Radiofrequency Ablation of Atrial Flutter

Etienne Delacretaz, MD; William G. Stevenson, MD; Gayle L. Winters, MD; Peter L. Friedman, MD, PhD

A 33-year-old man with cardiac and pulmonary sarcoidosis developed ventricular tachycardia managed with an implantable cardioverter-defibrillator and amiodarone therapy. Subsequently, episodes of atrial flutter triggered spurious therapies from the implantable cardioverter-defibrillator, and the patient underwent electrophysiological evaluation. Common atrial flutter (caudocranial septal and counterclockwise right atrial activation) was induced, with a cycle length of 270 ms. Entrainment with a postpacing interval equal to the flutter cycle length was demonstrated in the right atrial inferior isthmus (Figure 1A), indicating that this region was part of the macroreentrant circuit. A steerable 7F quadripolar 4-mm-tip thermistor radiofrequency (RF) ablation catheter (EP Technologies, Inc) was used to make a line of RF lesions extending from the tricuspid annulus to the inferior vena cava until bidirectional isthmus conduction block could be demonstrated. Atrial flutter ended during RF current application (Figure 1B). Subsequently, there was no recurrence of atrial flutter. However, progressive heart failure and frequent episodes of ventricular tachycardia continued, and heart transplantation was performed 3 weeks after RF ablation of atrial flutter. The explanted heart was examined after removal. A diaphragmatic view of the heart illustrates the relationship of the right atrial inferior isthmus with the coronary vessels (Figure 2). A longitudinal section of the right AV groove is seen in Figure 3A. RF lesions extended to depths up to 2 mm, whereas the distance from the endocardial surface at the ablation site to the right coronary artery is 4 mm. Microscopically, the RF lesions were characterized by coagulation necrosis with hemorrhage surrounded by a rim of granulation tissue (Figure 3B).

Ablation of atrial flutter has been established to be a safe procedure. Despite the proximity of the right coronary artery, no arterial damage has been reported thus far. To some extent, the arteries are protected by luminal blood flow, which serves as a heat sink, keeping the vessel wall cool when surrounding tissue is heated. However, with advances in technology, ablation catheters capable of creating larger and deeper lesions are entering clinical trials. The images in the present report showing proximity of the right coronary artery to the region targeted for ablation of common atrial flutter suggest that ablation systems capable of making deeper lesions require cautious evaluation if they are to be applied to ablation of atrial flutter.

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From the Department of Medicine, Cardiovascular Division, and the Department of Pathology (G.L.W.), Brigham and Women’s Hospital, Harvard Medical School, Boston, Mass.

Correspondence to W.G. Stevenson, MD, Cardiovascular Division, Brigham and Women’s Hospital, 75 Francis St, Boston, MA 02115.

The editor of Images in Cardiovascular Medicine is Hugh A. McAllister, Jr, MD, Chief, Department of Pathology, St Luke’s Episcopal Hospital and Texas Heart Institute, and Clinical Professor of Pathology, University of Texas Medical School and Baylor College of Medicine.

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Figure 1. Pacing and RF ablation at right atrial isthmus. A, From top, surface electrogram leads II, V₁, and V₆ and intracardiac tracings from high right atrium (HRA), pacing site in right atrial inferior isthmus (Abl), and right ventricular apex (RVA). Common atrial flutter is present with a cycle length (CL) of 270 ms. Last 3 stimuli (S) of a stimulus train at a cycle length of 240 ms are shown. Stimuli entrain tachycardia by continually resetting reentry circuit, as indicated by acceleration of all atrial electrograms to pacing rate during stimulation. Postpacing interval (PPI) approximates tachycardia cycle length, suggesting that inferior isthmus is within macroreentrant circuit. B, Surface ECG (leads I, III, V₂, and V₆) and atrial electrogram (HRA) during application of RF current. RF terminates atrial flutter during construction of a line of lesions between tricuspid annulus and inferior vena cava.

Figure 2. Posterior (diaphragmatic) view of heart with arterial and venous anatomy and its relationship to right atrial inferior isthmus (highlighted with rectangle). RCA indicates right coronary artery; CS, coronary sinus.

Figure 3. Top, Longitudinal section of posterior aspect of right AV groove with atrium, ventricle, tricuspid valve, and right coronary artery in AV groove fat pad. Dark brown lesions are areas of coagulation necrosis corresponding to sites at which RF current was applied. Maximal depth of lesion is 2 mm. Distance from endocardial surface at ablation site to edge of coronary artery is 4 mm. Bottom, Low-power microscopic section (hematoxylin and eosin, magnification ×33) of RF ablation site at right AV groove. There is a clear-cut coagulation necrosis of myocardium with surrounding loose granulation tissue and fat necrosis.
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