

# Katetrizační ablace FiS: Indikace, výsledky a perspektivy

Prof. MUDr. Petr Neužil, CSc., FESC



*Kardiocentrum Nemocnice Na Homolce  
Praha*



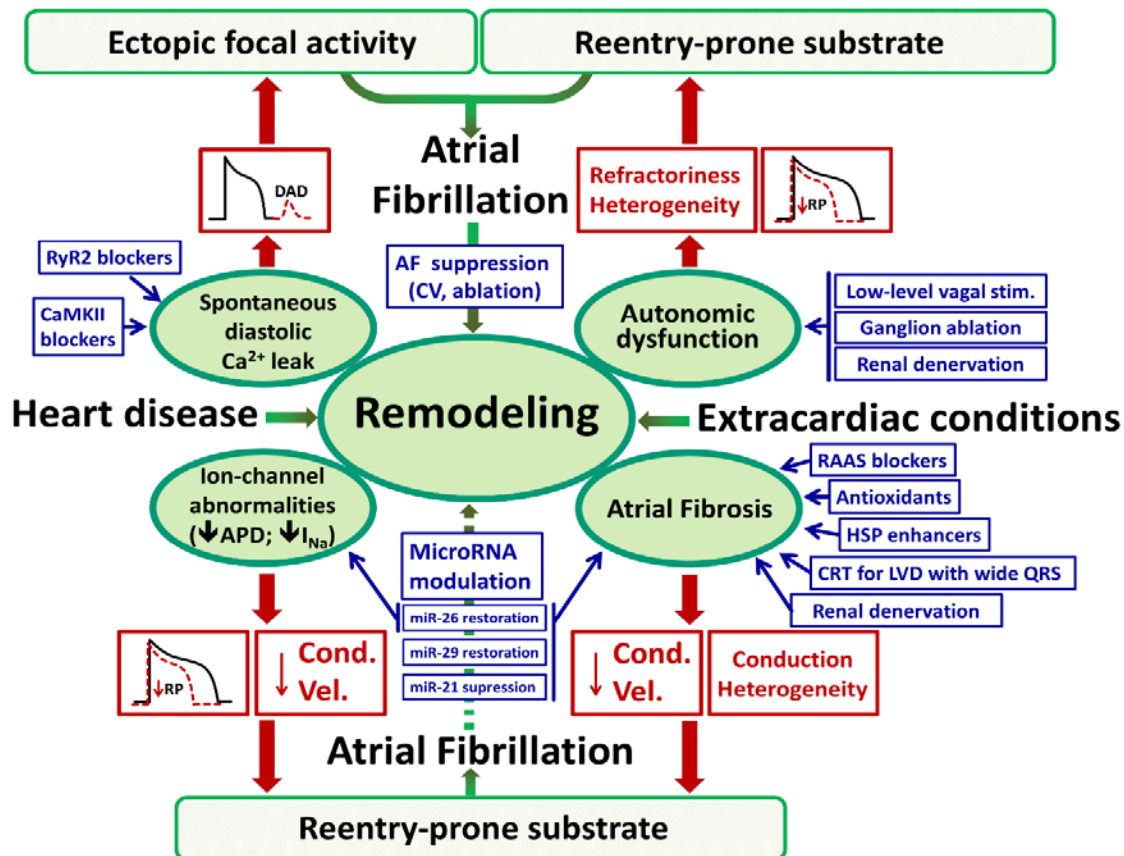
# Konflikt zájmů

- Konzultant & podpora výzkumného grantu:

- Abbott EP Inc
- ACT Medical Inc.
- Acutus Inc.
- Apama Medical Inc.
- Biosense Webster
- Boston Scientific Inc.
- Medtronic Inc.
- St Jude Medical Inc.
- VytronUS Inc.

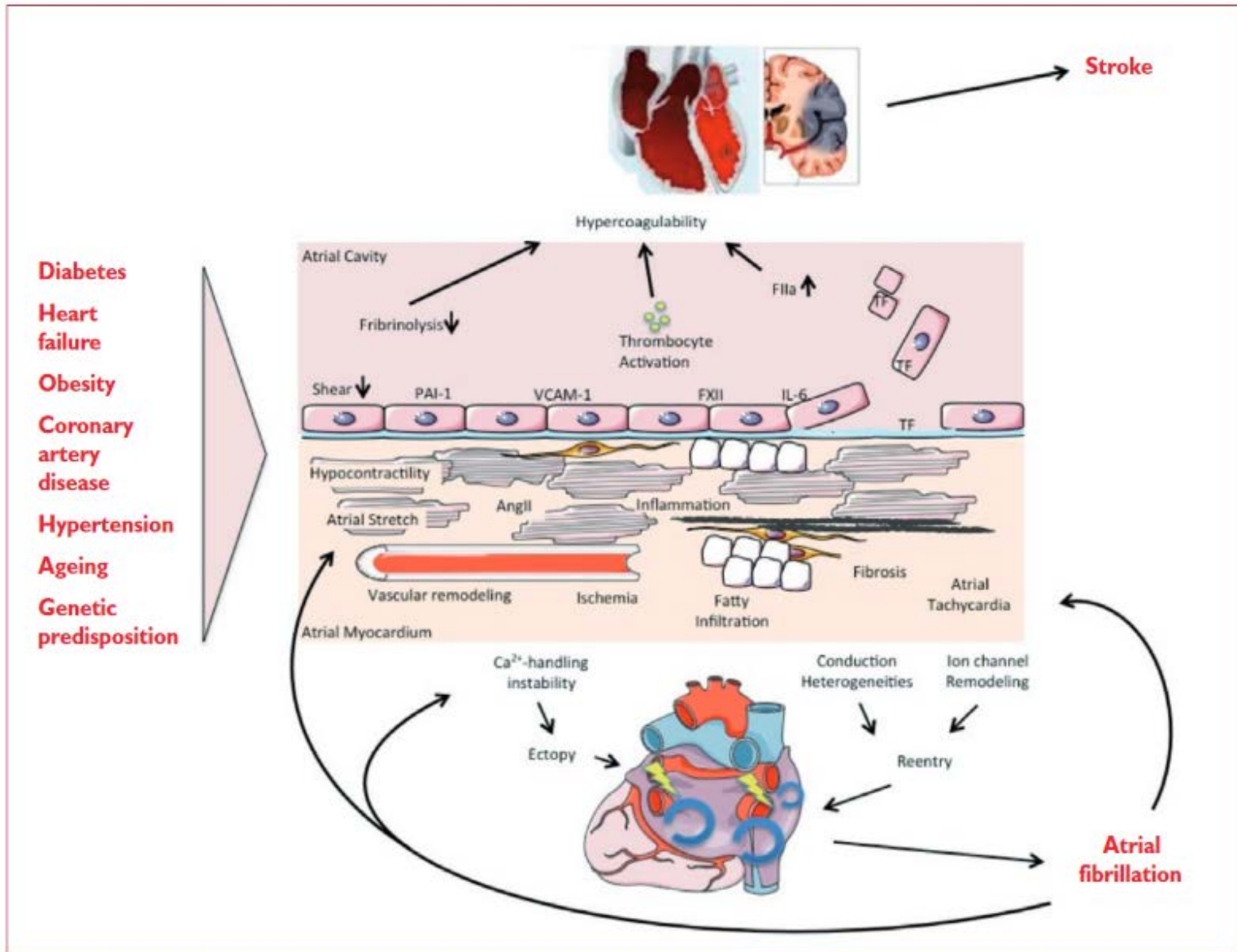
# Základní mechanismy vzniku FiS

- Strukturální procesy, funkční, elektrofyziologické a autonomní abnormality, následná remodelace vede k k potenciaci automacie - trigrů / reentry mechanismu



- Zpomalení vedení srdečního vzruchu a zkrácení refrakterity umožní vznik, udržení a následné stabilizace reentry mechanismu
- Opožděné následné potenciály vznikající díky abnormálnímu uvolnění Ca<sup>2+</sup> release ze sarkoplazmatického retikula v době diastoly, zvyšují aktivitu trigrů a tím fokálnímu původu vzniku Fibrilace síní

# Faktory ovlivňující průběh FiS



# Léčba fibrilace síní

Guidelines: ESC 2016, AHA/ACC/HRS 2014

Prevence CMP!!!!

Kontrola rytmu x kontrola frekvence

\* Antiarytmika

\* Nefarmakologická léčba

- **Katetrizační ablace – izolace plicních žil**
- **Neselektivní ablace AV uzlu (+ kardiostimulace)**
- **Kardiochirurgie – MAZE**
- **Neuromodulační léčba**

# Indikace ke katetrizační ablací fibrilace síní (ESC guidelines, update 2016)

**POTŘEBUJETE TYTO PILULKY?**

**ANO**

**NE**

**SPRÁVNĚ!**  
Bude vám po nich mnohem lépe!

Tak to se velmi mýlite! Vy ty pilulky potřebujete.

Pokud jste odpověděli správně, bude vám mnohem lépe

9P

Čestná hodba: ONDREJ HO PNER

# Katetrizační ablace fibrilace síní



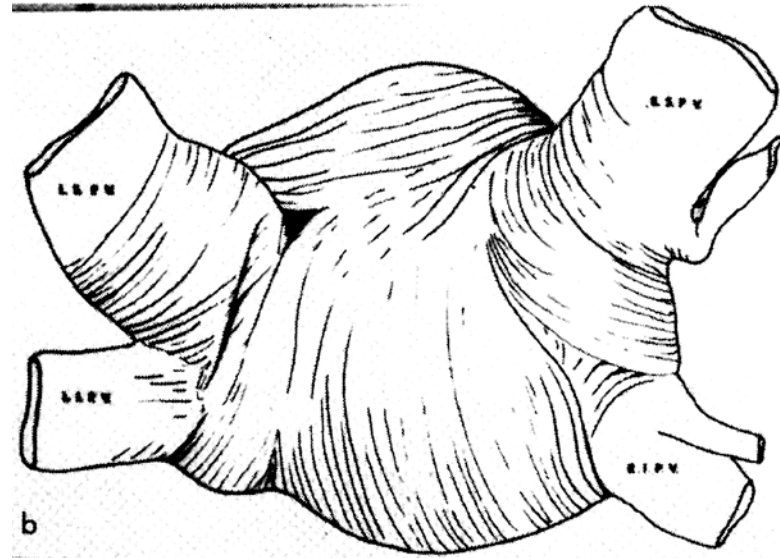
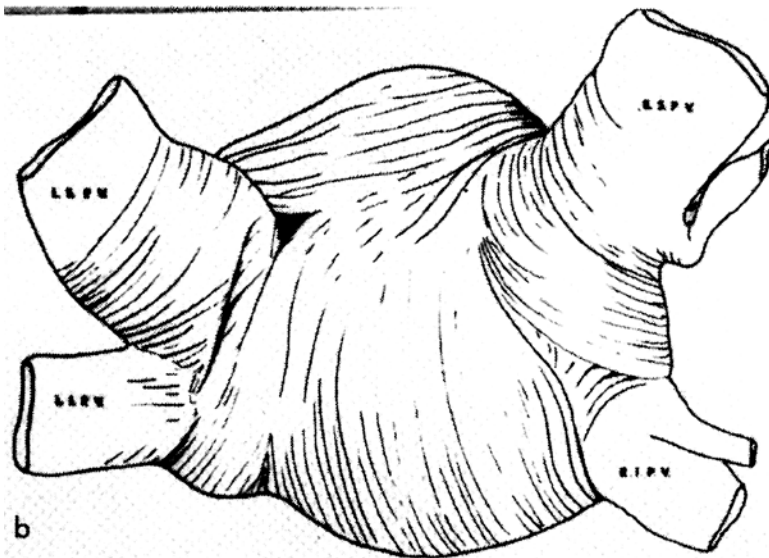
## 1. ablace (1995) Michel Haissaguerre

### Right and Left Atrial Radiofrequency Catheter Therapy of Paroxysmal Atrial Fibrillation

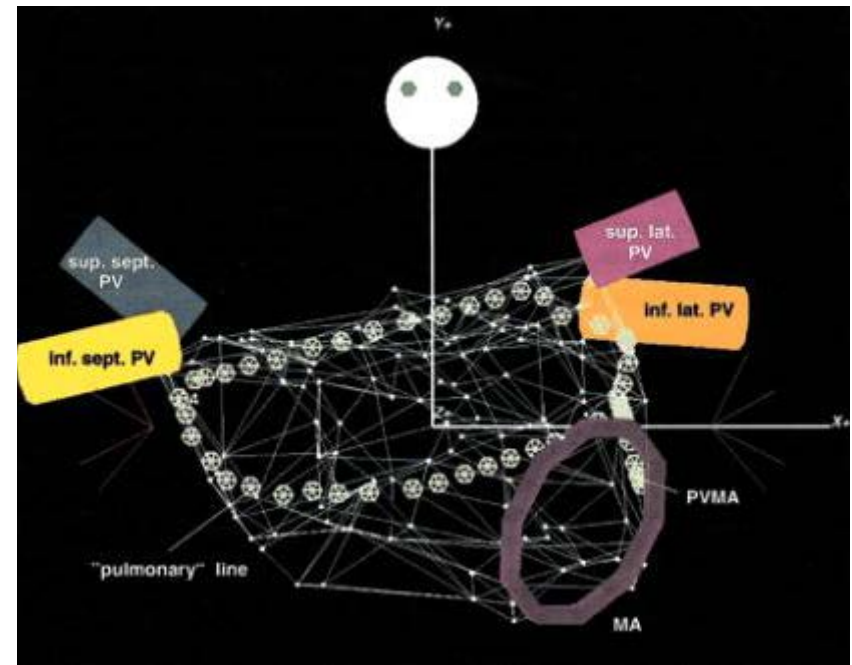
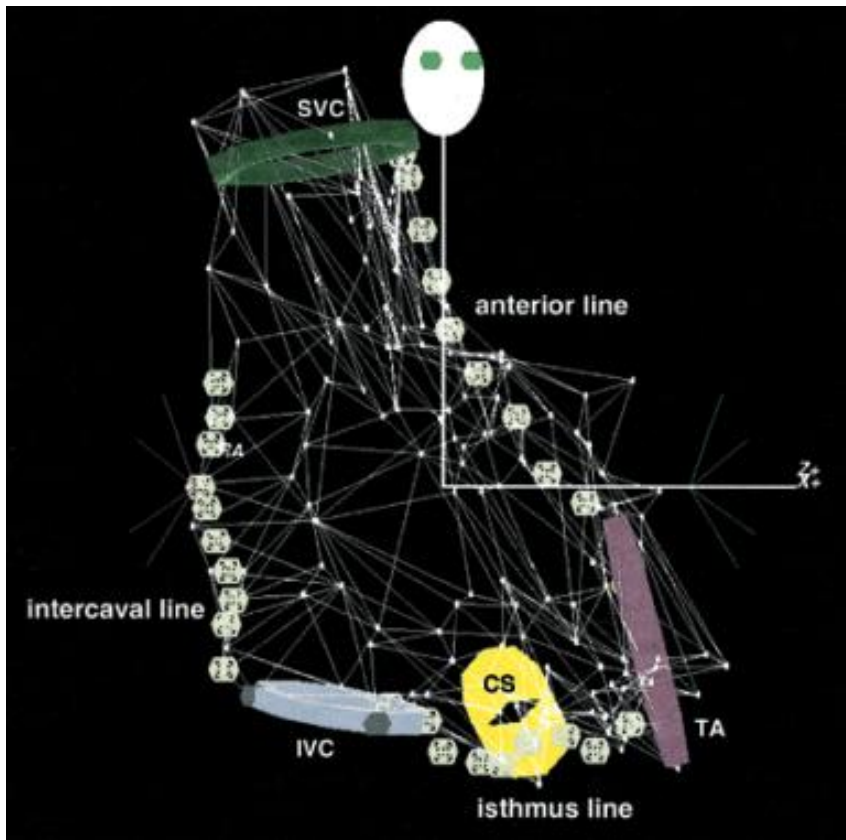
MICHEL HAÏSSAGUERRE, M.D., PIERRE JAÏS, M.D., DIPEN C. SHAH, M.D.,  
LAURENT GENCEL, M.D., VINCENT PRADEAU, M.D.,  
STÉPHANE GARRIGUES, M.D.,\* SALAH CHOUAIRI, M.D.,  
MÉLÈZE HOCINI, M.D., PHILIPPE LE MÉTAYER, M.D.,  
RAYMOND ROUDAUT, M.D., and JACQUES CLÉMENTY, M.D.

From the Service de Cardiologie, Hôpital Cardiologique, and \*Laboratoire de Biostatistiques, Inserm U330,  
Université de Bordeaux II, Bordeaux, France

*(J Cardiovasc Electrophysiol, Vol. 7, pp. 1132-1144, December 1996)*



# Vývoj 3D navigačních systémů: CARTO (1996)



45 nem., 7.9+/-1.4 hod. LS,  
6.6+/-2.0 hodPS,  
100% rekurence!!!

V levé síni nedosaženo kompletních  
linií pouze na CTI

S Ernst, Circulation, 1999



# Indikace ke katetrizační ablací fibrilace síní

(ESC guidelines, update 2016)



- **Paroxysmální** fibrilace síní

- Symptomatická FS, po selhání AA **I/A**
- Symptomatická FS, první volba **IIa/B**

jednoznačná indikace

vhodná  
indikace

- **Perzistující** fibrilace síní

- Symptomatická FS, po selhání AA **IIa/C**

vhodná  
indikace

- **Dlouhodobě perzistující** fibrilace síní

- Symptomatická FS, po selhání AA **IIb/C**

má být zvažena

# Indikace ke katetrizační ablaci fibrilace síní

(ESC guidelines, update 2016)



EUROPEAN  
SOCIETY OF  
CARDIOLOGY®

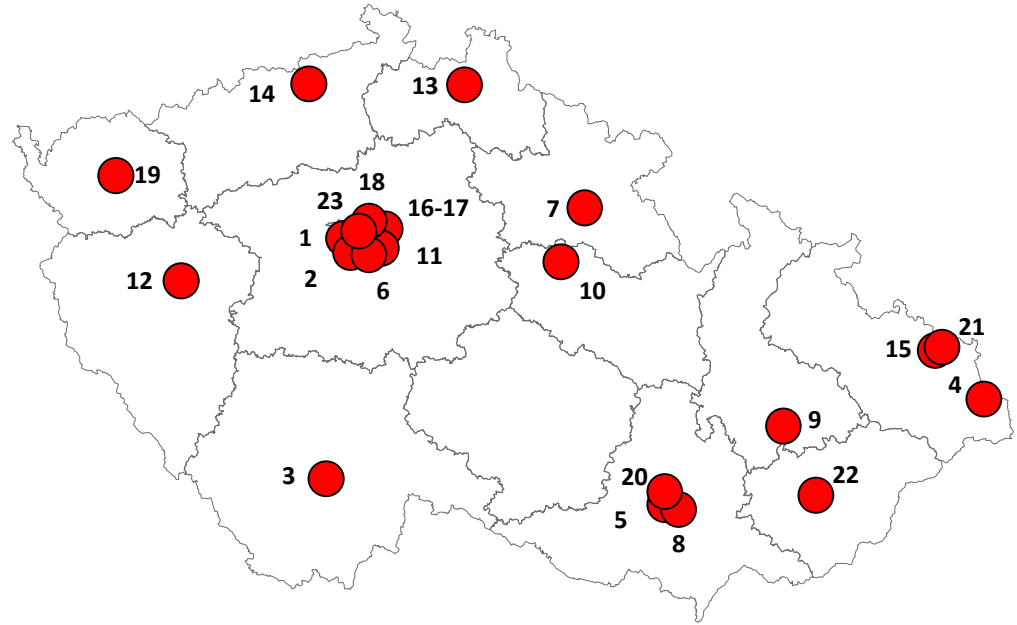
Stále se jedná „jen?“ o ovlivnění  
symptomů.

Mortalitní data .....

Provedení ablace ve zkušeném  
centru!

# Centra provádějící ablace v ČR

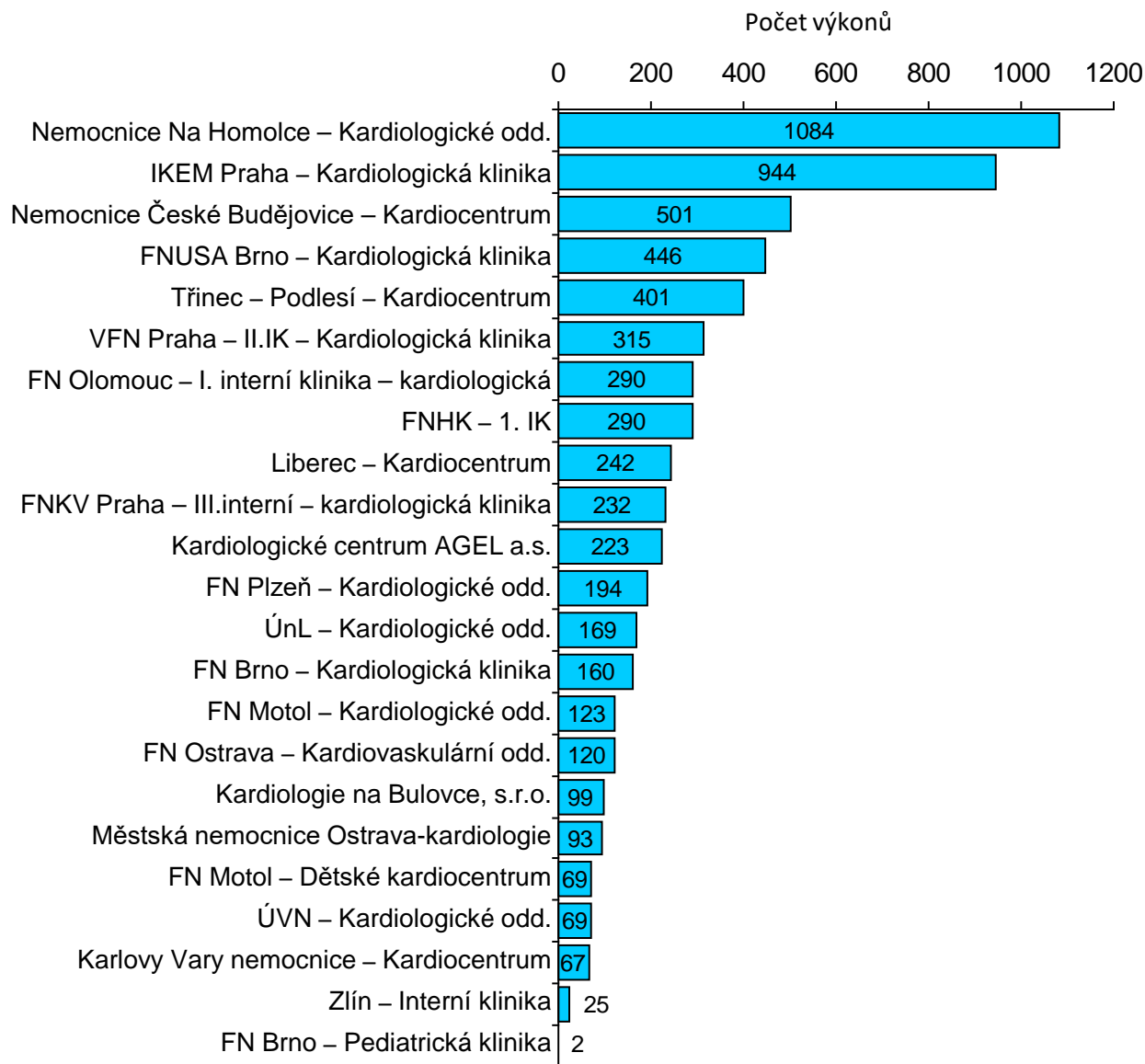
1. Nemocnice Na Homolce – Kardiologické odd.
2. IKEM Praha – Kardiologická klinika
3. Nemocnice České Budějovice – Kardiocentrum
4. Třinec - Podlesí – Kardiocentrum
5. FNUSA Brno – Kardiologická klinika
6. VFN Praha – II.IK - Kardiologická klinika
7. FNHK – 1. IK
8. FN Brno – Kardiologická klinika
9. FN Olomouc – I. interní klinika – Kardiologická
10. Kardiologické centrum AGEL a.s.
11. FNKV Praha – III.interní - Kardiologická klinika
12. FN Plzeň – Kardiologické odd.
13. Liberec – Kardiocentrum
14. ÚnL – Kardiologické odd.
15. FN Ostrava – Kardiovaskulární odd.
16. FN Motol – Kardiologické odd.
17. FN Motol – Dětské kardiocentrum
18. Kardiologie na Bulovce, s.r.o.
19. Karlovy Vary – Kardiocentrum
20. FN Brno – Pediatrická klinika
21. Městská nemocnice Ostrava – Kardiologie
22. Zlín – Interní klinika
23. ÚVN – Kardiologické odd.



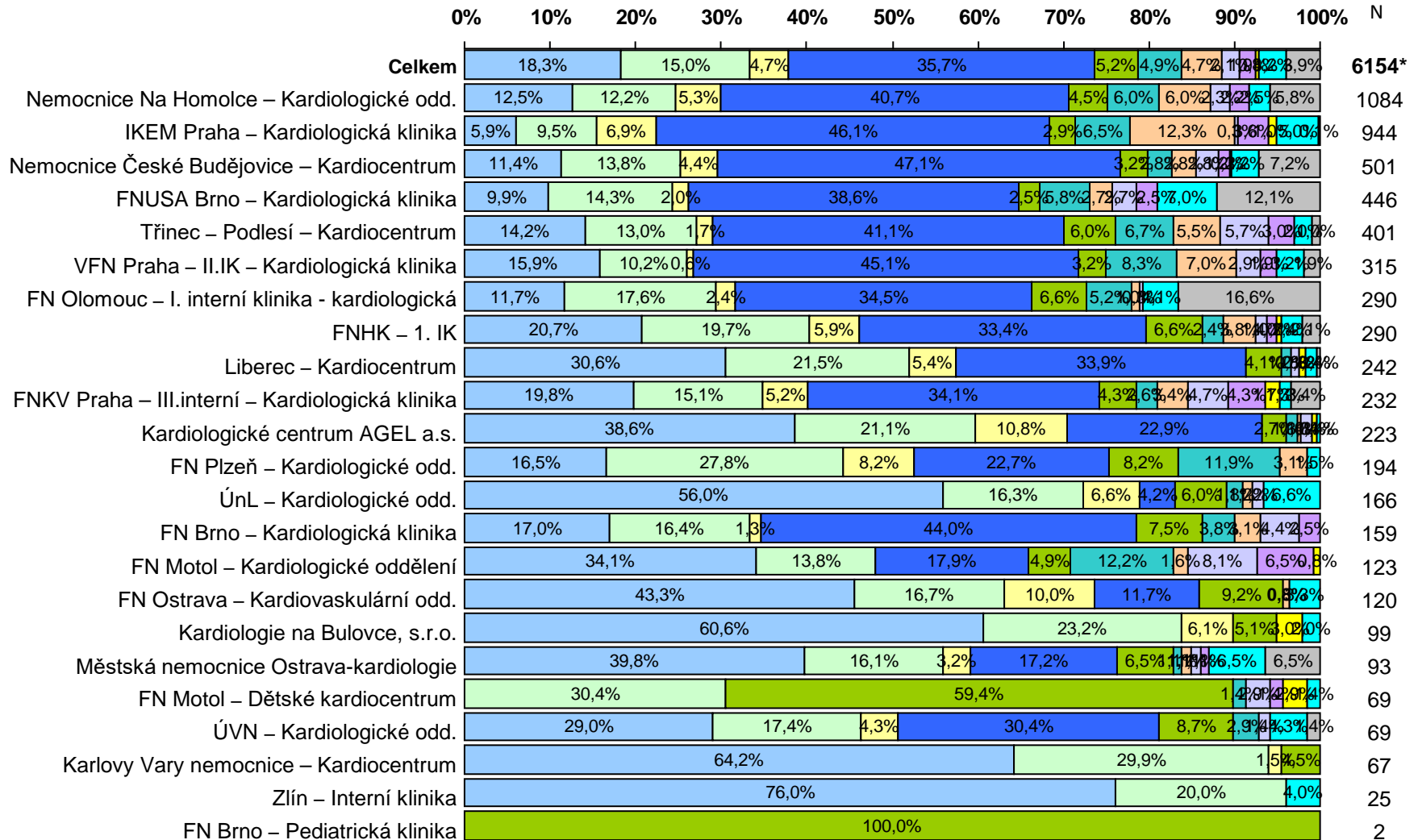
Za období 1. 1. 2015 – 31. 12. 2015 bylo do registru zadáno celkem 6 158 **validních záznamů výkonu u 5 987 pacientů.**

# Výkony v centrech

Báze: všechny výkony 2015  
(N = 6 158)



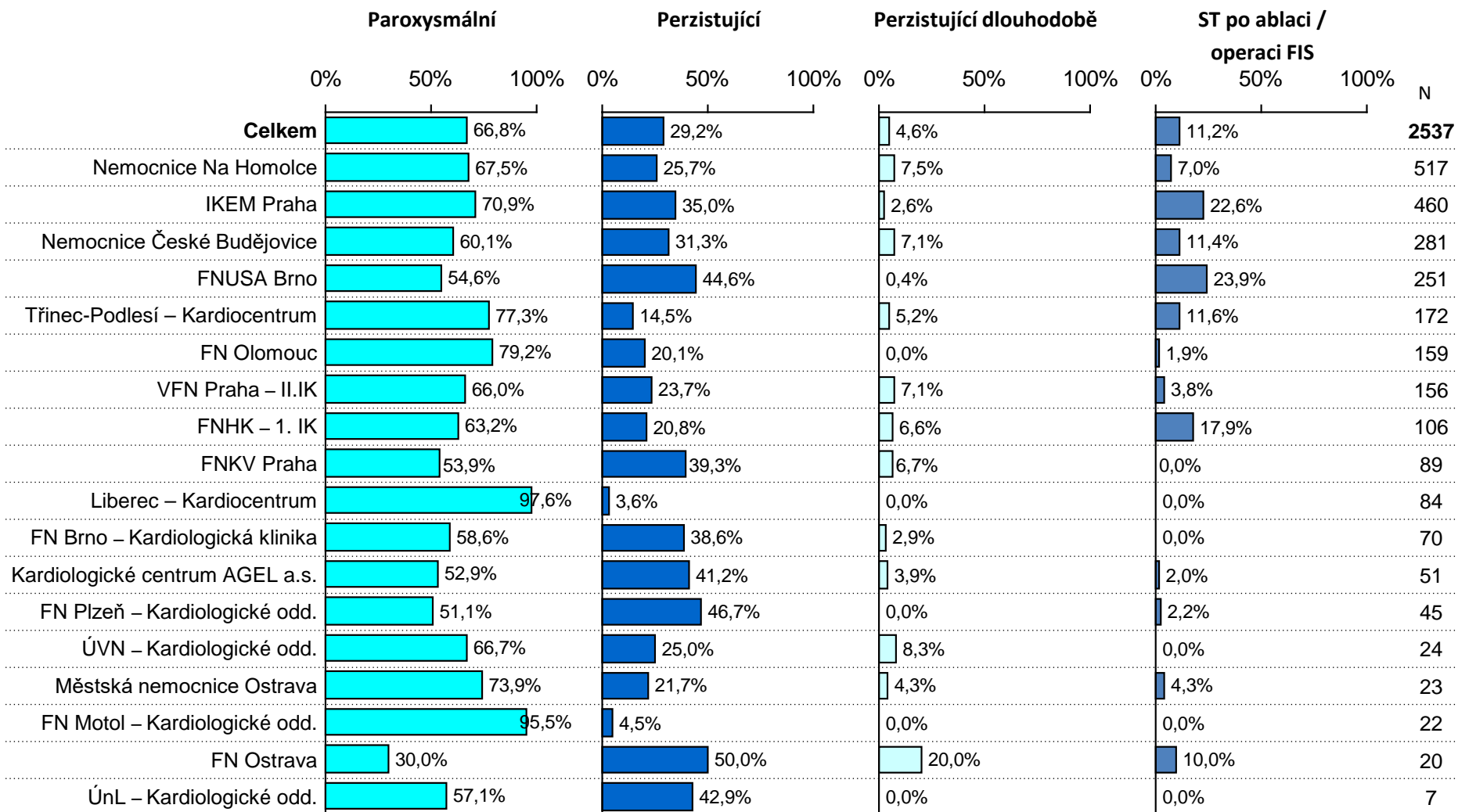
# Indikace ablací v centrech



- Flutter síní I. typu
- Přidatná dráha
- Makroentry síňová tachykardie
- AVNRT
- Komorová tachykardie bez struk. postižení srdce
- Jiné indikace ablace
- AV uzel
- Komorová tachykardie při struk. postižení srdce
- Jiné kombinace
- Fibrilace síní
- Fokální síňová tachykardie
- Flutter síní + Fibrilace síní

\* 4 pacienti bez uvedené indikace ablace

# Fibrilace síní dle center

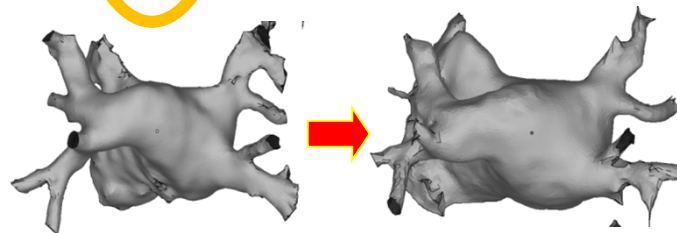


Poznámka: Jeden pacient může mít více typů fibrilace síní.

# Jaké jsou příčiny selhání ?

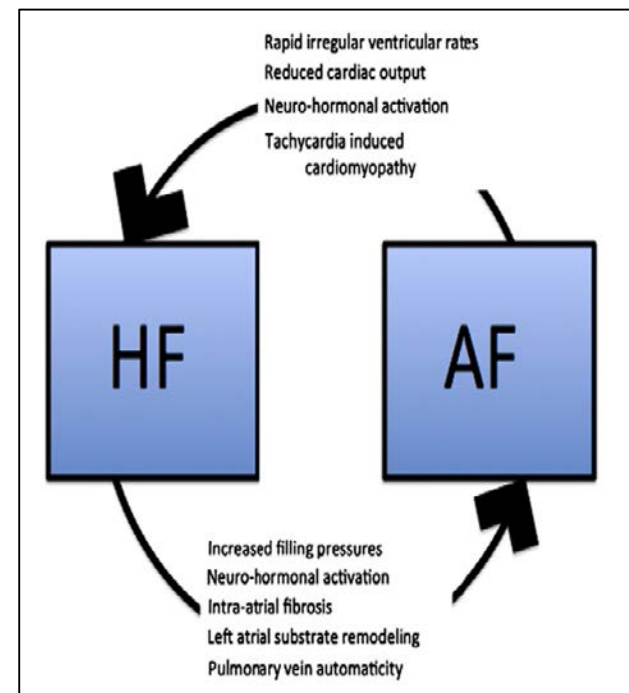
Study	# pts	Progression
UK general practice, 2005	525 2.7 years	17%
Tokyo study, 1995	137 1 year	22%
CARAF, 2001	899 44 years	19%
CARAF, 2005	757 8 (2-1)1 years	25%
Danish study, 1986	426 9 years	33%
Parkinson, 1930	200 10 years	25%
Tokyo study, 2004	171 14 years	77%

- **Gapy – průniky v liniích**
  - reparace tkáně
  - tloušťka srd. stěny
  - kontakt při ablaci
  - použitá energie/typ katetru
  - zkušenost operátéra
- **Trigger mimo plicní žíly**
- **Progrese onemocnění**



# Fibrilace síní a srdeční selhání

- Prevalence FS **stoupá** se stupněm CHSS: NYHA I → 5% vs. NYHA IV → 50%
- Prevalence CHSS je u nemocných s FS **vysoká : > 40%**.
- **20-30%** pacientů s FS mám dysfunkci LK
- **Khazanie et al. (2014)** Retrospektivní analýza 27829 pac. se srdečním selháním hospitalizovaných ve 281 nemocnicích v USA, období 2006-2008:  
Přítomnost FS zvyšuje více než 3x riziko oproti pacientům bez FS:
  - **celková mortalita (HR 1.14; 1.08–1.20)**
  - **rehospitalizace pro SS a CMP/TIA (HR: 1.15; 1.08–1.21)**





# Studie AATAC-AF

*Ablation vs. Amiodarone for Treatment of Atrial Fibrillation in Patients with Congestive Heart Failure and an Implanted ICD/CRTD*

- Randomizovaná multicentrická studie
- **Perzistující FS** se srdečním selháním NYHA II-III, LV EF  $\leq 40\%$  a implantovaným ICD/CRTD
- **203 pac.**: 102 ablace x 101 amiodaron
- **Primární endpoint:** udržení sinusového rytmu
- **Sekundární endpoint:** celková mortalita, rehospitalizace pro FS nebo CHSS, EF LK, 6MWD, MLHFQ

# Studie AATAC-AF

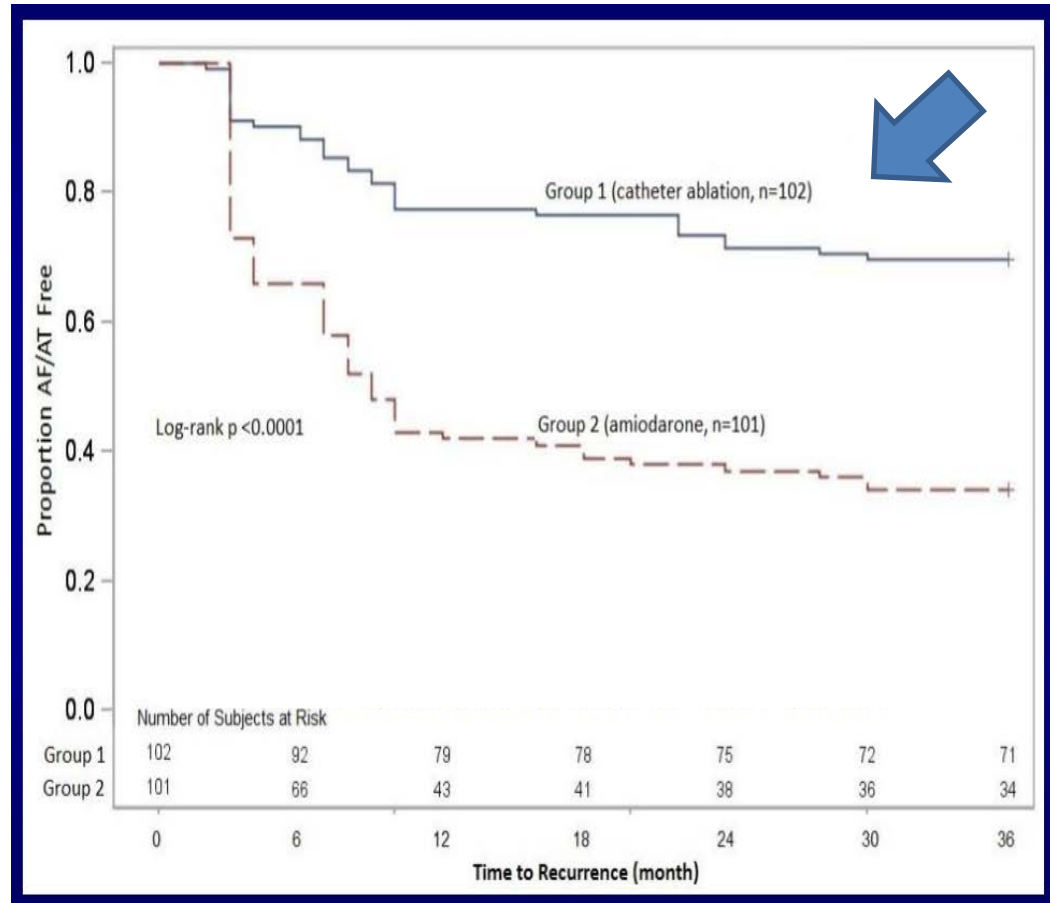
*Ablation vs. Amiodarone for Treatment of Atrial Fibrillation in Patients with Congestive Heart Failure and an Implanted ICD/CRTD*

●  
Primární endpoint:

Group I: **70%**

Group II: **34%**

(10% pac. muselo vysadit amiodaron pro nežádoucí účinky)



# Studie AATAC-AF

*Ablation vs. Amiodarone for Treatment of Atrial Fibrillation in Patients with Congestive Heart Failure and an Implanted ICD/CRTD*

- **Sekundární endpoint:**
  - EF LK zlepšení o  $9.6 \pm 7.4\%$  vs.  $4.2 \pm 6.2\%$  ( $p < 0.001$ )
  - 6MWD zlepšení o  $27 \pm 38$  vs.  $8 \pm 42$ m ( $p < 0.001$ )
  - MLHFQ score sníženo  $14 \pm 18$  vs.  $2.9 \pm 15$  ( $p < 0.001$ )

	ablation	amiodarone	p
rehospitalizace	32 [31%]	58 [57%]	<0.001
mortalita	8 [8%]	18 [18%]	0.037

# Fibrilace síní a srdeční selhání

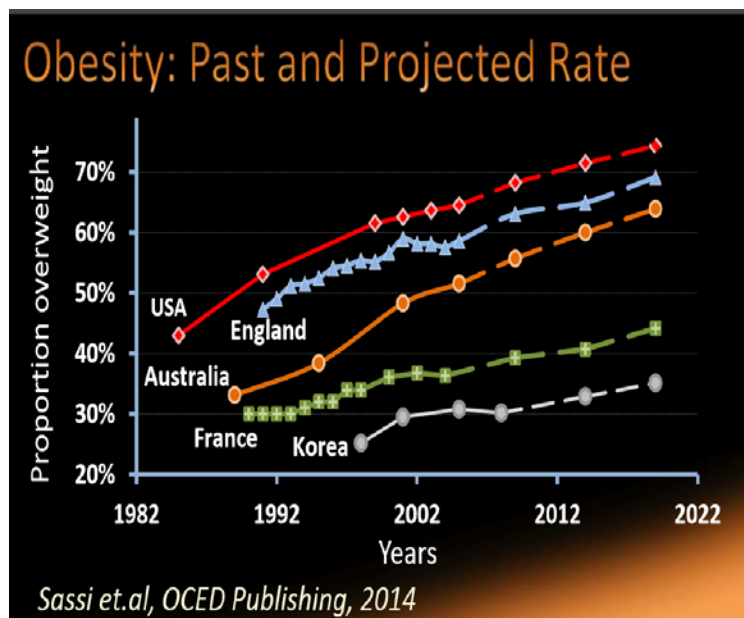


AF ablation should be considered in symptomatic patients with AF and heart failure with reduced ejection fraction to improve symptoms and cardiac function when tachycardiomyopathy is suspected.

**IIa**

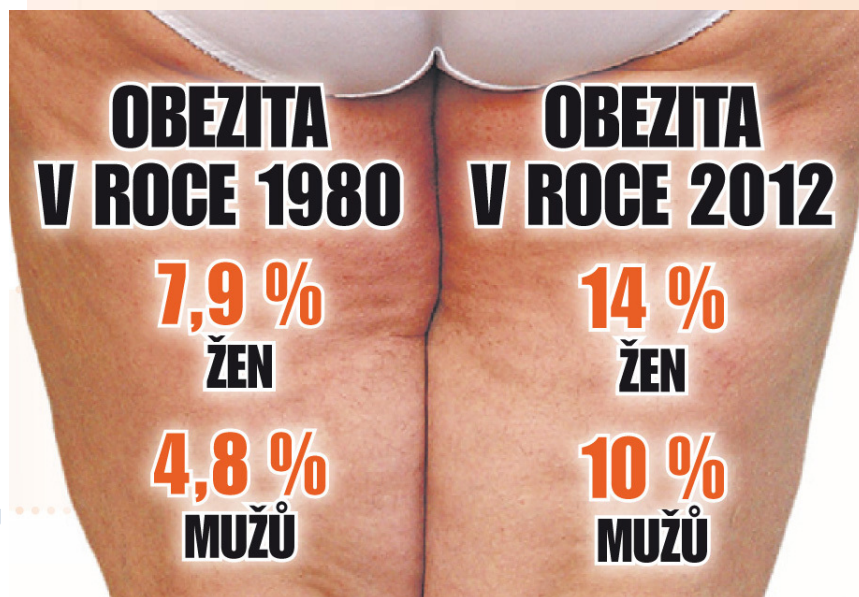
**C**

# Obezita



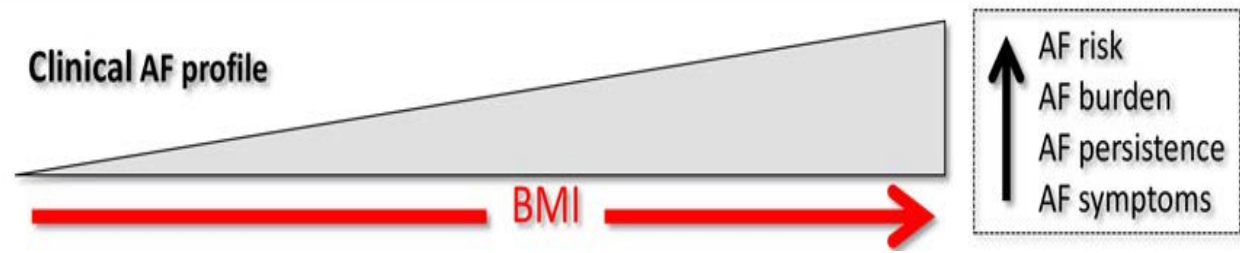
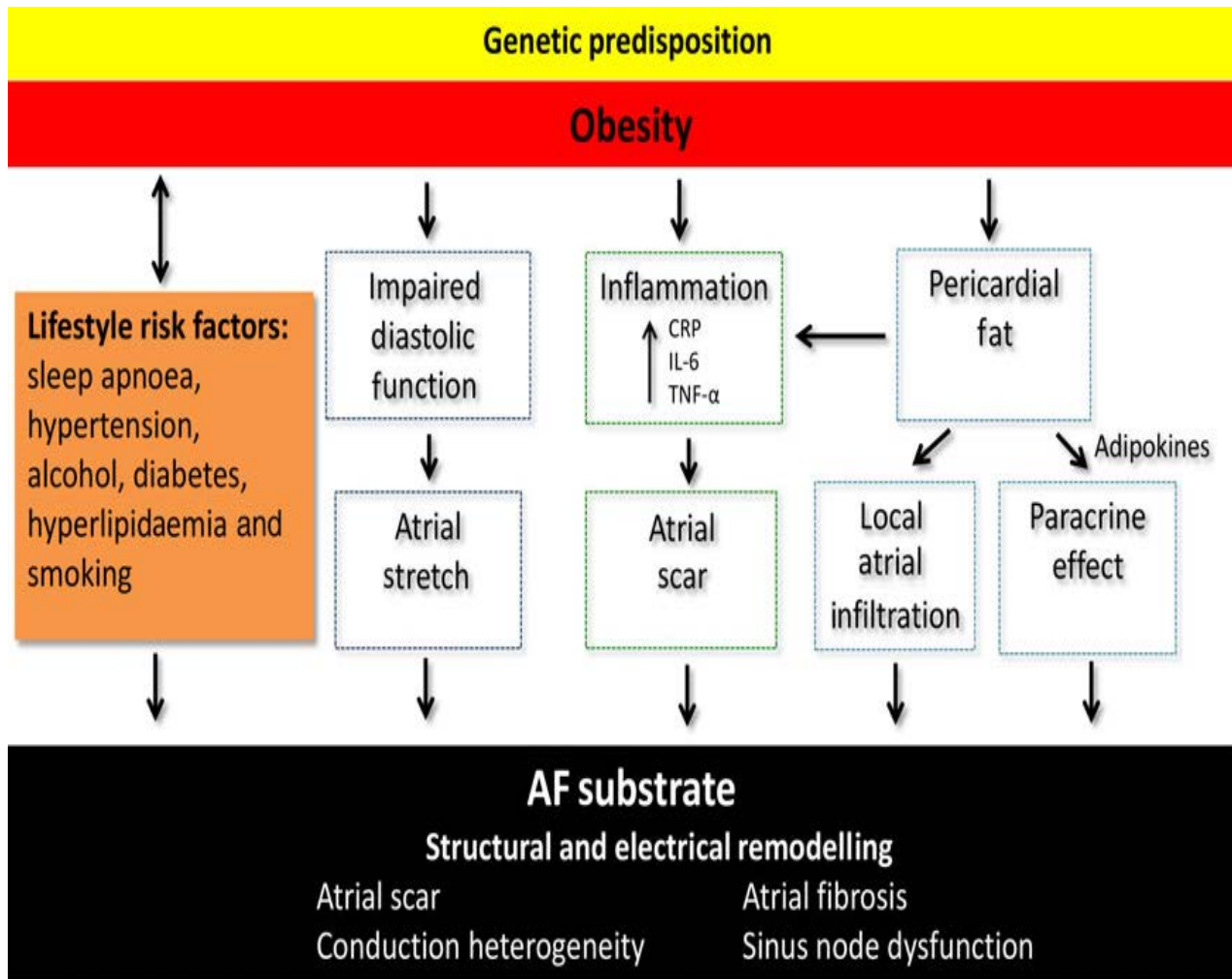
## Jak je to v Česku:

- Každý pátý Čech je obézní (což je zhruba 425 000 lidí).



...až 50% zvýšení rizika rozvoje FS\*!!!!

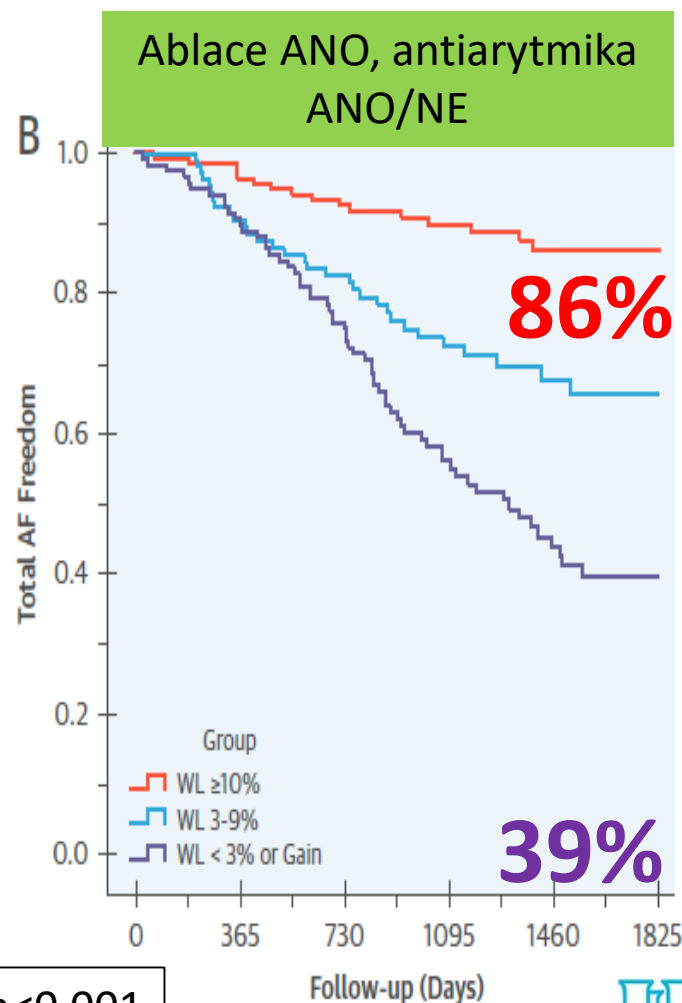
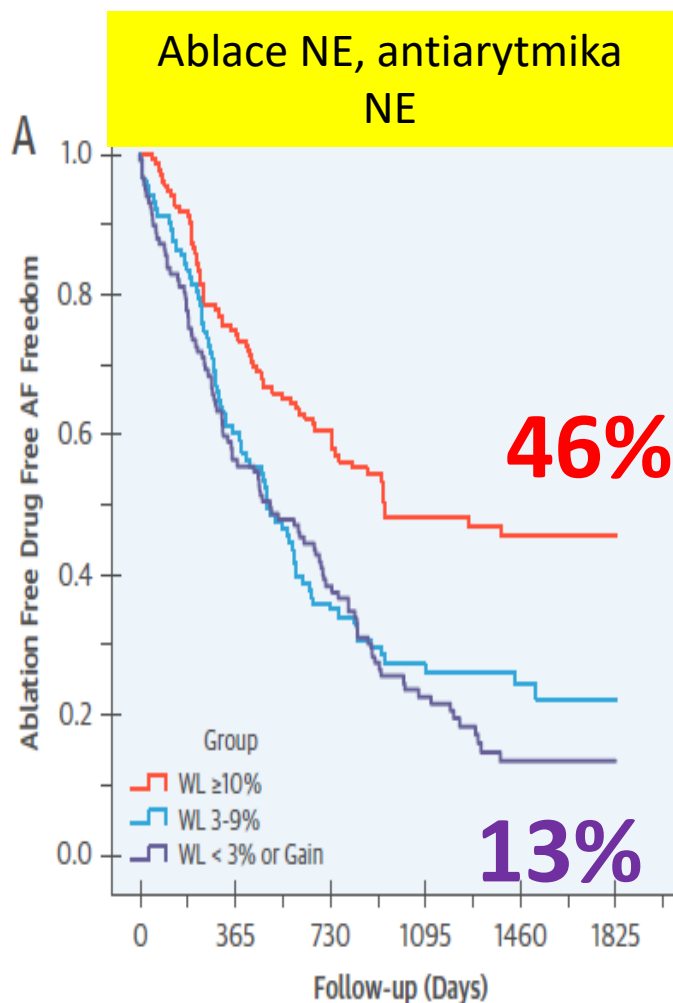
\*Wanahita N, Messerli FH, et al. Am Heart J. 2008;155(2):310-315



# LEGACY

hodnocení dlouhodobého efektu hubnutí a fluktuace váhy na kontrolu rytmu u obézních pac. s FS

- 355 pac.
- 5 let FU
- I. WL  $\geq 10\%$
- II. WL 3-9%
- III. WL  $< 3\%$



$p < 0,001$

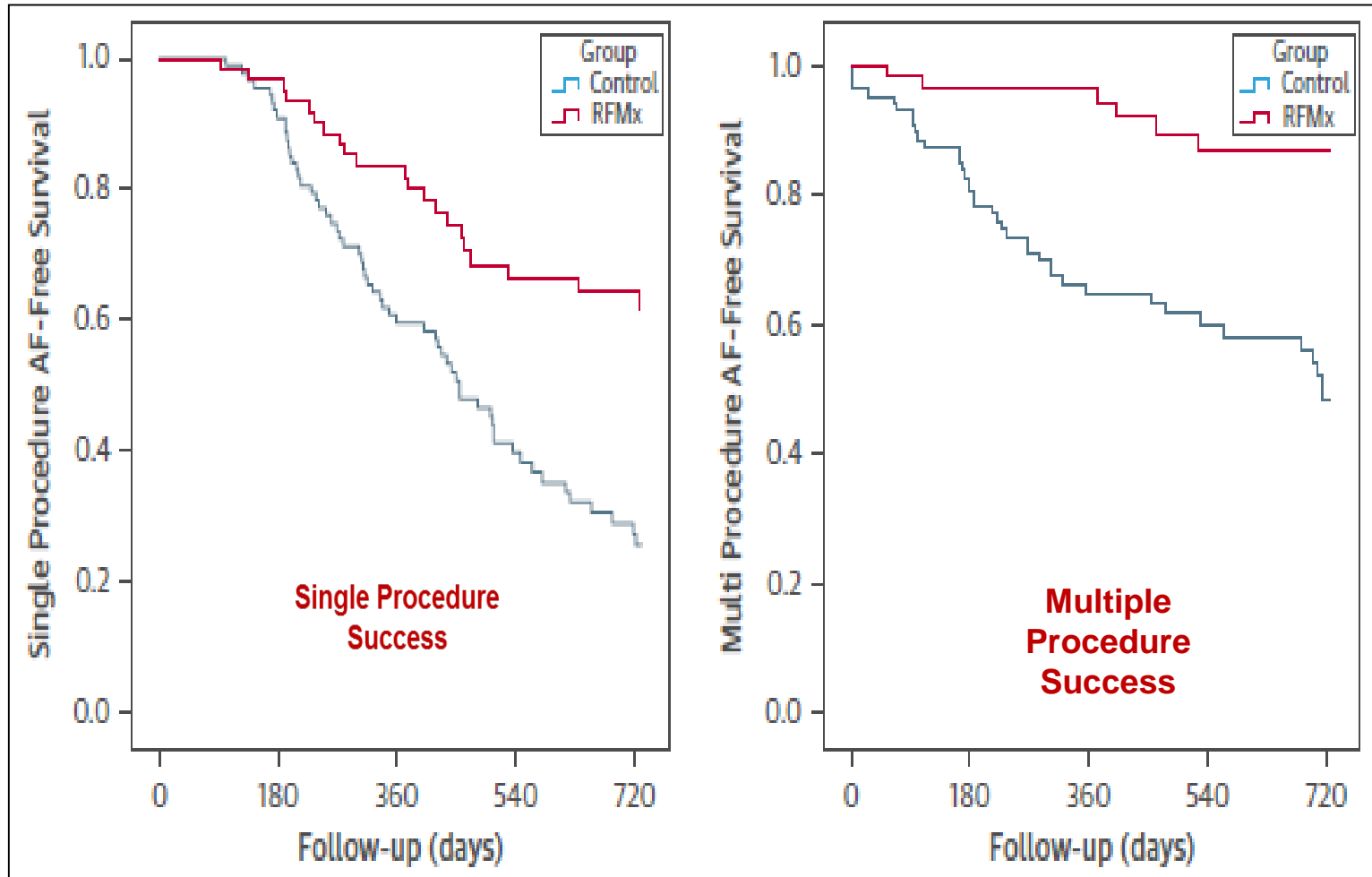
Rajeev K. Pathak, JACC, 2014 a 2015

# ARREST-AF

- 149 pac. s parox./perzist. FS a BMI>27kg/m<sup>2</sup> podstoupilo ablaci FS
- **Randomizace:**
  - agresivní management RF x kontrolní skupina
- **Rizikové faktory:** obezita, korekce TK, fitness, omezení spotřeby alkoholu, kouření, korekce hyperlipidémie, hyperglykémie, OSA



# ARREST-AF



# Obezita a FiS



- Neléčit jen fibrilaci síní, ale celého pacienta komplexně!

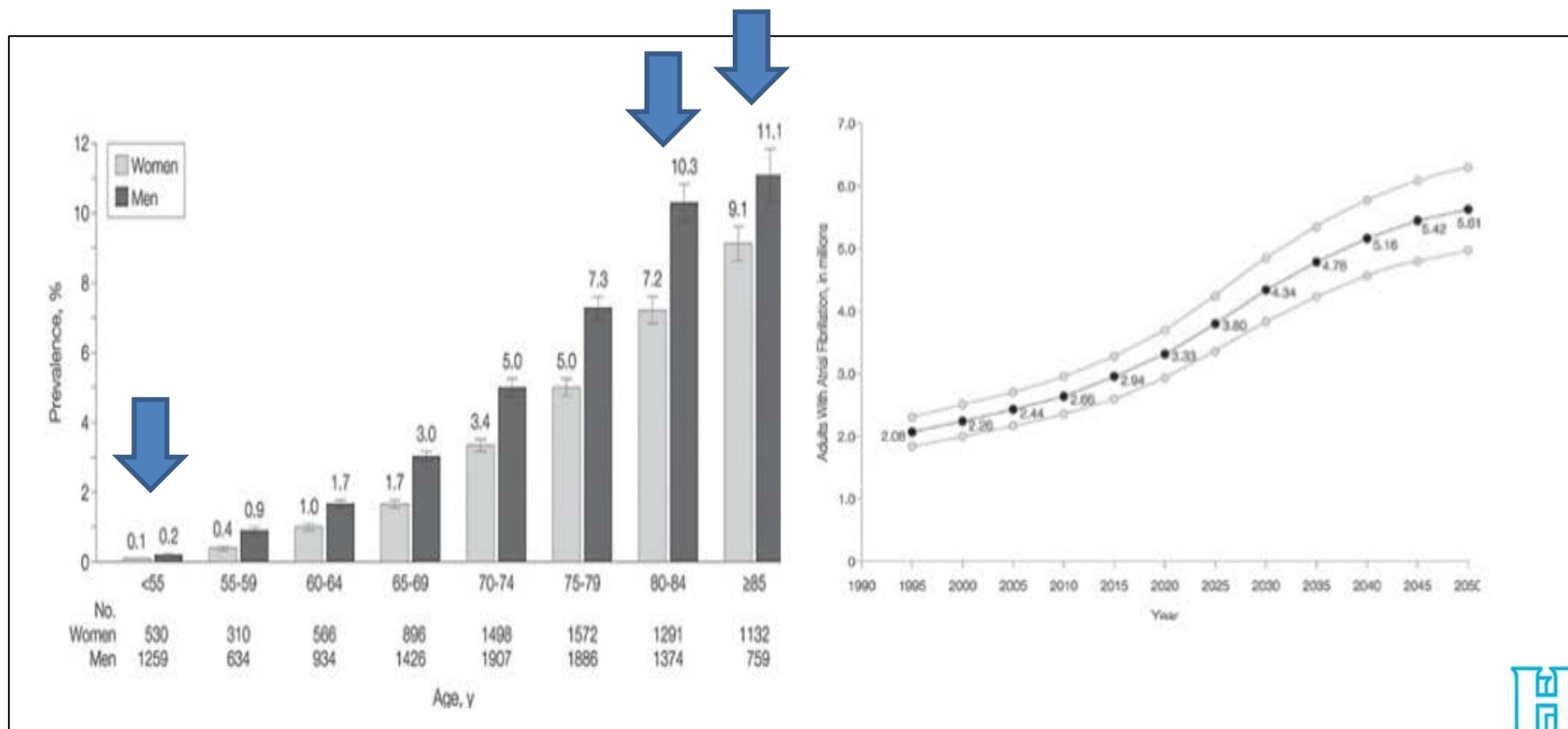


Recommendations	Class	Level
In obese patients with AF, weight loss together with management of other risk factors should be considered to reduce AF burden and symptoms.	<b>IIa</b>	<b>B</b>

- Odložit katetrizační ablaci po redukci hmotnosti, ....

# Prevalence FS se zvyšuje s narůstajícím věkem

- .... 0.1% u pac. < 55 let vs. 9% u pac > 80 let



## Long-Term Clinical Efficacy and Risk of Catheter Ablation for Atrial Fibrillation in the Elderly

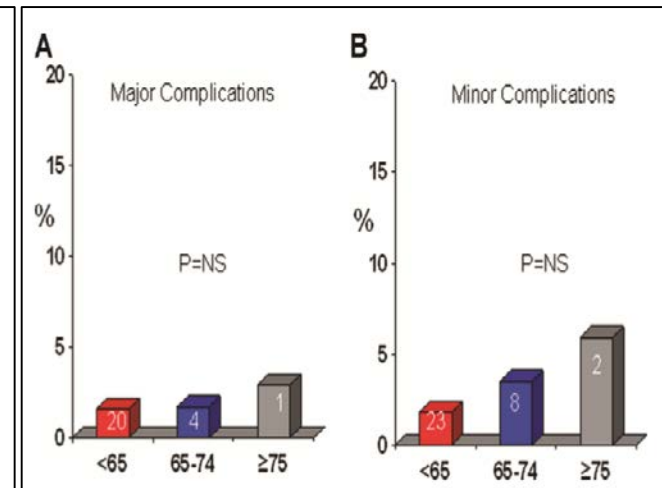
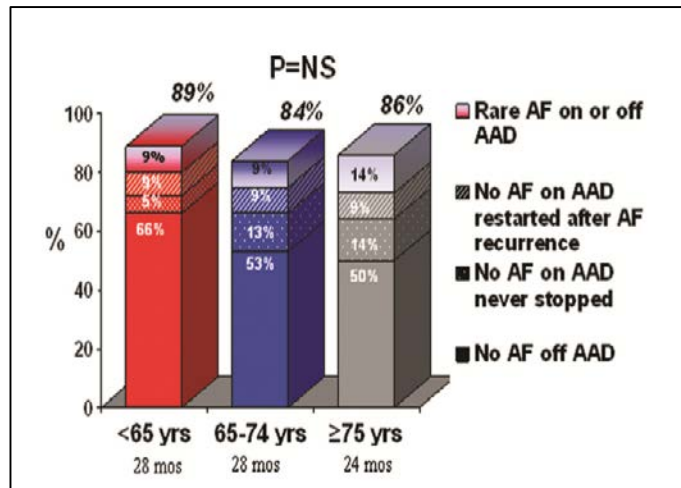
ERICA ZADO, P.A.-C., DAVID J. CALLANS, M.D., MICHAEL RILEY, M.D. PH.D., MATHEW HUTCHINSON, M.D., FERMIN GARCIA, M.D., RUPA BALA, M.D., DAVID LIN, M.D., JOSHUA COOPER, M.D., RALPH VERDINO, M.D., ANDREA M. RUSSO, M.D., SANJAY DIXIT, M.D., EDWARD GERSTENFELD, M.D., and FRANCIS E. MARCHLINSKI, M.D.

From the Cardiovascular Division, Department of Medicine, Hospital of the University of Pennsylvania, Philadelphia, Pennsylvania, USA

<65 let	948 pac.
≥65 and <75 let	185 pac.
≥75 let	32 pac.

- 1165 pac./1506 ablací
- Periprocedurální komplikace: minimální/bez rozdílu mezi věkovými skupinami
- Follow up 24m:

Starší pacienti: **méně často podstupovali reablace**  
**častěji po ablaci léčení antiarytmiky** (29 vs 37%,  $p = 0.02$ ).



# Přidružená onemocnění

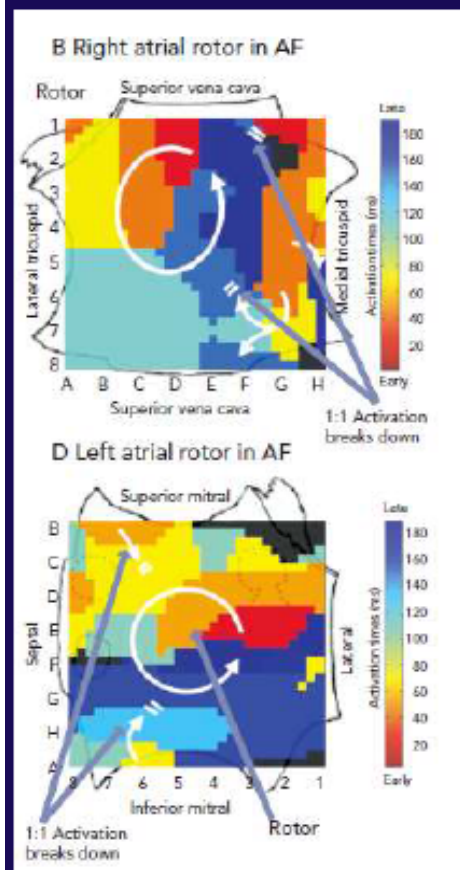
	Total population				1:3 Propensity-score matched population			
	Group 1 (Age<55) n=675	Group 2 (55≤Age<75) n=1,041	Group 3 (Age≥75) n=109	†p-value	Group 1 (Age<55) n=327	Group 2 (55≤Age<75) n=327	Group 3 (Age≥75) n=109	†p-value
Age (years)	46.4±7.0	63.4±5.35	77.3 ± 2.7	<0.001	46.1±7.4	63.5±5.3	77.3±2.7	<0.001
Female, n (%)	117(17.3)	315(30.3)	39(35.8)	<0.001	117(35.8)	118(36.1)	39(35.8)	0.996
Persistent AF, n (%)	191(28.3)	325(31.2)	29(26.6)	<0.001	90(27.5)	88(26.9)	29(26.6)	0.976
BMI, kg/m <sup>2</sup>	25.2±3.4	24.6±2.7	23.8±2.7	0.001	24.9±3.8	24.9±2.7	23.8±2.8	0.004
HF, n (%)	50(7.4)	87(8.4)	20(18.3)	0.001	25(7.6)	22(6.7)	20(18.3)	0.001
Hypertension, n (%)	198(29.3)	560(53.8)	88(80.7)	<0.001	83(25.4)	173(52.9)	88(80.7)	<0.001
DM, n (%)	56(8.3)	168(16.1)	27(24.8)	<0.001	22(6.7)	51(15.6)	27(24.8)	<0.001
Stroke/TIA, n (%)	53(7.9)	143(13.7)	22(20.2)	<0.001	26(8.0)	36(11.0)	22(20.2)	0.002
CHADS <sub>2</sub> score	0.61±0.85	1.06±1.07	2.64±1.11	<0.001	0.56±0.80	0.97±1.00	2.64±1.11	<0.001
CHA <sub>2</sub> DS <sub>2</sub> -VASc score	0.84±0.97	1.96±1.48	4.40±1.38	<0.001	0.94±0.96	1.96±1.39	4.40±1.38	<0.001
Post-ABL medication								
ARB, n (%)	169(25.1)	390(37.5)	53(48.6)	<0.001	73(22.4)	122(37.4)	53(48.6)	<0.001
Beta blocker, n (%)	199(29.6)	327(31.5)	40(36.7)	0.302	106(32.5)	105(32.2)	40(36.7)	0.670
Statin, n(%)	118(17.5)	324(31.2)	49(45.0)	<0.001	56(17.2)	117(35.9)	49(45.0)	<0.001



# Stáří (> 75 let) a ablace FiS



# FiRM

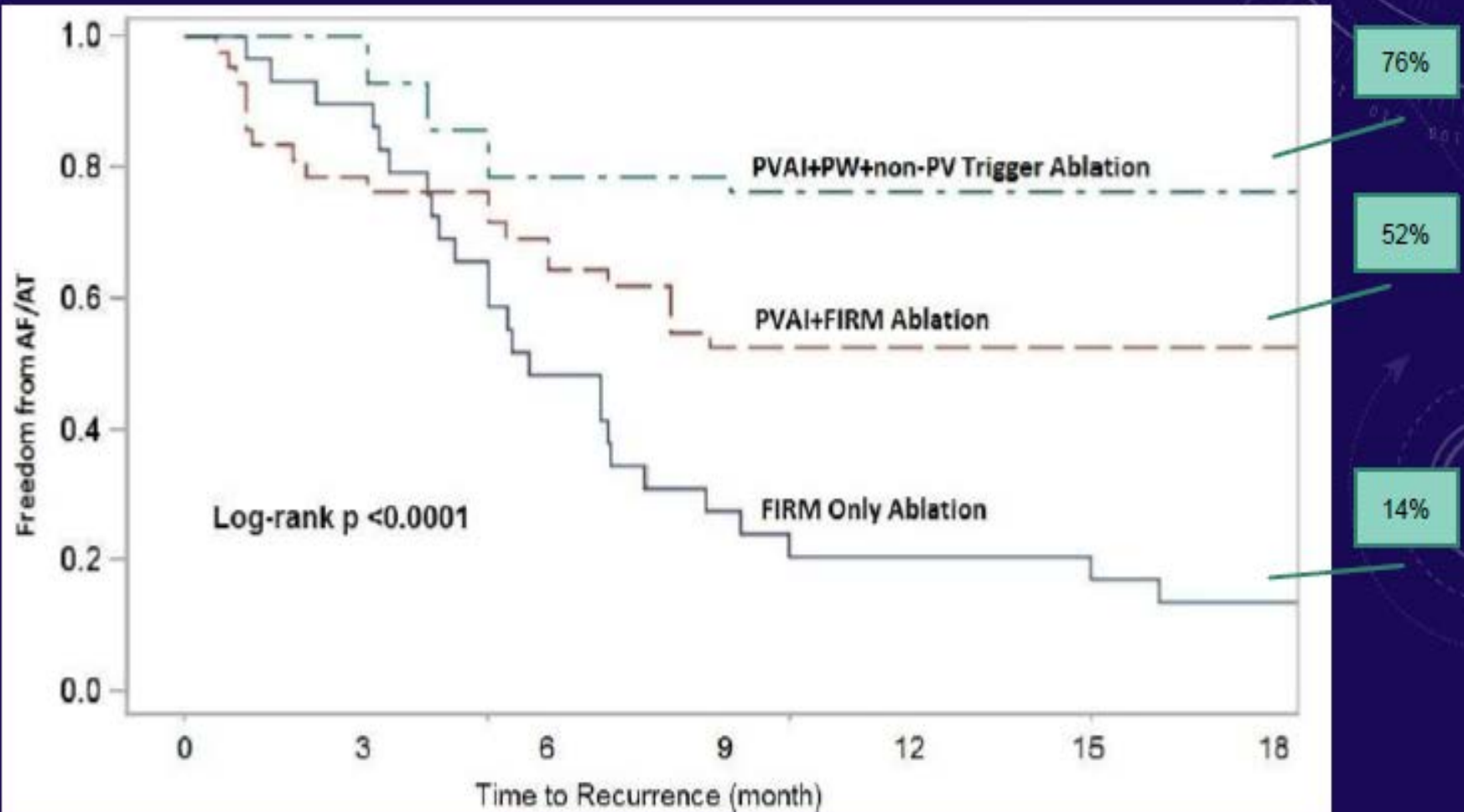


Author	Year	Study
Narayan et al CONFIRM	2012 2014	Case-control, single center, mid-term results Very long-term results
Miller et al	2014	Single arm, multicenter, long-term results
Tomassoni et al	2015	Single arm, single center, long-term results
Buch et al	2016	Single arm, multicenter, long-term results
Sommer et al	2016	Single arm, single center, mid-term results
Bernsten et al	2016	Single arm, single center, long-term results

All non-randomized studies

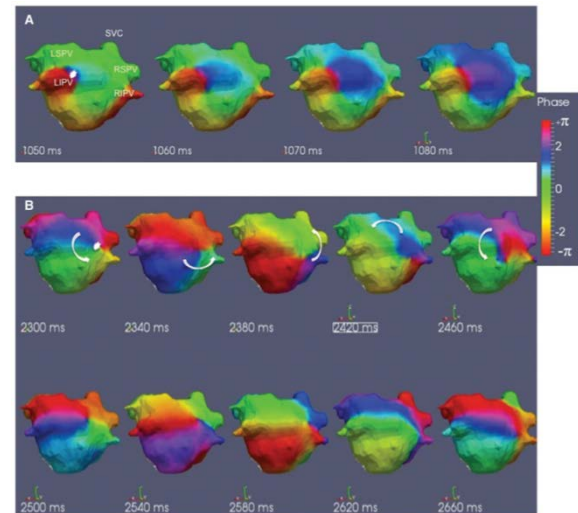
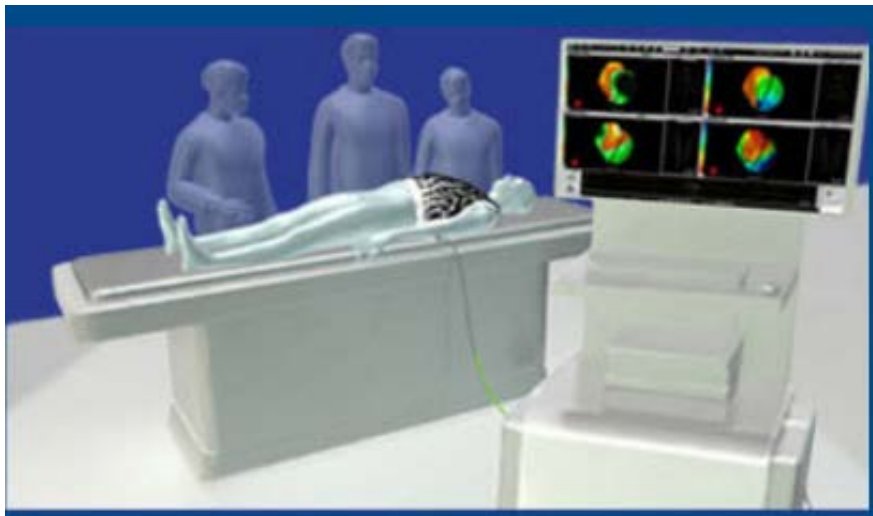
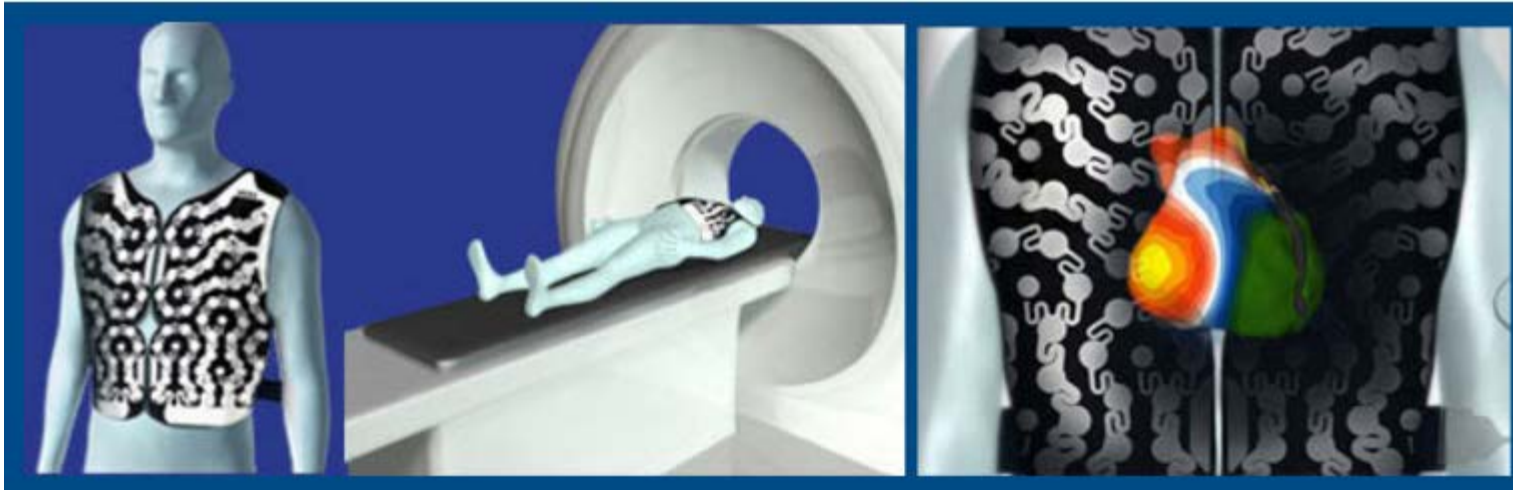
Narayan et al. J Am Coll Cardiol. 2012;60:628–36  
 Narayan et al. J Am Coll Cardiol. 2014;63:1761–8  
 Miller et al. J Cardiovasc Electrophysiol. 2014;25:921–9  
 Tommassoni et al. Journal of Innovations in Cardiac Rhythm Management 2015;6:2145–2151  
 Buch et al. Heart Rhythm 2016;13:636–641  
 Sommer et al. J Cardiovasc Electrophysiol. 2016;27:274–80  
 Bernsten et al. Heart Rhythm 2016; ePub ahead of print

# Studie OASIS



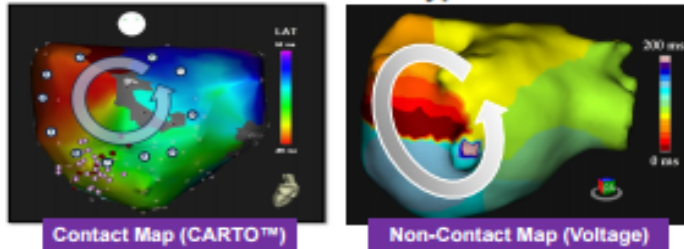


# CardioInsight – ECVUE Medtronic

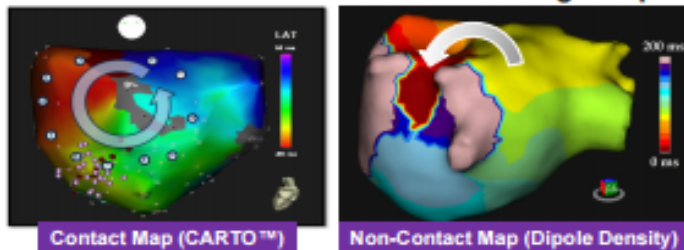


# Acutus Medical Atypical Flutters

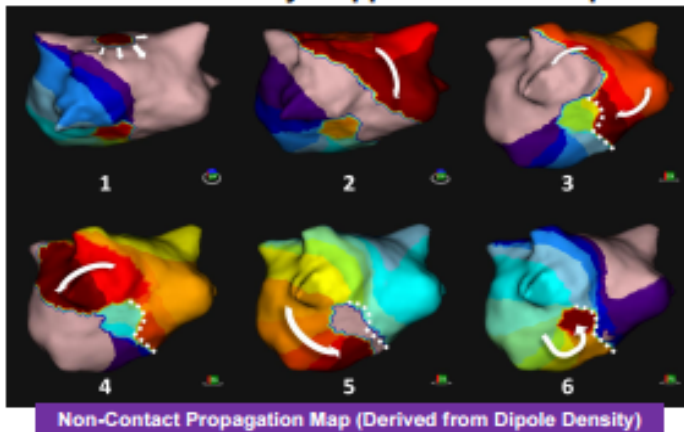
Conventional and Non-contact Voltage maps correlate well in Stable Atypical Flutters



Non-contact Dipole Density mapping reveals details not seen in Conventional Voltage map



Example of a Complex, Atypical Flutter which was only mapped with AcQMap



## Results

### Patient Demographics

<b>N:</b>	11 subjects	<b>Prior ablation:</b>	64%
<b>Mean:</b>	64.7 ± 5.8 years	<b>Hypertension:</b>	91%
<b>Gender:</b>	64% Male	<b>Dilated CM:</b>	27%
<b>Left atrial size:</b>	49.8 ± 3.5 mm	<b>Prior CVA:</b>	9%
<b>AT/AF Duration:</b>	4.7 ± 4.6 years	<b>Vascular Disease:</b>	9%

### Procedural Rhythms

<b>Atypical Flutter</b>	100% (11/11)	CL 312±84ms (range 206-567 ms)
	22 Atypical Flutters	
<b>Atrial Fibrillation</b>	91% (10/11)	

### Mapping Results

Patient Number	Rhythm Stability	Contact Mapping	Non-Contact Dipole Density Mapping
1 – 4	Stable atypical flutters*	100%	100%
5 – 11	Unstable atypical flutters; Multiple complex, irregular rhythms	13%	100%

\* Good correlation between mapping systems

### Conclusions

- In stable rhythm patterns, there was good agreement among all map types.
- In more complex, irregular rhythms, contact mapping was largely unsuccessful, whereas dipole density non-contact mapping successfully identified the pattern for atypical atrial flutters.

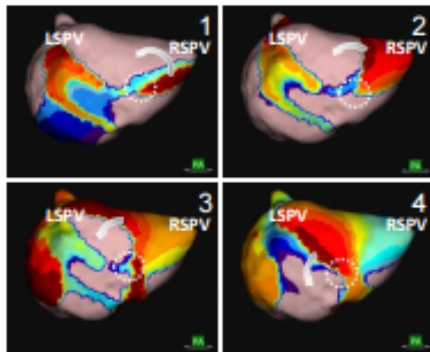
# Acutus Medical Afib mapping

## Results

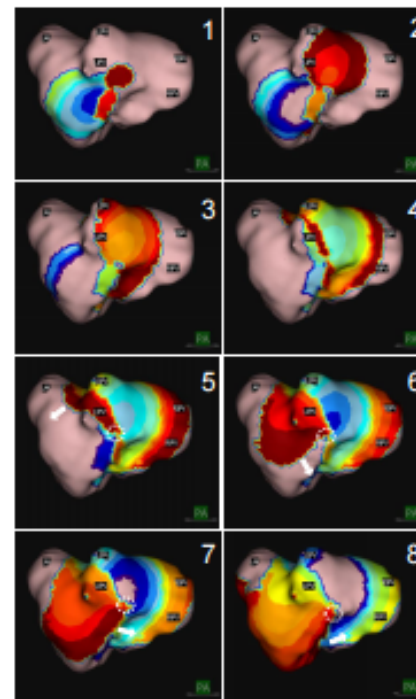
**N:** 12 subjects  
**Mean Age:** 58 years (45-74)  
**BMI:** 29 (25-39)  
**AF Duration:** 4.6 years (2-10)

- A total of 112 sec of left atrial AF was mapped (42 maps: 1 to 3 seconds of AF per map)
- Multiple waves spread out from focal sites and short-lasting zones of rotation
- Higher complexity was observed in the septum and region between the antral junctions of the pulmonary veins, including irregular short-radius reentry and patient specific central paths of rotation

## Examples of Activation Patterns and Locations in Atrial Fibrillation

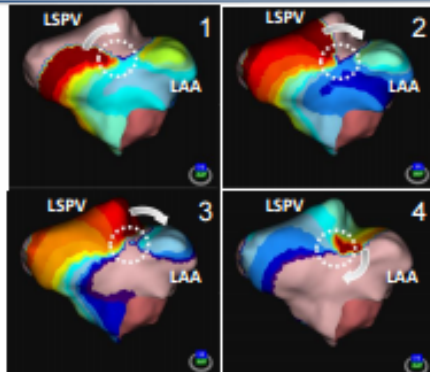


Counterclockwise rotational activation on the posterior wall near the RIPV at four instances in time



Focal activation on the posterior wall near the LIPV

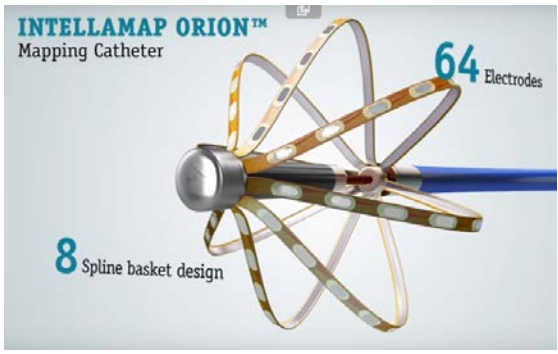
Followed by counterclockwise rotational activation at the LIPV



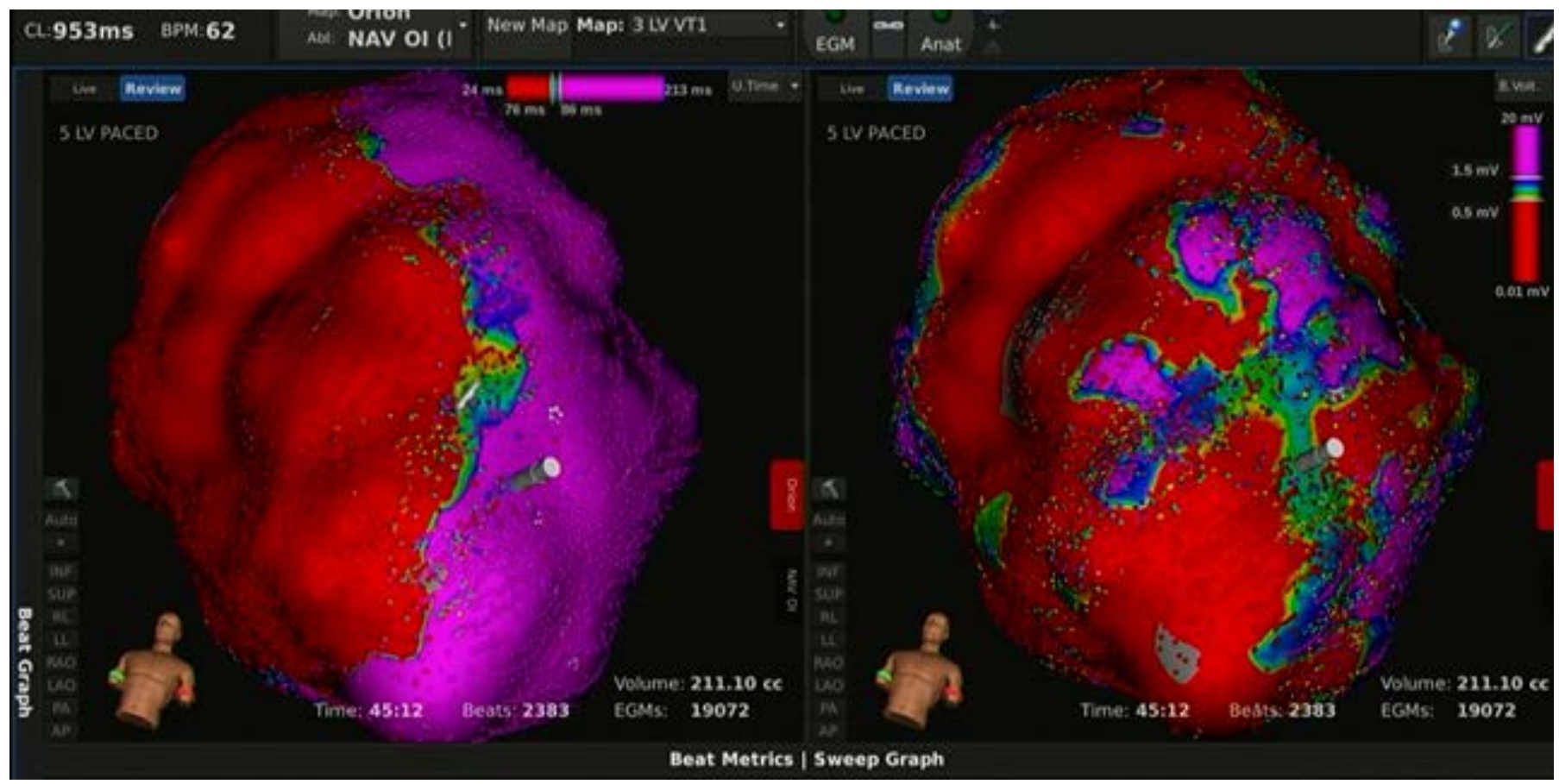
Clockwise irregular-rotational conduction at the ridge between the LSPV and base of LAA

## Conclusions

- Ultrasound-based imaging and dipole density mapping is feasible in persistent AF.
- It may enable more detailed visualization of propagation patterns and potential therapeutic targets.
- Further clinical studies are needed to determine clinical benefit



# Rhythmia Boston Scientific



# Závěr

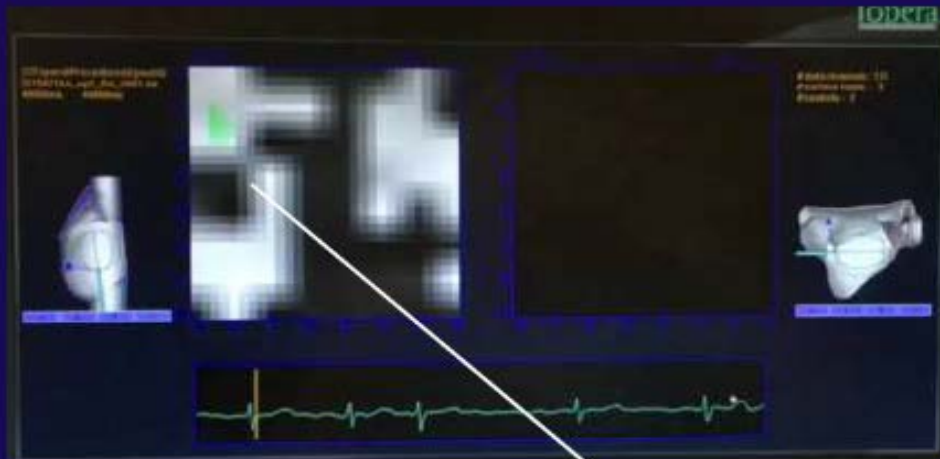
- U **všech** (i „komplikovaných“) nemocných s FS zvažovat přínos katetrizační ablace.
- Ve správně indikovaných případech přináší **lepší výsledky než farmakologická léčba.**
- Katetrizační ablace dominuje i v léčbě srdečního selhávání doprovázené fibrilací síní:
  - Zlepšuje kvalitu života, symptomy
  - Zvyšuje EF LK
  - Snižuje **četnost rehospitalizací**
  - Snižuje **celkovou mortalitu**

# Závěr

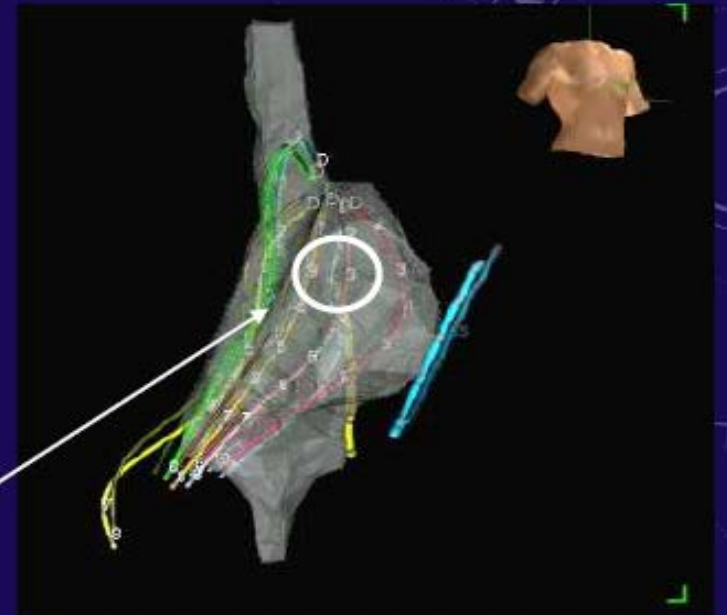
- Jednoznačná indikace u tachykardické KMP
- U obézních nemocných nutnost **hubnutí** a zdravý životní styl!
- Léčba fibrilace síní  
(*rate control x rhythm control x catheter ablation*)  
**u seniorů nemá být diskriminována věkem**



# FiRM - OASIS



A-B 2-3



FIRM mapping to identify AF sources\* was repeated until:

- all rotors were identified and ablated
- AF organized into AT or converted to SR

\*rotor: sustained clockwise or counterclockwise activation around a center of rotation



\*focal impulse: centrifugal activation from an origin

FIRM-only

FIRM+PVAI

< 1%



# FiRM - OASIS

	<i>FiRM-only</i> N = 29	FiRM + PVAI N = 42	PVAI + PW + triggers N = 42	P
Patients with AF sources	100%	100%	-	
Number of AF sources	116	177	-	
per patient	4.0 ± 1.2	4.2 ± 1.7	-	
RA	39%	33%	-	
LA	61%	67%	-	
Procedural time (min)	222 ± 49	233 ± 48	131 ± 51	< 0.001
RF time (min)	49 ± 17	33 ± 21	29 ± 16	< 0.001
Complications	0%	4.8%	2.4%	NS

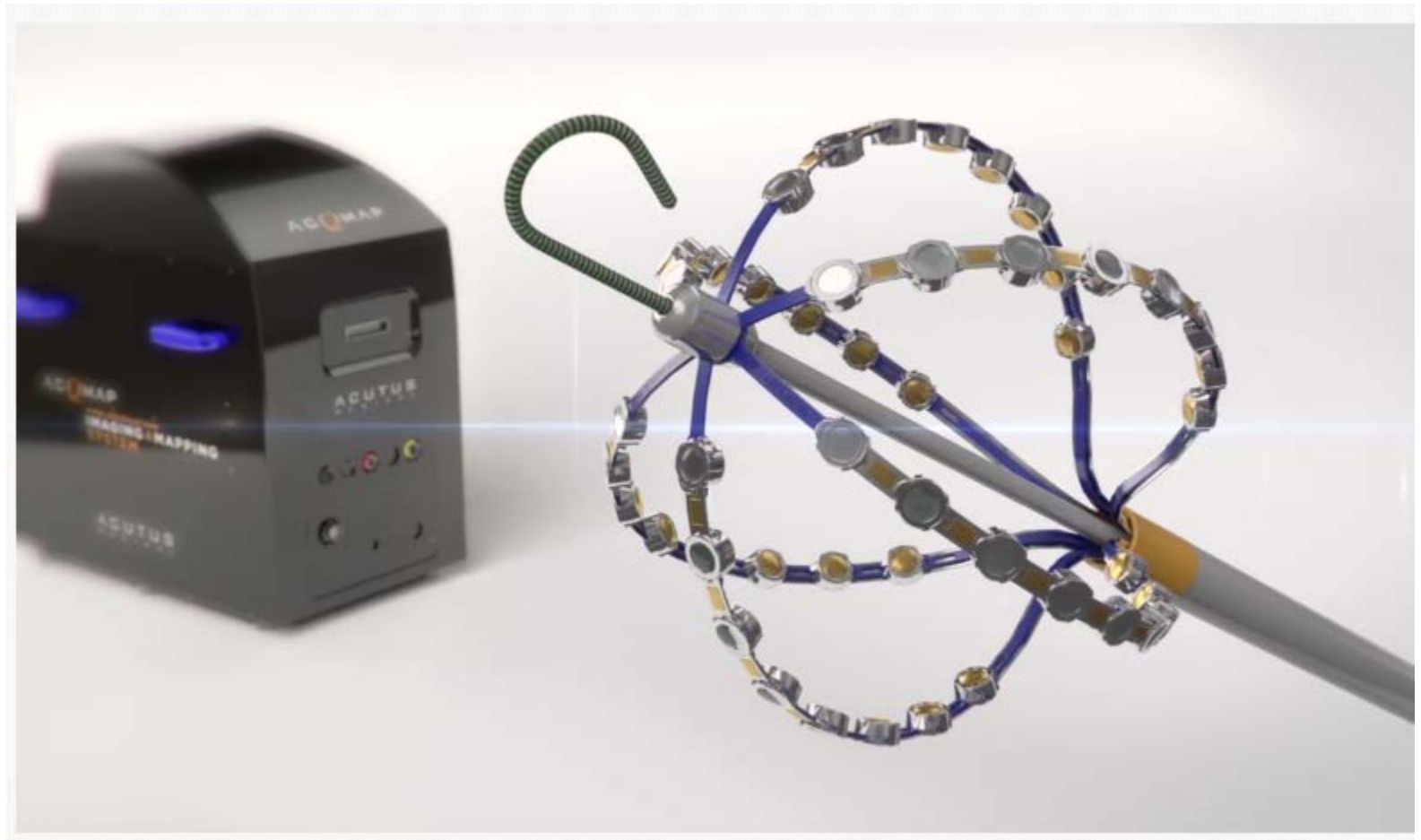
1 groin hematoma  
1 small pericardial effusion

1 groin hematoma

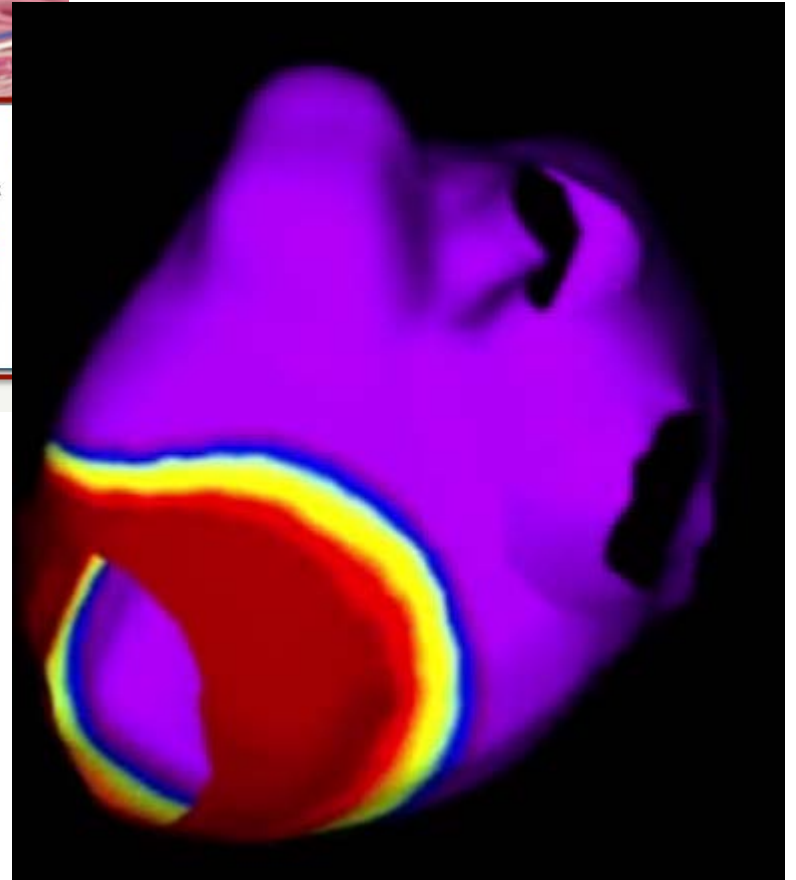
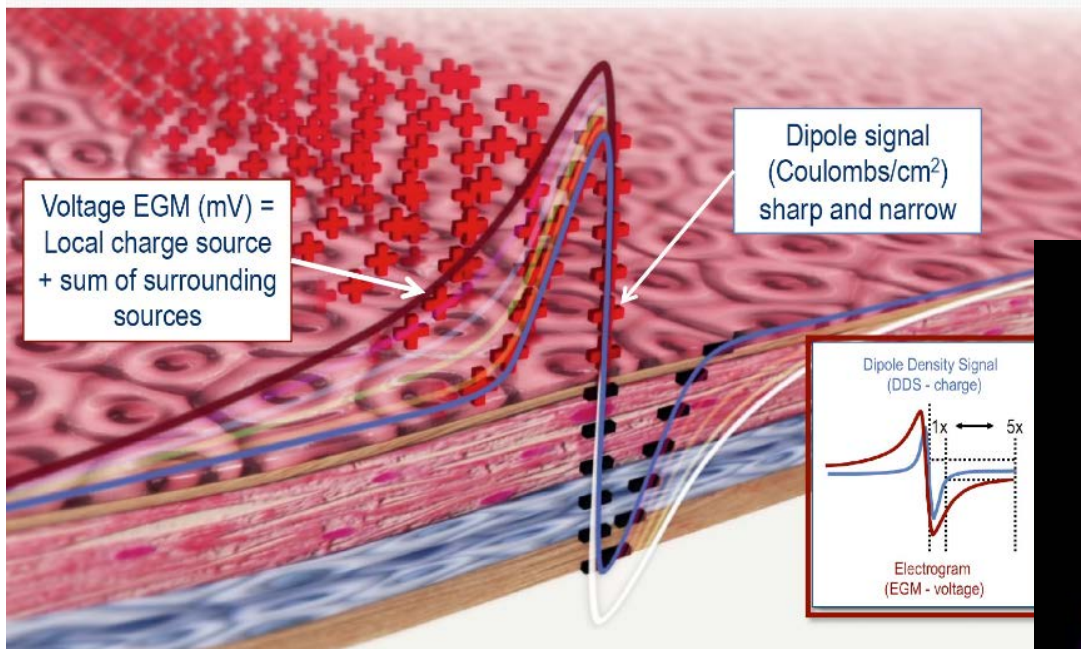
# **CardioInsight – ECVUE Medtronic studie AFACART**

- **předb. výsledky prezentovány Orlando AF 2015, probíhá FUP**
- **Nerandomizovaná feasibility studie persist FiS**
- **8 evropských center bez předchozí zkušenosti**
- **Mapování – ablace rotorů a lokálních spouštěčů ... PVI ...lin. Leze... eIKV**
- **endpoint absence FiS/AT 12mo**

# Acutus Medical




# Acutus Medical



# Acutus Medical

Low Help

Nav Control Acquisition Waveforms Maps ID: 05-29 Session: 4/17/2016  ACQMAP

Localization Enhancement Mode On

RAO AP LAO LL LPO PA RPO RL

Surface In Use  Build  Existing Surface

3-D Display Controls

Filters >

- None
- # of Points
- # of Points in 1 Std dev
- Std dev

# of Points in 1 Std >= 4.10

0  10

Enable Weighted Average

Remove Vertices that are under threshold

Note: Once the option below checked, the vertices below threshold will be removed from final surface

Colors

Above Threshold

Below Threshold

Update Surface

Save Raw Surface

Preprocess

Edit Surface

Start Recording

Copy Anatomy

Advanced

Excluded from Calculation Please Check ACM Catheter Electrodes(4,5,9,11,12,45,47)

Localization Setting Loading AcQMap Catheter AcQMap View

Settings Pause Gen2(OTW)  Fitted  Raw

Auxiliary Positional Reference Electrodes 7,8,9,10 Update



















Auxiliary Reference Electrodes Alignment  None  Translation  Translation + Rotation  View Voltage

AcQMap Excluded Electrodes Update


Auxiliary Catheter Channel Mapping

Channel Mapping Aux 1: 2-10-2  Aux 2: None Aux 3 - Abt: Abt 2.5

Localization Configuration

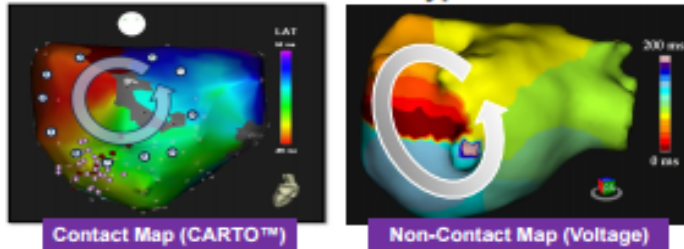
                 

Pause  Low Pass lp\_64coeff\_cut100\_stop  High Pass HP cutoff 1.0 Hz order 1  Decimation Meth Exec Time 1.967 Time Betwn Calls 15.000 Queue Reads 5.00

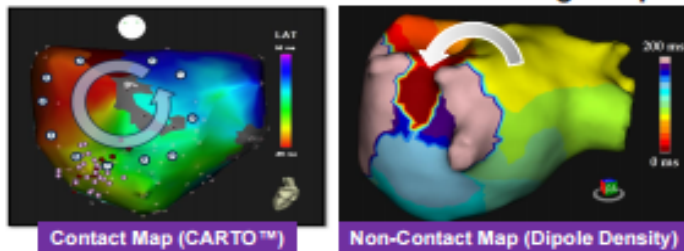
Enable Data Stream Ready 02:40:41  04:29 5:40 PM Disable Data Stream

# Acutus Medical Atypical Flutters

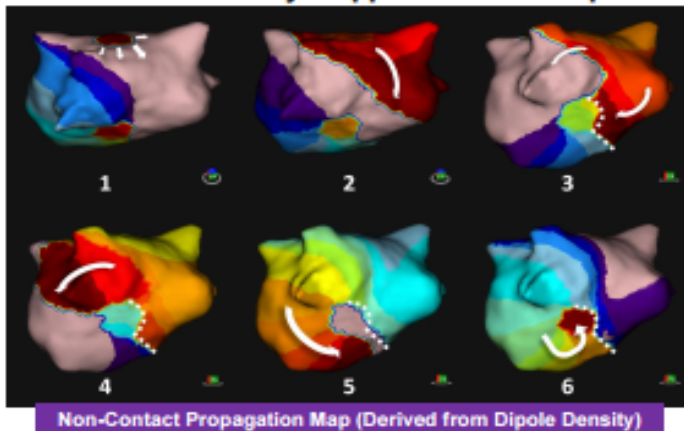
## Conventional and Non-contact Voltage maps correlate well in Stable Atypical Flutters



## Non-contact Dipole Density mapping reveals details not seen in Conventional Voltage map



## Example of a Complex, Atypical Flutter which was only mapped with AcQMap



## Results

### Patient Demographics

<b>N:</b>	11 subjects	<b>Prior ablation:</b>	64%
<b>Mean:</b>	64.7 ± 5.8 years	<b>Hypertension:</b>	91%
<b>Gender:</b>	64% Male	<b>Dilated CM:</b>	27%
<b>Left atrial size:</b>	49.8 ± 3.5 mm	<b>Prior CVA:</b>	9%
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<b>Atypical Flutter</b>	100% (11/11)	CL 312±84ms (range 206-567 ms)
	22 Atypical Flutters	
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Patient Number	Rhythm Stability	Contact Mapping	Non-Contact Dipole Density Mapping
1 – 4	Stable atypical flutters*	100%	100%
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\* Good correlation between mapping systems

### Conclusions

- In stable rhythm patterns, there was good agreement among all map types.
- In more complex, irregular rhythms, contact mapping was largely unsuccessful, whereas dipole density non-contact mapping successfully identified the pattern for atypical atrial flutters.

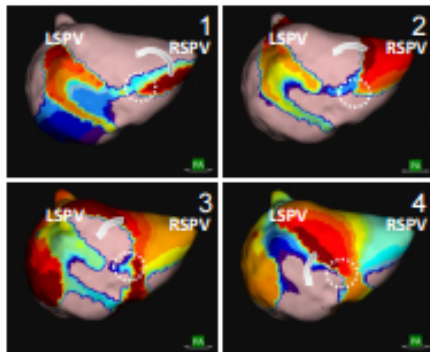
# Acutus Medical Afib mapping

## Results

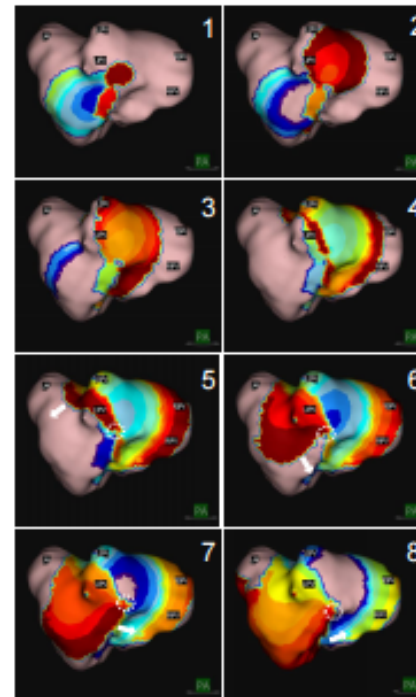
**N:** 12 subjects  
**Mean Age:** 58 years (45-74)  
**BMI:** 29 (25-39)  
**AF Duration:** 4.6 years (2-10)

- A total of 112 sec of left atrial AF was mapped (42 maps: 1 to 3 seconds of AF per map)
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## Examples of Activation Patterns and Locations in Atrial Fibrillation

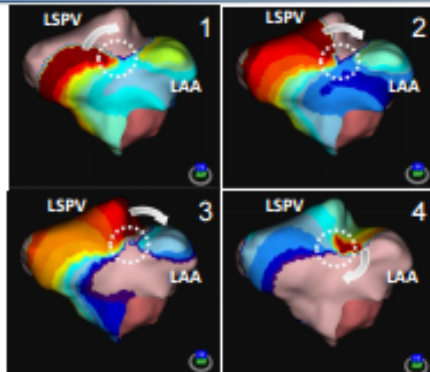


Counterclockwise rotational activation on the posterior wall near the RIPV at four instances in time



Focal activation on the posterior wall near the LIPV

Followed by counterclockwise rotational activation at the LIPV



Clockwise irregular-rotational conduction at the ridge between the LSPV and base of LAA

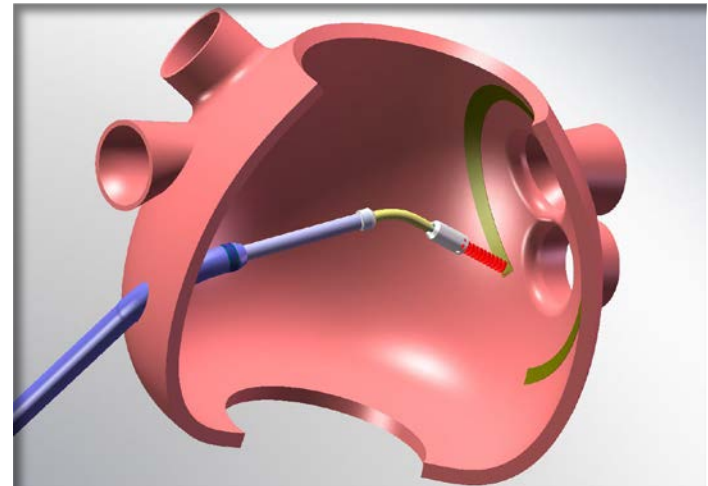
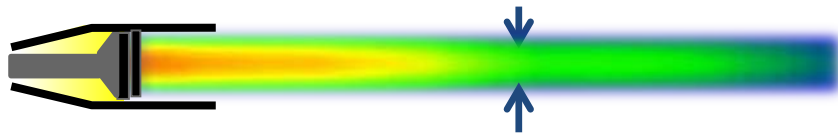
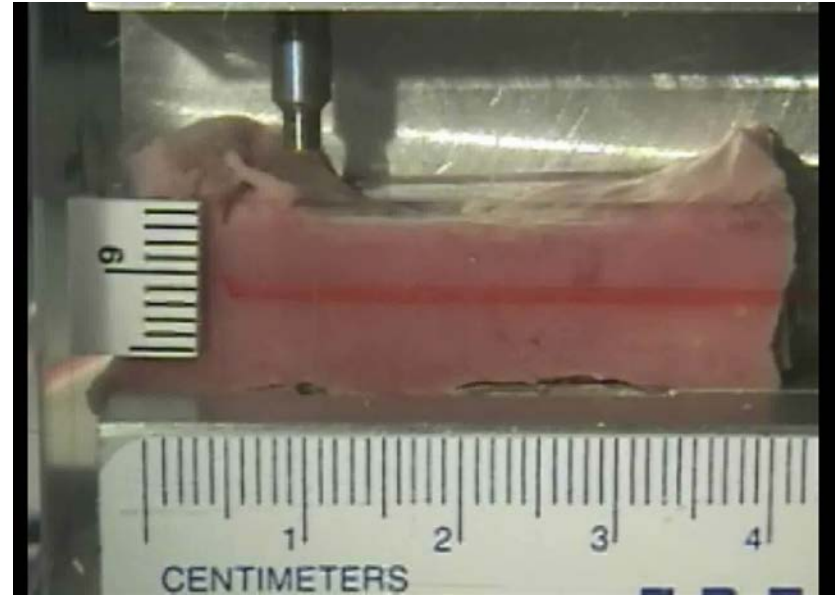
## Conclusions

- Ultrasound-based imaging and dipole density mapping is feasible in persistent AF.
- It may enable more detailed visualization of propagation patterns and potential therapeutic targets.
- Further clinical studies are needed to determine clinical benefit

# Low Intensity Collimated Ultrasound (LICU)

## To Create Non-Contact Continuous Lesions

- Narrow, unfocused beam
- Both imaging and ablation
  - Can be simultaneous
- Energy not absorbed by blood
  - Allows for non-contact ablation
- Robotically-Controlled
  - Customized lesion sets





# Low Intensity Collimated Ultrasound (LICU)

Robotically-controlled segment retracted

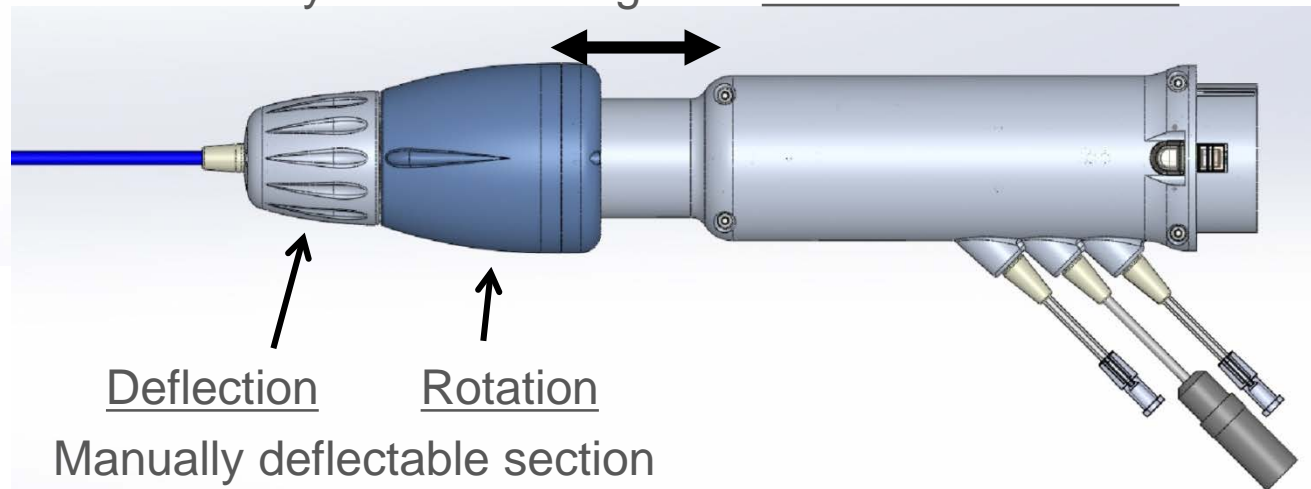


Manually deflectable section



Robotically-controlled segment extended

Robotically-controlled segment extension/retraction



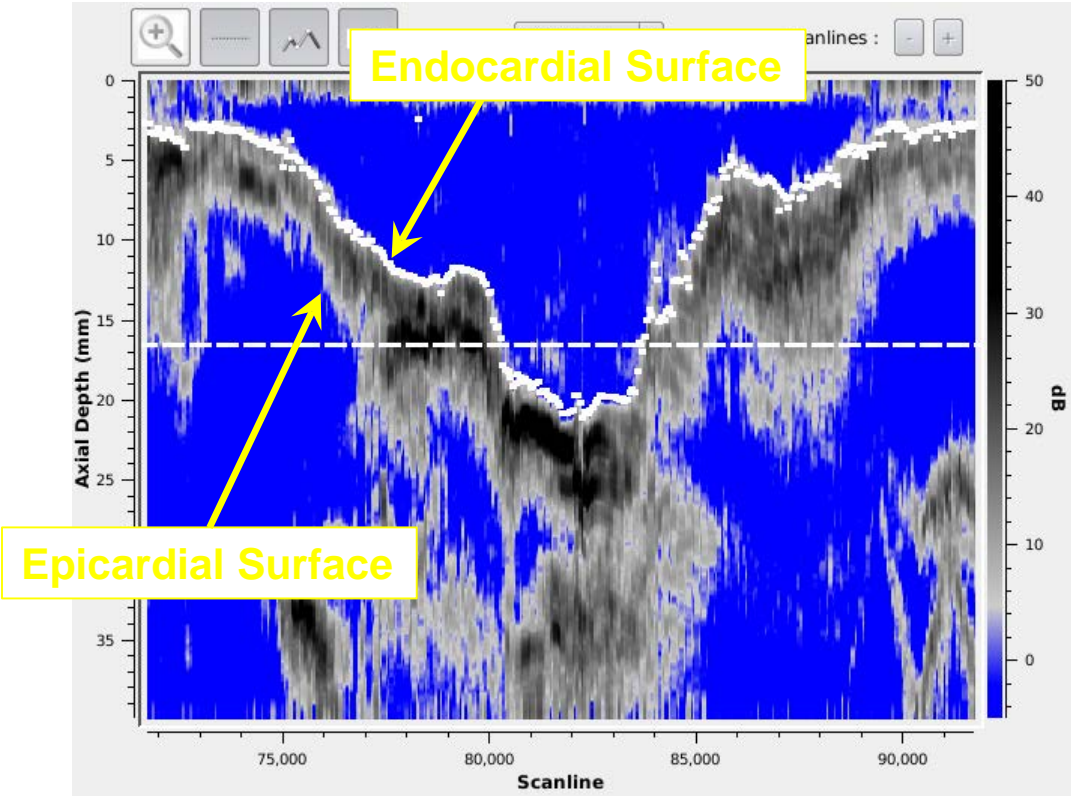
Deflection

Rotation

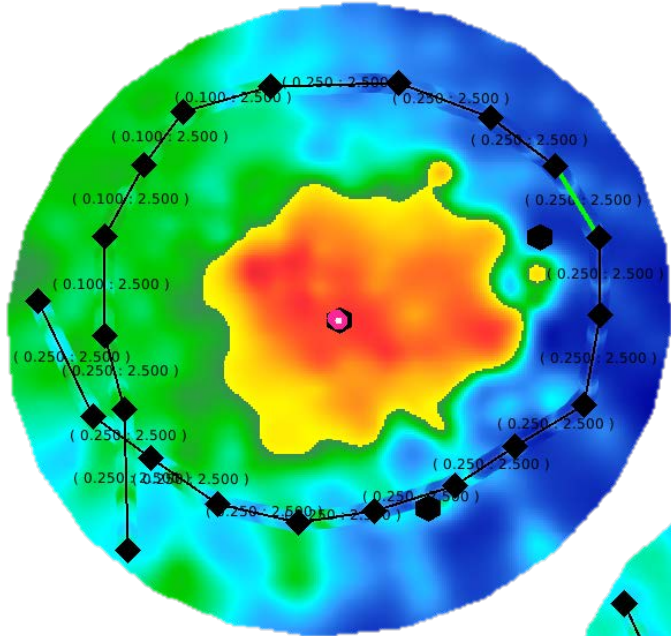
Manually deflectable section



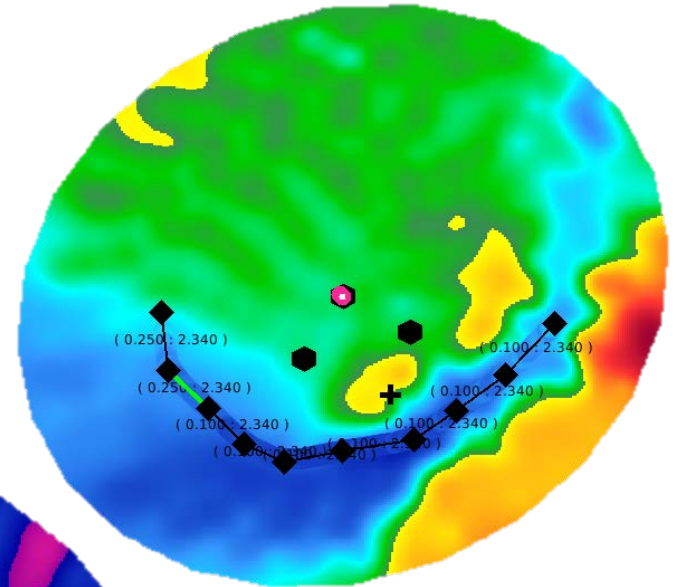
# Low Intensity Collimated Ultrasound (LICU)



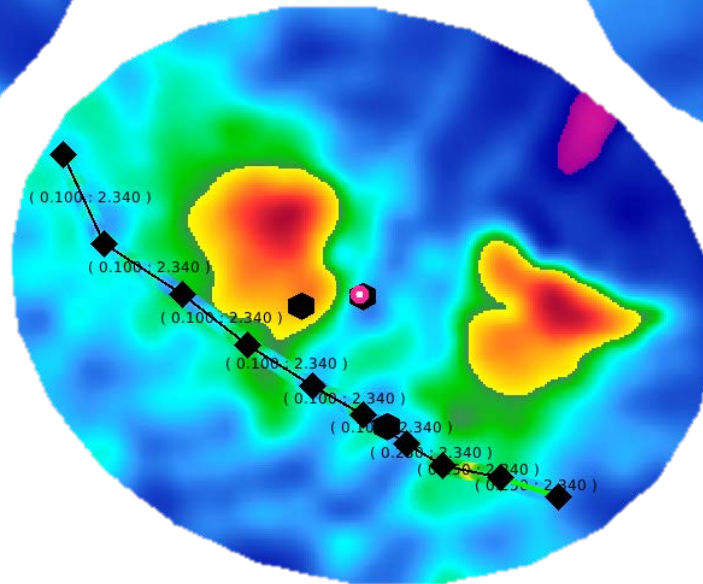
# Low Intensity Collimated Ultrasound (LICU)



Circles

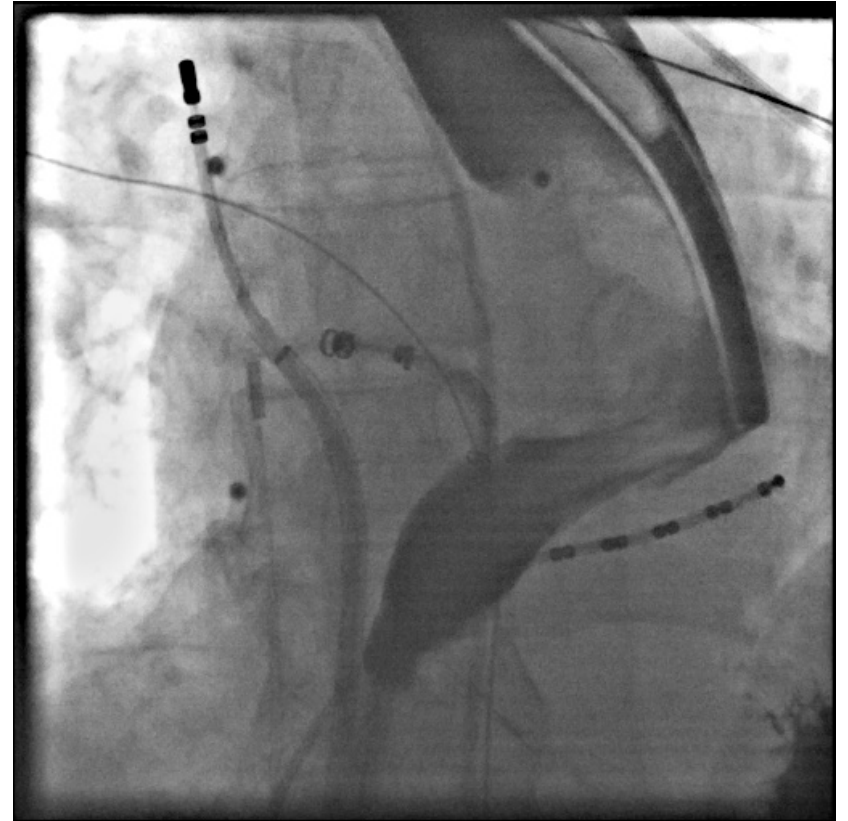
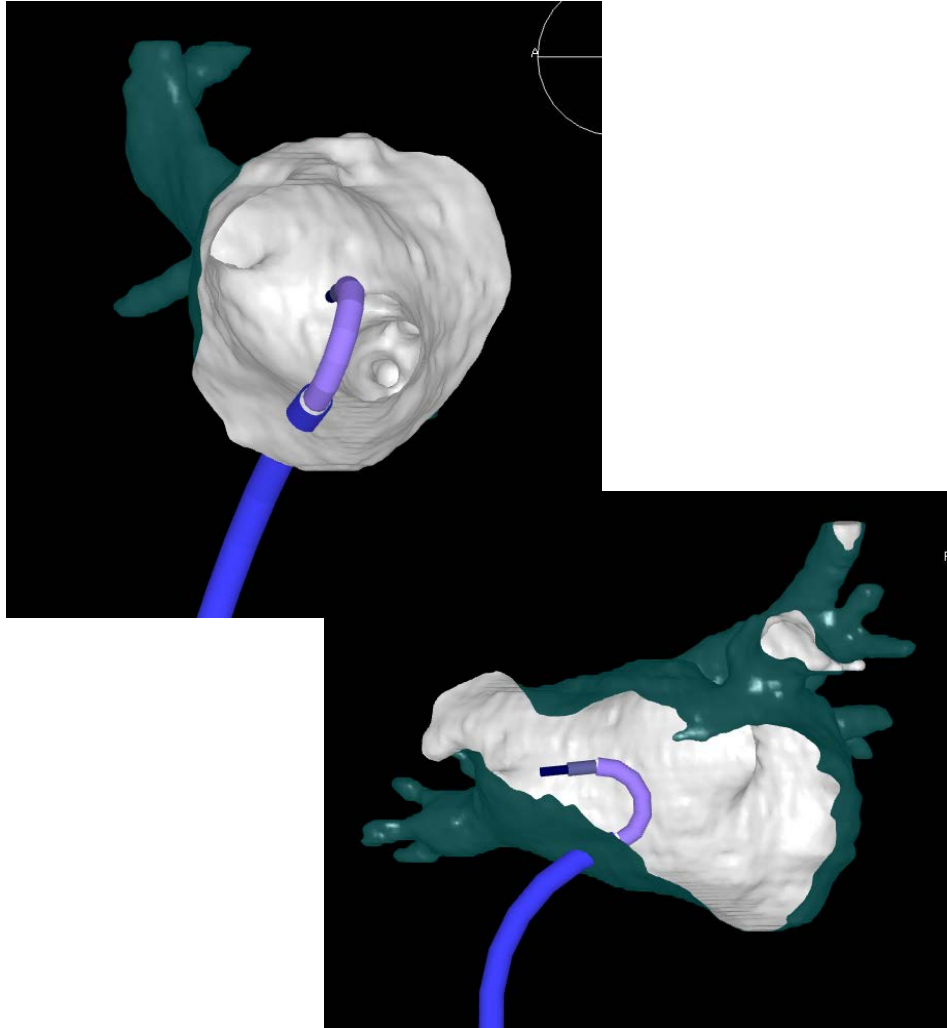


Arcs



Lines

# LICU: Clinical Feasibility



# LICU: Clinical Feasibility Ablation Protocol

- Patient Population: Paroxysmal AF patients
- General Anesthesia
- Create Electroanatomical LA-PV Anatomy
- Introduce LICU ablation system
- Position LICU catheter to point at PV pair
  - Deviate esophagus in contralateral direction
- Create 2D/3D regional image
  - Sequential either LPVs or RPVs
- Plan ablation lesion set
- Automated ablation

# Faktory ovlivňující efekt ablace FS

Polymorbidita

Srdeční selhání, ICHS

Obezita, OSA

Diabetes mellitus

Renální selhání

Vyšší věk (> 75 let)

Kouření, alkohol

Asymptomatická fibrilace síní



# Faktory ovlivňující efekt ablace FS

Polymorbidita

..... **Srdeční selhání**

..... **Obezita**

Diabetes mellitus

Renální selhání

..... **Vyšší věk**

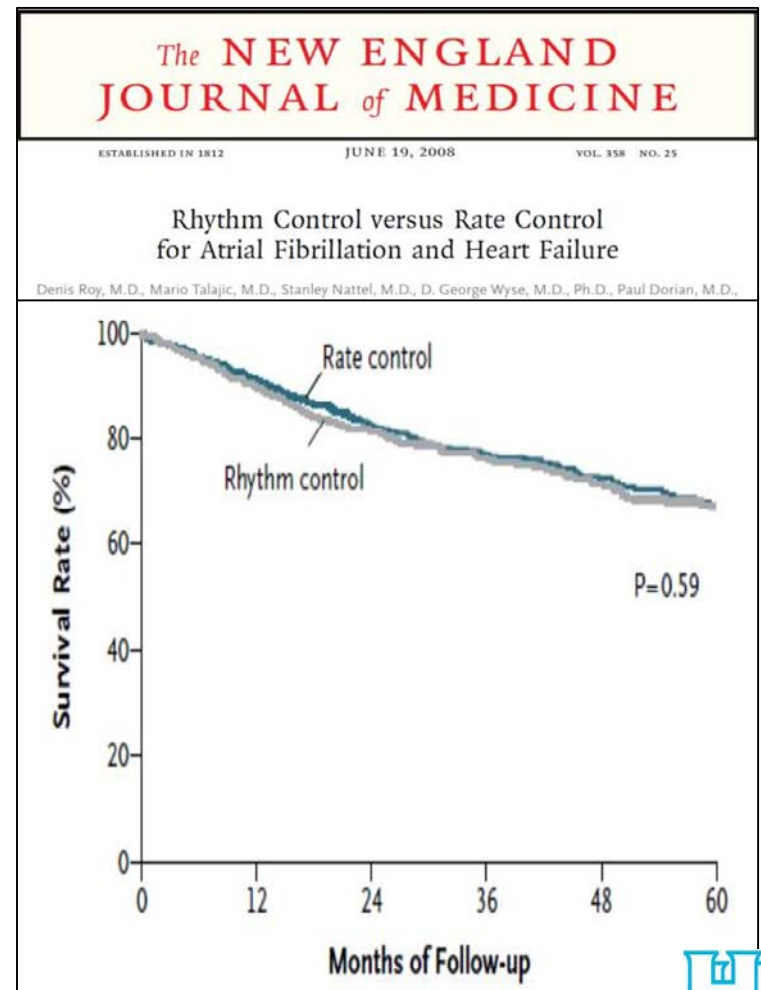
Kouření, alkohol

Asymptomatická fibrilace síní



# Studie AF-CHF

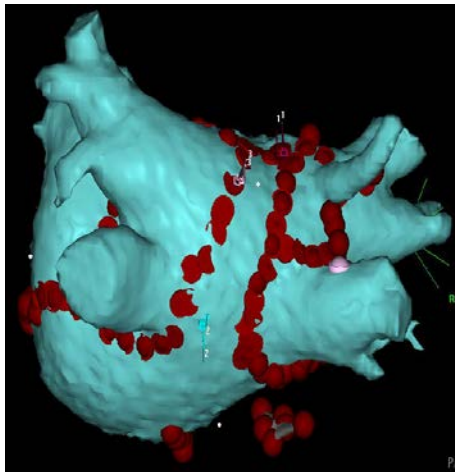
- Randomizace 1376 pac. se systolickou dysfunkcí LK a FS:
- rhythm control vs. rate control (medikamentózní léčba)
- • 682 Rhythm-control, 694 Rate-control
- • Celková mortalita:  
**27% vs 25% (P = 0.59)**
- • Žádný rozdíl ani v mortalitě z kardiovask. příčin, zhoršení CHSS, četnost CMP/TIA



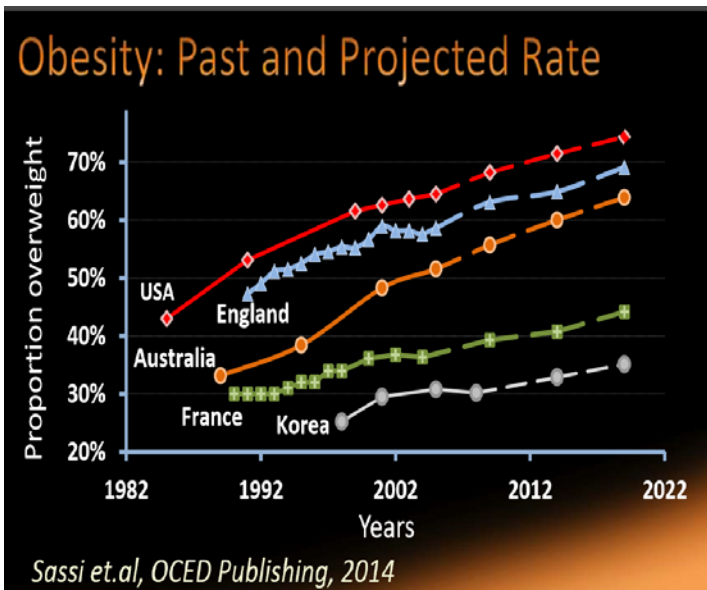


# Tachykardií indukovaná kardiomyopatie

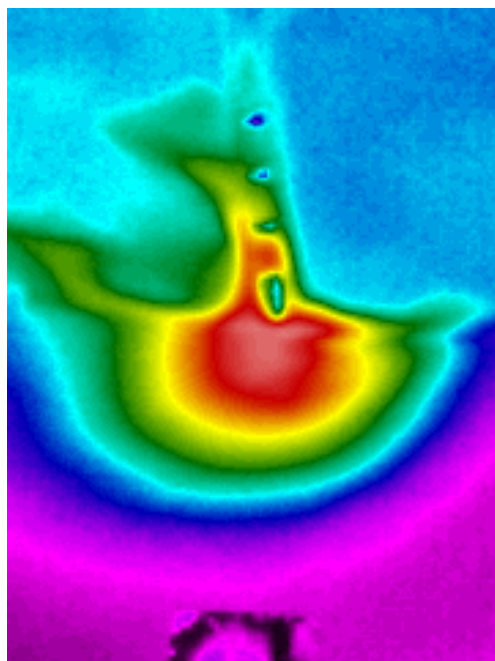
- Muž, 68 let, konec r. 2014 postupně námahová dušnost, nárůst váhy, otoky DK
- 2/2015 referován do NNH pro srdeční selhání, perzistující FS s rychlou komorovou odpovědí
- ECHO: dilatace LK (67/59mm), difusní hypokineza, EF LK 20%, LS PLAX 46mm, lehká MI regurgitace
- Komplexní katetrizační ablace, terminace FS ablací!!



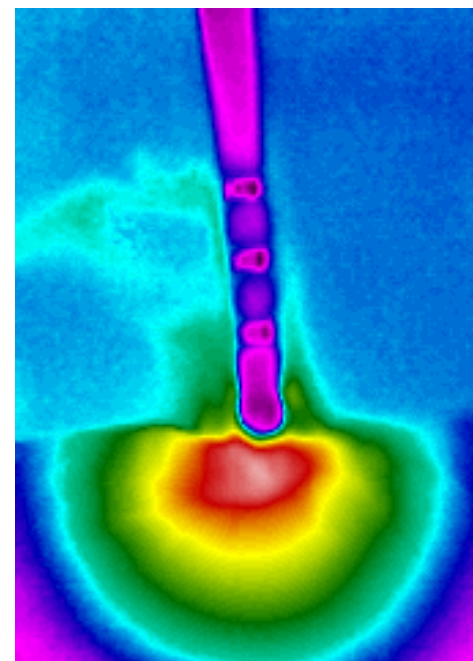
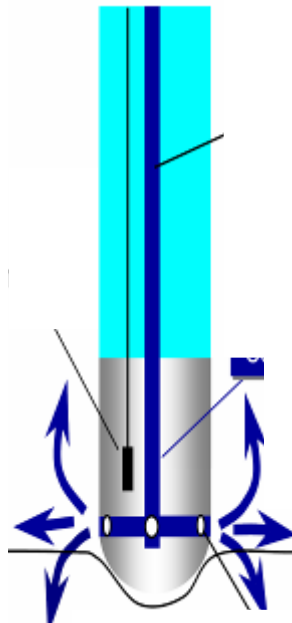
# Obezita



# Radiofrekvenční ablace s chlazením průtokem fyziologického roztoku



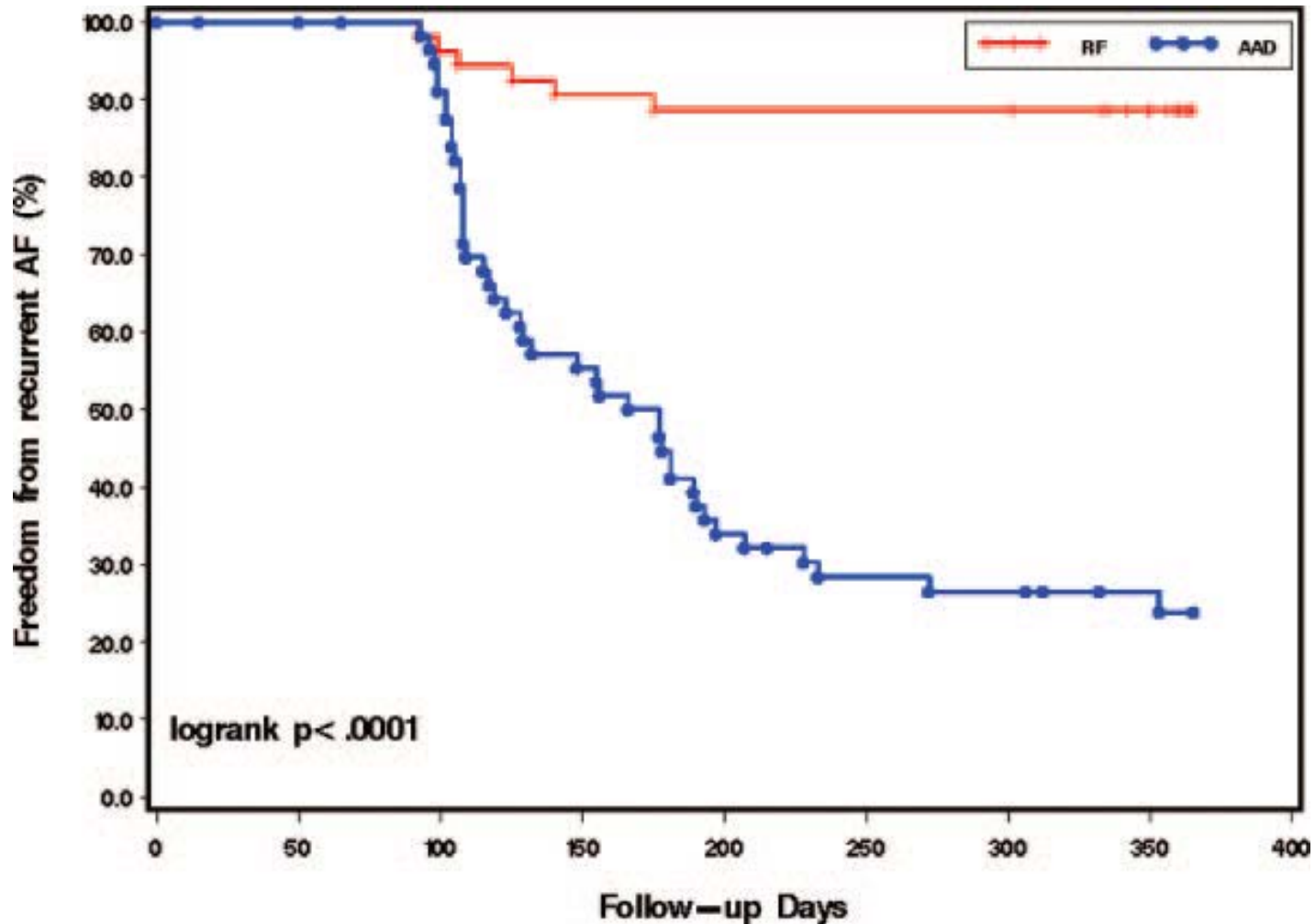
Standardní aplikace RF



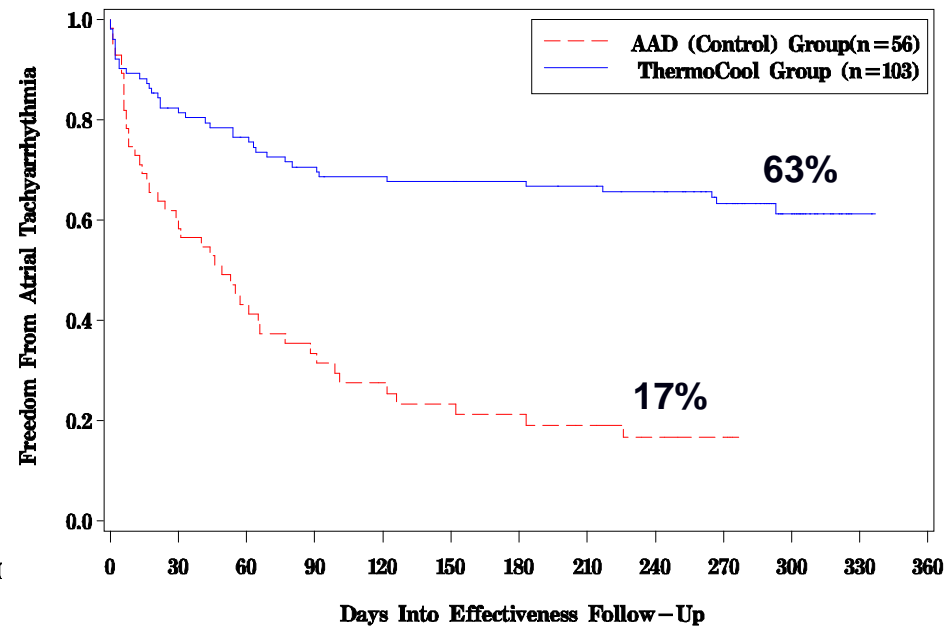
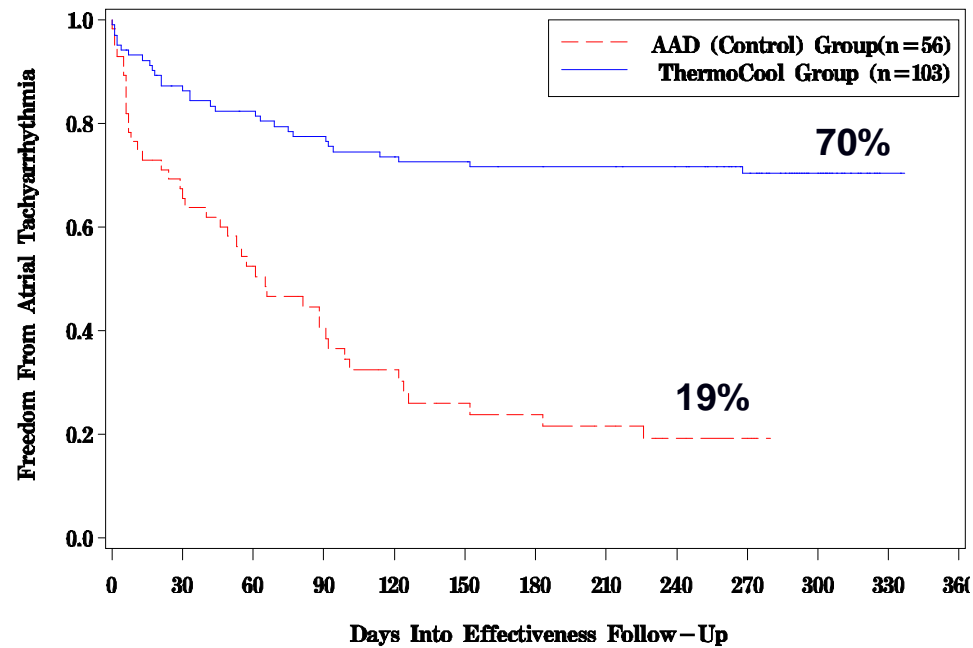
RF aplikovaná s irrigací



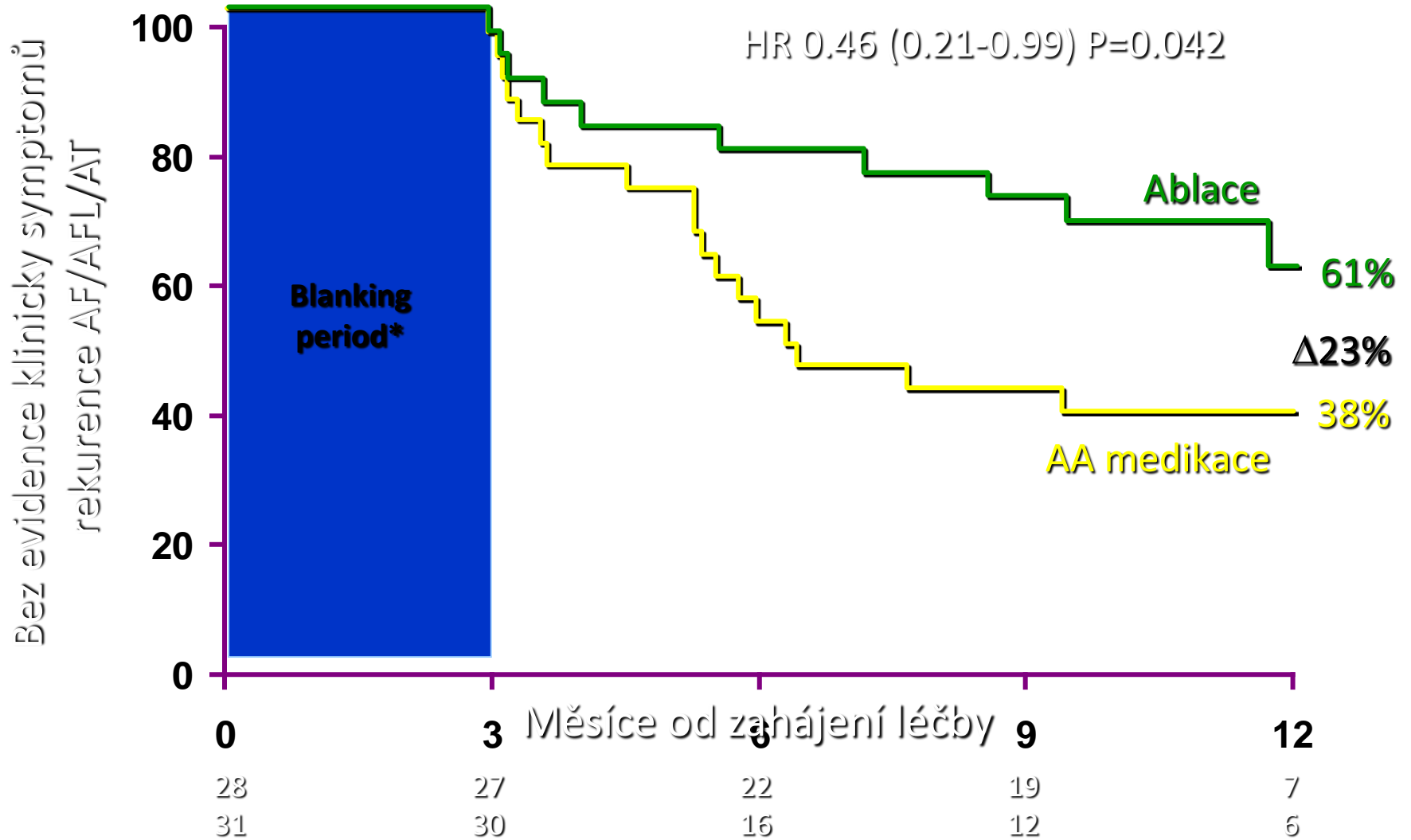
# A4: Ablace vs Farmakoterapie u PAF



# Studie Thermocool - AF

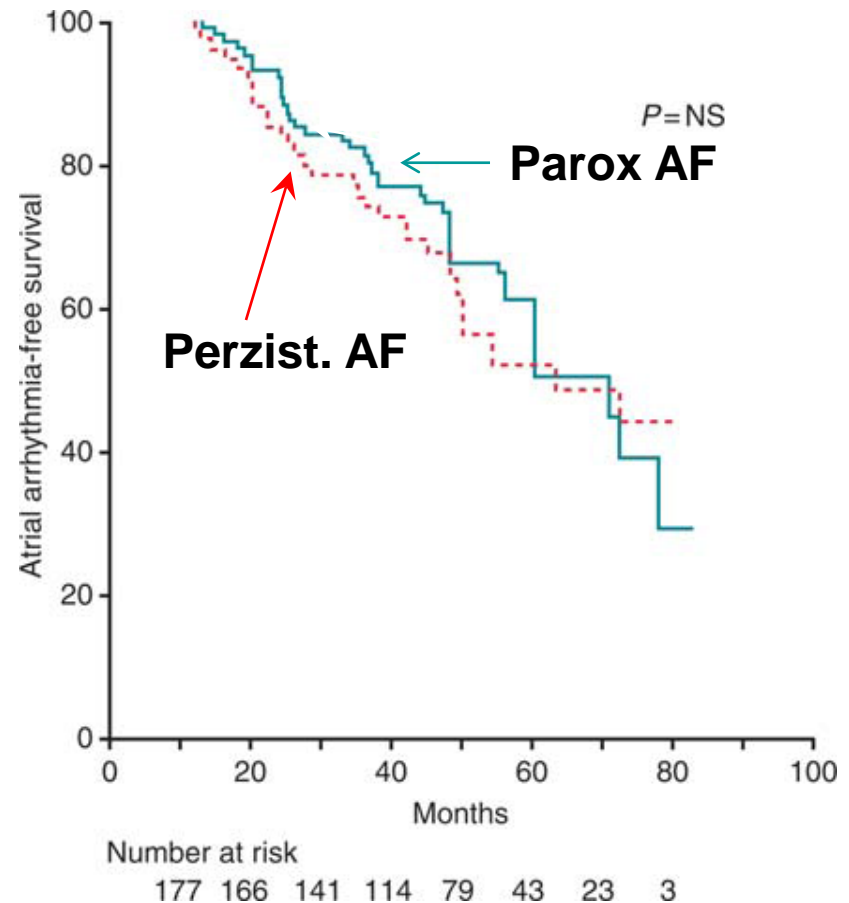


# CABANA – Pilotní studie

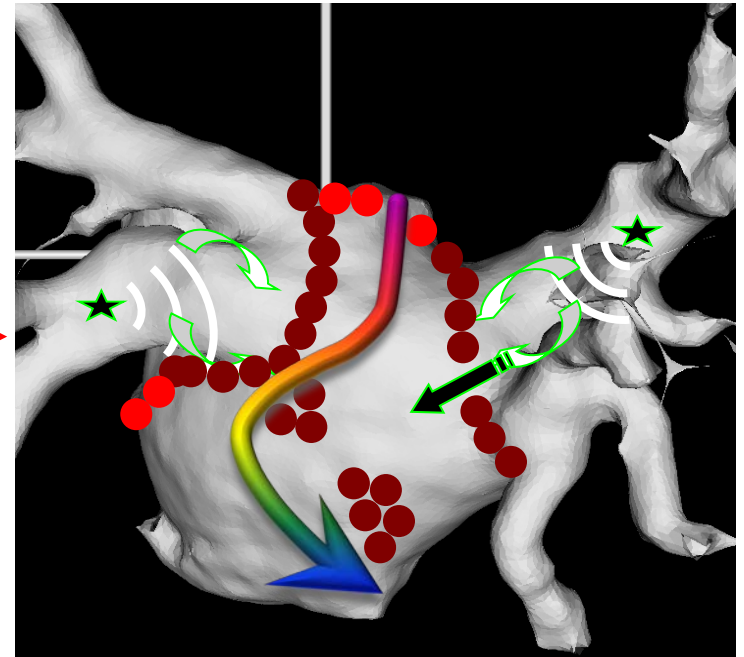
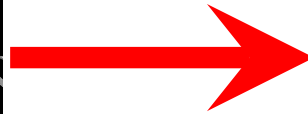
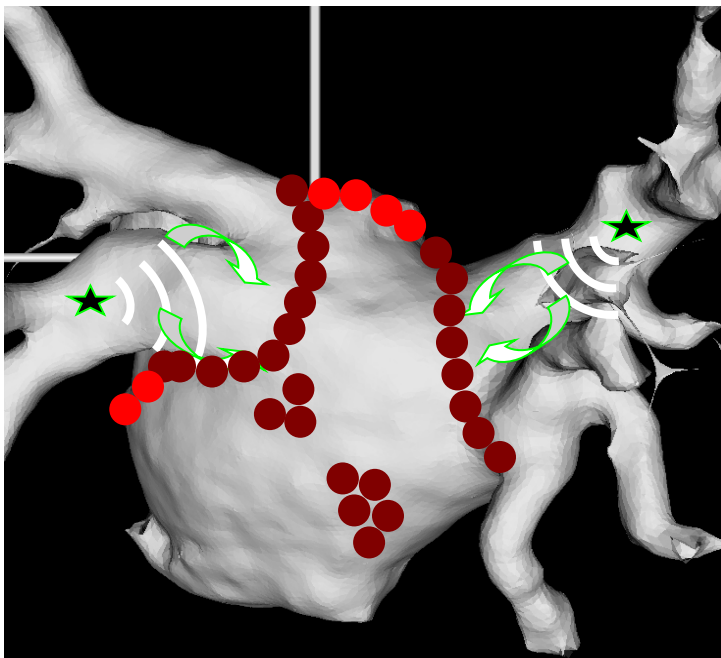


# Long-term Outcome after PVI: Late Recurrence

- n = 177 229 nem. bez rekurence v prvním roce
- Sledování  $50 \pm 13$  měs. (36 – 83 měs.)
- 42% rekurence FiS
  - 13% / 2 roky
  - 22% / 3 roky
  - 35% / 4 roky
  - 47% / 5 let
  - 55% / 6 let

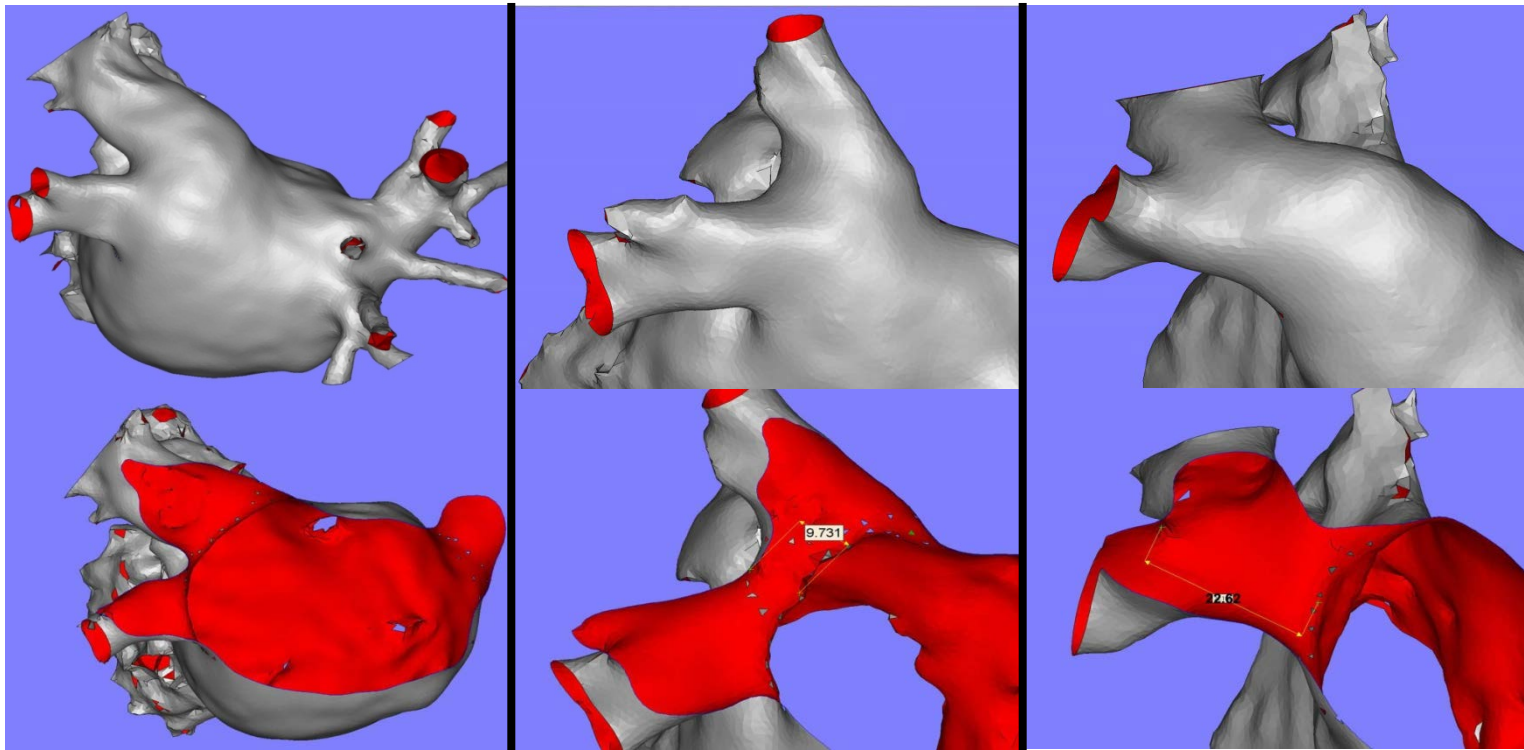


# Fibrilace síní: proč ablace selhává?

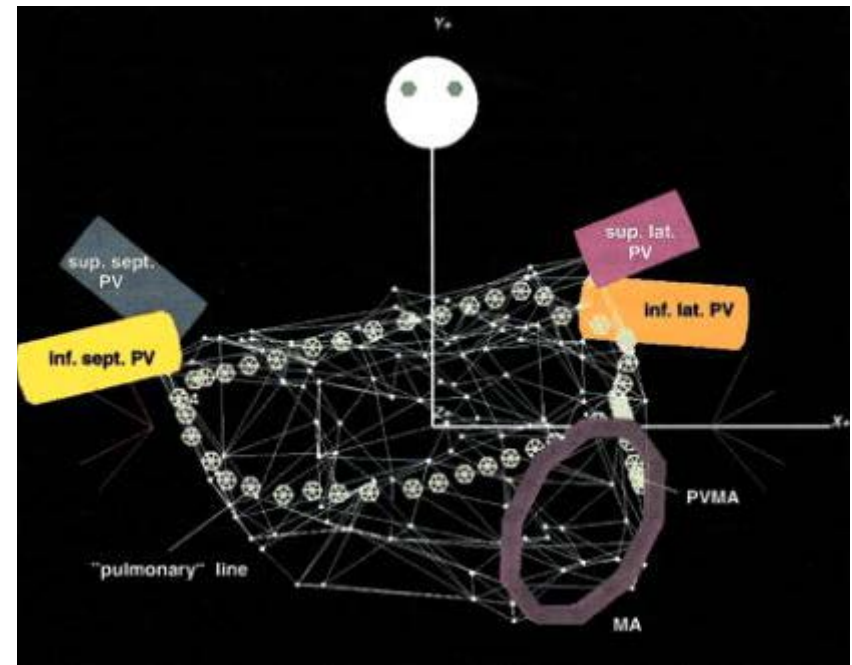
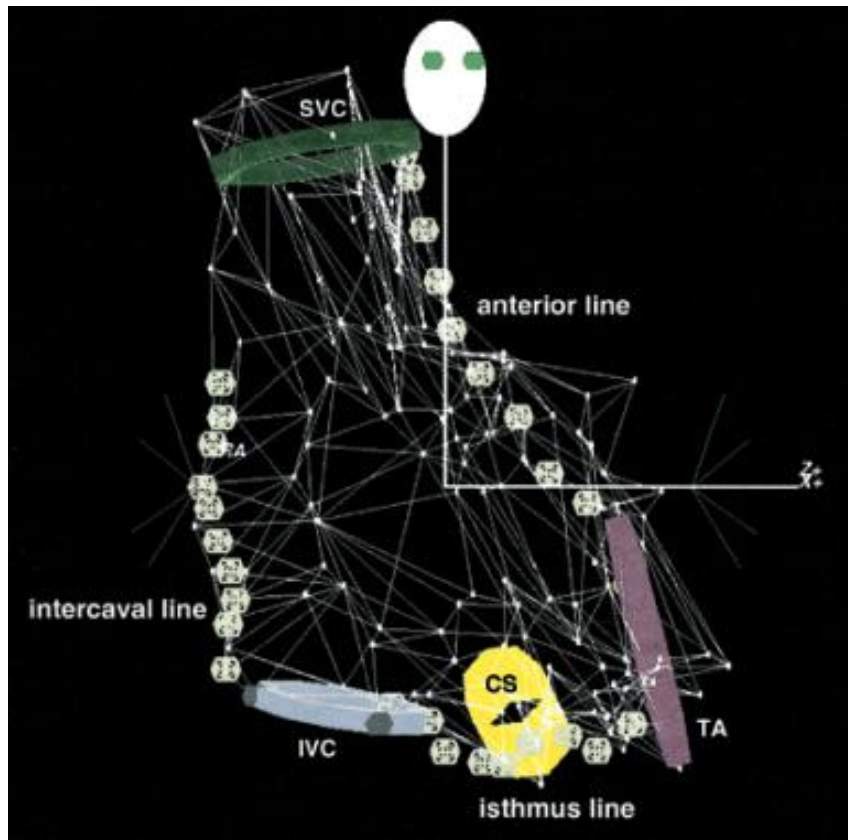




# Pokrok v léčbě fibrilace síní



# Vývoj 3D navigačních systémů - CARTO



45 nem., 7.9+/-1.4 hod. LS,  
6.6+/-2.0 hodPS,  
100% rekurence!!!

V levé síni nedosaženo kompletních  
linií pouze na CTI

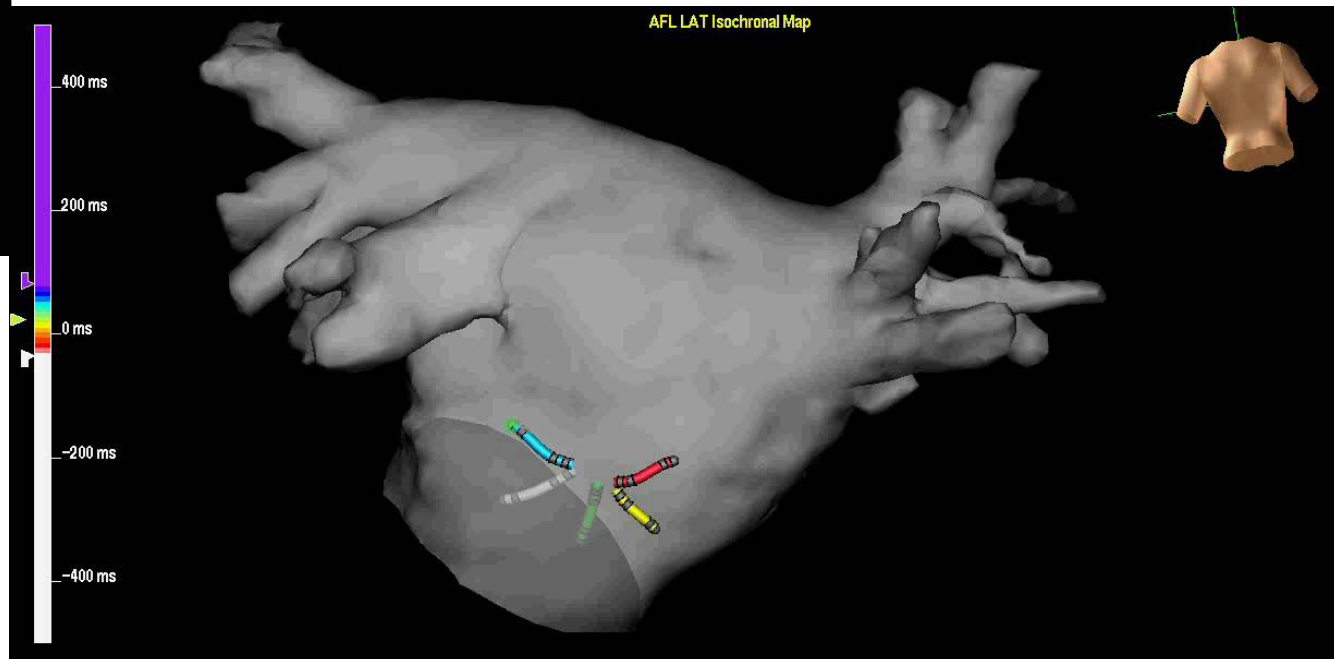
# Integrace 3D zobrazení ICE - navigace

The screenshot displays a complex medical software interface for ICE navigation. The main window is divided into several panels:

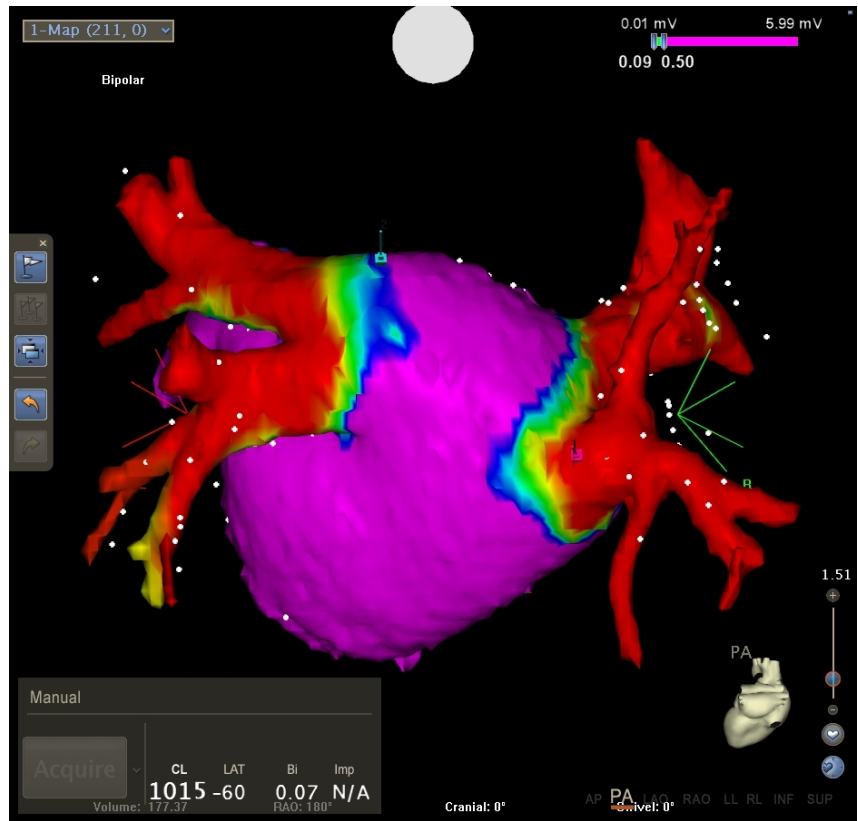
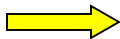
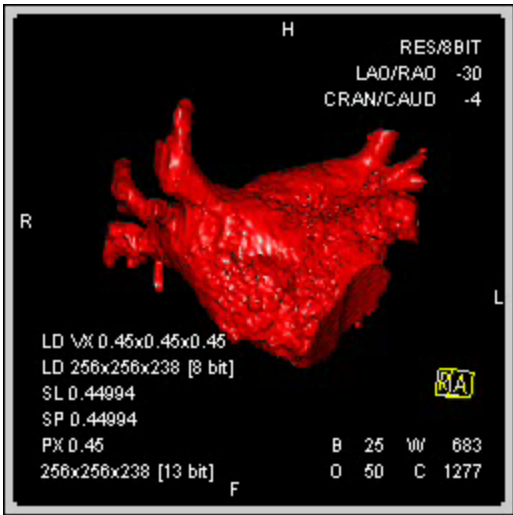
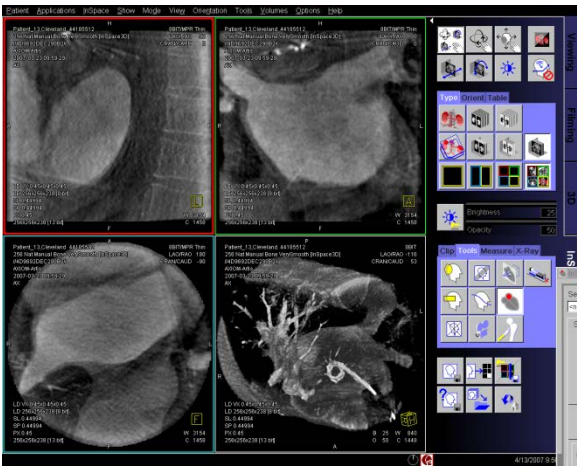
- Top Panel:** Contains menu options (File, Edit, Display, Setup, View, Tools, Image, System, Help) and a toolbar with navigation icons. The top right corner shows the time "13:45" and date "18/Jan/2008".
- Left Panel (Map Viewer):** Shows a 3D anatomical model of the heart with a green plane (LAT) and red dots representing ablation points. A scale bar indicates "1.14 cm".
- Center Panel (Map Viewer):** Shows a similar 3D model from a different perspective, with a color scale ranging from "-193ms" to "90ms". A scale bar indicates "1.24 cm".
- Right Panel (Ultrasound Viewer):** Displays two ultrasound waveforms. The top waveform is labeled "200.0 mm/sec" and the bottom one "100.0 mm/sec".
- Bottom Left Panel (Tag & Type):** A list of tags and types for ablation points, including "Ablation", "Transient Event", "His", "Pacing Site", "Double Potential", "Fragmented Signal", "Scar", "Location only", and "Hot".
- Bottom Center Panel (Table):** A table with columns for ID, Location, Type, RF#, and Time.
- Bottom Right Panel (Registration Tools):** Includes a "Registration Tools" window with "Show" and "Active Only" options, and a "NAVISTAR" window showing a 3D model of the catheter tip.
- Bottom Right Panel (Buttons):** A yellow "ABLATION ON" button and two blue buttons labeled "Auto Freeze" and "Freeze".

ID	Location	Type	RF#	Time
N 107	-50 ABL	L.O.	RF# 23	13:42:52
N 108	-14s ABL	L.O.	RF# 23	13:43:01
N 109	-80 ABL	L.O.	RF# 23	13:43:22
N 110	-23 ABL	L.O.	RF# 23	13:43:52
N 111	-92 ABL	L.O.	RF# 24	13:44:06
N 112	-137 ABL	L.O.	RF# 24	13:44:27
N 113	-47 ABL	L.O.	RF# 24	13:45:07

# Integrace 3D zobrazení CT/MR - navigace



# On site Dyna CT + CARTO 3



# Mapovací Systém „Rhythmia“

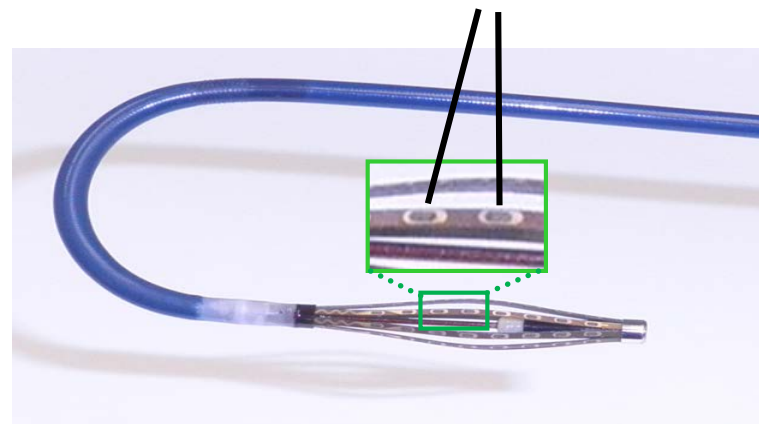
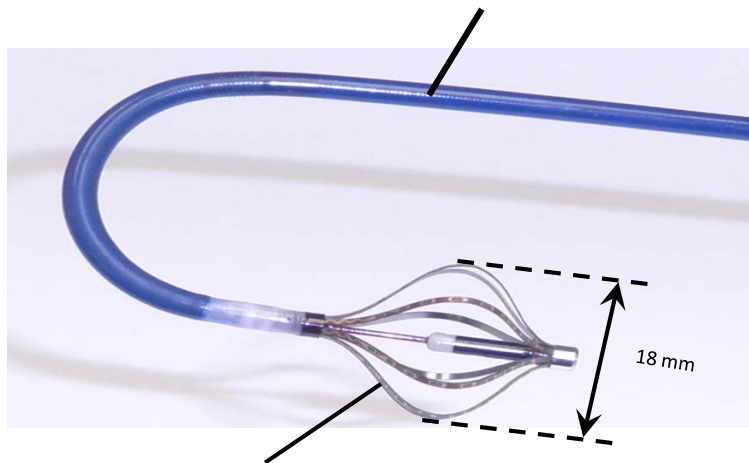
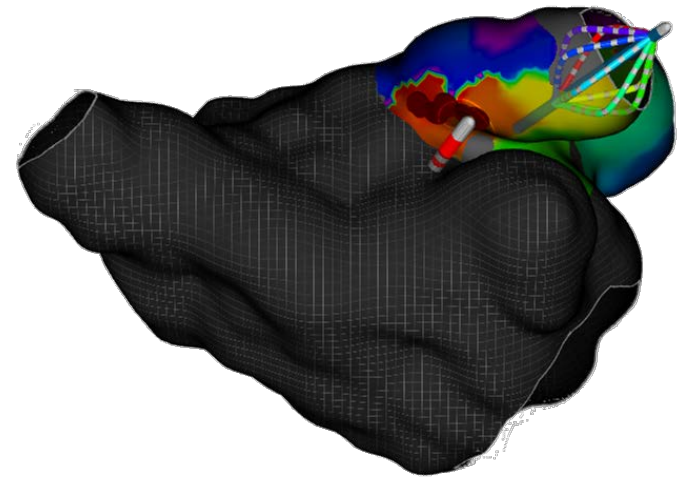
Aktivační / voltážová vizualizace



64 Elektrodový katetr

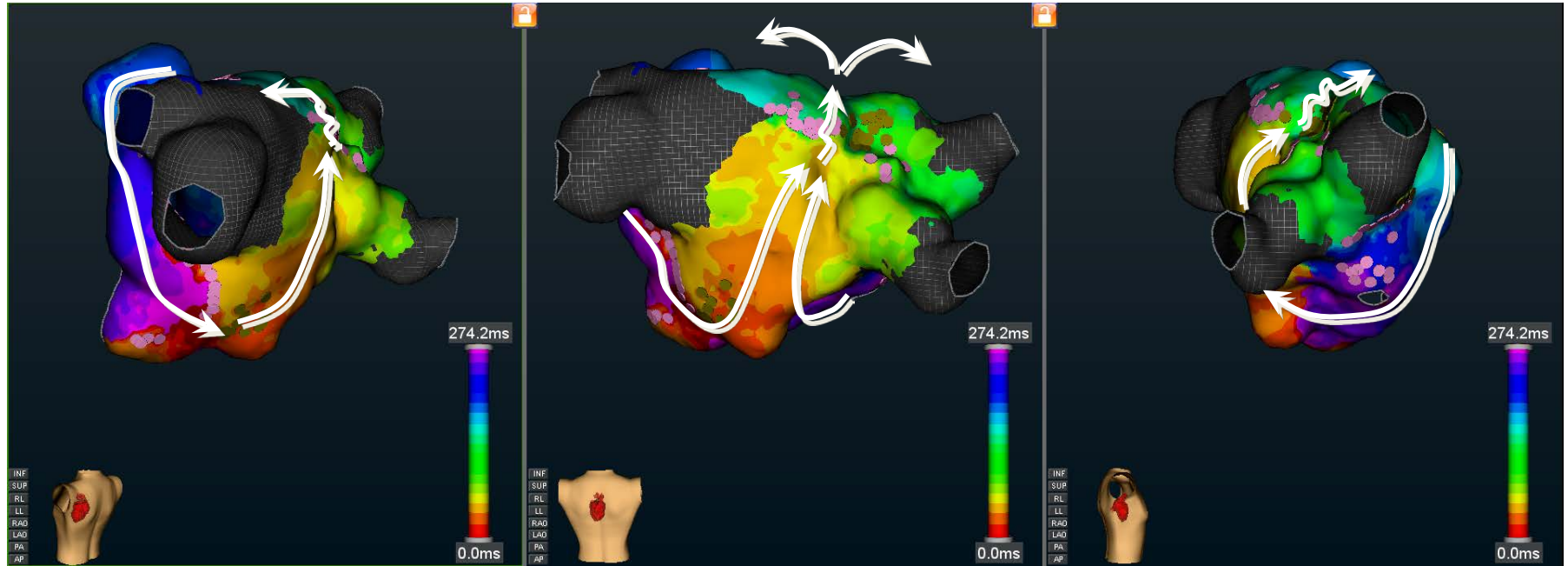


# Rhythmia : mapovací katetr



# Mapování levé síně – post MAZE

59Yrs, Male, AF patient, 5<sup>th</sup> procedure.



Rhythmia Mapping System



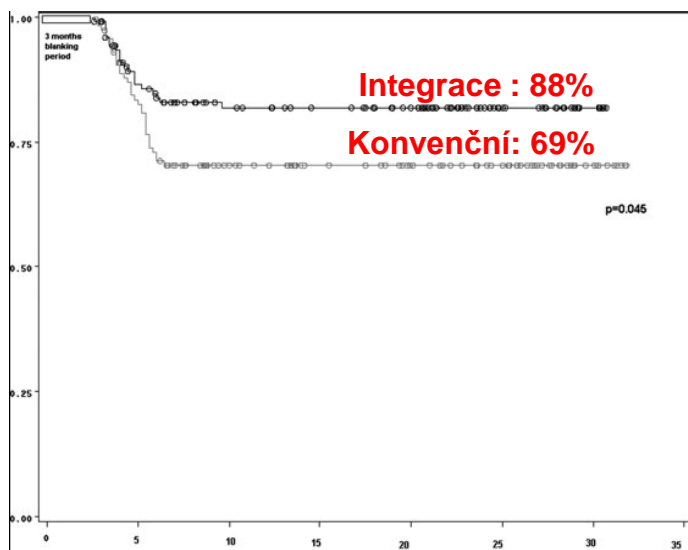
# „Image-Guided Therapy“: Klinická data

Procedural Characteristics

	Group 1*	Group 2†	P
Fluoroscopy time (minutes)	56 ± 18	45 ± 12	<0.0001
Procedural duration (minutes)	170 ± 20	150 ± 23	<0.0001
Mean total energy delivered (J)	76,550 ± 12,400	67,270 ± 11,800	<0.0001
Mean RF delivery times (min)	49 ± 13	46 ± 14	= 0.08
Mean radiation exposure (uGray*m <sup>2</sup> )	28,775 ± 5,540	21,340 ± 2,355	<0.001
Effective biological dose (mSv)	78 ± 14 (first 60 cases) 65 ± 11 (last cases)	44 ± 5	<0.001

\*Radiation times of the ablation procedure and the CT scan acquisition.

†Radiation times of the ablation procedure including the venography.



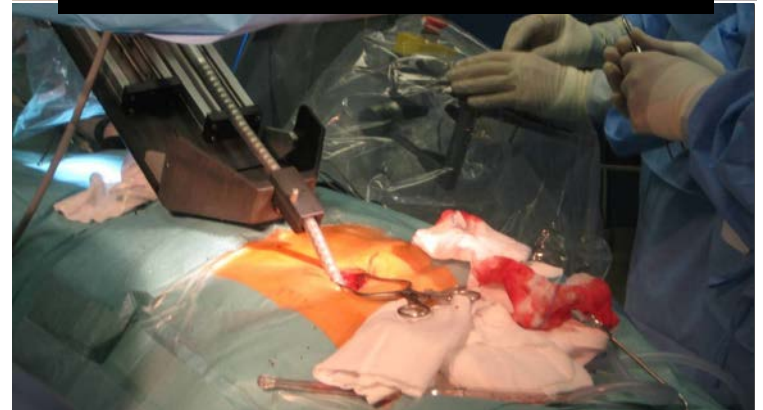
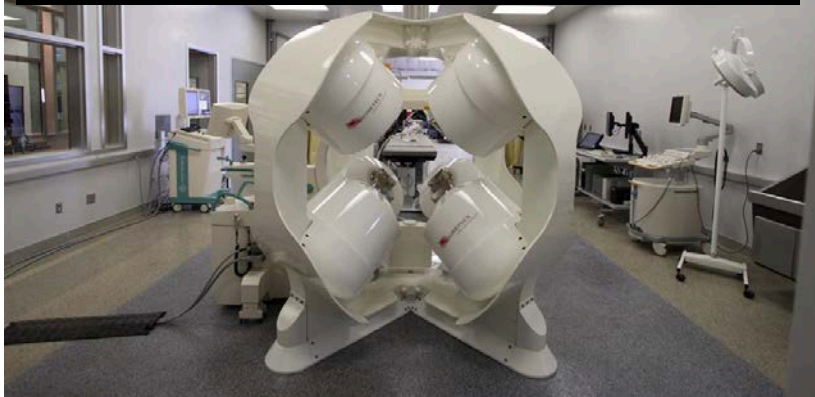
# Dálkově navigované systémy



Magnetická navigace  
Stereotaxis + Magnetecs



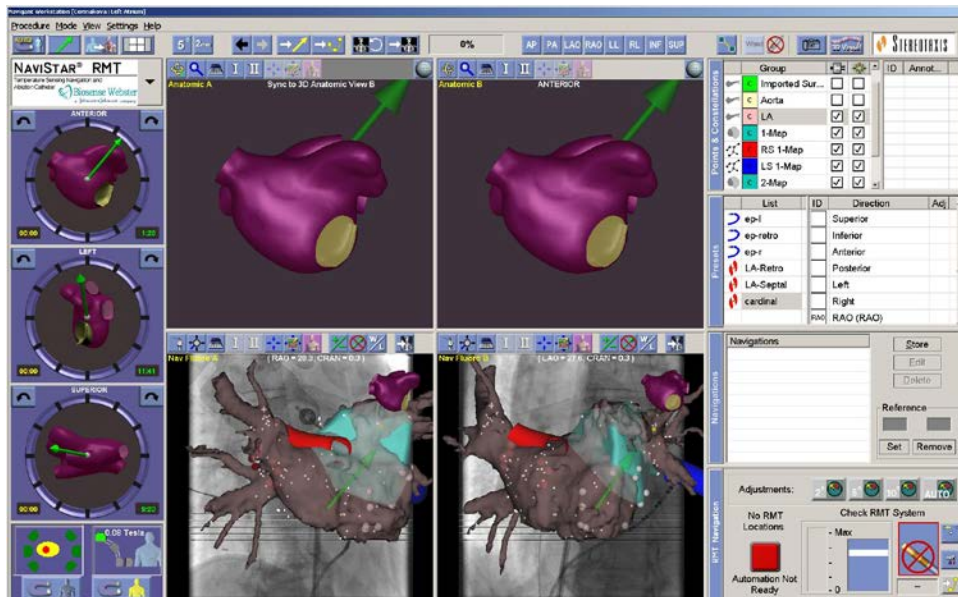
Robotická navigace  
Hansen + Cardiorobotics



# Dálkově navigované systémy

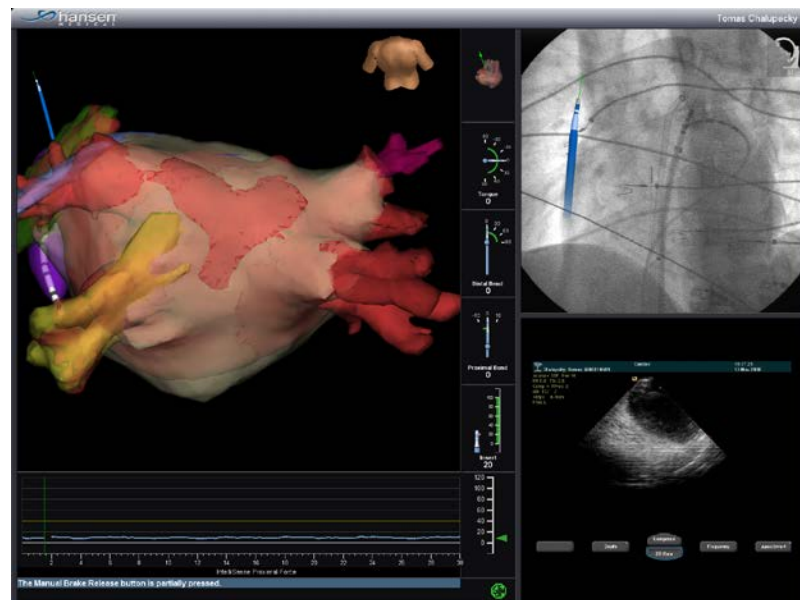
**Magnetická navigace  
Niobe – Stereotaxis Inc.**

**Základní obrazovka pro  
navigaci**



**Robotická navigace  
Sensei - Hansen Med.Inc.**

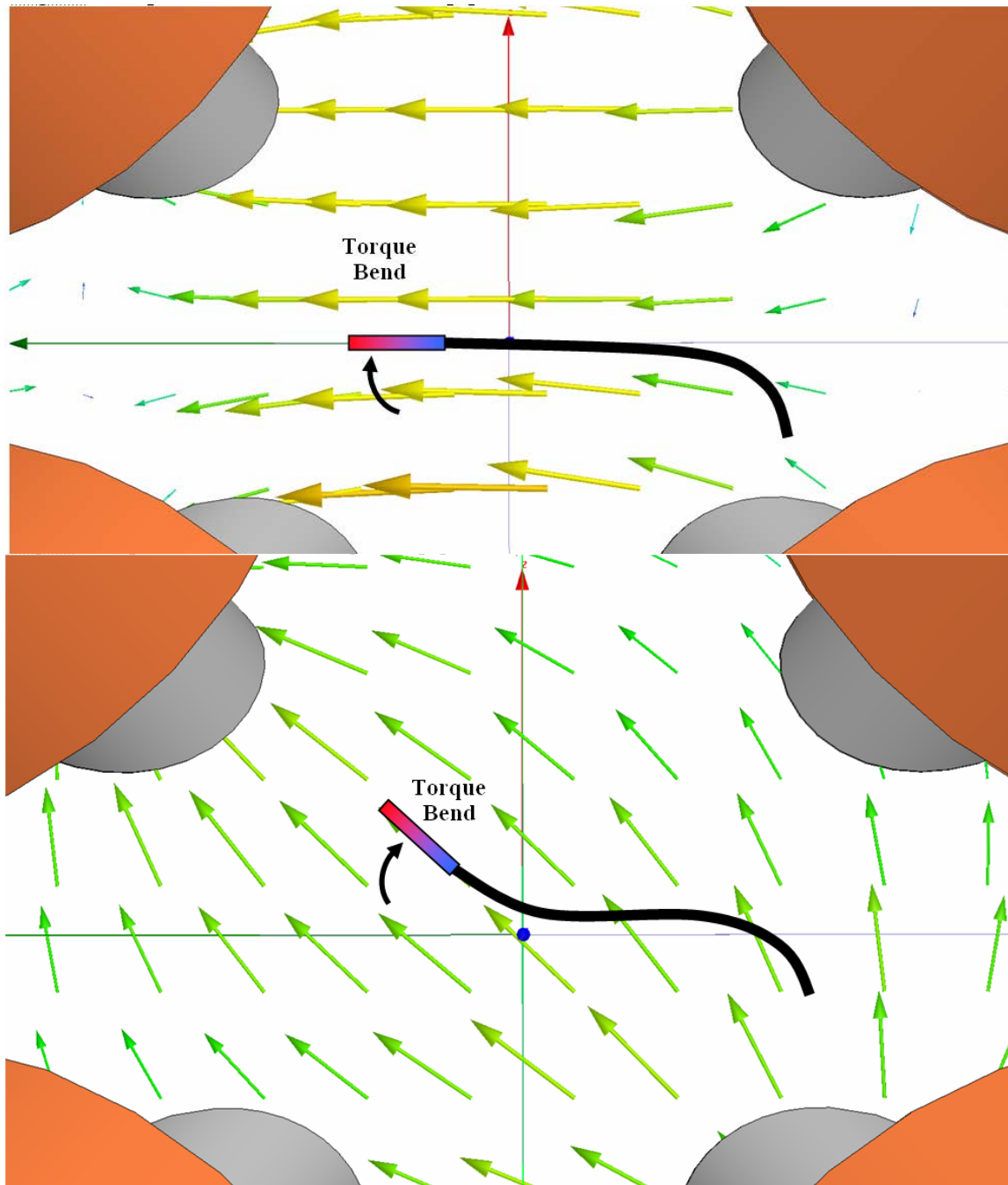
**Základní obrazovka pro navigaci**



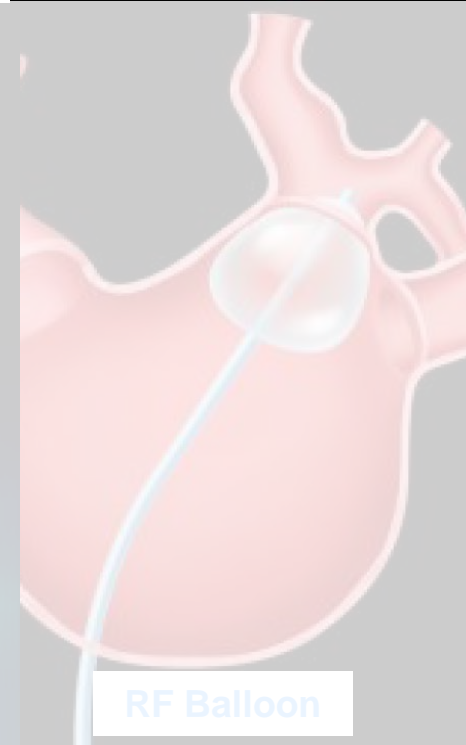
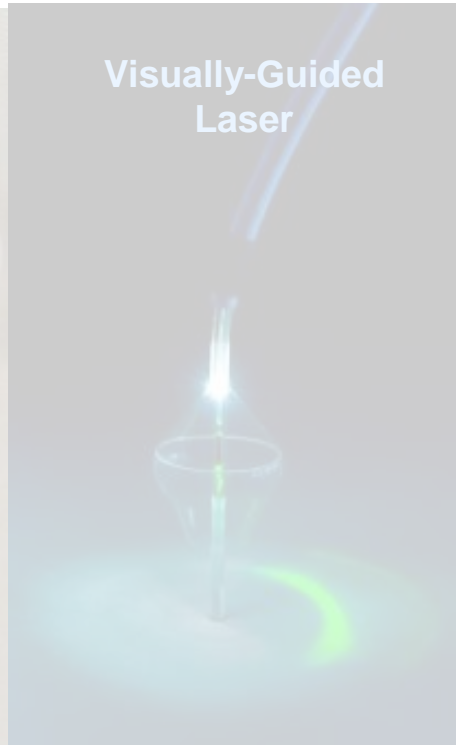
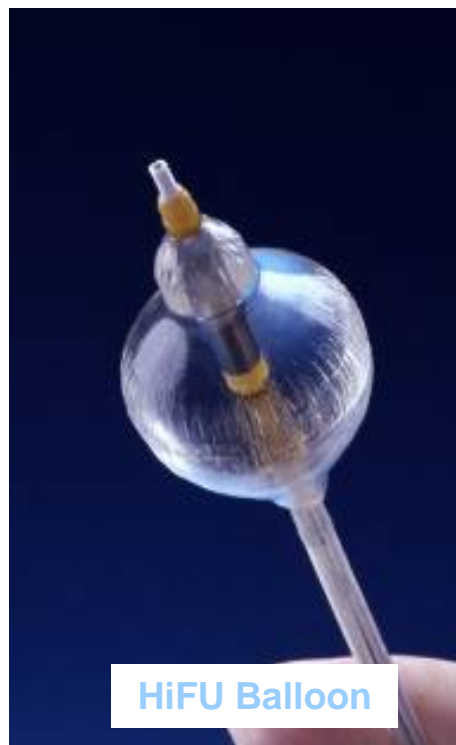
# Dálkově navigované systémy

**Elektromagnetická navigace  
CGCI – Magnetecs Inc.**

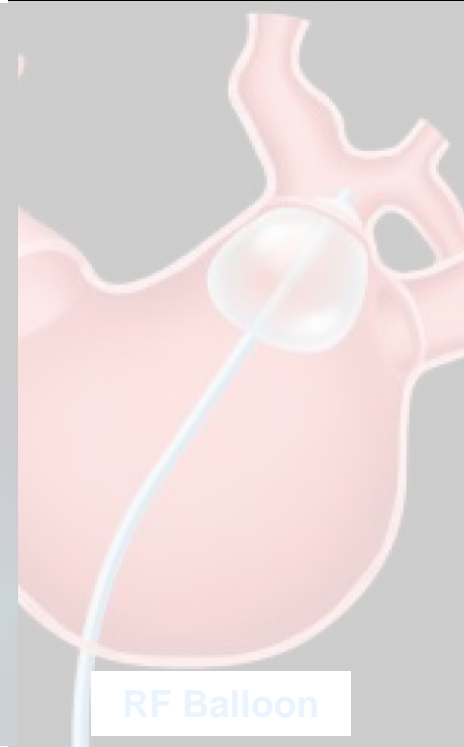
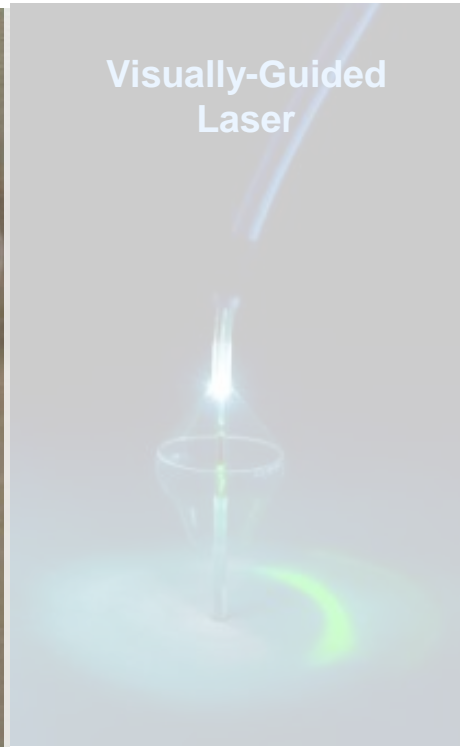
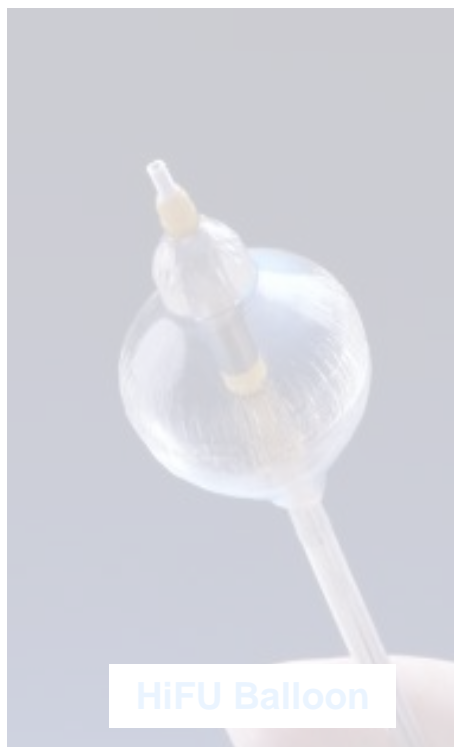




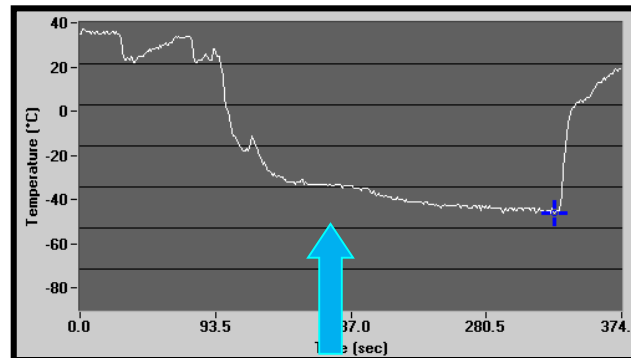
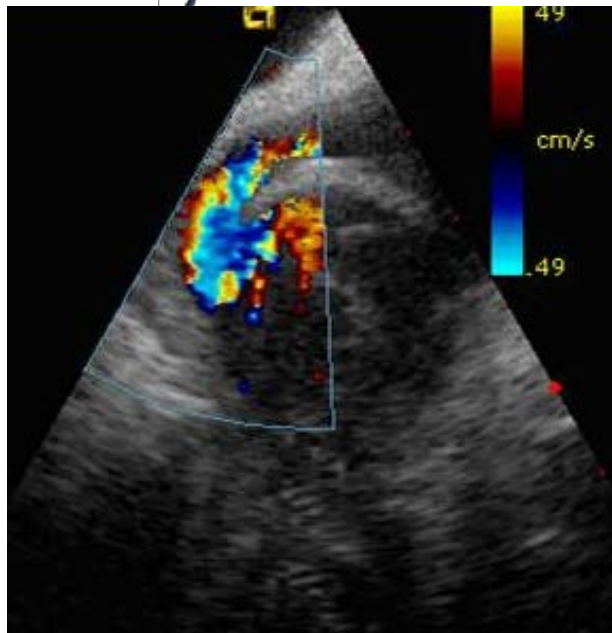
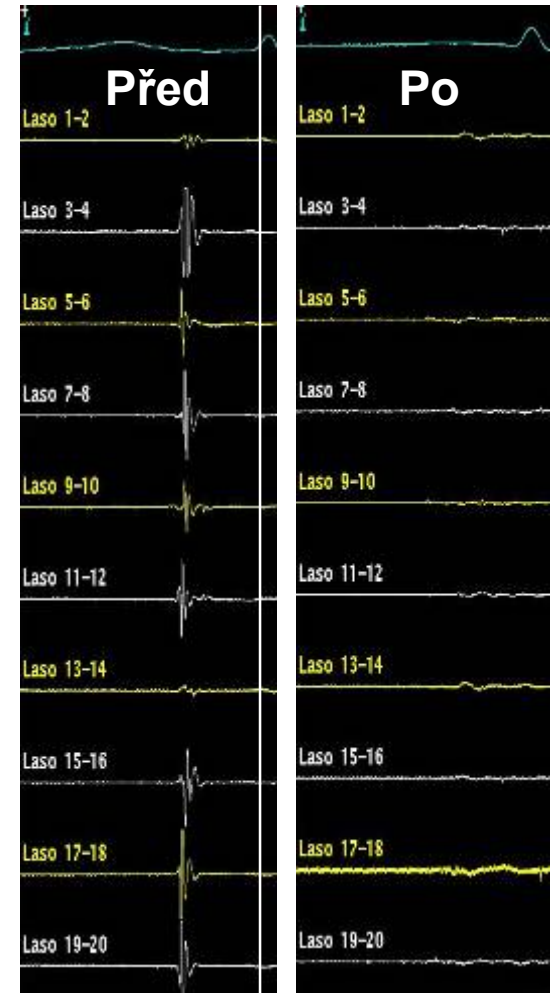
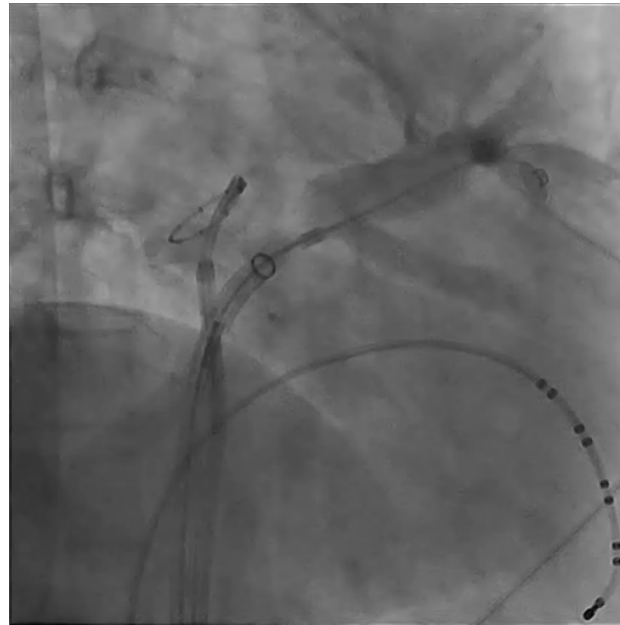
# Balónkové ablační katetry



# Balónkové ablační katetry



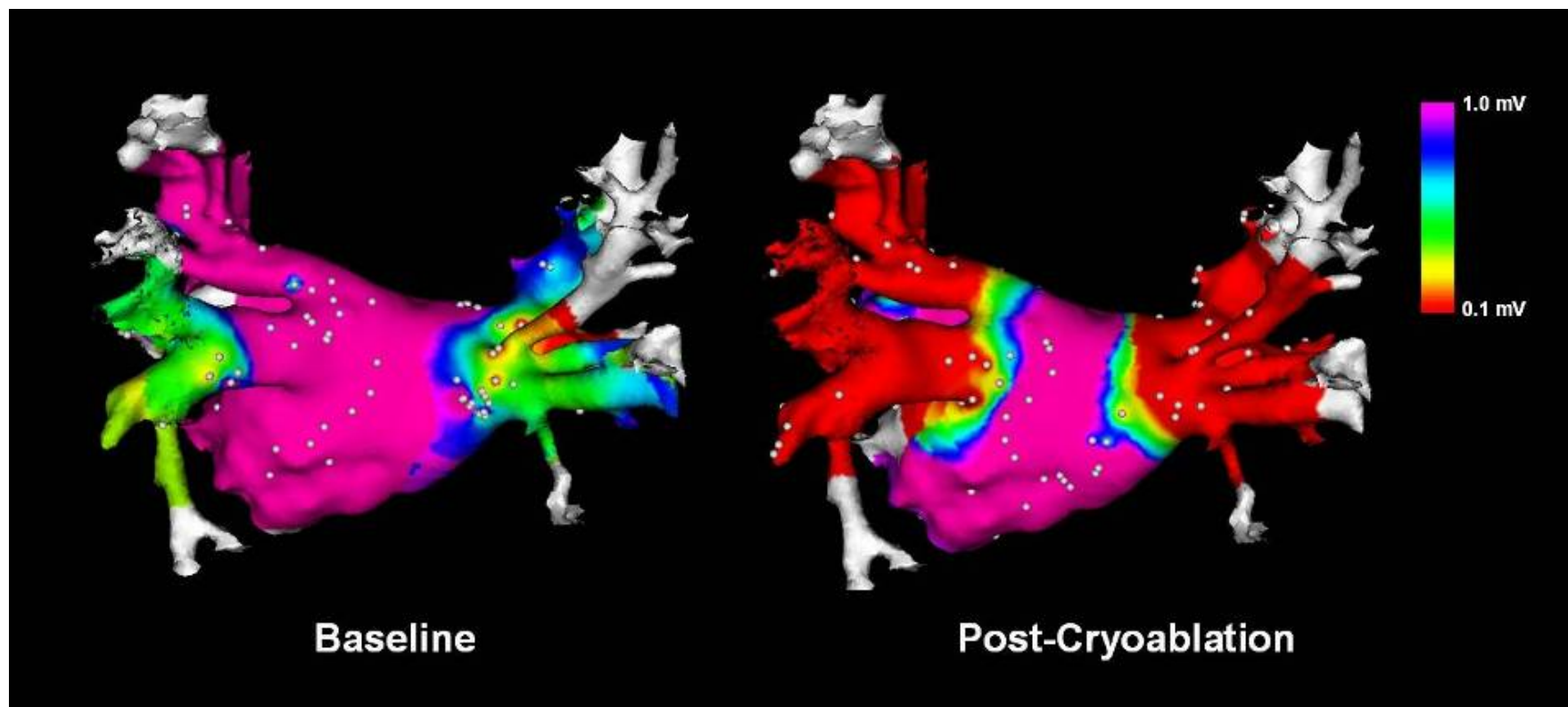
# Ablace kryobalónkem



Manévr: „Pulldown“



# Úroveň izolace plicních žil



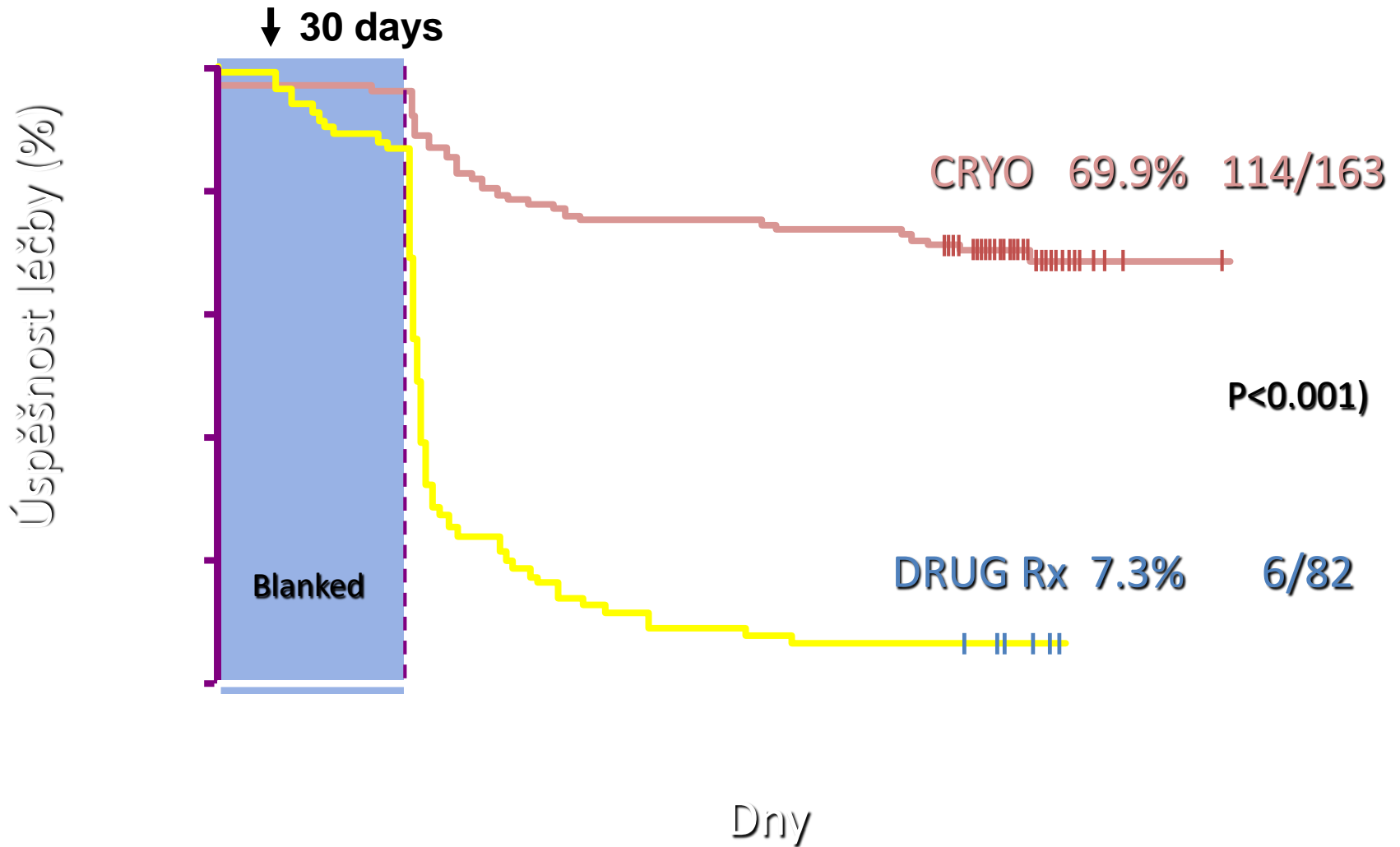
# Efekt kryoablace na jícen



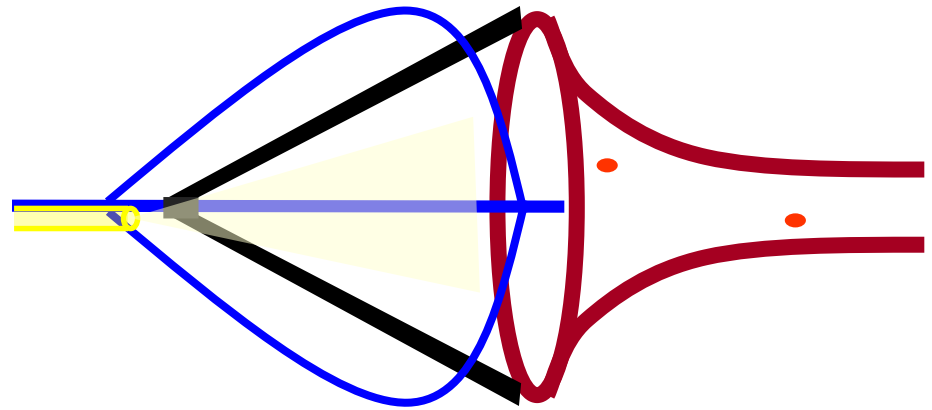
Celkem 67 n. cryoablace - endoskopie jícnu prokázala ulcerace u 6 z 35 (17%)  
Neprokazovali jsme atrio-esofageální píštěl;  
bez průkazu defektu během kontrolní endoskopie

# STOP – AF analýza efektivity

## Úspěšnost léčby



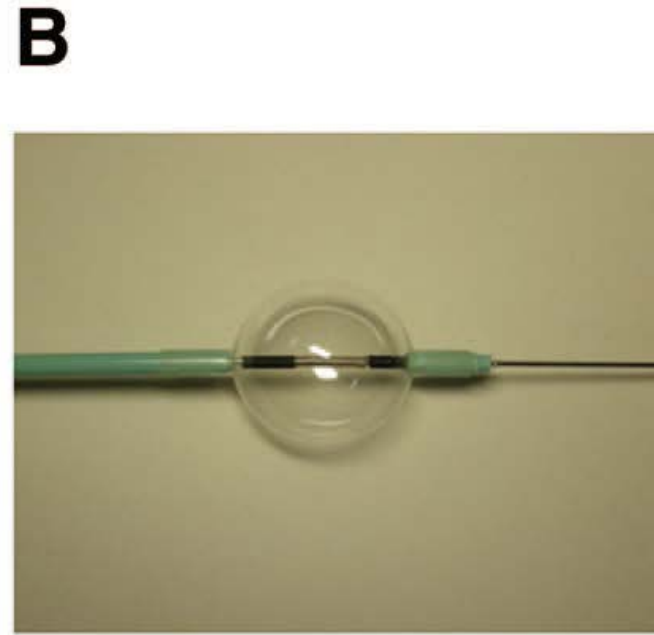
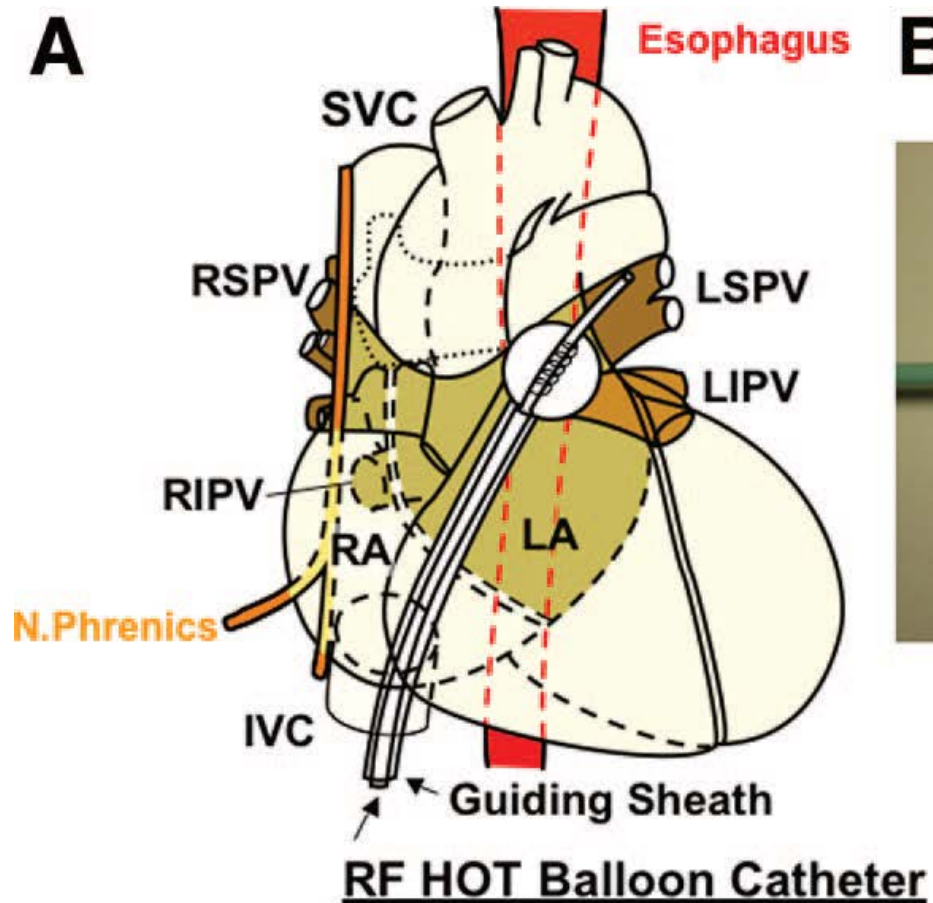
# Visualizace Laserové Ablace



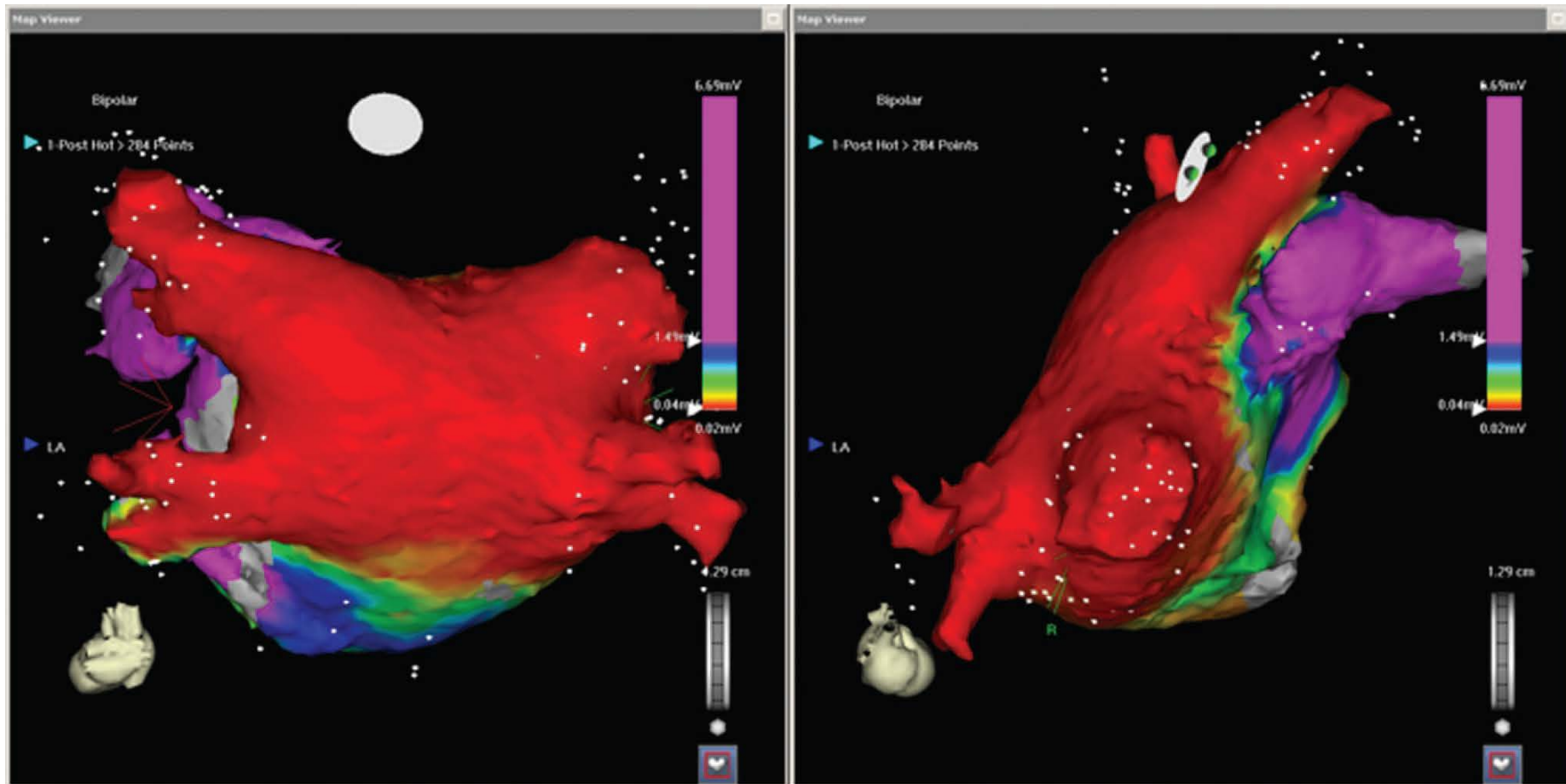
# Odovídající vizualizace „gapu“



# Hot Balloon



# Hot Balloon



# Limitace použití balónkových katetrů

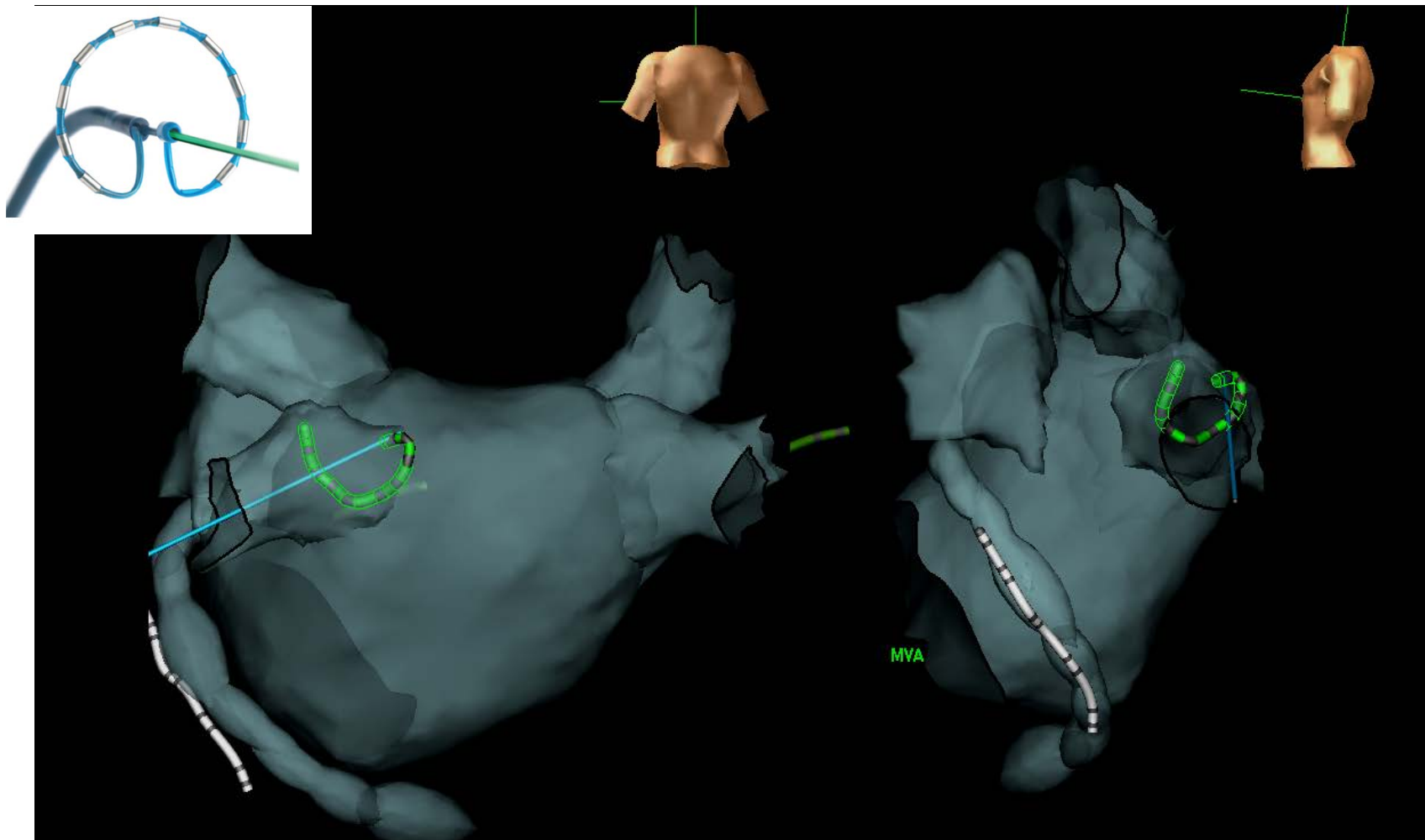
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# Lineární RF aplikace



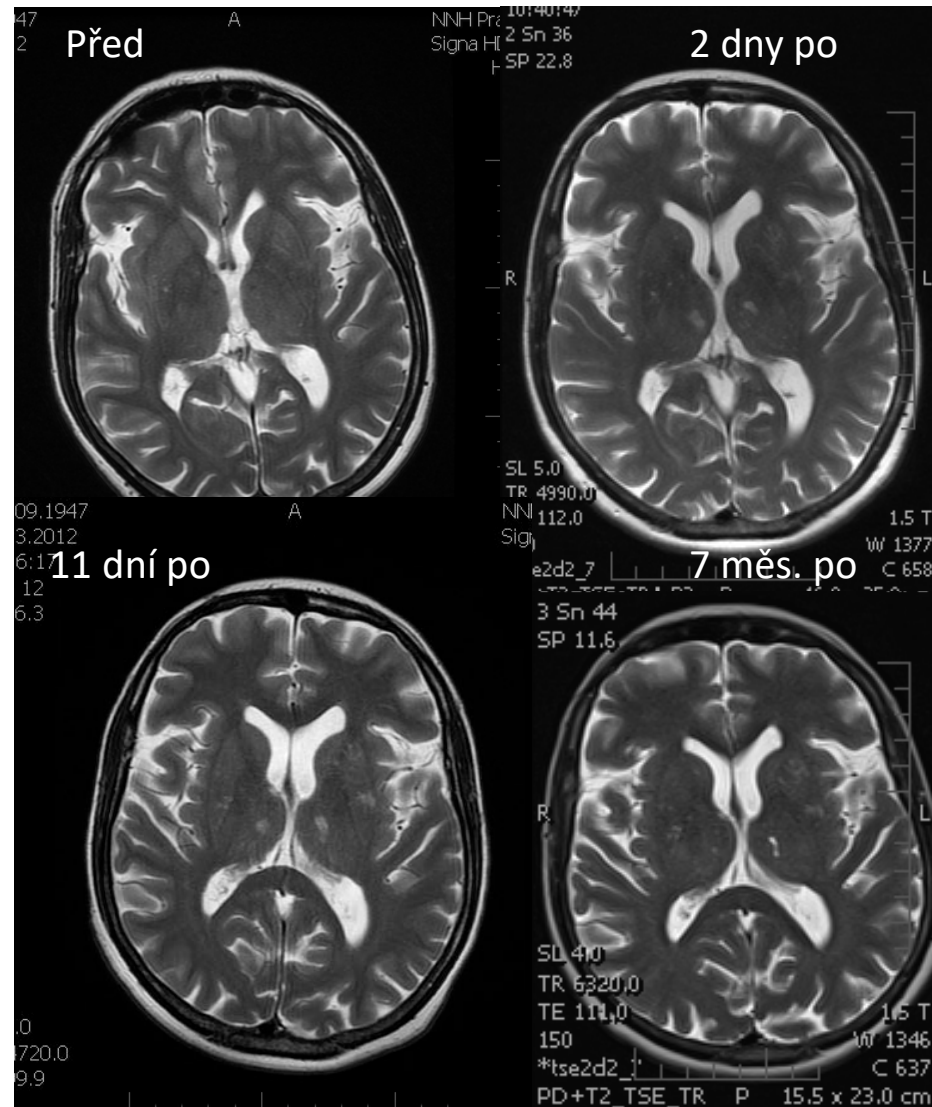
# Lineární RF aplikace



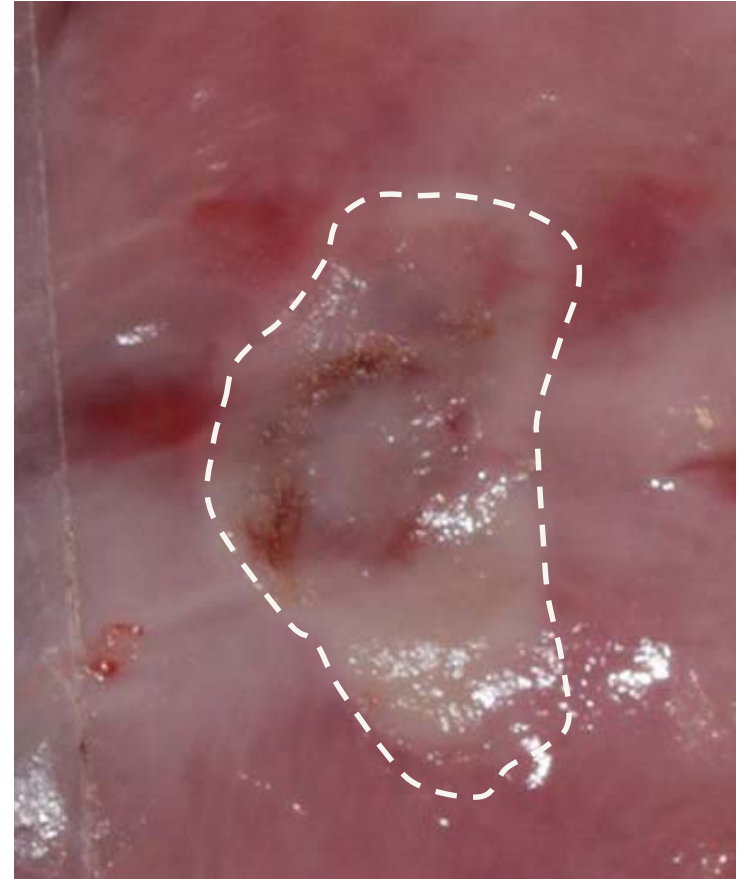
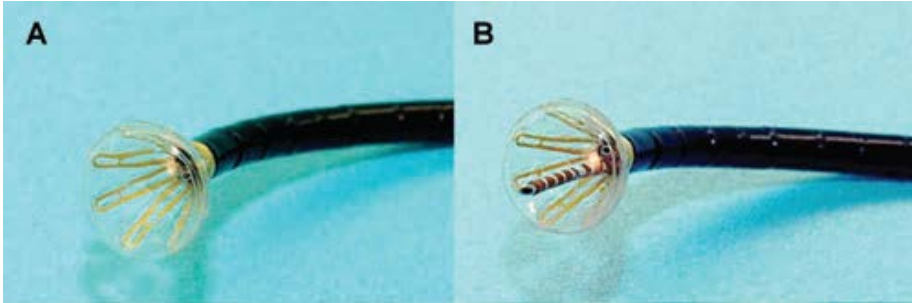
# Výsledky: nálezy při MR mozku po IPŽ

	All Patients (n=86)	Laserballoon (n=44)	Cryoballoon (n=20)	Irrigated RF (n=22)	P-value
Number of Pts with New Embolic Lesion	11 (13%)	6 (13.6%)	1 (5.0%)	4 (18.2%)	0.4870
Number of Pts with New Asymptomatic Embolic Lesion	10 (12%)	5 (11.4%)	1 (5.0%)	4 (18.2%)	0.4148
Number of New asymptomatic Lesions	20	9	1	10	
Number of New Asymptomatic Lesions per Pt (range)		1 – 2 Max Size: 8 mm	1 Max Size: 2 mm	1 – 4 Max Size: 4 mm	
New Lesion Location		parietal, basal ganglion, occipital, temporal, frontal, thalamus	cerebellar	cerebellar, frontal, parietal, occipital, temporal	

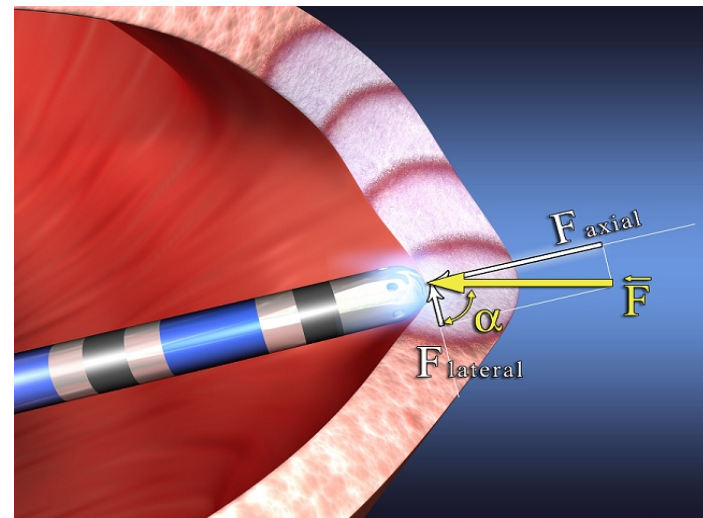
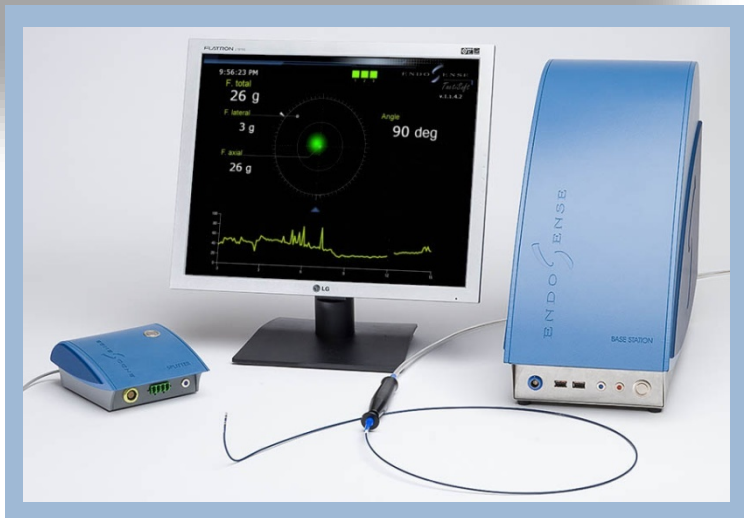
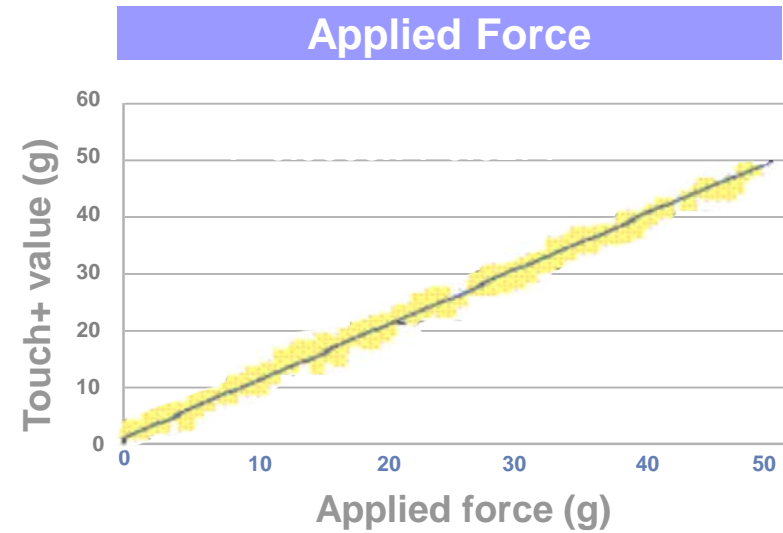
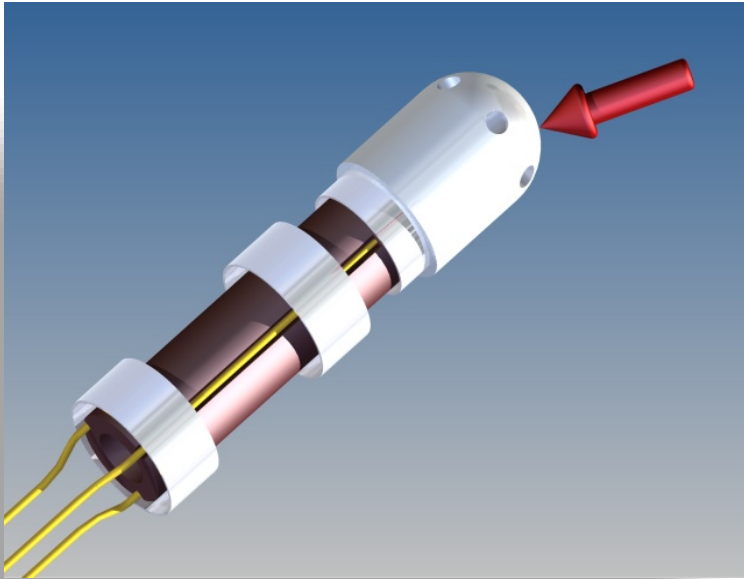
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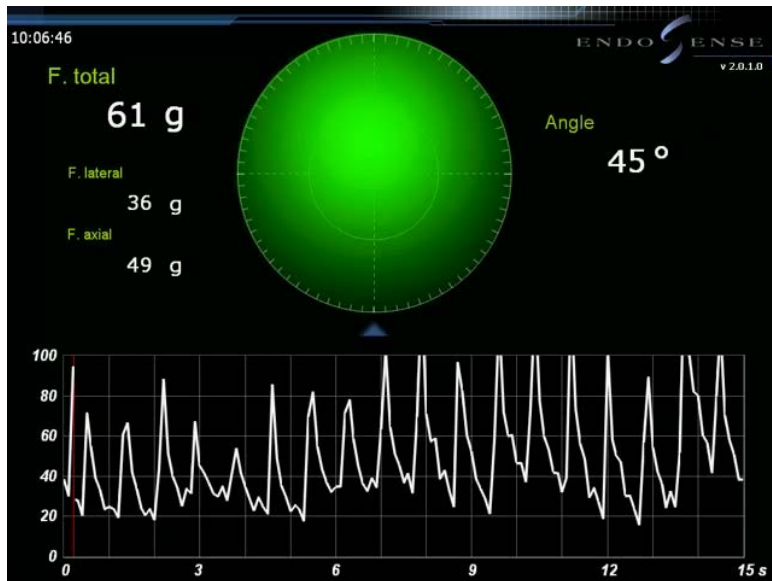
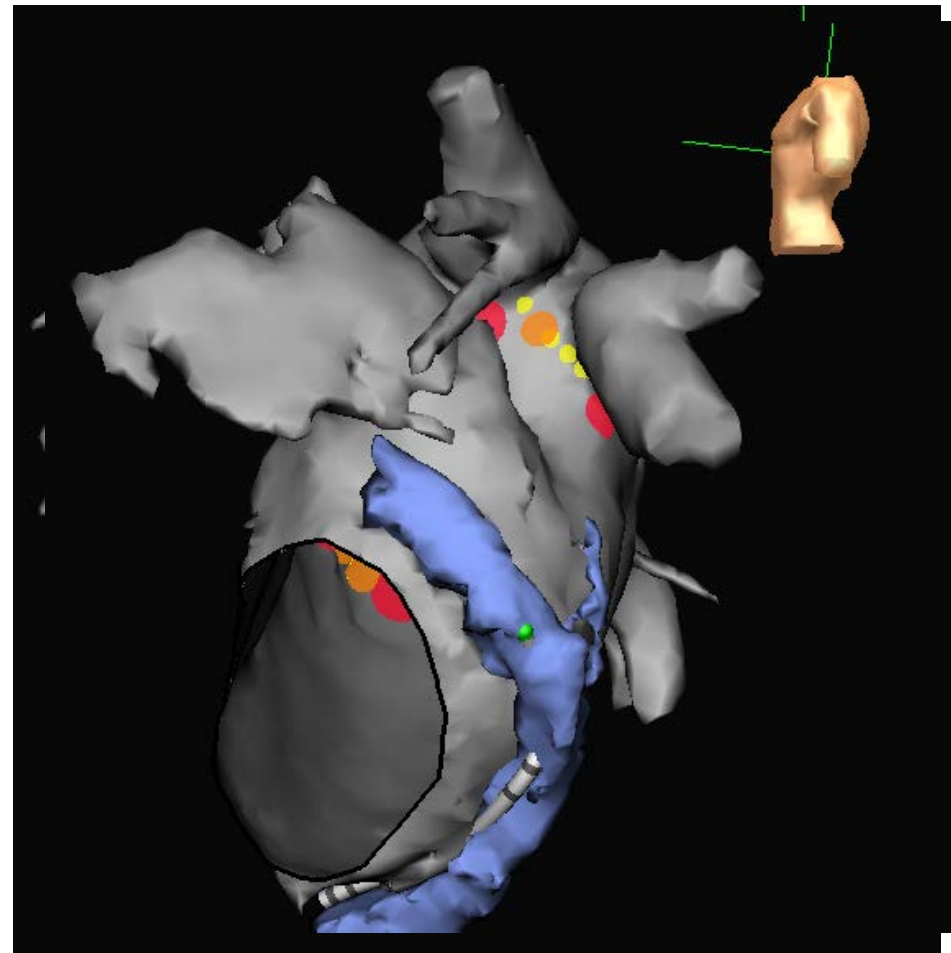
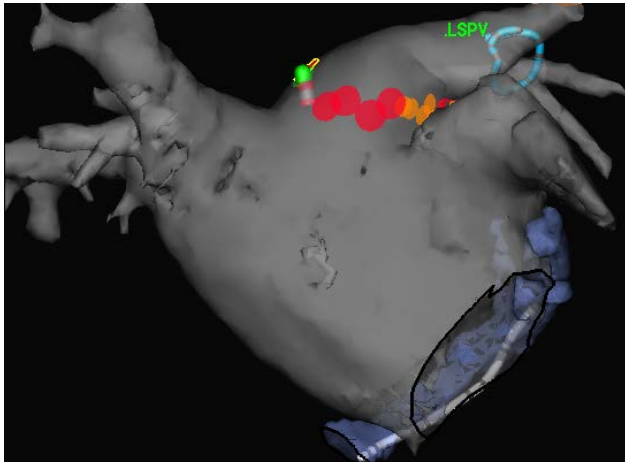
# Vizualizace RF aplikace



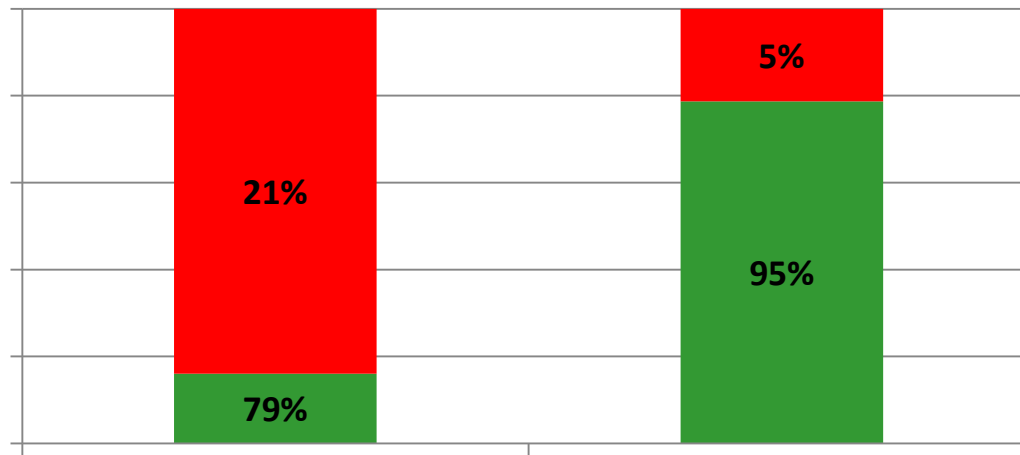
# Detekce aplikovaného tlaku



# Příklad extrémně vysokého přitlaku



# Min FTI jako prediktor chronického efektu provedené ablace (EFFICAS I)



- Každá aplikace RF by měla být provedena s parametrem FTI > 400 gs !