Intracardiac Echocardiography-Guided Interventions
Do We Need Trials To Prove Equivalency/Superiority to Transesophageal Echocardiography?*

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It may be surprising to realize that the initial work in intracardiac echocardiography (ICE) imaging appeared in the early 1960s, preceding the development of interventional catheterization procedures (1). The increasingly sophisticated catheter-based structural interventions that have emerged over the past decade, stimulated the growth of ICE to become an established imaging modality that holds distinct advantages for use in practice such as transseptal access (2), atrial and ventricular septal defects closure (3), and radiofrequency ablation for cardiac arrhythmias (4). Furthermore, in our center, we use it exclusively to guide all congenital and structural interventional procedures. As opposed to transesophageal echocardiogram (TEE), ICE offers comparable, if not superior, imaging without the need for general anesthesia. The use of ICE also allows the interventionalist to simultaneously perform the procedure as well as the imaging part without the need of additional echocardiographic personnel.

The introduction of percutaneous left atrial appendage (LAA) closure into clinical practice has stirred considerable interest to reduce the risk of thromboembolism in patients with atrial fibrillation, with several clinical trials demonstrating high procedural success rates and noninferiority to warfarin for preventing embolic stroke (5). The procedure is fairly intricate with echocardiographic guidance being an essential tool at all stages of this procedure.

Pre-procedural echocardiography is required to screen suitable candidates and to define LAA morphology and dimension. Periprocedural echocardiography has a major role in guiding and deployment of the device as well as for screening for complications and assessment of procedural success. Post-procedural echocardiography is important in the surveillance and monitoring of long-term outcome, including complications. TEE is widely considered the gold standard tool in visualizing the LAA and is typically used to guide implantation of the LAA device. To obviate the need for endotracheal and esophageal intubation, there has been increased interest in performing the procedure under ICE guidance only. Over the past decade, there have been several reports discussing the utilization of ICE in guiding LAA closure; however, to date, comparative studies between the 2 imaging modalities in guiding LAA closure are lacking (6,7).

In this issue of JACC: Cardiovascular Interventions, Berti et al. (8) contribute significantly to the current experience regarding the utility of periprocedural ICE as an alternative to TEE in guiding LAA occlusion procedures. This is the largest reported observational study from 2 centers addressing the application of ICE as an imaging modality in guiding LAA device closure. They report the short-term and mid-term results from 121 patients with mean age of 77 years, who underwent ICE-guided percutaneous LAA occlusion using Amplatzer Cardiac Plug I and II devices (St. Jude Medical, St. Paul, Minnesota). All patients had non-rheumatic atrial fibrillation with high stroke risk and absolute contraindication for oral anticoagulation. The ICE catheter was positioned either in the right atrium or coronary sinus. From those positions, the LAA dimension was defined and followed by implantation of the appropriate device size. The LAA dimension

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obtained by ICE correlated well with those obtained by angiography and, to a lesser degree, with pre-procedural TEE. In the majority of cases, the initial device size selected based on ICE measurements was implanted successfully. Excellent technical (96.7%) and procedural outcomes (93.4%) were achieved with 4 patients having major adverse events. These data support the pre-existing literature reporting the feasibility of ICE imaging in guiding LAA device closure as an acceptable alternative to TEE (9). However, what conclusions can be drawn regarding the broad applicability using ICE to assist in such interventions? Although we do believe that ICE imaging is able to perform the intraprocedural tasks typically provided by TEE, nevertheless, as the investigators highlight in their discussion, there are several deficiencies in the study that may limit its broad applicability. Because accurate echocardiographic measurement of the LAA anatomy is critically important for successful device closure, using ICE instead of TEE to routinely guide LAA device implantation would only be clinically practical if ICE imaging were able to produce high-quality images consistently. Although we recognize that there is no generally accepted standard protocol for LAA imaging with ICE, it is self-evident that complete imaging of this complex 3-dimensional structure requires multiple 2-dimensional planes at a minimum to properly define its dimensions. In this study, LAA imaging was obtained by positioning the ICE catheter either in the right atrium or coronary sinus; however, the investigators offer no consistent methodology (views) by which the imaging was performed or description of the quality of the images acquired. In our experience, right atrial views are rarely sufficient to visualize the complex anatomy of the LAA, partly due to the variable interatrial septum orientation and distance from the LAA to the ICE position in the right atrium (the LAA lies in the echo far field, which often requires lowering the frequency to increase the imaging field depth, resulting in significantly compromised far-field tissue resolution). This imaging limitation can be easily overcome by placing the ICE catheter in the left pulmonary artery, in closer proximity to the LAA. Similarly, positioning the catheter in the left pulmonary artery offers superior image quality of the LAA and ease of probe manipulation as opposed to that in the coronary sinus (10). Certainly, there is a significant learning curve in order to gain proficiency in navigating the ICE catheter within the heart and to obtain pristine images. 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 investigators report a high level of agreement regarding device size selection based on ICE and pre-procedural TEE imaging. However, the validity of such a conclusion is compromised as the operators were not blinded to the 2 imaging modalities. Moreover, we agree with the investigators that it may be inappropriate to generalize the results of the study to all ICE systems, because a wide variety of ICE systems is commercially available with variable transducer functionality. Finally, patients left with relevant residual peridevice leakages experience no real benefit from the procedure and have to stay on anticoagulation therapy. The investigators outline in their discussion the importance of residual peridevice leak; however, they do not comment on either the echocardiographic or angiographic assessment of device sealing of the LAA, which is an important variable of the success of the procedure.

The investigators should be praised for their excellent technical and procedural outcomes with results very comparable to those reported with TEE-guided implantation (11). Although imaging with ICE is invasive and may increase costs, it offers less procedural discomfort for the patient and potentially reduces the procedural time. It also eliminates the need for an anesthesiologist and echocardiographic personnel, enhancing in turn the cost-effectiveness of using this imaging tool. Although it can be concluded from this study that the use of periprocedural ICE is feasible and safe in guiding LAA device closure, this study, like most observational studies, serves as an initial step toward a pivotal trial that will compare the 2 imaging modalities in relation to LAA device closure. Perhaps future endeavors should be directed toward eliminating the need for pre-procedural TEE such that all the tasks required for LAA device closure can be achieved solely by ICE imaging thereby minimizing the excessive cost and risk associated with duplicative TEE studies.

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