



Review Article

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Abdominal aortic aneurysm screening, advantages and controversies for screening in women

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Abstract

A pathologic dilation of the aorta to greater than 1.5 times normal dimension is an aortic aneurysm. Abdominal aortic aneurysm (AAA) is often related to pre-existent atherosclerotic vascular disease. AAA risk of rupture is nearly proportional to its size. Males are more often affected than females per review of current literature. AAA can be an incidental finding on routine imaging in several cases. Most patients are usually asymptomatic. Ruptured AAA carries a high mortality rate. Abdominal ultrasonography is a widely used technique for screening AAA. AAA screening helps decrease mortality from rupture. Aggressive risk factor modification and smoking cessation is highly recommended. Surgery is indicated for AAA with a diameter measuring 5.5 cm or rapidly enlarging >1cm/year. The AAAs in females can rupture at smaller diameters compared to males; Society for Vascular Surgery guidelines emphasize AAA repair in females when AAA diameter is in the range of 5cm to 5.4cm. AAA in females have increased risk of rupture and it may rupture at smaller diameters when compared to males with AAA. "The United States Preventive Services Task Force guidelines recommend a onetime screening for AAA in men aged 65-75 years who have ever smoked by abdominal ultrasound; however, it makes no recommendations for screening of men that have never smoked. Furthermore, it recommends against routine screening for AAA in women (Grade D)." Further investigation is needed to refine screening for AAA, especially in women.

Keywords: Abdominal aortic aneurysm, Screening of AAA, Rate of enlargement of AAAs, Surveillance of AAAs.

INTRODUCTION

A pathologic dilation of the aorta to greater than 1.5 times normal dimension is an aortic aneurysm. Aortic aneurysms located below the diaphragmatic crura and above the bifurcation of the common iliac arteries are described as Abdominal aortic aneurysm.

Aortic aneurysms are caused by degenerative disease within aortic wall, leading to inflammation, loss of elasticity, and aortic dilatation [1]. Genealogic studies have demonstrated a strong familial component to developing AAA, with up to 28% of patients having a first degree relative with an aortic aneurysm. First degree male relatives of patients with AAA have a greater risk of aneurysm [2,3].

Risk Factors:

Factors implicated in development of AAA include current or a past history of tobacco use- smoking, first degree relative with AAA, male gender, advanced age, hyperlipidemia, hypertension, atherosclerotic disease at other vascular sites, history of AAA repair, history of peripheral aneurysm, white ethnicity. Less common risk factors include Marfan syndrome, collagen vascular diseases, Ehlers-Danlos syndrome [4-6].

The FDA issued a warning in 2018 that fluoroquinolones may elevate the risk of aortic aneurysm [7].

Rate of enlargement of aneurysm:

Rate of enlargement of AAA ranges between 0.2cm/year to greater than 3 cm/year. A majority of aneurysms enlarge at a rate of 2.6mm/year. Laplace's law defines the enlargement of aneurysms.

$$\text{Wall tension} = \text{transmural pressure (TP)} \times \text{radius (r)}.$$

Hence, with increased radius due to luminal dilation from aneurysm, the wall tension will increase at a given TP. This results in a further increase in the radius and leads to a cycle of growth of the aneurysm. Surface tension on the wall increases as a function of pressure and radius, thus AAA rupture risk is directly

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related to aortic dimension [4,8-10].

AAAs more than 6 cm have higher than 20% per year risk of rupture. In about 80% of cases, the rupture usually occurs into left retroperitoneal space. AAA can also rupture in the IVC. Ruptured AAA carries a high mortality rate [9,10].

Epidemiology:

AAA affects men more commonly than women. AAA is prevalent amongst 5 % males and among 1% to 2.2% females above age 65 years. Increased incidence of AAA is noted in males above age 55 years and in females above age 70 years. Majority of cases (95%) involve the infrarenal aorta [11].

Although AAA is more common in males, rupture occurs three times more often and at smaller aortic sizes in females [11-13].

A ruptured abdominal aortic aneurysm has poor prognosis-25% die suddenly, 50% die in the hospital before any surgical intervention and the operative mortality of surgical intervention is 50%. Overall 30-day survival is approximately 10%. Annual rate of rupture of abdominal aortic aneurysm is 0.3% for aneurysm less than 4 cm, 1% for aneurysm dimension 4-5cm, 6 to 10% for aneurysm dimension 5-6cm and more than 15% for aneurysm dimension more than 6 cm [6,10,11,14].

Clinical Presentation:

AAAs are often an incidental finding. Most patients are asymptomatic. Rapid enlargement of AAA may be associated with severe abdominal or back or flank pain, sudden onset, constant, not affected by position or movement. Features of shock such as hypotension, tachycardia, oliguria, cyanosis, altered mental status can develop with ruptured aneurysm. A palpable pulsatile mass may be felt on abdominal examination [9,11,12,15].

Diagnostic testing:

Ultrasonography in AAA:

Abdominal ultrasound is a widely used technique for screening AAA. Abdominal Ultrasound can obtain longitudinal and transverse images of the aneurysm and can accurately measure size to within +/- 0.3cm. Ultrasound is widely available, cost effective, avoids ionizing radiation exposure. Ultrasound is an effective option to monitor serial aneurysm growth. Abdominal ultrasound is noted to have a sensitivity of 100%, and a specificity of nearly 96% to detect infrarenal AAA. It can detect free peritoneal blood [9,11,16-18].

Disadvantages of abdominal ultrasound include poor definition of branch vessels, as a result, making it insufficient for preoperative evaluation. Common disadvantages in bedside ultrasonography to evaluate AAA are failure to compress the overlying bowel adequately with probe pressure, overestimation of the aneurysmal width due to lack of transverse measurement, failure to measure the external diameter, inability to detect leakage or rupture [9,11,16,18].

Indications for bedside abdominal ultrasonography are clinical suspicion of AAA, particularly in the elderly patients above age 60 years who present with nonspecific pain in the back, flank, groin or abdomen; for urgent evaluation of an unstable patient [16,18].

CT aortography with cardiac gating allows for accurate evaluation of aneurysm shape, three-dimensional analysis of branch vessels. CT measurements have been validated to within +/- 0.2cm. The major disadvantage of CT is ionizing radiation, IV contrast which limits its use in follow-up of chronic aneurysm. The advantage with CT is in evaluating for extravasated blood in acute or subacute rupture. CT and CT angiography is the main modality for defining and to plan AAA repair with the added advantage of CT over ultrasound with respect to

defining aortic size, extension into suprarenal aorta, involvement of visceral arteries, rostral-caudal extent [9,11,14,15].

MRI provides definition of aneurysm size, suprarenal and iliofemoral extension. It is disadvantaged by cost and limited availability. MRI imaging is comparable to CT and ultrasound with the added benefit of no exposure to ionizing radiation or contrast exposure [11,14,15].

Aortography defines branch vessel impingement, suprarenal and iliofemoral involvement. It tends to underestimate the size especially when the mural thrombus is present. It is invasive, requires the use of IV contrast and ionizing radiation. It is less useful as an initial diagnostic modality [11,14,15].

Therapy:

Medical therapy:

At least in one clinical trial, beta blockers have been shown to decrease the rates of enlargement and risk of rupture. Aggressive risk factor modification with control of hypertension and hyperlipidemia is important to prevent atherosclerosis in other vascular sites. Aspirin and Statin therapy should be started in these patients. Smoking cessation is strongly recommended [1,12,15,19].

Endovascular aortic repair:

Percutaneous aortic stent grafting is a less invasive option for the repair of AAA especially in the elderly patients, and those with significant cardiac, pulmonary and renal dysfunction. Suitable anatomy necessary for stent grafting. Only 30 to 60% of patients will have anatomy suitable for endovascular repair [9,12,14,19-21].

Surgical therapy:

All patients who are considered for surgical repair of AAA require preoperative cardiac risk assessment. Perioperative mortality in elective procedures is 4% to 6%. Surgery is indicated for AAA with a diameter measuring 5.5 cm or rapidly enlargement >1cm/year [12,17,19]. Symptomatic patients should be referred for repair [9,12,14,17,19,21,22].

Complications:

Death, colonic ischemia, myocardial ischemia and infarction, renal failure, groin infection, atheroembolism [12,14,20,23].

Surveillance:

AAA should be repaired if the AAA expands by 1cm or more in 1 year or by 0.5cm or more in a 6-month period. Surgical repair is recommended in symptomatic patients, regardless of size of the AAA. Elective repair of AAA is also recommended when AAA is associated with peripheral artery disease and or aneurysm.

The AAAs in females can rupture at smaller diameters compared to males; SVS guidelines emphasize AAA repair in females when AAA diameter is in the range of 5cm to 5.4cm. AAA in females have increased risk of rupture and it may rupture at smaller diameters when compared to males with AAA [1,4,15,24-26].

Refer to table 1 below.

Screening for AAA:

"The U.S. Preventive Services Task Force (USPSTF) currently recommends a onetime screening for AAA in men aged 65-75 years who have ever smoked by abdominal ultrasound. The USPSTF makes no recommendations for or against screening of men that have never smoked. The USPSTF recommends against routine screening for AAA in women [27,28]". These recommendations from USPSTF rely on a systematic review of four large randomized trials of screening AAA with

Table 1: AAA size and estimated annual AAA rupture risk and recommended plan [1,4,9,13,15,24-28].

Aneurysm diameter size	Risk of AAA rupture/year	Recommended surveillance plan
<4cm	0%	Abdominal ultrasound every 2-3-year intervals
4-4.9cm	0.5-5%	Abdominal ultrasound every 6-12-month intervals
5-5.4cm	3-15%	Abdominal ultrasound every 6-month intervals
5.5cm	3-15%	Elective repair for > 5.5cm

Table 2: AAA Overview [1,5,7,15,16,24,27,28]

AAA definition	Pathologic dilation of abdominal aorta (3cm or greater in diameter). Commonly involves infrarenal aorta.
Risk factors	Cigarette smoking, male gender, advanced ages, hypertension, hyperlipidemia, atherosclerosis, first degree relative with AAA, Marfan syndrome, Fluoroquinolones
Clinical presentation	Mostly asymptomatic. Rupture of AAA may present with sudden severe back or flank pain, features of shock.
Diagnostic testing	Abdominal ultrasound, CT/MRI abdomen
Therapy	Aggressive lifestyle modification of risk factors, Aspirin, Statin, Smoking cessation. Elective repair of AAA for size greater than or equal to 5.5cm in diameter and or rapidly enlarging AAA such as 1cm or greater/year or 0.5cm or more in 6-month time period.
Screening	The Society for vascular surgery and the American Association for vascular surgery recommend ultrasound screening for all men 60 to 85 years of age, women 60 to 85 years of age with cardiovascular risk factors, and all patients over 50 years of age with a family history of AAA. The U.S. Preventive Services Task Force (USPSTF) currently recommends a onetime screening for AAA in men aged 65-75 years who have ever smoked by abdominal ultrasound.
Pearls	Although AAA is more common in males, rupture occurs three times more often and at smaller aortic sizes in females.

abdominal ultrasound beneficial amongst males aged 65 to 75 years with a personal history of smoking alone. The Society for vascular surgery and the American Association for vascular surgery recommend ultrasound screening for all men 60 to 85 years of age, women 60 to 85 years of age with cardiovascular risk factors, and all patients over 50 years of age with a family history of AAA [1,11,13,15-17,23,24,27-29,30-35].

CONCLUSION

Imaging techniques used for aortic disease require longitudinal follow up, these need to be cost effective and avoid unnecessary radiation exposure. Clinical studies exploring cost-effectiveness and safety of various screening protocols are needed.

Controversy remains regarding medical versus surgical management of aneurysms between 5 cm and 5.5 cm and are currently managed on a case-by-case basis.

AAA in females have increased risk of rupture and it may rupture at smaller diameters when compared to males with AAA. Thus, some vascular societies have emphasized that females with AAA should undergo elective repair at aortic diameters between 4.5cm to 5cm.

Further investigation is needed to refine screening for AAA, especially in women.

AAA screening helps decrease mortality from rupture.

Conflict of interest

There is no conflict of interest.

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