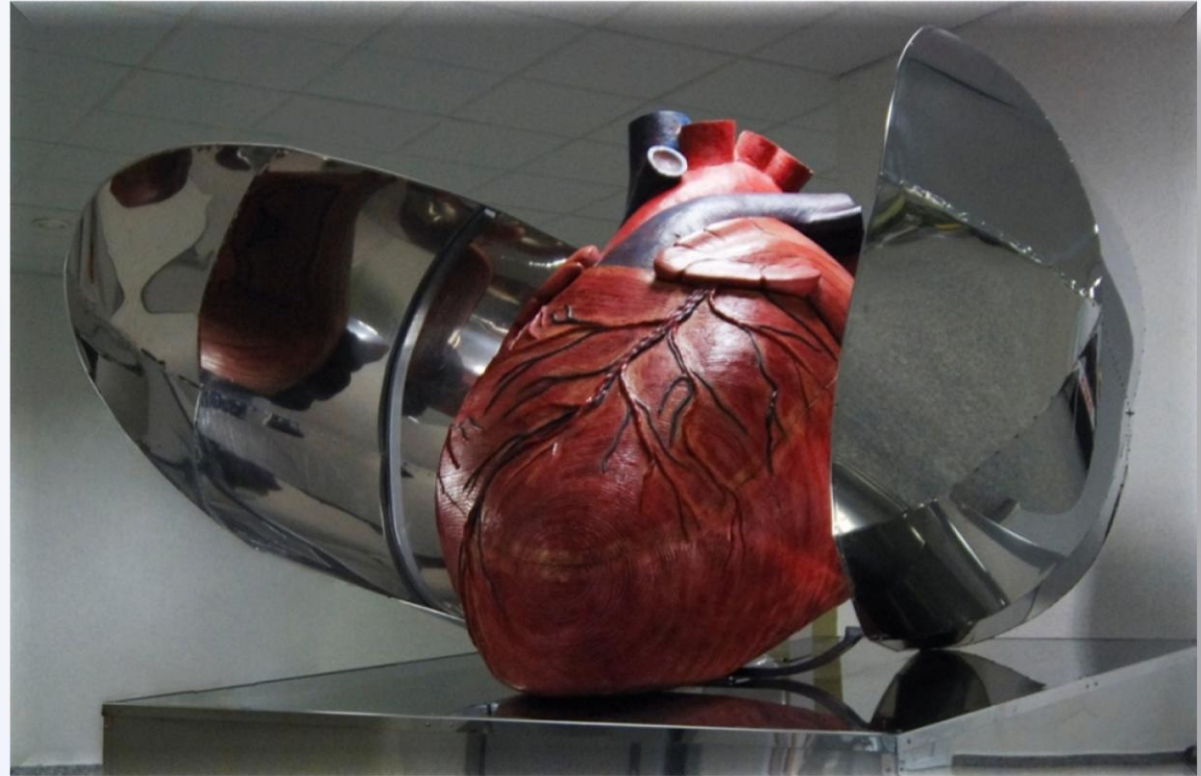


# Inovace v arytmologii - ablace



*Josef Kautzner*

*Institut klinické a experimentální medicíny, Praha*

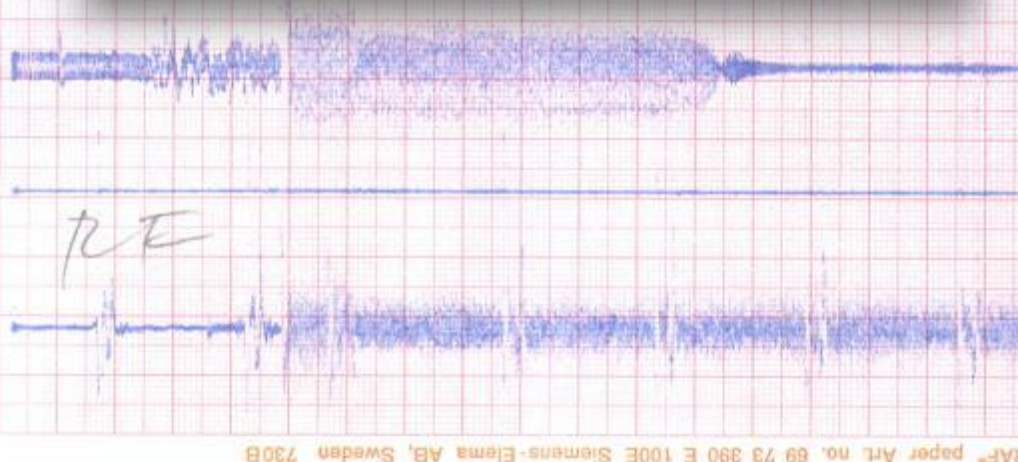
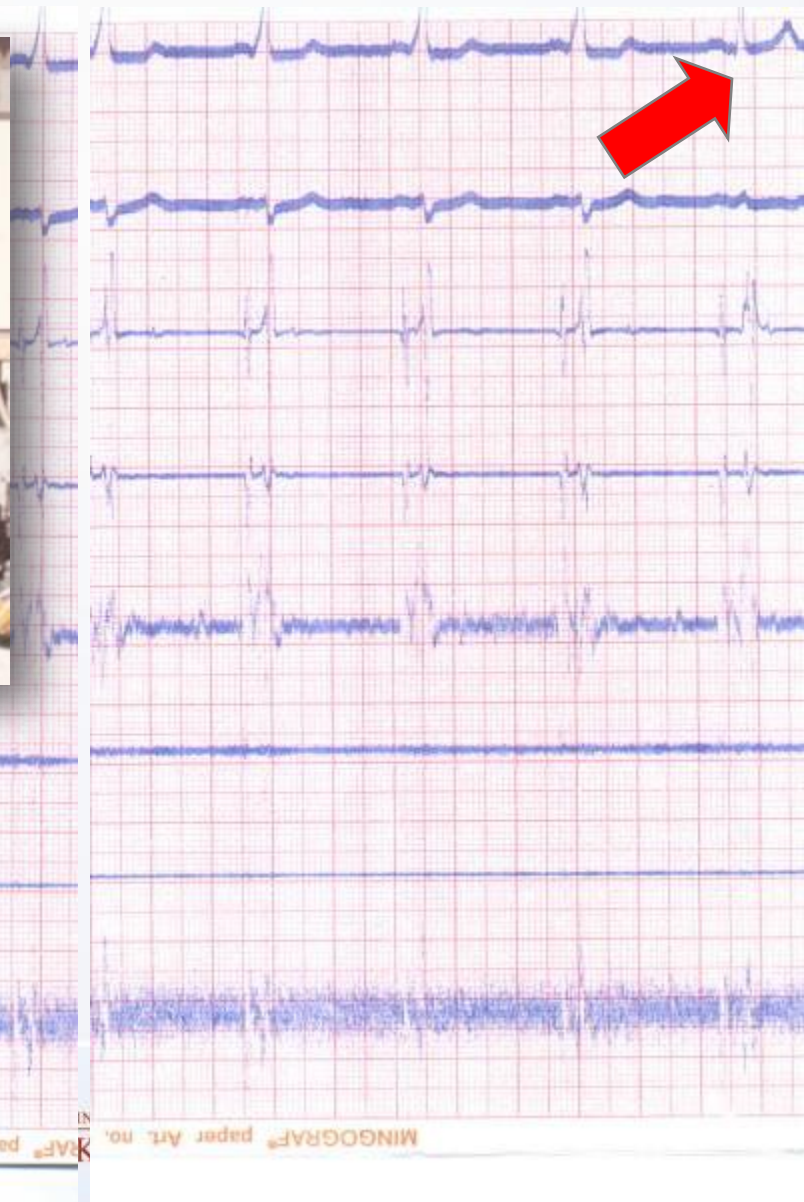
**joka@medicon.cz**

**www.ikem.cz**

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KLINIKA KARDIOLOGIE



# 1. RF ablace v IKEM -1992

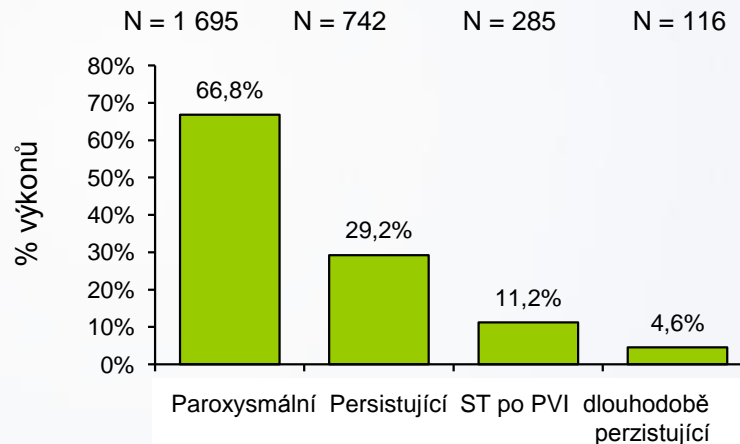
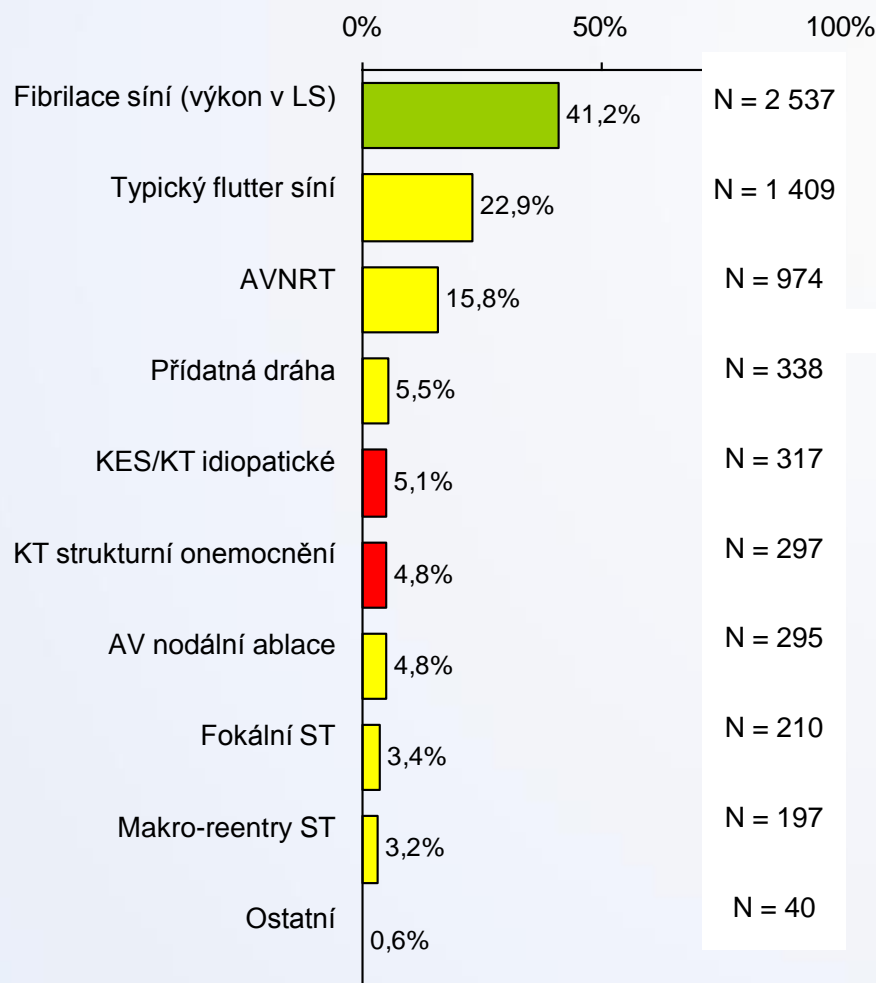


- **Nepřerušená antikoagulační léčba při ablaci FS**
- **Nové koncepty intervenční elektrofyzologie**
  - Mapovací systémy
  - Zobrazování “on–line”
  - Senzory a mikroelektrody v hrotu katetru
  - Alternativní zdroje energie
  - Dálková navigace (robotická procedura)





# Ablace FS je nejčastějším výkonem v ČR



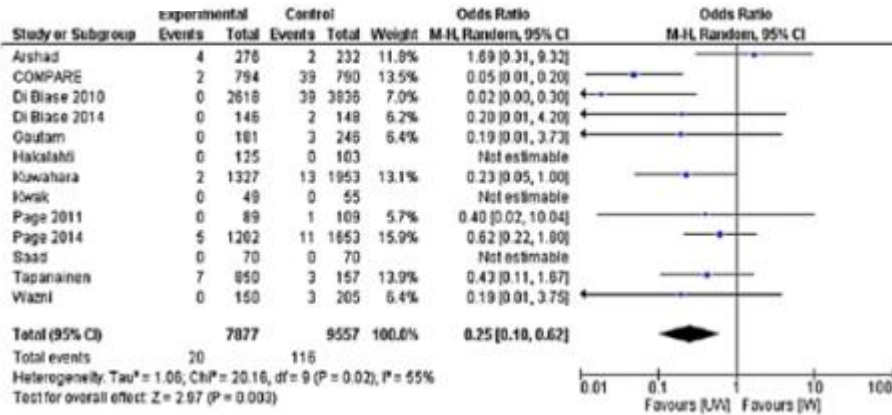
Fibrilace síní (N = 2 537)

**Všechny výkony v 2015  
(N = 6 158)**

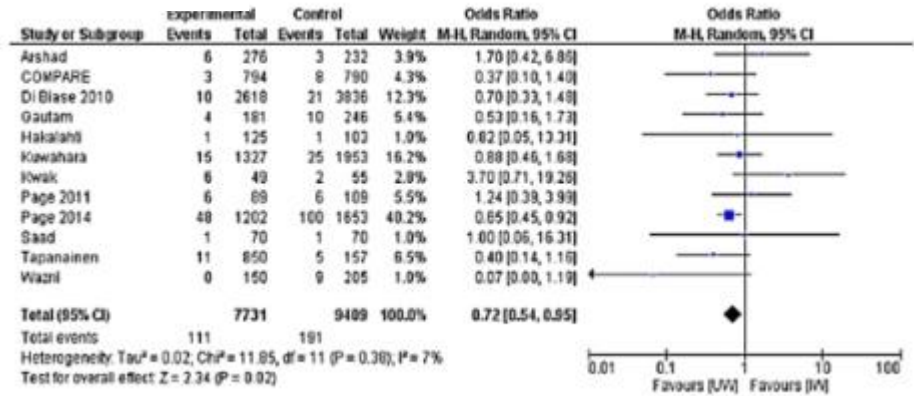
Jeden výkon může být pro více než jeden typ arytmie

# Metaanalýza trombotických a krvácivých komplikací při ablací fibrilace síní – nepřerušovaný vs přerušovaný warfarin)

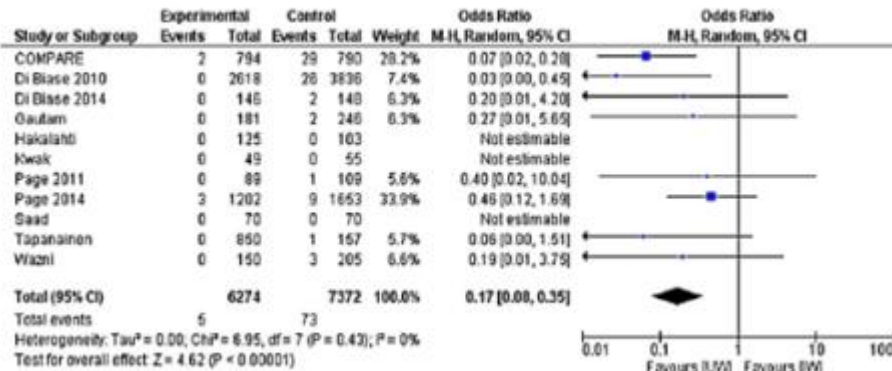
## CMP/TIA



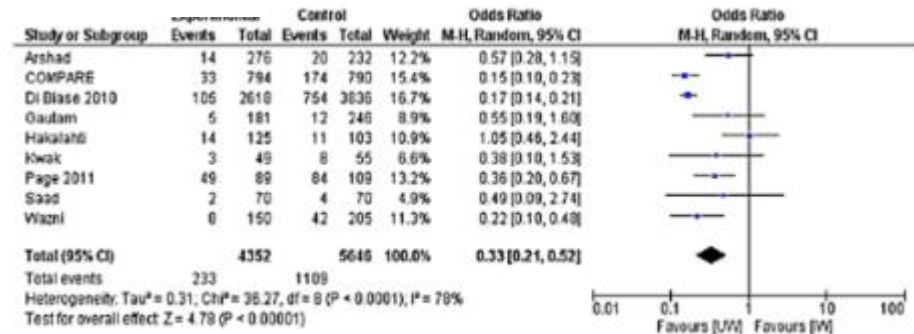
## Větší krvácení



## CMP

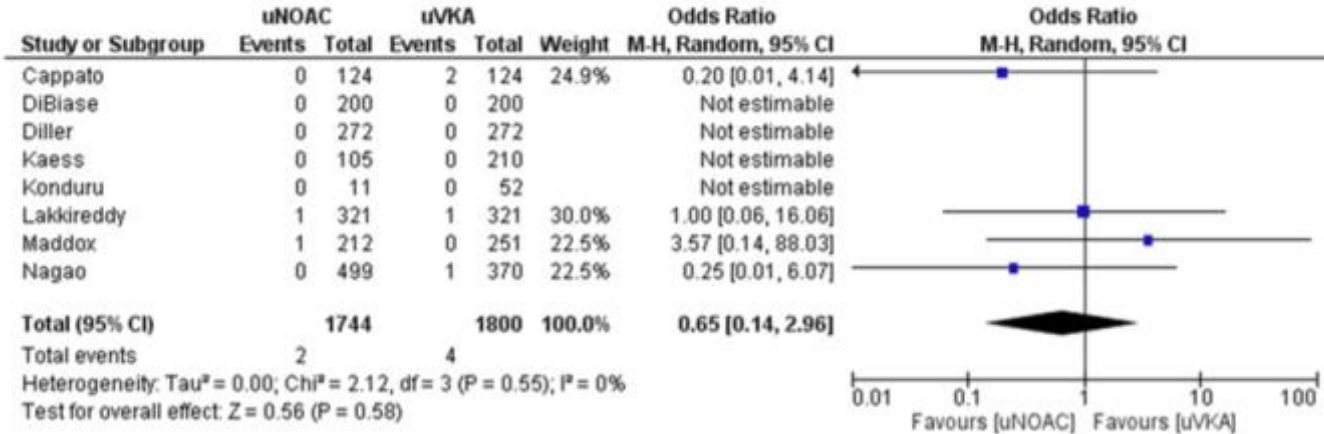


## Menší krvácení

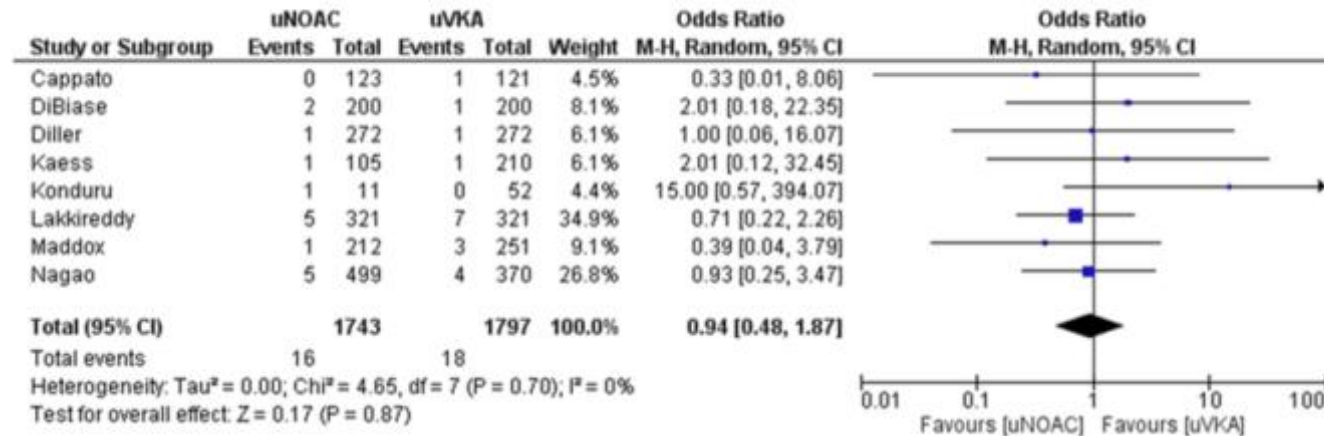


# Metaanalýza trombotických a krvácivých komplikací při ablaci fibrilace síní – nepřerušovaný NOAC a warfarin)

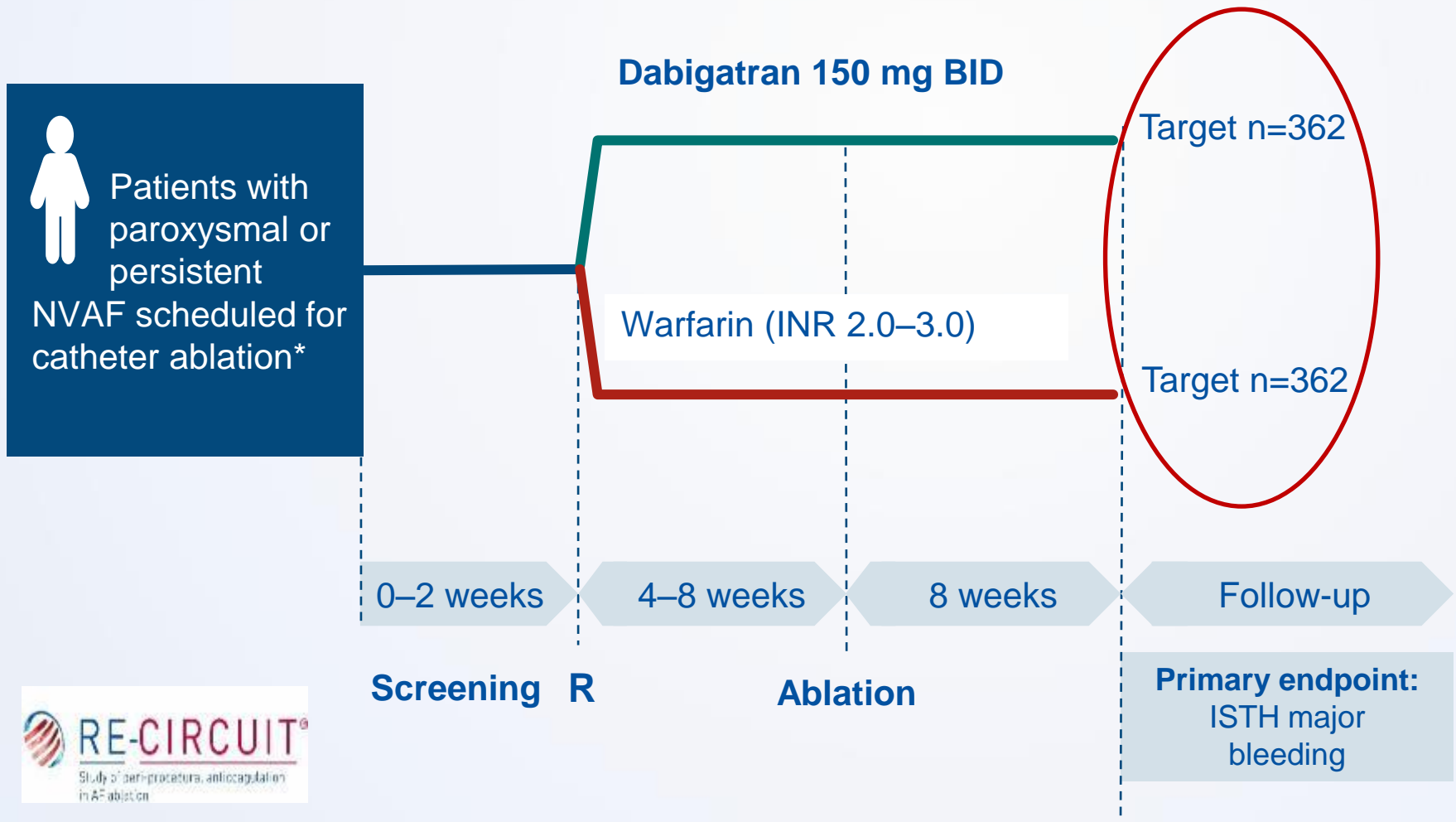
## CMP/TIA



## Větší krvácení



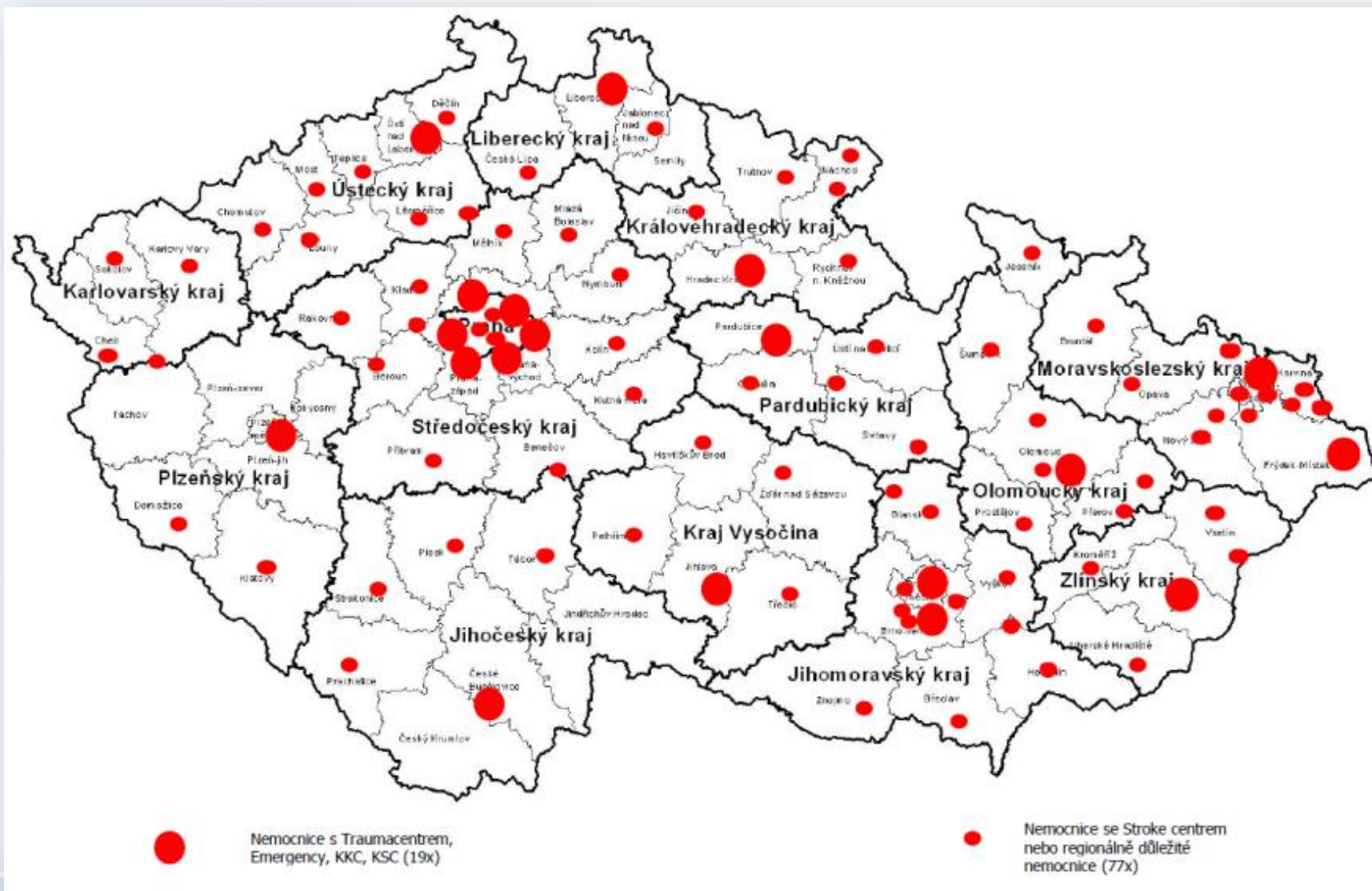
# RE-CIRCUIT™ will provide prospective randomised data on the use of uninterrupted dabigatran in patients undergoing catheter ablation



- \*Eligible for dabigatran 150 mg BID according to local label
- ISTH, International Society on Thrombosis and Haemostasis; R, randomisation  
Boehringer Ingelheim Clinical Trial Protocol, Trial No. 1160.204; ClinicalTrials.gov NCT02348723

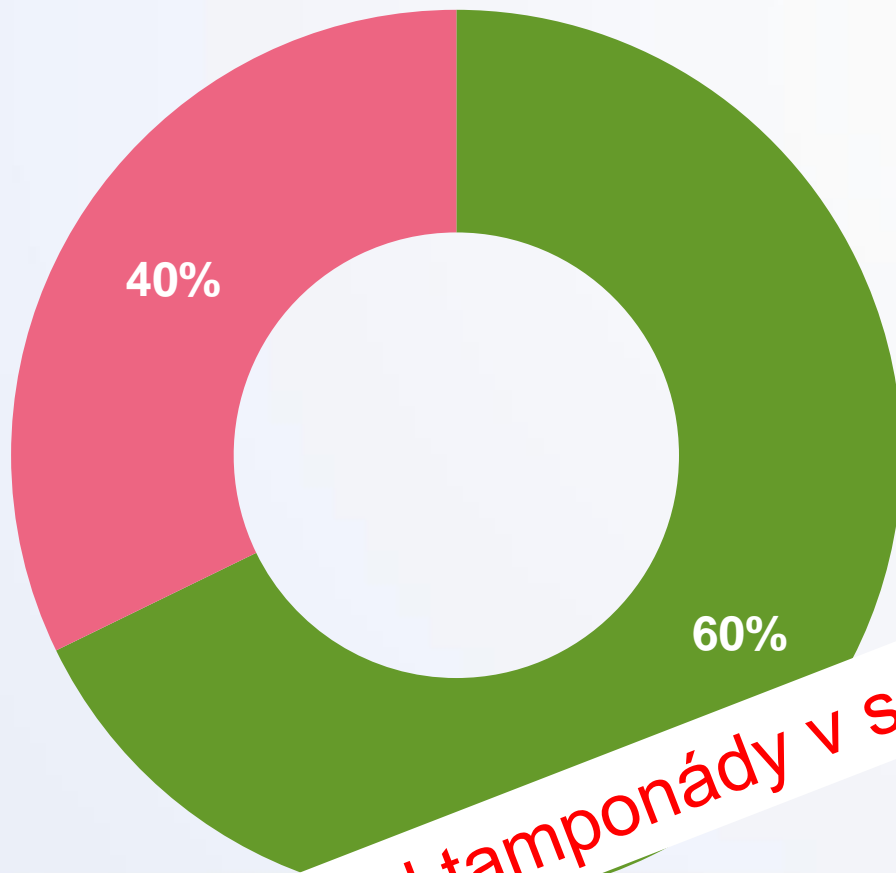


# Praxbind široce dostupný - v 96 nemocnicích





# Podání Praxbind v ČR (leden – říjen 2016)



**35x podání Praxbind**

21x akutní výkon/trauma

14x krvácení/iCMP

**1 případ tamponády v souvislosti s výkonem**

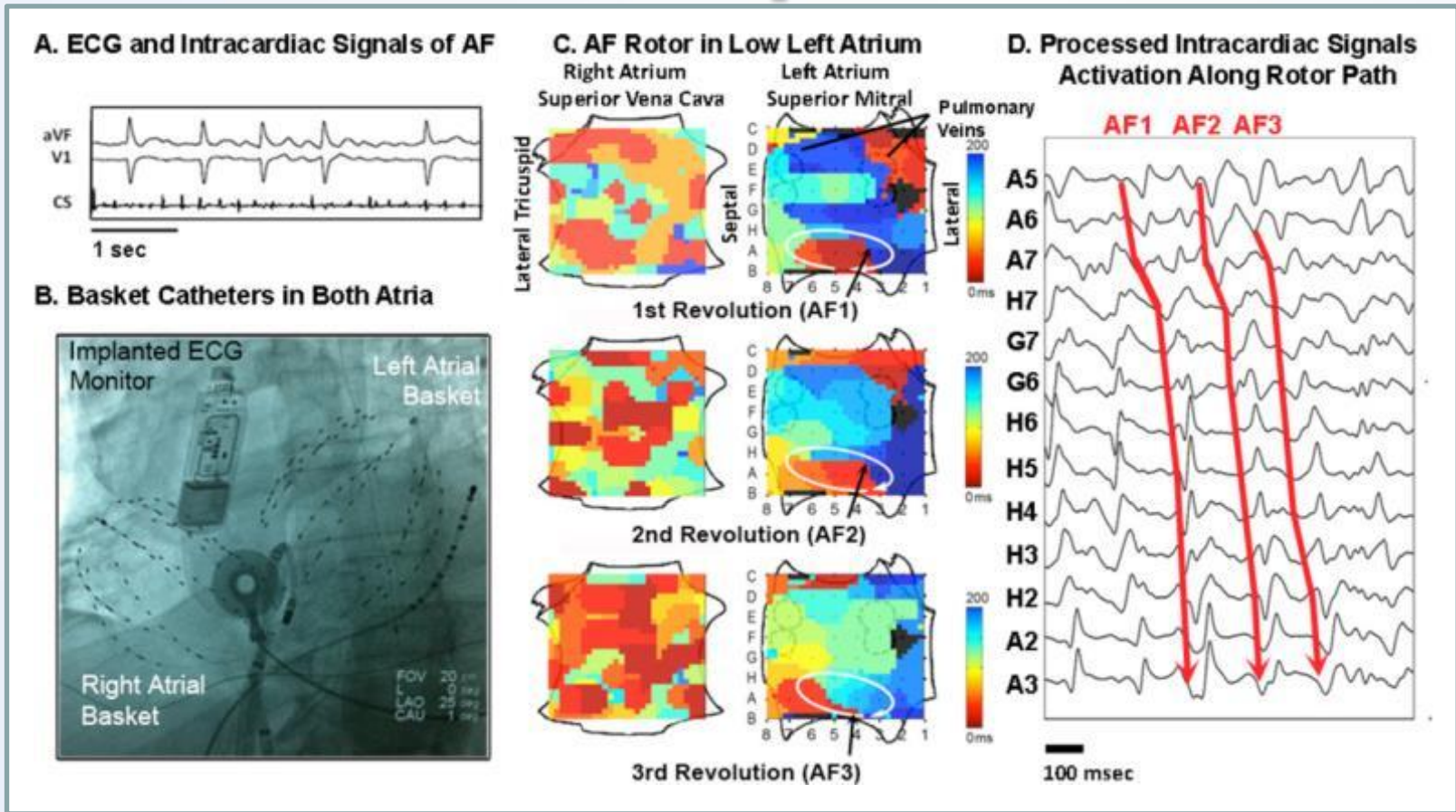
■ Akutní výkon/trauma

■ Krvácení/iCMP

# Nové mapovací systémy



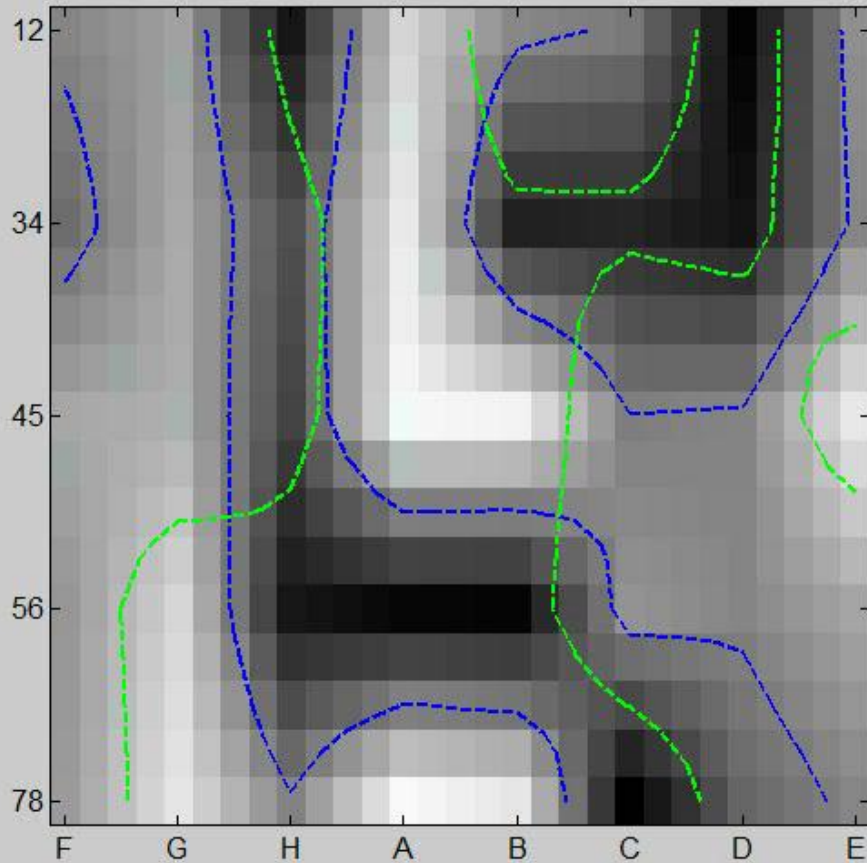
# Intrakardiální mapování rotorů při FS



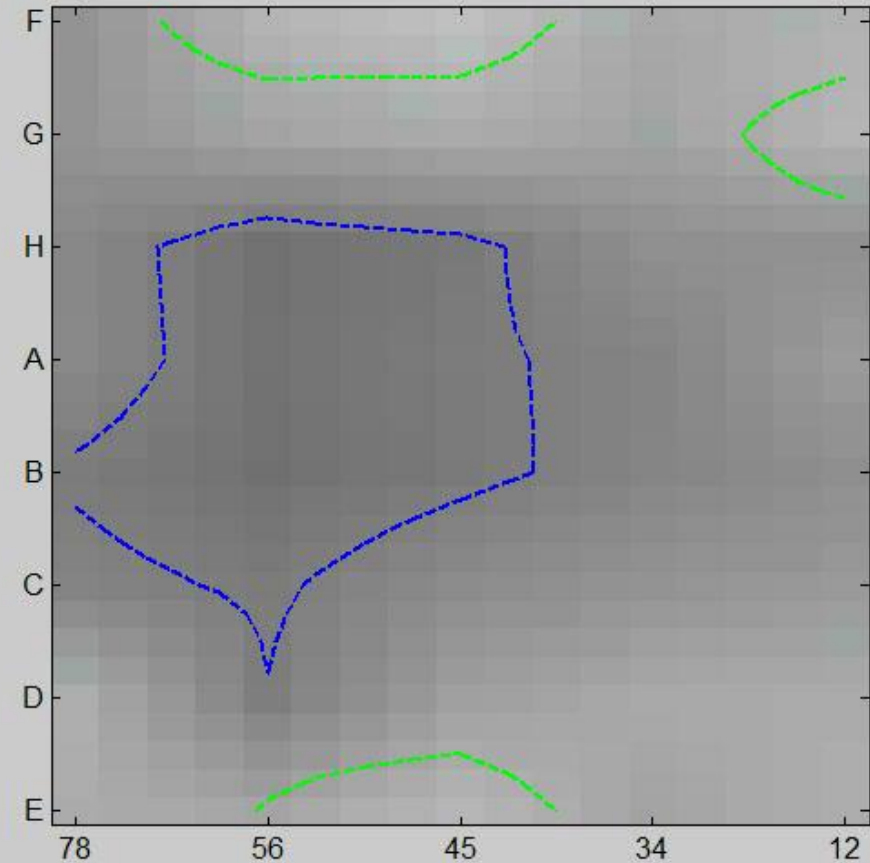


# Intrakardiální mapování rotorů

Catheter 2 748 msec

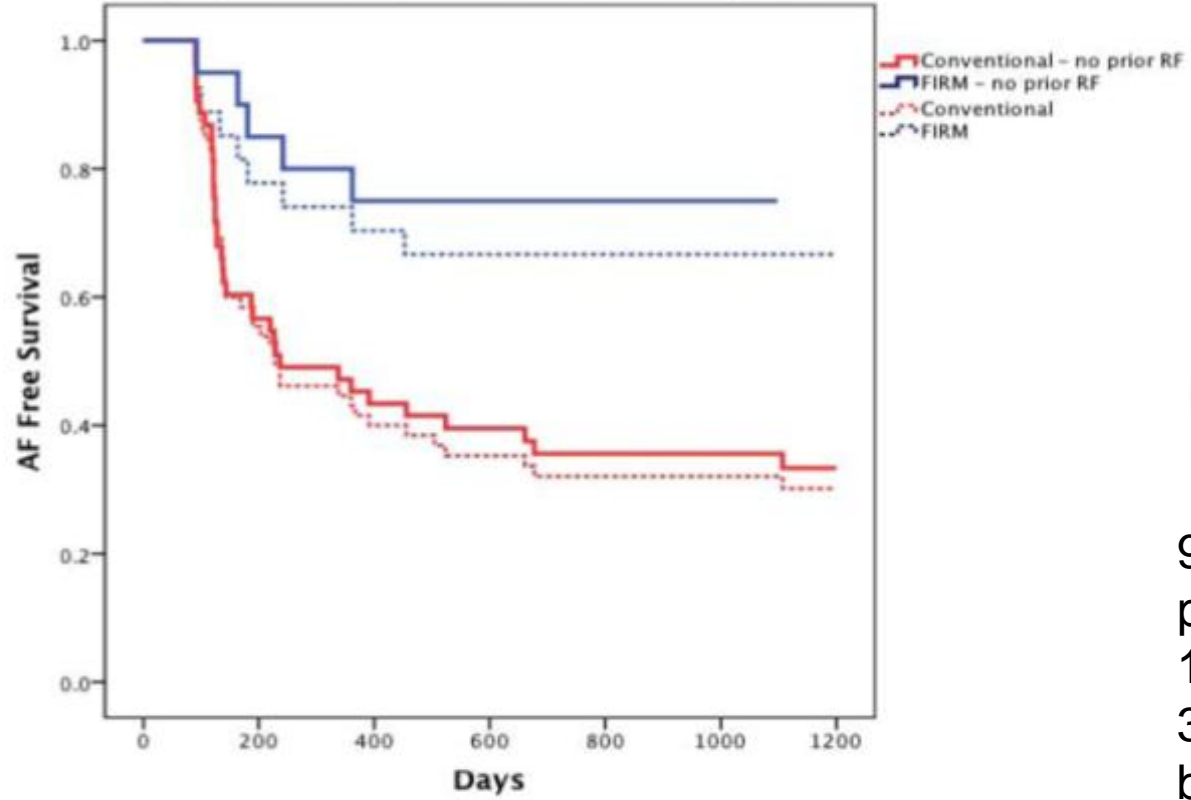


Catheter 1 280 msec



Topera - Courtesy of S Narayan

All patients, single procedure, p=0.005 No prior RF, p=0.004



Number at risk	27	21	19	18	15	5	1
	65	36	26	22	19	17	15
No prior ablation	20	17	15	15	12	3	0
	53	30	23	20	17	16	14

# Studie CONFIRM

92 pts s FS (70.7%  
persistující)  
107 procedur  
36 FIRM- guided, 71 Firm-  
blinded

Lokalizované rotory nebo  
fokální zdroje: 97 %

Akutní endpoint: Terminace FS nebo  
zpomalení FS - 86% FIRM-guided versus  
20% FIRM-blinded cases (p<0.001)



# Nicméně, další studie ...

- FIRM-guided procedury (n=24; 50% paroxysmal)
- Všichni měli identifikovány rotory ( $2.3 \pm 0.9$  na pacienta; 72% v LS)
- Předem specifikovaný akutní end point dosažen u 12 z 24 (50%) pts: terminace FS (n=1), organizace (n=3), >10% zpomalení CL (n=8)
- Off-line analýza neprokázala rozdíly mezi místy rotorů a vzdálenými místy v dominantní frekvenci nebo Shannonově entropii
- Electroanatomické mapování nezjistilo rotační charakter aktivace v místech identifikovaných jako rotory u 23 z 24 pts (96%)



# Výsledky ablace řízené mapováním rotorů



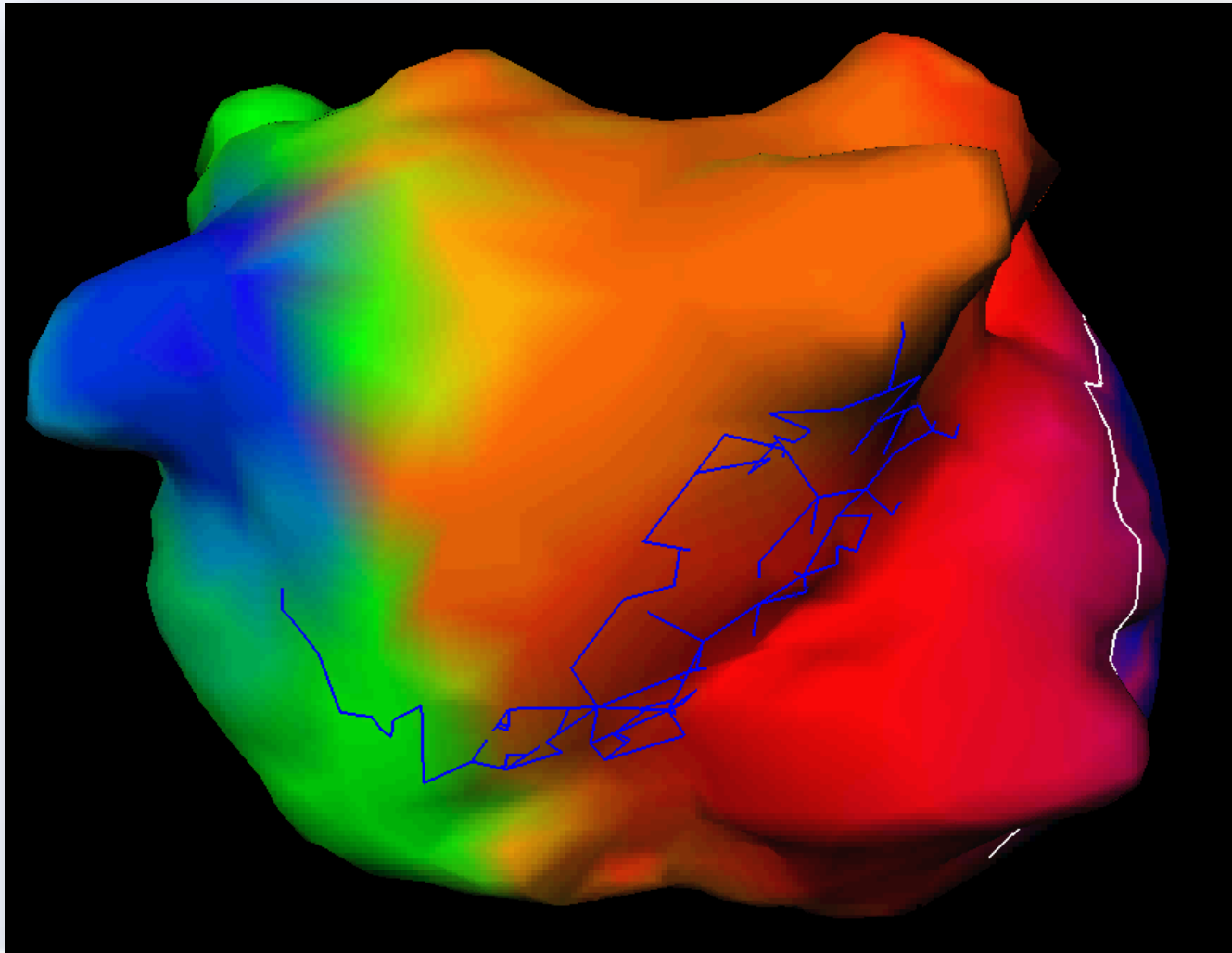
Po 5.7 měsících sledování, byla úspěšnost udržení SR bez AA léků pouze 17%

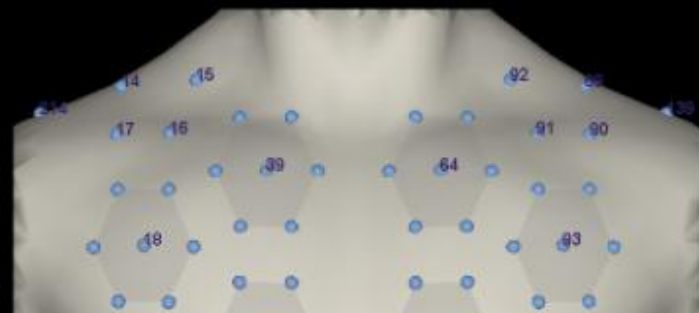
Patients with AF	
Number of rotors per patient	4.0 ± 1.2
RA rotors	44 (38%)
LA rotors	71 (62%)
Number of focal rotors	1
Procedural time (minutes)	222 ± 49
RF time (minutes)	35 ± 16
Acute success	12 (41%)
AF slowing ≥ 10%	2 (7%)
AF organization	10 (34%)
AF termination	0 (0%)
DC cardioversion	29 (100%)
Complications	0 (0%)

Values are given as mean ± SD or number (%).

Gianni C, et al. Heart Rhythm 2016;13:830–835

# Panoramatické mapování





Stop Acquisition

Send Mode

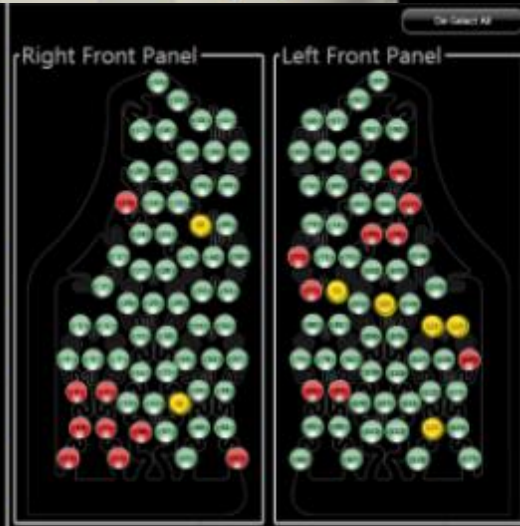
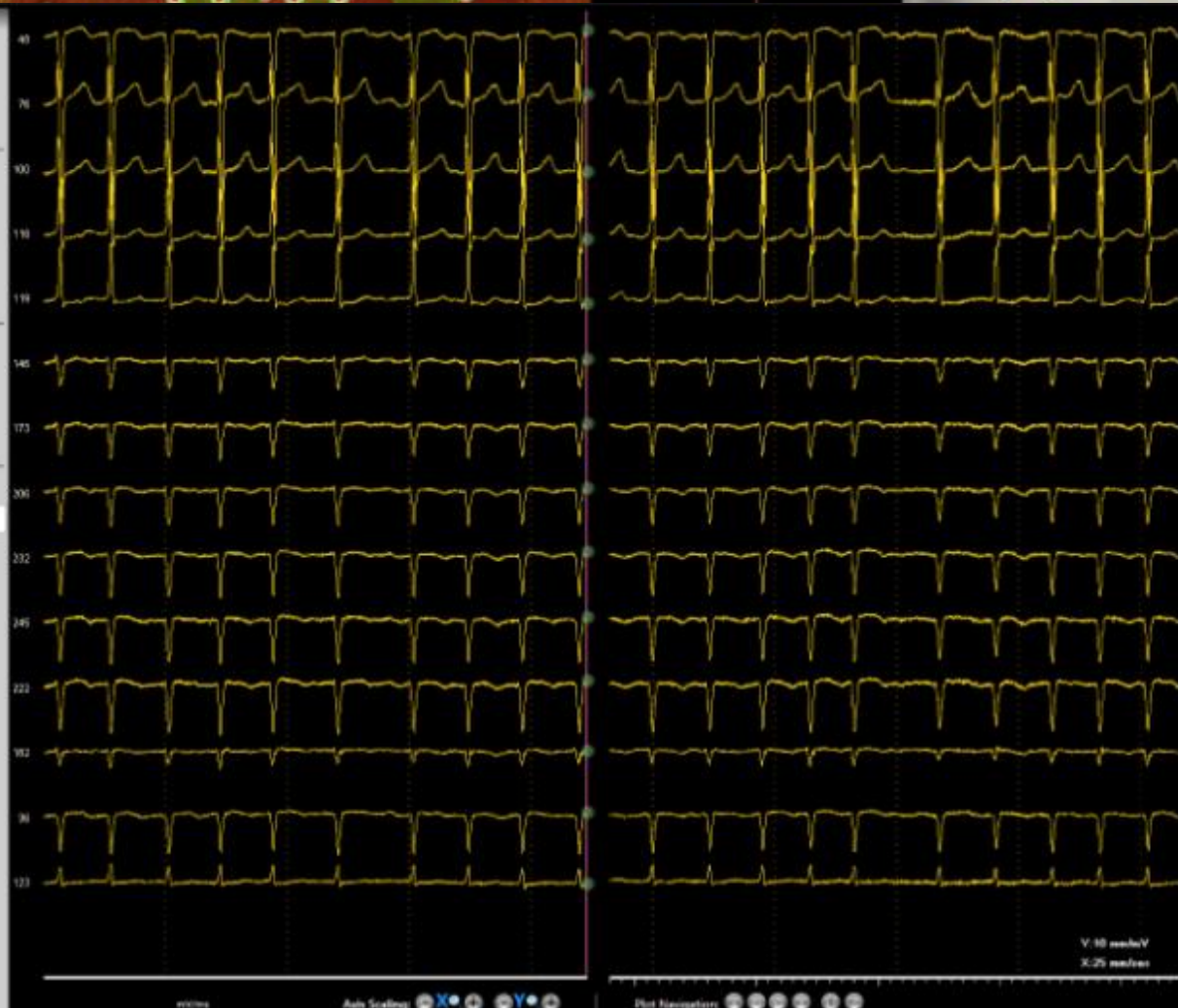
Interval Selection

Phase Mapping Mode

Bookmarking

Acquisition Filters

Low-Pass Acquisition Filter





# Driver Domains in Persistent Atrial Fibrillation

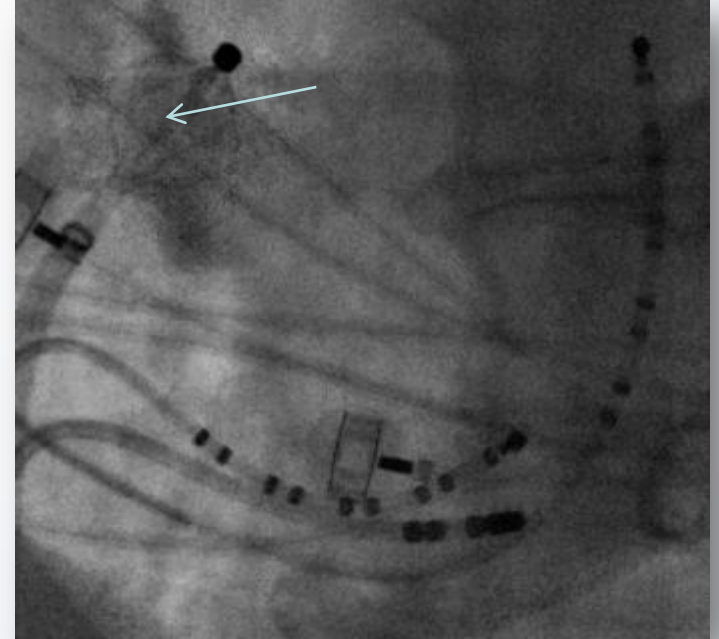
Michel Haissaguerre, MD; Meleze Hocini, MD; Arnaud Denis, MD; Ashok J. Shah, MD; Yuki Komatsu, MD; Seigo Yamashita, MD; Matthew Daly, MD; Sana Amraoui, MD; Stephan Zellerhoff, MD; Marie-Quitterie Picat, MD; Adam Quotb, PhD; Laurence Jesel, MD; Han Lim, MD; Sylvain Ploux, MD; Pierre Bordachar, MD; Guillaume Attuel, PhD; Valentin Meillet, MSc; Philippe Ritter, MD; Nicolas Derval, MD; Frederic Sacher, MD; Olivier Bernus, PhD; Hubert Cochet, MD; Pierre Jais, MD; Remi Dubois, PhD

**Background**—Specific noninvasive signal processing was applied to identify drivers in distinct categories of persistent atrial fibrillation (AF).

**Methods and Results**—In 103 consecutive patients with persistent AF, accurate biatrial geometry relative to an array of 252 body surface electrodes was obtained from a noncontrast computed tomography scan. The reconstructed unipolar AF electrograms acquired at bedside from multiple windows (duration,  $9 \pm 1$  s) were signal processed to identify the drivers (focal or reentrant activity) and their cumulative density map. The driver domains were catheter ablated by using AF termination as the procedural end point in comparison with the stepwise-ablation control group. The maps showed incessantly changing beat-to-beat wave fronts and varying spatiotemporal behavior of driver activities. Reentries were not sustained (median, 2.6 rotations lasting  $449 \pm 89$  ms), meandered substantially but recurred repetitively in the same region. In total, 4720 drivers were identified in 103 patients: 3802 (80.5%) reentries and 918 (19.5%) focal breakthroughs; most of them colocalized. Of these, 69% reentries and 71% foci were in the left atrium. Driver ablation alone terminated 75% and 15% of persistent and long-lasting AF, respectively. The number of targeted driver regions increased with the duration of continuous AF: 2 in patients presenting in sinus rhythm, 3 in AF lasting 1 to 3 months, 4 in AF lasting 4 to 6 months, and 6 in AF lasting longer. The termination rate sharply declined after 6 months. The mean radiofrequency delivery to AF termination was  $28 \pm 17$  minutes versus  $65 \pm 33$  minutes in the control group ( $P < 0.0001$ ). At 12 months, 85% patients with AF termination were free from AF, similar to the control population (87%);  $P =$  not significant.

**Conclusions**—Persistent AF in early months is maintained predominantly by drivers clustered in a few regions, most of them being unstable reentries. (*Circulation*. 2014;130:530-538.)

# Mapování v kvalitě „Ultra-High Density“

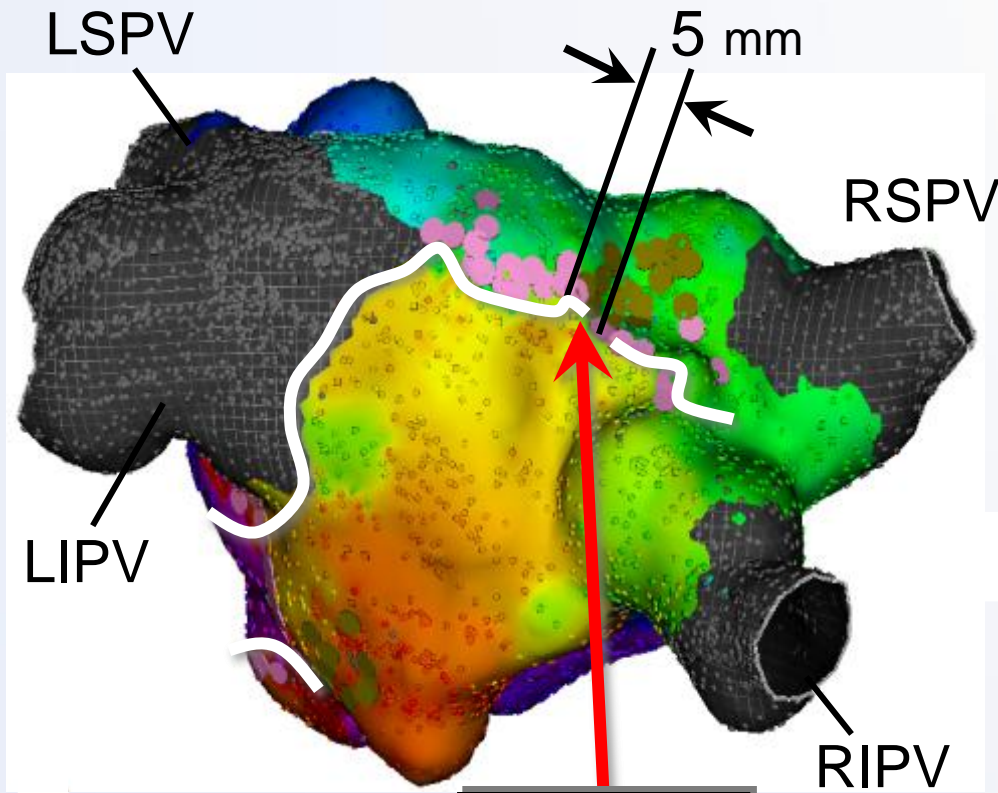


- 8F steerable basket catheter (mean 1.6cm changeable)
- 8 splines with 64 electrodes (spacing 2.5mm)
- Location using magnetic field/impedance

Automated Rhythmia Map  
(10 min, 9770 points)

Pont-by-Point CARTO Map  
(29 min, 393 points)

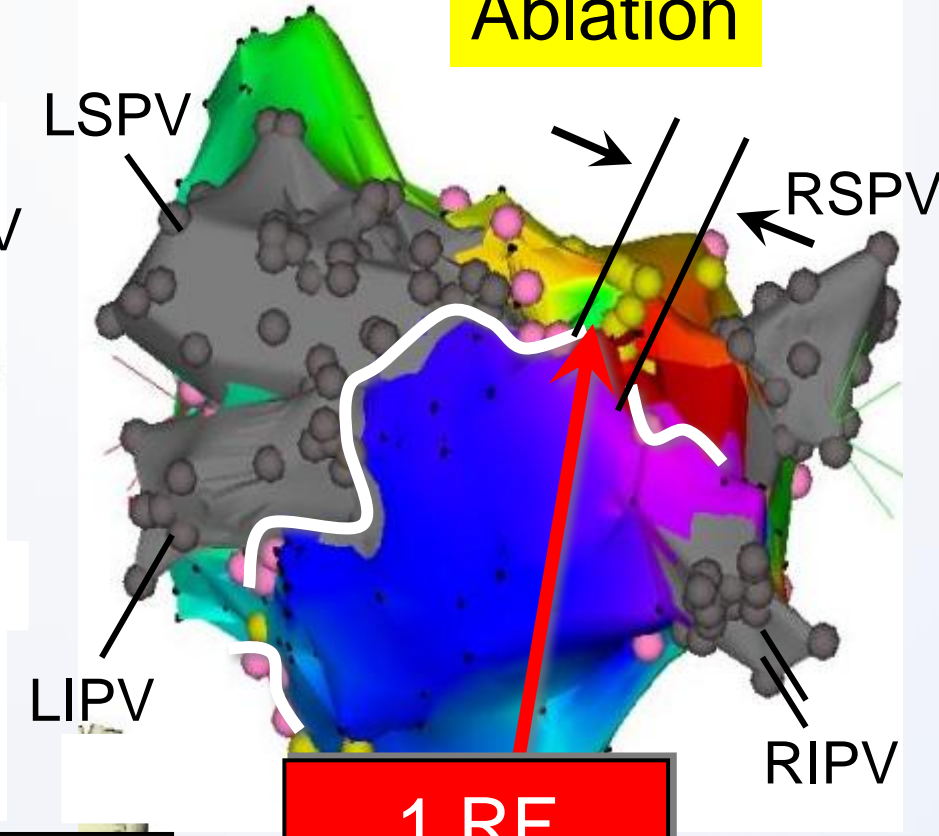
Mapping Resolution: 1.9 mm



Narrow Channel

PA Projection

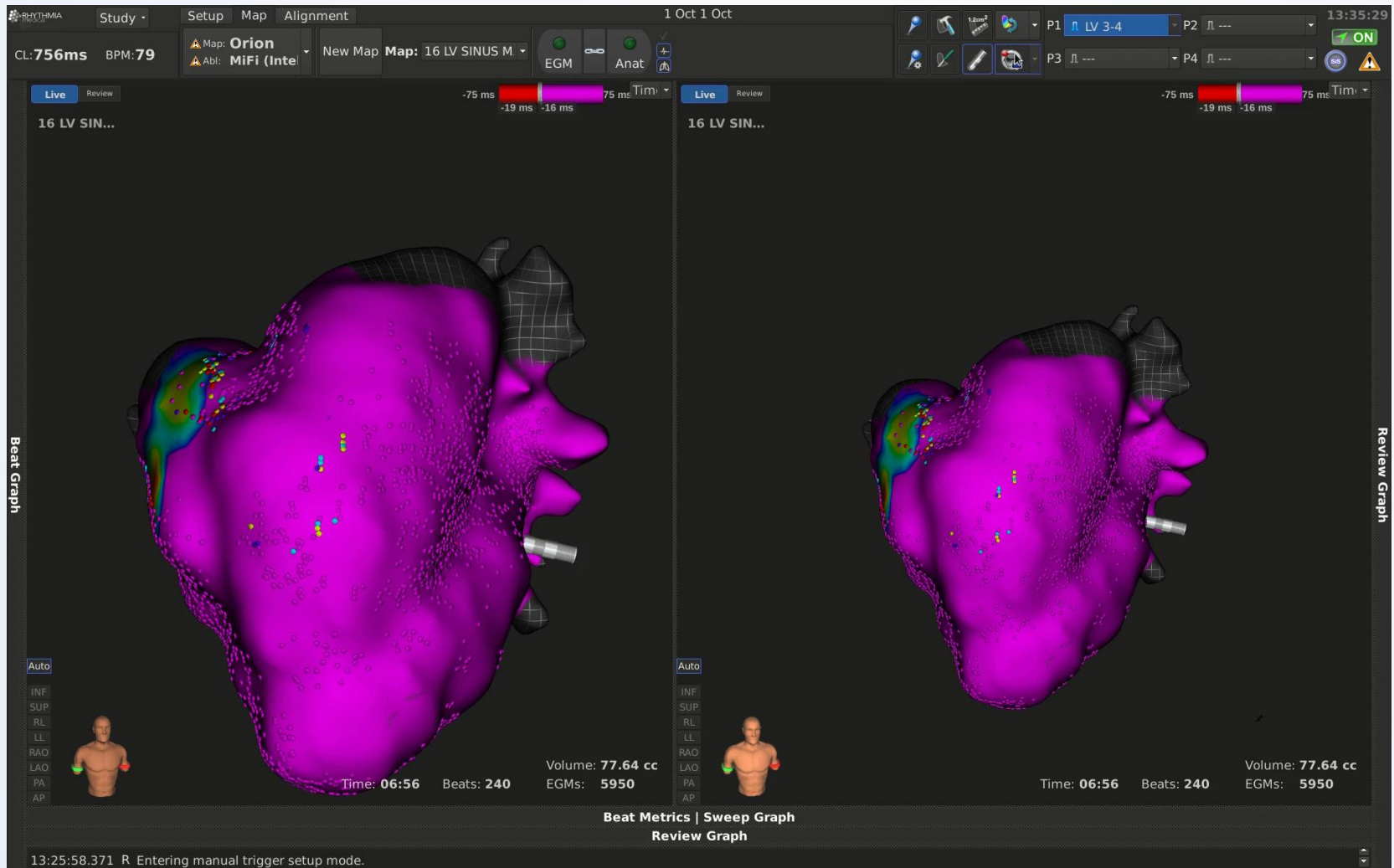
Ablation



1 RF  
(30 Watts)



# Aktivace levé komory (ovce)

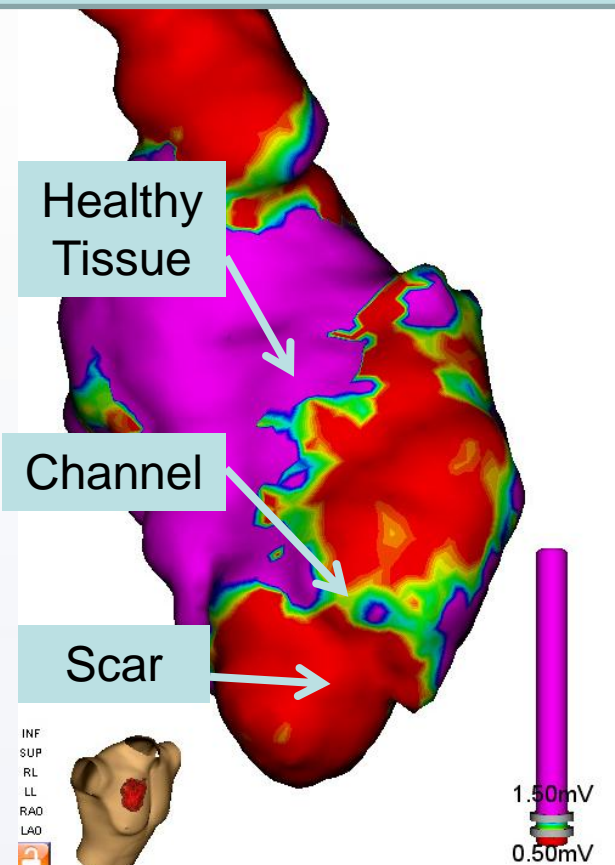
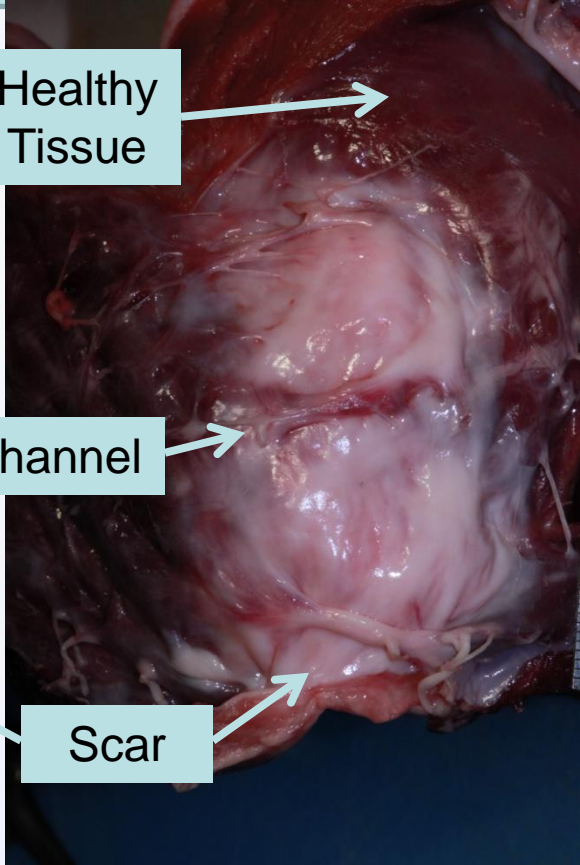
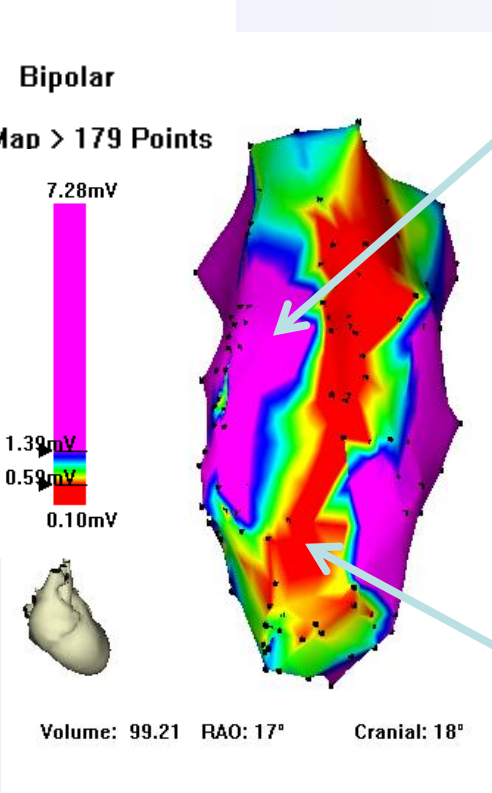


# Mapování substrátu (poinfarktová jizva u ovce)

90 Minute CARTO Map

Excised Heart

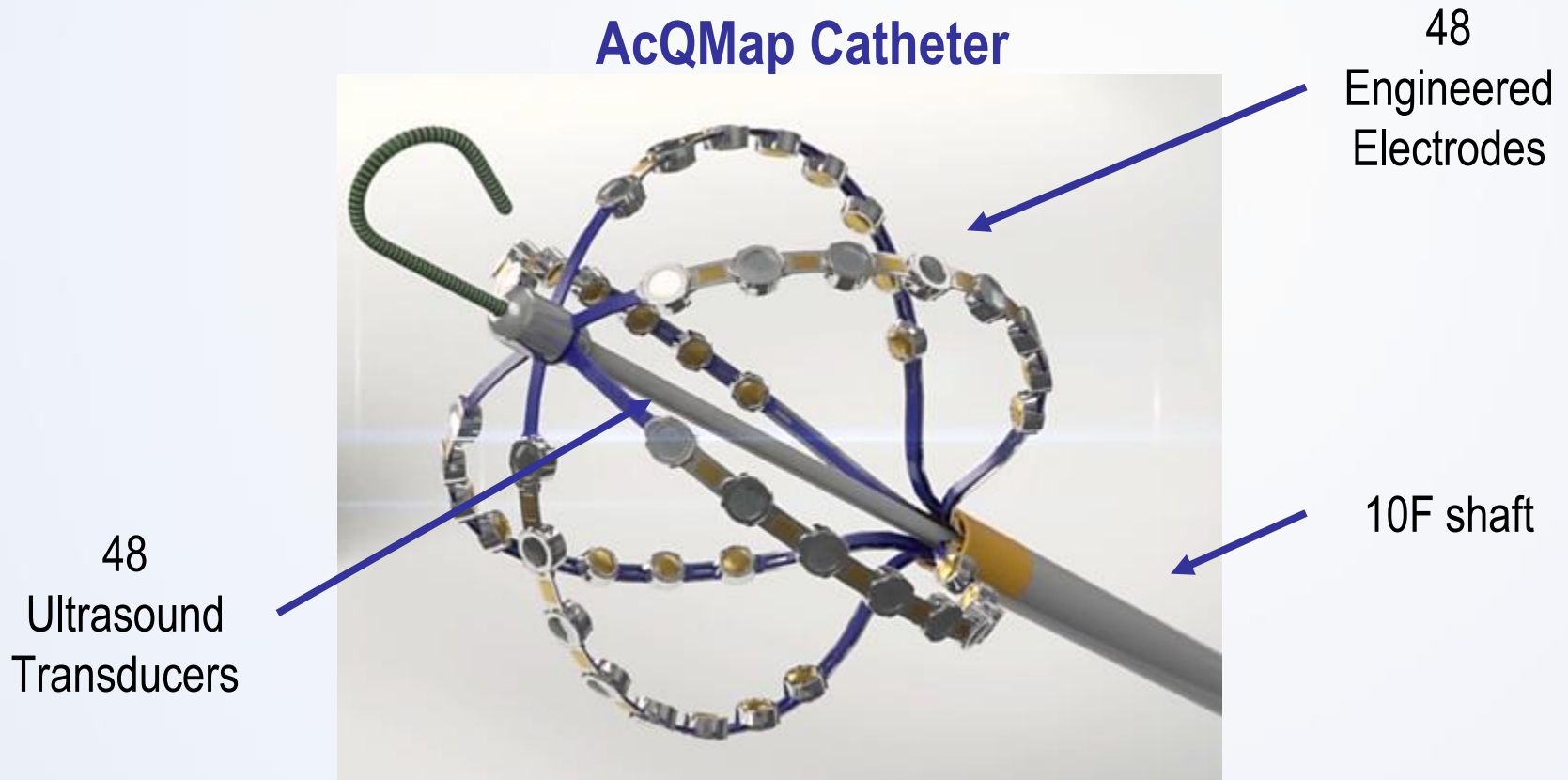
19 Minute Rhythmia™ Map



No channel identified on CARTO system after 90 minutes of mapping

# Bezkontaktní mapování

## AcQMap Catheter



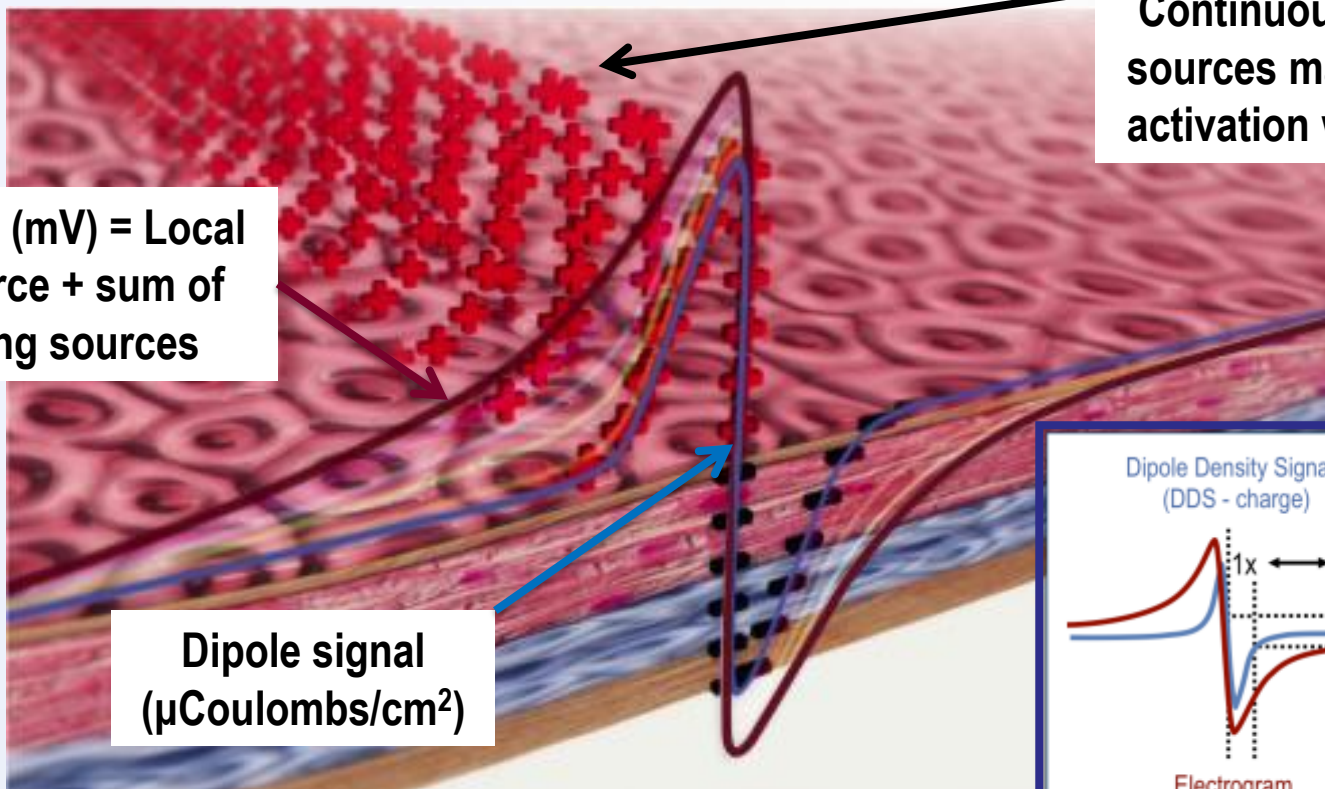
25mm basket diameter

Up to 144,000 ultrasound points/minute

150,000 intra-cardiac unipolar voltage samples/second



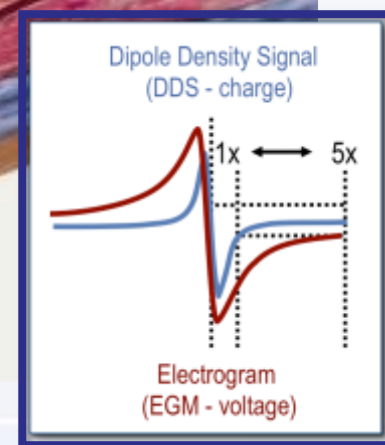
# Inverzní a dopředný algoritmus k analýze intrakardiální voltáže k vytvoření dipolární denzity



Continuous layer of sources make up the activation wave front

Voltage EGM (mV) = Local charge source + sum of surrounding sources

Dipole signal ( $\mu\text{Coulombs}/\text{cm}^2$ )



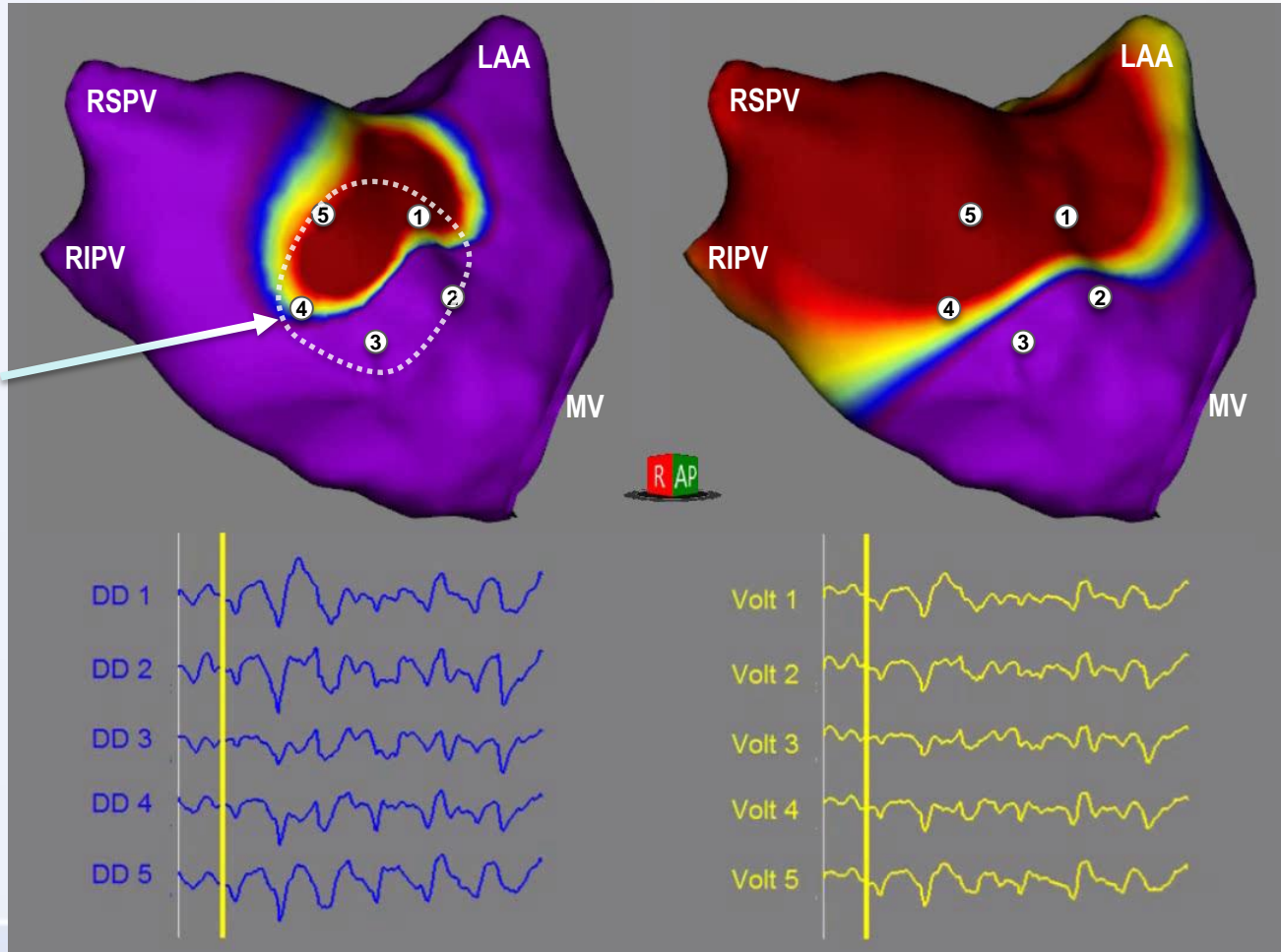


# Mapy dipolární denzity a voltáže při FS (Raw data)

AcQMap Dipole Density

AcQMap Voltage

Region of irregular reentry



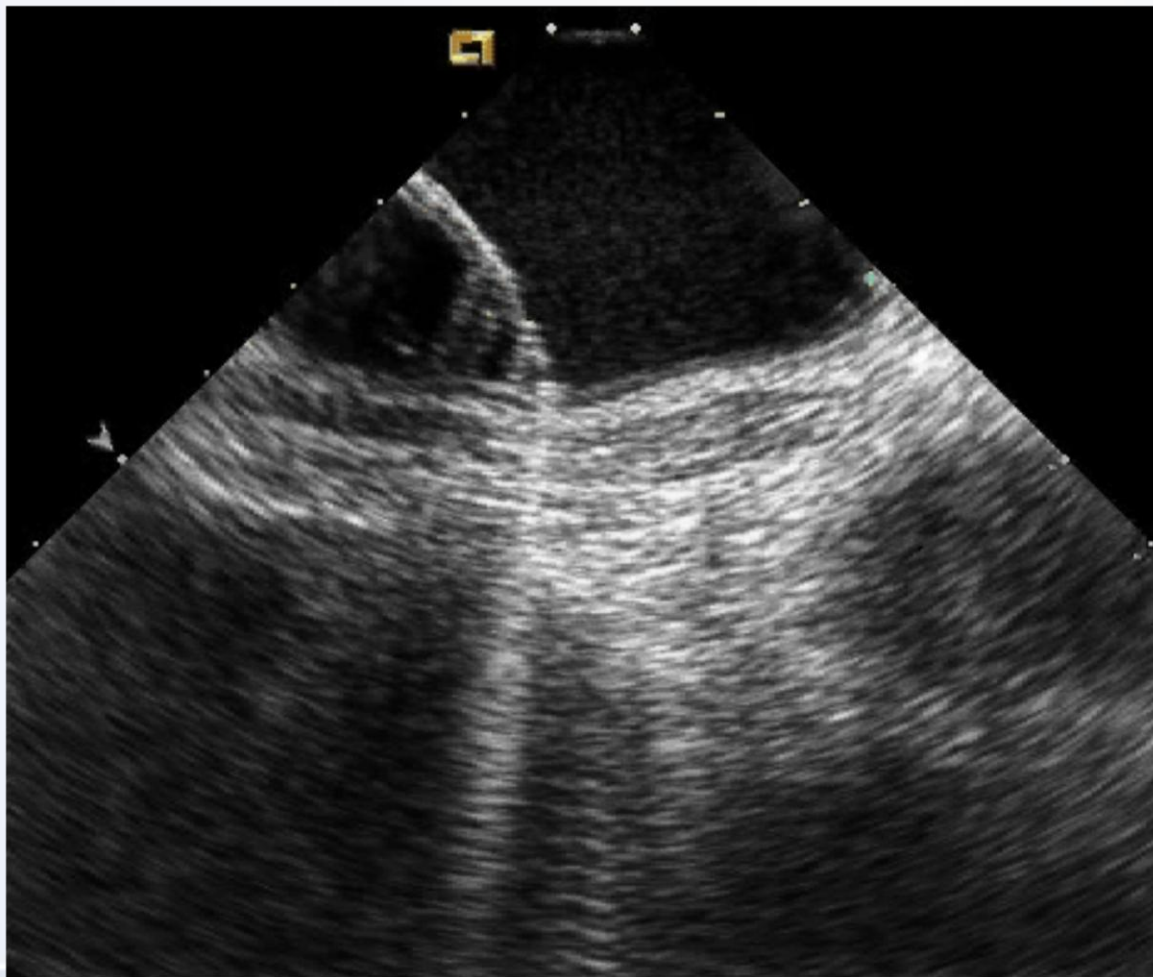
Locally discrete deflections  
RS-pattern reveals direction of conduction

Minimally discrete deflections with significant fractionation

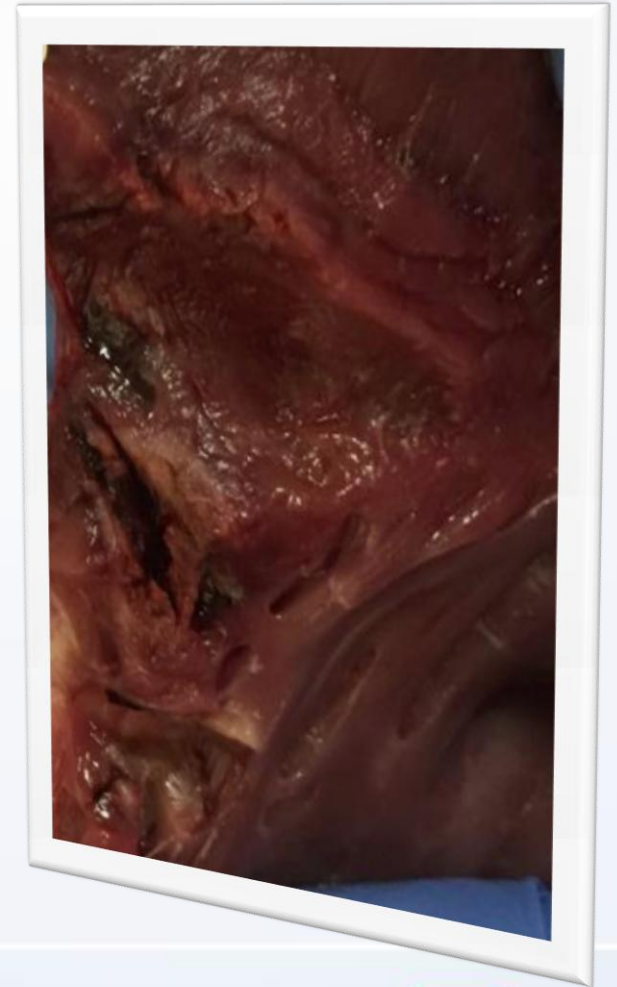
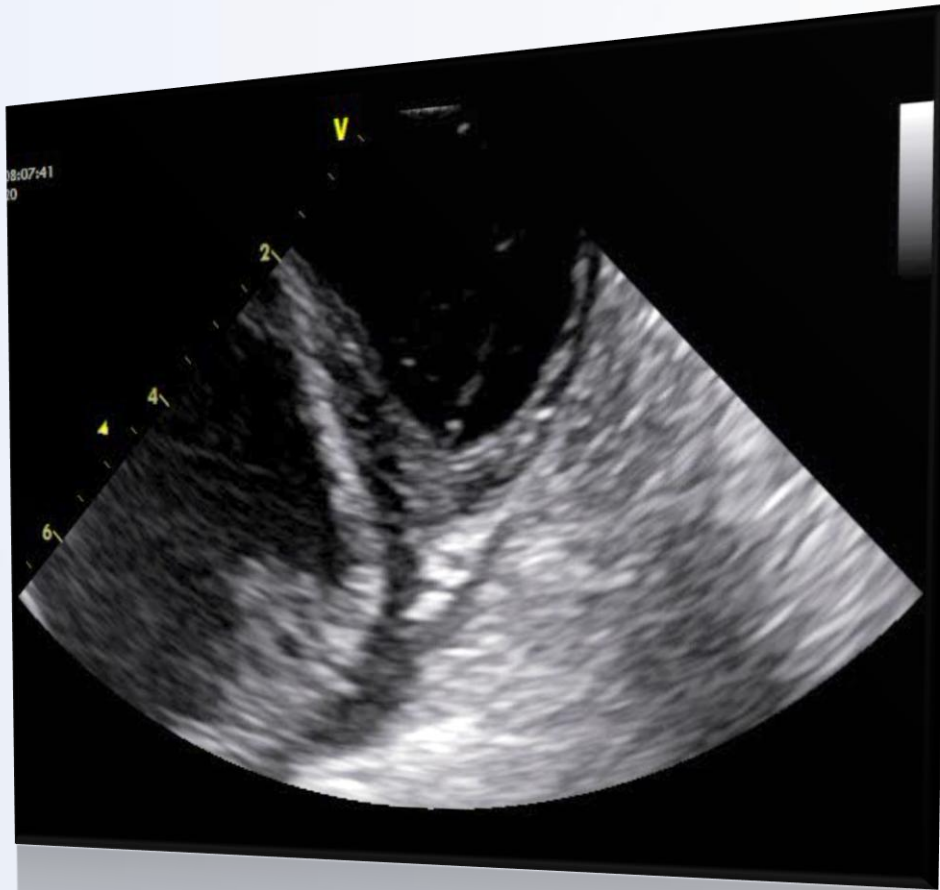
# Zobrazování on-line



# Zobrazení anatomie, kontaktu katetru..



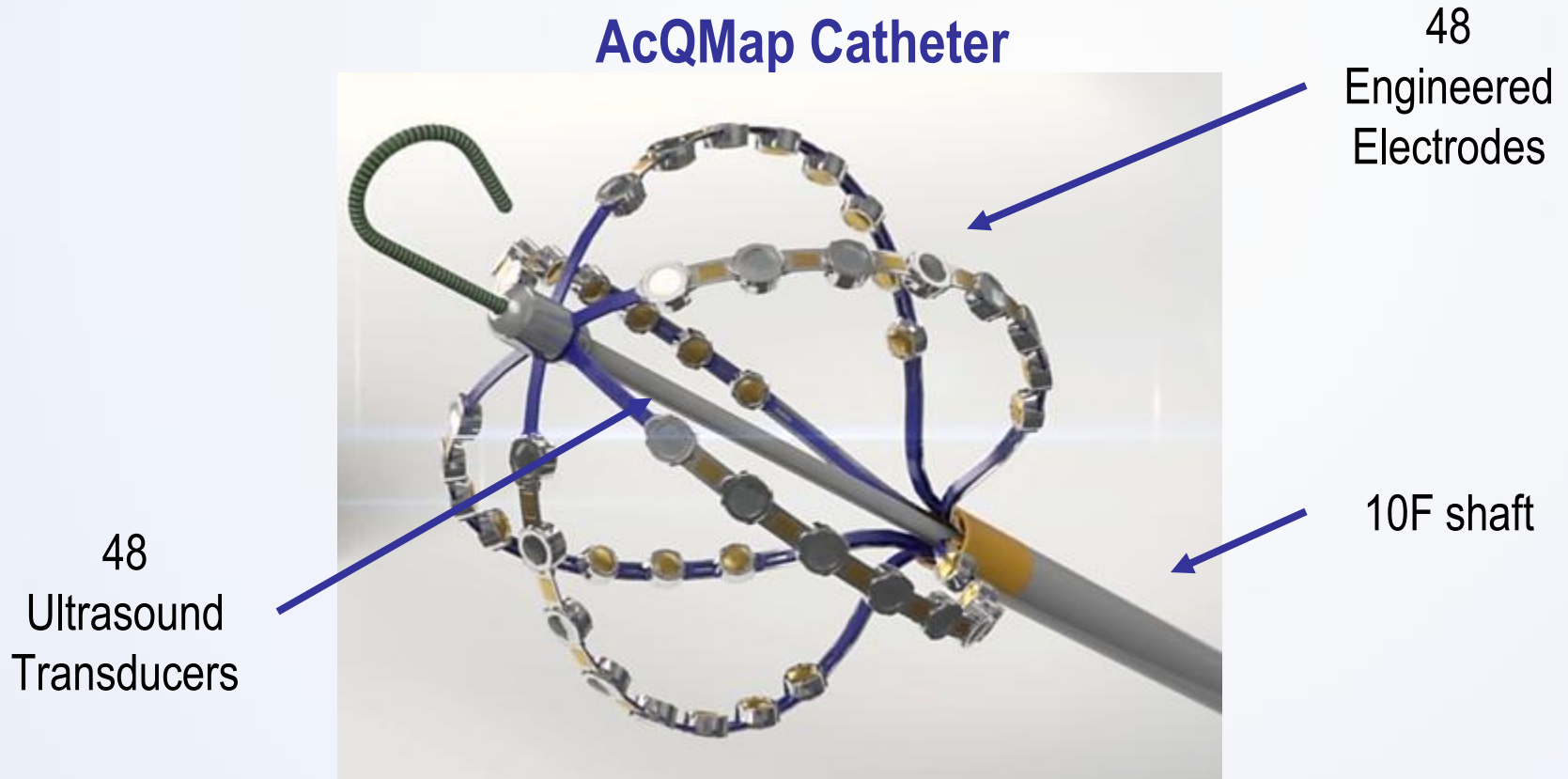
# Experimentální náhlé přehřátí tkáně





# 3D zobrazovací USG katetr

## AcQMap Catheter



48

Engineered  
Electrodes

48

Ultrasound  
Transducers

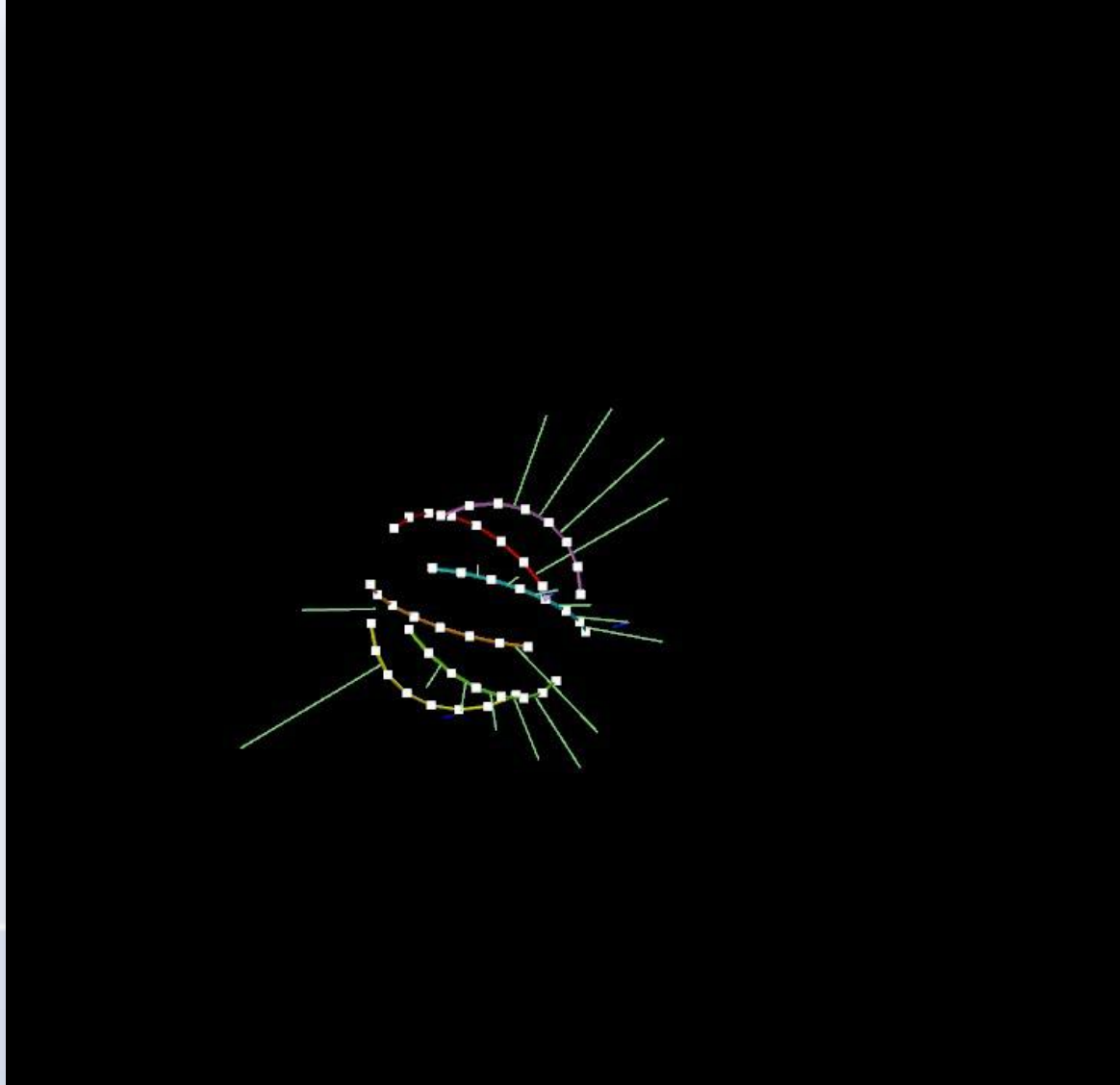
10F shaft

25mm basket diameter

Up to 144,000 ultrasound points/minute

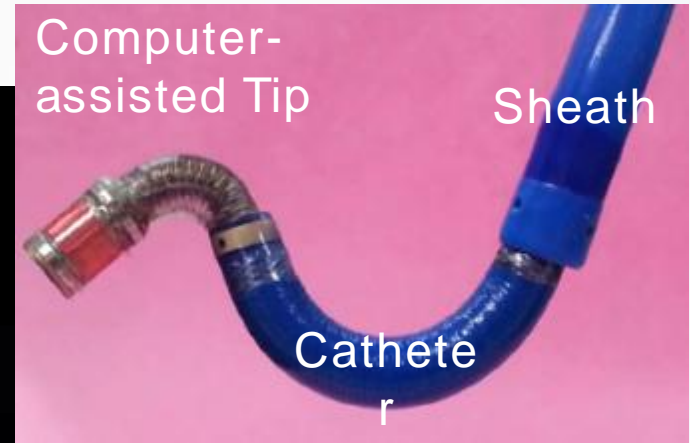
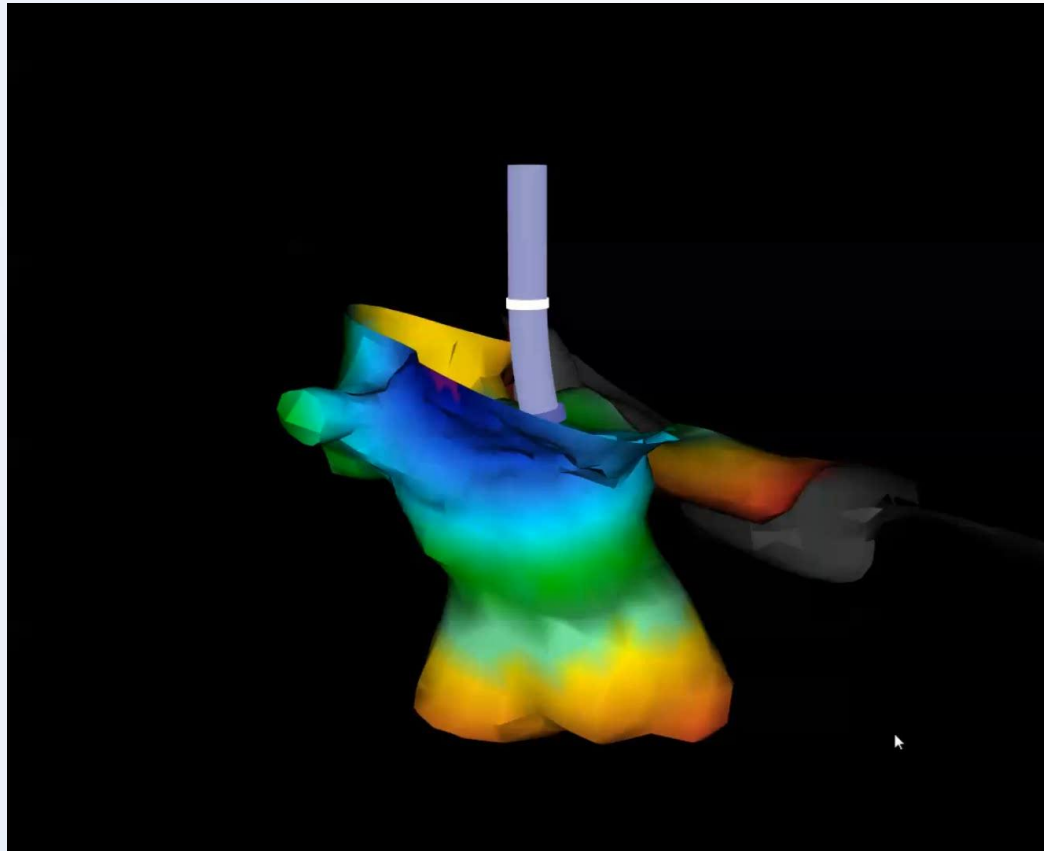
150,000 intra-cardiac unipolar voltage samples/second

# Měřením odrazů tkáně lze sestavit přesnou 3D anatomii srdce



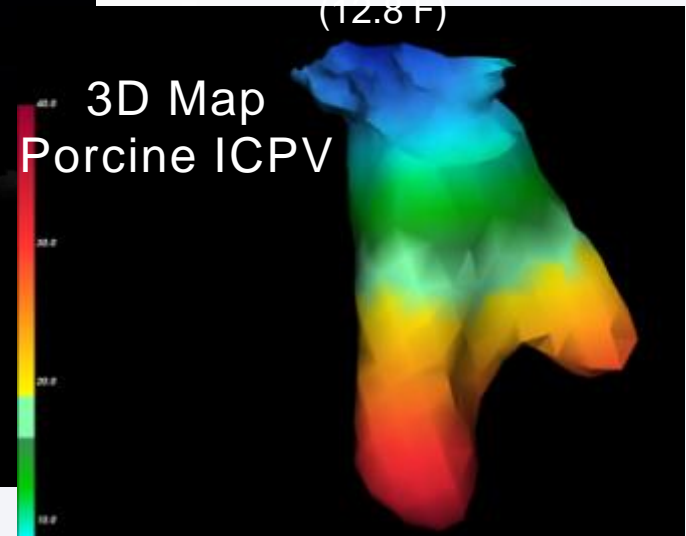
2x

# Roboticky generovaný 3D obraz



(12.8 F)

3D Map  
Porcine ICPV



# Senzory a mikroelektrody v hrotu katetru



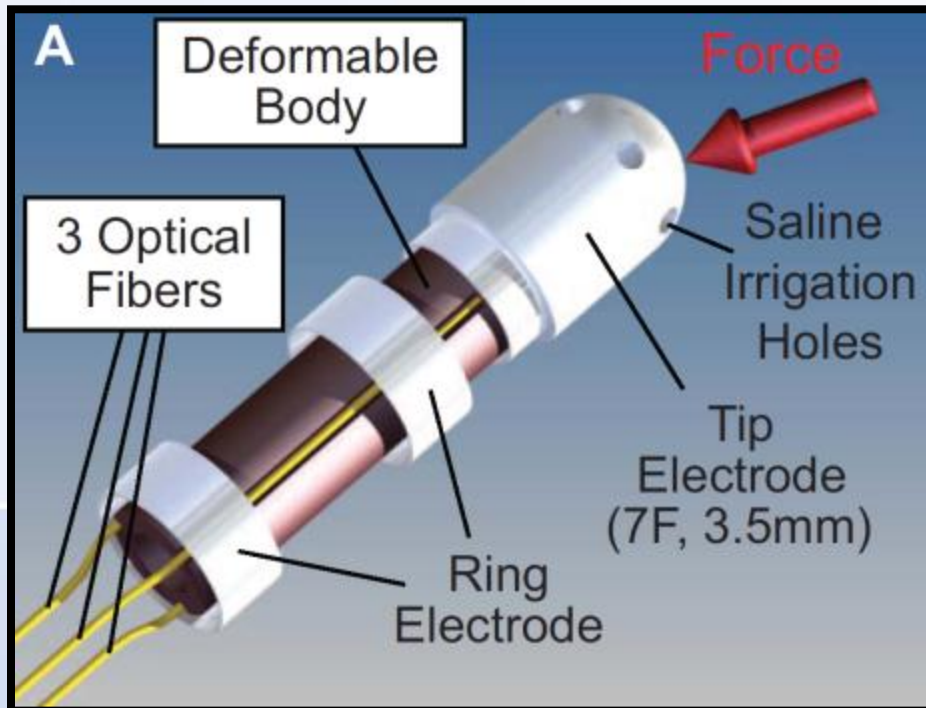


# Posouzení síly kontaktu katetru s tkání

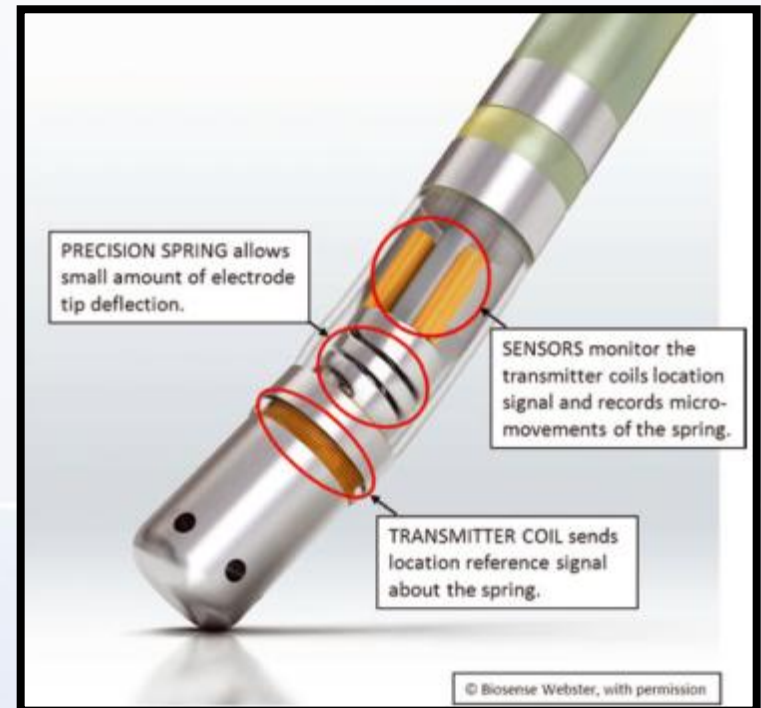
- nepřímé: **IntelliSense** (Hansen Medical)
- náhradní: **Ensite VeriSense** (SJM)
- přímé:



**TactiCath™**

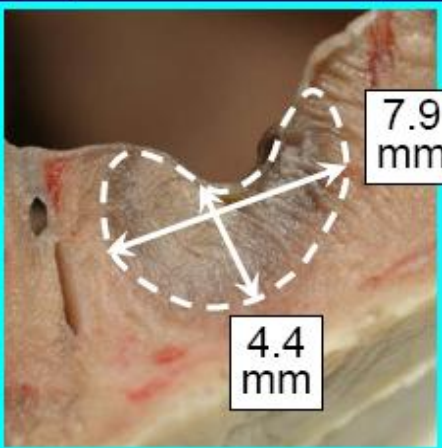


**ThermoCool® SmartTouch™**

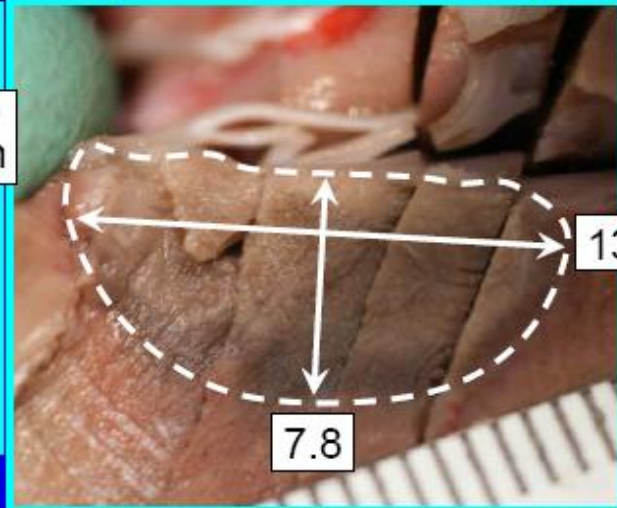


# LV Lesion Dimensions (40W, 60 sec)

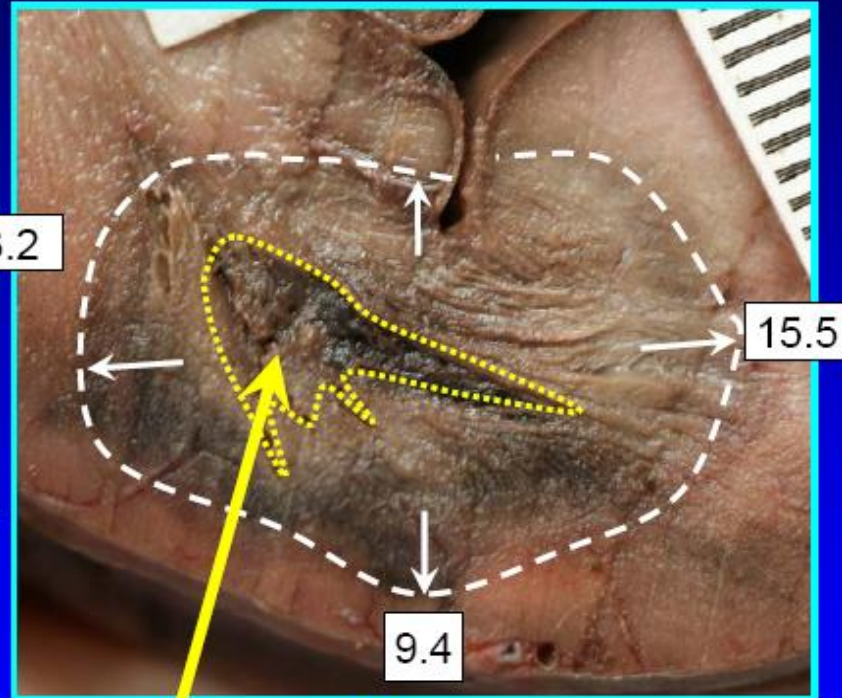
Low Contact Force (8g)



Moderate Contact Force (22g)



High Contact Force (60g)



Crater Formation Hemorrhage (Steam Pop)

5mm

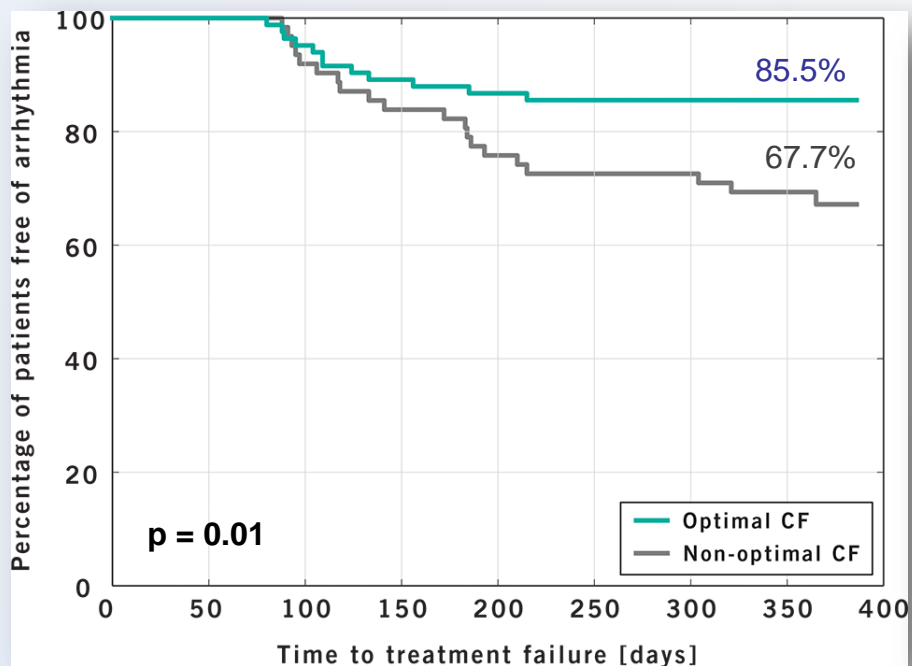
Nakagawa H, et al. Heart Rhythm 2009;6:S65

# Studie TOCCASTAR

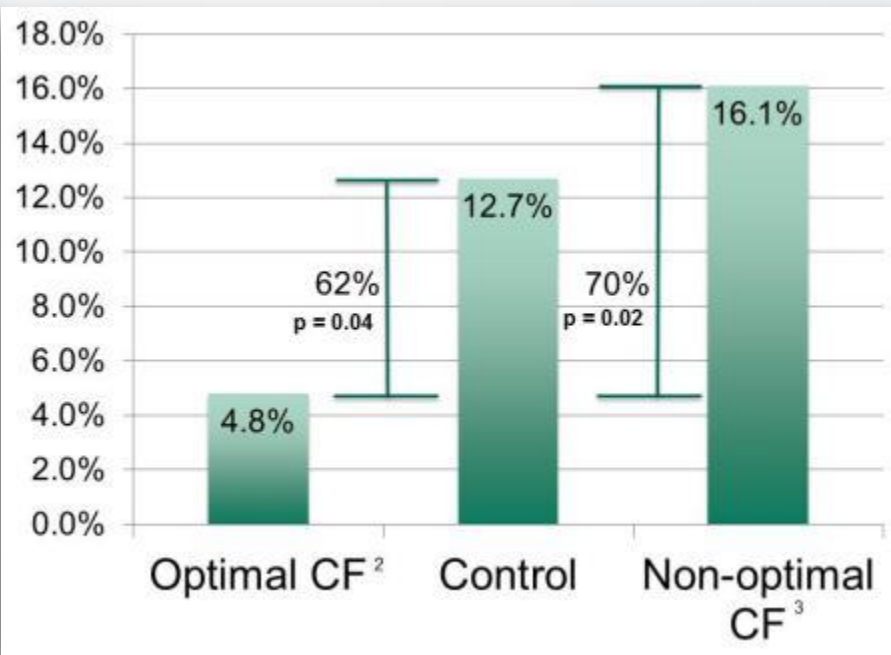
## Prespecifikovaná následná analýza

### Vliv optimalizované kontaktní síly

**Optimal CF<sup>2</sup> vs. Non-optimal CF<sup>3</sup>**  
**Clinically Relevant Success at 12 months**



**Contact Force and Control:**  
**Rate of Repeat Ablation<sup>1</sup>**



Proporce nemocných s optimalizovanu silou C = 57 %

1. Repeat ablation after the protocol defined 3 month blanking period; protocol defined success used for analysis
2. Optimal CF cohort defined as those patients where  $\geq 90\%$  lesions  $\geq 10g$
3. Non-optimal CF cohort defined as those patients where  $< 90\%$  lesions  $\geq 10g$

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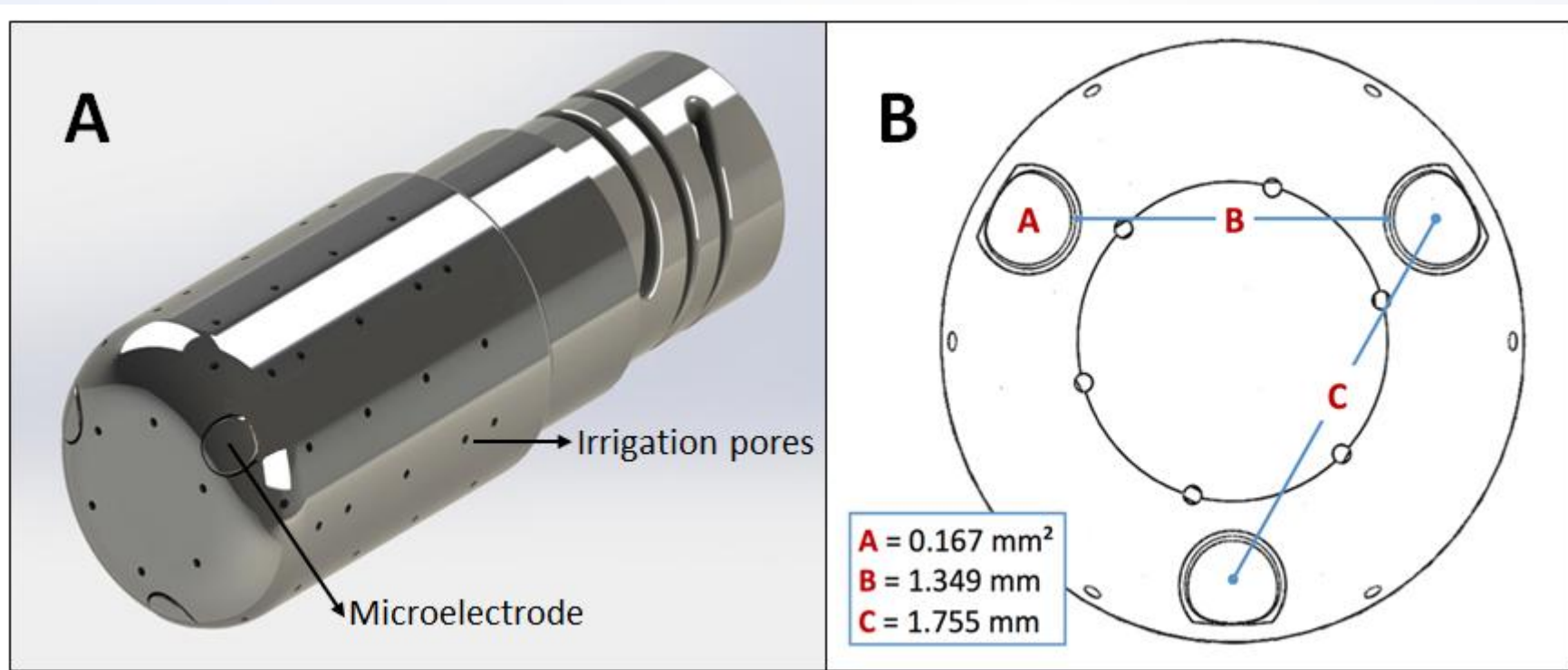


The TactiCath Quartz Set is currently undergoing FDA review for premarket approval

CAUTION: Investigational device in the United States. Limited by Federal (or U.S.) law to investigational use. Not available for sale in the U.S.



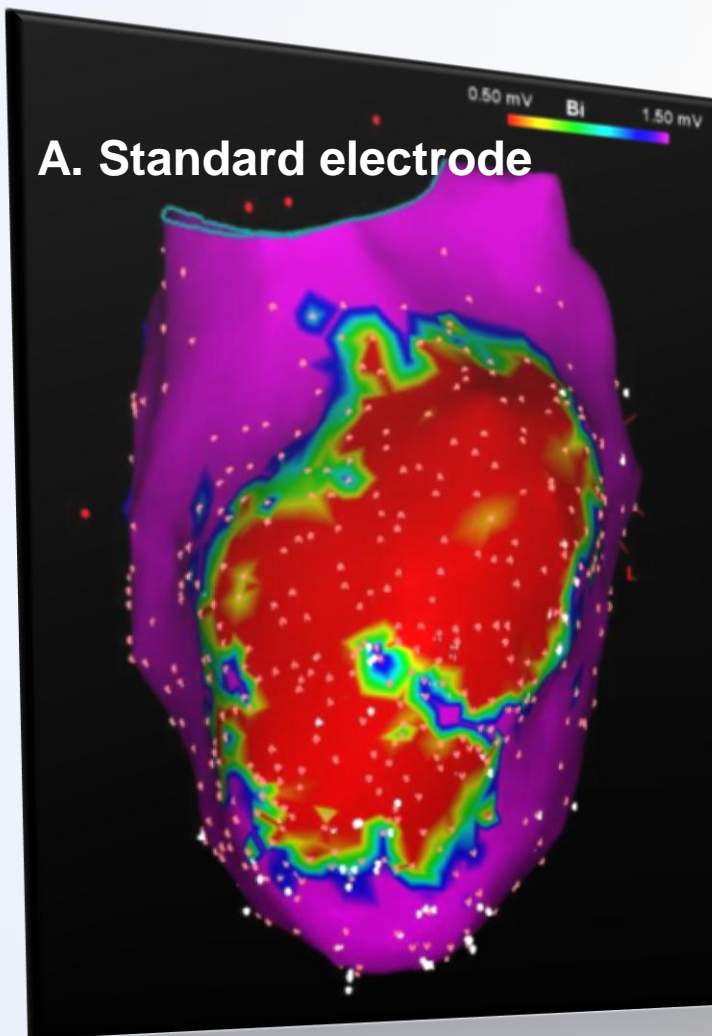
# Katetr s mnohočetnými termistory a mikroelektrodami



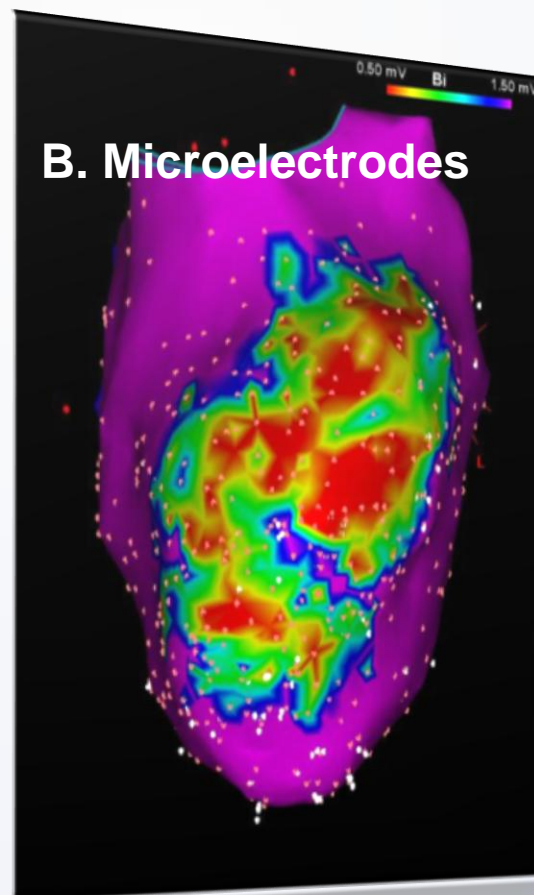


# Mapování jizvy po IM v experimentu

A. Standard electrode



B. Microelectrodes

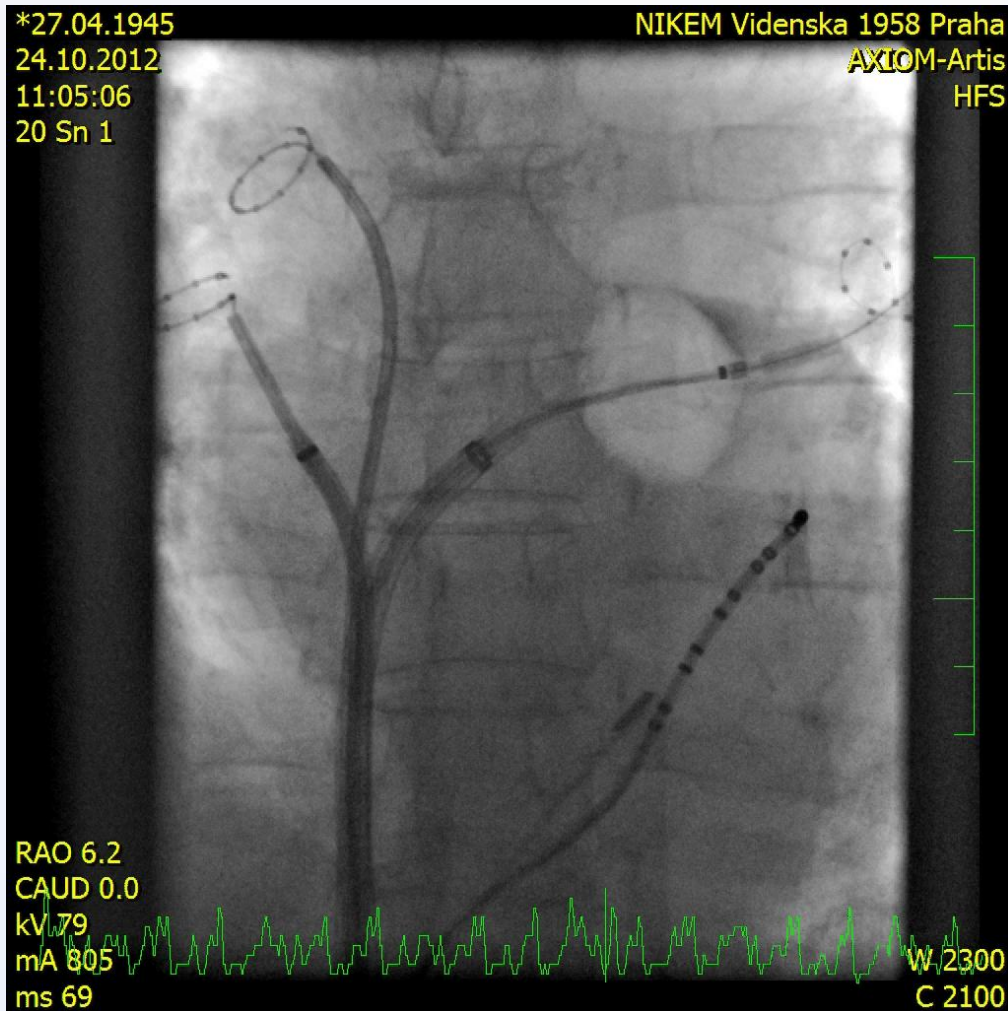


Laskavostí dr E Antera

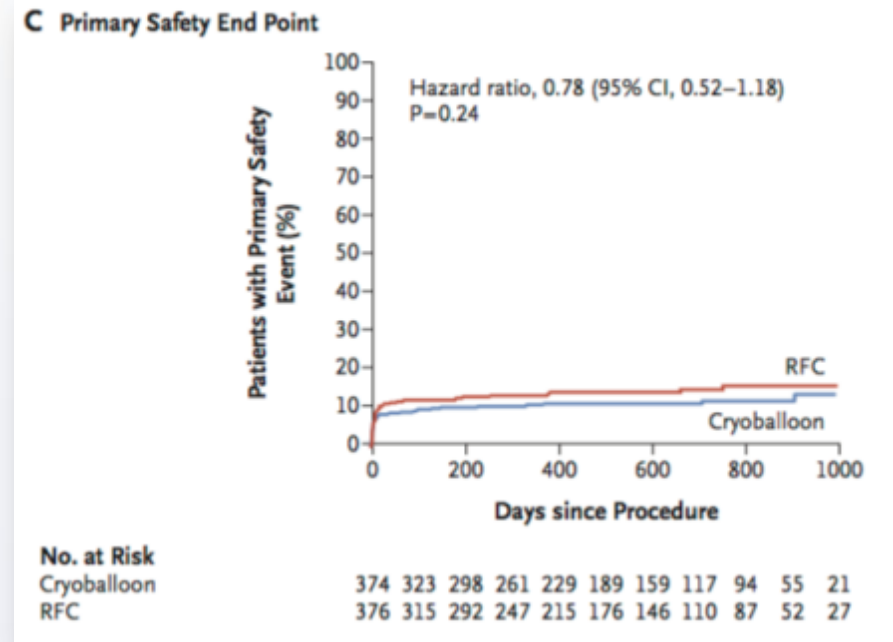
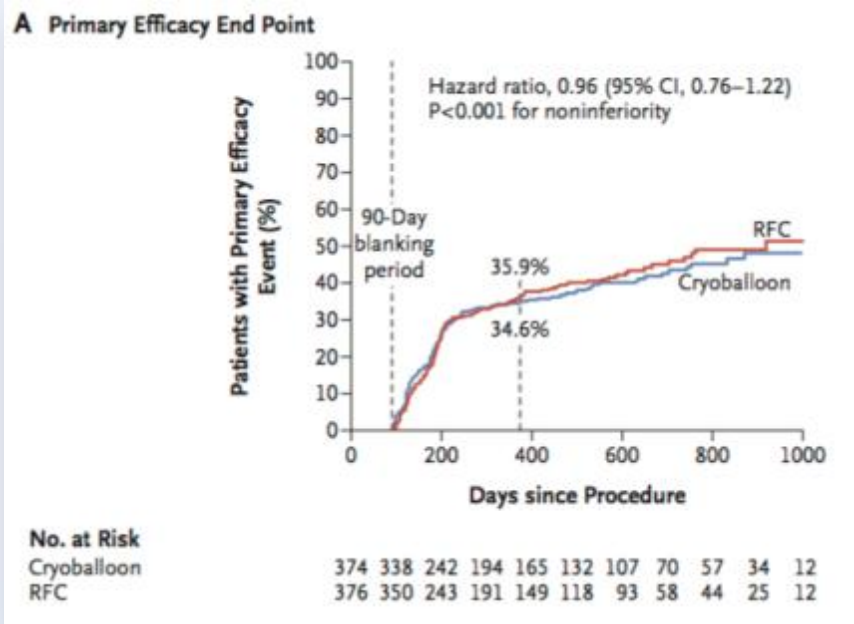
# Alternativní zdroje energie



# Kryobalon



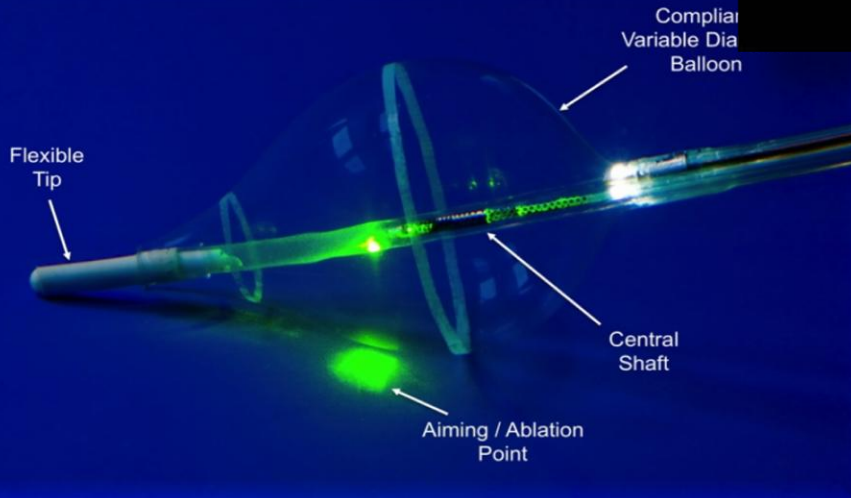
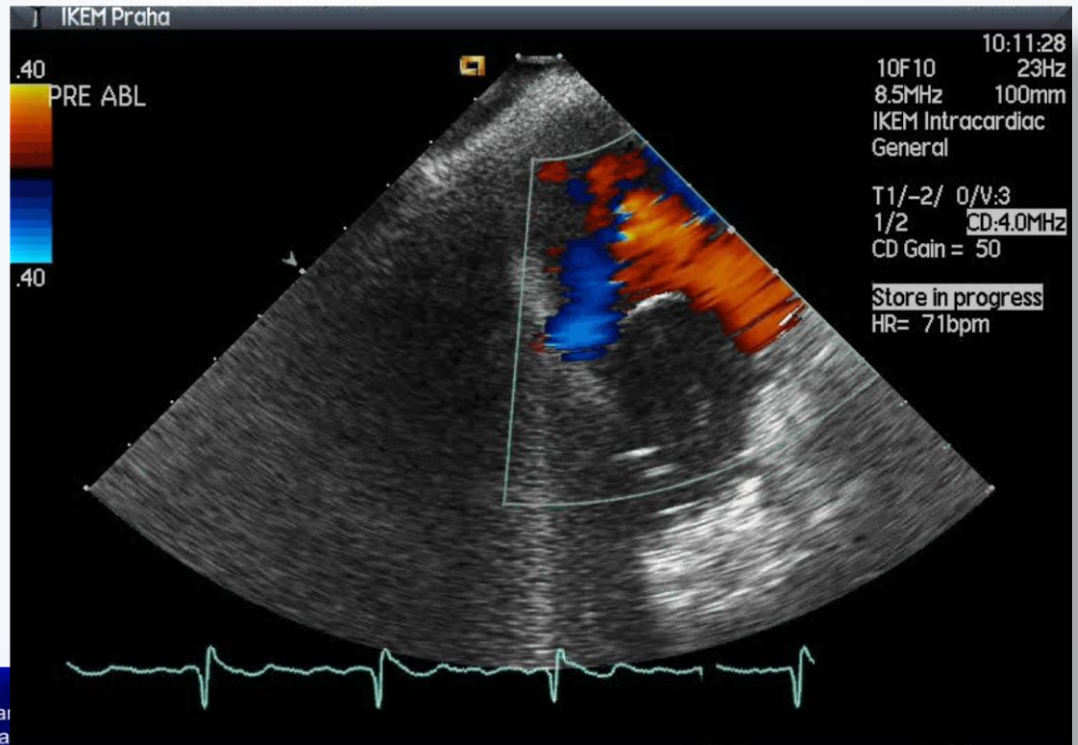
# Studie “FIRE and ICE”



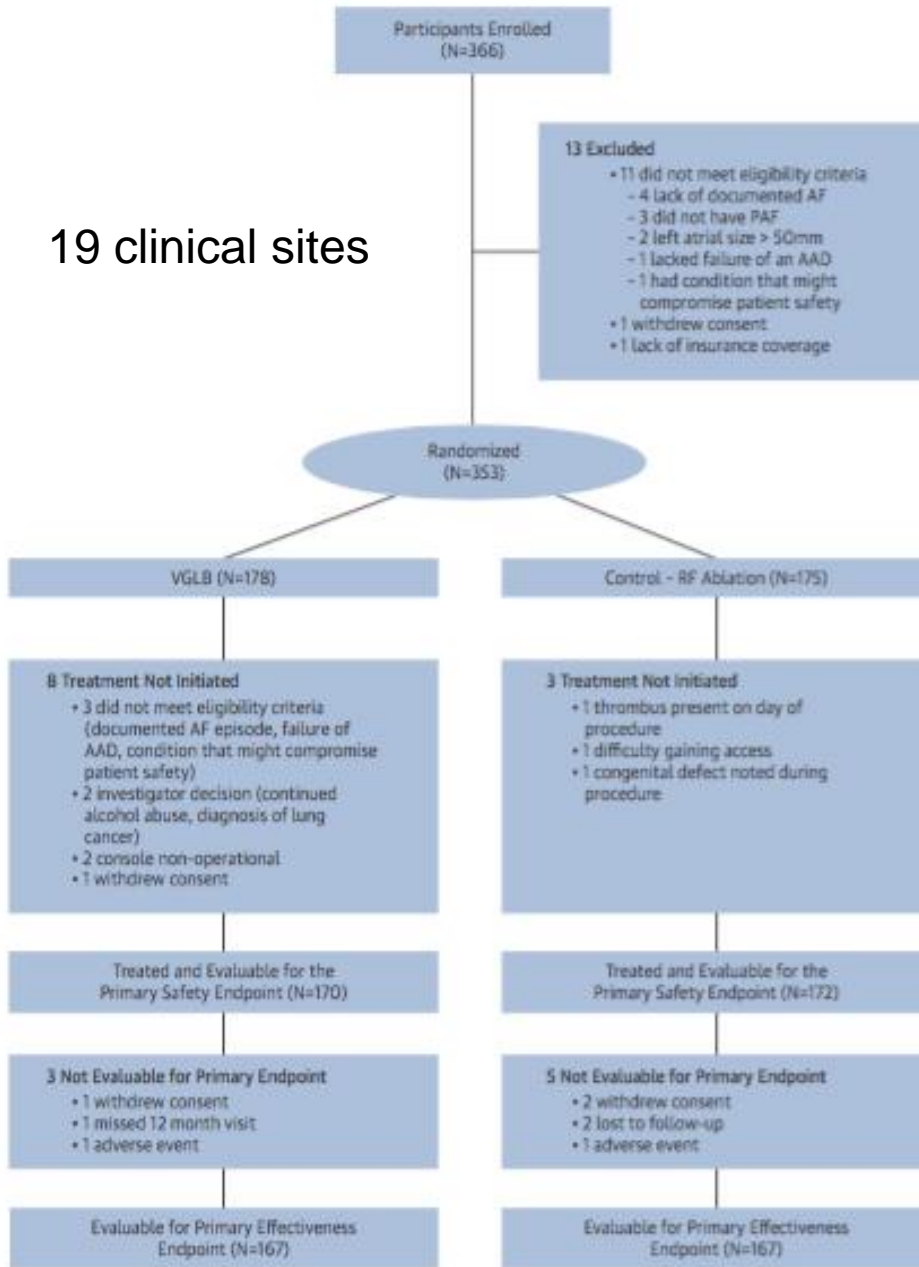
Kuck KH, et al. N Engl J Med 2016;374:2235-45.



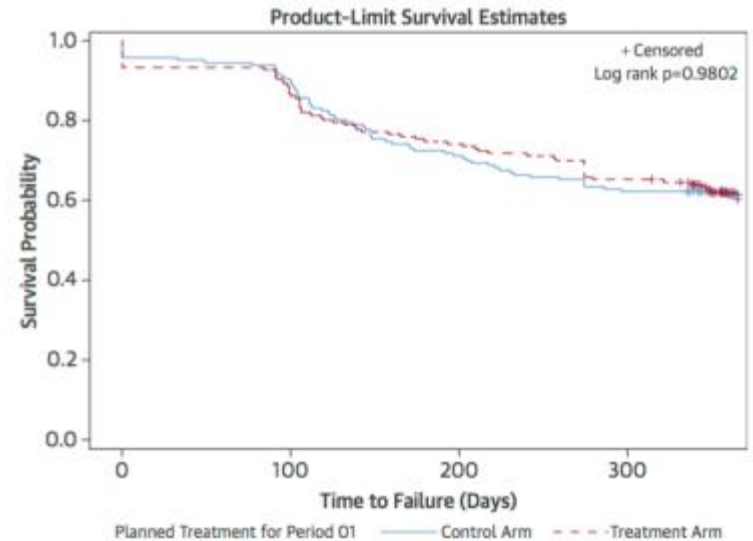
# LaserBalloon Catheter



19 clinical sites



# Randomized controlled trial



primary adverse event rate:  
 11.8% in the VGLB group  
 14.5% in controls (noninferiority)

Diaphragmatic paralysis:  
 (3.5% vs. 0.6%;  $p < 0.05$ )

# Robotická navigace



# Systemy vzdálené navigace



**Magnetic navigation  
Niobe – Stereotaxis Inc.**



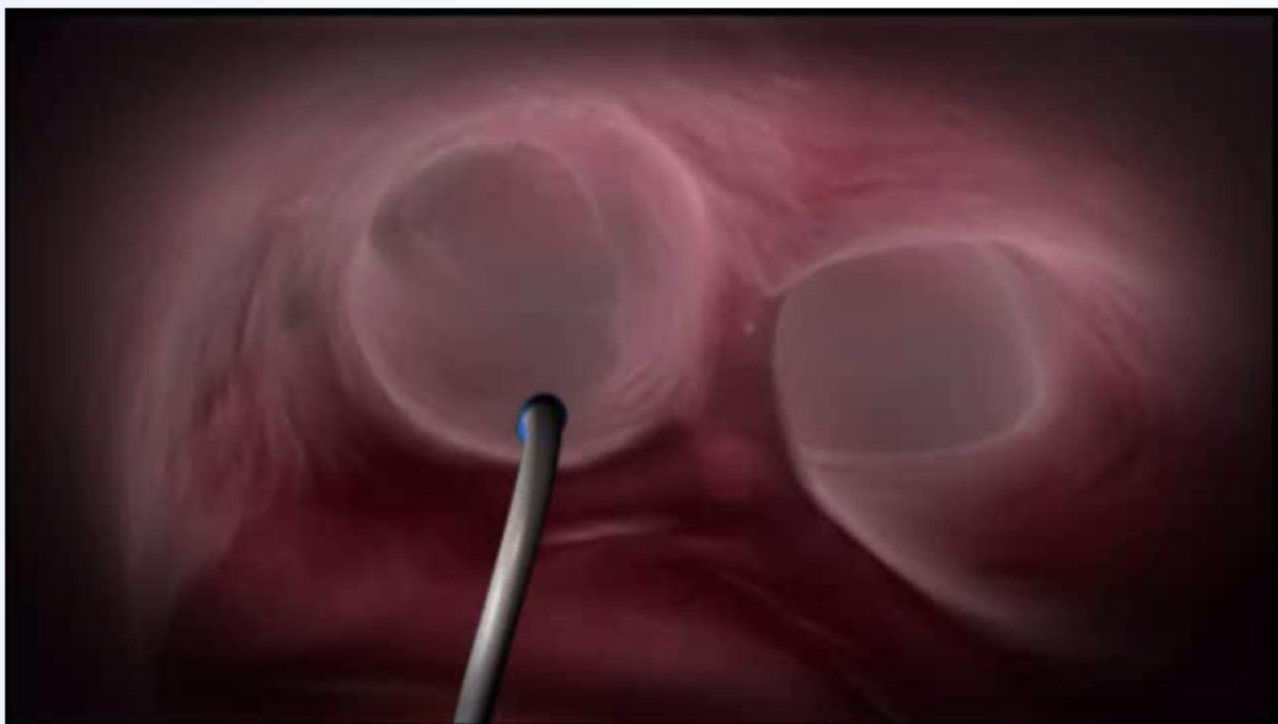
**Robotic navigation  
Sensei - Hansen Medical Inc.**



# Autopilot



# Opravdová robotická ablace



# Závěry

- Nepřerušovaná léčba antikoagulancii je současným standardem při katetrizační ablaci FS
- Nové technologie představují značný potenciál pro mapováním navigovanou ablaci během perzistující FS
- Alternativní energie mohou přispět k většímu rozšíření dostupnosti katetrizační ablace FS
- On-line zobrazování a nové senzory v katetrech jsou možnou cestou k umožnění opravdové robotické ablace v budoucnosti



Děkuji za Vaši pozornost...

