Type B Dissections: Past, Present, Future

The Houston Aortic Symposium

Aortic Dissection (Distal)

Friday, February 24, 2017

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Michael Dake, MD

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  - Graftwork
  - Intact
- Officer, Director, Board Member or other Fiduciary Role
  - VIVA Physicians Group
- Speaker's Bureau
  - None

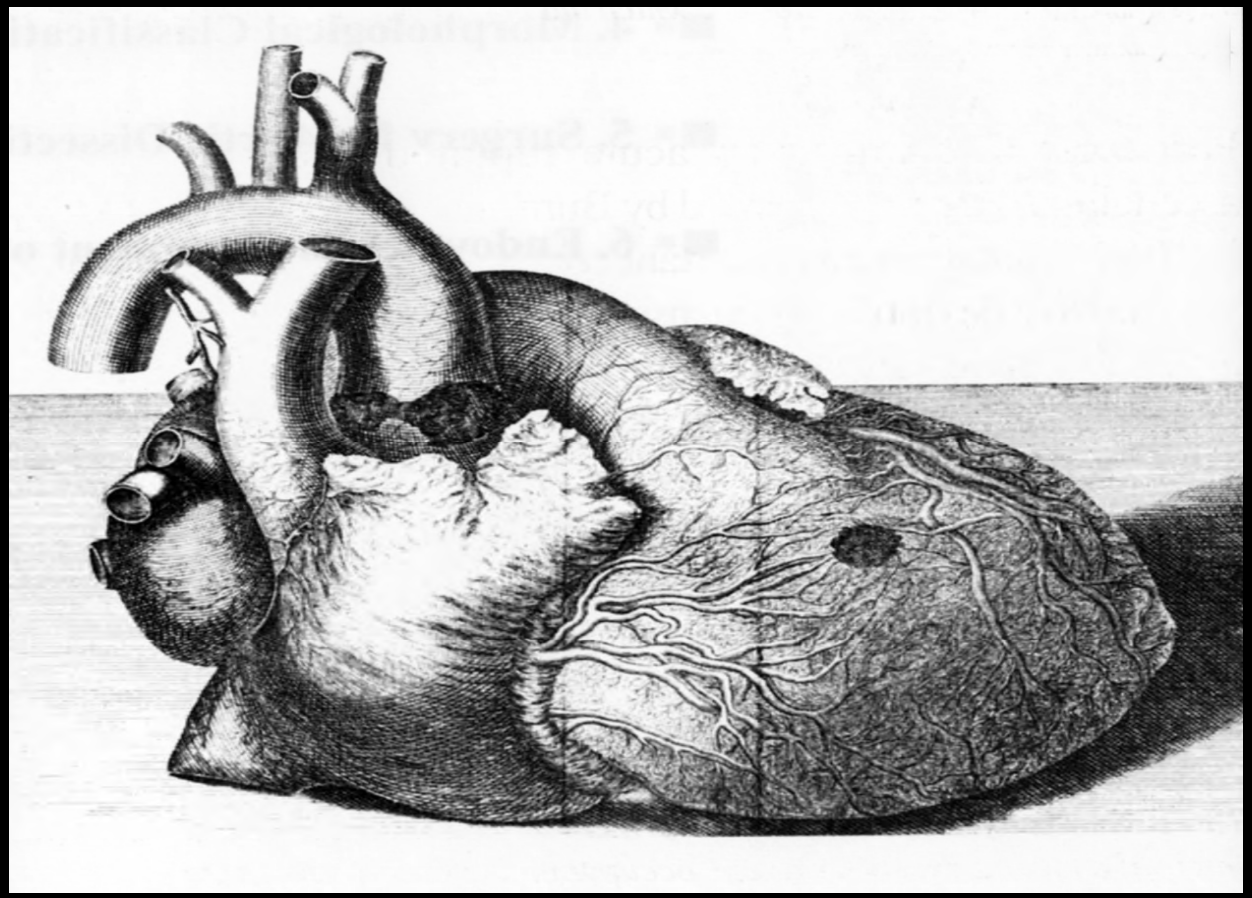
History …

on 25 Oct. 1760, King George II (age 76), rose at his normal hour of 6 am, called as usual for his chocolate, and repaired to the closet-stool. The German valet de chamber heard a noise, ‘louder than the royal wind’, and then a groan, he ran in and found the King lying on the floor …

Portrait by John Shackleton, in or after 1755

At necropsy the next day Dr Nicholls, physician to his late Majesty, found the pericardium distended with a pint of coagulated blood, probably from an orifice in the right ventricle, and a transverse fissure on the inner side of the ascending aorta, 3.75 cm long, through which blood had recently passed in its external coat to form a raised ecchymosis, this appearance being interpreted as an incipient aneurysm of the aorta.

Leonard JC. BMJ 1979;2:260-262



SURGICAL MANAGEMENT OF DISSECTING ANEURYSMS OF THE AORTA

Michael E. De Bakey, M.D., Walter S. Henly, M.D., Denton A. Cooley, M.D., George C. Morris, Jr., M.D., E. Stanley Crawford, M.D., and Arthur C. Beall, Jr., M.D., Houston, Texas

DISSECTING aneurysm has long been recognized as an ominous and highly lethal form of aortic disease, for which no effective therapy was available until about a decade ago.[3, 5, 11, 17] More recently an increasing number of reports have appeared indicating that the natural course of the disease can be altered favorably by surgical treatment.[1, 2, 6, 8, 10, 12, 13, 15, 16, 18] During the past decade, since our first successful operation for a dissecting aneurysm of the aorta, we have employed some form of surgical treatment in 179 patients with either acute or chronic types of the disease. As a consequence of this experience, a much better understanding of the anatomic and pathologic patterns of the disease has been obtained, leading to the development of specific and more effective methods of surgical treatment. Accordingly, this report is concerned

January 1965
J Thor Cardiovasc Surg
1965; 49; 130

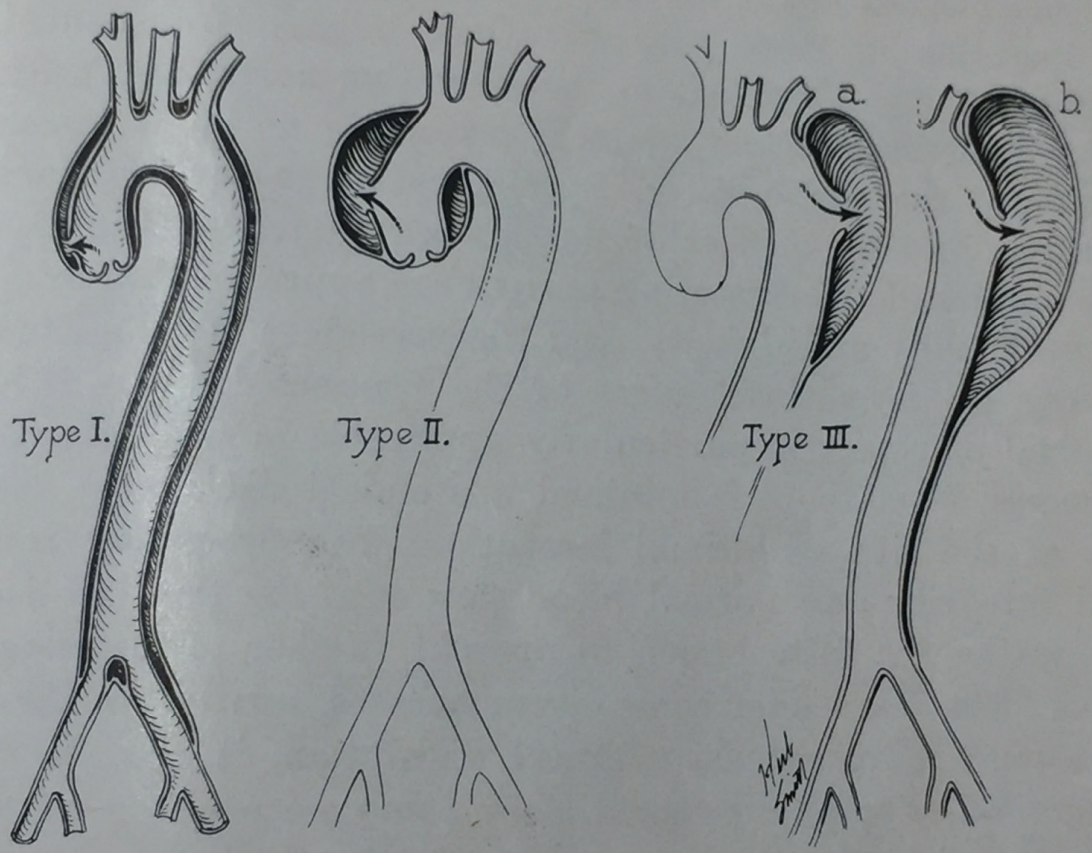


Fig. 1.—Drawing which illustrates surgical classification of dissecting aneurysm of aorta into three basic types in accordance with origin and extent of dissecting process.

Management of Acute Aortic Dissections

Pat O. Daily, M.D., H. Ward Trueblood, M.D.,
Edward B. Stinson, M.D., Robert D. Wuerflein, M.D.,
and Norman E. Shumway, M.D.

Acute dissecting aneurysm of the aorta continues to be associated with an excessively high mortality. Consequently, both surgical and nonsurgical therapeutic approaches have evolved. The superiority of one method over the other has not been clearly demonstrated. At most institutions the tendency has been to use one method to the exclusion of the other.

In reviewing the literature [13, 14, 16–18] and the experience at Stanford University Hospital, it has become apparent that there is a very significant and distinct difference in the clinical course and prognosis in patients in whom the ascending aorta is involved with dissection as opposed to those in whom disease does not extend proximal to the left subclavian artery. Aortography makes it possible in nearly all cases to determine the site of the initial intimal tear [12, 22] or at least to determine if the ascending aorta is involved. A therapeutic approach has evolved which utilizes both surgical and medical methods of management, depending upon the origin of the dissection. The present report describes this method of management and relates the experience at the Stanford University Hospital.

CLINICAL SERIES AND RESULTS

From April, 1964, to June, 1969, 35 patients with dissecting aortic aneurysm were treated by the Cardiovascular Surgery Service at Stanford University Hospital. There has been 100% follow-up on these patients as of June, 1969.

The average age in this group of patients was 58 years, with a range from 34 to 72. Approximately one-third were women. In 30 patients the dissection was acute, of less than two weeks' duration. In the remaining 5 patients the dissection had been present more than two weeks and was considered to be chronic.

Initially, surgical or medical therapy was generally selected after consideration of the patient's condition and evaluation of complications from dissection, such as renal artery involvement, mesenteric ischemia, or aortic insufficiency. These complications placed the patient into the surgical group. Later in the series, patients found to have ascending aorta involvement were operated upon immediately, whereas the others were evaluated for surgical or medical treatment as outlined above.

From the Department of Surgery, Division of Cardiovascular Surgery, Stanford University School of Medicine, Stanford, Calif. 94305.

Presented at the Sixth Annual Meeting of The Society of Thoracic Surgeons, Atlanta, Ga., Jan. 12–14, 1970.

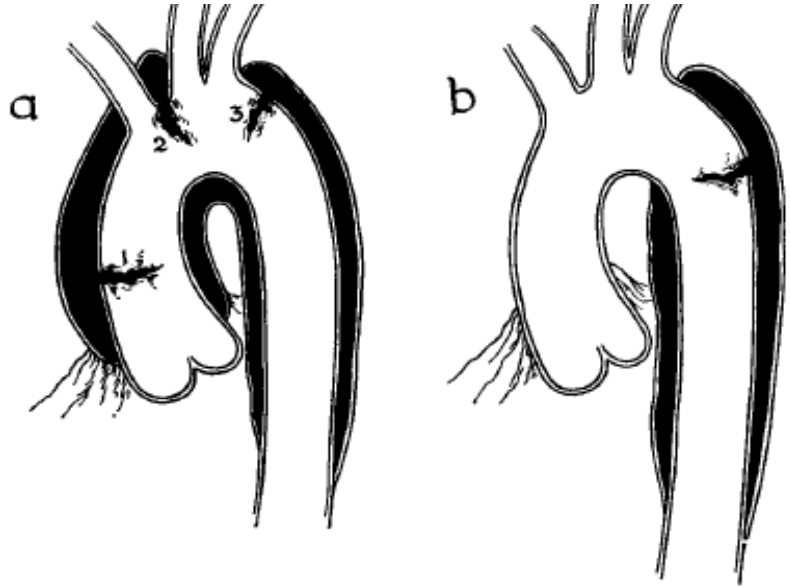


FIG. 3. Classification of aortic dissections. In type A the ascending aorta is dissected (a). *The intimal tear has always been at position* 1, *but it can occur at positions* 2 *or* 3 *(see text). In type B dissection the dissection is limited to the descending aorta* (b), *and the intimal tear is usually within 2 to 5 cm. of the left subclavian artery.*

Ann Thorac Surg 1970

From this therapeutic standpoint, it is suggested that aortic dissection classification be further simplified to designate whether the ascending aorta is involved. In this classification, type A indicates involvement of the ascending aorta from dissection originating there or from a proximal dissection. Type B dissections are limited to the descending aorta. These types are diagramed in Figure 3.

Dissecting Aneurysm of the Descending Aorta

Improved Surgical Results in 91 Patients

George J. Reul, Jr., MD; Denton A. Cooley, MD; Grady L. Hallman, MD; Sitaram B. Reddy, MD; E. Ross Kyger III, MD; Don C. Wukasch, MD

PATIENTS AND METHODS

We have classified dissecting aneurysms originating in the descending thoracic aorta (type III or descending arch) into four subtypes (Fig 1). The subtypes have the same site of origin, that is, distal to the left subclavian artery, but vary according to extension of the dissection: type III-A extends to the midthoracic aorta (Fig 2); type III-B extends to the level of the diaphragm (Fig 3); in type III-C the dissecting aneurysm and false channel extend below the diaphragm (Fig 4); type III-D is a retrograde extension into the ascending aorta with antegrade dissection below the diaphragm (Fig 5). The surgical management of each of these lesions is different, as is the prognosis and the importance of early surgical intervention.

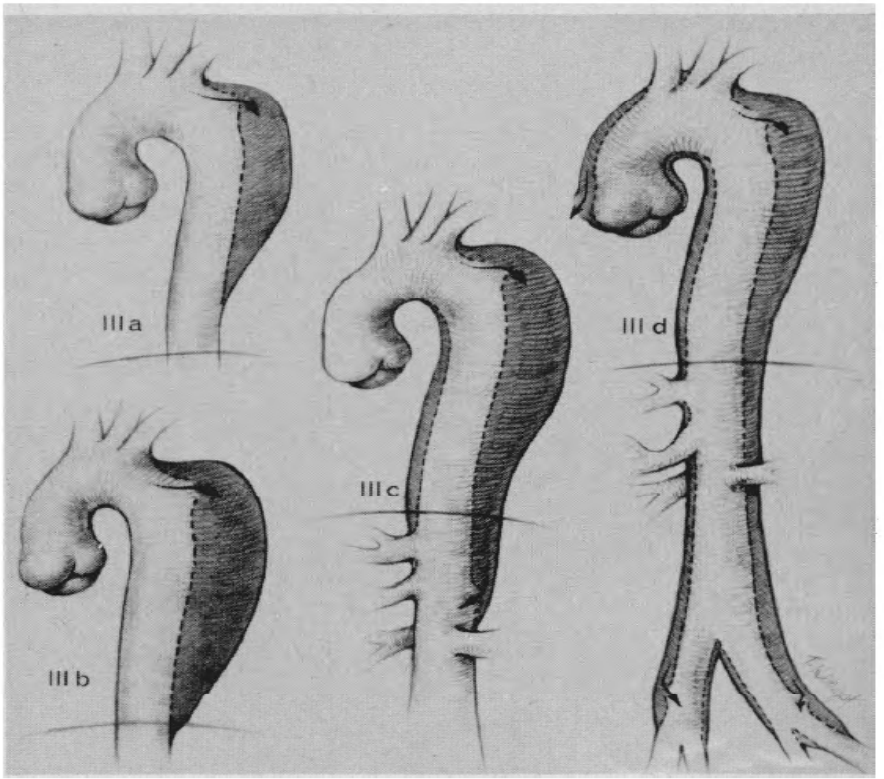


Fig 1.—Subtypes of type III dissection of thoracic aorta. All have initiation of dissecting process at or below subclavian artery. Subtypes are according to extent of dissection, either retrograde or antegrade.

ARCH SURG 1975

September 1965
J Thor Cardiovasc Surg
1965; 50; 364

Treatment of dissecting aneurysms of the aorta without surgery

Myron W. Wheat, Jr., M.D., Roger F. Palmer, M.D. (by invitation), Thomas D. Bartley, M.D. (by invitation), and Robert C. Seelman, M.D. (by invitation), Gainesville, Fla.*

Dissecting aneurysm of the aorta is one of the most serious problems confronting the cardiovascular surgeon. De Bakey and his group have been leaders in emphasizing the high mortality for this catastrophic lesion without surgical intervention. Recently, De Bakey's group updated their surgical experience to 179 cases with an current surgical management and to re examine the untreated course of acut dissecting aortic aneurysm. From suc considerations, the following points a clear: (1) In the untreated dissecti aneurysm, few patients die immediatel The untreated mortality rate is only 3 p cent immediately but progressively ri

J Thorac Cardiovasc Surg. 1965 Sep;50:364-73.

TREATMENT OF DISSECTING ANEURYSMS OF THE AORTA WITHOUT SURGERY.

WHEAT MW Jr, PALMER RF, BARTLEY TD, SEELMAN RC.

New Drug Therapy Replaces Surgery In Some Dissecting Aortic Aneurysms

In six consecutive cases in which the new therapy was used, all patients are surviving 9 to 15 months later—but . . . "By rights, most or all of these patients should be dead."

A team of investigators at the University of Florida College of Medicine is substituting a drug regimen for surgical intervention in certain cases of acute dissecting aneurysms of the aorta.

In six consecutive cases in which the new therapy has been used, all patients are surviving 9 to 15 months later, the Florida group told the annual meeting in New Orleans of The American Association for Thoracic Surgery. Surgery has been performed on only one of the six patients, and that was on an elective basis nine months after diagnosis.

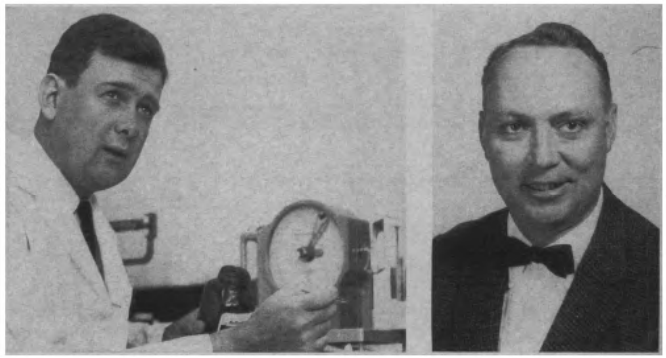
In contrast, death occurred within five days after surgical repair in each of six earlier consecutive cases in which the drug therapy was not used.

Describing the series of surviving patients, Myron W. Wheat, Jr., MD, chief of thoracic and cardiovascular surgery at Florida, told THE JOURNAL: "By rights, most or all of these patients should be dead."

Dissecting aneurysm of the aorta is "one of the most serious problems confronting the cardiovascular surgeon," he said. Mortality after surgery ranges from 21% reported by one group to greater than 60%, as reported by most surgeons.

On the other hand, Wheat said, the mortality rate in the untreated is 3% immediately, but rises to 21% in 24 hours, 60% in two weeks, and 90% in three months. Healing can occur, in some cases, through recanalization.

Concluding that "the principal cause of death is not directly attributable to the initial tear, but is more related to forces that continue the dissection," the Florida group sought to define and reduce these forces. If this could be accomplished, they reasoned, static

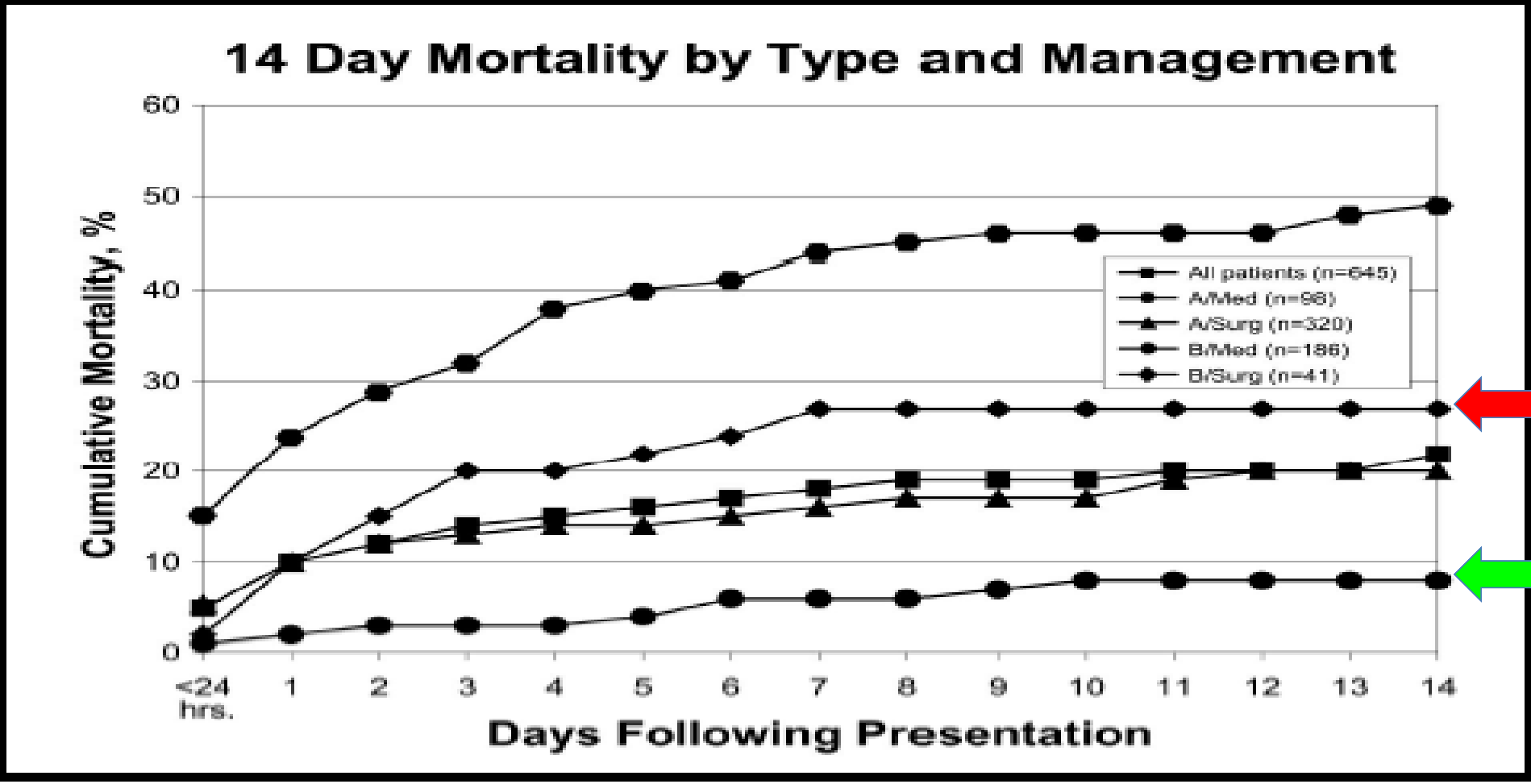


Near Right: **Roger Palmer, MD. *Far Right:* Myron W. Wheat, Jr., MD, both of the University of Florida College of Medicine. Wheat is chief of thoracic and cardiovascular surgery.**

IRAD: International Multicenter Prospective Registry

JAMA 2000;283:897-903.

Circulation 2003; 108 [Suppl II]: II312-II 317



Aneurysmal degeneration of the thoracoabdominal aorta after medical management of type B aortic dissections

Christopher A. Durham, MD, Nathan J. Aranson, MD, Emel A. Ergul, MS, Linda J. Wang, MD, Virendra I. Patel, MD, MPH, Richard P. Cambria, MD, and Mark F. Conrad, MD, MMSc, *Boston, Mass*

Background: Patients with uncomplicated type B aortic dissections who are managed medically are at risk of aortic aneurysmal degeneration over time. However, the effect of improvement in antihypertensive medications and stricter blood pressure control is unknown. The goal of this study was to determine the rate of aneurysmal degeneration in a contemporary cohort of patients with medically treated type B dissection.

Methods: Included were all patients with acute uncomplicated type B aortic dissection who were initially managed medically between March 1999 and March 2011 and had follow-up axial imaging studies. Maximum aortic growth was calculated by comparing the initial imaging study to the most current scan or imaging obtained just before any aortic-related intervention. An increase of ≥5 mm was the threshold considered as aortic growth. Predictors of aortic aneurysmal degeneration were determined using Cox proportional hazards models.

Results: We identified 200 patients (61% men) with medically managed acute type B dissections receiving multiple imaging studies. Patients were an average age of 63.4 years, and 75.5% had a history of hypertension. Mean follow-up was 5.3 years (range, 0.1-14.7 years). Mean time between the initial and final imaging studies was 3.2 years (range, 0.1-12.9 years). At 5 years, only 51% were free from aortic growth. Fifty-six patients (28%) required operative intervention (50 open, 6 endovascular repair) for aneurysmal degeneration, and the actuarial 5-year freedom from intervention was 76%. After excluding five patients (2.5%) with early rapid degeneration requiring intervention within the first 2 weeks, the mean rate of aortic growth was 12.3 mm/y for the total aortic diameter, 3.8 mm/y for the true lumen diameter, and 8.6 mm/y for the false lumen diameter. Only aortic diameter at index presentation >3.5 cm was a risk factor for future growth (odds ratio, 2.54; 95% confidence interval, 1.34-4.81; $P < .01$). Complete thrombosis of the false lumen was protective against growth (odds ratio, 0.19; 95% confidence interval, 0.11-0.42; $P < .01$).

Conclusions: Although medical management of uncomplicated acute, type B aortic dissections has been the standard of care, at 5 years, a significant number of patients will require operative intervention for aneurysmal degeneration. Further studies of early intervention (eg, thoracic endovascular aortic repair) for type B aortic dissection to prevent late aneurysm formation are needed. (J Vasc Surg 2015;62:900-6.)

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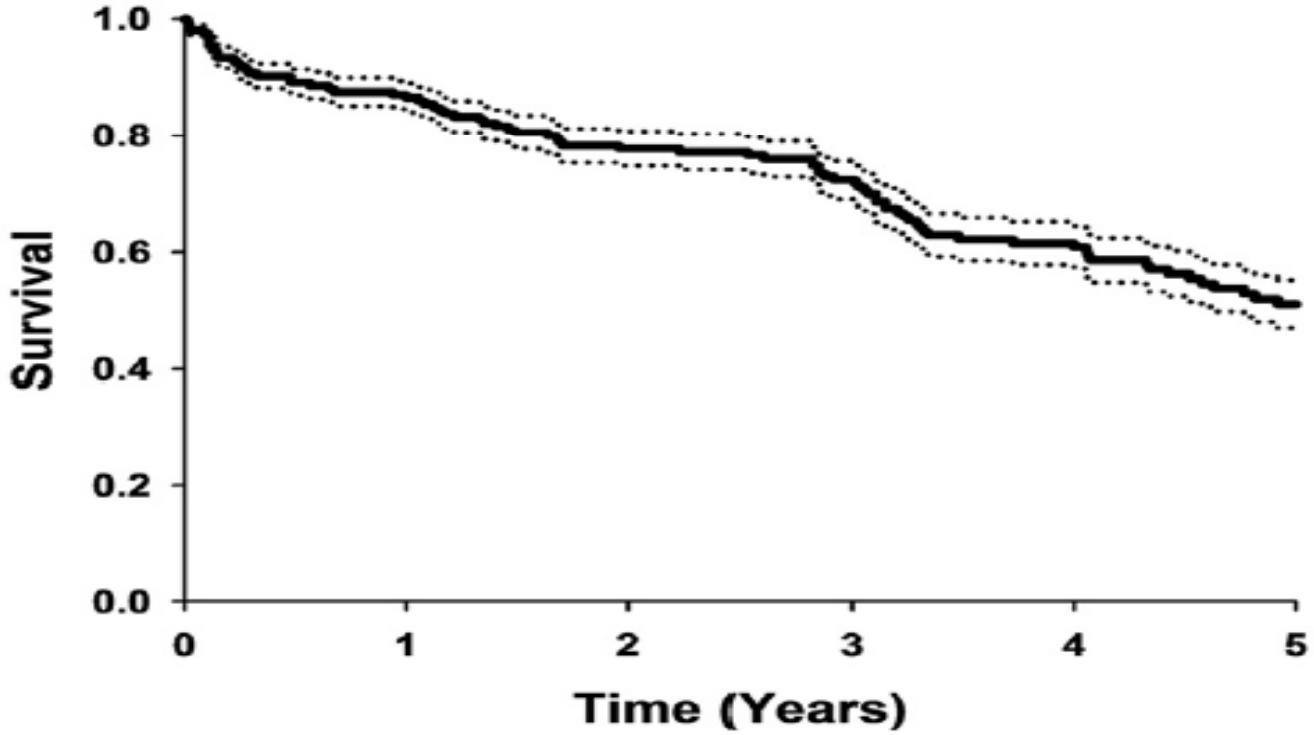

At risk:	200	161	134	117	85	54
Survival (%):	100.0	86.6	77.8	72.3	60.8	51.1
SE (%):	0.0	2.5	3.0	3.3	3.7	4.1

Fig 1. Kaplan-Meier curve shows freedom from aortic growth in 200 patients with uncomplicated, acute type B dissection.

verse tear in the intima beginning just above the aortic valve, with separation of the intramural layers that terminates just proximal to the origin of the innominate artery (Fig. 1). It also is characterized by a relatively thin outer layer that usually assumes the appearance of a fusiform aneurysm and often is associated with incompetence of the aortic valve. This type is more likely to be found in patients with certain stigmata of Marfan's disease.

TYPE III.—This form of the disease is characterized by the fact that the dissecting process arises in the descending thoracic aorta usually at or just distal to the origin of the left subclavian artery and extends distally for a varying distance. In some instances the dissecting process is limited to the descending thoracic aorta (Fig. 1). Circumferentially there is also variation in the extent of the dissecting process, but it is usually incomplete. In most cases, however, progressive dilatation of the outer layer and consequent enlargement of the false lumen with ultimate rupture is limited to the descending thoracic aorta.

SURGICAL METHODS OF TREATMENT

TYPE I.—Because of the tendency for this form of the disease to progress rapidly toward a fatal termination, surgical treatment should be applied as soon as possible after onset. The procedure consists essentially in transection of the ascending aorta with the use of temporary cardiopulmonary bypass and obliteration of the false lumen by approximation of the inner and outer walls

The natural history of medically managed acute type B aortic dissection

Christopher A. Durham, MD, Richard P. Cambria, MD, Linda J. Wang, MD, Emel A. Ergul, MS, Nathan J. Aranson, MD, Virendra I. Patel, MD, MPH, and Mark F. Conrad, MD, MSSc, *Boston, Mass*

Objective: Although medical management of acute uncomplicated type B aortic dissection remains the standard of care, contemporary data regarding the natural history of medically treated patients are sparse. The goal of this study was to evaluate the natural history of patients with acute type B aortic dissection who were initially managed with medical therapy alone.

Methods: All patients with acute type B aortic dissection who were initially managed medically between March 1999 and March 2011 were included. Failure of medical therapy was defined as any death or aorta-related intervention. Early failure occurred within 15 days of presentation. Predictors of long-term outcomes were determined using backward stepwise regression.

Results: A total of 298 patients with medically managed acute type B dissections were identified. The cohort had an average age of 65.9 years at presentation and was 61.7% male. There were 174 (58.4%) failures including 119 deaths and 87 interventions (24 endovascular, 63 open); 57 (66%) interventions were performed for aneurysmal degeneration. There were 37 (12%) early failures including 14 deaths and 25 interventions (10 endovascular, 15 open). Aneurysmal degeneration was the indication for intervention in six patients (24%). Mean follow-up was 4.2 years (range, 0.1-14.7 years). Kaplan-Meier estimate demonstrated that freedom from intervention was 77.3% ± 2.4% at 3 years and 74.2% ± 2.5% at 6 years. There were no predictors of freedom from intervention. Kaplan-Meier estimate demonstrated that the intervention-free survival was 55.0% ± 3.0% at 3 years and 41.0% ± 3.2% at 6 years. End-stage renal disease was predictive of failure of medical treatment (hazard ratio, 2.60; confidence interval, 1.19-5.66; $P = .02$), and age >70 years was protective against failure (hazard ratio, 0.97; confidence interval, 0.95-0.98; $P < .01$). Kaplan-Meier estimate demonstrated that survival after 6 years was higher in patients who underwent interventions (76% vs 58%; $P = .018$).

Conclusions: The majority of patients with acute type B dissection will fail medical therapy over time as evidenced by a 6-year intervention-free survival of 41%. Patients who underwent any aortic intervention had a significant survival advantage over those who were treated with medical management alone. Further study is necessary to determine who will benefit most from early intervention. (J Vasc Surg 2015;61:1192-9.)

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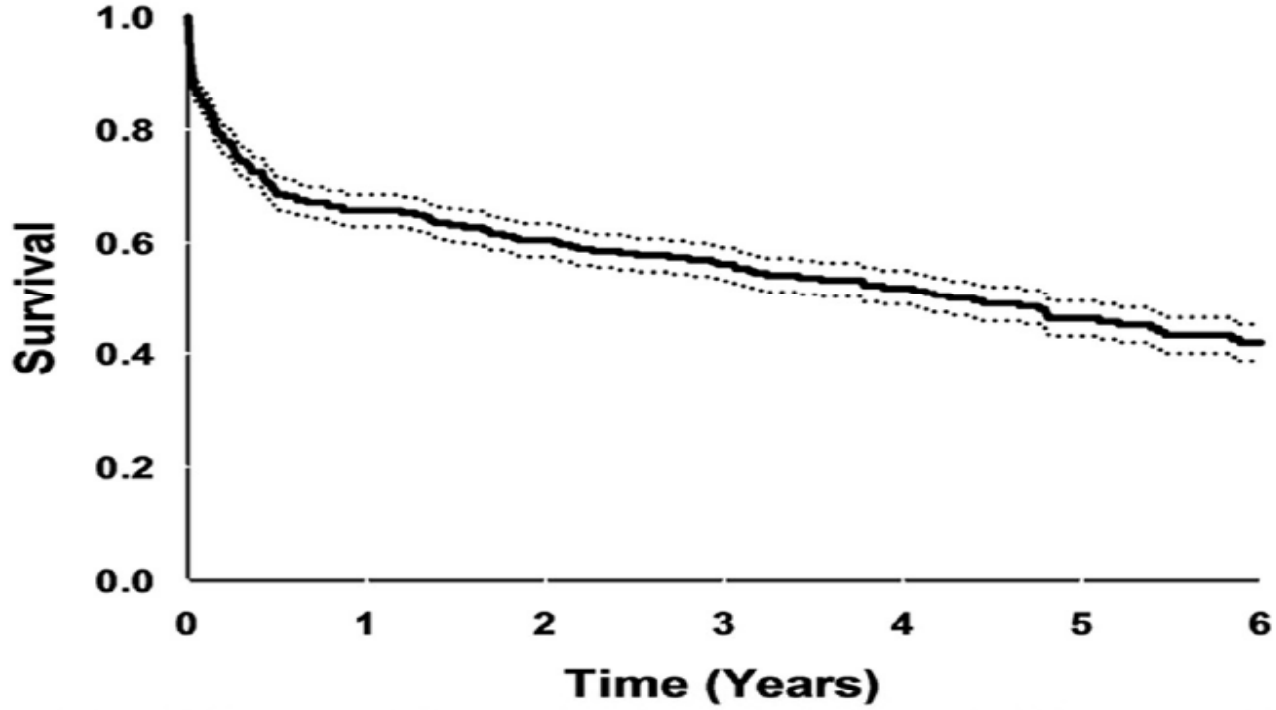
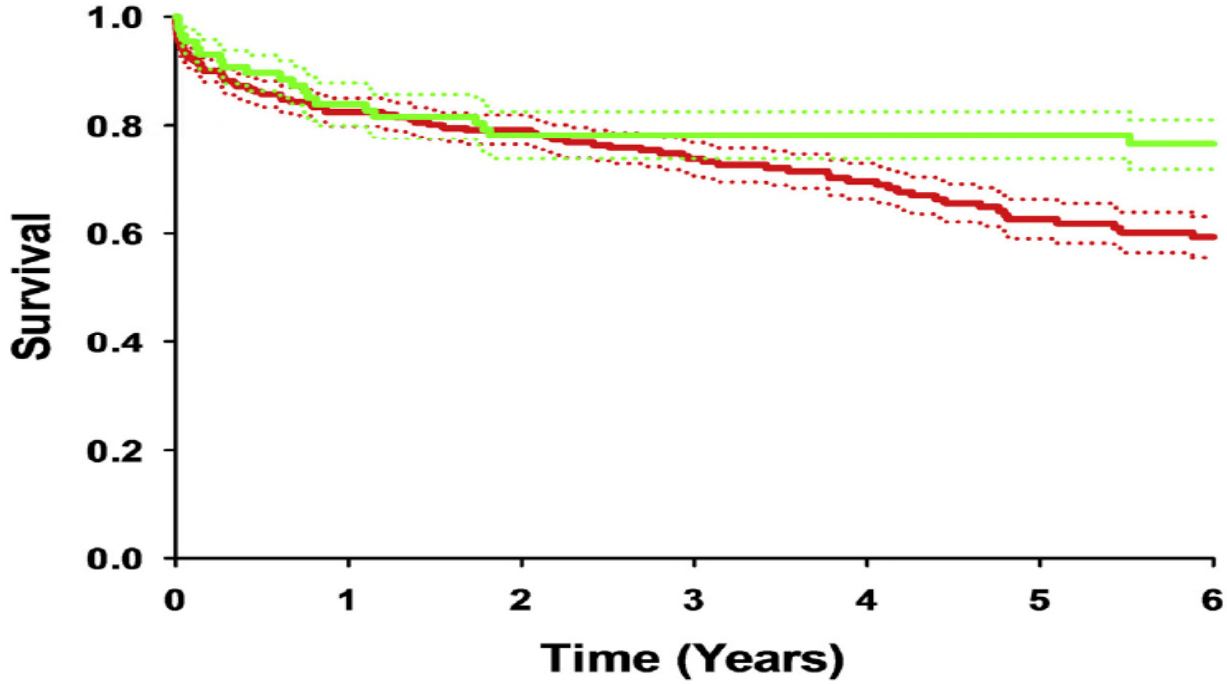


At risk:	298	179	158	139	111	82	64
Survival:	100.0	65.6	60.0	56.2	51.9	46.3	41.9
SE(+/-):	0.0	2.8	2.9	3.0	3.1	3.2	3.3

Fig 2. Kaplan-Meier curve for intervention-free survival of 298 patients with uncomplicated, acute type B dissection. *SE,* Standard error.

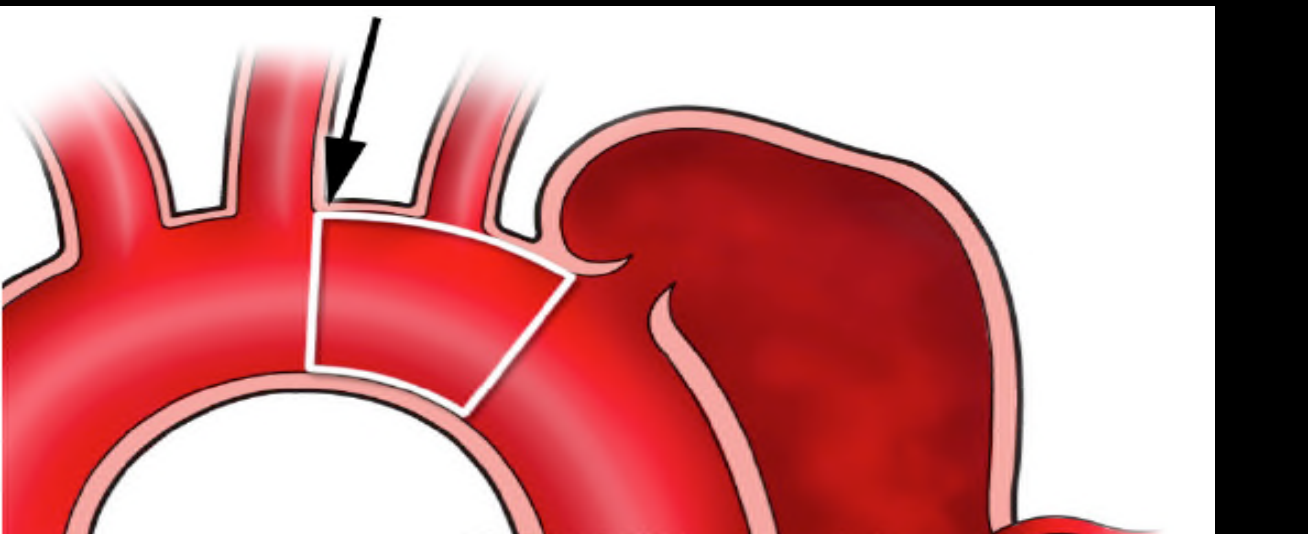


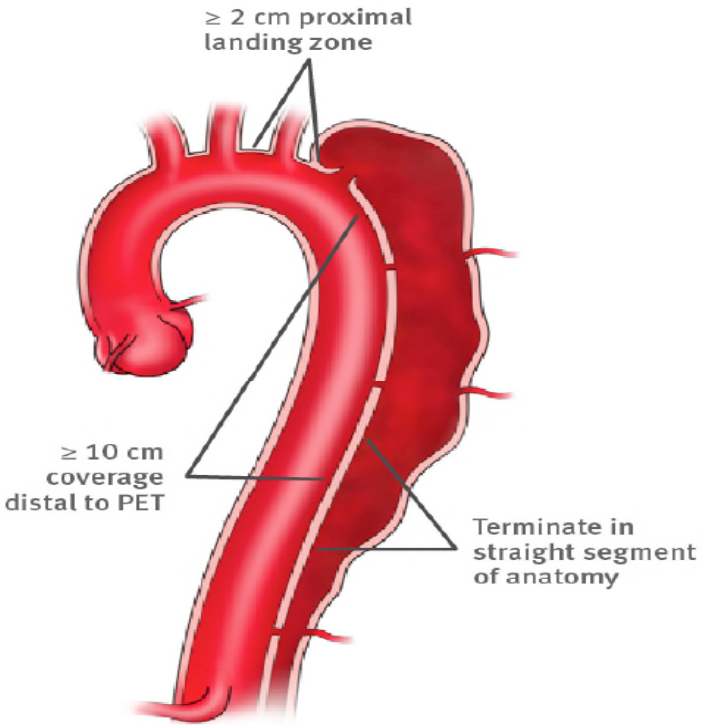
Intervention:							
At risk:	87	73	68	65	59	53	43
Survival:	100.0	83.9	78.2	78.2	78.2	78.2	76.4
SE(+/-):	0.0	3.9	4.4	4.4	4.4	4.4	4.7
Medically Managed:							
At risk:	211	174	167	136	108	82	65
Survival:	100.0	82.5	79.2	73.6	68.9	62.6	59.3
SE(+/-):	0.0	2.6	2.8	3.1	3.3	3.6	3.8

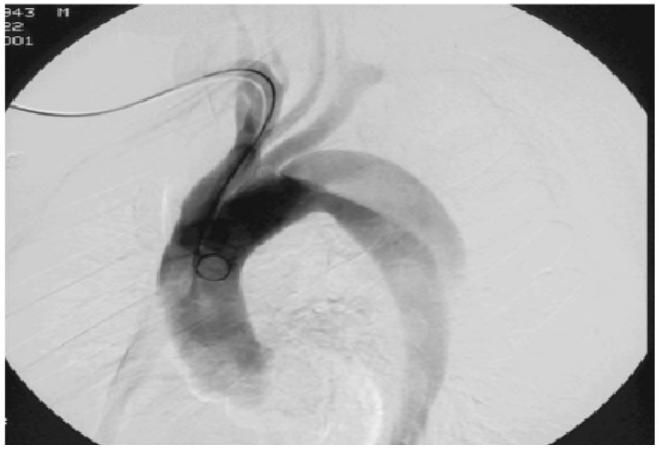
Fig 3. Kaplan-Meier curve for survival of 298 patients with uncomplicated, acute type B dissection, from the time of presentation, stratified by those undergoing intervention (*green*) and those remaining medically managed throughout the operative period (*red*) ($P = .018$). *SE*, Standard error.

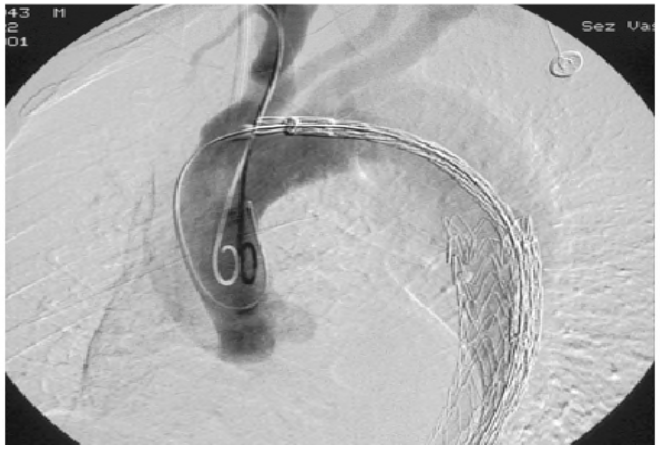
Standard TEVAR treatment for classical site of PIT in type B

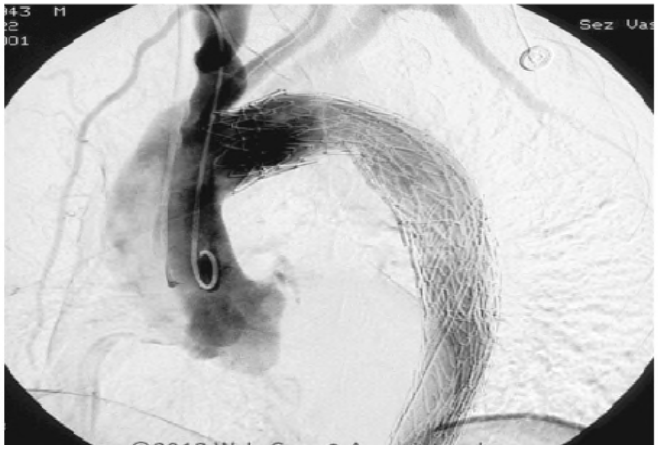
Deployment Considerations







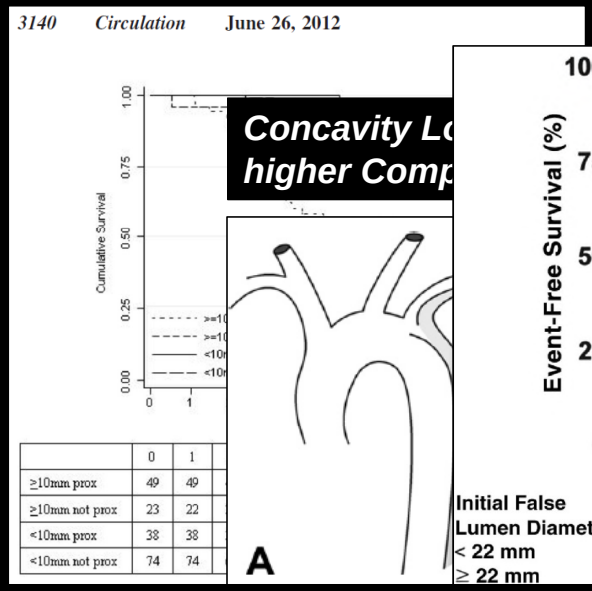


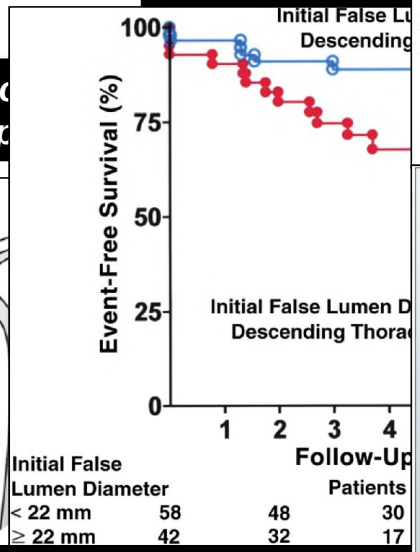


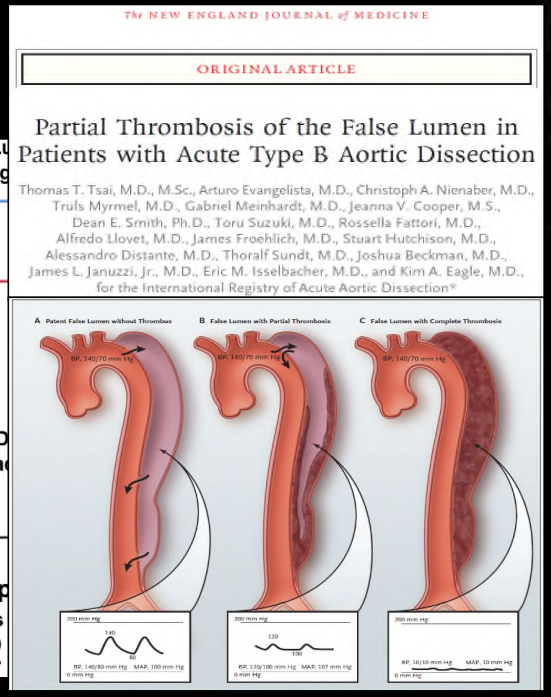
All Type B Dissection

2013

- Complicated
- Chronic
- Uncomplicated







European Heart Journal (2014) **35**, 2873–2926
doi:10.1093/eurheartj/ehu281

ESC GUIDELINES

2014 ESC Guidelines on the diagnosis and treatment of aortic diseases

Document covering acute and chronic aortic diseases of the thoracic and abdominal aorta of the adult

The Task Force for the Diagnosis and Treatment of Aortic Diseases of the European Society of Cardiology (ESC)

Authors/Task Force members: Raimund Erbel* (Chairperson) (Germany), Victor Aboyans* (Chairperson) (France), Catherine Boileau (France), Eduardo Bossone (Italy), Roberto Di Bartolomeo (Italy), Holger Eggebrecht (Germany), Arturo Evangelista (Spain), Volkmar Falk (Switzerland), Herbert Frank (Austria), Oliver Gaemperli (Switzerland), Martin Grabenwöger (Austria), Axel Haverich (Germany), Bernard Iung (France), Athanasios John Manolis (Greece), Folkert Meijboom (Netherlands), Christoph A. Nienaber (Germany), Marco Roffi (Switzerland), Hervé Rousseau (France), Udo Sechtem (Germany), Per Anton Sirnes (Norway), Regula S. von Allmen (Switzerland), Christiaan J.M. Vrints (Belgium).

ESC Committee for Practice Guidelines (CPG): Jose Luis Zamorano (Chairperson) (Spain), Stephan Achenbach (Germany), Helmut Baumgartner (Germany), Jeroen J. Bax (Netherlands), Héctor Bueno (Spain), Veronica Dean (France), Christi Deaton (UK), Çetin Erol (Turkey), Robert Fagard (Belgium), Roberto Ferrari (Italy), David Hasdai (Israel), Arno Hoes (The Netherlands), Paulus Kirchhof (Germany/UK), Juhani Knuuti (Finland), Philippe Kolh

Recommendations for treatment of aortic dissection

Recommendations	Class[a]	Level[b]	Ref.[c]
In all patients with AD, medical therapy including pain relief and blood pressure control is recommended.	I	C	
In patients with Type A AD, urgent surgery is recommended.	I	B	1,2
In patients with acute Type A AD and organ malperfusion, a hybrid approach (i.e. ascending aorta and/or arch replacement associated with any percutaneous aortic or branch artery procedure) should be considered.	IIa	B	2,118, 202–204, 227
In uncomplicated Type B AD, medical therapy should always be recommended.	I	C	
In uncomplicated Type B AD, TEVAR should be considered.	IIa	B	218,219
In complicated Type B AD, TEVAR is recommended.	I	C	
In complicated Type B AD, surgery may be considered.	IIb	C	

[a]Class of recommendation.
[b]Level of evidence.
[c]Reference(s) supporting recommendations.
AD = aortic dissection; TEVAR = thoracic endovascular aortic repair.

Eur J Vasc Endovasc Surg (2017) 53, 4—52

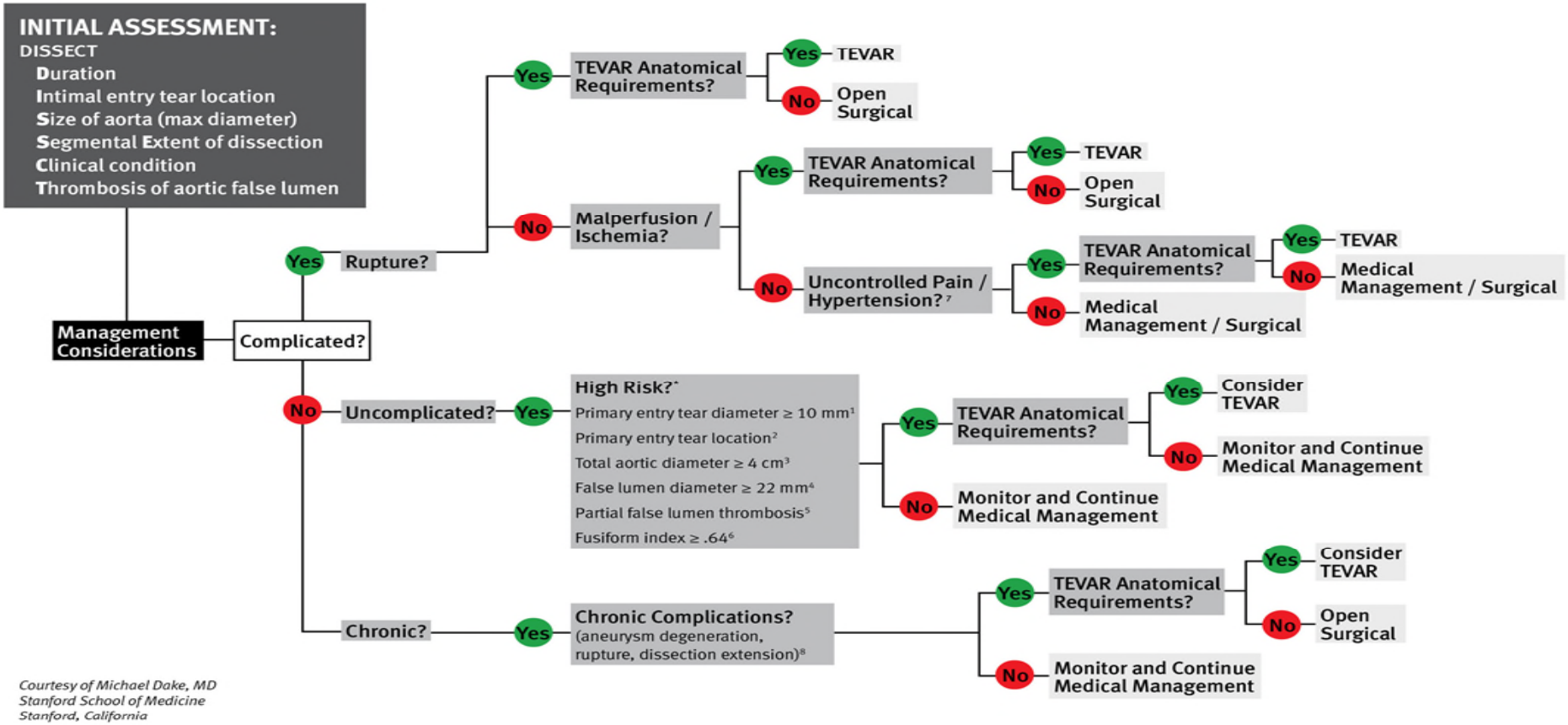
Editor's Choice — Management of Descending Thoracic Aorta Diseases

Clinical Practice Guidelines of the European Society for Vascular Surgery (ESVS)

Writing Committee [a] **V. Riambau, D. Böckler, J. Brunkwall, P. Cao, R. Chiesa, G. Coppi, M. Czerny, G. Fraedrich, S. Haulon, M.J. Jacobs, M.L. Lachat, F.L. Moll, C. Setacci, P.R. Taylor, M. Thompson, S. Trimarchi, H.J. Verhagen, E.L. Verhoeven,**
ESVS Guidelines Committee [b] **P. Kolh, G.J. de Borst, N. Chakfé, E.S. Debus, R.J. Hinchliffe, S. Kakkos, I. Koncar, J.S. Lindholt, M. Vega de Ceniga, F. Vermassen, F. Verzini,**
Document Reviewers [c] **P. Kolh, J.H. Black III, R. Busund, M. Björck, M. Dake, F. Dick, H. Eggebrecht, A. Evangelista, M. Grabenwöger, R. Milner, A.R. Naylor, J.-B. Ricco, H. Rousseau, J. Schmidli**

Recommendation 16	Class	Level of evidence	References
In patients with complicated acute type B aortic dissection, endovascular repair with thoracic endografting should be the first line intervention	I	C	6,85–89,92–94,96–99, 103,109
Recommendation 17			
In complicated acute type B aortic dissection, endovascular fenestration should be considered to treat malperfusion	IIa	C	73,100–102
Recommendation 18			
To prevent aortic complications in uncomplicated acute type B aortic dissection, early thoracic endografting may be considered selectively	IIb	B	104

A Physician Perspective When Treating Aortic Type B Dissections



Courtesy of Michael Dake, MD
Stanford School of Medicine
Stanford, California

* Most commonly discussed high-risk indicators

OK, so what about the management of acute uncomplicated type B aortic dissection?

THE OFFICIAL NEWSPAPER OF THE SVS® SOCIETY for VASCULAR SURGERY

VOL. 10 • NO. 7 • SEPTEMBER 2014

Vascular Specialist

POINT/COUNTERPOINT

Type B aortic dissections are all complicated and require TEVAR.

YES: TEVAR is clearly indicated.

FRANK R. ARKO III, M.D.

Aortic dissection is a devastating condition afflicting an estimated two to eight per 100,000 people annually and comprises a large portion of the clinical entity known as the acute aortic syndromes. Patients presenting with an uncomplicated type B acute aortic dissection (TBAD) generally have low in-hospital mortality rates (2.4%-9%) when managed appropriately with anti-impulse therapy. However, survival continues to decrease with follow-up, with survival ranging from 80% and more than 95% at 1 year, progressing to approximately 75% at 3-4 years, and 48%-65% at 10 years. In late follow-up, the development of a new dissection with complications is estimated to occur in 20%-50% of patients. Complicated aortic dissections affect at a significantly earlier follow-up period in the patients with a patent FL.[1,2,3]

DR. ARKO

The aortic diameter may also influence the patency of the FL at presentation. In a review of 110 patients presenting with acute uncomplicated TBAD, 44% were identified to have a patent FL on initial imaging. Thirty-one percent of these patients had a maximum aortic diameter of 45 mm or more versus 14% of patients with a thrombosed FL ($P = .053$).

Incidentally, patients with FL patency were on average 4 years younger than their thrombosed counterparts (62 vs. 66 years, $P = .009$).

Moreover, it appears that the long-term risks associated with a patent FL are further augmented by aortic dilatation at presentation. When combining both risk factors (FL patency and aortic diameter of 40 mm or more),

NO: Evidence supports careful choice of patients.

MURRAY L. SHAMES, M.D.

While the role of TEVAR has been proven to treat complications of acute type B dissections,[1] its value as a prophylactic treatment in uncomplicated cases remains controversial. Optimal medical treatment (OMT) with strict blood pressure (systolic BP less than 120 mm Hg) and heart rate control is associated with a low morbidity and mortality, despite the risk of progressive aortic dilation. On the other hand, TEVAR can result in early death and significant neurologic complications; other devastating complications of TEVAR include retrograde aortic dissection and access vessel rupture with a high associated mortality.

DR. SHAMES

port improved aortic remodeling at 2 years with TEVAR. The results of INSTEAD have been challenged because critical analysis of the INSTEAD trial has determined that the results were underpowered and that there was a 21% crossover in the OMT group and four patients received TEVAR who should have been excluded.[5]

Subsequent long-term analysis of the INSTEAD XL data does demonstrate a significant survival benefit and freedom from aortic adverse events in the TEVAR group after the initial 2-year analysis.[6] At the 5-year follow up only 27 patients remained without a TEVAR. Fortunately there were no adverse events in the patients who crossed over to TEVAR from the OMT group, demonstrating

Recommendations for treatment of aortic dissection

Recommendations	Class[a]	Level[b]	Ref.[c]
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[a]Class of recommendation.
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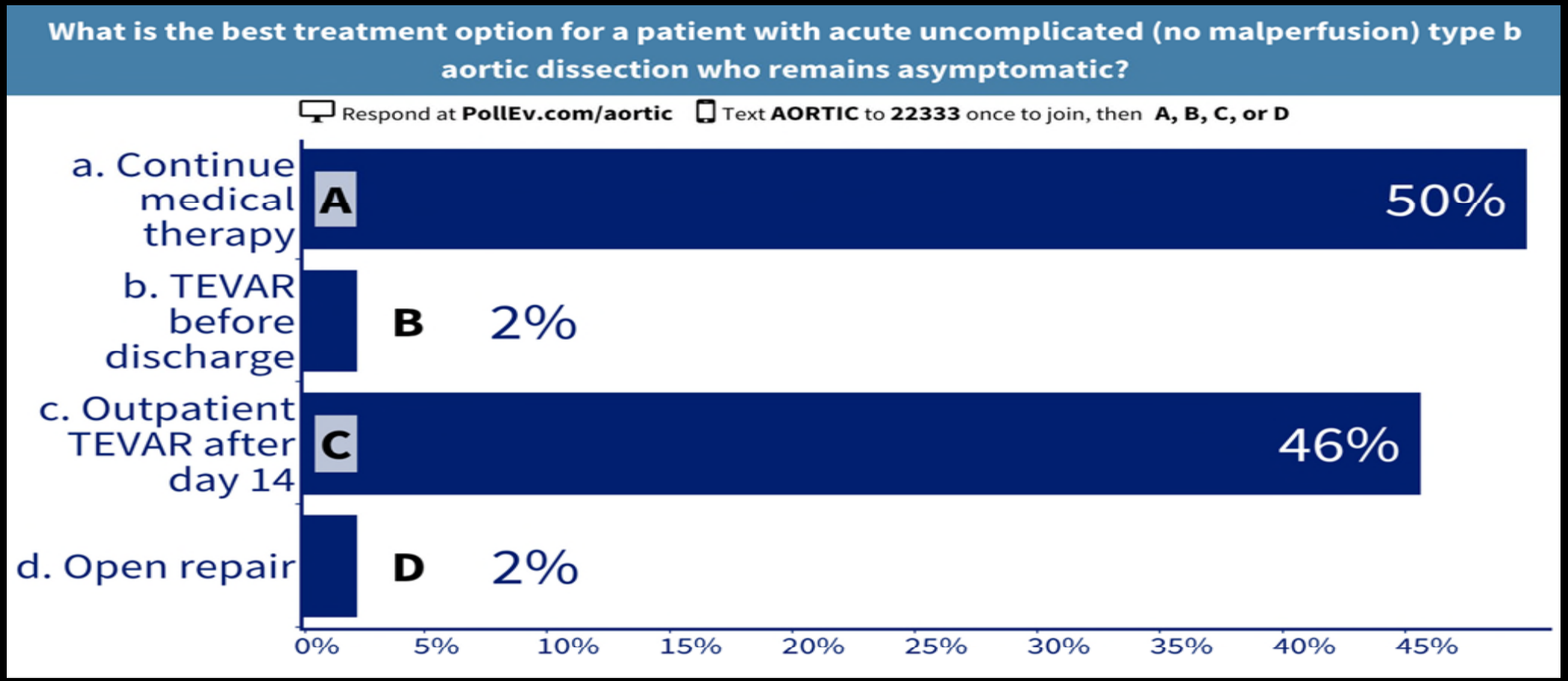
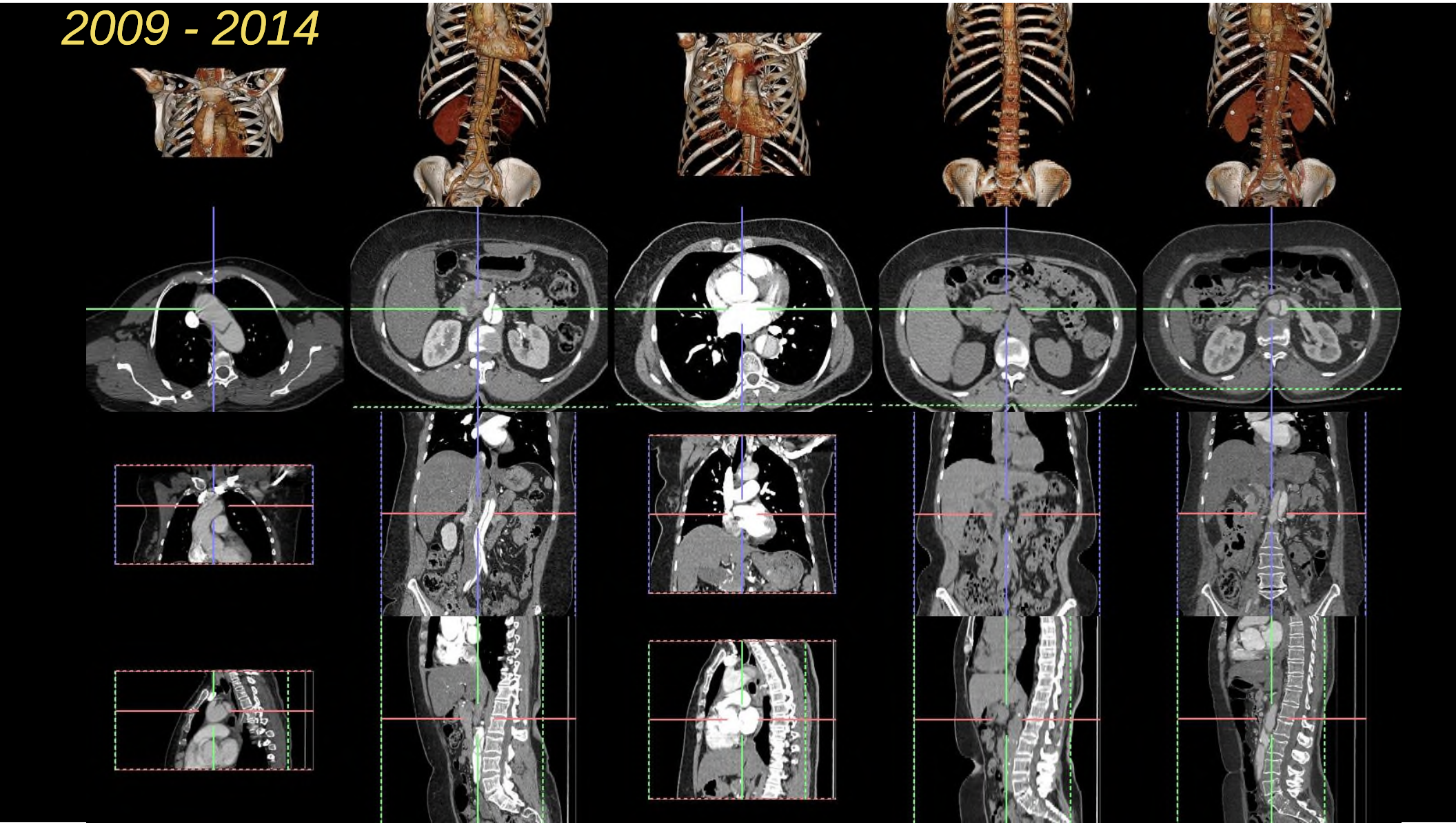
[c]Reference(s) supporting recommendations.
AD = aortic dissection; TEVAR = thoracic endovascular aortic repair.


What is the best treatment option for a patient with acute uncomplicated (no malperfusion) type b aortic dissection who remains asymptomatic?
Respond at PollEv.com/aortic
Text AORTIC to 22333 once to join, then A, B, C, or D
a. Continue medical therapy
A
50%
b. TEVAR before discharge
B
2%
c. Outpatient TEVAR after day 14
C
46%
d. Open repair
D
2%
0%
5%
10%
15%
20%
25%
30%
35%
40%
45%

So, can we predict who is at higher risk of expansion or late complications?


2009 - 2014

The Complications of Uncomplicated Acute Type-B Dissection: The Introduction of the Penn Classification

John G.T. Augoustides, MD, FASE, FAHA,* Wilson Y. Szeto, MD,† Edward Y. Woo, MD,†
Michael Andritsos, MD,‡ Ron M. Fairman, MD,† and Joseph E. Bavaria, MD†

Predictors of Late behavior

- *Size of Aorta*
- *Size of False Lumen*
- *Use of Calcium Channel Blockers*
- *Gender*
- *Age*
- *Location of Entry Tear on curvature of Aorta*
- *Size of Entry tears*
- *# Re-entry Tears*
- *Ulcer like projections*

J Cardiovasc Thorac Anes 2012;26:1139-44

Current evidence for thoracic aorta type B dissection management

Laura Capoccia[1] and Vicente Riambau[2]

Vascular
0(0) 1–9
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DOI: 10.1177/1708538113504400
vas.sagepub.com
SAGE

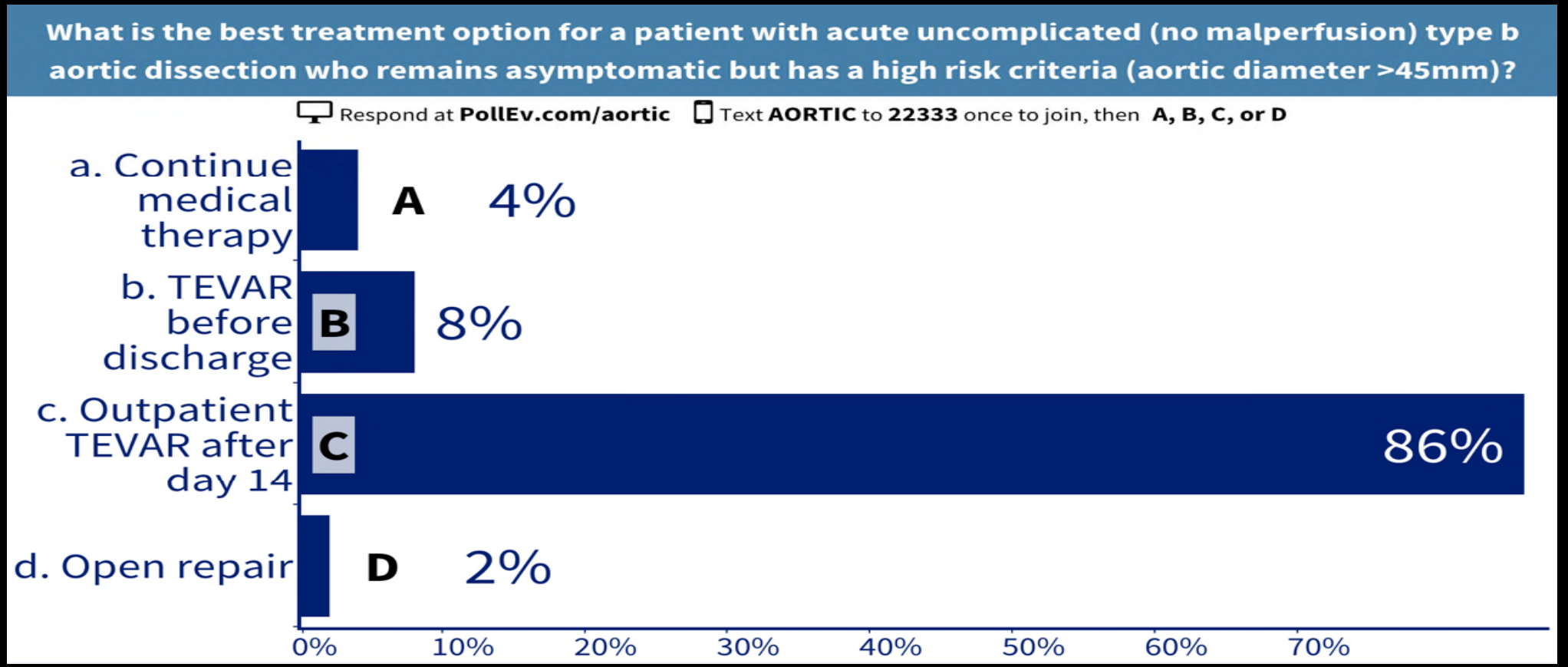
REVIEW: Unfavorable Predictive Factors

- *Size of aorta > 40mm*
- *Initial false lumen diameter > 22 mm*
- *Perfused false lumen / partial thrombosis*
- *Entry tear > 9 mm*
- *Entry tear on the concavity of the aortic arch*
- *Short distance between entry tear and LSA*
- *Dissection extending to infrarenal aorta*
- *Re-Elevation of D-Dimer levels (other serologic markers)*
- *MARFAN SYNDROME*
- *White Race*
- ***Increased wall shear stress***

Vascular 2013;e-pub

So, can we predict who is at higher risk of expansion or late complications?

Yes,
but not very accurately
and too many predictors


What is the best treatment option for a patient with acute uncomplicated (no malperfusion) type b aortic dissection who remains asymptomatic but has a high risk criteria (aortic diameter >45mm)?
Respond at PollEv.com/aortic
Text AORTIC to 22333 once to join, then A, B, C, or D
a. Continue medical therapy
A
4%
b. TEVAR before discharge
B
8%
c. Outpatient TEVAR after day 14
C
86%
d. Open repair
D
2%
0%
10%
20%
30%
40%
50%
60%
70%

So, where are we today – February 24, 2017?

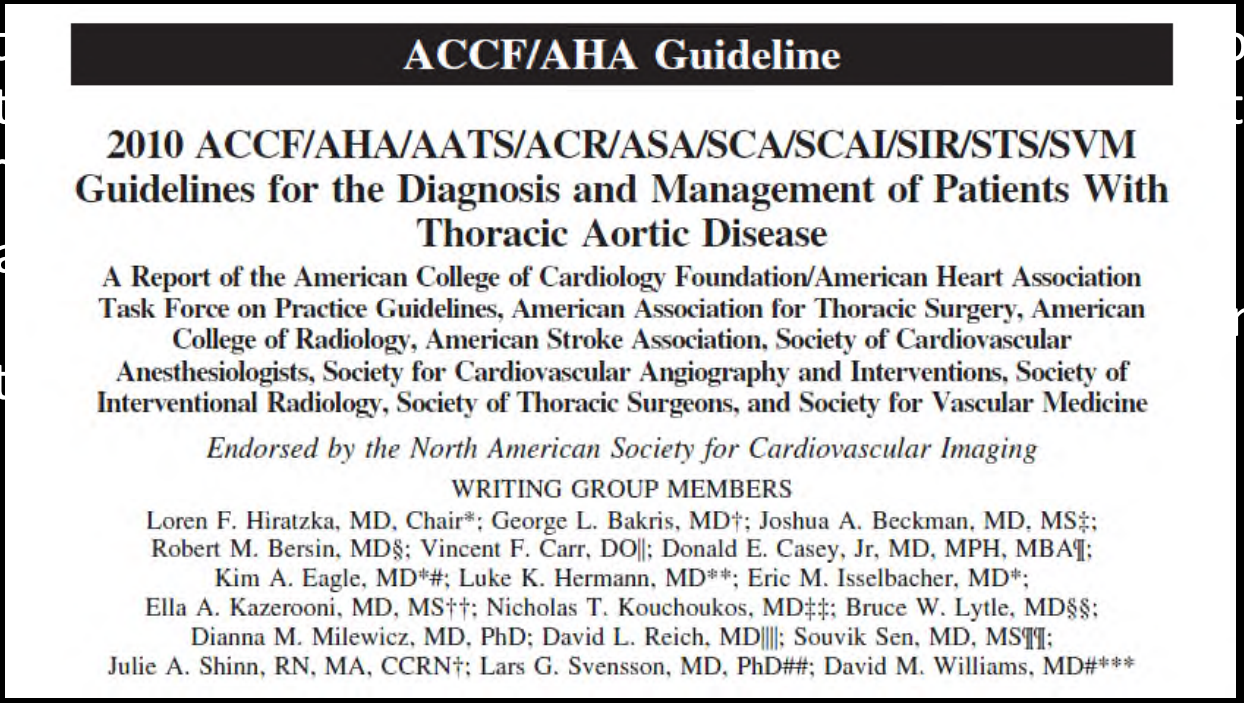
Who to treat?

In all initially uncomplicated type B dissections, should we look for "high risk" features that predict early progression or just plan to treat all except those in whom the procedure may be difficult or at risk of complication?

So, at present how do prioritize factors that influence treatment success and failure

18.6. Prediction Models of Aortic Rupture and the Need for Preemptive Interventions

- We need t … ortic diameter t … timing for surgical or …
- Since the a … radiological data has a … nts that could be linked t …



ACCF/AHA Guideline

2010 ACCF/AHA/AATS/ACR/ASA/SCA/SCAI/SIR/STS/SVM Guidelines for the Diagnosis and Management of Patients With Thoracic Aortic Disease

A Report of the American College of Cardiology Foundation/American Heart Association Task Force on Practice Guidelines, American Association for Thoracic Surgery, American College of Radiology, American Stroke Association, Society of Cardiovascular Anesthesiologists, Society for Cardiovascular Angiography and Interventions, Society of Interventional Radiology, Society of Thoracic Surgeons, and Society for Vascular Medicine

Endorsed by the North American Society for Cardiovascular Imaging

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Circulation 2010; 121: e266-e369

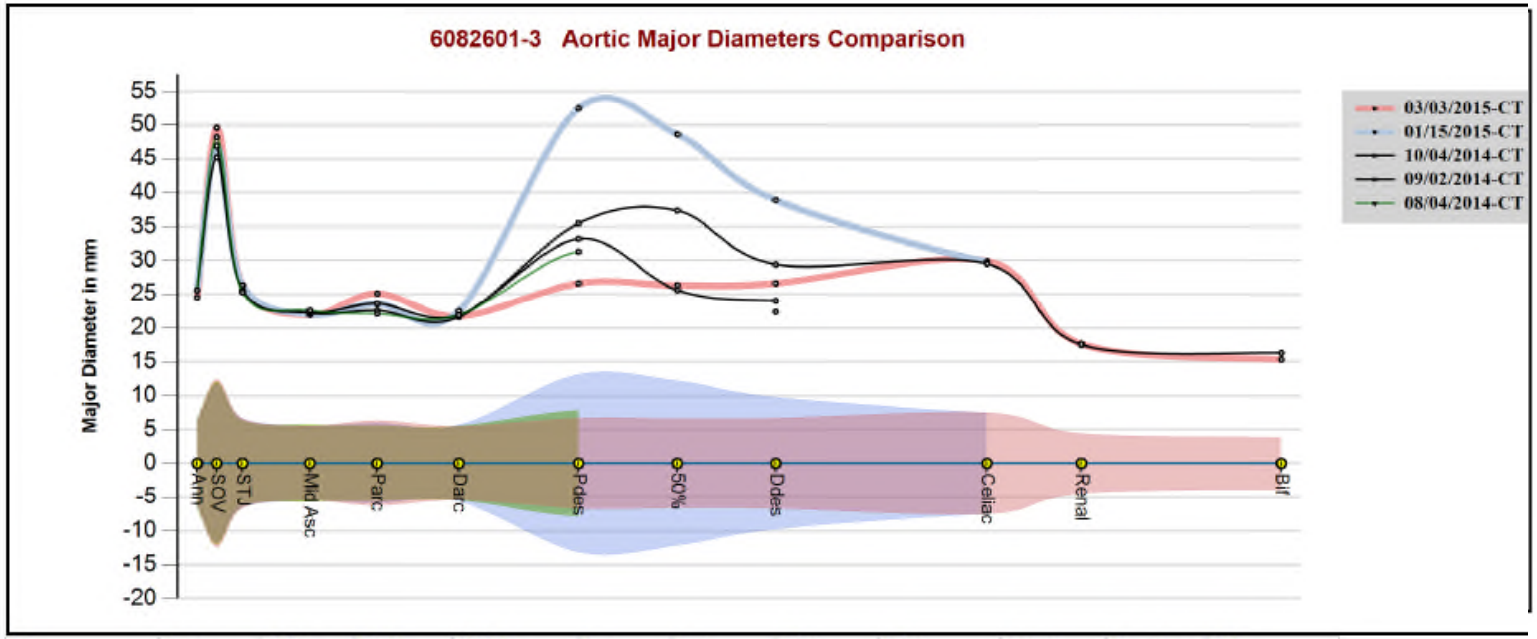
Chronic Aortic Dissection:

Aortic Surveillance Program

Clinical Visualization: Routine Follow-up

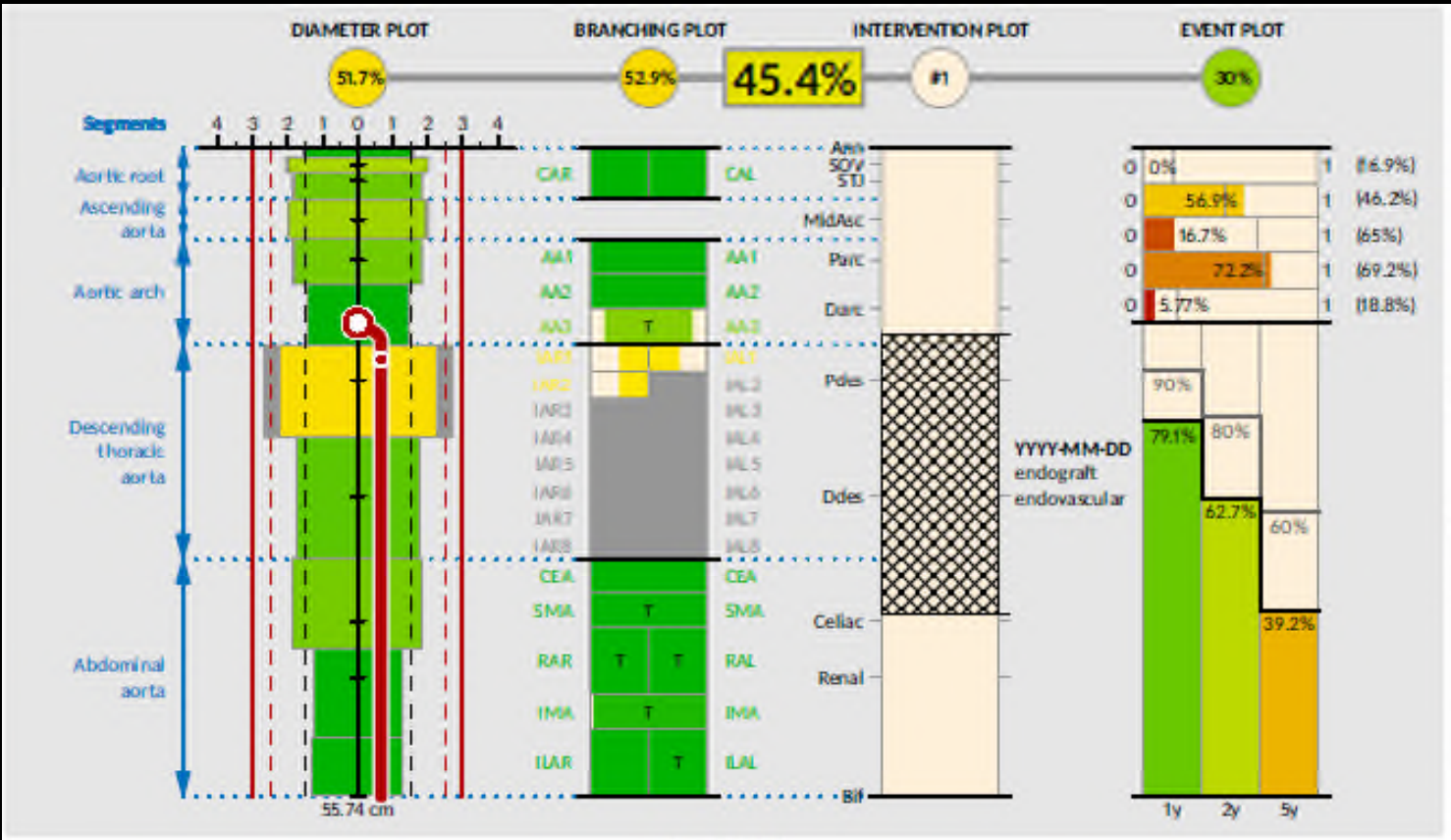
Stanford MEDICINE Cardiothoracic Surgery

Stanford Radiology 3DQ Imaging Laboratory

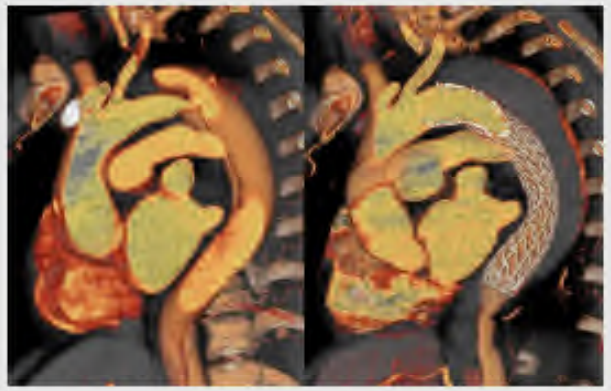


Dt	Ann	SOV	STJ	MidAsc	Parc	Darc	Pdes	Ddes	Celiac	Renal	Bif
3/3/15	24.5	49.6	26.4	21.9	25.1	21.7	26.6	26.6	29.9	17.6	15.3
1/15/15	25.6	46.9	26.3	22.0	23.6	22.5	52.5	38.9	29.8		
10/4/14	25.6	45.2	25.5	22.2	22.6	21.6	35.5	29.4	29.5	17.5	16.3
9/2/14		46.9	25.6	22.3	23.6	21.9	33.2	24.0			
8/4/14	25.6	48.2	25.3	22.6	22.1	21.9	31.3	22.4			

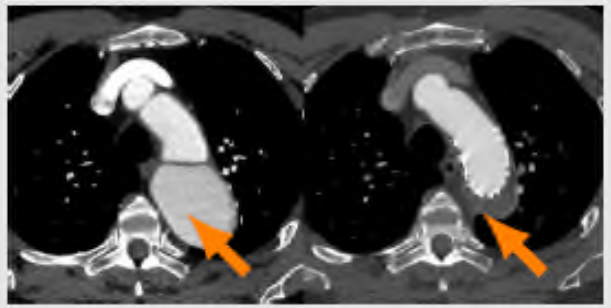
Aortic Dissection Maps



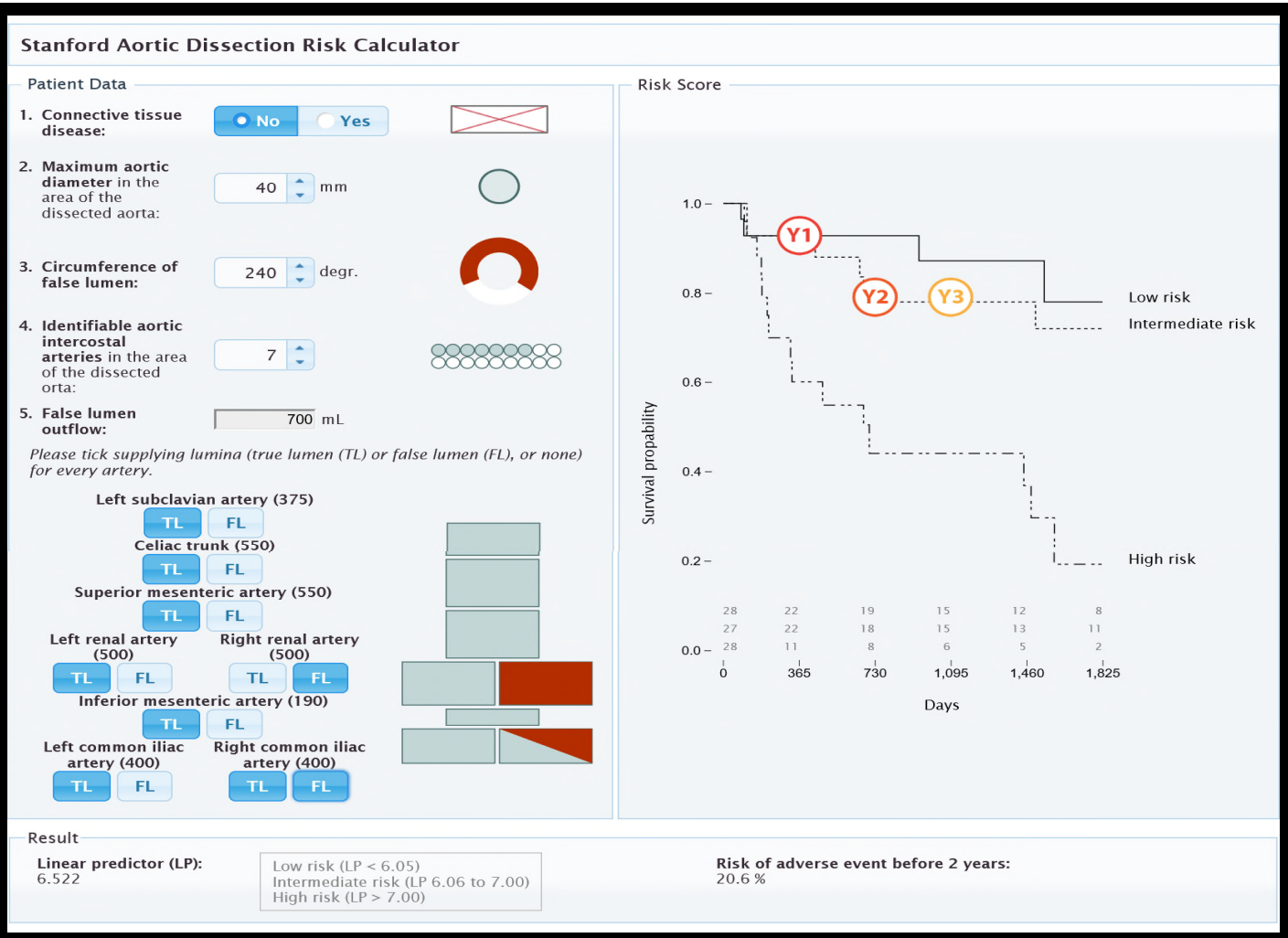
(a) ADM



(b) Coronal Views

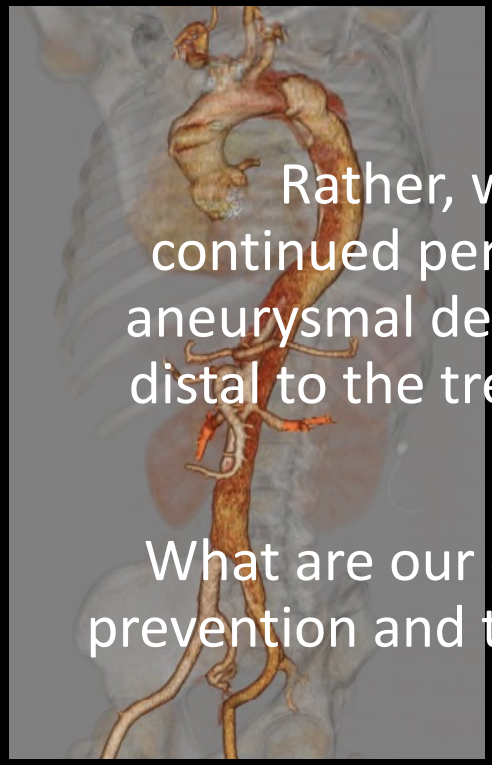


(c) Axial Slices

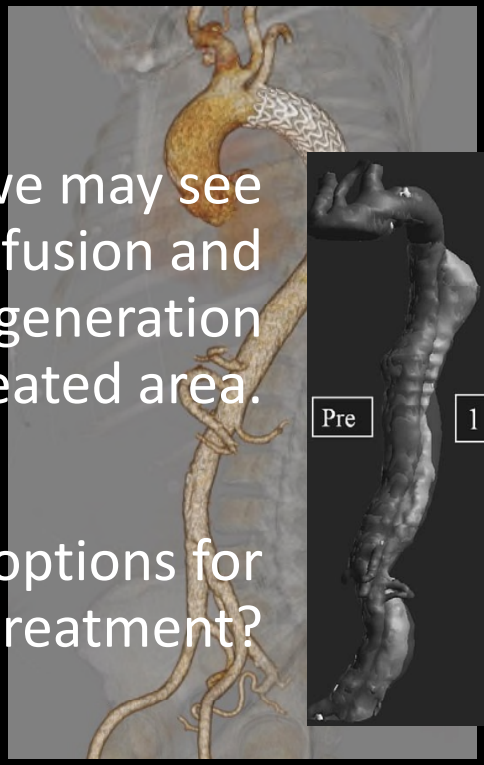


Sailer AM, van Kuijk SMJ, Nelemans PJ, Chin A, Kino A, Huininga M, Schmidt J, Mistelbauer G, Bäumler K, Chiu P, Fischbein MP, Dake MD, Miller DC, Schurink GWH, Fleischmann D. CT imaging features in acute uncomplicated Stanford type-B aortic dissection predict late adverse events. Circulation Cardiovascular imaging. 2017;(in press)

Remaining Gaps



Pre-treatment

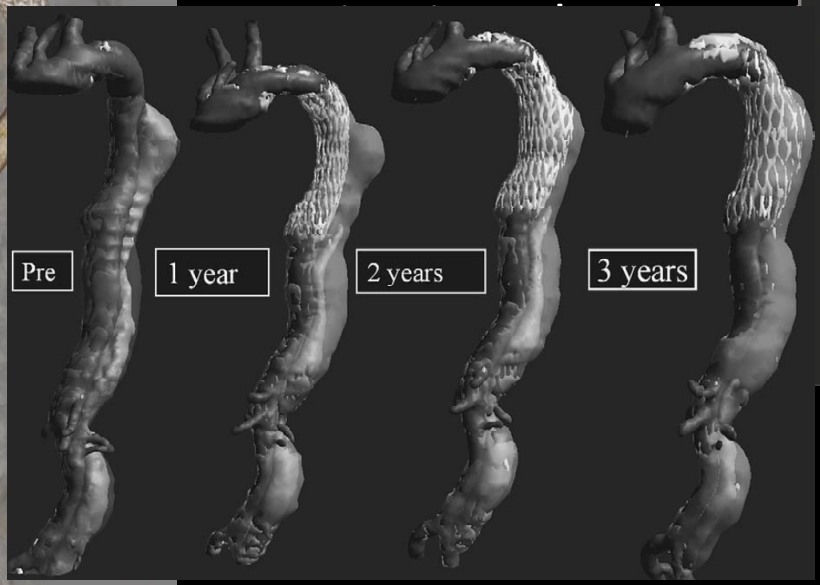


1 year follow-up

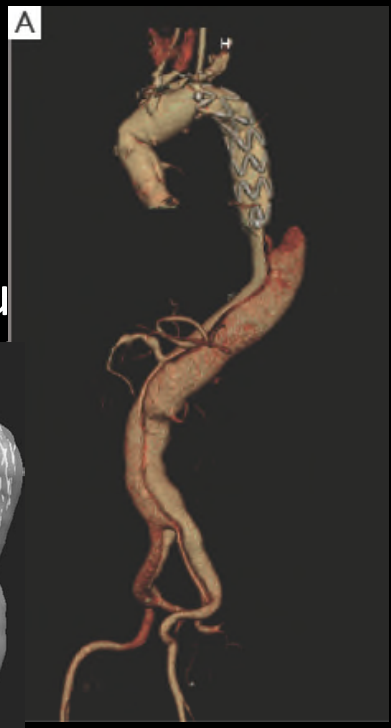
Rather, we may see continued perfusion and aneurysmal degeneration distal to the treated area.

What are our options for prevention and treatment?

Can have excellent resu



Khoynezhad et al. 2009



Eur J Vasc Endovasc Surg (2017) 53, 4—52

Editor's Choice — Management of Descending Thoracic Aorta Diseases

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Recommendation 36	Class	Level of evidence	References
Open repair of aneurysmal or symptomatic chronic type B aortic dissection in patients with low surgical risk should be considered in dedicated centres with low complication rates	IIa	C	41,180
Recommendation 37			
In patients with chronic type B dissection undergoing operative repair, intra-procedural cerebrospinal fluid drainage, left heart bypass, and moderate hypothermia should be considered to reduce procedural mortality and spinal cord injury.	IIa	C	41,183

Eur J Vasc Endovasc Surg (2017) 53, 1—3

EDITORIAL

Management of Descending Thoracic Aorta Disease: Evolving Treatment Paradigms in the TEVAR Era

The ESVS guidelines are reflective of a recent, dramatic change in the management of descending thoracic aorta disease marked by the steady adoption of endovascular repair as standard of care.[5,6] When repair is indicated, thoracic endovascular aneurysm repair (TEVAR) is now the first-line recommended treatment for intact and ruptured descending thoracic aneurysm (DTAA), blunt traumatic thoracic aortic injury, acute Stanford type B aortic dissection (TBAD), intramural hematoma, and penetrating aortic ulcer. For each of these processes, the ESVS guidelines offer a type I or IIA recommendation for endovascular therapy first. Taken together, this is a powerful statement supporting the broad applicability and growing preference for TEVAR.

Importantly, the primacy of open surgical repair is emphasized in certain instances. For chronic TBAD with persistent symptoms or aneurysmal degeneration, open repair is recommended in patients with appropriate surgical risk. Owing to aortic membrane thickening and consequent poor plasticity in the chronic phase, TEVAR is less likely to offer durable benefit owing to persistent pressurization of the false lumen through distal fenestrations. Adjunctive endovascular techniques, such as false lumen embolization, may aid in causing false lumen thrombosis.[15] However, open aortic repair is currently the only reliable way to treat chronic TBAD when repair is indicated.

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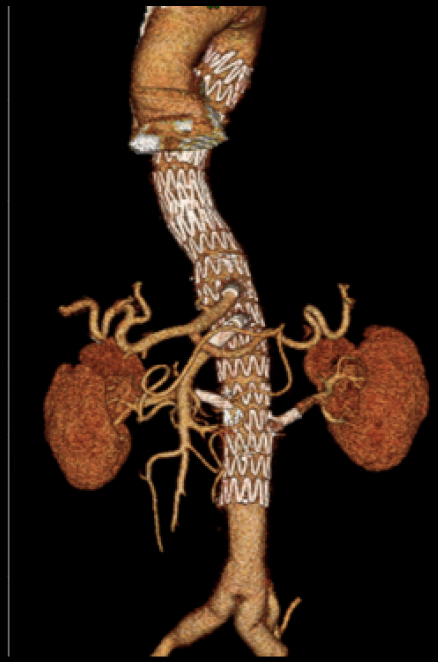
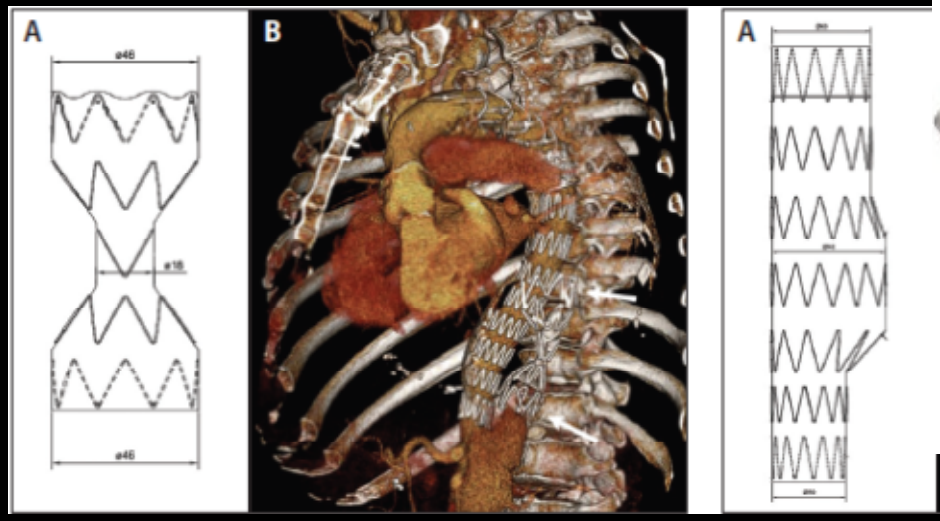
Additional Aortic Techniques

- Branched devices
- Full metal jacket



Adjunctive False Lumen Techniques

- Coils
- False lumen occlusion devices
  - Candy plug
  - Knickerbocker



A J.J. GRAVES MYSTERY
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LITTLE SECRETS
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—Tony Parinello, author of Getting to YES (The Very Important Top Offices): 50 Steps to YES's Office
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SECRETS
INNOVATION'S
DIRTY LITTLE
SECRET
TELL ME
A SECRET
SO DIRTY
IT TURNS
YOU ON
JUST TO
dirty
little
secrets
Dirty Little
Secret
DIRTY Little SECRETS
Breaking the Silence on Teenage Girls and Promiscuity
It's not about when girls are having sex.
It's about why.
FROM THE AUTHOR OF LOOSE GIRL
KERRY COHEN
An apartment building with nine tenants and one...
Dirty Little
Secret
starring
JACK CELI and SONIA LaDARE
A Dirt Nap FILM
COMING THIS HOLIDAY SEASON TO A THEATER NEAR YOU.

A morphologic study of chronic type B aortic dissections and aneurysms after thoracic endovascular stent grafting

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Background: The long-term results of treating chronic aortic dissections and aneurysms in association with dissections with thoracic endovascular aortic repair (TEVAR) are unknown, and the timing for intervention is uncertain. We evaluated the morphology of stent graft and aorta remodeling and the volumetric changes in these patients after successful TEVAR.

Methods: Serial computed tomography scans of 32 patients who underwent TEVAR for uncomplicated chronic dissections (group A, n = 17) and chronic dissections with aneurysms (group B, n = 15) were analyzed at 1, 6, 12, and 36 months. Stent graft diameter changes and positional migration were assessed three-dimensionally using Mimics 14.0 (Materialize, Leuven, Belgium). Volumetric data for true lumen, false lumen, thrombus load, and aortic size were measured by Aquarius iNtuition 4.4 software (TeraRecon, San Mateo, Calif). Results were compared between the two groups and with stent graft diameter, length, and oversizing.

Results: Aortic stent grafts remodeled progressively, with inlet area increasing 4.4%, 10.1%, and 14.2% and outlet area increasing 42.6%, 67.2%, and 72.3%, respectively, at 6, 12, and 36 months. True lumen volume increased progressively in group A (114 to 174 mL) and group B (124 to 190 mL) from baseline to 36 months. False lumen volume decreased in group A (150 to 88 mL) and group B (351 to 250 mL), whereas thrombus load in the false lumen increased from 73% to 80% in group A and 84% to 87% in group B in 3 years. Eight patients (4 in each group) showed an increase in total aortic volume of >10%, 12 showed a static volume, and 12 showed shrinkage. Aortic volume change had no relationship to pathology, stent graft sizing, and thrombus load but was positively associated with the placement of a longer graft. A small but progressive distal migration of stent grafts was noted in all patients (3.1, 4.5, and 5.1 mm at 6, 12, and 36 months) but was more prominent in shorter stent grafts (≤162 mm). No deaths, rupture, or secondary interventions occurred during follow-up.

Conclusions: Aortic remodeling after TEVAR in chronic dissection is a continuous process. There were no significant differences between chronic dissections and aneurysms in all volumetric parameters. Treating chronic dissections early, before aneurysm formation, did not appear to have a morphologic advantage. (J Vasc Surg 2012;55:1268-76.)

Evaluation of volumetric measurements in patients with acute type B aortic dissection – thoracic endovascular aortic repair (TEVAR) vs conservative

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Objective: The aim of this retrospective study was to evaluate aortic volume changes in patients with acute type B aortic dissection (TBD), treated either by thoracic endovascular aortic repair (TEVAR) or conservatively.

Materials and Methods: From July 1996 through March 2008, 76 patients presenting with acute TBD were referred to our department. To ensure a follow-up of at least 24 months, only 64 of them were included in the present study, with the cut-off for inclusion being March 2006. Twenty-nine of these patients underwent TEVAR and 35 patients underwent conservative treatment. Indications for TEVAR were life-threatening symptoms. Follow-up was performed postinterventionally in patients after TEVAR and at 3, 6, and 12 months, and yearly thereafter in both groups. It included clinical examinations, computed tomography (CT) scans, analysis of volume changes in true thoracic lumen (TTL), false thoracic lumen (FTL), thoracic lumen (TL), abdominal lumen (AL), and aortic diameter measurements. In addition, the extent of thrombosis and its influence on volume changes were assessed.

Results: Mean follow-up was 41 months after TEVAR and 46 months in the conservatively-treated patients. At 60 months, cumulative rates of freedom from dissection-related death and rupture-free survival were 82.6% and 93.1% in the TEVAR group, respectively. They were 74.9% and 88.5% in the conservatively-treated group, respectively. In the conservatively-treated patients, 3 patients died of late aortic rupture, 4 were converted to open surgery, and 2 to TEVAR. Evaluation of volume changes showed better results in the TEVAR group within 24 months. However, within 60 months the difference between the two groups was no longer relevant. Relating to thrombosis of the FTL, analyses showed slightly better overall results and promotion of thrombus formation after TEVAR. However, at 60 months the results showed a tendency towards approximation between the two groups.

Conclusion: Our data suggest that TEVAR seems to delay the natural course of the disease but not to stop it. (J Vasc Surg 2009;49:20-8.)

Uncomplicated Dissection

Why does the false lumen grow?

- Wall of false lumen is only adventitia…mechanical properties?
- What's the pressure in the false lumen?
- Can we predict pressure in false lumen from imaging studies?

Blood pressure (heart/true lumen)

FL inflow

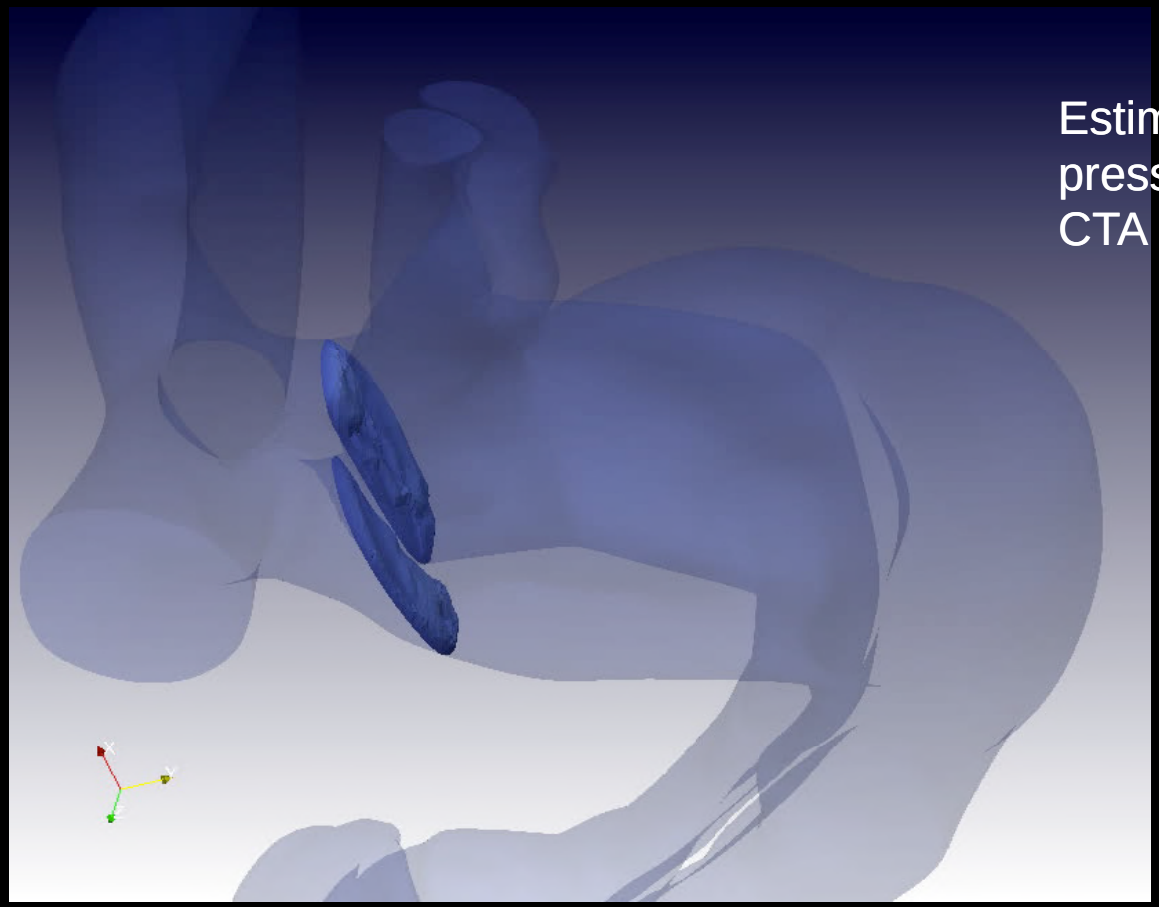
FL dimension (length/circumference)
maximum diameter

FL outflow

Outer wall properties

Kathrin Baeumler PhD

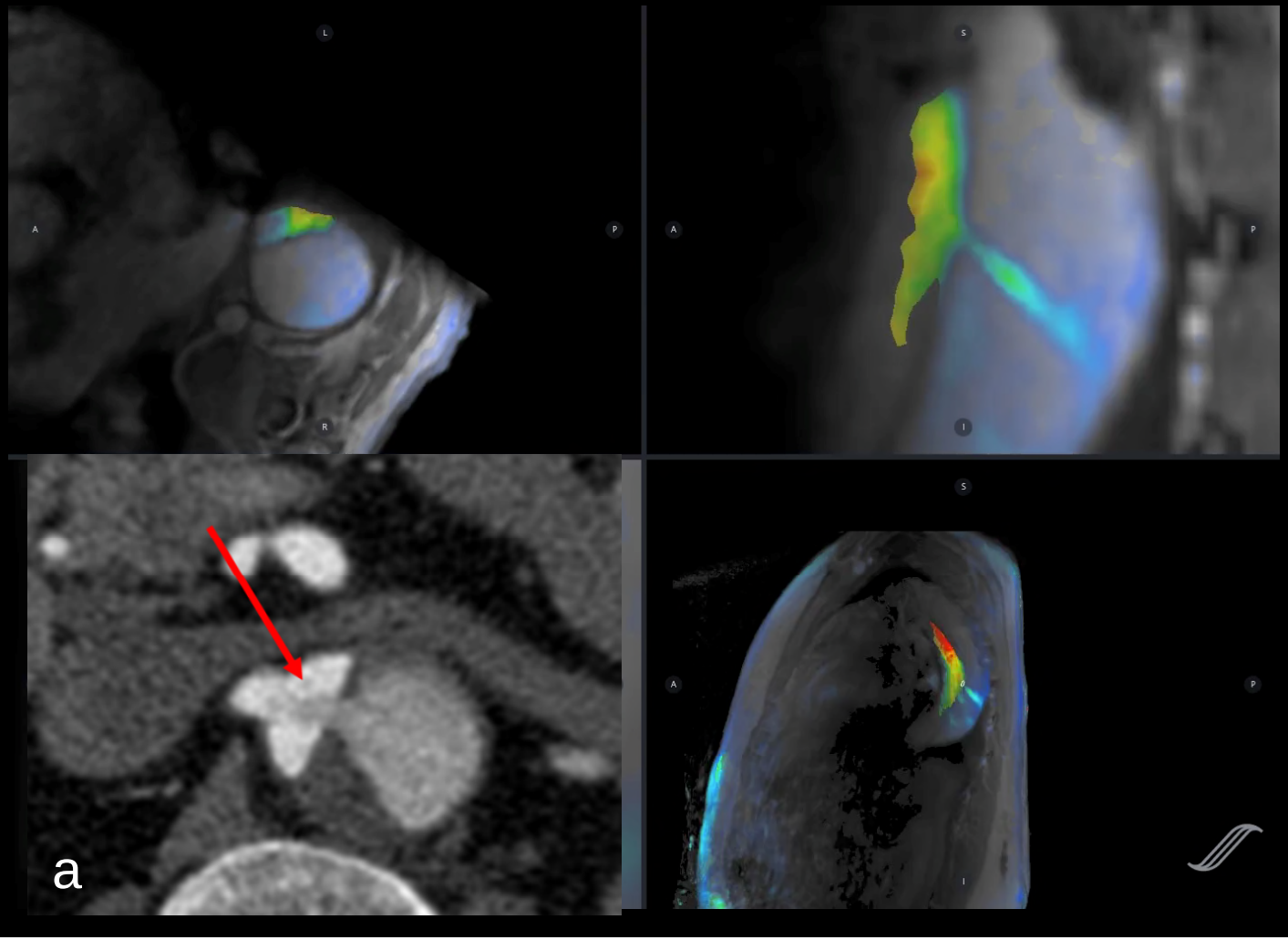
Velocity at cross section

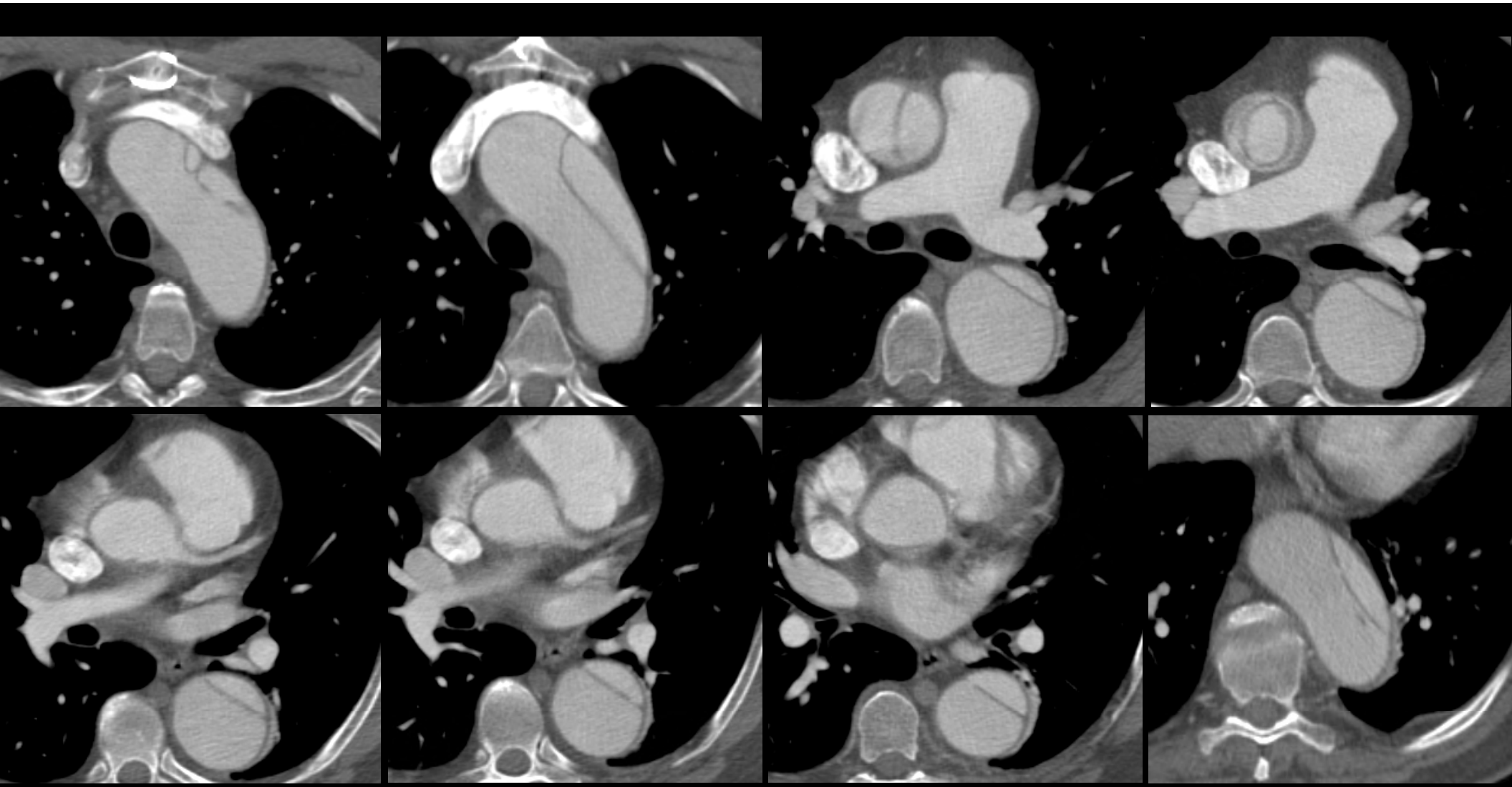


Estimating true and false lumen pressure in aortic dissection using CTA

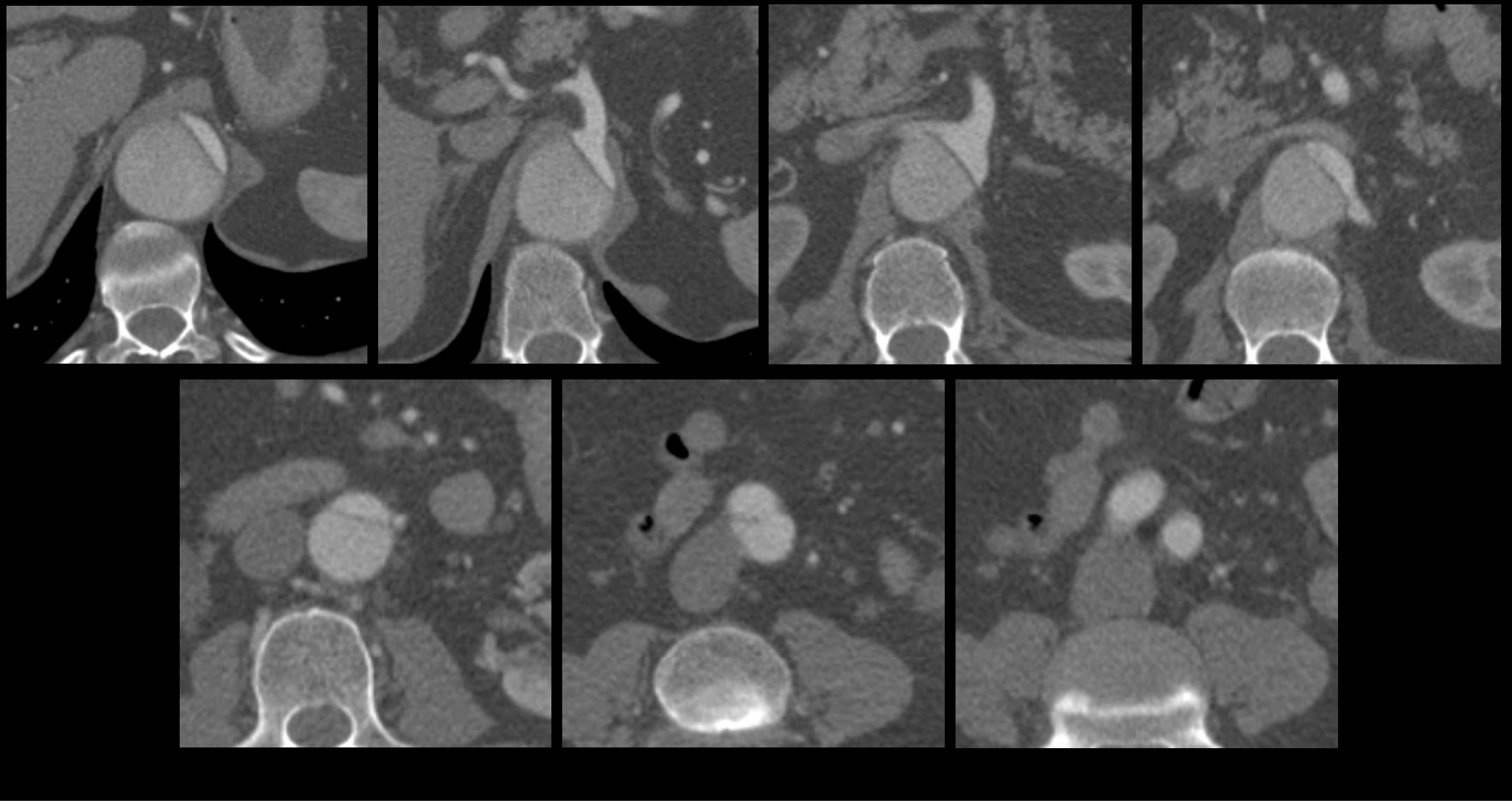
Stanford CVI Seed Grant
APA 2016, Seattle

Phase contrast (4DFlow) MRA





Initial scan s/p type A repair for type A aortic dissection



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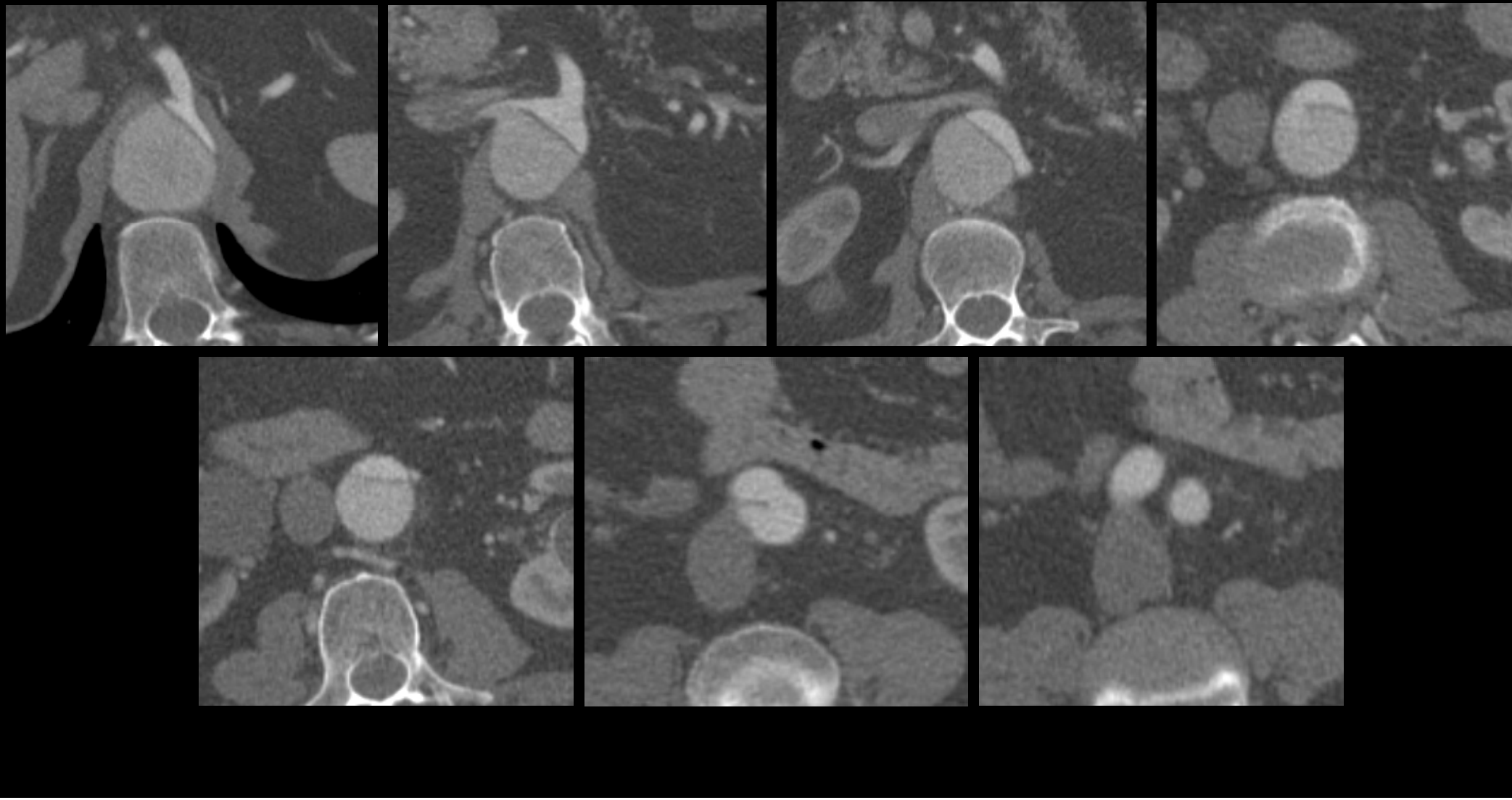
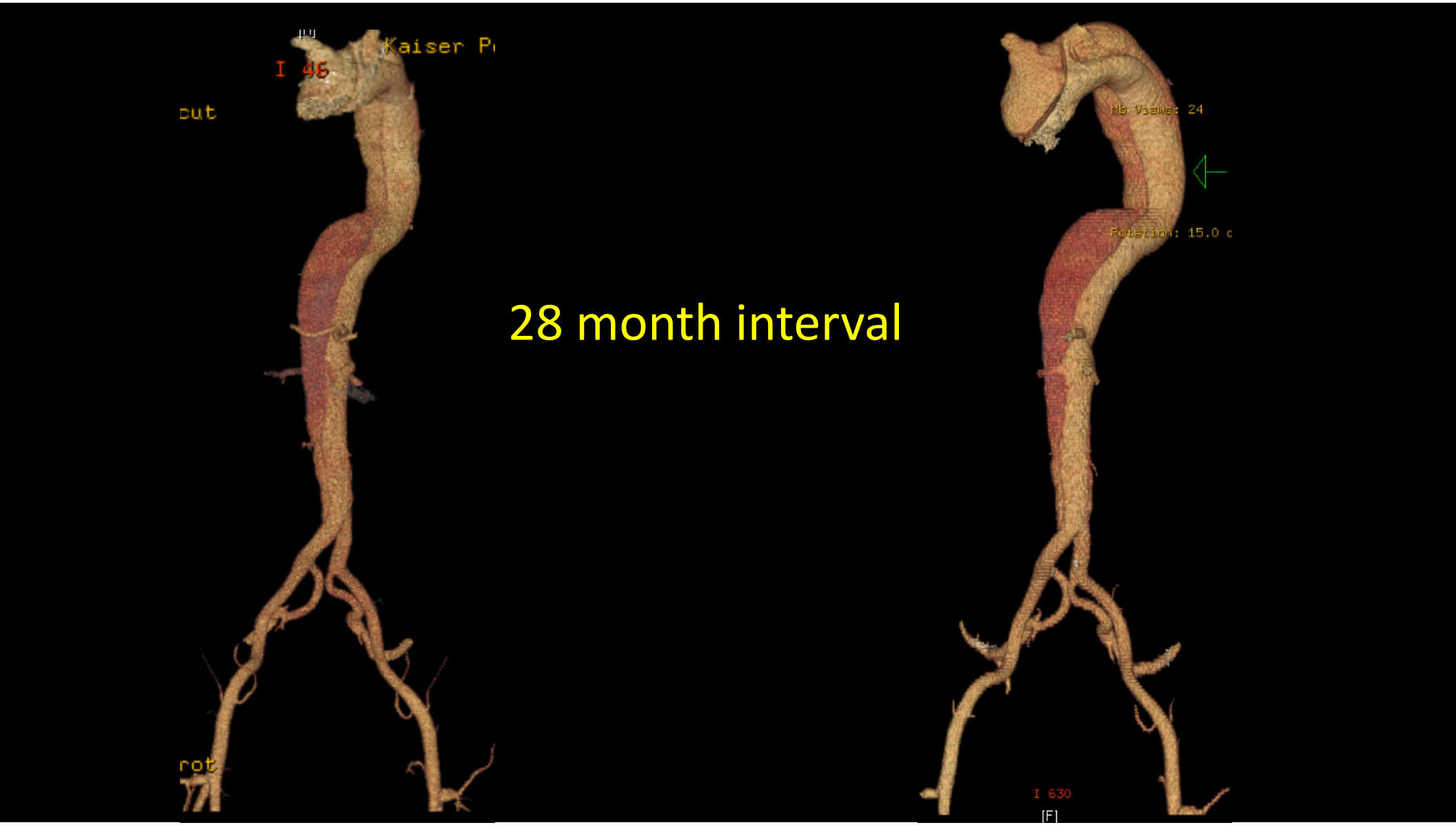
Follow-up CT 28 months later; proximal arch 10 mm larger and proximal descending 6 mm larger

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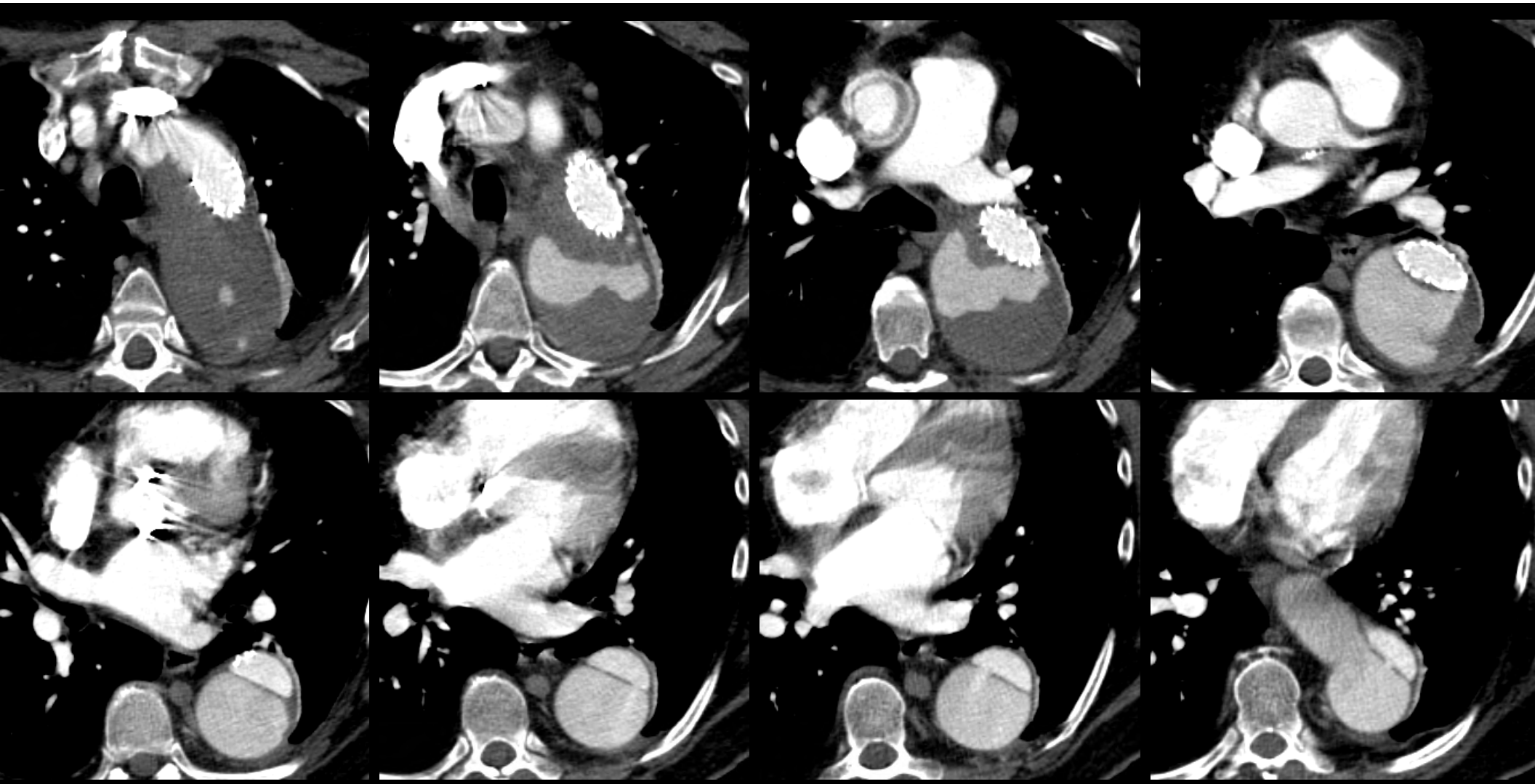
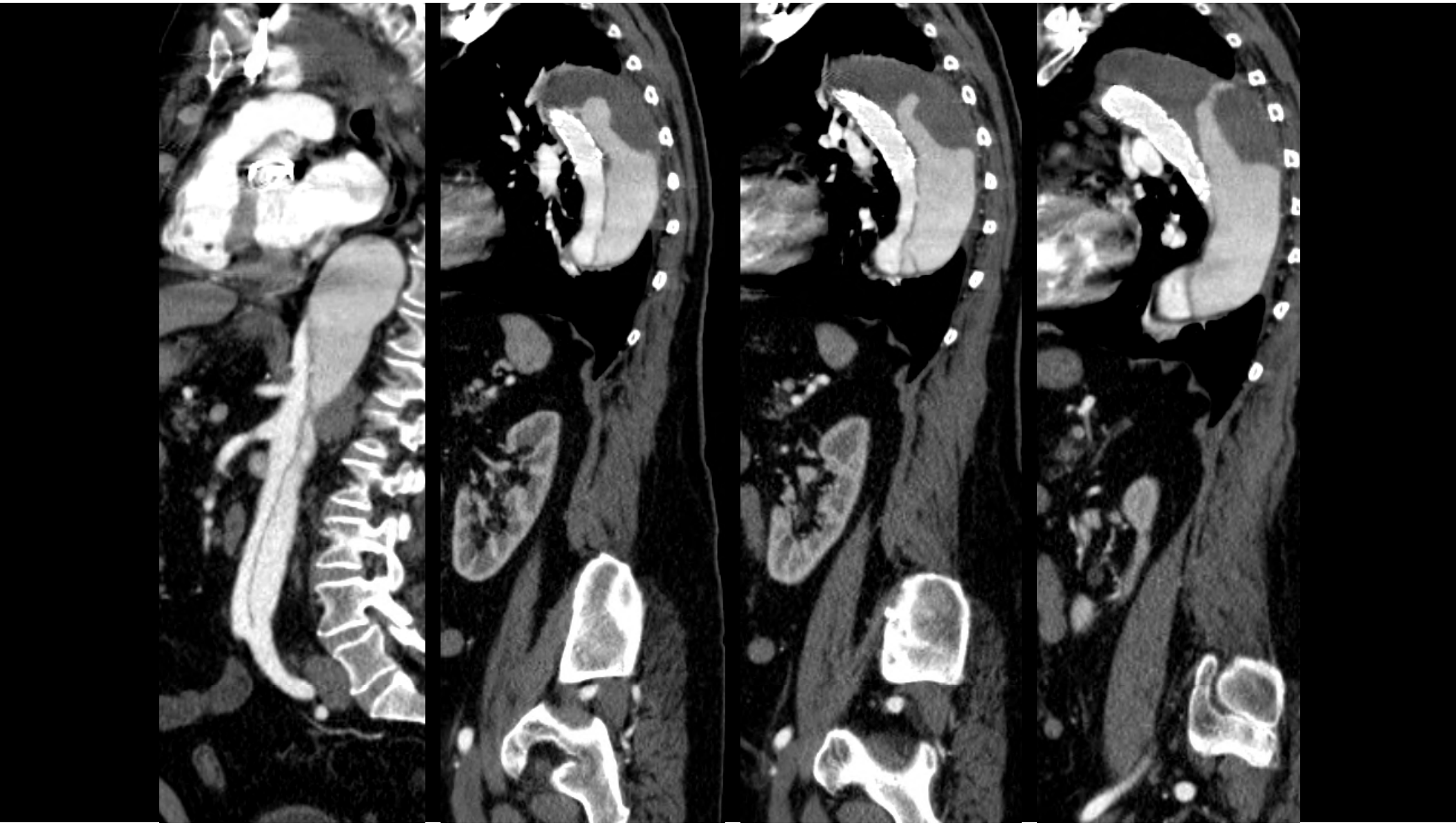
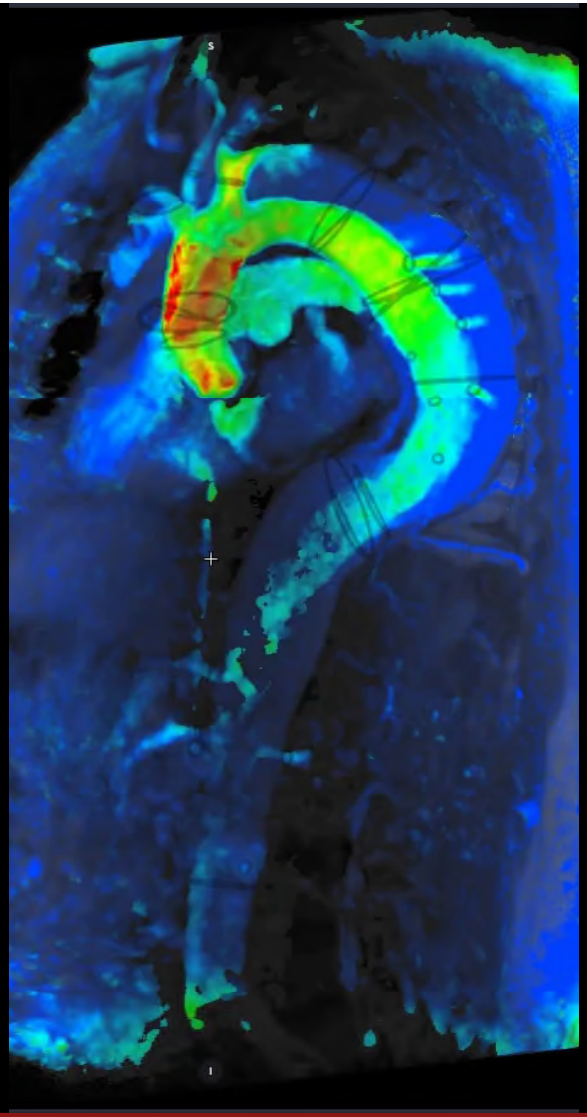
Operative intervention: Total arch replacement and frozen elephant trunk deployment



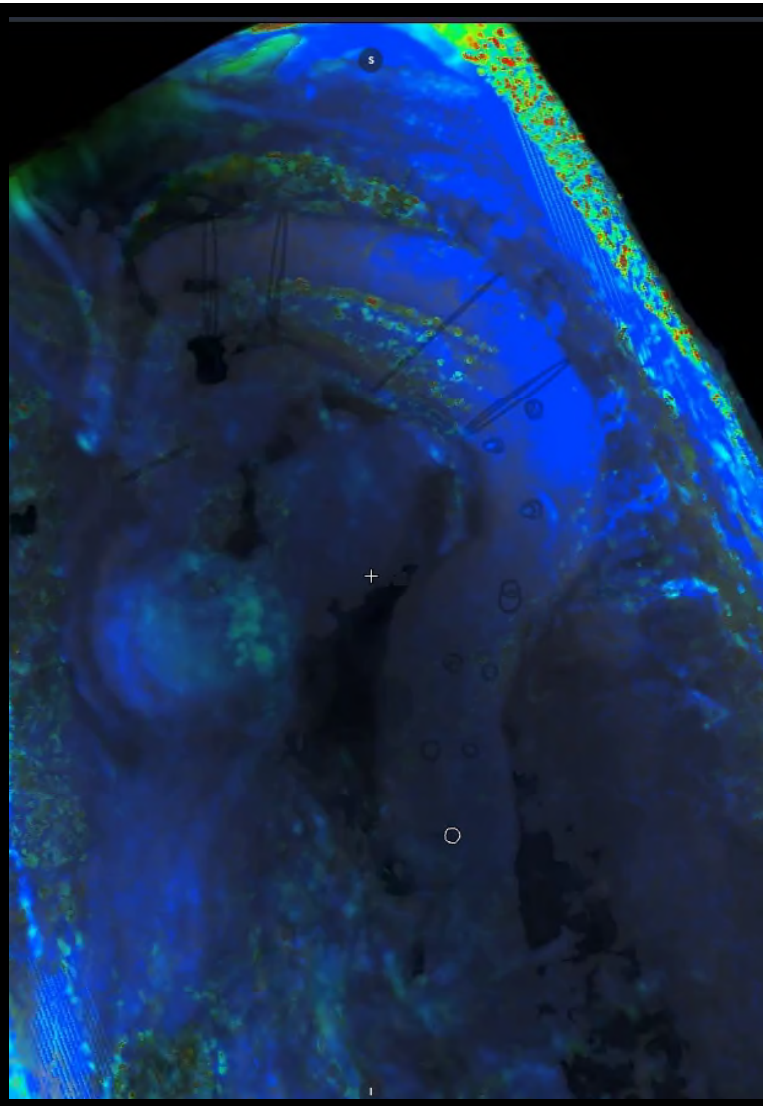
6 months post total arch and frozen elephant trunk – prox descending interval increase of 11 mm

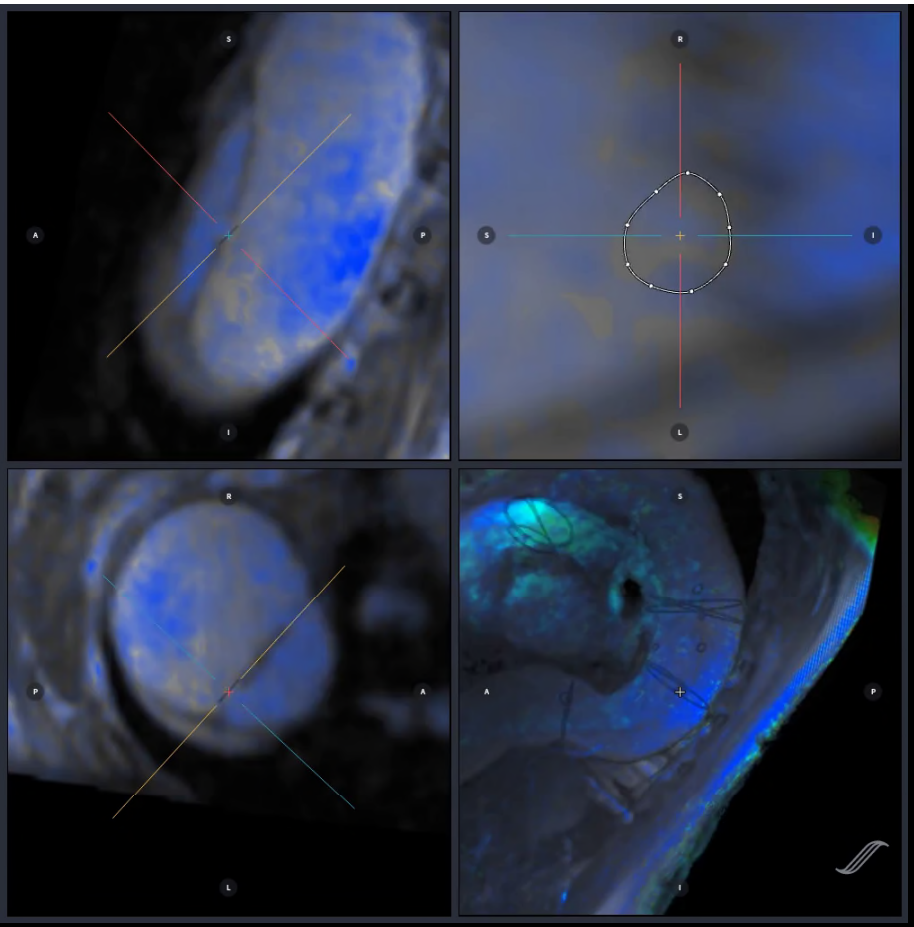


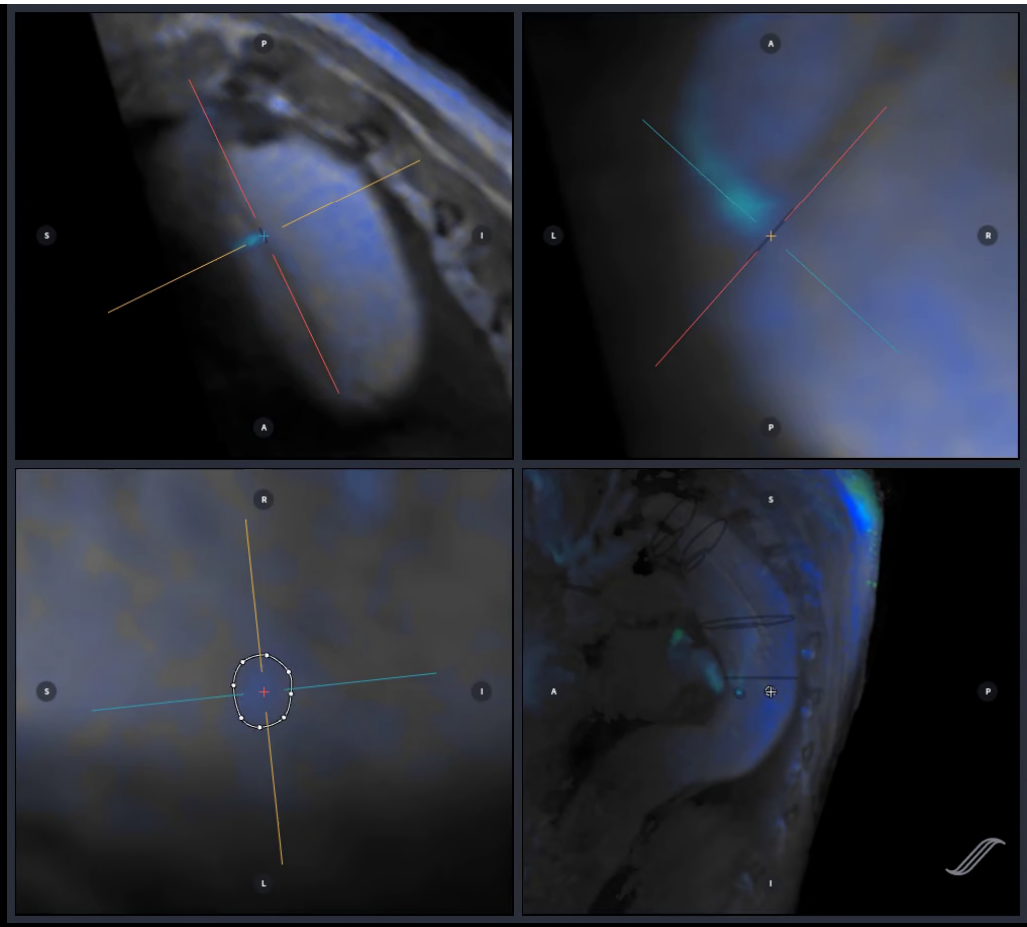


PRE

POST



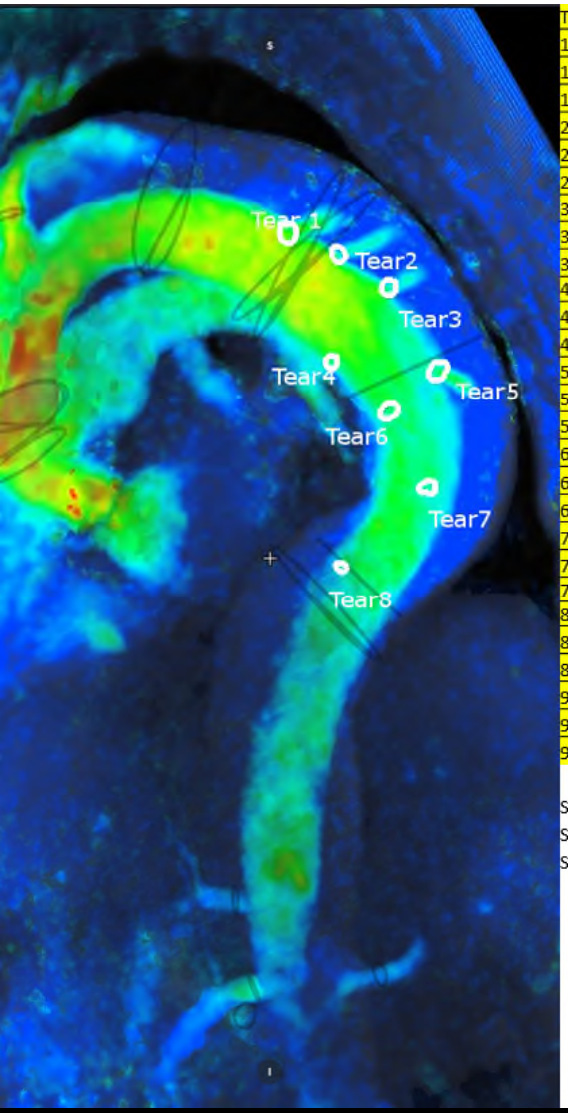




PRE, Nov 13th

Tear 5 = Tear 2

POST, Nov 25th

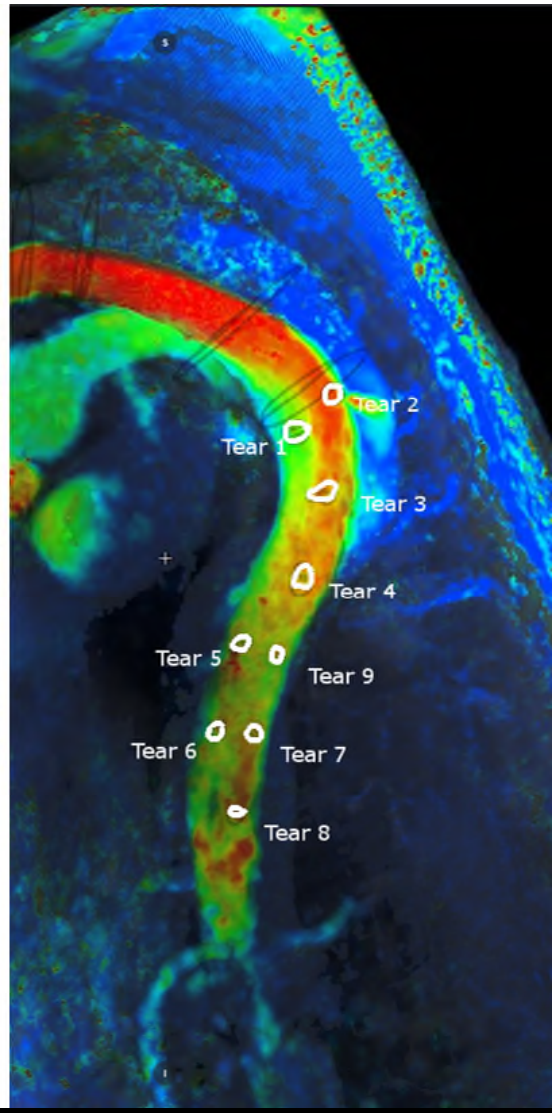


Tear	Net	Forward	Reverse
1 BOTH	0.17	0.21	-0.05
1 FL	0.22	0.22	0.00
1 TL	0.08	0.08	0.00
2 BOTH	0.10	0.10	0.00
2 FL	0.08	0.08	0.00
2 TL	0.02	0.03	0.00
3 BOTH	0.09	0.11	-0.01
3 FL	0.12	0.12	0.00
3 TL	0.03	0.04	0.00
4 BOTH	0.04	0.06	-0.02
4 FL	0.10	0.10	0.00
4 TL	0.03	0.03	0.00
5 BOTH	0.15	0.17	-0.01
5 FL	0.17	0.17	0.00
5 TL			
6 BOTH	0.11	0.16	-0.05
6 FL	0.16	0.16	0.00
6 TL	0.02	0.02	0.00
7 BOTH	0.14	0.14	0.00
7 FL	0.09	0.09	0.00
7 TL	0.01	0.01	0.00
8 BOTH	0.03	0.07	-0.04
8 FL	0.09	0.09	0.00
8 TL	0.00	0.01	0.00
9 BOTH			
9 FL			
9 TL			
SUM BOTH	1.86	1.02	-0.19
SUM FL	1.03	1.03	0.00
SUM TL	0.19	0.22	0.00

PRE

Tear	Net flow	Forward	Reverse
1 BOTH	0.29	0.46	-0.17
1 FL	0.33	0.33	0
1 TL	0.21	0.24	-0.3
2 BOTH			
2 FL	0.23	0.23	0
2 TL	0.1	0.1	0
3 BOTH	0.01	0.12	-0.11
3 FL	0.12	0.12	0
3 TL	0.1	0.1	0
4 BOTH	0.17	0.17	0
4 FL	0.15	0.15	0
4 TL	0	0	0
5 BOTH	0.11	0.15	-0.04
5 FL	0.08	0.08	0
5 TL	0.03	0.03	0
6 BOTH	0.14	0.14	0
6 FL	0.05	0.05	0
6 TL			
7 BOTH	0.04	0.06	-0.02
7 FL			
7 TL			
8 BOTH	0.09	0.06	0
8 FL			
8 TL			
9 BOTH	0.07	0.09	-0.02
9 FL			
9 TL			
SUM BOTH	0.92	1.25	-0.36
SUM FL	0.96	0.96	0.00
SUM TL	0.44	0.47	-0.30

POST



Post- surgery: twice as much flow from FL to TL in diastole

Analysis/Summary

- Patient risk profiles used to predict disease progression after aortic dissection are increasingly focused on physiological features including pressure and flow in both the true and false lumens
- Balanced FL inflow and outflow and equal pressures in both lumens throughout the cardiac cycle are protective
- In uncomplicated dissection, progression of disease is generally associated with limited FL outflow (FL flow imbalance, increase in FL diastolic pressure, partial FL thrombosis)
- After TEVAR with covering of the primary entry tear, FL enlargement is frequently related to the number of septal fenestrations (relative mismatch in FL inflow/outflow)

Conclusion

The current focus of endovascular dissection management is expanding to include not only who should we treat, but who should we treat better.

i.e., the field is moving to increase our prognostic scope beyond how to assess the individual risk to a patient with uncomplicated type B dissection toward how best to predict the risk of disease progression after TEVAR.