Minimal dose of cryoballoon ablation leading to atrioesophageal fistula formation

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Introduction

Cryoballoon ablation (CBA) continues to become more prevalent for safe and effective pulmonary vein isolation in the treatment of atrial fibrillation.[1–6] Although CBA is regarded as a safe procedure, the most modern iteration of the cryoballoon (Arctic Front II; Medtronic Inc, Minneapolis, MN) has been associated with major procedure-related events in 5.8% of cases, most importantly with unresolved phrenic nerve injury in 3.2% of patients.[7] While more rare, atrioesophageal fistula (AEF) is a well-recognized and feared complication of radiofrequency ablation, where it occurs in about 0.08% (0.05%–0.11%) of cases.[8] This complication has been reported by case reports in the CBA literature and is estimated to have an incidence of <1 in 10,000.[1,9–13] These cases are generally associated with the left inferior pulmonary vein (LIPV) and longer balloon inflation times. Given the rarity of this complication, the minimal amount of CBA dosing needed to create an AEF has not been well described. We present a case of AEF after CBA with the lowest known dose that has led to this complication as a caution of the need for better understanding of CBA dosing.

KEY TEACHING POINTS

- Cryoballoon ablation continues to become more prevalent for safe and effective pulmonary vein isolation.
- Atrioesophageal fistula is a well-recognized and feared complication of radiofrequency ablation but is less common in cryoballoon ablation.
- We present a case of atrioesophageal fistula after cryoballoon ablation with the lowest known dose that has led to this complication.
- This case outlines the importance of proper cryo dosing, rewarming, and consideration of anatomy to provide robust and safe lesions.

Case report

A 67-year-old Chinese man was referred for CBA for paroxysmal atrial fibrillation despite antiarrhythmic use. Preprocedural chest computed tomography with contrast demonstrated 4 pulmonary veins with a common left lower pulmonary vein antrum. The procedure was performed using the second-generation Medtronic Arctic Front Advance™ with deep sedation and without esophageal temperature monitoring or 3D mapping. CBA performed at the LIPV had a time to isolation of 46 seconds and was terminated early at 120 seconds owing to temperature reaching −60°C. A freeze-thaw-freeze was performed with a second ablation of 180 seconds with the nadir temperature at -55°C. Entrance and exit blocks were confirmed with a combination of pacing and isoproterenol infusions showing acute isolation. The patient was discharged home without evidence of complications.

The patient presented 2 weeks later with fever, chills, and melena. Blood cultures were positive for streptococcal infection. Emergent computed tomography demonstrated evidence of AEF (Figure 1). Emergency surgical repair was performed, noting a 0.5-cm AEF with LIPV involvement. Surgical investigation demonstrated the LIPV to have ruptured from the endocardium outward and focus of inflammation and necrosis on the corresponding surface of the esophagus, with extensive adhesion to the surrounding tissue. The patient underwent surgical repair utilizing pericardium patch. The patient recovered from surgery and was discharged from the hospital. The patient continues to do

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Figure 1 Computed tomography scan demonstrating atrioesophageal fistula.

well after a 2-year follow-up but has mild persistent dysphagia.

Discussion

Collateral injury during CBA is thought to be a dose-dependent complication. In previous cases, LIPV AEF was noted with median ablation times ranging from 180 to 360 seconds over multiple inflations.[1] In this case, LIPV AEF occurred with only a 120-second dose followed by an 180-second dose. This may indicate the need for improved dosing endpoints. Unfortunately, the thaw time was not available for this case, but that is likely an important factor in the safety of the discussion. Sufficient rewarming is needed, as opposed to the traditional freeze-thaw-freeze technique.[14] This case demonstrates that sufficient rewarming in addition to thawing the balloon is required to prevent significant injury to collateral tissues. If an additional ablation is required, we allow for greater than 8 minutes in between each dose to allow for complete thawing (and will usually proceed to another ablation area in the meantime). In addition, consideration may be needed based on the normal variant anatomy in this patient. The common left antrum may have created an overlap between freeze areas, as well as fixation of the esophagus to the LIPV antrum, making critical damage to tissues more likely, as it brings the surface closer to the esophagus and was likely a contributor to the fistula formation, along with incomplete rewarming of the cryoballoon. The proximity to the esophagus may increase the risk of damage to the esophagus, though the LIPV in general may be more susceptible to injury.[1] The utilization of esophageal temperature monitoring is controversial, as it has a poor negative predictive value—the location of the temperature probe does not always abut the left atrial side of the esophageal lumen. In addition, if deep sedation is utilized instead of intubation, as it was in this case, esophageal temperature monitoring cannot be easily used. Despite this, we generally will use esophageal temperature monitoring for all intubated patients, as they have been shown to be associated with lower injuries.[14] Another important strategy to reduce the risk of AEF formation, in addition to allowing for sufficient thaw time, is to consider other strategies, such as esophageal deviation and active warming, both of which have limited data. This case outlines the importance of proper cryo dosing, rewarming, and consideration of anatomy to provide robust and safe lesions.

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