# Cardiac Tamponade Due to Right Ventricle Perforation: A Rare Complication of Catheter Ablation for Ventricular Tachycardia Storm

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## ABSTRACT

*Cardiac tamponade is a rare but fatal complication of catheter ablation. We are reporting a case of a 73-year-old male with ventricular tachycardia (VT) storm undergoing urgent VT ablation, who was later found to have right ventricle (RV) perforation—an unusual site for catheter ablation complication. The patient underwent isochronal late activation mapping (ILAM)-based ablation and elimination of local abnormal ventricular activities (LAVA). After procedure, his blood pressure rapidly decreased, and he was found to have cardiac tamponade. The tamponade was recurring despite of pericardial pigtail placement; thus, the patient was prepared for open-heart surgery. To preserve blood, auto transfusion was used as a bridging therapy.*

***Keywords:*** *Ablation; Complication; Cardiac tamponade; Ventricular tachycardia; Right ventricle perforation.*

## INTRODUCTION

Electrical storm (also known as arrhythmic storm or VT/VF storm) is a life-threatening condition caused by cardiac electrical instability and clinically defined by >= 3 episodes of sustained VT, VF, or appropriate shocks form an ICD (intracardiac defibrillator) within 24 hours.[1,2] In patients with vulnerable anatomic or electrical substrates, triggers such as myocardial ischemia, inflammation, hemodynamic decompensation, drugs, electrolytes imbalance, and autonomic nervous system imbalance, can lead to sustained ventricular arrhythmia. When antiarrhythmic drugs failed to terminate electrical storm, catheter ablation should be considered.[1] One of the techniques used in VT ablation is isochronal late activation mapping (ILAM), a method to map substrate activation and identify target region for ablation.[3]

There are several complications that may complicate VT ablation, such as access-site vascular injury, procedure related thromboembolism, cardiac perforation with or without tamponade, and even death.[4] Cardiac tamponade is a rare but fatal complication of catheter ablation, caused by rupture of cardiac wall.[5] Surgery is indicated in repeated or fast-growing pericardial effusion. Autotransfusion may be used to preserve blood loss while preparing for surgery.[6] In this case report, we present a 73-year-old male patient with VT storms and signs of cardiac tamponade right after ablation due to right ventricle (RV) perforation. Autotransfusion was commenced to bridge the gap before surgery.

## CASE ILLUSTRATION

A 73-year-old male presented at the emergency department with chest pain and VT. The VT recurred four times, even after electrical cardioversion combined with beta blockers and amiodarone therapy. He was then put on general anesthesia and lidocaine drip to control the VT storm. An urgent VT ablation was scheduled for the next day. The patient had acute myocardial infarction (MI) with an episode of VT one month prior to admission. He had no signs of structural heart disease or cardiac channelopathies.

The 12-lead electrocardiogram (ECG) during VT showed a right bundle branch block-like (RBBB-like) pattern with positive inferior and negative I-aVL leads, and a transition zone in V5, suggestive of VT originating from the mid anterior wall of the left ventricle (LV) (**Figure 1a**).

Via femoral access, a hemodynamic sensor was attached to the arterial sheath. Electroanatomical mapping (EAM) of the LV was done using a duodecapolar catheter and 3D electroanatomical mapping, which showed a large area of low voltage in the posterolateral area from base to apex (**Figure 1b**). A 5-Fr quadripolar fixed-curve catheter was placed in the apex of the RV to help induce VT. Due to the inability to induce VT using RV and LV S1S3 combined with isoproterenol infusion,

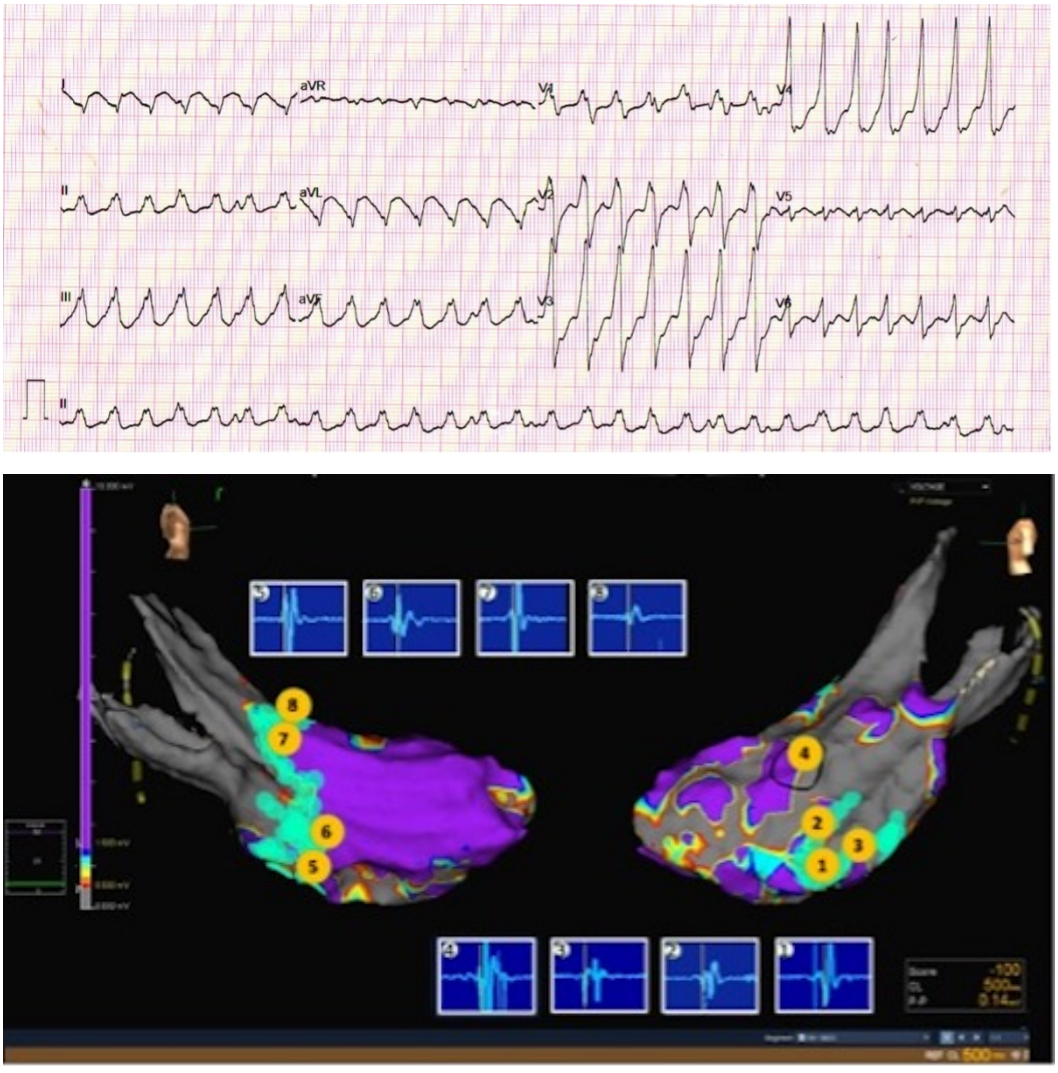


**Figure 1. (a) 12-lead ECG during VT attack.** ECG strip showed ventricular tachycardia with a rate of 200 bpm, right axis deviation, no visible p wave, wide QRS complex, and RBBB-like pattern with positive inferior lead and negative I-aVL leads. **(b) Voltage mapping.** Voltage mapping from the RAO and LAO views showed large areas of low voltage (scars) in the posterolateral LV. Black circle: ablation site; green spots: LAVA spots.

we proceeded with ILAM-based ablation and elimination of LAVA throughout the borderzone of the low voltage area in the LV.

We observed the patient for 30 minutes after ablation, during which no VT was induced. Close to the end of the procedure, we observed a sudden drop in blood pressure immediately after removing the RV catheter, which prompted immediate fluid resuscitation. A bedside echocardiogram showed pericardial effusion (**Figure 2a**), and subsequent pericardial puncture revealed blood in the pericardial space. A 6-Fr sheath with a pigtail was then inserted into the pericardial space; however, after evacuating 50 mL of blood, the tamponade reoccurred within 5 minutes.

Because of the rapidly recurring tamponades, consultations were held with the cardiac surgeon, and the patient was prepared for open-heart surgery. To save blood loss, we started autotransfusion using a three-way valve at the end of a pigtail with a male-to-male connector, which then connected to the end of the femoral-vein sheath (**Figure 3)**. This maintained hemodynamic status and preserved blood simultaneously.

After stabilization, right heart ventriculography was performed because hypotension occurred immediately after RV catheter withdrawal. The right heart ventriculography showed a leak in the inferior apical wall of the RV at the site of a previous RV lead placement **(Figures 2c and 2d**). This was later confirmed by the surgeon (**Figure 2b**).

The patient was discharged 3 weeks after surgery. He was then put on ICD and another VT ablation was done a few weeks after his first ablation, during which another LAVA elimination was performed. He remained VT free 6 months later.

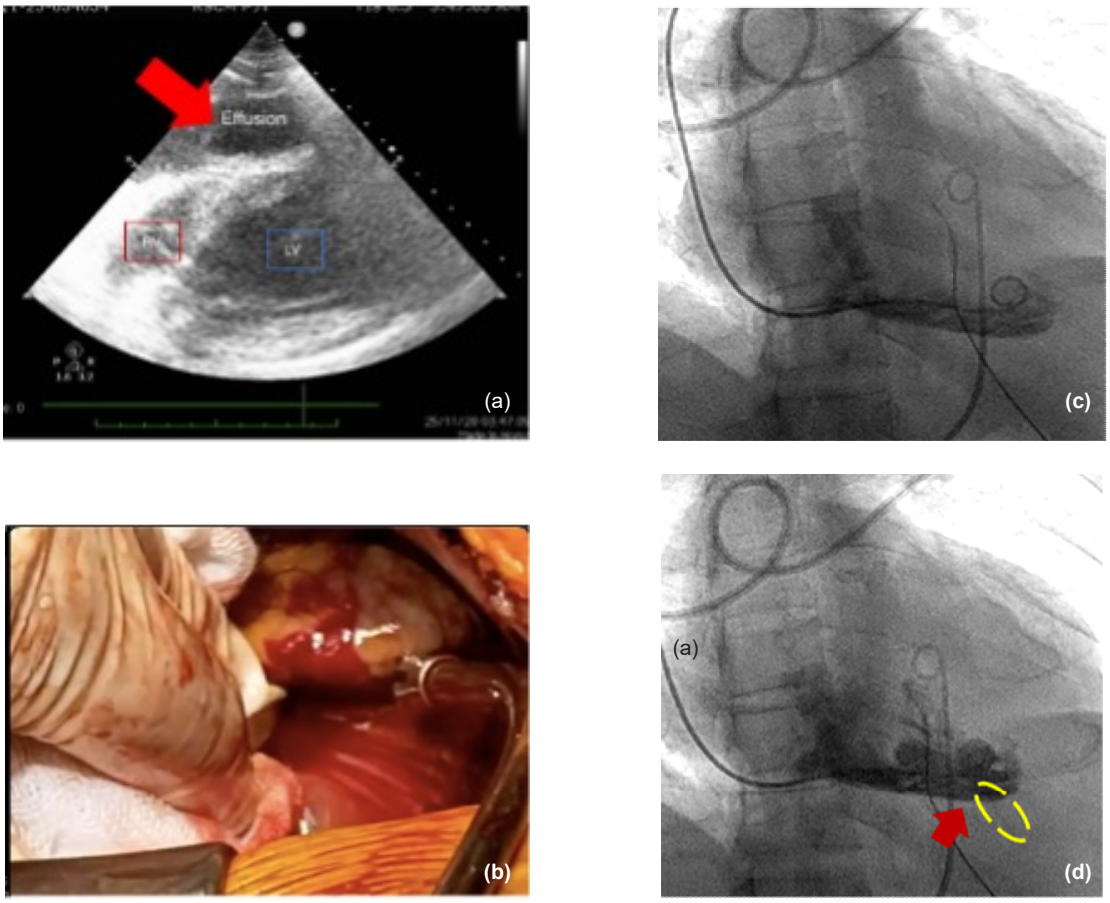


**Figure 2.** (a) Pericardial effusion. Subcostal view echocardiogram showing pericardial effusion below the RV. Red arrow: effusion; red box: RV; blue box: LV. (b) Rupture of the RV. Laceration of the RV wall found during open-heart surgery (c), (d) RAO view of contrast right ventriculography. The red arrow and yellow circle show contrast seeping through the inferior apical wall of the RV.

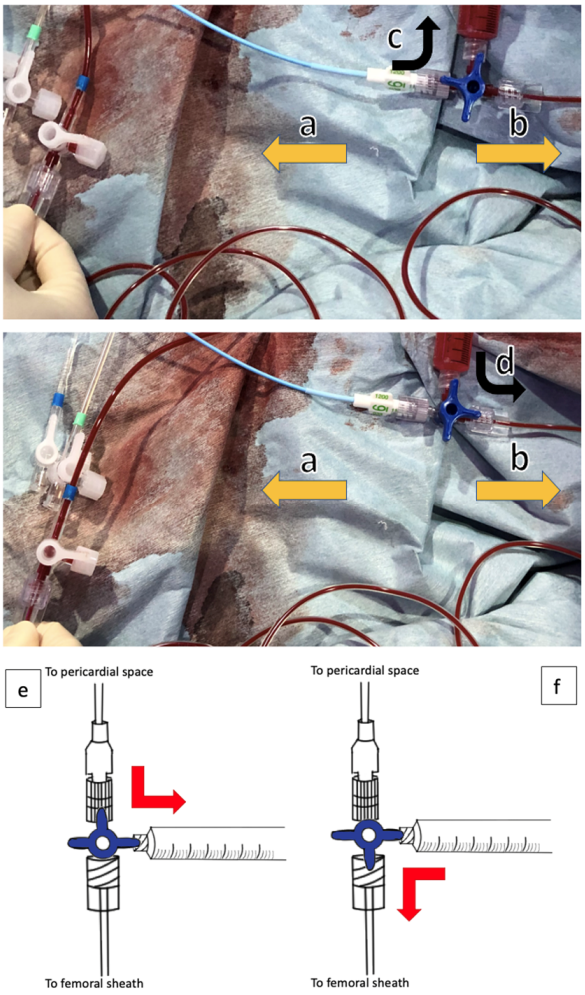


**Figure 3.** Autotransfusion. (a). Pigtail connected to the patient's pericardial space. (b). Male-to-male connector to the patient's femoral sheath. (c).Withdrawing blood from the pericardial space. (d). Transfusing blood to the femoral vein via the femoral sheath.(e). Schematic illustration of blood withdrawal from the pericardial space. (f).Schematic illustration of blood transfusion to the femoral vein via the femoral sheath.

## DISCUSSION

This patient had four recurrent VT episodes within 24 hours, which fits the definition of an electrical storm. Since antiarrhythmic drugs failed to terminate the VT storm, urgent VT ablation was performed. Although there are continued efforts to improve the safety of catheter ablation, pericardial tamponade is still one of the most frequent and deadly complications. Patients with BMI >35, age >75, and high INR are at higher risk of complication.[7] However, our patient did not possess any of these risk factors.

Early detection of complication is essential in managing patients after interventions. Mujovic et al.[8] reported that cardiac tamponade was a complication in 0.8% of patients undergoing catheter ablation for cardiac arrhythmias. In this patient, tamponade was noticed right after the procedure, indicated by a sudden drop in blood pressure. This timing was also reported in 17.6% of patients with cardiac tamponade after AF ablation.[6] Cardiac tamponade after VT ablation is rare. However, Calkins et al.[9] found that all cardiac tamponades occur during or immediately after VT ablation, while Xu et al.[10] reported a rare case of cardiac tamponade after 19 days. Once a drop in blood pressure is noticed, an immediate bedside echocardiography should be performed. Echocardiography could reveal the possible cause of the low blood pressure and the probable location of a rupture.[11]

Cardiac rupture is usually caused by mechanical trauma secondary to catheter manipulation or myocardial tissue injury induced

by RF ablation, but there are also reports of non-ablation catheter-related ruptures.[5,9] In our case, the rupture was located in the free wall of the RV, while ablation was done on the posterolateral wall of the LV. The presumed mechanism of perforation was the placement of the pacing catheter in the right ventricular apex. A rapid and dynamic heart after the infusion of high-dose isoproterenol is more susceptible to penetration by an RV catheter.[5] This mechanism was found in two out of 51 cardiac tamponades after AF ablation.[8] However, to our knowledge, this is the first report of this mechanism in a case of cardiac tamponade after VT ablation.

Another proposed risk factor for this patient is his previous MI. Previous recent myocardial infarctions might worsen an already delicate RV wall.[12] The use of a smaller catheter in our patient (5 Fr), in contrast to the usual 6-Fr catheter, might also play a role in increasing the risk of perforation, although there is no previous reported case known to us.

Surgery is indicated in repeated or fast-growing pericardial effusion. Autotransfusion may be used in order to preserve blood loss while preparing for surgery. The first successful autotransfusion was done in 1886 by John Duncan,[13] who used the technique during a leg amputation. Since then, several case reports and series have proven the life-saving potential of autotransfusion. Venkatachalam et al.[14] reported nine successful cases of autotransfusion in ablation procedure-related pericardial effusion using a cell salvage system. Unfortunately, blood filtering systems may not always be available in cardiac catheterization laboratory. However, Fioca et al.[15] reported 30 direct whole-blood transfusions in acute tamponades during catheter-based cardiac procedures, and no major adverse reactions were observed. In our patient, a direct whole-blood transfusion was given as a bridging therapy before surgery, and this temporarily stabilized his hemodynamic condition.

## CONCLUSION

Cardiac tamponade is a rare but fatal complication of catheter ablation. A rupture could occur not only at the site of ablation but also at other sites, such as the tip of the pacing catheter. Direct autotransfusion may be used as a bridging therapy before surgery in patients with cardiac tamponades.

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## CONFLICT OF INTEREST

The authors have no conflicts to disclose.

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