

## EDITORIAL COMMENT

# Epicardial Approach to the Ablation of Ventricular Tachycardia in Coronary Artery Disease: An Alternative or Ancillary Approach\*

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In this issue of the *Journal*, Sosa et al. (1) evaluate the feasibility, safety and efficacy of an epicardial approach to ablate ventricular tachycardia secondary to myocardial infarction. Sosa and his colleagues have recently introduced the technique of epicardial mapping to approach and ablate ventricular tachycardia due to Chagas' disease (2,3). The technique involves introducing a standard ablation catheter into the pericardial space using a subxiphoid pericardial puncture technique (4). Having successfully ablated ventricular tachycardia due to Chagas' disease in which the reentrant circuits are presumed to be epicardial, the authors speculated that a similar technique could be used to treat

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postinfarction ventricular tachycardias that have a critical epicardial or subepicardial component. Because previous intraoperative mapping of ventricular tachycardias associated with prior infarction suggested that critical components of the reentrant circuit or of the circuit itself might be present on the epicardium more commonly in inferior wall infarction (5–8), the authors sought to evaluate the utility of this technique in such patients. The authors selected 14 consecutive patients with recurrent and drug refractory sustained monomorphic ventricular tachycardia that was tolerated enough to map in order to undergo a radiofrequency (RF) ablation. All patients in the series had an old inferior infarction and, of interest, had at least two episodes of monomorphic ventricular tachycardia prior to hospitalization. Approximately two thirds of the ventricular tachycardias had a left bundle branch block configuration. The mean tachycardia cycle length was relatively long ( $412 \pm 51$  msec). Spontaneous recurrences are stated to have occurred in 10 patients despite antiarrhythmic drugs, which appears to be discordant from their initial statement that all

14 patients had drug-refractory ventricular tachycardia. The mean ejection fraction of these patients was  $50 \pm 12\%$ , which is substantially higher than most prior series of patients with ventricular tachycardia undergoing either RF ablation or intraoperative mapping and endocardial resection (9–11) in which ejection fractions were generally in the 25% to 35% range. Even more interesting is the fact that three patients had patent coronary arteries and the remaining essentially had single vessel occluded (right coronary artery) disease with only two patients having any diseases (both noncritical) in the left coronary tree. Thus, this group of patients is highly selected and remarkably different from any others undergoing similar procedures.

The pericardial space was entered through a subxiphoid approach as previously described (2–4). Small amounts of contrast media are injected using this approach to document when the needle tip is inside the pericardial space. Thus, contrast media can accumulate in the mediastinum if the needle is not in the pericardial space. Once the pericardial space is entered with the needle, a guide wire is passed through the needle over which a sheath/introducer is passed. The introducer and guide wire are removed and a standard ablation catheter is passed through the sheath and positioned in the pericardium. The authors state that there was no problem in navigating the catheter through the pericardial space to the epicardial surface over the prior inferior infarction where the presumed tachycardias arose (12). No pericardial adhesions were found.

Tachycardias were then induced using standard programmed stimulation and mapping was undertaken. It is of note that in not a single patient was standard entrainment mapping used. The authors stated a high stimulation threshold made this method of identifying critical components of the reentrant circuit unusable. Consequently, they used an empiric thermal mapping technique in which short applications of RF energy were given at "good sites." If the tachycardia terminated, RF energy would be maintained for an additional 30 s. If the tachycardia did not terminate, the catheter was manipulated until "better electrograms" were obtained and new thermal mapping pulses were given. The authors failed to specify what "good" or "better" electrograms were. It remains difficult to understand why pacing techniques were not attempted to more precisely define appropriate ablation sites, even if high current were used.

The authors recognize the potential danger of damaging epicardial coronary vessels during application of RF energy due to potential proximity of the RF application and the coronary tree. They attempted to minimize the danger by using three approaches: 1) observing the distance of the catheter from the coronary arteries as demonstrated by coronary arteriography at the beginning of the procedure; 2) observing the distance between the ablating catheter and the epicardial veins (based on the assumption that the coronary

\*Editorials published in *Journal of the American College of Cardiology* reflect the views of the author and do not necessarily represent the views of JACC or the American College of Cardiology.

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artery runs near the vein); or 3) guessing where the catheter was in relation to the apex of the heart and the coronary sinus catheter which was used as a reference. The authors then state, based on these "maneuvers," they positioned the catheter at least 12 mm from where they thought a coronary artery was before RF energy was delivered. Unfortunately, there is no validation as to how close the catheter was to the coronary artery. Clearly, angiography done during sinus rhythm provides an anatomic reference that may be 1 to 3 cm removed from where the catheter position is during ventricular tachycardia. Thus, the relationship between the RF applications and the exact sites of the coronary arteries remains uncertain. Although the short-term results may indicate "safety," the long-term outcome regarding damage to coronary arteries requires longer follow-up.

As to the efficacy of this technique, the results of the current study were underwhelming. Thirty ventricular tachycardias were induced in the 14 patients but only 18 were considered mappable. Of these, only seven (39%) were terminated by an epicardial RF application, and an additional three were interrupted by standard endocardial ablation (the method of mapping is undescribed). Neither epicardial nor endocardial mapping and ablation could terminate the remaining eight mappable ventricular tachycardias. Thus, only 55% of mappable ventricular tachycardias were able to be terminated by either epicardial or endocardial approaches. Twelve of the tachycardias could not be mapped because of hemodynamic intolerance. It is unstated how many of the tachycardias that were ablated were the same as the spontaneous clinical tachycardia of the patient nor is it stated how many of the nonmappable tachycardias (in the setting of the catheterization laboratory and pericardial mapping) were similar to the spontaneously occurring clinical tachycardia. Most patients required several RF pulses. It would be important to know whether these pulses can be associated with permanent injury to the heart or whether in fact they may lead to future arrhythmogenicity. Radiofrequency application, via the pericardial space, may not produce the same lesion as an endocardial approach in which the tip of the catheter is bathed in blood. Therefore, the possibility that these lesions may ultimately be proarrhythmic requires evaluation. No significant complications were experienced during the procedure, and the seven patients in whom epicardial ablation was successful have remained asymptomatic for  $14 \pm 2$  months. The authors state that two patients are taking antiarrhythmic drugs and two patients are not taking antiarrhythmic drugs, but that leaves three patients unaccounted for.

## DISCUSSION

The current article by Sosa et al. (1) describes the potential utility of an epicardial approach to ventricular tachycardias associated with inferior myocardial infarction. Since the patients in whom this approach was applied are markedly different than most other patients in whom catheter ablation

or surgical ablation is undertaken, it is uncertain how broadly applicable this technique will be in the general population of patients with ventricular tachycardia secondary to coronary artery disease. As previously described, most of the so-called epicardial tachycardias occur with nontransmural inferior wall infarctions. This represents between 5% and 15% of all patients with ventricular tachycardias undergoing operative therapy of ventricular tachycardia (13-17). It is of note that in the patient population described in this article, only one had an aneurysm, and the average ejection fraction was 50%, a figure significantly higher than reported in other series of surgical or catheter ablation of ventricular tachycardias. Although the successful ablation of tachycardias from the epicardium, and even the recording of diastolic activity at that site, suggests that at least a critical component of the reentrant circuit lies in the epicardium or subepicardium, it does not prove it. It certainly does not prove that the entire reentrant circuit is epicardial. Simultaneous endocardial, intramural and epicardial mapping would need to be undertaken to prove this. All this can prove is that RF energy can produce a lesion that destroys a critical component of the reentrant circuit. It should be stated that intraoperative and/or catheter-based endocardial approaches have also been successful in ablating such tachycardias in similar patients (18,19). Thus, successful ablation may reflect the extent of the RF lesion but does not necessarily tell you the exact location of the circuit. Clearly, if the wall is thin, application on either the endocardial or epicardial surface can disrupt circuits that are within 5 mm of the site of application of the RF energy.

It is somewhat surprising that the success rate of the epicardial approach is so low. Prior reviews of RF ablation of ventricular tachycardia in humans demonstrate at least a 70% acute success rate (8-11). Perhaps if entrainment mapping were used on the epicardium, the success rate of this approach would be better. Theoretically, the epicardial approach has several potential advantages. Endovascular complications would be reduced, including arteriovenous fistulas, pseudoaneurysms, arterial emboli from the aorta, valve damage, stroke from the coagulum produced by the ablation itself and the complications of heparin. However, there is an increased potential for tamponade and perforation of the heart with the initial attempt at entering the pericardium, risk of coronary occlusion because of the limitation of accurately evaluating how close the RF application is to the coronary arteries, mediastinitis, and other complications of extravascular radiocontrast material, and apparently, a lower success rate of ablation. Nevertheless, technological advances should facilitate the pericardial entry, and the ability to more precisely localize the critical site in the circuit required for successful ablation, using entrainment mapping, would be expected to lead to a greater success rate of ablation using this technique. At this time, however, the endocardial approach should be preferred. An epicardial approach to ventricular tachycardias associated with coronary artery disease should be reserved for those

patients in whom a standard endocardial approach fails. At this time, the epicardial approach should be considered "an approach in evolution," and should be limited to centers dedicated to exploring the development of this technique. As such, it remains an ancillary, not alternative, approach for the ablation of infarct-related ventricular tachycardia.

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