Comparative effectiveness of coronary screening in heart valve surgery: Computed tomography versus conventional coronary angiography

Wonjae Lee, MD,[a] Joon Bum Kim, MD, PhD,[b] Dong Hyun Yang, MD, PhD,[c] Cherry Kim, MD, PhD,[e] Jihoon Kim, MD, PhD,[b] Min Ho Ju, MD,[b] Ho Jin Kim, MD,[b] Joon-Won Kang, MD, PhD,[c] Sung-Ho Jung, MD, PhD,[b] Young-Hak Kim, MD, PhD,[d] Suk Jung Choo, MD, PhD,[b] Cheol Whan Lee, MD, PhD,[d] Cheol Hyun Chung, MD, PhD,[b] Jae Won Lee, MD, PhD,[b] and Tae-Hwan Lim, MD, PhD[c]

ABSTRACT

Background: Although conventional coronary angiography (CAG) is considered the gold standard for coronary artery disease (CAD) screening in the setting of heart valve surgery, coronary artery computed tomography angiography (CCTA) has emerged as an alternative modality. This study was conducted to evaluate the clinical outcomes of CCTA compared with conventional CAG for CAD screening in patients undergoing heart valve surgery.

Methods: A total of 3150 consecutive patients aged >40 years or with coronary risk factors undergoing elective valve operations between 2001 and 2015 were evaluated. Of these, 1402 patients underwent CCTA (CT group) and 1748 patients underwent conventional CAG (CAG group) for CAD screening.

Results: The 30-day mortality rates were similar in the 2 groups (2.1% in the CT group vs 1.7% in the CAG group; $P = .463$); however, the incidence of low cardiac output syndrome was higher in the CT group (2.3% vs 1.0%; $P = .008$). The final rate of detection of significant CAD ($\geq$50% stenosis) (4.9% vs 9.7%; $P < .001$) and proportion of receiving coronary bypass grafting (CABG) (2.9% vs 4.3%; $P = .041$) were lower in the CT group. After adjustment by propensity score matching (563 pairs), the main findings of our crude analyses did not change, with lower rates of CAD detection (odds ratio [OR], 0.56; 95% confidence interval [CI], 0.36-0.85) and CABG (OR, 0.47; 95% CI, 0.26-0.81), a similar risk of early mortality (OR, 1.51; 95% CI, 0.54-4.52), but a higher risk of low cardiac output syndrome (OR, 3.30; 95% CI, 1.16-11.78) in the CT group compared with the CAG group.

Conclusions: The detection of significant CAD and identification of candidates for CABG were inferior with CCTA compared with conventional CAG in patients scheduled for elective heart valve operations. (J Thorac Cardiovasc Surg 2017;■:1-9)
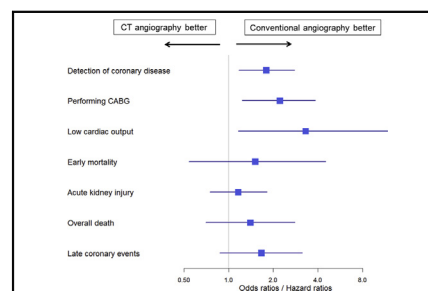
Comparative outcomes between CCTA and conventional CAG in heart valve surgery.

Central Message

Computed tomography angiography may be inferior to conventional coronary angiography in detecting coronary disease and in identifying candidates for coronary artery bypass grafting among patients scheduled for heart valve operations.

Perspective

Coronary artery computed tomography angiography (CCTA) may be inferior to conventional coronary angiography (CAG) in detecting coronary disease and in identifying candidates for coronary artery bypass grafting among patients scheduled for heart valve operations. Further prospective researches are needed to validate the feasibility of CCTA compared with conventional CAG.

See Editorial Commentary page XXX.

Abbreviations and Acronyms
AKI = acute kidney injury
CABG = coronary artery bypass grafting
CAD = coronary artery disease
CAG = coronary angiography
CCTA = coronary computed tomography angiography
CI = confidence interval
CT = computed tomography
HR = hazard ratio
LCO = low cardiac output syndrome
MACE = major adverse cardiac event
OR = odds ratio
PS = propensity score

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Current practice guidelines recommend screening for coronary artery disease (CAD) before cardiac surgery in patients aged >40 years or with coronary risk factors, to reduce the risk of complications related to perioperative myocardial ischemia.[1-3] For this, conventional coronary angiography (CAG) has been considered the gold standard method for detecting obstructive CAD and has commonly been used for CAD evaluation before surgery. However, the invasive nature of CAG has called for an alternative modality that is noninvasive while still as effective. Coronary computed tomography angiography (CCTA) has been validated for its accuracy and efficacy in detecting CAD in many clinical settings.[4] With the introduction of 320-slice and 640-slice CT, the accuracy of CCTA has improved further, with less radiation and with better performance even in the presence of tachyarrhythmias, such as atrial fibrillation.[5,6] In perioperative CAD screening for patients undergoing noncardiac surgery, CCTA is generally considered useful for excluding CAD in patients at low risk for atherosclerosis, and recently has been encouraged as an alternative to invasive CAG.[7,8]

Currently, CCTA is suggested as an alternative approach for preoperative CAD evaluation in patients with low or intermediate pretest likelihood of CAD undergoing elective heart valve operations (class IIa recommendation).[3] Based on several recent studies have shown excellent diagnostic accuracy of CCTA in the preoperative assessment for elective valve surgery to rule out the presence of significant

CAD,[9-11] some have suggested expanding the role of CCTA as a gatekeeper before invasive CAG in patients undergoing valve surgery.[12] Given relatively small sample sizes of these recent studies and the questionable reproducibility of the results of such studies, there have been calls for further studies performed in real-world clinical settings with reasonable cohort sizes to validate the feasibility of CCTA compared with conventional CAG. Thus, in the present study, we sought to compare CCTA and invasive CAG as CAD screening modalities in patients undergoing elective heart valve surgery in terms of perioperative and long-term clinical outcomes.

METHODS
Study Subjects and Outcome Measures

In a review of the institutional prospective cardiac surgical database in Asan Medical Center, Seoul, Korea, we identified 6104 consecutive patients age >40 years or with a coronary risk factor (ie, diabetes, hypertension, dyslipidemia, or severe [obesity body mass index ≥ 30 kg/m^2]) undergoing heart valve surgery between January 2001 and December 2015. After excluding patients with emergent surgery, infective endocarditis, or preexisting coronary disease, 3212 patients were judged to meet our enrollment criteria. Of these, 3150 patients who underwent preoperative coronary imaging studies by either conventional CAG (n = 1748; CAG group) or CCTA (n = 1402; CT group) composed the study cohort.

The choice of imaging modality was affected by the pretest probability of coronary disease, with CCTA preferred in low-risk patients, but was finally at the surgeon's discretion. In addition, attributed to its less invasive nature combined with the advent of the more accurate CCTA, there was a strong trend toward increasing use of CCTA over CAG in recent years. The majority of patients included in this study were referred to our institution, a large-volume tertiary-referral center, from other hospitals for surgical treatment under the diagnosis of severe cardiac valvulopathy. The study protocol was approved by the Institutional Review Board of the Asan Medical Center. The requirement for informed consent from individual patients was waived from the Board due to the retrospective study design.

The primary objective of this study was to compare the detection rate of significant CAD (>50% stenosis) confirmed by CAG, and the rate of concomitant performance of coronary artery bypass grafting (CABG), between the CAG and CT groups. For further measures, early complications, including mortality; acute kidney injury (AKI); low cardiac output syndrome, defined by hemodynamic collapse requiring mechanical support (extracorporeal life support or intra-aortic balloon pump); and neurologic injuries occurring within 30 days after an index surgery, were also evaluated. AKI was defined as a >2-fold increase in the serum creatinine, or a 50% decrease in glomerular filtration rate based on RIFLE (risk, injury, failure, loss, and end-stage kidney disease) criteria.[13]

Late follow-up events potentially relevant to CAD, including all-cause mortality, requirement for coronary revascularization, and myocardial infarction, were also reviewed and compared as a composite endpoint representing a major adverse cardiac event (MACE). For data collection, additional retrospective chart reviews were conducted to obtain detailed information on perioperative variables and follow-up outcomes.

Coronary Imaging

Systemic, thorough reviews of CCTA and CAG findings were conducted by expert radiologists and interventional cardiologists, respectively. These imaging data were summarized in 9 parameters, as proposed in the CONFIRM registry.[14] The degree of stenosis was classified as minimal (<30%), mild (30%-49%), moderate (50%-69%), or severe ($\geq$70%). In general, the presence of moderate-to-severe coronary stenosis, calcification