Bailout cryoballoon ablation for hemodynamically unstable atrial fibrillation in patients with decompensated heart failure

Yasuhiro Matsuda, MD, Masaharu Masuda, MD, PhD, Mitsutoshi Asai, MD, PhD, Osamu Iida, MD, Takashi Kanda, MD, Toshiaki Mano, MD, PhD

From the Kansai Rosai Hospital Cardiovascular Center, Amagasaki, Japan.

Introduction

Atrial fibrillation (AF) episodes during the decompensated phase of heart failure (HF) sometimes leads to unstable hemodynamics, resulting in a worsening of congestion and/or impaired tissue perfusion.

Previous studies have reported that 20% to 35% of patients with acute HF had AF on admission and that 17% of patients admitted for acute myocardial infarction had new-onset AF.[1,2]

Although rhythm control or rate control for AF is conducted using antiarrhythmic agents and electrical cardioversion, AF is often intractable in these situations. Catheter ablation has been established as a therapy for AF but is more invasive than medical therapy. Further, the efficacy and safety of catheter ablation in hemodynamically unstable patients remains controversial.

Compared with radiofrequency catheter ablation, cryoballoon ablation (CBA) has a shorter procedure time[3] and requires less saline irrigation flow. Pulmonary vein isolation is therefore a shorter procedure time and smaller volume load with CBA than radiofrequency catheter ablation, and may be easier to perform in hemodynamically unstable patients. Nevertheless, the clinical efficacy and safety outcomes of CBA in hemodynamically unstable HF have not been well clarified.

Here, we report a series of 5 cases of CBA as bailout for hemodynamically unstable AF in patients with decompensated HF.

Indications

Indications for CBA were as follows: CBA was the initial catheter ablation procedure for AF; rhythm control, namely maintenance of sinus rhythm, was required because hemodynamic status had become unstable by AF; no other treatment for rhythm control was indicated apart from catheter ablation; and rhythm control was expected to be achieved by pulmonary vein isolation only, without additional ablation. Hemodynamically unstable decompensated HF was defined as acute and symptomatic HF that needed oxygen inhalation, inotropic agents, or mechanical support.

KEY TEACHING POINTS

- Cryoballoon ablation (CBA) can be safely performed in patients with hemodynamically unstable atrial fibrillation (AF).
- CBA is a reasonable bailout when concern exists over the use of antiarrhythmic agents.
- Indications for CBA should be cautiously considered: hemodynamic status is exacerbated by AF; all possible therapies have been tried; and it is possible that AF can be controlled by pulmonary vein isolation.

Procedure

Transesophageal echocardiography was performed before the procedure. When transesophageal echocardiography could not be performed because of poor general condition, we observed the left atrial appendage by using intracardiac echocardiography during the CBA. CBA was performed under intravenous sedation with dexmedetomidine. An Arctic Front Advance cryoballoon catheter with a balloon size of 28 mm (Medtronic, Inc, Minneapolis MN) was passed into each pulmonary vein. After confirmation of pulmonary vein occlusion by contrast and/or intracardiac echocardiography, CBA commenced and continued for 180 seconds. If pulmonary veins could not be isolated with CBA, touch-up ablation was performed using a FlexAbility (St. Jude Medical, Inc, St. Paul, MN) open-irrigated linear ablation catheter with a 3.5 mm tip.

KEYWORDS Atrial fibrillation; Catheter ablation; Cryoballoon ablation; Decompensated heart failure; Intensive care
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All authors have no conflicts to disclose. **Address reprint requests and correspondence:** Dr Masaharu Masuda, Kansai Rosai Hospital Cardiovascular Center, 3-1-69 Inabaso, Amagasaki-shi, Hyogo, 660-8511, Japan. E-mail address: masuda-masaharu@kansaih.johas.go.jp.

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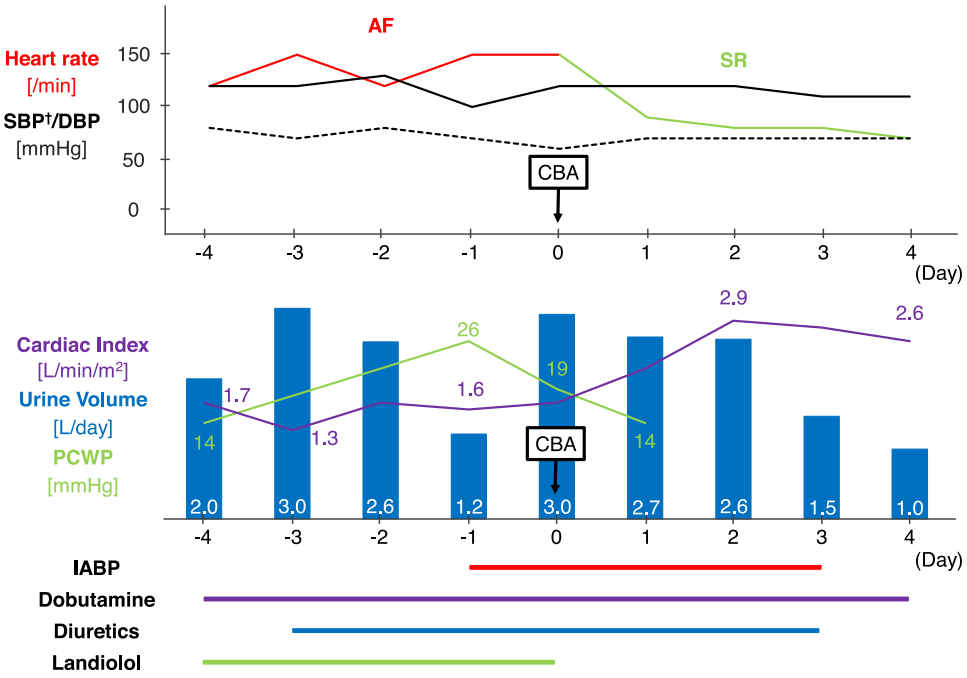

Figure 1 Hemodynamic status in the periprocedural period. In patient 1, unstable hemodynamic status by atrial fibrillation (AF) was improved after cryoballoon ablation (CBA). †Augmented diastolic pressure was shown when intra-aortic balloon pump (IABP) was inserted. DBP = diastolic blood pressure; PCWP = pulmonary capillary wedge pressure; SBP = systolic blood pressure; SR = sinus rhythm.

Hydration before the procedure was avoided. If necessary, electrodes were inserted into the coronary sinus, right ventricle, and right atrium on a case-by-case basis. Infusion of isoproterenol and induction of atrial arrhythmia by atrial burst stimuli was avoided if hemodynamic status was unstable during the procedure.

Case report

Patient 1

History of presentation

A 61-year-old male patient was admitted to our hospital because of acute HF. His CHA_2DS_2-VASc score was 3 points and he did not have severe valve disease. AF was incessant and urine volume was decreased despite the use of diuretics and dobutamine. Infusion of landiolol for 5 days and repeat cardioversion were performed for AF with tachycardia, but the AF could not be controlled. Intra-aortic balloon pump was inserted to support deteriorating hemodynamics, but it worked inadequately because of tachycardia during AF. The initial AF occurred within 1 month before the procedure.

Management and follow-up

CBA was performed and rhythm control was achieved immediately after the procedure. AF burden decreased from 100% to 0%. Cardiac index was increased and pulmonary capillary wedge pressure was decreased, and the intra-aortic balloon pump was successfully removed. Left ventricular ejection fraction was also improved after CBA (34%→50%). He was moved out of the intensive care unit 5 days after the procedure. Although he was medically ready for discharge 9 days after the procedure, it took time to provide the discharge support until 18 days after the procedure. Hemodynamic status in the periprocedural period is shown in Figure 1. During 24-month follow-up after CBA, he remained alive without AF recurrence or progression of HF.

Patient 2

History of presentation

A 73-year-old male patient was admitted to our hospital because of acute myocardial infarction. His CHA_2DS_2-VASc score was 3 points and he did not have severe valve disease. As the culprit lesion was in the left main trunk, a drug-eluting stent was implanted in the left main trunk and left anterior descending artery, and postdilation was performed by using a kissing balloon technique. Acute HF occurred secondary to acute myocardial infarction. Endotracheal intubation and mechanical ventilation for respiratory failure were required, and an intra-aortic balloon pump was inserted because of unstable hemodynamic status. During the course of intensive care, incessant AF occurred and could not be controlled despite the use of amiodarone by an intravenous infusion for 9 days and cardioversion. The AF exacerbated his low output syndrome, and the intra-aortic balloon pump could not be removed. The initial AF occurred 9 days before the procedure, and the rhythm on the day of the procedure was sinus rhythm.

Table 1 Baseline characteristics of patients with decompensated heart failure

Patient	Age	Sex	Cause of heart failure	Type of AF (duration)	Past history	LVDd (mm)	LVEF (%)	LAD (mm)	NT-Pro BNP (BNP) (pg/mL)	Creatinine (mg/dL)	Inotropic agents	IABP	Ventilation
1	61	Male	Tachycardia-induced cardiomyopathy	PeAF (1 month)	Stroke	56	34	40	4017	0.75	Dobutamine	Yes	No
2	73	Male	Ischemic cardiomyopathy	PAF	HT	38†	40	38†	(123)	2.28	Dobutamine	Yes	Yes
3	75	Female	Ischemic cardiomyopathy	PAF	HT, HD	55	47	49	70,000	6.25	No	No	No
4	61	Male	Ischemic cardiomyopathy	PAF	HT	63‡	40	58‡	7968	2.79	No	No	No
5	66	Male	Dilated cardiomyopathy	PAF	IP	66	11	50	4621	1.54	Dobutamine	No	No

AF = atrial fibrillation; BNP = brain natriuretic peptide; HD = hemodialysis; HT = hypertension; IABP = intra-aortic balloon pump; IP = interstitial pneumonia; LAD = left atrial diameter; LVDd = left ventricular diastolic diameter; LVEF = left ventricular ejection fraction; NT-proBNP = N-terminal pro-brain natriuretic peptide; PAF = paroxysmal atrial fibrillation; PeAF = persistent atrial fibrillation.
†Four days after the procedure.
‡Twelve days after the procedure.

Management and follow-up

CBA was performed. Although early recurrence of AF sometimes occurred in the periprocedural period, AF episodes and AF burden were significantly decreased (78% → 38%). In addition, cardiac index was increased and the intra-aortic balloon pump could be successfully removed after the next day of the CBA procedure. Left ventricular ejection fraction was also improved after CBA (40% → 45%). He was moved out of the intensive care unit 6 days after the procedure, and he was discharged 53 days after the procedure because he needed physical therapy. Rhythm control was achieved after the blanking period. We used a dual antiplatelet therapy with aspirin and prasugrel. We also used edoxaban for 3 months after the procedure. We stopped aspirin 1 year after the procedure. During 24-month follow-up after CBA, he remained alive and without AF recurrence.

Patient 3

History of presentation

A 75-year-old female hemodialysis patient was admitted to our hospital because of acute HF. Her CHA_2DS_2-VASc score was 5 points and she did not have severe valve disease. Incessant AF tachycardia during hemodialysis resulted in dysdialysis syndrome despite the use of carvedilol, verapamil, or aprindine, and congestion was not improved by ultrafiltration. The initial AF occurred 79 days before the procedure, and the rhythm on the day of the procedure was sinus rhythm.

Management and follow-up

CBA was performed and rhythm control was achieved immediately after the procedure. AF burden decreased from 33% to 0%. Ultrafiltration was improved and her congestion disappeared. She was discharged 23 days after the procedure because she needed physical therapy. She died 4 months after CBA and presumed cause of death was exacerbation of congestion.

Patient 4

History of presentation

A 61-year-old male patient was admitted to our hospital because of acute myocardial infarction. His CHA_2DS_2-VASc score was 2 points and he did not have severe valve disease. The culprit lesion was the left circumflex artery segment 13, and 2 drug-eluting stents were emplaced. Acute HF occurred secondary to acute myocardial infarction and an intra-aortic balloon pump was inserted. The intra-aortic balloon pump was then removed, but this induced AF and his congestion became worse. AF could not be controlled despite the intravenous infusion of both amiodarone and landiolol for 3 days. AF was also refractory to cardioversion. The initial AF occurred 4 days before the procedure, and AF lasted for 2 days until the procedure.

Table 2 Periprocedural characteristics of patients with decompensated heart failure

Patient	Procedure time (min)	Contrast dose (mL)	Touch-up ablation	Before CBA				After CBA				Complication	Death[‡]	Rhythm outcome[‡]
				Rhythm	HR (/min)	BP (mm Hg)	LAP[†] (mm Hg)	HR (/min)	BP (mm Hg)	LAP[†] (mm Hg)	Cr (mg/dL)			
1	83	30	No	AF	150	120[§]/60	19	90	120[§]/70	14	0.81	No	No	No recurrence
2	47	35	No	SR	80	120[§]/100	19	80	120[§]/60	14	2.33	Mild groin hematoma	No	No recurrence
3	59	30	No	SR	70	130/60	16[¶]	75	120/70	-	4.91	No	Yes	No recurrence
4	59	30	Yes	AF	130	110/70	21	110	120/70	19	3.02	No	No	No recurrence
5	87	20	No	AF	100	120/60	20	90	120[§]/70	10	1.24	No	Yes	No recurrence

AF = atrial fibrillation; BP = blood pressure; CBA = cryoballoon ablation; Cr = creatinine; HR = heart rate; LAP = left atrial pressure; SR = sinus rhythm.

[†]Presumed by Swan-Ganz catheters.

[‡]At 24-month follow-up after CBA.

[§]Augmented iastolic pressure was shown when intra-aortic balloon pump was inserted.

[¶]Measured during CBA.

Management and follow-up

CBA was performed. Although AF sometimes recurred early in the periprocedural period, AF episodes and AF burden significantly decreased (almost 100% → 50%). Cardiac index was also increased. He was moved out of the intensive care unit 11 days after the procedure. Although he was medically ready for discharge 15 days after the procedure, he received in-hospital physical therapy until 28 days after the procedure. Rhythm control was achieved after the blanking period. During 24-month follow-up after CBA, he remained alive without AF recurrence.

Patient 5

History of presentation

A 66-year-old male patient was admitted to our hospital because of HF exacerbation. His CHA_2DS_2-VASc score was 2 points and he had severe secondary mitral regurgitation. As incessant AF occurred after admission, his low perfusion became worse and the biventricular pacing level of his cardiac resynchronization therapy defibrillator decreased to 84%. Amiodarone was difficult to use because of interstitial pneumonia. He required intensive care and insertion of an intra-aortic balloon pump because of worsening low output syndrome. The initial AF occurred 3 years before the procedure, and AF lasted for 2 days until the procedure.

Management and follow-up

CBA was performed and rhythm control was achieved immediately after the procedure. AF burden was almost 100% a few days before the procedure and it decreased to 0% after the procedure. The intra-aortic balloon pump was successfully removed. The biventricular pacing level of the cardiac resynchronization therapy defibrillator increased to 94%, and left ventricular ejection fraction was also improved (10% → 16%). He was moved out of the intensive care unit 10 days after the procedure, and he was discharged from the hospital 66 days after the procedure because he needed physical therapy. He died owing to exacerbation of HF 11 months after CBA, although without any recurrence of AF.

Baseline characteristics and periprocedural characteristics of the 5 patients are summarized in Table 1 and Table 2.

Discussion

Here, we performed CBA in 5 patients with hemodynamically unstable HF. In all cases, AF disappeared after CBA, and the patients were discharged with an improved hemodynamic status.

Physicians often hesitate to perform catheter ablation for patients with decompensated HF owing to concerns about postprocedural exacerbation of HF. Indeed, HF is associated with many symptoms, including low blood pressure and pulmonary edema.[4] These increase the risk of complications of catheter ablation,[5] and the procedure is generally considered high-risk for patients with unstable hemodynamics. Indications for catheter ablation, which is more invasive than

treatment with antiarrhythmic agents, are generally considered limited in these patients. However, CBA is not a complex procedure, and it has a shorter procedure time than radiofrequency catheter ablation.[2] This shorter procedure time in turn reduces unnecessary intravenous sedation, as well as the use of heparin and hydration, which can induce complications. Accordingly, CBA achieves pulmonary vein isolation less invasively than radiofrequency catheter ablation and can be performed in patients with hemodynamically unstable HF.

The candidates who benefited most from CBA were patients with recently occurring AF. Conversely, patients 3 and 5, who died several months after the procedure, had had AF for a long time. The reason for this difference in outcome might be that the hemodynamics were negatively affected by the long-term AF.

However, radiofrequency catheter ablation with a high power and short duration[6] or atrioventricular nodal ablation with cardiac resynchronization therapy[7] might be other strategies for AF with hemodynamically unstable HF. Therefore, indications for CBA in patients with hemodynamically unstable HF should be cautiously considered; these include that hemodynamic status is exacerbated by AF, all possible therapies to treat AF have been tried, and it is highly possible that AF can be controlled by pulmonary vein isolation only. CBA has the potential to become an important therapy for hemodynamically unstable HF if indications for CBA are carefully established.

Conclusions

CBA can be used as a bailout therapy for decompensated HF in cases where AF contributes to a deterioration in hemodynamics.

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