EWHA WOMANS UNIVERSITY MEDICAL CENTER

Atrial tachycardias post AF ablation

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RT, CEPS

2023 KHRS

EUMC MOKDONG

CONTENTS

Incidence

✔ **Catheter ablation is a representative treatment** for paroxysmal AF as well as persistent AF and longstanding AF that are unresponsive to medication and have a high rate of recurrence.

✔ Unfortunately, Atrial tachycardia occurring after AF ablation is **often symptomatic complex and poorly controlled** by anti-arrhythmia drugs.

Incidence

Journal of the American College of Cardiology
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ISSN 0735-1097/07/$32.00
doi:10.1016/j.jacc.2007.07.044

Heart Rhythm Disorders

Atrial Tachycardia After Circumferential Pulmonary Vein Ablation of Atrial Fibrillation

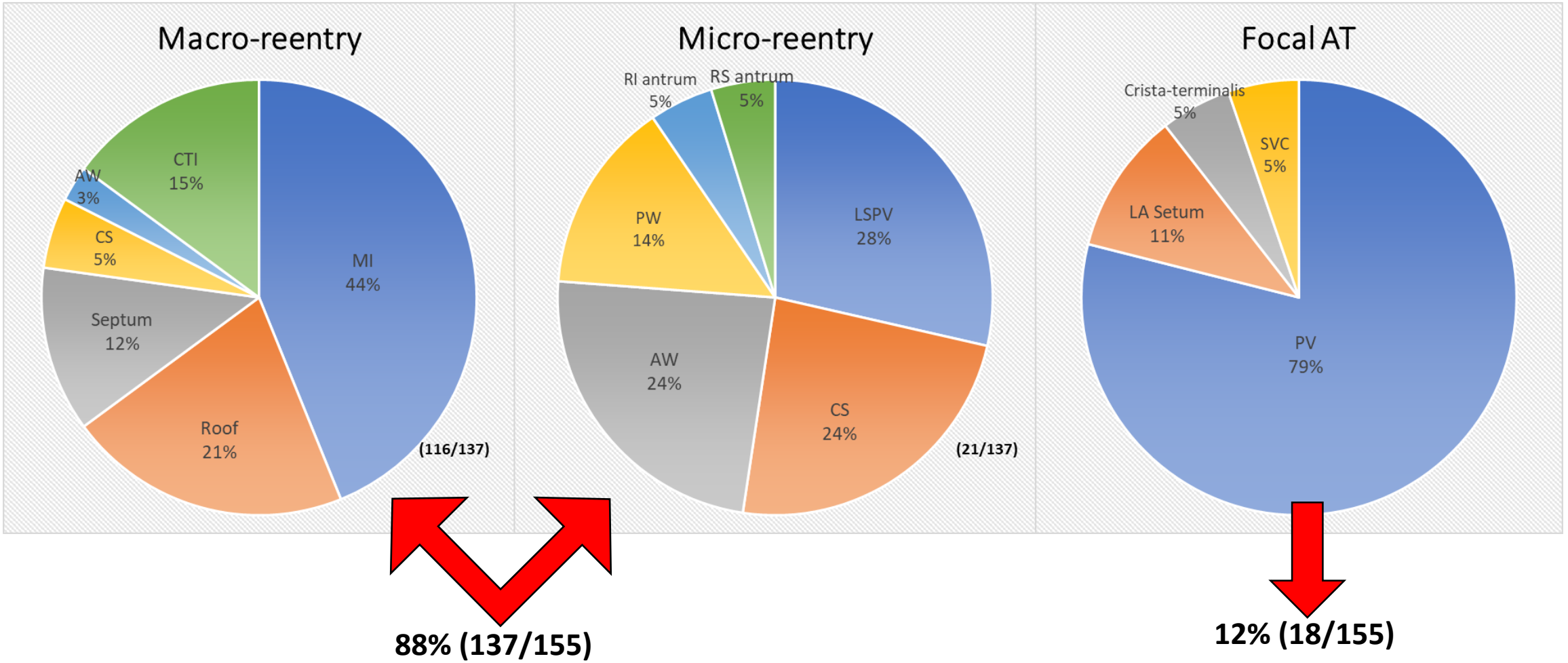
Mechanistic Insights, Results of Catheter

A total of 155 ATs were mapped, and the mechanism was re-entry in 137 (88%) and focal in 18 (12%). The most common left atrial (LA) ablation targets were the mitral isthmus, roof, and septum. The critical isthmus in 115 of the 120 LA re-entrant ATs (96%) traversed a prior ablation line, consistent with a gap-related mechanism. Catheter ablation was successful in 66 of the 78 patients (85%). After a mean follow-up of 13 ± 10 months, 60 of the 78 patients (77%) were free of AT/AF without antiarrhythmic medications. Re-entrant septal AT was associated with recurrence (odds ratio 7.3; 95% confidence interval 1.5 to 36; p = 0.02), whereas PV isolation during the AT procedure was associated with a favorable outcome (odds ratio 0.17; 95% confidence interval 0.04 to 0.81; p = 0.03).

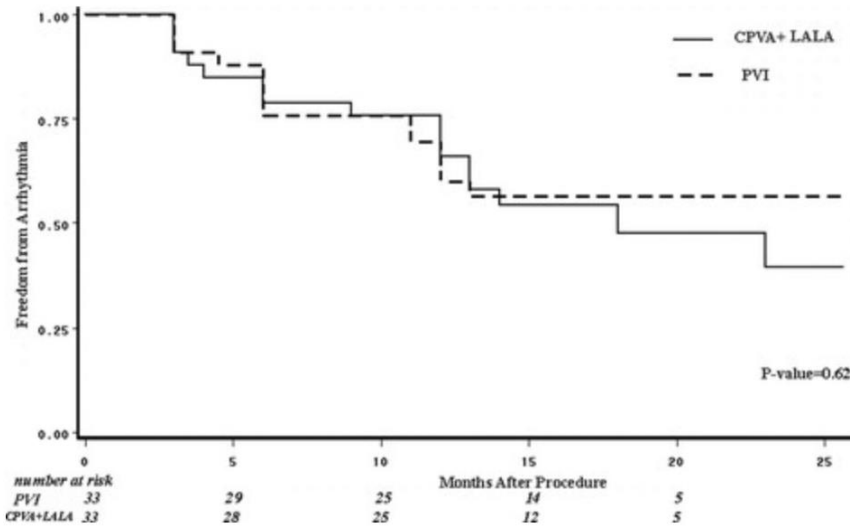
Approximately 90% of ATs after CPVA are re-entrant, and nearly all are related to gaps in prior ablation lines. These findings suggest that the prevalence of these arrhythmias may be reduced by limiting the number of linear lesions, demonstration of linear block, and pulmonary vein disconnection during the initial AF procedure. (J Am Coll Cardiol 2007;50:1781–7) © 2007 by the American College of Cardiology Foundation

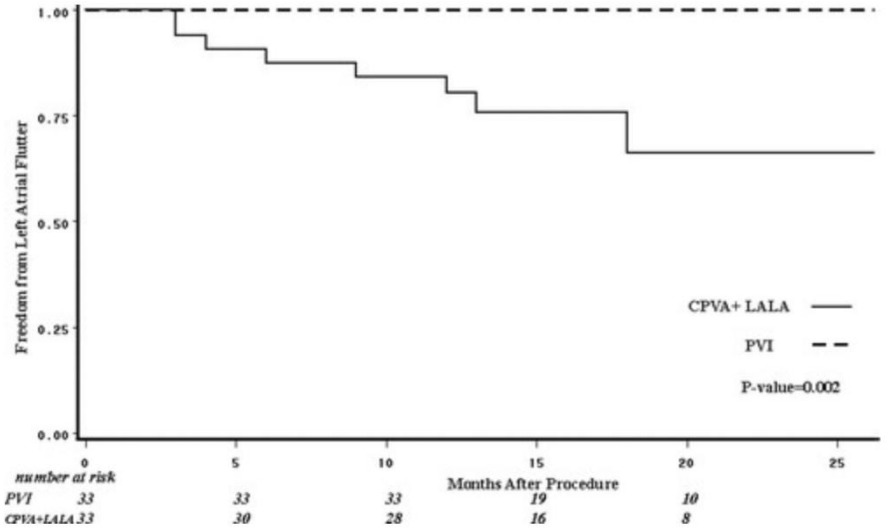
These findings suggest that the prevalence of these arrhythmias may be reduced by limiting the number of linear lesions, demonstration of linear block, and pulmonary vein disconnection during the initial AF procedure. (J Am Coll Cardiol 2007;50:1781–7) © 2007 by the American College of Cardiology Foundation

Incidence


Macro-reentry
MI 44%
Roof 21%
Septum 12%
CS 5%
AW 3%
CTI 15%
(116/137)
Micro-reentry
LSPV 28%
CS 24%
AW 24%
PW 14%
RI antrum 5%
RS antrum 5%
(21/137)
Focal AT
PV 79%
LA Setum 11%
Crista-terminalis 5%
SVC 5%
88% (137/155)
12% (18/155)

Incidence



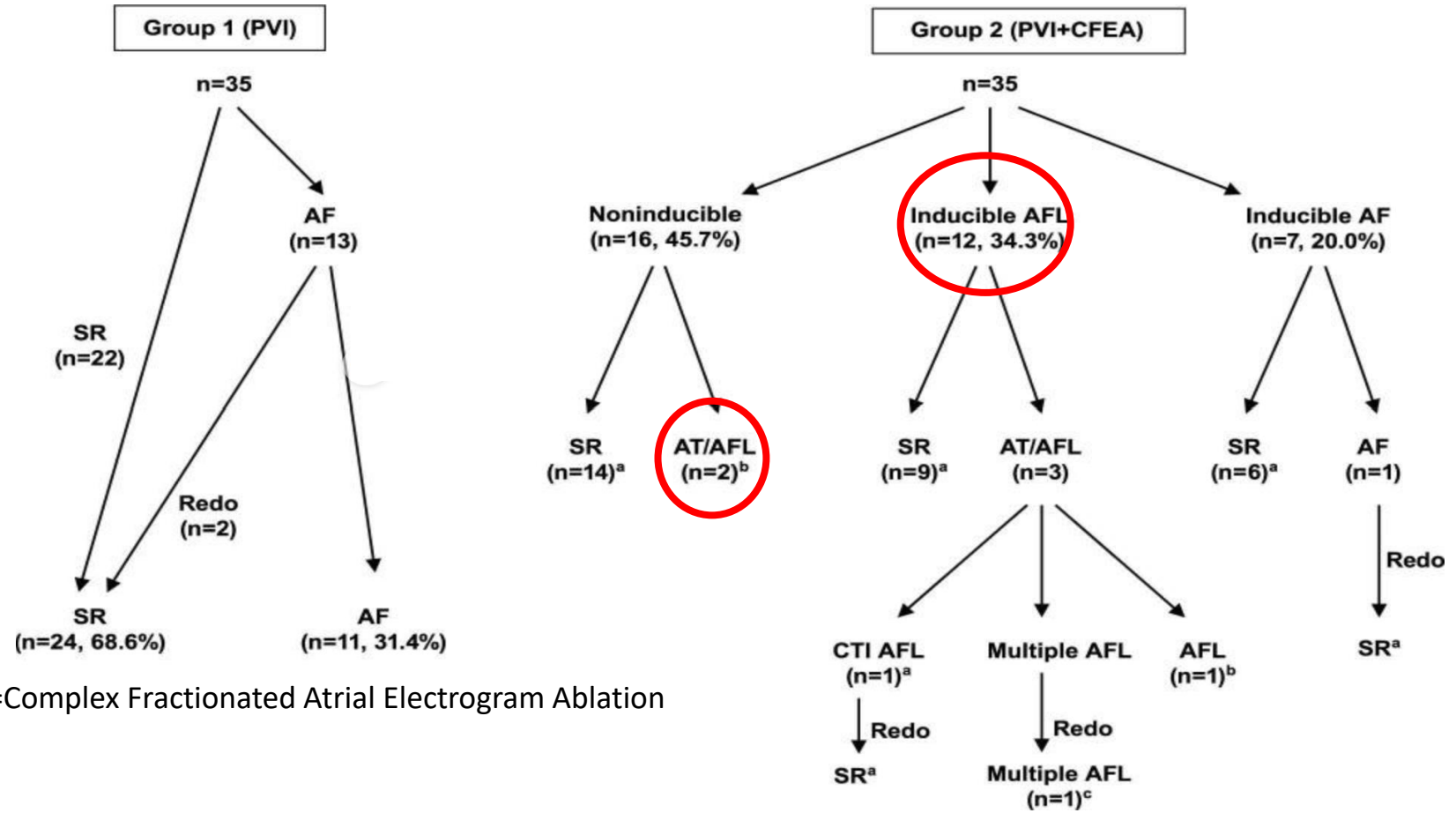


*PVI=Pulmonary vein isolation.
*LALA=Roof line and Mitral isthmus line.

✔ The majority of the AFL that occur after linear ablation was **due to gaps in the prior ablation lines.**

Circulation: Arrhythmia and Electrophysiology. 2010;3:243–248

Incidence



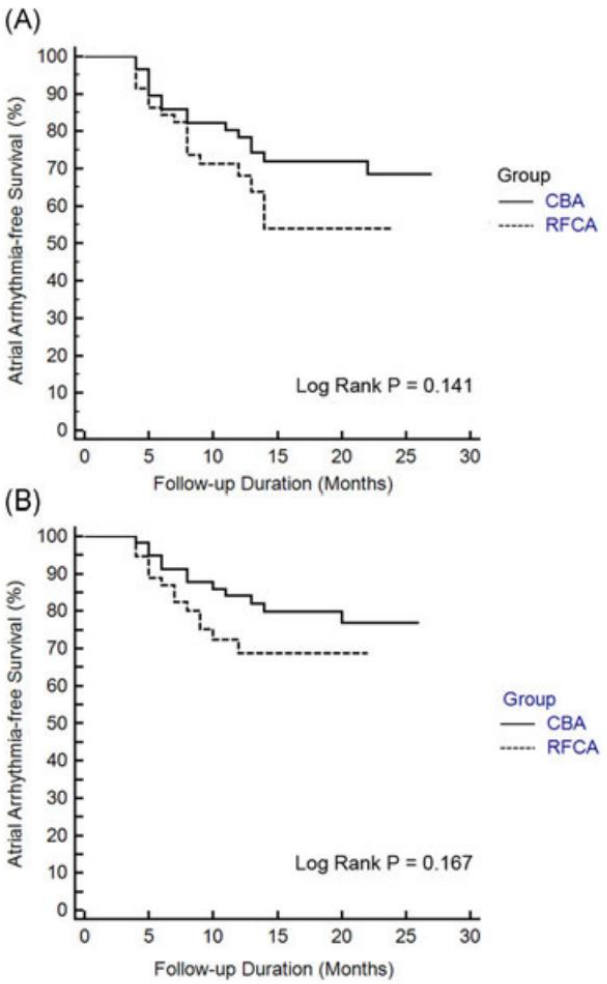
*CFEA=Complex Fractionated Atrial Electrogram Ablation

✔ It is possible that **atrial tachycardia** are created in regions where there are **clusters of noncontiguous ablation lesions**.

Tex Heart Inst J 2012;39(3):372-9)

Circulation. 2007;115:2606–2612

Incidence



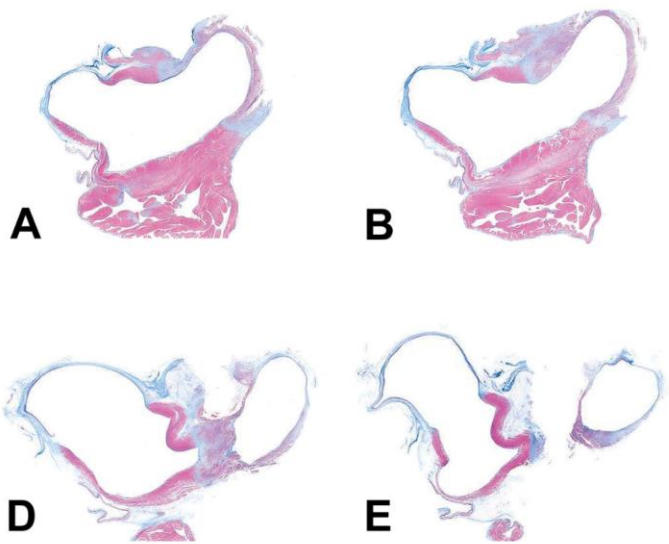
*Characteristics of LA substrate and recurrent patterns of atrial arrhythmia in patients receiving repeat ablation procedure

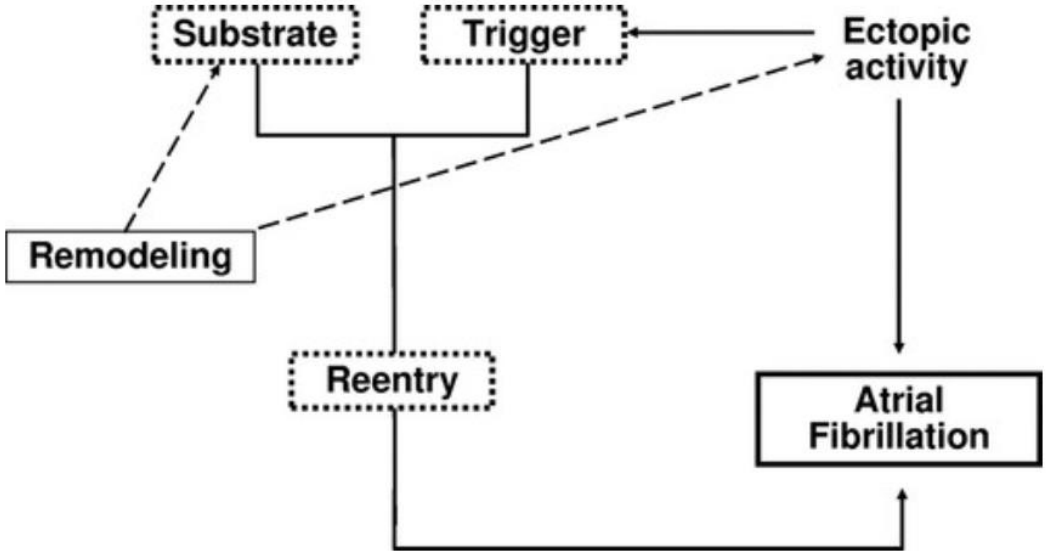
	CBA group, *n* = 11	RFCA group, *n* = 16	*P* value
Mean LA voltage, mV, first procedure	1.4 ± 0.02	1.7 ± 0.43	NS
Mean LA voltage, mV, second procedure	0.6 ± 0.26	1.2 ± 0.45	0.027
Comparison of mean LA voltage between two procedures	*P* = 0.042	*P* = 0.037	–
LA scar area, second procedure, cm^2	19.4 ± 9	7.3 ± 7	0.01
PV reconnection, second procedure, *n* (%)	9 (81.8)	15 (93.8)	NS
Distributions of reconnected PVLSPV, *n* (%)	5 (45.5)	12 (75)	NS
LIPV, *n* (%)	3 (27.3)	7 (43.8)	–
RSPV, *n* (%)	6 (54.5)	11 (68.8)	–
RIPV, *n* (%)	7 (63.6)	12 (75)	–
Non-PV trigger, second procedure, *n* (%)	7 (63.6)	2 (12.5)	0.009
Distributions of non-PV trigger VOM, *n* (%)	3 (27.3)	2 (12.5)	NS
SVC, *n* (%)	3 (27.3)	1 (6.3)	–
CS ostium, *n* (%)	3 (27.3)	0 (0)	–
LA flutter, *n* (%)	6 (54.5)	2 (12.5)	0.027
Distributions of LA flutter roof flutter, *n* (%)	3 (27.3)	0 (0)	NS
Perimitral flutter, *n* (%)	5 (45.5)	2 (12.5)	–
Septal flutter, *n* (%)	1 (9)	0 (0)	–

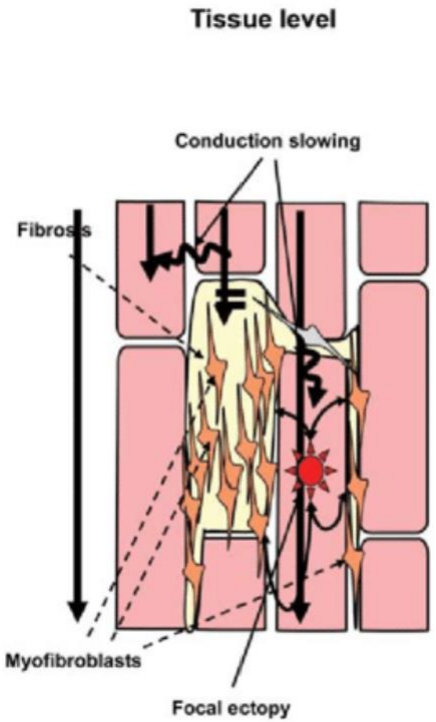
✔ CBA would result in more myocardial injury and transmural lesions than RFCA.
Therefore, **CBA may cause progression of a proarrhythmic substrate in the atrial.**

J Cardiovasc Electrophysiology. 2019;30:16-24.

Classification & Mechanism



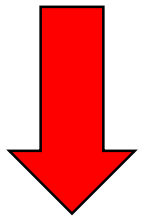




Toxicologic PathologyVolume 47, Issue 3, April 2019, Pages 311-328
Circulation: Arrhythmia and Electrophysiology. 2008;1:62–73
European Heart Journal 33(15):1870-7

Classification & Mechanism

- ✔ **Gaps after PV isolation**
- ✔ **Extensive LA ablation (Extensive PV ablation, linear ablation, CAFÉ ablation, Other substrate ablation, broad scar area..)**



When damaged tissue heals, healthy and scar tissue form inhomogeneous areas.

Together with Atrial remodeling, A gap, low volatege area and slow conduction zone make a atrial tachycardia after AF ablation.

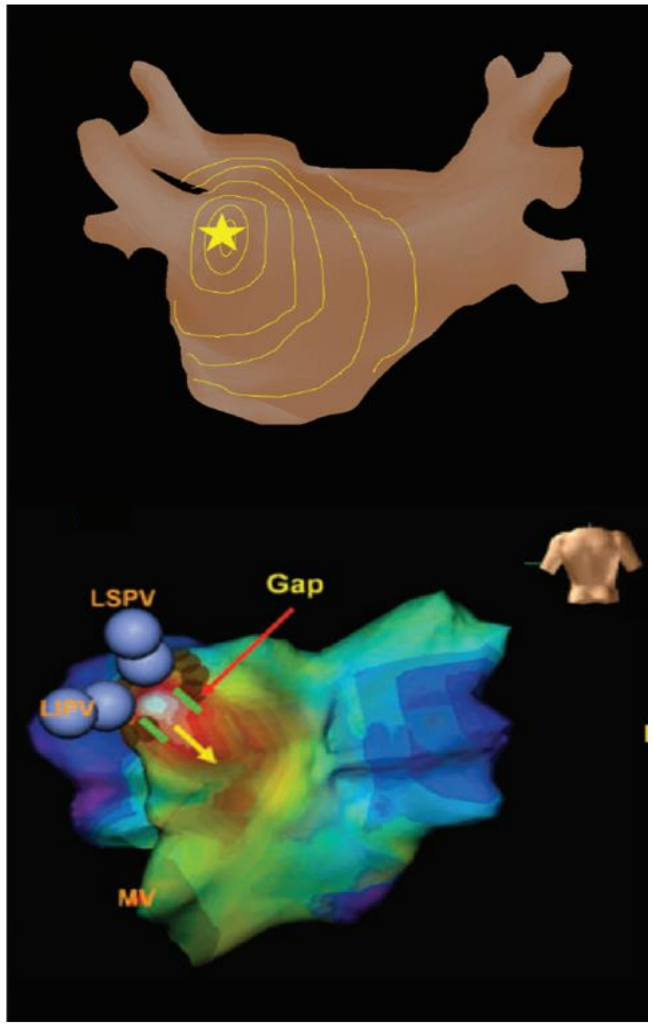
Classification & Mechanism

✔ **Focal** Atrial Tachycardia

✔ **Macro-reentry** Atrial Tachycardia

✔ **Micro-reentry** Atrial Tachycardia

Classification & Mechanism



Focal Atrial Tachycardia

✔ Caused by abnormal automaticity or triggered activity

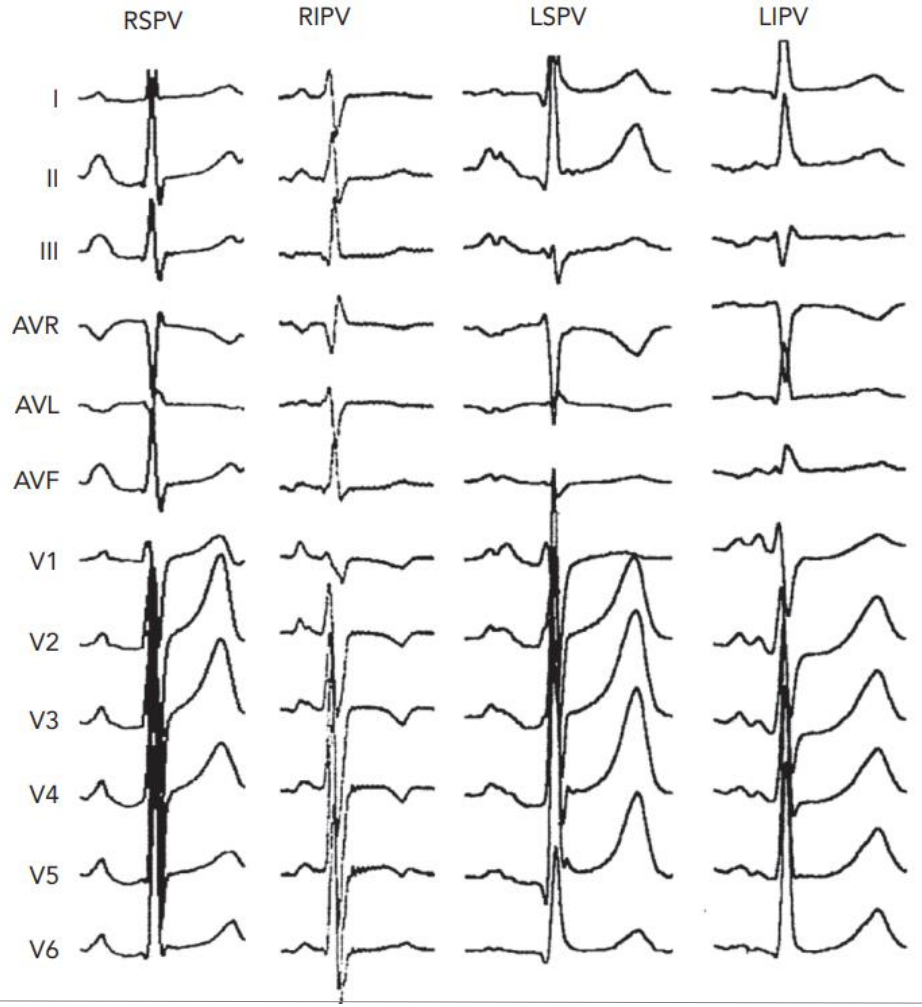
✔ Centrifugal activation.

✔ PV focal AT is more likely to occur after AF ablation.

Arrhythmia & Electrophysiology Review 2020;9(2):54–60

Classification & Mechanism

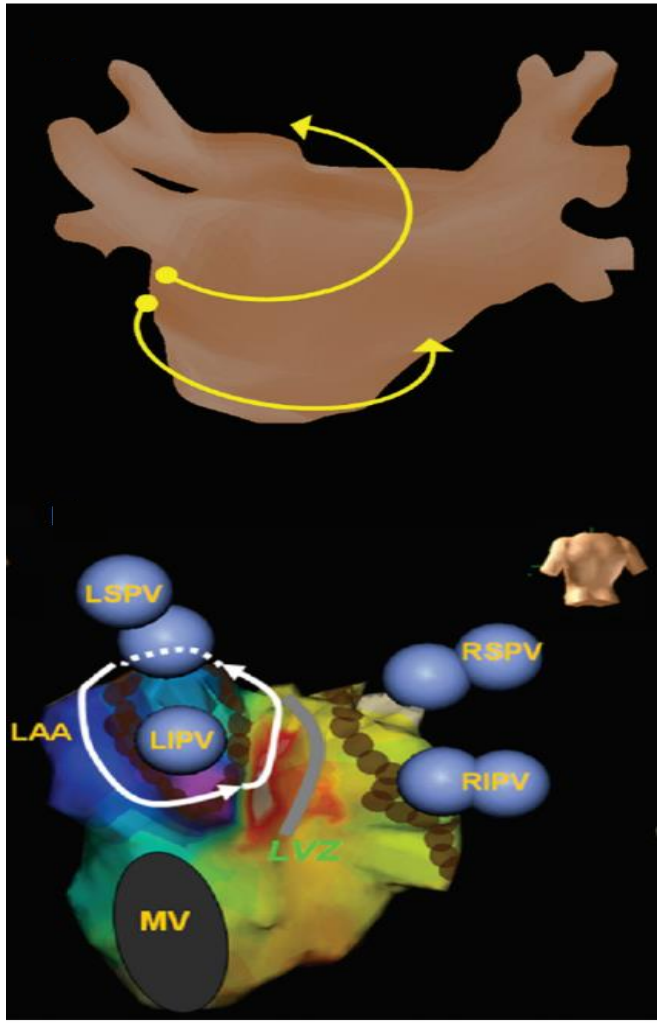
P-wave morphology for each of the PV sites



	RT-PV	LT-PV
Lead I	Positive	Low amplitude
Inferior Lead	Notch(-)	Notch(+)
aVL	Mostly negative or isoelectric	Mostly negative or isoelectric
aVR	Negative	Negative (except for LIPV)
Precordial (V1-V6)	Positive	M shape Positive

Circulation. 2003;108:1968–1975

Classification & Mechanism



Macro-reentry Atrial Tachycardia

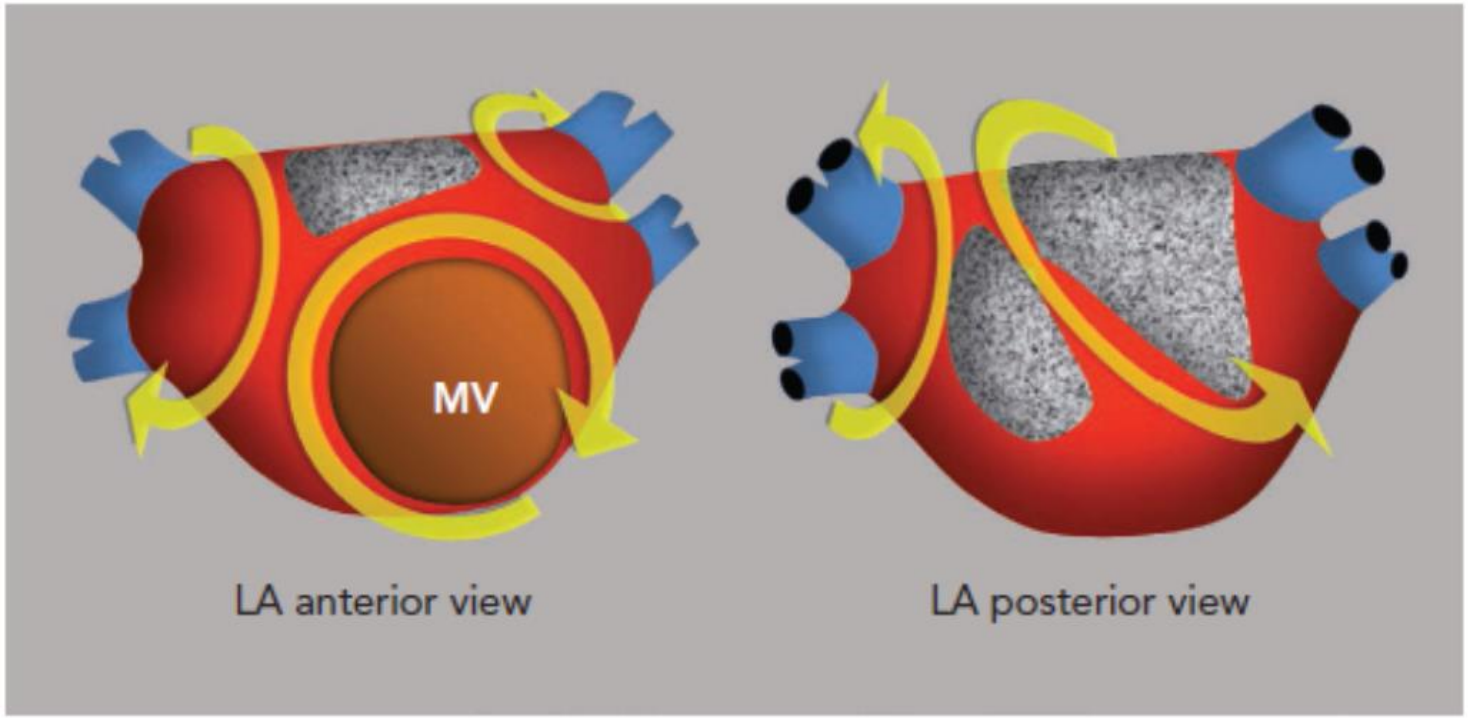
✓ Most common atrial tachycardia after AF ablation.

✓ Related to atrial remodeling, surgical atriotomy and extensive ablation.

✓ Occur easily and do not termination well.

Arrhythmia & Electrophysiology Review 2020;9(2):54–60

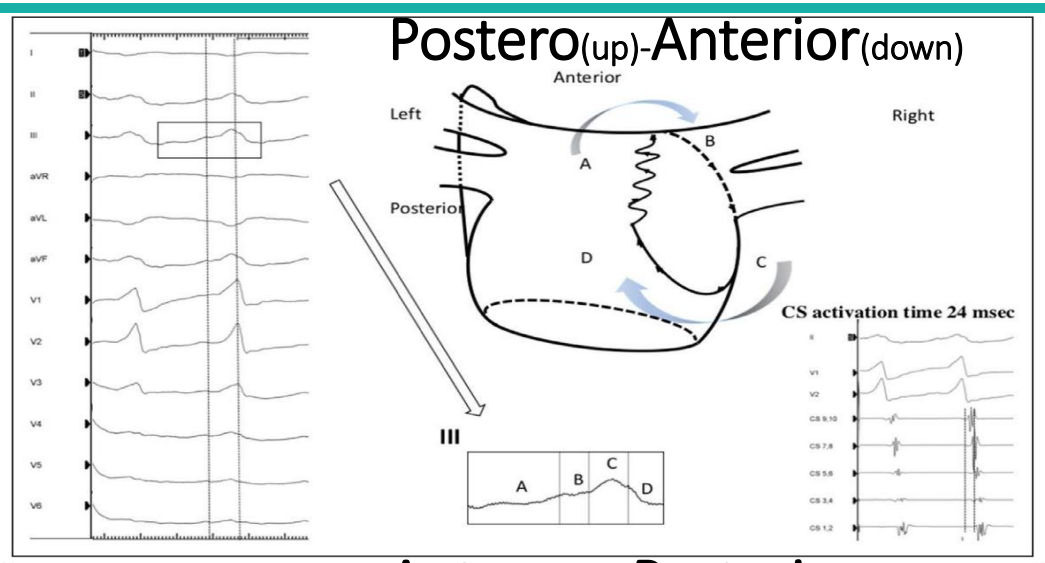
Classification & Mechanism

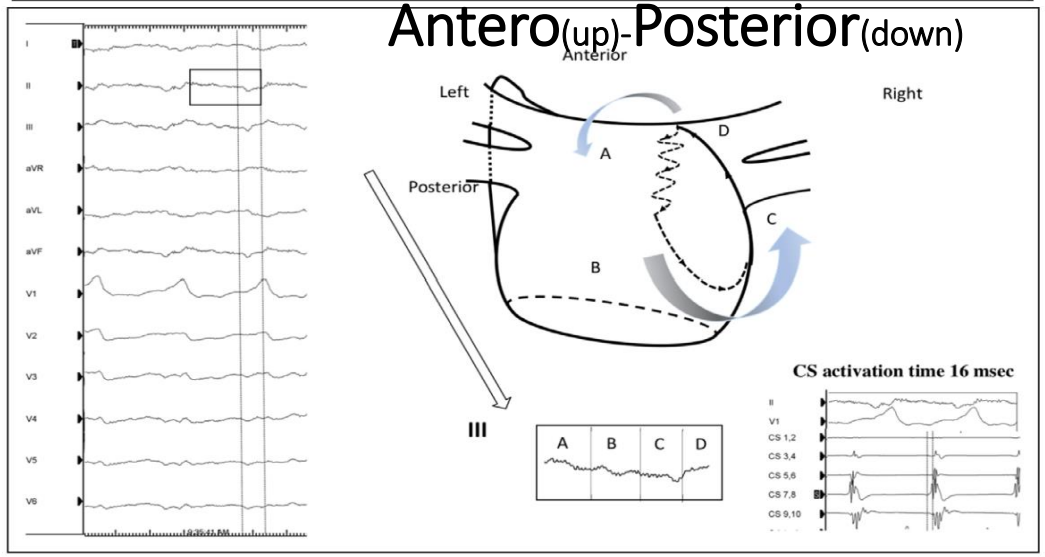


✓ Include Roof and Perimitral

Arrhythmia & Electrophysiology Review 2017;6(2):55–62.

Classification & Mechanism



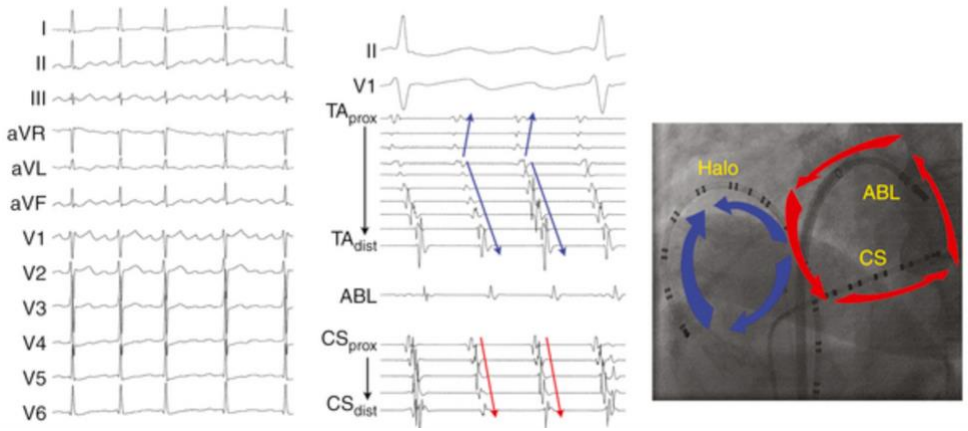


	Postero-Anterior(PA)	Antero-Posterior(AP)
V1	Positive	Positive
Inferior Lead	Positive	Negative
CS activation time	Less than 39ms	Less than 39ms

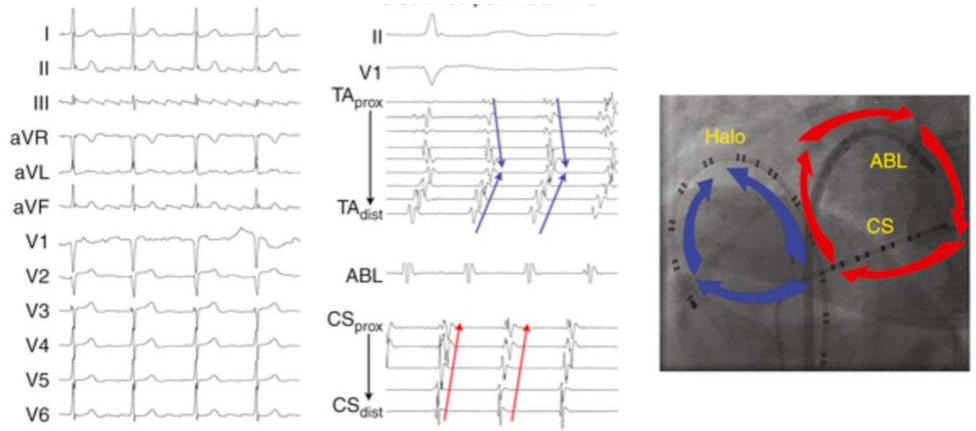
Circ Arrhythm Electrophysiol. 2018;11:e005948

Classification & Mechanism

Counter-clockwise perimitral-AFL



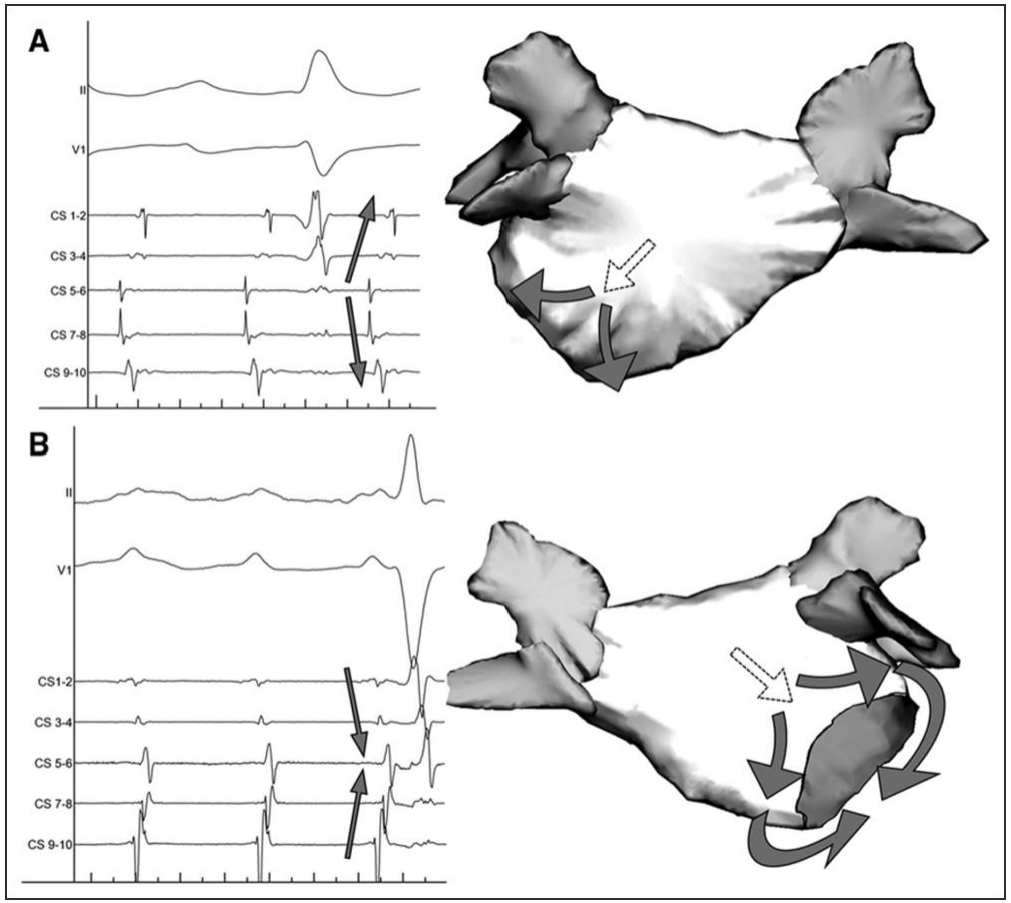
Clockwise perimitral-AFL

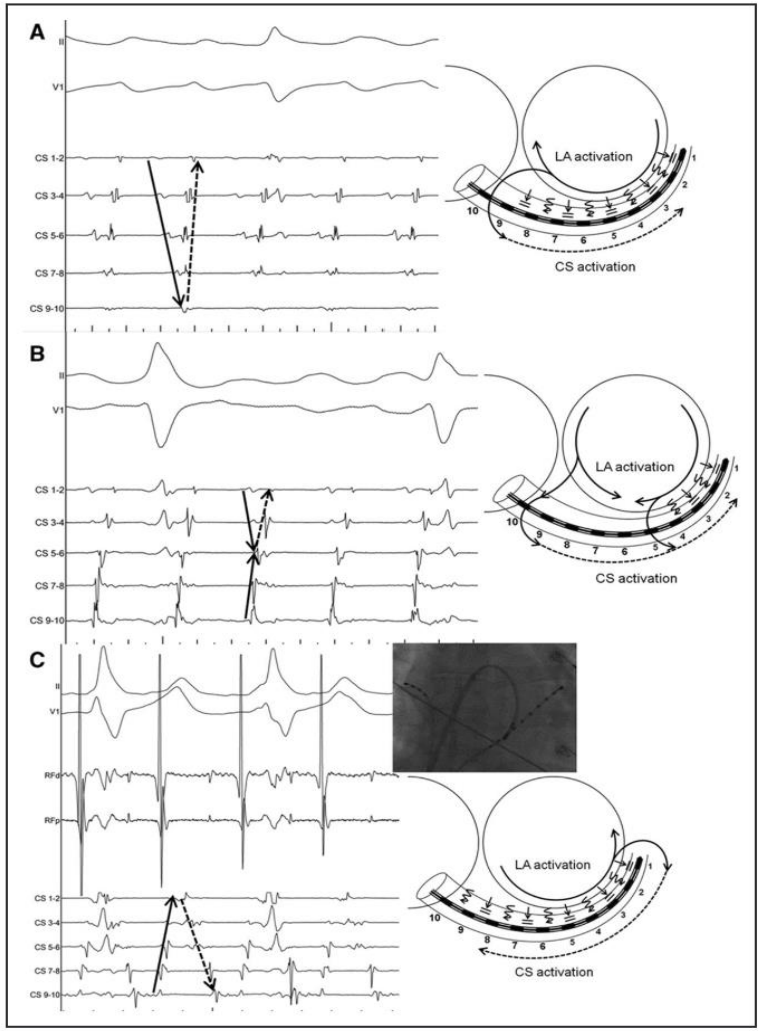


P wave	Counter-clockwise	Clockwise
V1	Positive	Positive
Inferior Lead	Positive	Negative
CS activation time	More than 39ms	More then 39ms
CS activation	Proximal to distal	Distal to proximal

Jun 22, 2016 | Posted by admin in MUSCULOSKELETAL MEDICINE

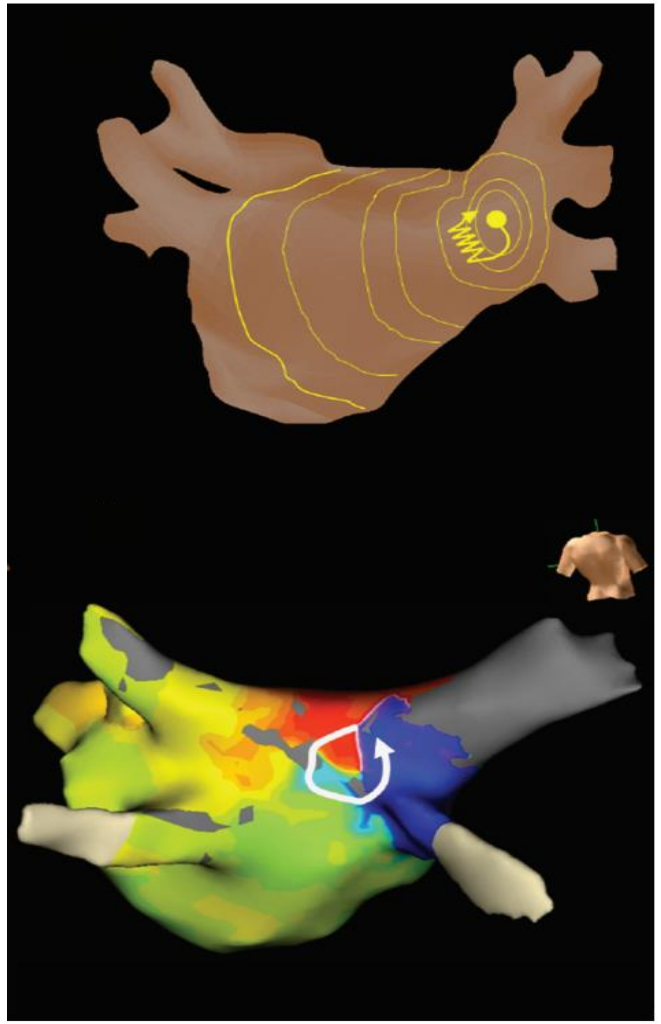
Classification & Mechanism





Circulation: Arrhythmia and Electrophysiology. 2013;6:481–490

Classification & Mechanism

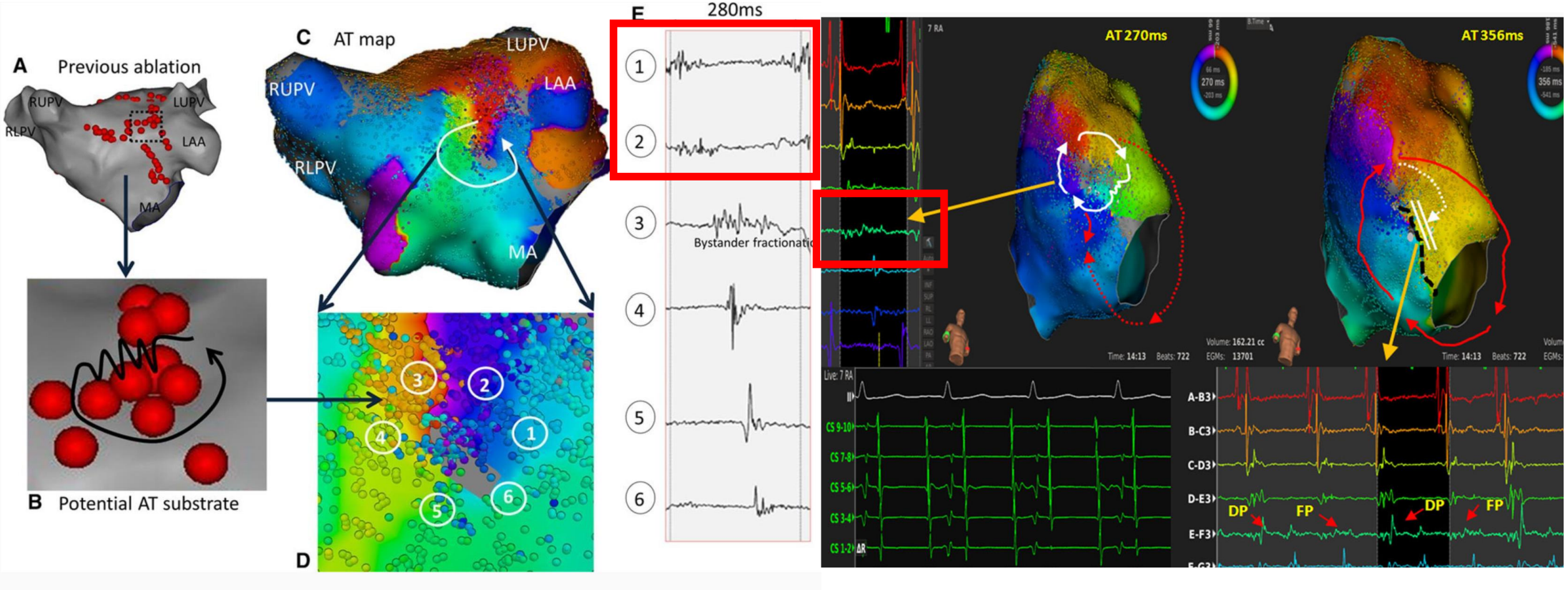


Micro-reentry Atrial Tachycardia

- ✓ A circuit smaller than 2-3 cm in the atrium.
- ✓ Centrifugal activation.
- ✓ Noted predominantly in regions previous ablation.
- ✓ Occur in low voltage and scar area.

Arrhythmia & Electrophysiology Review 2020;9(2):54–60

Classification & Mechanism



Circulation: Arrhythmia and Electrophysiology. 2017;10:e004724
Circulation: Arrhythmia and Electrophysiology. 2019;12:e007634

Mapping and Ablation strategy

1. Right vs Left ?
2. Focal vs Macro-reentry ?
3. Focal vs Micro-reentry ?
4. Endo vs Epi?

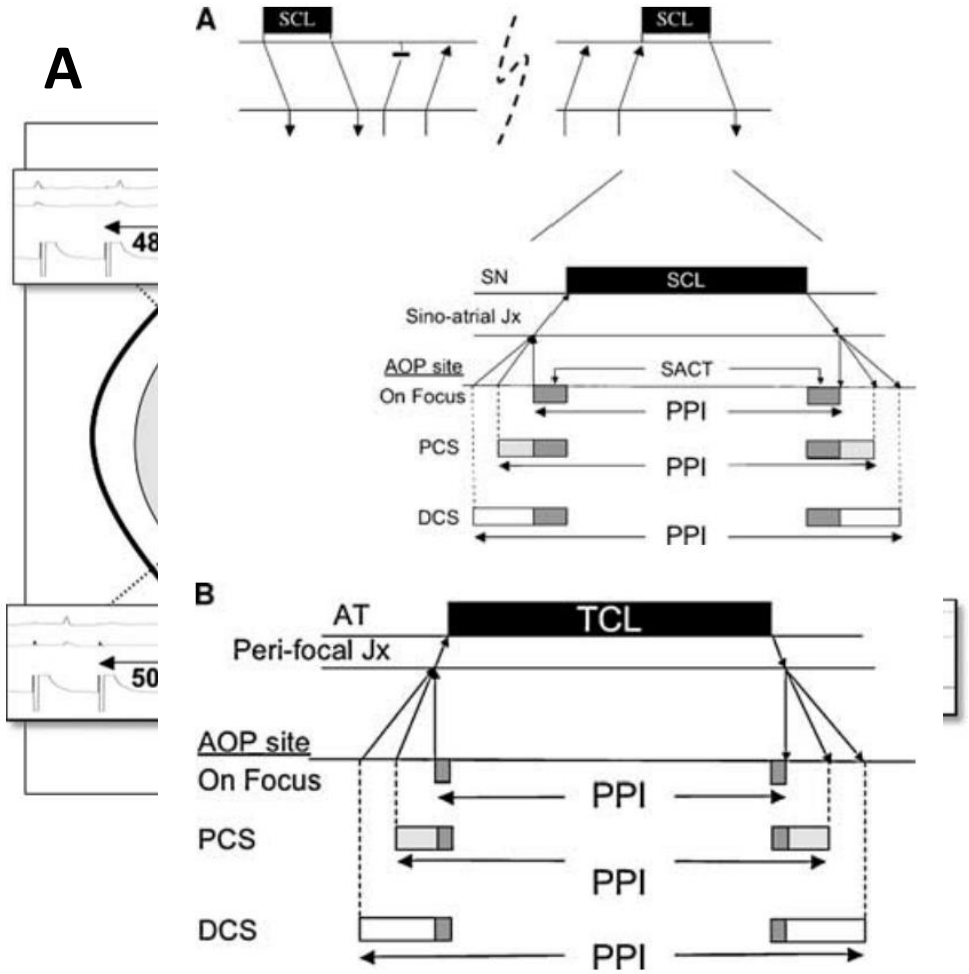
Mapping and Ablation strategy

1. Right vs Left ?

	(A)	(B)	(C)	(D)
CS Prox ↓ CS Distal				
Differential Diagnosis	• RA tachycardia • Counterclockwise perimitral • Septal • Right PVs	• Clockwise perimitral • Lateral LA • Left PVs	• Roof-dependent (descending posterior) • Posterior LA	• Roof-dependent (descending anterior) • Anterior LA

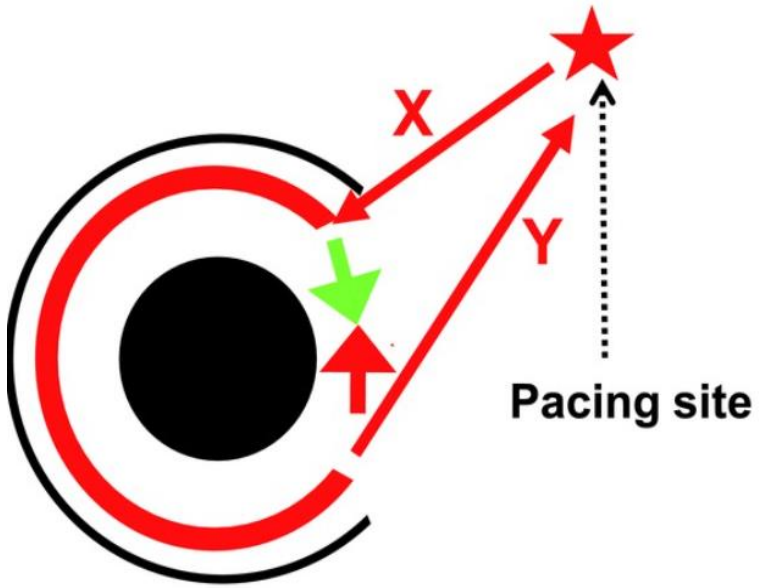
J Cardiovasc Electrophysiol. 2019;30:3057 – 3067

Mapping and Ablation strategy



B

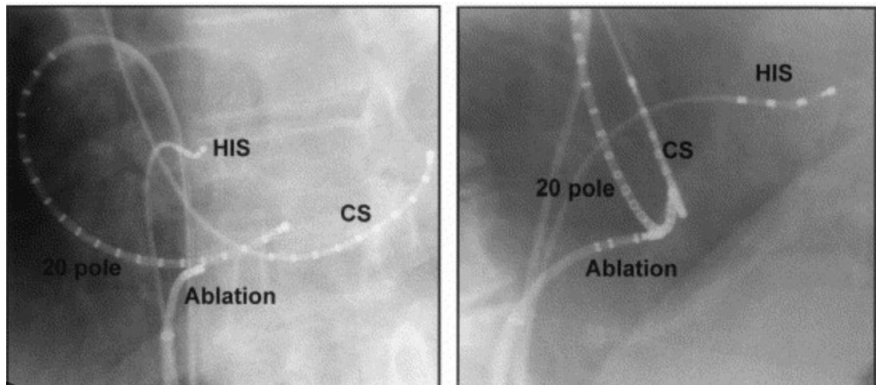
Pacing away from the reentrant circuit

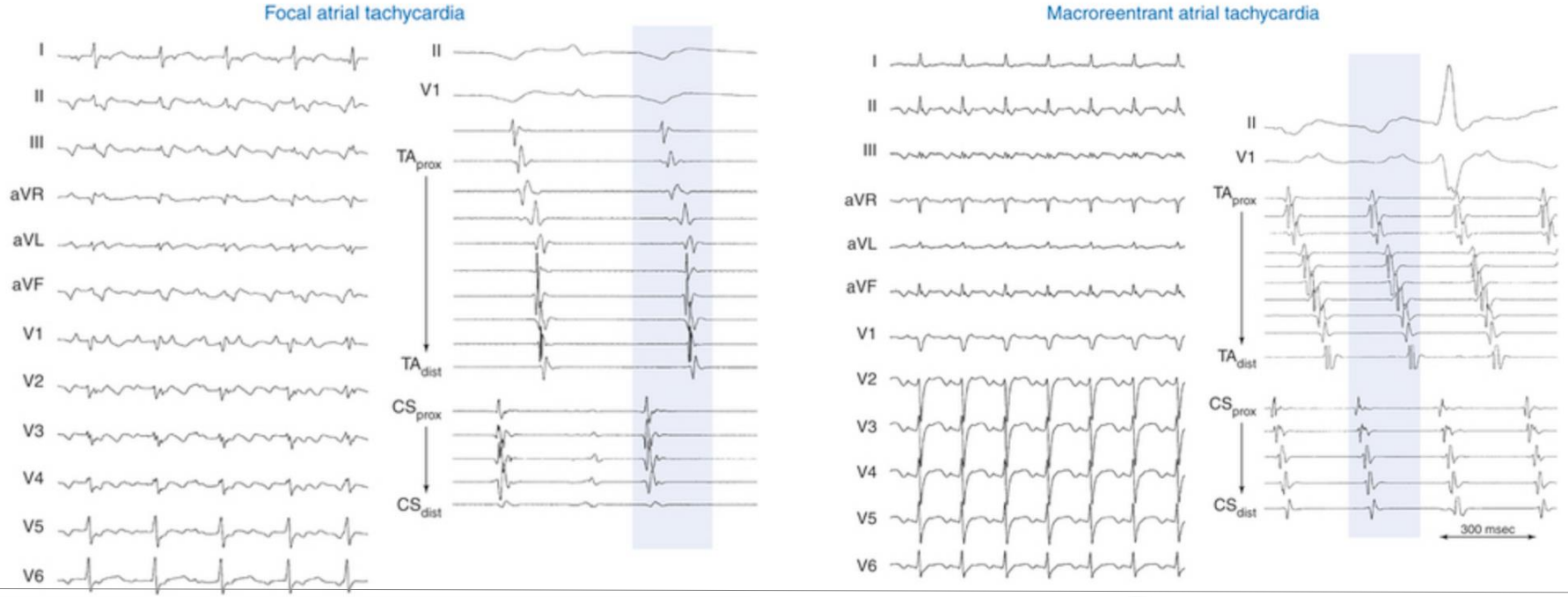


Pacing Clin Electrophysiol . 2013 May;36(5):641-61
J Cardiovasc Electrophysiol, Vol. 18, pp. 1-6, January 2007

Mapping and Ablation strategy

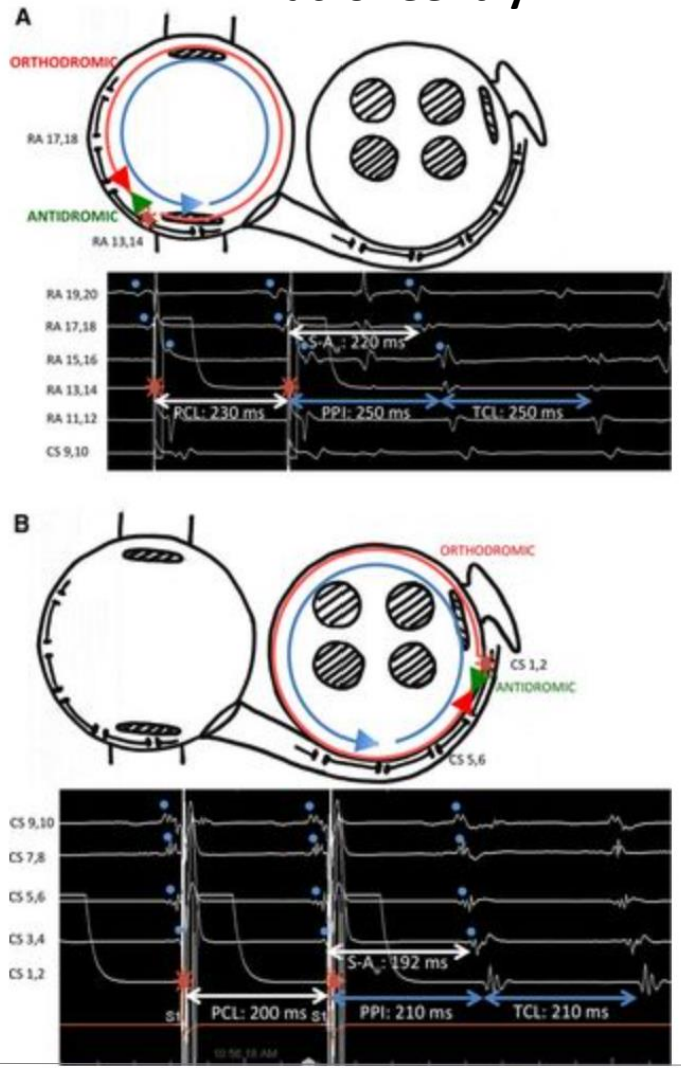
2. Focal vs Macro-reentry ?



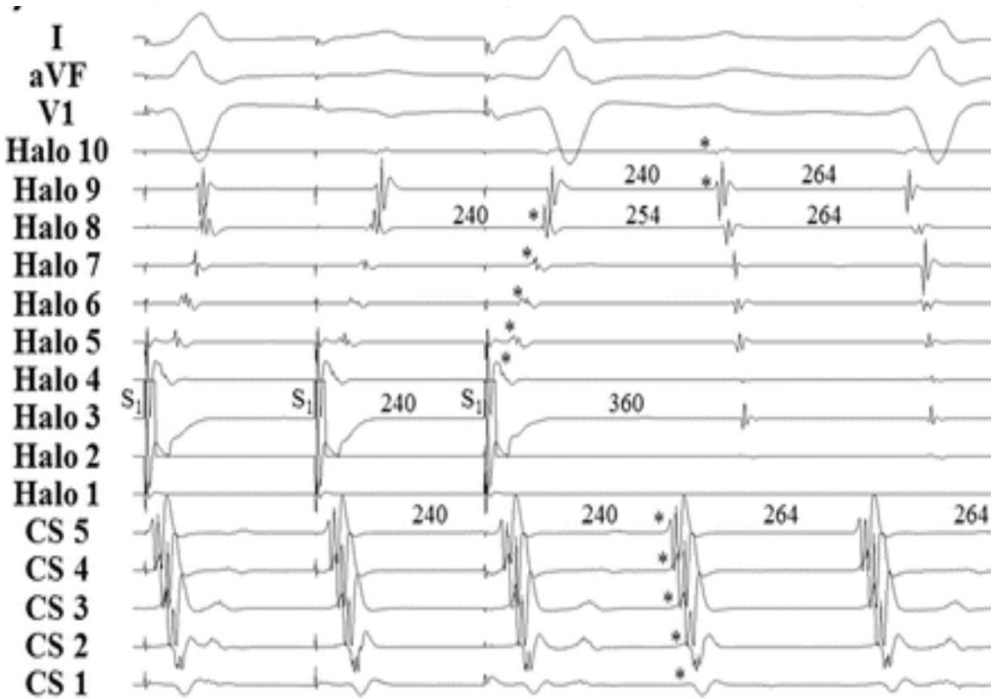


Mapping and Ablation strategy

Macro reentry



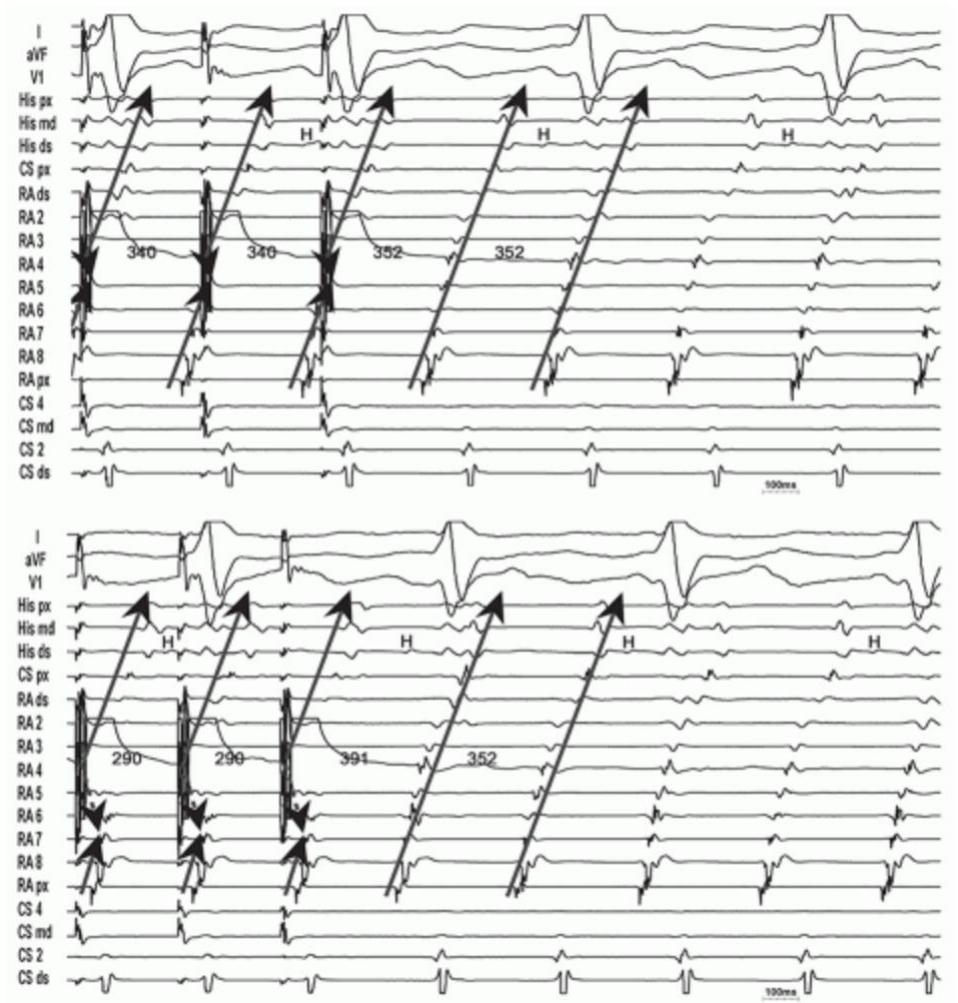
Focal AT



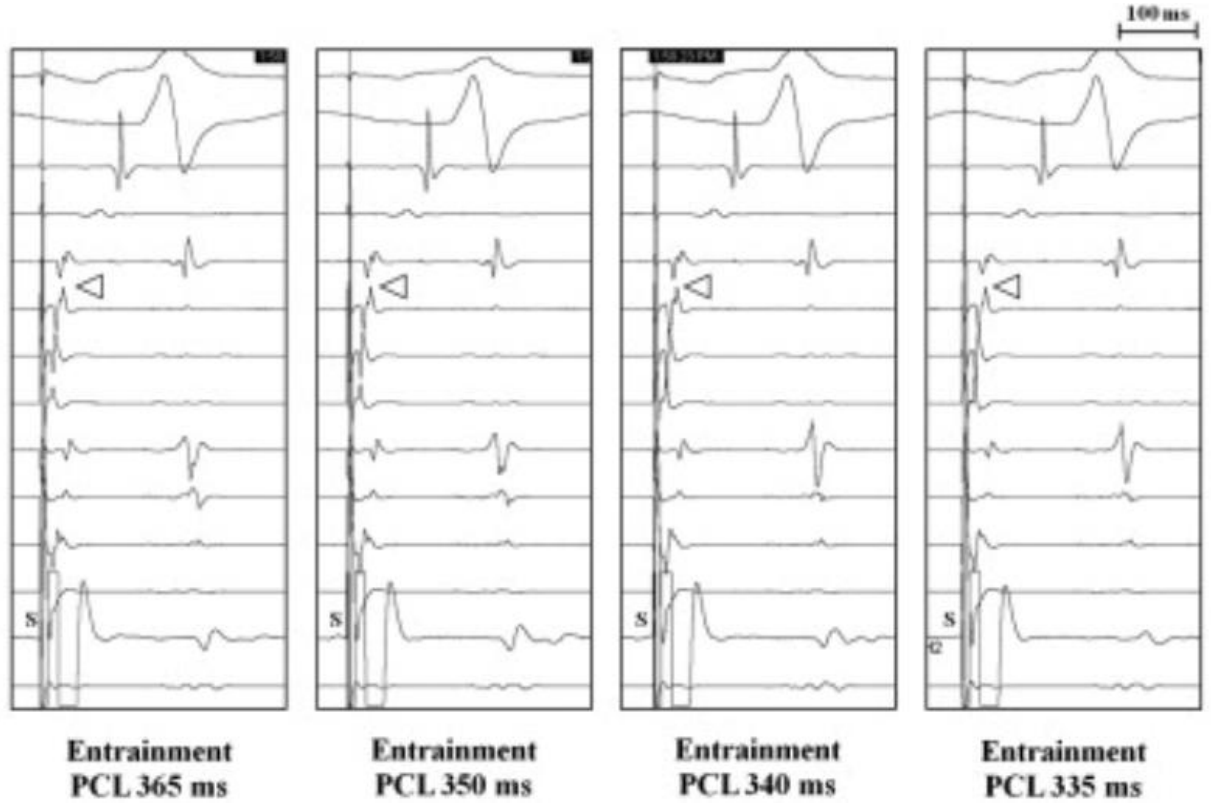
Circulation Volume 129, Issue 24, 17 June 2014; Pages 2503-2510

Mapping and Ablation strategy

Macro reentry



Focal AT

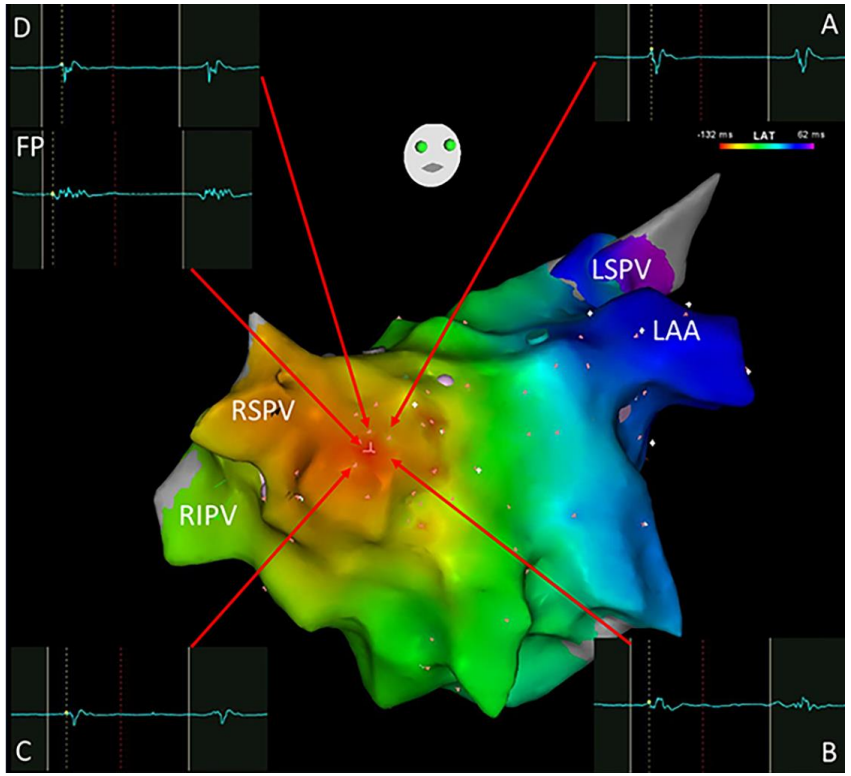


Journal of Arrhythmia 28 (2012) 65–70
Oct 13, 2019 | Posted by drzezo in CARDIOLOGY | Comments Off on Atrial Flutter

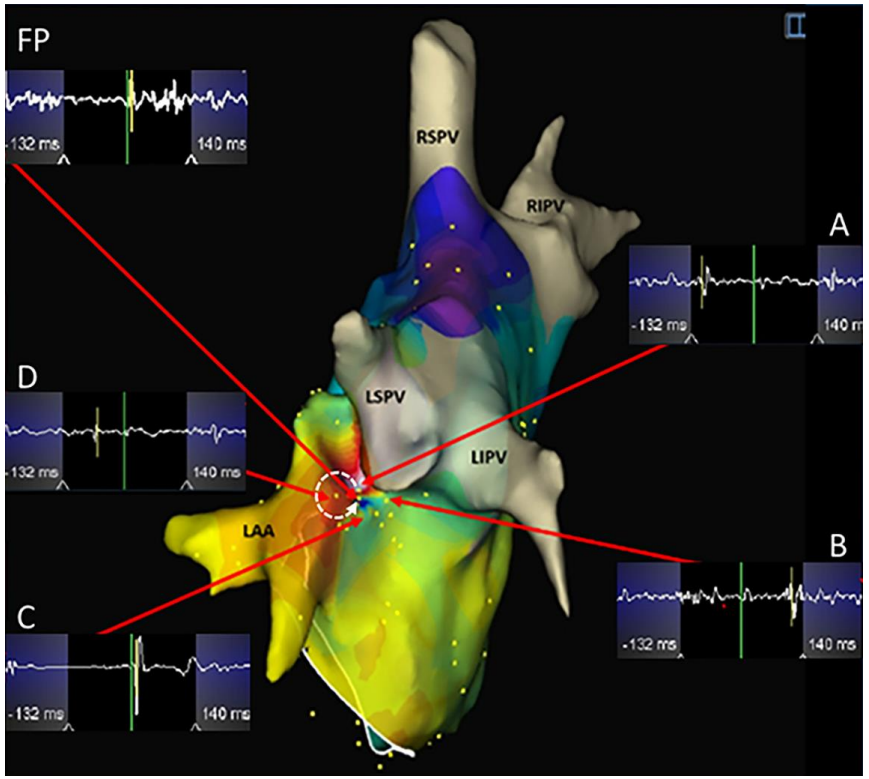
Mapping and Ablation strategy

3. Focal vs Micro-reentry ?

Focal



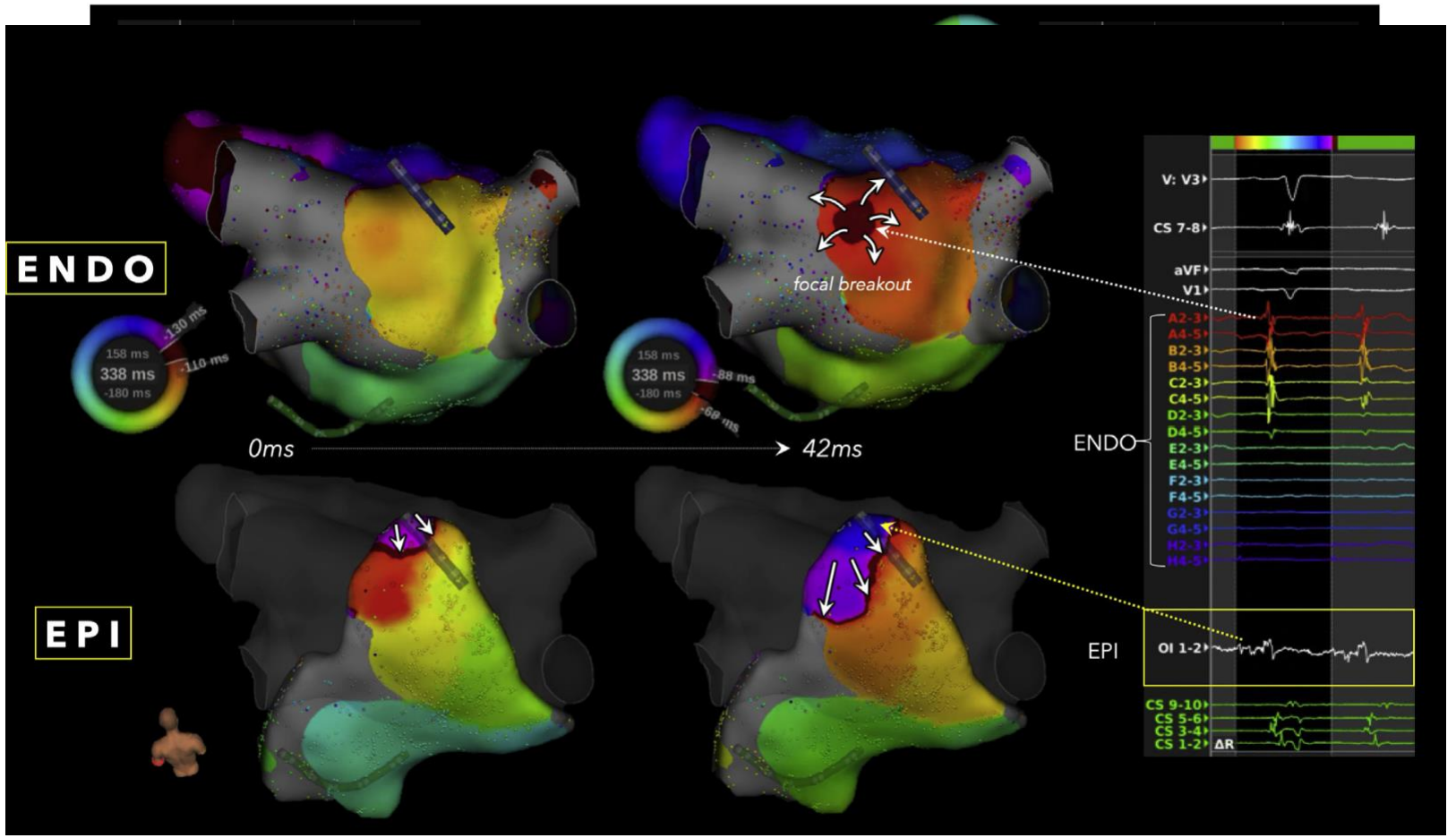
Micro-reentry



Front Cardiovasc Med. 2022 Mar 10;8:759563

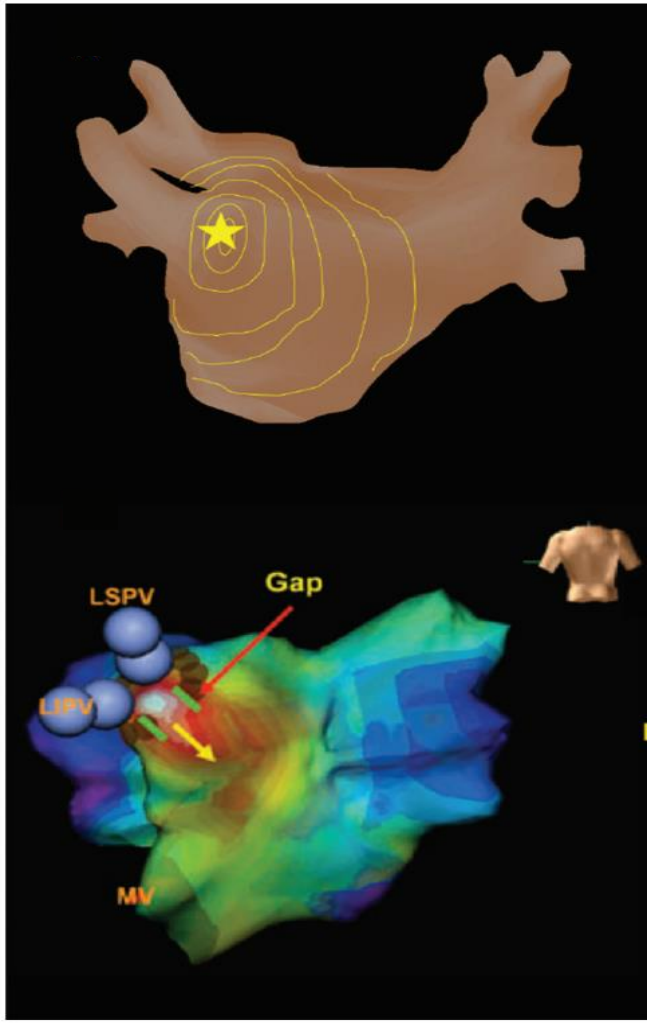
Mapping and Ablation strategy

4. Endo vs EPI?



JACC: CLINICAL ELECTROPHYSIOLOGY VOL. 6, NO. DECEMBER 2020:1812–2

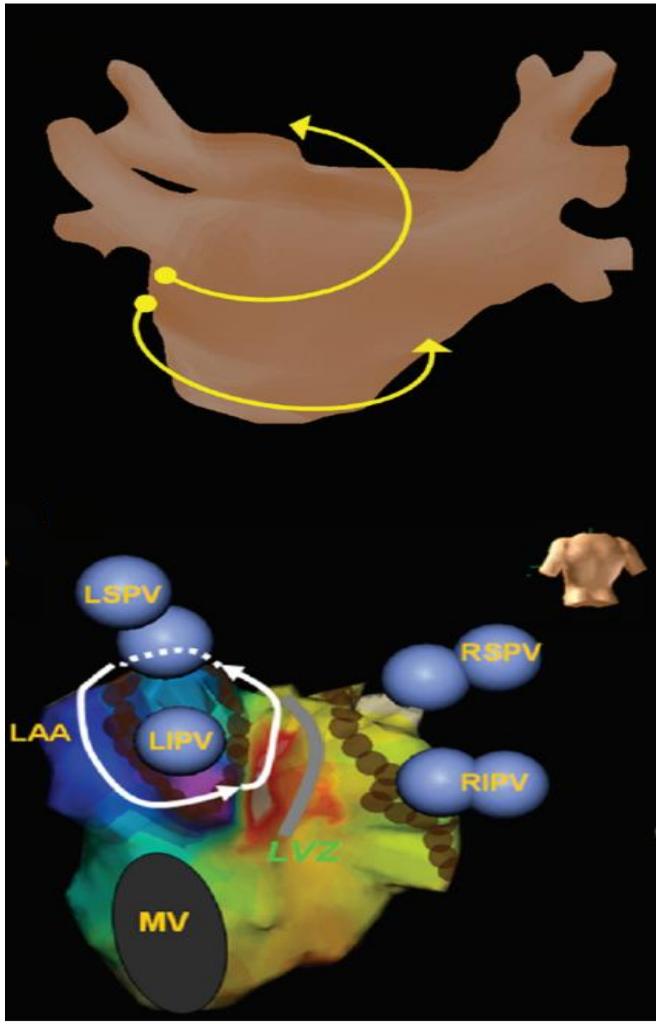
Mapping and Ablation strategy



Focal Atrial Tachycardia

- ✔ Check origin. If origin is left side, We **check the previous ablation lines.**
- ✔ A multipolar 3D mapping catheter is used to **find the earliest point** and ablate this point.
- ✔ Earliest Target site **is more than 30ms faster than P wave** and unipolar shows **QS pattern at the ablation catheter**.
- ✔ The **acceleration of tachycardia during ablation** is an **excellent** target site.

Mapping and Ablation strategy



Macro-reentry Atrial Tachycardia

✔ Confirm an **Intracardiac concealed fusion and progressive fusion.**

-> Beware of changed to other tachycardia while pacing.

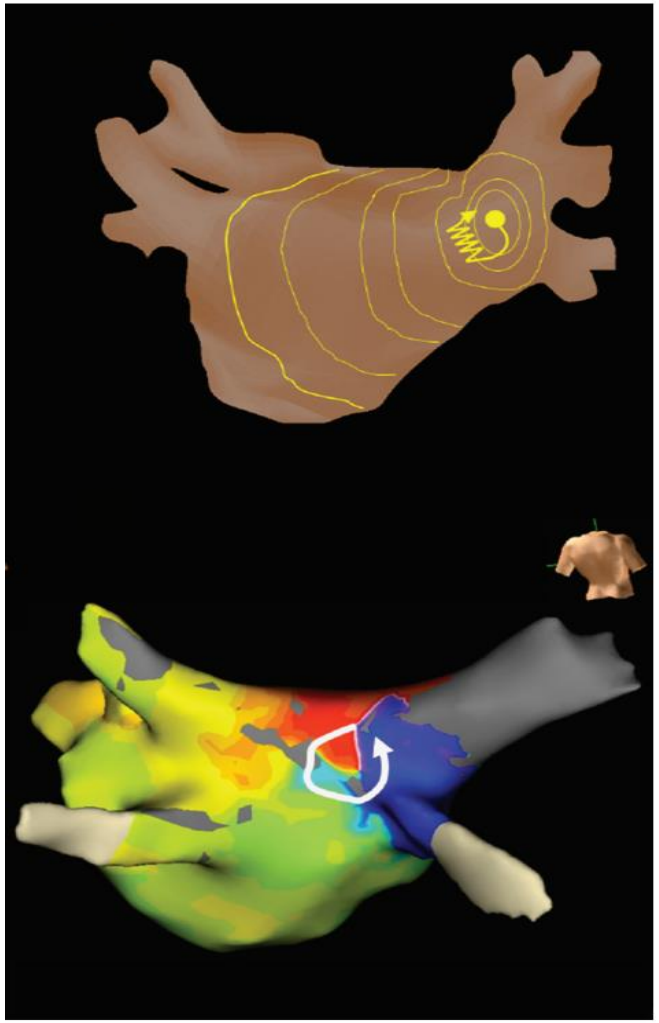
✔ Confirm a PPI-TCL **within 30ms to differentiate circuit site.**

-> Beware of the rate-dependent conduction delay.

✔ If circuit is left side, We Check the **previous ablation lines.**

✔ The **target site** is where **the early and late points meet** in the LAT(local activation time).

Mapping and Ablation strategy



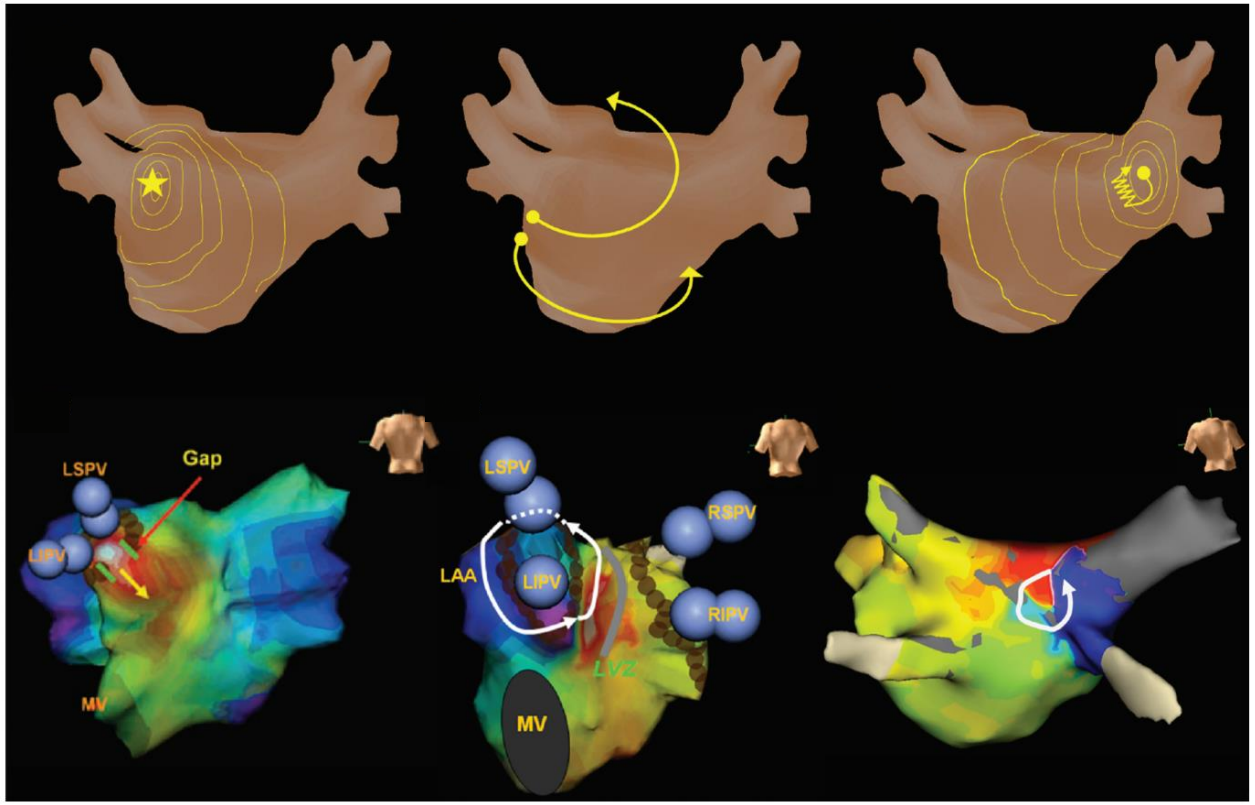
Micro-reentry Atrial Tachycardia

✔ If origin is left side, we check the **previous ablation lines.**

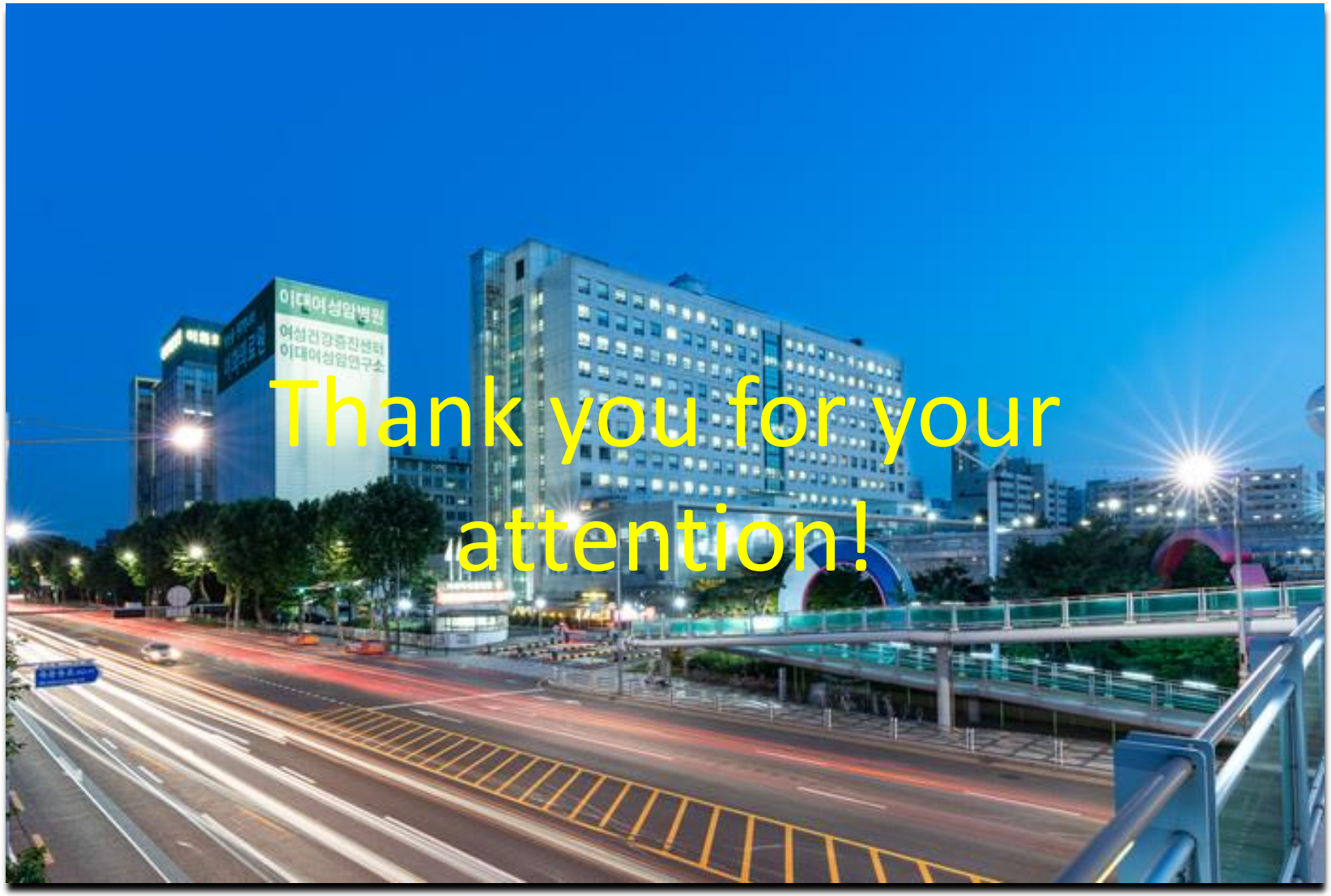
✔ Absolutely **need a high-density mapping** due to the presense of multiple slow conduction **isthmuses in the low-voltage area.**
-> beware of wavefront collision and artifacts

✔ The **target site** is where the **long duration and low voltage fractionated EGMs**

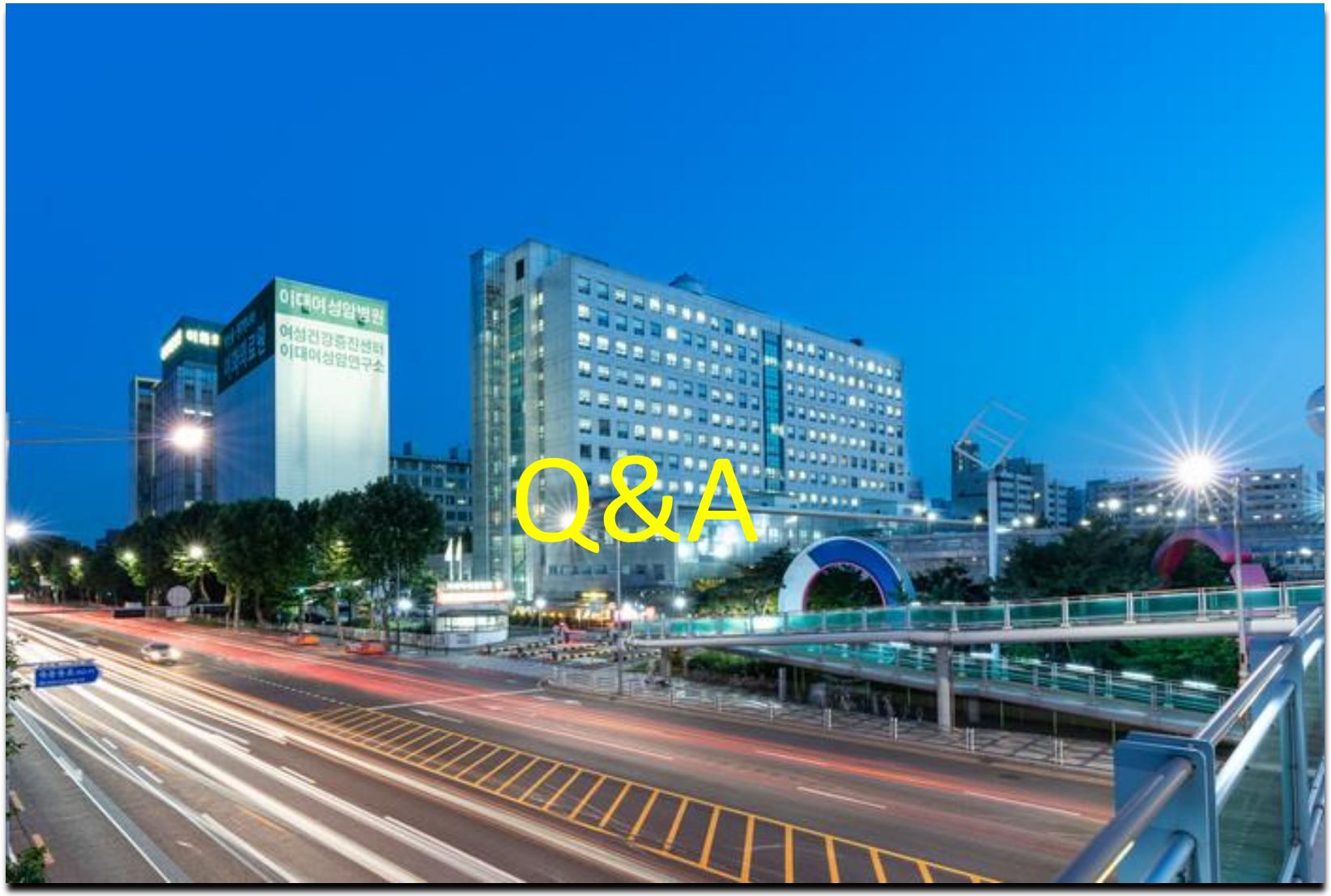
Conclusion



✓ **Knowing Mechanism and Substration is very important for treatment atrial tachycardias after AF ablation.**



Thank you for your attention!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