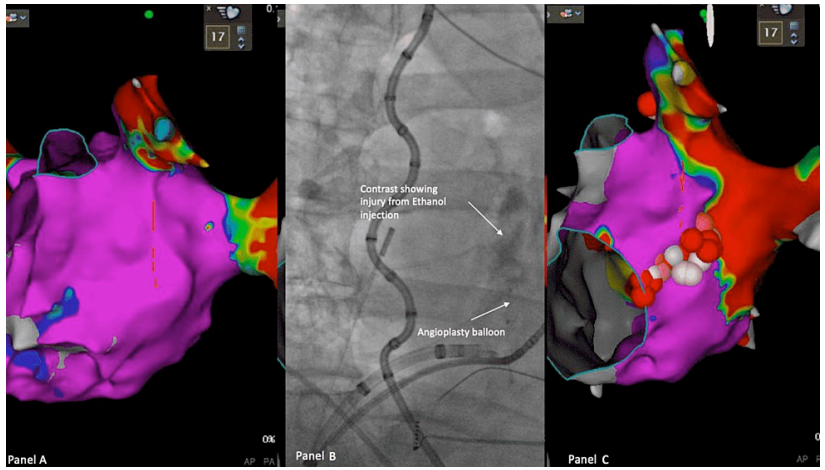
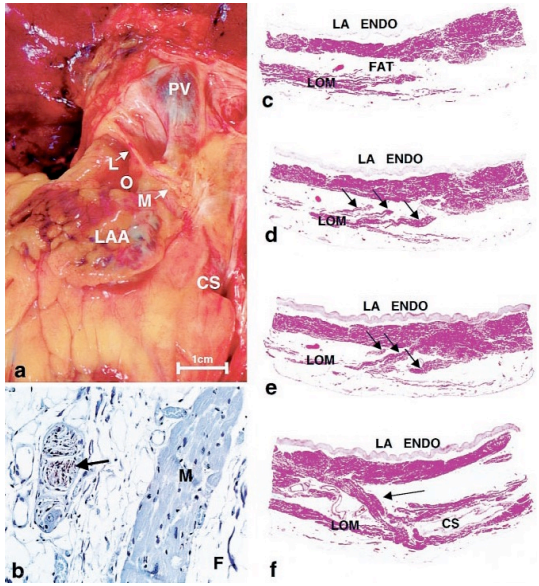
Marshall Veninin Ethanol Ablasyonu





Dr. Timuçin Altın
Ankara Üniversitesi Tıp Fakültesi
Kardiyoloji Anabilim Dalı

AF Zirvesi,
08..12.2023, Antalya

The Ligament of Marshall: A Structural Analysis in Human Hearts With Implications for Atrial Arrhythmias

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Hyrar S. Karagueuzian, PHD, FACC,* Peng-Sheng Chen, MD, FACC,*
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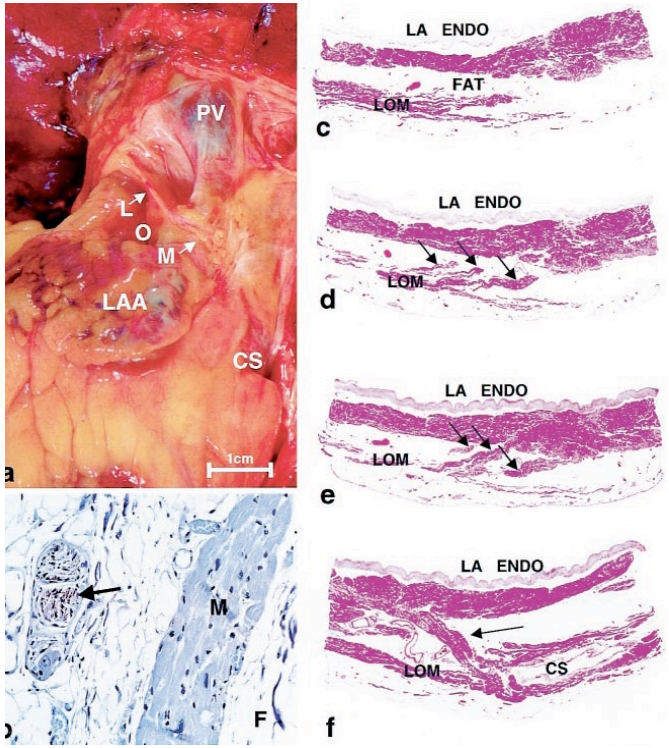
OBJECTIVES We sought to study the anatomy of human ligament of Marshall (LOM).

BACKGROUND Although the LOM has been implicated in the genesis of focal atrial tachyarrhythmias, its gross anatomic and microscopic features in humans hearts have not been completely defined.

METHODS We studied seven postmortem human hearts from five men and two women with a mean age of 52 ± 26 years. Four did not have any heart disease. One woman had dilated cardiomyopathy, and two men had chronic atrial fibrillation. A block of tissue encompassing the LOM from the coronary sinus (CS) cephalad, between the atrial appendage and left pulmonary veins, was dissected. Serial sections from this tissue were then stained with hematoxylin and eosin, trichrome, and/or tyrosine hydroxylase.

RESULTS The LOM consists of multiple sympathetic nerve fibers, ganglia, blood vessels and multiple myocardial tracts (Marshall Bundles) insulated by fibrofatty tissue. One or more myocardial tracts was inserted directly into the left atrial free wall and CS. The distance between insertion sites was 7.8 ± 2.5 mm. Nerve fibers, some tyrosine hydroxylase positive, were present within the fibrofatty matrix and within the myocardial tracts.

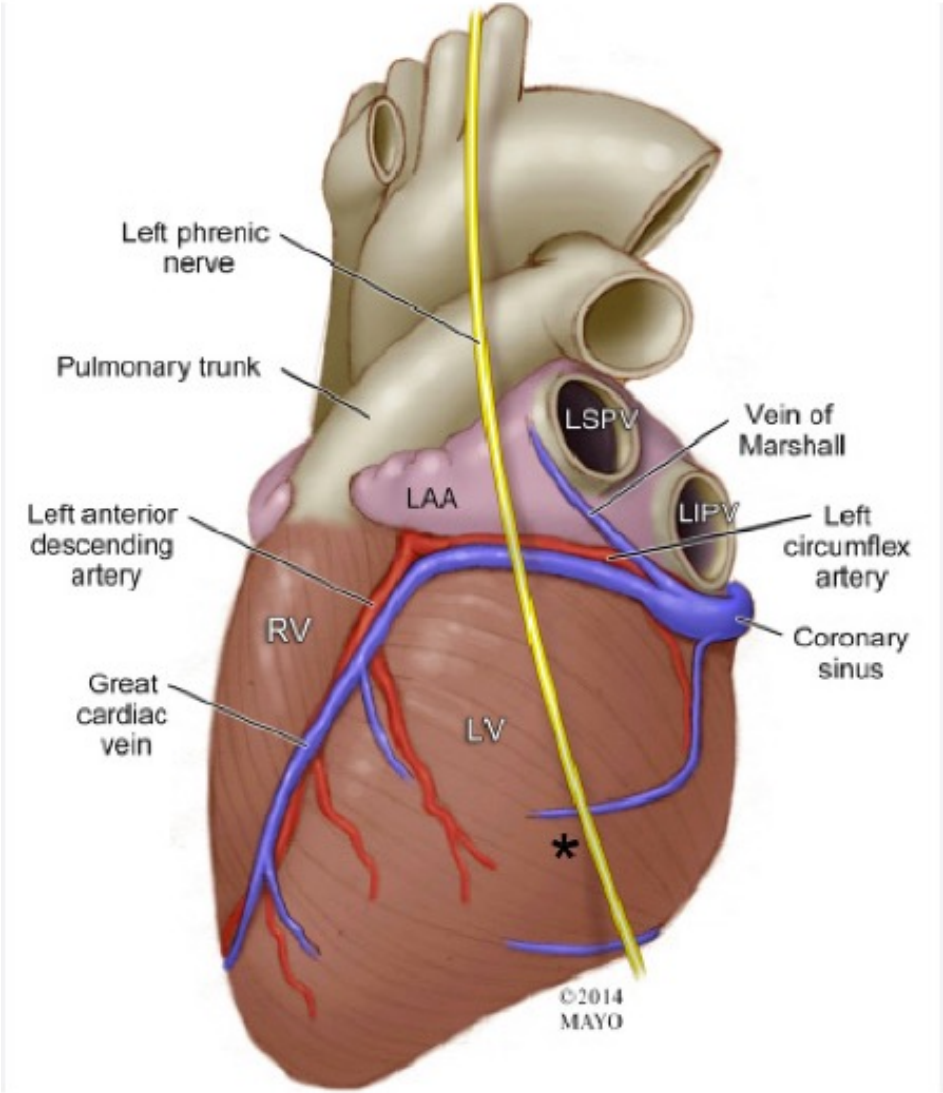
CONCLUSIONS Human LOM 1) is innervated by sympathetic nerve fibers; 2) is more complex than the LOM in canine hearts; and 3) has multiple myocardial tract insertions into the left atrial free wall and CS, forming a substrate of reentry. Radiofrequency catheter ablation from the CS may fail to reach the free wall insertion (J Am Coll Cardiol 2000;36:1324–7) © 2000 by the American College of Cardiology

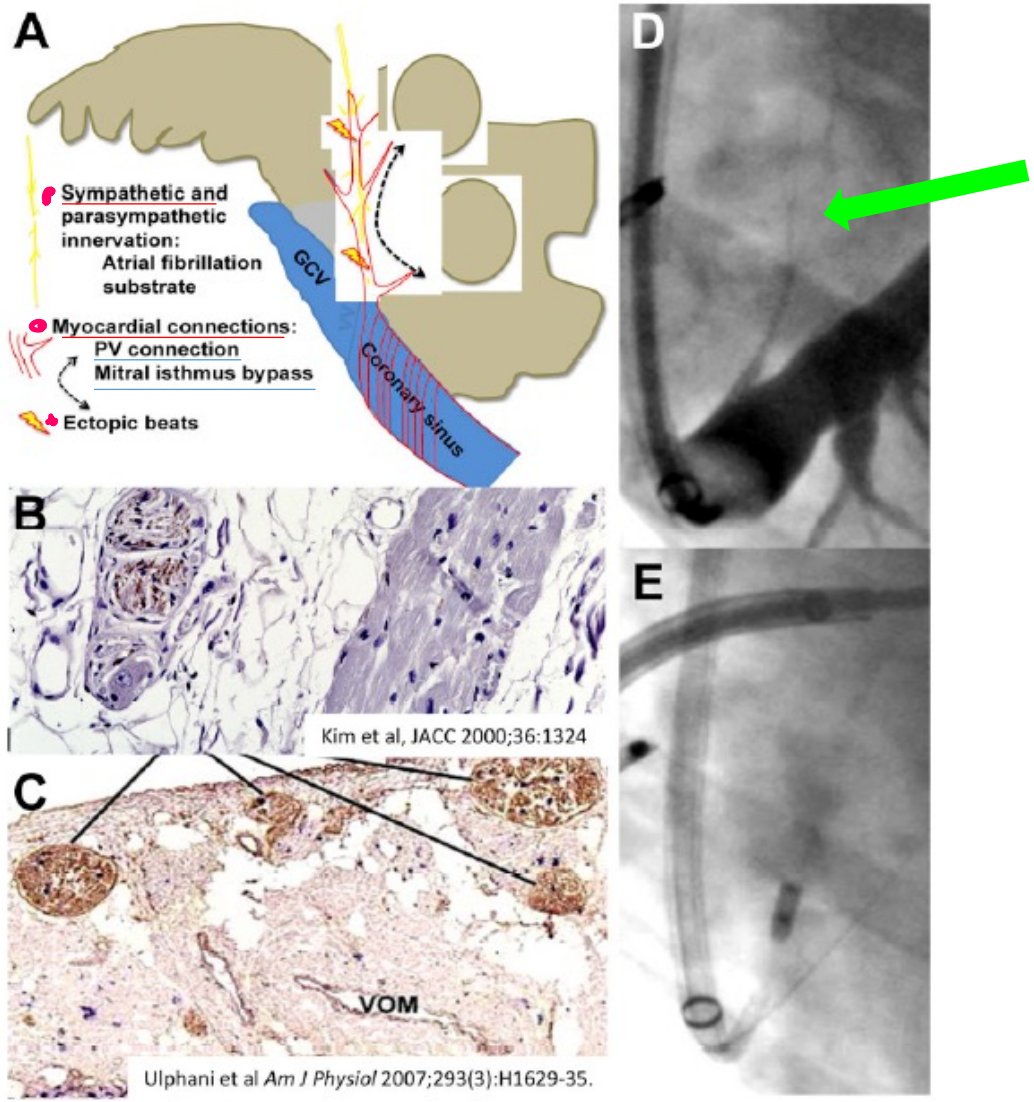


Lig. of Marshall

- Kan damarları
- Sinir lifleri
- Miyokard lifleri (Marshall bundles)

Marshall Ligamenti ….





Marshall Ligamenti ….

- Nöral ağ
- Miyokart lifleri
- Aritmojenik odak

→ **Atriyal fibrilasyon**

Trigger/substrat

EP remodeling - idame

PV reconnection

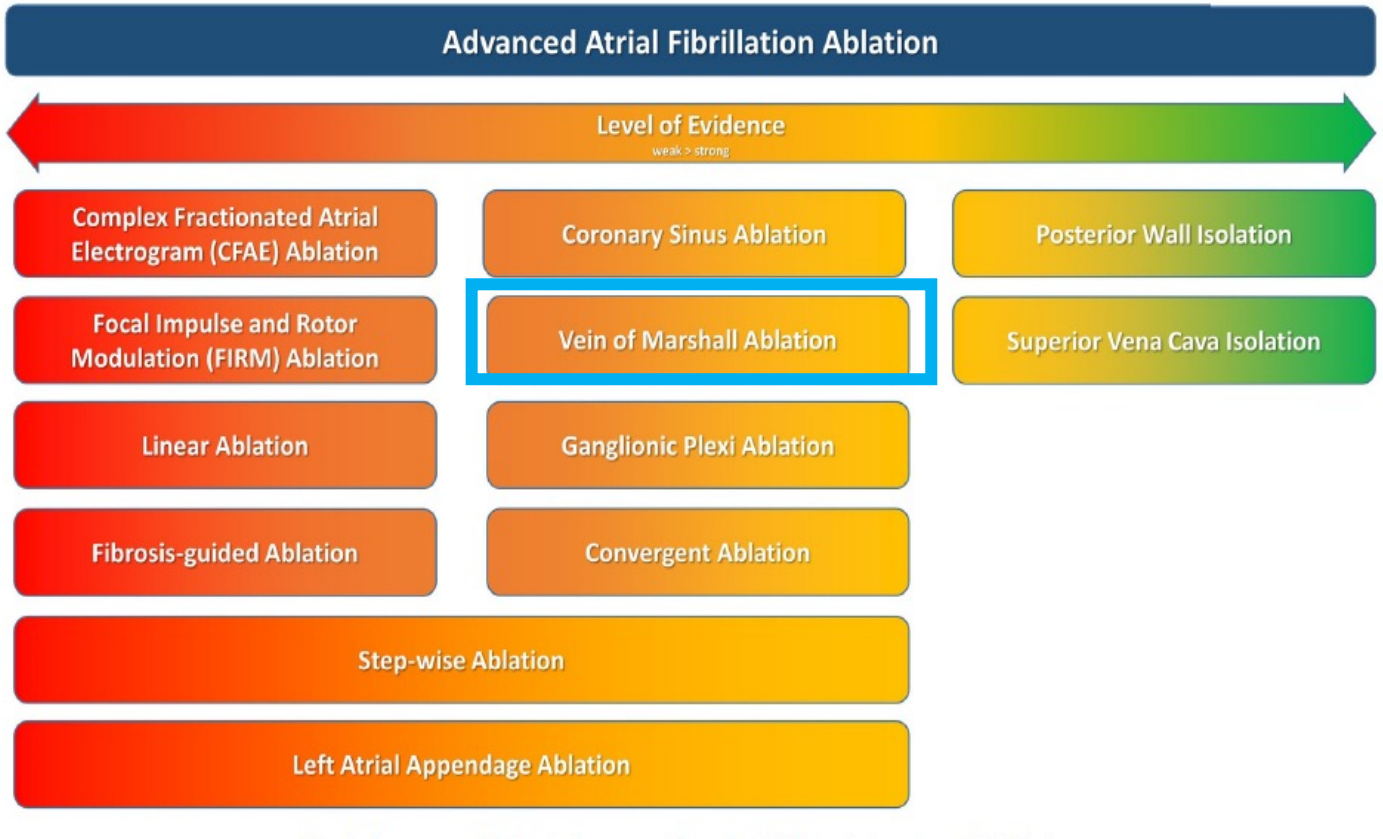
- Mitral isthmusa komşu

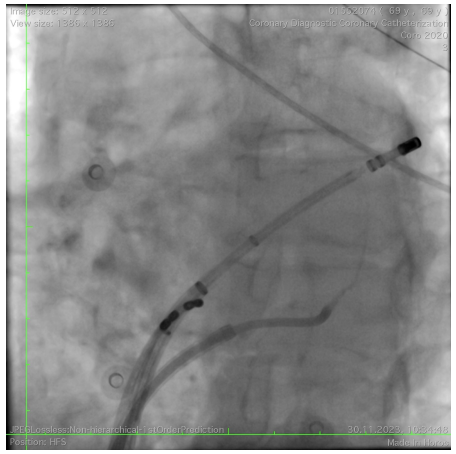
→ **Perimitral flutter**

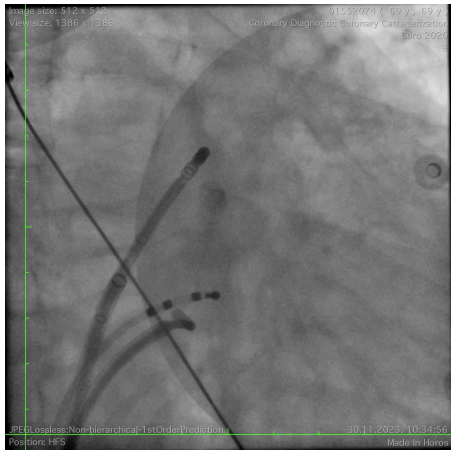
Persistan Atriyal fibrilasyon Ablasyonu

PVI

+







Trends in Cardiovascular Medicine, https://doi.org/10.1016/j.tcm.2022.04.002

Marshall Ven Alkol ablasyonu

- %96-98 ethanol
- Sitotoksik, kimyasal ablasyon
- 10-15 dk içinde, endokardiyal bipolar voltajda düşme.
- Hasar miktarı; VOM boyutu, ve ethanol dozuna bağlıdır.

- <u>Alkol ablasyonu ile ne yapıyoruz</u>?
  - Lokal ablasyon
  - AF trigger eliminasyonu
  - Atriyal denervasyon (atriyal refrakter periyot…)
  - Mitral isthmusta bidirectional blok sağlamada kolaylık

İnsanda ilk VOM Ethanol Ablasyonu - 2009

Circ Arrhythm Electrophysiol. 2008 December 7; 2(1): 50–56. doi:10.1161/CIRCEP.108.818427.

Retrograde ethanol infusion in the vein of Marshall: Regional left atrial ablation, vagal denervation and feasibility in humans

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Abstract

Background: The vein of Marshall (VOM) is an attractive target during ablation of atrial fibrillation due to its autonomic innervation, its location anterior to the left pulmonary veins and drainage in the coronary sinus.

Methods and results: We studied 17 dogs. A coronary sinus venogram showed a VOM in 13, which was successfully cannulated with an angioplasty wire and balloon. In 5 dogs, electroanatomical maps of the left atrium were performed at baseline and after ethanol infusion in the VOM, which demonstrated a new crescent-shaped scar, extending from the annular left atrium towards the posterior wall and left pulmonary veins. In 4 other dogs, effective refractory periods (ERP) were measured at 3 sites in the left atrium, before and after high-frequency bilateral vagal stimulation. The ERP decreased from 113.6±35.0 ms to 82.2±25.4 ms ($p<0.05$) after vagal stimulation. After VOM ethanol infusion, vagally-mediated ERP decrease was eliminated (from 108.6±24.1 ms to 96.4 ±16.9ms, p=NS). The abolition of vagal effects was limited to sites near the VOM (ERP: 104±14 ms, vs 98.6±12.2 ms post vagal stimulation, p=ns), as opposed to sites remote to VOM (ERP: 107.2 ±14.9 ms, vs 78.6±14.7ms post vagal stimulation, $p<0.05$). To test feasibility in humans, 5 patients undergoing pulmonary vein antral isolation had successful VOM cannulation and ethanol infusion: left atrial voltage maps demonstrated new scar involving the infero-posterior left atrial wall extending towards the left pulmonary veins.

Conclusions: Ethanol infusion in then VOM achieves significant left atrial tissue ablation, abolishes local vagal responses and is feasible in humans.

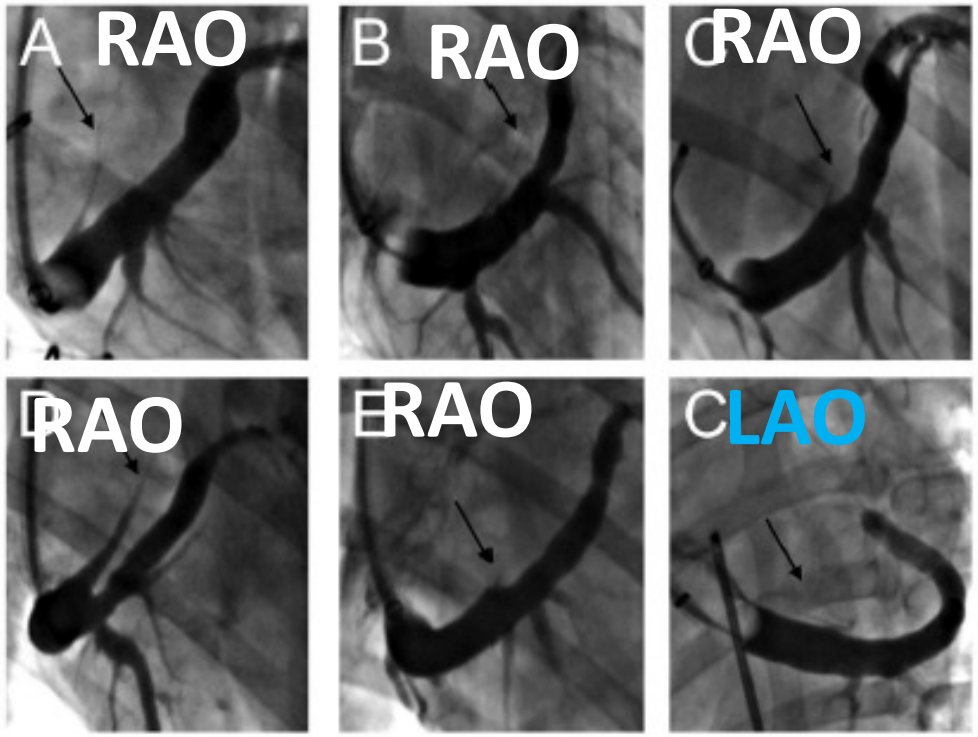
Keywords

ethanol; ablation; vein of Marshall; atrial fibrillation; vagal

Circ Arrhythm Electrophysiol. 2008 December 7; 2(1): 50–56. doi:10.1161/CIRCEP.108.818427.

İnsanda ilk VOM Ethanol Ablasyonu - 2009

Köpekte



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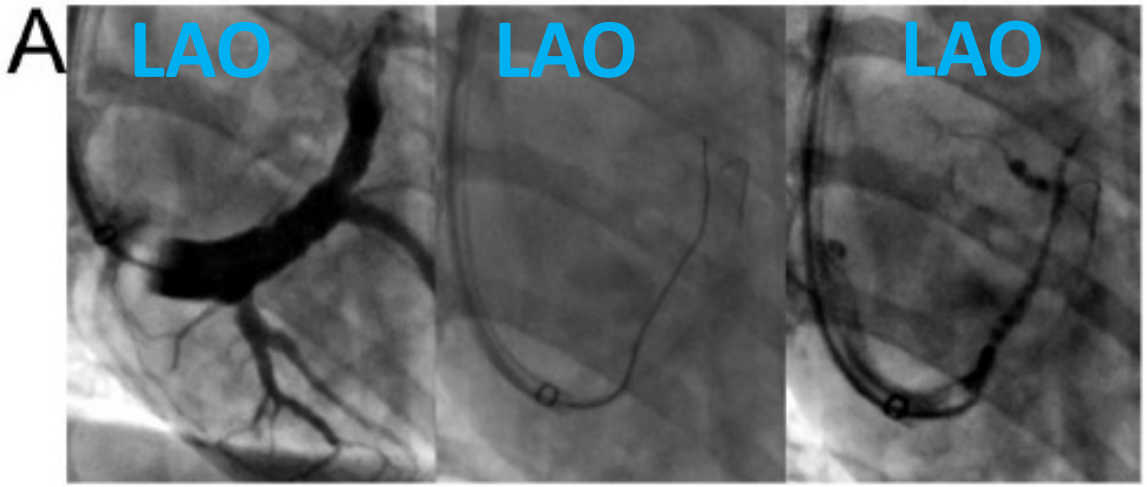
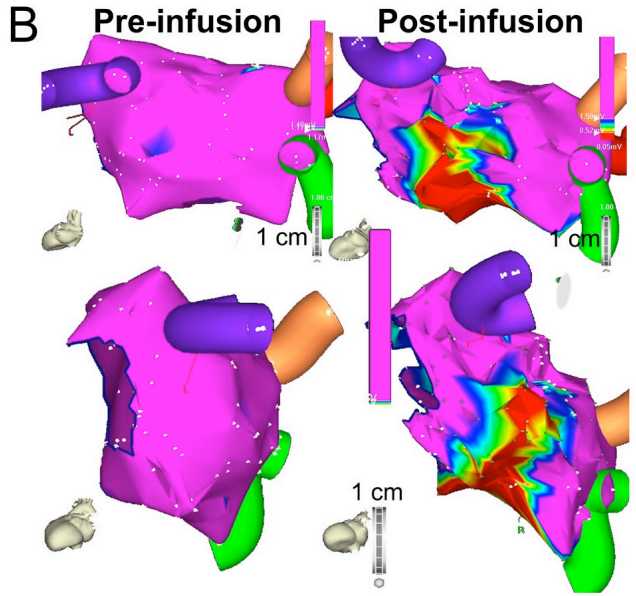
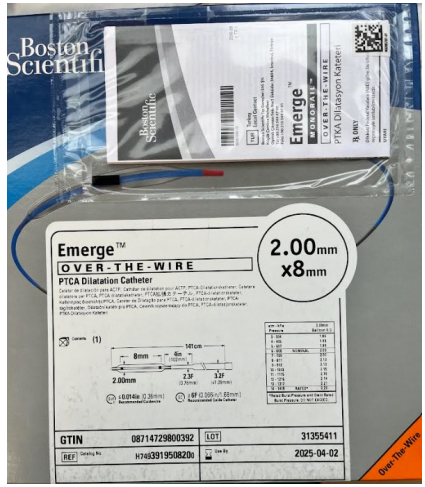




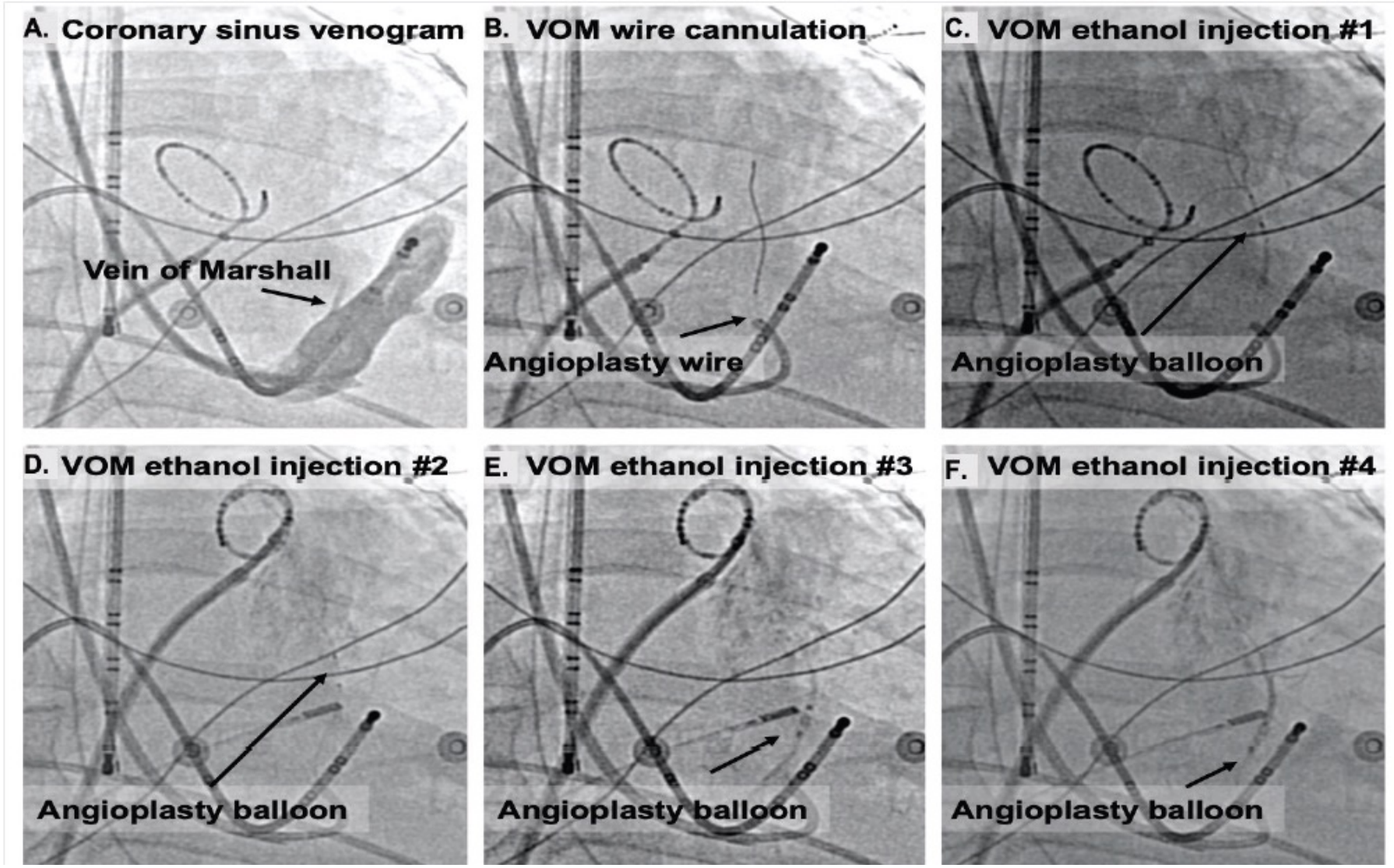
Circ Arrhythm Electrophysiol. 2008 December 7; 2(1): 50–56. doi:10.1161/CIRCEP.108.818427.

Marshall Ven Alkol ablasyonu – Teknik

- Koroner sinüs kanülasyonu (uzun kılıf-femoral/juguler)
- CS balon kateter ile ya da inner (LİMA-sağ guiding) venogram (VOM varlığı için)
- VOM kanülasyonu (RAO'da posterior-LAO'da superior yönelimli)
- 0,014 tel ilerletilmesi (önceden OTW balon katetere yüklenmiş), 1,5-2,5 mm çap/6-12 mm uzunluğunda OTW balon kateter
- Balon şişirilmesi (kontrast verilmesi– kaçak olmadığına emin olunmalı…)
- 3-4 kez, 1-3 cc alkol, 2 dk içinde infüzyon.

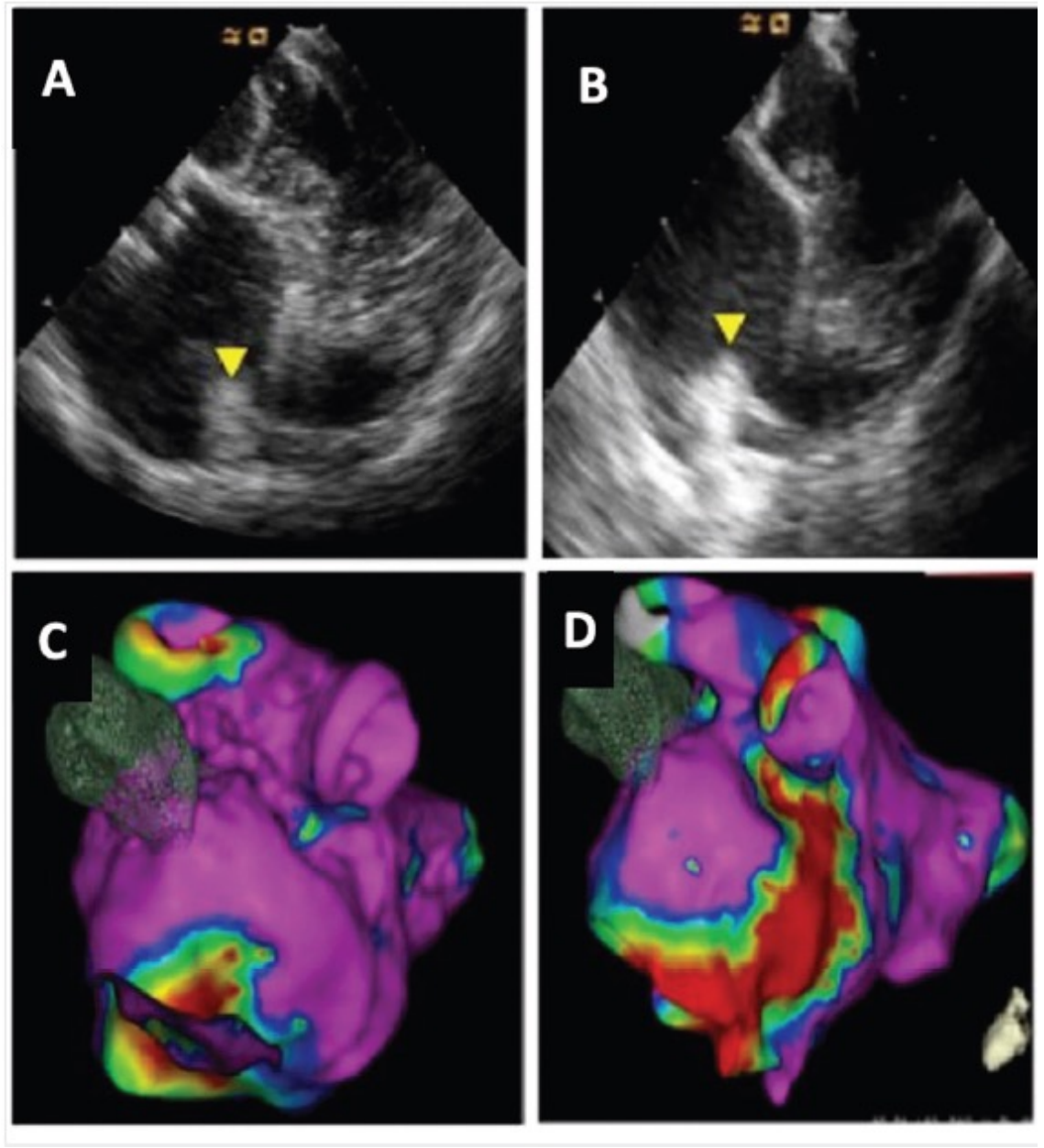


Marshall Ven Alkol ablasyonu – Teknik-



Önce

Sonra



2009

Ethanol infusion in the vein of Marshall: Adjunctive effects during ablation of atrial fibrillation

PVI'a ek olarak

Pre-adjunctive= Önce ethanol

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From the Methodist DeBakey Heart and Vascular Center and Methodist Hospital Research Institute, The Methodist Hospital, Houston, Texas.

BACKGROUND The vein of Marshall (VOM) is a left atrial (LA) vein that contains autonomic innervation and triggers of AF. Its location coincides with areas usually ablated during pulmonary vein (PV) antral isolation (PVAI).

OBJECTIVE This study sought to delineate the safety and ablative effects of ethanol infusion in the VOM during catheter ablation of atrial fibrillation (AF).

METHODS Patients undergoing PVAI (n = 14) gave consent for adjunctive VOM ethanol infusion. In 10 of 14 patients, the VOM was cannulated with an angioplasty wire and balloon. Echocardiographic contrast was injected in the VOM under echocardiographic monitoring. Two infusions of 100% ethanol (1 ml each) were delivered via the angioplasty balloon in the VOM. LA bipolar voltage maps were created before and after ethanol infusion. Radiofrequency ablation times required to isolate each PV and other procedural data were compared with those of 10 age-, sex-, AF type– and LA size–matched control subjects undergoing conventional PVAI.

RESULTS The VOM communicated with underlying myocardium, as shown by echocardiographic contrast passage into the LA. There were no acute complications related to VOM ethanol infusion, which led to the creation of a low-voltage area in the LA measuring 10.6 ± 7.6 cm^2 and isolation of the left inferior PV in 4 of 10 patients. Radiofrequency ablation time required to achieve isolation of the left inferior PV was reduced (2.2 ± 4 min vs. 11.4 ± 10.3 min in control subjects, $P < .05$).

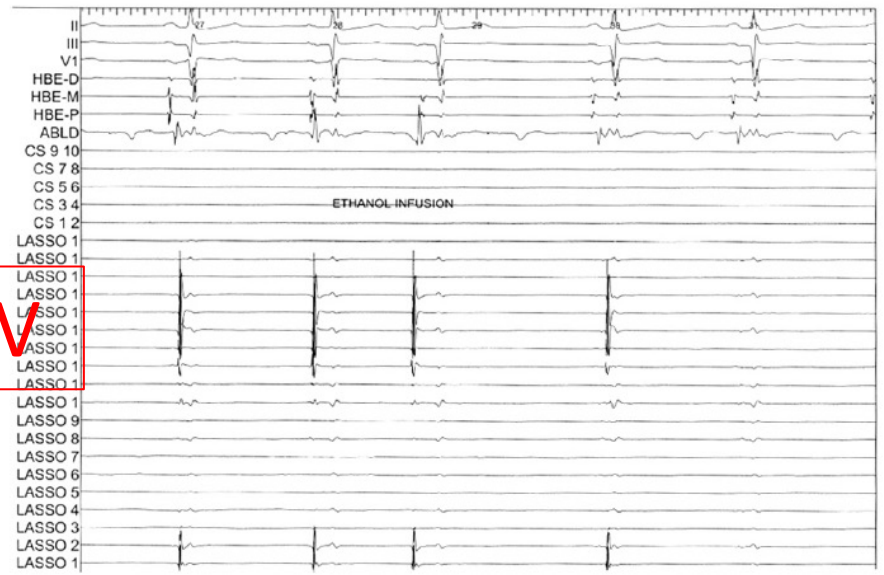
CONCLUSION VOM ethanol infusion is safe in humans, decreases radiofrequency ablation time in the left inferior PV, and may have a role as an adjunct to PVAI.

KEYWORDS Vein of Marshall; Ethanol; Ablation; Alcohol; Atrial fibrillation

ABBREVIATIONS AF = atrial fibrillation; **LA** = left atrial/atrium; **PV** = pulmonary vein; **PVAI** = pulmonary vein antral isolation; **VOM** = vein of Marshall

(Heart Rhythm 2009;6:1552–1558) © 2009 Heart Rhythm Society. All rights reserved.

LIPV



e 4 Intracardiac and left inferior pulmonary vein electrograms during vein of Marshall ethanol infusion. **Top:** Selected surface electrocardiograph . During ethanol infusion, an atrial extrasystole is seen (third beat). By the fifth beat, complete elimination of all pulmonary vein potentials is CS = coronary sinus electrograms; HBE = His bundle electrograms; LASSO = circular duodecapolar signals recorded from the left inferior onary vein ostium.

LIPV izolasyon RF süresinde azalma !!!!

Long-term efficacy and safety of adjunctive ethanol infusion into the vein of Marshall during catheter ablation for nonparoxysmal atrial fibrillation

Chih-Min Liu MD[1,2] | Li-Wei Lo MD, PhD[1,2] | Yenn-Jiang Lin MD, PhD[1,2] | Chin-Yu Lin MD[1,2] | Shih-Lin Chang MD, PhD[1,2] | Fa-Po Chung MD[1,2] | Tze-Fan Chao MD[1,2] | Yu-Feng Hu MD, PhD[1,2] | Ta-Chuan Tuan MD[1,2] | Jo-Nan Liao MD[1,2] | Yun-Yu Chen MPH[1,3] | Ling Kuo MD[1,2] | Ting-Yung Chang MD[1,2] | Quang Minh Hoang MD[1] | Simon Salim MD[1] | Jennifer Jeanne B. Vicera MD[1] | Cheng-I Wu MD[1,2] | Chieh-Mao Chuang MD[1] | Ting-Chung Huang MD[1] | Shih-Ann Chen MD[1,2]

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Disclosure: None

Funding information
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Abstract

Introduction: We aimed to clarify the effect of vein of Marshall (VOM) ethanol infusion for treating VOM triggers and/or mitral flutter after first-attempt endocardial ablation in patients with nonparoxysmal atrial fibrillation (AF).

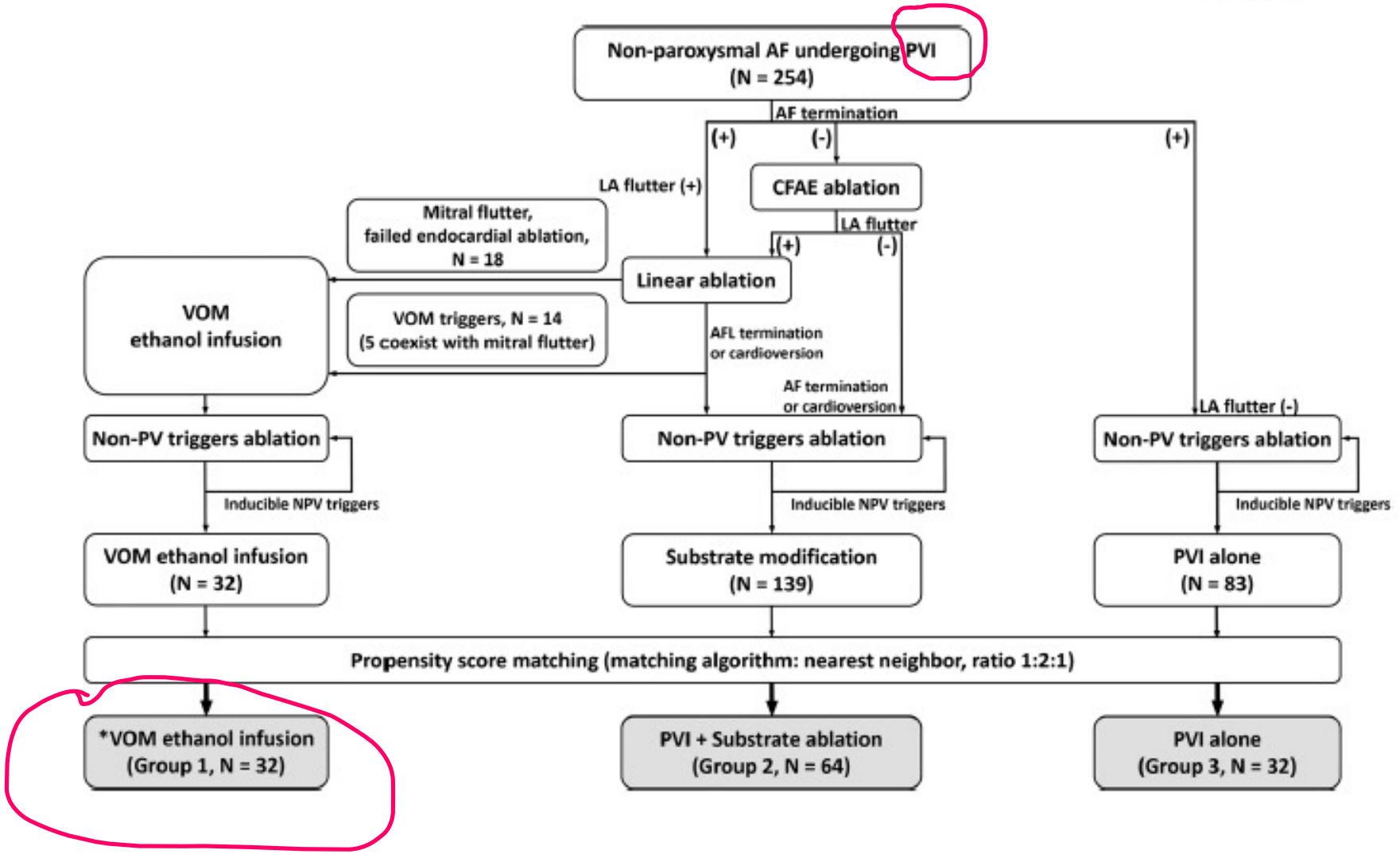
Methods and Results: Of the 254 consecutive patients (age, 56 ± 10 years; 221 male) undergoing catheter ablation for drug-refractory nonparoxysmal AF, 32 (12.6%) received VOM ethanol infusion. The patients were stratified into group 1 (pulmonary vein isolation [PVI], substrate modification, VOM ethanol infusion), group 2 (PVI, substrate modification), and group 3 (PVI alone). Propensity-matched analysis (N = 128) of long-term outcomes (3.9 ± 0.5 years) revealed a higher AF recurrence risk in group 2 (hazard ratio [HR], 4.17; 95% confidence interval [95% CI], 1.63-10.69; $P = .003$) and group 3 (HR, 1.82; 95% CI, 1.09-3.04; $P = .021$) than in group 1, as well as a higher atrial arrhythmia recurrence risk in group 2 than in group 1 (HR, 2.42; 95% CI, 1.16-5.03; $P = .018$). A higher procedural termination rate was observed in group 1 than groups 2 and 3 (41.7% vs 17.2% vs 18.8%; $P = .042$). On multivariate analysis, VOM ethanol injection was an independent predictor of freedom from recurrence of AF (HR, 0.20; 95% CI, 0.08-0.52; $P = .001$) and atrial arrhythmia (HR, 0.35; 95% CI, 0.17-0.74; $P = .005$), whereas a left atrial diameter >45 mm and hypertension were independent risk factors for recurrence. Periprocedural complications rates were comparable among the groups.

Conclusion: Adjunctive VOM ethanol infusion is effective and safe for treating nonparoxysmal AF in patients with VOM triggers and/or refractory mitral flutter, providing good long-term freedom from AF and atrial arrhythmia.

Long-term efficacy and safety of adjunctive ethanol infusion into the vein of Marshall during catheter ablation for nonparoxysmal atrial fibrillation

Chih-Min Liu MD[1,2] | Li-Wei Lo MD, PhD[1,2] | Yenn-Jiang Lin MD, PhD[1,2] |

Post-adjunctive= En son ethanol

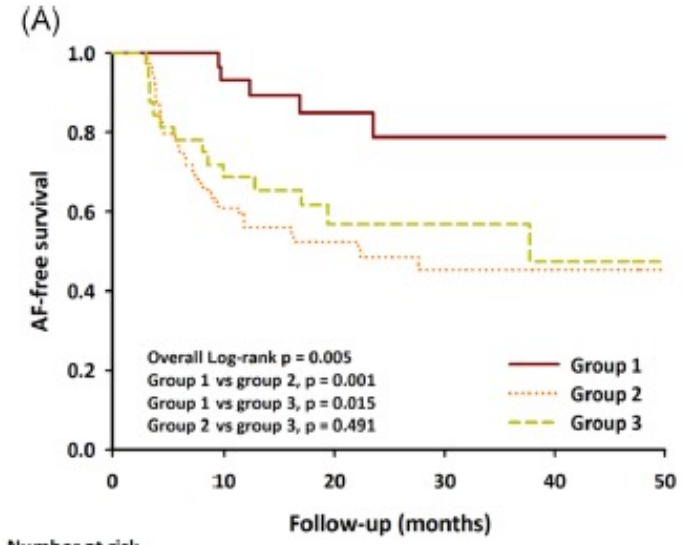


J Cardiovasc Electrophysiol. 2019;30:1215-1228.

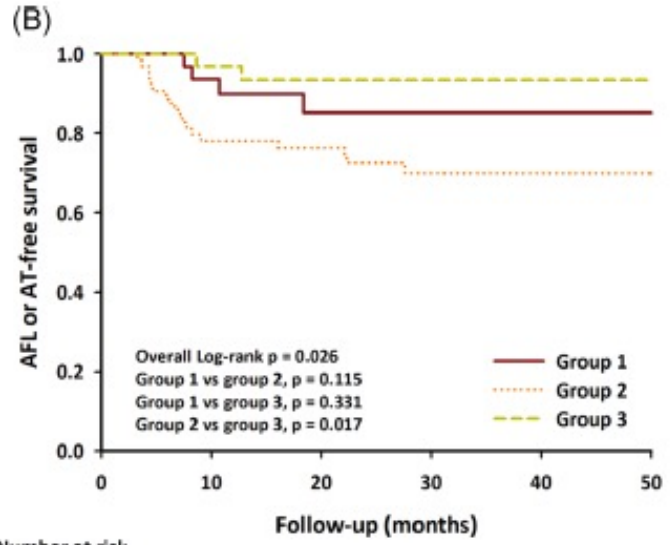
Long-term efficacy and safety of adjunctive ethanol infusion into the vein of Marshall during catheter ablation for nonparoxysmal atrial fibrillation

Chih-Min Liu MD[1,2] | Li-Wei Lo MD, PhD[1,2] | Yenn-Jiang Lin MD, PhD[1,2]

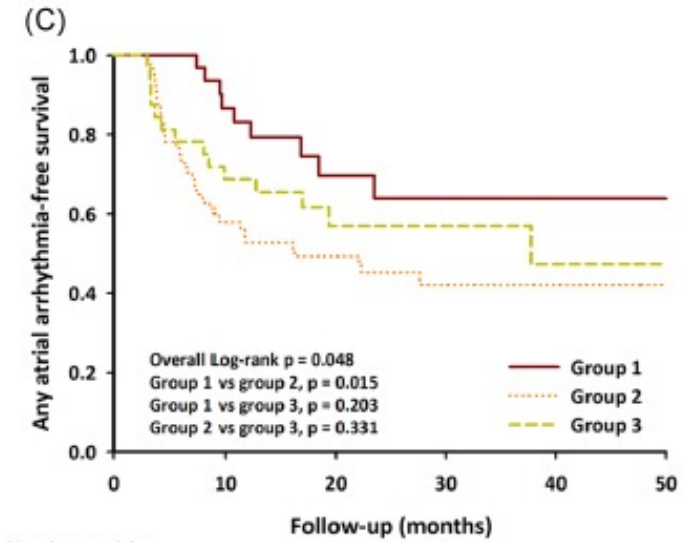
Uzun süreli takip



Number at risk						
Group 1	32	27	16	10	8	3
Group 2	64	39	27	13	4	2
Group 3	32	22	11	8	4	2



Number at risk						
Group 1	32	27	17	12	9	4
Group 2	64	50	41	25	14	4
Group 3	32	31	20	13	9	2



Number at risk						
Group 1	32	25	13	8	6	2
Group 2	64	37	25	12	4	2
Group 3	32	22	11	8	4	2

J Cardiovasc Electrophysiol. 2019;30:1215-1228.

MARSHALL bundles elimination, Pulmonary veins isolation and Lines completion for ANatomical ablation of persistent atrial fibrillation: MARSHALL-PLAN case series

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Disclosures: None.

Abstract

Introduction: Beyond pulmonary veins (PV) isolation, the ablation strategy for persistent atrial fibrillation (AF) remains controversial. Substrate ablation may provide a high termination rate but at the cost of impaired atrial physiology and recurrent complex re-entries. To overcome these pitfalls, we investigated a new lesion set based on important anatomical considerations.

Methods and Results: The case series included 10 consecutive patients with persistent AF. Three atrial structures were successively targeted: (1) coronary sinus and vein of Marshall (CS-VOM) musculature elimination; (2) PVs isolation; and (3) anatomical isthmuses block. The lesion set completion was the procedural endpoint. Step 1: VOM ethanol infusion was feasible in all cases (mean time of 33.4 ± 9.4 minutes), mean radiofrequency (RF) time for CS-VOM bundles was 14.4 ± 6.9 minutes. Step 2: mean RF time for PV isolation was 27.7 ± 9.3 minutes. Step 3: mean RF time for mitral, roof, and cavotricuspid lines was 5.7 ± 2.3, 8.1 ± 4.3, and 5.9 ± 1.9 minutes, respectively. The lesion set was achieved in all patients. Mean procedure time was 270 ± 29.9 minutes. AF termination and noninducibility were, respectively, obtained in 50% and 90% of the patients. After a 6-month follow-up, all patients were free from arrhythmia recurrence.

Conclusion: The present case series reports a new ablation strategy systematically targeting anatomical structures previously identified as possibly involved in the fibrillatory process and the recurrent tachycardias. The resulting lesion set provides good short-term outcomes. Although promising, these preliminary results need to be confirmed in the larger prospective study.

KEYWORDS
alcohol injection, atrial fibrillation, catheter ablation, coronary sinus ablation, vein of Marshall

2.2.1 | Step 1: CS-VOM bundles elimination

- *VOM ethanol infusion*: targeting epicardial muscular bundles accompanying the VOM (Figure 2). After CS cannulation with the sheath, a left internal mammary artery (LIMA) catheter was inserted, pointing both posteriorly and superiorly in right anterior oblique view. Angiographic contrast was injected near the Vieussens valve to localize the VOM. An angioplasty guide wire was advanced inside the lumen and used to position a preloaded angioplasty balloon (Mini Trek; 6-8 mm length and 2 mm nominal diameter) in the proximal VOM. Angiographic contrast was delivered through the lumen to visualize VOM arborization and assess any leakage back in the CS.[11] Ethanol (100%) infusion was carried out in three separate 1-minute injections. Repeat angiograms were performed after each injection to confirm balloon stability. The endpoint was ethanol injection, for a total amount of 6 to 12 mL.
- *CS and great cardiac vein ablation*: targeting epicardial muscular bundles accompanying the CS. Using the sheath, ablation started at the great cardiac vein, which frequently shows myocardial coverage.[12] Ablation was pursued up to 1 cm after VOM ostium, respecting CS proximal portion to limit the risk of atrioventricular node-injury. The endpoint was the elimination of all sharp near-field electrograms.
- *Ridge and "saddle" ablation*: targeting the Marshall bundles from an endocardial aspect. The "saddle" area (the crescent-shaped region between the high ridge, the left atrial appendage (LAA), the left superior PV and the roof) and the ridge are the insertion sites of the Marshall bundles.[13] Ethanol infusion most often has a significant impact on the ridge below the carina, but atrial signals frequently persist above this level, requiring additional RF applications. Ablation started at the lower part of the ridge displaying these signals and was pursued up to the "saddle." The endpoint was the elimination of all sharp near-field electrograms.

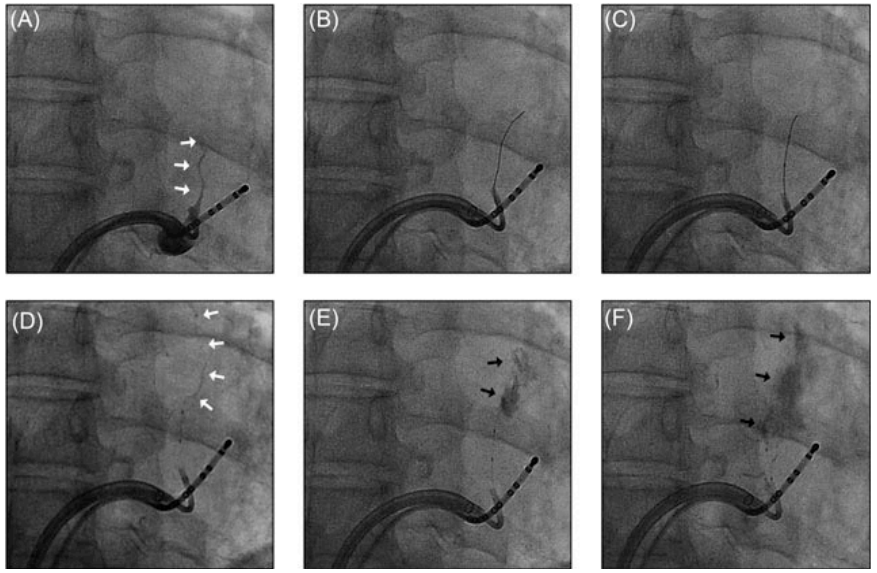
2.2.2 | Step 2: Wide antral PV isolation

This step aimed for PV isolation using wide antral circumferential ablation (WACA). Complete left PV encirclement was not systematically needed as step 1 participated in left antrum isolation. The endpoint was antral circumferential exit block.[14]

2.2.3 | Step 3: Lines of block

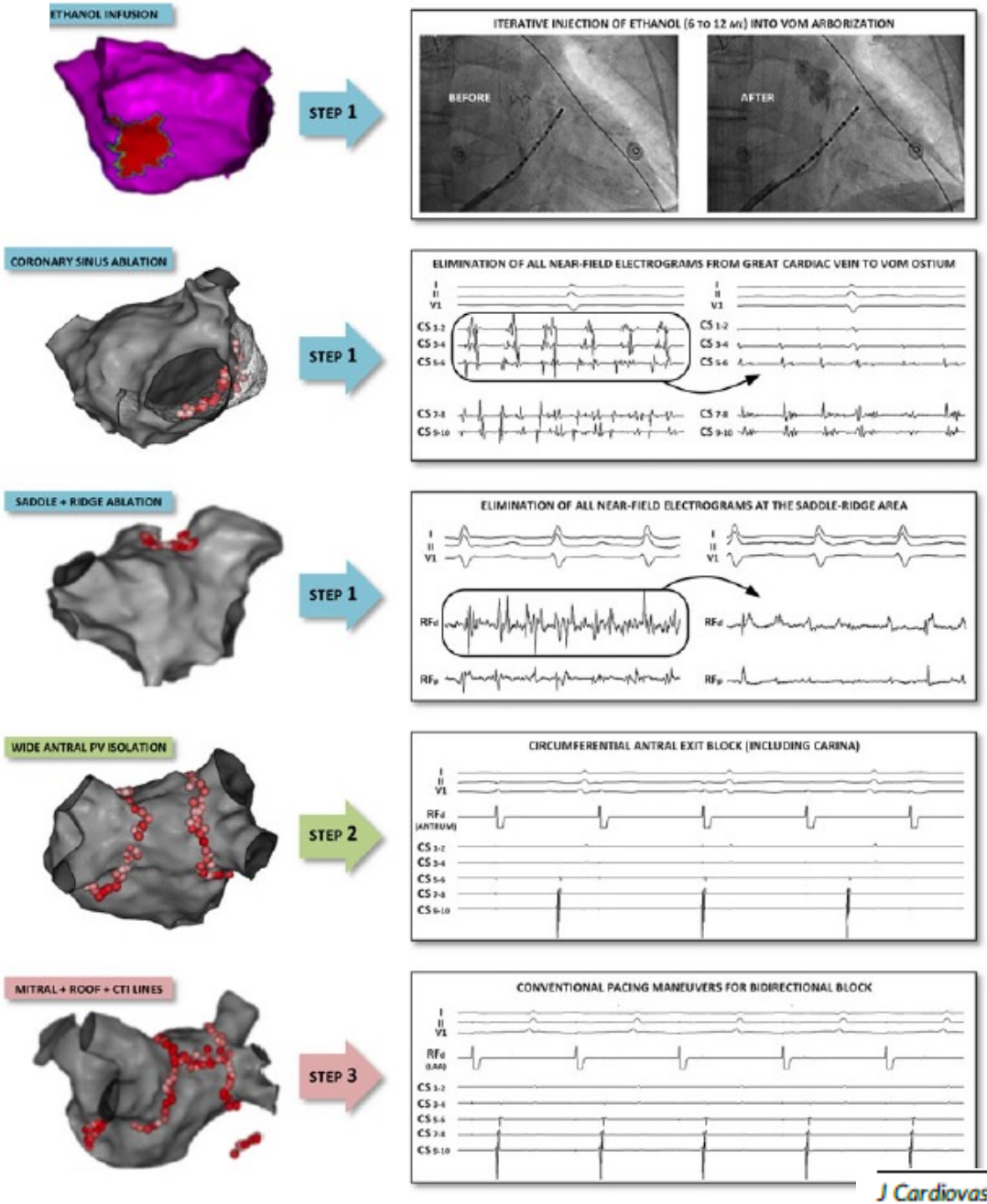
This step aimed for a bidirectional block of the three main anatomical isthmuses (mitral, roof, and cavotricuspid). When performed during ongoing AF, electrograms abolition along each line was the endpoint. The mitral line ran posteriorly through the

MARSHALL bundles elimination, Pulmonary veins isolation and Lines completion for ANatomical ablation of persistent atrial fibrillation: MARSHALL-PLAN case series



the patients. After a 6-month follow-up, all patients were free from arrhythmia recurrence.

Conclusion: The present case series reports a new ablation strategy systematically targeting anatomical structures previously identified as possibly involved in the fibrillatory process and the recurrent tachycardias. The resulting lesion set provides good short-term outcomes. Although promising, these preliminary results need to be confirmed in the larger prospective study.



J Cardiovasc Electrophysiol. 2019;30:7-15.

JAMA | Original Investigation

Effect of Catheter Ablation With Vein of Marshall Ethanol Infusion vs Catheter Ablation Alone on Persistent Atrial Fibrillation
The VENUS Randomized Clinical Trial

Miguel Valderrábano, MD; Leif E. Peterson, PhD; Vijay Swarup, MD; Paul A. Schurmann, MD; Akash Makkar, MD; Rahul N. Doshi, MD; David DeLurgio, MD; Charles A. Athill, MD; Kenneth A. Ellenbogen, MD; Andrea Natale, MD; Jayanthi Koneru, MD; Amish S. Dave, MD, PhD; Irakli Giorgberidze, MD; Hamid Afshar, MD; Michelle L. Guthrie, RN; Raquel Bunge, RN; Carlos A. Morillo, MD; Neal S. Kleiman, MD

IMPORTANCE Catheter ablation of persistent atrial fibrillation (AF) has limited success. Procedural strategies beyond pulmonary vein isolation have failed to consistently improve results. The vein of Marshall contains innervation and AF triggers that can be ablated by retrograde ethanol infusion.

OBJECTIVE To determine whether vein of Marshall ethanol infusion could improve ablation results in persistent AF when added to catheter ablation.

DESIGN, SETTING, AND PARTICIPANTS The Vein of Marshall Ethanol for Untreated Persistent AF (VENUS) trial was an investigator-initiated, National Institutes of Health–funded, randomized, single-blinded trial conducted in 12 centers in the United States. Patients (N = 350) with persistent AF referred for first ablation were enrolled from October 2013 through June 2018. Follow-up concluded in June 2019.

INTERVENTIONS Patients were randomly assigned to catheter ablation alone (n = 158) or catheter ablation combined with vein of Marshall ethanol infusion (n = 185) in a 1:1.15 ratio to accommodate for 15% technical vein of Marshall ethanol infusion failures.

MAIN OUTCOMES AND MEASURES The primary outcome was freedom from AF or atrial tachycardia for longer than 30 seconds after a single procedure, without antiarrhythmic drugs, at both 6 and 12 months. Outcome assessment was blinded to randomization treatment. There were 12 secondary outcomes, including AF burden, freedom from AF after multiple procedures, perimitral block, and others.

RESULTS Of the 343 randomized patients (mean [SD] age, 66.5 [9.7] years; 261 men), 316 (92.1%) completed the trial. Vein of Marshall ethanol was successfully delivered in 155 of 185 patients. At 6 and 12 months, the proportion of patients with freedom from AF/atrial tachycardia after a single procedure was 49.2% (91/185) in the catheter ablation combined with vein of Marshall ethanol infusion group compared with 38% (60/158) in the catheter ablation alone group (difference, 11.2% [95% CI, 0.8%-21.7%]; $P = .04$). Of the 12 secondary outcomes, 9 were not significantly different, but AF burden (zero burden in 78.3% vs 67.9%; difference, 10.4% [95% CI, 2.9%-17.9%]; $P = .01$), freedom from AF after multiple procedures (65.2% vs 53.8%; difference, 11.4% [95% CI, 0.6%-22.2%]; $P = .04$), and success achieving perimitral block (80.6% vs 51.3%; difference, 29.3% [95% CI, 19.3%-39.3%]; $P < .001$) were significantly improved in vein of Marshall–treated patients. Adverse events were similar between groups.

CONCLUSIONS AND RELEVANCE Among patients with persistent AF, addition of vein of Marshall ethanol infusion to catheter ablation, compared with catheter ablation alone, increased the likelihood of remaining free of AF or atrial tachycardia at 6 and 12 months. Further research is needed to assess longer-term efficacy.

TRIAL REGISTRATION ClinicalTrials.gov Identifier: NCT01898221

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Visual Abstract

Supplemental content

CME Quiz at jamacmelookup.com

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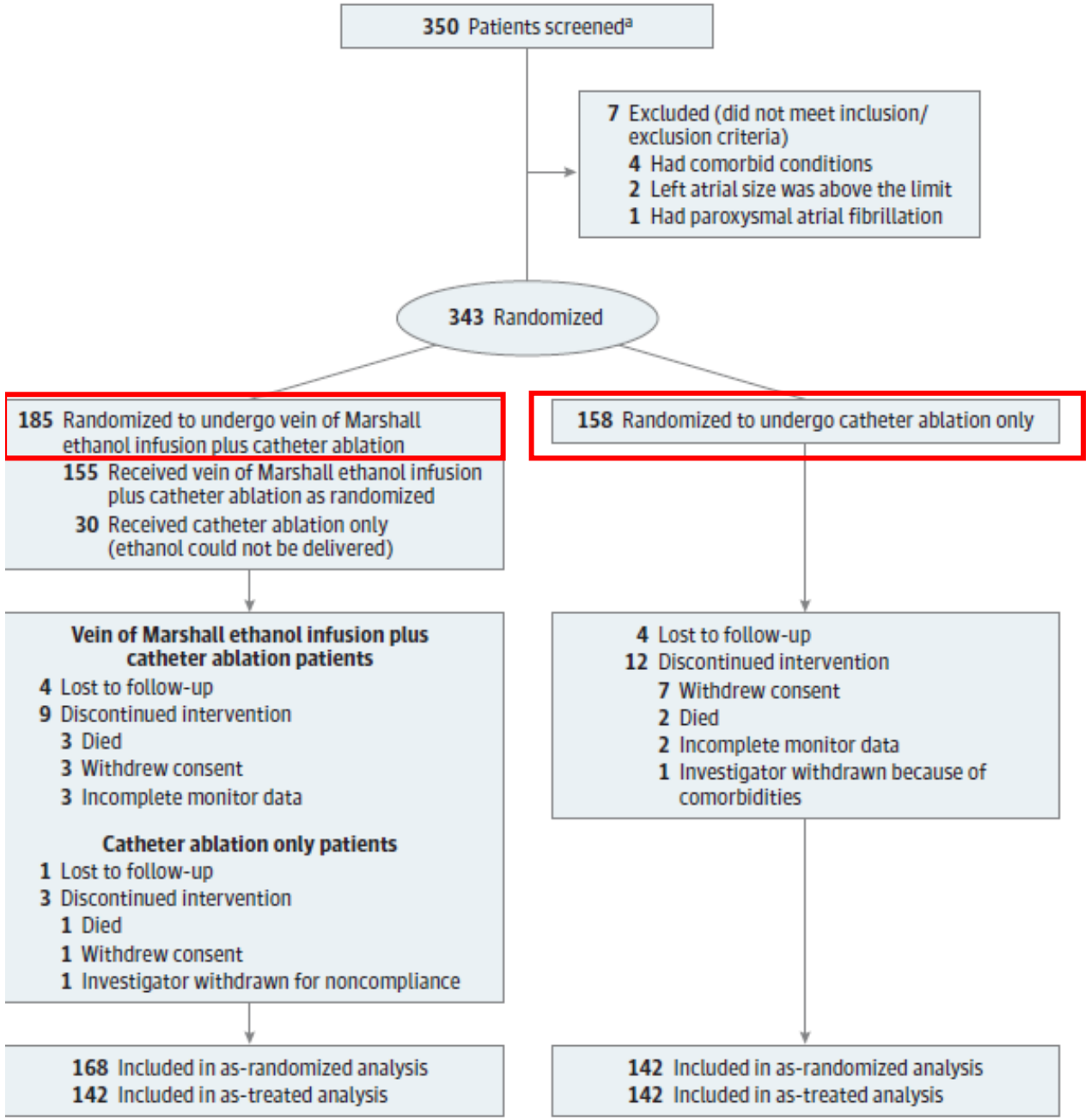

JAMA | Original Investigation

Effect of Catheter Ablation With Vein of Marshall Ethanol Infusion vs Catheter Ablation Alone on Persistent Atrial Fibrillation
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- VOM grubunda, *%84 hastada başarılı etanol* verilebilmiş.
- Her iki grupta da, *PVI'a ek* substrat ablasyonu oranı *%96 !!!*
- RFA süresi, kateter ablasyon grubunda daha fazla, ama floroskopi ve total işlem süresi, VOM grubunda daha fazla.
- VOM ethanol ablasyonuna bağlı komplikasyon yok!!!

JAMA. 2020;324(16):1620-1628. doi:10.1001/jama.2020.16196

JAMA | Original Investigation

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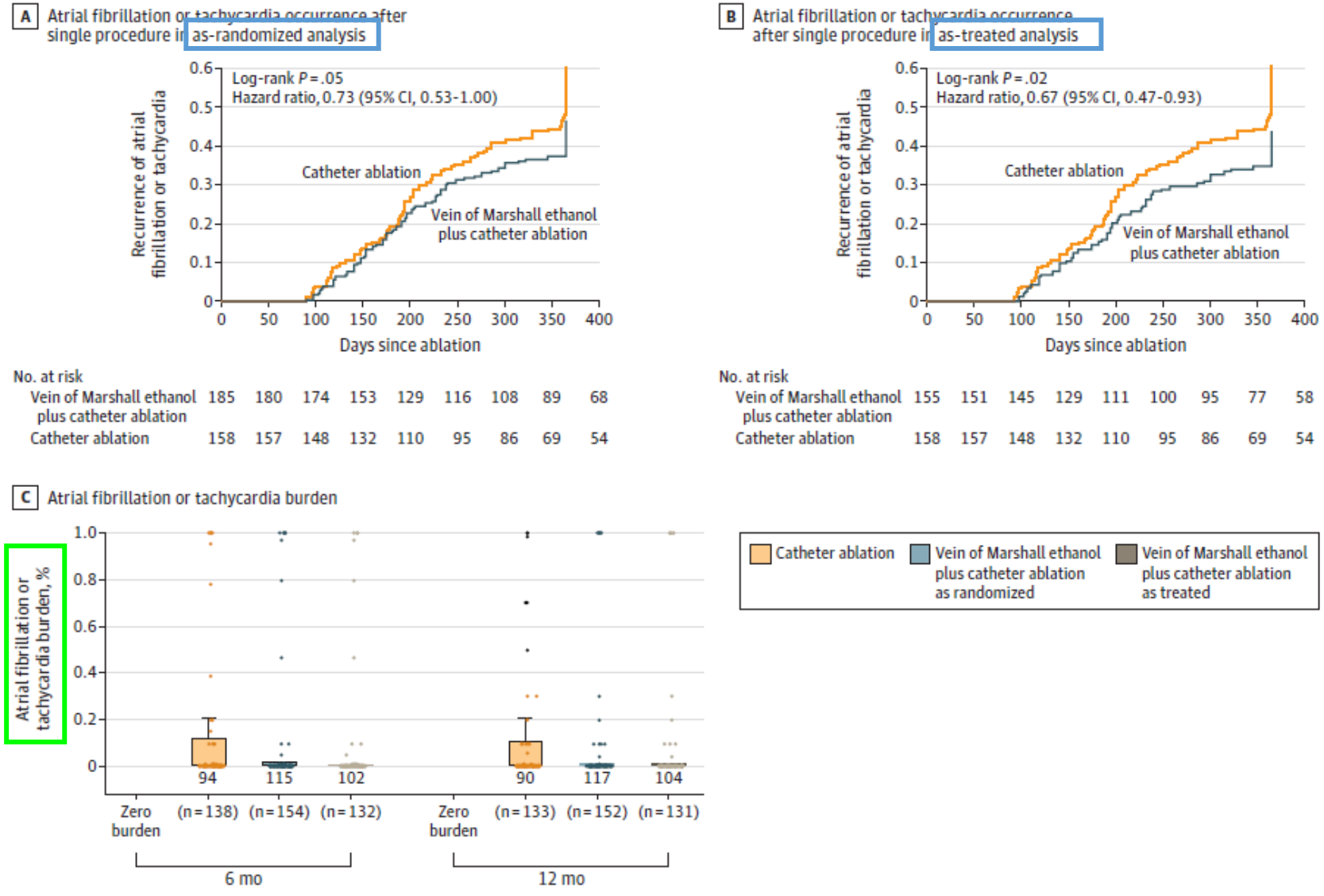
Figure 2. Time to Recurrence of Atrial Fibrillation or Tachycardia and Atrial Fibrillation Burden



Nüks atriyal fibrilasyon (VOM- LIPV Bağlantısı)

Role of the Vein of Marshall in Atrial Fibrillation Recurrences After Catheter Ablation: Therapeutic Effect of Ethanol Infusion

AMISH S. DAVE, M.D., PH.D., JOSÉ L. BÁEZ-ESCUDERO, M.D., CHRISTINE SASARIDIS, M.H.A., THOMAS E. HONG, M.D., F.A.C.C., TAPAN RAMI, M.D., F.A.C.C., and MIGUEL VALDERRÁBANO, M.D., F.A.C.C

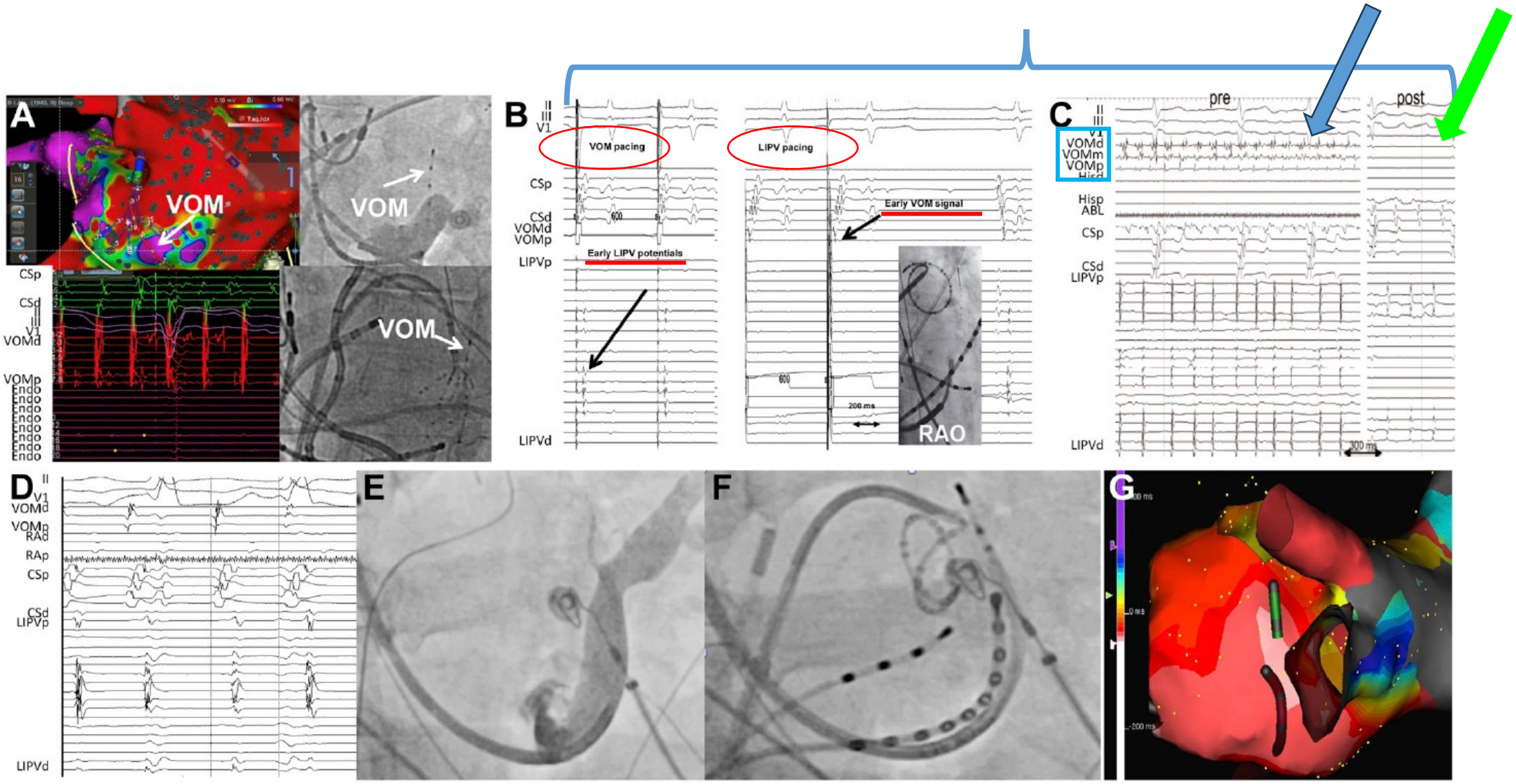
From the Methodist DeBakey Heart and Vascular Center and Methodist Hospital Research Institute, The Methodist Hospital, Houston Texas, USA

Vein of Marshall Ethanol in Recurrent AF. ***Introduction*: Atrial fibrillation (AF) or flutter can recur after pulmonary vein (PV) antral isolation (PVAI). The vein of Marshall (VOM) has been linked to the genesis of AF. We hypothesized that the VOM may play a role in AF recurrences and that VOM ethanol infusion may have therapeutic value in this setting.**

***Methods and Results:* Sixty-one patients with recurrent AF or flutter after PVAI were studied. The VOM was successfully cannulated in 54; VOM and PV electrograms were recorded, and differential PV-VOM pacing was performed. VOM signals were present in all patients; however, VOM triggers of AF could not be demonstrated. VOM tachycardia was present in 1 patient. Left inferior (LIPV) and left superior (LSPV) reconnection was present in 32 and 30 patients, respectively. Differential pacing in VOM and LIPV showed VOM-mediated LIPV reconnection in 5/32 patients. In others, VOM and PV connected indirectly via left atrial tissues. Up to four 1 cc infusions of 98% ethanol were delivered in the VOM. Regardless of the reconnection pattern, ethanol infusion eliminated LIPV and LSPV reconnection in 23/32 and 13/30 patients, respectively. Ethanol terminated VOM and LIPV tachycardias in 2 patients. There were no acute procedural complications.**

***Conclusions:* VOM signals are consistently present in recurrent AF. VOM may rarely play a role in PV reconnection. However, VOM ethanol infusion can be useful in patients with recurrent AF after PVAI, assisting in achieving redisconnection of reconnected left PVs.** *(J Cardiovasc Electrophysiol, Vol. 23, pp. 583-591, June 2012)*

Nüks atriyal fibrilasyon (VOM- LIPV Bağlantısı)



Heart Rhythm. 2021 July ; 18(7): 1074–1082.

Perimitral Flutter

Ethanol infusion in the vein of Marshall facilitates mitral isthmus ablation

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BACKGROUND Treatment of perimitral flutter (PMF) requires bidirectional mitral isthmus (MI) block, which can be difficult with radiofrequency ablation (RFA). The vein of Marshall (VOM) is located within the MI.

OBJECTIVE To test whether VOM ethanol infusion could help achieve MI block.

METHODS Perimitral conduction was studied in patients undergoing ablation of atrial fibrillation. Group 1 included 50 patients with a previous atrial fibrillation ablation undergoing repeat ablation, 30 of whom had had MI ablation. Spontaneous (8 of 50) or inducible PMF (21 of 50) was confirmed by activation mapping. Group 2 included 21 patients undergoing de novo VOM ethanol infusion. The VOM was cannulated with a quadripolar catheter for pacing and with an angioplasty balloon to deliver up to four 1-mL infusions of 98% ethanol. Voltage maps were created before and after VOM ethanol infusion. Bidirectional MI block was verified by differential pacing. RFA times required to achieve it were assessed.

RESULTS In group 1, VOM ethanol infusion acutely terminated PMF in 5 of 29 patients. RFA needed to achieve bidirectional MI block was 2.2 ± 1.6 minutes. Presence of PMF or previous MI ablation did not affect RFA times. In group 2, RFA needed to achieve bidirectional MI block was 2.0 ± 1.6 minutes (P = NS). Five patients had bidirectional MI block achieved solely by VOM ethanol infusion without RFA. In both groups, ablation after VOM ethanol infusion was required in the annular aspect of the MI. There were no acute complications.

CONCLUSION VOM ethanol infusion is useful in the treatment of PMF and assists in reliably achieving bidirectional MI block.

KEYWORDS Perimitral flutter; Atrial fibrillation; Vein of Marshall; Ethanol

ABBREVIATIONS **AF** = atrial fibrillation; **CS** = coronary sinus; **LAA** = left atrial appendage; **LIPV** = left inferior pulmonary vein; **MI** = mitral isthmus; **PMF** = perimitral flutter; **PV** = pulmonary vein; **RFA** = radiofrequency ablation; **VOM** = vein of Marshall

(Heart Rhythm 2012;9:1207–1215) © 2012 Heart Rhythm Society. All rights reserved.

Table 1 Clinical characteristics and procedural parameters

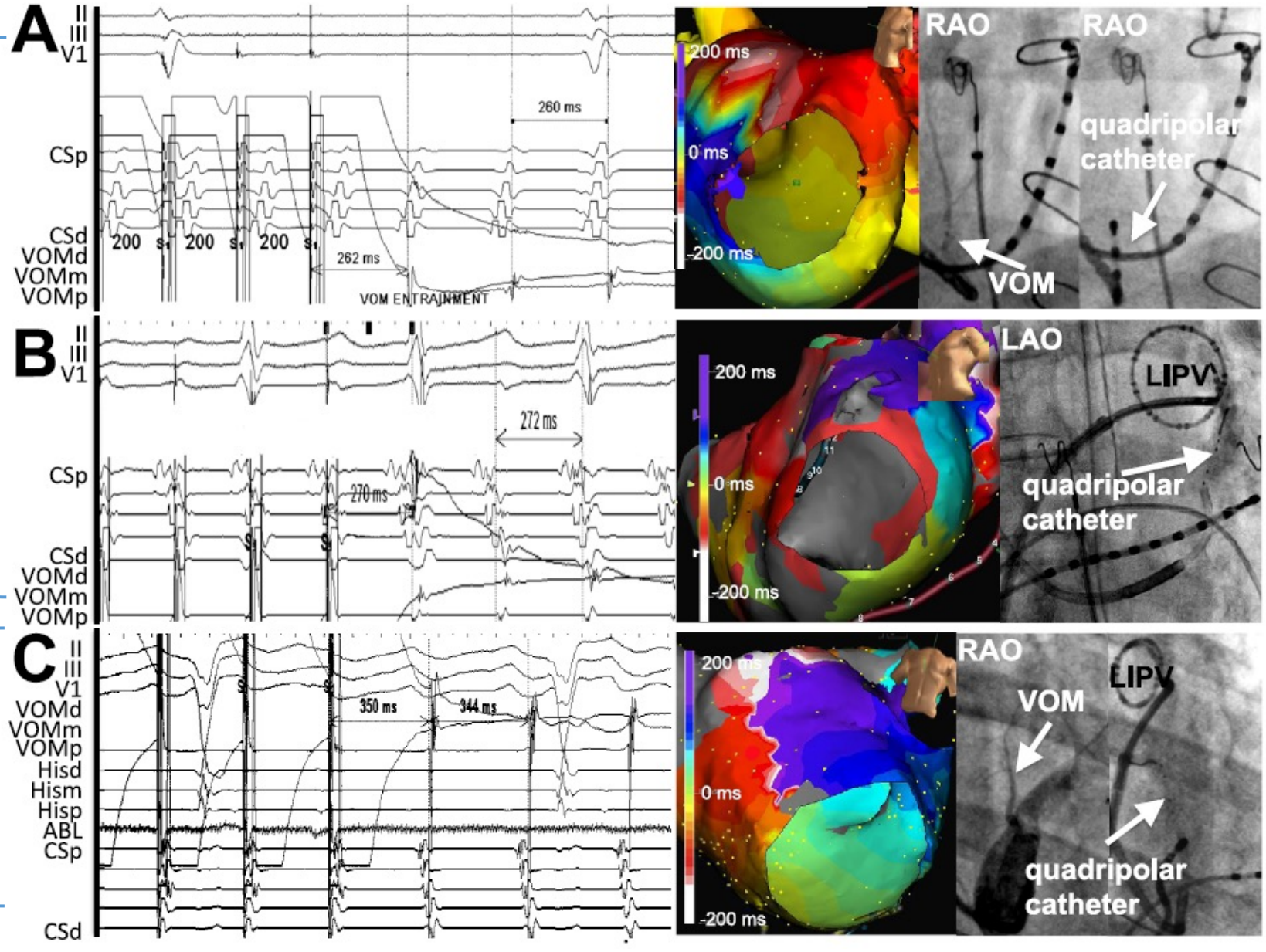
	Group 1 (n = 50)	Group 2 (n = 21)	*P*
	2. ablasyon	İlk ablasyon	
Age (y), mean ± SD	64 ± 9	63 ± 8	.78
Sex: Woman, n (%)	13 (26)	7 (33)	.77
Paroxysmal AF, n (%)	22 (44)	18 (86)	<.001
Left ventricular EF (%), mean ± SD	56 ± 11	64 ± 8	<.01
Left atrial volume by MRI or CT (cm^3), mean ± SD	110 ± 42	108 ± 29	.83
Previous MI line, n (%)	30 (60)	0 (0)	<.001
PMF present, n (%)	8 (16)	0 (0)	.09
PMF induced, n (%)	21 (42)	0 (0)	<.001
Ethanol-induced scar (cm^2), mean ± SD	8.8 ± 4.5	7.7 ± 3.2	.43
RF time (min), mean ± SD	2.2 ± 1.7	2.0 ± 1.6	.67
Bidirectional block, n (%)	50 of 50	21 of 21	1
VOM procedure time (min), mean ± SD	56 ± 17	58 ± 14	.65
VOM fluoroscopy time (min), mean ± SD	8.5 ± 4.6	8.6 ± 4.5	.9
Total procedure time (min), mean ± SD	217 ± 70	203 ± 52	.43
Total fluoroscopy time (min), mean ± SD	26 ± 13.1	17.5 ± 5.5	.01
Recurrent AF, n (%)	7 (14)	5 (23)	<.001
Recurrent flutter, n (%)	7 (14)	0 (0)	<.001

AF = atrial fibrillation; CT = computed tomography; EF = ejection fraction; MI = mitral isthmus; MRI = magnetic resonance imaging; PMF = perimitral flutter; RF = radiofrequency; VOM, vein of Marshall.

Perimitral flutter (VOM Antrenman)

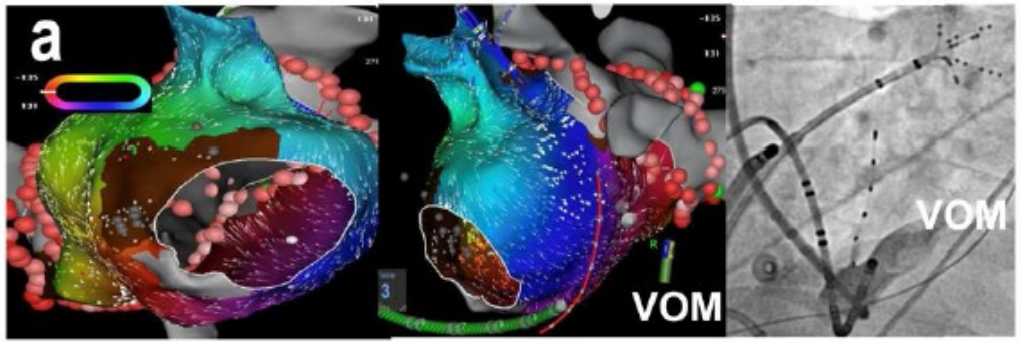
Concealed

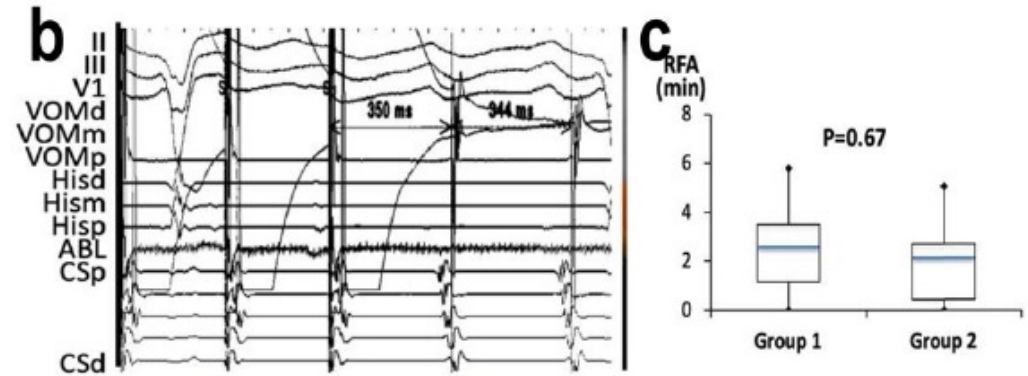
Overt

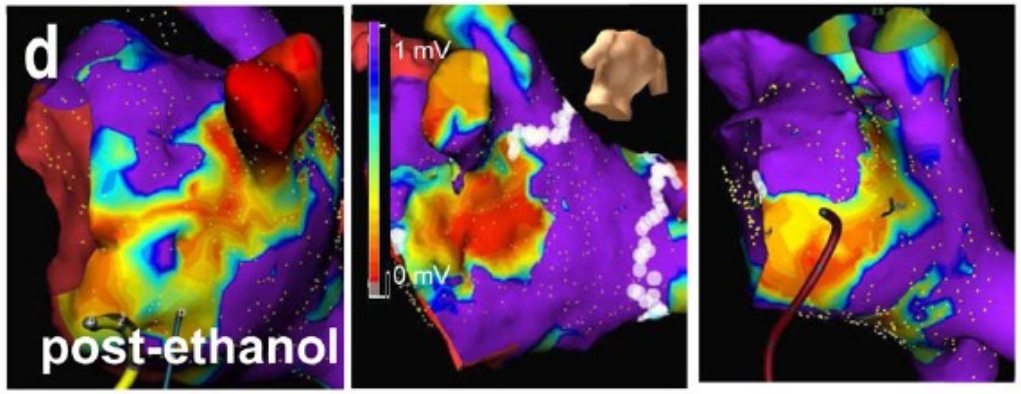


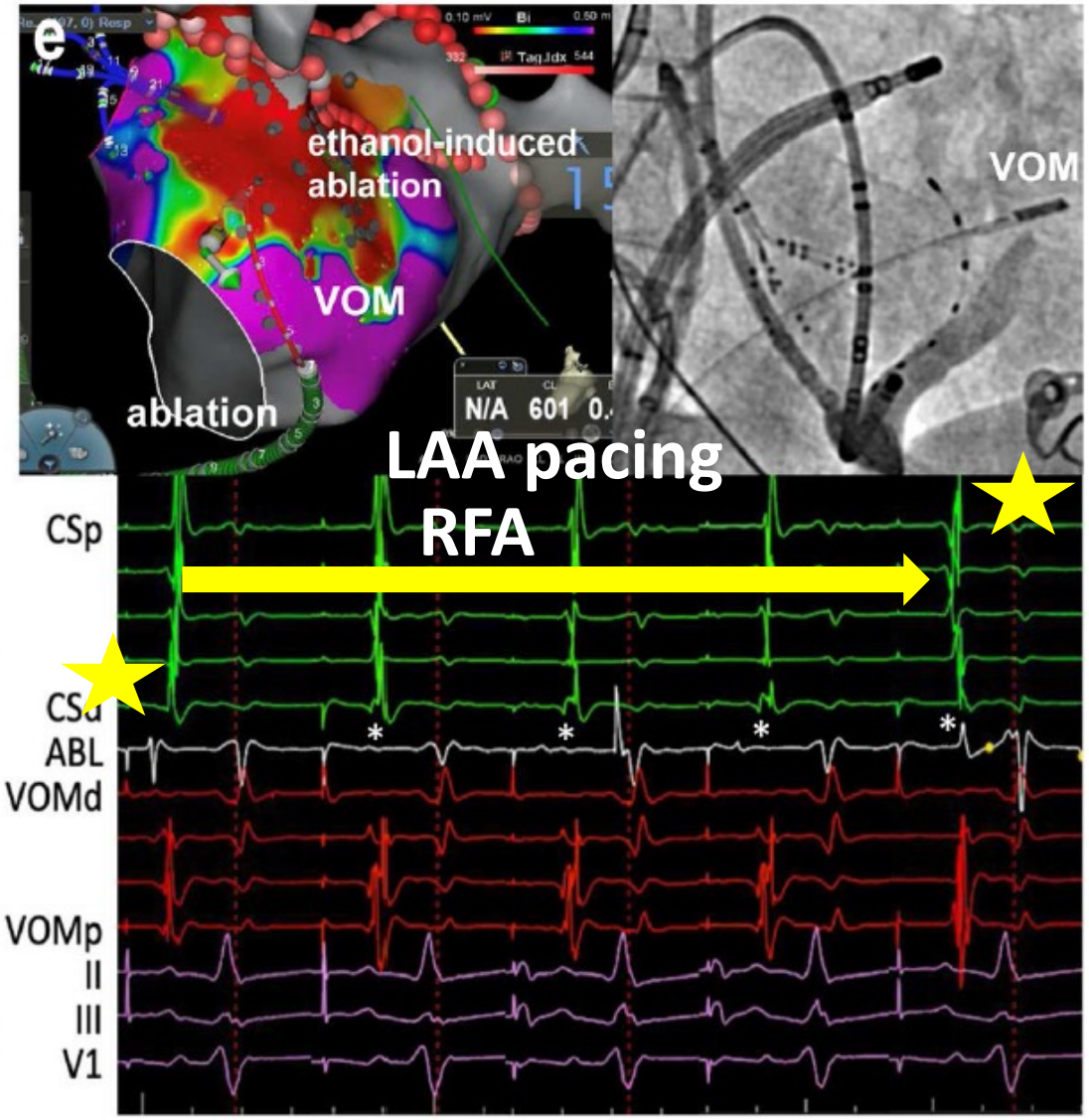
Heart Rhythm 2012;9:1207–1215

Perimitral flutter (VOM Ethanol)









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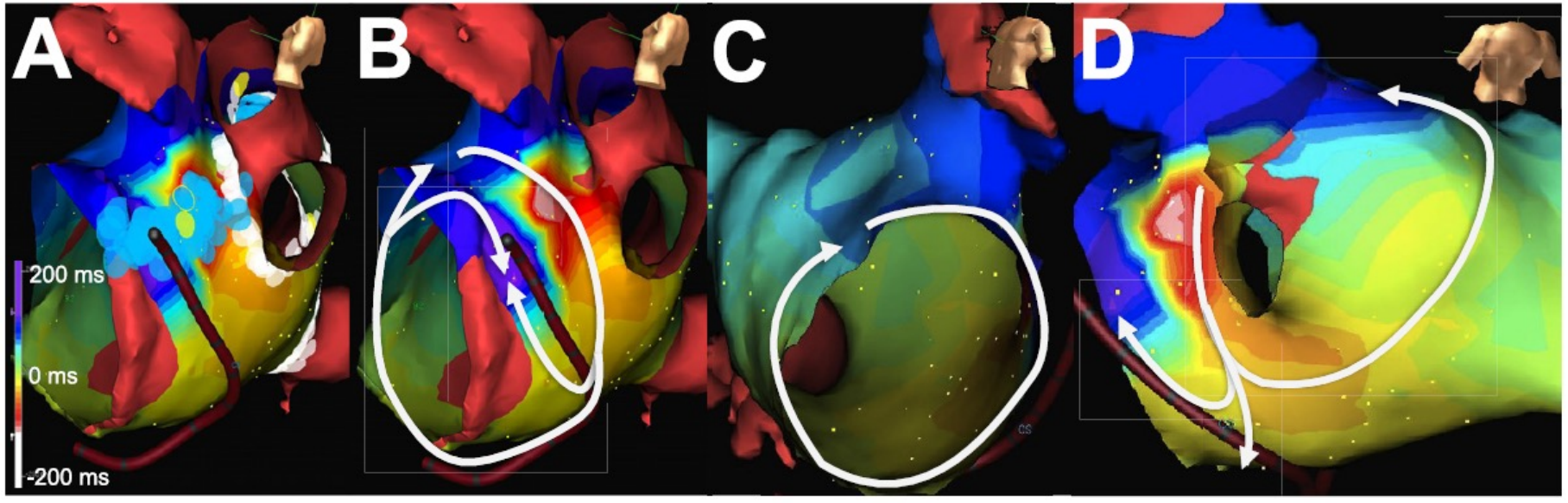
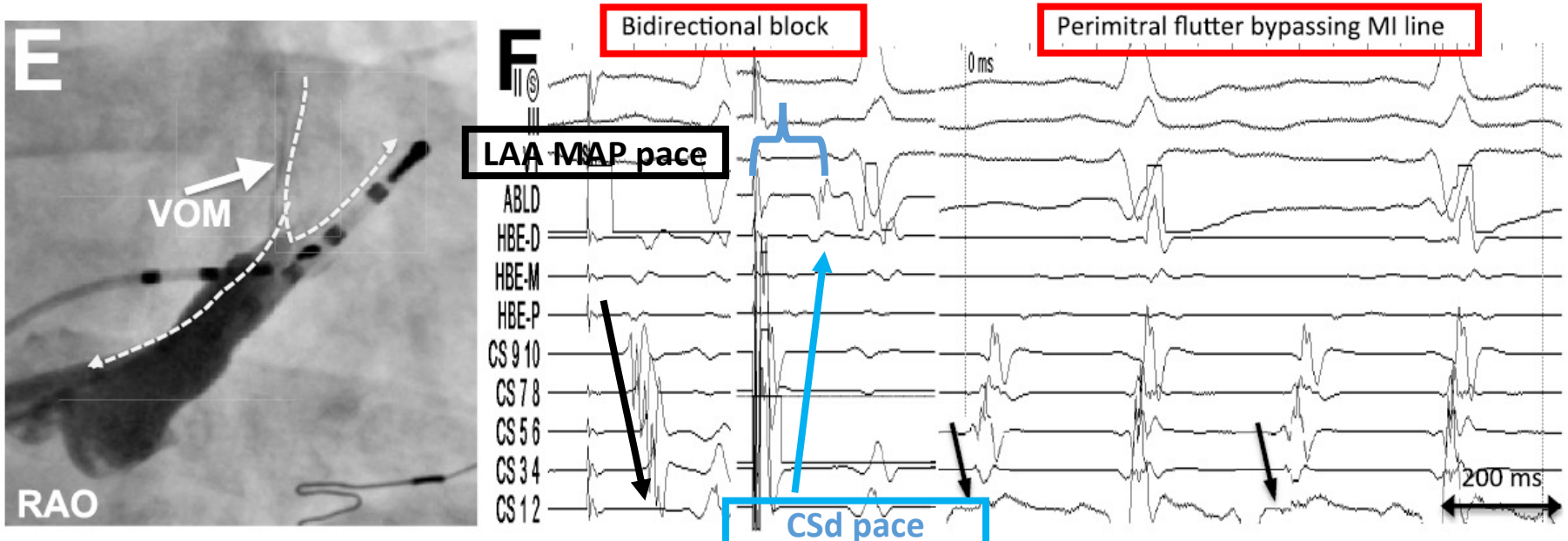
Perimitral flutter (Mitral isthmus bypass)

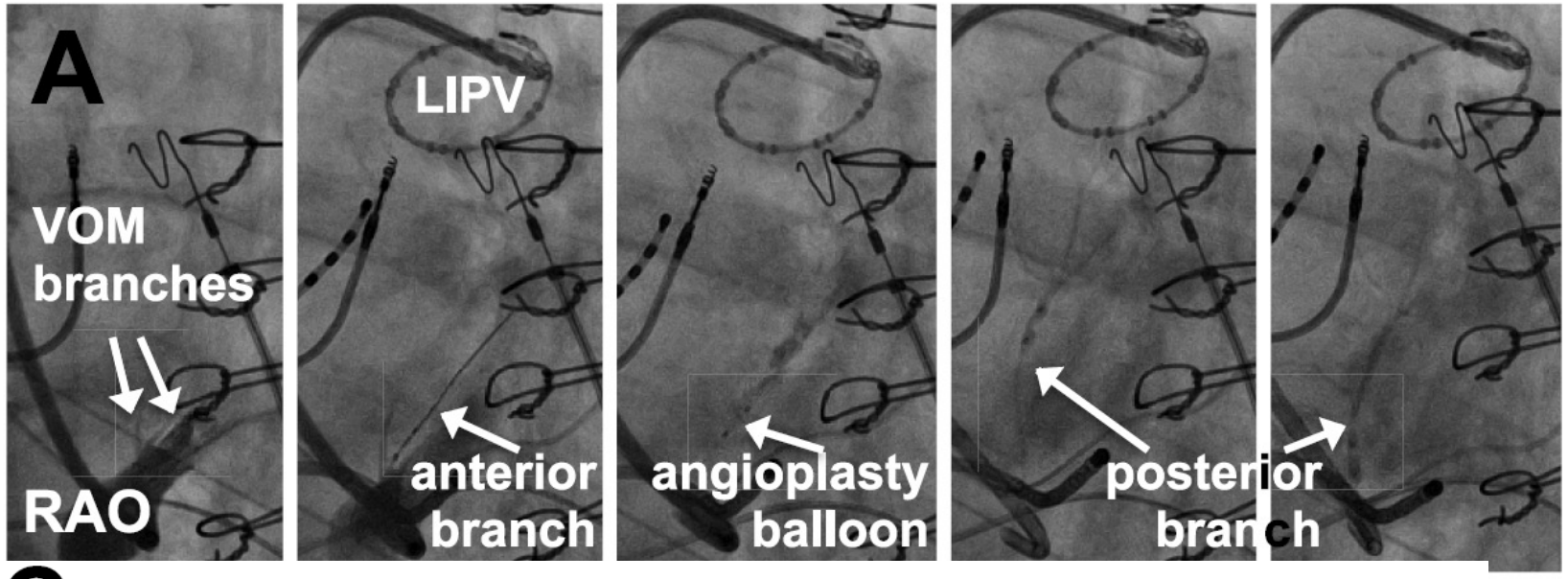


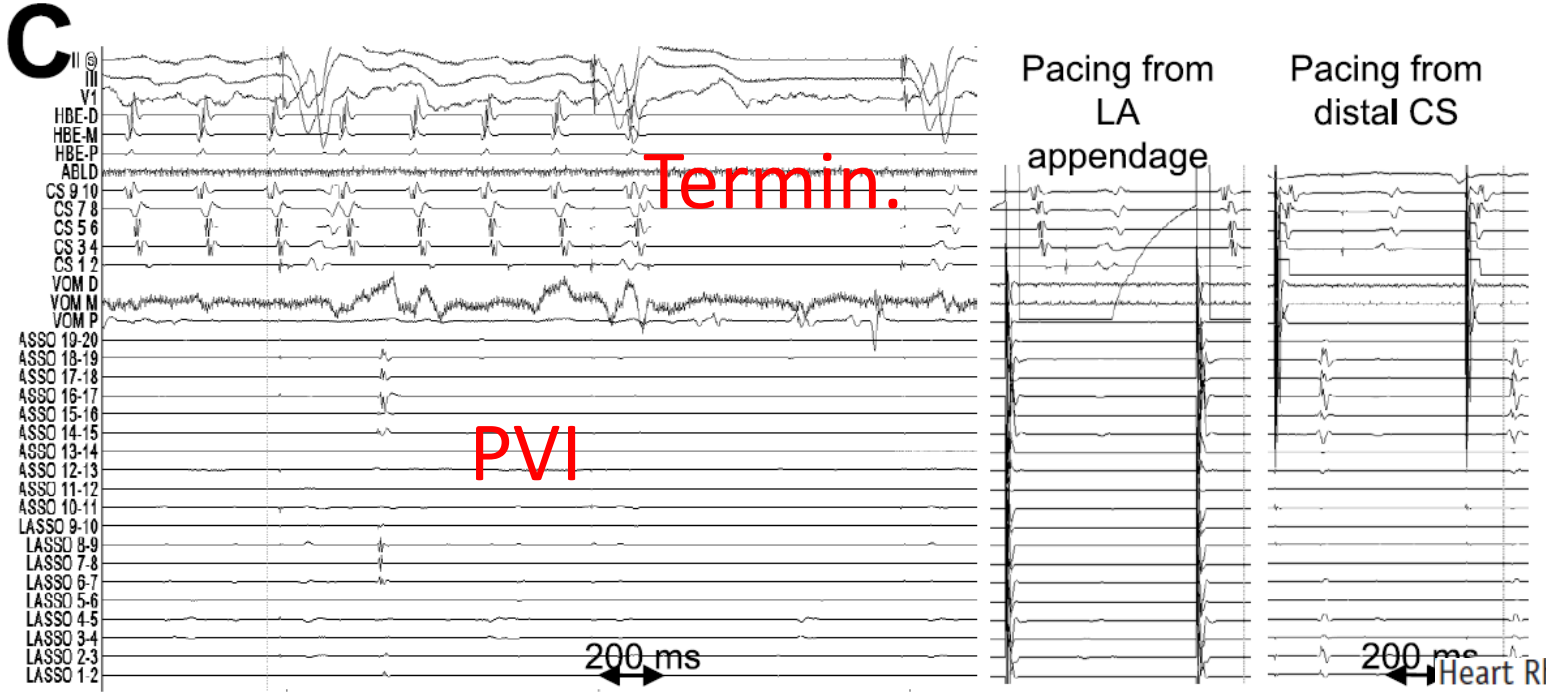


Heart Rhythm 2012;9:1207–1215

Perimitral flutter (Ethanol sırasında sonlanma + LIPVI)

PMF terminasyon oranı: %23

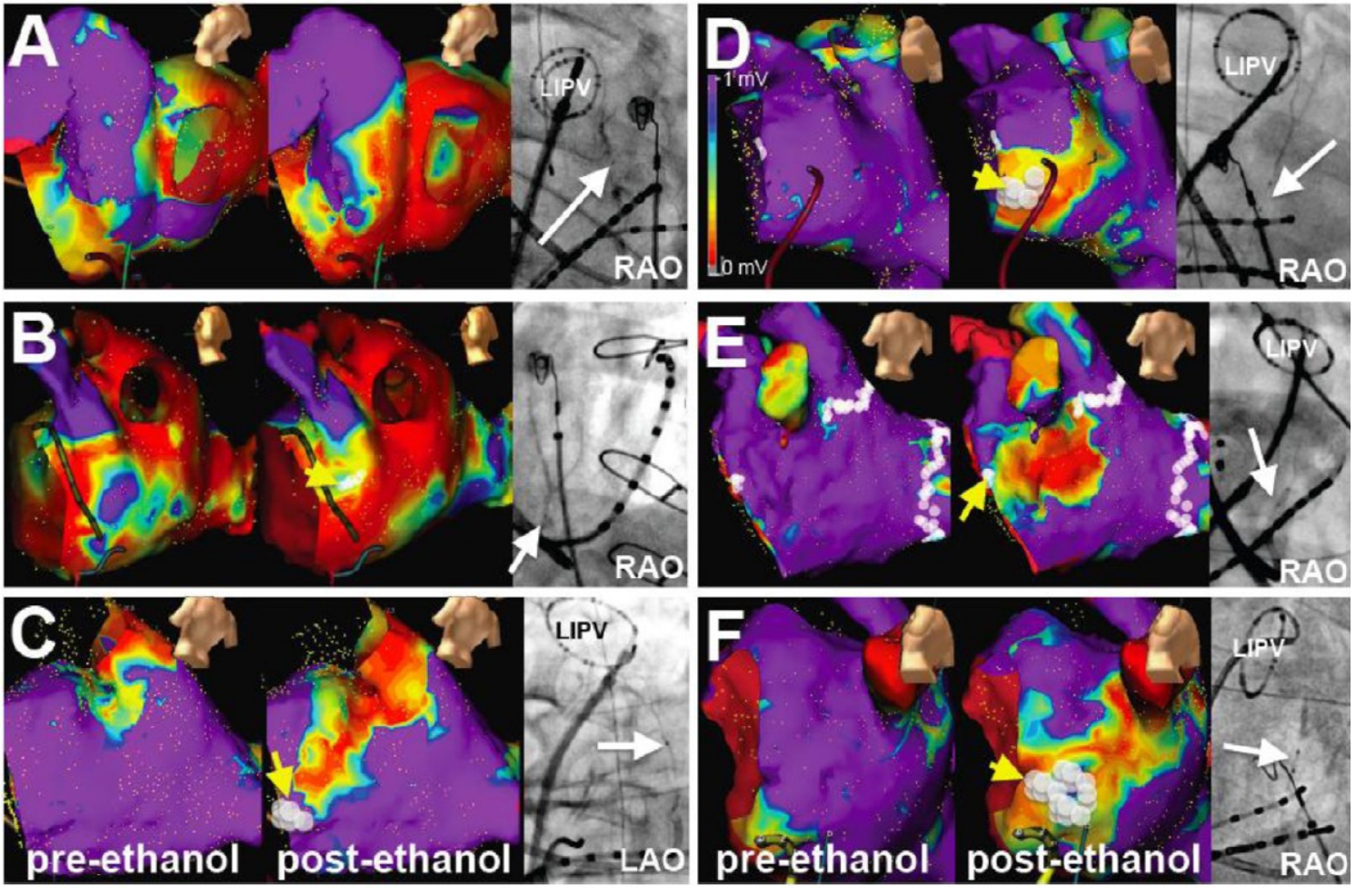




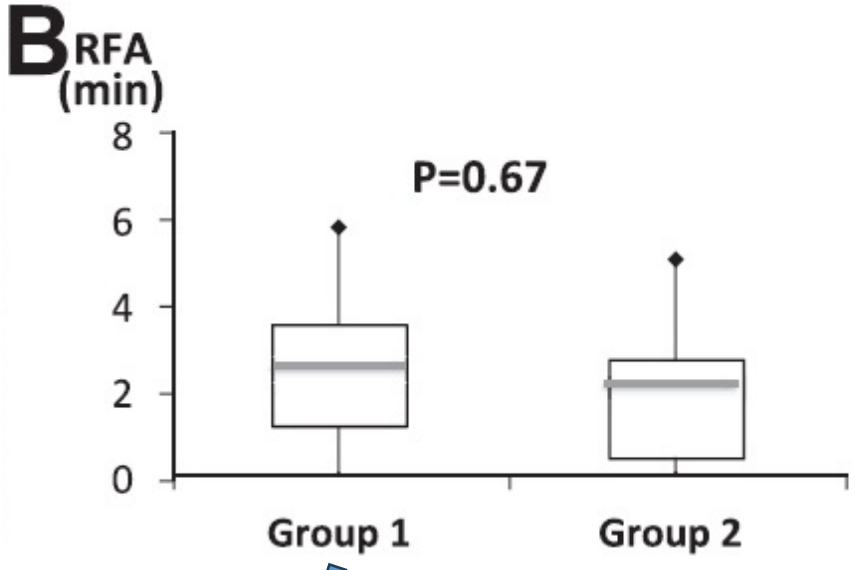
Heart Rhythm 2012;9:1207–1215

Perimitral flutter (RFA süresi)

Anuler gap



RFA süre



Daha önce %60'ına Mİ ablasyonu yapılmış

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CLINICAL TRIAL

CLINICAL CARDIOLOGY WILEY

Efficacy and feasibility of vein of Marshall ethanol infusion during persistent atrial fibrillation ablation: A systematic review and meta-analysis

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Funding information

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Abstract

Background: Catheter ablation (CA) is currently used to treat persistent atrial fibrillation (PeAF). However, its effectiveness is limited. This study aimed to estimate the effectiveness of the vein of Marshall absolute ethanol injection (VOM-EI) for PeAF ablation.

Hypothesis: Adjunctive vein of Marshall ethanol injection (VOM-EI) strategies are more effective than conventional catheter ablation (CA) and have similar safety outcomes.

Methods: We extensively searched the literature for studies evaluating the effectiveness and safety of VOM-EI + CA compared with CA alone. The primary endpoint was the rate of acute bidirectional block of the isthmus of the mitral annulus (MIBB). The secondary endpoints were atrial fibrillation (AF) or atrial tachycardia (AT) recurrence over 30 seconds after a 3-month blanking period. Weighted pooled risk ratios (RRs) and corresponding 95% confidence intervals (CIs) were calculated using a random effects model.

Results: Based on the selection criteria, nine studies were included in this systematic review, including patients with AF ($n = 2508$), persistent AF ($n = 1829$), perimitral flutter ($n = 103$), and perimitral AT ($n = 165$). There were 1028 patients in the VOM-EI + CA group and 1605 in the CA alone group. The VOM-EI + CA group showed a lower rate of AF/AT relapse (RR = 0.70; 95% CI = 0.53–0.91; $p = .008$) and a higher rate of acute MIBB (RR = 1.29; 95% CI = 1.11–1.50; $p = .0007$) than the CA alone group.

Conclusion: Our meta-analysis revealed that adjunctive VOM-EI strategies are more effective than conventional CA and have similar safety outcomes.

KEYWORDS

ablation, atrial fibrillation, atrial tachycardia, ethanol infusion, vein of Marshall

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CLINICAL TRIAL

CLINICAL CARDIOLOGY WILEY

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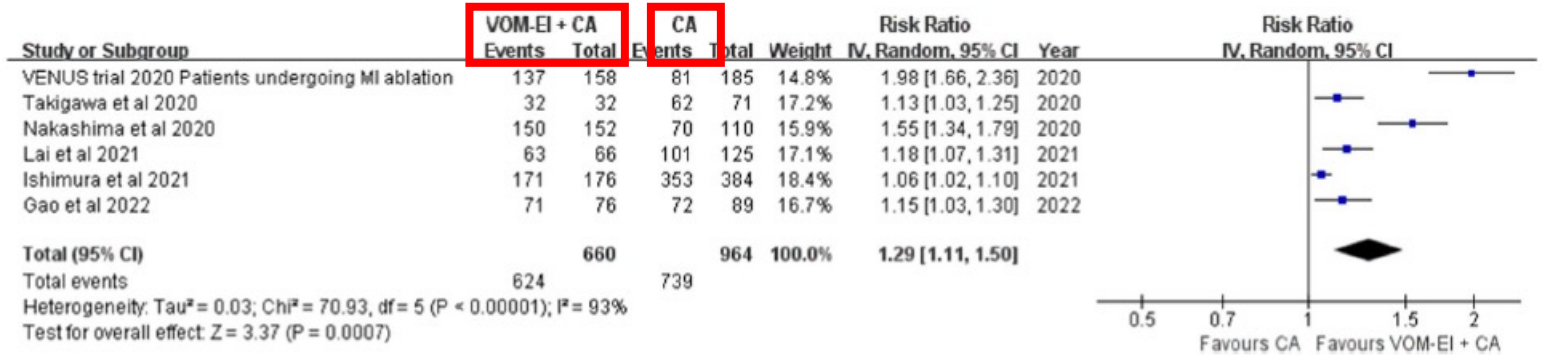


FIGURE 2 Pooled effect sized of VOM-EI for mitral isthmus ablation. CA, catheter ablation; CI, confidence interval; VOM-EI + CA, vein of Marshall absolute ethanol injection with catheter ablation.

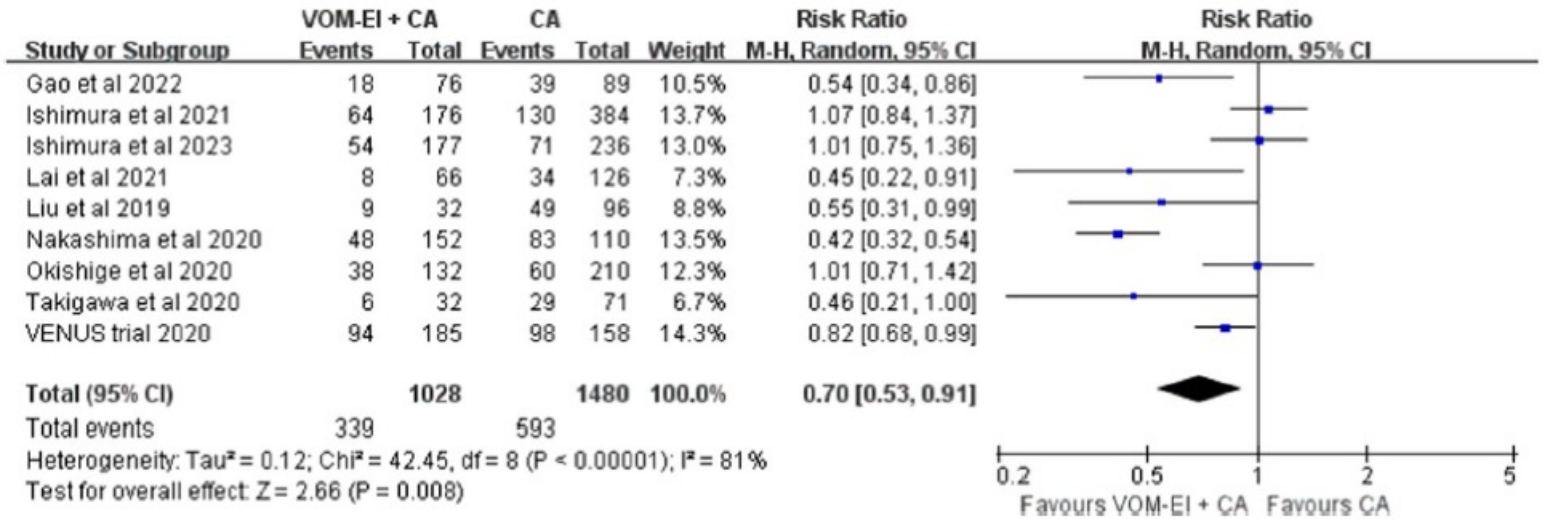


FIGURE 3 The overall pooled effect of VOM-EI on recurrence of atrial arrhythmias. CA, catheter ablation; CI, confidence interval; M-H, Mantel–Haenszel; VOM-EI + CA, vein of Marshall absolute ethanol injection with catheter ablation.

Olgu 1

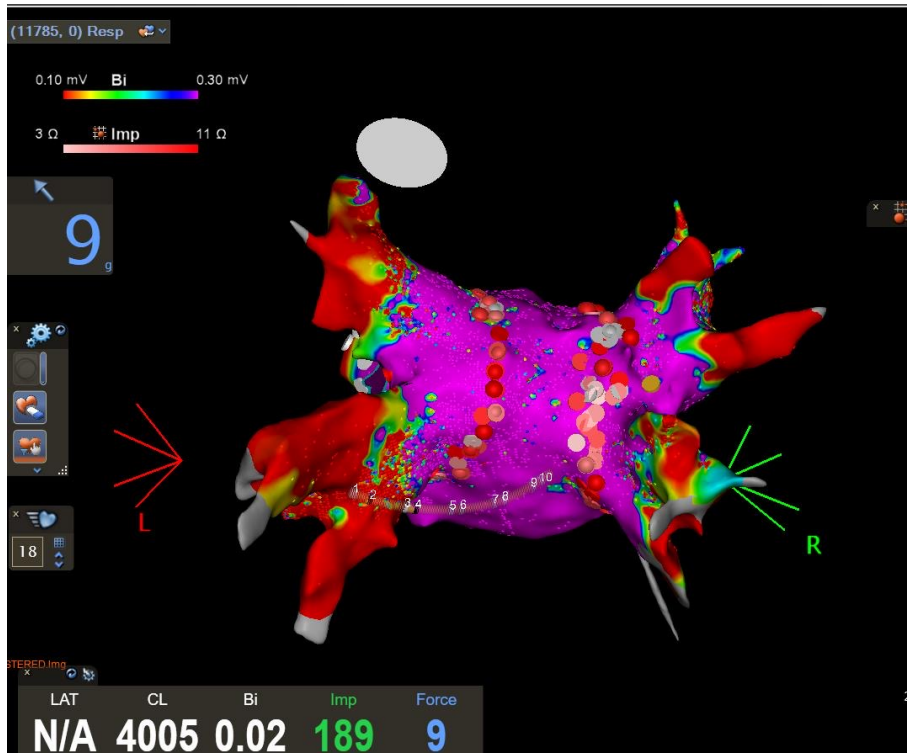
65 y, K,

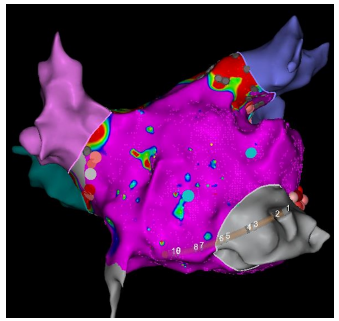
HT +

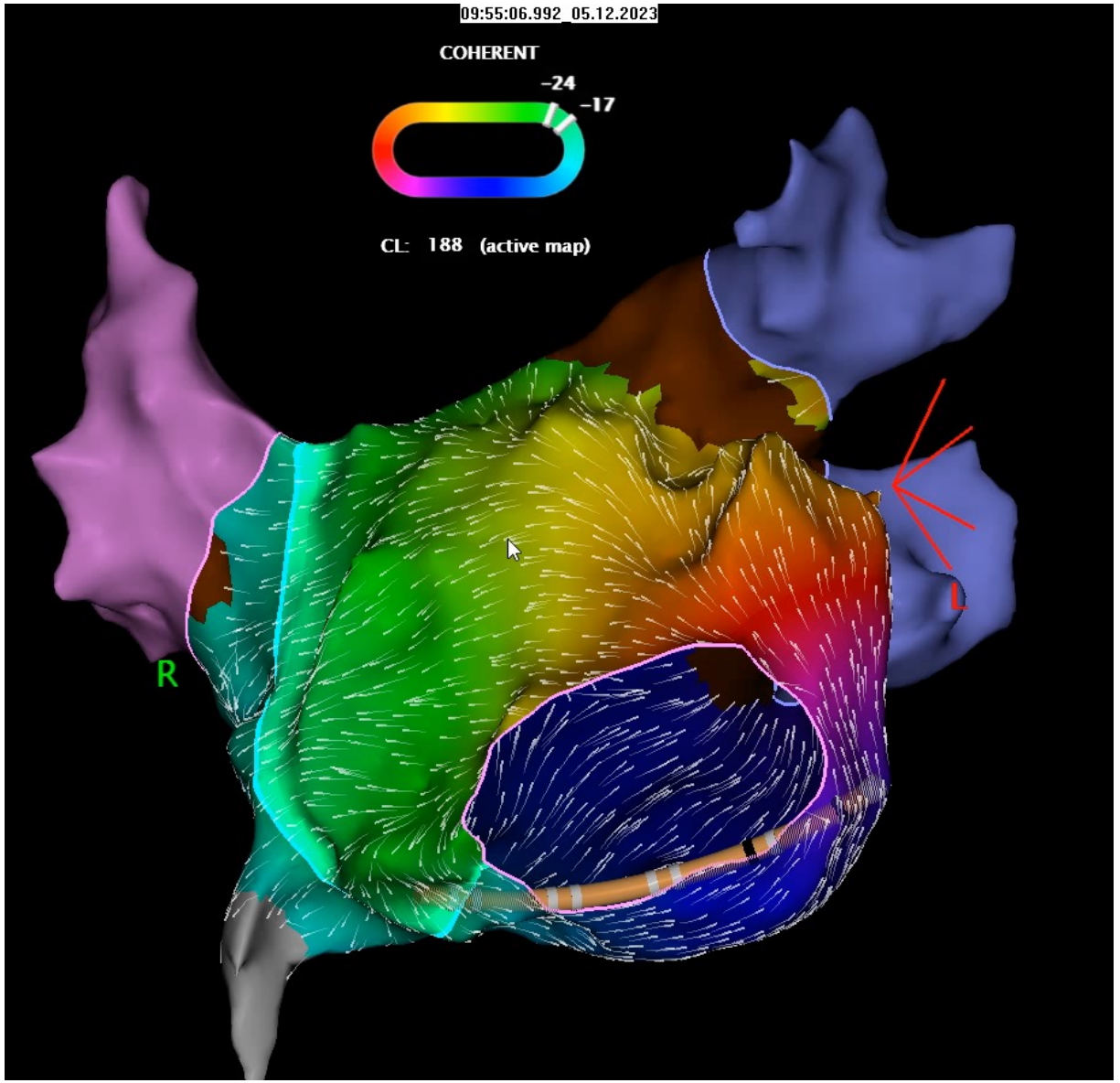
10 yıldır çarpıntı şikayeti

Son zamanlarda her gün AF atağı

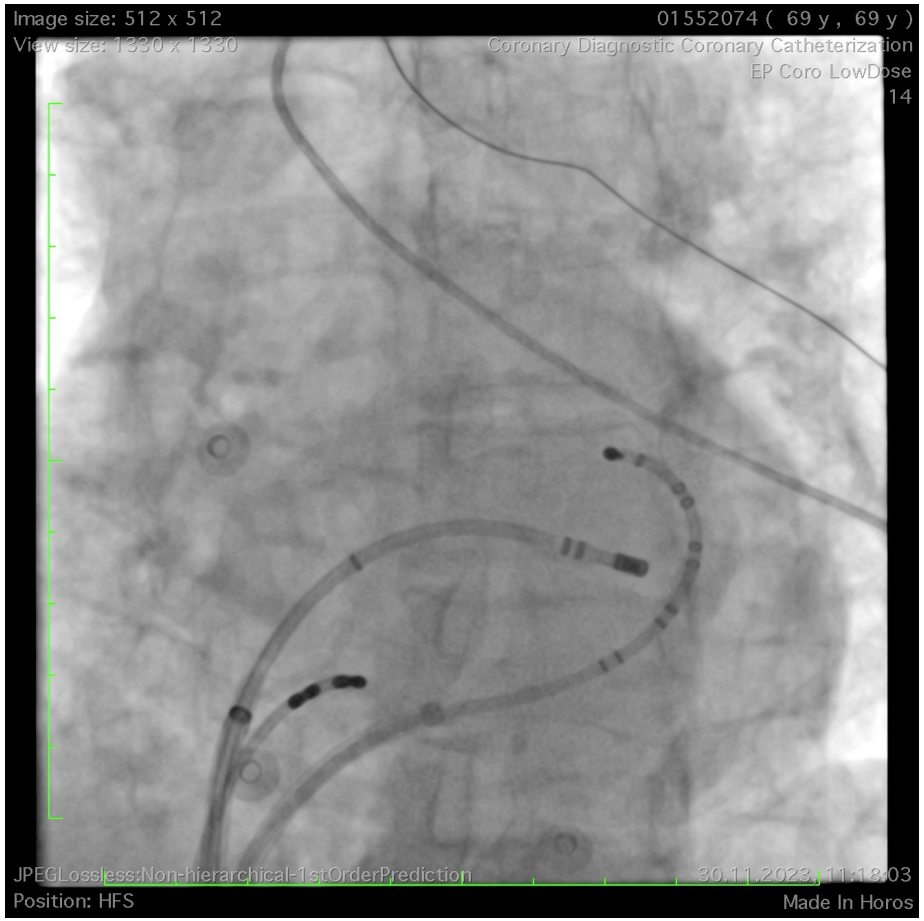
PVI sonrasında pacing manevraları ile AT indüklendi
Anterior duvar voltaj normal

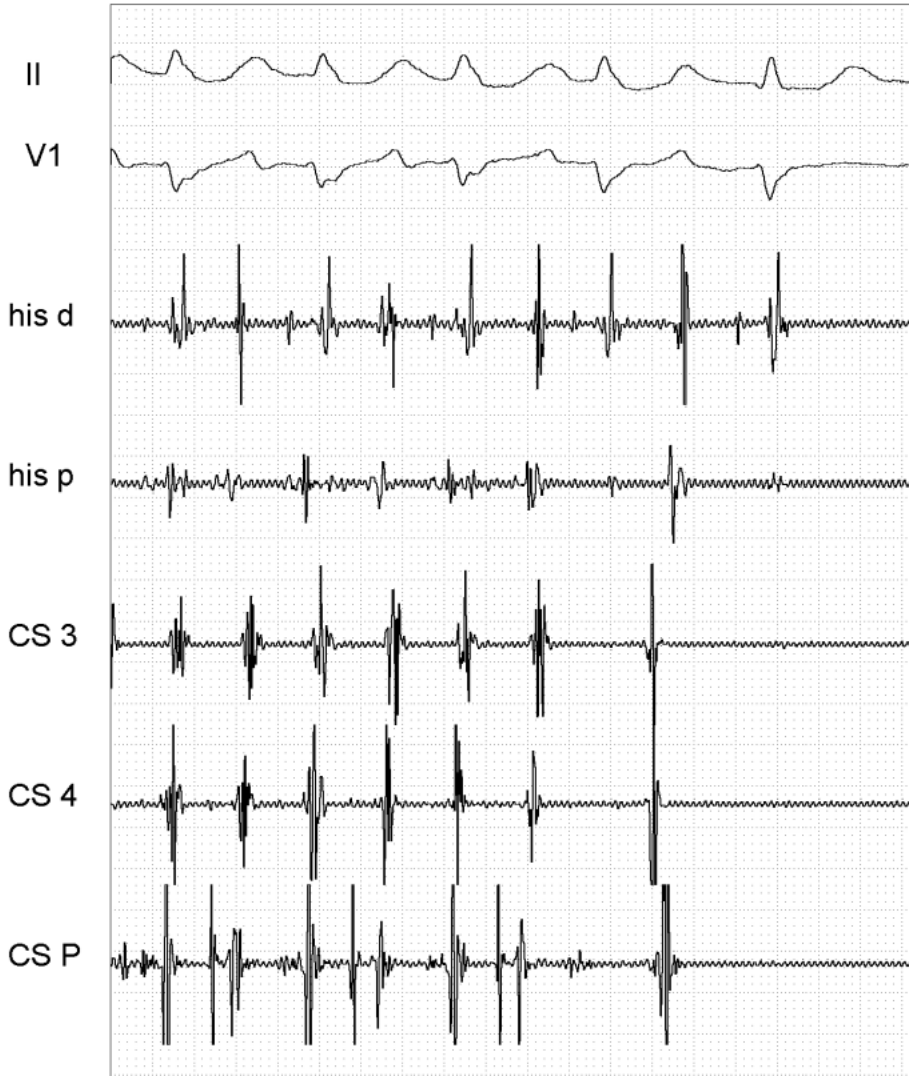






AT sonlanması

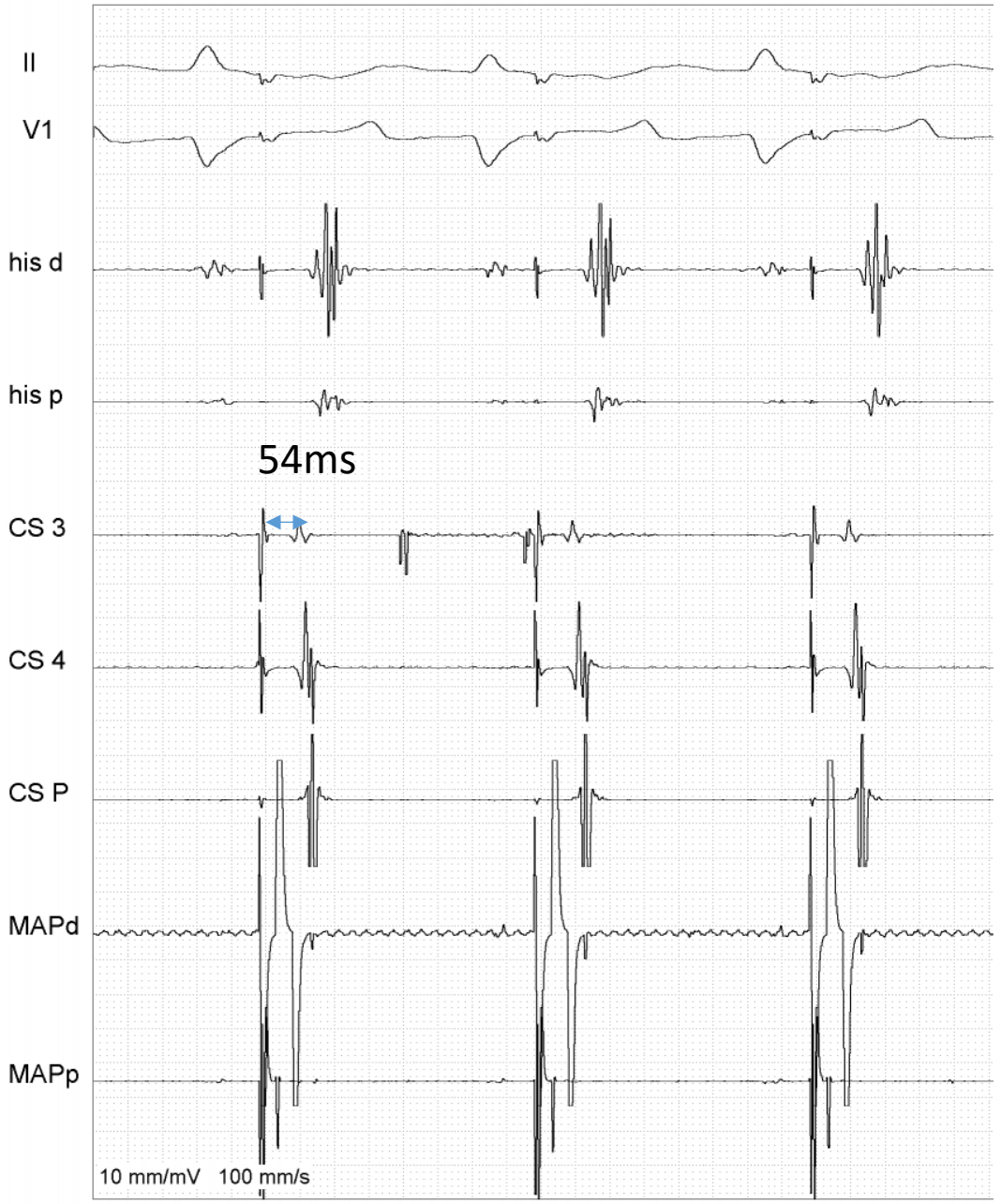




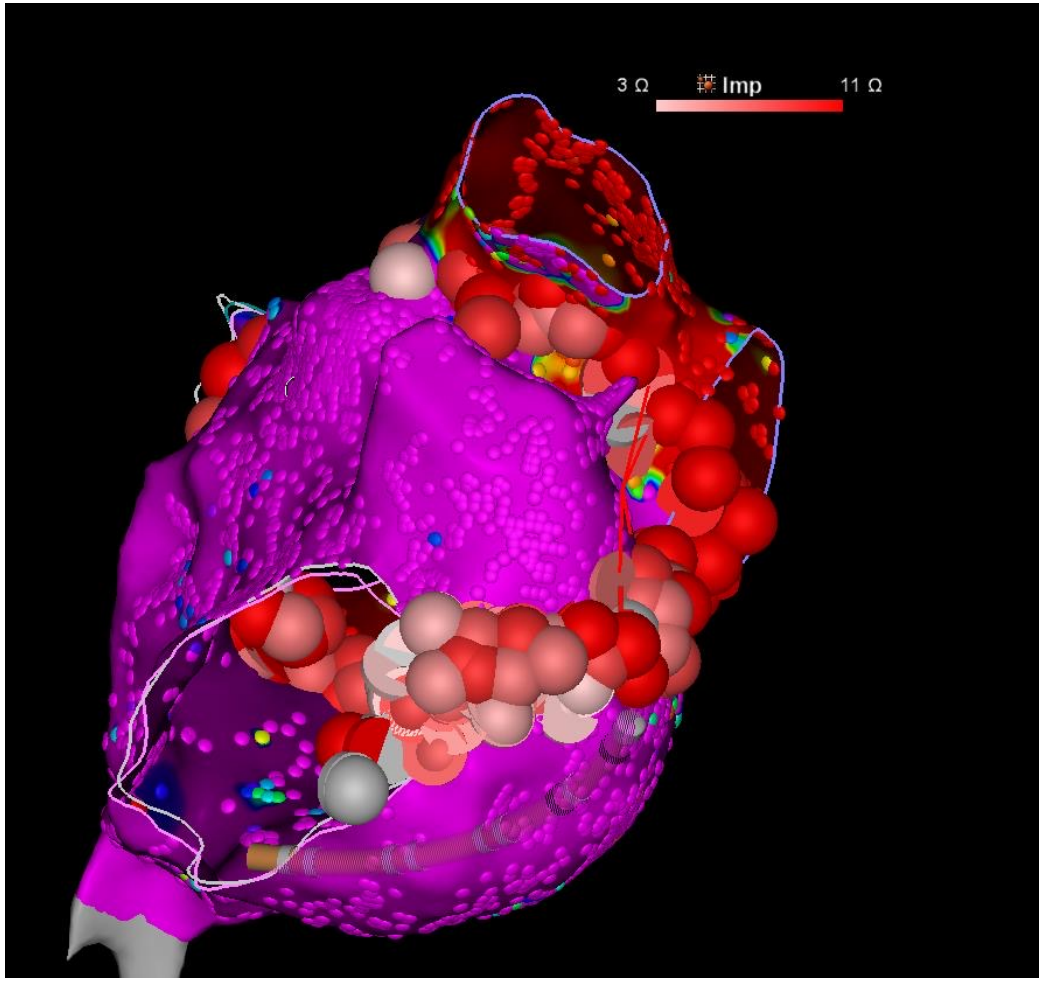
AT sonlandıktan sonra;

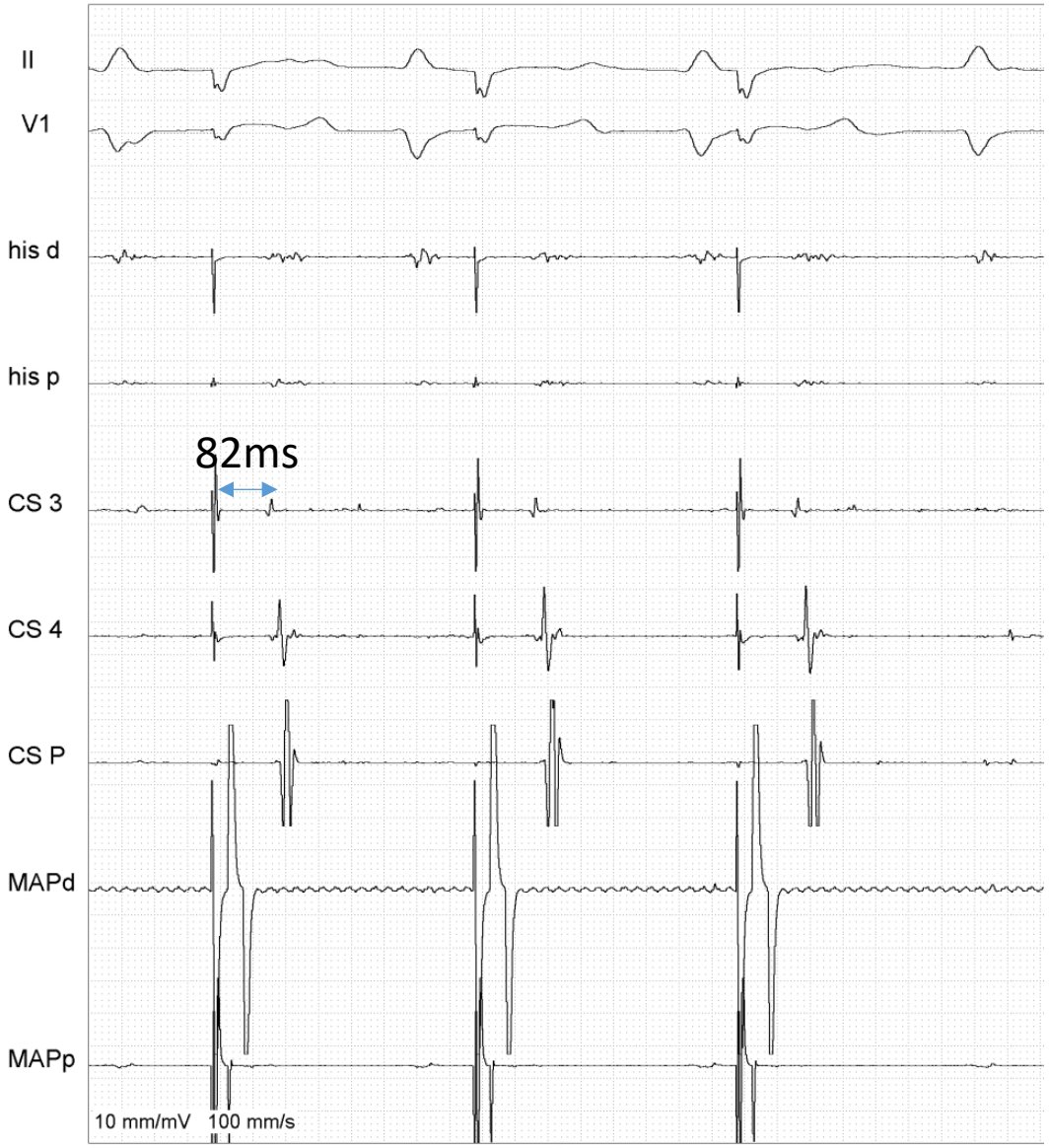
Map LAA’da

LAA’dan pace ile CD distal önde, 54ms

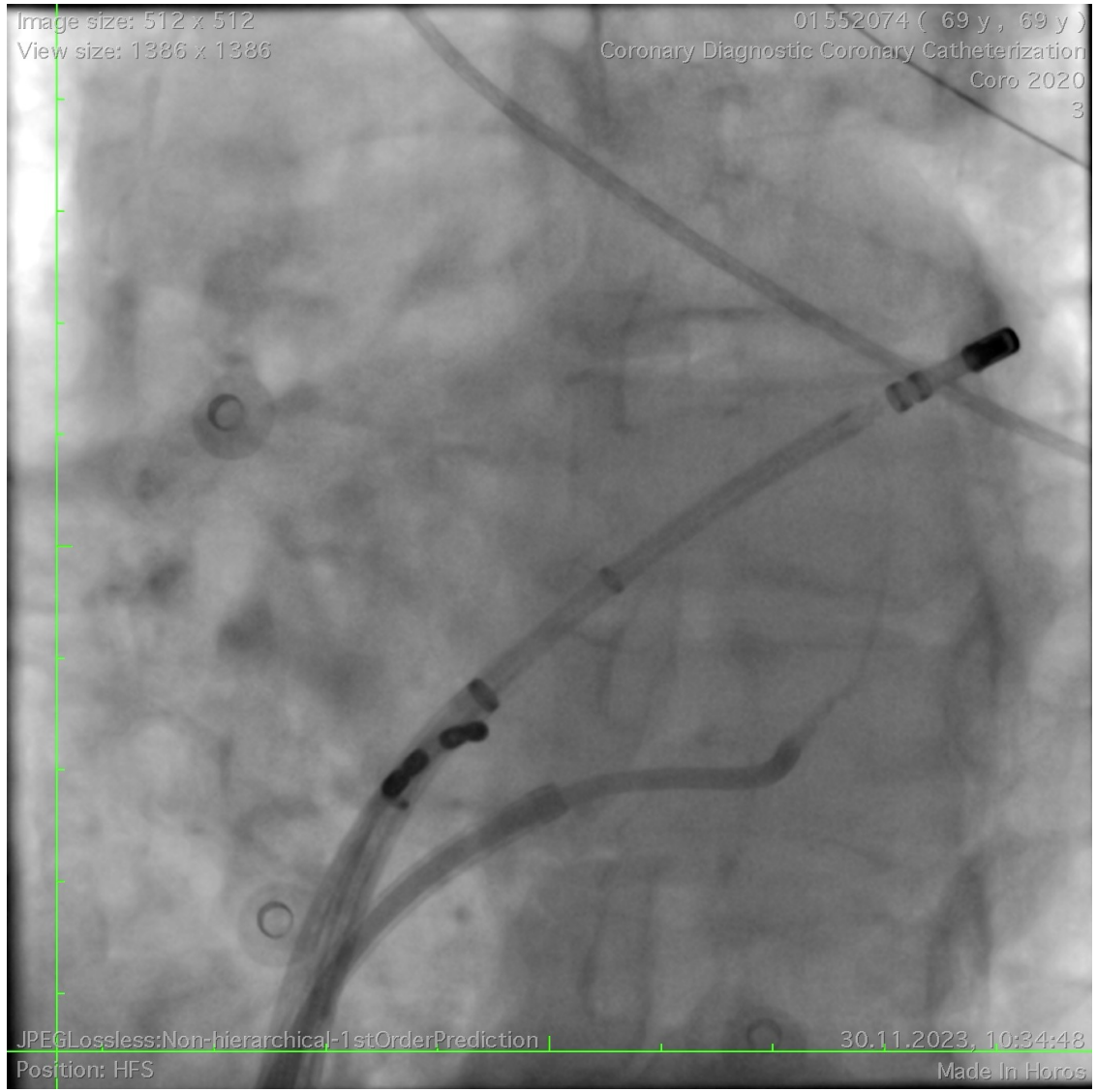


Endo hat tamamlandığında: Uzama var, blok yok





LAO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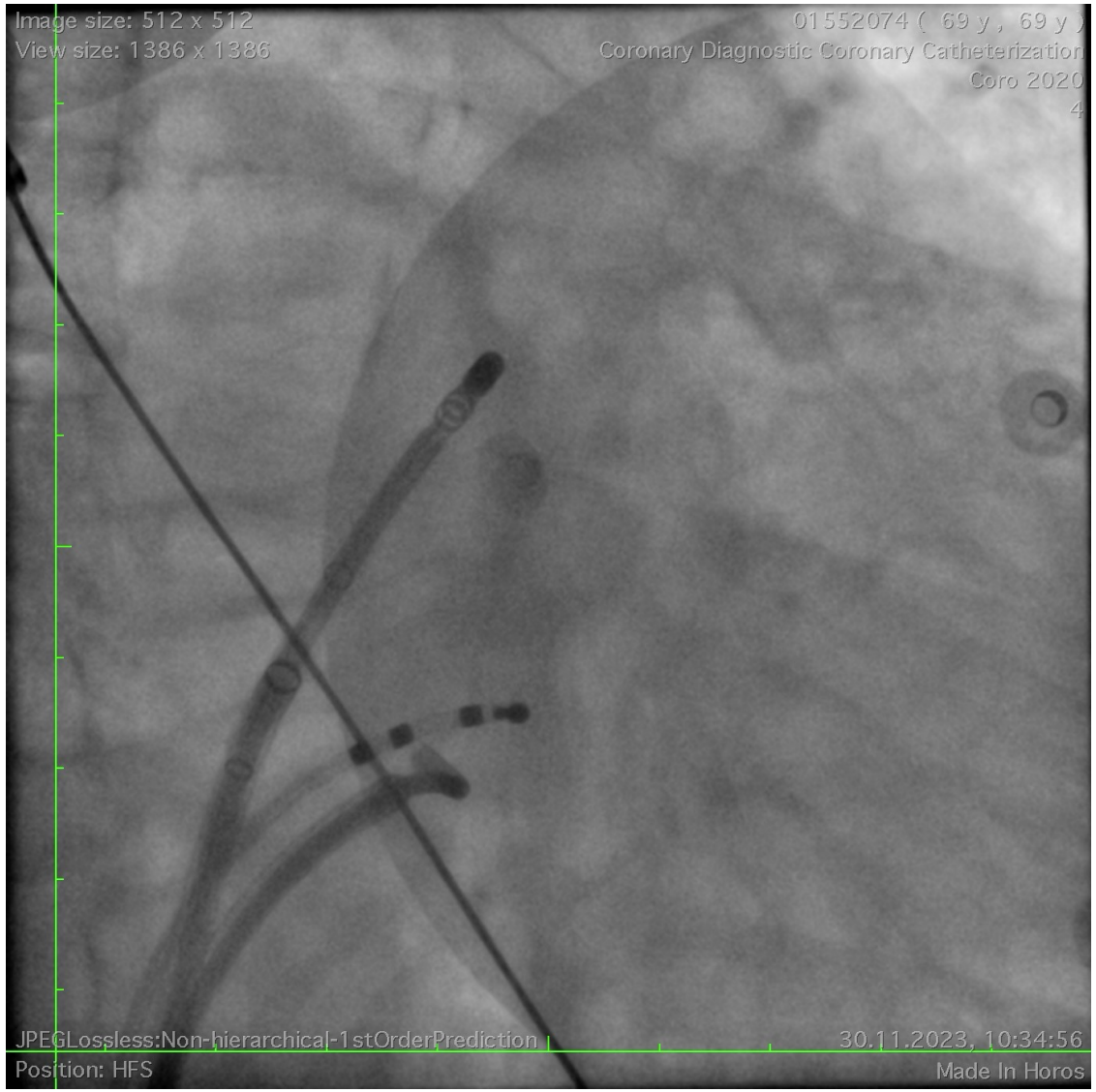
RAO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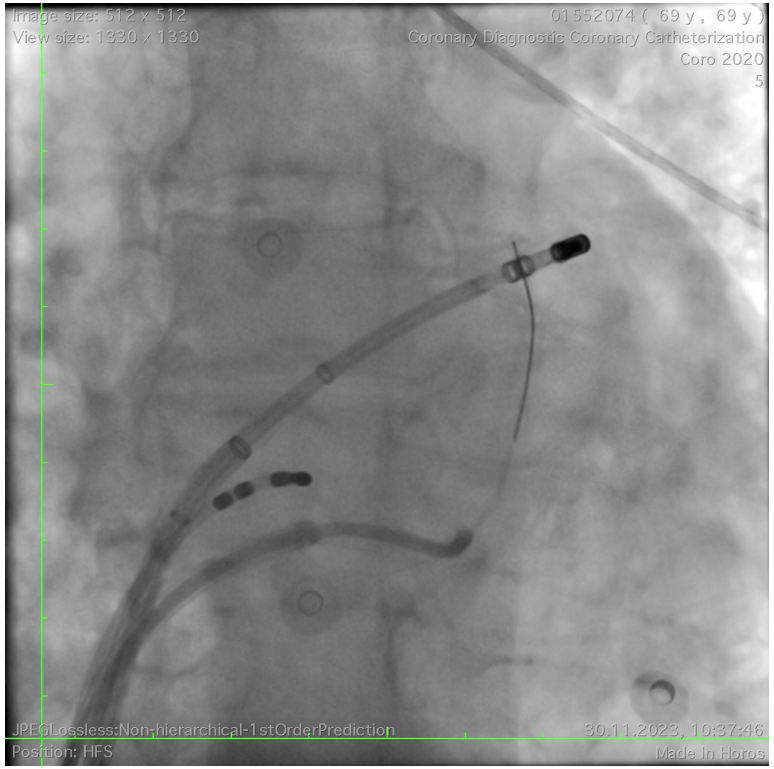
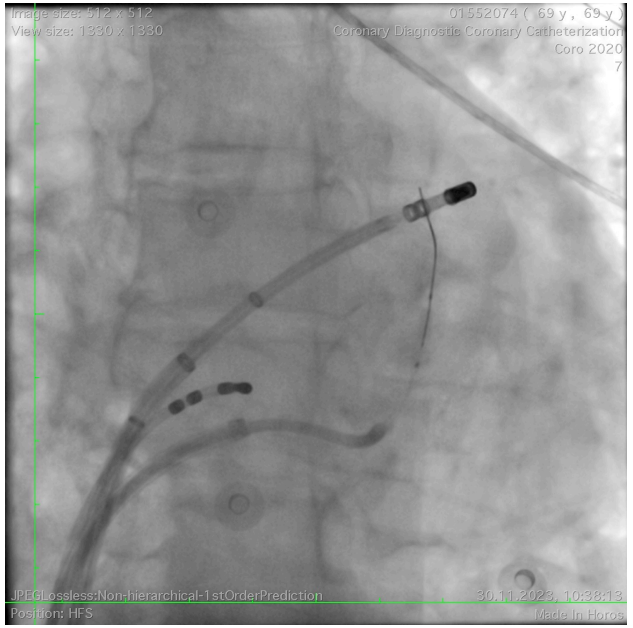
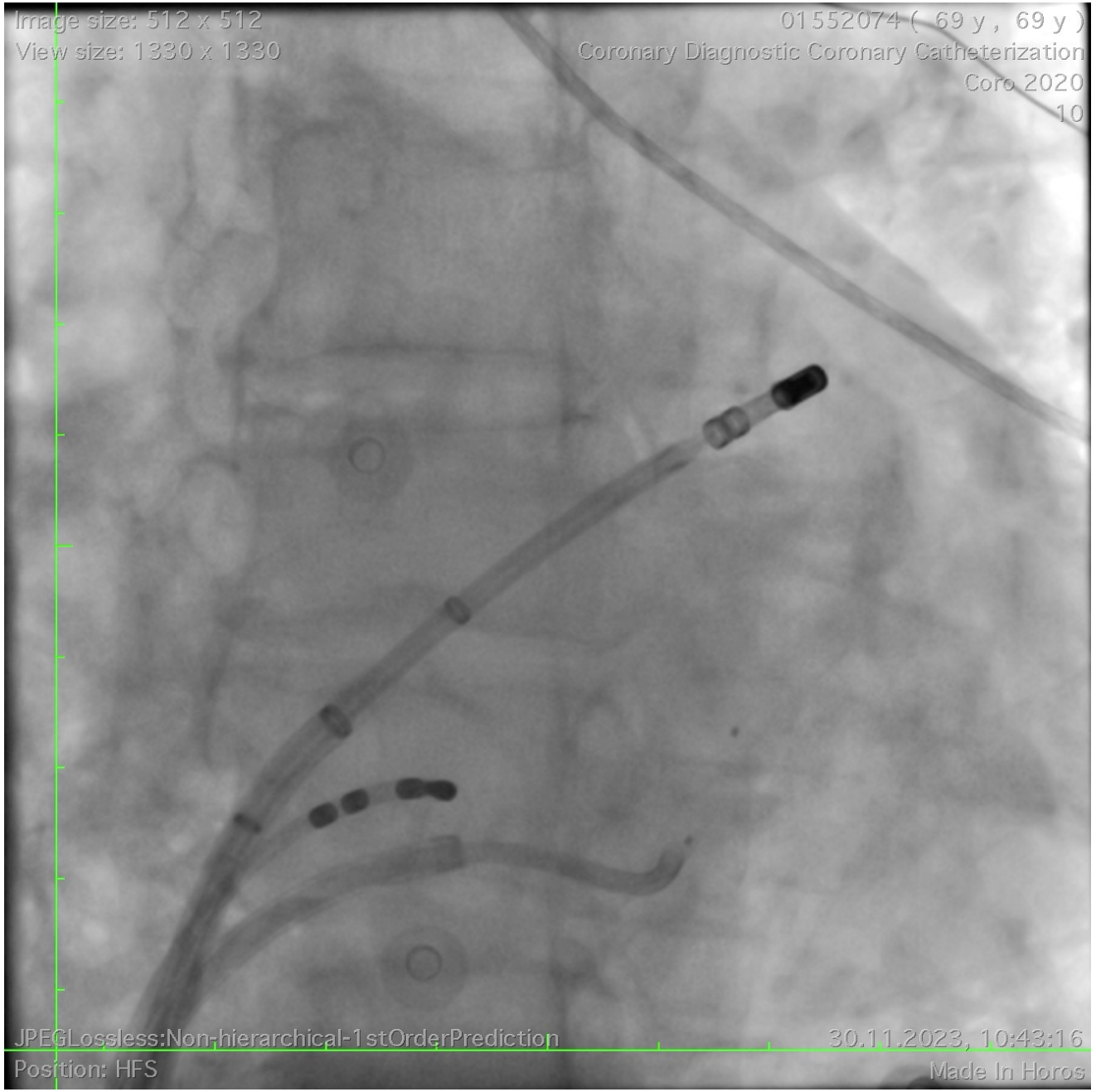
01552074 (69 y , 69 y)
Coronary Diagnostic Coronary Catheterization
Coro 2020
4
JPEGLossless:Non-hierarchical-1stOrderPrediction
30.11.2023, 10:34:56
Position: HFS
Made In Horos

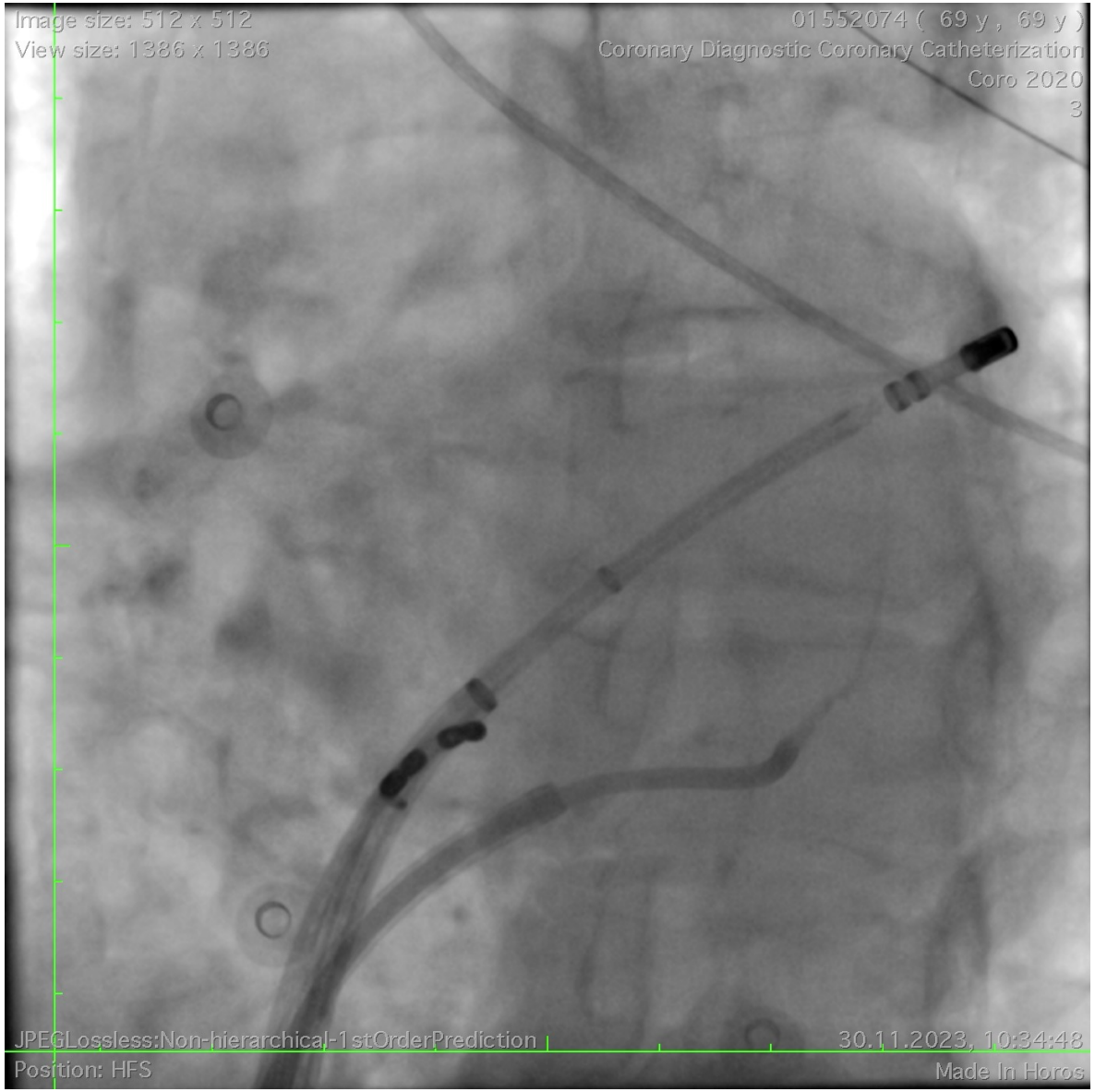
VOM distali oblitere







PRE vs POST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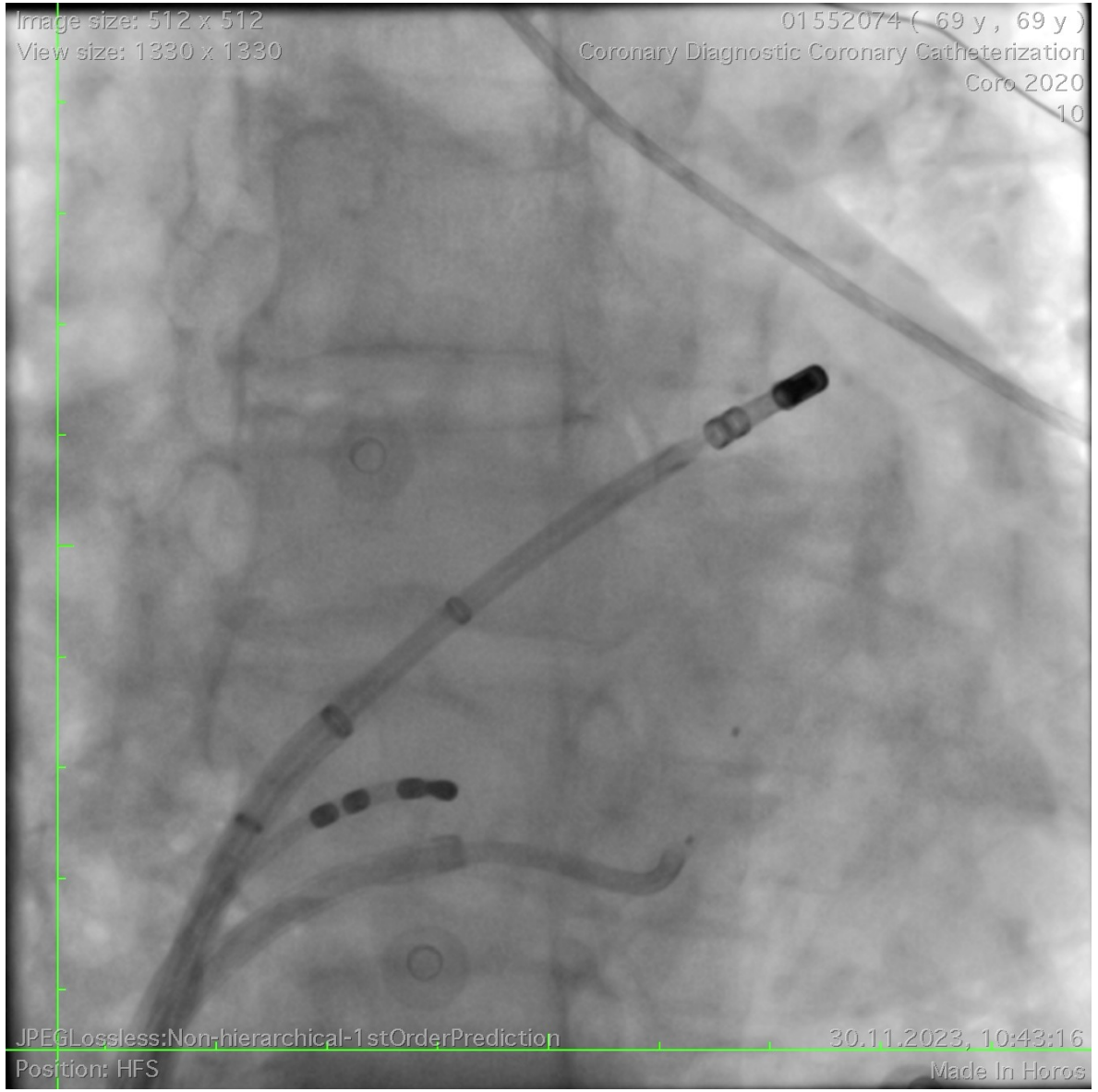
01552074 (69 y , 69 y)
Coronary Diagnostic Coronary Catheterization
Coro 2020
3
JPEGLossless:Non-hierarchical-1stOrderPrediction
30.11.2023, 10:34:48
Position: HFS
Made In Horos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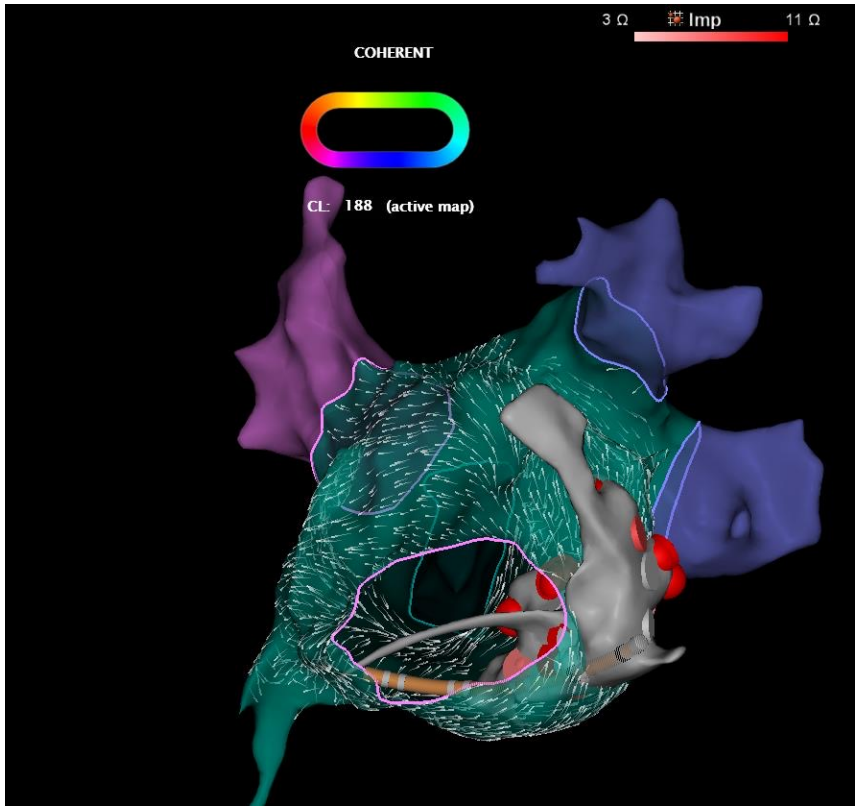
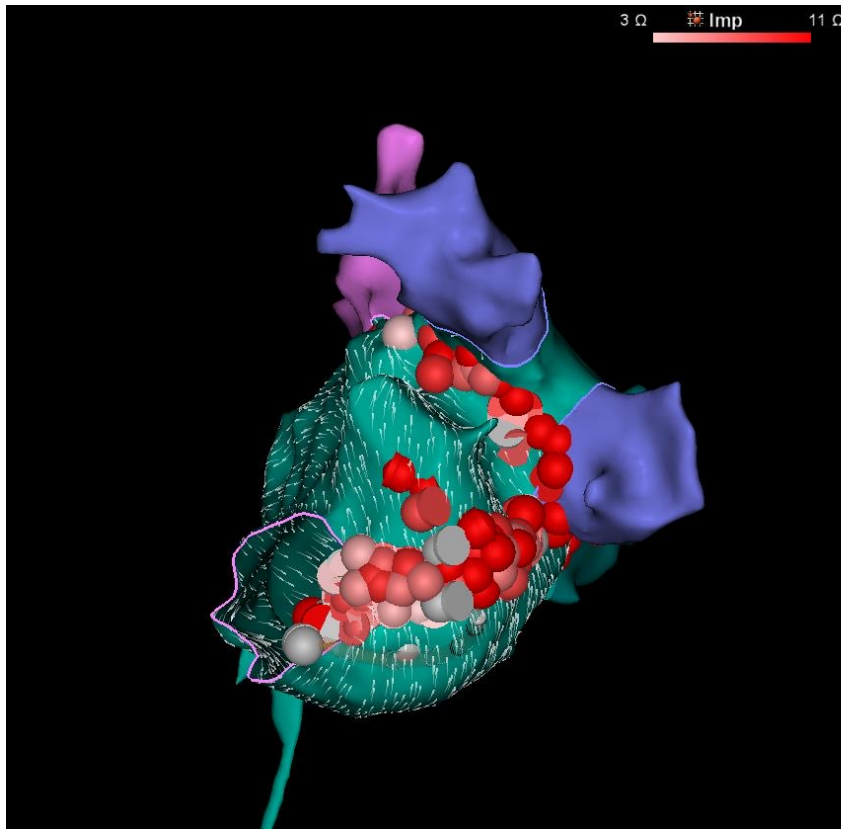
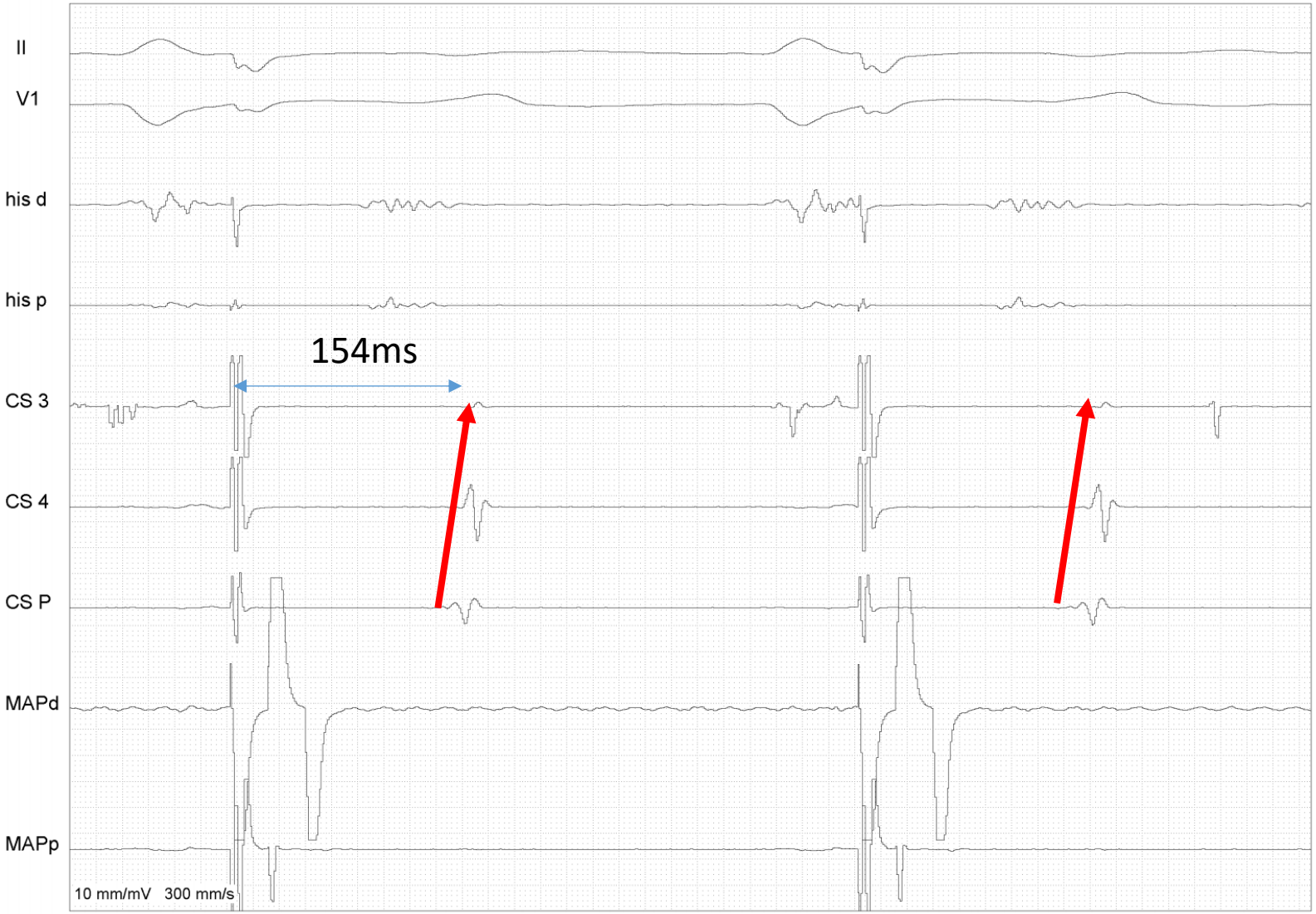
01552074 (69 y , 69 y)
Coronary Diagnostic Coronary Catheterization
Coro 2020
10
JPEGLossless:Non-hierarchical-1stOrderPrediction
30.11.2023, 10:43:16
Position: HFS
Made In Horos

VOM etanol sonrasında blok halen yok, CS içi miyokardial liflere ablasyon



Ardından: Endoda rekonnekisyon? Gap? tespit edildi. Rf sonrası: Mitral isthmusta blok

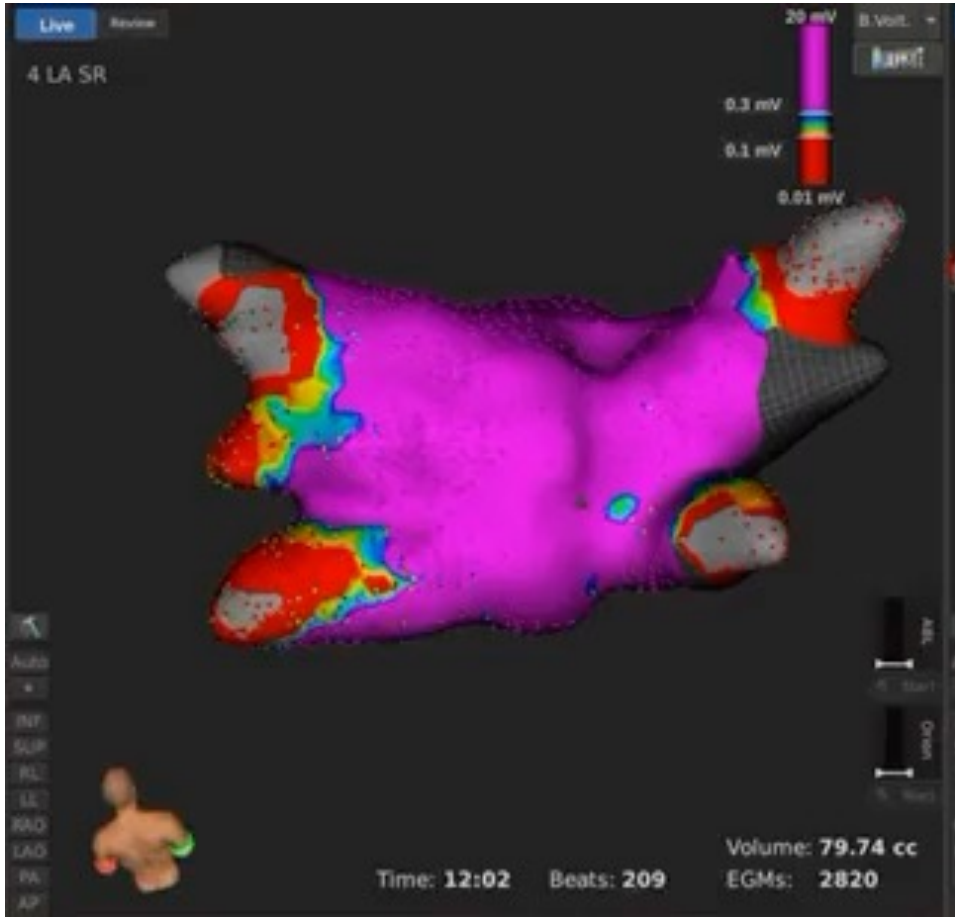




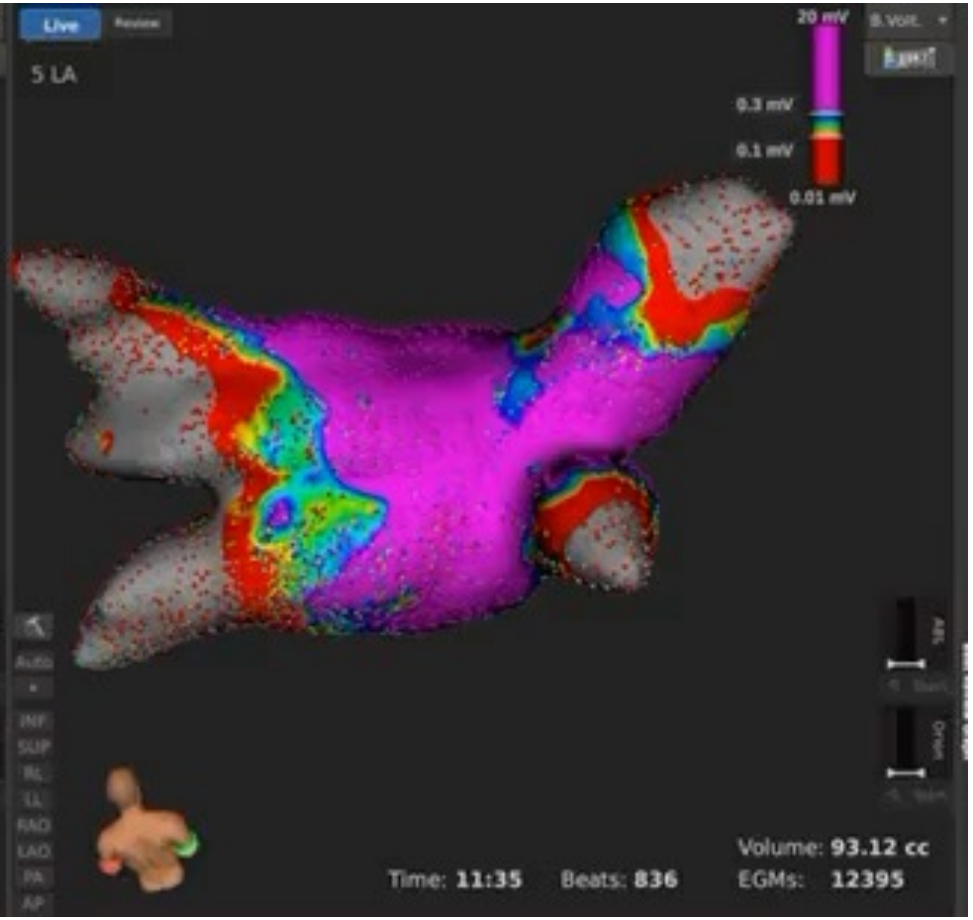
Olgu 2

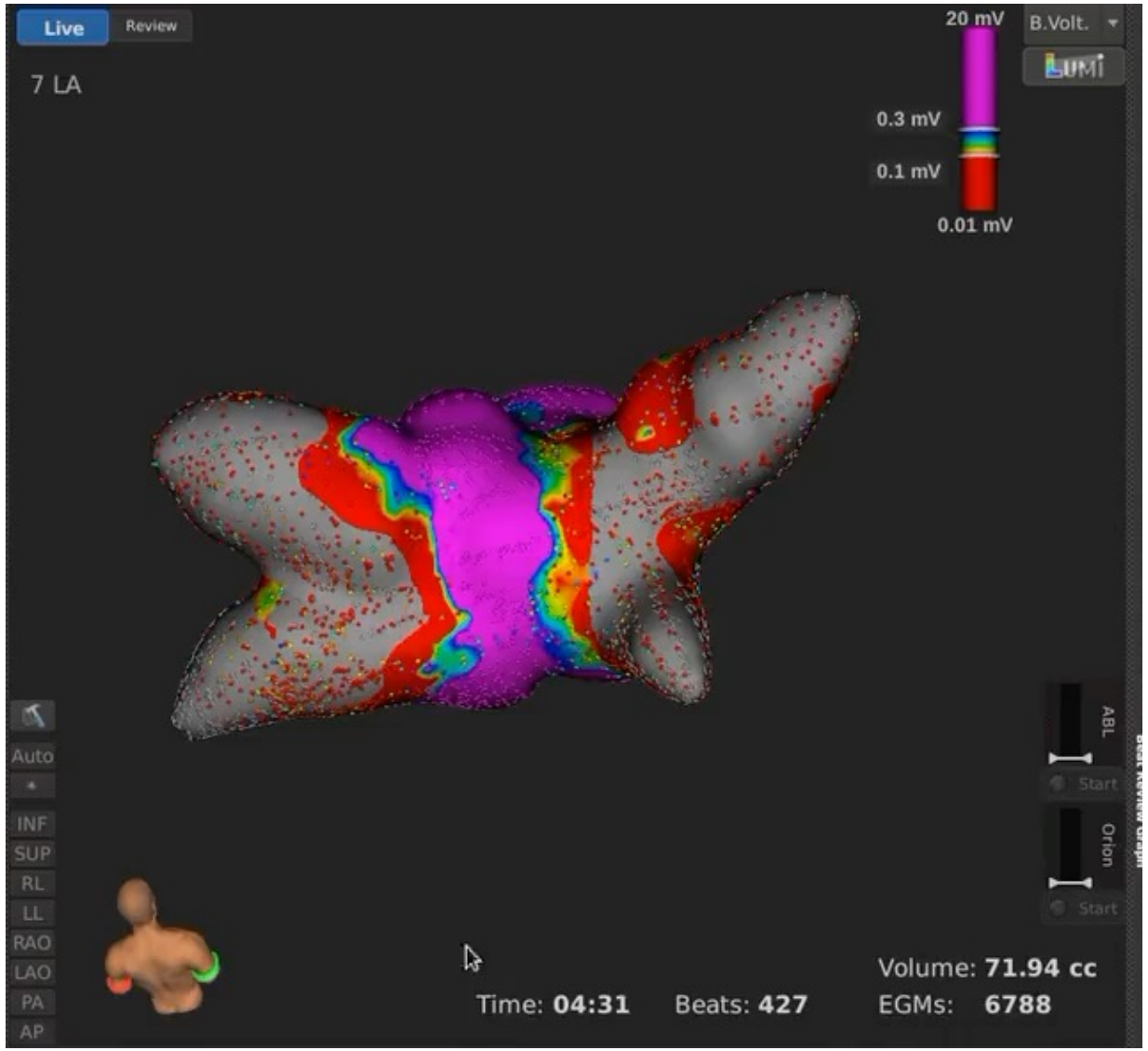
68 yaş, E, persistan AF

Önce



Sonra




Live
Review
7 LA
20 mV
B.Volt.
0.3 mV
0.1 mV
0.01 mV
Auto
INF
SUP
RL
LL
RAO
LAO
PA
AP
ABL
Start
Orion
Start
Time: 04:31
Beats: 427
Volume: 71.94 cc
EGMs: 6788

Teşekkür ederim……

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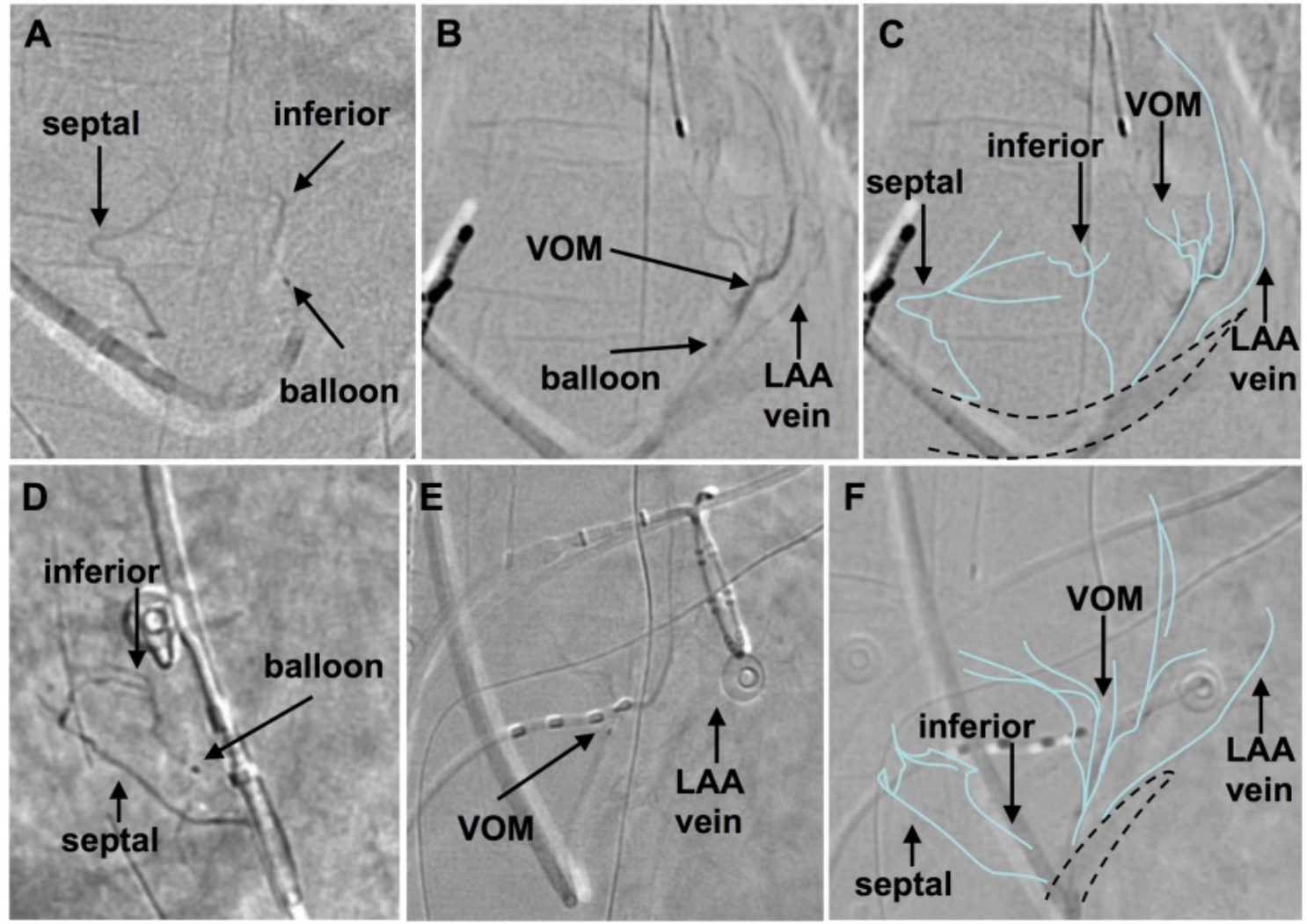
The Human Left Atrial Venous Circulation as a Vascular Route for Atrial Pharmacological Therapies

Effects of Ethanol Infusion

Miguel Valderrábano, MD, Percy Francisco Morales, MD, Moisés Rodríguez-Mañero, MD, Candela Lloves, MD, Paul A. Schurmann, MD, Amish S. Dave, MD, PhD

FIGURE 2 Inferior LA Vein as a Separate Vein



The inferior LA vein and the VOM were selectively cannulated, demonstrating the proximal LA veins. **(A to C)** LAO projection. **(D to F)** RAO projection. **(A, D)** Selective inferior vein venogram opacifies septal LA veins through post-capillary collaterals. **(B, E)** VOM selective venogram opacifies the VOM and its branches, as well as the LAA vein. **(C, F)** Outline of all visible veins combined. Abbreviations as in Figure 1.