

Examining the Risks and Benefits of Transesophageal Echocardiogram Imaging During Catheter Ablation for Atrial Fibrillation

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Transesophageal echocardiography (TEE) has become a routine diagnostic tool. The use of TEE in clinical practice is diverse, extending from the intraoperative management of patients who undergo cardiac surgery, aortic surgery, lung transplantation, and liver transplantation,¹⁻⁵ to emergent assessment of patients in the emergency room or intensive care unit,^{5,6} to the evaluation of left atrial appendage anatomy and function before cardioversion in patients with persistent atrial fibrillation (AF).^{7,8}

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Although TEE is a noninvasive diagnostic technique that is considered relatively safe across a broad spectrum of patients, severe life-threatening complications have been reported.⁵ The reported rates of major TEE-related complications range from 0.2% to 0.5%.^{5,9,10} Lennon et al¹¹ examined patients for late complications and estimated a higher rate of gastrointestinal injuries of 1.2%. Mechanical injury to the esophageal and gastric body can lead to life-threatening bleeding. The estimated risk of significant gastrointestinal bleeding is 0.02% and 1.0%.^{10,11} Patients with friable mucosal tissue from underlying disease are at higher risk.⁵

There are also distinct aspects of potential thermal injury in patients who undergo extensive ablation of the posterior left atrium for treatment of AF. Esophageal heating and potential injury can occur from piezoelectric crystal vibration within the TEE probe tip or by direct tissue heating from absorbed ultrasound energy.¹² In addition, the TEE probe may also serve as a radiofrequency energy antenna and draw energy into the esophagus. This possibility, coupled with those previously mentioned, was raised in a large surgical series of left atrial ablation patients in which 1.3% developed an atrial esophageal injury, of which all had a TEE probe maintained within the esophagus.¹³ With catheter ablation in general, esophageal injury is not rare, with esophageal ulcerations reported

to occur in up to 17% of cases and atrial esophageal fistulas estimated between 0.1% and 0.25%.¹⁴ In patients undergoing catheter ablation, the potential adverse influence of a periprocedural TEE and risk of fistula has not been explored.

These background data of esophageal injury risk associated with TEE placement and use provide context for the observations reported by Kumar et al¹⁵ in this issue of *Circulation: Arrhythmia and Electrophysiology*. In an insightful prospective series of 1110 AF ablation procedures, they observed a procedural incidence of esophageal hematoma of 0.27% (3/1110). Unlike the near inevitability of mortality with atrial esophageal fistula, the authors report 0% mortality with this complication.

Although a true understanding of the spectrum of symptoms with this complication is limited, with only 3 cases to review, the authors found that patients complained of odynophagia, regurgitation, and hoarseness within 12 hours of the procedure. Fortunately, all 3 patients were successfully managed conservatively with cessation of anticoagulation, bowel rest, and analgesia. Morbidity with this complication is significant, with 2 of 3 patients experiencing adverse sequelae. One patient experienced persistent esophageal dysmotility resulting from a stricture and required dilation, and the other patient experienced vocal cord paralysis with unclear resolution, although hoarseness improved after 6 months.

Because this is a relatively recently reported complication,¹⁶ despite many thousands of ablative outcome data in the literature, the true incidence and risk factors are unknown. In all cases, a TEE probe was inserted. In the image by Nguyen et al,¹⁶ a TEE was used at the start of the case to examine the left atrial appendage and then removed. In this case report, there are no comments provided regarding the difficulty with TEE insertion or the degree of probe manipulation. In the study by Kumar et al,¹⁵ the authors report that all the insertions were without difficulty, and the probe was used not only to examine left atrial and appendage anatomy, but also to assist with transseptal catheterization. The latter is significant, because the patients were fully anticoagulated immediately after the first transseptal catheterization. After the catheterization, the TEE probe was not fully removed but left in a nonlocked position above the cardiac silhouette. By enhancing the distance from the catheter tip and the TEE probe, any potential communication or antennae effect should have been minimized. The probe was then reinserted in all patients to examine the pulmonary venous flow and pericardial space at the end of the study. The probe was also used emergently in the event of hemodynamic instability to examine the pericardial space.

The opinions expressed in this article are not necessarily those of the editors or of the American Heart Association.

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Clearly, placement of a TEE probe is a risk factor for significant esophageal injury in patients who undergo ablation. The observed incidence in the study by Kumar et al¹⁵ is in line with rates expected with TEE insertion in general. We believe it is encouraging that this incidence is not higher, given the postprobe insertion exposure to high doses of systemic anticoagulation required for AF ablation. From their experience, there may be ablation procedural aspects used that help us to understand why this complication may have occurred, and as such, perhaps minimized. We suspect that the extent of use of the probe is also a risk factor for esophageal hematoma, which made this complication more clinically apparent in their population. Additional manipulation of a well-placed TEE probe can result in an increased risk of injury, in particular, anteflexion at the gastroesophageal junction, a maneuver often used to examine the pericardium.^{5,17,18} Finally, necrosis of tissue from direct pressure of the TEE probe is also a risk factor associated with prolonged TEE use. This may be the mechanism behind the upper esophageal hematoma that occurred in the region exposed to the probe point for the majority of the case after transseptal access. Tissue necrosis at the probe-mucosal interface is more common if the probe is maintained in a locked or fixed position, both of which were avoided by the authors.¹⁷

Given this now well-described complication coupled with concerns of severe esophageal injury during ablation in general, we recommend that operators consider the following concepts. First, with intubation under general anesthesia, avoid forceful placement or removal of the probe. In those treated with conscious sedation, having the patient swallow to advance the probe can minimize excessive force. Second, never insert the probe in a locked position. Also, minimize unnecessary manipulation of the TEE probe to avoid small mucosal tears that may result in a large hematoma after high doses of heparin are administered. Finally, during ablation, remove the probe to avoid esophageal heating, tissue necrosis, and the possibility of direct radiofrequency injury into the esophagus. Alternative strategies to consider are the placement of an intracardiac echocardiogram catheter to assist with transseptal access, to monitor the pericardial space, and to assess the pulmonary vein Doppler velocities after the procedure. Of course, this strategy involves an additional vascular access with inherent risks, as well as an additional stiff intracardiac catheter that increases procedural cost and requires careful manipulation to avoid perforation. Another possibility is the initial use of a TEE to examine for left atrial appendage thrombus, with subsequent transthoracic echocardiography imaging of the pericardial space and pulmonary venous flow velocities.

This complication, as well as the methods used to minimize its incidence, is particularly germane to the use of a TEE probe or a similar device to divert the esophageal course to minimize risk of thermal esophageal injury during posterior left atrial ablation.^{19,20} Diversion of the esophagus as a benefit to allow posterior left atrial ablation must be considered with the risks of mechanical esophageal injury, as well as potential esophageal anatomic distortion, rather than diversion.

In conclusion, we commend the effort by Kumar et al to describe the presentation, diagnosis, and outcome of a new complication associated with AF ablation. Valuable insight is gleaned from exploring setbacks and adverse events with any

procedure, and such knowledge will ultimately advance the therapy and make it safer.

Disclosures

Dr Bunch receives minor speaker honorarium from Sanofi Aventis, Biosense Webster, Janssen Pharmaceuticals, and Gilead Pharmaceuticals. He also acts on the advisory board to Boston Scientific and St. Jude Medical. Dr Day receives minor speaker honorarium and acts on the advisory board for St. Jude Medical and Boston Scientific.

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