# The Emerging Atrial Fibrillation Epidemic: Treat It, Leave It or Burn It

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# Disclosures

- Consultant
  - Advisory Board, Medtronic

# Atrial fibrillation management

- Catheter ablation is now an accepted non-pharmacological treatment
- "Cure" is an expectation among patients and referring physicians
- Despite guidelines for management of AF, we come across patients who need individualized treatment plan

# Four clinical scenarios

1. Drug refractory LAA thrombus
    1. Management challenges during planned PVI
2. Focal trigger initiated AF
    1. Focal ablation vs. Circumferential ablation of all four pulmonary veins
3. Initial experience with Arctic Front Cryo ablation for Pulmonary vein isolation
4. Role of AVN ablation and Pacemaker for difficult to treat Atrial fibrillation

# Case 1

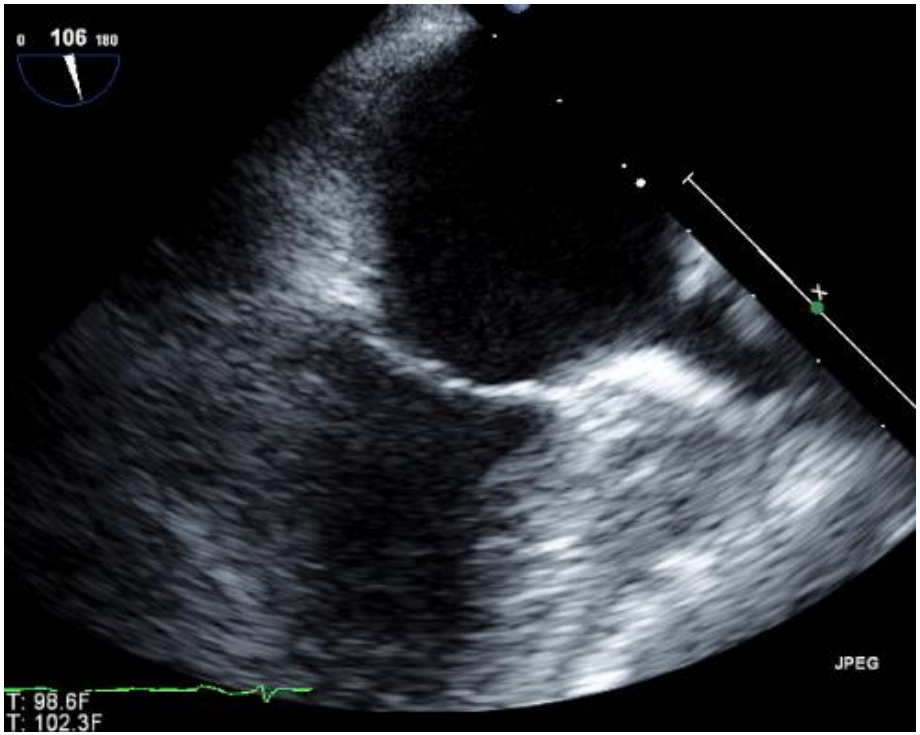
- 71 year old female history of symptomatic paroxysmal AF for nearly 20+ years
  - 2002: started on Digoxin
  - 2005: Pacemaker for tachy-brady episodes
  - 2007: started on Sotalol
    - AP/VP: 95%/4%
  - 2009: symptomatic AF recurrence requiring Cardioversion
  - 2010: second symptomatic AF recurrence
    - Sotalol continued
  - 2012: recurrent symptomatic AF
    - Amiodarone started for PAF, developed side effects and intolerance. Amiodarone stopped.
    - April 2012: referred for PVI while on coumadin

# Case 1

- Pre ablation
  - 3 days before: CT chest showed no thrombus
  - Day of procedure: TEE shows LAA thrombus
  - Procedure cancelled
- Anti-coagulation initiated

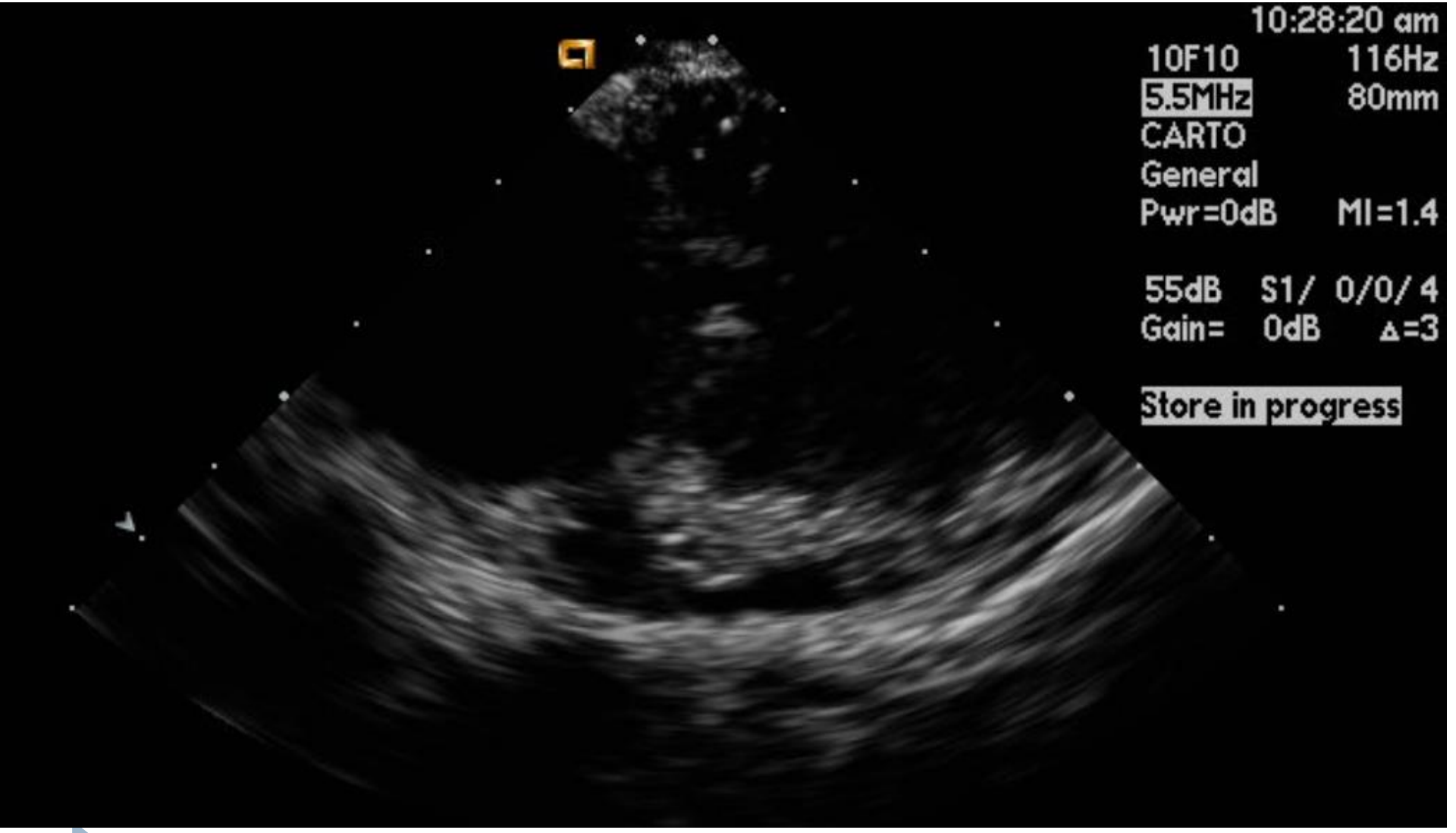
# Case 1
# Post 2 month anticoagulation


# Case 1
# Post 5 months of anticoagulation




- TEE reported no thrombus
- Ablation scheduled
- Coumadin continued

# Case1
# Post 6 month anticoagulation-ICE



# Pre Ablation Anticoagulation HRS 2012 guidelines

- Anticoagulation guidelines that pertain to cardioversion of AF be adhered to in patients who present for an AF ablation in atrial fibrillation at the time of the procedure.

In other words, if the patient has been in AF for 48 hours or longer or for an unknown duration, **we require three weeks of systemic anticoagulation at a therapeutic level prior to the procedure, and if this is not the case, we advise that a TEE be performed to screen for thrombus.**

Furthermore, each of these patients will be anticoagulated systemically for two months post ablation anticoagulated with warfarin should be considered.

# Current Guidelines

- For patients in whom **thrombus is identified** by transesophageal echocardiogram, oral anticoagulation (INR 2.0 to 3.0) is reasonable for at least 3 week prior to and 4 week after restoration of sinus rhythm, and a longer period of anticoagulation may be appropriate even after apparently successful cardioversion, because the risk of thromboembolism often remains elevated in such cases. (Level of Evidence: C)

# Pulmonary Vein isolation procedure in patients with drug refractory LAA Thrombus

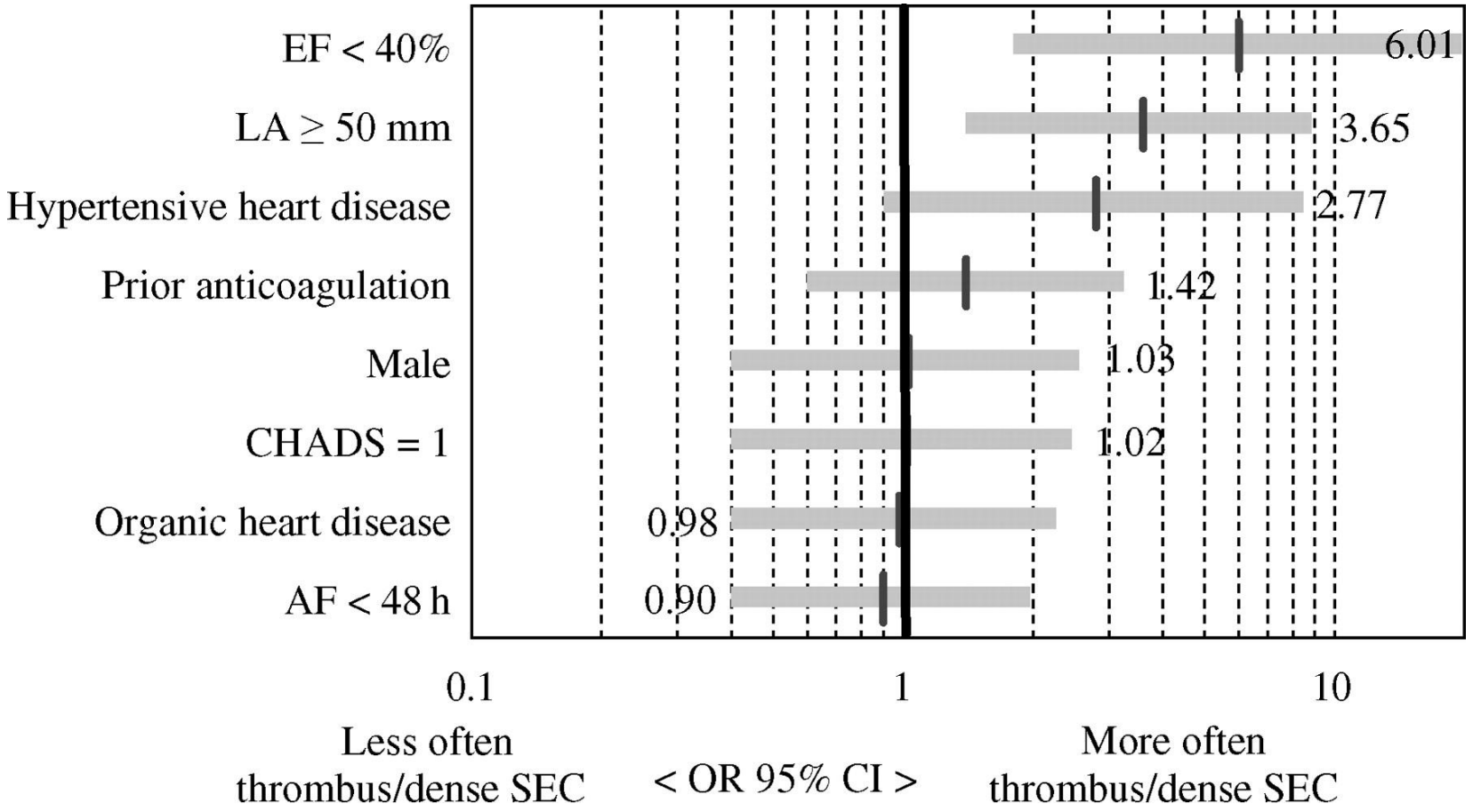
- HRS guidelines-2012

"The presence of a left atrial thrombus is a contraindication to catheter ablation of AF"

# Next step

- Is it LAA thrombus?
  - ? Proceed with Catheter ablation
  - ? Change Warfarin to Dabigatran
  - ? Change Warfarin to Rivaroxaban
  - ? Surgical epicardial ablation
  - ? Surgical resection of LAA
  - ? LAA ligation and 'Hybrid procedure'
- OR
  - ?Abandon the procedure
    - Continue aggressive anticoagulation and rate control

**Predictors of left atrial thrombus or dense spontaneous echo contrast (SEC) in patients with CHADS 0/1 (multivariable analysis).**




**Kleemann T et al. Eur J Echocardiogr 2009;10:383-388**



European Heart Journal Cardiovascular Imaging

Europace (2010) 12, 927–932
doi:10.1093/europace/euq074



# Incidence of left atrial thrombus prior to atrial fibrillation ablation: is pre-procedural transoesophageal echocardiography mandatory?

**James W. McCready*, Laurence Nunn, Pier D. Lambiase, Syed Y. Ahsan, Oliver R. Segal, Edward Rowland, Martin D. Lowe, and Anthony W. Chow**

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*Received 4 November 2009; accepted after revision 19 February 2010; online publish-ahead-of-print 19 March 2010*

**Aims** The exact role of transoesphageal echo (TOE) prior to atrial fibrillation (AF) ablation remains unclear. This study examines the incidence and predictors of left atrial (LA) thrombus in patients undergoing AF ablation.

**Methods and results** Patients were treated with warfarin for at least 4 weeks prior to ablation. This was substituted with therapeutic dalteparin 3 days before the procedure. All patients underwent TOE to exclude LA thrombus. Six clinical risk factors for thrombus were defined, known to be risk factors for stroke in AF: age >75, diabetes, hypertension, valve disease, prior stroke, or transient ischaemic attack and cardiomyopathy. A total of 635 procedures were performed. The incidence of thrombus was 12/635 (1.9%) despite therapeutic anti-coagulation. Patients with thrombus had larger LA diameter, mean 50.6 ± 6.2 mm vs. 44.2 ± 7.6 ($P = 0.006$). In univariate analysis, persistent AF [odds ratio (OR) = 10.4 with 95% CI 1.8–19.1], hypertension [OR = 11.7 with 95% CI 2.5–54.1], age >75 (OR = 4.5 with 95% CI 1.2–17.2), and cardiomyopathy (OR 5.9 with 95% CI 1.8–19.1) were significantly associated with thrombus. In multivariate analysis, hypertension (OR = 14.2 with 95% CI 2.6–77.5), age >75 (OR = 8.1, 95% CI 1.5–44.9), and cardiomyopathy (OR = 10.5 with 95% CI 2.6–77.5) were independently associated with thrombus. There was no thrombus in patients without clinical risk factors.

**Conclusion** In patients presenting for AF ablation, LA thrombus is only seen in those with clinical risk factors. TOE is indicated in this group but may be unnecessary in patients without clinical risk factors.

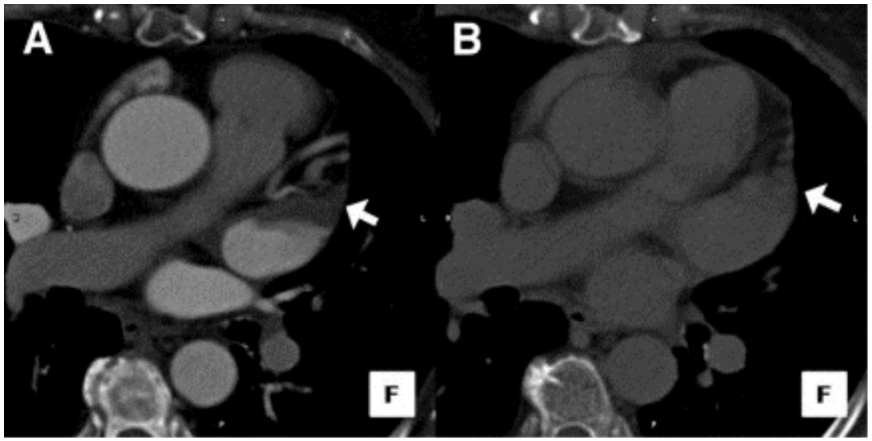
**Keywords** Atrial fibrillation • Anti-coagulation • Transoesophageal echocardiography • Fibrinolytic agents • Radiofrequency catheter ablation

# Reliability OF PRE-ABLATION CT SCAN FOR DETECTION OF LAA THROMBUS

JACC Journals

# Detection of Left Atrial Appendage Thrombus by Cardiac Computed Tomography: A Word of Caution*

J Am Coll Cardiol Img. 2009;2(1):77-79. doi:10.1016/j.jcmg.2008.10.003




## Figure Legend:

**Axial Image of a Cardiac Computed Tomography Study Performed in a Patient Before Radiofrequency Pulmonary Vein Ablation**

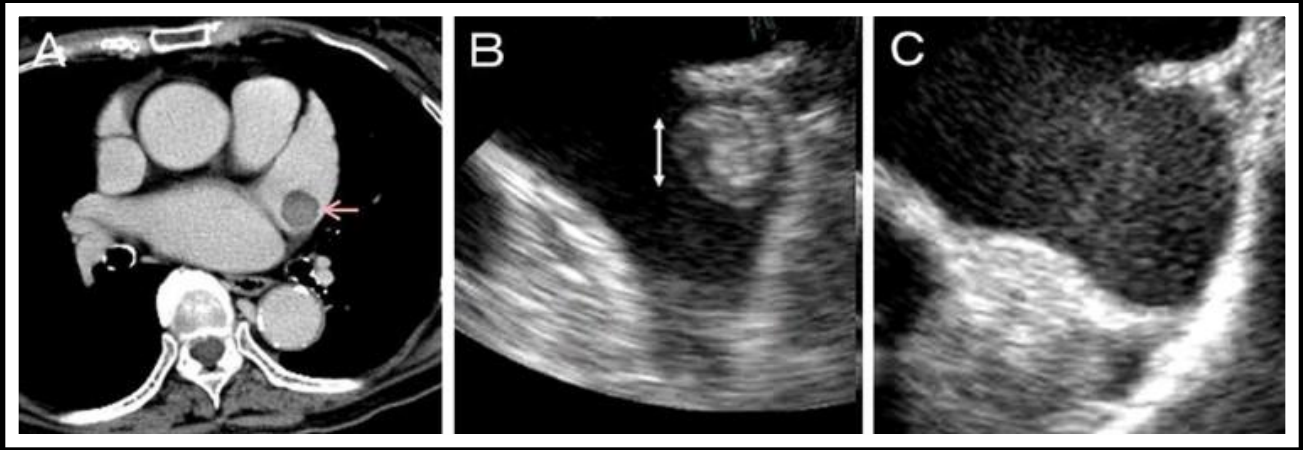
**(A) Initial image obtained after contrast injection demonstrates filling defect in the left atrial appendage tip. (B) Delayed image obtained 1 min after initial scan shows homogeneous opacification, suggesting an absence of thrombus. F = feet.**

# Immediate disappearance of large thrombus in left atrium without evidence of systemic embolization after heparin treatment

Gaku Oishi, MD, Akihiko Hodatsu, MD, Mika Mori, MD, Kensuke Fujioka, MD, Kenshi Hayashi, MD, FJCC, Tetsuo Konno, MD, FJCC, Masa-aki Kawashiri, MD and Masakazu Yamagishi, MD, FJCC

Journal of Cardiology Cases
Volume 5, Issue 3, Pages e160-e162 (June 2012)
DOI: 10.1016/j.jccase.2011.12.001

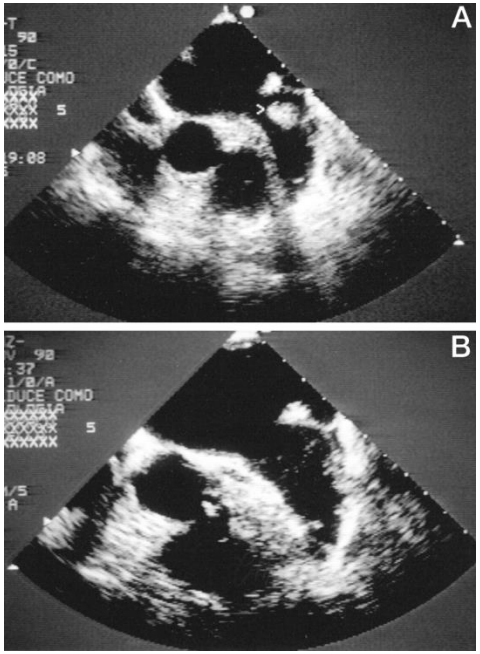
# Figure 2




Source: Journal of Cardiology Cases 2012; 5:e160-e162 (DOI:10.1016/j.jccase.2011.12.001 )

# Atrial Thrombi Resolution After Prolonged Anticoagulation in Patients With Atrial Fibrillation*: A Transesophageal Echocardiographic Study

Chest. 1999;115(1):140-143. doi:10.1378/chest.115.1.140




## Figure Legend:

TEEs (horizontal plane) of the left atrium andleft atrial appendage (patient No. 4 of the table). Panel A shows theleft atrium and appendage in a 60-year-old woman affected by mitralstenosis and aortic regurgitation. The duration of atrial fibrillationwas unknown. Note the pedunculated thrombus (white arrow) at the mouthof left atrial appendage. Panel B shows the same patient after 4 weeksof warfarin. The thrombus had completely resolved. Scant spontaneousechocontrast can be seen in left atrial appendage.

*Chest*. 1999;115(1):140-143. doi:10.1378/chest.115.1.140

**Table 1.** Clinical and Echocardiographic Characteristics*

| Patient/Age/Sex | Arrhythmia Duration | Thrombus Location | LA Size, mm | Underlying Disease | SC | TEE Probe | F/U TEE, wk | Thrombus on F/U TEE |
|---|---|---|---|---|---|---|---|---|
| 1 /72/M | Undetermined | LAA | 54 | AS | + | Monoplane | 5 | 0 |
| 2 /64/M | Undetermined | LAA | 44 | AS | + | Monoplane | 4 | 0 |
| 3 /61/M | Undetermined | LAA | 39 | AF-related HF | 0 | Monoplane | 4 | 0 |
| 4 /60/F | Undetermined | LAA | 46 | MS and AR | + | Monoplane | 4 | 0 |
| 5 /59/M | Undetermined | LAA | 44 | DCM | + | Omniplane | 4 | 0 |
| 6 /74/F | 30 days | LAA | 37 | AF-related HF | + | Omniplane | 6 | 0 |
| 7 /65/M | Undetermined | LAA | 50 | MVP | + | Omniplane | 4 | 0 |
| 8 /61/F | 20 days | LAA | 44 | MS and AR | + | Omniplane | 5 | 0 |
| 9 /71/F | Undetermined | LAA | 46 | AF-related HF | + | Omniplane | 4 | 0 |
| 10 /66/M | 30 days | LAA | 43 | DCM | + | Omniplane | 4 | + |
| 11 /70/F | Undetermined | LAA | 41 | UH | 0 | Omniplane | 9/33 | +/+ |

*

AR = aortic regurgitation; AS = aortic stenosis; DCM = dilated cardiomyopathy; F/U = follow-up; HF = heart failure; LAA = left atrial appendage; MS = mitral stenosis; MVP = mitral valve prolapse; SC = spontaneous echo contrast; UH = uncomplicated hypertension; M = male; F = female.

# Is Rivaroxaban better?

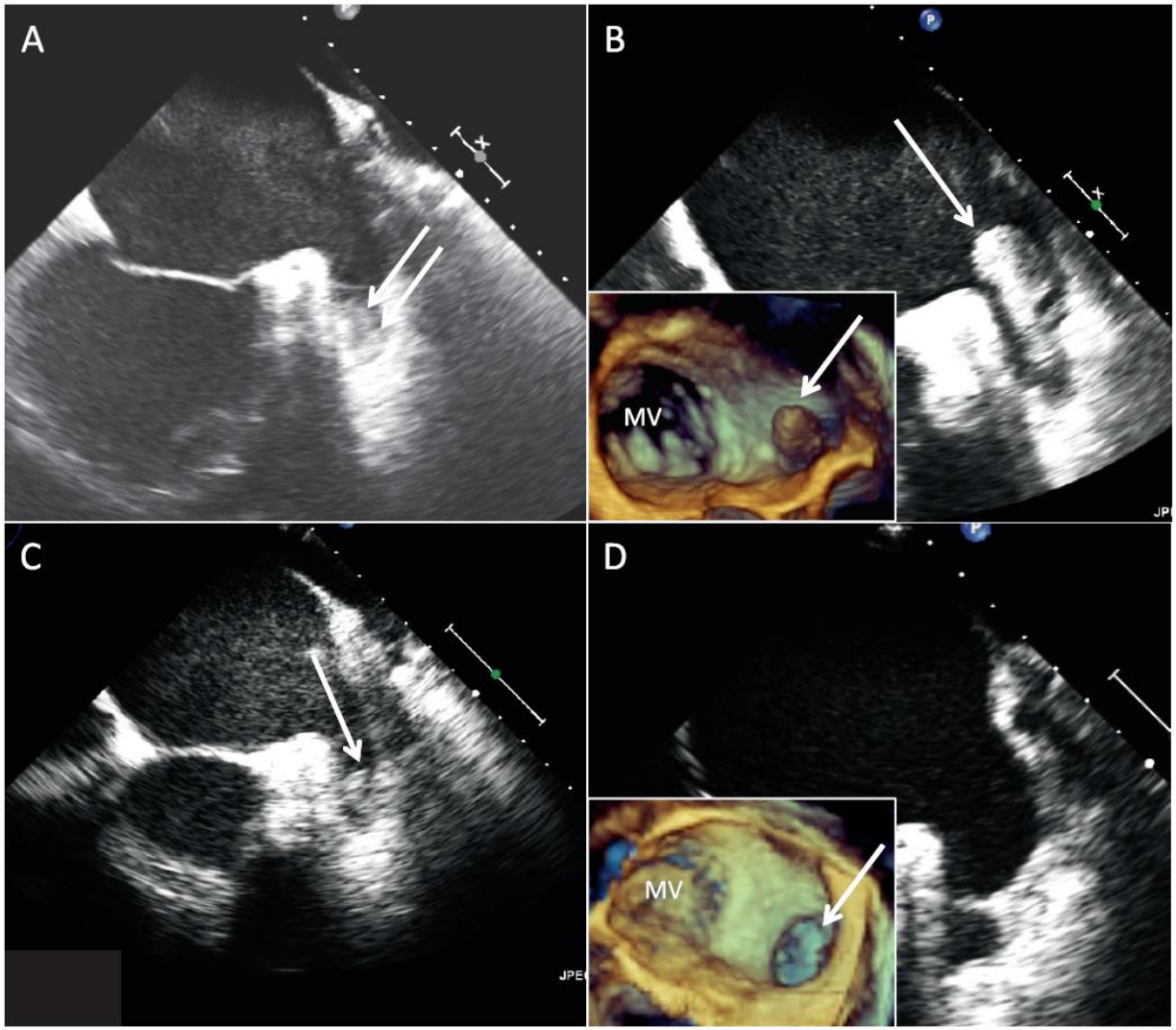



**Figure 1: Thrombus development under different oral anticoagulant regimen with vitamin K antagonist (VKA) (A, B) and rivaroxaban (C, D).** A) Small thrombus formation in the left atrial appendage (LAA) apex at first presentation (arrows). B) 2D and 3D enface view (smaller image) of markedly increased thrombus size under continued VKA therapy (arrows). C) Decreased thrombus formation after four weeks (arrow). D) Complete thrombus resolution after six weeks of anticoagulant therapy with rivaroxaban (D, arrow pointing at "empty" LAA in the 3D enface view). MV, mitral valve.

# Is Dabigatran better?

doi:10.1093/eurheartj/eht148

# Dabigatran for left atrial thrombus

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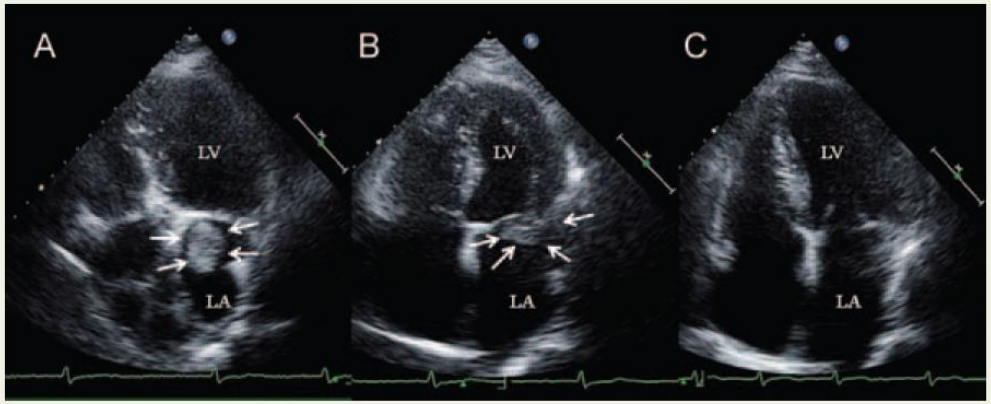
* Corresponding author. Tel: +81 45 851 2621, Fax: +81 45 851 8316, Email: aziro-youichi@yokohamamc.jp



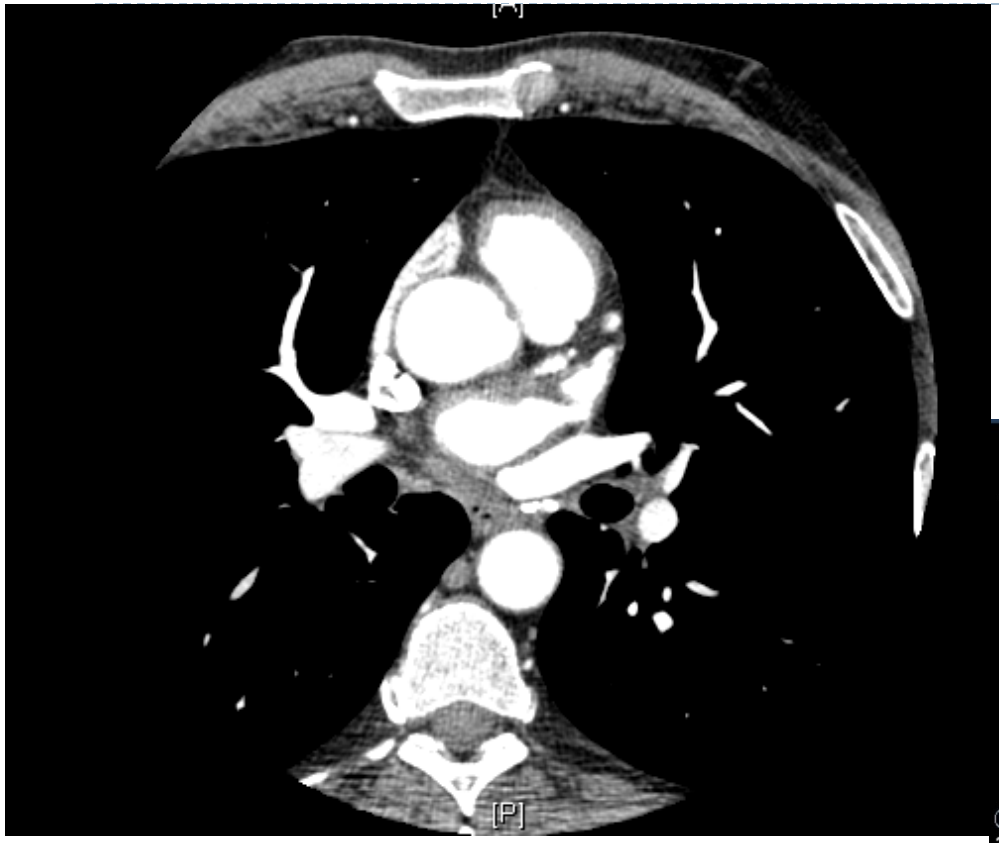

A 72-year-old woman was admitted to our hospital with acute exacerbation of chronic heart failure. Her medical history included chronic heart failure, permanent atrial fibrillation, and psychiatric disease. Despite a CHA2DS2-VASc score of 5, poor drug compliance compelled her to warfarin administration. Coarse crackles were evident over both lungs and a chest X-ray showed pulmonary congestion. Electrocardiography showed atrial fibrillation with a ventricular heart rate of 98. Blood tests revealed BNP 775.7 pg/mL and D-dimer 4.0 μg/mL. The heart failure was promptly compensated by intravenous furosemide. However, transthoracic echocardiography (TTE) demonstrated a mobile high echoic mass of 2.6 × 3.0 cm in the left atrium (LA) (*Panel A*, white arrows; LA, left atrium; LV, left ventricle). We administered heparin and warfarin, and TTE after 1 month showed that the LA mass had shrunk to 1.7 × 1.0 cm, confirming that it was thrombus (*Panel B*, white arrows). Warfarin was changed to dabigatran 300 mg/day because she had a delusional disorder. She has remained on dabigatran for 4 months without any serious bleeding complications, and TTE confirmed that the thrombus had disappeared (*Panel C*).

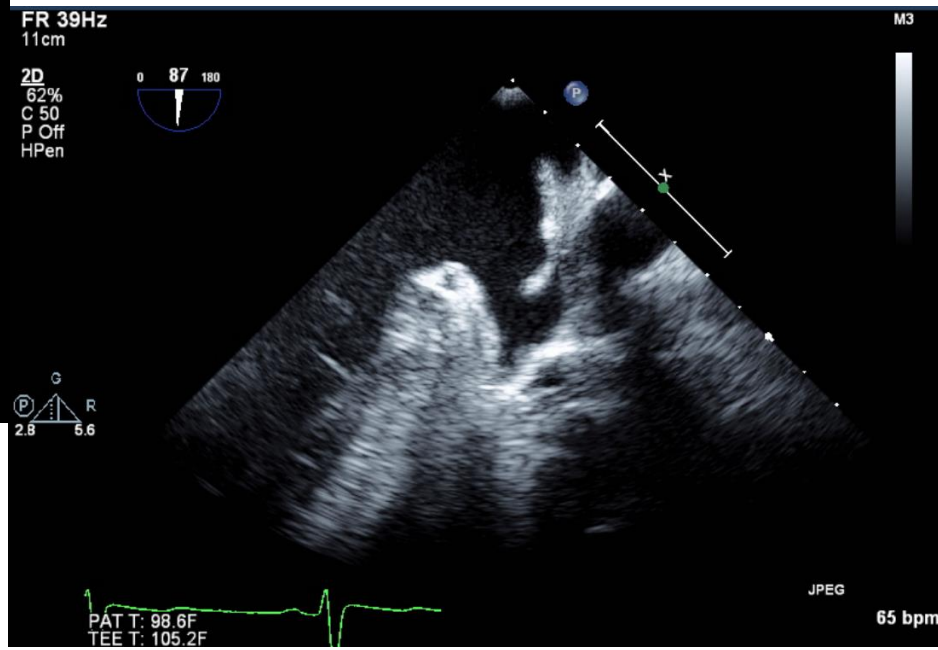
Dabigatran is a direct thrombin inhibitor that exerts anticoagulant effects by binding to the active site of thrombin. Since it acts independently of antithrombin, it can inhibit thrombin bound to fibrin and fibrin degradation products, implying that it also has thrombolytic properties. In fact, dabigatran possibly induced thrombolysis in this patient, indicating that this drug could be a therapeutic option for patients with intracardiac thrombus.

# Case 2

- 48 year old patient with history of palpitation, htn, sleep apnea diagnosed with PAF in 2008
- 2011:EP consulted for symptomatic AF
  - Echo; normal LV function and chamber size
  - Abnormal stress test, recommended cath
    - Non-significant CAD by cath
  - Sotalol initiated for PAF management
- Recurrent symptomatic AF
  - Considered for ablation in Dec 2011
  - Pre procedure CT heart and TEE performed

# Dec 2011


[A]
[P]


FR 39Hz
11cm
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62%
C 50
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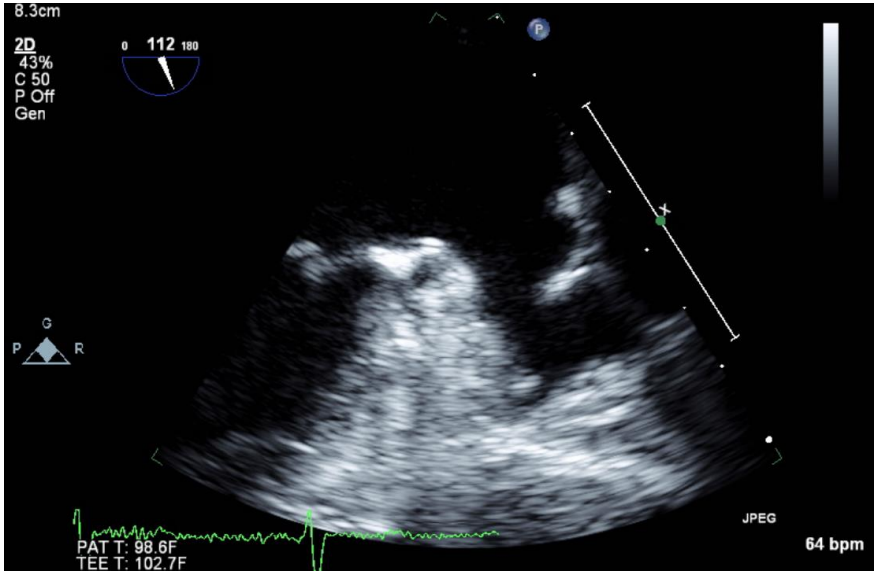
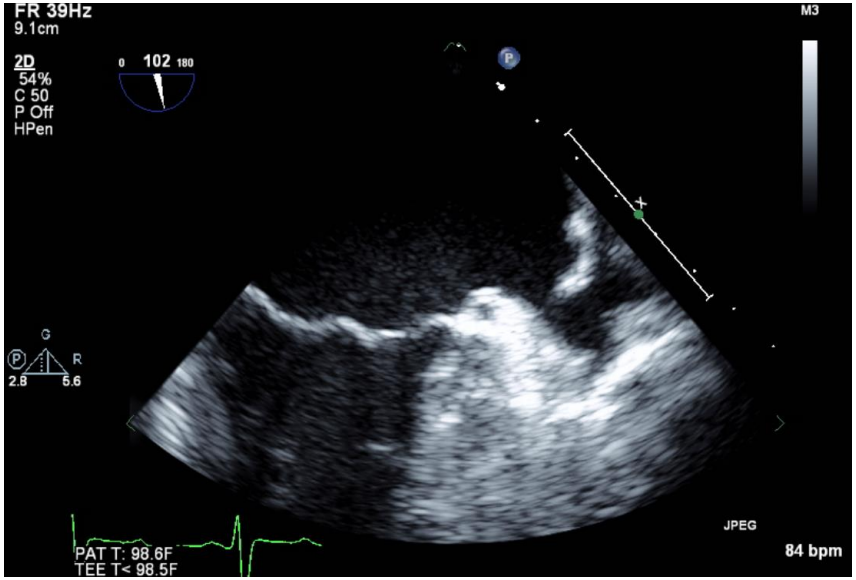
PAT T: 98.6F
TEE T: 105.2F
65 bpm

# Feb 2012 and June 2012



# Next step

- Is it LAA thrombus?
  - ? Proceed with Catheter ablation
  - ? Change Warfarin to Dabigatran
  - ? Change Warfarin to Xarelto
  - ? Surgical resection of LAA
  - ? Surgical ablation
  - ? LAA ligation and 'Hybrid procedure'
- OR
  - ?Abandon the procedure
    - With Aggressive anticoagulation

# Left atrial appendage occlusion or resection: Is there a role?

**TABLE 1. Review of Published Reports Detailing the Frequency and Site of Thrombus Location in Patients With Nonrheumatic Atrial Fibrillation***

| Setting | No. of Patients | Thrombus Location (n, %) LA Appendage | LA Cavity | Total |
|---|---|---|---|---|
| TEE† | 317 | 66 (20.8) | 1 (0.3) | 67 (21.1) |
| TEE | 233 | 34 (14.6) | 1 (0.4) | 35 (15.0) |
| Autopsy | 506 | 35 (6.9) | 12 (2.4) | 47 (9.3) |
| TEE | 52 | 2 (3.8) | 2 (3.8) | 4 (7.7) |
| TEE | 48 | 12 (25.0) | 1 (2.1) | 13 (27.1) |
| TEE and operation | 171 | 8 (4.7) | 3 (1.8) | 11 (6.4) |
| ACUTE | 549 | 67 (12.2) | 9 (1.6) | 76 (13.8) |
| TEE | 272 | 19 (7.0) | 0 (0) | 19 (7.0) |
| TEE | 60 | 6 (10.0) | 0 (0) | 6 (10.0) |
| Total | 2208 | 249 (11.3) | 29 (1.3) | 278 (12.6) |

*Modified from references 4 and 43; †5% of patients in this trial had mitral stenosis or prosthetic mitral valve.

LA indicates left atrium; ACUTE, Assessment of Cardioversion Using Transesophageal Echocardiography Multicenter Trial.

Stroke February 1, 2007 vol. 38 no. 2 624-630

**Table 2.** Characteristics of Patients With Embolic Events Versus No Embolic Event

| | Embolic Event (n = 27) | No Embolic Event (n = 178) | p Value |
|---|---|---|---|
| Age (yrs) | 62 ± 12 | 62 ± 10 | 0.9 |
| Female gender | 18 (66.7%) | 112 (62.9%) | 0.7 |
| Mean time from MVR to TEE (months) | 73.8 ± 60.9 | 68.6 ± 68.2 | 0.7 |
| Mechanical prosthesis | 24 (88.9%) | 163 (91.6%) | 0.6 |
| LA size | 55 ± 10 | 58 ± 12 | 0.2 |
| LA or LAA thrombus | 4 (14.8%) | 6 (3.4%) | 0.03* |
| Mean LVEF | 59 ± 14 | 56 ± 12 | 0.5 |
| Sinus rhythm | 4 (14.8%) | 25 (14%) | 0.9 |
| LAA ligation | 2 (7.4%) | 56 (31.5%) | 0.01 |
| Severe mitral prosthetic regurgitation | 2 (7.4%) | 20 (11.2%) | 0.7* |
| LASEC grade 3 or 4 | 16 (64%) | 26 (21.3%) | < 0.001† |

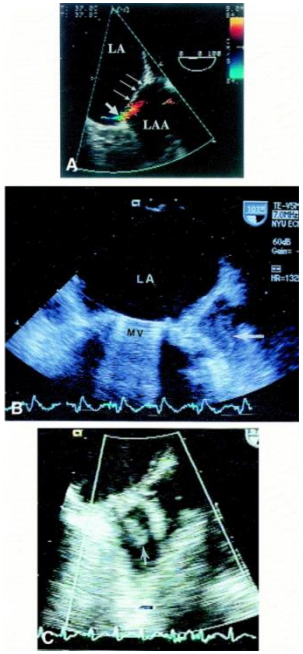
*Fisher test was performed instead of chi-squared test. †In the analysis of this variable, only patients without LAA ligation were included.

LASEC = left atrial appendage spontaneous echo contrast. Other abbreviations as in Table 1.

J Am Coll Cardiol. 2003;42(7):1253-1258. doi:10.1016/S0735-1097(03)00954-9

## From: Surgical left atrial appendage ligation is frequently incomplete: a transesophageal echocardiographic study

J Am Coll Cardiol. 2000;36(2):468-471. doi:10.1016/S0735-1097(00)00765-8




### Figure Legend:

**(A) Transesophageal echocardiogram, transverse plane, of an incompletely ligated LAA. Color flow traverses the separation between the LAA and the left atrial body (bold arrow). The ligation suture line is shown with thin arrows. (B) Vertical plane transesophageal echocardiogram of a patient with a mitral mechanical prosthesis and an incompletely ligated LAA. Note the presence of spontaneous echo contrast (arrow) in the LAA compared with the relative absence of this finding in the left atrial body. (C) Vertical plane transesophageal echocardiogram of a patient with a mitral bioprosthesis and an incompletely ligated LAA. Thrombus is seen within the appendage (arrow). LA = left atrium; LAA = left atrial appendage; MV = mitral valve.**

# Fig. 1

# Follow up

## Case 1

- Discussion

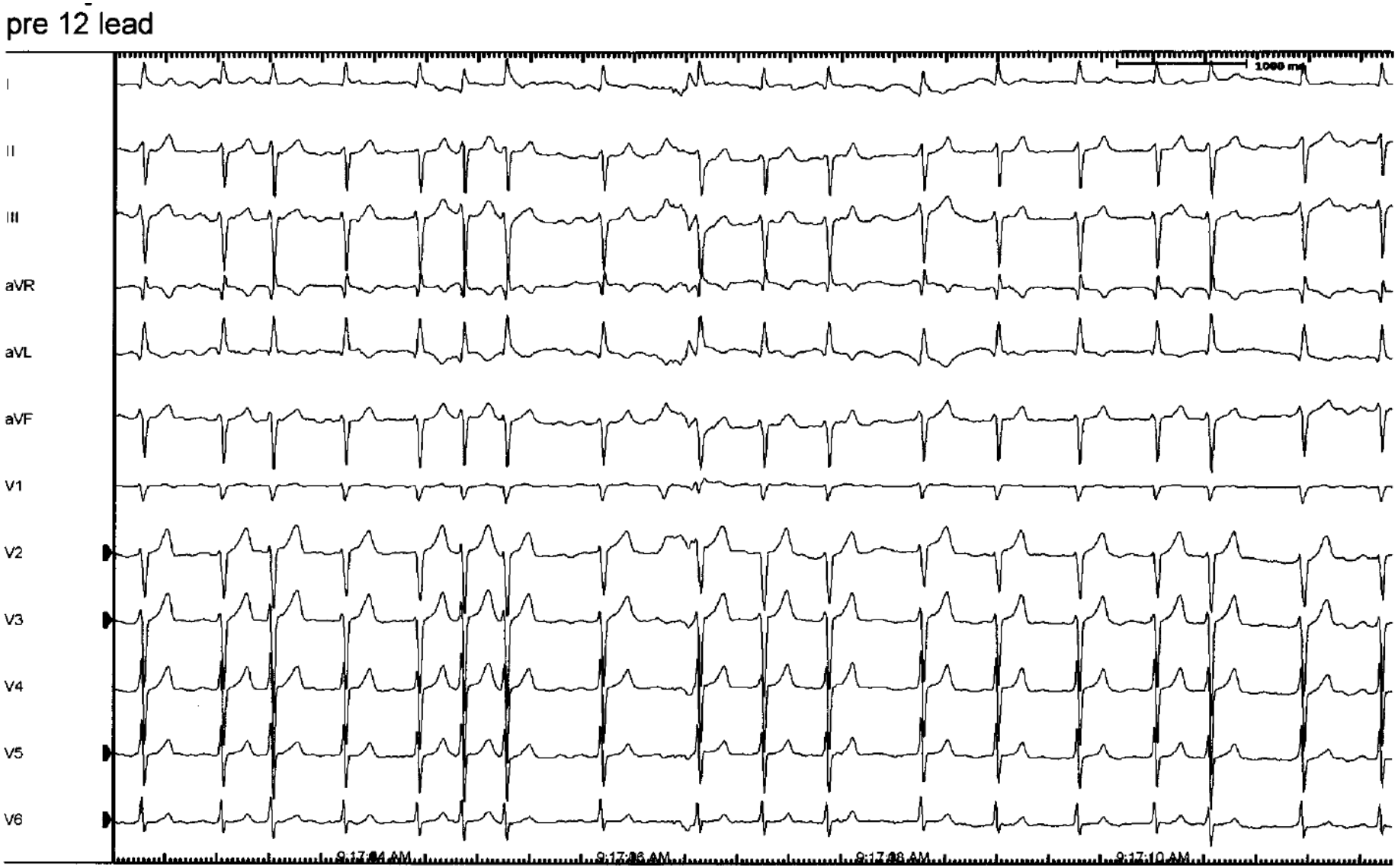
## Case 2

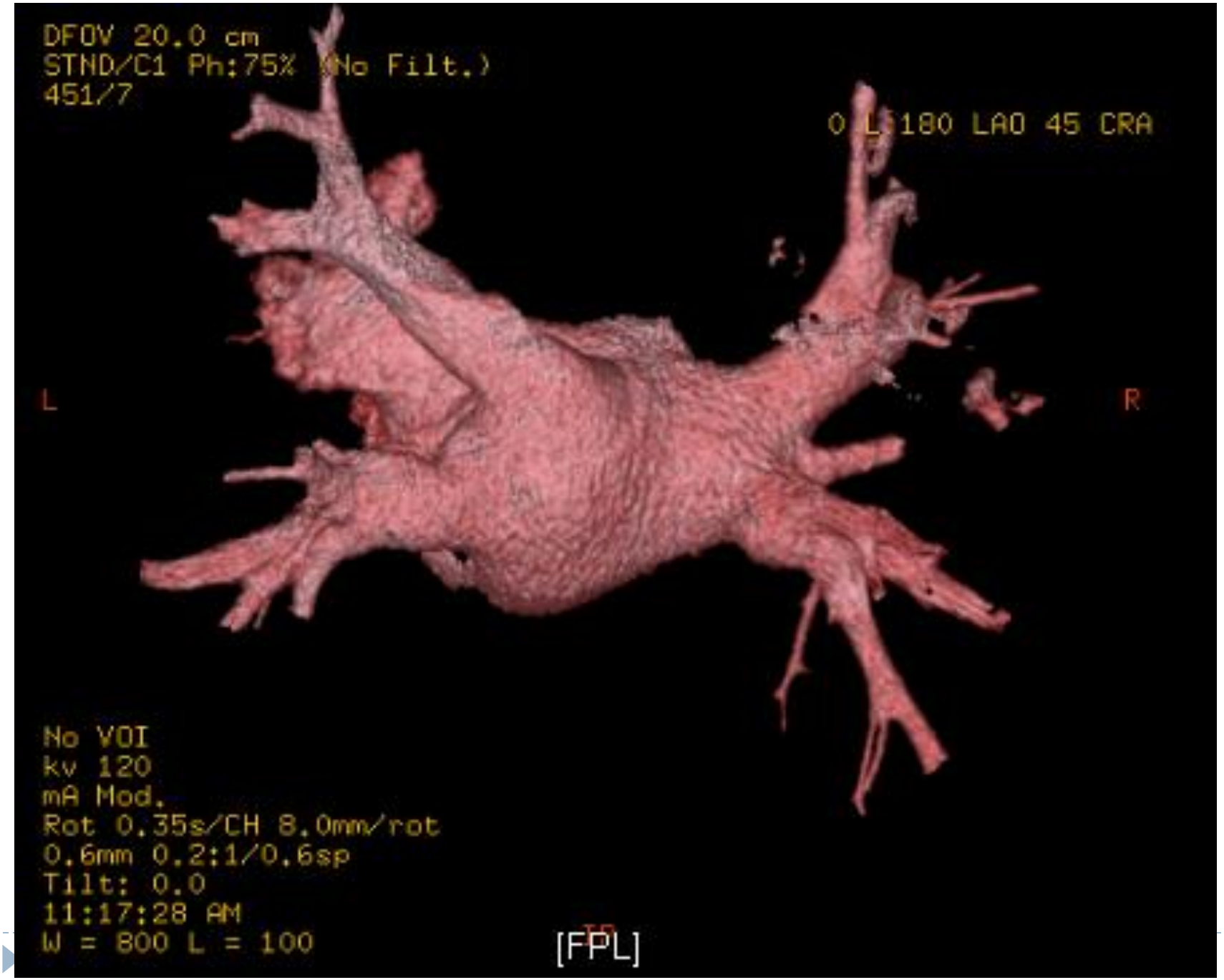
- Discussion

# Case 3

- 72 year old male was referred for PVI
  - h/o AF,obesity and htn
  - had failed Tikosyn with recurrent AF while on medical therapy
  - Pre procedure anticoagulation with Warfarin

# Baseline EKG

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STND/C1 Ph:75% (No Filt.)
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0 L 180 LAO 45 CRA
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kv 120
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Rot 0.35s/CH 8.0mm/rot
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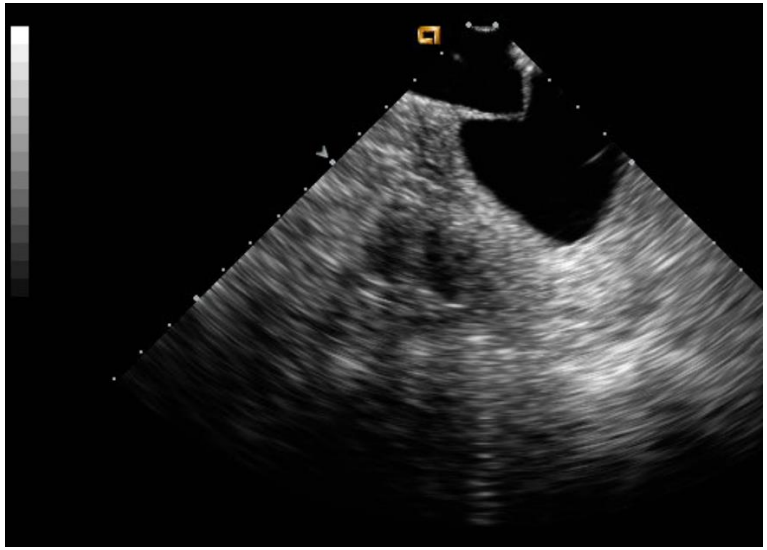
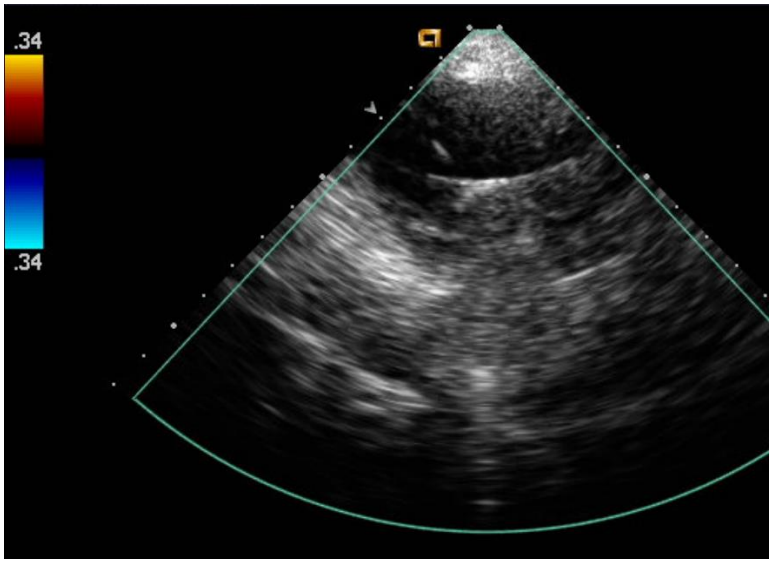
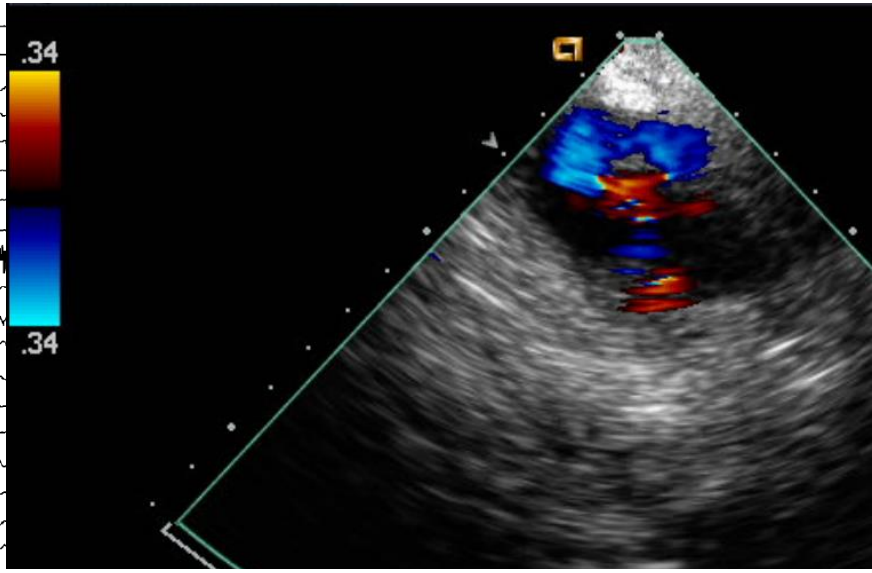
# Case 3

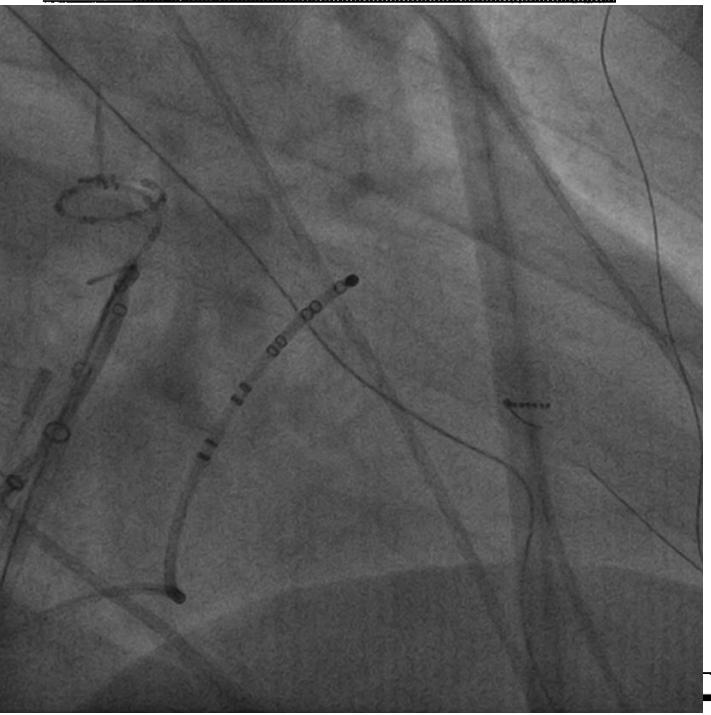




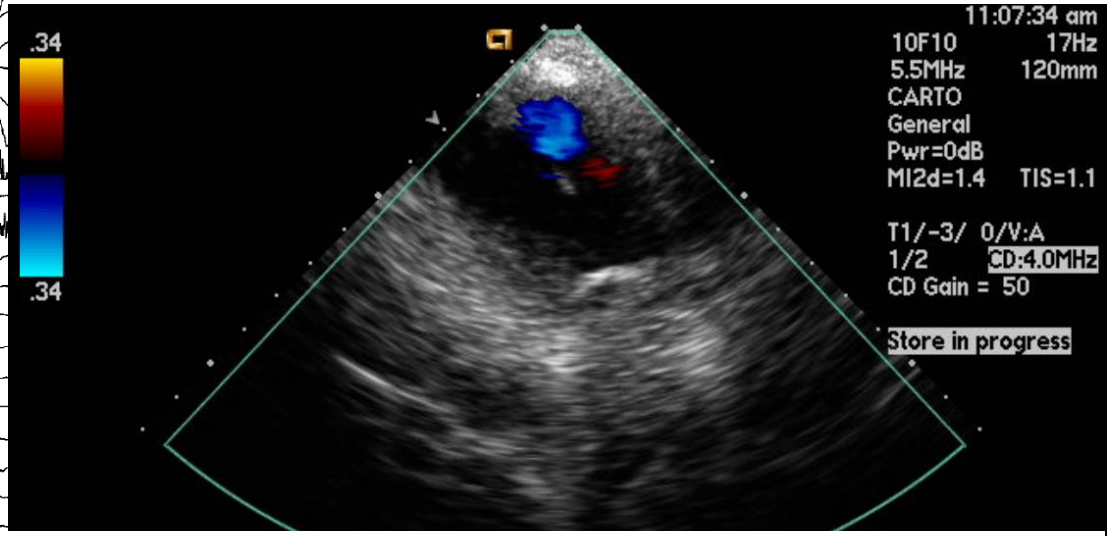
LSPV pre ablation

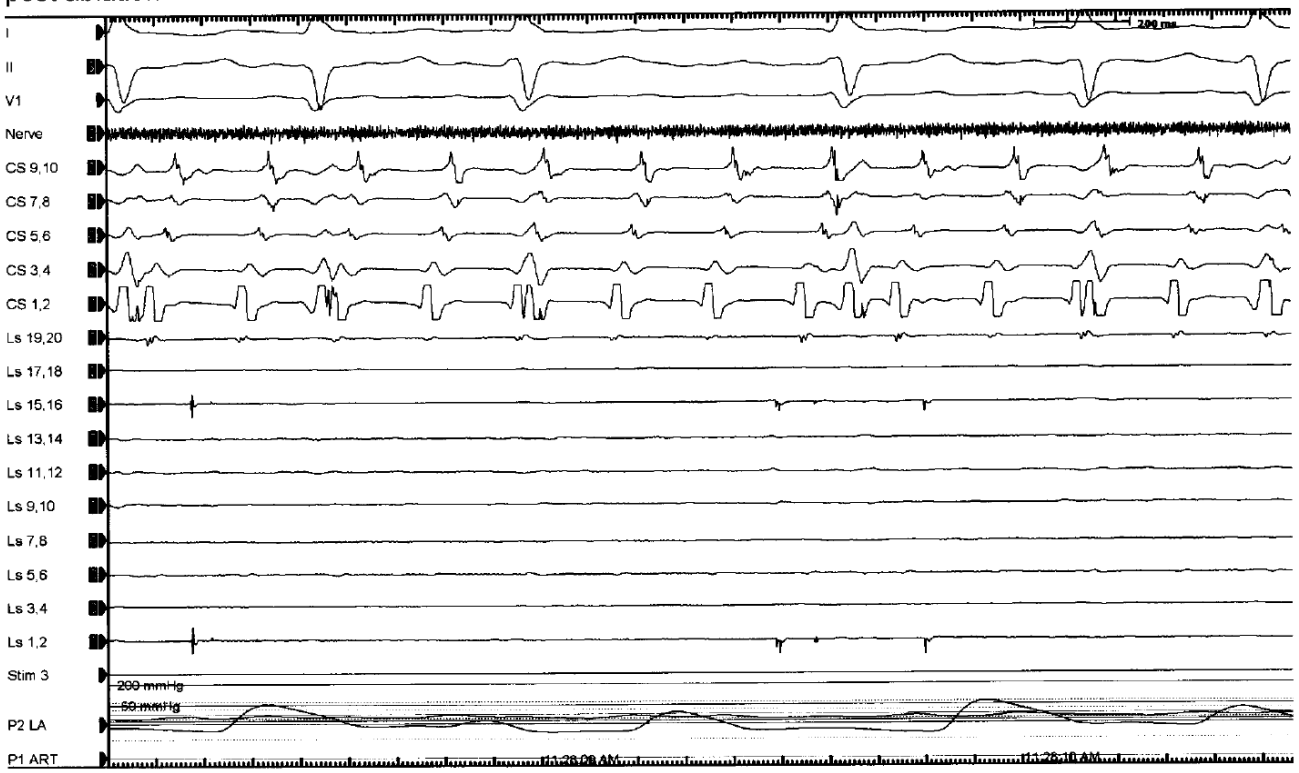

post ablation LSPV



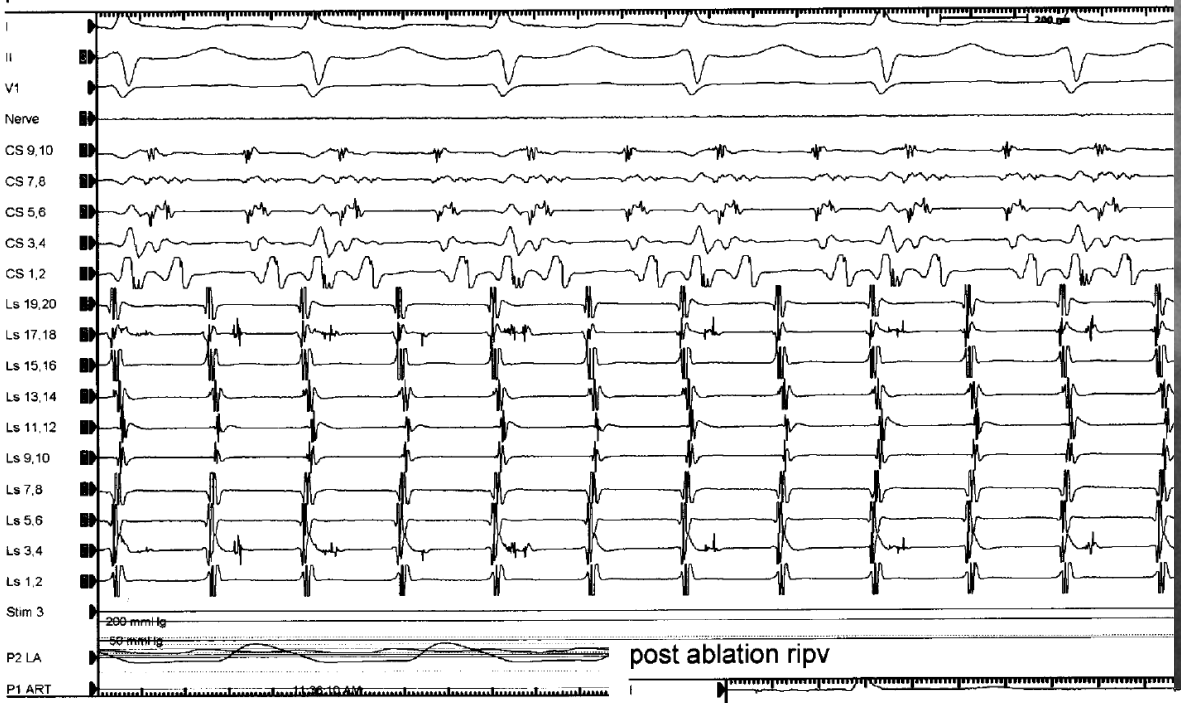
pre ablation LIPV

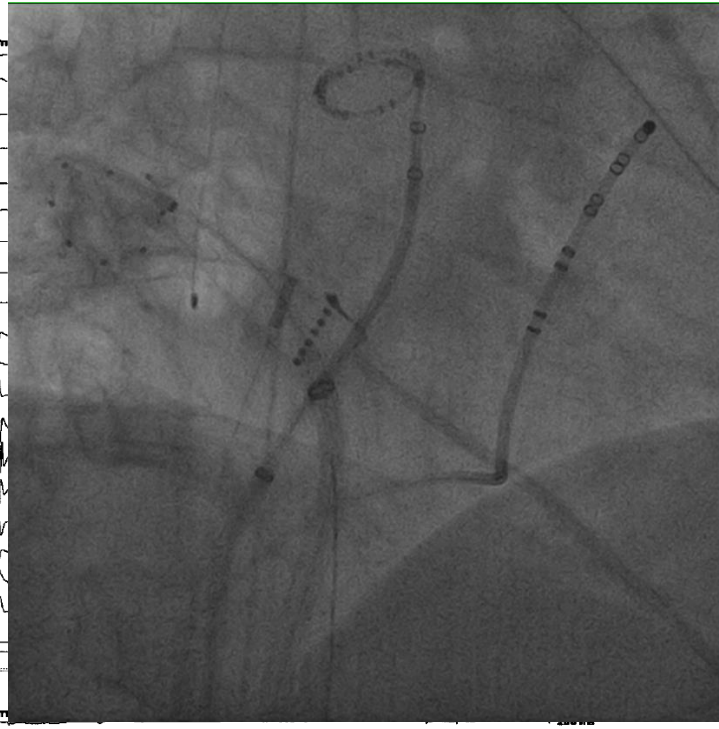




post ablation LIPV

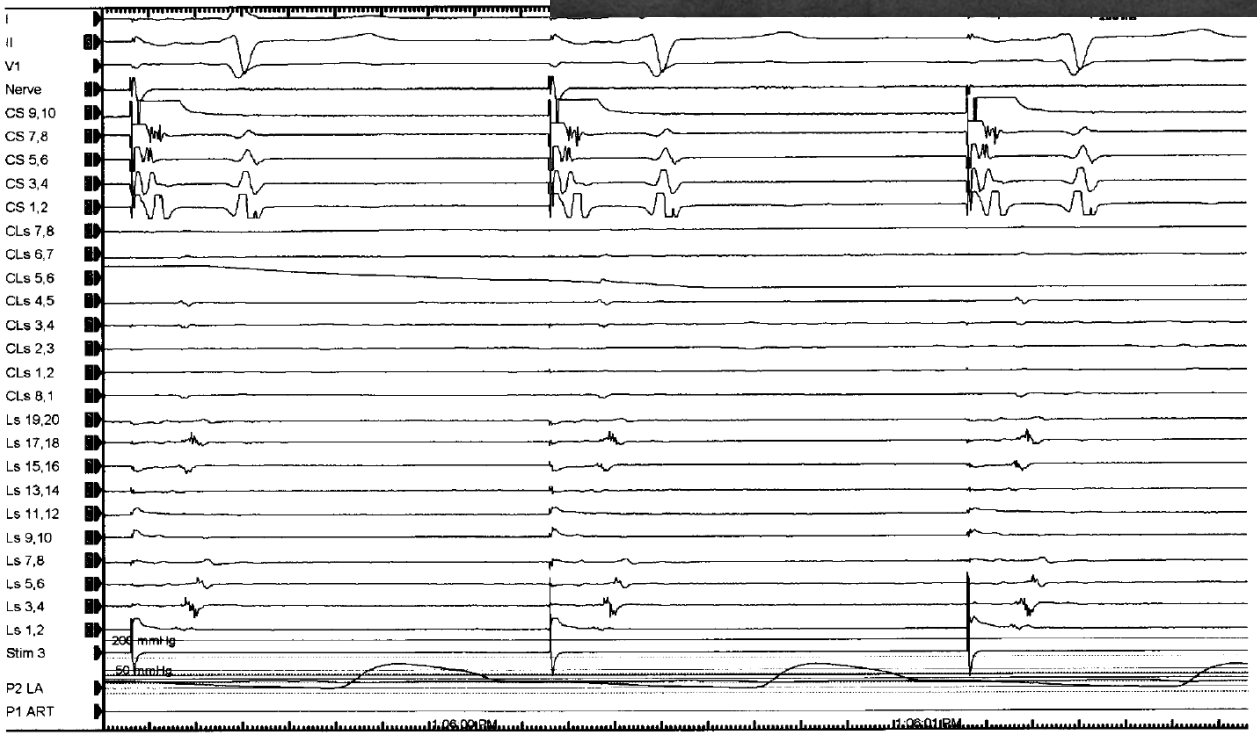


pre ablation RIPV

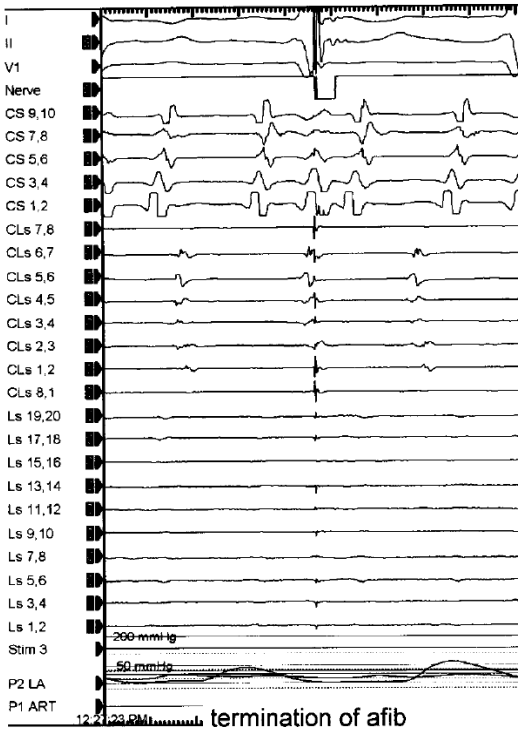


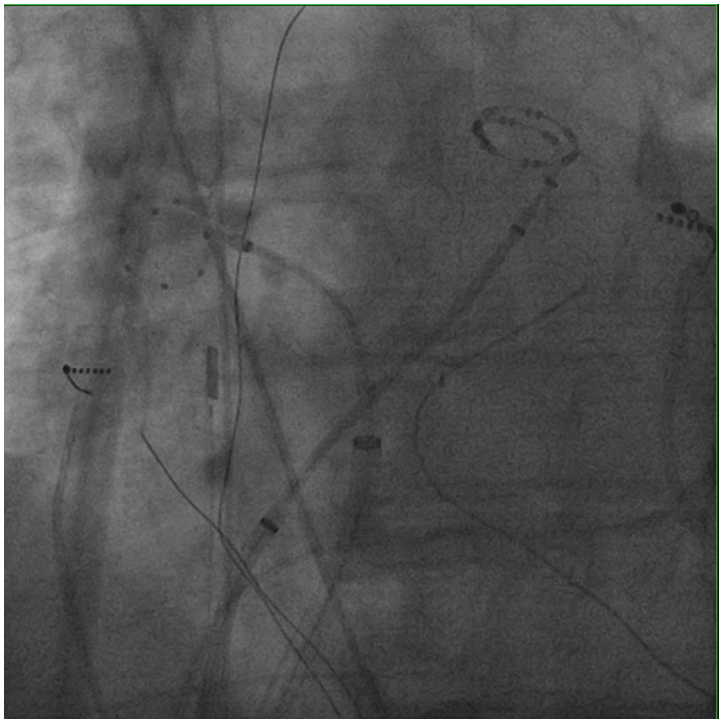



post ablation ripv

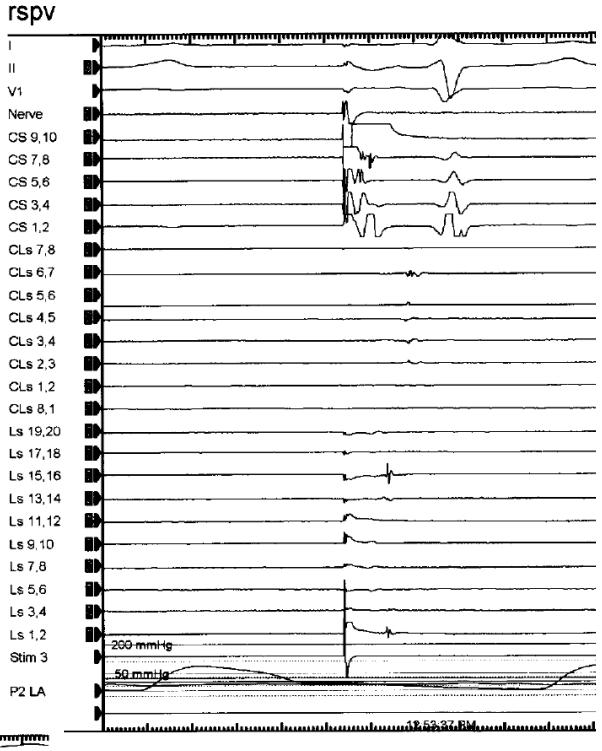


RSPV 5 minutes

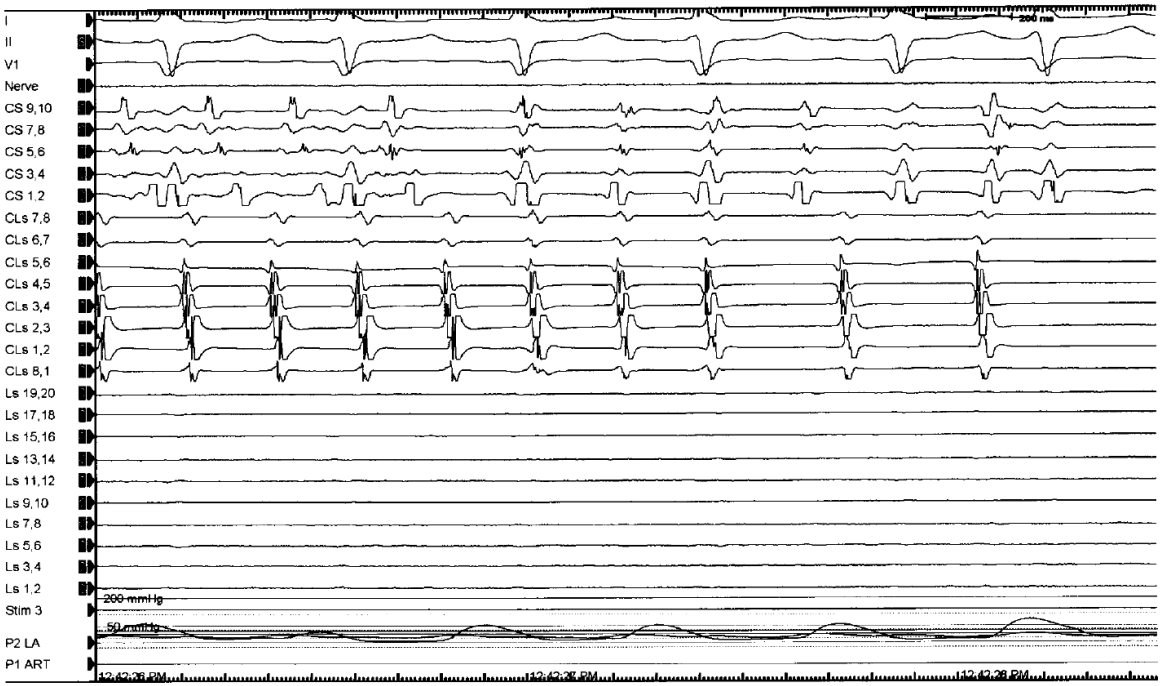


rspv




termination of afib



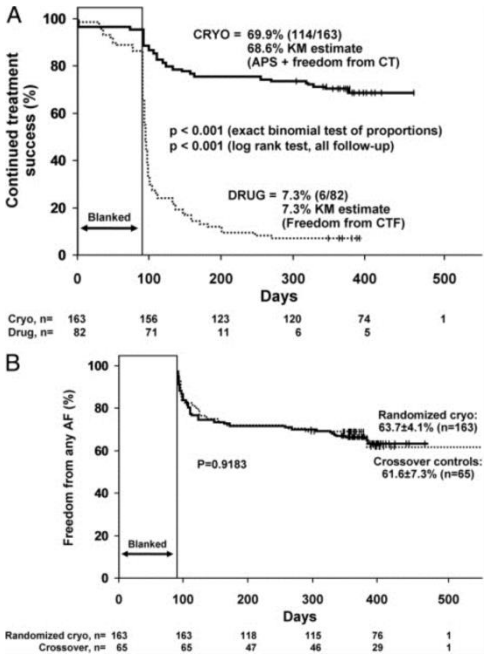
# adenosine effect

# 3 month follow up

- Patient off Class 1C or III agents
- Hypertension management required CCB and BB therapy
  - Few break through episodes in first thirty days
  - No breakthrough episodes after that
- Off anticoagulation for now and maintained on Aspirin

## From: Cryoballoon Ablation of Pulmonary Veins for Paroxysmal Atrial Fibrillation: First Results of the North American Arctic Front (STOP AF) Pivotal Trial

J Am Coll Cardiol. 2013;61(16):1713-1723. doi:10.1016/j.jacc.2012.11.064




### Figure Legend:

**Procedural Success Given as Freedom From CTF as a Function of Time**

**(A) Intention-to-treat primary effectiveness endpoint for freedom from chronic treatment failure (CTF) between patients treated with cryoablation and those treated with drugs. (B) Freedom from any AF between the on-treatment cryoablation and drug-treated patients. KM = Kaplan-Meier estimates; OR = odds ratio.**

# CRYOBALLOON VERSUS RADIOFREQUENCY FOR PULMONARY VEIN RE-ISOLATION AFTER A FAILED INITIAL ABLATION PROCEDURE IN PATIENTS WITH PAROXYSMAL ATRIAL FIBRILLATION

Moderated Poster Contributions
Poster Sessions, Expo North
Monday, March 11, 2013, 9:45 a.m.-10:30 a.m.

Session Title: Atrial Fibrillation Ablation
Abstract Category: 4. Arrhythmias: AF/SVT
Presentation Number: 1278M-40

Authors: *Evgeny Pokushalov, Alexander Romanov, Sergey Artyomenko, Vera Baranova, Denis Losik, Sevda Bairamova, Alexander Karaskov, Suneet Mittal, Jonathan S. Steinberg, State Research Institute of Circulation Pathology, Novosibirsk, Russian Federation, The Valley Health System and Columbia University College of Physicians and Surgeons, New York, NY, USA*

**Background:** Catheter ablation of paroxysmal atrial fibrillation (PAF) is associated with an important risk of early and late recurrence, necessitating repeat ablation procedures. The aim of this prospective randomized patient-blind study was to compare the efficacy and safety of cryoballoon (Cryo) versus radiofrequency (RF) ablation of PAF after failed initial RF ablation procedure.

**Methods:** Patients with a history of symptomatic PAF after a previous failed first RF ablation procedure were eligible for this study. Patients were randomized to Cryo or RF redo ablation. The primary endpoint of the study was recurrence of atrial tachyarrhythmia, including AF and left atrial flutter/tachycardia, after a second ablation procedure at 1 year of follow-up. All patients were implanted with a cardiac monitor to continuously track the cardiac rhythm. Patients with an AF burden (AF%) ≤0.5% were considered AF-free (Responders), while those with an AF% > 0.5% were classified as patients with AF recurrences (non-Responders).

**Results:** Eighty patients with AF recurrences after a first RF pulmonary vein isolation (PVI) were randomized to Cryo (N = 40) or to RF (N = 40). Electrical potentials were recorded in 77 mapped PVs (1.9 ± 0.8 per patient) in Cryo Group and 72 PVs (1.7 ± 0.8 per patient) in RF Group (P = 0.62), all of which were targeted. In Cryo group, 68 (88%) of the 77 PVs were re-isolated using only Cryo technique; the remaining 9 PVs were re-isolated using RF. In RF group, all 72 PVs were successfully re-isolated (P =0.003 vs. Cryo). By intention-to-treat, 23 (58%) RF patients were AF-free versus 17 (43%) Cryo patients on no antiarrhythmic drugs at 1 year (P = 0.06). Three patients had temporary phrenic nerve paralysis in the Cryo group; the RF group had no complications. Of the 29 patients who had only Cryo PVI without any RF ablation, 11 (38%) were AF-free versus 20 (59%) of the 34 patients who had RF only (P = 0.021).

**Conclusions:** When patients require a redo pulmonary vein isolation ablation procedure for recurrent PAF, RF appears to be the preferred energy source relative to Cryo.

Am Coll Cardiol. 2013;61(10_S):. doi:10.1016/S0735-1097(13)60402-7

# Summary

- Cryo ablation is an effective alternative to RF ablation for PVI
- Major risk factors include Phrenic nerve palsy and pulmonary vein stenosis
- Second generation Cryoballoon is more effective
- Cost of the equipment and potential need for a second ablation catheter is significant.