VŠEOBECNÁ FAKULTNÍ NEMOCNICE V PRAZE

1. LÉKAŘSKÁ FAKULTA Univerzita Karlova

ABLACE MIMO PLICNÍ ŽÍLY S VYUŽITÍM PFA

Štěpán Havránek

II. interní klinika – klinika kardiologie a angiologie
1. LF UK a VFN v Praze

KOMPLEXNÍ KARDIO VASKULÁRNÍ CENTRUM VFN Praha

Proč ablovat mimo plicní žíly?

Izolace plicních žil je základní krok při ablaci AF

Rekurence AF, zejména u perzistentních AF

Existence extra PV zdrojů a substrátu

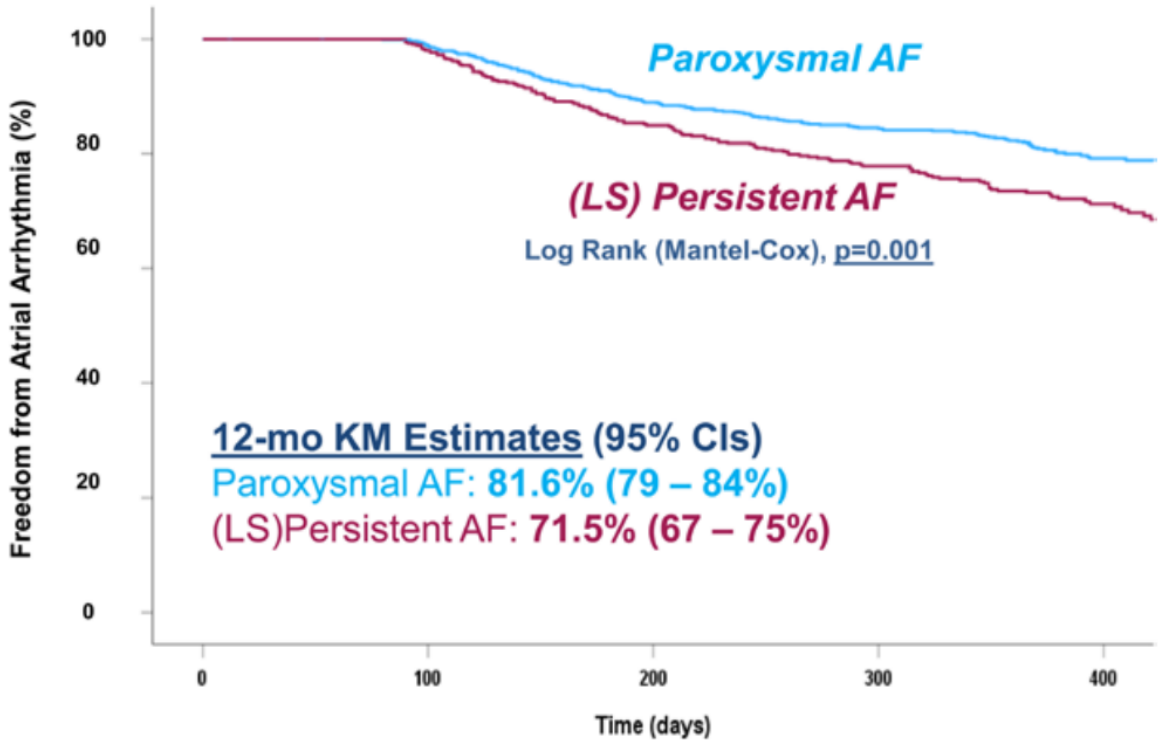
Nové technologie a nové přístupy

Místa pro ablaci mimo PVI:

- EGMs
- Zadní stěna
- Mitrální linie
- Koronární sinus
- LAA
- Pravá síň (včetně CTI)

MANIFEST PF Registry

- **Paroxysmální / perzistentní FS**
  - 54 center
  - 1568 pacientů



Reddy V. NEJM 2023; Turagam MK. Circulation 2023

ZADNÍ STĚNA

Proč zadní stěna?

Embryonální vývoj souvisí s plicními žilami

Zdroje na zadní stěně + role v udržení AF

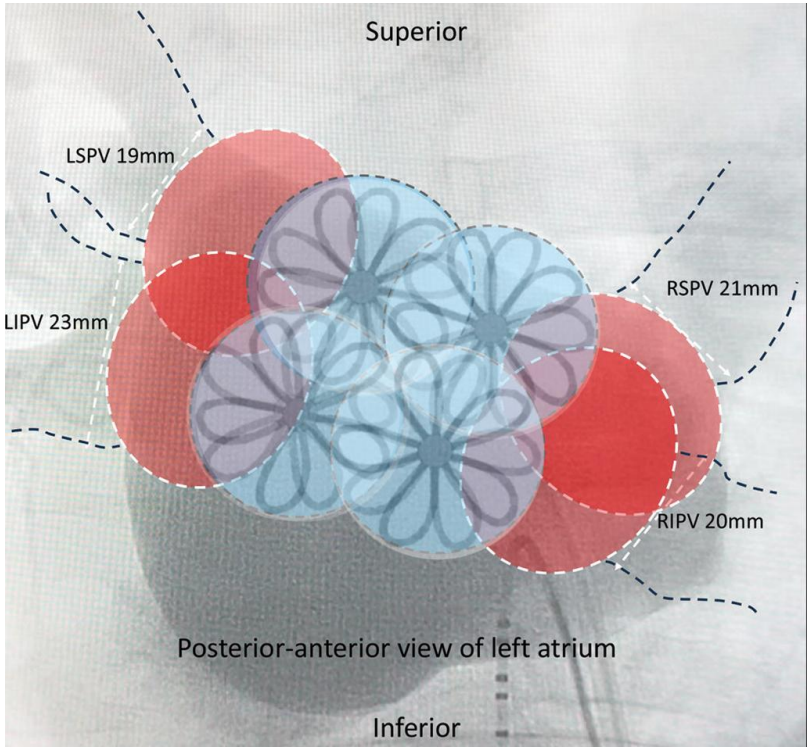
Přítomnost významné remodelace

Ablace na zadní stěně - eliminace zdrojů a mechanismy udržení AF

Široce aplikovaný přístup

Konkrétní strategie – překryvy, dublování aplikací, ověření….

Data o klinickém přínosu?



Chen S et al. Circulation: Arrhythmia and Electrophysiology 2025

Benefit PVI + PWI u perzistentní FS

26 studií
3287 pacientů

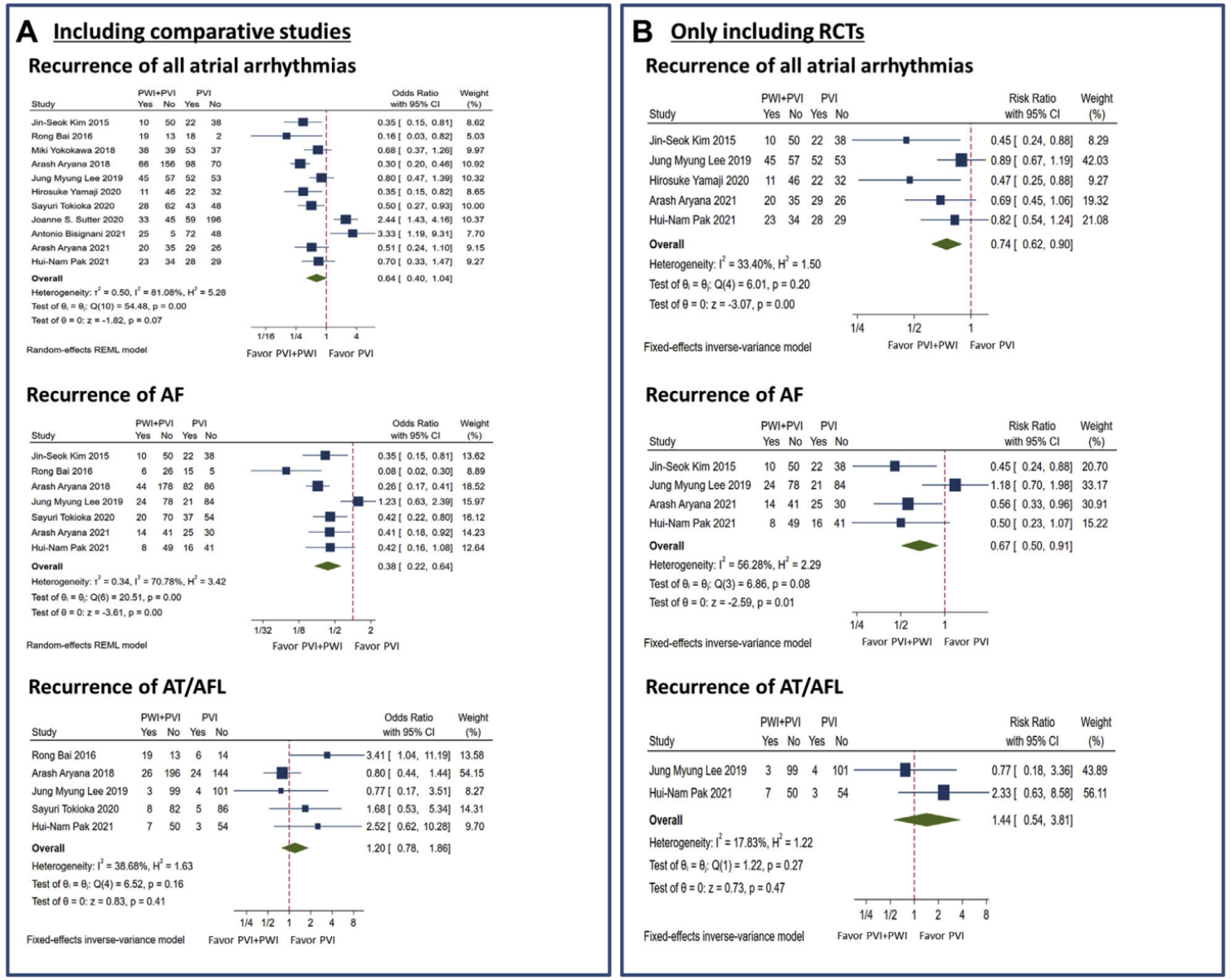
Paroxysmální AF 23%

Průměrný věk 61 let, mužů 73%

LAD v průměru 44 ± 7 mm

Follow-up 15 ± 8 měsíců

Efekt PWI jen u non-parox AF



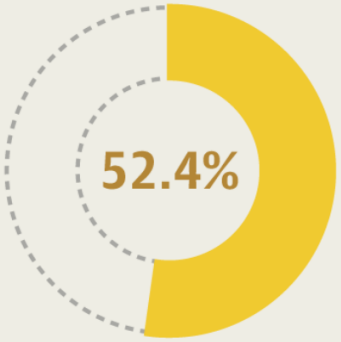
Jiang X et al. JACC: Clinical Electrophysiology 2022

CAPLA

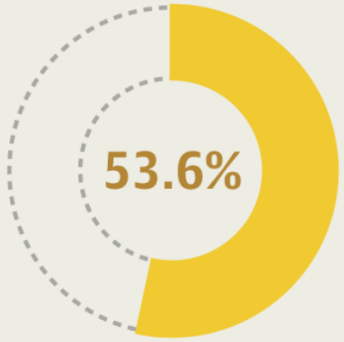
FINDINGS

Free from atrial arrhythmia at 12 months

PVI with PWI
89 of 170 patients



PVI alone
90 of 168 patients

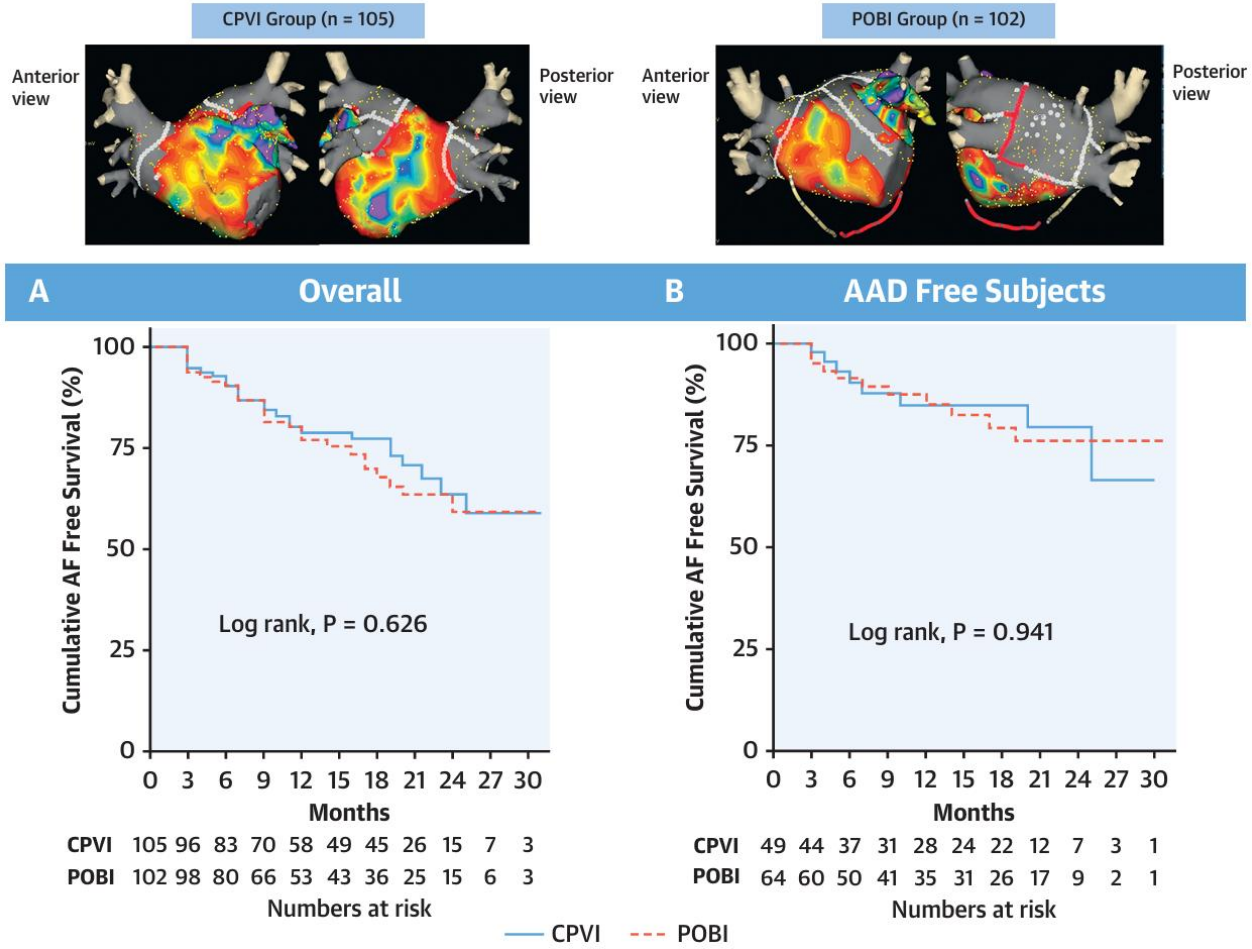


Addition of PWI to PVI alone did not significantly improve freedom from atrial arrhythmia at 12 months compared with PVI alone:

Between-group difference, **−1.2%**

Hazard ratio, **0.99** (95% CI, 0.73 to 1.36); *P* = .98

POBI-AF

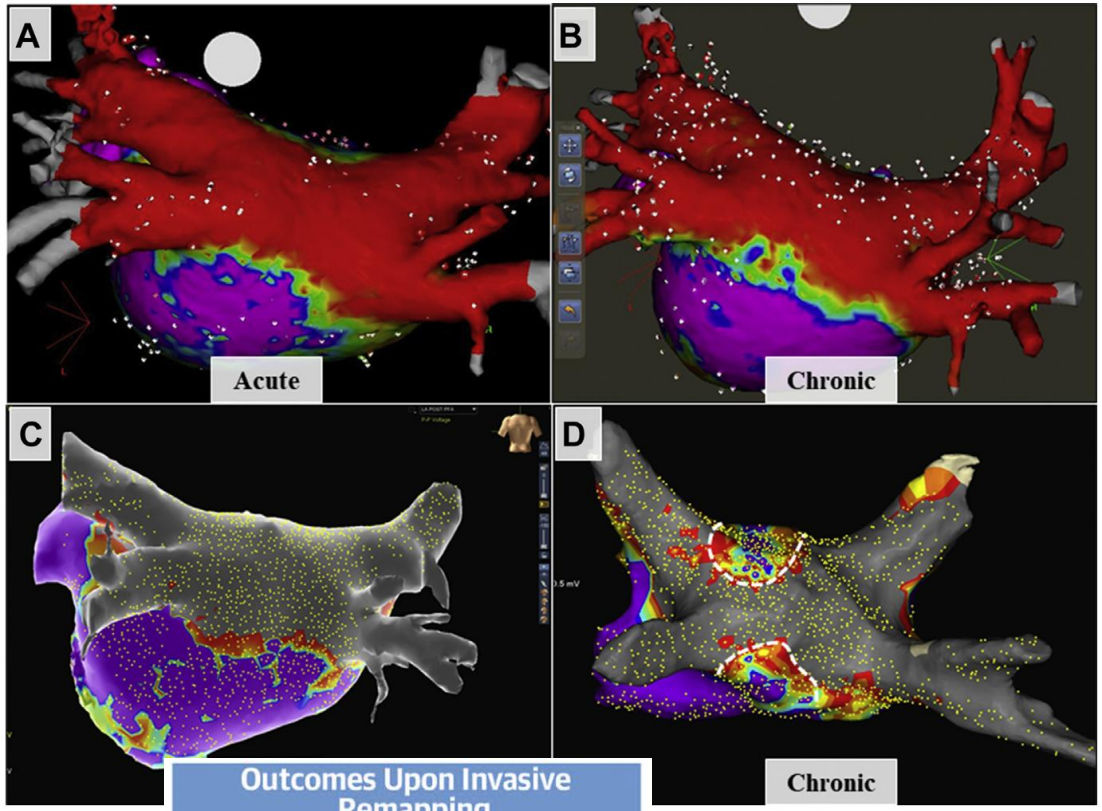


Box inkompletní u 13,5%
Redo: trvalá PWI jen u 32 a 50% pacientů

Kistler PM et al. JAMA 2023, Lee JM et al. JACC EP 2019.

Trvanlivost lézí – pentaspline katétr

Primary feasibility endpoint (n = 25)	
Acute PV isolation	96/96 (100)
Secondary feasibility endpoints (n = 25)	
Chronic PV isolation (n = 22)	82/85 (96)
Chronic LAPW isolation (n = 22)	
Full cohort (n = 22)	21/22 (95)*
Treated using pentaspline catheter only (n = 21)	21/21 (100)*
Acute CTI block (n = 13)	13/13 (100)
Chronic CTI block (n = 12)	9/12 (75)
Primary safety endpoints	
Early onset (within 30 days of index procedure)	
Death	0/25 (0)
Myocardial infarction	0/25 (0)
Diaphragmatic paralysis	0/25 (0)
Stroke or TIA	0/25 (0)
Peripheral or organ thromboembolism	0/25 (0)
Cardiac tamponade/perforation	1/25 (4)†
Vascular access complications	0/25 (0)
Hospitalization (initial or prolonged)	0/25 (0)
Heart block	0/25 (0)
Pericarditis	0/25 (0)
Late onset (any time during follow-up)	
PV stenosis (>70% from baseline)	0/25 (0)
Atrioesophageal fistula	0/25 (0)

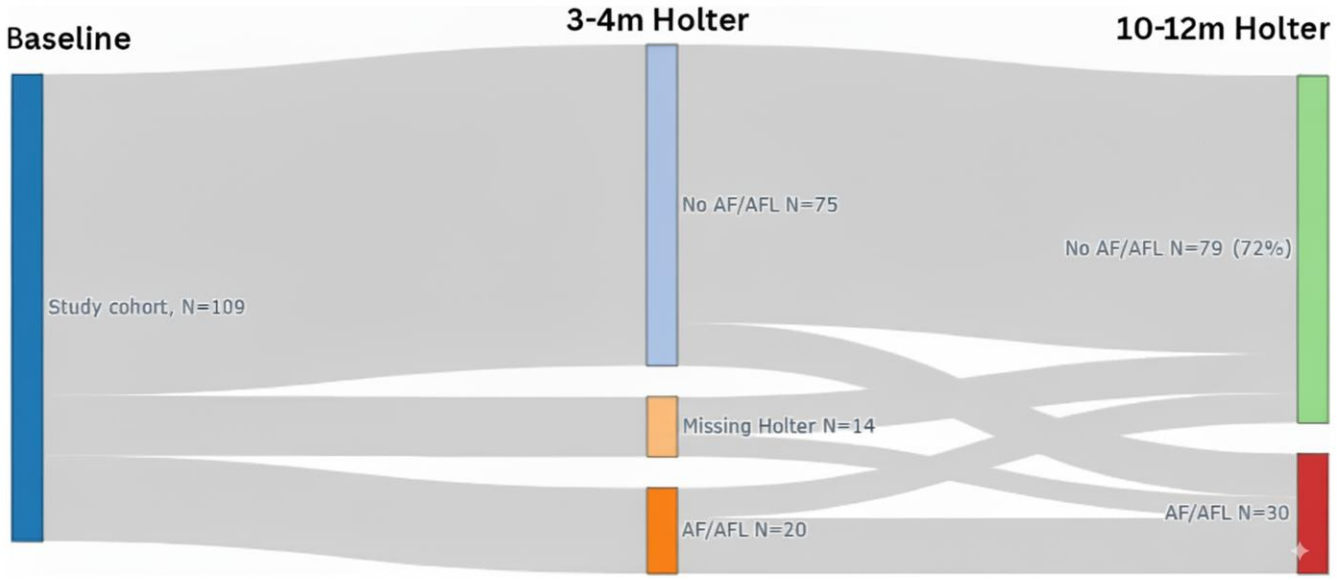


Reddy V et al. JACC 2020.

Prospektivní sledování pacientů s perzist-AF

Variable	Study cohort, n = 109 (%)
Age (IQR)	70 (63–75)
Female sex	33 (30)
Hypertension	59 (54)
Diabetes	26 (24)
Coronary artery disease	25 (23)
Congestive heart failure	25 (23)
Previous stroke	11 (10)
Ejection fraction, median (IQR)	60 (49–60)
LA diameter (mm), median (IQR)	51 (47–58)
LA volume, median (IQR)	162 (136–198)
Procedure-related variables:	
Catheter size	
31 mm	65 (60)
35 mm	44 (40)

Akutní izolace 100%
Čas výkonu cca 80 min
Počet aplikací cca 60



Přídatné léze u 10% nemocných
- Perimitrální flutter 8
- Lok. reentry na přední stěně 2
- CTI 1

Chorin E et al. Heart Rhythm 2025.

Faktory spojené se selháním léčby

	Univariate		Multivariate	
Variable	OR (95% CI)	*P* value	adjusted OR (95% CI)	*P* value
Age	1.21 (0.97–1.07)	.40	0.99 (0.94–1.05)	.25
Female sex	1.07 (0.44–2.61)	.89	1.13 (0.40–3.21)	.24
Hypertension	0.94 (0.41–2.16)	.89	—	—
Coronary artery disease	2.32 (0.91–5.89)	.08	1.39 (0.47–4.16)	.40
Congestive heart failure	0.92 (0.34–2.47)	.87	—	—
Preprocedure AAD	0.20 (0.05–0.72)	.01	0.12 (0.02–0.67)	.016
Ejection fraction	1.03 (0.98–1.08)	.29	—	—
LA diameter	1.04 (1.01–1.13)	.04	1.05 (0.99–1.11)	.07
LA volume	1.00 (0.99–1.01)	.36	—	—
35 vs 31 mm catheter	1.07 (0.45–2.55)	.88	—	—
Use of mapping	1.14 (0.37–3.49)	.81	—	—

Chorin E et al. Heart Rhythm 2025.

Klinický efekt PVI a PWI

ADVANTAGE AF
- Prospective
- Single-arm
- Multicentre

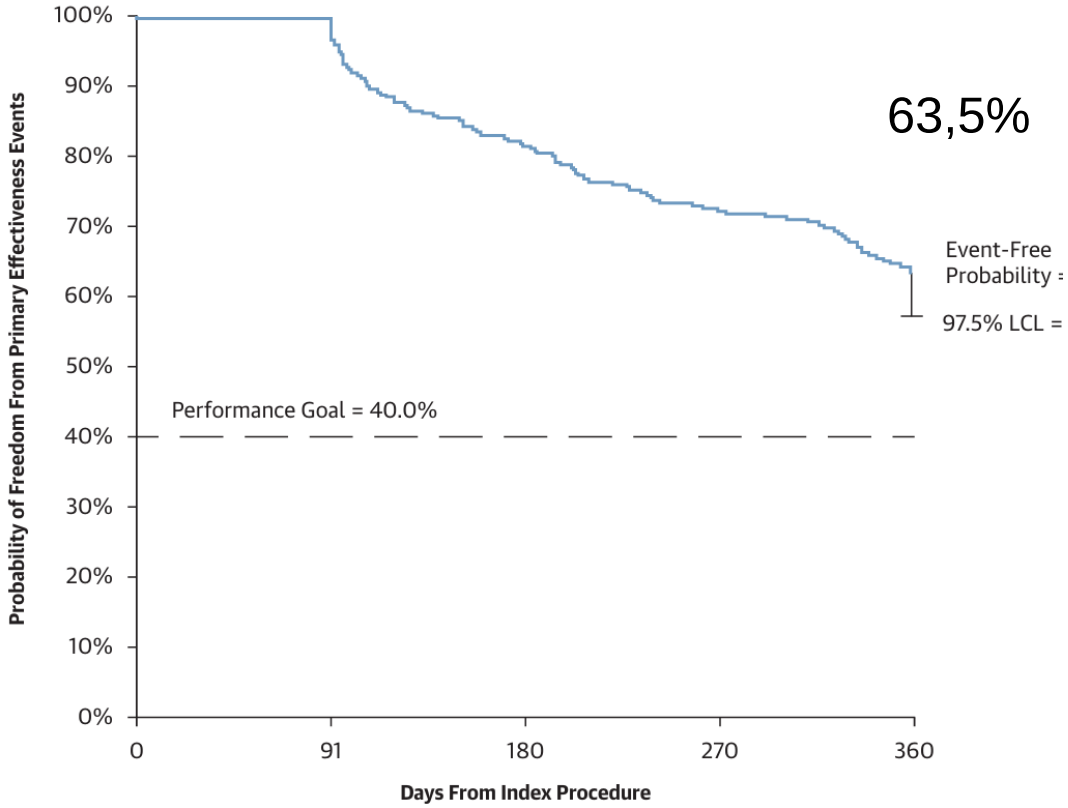
Pentaslpine katétr

Acute success	99.6
Procedure time, min	
Total procedure time	103 ± 34.8
Dwell time	58.5 ± 19.9
Fluoroscopy time	19.5 ± 13.1
PVI time	26.8 ± 15.0
PWI time	18.4 ± 15.0
PFA application	
PVI	45.1 ± 9.3
PWI	32.0 ± 12.7
Electroanatomic mapping system usage (for PW)	195 (75)
Cavotricuspid isthmus ablation	50 (19.2)

Reddy VY et al. JACC 2025.

Klinický efekt PVI a PWI

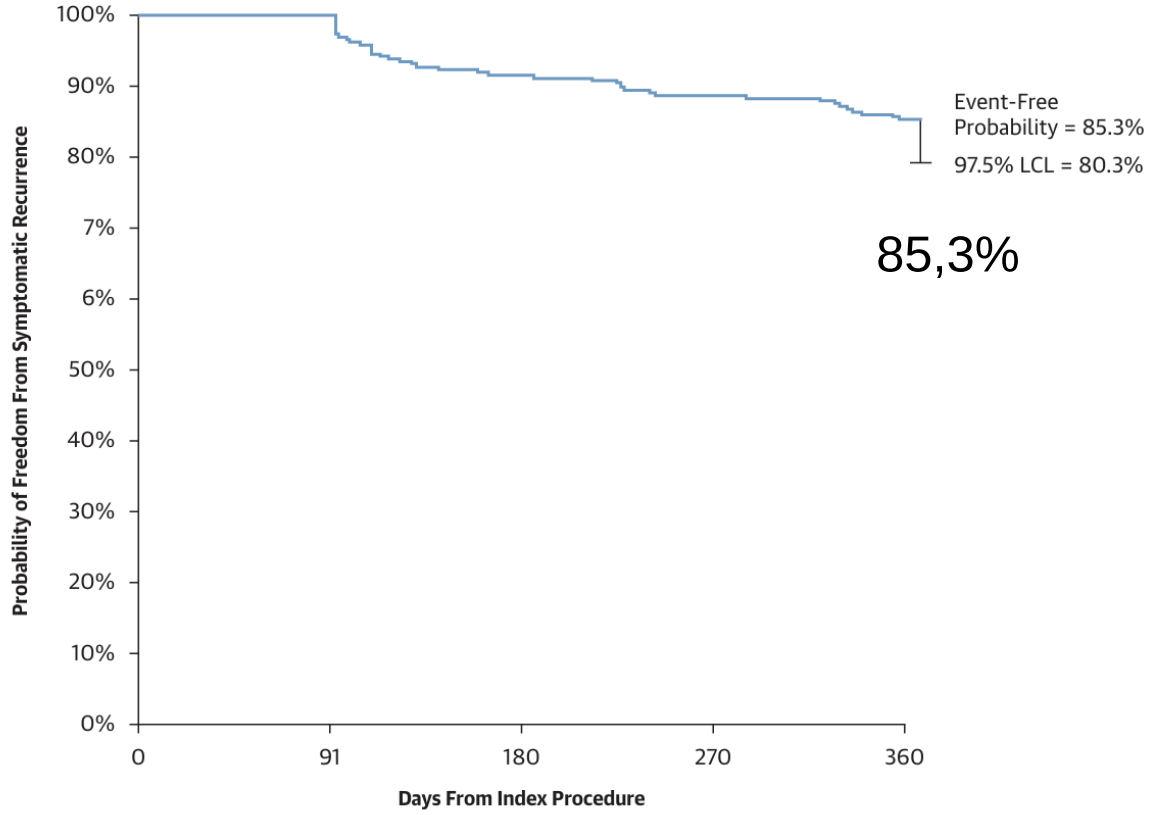
Absence AF / AT



63,5%

Subjects at Risk	259	251	209	184	159
Subjects With Event	1	9	48	72	94
Event-Free Probability	99.6%	96.5%	81.5%	72.1%	63.5%

Absence symptomatické AF / AT



85,3%

Subjects at Risk	260	253	235	226	213
Subjects With Event	0	7	22	29	38
Event-Free Probability	100.0%	97.3%	91.5%	88.8%	85.3%

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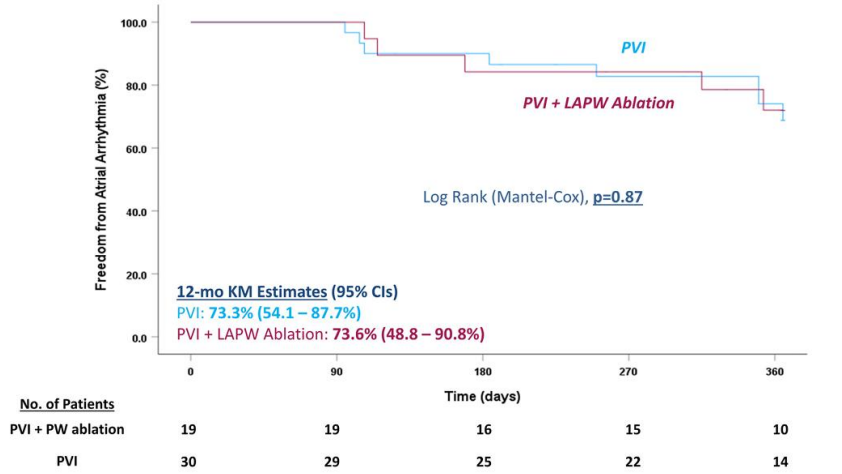
Reddy VY et al. JACC 2025.

Podanalýza MANIFEST-PF

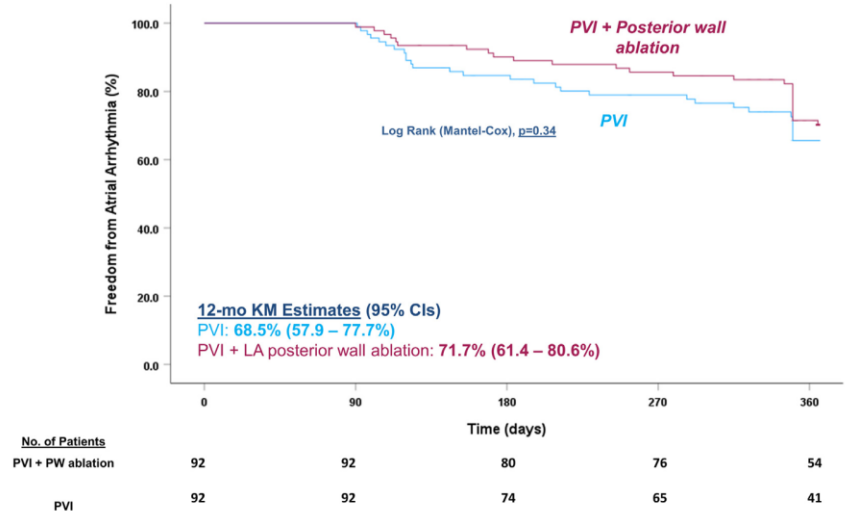
	Entire Cohort (N = 547)	PVI + LAPW Ablation (n = 131)	PVI (n = 416)	*P* Value
Age, y	66.3 ± 2.6	64.8 ± 10.4	66.7 ± 10.8	0.08
Female	165 (30.2)	36 (27.5)	129 (31.0)	0.51
CHA_2DS_2-VASc score	2.5 ± 1.6	2.3 ± 1.6	2.6 ± 1.6	0.08
Mean body mass index, kg/m^2	28.9 ± 5.2 (n = 544)	28.9 ± 4.5	28.9 ± 5.4	0.96
Past medical history				
Atrial flutter	66 (15.5) (n = 427)	22 (17.2)	44 (14.7)	0.56
Coronary artery disease	77 (18.0) (n = 427)	16 (12.5)	61 (20.4)	0.055
Diabetes	97 (17.7)	29 (22.1)	68 (16.3)	0.15
Hypertension	377 (68.9)	90 (68.7)	287 (69.0)	1.00
Heart failure	139 (25.4)	35 (26.7)	104 (25.0)	0.73
Sleep apnea	48 (11.6) (n = 413)	13 (11.0)	35 (11.9)	0.86
Prior stroke/TIA	38 (7.0)	7 (5.4)	31 (7.5)	0.55
COPD	29 (7.9) (n = 365)	10 (9.4)	19 (7.3)	0.52
Echocardiographic parameters				
LVEF, %	57 (50-60) (n = 486)	60 (50-60)	55 (50-60)	0.31
LA diameter, mm	44 (40-48) (n = 429)	45 (42-48)	44 (40-48)	0.04
Antiarrhythmic medications				
Class I AADs	74 (13.6) (n = 545)	24 (18.3)	50 (12.1)	0.08
Class III AADs	137 (25.1) (n = 546)	30 (22.9)	107 (25.8)	0.56

12% PVI + LAPW pacientů mělo i mitrální isthmus

Primární endpoint



Propensity matched cohort



Turgam MK et al. JACC EP 2024.

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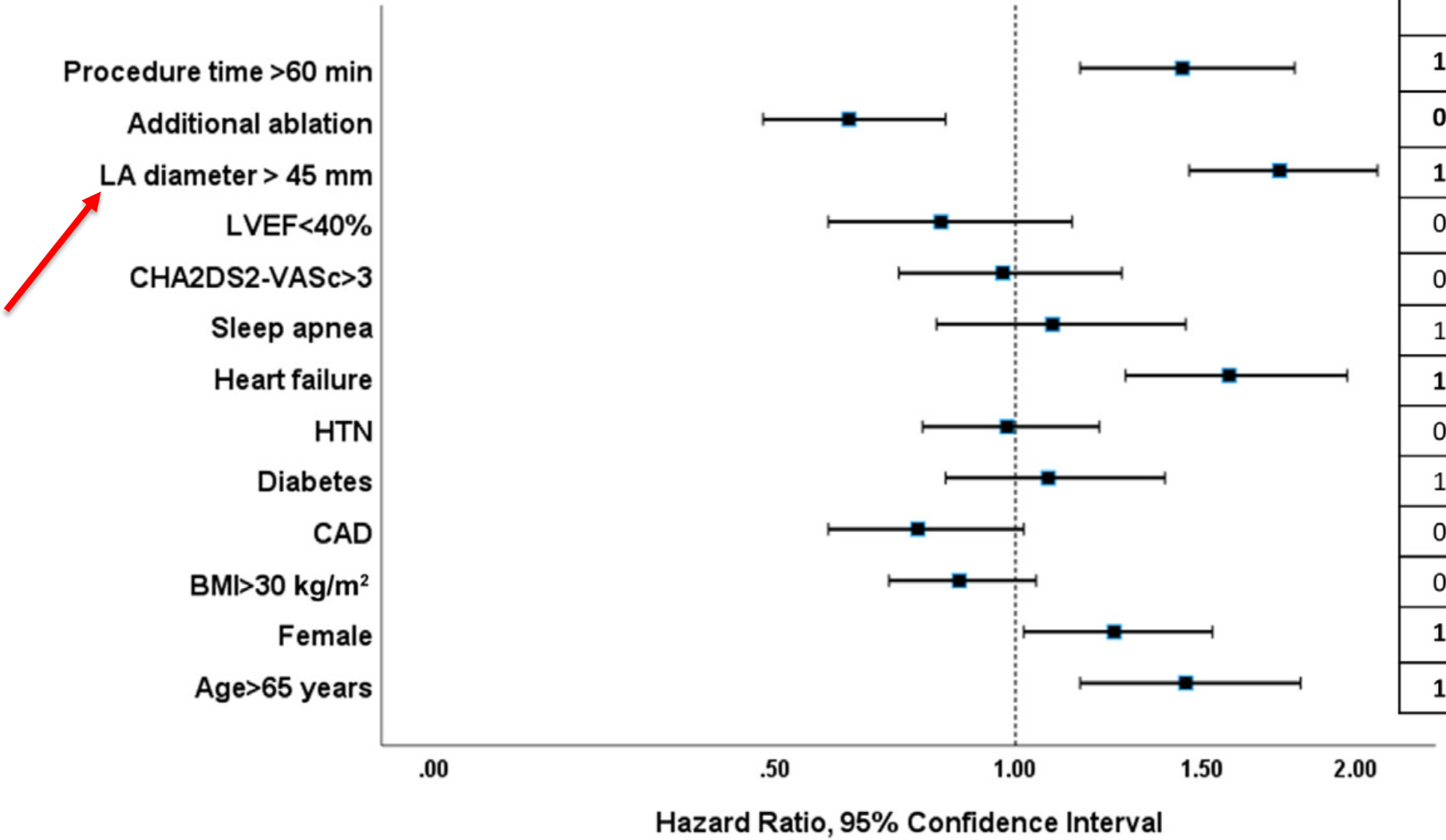
Faktory spojené se selháním výkonu

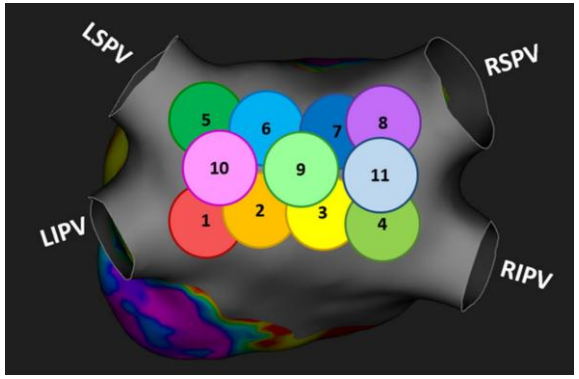


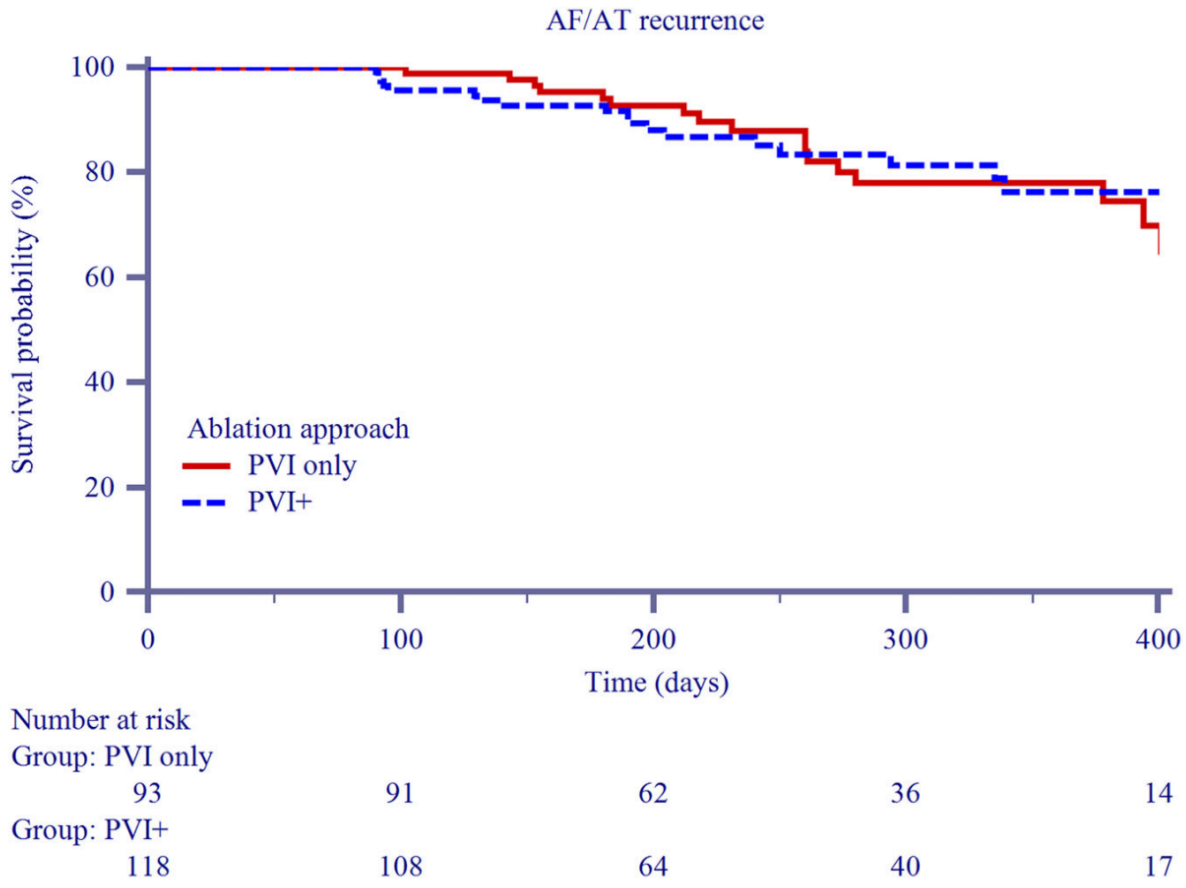
Hazard Ratio (95% CI)	P-value
1.45 (1.16 – 1.79)	**<0.001**
0.64 (0.48 – 0.84)	**0.002**
1.74 (1.46 – 2.08)	**<0.001**
0.83 (0.60 – 1.14)	0.25
0.97 (0.74 – 1.27)	0.85
1.09 (0.82 – 1.45)	0.53
1.59 (1.28 – 1.97)	**<0.001**
0.98 (0.79 – 1.21)	0.85
1.08 (0.84 – 1.39)	0.53
0.78 (0.60 – 1.02)	0.07
0.87 (0.72 – 1.05)	0.15
1.25 (1.02 – 1.53)	**0.03**
1.45 (1.16 – 1.81)	**<0.001**

Turgam MK et al. JACC EP 2024.

Nerandomizované srovnání

Parameter	Overall population (*n* = 249)	Redo procedures (*n* = 38)	De novo PVI only (*n* = 93)	De novo PVI plus additional lesion set (*n* = 118)
Age, years	63.4 ± 9	62.4 ± 7	63.4 ± 9	64.4 ± 8
Female Gender, *n* (%)	51 (20.5)	3 (7.9)	22 (23.7)	26 (22)
Indication for ablation:				
• Persistent AF, *n* (%) • Long-standing persistent AF, *n* (%)	• 195 (78.3) • 54 (21.7)	• 26 (68.4) • 12 (31.6)	• 77 (82.8) • 16 (17.2)	• 92 (78.0) • 26 (22.0)
Symptomatic patient, *n* (%)	228 (91.6)	36 (94.7)	82 (88.2)	110 (93.2)
History of AT/AFL:				
• AT only, *n* (%) • AFL only, *n* (%) • Both AT and AFL, *n* (%)	13 (5.2) • 3 (1.2) • 9 (3.6) • 1 (0.4)	5 (13.2) • 1 (2.6) • 3 (7.9) • 1 (2.6)	3 (3.2) • 1 (1.1) • 2 (2.2) • 0 (0.0)	5 (4.2) • 1 (0.8) • 4 (3.4) • 0 (0.0)
LVEF, %	53.7 ± 10	50.6 ± 11	55.2 ± 10	53.4 ± 9
Left atrial volume, mL	42.6 ± 13	47.8 ± 13	42.3 ± 14	42.0 ± 13

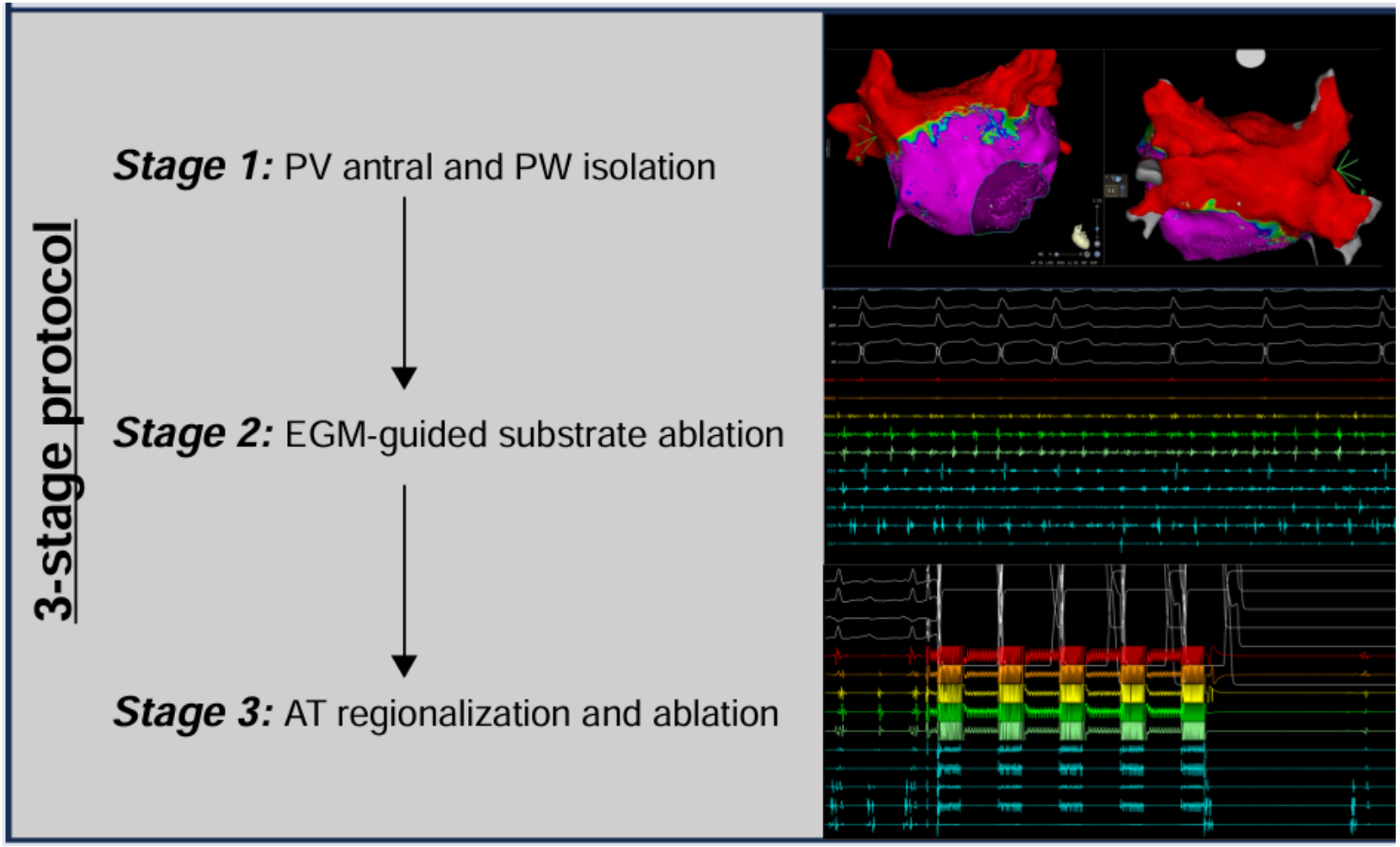




Schiavone M et al. JCE 2024.

Klinická data: PFA u perzistentní a LS perzistentní AF

PerAF>6mo and LSPAF patients (*n* = 72)



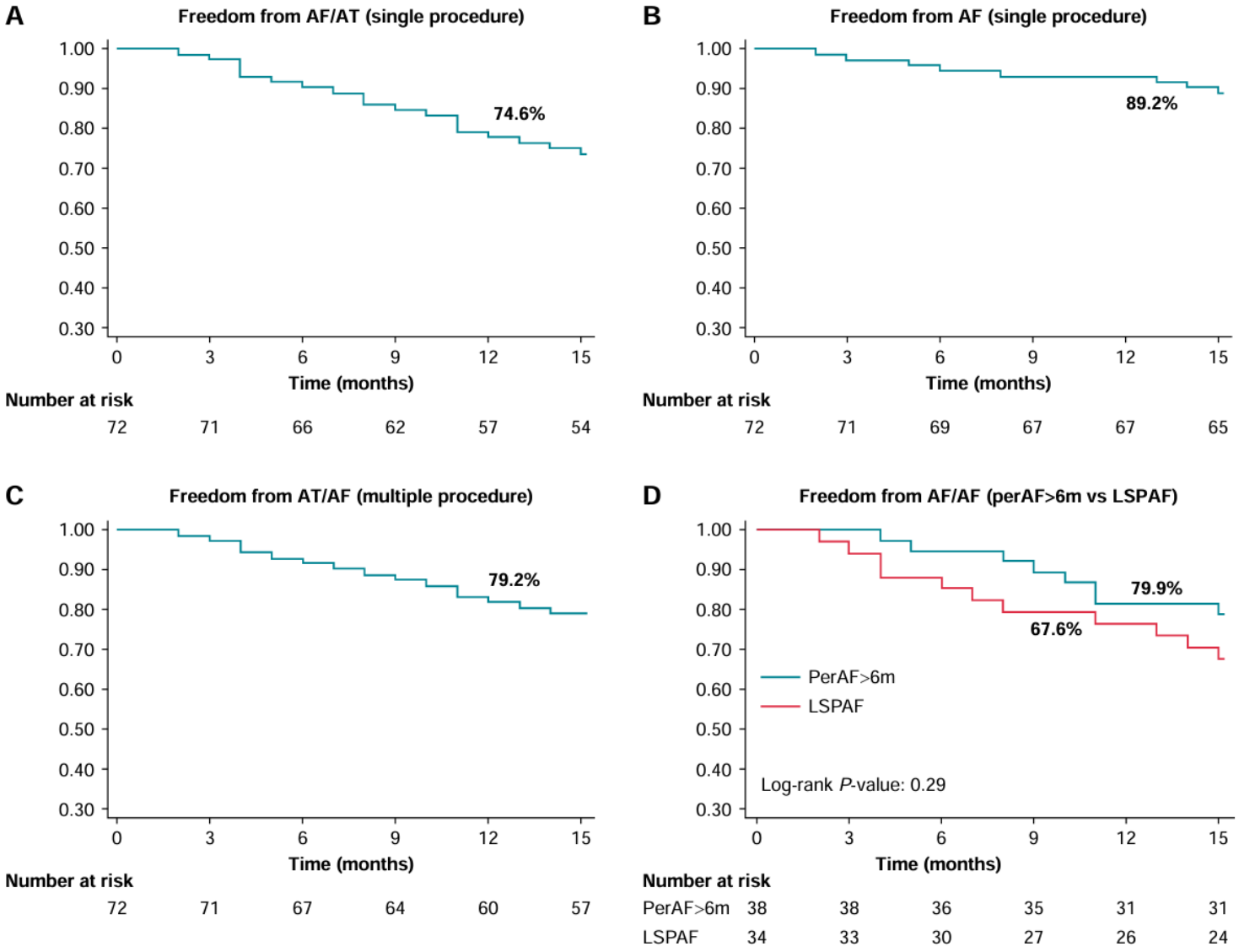
Kontinuální EGM, <0,25 mV

„burst of fractionated EGMs“

Rychlé, nefrakcionované EGMs (CL <120 ms)

Della Rocca et al. Europace 2024.

Klinická data: PFA u perzistentní a dlouhodobě perzistentní AF



- **Procedural time: 112 ± 25 min**
- **AF termination: 95.8%**
- **12-mo arrhythmia-free survival>80%**

Della Rocca et al. Europace 2024.

LATERÁLNÍ MITRÁLNÍ ISTMUS

Akutní a dlouhodobá durabilita lézí mimo PV a PW

N=236	
Age, y; mean±SD	68.3±9.81
BMI, kg/m²; mean±SD	29.4±5.1
Sex (female), n (%)	73 (30.9%)
Hypertension, n (%)	144 (61%)
Diabetes, n (%)	51 (21.6%)
History of Stroke/TIA, n (%)	23 (9.7%)
Coronary artery disease, n (%)	112 (47.5%)
Congestive heart failure, n (%)	72 (30.5%)
LVEF, mean±SD	53.7±9.3
CHA2DS2-VASc, mean ± SD	2.62±1.48
HAS-BLED, mean±SD	1.98±0.71

N=236			
General anesthesia, n (%)		236 (100%)	
Farawave catheter device size, n (%)		31 mm	198 (83.9%)
		35 mm	38 (16.1%)
Total procedural time, mean±SD		55.8±15.7	
Fluoroscopy time, mean±SD		24.6±9.6	
Coronary sinus	PF application, mean±SD	22±8	
	Acute reconnection, n (%)	52 (26.4%)	
Left atrial appendage	PF application, mean±SD	16±4	
	Acute reconnection, n (%)	4 (1.56%)	
Mitral isthmus	PF application, mean±SD	28±6	
	Acute reconnection, n (%)	52 (26.4%)	

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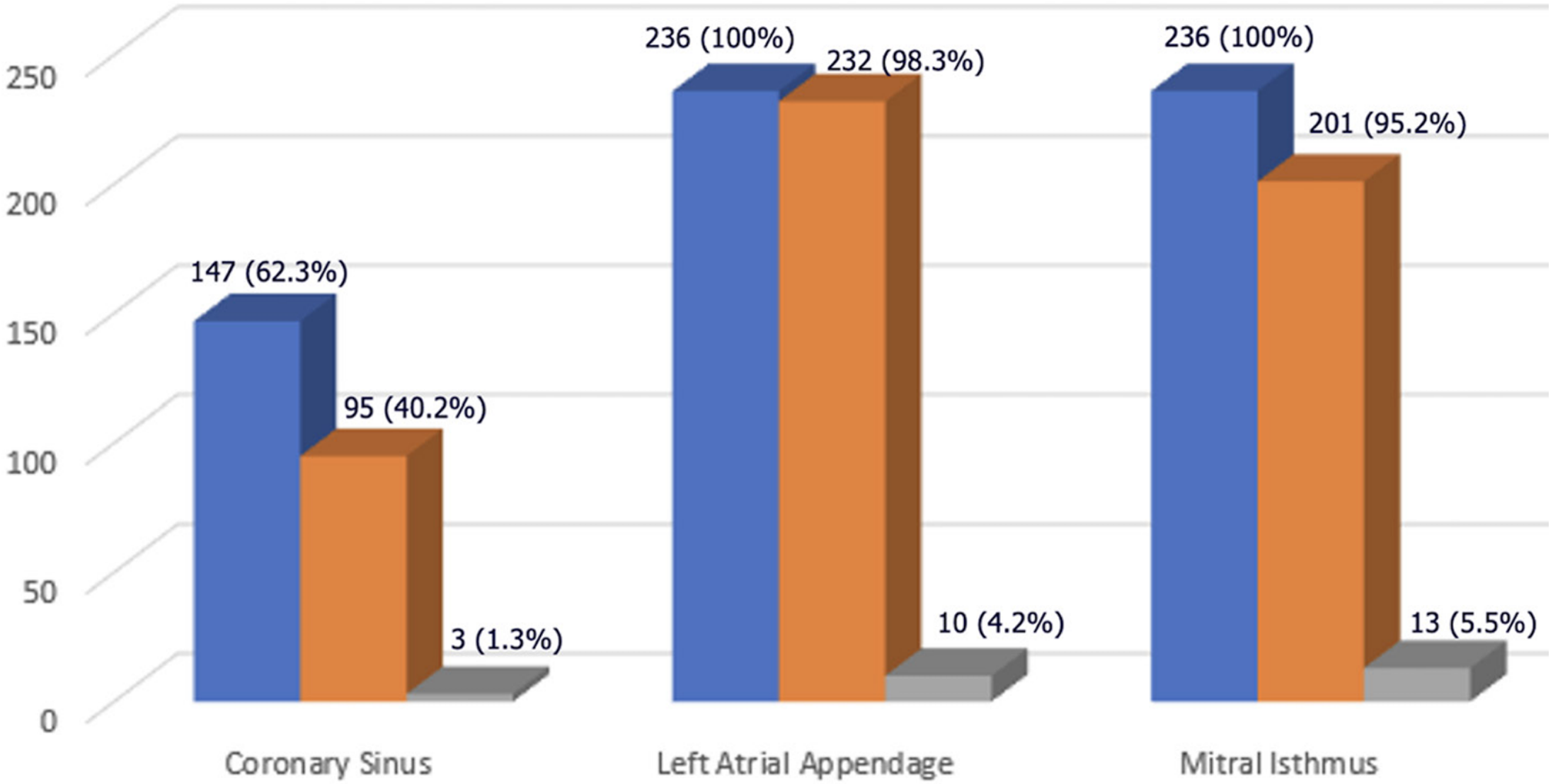
La Fazia VM et al. Circulation: Arrhythmia and Electrophysiology 2025.

Akutní a dlouhodobá durabilita lézí mimo PV a PW



La Fazia VM et al. Circulation: Arrhythmia and Electrophysiology 2025.

Analýza registru EU-PORIA

	Entire cohort			Propensity score matched		
	only PVI $n = 347$	PVI + α $n = 101$	p value	only PVI $n = 75$	PVI + α $n = 75$	p value
Sedation technique						
General anaesthesia, n (%)	46 (13)	49 (49)	< 0.001	13 (17)	37 (49)	< 0.001
Deep sedation, n (%)	301 (87)	54 (51)		62 (83)	38 (51)	
Use of 3D mapping, n (%)	130 (38)	60 (59)	< 0.001	25 (33)	46 (61)	0.001
Skin-to-skin procedure time (min)	67 ± 37	102 ± 44	< 0.001	63 ± 34	100 ± 40	< 0.001
Fluoroscopy time (min)	16 ± 9	24 ± 10	< 0.001	16 ± 9	24 ± 10	< 0.001
Ablation device used						
31 mm, n (%)	258 (74)	50 (49)	< 0.001	60 (80)	41 (54)	0.001
35 mm, n (%)	89 (26)	51 (51)		15 (20)	34 (46)	
Extra-PV ablation						
Posterior wall isolation, n (%)	0 (0)	88 (87)	NA	0 (0)	67 (89)	NA
Mitral isthmus ablation, n (%)	0 (0)	37 (37)	NA	0 (0)	28 (37)	NA
Cavo-tricuspid isthmus ablation, n (%)	0 (0)	3 (3)	NA	0 (0)	3 (4)	NA
Type of recurrence						
AF	89 (26)	23 (23)	0.603	18 (24)	20 (27)	0.851
AT/AFL	24 (7)	19 (19)	0.001	5 (7)	15 (20)	0.029

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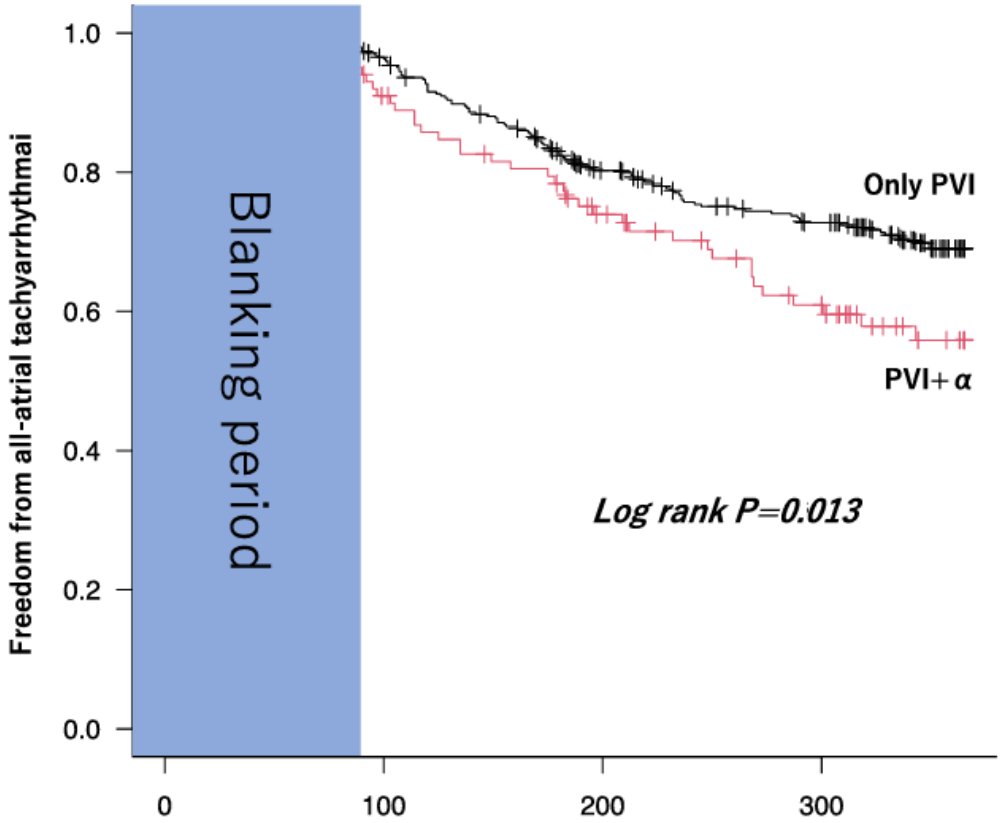
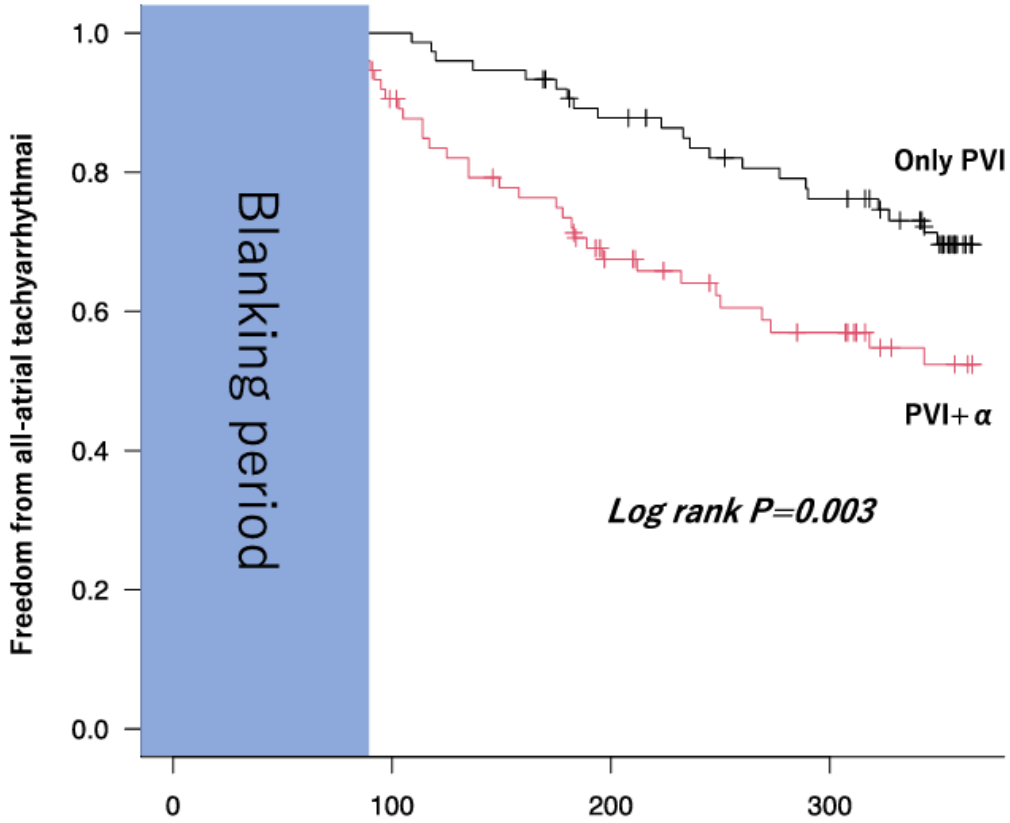
Analýza registru EU-PORIA

Absence AF / AT celá populace



Absence AF / AT – matched cohort



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Chen S et al. Circulation: Arrhythmia and Electrophysiology 2025.

PŘEDNÍ LINIE

Srovnání PFA vs RFA

Study population: PVI + anterior MIL

70 years

40%

36% paroxysmal

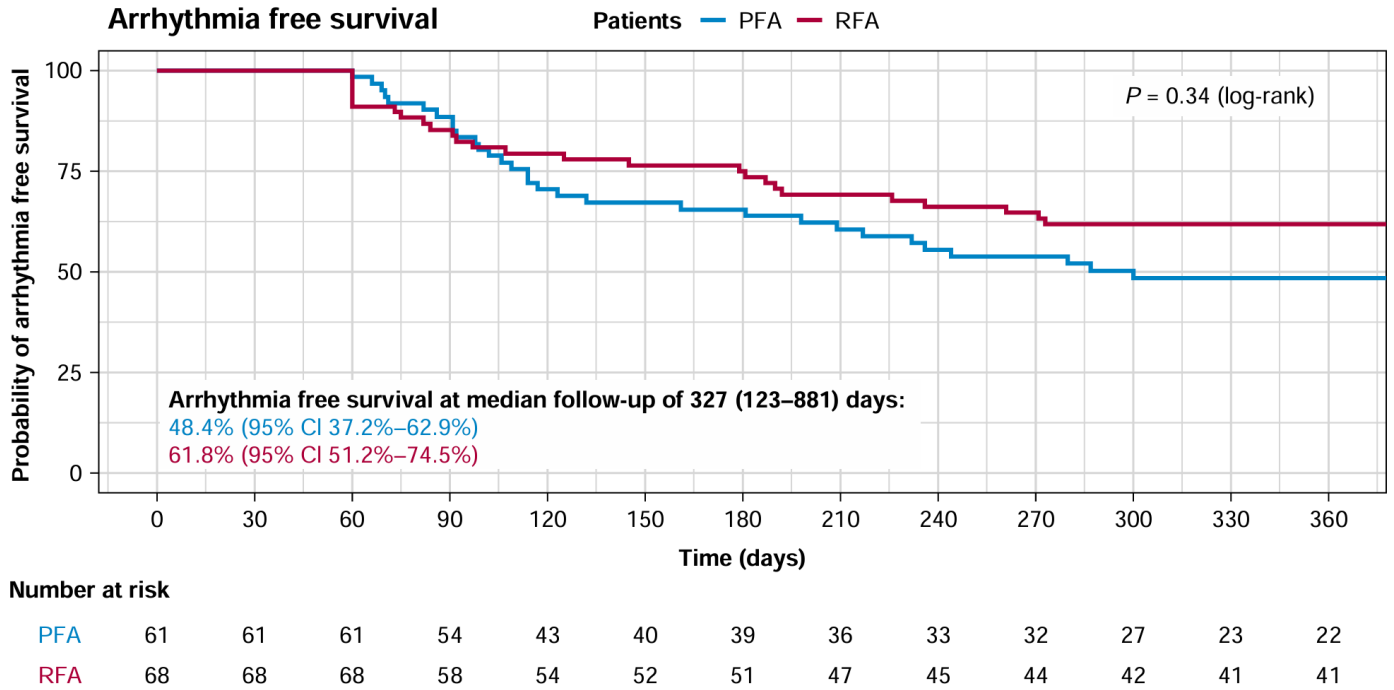
64% persistent AF

PFA *n* = 61

RFA *n* = 68

Procedural characteristics

	PFA	RFA
Procedure duration (min)	71 (60–94)	108 (87–153)
LA Dwell time (min)	53 (43–71)	80 (69–125)
Fluoroscopy time (min)	9 (7–13)	8 (5–13)
PV duration (sec)	15 (0–80)	245 (0–928)
Anterior MIL duration (sec)	35 (25–57.5)	473 (253–733)
Complications	1	2



Prospektivní, monocentrické srovnání
SWISS-AF-PVI registr

VŠEOBECNÁ FAKULTNÍ NEMOCNICE V PRAZE

1. LÉKAŘSKÁ FAKULTA Univerzita Karlova

KOMPLEXNÍ KARDIO VASKULÁRNÍ CENTRUM VFN Praha

Brugger J et al. Europace 2025.

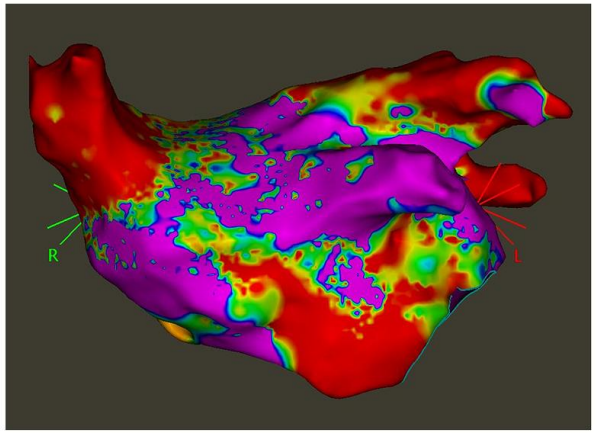
Lokalizace gapů

34 pacientů redo
- 12 PFA
- 22 RFA

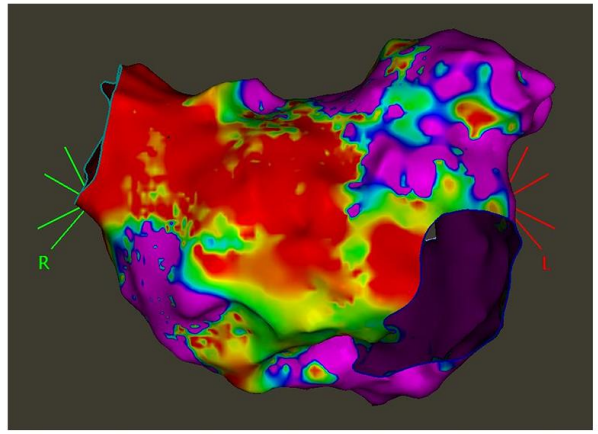
18 (53%) nekompletní linii
- RSPV 33%
- Anulus 20%
- Anterior wall 27%

- Nebyl rozdíl mezi PFA a RFA

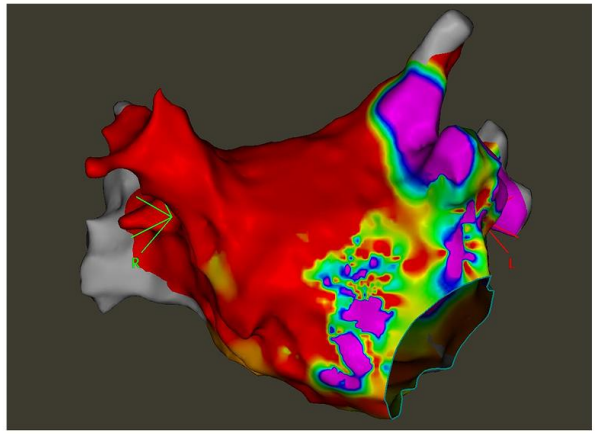
RFA

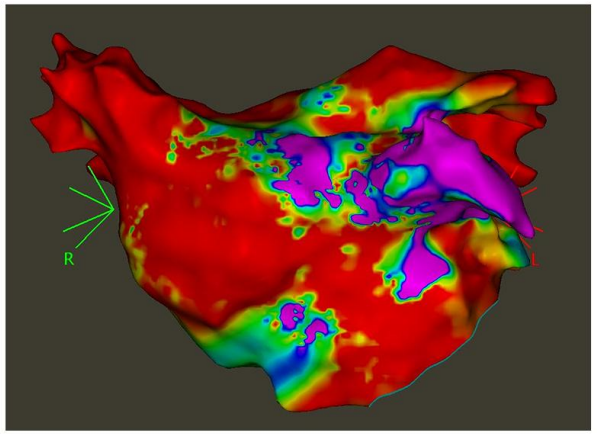


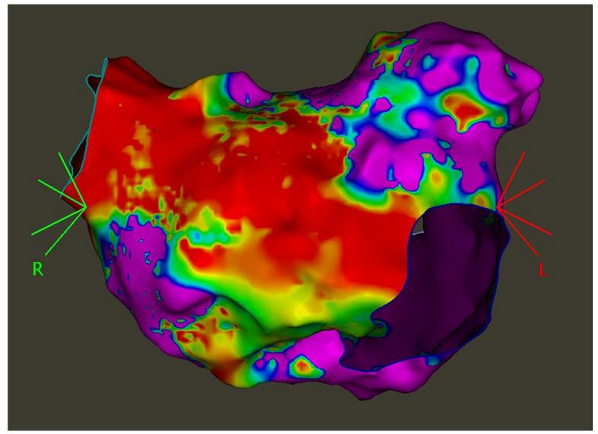
PFA

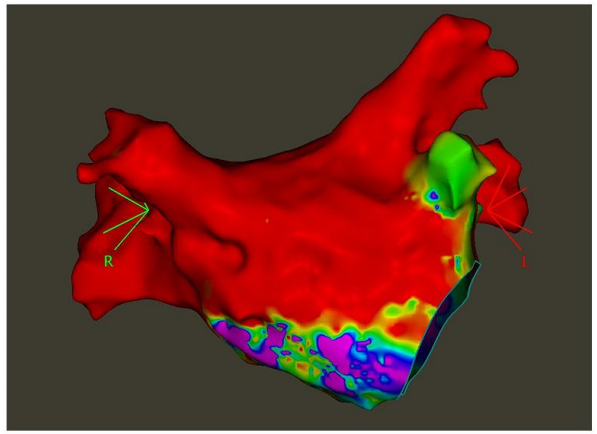


PFA







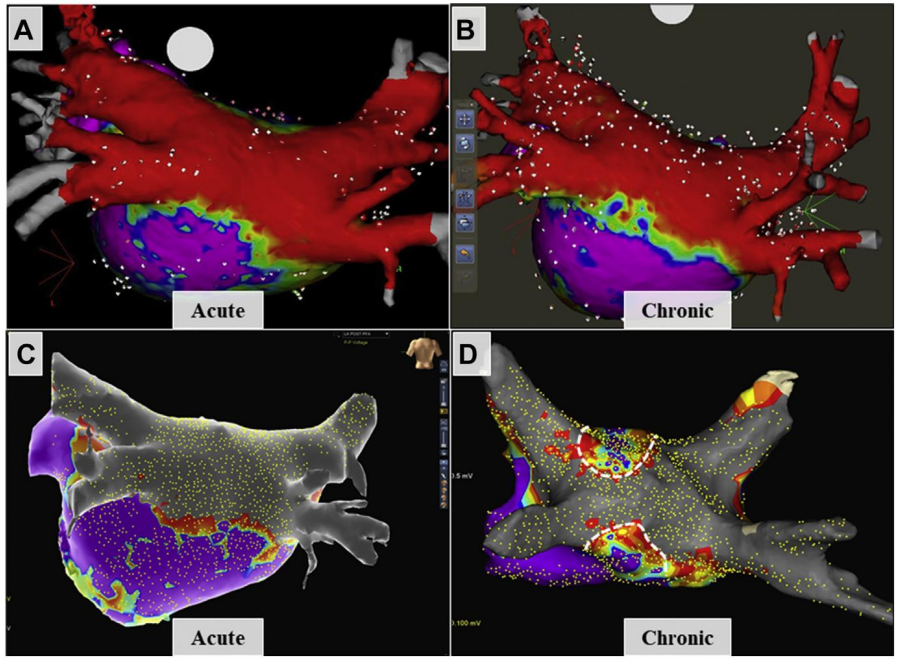


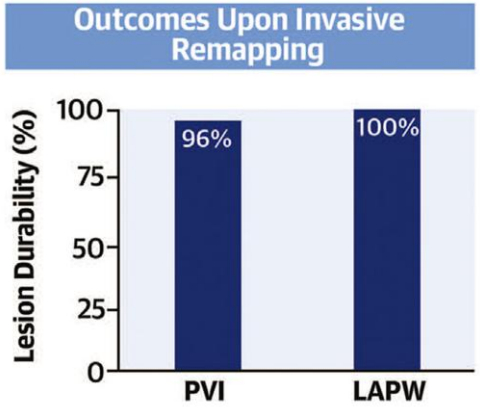
Brugger J et al. Europace 2025.

CTI

Trvanlivost lézí u PFA

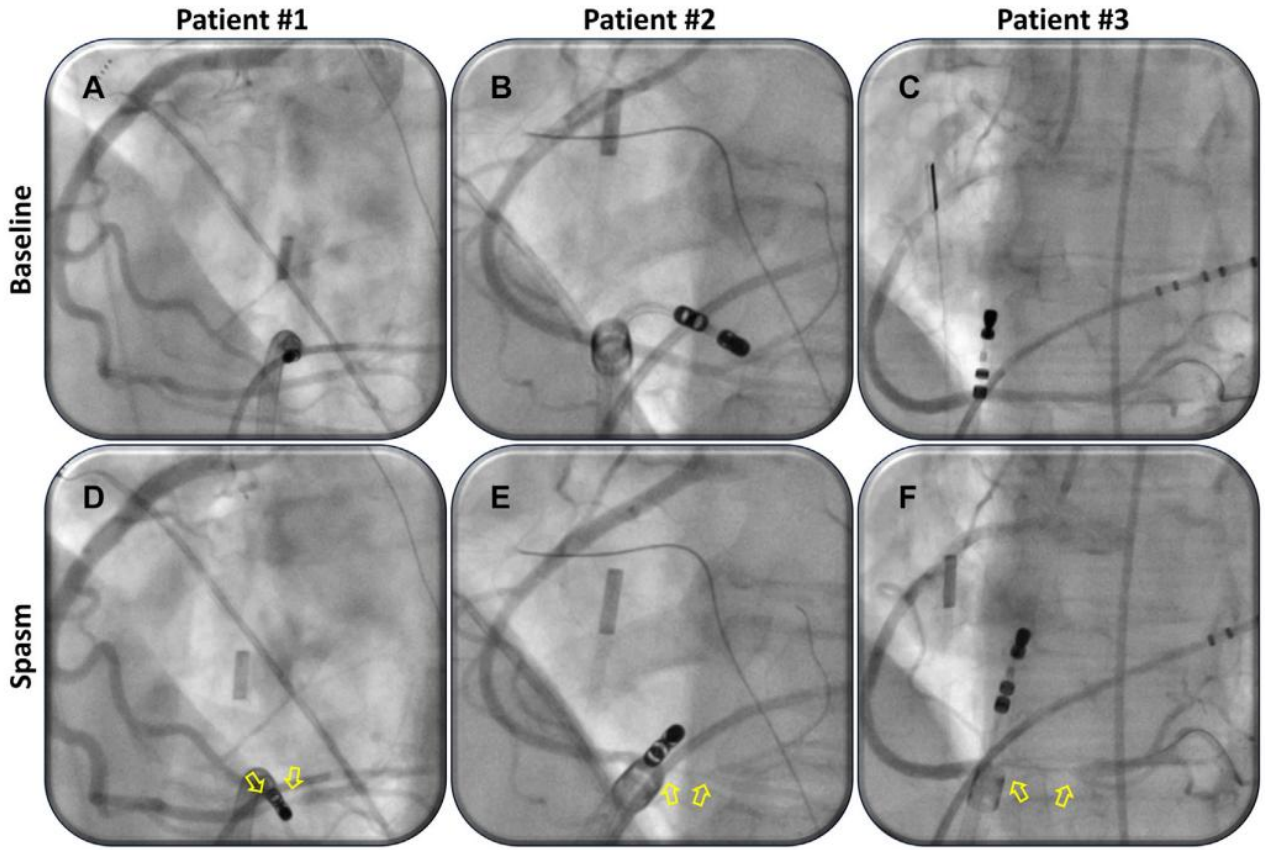
Primary feasibility endpoint (n = 25)	
Acute PV isolation	96/96 (100)
Secondary feasibility endpoints (n = 25)	
Chronic PV isolation (n = 22)	82/85 (96)
Chronic LAPW isolation (n = 22)	
Full cohort (n = 22)	21/22 (95)*
Treated using pentaspline catheter only (n = 21)	21/21 (100)*
Acute CTI block (n = 13)	13/13 (100)
Chronic CTI block (n = 12)	9/12 (75)
Primary safety endpoints	
Early onset (within 30 days of index procedure)	
Death	0/25 (0)
Myocardial infarction	0/25 (0)
Diaphragmatic paralysis	0/25 (0)
Stroke or TIA	0/25 (0)
Peripheral or organ thromboembolism	0/25 (0)
Cardiac tamponade/perforation	1/25 (4)†
Vascular access complications	0/25 (0)
Hospitalization (initial or prolonged)	0/25 (0)
Heart block	0/25 (0)
Pericarditis	0/25 (0)
Late onset (any time during follow-up)	
PV stenosis (>70% from baseline)	0/25 (0)
Atrioesophageal fistula	0/25 (0)

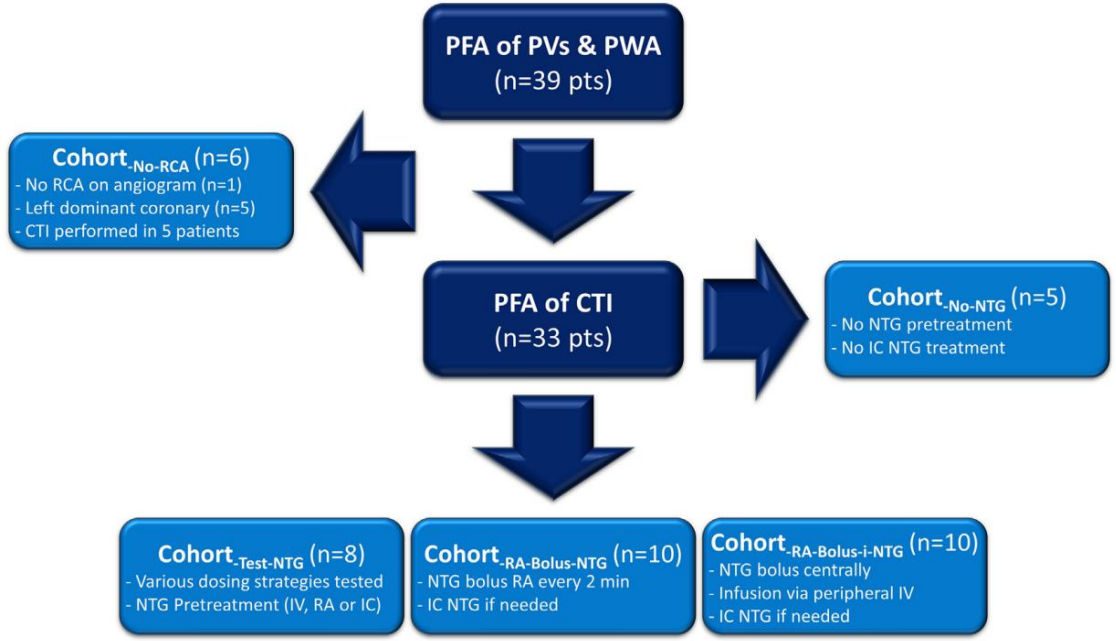


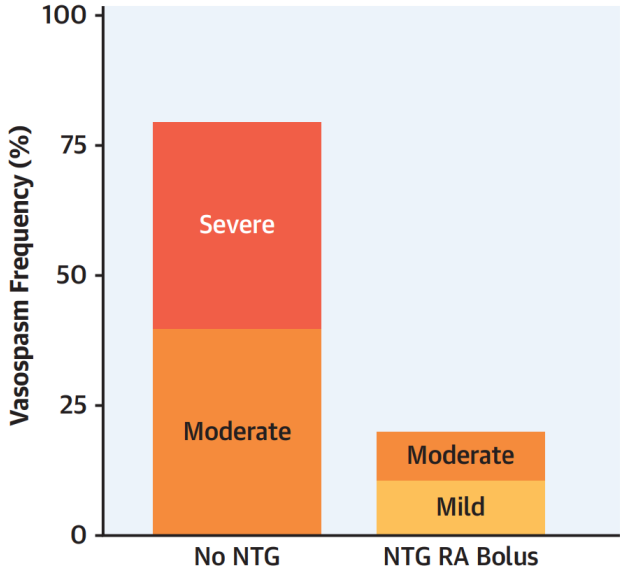


Reddy V et al. JACC 2020.

Prevence vasospasmů u PFA CTI

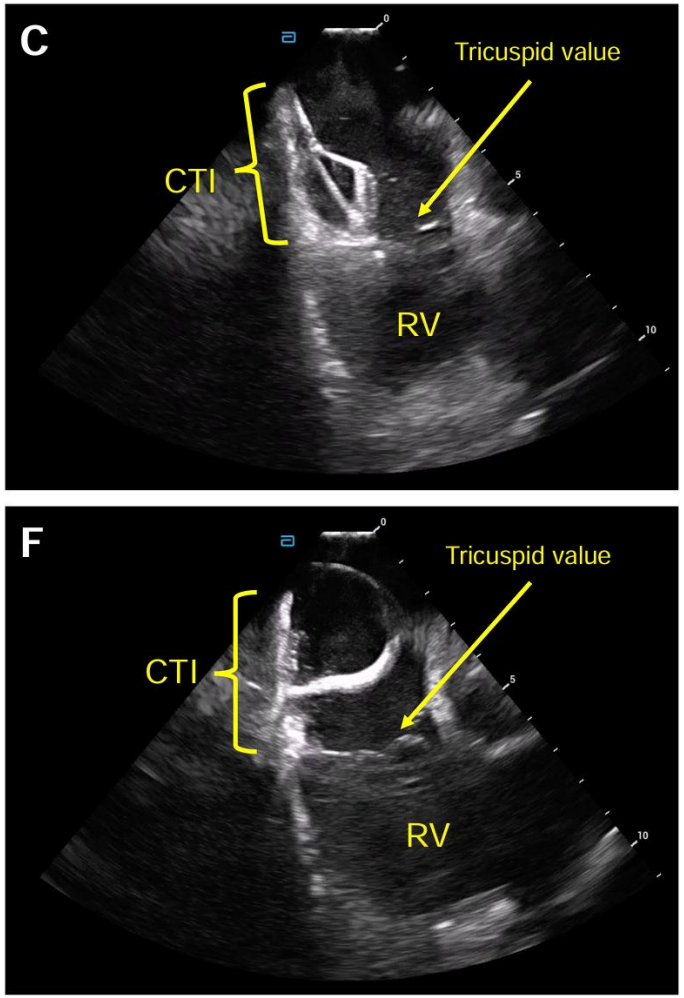


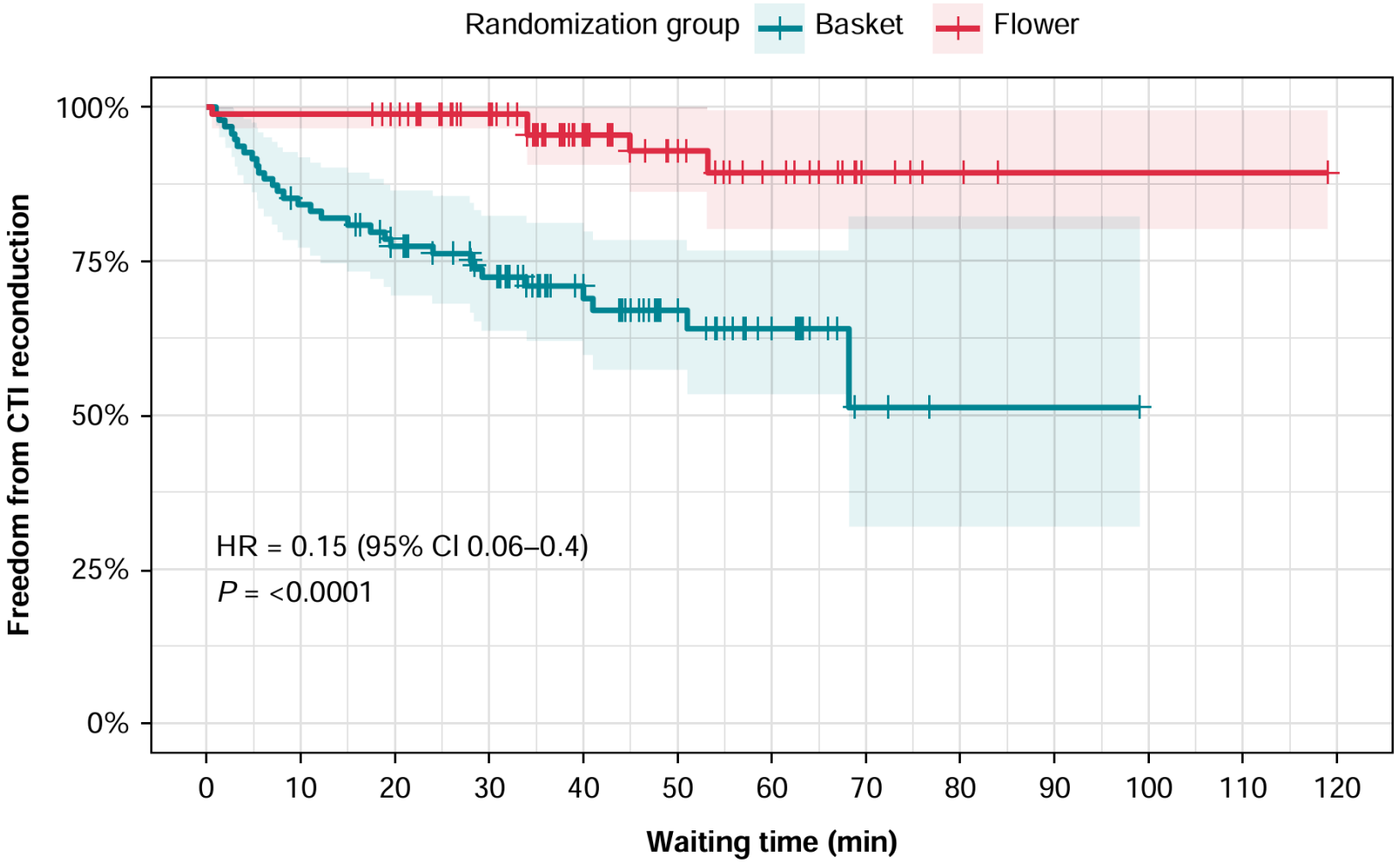




Mayshev Y et al. JACC EP 2024.

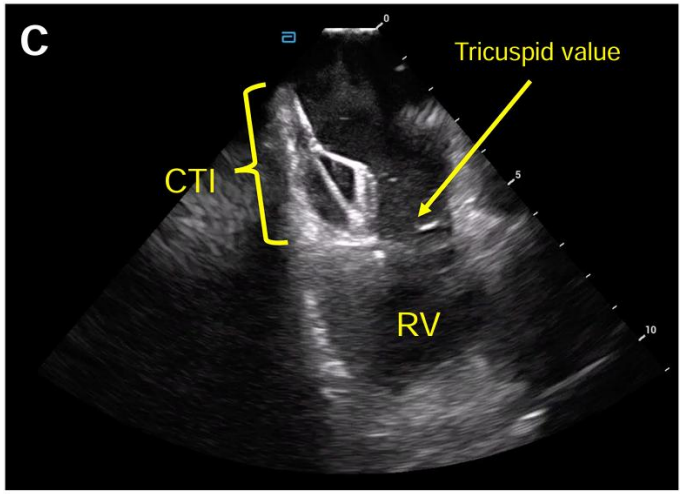
Pentaspline catheter

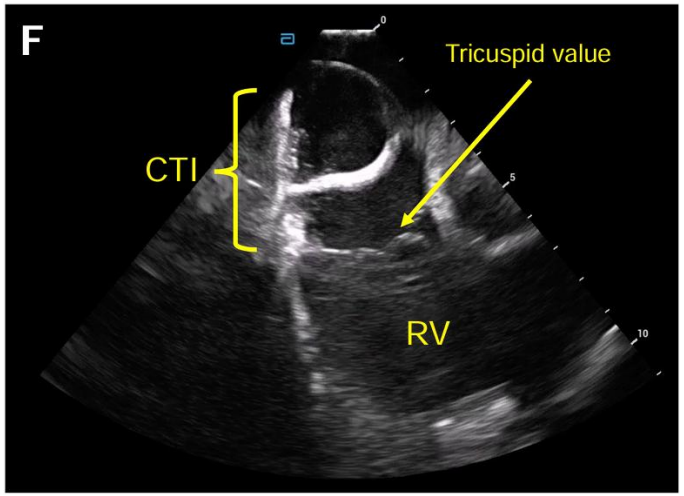


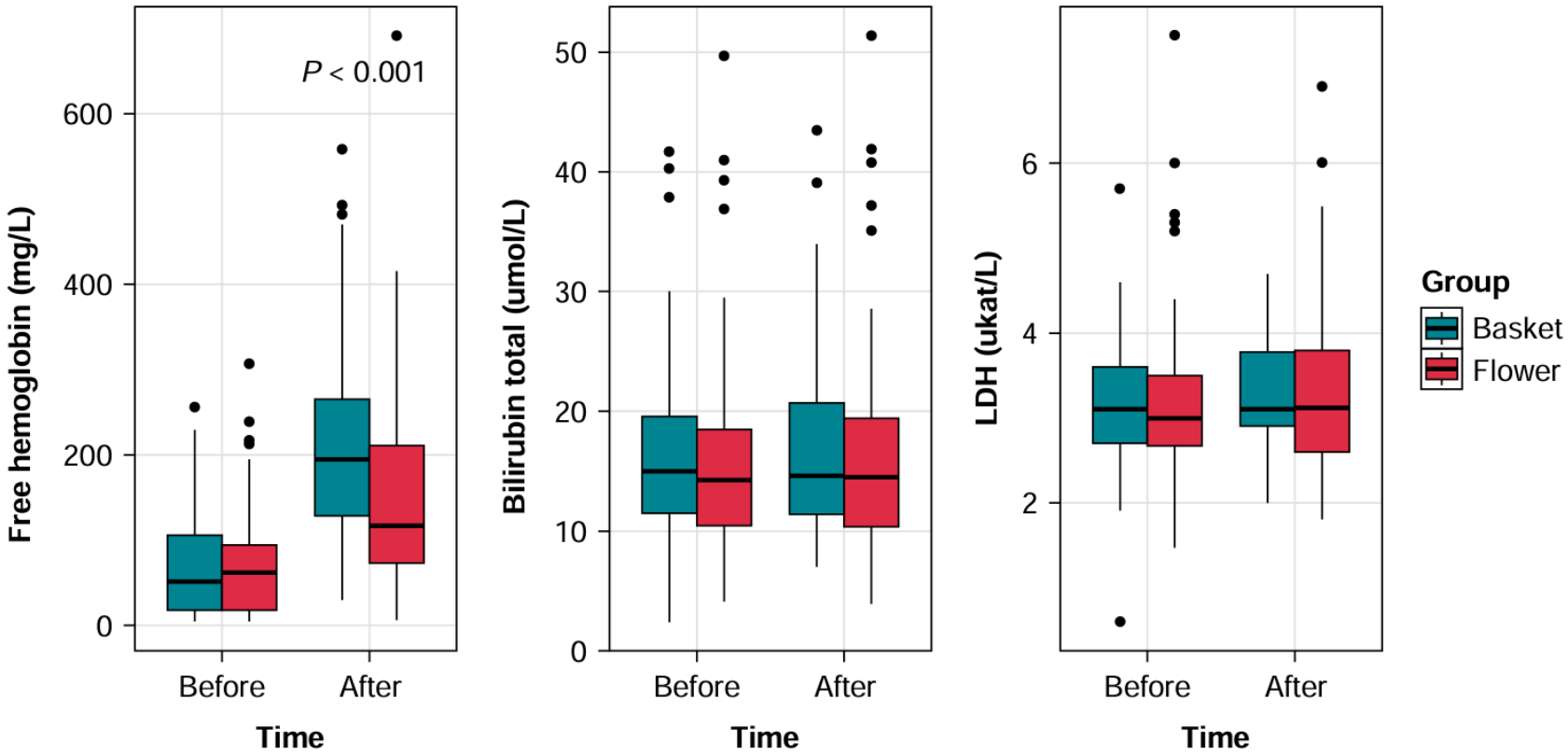


Stodajinovic P et al. Europace 2025.

Pentaspline catheter







Stodajinovic P et al. Europace 2025.

ZÁVĚRY

PFA po provedení PVI

- Prováděna jak u paroxysmálních i non-paroxysmálních AF
- Snadnost, rychlost a bezpečnost
- Data převážně pro pentaspline katétr (designovaný pro PVI)
- PWI – technicky snadný výkon, rychlý a nejspíše trvalý. Klinický přínos je otazný.
- Blok na liniích v LA (pentaspline katétrem) často pouze přechodný
- Kavo-trikuspidální isthmus – je možné dosáhnout trvalého bloku vyšší efektivita „flower“
- Řada protokolů s předpokládaně odlišnými výsledky

Děkuji za pozornost