Editorial

Imaging the Left Atrial Appendage With Intracardiac Echocardiography

Leveling the Playing Field

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Amid the boundless scientific discovery of the mid-19th century, Henry David Thoreau reflected, "The question is not what you look at, but what you see." Scientific discovery emerges from novel perspectives on commonly observed phenomena. To truly "see" in the scientific sense, we must approach questions using the proper point of view. In this context, perspective is at least twice as important in comparative studies. To be fair and scientifically rigorous, each technique needs to be interpreted under optimal conditions.

Article see p 571

In this issue of *Circulation: Arrhythmia and Electrophysiology*, Saksena and colleagues[1] present the results of the Intracardiac Echocardiography Guided Cardioversion Helps Interventional Procedures (ICE-CHIP) study: a prospective comparison of intracardiac echocardiography (ICE) with transesophageal echocardiography (TEE) in a cohort of patients with atrial fibrillation (AF) undergoing invasive electrophysiology procedures. The major outcome variables were imaging completeness and concordance between the 2 imaging modalities in visualizing (1) the interatrial septum, (2) the left atrium (LA), and (3) the left atrial appendage (LAA). The major finding of clinical importance in the study was the lack of sensitivity of ICE to detect LAA thrombus when present on TEE.

The incidence of spontaneous LA thrombosis detected by TEE in patients with AF referred for AF ablation has been reported to be quite low, ranging from 0% to 1.6%.[2,3] Although the authors argue otherwise, TEE is widely considered to be the clinical gold standard in the diagnosis of LA thrombosis. Correlative studies with pathological specimens of ultrasound images are rare. To further complicate the situation, some patients undergoing TEE may have equivocal findings or acoustic artifacts that may be incorrectly interpreted as thrombus, thereby delaying their planned ablation procedure. Furthermore, TEE imaging cannot be safely performed in a minority of patients, thus creating a potential niche for ICE to exclude thrombus in selected patients.[4–7] Because the overall incidence of LA thrombus in patients referred for AF ablation is low and many centers already use ICE to facilitate their AF ablation procedures, using ICE to exclude thrombus in this population could minimize the excessive cost and risk associated with duplicative TEE studies.

As the authors highlight in their discussion, there are several methodological deficiencies in ICE-CHIP that may limit its broad applicability. First, although the authors report complete ICE imaging of the LA and LAA in 94% and 85% of patients, respectively, they offer no consistent methodology by which this survey was performed. It seems curious that little or no advice was given to operators in this study about how studies would be judged as "complete." In fact, 95% of patients with complete ICE studies did not have LAA pulsed Doppler flow velocity measured. Although we recognize that there is no generally accepted standard protocol for LAA imaging with ICE, it is axiomatic that fully imaging this complex 3D structure requires multiple 2D planes at a minimum. It is also our experience, as the authors assert, that there is a significant learning curve required both to navigate the phased-array ICE catheter within the heart and to interpret ICE images. This learning curve builds naturally on prior training in ultrasonography; however, there is no substitute for hands-on learning. Although not explicitly stated in the study methodology, it is assumed that all of the operators in the study were highly skilled in ICE imaging. Another unavoidable criticism is that the blinded reviewers certainly would easily discriminate the 2 imaging modalities during adjudication of the study end points.

The authors define concordance as the chief comparative metric in the study. Despite no difference in the overall proportion of ICE and TEE studies with LA and LAA spontaneous echo contrast, there was strikingly low concordance between the 2 imaging studies within individuals (65% and 60%, respectively). Conversely, there was a high concordance in detecting LA and LAA thrombus (97% and 92%, respectively). The large number of "normal" patients in this cohort may inflate the observed concordance of thrombus detection, thereby limiting its prospective value. Moreover, the markedly disparate concordance between ICE and TEE images for the related clinical entities of spontaneous echo contrast and thrombus discloses fundamental differences in the imaging techniques. The 2 patients with normal ICE studies who were found to have thrombus on TEE underscore this point.

It is not surprising that the image quality obtained with ICE was poor. In our experience, complete imaging of the LAA with phased-array ICE from the right atrium is achieved in a minority of patients, which may in part be due to variability in the thickness and the orientation of the interatrial septum

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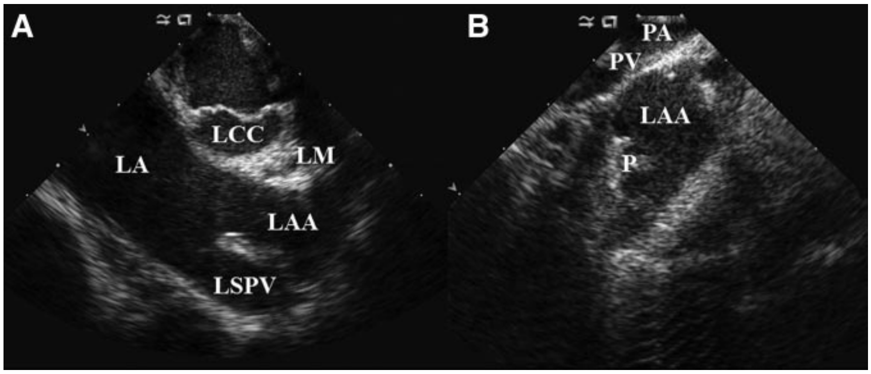

Figure. Two views of the LAA obtained with the phased-array AcuNav catheter (Siemens Acuson; Mountain View, Calif). A, The imaging catheter is placed through the tricuspid valve and rotated 180° to obtain a superior view. The aortic valve is seen in short axis, with the mouth of the LAA visible adjacent to the left coronary cusp. Note the proximity of the left main coronary artery to the LAA. The proximal segment of the left superior pulmonary vein also is visible in this view. B, The imaging catheter is now deflected superiorly, inserted through the pulmonic valve and directed leftward in the pulmonary artery. The LAA is now seen in the near field with detailed visualization of the pectinate musculature. LCC indicates left coronary cusp; LM, left main coronary artery; LSPV, left superior pulmonary vein; P, pectinate musculature; PA, pulmonary artery; PV, pulmonic valve.

through which the ICE images are obtained. When imaging from the right atrium, the LAA lies obviously in the echo far field; enlargement of the LA merely increases the distance of the LAA from the imaging transducer, which often requires lowering the imaging frequency to enhance the imaging field depth, often severely compromising far-field tissue resolution. This concept is analogous to the poor resolution of anterior structures (eg, the right ventricle) with TEE. Although it was not part of the present study, this anatomic limitation with ICE can be easily overcome by navigating the phased-array catheter in closer proximity to the LAA, commonly through the left pulmonary artery (Figure). Several reports have highlighted the importance of novel imaging planes to more completely visualize the LAA.[8,9] Finally, because there are multiple commercially available phased-array ICE systems with variable transducer functionality and navigability, it may be inappropriate to generalize the results of the trial to all ICE systems.

Like most trials, ICE-CHIP provokes more questions than it answers. It serves as a much-needed first step toward a just comparison of LA imaging with ICE and TEE. A pivotal trial will be very difficult to design because the critical end point (the finding of LAA thrombus) is rare in patients referred for AF ablation, and invasive examinations are hard to justify once a positive finding is made with TEE. Nonetheless, the operators who have experienced the exquisite detail achieved when imaging with ICE proximate to the LAA remain confident that ICE will eventually win the day.

Disclosures

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