Combined Computed Tomography Angiography (CTA) and Single Photon Emission Computed Tomography Is Not Superior to CTA Plus High-Risk Plaque Assessment in Predicting Future Cardiac Events

– Is It True? –

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Coronary computed tomography angiography (CTA) has emerged as a promising first-line test for detecting coronary artery disease (CAD) before proceeding to invasive coronary angiography (CAG). Many investigators have reported the advantage of its high negative predictive value. Therefore, CTA is an effective alternative to CAG for ruling out obstructive CAD. However, diagnostic accuracy depends on the pre-test probability in general. In patients with high pre-test probability or known CAD, CTA is less effective for excluding obstructive CAD because the negative predictive value negatively correlates with the pre-test probability. In addition, relatively low positive predictive value brings about debate that borderline stenosis on CTA leads to many unnecessary invasive CAG, especially for patients with low pre-test probability. Additionally, some of these redundant CAG lead to fruitless coronary interventions.

Although CTA demonstrates “anatomic” stenosis, SPECT refers to “physiologic” stenosis. Recently, “physiologic” stenosis proved to be superior to “anatomic” stenosis for guiding percutaneous coronary intervention with respect to prognosis using fractional flow reserve. Therefore, if SPECT was used instead of CTA, many of these fruitless CAG would not be performed, resulting in cost saving. The indication for invasive CAG and coronary intervention is critical because these procedures cost a lot and are not harmless. What is the purpose of the treatment of CAD? One is relief of symptoms; however, the ultimate goal is definitely an improved prognosis. In this context, SPECT is the most valuable non-invasive tool.

Li et al compared SPECT with CTA for diagnosis of CAD. There was no difference between the 2 modalities in diagnostic performance, despite many discrepancies. Therefore, they provide different but complementary information. Combining these 2 modalities may be useful for better management of CAD, especially for patients with borderline results of the first test.

Hard events such as cardiac death and non-fatal myocardial infarction usually occur in relation to acute coronary syndrome (ACS). Rupture of coronary plaque is a trigger of most ACS attacks. Therefore, identification of vulnerable plaque may be a key in preventing hard events. Recent CTA technology makes it possible to assess coronary plaque, and the features of high-risk plaque (HRP) have been proved. However, HRP may not always be associated with coronary events. In patients with mild chronic kidney disease, the severity of stenosis may be related to a high-risk of coronary artery events rather than the characteristics of plaque. In this issue of the Journal, Motoyama et al evaluate the role of combined SPECT and CTA evaluation for risk stratification of CAD. For SPECT, they quantified the perfusion defect at stress as the summed stress score (SSS) and inducible ischemia as the summed difference score (SDS). For CTA, coronary stenosis and HRP, including positive remodeling and low-attenuation plaque, were evaluated.

Although perfusion scores on SPECT alone, such as SSS >4 and SDS >0, did not reach the significant level as predictors of cardiac events, HRP demonstrated significant power to predict cardiac events. However, both SSS >0 and HRP predicted the same 5 events (45.5%) out of 11 events in total. Therefore, the difference between these 2 parameters probably depends more on the high false-positive rate of SDS >0 than that of HRP (31.0% vs. 10.7%). Low cut-off values such as “<0” for SDS permitted many false-positive defects on SPECT because they used thallium (Tl), and more than 70% of event-negative patients were male. On SPECT, the inferior wall of males tends to demonstrate a “false defect” because of diaphragmatic attenuation, which is exaggerated by the low peak perfusion scores.
energy of Tl. If they used technetium as the myocardial perfusion tracer instead of Tl and set the cut-off value of SDS as high as around 5, ischemia on SPECT would indicate significant power for prediction of cardiac events. Many prognostic studies demonstrate that moderate to severe ischemia (at least >7.5% of LV) is associated with hard cardiac events. In the present study, 11 events included 9 hard events (81.8%). Therefore, SDS >5 (corresponding to >7.4% of LV in a 17-segment model) may be a reasonable cut-off value for prognostic study. Otherwise, the best cut-off value for TI SPECT should be determined using receiver-operating characteristic analysis.

Stenosis (+) on CTA ameliorated the false-positive rate on SPECT in the stenosis (+) with SDS >0 category, because SDS >0 due to false positives is usually associated with stenosis (−), and they are eliminated from this category by the nature of the high negative predictive value of CTA. Therefore, although SDS >0 alone could not predict a positive value, the combination of stenosis (+) with SDS >0 revealed as high a predictive value as HRP.

It is known that up to 31% of women and 14% of men experiencing acute myocardial infarction have non-significant coronary stenosis on CAG. However, CTA can identify HRP even in the absence of significant coronary artery stenosis. SPECT cannot identify the patients in this category. Therefore, it is expected that SPECT and CTA supplement each other in the combined assessment of CAD.

The authors tried to demonstrate comprehensive evaluation of the prognosis using the combination of CTA and SPECT and expected a higher predictive value than from each single modality. However, the combination of these 2 imaging parameters could not indicate a higher prognostic value, compared with the CTA parameter alone, HRP. Both SSS >4 and SDS >0 may be appropriate cut-off values for “ischemia”, but are too low for prognosis. Similar prognostic study with the combination of CTA and SPECT using higher cut-off values may elucidate its real prognostic value.

References


2. Mowatt G, Cook JA, Hillis GS, Walker S, Fraser C, Jia X, et al. 64-


