American College of Radiology
ACR Appropriateness Criteria®
Screening for Abdominal Aortic Aneurysm

Variant: 1 Adult. Abdominal aortic aneurysm screening. Asymptomatic, with or without a family history of AAA or history of smoking.

Procedure	Appropriateness Category	Relative Radiation Level
US aorta abdomen	Usually Appropriate	O
US duplex Doppler aorta abdomen	May Be Appropriate	O
CT abdomen and pelvis without IV contrast	May Be Appropriate (Disagreement)	☢☢☢
Radiography abdomen and pelvis	Usually Not Appropriate	☢☢☢
Aortography abdomen and pelvis	Usually Not Appropriate	☢☢☢☢
MRA abdomen and pelvis with IV contrast	Usually Not Appropriate	O
MRA abdomen and pelvis without and with IV contrast	Usually Not Appropriate	O
MRA abdomen and pelvis without IV contrast	Usually Not Appropriate	O
MRI abdomen and pelvis with IV contrast	Usually Not Appropriate	O
MRI abdomen and pelvis without and with IV contrast	Usually Not Appropriate	O
MRI abdomen and pelvis without IV contrast	Usually Not Appropriate	O
CT abdomen and pelvis with IV contrast	Usually Not Appropriate	☢☢☢
CT abdomen and pelvis without and with IV contrast	Usually Not Appropriate	☢☢☢☢
CTA abdomen and pelvis with IV contrast	Usually Not Appropriate	☢☢☢☢
CTA abdomen and pelvis without and with IV contrast	Usually Not Appropriate	☢☢☢☢

Panel Members

Yoo Jin Lee, MD[a]; Ayaz Aghayev, MD[b]; Ezana M. Azene, MD, PhD[c]; Salman Bhatti, MD[d]; Joshua C. Ewell, DO[e]; Sandeep S. Hedgire, MD[f]; A. Tuba Karagulle Kendi, MD[g]; Esther S. H. Kim, MD, MPH[h]; David S. Kirsch, MD[i]; Prashant Nagpal, MD[j]; Anil K. Pillai, MD[k]; Beth Ripley, MD, PhD[l]; Andrew Tannenbaum, MD[m]; Molly E. W. Thiessen, MD[n]; Richard Thomas, MD, MBBS[o]; Sarah Woolsey, MD, MPH[p]; Michael L. Steigner, MD[q].

Summary of Literature Review

Introduction/Background

Abdominal aortic aneurysm (AAA) is a serious condition in which the diameter of the abdominal aorta exceeds 3.0 cm, with the infrarenal aorta being the most commonly affected area. The occurrence of AAA is more common in men ≥65 years of age, with a prevalence ranging from 9.1% to 22%. In comparison, women ≥65 years of age have a lower prevalence of AAA, with rates ranging from 2% to 6.2% [1,2]. AAA can develop due to various factors such as inflammatory, proteolytic, and neovascular changes that result in the loss of elastin and accumulation of fibrous material in the arterial wall [3]. Identified risk factors for AAA include a family history of aortic aneurysm or cardiovascular disease, being male, smoking, hypertension, hypercholesterolemia, peripheral artery disease, increasing age, genetic syndromes, and inflammatory diseases [4,5]. Factors associated with expansion and rupture of AAA include large aneurysm diameter, rapid growth, smoking, hypertension, high peak wall stress, a history of cardiac or renal

transplant, decreased forced expiratory volume, and being female [6,7]. AAA may enlarge over time but typically remains asymptomatic until rupture. The risk of death from an AAA rupture is estimated to be between 75% and 90%, and up to 5% of sudden deaths in the United States are caused by AAA rupture [8-10]. For individuals with asymptomatic AAA, elective surgical repair is considered the best way to prevent rupture and can be performed using an open surgical or endovascular approach. Screening or imaging surveillance is widely used to detect AAA that requires repair, with a generally accepted threshold of an aneurysm diameter exceeding 5.5 cm in men and 5.0 cm in women. Screening studies have found that AAA affects at least 4% to 8% of the population [11]. Given the high mortality and morbidity associated with AAA rupture, imaging screening continues to play a crucial role in the management of AAA.

Discussion of Procedures by Variant

Variant 1: Adult. Abdominal aortic aneurysm screening. Asymptomatic, with or without a family history of AAA or history of smoking.

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A. Aortography abdomen and pelvis

There is no relevant literature to support the use of conventional angiography for screening of AAA. Aortography is invasive, time-consuming, and poses the risks of embolization, perforation, and bleeding [12]. Other noninvasive techniques to screen for AAA make this invasive option less desirable.

Variant 1: Adult. Abdominal aortic aneurysm screening. Asymptomatic, with or without a family history of AAA or history of smoking.
B. CT abdomen and pelvis with IV contrast

As mentioned from the CT angiography (CTA) abdomen and pelvis without and with intravenous (IV) contrast section below, contrast-enhanced CT scans have not been generally accepted as a first-line screening tool for AAA [13]. Increasing number of abdominal CT scans in most hospitals results in diagnosis of many incidental AAAs. Retrospective review studies of abdominal CT scans done for a variety of reasons showed a prevalence of 2.2% to 5.8% for AAA [14,15].

Variant 1: Adult. Abdominal aortic aneurysm screening. Asymptomatic, with or without a family history of AAA or history of smoking.
C. CT abdomen and pelvis without and with IV contrast

Again, as mentioned from the CTA abdomen and pelvis without and with IV contrast section below, contrast-enhanced CT scans have not been generally accepted as a first-line screening tool for AAA [13].

Variant 1: Adult. Abdominal aortic aneurysm screening. Asymptomatic, with or without a family history of AAA or history of smoking.
D. CT abdomen and pelvis without IV contrast

Noncontrast CT can be considered as a screening examination for AAA, which can be especially beneficial in the setting of obesity or poor sonographic window. One study reported that noncontrast CT was superior to ultrasound (US) concerning sensitivity ranging from 83% to 89% depending on the measured plane when compared to US with 57% to 70%, although specificity was high for both studies measuring 98% and 99%, respectively [13]. With modern CT imaging technology, noncontrast CT has been proposed as an alternative screening method to offer more reliable examinations with additional information, including aortic wall calcifications, as well as thoracic and iliac aortic abnormality [13]. When compared to CTA, a study reported that the low-dose noncontrast CT exhibited similar accuracy and reproducibility of

measurements in AAA [16].

Variant 1: Adult. Abdominal aortic aneurysm screening. Asymptomatic, with or without a family history of AAA or history of smoking.
E. CTA abdomen and pelvis with IV contrast

Contrast-enhanced CT scans are known to be more precise when compared to US, with near 100% sensitivity and specificity, and are more reliable than US at determining size and extent and demonstrating adjacent structures, and are not degraded by bowel gas or obesity. Although contrast-enhanced CTA is an effective diagnostic tool, it has not been generally accepted as a screening tool due to its use of IV contrast [12,13].

CTA imaging of AAA is now well-established and is a popular imaging choice for diagnostic and presurgical/intervention study and sometimes surveillance of AAA, with particular strength in demonstrating the size, extent, and other characteristics of an aneurysm and associated aortic branch disease.

The difference between US and CTA measurements of AAA were reported, with general accusation that US underestimates AAA diameter and that CT demonstrates a closer reflection of the actual diameter, with parallel debate over the ideal measuring method without complete consensus [17,18]. Recent updates from the 2018 The Society for Vascular Surgery guidelines for the care of AAA patient now recommends using the outer wall to outer wall for measurement of the maximum aneurysm diameter [6], moving away from the inner wall to inner wall measurements.

Variant 1: Adult. Abdominal aortic aneurysm screening. Asymptomatic, with or without a family history of AAA or history of smoking.
F. CTA abdomen and pelvis without and with IV contrast

Noncontrast CT scans were not commonly used as a primary screening tool for AAA in the past, but recent studies have explored their potential as an alternative method [13,19]. One such study of 533 patients reported a higher sensitivity (83%-89% versus 57%-70%) with high specificity over 98% when compared to US [12]. The added benefit of the noncontrast CT when performed in addition to the CTA is that it allows for a more accurate detection of aneurysm calcification and thoracic and iliac lesions compared to US.

Variant 1: Adult. Abdominal aortic aneurysm screening. Asymptomatic, with or without a family history of AAA or history of smoking.
G. MRA abdomen and pelvis with IV contrast

Similar to the CT, MR angiography (MRA) is also highly accurate in detecting AAA and shows excellent reproducibility in between MRI examinations but has not been accepted as a screening tool [13]. MRA can serve as an alternative tool for CT or US. MRA has the potential to provide further information on AAA beyond its morphology, for example, AAA wall strain and stiffness, which may contribute to better understanding of AAA pathophysiology, biomechanics, and risk for rupture [20].

Variant 1: Adult. Abdominal aortic aneurysm screening. Asymptomatic, with or without a family history of AAA or history of smoking.
H. MRA abdomen and pelvis without and with IV contrast

There is insufficient evidence to support noncontrast MRA as a screening examination for AAA. However, a prospective study of nonenhanced MRA compared with contrast-enhanced CTA demonstrated equivalent accuracy of measurements in preoperative planning for endovascular aortic repair (EVAR) of AAA [21]. Noncontrast MRA sequences such as 3-D noncontrast black-blood cardiovascular MR technique has been

studied with compressed sensing to decrease its long scan time [22].

Variant 1: Adult. Abdominal aortic aneurysm screening. Asymptomatic, with or without a family history of AAA or history of smoking.
I. MRA abdomen and pelvis without IV contrast

There is insufficient evidence to support the use of a noncontrast MRA as a screening examination for AAA.

Variant 1: Adult. Abdominal aortic aneurysm screening. Asymptomatic, with or without a family history of AAA or history of smoking.
J. MRI abdomen and pelvis with IV contrast

There is insufficient evidence to support the use of MRI that lacks MRA sequences as a screening examination for AAA.

Variant 1: Adult. Abdominal aortic aneurysm screening. Asymptomatic, with or without a family history of AAA or history of smoking.
K. MRI abdomen and pelvis without and with IV contrast

There is insufficient evidence to support the addition of a noncontrast MRI as a screening examination for AAA.

Variant 1: Adult. Abdominal aortic aneurysm screening. Asymptomatic, with or without a family history of AAA or history of smoking.
L. MRI abdomen and pelvis without IV contrast

There is insufficient evidence to support a noncontrast MRI as a screening examination for AAA.

Variant 1: Adult. Abdominal aortic aneurysm screening. Asymptomatic, with or without a family history of AAA or history of smoking.
M. Radiography abdomen and pelvis

There is no relevant literature to support the use of abdomen and pelvis radiograph for routine screening of AAA, although calcified aneurysmal walls may be visualized by abdomen and pelvis radiograph.

Variant 1: Adult. Abdominal aortic aneurysm screening. Asymptomatic, with or without a family history of AAA or history of smoking.
N. US aorta abdomen

US is the most widely used screening and surveillance imaging method for the evaluation of AAA, which is implemented in screening programs in several countries [13,23-26]. The U.S. Preventive Services Task Force recommends one-time screening for AAA with US in men 65 to 75 years of age, who have ever smoked, with reported screening rates ranging 13% to 26% [27-29]. US is safe, portable, easy to operate, and proven beneficial for screening of AAA, with sensitivity and specificity close to 100% and a high accuracy comparable to CT, MRI, or MRA [13]. However, US was reported to show significant interobserver variability [13,30,31] and does not fully reflect other aneurysm characteristics such as intraluminal thrombus, plaque ulceration, or surrounding inflammation, which CT shows strength in [32]. Recent studies on specifying local wall strain information attempt to further stratify the risk of rupture using noninvasive imaging such as real-time 3-D US speckle tracking imaging [33,34].

US examination can measure the dimensions of the suprarenal, juxtarenal, pararenal, and infrarenal aorta. Imaging of the iliac arteries should also be included given close correlation. In 1% to 2 % of cases, the aorta cannot be well evaluated due to bowel gas or anatomical challenges regarding aortic depth [32,35].

Variant 1: Adult. Abdominal aortic aneurysm screening. Asymptomatic, with or without a family history of AAA or history of smoking.

O. US duplex Doppler aorta abdomen

Color Doppler US imaging is not currently a required component of sonographic screening or surveillance examination; however, it can be used as a screening imaging method. A study focusing on the variability in protocols and interobserver variabilities through literature review propose a harmonized US size acquisition and reading guidelines including reporting of the mean of 3 plane measurements [17]. Several studies use 3-D US technology for detection of AAA, including rupture risk prediction models, but there are currently insufficient data to build consensus [36-39].

Summary of Highlights

ıriant 1: US of the aorta abdomen is usually appropriate for AAA screening in an adult patient who is asymptomatic with or without a family history of AAA or history of smoking. The panel did not agree on recommending CT abdomen and pelvis without IV contrast for this clinical scenario. There is insufficient medical literature to conclude whether or not these patients would benefit from this procedure in this scenario. Screening with this procedure in this patient population is controversial but may be appropriate.

Supporting Documents

The evidence table, literature search, and appendix for this topic are available at https://acsearch.acr.org/list. The appendix includes the strength of evidence assessment and the final rating round tabulations for each recommendation.

For additional information on the Appropriateness Criteria methodology and other supporting documents, please go to the ACR website at https://www.acr.org/Clinical-Resources/Clinical-Tools-and-Reference/Appropriateness-Criteria.

Gender Equality and Inclusivity Clause

The ACR acknowledges the limitations in applying inclusive language when citing research studies that predates the use of the current understanding of language inclusive of diversity in sex, intersex, gender, and gender-diverse people. The data variables regarding sex and gender used in the cited literature will not be changed. However, this guideline will use the terminology and definitions as proposed by the National Institutes of Health.

Appropriateness Category Names and Definitions

Appropriateness Category Name	Appropriateness Rating	Appropriateness Category Definition
Usually Appropriate	7, 8, or 9	The imaging procedure or treatment is indicated in the specified clinical scenarios at a favorable risk-benefit ratio for patients.
May Be Appropriate	4, 5, or 6	The imaging procedure or treatment may be indicated in the specified clinical scenarios as an alternative to imaging procedures or treatments with a more favorable risk-benefit ratio, or the risk-benefit ratio for patients is equivocal.
May Be Appropriate (Disagreement)	5	The individual ratings are too dispersed from the panel median. The different label provides transparency regarding the panel's recommendation.

		"May be appropriate" is the rating category and a rating of 5 is assigned.
Usually Not Appropriate	1, 2, or 3	The imaging procedure or treatment is unlikely to be indicated in the specified clinical scenarios, or the risk-benefit ratio for patients is likely to be unfavorable.

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, because of both 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 with 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 (e.g., region of the body exposed to ionizing radiation, the imaging guidance that is used). The RRLs for these examinations are designated as "Varies."

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Disclaimer

The ACR Committee on Appropriateness Criteria and its expert panels have developed criteria for determining appropriate imaging examinations for diagnosis and treatment of specified medical condition(s). These criteria are intended to guide radiologists, radiation oncologists and referring physicians in making decisions regarding radiologic imaging and treatment. Generally, the complexity and severity of a patient's clinical condition should dictate the selection of appropriate imaging procedures or treatments. Only those examinations generally used for evaluation of the patient's condition are ranked. Other imaging studies necessary to evaluate other co-existent diseases or other medical consequences of this condition are not considered in this document. The availability of equipment or personnel may influence the selection of appropriate imaging procedures or treatments. Imaging techniques classified as investigational by the FDA have not been considered in developing these criteria; however, study of new equipment and applications should be encouraged. The ultimate decision regarding the appropriateness of any specific radiologic examination or treatment must be made by the referring physician and radiologist in light of all the circumstances presented in an individual examination.

[a]University of California San Francisco, San Francisco, California. [b]Panel Chair, Brigham & Women's Hospital, Boston, Massachusetts. [c]Gundersen Health System, La Crosse, Wisconsin. [d]University of Pittsburgh Medical Center, Pittsburgh, Pennsylvania; Society for Cardiovascular Magnetic Resonance. [e]Rutgers, New Jersey Medical School, Newark, New Jersey; Committee on Emergency Radiology-GSER. [f]Massachusetts General Hospital and Harvard Medical School, Boston, Massachusetts. [g]Mayo Clinic, Rochester, Minnesota; Commission on Nuclear Medicine and Molecular Imaging. [h]Atrium Health, Sanger Heart and Vascular Institute, Charlotte, North Carolina; American Society of Echocardiography. [i]Ochsner Hospital, Baton Rouge, Louisiana. [j]University of Wisconsin School of Medicine and Public Health, Madison, Wisconsin. [k]UT Southwestern Medical Center, Dallas, Texas. [l]VA Puget Sound Health Care System and University of Washington, Seattle, Washington. [m]Mercyhealth, Rockford, Illinois. [n]Denver Health Medical Center, Denver, Colorado and University of Colorado School of Medicine, Aurora, Colorado; American College of Emergency Physicians. [o]Lahey Hospital and Medical Center, Burlington, Massachusetts. [p]Association for Utah Community Health, Salt Lake City, Utah;

American Academy of Family Physicians. [9]Specialty Chair, Brigham & Women's Hospital, Boston, Massachusetts.