Cleveland Clinic uses a comprehensive, multidisciplinary approach to treat patients with aortic disease. Using conventional, minimally invasive and endovascular techniques, our surgeons treat all sections of the aorta, from the aortic valve to the blood supply to the pelvic vasculature.

A total of 1,173 aortic surgeries were performed at Cleveland Clinic in 2011. The majority were open procedures to repair the ascending aorta/arch.
In 2011, Cleveland Clinic performed 707 elective and emergency procedures to treat patients with problems of the ascending aorta and arch. Over time, the number of minimally invasive techniques performed has increased.

Patients who require emergency treatment of the ascending aorta and arch represent a challenging population. In 2011, we performed 209 of these procedures and maintained a low mortality rate of 7.2 percent.

Cleveland Clinic’s Acute Aortic Treatment Center provides rapid transport, treatment and follow-up for patients with aortic dissection and impending aneurysm rupture. More than 4,500 patients were transported by Cleveland Clinic’s Critical Care Transport team in 2011. More than one-third of the patients transported were treated in the Miller Family Heart & Vascular Institute, and many had acute aortic syndromes.

Call 877.379.CODE (2633) to expedite the transfer of patients with acute aortic syndromes.

Cleveland Clinic performed 498 elective ascending aorta and arch surgeries. Rates of stroke and mortality were 2 percent and 0.4 percent, respectively.
Aortic Arch Aneurysm Repairs

In 2011, Cleveland Clinic surgeons performed 222 procedures to repair aortic arch aneurysms. Of these, 152 were elective and 70 were emergency surgeries. Aortic arch aneurysms are one of the most complicated conditions to treat. We use open and endovascular procedures that incorporate the use of fenestrations, branches or hybrid techniques. Despite the complexity of these procedures, the rate of death and stroke remained low.

Elective Arch Aneurysm Operations Volume, Stroke and Mortality
2007 – 2011

Emergency and Urgent Arch Aneurysm Operations Volume, Stroke and Mortality
2007 – 2011

3-D reconstruction of aortic arch aneurysm complicating a chronic aortic dissection.

3-D reconstruction of an aortic arch branch graft. There are branches for the innominate and left common carotid arteries. This technique allows treatment of very complex anatomy without opening the chest.
Cleveland Clinic surgeons are internationally recognized as some of the best-trained surgeons to treat patients with extensive thoracic aneurysmal disease. We use a comprehensive, multidisciplinary approach that allows each patient to receive the best possible individual treatment.

**Novel Technique for Chronic Extensive Dissection with Aneurysm**

Patients who survive an acute dissection that involves multiple segments of the aorta often require multiple major operations to eliminate the risk of rupture and death. A novel approach combining open “elephant trunk” repair with a fenestration procedure of the distal aorta provides a dependable endovascular solution to complete the repair in these complex cases.


**Coarctation and Late Complications in Adults and Adolescents**

A growing number of adults and adolescents are diagnosed with aortic coarctation after childhood. The number of patients who have late complications after treatment is also rising. Our multidisciplinary team has extensive experience using open, hybrid and endovascular procedures to treat patients in this population. During a 10-year study of 110 patients treated with these procedures, there was no incidence of hospital mortality.

**Aortic Disease (continued)**

**Advances in the Genetic Understanding of Disease**

Understanding rare aortic disease is a major priority for Cleveland Clinic's Aortic Team. We have demonstrated 100 percent success in treating patients with Takayasu arteritis using an endovascular approach to place stent grafts. The stent grafts remained patent throughout the follow-up period. Newer endovascular techniques have allowed us to use alternate treatment methods that may lead to better outcomes than traditional, open surgery to treat patients with this complex disease.


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**Descending Thoracic Aortic (DTA) Disease**

It is common for aortic dissections or ruptured aneurysms to occur in the descending thoracic aorta (DTA). These conditions require rapid evaluation and treatment. Cleveland Clinic surgeons treat patients with these conditions using both open and endovascular procedures.

**DTA Repair Volume and Type (N = 612)**

2008 – 2011

- 9% Open Emergency (N = 56)
- 22% Open Elective (N = 137)
- 22% Endo Emergency (N = 132)
- 47% Endo Elective (N = 287)

From 2008 through 2011, Cleveland Clinic performed 612 DTA repairs. The majority of these procedures were endovascular repairs.

**DTA Repair Hospital Mortality (N = 612)**

2008 – 2011

Extensive experience with both open and endovascular treatment options for patients with descending thoracic aortic disease allows us to offer life-saving therapy to patients. This includes even those who require high-risk emergency treatment. For elective repairs, the mortality was low at 2.4 percent for open repairs and 2.8 percent for endovascular repairs in 2011.

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**Mortality (%)**

- **Open**

- **Endo**
Protection of Spinal Function

The repair of thoracoabdominal aneurysms has historically been associated with a risk of spinal cord injury or paralysis. We have worked to evolve our techniques to protect the spinal cord. In cases of thoracoabdominal aneurysm repair, this means frequently staging the repair so the impact on the spinal cord is gradual, rather than sudden. Our results to date show this approach is successful. The rate of spinal cord injury with this technique is 3.38 percent in all cases of thoracoabdominal aneurysms treated with endovascular devices. This rate is lower than that reported by other centers. We have also incorporated advanced techniques to protect the spinal cord during open thoracoabdominal aortic repairs. This includes adding papaverine to the intrathecal space during surgery, which helped reduce the rate of paraplegia to 3.6 percent.

Thoracoabdominal Aortic (TAA) Surgeries

Our surgeons use both open and endovascular procedures to treat patients with diseases of the thoracoabdominal aorta (TAA). These are the most challenging aortic procedures.

TAA Surgeries by Type

2008 – 2011

Crawford Classification of Aortic Aneurysms

Type I
Aneurysms involve most or all of the descending thoracic aorta to the level of the renal arteries.

Type II
Aneurysms involve most or all of the descending thoracic aorta, with abdominal extension to below the renal arteries.

Type III
Aneurysms involve the lower portion of the descending thoracic aorta, extending to the abdominal aorta below the level of the renal arteries.

Type IV
Aneurysms involve the upper half or all of the abdominal aorta.
Despite the complexity of TAAA surgery, the mortality rates at Cleveland Clinic remain low. We continue to make improvements through the use of multimodality approaches. In 2011, the mortality rate for endovascular branch vessel procedures was 2.8 percent. The rate for open elective repairs was 3.13 percent. Emergency repairs require open surgery. The mortality rate for these procedures was 5.26 percent.

Bifurcated-Bifurcated Device

Iliac aneurysms are common in patients with abdominal aortic aneurysms. This condition often limits the use of standard endografts for treatment. The goal of treatment with a bifurcated-bifurcated device is to eliminate the process of placing branched grafts into internal iliac arteries while allowing the preservation of blood flow to the pelvis.

Preserving pelvic blood flow is important because it contributes to spinal cord, buttock muscle and sexual function. Therefore, our patients have an improved quality of life after the repair.

Fewer components are needed to complete complex repairs when the bifurcated-bifurcated device is used. This results in a shorter operation and, ideally, a shorter recovery.
AAA Screening
Aneurysms can progress to a very advanced state without any symptoms. Often, they are diagnosed by accident. Because of this, many studies support population-based, one-time ultrasound screening for patients at high risk (usually those over age 65). Screening can detect the condition before it becomes fatal.

Cleveland Clinic’s dedication to the care of patients with aortic disease begins before diagnosis. Our new aneurysm screening program is designed to aid the treatment of patients with aortic aneurysms. In the near future, all patients who are treated at Cleveland Clinic for any medical condition will be screened for aneurysms. This proactive approach to care will help identify disease before it becomes critical and allow us to educate patients about their condition and treatment options.

Abdominal Aortic Aneurysms (AAA)
The abdominal aorta is second to the ascending aorta for aneurysm formation. Cleveland Clinic treats patients with AAAs both below and adjacent to the renal arteries. Our surgeons use both open and endovascular repair procedures.

AAA Procedure Volume and Type (N = 800)

<table>
<thead>
<tr>
<th>Procedure Type</th>
<th>Cases (N)</th>
</tr>
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<tbody>
<tr>
<td>Endovascular</td>
<td>472</td>
</tr>
<tr>
<td>Open</td>
<td>328</td>
</tr>
</tbody>
</table>

Cleveland Clinic surgeons performed 800 AAA repair surgeries from 2008 through 2011. The majority of the procedures were endovascular repairs (endo and fenestrated grafts).

Open AAA Repair Volume and Type (N = 328)

<table>
<thead>
<tr>
<th>Procedure Type</th>
<th>Cases (N)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Elective</td>
<td>273</td>
</tr>
<tr>
<td>Emergency</td>
<td>55</td>
</tr>
</tbody>
</table>

Cleveland Clinic surgeons performed 328 open AAA repairs from 2008 through 2011. Although open repairs are associated with greater risk, we maintain high volumes and excellent outcomes.
Cleveland Clinic surgeons performed 472 endovascular AAA repair procedures in 2011. A total of 42 fenestrated grafts were used to repair juxtarenal aneurysms.

The mortality rate for elective AAA open repair was 4.35 percent in 2011. The mortality rate for emergency open repair of ruptured AAAs was 0 percent.

Cleveland Clinic surgeons performed 472 endovascular AAA repair procedures in 2011. A total of 42 fenestrated grafts were used to repair juxtarenal aneurysms.

The mortality rate for elective endovascular AAA repair was 1.37 percent in 2011. The rate for emergency repairs was 0 percent.