Coronary angiography (CA) to screen for the presence of coronary artery disease (CAD) is routinely performed before elective heart valve surgery. Its use is liberally advocated across a wide spectrum of patients by the writing committees for the treatment of patients with valvular heart disease (VHD) of the American College of Cardiology/American Heart Association and the European Society of Cardiology.\textsuperscript{1,2} Class I indications, all with level of evidence C, include men 35 to 40 years or older, postmenopausal women, and premenopausal women with coronary risk factors, in addition to the more traditional considerations of suspected myocardial ischemia, left ventricular systolic dysfunction, and any history or other signs of CAD. These recommendations are predicted on 2 major factors; namely, that clinical, ECG, echocardiographic, and radionuclide markers are less specific for CAD in the setting of severe VHD and that periprocedural and long-term outcomes are improved in patients with significant CAD undergoing combined valve and coronary bypass surgery compared with patients in whom revascularization is not performed. The evidence base for this latter claim derives primarily from older, single-center observational studies in patients with aortic stenosis (AS) and CAD.\textsuperscript{3,4} The more recent application of “hybrid” percutaneous coronary intervention with less invasive valvular heart surgery is gaining increasing acceptance,\textsuperscript{5} though there remains concern regarding the hazards and timing of dual antiplatelet therapy and institutional practices vary widely.

Technological advancements over the past 3 decades now allow for the safe and effective diagnosis and treatment of a variety of cardiovascular disorders using noninvasive or minimally invasive approaches. Lower procedural risks, faster recovery times, shorter hospital stays, reduced costs, and improved patient satisfaction underscore the increasing value of these innovations. As limited examples, consider the currently accepted roles of Doppler echocardiography for the evaluation of patients with valvular and congenital heart diseases, computed tomography (CT) and magnetic resonance angiography for the assessment of patients with aortic and peripheral vascular disease, percutaneous coronary intervention, endovascular stent graft therapy, implanted devices and radiofrequency ablation for rhythm management, and primary valve repair techniques. CT coronary angiography (CTCA) for the detection of CAD is no exception when applied to appropriately selected patient subsets, particularly because of its very high negative predictive value (NPV).

CTCA has been evaluated in a variety of clinical settings, ranging from suspected coronary artery anomaly to undifferentiated dilated cardiomyopathy. More extensively studied populations include stable patients with suspected CAD and patients with acute chest pain syndromes.\textsuperscript{6,7} To date, there have been comparatively fewer studies in patients with primary VHD. Gilard et al\textsuperscript{8} compared 16-slice CTCA with quantitative CA (QCA) in 55 patients (n=63 screened) with severe AS referred for elective surgery. Patients with irregular heart rhythms were excluded. Eight of the 55 patients (14%) received intravenous atenolol without incident if the resting heart rate exceeded 70 beats per minute. The prevalence of CAD was 20% (11/55). In a patient-based analysis, sensitivity, specificity, and NPV were 100%, 80%, and 100%, respectively. Technical problems related to calcification, motion artifact, and/or low signal-to-noise ratio prevented accurate luminal assessment in 25% of patients. Similar results using 16-slice CTCA were reported by Manghat et al\textsuperscript{9} for 40 patients with severe AS and by Reant et al\textsuperscript{10} for 40 patients with severe VHD, including 27 subjects with AS. Pouleur et al\textsuperscript{11} evaluated 82 patients with VHD using 40-slice CTCA with similar results. Meijboom et al\textsuperscript{12} screened 145 consecutive patients with VHD scheduled for elective surgery but excluded 75 (52%) for technical or clinical reasons. Specific criteria for administration of metoprolol, especially among patients with AS (n=31), were prespecified. Patient-based analysis of the diagnostic performance of 64-slice CTCA yielded a sensitivity, specificity, and NPV of 100% (78 to 100), 92% (81 to 98), and 100% (91 to 100), respectively. Vessel- and segment-based analyses for these 70 patients showed equally impressive results. The prevalence of CAD by QCA (≥50% stenosis) was 25.7% (18/70). The calculated radiation exposure for the CTCA protocol was calculated at 15.2 mSv for men and 21.4 mSv for women. Twenty-six patients with atrial fibrillation (AF) or undefined severe arrhythmia were excluded, and fewer than half the patients screened (n=145) were subsequently enrolled (n=70). Finally, Scheffel et al\textsuperscript{13} used 64-slice CTCA to evaluate 50 patients with aortic regurgitation, 26% (13/50) of whom had significant CAD by QCA (≥50% stenosis). Three patients were excluded because of a lack of sinus rhythm. By patient-based analysis, sensitivity, specificity, and NPV were

**One More Step for Computed Tomography Coronary Angiography Before Heart Valve Surgery**

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The opinions expressed in this article are not necessarily those of the editors or of the American Heart Association.

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100%, 95%, and 100%, respectively. Preoperative invasive CA could have been avoided in 70% (35/50) of patients.

As reported in this issue of *Circulation: Cardiovascular Imaging*, Bettencourt et al. have extended these preliminary observations regarding the utility of 64-slice CTCA in patients with VHD to a larger population of patients (n=237 enrolled, 452 screened) across a wider spectrum of valve lesions, inclusive of 32 subjects (14%) with AF. However, 9 patients were excluded because of resting heart rates >85 beats per minute. Efforts were made to reduce radiation dose, including electrocardiographically controlled tube current modulation (ECTCM) and lower (100-kV) tube voltage for patients <65 kg in weight. β-Adrenoreceptor blocker administration was individually titrated to heart rate, AS, LV systolic dysfunction, and/or NYHA symptom status. All patients underwent a preliminary low-dose scan to assess for coronary artery calcification (CAC). The prevalence of CAD, defined by stenosis severity >50% by independent visual interpretation of invasive CA, was 18% (44/237). The mean total radiation exposure was 12.5±2.5 mSv (CAC scan; 2.7±0.5 mSv; CTCA scan; 9.8±2.3 mSv). Radiation dose for the CTCA scan was higher for patients with versus those without AF (11.1±3.0 versus 9.6±2.2, P<0.02) and related in part to the inability to use ECTCM in a higher proportion of AF patients. By convention and consistent with previous studies, segments that could not be evaluated for technical reasons were assumed to be positive for CAD. Patient-based analysis yielded a sensitivity, specificity, and NPV of 95% (84 to 99), 89% (83 to 93), and 99% (96 to 100), respectively. With vessel- and segment-based analyses, sensitivity declined and specificity increased, though there was no change in NPV. Two of the 237 patients (0.8%) had false-negative CTCA scans, but false-negative rates by segment analysis were acceptably low (10 segments among 8 patients, 0.3%) and apparently not related to AF. Overall, the NPV rate for patients with AF was 96% (80 to 99) versus 99% (96 to 100) for patients without AF. A CAC score of 390 or higher was predictive of a positive or inconclusive CTCA with sensitivity 84%, specificity 92%, and AUC 0.92 (95% CI, 0.87 to 0.97). Accordingly, these patients could be referred directly to invasive CA to avoid repeated radiation and intravenous contrast exposure.

The aggregate data, though clearly limited, imply that CTCA can be pursued as an alternative to invasive CA in selected VHD patients referred for elective surgery, preferably at high-volume, experienced centers with expertise in techniques for radiation dose reduction (ECTCM, 100-kV tube voltage, sequential scanning). Appropriate candidates at this time point in the evolution of the technology would include patients with low or low-to-intermediate pretest probability of significant CAD based on age, sex, symptoms, risk factors, absence of pathological Q-waves on resting ECG, and CAC scores <400.10,15 AF, particularly at fast rates, still poses technical challenges, and patients must be able to tolerate β-adrenoreceptor blockers when needed for scan acquisition. The number of VHD patients with AF reported to date is far too small to draw firm conclusions. Continued advances in dual-source CT technology to improve temporal resolution may allow expansion of the role of CTCA for this indication, though prospective validation in VHD patients with AF will be required. Patients must be educated regarding the trade-offs between invasive CA and CTCA in a manner that allows them to exercise individual choice based on their values and preferences. The overall risk of major complications with invasive CA is 1.7%, exclusive of the pain and discomfort associated with vascular puncture.16 Effective radiation dose has been estimated at 7 mSv (range, 2 to 16) with invasive CA versus 16 mSv (range, 2 to 32) for CTCA.17,18 Although it was relatively lower in the current study of Bettencourt et al. By comparison, effective radiation dose is 0.1 mSv (range, 0.05 to 0.24) with posteroanterior and lateral chest radiographs. Cardiovascular clinicians infrequently discuss the issue of radiation exposure from diagnostic testing with their patients but should be prompted to do so more diligently in view of the reported small but not negligible lifetime attributable risk of cancer with CTCA.19 This risk is most significant for younger women, that is, the group with the lowest pretest probability of significant CAD. Caution is warranted at this stage in the development of CTCA to select VHD patients carefully and maximize efforts to limit radiation dose. In this regard, institutional best practices should be shared. Future advances in CTCA techniques will probably lead to its more widespread use in this population.

**Disclosures**

None.

**References**


statement from the American Heart Association Committee on Cardiovascular Imaging and Intervention, Council on Cardiovascular Radiology and Intervention, and Committee on Cardiovascular Imaging, Council on Clinical Cardiology. Circulation. 2006;114:1761–1791.


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