INNOVATIVE TECHNIQUES

Mechanical Displacement of the Esophagus to Allow Pulmonary Vein Isolation During Left Atrial Ablation

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ABSTRACT. Esophageal injury from radiofrequency ablation of the left atrium is a rare, but devastating complication of the approach. When the esophageal location overrides or approximates the pulmonary veins, invasive electrophysiologists are left with a difficult decision to either isolate the pulmonary vein and risk untoward injury of the esophagus or to not complete the procedure and risk procedural efficacy. One alternative option is to move the esophagus with an endoscopic probe. A recent case series reported that this approach was feasible and allowed pulmonary vein isolation. However, the investigators did not show if they displaced the esophagus or merely distorted it. We report a case series in which the esophagus is imaged during manipulation with a transesophageal probe and demonstrate that the organ was successfully displaced in two of four patients, allowing pulmonary vein isolation using radiofrequency energy delivery. Long-term follow-up was favorable in all patients without clinical evidence of esophageal injury. Two of the patients remain in sinus rhythm without antiarrhythmic medications.

KEYWORDS. ablation, arrhythmia, atrium, fibrillation, myocardium, esophagus.

Introduction

Radiofrequency ablation of the left atrium continues to be a viable and increasingly used therapeutic option for medically refractive atrial fibrillation (AF). The success and use of the technique has increased as procedural complications have been minimized. Esophageal injury that has a subacute presentation and is often fatal remains one of the most devastating complications of the approach.1 Since the esophagus lies directly posterior to the thin-walled left atrium, it is vulnerable to thermal injury during radiofrequency energy delivery. Fortunately, the complication is rare, but the paucity of reported cases limits our ability to define patient and technique risk characteristics.

In the absence of a defined means to minimize the complication, there exist opportunities to introduce techniques to improve safety. Recently Chugh et al2 reported a case series of 12 patients in which an attempt to move the esophagus with an endoscopic probe was made to allow pulmonary vein isolation. In this study, the authors successfully moved the esophagus in 10 patients with a maximal displacement from the left-sided pulmonary veins of 2.4 cm, and 2.1 cm for the right pulmonary veins. The displacement was measured using fluoroscopy. A major limitation to their findings was the uncertainty of true mechanical displacement versus anatomic distortion.3 If mechanical displacement occurred, then the safety profile likely improved through increasing distance from the energy source and vulnerable tissues. In contrast, if mechanical distortion of the esophagus occurred, then the safety profile may have worsened by increasing the potential area of vulnerable tissue that approximated the posterior left atrium. Herein, we present a case series of patients with medically refractive AF and multiple prior ablations in which we sought to mechanically displace the esophagus to allow successful isolation of the pulmonary veins.

Case series

In order to explain the technique, an example case will be highlighted with summation of the other cases. A
isolated the vein along the side approximating the esophagus. Next, cryothermal energy is used to block into the pulmonary vein, which may compromise after the line is complete in order to obtain entrance often necessary to perform ablation closer to the vein difficulty in making the lines complete. In addition, it is limited by the extent of ablation required and the inferior line along the coronary sinus. This approach esophagus, the superior line along the left atrial roof, and encircling lesion with the posterior line medial to the ablative attempt. The first was to create a very large given her symptomatic state and that it was her third considered three potential approaches to isolate the vein immediately adjacent to the left superior pulmonary vein. We next, cryothermal energy delivery, it is typically not transmural or significantly disruptive to the underlying connective tissue. However, with a persistent safety risk and a question of efficacy equivalence compared with radio-frequency ablation, we decided first to try a different approach. This approach was to attempt to displace the esophagus away from the left superior pulmonary vein using a transesophageal echocardiography probe.

We first sought to understand if the probe distorted or displaced the esophagus. Prior to introduction of the probe, 10 ml of barium contrast was introduced into the esophagus just superior to the left atrium (Figure 1). The probe was then placed at a level just below the pulmonary vein and deflected. The barium within the esophagus showed that the structure was displaced with minimal distortion (Figure 2). We then delivered radio-frequency energy (30 watts, maximum temperature of $32^\circ C$) to the posterior wall with a line close to the left pulmonary vein orifice. The probe was removed after completion of the posterior line, returning the esophagus to its native position. Using a nasogastric tube, the barium was sucked out of the esophagus and stomach. The remainder of the procedure included the creation of wide area circumferential ablation lesions to isolate the veins; a left atrial roof line; a mitral annular line with confirmation or medial-to-lateral and lateral-to-medial block; and a low septal line to connect the right-sided encircling lesions with the mitral annulus. Assessment of the prior cavitricuspid isthmus linear ablation showed that it was complete.

After completion of this case, three additional patients (two men, one woman, average age 66 years) also had

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**Figure 1:** A fluoroscopic image (left anterior oblique projection) of the left atrium. A circular mapping catheter was placed in the left common pulmonary vein (LCPV). The ablation catheter is marked. The esophagus location prior to introducing the transesophageal echocardiography probe is marked with 10 ml of barium.
procedures complicated by an esophageal location that approximated a pulmonary vein and did not allow complete isolation (one right superior pulmonary vein, two left superior pulmonary veins). Similar methods were used for each case that was performed under general anesthesia with paralytics. In one case, the esophagus was successfully displaced to allow complete pulmonary vein isolation using radiofrequency ablation. In the other two, despite multiple attempts with repositioning the probe within the esophagus, the complete esophagus body was not displaced beyond the site of anticipated energy delivery. In these two cases, cryoenergy was used as an alternative (−80°C, 4 min per application) with successful pulmonary vein isolation.

Over a follow-up period of 10.5 ± 2.2 months, two patients remained free of AF, and two had recurrences after the 3-month blanking period and were in sinus rhythm but remained on antiarrhythmic medications. There were no observed clinical complications with the esophagus during the procedure or over the follow-up period.

Discussion

This case series demonstrates that the esophagus can be displaced with a transesophageal echocardiogram probe with minimal luminal distortion. The use of barium contrast was helpful in delineating the esophageal lumen and assuring that displacement had occurred. Until more data are available to answer the question regarding displacement versus distortion, additional imaging with an agent such as barium under fluoroscopy is needed to assure that the esophagus is actually moved. Nonetheless, this case shows that displacement is feasible and allows isolation of the targeted pulmonary veins with radiofrequency energy.

In patients treated for their AF with a catheter-based ablation, the esophageal location is often near or adjacent to the pulmonary veins. With this scenario, the operator faces the decision of not isolating the vein, which may compromise the efficacy of the procedure versus exposing the esophagus to potential injury. There is no currently available approach that can remove the risk of untoward injury. The utility of intraluminal temperature probes is significantly limited by the need to move them to follow the catheter tip location as much as possible; significant temperature discrepancies between the external and internal esophagus; and thermal latency of heat transfer that makes detection too late to minimize significant external heating.5,6 Energy delivery techniques can be used to limit deep tissue heating by minimizing lesion depth, but these do not remove the
risk completely.\textsuperscript{5} Displacement of the esophagus and maximizing the distance from the energy source is likely the best possible means to complete the pulmonary vein isolation and minimize untoward thermal injury until new technologies become available. However, this approach is not without risk, as the probe can cause esophageal injury during insertion and may serve as radiofrequency energy antennae and increase injury. These risks were born out in the early surgical experience in which there was a higher risk of atrioesophageal fistula when a transesophageal echocardiogram probe was used.\textsuperscript{7} Given these potential risks, the probe should be removed as soon as possible after energy delivery is complete in the targeted areas.

References


