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LETTERS TO THE EDITOR

3D Real-Time TEE During Pulmonary Vein Isolation in Atrial Fibrillation

Real-time 3-dimensional transesophageal echocardiography (RT3DTEE) has the potential of giving fluoroless real-time images during electrophysiological procedures (1). We sought to prospectively evaluate the ability of RT3DTEE to visualize the pulmonary vein (PV) ostia and to compare RT3DTEE and the electroanatomic mapping system (EAMS) for localizing the ablation catheter tip during pulmonary vein isolation (PVI).

A total of 22 patients underwent PVI under general anesthesia. Following an RT3DTEE-guided double trans-septal puncture, a circumferential multipolar catheter and an irrigated ablation catheter were positioned in the left atrium (LA). For the creation of the atrial geometry, the EAMS and fluoroscopy were used. Ablation was performed to encircle the antrum of the veins.

RT3DTEE (Philips iE33 ultrasound system with an X7-2t probe, Philips Medical Systems, Andover, Massachusetts) was performed as previously described

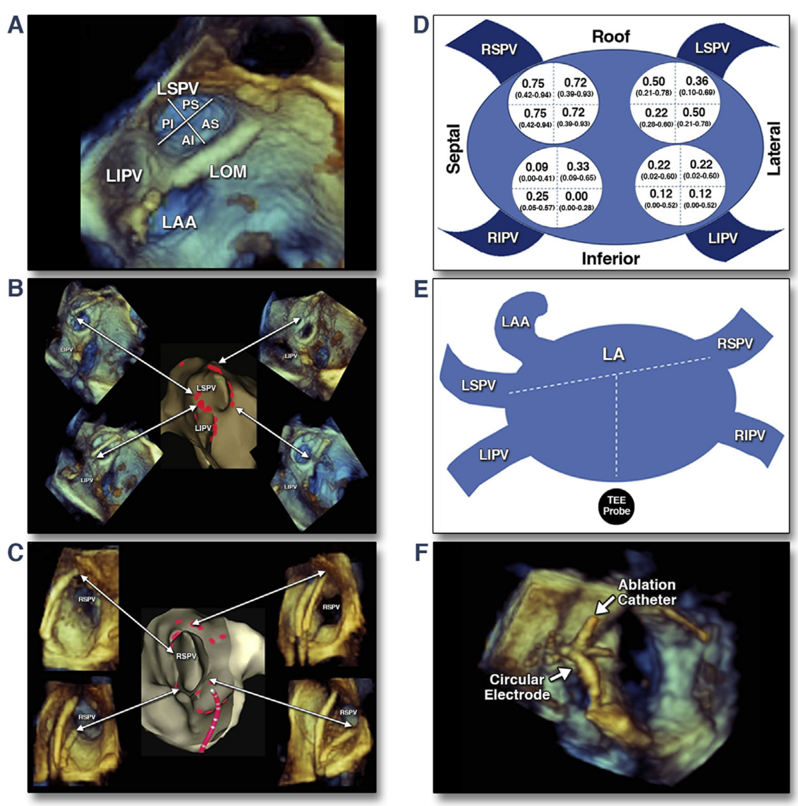

FIGURE 1 RT3DTEE During Pulmonary Vein Isolation

(A) Image of the left superior pulmonary vein (LSPV) divided into 4 quadrants: anterosuperior (AS), anteroinferior (AI), posterosuperior (PS), and posteroinferior (PI). The ablation catheter is tracked in different quadrants of the LSPV **(B)** and right superior pulmonary vein (RSPV) **(C)**. **(D)** The pulmonary vein ostia and their quadrants from an anteroposterior view are shown along with the agreement between real-time 3-dimensional transesophageal echocardiography (RT3DTEE) and the electroanatomic mapping system for the localization of the catheter tip (95% confidence intervals are shown in parentheses). **(E)** The relative position of the transesophageal echocardiography (TEE) probe and the left-rotated left atrium (LA) (superior view) determine a more open angle of visualization for RSPV than for LSPV. **(F)** Overlap of the ablation catheter and the circular mapping electrode. The bubbles may interfere with the discrimination between the 2 catheters. LAA = left atrial appendage; LIPV = left inferior pulmonary vein; LOM = ligament of Marshall; LSPV = left superior pulmonary vein; RIPV = right inferior pulmonary vein.

(1). The left superior pulmonary vein (LSPV) was visualized by using the zoom modality toward the left atrial appendage followed by a counterclockwise rotation. From that position, a gentle angulation of the 3-dimensional image permitted visualization of left inferior pulmonary vein (LIPV). When the septum was in an "en face" perspective, a left-to-right 90° rotation disclosed the right PVs.

Visualization of the PVs by RT3DTEE was categorized as "optimal" if the whole ostium was visualized, "partial" if the ostial circumference could be partially seen, or "none" if the PV ostium could not be identified or a good and stable visualization was not possible.

To assess the position of the ablation catheter tip, each ostium was divided into 4 quadrants (Fig. 1A). Each position visualized on echocardiography was assigned to a quadrant, and the same position was assigned by 2 blinded electrophysiologists (M.A. and F.R.) using EAMS (Figs. 1B and 1C).

The proportion of optimal, partial, and absent visualization, as well as the true positive rate for catheter location by RT3DTEE compared with EAMS, was analyzed using logistic regression.

No periprocedural or post-procedural complication was reported through 6 months of follow-up. In 4 patients, visualization of all PVs was possible, and 3 of 4 PVs were visualized in 11 patients. In 2 patients, no PV could be visualized. The visualization was optimal in 0.63 (95% confidence interval [CI]: 0.52 to 0.73) of the LSPV cases and in 0.77 (95% CI: 0.67 to 0.85) of the right superior pulmonary vein (RSPV) cases. One-half of the right inferior pulmonary vein (RIPV) (95% CI: 0.39 to 0.60) and 0.47 of the LIPV (95% CI: 0.35 to 0.59) cases could not be seen. No chest deformity distorting the heart was present in any case. The overall true positive rate for localization of the ablation catheter tip per vein was low: 0.38 (95% CI: 0.31 to 0.46). The result was highly dependent on the vein (logistic model $p < 0.001$); RSPV showed a significantly better agreement than RIPV and LIPV ($p < 0.008$) (Fig. 1D).

Our results suggest that RT3DTEE has limited value in identifying PV ostia and catheter location during PVI. These results are contradictory to those of Ottaviano et al. (2), who performed the same echocardiographic technique using the cryoballoon for PVI. Our negative results may be due to a number of reasons. First, the natural left rotation of the heart in the chest may give a sharper angle between the transesophageal echocardiography probe and the LSPV ostium compared to the RSPV (Fig. 1E). LIPV and RIPV are less likely to be visualized due to their relative posterior position, the sharper take-off from the atrium, and the smaller size of the ostia compared with the superior veins. The supine position of the patient could produce an anteroposterior pressure of the atrium. In addition, having a rigid endotracheal tube may attenuate the free movements of the probe inside of the esophagus.

The metallic tip of the ablation catheter may generate significant acoustic artefacts (Fig. 1F) that, when added to the previously mentioned handicaps, could explain the poor accuracy in the localization of the ablation catheter tip in comparison with EAMS.

Further studies are needed to evaluate whether the use of RT3DTEE may have value in guiding PVI.

Marta Acena, MD
François Regoli, MD, PhD
Francesco Fulvio Faletra, MD
Massimo Tritto, MD
Catherine Klersy, MD, MB
Romina Murzilli, MD
Francesca Scopigni, MD
Maria Penco, MD
Elena Pasotti, MD
Tiziano Moccetti, MD
Angelo Auricchio, MD, PhD*
*Division of Cardiology
Fondazione Cardiocentro Ticino
Via Tesserete 48
CH-6900 Lugano
Switzerland
E-mail: Angelo.Auricchio@cardiocentro.org
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Fatigue Crack Growth Under Pulsatile Pressure and Plaque Rupture

Identification of vulnerable plaque pre-rupture is extremely important for patient risk stratification. The mechanism of plaque rupture is still not entirely clear, but it is thought to be a process involving multiple factors. From a biomechanical viewpoint, plaque rupture is usually seen as a structural failure when the plaque cannot resist the hemodynamic