Transvenous ethanol ablation in epicardial localization of ventricular arrhythmias: a case report

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Background
An endocardial radiofrequency ablation is a common approach for the treatment of idiopathic ventricular arrhythmia. However, rare cases have been reported in which ventricular arrhythmia could not be ablated from endocardium due to an epicardial origin of the arrhythmia.

Case summary
In this article, we describe the rarely used, but acceptable approach to terminate ventricular arrhythmias in the summit of the left ventricle. We present a case of a 56-year-old patient with sustained monomorphic premature ventricular complexes, originating from the summit of the left ventricle, that were successfully eliminated. After unsuccessful ablation of the anterior wall right ventricular outflow tract, left coronary cusp, and distal coronary sinus, arrhythmia was eliminated by method of transvenous ethanol ablation. Complaints, such as palpitations and weakness, resolved after the procedure.

Discussion
This approach is used when an epicardial location of the substrate of arrhythmia is suspected and ablation through the right ventricular outflow tract, left coronary cusp, and great cardiac vein fails. The total effectiveness of eliminating ventricular arrhythmia increases if it is possible to use endo- and epicardial methods of mapping and ablation. In clinics with extensive experience in this area, ethanol ablation of epicardial ventricular arrhythmia is safe and effective.

Keywords
Premature ventricular complexes • Ventricular arrhythmias • Radiofrequency ablation • Selective coronary angiography • Ethanol • Case report

Introduction
Radiofrequency ablation (RFA) is recognized as the first line of treatment for ventricular arrhythmias (VAs) in patients without structural heart disease, but approaches and outcomes depend on the origin of the arrhythmia. The endocardial approach is a widely accepted method for the ablation of idiopathic VA; however, rare cases have

Learning points
• Transvenous ethanol ablation is an effective method in patients with ventricular arrhythmias originating from the left ventricular summit, whose endo- or epicardial radiofrequency ablation is not effective. It can be safely performed in experienced centres.
been reported in which VA could not be eliminated using endocardial ablation. Most idiopathic left-sided VAs come from the aortic root or the septum of the left ventricle, but some of them come from the endocardium of the left ventricular outflow tract, mitral annulus, and mitral-aortic continuity. In ~9–15% of cases, it is not possible to detect arrhythmogenic foci in these zones, and it has been established that VA in these patients is epicardial in origin. Idiopathic VA originating from the epicardium is distant from the endocardium and does not respond to the standard approach using endocardial ablation. The transvenous approach is uniquely suited for the successful ablation of epicardial VA with minimal side effects.

Timeline

| Dates     | Relevant past medical history and interventions                      |
|-----------|-----------------------------------------------------------------------|
| 2016      | Symptoms of arrhythmia began in 2016 with no provoking factors. There was no family history of arrhythmia and the patient denied smoking and alcohol consumption. |
| May 2016  | Primary visit to the cardiologist. Premature ventricular complexes (PVCs) were diagnosed. On 24 h ECG monitoring—sinus rhythm. 15 200 (14% of total beats) single monomorphic PVCs. Echocardiogram—no structural pathology. General and biochemical blood tests—unremarkable. Metoprolol 50 mg a day. Propafenone 450 mg a day. |
| December 2018 | Follow-up visit. The patient reported no improvement. On 24 h ECG monitoring—sinus rhythm. 24 185 (23% of total beats) single monomorphic PVCs. Changing of propafenone to amiodarone using the regime, 600 mg for 10 days, then 400 mg for 10 days, 200 mg a day thereafter. |
| May 2019  | Follow-up visit. The patient reported no improvement. On 24 h ECG monitoring—sinus rhythm. About 47 000 (46% of total beats) single monomorphic PVCs. Biochemical analysis, thyroid hormones were normal. Infection screening for Hepatitis B, C, and HIV were negative. Discontinuation of anti-arrhythmic drugs. The patient was referred for radiofrequency ablation Transvenous ethanol ablation of ventricular ectopic focus from the summit of the left ventricle. |
| August 2019 | Operation day. Biochemical analysis, thyroid hormones were normal. Infection screening for Hepatitis B, C, and HIV were negative. |
| September 2019 | Post-operation follow-up (1 month) The patient had a consultation with a cardiologist and did not report any symptoms. On 24 h ECG monitoring—sinus rhythm. No PVCs. |
| November 2019 | Post-operation follow-up (3 months) The patient had a consultation with a cardiologist and did not report any symptoms. On 24 h ECG monitoring—sinus rhythm. No PVCs. |
| February 2020 | Post-operation follow-up (6 months) The patient had a consultation with a cardiologist and did not report any symptoms. On 24 h ECG monitoring—sinus rhythm. No PVCs. |

Case presentation

A 56-year-old patient who worked as an engineer was admitted to the department of cardiac arrhythmias with complaints of palpitations, weakness, fatigue, and shortness of breath on the background of physical exertion. The patient had no past medical history. The patient’s vital signs were stable, blood pressure 120/80 mmHg, pulse rate 76 b.p.m., oxygen saturations 97% at the rest. On auscultation, there were no abnormal heart sounds or breath sounds. When conducting echocardiography, cardiac magnetic resonance, and coronary angiography, structural heart pathology was not detected. On laboratory analysis (full blood count, serum biochemical and electrolyte test, thyroid hormone test), there was no deviation from the reference ranges. Daily 24-h Holter monitoring showed frequent single monomorphic premature ventricular complexes (PVCs), with a total of 47 000 (46% of total beats). From the history, symptoms of arrhythmia began in 2016 with no provoking factors. There was no fami-
600 mg for 10 days, then 400 mg for 10 days, 200 mg a day thereafter for 5 months).

The epicardial origin of PVCs was assumed based on a surface ECG, which showed a high to low axis and complete blockade of the left branch of the His bundle with a pseudo-delta wave, the absence of Q waves in the inferior leads (II, III, AVF), the presence of the S wave in lead I, and the deep Q wave in leads AVL, the transitional zone in V3, and also the high R waves in the inferior leads (see Figure 1). After the failure of more than two anti-arrhythmic medications and following discussion with the patient, the decision was made to pursue an elective cardiac ablation, and the case was discussed with the Heart Team in a multi-disciplinary meeting.

After informed patient consent was taken, the electrophysiological procedure began. Despite the obvious signs of epicardial localization of the arrhythmogenic focus, attempts were made to map in the outflow tract of the right ventricle, the left sinus of Valsalva, and under the aortic valve. However, in the areas above, neither an early ventricular activation zone nor signs of satisfactory stimulation mapping (the similarity of the pacing and spontaneous ventricular complexes) were detected. Then, a decision was made to map the PVCs through the coronary sinus system. Open irrigated tip ablation catheter (4-pole Thermocool 7 Fr with a 4-mm distal electrode and

![Figure 1](https://academic.oup.com/ehjcr/advance-article/doi/10.1093/ehjcr/ytaa412/5999159)

Figure 1 The 12-lead ECG of premature ventricular complexes arising from the summit of left ventricle.

![Figure 2](https://academic.oup.com/ehjcr/advance-article/doi/10.1093/ehjcr/ytaa412/5999159)

Figure 2 The positions of ablating electrode in the great cardiac vein (area of left ventricular summit) in left anterior oblique: 31° CAU: 8° (A) and right anterior oblique: 2° CAU: 37° (B). Then, the interested vein (*marked with an asterisk) was found during coronary sinus venography in right anterior oblique: 32° CAU: 2° (C) and left anterior oblique: 27° CAU: 2° (D). After that, vein was obliterated with ethanol injection in right anterior oblique: 33° CAU: 3° (E) and left anterior oblique: 36° CAU: 2° (F).
inter-electrode distance of 2–5–2 cm) was positioned in the early zone. Then selective coronary angiography was performed, which established that the early zone was located at a safe position from the bifurcation of the left coronary artery (LCA) (>4 mm) (see Figure 2A and B). From the distal pair of electrodes of the ablation catheter, complexes obtained on stimulation were identical to spontaneous PVC complexes (V-QRS time 25 ms). Under constant fluoroscopic control and selective coronary angiography of the LCA, a series of point radiofrequency applications was performed with a power of 25 W, a resistance of 280 ohms, an irrigation rate of 17 mL/min, and a temperature limit of 45°C. The total ablation time was 60 s, and a temporary effect of disappearance of the target ventricular ectopic was achieved at the end of ablation, with subsequent return of ectopic activity. There were no signs of ST-segment elevation or thermal damage to the coronary vessels.

Next, it was decided to perform transvenous alcohol ablation of the veins of the left ventricular (LV) summit. To do this, venography of the coronary sinus was performed in the projections of the left and right anterior oblique, and an interesting vein emanating from the region of the LV summit was discovered (see Figure 2C and D). Then, this vein was catheterized by an over-the-wire (OTW) balloon microcatheter. Then, a solution of 96% ethanol in a total amount of 6.0 mL was introduced inside the vein of interest; simultaneously, the OTW balloon had been dilated. Ethanol ablation was gradually controlled by contrast injection. Within 3 min, PVCs disappeared constantly, and the vein was completely obliterated; this was confirmed on control venography (see Figure 2E and F). Immediately after 30 min of observation, programmed (a drive train of 8 beats at 400 ms cycle length and one extrastimuli with 10 ms decremental step) and incremental stimulation with low rate (<250 beats/min) stimulation was carried out, also following administration of sympathomimetics (phenylephrine, isoproterenol), and it was not possible to induce PVCs. The final stage of the operation was controlled coronary angiography, which showed intact LCA. Also, after 2 days, a stress test (treadmill) and ECG were performed, which showed no pathologic ventricular activity (see Figure 3).

The patient was discharged with recommendations for taking antiplatelet agents for 4 weeks. At 1, 3, and 6 months after eliminating the focus of arrhythmia, the patient did not report any symptoms. On the latest 24-h ECG performed at 6 months post-procedure, sinus rhythm and 26 premature atrial complexes were
recorded, ventricular ectopic activity and pause more than 1500 ms were not recorded.

**Discussion**

At the moment, there are insufficient data on the prevalence, ECG characteristics, and primary localization of arrhythmogenic zones around the summit of the left ventricle. Also, the effectiveness of catheter ablation in these cases is not clear. Transvenous ethanol ablation is used when other approaches fail. Half-saline irrigation, bipolar ablation are mostly avoided because of putative risk of steam-pop (the audible sound produced by intramyocardial explosion when tissue temperature reaches 100°C). According to Baman et al., in almost 70% of patients, foci of epicardial arrhythmias were successfully removed via ablation in the large cardiac vein. However, difficulties and the inability to perform RFA may occur due to the high resistance in the area of the large cardiac vein. Besides this, ablation through the venous system increases the risk of complications, such as damage to vein or arteries located nearby. Therefore, to prevent complications, selective coronary angiography should be used in combination with fluoroscopy to accurately locate the ablation catheter. It was shown that the elimination of foci of VA located in the epicardium is possible through the coronary venous system due to ethanol injection and can be successful in several patients. Transvenous ethanol ablation is effective and safer than other alternative methods. The possible benefit of this approach is the lower risk of cardiac damage, mostly superficially (epicardial). Nevertheless, the use of ethanol in the coronary venous system can be associated with certain difficulties, since it can potentially lead to complications such as stenosis or rupture of the veins, venous thrombosis, cardiac tamponade, or damage to the coronary arteries.

**Conclusion**

The incidence of epicardial VA is different in the analysed patient populations and depends on the underlying heart disease. According to the data accumulated in world practice, epicardial VA is one of the most common causes of the ineffectiveness of endocardial VA ablation. If it is possible to use the endo- and epicardial method of mapping and ablation, the total effectiveness of eliminating VA increases. Epicardial transvenous alcoholic ablation of VAs is still a rather specialized procedure and has not entered into the routine practice of centres with little experience in mapping and ablation of VAs. The procedure is safer and more effective in experienced centres.

**Lead author biography**

Bakhodir Narziev graduated from the Tashkent Medical Academy in 2016. He was a trainee resident in the Cardiology Department, Tashkent Medical Academy from 2016 to 2019. Currently, working as an intervention- al electrophysiologist at the ‘American Hospital’ Clinic, Tashkent, Uzbekistan, and is involved in the investigation and treatment of patients with all forms of arrhythmia problems including ablation and device therapy. He is also an active member of the Heart Team Association of Uzbekistan, EHRA, and HRS.

**Supplementary material**

Supplementary material is available at European Heart Journal - Case Reports online.

*Slide sets:* A fully edited slide set detailing this case and suitable for local presentation is available online as Supplementary data.

Consent: The authors confirm that written consent for submission and publication of this case report including image(s) and associated text has been obtained from the patient in line with COPE guidance.

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