Editorial Comment

Combined Pulmonary Vein and LA/LAA Thrombus Assessment
Can CMR Kill Two Birds With One Stone?*

Warren J. Manning, MD,a,b Aferdita Spahillari, MDa

Atrial fibrillation is the most common sustained arrhythmia worldwide (1), and catheter-based pulmonary vein isolation (PVI) is becoming a dominant approach to its management. Stroke and transient ischemic attack are known risks of PVI (2). To improve PVI safety, atrial thrombus needs to be excluded. Traditionally, patients undergo elective computed tomography angiography or magnetic resonance angiography (MRA) before PVI for characterization of pulmonary vein anatomy and transesophageal echocardiography (TEE) immediately before the PVI to exclude atrial thrombi. Despite being the gold standard for detection of atrial and atrial appendage thrombi (3), TEE is moderately invasive. Because TEE does not optimally image the pulmonary veins, patients routinely undergo both MRA (or computed tomography angiography) as well as TEE, increasing health care costs and patient inconvenience. It would be preferable to have a single noninvasive imaging modality that allowed for both pulmonary vein evaluation and exclusion of atrial and atrial appendage thrombi.

In this issue of JACC, Kitkungvan et al. (4) report on the diagnostic performance of 3 cardiac magnetic resonance (CMR) sequences for the detection of left atrial (LA)/left atrial appendage (LAA) thrombus in patients referred for pulmonary vein MRA. Both 1.5-T and 3-T systems were used. The authors sought to answer 2 important questions:

1. How does CMR perform compared with TEE in the detection of LA and LAA thrombi in participants referred for PVI?
2. What is the best CMR sequence for detecting LA/LAA thrombus?

In this registry study, 261 patients (median CHA2DS2VASc [congestive heart failure, hypertension, ≥75 years of age, diabetes mellitus, stroke/transient ischemic attack, vascular disease, age 65–74 years, sex category] score = 2; 73.6% anticoagulated; 9.2% with previous neurologic event) underwent CMR and TEE within 7 days (mean 1.3 ± 2.3 days). The 3 CMR sequences assessed were: 1) cine-CMR of the LA and LAA in at least 2 orthogonal views; 2) contrast-enhanced MRA; and 3) single-shot, multislice, long inversion time-delayed enhancement CMR (TI-DE-CMR). Multiplane 2- and 3-dimensional TEE were performed by qualified cardiologists.

Nine (3.5%) participants were found to have LA or LAA thrombus according to TEE, and all CMR techniques had good diagnostic accuracy and high negative predictive value compared with TEE (4). Long TI-DE-CMR identified all cases of thrombi identified by using TEE (although with 2 false-positive findings in patients with CHA2DS2VASc scores ≥3) and had the best overall diagnostic performance. Cine CMR seemed to miss smaller LAA thrombi, whereas MRA seemed to miss larger mural LA thrombi. Long TI-DE-CMR also had the highest interobserver agreement. Additional advantages of the long TI-DE-CMR sequence included decreased susceptibility artifacts and no requirement for breath-holding given an abbreviated acquisition time.

No clinical stroke or TIA was reported in participants without LA/LAA thrombus who subsequently

*Editorials published in JACC: Cardiovascular Imaging reflect the views of the authors and do not necessarily represent the views of JACC: Cardiovascular Imaging or the American College of Cardiology.

From the aDepartment of Medicine, Cardiovascular Division, Beth Israel Deaconess Medical Center and Harvard Medical School, Boston, Massachusetts; and the bDepartment of Radiology, Beth Israel Deaconess Medical Center and Harvard Medical School, Boston, Massachusetts. Both authors have reported that they have no relationships relevant to the contents of this paper to disclose. Raymond Kim, MD, served as Guest Editor for this paper.
underwent PVI (4). The investigators concluded that multicomponent CMR is a feasible imaging modality for simultaneous evaluation of pulmonary vein anatomy and detection of LA/LAA thrombus. The results are consistent with earlier research demonstrating the superiority of long TI-DE-CMR in the detection of left ventricular thrombus (5). Detection of left ventricular thrombus by using DE-CMR has previously been validated against pathologic specimens (6).

Strengths of the study by Kitkungvan et al. (4) include the large number of patients and a relatively short interval between the performance of CMR and TEE. The main clinical implication of the study stems from the high negative predictive value of the long TI-DE-CMR sequence. In a study population with low prevalence of LA/LAA thrombi (similar to other cohorts [3,7]), a negative predictive value of 100% for the long TI-DE-CMR sequence would suggest that no further testing for thrombus evaluation is needed before PVI. The sensitivity on the other hand, although high, had much wider confidence intervals. This outcome raises the question of whether the findings are reproducible in a prospective multicenter setting. Although the study evaluated the interobserver image agreement, it did not evaluate variability in CMR acquisition. Issues with image interpretation reproducibility are a widespread phenomenon in diagnostic imaging.

Kitkungvan et al. (4) found that the long TI-DE-CMR sequence was feasible to perform in the presence of irregular cardiac rhythm, which is important to this population, and the findings were independent of field strength. In a post-hoc analysis, there were no significant differences in the diagnostic accuracy of CMR for thrombus detection in participants with atrial fibrillation compared with those in sinus rhythm. However, there were few thrombi, and the study was underpowered to detect a difference. Furthermore, the diagnostic ability of CMR to detect right atrial or right atrial appendage thrombi was not assessed.

A diagnostic study that confidently answers 2 clinical questions is appealing from a practical and financial point of view. However, for this approach to become incorporated into clinical practice, the optimal timing for exclusion of LA/LAA thrombus in patients referred for PVI should be determined. At our institution, pulmonary vein MRA is often performed 1 to 2 weeks before elective PVI, whereas TEE is performed the morning of the procedure. The approach described by Kitkungvan et al. (4) would require that CMR be performed in closer proximity (1 to 2 days) to the procedure to avoid the potential development of thrombus between CMR and PVI. The superior long TI-DE-CMR sequence would not require additional gadolinium beyond the standard pulmonary MRA. However, gadolinium carries risks of immediate hypersensitivity reaction (8), nephrogenic systemic fibrosis in patients with advanced kidney disease (9), and potential but unknown risks of residual brain gadolinium many years after exposure (10). The clinical implication of these factors is unknown.

Another imaging modality of potential utility in this arena is intracardiac echocardiography. Although moderately invasive, this technique is often used to guide transeptal puncture and to confirm catheter position during PVI. It has shown promise in identifying anatomic structures such as pulmonary veins as well as detection of LA/LAA thrombus (11). Could intracardiac echocardiography become a disruptive technology that replaces the need for both TEE and MRA/computed tomography angiography in this population? Similarly, could CMR displace TEE for exclusion of LA/LAA thrombus in patients before elective cardioversion from atrial fibrillation? This scenario may be especially attractive for those with a relative contraindication to TEE (e.g., esophageal stricture, Zenker’s diverticulum) or at higher risk for conscious sedation (e.g., sleep apnea).

Kitkungvan et al. (4) have made a valuable contribution to our knowledge base by extending the role of CMR from anatomic assessment of pulmonary veins to identification of LA and LAA thrombus. However, further study is needed to: demonstrate reproducibility; confirm results in a larger, multicenter study; and optimize the interval between CMR and PVI, especially for patients with atrial fibrillation for whom anticoagulation is discontinued between CMR and PVI. With these confirmations, CMR will then “kill two birds with one stone!”

REPRINT REQUESTS AND CORRESPONDENCE: Dr. Warren J. Manning, Department of Medicine, Cardiovascular Division, Beth Israel Deaconess Medical Center, 330 Brookline Avenue, Boston, Massachusetts 02215. E-mail: wmanning@bidmc.harvard.edu.

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**KEY WORDS** cardiovascular MRI, left atrial appendage, pulmonary vein isolation, thrombus