Anti Thrombotic Therapy: Ablation of AF and Left Atrial Flutter

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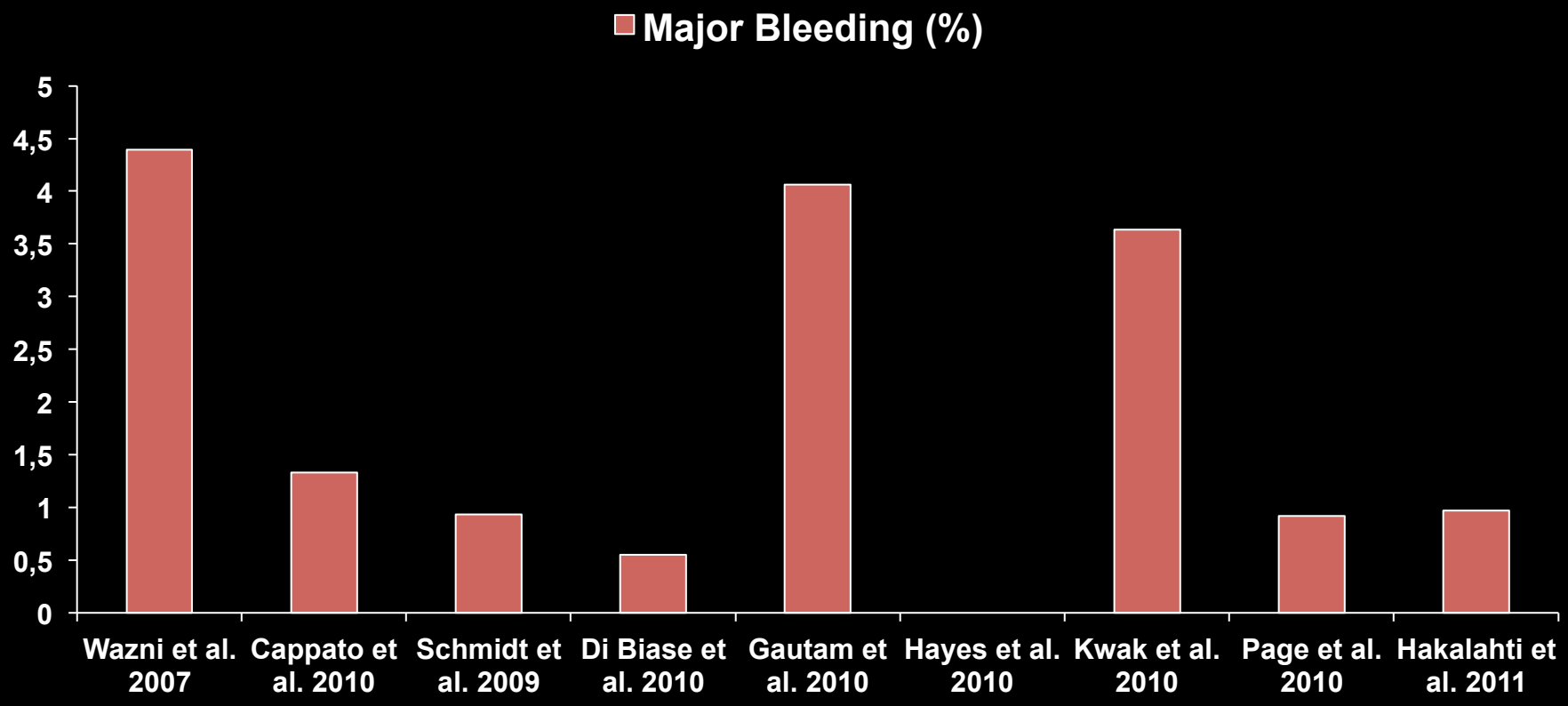
Bleeding Complications

- Puncture site hematoma
- Retroperitoneal Bleeding
- Pseudoaneurysm
- Pericardial effusion
- Pericardial tamponade

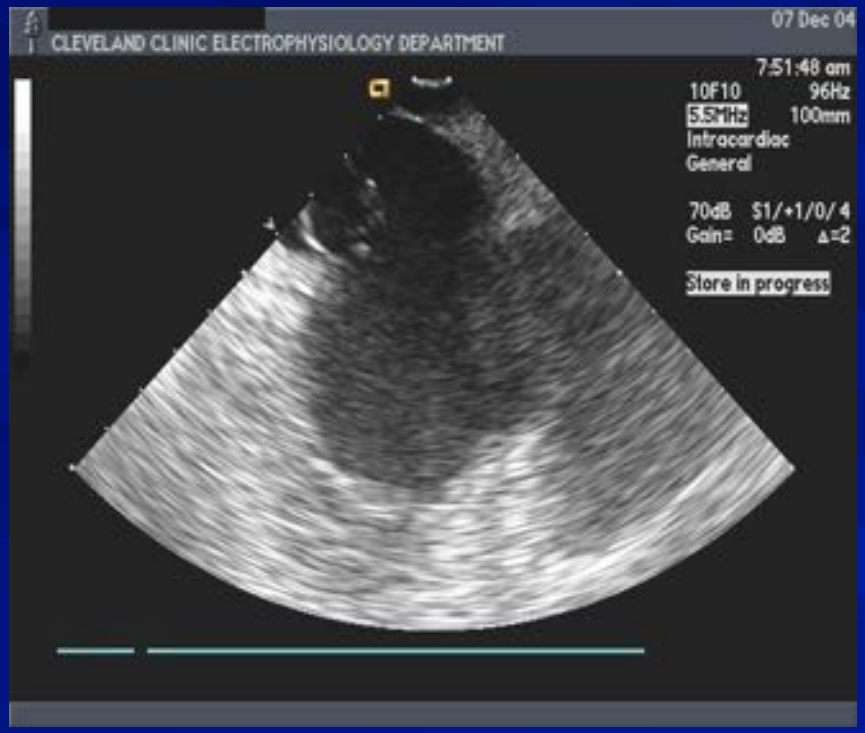
Periprocedural Risk of Major Bleeding during AF Ablation (warfarin discontinuation)

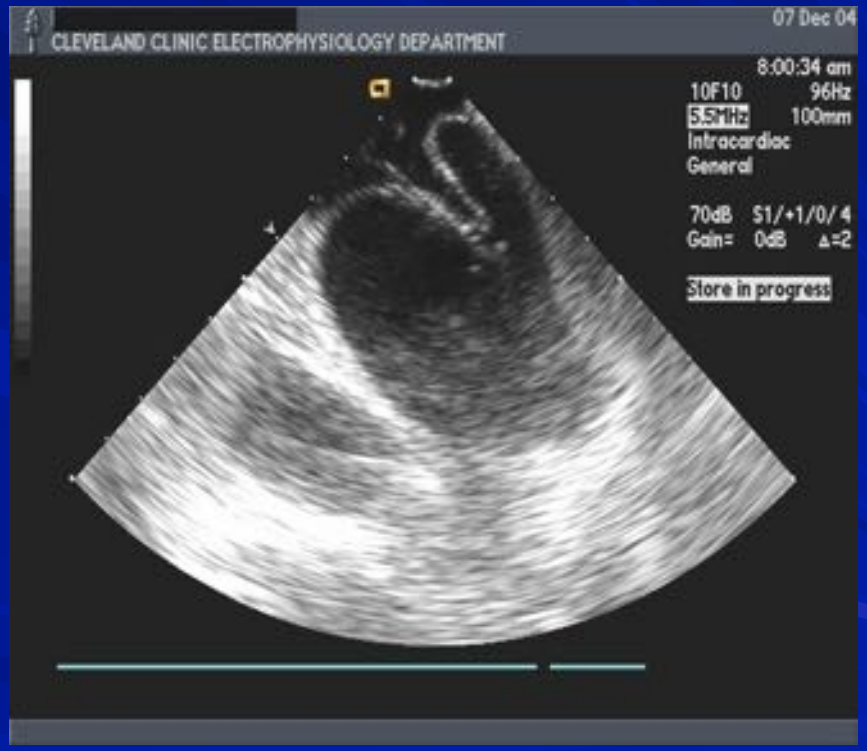


Cardiac Perforation / Tamponnade

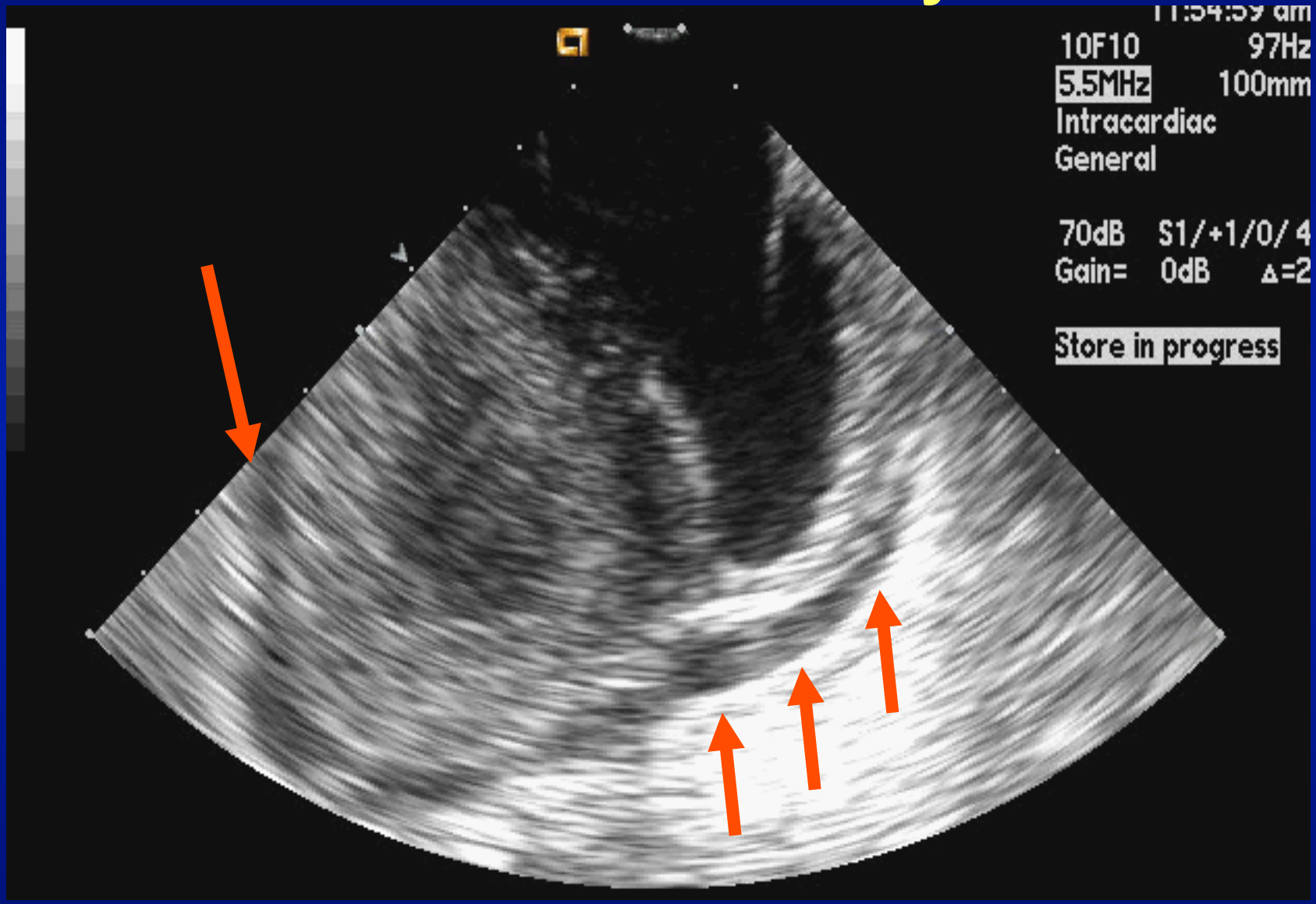
- Incidence: 1-3%
- Related to TS puncture, catheter navigation, RF delivery in addition to anticoagulation
- Pericardial effusion: up to 25%
- More common with the OIC.
- Common perforation sites: LAA, LA roof , Mitral isthmus.

IAS Aneurysm

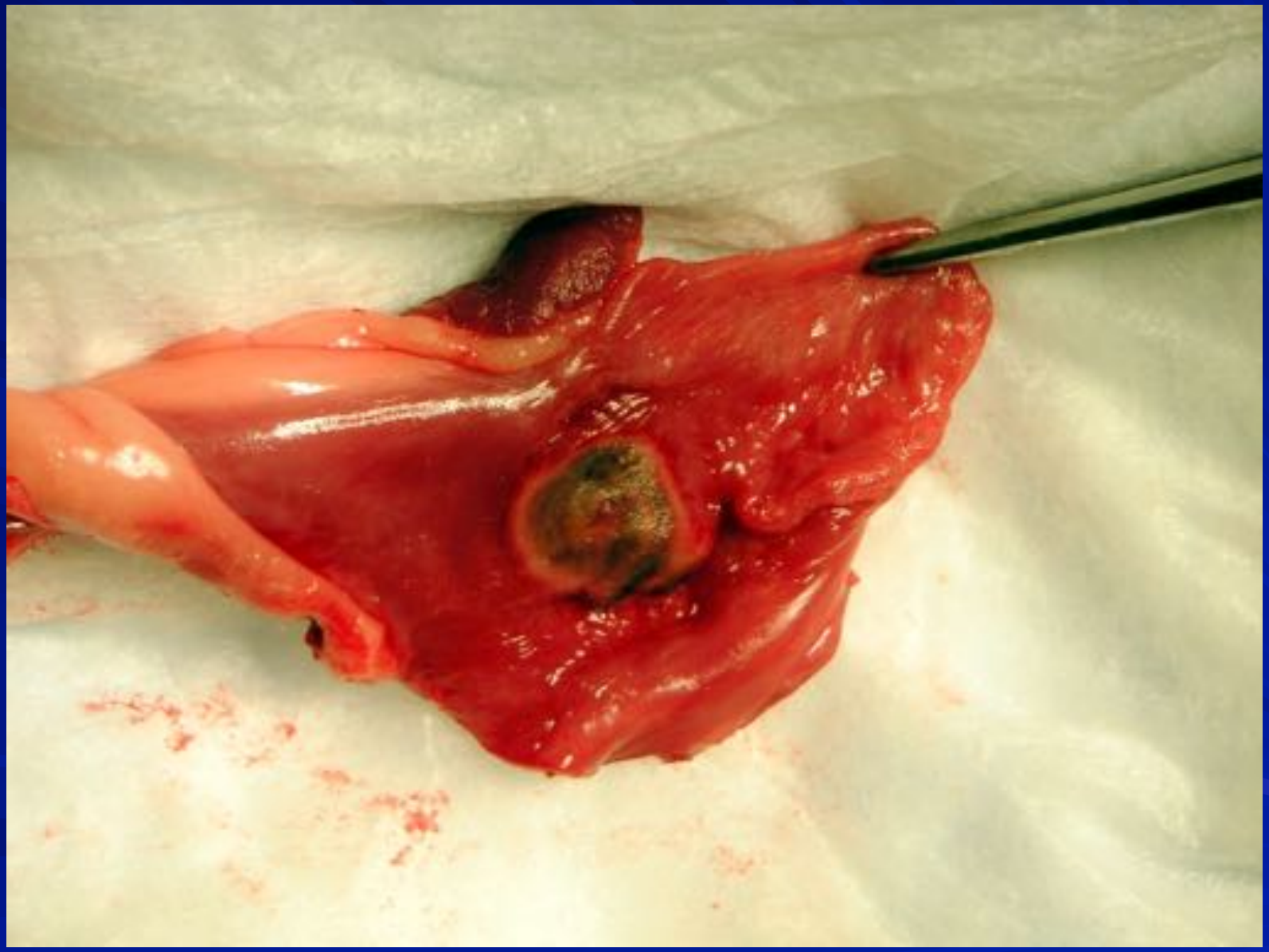




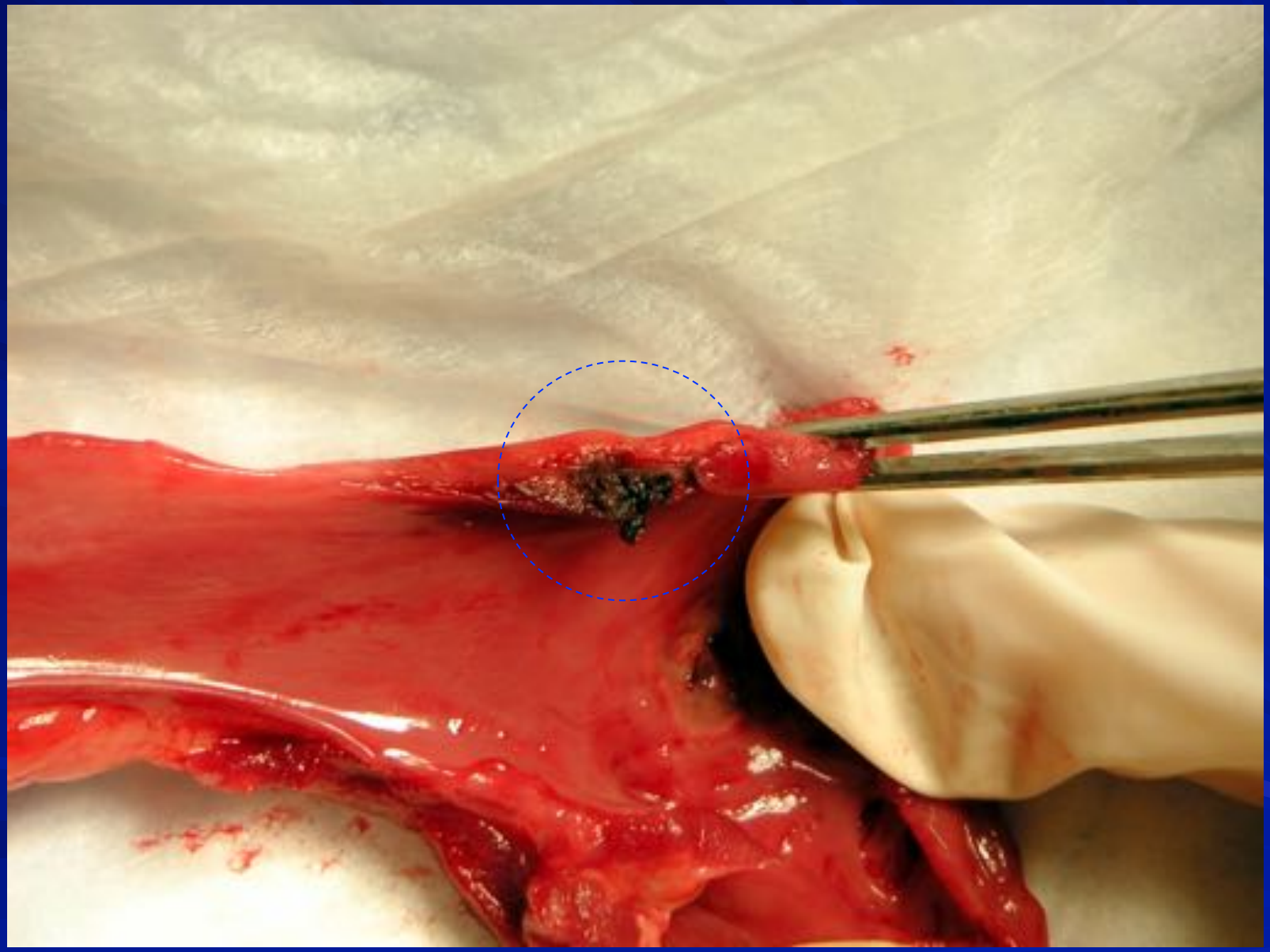
Pericardial Effusion by ICE



LA-LAA junction lesion, epicardial side



LSPV lesion, popping(+)



Prevention

- Pre-prepare the subxyphoid area
- Transseptal puncture: ICE Guidance
- Use RF neddle for transeptal
- Monitor with ICE during the procedure
- Monitor and titrating energy delivery to avoid pops. (impedance change, bubble formation).
- Keep contact force below 20 grams

Power Protocol with Open Irrigation

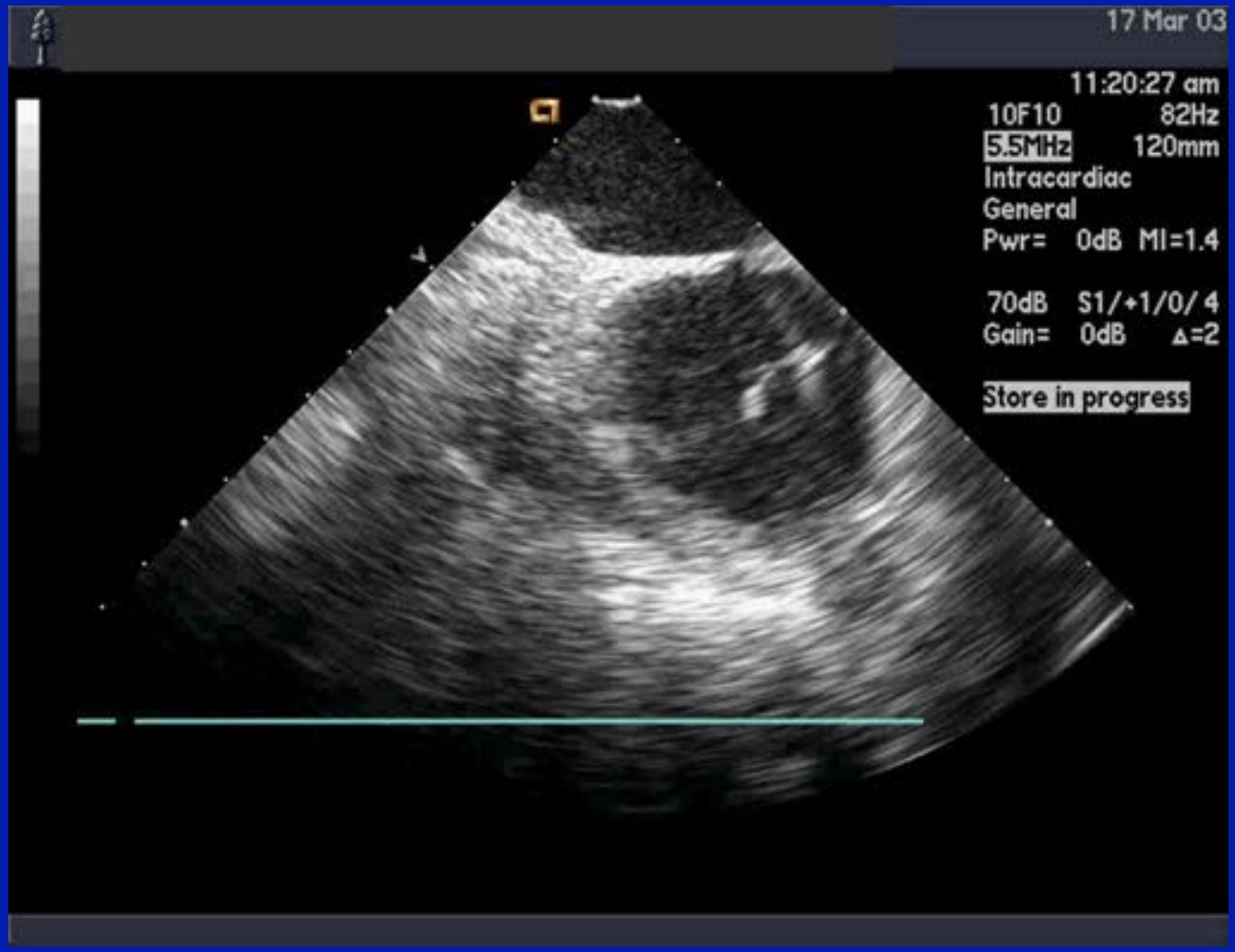
- Start at 40 w
- Reduce the power to 30-35w on the esophagus
- Power application 20 sec
- Keep contact force below 20 grams
- Do not increase the power when perpendicular to the atrial wall
- Monitor the impedance

RF Catheter ablation:

Thromboembolic complications

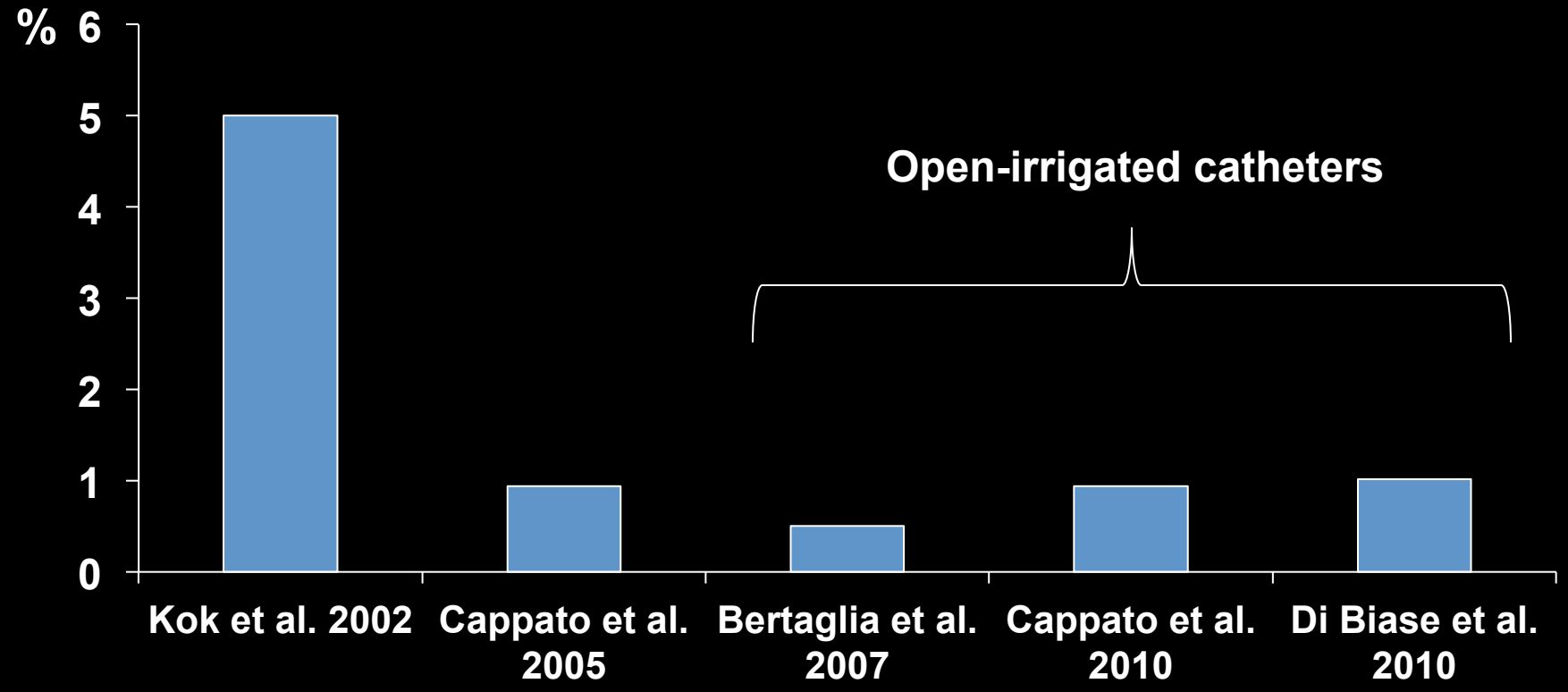
- Char formation, Air Embolism, RF Time
- Soft Thrombus formation

Intra-procedural early detection of complications



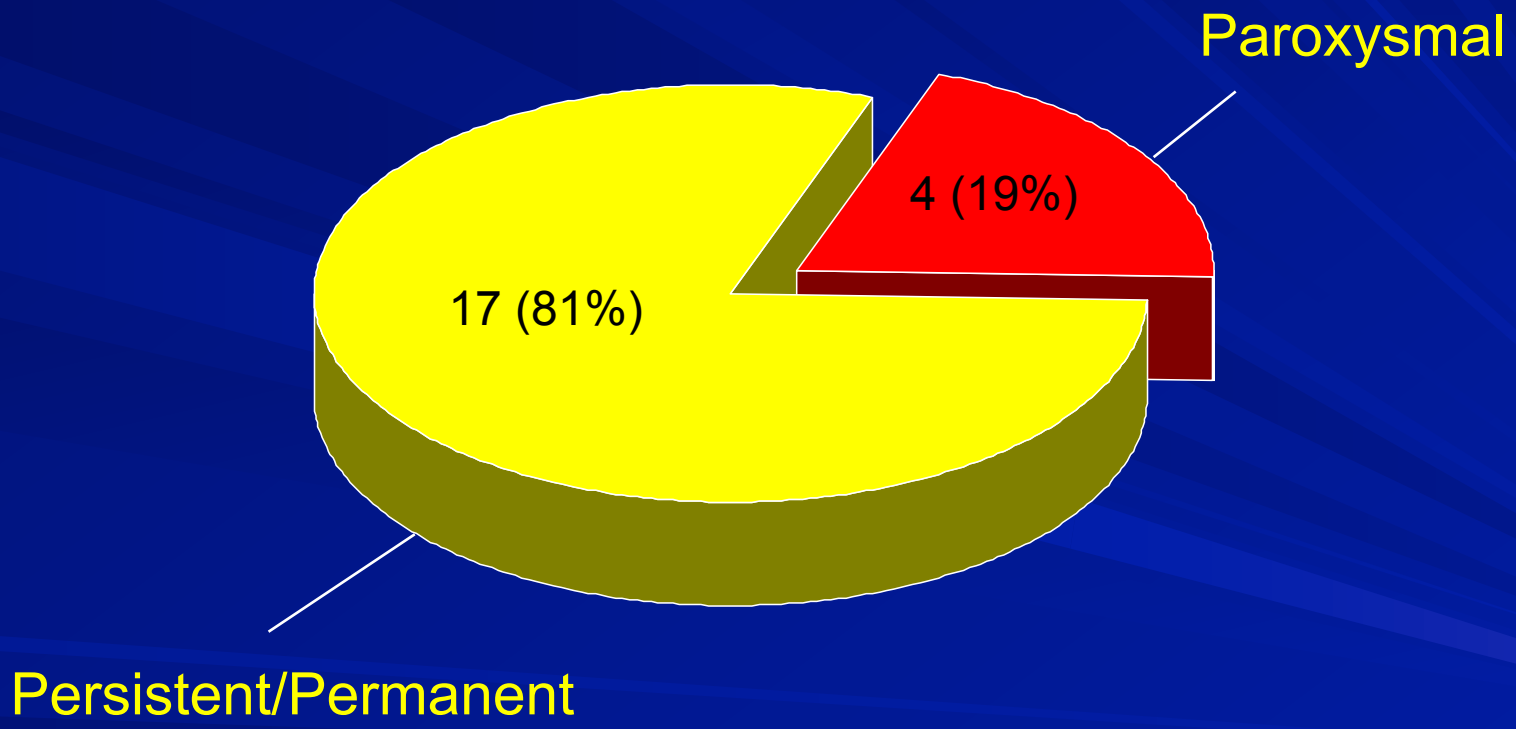
ACT < 350 sec; between 1.5 and 12% after Transseptal access

AF ablation and Periprocedural Stroke: an Ominous Association



Cappato et al. Circulation 2005;111:1100
Cappato et al. Circulation AE 2010;3:32-38
Kok et al. JCE 2002;13:764-67
Bertaglia et al. Heart Rhythm 2007;4:1265-71
Di Biase et al. Circulation 2010;121:2550-56

Type of atrial fibrillation in stroke patients



Patel D, Natale A, et al JCE 2009

Circulation

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Atrial Fibrillation Ablation in Patients With Therapeutic International Normalized Ratio: Comparison of Strategies of Anticoagulation Management in the Periprocedural Period

Oussama M. Wazni, Salwa Beheiry, Tamer Fahmy, Conor Barrett, Steven Hao, Dimpi Patel, Luigi Di Biase, David O. Martin, Mohamed Kanj, Mauricio Arruda, Jennifer Cummings, Robert Schweikert, Walid Saliba and Andrea Natale

Circulation 2007;116;2531-2534; originally published online Nov 12, 2007;
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Circulation 2007

Patient Characteristics

Table 1. Patient Characteristics

Characteristic	LMWH 1 mg/kg BID (n=105): Group 1	LMWH 0.5 mg/kg BID (n=100): Group 2	Warfarin (n=150): Group 3	*P*
Age, y	56±9.6	55.5±12.0	55.1±10.6	0.652
Female gender, %	21	20	25	0.477
LVEF, %	54.3±8	52.4±9.3	55.8±8	0.312
LA diameter, cm	4.4±0.9	4.5±0.8	4.4±0.7	0.481
Creatinine, mg/dL	1.0±0.1	1.0±0.1	1.0±0.2	0.6
INR	1.17±0.3	1.2±0.2	2.7±0.5	0.001
Maximum ACT, s	468	475	500	0.6
SEC, %	25	26	2	0.001

LVEF indicates left ventricular ejection fraction; LA, left atrium; ACT, activated clotting time; and SEC, spontaneous echocardiographic contrast.

Complications

Table 2. Complications

	Group 1 (n=105)	Group 2 (n=100)	Group 3 (n=150)	Exact *P*
Ischemic stroke, n	1	2	0	0.12
Pericardial effusion, n	1	2	1	0.69
Minor bleeding, n	23	19	8	<0.001
Major bleeding, n	9	0	0	<0.001

Group 1- LMWH 1 mg/kg BID, Group 2- LMWH 0.5 mg/kg BID, Group 3- on Warfarin

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Periprocedural Stroke and Management of Major Bleeding Complications in Patients Undergoing Catheter Ablation of Atrial Fibrillation: The Impact of Periprocedural Therapeutic International Normalized Ratio

Luigi Di Biase, J. David Burkhardt, Prasant Mohanty, Javier Sanchez, Rodney Horton, G. Joseph Gallinghouse, Dhanunjay Lakkireddy, Atul Verma, Yaariv Khaykin, Richard Hongo, Steven Hao, Salwa Beheiry, Gemma Pelargonio, Antonio Dello Russo, Michela Casella, Pietro Santarelli, Pasquale Santangeli, Paul Wang, Amin Al-Ahmad, Dimpi Patel, Sakis Themistoclakis, Aldo Bonso, Antonio Rossillo, Andrea Corrado, Antonio Raviele, Jennifer E. Cummings, Robert A. Schweikert, William R. Lewis and Andrea Natale

Circulation 2010;121:2550-2556; originally published online Jun 1, 2010;

Periprocedural Stroke and Management of Major Bleeding Complications in Patients Undergoing Catheter Ablation of Atrial Fibrillation

The Impact of Periprocedural Therapeutic International Normalized Ratio

Luigi Di Biase, MD; J. David Burkhardt, MD; Prasant Mohanty, MBBS, MPH; Javier Sanchez, MD; Rodney Horton, MD; G. Joseph Gallinghouse, MD; Dhanunjay Lakkireddy, MD; Atul Verma, MD; Yaariv Khaykin, MD; Richard Hongo, MD; Steven Hao, MD; Salwa Beheiry, RN; Gemma Pelargonio, MD; Antonio Dello Russo, MD; Michela Casella, MD; Pietro Santarelli, MD; Pasquale Santangeli, MD; Paul Wang, MD; Amin Al-Ahmad, MD; Dimpi Patel, DO; Sakis Themistoclakis, MD; Aldo Bonso, MD; Antonio Rossillo, MD; Andrea Corrado, MD; Antonio Raviele, MD; Jennifer E. Cummings, MD; Robert A. Schweikert, MD; William R. Lewis, MD; Andrea Natale, MD, FHRS, FACC

- **Group 1: Ablation with an 8-mm catheter off warfarin**
- **Group 2: Ablation with an *open irrigated catheter off warfarin***
- **Group 3: Ablation with an open irrigated catheter on warfarin**

Di Biase, Natale et al.,Circulation,2010; 121: 2550-6

Periprocedural Stroke and Management of Major Bleeding Complications in Patients Undergoing AF Catheter Ablation The Impact of Periprocedural Therapeutic INR

Complication	Group 1 (n=2488), n (%, 95% CI)	Group 2 (n=1348), n (%, 95% CI)	Group 3 (n=2618), n (%, 95% CI)	*P*, Multiple Comparison Between Group 3 and Groups 1 and 2
Stroke/TIA	27 (1.1, 0.72–1.58)	12 (0.9, 0.46–1.56)	0 (0)	<0.05
Minor bleeding	498 (20, 18.3–21.9)	256 (19, 16.7–21.5)	105 (4, 3.3–4.9)	<0.05
Major bleeding	10 (0.4, 0.19–0.74)	11 (0.8, 0.41%–1.46%)	10 (0.4, 0.18–0.70)	>0.05
Pericardial effusion	11 (0.4, 0.22–0.79)	11 (0.8, 0.41–1.46)	12 (0.5, 0.24–0.80)	>0.05

Di Biase, Natale et al.,Circulation,2010; 121: 2550-6

Pericardial Effusion Management

	Patients off Warfarin (n=3836)	Patients on Warfarin (n=2618)	*P*
Patients with pericardial effusion, n (%, 95% CI)	22 (0.57, 0.36–0.87)	12 (0.46, 0.24–0.80)	0.602
Requiring pericardiocentesis, n (%, 95% CI)	9 (0.23, 0.11–0.45)	8 (0.31, 0.13–0.60)	0.626
Requiring fresh frozen plasma, n (%, 95% CI)	0	8 (0.31, 0.13–0.60)	<0.001
Median blood units for transfusion, n (%, 95% CI)	1 (0.03, 0.00–0.15)	3 (0.11, 0.02–0.33)	0.043
Requiring surgery, n (%, 95% CI)	3 (0.08, 0.02–0.23)	1 (0.04, 0.00–0.21)	0.651
Mean pericardial fluid aspiration, cm^3	700±300	1200±200	<0.001
Mean protamine for reversal, mg	45±15	70±15	<0.001

Di Biase, Natale et al.,Circulation,2010; 121: 2550-6

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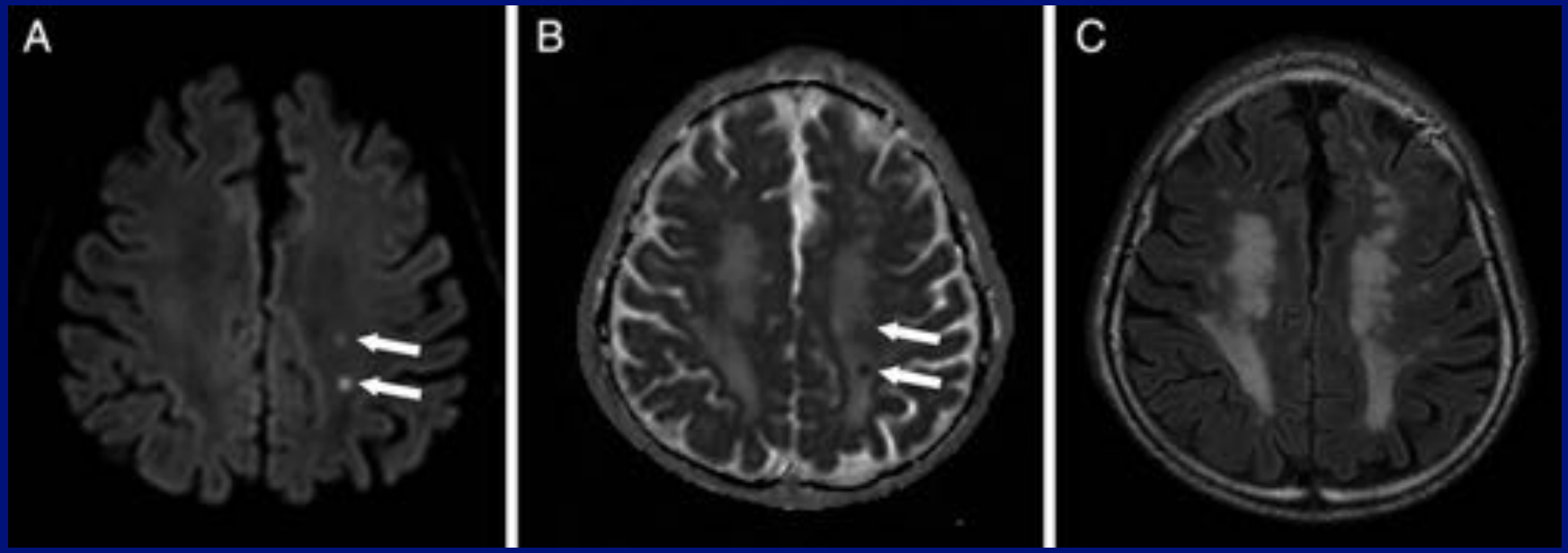
Silent Ischemia

Periprocedural Clinical Silent Cerebral Ischaemia After PV Ablation.



Schrickel JW et al.: Incidence and predictors of silent cerebral embolism during pulmonary vein catheter ablation for atrial fibrillation. Europace 2010; 12: 52-57

Silent Cerebral Positive Findings

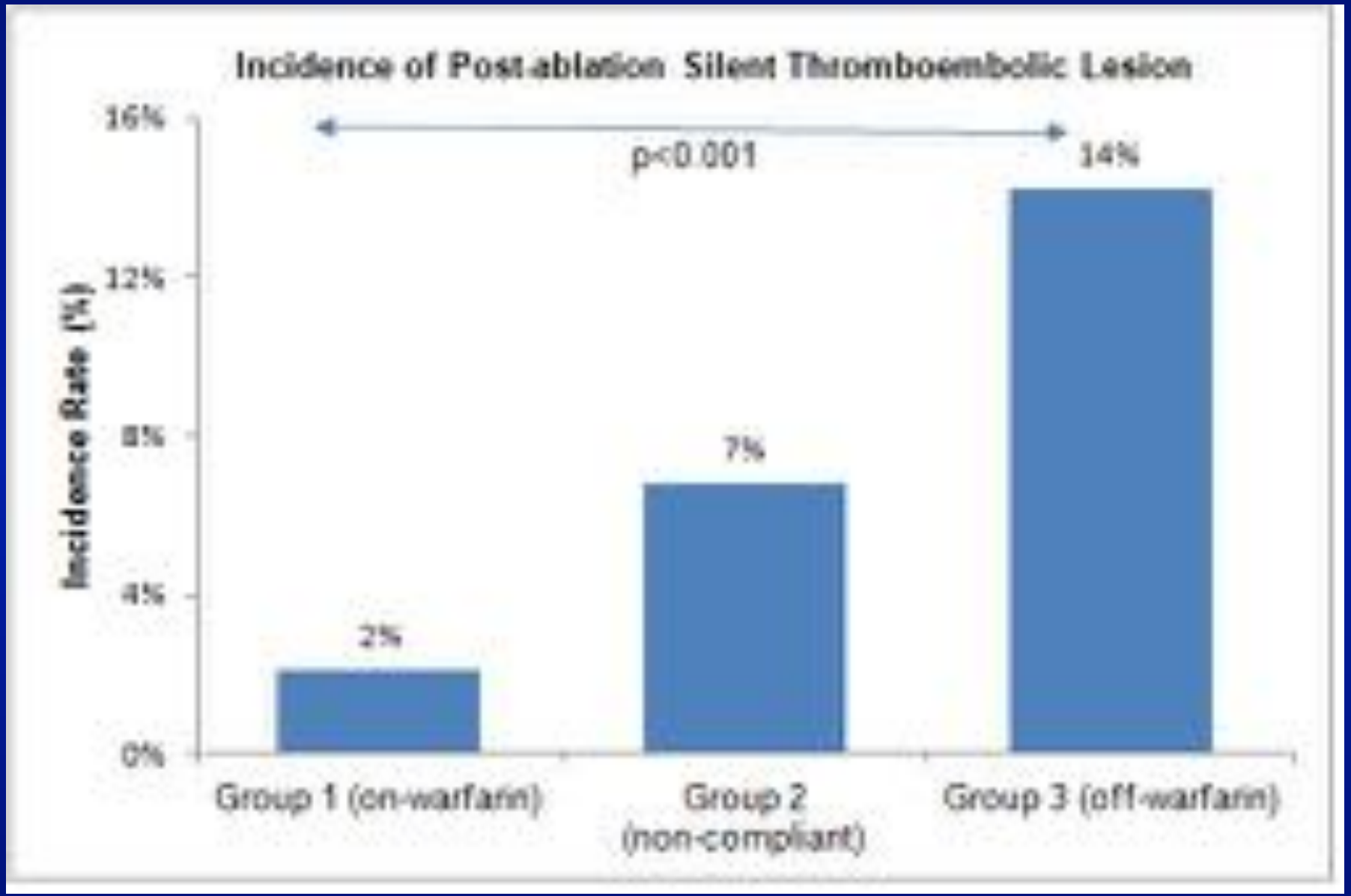
Publication	ACT	n	Ablation technique	Positive DW MRI
Lickfett JCE 2006	>250	10	Irigated RF ablation	1 (10%)
Schwarz Heart Rythm 2010	>300	13 9	Irigated RF ablation	3 (14,3%)
Neuman Europace 2010	>300	44 45	Irigated RF Cryoballoon	3 (6,8%) 4 (8,9%)
Gaita Circulation 2010	250-300	232	Irigated RF ablation	33 (14%)
Schrickel Europace 2010	>250	53	Irigated RF ablation	6 (11%)
Siklódy Clin Res Cardiol 100, 2011	>300	27 23 24	RF Cryoballoon Phased RF	2 (7,4%) 1 (4,3%) 8 (33%)
Gaita JCE 2011	>300	36 36 36	Irigated RF ablation Phased RF Cryoballoon	3 (8,3%) 14 (38,9%) 2 (5,6%)

Does The Peri-procedural Anticoagulation Management For Af Affect The Prevalence Of Silent Thromboembolic Lesion Detected By Diffusion Cerebral Magnetic Resonance Imaging (dmri) In Patients Undergoing Atrial Fibrillation Ablation With Open Irrigated Radiofrequency Energy? Results From A Prospective Multicenter Study.

Methods: Consecutive patients undergoing RF ablation for AF with “therapeutic” warfarin and receiving heparin bolus before transseptal (group 1, n=146) were compared with a group of pts that had protocol deviation in terms of maintaining the therapeutic pre-procedure INR (patients with subtherapeutic INR) and/or failure to receive pre-transseptal heparin bolus infusion (non-compliant population, group 2, n=134) and with a group of patients undergoing RF ablation with warfarin discontinuation bridged with low weight molecular heparin (group 3, n=148).
All patients underwent preablation and postablation (within 24 hours) dMRI.
All patients had to maintain ACT above 300 secs during the entire procedure.

Di Biase, Gaita, Natale et al HR 2013

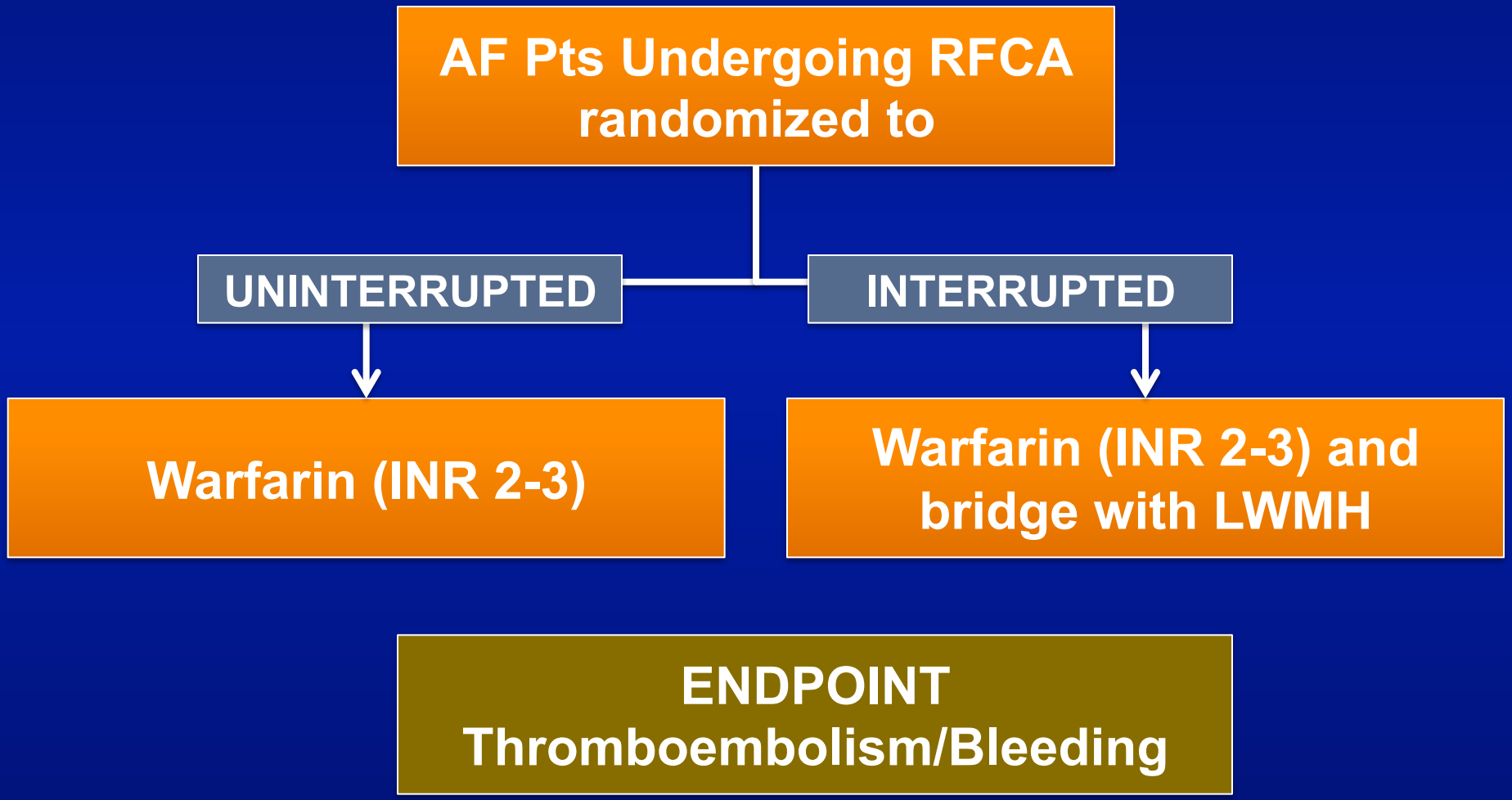
Incidence of Post Ablation Silent Thromboembolic Lesion with Cardioversion



Di Biase, Gaita, Natale et al HR 2013

COMPARE STUDY

RCT Continuos vs Discontinuos Warfarin Periprocedural Anticoagulation in pts with High CHAD2S SCORE



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Results: Thromboembolic Events

- There were 39 TE [3.7% (29) strokes and 1.3% (10) TIA] events in group 1 respectively:
  - 2 (0.8%) in PAF (paroxysmal),
  - 5 (2.9%) in persistent AF,
  - 32 (8.2%) in LSP AF with a total of **37 TE events in non-PAF.**
- Two (0.25%) strokes in LSP pts were observed in group 2 ($p < 0.001$) with sub therapeutic INR the day of the procedure.
- When stratified by AF type, the event rate for stroke/TIA in PAF was **0.47%** (2/429) compared to **3.2%** (37/1155) in non-PAF; $p<0.001$.

Di Biase, Natale, et al Circulation 2014

CONCLUSIONS

- This multicenter randomized study shows that in higher risk pts therapeutic INR protects against peri-procedural thromboembolic events.
- The risk of these complications during AF ablation is predominantly confined to pts with non paroxysmal AF and especially long standing persistent AF.
- Therefore, future studies assessing the protecting value of newer anticoagulants should be performed in comparison with on warfarin treatment and enrolling pts with LSPAF since in paroxysmal pts these events are relatively rare.

Di Biase, Natale, et al Circulation 2014

Silent Thromboembolic Lesions Following Catheter Ablation For Atrial Fibrillation Using Radiofrequency Energy: Results From A Sub-study of The "COMPARE" Randomized Trial

Luigi Di Biase, MD, PhD, FACC, FHRS, J.David Burkhardt, MD, Pasquale Santangeli, MD, Prasant Mohanty, MBBS,MPH, Javier E. Sanchez, MD, Rong Bai, MD; Sanghamitra Mohanty, MD; Chintan Trivedi, MD, MPH; Richard Hongo, MD, Steven Hao, MD; Salwa Beheiry, RN; Rodney Horton, MD; Dhanunjaya Lakkireddy, MD, Yaruva Madhu Reddy, MD; Sakis Themistoklakis, MD; Antonio Rossillo, MD; Antonio dello Russo, MD; Jason D. Zagrodzky, MD; Gaetano Fassini, MD; Michela Casella, MD; Giovanni Forleo, MD; Gemma Pelargonio, MD; Claude S Elayi, MD; Maria Lucia Narducci, MD; Claudio Tondo, MD; Robert Schweikert, MD, Andrea Natale, MD, FHRS, FACC

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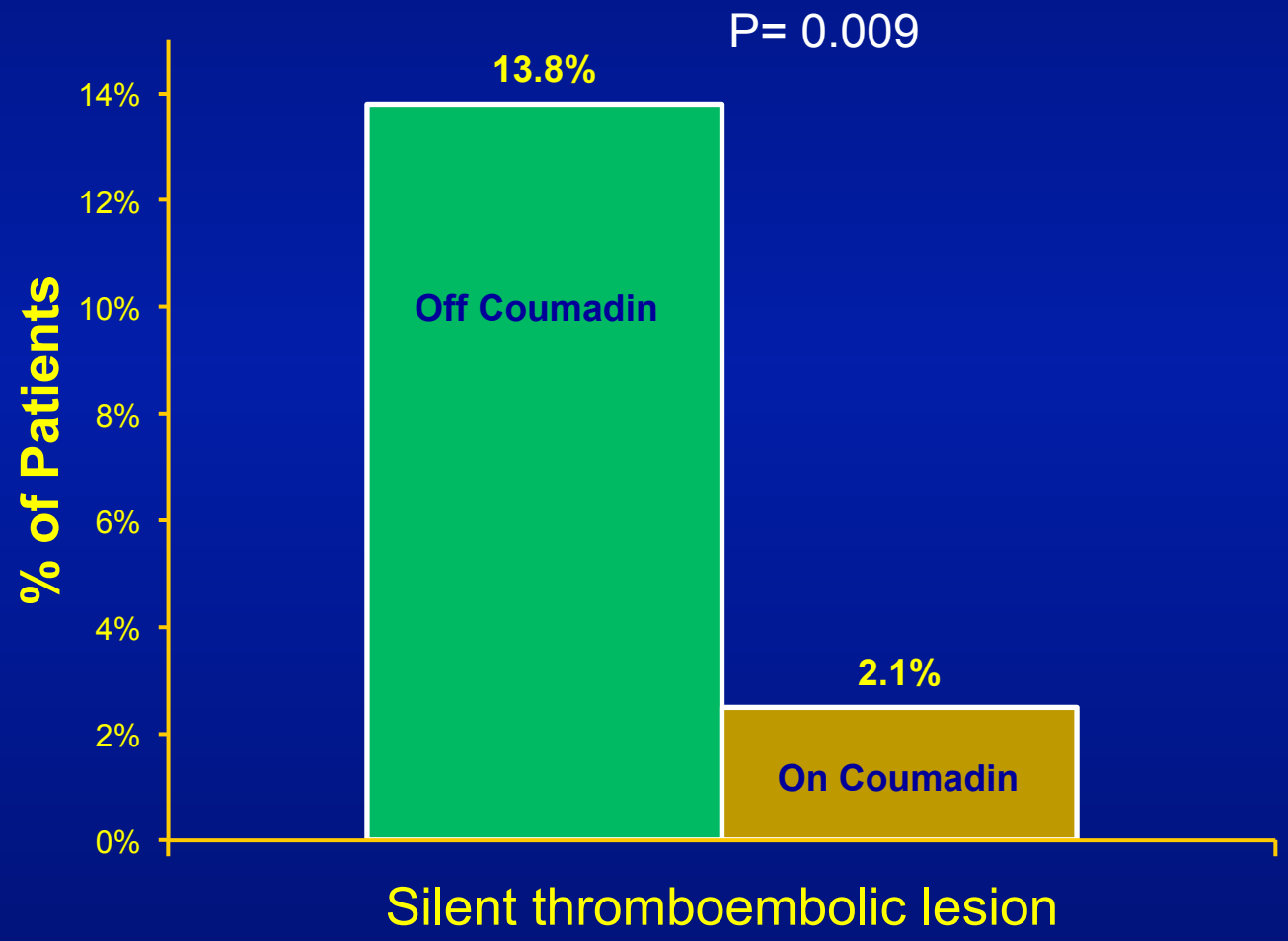
STL


P= 0.009
13.8%
2.1%
Off Coumadin
On Coumadin
% of Patients
14%
12%
10%
8%
6%
4%
2%
0%
Silent thromboembolic lesion

Dabigatran

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Heart Rhythm Disorders

Feasibility and Safety of Dabigatran Versus Warfarin for Periprocedural Anticoagulation in Patients Undergoing Radiofrequency Ablation for Atrial Fibrillation

Results From a Multicenter Prospective Registry

Dhanunjaya Lakkireddy, MD,* Yeruva Madhu Reddy, MD,* Luigi Di Biase, MD, PHD,†‡§ Subba Reddy Vanga, MD,* Pasquale Santangeli, MD,† Vijay Swarup, MD,‖ Rhea Pimentel, MD,* Moussa C. Mansour, MD,¶ Andre D'Avila, MD, PHD,# Javier E. Sanchez, MD,† J. David Burkhardt, MD,† Fadi Chalhoub, MD,¶ Prasant Mohanty, MBBS, MPH,† James Coffey, MD,# Naushad Shaik, MD,** George Monir, MD,†† Vivek Y. Reddy, MD,# Jeremy Ruskin, MD,¶ Andrea Natale, MD†§‡‡

Kansas City, Kansas; Austin, Texas; Foggia, Italy; Phoenix, Arizona; Boston, Massachusetts; New York, New York; Kissimmee and Orlando, Florida; and San Francisco, California

Methods

- tion for

Dabigatran Group (cases)

Comprised of 145 consecutive patients on anticoagulation with 150mg of dabigatran etexilate (Pradaxa®) twice daily for at least 30 days before AF ablation

Warfarin group (controls)

An equal number (145) of patients undergoing AF ablation during the same time period, matched on age, gender and type of AF

Patients without therapeutic INR at the time of the procedure were excluded

Methods: On Dabigratan Group

- Patients on dabigatran were instructed to hold the dose on the morning of the procedure.
- Dabigatran was resumed within three hours after hemostasis and when patient was ready to have oral intake after the ablation procedure was completed.

Complications

		Total (290)	Dabigatran (Cases, n= 145)	Warfarin (Controls, n =145)	p value
Major Bleeding Complications		10 (3%)	9 (6%)	1 (1%)	**0.019**
	Periprocedural Pericardial Tamponade	7 (2%)	6 (4%)	1 (1%)	0.120
	Late Pericardial Tamponade	3 (1%)	3 (2%)	0 (0%)	0.250
Minor Bleeding Complications		20 (7%)	12 (8%)	8 (6%)	0.350
	Groin Hematoma	11 (4%)	6 (4%)	5 (3%)	0.760
	Pericardial Effusion without Tamponade	10 (3%)	6 (4%)	4 (3%)	0.750
Total Bleeding Complications		29 (10%)	20 (14%)	9 (6%)	**0.031**
Embolic Complications (CVA/TIA)		3 (1%)	3 (2%)	0 (0%)	0.250
Composite of bleeding and embolic complications		32 (11%)	23 (16%)	9 (6%)	**0.009**

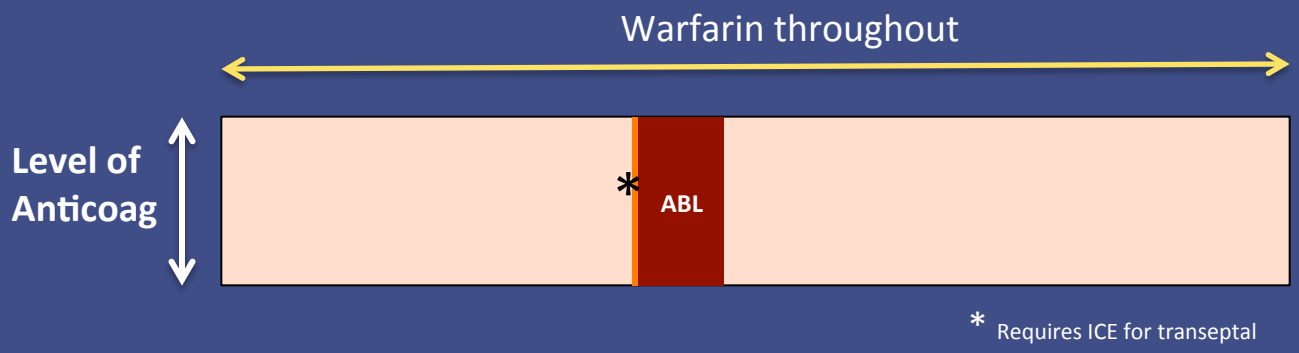
No intracranial hemorrhage or deaths occurred in the study.
Of note, all 3 thromboembolic complications occurred in non- paroxysmal patients of the dabigatran group while no embolic complications occurred in the warfarin group (p=0.25 for comparison).
Neurological symptoms improved in all patients with no residual deficits noted at 30 day follow-up.

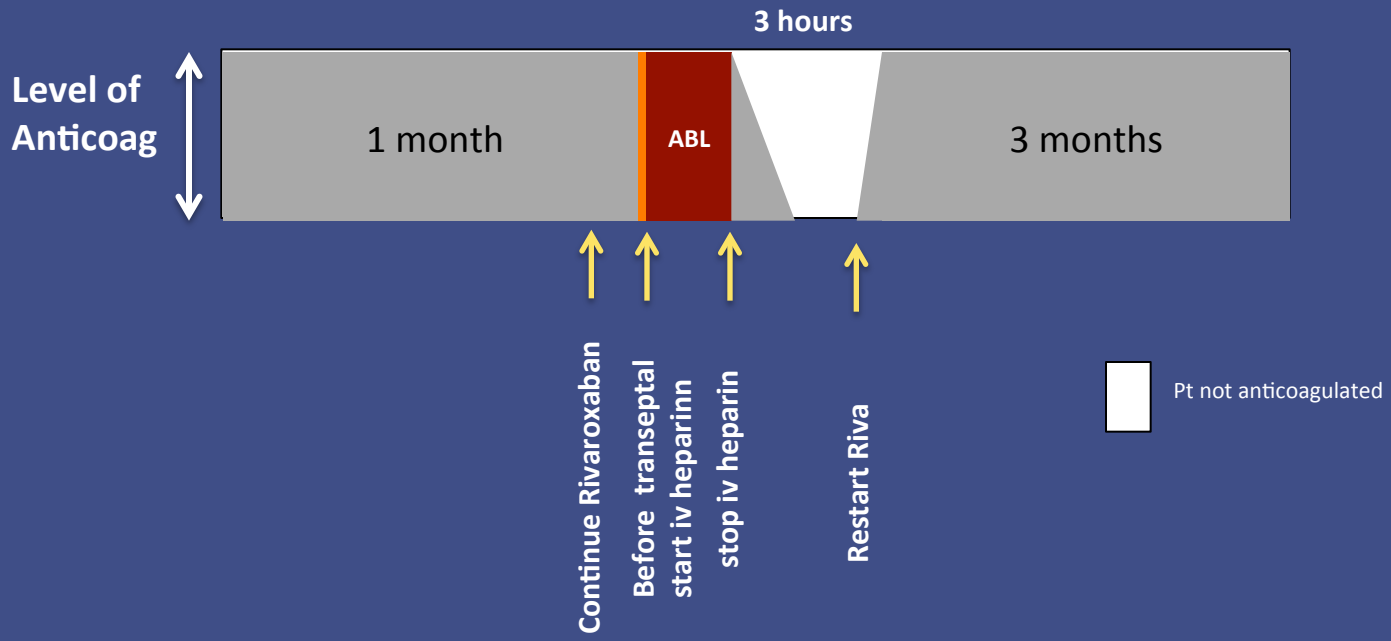
Rivaroxaban

Feasibility & Safety of Uninterrupted Rivaroxaban vs Warfarin for Periprocedural Anticoagulation in Patients Undergoing Radiofrequency Ablation for Atrial Fibrillation: Results from a Multicenter Prospective Registry

Lakkireddy, Natale, et al JACC 2014

Our Experience with Rivaroxaban





Lakkireddy, Natale, et al JACC 2014

Baseline characteristics	Group		p value
	Rivaroxaban N= 321	Warfarin N =321	
Age (mean, std dev)	63 ±10	63 ±10	0.98
Body Mass Index (mean, std dev)	30 ± 6	30 ±6	0.162
Male (%)	221 (69)	221 (69)	1.0
Caucasian (%)	277 (86)	292 (91)	0.06
Paroxysmal Atrial Fibrillation (AF) (%)	164 (51)	164 (51)	1.00
Duration of AF in months; Med (IQR)	42 (20-81)	48 (22-84)	0.243
Re-Do Procedure	88 (27)	74 (23)	0.203
Heart Failure (%)	30 (7)	23 (6)	0.315
Hypertension (%)	177 (55)	199 (62)	0.078
Age > 75 yrs (%)	41 (13)	41 (13)	1.00
Diabetes (%)	59 (18)	64 (20)	0.616
Transient Ischemic Attack or Stroke (%)	34 (11)	26 (8)	0.278
Coronary artery disease (%)	60 (19)	67 (21)	0.488
Peripheral Artery Disease	17 (5)	25 (8)	0.20

Baseline characteristics	Group		p value
	Rivaroxaban N= 321	Warfarin N =321	
Mean CHADS2 Score	1.16 ±1.0	1.18 ±1.0	0.876
Median CHADS2	1 (0-2)	1 (0-2)	0.737
Mean CHADSVasc Score	2.17±1.6	2.21 ±1.5	0.781
Median CHADSVasc Score	2 (1-3)	2 (1-3)	0.808
Mean HAS BLED Score	1.47 ±0.9	1.70 ±1.0	0.032
Mean Left Atrial Size in cm	4.4 ±0.8	4.3 ±0.8	0.114
Mean Left Ventricular Ejection Fraction %	58 ±8	57 ±8	0.184
Aspirin (%)	98 (31)	84 (26)	0.220
Clopidogrel (%)	22 (7)	15 (5)	0.236
Beta Blocker (%)	186 (58)	192 (60)	0.63

Procedural Variables

Procedural Variables	Group		p value
	Rivaroxaban N = 321	Warfarin N= 321	
Sinus Rhythm on Arrival to the Lab (%)	209 (65)	228 (71)	0.110
Ablation of CFAE/ Posterior Wall	116 (36)	125 (39)	0.463
Additional Linear Lesions including Right Atrial	101 (31)	118 (37)	0.157
Cardioversion during procedure	102 (32)	90 (28)	0.300
Acute PV Isolation (%)	317 (99)	314 (99)	1.0
Procedural Time (min) mean ± SD	195 ±62	198 ±66	0.550
Fluoroscopy Time (min) mean ± SD	49 ±20	51 ±30	0.320
RF Time (min); mean ± SD	56 ±25	58 ±29	0.349

Lakkireddy . Natale et al, JACC 2014

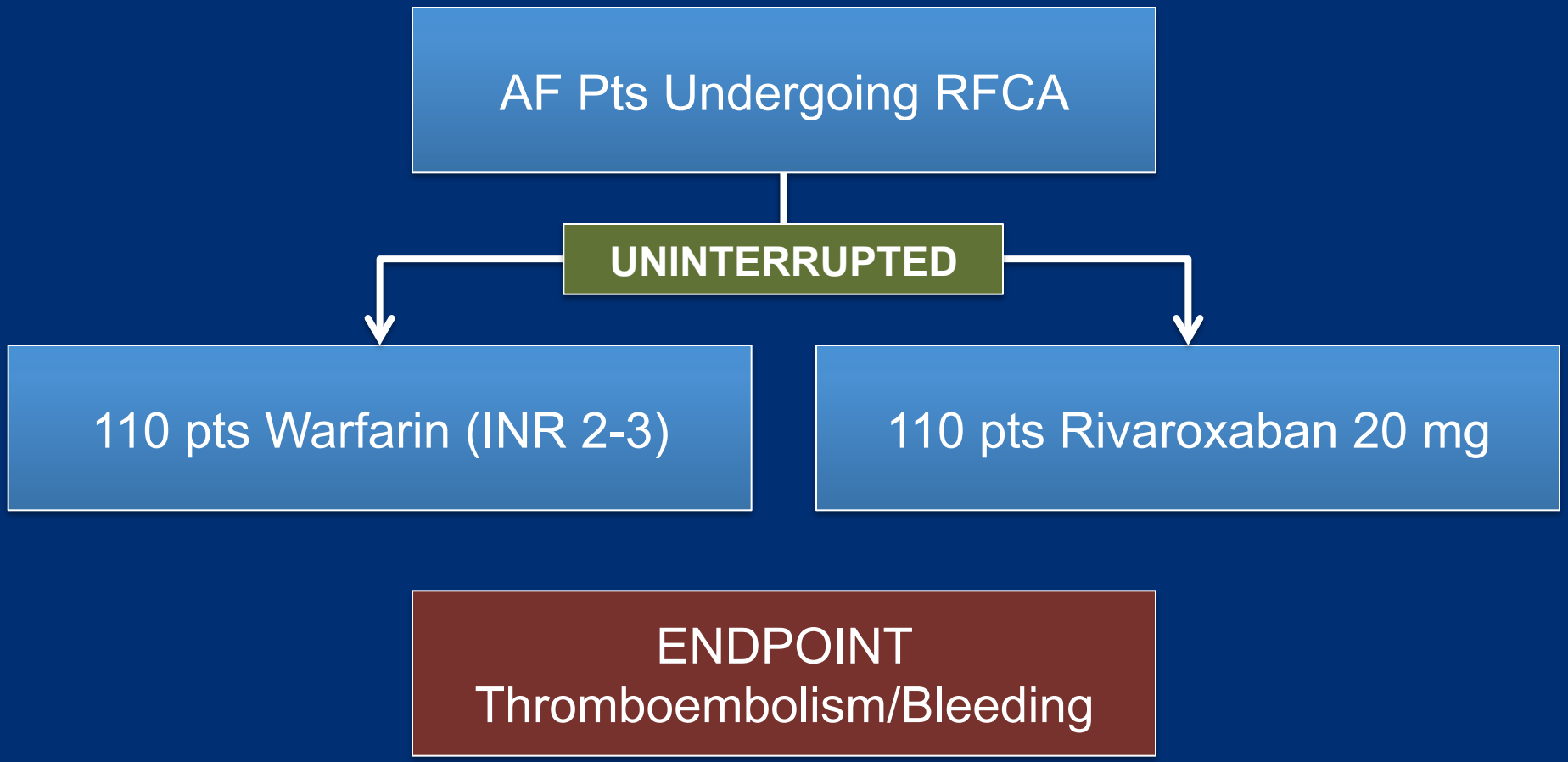
Differences in outcomes

Outcomes	Rivaroxaban (N =321)	Warfarin (N = 321)	Total (N = 642)	p value
Major Bleeding Complications	5 (1.6)	7 (2.2)	12 (1.9)	0.772
Early Cardiac Tamponade	2 (0.6)	4 (1.2)	6 (0.9)	
Delayed Cardiac Tamponade	1 (0.3)	0 (0)	1 (0.2)	
≥Moderate Access Site Hematomas	2 (0.6)	3 (0.9)	5 (0.8)	
Minor Bleeding Complications	16 (5.0)	19 (5.9)	35 (5.5)	0.602
< Moderate Access Site Hematoma	13 (4.0)	18 (5.6)	31 (4.8)	
Insignificant Pericardial Effusions	3 (0.9)	1 (0.3)	4 (0.6)	
All Bleeding Complications	21 (6.5)	26 (8.1)	47 (7.3)	0.449
Thrombo-embolic Complications (Stroke/TIA)	1 (0.3)	1 (0.3)	2 (0.3)	1.0
Transient Ischemic Attack	1 (0.3)	1 (0.3)	2 (0.3)	
Stroke	0	0	0	
Bleeding and Thrombo-embolic Complications	22 (6.8)	27 (8.4)	49 (7.6)	0.457
Other Complications	3 (0.9)	2 (0.6)	5 (0.8)	1.0

Lakkireddy, Natale, et al, JACC 2014

- In our multicenter experience, uninterrupted Rivaroxaban appears to be feasible and a safe alternative to uninterrupted warfarin in patients undergoing AF ablation.
- Future larger and randomized trials are needed to confirm our findings

RCT – Warfarin vs. Rivaroxaban for Periprocedural Anticoagulation: Venture AF



Cappato, Natale et al EHJ 2015

Potential Plus and Minus of The Venture AF

- First Randomized Multicenter Study
- Include mostly paroxysmal patients
- Small Sample Size
- No MRI Study For Asymptomatic Thromboembolic Events
- Did not mandate pre-transeptal Heparin bolus

Uninterrupted Rivaroxaban reduces the prevalcence of Silent Cerebral Ischemia during radiofrequency ablation of AF

Forty nine (49) consecutive patients undergoing ablation of AF while on rivaroxaban 20 mg for at least 3 weeks before the procedure were enrolled in this prospective study.

Twenty four (24) patients discontinued rivaroxaban at least 24 hours before the procedure and were bridged with low molecular weight heparin (GROUP I)

Twenty five (25) patients underwent ablation without rivaroxaban discontinuation (GROUP II) .

Group I patients underwent heparin bolus after transseptal access was obtained, while group II underwent heparin bolus before transseptal. All patients underwent pre and post ablation dMRI.

Abstract HRS 2014

Uninterrupted Rivaroxaban reduces the prevalcence of Silent Cerebral Ischemia during radiofrequency ablation of AF

All 49 patients had persistent and long standing persistent AF.

At post-procedure dMRI, silent thromboembolic lesions were (29.2%) patients in Group I and none in patient in Group II (p= 0.004).

Rivaroxaban discontinuation was the strongest predictor of post-procedure SCI.

Uninterrupted rivaroxaban before radiofrequency ablation of AF reduces the prevalence of SCI as detected by dMRI.

A controlled randomized study with a larger sample size is warranted to confirm our findings.

Abstract HRS 2014

Texas Cardiac Arrhythmia Institute

Feasibility and Safety of Uninterrupted Rivaroxaban in Patients Undergoing Radiofrequency Ablation for Long Standing Persistent Atrial Fibrillation

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Abstract

Introduction: Periprocedural anticoagulation management is key to minimize bleeding and thromboembolic complications during and after radiofrequency catheter ablation. Uninterrupted strategies with warfarin in high risk patients have shown superiority over bridging strategies.
We sought to assess the safety and feasibility uninterrupted rivaroxaban during atrial fibrillation (AF) ablation in patients with long standing persistent atrial fibrillation.

Methods: One hundred and ninety six (196) consecutive patients undergoing AF ablation with uninterrupted rivaroxaban (last dose taken with food the night before the procedure and the following dose taken the night of the procedure) were matched by age and sex with an equal number of patients undergoing AF ablation with uninterrupted warfarin on a "therapeutic range". All patients underwent pulmonary vein antrum isolation and ablation of non pulmonary vein triggers as disclosed by isoproterenol challenge test.

Results: Baseline characteristics and procedural variables were similar between groups. Mean INR in warfarin group was 2.2 ± 0.3. The CHADS2 Score was ≥ 2 in 141 (72%) in the rivaroxaban group and 130 (66%) in the warfarin patients (p=0.20). One pericardial tamponade and one groin hematoma occurred in rivaroxaban group while 2 patients in warfarin group developed groin hematoma. One TIA with positive MRI was present in the rivaroxaban group.

Conclusions: Uninterrupted rivaroxaban therapy appears to be as safe and efficacious as uninterrupted warfarin strategy in preventing bleeding and thromboembolic events in patients undergoing long standing persistent AF ablation.

Introduction

-Periprocedural anticoagulation management is key to minimize bleeding and thromboembolic complications during and after radiofrequency catheter ablation.
-Uninterrupted strategies with warfarin in high risk patients have shown superiority over interrupted strategies.
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Methods

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Results

- Baseline characteristics and procedural variables were similar between groups.
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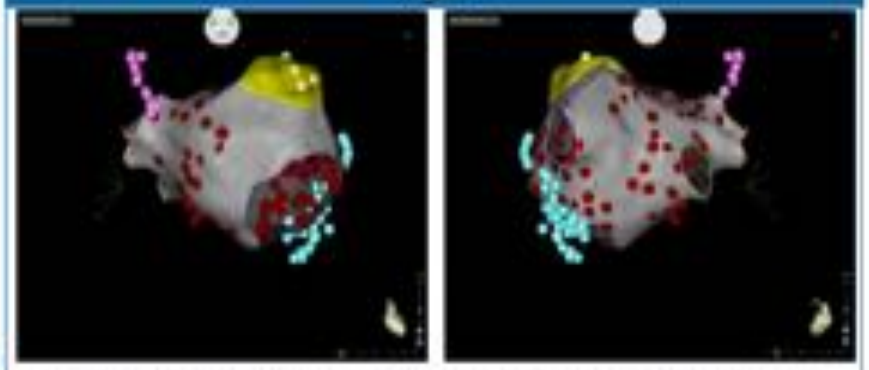
- One pericardial tamponade and one groin hematoma occurred in rivaroxaban group while 2 patients in warfarin group developed groin hematoma.
- One TIA with positive MRI was present in the rivaroxaban group.

Figure



- Antero posterior (AP, left panel) and postero superior (PA, right panel) of a 3D map reconstruction of the left atrium in a patient with long standing persistent atrial fibrillation undergoing extensive ablation, with pulmonary vein antrum and posterior wall isolation (red arrows) plus ablation of non PV triggers such as the left atrial appendage (yellow dots) the coronary sinus (light blue dots) and the superior vena cava (pink dots).

Conclusions

Uninterrupted rivaroxaban therapy appears to be as safe and efficacious as uninterrupted warfarin strategy in preventing bleeding and thromboembolic events in patients undergoing long standing persistent AF ablation.

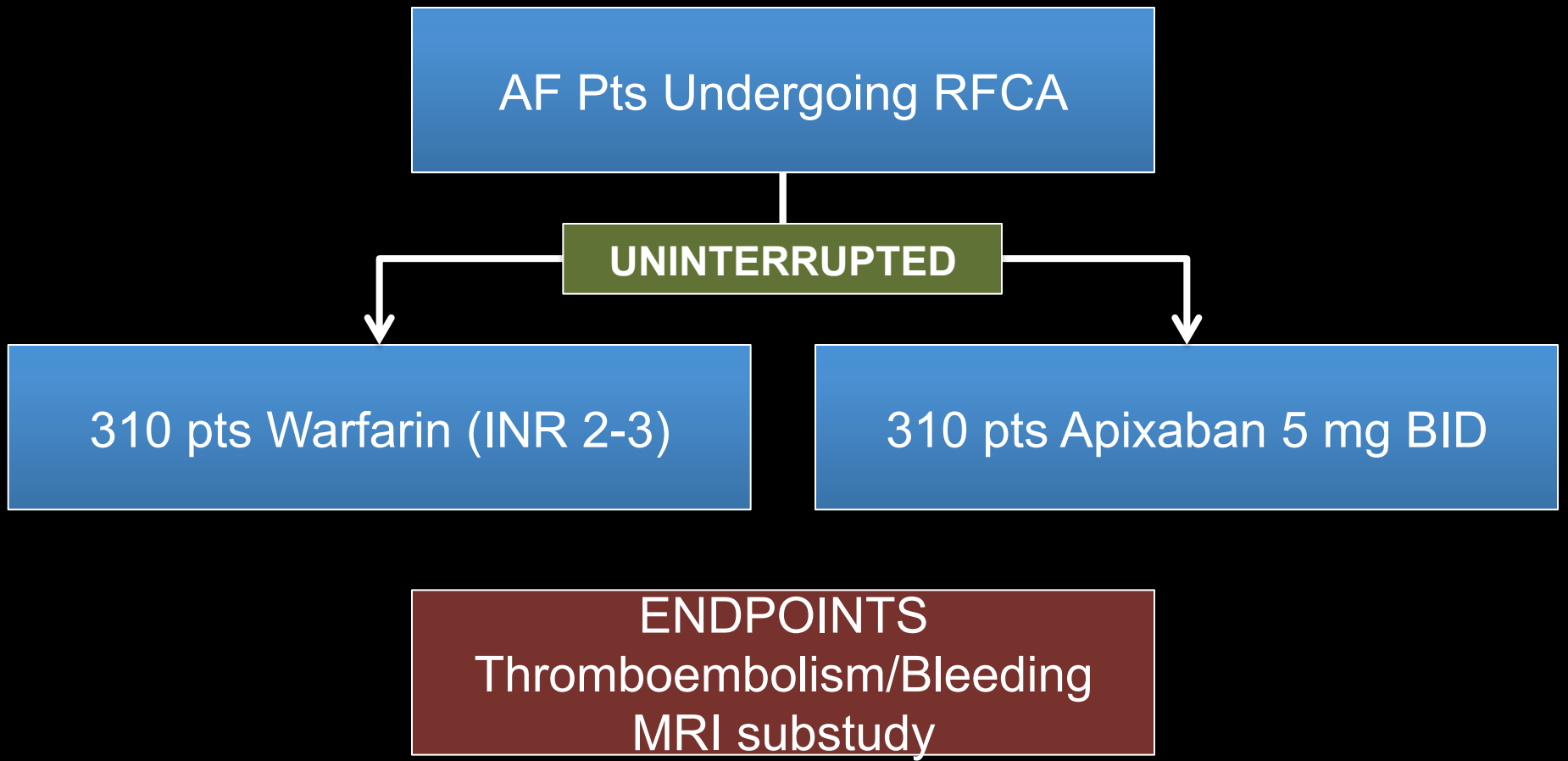
Disclosures

Dr. Di Biase is a consultant for Hansen Medical, Biosense Webster, St Jude Medical and received speaker honoraria/travel reimbursement from Biotronik, Atricure, Epi EP and Medtronic. Dr. Natale received speaker honoraria from Boston Scientific, Biosense Webster, Medtronic, Biotronik and St Jude. Dr Natale is a consultant for Biosense Webster, Janssen and St Jude Medical. All the remaining authors have no disclosures.

AHA Abstract 2014

Apixaban

RCT – Warfarin vs. Apixaban for Periprocedural Anticoagulation: AXAFA study

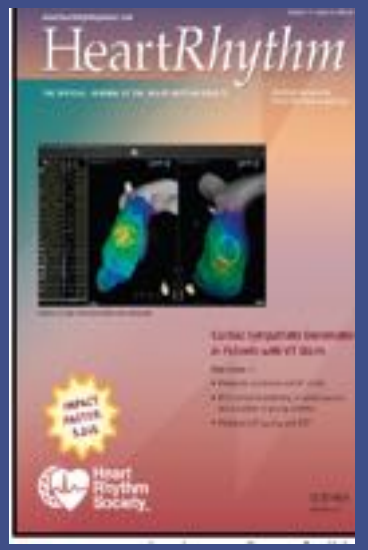


Potential Plus and Minus of The AXAFA Study

- Randomized Multicenter Study
- Include Non-paroxysmal patients
- Larger Sample Size
- MRI Study For Asymptomatic Thromboembolic Events
- Does not mandate pre-transeptal Heparin bolus

Feasibility And Safety of uninterrupted peri-procedural Apixaban administration in patients undergoing radiofrequency catheter ablation for atrial fibrillation: Results From a Multicenter Study

Luigi Di Biase[*†‡§], MD, PhD; Dhanujaya Lakkireddy[‖], MD, Chintan Trivedi[*], MD, MPH, Thomas Deneke[¶], MD, Martin Martinek[#], MD, Sanghamitra Mohanty[*], MD, Prasant Mohanty[*], MBBS, MPH, Sameer Prakash[††], BS, Rong Bai[*], MD, Madhu Reddy, MD[‖]; Carola Gianni[*], MD; Rodney Horton[*], MD, Shane Bailey[*], MD, Elisabeth Sigmund[#], MD, Michael Derndorfer[#], MD, Anja Schade[¶], MD; Patrick Mueller[¶], MD; Atilla Szoelloes[¶], MD; Javier Sanchez[*], MD, Amin Al-Ahmad[*], MD, Patrick Hranitzky[*], MD, G. Joseph Gallinghouse[*], MD, Richard H. Hongo[‡‡], MD, Salwa Beheiry[‡‡], RN, Helmut Pürerfellner[#], MD, J. David Burkhardt[*], MD, Andrea Natale[*‡‡§§***†††], MD



Di Biase, Lakkireddy, Natale et al Heart Rhythm. 2015

Results

- Study Population :
- 200 pts in the apixaban group; 200 pts in the warfarin group (N = 400) matched by age, gender, AF type and institute where ablation was performed
- Mean Age : 65.9 ± 9.9 years
- Male : 71.5%
- Paroxysmal AF : 16.5%, Non-Paroxysmal AF : 83.5%
- Hypertension : 68.5%
- Diabetes : 19.0 %
- Baseline Characteristics were similar between the groups

Di Biase, Natale et al, HR 2015

Results

- A subset of 29 patients with non paroxysmal AF underwent post ablation dMRI in the uninterrupted apixaban group and all were negative for SCI.

Di Biase, Natale et al, HR 2015

Comparison of Baseline Demographics, Clinical parameters, Medication Use between Patients on Apixaban and Warfarin

Characteristics	Apixaban (N=200)	Warfarin (N=200)	p-value
Age (yrs)	65.9 ± 9.9	65.9 ± 9.9	1.0
Male	143 (71.5)	143 (71.5)	1.0
Caucasian	183 (91.5)	187 (93.5)	0.45
Body Mass Index	29.4 ±6.0	30.1 ±6.5	0.25
Type of AF Paroxysmal AF Non-Paroxysmal AF	 33 (16.5) 167 (83.5)	 33 (16.5) 167 (83.5)	1.0
Duration of AF (Median, IQR)	36 (10.5, 84)	36.0 (12.0, 96)	0.62
Heart Failure	22 (11)	19 (9.5)	0.62
Hypertension	136 (68.0)	138 (69.0)	0.83
Coronary Artery Disease	29 (14.5)	29 (14.5)	1.0
Dyslipidemia	106 (53.0)	114 (57.0)	0.42
Sleep Apnea	22 (11.0)	14 (7.0)	0.16
Transient Ischemic attack/Stroke	11 (5.5)	10 (5.0)	0.82
Diabetes	37 (18.5)	39 (19.5)	0.80
Left Atrial size(cm)	4.5 ±0.8	4.5 ± 0.9	0.80
LV ejection fraction (%)	56.1 ±9.4	56.9 ±10.6	0.45
Aspirin	56(28.0)	67 (33.5)	0.23
ACE inhibitor/ARBs	56 (28.0)	50 (25.0)	0.50
Digoxin	29 (14.5)	35 (17.5)	0.41
Statin	93 (46.5)	93 (46.5)	1.00

Comparison of Bleeding Score and Procedural Characteristics between Patients on Apixaban and Warfarin			
Characteristics	**Apixaban (N=200)**	**Warfarin (N=200)**	**p-value**
$CHADS_2$ score	1.28 ±0.9	1.27 ±0.8	0.95
$CHADS_2$ score **0** **1** **≥2**	 39 (19.5) 82 (41.0) 79 (39.5)	 36(18.0) 85 (42.5) 79 (39.5)	0.92
CHA_2DS_2-VASc score	2.28 ±1.4	2.30 ± 1.4	0.89
HAS-BLED score	1.74 ±0.98	1.74 ± 0.94	0.96
Baseline INR	1.90 ±0.5	2.16 ±0.5	<0.001
Presence of Scar	136 (68.0)	134 (67.0)	0.82
Cardioversion during the procedure	80 (40.0)	82 (41.0)	0.84
Additional Periprocedural Heparin Unit	3.6 ± 1.4	1.6 ± 0.7	<0.001
ACT during procedure (seconds)	342.1 ± 23.1	363.1 ± 26.5	<0.001

- There were no differences in the usage of medications and bleeding score between the groups
- Average INR and mean ACT were higher in the warfarin group ($p<0.001$)
- After the bolus of heparin, patients in the apixaban group required more additional heparin units compared to the warfarin group

Di Biase, Natale et al, HR 2015

Composite of bleeding and embolic complications

- Overall, there was no difference in the composite of bleeding and embolic complications between the apixaban group[9(4.5%)] and the warfarin group[6(3.0%)] **(p-value = 0.43)**

Di Biase, Lakkireddy, Natale et al Heart Rhythm. 2015 Feb 26.

Thromboembolic complications

- dMRI was negative for silent cerebral ischemia for the subset of population(n=29) in the apixaban group.
- No patients suffered Stroke/TIA.

Di Biase, Lakkireddy, Natale et al Heart Rhythm. 2015 Feb 26.

Complications

- Total Bleeding Complication : 15 (3.8%)
  - 9(4.5%) in the apixaban group,
  - 6(3.0%) in the warfarin group, p = 0.4
- Major Bleeding Complications : 3 (0.8%)
  - 2(1.0%) in the apixaban group
  - 1(0.5%) in the warfarin group, p=1.0
- Minor Bleeding Complications : 12 (3.0%)
  - 7(3.5%) in the apixaban group
  - 5(2.5%) in the warfarin group, p=0.6

Di Biase, Natale et al, HR 2015

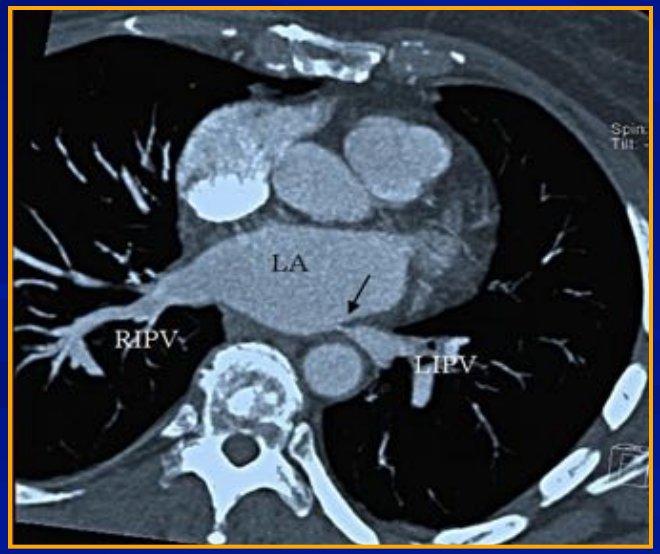
Complications

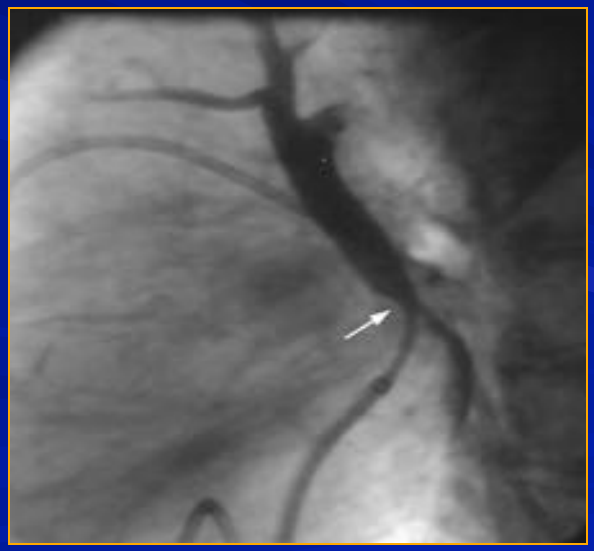
- **Major Bleeding Complications**
  - All complications were Pericardial effusion (PE) with tamponade (0.8%)
  - 1 early PE in both the groups, 1 delayed PE in the apixaban group
  - Managed by percutaneous pericardial drainage
  - None of the patients required surgical drainage
- **Minor Bleeding Complications**
  - Groin Hematoma(1.3%)
    - 3 (1.5%) patients in the apixaban group
    - 2 (1.0%) patients in the warfarin group, p=1.0
  - Pericardial Effusion without Tamponade (1.3%)
    - 3 (1.5%) patients in the apixaban group
    - 2 (1.0%) patients in the warfarin group, p=1.0
  - GI bleeding :1 (0.5 %) patient in the apixaban group
  - Hematuria : 1 (0.5%) patient in the warfarin group
- **Thromboembolic Complication**
  - **Stroke/TIA :** No patient had thromboembolic complications

Di Biase, Natale et al, HR2015

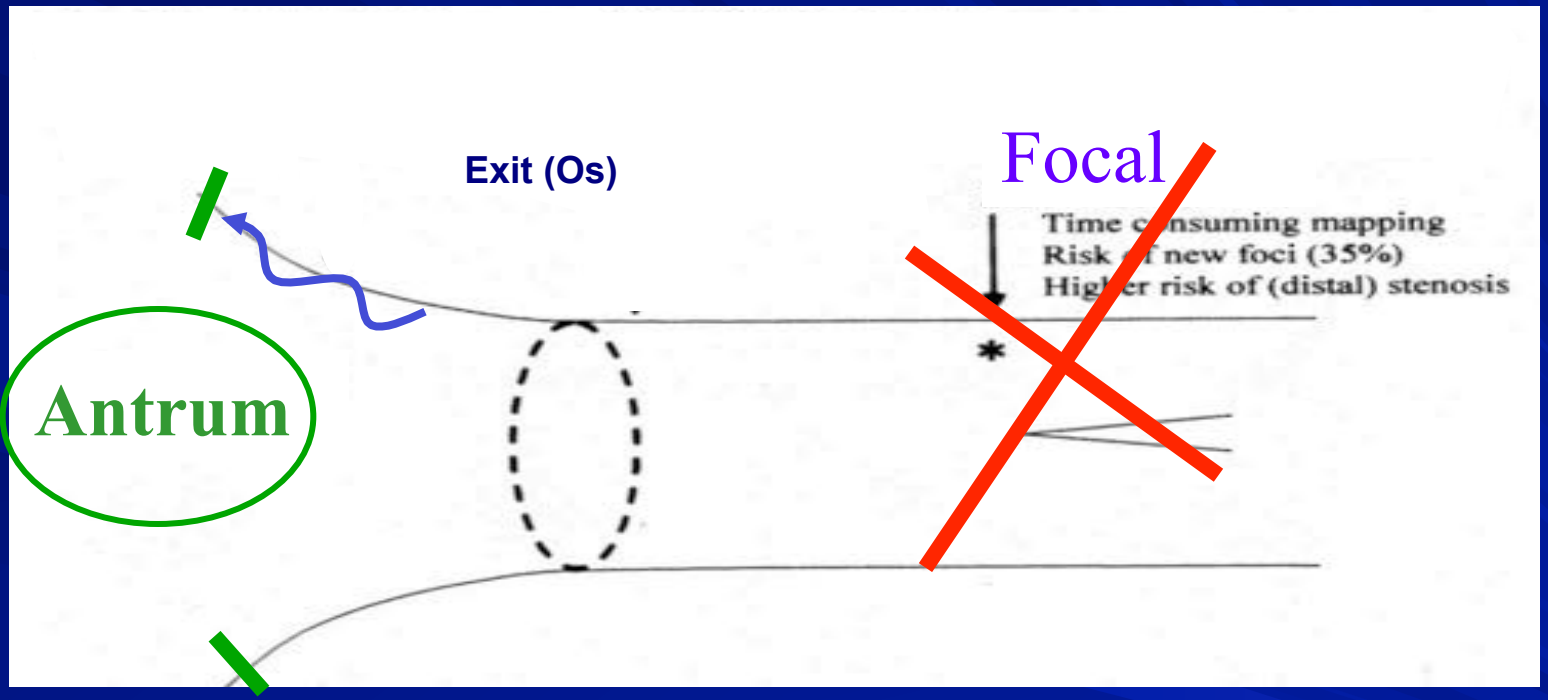
PV stenosis

- Overall incidence: 1-29%
- Severe PV stenosis: 1.6% ….and decreasing
- Depends on ablation approach



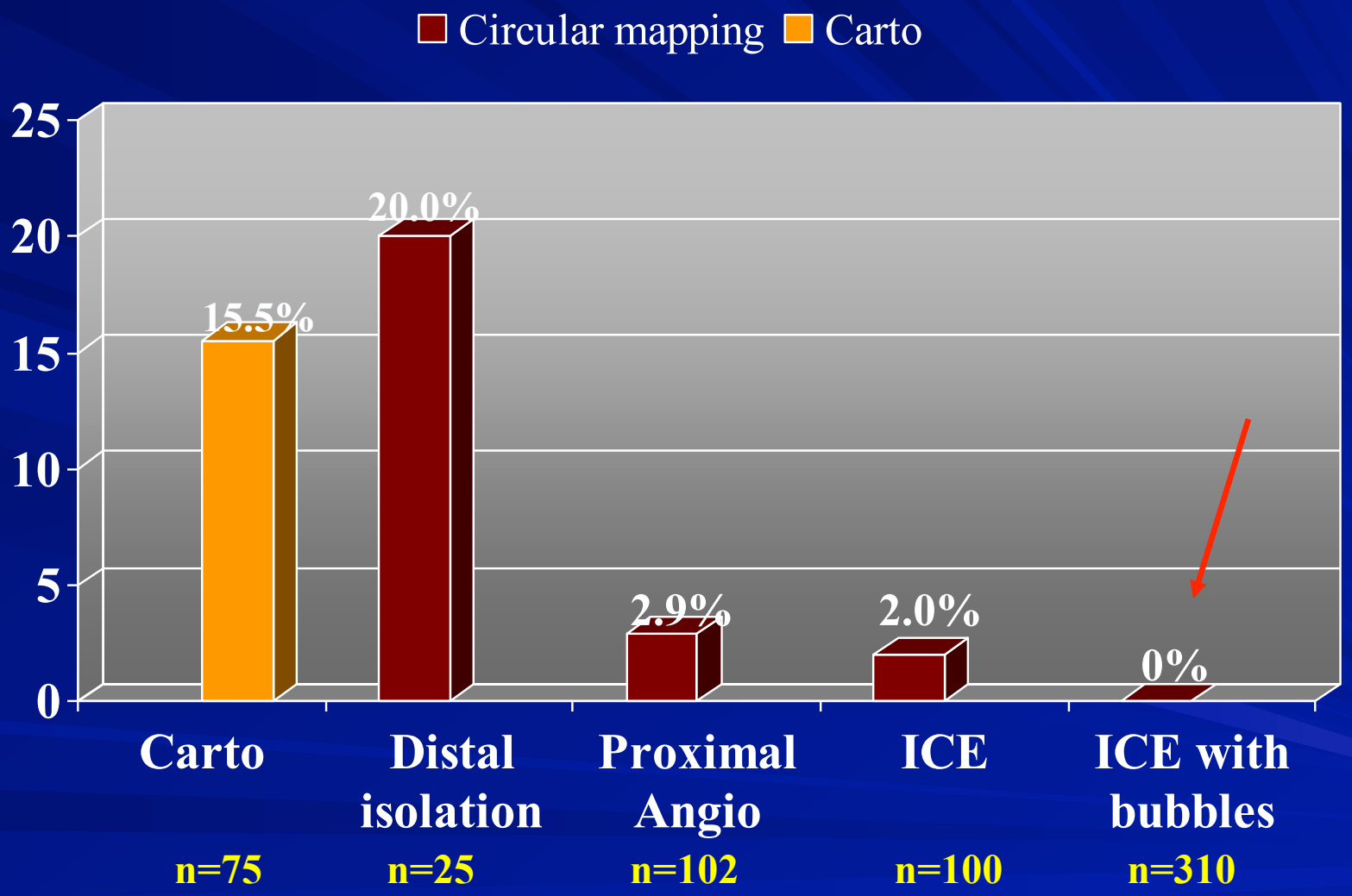


AF Catheter Ablation Strategies



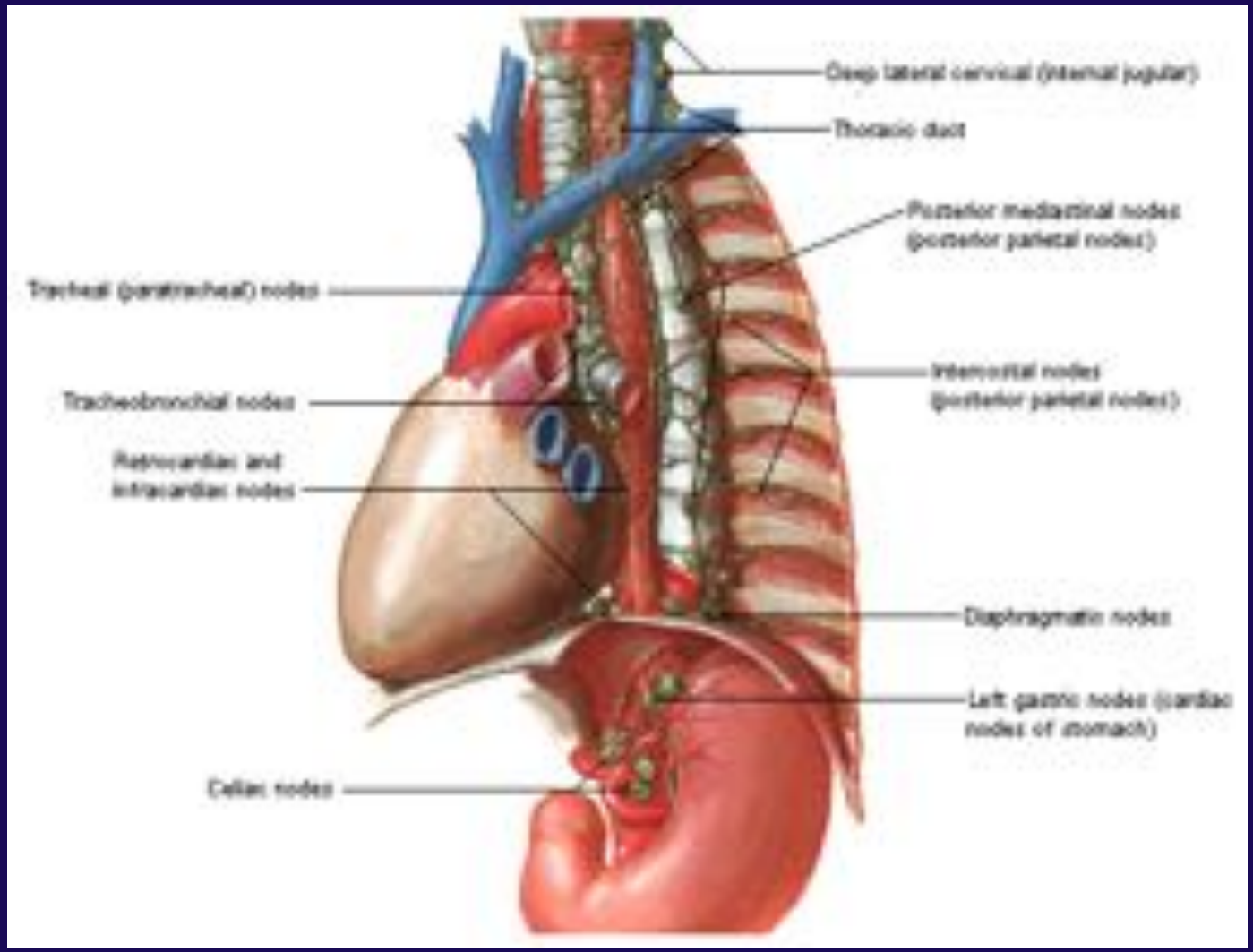
More Proximal ablation: The PV **Antrum**

Severe PV Stenosis



Saad E, Natale A, et al Circulation 2004

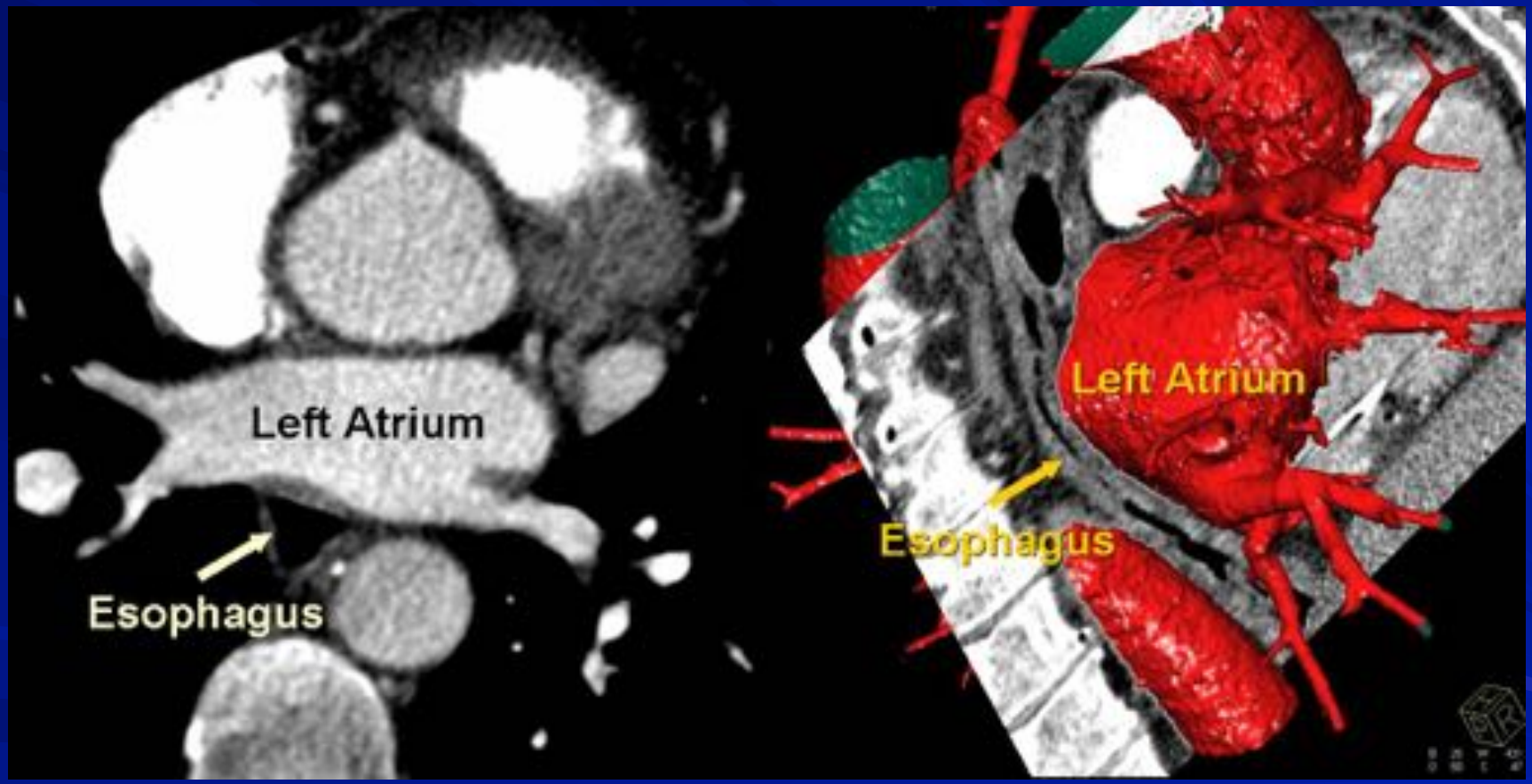
Saad et al Circulation 2004



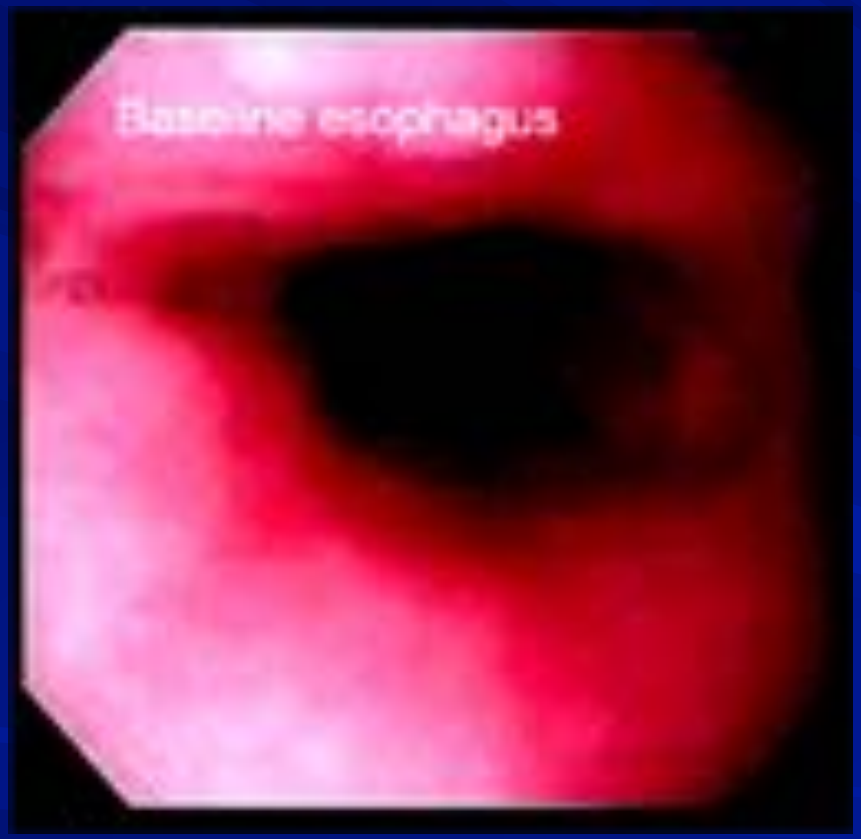
Esophageal Injury

- The esophagus is close to the posterior LA wall.
- The posterior LA wall is thin
- The esophagus has a variable course

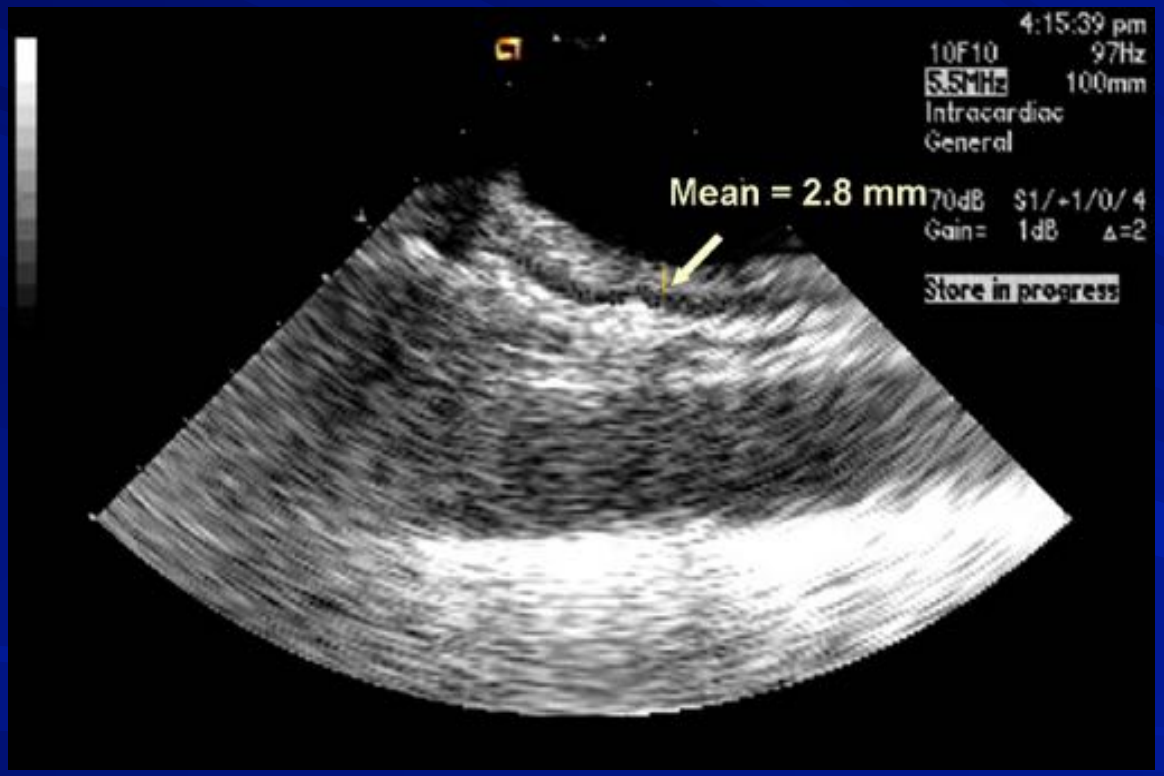
LA- Esophagus Proximity: Anatomy



Posterior LA ablation: Impact on Esophageal Lumen



Posterior LA Wall Thickness by ICE



The mean LA wall thickness as measured by ICE

2.8mm +/- 0.9mm

(1.9mm – 4.0mm)

Cummings J, Natale A,et al Circulation 2005

Esophageal Course

	Right PVs	Mid Posterior Wall	Left PVs
Esophageal Course	28.4% (21/81)	33% (27/81)	38.3%(31/81)

Cummings et al Circulation 2005

Cummings J, Natale A,et al Circulation 2005

Atrial Esophageal Fistula

- Incidence 0.01% - underestimated due to underreporting
- Mechanism – thermal injury to anterior esophageal wall following ablation along posterior LA wall
  - Once injured, fistula development preceded by inflammatory response leading to atrial and esophageal tissue necrosis

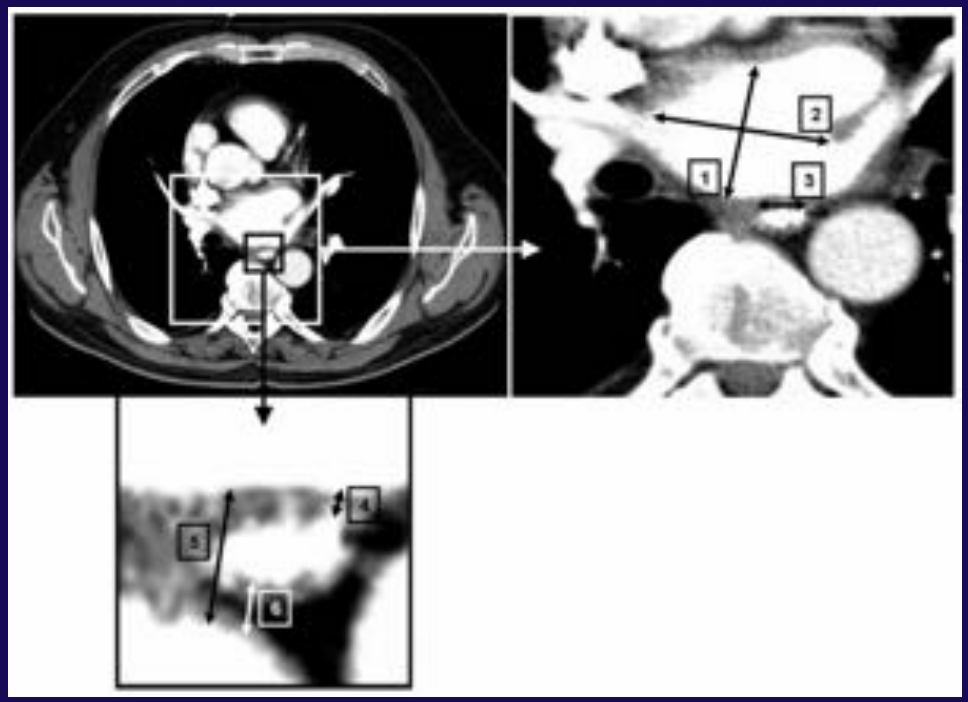
Contributing Factors

- Power >50W (8mm) or >35W (irrigated tip)
- Long Energy application
- Small Atrial Size
- Use of Large Tip Catheters ???
- Overlapping lesions in posterior LA ???
- High contact pressure

Identification of a high-risk population for esophageal injury during radiofrequency catheter ablation of atrial fibrillation: Procedural and anatomical considerations

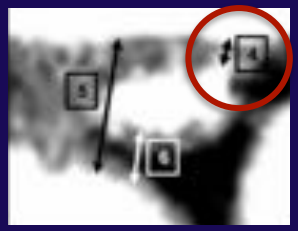
Martin Martinek, MD,* Christian Meyer, MD,* Said Hassanein, MD,* Josef Aichinger, MD,* Gabor Bencsik, MD,† Rainer Schoefl, MD,‡ Gernot Boehm, MD,§ Hans-Joachim Nesser, MD,* Helmut Purerfellner, MD*

Figure 1 Endoscopic appearance of esophageal lesions. **A:** Necrotic ulceration. **B:** Erythema.



Heart Rhythm. 2010;7:1224–30

	Esophageal ulceration		
	No	Yes	*P* value
Type of atrial fibrillation			
Paroxysmal	171	1	.023
Persistent	90	5	
Sedation/anesthesia			
Deep sedation	224	5	.863
General anesthesia	37	1	
Additional ablation sites			
Roof line	108 of 261	6 of 6	.006
Left atrial isthmus line	45 of 261	4 of 6	.011
Coronary sinus	61 of 261	5 of 6	.004
Inferior line	26 of 261	2 of 6	.115
CFAE ablation	40 of 261	1 of 6	.636
Radiofrequency energy (Ws) delivered			
On posterior wall	24,739 ± 9,374	22,180 ± 17,360	.648
Total	71,440 ± 22,928	61,583 ± 41,960	.467
1 LA anteroposterior diameter	35.0 ± 6.0	43.2 ± 9.1	.001
2 LA transverse diameter	49.8 ± 6.4	58.3 ± 5.9	.001
3 LA to esophagus contact width	17.2 ± 5.2	22.5 ± 3.1	.013
4 LA to esophagus distance	2.5 ± 0.7	2.0 ± 0.3	.0001
5 LA to spine distance	13.5 ± 5.1	9.2 ± 1.6	.038
6 Esophagus spine distance	6.9 ± 4.1	5.0 ± 1.0	.255
7 Craniocaudal LA - esophagus contact (<5 mm LA* to spine)	60 ± 13	64 ± 24	.724



	Esophageal ulceration	
	Standard coefficient	*P* value
Persistent atrial fibrillation	0.145	.8033
Roof line	0.195	.2663
Left atrial isthmus line	0.258	.0789
Coronary sinus	0.253	.0729
Left atrium to esophagus distance	−0.159	.0176
Significance (analysis of variance)		.001

Heart Rhythm. 2010;7:1224–30

Impact of esophageal temperature monitoring guided atrial fibrillation ablation on preventing asymptomatic excessive transmural injury

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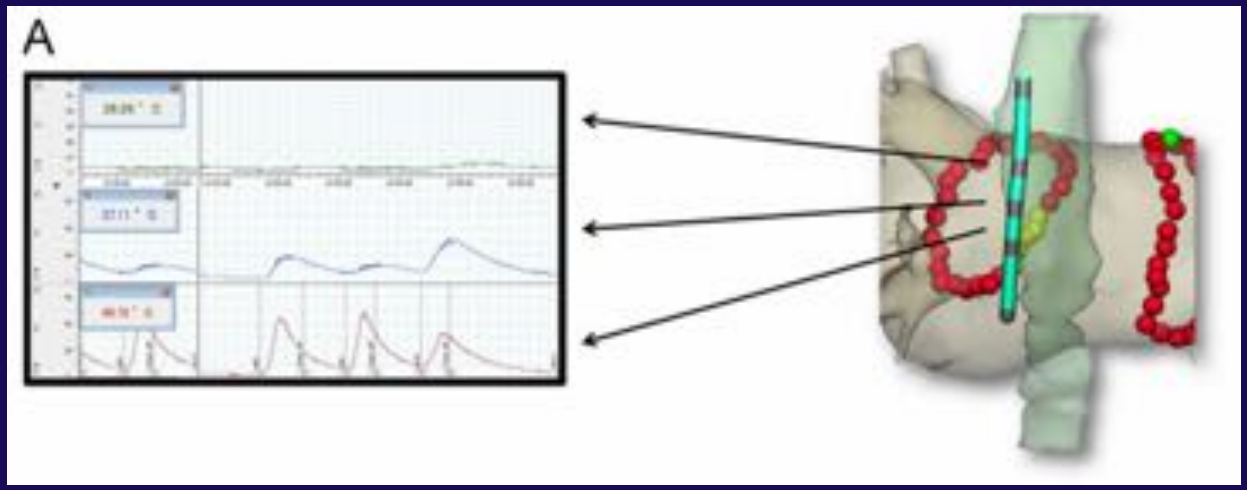


Incidence of ETI and AF recurrence in the 2 patient groups.

	ETM group	Non-ETM group	*p* Value
ETI (*n*, %)	2 (3)	9 (11)	0.06
Esophageal injury (*n*, %)	0 (0)	6 (7,5)	0.03
Periesophageal nerve injury (*n*, %)	2 (3)	3 (4)	1.00
AF recurrence (*n*, %)	20 (25)	19 (24)	1.00

Journal of Arrhythmia. 2015 [ePub ahead of print]

Esophageal Capsule Endoscopy After Radiofrequency Catheter Ablation for Atrial Fibrillation

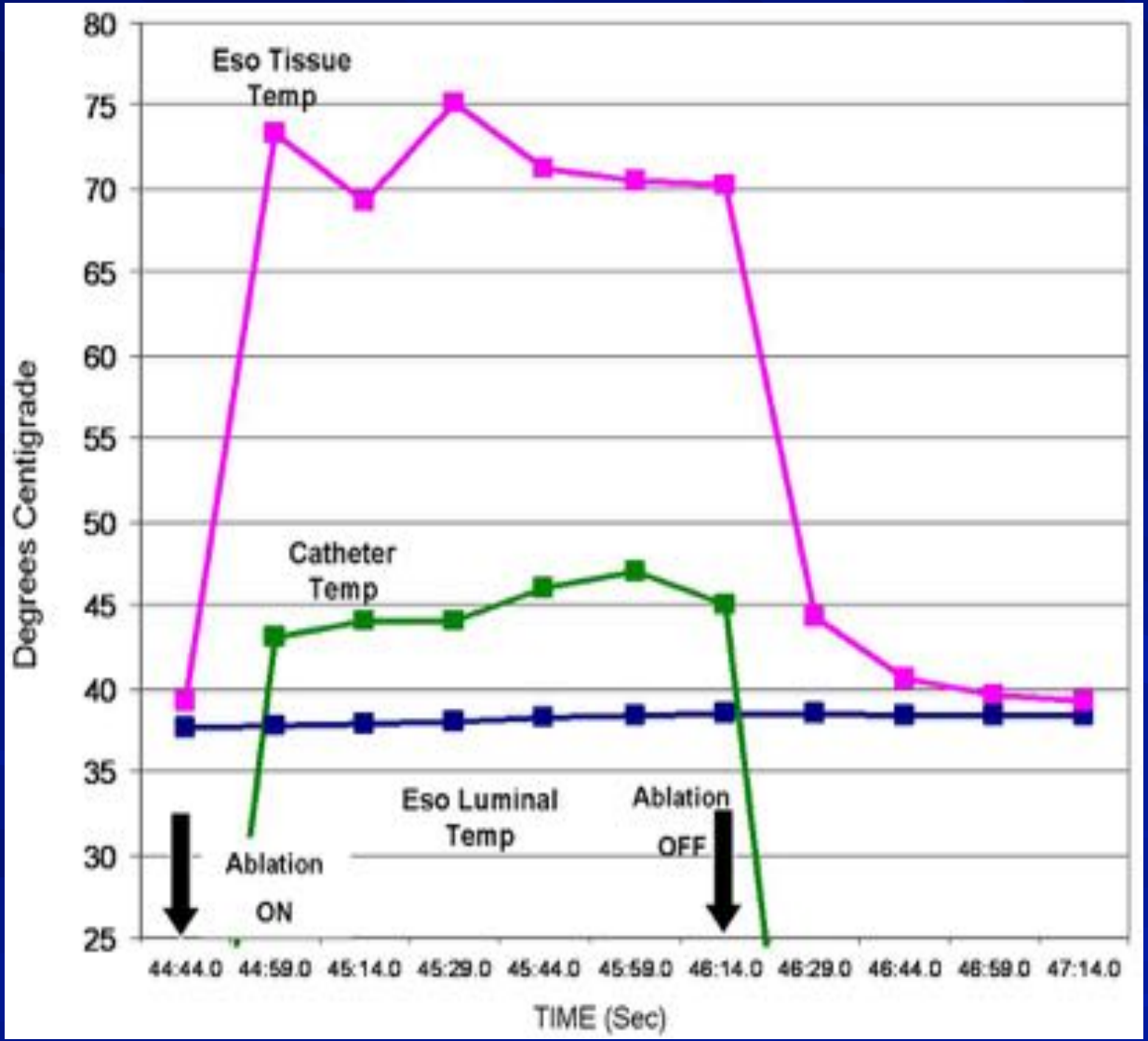
Documented Higher Risk of Luminal Esophageal Damage With General Anesthesia as Compared With Conscious Sedation

Luigi Di Biase, MD; Luis Carlos Saenz, MD; David J. Burkhardt, MD; Miguel Vacca, MD; Claude S. Elayi, MD; Conor D. Barrett, MD; Rodney Horton, MD; Rong Bai, MD; Alan Siu, MD; Tamer S. Fahmy, MD; Dimpi Patel, DO; Luciana Armaganijan, MD; Chia Tung Wu, MD; Sonne Kai, MD; Ching Keong Ching, MD; Karen Phillips, MD; Robert A. Schweikert, MD; Jennifer E. Cummings, MD; Mauricio Arruda, MD; Walid I. Saliba, MD; Milan Dodig, MD; Andrea Natale, MD

	Group 1: General Anestesia (n=25)	Group 2: Conscious Sedation (n=25)	*P* Value
Maximum esophageal temperature	40.6±1°C	39.6±0.8°C	<0.003
Time to baseline temperature recovery, seconds	29±3	18±2	<0.001
Time to peak temperature, seconds	9±7	21±9	<0.001
Esophageal tissue damage, n (%)	12 (48)	1 (4)	<0.001

Circ Arrhythm Electrophysiol. 2009;2:108–12

Is luminal esophageal temperature the best



- Animal data clearly demonstrate that external esophageal tissue temperatures exceed luminal temperatures by far
- However, tissue temperature monitoring in humans is not currently feasible

Esophageal Luminal Temperature Measurement Underestimates Esophageal Tissue Temperature During Radiofrequency Ablation Within the Canine Left Atrium: Comparison Between 8 mm Tip and Open Irrigation Catheters

JENNIFER E. CUMMINGS, M.D., CONOR D. BARRETT, M.R.C.P., KENNETH N. LITWAK, D.V.M., PH.D., LUIGI DI BIASE, M.D., PUNAM CHOWDHURY, M.D., SEIL OH, M.D., CHI KEONG CHING, M.D., WALID I. SALIBA, M.D., ROBERT A. SCHWEIKERT, M.D., J. DAVID BURKHARDT, M.D., SHARI DE MARCO, R.V.T., LUCIANA ARMAGANIJAN, M.D., and ANDREA NATALE, M.D.*†‡

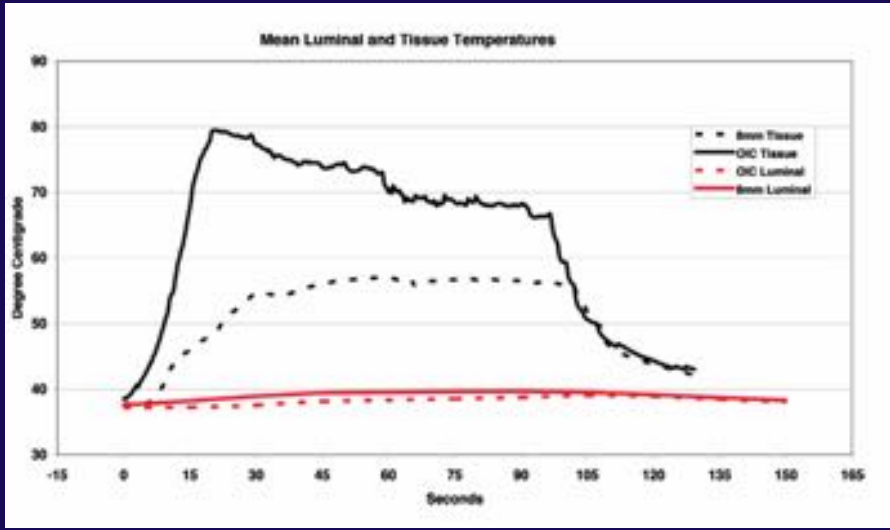
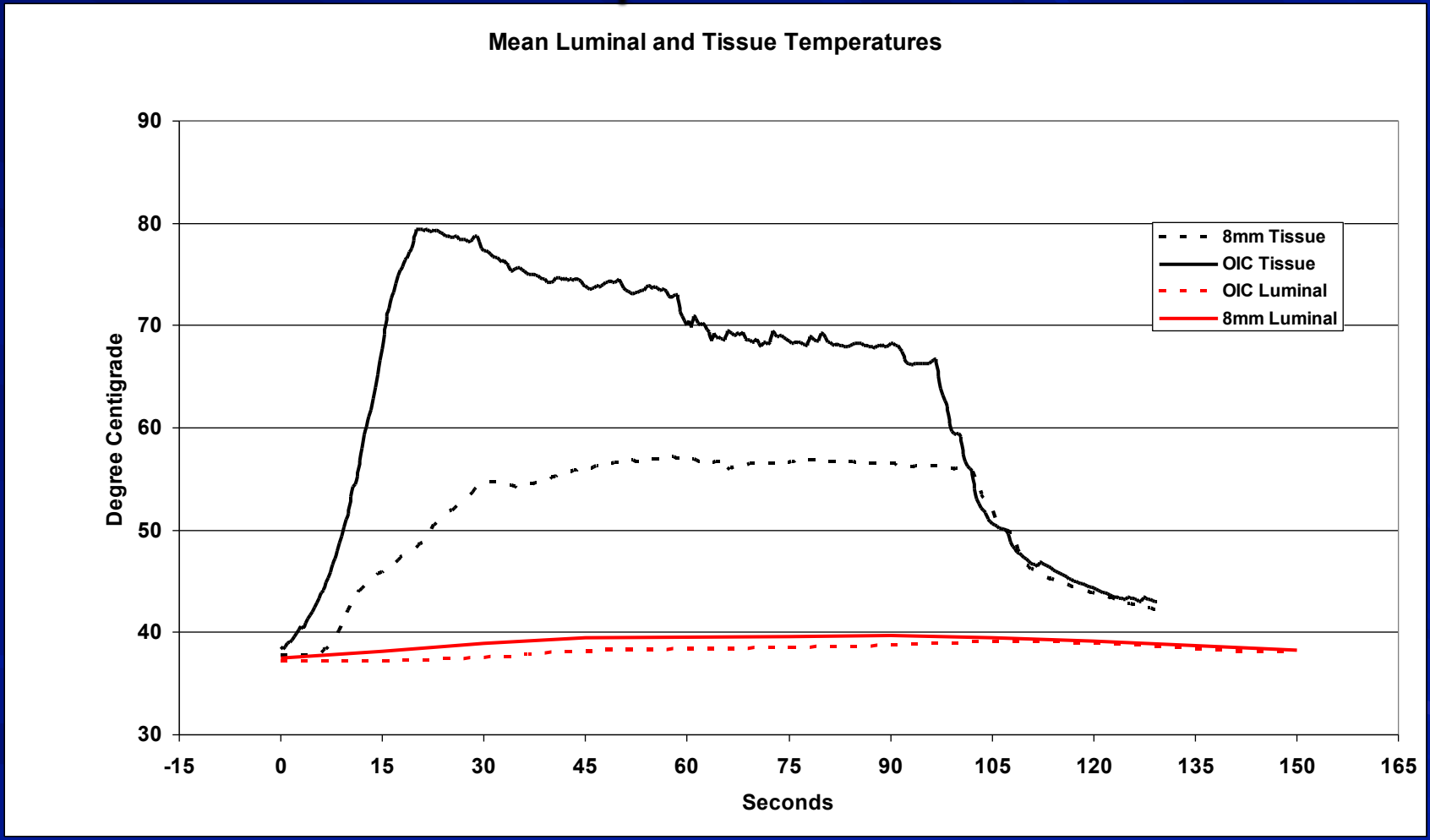


Figure 3. *The three panels are a representative example of esophageal injury during lesions delivered by an open irrigated catheter. Panel A demonstrates the endocardial lesions sites, Panel B demonstrates the same lesions on the epicardial surface, and Panel C demonstrates the associated external esophageal injury associated with these lesions.*

J Cardiovasc Electrophysiol. 2008;19:641–4

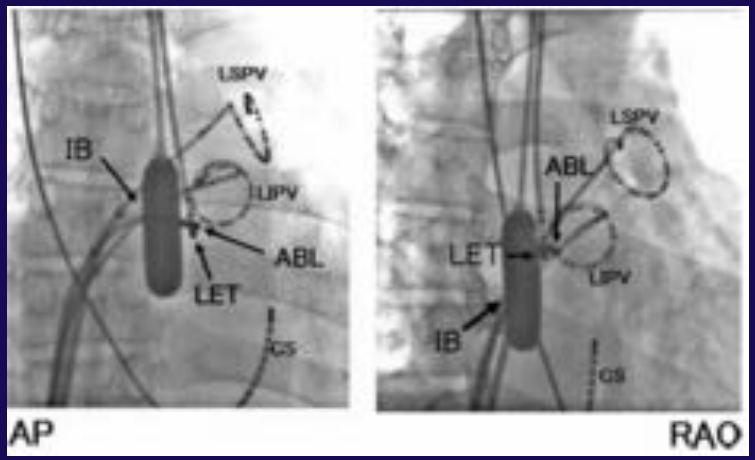
Time Course Of Luminal And Tissue Temperatures

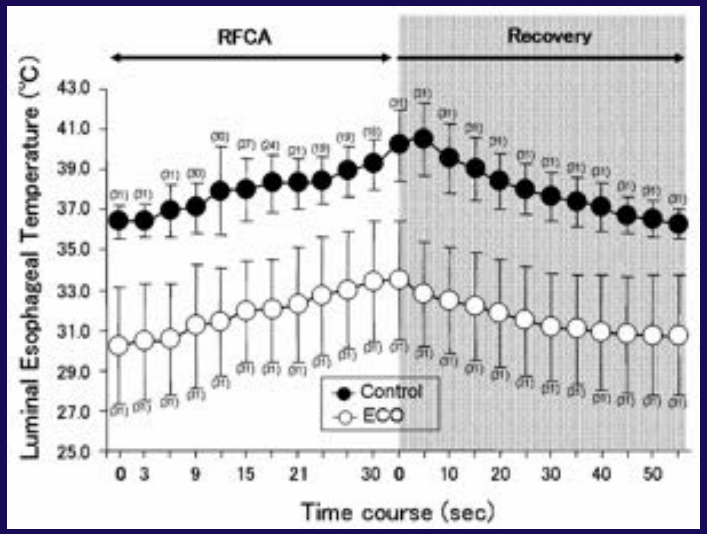


Cummings J, Natale A, JCE 2009

Atrial Fibrillation Ablation with Esophageal Cooling with a Cooled Water-Irrigated Intraesophageal Balloon: A Pilot Study

TAKESHI TSUCHIYA, M.D.,* KEIICHI ASHIKAGA, M.D.,† SUSUMU NAKAGAWA, M.D.,‡
KIYOSHI HAYASHIDA, M.D.,§ and HIROSHI KUGIMIYA, M.D.¶





J Cardiovasc Electrophysiol. 2007;18:145–50

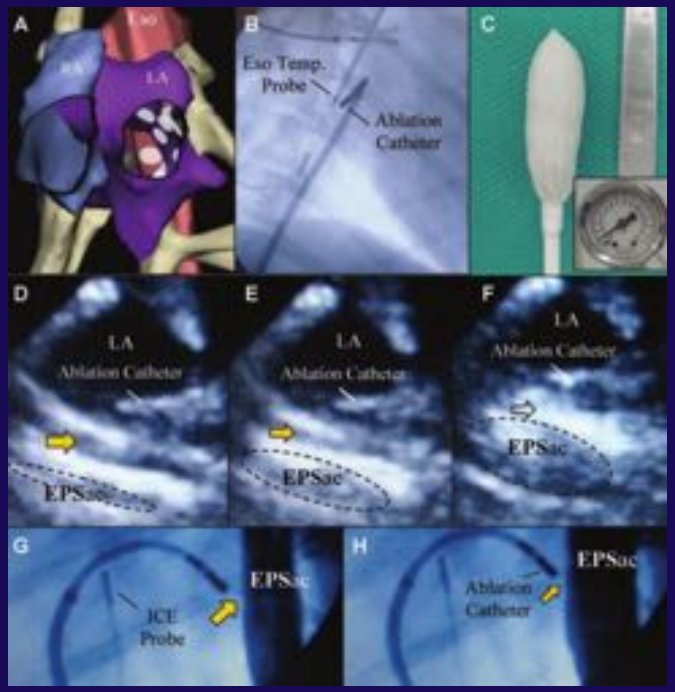
Feasibility and Safety of Using an Esophageal Protective System to Eliminate Esophageal Thermal Injury: Implications on Atrial-Esophageal Fistula Following AF Ablation

MAURICIO S. ARRUDA, M.D.,* LUCIANA ARMAGANIJAN, M.D.,† LUIGI DI BIASE, M.D.,‡,¶ RASSOLL RASHIDI, B.M.E.,§ and ANDREA NATALE, M.D.‡

From the *Case Western Reserve University School of Medicine, Cleveland, Ohio, USA; †Hamilton Health Sciences, Hamilton, Ontario, Canada; ‡Texas Cardiac Arrhythmias Institute, Austin, Texas, USA; ¶Department of Cardiology, University of Foggia, Foggia, Italy; and §RossHart Technologies Inc., Cleveland, Ohio, USA

Effects of Circulating EPSac Fluid Temperature on Esophageal Thermal Injury

		Circulating EPSac Fluid Temperature							
		25°C		15°C		10°C		5°C	
RF Power	Duration 30 Seconds RF (N)	Mean IT (°C)	ESO Injury	Mean IT (°C)	ESO Injury	Mean IT (°C)	ESO Injury	Mean IT (°C)	ESO Injury
25 W	12	65	Yes	60	Yes	49	No	45	No
35 W	12	64	Yes	62	Yes	52	No	52	No
45 W	12	67	Yes	62	Yes	55	No	55	No



No injury with circulating fluid tempearture of 10 or 5 °C

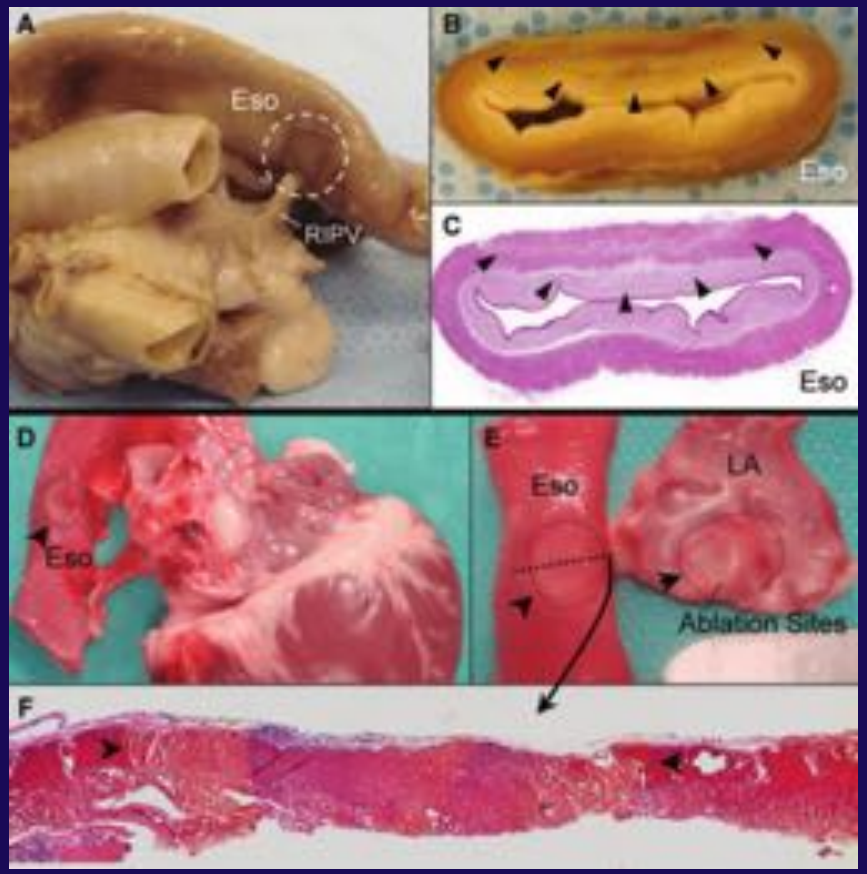
↓

2 dogs

- 1 control
- 1 ESO 25 °C (room temp)
- 2 ESO 10 °C
- 2 ESO 5 °C

1 with esophagus displaced toward LA

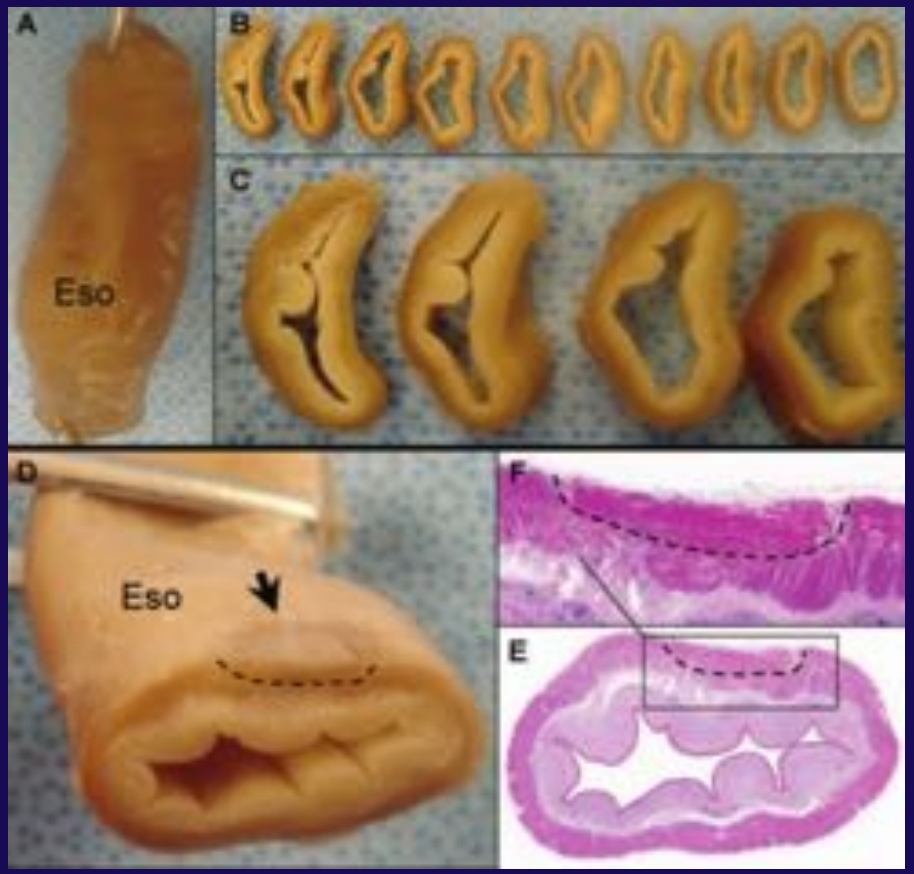
J Cardiovasc Electrophysiol. 2009;20:1272–8



Transmural lesions
- Control
- ESO 25 °C

No lesion
- ESO 5° and 10 °C

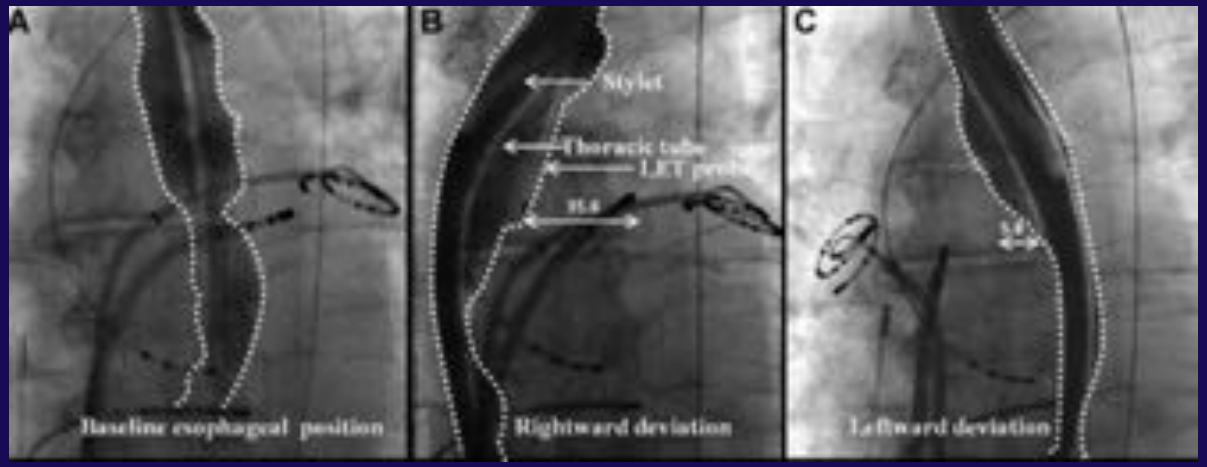
Muscolaris lesion
- ESO 5 °C and 10 °C when esophagus dislaced toward LA



J Cardiovasc Electrophysiol. 2009;20:1272–8

Mechanical Esophageal Displacement During Catheter Ablation for Atrial Fibrillation

JACOB S. KORUTH, M.D., VIVEK Y. REDDY, M.D., MARC A. MILLER, M.D., KALPESH K. PATEL, M.D., JAMES O. COFFEY, M.D., AVI FISCHER, M.D., J. ANTHONY GOMES, M.D., SRINIVAS DUKKIPATI, M.D., ANDRE D'AVILA, M.D., and ALEXANDER MITTNACHT, M.D.



Number of pts with temp rises > 38.5° (n = 20)	3/20 (15%)
Number of pts with temp rises > 40°	0/20 (0%)
Mean number of lesions/pt with temp rise > 38.5°	2

Number of pts with temp rises > 38.5°	18/20 (90%)
Mean number of lesions/pt with temp rise > 38.5°	6.15 ± 4.3

Control group

J Cardiovasc Electrophysiol. 2012;23:147–54

Outcomes of Atrioesophageal Fistula Following Catheter Ablation of Atrial Fibrillation Treated with Surgical Repair versus Esophageal Stenting

SANGHAMITRA MOHANTY, M.D., M.S.,*,† PASQUALE SANTANGELI, M.D.,*,‡ PRASANT MOHANTY, M.B.B.S., M.P.H.,* LUIGI DI BIASE, M.D., PH.D.,*,‡,§,¶ CHINTAN TRIVEDI, M.D., M.P.H.,* RONG BAI, M.D.,*,# RODNEY HORTON, M.D.,* J. DAVID BURKHARDT, M.D.,* JAVIER E. SANCHEZ, M.D.,* JASON ZAGRODZKY, M.D.,* SHANE BAILEY, M.D.,* JOSEPH G. GALLINGHOUSE, M.D.,* PATRICK M. HRANITZKY, M.D.,* ALBERT Y. SUN, M.D.,‖ RICHARD HONGO, M.D.,** SALWA BEHEIRY, R.N.,** and ANDREA NATALE, M.D.*,§,**,††,‡‡,§§

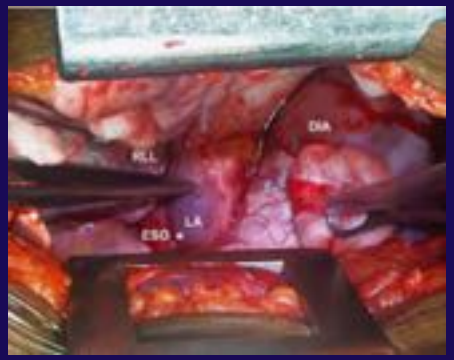
5	62	F	PAF	39 °C	25 W	No	6 weeks	Stroke/TIA, systemic embolism, chest pain, GI hemorrhage, leukocytosis	Diminished reflexes on extremities, paresis of left leg, convulsions	Stent	Deceased
6	51	M	LSPAF	38 °C	35 W	Yes	4 weeks	Fever, chest pain, sepsis, stroke/TIA, leukocytosis	Unable to move right side, altered mental status	Surgical repair	Alive
7	59	M	LSPAF	39 °C	30 W	Yes	2 weeks	Fever, rigor, chest pain, sepsis, gastrointestinal bleeding, systemic embolism, stroke/TIA	Sudden blindness, weakness of leg	Surgical repair	Alive
8	42	M	PerAF	40 °C	36 W	Yes	3 weeks	Fever, rigor, chest pain, sepsis, systemic embolism, stroke/TIA	Sudden blindness, weakness of leg	Surgical repair	Alive
9	56	M	PAF	39 °C	25 W	Yes	4 weeks	Fever, chest pain, dysphagia, confusion, leukocytosis, postprandial TIA, multiple petechiae	Weakness of right arm	Surgical repair	Alive

Esoph.: esophageal; LAPW = left atrial posterior wall; LSPAF = longstanding persistent AF; PAF = paroxysmal atrial fibrillation; PerAF = persistent atrial fibrillation; PPI = proton pump inhibitors; NA = available; Temp.: temperature; TIA = transient ischemic attack; W = Watts.
*Only epicardial surgical ablation performed.

J Cardiovasc Electrophysiol. 2014; 25:579–84

Clinical outcomes after repair of left atrial esophageal fistulas occurring after atrial fibrillation ablation procedures

Sheldon M. Singh, MD,* Andre d'Avila, MD, PhD,† Steve K. Singh, MD, MSc,‡ Paul Stelzer, MD,§ Eduardo B. Saad, MD, FHRS,‖ Allan Skanes, MD, FHRS,¶ Arash Aryana, MD, FHRS,# Jason S. Chinitz, MD,† Robert Kulina, MD,† Marc A. Miller, MD,† Vivek Y. Reddy, MD†



The mean age of all cases reported was 55 ± 13 years, and 75% were men. Cases presented 30 ± 12 days postablation. Overall, 55% (16 of 29) of the patients receiving an intervention for LAEF died: the case fatality rate was 41% (9 of 22) for surgical repair and 100% for esophageal stent.

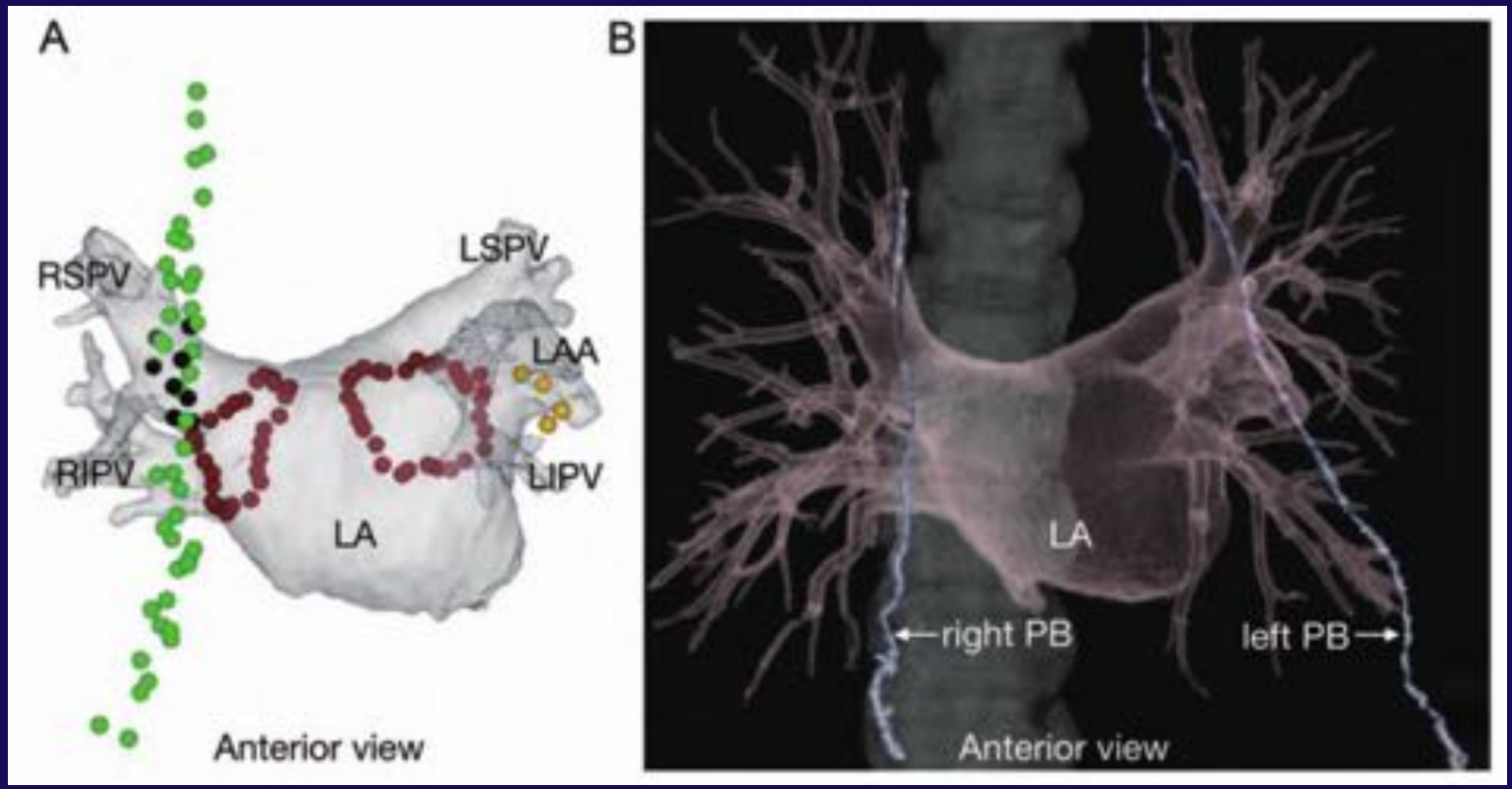
Heart Rhythm. 2013;10:1591–7

Phrenic Nerve Injury

- Incidence: 0.48%
- Right Phenic Nerve most commonly involved (80%)
- Associated with symptoms in 69% of affected patients
- Recovery in 81% (Partial 17%)
- Mean time to recovery 7±7 months

Three-dimensional imaging and mapping of the right and left phrenic nerves: relevance to interventional cardiovascular therapy

Kotaro Fukumoto[1*], Seiji Takatsuki[1], Masahiro Jinzaki[2], Minoru Yamada[3], Kojiro Tanimoto[1], Nobuhiro Nishiyama[1], Yoshiyasu Aizawa[1], Yoko Hagiwara[1], Yukiko Fukuda[1], Takehiro Kimura[1], Shunichiro Miyoshi[1], Sachio Kuribayashi[2], and Keiichi Fukuda[1]

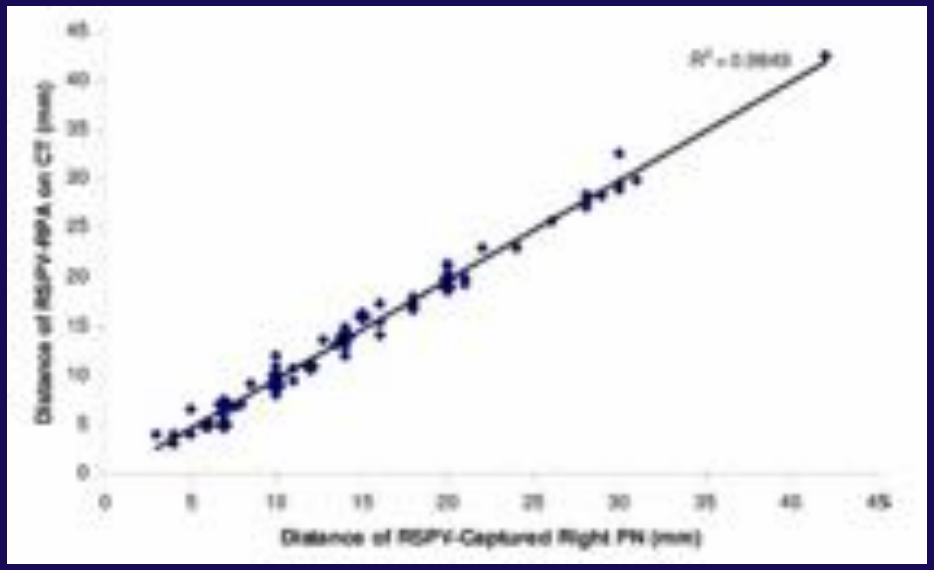


Pace-mapping predicts PN location

Europace. 2013;15:937–43

Locating the right phrenic nerve by imaging the right pericardiophrenic artery with computerized tomographic angiography: Implications for balloon-based procedures

Rodney Horton, MD, FACC,*† Luigi Di Biase, MD,*†‡ Vivek Reddy, MD,§ Petr Neuzil, MD,‖
Prasant Mohanty, MBBS, MPH,* Javier Sanchez, MD,* Tuan Nguyen, MD,* Sanghamitra Mohanty, MD,*
G. Joseph Gallinghouse, MD,* Shane M. Bailey, MD,* Jason D. Zagrodzky, MD,*
J. David Burkhardt, MD,* Andrea Natale, MD, FACC, FHRS*†‡¶#



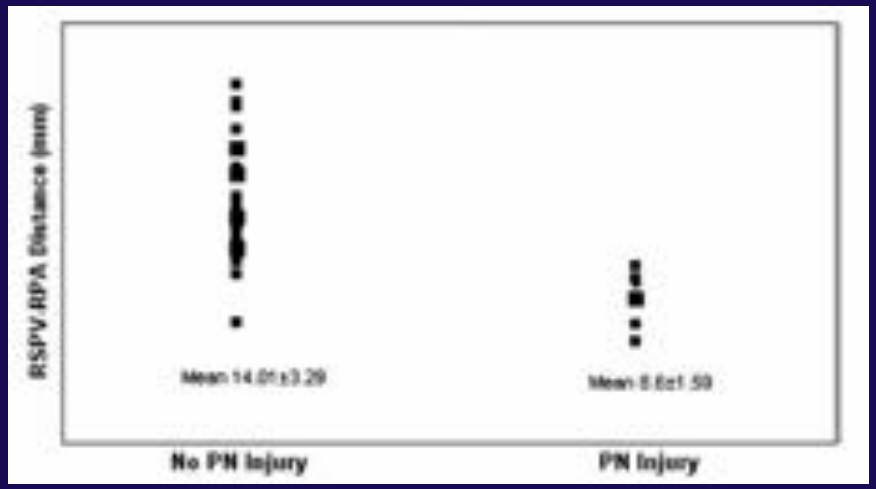
When measured in AP, distance RSPV-RPA on CT* is identical to the distance of RSPV-PN capture on fluoroscopy

*64-slices MDCT coronary artery protocol

Heart Rhythm. 2010;7:937–41

3 groups, based on RSPV-RPA distance

- short ≤ 10 mm
- medium 10.1 to 20 mm
- long > 20 mm



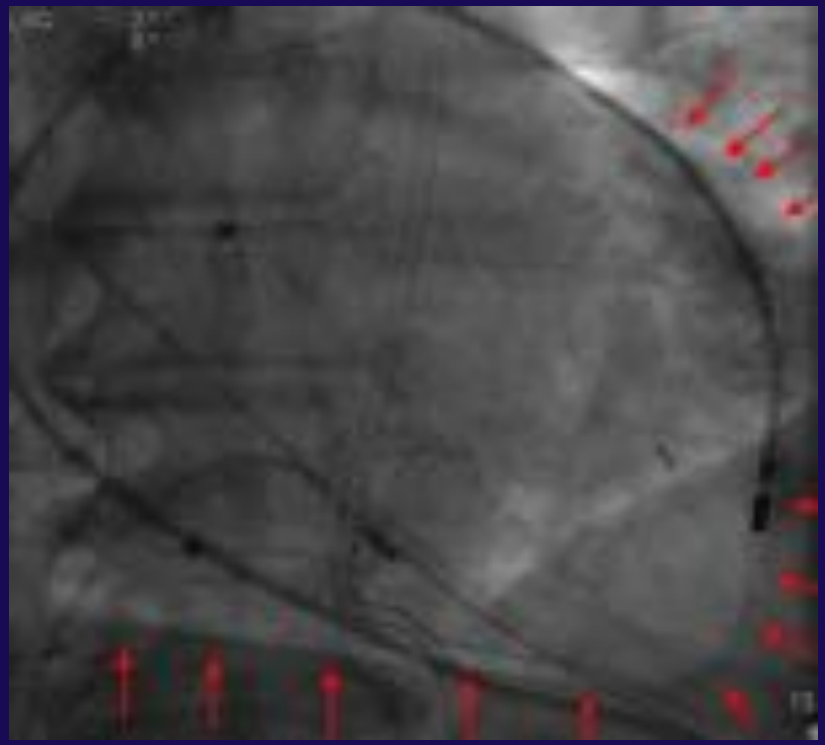
37 balloon-ablation procedures

- 7 patients with short RSPV-RPA
- 6/7 had PN injury

Heart Rhythm. 2010;7:937–41

Prevention of phrenic nerve injury during epicardial ablation: Comparison of methods for separating the phrenic nerve from the epicardial surface

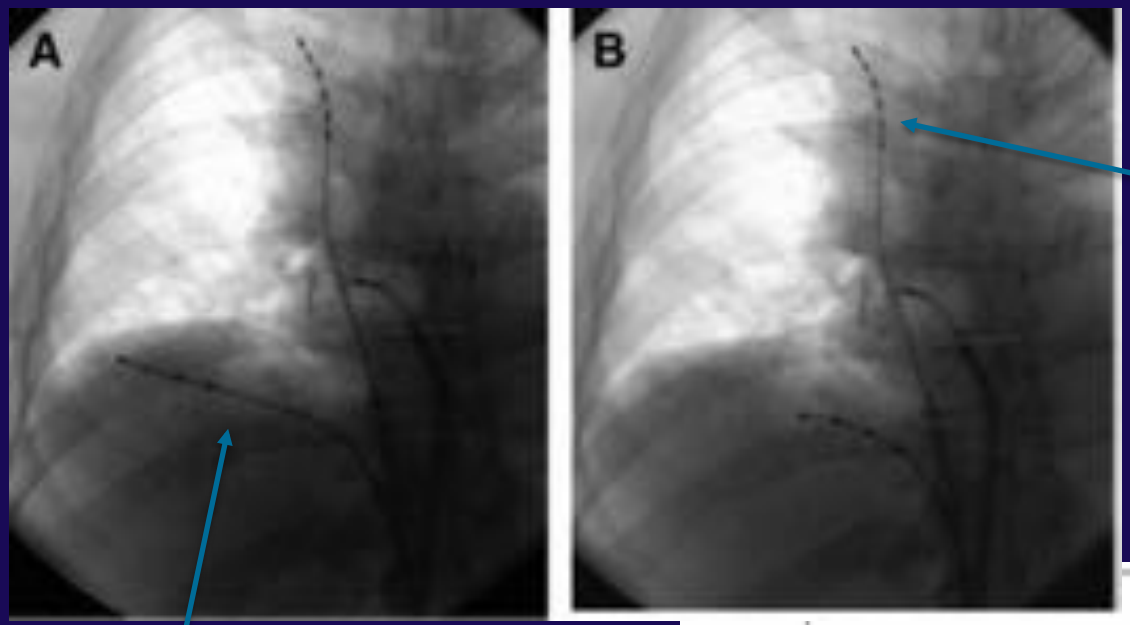
Luigi Di Biase, MD,*† J. David Burkhardt, MD,* Gemma Pelargonio, MD,¶ Antonio Dello Russo, MD,¶ Michela Casella, MD,¶ Pietro Santarelli, MD,¶ Rodney Horton, MD,* Javier Sanchez, MD,* Joseph G. Gallinghouse, MD,* Amin Al-Ahmad, MD,‡ Paul Wang, MD,‡ Jennifer E. Cummings, MD,§ Robert A. Schweikert, MD,§ Andrea Natale, MD, FHRS*‡§



Heart Rhythm. 2009;6:957–61

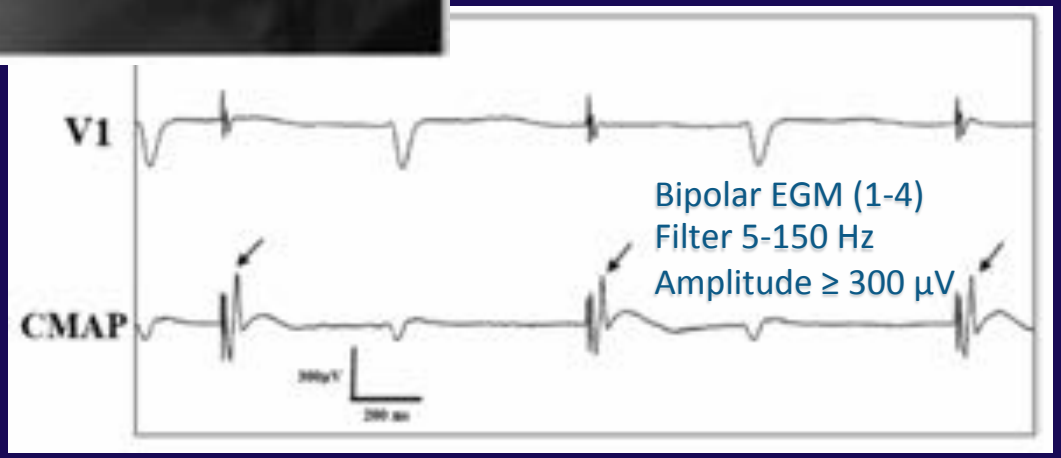
Novel Electromyographic Monitoring Technique for Prevention of Right Phrenic Nerve Palsy During Cryoballoon Ablation

Frédéric Franceschi, MD, PhD; Linda Koutbi, MD; Julien Mancini, MD, PhD; Shahram Attarian, MD, PhD; Sébastien Prevôt, MD; Jean-Claude Deharo, MD



Hexapolar in the SVC
> PN pacing at high output

Quadripolar (4-10-4 mm) in the hepatic vein
> record diaphragmatic compound motor action potential (CMAP)



Circulation: Arrhythmia and Electrophysiology. 2013;6:1109-14

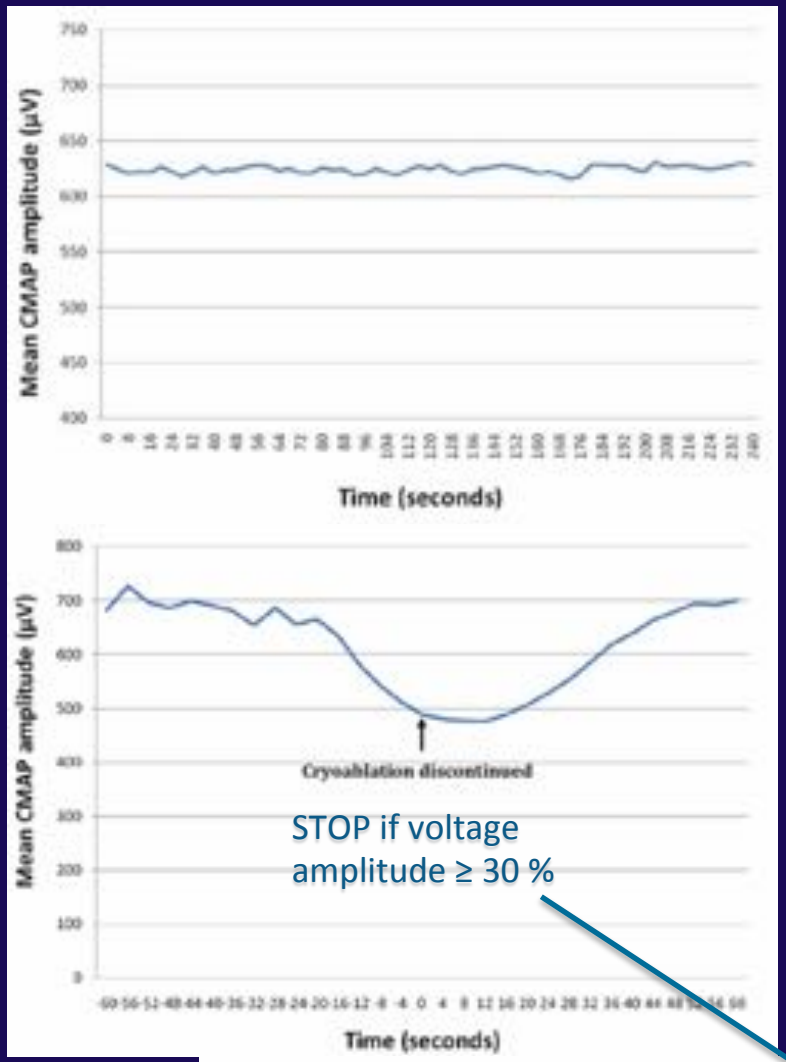
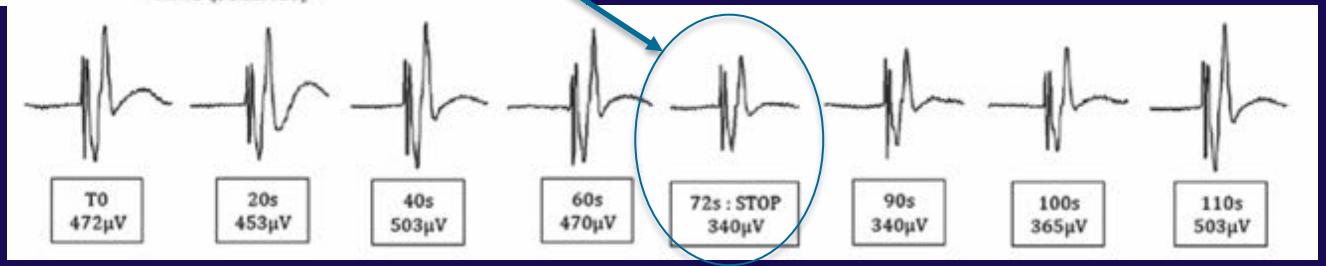


Table. Baseline Patient and Procedure Characteristics	
Patients included	57
Age, y	59±9
Male sex, n	47
Hypertension/ICM/DCM, %	19.3/3.5/7
LA diameter, mm	39.9±2.3
Paroxysmal/persistent, %	86/14
Procedural time, min	144±29
Fluoroscopy time, min	30±12
Cryoballoon applications, n	9±2
Cryoballoon 23/28/23–28 mm	63/32/5

57 balloon-ablation procedures

- 50 stable PN capture
- 6 patients with CMAP amplitude reduction ≥ 30 %
- No PN injury

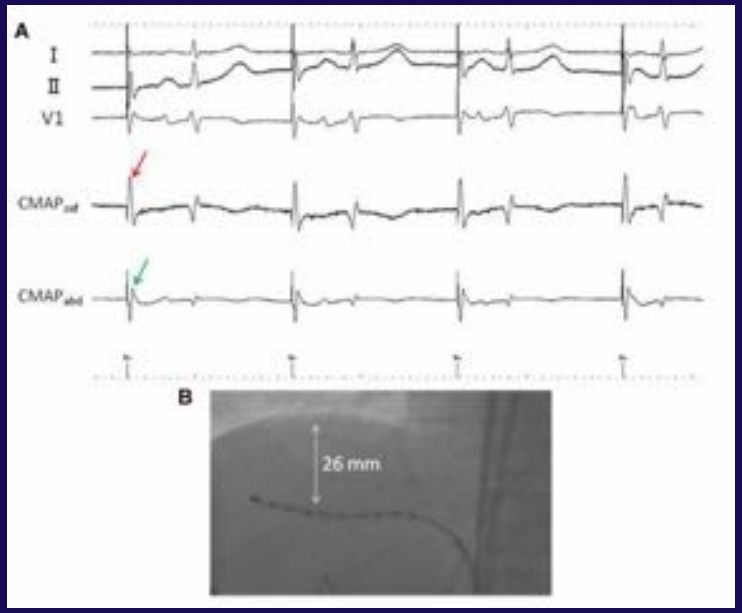
STOP if voltage amplitude ≥ 30 %

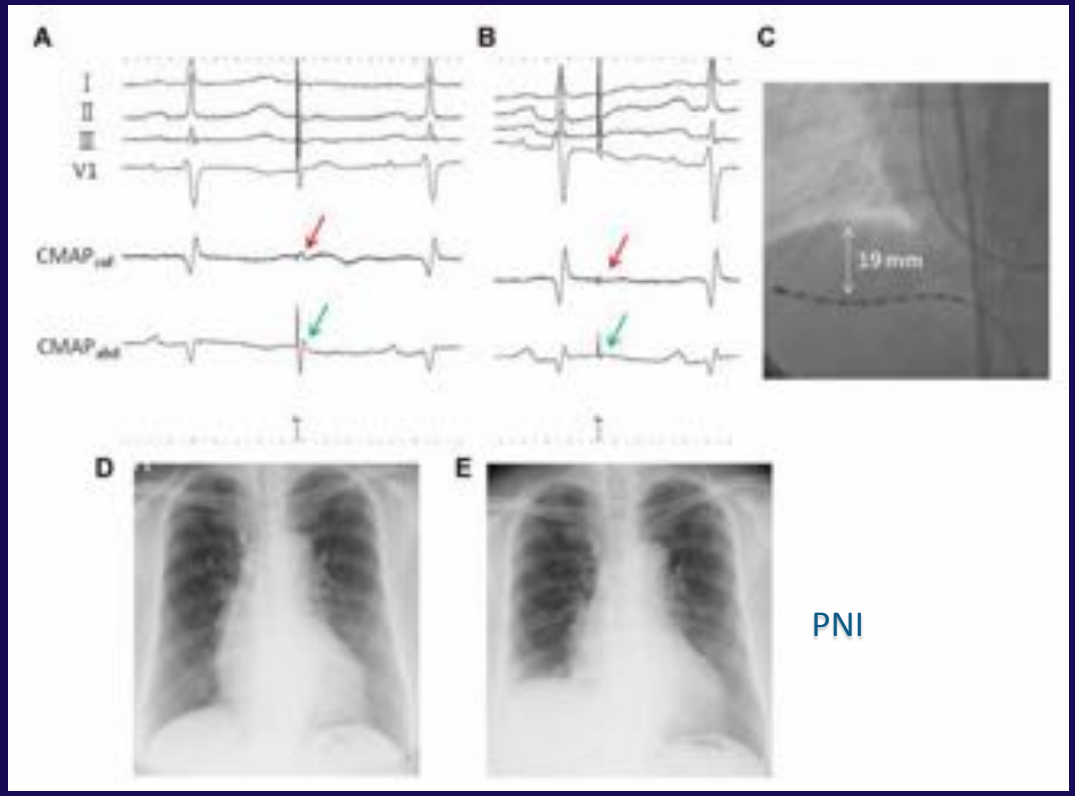


Circulation: Arrhythmia and Electrophysiology. 2013;6:1109-14

Evaluation of Diaphragmatic Electromyograms in Radiofrequency Ablation of Atrial Fibrillation: Prospective Study Comparing Different Monitoring Techniques

SHINSUKE MIYAZAKI, M.D.,* NOBORU ICHIHARA, M.D.,* HIROSHI TANIGUCHI, M.D.,* HITOSHI HACHIYA, M.D.,* HIROAKI NAKAMURA, M.D.,* EISUKE USUI, M.D.,* YOSHIHISA KANAJI, M.D.,* TAKAMITSU TAKAGI, M.D.,* JIN IWASAWA, M.D.,* AKIO KUROI, M.D.,* KENZO HIRAO, M.D.,† and YOSHITO IESAKA, M.D.*





PNI

J Cardiovasc Electrophysiol. 2015;26:260-6

Conclusions

- Uninterrupted coumadin and factor X during ablation of atrial fibrillation and left atrial flutter appear to reduce the risk of thromboembolic complications without increasing the risk of bleeding
- This approach benefits more non paroxysmal AF patients which carry a higher risk of such complication

Conclusions

- Therefore, the protective effects of new drugs should be tested in non paroxysmal patients

Be Careful…

Know what you are doing…

Keep Your Eyes on the Target