Abdominal aortic aneurysm: what to order (evidence based review)

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Learning objectives

The aim of this educational poster is: 1) to review relevant studies regarding evaluation of abdominal aortic aneurysm supported on good quality secondary evidence based databases search; 2) to discuss evidence levels in these studies; 3) to uncover a rational evaluation strategy;
Background

Abdominal aorta aneurysm (AAA) is a permanent pathological dilation of the aorta with a diameter greater than 30 mm or 1.5 times the expected postero-anterior (PA) diameter of that segment, with most of aneurysms originating below renal arteries origin.

Different imaging techniques are available to assess this pathology: ultrassonography, computed tomography, magnetic resonance angiography and conventional aortography.

The United States Preventive Services Task Force (USPSTF) evidence level is one among other accepted classification system, and grades its recommendations according to one of five classifications (A, B, C, D, I) reflecting the strength of evidence and magnitude of net benefit.

A
The USPSTF strongly recommends that clinicians provide [the service] to eligible patients. The USPSTF found good evidence that [the service] improves important health outcomes and concludes that benefits substantially outweigh harms.

B
The USPSTF recommends that clinicians provide [this service] to eligible patients. The USPSTF found at least fair evidence that [the service] improves important health outcomes and concludes that benefits outweigh harms.

C
The USPSTF makes no recommendation for or against routine provision of [the service]. The USPSTF found at least fair evidence that [the service] can improve health outcomes but concludes that the balance of benefits and harms is too close to justify a general recommendation.

D
The USPSTF recommends against routinely providing [the service] to asymptomatic patients. The USPSTF found at least fair evidence that [the service] is ineffective or that harms outweigh benefits.
The USPSTF concludes that the evidence is insufficient to recommend for or against routinely providing [the service]. Evidence that the [service] is effective is lacking, of poor quality, or conflicting and the balance of benefits and harms cannot be determined.

Based on available evidence, the USPSTF makes recommendations as follows:

**Strength of Recommendations**

**Good**
Evidence includes consistent results from well-designed, well-conducted studies in representative populations that directly assess effects on health outcomes.

**Fair**
Evidence is sufficient to determine effects on health outcomes, but the strength of the evidence is limited by the number, quality, or consistency of the individual studies, generalizability to routine practice, or indirect nature of the evidence on health outcomes.

**Poor**
Evidence is insufficient to assess the effects on health outcomes because of limited number or power of studies, important flaws in their design or conduct, gaps in the chain of evidence, or lack of information on important health outcomes.

Based on a good quality evidence based databases review (Dynamed, Uptodate, Clinical Evidence and BMJ Best Practices), the authors propose a systematic approach to the largest and most methodologically rigorous published reports regarding abdominal aortic aneurysm evaluation, discussing ultrasonography, CT and magnetic resonance angiography test characteristics and proposing a rational evaluation strategy.

A classification based on the U.S. Preventive Services Task Force (USPSTF) evidence level will be provided.
Imaging findings OR Procedure details

There is limited publications regarding the generic use of imaging in evaluating palpable abdominal masses since the 80’s decade, instead of that, new reviews and case reports have focused on evaluation of specific masses using computed tomography (CT), ultrasound (US), and magnetic resonance imaging (MRI).

Ultrasonography:

B mode ultrasound is a more useful technique in the diagnosis of infrarenal aneurysms than suprarenal aneurysms. On the other hand, duplex ultrasound is less accurate than B mode ultrasound in small abdominal aortic aneurysms. This technique has the advantage of being less costly and not using ionizing radiation, being a definitive screening modality with the additional ability to detect thrombus or echogenic calcification in or adjacent to the aortic wall.

Still, this test only measures aortic diameter accurately and has potential problems associated as an operator dependent technique, frequently does not giving accurate depiction the cranial and caudal extent of abdominal aortic aneurysm, as well as the involvement of the visceral, renal, and iliac arteries. In addition, in approximately 1-2% of cases, the aorta cannot be imaged due to technical difficulty, such as overlying bowel gas or obesity.

In a cohort study of 146 patients (Vidakovik et al 2007) referred to vascular surgery department for treatment of peripheral arterial disease (in which 79.5% had an abdominal aortic aneurysm defined as infrarenal aorta > 30 mm on CT as a reference standard), ultrasound was done by two operators blinded to Computed Tomography (CT) results. Diagnostic performance in this adequate quality setting for detecting AAA was: 97% sensitivity and 97% specificity. (grade B)

This result is consistent with the value of almost 100% sensitivity and specificity referred by early authors in 1989, such as LaRoy.

Multidetector computed tomography (CT):

CT may reveal suprarenal extension and other essential abdominal abnormalities that influence aneurysm surgical repair with the aptitude of revealing the eventual presence of retroperitoneal rupture. Intravenous iodinated contrast injection is necessary to maximize test capabilities, although noncontrast CT will accurately measure the diameter and
delineate its extent, significantly decreasing the need for angiography. 3D reconstructions using maximum intensity projections and curved planar reformations help in this capacity as well as in the depiction of extra-aortic abdominal structures.

Based on an analysis of 334 patients in American National Endograft Trial (Sprouse, 2003) designed to assess the paired differences in AAA diameter between measurements obtained with computed tomography (axial images) and ultrasound evaluation (transverse images), CT estimates of abdominal aortic aneurysm size were significantly and consistently larger than maximal AAA diameter measured with ultrasound.

In 95% (n=312) of cases, CT estimates were 8.9 mm superior (P< 0.001) to US, with discrepancy increasing when abdominal aortic aneurysm enlarged, though not statistically significant.

A multicenter, randomized study by Lederle FA et al, 1995, evaluated the report interobserver and intraobserver variability of small abdominal aortic aneurysm computed tomography (CT) measurements diameter and agreement between CT and ultrasonography with CT estimates from participating centres compared with measurements made from the same scan by a central laboratory. This trial found for interobserver pairs of local and central abdominal aortic aneurysm diameter CT measurements (n = 806) a difference of # 2 mm in 65% of pairs, with 17% differ # 5 mm. Of 258 ultrasound-measured and central CT pairs, the difference was 2 mm or less in 44% and at least 5 mm in 33%.

Ultrasound measurements were smaller than central CT measurements by an average of 27 mm (p < 0.0001) in this report.

CT scan inconvenience compared to ultrasound include superior cost and the need for intravenous contrast.

**MRI angiography (MRA)**

In the present moment, no comparative studies evaluating MRI versus CT or US are available. In the absence of data, the usefulness of MRI in evaluating palpable masses is unknown. It is likely comparable to CT and US. (Grade I)

In a prospective study (Peterson 1995) evolving 38 patients to evaluate resonance arteriography (MRA) use as a preoperative study, all patients underwent biplane conventional arteriography and MRA with a gadolinium-enhanced technique and with conventional arteriography and intraoperative findings as standard.
MRA proved highly accurate in the determination of multiple key anatomic elements: the proximal extent of aneurysmal disease was correctly predicted in 87% patients as well as significant iliofemoral occlusive disease (sensitivity of 83%). Iliac or femoral aneurysms were detected with a sensitivity of 79% and specificity of 86%. Significant renal artery stenosis was detected with a sensitivity of 71% and a specificity of 99%. Accessory renal arteries were correctly identified in 71% and correctly predicted the proximal cross-clamp site in 87% of patients with use of MRA as compared with the actual operative conduct. Proximal anastomotic sites were correctly predicted in 95% with MRA and 97% with conventional aortography. Renal revascularization was predicted by MRA with a sensitivity of 91% and specificity of 100%. The use of bifurcated aortic prostheses was correctly predicted by MRA in 75%, which was similar to that predicted by conventional aortography (81%). (grade B)

Another retrospective trial (Bhirangi K, 2000) enrolled 47 patients with preoperative gadolium-enhanced MRA compared with subsequent surgical evaluation of anatomic extent of abdominal aortic aneurysms and assessment of other visceral arteries and common iliac arteries. MRA accurately assessed the proximal extent (distance from renal vessels) of the AAA in 96% patients, and in all (100%) patients, this technique identified the distal extent (relation to aortic bifurcation or extension into iliac vessels) of the aneurysm. 67% accessory renal arteries were correctly identified and MRA also accurately diagnosed 10/12 cases of inferior mesenteric artery (IMA) occlusion and six retroaortic left renal veins. (grade B)

These small studies produced evidence supporting use of MRA in abdominal aortic aneurysms preoperative evaluation, even though it is a more expensive, less available and time consuming high-resolution examination method.

Owing the imaging quality and high resolution of multidetector computed tomography and Magnetic resonance angiography, conventional catheter-based aortography is now infrequently used in the abdominal aneurysms diagnosis and evaluation.

Based on the available evidence found and test's characteristics in the evaluation of abdominal aortic aneurysm (AAA), the authors recommend:

- Start with ultrasound abdominal aortic evaluation after palpable mass detection, since only 16% to 38% of patients referred for suspected abdominal mass will have the diagnosis confirmed by imaging study (grade B)
- After performing US and in presence of a suspected AAA or inconclusive findings confirm the results with abdominal CT with or without iv contrast (Grade A)
• MRI abdomen with or without contrast: insufficient data (Grade I), probably of use when computed tomography contra-indicated.
Images for this section:

Fig. 0: MDCT MIP 3D reconstruction revealing sacular abdominal aortic aneurysm

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**Fig. 0:** MDCT MPR coronal reconstruction: large sacular abdominal aortic aneurysm below left renal artery, with an endoluminal thrombus

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Fig. 0: MDCT 3D reconstruction illustrating abdominal aorta lumen with a sacular aneurysm

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Conclusion

There is some good quality evidence regarding abdominal aortic aneurysm evaluation supporting a rational evaluation strategy, however information lack regarding evaluation of new techniques, such as abdomen MRI, needs to be overcome.
Images for this section:

**Fig. 0**: MDCT 3D reconstruction revealing sacular abdominal aortic aneurysm

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References

