

Cardiac Tamponade During Catheter Atrial Fibrillation Ablation: A Life-Threatening Complication

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Abstract

Catheter ablation has become an important treatment strategy for the management of atrial fibrillation (AF) in symptomatic patients. Pulmonary vein isolation (PVI) is increasingly used to restore rhythm in patients with AF and flutter. The serious procedural complication rate has significantly reduced over time and most patients undergo PVI without any adverse events. We present the case of a 70-year-old man with symptomatic AF who underwent elective PVI that was complicated by large pericardial effusion from left atrial appendage (LAA) perforation resulting in cardiac tamponade requiring emergency pericardiocentesis followed by sternotomy to suture the LAA. The perforated LAA was sutured and the LAA was closed surgically through sternotomy by using AtriClip and a large amount of blood was evacuated achieving good cardiac output and hemodynamic stability. A surgical PVI was performed twice restoring normal sinus rhythm. The patient was discharged home, however, he returned to the hospital a few days later with atrial flutter with a rapid ventricular response. He underwent direct current cardioversion (DCCV) and remained in sinus rhythm during the rest of his admission. His bisoprolol was switched to Sotalol to maintain normal sinus rhythm and he was discharged home with outpatient follow-up.

Categories: Cardiac/Thoracic/Vascular Surgery, Cardiology, Emergency Medicine

Keywords: rhythm versus rate control, atriclip, left atrial appendage perforation, emergency sternotomy, emergency pericardiocentesis, massive pericardial effusion, direct current cardioversion, cardiac catheter ablation, atrial flutter rapid ventricular response, atrial fibrillation management

Introduction

Atrial fibrillation (AF) ablation is one of the substantial treatment options for rhythm control, especially among patients who have symptomatic AF that is refractory to pharmacological and/or electrical cardioversion or among patients who are intolerant to anti-arrhythmic medications [1]. Cardiac tamponade is a rare complication of catheter ablation for AF or pulmonary vein isolation (PVI) and the incidence of delayed cardiac tamponade (DCT) has been reported as 0.2% [2]. The effectiveness of cardiac catheter ablation in AF has been well-established recently; however, care needs to be taken to minimize the procedure-related complications [3]. A large study showed that AF ablation-related major complications occurred in 4.54%-6% of patients and the mortality rate associated with AF ablation was 0.15% [3]. The most common cause of AF ablation-related death was cardiac tamponade reported to be 1%-1.31% [3,4]. Patients who develop cardiac tamponade due to atrial appendage perforation require emergency pericardiocentesis and/or emergency surgical repair [5]. It is important to mention that the incidence of serious periprocedural complications such as left atrial appendage (LAA) perforation is rare [4].

The serious complications of pericardial effusion and cardiac tamponade can occur anytime during the catheter ablation procedure. This can result from the trans-septal puncture, extensive catheter manipulation, application of radiofrequency (RF) energy, or steam pops under an intense anticoagulation regimen and the incidence was reported between 1.0% and 2.0% in another study [6]. The presumed mechanism of cardiac tamponade was related to the right ventricular apical ablation catheter placement, PVI, trans-septal puncture, cavotricuspid isthmus (CTI) ablation, and left atrial (LA) linear ablation in 33 patients whereas the cause was not clear in 18 patients [6]. We present a case of pericardial tamponade secondary to LAA perforation during LA mapping.

Case Presentation

A 70-year-old male known to have symptomatic paroxysmal AF with a previously performed failed DCCV and unresponsive to medications, presented for an elective AF pulmonary venous isolation (PVI) catheter ablation. His past medical history included hypertension, previous transient ischaemic attack, pre-diabetes, stage 2 chronic kidney disease with a baseline estimated glomerular filtration rate (eGFR) of 53, early Dupuytren's contracture, carpal tunnel syndrome, and previous radiotherapy for prostate cancer. The patient underwent pre-procedural TOE before the PVI that did not show any LAA thrombus or pericardial effusion. A

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TOE-guided trans-septal puncture was performed and left atrial (LA) 3D mapping was started. However, during the LA mapping, a significant drop in blood pressure was noted and hence emergency TOE images were obtained. A large pericardial effusion indicating tamponade was noted, and an emergency pericardial drain was inserted, which drained about 1 liter of hemorrhagic pericardial effusion. He received protamine and octaplex to reverse the effects of anticoagulation and to achieve hemostasis. The pericardial fluid reaccumulated quickly requiring an urgent sternotomy procedure and a large amount of blood including clots was evacuated by opening the pericardium achieving good output and the bleeding was repaired with two 4/0 pledgeted prolins. The LAA was identified to be the source of bleeding and a 35 mm atriclip was applied achieving hemodynamic stability. He underwent PVI twice during the surgery given hemodynamic stability and the patient returned to normal sinus rhythm post-PVI ablation. His blood pressure dropped during the procedure to 90 systolic, however, improved to 140/70 after the sternotomy and PVI ablation. Postoperatively, the patient maintained normal sinus rhythm and was admitted to the intensive care unit (ICU) for close monitoring. TTE performed two days later showed a moderate pericardial effusion infero-laterally and by the right atrium (RA) measuring laterally about 1.37 cm, basal posterior 0.9 cm, and 0.5 cm by the RA. TTE demonstrated preserved left ventricular function with ejection fraction > 55% and no obvious regional wall motion abnormalities (Videos 1, 2, Figure 1). Chest radiography showed sternotomy sutures, a left atrial appendage closure device, and a central venous cannulation line (Figure 2).

VIDEO 1: Apical 4 chambers view showing pericardial effusion

View video here: <https://vimeo.com/858792846?share=copy>

VIDEO 2: Apical two chambers echocardiographic view showing pericardial effusion

View video here: <https://vimeo.com/858792144?share=copy>

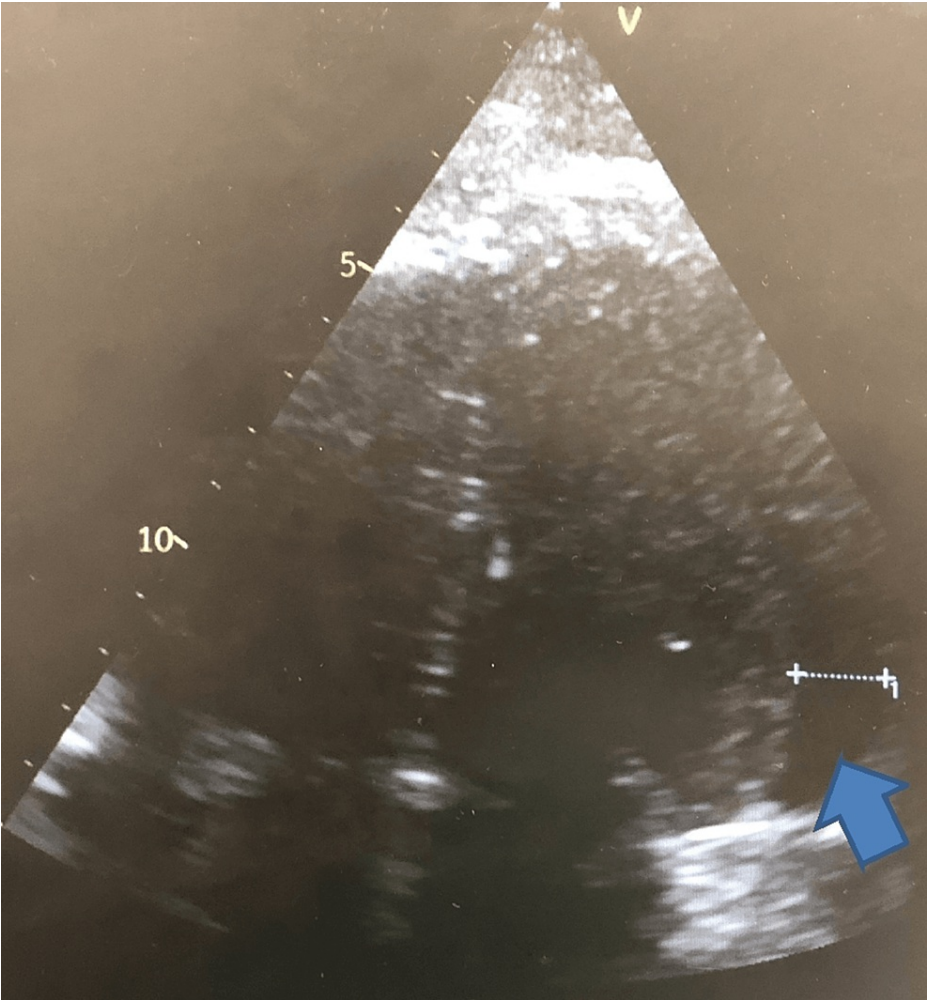


FIGURE 1: Apical 4 chamber echocardiographic view showing pericardial effusion (pointed blue arrow)

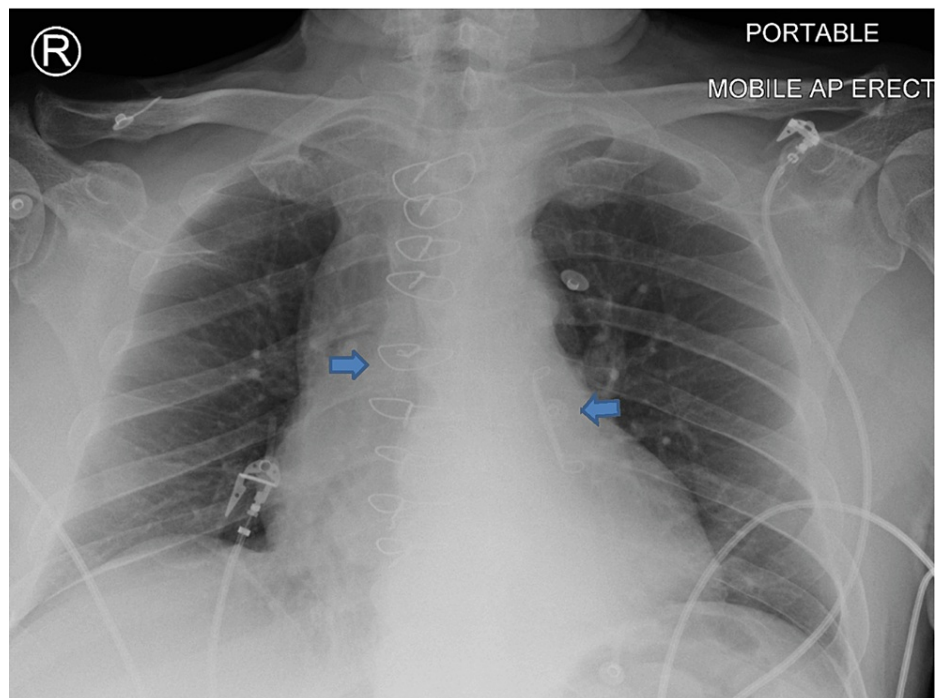


FIGURE 2: Antero-posterior chest radiography showing sternotomy sutures, and left atrial appendage closure device (pointed arrows).

The pericardial drain was kept overnight and removed 24 hours later. Lab tests showed hemoglobin 105 g/L before surgery which dropped to 95 g/L post procedure. Creatinine was 76 $\mu\text{mol/L}$ (normal range 59-104 $\mu\text{mol/L}$), C reactive protein 113 mg/L (normal range 0-5 mg/L), white cell counts $13.0 \times 10^9/\text{L}$ (normal range 4-10), neutrophils $10.6 \times 10^9/\text{L}$ (normal range 2-7), platelet count $560 \times 10^9/\text{L}$ (normal range 150-410). He was stepped down from ICU the following day, and he initially had slightly low urine output that gradually improved. The patient was discharged home on oral bisoprolol and was also given a course of oral Co-Amoxiclav 625 mg three times daily for seven days due to small left basal changes on the chest radiography. The patient was discharged home four days later on bisoprolol 3.75 mg once in the morning and 2.5 mg once in the evening. Other medications included apixaban 5 m twice daily, dapagliflozin 10 mg once daily, lansoprazole 30 mg once daily, rosuvastatin 5 mg once daily, and tamsulosin MR 400 mg once daily. The patient had high CHADS-VASc score of 4 and anticoagulation was continued for the next two to three months.

He was readmitted to hospital a few days later following an episode of collapse and loss of consciousness. Emergency services ECG showed 2:1 fast atrial flutter with a heart rate of 146 bpm. Subsequently, bisoprolol was switched to sotalol 40 mg twice daily initially, which was then uptitrated to 80 mg twice daily to achieve rhythm control following a successful synchronized DCCV shock of 360 joules. The bedside echo did not show any reaccumulation of the pericardial effusion. The patient was discharged home with outpatient follow-up and has remained in normal sinus rhythm since. His sternotomy wound has healed without any complications (Figure 3).



FIGURE 3: Sternotomy wound showing normal healing process without any signs of infection

Discussion

AF is the most common clinically encountered symptomatic cardiac arrhythmia worldwide. The presenting clinical features vary considerably among patients from palpitations, chest pain, dyspnea, and dizziness, to potentially life-threatening conditions such as ischemic stroke which is a complication of AF [6]. Treatment of AF is complex and variable and depends on the intended objectives, as there are multiple modalities of treatments available, and often multiple modalities can be utilized simultaneously. Currently, available options are medical therapy, which can be medication strategies that result in rate control or pharmacological rhythm control in addition to medications to the prevention of complications such as stroke [5], electrical cardioversion cardiac electrophysiologic ablation procedures such as catheter and cryo-balloon ablations, a cardiac structural device to prevent strokes such as left atrial appendage (LAA) closure device and, in some cases, surgical interventions [7]. Elderly patients over 65 years old who have minimal symptoms are usually recommended to be treated with a rate control medication strategy as it has been demonstrated that this strategy results in improved symptoms and decreased hospitalizations and is associated with less side effect profile or complications [8,9].

Nonetheless, in severely symptomatic patients, young patients < 65 years old, or individuals with a first diagnosis of AF, the primary objective of AF treatment is to maintain a normal sinus rhythm [10]. The restoration of normal sinus rhythm results in the resolution of symptoms and therefore an improvement in the quality of life. The most anti-arrhythmic drugs utilized to chemically cardiovert AF are class Ic and IIIc anti-arrhythmic medications. However, those anti-arrhythmic are associated with significant side effect profiles and poor tolerance [7].

Another established strategy of rhythm control in symptomatic AF patients is catheter ablation which aims to isolate or exterminate foci that initiate and sustain the AF [10]. Catheter ablation is associated with higher success in eliminating AF than medical therapy [11] and is associated with comparable if not reduced adverse cardiovascular outcomes when compared to medical rhythm control [12]. Moreover, catheter ablation can be the first line of treatment in some patients [13]. However, catheter ablation is an invasive procedure that remains associated with considerable complications despite the reduction in the incidence of AF catheter-related complications over the year with a low incidence of overall complications of around 4.51% and severe complications of around 2.44% [10]. One of the uncommon yet potentially fatal is cardiac perforation, with both atrial and right ventricular apex being the most common site of perforations during

ablations [14]. A perforation to the LAA seldom happens during AF ablation subsequently causing a tamponade similar to this case discussed. In two similar reported cases, surgical closure of the LAA by AtriClip was also used successfully [15]. This can be useful in preventing further AF-related complications.

The Japanese Registry of All Cardiac and Vascular Diseases-Diagnosis Procedure Combination (JROAD-DPC) study demonstrated that between April 2012 and March 2018 from 1,058 hospitals, 135,299 patients with AF underwent catheter ablation in 456 hospitals [16]. The study reported an in-hospital complication rate of 3.4%. Cardiac tamponade incidence was reported as 1.2% and in-hospital mortality was about 0.04% [16]. Certain factors such as old age, women, lower body mass index, and higher burden of comorbidities such as hypertension and diabetes were associated with higher complication risk in multivariate analysis. Cheng et al. reported a significant increase in quarterly rates of mortality and procedural complications following catheter ablation for AF between 2010 and 2015 which could be due to an increased number of comorbidities in these patients such as 26.9% of patients having ischaemic heart disease [17].

Yoshiaki et al. reported 29 events in 27 patients with cardiac tamponade who underwent catheter ablation for AF. 23 patients had structurally normal hearts, one had atrial septal defect closure, one had mild to moderate aortic regurgitation and two exhibited hypertrophic obstructive cardiomyopathy (HOCM) [3]. Cardiac tamponade was caused by intracardiac catheter manipulation in 24 patients, atrial septum puncture in three patients, and postprocedural inflammation in two patients, respectively. Twenty three of the 29 events occurred during the ablation procedure, four during ward stay and two events occurred during the first 33 days post procedure. Catheter ablation was completed in 19 events whereas in 10 events, the catheter ablation could not be completed on the first attempt. Cardiac tamponade was managed through percutaneous pericardial puncture in 21 events and seven events were managed conservatively whereas in one patient, a puncture was not attempted due to difficult anatomy [3,18].

Yoshimoto et al. reported that there is a lack of anticoagulation strategy in patients post AtriClip device procedure [19]. They recommended a three-month anticoagulation strategy post procedure to minimize risk of stroke or thromboembolism in patients. The stroke free rate during the follow-up for patients in this study was 98.9% despite having an estimated stroke risk of 4% based on the CHA2DS2-Vasc score for the entire cohort confirming the effectiveness of this strategy. Kim et al. reported in their study that patients continued with oral anticoagulation for 110 days and 90% of patients were able to discontinue the oral anticoagulant therapy which showed 73% reduction in risk of CHA2DS2-Vasc score predicted stroke [20]. The PROTECT AF trial demonstrate the efficacy of LAA exclusion in stroke prevention in patients not on anticoagulant therapy [21]. The expert consensus based on this study is not to use anticoagulant therapy in patients post AtriClip but instead to start aspirin on day 1 post-operatively and to continue indefinitely thereafter [22].

Conclusions

AF is a very common disease with significant mortality and morbidity and catheter ablation is becoming a more common long-term management strategy to restore normal sinus rhythm. The procedure is associated with certain risks although the complications risk has reduced recently. Cardiac tamponade is a rare life-threatening complication of catheter ablation and patients usually require emergency intervention to avoid a fatal outcome. Patients may require percutaneous pericardial drain or sternotomy depending on the severity of the complication.

Additional Information

Disclosures

Human subjects: Consent was obtained or waived by all participants in this study. **Conflicts of interest:** In compliance with the ICMJE uniform disclosure form, all authors declare the following: **Payment/services info:** All authors have declared that no financial support was received from any organization for the submitted work. **Financial relationships:** All authors have declared that they have no financial relationships at present or within the previous three years with any organizations that might have an interest in the submitted work. **Other relationships:** All authors have declared that there are no other relationships or activities that could appear to have influenced the submitted work.

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