ESC European Society of Cardiology

European Heart Journal - Case Reports (2024) **8**, ytae455
https://doi.org/10.1093/ehjcr/ytae455

CASE REPORT
Electrophysiology

Bipolar catheter ablation of a left atrial anteroseptal line in a patient with peri-mitral atrial flutter: a case report

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Received 2 March 2024; revised 14 June 2024; accepted 23 August 2024; online publish-ahead-of-print 2 September 2024

Background Treatment of recurring atrial flutter can be challenging due to anatomical obstacles preventing complete conduction block of linear ablation lesions. Epicardial or bipolar ablation can be used as an alternative to create deeper ablation lesions but is still limitedly used in patients with atrial flutter.

Case summary We describe a case of a 54-year-old patient with recurring peri-mitral flutter treated with ablation of an anteroseptal line using bipolar ablation to achieve a complete conduction block.

Discussion As conventional ablation cannot always achieve, complete conduction block in linear ablation lesions alternatives may be used to create deeper lesions. In this, case bipolar ablation was used successfully for an anteroseptal line in a patient with recurring peri-mitral flutter.

Keywords Electrophysiology • Atrial flutter • Bipolar ablation • Peri-mitral flutter • Anteroseptal line • Case report

ESC curriculum 5.4 Atrial flutter • 5.5 Supraventricular tachycardia

Learning points

- Bipolar ablation can be used as an alternative for conventional ablation to treat atrial flutter.
- Bipolar ablation can help to overcome anatomical obstacles that prevent complete linear conduction block.

Introduction

Ablation of left atrial linear lesions is needed in the treatment of left atrial flutter. However, achievement of sustained left atrial lesions can be challenging: myocardial sleeves, epicardial connections, such as the bundle of Bachmann, or myocardial thickness can lead to uncomplete conduction blocks or recovery of the linear ablation lesion.[1] Epicardial or bipolar ablation can be used to overcome these difficulties. We present a case where bipolar ablation was used to successfully treat peri-mitral flutter, when unipolar ablation (UPA) did not result in complete conduction block.

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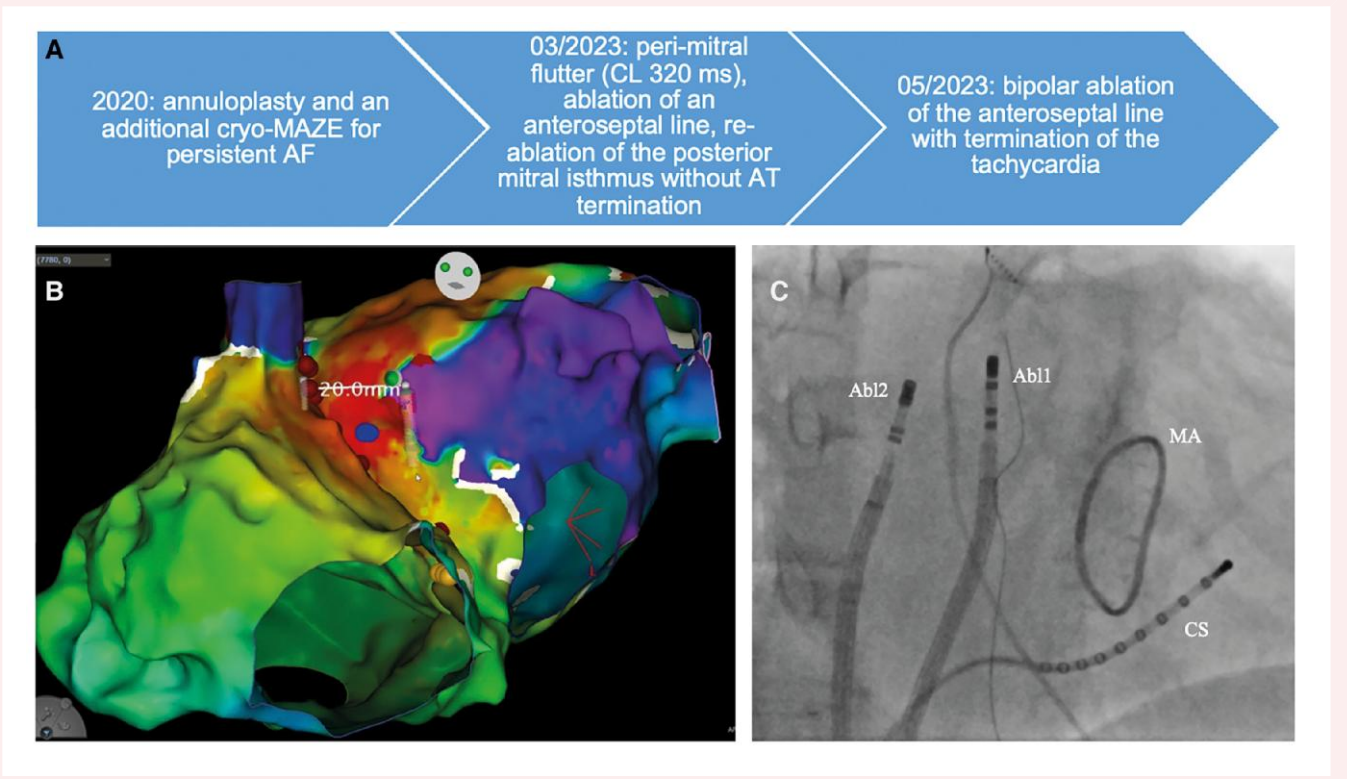
Handling Editor: Stefano Bordignon
Peer-reviewers: Deepti Ranganathan; Piotr Futyma
Compliance Editor: Piera Ricci

Summary figure



Case presentation

A 54-year-old patient presented to our hospital with palpitations and dyspnoea. Electrocardiography at admission showed atrial flutter with a 2:1 conduction and a ventricular rate of 91/min (*Figure 1*). Physical examination and questioning of the patient were without any abnormalities. He did not express chest pain or difficulties in breathing in rest. Slight dyspnoea was stated when walking.

The patient's history included a minimally invasive mitral valve reconstruction due to mitral valve prolapse with annuloplasty and an additional cryo-MAZE for persistent atrial fibrillation (pulmonary vein isolation, posterior box isolation, and posterior linear ablation to the mitral annulus) in 2020.

Three years later, when admitted to the hospital with atrial flutter, an EP study with a bi-atrial 3D high-density electroanatomical map confirmed peri-mitral flutter (CL 320 ms, Supplementary data online, *Videos S5 and S6*). Ablation of an anteroseptal line (right superior pulmonary vein to mitral valve annulus) was performed. The ablation procedure was performed under deep sedation with propofol. Despite extensive endocardial ablation (radiofrequency (RF) ablation with Thermocool Smarttouch SF; Biosense Webster; ablation index of 550, 50 W) from the left and right atrium and re-ablation of the posterior mitral isthmus, the tachycardia could not be terminated. Ablation from the coronary sinus (CS) was not feasible due to the narrowing of the CS after annuloplasty. Due to missing substrate in the left atrium, no other linear lesion was ablated. After cardioversion, the patient was rescheduled for a second procedure using bipolar RF ablation 8 weeks after the initial procedure.

For this procedure, a 3D high-density electroanatomical map of the left and right atrium was created using electroanatomical mapping system (CARTO 3, Biosense Webster) and a multipolar mapping catheter (Octaray™, Biosense Webster, Inc.) (*Figure 2*). As shown in *Figure 3*, an open-irrigated ablation catheter (Thermocool Smarttouch SF; Biosense Webster) was placed in the left atrium and a second open-irrigated ablation catheter (Celsius Thermocool, Biosense Webster) was placed on the opposite side of the anteroseptal line in the right atrium (Supplementary data online, *Figure S4*). Both catheters were connected to a bipolar ablation (BPA) certified generator system (HAT 500® system; OSYPKA, Germany). Peri-mitral flutter was induced via programmed stimulation. Ablation was performed with 25 W and RF pulses of 60 s duration with an irrigation flow rate of 17 mL/min.

Both catheters were moved along the anteroseptal line with repeat RF ablations delivered (*Figure 3*). Arrhythmia termination was achieved during ablation (*Figure 4*, Supplementary data online, *Figures S1 and S2, Video S3*). The total ablation time was 12 min and 25 s with 15 applications. Complete block of the anteroseptal line was confirmed by combined differential pacing manoeuvres and activation mapping. After programmed and burst stimulation, no arrhythmia could be induced.

After a follow-up of 12 months, the patient remained asymptomatic and free from recurrences of atrial arrhythmias without antiarrhythmic medication.

Discussion

Unipolar ablation may be insufficient to achieve complete conduction block for left atrial ablation lines. Incomplete linear lesions may lead to the new substrate and can therefore be proarrhythmic.[2] Inter-atrial connections, myocardial thickness, or epicardial fibres add to the difficulties in achieving complete linear lesions. The EARNEST PVI study of

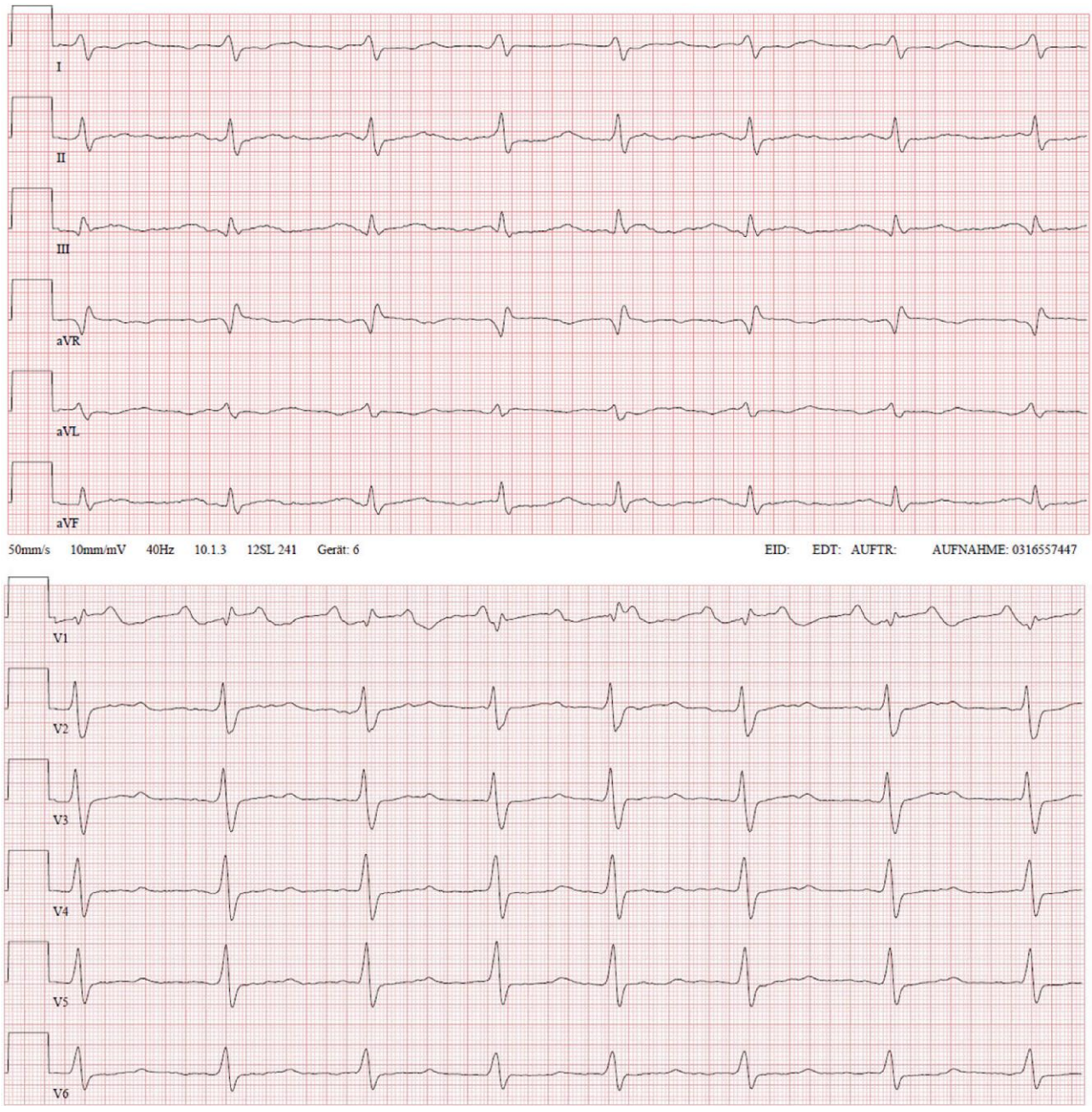


Figure 1 Electrovardiography at admission showing atrial flutter with a 2:1 conduction. Ventricular rate is 91 b.p.m.

Masuda *et al.*[3] has shown that within initial ablation, complete conduction block of left atrial lines can be achieved in only 75% of the patients and reconnection rates vary between 20% and 30%.

Lai *et al.* evaluated different anatomical structures as origins for bi-atrial tachycardias (BiAT). Their findings support that the Bachmann bundle (BB), a sub-epicardial muscular band, and other septal bundles (such as septal pulmonary bundle or septoatrial bundle), as well as transseptal fibres around the fossa ovalis and muscular sleeves around the coronary sinus, complicate re-entry tachycardia ablations.[4] Sekihara *et al.*[5] describe a case in which ablation of the BB was used to successfully treat therapy refractory BiAT. Further findings support the involvement of BB in atrial fibrillation or flutter circuits, describing up to 72% of successful sinus rhythm restoration when ablating the BB.[6] In addition, anatomical structures such as the vein of Marshall (VOM), an embryological remnant of the superior vena cava, have been identified as potential triggers for sustaining arrhythmias. Being located within the mitral isthmus, VOM ethanol infusion and catheter ablation of the latter have been proven to be highly feasible and facilitate blockage of mitral isthmus and can therefore be used as an additional treatment strategy for recurring re-entry tachyarrhythmias.[7,8]

Another possible explanation of bi-atrial flutter is the involvement of epicardial connecting fibres that complicate achieving complete conduction block.[9] Epicardial ablation can be used as an alternative to treat these arrhythmias but is however associated with a higher risk for

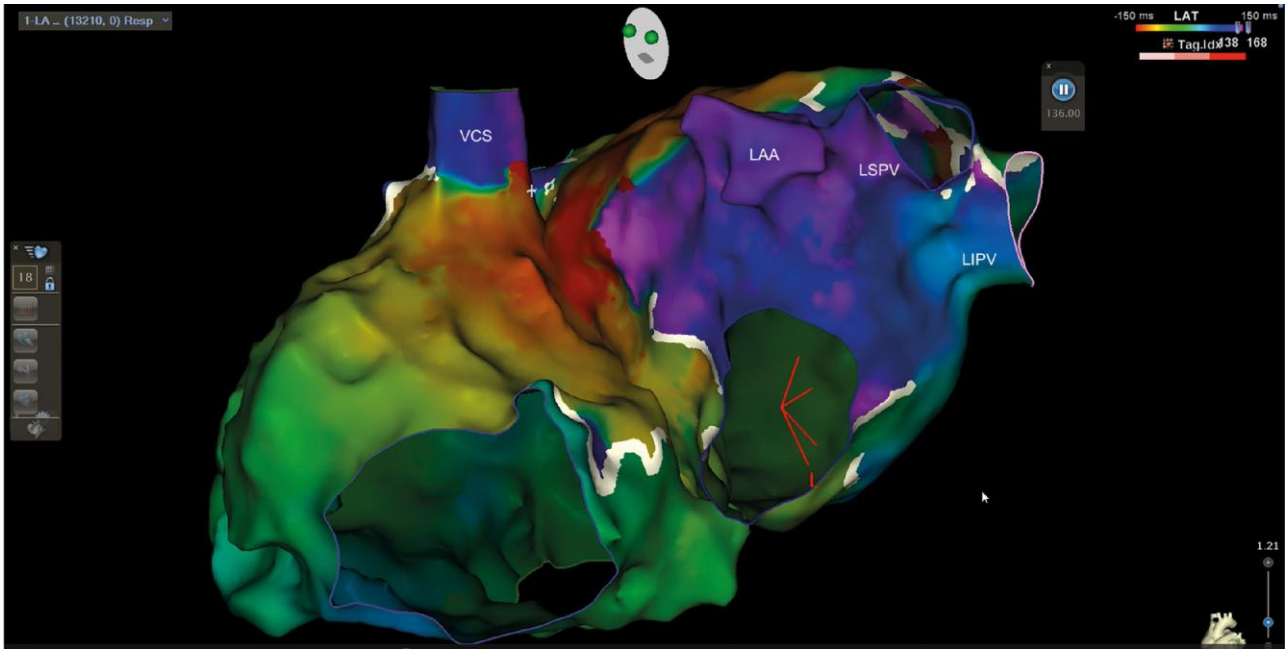


Figure 2 3D endocardial activation map of the left and right atrium in left anterior oblique (LAO) view. Complete cycle length of 320 ms is represented by colour code. Legend of colour coding is provided in the upper right corner (setting −150 to 150 ms). LAA, left atrial appendage; LIPV; left inferior pulmonary vein; LSPV, left superior pulmonary vein; VCS, vena cava superior.

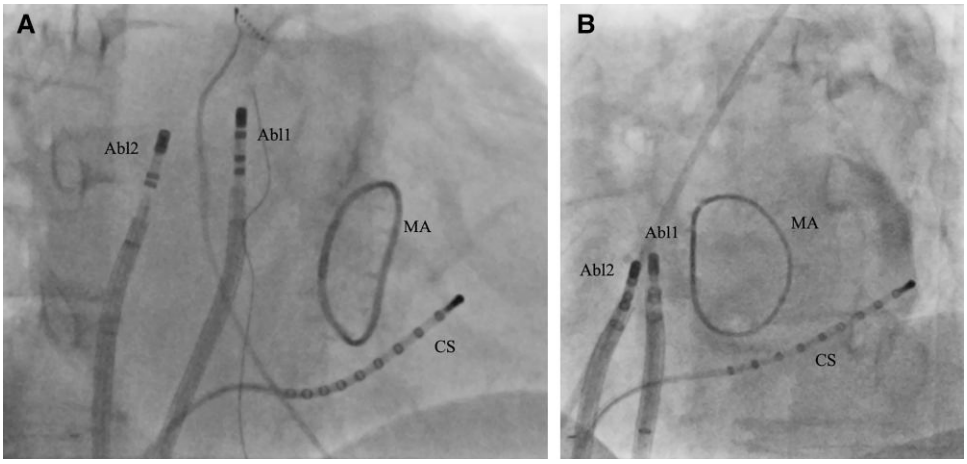


Figure 3 (*A*) Fluoroscopy image in anterior-posterior (AP) view. Start of bipolar ablation. The ablation catheters are positioned in the superior vena cava and the left atrium. Diagnostic decapolar coronary sinus (CS) catheter is positioned in the coronary sinus. The annulus of the replaced mitral valve (MA) is visible. (*B*) End of bipolar ablation. Visible are the two ablation catheters positioned in the left and right atrium. Left anterior oblique view. Abl1, first open-irrigated ablation catheter; Abl2, second open-irrigated ablation catheter.

major complications compared to UPA.[10] Bipolar ablation, as an alternative, has been proven to be superior to UPA in creating deep transmural lesions *in vitro* and *in vivo* experiments and can be used in cases with recurring therapy refractory tachyarrhythmia.[11,12] As Koruth *et al.* have shown in their study using porcine hearts for bipolar ablation (two irrigated catheters, RF ablation, max of 50 W, 120 s), it can generate a lesion thickness of 17.4 ± 3.3 mm, compared with 15.5 ± 5.2 mm using UPA.[12] Transmurality could be achieved in 82% of the cases using bipolar ablation, whereas using unipolar energy, only 33% of the used porcine hearts showed complete transmural lesions.[11] Yamagata *et al*. described the first-in-man bipolar ablation of an atrial flutter. Their findings support the positive effects of bipolar ablation on therapy refractory arrhythmias due to the lack of transmurality of ablation lesions with UPA.[13]

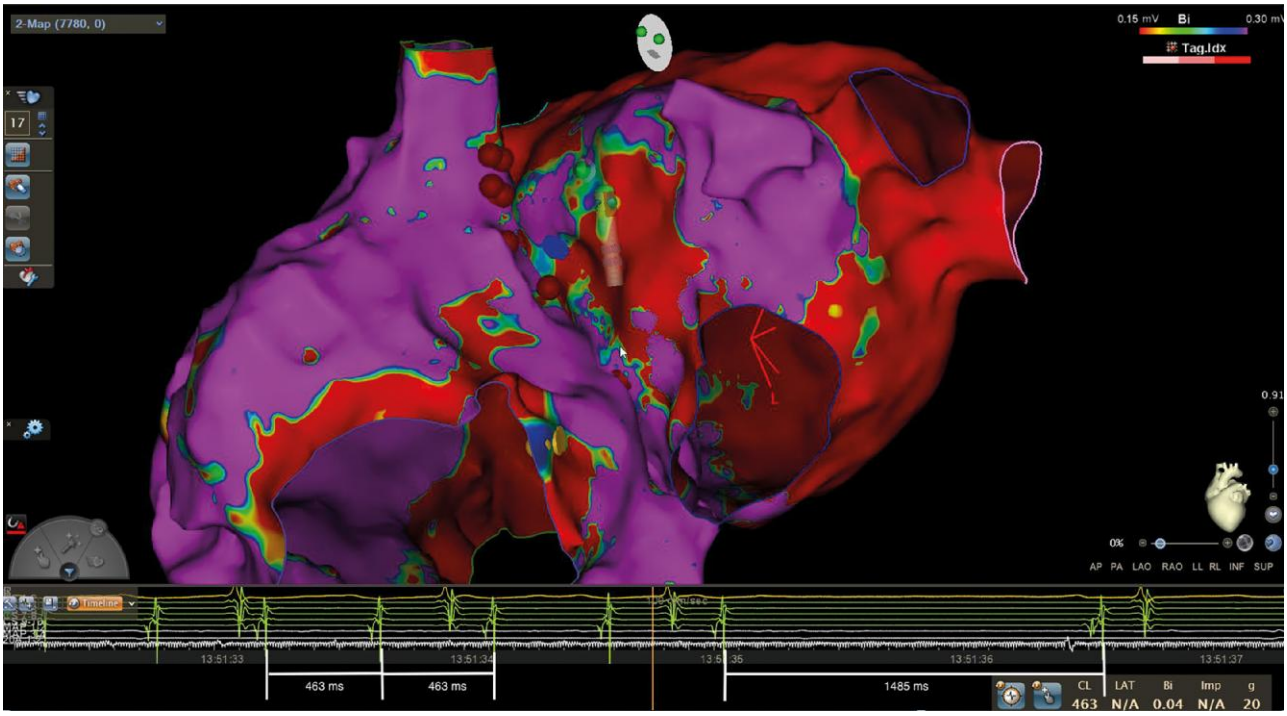


Figure 4 Termination of tachycardia. Left anterior oblique view of 3D electroanatomical endocardial voltage map showing the substrate along the inter-atrial septum. Right and left atriums are visible. One of the two open-irrigated ablation catheters is visible in the left atrium. Marked 3-dimensional point on the anterior wall of the left atrium shows the point at which termination of tachycardia was reached. Green intra-cardial electrocardiographic recordings of diagnostical coronary sinus (CS) catheter show prolongation (320 ms at procedure beginning vs. 463 ms before termination) and termination of tachycardia. After termination bradycardic sinus rhythm takes over.

Bipolar RF ablation has been successfully used in patients with premature ventricular contractions, accessory pathways, and ventricular tachycardia in cases when previous ablation using conventional RF ablation had failed.[14,15] In this case report, we demonstrate that bipolar ablation can also be used in patients with recurring atrial flutter and is a valuable alternative for unipolar or epicardial ablation.

Patient's perspective

The patient was relieved to be free of any recurring arrhythmias and satisfied with the received treatment.

Lead author biography

Nadja Martins is a doctoral student at Charité in Berlin. She has a special interest in cardiology and rhythmology.

Supplementary material

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

Consent: The authors confirm that written consent was obtained from the patient for the submission and publication of this case, including images, in line with COPE guidance.

Conflict of interest. None declared.

Funding: None declared.

Data availability

The data underlying this article will be shared upon reasonable request to the corresponding author.

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