Coronary Computed Tomographic Angiography for Suspected Stable Coronary Artery Disease: Gap Between the 2013 European Society of Cardiology Guideline Recommendations and Clinical Practice

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Introduction

Coronary computed tomographic angiography (CCTA) as a noninvasive diagnostic technique for the evaluation of coronary anatomy is widely used clinically. Its advantages include high sensitivity and specificity for the diagnosis of present of coronary artery lesions and lesion characteristics, short scan time, low patient radiation exposure, and acceptable to patients. The sensitivity and specificity of CCTA for diagnosing coronary artery disease are 83%–100% and 70%–80% at patient level or 83%–97% and 93%–100% at vessel level. It can be proceeded in out-patient clinic for the most of the candidates. In high patient volume hospitals and most county hospitals, even more multi-slice computed tomography scanners are used for screening the coronary artery disease (CAD), but there is no stress testing equipment for functional evaluation of CAD before CCTA. The rule of CCTA in management of patients with symptoms suspicious for CAD comparing to well-established other noninvasive stress techniques including stress exercise electrocardiogram (ECG), single photon emission computed tomography (SPECT), and stress cardiac echocardiography is still not well-studied in different patients population. Assessment of patients with typical of stable or atypical angina generally follows the guidelines and established stepwise approach which based on evidence of clinical studies.[1-3] The first step for the approach of CAD includes careful history taking, basic physical examination, routine ECG, and risk factors assessment to define the likelihood of CAD. Depending on the risk factors, patients are classified into subgroups of low, intermediate, and high pretest likelihood probability, and further noninvasive and invasive evaluation methods are referred. Patients with positive result of most common used stress ECG are only 41% likely to have obstructive coronary heart disease defined by invasive coronary angiography.[4] This is why stress testing is less referred compared to CCTA for the initial test. Some of the exercise ECG results are not interpretable.

Analysis of Gap Between the Guideline Recommendations and Clinical Practice

The 2012 American College of Cardiology Foundation (ACCF)/American Heart Association (AHA) guideline for the diagnosis and management of patients with stable ischemic heart disease (SIHD) recommended that CCTA can be useful for risk assessment in patients with SIHD, who have an indeterminate result from functional testing (Class IIa).[1] In 2013 European Society of Cardiology (ESC) Guidelines on the management of stable coronary artery disease (SCAD) (2013G), CCTA was recommended on consideration of pretest probability.[2] How degree guidelines change clinical practice in application of CCTA as a diagnostic technique has not been well defined. In a multicenter CCTA study, Chinnaiyan *et al.* found

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that stress tests including treadmill exercise testing, stress echocardiography, and myocardial perfusion imaging with SPECT had poor predictive value for CAD. The valuable predictors included old age, typical angina, hypertension, and current smoking.[5] Typical angina was more accurate predictive than stress test. In symptomatic patients with suspected CAD of 53% pretest likelihood of obstructive CAD, who required noninvasive testing, a strategy of initial CCTA compared with functional testing did not improve clinical outcomes including death, myocardial infarction, hospitalization of unstable angina, and procedure complications over a median follow-up of 2 years.[6] The disadvantages of CCTA include contrast induced nephropathy, allergic reaction and radiation exposure. Careful evaluation the possible risk factors are most important to differentiate high risk one and necessary monitoring and pre-treatment are needed.

Zhou et al.[7] reported that 5320 patients with suspected and scheduled for CCTA were included and patients with acute coronary syndrome (ACS), history of previous coronary revascularization and impaired renal function, atrial fibrillation, and age more than 90 years were excluded from the study. More than 43% of the patients had angina and 61.4% of the patients received appropriate CCTA without significant change over the study period. The rates of appropriate of CCTA in period of 8 months before and after the publication of 2013G were compared overall patients and in different subgroups. There was no significant difference in all subgroups. The study by Zhou et al.[7] was a single center, large sampled size study. Limitations of this study were presented. Firstly, this was not a randomized trial. Refer physicians may favor CCTA or functional tests, these may further affect decision making. Secondly, bias from referred patient population could not be excluded. Finally, the period from publication of ESC 2013G to the study is limited and may be too short for the physicians to fully accepted and appropriately used in practice. One recent opened-label, parallel-group, randomized study for patients with chest pain suspected CAD showed that CCTA can clarify the diagnosis, enables targeting of intervention, and 38% reduction in fatal and nonfatal myocardial infarction.[8]

In 2013 ESC Guidelines on the management of SCAD (2013G), the indications of CCTA for patients with SCAD should be considered an alternative to stress tests in patients with ejection fraction (EF) >50% and pretest probability between 15% and 50%. In patients with EF ≥50% and pretest probability between 50% and 85% or with EF <50% and without typical angina, CCTA should be considered a complement to stress tests. The guideline indicates that CCTA could be used in patients with normal left ventricular function and moderate risk of CAD.

From Zhou's et al.[7] study, we found that the inappropriate rate of CCTA in SCAD patients is high and not affected by the publication of 2013G. The first reason of it includes that the referred physician does not apply the guideline in low-risk CAD patient group in which the stress test is often recommended as a screen test before CCTA. The treating physicians might be unaware of the guideline recommendations or even known guidelines but not believe it and modified during clinical practice. The others include patient's willingness to CCTA instead of exercise tests or medical economic consideration. Both anatomy and functional studies are important for the management of suspected CAD. There is conflicting about which to be initially referred and the choice is related to the interaction of patient's disease burden, socioeconomic status, medical insurance payment, and experience of medical team. The relative low predictive value of stress test and less trained staff for processing the test results in a low rate of recommendation and an increasing applications of CCTA as the first study to evaluate the suspected angina patients. In addition, an increasing proportion of patients are more likely to accept CCTA before invasive coronary angiography in low- and high-risk groups of CAD. However, early studies demonstrated that CCTA owns high sensitivity and specificity, only 70% positive predictive value in one registry study. Gaps between guideline and clinical practice were seen not only in diagnostic applications but also in guideline-directed medical therapy for secondary prevention in high-risk CAD patients.[9] The present study provides a valuable insights into the status of CCTA in current practice use of diagnosis of SCAD. Gaps between guidelines and clinical practice are still significant, even different new versions of guidelines in management of hypertension, lipid, and ACS published recently.

Discussion

How to improve the appropriate application of CCTA in the management of SIHD? Firstly, improvement of physician's compliance with evidence-based guidelines is the most important step. CCTA is not a screening test for all suspected CAD patients, especially low-risk one. Secondly, educating patient to follow physician's advises during clinical practice and making insurance payment limitations for CCTA depending on current guidelines can also decrease the inappropriate application in low pretest probability of CAD. We should rethink our current practice of less inappropriate initial complicated test, and a step-by-step from simple to complex model should be cost and benefit. Questions are still remained about when to chose CCTA or stress tests including stress ECG, stress echocardiography or SPECT. A guideline or consensus for the application of CCTA for evaluation of coronary artery disease is needed. A simple imaging algorithm for CCTA will be helpful in clinical practice especially for physicians who are at community hospitals or one not a cardiovascular specialist. Of cause, well-designed prospective multicenter trials which including different levels of hospitals are needed to test which initial test will be appropriate for management of obstructive artery disease before invasive coronary angiography.

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Conflicts of interest
There are no conflicts of interest.

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