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Complications after radiofrequency ablation of AF: Atrial-esophageal and pericardioesophageal fistulas



K. Seidl,

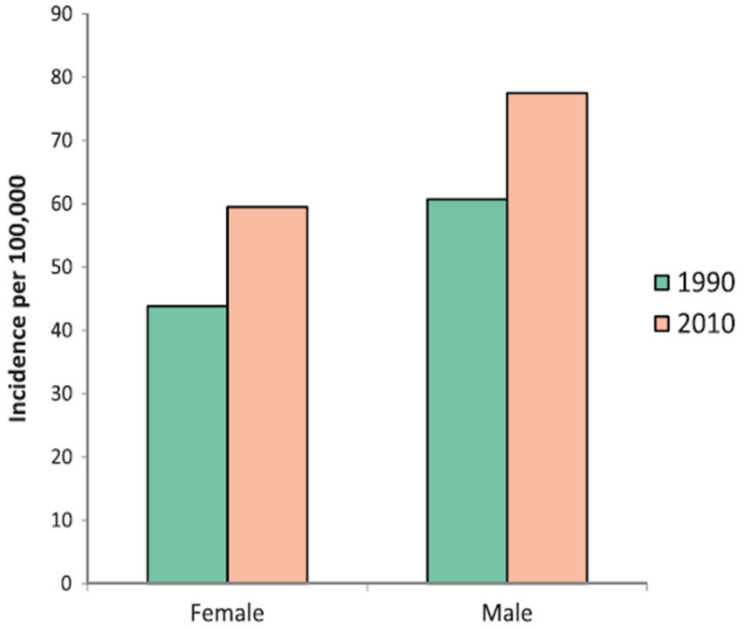
Med. Klinik I und IV

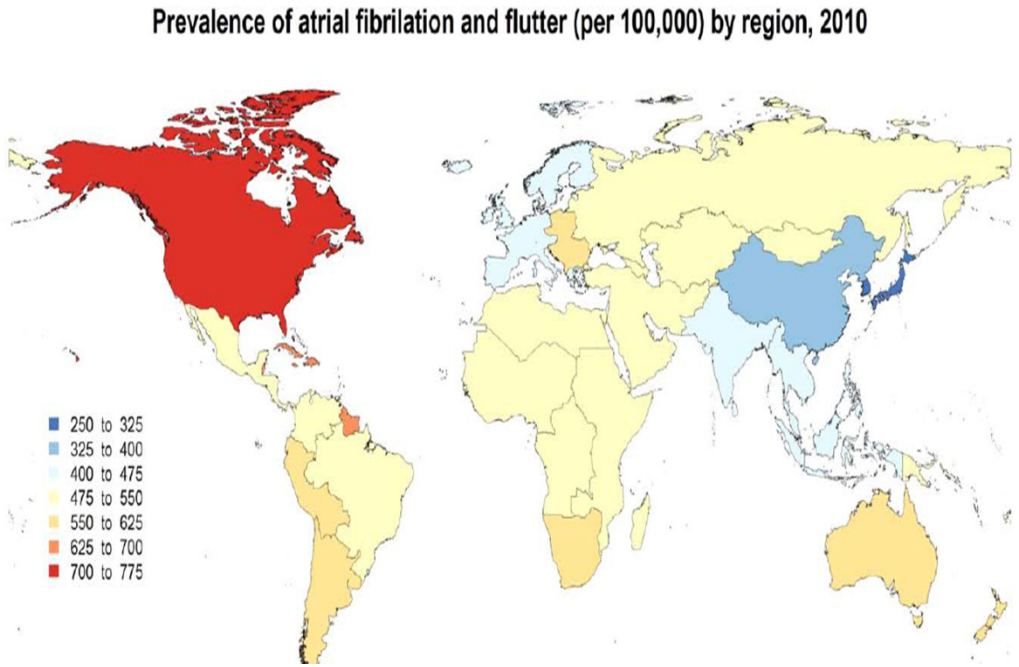
Ingolstadt

KLINIKUM INGOLSTADT

Epidemiology

Incidence and prevalence of AF1990 vs 2010

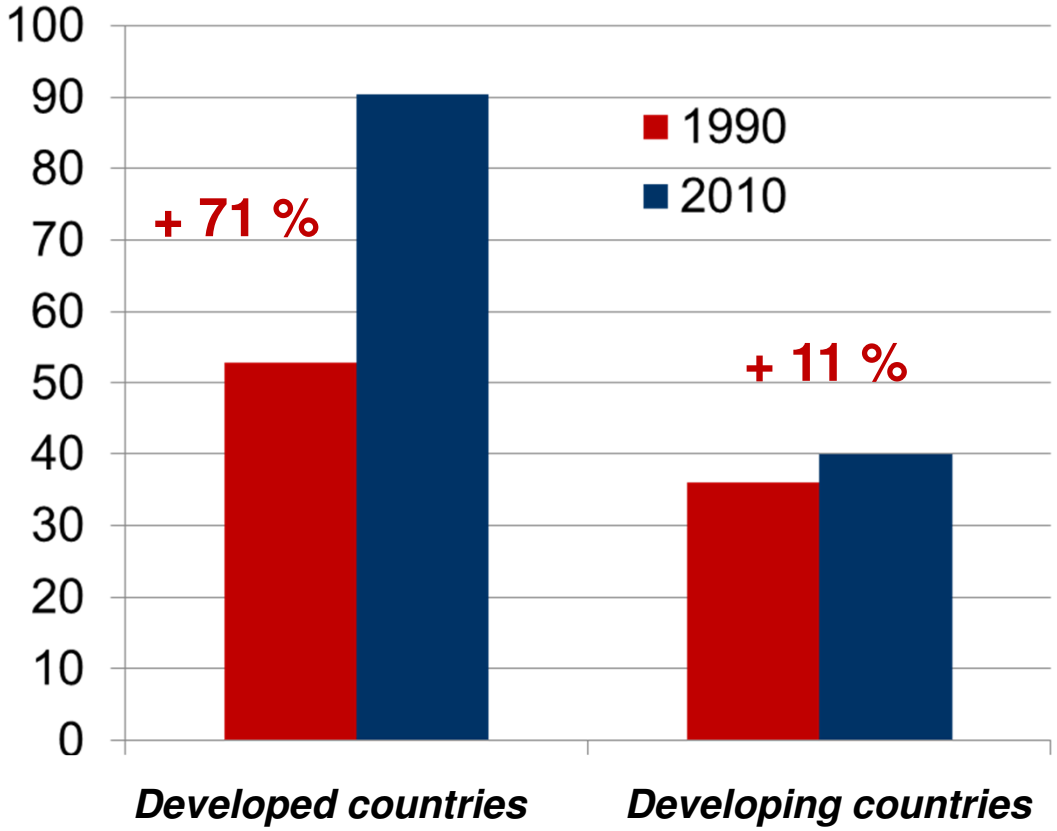




Chugh et et al: Circulation 2014;129:1837-847

Epidemiology

Incidence AF 1990 vs 2010



AF prevalence in octarians

USA	27 %
Spain	26 %
Denmark	12 %
China	3%

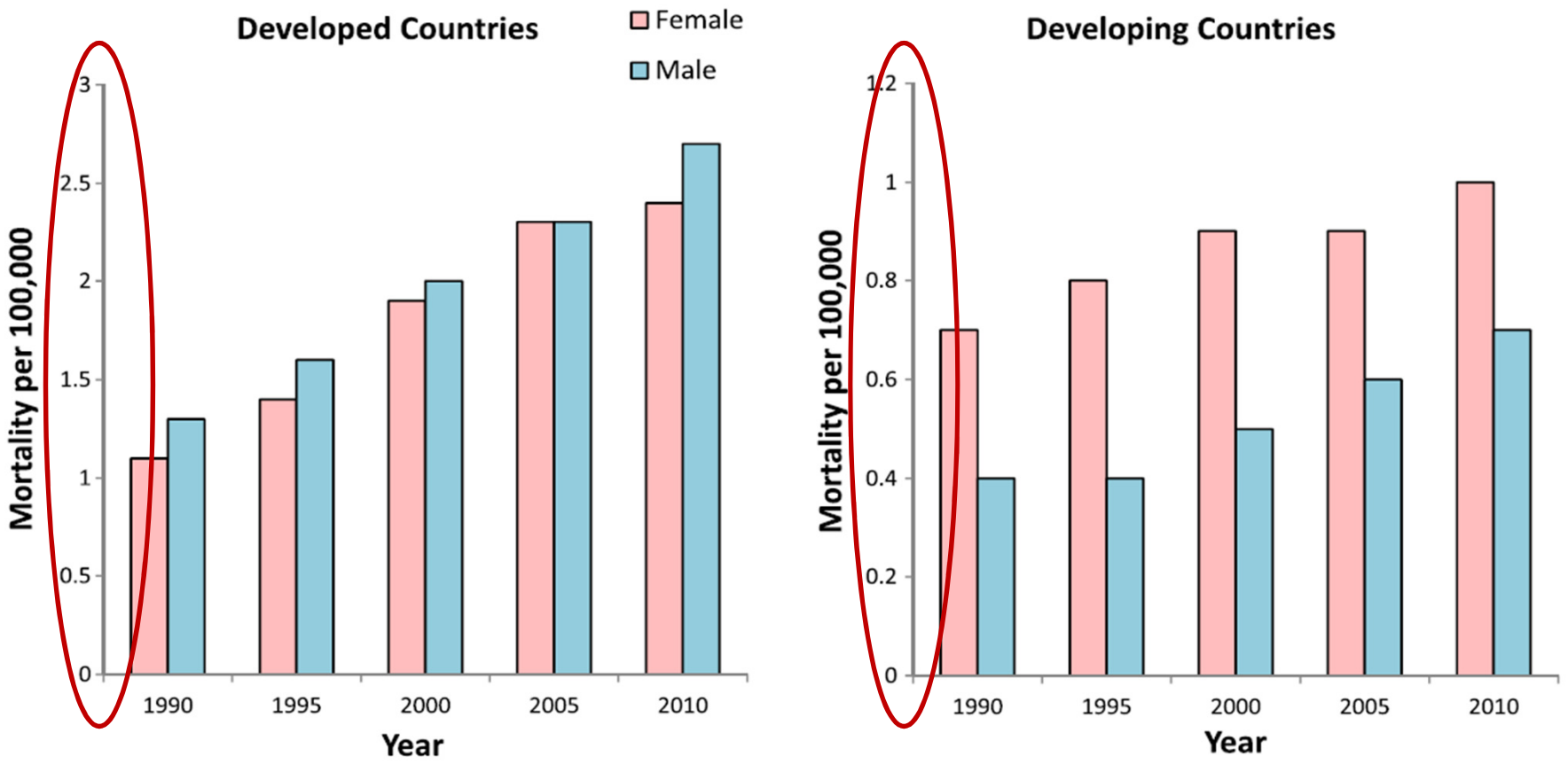
Chugh et al: Circulation 2014;129:1837-847

Hypertension 2012, 60 A 100

Mortality associated with AF

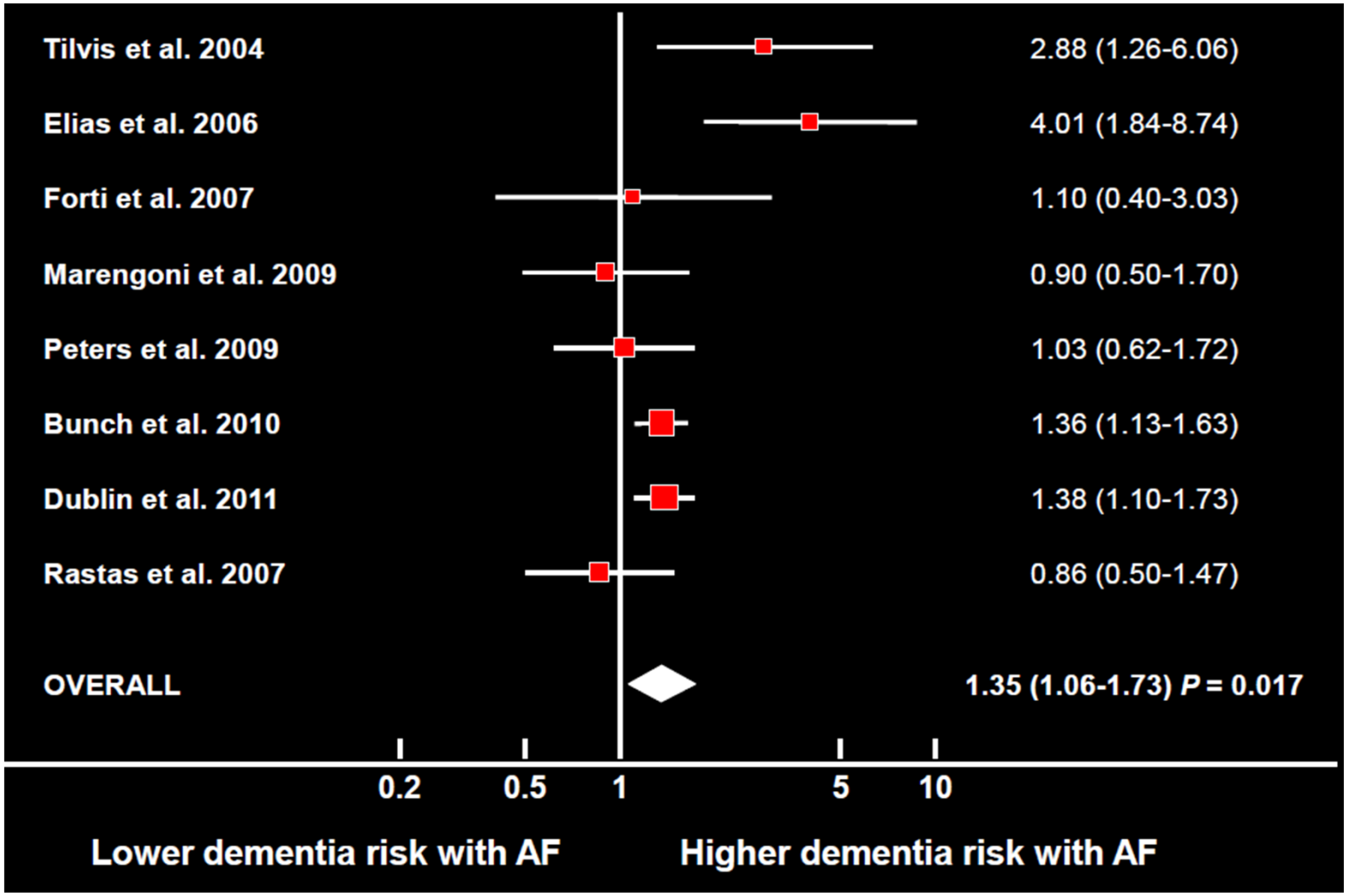
Worldwide

- 50 %



Chugh et et al: Circulation 2014;129:1837-847

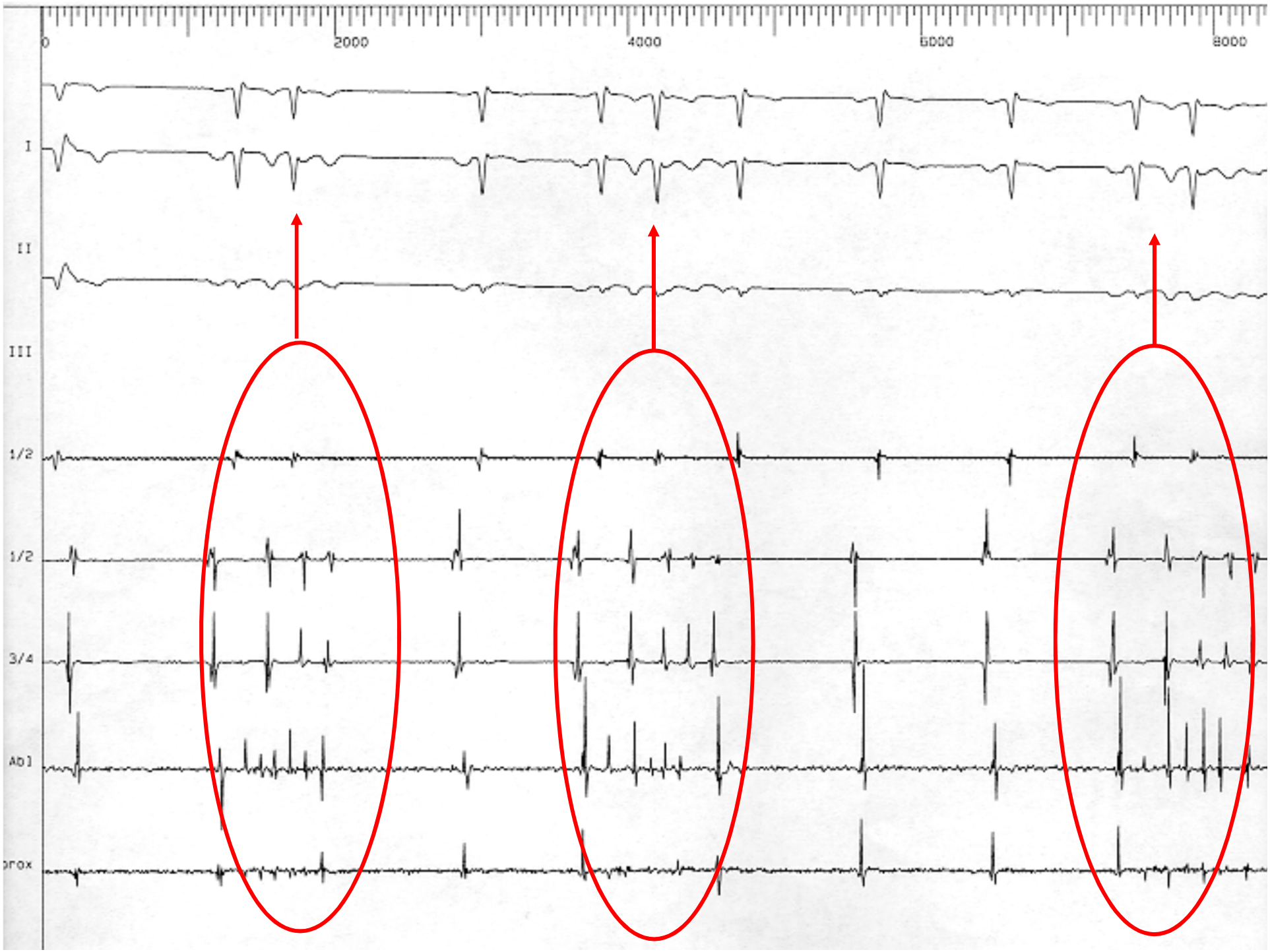
AF and Dementia



Natale et et al: HRS 2014

Treatment options for AF

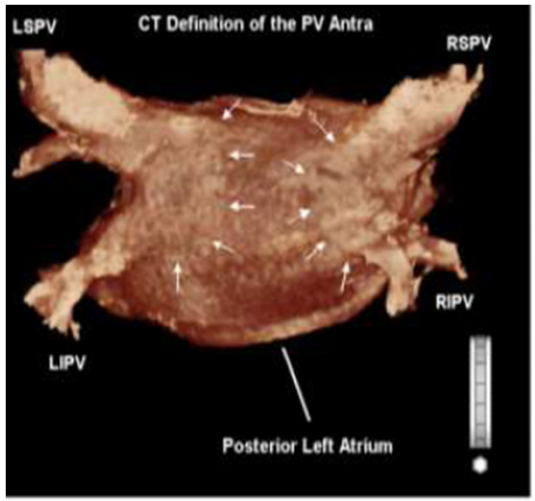
- ***Drug treatment: rhythm vs rate control***
  - ✓ ***Caution: Proarrhythmic effects***
- ***Interventional treatment: Catheter ablation***
  - ✓ ***Caution: Complications, can occur weeks later***
  - ✓ ***Awareness to all physicans involved in treatment***

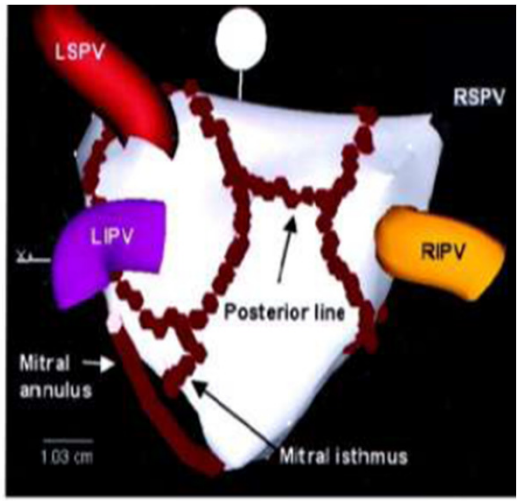

0
2000
4000
6000
8000
I
II
III
1/2
1/2
3/4
Abl
prox

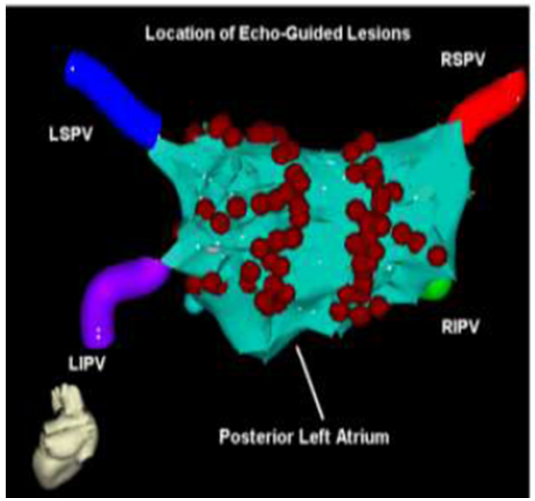
Different methods for different AF

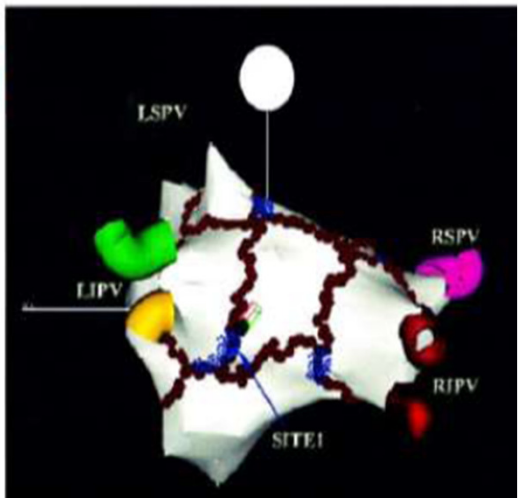
paroxysmal AF vs long lasting AF

Paroxysmal AF

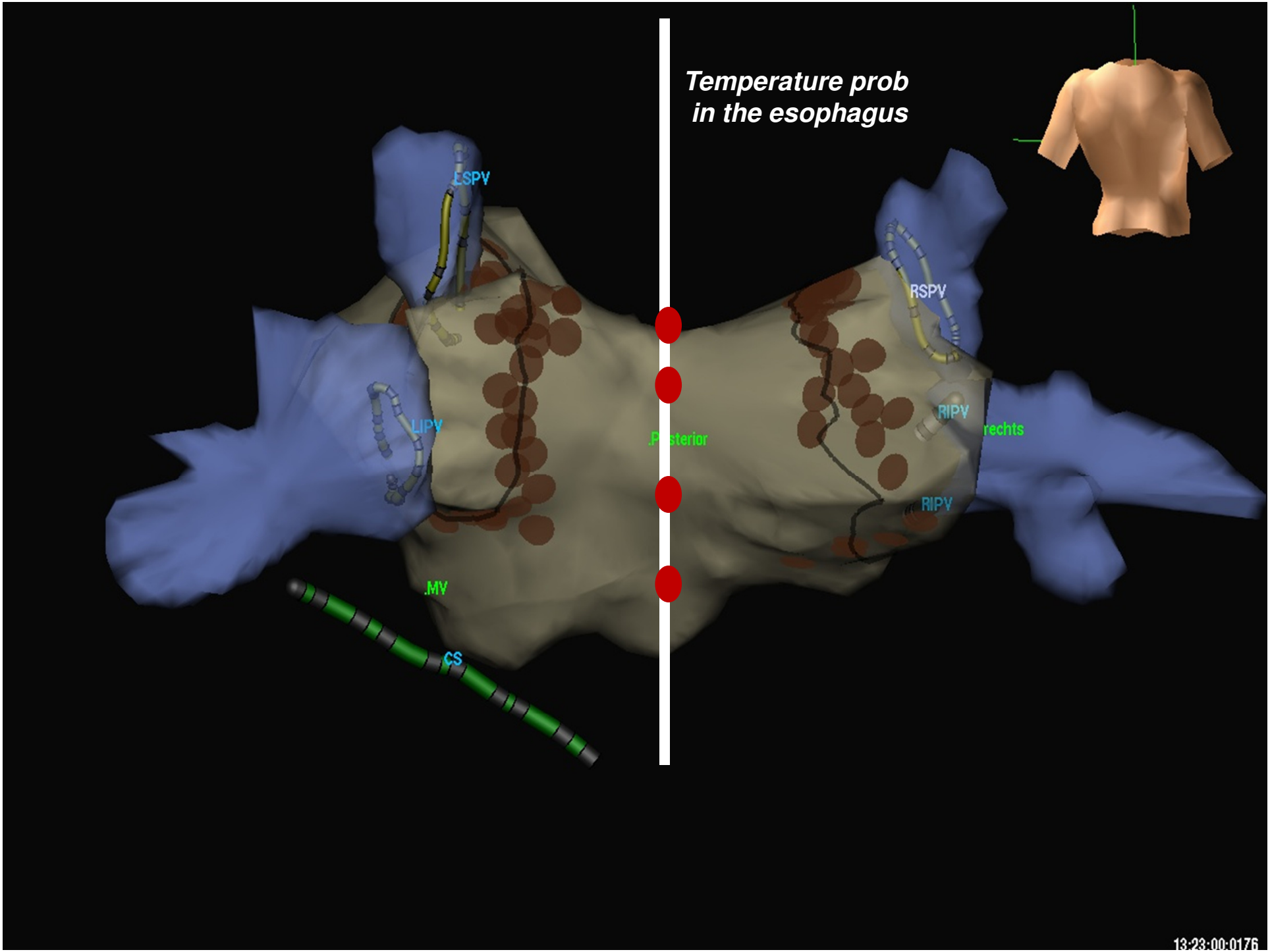


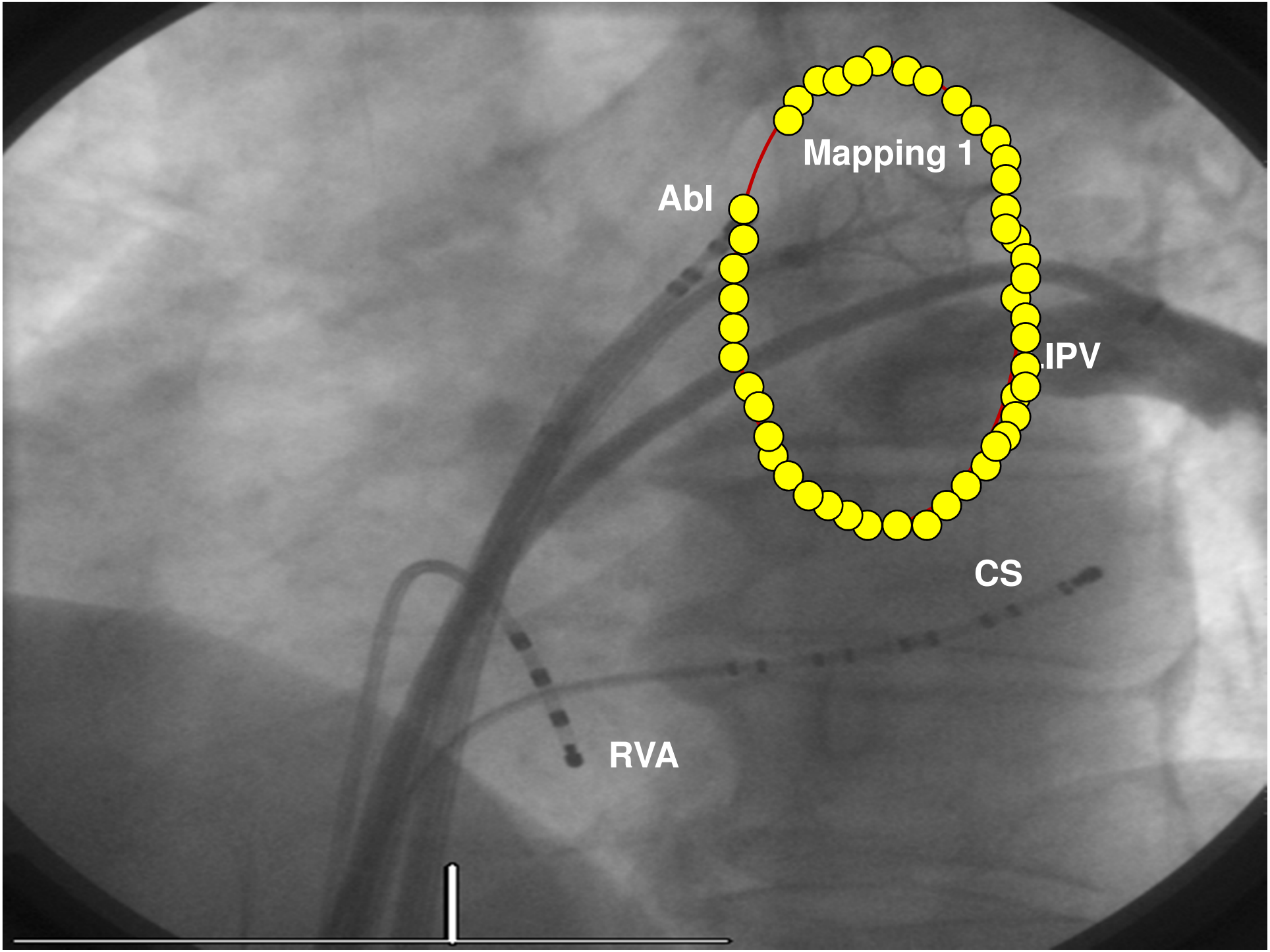


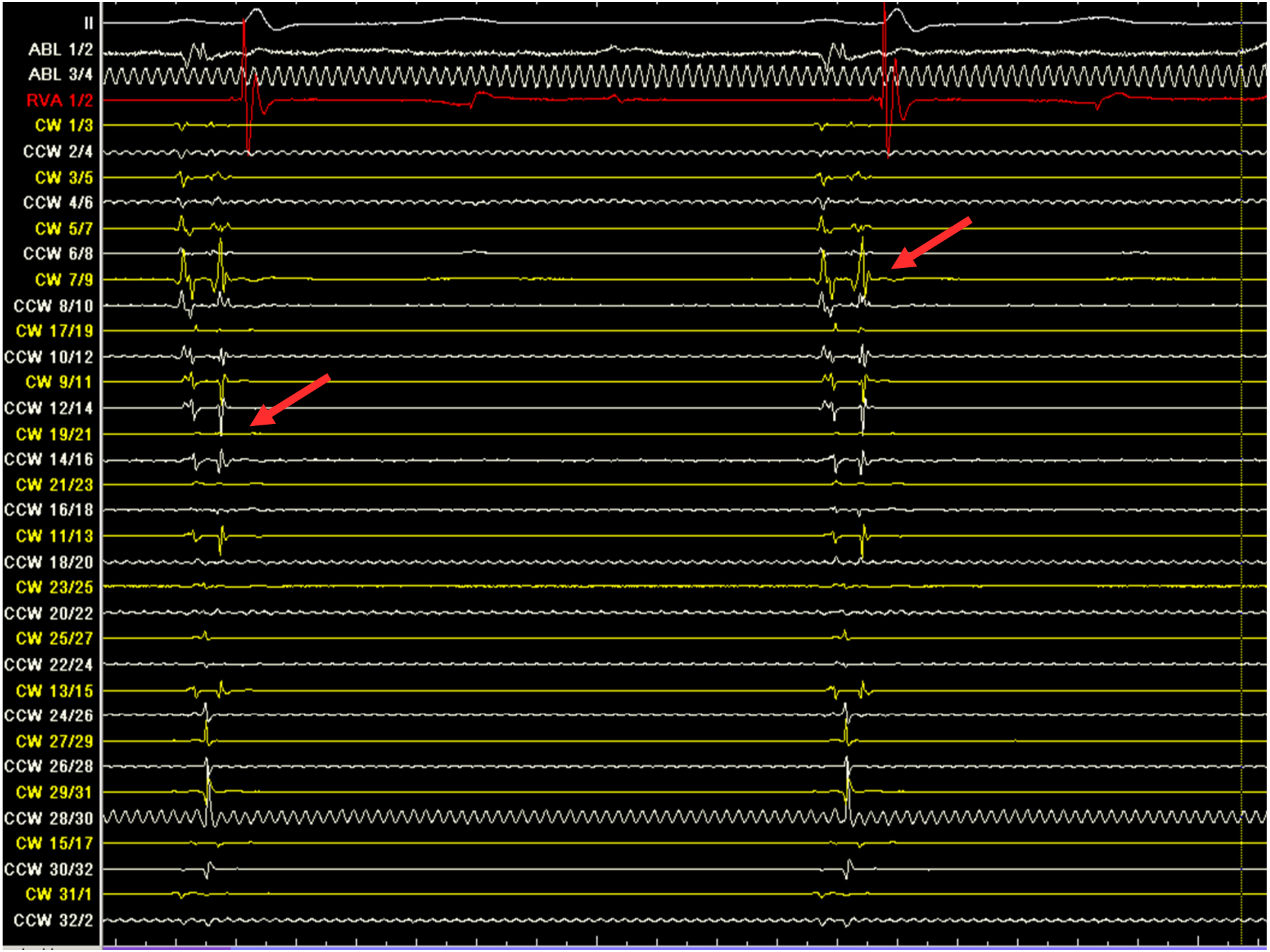


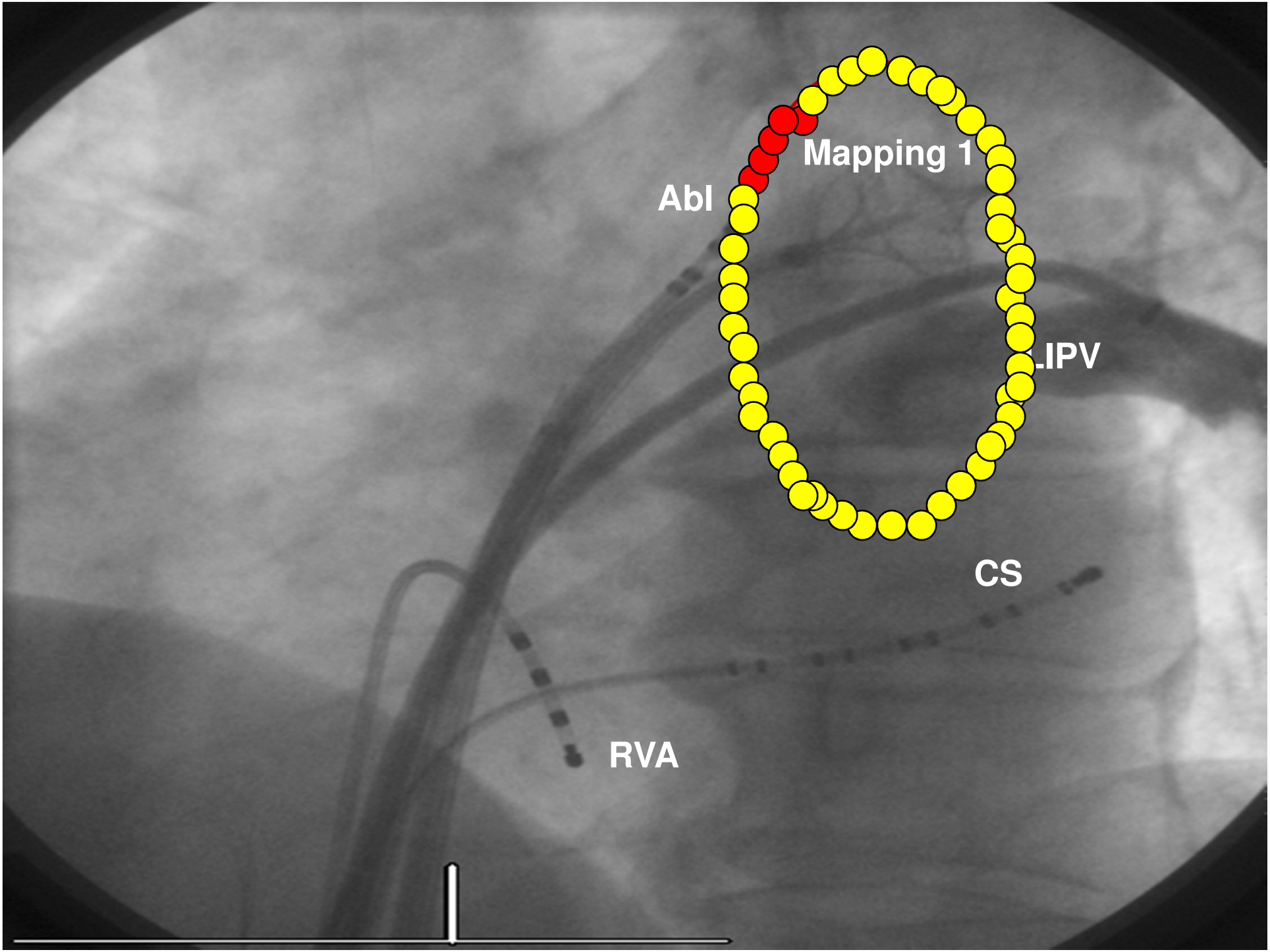


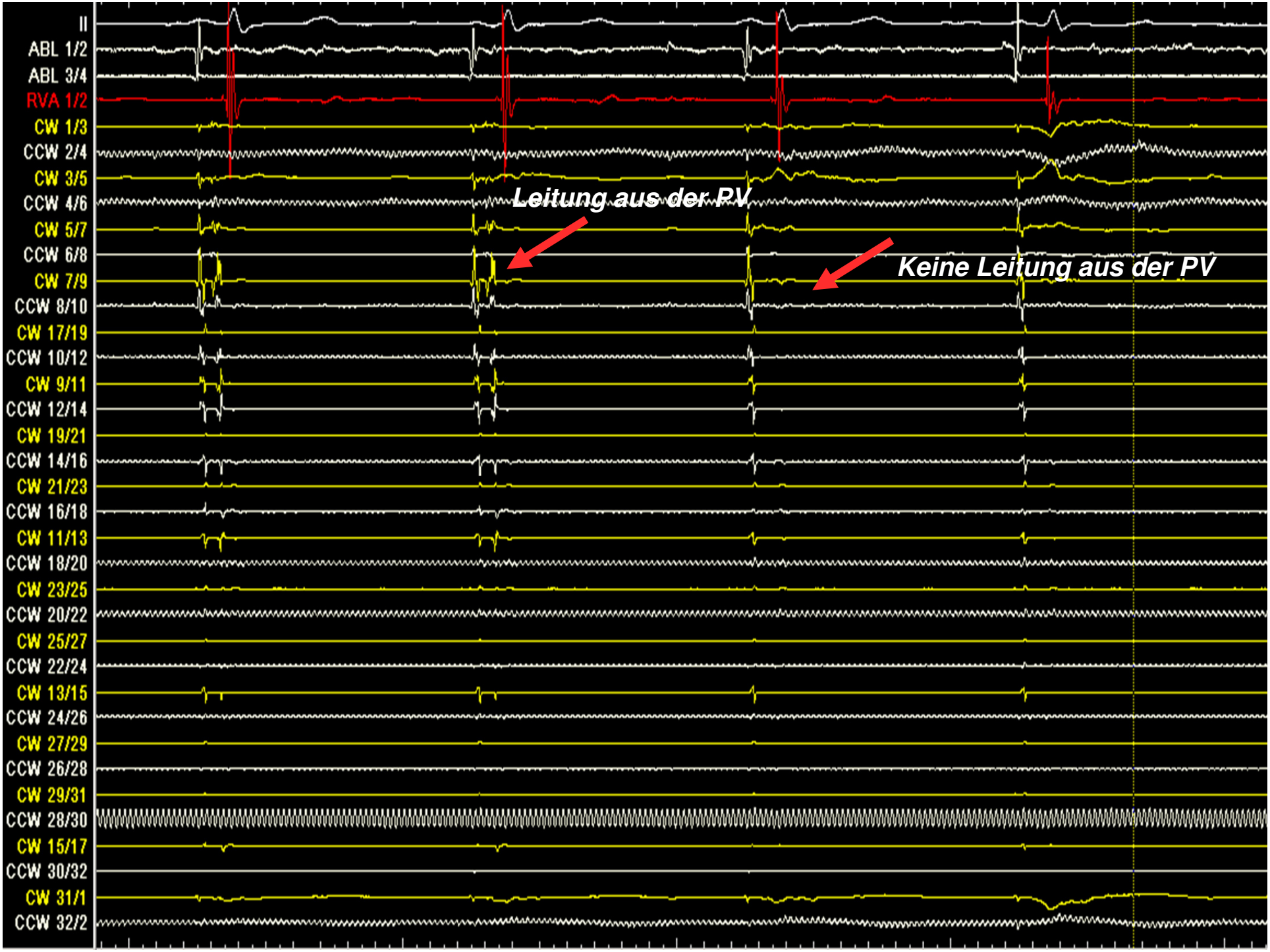
Long lasting AF


Temperature prob
in the esophagus
LSPV
LIPV
RSPV
RIPV
RIPV
rechts
MV
CS
13:23:00:0176


Mapping 1
Abl
IPV
CS
RVA

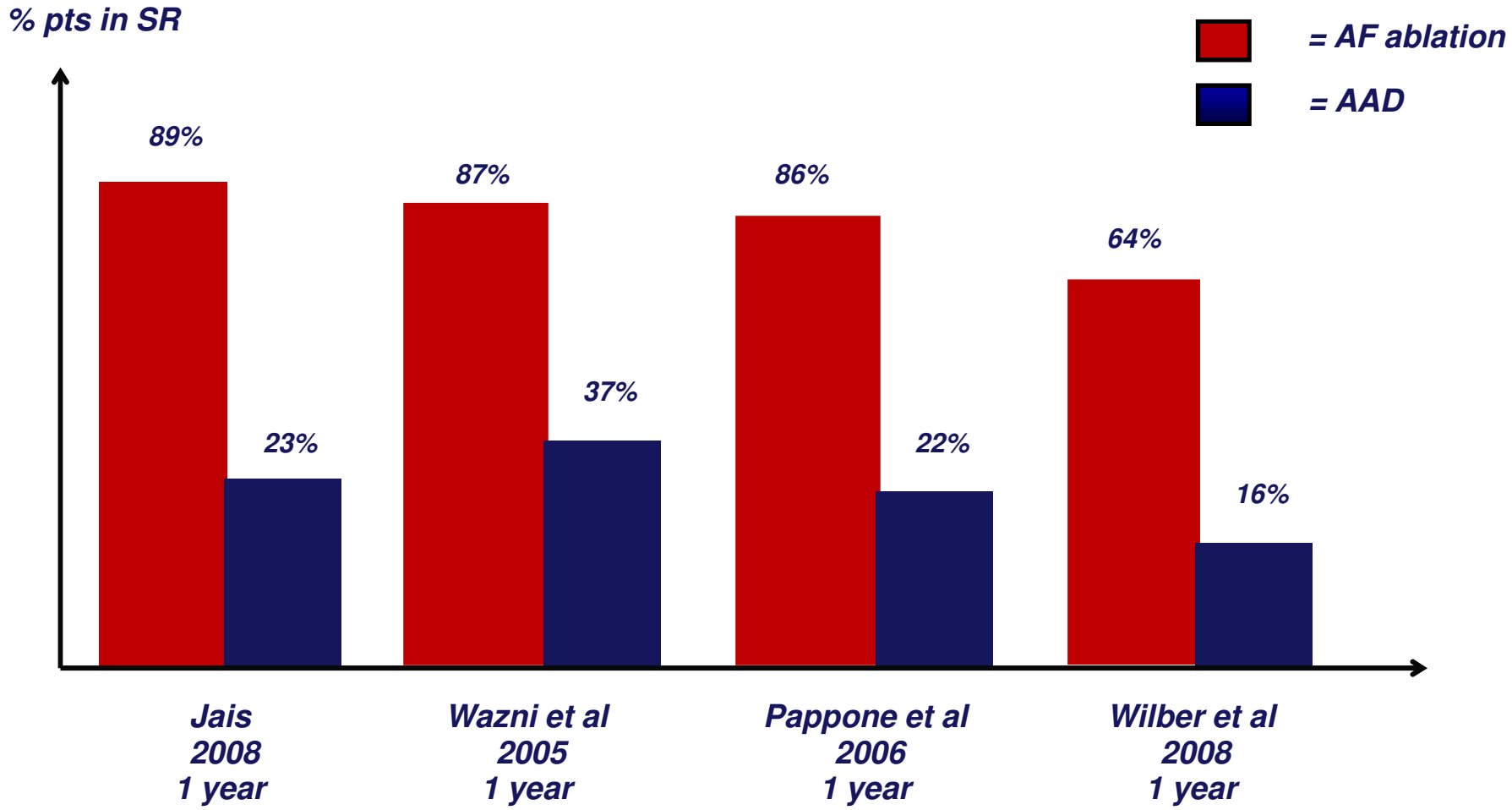

II
ABL 1/2
ABL 3/4
RVA 1/2
CW 1/3
CCW 2/4
CW 3/5
CCW 4/6
CW 5/7
CCW 6/8
CW 7/9
CCW 8/10
CW 17/19
CCW 10/12
CW 9/11
CCW 12/14
CW 19/21
CCW 14/16
CW 21/23
CCW 16/18
CW 11/13
CCW 18/20
CW 23/25
CCW 20/22
CW 25/27
CCW 22/24
CW 13/15
CCW 24/26
CW 27/29
CCW 26/28
CW 29/31
CCW 28/30
CW 15/17
CCW 30/32
CW 31/1
CCW 32/2


Mapping 1
Abl
LIPV
CS
RVA

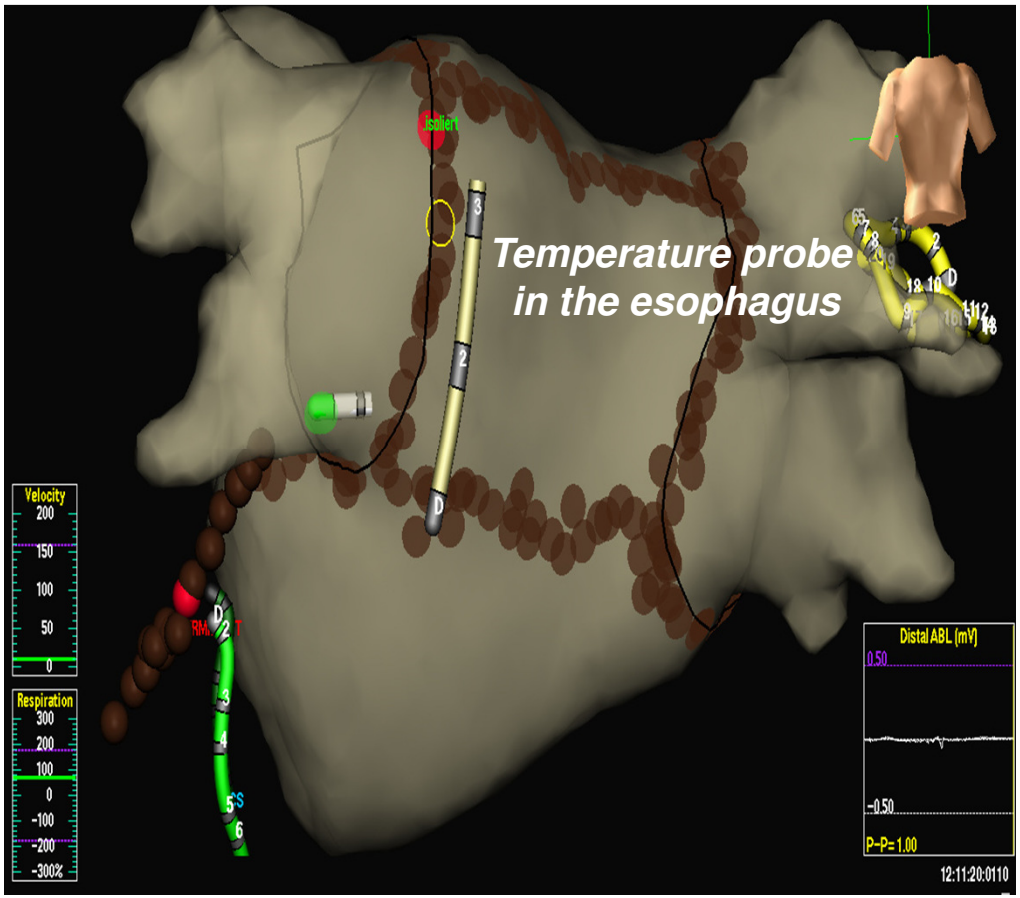

II
ABL 1/2
ABL 3/4
RVA 1/2
CW 1/3
CCW 2/4
CW 3/5
CCW 4/6
CW 5/7
CCW 6/8
CW 7/9
CCW 8/10
CW 17/19
CCW 10/12
CW 9/11
CCW 12/14
CW 19/21
CCW 14/16
CW 21/23
CCW 16/18
CW 11/13
CCW 18/20
CW 23/25
CCW 20/22
CW 25/27
CCW 22/24
CW 13/15
CCW 24/26
CW 27/29
CCW 26/28
CW 29/31
CCW 28/30
CW 15/17
CCW 30/32
CW 31/1
CCW 32/2
Leitung aus der PV
Keine Leitung aus der PV

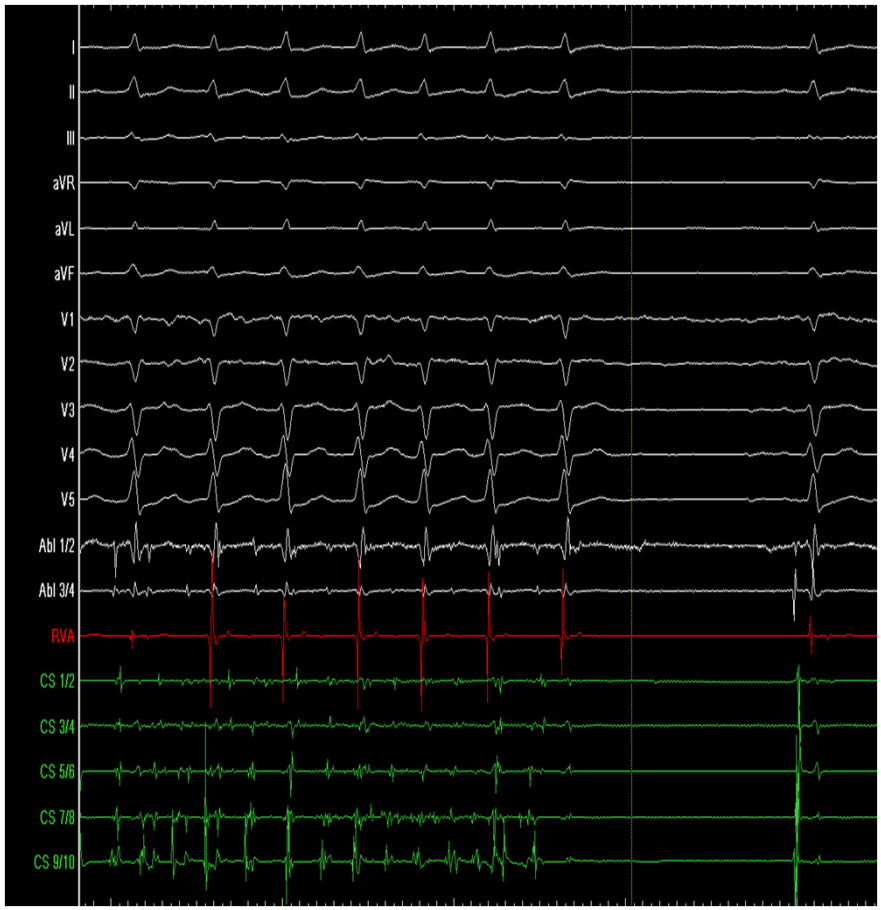
Effectivness of AF ablation in pts with paroxysmal AF

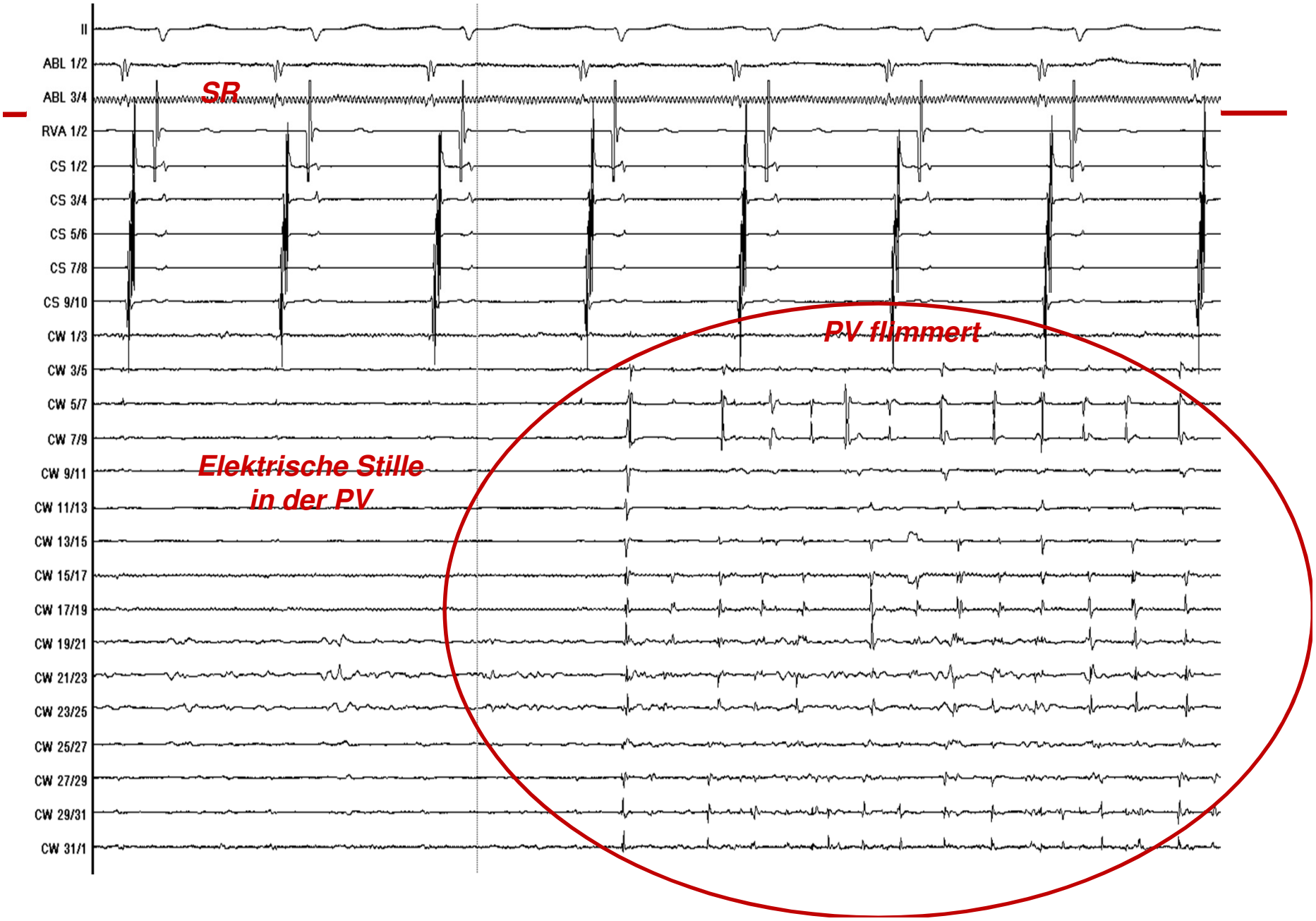
ADD vs catheter ablation



Trigger-elimination plus Substrat-modification in pts with long lasting AF

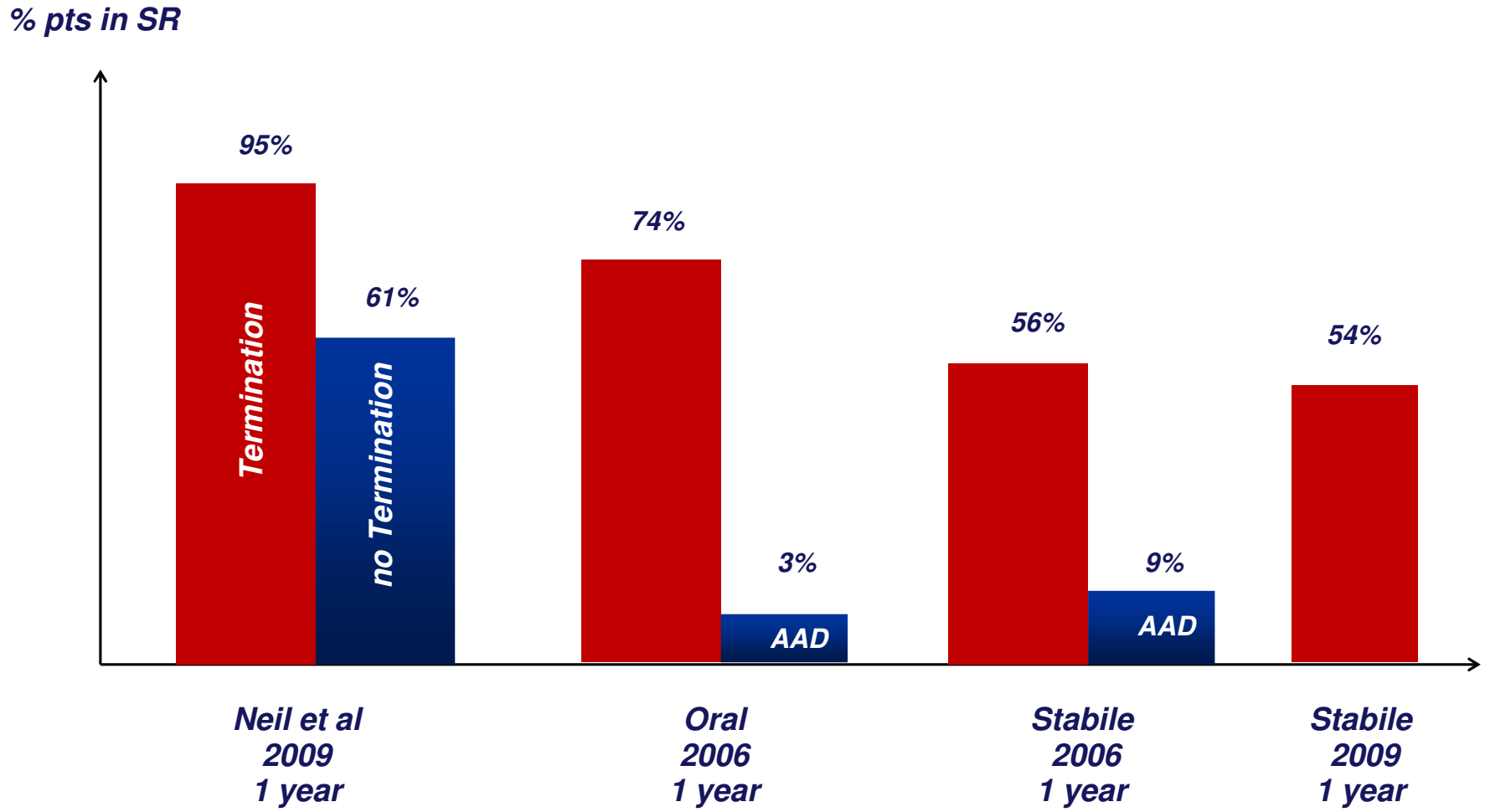




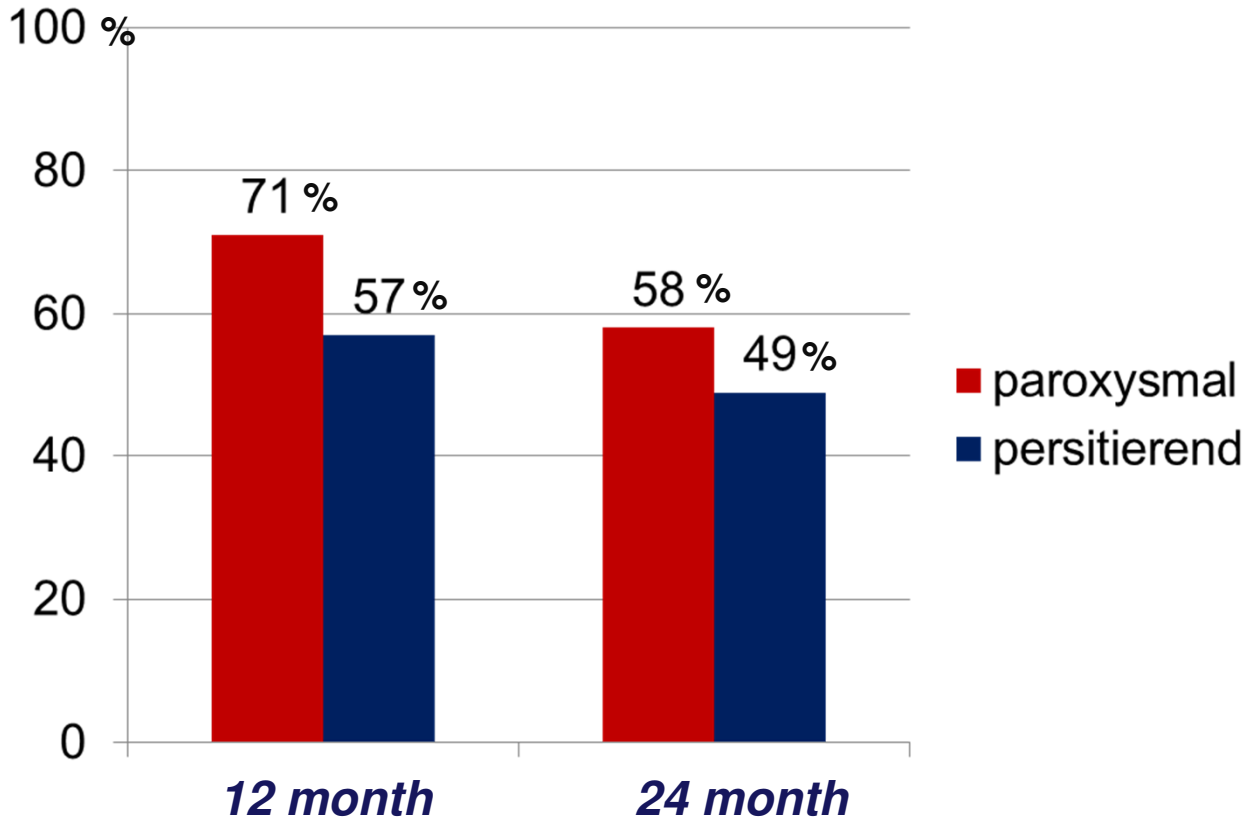

II
ABL 1/2
ABL 3/4
RVA 1/2
CS 1/2
CS 3/4
CS 5/6
CS 7/8
CS 9/10
CW 1/3
CW 3/5
CW 5/7
CW 7/9
CW 9/11
CW 11/13
CW 13/15
CW 15/17
CW 17/19
CW 19/21
CW 21/23
CW 23/25
CW 25/27
CW 27/29
CW 29/31
CW 31/1
SR
PV flimmert
Elektrische Stille
in der PV

Effectivness of AF ablation in pts with long standing AF

ADD vs catheter ablation

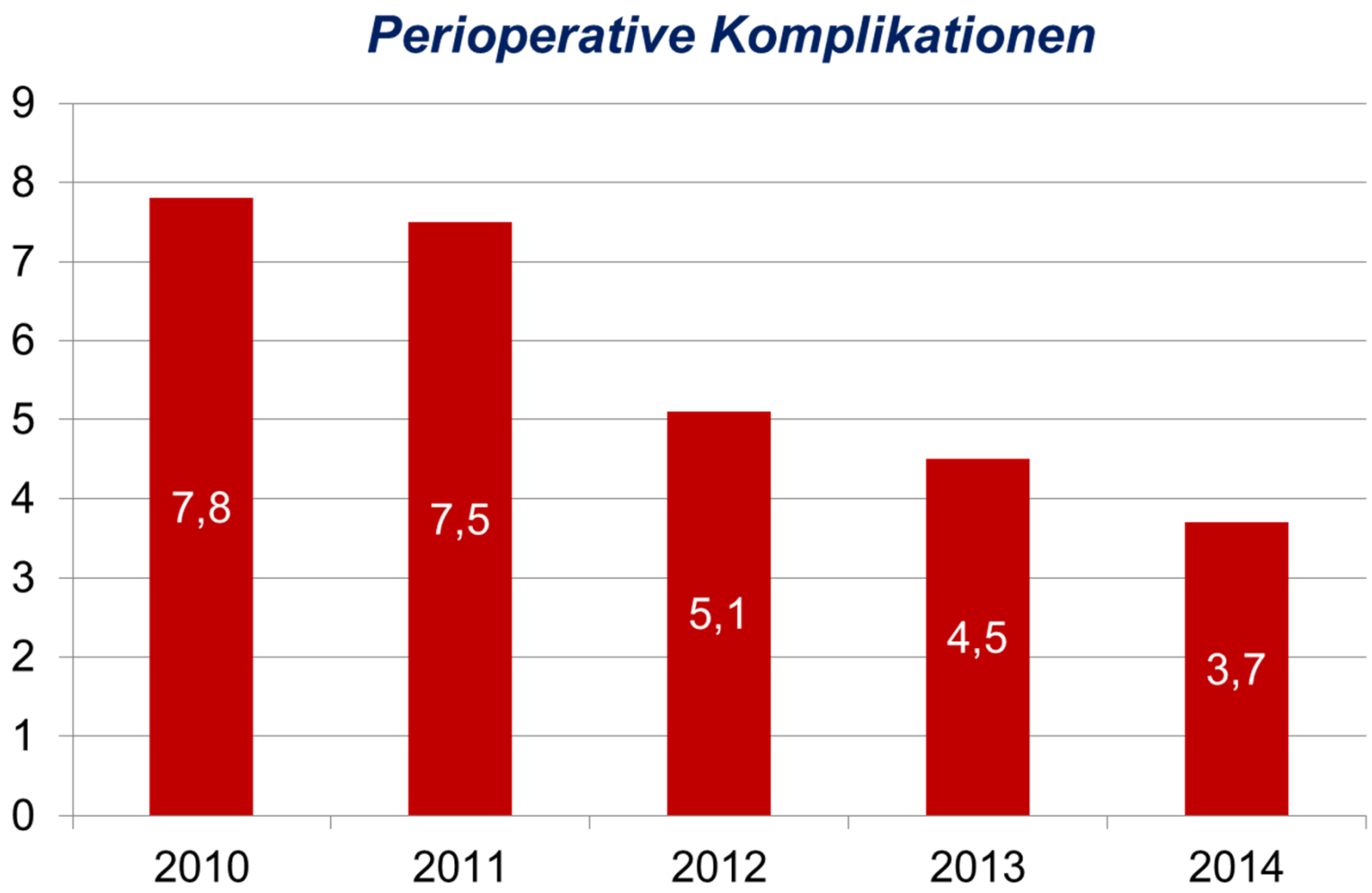


Success rate
Single center expierience in 2034 pts



Perioperative complicationssince 2010

During or after catheter ablation (n = 2034 pts)

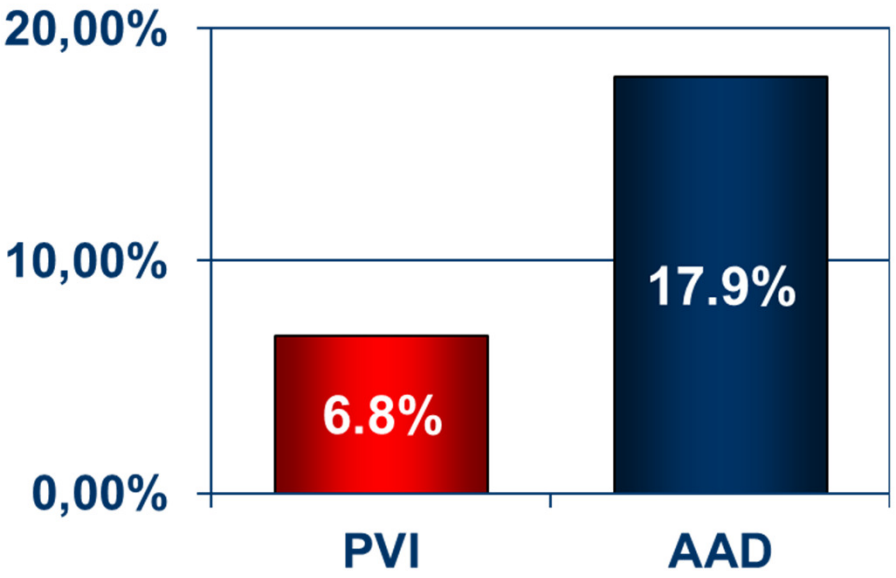


World wide complication rate Multicenter expierence

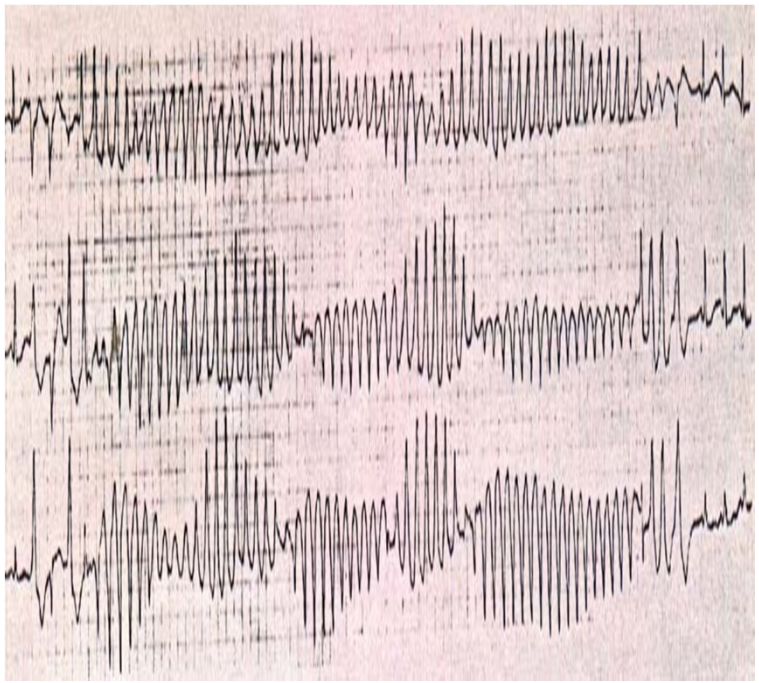
Left atrial flutter	2% - 12%
Vascular complications	1% - 5%
Perikardial tamponade	0.5% - 3%
Stroke	0.5% - 2%
PV Stenossis	1%
Phrenicusparese	0.5%
Atrio-esophageal fistula	0.2%
Injury f the mitral valve	<0.1%
death	0.1%
overall complication rate (Cappato et al)	5.9%

Calkins et al, Europace 2007 ,9, 335-379 Cappato et al, Circulation 2005; 111, 1100-1105

Compliation rate after PVI (AF ablation) vs Side effects of AAD treatment



Wilber, et al, AHA 2008 late breaking clinical trials



Side effects, proarrhythmia

Worldwide complication after RF ablation
Demographics

Table 1. Demographics

	No. of Studies	Mean	SD	Minimum	Maximum
Total	192				
Age, y	182	57.3	3.5	51.0	77.0
Men, %	181	75.0	11.1	42.0	100.0
Ejection fraction, %	130	58.5	4.8	48.0	70.0
Left atrial size, mm	130	41.9	3.3	32.0	55.0
Paroxysmal AF, %	192	43.6	33.8	0.0	100.0
Valvular disease, %	46	11.8	16.4	0.0	100.0
Coronary artery disease, %	85	11.3	10.4	0.0	87.0
Heart failure, %	29	9.1	6.2	0.0	24.5
Nonischemic cardiomyopathy, %	27	5.9	4.9	0.0	22.7
Hypertrophic cardiomyopathy, %	16	5.0	6.1	0.0	19.0
Congenital, %	4	1.6	2.3	0.0	5.0

AF indicates atrial fibrillation.

Gupta et al, Circ Arrhythm Electrophysiol. 2013;6:1082-1088

Worldwide complication after RF ablation
Ablation strategy

Table 5. Ablation Strategy

Ablation Strategy	Description	No. of Studies	% Pooled Complication Rate (95% CI)	*P* Value	I^2 Statistic
1	PVI alone	23	2.8 (2.05–3.70)	...	74.2
2	PVA ablation/PVAI	34	2.7 (1.89–3.70)	0.874	86.7
3	Linear substrate	25	2.5 (1.81–3.22)	0.545	75.1
4	CFAE alone	3	4.2 (2.86–5.86)	0.091	12.2
5	CFAE as adjunct	10	2.0 (1.51–2.57)	0.098	53.6
6	Tailored	49	3.2 (2.62–3.74)	0.509	84.5
7	Stepwise	8	3.0 (2.06–4.04)	0.800	47.7

CFAE indicates complex fractionated atrial electrogram; CI, confidence interval; PVA, pulmonary vein antral; PVAI, pulmonary vein antrum isolation; and PVI, pulmonary vein isolation.

***Gupta et al, Circ Arrhythm Electrophysiol*. 2013;6:1082-1088**

Worldwide complication after RF ablation
Major complications

Table 2. Major Complications

	No. of Studies	% Pooled Complication Rate (95% CI)	I^2 Statistic
Acute complication rate	183	2.9 (2.60–3.22)	83.8
Type of complication			
Death	58	0.06 (0.03–0.09)	0.0
Atrioesophageal fistula	67	0.08 (0.05–0.11)	0.0
Pulmonary vein stenosis*	118	0.5 (0.34–0.60)	79.6
Vascular complications†	117	1.4 (1.02–1.79)	94.1
Arteriovenous fistula	45	0.40 (0.28–0.55)	45.5
Femoral pseudoaneurysm	49	0.5 (0.34–0.60)	41.2
Stroke/TIA‡	155	0.6 (0.50—0.67)	46.8
Stroke	111	0.4 (0.30–0.44)	34.3
TIA	94	0.4 (0.28–0.47)	37.9
Tamponade	131	1.0 (0.83–1.14)	68.5
Pericardial effusion	67	0.7 (0.56–0.88)	55.0
Phrenic nerve injury	48	0.4 (0.22–0.54)	70.2
Diaphragmatic paralysis	21	0.3 (0.15–0.43)	0.0
DVT/PE	33	0.15 (0.09–0.21)	0.0
Pneumothorax	22	0.2 (0.08–0.29)	0.0
Hemothorax	25	0.2 (0.10–0.28)	0.0
Sepsis, abscesses, or endocarditis	20	0.1 (0.06–0.24)	0.0
Valve damage	26	0.2 (0.08–0.25)	0.0

***Gupta et al, Circ Arrhythm Electrophysiol* 2013;6:1082-1088**

Worldwide complication after RF ablation

Major complications

Gupta et al, Circ Arrhythm Electrophysiol. 2013;6:1082-1088

Table 3. Major Complications (2007–2012)

	No. of Studies	% Pooled Complication Rate (95% CI)	I^2 Statistic
Acute complication rate	140	2.6 (2.31–2.95)	82.2
Type of complication			
Death	45	0.06 (0.03–0.09)	0
Atrioesophageal fistula	53	0.07 (0.04–0.11)	0
Pulmonary vein stenosis*	90	0.4 (0.30–0.58)	76.8
Vascular complications†	86	1.2 (0.83–1.72)	95.4
Arteriovenous fistula	32	0.4 (0.24–0.58)	50.2
Femoral pseudoaneurysm	38	0.4 (0.29–0.57)	40.6
Stroke/TIA‡	119	0.55 (0.46–0.65)	48.3
Stroke	85	0.3 (0.26–0.43)	37.8
TIA	74	0.3 (0.25–0.43)	36.1
Tamponade	99	0.9 (0.75–1.10)	67.7
Pericardial effusion	55	0.7 (0.52–0.83)	44.9
Phrenic nerve injury	38	0.4 (0.19–0.60)	74.7
Diaphragm paralysis	15	0.2 (0.10–0.40)	0
DVT/PE	23	0.1 (0.08–0.21)	0
Pneumothorax	17	0.15 (0.06–0.28)	0
Hemothorax	22	0.2(0.10–0.29)	0
Sepsis, abscesses, or endocarditis	16	0.1 (0.04–0.24)	0
Valve damage	22	0.15 (0.08–0.25)	0

Table 4. Major Complications: Studies With Prospective Listing

	No. of Studies	% Pooled Complication Rate (95% CI)	I^2 Statistic
Overall acute complication rate	42	3.5(2.90–4.14)	89.2
Type of complication			
Death	17	0.03 (0.01–0.07)	0
Atrioesophageal fistula	18	0.06 (0.02–0.11)	0
Pulmonary vein stenosis*	25	0.3 (0.15–0.58)	89
Vascular complications†	34	1.9 (1.05–2.93)	97.5
Arteriovenous fistula	14	0.3 (0.19–0.51)	45.8
Femoral pseudoaneurysm	15	0.5 (0.30–0.75)	68.3
Stroke/TIA‡	41	0.5 (0.38–0.65)	64.1
Stroke	29	0.3 (0.21–0.49)	66.2
TIA	22	0.2 (0.13–0.34)	34.2
Tamponade	28	1.0 (0.65–1.28)	82.3
Pericardial effusion	16	0.6 (0.37–0.82)	64.9
Phrenic nerve injury	12	0.5 (0.13–1.07)	89
Diaphragmatic paralysis	1	0.1 (0.08–0.74)	...
DVT/PE	7	0.1 (0.05–0.20)	0
Pneumothorax	3	0.1 (0.01–0.30)	0
Hemothorax	6	0.2 (0.08–0.36)	0
Sepsis, abscesses, or endocarditis	3	0.15 (0.02–0.38)	0
Valve damage	6	0.1 (0.04–0.30)	0

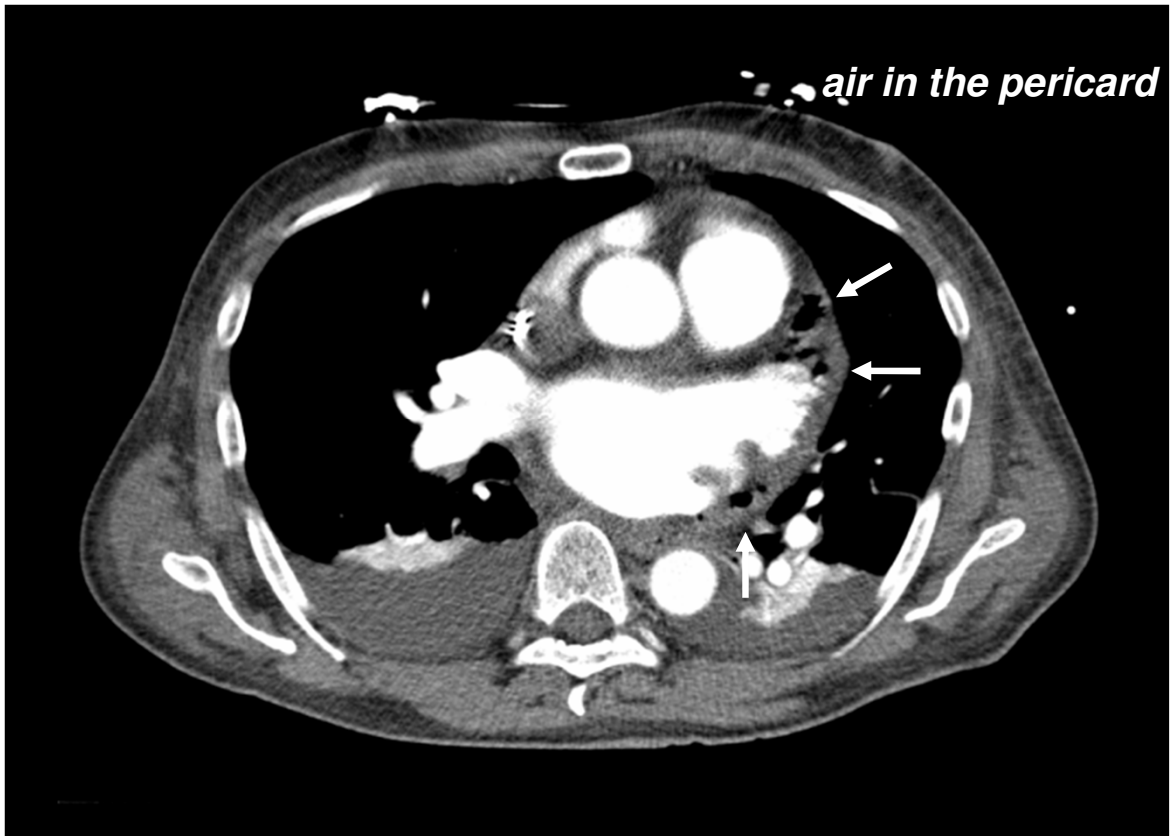
Ablation procedure and post-procedural care prior to the complications

- *TEE was performed to exclude thrombus formation within the LA. Mapping and ablation were performed under the guidance of 3D mapping systems.*
- *A temperature probe in the esophagus at the level of the LA was set to a maximum of 41℃ and provided intra-esophageal temperature feedback during the procedure.*
- *The standard ablation setting consisted of a pre-selected catheter tip temperature of 48℃, a power of 40 W (30 W at the posterior wall of the LA), and a flow rate of 30 ml/min.*
- *Wide area circumferential ablation around both ipsilateral PVs was performed.*
- *Ablation procedures are performed with uninterrupted phenprocoumon (INR 2 to 3; patient 1) or with direct oral anticoagulants withheld 24 h before and restarted 12 hours after the procedure.*
- *proton pump inhibitor was not routinely prescribed.*
- *In case of symptoms of any kind after discharge, patients were advised to contact our institution or the referring physician. Additionally the referring physician was advised to contact us, if unusual symptoms occurred.*

Peridardial – esophageale Fistula

72 year old male pts, highly symptomatic AF, nonischemic heart disease, EF 30 %, ICD, AF ablation was performed

*The patient presented to our hospital **24 days after RFA** complaining swallowing difficulties, nausea, vomiting, shivering fits and general fatigue over the last days before admission.*

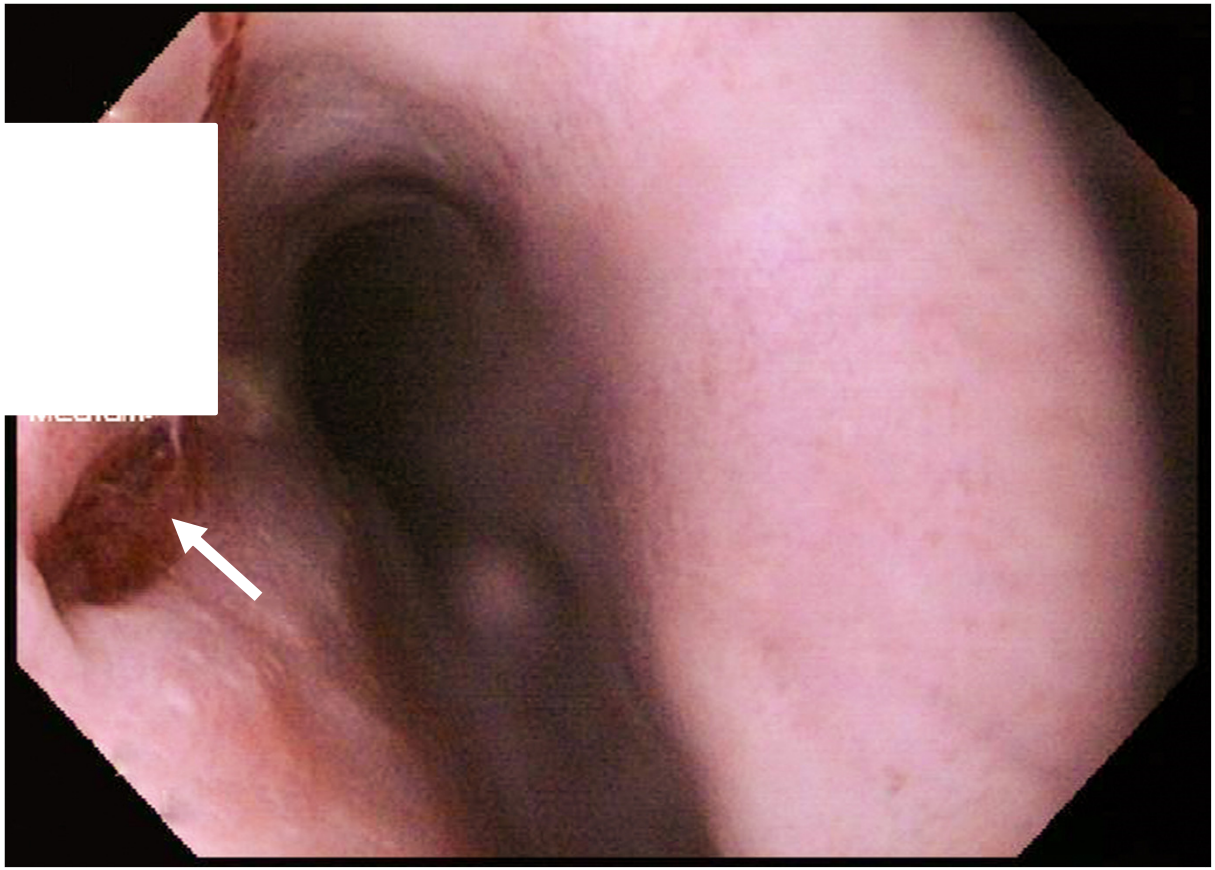


He was transferred to our intensive care unit. Hemodynamic deterioration occurred and resuscitation had to be performed requiring artificial ventilation and medical circulatory support.

After stabilization the diagnosis of a pericardioesophageal fistula was established by CT scan showing mediastinal and pericardial air accumulation.

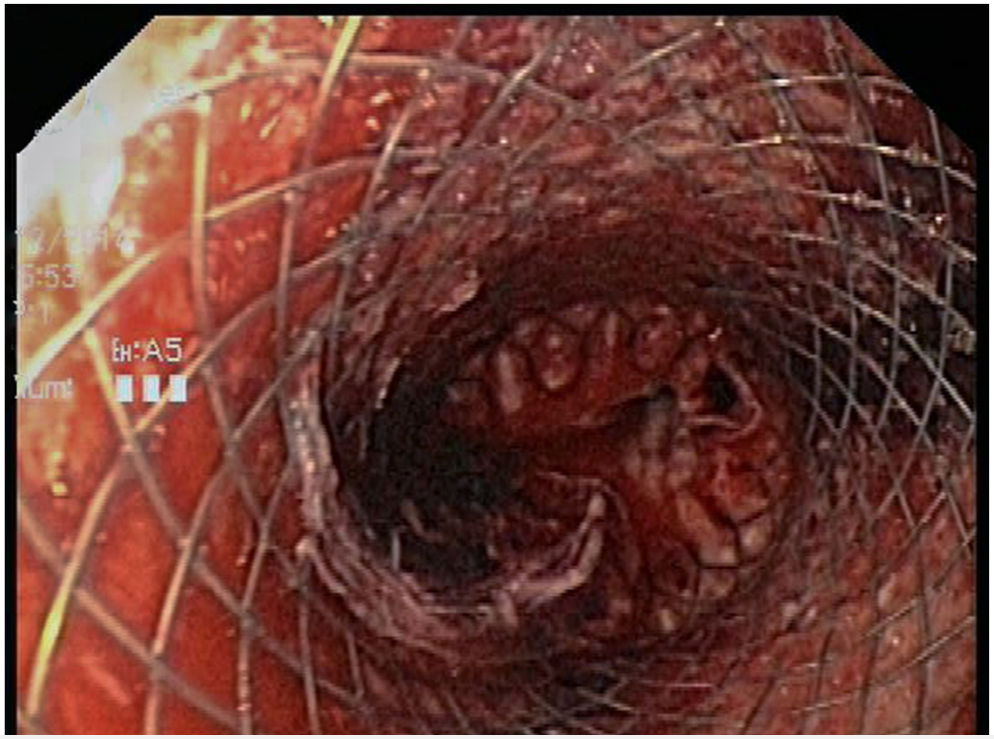
Esophageal fistula during ÖGD

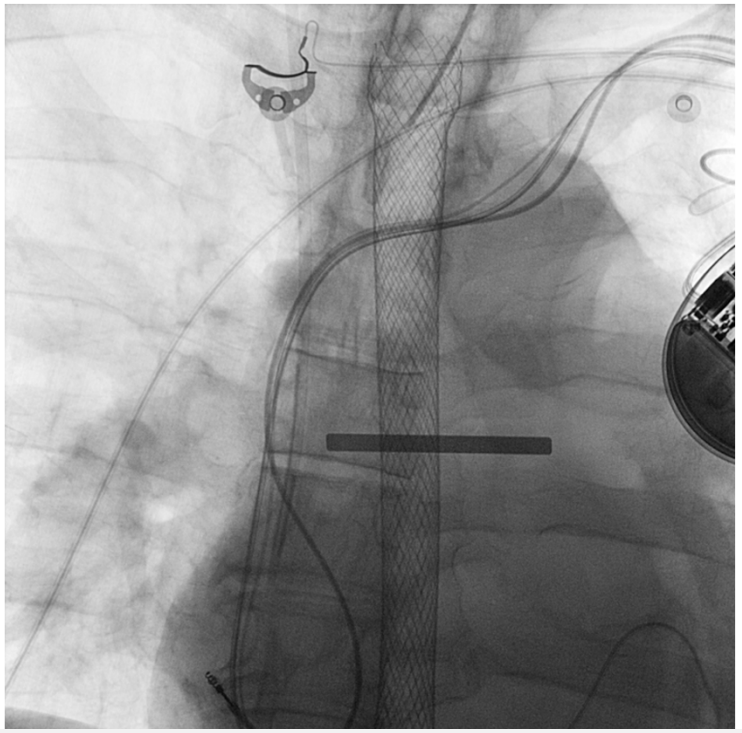
Because of hemodynamic instability and the severe depressed left ventricular function, a surgical treatment was not considered. Alternatively, an endoscopic treatment was chosen after verification of a fistula.



Stent implantation after the detection of the esophagel lesion

The esophagus was stented using careful carbon dioxide (CO_2) insufflation and X-ray control.



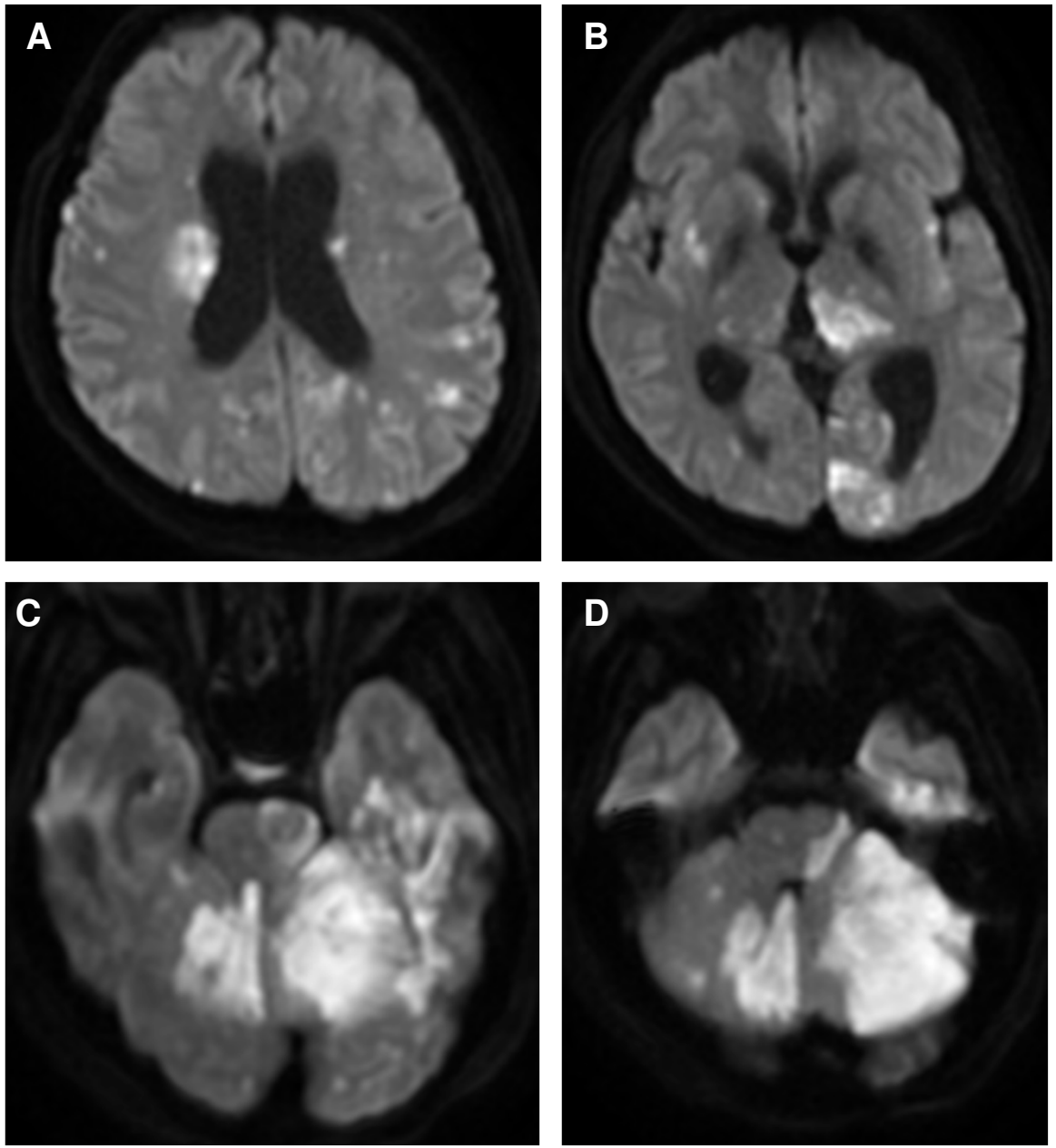


Over the course of a few hours after stenting, the patient stabilized and catecholamine therapy could be reduced and finally withdrawn within 4 days.
Two days after the stenting procedure blood was detected in the stomach. The endoscopy revealed little bleeding at the distal and proximal end of the stent, which suspended the same day.

Peridardial – esophageale fistula in a 72 yrs old male pt

Over the next days further stabilization seemed to occur. However, at day 8 blood was detected in his pharynx. Bronchoscopy and endoscopy were performed immediately. Whereas bronchoscopy was unremarkable endoscopy showed severe bleeding in the esophagus, which could not be stopped. At this time hemodynamic deterioration necessitated temporal cardiopulmonary resuscitation. Despite intensive care measures the patient deceased one hour later.

Septic stroke in pts atrioesophageal fistula



Sequelae of atrioesophageal fistula Mediastinitis and Stroke

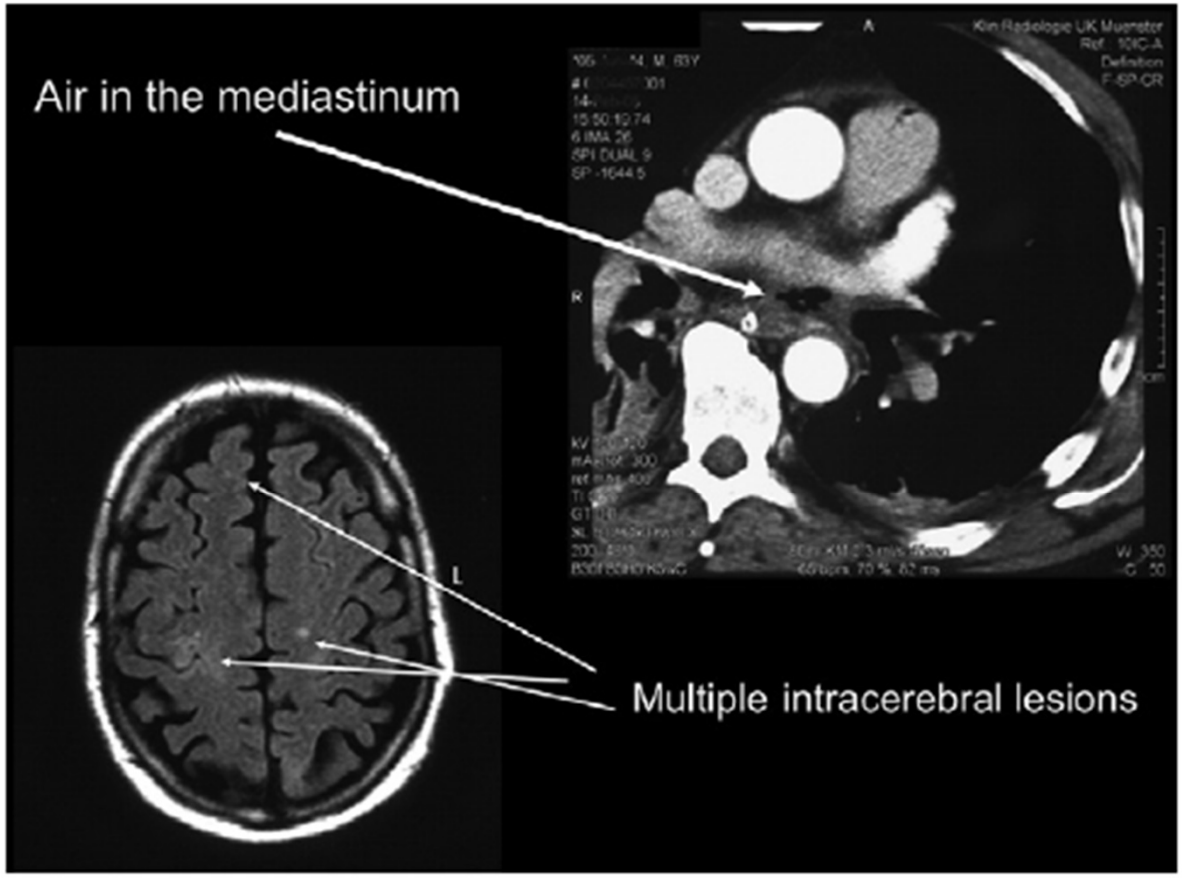
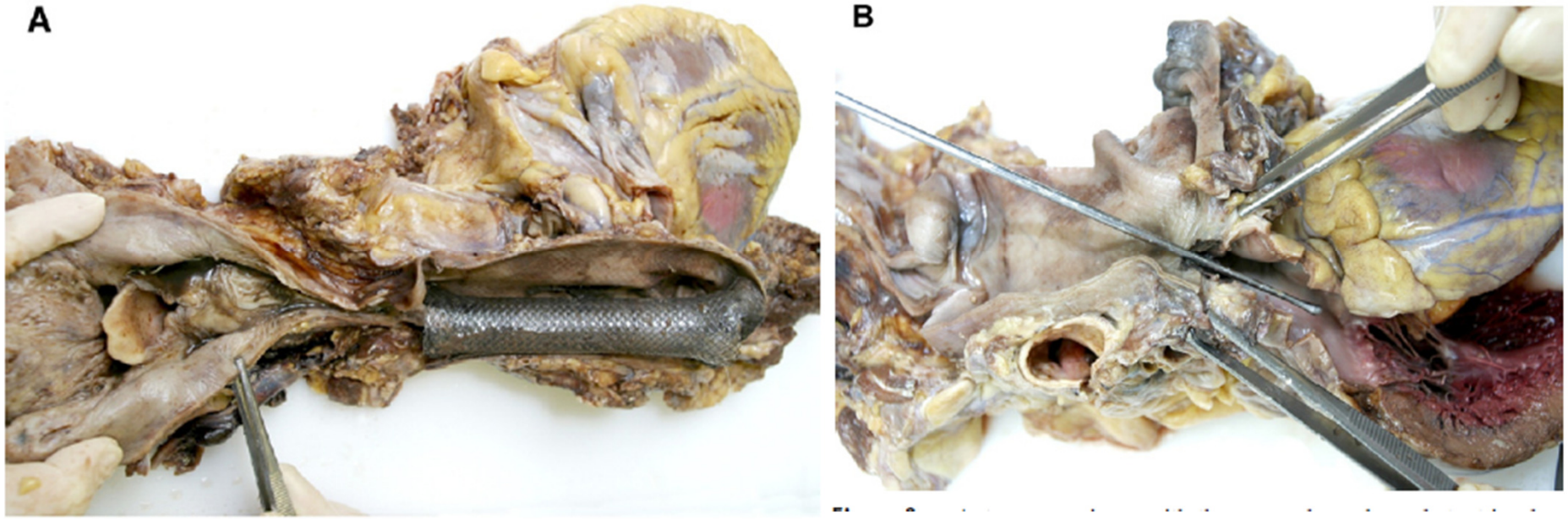


Figure 1 Computed tomography scans of the head (**left**) and the chest (**right**) showing the sequelae of the atrioesophageal fistula.

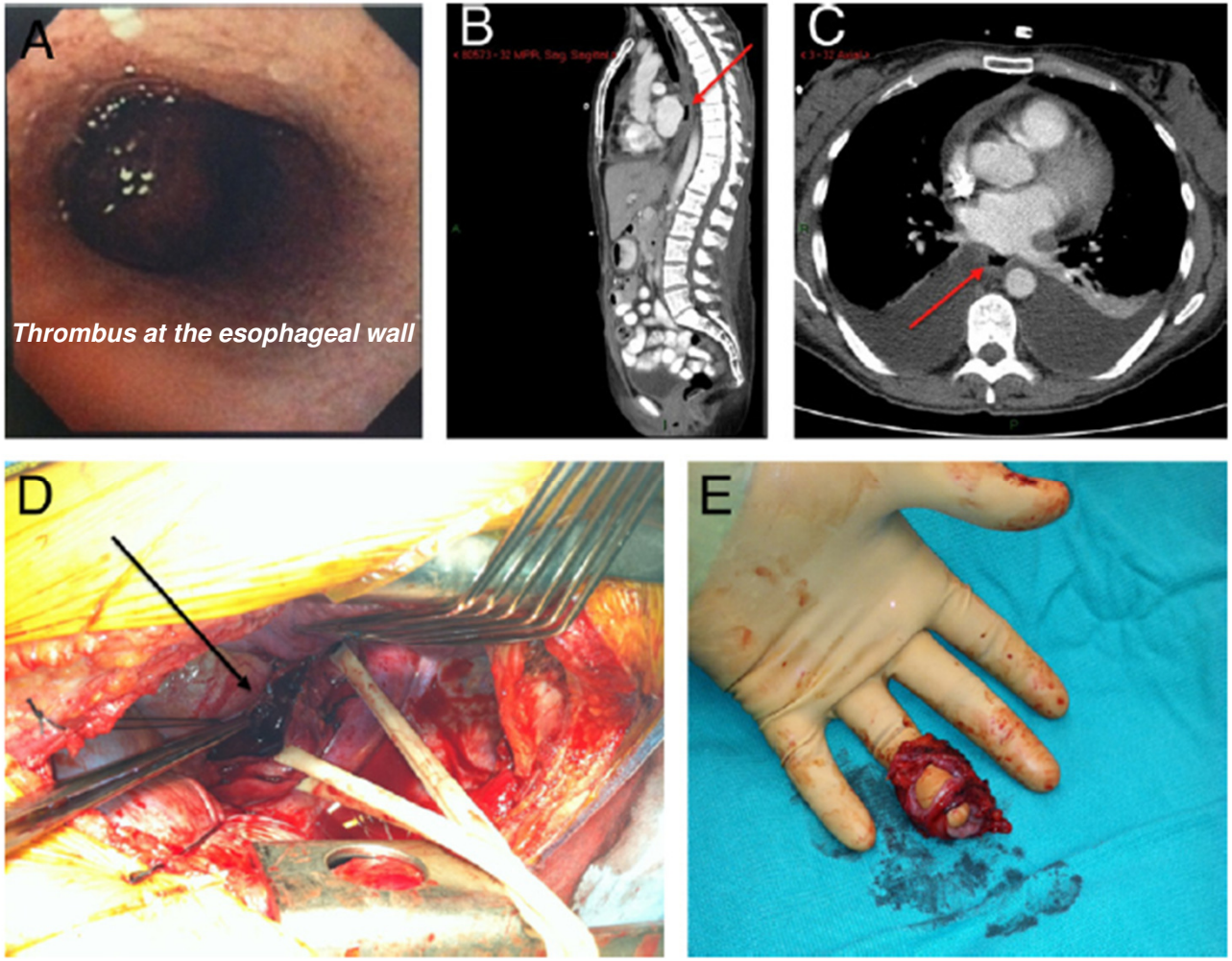
Zellerhof et al; Heart Rhythm 2011;8:624–626

Autopsy specimen with the covered esophageal stent in place (A) and a probe depicting the course of the atrioesophageal fistula after removal of the stent (B).



Zellerhof et al; Heart Rhythm 2011;8:624–626

4 weeks after AF ablation: minor hematemesis; EGD

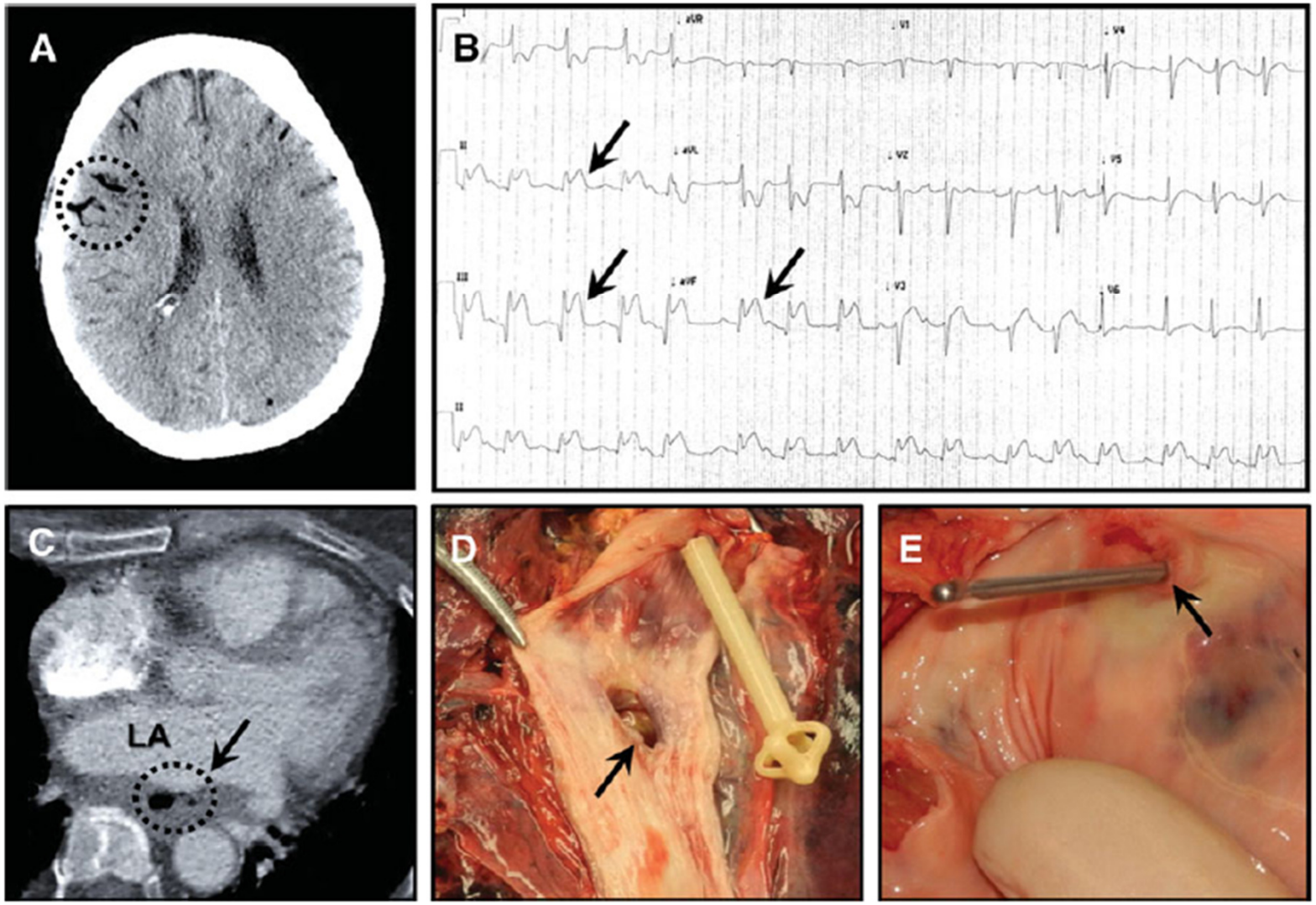


Rivera et al Journal of the American College of Cardiology Vol. 61, No. 11, 2013

Sequelae of atrioesophageal fistula

cerebral air embolism, inferior ST elevation, CT Scan with air connecting the esophagus and LA, autopsy with large fistula in the esophagus and lesion in the LA

Aryana etal, J Cardiovasc Electrophysiol, Vol 24, pp. 933-934, August 2013.



Management of complications in our institution

- *Every occurring complication has to be verified and transparently discussed. It demands detailed analysis and evaluation of the in-house standard operating procedure All complications will be discussed in an interdiscilinary board*
  - *each complication will teach us something*
  - *considering and rethinking about our standards*
- *Servere complications will be discussed internally and externally*
- *deadly complications: Monitoring of an external specialist will be performed*
- *Publication*

Change in our ablation procedure and post-procedural care: Modification of our SOP

1) *RF application is reduced to a preset temperature of 42℃ and a power of 25-30 W in the left atrial posterior wall.*
2) *Esophageal temperature monitoring is still keeping our routine. However, the preset temperature alert is reduced from 41℃ to 40℃. If the temperature exceeds 40℃, an esophagoscopy will be performed routinely on day 2 after the procedure. If an esophageal injury is detected, the patient will stay in hospital and a control endoscopy will be performed 4-5 days later. If the ulceration decreased the patient will be discharged, otherwise the patient will receive antibiotics and mashed food until there is healing observed.*
3) *All patients routinely will be treated with a proton pump inhibitor in combination with sucralfate for a minimum of 4 weeks.*
4) *All patients are advised to contact our institution or the referring physician in case of symptoms of any pre-specified kind after discharge. Patients are informed of specific warning signs such as difficulties in swallowing, nausea, vomiting, shivering fits, general fatigue, fever, chills, and recurrent neurological events.*
5) *If an atrial-esophageal fistula is suspected, endoscopy should be avoided or undertaken with caution.*
6) *Furthermore, urgent transfer to a cardiothoracic center will be mandatory as surgical treatment is considered the treatment of choice*

Summary

- ***It is recognized that some rare complications, especially those with delayed onset as it is seen with atrial-esophageal fistulas, might be underreported.***

- ***Most reports on these complications originate from large volume centers where complications would be expected to be less frequent than in lower volume centers.***

- ***Nevertheless it is important to publish such rare complications to increase awareness in the multidisciplinary medical community (cardiology, neurology, gastroenterology, cardiac surgeons) and to enhance earlier recognition and treatment.***

Conclusion

- ***RFA ablation has demonstrated increasing success in the treatment of AF.***
- ***However, AF is rarely a life-threatening rhythm if well managed. Thus, the future of ablation as a therapy for AF depends on preventing serious complication.***
- ***The number of unreported cases of atrial-esophageal and pericardioesophageal fistulas may be high owing to selective reporting and missed diagnosis.***
- ***The early recognition of an atrial-esophageal or pericardioesophageal fistula may be missed due to the low awareness of this rare complication.***
- ***Constant interdisciplinary communication and attention are needed to recognize and manage such an rare but potentially evolving complications promptly.***

Thanks' for your kind attention!!!!!!



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