Unfallkrankenhaus Berlin

Welchen Vorteil bietet die Cryoablation bei Vorhofflimmern?

B. Keweloh

Unfallkrankenhaus Berlin

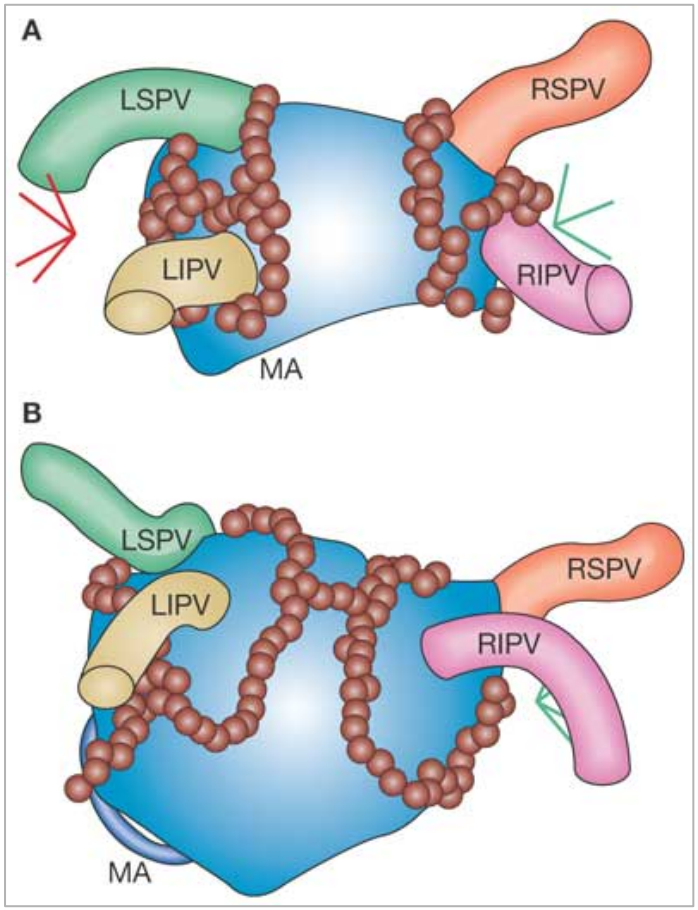
Kardiologie heute

Berlin 20.11.2010

Standards of Radio Frequency Ablation of Atrial Fibrillation

1. Pulmonary vein isolation

2. Additional substrate modification of LA:
   - Linear Lesions
   - CAFE Ablation
   - Ganglionated Plexus Ablation



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Complications RF-PV Isolation

Pulmonary vein stenosis	1,3	%
Esophageal injury	0,25	%
Coronary artery injury	0,25	%
Cardiac tamponade	2,4	%
Phrenic nerve injury	0,5	%

** Pooled data from n>50 published studies using RF Ablation:

Pappone et al	JACC 2003:42,185-197
Nademanee K et al	JACC 2004:43,2044-53
Kottkamp H et al	JACC 2004:44:869-877
Haissaguerre M et al	JCE 2005:16:1125-1137
Lim et Al	PCE 2006:29:374-379
....	

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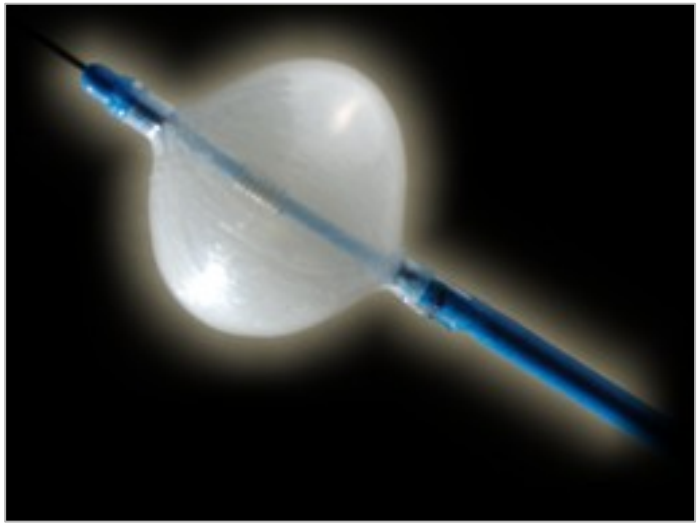
Alternative Energy Sources to Radio Frequency

- Ultrasound
- Laser
- Freezing / Cryo Technique

Medtronic / CryoCath Ablation Technology

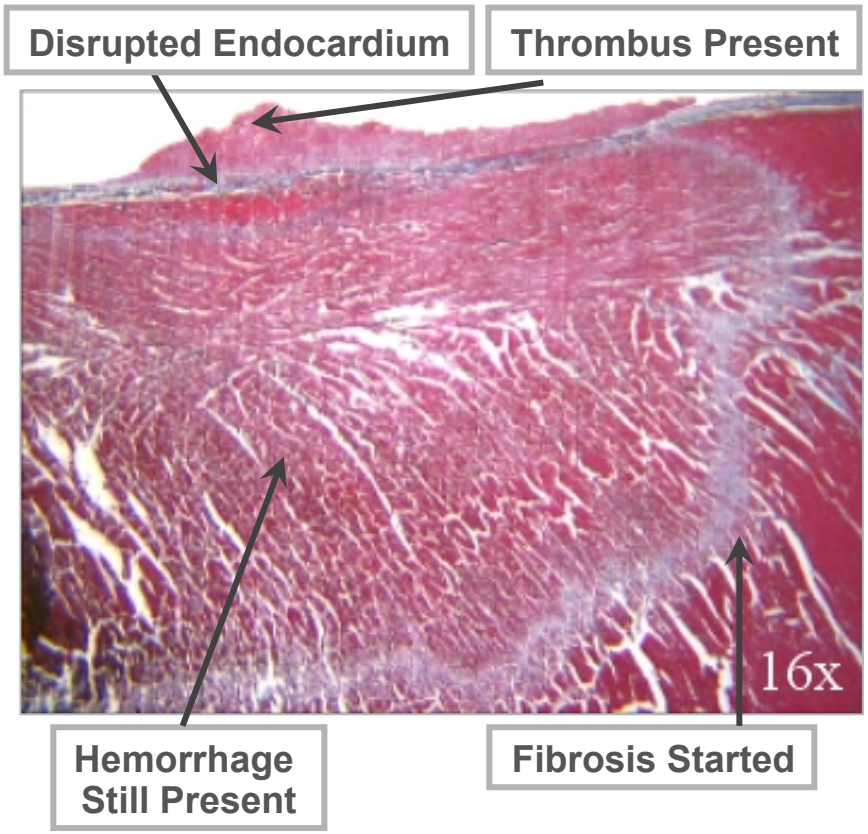


Arctic Front Balloon

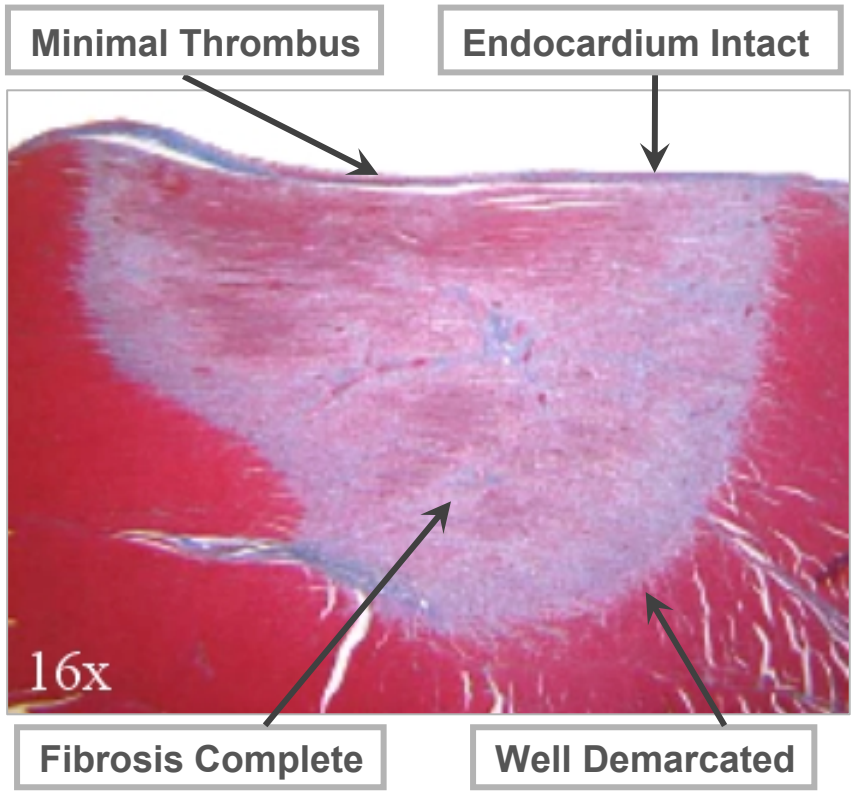
Steerable transseptal Sheath

Focal Cryo Ablation Catheters

Effect on the Connective Tissue Matrix



RF Lesion at 1 Week (canine model)
+70° C • 50 W • 60 seconds



Cryolesion at 1 Week (canine model)
-75° C • 1 x 4 minutes

Khairy P, et al. *Circulation*. 2003;107:2045-2050.

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Paroxysmal atrial fibrillation, case report 1

- Male patient, 46 years
- Paroxysmal atrial fibrillation since 2 years
- Takes ß-blocker, one episode in 14 days, usually terminated by flecainide as pill in the pocket concept
- Echo and Exercise ECG normal
- LA not enlarged
- No structural heart disease

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Small ballon, single freeze Cryo-PVI approach (ukb)

Symptomatic PAF despite ß-blockers, normal LA size, veins < 20mm

- One quadripolar catheter in RVA / SVC
- Single transseptal puncture
- PV angiography
- Occlusion by Cryoballon, 1 x 300s freezing per vein
- If Occlusiongrade 3 or 4 no Lasso Measurements
- Cardioversion if necessary

Occlusion Grade

1 - no occlusion

2 - incomplete occlusion with big contrast leak to LA

3 - subtotal occlusion with small leak to LA

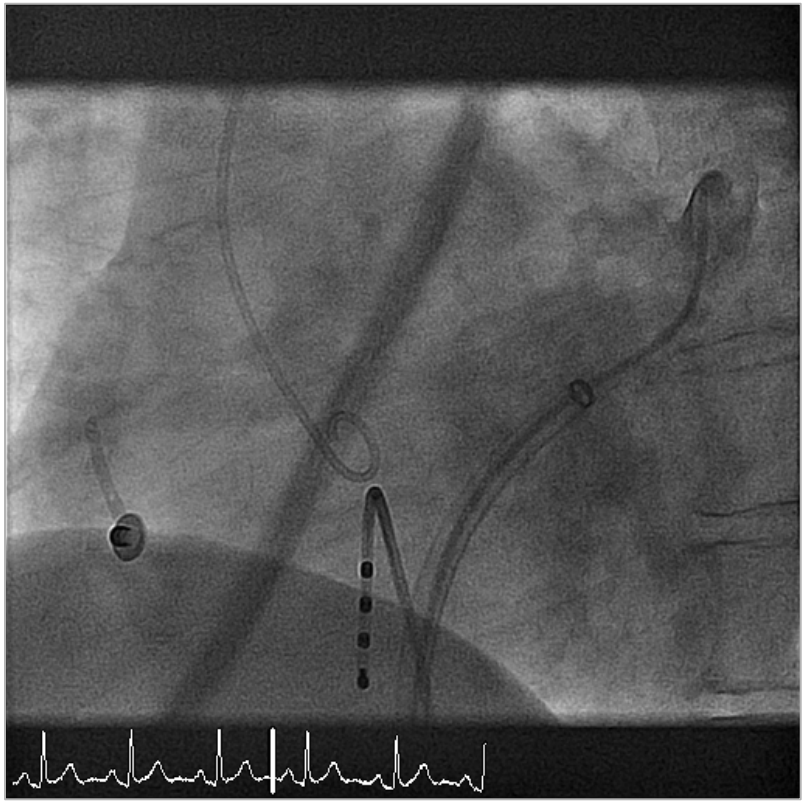
4 - total occlusion

Neumann, Vogt, Schumacher et al,

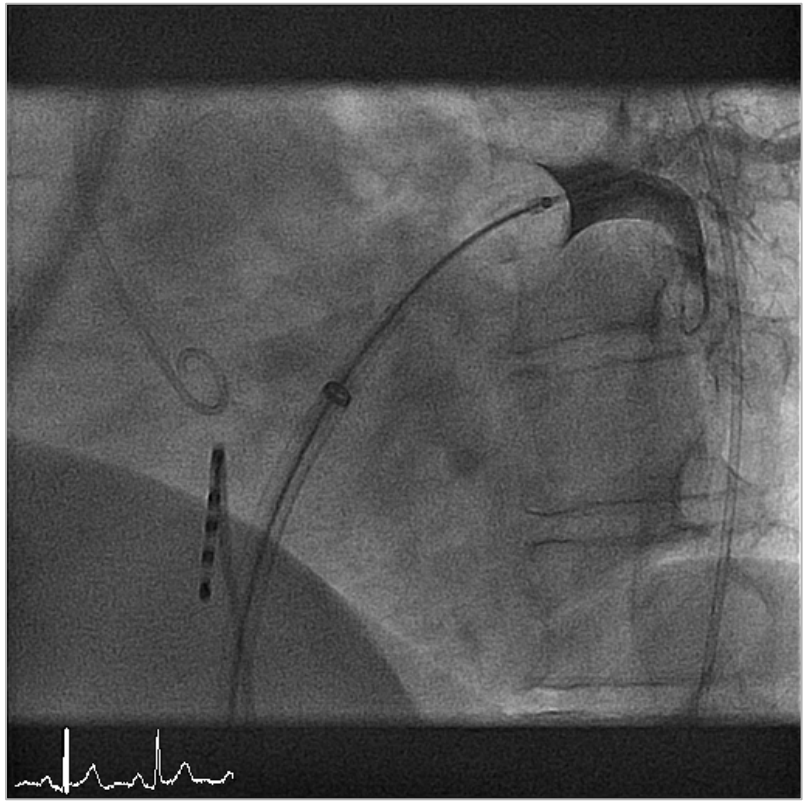
JACC 2008, Vol 52, No 4, 273-78

LSPV

Angiography

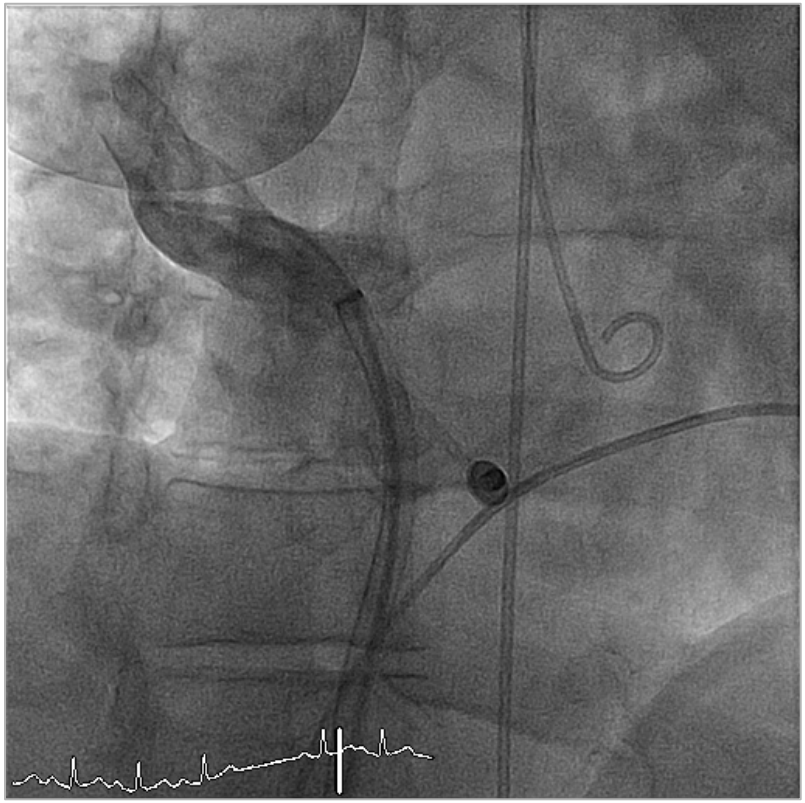


Ablation

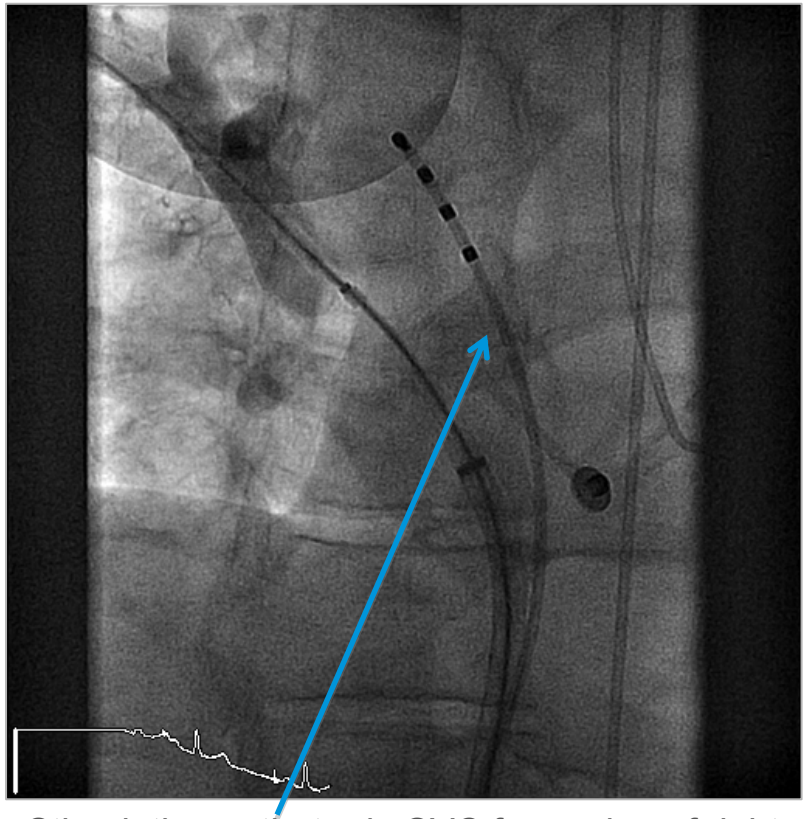


RSPV

Angiography

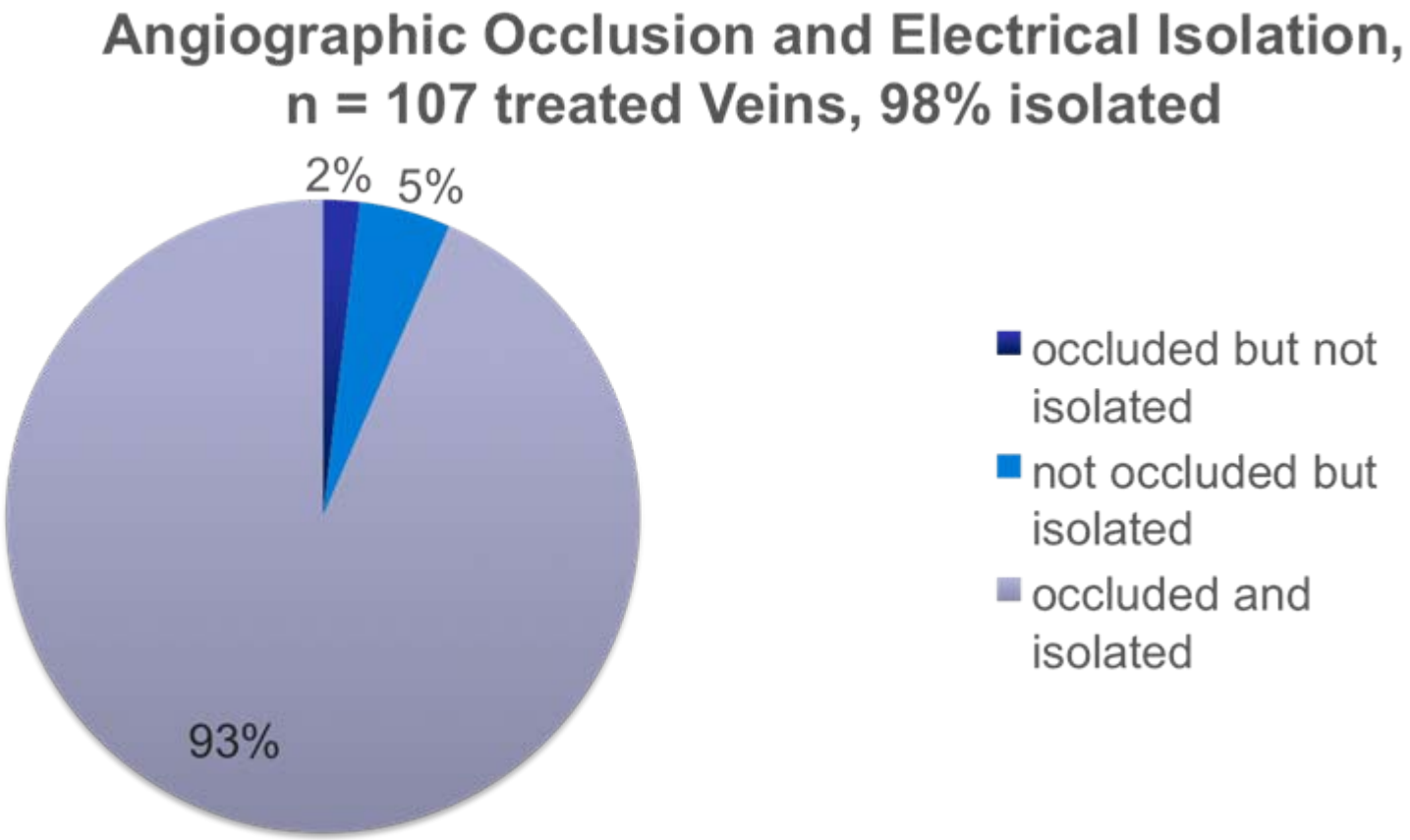


Ablation

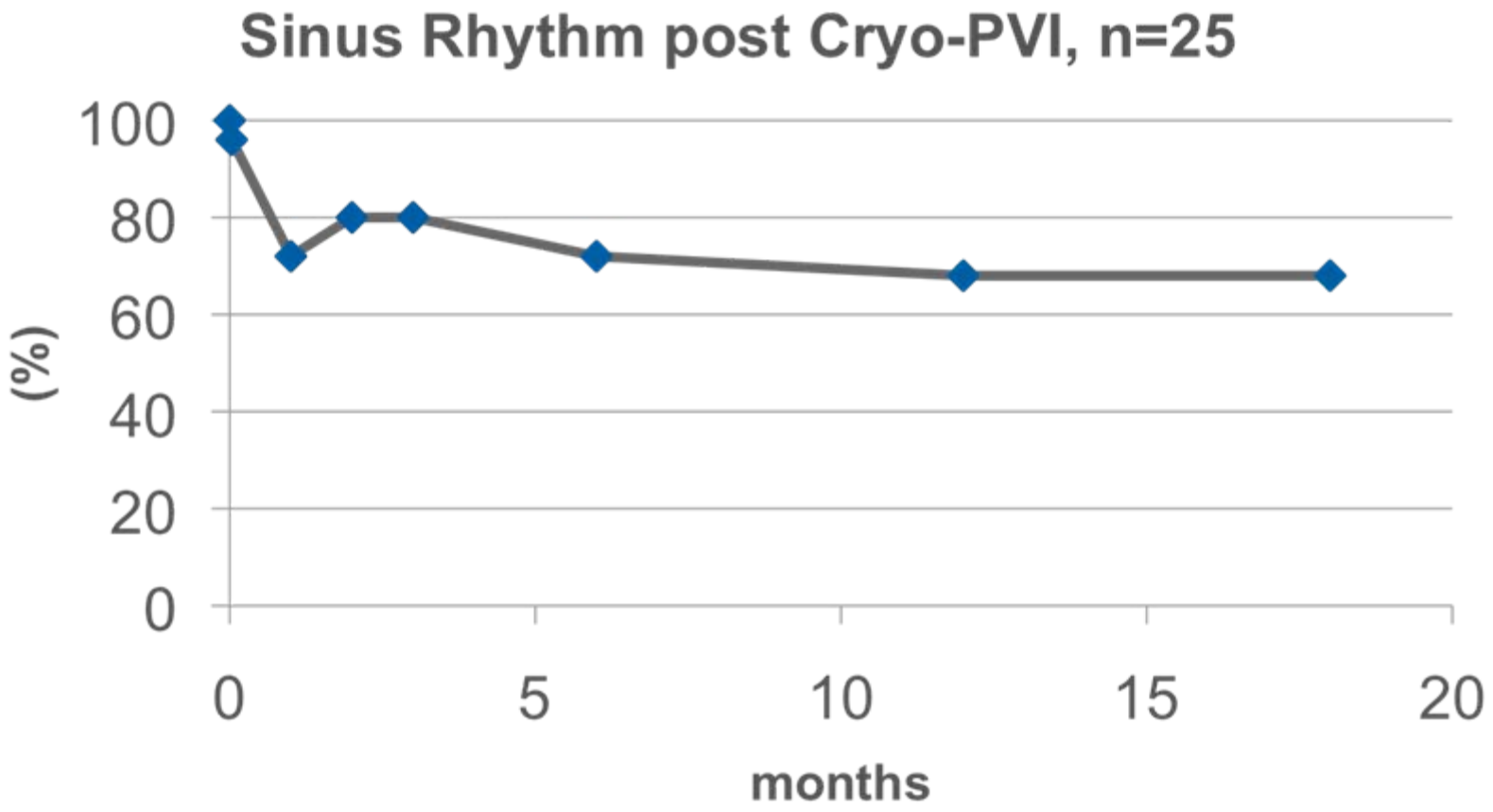


Stimulation catheter in SVC for pacing of right phrenical nerve

PV Isolation rate, ukb



Small Ballon -Single Freeze - Approach, ukb



Keweloh B, Winterhalter M, Siaplaouras S et al.
CRT 2/2009 Washington, DGK 4/2009 Mannheim, ESC 9/2009 Barcelona, DGK 4/2010 Mannheim, ESC 2010 Stockholm

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PVI Complications ukb, n=70

Pericardial effusion	2/70
Transient ST segment elevation	1/70
Thrombembolic events	0/70
PV Stenosis	0/70
Esophageal injury	0/70
Coronary artery injury	0/70
Left atrial flutter	2/70
Right phrenic nerve palsy, trans.	10/70

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Persistent atrial fibrillation, case report

- Female patient, 57 years
- Hypertension
- EF normal, LA enlarged
- PsAF since 1/2010, before 2 years of PAF
- After cardioverion only 1 week in SR
- Dronedarone efficient but stopped because of QT Prolongation

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Best fitting balloon, standard Cryo-PVI approach

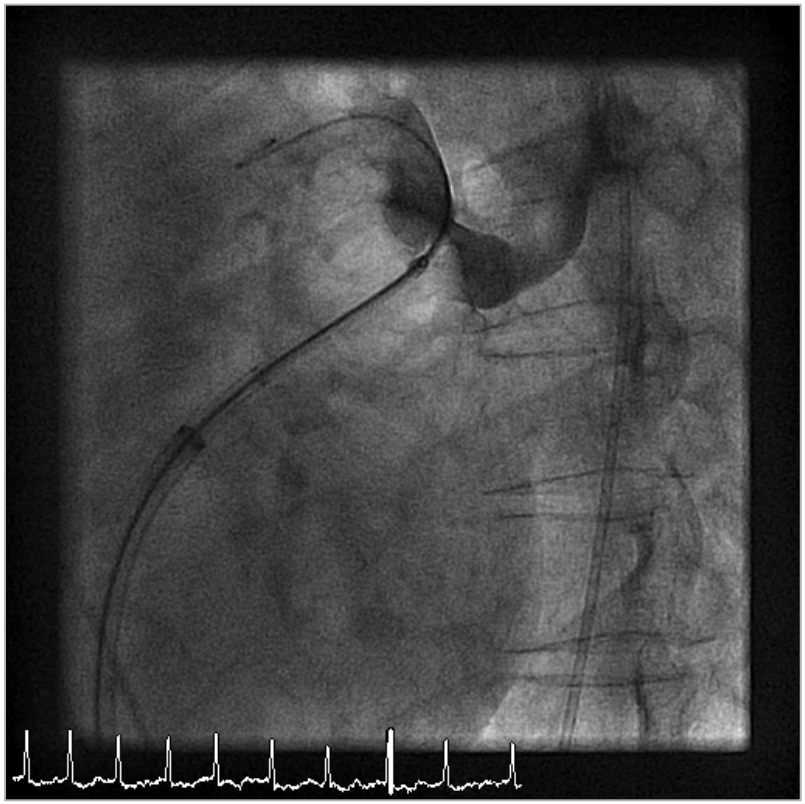
Symptomatic PsAF despite AA, enlarged LA, all vein sizes

- Quadripolar catheter in RVA / SVC
- Transseptal puncture
- PV angiography
- Biggest PV > 20mm = 28mm Balloon
  Biggest PV < 20mm = 23mm Balloon
- 2 x 300-360 s freezing per vein
- CS catheter, Lasso catheter: proof of isolation
- Touch up with Balloon or focal catheter

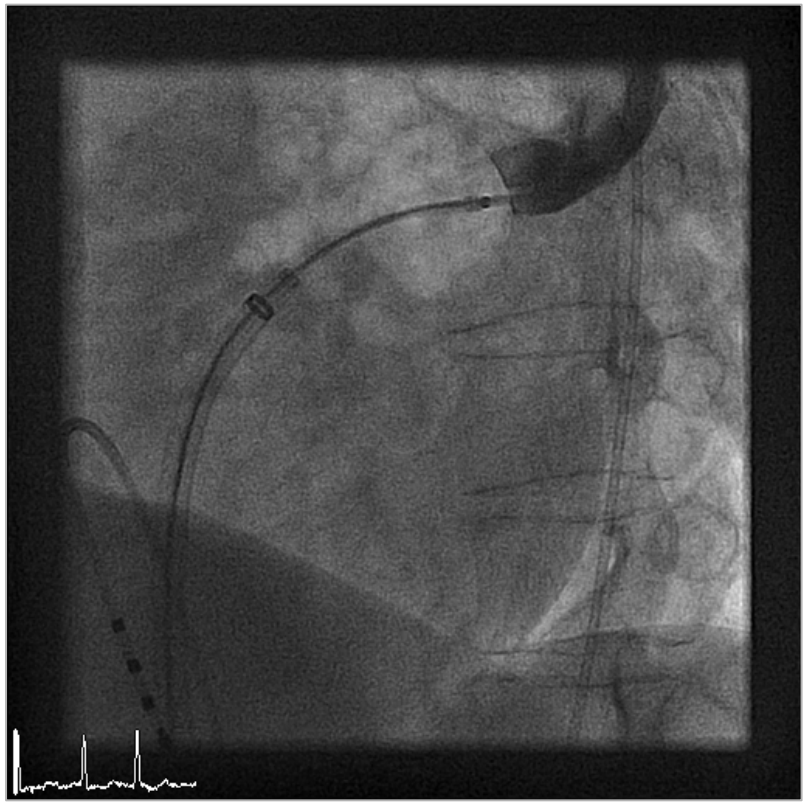
LSPV

Ablation

Guide wire in upper branch

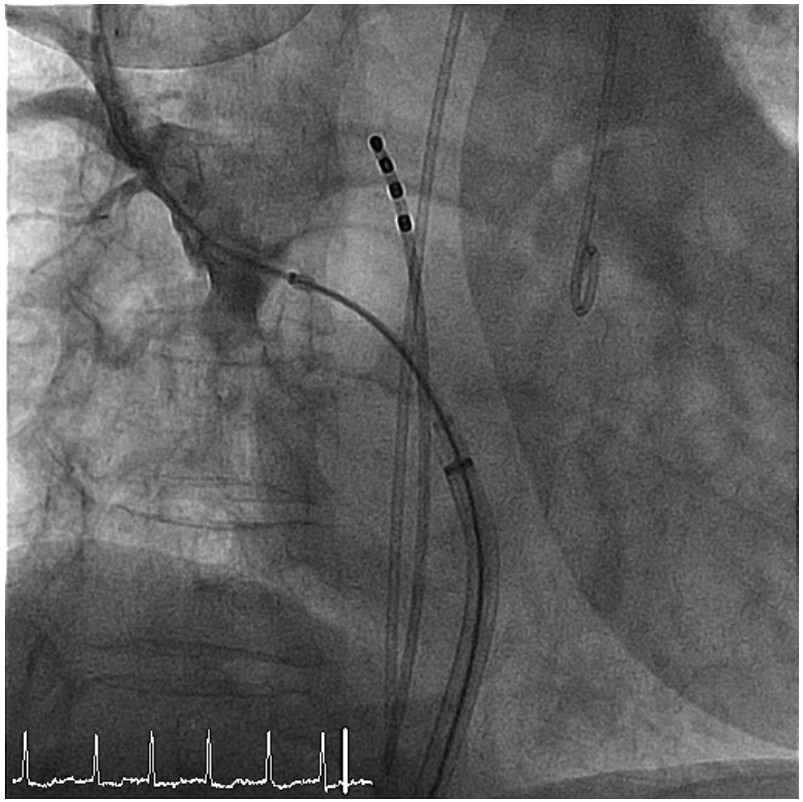


Guide wire in lower branch



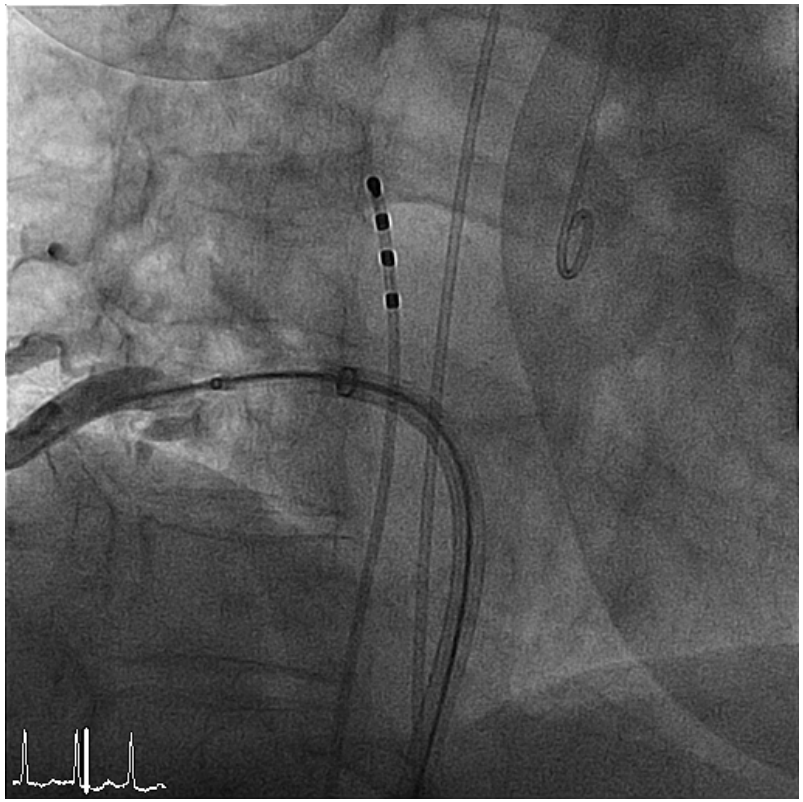
RSPV

Ablation

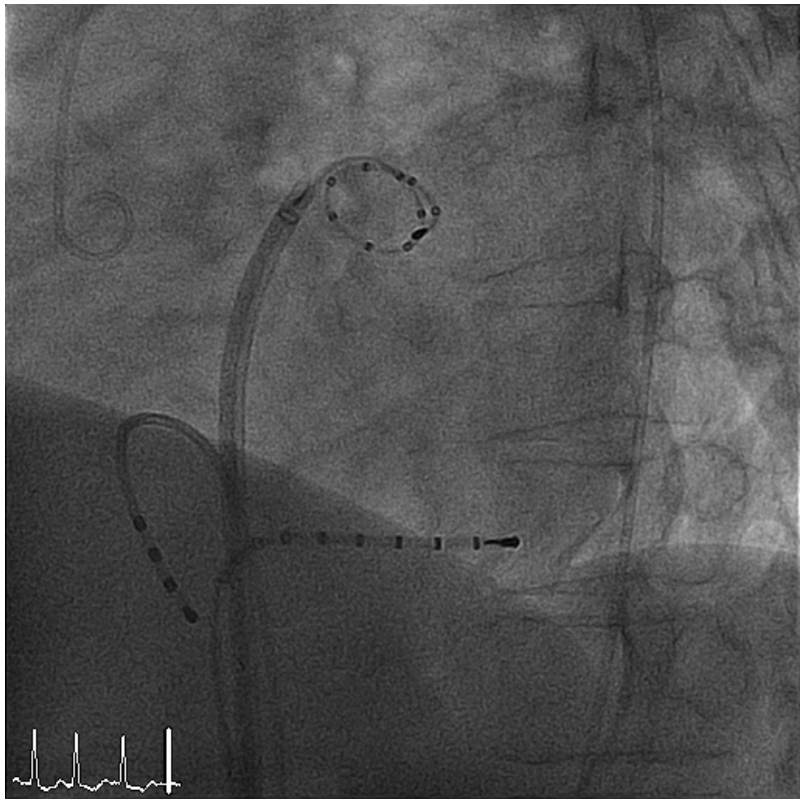


RIPV

Ablation



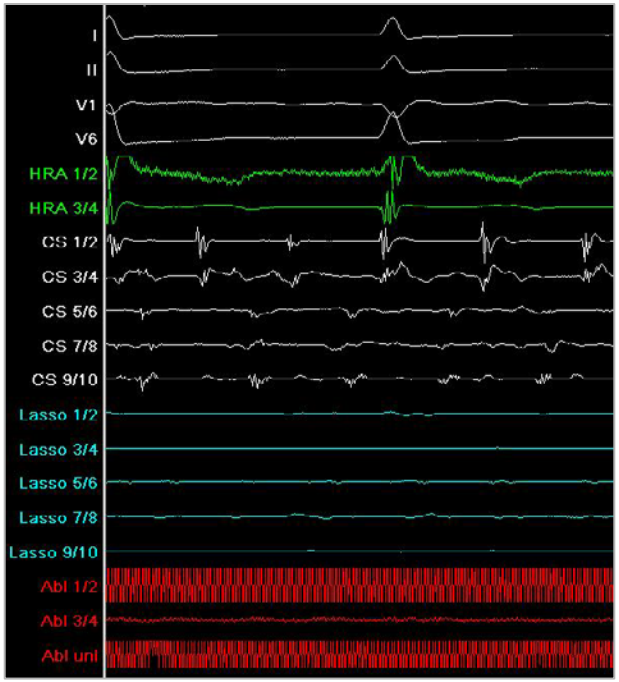
Proof of PV isolation

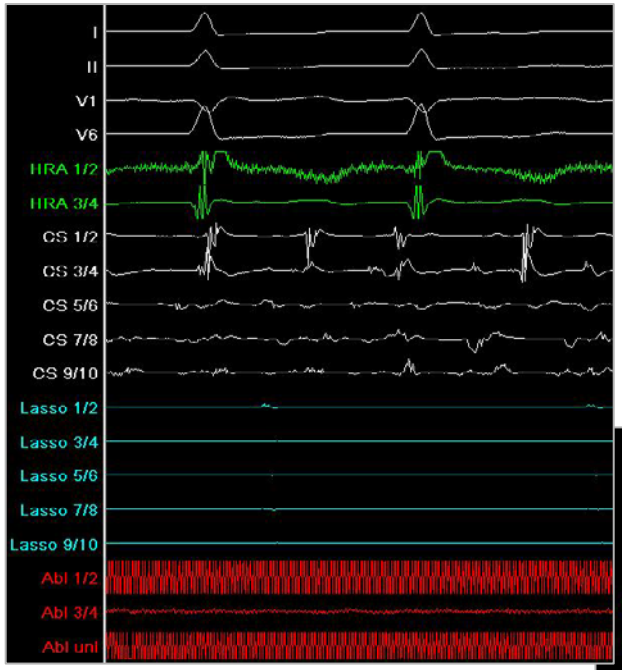


Sizeable
Lasso catheter

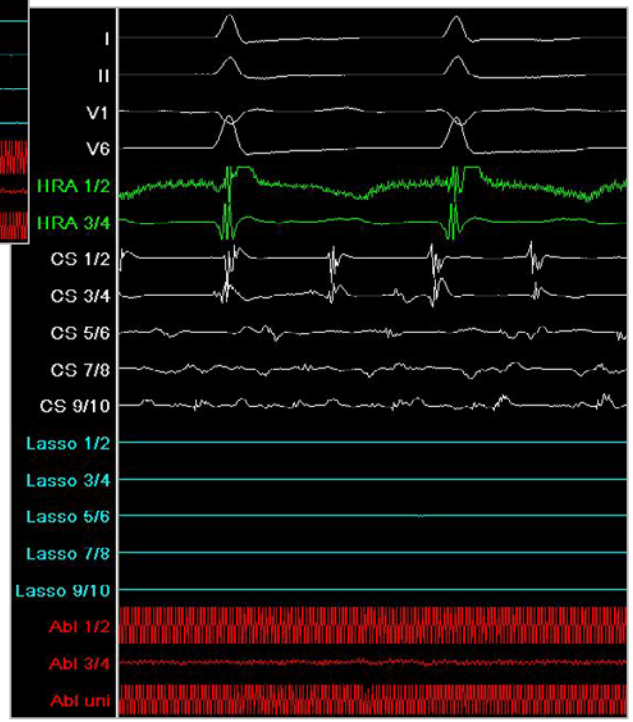
CS catheter

LSPV OCG 4



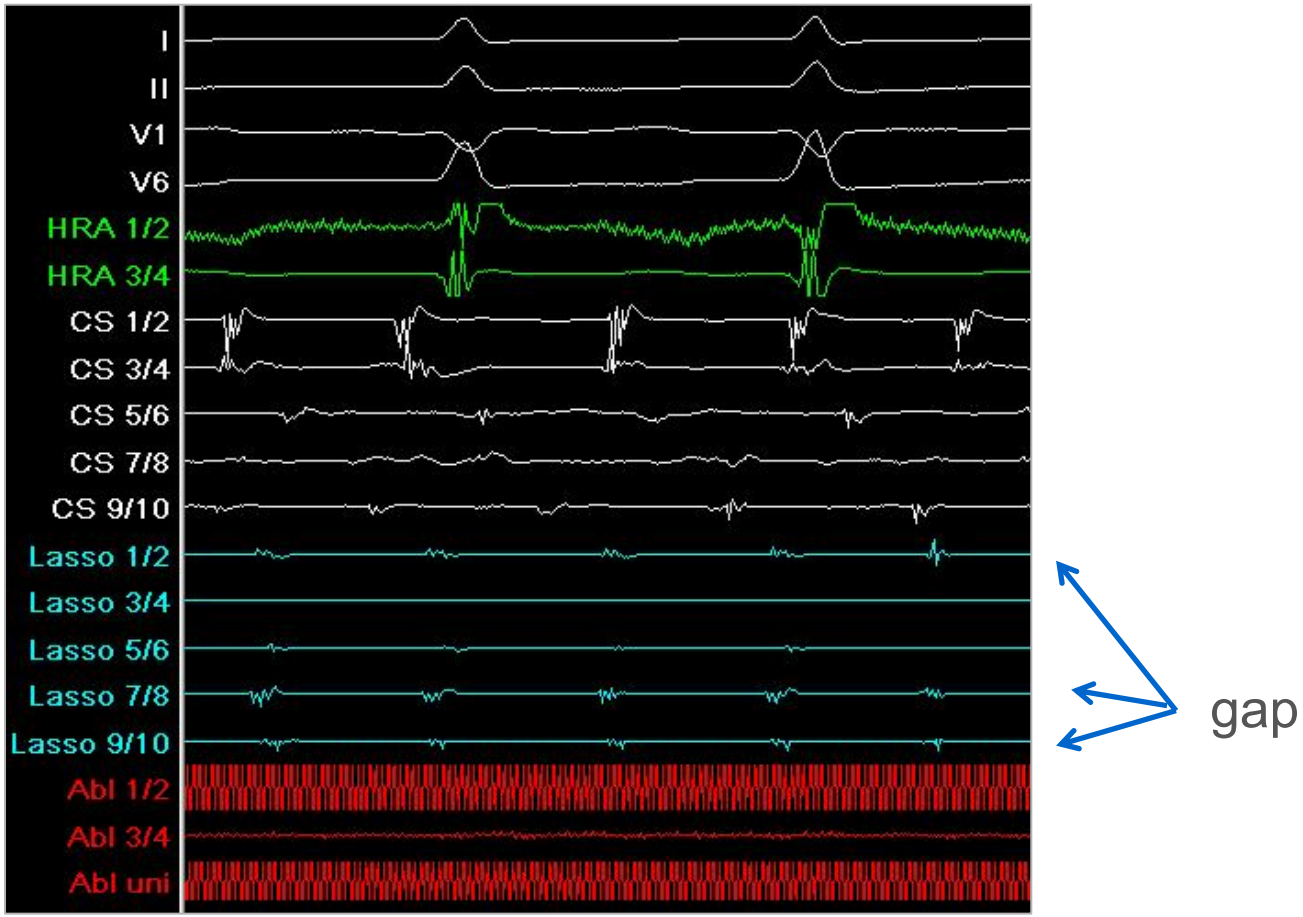


RSPV OCG 4

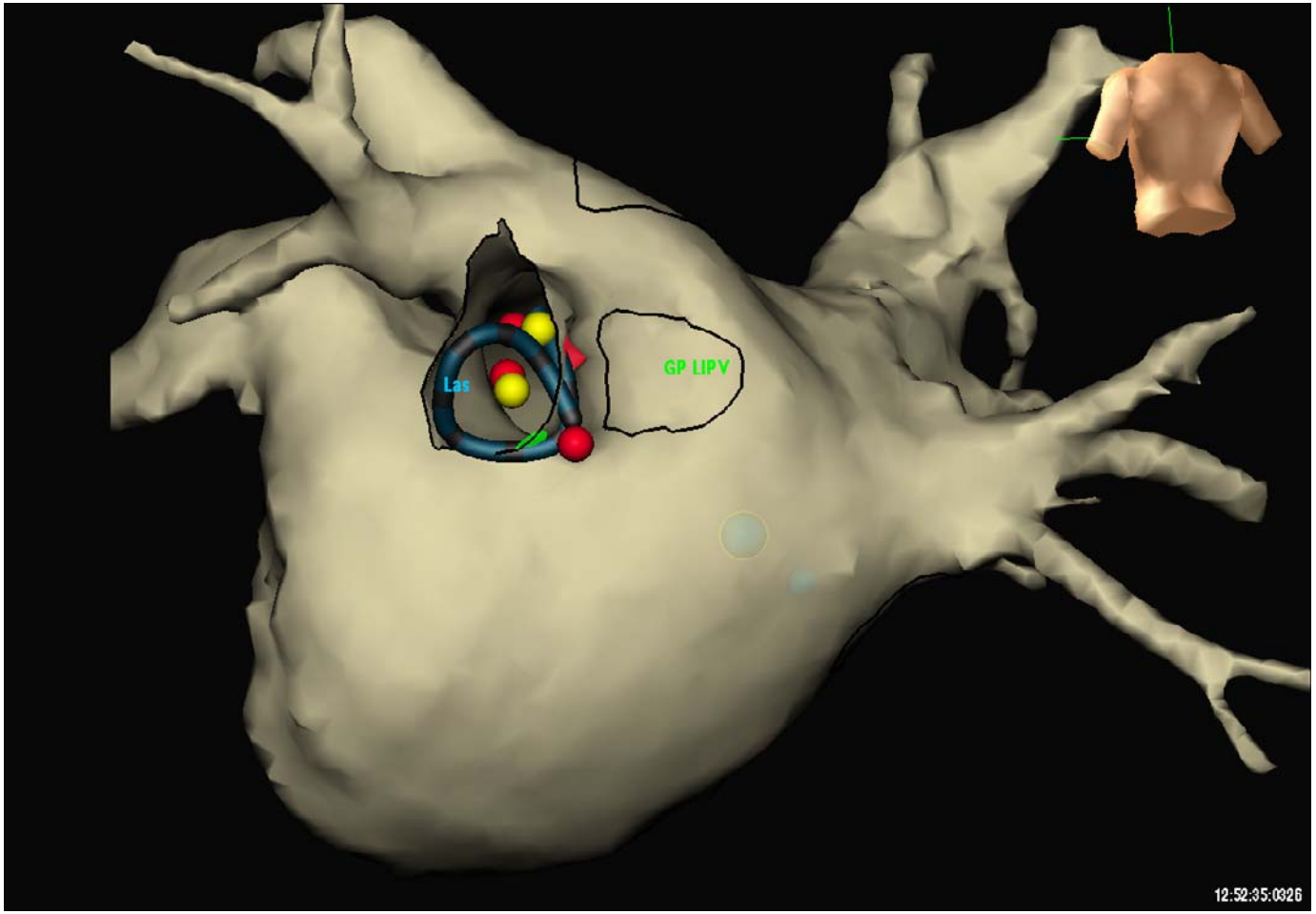


RIPV OCG 3

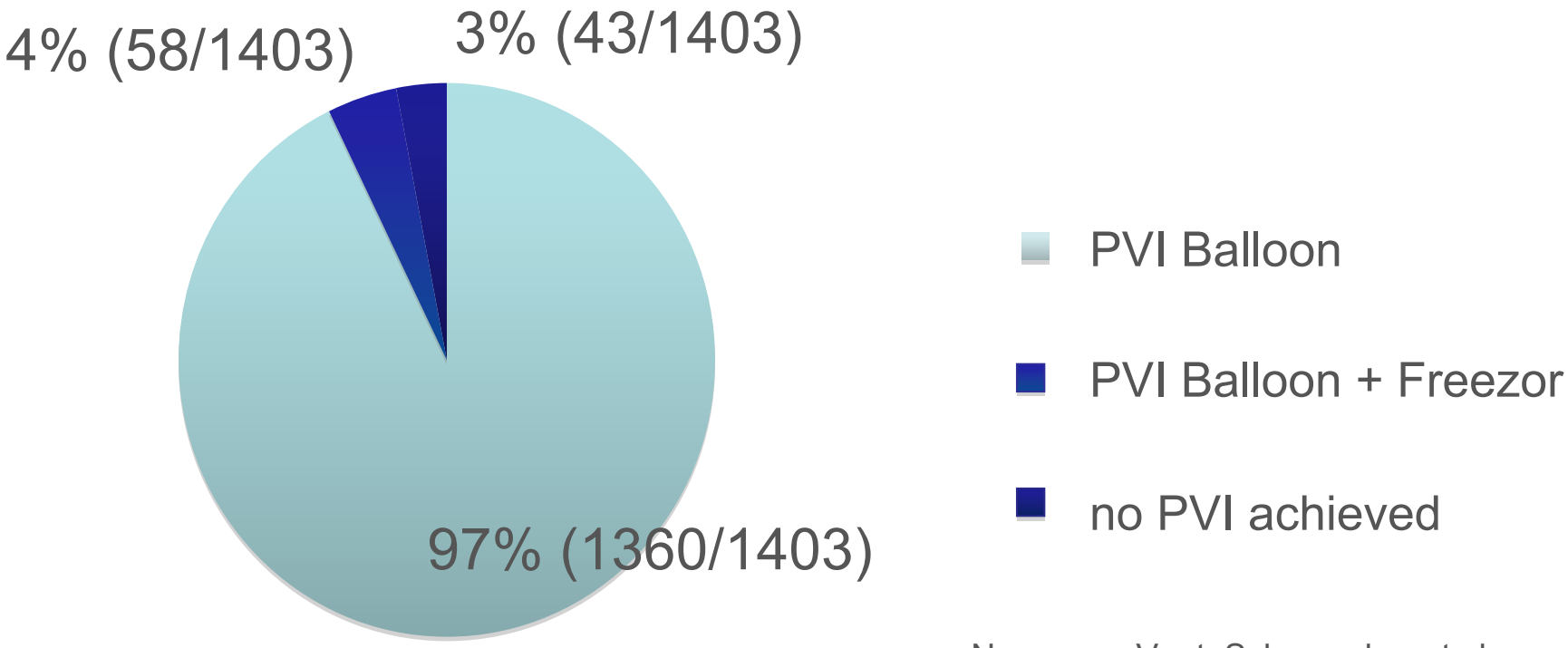
LIPV post Ablation, Occlusion Grade 3



Closing the Gaps of LIPV



Acute PV Isolation rate n = 1403



Neumann, Vogt, Schumacher et al,
JACC 2008, Vol 52, No 4, 273-78

Success Rate PV Isolation
Radio Frequency vs Cryo Technology

	Radio Frequency (%) **	CryoCath (%) *
Paroxysmal Atrial Fibrillation	38-78%	74%
Permanent Atrial fibrillation	35%	38%

** Pooled data from n>50 published studies using RF Ablation:

Pappone et al	JACC 2003:42,185-197
Nademanee K et al	JACC 2004:43,2044-53
Kottkamp H et al	JACC 2004:44:869-877
Haissaguerre M et al	JCE 2005:16:1125-1137
Lim et Al	PCE 2006:29:374-379
....	

* Neumann, Vogt, Schumacher et al, JACC 2008,52,4,273-78

Complications PV Isolation, n = 346 pts.

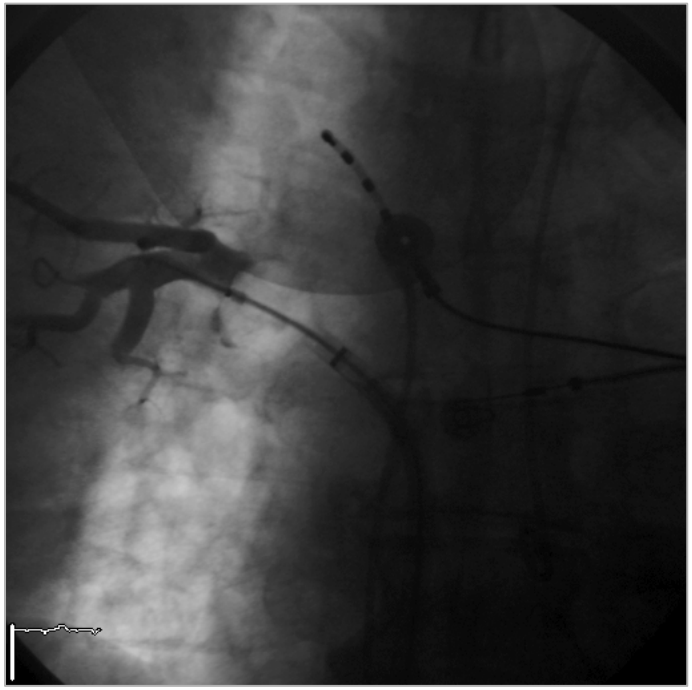
	RF (%)	CryoCath (%)	
Pulmonary vein stenosis	1,3	0	
Esophageal injury	0,25	0	
Coronary artery injury	0,25	0	(0,5 transient ST elevation)
Cardiac tamponade	2,4	0	(0,5 Pericardial effusion)
Phrenic nerve injury	0,5	7,5	(0 one yr follow up)

Neumann, Vogt, Schumacher et al,

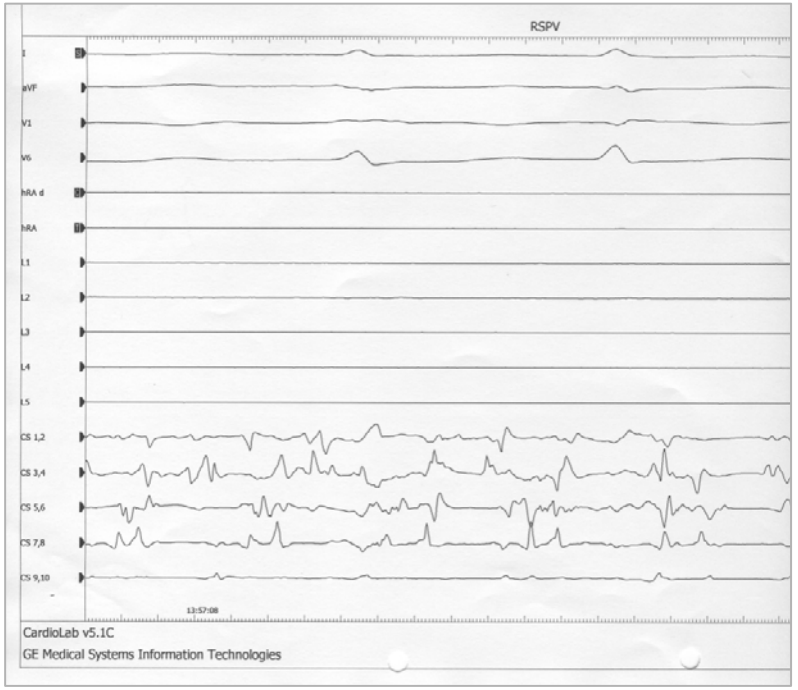
JACC 2008, Vol 52, No 4, 273-78

Ablation RSPV, phrenicus paresis

PP after 140 seconds of cryo application, application immediately stopped, PP transient, no PP at the end of the procedure

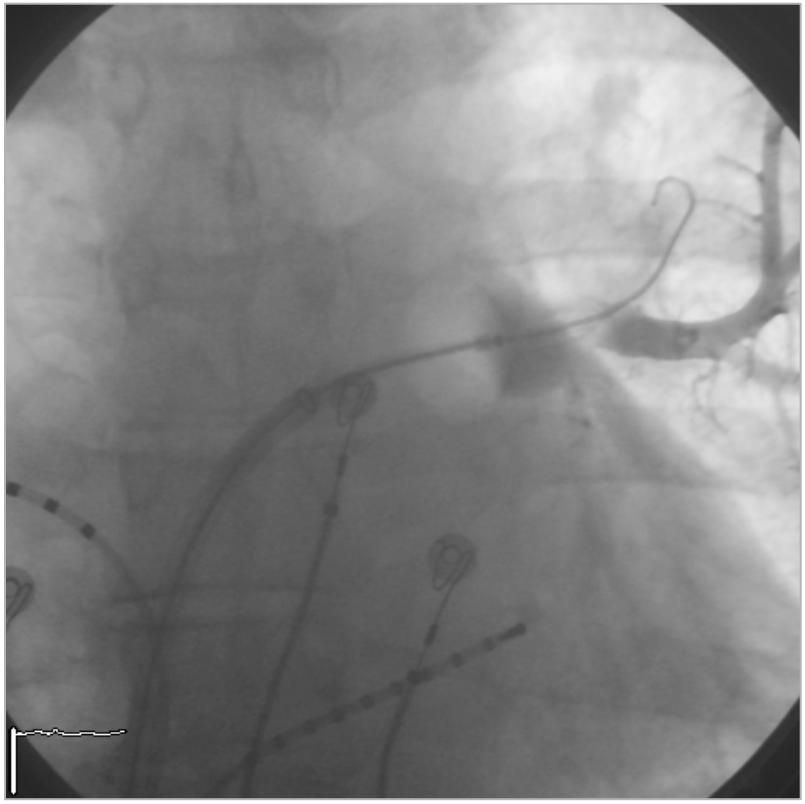


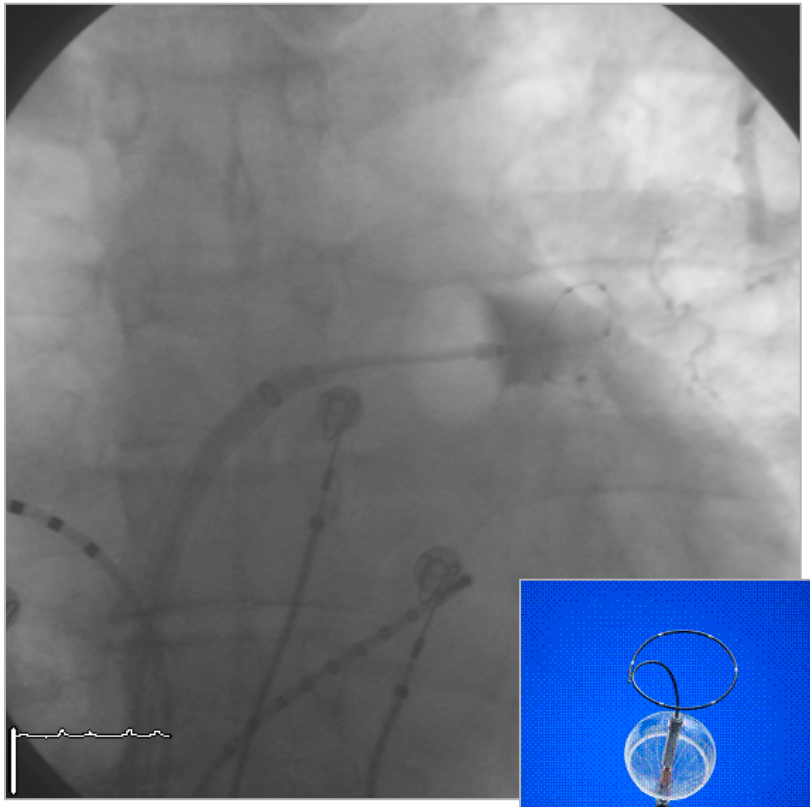
Occlusion grade 4



RSPV post ablation

Ablation LI
Straight guide wire / Promap Lasso guide wire



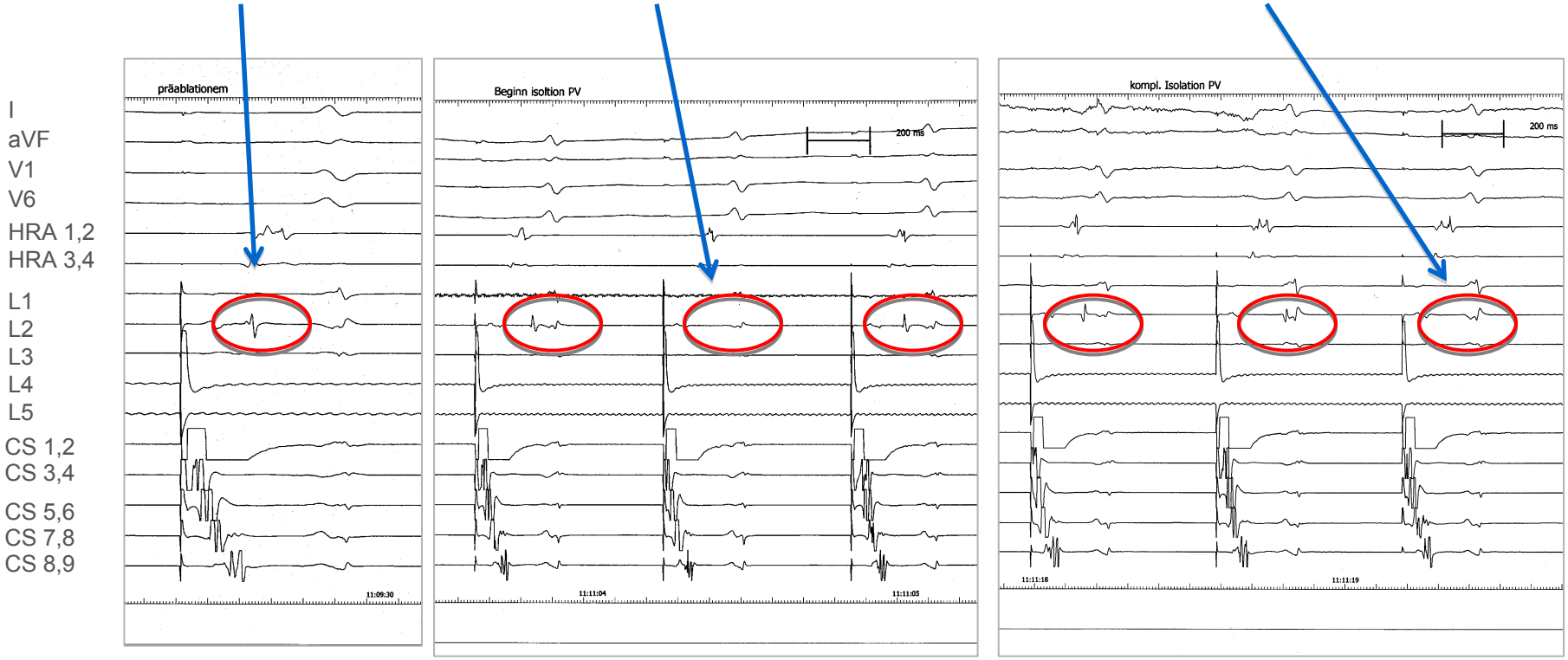


PV-Isolation, pot. recorded during ablation with ProMAP

Before ablation

First degree block

Complete block after 47 sec



Time to Block

- 80 Cryo-PVI pts, measurements of time to block by Pro MAP Lasso wire:

  Time to Block < 82 sec
  = no PV reconnection
  = no AF reoccurance
  (spec & sens of 95%)

➢ good occlusion, short freezing time to block, no reoccurance of AF

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Cryoballon PVI, first conclusions

- in PAF with normal LA efficient and fast method, very safe, no PV potential measuring neccessary if vein totally occluded, single freeze, small ballon aproach possible

- bigger veins need bigger balloons, best fitting balloon aproach including PV measurements and touch up freezing for all other cases recommended

- in PsAF outcome to poor, additional substrate modification is needed, so far no approach published with cryo

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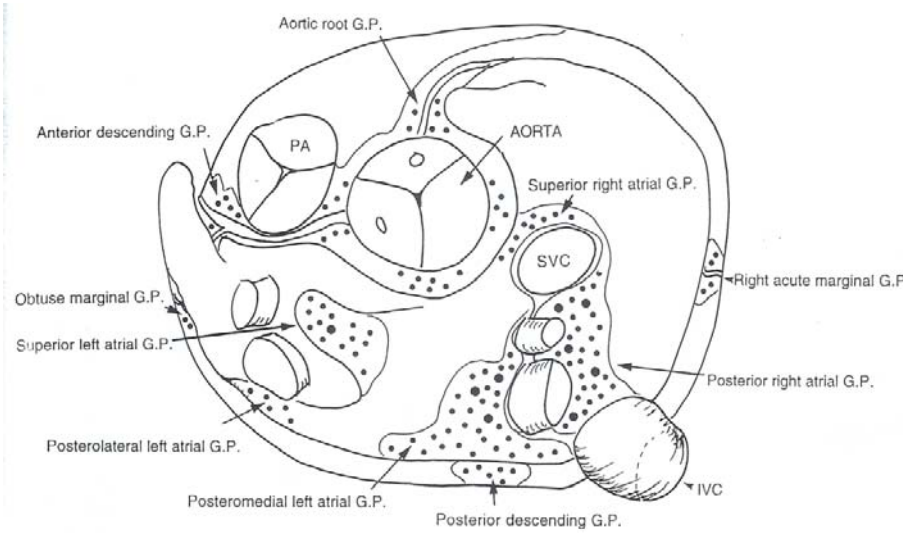
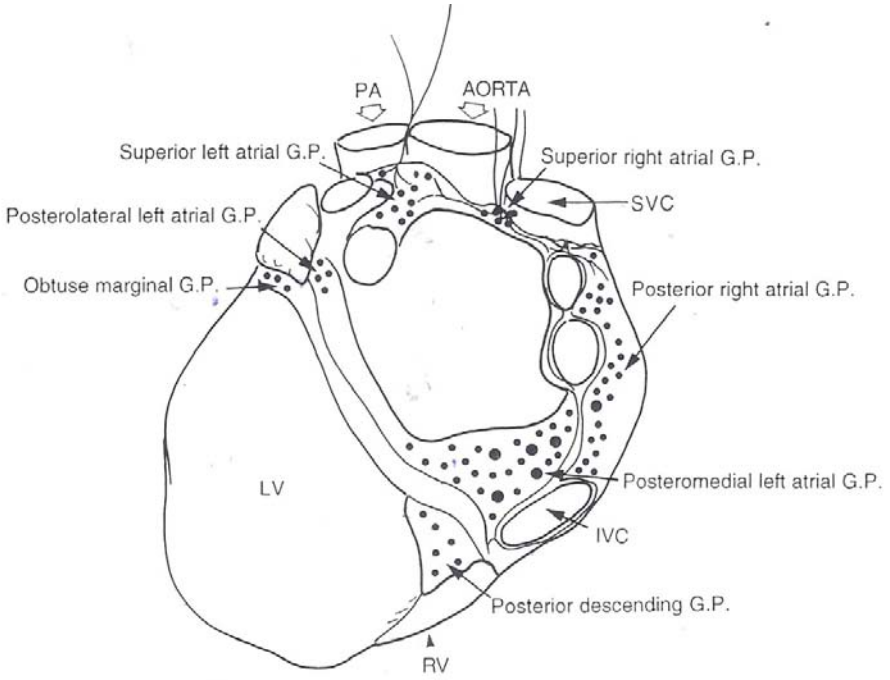
Which LA substrate modifications (additional to pulmonary vein isolation) is possible with the Cryo Technique?

1. Linear Lesions
2. Complex Atrial Fractionated Electrograms (CAFE) ablation
3. Ganglionated Plexus Ablation

Human intrinsic cardiac nervous system, location of ganglionated plexus





Gross and Microscopic Anatomy of the Human Intrinsic Cardiac Nervous system, J.A.Armour et al

The Anatomical Record 247:289-298 (1997)

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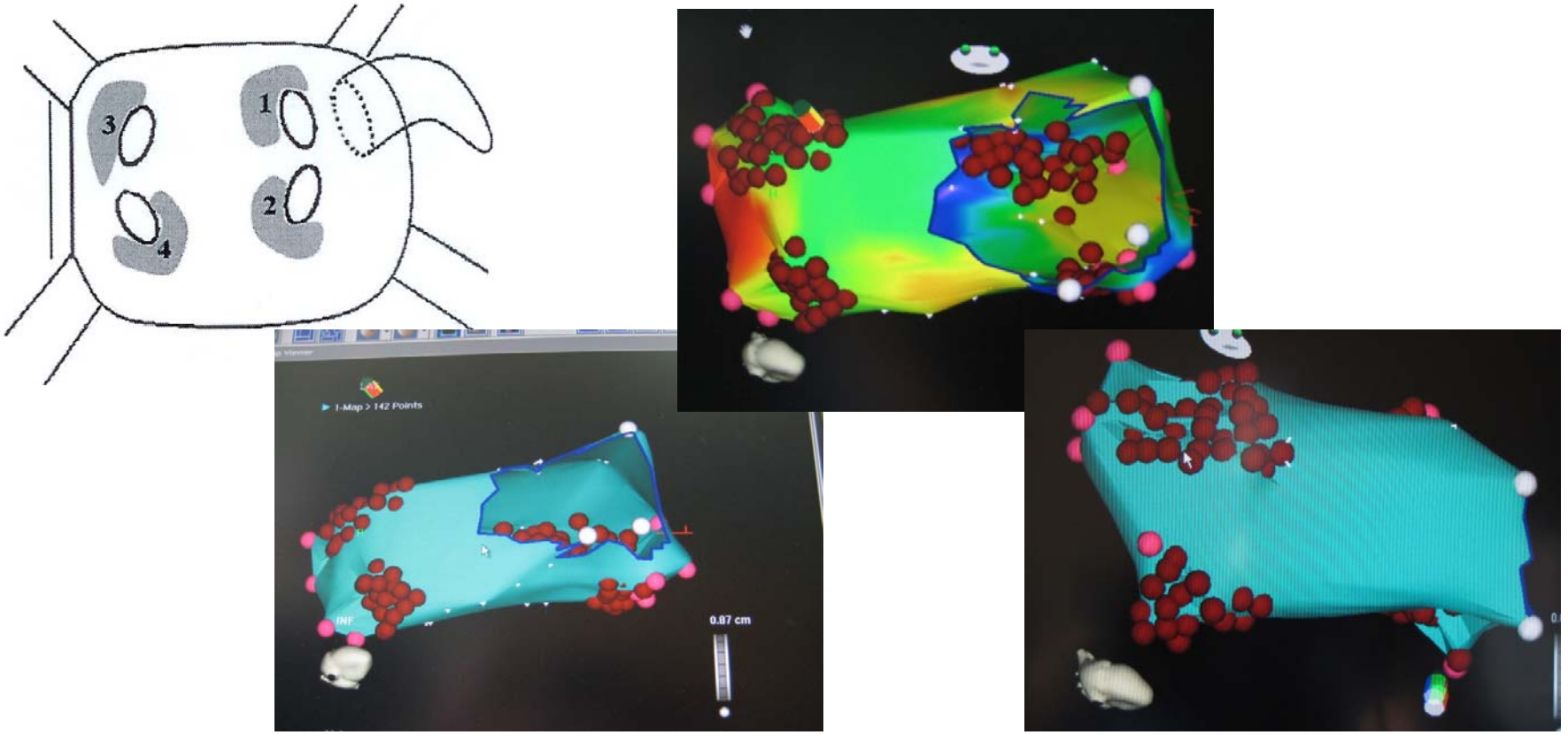
Basic science, ganglionated plexus ablation

- High frequency stimulation of GP leads to atrial fibrillation
- Neurotransmitter from GP (acetylcholine, epinephrine) shorten atrial refractary period
- GP ablation transiently decreases heart rate variability
- Cardiac GP have a low anatomic location variation

Catheter Ablation of Left Atrial Ganglionated Plexi for Atrial Fibrillation, targeted GP Areas



Pokushalov E et al, Heart Rhythm. 2009 Sep;6(9):1257-64

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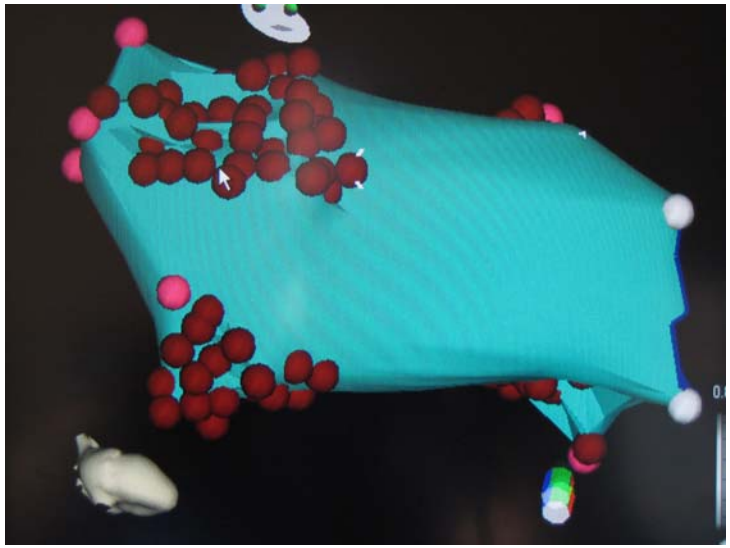
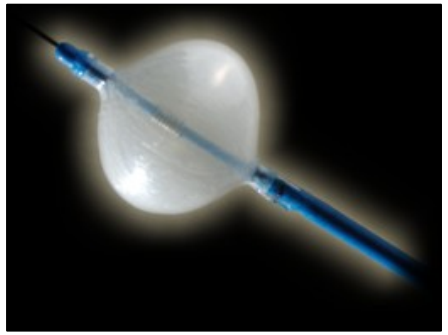
GPA for treating Atrial fibrillation

- N=58 Patienten, 41-67 Jahre (21permanent/22persistierent/15 paroxysmal)
- Vorhofgröße 93.1+- 6.1 ml
- Ganglien Plexus Ablation, 4 Regionen des linken Vorhofes
- Keine circumferentielle Pulmonalvenenisolation
- Vorhofflimmern terminierte in 94.1%
- 7 Monats Erfolgsrate: 86% SR

Cryo-Ganglionated Plexus Ablation ?

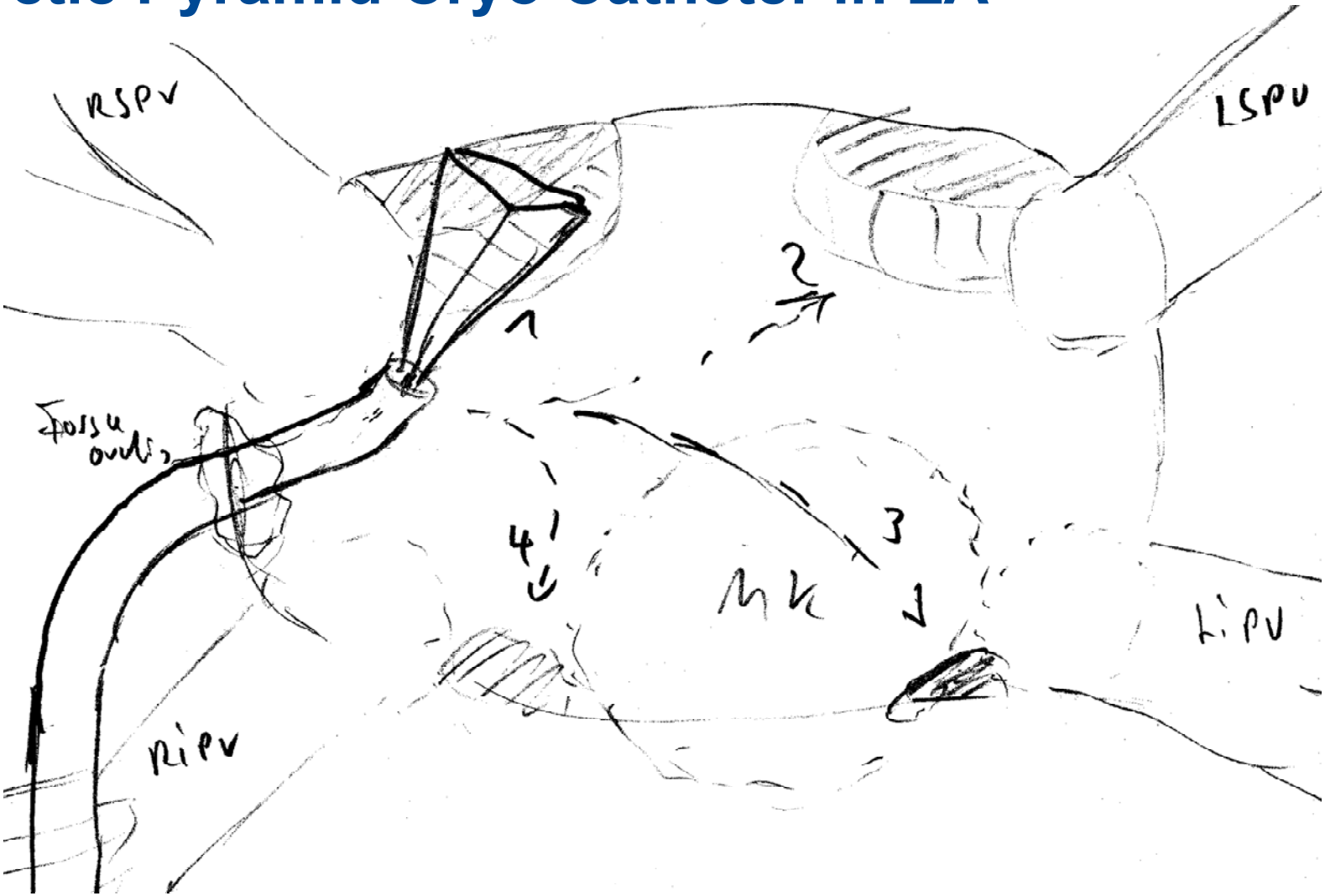
- Idea: Combining the efficacy of the anatomical guided GP ablation approach with the safety of the Cryo technology



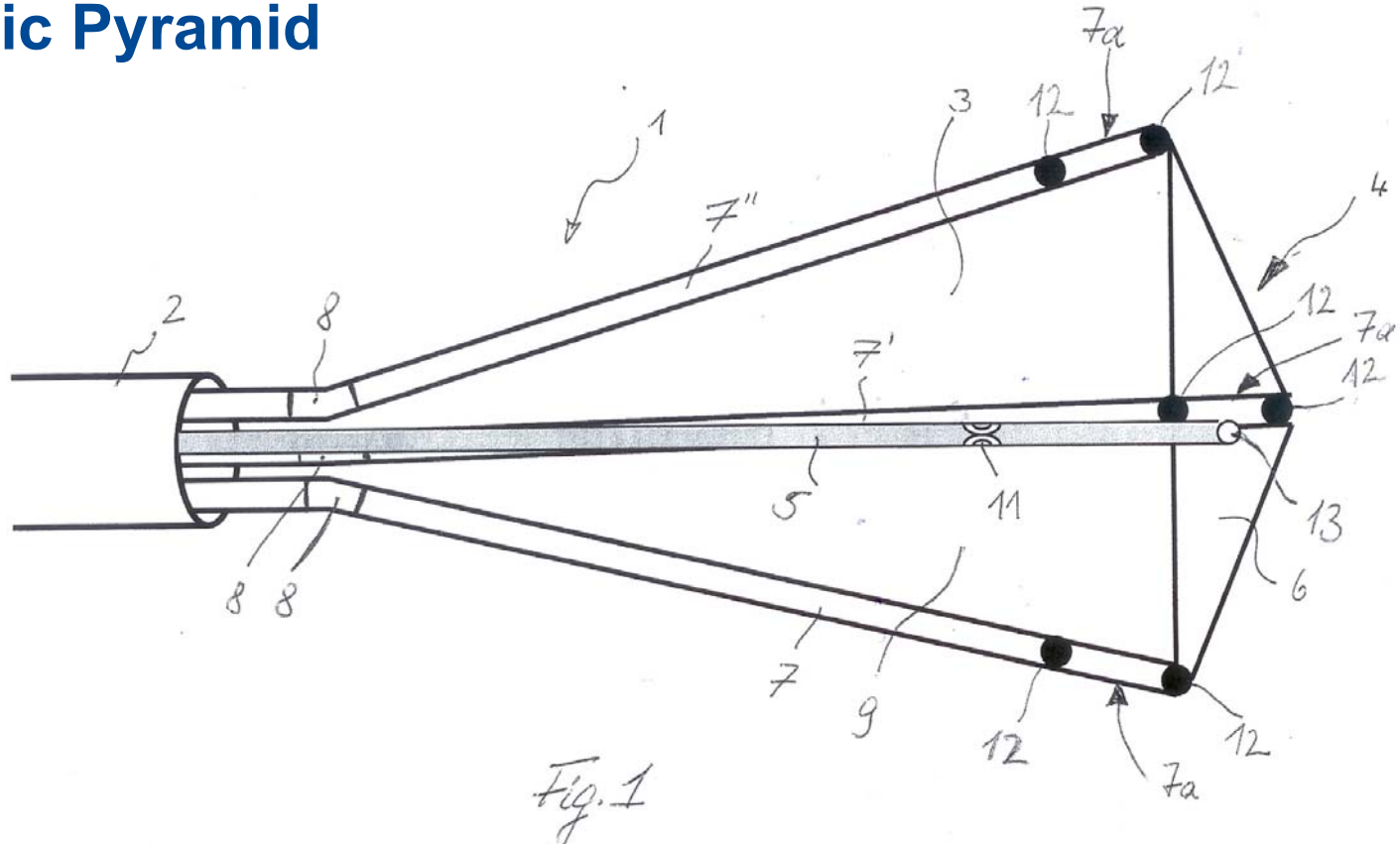


Problems:
Focal cryo ablation to slow
balloon does not hit all of the GP target areas

Arctic Pyramid Cryo Catheter in LA



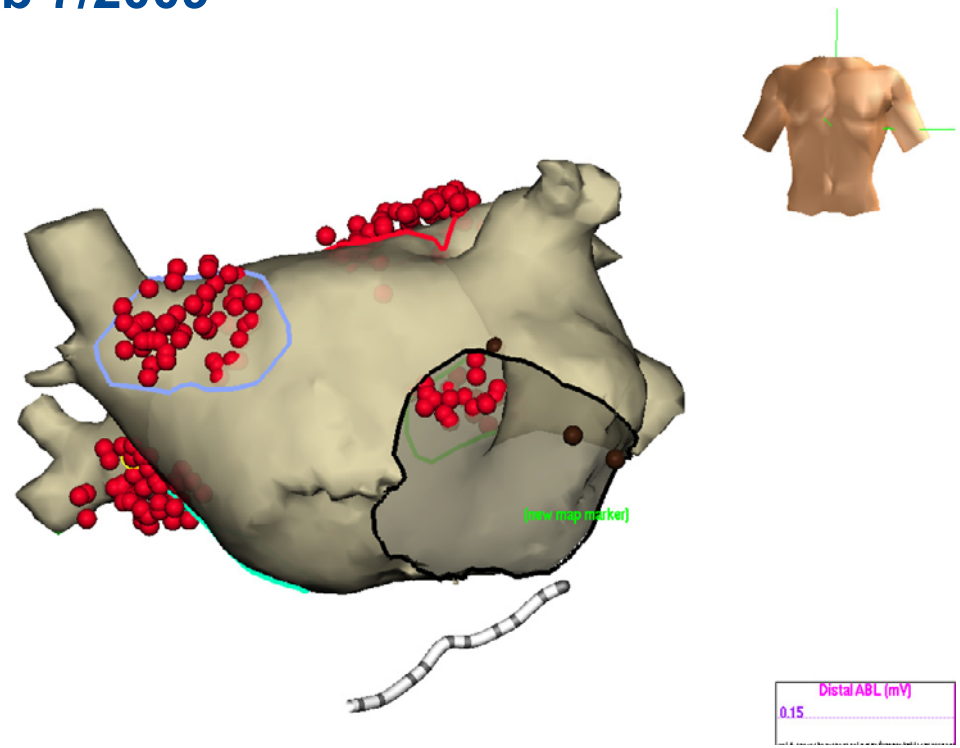
Arctic Pyramid



Patentanmeldung, Deutsches Patent- und Markenamt München, 29.05.2009, KEW090501GDE-5/CS

RF Ganglionated plexus ablation

first two cases ukb 7/2009

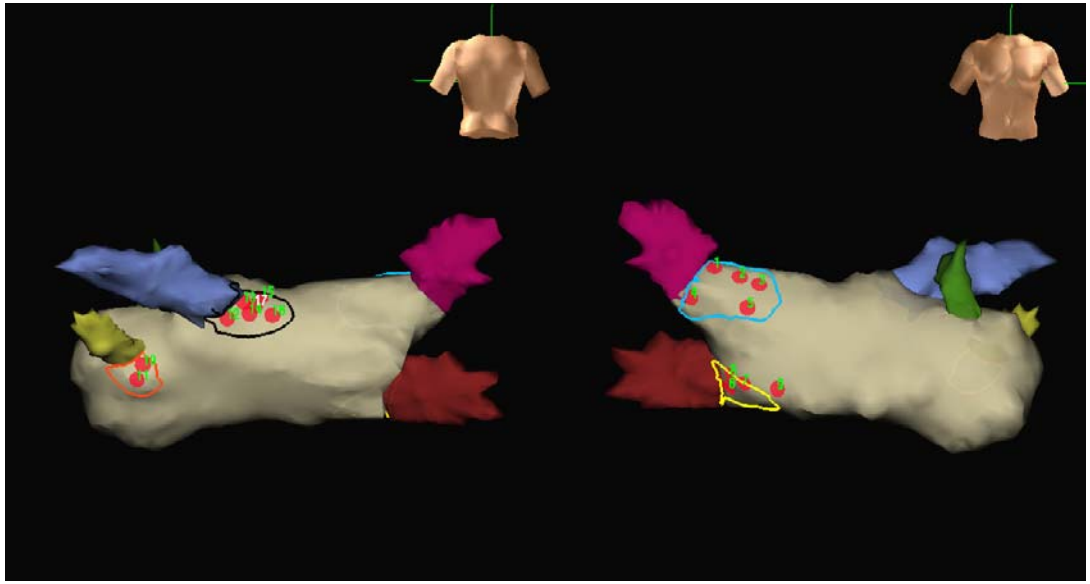


3D EnSite NavX Map combined with CT scan

Cryo ganglionated plexus ablation 20 cases since 7/2009

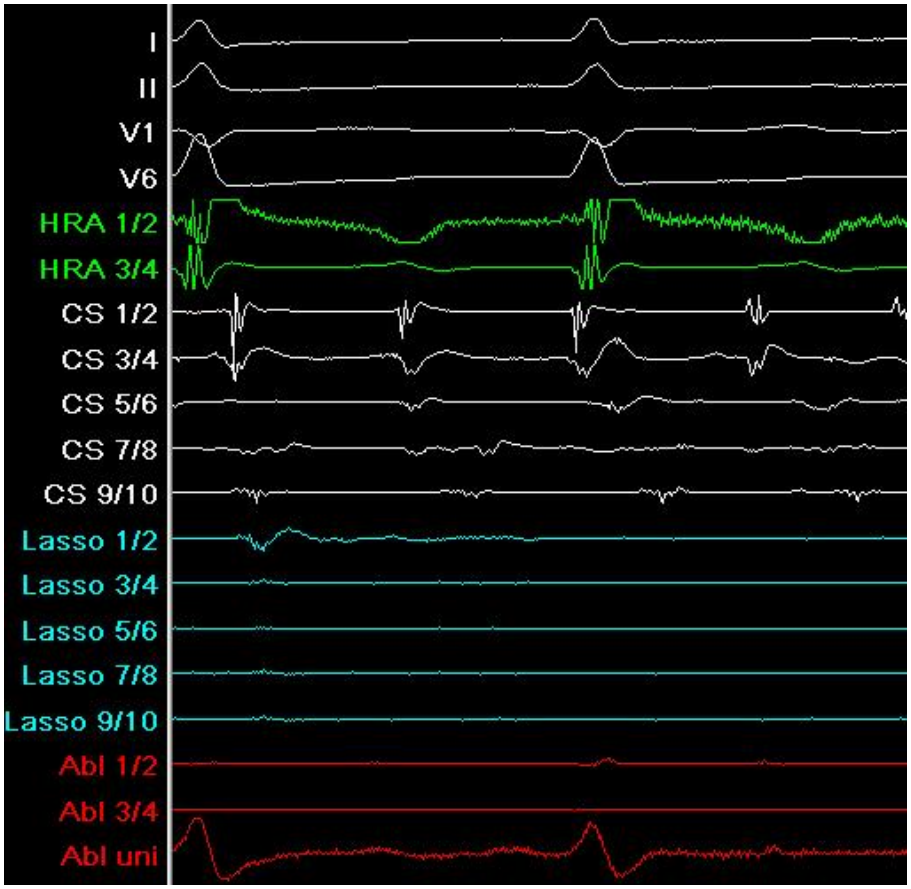
Technique:

- CS catheter
- Single transseptal puncture stearable Agilis Sheat
- Freezor Extra focal Cryo catheter
- Ensite NavX 3D Map of LA
- Anatomical GPA, 4 areas, 3 minutes freezing per point, 30-40 points, additional lesions from RA

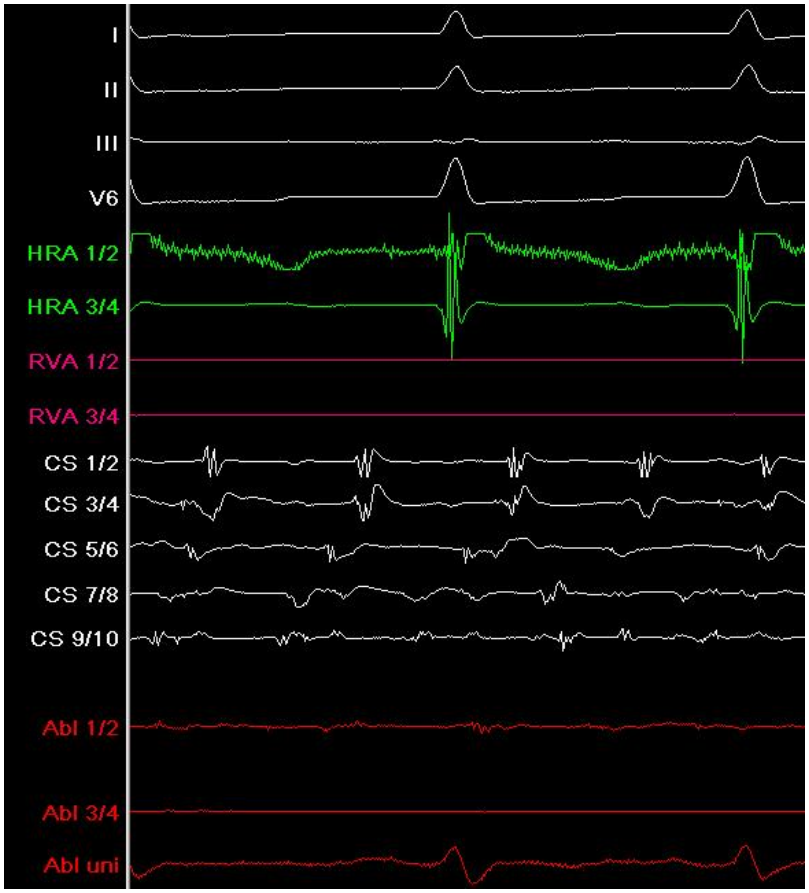


Voltage Mapping, GP target Areas

LI GP Area



LS GP Area

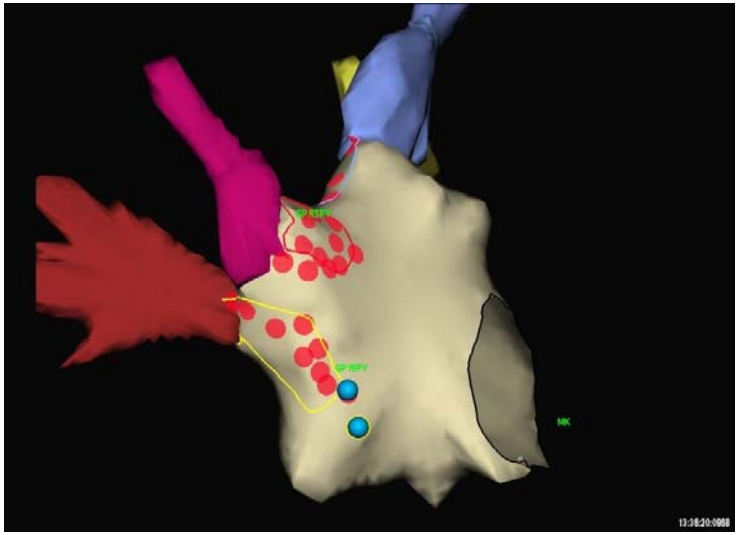


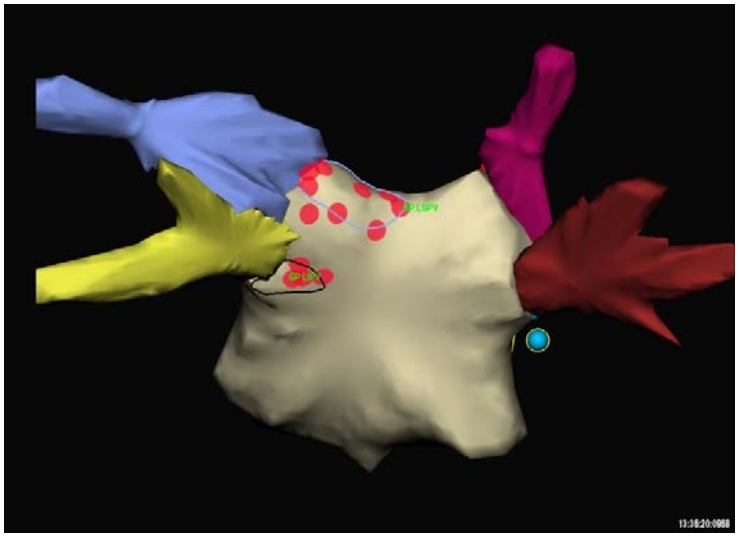
Cryo GPA

- Male pat, 67 years
- non significant coronary heart disease
- CTI ablation 2009
- No more Aflut but highly symptomatic episodes of PAF
- Normal LA size

- 32 lesions in 4 regions including from RA

- 3months follow up 72h ECG: 10h PAF, symptoms better, fewer episodes





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Cryo GPA, results & conclusions

- 20 pts. so far:
- 8 pts Cryo GPA in PAF, 2 pt Cryo GPA in PsAF
- 5 pts Cryo PVI + GPA in PsAF, 5 pts Cryo PVI + GPA in LsAF

- Cryo GPA technically possible
- The cryoballoons ablate big parts of the GP target areas (28 > 23mm balloon) if GPA is used additional to PVI
- Stand alone Cryo GPA with focal cryo catheter is possible but takes very long (4h)
- Wall potentials reduced, transmurality unknown, efficiency unknown
- Success rate so far not known

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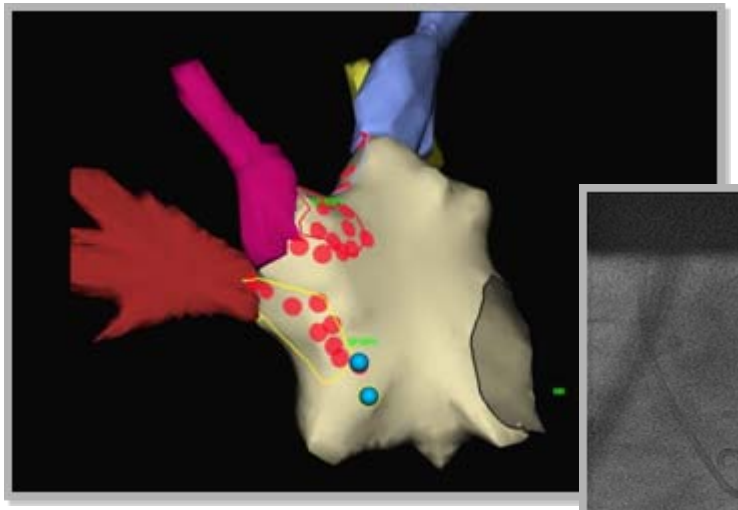
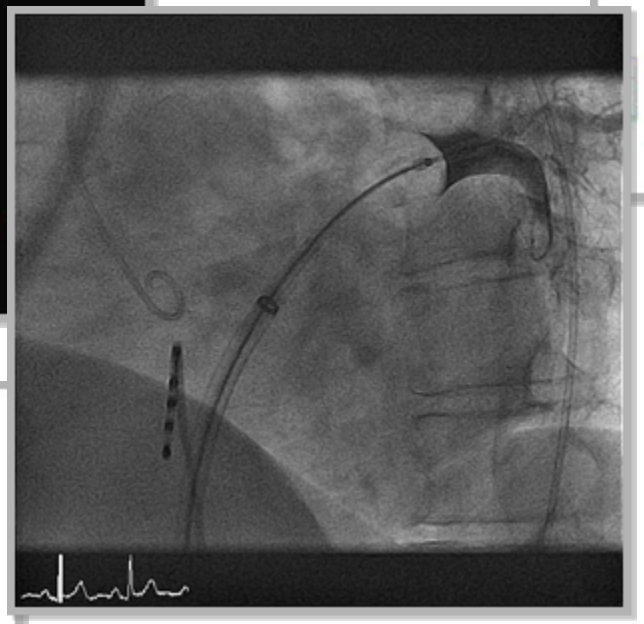
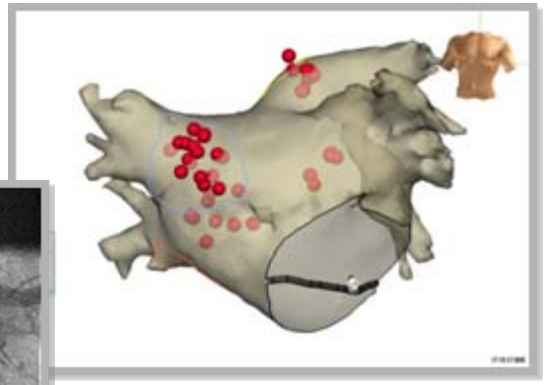
Which adventages does the cryo technique offer?

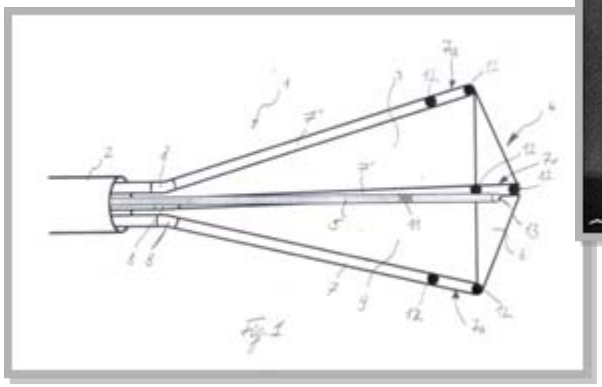
- Cryoballon technically easy, very standardized, short procedure
- Very good success rates in Paroxysmal AF
- Success rates yet low in PsAF and LsAF, as with RF ablation, but we are working on it...
- Very safe technology

Vielen Dank für Ihre Aufmerksamkeit !



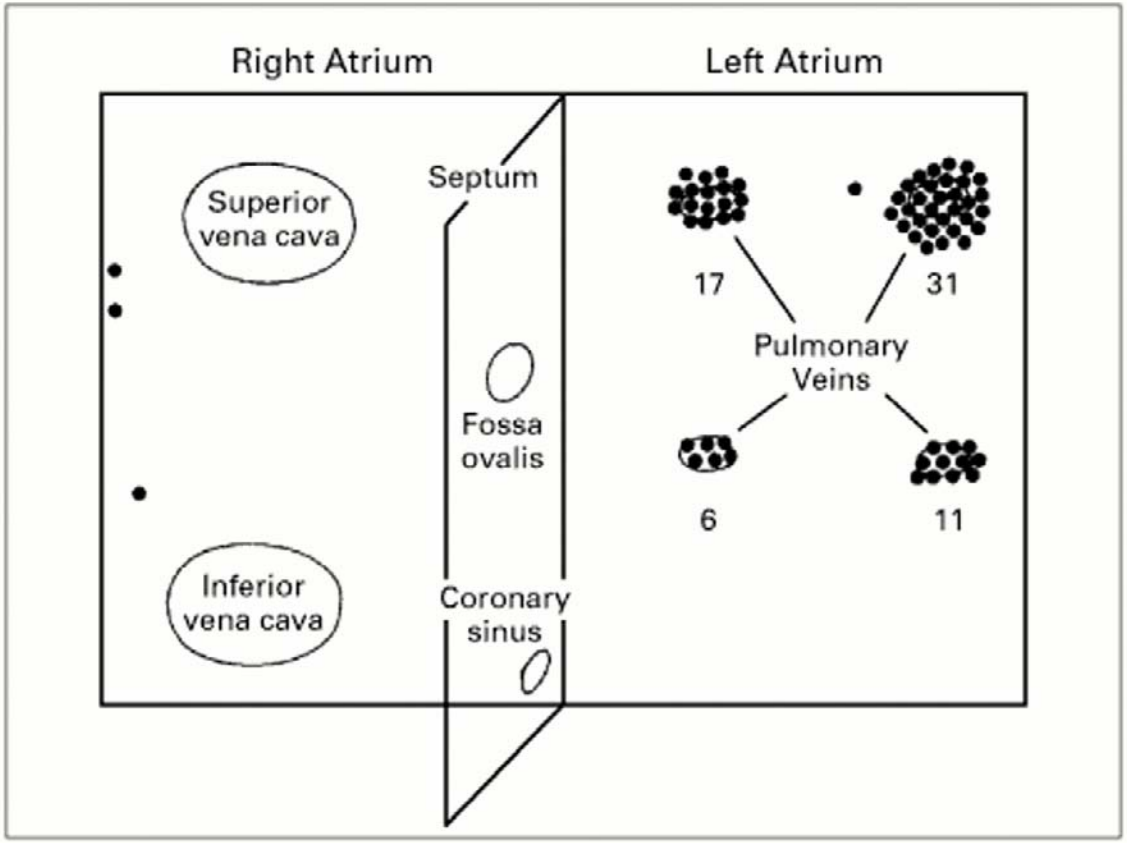






Unfallkrankenhaus Berlin

Diagram of the Sites of 69 Foci Triggering Atrial Fibrillation in 45 Patients



Haissaguerre M et al. N Engl J Med 1998;339:659-666

Cryoballon PVI with real time recordings from the pulmonary veins

- 18 pts, 39 of 72 PV´s = 54% real time ProMap recording during PVI
- 46% without recording: no PVI, distal position ProMap, isolation with regular guide wire
- Time to block shorter in PV with sustained isolation > 30 minutes

Chun, Kuck et al, J Cardiovasc Electrophysiology 2009 Nov;20(11):1203-10

- 23 pts, 51% ProMap, feasibility study

Tang, Gerds-Li et al, J Cardiovasc Electrophysiology 2010 Jun 1;21(6):626-31

Unfallkrankenhaus Berlin

Long-term clinical outcome after GP - ablation for atrial fibrillation: anatomical approach versus selective approach

80 patients. Two groups. At 12 months, 42.5% of patients who underwent SGPA and 82.5% of patients who underwent AGPA were free of symptomatic PAF. Parasympathetic denervation was more prominent in patients free of AF compared to these with AF recurrence.

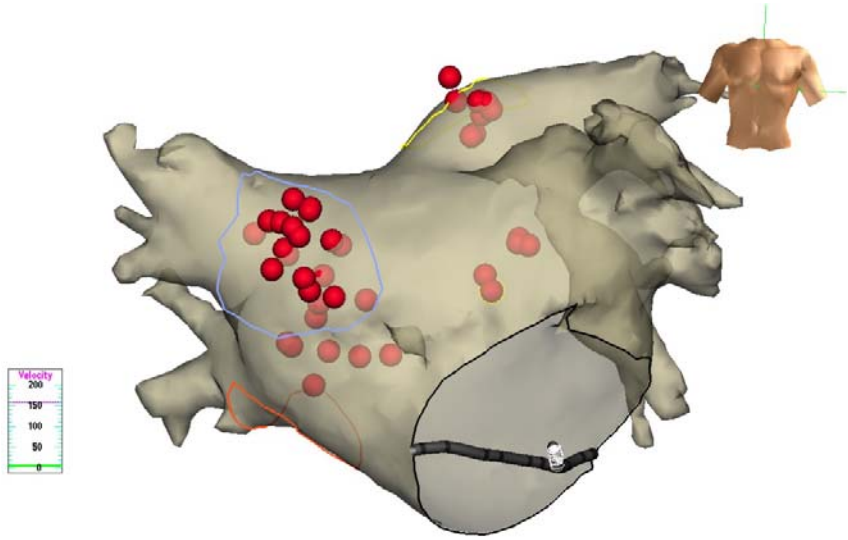
Pokushalov et al Europace Journal (2009) 11 (S6), Abstract 91

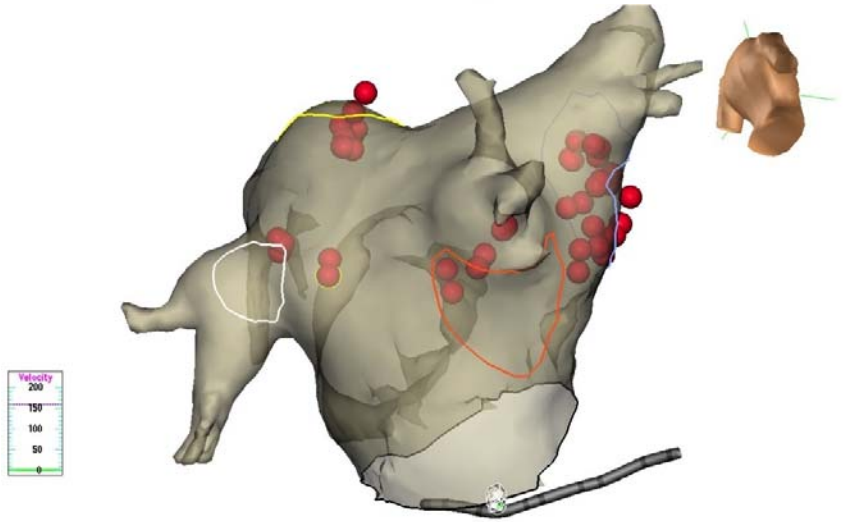
Cryo GPA

- Male pat, 80 years
- PAF since 1 year
- 2 symptomatic episodes per week

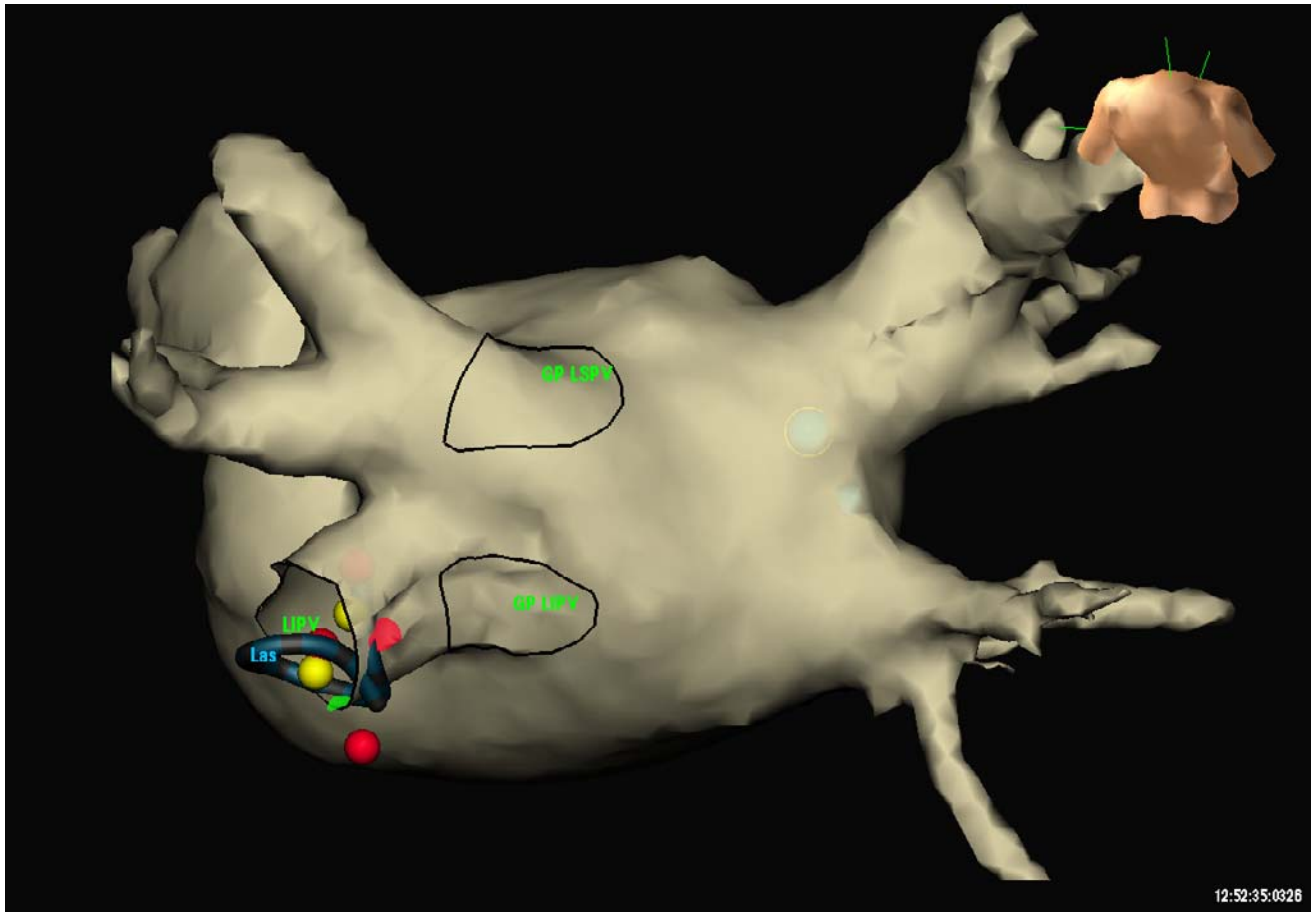
- 19 lesions in 4 regions

- 3months follow up:
- Sinusrhythm





After Cryo-PVI additional Cryo-GPA as Substrate Modification



Cryoballon PVI temporarily modulates the intrinsic cardiac autonomic nervous system

- 14 pts, PAF, Cryoballon PVI, acute HR changes, heart rate variability during holter at 1 week, 1, and 3 months
- 36% braycardia during PVI, HRV decreased at 1 week and 1 months, normalised at 3 month

Oswald, Klein et al, J Interv Card Electrophysiology 2010 Oct;29(1):57-62