



Case Presentation: Aortic Dissection

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APPE Formal Presentation
Novant Health Presbyterian Medical Center
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Objectives



Describe the pathophysiology/etiology/diagnosis parameters of Aortic Dissection

Describe treatment and surgical options for Aortic Dissection

Review primary literature and how it relates to the patient case

Patient Case - ZZ

HPI	71 year old female; presented with neck pain who underwent CTA of the neck and was noted to have Type A Aortic Dissection
PMH	No pertinent past medical history Tubal ligation
Allergies	PCN → Swelling Lorazepam → Hallucinations/Delirium
SH	Smoker (3-4 cigarettes daily)

Prior to Admission Medications

Amlodipine PO 5 mg QD

Lisinopril PO 20 mg QD

Patient Case - ZZ

Admitted for Ascending Aortic Dissection Procedure → (9/15 at 1315)

Transferred to NHPMC CVRU → (9/15 at 2341)

Transferred into NHPMC CCU → (9/18 at 1026)

Transferred out of NHPMC CCU → (9/22 at 1431)

Transferred into NHPMC Int. Cardiac Care (5D) → (9/22 at 1431)

Discharged → (9/26 at 1327)

Pathophysiology/Etiology/Diagnosis Aortic Dissection

Aortic Dissection: Pathophysiology

Aortic Wall Inflammation



Apoptosis of Vascular Smooth Muscle Cells



Degeneration of Aortic Media


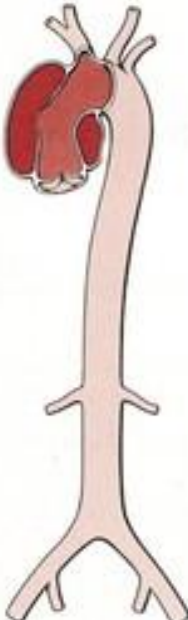



Elastin Disruption



Vessel Dissection

Aortic Dissection: Classification

De Bakey Type I	Type II	Type III
		
Stanford	Type A	Type B
<p>De Bakey</p> <p>Type I Originates in the ascending aorta, propagates at least to the aortic arch and often beyond it distally</p> <p>Type II Originates in and is confined to the ascending aorta</p> <p>Type III Originates in the descending aorta and extends distally down the aorta or, rarely, retrograde into the aortic arch and ascending aorta</p>		
<p>Stanford</p> <p>Type A All dissections involving the ascending aorta, regardless of the site of origin</p> <p>Type B All dissections not involving the ascending aorta</p>		

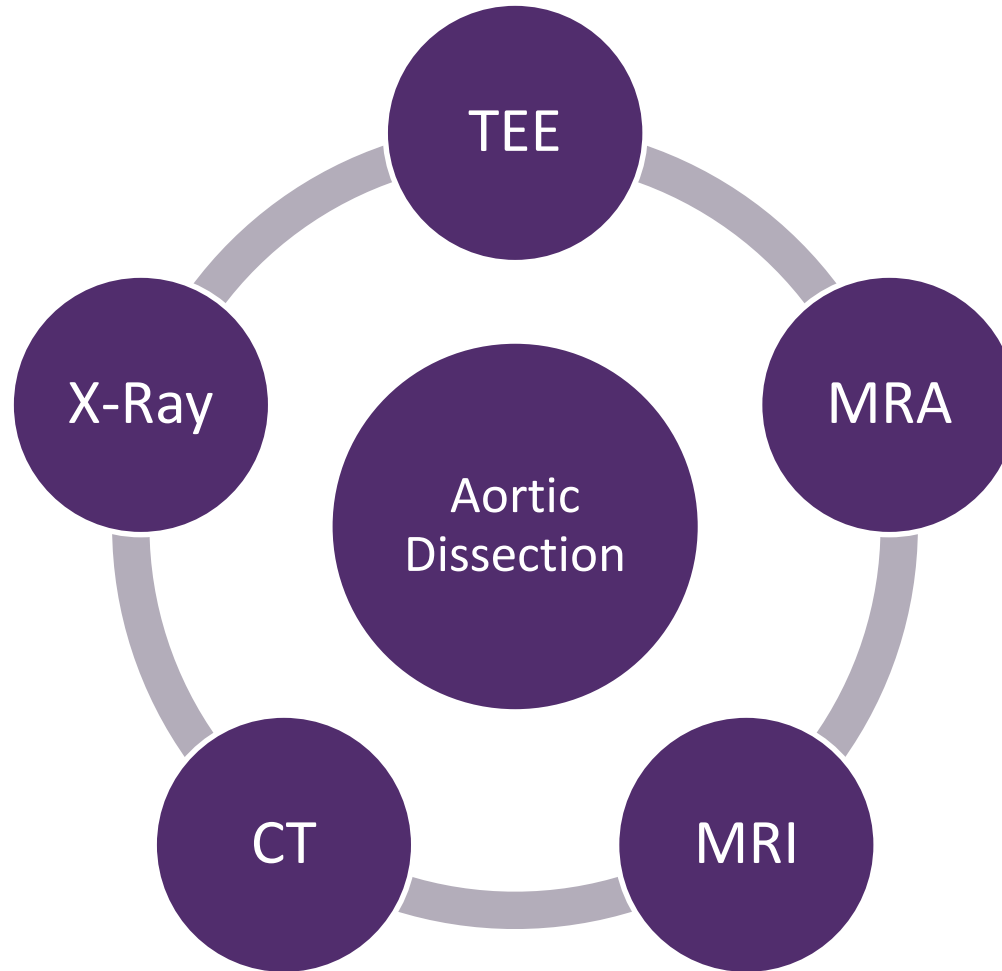
Aortic Dissection: Etiology

Aortic dissections often occur in patients with preexisting degeneration of the aortic media. Causes and risk factors include connective tissue disorders, atherosclerotic disease, and injury

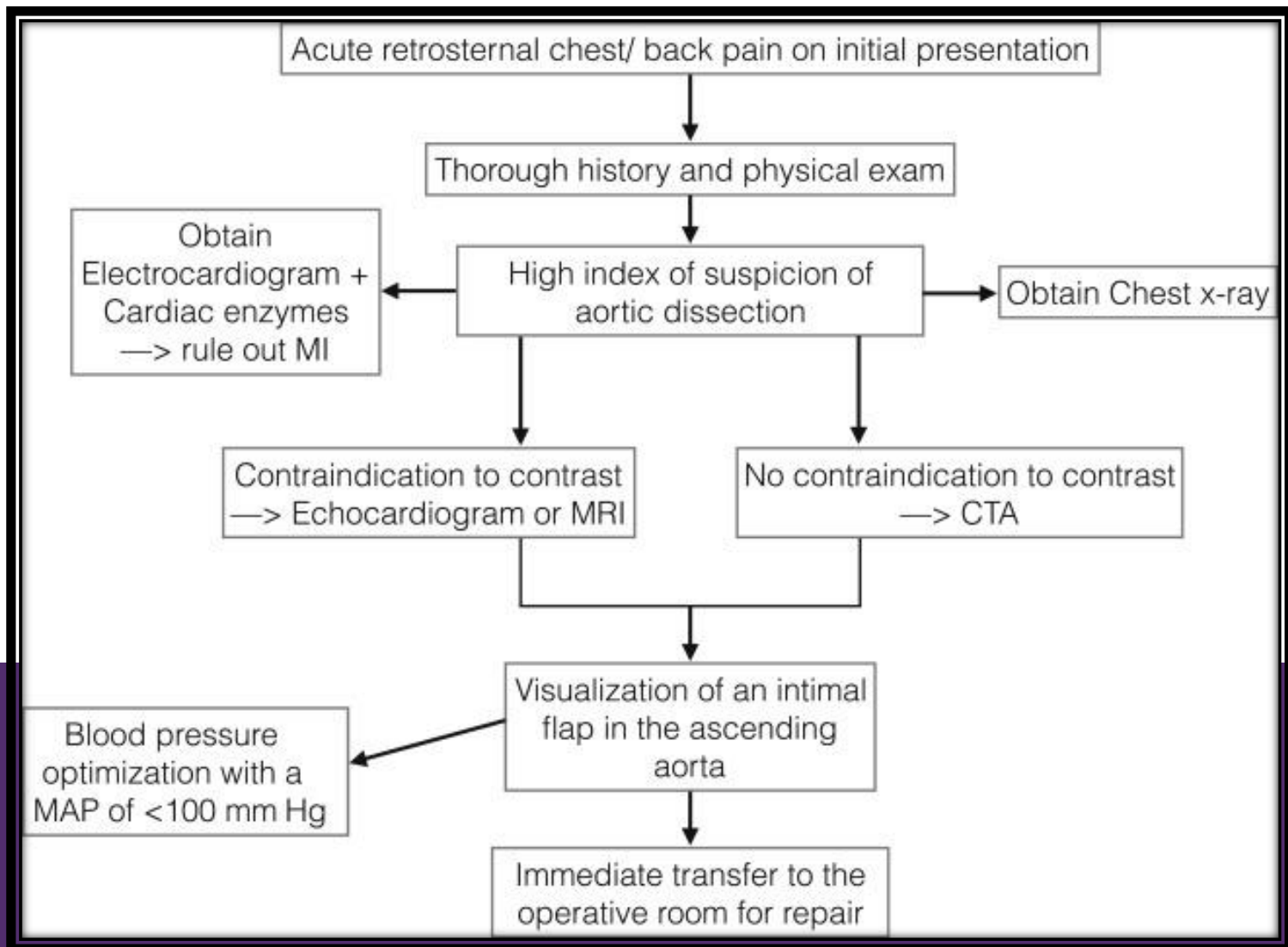
Conditions Contributing to Aortic Dissection

CATEGORY	EXAMPLES
ATHEROSCLEROTIC RISK FACTORS	COCAINE DYSLIPIDEMIA HTN SMOKING
CONNECTIVE TISSUE DISORDERS	GIANT CELL ARTERITIS EHLERS-DANLOS SYNDROME MARFAN SYNDROME TURNER SYNDROME
IATROGENIC	AORTIC CATHETERIZATION AORTIC VALVE SURGERY
TRAUMA	DECELERATION INJURIES

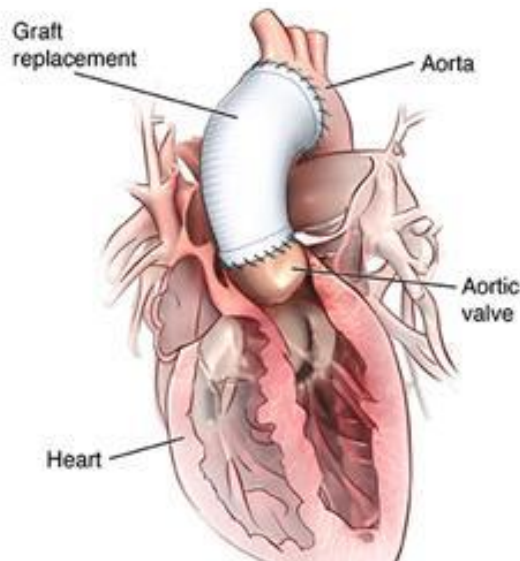
Aortic Dissection: Diagnosis



Initial Management Aortic Dissection



Aortic Dissection: Surgical Options



The surgeon will attach a synthetic graft to the end of a tube (catheter) → place the catheter into an artery in your leg.

Using X-ray images as a guide, the surgeon will thread the graft through your artery, to the affected part of the aorta for the repair.

And finally the surgeon will remove the catheter. He or she will close the incision and put a small bandage on the wound.

Aortic Dissection: Type A Treatment

Type A aortic dissection

Treatment for type A aortic dissection may include:

- **Surgery.** Surgeons remove as much of the dissected aorta as possible, block the entry of blood into the aortic wall and reconstruct the aorta with a synthetic tube called a graft. If the aortic valve leaks as a result of the damaged aorta, it may be replaced at the same time. The new valve is placed within the graft used to reconstruct the aorta.
- **Medications.** Some medications, such as beta blockers and nitroprusside (Nitropress), reduce heart rate and lower blood pressure, which can prevent the aortic dissection from worsening. They may be given to people with type A aortic dissection to stabilize blood pressure before surgery.

Aortic Dissection: Type B Treatment

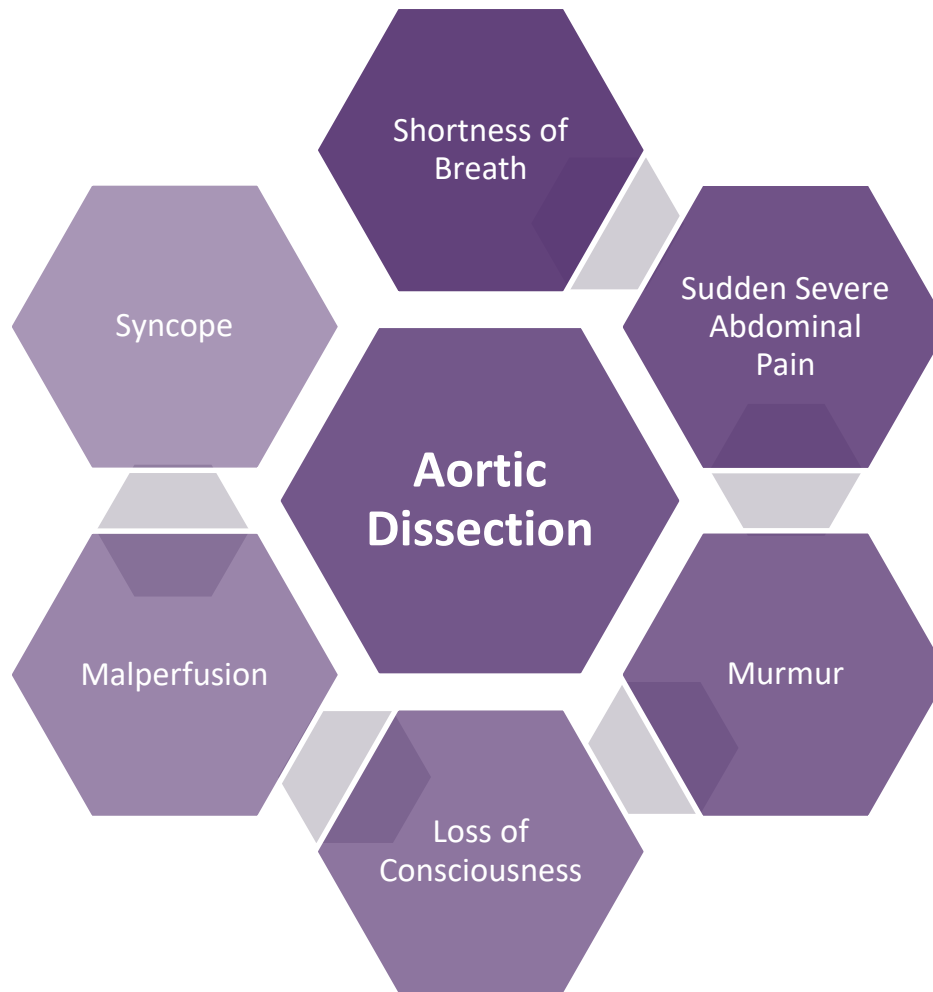
Type B aortic dissection

Treatment of type B aortic dissection may include:

- **Medications.** The same medications that are used to treat type A aortic dissection may be used without surgery to treat type B aortic dissections.
- **Surgery.** The procedure is similar to that used to correct a type A aortic dissection. Sometimes stents — small wire mesh tubes that act as a sort of scaffolding — may be placed in the aorta to repair complicated type B aortic dissections.

Signs and Symptoms Aortic Dissection

Aortic Dissection: Signs and Symptoms



Risk Factors Aortic Dissection

Aortic Dissection: Risk Factors

Uncontrolled High Blood Pressure
(hypertension)

Hardening of the arteries
(atherosclerosis)

Weakened and Bulging Artery
(pre-existing aortic aneurysm)

Aortic Valve Defect
(bicuspid aortic valve)

Narrowing of the aorta at birth
(aortic coarctation)

Pharmacological Treatment Aortic Dissection

Beta Blocker Therapy

Drug	MOA	Dose	Onset of Action	Duration
Labetalol	Non-selectively antagonizes beta-adrenergic receptors, and selectively antagonizes alpha-1-adrenergic receptors.	<ul style="list-style-type: none"> 20 mg initially, followed by 20 - 80 mg every 10 minutes to a total dose of 300 mg Infusion → 0.5 - 2 mg/min 	5-10 minutes	3-6 hours
Esmolol	Beta-1 receptor blocker; blocks beta-adrenergic receptors in the heart, which leads to decreased force and rate of heart contractions.	<ul style="list-style-type: none"> 250 to 500 mcg/kg loading dose over one minute then infuse at 25 to 50mcg/kg/min Maximum of 300 mcg/kg/minute 	1-2 minutes	10-30 minutes

Vasodilator Therapy

Drug	MOA	Dose	Onset of Action	Duration
Nitroprusside	Breaks down to release nitric oxide. NO activates guanylate cyclase in vascular smooth muscle and increases intracellular production of cGMP.	<ul style="list-style-type: none">• Initial → 0.25-10.00 mcg/kg/min• Max → 10 mcg/kg/min	Immediate	1-2 minutes

Primary Literature Aortic Dissection

Chen et al

Effect of β -blocker therapy on late outcomes after surgical repair of type A aortic dissection

Shao-Wei Chen, MD, PhD,^{a,b} Yu-Sheng Lin, MD,^c Victor Chien-Chia Wu, MD,^d Ming-Shyan Lin, MD,^c An-Hsun Chou, MD, PhD,^e Pao-Hsien Chu, MD,^d and Tien-Hsing Chen, MD^f

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Shao-Wei Chen, MD, PhD^{a,b}, Yu-Sheng Lin, MD,^c Victor Chien-Chia Wu, MD,^d Ming-Shyan Lin, MD,^c

Design

Purpose

- To evaluate the effects of b-blocker therapy on long-term outcomes in patients after surgical repair of Type A Aortic Dissection.

Methods

- Retrospective, Propensity-score Matched, Longitudinal Study

Results

TABLE 2. Time to event outcome during the follow up

Variable	β -Blocker (n = 396)	Non- β -blocker (n = 396)	β -Blocker vs non- β -blocker	
			HR (95% CI)*	P value
MACCE†	76 (19.2)	115 (29.0)	0.61 (0.46-0.82)	.001
All-cause mortality	64 (16.2)	94 (23.7)	0.65 (0.48-0.90)	.008
Acute myocardial infarction	1 (0.25)	2 (0.51)	0.51 (0.05-5.55)	.578
Heart failure	10 (2.5)	13 (3.3)	0.78 (0.35-1.73)	.544
Stroke	14 (3.5)	23 (5.8)	0.61 (0.31-1.19)	.144
Redo surgery	25 (6.3)	16 (4.0)	1.64 (0.89-3.00)	.113
Redo open surgery	7 (1.8)	5 (1.3)	1.43 (0.45-4.53)	.546
Redo stent/endo	18 (4.5)	11 (2.8)	1.71 (0.80-3.66)	.165
Chronic kidney disease	48 (12.1)	56 (14.1)	0.85 (0.58-1.26)	.426
Readmission from any cause	170 (42.9)	203 (51.3)	0.74 (0.60-0.91)	.005
Uncontrolled hypertension				
Emergency room visit	14 (3.5)	20 (5.1)	0.70 (0.35-1.41)	.322
Admission	5 (1.3)	7 (1.8)	0.73 (0.23-2.30)	.589
Any	17 (4.3)	25 (6.3)	0.68 (0.36-1.28)	.231

Data are presented as n (%) except where otherwise noted. HR, Hazard ratio; CI, confidence interval; MACCE, major adverse cardiovascular and cerebrovascular event. *Estimated using Fine and Gray's subdistribution hazard model which considered all-cause mortality as a competing risk. The results of all-cause mortality and MACCE were derived from Cox proportional hazard model. †Any one of mortality, acute myocardial infarction, heart failure, or stroke.

MACCE = major adverse cardiac and cerebral events

Conclusions

Beta Blocker usage has a protective effect on patients after surgical repair of TAAD. Compared with the non-b-blocker group, the b-blocker user group had significantly lower risks of mortality, MACCE, and readmission for any cause.

Strict medication adherence of b-blocker therapy was associated with a survival benefit.

MACCE = major adverse cardiac and cerebral events

Type-Selective Benefits of Medications in Treatment of Acute Aortic Dissection (from the International Registry of Acute Aortic Dissection [IRAD])

Toru Suzuki, MD^{a,*}, Eric M. Isselbacher, MD^b, Christoph A. Nienaber, MD^c, Reed E. Pyeritz, MD^d, Kim A. Eagle, MD^e, Thomas T. Tsai, MD^f, Jeanna V. Cooper, MS^e, James L. Januzzi, Jr., MD^b, Alan C. Braverman, MD^g, Daniel G. Montgomery, BS^c, Rossella Fattori, MD^h, Linda Pape, MDⁱ, Kevin M. Harris, MD^j, Anna Boohar, MD^c, Jae K. Oh, MD^k, Mark Peterson, MD^l, Vijay S. Ramanath, MD^m, and James B. Froehlich, MD^c

Design

Purpose

- To review the effects of medications on the outcome of Aortic Dissection by looking at medications given at discharge and during hospital stay.

Methods

- IRAD is a multinational registry of 24 referral centers in 12 countries. Data from patients enrolled in IRAD from December 26, 1995 with follow-up to 5 years was examined, with a focus on patients discharged alive with medication and follow-up data that included the use of medications.

Results

Table 3
Multivariate analysis on factors affecting long-term mortality

Variable	p Value	Hazard Ratio	95% CI
Type A			
Age ≥ 70 years	0.002	2.440	1.393–4.272
History of atherosclerosis	0.273	1.415	0.761–2.633
Previous cardiac surgery	0.498	1.330	0.582–3.040
Angiotensin-converting enzyme inhibitor at discharge	0.585	0.853	0.481–1.512
β Blocker at discharge	0.022	0.471	0.248–0.897
Calcium channel blocker at discharge	0.159	1.479	0.858–2.549
Type B			
Female gender	0.454	0.827	0.504–1.359
Age ≥ 70 years	0.001	2.321	1.383–3.897
Previous aortic aneurysm	0.183	1.418	0.848–2.371
History of atherosclerosis	0.380	1.248	0.761–2.046
Renal failure	0.611	0.841	0.431–1.640
Pleural effusion on chest radiograph	0.116	1.570	0.895–2.756
Hypotension	0.033	2.330	1.072–5.064
Angiotensin-converting enzyme inhibitor at discharge	0.378	0.813	0.513–1.289
β Blocker at discharge	0.375	0.719	0.347–1.491
Calcium channel blocker at discharge	0.012	0.554	0.348–0.880

This analysis shows that the use of blockers was significantly associated with improved survival (OR 0.47, 95% CI 0.25 to 0.90, p 0.02) and that older age was associated with poor survival (OR 2.44, 95% CI 1.39 to 4.27, p 0.002).

The analysis for type A used a model including a history of atherosclerosis and previous cardiac surgery.

Almost all patients (96%) were discharged with antihypertensive medication. All patients, as well as those with type A overall and those with type A treated surgically, showed that blockers, the most commonly used agent in patients with aortic dissection (88.6%), were associated with improved survival.

Conclusions

The analysis confirmed that blockers are the most widely used class of medication in almost all patients with aortic dissection, in accordance with the guidelines, and that not only are they beneficial for all patients but also for patients with Type A overall and those treated surgically, in particular.

Renin angiotensin system inhibitors (e.g., angiotensin converting enzyme inhibitors) did not show an association with mortality in the cohort.

Guidelines Aortic Dissection

American (AHA/ACC) guidelines 2010

Initial management of thoracic aortic dissection

Intravenous beta-blockade should be initiated and titrated to a target heart rate of <60 bpm	I	C
Non-dihydropyridine calcium channel blocking agents as an alternative for rate control	I	C
If systolic BP remains >120 mmHg after adequate heart rate control, angiotensin-converting enzyme inhibitors and/or other vasodilators should be administered to further reduce BP that maintains adequate end-organ perfusion	I	C
Beta-blockers should be used cautiously with aortic regurgitation because they will block compensatory tachycardia	I	C
Vasodilator therapy should not be initiated prior to rate control to avoid associated reflex tachycardia	III	C

AHA, American Heart Association; ACC, American College of Cardiology; BP, blood pressure.

Patient Case - ZZ

Pre-Procedure Findings

- Type A aortic dissection with a tear on the anterior portion at the STJ with retrograde thrombus to the level of the right coronary.
- Friable (tissue that tears) and thin tissue, very friable dissected aortic tissue

Patient Case - ZZ

Patient had Ascending Aortic Aneurysm Replacement Surgery (9/15)

Patient experienced post-op leukocytosis, emphysema, thrombocytopenia, hypoxia

(POD #3)

Patient experienced AFib with RVR

(POD #5)

Patient presented with Severe Emphysema on CT Scan

(POD #6)

Patient's thrombocytopenia, hypoxia resolved

(POD #7)

Patient taken off ABX as no sign of infection

(POD #9)

Patients AFib → SR (Normal Sinus Rhythm)


(POD #10)

Patient Case – ZZ

Discharge Medications



Summary



An **aortic dissection** is a serious condition in which the inner layer of the **aorta**, the large blood vessel branching off the heart, **tears**. Blood surges through the tear, causing the inner and middle layers of the **aorta** to separate (dissect).

Type A Aortic Dissection patients will need **mandatory** surgery as a tear in the ascending aorta is more severe and life threatening. And medication alone will not suffice.

Medications such as Beta Blockers and Vasodilators play a key role in the management of Aortic Dissection.

Surgery is the mainstay of treatment for more severe aortic dissections such as Type A – which the patient ZZ presented with.

Resources

1. Chen SW, Lin YS, Wu VC, et al. Effect of β -blocker therapy on late outcomes after surgical repair of type A aortic dissection. *The Journal of Thoracic and Cardiovascular Surgery*. May 2019. doi:<https://doi.org/10.1016/j.jtcvs.2019.05.032>.
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3. Coady M.A., Rizzo J.A., Goldstein L.J., et al: Natural history, pathogenesis, and etiology of thoracic aortic aneurysms and dissections. *Cardiol Clin* 1999; 17: pp. 615-635
4. Larson E.W., and Edwards W.D.: Risk factors for aortic dissection: a necropsy study of 161 cases. *Am J Cardiol* 1984; 53: pp. 849-855
5. Núñez-Gil I.J., Bautista D., Cerrato E., et al: Incidence, Management, and Immediate- and Long-Term Outcomes After Iatrogenic Aortic Dissection During Diagnostic or Interventional Coronary Procedures. *Circulation* 2015; 131: pp. 2114-2119
6. Takamoto S., Ishimaru S., Ueda Y., Ookita Y., Ogino H., Kazui T., Kato M., Tabayashi K., Nakajima Y., Kuribayashi S., Matsuo H., Miyata T., and Yoshida K.: Guidelines for diagnosis and treatment of aortic aneurysm and aortic dissection (JCS 2006). *Circ J* 2006; 70: pp. 1569-1646



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