

# Esophageal Injury During Radiofrequency Catheter Ablation for Atrial Fibrillation: Can It Be Prevented?

by Steven Greenberg, MD, FCCP and Jose Nazari, MD

Official Journal of the Anesthesia Patient Safety Foundation

Dear Q&A,

What are the patient safety and anesthesia practice implications of actively cooling the esophagus during atrial fibrillation ablations under general anesthesia?"

Sam Moore, CRNA



Dear Dr. Moore,

Thank you for your inquiry. There are several potential unproven preventative measures to reduce the risk of esophageal injury. None of the present modalities are substantiated by a significant amount of quality evidence. Here is some general information regarding this important topic.

Atrial fibrillation (AF) is the most common arrhythmia affecting patients around the world today.<sup>1</sup> There is a 9% prevalence among those greater than 80 years old.<sup>2</sup> Treatment modalities such as Radiofrequency Catheter Ablation (RCA) have become a conventional and successful way to manage symptomatic patients with drug-resistant paroxysmal and refractory AF.<sup>3</sup> One worldwide survey reported that over 20,000 AF catheter ablation procedures were performed between 2003-2006.<sup>4</sup> The effectiveness rate of this procedure has been reported at 60-90%.<sup>5</sup> AF catheter ablation creates lesions around the pulmonary vein ostia to isolate and subsequently eliminate AF triggers. Extensive RF ablation of the posterior aspect of the pulmonary ostia and left atrium may result in damage to nearby structures such as the esophagus. Significant thermal injury can lead to the relatively common phenomenon of esophageal ulceration (6-26%) or the rare event known as atrioesophageal fistula (0.015%-0.04%).<sup>6</sup> The latter complication typically results in a greater than 75% mortality rate.<sup>6</sup> Several reports suggest that the incidence of esophageal injury is higher in patients undergoing procedures with general anesthesia vs. monitored anesthesia care secondary to higher temperatures achieved with general anesthesia.<sup>7</sup> The following review will discuss the controversies surrounding the strategies that seek to reduce these unwanted complications.

Several untested measures may potentially reduce the risk of esophageal injury. None of the present modalities are substantiated by a robust amount of quality evidence. Pre-procedure assessment of the esophageal position in relation to the left atrium by CT/MRI scanning may be helpful to identify those patients at higher risk for esophageal injury (e.g., the closer these

structures are to one another the higher the risk of injury).<sup>6</sup> The following potentially preventative methods can be instituted during catheter ablation: limiting energy delivery on the posterior wall of the left atrium (LA), luminal esophageal temperature (LET) monitoring, mechanical deflection of the esophagus during catheter ablation, and esophageal cooling/insulating techniques.<sup>1-6</sup>

The most widely utilized clinical strategy to reduce esophageal injury during AF ablation is limiting the amount of power and duration of RF along the posterior LA wall.<sup>1</sup> Tilz et al. demonstrated that 100% of his subjects developed esophageal mucosal injury with 30W, while only 1 subject had an injury in the 20W group.<sup>8</sup> Specialized catheters and other tools to aid cardiologists in directly visualizing the posterior LA wall during ablation may reduce this unwanted complication.<sup>7</sup>

Photographs of esophageal ulcerations resulting from ablation procedures without luminal esophageal temperature monitoring in 4 separate patients.

Patient		
Location of ulcer	30cm from incisors	17-23cm from incisors
Lesion description	Linear superficial ulcer with white exudates	Linear ulcer

Patient		
Location of ulcer	35cm from incisors	30cm from incisors
Lesion description	Linear ulcer	Linear ulcer

LET monitoring is also a commonly employed method for reducing esophageal injury.<sup>1</sup> Recent studies suggest that lower LETs may result in a lower incidence of esophageal injuries.<sup>9</sup> The LET must be in close proximity to the RF site in order to accurately detect higher risk situations. Suboptimal positioning of the LET monitor may result in esophageal injury despite acceptable LETs. Lastly, the LET may fix the esophagus into one position, thereby promoting contact with the LA wall.<sup>8</sup> Cardiologists may use electroanatomical mapping systems to visualize the distance between the catheter tip and the esophagus as well as the location of the LET monitoring tip site.<sup>8</sup> Even with LET monitoring, esophageal injuries can still be seen in up to 26% of patients.<sup>1</sup>

Several temperature probes have been created to monitor temperature. The deflectable esophageal device has been reported to be more effective than other probes as it can be placed very close to the ablation site.<sup>10</sup> Alternatively, the multi-thermocouple esophageal temperature probe has 3 thermocouples that can measure esophageal temperature at 3 different sites.<sup>10</sup> A recent study of 100 patients undergoing RF ablation for AF compared these 2 monitoring devices.<sup>10</sup> The incidence of mild to moderate esophageal injury (between 20-30%) was nearly identical in both groups.<sup>10</sup> More devices are being developed to more accurately monitor temperature to subsequently reduce the risk of esophageal injuries.

Another potential preventative strategy is mechanical deflection of the esophagus during catheter ablation.<sup>8</sup> This maneuver displaces the esophagus away from the posterior wall of the LA. Endoscopic manipulation and endotracheal stylets introduced into a chest tube have been studied. However, these techniques are limited by their invasiveness and lack of consistency in eliminating the proximity between the esophagus and the LA.<sup>8</sup>

Lastly, esophageal insulation from thermal injury can be achieved to minimize esophageal injuries by two approaches.<sup>1,8</sup> A fluid filled balloon catheter can be directly placed into the oblique sinus to displace the esophagus away from the LA, thereby protecting it.<sup>8</sup> This approach is rarely used because it is invasive and patients are susceptible to bleeding and infection. Alternatively, a cooling solution (e.g. saline) may be introduced through an oral or nasogastric tube when the LET reaches a certain threshold (typically  $>39^{\circ}$  C) to reduce esophageal injury.<sup>1</sup> A recent observational study of 318 consecutive patients undergoing catheter ablation for AF suggested a benefit with esophageal cooling (with  $10^{\circ}$  C saline mixed with gastrografin or iopamidol).<sup>11</sup> Ninety-five percent of patients did not develop esophageal ulcers when cooling was initiated at  $\geq 39^{\circ}$  C. However, 4 patients in this cohort developed bronchitis from aspiration of the saline/contrast solution. All of these patients recovered within 1 week without long term sequelae. Further studies are warranted prior to routine adoption of this technique.<sup>9</sup>

Atrial fibrillation is an extraordinarily common arrhythmia in clinical practice and therefore techniques such as catheter ablation are a relatively less invasive (than surgery) treatment modality employed throughout the world. However, like any other procedure, it has its own inherent risks. Catheter ablation induced esophageal ulcer is quite common, but fortunately most of these ulcers heal without reported long term sequelae. Still, many cardiologists believe that these same esophageal ulcers can be harbingers for the deadly atri-esophageal fistula complication. Several preventative modalities discussed have been proposed to reduce the incidence of esophageal injury. Further research is required in order to determine which one if not all of these techniques should be adopted by cardiologists worldwide.

---

Dr. Greenberg is Assistant Editor of the APSF Newsletter, Clinical Associate Professor in the Department of Anesthesiology/Critical Care at the University of Chicago Pritzker School of Medicine, and Director of Critical Care Services at Evanston Hospital, NorthShore University HealthSystems.

Dr. Nazari is Associate Director, Cardiac Electrophysiology/Division of Cardiology at NorthShore University HealthSystem and Clinical Assistant Professor in the Department of Internal Medicine/Cardiology at the University of Chicago Pritzker School of Medicine.

#### References

1. Enzhao L, Shehata M, Liu T, et al. Preventions of esophageal thermal injury during radiofrequency ablation for atrial fibrillation. *J Interv Card Electrophysiol* 2012; 35: 35-44.
2. Keshishian J, Young J, Hill E, et al. Esophageal injury following radiofrequency ablation for atrial fibrillation: Injury classification. *Gastroenterology & Hepatology* 2012; 8: 411-414.
3. Takahashi A, Kuwahara T, Takahashi Y. Complications in the catheter ablation of atrial fibrillation-incidence and management. *Circ J* 2009; 73: 221-226.

4. Cappato R, Calkins H, Chen SA, et al. Updated worldwide survey on the methods, efficacy, and safety of catheter ablation for human atrial fibrillation. *Circ Arrhythm Electrophysiol* 2010; 3: 32-8.
5. Lin WS, Tai CT, Hseish MH, et al. Catheter ablation of paroxysmal atrial fibrillation initiated by non-pulmonary vein ectopy. *Circulation* 2003; 107: 3176-3183.
6. Dagues N, Anastasiou-Nana M. Prevention of atrial-esophageal fistula after catheter ablation of atrial fibrillation. *Current Opinion in Cardiology* 2011; 26: 1-5.
7. Di Biase L, Burkhardt DJ, Vacca M, et al. Esophageal capsule endoscopy after radiofrequency catheter ablation for atrial fibrillation: Documented higher risk of luminal esophageal damage with general anesthesia as compared with conscious sedation. *Circulation, Arrhythmia and Electrophysiology* 2009; 2: 108-112.
8. Tilz RR, Chun KR, Metzner A, et al. Unexpected high incidence of esophageal injury following pulmonary vein isolation using a remote robotic navigation system. *J Cardiovasc Electrophysiol* 2010; 21: 853-858.
9. Nair Girish, Nery PB, Redpath CJ, et al. Atrioesophageal fistula in the era of atrial fibrillation ablation: A review. *Canadian Journal of Cardiology* 2014; 30: 388-395.
10. Kuwahara T, Takahasi A, Takahashi Y, et al. Incidences of esophageal injury during esophageal temperature monitoring: A comparative study of a multithermocouple temperature probe and a deflectable temperature probe in atrial fibrillation ablation. *J Interv Card Electrophysiol* 2014; 39: 251-257.
11. Sohara H, Satake S, Takeda H, et al. Prevalence of esophageal ulceration after atrial fibrillation ablation with the hot balloon ablation catheter: What is the value of esophageal cooling? *J Cardiovasc Electrophysiol* 2014; 25: 686-692.