23rd Prague Workshop on Catheter Ablation

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Ablation of low voltage areas in persistent AF

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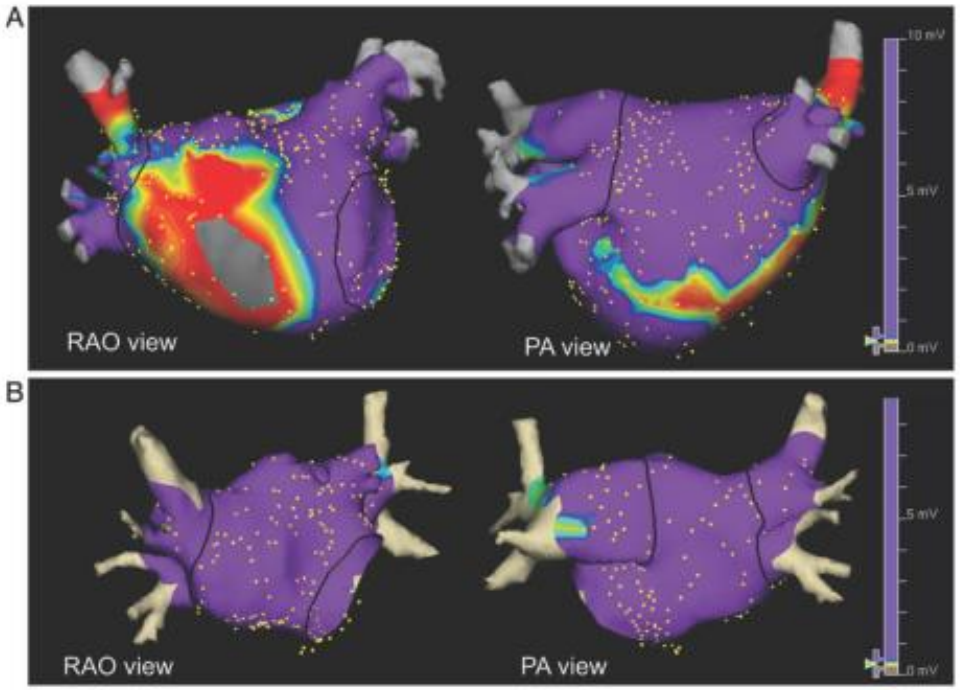
Conflict Of Interest

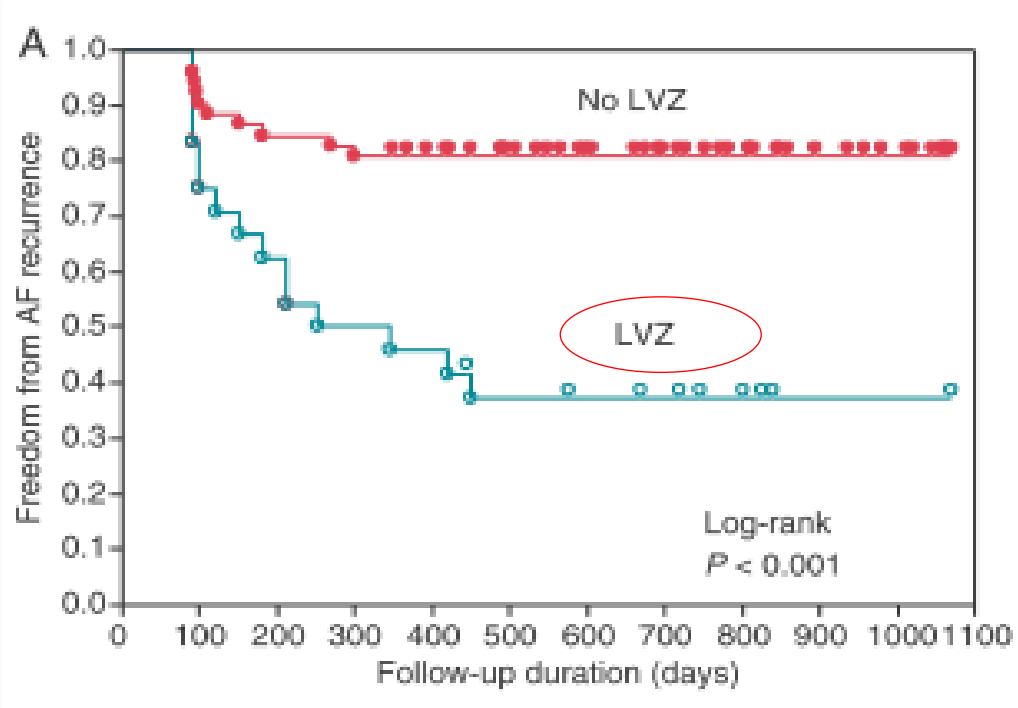
- Takanori Yamaguchi received honoraria from Abbott Medical Japan.

- Takanori Yamaguchi and Toyokazu Otsubo are affiliated with the Department of Advanced Management of Cardiac Arrhythmia, Saga University, sponsored by Abbott Medical Japan, Nihon Kohden Corporation, Japan Medtronic, Japan Lifeline, Boston Scientific Japan, and Fides-ONE Corporation.

- The other authors declare that they have no conflict of interest. This research did not receive a grant from any funding agency in the public, commercial, or not-for-profit sectors.

Low-voltage Area < 0.5mV Predicts Recurrence after PVI alone



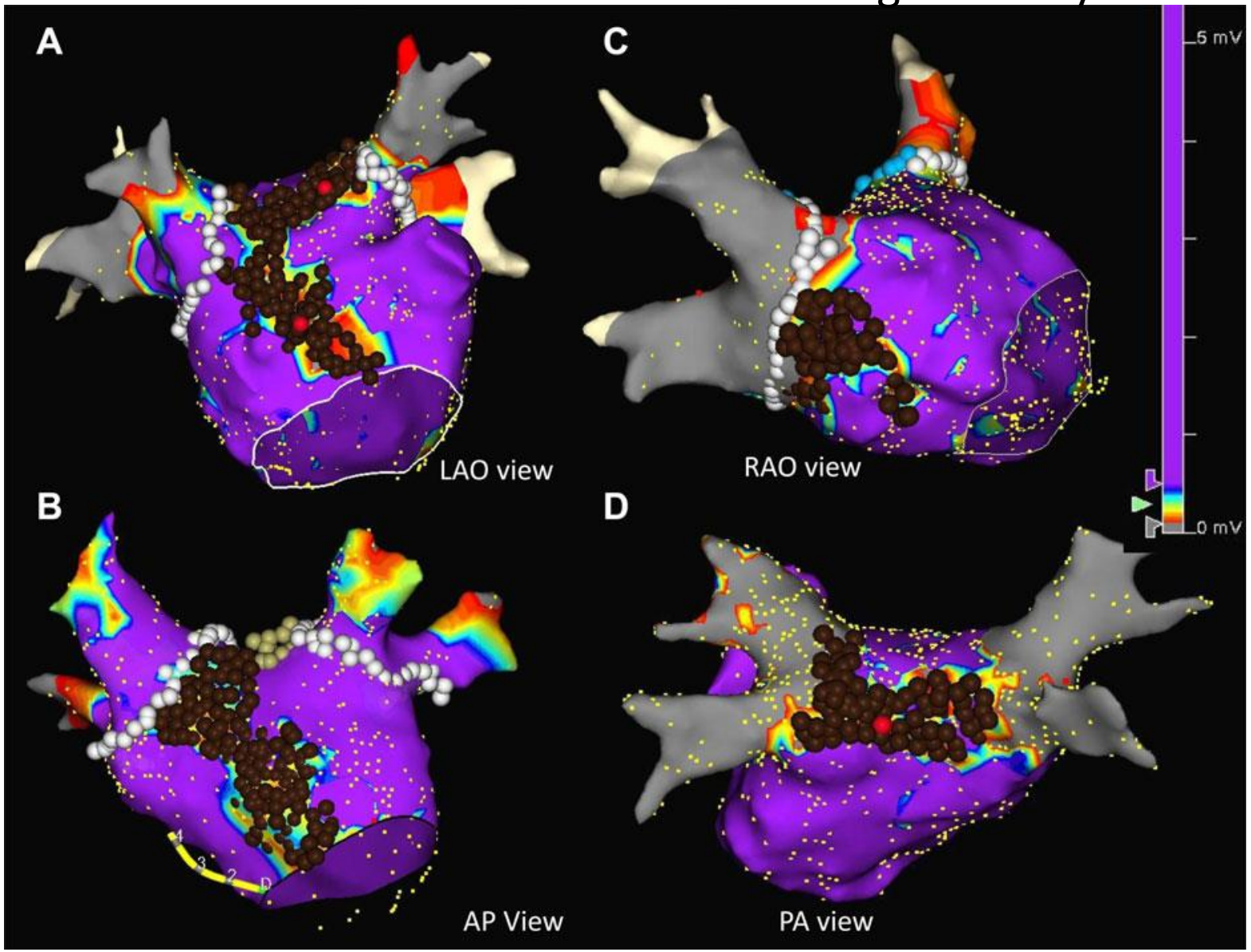


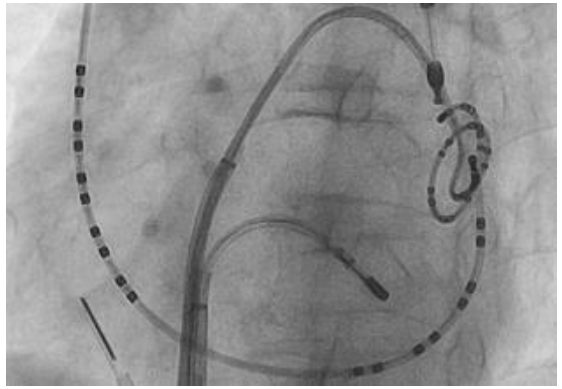
Yamaguchi, et al Europace. 2014;16(4):511-20）

LVZ has been considered as a surrogate of fibrotic tissue, and may be a marker of AF substrate

Ablation Targeting LVA on the assumption that LVA works as AF substrate

LVA < 0.5mV during sinus rhythm

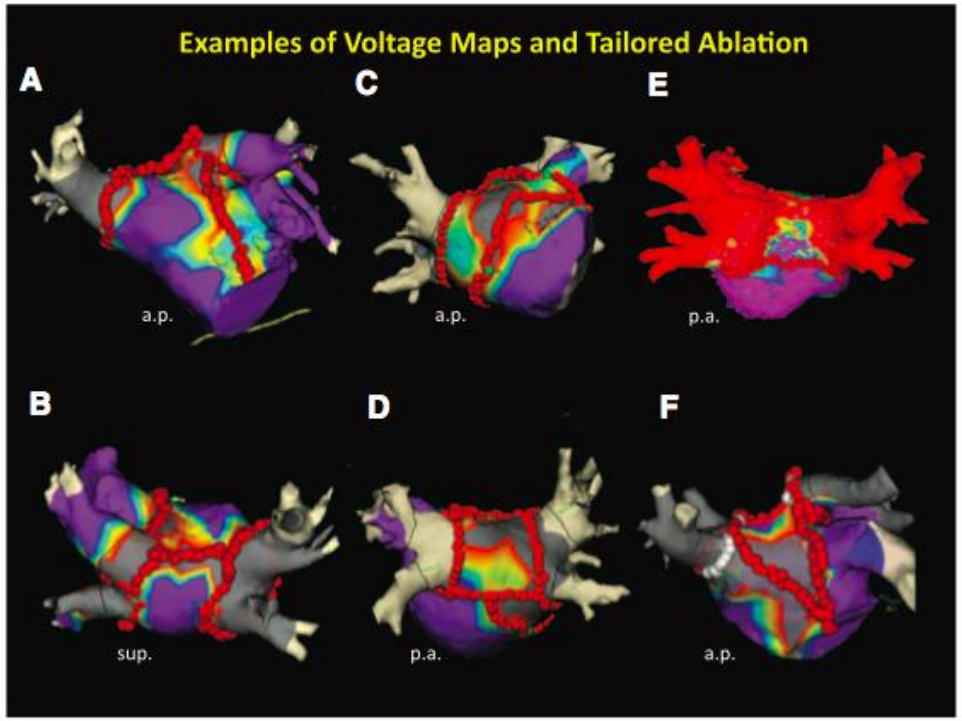




101 patients with Nonparoxysmal AF

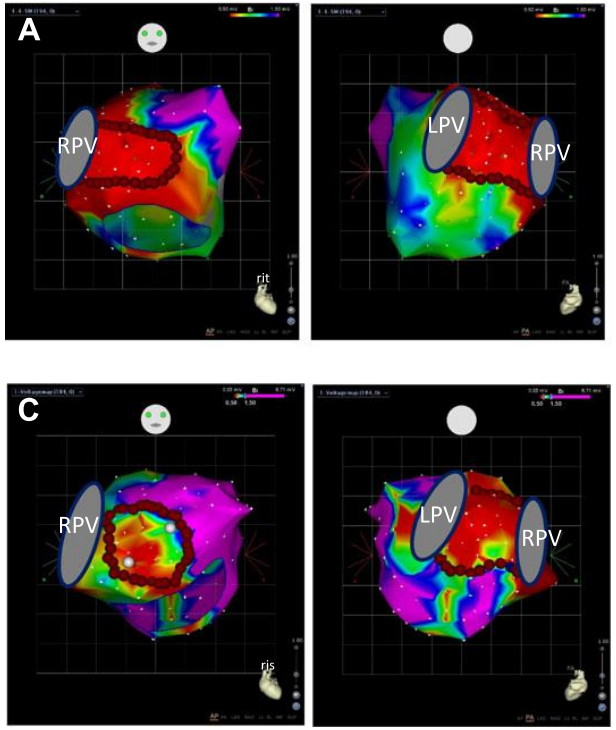
Yamaguchi JCE 2016

Low-voltage based substrate ablation



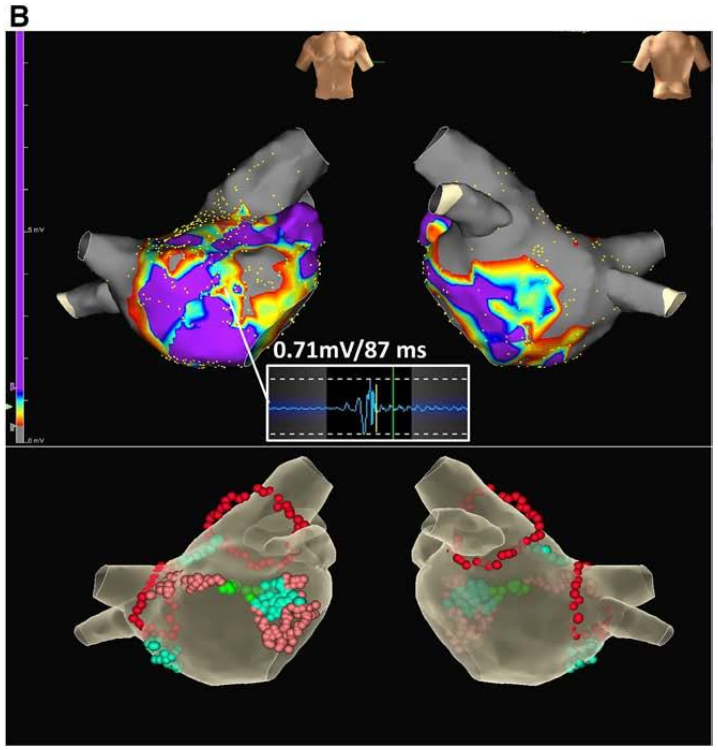
Linear ablation across low-voltage area
Isolation of low-voltage area

Rolf et al. Circ AE 2014;5:825-833



BIFA: Box isolation of fibrotic areas

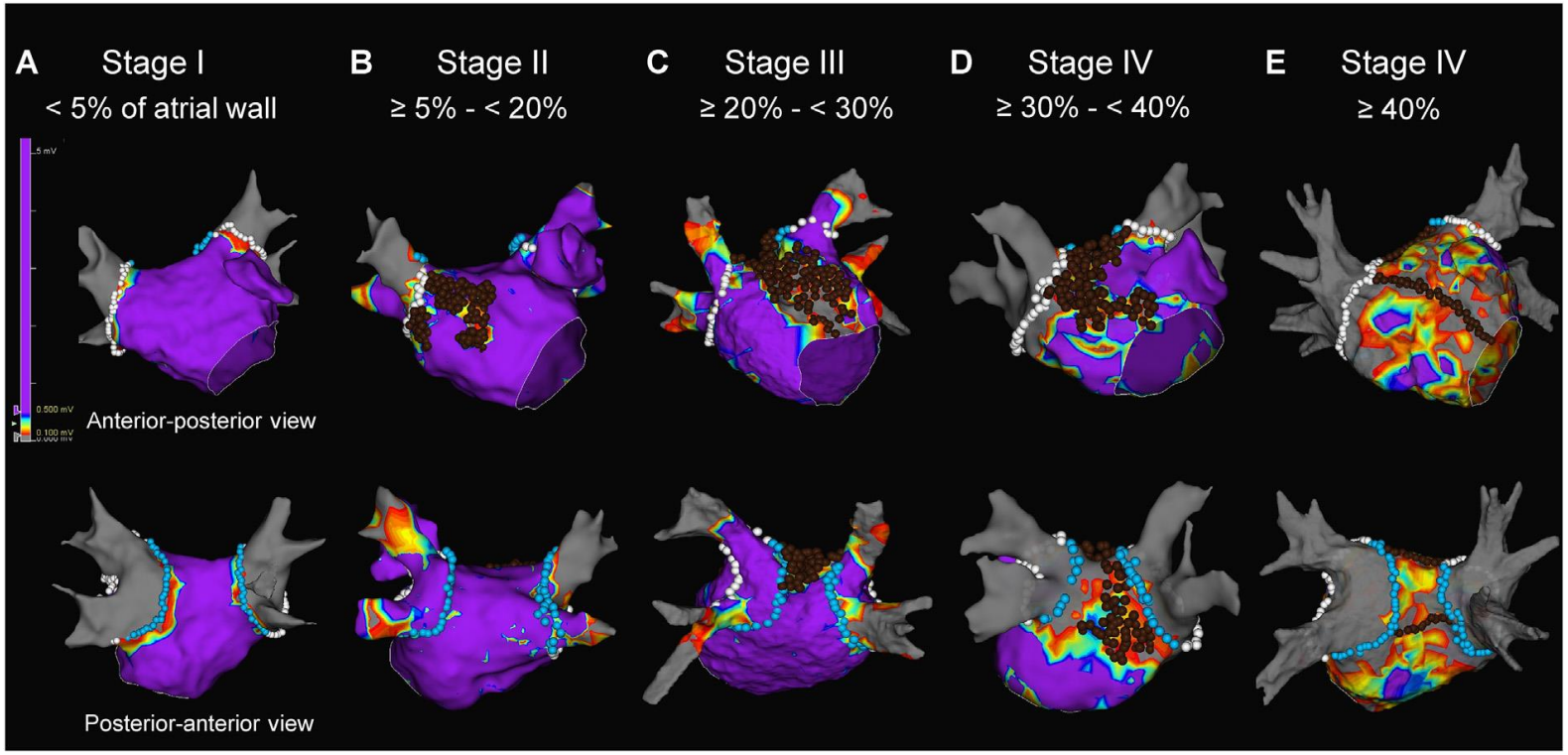
Kottkamp et al. JCE 2016;27:22-30

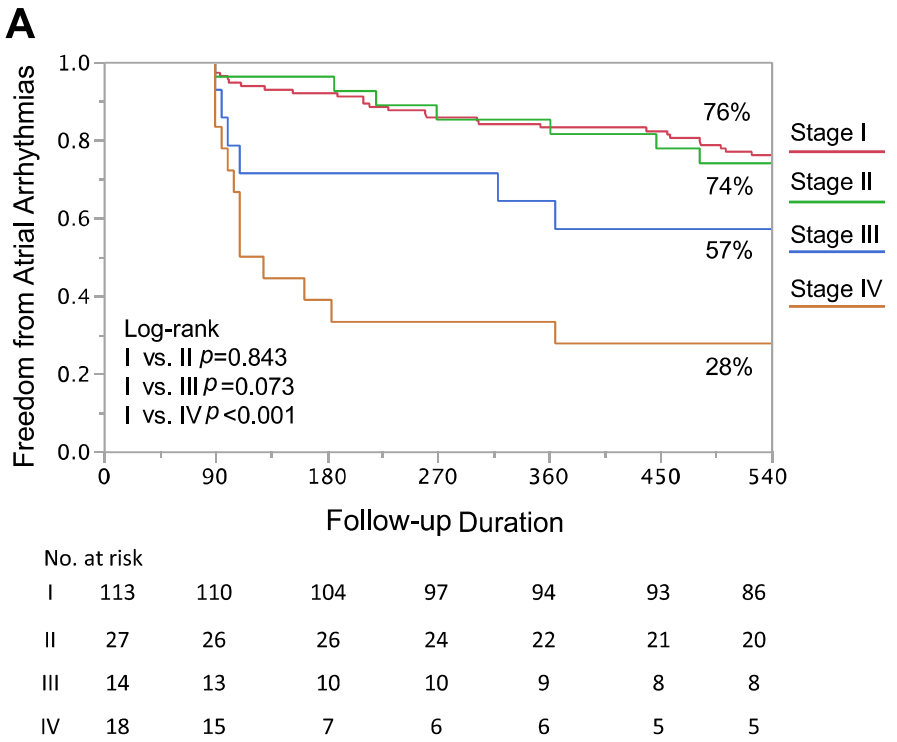


LVA homogenization and de-channeling

Yang et al. Circ Arrhythm Electrophysiol. 2016;9:e003382.

Low-voltage based substrate ablation



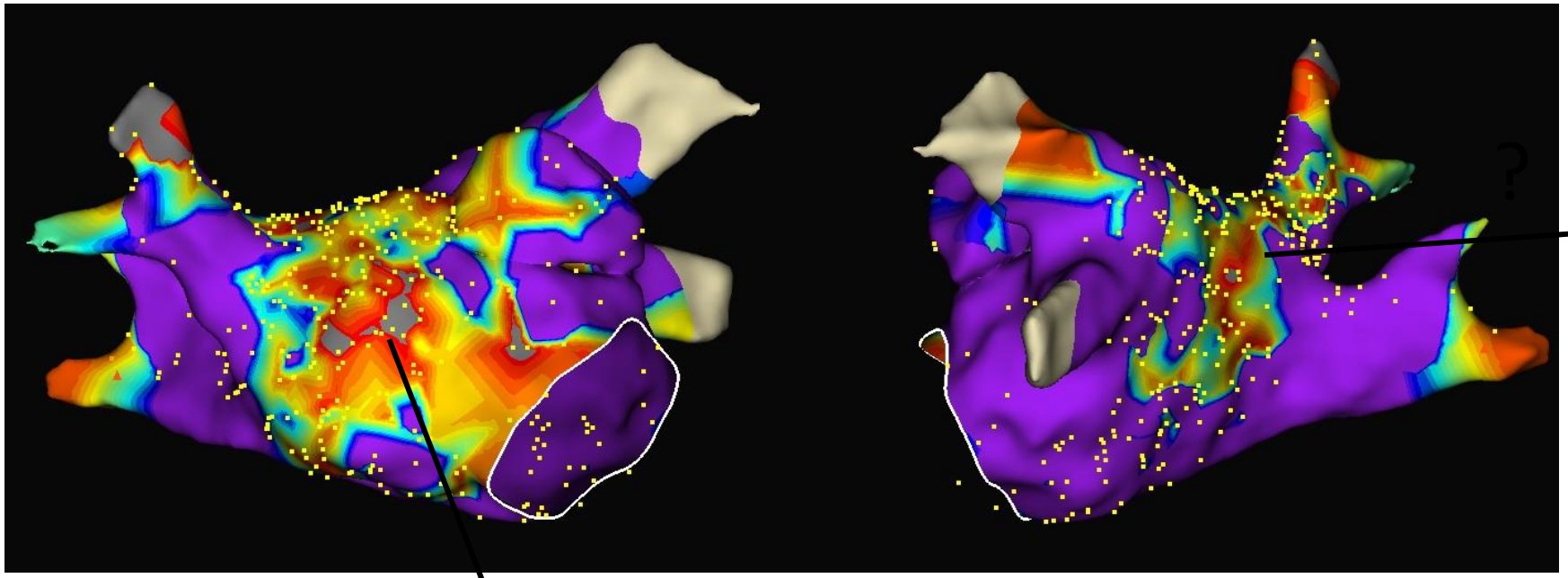


172 non-PAF patients
Stage 1 = 66%
Stage 2 = 16%
Stage 3 = 14%
Stage 4 = 10%

Yamaguchi et al. J of Cardiology 2018

Does low voltage area reflect local fibrosis (or local diseased tissue)?
Does Non-Low voltage area reflect healthy tissue?

<0.5 mV



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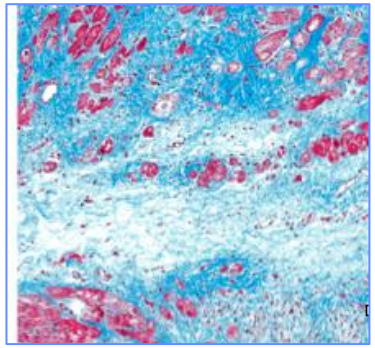

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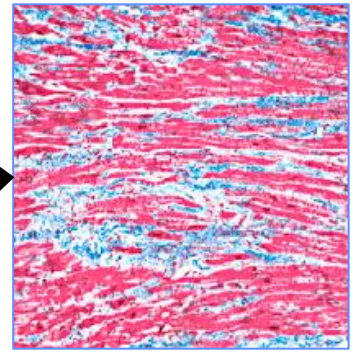
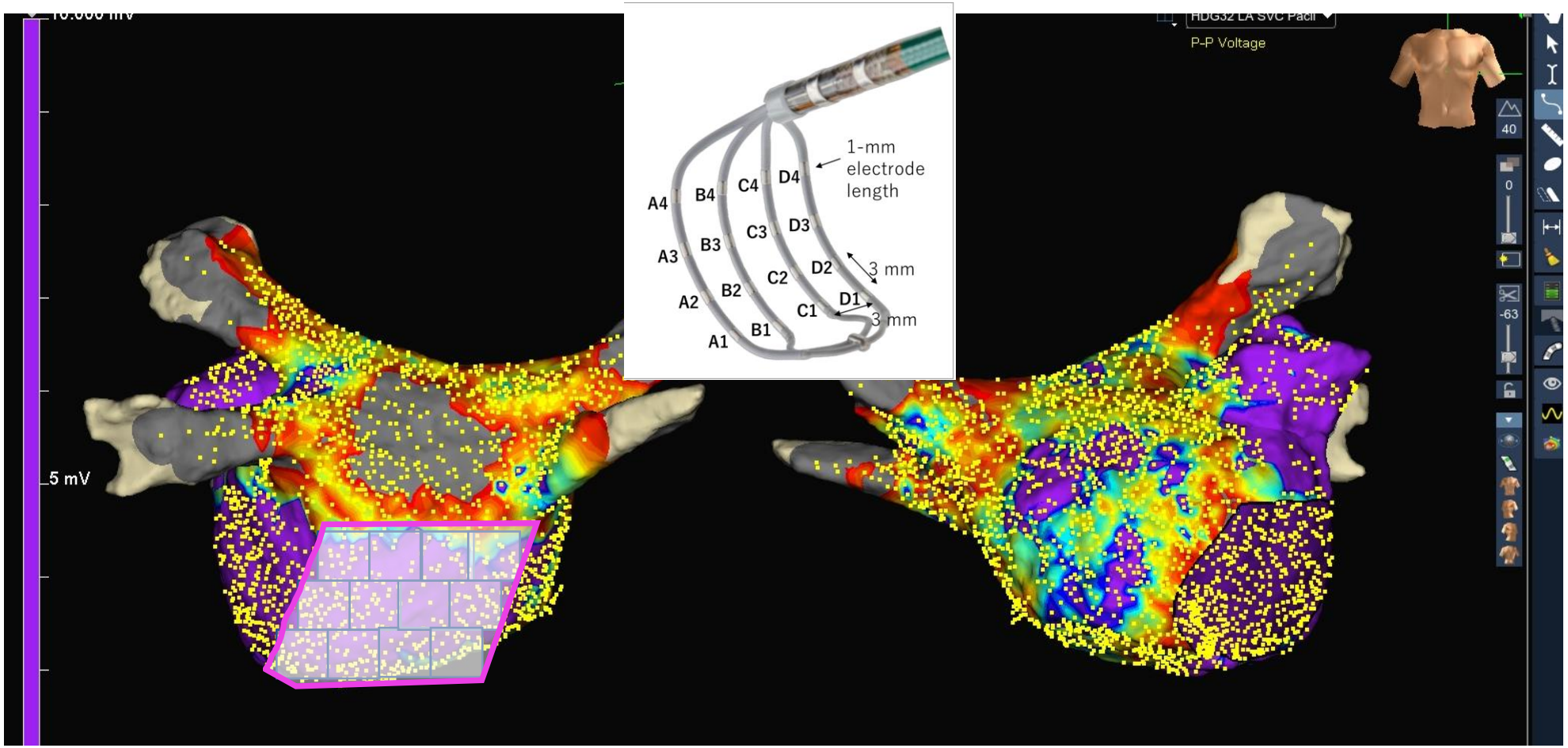


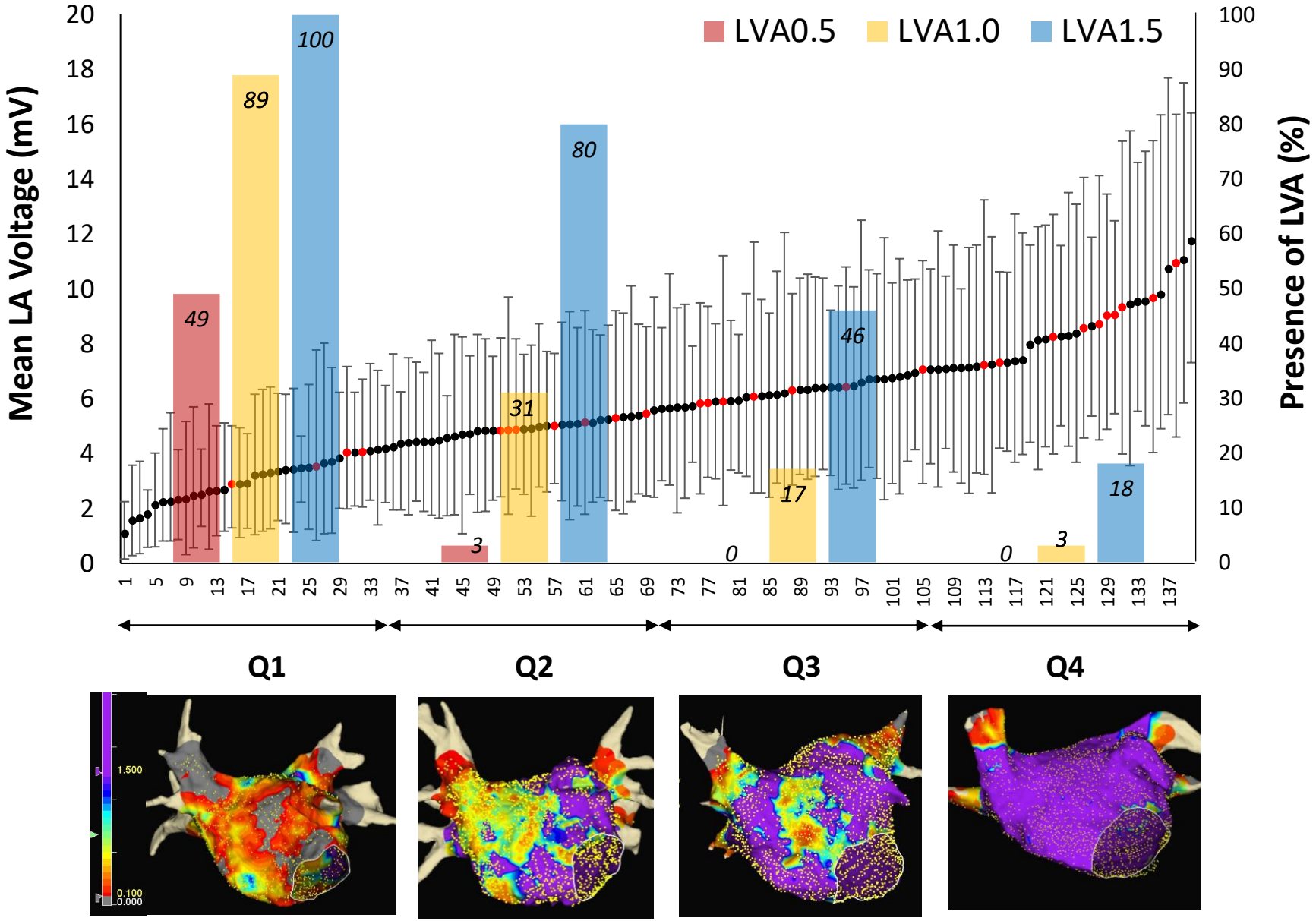
mean LA voltage



High-density voltage map was created using HD grid during right atrial appendage pacing
LA was subdivided into each 1cm2 area.
Mean LA voltage was calculated using the highest voltage of each sub-area in the whole LA.

Figure 1

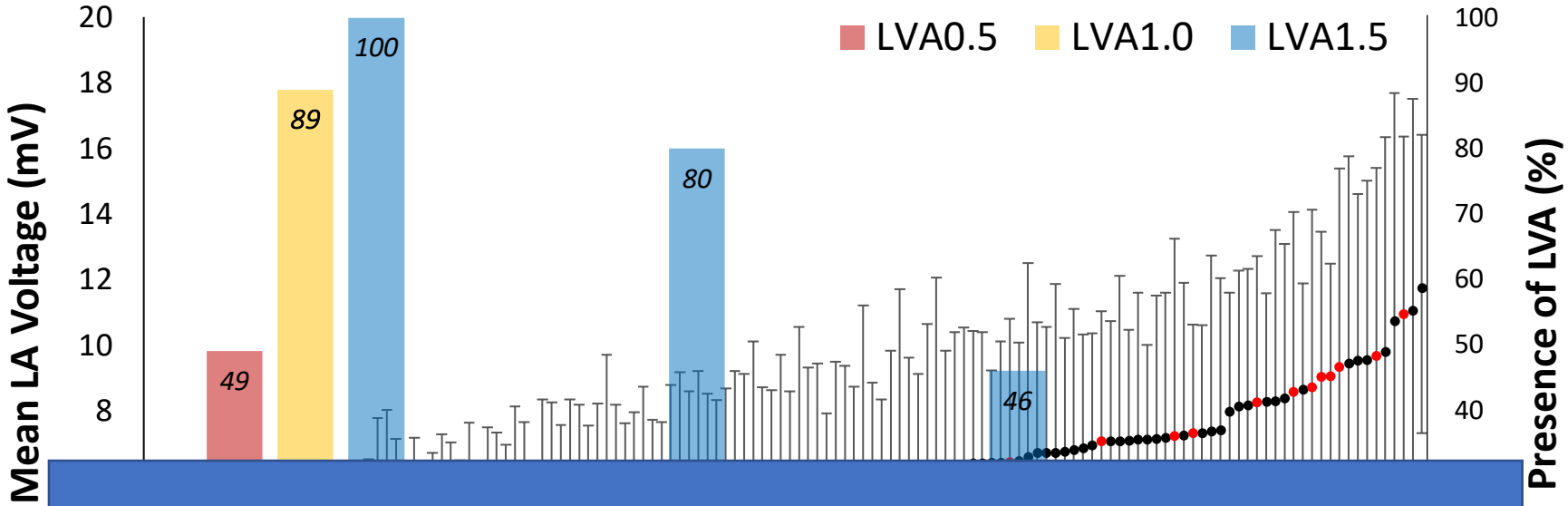
Relationship between LVA and mean LA voltage



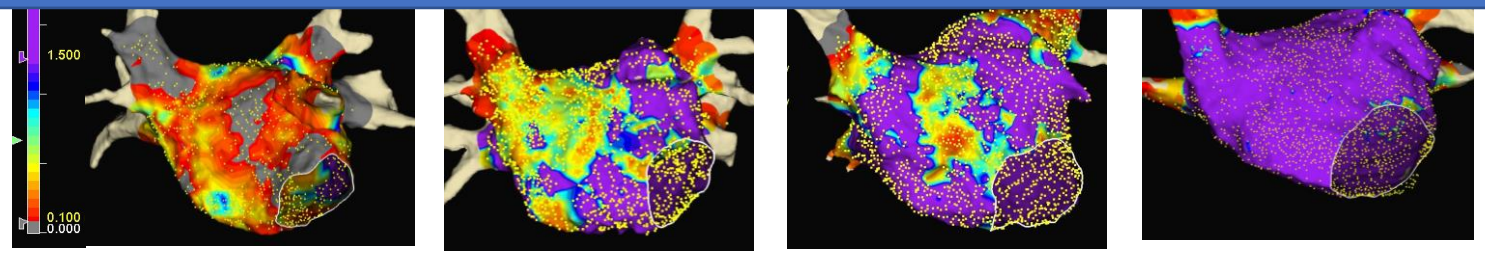
LVA defined as < 1.5mV

Figure 1

Relationship between LVA and mean LA voltage



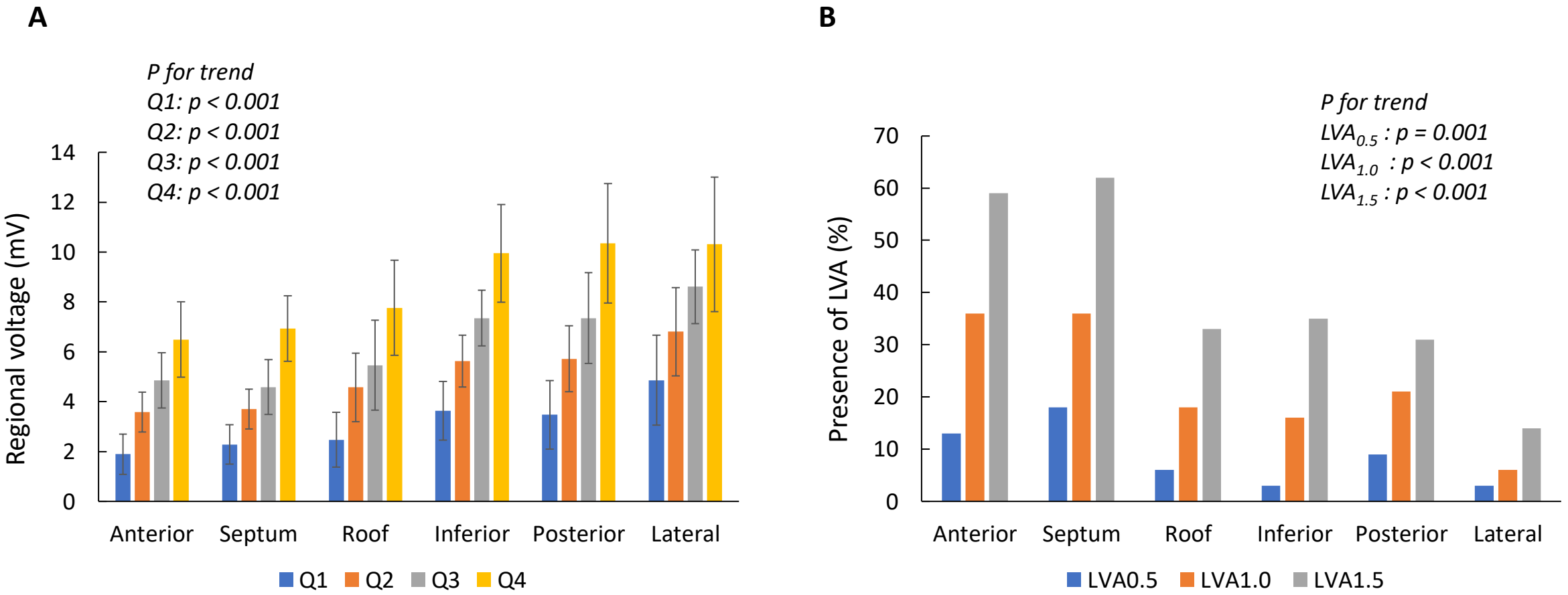
While individual LVAs represent localized voltage reduction, the presence of LVA reflects the global voltage reduction.



LVA defined as < 1.5mV

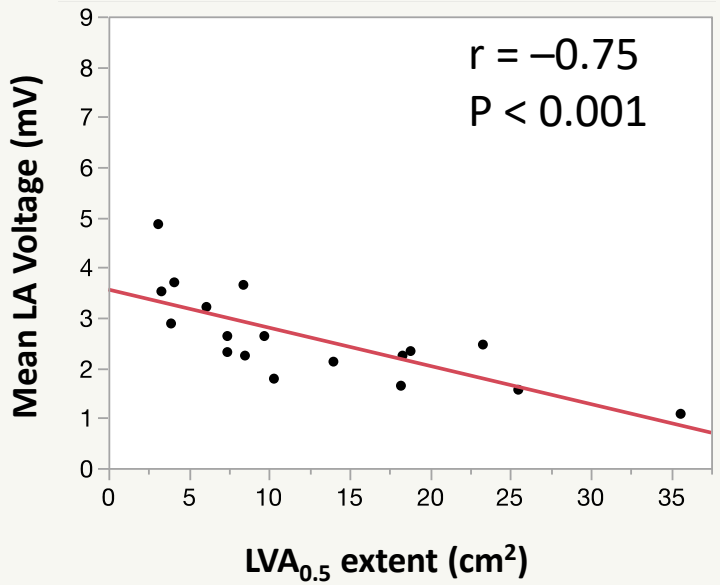
Figure 2

Relationship between regional voltage, mean LA voltage, and LVA

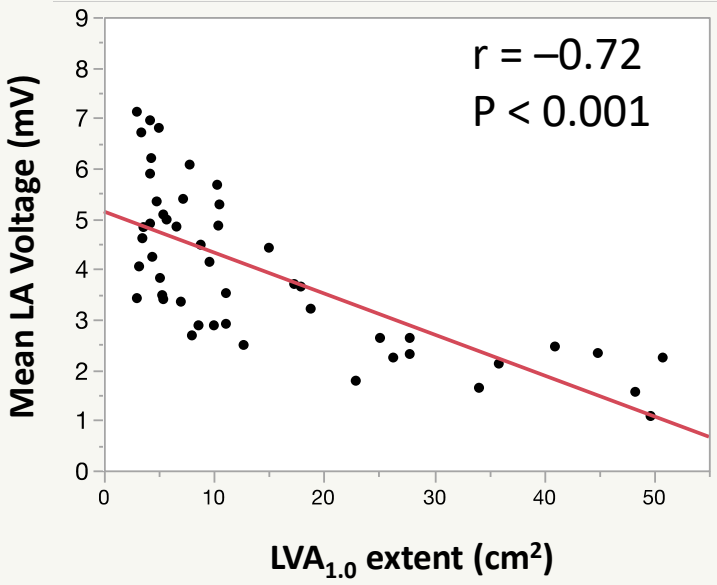


Relationship between the extent of LVA and mean LA voltage

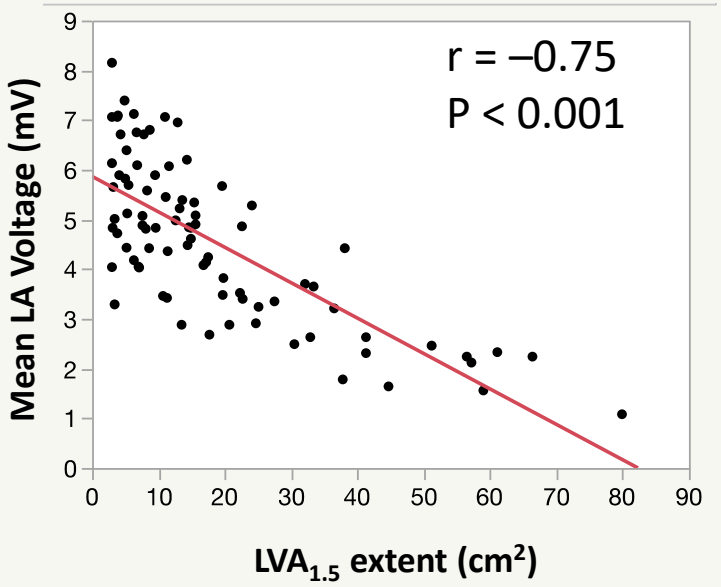
LVA <0.5mV



LVA <1.0mV

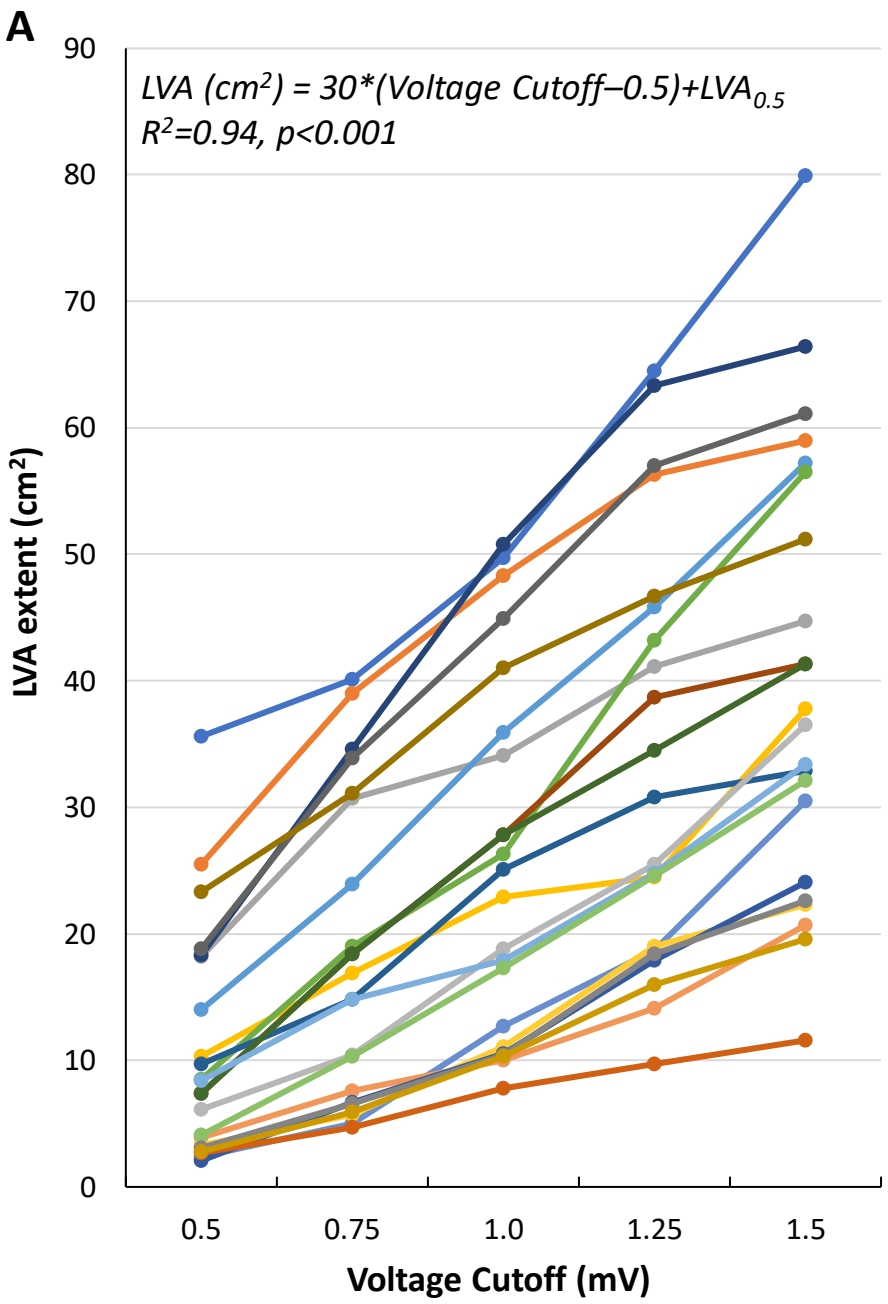


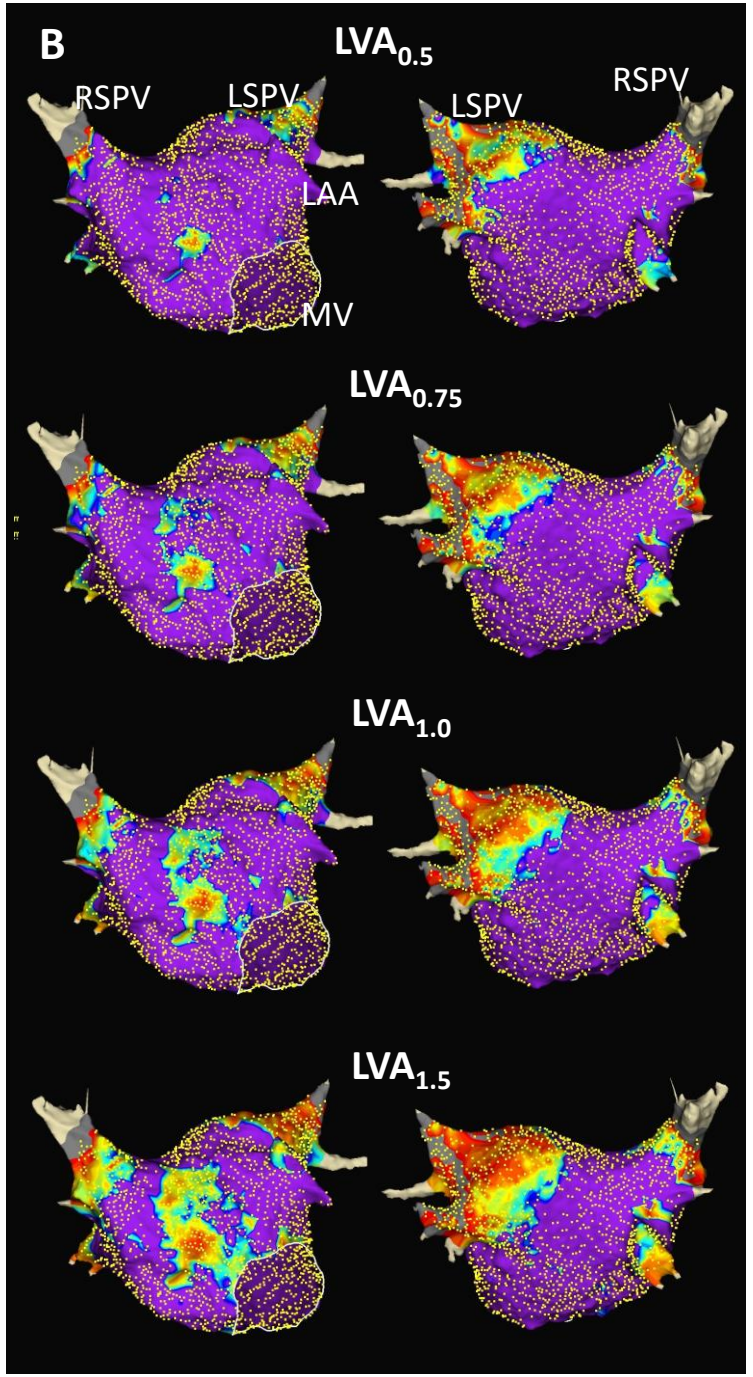
LVA <1.5mV

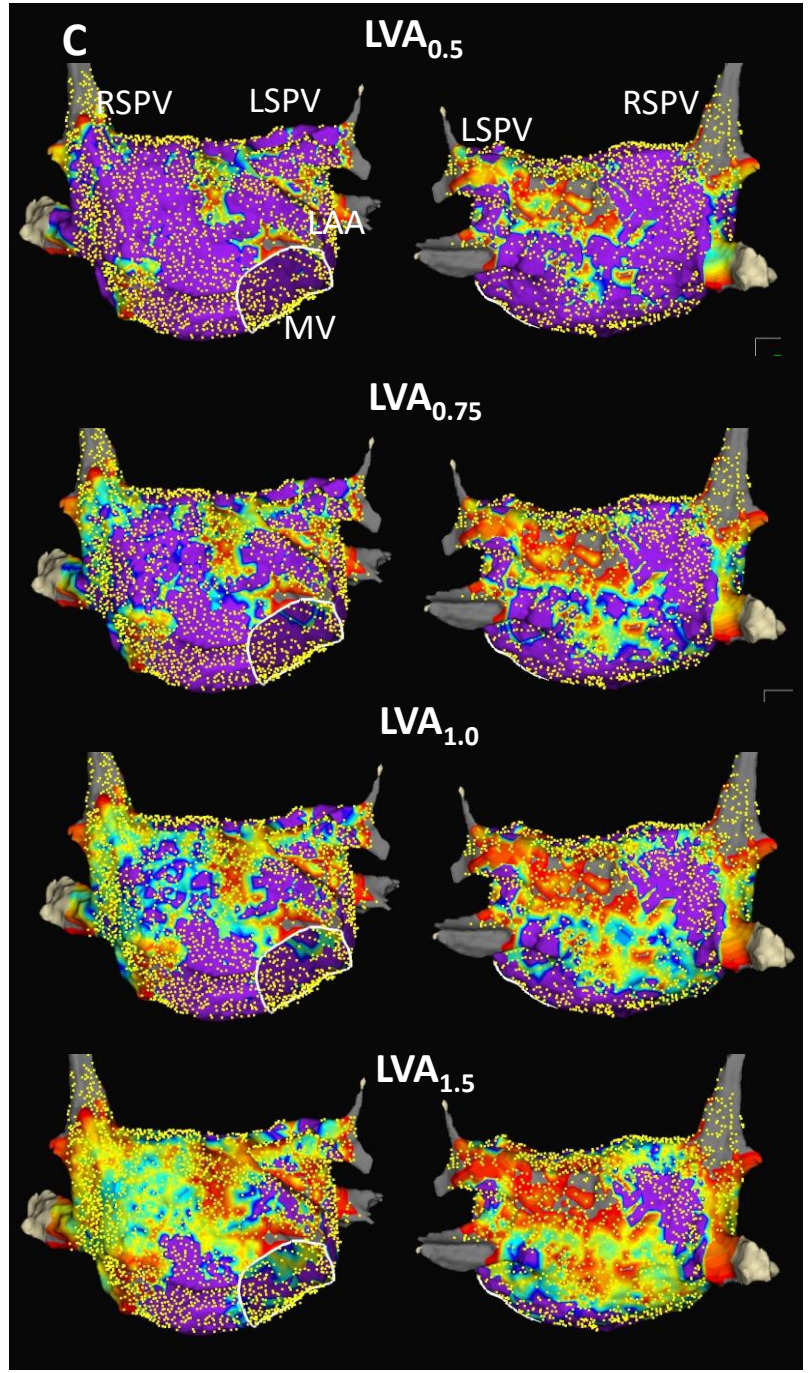


There was a negative linear relationship between LVA extent at any cutoff and mean LA voltage.

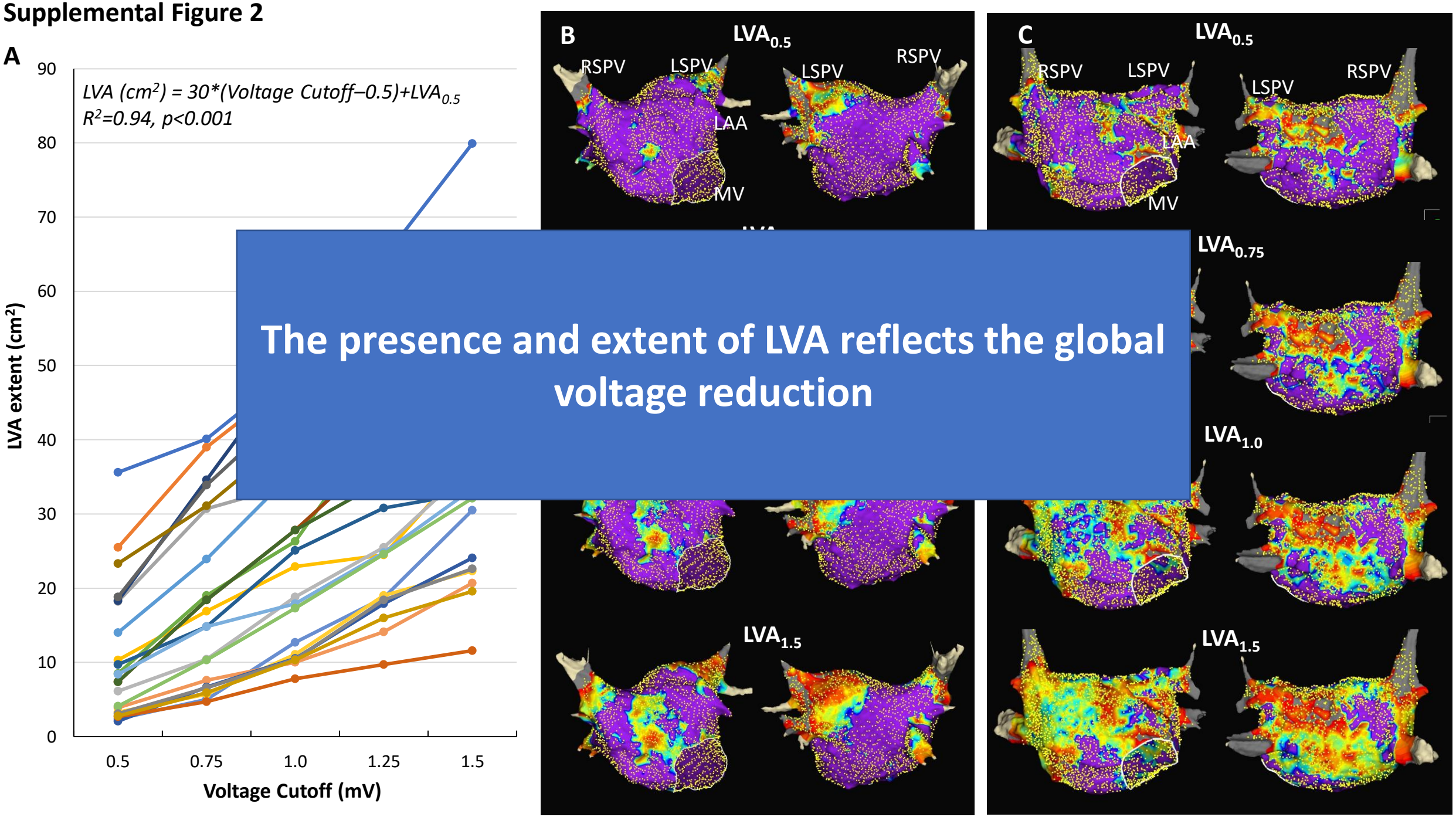
Supplemental Figure 2







Supplemental Figure 2



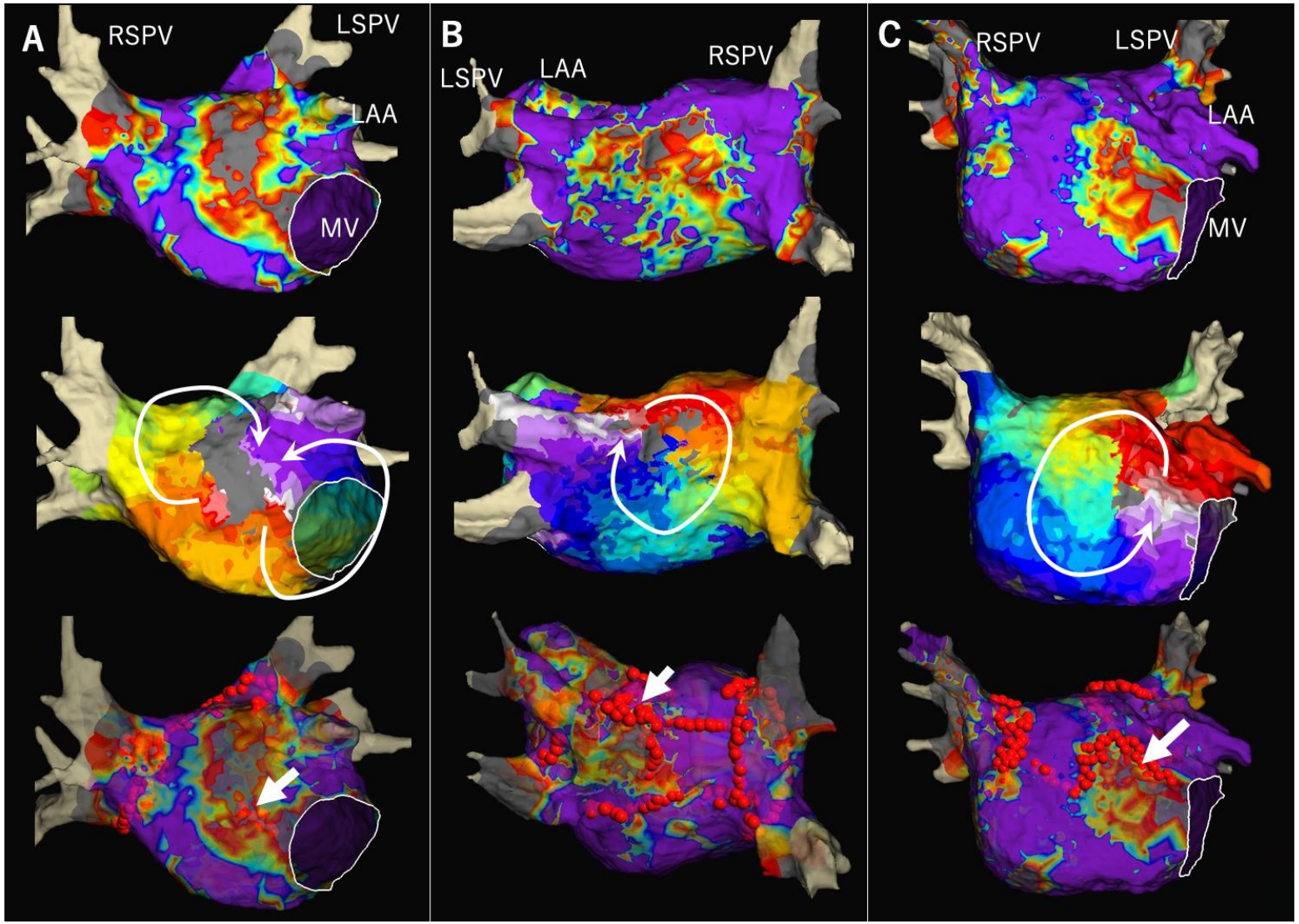
Can the LVA be a target for AF substrate ablation?

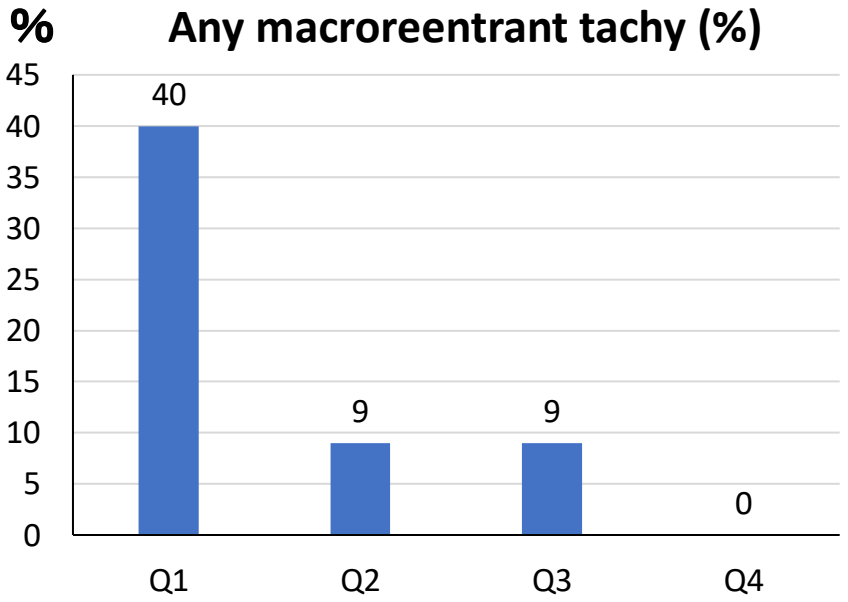
Although we previously reported the efficacy of LVA ablation,
Based on this study, my current opinion would be ‘No‘,
because LVA is a reflection of global voltage reduction.

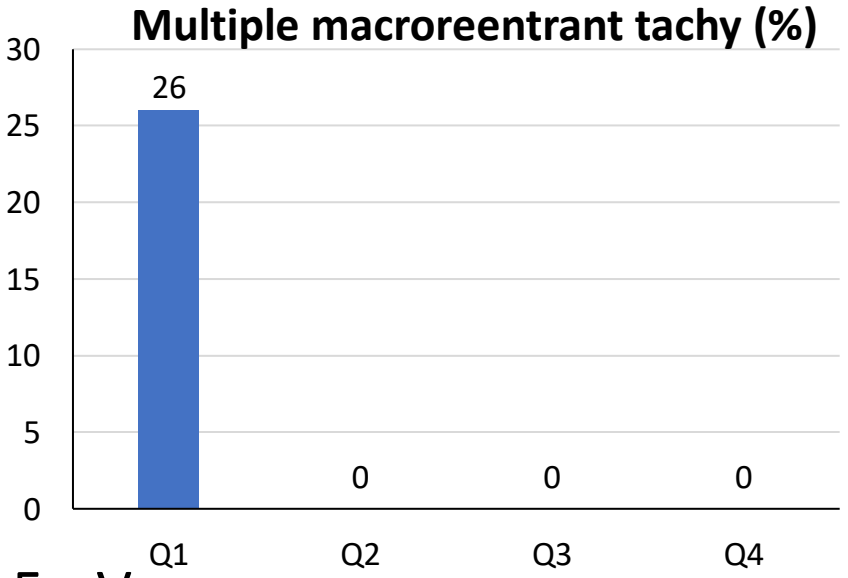
Why LVA ablation improved outcomes in the previous studies?

Relationship between mean LA voltage and inducibility of LA macroreentrant tachycardia

Figure 3







The critical isthmuses of the AT were identified in the LVA <0.5mV

Can the LVA be a target for AF substrate ablation?

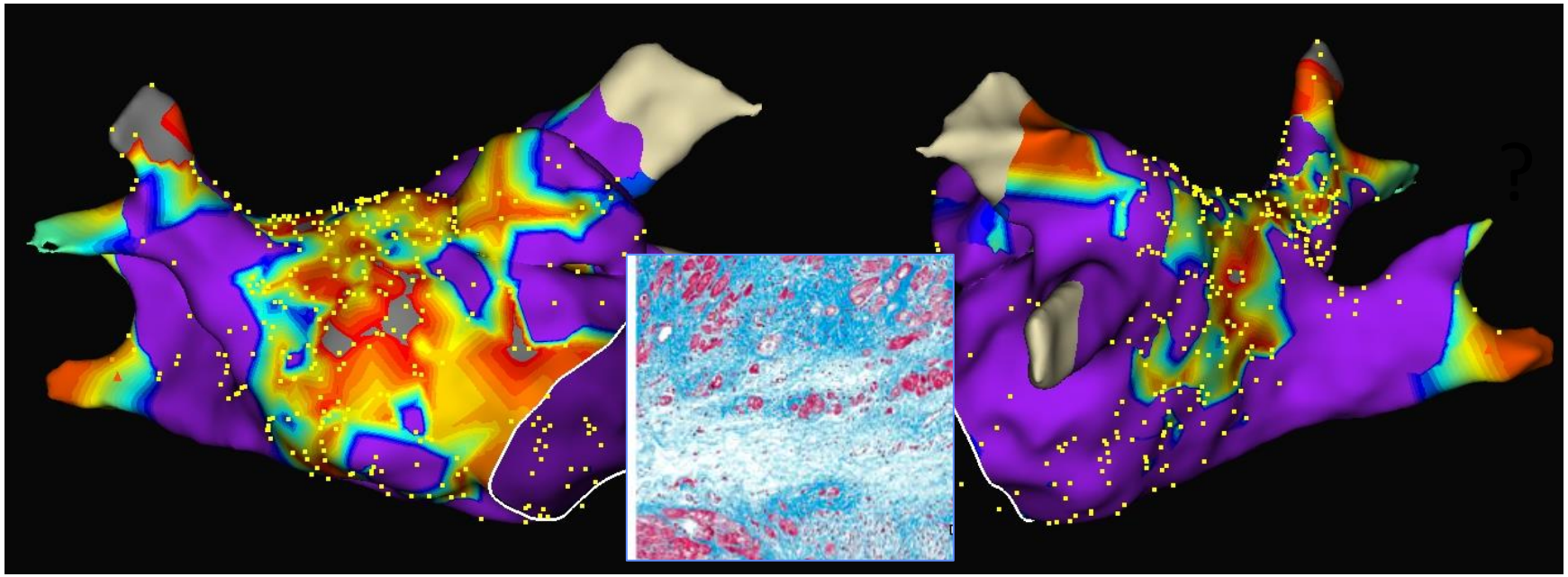
Based on this study, my opinion would be ‘No‘,
because LVA is a reflection of global voltage reduction.

Why LVA ablation improved outcomes in the previous studies?

LVA ablation might have eliminated a substrate for LA macroreentrant tachycardia.

What is the primary cause of atrial voltage reduction?
No histological validation has been reported

<0.5 mV



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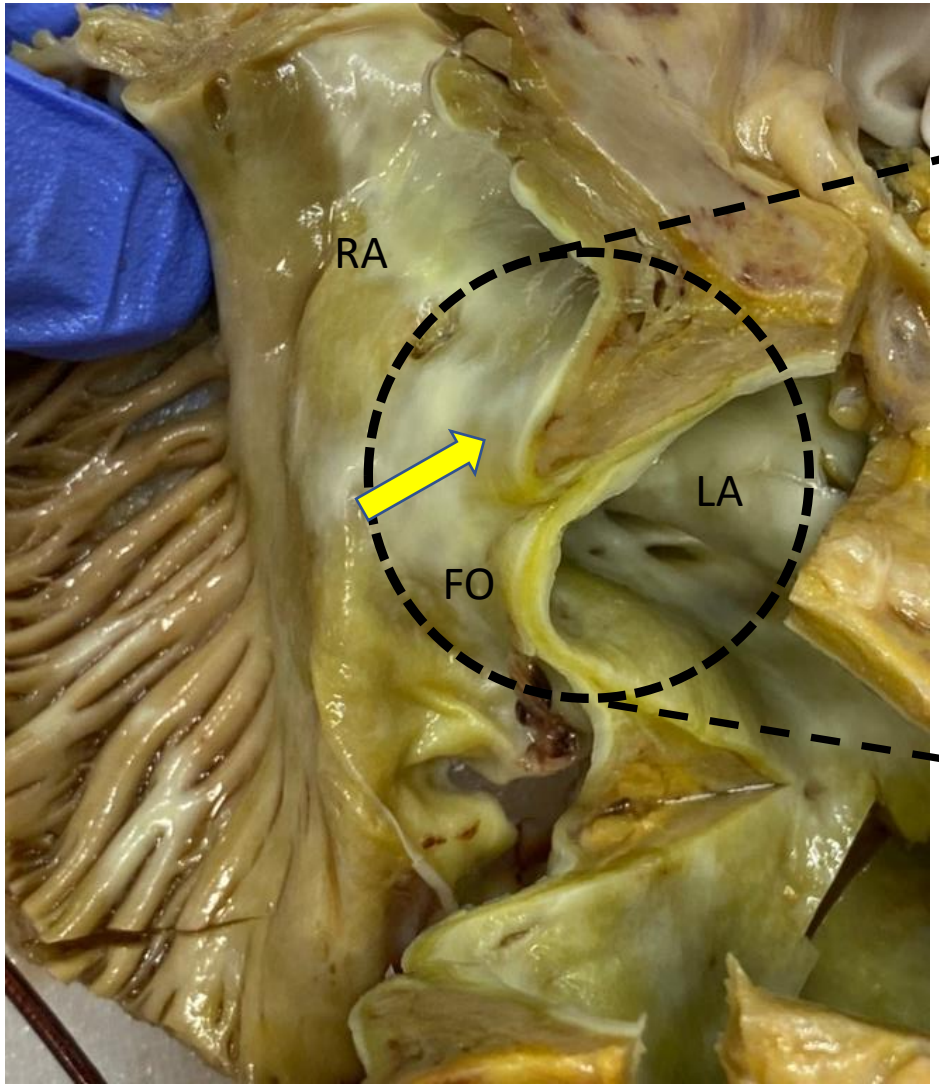
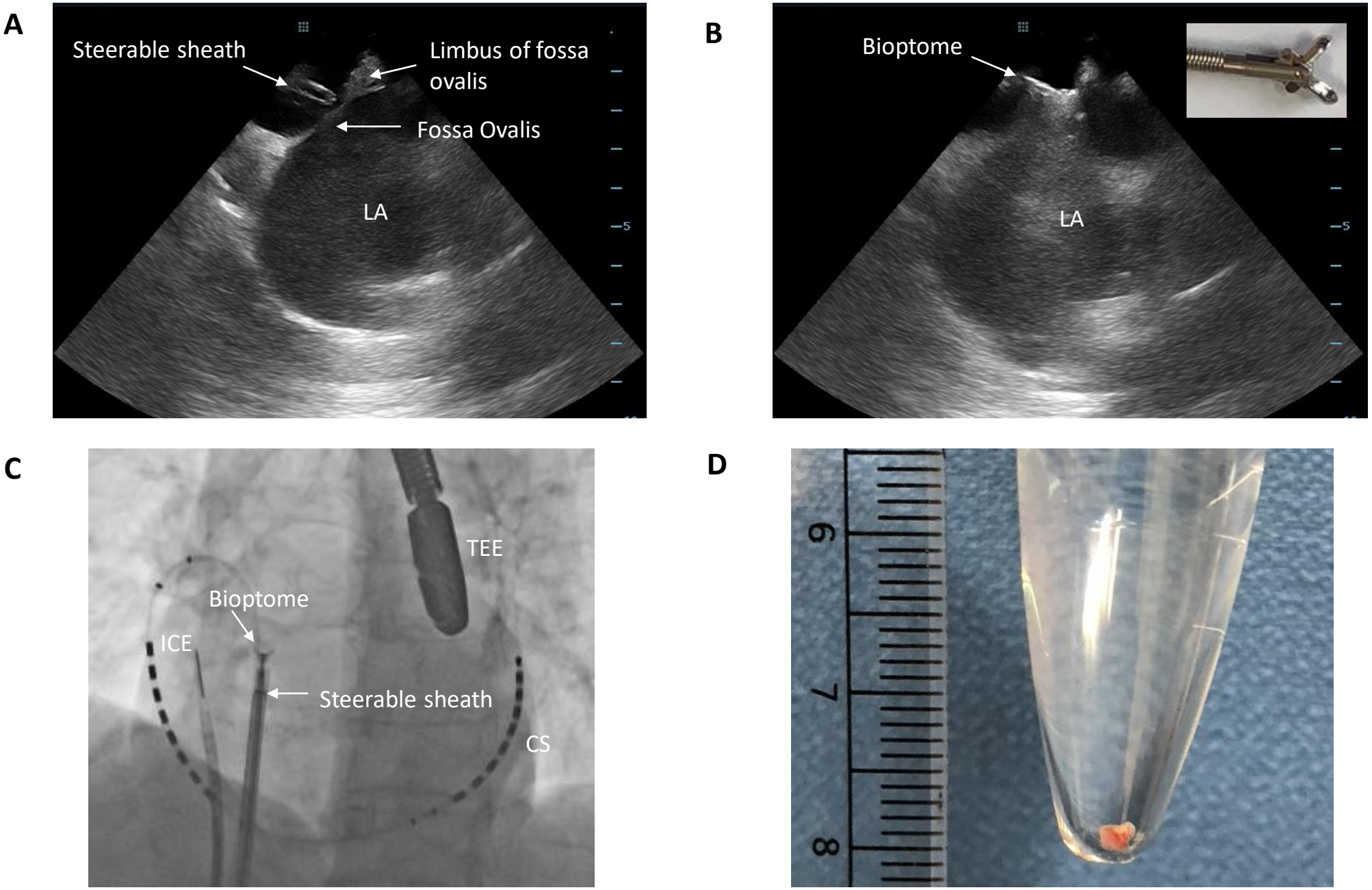
Among the 140 patients, 28 patients underwent histological evaluation of biopsy samples obtained from RA septum

Biopsy site at limbus of fossa ovalis



Our autopsy case

Supplemental Figure 2



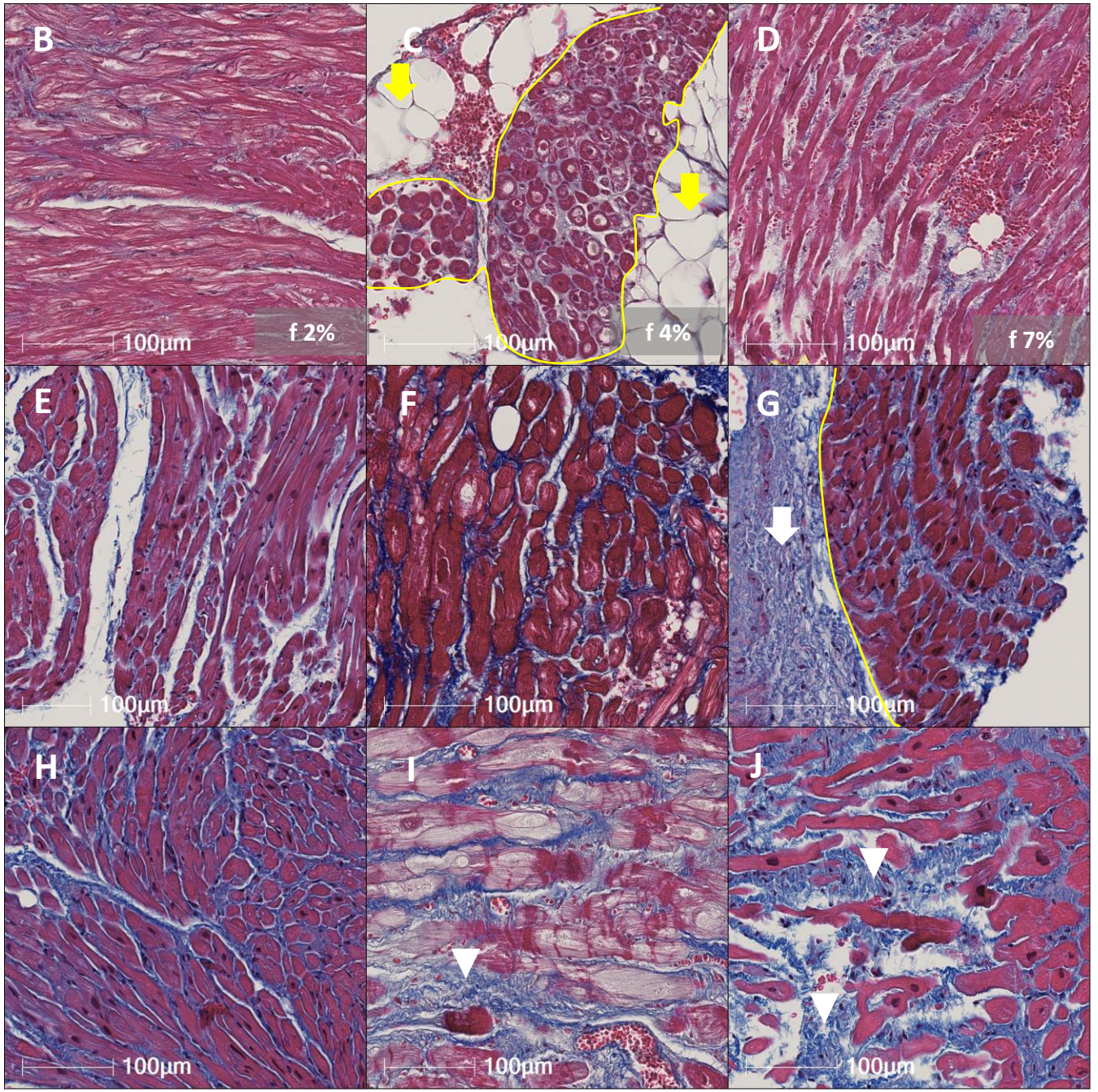
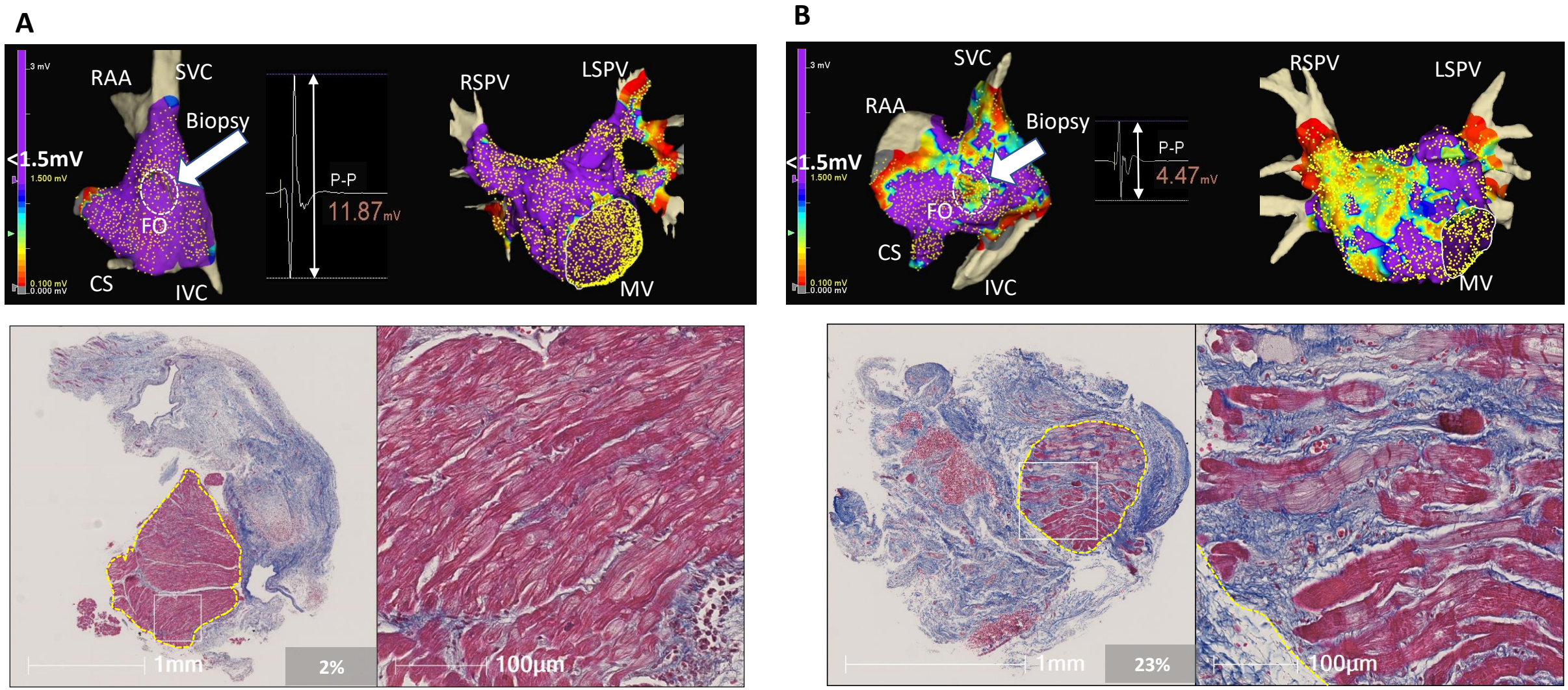
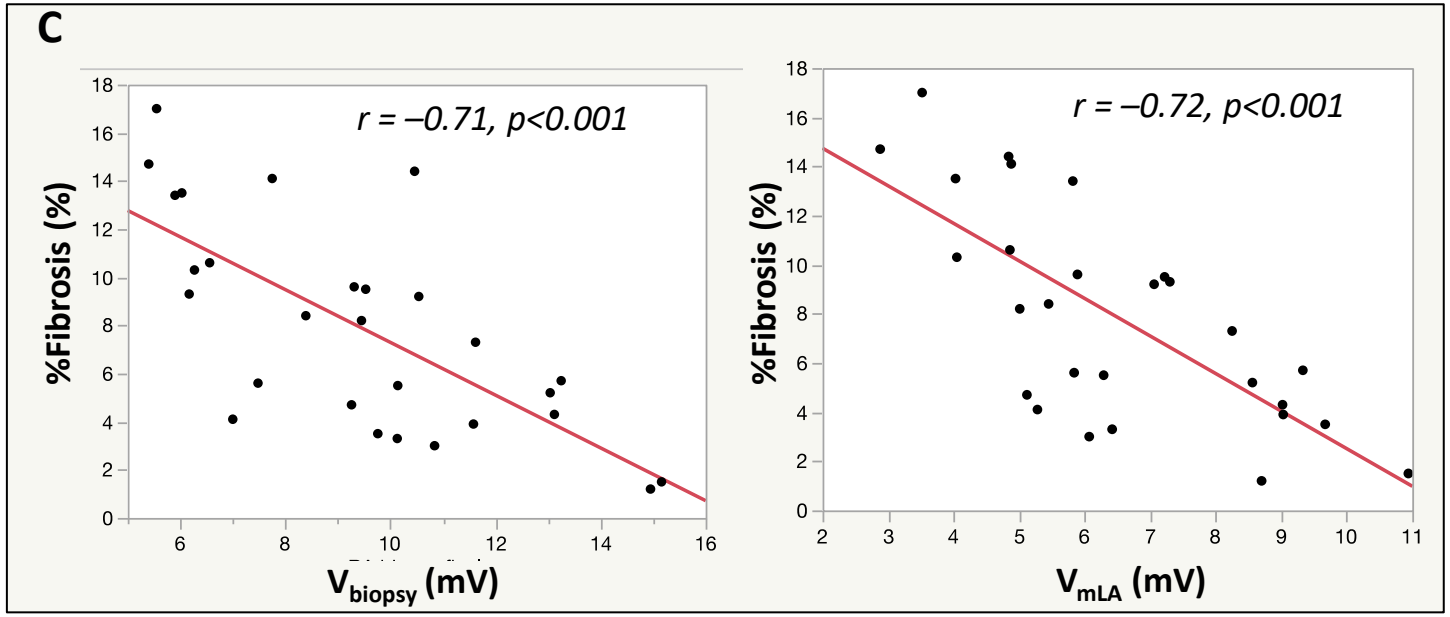
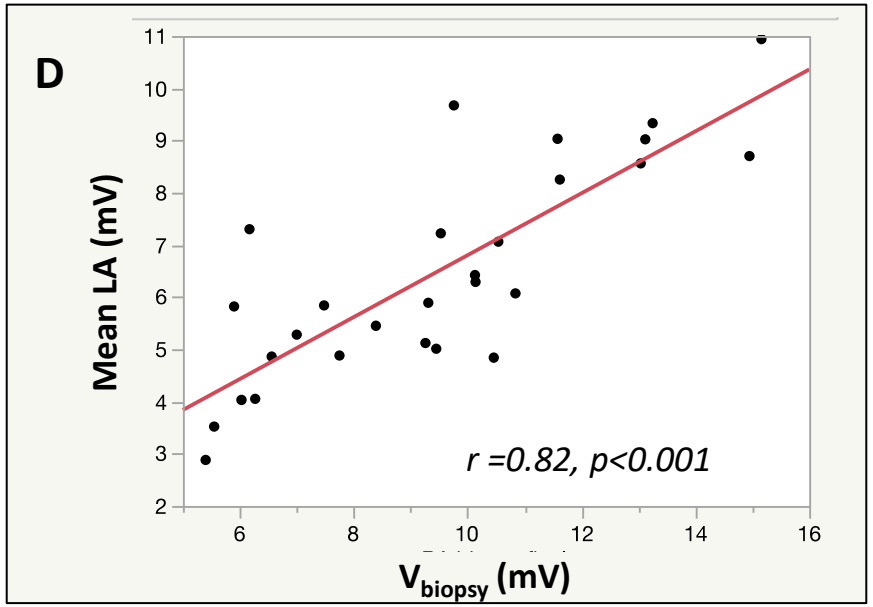

B
100µm
f 2%
C
100µm
f 4%
D
100µm
f 7%
E
100µm
F
100µm
G
100µm
H
100µm
I
100µm
J
100µm

Figure 6


A
B
3 mV
<1.5mV
1.500 mV
0.100 mV
0.000 mV
RAA
SVC
Biopsy
FO
CS
IVC
P-P
11.87 mV
RSPV
LSPV
MV
P-P
4.47 mV
1mm
2%
100µm
23%

Relationship between bipolar voltage and fibrosis





Suggesting the primary cause of voltage reduction at biopsy site and in the LA is fibrosis.

Conclusion

- LVA is a local reflection of diffuse voltage reduction, the primary cause of which was histologically revealed as fibrosis.
- LVA would not be an exclusive substrate for AF, but could be a substrate for LA macroreentrant tachycardia.
- Currently, we do not ablate LVA as AF substrate modification, but target it as AT substrate when AT is induced after PVI.
- Let’s see a video live demonstration!