学位論文の要旨

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学位論文名　Comparison of CTAC and Prone Imaging for the Detection of Coronary Artery Disease Using CZT SPECT

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論文内容の要旨

INTRODUCTION

Myocardial perfusion imaging (MPI) is useful for evaluating patients with coronary artery disease (CAD), assessing patients' risk of future cardiac events, and evaluating therapeutic efficacy. A recently developed high-efficiency ultrafast multipinhole cardiac camera with cadmium-zinc-telluride (CZT) detectors shows higher photon sensitivity and spatial resolution compared with conventional Anger cameras. Its overall accuracy has improved compared with the Anger camera. Soft tissue attenuation of tracer activity, mainly in the inferior and inferolateral area, can result in artifactual perfusion abnormalities in the right coronary artery (RCA) and left circumflex (LCx) territories. The CZT camera, as with the Anger camera, displays these artifacts as inferior wall defects. The method to eliminate artifacts by imaging in the prone position in conventional Anger camera has been reported. Computed tomographic attenuation correction (CTAC) has also been reported to be a useful method to improve the specificity of a diagnosis of inferior wall ischemia, and as for the use of a CZT camera, one study showed improvement of diagnostic accuracy with vascular territory analysis. However, clinical experience using the CZT camera is limited. There are few reports on using both prone acquisition and CTAC to reduce attenuation artifact, and no report has compared these measures employed as part of the same examination. We evaluated how addition of both prone imaging and CTAC might improve diagnostic accuracy in the inferior and inferolateral area.

MATERIALS AND METHODS

The study population consisted of 85 consecutive patients who were referred for invasive coronary angiography (CAG) and also underwent rest/stress myocardial perfusion imaging (MPI) on a CZT camera (Discovery NM 530c, GE Healthcare, Haifa, Israel) in the supine and prone positions and a 16-slice CT scan (Discovery NM/CT 670, GE Healthcare, Haifa, Israel) at Shimane University Hospital to examine known or suspected CAD between April 2013 and March 2014. Exclusion criteria were prior coronary artery bypass grafting (n = 4), hemodialysis (n = 3), and inability to lie prone (n = 6). The remaining 72 patients were investigated. SPECT images were iteratively reconstructed using the transmission data generated from the 16-slice CT. Reversible perfusion defects on MPI were assumed to be cardiac ischemia until CAG was performed. The findings of inferior/inferolateral wall ischemia on MPI were compared with the findings in the RCA or LCx on CAG. Sensitivity, specificity, accuracy, and positive and negative likelihood ratios (LR) were calculated to predict the ability of MPI (each method) to identify myocardial ischemia in comparison with an ischemic result of CAG or fractional flow reserve (FFR) on a per-patient basis. The study protocol was approved by the Ethics Committee of Shimane University and written informed consent was obtained from all subjects.

RESULTS AND DISCUSSION

All patients successfully underwent rest/stress imaging with the CZT camera and invasive CAG one day after MPI. Between MPI and CAG, there were no signs of ischemia progression such as chest pain in any patient. Twenty-four patients (33%) were diagnosed with cardiac ischemia and 35 vessels were interpreted as abnormal with CAG and/or FFR. Two patients had triple-vessel disease. The number of patients with left anterior descending artery (LAD) stenosis, LCx stenosis, or RCA stenosis was 17 (24%), 14 (19%), and 9 (13%), respectively. Two patients had both LCx and RCA stenosis. There were no patients with left main trunk disease. Seventeen (24%) patients had LCx and/ or RCA stenoses. Per-patient comparison of MPI with invasive CAG was assessed. Visual per-patient analysis of MPI revealed reversible perfusion defects in 16 patients (22%) with standard supine images, 23 patients (32%) with prone images, and 15 patients (21%) with CTAC images. Per-patient sensitivity, specificity, and accuracy of supine images to predict cardiac ischemia on CAG were 35% [95% confidence interval (CI) 19–52], 86% (95% CI 80–92), and 74% (95% CI 66–82); those of prone images were 65% (95% CI 45–81), 82% (95% CI 76–87), and 78% (95% CI 68–85), and those of CTAC images were 59% (95% CI 41–71), 93% (95% CI 87–97), and 85% (95% CI 76–91), respectively. Positive LRs were 2.4 (95% CI 1.6–3.7) in supine, 3.6 (95% CI 2.8–4.4) in prone, and 8.1 (95% CI 4.7–13.8) in CTAC images, showing significant differences between supine and CTAC images to predict cardiac ischemia. Negative LRs were 0.76 (95% CI 0.71–0.81) in supine, 0.43 (95% CI

0.35–0.54) in prone, and 0.44 (95% CI 0.38–0.53) in CTAC image, showing significant difference between supine images and other two images.

We analyzed the diagnostic accuracy for inferior and inferolateral wall ischemia on MPI in the prone position and with CTAC and the usual supine position images individually, in comparison with CAG. This was the first report in which the diagnostic quality of images based on prone images and CTAC, in addition to simple supine images, obtained with the CZT camera was estimated. In our study, the addition of prone images or CTAC images turned out to be useful. We are often faced to the artifact on MPI in interpreting and it makes difficult to judge whether ischemia or not. Our additional methods can reduce the impact of the artifact in the inferior and inferolateral wall. These changes led to an increase in sensitivity of diagnosing ischemia. Furthermore, if the use of CTAC is established, prone imaging may not always be needed in assessing the inferior and inferolateral area, and examination time will be reduced. Another advantage of CTAC imaging is that it can perform well in elderly people with kyphosis, who may have difficulty assuming the prone position.

CONCLUSION

Adding prone acquisition and CTAC–corrected supine images improved the ability to identify ischemia in the inferior and inferolateral area.