

# Mapping catheter-related mitral valve injury: a case report

Simran Shergill \* and Nigel R.A. Clarke 

Department of Cardiology, South Warwickshire NHS Foundation Trust, Lakin Road, Warwick CV34 5BW, UK

Received 10 March 2020; first decision 22 April 2020; accepted 12 August 2020; online publish-ahead-of-print 18 September 2020

## Background

An increasing number of catheter ablations are performed for symptomatic tachyarrhythmias and commonly involve the left atrium, increasing the risk of catheter interaction with the mitral valve (MV) complex. Mitral valve trauma at the time of atrial fibrillation (AF) ablations remains a rare yet emergent situation that requires prompt diagnosis and management to prevent the long-term sequelae of heart failure secondary to MV dysfunction.

## Case summary

We present a case of a 69-year-old female with symptomatic paroxysmal AF and atrial flutter who underwent a combined ablation procedure. During the pulmonary vein isolation procedure, the mapping catheter became entangled within the MV apparatus but was freed. She presented to our hospital 2 weeks later with dyspnoea, lethargy, and a cough. Clinical examination revealed a pansystolic murmur and right moderate pleural effusion. Transthoracic echocardiogram (TTE) demonstrated a flail posterior MV leaflet with severe eccentric mitral regurgitation (MR). She underwent urgent valve repair at the regional cardiothoracic centre. Upon review 2 months later, she was symptom free with surveillance TTE demonstrating a preserved left ventricular systolic function with a trace of MR.

## Discussion

Mitral valve injury secondary to catheter entrapment at the time of left-sided ablations is a rare yet serious complication and can present as an emergent situation requiring prompt recognition and early surgical management to salvage valve and cardiac function.

## Keywords

Atrial fibrillation • Ablation • Mapping catheter • Pulmonary vein isolation • Mitral valve injury • Mitral valve repair • Case report

## Learning points

- Clinicians should be aware of this rare yet serious complication of left-sided catheter ablations.
- Prompt recognition and early surgical repair is key to restore mitral valve function and prevent the development of heart failure in cases of significant injury.

## Introduction

Catheter ablation procedures for tachyarrhythmias are commonplace in current day cardiology practice. Pulmonary vein isolation (PVI) remains a cornerstone to the management of symptomatic atrial fibrillation (AF) with procedural adverse events being rare but can include stroke, pericardial effusion with subsequent tamponade, valvular injury, pulmonary vein (PV) stenosis, and atrio-oesophageal

\* Corresponding author. Tel: +44 1926 495321, Email: [simran.shergill@nhs.net](mailto:simran.shergill@nhs.net)

Handling Editor: Sommer Philipp

Peer-reviewers: Ang Richard; Khan Habib

Compliance Editor: Vamvakidou Anastasia

Supplementary Material Editor: Green Peregrine

© The Author(s) 2020. Published by Oxford University Press on behalf of the European Society of Cardiology.

This is an Open Access article distributed under the terms of the Creative Commons Attribution Non-Commercial License (<http://creativecommons.org/licenses/by-nc/4.0/>), which permits non-commercial re-use, distribution, and reproduction in any medium, provided the original work is properly cited. For commercial re-use, please contact [journals.permissions@oup.com](mailto:journals.permissions@oup.com)

fistula formation.<sup>1,2</sup> Mitral valve (MV) trauma is a rare but recognized complication with catheter ablations involving the left atrium (LA). Resultant damage is often severe with significant valve dysfunction requiring urgent repair. Without prompt recognition and management, survival is often poor with resultant heart failure.<sup>3</sup> We report a case of MV injury secondary to mapping catheter-related trauma at the time of a PVI ablation.

## Timeline

Date	Event
2012–2015	Medical management of paroxysmal atrial fibrillation and atrial flutter in the cardiology outpatients with bisoprolol and flecainide
February 2015	Referred for a combined ablation procedure due to deterioration in symptoms and placed on sotalol in the interim
3 December 2015	Elective pulmonary vein isolation and cavotricuspid isthmus ablation. Mapping catheter entangled in mitral valve (MV) apparatus but freed. On-table transthoracic echocardiogram (TTE) demonstrated no significant mitral regurgitation (MR) or pericardial fluid
Admission 15 December 2015	Presentation with shortness of breath, lethargy, and cough. New pansystolic murmur at the apex and right moderate pleural effusion
4 h later	TTE demonstrated a flail posterior mitral valve leaflet with a severe eccentric jet of MR
Local hospital admission	Management with intravenous diuretics. Coronary angiogram demonstrated unobstructed coronaries. Transferred to regional cardiothoracic centre
31 December 2015	MV repair with tricuspid valve annuloplasty, Cox-maze, and left atrium appendage ligation. Uncomplicated post-operative period
February 2016	Clinic follow-up; patient free of symptoms with TTE demonstrating a trace of MR and preserved left ventricular systolic function

## Case presentation

A 69-year-old female with a background of paroxysmal AF and typical type I atrial flutter presented to the clinic with worsening exertional breathlessness and periodic palpitations. Despite flecainide and bisoprolol her symptoms continued to deteriorate. She was referred for a cavotricuspid isthmus (CTI) and PVI ablation procedure and placed on sotalol in the interim. Other past medical history included hypertension and hypothyroidism. Atrial fibrillation and atrial flutter had been diagnosed in 2012 as was followed up regularly in the cardiology outpatients. Medication history included losartan 12.5 mg OD,

ramipril 10 mg OD, sotalol 40 mg TDS, levothyroxine 75 µg OD, and warfarin 3 mg OD.

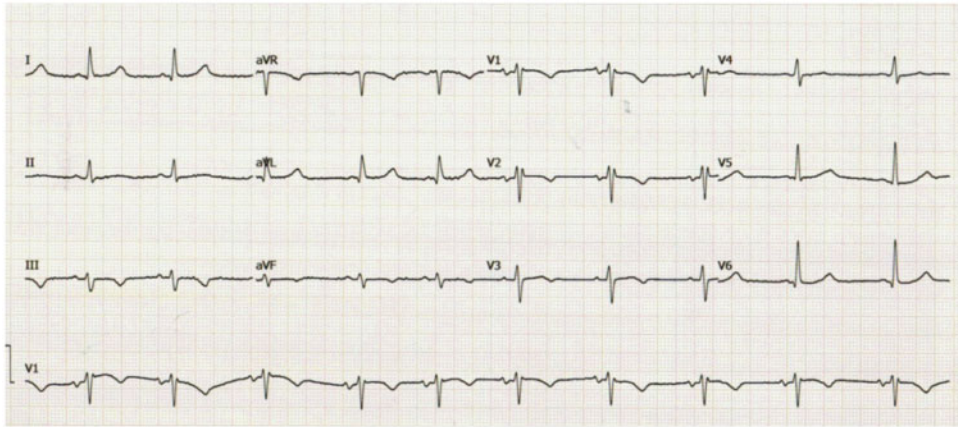
The elective combined procedure utilized the CARTO-3 system for mapping and ablation. A decapolar catheter was placed in the coronary sinus and quadrapolar catheter was positioned by the His bundle; during catheter manipulation the patient went into AF. Double transeptal puncture was uncomplicated with a circular Lasso mapping catheter delivered through a LAMP-90 sheath and a ThermoCool SmartTouch ablation catheter with contact force sensing placed through the second LA access. During PV mapping the Lasso catheter became entangled within the MV apparatus but was subsequently freed up using sheath advancement; obvious damage to the catheter was noted on withdrawal. The mapping catheter was replaced, and all PVs were silent at the end of the procedure with the patient in sinus rhythm. The CTI line was then performed in the right atrium but was complicated by a further episode of AF requiring cardioversion. The patient remained haemodynamically stable throughout the procedure and on-table transthoracic echocardiogram (TTE) demonstrated no significant mitral regurgitation (MR) or pericardial effusion. The patient was admitted overnight and discharged the following morning with normal physical observations and in sinus rhythm.

Following discharge, she reported increasing shortness of breath on exertion, a non-productive cough and general lethargy. A course of oral amoxicillin and steroids was prescribed by her General Practitioner for a suspected lower respiratory tract infection. Her breathlessness continued to deteriorate, and she presented to our hospital 12 days following her ablation procedure.

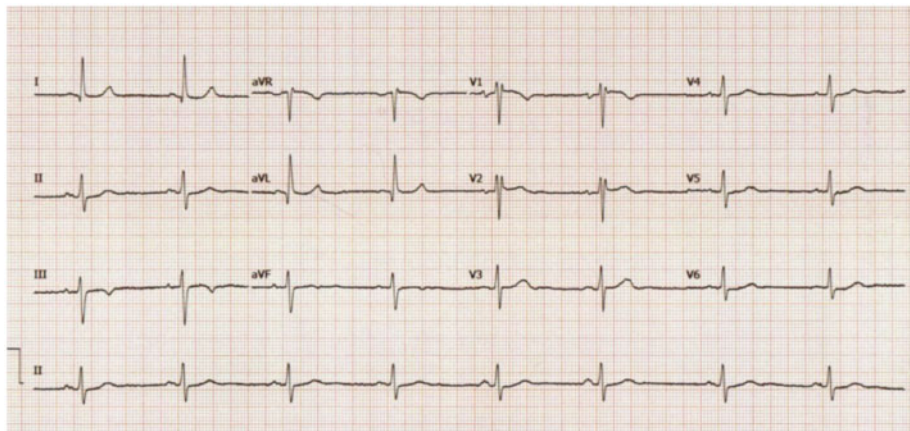
On examination, her venous pressure was raised to the tragus. Stony dullness and decreased air entry at the right base was consistent with a moderate pleural effusion. A new 3/6 pansystolic murmur at the apex radiating to the aortic region suggested a fault with the posterior mitral valve leaflet (PMVL). There was no peripheral oedema or stigmata of infective endocarditis. The blood counts showed an elevated white cell count of  $18.36 \times 10^9/L$  (normal:  $4-11 \times 10^9/L$ ) due to a neutrophilia and a mild anaemia at 112 g/L (normal: 120–150 g/L). There was mild renal impairment with a creatinine of 115, baseline 67 µmol/L (normal: 50–90 µmol/L), the C-reactive protein was 3 mg/L (normal: <11 mg/L), and troponin-T measured 42 ng/L (normal: <14 ng/L).

Resting 12-lead electrocardiogram (ECG) demonstrated sinus rhythm and partial right bundle branch block with T-wave inversion in leads III, aVF, and  $V_1-V_3$  (Figure 1); the anterior T-wave inversion was new when compared with a historical ECG (Figure 2). Chest X-ray showed a moderate right and small left pleural effusion (Figure 3). Urgent bedside TTE demonstrated vigorous left ventricular (LV) systolic function, a flail PMVL causing severe eccentric MR with a vena contracta of 0.7 cm and PV flow reversal. Biatrial dilatation was noted with an LA indexed volume of 36 mL/m<sup>2</sup>. There was also moderate tricuspid regurgitation, no obvious vegetations in the left or right heart, and a small rim of posterior pericardial fluid with no haemodynamic compromise (Video 1).

Iatrogenic trauma to the MV was the initial working diagnosis. The alternative diagnosis was coronary artery embolization during the ablation procedure with subsequent myocardial infarction (MI).



**Figure 1** Admission electrocardiogram demonstrated sinus rhythm and partial right bundle branch block with T-wave inversion in leads III, aVF, and V<sub>1</sub>–V<sub>3</sub>.



**Figure 2** Historical electrocardiogram demonstrated sinus rhythm and partial right bundle branch block with T-wave inversion in leads III and aVF.

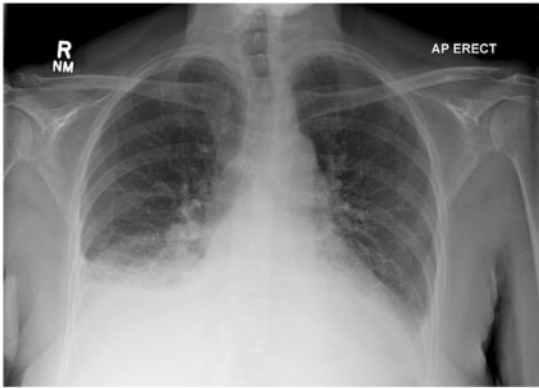
The patient was commenced on intravenous loop diuretics (furosemide 80 mg BD) and continued on her angiotensin-converting enzyme inhibitor whilst awaiting transfer for surgery. A diagnostic coronary angiogram demonstrated unobstructed coronary arteries with LV angiogram demonstrating the broad jet of MR (*Video 2*).

The patient was transferred to the regional cardiothoracic centre 2 weeks following admission to our hospital. On-table transoesophageal echocardiogram demonstrated a P1 prolapse and she underwent an MV repair via a midline sternotomy with a tricuspid valve annuloplasty, Cox-maze procedure, and LA appendage ligation. Inspection of the MV intra-operatively confirmed a P1 prolapse due to avulsion of the associated chords attached to the posteromedial papillary muscle. Triangular resection of P1 was undertaken with plication of the annulus and remodelling with a 30 mm Physio-2 annuloplasty ring. Good MV opening and competence was confirmed on the table and she was discharged 5 days later following an uncomplicated post-operative period.

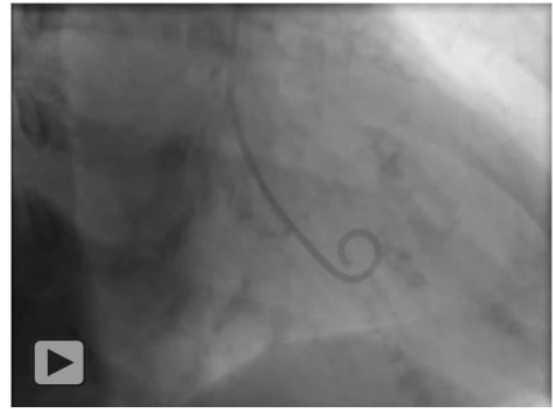
Our patient was reviewed in the clinic 2 months later where she was symptom free with an unrestricted exercise tolerance and TTE demonstrated a preserved LV systolic function with a trace of MR (*Video 3* and *Figure 4*).

## Discussion

Mitral valve trauma remains a rare yet serious complication of left-sided ablations. Catheter entrapment within the valve complex is the more common mechanism of injury, however, radiofrequency energy disruption of the valvular apparatus has also been reported in the literature.<sup>4</sup> A description of three cases in 2007 found an incidence of 0.9% of catheter-related MV trauma causing significant valve dysfunction.<sup>5</sup> However, a 2009 worldwide survey that collected data from over 182 centres on the safety of AF catheter ablations, reported 11 cases of procedural MV injury giving an overall incidence of 0.07%.<sup>6</sup>



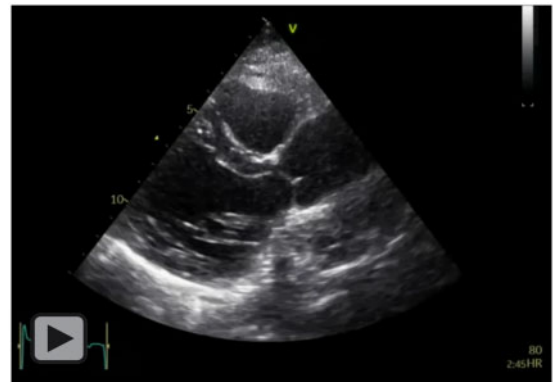
**Figure 3** Chest X-ray on admission demonstrated a moderate right and small left pleural effusion.



**Video 2** Left ventricular angiogram with a vigorous left ventricular systolic function and broad jet of mitral regurgitation.



**Video 1** Transthoracic echocardiogram on admission demonstrated a flail posterior mitral valve leaflet with severe eccentric mitral regurgitation. (A) Parasternal long-axis. (Ai) Parasternal long-axis colour Doppler through mitral valve. (B) Parasternal short-axis at basal segments. (C) Apical four-chamber. (Cii) Apical four-chamber with colour Doppler through mitral valve. (Ciii) Apical mitral valve zoomed. (Civ) Apical four-chamber with colour Doppler through tricuspid valve. (D) Apical three-chamber window.

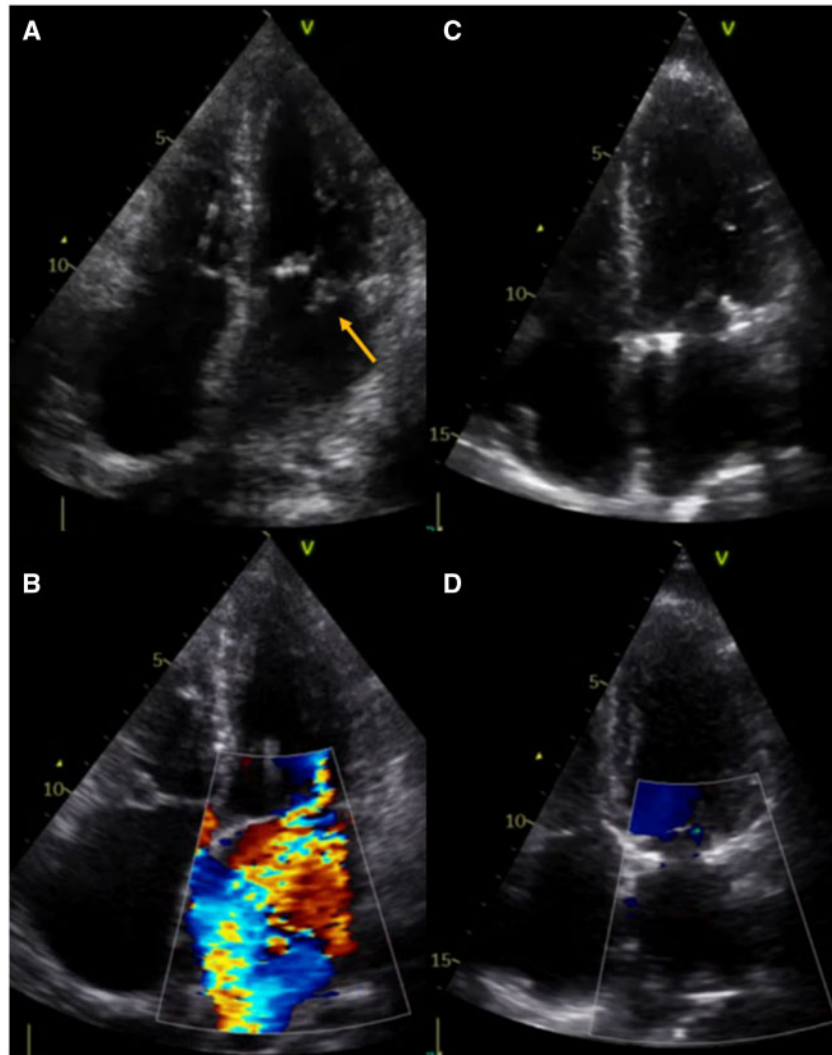


**Video 3** Recovery transthoracic echocardiogram showing a preserved left ventricular systolic function and trace of mitral regurgitation. (Ai) Parasternal long-axis. (Aii) Parasternal long-axis with colour Doppler through mitral valve. (Aiii) Parasternal long-axis mitral valve zoomed. (B) Parasternal short-axis at basal segments. (C) Apical four-chamber. (Cii) Apical four-chamber with colour Doppler through mitral valve. (D) Pulse wave Doppler through mitral valve. (Ei) Apical four-chamber of right heart. (Eii) Apical four-chamber with colour Doppler through tricuspid valve. (F) Subcostal window.

Consequently, the exact incidence is unknown and likely underestimated due to procedural adverse events being reported on a voluntary basis.<sup>7</sup> However, an expert consensus statement confirms a decreased incidence in recent years; likely due to increased awareness of this complication.<sup>8</sup>

The 2017 HRS/EHRA/ECA/APHRS/SOLAECE consensus statement on catheter ablations for AF, stress the importance of prompt recognition of valvular injury during the time of a PVI.<sup>8</sup> When catheter entrapment within the MV apparatus is suspected, echocardiography is vital for prompt diagnosis; even in cases where the catheter is freed from the valve complex.<sup>3</sup> As highlighted, the resultant damage is often severe with significant valvular incompetence resulting in an emergent presentation.

In our case, we hypothesize that the severity of the valve dysfunction may not have been apparent immediately following catheter freedom from the MV complex due to the preservation of the other chordae; providing initial integrity to the valve. Intraoperative findings demonstrated compromise to only the P1 scallop chords and with the on-table TTE being unremarkable, progression of MV dysfunction and haemodynamically significant MR could have ensued in the hours following the procedure. Alternatively, the findings of MV injury and subsequent MR could have been missed during the on-table TTE. During the procedure, it was felt a large part of the entrapment was the damaged catheter catching on the sheath tip; possibly leading to



**Figure 4** Transthoracic echocardiogram following the combined ablation procedure (A and B) and post-surgical repair (C and D). (A) Flail posterior mitral valve leaflet arrowed in apical four-chamber. (B) Colour Doppler through mitral valve in apical four-chamber demonstrating the eccentric jet of severe mitral regurgitation. (C) Good mitral valve competence in apical four-chamber following surgical repair. (D) Colour Doppler through mitral valve repair in apical four-chamber with no significant mitral regurgitation.

underestimations of the degree of MV entanglement at the time. In summary, detailed echocardiographic assessment is vital in cases of MV entrapment during left-sided catheter ablations. Following this case, routine institutional practice is to perform detailed TTE the following day in complicated cases.

Admission ECG demonstrated new T-wave inversion in the anterior chest leads; prompting a differential diagnosis of MI secondary to coronary artery embolization during the ablation procedure. However, given the absence of chest pain, TTE findings and reported intraoperative complication of MV entrapment, this was less likely and most probably reflected non-specific changes in the context of acute severe MR.

It is well documented that patients with MR secondary to ruptured chordae tendinae or flail leaflets have improved long-term survival

without resultant heart failure when surgical correction is performed promptly following diagnosis.<sup>3</sup> As described in our case, prompt diagnosis with timely referral for MV repair enabled a good outcome for our patient with preservation of cardiac function and freedom from symptoms.

## Conclusion

Early surgical repair of MV injury secondary to catheter entrapment is vital to salvage and restore valve function and prevent the long-term sequelae of heart failure. Clinicians should be aware of this rare yet serious operative complication of a common procedure in modern-day cardiology.

## Lead author biography



Dr Simran Shergill graduated from the University of Birmingham in 2015. He completed his MRCP in 2018 and is currently working as a Cardiology Specialty Doctor at South Warwickshire NHS Foundation Trust.

## 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 author/s 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.

**Conflict of interest:** none declared.

## References

1. De Greef Y, Ströker E, Schwagten B, Kupics K, De Cocker J, Chierchia GB et al. Complications of pulmonary vein isolation in atrial fibrillation: predictors and comparison between four different ablation techniques: results from the Middelheim PVI-registry. *EP Europace* 2018;**20**:1279–1286.
2. Rehman KA, Wazni OM, Barakat AF, Saliba WJ, Shah S, Tarakji KG et al. Life-threatening complications of atrial fibrillation ablation: 16-year experience in a large prospective tertiary care cohort. *JACC Clin Electrophysiol* 2019;**5**:284–291.
3. Suri RM, Vanoverschelde J-L, Grigioni F, Schaff HV, Tribouilloy C, Avierinos J-F et al. Association between early surgical intervention vs watchful waiting and outcomes for mitral regurgitation due to flail mitral valve leaflets. *JAMA* 2013;**310**:609–616.
4. Desimone CV, Hu T, Ebrille E, Syed FF, Vaidya VR, Cha YM et al. Catheter ablation related mitral valve injury: the importance of early recognition and rescue mitral valve repair. *J Cardiovasc Electrophysiol* 2014;**25**:971–975.
5. Kesek M, Englund A, Jensen SM, Jensen-Urstad M. Entrapment of circular mapping catheter in the mitral valve. *Heart Rhythm* 2007;**4**:17–19.
6. Cappato R, Calkins H, Chen S-A, Davies W, Iesaka Y, Kalman J et al. Updated worldwide survey on the methods, efficacy, and safety of catheter ablation for human atrial fibrillation. *Circ Arrhythm Electrophysiol* 2010;**3**:32–38.
7. Wu RC, Brinker JA, Yuh DD, Berger RD, Calkins HG. Circular mapping catheter entrapment in the mitral valve apparatus: a previously unrecognized complication of focal atrial fibrillation ablation. *J Cardiovasc Electrophysiol* 2002;**13**:819–821.
8. Calkins H, Hindricks G, Cappato R, Kim Y-H, Saad EB, Aguinaga L et al.; Document Reviewers. HRS/EHRA/ECAS/APHRS/SOLAECE expert consensus statement on catheter and surgical ablation of atrial fibrillation. *EP Europace* 2018;**20**:e1.