



What Should we do at Redo Ablation Procedure?

: Additional ablation after PVI

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1. Background

Impact of Non-Pulmonary Vein Foci on the Outcome of the Second Session of Catheter Ablation for Paroxysmal Atrial Fibrillation

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Impact of Non-PV AF Foci on the Second Catheter Ablation for PAF. *Background:* Paroxysmal atrial fibrillation (AF) is primarily triggered by pulmonary veins (PVs). However, non-PV AF foci may also trigger AF.

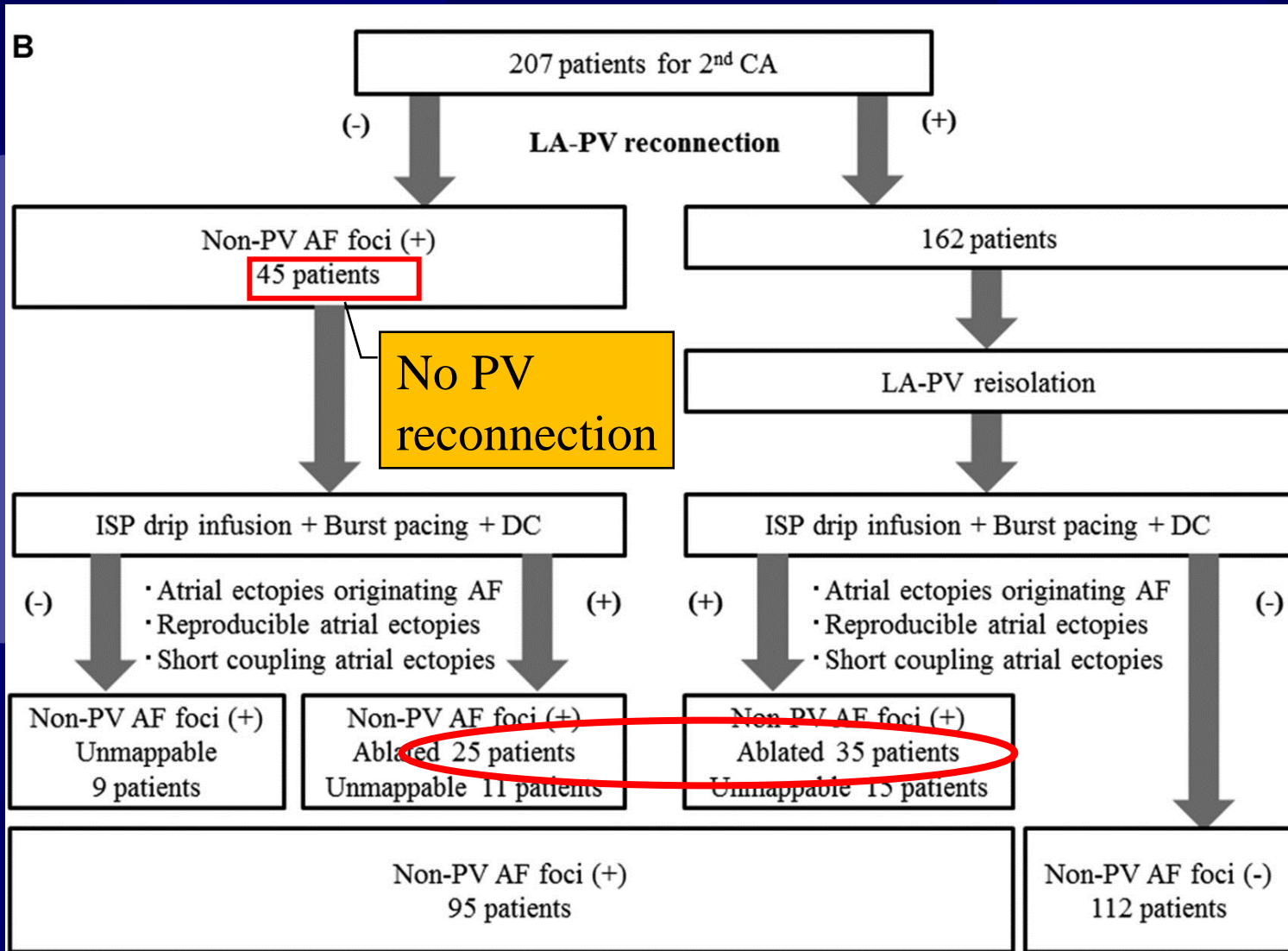
Methods: We examined 207 patients (mean age, 62 ± 11 years; 166 men) who underwent a second catheter ablation (CA) and evaluated the clinical significance of non-PV AF foci on the outcomes.

Results: Electrical reconnections between the PVs and left atrium (LA) were observed in 162 patients (78.3%). Non-PV AF foci were identified in 95 patients (45.9%, 60 patients with successfully ablated non-PV AF foci and 35 with unmappable non-PV AF foci). During a median follow-up period of 22.7 months, 61 patients (29.5%; 18/112 [16.1%] without non-PV AF foci vs. 20/60 [33.3%] with successfully ablated non-PV AF foci vs. 23/35 [65.7%] with unmappable non-PV AF foci, $P < 0.0001$) developed AF recurrence; 52 (85.2%) developed recurrence within 1 year. The presence of non-PV AF foci was a significant clinical predictor of AF recurrence after the second CA; successfully ablated non-PV AF foci increased the AF recurrence risk by 2.24 times (95% confidence interval [CI], 1.12–4.54; $P = 0.02$), and unmappable AF foci increased this risk by 5.58 times (95% CI, 2.73–11.63; $P < 0.0001$).

Conclusion: Nearly half of the patients had non-PV AF foci at the second CA session. AF recurred after the second CA session in approximately 30%, with most recurrences happening within 1 year. The presence of non-PV AF foci significantly increased the AF recurrence risk after a second CA. When non-PV AF foci were unmappable, the AF recurrence rate was extremely high. (*J Cardiovasc Electrophysiol*, Vol. 26, pp. 739-746, July 2015)

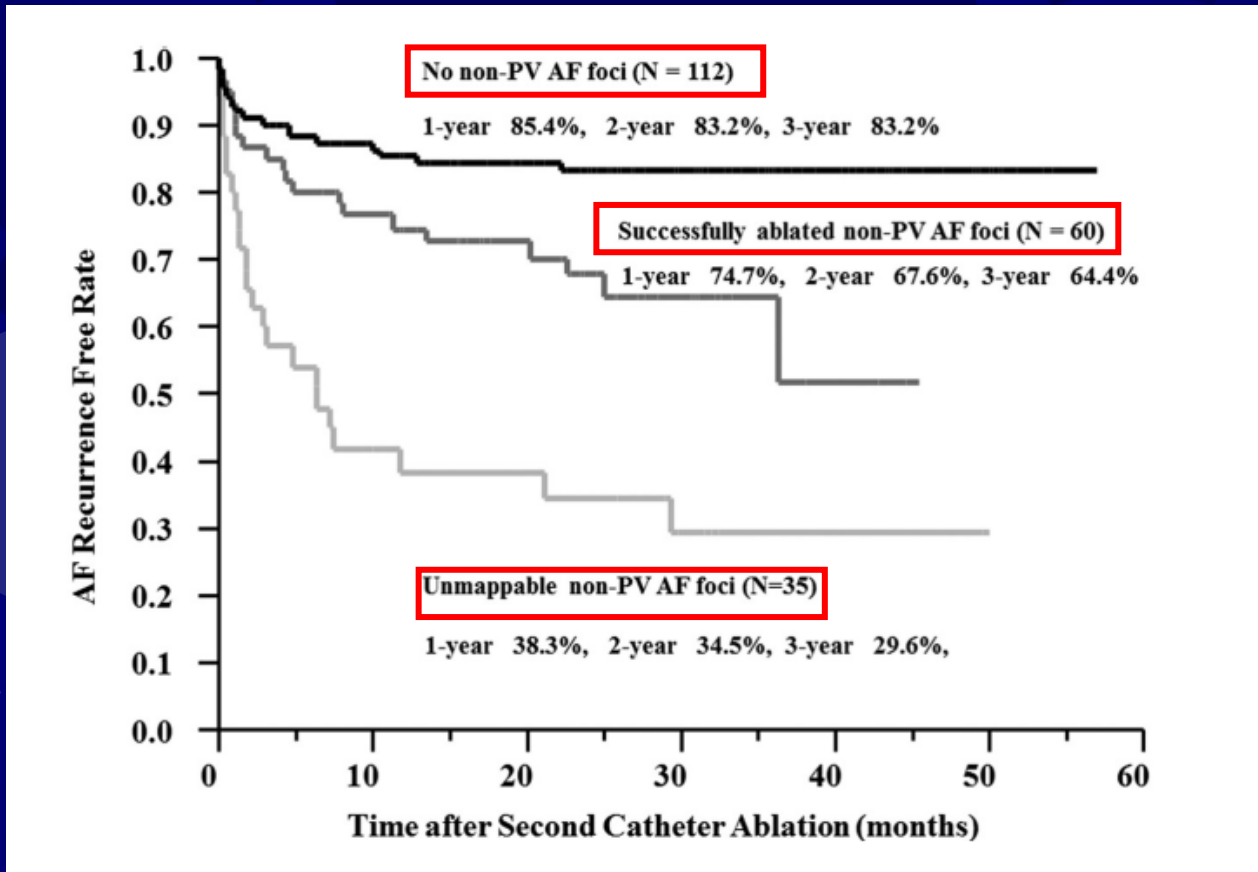


LA-PV reconnection in 2nd ablation after PAF ablation





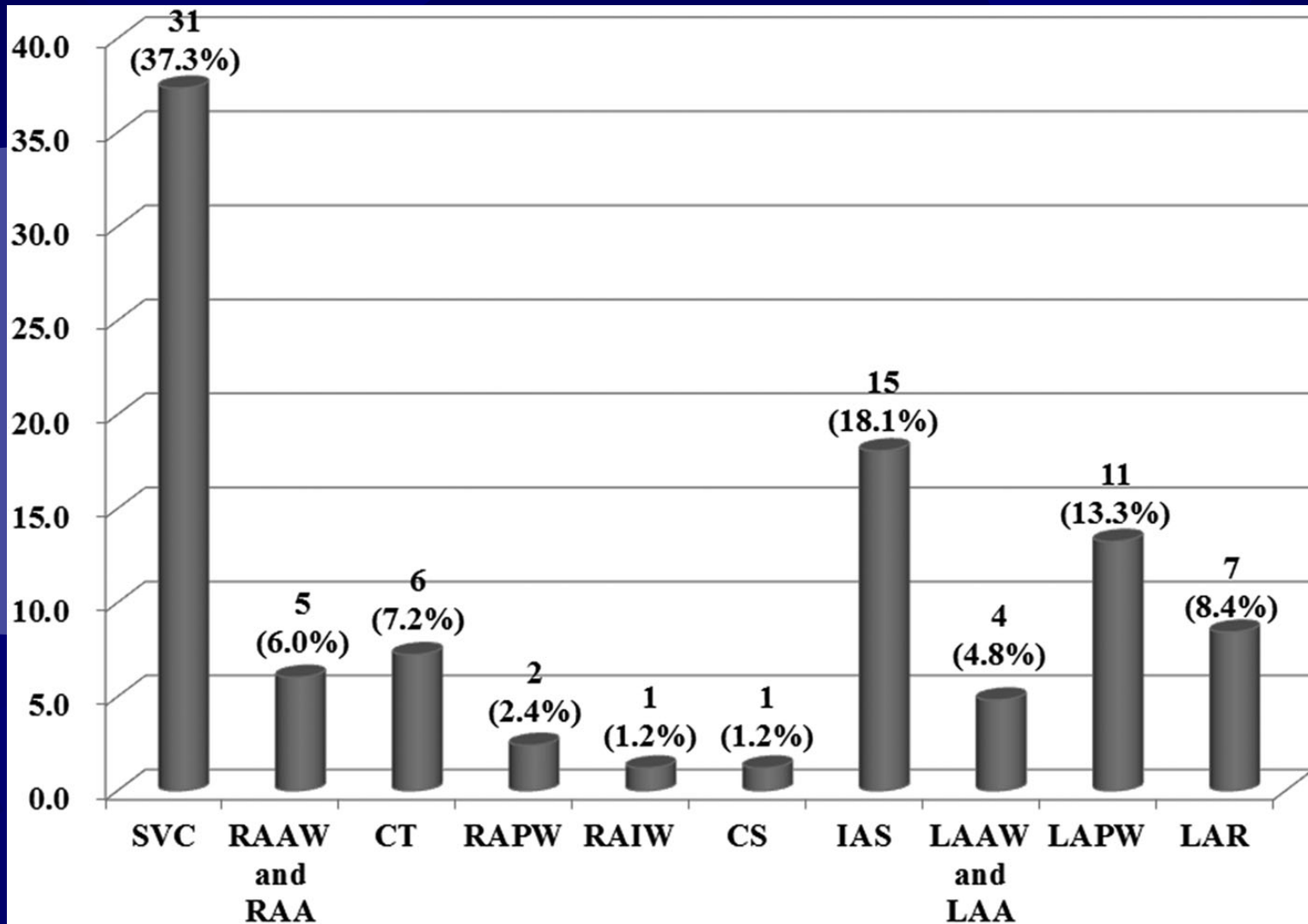
AF recurrence free rate



- The presence of non-PV AF foci was a significant clinical predictor of AF recurrence after the second CA



Locations of non-PV AF foci



M Takigawa, et al. J Cardiovasc Electrophysiol. 2015

Electrophysiologic Findings and Long-Term Outcomes in Patients Undergoing Third or More Catheter Ablation Procedures for Atrial Fibrillation

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Outcomes After Third or More Catheter Ablation for Atrial Fibrillation. *Introduction:* Pulmonary vein (PV) status, arrhythmia sources, and outcomes with ≥ 3 ablation procedures have not been characterized.

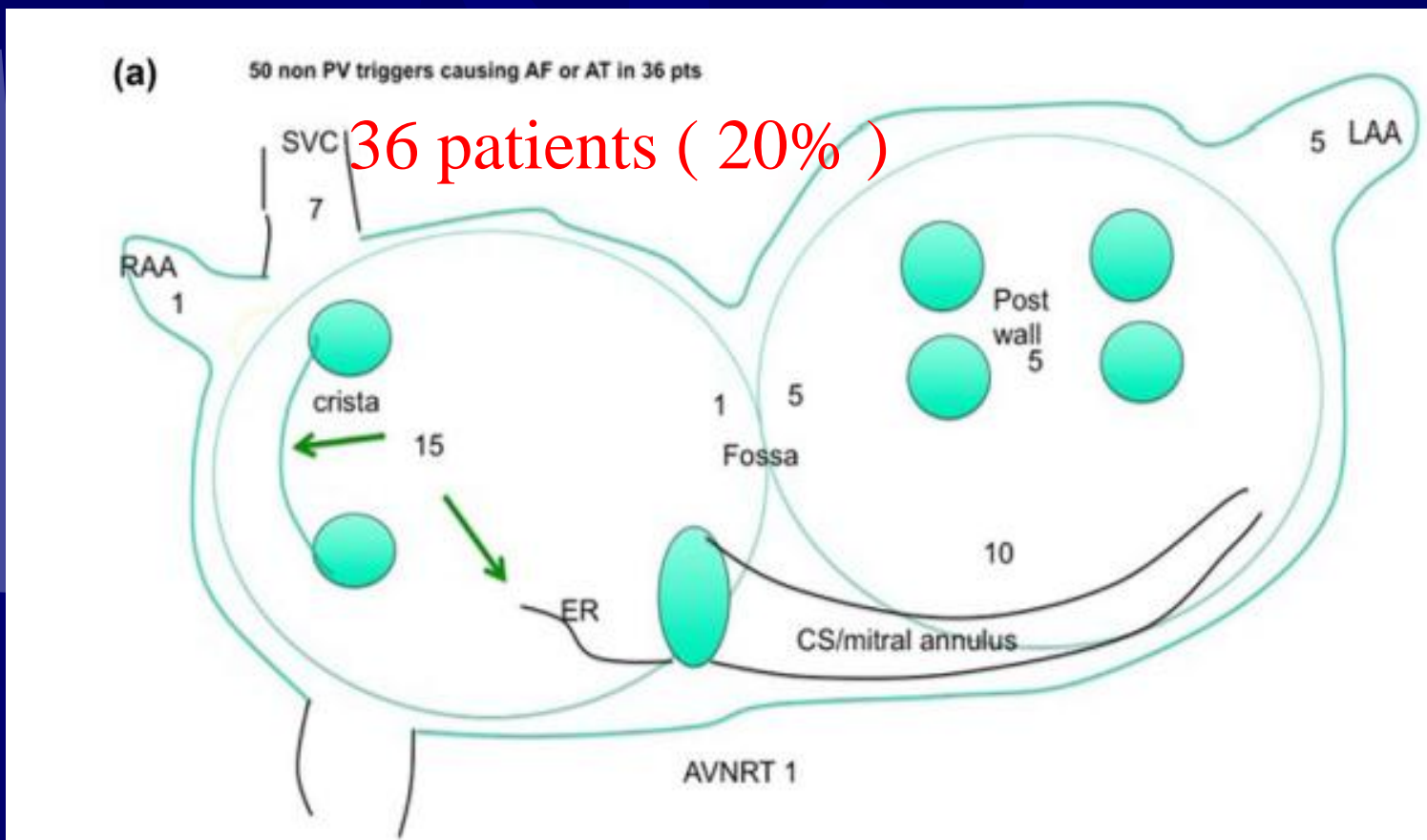
Methods and Results: All patients with ≥ 3 procedures were included and underwent antral reisolation of reconnected PVs and ablation of non-PV triggers. Of 2,886 patients who underwent PVI, 181 (6%) had more than 2 ablation procedures (3 procedures in 146 and ≥ 4 procedures in 35). In 12 patients, the clinical arrhythmia was other than AF. Of the remaining 169 patients, 69 (41%) had 4 reconnected PVs, 27 (16%) had 3, 31 (18%) had 2, and 29 (17%) had 1. Only 13 (8%) had all PVs still isolated. Provocative techniques in 127 patients initiated PV triggers in 92 patients, including AF or PV atrial tachycardia in 64 (50%), and reproducible PV APDs in 28 (22%). Thirty-six (20%) had a new non-PV trigger targeted. At a mean of 36 months (12–119 months) after last procedure, 63 patients (47%) had no AF off antiarrhythmic drugs (AAD); 28 (21%) had no AF with AAD; and 18 (13%) had rare AF with good symptom control; 26 patients (19%) had recurrent AF.

Conclusions: At time of third or greater AF ablation, PV reconnection is the rule (92%) and PV triggers initiating AF can be demonstrated. Following repeat PVI and targeting non-PV triggers, 81% of patients had clinical AF control. Our findings suggest that PV reisolation and attempts to identify and eliminate non-PV triggers are effective and support the role of multiple repeat procedures for AF recurrence. (*J Cardiovasc Electrophysiol*, Vol. 26, pp. 371-377, April 2015)

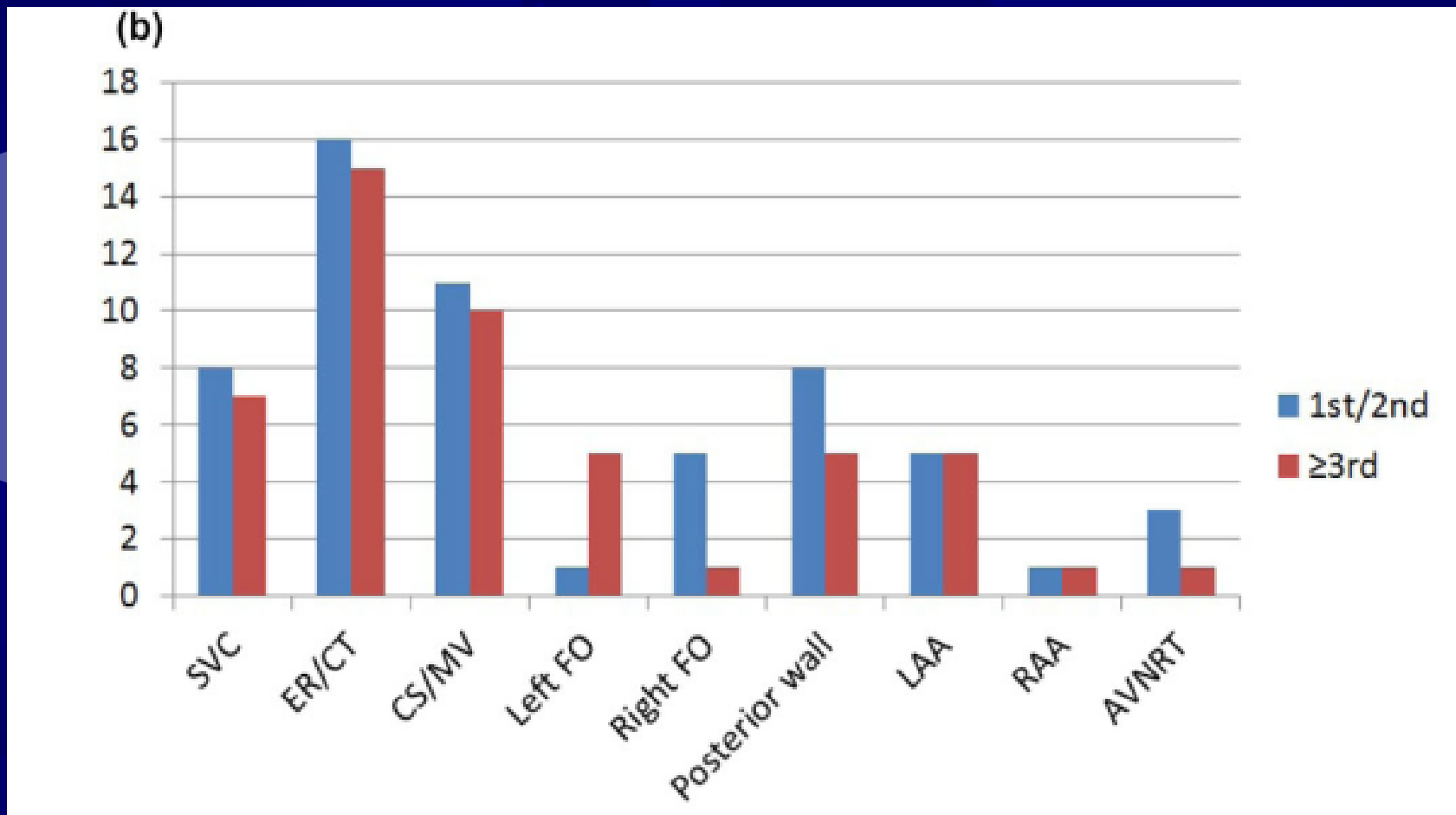
PVs at time of repeat ablation



Distribution of new non-PV triggers at time of the third or fourth ablations



Distribution of the non-PV triggers in first and second compared to third and fourth ablation.





Additional ablation after PVI

Where and how to ablate?

Importance of nonpulmonary vein foci in catheter ablation for paroxysmal atrial fibrillation



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BACKGROUND Pulmonary vein (PV) isolation is an established treatment strategy for paroxysmal atrial fibrillation (PAF). However, the recurrence rate of PAF is 8% to 37%, despite repeated procedures, and the catheter ablation strategy for PAF with non-PV foci is unclear.

OBJECTIVE The purpose of this study was to assess the PAF ablation strategy for non-PV foci.

METHODS The study included 304 consecutive patients undergoing PAF ablation (209 males, age 63.0 ± 10.4 years) divided into 3 groups: group 1 (245 patients) with no inducible non-PV foci; group 2 (34 patients) with atrial fibrillation (AF) originating from non-PV foci and all the foci successfully ablated; and group 3 (25 patients) with AF originating from non-PV triggers, but without all foci being ablated or with persistently inducible AF.

RESULTS Mean follow-up period was 26.9 ± 11.8 months, and AF recurrence rates since the last procedure were 9.8%, 8.8%, and 68.0% in groups 1, 2, and 3, respectively. There was no statistically significant difference in recurrence rate between

groups 1 and 2 ($P = .89$); however, there were statistically significant differences between groups 3 and 1 ($P < .0001$) and groups 3 and 2 ($P < .0001$). The patients in group 2 had an AF-free outcome to equivalent to those who had PV foci in group 1 ($P = .83$).

CONCLUSION Success rates can be improved for PAF ablation if non-PV foci are detected and eliminated.

KEYWORDS Catheter ablation; Atrial fibrillation; Pulmonary vein isolation; Mapping; Nonpulmonary vein foci

ABBREVIATIONS AAD = antiarrhythmic drug; AF = atrial fibrillation; CA = catheter ablation; CFAE = complex fractionated atrial electrogram; CT = crista terminalis; LA = left atrium; LAFW = left atrial free wall; LAPW = left atrial posterior wall; PAF = paroxysmal atrial fibrillation; PV = pulmonary vein; SVC = superior vena cava

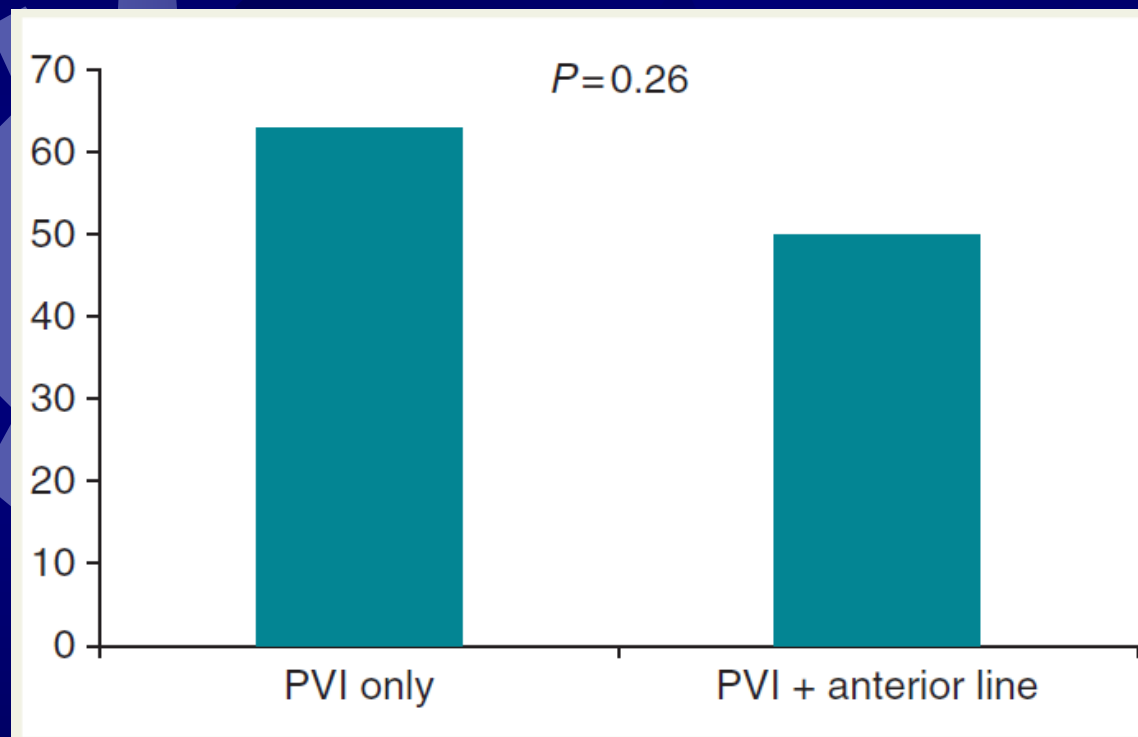
(Heart Rhythm 2015;12:1918–1924) © 2015 Heart Rhythm Society. All rights reserved.



Recurrence of PAF after PVI

- Prospective, randomized trial
- Total 77 patients, redo procedure
- Repeat PVI, n=41
- PVI + anterior line, n=36
- FU of 12 months

Sinus rhythm off AAD after a FU of 12 months



SR with AAD off

PVI only, 63%

PVI + anterior line, 50%

Ablation of Perimitral Flutter Following Catheter Ablation of Atrial Fibrillation: Impact on Outcomes from a Randomized Study (PROPOSE)

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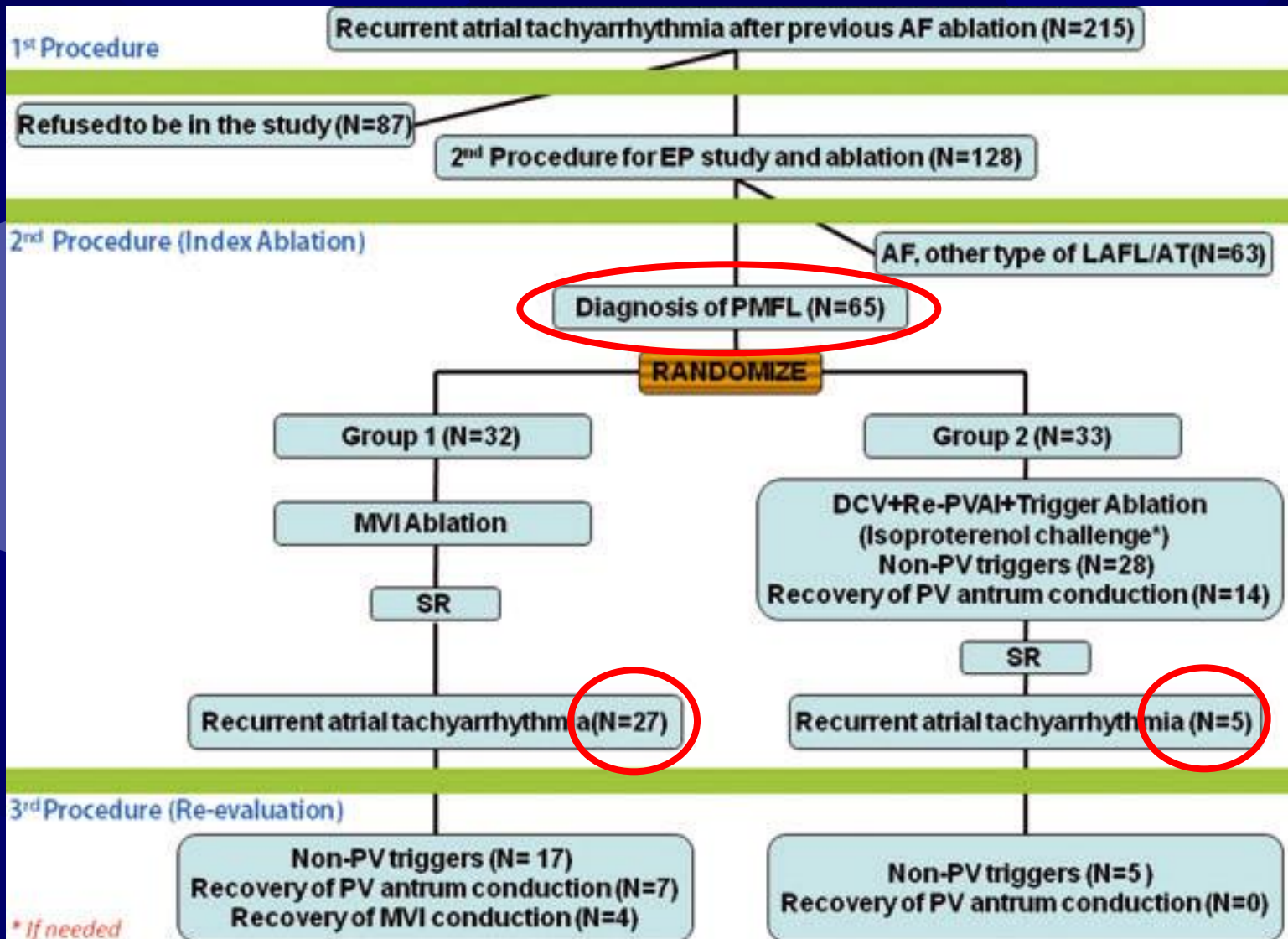
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MVI Block vs Trigger Ablation in PMFL. *Introduction:* Patients with previous ablation for atrial fibrillation (AF) may experience recurrence of perimitral flutter (PMFL). These arrhythmias are usually triggered from sources that may also induce AF. This study aims at determining whether ablation of triggers or completing mitral valve isthmus (MVI) block prevents more arrhythmia recurrences.

Methods and Results: Sixty-five patients with recurrent PMFL after initial ablation of long standing persistent AF were included in this study. Thirty-two patients were randomized to MVI ablation only (Group 1) and 33 were randomized to cardioversion and repeat pulmonary vein (PV) isolation plus ablation of non-PV triggers (Group 2). MVI bidirectional block was achieved in all but 1 patient from Group 1. In Group 2, reconnection of 17 PVs was detected in 14 patients (42%). With isoproterenol challenge, 44 non-PV trigger sites were identified in 28 patients (85%, 1.57 sites per patient). At 18-month follow-up, 27 patients (84%) from Group 1 had recurrent atrial tachyarrhythmias, of whom 15 remained on antiarrhythmic drug (AAD); however, 28 patients from Group 2 (85%, $P < 0.0001$ vs Group 1) were free from arrhythmia off AAD. The ablation strategy used in Group 2 was associated with a lower risk of recurrence (hazard ratio = 0.10, 95% CI 0.04–0.28, $P < 0.001$) and an improved arrhythmia-free survival (log rank $P < 0.0001$).

Conclusion: In patients presenting with PMFL after ablation for longstanding persistent AF, MVI block had limited impact on arrhythmia recurrence. On the other hand, elimination of all PV and non-PV triggers achieved higher freedom from atrial arrhythmias at follow-up. (*J Cardiovasc Electrophysiol*, Vol. 23, pp. 137-144, February 2012)

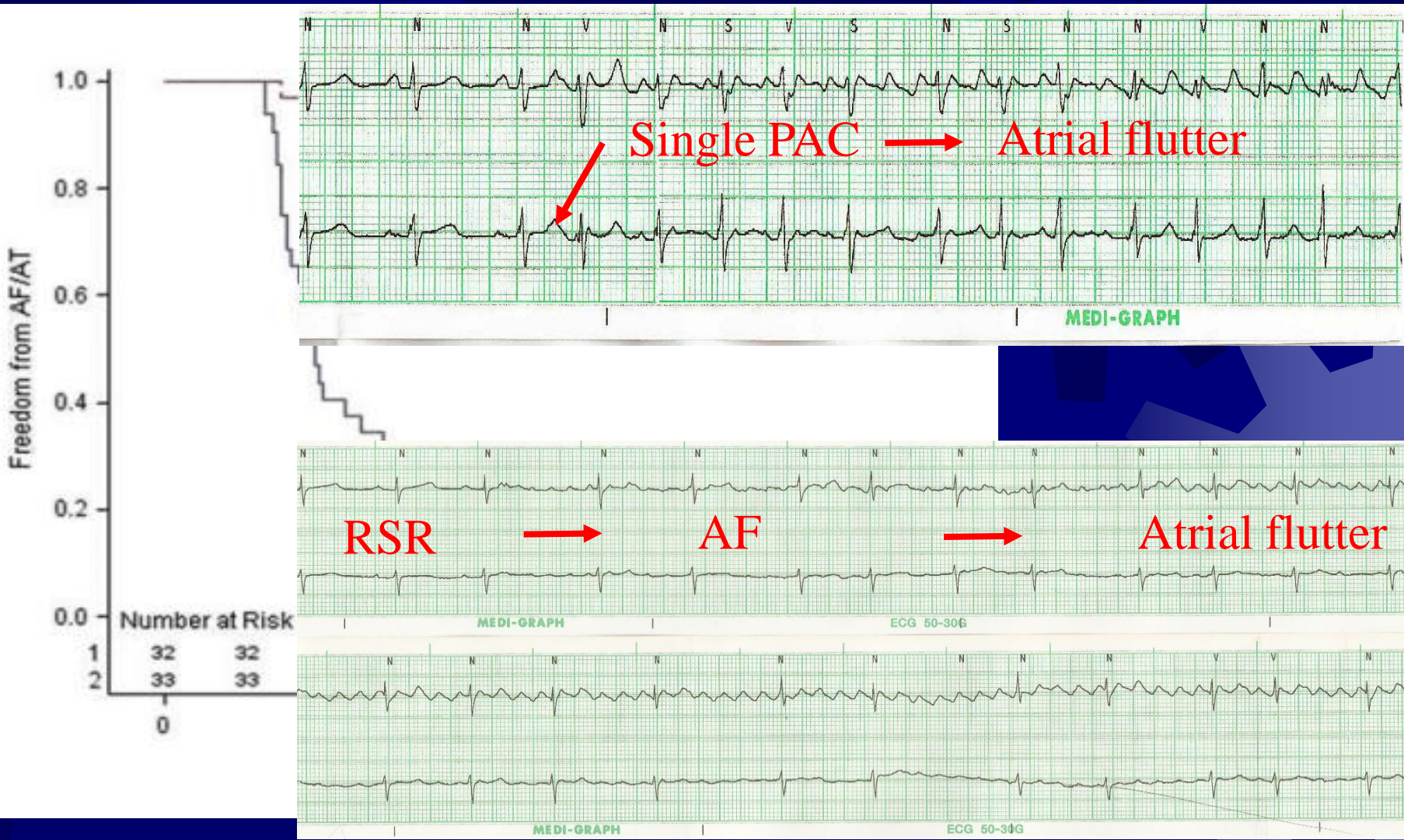
PMI block vs Trigger ablation in perimitral AFL (redo)



Rong Bai, et al. J Cardiovasc Electrophysiol. 2012



PMI block vs Trigger ablation in perimitral AFL (redo)



Rong Bai, et al. *J Cardiovasc Electrophysiol.* 2012





Where and how to ablate?

- Only Linear line is not enough in redo procedure.
- Find non-PV trigger foci



3 Steps for repeat ablation

1. LA-PV reconnection

→ LA-PV reisolation

2. Recurred rhythm is AT or AFL.

→ target ablation

3. Then, find non-PV trigger foci .

→ trigger ablation



Redo ablation data of
Seoul St. Mary's hospital

Baseline characteristics of redo patients

	Redo patients (N=106)
Male	86 (81.1%)
AF type	
Paroxysmal	46 (43.4%)
Persistent	47 (44.4%)
Long standing persistent	13 (12.3%)
Left atrium size (mm)	41.9±12.1
CHADS2-Vasc score	1.5±1.4
0~1	61 (57.5%)
2~4	41 (38.7%)
> 4	4 (3.8%)
Recurred rhythm	
AF	55 (51.9%)
Macro-reentry AT/Flutter	51 (48.1%)



PV reconnection

N=98 (92.5%)

PV reconnection number

2.8 ± 1.3

LSPV

78 (73.6%)

LIPV

73 (68.9%)

RSPV

72 (67.9%)

RIPV

70 (66.0%)



Paroxysmal AF
(n=46)

Persistent AF (n=60)

Recurred rhythm

AF

36 (78.3%)

31 (51.7%)

Macro-reentry
AT/Flutter

10 (21.7%)

29 (48.3%)

Ablation lesion

Posterior wall

15 (32.6%)

31 (51.7%)

Mitral isthmus

10 (21.7%)

23 (38.3%)

LOM

13 (28.3%)

17 (28.3%)

SVC

8 (17.4%)

13 (21.7%)

CTI

13 (28.3%)

21 (35.0%)

CFAE

1 (2.2%)

3 (5.0%)

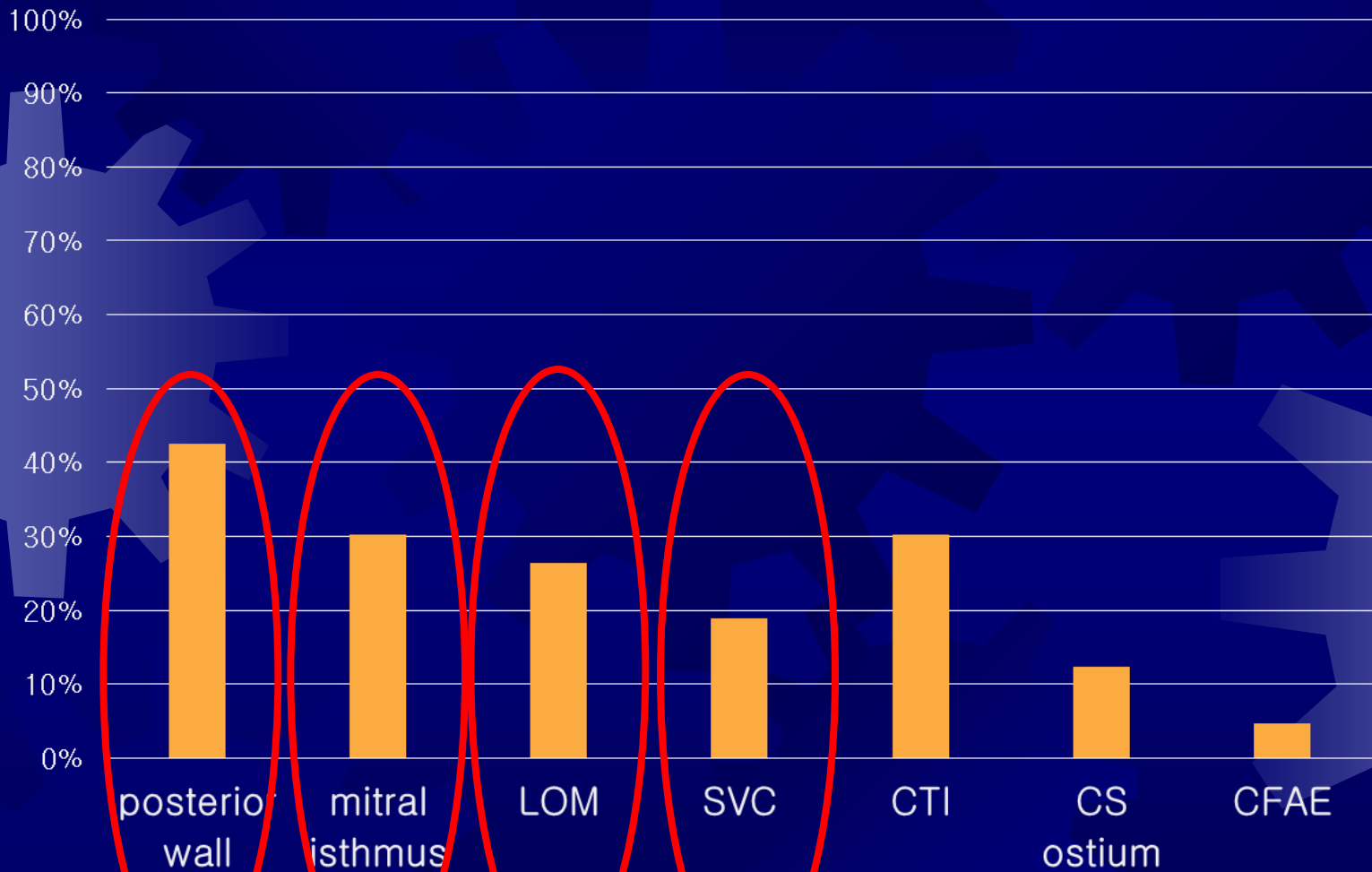




Trigger foci in repeat procedure

- PV only
: N=24 (22.6%)
- PV + non-PV foci
: N=82 (77.4%)

Ablation lesion at redo procedure



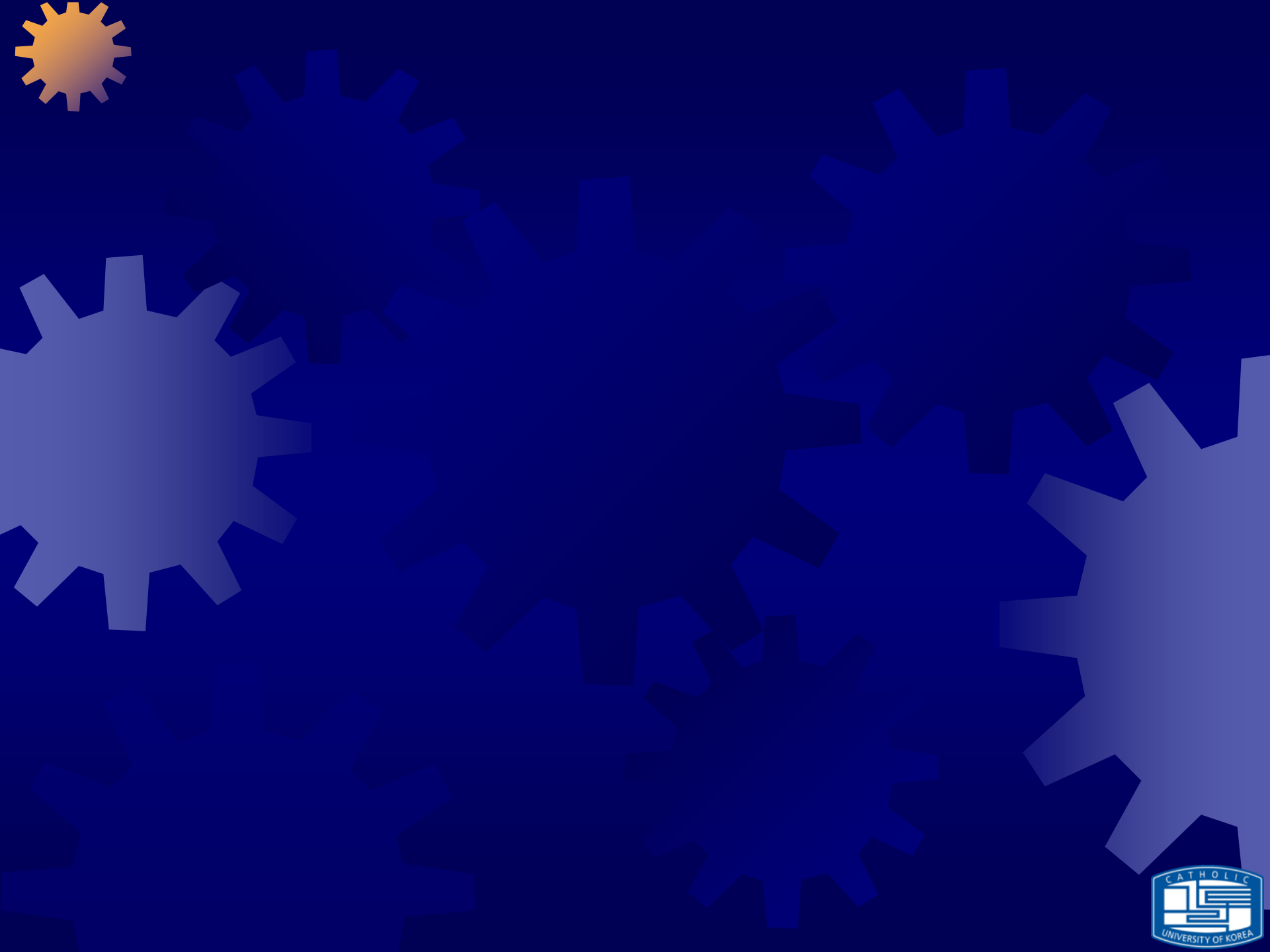


Conclusions

- 1) PV reisoletion is the most important site in AF ablation but only PV is not enough in redo procedure.
- 2) The attempts to identify and eliminate non-PV triggers are important and support the role of multiple repeat procedures for AF recurrence



Thank you for your attention



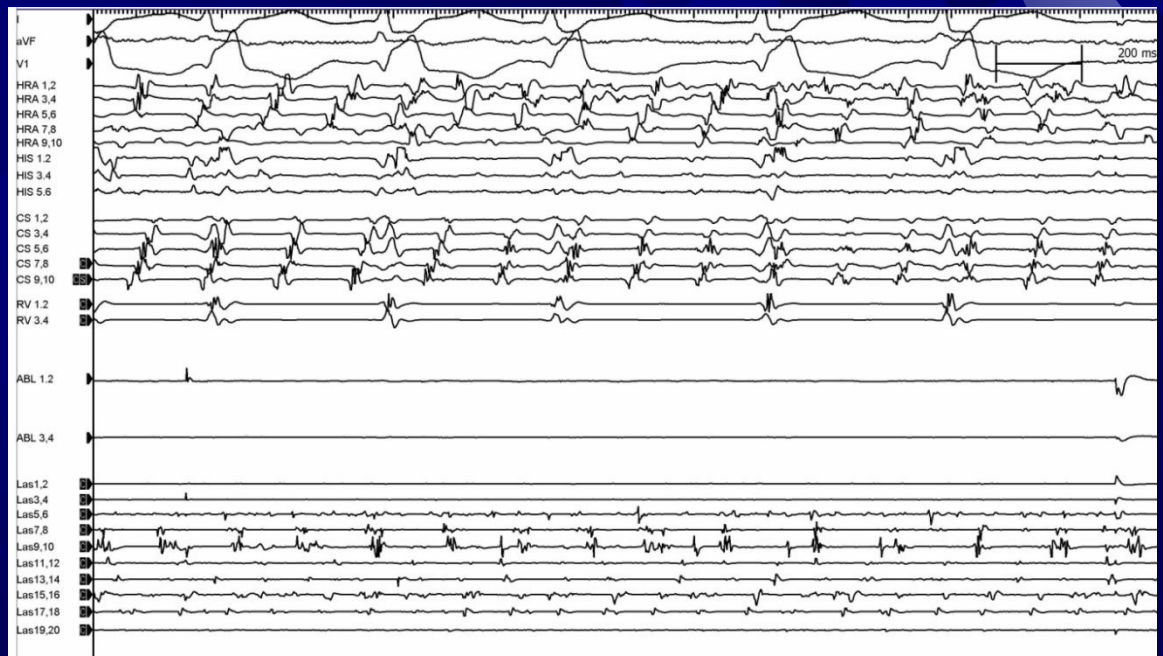
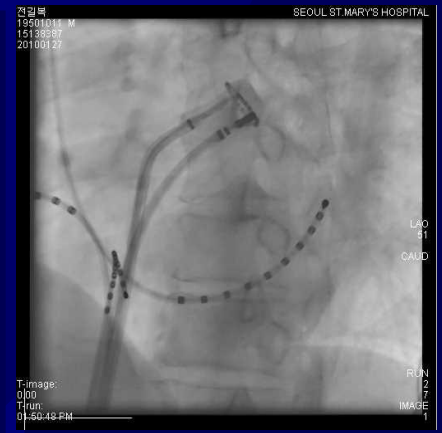
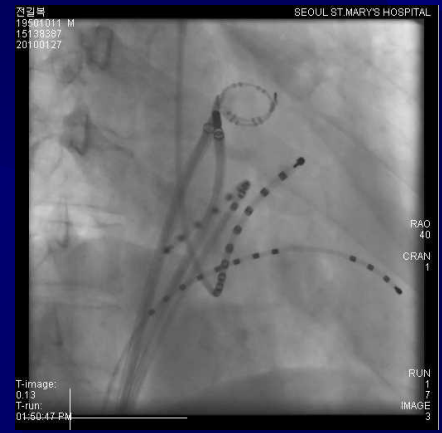
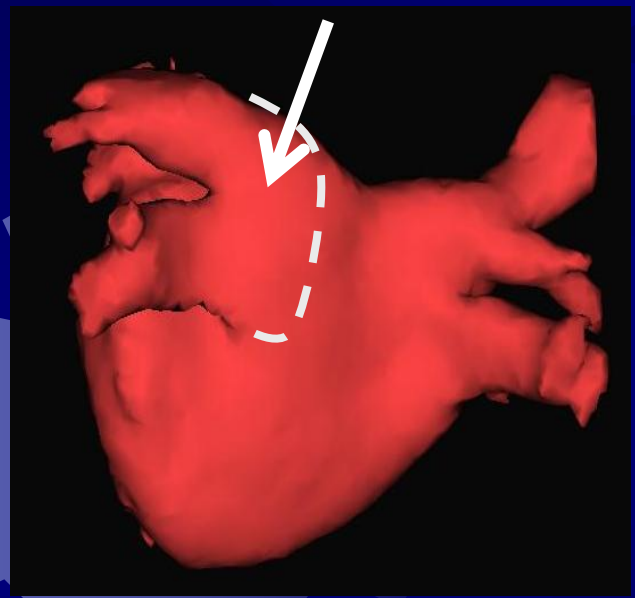


Back up slides

Post wall ablation



Where is the true PV antrum ?

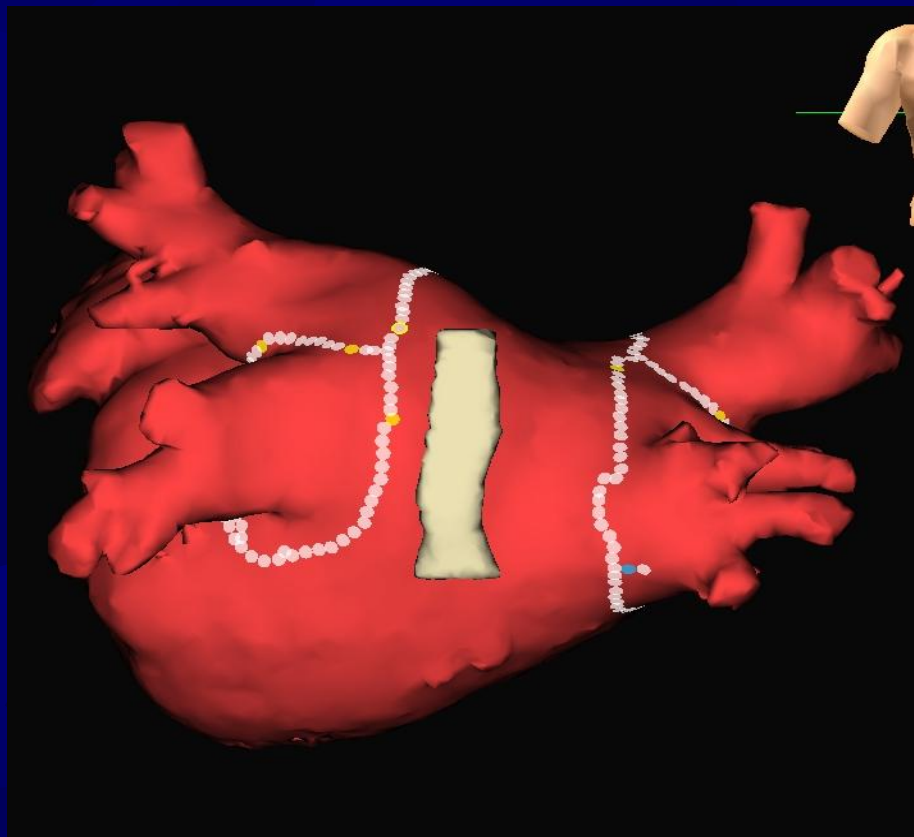
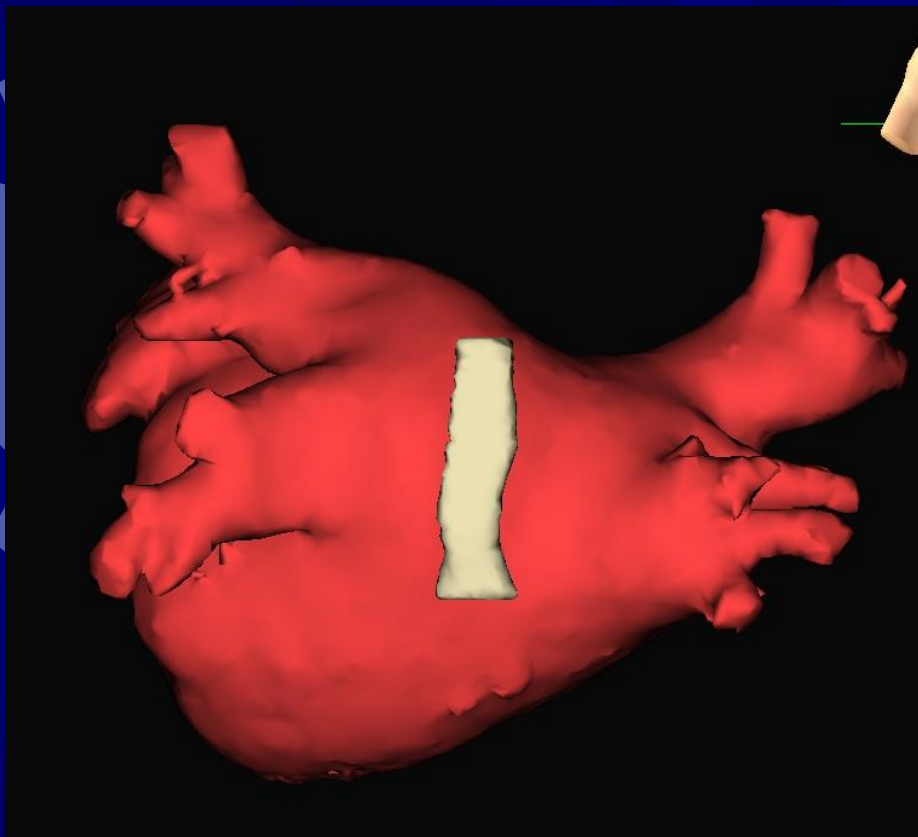


Emphasizing on map potential during Geometry



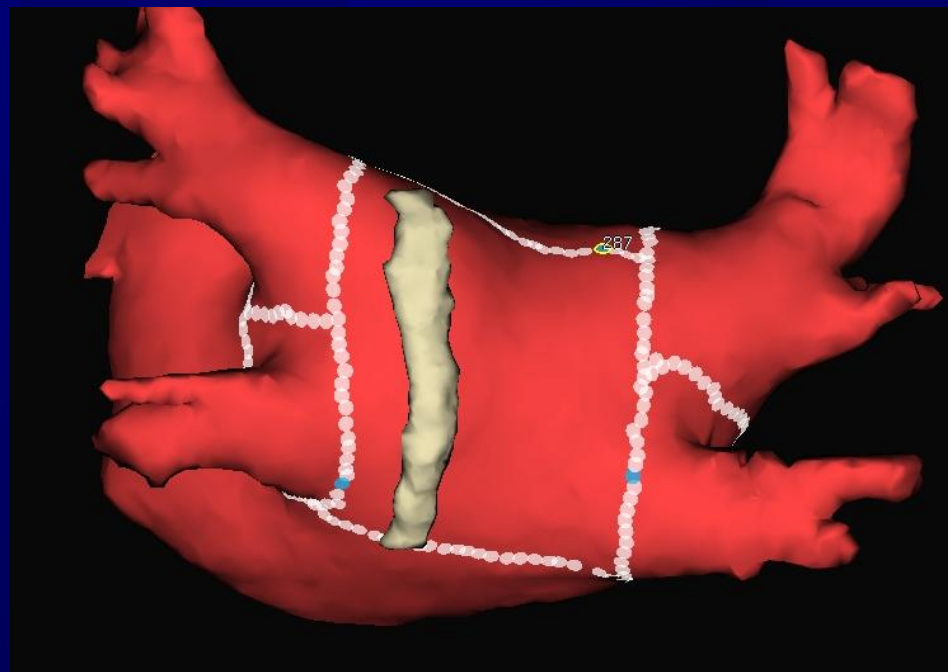
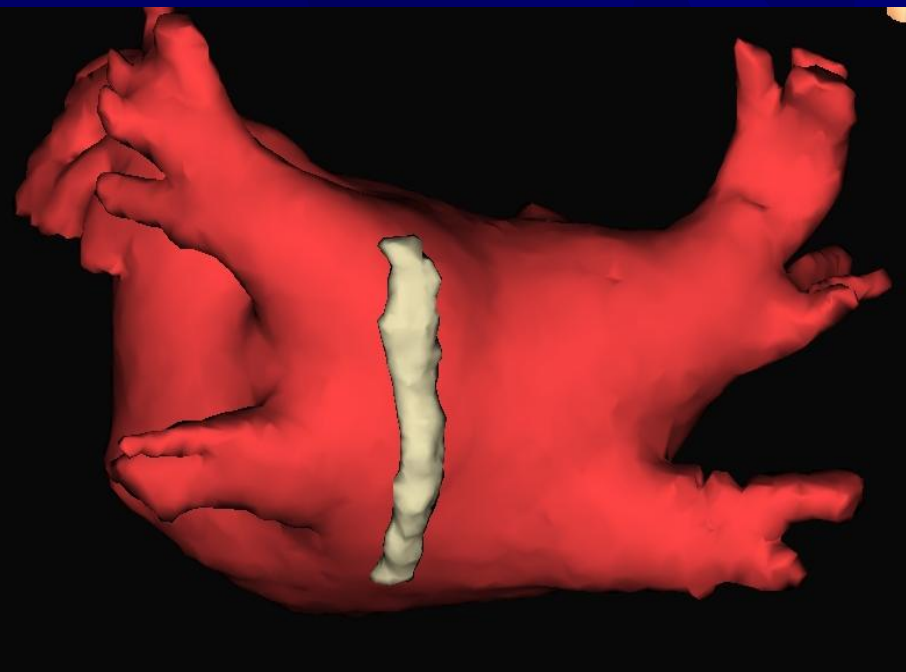


Location of Esophagus





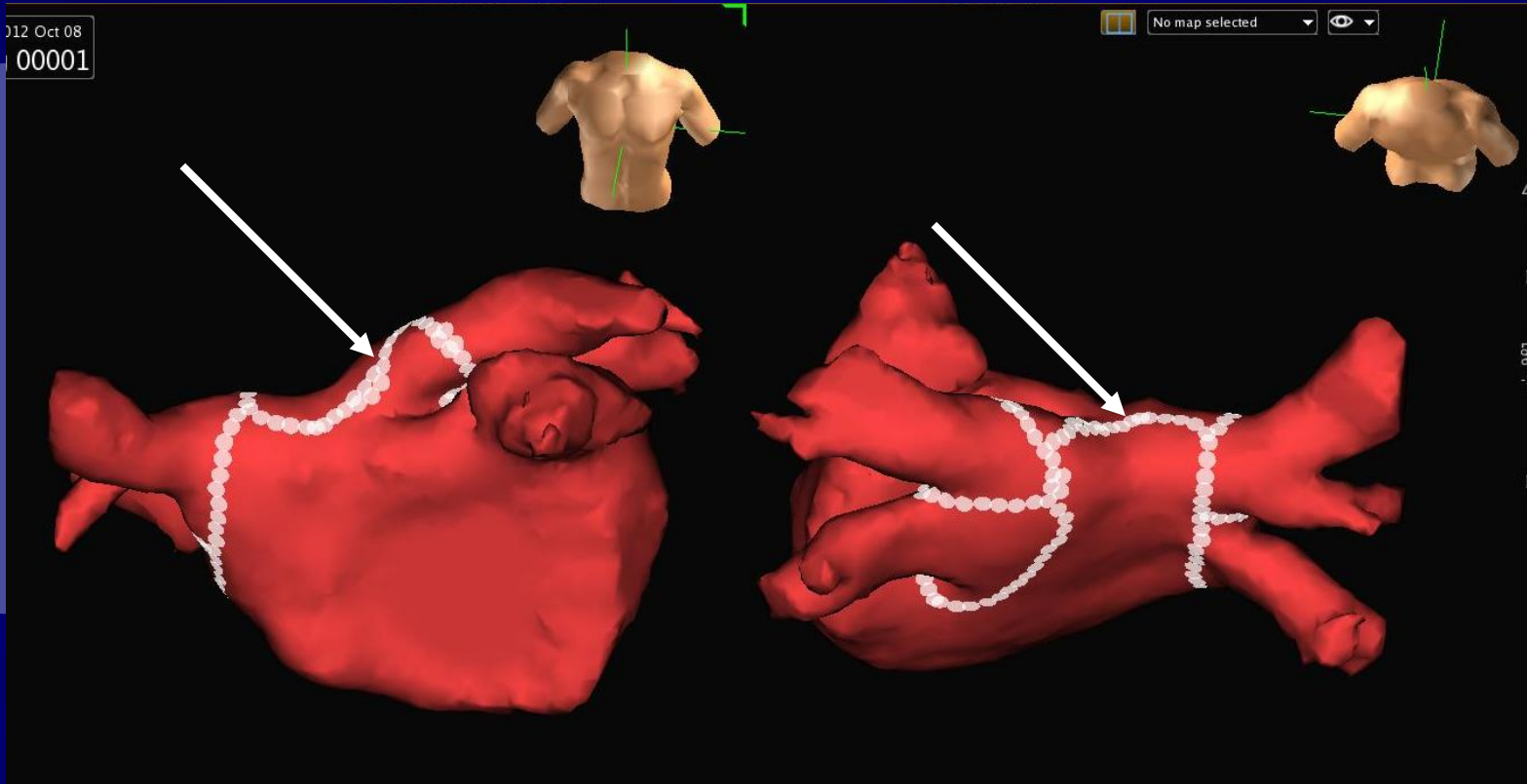
Location of Esophagus





Roof dependent flutter

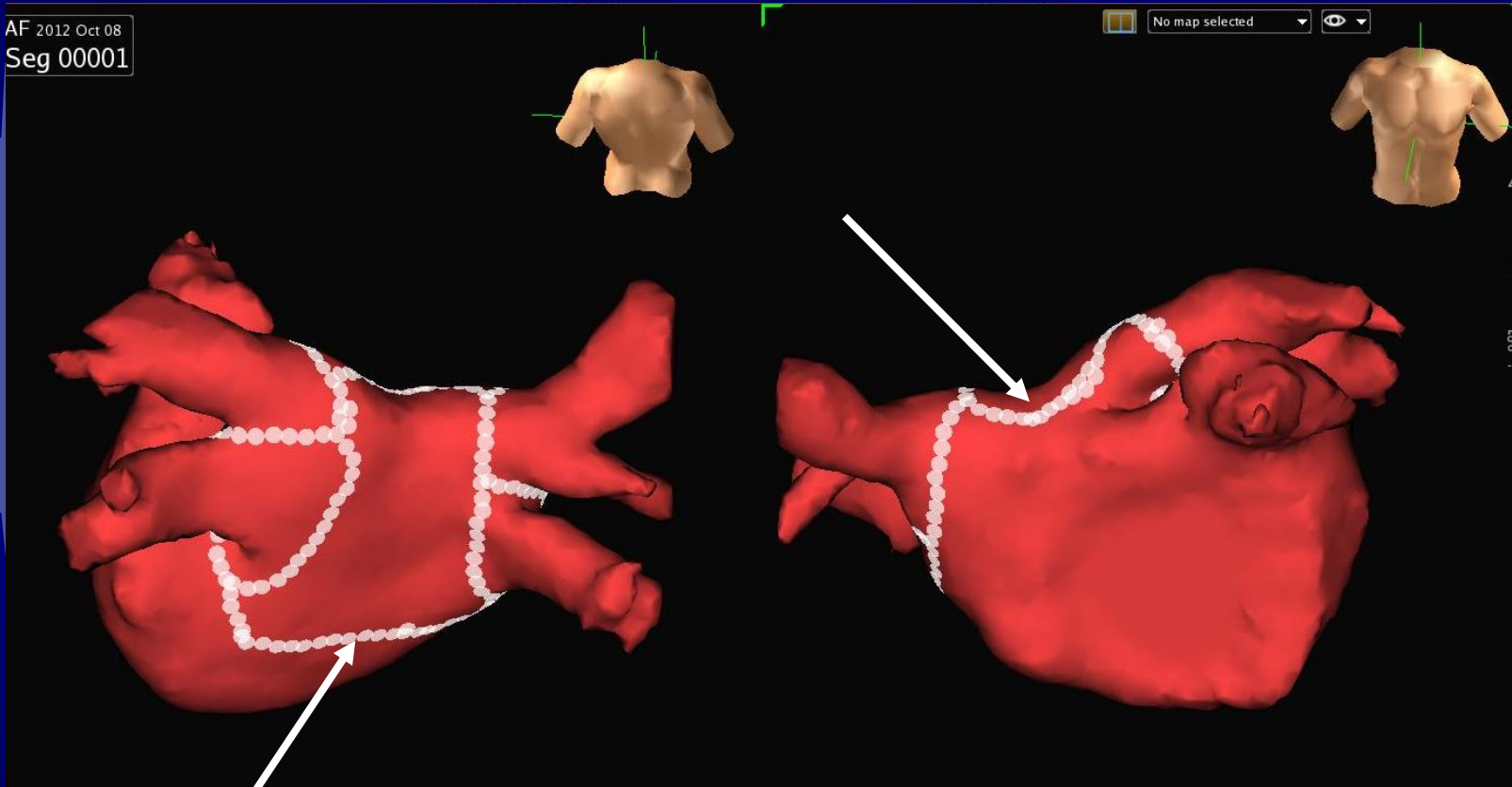
Roof line : termination, BDB



Anterior

Posterior

Roof line + Inferior line



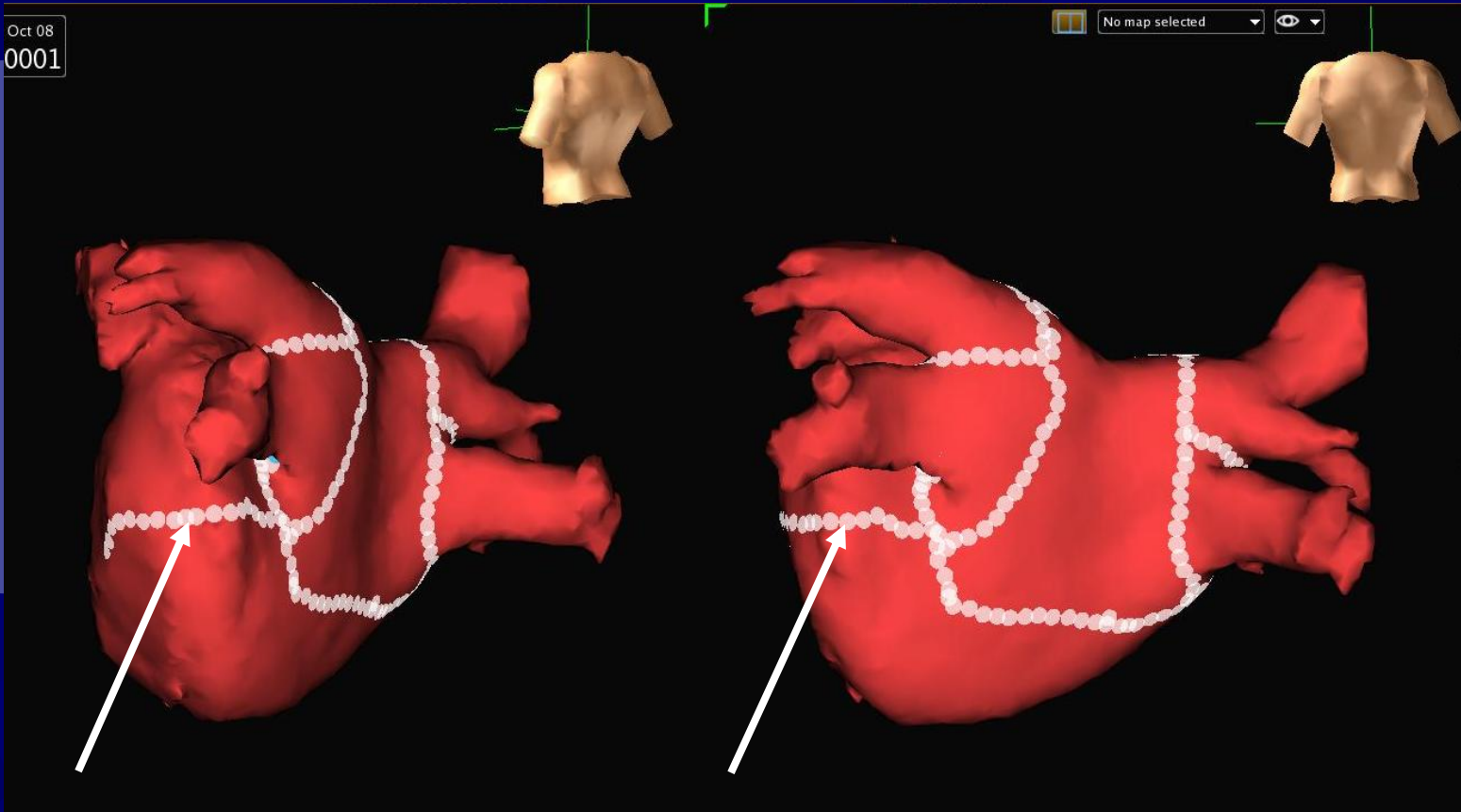
Anterior

Posterior



Perimitral atrial flutter

MVI line : termination, BDB

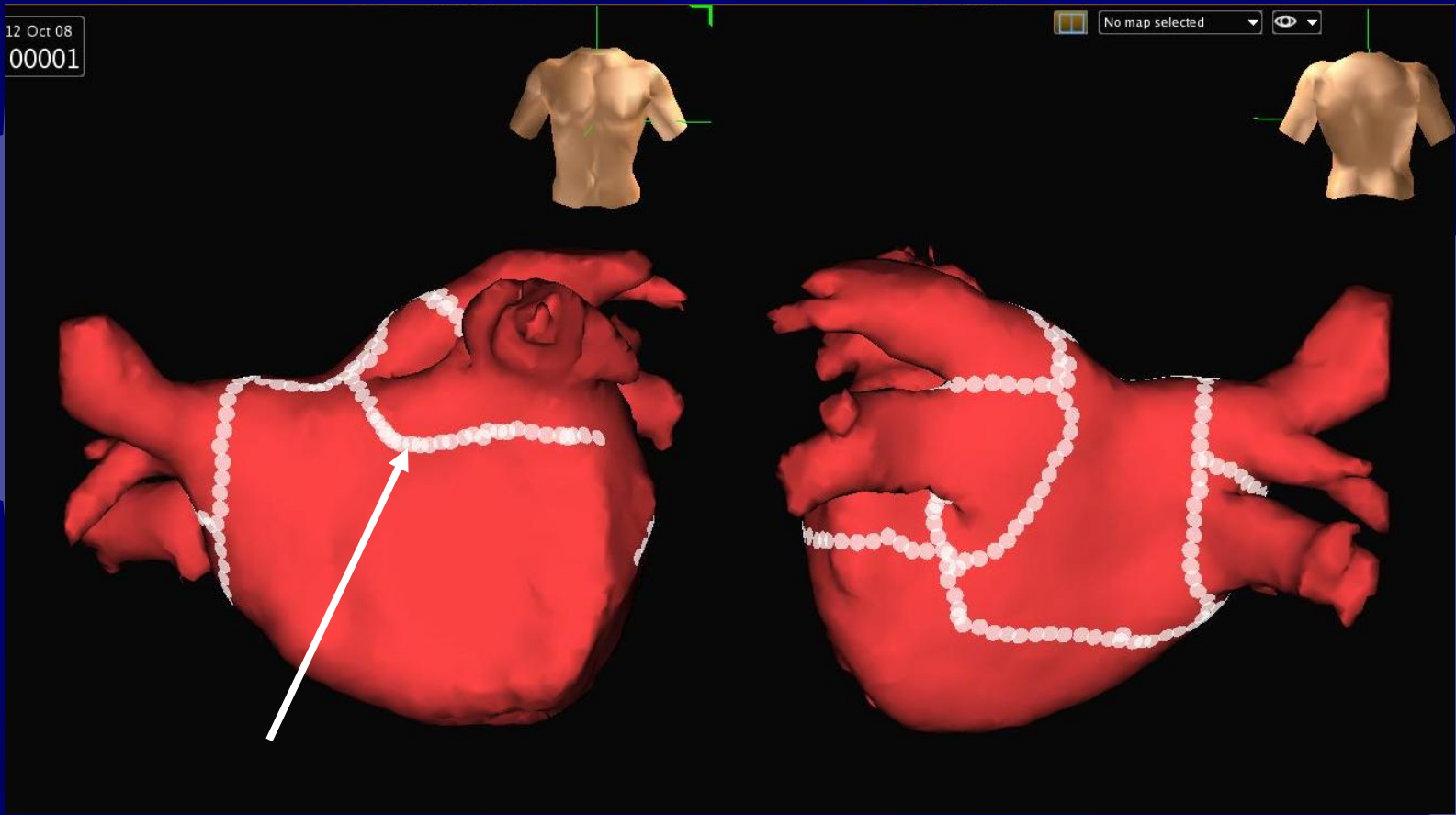


Posterior

Posterior



MVI line + Ant line



Anterior

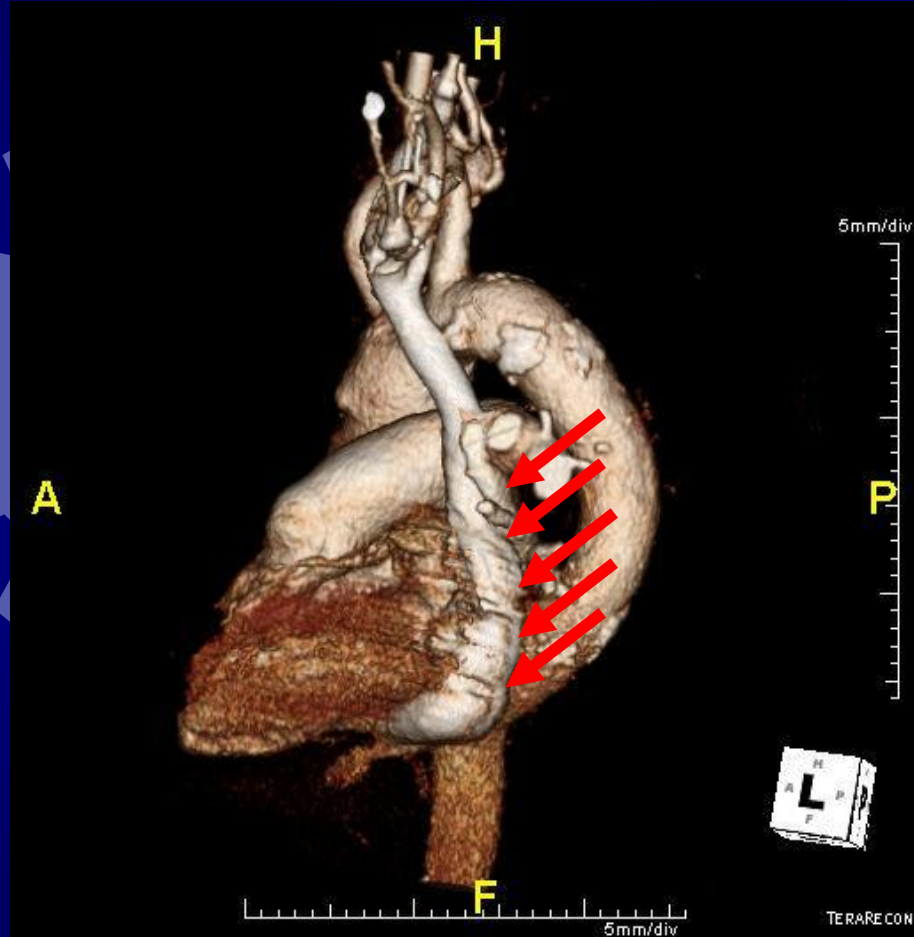
Posterior



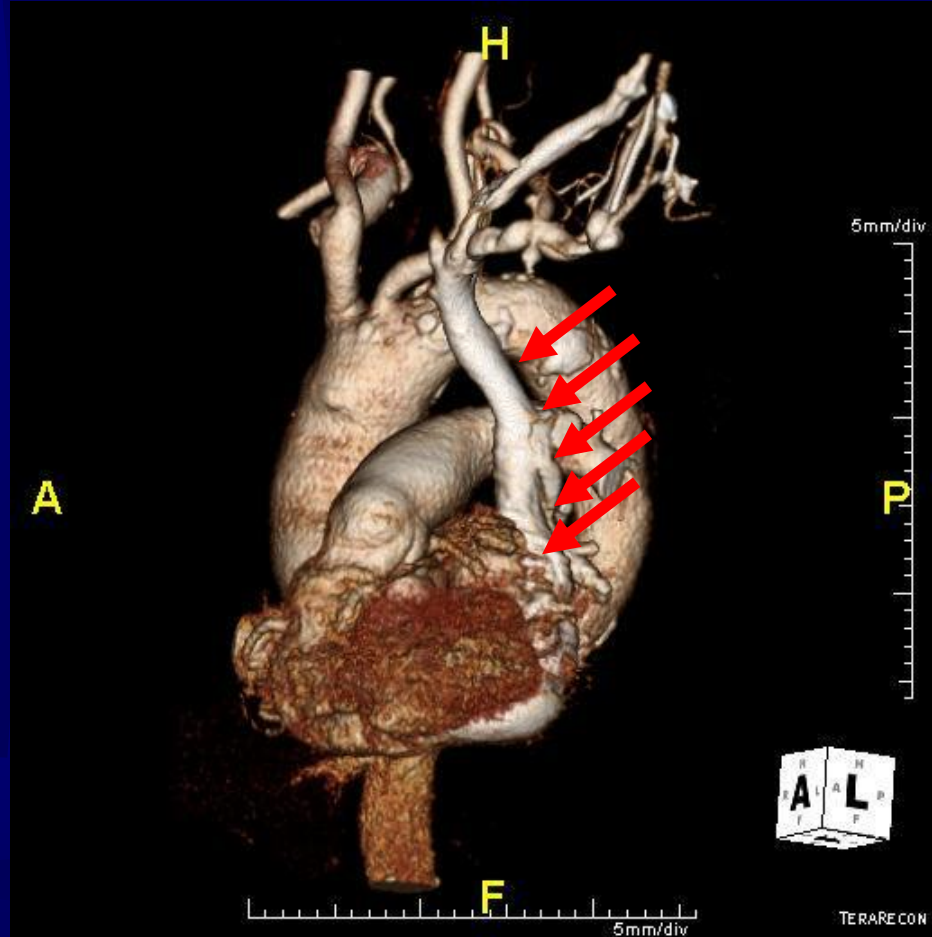
Ligament of Marshall



2. Ligament of Marshall : Persistent Left side SCV

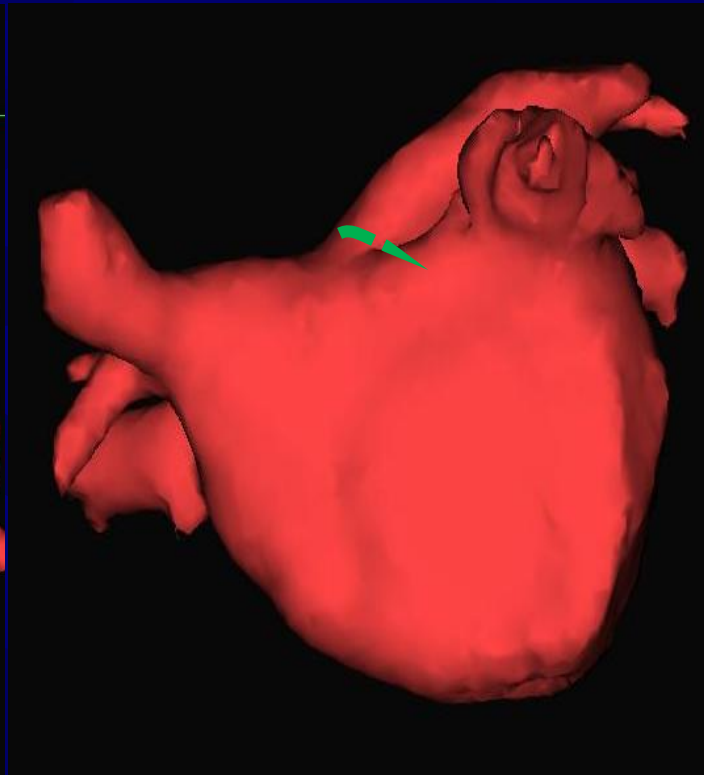
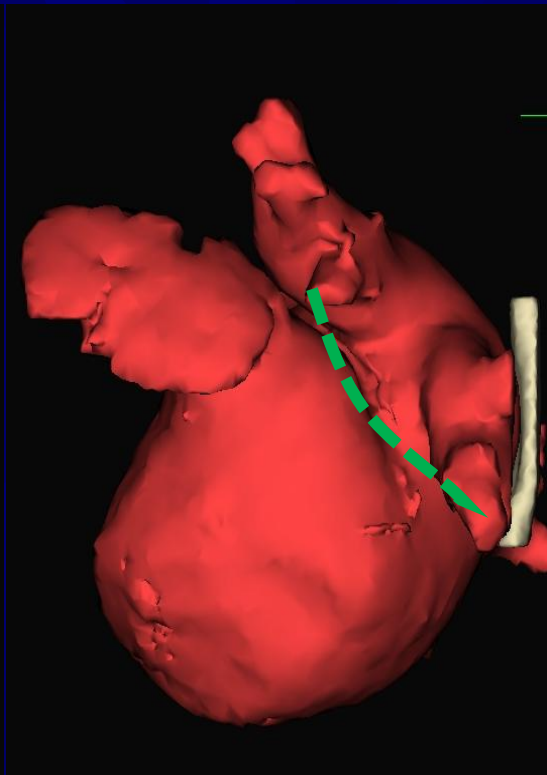
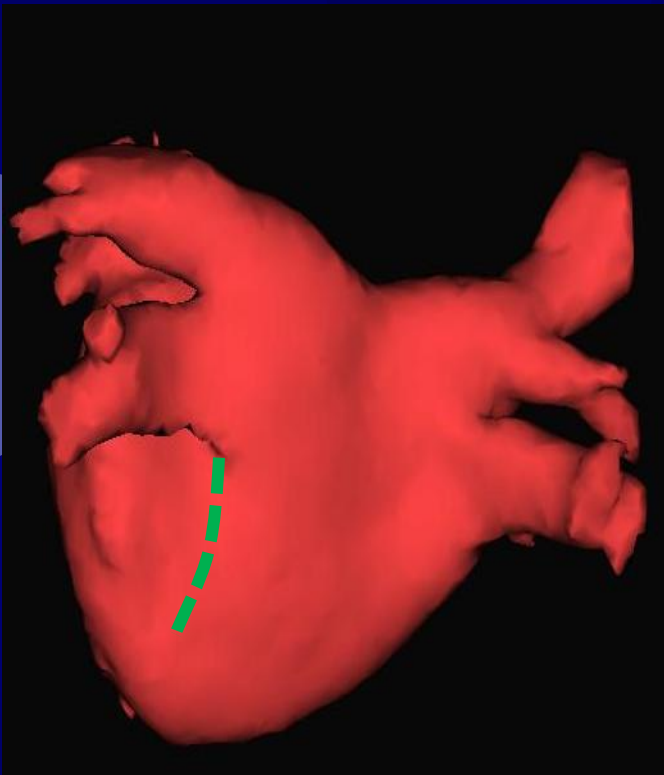


LAT

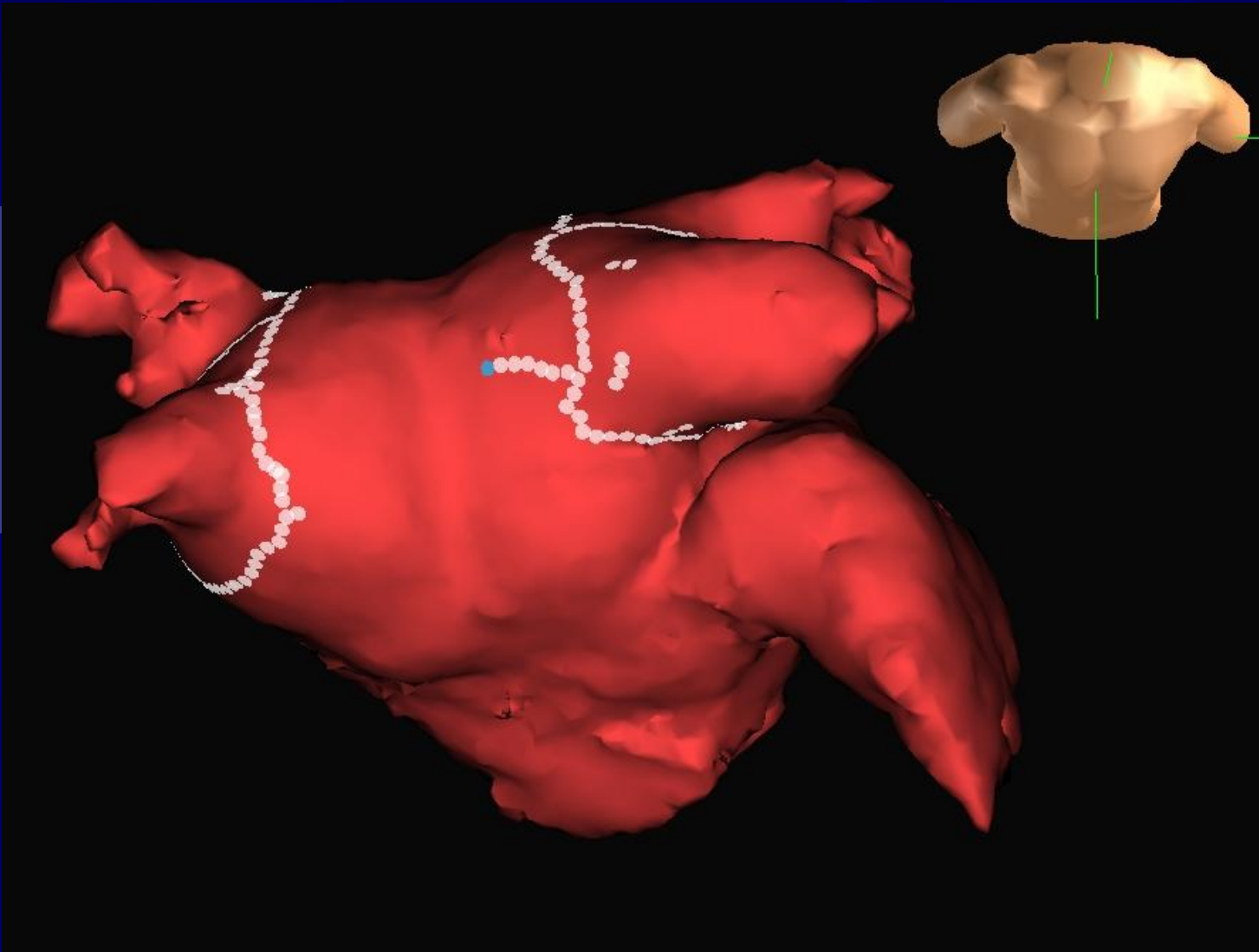


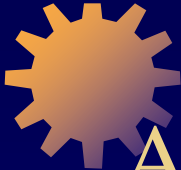
AP

The course of ligament of Marshall



1) Sup remnants of Persistent Left side SCV



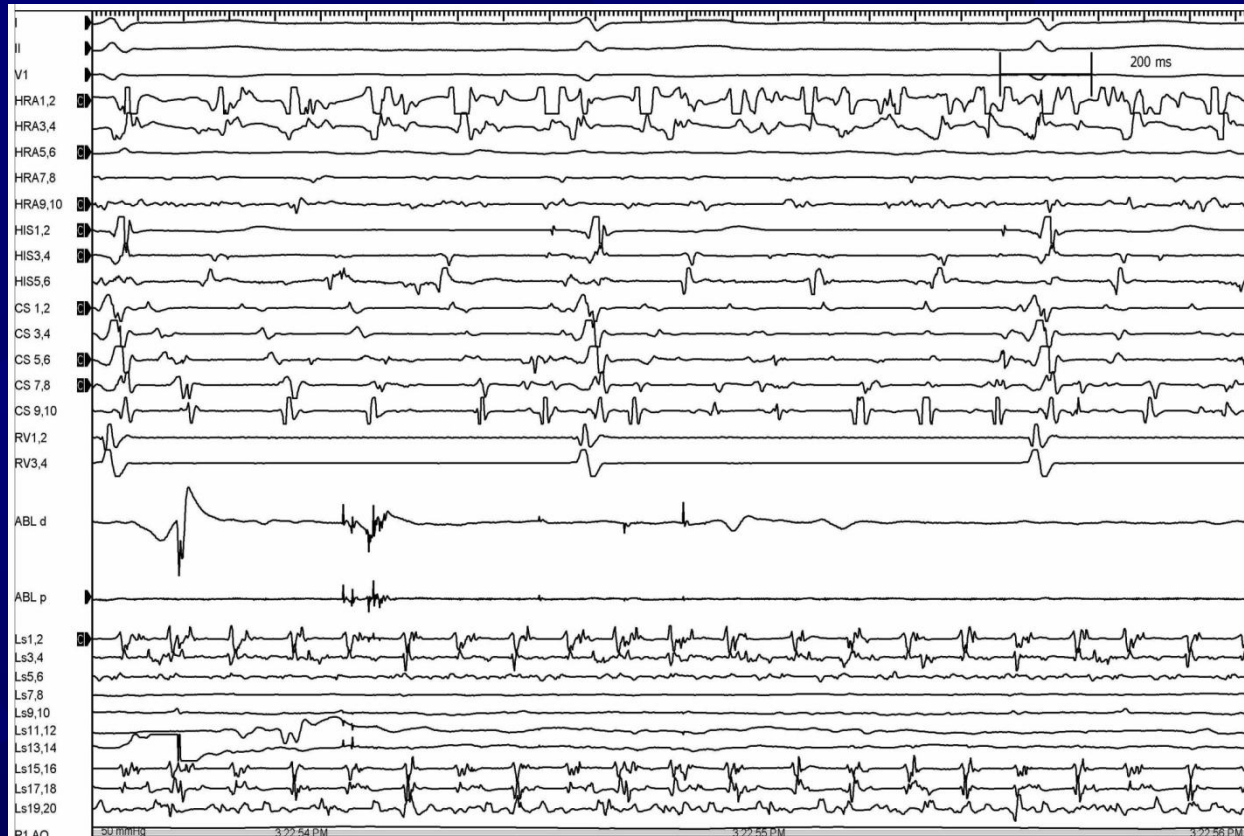
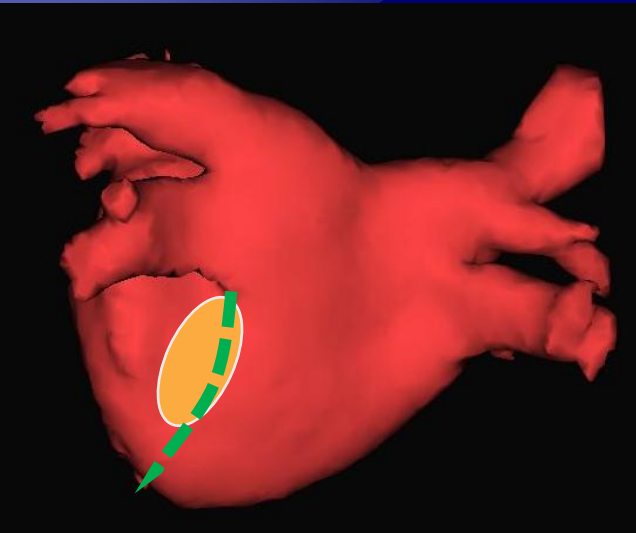


AF termination



2) How to make perimitral block?

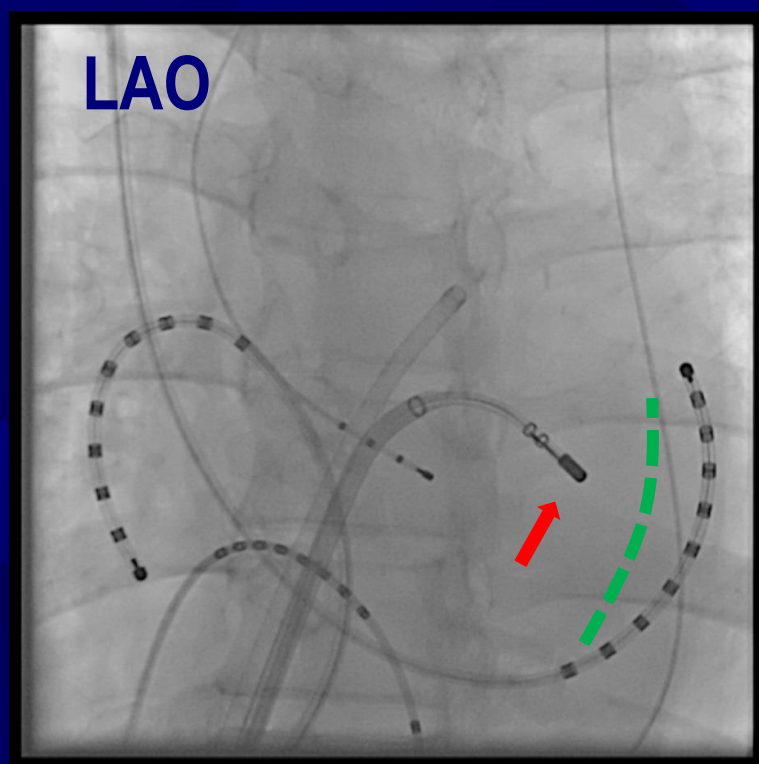
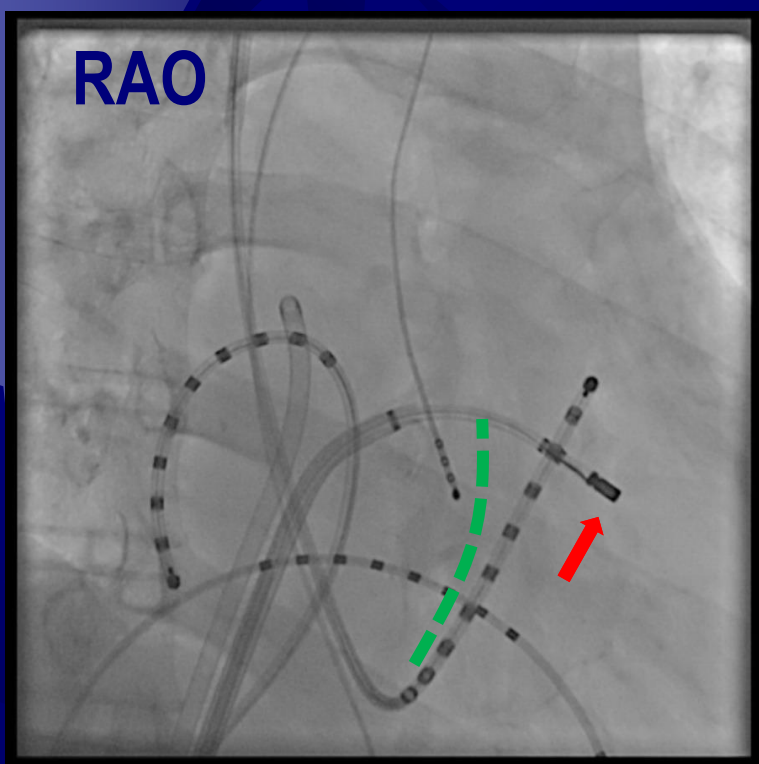
- 1) Mitral valve isthmus line ablation
- 2) Ant line ablation



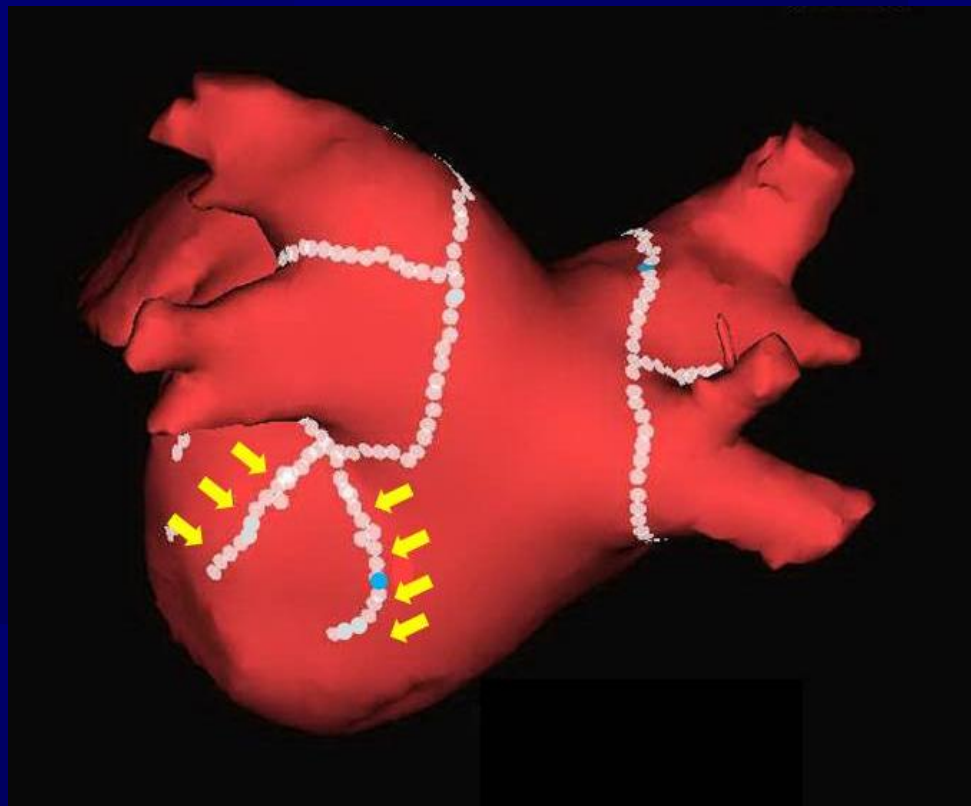
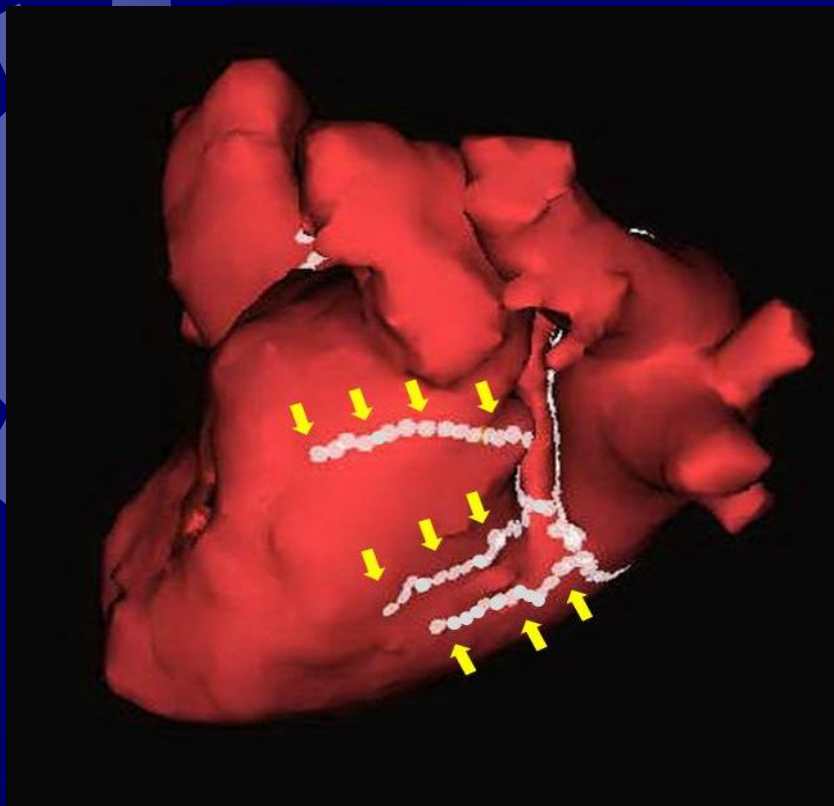


Fluoroscopic-guided ablation

- Patients who had still AF after PV isolation

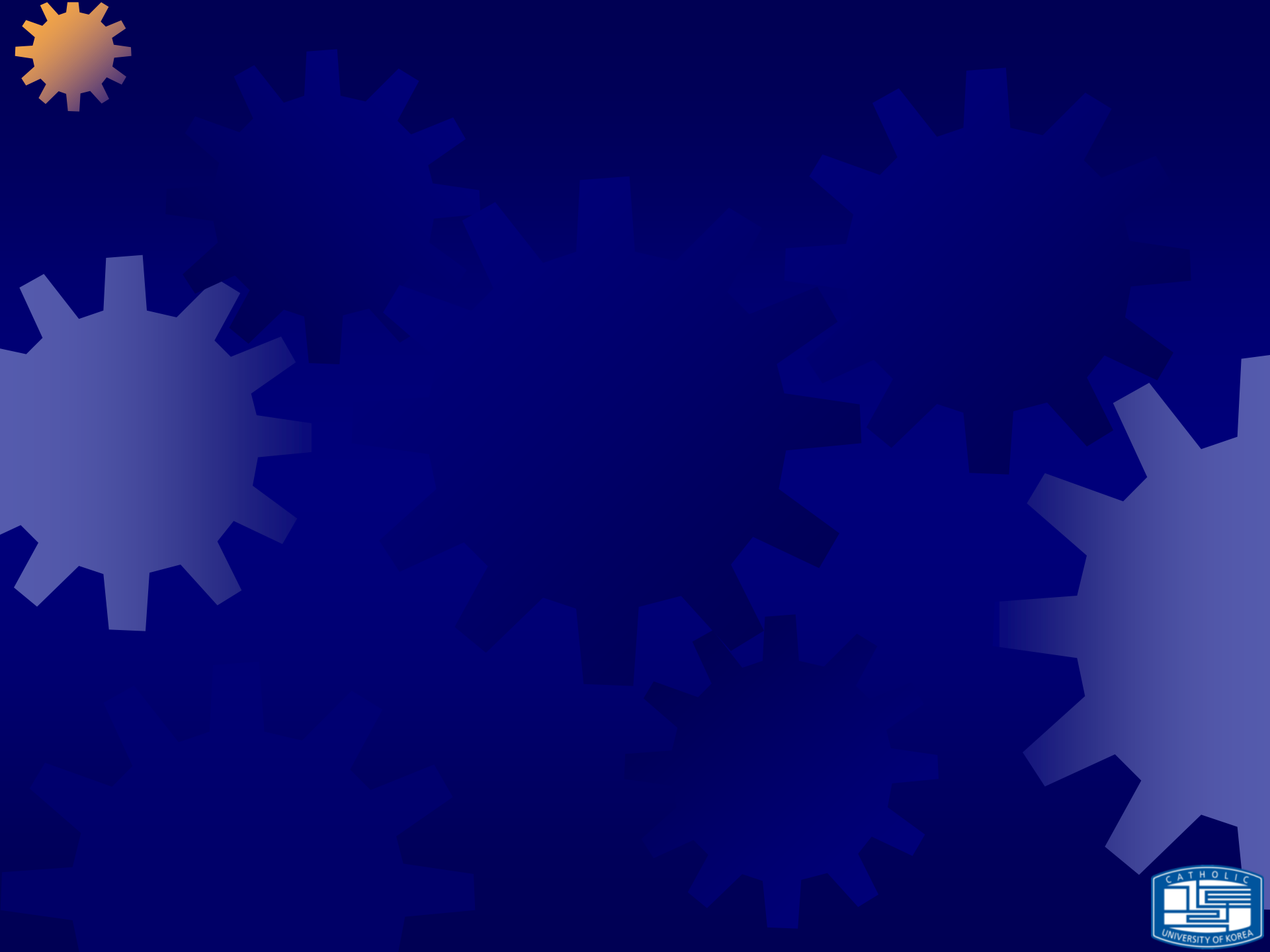


(1) Mitral valve isthmus & LOM ablation



Abrupt AF termination







1. Background

- End points of redo AF ablation

1) PAF : CPVI only

CPVI + non PV foci , additional line, CFE

2) PEAFF : CPVI only

CPVI + non PV foci , additional line, CFE



Steps for repeat ablation

- Basic Rhythm

1) AF :

PV +, \rightarrow PVI \rightarrow AF:-, \rightarrow reinduction \rightarrow AFL, AF
 \rightarrow Non PV foci, linear ablation \rightarrow AF, AFL:-

PV - , \rightarrow Non PV foci \rightarrow AF:-, \rightarrow reinduction
 \rightarrow AFL, AF \rightarrow Non PV foci, linear ablation \rightarrow AF,
AFL:-



2) AFL

PV +, \rightarrow PVI \rightarrow AFL: -, \rightarrow reinduction \rightarrow AF, AFL

\rightarrow non PV foci, linear ablation \rightarrow AF, AFL : -

PV -, \rightarrow linear abl, non PV foci \rightarrow AfL : -, \rightarrow
reinduction \rightarrow AF, AFL \rightarrow non PV foci, linear
ablation \rightarrow AF, AFL : -