JOURNAL OF INTERNATIONAL SCIENTIFIC RESEARCH
Volume 4, Issue 1, March, 2026 Online ISSN: 3030-3508
https://spaceknowladge.com

THORACIC AND ABDOMINAL AORTIC ANEURYSMS AND THEIR COMPLICATIONS

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ARTICLE INFORMATION

ARTICLE HISTORY:

Received:12.03.2026
Revised: 13.03.2026
Accepted:14.03.2026

KEYWORDS:

Aortic aneurysm, thoracic aortic aneurysm, abdominal aortic aneurysm, cardiovascular diseases, atherosclerosis, hypertension, aortic rupture, diagnostics, surgical treatment, endovascular therapy.

ABSTRACT:

This article analyzes the etiology, developmental mechanisms, clinical manifestations, complications, and contemporary treatment approaches of Thoracic Aortic Aneurysm (TAA) and Abdominal Aortic Aneurysm (AAA). Aortic aneurysm is one of the severe cardiovascular pathologies, characterized by the dilation of the vessel due to weakening of the aortic wall. This condition often remains asymptomatic for a long period and is frequently detected incidentally. However, as the aneurysm enlarges, the risk of rupture increases, potentially leading to life-threatening complications such as aortic rupture. The article examines the main risk factors for thoracic and abdominal aortic aneurysms, including atherosclerosis, hypertension, and hereditary disorders, particularly Marfan syndrome. Additionally, it provides information on diagnostic methods, such as ultrasonography, computed tomography, and angiography. The treatment approaches discussed include conservative monitoring, pharmacological therapy, and surgical interventions, including endovascular stent-graft

placement. The study findings emphasize the importance of early detection and appropriate management of aortic aneurysms to prevent severe complications.

The aorta, especially in the region close to the heart, has multiple segments, among which thoracic and abdominal aneurysms are the most clinically significant. The development of these aneurysms is influenced by numerous factors, including age over 60, smoking, alcohol consumption, chronic hypertension, and well-known genetic disorders such as Marfan syndrome. Additionally, these aneurysms are observed far more frequently in men than in women.With aging, the elastic fibers in the vessel wall decrease, leading to reduced vascular strength, a condition that particularly predisposes the aorta to aneurysm formation. During atherosclerosis, lipid and cholesterol deposits accumulate in the vessel wall, weakening it and contributing to dilation. Certain genetic disorders, such as Ehlers-Danlos syndrome, also reduce the integrity of the vascular wall and can promote aneurysm development.

An aneurysm is a pathological condition characterized by the dilation or bulging of a specific segment of a blood vessel due to weakening of the vessel wall. Under normal conditions, blood vessels are elastic and resilient; however, under the influence of various factors, the vessel wall may weaken and progressively dilate under the pressure of blood flow. This condition is referred to as an aneurysm. Aneurysms most commonly occur in large arteries, particularly the aorta and cerebral vessels. For example, an aortic aneurysm is associated with dilation of the aortic wall, while a cerebral aneurysm develops in the blood vessels of the brain.

Several factors can contribute to aneurysm formation. Among the most important is atherosclerosis, where the accumulation of lipids and cholesterol in the vessel wall weakens it. Additionally, prolonged hypertension exerts excessive pressure on the vessel wall, promoting its expansion. Other contributing factors include congenital vessel wall weakness, trauma, infections, and certain hereditary disorders.

Aneurysms can be classified into two types: true and false (pseudoaneurysms). The main difference between them lies in the involvement of the vessel wall and the formation of a hematoma. In a true aneurysm, all three layers of the vessel wall are damaged, whereas in a false aneurysm, only two layers are affected, leading to hematoma formation. In pseudoaneurysms, blood supply to the vessel wall is compromised, and due to insufficient nutrients, the wall gradually becomes fragile.Aneurysms most commonly occur at the T2

(sternal notch) and T4 (sternal angle) levels, extending downward along the manubrium of the sternum. The most dangerous aspect of an aneurysm is that it may remain asymptomatic for a long period. However, some minor signs may appear, such as compression of the airways due to the aneurysm's bulging, which can lead to difficulty breathing and dysphagia caused by esophageal compression. As the aneurysm enlarges, the risk of rupture increases. In patients with thoracic aneurysms, severe pain in the chest and back is often observed.

When the area of the aneurysm is palpated, it may feel as if the heart itself is beating at that spot. On chest X-ray (CXR) examination, the mediastinum may appear widened due to weakening of the aortic wall and an increase in vessel diameter. The aorta passes through the central part of the thoracic cavity—the mediastinum—allowing observation of the posterior displacement of the trachea. If the vessel ruptures, internal bleeding occurs, which is life-threatening. Therefore, early detection and timely treatment of aneurysms are crucial for preventing severe complications of cardiovascular diseases.

It is also important to note that thoracic aneurysms can be classified into several types:

1. **Ascending thoracic aortic aneurysm**
2. **Aortic arch thoracic aortic aneurysm**
3. **Descending thoracic aortic aneurysm**

Ascending thoracic aortic aneurysm develops in the portion of the aorta closest to the heart. This type is often associated with connective tissue disorders, particularly Marfan syndrome**.** In this condition, the aortic wall gradually dilates, and in some cases, it may lead to aortic valve insufficiency.

Aortic arch thoracic aortic aneurysm develops in the arch portion of the aorta. Major arteries that supply blood to the brain and upper limbs originate from the aortic arch; therefore, an aneurysm in this region may, in some cases, cause impaired blood circulation or neurological symptoms.

Descending thoracic aortic aneurysm occurs in the descending segment of the thoracic aorta. This type is often associated with atherosclerosis and long-standing hypertension. As the aneurysm enlarges, it may compress surrounding organs or carry a risk of rupture.In general, the types of thoracic aortic aneurysms are distinguished based on the segment of the aorta involved. This classification is important for accurate diagnosis and selecting the most appropriate treatment strategy.

Abdominal aortic aneurysm (AAA) develops in the abdominal segment of the aorta and is primarily influenced by high blood pressure from cardiac output and a decreased amount of elastin in the vessel wall. These are the main contributing factors. Other risk factors

include smoking, male sex, age over 60, and higher prevalence among Caucasian individuals. The underlying reasons for this include genetic predisposition, atherosclerosis, and socio-demographic factors.Studies indicate that among Caucasians, the aortic wall may be genetically more susceptible due to relatively weaker elastin and collagen fibers. As a result, the vessel wall gradually weakens under prolonged exposure to high blood pressure and atherosclerosis, increasing the risk of aneurysm development. Additionally, the prevalence of atherosclerosis and hypertension is relatively higher in the Caucasian population, further weakening the aortic wall and raising the likelihood of aneurysm formation. Socio-demographic factors also contribute to the overall risk.

Due to increased life expectancy and better access to medical care, aortic aneurysms often develop asymptomatically in the early stages and are frequently detected incidentally. Some studies have shown a higher prevalence of aneurysms among men, which may be associated with sex and racial factors.

Abdominal aortic aneurysms (AAA) are also frequently asymptomatic. When the aneurysm enlarges, patients may experience severe pain in the abdominal region, the posterior part of the abdomen, and in areas near the spleen. If left untreated and the aneurysm ruptures, internal bleeding into the abdominal cavity can cause severe abdominal distension and put the patient into a state of shock.Several preventive and management strategies are recommended: if a patient is suspected of having an early-stage AAA, gradual cessation of smoking and alcohol consumption under medical guidance is advised. For patients with moderate-risk AAA, aspirin and statin therapy may be implemented. If the aneurysm reaches a diameter greater than 5.5 cm or shows rapid progression without prior medical supervision, surgical intervention is urgently recommended, as such aneurysms are at high risk of imminent rupture.

Abdominal aortic aneurysms (AAA) can be classified into three types based on their location:

1. **Suprarenal abdominal aortic aneurysm** — located above the renal arteries, this type is often associated with hereditary disorders and congenital anomalies.
2. **Infrarenal abdominal aortic aneurysm** — located below the renal arteries, it is the most common type and is usually linked to **atherosclerosis** and **hypertension**.
3. **Juxtarenal abdominal aortic aneurysm** — situated near the renal arteries without involving them. This type complicates surgical treatment because the renal arteries are at risk.

Tertiary syphilis represents the late stage of syphilis infection caused by the bacterium Treponema pallidum. If untreated, the disease gradually causes severe damage to the body over several years. During this stage, the bacterium can also affect the aortic wall, potentially leading to aneurysm formation.

Aortic aneurysms, particularly in the thoracic aorta, often develop in a saccular form. The complications of tertiary syphilis are not limited to the cardiovascular system; the infection can also affect the nervous system, leading to reflex abnormalities, coordination issues, and sensory deficits. Other organs, including the liver, gastrointestinal tract, bones, and muscles, may also be affected.If syphilis is not treated during the primary and secondary stages, the bacterium spreads through the bloodstream to various organs, initiating an inflammatory process in the weakened sections of the aortic wall. This leads to stretching and dilation of the aorta, resulting in the formation of a saccular aneurysm. Early detection of tertiary syphilis and treatment with penicillin can prevent its progression. In advanced stages, if an aortic aneurysm has already formed, surgical intervention is required to manage the cardiovascular complications.

Treatment of Thoracic Aortic Aneurysm (TAA):

1. **Medical therapy:**
   - **Beta-blockers** such as atenolol, bisoprolol, and metoprolol can be used to slow heart rate.
   - **Angiotensin II receptor blockers (ARBs)** like valsartan and losartan are prescribed if blood pressure is not adequately controlled with beta-blockers.
   - To reduce cholesterol, physicians may recommend statins such as atorvastatin or simvastatin.
2. **Surgical treatment:**
   - Options include open thoracic surgery or endovascular repair**.**
   - Emergency surgery may be necessary for a ruptured or dissected aortic aneurysm; however, the associated risks and potential complications are high.
   - Therefore, clinicians prefer early detection and elective repair of thoracic aortic aneurysms before rupture occurs, combined with lifelong monitoring and appropriate prophylactic surgical interventions.

Turner syndrome is a genetic disorder in females associated with the X chromosome, typically characterized by a 45,X karyotype. This syndrome is associated with abnormalities in the development of various physical features and internal organ systems, including the cardiovascular system. Patients with Turner syndrome have an increased risk of developing

aortic aneurysms, with the most common types being thoracic aortic aneurysms**,** particularly ascending thoracic aortic aneurysms and aortic root dilation**.**

Causes of aneurysm development in Turner syndrome:

1. **Congenital weakness of the aortic wall:** In Turner syndrome, connective tissues are often underdeveloped. Weakness of elastin and collagen fibers in the aortic wall leads to stretching and dilation under the influence of blood pressure.
2. **Congenital anomalies of the thoracic aorta and aortic valve:** Patients frequently have a **bicuspid aortic valve,** which increases stress on the aortic wall and raises the risk of aortic dilation.
3. **Hypertension:** High blood pressure is relatively common in women with Turner syndrome. Prolonged elevated blood pressure contributes to stretching of the aortic wall, promoting aneurysm development.
4. **Age-related progressive changes:** In Turner syndrome, the aortic wall gradually weakens with age, which particularly increases the risk of aneurysm development during adolescence and adulthood.

Aneurysms in patients with Turner syndrome often remain asymptomatic for a long period, but rupture poses a life-threatening risk. Therefore, continuous aortic monitoring in this population is essential, using ultrasonography, computed tomography (CT), or magnetic resonance imaging (MRI)**.**

The development of aneurysms in women with Turner syndrome is associated with genetic and congenital factors**,** aortic valve anomalies**,** elastin-collagen deficiency**,** and hypertension**.** Early diagnosis, regular monitoring, and, when necessary, surgical or endovascular intervention are crucial to prevent severe complications in this population.

Conclusion: Thoracic and abdominal aortic aneurysms are serious cardiovascular conditions that often remain asymptomatic for extended periods. Their development is associated with genetic predisposition, elastin and collagen deficiencies, hypertension, atherosclerosis, infections, and hereditary disorders. Early detection, regular monitoring, and surgical intervention when necessary are crucial for preventing complications related to aortic aneurysms. Additionally, certain populations—such as women with Turner syndrome and individuals of Caucasian descent—have a higher risk of aneurysm development and therefore require specialized surveillance.

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