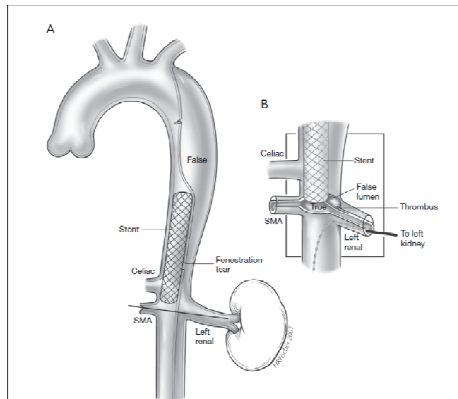
## Michigan approach: Fenestration first

Yang et al

Adult: Aortic Dissection

### Managing patients with acute type A aortic dissection and mesenteric malperfusion syndrome: A 20-year experience

Bo Yang, MD, PhD,<sup>a</sup> Elizabeth L. Norton, MS,<sup>b</sup> Carlo Maria Rosati, MD,<sup>a</sup> Xiaoting Wu, PhD,<sup>a</sup> Karen M. Kim, MD,<sup>a</sup> Minhaj S. Khaja, MD, MBA,<sup>c</sup> G. Michael Deeb, MD,<sup>a</sup> David M. Williams, MD,<sup>c</sup> and Himanshu J. Patel, MD<sup>d</sup>



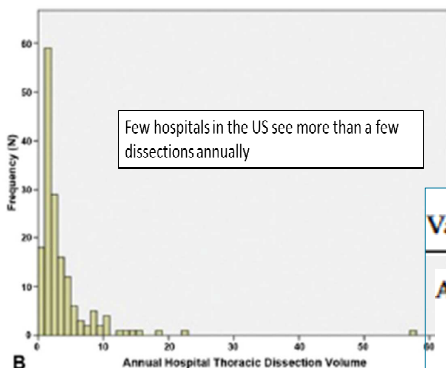
(J Thorac Cardiovasc Surg 2019;158:675-87) 25

## Who/Where Should Surgery be Done?

TABLE 2. Interhospital transfer recommendations

Recommendations	COR	LOE	References
<b>Interhospital Transfer</b>			
1. When cardiac surgery is not immediately available, it is reasonable to transfer patients with ATAAD to a Comprehensive Aortic Center.	Ila	B	3,6,10,12
2. It may be reasonable to transfer patients with complicated ATAAD to a Comprehensive Aortic Center.	IIb	C	7,10,11

## Where should the operation be performed?



### National Outcomes in Acute Aortic Dissection: Influence of Surgeon and Institutional Volume on Operative Mortality

Joanna Chikwe, MD, Paul Cavallaro, BS, Shinobu Itagaki, MD, Matthew Seigerman, BS, Gabrielle DiLuozzo, MD, and David H. Adams, MD

Department of Cardiothoracic Surgery, Mount Sinai Medical Center, New York, New York

Variable Description	Frequency (%)	Mortality Rate (%)	Unadjusted <i>p</i> Value
Acute dissection surgeon annual volume			
Lowest (<1)	21.8	27.5	<0.001
Low (1 <2)	31.7	22.9	
High (2 <5)	27.0	19.0	
Highest (>5)	18.1	17.0	

mortality of 27.5%, compared with 17.0% for those averaging 5 or more annually (odds ratio, 1.78; 95% confidence interval, 1.39 to 2.29; *p* < 0.001). This was similar to

(Ann Thorac Surg 2013;95:1563-9)  
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## Who should perform the operation?

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http://dx.doi.org/10.1016/j.jacc.2014.10.085

**Dissection of the Aorta**

### Outcomes of Acute Type A Dissection Repair Before and After Implementation of a Multidisciplinary Thoracic Aortic Surgery Program

Nicholas D. Andersen, MD, Arvin M. Ganapathi, MD, Jennifer M. Hanna, MD, MBA, Judson B. Williams, MD, MHS, Jeffrey G. Gao, MD, G. Chad Hughes, MD  
Durham, North Carolina

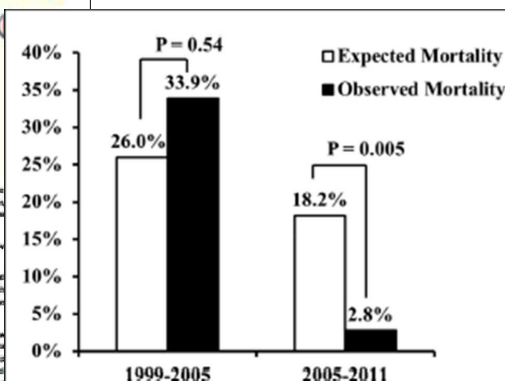
**Objectives** The purpose of this study was to compare the results of acute type A aortic dissection (ATAAD) repair before and after implementation of a multidisciplinary thoracic aortic surgery program (TASP) at our institution. High-volume thoracic aortic surgeons, a multidisciplinary approach to thoracic aortic disease management, and a standardized protocol for ATAAD repair.

**Background** Outcomes of ATAAD repair may be improved when operations are performed at specialized high-volume thoracic aortic centers.

**Methods** Between 2009 and 2013, 528 patients underwent ATAAD repair at our institution. Records of patients who underwent ATAAD repair 6 years before (n = 56) and 6 years after (n = 72) implementation of the TASP were retrospectively compared. Expected operative mortality rates were calculated using the International Acute Aortic Dissection pre-operative prediction model.

**Results** Baseline risk profile and expected operative mortality rates were comparable between patients who underwent ATAAD repair before and after implementation of the TASP. Operative mortality before TASP implementation was statistically equivalent to the expected operative mortality rate of 26.0% (observed-to-expected ratio 1.30; *p* = 0.94). Operative mortality after TASP implementation fell to 2.8% and was statistically compared with the expected operative mortality rate of 18.2% (observed-to-expected mortality rate 0.008). Differences in survival persisted over long-term follow-up, with 5-year survival rates of 85% TASP patients compared with 55% for pre-TASP patients (*p* = 0.002).

**Conclusions** ATAAD repair can be performed with results approximating those of elective proximal aortic surgery operations performed by a high-volume multidisciplinary thoracic aortic surgery team. Efforts to centralize care of patients undergoing ATAAD are warranted. (J Am Coll Cardiol) 2014;63:1796-1804. © 2014 by the American College of Cardiology Foundation



**Figure 1** Observed and Expected Operative Mortality Rates for Acute Type A Aortic Dissection Repair



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## Care can be Regionalized: Minneapolis MN

**Innovations in Care**


**Multidisciplinary Standardized Care for Acute Aortic Dissection**  
**Design and Initial Outcomes of a Regional Care Model**

Kevin M. Harris, MD\*; Craig E. Strauss, MD, MPH\*; Sue Deval, PhD; Barbara T. Unger, RN; Timothy J. Kroschus, MD, PhD; Subbarao Inampudi, MD; Jonathan D. Cohen, MD; Christopher Kapsner, MD; Lori L. Boland, MPH; Frazier Eales, MD; Eric Rohman, BA; Quirino G. Orlandi, MD; Thomas F. Flavin, MD; Vibhu R. Kohettry, MD; Kevin J. Graham, MD; Alan T. Hirsch, MD; Timothy D. Henry, MD

"No physician can diagnose a ... thinks about."

Patients with acute aortic dissection (AAD) have an in-hospital mortality of 26%, with type A AAD, the mortality risk is even higher. Until emergency surgical repair is available, therefore critical that AAD be recognized and that surgical care be provided expeditiously. The International Registry of Acute Aortic Dissection (IRAD) indicates that the median time from ED presentation to definitive diagnosis is 4.5 hours, with an additional 4 hours surgical intervention for type A patients. Delay to surgery is often the result of transfer to smaller community hospitals and emergent AAD. Transfer to high-volume centers with highly specialized facilities and even at such centers, current surgical care is often delayed.

**Goals and Vision of the Model**  
In an effort to address factors that delay optimal management, a standardized protocol for the regional treatment of AAD was developed and implemented with the goal of integrated, and coordinated care throughout all phases of care. The model is a collaborative team design for ST-elevation myocardial infarction (STEMI), the specific aim is to decrease the time from hospital admission to treatment and to improve clinical outcomes for AAD. A collaborative team design



Time from Dx to OR cut from 8 hrs to 5.6

**Table 3. Time to OR in Surgically Managed Type A AAD Patients, Before and After Protocol Implementation, by Hospital of Initial Presentation**

Variable	Before Protocol			After Protocol			P Value
	n	Time		n	Time		
Time from initial presentation to OR							
All hospitals	20	482	(252, 1137)	37	338	(223, 586)	0.188
Tertiary	5	192	(136, 219)	7	233	(165, 295)	0.421
Community (all)	15	728	(369, 1487)	30	366	(229, 784)	0.039
Community (in-network only)	15	728	(369, 1487)	22	316	(216, 1099)	0.056
Time from diagnosis to OR*	20	113	(51, 174)	37	51	(34, 98)	0.006

Values are expressed as median (25th percentile, 75th percentile). Three type A surgically managed patients treated after protocol implementation were excluded from these analyses owing to unclear presentation time.

\*Within tertiary facility.