



Case Report

Catheter ablation of atrial tachyarrhythmias after a Maze procedure: A single center experience



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ABSTRACT

Significant recurrence of atrial tachyarrhythmias are observed after the surgical Cox Maze procedure (CMP). We retrospectively enrolled 11 consecutive patients who had atrial tachyarrhythmias (ATAs) that recurred after a biatrial CMP and underwent catheter ablation. Information including the site of any incomplete lesions and the etiology of the clinical ATAs was shared with the surgical team as feedback. In a total of 11 patients, 12 clinical ATAs were identified. They consisted of 2 atrial fibrillations and 10 atrial tachycardias (ATs). In 6 patients, the CMP was performed after the beginning of this investigation. In a total of 10 ATs, we diagnosed 5 mitral annular flutters, 2 roof-dependent flutters, 1 pulmonary vein (PV)-reentrant AT, and 1 localized reentrant AT. A total of 6 patients had reconnected perimitral block lines. PV reconnections were observed in 3 and posterior wall (PW) residual conduction was also observed in 3 cases. However, no residual conduction of the pulmonary vein isolation (PVI) and only 1 residual conduction of the PW were observed in 5 patients who underwent their index surgery after the beginning of this investigation. This fact may implicate that sharing the information from the electrophysiological study of postsurgical ATAs with the surgical team may contribute to the refinement of the CMP in each facility.

<Learning objective: Reconduction of the surgical lesion is the major etiology of recurrence of atrial tachyarrhythmias after the surgical Cox Maze procedure. Although perimitral block line seemed to be the most frequent reconduction site, our study suggested that durable lesion of the PVI and the PW isolation could be achieved by improving surgical techniques by feedback from the electrophysiological team to the surgical team.>

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Introduction

The surgical Cox Maze procedure (CMP) was the first therapeutic intervention for atrial fibrillation (AF) with a modification of the atrial conduction and established the prophylaxis of AF [1–3]. The contemporary Cox Maze IV (CMP-IV) utilizes a combination of incisional scars and ablation lesions created by radiofrequency or cryothermal energy [2]. The CMP-IV reduced the complexity and procedural time as compared to the

Cox Maze III (CMP-III) using a “cut and sew” technique [2,3]. On the other hand, the ablation lesions are not as reliable as incisional scar even if created under direct visualization, which causes a common problem of percutaneous catheter ablation: recurrence of atrial tachyarrhythmias (ATAs) due to reconnections of block lines [4]. In the present report, the residual conduction of surgical block lines in the left atria (LA) was investigated in patients who underwent catheter ablation for relapsed ATAs after the CMP.

Case report

We retrospectively enrolled 11 consecutive patients who had ATAs that recurred after a biatrial CMP and underwent catheter ablation from April 2011 to July 2015 in our institution. The ATAs

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included AF and atrial tachycardias (ATs). All patients gave their written consent prior to the procedure. The present study was approved by the domestic ethical committee.

Surgical procedure

From 1998 to 2013, all patients underwent a CMP-III/IV concomitantly with the index operation for the primary disease. CMP-III was performed as previously reported [5]. The technique we adopted for the CMP-IV during the period of this study entailed the use of a radiofrequency ablation device (AtriCure, Inc., Mason, OH, USA) and cryoablation device (142 Cryo Unit, Spemby Medical, Andover, UK). All patients underwent a bilateral pulmonary vein isolation (PVI) and ablation of the right lesion set on the beating heart using a bipolar RF ablation clamp; additional ablation using a unipolar device (cryoablation or RF ablation) was performed where necessary to complete the ablation lines. The left atrial lesion set, which was approached from the incised right pulmonary vein and through the amputated left atrial appendage, was ablated similarly but under an aortic cross clamp. The left and right pulmonary vein lesions were connected to create a box lesion on the left atrium. A linear lesion for the perimitral block line was made by a bipolar RF ablation from the right side of the left atrium to the posterior portion of the mitral annulus. An endocardial ablation was then performed for the mitral annular lesion for 120 s. Additional epicardial ablation using monopolar RF was performed to connect this ablation line to the coronary sinus at the end of the mitral isthmus lesion. We made an interatrial septal line. Other procedural details of our Maze procedure were similar to those described by Cox et al. [6,7]. None of the patients required a deviation or abortion of the procedure in the present study.

Ablation procedure

All antiarrhythmic drugs were discontinued for five half-lives prior to the procedure. All electrocardiograms were recorded and stored on a workstation lab (RMS-4000/RMS-5000, NIHON KOHDEN, Tokyo, Japan). Local intracardiac potentials with location tags were also stored and analyzed on a non-fluoroscopic three-dimensional mapping system (CARTO XP/CARTO3, Biosense-Webster, Diamond Bar, CA, USA). The mapping and RF ablation catheters were all inserted from the femoral approach. An irrigated-tip ablation catheter (Thermocool, Biosense-Webster) was used in all cases. Conduction block of the PVI, roof line, bottom line, and perimitral line were examined before starting ablation if possible. The endpoint was to complete all block lines and the non-inducibility of any ATAs under atrial burst pacing with minimum cycle length of 200 ms. After an electrophysiological study,

information including the site of any incomplete lesions and the etiology of the clinical ATAs was shared with the surgical team as feedback.

Results

The patient characteristics and surgical information are shown in Table 1. In a total of 11 patients enrolled, 12 clinical ATAs were identified. They consisted of 2 AFs and 10 ATs. The index CMPs were 10 CMP-IVs and 1 CMP-III. The ablation procedures were performed 40.4 ± 51.4 months after the index CMP. During the CMP-IVs, a combination of a linear RF device and pen-type cryothermal device was used in 9 cases and a cryothermal device was exclusively used in Case 7. In 6 patients (Cases 4, 5, 8–11), the CMP was performed after the beginning of this investigation in 2011.

The diagnosis and characteristics of the clinical ATAs are shown in Table 2. We had no arrhythmias originating from the right atria. In the two AF cases, residual conduction of the PVI was observed and it was successfully re-isolated. In a total of 10 ATs, 9 ATs were on-going at the beginning of the ablation procedure. One AT of Case 4 was provoked after eliminating another AT. The 9 ATs except Case 5 were successfully mapped to elucidate the detailed activation. We diagnosed 5 mitral annular flutters (MAFs), 2 roof-dependent flutters (RDFs), 1 PV-reentrant AT, and 1 localized reentrant AT arising from the interatrial septum. We found the perimitral block line was the most dominant site of the residual conduction in this investigation. A total of 6 patients had reconnected perimitral block lines, while 5 exhibited MAFs as shown in Fig. 1. They were successfully treated by radiofrequency catheter ablation, however, attempts to complete the native surgical block line all failed and a novel block line was needed. We experienced no recurrences of ATAs except for in Case 5. PV reconnections were observed in 3 including 2 AF cases. As for Case 7, multiple gaps of the left PVI resulted in a PV-reentrant tachycardia. There was a PV reconnection even in Case 1 of a CMP-III. Posterior wall (PW) residual conduction was also observed in 3 cases in which 2 exhibited RDFs. No residual conduction of the PVI and only 1 residual conduction of the PW were observed in 5 patients who underwent their index surgery after the beginning of this investigation. There were no complications, including cardiac tamponade, cerebral infarctions, or bradycardia requiring a pacing device throughout the investigation.

Discussion

In the present study, the perimitral block line was the most frequent reconduction site in patients with a prior CMP. Although it was uncertain whether the lesions reconducted after the CMPs or

Table 1 Patient characteristics.

Case	Sex	Age	Primary disease	AF type	Operation	LAD, mm	Maze method	Postoperative months
1	F	60	MR	Paroxysmal	MVR	51	Cox	186
2	F	74	MR	Paroxysmal	MVR	63	Cox IV	6
3	M	64	MR	Persistent	MVP	44	Cox IV	48
4	M	51	ASD	Persistent	ASDC	56	Cox IV	60
5	M	69	IHD	Persistent	CAB	43	Cox IV	4
6	F	81	MR	Persistent	MVP	50	Cox IV	25
7	M	78	IHD	Paroxysmal	CAB	48	Cox IV	30
8	M	78	MR	Persistent	MVP	45	Cox IV	31
9	M	74	MR	Persistent	MVR	51	Cox IV	6
10	M	64	MR	Persistent	MVP	42	Cox IV	17
11	F	77	AR, ischemic	Persistent	AVR/CAB	52	Cox IV	31

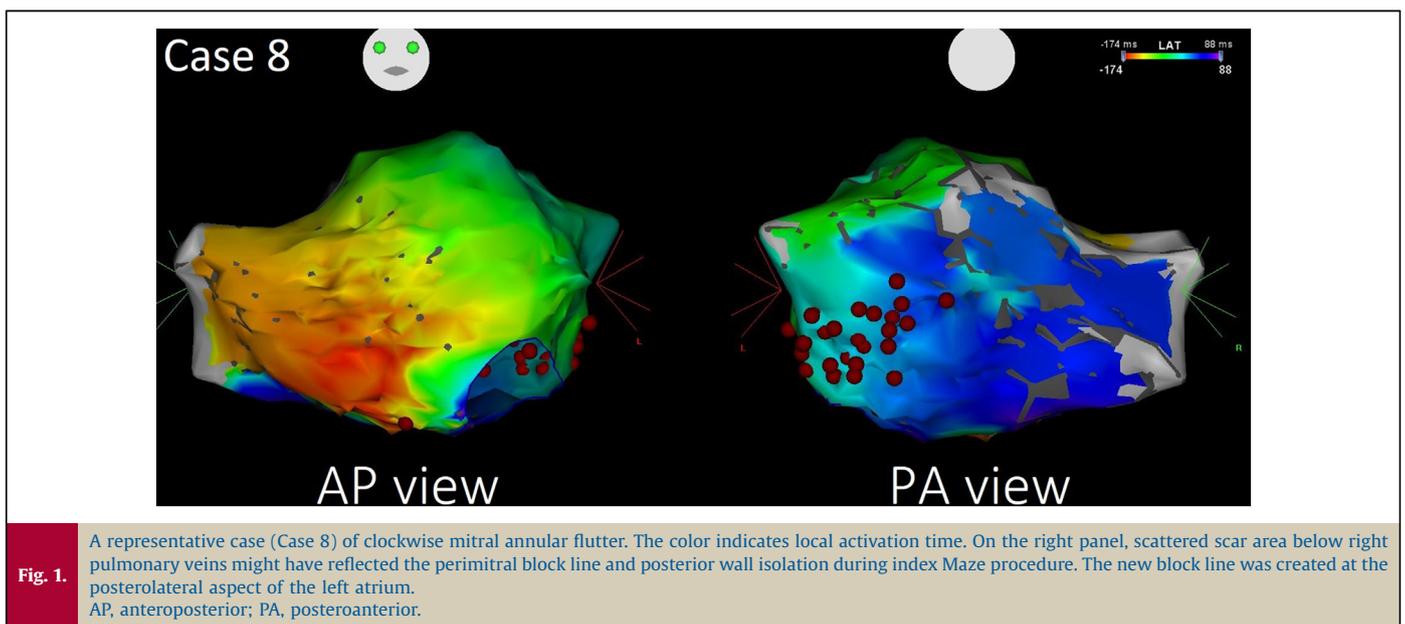
AF, atrial fibrillation; AR, aortic regurgitation; ASDC, atrial septal defect closure; AVR, aortic valve replacement; CAB, coronary artery bypass; IHD, ischemic heart disease; LAD, left atrial diameter; MR, mitral regurgitation; MVP, mitral valvuloplasty; MVR, mitral valve replacement.

Table 2 Diagnosis of ATAs and reconnection sites.

Case	Clinical ATA	TCL	Diagnosis	LA Reconnection			FU(months)	Rec
				PV	PW	Perimitral		
1	PAF	N/A	PAF	RPV	–	–	41	–
2	PAF	N/A	PAF	LPV	–	–	46	–
3	Persistent AT	243	RDF	–	–	–	31	–
4*	Persistent AT	264/250	RDF/MAF	–	–	–	20	–
5	Persistent AT	376	Septal	–	–	–	13	–
6	Persistent AT	250	Septal reentry	–	–	–	12	+
7	Persistent AT	293	PV reentry	L/RPV	–	–	21	–
8*	Persistent AT	258	MAF	–	–	–	21	–
9*	Persistent AT	300	MAF	–	–	–	12	–
10*	Persistent AT	204	MAF	–	–	–	14	–
11*	Persistent AT	239	MAF	–	–	–	6	–

AT, atrial tachycardia; ATA, atrial tachyarrhythmia; FU, period of follow-up; LA, left atrium; LPV, left pulmonary vein; MAF, mitral annular flutter; PAF, paroxysmal atrial fibrillation; PV, pulmonary vein; PW, posterior wall; RDF, roof-dependent flutter; Rec, recurrence; RPV, right pulmonary vein; TCL, tachycardia cycle length.

* Indicating cases who underwent their index surgery after the start of the present investigation.



were initially created, these facts were identical to the results of previous reports [4,8,9]. Creating a transmural lesion in thick annular tissue should be the cornerstone during the CMP procedure. Indeed, residual conduction of perimitral block line seemed more dominant even after starting this investigation (because Cases 1 and 2 had no reconnection of perimitral line, surgical procedure Case 4 was not performed about the feedback). This might have been due to 1) spontaneously increased number of CMP after starting the present study 2) that repeated ablation around PV reduced time for perimitral block. As for PVs and PW, incomplete lesions could be considered mainly due to an inadequate application of the ablation energy. We found that in the cases that received a CMP-IV after feedback from the EP-team had no residual conduction of the PVs. It might have been due to an increased application of a sandwich-type ablation device during the CMP. In this regard, sharing the information from the EP study of postsurgical ATAs with the surgical team may contribute to the refinement of the CMP in each facility. However, because the initial 2 cases had only reconnection of PVs, CMP of Case 4 was not performed after the feedback about residual conduction of perimitral line. No postoperative ATs originating from the right atrium were observed during the study period at our facility. This

fact was incompatible with the previous larger investigations reporting significant right atrial tachycardia [4,8]. One of the reasons might be that a surgical LA access was routinely established by a right lateral incision, not by a superior transseptal approach at our facility.

Conclusion

We experienced 11 cases of post-CMP ATAs. Mitral annular lesions were the dominant residual conduction site as well as the substrate for clinical ATAs. Residual conduction of the linear lesion might be decreased by feedback from the EP-team to the surgical team.

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None.

Conflict of interest

All authors declare no conflict of interest related to this study.

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