Pulsatile Abdominal Mass, Suspected Abdominal Aortic Aneurysm
EVIDENCE TABLE

Reference	Study Type	Patients/ Events	Study Objective (Purpose of Study)	Study Results	Study Quality
1. Bickerstaff LK, Hollier LH, Van Peenen HJ, Melton LJ, 3rd, Pairolero PC, Cherry KJ. Abdominal aortic aneurysms: the changing natural history. *J Vasc Surg.* 1984;1(1):6-12.	Review/Other-Dx	296 patients	To describe the clinical spectrum and natural history of AAAs diagnosed among the residents of this Midwest community and to provide an estimate of the incidence of this condition in the general population.	There were 296 patients (196 men and 100 women) for an incidence of 21.1 aneurysms/100,000 person-years. The median age at diagnosis was 69 years for men and 78 years for women. 78% of patients were asymptomatic at the time of diagnosis; their aneurysms were incidental findings. Rupture occurred in 60 patients (20.3%). 36 patients (12.2%) had rupture of the aneurysm as the presenting complication. For previously diagnosed aneurysms that subsequently ruptured, the average period from diagnosis to rupture was 48.7 months. Rupture occurred in only 2 aneurysms <5 cm. The overall mortality rate from rupture was 15.5%. Evaluation of data (including autopsy reports) by decade revealed an absolute increase in the incidence of AAAs in the population under study, More aneurysms of all sizes occurred from 1971 to 1980 than in the previous 2 decades combined. Although US examination has increased the detection of small aneurysms, the incidence of aneurysms 7 cm or larger at the time of diagnosis has also increased; the frequency of rupture was greatest in the last decade.	4
2. Ernst CB. Abdominal aortic aneurysm. *N Engl J Med.* 1993;328(16):1167-1172.	Review/Other-Dx	N/A	To address the contemporary knowledge and management of infrarenal AAAs.	The available data indicate that identification and early aortic reconstruction for AAAs 5cm or more in diameter will save lives and improve the quality of life substantially.	4
3. Guirguis EM, Barber GG. The natural history of abdominal aortic aneurysms. *Am J Surg.* 1991;162(5):481-483.	Review/Other-Dx	300 patients	To examine the rate of expansion of AAAs and the risk of rupture in relation to their size.	The mean age of the patients was 70.4 years, and 211 (70%) were men. The mean initial aneurysm diameter was 4.1 cm. Among the 208 patients who underwent more than 1 US or CT scan, the diameter of the aneurysm increased by a median of 0.3 cm per year. The 6-year cumulative incidence of rupture was 1% and 2% among patients with aneurysms <4.0 cm and 4.0 to 4.9 cm in diameter, respectively (P>0.05). In comparison, the 6-year cumulative incidence of rupture was 20% among patients with aneurysms >5.0 cm in diameter (P<0.004).	4

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4. Neville A, Herts BR. CT characteristics of primary retroperitoneal neoplasms. *Crit Rev Comput Tomogr*. 2004;45(4):247-270.	Review/Other-Dx	N/A	To review the CT characteristics of primary retroperitoneal neoplasms.	Certain CT characteristics can help suggest tumor type. CT is useful for diagnosis and assessment of the size and extent of retroperitoneal tumors, and assessment of the involvement of organs and vasculature.	4
5. Johnston KW, Rutherford RB, Tilson MD, Shah DM, Hollier L, Stanley JC. Suggested standards for reporting on arterial aneurysms. Subcommittee on Reporting Standards for Arterial Aneurysms, Ad Hoc Committee on Reporting Standards, Society for Vascular Surgery and North American Chapter, International Society for Cardiovascular Surgery. *J Vasc Surg*. 1991;13(3):452-458.	Review/Other-Dx	N/A	To define and classify arterial aneurysms and recommend standards for describing the causes, manifestations, treatment, and outcome criteria that is important when publishing data on aneurysmal disease.	N/A	4
6. Wanhainen A, Themudo R, Ahlstrom H, Lind L, Johansson L. Thoracic and abdominal aortic dimension in 70-year-old men and women--a population-based whole-body magnetic resonance imaging (MRI) study. *J Vasc Surg*. 2008;47(3):504-512.	Review/Other-Dx	231 patients	To determine the optimal dividing-line between normal aorta and aneurysm for different aortic segments in 70-year-old men and women by means of whole-body MRI.	The mean diameter of the 6 segments were 4.0 cm (SD 0.4), 3.2 cm (0.3), 3.0 cm (0.3), 2.8 cm (0.3), 2.4 cm (0.5), and 2.3 cm (0.3) in men. The corresponding diameter in women was 3.4 cm (0.4), 2.8 cm (0.3), 2.7 cm (0.3), 2.7 cm (0.3), 2.2 cm (0.3), and 2.0 cm (0.2). The mean ratio to the suprarenal aorta was 1.4 (SD 0.2) for the ascending aorta, 1.2 (0.1) for the descending aorta, and 0.9 (0.2) for the infrarenal aorta in men. The corresponding ratios in women were 1.3 (0.2), 1.0 (0.1), and 0.8 (0.1). For men the suggested dividing-line (diameter and ratio) between normal aorta and aneurysm for the ascending aorta is 4.7 cm diameter and 1.8 ratio, for the descending aorta 3.7 cm diameter and 1.5 ratio, and for the infrarenal aorta is 3.0 cm diameter and 1.1 ratio. The corresponding dividing-lines for women are 4.2 cm diameter and 1.7 ratio, 3.3 cm diameter and 1.3 ratio, and 2.7 cm diameter and 1.0 ratio.	4

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Reference	Study Type	Patients/ Events	Study Objective (Purpose of Study)	Study Results	Study Quality
7. Richards T, Dharmadasa A, Davies R, Murphy M, Perera R, Walton J. Natural history of the common iliac artery in the presence of an abdominal aortic aneurysm. *J Vasc Surg*. 2009;49(4):881-885.	Review/Other-Dx	191 patients	To assess the natural history of the common iliac artery in the presence of an AAA and develop a model to predict common iliac artery growth.	Average baseline common iliac artery was 12 mm (SD, 5.0); 41% of patients had 1 common iliac artery over 16 mm. A common iliac artery >16 mm was more likely to expand (81% vs 53%, *P*=.0001) particularly in patients with an AAA that expanded (73% vs 43%, *P*=.0005). A larger AAA was associated with a larger common iliac artery (*P*=.0341). Common iliac artery growth rate was proportional to baseline size. A common iliac artery of 16 mm was predicted to take 10 years to reach 25 mm (156% or 5.6% per annum) or if 23 mm at baseline 10 years to reach 35 mm (152% or 5.2% per annum). Overall, a common iliac artery was predicted to increase in diameter by 5.7% (+/- 0.5%) per annum. The common iliac artery in the presence of an AAA expands over time. Common iliac artery >16 mm are more likely to increase. Routine duplex examination of a common iliac artery <16 mm may not be necessary when following up AAA.	4
8. Schermerhorn ML, Cronenwett JL. Chapter 100 - Abdominal Aortic and Iliac Aneurysms. In: Rutherford RB, ed. *Vascular Surgery*. 6th ed. Philadelphia, PA: Elselvier Saunders; 2005.	Review/Other-Dx	N/A	Book chapter.	N/A	4
9. Lederle FA. A summary of the contributions of the VA cooperative studies on abdominal aortic aneurysms. *Ann N Y Acad Sci*. 2006;1085:29-38.	Review/Other-Dx	N/A	To provide a summary of the contributions of 3 different studies on AAA by the Department of Veterans Affairs Cooperative Studies Program.	No results stated in abstract.	4
10. Chaikof EL, Brewster DC, Dalman RL, et al. The care of patients with an abdominal aortic aneurysm: the Society for Vascular Surgery practice guidelines. *J Vasc Surg*. 2009;50(4 Suppl):S2-49.	Review/Other-Dx	N/A	To provide recommendations for evaluating the patient, including risk of aneurysm rupture and associated medical comorbidities, guidelines for selecting surgical or endovascular intervention, intraoperative strategies, perioperative care, long-term follow-up, and treatment of late complications.	No results stated in abstract.	4

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Reference	Study Type	Patients/ Events	Study Objective (Purpose of Study)	Study Results	Study Quality
11. Fleming C, Whitlock EP, Beil TL, Lederle FA. Screening for abdominal aortic aneurysm: a best-evidence systematic review for the U.S. Preventive Services Task Force. *Ann Intern Med.* 2005;142(3):203-211.	Meta-analysis	4 studies: MASS study 67,800; Western Australia study 38,704; Vibourg County study 12,658; Chichester study 15,775 patients assigned to treatment	To examine the benefits and harms of AAA screening.	For men 65–75 years of age, invitation to attend AAA screening reduces AAA-related mortality.	M
12. Glover MJ, Kim LG, Sweeting MJ, Thompson SG, Buxton MJ. Cost-effectiveness of the National Health Service Abdominal Aortic Aneurysm Screening Programme in England. *Br J Surg.* 2014;101(8):976-982.	Review/Other-Dx	N/A	To re-estimate the cost-effectiveness of AAA screening as operationalized in England using the most up-to-date available data.	The revised and updated model produced estimates of the long-term incremental cost-effectiveness of pound5758 (95% CI, pound4285 to pound7410) per life-year gained, or pound7370 (pound5467 to pound9443) per quality-adjusted life-year gained.	4
13. Guirguis-Blake JM, Beil TL, Senger CA, Whitlock EP. Ultrasonography screening for abdominal aortic aneurysms: a systematic evidence review for the U.S. Preventive Services Task Force. *Ann Intern Med.* 2014;160(5):321-329.	Review/Other-Dx	N/A	To systematically review evidence about the benefits and harms of US screening for AAAs in asymptomatic primary care patients.	Reviews of 4 randomized control trials involving 137,214 participants demonstrated that 1-time invitation for AAA screening in men aged 65 years or older reduced AAA rupture and AAA-related mortality rates for up to 10 and 15 years, respectively, but had no statistically significant effect on all-cause mortality rates up to 15 years. Screening was associated with more overall and elective surgeries but fewer emergency operations and lower 30-day operative mortality rates at up to 10- to 15-year follow-up. 1 randomized control trial involving 9342 women showed that screening had no benefit on AAA-related or all-cause mortality rates.	4

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Reference	Study Type	Patients/ Events	Study Objective (Purpose of Study)	Study Results	Study Quality
14. Zarrouk M, Lundqvist A, Holst J, Troeng T, Gottsater A. Cost-effectiveness of Screening for Abdominal Aortic Aneurysm in Combination with Medical Intervention in Patients with Small Aneurysms. *Eur J Vasc Endovasc Surg.* 2016;51(6):766-773.	Observational-Tx	4,300 65-year-old men invited to screening	To evaluate, using a Markov simulation model, potential outcomes of the disease defined as specific health states to estimate cost-effectiveness, and to help in the decision making process.	The additional costs of the screening strategy compared with no screening were euro169 per person and year. The incremental health gain per subject in the screened cohort was 0.011 additional quality adjusted life years, corresponding to an incremental cost-effectiveness ratio of euro15710 per quality adjusted life years. Assuming a 10% reduction of all-cause mortality, the incremental cost of screening was euro175 per person and year. The gain per subject in the screened cohort was 0.013 additional quality adjusted life years, corresponding to an incremental cost-effectiveness ratio of euro13922 per quality adjusted life year.	2
15. Laine MT, Vanttinen T, Kantonen I, et al. Rupture of Abdominal Aortic Aneurysms in Patients Under Screening Age and Elective Repair Threshold. *Eur J Vasc Endovasc Surg.* 2016;51(4):511-516.	Observational-Dx	585 patients	To identify the proportion of AAA ruptures that occur before the screening age or threshold diameter for operative repair is reached.	A total of 585 patients diagnosed with rupture of AAA were admitted to the 2 hospitals during the 12 year period. The mean age at the time of rupture was 73.6 years (SD 9.5, range 42-96 years). 18.3% of patients were under 65: 21.4% of men and 3.0% of women. Men were on average 8 years younger than women. The OR for rupture before 65 years of age for smokers was 2.1 compared with non-smokers, and 28.4% of smokers were under 65 at the time of rupture. Of all rupture of AAA patients, 327 had a CT scan confirming rupture. The mean AP diameter of the aneurysm was 75.6 mm (SD 15.8, range 32-155 mm). The mean size was significantly lower in women than in men (70.5 vs 76.8, *P*=.005).	3

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Reference	Study Type	Patients/ Events	Study Objective (Purpose of Study)	Study Results	Study Quality
16. Durieux R, Van Damme H, Labropoulos N, et al. High prevalence of abdominal aortic aneurysm in patients with three-vessel coronary artery disease. *Eur J Vasc Endovasc Surg*. 2014;47(3):273-278.	Review/Other-Dx	1,000 patients	To determine the prevalence of AAA in patients undergoing coronary angiography and to determine the risk factors and a coronary profile associated with AAA.	The overall number of previously repaired, already diagnosed, and new cases of AAA in the study population was 42, yielding a prevalence of 4.2%. Among the patients with newly detected AAAs, only 2 had an AAA diameter of >54 mm and were therefore treated surgically. In men aged ≥65 years, the prevalence reached 8.6%, while in men with three-vessel CAD it was 14.4%. Multivariate analysis showed that age ≥65 years (*P*=.003), male gender (*P*=.003), family history of AAA (*P*=.01), current smoking (*P*=.002), and three-vessel CAD (*P*<.001) were significantly associated with a higher prevalence of AAA.	4
17. Joergensen TM, Houlind K, Green A, Lindholt JS. Abdominal aortic diameter is increased in males with a family history of abdominal aortic aneurysms: results from the Danish VIVA-trial. *Eur J Vasc Endovasc Surg*. 2014;48(6):669-675.	Review/Other-Dx	18,614 male participants	To investigate, at a population level, whether a family history of AAA is independently related to increased aortic diameter and prevalence of AAA in men, and to elucidate whether the mean aortic diameter and the prevalence of AAA are different between participants with male and female relatives with AAA.	From the screened cohort, 569 participants had at least 1 first degree relative diagnosed with AAA, and 38 had AAA. Participants with a family history of AAA (+FH) had a significantly larger mean maximum aortic diameter (20.50 mm) compared with participants without family history of AAA (-FH) (19.07 mm, *P*<.0001), and +FH with female relatives with AAA had significantly larger mean maximum aortic diameter (21.8 mm) than +FH with male relatives (19.9 mm, *P*=.007). Furthermore the prevalence of AAA was significantly higher among +FH (6.7%) compared with -FH (3.0%) with an OR of 2.2 (95% CI: 1.6 to 3.2, *P*<.001) and +FH with female relatives with AAA had a more than two and a half times increased prevalence of AAA compared with +FH with male relatives with AAA with an OR of 2.65.	4

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Reference	Study Type	Patients/ Events	Study Objective (Purpose of Study)	Study Results	Study Quality
18. Svensjo S, Bjorck M, Wanhainen A. Update on screening for abdominal aortic aneurysm: a topical review. *Eur J Vasc Endovasc Surg.* 2014;48(6):659-667.	Review/Other-Dx	N/A	To present an up-to-date review of AAA-screening within the context of a rapidly changing AAA epidemiology.	Summarizing randomized control trial results and recent studies; contemporary one-time screening of men for AAA appears highly cost-effective, and seems to remain an effective preventive health-measure. However, several issues regarding screening need to be addressed: most importantly; the current degree of incidental detection of AAAs, the threshold diameter for follow-up, targeted screening in risk groups, and the possible need for re-screening in an elderly population with ever increasing longevity.	4
19. Khan S, Verma V, Verma S, Polzer S, Jha S. Assessing the potential risk of rupture of abdominal aortic aneurysms. *Clin Radiol.* 2015;70(1):11-20.	Review/Other-Dx	N/A	To review biomechanical, radiological, and epidemiological characteristics of AAAs that are associated with higher rupture risk.	For clinicians, knowing and considering a wide variety of risk factors in addition to AAA size is important to initiate early and proper intervention for AAA repair. Although there is no official quantitative risk score of AAA rupture risk that takes other non-size-related variables into account, if clinicians are aware of these other parameters, it is hoped that intervention can be appropriately performed for higher-risk AAAs that have not met the size-threshold for elective repair.	4
20. Kristmundsson T, Dias N, Resch T, Sonesson B. Morphology of Small Abdominal Aortic Aneurysms Should be Considered before Continued Ultrasound Surveillance. *Ann Vasc Surg.* 2016;31:18-22.	Observational-Dx	248 patients	To evaluate AAA morphology in a cohort of patients presenting with ruptured AAA and to explore if aneurysms with diameters below the recommended threshold for elective repair (<55 mm) have some distinctive morphological characteristics.	A total of 248 patients were identified. Of those, 83% (n = 206) had high-quality CT scans available and were included in the study. Patients were on average 75 years old and 85% were men. Mean aneurysm diameter was 76 +/- 14 mm and 95% (n = 197) had fusiform morphology. 6% (n = 12) were <55 mm and those included all saccular aneurysms in women (n = 3) and 22% of saccular aneurysms in men (n = 2). The remaining saccular aneurysms (n = 4) were small with a maximal diameter of 56 mm. Aneurysms <55 mm had less angulated proximal necks than their larger counterparts (*P*<0.01). No other morphological differences were found between the groups.	3

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21. Diehm N, Herrmann P, Dinkel HP. Multidetector CT angiography versus digital subtraction angiography for aortoiliac length measurements prior to endovascular AAA repair. *J Endovasc Ther.* 2004;11(5):527-534.	Observational-Dx	21 patients; 2 observers; 42 events	To assess variation between DSA and MDCTA in measuring vessel length prior to EVAR.	CTA was performed with good intraobserver agreement for all length parameters except H3 in reader 2 (P<0.05). While good interobserver agreement was demonstrated for CTA over long aortoiliac distances (H4a, H4b), higher interobserver agreement was obtained with DSA for shorter segments (H1, H2). Considerable differences were observed between CTA and DSA for the lengths H2 and H4b.	2
22. Wyers MC, Fillinger MF, Schermerhorn ML, et al. Endovascular repair of abdominal aortic aneurysm without preoperative arteriography. *J Vasc Surg.* 2003;38(4):730-738.	Observational-Dx	196 patients	To evaluate the utility of 3D reconstruction and computer-aided measurement, planning, and simulation software for preoperative evaluation of patients who might be candidates for EVAR.	For a subset of cases in which a comparison could be made, 3D reconstruction and computer-aided measurement, planning, and simulation software was superior to angiography for prediction of endograft length and iliac access. Hospital mortality was zero, and 30-day mortality was 0.5%. In 3 patients immediate conversion to open repair (1.5%) was necessary because of previously unknown stent-graft mechanical limits. Incidence of endoleak was 15% at 1 month, 10% at 6 months, 6% at 12 months, and 7% at 24 months, and 92% of endoleaks were type II. Mean follow-up was 18 months. Aneurysm-related mortality was zero. 19 secondary procedures (all endovascular) were performed in 16 patients (8%). For all graft types, freedom from secondary procedure was 94% at 1 year and 90% at 2 years, and this was better for endografts ultimately approved by the U.S. Food and Drug Administration (96% at 1 year, 95% at 2 years; P=.02). No known measurement-related complications occurred in the series. Results for secondary intervention and endoleak compare favorably to series with similar endograft types.	3

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23. Budde RP, Huo F, Cramer MJ, et al. Simultaneous aortic and coronary assessment in abdominal aortic aneurysm patients by thoraco-abdominal 64-detector-row CT angiography: estimate of the impact on preoperative management: a pilot study. *Eur J Vasc Endovasc Surg.* 2010;40(2):196-201.	Observational-Dx	28 patients	To estimate the influence of information on the coronary arteries obtained from routine thoraco-abdominal CTA on preoperative clinical management in AAA patients.	On CTA, 17 patients (61%) had significant coronary disease (>50% stenosis) including left main (n=4), single (n=7) and multiple (n=6) vessel disease. Grading confidence was adequate or high in 86% of proximal and middle segments. Based on CTA findings, patient management would have been changed in 4/28 patients (14%; 95% CI, 1%–27%) by adding coronary angiography (n=4). In 5 patients who underwent coronary artery bypass grafting previously, CT did not change management but confirmed graft patency. Information on coronary pathology and coronary bypass graft patency can be readily obtained from thoraco-abdominal CTA and may alter preoperative patient management, as shown in 14% of AAA patients in our study.	4
24. Larsson E, Vishnevskaya L, Kalin B, Granath F, Swedenborg J, Hultgren R. High frequency of thoracic aneurysms in patients with abdominal aortic aneurysms. *Ann Surg.* 2011;253(1):180-184.	Review/Other-Dx	1,055 AAA patients; 354 underwent CT	To investigate the prevalence of thoracic aortic aneurysms in patients with AAA.	Mean age was 74 years, 23% were women. The presence of comorbid conditions did not differ between men and women except for a higher proportion of female smokers (P=0.003). When sex-specific criteria were used, 100 patients (28%) had a thoracic aortic aneurysms, 38 (48%) of the women compared with 62 (23%) of the men (P<0.0001). OR for women compared with those of men to have a concurrent thoracic aortic aneurysms was 3.09 (95% CI, 1.84–5.22). More than one fourth of patients with AAA attending a regular outpatient clinic have concomitant thoracic aortic aneurysms, and women are particularly affected. During the last decades, the therapeutic options for thoracic aortic aneurysms patients have changed considerably. Physicians need to increase the efforts to investigate also the thoracic aorta in AAA patients.	4

Reference	Study Type	Patients/ Events	Study Objective (Purpose of Study)	Study Results	Study Quality
25. Aboyans V, Bataille V, Bliscaux P, et al. Effectiveness of screening for abdominal aortic aneurysm during echocardiography. *Am J Cardiol.* 2014;114(7):1100-1104.	Review/Other-Dx	1,382 patients	To assess the actual rate of AAA among patients undergoing TTE and the feasibility of its screening in a large multicenter study.	Of 1,382 consecutive patients, abdominal aorta imaging was feasible in 96.7%, with a median delay of 1.7 minutes (>3 minutes in 3.6% of cases). We found AAA in 50 patients (3.7%). Unknown AAA (2.7%) was more frequent in men than women (3.7% vs 1.3%, respectively, *P*=0.007) and increased by age at 2.2%, 2.5%, and 5.8% in age bands of 65 to 74, 75 to 84, and 85+ years, respectively. None of the female participants aged <75 years had AAA. Smoking status and family history of AAA were significantly more frequent among patients with AAA. The ascending aorta was larger in those with AAA (36.2+/-4.7 vs 34.0+/-5.2 mm, *P*=0.006), and bicuspid aortic valve and/or major aortic regurgitation were also more frequent (8% vs 2.6%, *P*=0.017).	4
26. Aboyans V, Kownator S, Lafitte M, et al. Screening abdominal aorta aneurysm during echocardiography: literature review and proposal for a French nationwide study. *Arch Cardiovasc Dis.* 2010;103(10):552-558.	Review/Other-Dx	20,000+ patients; 10 centers	To collect all of the available data on the feasibility and results of AAA screening and the risk factors for prevalent AAA in patients undergoing TTE.	While the studies differed regarding patient selection and AAA definition, the feasibility of AAA screening during TTE was excellent (mostly >90%), with the need for an average of 2–7 minutes to be added to the cardiac imaging time. The prevalence of AAA >30 mm ranged from 0.8% to 6.5%, and up to 19% in men aged >70 years. The risk factors for the presence of AAA among attendees of echocardiography laboratories were similar to those reported in the general population: age, male gender, smoking, hypertension, family history of AAA and prevalent atherosclerotic diseases. Some echocardiography-specific factors, such as left ventricular hypertrophy or dilation and poor left ventricular ejection fraction were also reported. To better assess the benefit of and indications for AAA screening during TTE in clinical practice, a multicenter, nationwide, screening study in echocardiography laboratories is proposed.	4

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27. Fadel BM, Bakarman H, Al-Admawi M, Bech-Hanssen O, Di Salvo G. Pulse-wave Doppler interrogation of the abdominal aorta: a window to the left heart and vasculature. *Echocardiography.* 2014;31(4):543-547.	Review/Other-Dx	N/A	To review the usefulness of pulse Doppler recording of the abdominal aorta and provide case examples of its value in various disease states.	No results stated in abstract.	4
28. Roshanali F, Mandegar MH, Yousefnia MA, Mohammadi A, Baharvand B. Abdominal aorta screening during transthoracic echocardiography. *Echocardiography.* 2007;24(7):685-688.	Review/Other-Dx	1,285 patients	To investigate the use of a modified abdominal US examination performed as an extension of a routine diagnostic TTE. This modified examination is arguably a simple, safe, quick, and accurate way to identify patients with AAA.	1,175 abdominal aortas were visualized (91.4%). The prevalence of AAA was 3.8% (45/1175), which increased with age. 6 patients, who had diameters >5 cm, were referred to a surgeon. In the patients with AAA, left ventricular hypertrophy and left ventricular dilatation were more frequent. Routine screening of the abdominal aorta during TTE is recommended on account of the prevalence of AAA in unselected and, in particular, older patients.	4
29. Alund M, Mani K, Wanhainen A. Selective screening for abdominal aortic aneurysm among patients referred to the vascular laboratory. *Eur J Vasc Endovasc Surg.* 2008;35(6):669-674.	Review/Other-Dx	5,924 total patients screened for AAA; 179 found to have AAA	To review the prevalence of AAA found at this selective high-risk screening.	In a logistic regression model male gender, age and duplex-verified arterial stenosis were independently associated with AAA (OR 3.2, 2.0/20 years and 2.0, respectively, *P*<0.001). In men <60 years the AAA prevalence was 0.9% (95% CI 0.2%–1.6%) when arterial stenosis was absent and 1.5% (0.0%–3.2%) when present. In men ≥60 years the AAA prevalence was 4.0% (3.0%–5.1%) when no arterial stenosis was found and 7.3% (5.7%–8.9%) when found. The corresponding prevalence in women were 0%, 0%, 1.2% (0.5%–1.8%), and 3.1% (1.9%–4.3%), respectively. Men ≥60 years referred for arterial examination have a significant risk of having an AAA while only women ≥65 years with a duplex verified arterial stenosis have a sufficient risk of having an AAA. Studies to evaluate the benefit of selective high-risk screening are warranted.	4

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Reference	Study Type	Patients/ Events	Study Objective (Purpose of Study)	Study Results	Study Quality
30. Dupont A, Elkalioubie A, Juthier F, et al. Frequency of abdominal aortic aneurysm in patients undergoing coronary artery bypass grafting. *Am J Cardiol.* 2010;105(11):1545-1548.	Review/Other-Dx	217 patients	To clarify the prevalence and the risk factors for unsuspected AAA in patients who underwent coronary artery bypass grafting for severe coronary artery disease and to identify the most at risk patients for AAA.	Factors significantly associated by univariate analysis with asymptomatic AAA presence were smoking (P=0.003), symptomatic peripheral artery disease (P=0.006), significant carotid artery stenosis (P=0.007), and larger femoral and popliteal diameters (P=0.008 and P=0.0012, respectively). The other classic demographic, clinical, and biologic features were equally distributed among patients. In patients who underwent coronary artery bypass grafting who were men and aged <75 years with smoking histories, the prevalence of AAA was as high as 24% when they had concomitant peripheral arterial disease and/or carotid artery stenosis (vs 4.4% in the absence of either condition, P=0.007), justifying consideration of AAA screening in this subgroup of in-hospital patients.	4

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31. Long A, Bui HT, Barbe C, et al. Prevalence of abdominal aortic aneurysm and large infrarenal aorta in patients with acute coronary syndrome and proven coronary stenosis: a prospective monocenter study. *Ann Vasc Surg.* 2010;24(5):602-608.	Review/Other-Dx	306 patients	To evaluate the prevalence of AAA and of large abdominal aorta in patients hospitalized for acute coronary syndrome and coronary stenosis of 50% or greater.	AAAs were diagnosed in 20 patients (6.6%). Mean diameter was 33 +/- 3.7 mm, and median diameter [min-max] was 31 mm [30–45 mm]. All except 1 AAA were between 30 and 40 mm. No AAAs were detected in patients <50 years. Prevalence reached 7.7% in patients >50 years. Using stepwise logistic regression analysis, age (OR 1.04. 95% CI, 1.00–1.09 per year of age, P=0.06) and previous coronary events (OR 2.44, 95% CI, 0.96–6.25, P=0.06) showed a borderline significant association with AAA. Large infrarenal aortic diameter was observed in 32% of patients. Age (OR 1.03, 95% CI, 1.02–1.05 per year of age, P<0.0001), male gender (OR 16.7, 95% CI, 6.25–50.0, P<0.0001), and overweight (OR 2.0, 95% CI, 1.2–3.4, P=0.01) showed a significant independent association with large aorta. AAA and large infrarenal aorta prevalence seems high in patients with acute coronary syndrome and proven coronary stenosis of 50% or greater. Previous coronary events and older age might be associated with higher risk of AAA, and age, male gender, and obesity are significantly associated with large infrarenal aorta.	4

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Reference	Study Type	Patients/ Events	Study Objective (Purpose of Study)	Study Results	Study Quality
32. Gratama JW, van Leeuwen RB. Abdominal aortic aneurysm: high prevalence in men over 59 years of age with TIA or stroke, a perspective. *Abdom Imaging*. 2010;35(1):95-98.	Review/Other-Dx	N/A	To review the prevalence of AAA in men over 59 years of age with transient ischemic attack or stroke.	Recently, men >59 years of age presenting with stroke or a transient ischemic attack at the neurology department were found to have a doubled prevalence of AAA. This confirmed data of another study (SMART), which included broader inclusion criteria (either manifest atherosclerotic disease or only risk factors for atherosclerosis). Incorporation of an aortic US into the neurological workup of these patients could result in an effective screening program. However, before that, several cost-effectiveness issues need to be resolved, such as growth rate of the detected aneurysms, risk of death by AAA rupture in this patient group with increased co-morbidity and decreased life expectancy, peri-operative risk of open or endovascular repair.	4
33. Matsumura Y, Wada M, Hirakawa D, et al. Clinical utility of transthoracic echocardiography for screening abdominal aortic aneurysm: a prospective study in a Japanese population. *Cardiovasc Ultrasound*. 2016;14:8.	Observational-Dx	1,912 patients	To evaluate the clinical utility of TTE for screening AAA and to identify important TTE indices associated with AAA in a Japanese population.	The abdominal aorta was visualized in 95.1% (1818/1912) by TTE. AAA was identified in 2.6% (47/1818). The aortic root size was significantly larger in patients with AAA than those without (36.0 +/- 4.1 vs. 31.7 +/- 4.2 mm, P<0.001). The aortic root size had a fair correlation with abdominal aortic size (r = 0.31, P<0.001). The aortic root size of ≥34 mm was predictive of AAA by receiver operating characteristic curve analysis (area under the curve = 0.78, P<0.001). Multiple logistic regression analysis revealed that aortic root size (hazard ratio 1.23, P<0.001) and age (hazard ratio 1.05, P=0.013) were the independent predictors of AAA.	3

Pulsatile Abdominal Mass, Suspected Abdominal Aortic Aneurysm
EVIDENCE TABLE

Reference	Study Type	Patients/ Events	Study Objective (Purpose of Study)	Study Results	Study Quality
34. Behr-Rasmussen C, Grondal N, Bramsen MB, Thomsen MD, Lindholt JS. Mural thrombus and the progression of abdominal aortic aneurysms: a large population-based prospective cohort study. *Eur J Vasc Endovasc Surg.* 2014;48(3):301-307.	Review/Other-Dx	416 patients	To investigate whether the relative size of intraluminal thrombus in AAAs is associated with AAA growth.	The mean size of the AAA was 40.6 mm, and the mean observation time was 1.78 years. In the group with AAAs measuring 30–34 mm, 42% had intraluminal thrombus, with a mean relative size of 12% of the outer area. In the group with AAAs measuring >64 mm, the presence of intraluminal thrombus increased to 100%, with a mean relative size of 70% of the outer area. Univariate analysis showed relative intraluminal thrombus size, aortic diameter, smoking history, and diastolic blood pressure were significantly positively associated with growth rate, while the presence of diabetes mellitus was significantly negatively associated with growth rate. The relative intraluminal thrombus size remained significantly positively associated with the growth rate after a multivariate linear regression adjusting for potential confounders.	4
35. Singh K, Bonaa KH, Solberg S, Sorlie DG, Bjork L. Intra- and interobserver variability in ultrasound measurements of abdominal aortic diameter. The Tromso Study. *Eur J Vasc Endovasc Surg.* 1998;15(6):497-504.	Observational-Dx	1st US: 6,892 patients; 2nd US: 112 patients 4 observers (3 sonographers and 1 radiologist)	To assess the variability of US measurements at different levels of the abdominal aorta.	Variability was similar in the beginning and end of the survey period. Both the intra- and interobserver variability were <4 mm for all sonographers in measurements of maximal infrarenal aortic diameter, and variability was similar for measurements in the anterior-posterior and transverse plane. Variability was greater for measurements at the renal level than aortic bifurcation level. The radiologist had lower variability than the other sonographers.	4

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Reference	Study Type	Patients/ Events	Study Objective (Purpose of Study)	Study Results	Study Quality
36. Manning BJ, Kristmundsson T, Sonesson B, Resch T. Abdominal aortic aneurysm diameter: a comparison of ultrasound measurements with those from standard and three-dimensional computed tomography reconstruction. *J Vasc Surg*. 2009;50(2):263-268.	Observational-Dx	109 patients	To define the relationship between commonly used CT measurement techniques and those based on current reporting standards and to compare the values obtained with diameter measured using US.	The mean of each series of readings on CT was significantly larger than the mean US-anteroposterior measurement (P<.001), and they also differed significantly from each other (P<.001). The CT-perpendicular to the centerline of flow diameter was larger than CT-anteroposterior and CT-perpendicular to the maximal ellipse by mean values of 3.0 +/- 6.6 and 5.9 +/- 6.0 mm, respectively. The CT-maximal ellipse diameter was larger than CT-perpendicular to the centerline of flow by a mean of 2.4 +/- 5 mm. The US-anteroposterior diameter was smaller than CT-anteroposterior diameter by 4.2 +/- 4.9 mm, CT-maximal ellipse by 9.6 +/- 8.0 mm, CT-perpendicular to the maximal ellipse by 1.3 +/- 5 mm, and smaller than CT-perpendicular to the centerline of flow by 7.3 +/- 7.0 mm. Aneurysm size did not significantly affect these differences. 78% of 120 pairs of intraobserver CT measurements and 65% of interobserver CT measurements differed by <2 mm. CT-based measurements of aneurysm size tend to be larger than the US-anteroposterior measurement. CT-perpendicular to the centerline of flow diameters are consistently larger than CT-perpendicular to the maximal ellipse as well as CT-anteroposterior measurements. These differences should be considered when applying evidence from previous trials to clinical decisions.	3

Reference	Study Type	Patients/ Events	Study Objective (Purpose of Study)	Study Results	Study Quality
37. Nyhsen CM, Elliott ST. Rapid assessment of abdominal aortic aneurysms by 3-dimensional ultrasonography. *J Ultrasound Med.* 2007;26(2):223-226.	Observational-Dx	30 consecutive patients	To assess the application and accuracy of 3D volume acquisition US in the measurement of AAA.	AAA diameters were between 2.9 and 6.75 cm. For both anteroposterior and transverse diameters, a paired t-test showed a Pearson correlation coefficient of 0.98 (significant at the *P*=.01 level) and a coefficient of determination of 0.96. Bland-Altman analysis showed that the mean difference between the 2 sets of measurements was very close to zero (*P*=.05). Thus, there was no significant difference between the conventional and 3D volume measurement methods. The scan acquisition time for the 3D volume data was only 3 seconds for each set (anteroposterior and transverse). 3D US using volume acquisition offers a new opportunity to acquire fast and reliable AAA measurements. The reduced scan times can be used to allow greater patient throughput and will help cope with the increasing workload of AAA surveillance. By archiving a complete set of data, 3D US allows subsequent analysis and comparison of measurements.	2
38. Vidakovic R, Feringa HH, Kuiper RJ, et al. Comparison with computed tomography of two ultrasound devices for diagnosis of abdominal aortic aneurysm. *Am J Cardiol.* 2007;100(12):1786-1791.	Experimental-Dx	146 patients	To compare a 2D, handheld US device and a newly developed US volume scanner (based on bladder scan technology) with CT for diagnosing AAA.	AAAs were diagnosed by CT in 116 patients (80%). The absolute difference of aortic diameter between US and CT was <5 mm in 88% of patients. Limits of agreement between US and CT (-6.6 to 9.4 mm) exceeded the limits of clinical acceptability (+/-5 mm). An excellent correlation between US and CT was observed (r = 0.98). The correlation coefficient between the volume scanner and CT was 0.86, with agreement of 90% and kappa value of 0.73. Using an optimal cut-off value of >56 ml, defined by receiver-operating characteristic curve analysis, sensitivity, specificity, and the PPV and NPV of the volume scanner for detecting AAA were 90%, 90%, 97%, and 71%, respectively. In conclusion, this study shows that a 2D, handheld US device and a newly developed US volume scanner can effectively identify patients with AAAs confirmed by CT.	2

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Reference	Study Type	Patients/ Events	Study Objective (Purpose of Study)	Study Results	Study Quality
39. Cohan RH, Siegel CL, Korobkin M, et al. Abdominal aortic aneurysms: CT evaluation of renal artery involvement. *Radiology*. 1995;194(3):751-756.	Observational-Dx	30 patients	To determine whether CT assessment of the proximal extent of ruptured aneurysms can help the surgeon determine whether to initially clamp the pararenal aneurysm neck or the supraceliac aorta. 24 patients had contrast; 6 patients did not.	For 49 of 50 vessels in 25 patients, the authors correctly predicted at CT that AAAs originated caudal to the main renal artery origins. They also predicted that 9 main renal arteries in 5 patients originated directly from the AAAs, but this was correct in only 5 arteries. Suprarenal clamping was required in all 5 patients. Infrarenal clamps were used before reconstruction in all 12 of the patients whose AAAs appeared to originate at least 30 mm below the main renal arteries.	3
40. Fukuhara R, Ishiguchi T, Ikeda M, et al. Evaluation of abdominal aortic aneurysm for endovascular stent-grafting with volume-rendered CT images of vessel lumen and thrombus. *Radiat Med.* 2004;22(5):332-341.	Observational-Dx	11 patients; 5 observers; 55 events	To evaluate the accuracy of CT images of AAA with volume-rendered display of vessel lumen and thrombus and to evaluate its usefulness in the planning of stent-grafting.	Accuracy of measurements was higher on volume-rendered images than on axial/MPR in 7 of 13 regions. Interobserver variance of volume-rendered images was smaller in 7 of 14 regions. Detection of renal and internal iliac artery involvements was better on volume-rendered images (P<0.05). Overall diagnostic value was also higher on volume-rendered images (P<0.05).	1
41. Kurabayashi M, Okishige K, Ueshima D, et al. Diagnostic utility of unenhanced computed tomography for acute aortic syndrome. *Circ J.* 2014;78(8):1928-1934.	Experimental-Dx	219 patients	To evaluate how well acute aortic syndrome can be diagnosed based solely on unenhanced CT images in patients presenting to the emergency room with chest or back pain.	Diagnosis of acute aortic syndrome was confirmed in 103 patients (47%, 95 acute aortic dissection and 8 ruptured thoracic aortic aneurysm patients) based on evaluation of both unenhanced and contrast-enhanced CT images, which was used as the reference standard for validating the diagnostic value of the unenhanced CT findings. Sensitivity and specificity of the findings of a high-attenuation crescent, which represents hematoma in the aortic wall, were 61.2% and 99.1%, respectively. Sensitivity and specificity of linear high density in the aorta, which represents an intimal flap, were 59.2% and 96.6%, respectively. If unenhanced CT showed none of high-attenuation crescent, linear high density, internal displacement of intimal calcification, or thoracic aortic aneurysm, the NPV was 93.3%.	2

Reference	Study Type	Patients/ Events	Study Objective (Purpose of Study)	Study Results	Study Quality
42. Jalalzadeh H, Indrakusuma R, Planken RN, Legemate DA, Koelemay MJ, Balm R. Inflammation as a Predictor of Abdominal Aortic Aneurysm Growth and Rupture: A Systematic Review of Imaging Biomarkers. *Eur J Vasc Endovasc Surg.* 2016.	Review/Other-Dx	7 studies; 202 AAA patients	To determine which inflammatory imaging biomarkers are associated with AAA growth and rupture.	7 studies were included, comprising 202 AAA patients. FDG-PET/CT was evaluated in 6 studies. MRI with ultrasmall superparamagnetic particles of iron oxide was evaluated in 1 study. 2 of 6 FDG-PET/CT studies reported a significant negative correlation (r=.383, *P*=.015) or a significant negative association (*P*=.04). 4 of 6 FDG-PET/CT studies reported no significant association between FDG uptake and AAA growth. The single study investigating ultrasmall superparamagnetic particles of iron oxide-MRI demonstrated that AAA growth was 3 times higher in patients with focal ultrasmall superparamagnetic particles of iron oxide uptake in the AAA wall compared to patients with diffuse or no ultrasmall superparamagnetic particles of iron oxide uptake in the wall (0.66 vs 0.24 vs 0.22 cm/y, *P*=.020). In the single study relating FDG uptake results to AAA rupture, the association was not significant.	4
43. Mora C, Marcus C, Barbe C, Ecarnot F, Long A. Measurement of maximum diameter of native abdominal aortic aneurysm by angio-CT: reproducibility is better with the semi-automated method. *Eur J Vasc Endovasc Surg.* 2014;47(2):139-150.	Observational-Dx	68 patients	To identify the technique yielding the best reproducibility from among various measures of native maximum AAA diameter with CTA.	Intra-observer reproducibility was high. The limits of agreement were within the clinically accepted range [-5; +5 mm] in 27/30 (90%) comparisons. The method common to all 3 observers that yielded the lowest values was the semi-automated method. Inter-observer reproducibility was poorer. The limits were outside the clinically accepted range in 26/30 (87%) comparisons. The semi-automated method led to lower intra- (0%) and inter-observer (5.88%) discordances rates.	2
44. Hayter RG, Rhea JT, Small A, Tafazoli FS, Novelline RA. Suspected aortic dissection and other aortic disorders: multi-detector row CT in 373 cases in the emergency setting. *Radiology.* 2006;238(3):841-852.	Observational-Dx	373 evaluations	To retrospectively review the authors' experience with MDCT for detection of aortic dissection in the emergency setting.	Overall, 112 findings were interpreted as positive for acute aortic disorder, an alternative finding, or both at CT. No interpretations were false-positive, 1 was false-negative, 67 were true-positive, and 304 were true-negative. Sensitivity, specificity, PPV, NPV, and accuracy were 99% (67/68), 100% (304/304), 100% (67/67), 99.7% (304/305), and 99.5% (371/373), respectively.	3

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Reference	Study Type	Patients/ Events	Study Objective (Purpose of Study)	Study Results	Study Quality
45. Rakita D, Newatia A, Hines JJ, Siegel DN, Friedman B. Spectrum of CT findings in rupture and impending rupture of abdominal aortic aneurysms. *Radiographics*. 2007;27(2):497-507.	Review/Other-Dx	N/A	To review CT findings of ruptured AAA.	No results stated in abstract.	4
46. Roy J, Labruto F, Beckman MO, Danielson J, Johansson G, Swedenborg J. Bleeding into the intraluminal thrombus in abdominal aortic aneurysms is associated with rupture. *J Vasc Surg*. 2008;48(5):1108-1113.	Observational-Dx	42 patients	To determine signs of bleeding in the intraluminal thrombus and the site of rupture using multislice CT imaging in patients with AAA.	The crescent sign was more frequent in the ruptured group (38% vs 14%, *P*=.02), but there was no significant difference in the presence of localized areas of hyper attenuation in the 2 groups. The attenuation in the thrombus was significantly higher in patients with rupture than in those with intact aneurysms (*P*=.02). The site of rupture could be localized in 29/42 patients. Ruptures occurred both through the thrombus-covered and the thrombus free wall. In 45% of the patients, the rupture site was localized in the left lateral wall, in 24% in the anterior wall, in 24% in the right lateral wall, but only in 7% in the posterior wall. The site of rupture could be identified in a majority of cases of AAA with routine multislice CT.	4
47. Apter S, Rimon U, Konen E, et al. Sealed rupture of abdominal aortic aneurysms: CT features in 6 patients and a review of the literature. *Abdom Imaging*. 2010;35(1):99-105.	Observational-Dx	6 patients and 31 consecutive patients	To assess the CT features of sealed rupture of AAA.	The mean size of the aneurysm was 6.24 +/- 2.01 cm, compared to 6.01 +/- 0.99 cm in the control group, without statistically significant difference (t = 0.75, df = 97, *P*=0.46). A draped aorta was detected in all patients with a sealed rupture. Vertebral erosion was present in all 6, but mentioned in only 14 of the cases reported. A sealed rupture of an AAA can occur in relatively small aneurysms. A draped aorta and adjacent vertebral erosion are characteristic CT signs of such a rupture.	4
48. American College of Radiology. ACR–NASCI–SIR–SPR Practice Parameter for the Performance and Interpretation of Body Computed Tomography Angiography (CTA). Available at: http://www.acr.org/~/media/ACR/Documents/PGTS/guidelines/Body_CTA.pdf.	Review/Other-Dx	N/A	Guidance document to promote the safe and effective use of diagnostic and therapeutic radiology by describing specific training, skills and techniques.	N/A	4

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Reference	Study Type	Patients/ Events	Study Objective (Purpose of Study)	Study Results	Study Quality
49. Ruff A, Patel K, Joyce JR, Gornik HL, Rothberg MB. The use of pre-existing CT imaging in screening for abdominal aortic aneurysms. *Vasc Med.* 2016:[Epub ahead of print].	Observational-Dx	142 patients	To evaluate the sensitivity of CT imaging of the abdomen for the detection of AAA when performed for other clinical indications.	Of 142 patients with both a CT scan and an AAA on US, 127 (89.4%) were noted to have an AAA in the report of a CT scan performed within the 3 years prior to the US. An additional 10 films demonstrated an AAA that was not mentioned in the report. The sensitivity of pre-existing CT scans for AAA screening was 97.2% (137/141) [95% CI: 93.4%-99.0%]; 123 (86.6%) of these positive findings were reported in the findings narrative and 120 (84.5%) were reported in the radiologist's final impression.	3
50. Lyck Hansen M, Dahl Thomsen M, Rasmussen LM, Lindholt JS. Abdominal aortic aneurysm, arterial stiffening and the role of the intraluminal thrombus. *Vasa.* 2015;44(5):349-353.	Review/Other-Dx	157 patients	To evaluate the possible relation between AAA sizes, intraluminal thrombus, pulse wave velocity and pulse wave analysis in order to further clarify whether or not measure of arterial stiffness has a role and a purpose in patients with AAA.	In total, 157 patients were included. Mean age was 73 years. Mean AAA size was 42.2 mm. 56 of the patients had an intraluminal thrombus, and patients with AAA and intraluminal thrombus had a significantly higher Aix75 than patients with AAA but without intraluminal thrombus (Mean = 28.3 +/- 1.4 SEM vs 24.9 +/- 0.81, *P*=0.027), a difference that was also significant when adjusting for AAA size, blood pressure and age. There was no difference in pulse wave velocity between the groups.	4

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Reference	Study Type	Patients/ Events	Study Objective (Purpose of Study)	Study Results	Study Quality
51. Parr A, McCann M, Bradshaw B, Shahzad A, Buttner P, Golledge J. Thrombus volume is associated with cardiovascular events and aneurysm growth in patients who have abdominal aortic aneurysms. *J Vasc Surg*. 2011;53(1):28-35.	Review/Other-Dx	98 patients	To prospectively assess the association of infrarenal abdominal aortic thrombus volume with cardiovascular events and AAA growth.	There were 28 cardiovascular events during follow-up. The incidence of cardiovascular events was 23.4% and 49.2% for patients with small (smaller than the median) and large (median or larger) volumes of aortic thrombus, respectively, at 4 years (P=.040). AAA thrombus volume of median or larger was associated with increased cardiovascular events (RR 2.8, 95% CI, 1.01–5.24) independent of other risk factors, including initial AAA diameter, but was only of borderline significance when patients were censored at the time of AAA repair (RR, 2.35; 95% CI, 0.98–5.63). In the subset of patients with CTA follow-up, the median annual increase in AAA volume was 5.1 cm^3 (IQR, 0.8–10.3 cm^3). Annual AAA volume increase was positively correlated with initial AAA diameter (r = 0.44, P=.006) and thrombus volume (r = 0.50, P=.001). Median or larger aortic thrombus volume was associated with rapid AAA volume increase (≥ 5 cm/y), independent of initial aortic diameter (RR, 15.0; 95% CI, 1.9–115.7; P=.009). In this small cohort, infrarenal aortic thrombus volume was associated with the incidence of cardiovascular events and AAA progression. These results need to be confirmed and mechanisms underlying the associations clarified in large further studies.	4

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Reference	Study Type	Patients/ Events	Study Objective (Purpose of Study)	Study Results	Study Quality
52. Vega de Ceniga M, Gomez R, Estallo L, de la Fuente N, Viviens B, Barba A. Analysis of expansion patterns in 4-4.9 cm abdominal aortic aneurysms. *Ann Vasc Surg*. 2008;22(1):37-44.	Review/Other-Dx	195 patients	To analyze the growth pattern of 4–4.9 cm infrarenal AAA.	The follow-up period was 50 +/- 36.4 months (6.5–193.7). The growth pattern (n=131) was continuous in 15 (11.5%) and discontinuous in 116 (88.5%) AAA. The mean expansion rate was higher in AAAs with continuous expansion (7.92 +/- 3.74 vs 2.74 +/- 2.94 mm/year, $P<0.0001$). No cardiovascular risk factors or comorbidity influenced the expansion pattern ($P>0.05$). The eccentric thrombus was associated with a greater incidence of continuous growth ($P=0.05$), with no influence of aortic calcification ($P>0.1$). The expansion of 4–4.9 cm AAA is mostly irregular and unpredictable. The researchers have not found any modifiable risk factors which influence their growth pattern. The eccentric distribution of the thrombus is associated with continuous expansion.	4
53. Brunner-Ziegler S, Hammer A, Seidinger D, Willfort-Ehringer A, Koppensteiner R, Steiner S. The role of intraluminal thrombus formation for expansion of abdominal aortic aneurysms. *Wien Klin Wochenschr*. 2015;127(13-14):549-554.	Observational-Dx	166 patients	To study AAA expansion rates in patients receiving contemporary treatments for cardiovascular risk factor control and to identify predictors of AAA progression.	In total, 166 patients (123 men and 43 women, mean age 68 +/- 9 years) were included. Patients were followed over a mean period of 1.4 +/- 1.2 years with a mean number of follow-up investigations of 4.4 +/- 2.7. Overall, mean maximum AAA diameter at baseline was 37.4 +/- 8.2 mm. The average expansion rate of AAA diameter throughout the follow-up period was 2.0 mm per year (95% CI: 1.6-2.4). At initial investigation, intraluminal thrombus formation was present in 56.6% of all patients. AAA diameter at baseline, time of follow-up as well as presence and size of intraluminal thrombus formation were identified as independent predictors of AAA expansion rate. Importantly, gender and presence of cardiovascular risk factors were not associated with AAA progression rate.	4

Pulsatile Abdominal Mass, Suspected Abdominal Aortic Aneurysm
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Reference	Study Type	Patients/ Events	Study Objective (Purpose of Study)	Study Results	Study Quality
54. Truijers M, Fillinger MF, Renema KW, et al. In-vivo imaging of changes in abdominal aortic aneurysm thrombus volume during the cardiac cycle. *J Endovasc Ther.* 2009;16(3):314-319.	Review/Other-Dx	17 patients	To evaluate in-vivo thrombus compressibility in AAA to hopefully shed light on the biomechanical importance of intraluminal thrombus.	A substantial interpatient variability was observed in thrombus compressibility, ranging from 0.4% to 43.6% (0.2 to 13.5 mL, respectively). Both thrombus and lumen volumes varied substantially during the cardiac cycle. As lumen volume increased (5.2%, IQR 2.8%–8.8%), thrombus volume decreased (3.0%, IQR 1.0%–4.6%). Total aneurysm volume remained relatively constant (1.3%, IQR 0.4-1.9%). Changes in lumen volume were inversely correlated with changes in thrombus volume ($r = -0.73$; $P=0.001$). In-vivo thrombus compressibility varied from patient to patient, and this variation was irrespective of aneurysm size, pulse pressure, and thrombus volume. This suggests that thrombus might act as a biomechanical buffer in some, while it has virtually no effect in others. Whether differences in thrombus compressibility alter the risk of rupture will be the focus of future research.	4
55. Sakuta A, Kimura F, Aoka Y, Aomi S, Hagiwara N, Kasanuki H. Delayed enhancement on computed tomography in abdominal aortic aneurysm wall. *Heart Vessels.* 2007;22(2):79-87.	Observational-Dx	110 patients	To evaluate delayed enhancement of the aortic wall of atherosclerotic aneurysms using CT and to evaluate the relationships between delayed enhancement and wall thickness of AAA, diameter of AAA, serum levels of C-reactive protein which indicate inflammation status, and pathological findings.	Delayed enhancement on CT was demonstrated in 66/110 patients with atherosclerotic AAA (60.0%). Patients with delayed enhancement demonstrated significantly larger AAA diameter (4.8 +/- 0.9 vs 3.9 +/- 0.6 cm, $P<0.0001$) and significantly higher levels of C-reactive protein (5.0 +/- 6.0 vs 2.3 +/- 2.9 mg/L, $P=0.033$) than those patients without delayed enhancement. Patients with delayed enhancement also had significantly thicker and more severe atheroma and a tendency toward more prominent inflammation and vascularity in pathologic findings. There was no significant difference in wall thickness between AAA with and without delayed enhancement (1.44 +/- 0.7 vs 1.24 +/- 0.22 mm, $P=0.352$). Delayed enhancement on CT demonstrated in over half of atherosclerotic AAA may be associated with chronic inflammation by atherosclerosis.	3

Reference	Study Type	Patients/ Events	Study Objective (Purpose of Study)	Study Results	Study Quality
56. Chisci E, Alamanni N, Iacoponi F, et al. Grading abdominal aortic aneurysm rupture risk. *J Cardiovasc Surg (Torino)*. 2015.	Observational-Dx	143 patients	To develop a scoring system to grade the risk of rupture of an AAA in individual patients.	There were 143 patients examined. 91 AAAs (18 ruptured AAAs), and 52 had a nonaneurysmal aorta. The 2D oscillatory shear index was the best computational fluid dynamics criterion following multivariate analysis and receiver operating characteristic curves evaluation. An AAA was deemed at low, moderate, or high risk of rupture, respectively, according to whether the risk score was defined as AAA I (total score<2.3), AAA II (2.3–6.5) or AAA III (>6.5). The only protective factor was found in diabetes (OR=0.775; CI: 0.665–0.902).	3
57. Yau FS, Rosero EB, Clagett GP, et al. Surveillance of small aortic aneurysms does not alter anatomic suitability for endovascular repair. *J Vasc Surg*. 2007;45(1):96-100.	Review/Other-Dx	54 patients	To determine whether small AAA growth is associated with the development of morphologic characteristics that decrease eligibility for EVAR.	The median age of the study cohort was 73 years (IQR, 65–77 years). The median follow-up period was 24 months (IQR, 15-36 months). The median small AAA diameter increased from 44.5 mm (IQR, 41–48 mm) to 48.9 mm (IQR, 45.7–52.0 mm). The median aortic neck diameter increased from 23.0 to 24.0 mm (*P*=.002), whereas median neck length decreased from 26.5 to 20.0 mm (*P*=.001). Aortic aneurysm median tortuosity index increased from 1.09 to 1.11 (*P*=.05). No significant changes in iliac artery morphology occurred. Overall, the anatomic suitability for endovascular repair did not significantly change during the study period (74% vs 69%; McNemar test; *P*=.25). Changes in aortic morphology are frequently associated with small AAA growth at mid-term follow-up, but such changes are minor and do not affect overall anatomic suitability for EVAR. These data reveal that continued surveillance of small AAAs does not threaten the window of opportunity for EVAR.	4

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Reference	Study Type	Patients/ Events	Study Objective (Purpose of Study)	Study Results	Study Quality
58. Kubo S, Tadamura E, Yamamuro M, et al. Multidetector-row computed tomographic angiography of thoracic and abdominal aortic aneurysms: comparison of arterial enhancement with 3 different doses of contrast material. *J Comput Assist Tomogr.* 2007;31(3):422-429.	Experimental-Dx	115 total patients; 25 patients without AAA	To compare the quality of MDCTA in patients with and without aortic aneurysms by 3 different amounts of contrast media.	In group C, attenuation was lower in distal than those in proximal and middle areas (P<0.05). Contrast enhancement in abdominal aneurysmal lumen was more inhomogeneous in group C (P=0.003). Visual analysis showed contrast enhancement was more nonuniform in group C (P=0.004), and perivenous artifacts were more conspicuous in group A (P<0.0001). 75 mL contrast media followed by 20 mL saline flush can produce optimal contrast enhancement at systemic MDCTA in patients with aortic aneurysms.	2
59. Nonent M, Thouveny F, Simons P, et al. Iodixanol in multidetector-row computed tomography angiography (MDCTA): diagnostic accuracy for abdominal aorta and abdominal aortic major-branch diseases using four-, eight- and 16-detector-row CT scanners. *Acta Radiol.* 2007;48(1):48-58.	Observational-Dx	173 patients	To compare iodixanol-enhanced MDCTA with DSA, perioperative angiography, or surgical findings in the evaluation of the abdominal aorta and its main branches.	In 132/136 evaluable cases, MDCTA diagnosis matched the reference diagnosis, yielding an agreement rate of 97.1% (95% CI, 92.6%–99.2%). The quality of most MDCTA scans (147/173) was rated as excellent. Overall mean attenuation was 305.7 HU. MDCTA appeared more accurate than DSA for identification of lesion calcification, thrombus, irregularity, and ulceration. Tolerability of iodixanol was good, and no serious adverse events were reported. MDCTA using iodixanol is a promising, noninvasive alternative for evaluating patients with abdominal aortic disease.	3
60. Catalano C, Fraioli F, Laghi A, et al. Infrarenal aortic and lower-extremity arterial disease: diagnostic performance of multi-detector row CT angiography. *Radiology.* 2004;231(2):555-563.	Observational-Dx	50 patients	To compare MDCTA with DSA in evaluation of the infrarenal aorta and lower-extremity arterial system.	Substantial to almost perfect interobserver agreement was achieved in all cases. At DSA, 349 diseased segments were found among the 1,137 segments evaluated. Sensitivity, specificity, and accuracy, based on a consensus reading of MDCTA, were 96%, 93%, and 94%, respectively. A statistically significant difference (P<.05) between DSA and MDCTA was present only in arteries graded 1 or 2. Interobserver agreement was almost perfect among the 3 readers for treatment recommendations based on findings at CTA and DSA.	2

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Reference	Study Type	Patients/ Events	Study Objective (Purpose of Study)	Study Results	Study Quality
61. Ihara T, Komori K, Yamamoto K, Kobayashi M, Banno H, Kodama A. Three-dimensional workstation is useful for measuring the correct size of abdominal aortic aneurysm diameters. *Ann Vasc Surg*. 2013;27(2):154-161.	Review/Other-Dx	141 patients	To measure maximum major-axis diameters using a 3D workstation and compare them with the traditional maximum minor-axis diameters measured using thin-slice axial CT.	The mean traditional maximum minor-axis diameter was 51.2 +/- 8.2 mm, whereas the mean maximum major-axis diameter on curved multiplanar reconstruction images was 54.7 +/- 10.1 mm. 68 patients had a mean aneurysm size of <50 mm when measured by the traditional minor-axis diameter. Among these patients, 5 (7.4%) had a major-axis diameter >55 mm on curved multiplanar reconstruction images.	4
62. Ganten MK, Krautter U, von Tengg-Kobligk H, et al. Quantification of aortic distensibility in abdominal aortic aneurysm using ECG-gated multi-detector computed tomography. *Eur Radiol.* 2008;18(5):966-973.	Review/Other-Dx	67 patients	To detect distensibility changes that might be an indicator for an increased risk of rupture, cross-sectional area changes of AAA have been determined using ECG-gated CT.	The aorta could be segmented successfully in all patients. Upstream AAA distensibility D was significantly higher than at AAA level for both groups: means above AAA (at AAA) D(above)=(1.3+/-0.8) x 10(-5) Pa(-1) (D(AAA)=(0.6+/-0.5) x 10(-5) Pa(-1)) t-test *P*(D)<0.0001. Differences of the distensibility between smaller and larger aneurysms were not found to be significant. Distensibility can be measured noninvasively with ECG-gated CT. The reduction of distensibility within aneurysms compared to normal proximal aorta is subtle; the lack of difference between both small and large aneurysms suggests that this reduction occurs early in the aneurysm's development. Hence, reduced distensibility might be a predictive parameter in patients with high risk of aortic disease.	4

Reference	Study Type	Patients/ Events	Study Objective (Purpose of Study)	Study Results	Study Quality
63. Li ZY, Sadat U, J UK-I, et al. Association between aneurysm shoulder stress and abdominal aortic aneurysm expansion: a longitudinal follow-up study. *Circulation.* 2010;122(18):1815-1822.	Review/Other-Dx	44 patients with AAA	To evaluate the association between aneurysm shoulder stress and AAA expansion.	Slowly and rapidly expanding aneurysms had comparable baseline maximum diameters (median, 4.35 cm [IQR, 4.12 to 5.0 cm] vs 4.6 cm [IQR, 4.2 to 5.0 cm]; P=0.32). Rapidly expanding AAAs had significantly higher shoulder stresses than slowly expanding AAAs (median, 300 kPa [IQR, 280 to 320 kPa] vs 225 kPa [IQR, 211 to 249 kPa]; P=0.0001). A good correlation between shoulder stress at baseline and expansion rate was found (r=0.71; P=0.0001). A higher shoulder stress was found to have an association with a rapidly expanding AAA. Therefore, it may be useful for estimating the expansion of AAAs and improve risk stratification of patients with AAAs.	4
64. Speelman L, Hellenthal FA, Pulinx B, et al. The influence of wall stress on AAA growth and biomarkers. *Eur J Vasc Endovasc Surg.* 2010;39(4):410-416.	Review/Other-Dx	37 patients	To investigate the relation between AAA wall stress, AAA growth rate and biomarker concentrations.	A relative low AAA wall stress was associated with a lower aneurysm growth rate. Growth rate was also positively related to matrix metalloproteinase-9 plasma concentration (r=0.32). The average matrix metalloproteinase-9 and C-reactive protein concentrations increased with increasing degrees of relative wall stress, although the absolute and relative wall stress did not correlate with any of the biomarkers. Although lower relative wall stress was associated to a lower AAA growth rate, no relation was found between biomarker concentrations and wall stress. Future research may focus on more and extensive biomarker measurements in relation to AAA wall stress.	4

Pulsatile Abdominal Mass, Suspected Abdominal Aortic Aneurysm
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Reference	Study Type	Patients/ Events	Study Objective (Purpose of Study)	Study Results	Study Quality
65. Li ZY, J UK-I, Tang TY, Soh E, See TC, Gillard JH. Impact of calcification and intraluminal thrombus on the computed wall stresses of abdominal aortic aneurysm. *J Vasc Surg*. 2008;47(5):928-935.	Review/Other-Dx	20 patients	To evaluate the impact of calcification and intraluminal thrombus on the computed wall stresses of AAA.	Maximum stress was not correlated with the percentage of calcification, and was negatively correlated with the percentage of intraluminal thrombus (r = -0.56; *P*=.011). Exclusion of calcification from analysis led to a significant decrease in maximum stress by a median of 14% (range, 2%–27%; *P*<.01). When intraluminal thrombus was eliminated, maximum stress increased significantly by a median of 24% (range, 5%–43%; *P*<.01). The presence of calcification increases AAA peak wall stress, suggesting that calcification decrease the biomechanical stability of AAA. In contrast, intraluminal thrombus reduces the maximum stress in AAA. Calcification and intraluminal thrombus should both be considered in the evaluation of wall stress for risk assessment of AAA rupture.	4
66. Heng MS, Fagan MJ, Collier JW, Desai G, McCollum PT, Chetter IC. Peak wall stress measurement in elective and acute abdominal aortic aneurysms. *J Vasc Surg*. 2008;47(1):17-22; discussion 22.	Observational-Dx	70 patients	To investigate the interoperator and intraoperator reliability of finite element analysis in the calculation of peak wall stress in AAA and examine the variation in peak wall stress in elective and acute AAAs.	The intraclass correlation coefficient was 0.71 for interoperator reliability and 0.84 for intraoperator reliability. There was no statistically significant difference in the mean (SD) maximal AAA diameter between elective (6.47 [1.30] cm) and acute (7.08 [1.39] cm) patients (*P*=.073). The difference in peak wall stress between elective (0.67 [0.30] MPa) and acute (1.11 [0.51] MPa) patients (*P*=.008) was statistically significant, however. Interoperator and intraoperator reliability in the derivation of peak wall stress is acceptable. Peak wall stress, but not maximal diameter, was significantly higher in acute AAAs than in elective AAAs.	4

Reference	Study Type	Patients/ Events	Study Objective (Purpose of Study)	Study Results	Study Quality
67. Truijers M, Pol JA, Schultzekool LJ, van Sterkenburg SM, Fillinger MF, Blankensteijn JD. Wall stress analysis in small asymptomatic, symptomatic and ruptured abdominal aortic aneurysms. *Eur J Vasc Endovasc Surg.* 2007;33(4):401-407.	Observational-Dx	30 patients with small AAA; 10 asymptomatic; 10 symptomatic; 10 ruptured	To evaluate the potential of wall stress analysis for the identification of AAA at elevated risk of rupture in spite of small diameter.	No differences were observed in diameter between asymptomatic, symptomatic or ruptured aneurysms (5.1+/-0.2 cm vs 5.1+/-0.2 cm vs 5.3+/-0.2 cm. respectively; *P*=0.57). Peak aortic wall stress at maximal systolic blood pressure is significantly higher in ruptured than asymptomatic aneurysms (51.7+/-2.4 N/cm(2) vs 39.7+/-3.3 N/cm(2), respectively; *P*=0.04). Wall stress analysis at uniform blood pressure, performed to correct for higher blood pressure in the symptomatic and rupture group did not result in significant differences in peak wall stress (asymptomatic 31.7+/-2.3 N/cm(2); symptomatic 30.5+/-1.3 N/cm(2); rupture 36.7+/-4.0 N/cm(2); *P*=0.26). Wall stress analysis at maximal systolic blood pressure is a promising technique to detect aneurysms at elevated aneurysm rupture risk. Since no significant differences were found at uniform blood pressure, the need for adequate blood pressure control in aneurysm patients is reiterated.	4
68. Willmann JK, Lachat ML, von Smekal A, Turina MI, Pfammatter T. Spiral-CT angiography to assess feasibility of endovascular aneurysm repair in patients with ruptured aortoiliac aneurysm. *Vasa.* 2001;30(4):271-276.	Observational-Dx	24 patients with suspected rupture; 18 patients with ruptured AAA	To evaluate spiral CTA as a technique for assessing feasibility of EVAR in patients with ruptured aortoiliac aneurysm.	The mean acquisition time of the spiral-CT scan was 80 seconds (range 70 to 100 seconds), the mean overall procedure time, including image reconstruction, 5 minutes (range, 4 to 6 minutes). 2D images were directly evaluated during CT data acquisition, and 3D image reconstructions within 10 minutes (range, 8 to 11 minutes) after the spiral-CT scan. AAA rupture was assessed in 14/24 patients (58%): in 10/14 patients (71%) rupture was contained to the retroperitoneum, and in 4/14 patients (29%) intraperitoneal rupture was observed. Successful EVAR was performed in 6/14 patients (43%) with ruptured AAA, and in 8/10 patients (80%) without ruptured AAA. Open surgery was exclusively performed in 6/24 patients (25%) with inappropriate anatomy for EVAR and in 4/24 patients (17%) with intraperitoneal rupture.	3

Pulsatile Abdominal Mass, Suspected Abdominal Aortic Aneurysm
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Reference	Study Type	Patients/ Events	Study Objective (Purpose of Study)	Study Results	Study Quality
69. Pinho DF, Kulkarni NM, Krishnaraj A, Kalva SP, Sahani DV. Initial experience with single-source dual-energy CT abdominal angiography and comparison with single-energy CT angiography: image quality, enhancement, diagnosis and radiation dose. *Eur Radiol.* 2013;23(2):351-359.	Observational-Dx	35 patients	To assess image quality of virtual monochromatic spectral images, compared to single-energy CT, and to evaluate the feasibility of material density imaging in abdominal aortic disease.	Image quality and noise were better at 70 keV ($P<0.01$). Renal artery branch visualization was better at 50 keV ($P<0.005$). Attenuation and contrast-to-noise ratio were higher at 50 and 70 keV ($P<0.0001$). The material density water images had diagnostic quality but higher noise than true unenhanced images ($P<0.0001$). Radiation dose was lower using single-phase single-source dual-energy CT compared to dual-phase single-energy-CT ($P<0.0001$).	3
70. Atar E, Belenky A, Hadad M, Ranany E, Baytner S, Bachar GN. MR angiography for abdominal and thoracic aortic aneurysms: assessment before endovascular repair in patients with impaired renal function. *AJR Am J Roentgenol.* 2006;186(2):386-393.	Observational-Dx	19 patients	To establish the possibility of MRA as the main technique before endovascular repair and compare preprocedure measurements by MRA and DSA in patients with impaired renal function.	MRA is effective and reliable for use as the sole imaging method.	2
71. Michaely HJ, Herrmann KA, Kramer H, et al. High-resolution renal MRA: comparison of image quality and vessel depiction with different parallel imaging acceleration factors. *J Magn Reson Imaging.* 2006;24(1):95-100.	Observational-Dx	26 patients	To examine the image quality and vessel depiction of renal MRA with different parallel imaging acceleration factors.	Signal-to-noise decreased significantly with integrated parallel imaging techniques 3 in the phantom measurements. The 2 readers found no difference in noise, but significantly fewer artifacts with integrated parallel imaging techniques 3. The depiction of segmental vessels was significantly better for both readers with integrated parallel imaging techniques 3, and the subsegmental vessels were rated significantly better by 1 reader. Integrated parallel imaging techniques3 also resulted in a better inter-reader agreement.	2

Pulsatile Abdominal Mass, Suspected Abdominal Aortic Aneurysm
EVIDENCE TABLE

Reference	Study Type	Patients/ Events	Study Objective (Purpose of Study)	Study Results	Study Quality
72. Wolf F, Plank C, Beitzke D, et al. Prospective Evaluation of High-Resolution MRI Using Gadofosveset for Stent-Graft Planning: Comparison With CT Angiography in 30 Patients. *AJR Am J Roentgenol.* 2011;197(5):1251-1257.	Observational-Dx	30 consecutive patients	To compare high-resolution gadofosveset-enhanced MRA with the reference standard CTA in planning EVAR of AAA.	Diameter and length measurements showed small but significant differences (P<0.001) between MRA and CTA. Stent-graft selection according to these measurements showed 100% concordance between both modalities. Subjective imaging parameters showed significantly better results for CTA compared with MRA (P<0.001). In this study, MRA using a blood pool contrast agent has shown the ability to provide reliable and exact measurements before EVAR, allowing noninvasive planning of the intervention despite lower image-quality and without the disadvantages of ionizing radiation and nephrotoxicity.	2
73. Collidge TA, Thomson PC, Mark PB, et al. Gadolinium-enhanced MR imaging and nephrogenic systemic fibrosis: retrospective study of a renal replacement therapy cohort. *Radiology.* 2007;245(1):168-175.	Observational-Dx	1,826 patients	To retrospectively compare the frequency of administration and cumulative dose of gadolinium-based contrast agent in dialysis-dependent patients who did and those who did not develop nephrogenic systemic fibrosis.	14/1,826 patients had a diagnosis of nephrogenic systemic fibrosis. Mortality was similar for affected and nonaffected patients. 13 (93%) of 14 patients with nephrogenic systemic fibrosis had undergone gadolinium-enhanced MRI compared with 408 (22.5%) of 1,812 nonaffected patients (P<.001). Patients with nephrogenic systemic fibrosis received a higher median cumulative dose of gadodiamide (0.39 vs 0.23 mmol per kilogram of body weight, P=.008) and underwent more gadolinium-enhanced MRI than their nonaffected gadolinium-exposed counterparts.	4

Pulsatile Abdominal Mass, Suspected Abdominal Aortic Aneurysm
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Reference	Study Type	Patients/ Events	Study Objective (Purpose of Study)	Study Results	Study Quality
74. van 't Veer M, Buth J, Merkx M, et al. Biomechanical properties of abdominal aortic aneurysms assessed by simultaneously measured pressure and volume changes in humans. *J Vasc Surg*. 2008;48(6):1401-1407.	Observational-Dx	10 patients	To determine the compliance and distensibility of the AAA by simultaneous instantaneous pressure and volume measurements; to compare the influence of direct and indirect pressure measurements.	The AAA maximal diameter was 5.8 +/- 0.6 cm. A strong linear relation between the pressure and volume data was found. Distensibility was 1.8 +/- 0.7 x 10(-3) kPa(-1). Average compliance was 0.31 +/- 0.15 mL/kPa with accompanying estimates for Young's moduli of 9.0 +/- 2.5 MPa. Brachial cuff measurements demonstrated an underestimation of 5% for systolic (*P*<.001) and an overestimation of 12% for diastolic blood pressure (*P*<.001) compared with the pressure measured within the aneurysm. Distensibility and compliance of the wall of the aneurysm were determined in humans by simultaneous intra-aneurysmal pressure and volume measurements. A strong linear relationship existed between the intra-aneurysmal pressure and the volume change of the AAA. Brachial cuff measurements were significantly different compared with invasive intra-aneurysmal measurements. Consequently, no absolute distensibility values can be determined noninvasively.	3

Pulsatile Abdominal Mass, Suspected Abdominal Aortic Aneurysm
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Reference	Study Type	Patients/ Events	Study Objective (Purpose of Study)	Study Results	Study Quality
75. Harloff A, Nussbaumer A, Bauer S, et al. In vivo assessment of wall shear stress in the atherosclerotic aorta using flow-sensitive 4D MRI. *Magn Reson Med.* 2010;63(6):1529-1536.	Review/Other-Dx	62 patients; 31 healthy volunteers	To correlate atherogenic low wall shear stress and high oscillatory shear index with the localization of aortic plaques. Flow-sensitive 4D MRI was used to acquire 3D blood flow in the aorta of patients with proven aortic atherosclerosis and healthy volunteers.	Planewise analysis revealed a good correlation (r = 0.85) of individual low wall shear stress magnitude but not of high oscillatory shear index with plaque distribution. Although plaques occurred only rarely in the ascending aorta, the incidence of low wall shear stress magnitude and high oscillatory shear index was similar to findings in other aortic segments where plaques occurred more frequently. Case-by-case comparisons of plaque location and critical wall parameters revealed a shift of atherogenic wall shear stress magnitude (78% of all cases) and oscillatory shear index (91%) to wall segments adjacent to the atheroma. Results indicate that the predictive value of wall shear stress for plaque existence depends on the aortic segment and that locations of critical wall parameters move to neighboring segments of regions affected by atherosclerosis.	4
76. Hoornweg LL, Wisselink W, Vahl A, Balm R. The Amsterdam Acute Aneurysm Trial: suitability and application rate for endovascular repair of ruptured abdominal aortic aneurysms. *Eur J Vasc Endovasc Surg.* 2007;33(6):679-683.	Experimental-Dx	256	To evaluate anatomical suitability and application rate for endovascular repair of patients with a ruptured AAA.	In 128/256 patients, presenting with clinical suspicion of a ruptured aneurysm, ruptured AAA was diagnosed. 105 patients were brought to a trial center and CTA confirmed ruptured AAA in 83 patients. In 38/83 patients (45.8%) with positive CTA, the anatomy of the aorta and iliac arteries was considered suitable for endovascular repair. Exclusion from endovascular repair was due to unsuitable infrarenal neck or iliac anatomy (37 and 8 patients respectively). Overall, endovascular treatment was applicable in 38/128 patients (29.7%) with a ruptured AAA in the Amsterdam region and in 38 out of 105 patients (35.5%) admitted to the trial centers.	3

Pulsatile Abdominal Mass, Suspected Abdominal Aortic Aneurysm
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Reference	Study Type	Patients/ Events	Study Objective (Purpose of Study)	Study Results	Study Quality
77. Cho KJ. Carbon Dioxide Angiography: Scientific Principles and Practice. *Vasc Specialist Int.* 2015;31(3):67-80.	Review/Other-Dx	N/A	To discuss the scientific principles, techniques and practice of CO2 angiography.	Understanding of the unique physical properties of CO2 (high solubility, low viscosity, buoyancy, and compressibility) is essential in obtaining a successful CO2 angiogram and in guiding endovascular intervention. Unlike iodinated contrast material, CO2 displaces the blood and produces a negative contrast for digital subtraction imaging. Indications for use of CO2 as a contrast agent include: aortography and runoff, detection of bleeding, renal transplant arteriography, portal vein visualization with wedged hepatic venous injection, venography, arterial and venous interventions, and EVAR. CO2 should not be used in the thoracic aorta, the coronary artery, and cerebral circulation. Exploitation of CO2 properties, avoidance of air contamination and facile catheterization technique are important to the safe and effective performance of CO2 angiography and CO2-guided endovascular intervention.	4
78. Formosa A, Santos DM, Marcuzzi D, Common AA, Prabhudesai V. Low Contrast Dose Catheter-Directed CT Angiography (CCTA). *Cardiovasc Intervent Radiol.* 2016;39(4):606-610.	Review/Other-Dx	53 patients	To analyze a cohort who had catheter-directed CTA for 1 of 3 indications: access vessel suitability prior to transfemoral aortic valve implantation, preoperative assessment and planning for EVAR, and characterization of pelvic and lower extremity arteries in patients with peripheral vascular disease.	We show that catheter-directed CTA can image vasculature with adequate diagnostic detail to allow assessment of lower extremity disease, anatomic suitability for EVAR, as well as potential contraindications to transfemoral aortic valve implantation. Average contrast volumes for pre-transfemoral aortic valve implantation, pre-EVAR, and peripheral vascular disease cases were 7, 11, and 28 mL, respectively.	4

Reference	Study Type	Patients/ Events	Study Objective (Purpose of Study)	Study Results	Study Quality
79. Isaacson AJ, Burke LM, Vallabhaneni R, Farber MA. Ultralow Iodine Dose Transarterial Catheter-Directed CT Angiography for Fenestrated Endovascular Aortic Repair Planning. *Ann Vasc Surg.* 2016.	Review/Other-Dx	8 patients	To describe the results of the first 8 patients who underwent transarterial catheter-directed-CTA using ultralow iodine contrast dose.	The mean serum creatinine before transarterial catheter-directed-CTA was 2.1 +/- .32 mg/dL, and the mean estimated glomerular filtration rate was 29.7 +/- 6.31 mL/min/1.73 m2. After transarterial catheter-directed-CTA, the mean serum creatinine was 1.9 +/- .25 mg/dL and the mean estimated glomerular filtration rate was 32.9 +/- 5.12 mL/min/1.73 m2. All 8 of the studies were determined to be adequate for fenestrated EVAR planning independently by 2 vascular surgeons. 6 of the patients underwent successful fenestrated EVAR and 2 opted for watchful waiting.	4
80. Kotze CW, Menezes LJ, Endozo R, Groves AM, Ell PJ, Yusuf SW. Increased metabolic activity in abdominal aortic aneurysm detected by 18F-fluorodeoxyglucose (18F-FDG) positron emission tomography/computed tomography (PET/CT). *Eur J Vasc Endovasc Surg.* 2009;38(1):93-99.	Review/Other-Dx	14 patients	To detect increased metabolic activity in the wall of the AAA with FDG, mediated by glucose transporter protein, using a dedicated hybrid PET/64-detector CT.	The mean aneurysm diameter was 5.4 cm (SD+/-0.8). 2 aneurysms had the CT characteristics of inflammatory aneurysms. 12 aneurysms showed increased FDG uptake (SUV(max)>2.5). There was no significant difference in FDG uptake between heavily calcified aneurysms and non-heavily calcified aneurysms (t-test). There was a significant increase in the FDG uptake in the 2 inflammatory aneurysms compared to the other 12 aneurysms (t-test; *P*=0.04). The findings in this study offer in vivo evidence that the AAA wall shows increased glucose metabolism, mediated by the glucose transporter proteins: this increased metabolic activity as detected by PET/CT may be present in most AAAs.	4
81. Truijers M, Kurvers HA, Bredie SJ, Oyen WJ, Blankensteijn JD. In vivo imaging of abdominal aortic aneurysms: increased FDG uptake suggests inflammation in the aneurysm wall. *J Endovasc Ther.* 2008;15(4):462-467.	Observational-Dx	34 patients; 17 with AAA; 17 controls	To study the potential of integrated PET/CT to identify aneurysm wall inflammation.	AAAs showed significantly higher FDG uptake than the normal-sized aorta in age-matched controls (SUV 2.52+/-0.52 vs 1.78+/-0.45, respectively; *P*<0.001). The level of FDG uptake did not correlate with maximal aneurysm diameter (r=0.09; 95% CI -0.42 to 0.56; *P*=0.7). FDG-PET/CT is a promising technique to identify inflammation of the aneurysm wall. Irrespective of aneurysm diameter, asymptomatic AAAs show more FDG uptake and more inflammatory activity in the wall than the non-dilated abdominal aorta of sex/age-matched controls.	4

Pulsatile Abdominal Mass, Suspected Abdominal Aortic Aneurysm
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Reference	Study Type	Patients/ Events	Study Objective (Purpose of Study)	Study Results	Study Quality
82. Reeps C, Essler M, Pelisek J, Seidl S, Eckstein HH, Krause BJ. Increased 18F-fluorodeoxyglucose uptake in abdominal aortic aneurysms in positron emission/computed tomography is associated with inflammation, aortic wall instability, and acute symptoms. *J Vasc Surg*. 2008;48(2):417-423; discussion 424.	Review/Other-Dx	15 patients; 12 asymptomatic; 3 symptomatic AAA	To analyze the histopathologic changes in AAA wall correlated with increased FDG uptake for further implications on aortic wall stability and AAA rupture risk.	Symptomatic AAA showed significantly increased FDG uptake compared with asymptomatic AAA (SUV(max), 3.5 +/- 0.6 vs 7.5 +/- 3; *P*<.001). Thus, increased FDG uptake was correlated with higher densities of inflammatory infiltrates (r = +0.87, *P*<.01) and macrophage and T-cell infiltrations (r = +0.95, *P*<.01 and r = +0.66, *P*<.05), with higher matrix metalloproteinase-9 expressions (r = +0.86; *P*<.01), and with reduction of collagen fiber (r = -0.76; *P*<.01) and vascular smooth muscle cells (r = -0.71; *P*<.01). Consecutive correlations were found for total inflammatory infiltrates, T lymphocytes, and macrophages with matrix metalloproteinase-9 expression (r = +0.79, +0.79 and +0.74; *P*<.01). Moreover, matrix metalloproteinase-9 expression was correlated with decreasing collagen fiber content (r = -0.53, *P*<.05) and vascular smooth muscle cell density (r = -0.57, *P*<.05). Maximum aortic FDG uptake correlated significantly with inflammation, followed by increased matrix metalloproteinase expression and histopathologic characteristics of aneurysm wall instability and clinical symptoms.	4
83. Murakami M, Morikage N, Samura M, Yamashita O, Suehiro K, Hamano K. Fluorine-18-fluorodeoxyglucose positron emission tomography-computed tomography for diagnosis of infected aortic aneurysms. *Ann Vasc Surg*. 2014;28(3):575-578.	Review/Other-Dx	11 cases	To examine the usefulness of FDG-PET/CT in the diagnosis of infected aneurysms in suspected cases (based on clinical symptoms, CT findings, and presence of inflammatory markers in the blood such as white blood cells and C-reactive protein) of infected aortic aneurysms.	Patients with a final diagnosis of infected aortic aneurysms showed a SUVmax of >4.46, whereas infection-free cases had an SUVmax of <2.59 (mean 6.5 +/- 1.8 vs. 1.9 +/- 0.5; *P*<0.001).	4

Pulsatile Abdominal Mass, Suspected Abdominal Aortic Aneurysm
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Reference	Study Type	Patients/ Events	Study Objective (Purpose of Study)	Study Results	Study Quality
84. Xu XY, Borghi A, Nchimi A, et al. High levels of 18F-FDG uptake in aortic aneurysm wall are associated with high wall stress. *Eur J Vasc Endovasc Surg.* 2010;39(3):295-301.	Review/Other-Dx	5 patients	To evaluate the association between wall stress and levels of metabolic activities in aneurysms of the descending thoracic and abdominal aorta.	The distribution of wall stress in the aneurysm wall was highly nonuniform depending on the individual geometry. Predicted high wall stress regions co-localized with areas of positive FDG uptake in all 5 patients examined. In the 2 ruptured cases, the locations of rupture corresponded well with regions of elevated metabolic activity and high wall stress. These preliminary observations point to a potential link between high wall stress and accelerated metabolism in aortic aneurysm wall and warrant further large population-based studies.	4

Evidence Table Key

Study Quality Category Definitions

- *Category 1* The study is well-designed and accounts for common biases.
- *Category 2* The study is moderately well-designed and accounts for most common biases.
- *Category 3* There are important study design limitations.
- *Category 4* The study is not useful as primary evidence. The article may not be a clinical study or the study design is invalid, or conclusions are based on expert consensus. For example:
  - a) the study does not meet the criteria for or is not a hypothesis-based clinical study (e.g., a book chapter or case report or case series description);
  - b) the study may synthesize and draw conclusions about several studies such as a literature review article or book chapter but is not primary evidence;
  - c) the study is an expert opinion or consensus document.
- M = Meta-analysis

Dx = Diagnostic

Tx = Treatment

Abbreviations Key

AAA = Abdominal aortic aneurysm

CI = Confidence interval

CT = Computed tomography

CTA = Computed tomography angiography

DSA = Digital-subtraction angiography

ECG = Electrocardiogram

EVAR = Endovascular aneurysm repair

FDG-PET = Fluorine-18-2-fluoro-2-deoxy-D-glucose-positron emission tomography

IQR = Interquartile range

MDCTA= Multidetector computed tomography angiography

MPR = Multiplanar reformations

MRA = Magnetic resonance angiography

MRI = Magnetic resonance imaging

NPV = Negative predictive value

OR = Odds ratio

PPV = Positive predictive value

RR = Relative risk

SD = Standard deviation

SUV = Standardized uptake value

TTE = Transthoracic echocardiography

US = Ultrasound