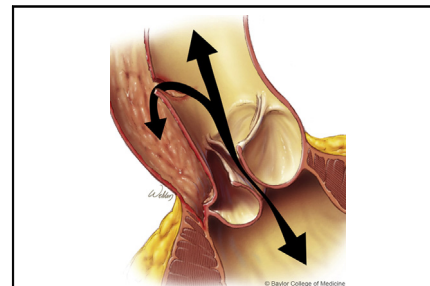


Overview of contemporary guidelines for management of acute type A aortic dissection



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Disruption of the aorta: Contemporary guidelines offer recommendations on aortic management.

CENTRAL MESSAGE

Contemporary American, European, and Japanese guidelines offer guidance on the diagnosis, management, transfer, surgical techniques, and long-term management of acute type A aortic dissection.

PERSPECTIVE

Contemporary guidelines of ATAAD offer consistent treatment recommendations from diagnosis to long-term surveillance. American, European, and Japanese guidelines are largely concordant, offering guidance on diagnosis, interfacility transfer, surgical techniques and long-term management, incorporating unique details and perspectives on management.

Major cardiology and cardiac surgery societies have published clinical practice guidelines to offer a conceptual framework and practical recommendations for the treatment of acute type A aortic dissection (ATAAD). We summarize and compare the following contemporary guidelines: the American Heart Association (AHA)/American College of Cardiology (ACC) 2022 guidelines on the diagnosis and management of aortic disease, the Japanese Circulation Society 2020 guidelines on aortic aneurysm and aortic dissection, and the more recent joint European Association for Cardio-Thoracic Surgery (EACTS)/Society of Thoracic Surgeons (STS) guidelines for diagnosing and treating acute and chronic syndromes of the aortic organ (defining the aorta as an organ for the first time). Additionally, we review the American Association of Thoracic Surgery (AATS) 2021 expert consensus document (ECD) on surgical management of aortic dissection, which offers a more in-depth focus on surgical technique and decision making with respect to relevant treatment questions.¹⁻⁴

Diagnosis

The diagnosis of ATAAD remains a clinical challenge with a high incidence of misdiagnosis as the signs and symptoms of ATAAD often overlap with other common complaints.⁵ Computed tomography angiography (CTA) of the chest, abdomen and pelvis is the recommended modality by all guidelines for diagnosing ATAAD and other acute aortic syndromes. Electrocardiogram gating technique is preferred, if available, due to improved diagnostic certainty with reduction of artifact.¹⁻⁴

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Sequelae of ATAAD should be identified at the time of initial diagnosis and these include acute aortic regurgitation, malperfusion (coronary, cerebral, spinal, visceral, peripheral), and rupture (intrapericardial, intrathoracic, intra-abdominal). These risk factors influence both treatment decisions and outcomes. Physical examination, electrocardiogram, and CTA are usually sufficient for evaluation. The EACTS/STS guidelines also recommend preoperative transthoracic echocardiography.³

Interfacility Transfer

Recognition and diagnosis of ATAAD upon presentation is especially important for centers without definitive means

Abbreviations and Acronyms

ACC	= American College of Cardiology
ACP	= antegrade cerebral perfusion
AATS	= American Association for Thoracic Surgery
AHA	= American Heart Association
ATAAD	= acute type A aortic dissection
CTA	= Computed Tomography Angiography
EACTS	= European Association for Cardio-Thoracic Surgery
ECD	= expert consensus document
IMH	= intramural hematoma
STS	= Society of Thoracic Surgeons
VSARR	= valve sparing aortic root replacement

for surgical repair who need to transfer care promptly.^{1,2} Process delays in facilitating patient transfer to an operating room can occur on many levels from diagnosis to transfer. Direct-to-operating programs streamline patient transfers from emergency rooms resulting in shorter times to surgical intervention and have been shown to decrease operative mortality.^{6,7}

Outcomes for patients with ATAAD may be improved when managed at high-volume aortic centers,²⁻⁴ despite risk of death during interhospital transfer. Contemporary guidelines emphasize the advantages of high-volume, multidisciplinary comprehensive aortic centers that may have more resources to treat complex aortic issues, although regionalization of care must be balanced with timely treatment.²⁻⁴

Classification

Classification by origin of the primary entry tear, chronicity, and pathology must be determined to guide treatment. Although the traditional Stanford and DeBakey classification schemes offer important conceptual perspectives on classifying acute aortic syndromes, the more recent 2022 Society for Vascular Surgery and STS guidelines propose a revised system based on the aortic pathology, location of primary intimal tear, and the proximal and distal extent of pathology.⁸ Similarly, the type/entry/malperfusion classification has been proposed in the European guidelines, where *type* refers to dissection extension, *entry* refers to primary tear location, and *malperfusion* is scored based on which organ is malperfused.³ European and American guidelines define acute dissection as up to 14 days after dissection onset, subacute 15 to 90 days after dissection onset, and chronic 91 days after dissection onset.^{2,3}

Aortic dissections, intramural hematomas (IMHs), and penetrating aortic ulcers coexist along the spectrum of acute aortic syndromes. IMH is a specific aortic pathology described as hemorrhage within the media layer of the aorta

that can be seen with or without a tear in the intima. This is evident on CTA imaging as hyperdense thickening of the aorta, either circumferentially or in a crescent shape, without clear evidence of a dissection. The Japanese guidelines refer to this entity as “aortic dissection with thrombosed false lumen,” underlying the reality that this pathology often represents a thrombosed dissection without a clear intimal tear.¹ The natural course of IMH is unpredictable with some instances advancing to dissection or rupture, whereas others may simply resorb.^{2,9} Those with high-risk features on imaging should undergo urgent surgical repair as described below. Penetrating atherosclerotic ulcers are often associated with IMH and can degenerate into aortic dissection or progress to frank rupture.^{10,11}

Initial Medical Management

There is concordance among guidelines regarding initial treatment with anti-impulse therapy to decrease aortic wall stress and limit dissection propagation in patients presenting with acute aortic syndromes.¹⁻⁴ The objective of early initiation of anti-impulse therapy is to decrease heart rate and blood pressure without compromising end-organ function.^{2,12} The American, European, and Japanese guidelines recommend targeting a systolic blood pressure between 100 and 120 mm Hg but vary slightly in heart rate goals (all approximately 60 to 80 beats per minute). Pain control is an important adjunct to anti-impulse therapy to assist with hemodynamic management.¹⁻⁴ Patients should be monitored in an intensive care unit or operating room setting with invasive hemodynamic monitoring using an arterial line.² First line anti-impulse treatment should include use of beta-adrenergic blockers such as esmolol to reduce systemic blood pressure and heart rate.¹⁻⁴ Additional agents such as calcium channel blockers and vasodilators can be added as needed.^{1,2} Vasodilators should not be used in isolation due to potential reflex tachycardia, which may further propagate the dissection. The AATS ECD additionally recommends that in patients presenting with hypotension, it is reasonable to target a goal systolic blood pressure of 90 mm Hg using volume resuscitation.⁴

Surgical Management

Guiding principles for definitive surgical repair include a tear-oriented approach with resection of the primary entry tear, re-establishment of true lumen perfusion, and correction of malperfusion. The guidelines are consistent on the need for emergency surgery and a tear-oriented approach to ATAAD.¹⁻⁴

Cannulation for Cardiopulmonary Bypass and Perfusion Strategy

The challenge of establishing cardiopulmonary bypass in patients with aortic dissection requires confirmation of true

lumen arterial perfusion. Several techniques have been described although data are limited to retrospective studies.⁴ The right axillary artery has been shown to have decreased risk of stroke and allows for ease of institution of antegrade cerebral perfusion (ACP) during hypothermic circulatory arrest. Direct ascending aortic cannulation using the Seldinger technique under imaging guidance has gained popularity as an alternative cannulation option. This technique avoids the need for a right axillary artery cutdown but can be technically challenging. Femoral artery cannulation is still commonly employed; however, the unpredictable nature of retrograde arterial flow in the dissected aorta may inadvertently contribute to dynamic malperfusion of organ beds. The AATS ECD and ACC/AHA provide specific guidance with respect to cannulation strategy: right axillary artery and direct aortic cannulation are both given IIa recommendations,^{2,4} and femoral artery cannulation is given a IIb recommendation due to the aforementioned concerns of retrograde flow.⁴ The EACTS/STS guidelines similarly provide a IIa indication for axillary or direct cannulation but do not address femoral cannulation (Figure 1).³ Additionally, innominate cannulation is another alternative approach described by ACC/AHA (IIa, level of evidence B) and EACTS.^{2,3}

Hypothermic circulatory arrest times may be prolonged during aortic arch interventions in patients with aortic dissection. Either ACP or retrograde cerebral perfusion strategies can be used as cerebral perfusion adjuncts to mitigate the risk of cerebrovascular ischemia. The AATS ECD suggests the use of either ACP and retrograde cerebral perfusion as reasonable adjuncts to circulatory arrest (IIa).⁴ Because there is evidence that moderate hypothermia with concomitant ACP is safe and comparable to deep hypothermia, either moderate or deep hypothermia is considered reasonable to use during arch reconstruction.¹⁻⁴

Aortic Root Management

Aortic dissections commonly extend to the aortic root; however, the majority of aortic roots can be reconstructed without the need for replacement. Principles for root management include restoration of aortic valve competence, correction of coronary malperfusion, and obliteration of the false lumen (Figure 2). The ACC/AHA guidelines provide class I recommendations for aortic valve resuspension for the partially dissected root but recommend root replacement in the presence of extensive aortic root destruction (including tear in the root) or known genetic aortic disorder.¹³ The AATS ECD similarly gives a class I indication for valve resuspension in most patients with ATAAD and, importantly, includes root aneurysm along with primary root entry tear as class I recommendations for replacing the root.^{1,4} The Japanese guidelines are in line with these recommendations and, notably, the EACTS/STS guidelines do not provide specific recommendations for root management in the setting of ATAAD.¹

Aortic root replacement is considered reasonable (class IIa indication) in patients with Marfan syndrome or other hereditary thoracic aortic disorders. Valve-sparing aortic root replacement (VSARR) in the setting of acute aortic dissection is a technically challenging operation and should only be considered by experienced aortic surgeons in relatively stable patients. The AATS ECD and AHA guidelines provide only a IIb recommendation for VSARR in selected patients.^{2,4} The Japanese guidelines similarly suggest VSARR may be performed by experienced surgeons in select patients.¹ Coronary malperfusion by either static or dynamic obstruction is associated with high mortality. If malperfusion is not addressed by aortic root resuspension or replacement, then coronary artery bypass grafting should be performed to re-establish coronary perfusion (class I indication).⁴

ADULT

Recommendation Table: ATTAD	COR	LOE
Cannulation and Perfusion Strategy		
AATS Consensus Document, EACTS/STS Guidelines of the Aortic Organ, and ACC/AHA		
Axillary artery cannulation is reasonable for stable patients undergoing ATAAD repair.	IIa	B
Direct aortic cannulation with imaging guidance is reasonable for ATAAD repair.	IIa	B
Antegrade cerebral perfusion (ACP) or retrograde cerebral perfusion (RCP) strategies as adjuncts to circulatory arrest.	IIa	B

FIGURE 1. Class of recommendation (COR) and level of evidence (LOE): cannulation and perfusion strategy, American and European guidelines. ATAAD, Acute type A aortic dissection. ATAAD, Acute type A aortic dissection; AATS, American Association of Thoracic Surgeons; STS, Society of Thoracic Surgeons; ACC, American College of Cardiology; AHA, American Heart Association. *American Association for Thoracic Surgery Consensus Document, European Association for Cardio-Thoracic Surgery/Society of Thoracic Surgeons Guidelines of the Aortic Organ, and American College of Cardiology/American Heart Association.

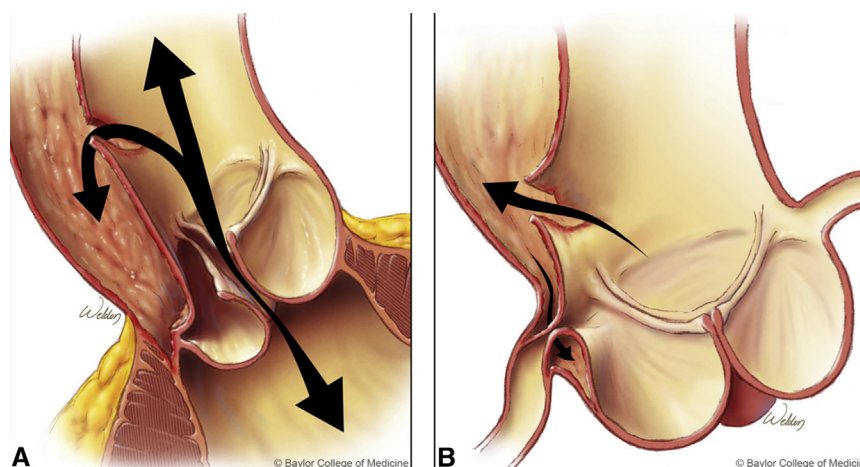


FIGURE 2. Disruption of the aortic root by acute type A dissection. A, Dissection flap extends to sinotubular junction causing prolapse of the valve commissure resulting in aortic regurgitation. B, Malperfusion of the coronary artery from pressurization of the false lumen. Restoration of aortic valve competence, correction of coronary malperfusion, and obliteration of the false lumen are important principles for aortic root management. Used with permission.⁴

Aortic Arch

The management of ascending aortic resection has evolved over several decades from a cross-clamped distal anastomosis to an open distal anastomosis technique under circulatory arrest. This technique effectively allows for resection of the entire ascending aorta and primary entry tear, and it is supported by class I recommendations in all major guidelines.¹⁻⁴

Extended aortic arch replacement strategies vary significantly and often employ hybrid techniques for arch reconstruction. The AATS ECD suggests that extended arch replacement is reasonable (class IIa indication) in the following situations: primary arch entry tear or tear within

the proximal descending thoracic aorta, brain or peripheral malperfusion, and arch or descending aorta aneurysm or rupture. In patients with Marfan syndrome or hereditary thoracic aortic disorders, the use of extended arch replacement may be considered (class IIb indication). The concomitant addition of a frozen elephant trunk extension is given a class IIb indication to promote favorable aortic remodeling.⁴ The ACC/AHA guidelines provide a weaker class IIb indication for extended aortic repair with antegrade stenting.² The Japanese guidelines rationalize the same indications for extended arch replacement with or without frozen elephant trunk, although a specific class of recommendation is not provided.¹ The EACTS/STS guidelines

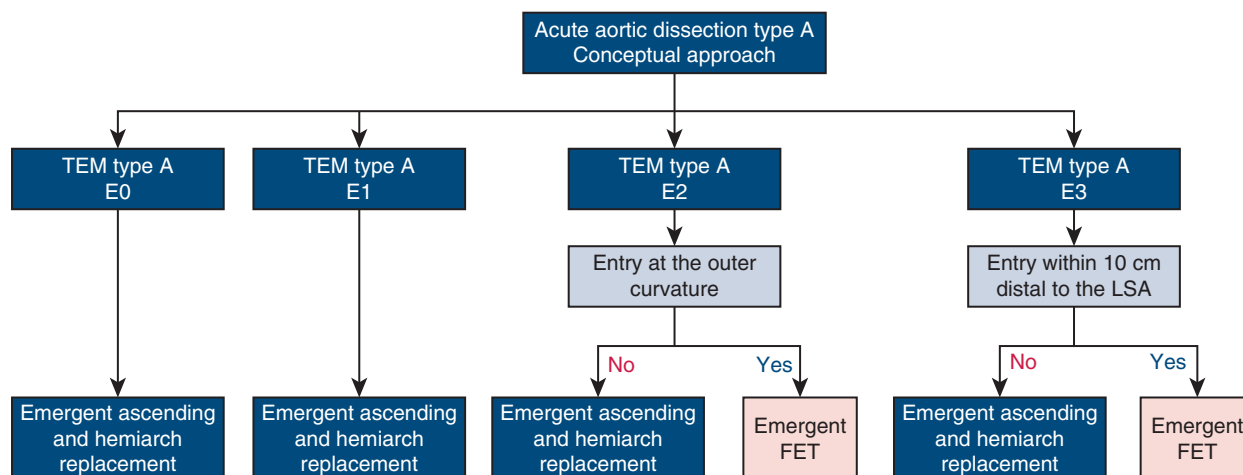


FIGURE 3. European Association for Cardio-Thoracic Surgery/Society of Thoracic Surgeons conceptual approach extent of treatment for acute type A aortic dissection. E0 = no entry visible, E1 = ascending entry, E2 = arch entry, and E3 = descending entry. TEMtype, Entry, malperfusion; LSA, left subclavian artery; FET, Frozen Elephant Trunk. Used with permission.³

offer a conceptual framework for when to consider extended arch surgery. In patients with arch entry tear on the outer curvature or entry tear within 10 cm distal to the left subclavian artery, arch replacement with frozen elephant trunk is recommended.³

In the subset of patients with an intimal disruption in the aortic arch without a dissected ascending aorta (the so-called non-A non-B dissection), there is a paucity of available outcomes data.¹⁴ However, the EACTS/STS guidelines provide the most definitive guidance in this area, giving a IIa recommendation for early repair with aortic arch replacement and frozen elephant trunk. These guidelines propose an algorithm for how to manage these rarer dissections based on location of the primary entry tear (Figure 3).³

Intramural Hematoma in the Ascending Aorta

Although acute type A IMH is a life-threatening pathology, management strategies vary in terms of surgical versus medical management. The European and American guidelines are consistent in recommending urgent surgery for patients with type A IMH, particularly in the setting of certain high-risk features (aortic diameter >50 mm, hematoma thickness >11 mm, pericardial effusion, aortic regurgitation, and ulcer-like projections).^{2,3}

The Japanese guidelines recommend conservative medical treatment with strict blood pressure control as a reasonable (IIa indication) first-line strategy. Both medical management and urgent open surgery are given IIa indications for patients without “ulcer-like projections.” Patients with “ulcer-like projections,” aortic diameter >50 mm, or false lumen thickness >11 mm are recommended to undergo surgery due to poor prognosis with medical management (Figure 4).¹

Malperfusion

Preoperative malperfusion is present in up to 41% of cases of ATAAD.¹⁵ Cerebral malperfusion can vary in clinical presentation from mild neurologic deficits to coma. The management of this subset of patients in the setting of ATAAD is controversial. Although up to 50% patients of patients can have residual neurological deficits following aortic repair, immediate surgery has been shown to reduce mortality and reverse coma in select patients.⁴ American, European, and Japanese guidelines agree that early intervention is reasonable (class IIa indication) in the setting of nonhemorrhagic stroke or neurological deficit.¹⁻⁴ Limb ischemia may resolve after proximal aortic repair, particularly if dynamic obstruction is alleviated, although

ADULT

		COR	LOE
JCS 2020	Urgent open surgery should be considered for patients with aortic dissection with thrombosed false lumen	IIa	C
	Medical treatment should be considered for patients with aortic dissection with thrombosed false lumen	IIa	C
ACC/AHA 2022	In patients with complicated acute type A IMH, prompt open surgical repair is recommended	I	B
	In selected patients with complicated acute type A IMH at increased operative risk and do not have high risk imaging features, medical management may be considered	IIb	C
AATS ECD 2021	Surgery is recommended in patients with type A IMH and one or more high-risk features	I	C
	Expectant management may be reasonable for type A IMH patients with significant comorbidities in the absence of high-risk features	IIb	C
EACTS/STS 2024	In patients with acute type A IMH with complications or high-risk features, emergency surgery is recommended.	I	B
	Optimal medical therapies and serial imaging may be considered in patients with type A IMH in the absence of high-risk features.	IIb	C
	In selected patients with acute type A IMH without high-risk features but a tear in the descending aorta, TEVAR may be considered in addition to Optimal Medical Therapy in specialized centers.	IIb	C

FIGURE 4. Management of intramural hematoma in the ascending aorta; class of recommendation (COR) and level of evidence (LOE) for American, European, and Japanese guidelines. JCS, Japanese Circulation Society; ACC, American College of Cardiology; AHA, American Heart Association; IMH, intramural hematoma; AATS, American Association for Thoracic Surgery; ECD, expert consensus document; EACTS, European Association for Cardio-Thoracic Surgery; STS, Society of Thoracic Surgeons; TEVAR, Thoracic endovascular aorta repair.

TABLE 1. Level-1 recommendations for acute type A aortic dissection (ATAAD): American, European, and Japanese guidelines*

Computed tomography angiography of the chest, abdomen, and pelvis with electrocardiogram gating is the recommended modality for diagnosing ATAAD and other acute aortic syndromes
Anti-impulse control therapy with beta-blockers as first-line therapy after diagnosis of ATAAD
Emergency surgery remains the standard of care for ATAAD
Tear-oriented approach: Resect aneurysmal aorta and proximal extent of the dissection
Open distal anastomosis is recommended for surgical repair

*American College of Cardiology/American Heart Association, European Association for Cardio-Thoracic Surgery/Society of Thoracic Surgeons, Japanese Circulation Society, and American Association for Thoracic Surgery expert consensus document.

additional open or endovascular limb interventions may be needed to restore perfusion.⁴

Mesenteric malperfusion is the most dreaded complication and is associated with an almost 5-fold risk of operative mortality.¹⁵ In select patients, a malperfusion-first strategy of correcting mesenteric malperfusion syndrome before aortic repair may be warranted and is discussed further below.^{1-3,12,16} Mesenteric malperfusion is a devastating complication of ATAAD and is associated with poor outcomes due to irreversible end organ failure. The treatment strategy has conventionally been proximal aortic repair first, which may not be sufficient in the setting of branch vessel static obstruction and may delay mesenteric reperfusion. Therefore, an alternative surgical strategy tailored to quickly restoring end-organ perfusion before proximal aortic repair has been shown in some series to improve operative mortality.¹⁵ This malperfusion-first strategy using thoracic endovascular aortic repair, endovascular aortic fenestration, and branch vessel stenting is given a IIa indication in the ECD and AHA but a weaker IIb indication in the EACTS/STS guidelines.²⁻⁴ The Japanese guidelines suggest a malperfusion-first strategy may be considered in select cases at high risk of intestinal necrosis.¹

Long-Term Management/Surveillance

Lifelong imaging surveillance and on-going clinical management with a focus on lifestyle modification and blood pressure control is essential after diagnosis and surgical repair of ATAAD. There is general consensus among guidelines that individuals receiving treatment for ATAAD should be imaged postoperatively, 6 months, and annually using CTA or magnetic resonance angiography.¹⁻³ Echocardiography to monitor the aortic valve and to assess heart function is recommended.⁴ Family screening with echocardiogram of all first-degree relatives is also recommended.^{2,4} Genetic screening for patients with ATAAD is suggested according to the AATS ECD and recent EACTS guidelines.^{3,4}

Shared decision making by patients and multidisciplinary aortic teams should be used regarding approach and timing of reinterventions. Factors, including family history, genetics, and operative risk, must be considered in addition to aortic growth and size.²⁻⁴

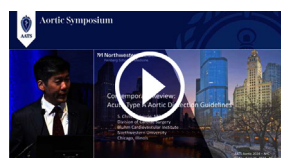
Aortic dissection risk can be increased in the setting of connective tissue disorders.¹⁷

CONCLUSIONS

Contemporary guidelines of ATAAD offer consistent treatment recommendations from diagnosis to long-term surveillance. The largely concordant American, European, and Japanese guidelines offer guidance on diagnosis and management, interfacility transfer, surgical techniques, and decision making, each offering unique details and perspective on management (Table 1).

Webcast

You can watch a Webcast of this AATS meeting presentation by going to: <https://www.aats.org/resources/type-a-dissection-overview-of-7647>.



Conflict of Interest Statement

Dr Mehta has been a consultant for W.L. Gore & Associates and received honoraria from Baxter. Dr Malaisrie has received grants and honoraria from Edwards, grants from Medtronic, grants and honoraria from Artivion, grants and honoraria from Terumo, and honoraria from Atricure. All other authors reported no conflicts of interest.

The *Journal* policy requires editors and reviewers to disclose conflicts of interest and to decline handling and reviewing manuscripts for which they may have a conflict of interest. The editors and reviewers of this article have no conflicts of interest.

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Key Words: aortic, acute aortic syndromes, acute type A dissection, aortic guidelines