



# ACUTE AORTIC TREATMENT CENTER

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## Abstract

Acute aortic syndromes are a life-threatening set of conditions that require rapid triage and intervention to obtain satisfactory outcomes. The Methodist Hospital is the first institution to establish an Acute Aortic Treatment Center (AATC) based on a clinical care pathway that expedites the care of acute aortic syndromes. This pathway has resulted in a 64% reduction in time to definitive therapy and a reduction in intensive care unit (ICU) length of stay. Establishment of a multidisciplinary pathway to treat acute aortic syndromes improves efficiency and enhances outcomes.

## Introduction

Acute aortic syndromes remain life threatening.<sup>1,2</sup> The keys to successful treatment of acute aortic disease are early diagnosis, treatment, and disposition.<sup>1-9</sup> Management of acute aortic disease has changed with the increasing realization that endovascular therapies may offer distinct advantages in these situations. Aortic disease represents a unique area in cardiovascular (CV) surgery, where application of the general concept of “door-to-balloon time” would be beneficial. These paradigms have already demonstrated a significant impact on quality, outcomes, and healthcare costs for trauma, myocardial infarction, and stroke.

## Concepts of Pathways

The concepts of the Acute Aortic Treatment Center clinical pathway are similar to those used as the foundation of the golden hour of trauma, door-to-balloon time for acute myocardial infarction, and door-to-lysis times in the management of acute stroke.<sup>10-12</sup> Each pathway has benefited patients and improved processes.<sup>13,14</sup> Hospital and surgeon volume, taken as a surrogate marker for quality, has been directly correlated with lower morbidity and mortality as well as with differences in perioperative complications after aortic surgeries. The presence of a well-prepared and organized trauma service has been shown to have collateral benefit and to improve the outcome in patients treated for ruptured abdominal aortic aneurysms (AAA).<sup>8</sup>

## Aortic Centers

The concept of aortic centers, in which a multidisciplinary team is assembled for comprehensive aortic care, has been adopted by many groups with the goal

of improving outcomes and increasing clinical volumes.<sup>15-17</sup> These centers are developed to improve patient access and management and to increase patient volume by providing a differentiation factor in the local market.<sup>16,18</sup> The diffusion of aortic endograft technology into the community and the evolution of cardiovascular skill sets in practitioners have stifled further development of this concept. There is considerable debate on the regionalization of vascular care, with advanced procedures being funneled into high-volume tertiary and quaternary centers of excellence with a comprehensive, experienced faculty and a multidisciplinary approach.<sup>19</sup> The Leapfrog Group healthcare quality initiative has proposed “evidence-based” hospital referral criteria for specific procedures, including elective abdominal aortic aneurysm repair. These criteria include an annual hospital AAA operative volume exceeding 50

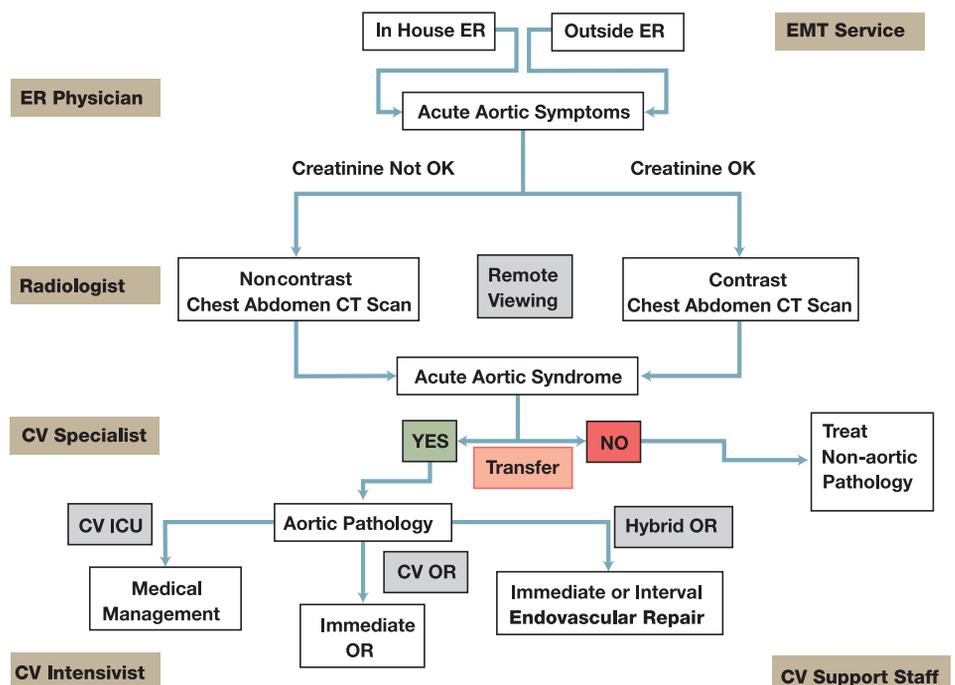


Figure 1. AATC Pathway

cases and provision of ICU care by board-certified intensivists.<sup>19-21</sup> It has been reported that patients transferred with a ruptured AAA had an over twofold increase in ICU days used but no difference in total length of stay.<sup>22</sup> However, acceptance of transfer patients with ruptured aortic aneurysms from community centers did not adversely affect patient survival.<sup>22, 23</sup>

The Acute Aortic Treatment Center (AATC) builds on these foundations but is centered on a single, difficult-to-manage disease process. Implementation of the AATC has resulted in a growth in emergency and after-hours care, emergent and urgent procedures, and acceleration in semi-elective interventions within the inpatient environment.

### The AATC Pathway (Figure 1)

The AATC leverages the hospital's existing rapid-response services infrastructure that was created to shorten door-to-balloon times for acute myocardial infarction, rapid intervention at a stroke center, or effective management within the "golden" hour at a trauma center. The AATC requires that five essential physician positions be in place to effectively operate: 1) an emergency room (ER) physician to function as a point person in the ER and act as an interface with emergency medical technician (EMT) service personnel; 2) the medical director of the CVICU to coordinate care for emergent stabilization; 3) a computed tomography (CT) radiologist to provide emergent interpretation of CT imaging; 4) an on-call triaging AATC CV surgeon; and 5) cardiac and vascular surgeons who work in close collaboration as part of a CV therapy team or CV department. In addition to the physician coordination, the center requires development and implementation of a clinical pathway from diagnosis through emergent transportation to the AATC and a clinical pathway from the emergency room through the scanner to the ICU or operating room. Specific protocols are in place for the management of each of the following clinical presentations: Type A dissection (e.g., immediate operating room intervention), Type B dissection (e.g., medical management), malperfusion syndromes, intramural hematoma, ruptured thoracic aorta, ruptured abdominal aortic aneurysms, symptomatic thoracic aneurysms, symptomatic abdominal aneurysms, penetrating ulcers, thoracic aortic injury, and shaggy aortic syndrome. There are two mechanisms for patient entry into the AATC clinical care pathway.

#### Pathway A

The patient is transported to the AATC, and CT imaging from an outside institution is immediately uploaded to PACS, if available. There is an in-house radiologist on call who reads the CT and immediately contacts the responsible emergency room physician with the findings. The treatment continues according to the Common Pathway.

#### Pathway B

The emergency room physician examines the patient and, if acute aortic syndrome is suspected, labs are collected and analyzed with i-Stat (turnaround time: 10 minutes) to determine the creatinine concentration. If the patient's creatinine is  $\leq 1.6$  mg/dL, a CT of the chest, abdomen, and pelvis with contrast is promptly obtained; however, if the patient's creatinine is  $>1.6$  mg/dL or he has an iodine or contrast allergy, a CT of the chest without contrast is obtained. This scan is then reviewed by the in-house radiologist on call and discussed with the emergency room physician.

### Common Pathway

If acute aortic syndrome is suspected or confirmed, a group page is sent to the following personnel: CV anesthesiologist on call, CVICU attendings and staff, operating room (OR) supervisor, nursing supervisor, and security. While this is being done, the CV surgeon reviews CT scans on site or via Web-based viewing and determines patient disposition. If the patient had a non-contrast CT, the AATC surgeon will make a decision about the risk/benefit ratio of proceeding with contrast because it may be necessary to add a contrast scan for diagnosis/decision making. If intervention is necessary, the AATC surgeon decides whether an open surgical intervention (such as for type A dissection), an endovascular repair (which is appropriate for ruptures of thoracic and abdominal aneurysms and dissection with malperfusion syndromes), hybrid procedures, or medical management (such as for type B dissection) will be needed; a cardiac anesthesiologist is paged, and if an endovascular route is taken, the radiology technician is paged. Once the therapeutic decision is made, the AATC surgeon calls the CVICU intensivist with the treatment plan and the patient is transported expeditiously to the appropriate destination (OR or CVICU). Within the protocol, there are standard treatment algorithms for each condition. Type A dissections and acute AAAs are moved to the OR for surgery and Type B dissections moved to the CVICU for aggressive medical therapy. The CV OR staff are in-house 24 hours daily. If there is a lag, the CVICU attending will become the CV anesthesiologist to expedite care and begin the case. If an AAA is considered appropriate for endovascular aneurysm repair, the procedure will be performed in a dedicated OR suite. All postoperative care occurs in one unit of the CVICU and follows approved CV protocols.

### Outcomes of the AATC at Methodist

We have recently documented the results of Methodist's AATC.<sup>24</sup> Following the center's initiation, 49% of patients admitted with aortic disease to the CV services line were considered to have acute aortic disease. This represented a 30% increase in the total number of admissions and a 25% increase in acute pathology. Given the mechanisms in the pathway, a greater number of patients are being referred from emergency rooms and outside hospitals. While there was no difference in the number of ruptured aneurysms encountered, there was a twofold increase in thoracic aortic dissections. Initiation of the treatment pathway resulted in a highly significant reduction in time to definitive therapy (64% decrease;  $p = 0.0001$ ). There was an increase in those undergoing medical therapy alone in the AATC cohort that was consistent with the increase in aortic dissections. Despite the increase in acuity, mortality (4% in the pre-AATC cohort vs. 6% in the AATC cohort), and morbidity (41% vs. 45%), rates were unchanged. Furthermore, there was a significant decrease in ICU length of stay (5 vs. 4 days, pre-AATC cohort vs. AATC cohort) but total hospital length of stay was unchanged (11 vs. 10 days), suggesting that rapid intervention preserved resources, allowing the patient to be cared for more efficiently and in a cost-effective manner.

### Conclusion

Establishment of a multidisciplinary AATC pathway was associated with a marked reduction in time to definitive treatment, improved throughput with reduced ICU time, and maintained clinical efficacy. The concept is a landmark in advancing cardiovascular care.

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