

# **Acute and Long-term Results of Bipolar Radiofrequency Catheter Ablation of Refractory Ventricular Arrhythmias with Deep Intramural Origins**

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# The Korean Heart Rhythm Society COI Disclosure

*Name of first author: **Miyako IGARASHI***

The authors have no financial conflicts of interest  
to disclose concerning the presentation.

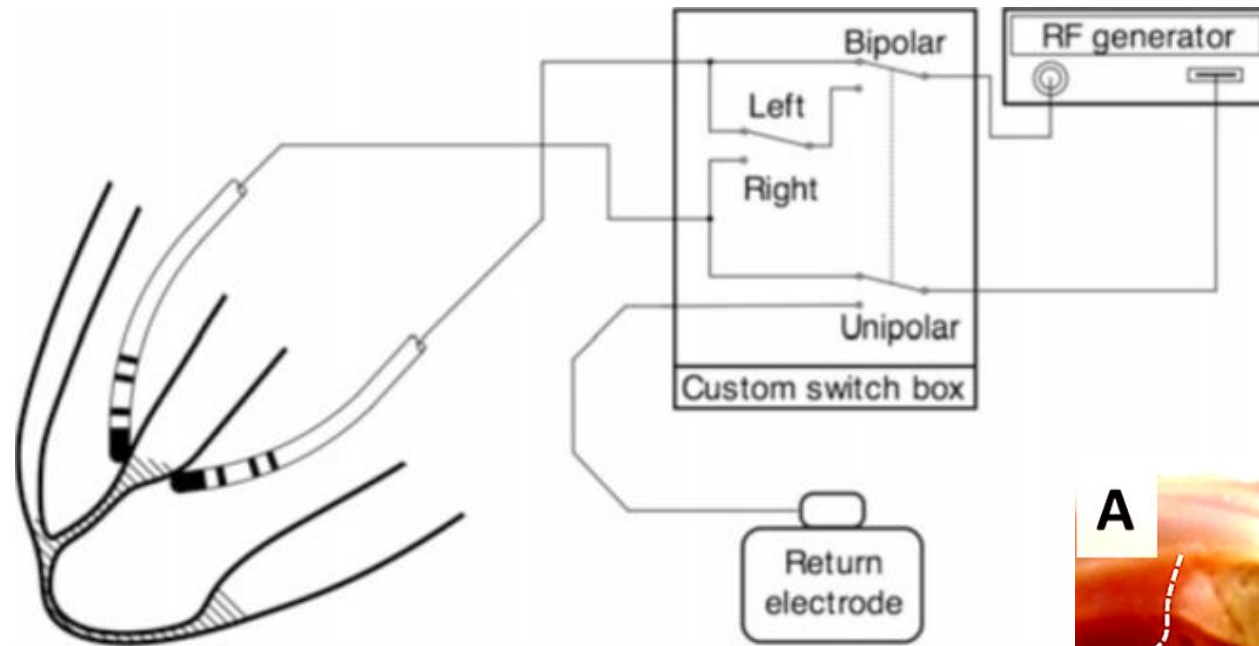


# Introduction

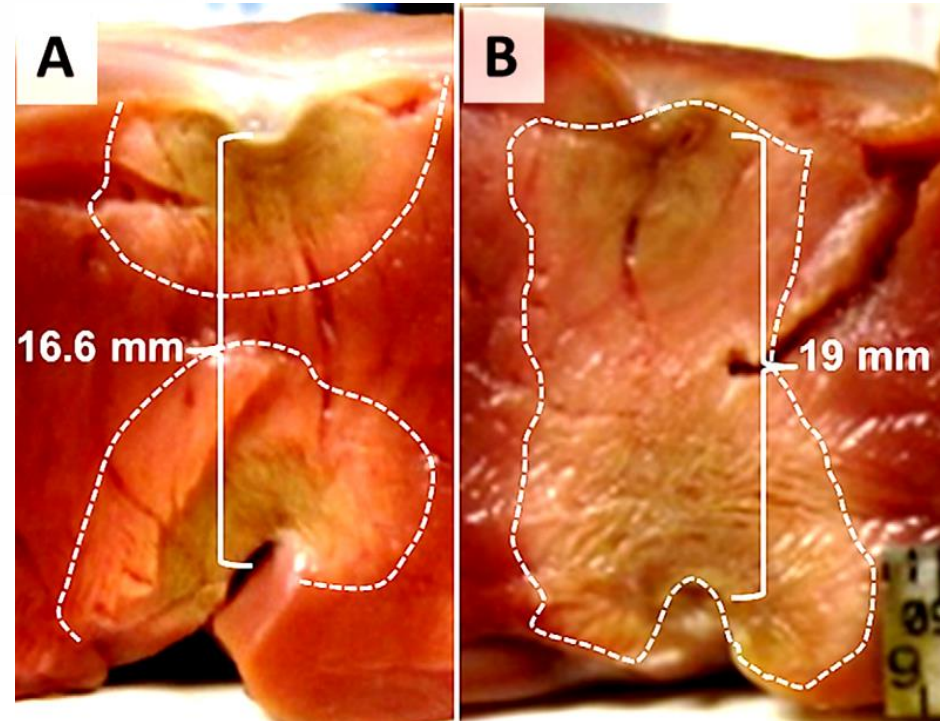
- Radiofrequency catheter ablation (RFCA) is one of the therapies for ventricular tachycardia (VT).
- However, if the arrhythmia's origin or circuit is located at deep intramural sites, RFCA might be difficult and fail.
- If endocardial or epicardial approaches do not suppress VT, some patients may require intramural or transmural ablation.



# Bipolar ablation



*Sivagangabalan G, et al.  
PACE 2010; 33: 16 - 26*



*Koruth JS, Reddy VY et al.  
Heart Rhythm 2012; 9: 1932 - 41*



# Acute and long-term results of bipolar radiofrequency catheter ablation of refractory ventricular arrhythmias of deep intramural origin

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**BACKGROUND** Successful bipolar radiofrequency catheter ablation (RFCA) of refractory ventricular arrhythmias (VAs) has been reported. However, the efficacy, safety, and long-term outcomes of bipolar RFCA of VAs are not fully determined.

**OBJECTIVE** The purpose of this study was to evaluate the effectiveness and safety of bipolar RFCA in treating refractory VAs during long-term follow-up.

**METHODS** Eighteen patients who underwent bipolar RFCA for ventricular tachycardia (VT) at 7 institutions were retrospectively investigated. Underlying heart diseases included remote myocardial infarction (n = 3 [17%]) and nonischemic cardiomyopathy (n = 15 [83%]). Although unipolar RFCA was performed in all patients, either it failed to suppress VT or VT recurred. The interventricular septum, left ventricular free wall, and left ventricular summit were targeted for bipolar RFCA.

**RESULTS** Acute success (VT termination and/or noninducibility) was achieved with bipolar RFCA in 16 patients (89%). Complications during the procedure included complete atrioventricular block (n =

2) and coronary artery stenosis (n = 1). One patient underwent chemical ablation after bipolar RFCA failure. At 12-month follow-up, VT recurred in 8 patients (44%). However, in patients with recurrence, VT burden had decreased: only 4 patients underwent re-RFCA, and only 1 of the 4 required chemical ablation. In the remaining 4 patients, re-RFCA was not required, as VT was controlled by medication or an implantable cardioverter-defibrillator.

**CONCLUSION** Bipolar RFCA is useful for acute suppression of refractory VT. Although VT recurrence rates during long-term follow-up were relatively high, we observed a significant reduction in VT burden.

**KEYWORDS** Bipolar ablation; Complication; Outcome; Radiofrequency catheter ablation; Ventricular arrhythmias

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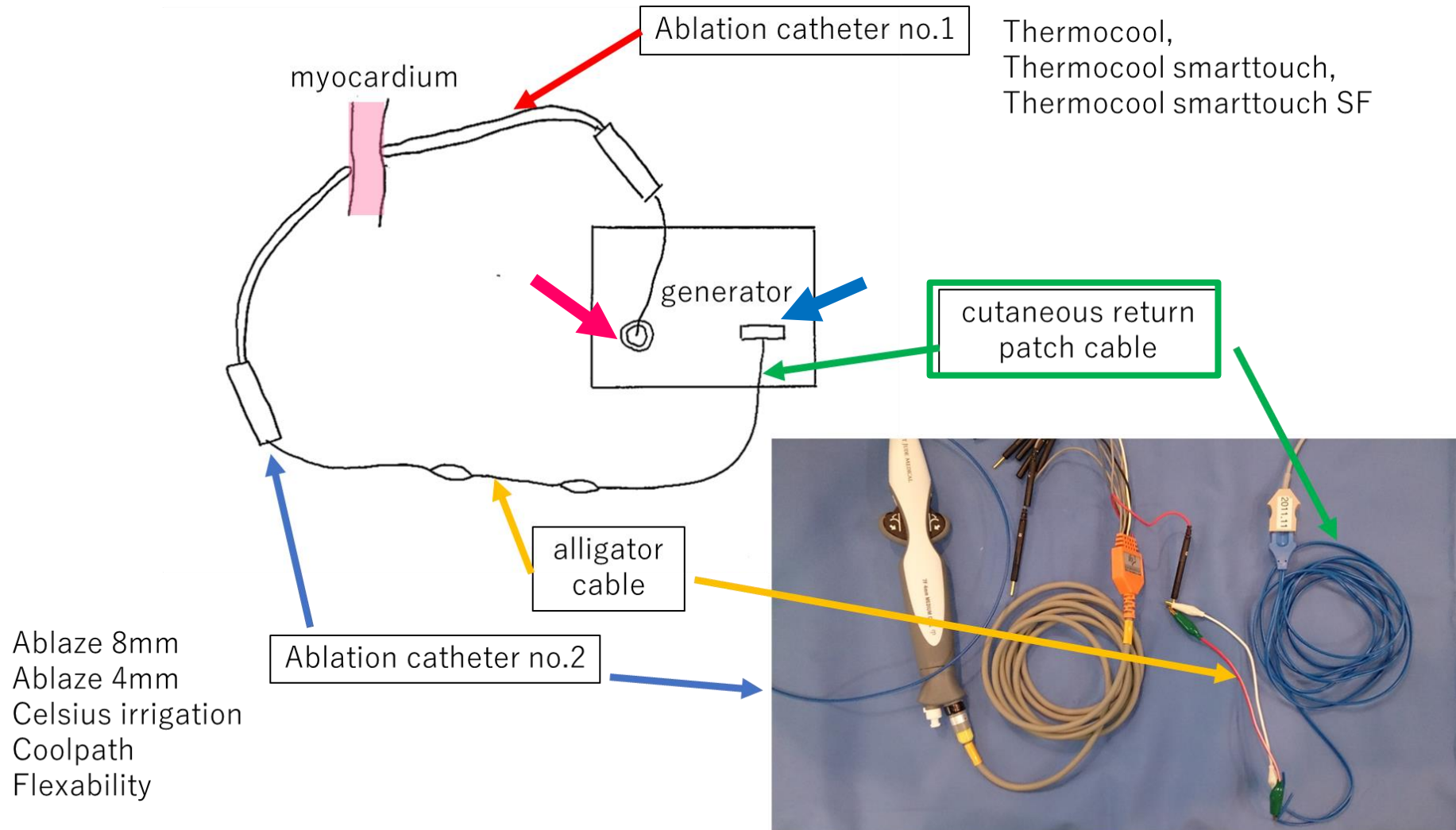


# Study population

- 18 patients with structural heart disease who underwent their first bipolar RFCA for VT at 7 institutions from 2012 to 2017 were retrospectively investigated.
- Although unipolar RFCA was performed in all patients, either it failed to suppress VT or VT recurred.



# Bipolar ablation setup





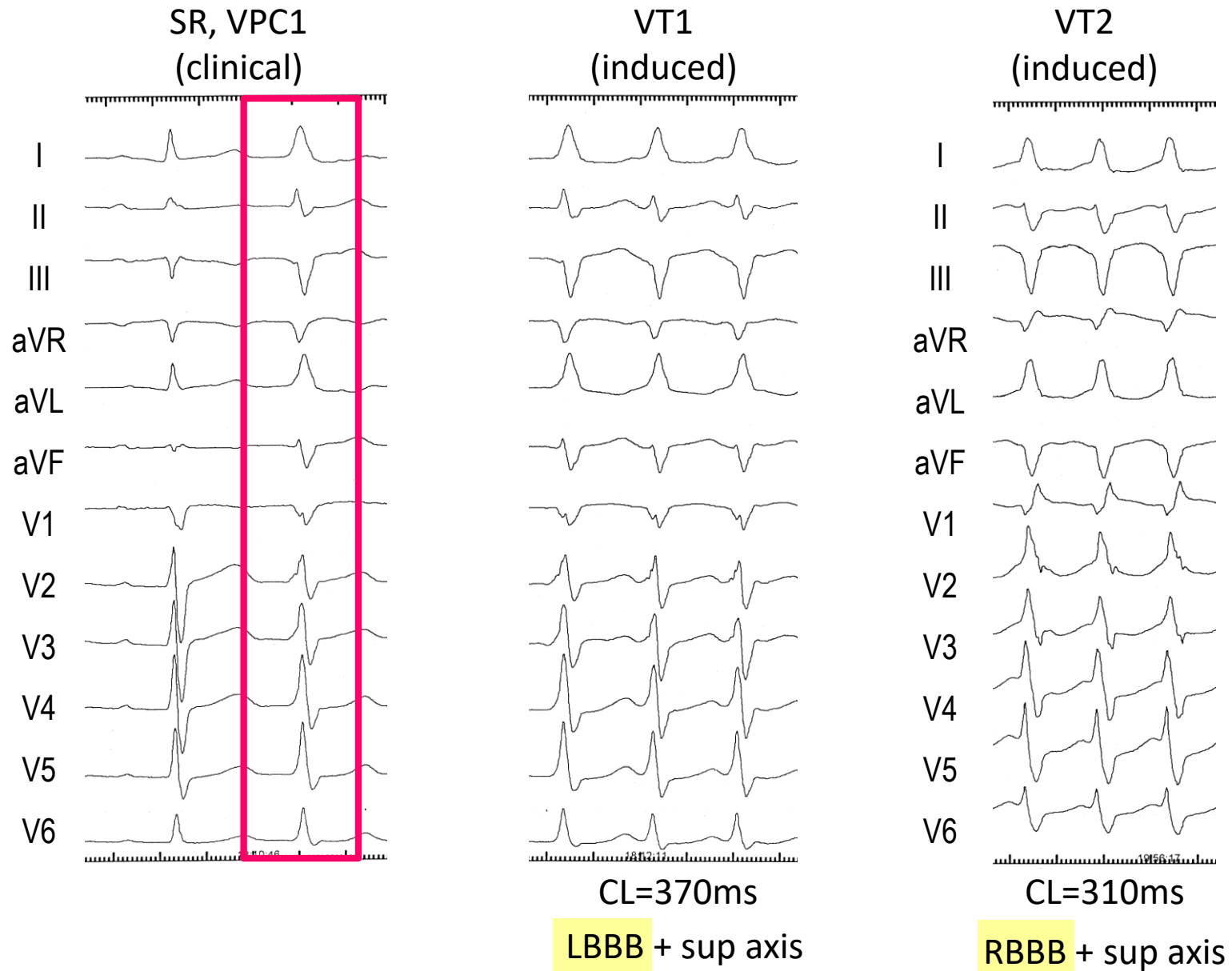
# A representative case

- 63 years old, man with cardiac sarcoidosis and ventricular tachycardia (VT). He received an ICD implantation.
- He was admitted to our institution due to frequent defibrillator shocks.
- Echocardiography showed reduced left ventricular systolic function with a 50% of ejection fraction and an aneurysm in the basal septum.

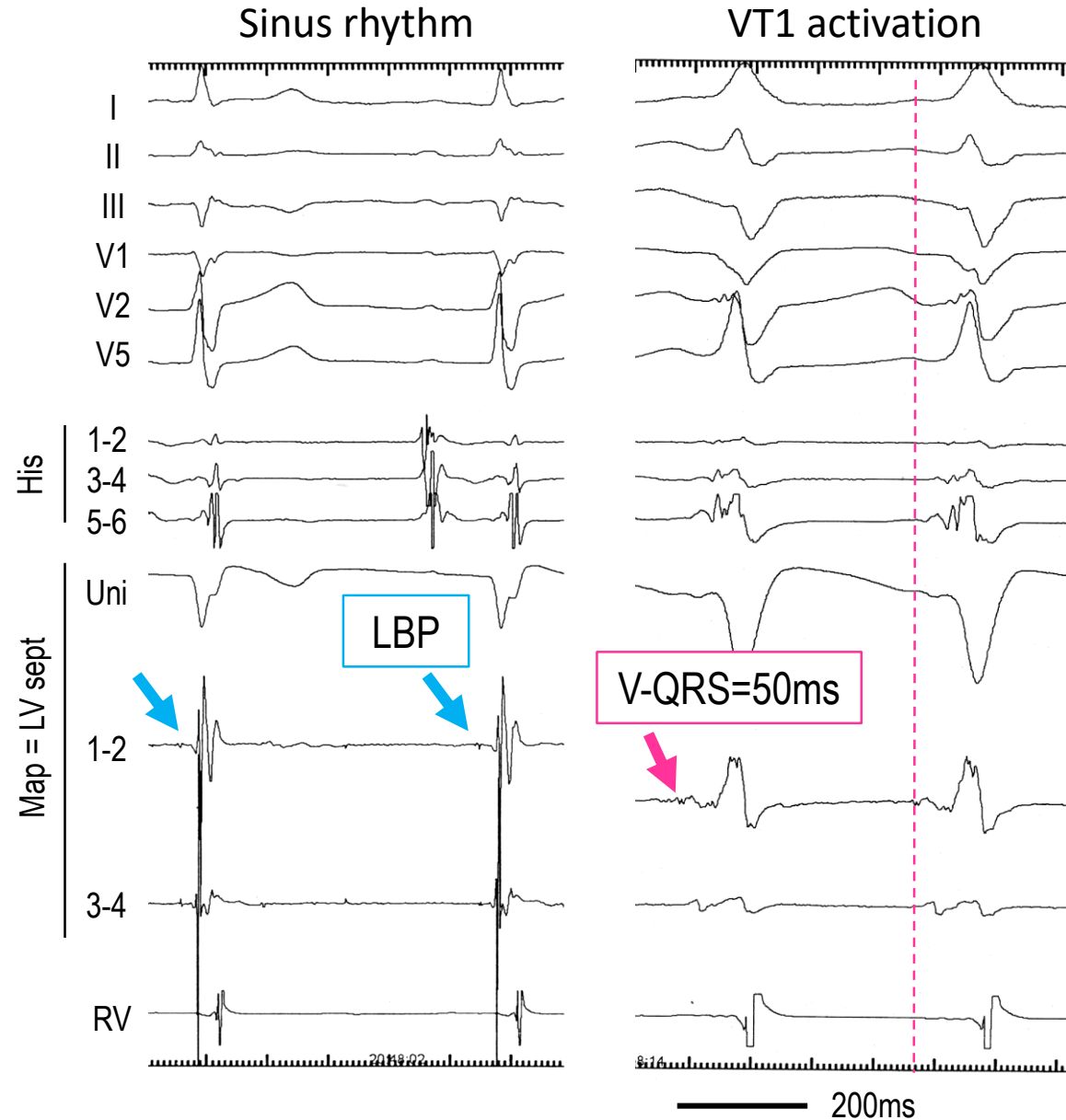
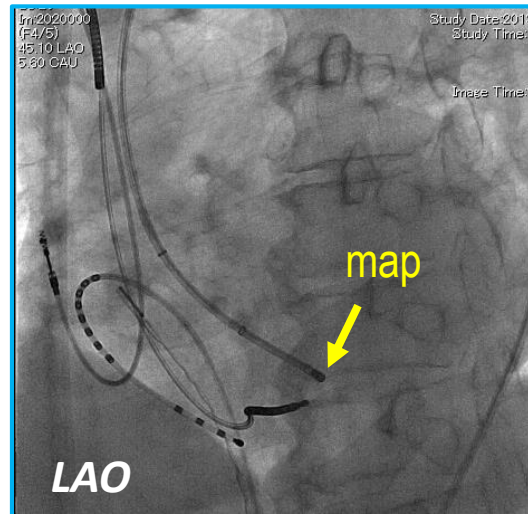
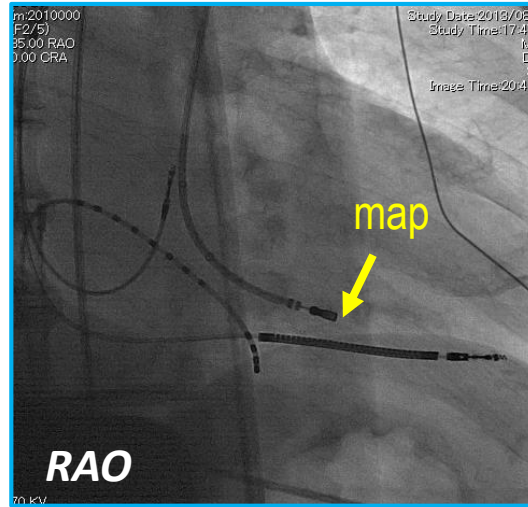




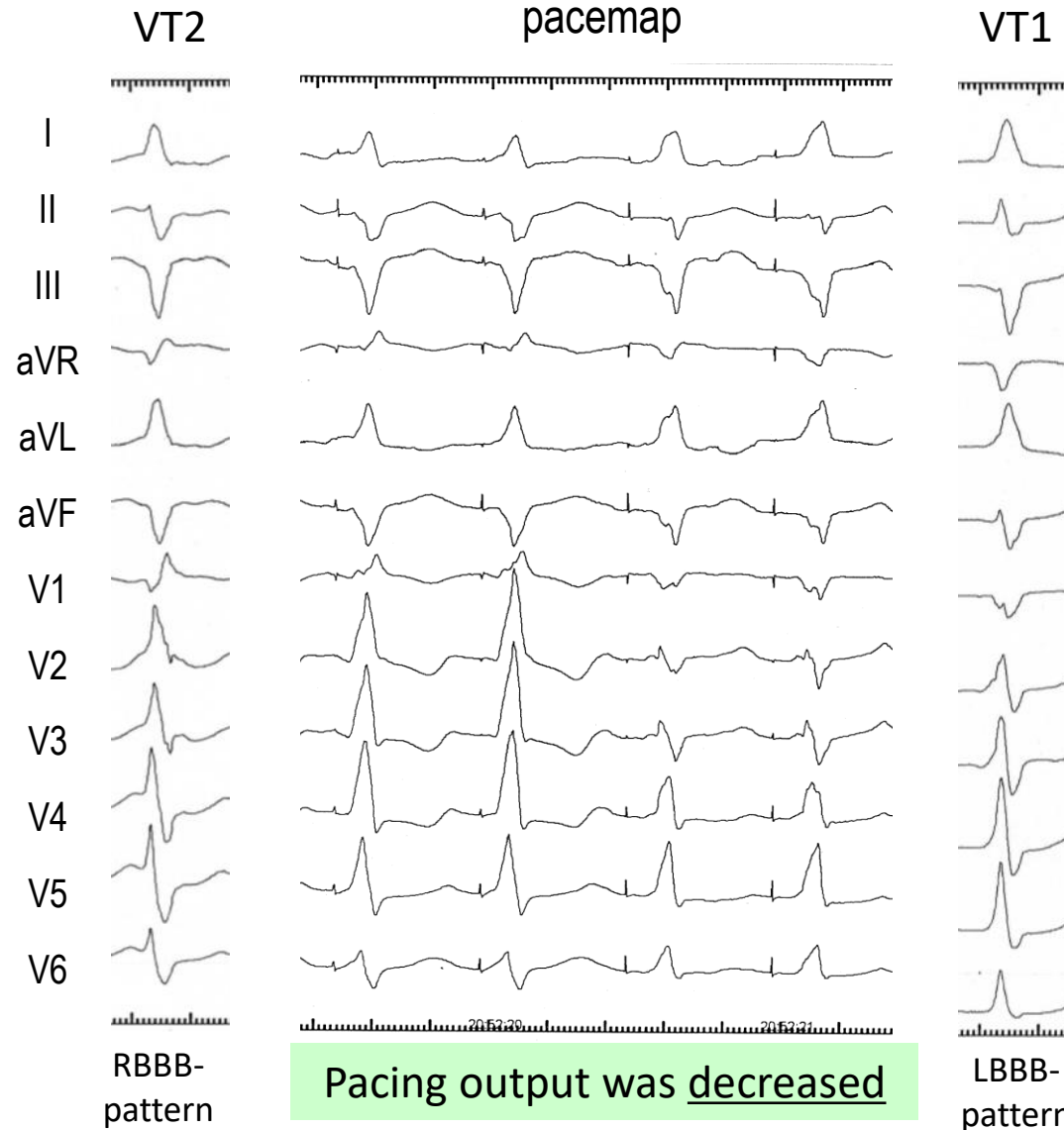
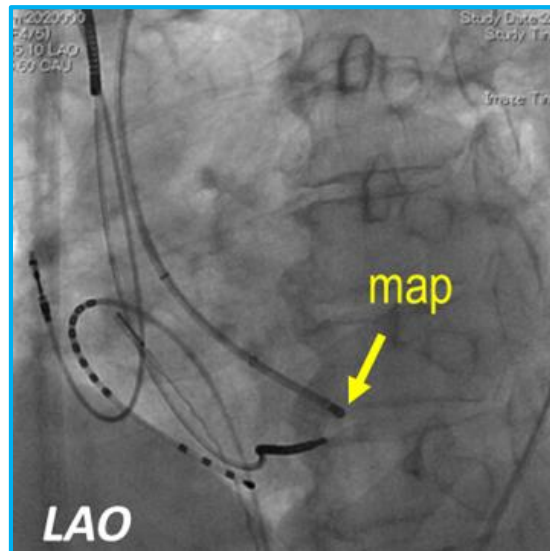
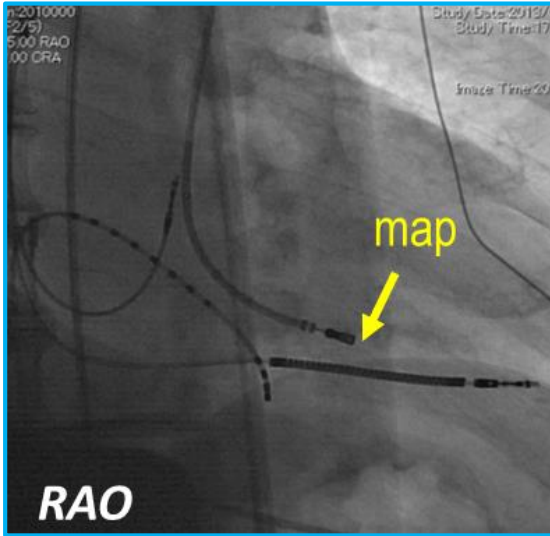
# Clinical VPC and induced VTs



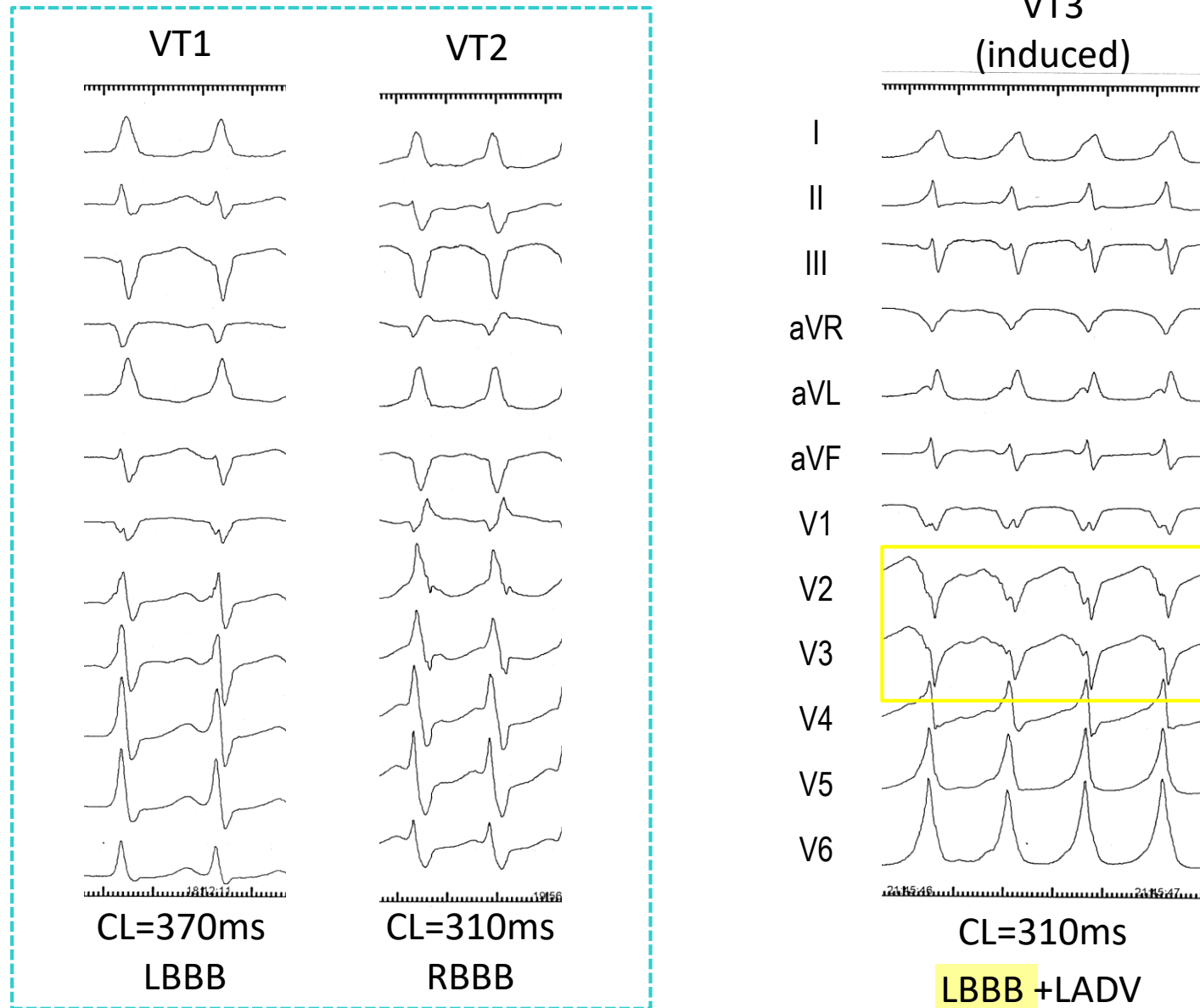
# Mapping at LV septum



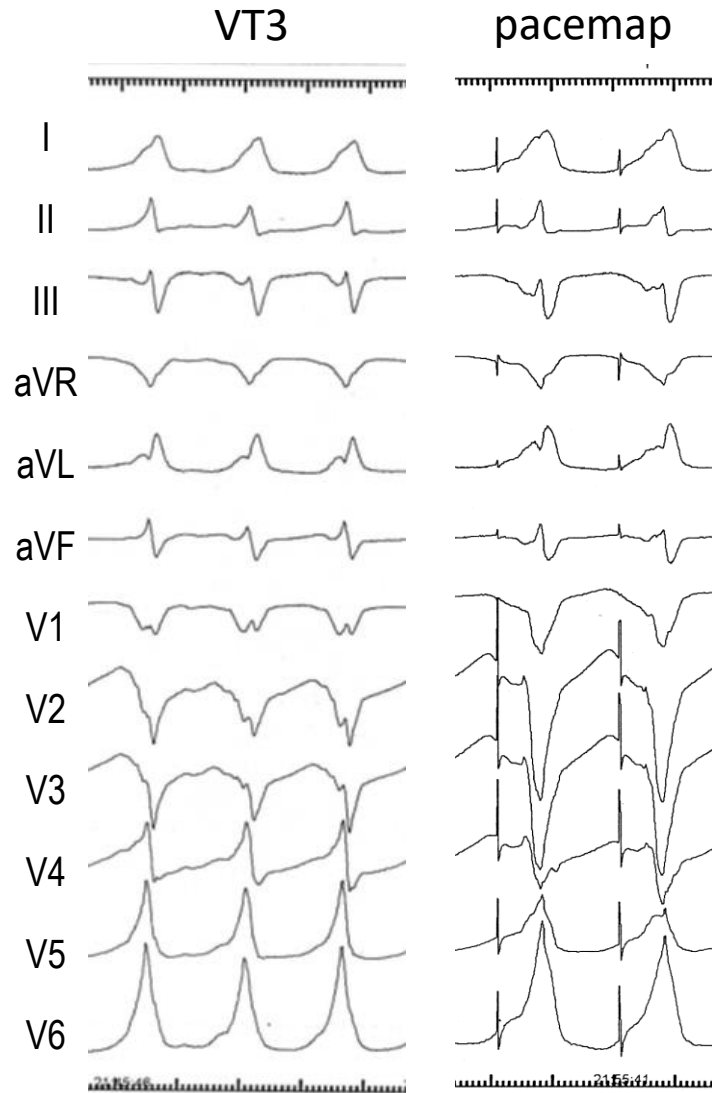
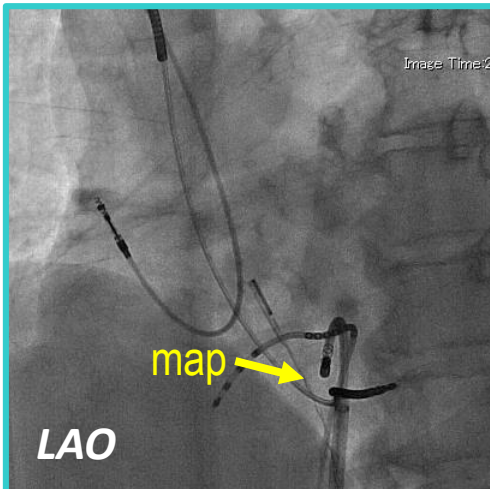
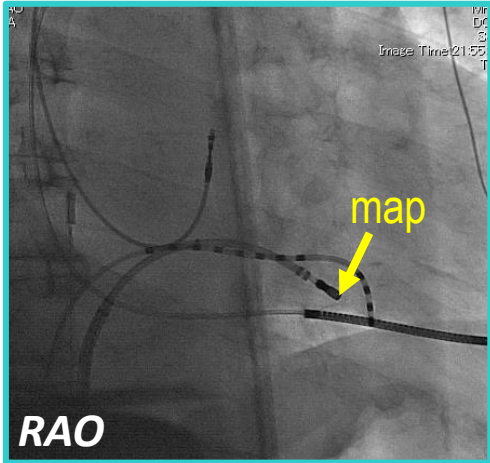
# Pacemapping at LV septum



# Another VT was induced after LV ablation

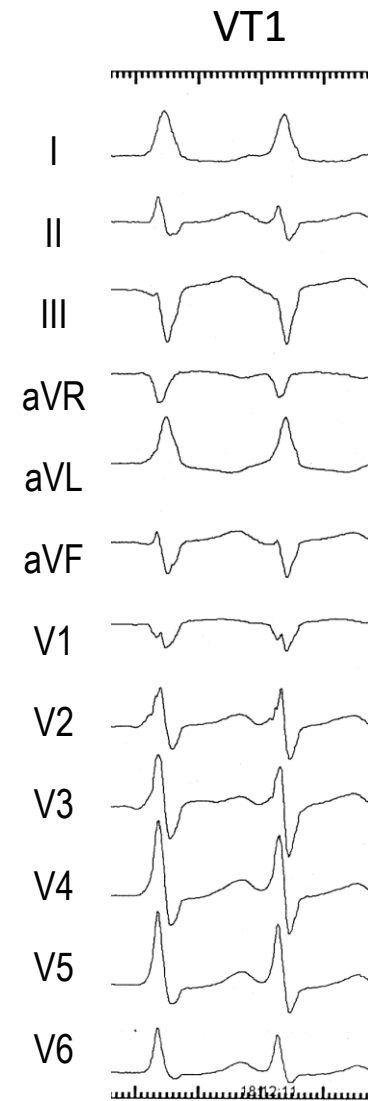
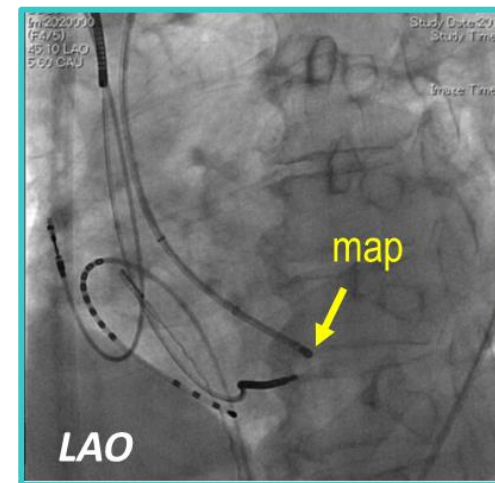
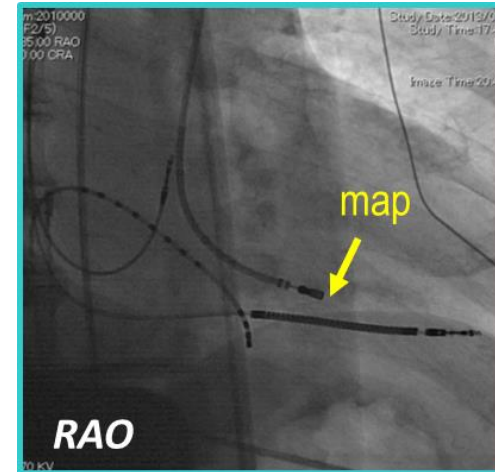


# Mapping and RFCA at RV septum



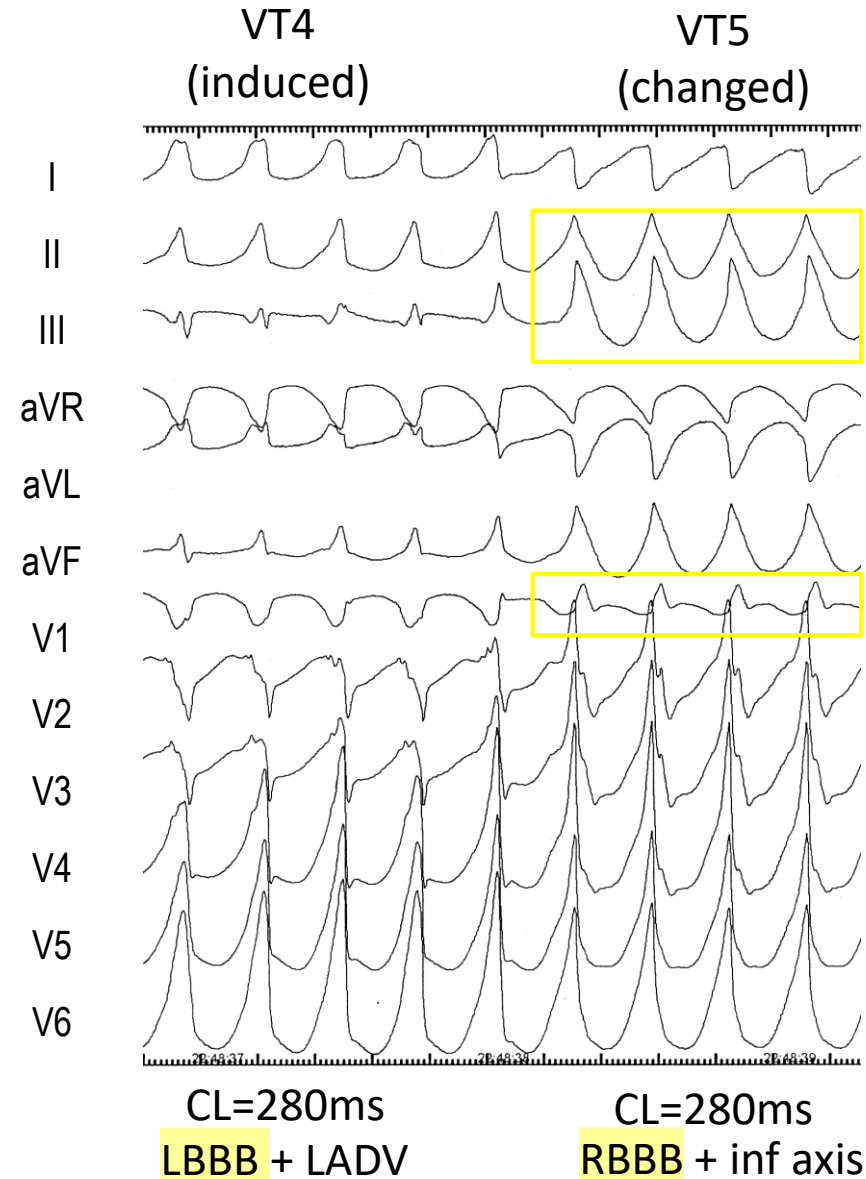
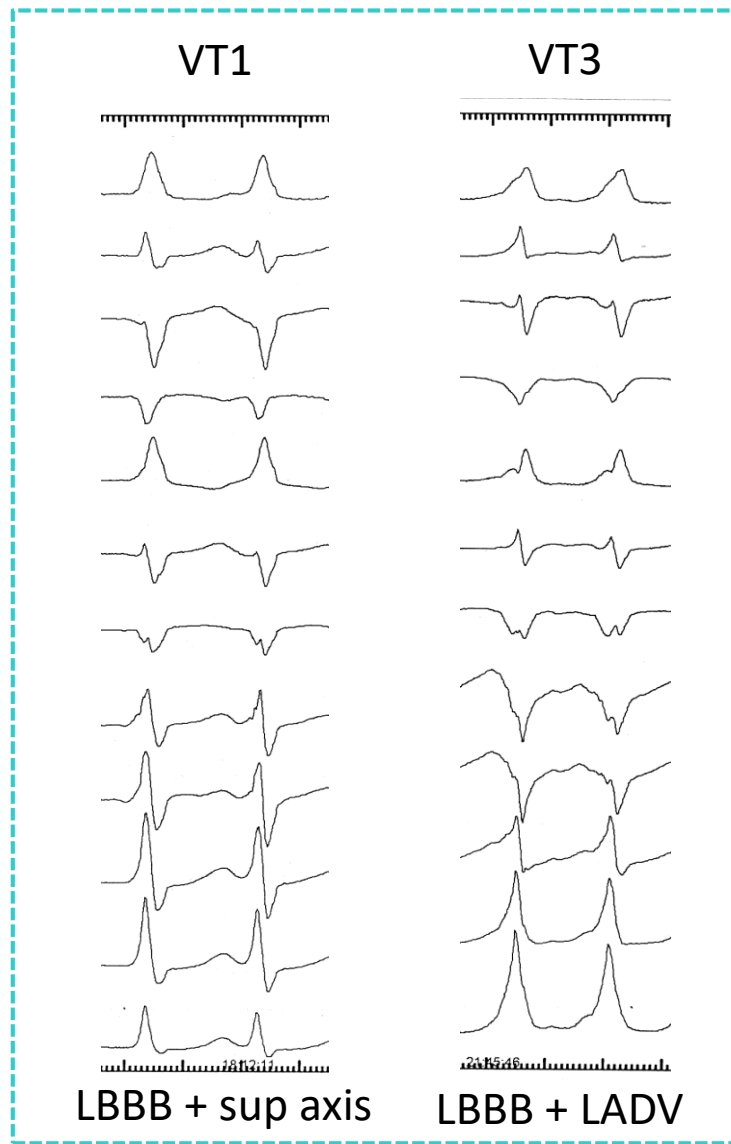
CL=310ms

LBBB +LADV

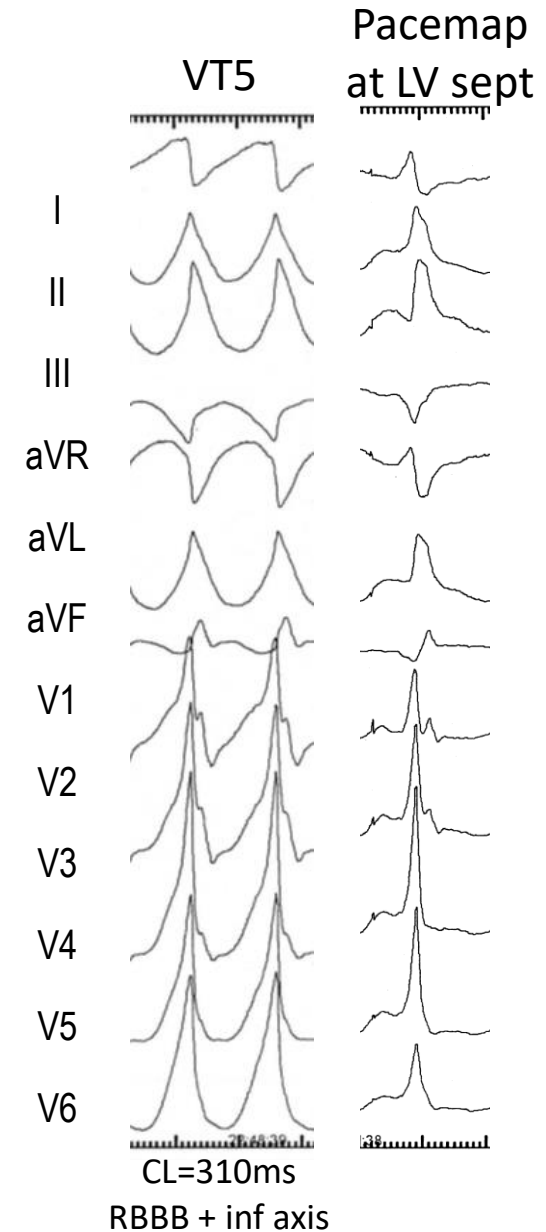
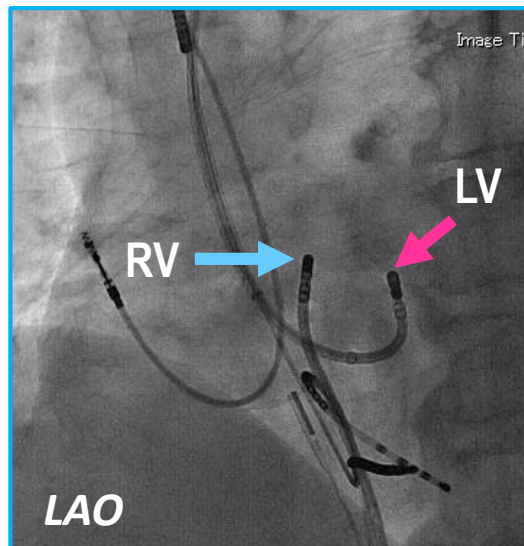
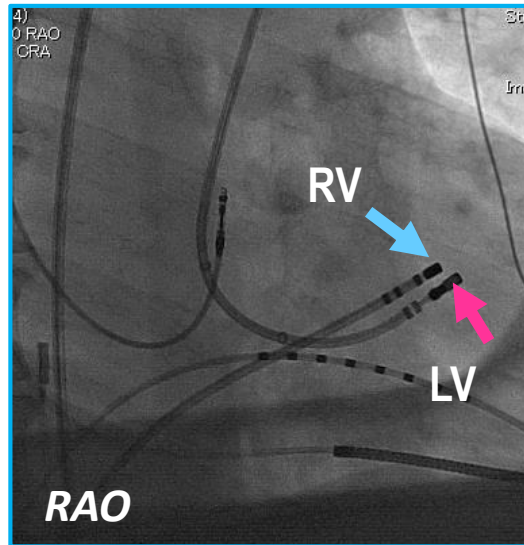
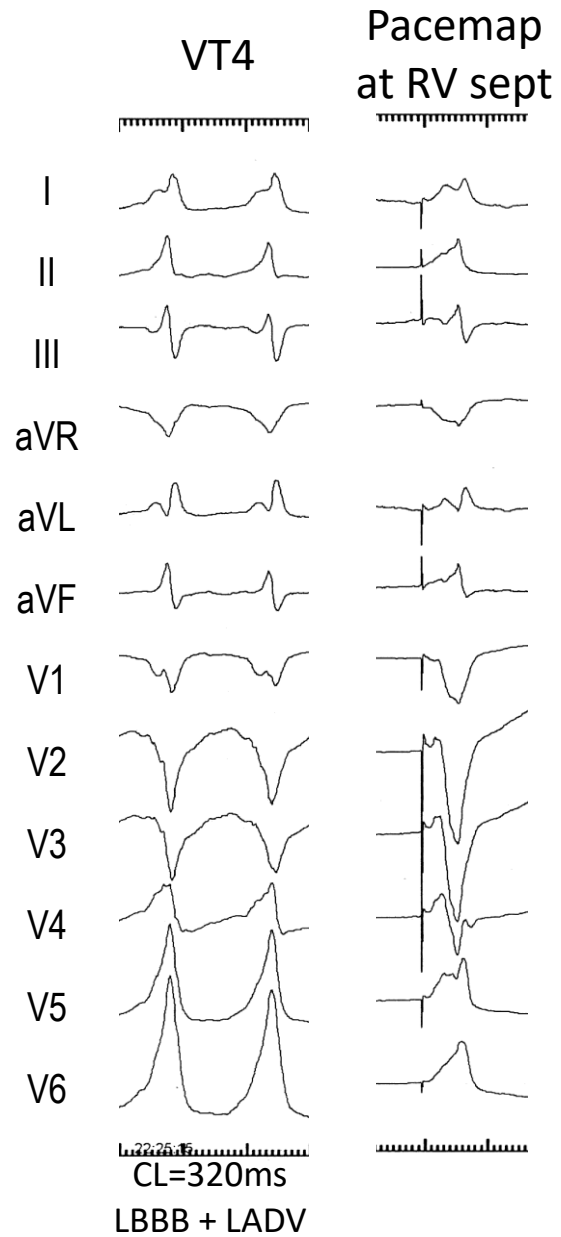




# Other VTs were induced after unipolar RFCA at LV and RV septum

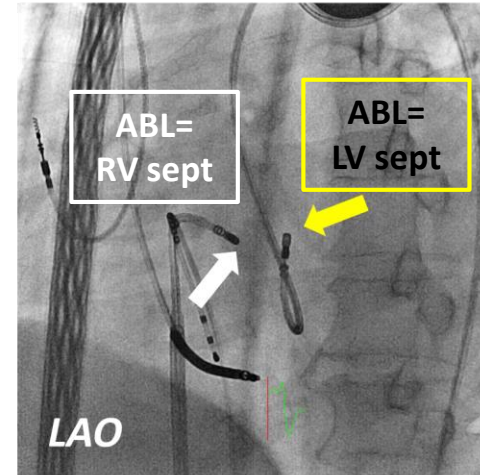
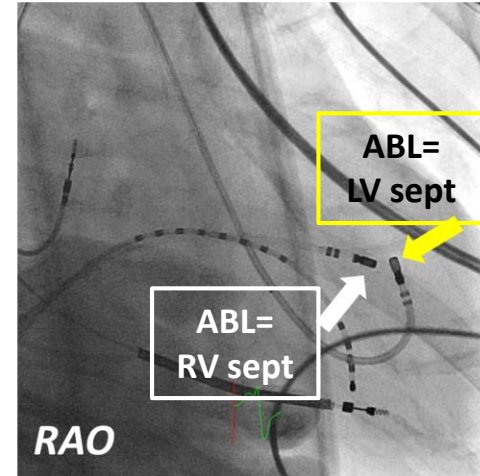
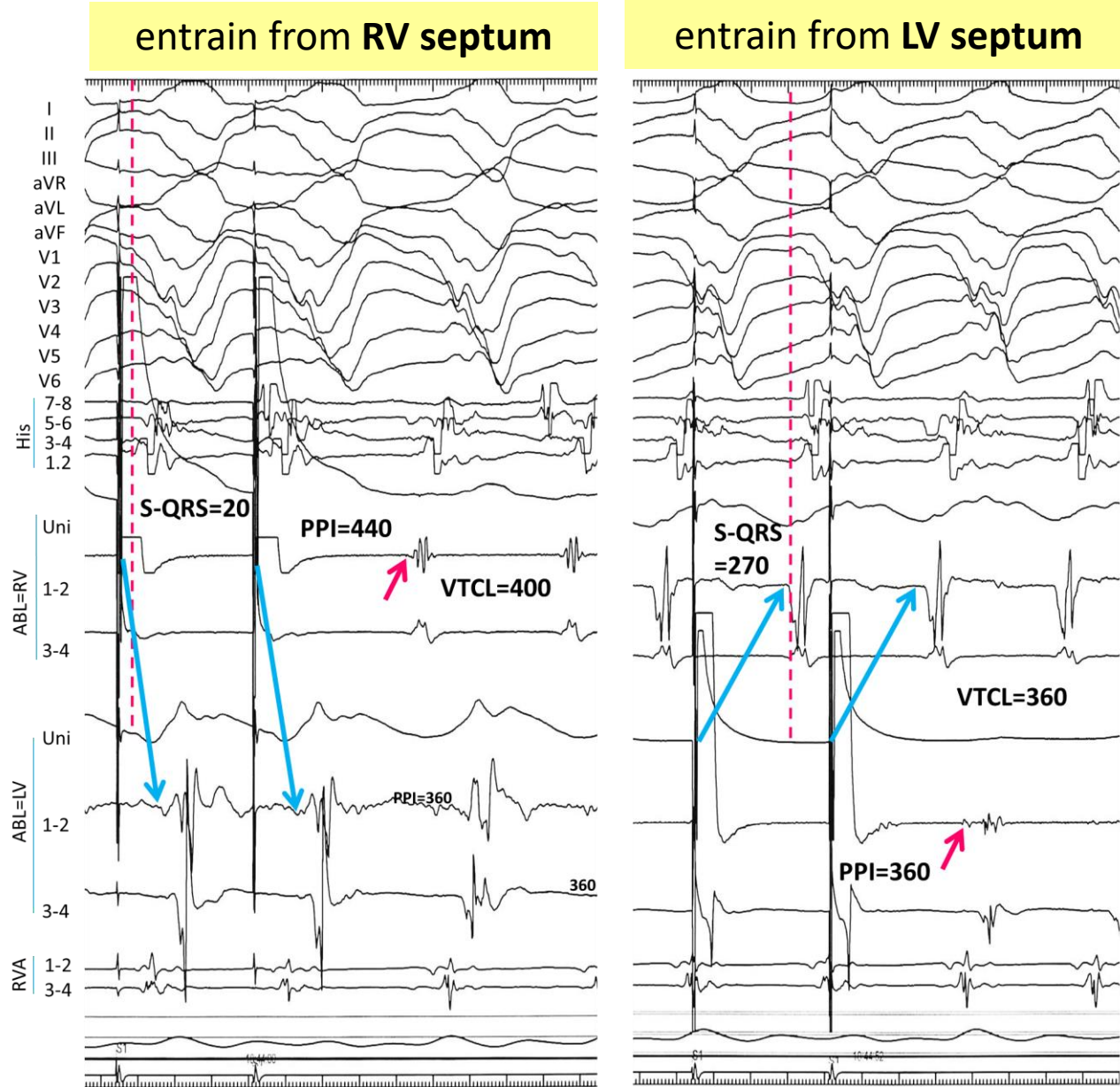


# Bipolar ablation at ventricular septum





# A representative case 2 with HCM and VT



# Baseline characteristics

Case	age, years	gender	underlying heart disease	ICD	UCG		Prior sessions
					DD, mm	EF, %	
1	74	M	cardiac sarcoidosis	CRTD	53	43	2
2	56	M	remote myocardial infarction	none	55	47	1
3	73	M	non-ischemic cardiomyopathy	none	50	44	1
4	63	M	cardiac sarcoidosis	ICD	60	55	5
5	61	M	non-ischemic cardiomyopathy	none	57	51	1
6	65	M	cardiac sarcoidosis	ICD	53	51	2
7	73	M	LV aneurysm	ICD	64	44	0
8	70	M	non-ischemic cardiomyopathy, p-AVR	ICD	73	12	2
9	63	M	hypertrophic cardiomyopathy	ICD	52	40	1
10	71	M	hypertrophic cardiomyopathy	none	54	40	2
11	67	M	remote myocardial infarction	ICD	75	21	2
12	71	M	dilated cardiomyopathy	none	60	29	2
13	70	M	remote myocardial infarction	ICD	59	42	1
14	60	M	dilated cardiomyopathy	none	74	21	2
15	52	M	cardiac sarcoidosis	ICD	59	40	1
16	64	F	dilated cardiomyopathy	none	57	40	2
17	68	F	cardiac sarcoidosis	CRTD	43	51	3
18	45	M	hypertrophic cardiomyopathy	ICD	54	61	1
m ± SD	65 ± 8	16M			58 ± 9	41 ± 13	1.7 ± 1.1



# The acute results of bipolar ablation

No.	VT	target site	ablation catheter ①		ablation catheter ②		acute success	acute result
1	3	septum	IR	LV septum	IR	RV septum	yes	termination and non-sustainable
2	2	septum	IR	LV septum	IR	RV septum	yes	non-inducible
3	1	septum	IR	LV septum	IR	RV septum	yes	NSVT elimination
4	5	septum	IR	LV septum	IR	RV septum	yes	non-inducible
5	3	LV summit	IR	LCC	IR	RVOT	yes	NSVT elimination
6	5	septum	IR	LV septum	4mm NI	RV septum	yes	non-inducible
7	3	septum	IR	LV septum	IR	RV septum	no	2 non-inducible, 1 inducible
8	7	septum	IR	LV septum	IR	RV septum	yes	non-inducible
9	4	LV free wall	IR	LV endo	IR	epi	yes	termination and non-inducible
10	1	LV free wall	IR	LV endo	8mm NI	epi	yes	NSVT elimination
11	4	LV free wall	IR	LV endo	4mm NI	epi	yes	termination and non-inducible
12	1	LV summit	IR	LV endo	8mm NI	epi	yes	NSVT elimination
13	2	septum	IR	RV septum	4mm NI	LV septum	yes	termination and non-inducible
14	1	LV summit	IR	LV endo	8mm NI	AIVV	yes	NSVT elimination
15	5	septum	IR	LV septum	IR	RV septum	yes	termination and non-inducible
16	3	LV summit	IR	LV endo	IR	LAA	yes	termination and non-inducible
17	2	anterior junction	IR	LV septum	IR	RV septum	yes	termination and non-inducible
			IR	LV endo	IR	epi		
18	2	LV summit	IR	LV endo	IR	epi	yes	non-inducible
		septum	IR	LV septum	IR	RV septum	no	inducible

※ IR = irrigation, NI = non-irrigation



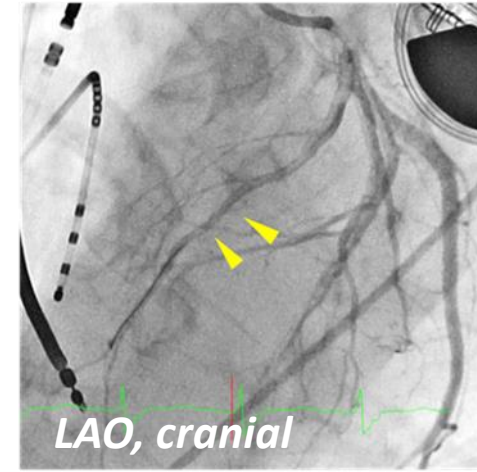
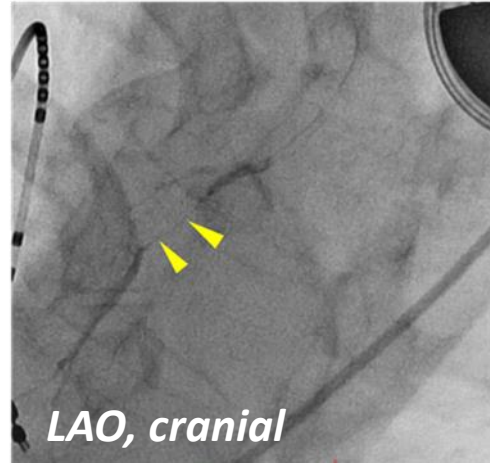
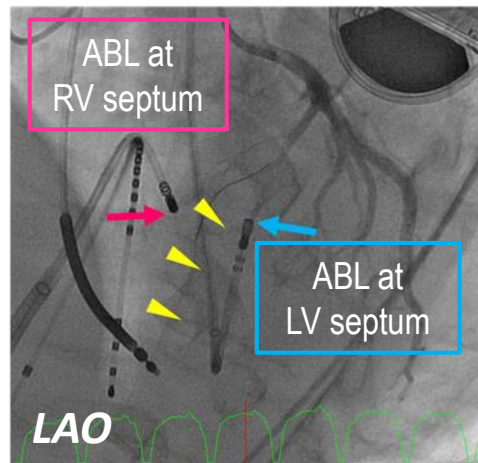
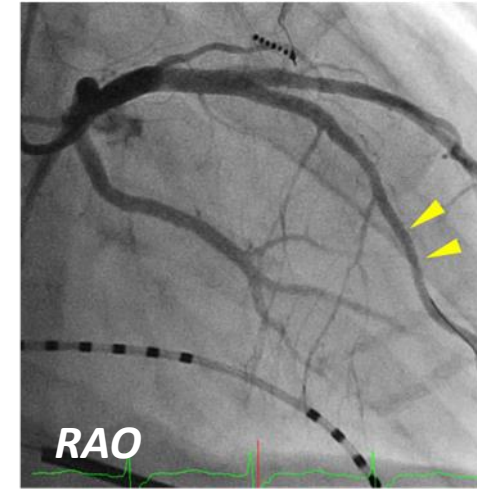
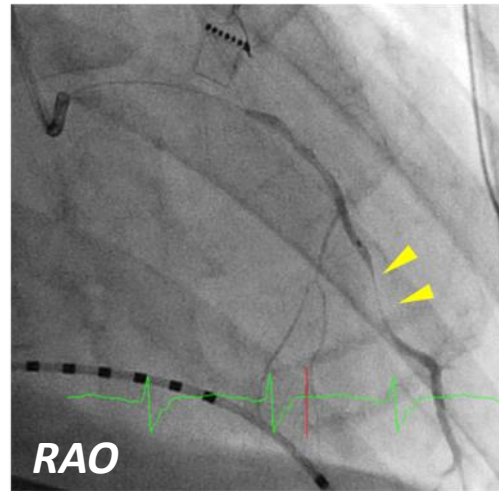
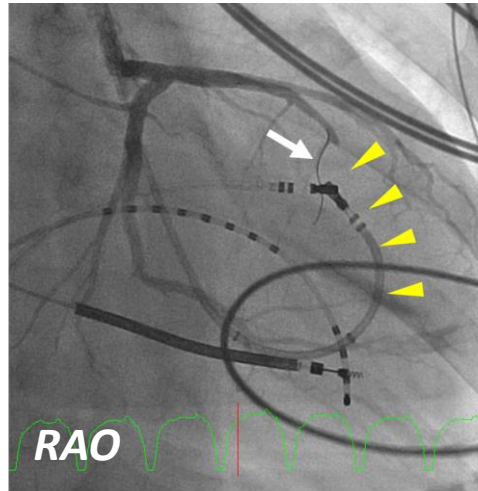
# Complication

- **Steam pop** in 1 case (case no.1) with cardiac sarcoidosis during bipolar RFCA at ventricular septum with 45-50W output.
  - No cardiac tamponade. No septal perforation.
- **Complete AV block** in 2 cases. In a case with cardiac sarcoidosis (case no.4), complete AV block occurred during LV unipolar ablation. ICD was upgraded to CRTD.



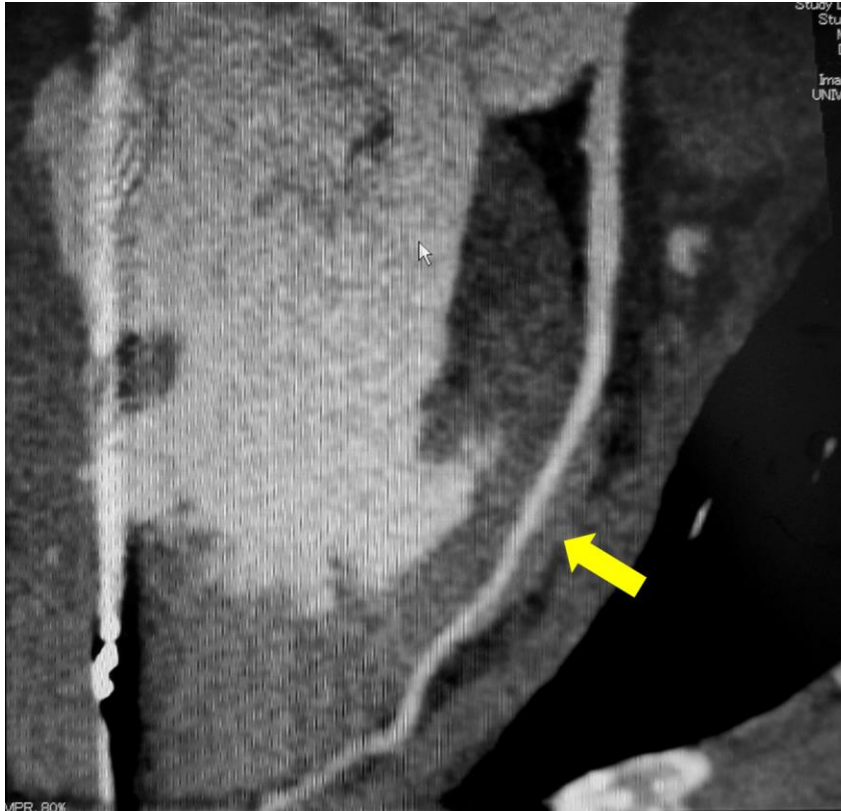
- **Coronary artery occlusion (LAD#8)** was revealed in the patient with HCM (case no.18) after bipolar RFCA.  
→ drug eluting stent was implanted.

after PCI

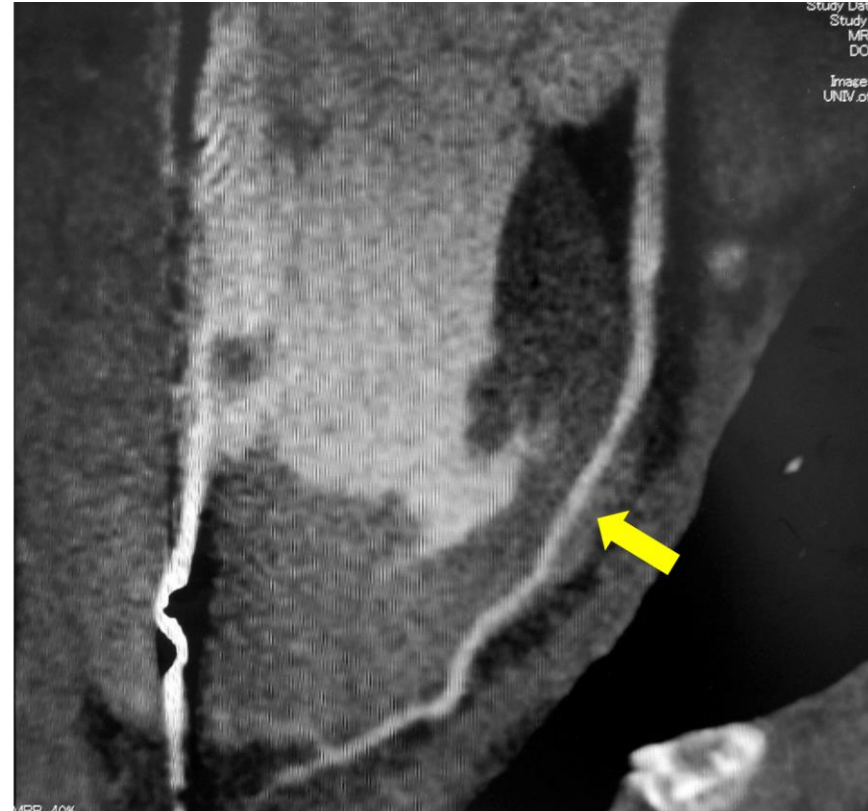




# Cardiac CT before ablation



Diastole



Systole



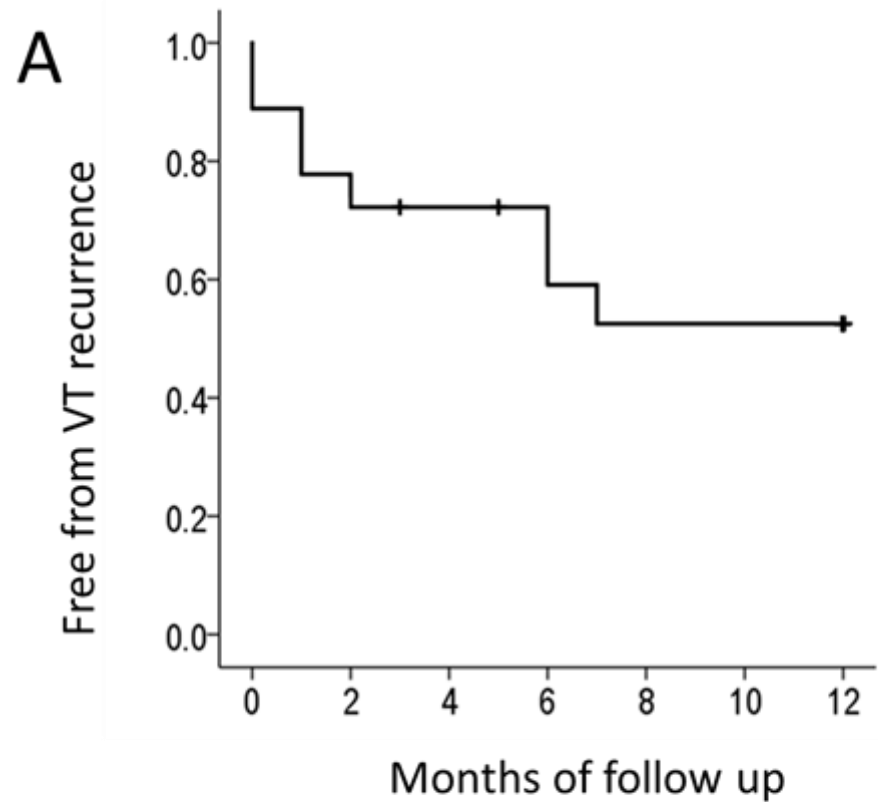
# Outcome after bipolar ablation

No.	underlying heart disease	target site in last session	recurrence at <b>12 mo.</b>	outcome	following therapy
1	sarcoidosis	septum	-	-	-
2	OMI	septum	-	-	-
3	NICM	septum	-	-	-
4	sarcoidosis	septum	+	ICD shock	bipolar re-RFCA
5	NICM	LV summit	+	NSVT	medication
6	sarcoidosis	septum	+	ICD shock	unipolar re-RFCA
7	LV aneurysm	septum	+	ATP	none
8	sarcoidosis, p-AVR	septum	+	ICD shock	bipolar re-RFCA
9	HCM	LV free wall	+	VT storm	chemical ablation
10	HCM	LV free wall	-	-	-
11	OMI	LV free wall	+	death due to cancer	-
12	DCM	LV summit	-	-	-
13	OMI	septum	-	-	-
14	DCM	LV summit	-	death due to HF	-
15	sarcoidosis	septum	-	-	-
16	DCM	LV summit	-	-	-
17	sarcoidosis	anterior junction	+	ICD shock	medication
18	HCM	LV summit	-	-	-

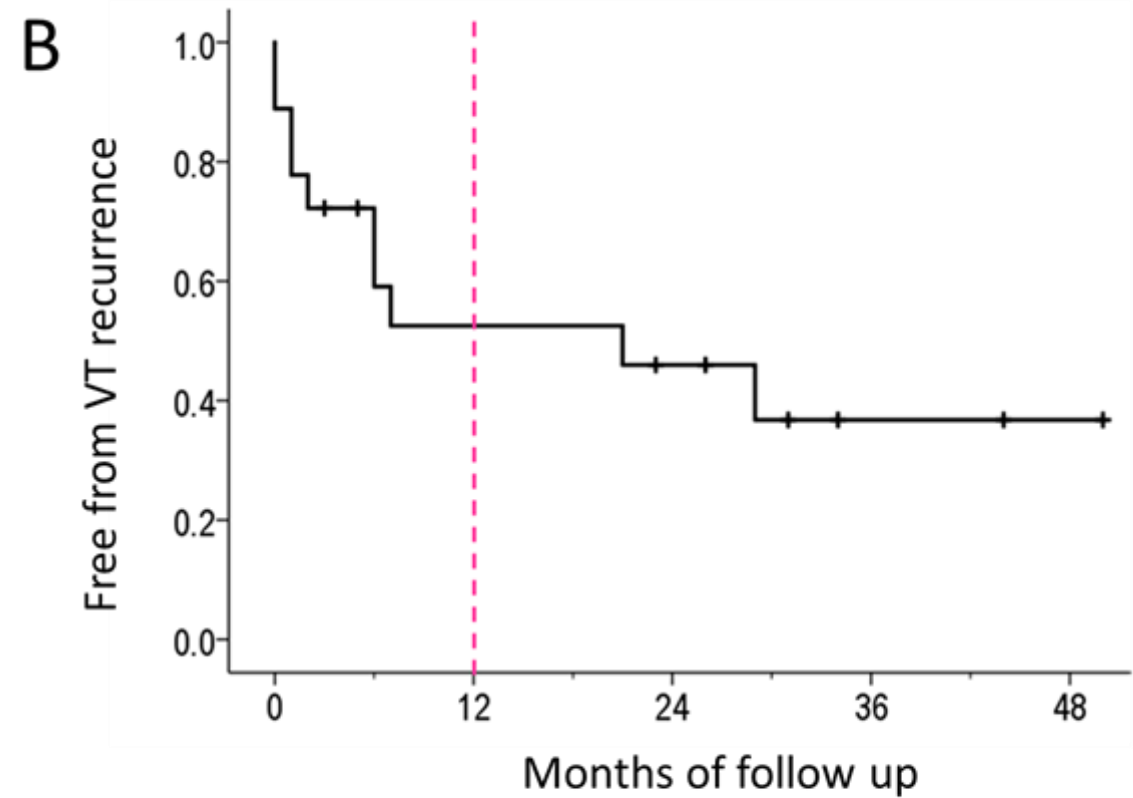




# Survival curves showing VT recurrence



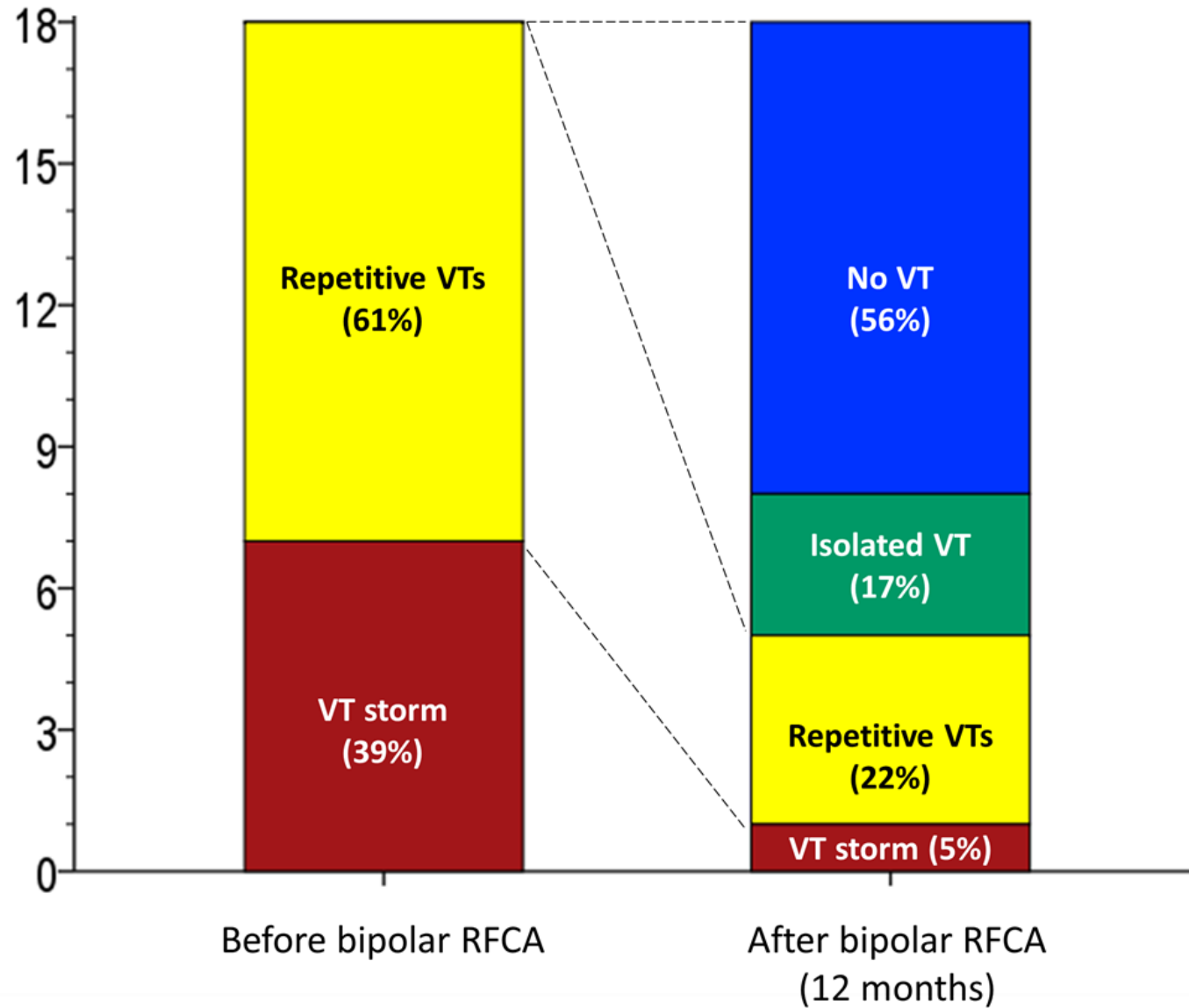
No. of pts at risk	18	14	12	11	8	8	8
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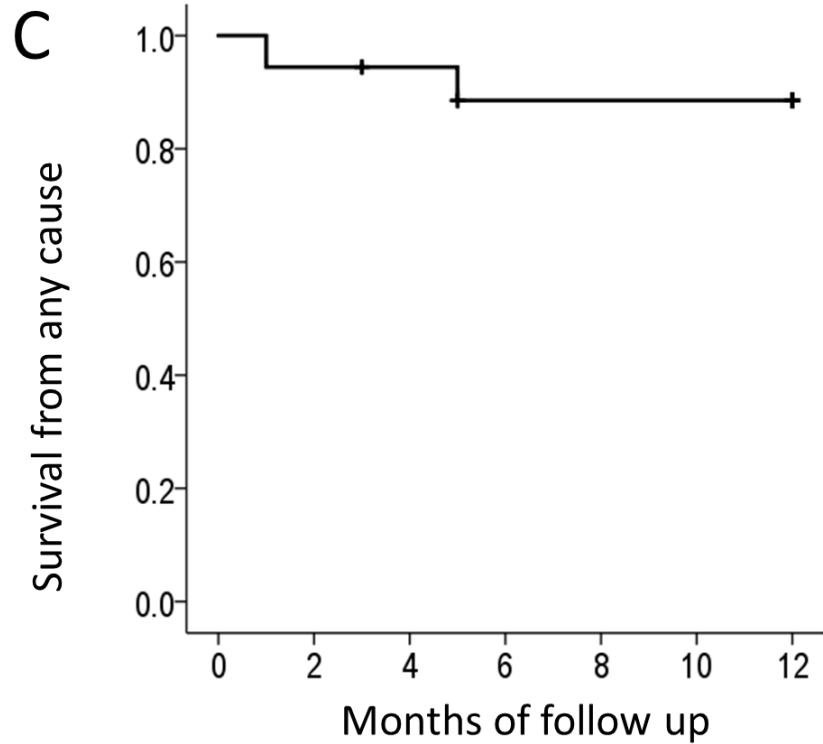
No. of pts at risk	18	11	8	8	6	4	2	2	1
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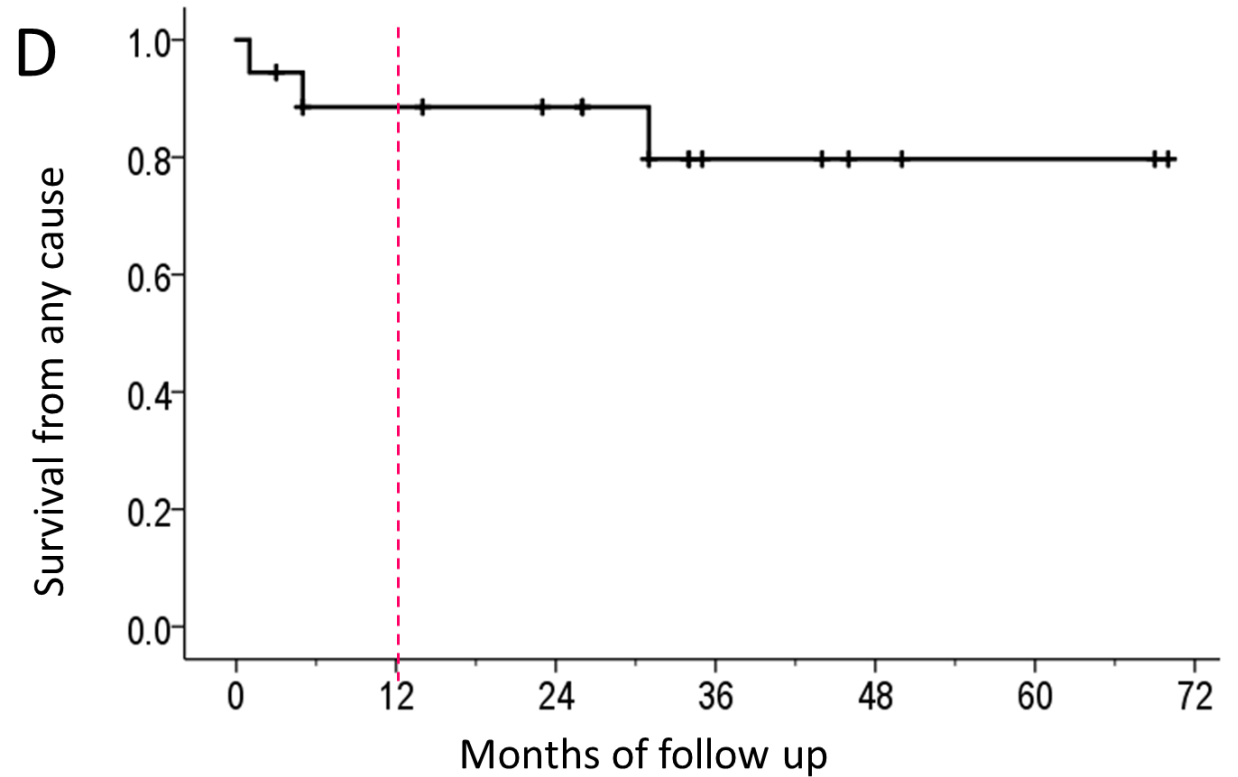
# Change in VT burden after bipolar RFCA



# Survival from any cause of death



No. of pts at risk	0	1	3	5	7	9	11
No. of pts at risk	18	17	16	14	14	14	14



No. of pts at risk	0	1	12	18	24	30	36	42	48	54	60	66
No. of pts at risk	18	14	14	13	12	10	5	5	3	2	2	2



# Summary

- Acute success was achieved with bipolar RFCA in most patients with refractory VAs (89%).
- Complications (steam pop, complete AV block, coronary artery occlusion) during the ablation procedure occurred in 4 cases (22%).
- VT recurrence rate was relatively high (44%) at 12 months follow-up after acute success of bipolar RFCA.
- However, VT burden decreased even in the patients with VT recurrence after bipolar RFCA.
- Therefore, re-RFCA for sustained VT was necessary for only 4 patients.



# Discussion

- Bipolar ablation is 'Off-label' therapy.
- Complication including septal perforation, cardiac tamponade, or complete AV block may happen.
- Local endocardial electrogram and pacemapping are not reliable because of intramural origin.
- Temperature and impedance measurements were available only for the ablation catheter connected to the standard location on the ablation generator.
- Impedance decrease is not reliable.



# Conclusion

- Bipolar RFCA was useful for refractory VT for acute suppression.
- While the VT recurrence rate during long-term follow-up was relatively high, a significant reduction of VT burden and its favorable effect on cardiac mortality was observed.



*Thank you for your attention!*

