

# Prevention of esophageal thermal injury during radiofrequency ablation for atrial fibrillation

Enzhao Liu · Michael Shehata · Tong Liu · Allen Amorn · Eugenio Cingolani · Vinod Kannarkat · Sumeet S. Chugh · Xunzhang Wang

Received: 30 September 2011 / Accepted: 16 December 2011 / Published online: 21 June 2012  
© Springer Science+Business Media, LLC 2012

**Abstract** Pulmonary vein isolation using radiofrequency ablation is an effective therapy in patients with atrial fibrillation. However, the esophagus descends in close proximity to the posterior wall of the left atrium and renders this structure susceptible to thermal injury. Esophageal ulceration has been hypothesized to be a precursor to left atrial–esophageal fistula, a procedural complication associated with poor prognosis. In this review, we have analyzed and summarized the published data regarding esophageal thermal injury during catheter ablation for atrial fibrillation and strategies to minimize risk of this complication. While esophageal temperature monitoring can be useful, multiple factors such as patient characteristics and specific strategies for radiofrequency energy delivery also merit consideration.

**Keywords** Atrial fibrillation · Radiofrequency ablation · Left atrium · Esophageal ulceration · Esophageal temperature monitoring

## 1 Magnitude of the problem

Atrial fibrillation (AF) is the most common cardiac arrhythmia encountered in medical practice. Pulmonary vein (PV)

isolation using radiofrequency (RF) ablation has become an effective therapy in symptomatic patients with AF. The cornerstone of AF catheter ablation is the placement of ablation lesions around the PV ostia to isolate AF triggers. However, the esophageal wall is adjacent to the left atrium (LA), near the posterior wall and the PV ostia. Extensive RF ablation of the posterior part of the PV ostia and the LA posterior wall may result in collateral damage to adjacent structures including the esophagus [1–6]. In order to create scar tissue and, thereby, electrically isolate the PVs or other arrhythmogenic areas from the LA, high temperatures are often reached during RF ablation. This may also cause tissue damage within the esophagus [7]. Left atrial–esophageal fistula formation is now a well-recognized complication of percutaneous AF ablation. Despite its low incidence (0.03%–0.1%), this complication remains devastating, with a resultant mortality in excess of 75% [3–6, 8–11]. Bleeding from atrial–esophageal fistula, septicemia, cerebrovascular accidents, and air embolism are the major reasons for a fatal outcome [4, 5].

Although the pathological progression of esophageal thermal injuries to left atrial–esophageal fistula after RF ablation has never been demonstrated in humans [12], esophageal ulceration, the hypothetical precursor to left atrial–esophageal fistula, has been reported to occur in as high as 48% of patients following AF ablation [13]. Thermal and/or ischemic injuries are the proposed mechanisms for esophageal injury, and the two mechanisms are interrelated. Thermal injury to the esophageal vasculature leads to an ischemic lesion that is progressive [14]. Thermal damage also induces an inflammatory reaction and subsequent granulation in the esophagus, which can lead to secondary perforation several days thereafter. This could explain why atrial–esophageal perforation usually occurs several days to weeks after the RF ablation [15, 16].

E. Liu · M. Shehata · T. Liu · A. Amorn · E. Cingolani · V. Kannarkat · S. S. Chugh · X. Wang  
The Heart Institute, Cedars Sinai Medical Center,  
Los Angeles 90048, CA, USA

X. Wang (✉)  
Heart Rhythm Center, The Heart Institute,  
Cedars–Sinai Health System,  
Los Angeles 90048, CA, USA  
e-mail: Xunzhang.Wang@cshs.org