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Severe esophageal injury after radiofrequency ablation - a deadly complication

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Abstract

Various degrees of esophageal injury have been described after radiofrequency ablation performed for treatment of atrial fibrillation. The main mechanism of injury is thermal and may lead to a range of esophageal mucosal changes, some clinically insignificant, however when deep ulceration occurs, this may be further complicated by perforation and mediastinitis, a rare but life threatening sequelae. We present a case of a severe esophageal injury leading to mediastinitis, with interesting endoscopic findings.

Key words: Atrial fibrillation; Radiofrequency ablation; Esophageal perforation; Ulceration; Mediastinitis

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Core tip: We report a case of esophageal perforation complicated by mediastinitis. Our report demonstrates the clinical course of a rare, yet deadly complication of radiofrequency ablation, with unique endoscopic findings. We believe that this report and brief review of the literature will serve an important reminder of this complication and its consequences, requiring a high index of suspicion for early diagnosis and treatment. Our report also serves as a reminder that a unified approach to treatment has yet to be established.

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INTRODUCTION

Radiofrequency ablation (RFA) is the electrical isolation of the pulmonary veins and the linear ablation of the left atrial roof, mitral isthmus and cavo-tricuspid isthmus to eliminate the focus causing atrial fibrillation (AF). This procedure has become the standard of care for drug-refractory symptomatic AF^[1] and it is being increasingly performed as first line therapy in certain patient populations^[1]. The extent of RFA varies from isolation of the pulmonary veins, to complex and extensive ablation in the left atrium, sometimes involving its entire posterior wall. Although the procedure is considered a safe one, the significant anatomical variability in the relationship between the esophagus and left atrium, places the esophagus in a vulnerable position, prone to injury. Various variables effecting heat transfer to the esophagus have been identified in recent years and new strategies to minimize the risk of esophageal injury are now utilized, however they have not eliminated its risk. The main mechanism of injury is thermal, resulting in esophageal dysmotility, ulceration or perforation, which may be further complicated by mediastinitis or left atrio-esophageal fistula formation, both rare but life threatening sequelae.

CASE REPORT

A 75-year-old man with past history significant for ischemic cardiomyopathy, biventricular congestive heart failure (ejection fraction of 20%-25%) and AF, was admitted to our institution for elective RFA for treatment of symptomatic atrial fibrillation, which was refractory to medical management. The procedure performed included complete pulmonary vein isolation, a mitral isthmus line and posterior wall ablation (aka: box lesion). A 7.5 French Johnson and Johnson EZ Steer Thermocool NAV Bi-Directional D-F curve irrigation catheter was used to produce catheter ablation, with a maximum power of 50 Watts and a total ablation time of 3401 s. Use of esophageal temperature probe was not documented. The RFA was successful and uneventful, however on day seven post procedure, the patient complained of retro-sternal chest pain, dysphagia and odynophagia followed by hematemesis, which resulted in a significant drop in hemoglobin and hematocrit and quickly led to hypovolemic shock. Immediate resuscitation was initiated and the patient was taken for emergent esophagogastroduodenoscopy (EGD) revealing a large clot extending along the entire length of the esophagus, and old blood in

the stomach and duodenum. The esophageal blood clot was extracted, revealing a 2 cm ulcer in the mid-esophagus with active oozing (Figure 1A). No endoscopic intervention was performed at that time. A non-contrast chest CT was urgently performed, revealing esophageal perforation and mediastinitis at a level adjacent to the posterior aspect of the left atrium (LA) (Figure 1B). Treatment was initiated with antibiotics, total parenteral nutrition (TPN) and esophageal rest. A follow-up EGD one week later revealed ulceration measuring 4 cm in diameter with a walled-off false lumen (Figure 1C), no intervention was performed. The patient was not responding to aggressive medical management, he remained in shock, requiring vasopressors, developed acute kidney injury requiring dialysis and shock liver. Two days later, the patient was taken for endoscopic stent placement, which was unsuccessful, as the patient was in critical condition. At that time he and his family requested transition to comfort care measures and asked that no further invasive treatment be undertaken. The patient expired soon thereafter.

DISCUSSION

Major complications observed with RFA (radiofrequency ablation) for AF are cardiac in nature however, damage to neighboring structures may also occur. Surrounding intracardiac structures at risk for damage include the aorta, coronary sinus, left atrial appendage, valves, chordae tendineae and atrial appendage. Extracardiac structures at risk for damage include the upper gastrointestinal structures such as the esophagus and stomach^[2], in which both structural and functional damage has been described^[2,3], pulmonary bronchi^[4], the adjacent nerves including the vagus nerve and right phrenic nerve^[3,5], aorta and the thoracic spine^[6]. The proximity of the esophagus to the posterior wall of the left atrium places it in a particularly vulnerable position^[7], prone to various degrees of thermal injury^[8-10].

Esophageal perforation is a rare but life-threatening complication of RFA for atrial fibrillation^[11-15] as demonstrated by the case presented. Factors that determine heat transfer to the esophagus during catheter ablation include the magnitude and duration of local tissue heating, as well as atrial tissue thickness^[16,17] and the thickness and character of intervening connective tissue, including adipose tissue between the heart and esophagus^[7,8,16,18]. Catheter tip size, contact pressure and catheter orientation are also important variables that determine what percentage of applied radiofrequency energy is actually delivered to cardiac tissue. Several techniques have been utilized to minimize the risk of esophageal injury, including avoidance of ablation near the esophagus, titration of radiofrequency energy delivery at the posterior left atrial endocardium and the use of alternative ablation methods^[18-20].

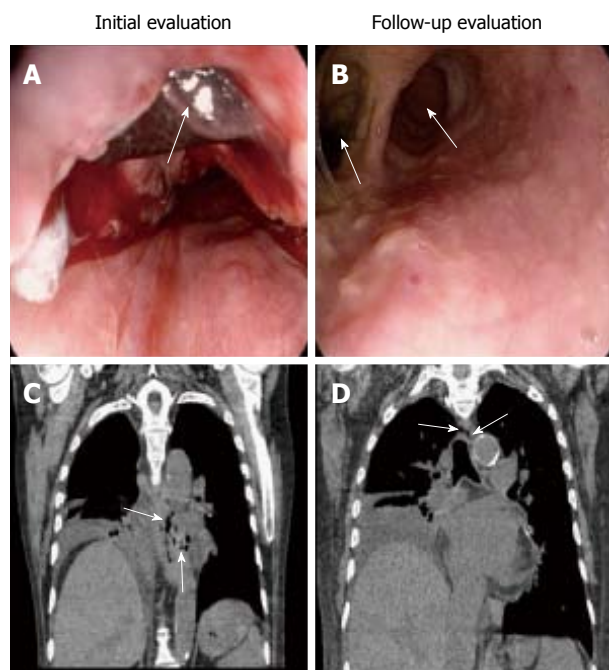


Figure 1 Emergent esophagogastroduodenoscopy. A: Emergent esophagogastroduodenoscopy (EGD) revealing a large blood clot extending along the esophagus, with an underlying large ulcer (2 cm) in mid esophagus; B: Non-contrast chest CT demonstrating mediastinitis; C: Follow up EGD revealing 4 cm ulceration, with a walled-off false lumen; D: Follow up CT demonstrating false lumen and mediastinitis.

Recent studies using surveillance endoscopy after RFA for atrial fibrillation, report various degrees of esophageal mucosal damage in approximately 15% of patients post catheter ablation^[18,20-22]. Prior to implementation of esophageal localization techniques, esophageal mucosal changes consistent with thermal injury were more prevalent, and in one single center study reported in up to 47% of patients, with necrotic or ulcer-like changes demonstrated in 18% of those patients^[23]. Esophageal perforation and atrio-esophageal fistula formation are an extremely rare, yet detrimental sequela of the aforementioned esophageal injuries, which may lead to death in up to 80% of patients^[12] and although utilization of various preventive measures have decreased the risk of severe esophageal injury, it has not been eliminated. The reasons for the high mortality rates are thought to be due to failure of early recognition as a result of lack of clinical awareness, delayed presentation, as exemplified by our case, and complex surgical repair that may be required for treatment^[12,14]. Therefore, a high index of suspicion and early recognition and treatment are imperative for prevention of poor outcomes.

Treatment of RFA-induced esophageal complications varies and should be managed by a multidisciplinary approach. Esophageal lesions may be treated with acid suppression, esophageal rest, parenteral nutrition or stent placement^[24]. Treatment

options for more severe injuries, such as perforation, mediastinitis and atrio-esophageal fistulas, range from conservative management to invasive approaches including endoscopic stenting, thoracostomy, diversion, primary surgical repair or a combination of those^[25]. There has been controversy in the literature regarding indications for surgical management of esophageal perforation^[26-28] and its mortality benefit, especially when treatment is delayed and randomized controlled studies on this subject are lacking. Conservative management has been advocated for cases of iatrogenic perforation, postemetic esophageal perforation or intrathoracic perforation as well as the presence of severe comorbidities and medical contraindications to surgery. Some suggest that medical treatment can be implemented for contained perforation in the mediastinum and the visceral pleura without penetration to another body cavity or when the perforation drains back into the esophagus^[26-30]. The use of endoscopic stents, has also been taking the front line in management of esophageal injuries^[31]. Despite the controversies, all are agreed upon the fact that early recognition of esophageal perforation plays a major prognostic role^[32], therefore it is pertinent to have a high index of suspicion in patients presenting with classic symptoms and even more so in those with recent history of an invasive procedure, such as RFA. The advancements in imaging technologies as well as endoscopic techniques may allow in the future for a broader range of minimally invasive treatment options, even in patients who are high risk candidates for surgical intervention, however a unified approach to treatment has yet to be established.

COMMENTS

Case characteristics

A 75-year-old patient with ischemic cardiomyopathy and refractory atrial fibrillation underwent radiofrequency ablation and developed retrosternal chest pain, dysphagia and odynophagia and hematemesis, seven days later.

Clinical diagnosis

The patient became hypotensive, tachycardic and oliguric and rapidly developed multiorgan failure, gross blood was extracted from his nasogastric tube.

Differential diagnosis

Peptic ulcer disease, esophagitis, atri-esophageal fistula, atri-bronchial fistula.

Laboratory diagnosis

Significant drop in Hemoglobin and hematocrit, elevated creatinine and BUN and abnormally elevated liver enzymes.

Imaging diagnosis

Initial esophagogastroduodenoscopy (EGD) revealed a large clot extending along the entire length of the esophagus with an underlying 2 cm ulcer, actively oozing. A non-contrast chest CT subsequently demonstrated esophageal perforation and mediastinitis at a level adjacent to the posterior aspect of the left atrium. A follow-up EGD revealed ulceration measuring 4 cm in diameter with a walled-off false lumen.

Pathological diagnosis

Pathological diagnosis was not made in this case.

Treatment

After initial resuscitation the patient was started on antibiotics, total parenteral nutrition and esophageal rest. At a later date an endoscopic esophageal stent placement was pursued, however it was unsuccessful.

Related reports

Esophageal injury is a well reported complication of radiofrequency ablation however, perforation and mediastinitis are a rare, yet life threatening complication. Treatment options and outcomes have been variable and largely depend on time of diagnosis and treatment as well as patient comorbidities.

Term explanation

Radiofrequency ablation refers to the isolation of the pulmonary veins and other electric foci, commonly located along the posterior wall of the left atrium, to ablate unwanted electrical discharges resulting in atrial fibrillation.

Experiences and lessons

Development of esophageal injury may complicate radiofrequency ablation. Prompt recognition is pertinent and management with a multidisciplinary approach is necessary.

Peer-review

This report demonstrates the clinical course of esophageal perforation, a devastating complication of radiofrequency ablation. Treatment options vary and remain a controversy and while many authors advocate for surgical management of patients with severe esophageal perforation, this approach is not feasible in high risk patients with multiple comorbidities.

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