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## Aortic Aneurysm

Patrick T. O’Gara, MD



**T**he aorta is the largest and strongest artery in the body. It is the blood vessel into which the heart pumps all the freshly oxygenated blood it has received from the lungs. Its numerous tributaries deliver blood throughout the entire body. The aorta arises from the base of the heart, courses upward and to the right toward the head, then sweeps backward and to the left, descending along the spine in the chest and upper abdomen, before it splits into 2 terminal branches, one to each leg. The portion of the aorta in the chest is called the thoracic aorta; the portion in the abdomen is called the abdominal aorta. Normal diameter is about 3.0 cm (1.2 inches), tapering to a width of about 2.0 cm (0.8 inch) in the abdomen. The aorta’s strength derives primarily from the elastic tissue contained in its walls. This elastic wrapping, which is in the middle part of the wall, allows the aorta to expand slightly when the heart muscle contracts and blood is ejected. When the heart fills, the aortic wall recoils, pushing blood along to the other parts of the body. The aorta has to be not only tough enough to withstand the pressure generated by every heartbeat, but also flexible enough to perform the recoil function.

The wall of the aorta can be weakened or damaged by several processes, of which normal aging and hypertension are perhaps the most common. In some people, a defect in the gene responsible for produc-

ing the special elastic tissue leads to thinning and weakening of the wall. Inflammation from overactivity of certain white blood cells, infection, and trauma are less common causes of aortic wall damage. Atherosclerosis, the build-up of cholesterol that characterizes coronary artery disease, affects the inner lining (endothelium) of the aorta and may lead to weakening of the wall. Atherosclerotic deposits commonly occur in the abdominal segment, below the level of the branches to the kidneys.

### What Is an Aneurysm?

With time and under the constant pressure of moving blood, a blister or bulge can develop at a weak spot in the aorta, similar to what happens to a cracked or frayed garden hose when the water is left running. When the bulge grows to more than one and a half times the aorta’s normal width, it is called an aneurysm (from the Greek word meaning “to widen”) (Figure 1). If left unattended, most aneurysms will grow, sometimes to a size that poses a risk for rupture. Because rupture of an aortic aneurysm is a catastrophic and life-threatening event, it is important to detect aneurysms in their earlier stages, to take simple measures to help prevent their expansion, and to proceed with repair once they reach a critical size. Because they are the most common type of aneurysm for which we have the best information regarding natural history and treatment, we

will focus on abdominal aortic aneurysm, often referred to as “triple A” or AAA. AAAs are responsible for 1% to 2% of all deaths in men over the age of 65 years and account for 15 000 deaths annually in the United States.

### Who Is at Risk?

AAAs occur much more commonly in men than in women and typically appear after the age of 50. Additional risk factors for their development include active cigarette smoking, high blood pressure, a family history of AAA in a first degree male relative (father, brother), and signs of cholesterol build-up in other parts of the body. As is true for all patients with coronary heart disease, smoking cessation, good blood pressure control, and cholesterol management are critical components of a prevention strategy.

### Detection

Most AAAs grow silently and are detected incidentally on radiographic studies performed for some other reason, such as an abdominal CT scan for suspected bowel disease or a spine CT scan for low back pain. Some would estimate that as many as 1.5 million people in the United States have undiagnosed AAAs. On rare occasion, though, aneurysms can expand rapidly or leak blood, causing pain in the abdomen, flank, or back. They can often go undetected on physical examination

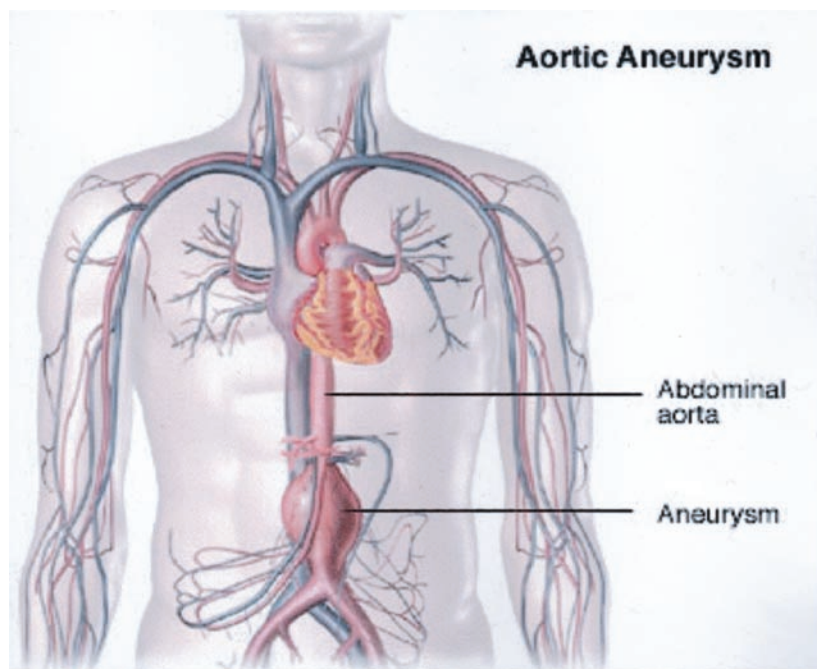
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**Figure 1.** Aortic aneurysm. Diagram of typical position of an abdominal aortic aneurysm. Note the bulging of the aorta above the branches to the legs. Reprinted with permission from HeartCenterOnline, "Aortic Aneurysm: Thoracic Aortic Aneurysm, Congenital Sinus of Valsalva Aneurysm," by Lee B. Weitzman. Available at: <http://www.heartcenteronline.com/myheartdr/common/articles.cfm?ARTID=295>. Accessed January 10, 2003.

because the aortic pulsation is difficult for your doctor to feel through the layers of the abdominal wall. Sometimes, a prominent pulsation behind the knee, where the popliteal artery runs, can be a clue to the presence of an AAA. If you have any of the risk factors listed above, you should expect that your doctor will examine all the pulses in your neck, arms, legs, and abdomen at each regular visit. If there is any suspicion that your abdominal aorta is enlarged, it can be viewed with a simple abdominal ultrasound, the same type of scan used to search for gallstones or to visualize a baby in the womb. The dimensions of the aorta can be measured and a decision made as to next steps. In some people, the abdomen is too large for ultrasound to provide an accurate picture, and a CT scan is necessary. Aneurysms should be re-imaged at least yearly, or when symptoms develop, to determine if they have enlarged. If surgery is recommended, a CT scan or MRI of the aorta is usually obtained to provide the surgeon a road map. Many patients with AAAs have other signs of cardiovascular disease, such as

angina, a previous heart attack, or a stroke. In these cases, your doctor may feel it is necessary to perform a stress test to get a better sense of your general cardiac health and to determine your fitness for complicated surgery.

## Treatment

### Surgery

Having an AAA is nerve-wracking for both the patient and doctor. The fear that the aneurysm will rupture drives the desire to fix it. Rupture is associated with a mortality rate of 80%. Surgery is a serious undertaking; mortality rates during surgery in the United States are in the range of 2% to 6% for repair under elective, non-emergency circumstances. When symptoms (pain) or signs (a tender, pulsating, abdominal mass) suggest expansion or leakage of an aneurysm, the decision is straightforward: surgery should be performed promptly and without delay. In most circumstances, though, the AAA does not cause symptoms, and the decision for surgery rests on knowledge of the size

of the aneurysm and/or its annual rate of growth. As a general rule, large aneurysms should be fixed, and smaller ones can be watched.

Two questions that frequently arise are how large should the aneurysm be to warrant surgery and what should the patient be doing while waiting and watching?

Previous studies have shown that the risk of rupture increases substantially, from about 1% per year to 10% per year, once the aneurysm's size reaches 5.0 cm (2 in.). The risk approaches 25% for AAAs that are 6.0 cm (2.4 in.) or larger in greatest width. Until recently, most experts would agree that elective repair should proceed if the AAA has grown by more than 0.5 cm (0.4 in.) over the course of 1 year or if it measures 5.0 cm (2 in.) or more in greatest width. Two studies published this year,<sup>1,2</sup> however, suggest that it might be safe to wait until the aneurysm reaches 5.5 cm (2.2 in.) in patients who can be examined and undergo either an ultrasound test or CT scan every 6 months. Such frequent follow-up is often not available to many patients. As with most aspects of cardiovascular medicine, "one size does not fit all," and you should discuss with your doctor the timing and the relative merits and hazards of elective AAA repair.

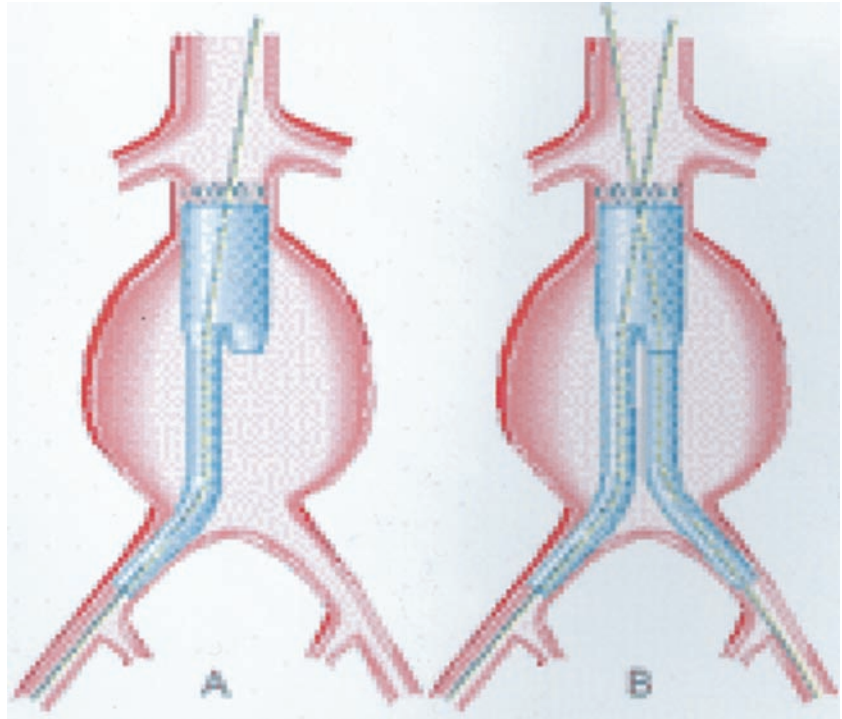
Surgery typically is performed through a long, vertical incision in the midline of the abdomen. The aorta is clamped above the aneurysm to interrupt temporarily the flow of blood through it. The sac of the aneurysm is incised and a synthetic tube is sewn in place to connect the 2 ends of the more normal-sized aorta. Sometimes, the repair has to include one or both of the terminal branches of the aorta (iliac arteries) that may also have become aneurysmal. Bypass of narrowed or blocked aortic branches to the kidneys or abdominal organs may also be required. After the tube is connected at both ends, the clamp is removed and the wall of the aneurysm is wrapped around the tube. Potential complications from such surgery include bleeding, infection, and kidney or bowel damage if the clamp has to be placed above the branches to these vital organs. Because coronary artery disease is so common among patients with AAA, a major worry is the risk of postoperative heart trouble. Surgery places a significant strain on the heart and can cause problems such

as angina or heart attack. Your doctor will take this concern into account when advising you about the surgery. Most often, use of medications to protect the heart will help patients to get through the operation successfully, but on rare occasion more invasive heart treatments (angioplasty, bypass surgery) are needed before the AAA surgery can proceed safely. As with any abdominal surgery, it will take time for bowel function to recover after the operation, and medications for pain will be needed for at least the first few days. Lastly, when discussing surgery with your doctor, be sure to ask about his/her experience and the number of AAA cases performed in his/her hospital relative to others. Research has shown that with AAAs, surgical outcomes are better in hospitals where such complex surgery is performed more often.

### Stent Grafting

A new and less invasive technique has been developed that involves placing a large metal scaffolding (stent) covered with a synthetic material into the aorta from one of the large arteries in the leg (femoral artery). Guided by x-rays, the stent is positioned so that it spans the entire aneurysm and directs the flow of blood centrally through its core (Figure 2). Over time, the aneurysm shrinks down around the stent. When positioned successfully, stents can eliminate many of the surgical complications. Patients spend fewer days in an intensive care unit, need fewer blood transfusions, and are discharged from the hospital earlier than with traditional surgery. The use of these devices, though, has been limited.

- Many patients are not candidates for this approach because of the particular anatomy of their aneurysms.
- There is a risk that the stent graft might leak.
- The orchestrated teamwork of a surgeon, a cardiovascular interventionalist, and an anesthesiologist, working in a major center with experience in the treatment of aortic aneurysms, is a necessity.



**Figure 2.** Aortic stent graft. Placement of a stent graft within an abdominal aortic aneurysm. The top of the graft is positioned just below the take-off of the arteries to the kidneys. Because the aneurysm also involves the origins of the branches to the legs, the stent graft is extended, like a pair of pants, to cover the entire area. Reprinted with permission from Blum U, Voshage G, Lammer J, et al. Endoluminal stent-grafts for infrarenal abdominal aortic aneurysms. *N Engl J Med.* 1997;336:13–20.

In many centers, this procedure is offered to the sickest patients who would have the most trouble getting through conventional surgery because of significant lung, heart, or kidney disease, but technical advances in the future may allow for more widespread use.

Abdominal aortic aneurysms are a major manifestation of atherosclerosis, a disease process that affects the entire vascular system. Whether to prevent an aneurysm from developing or to avoid problems such as heart attack or stroke, it is critical to pay attention to your diet, exercise regularly, watch your blood pressure and cholesterol, and stop smoking if you ever started.

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