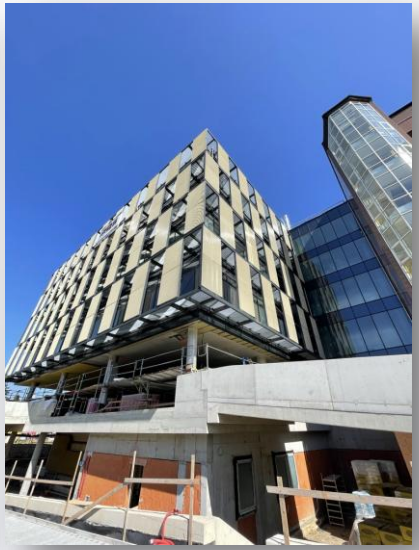
Current standards of catheter ablations and monitoring after the procedure



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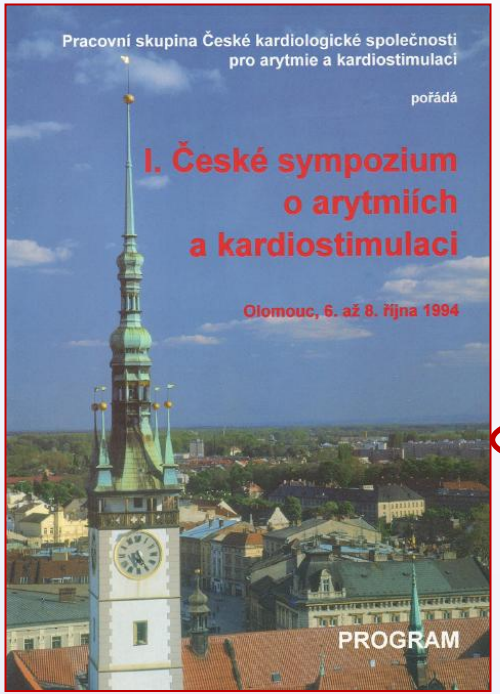
joka@medicon.cz
www.ikem.cz, @JosefKautzner

INSTITUT KLINICKÉ A EXPERIMENTÁLNÍ MEDICÍNY
KLINIKA KARDIOLOGIE

IK+E M

Český registr katetrizačních ablací

Počátek- 1994



30 min.

Kottkamp H. (Münster):
"Biophysical aspects of RF catheter ablation and clinical results in SVT and VT."
20 min.

Frommer M. (LAUSANNE):
"Clinical aspects of catheter ablation of supraventricular tachyarythmia."
10 min.

Kirkutis A., Puteliere I. (Kaunas, Lithuania):
"Radiofrequency ablation of cardiac disrhythmias in children."

Diskuse po každé přednášce.

10.00-10.15	PŘESTÁVKA	
10.15-12.15	L KATETROVÉ ABLACE U ARYTMIÍ - II (ČESKÁ SEKCE):	
	předsedající: Bytešník J., Praha Heinc P., Olomouc	
	20 min.	
	Heinc P. (I. interní klinika FN Olomouc): "Ablační léčba tachyarytmií."	
	10 min.	
	Čihák R., Bytešník J., Janoušek J., Lukl J., Vít P. (IKEM Praha, FN Praha-Motol, I. interní klinika FN Olomouc): "Registr katetrizačních ablací radiofrekvenčním (RF) proudem v ČR."	(L30)
	Fiala M., Lukl J., Heinc P. (I. interní klinika FN Olomouc): "Katetrové ablace atrioventrikulární junkce - naše zkušenosti."	(L31)
	Bytešník J., Čihák R., Krausová R., Šímová J. (IKEM Praha): "Léčba syndromu komorové preexcitace katetrizační ablací akcesorních síňokomorových svazků."	(L32)
	Bytešník J., Čihák R., Krausová R. (IKEM Praha): "Predikce úspěšnosti katetrizačního ovlivnění AV junkce radiofrekvenčním (RF) proudem u pacientů se supraventrikulárními tachyarytmiemi (SVT)."	(L33)
	Fiala M., Lukl J., Heinc P. (I. interní klinika FN Olomouc): "Selektivní radiofrekvenční katetrové ablace pro atrioventrikulární nodální reentry tachykardii."	(L34)
	Bytešník J., Čihák R., Krausová R., Šímová J. (IKEM Praha): "Léčba monomorfní komorové tachykardie radiofrekvenční katetrizační ablací."	(L35)

Diskuse 30 min. na závěr.

Conventional ablations

Catheter ablation in SVT – standard procedure

	Acute success (%)	Recurrence (%)	Complications (%)	Mortality (%)
Focal AT	85	20	1.4[a]	0.1
Cavotricuspid-dependent atrial flutter	95	10	2[b]	0.3
AVNRT	97	2	0.3[c]	0.01
AVRT	92	8	1.5[d]	0.1

Success rates, recurrence, and complications for focal atrial tachycardia and atrioventricular re-entrant tachycardia vary, being dependent on the location of the focus or pathway, respectively.[11–13,203–208]

[a]Vascular complications, AV block, and pericardial effusion.

[b]Vascular complications, stroke, myocardial infarction, and pericardial effusion.

[c]Vascular complications, AV block, and pericardial effusion.

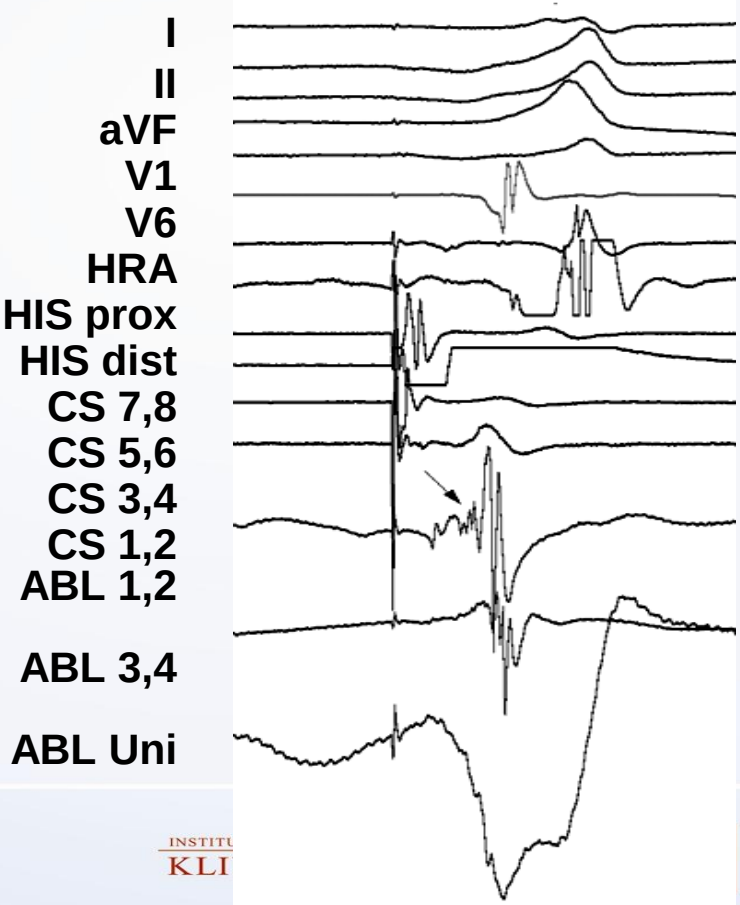
[d]Vascular complications, AV block, myocardial infarction, pulmonary thromboembolism, and pericardial effusion.

AT = atrial tachycardia; AV = atrioventricular; AVNRT = atrioventricular nodal re-entrant tachycardia; AVRT = atrioventricular re-entrant tachycardia.

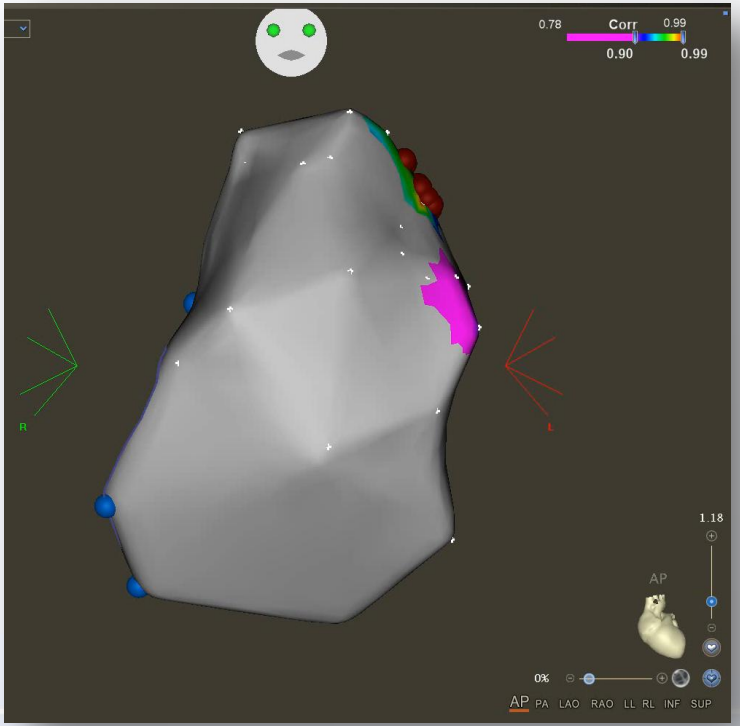
Brugada J, et al. Eur Heart J (2020) 41, 655–720

AP ablations today

- 2020 IKEM
- 25 patients
- age 42.2+/-16.4 years, median 37
- Fluoro time 4,5+/-2,3 min, median 4,6 min
- Fluoro dose103 +/-234 uGy.m2, median 24 uGy.m2
- No recurrences

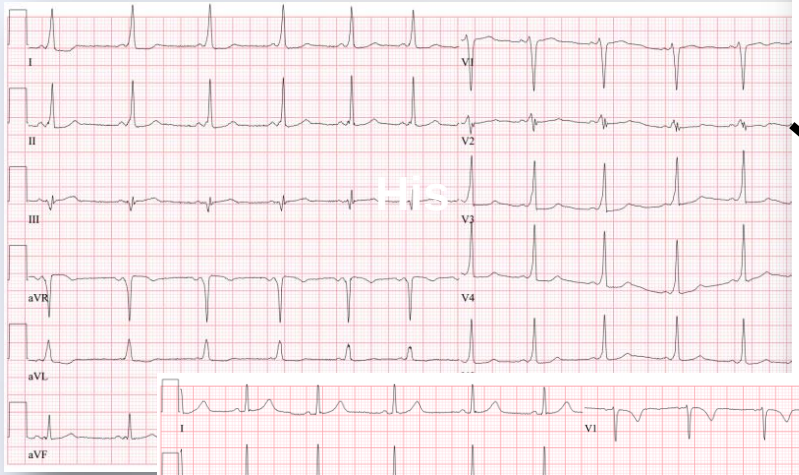


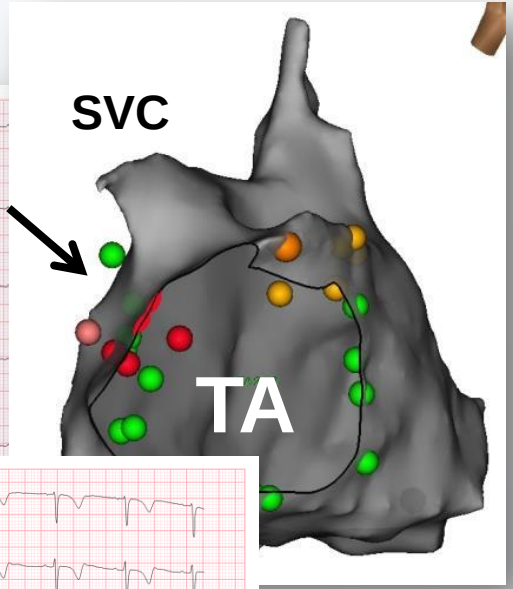
Activation mapping with tagging points in the anatomical shell obtained in SR

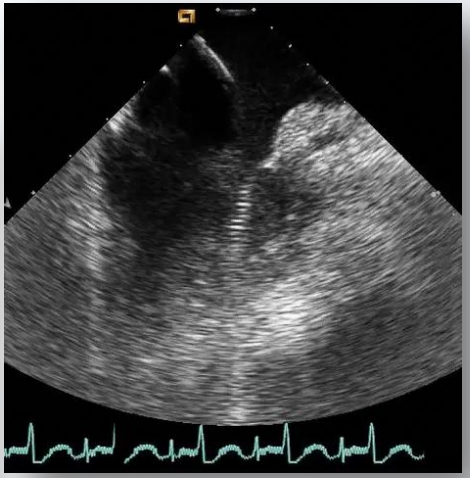


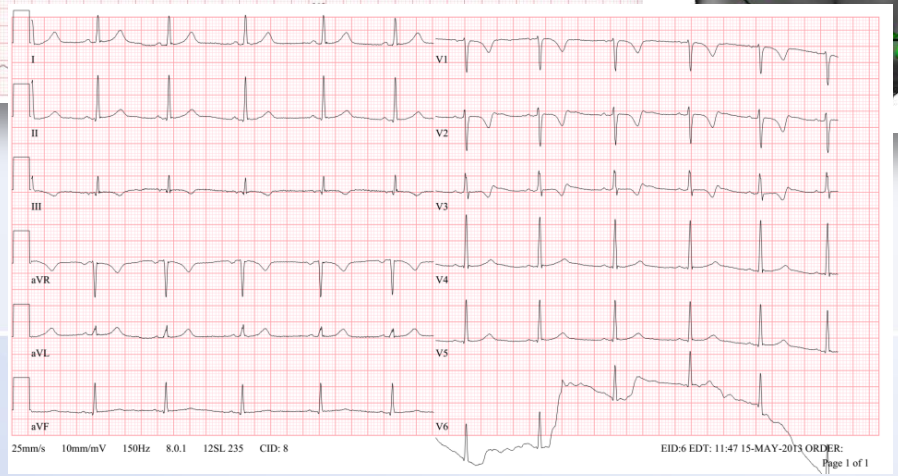
Zero fluoro ablation

27-y-old patient, gravidity 18 weeks, syncopal episodes and palpitations



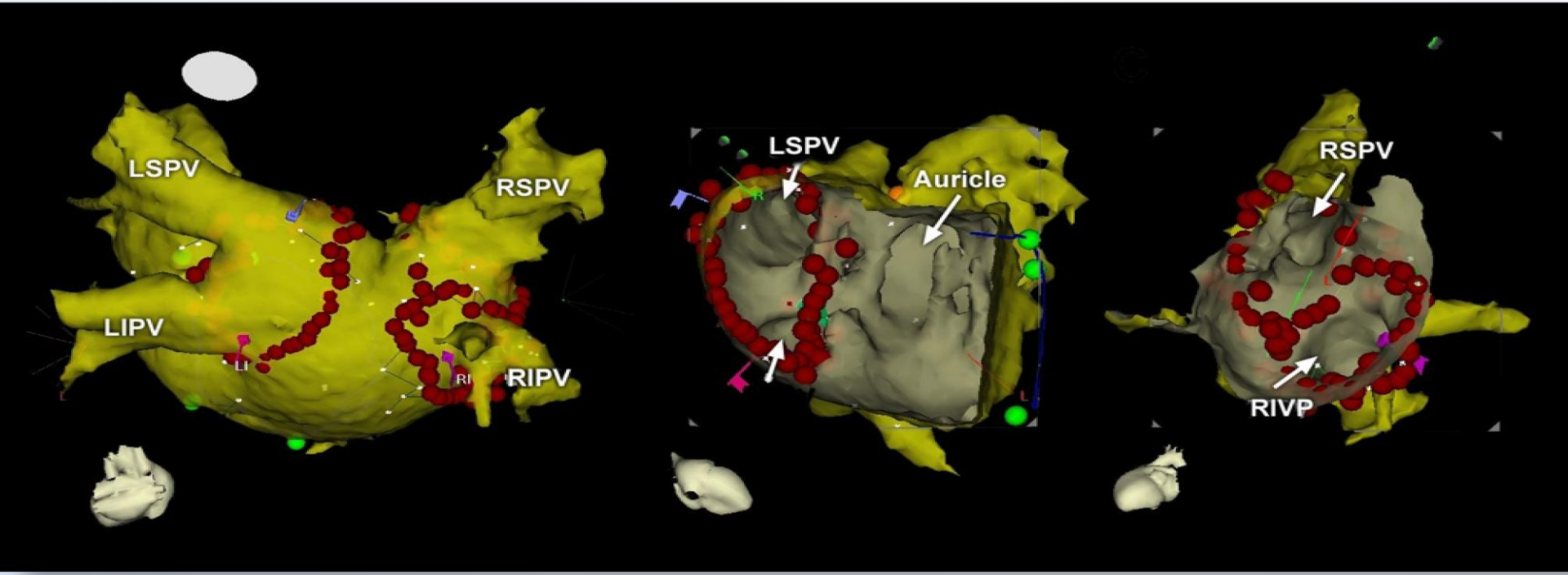






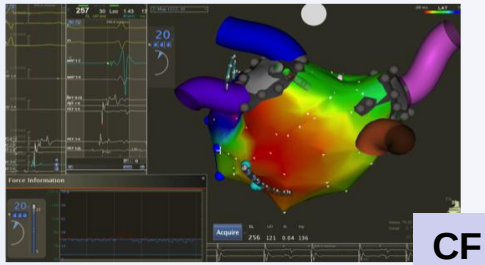
Atrial fibrillation

PV isolation = cornerstone of any AF ablation procedure



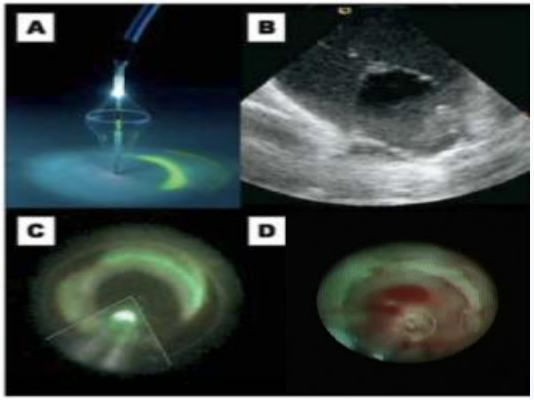
Many strategies and technologies have been used

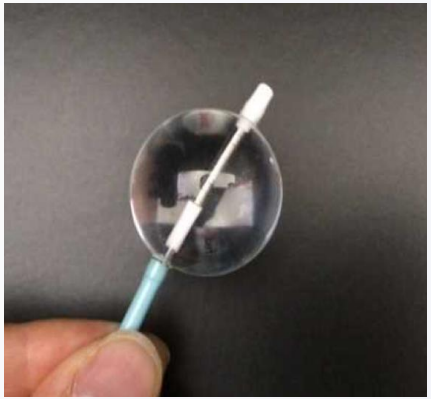
CF catheter,
Smart Touch, Biosense Webster



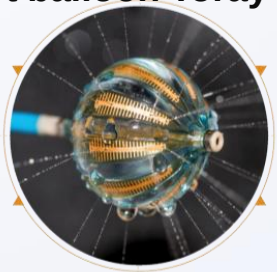
CF catheter,
TActicath,
Abbott

Laser baloon, Cardiofocus





Hot balloon Toray



Cryoballoon
Cryocath,
Medtronic

RF balloon,
Apama
Medical

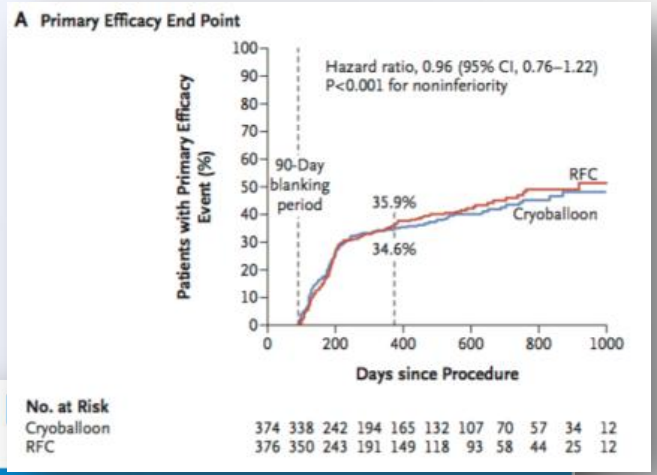
RF balloon, Helios
Biosense Webster

Cryo ablation was competing with RF

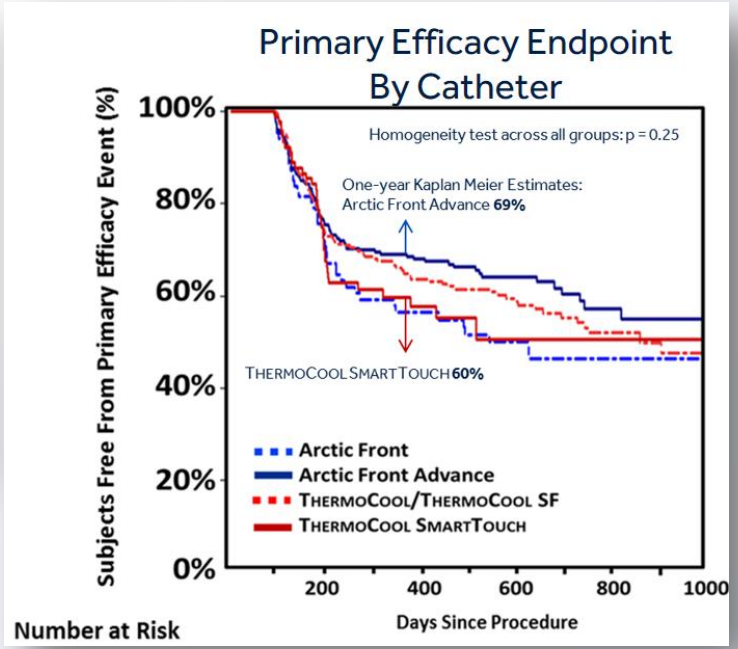
FIRE and ICE study

Primary endpoints (AF recurrence, AADs, re-ablation)

376 RF
374 CR

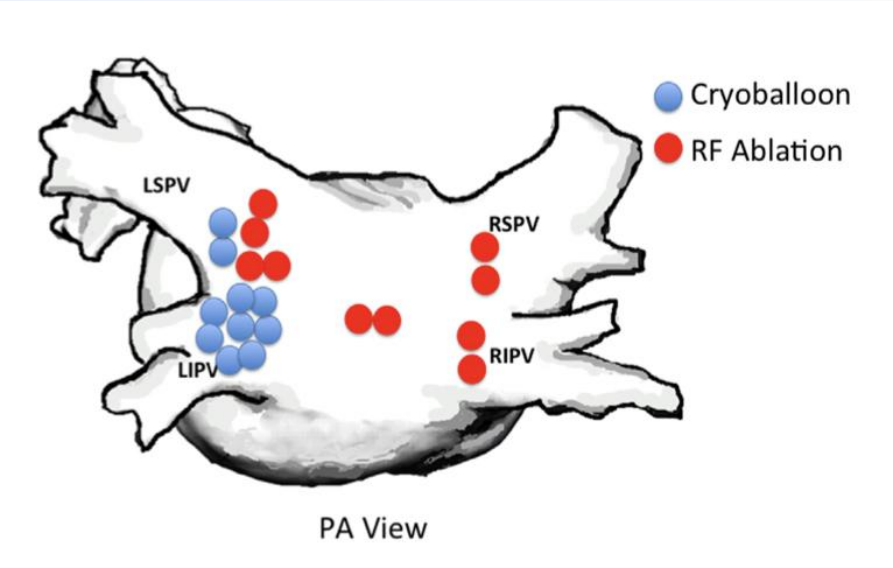


Time Measurement (minutes)	RFC (n=376)	Cryoballoon (n=374)	p-value**
Procedure Time***	140.9 ± 54.9	124.4 ± 39.0	<0.0001
LA Dwell Time***	108.6 ± 44.9	92.3 ± 31.4	<0.0001
Fluoroscopy Time	16.6 ± 17.8	21.7 ± 13.9	<0.0001



Kuck KH, et al. *N Engl J Med*. 2016; 374(23): 2235-45.

Risk of collateral damage remains for any thermal ablation



Atrioesophageal fistula locations

- AE fistula in cryoablation (1 /10 000 procedures)
- More often, phrenic nerve paresis can be observed, usually transitent
- Persistent paresis in cryoablation in 1,41% (sample of 7433 procedures from Netherlands 2016-17)

John RM, et al. Heart Rhythm 2017;14:184–189)
Mol D, et al. J Cardiovasc Electrophysiol 2022;33(3):559-564

Standards of follow up

Key issues

Recognition and management of complications

- Patients must be fully informed about the clinical signs and symptoms of rare but potentially dangerous ablation-related complications that may occur after hospital discharge (e.g. atrio-oesophageal fistula, pulmonary vein stenosis).

Follow-up monitoring:

Useful to assess procedural success and correlate symptom status with rhythm.[795,796] Recurrences beyond the first month post-ablation are generally predictive of late recurrences,[797,798] but recurrent symptoms may be due to ectopic beats or other non-sustained arrhythmia[640,799,800]; conversely the presence of asymptomatic AF after ablation is well described.[801–803]

Monitoring may be performed with intermittent ECG, Holter, Patch recordings, external or implanted loop recorder, or smart phone monitor (although the latter has not been validated for such use). Patients should be first reviewed at a minimum of 3 months and annually thereafter.[1]

Management of antiarrhythmic medication and treatment of AF recurrences

a. Continuing AAD treatment for 6 weeks to 3 months may reduce early AF recurrences, rehospitalizations and cardioversions during this period.[797,804] Clinical practice regarding routine AAD treatment after ablation varies and there is no convincing evidence that such treatment is routinely needed.

b. Subsequently, AADs may be weaned, ceased, or continued according to symptoms and rhythm status. Recent findings suggest that in AAD-treated patients remaining free of AF at the end of the blanking period, AAD continuation beyond the blanking period reduces arrhythmia recurrences.[805]

Management of anticoagulation therapy

a. In general, OAC therapy is continued for 2 months following ablation in all patients.[1,806] Beyond this time, a decision to continue OAC is determined primarily by the presence of CHA_2DS_2-VASc stroke risk factors rather than the rhythm status (*section 10.2.2.6*).

Tamponade is the most frequent life-threatening complication

Table 2 Causes and Proportions of Death in 32,569 Patients From 162 Centers

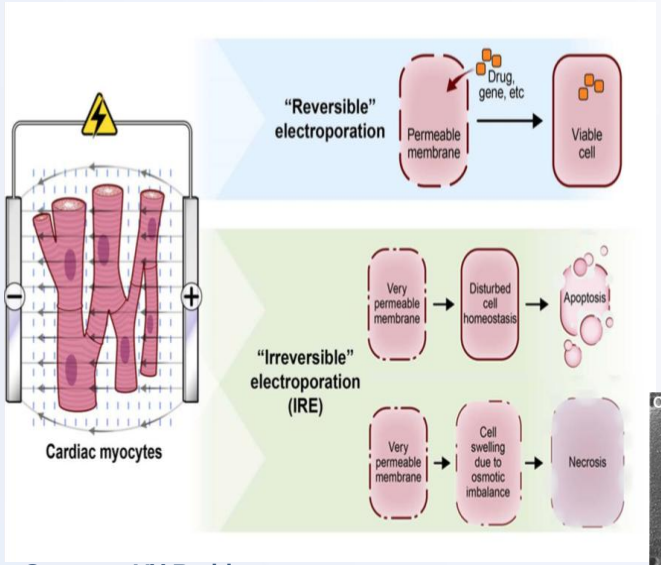
Cause of Death	Intraoperative (n)	Post-Operative (n)	Total (n)	Proportion (%)
Early death (within 30 days from procedure)				
Tamponade with subsequent cardiac arrest	5	2	7	21.8
Atrioesophageal fistula	0	5	5	15.6
Peripheral embolism				
Stroke	2	1	3	9.4
Myocardial infarction	1	0	1	3.1
Massive pneumonia	0	2	2	6.3
Extrapericardial pulmonary vein perforation	1	0	1	3.1
Irreversible torsades de pointes	1	0	1	3.1
Septicemia (3 weeks after procedure)	0	1	1	3.1
Sudden respiratory arrest	1	0	1	3.1
Acute pulmonary vein occlusion of both lateral veins	0	1	1	3.1
Hemothorax	0	1	1	3.1
Anaphylaxis	1	0	1	3.1
Late death (after 30 days from procedure)				
Complications from prior perioperative events				
Stroke			2	6.3
Tracheal compression from subclavian hematoma			1	3.1
Acute respiratory distress syndrome			1	3.1
Esophageal perforation from intraoperative TEE probe			1	3.1
Acutely precipitating events				
Tamponade with subsequent cardiac arrest in prior stroke			1	3.1
Intracranial bleeding under oral anticoagulation therapy in prior stroke			1	3.1

TEE = transesophageal echocardiographic.

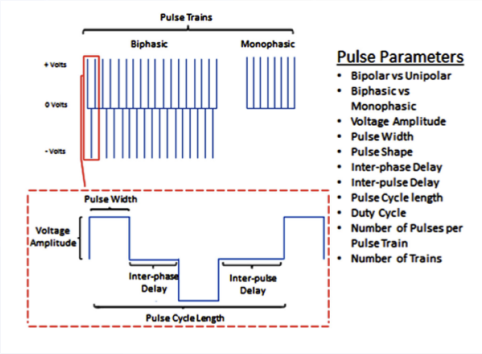
Cappato R, et al. JACC 2009;53:1798-1803

Pulsed electric field ablation (PEFA or PFA)

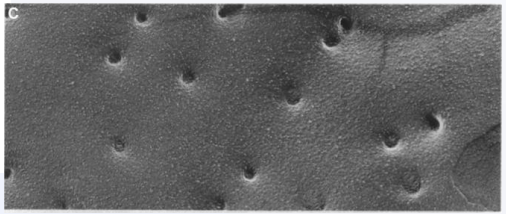
- Electroporation … ultrashort pulses of DC leading to destabilization of cell membranes („micropores“)



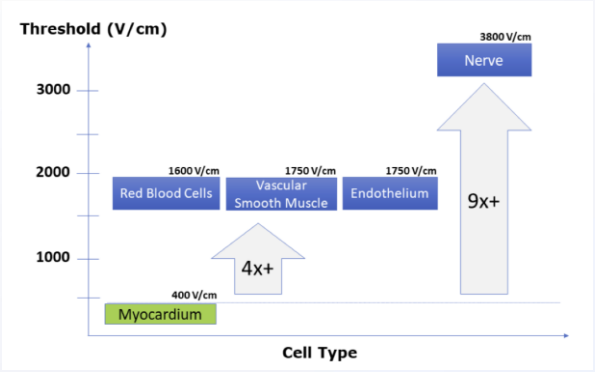
Courtesy VY Reddy



Bradley CJ, Haines DE. JCE 2020

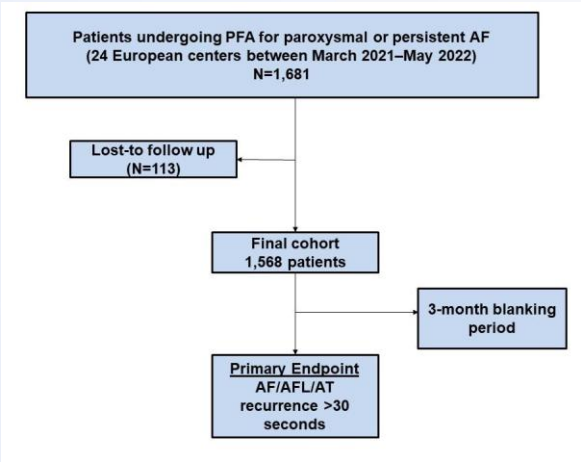


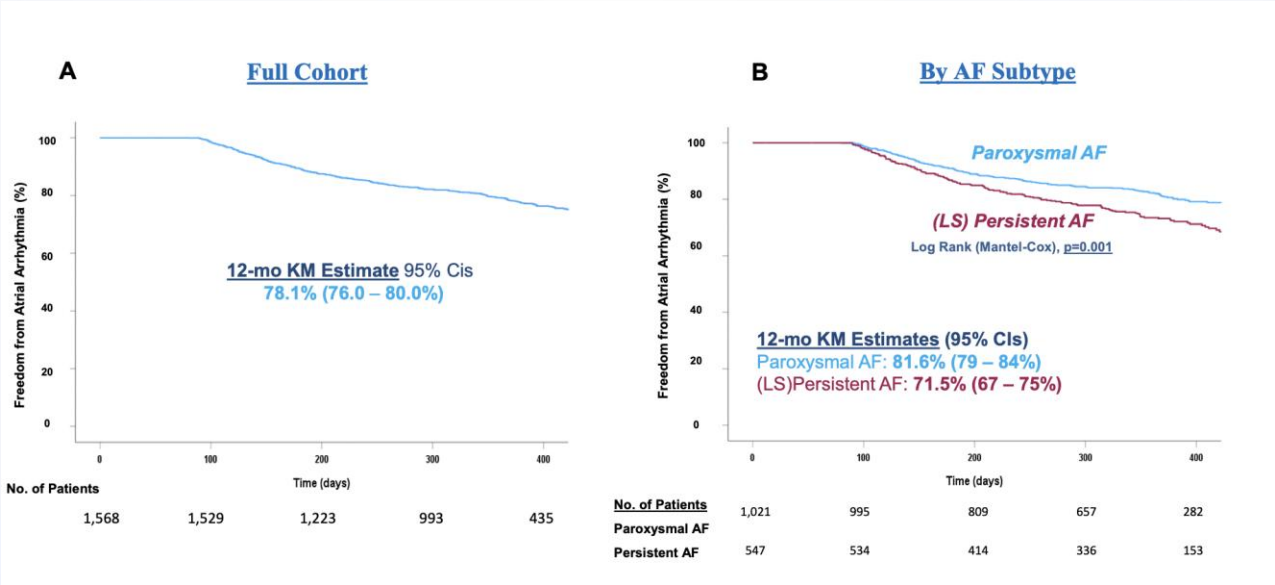
Chang DC Reese TS. Biophys J 1990;58:1-12,



Reddy VY, et al.
J Am Coll Cardiol 2019;74:315–26.

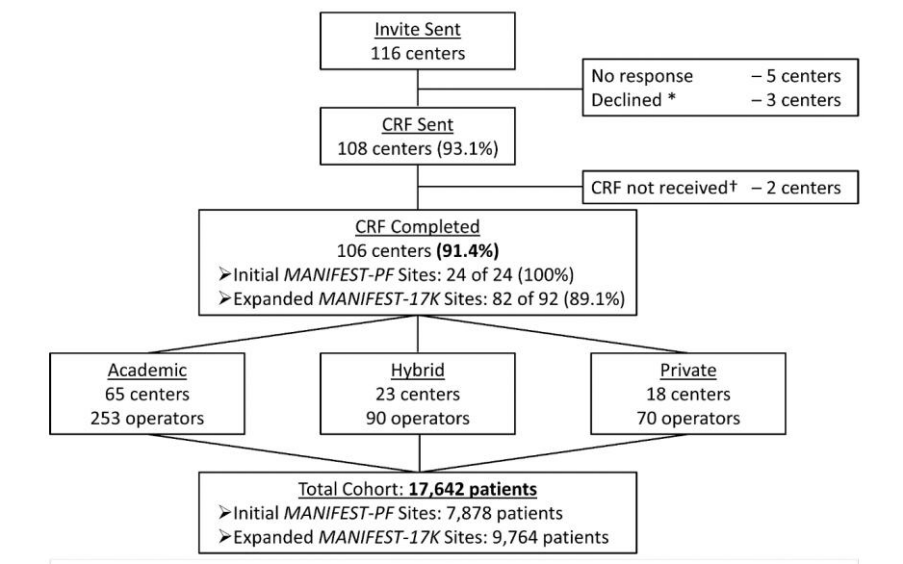
One-year outcomes from the MANIFEST PF registry

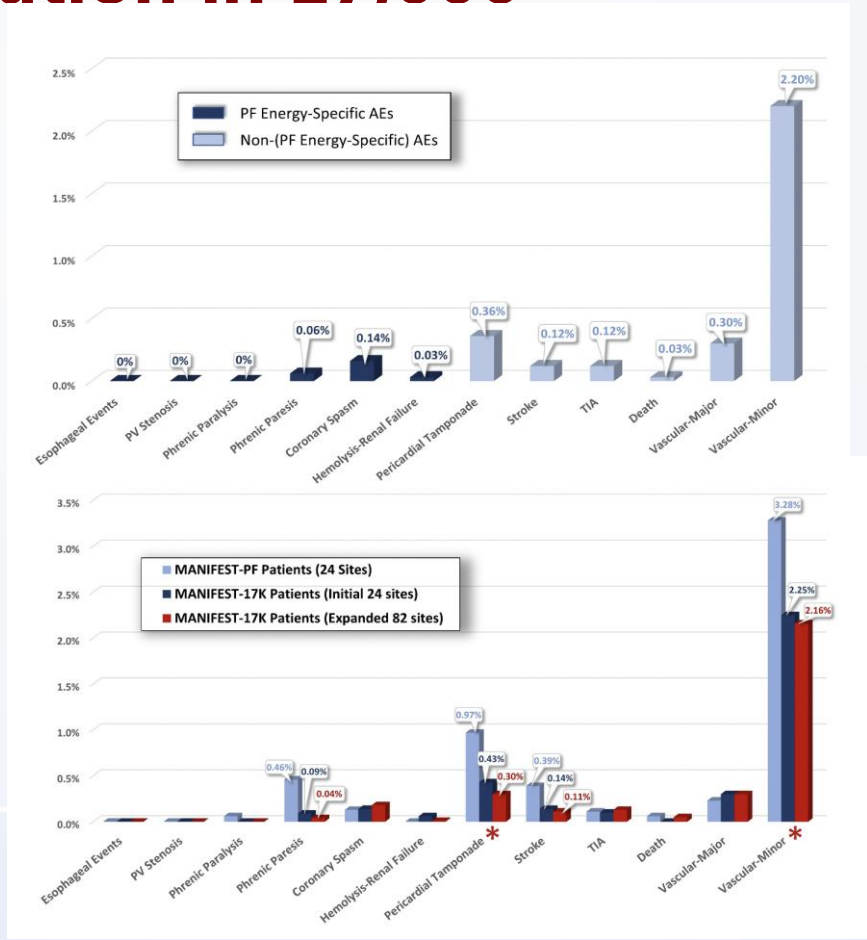




Turagam MK, et al. Circulation 2023;148(1):35-46

Safety of Pulsed Field Ablation in 17.000+ patients (MANIFEST 17K)





Reddy YV, et al. AHA 2023

An example of ablation in long-term persistent AF

Symptomatic, long standing AF (3 years), HFpEF LVEF 50-55%, LAVI 60cm3/m2,

Procedure duration 100 min, fluoro 8.9 min, dose 123 uGy.m2

1) Baseline (Farawave and CS recording)

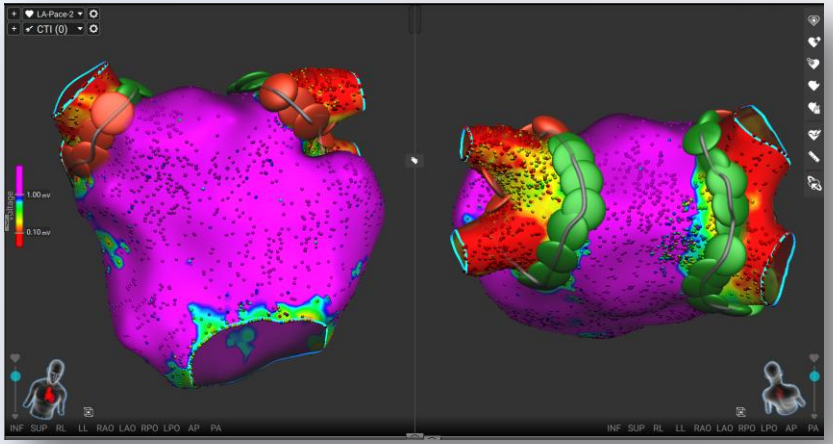
2) Perimitral flutter after PVI and PW isolation, entrainment from the septum

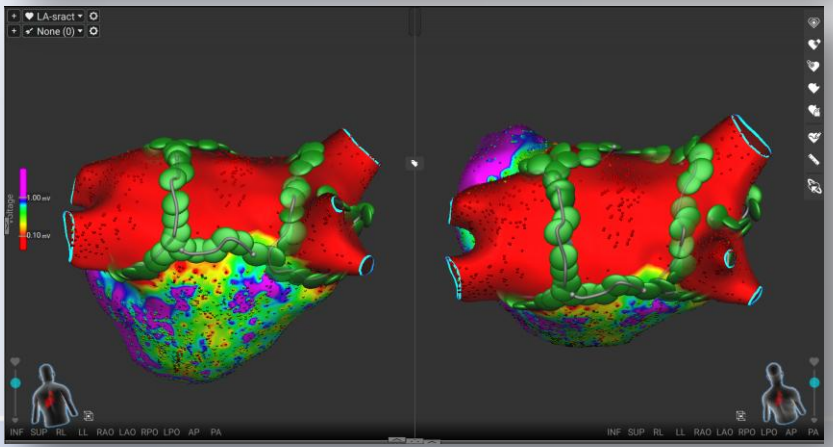
248 msec
242 BPM

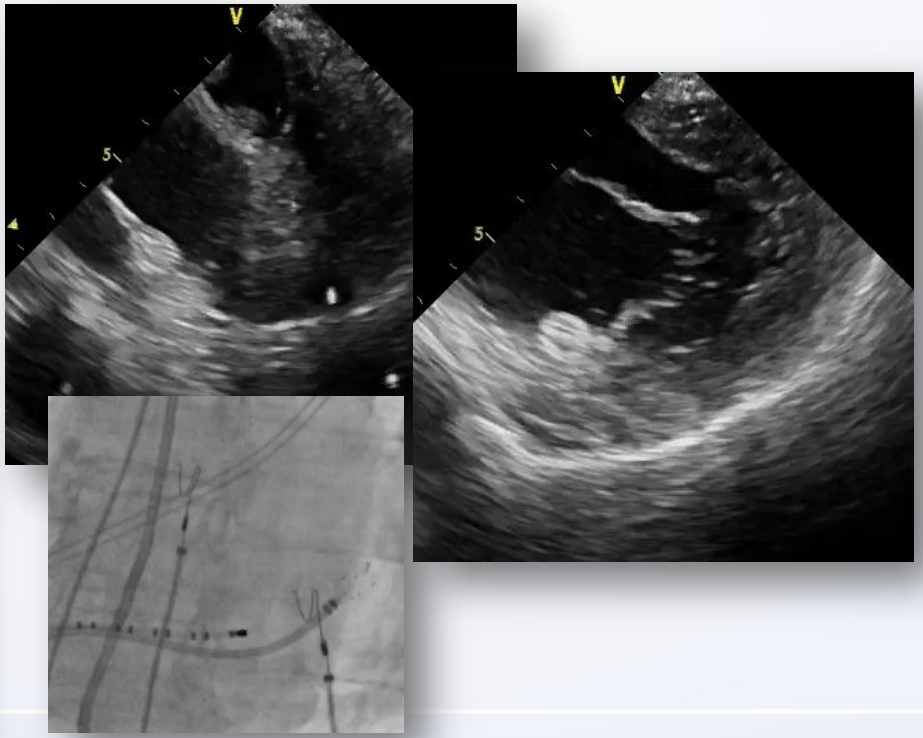
3) Switch to typical flutter)

4) Termination on CTI

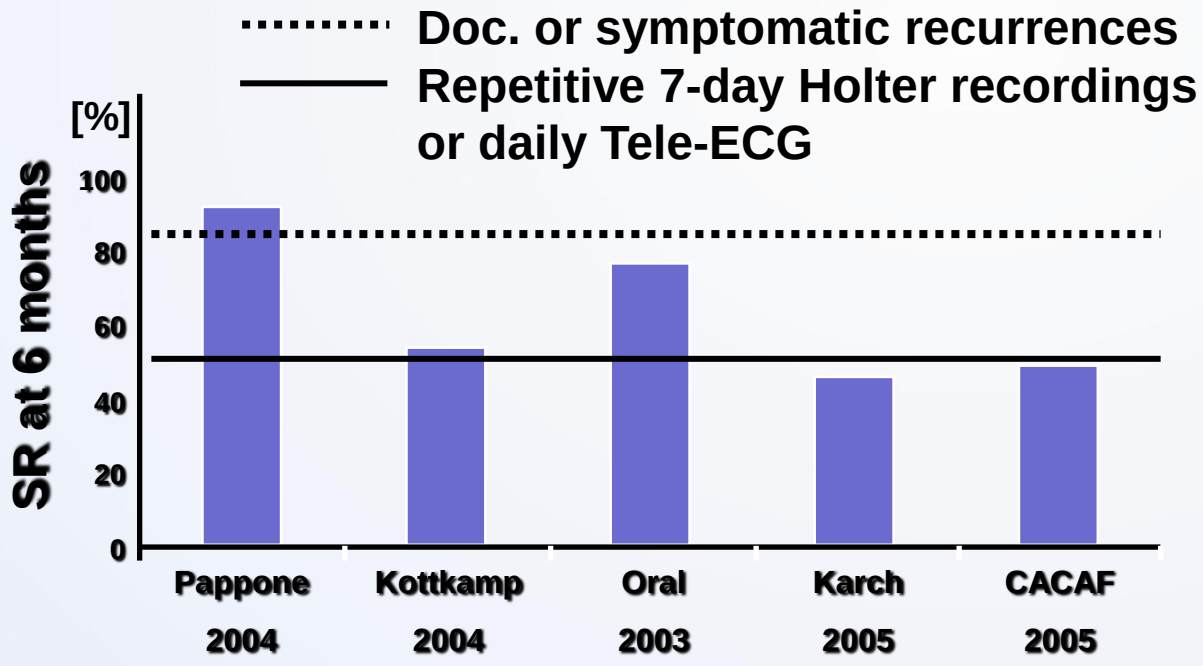
Sophisticated mapping and ablation system (AFFERA)



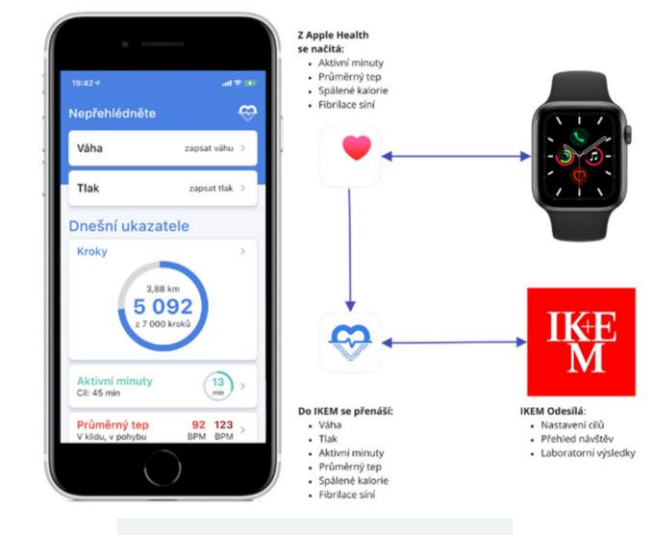




Reported results after catheter ablation of AF depend on the methods used for follow-up



New wearable technologies



WATCH

Automaticky zaznamenané

- Kroky
- Aktivní minuty
- Spálené kalorie
- Průměrný tep
- Fibrilace síní
- EKG*

iPhone

Manuálně zadané

- Váha
- Obvod pasu
- Tlak
- Jak se dnes cítíte?
- Pocit arytmie

ECGs stored in NIH (Zlatokop IKEM)

Účet IkemOnline

ID: 24186521
přihlašování přes jednorázové heslo

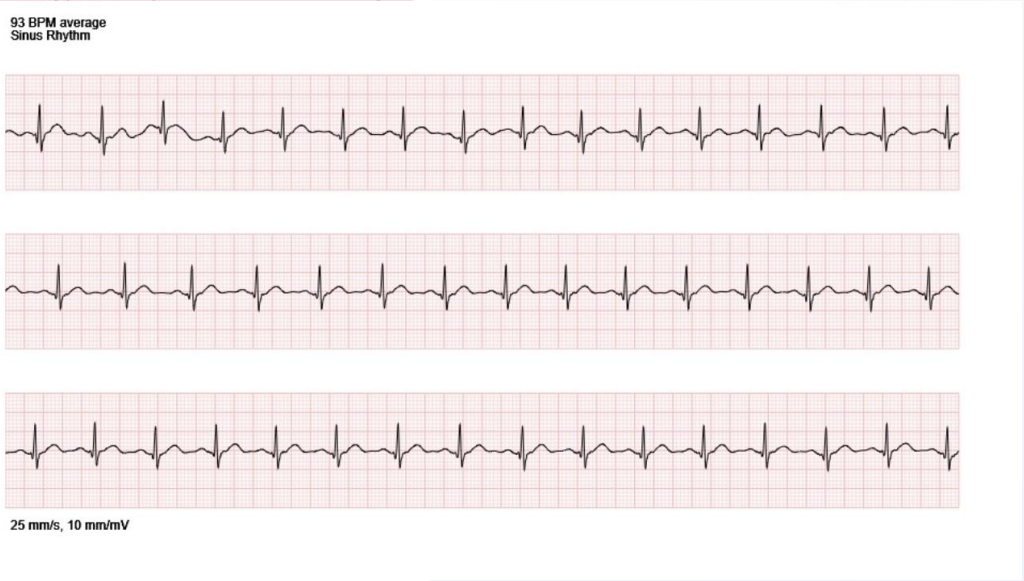
deaktivovat

Údaje ze senzorů (poslední přenos 7.4.2022 20:09)

kroky	⌀ 6514	▲4.78 %
čas v pohybu	⌀ 20	▲11.54 %
spáleno	⌀ 2816	▼-2.69 %
hmotnost	⌀ 96 kg	
krevní tlak	116 / 81	
tep. frekvence	102 akt. / 65 v klidu	▼-1.7 / ▼-0.6

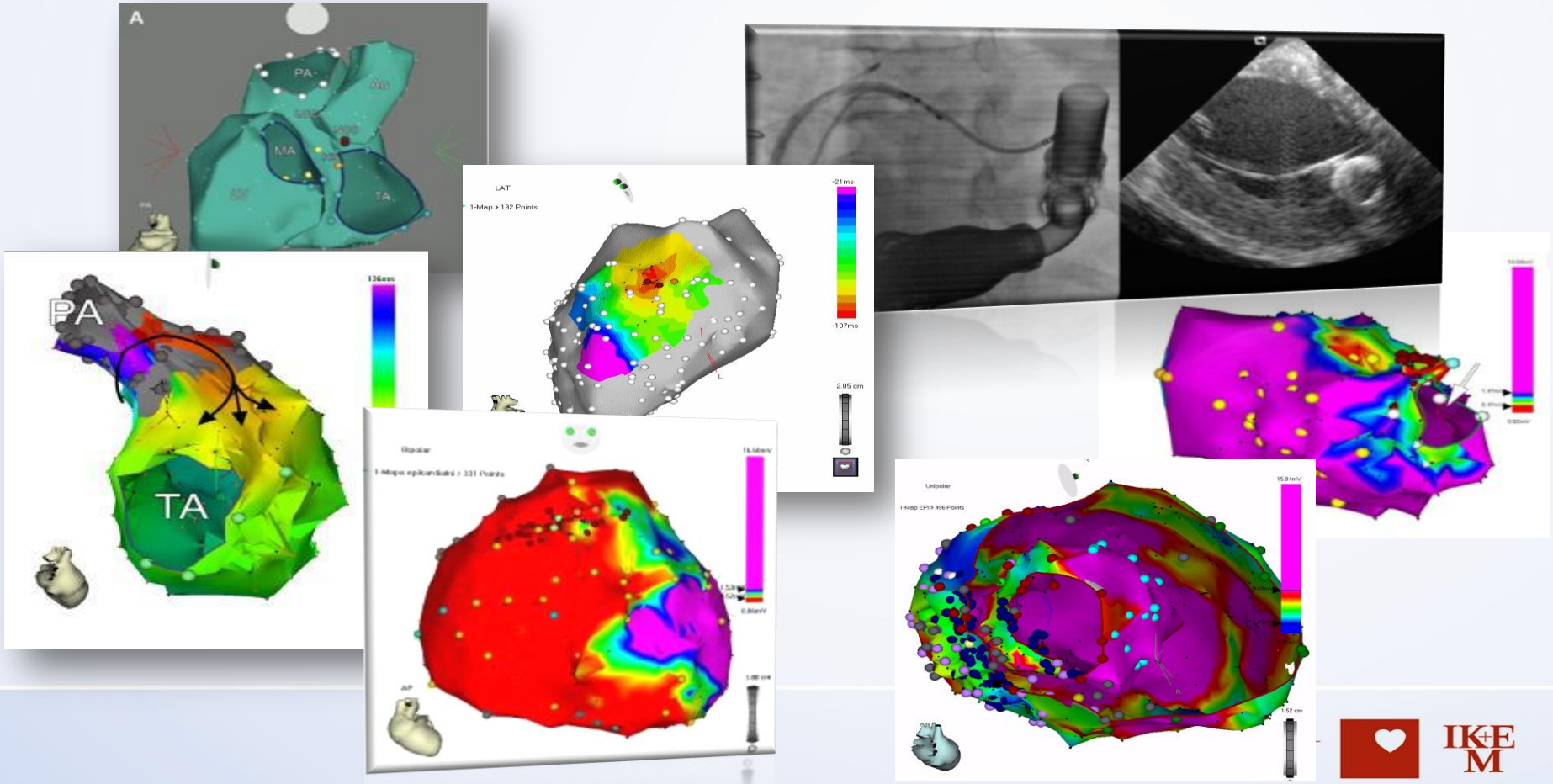
EKG záznamy (17)

- 13.1.2022 11:52
- 21.1.2022 06:21
- 27.1.2022 08:00
- 29.1.2022 04:06
- 29.1.2022 04:06
- 29.1.2022 04:44
- 29.1.2022 04:45
- 5.2.2022 12:28
- 5.2.2022 03:04

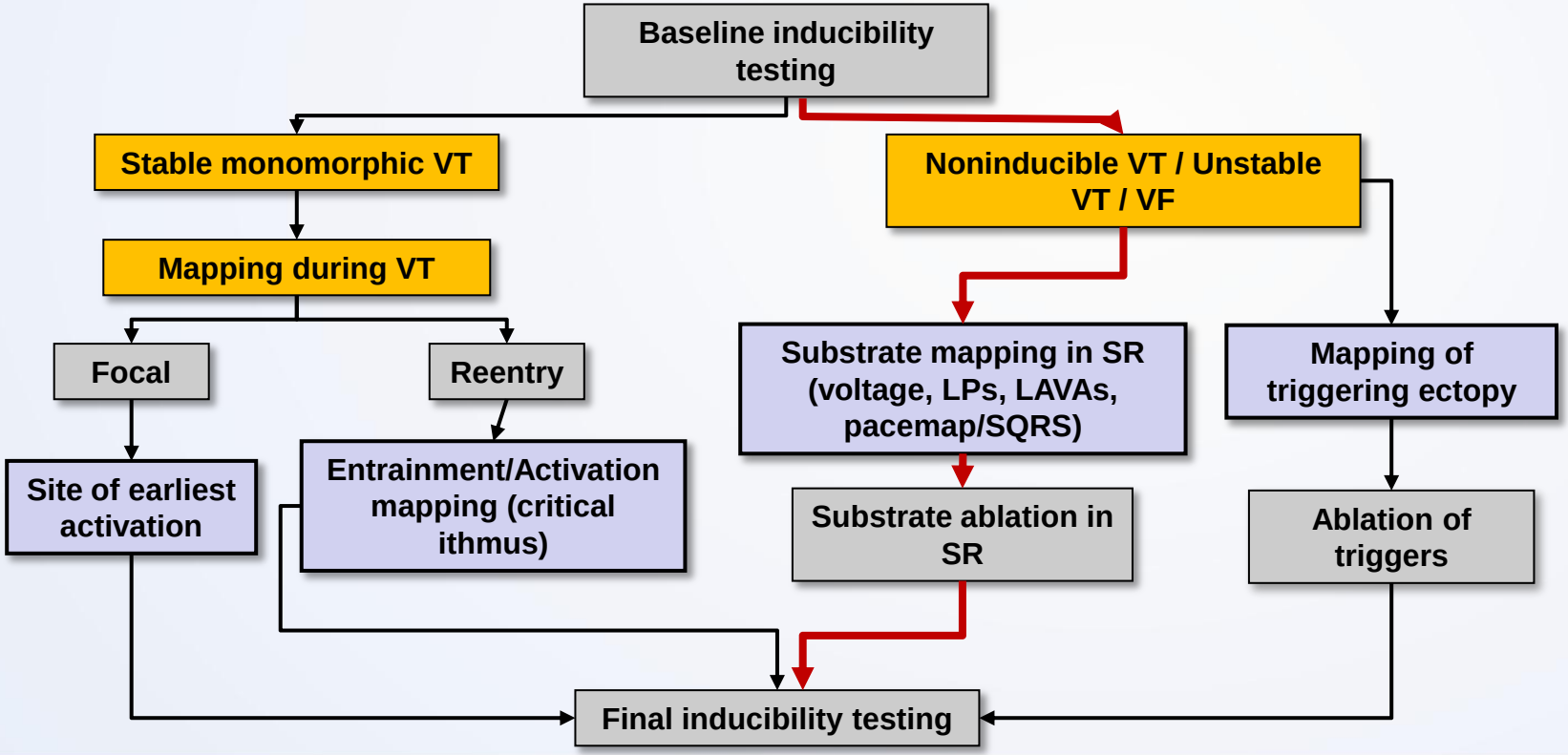


VT ablation in structural heart disease

VT ablation – a broad spectrum of substrates and strategies

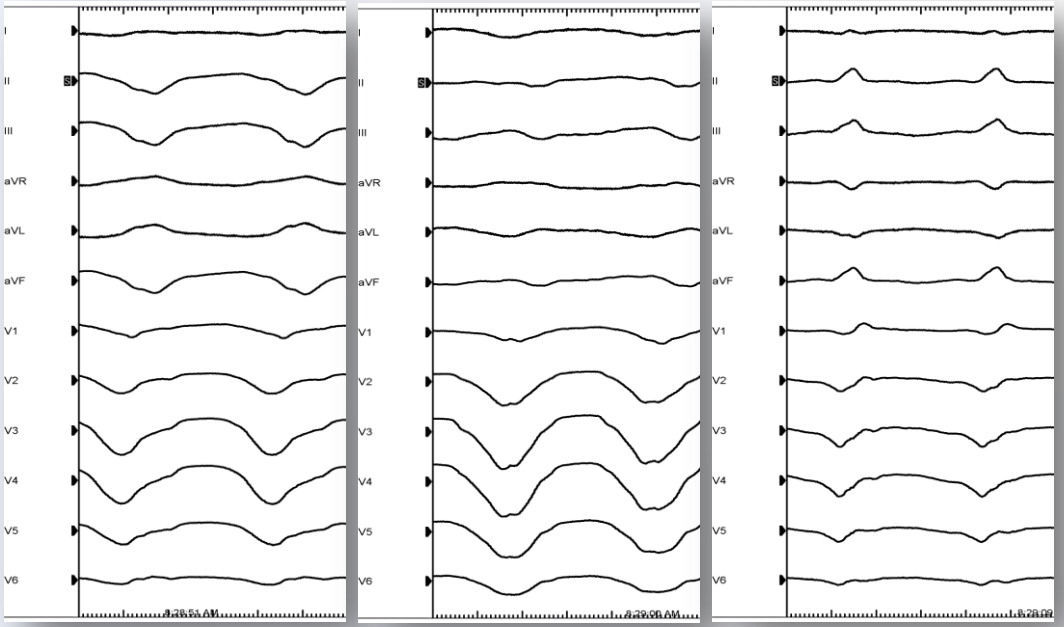


IKEM strategy of substrate-based approach in SHD-VT



Adapted from Kautzner et al. PACE 2003

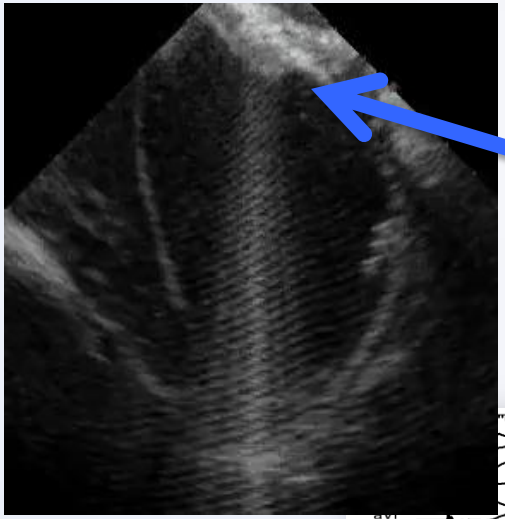
An example of an integrated approach

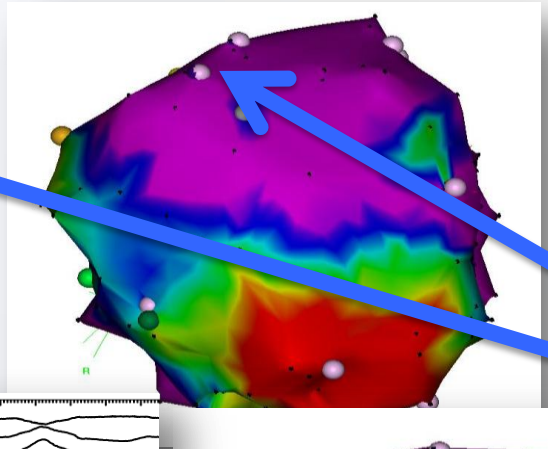


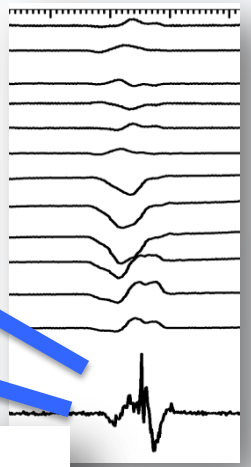
VT 1 VT 2 VT 3

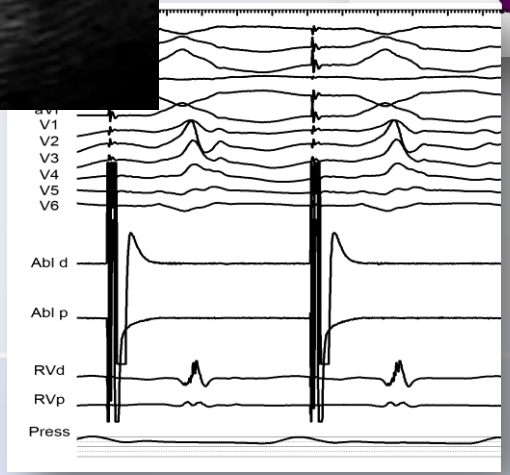
- 66-year-old male
- CAD, anterior MI in 1996
- PCI of LAD and RCA
- ECHO: severe LV dysfunction (LVEF 25%), aneurysm of anterior wall
- Recurrent ICD shocks for VTs with multiple CLs

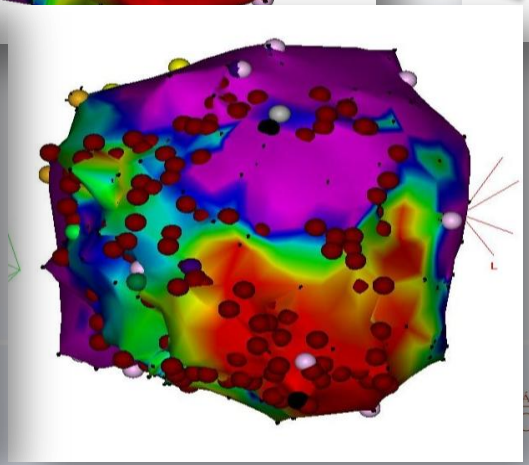
Actual scar could be substantially larger than area identified by bipolar voltage





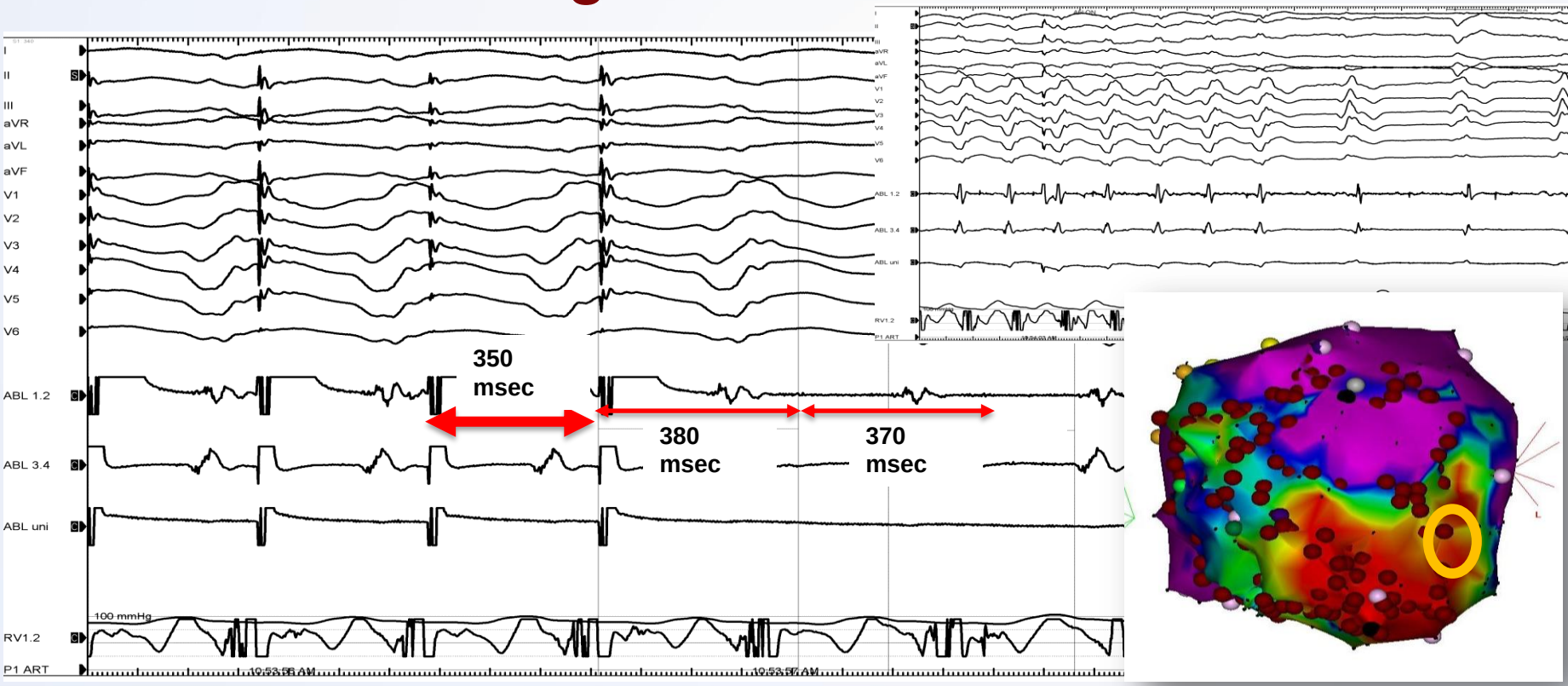






Lesion set eliminated LPs, LAVAs, channels of slow conduction

Entrainment during residual tolerated VT and RFA



Is PAINESD useful when strategy of ablation is predominantly substrate based w/o general anesthesia?

Population

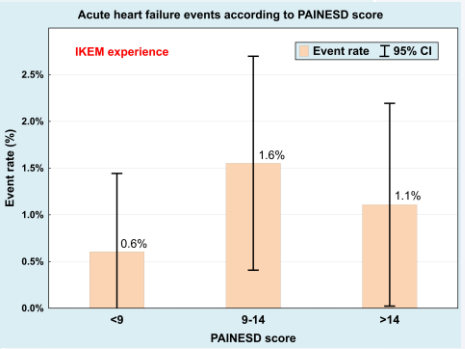
Patients who had their **first** ablation for **SHD-related** VA between **August 2006 and December 2020** and followed up to September 2022

Baseline Characteristics (N = 1124)

Age	63 ± 13 yrs
Males	87 %
Ischemic CMP	68 %
Electrical storm	25 %
Focally triggered VF	30 (2.6%)
NYHA	2.0 ± 1.0
LVEF	34 ± 12 %
Diabetes mellitus	32 %
COPD	12 %
PAINESD score	**11.4 ± 6.6**

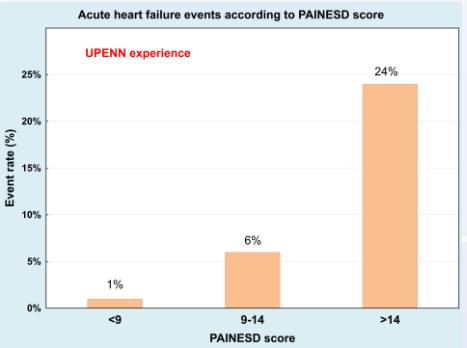
Periprocedural Characteristics (N = 1124)

General anesthesia	170 (15%)
Procedure time	187 ± 78 min
RF Time	23 ± 15 min
Major complications	7.5 %
Acute HF event	1.1 %

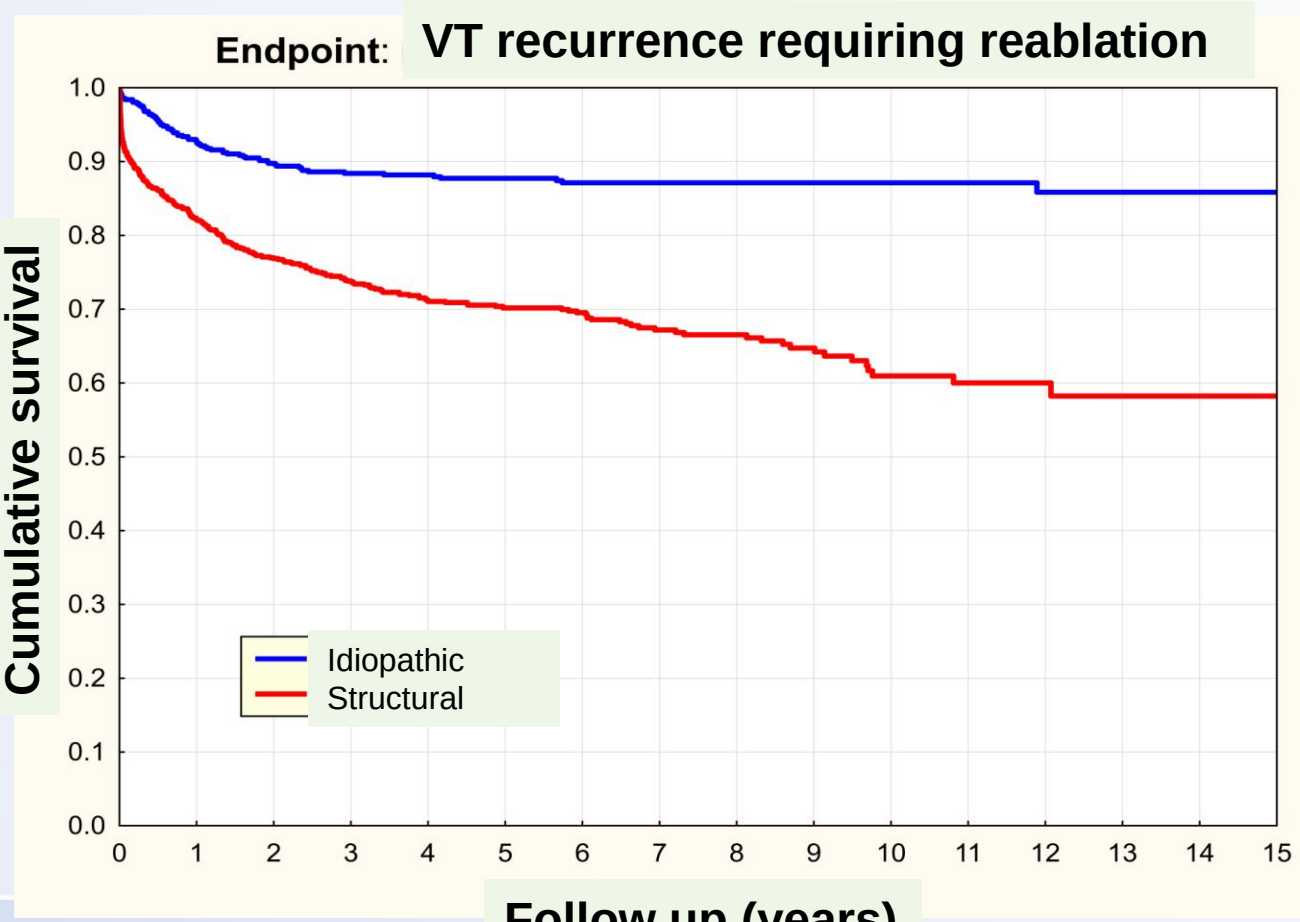


Clinical Outcome (N = 1124)

Follow up	4.1 (IQR: 2.0 – 7.2) yrs
Reablation	28 %
New LVAD	2.7 %
Heart transplant	5.2 %
All-cause death	48 %



Stojadinovic P, et al. Europace (under review)



Reablations: our experience

IKEM 8/2006-12/2020

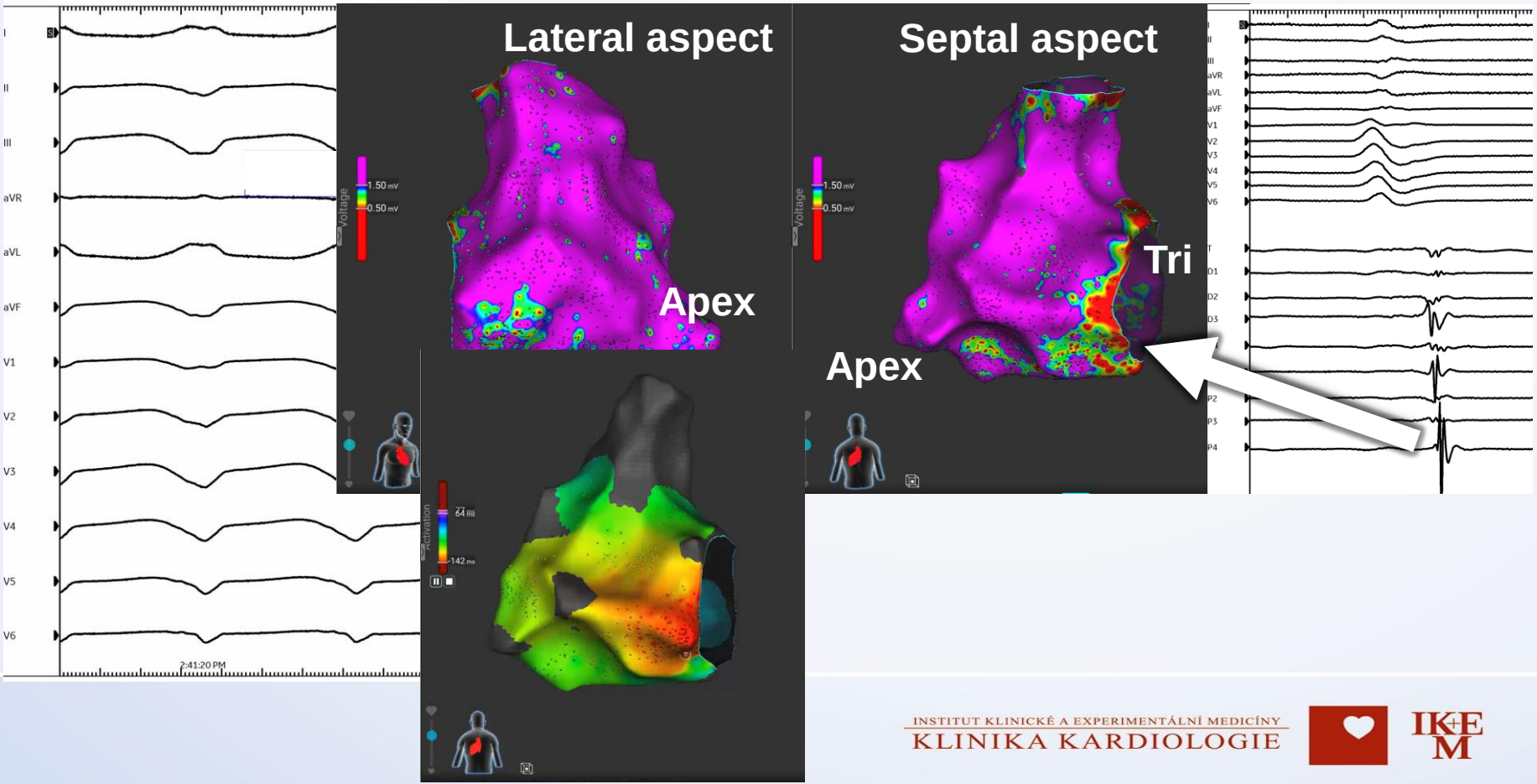
1124 VT ablations in structural HD

559 ablations for idiopathic VA

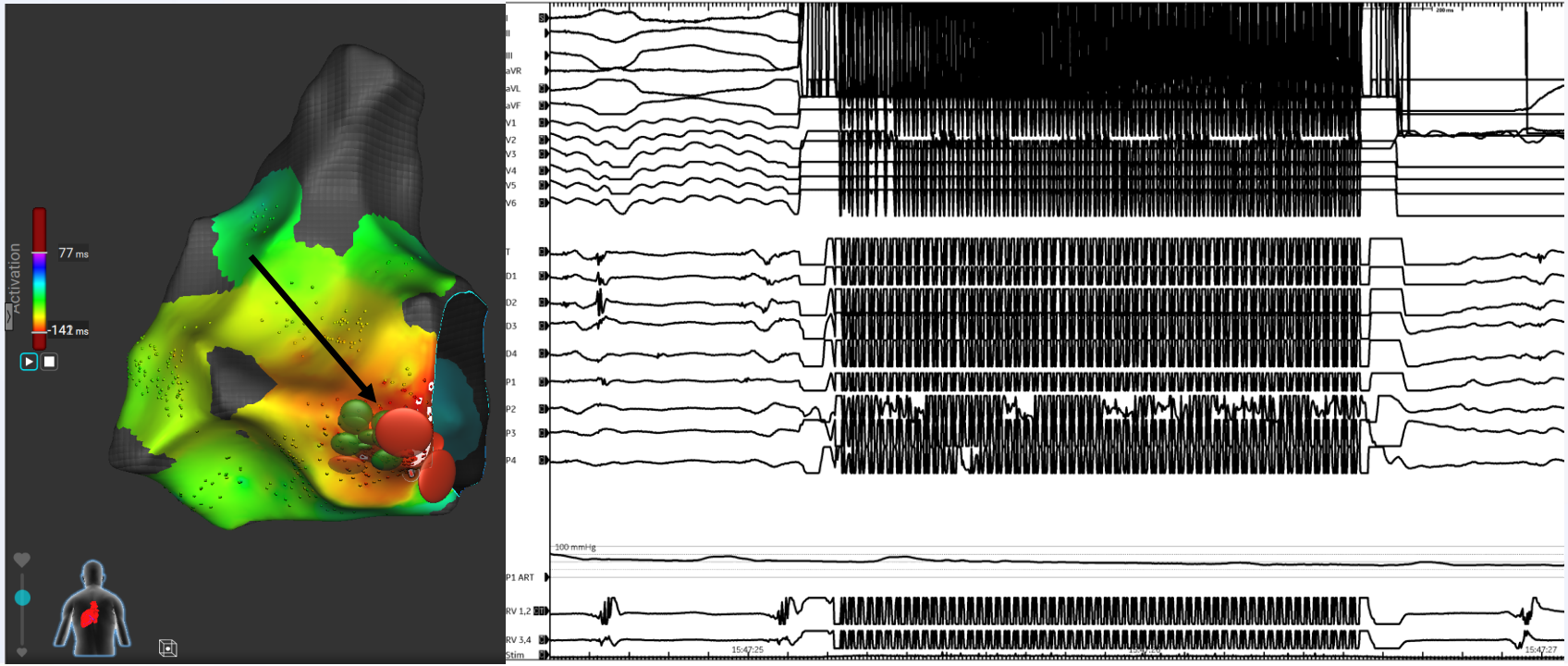
Novel technologies may improve ablation success

- 58-year-old male
- Non-ischemic cardiomyopathy
- 2D ICD (secondary prevention)
- ECHO: LVEF 35%, hypokinesis of apex
- MRI: LGE in basal lateral epi regions of LV and RV
- Two ablations, including endo-epicardial access
- Recurrent VTs (on amiodarone)

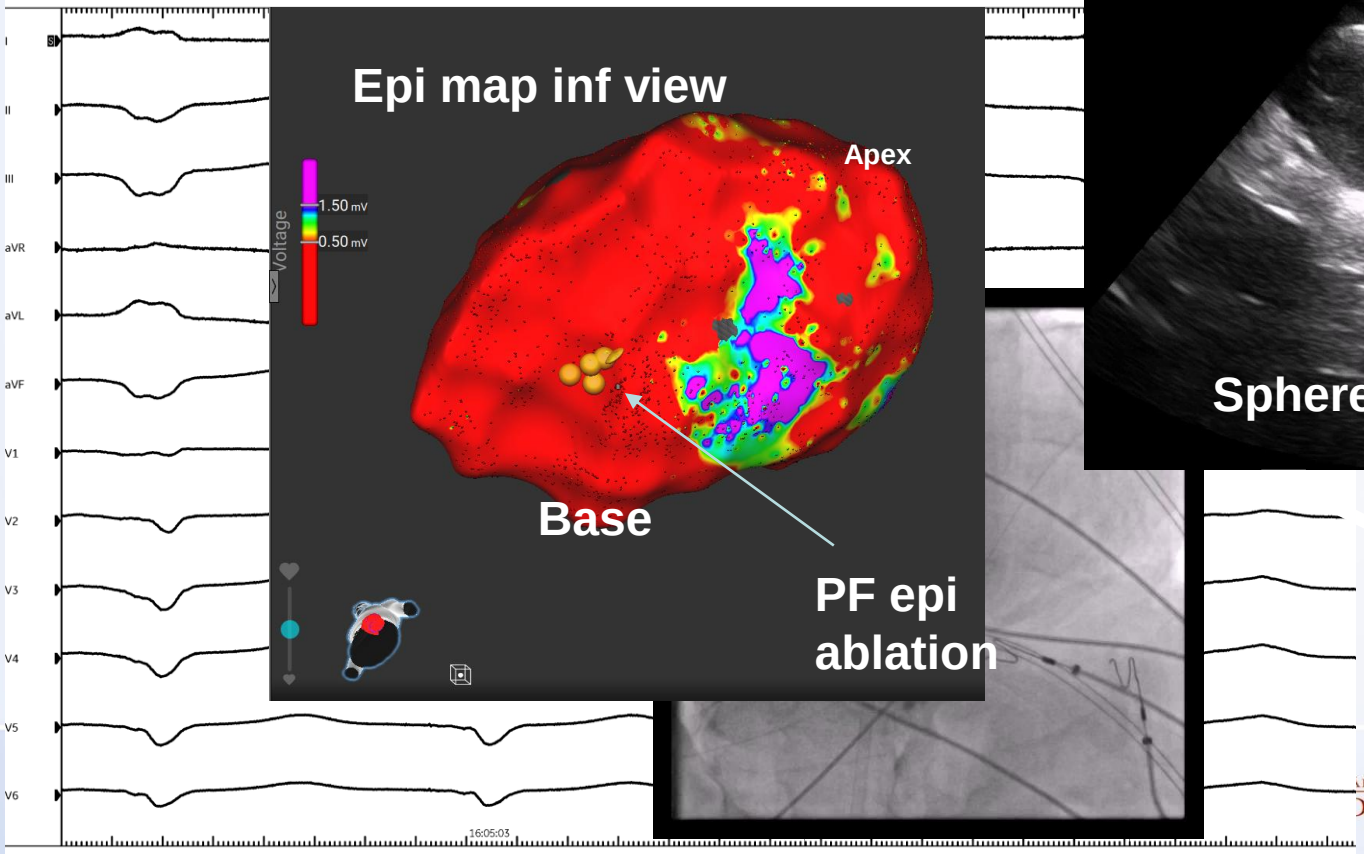
Inducible VT 157bpm (RV origin likely)

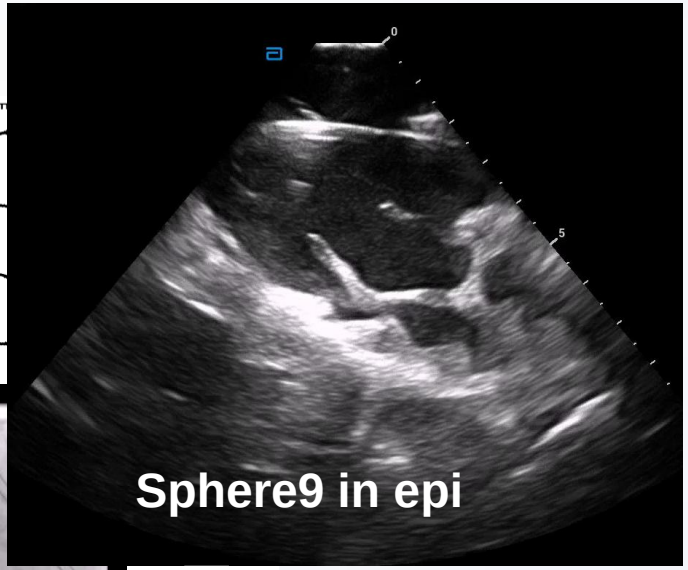


Endo ablation at the earliest site

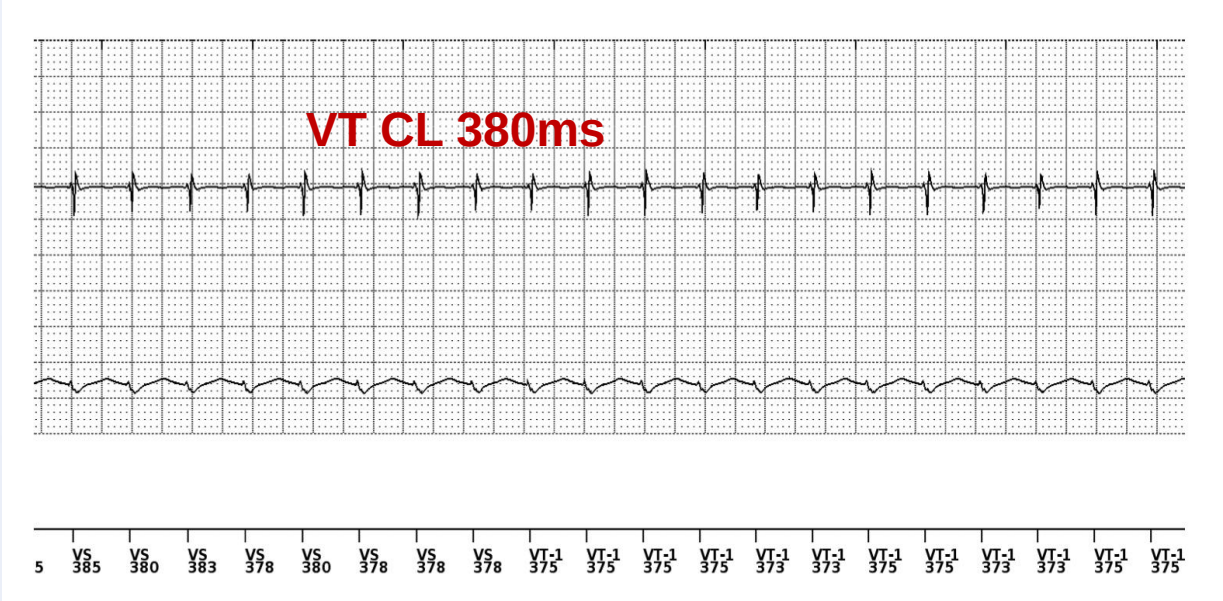


For very slow residual VT 93bpm – epi delivery was necessary





Monitoring of VT in CD is straightforward

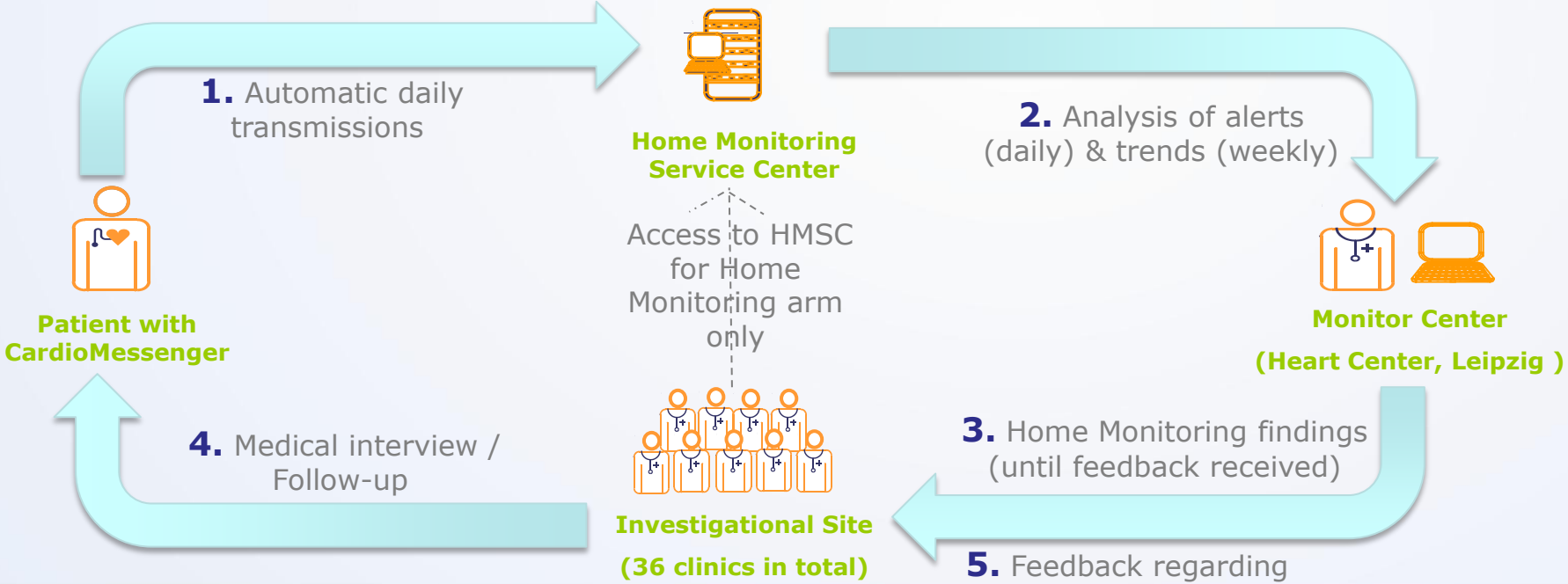


VT in monitoring VT1 zone-no therapy

14 Feb 2024 09:41	VT-1 at 160 min^{-1}, No Therapy
14 Feb 2024 08:06	VT-1 at 161 min^{-1}, No Therapy
13 Feb 2024 19:03	VT-1 at 162 min^{-1}, No Therapy
12 Feb 2024 15:35	NonSustV at 161 min^{-1}, Nonsustained
10 Feb 2024 23:43	VT-1 at 212 min^{-1}, No Therapy
10 Feb 2024 20:30	VT-1 at 162 min^{-1}, No Therapy
10 Feb 2024 19:17	VT-1 at 163 min^{-1}, No Therapy
10 Feb 2024 19:15	NonSustV at 163 min^{-1}, Nonsustained
10 Feb 2024 19:15	VT-1 at 162 min^{-1}, No Therapy
10 Feb 2024 16:48	VT-1 at 212 min^{-1}, ATPx1
10 Feb 2024 16:38	NonSustV at 163 min^{-1}, Nonsustained
10 Feb 2024 16:32	VT-1 at 163 min^{-1}, No Therapy
10 Feb 2024 16:31	VT-1 at 162 min^{-1}, No Therapy
10 Feb 2024 16:30	VT-1 at 162 min^{-1}, No Therapy
10 Feb 2024 16:27	VT-1 at 164 min^{-1}, No Therapy
10 Feb 2024 16:26	VT-1 at 163 min^{-1}, No Therapy
10 Feb 2024 16:22	VT-1 at 163 min^{-1}, No Therapy
10 Feb 2024 16:20	VT-1 at 161 min^{-1}, No Therapy
10 Feb 2024 16:18	NonSustV at 160 min^{-1}, Nonsustained
10 Feb 2024 16:16	VT-1 at 163 min^{-1}, No Therapy
10 Feb 2024 16:14	VT-1 at 163 min^{-1}, No Therapy
10 Feb 2024 16:05	VT-1 at 163 min^{-1}, No Therapy
10 Feb 2024 16:04	VT-1 at 163 min^{-1}, No Therapy
10 Feb 2024 16:02	VT-1 at 166 min^{-1}, No Therapy
10 Feb 2024 16:01	VT-1 at 173 min^{-1}, No Therapy
10 Feb 2024 15:58	NonSustV at 161 min^{-1}, Nonsustained
10 Feb 2024 14:19	NonSustV at 162 min^{-1}, Nonsustained

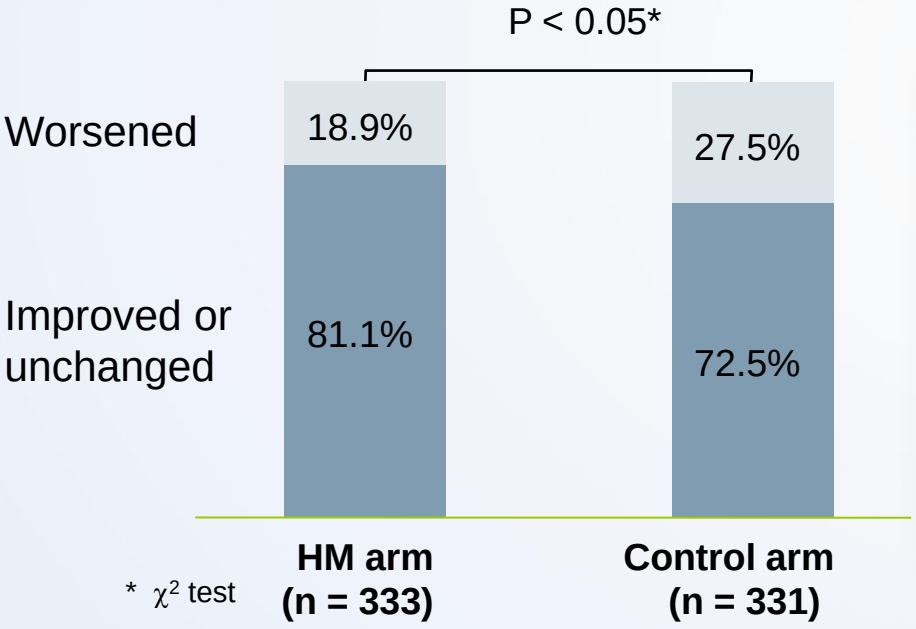
Biotronik HomeMonitoring uses everyday automated transmission and analysis of data with possibility of immediate reaction

In Time Study Design: Home Monitoring Workflow

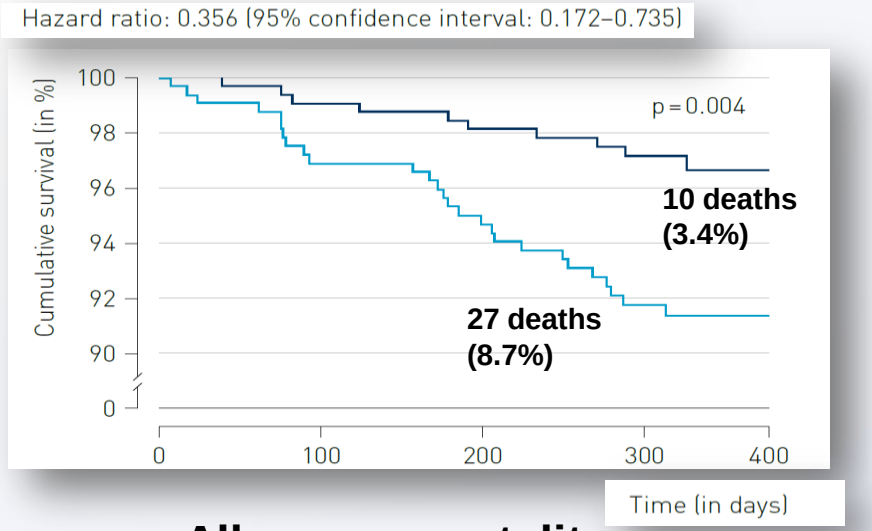


Hindricks G, et al. Lancet. 2014;384(9943):583-90

In Time Study: Less worsening of CHF and improvement of prognosis (mainly due to detection of arrhythmias)



Heart failure



All cause mortality

Hindricks G, et al.Lancet. 2014;384(9943):583-90.

Conclusions

- Conventional ablations have clear endpoints and low risk of complications
- Ablation of AF is highly efficacious, but complex procedure which has certain risks of complications and requires structured FU
- FU requires monitoring of AF recurrences using various tools
- VT ablation in structural heart disease should be tailored to individual cases and novel technologies may improve the outcomes
- Follow up in VT patiens is straightforward, since the patients have implantable devices (and these may be monitored at distance)