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CASE REPORT
Heart failure

Emergent catheter ablation for atrial fibrillation in a patient with acute decompensated heart failure on a mechanical haemodynamic support: a case report

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Background Atrial fibrillation (AF) is associated with the exacerbation of heart failure (HF). Although AF ablation has become an established treatment for patients with HF, it is usually an elective procedure. Here, we present a case of acute decompensated heart failure (ADHF) exacerbated by refractory AF, which was successfully treated with emergent AF ablation.

Case summary A 53-year-old, obese man with a history of myocardial infarction presented to our hospital. Heart function deteriorated with an ejection fraction of 9.8%, and he was repeatedly hospitalized due to worsening HF. This time, the patient was emergently admitted due to ADHF associated with persistent AF. Atrial fibrillation was refractory to electrical cardioversion. Despite optimized medical support, the patient developed haemodynamic collapse and multiple organ failure. Intra-aortic balloon pump (IABP) and mechanical ventilation were initiated in addition to intravenous catecholamines. Emergent AF ablation was performed. Following pulmonary vein isolation, sinus rhythm was restored and the patient's haemodynamic status dramatically improved. The IABP and mechanical ventilation were withdrawn within a few days, and the catecholamine dose was reduced. After cardiac rehabilitation, the patient was discharged.

Discussion Our case suggests that an emergent AF ablation is feasible and effective even in a patient with severe ADHF. An emergent AF ablation could be a therapeutic option to treat a critically unwell patient who has deteriorated due to a vicious cycle of AF and HF.

Keywords Atrial fibrillation • Emergent ablation • Acute decompensated heart failure • Low cardiac output

Learning points

- Atrial fibrillation (AF) is an important trigger or worsening factor of heart failure.
- Atrial fibrillation ablation is an established treatment option for patients with heart failure, whereas it is usually an elective procedure.
- Emergent AF ablation could be a therapeutic choice for patients with acute decompensated heart failure and refractory AF.
- Atrial fibrillation ablation can be accomplished without using a contrast agent in a haemodynamically unstable condition.

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Introduction

Catheter ablation of atrial fibrillation (AF) has become an established therapy, and the role of AF ablation has been increasing in recent times. Recent clinical trials have indicated that AF ablation is associated with reductions in cardiovascular morbidity and mortality in patients with heart failure (HF), and is recommended in the clinical guidelines.[1,2] However, since AF ablation is an elective procedure, the feasibility and efficacy of emergent AF ablation, in a haemodynamically decompensated patient, is unclear. Here, we present a case of acute decompensated heart failure (ADHF) in which emergent AF ablation dramatically improved the haemodynamic status and clinical course of the patient.

Timeline

30 years before admission	Multiple episodes of myocardial infarction treated with percutaneous coronary interventions.
1 month before admission	Hospitalization due to acute decompensated heart failure (ADHF).
Admission (Day 0)	Readmitted due to ADHF accompanying atrial fibrillation (AF) and acute kidney injury (AKI) with hyperkalaemia.
Day 1	A direct current electrical cardioversion (DC) restored sinus rhythm.
Days 6, 11, 13	AF recurred and needed repeat DC.
Day 17	AF recurred and became refractory to DC. Due to multiple organ failure and oliguria, dosage of dopamine and dobutamine infusion were increased. AF continued until Day 26.
Day 20	The AKI worsened to a level of anuria. Intra-aortic balloon pumping (IABP) and continuous haemodialysis/filtration (CHDF) was started. AF was refractory to DC. One dose of Digoxin was administered intravenously, and intravenous infusion of an ultra-short-acting beta1-selective blocker was used as a rate control strategy.
Day 22	Mechanical ventilation started due to respiratory failure/acidosis.
Day 26	CHDF was withdrawn. DC restored sinus rhythm temporarily.
Day 27	AF recurred and was refractory to DC. The haemodynamic status collapsed with intractable AF tachycardia.
Day 28	Emergent AF ablation (pulmonary vein isolation) was performed.
Day 29	IABP withdrawn. Dose of catecholamine was reduced.
Day 35	Mechanical ventilation was withdrawn. Cardiac rehabilitation started.
Day 79	Discharged on foot.

Case presentation

A 53-year-old man with a history of multiple myocardial infarctions was admitted to our hospital because of ADHF accompanied by acute kidney injury (AKI) and hyperkalaemia. On admission, the patient was alert and oriented. Physical examination revealed blood pressure 130/70 mmHg, irregular tachycardia to 143 beats per minute with an oxygen saturation of 94% on room air. Respiratory rate was 26 breaths per minute, and physical examination revealed wheezing rales heard in both lungs and oedema in the lower extremities bilaterally. Due to significant wheezing and irregular tachycardia, abnormal heart sounds were difficult to distinguish on cardiac auscultation. The patient had type 2 diabetes mellitus, chronic kidney disease, paroxysmal AF, and high low-density lipoprotein cholesterol. He was markedly obese with a body weight (BW) of 131 kg [body mass index (BMI) = 45.9 kg/m^2]. Laboratory tests showed an increase of brain natriuretic peptide (180.8 pg/mL, normal value: 18.4 < pg/mL), high serum potassium (9.4 mEq/l, normal value: 3.6–4.9 mEq/l). Serum urea nitrogen was 128.7 mg/dL (normal value: 8.0–22.0 mg/dL) and serum creatinine was 5.48 mg/dL (normal value: 0.60–1.10 mg/dL). An emergent continuous haemodialysis/filtration was conducted, and potassium value decreased. An electrocardiogram showed rapid AF rhythm plus ventricular premature beats around the rate of 160 beats per minute with left bundle branch block QRS morphology. The patient's left ventricle showed marked dilatation and diffuse hypokinesis on echocardiography. The end-diastolic and end-systolic diameters of the left ventricle were 70 and 64 mm, respectively, and the ejection fraction (EF) was 18%. The left atrial diameter was 48 mm. Mild mitral and tricuspid regurgitation were observed. The end-diastolic and end-systolic volumes were 403.9 and 364.2 mL, respectively, evaluated by cardiac magnetic resonance imaging (MRI). The EF on cardiac MRI was 9.8%. Coronary artery angiography was performed 1 month before admission and no significant stenotic lesion was found.

The medications were optimized as possible for chronic HF and other co-morbidities, including bisoprolol (2.5 mg), angiotensin II receptor blocker (ARB) (olmesartan 40 mg), vasopressin receptor antagonist (tolvaptan 15 mg), loop diuretics (furosemide 80 mg), mineralocorticoid receptor antagonist (spironolactone 12.5 mg), and amiodarone 200 mg. The maximum dose of ARBs was prescribed whereas dose of beta-blocker and spironolactone were sub-maximum doses due to frequent histories of ADHF/low output state and hyperkalaemia, which required emergent haemodialysis.

Direct current electrical cardioversion (DC) was repeated under the support of intravenous anti-arrhythmics (amiodarone and nifekalant) to improve the haemodynamic status. However, sinus rhythm could not be maintained, and AF recurred many times. The patient developed a low cardiac output state and multiple organ failure with persisting AF. Intra-aortic balloon pumping (IABP) and mechanical ventilation with intubation were initiated. Right heart catheterization (RHC) on Day 20 showed a mean pulmonary capillary wedge pressure of 57 mmHg and a cardiac index of 2.7 L/min/m^2, under the support of IABP and catecholamine infusion (DOA = 4.7 μg/mL/min, DOB = 5 μg/mL/min). On the same day, continuous haemodialysis/filtration (CHDF) was started because of acute kidney injury (AKI) and anuria. One dose of Digoxin was administered intravenously, and intravenous infusion of an ultra-short-acting beta1-selective blocker

(randiolol) was used as a rate control strategy. However, rate control of AF was challenging with the heart rate consistently greater than 120 b.p.m. despite sedation, with transient elevation up to 140 b.p.m. On Day 27, the haemodynamic status collapsed to a systolic blood pressure of 50 mmHg. Therefore, our Heart Team decided to perform an emergent catheter ablation of AF to overcome the vicious cycle of HF and AF. Bilateral pulmonary vein isolation (PVI) was performed using the Ensite system and an irrigated-tip ablation catheter (Tacticath, Abbott Laboratories, St Paul, MN, USA) (*Figure 1A* and *B*), under deep sedation with dexmedetomidine and thiamylal. Sinus rhythm was restored by DC cardioversion following PVI. The procedure time was 2 h. These procedures were completed without using contrast agents, considering AKI.

After PVI, the sinus rhythm was restored. The patient's haemodynamic condition improved dramatically, and catecholamine dosage was reduced. On the day after ablation, the IABP was removed. Renal function recovered and the patient began to produce urine. One week later, the patient was extubated, and mechanical ventilation was withdrawn. The patient's clinical course is summarized in *Figure 2*. There was an episode of AF recurrence after ablation, which was resolved by DC. After continuing cardiac rehabilitation program, the patient was discharged on foot, 1.5 months after the ablation.

Discussion

Emergent atrial fibrillation ablation for acute decompensated heart failure

Although AF ablation plays an important role in HF management, as demonstrated in previous clinical trials,[1,2] it is basically an elective procedure. However, as in our present case, physicians face serious ADHF exacerbated by refractory AF. Such patients generally receive comprehensive HF care, but with a traditional rate control for AF. It should be emphasized that our patient presented with very severe ADHF due to refractory AF, requiring mechanical ventilation and IABP. We assured that the patient could not be treated with rate control strategies, but a rhythm control was required. Consequently, the patient dramatically recovered from his severe condition following emergent AF ablation restoring sinus rhythm. It is suggested that emergent AF ablation can be an effective therapeutic choice in patients with medically intractable ADHF accompanied by AF. A recent report demonstrated AF ablation using the cryoballoon method in patients with ADHF.[3] It may be challenging to decide when to perform an emergent AF ablation in acute HF.[4] However, an insufficient response to fully available non-invasive therapies for both acute HF and AF would be an indicator for performing emergent AF ablation as in our case.

The benefits of AF ablation in patients with an EF of <25% still remain unclear. A subgroup analysis of CASTLE-AF did not show a significant benefit of catheter ablation with regard to death and worsening HF in patients with an EF <25%.[1] However, in our case, we decided to perform AF ablation to bail out the deteriorated haemodynamic condition. Although the catheter ablation led to a positive clinical outcome in our case, it needs to be carefully considered whether catheter ablation should be conducted for AF patients with an EF of <25%.

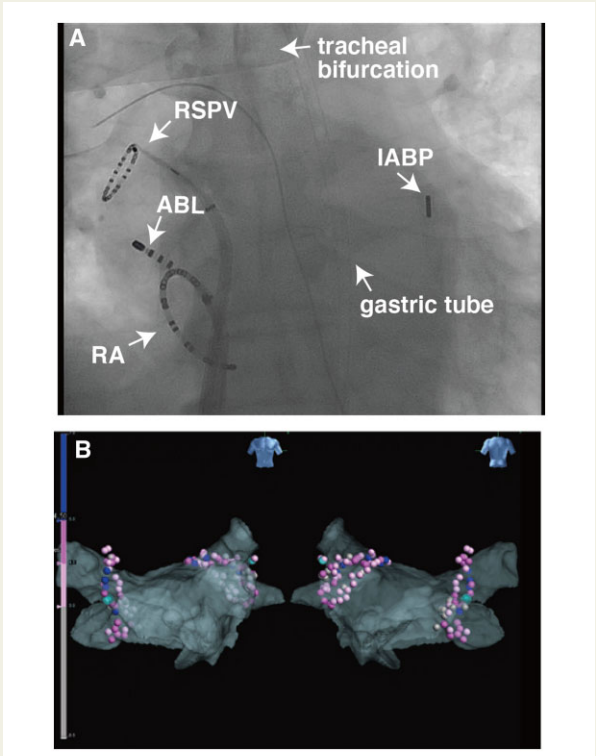


Figure 1 *(A)* Intraprocedural fluoroscopic anterior-posterior image. A ring catheter was positioned at the right superior pulmonary vein, and an ablation catheter was positioned near the right pulmonary vein carina. The patient was under mechanical ventilation (the intubation tube is not included in the image) with intra-aortic balloon pump support. *(B)* An EnSite mapping of the left atrium with ablation lesion tags. The pink, red, and blue points represent the ablation lesions, indicating the measured ablation index. The light-blue points represent the sites where the pulmonary veins were electrically isolated. The left figure is the anteroposterior view and the right figure is the posteroanterior view. ABL, ablation catheter; AP, anteroposterior view; IABP, intra-aortic balloon pump; RA, right atrium; RSPV, right superior pulmonary vein.

Ablation procedures

We did not conduct further mapping studies, other than a simple PVI, to minimize the time of procedure and invasiveness, since the patient's condition was extremely severe, considering a previous study.[5] We performed the procedure without using a contrast agent, suggesting that it is feasible to perform AF ablation without using a contrast agent, in cases with AKI. The manoeuvre in the LA and pulmonary veins (PV) can be safely guided using a 3D mapping system. A 3D geometry shell of the LA, generated at the beginning of the procedure using a multi-electrode catheter, helped the following catheter manipulations (*Figure 1*).

Although catheter ablation of AF in patients with HF is recommended in the guidelines,[2] there is no established ablation strategy provided for this particular population. Additional strategies such as linear lesions or complex fractionated electrograms (CFE) ablation may be considered, none of these strategies are superior to PV isolation alone.[6] In studies of catheter ablation of AF in patients with HF,

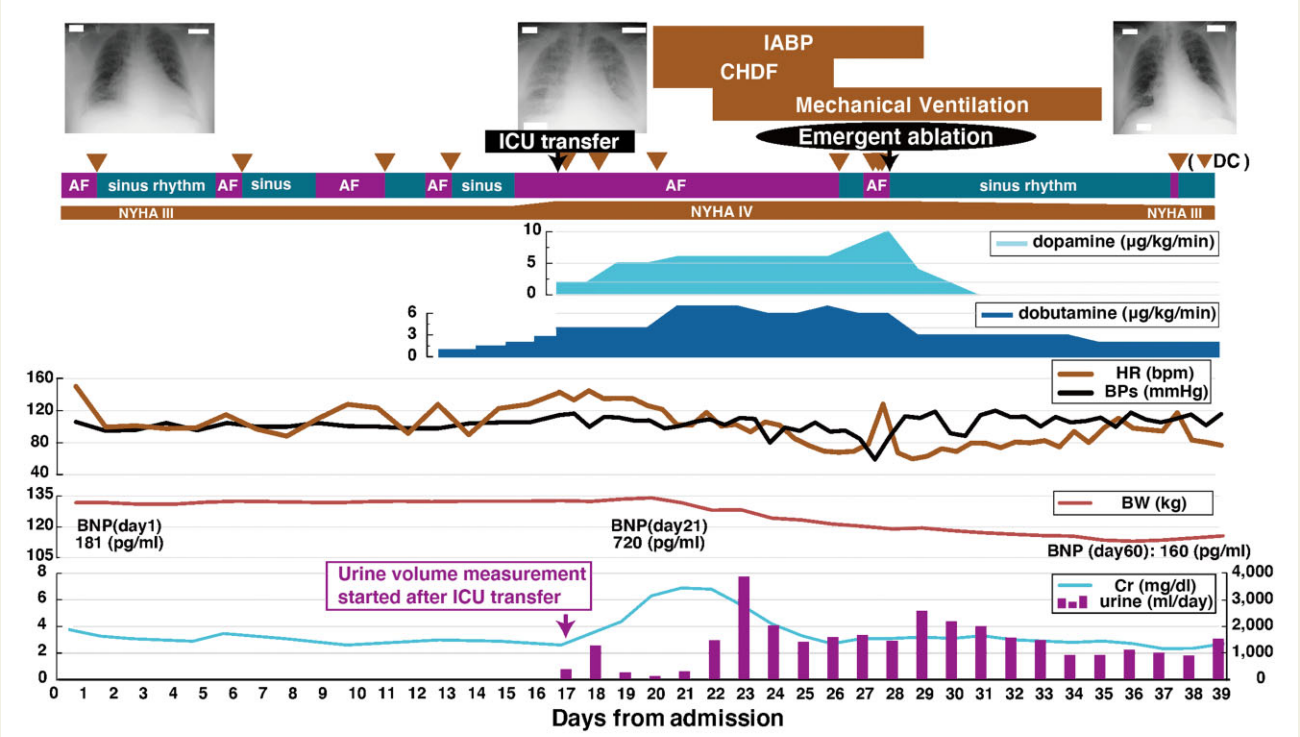


Figure 2 The clinical course of the patient. Clinical events and heart rhythm were indicated in the upper part. Cathecolamine infusion doses, heart rate, and blood pressure were shown in the middle. Changes in BW, serum creatinine and urine volume were shown in the bottom part. AF, atrial fibrillation; BNP, brain natriuretic peptide; BPs, systolic blood pressure; CHDF, continuous haemodialysis/filtration; Cr, serum creatinine; DC, direct current cardioversion; HR, heart rate; IABP, intra-aortic balloon pump; ICU, intensive care unit; NYHA, New York Heart Association functional classification.AF, atrial fibrillation; BNP, brain natriuretic peptide; BPs, systolic blood pressure; CHDF, continuous haemodialysis/filtration; Cr, serum creatinine; DC, direct current cardioversion; HR, heart rate; IABP, intra-aortic balloon pump; ICU, intensive care unit; NYHA, New York Heart Association functional classification.

the catheter ablation strategies were heterogeneous. In our case, we performed PV isolation alone considering the risk of complications by a longer procedure time with additional ablation. In addition, we believe that high-risk AF ablation like the present case should be performed in high-volume centres.[7]

Consideration of device therapy and heart transplantation

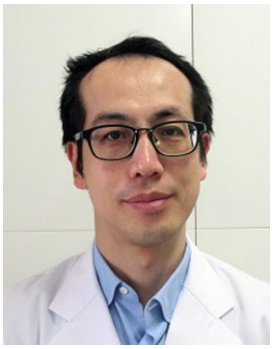
The patient was a possible candidate for an implantable cardioverter-defibrillator (ICD) and cardiac resynchronization therapy (CRT) implantation.[8] However, the patient was morbidly obese which may lead to device implantation-related complications; Therefore, we suggested the device implantation after BW reduction. We successfully implanted a CRT defibrillator after the patient was discharged from the presenting admission.

We also discussed the possibility of heart transplantation. In Japan, the number of heart transplantations performed is still limited, and the mean waiting period for a donated heart exceeded 800 days in 2015.[9] There were some difficulties for this patient to apply as a heart transplantation recipient. First, the patient had no family members. A statement by the Japanese Circulation Society strongly requires long-term supportive family members.[10] Second, the patient had co-morbidities such as morbid obesity and advanced diabetic nephropathy, which were of relative exclusion criterion for heart transplantation.

Conclusions

Emergent AF ablation could be a decisive therapeutic option in patients with medically intractable ADHF accompanied by refractory AF.

Lead author biography



Dr Tomoyuki Tobushi received the MD degree from Kyushu University (Fukuoka, Japan) in 2006. Since 2020, he has been working at the Japanese Red Cross Fukuoka Hospital as a cardiologist. The medical interest is in heart failure, arrhythmia, and sleep-disordered breathing.

Supplementary data

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

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

Consent: Written informed consent for publication was obtained from the patient in line with the COPE guidance.

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References

1. Marrouche NF, Brachmann J, Andresen D, Siebels J, Boersma L, Jordaens L, et al.; CASTLE-AF Investigators. Catheter ablation for atrial fibrillation with heart failure. *N Engl J Med* 2018;**378**:417–427.
2. Hindricks G, Potpara T, Dagres N, Arbelo E, Bax JJ, Blomström-Lundqvist C, et al.; ESC Scientific Document Group. 2020 ESC Guidelines for the diagnosis and management of atrial fibrillation developed in collaboration with the European Association for Cardio-Thoracic Surgery (EACTS). *Eur Heart J* 2021; **42**:373–498.
3. Matsuda Y, Masuda M, Asai M, Iida O, Kanda T, Mano T. Bailout cryoballoon ablation for hemodynamically unstable atrial fibrillation in patients with decompensated heart failure. *HeartRhythm Case Rep* 2020;**6**:685–689.
4. Gorenek B, Halvorsen S, ?Kudaiberdieva G, Bueno H, Van Gelder IC, Lettino M et al. Atrial fibrillation in acute heart failure: a position statement from the Acute Cardiovascular Care Association and European Heart Rhythm Association of the European Society of Cardiology. *Eur Heart J* 2020;**9**:348–357.
5. Verma A, Jiang CY, Betts TR, Chen J, Deisenhofer I, Mantovan R et al. Approaches to catheter ablation for persistent atrial fibrillation. *N Engl J Med* 2015;**372**:1812–1822.
6. Balla C, Cappato R. Atrial fibrillation ablation in heart failure. *Eur Heart J Suppl* 2020;**22**:e50–e53.
7. Vassilikos VP, Pagourelias ED, Laroche C, Blomström-Lundqvist C, Kautzner J, Maggioni AP, et al.; the AFA LT Registry Investigators Group. Impact of centre volume on atrial fibrillation ablation outcomes in Europe: a report from the ESC EHRA EORP Atrial Fibrillation Ablation Long-Term (AFA LT) Registry. *Europace* 2021;**23**:49–58.
8. Brignole M, Auricchio A, Baron-Esquivias G, Bordachar P, Boriani G, Breithardt OA et al. 2013 ESC guidelines on cardiac pacing and cardiac resynchronization therapy: the task force on cardiac pacing and resynchronization therapy of the European Society of Cardiology (ESC). Developed in collaboration with the European Heart Rhythm Association (EHRA). *Europace* 2013;**15**:1070–1118.
9. Fukushima N, Ono M, Saiki Y, Sawa Y, Nunoda S, Isobe M. Registry report on heart transplantation in Japan (June 2016). *Circ J* 2017;**81**:298–303.
10. The Japanese Circulation Society. Statement for heart transplantation. 2016. https://www.j-circ.or.jp/cms/wp-content/uploads/2020/02/JCS2016_isobe_h.pdf (21 November 2021).