# American College of Radiology
# ACR Appropriateness Criteria®

**Clinical Condition:** **Pulsatile Abdominal Mass, Suspected Abdominal Aortic Aneurysm**

| Radiologic Procedure | Rating | Comments | RRL* |
|---|---|---|---|
| US aorta abdomen | 9 | Initial examination. May be limited by body habitus or acoustic window. | O |
| CT abdomen without contrast | 8 | Preferred for symptomatic patients. Suitable for patients in whom US is not useful. | ☢☢☢ |
| CTA abdomen with contrast | 7 | Also enables preinterventional planning. | ☢☢☢ |
| MRA abdomen with or without contrast | 6 | Alternative to CTA. Unable to detect calcium. Site-specific expertise important. See statement regarding contrast in text under "Anticipated Exceptions." | O |
| Aortography abdomen | 2 | Essentially replaced by cross-sectional imaging for diagnostic purposes. May be used for preinterventional planning. | ☢☢☢ |
| **Rating Scale: 1,2,3 Usually not appropriate; 4,5,6 May be appropriate; 7,8,9 Usually appropriate** | | | ***Relative Radiation Level** |

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## Summary of Literature Review

Clinical palpation of a pulsating abdominal mass alerts the clinician to the presence of a possible abdominal aortic aneurysm (AAA), a common vascular disorder seen in older individuals, more commonly in male patients with a history of hypertension and smoking [1-3]. However, the finding of a pulsatile abdominal mass can also be caused by a tortuous abdominal aorta or transmitted pulsations from the aorta to a nonvascular mass [4].

Generally an arterial aneurysm is defined as a localized arterial dilatation at least 50% greater than the normal diameter. The term ectasia is applied to arterial dilatations <50% of expected normal diameter. However, the normal dimension of the infrarenal abdominal aorta is up to 2 cm in anteroposterior diameter. Thus, the infrarenal abdominal aorta is considered aneurysmal if it is ≥3 cm in diameter or ectatic between 2-3 cm in diameter [5].

Imaging studies are important in diagnosing the cause of a pulsatile abdominal mass and, if an AAA is found, in determining its size, involvement of abdominal branches, both visceral and parietal, and any associated significant stenosis involving abdominal visceral and extremity arteries. Imaging studies should also categorize the extent of aneurysm (ie, infrarenal aorta; infrarenal aorta and iliac, isolated iliac, juxtarenal, suprarenal, or thoracoabdominal aorta) [6].

Currently, elective repair is considered for AAAs ≥5.5 cm in diameter [7].

Population-based ultrasound (US) screening studies have been recommended for male patients over the age of 65 [8]. Risk for AAA increases with a history of hypertension and smoking. For AAAs between 3-5.5 cm in diameter, periodic US or computed tomography (CT) imaging at 6- to 12- month intervals dependent on rate of aneurysm enlargement on prior studies is recommended. When aneurysms have reached the size threshold for intervention (5.5 cm) or are considered clinically symptomatic, additional preintervention imaging studies should be performed to help define the optimal surgical or endovascular approach. For preintervention studies, multidetector CT (MDCT) or CT angiography (CTA) is the optimal choice. Magnetic resonance angiography (MRA) may be substituted if CT cannot be performed (for example, because the patient's allergy to iodinated contrast). In general, however, an MRA for AAA is performed with gadolinium contrast, so it is not suitable for patients with severe renal insufficiency. In such patients, the center where it is being performed must be able to perform MRA of AAA without the use of gadolinium contrast [9,10].

Other types of imaging studies that have been used in the past to delineate AAAs — including abdominal radiographs, intravenous urography and blood pool radionuclide imaging — are not recommended for diagnosis, surveillance or preintervention imaging.

Catheter arteriography has very limited utility in the preintervention evaluation of patients with AAAs, its sole utility being in patients with significant contraindications to both CTA (significant renal dysfunction) and MRA (significant renal dysfunction, cardiac pacemakers, claustrophobia). In patients with significant renal dysfunction, the combination of noncontrast CT and the lower load of iodinated contrast material that can be used with intra-arterial injection can decrease the risk of contrast-induced nephropathy.

### Ultrasound

US examination of the abdominal aorta should be a dedicated examination and not a component of a generalized abdominal US study. If possible, complete longitudinal evaluation of the full extent of the aneurysm and involvement of common iliac arteries should be performed. These studies should include a measurement of the leading edge to leading edge anteroposterior diameter in the proximal, mid, and distal infrarenal aorta and of the common iliac arteries. Lining mural thrombus should be delineated. Right and left kidneys should be imaged to determine size, parenchymal thickness, and presence or absence of hydronephrosis. In order to permit US to be used instead of CT for AAA follow-up, interindividual reproducibility of diameter measurements should be no ≤4 mm [11]. Color Doppler imaging is not a necessary component of sonographic screening or surveillance examination.

Approximately 5% of AAAs will be juxtarenal or juxta/suprarenal [12], and it may not be possible to accurately delineate the upper margin of such aneurysms or the precise involvement of abdominal visceral branches by sonographic study. That is why a more definitive

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study, such as CTA, should be performed prior to intervention.

**Computed Tomography**

Noncontrast CT is diagnostically equivalent to US for AAA detection and is recommended in patients for whom US is not suitable (for example those with obese body habitus). CT may be used as a diagnostic and preintervention study, suitable for patients presenting with pulsatile abdominal mass with or without clinical suspicion of contained aortic rupture, and in planning endovascular or surgical intervention in patients with AAAs >5.5 cm in external anteroposterior (AP) diameter [13-15]. In tortuous aneurysms, where a single dimension may be artifactually accentuated by the curvature of the aorta, the short-axis diameter of the aorta may be substituted for the AP diameter.

Contrast-enhanced multidetector CTA is the best diagnostic and preintervention planning study, accurately delineating the location, size, and extent of aneurysm and the involvement of branch vessels, allowing for accurate quantitative 3D measurements [16].

In patients with suspected thoracoabdominal aortic aneurysm, CTA may be tailored for an angiographic examination of the chest, abdomen, and pelvis [17]. In patients with suspected coexistent lower-extremity arterial disease, the arterial system from the diaphragm to the feet can be studied with MDCT or CTA [18].

Volume rendering, subvolume maximum-intensity pixel (MIP), and curved planar reformations are integral components of the 3D analysis. Semiautomated measurements of vessel diameter and length in relation to the proximal and distal aneurysm margins and branch vessels can be readily obtained from software techniques supplied by multiple vendors.

In patients with suspected contained rupture, nonintravenous contrast-enhanced CT is performed to better diagnose dissecting hematoma in the lining of the intra-aortic thrombus (the crescent sign) and other signs consistent with imminent or contained rupture [19,20]. In patients who have contained rupture, a rapid CT angiographic study then provides a template for decision making in relation to endovascular aneurysm repair or surgical aneurysmectomy [21].

**Magnetic Resonance Angiography**

Contrast-enhanced MRA is an alternative and effective diagnostic and preintervention study [22]. The acquisition speed and spatial resolution of contrast-enhanced MRA has improved with the introduction of parallel imaging techniques, narrowing the gap with CTA in relation to image quality [23,24]. Caution should be used in patients with severe renal dysfunction, generally considered as estimated GFR less than 30 ml/kg/minute, who may be at risk for nephrogenic systemic fibrosis [25]. In these patients, a non-contrast-enhanced study may be substituted. Sequences and imaging expertise required for a full evaluation of AAA without contrast may not be available at all centers, so noncontrast MRA should be restricted to those centers with this capability.

Three-dimensional display techniques, including multiplanar reformation, MIP display, and volume rendering, are integral to the display and analysis of 3D MRA.

**Catheter Arteriography**

Patients with significant contraindications to both CTA and MRA may have diagnostic catheter arteriography performed with a relatively low-contrast material load following US documentation of AAA and/or noncontrast CT findings [26].

Catheter arteriography may not demonstrate the aneurysm diameter accurately, as only the contrast column of an aneurysm containing lining mural thrombus may be displayed. In patients with marginal renal function, rapid intra-arterial injection of a relatively low volume of dilute contrast material from a catheter located in the mid descending thoracic aorta can be used for a diagnostic CTA study.

**Summary**

- The consensus of the literature supports aortic US as the initial imaging modality of choice when a pulsatile abdominal mass is present. Noncontrast CT may be substituted in patients for whom US is not suitable (for example, those with obese body habitus).
- US is recommended as a screening technique in the Medicare-eligible male population at highest risk.
- For definitive diagnosis and preintervention imaging, CTA and MRA are recommended.
- Currently, CTA is regarded as the superior test, as it is readily available, is robust, and provides high spatial resolution 3D displays suitable for interventional planning as well as delineation of pathology in abdominal visceral arterial branches and extremity outflow vessels.
- Contrast-enhanced MRA has improved significantly in terms of speed and spatial resolution with the advent of parallel processing techniques. It may replace CTA for interventional planning in patients for whom iodinated contrast is contraindicated.
- Noncontrast MRA sequences for full evaluation of AAA are in evolution and should only be performed in centers with expertise.
- Appropriate preintervention measurements of the aortoiliac arterial system can be obtained with either technique.
- Both CTA and MRA can be used for thoracoabdominal aortic and extremity studies, all in the same imaging session.

**Anticipated Exceptions**

Nephrogenic systemic fibrosis (NSF) is a disorder with a scleroderma-like presentation and a spectrum of manifestations that can range from limited clinical

sequelae to fatality. It appears to be related to both underlying severe renal dysfunction and the administration of gadolinium-based contrast agents. It has occurred primarily in patients on dialysis, rarely in patients with very limited glomerular filtration rate (GFR) (ie, <30 mL/min/1.73m$^2$), and almost never in other patients. There is growing literature regarding NSF. Although some controversy and lack of clarity remain, there is a consensus that it is advisable to avoid all gadolinium-based contrast agents in dialysis-dependent patients unless the possible benefits clearly outweigh the risk, and to limit the type and amount in patients with estimated GFR rates <30 mL/min/1.73m$^2$. For more information, please see the ACR *Manual on Contrast Media* [27].

**Relative Radiation Level Information**

Potential adverse health effects associated with radiation exposure are an important factor to consider when selecting the appropriate imaging procedure. Because there is a wide range of radiation exposures associated with different diagnostic procedures, a relative radiation level (RRL) indication has been included for each imaging examination. The RRLs are based on effective dose, which is a radiation dose quantity that is used to estimate population total radiation risk associated with an imaging procedure. Patients in the pediatric age group are at inherently higher risk from exposure, both because of organ sensitivity and longer life expectancy (relevant to the long latency that appears to accompany radiation exposure). For these reasons, the RRL dose estimate ranges for pediatric examinations are lower as compared to those specified for adults (see Table below). Additional information regarding radiation dose assessment for imaging examinations can be found in the ACR Appropriateness Criteria® Radiation Dose Assessment Introduction document.

| Relative Radiation Level Designations | | |
|---|---|---|
| **Relative Radiation Level*** | **Adult Effective Dose Estimate Range** | **Pediatric Effective Dose Estimate Range** |
| O | 0 mSv | 0 mSv |
| ☢ | <0.1 mSv | <0.03 mSv |
| ☢ ☢ | 0.1-1 mSv | 0.03-0.3 mSv |
| ☢ ☢ ☢ | 1-10 mSv | 0.3-3 mSv |
| ☢ ☢ ☢ ☢ | 10-30 mSv | 3-10 mSv |
| ☢ ☢ ☢ ☢ ☢ | 30-100 mSv | 10-30 mSv |
| *RRL assignments for some of the examinations cannot be made, because the actual patient doses in these procedures vary as a function of a number of factors (eg, region of the body exposed to ionizing radiation, the imaging guidance that is used). The RRLs for these examinations are designated as NS (not specified). | | |

**Supporting Document(s)**

- ACR Appropriateness Criteria® Overview
- Procedure Information
- Evidence Table

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