Version 7b

**Real-Time 3D Transesophageal Echocardiography: Development of a  
Protocol for Use in Atrial Fibrillation Ablation Procedures**

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Background: Three dimensional transesophageal echocardiography (3D TEE) is an emerging tool for guiding catheter-based ablation procedures. A literature search revealed no published guidelines for 3D TEE during atrial fibrillation ablation (AFA) procedures.

Methods: We evaluated 14 patients during AFA with both 2D and 3D TEE using multiple modes to develop a protocol for subsequent patients. All patients received general anesthesia and had an esophageal temperature probe. Images were obtained utilizing the iE33 Ultrasound System (Philips) with the X7-2t, a fully-sampled matrix array TEE transducer with ~3000 elements. We utilized x-plane imaging and live 3D zoom with appropriate cropping and image optimization.

Results: After review of our initial experience, we developed a five step protocol for use of the 3D TEE system during AFA:

1) 2D x-plane studies of heart/valves and Doppler flow studies of the visualized pulmonary veins were obtained at baseline. The left atrial (LA) appendage was evaluated for thrombus, particularly in those patients who did not have a pre-operative TEE.

2) During atrial transeptal puncture, TEE was used as an adjunct to intracardiac ultrasound (UltraICE, Boston Scientific) and fluoroscopy. Both x-plane and 3D modes were useful. The tilt-up-then-left (TUPLE)1 maneuver was used to correct angulation and place the 3D images in the appropriate right atrial anatomic view.

3) During electroanatomic mapping, an electrophysiologist’s (EP) view of the LA was developed for relevant structures using the TUPLE maneuver. The LA EP view enabled direct visualization of the multi-electrode mapping catheter while facilitating highly accurate registration of LA anatomy with the 3D navigation system (EnSite NavX, St Jude Medical, Inc.). 3D imaging was especially useful in patients who did not receive pre-operative pulmonary vein (PV) mapping with CT or MRI to determine the patency and number of PVs, and the presence of a common os.

4) During ablation, 3D TEE in the EP view enabled live visualization of LA structures, facilitating catheter placement and enabling direct visualization of tissue contact, particularly in the Ligament of Marshall region and the carinas of the PVs. Using these techniques, we found excellent concordance between the 3D TEE and NavX images. Visualization of the ablation catheter was aided by interrogation of irrigation flow at the tip.

5) With acute temperature elevations during AFA, side-angulation of the TEE probe was used to displace the esophagus.

Conclusions: Use of this comprehensive 3D TEE protocol standardizes image acquisition during AFA. This protocol can be modified according to the clinical situation, allows acquisition of relevant anatomic structures, and facilitates development of technical skills. 3D TEE is a technological advance with its potential yet to be fully realized. The establishment of a protocol provides a framework facilitating the use of 3D TEE during AFA.

1 Saric, M; Perk, G; Purgess, JR; Kronzon, I. Imaging atrial septal defects by real-time three-dimensional transesophageal echocardiography: step-by-step approach. *Journal of the American Society of Echocardiography*. 2010; 23: 1128