

**Suspected Infective Endocarditis
EVIDENCE TABLE**

Reference	Study Type	Patients/ Events	Study Objective (Purpose of Study)	Study Results	Study Quality
1. Cecchi E, Imazio M, Tidu M, et al. Infective endocarditis in drug addicts: role of HIV infection and the diagnostic accuracy of Duke criteria. <i>J Cardiovasc Med (Hagerstown)</i> . 2007;8(3):169-175.	Observational-Dx	201 consecutive patients (102 patients with HIV infection and 99 patients without HIV infection)	To compare prospectively the clinical features of patients with infective endocarditis with or without HIV infection and to evaluate the diagnostic accuracy of Duke criteria in intravenous drug users.	Infective endocarditis was the final diagnosis in 40/102 patients (38.2%) with HIV infection and in 55/99 HIV-negative patients (55.6%). Despite similar baseline features, longer vegetations were recorded in infective endocarditis without HIV infection (23.7 +/- 7.1 mm vs 13.6 +/- 6.8 mm; P=0.001). Patients with infective endocarditis and HIV infection had a higher total mortality at 2 months (respectively 12.5% vs 1.8%; P=0.09); almost all the deaths were recorded in patients with AIDS or a CD4 cell count below 200/mL, and no deaths were recorded in patients with HIV infection and a CD4 cell count >500/mL. Despite no identical clinical features, Duke criteria had a similar sensitivity, specificity and diagnostic accuracy in intravenous drug users with and without HIV infection.	3
2. Haldar SM, O'Gara PT. Infective endocarditis: diagnosis and management. <i>Nat Clin Pract Cardiovasc Med</i> . 2006;3(6):310-317.	Review/Other-Dx	N/A	Review diagnostic approaches for infective endocarditis, particularly echocardiography, and provide recommendations for treatment, emphasizing surgery in the acute setting.	Use of an integrated diagnostic schema, such as the modified Duke criteria, is useful. TTE and TEE should be performed promptly for all suspected infective endocarditis cases. Approach to imaging should be tailored to the individual's clinical situation.	4
3. Anguera I, Miro JM, Evangelista A, et al. Periannular complications in infective endocarditis involving native aortic valves. <i>Am J Cardiol</i> . 2006;98(9):1254-1260.	Review/Other-Dx	201 patients (46 with aortocavitary fistulization and 155 with nonruptured abscesses)	Retrospective multicenter descriptive study to determine the distinct clinical characteristics of patients with aortocavitary fistulae and nonruptured abscesses in native valve infective endocarditis and to evaluate the impact of fistulization on the outcomes of patients with native aortic valve infective endocarditis complicated with periannular lesions.	Actuarial 5-year survival rate in surgical survivors was 80% in patients with fistulae and 92% in patients with nonruptured abscesses (log-rank P=0.6). Aortocavitary fistulous tract formation in the setting of native valve infective endocarditis is associated with higher rates of heart failure, ventricular septal defect, and atrioventricular block than nonruptured abscess.	4

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4. Anguera I, Miro JM, San Roman JA, et al. Periannular complications in infective endocarditis involving prosthetic aortic valves. <i>Am J Cardiol.</i> 2006;98(9):1261-1268.	Review/Other-Dx	150 patients	To determine the distinctive clinical characteristics of patients with PVE and either aortocavitory fistulization or nonruptured abscesses.	Early-onset PVE was present in 73 patients (49%). Rates of heart failure (P=0.09), ventricular septal defect (P<0.01), and third-degree atrioventricular block (P=0.07) were higher in patients with fistulization. Surgical treatment was undertaken in 128 patients (83%). In-hospital mortality in the overall population was 39%. Multivariate analysis identified heart failure (OR 3.3, 95% CI; 1.6 to 6.8), renal failure (OR 2.5, 95% CI; 1.2 to 5.2), and co-morbidity (OR 2.4, 95% CI; 1.1 to 5.1) as independent risk factors for death. Fistulous tract formation was not associated with increased in-hospital mortality (OR 1.6, 95% CI; 0.7 to 3.7). The actuarial 5-year survival rate in surgical survivors was 100% in patients with fistulae and 78% in patients with nonruptured abscesses (log-rank P=0.14).	4
5. Baddour LM, Wilson WR, Bayer AS, et al. Infective endocarditis: diagnosis, antimicrobial therapy, and management of complications: a statement for healthcare professionals from the Committee on Rheumatic Fever, Endocarditis, and Kawasaki Disease, Council on Cardiovascular Disease in the Young, and the Councils on Clinical Cardiology, Stroke, and Cardiovascular Surgery and Anesthesia, American Heart Association: endorsed by the Infectious Diseases Society of America. <i>Circulation.</i> 2005;111(23):e394-434.	Review/Other-Dx	N/A	To represent the third iteration of an infective endocarditis “treatment” document developed by the American Heart Association under the auspices of the Committee on Rheumatic Fever, Endocarditis, and Kawasaki Disease, Council on Cardiovascular Disease of the Young to update recommendations for diagnosis, treatment, and management of complications of infective endocarditis.	The recommendations outlined in this update should assist physicians in all aspects of patient care in the diagnosis, medical and surgical treatment, and follow-up of infective endocarditis, as well as management of associated complications. Clinical variability and complexity in infective endocarditis, however, dictate that these guidelines be used to support and not supplant physician-directed decisions in individual patient management.	4

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6. Habib G, Badano L, Tribouilloy C, et al. Recommendations for the practice of echocardiography in infective endocarditis. <i>Eur J Echocardiogr.</i> 2010;11(2):202-219.	Review/Other-Dx	N/A	Recommendations for the practice of echocardiography in infective endocarditis to provide both an updated summary concerning the value and limitations of echocardiography in infective endocarditis, and clear and simple recommendations for the optimal use of both TTE and TEE in infective endocarditis, assisting health care providers in clinical decision-making.	Echocardiography plays a key role in infective endocarditis, concerning its diagnosis, the diagnosis of its complications, its follow-up under therapy, and its prognostic assessment. Echocardiography is particularly useful for the initial assessment of embolic risk and in decision-making in infective endocarditis. Transesophageal echocardiography plays a major role both before surgery and during surgery (intraoperative echocardiography). Echocardiographic results must be taken into consideration for both the decision to operate patients or not and the choice of the optimal timing for surgery. Recent advances in 3-D imaging offer additional importance to the echographic evaluation of patients with infective endocarditis. In all cases, however, the results of echocardiographic studies may be interpreted taking into account the clinical features of the patient.	4
7. Durack DT, Lukes AS, Bright DK. New criteria for diagnosis of infective endocarditis: utilization of specific echocardiographic findings. Duke Endocarditis Service. <i>Am J Med.</i> 1994;96(3):200-209.	Review/Other-Dx	353 patients	To compare new criteria including echocardiographic findings with older clinical criteria for establishing the diagnosis of infective endocarditis.	Newer criteria using echocardiographic findings were significantly better for establishing diagnosis (80% vs 51%, P<0.001) in 69 pathologically proven cases.	4
8. Aly AM, Simpson PM, Humes RA. The role of transthoracic echocardiography in the diagnosis of infective endocarditis in children. <i>Arch Pediatr Adolesc Med.</i> 1999;153(9):950-954.	Observational-Dx	173 consecutive patients	Retrospective review to determine the usefulness of TEE in children with high clinical suspicion of infective bacterial endocarditis.	TEE has poor sensitivity as a screening test for infective bacterial endocarditis in patients with low clinical probability.	3
9. Harris KM, Li DY, L'Ecuyer P, et al. The prospective role of transesophageal echocardiography in the diagnosis and management of patients with suspected infective endocarditis. <i>Echocardiography.</i> 2003;20(1):57-62.	Observational-Dx	43 consecutive patients	To examine the prospective role of TEE for the diagnosis and management of infective endocarditis. The results of TEE were compared to a clinical evaluation by an infectious disease specialist in patients in whom TEE was ordered to rule out infective endocarditis.	TEE positive in 11 patients, negative in 29, and indeterminate in 3. TEE positive in 6 (46%) of 13 high probability patients, 2 (67%) of medium probability patients, and 3 (11%) of 27 low probability patients. TEE only useful in high probability patients.	2

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10. San Roman JA, Vilacosta I, Lopez J, et al. Role of transthoracic and transesophageal echocardiography in right-sided endocarditis: one echocardiographic modality does not fit all. <i>J Am Soc Echocardiogr.</i> 2012;25(8):807-814.	Review/Other-Dx	N/A	To describe the differences between right-sided endocarditis and left-sided endocarditis and the different types of right-sided endocarditis according to the types of patients who have the disease.	No results stated in abstract.	4
11. Hill EE, Herijgers P, Claus P, Vanderschueren S, Peetermans WE, Herregods MC. Abscess in infective endocarditis: the value of transesophageal echocardiography and outcome: a 5-year study. <i>Am Heart J.</i> 2007;154(5):923-928.	Observational-Dx	115 patients	Prospective observational cohort study of patients with definite infective endocarditis according to the modified Duke criteria to analyze the: value of TEE in detecting abscess, predictors of abscess formation, outcome in patients with abscess formation in a contemporary patient population over a 5-year period.	Abscess was found perioperatively in 44 patients (38%). 21 abscesses (48%) were detected by TEE. Detection of abscess by TEE seemed to be underestimated. In most cases, abscess was missed in the presence of calcification in the posterior mitral annulus. Age, abscess, and staphylococcal infection predicted 6-month mortality. Early surgery may improve outcome in patients with an abscess.	3
12. Law A, Honos G, Huynh T. Negative predictive value of multiplane transesophageal echocardiography in the diagnosis of infective endocarditis. <i>Eur J Echocardiogr.</i> 2004;5(6):416-421.	Observational-Dx	83 consecutive patients; 2 independent reviewers	Analysis of data from echocardiography databases to determine the NPV of a negative TEE in patients with suspected infective endocarditis.	Calculated NPV of multiplane TEE in infective endocarditis was 98.6% if only the case of “definite infective endocarditis” is considered. NPV of multiplane TEE was 87.8% with assumption that all patients with “possible infective endocarditis” had the disease. TEE has an excellent NPV for ruling out infective endocarditis.	3
13. Thuny F, Di Salvo G, Belliard O, et al. Risk of embolism and death in infective endocarditis: prognostic value of echocardiography: a prospective multicenter study. <i>Circulation.</i> 2005;112(1):69-75.	Observational-Dx	384 consecutive patients; 2 blinded reviewers	Prospective multicenter study of patients with a definite diagnosis of infective endocarditis by current diagnostic criteria in the contemporary era, with systematic use of TEE, to assess the predictive value of clinical and echocardiographic parameters on the subsequent risk of embolism and death.	One-year mortality was 20.6%. In multivariable analysis, independently of the other predictors of death (age, female sex, creatinine serum >2 mg/L, moderate or severe congestive heart failure, and S aureus) and comorbidity, vegetation length >15 mm was a predictor of 1-year mortality (adjusted relative risk=1.8; 95% CI, 1.10 to 2.82; P=0.02).	3

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14. Vieira ML, Grinberg M, Pomerantzeff PM, Andrade JL, Mansur AJ. Repeated echocardiographic examinations of patients with suspected infective endocarditis. <i>Heart</i> . 2004;90(9):1020-1024.	Observational-Dx	262 patients with 266 episodes of suspected infective endocarditis	Prospective cohort study to evaluate the frequency and diagnostic yield of repeated TTE and TEE of patients with suspected infective endocarditis.	TTE examinations were repeated in 192 (72.2%) and TEE examinations were repeated in 49 (18.4%) of 266 episodes. A mean of 2.4 TTE and 1.2 TEE examinations were performed for each episode of suspected endocarditis. The second and third TTEs added diagnostic information in 34 (26.7%) and the second and third TEE added diagnostic information in 25 (19.7%) of 127 episodes with definite endocarditis. No additional diagnostic information was obtained after the third TTE or TEE. The usefulness of repeated TTE decreases with the number of repetitions.	3
15. Heidenreich PA, Masoudi FA, Maini B, et al. Echocardiography in patients with suspected endocarditis: a cost-effectiveness analysis. <i>Am J Med</i> . 1999;107(3):198-208.	Review/Other-Dx	N/A	To determine the cost-effectiveness of TEE in patients with suspected endocarditis. A decision tree and Markov model using published data to simulate the outcomes and a cost of care was used.	TEE is cost-effective for patients with a prior probability of endocarditis that is observed commonly in clinical practice. It is not effective with prior very low or high probability.	4
16. Cheitlin MD, Armstrong WF, Aurigemma GP, et al. ACC/AHA/ASE 2003 guideline update for the clinical application of echocardiography: summary article: a report of the American College of Cardiology/American Heart Association Task Force on Practice Guidelines (ACC/AHA/ASE Committee to Update the 1997 Guidelines for the Clinical Application of Echocardiography). <i>Circulation</i> . 2003;108(9):1146-1162.	Review/Other-Dx	N/A	Guidelines for the use of echocardiography in both adult and pediatric patients.	No results stated in abstract.	4
17. Cerqueira MD, Jacobson AF. Indium-111 leukocyte scintigraphic detection of myocardial abscess formation in patients with endocarditis. <i>J Nucl Med</i> . 1989;30(5):703-706.	Review/Other-Dx	3 patients	To show the effectiveness of radiolabeled leukocytes for demonstrating myocardial abscess.	Myocardial abscesses were demonstrated in three patients with nondiagnostic echocardiograms.	4
18. Gratz S, Raddatz D, Hagenah G, Behr T, Behe M, Becker W. 99mTc-labelled antigranulocyte monoclonal antibody FAB' fragments versus echocardiography in the diagnosis of subacute infective endocarditis. <i>Int J Cardiol</i> . 2000;75(1):75-84.	Review/Other-Dx	24 consecutive patients	To determine usefulness of immunoscintigraphy with a novel antigranulocyte antibody in endocarditis. 99mTc-Fab' and echocardiography were used in patients with suspected endocarditis.	The investigative compound in combination with TEE improves diagnostic accuracy compared with TTE/TEE in patients with subacute infective endocarditis.	4

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19. Morguet AJ, Munz DL, Ivancevic V, et al. Immunoscintigraphy using technetium-99m-labeled anti-NCA-95 antigranulocyte antibodies as an adjunct to echocardiography in subacute infective endocarditis. <i>J Am Coll Cardiol.</i> 1994;23(5):1171-1178.	Observational-Dx	72 consecutive patients	To assess the clinical value of immunoscintigraphy for the diagnosis of bacterial endocarditis.	Immunoscintigraphy had a sensitivity of 79% and specificity of 82% compared to echocardiography with a sensitivity of 88% and a specificity of 97%. The combination of echocardiography and immunoscintigraphy had a sensitivity of 100% and specificity of 82%.	3
20. Munz DL, Morguet AJ, Sandrock D, et al. Radioimmunoimaging of subacute infective endocarditis using a technetium-99m monoclonal granulocyte-specific antibody. <i>Eur J Nucl Med.</i> 1991;18(12):977-980.	Review/Other-Dx	20 patients; 6 controls	Comparison of immunoscintigraphy with echocardiography for localizing infective endocarditis in 20 suspected patients and 6 normal's.	Both made localization in 11/15 patients with confirmation of the disease. Immunoscintigraphy was positive in 4 patients with false negative echo; whereas, echo was correct in 4 patients with false negative immunoscintigraphy.	4
21. Bonfiglioli R, Nanni C, Morigi JJ, et al. (18)F-FDG PET/CT diagnosis of unexpected extracardiac septic embolisms in patients with suspected cardiac endocarditis. <i>Eur J Nucl Med Mol Imaging.</i> 2013;40(8):1190-1196.	Observational-Dx	71 patients	To assess the added value of FDG-PET/CT in the detection of extracardiac embolisms in the evaluation of patients with suspected valvular endocarditis.	Of the 71 patients with suspicion of infective endocarditis, we found unexpected extracardiac findings in 17 patients (24%) without any clinical suspicion. Extracardiac findings were subsequently evaluated with other imaging procedures.	3
22. Vind SH, Hess S. Possible role of PET/CT in infective endocarditis. <i>J Nucl Cardiol.</i> 2010;17(3):516-519.	Review/Other-Dx	2 patients	To present 2 cases of IE with negative echocardiographies in which PET/CT scans could confirm the suspected IE, as well as rule out any extra cardiac sites of infection.	No results stated in abstract.	4
23. Yen RF, Chen YC, Wu YW, Pan MH, Chang SC. Using 18-fluoro-2-deoxyglucose positron emission tomography in detecting infectious endocarditis/endoarteritis: a preliminary report. <i>Acad Radiol.</i> 2004;11(3):316-321.	Review/Other-Dx	6 patients	To evaluate the effectiveness of FDG-PET in the detection of infectious endocarditis/endoarteritis.	For all 6 patients, we also found increased FDG uptakes in the corresponding areas detected in echocardiography.	4

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24. Saby L, Laas O, Habib G, et al. Positron emission tomography/computed tomography for diagnosis of prosthetic valve endocarditis: increased valvular 18F-fluorodeoxyglucose uptake as a novel major criterion. <i>J Am Coll Cardiol.</i> 2013;61(23):2374-2382.	Observational-Dx	72 consecutive patients	To determine the value of FDG-PET/CT for diagnosing PVE.	36 patients (50%) exhibited abnormal FDG uptake around the site of the prosthetic valve. The sensitivity, specificity, PPV, NPV, and global accuracy were as follows (95% CI): 73% (54% to 87%), 80% (56% to 93%), 85% (64% to 95%), 67% (45% to 84%), and 76% (63% to 86%), respectively. Adding abnormal FDG uptake around the prosthetic valve as a new major criterion significantly increased the sensitivity of the modified Duke criteria at admission (70% [52% to 83%] vs 97% [83% to 99%], P=0.008). This result was due to a significant reduction (P<0.0001) in the number of possible PVE cases from 40 (56%) to 23 (32%).	2
25. Kouijzer IJ, Vos FJ, Janssen MJ, van Dijk AP, Oyen WJ, Bleeker-Rovers CP. The value of 18F-FDG PET/CT in diagnosing infectious endocarditis. <i>Eur J Nucl Med Mol Imaging.</i> 2013;40(7):1102-1107.	Observational-Dx	72 patients	To investigate the utility of FDG-PET/CT to diagnose infectious endocarditis in patients with gram-positive bacteraemia.	Sensitivity for diagnosing infectious endocarditis with FDG-PET/CT was 39% and specificity was 93%. The PPV was 64% and NPV was 82%. The mortality rate in patients without infectious endocarditis and without increased FDG uptake in or around the heart valves was 18%, and in patients without infectious endocarditis but with high FDG uptake in or around the heart valves the mortality rate was 50% (P=0.181).	2
26. Harris KM, Ang E, Lesser JR, Sonnesyn SW. Cardiac magnetic resonance imaging for detection of an abscess associated with prosthetic valve endocarditis: a case report. <i>Heart Surg Forum.</i> 2007;10(3):E186-187.	Review/Other-Dx	1 patient	A case report of a patient with a febrile illness and prosthetic aortic valve suspected of having infectious endocarditis.	MRI was useful in defining a paravalvular abscess associated with PVE due to propionibacterium acnes that was then successfully surgically repaired.	4
27. Higgins CB, Sakuma H. Heart disease: functional evaluation with MR imaging. <i>Radiology.</i> 1996;199(2):307-315.	Review/Other-Dx	N/A	Review of the methods and results of cine MRI and velocity-encoded MRI for evaluating cardiac function.	Cine MRI and velocity-encoded cine MRI are effective for grading the severity and quantization of the volume of valvular regurgitation respectively.	4

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28. Fagman E, Perrotta S, Bech-Hanssen O, et al. ECG-gated computed tomography: a new role for patients with suspected aortic prosthetic valve endocarditis. <i>Eur Radiol.</i> 2012;22(11):2407-2414.	Observational-Dx	27 patients	To investigate the agreement in findings between ECG-gated CT and TEE in patients with aortic PVE.	TEE suggested the presence of PVE in all patients [thickened aortic wall (n = 17), vegetation (n = 13), abscess (n = 16), valvular dehiscence (n = 10)]. ECG-gated CT was positive in 25 patients (93 %) [thickened aortic wall (n = 19), vegetation (n = 7), abscess (n = 18), valvular dehiscence (n = 7)]. The strength of agreement [kappa (95 % CI)] between ECG-gated CT and TEE was very good for thickened wall [0.83 (0.62–1.0)], good for abscess [0.68 (0.40–0.97)] and dehiscence [0.75 (0.48–1.0)], and moderate for vegetation [0.55 (0.26–0.88)]. The agreement was good between surgical findings (abscess, vegetation and dehiscence) and imaging for ECG-gated CT [0.66 (0.49–0.87)] and TEE [0.79 (0.62–0.96)] and very good for the combination of ECG-gated CT and TEE [0.88 (0.74–1.0)].	3
29. Gahide G, Bommart S, Demaria R, et al. Preoperative evaluation in aortic endocarditis: findings on cardiac CT. <i>AJR Am J Roentgenol.</i> 2010;194(3):574-578.	Observational-Dx	19 patients	To study the feasibility and diagnostic capability of preoperative cardiac CT for depicting aortic valvular pseudoaneurysms and vegetations in patients referred for aortic endocarditis requiring surgical intervention.	During a 4-year period, 19 consecutive patients (18 men and one woman) were included (mean age +/- SD, 55 +/- 13 years). Results are expressed on a per-patient basis. The sensitivity, specificity, PPV, and NPV of MDCT in depicting aortic valve pseudoaneurysms were 100%, 87.5%, 91.7%, and 100%, respectively. The sensitivity, specificity, PPV, and NPV of the MDCT in depicting the extension of the aortic valve pseudoaneurysms into the intervalvular fibrous body were each 100%. The sensitivity, specificity, PPV, and NPV of MDCT in depicting aortic valve vegetations were 71.4%, 100%, 100%, and 55.5%, respectively. The sensitivity, specificity, PPV, and NPV of MDCT for depicting aortic valve vegetations larger than 1 cm were all 100%.	2

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30. Feuchtner GM, Stolzmann P, Dichtl W, et al. Multislice computed tomography in infective endocarditis: comparison with transesophageal echocardiography and intraoperative findings. <i>J Am Coll Cardiol.</i> 2009;53(5):436-444.	Observational-Dx	37 consecutive patients	To determine the value of multislice CT for the assessment of valvular abnormalities compared with TEE and intraoperative findings in patients with infective endocarditis.	CT had sensitivity 97%, specificity 88%, PPV 97%, and NPV 88% on a per-patient basis (n = 37; excellent intermodality agreement kappa = 0.84). CT correctly identified 26/27 (96%) patients with valvular vegetations and 9/9 (100%) patients with abscesses/pseudoaneurysms compared with the intraoperative specimen. On a per-valve-based analysis, diagnostic accuracy for the detection of vegetations and abscesses/pseudoaneurysms compared with surgery was: sensitivity 96%, specificity 97%, PPV 96%, NPV 97%, and sensitivity 100%, specificity 100%, PPV 100%, NPV 100%, respectively. Multislice CT shows good results in detecting valvular abnormalities in infective endocarditis and could be applied in preoperative planning and exclusion of coronary artery disease before surgery.	2
31. Symersky P, Budde RP, de Mol BA, Prokop M. Comparison of multidetector-row computed tomography to echocardiography and fluoroscopy for evaluation of patients with mechanical prosthetic valve obstruction. <i>Am J Cardiol.</i> 2009;104(8):1128-1134.	Review/Other-Dx	13 consecutive patients with 15 prosthetic valves; 2 reviewers	Retrospective study to evaluate whether MDCT imaging could detect the morphologic substrate for functional abnormalities by comparing MDCT to echocardiography and fluoroscopy.	MDCT detected leaflet motion restriction in 7 patients compared to 4 by fluoroscopy. Confirmation of leaflet restriction was available in 5 patients. MDCT missed a periprosthetic leak. MDCT can identify causes of prosthetic valve obstruction that constitute indications for surgery but are missed at echocardiography or fluoroscopy.	4
32. Akhtar NJ, Markowitz AH, Gilkeson RC. Multidetector computed tomography in the preoperative assessment of cardiac surgery patients. <i>Radiol Clin North Am.</i> 2010;48(1):117-139.	Review/Other-Dx	N/A	To illustrate and discuss the importance of preoperative MDCT imaging in the preoperative evaluation of cardiac surgical patients.	The expanding imaging capabilities of MDCT have made it an important part of the preoperative assessment of the cardiac surgery patient. Ever decreasing imaging times, superior spatial resolution, and the 3D capabilities of MDCT improve diagnosis and enhance surgical planning. Understanding the imaging advantages of MDCT enable improved outcomes in this important patient population.	4
33. Rybicki FJ, Sheth T, Chen FY. Cardiac Surgical Imaging. In: Cohn L, ed. <i>Cardiac Surgery in the Adult</i> . 3rd ed. New York: McGraw-Hill; 2008:179-198.	Review/Other-Dx	N/A	Book chapter.	Book chapter.	4

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34. Gerber TC, Kantor B, McCollough CH. Radiation dose and safety in cardiac computed tomography. <i>Cardiol Clin.</i> 2009;27(4):665-677.	Review/Other-Dx	N/A	To review the existing data regarding biologic hazards of radiation exposure associated with medical diagnostic testing, the methodologies used to estimate radiation exposure and dose, and the measures that can be taken to effectively reduce that exposure.	The risk of causing a malignancy at the radiation dose levels used in cardiac imaging is hypothetical, not proven, and estimates of radiation dose have a wide margin of error. However, in the absence of certainty, the consensus opinions of influential expert panels advocate adopting a conservative estimate of radiation risks.	4
35. Earls JP, Berman EL, Urban BA, et al. Prospectively gated transverse coronary CT angiography versus retrospectively gated helical technique: improved image quality and reduced radiation dose. <i>Radiology.</i> 2008;246(3):742-753.	Observational-Dx	203 patients	To retrospectively compare image quality, radiation dose, and blood vessel assessability for CCTA obtained with a prospectively gated transverse CT technique and a retrospectively gated helical CT technique.	The mean effective dose for the group with the prospectively gated transverse technique was 2.8 mSv; this represents an 83% reduction as compared with that for the group with the retrospectively gated helical technique (mean, 18.4 mSv; P<.001). The image quality score for each of the arteries, as well as the overall combined score, was significantly greater for images obtained with prospectively gated transverse technique than for images obtained with retrospectively gated helical technique. The combined mean image quality score was 4.791 for images obtained with prospectively gated transverse technique vs 4.514 for images obtained with retrospectively gated helical technique (proportional odds model OR, 2.8; 95% CI: 1.7, 4.8). The percentage of assessable coronary artery segments was 98.6% (1,196/1,213) for images obtained with prospectively gated transverse technique vs 97.9% (1,741/1,778) for images obtained with retrospectively gated helical technique (P=.83).	2

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36. Husmann L, Valenta I, Gaemperli O, et al. Feasibility of low-dose coronary CT angiography: first experience with prospective ECG-gating. <i>Eur Heart J</i> . 2008;29(2):191-197.	Observational-Dx	41 consecutive patients	To determine the feasibility of prospective ECG-gating to achieve low-dose CCTA.	Mean effective radiation dose was 2.1 +/- 0.6 mSv (range, 1.1-3.0 mSv). Image quality was inversely related to heart rate (57.3 +/- 6.2, range 39-66 b.p.m.; $r = 0.58$, $P < 0.001$), vessel attenuation (346 +/- 104, range 110-780 HU; $r = 0.56$, $P < 0.001$), and body mass index (26.1 +/- 4.0, range 19.1-36.3 kg/m ²); $r = 0.45$, $P < 0.001$), but not to heart rate variability (1.5 +/- 1.0, range 0.2-5.1 b.p.m.; $r = 0.28$, $P = 0.069$). Nondiagnostic CCTA image quality was found in 5.0% of coronary segments. However, below a heart rate of 63 b.p.m. (n=28), as determined by receiver-operator characteristic, only 1.1% of coronary segments were non-diagnostic compared with 14.8% with heart rate of >63 b.p.m. ($P < 0.001$).	3
37. Stolzmann P, Leschka S, Scheffel H, et al. Dual-source CT in step-and-shoot mode: noninvasive coronary angiography with low radiation dose. <i>Radiology</i> . 2008;249(1):71-80.	Observational-Dx	40 patients	To prospectively investigate CT image quality parameters by using different protocols and to calculate radiation dose estimates for noninvasive coronary angiography performed with dual-source CT in the step-and-shoot mode.	Mean image noise was similar with protocols A and B. Mean attenuation in the aorta and coronary arteries with protocol A (444 HU) was significantly ($P < .001$) higher than that with protocol B (358 HU). The reduced contrast material dose in protocol C yielded attenuation similar to that with protocol B. Diagnostic image quality was achieved with all protocols in 1,237 (97.9%) of 1,264 coronary segments. No significant differences in image quality between the 100- and 120-kV protocols were found. Mean heart rate had a significant effect on motion artifacts (AUC = 0.818; 95% CI: 0.723, 0.892; $P < .001$), whereas heart rate variability had a significant effect on stair-step artifacts (AUC = 0.79; 95% CI: 0.687, 0.865; $P < .001$). The mean estimated effective dose was 1.2 mSv +/- 0.2 for protocols A and C and 2.6 mSv +/- 0.5 for protocol B.	2
38. Heilbron BG, Leipsic J. Submillisievert coronary computed tomography angiography using adaptive statistical iterative reconstruction - a new reality. <i>Can J Cardiol</i> . 2010;26(1):35-36.	Review/Other-Dx	N/A	To describe the use of a submillisievert CCTA examination using one case representation.	The ability to perform a diagnostic CCTA with such a low dose challenges the role of coronary calcium scoring and will likely have implications for the future use of this test.	4

**Suspected Infective Endocarditis
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Reference	Study Type	Patients/ Events	Study Objective (Purpose of Study)	Study Results	Study Quality
39. Achenbach S, Marwan M, Ropers D, et al. Coronary computed tomography angiography with a consistent dose below 1 mSv using prospectively electrocardiogram-triggered high-pitch spiral acquisition. <i>Eur Heart J.</i> 2010;31(3):340-346.	Observational-Dx	50 consecutive patients	To evaluate the feasibility and image quality of a new scan mode for CCTA with an effective dose of <1 mSv.	In all 50 patients, imaging was successful. Mean duration of data acquisition was 258 +/- 20 ms. Mean dose-length product was 62 +/- 5 mGy cm, the effective dose was 0.87 +/- 0.07 mSv (0.78-0.99 mSv). Of the 742 coronary artery segments, 94% had an image quality score of 1, 5.0% a score of 2, 0.9% a score of 3, and 4 segments (0.5%) were 'uninterpretable'. In nonobese patients with a low and stable heart rate, prospectively ECG-triggered high-pitch spiral CCTA provides excellent image quality at a consistent dose below 1.0 mSv.	3

**Suspected Infective Endocarditis
EVIDENCE TABLE**

Reference	Study Type	Patients/ Events	Study Objective (Purpose of Study)	Study Results	Study Quality
<p>40. Kung VW, Jarral OA, Shipolini AR, McCormack DJ. Is it safe to perform coronary angiography during acute endocarditis? <i>Interact Cardiovasc Thorac Surg.</i> 2011;13(2):158-167.</p>	<p>Review/Other-Dx</p>	<p>6 papers</p>	<p>To assess papers on performing coronary angiography in acute endocarditis.</p>	<p>The authors, journal, date and country of publication, patient group studied, study type, relevant outcomes, key results and limitations of these papers are tabulated. One of the papers is a case report, which reported a fatal vegetation embolism from an infected aortic valve into the left main coronary artery 14 hours after angiography. The remaining 5 papers are cohort studies. Four of these studies were performed between 1970 and 1980 before the era of echocardiography and were aimed at quantifying the severity of valvular regurgitation. No embolic complications or dislodgement of vegetations occurred in any of the 5 studies (186 patients). Guidelines published by the European Society of Cardiology (ESC) in 2009 recommended coronary angiography in the context of infective endocarditis for men >40 years old, postmenopausal women, and patients with at least one cardiovascular risk factor or a history of coronary artery disease. Exceptions include patients with large aortic vegetations which may be dislodged during catheterization, and when emergency surgery is necessary: 1) native aortic or mitral infective endocarditis with severe acute regurgitation or valve obstruction, or prosthetic valve infective endocarditis with severe prosthetic dysfunction (dehiscence or obstruction) causing refractory pulmonary oedema or cardiogenic shock; 2) native aortic, mitral, or prosthetic valve infective endocarditis with fistula into a cardiac chamber or pericardium causing refractory pulmonary oedema or shock.</p>	<p>4</p>

**Suspected Infective Endocarditis
EVIDENCE TABLE**

Reference	Study Type	Patients/ Events	Study Objective (Purpose of Study)	Study Results	Study Quality
41. Horstkotte D, Korfer R, Loogen F, Rosin H, Bircks W. Prosthetic valve endocarditis: clinical findings and management. <i>Eur Heart J.</i> 1984;5 Suppl C:117-122.	Observational-Tx	46 patients	To describe clinical findings and management of PVE.	Cumulative survival rate after 6 months was 31% for the conservatively treated, and 66% for the medically plus surgically treated patients. Survival rates at the end of a maximum follow-up of 20 years were 15% with conservative treatment and 51% after primary surgical therapy. Prognosis was worse ($P<0.01$) in patients who, during aortic PVE, developed heart failure refractant to therapy due to hemodynamically significant prosthetic valve dysfunction, to sepsis that persisted for more than 72 hours despite antibiotic therapy, to major septic embolism or to acute renal failure. Retrospective prognosis was more favorable for patients with early aortic ($P<0.02$) or mitral ($P<0.05$) valve re-replacement than for patients who had been treated medically only.	2

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.

Dx = Diagnostic

Tx = Treatment

Abbreviations Key

AUC = Area under the receiver operating characteristic curve

CCTA = Coronary computed tomography angiography

CI = Confidence interval

CT = Computed tomography

ECG = Electrocardiogram

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

HIV = Human immunodeficiency virus

MDCT = Multidetector computed tomography

MRI = Magnetic resonance imaging

NPV = Negative predictive value

OR = Odds ratio

PPV = Positive predictive value

PVE = Prosthetic valve endocarditis

TEE = Transesophageal echocardiography

TTE = Transthoracic echocardiography