Myocardial perfusion artifacts in left bundle branch block: A diagnostic challenge

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Left bundle branch block (LBBB) is usually an acquired conduction defect with the prevalence increasing with age.^{1–3} It occurs as a sequela of coronary artery disease (CAD), congenital heart disease, valvular heart disease, cardiomyopathy, myocarditis, and can also be iatrogenic or degenerative in nature.^{4,5} In patients with LBBB, the impulse from the atrioventricular node is transmitted via the slower ventricular myocardium rather than the specialized conduction system. As a result, the interventricular septum (IVS) and right ventricle free wall contract earlier than the left ventricle (LV) free wall, leading to mechanical dyssynchrony.⁶ This leads to an increased stretch of LV free wall, which eventually hypertrophies in response to the increased workload.⁷

An increasing number of patients referred for evaluation of CAD have LBBB on the resting electrocardiogram.⁸ Detection of significant CAD in these patients can be challenging due to the high frequency of artifacts observed during myocardial perfusion imaging (MPI) using single photon emission computed tomography (SPECT). These artifacts are more common with exercise stress and typically involve the IVS and cardiac apex (both supplied by the left anterior descending

artery) and may not truly reflect ischemia. This was first highlighted by McGowan et al. using Potassium-43 and Rubidium-81 in 1976, where they observed a majority (70%) of patients had septal perfusion defect without any significant CAD on angiography.⁹

Among patients with LBBB, the observed perfusion defects in the IVS may be due to significant CAD, microvascular disease, infiltrative cardiomyopathy, or artifacts (Figure 1). The non-CAD causes lower the positive predictive value of MPI in patients with LBBB leading to unnecessary invasive angiography.⁹

Thus current guidelines recommend the use of vasodilator pharmacologic stress with SPECT or PET MPI with regadenoson, dipyridamole, or adenosine over exercise in patients with LBBB to detect obstructive CAD.^{13,14} There are some nuances worth discussing regarding the use of vasodilators in those undergoing MPI. Regadenoson is thought to be more chronotropic than other vasodilators (although still much lower than exercise) and is thus expected to have more IVS imaging artifacts due to heart rate induced dysynchrony.^{4,13,15} But this expected observation was not seen in two small studies comparing regadenoson to other vasodilators on SPECT-MPI, and it seems that the data seen with adenosine/dipyridamole can be extended to regadenoson in patients with LBBB.^{13,16,17} The role of absolute myocardial blood flow (MBF) quantification using positron emission tomography (PET) MPI has been suggested to avoid misinterpretation of septal perfusion defects in patients with LBBB in two small studies.^{12,18}

In general, PET MPI has clear advantages over SPECT including higher photon energy, improved resolution, attenuation correction, lesser radiation exposure, shorter test time, and the ability to quantify absolute MBF.¹⁹ Whether these technical advantages translate into improved diagnostic performance in

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Figure 1. Etiologies of septal perfusion defect during myocardial perfusion imaging in LBBB^{4,8,10-12}.

patients with LBBB has not been systematically evaluated. Two small studies suggest that determination of absolute MBF (using Rb-82 and O15-[H₂O]) may improve the diagnostic performance of PET MPI in those with LBBB.^{12,18} In this issue of the journal, Meredith et al.,²⁰ using regadenoson, report that relative Rb-82 PET MPI without the use of absolute MBF measures can be reliably used to identify obstructive CAD in patients with LBBB. Given the small size and conflicting results with a previous O-15 study¹² we raise the following important questions that merit further research in a larger cohort:

1. How is the diagnostic accuracy of MPI (PET and SPECT) in those with LBBB affected by the choice of pharmacological stress agent?
2. Does relative PET MPI have fewer artifacts in those with LBBB and improved diagnostic accuracy for CAD as compared to SPECT-MPI?
3. Does the quantification of absolute MBF in IVS and cardiac apex improve diagnostic accuracy?
4. If yes, what is the ideal PET radiotracer for quantifying MBF in patients with LBBB?

Till future studies definitively address these questions, certain related MPI findings might point towards a possibility of CAD over the artifact. These include the presence of a reversible perfusion defect,²¹ an additional perfusion defect in the cardiac apex,²² involvement of other vascular territories (i.e., inferior, lateral, or anterior walls), and concomitant systolic dysfunction.⁸

While future studies try to address these questions, use of other non-invasive techniques like cardiac stress magnetic resonance and CT angiography in selected

cases may alleviate patient and clinician concern and avoid invasive angiography.²³

In conclusion, this study and others point out that there is clearly more to learn about myocardial perfusion imaging in LBBB patients and should encourage future research to help find the ideal technique, stressor, and radiotracer to reliably diagnose CAD in patients with LBBB.

Disclosures

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