Esophageal Perforation Secondary to Radiofrequency Catheter Ablation for Atrial Fibrillation

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Abstract
Radiofrequency catheter ablation of pulmonary veins is generally a safe procedure used in patients with atrial fibrillation. We report a case of a 67-year-old woman who suffered esophageal perforation following radiofrequency catheter ablation. Salient symptoms, such as dysphagia, severe chest pain, palpitations, and malaise, as well as the radiological findings of pneumopericardium and esophageal perforation were consistent with the presence of an atrio-esophageal fistula. This extremely rare complication warrants immediate surgical intervention. Atrio-esophageal fistula is best diagnosed by thoracic CT with contrast, and may be prevented during the procedure by careful esophageal temperature monitoring and reduction of radiofrequency energy.

Keywords: Radiofrequency catheter ablation; Esophageal perforation; Pneumopericardium; Atrio-esophageal fistula; Atrial fibrillation

Introduction
Radiofrequency Catheter Ablation (RFCA) of the pulmonary veins is widely recognized as a safe and effective procedure for patients suffering from recurrent atrial fibrillation, atrial flutter, and some cases of supra-ventricular tachycardia [1-4]. Although the incidence of esophageal injury secondary to RF ablation is low, this is a severe complication that must be carefully considered, as the consequences are often fatal [1,3]. We report a case of esophageal perforation that resulted in an atrio-esophageal fistula secondary to a routine RF ablation procedure for drug-refractory atrial fibrillation. We outline the key clinical consequences of this complication, present radiological findings that assist with proper diagnosis, and describe and review the most effective methods for detection and prevention.

Case Report
A 67-year-old Caucasian female with past medical history of Paroxysmal Atrial Fibrillation (PAF), atrial flutter, hypertension, and dyslipidemia, was transferred from a local community hospital for management of atrial tachyarrhythmia. Two weeks prior to admission, she was discharged from the hospital following uneventful radiofrequency catheter ablation procedure for her PAF. One day prior to admission, she presented to the community hospital with palpitations and severe, intense chest pain that awoke her in the middle of the night. At this time, her heart rate was in the 130s. Her chest pain was constant, pressure-like in quality, and lasted for 24 hours. The patient also complained of paroxysmal cough and odynophagia/dysphagia when eating whole foods. The patient reports feeling well one week after the RFCA procedure before developing chest pain and odynophagia. She did not have a history of fever, emesis, or signs of gastrointestinal bleeding.

Upon admission, temperature was 99.1°F, heart rate was 160, blood pressure was 106/69, and O2 saturation was 96% on room air. Heart auscultation revealed irregular rate and rhythm, with normal S1/S2 and no abnormal heart sounds. Jugular venous distension was present, with prominent, rapid pulsations.

Lab results revealed normal troponin levels. ECG demonstrated atrial tachycardia with variable block and no ischemic changes. There was ST segment elevation in leads I, II, AVL, V5, and V6. Transthoracic echocardiogram (TTE) showed a moderate size pericardial effusion with compression of the right atrial free wall. Of note, patient’s INR was 5 (normal INR 0.9–1.2) upon admission. The patient was found to have leukocytosis (24,000, 86% neutrophils) in the setting of recent steroid administration from the community hospital.

Chest X-ray showed evidence suggestive of pneumopericardium (Figure 1). This finding, as well as the patient’s poor clinical status, prompted the decision for thoracic CT, which confirmed the diagnosis of pneumopericardium (Figure 2). Esophagram was performed, revealing esophageal perforation at the level of the left atrium (Figure 3). The patient’s radiological findings and clinical history/status were consistent with the diagnosis of atrio-esophageal fistula. The patient was immediately admitted to the operating room for drainage of pericardial fluid and pleural effusions, where she underwent pericardial...
window, sternotomy with mediastinal washout, and esophagogastroduodenoscopy with esophageal stent placement.

The patient’s deteriorating hospital course was complicated with development of septic shock secondary to mediastinitis despite immediate surgical intervention and aggressive broad antibiotic therapy. Subsequently, she developed low-grade fever, oliguric renal failure, severe hypotension, elevated liver enzymes secondary to ischemic liver disease, continued leukocytosis, persistent pleural effusions, and frequent intermittent seizure-like activity. Eight days following admission, the patient showed signs of altered mental status secondary to toxic metabolic encephalopathy. Non-contrast head CT and MRI revealed massive bilateral strokes in middle cerebral artery territories, consistent with the diagnosis of persistent vegetative state. The patient’s negligible chance for meaningful neurological recovery was conveyed to the family, who decided to withdraw medical care except hydration and tube feeding. 25 days after admission, the patient was discharged and transferred to hospice care.

Discussion

Radiofrequency catheter ablation for treatment of atrial fibrillation is recognized as a safe procedure with a low incidence and prevalence of death, with Cappato et al. [1] reporting a death rate of <0.1%. Using a probe set to a predetermined temperature and duration, a series of transmural lesions are created in the left atrium. Although the radiofrequency temperature and energy are easily controlled, lesion depth can be variable, which may lead to undesirable consequences: non-transmural lesions will result in an unsuccessful operation, whereas lesions that are too deep may cause damage to adjacent anatomical structures [2]. Thus, unique precautions must be considered to avoid potentially fatal complications. These complications include puncture of intracardiac septa, cardiac tamponade, pulmonary vein stenosis, vascular accidents, thromboembolic events, nerve damage, and esophageal injury due to the proximity of the posterior wall of the left atrium and the esophagus [3].

Esophageal injury is a rare consequence of RF CA. Pappone et al. [4] reports a prevalence of 0.05% out of 4360 patients who have undergone circumferential pulmonary vein ablation, although an incidence rate of up to 1% has been reported. Despite the low incidence rate and prevalence of esophageal injury, development of atrio-esophageal fistula is the second most frequent cause of death that may be caused by RF catheter ablation, with cardiac tamponade found to be the most common fatal complication [1]. It is usually reported 3-35 days following the procedure [3,5,6], and is associated with mortality rates in excess of 70% [1].

Clinically, esophageal damage and atrio-esophageal fistula presents with several non-specific symptoms, such as general malaise, fever, chest pain, convulsions or seizures, loss of consciousness, dysphagia/odynophagia, septic shock, abdominal pain, anorexia, and hematemesis [3]. These patients often subsequently develop endocarditis/pericarditis and embolism leading to possible myocardial and/or cerebral infarctions.

Our patient displayed many of the signs and symptoms associated with esophageal damage following RF ablation of the pulmonary veins. Possible risk factors that predispose patients to these events may include body habitus and general health status [2]. In a healthy individual, there exists a large area of contact between the posterior left atrium and esophagus, with an intervening fat pad of 0.9 ± 0.2 mm [7]. However, our patient was malnourished and cachectic, and likely had a thinner than usual left atrium, with a very thin and variable layer of tissue between the left atrium and esophagus, predisposing to RF heat damage. There are no identified specific predictors of esopha-
the purposes of esophageal cooling [3]. Takahashi et al. [3] report an thicker [4], and use of a water-irrigated intraesophageal balloon for the transverse posterior left atrial line to the roof where the atrium is careful esophageal temperature monitoring, adjusting the position of tion to better identify the position of the esophagus and left atrium,
motion is critical in preventing patient death. By considering the patient's unique anatomic relationships prior to the procedure, using lower energy applications, and employing careful esophageal temperature monitoring, we hope that future cases of atrio-esophageal fistula will be avoided.

An early warning sign for esophageal perforation is dysphagia, as seen in our patient's intolerance of solid food. This symptom could be a sign of inflammatory esophagitis, eventually leading to atrio-esophageal fistula, even in the presence of a normal MRI following the ablation procedure [9]. For these patients, both transesophageal echocardiography and gastro-esophageal endoscopy can occasionally be effective if it reveals specific signs such as gas bubbles in the left atrial appendage or vegetation-like appearance of the posterior wall of the left atrium [3]. If discovered, immediate surgical intervention is mandatory to avoid fatal consequences.

Prevention and early diagnosis of atrio-esophageal fistula is ab-Geol damage following RF CA, although previous studies report that overlap of ablation lines in the posterior wall of the left atrium could create enough RF energy accumulation to cause esophageal trauma [4,8]. Furthermore, Scanavacca et al. [9] propose that due to specific anatomic relationships, RF energy directed a few millimeters outside of the inferior pulmonary vein ostia could precipitate esophageal perforation.

Figure 3: Single image from Gastrografin esophagram performed under fluoroscopic guidance with the patient in the supine position. Exam was lim-ited secondary to patient’s pain/discomfort. White arrow points to the area of Gastrografin extravasation. Amorphous density to the left represents the extravasated pool of contrast into the mediastinum (black arrow). Patient’s hand overlies the field of view.

References

**Figure 3:** Single image from Gastrografin esophagram performed under fluoroscopic guidance with the patient in the supine position. Exam was limited secondary to patient’s pain/discomfort. White arrow points to the area of Gastrografin extravasation. Amorphous density to the left represents the extravasated pool of contrast into the mediastinum (black arrow). Patient’s hand overlies the field of view.