ARRHYTHMIA (AF) THERAPIES AND THE EMERGENCE OF PULSED FIELD ABLATION

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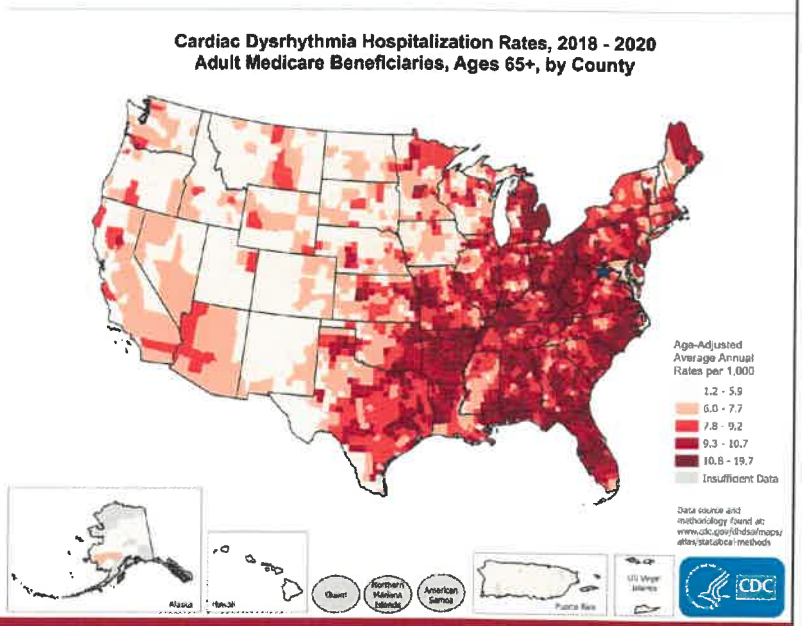
2024 Eugene and Betty Casey Cardiovascular Conference

DISCLOSURES

Speaker Honoraria/Travel grant: Boston scientific, Abbott
Consulting: Kardium Inc.

BACKGROUND:

- Estimated that 12.1 million people in the US with have AFib by 2030



https://www.cdc.gov/heartdisease/atrial_fibrillation.htm

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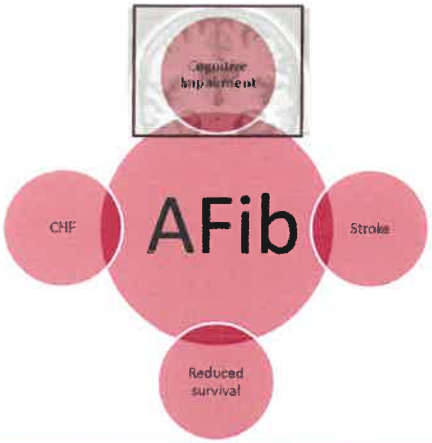
AFIB: SYSTEMIC EFFECTS

- Atrial fibrillation is the most common tachyarrhythmia



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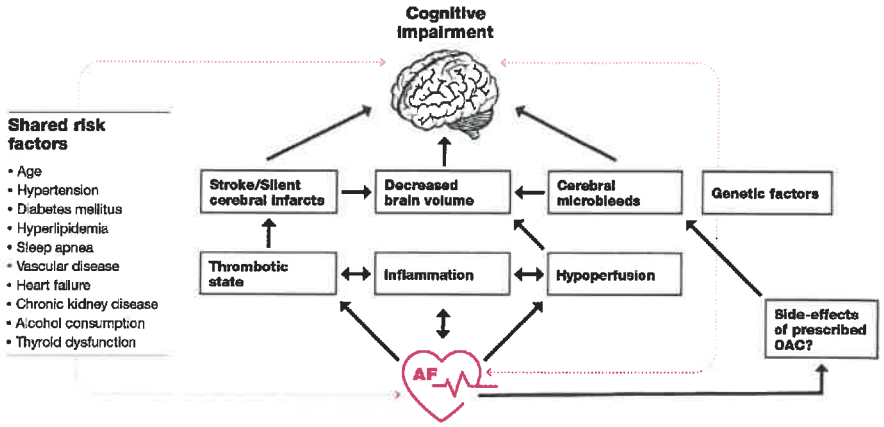
AFIB: COGNITIVE IMPAIRMENT



Rivard, L., Friberg, L., Conen, D., Healey, J. S., Berge, T., Boriani, G., ... & Freedman, B. (2022). Atrial fibrillation and dementia: a report from the AF-SCREEN international collaboration. *Circulation*, *145*(5), 392-409.

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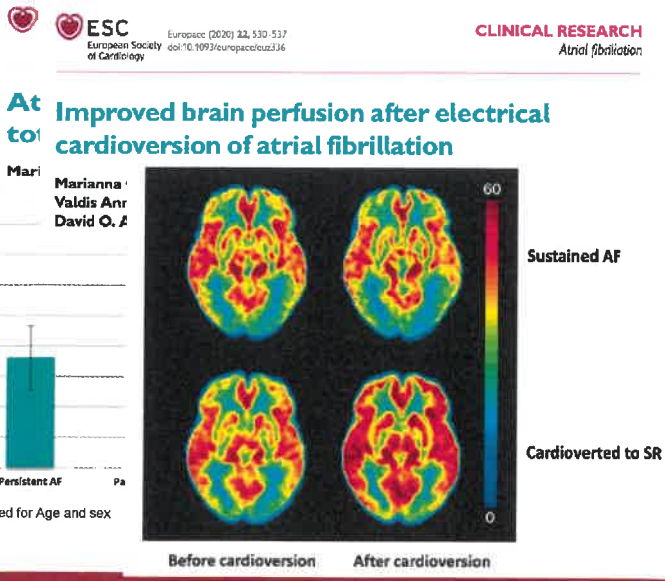
AFIB: BRAIN HYPOPERFUSION



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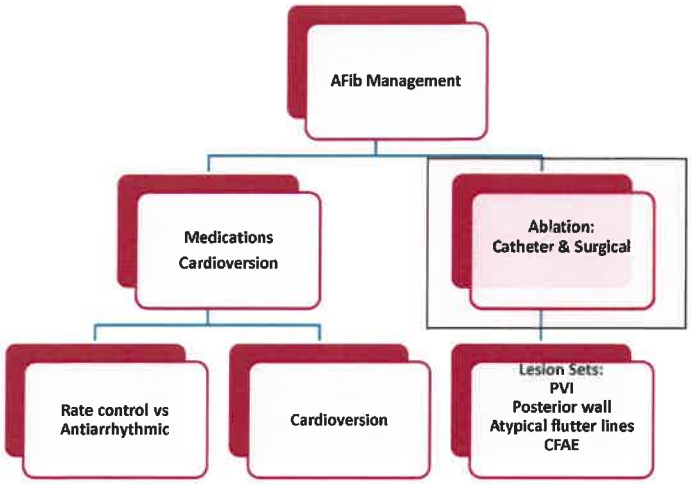
MANAGEMENT STRATEGIES



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BRIEF HISTORY: CATHETER ABLATION

- 1981: First catheter ablation by Dr. Melvin Sheinman
  - High energy DC shocks
  - His work led to development of Radiofrequency energy catheters: more precise
- 1998: Dr. Michelle Haissaguerre first described the use of catheter ablation for Afib.
- 2001: Empiric pulmonary vein isolation

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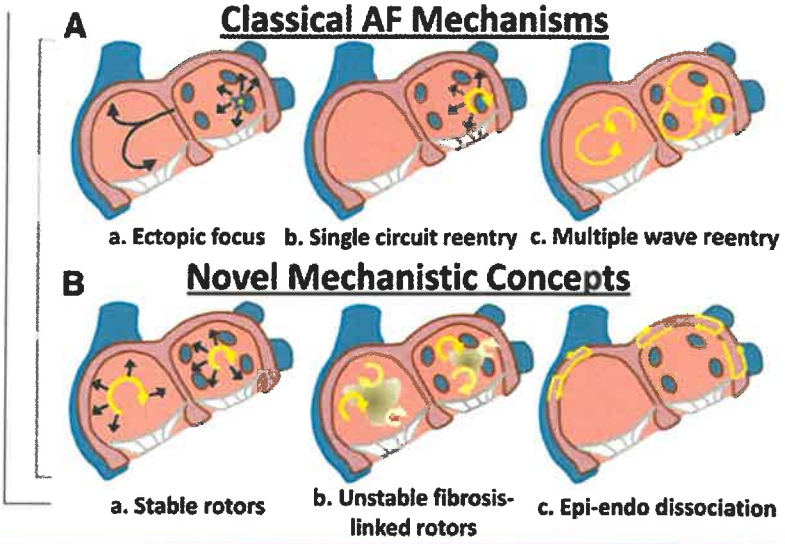
TRIGGERS OF AFIB



Nattel, Stanley, et al. New England Journal of Medicine 359.10 (2008): 1059-1060

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EVOLUTION IN MANAGEMENT

ORIGINAL ARTICLE

A Comparison of Rate Control and Rhythm Control in Patients with Atrial Fibrillation

The Atrial Fibrillation Follow-up Investigation of Rhythm Management (AFFIRM) Investigators*

Rhythm

Rate

Wyse, Gordon, et al. "A comparison of rate control and rhythm control in patients with atrial fibrillation." New England Journal of Medicine 347.23 (2002): 1825-1833.

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EVOLUTION IN MANAGEMENT: AFFIRM TRIAL

ORIGINAL ARTICLE

A Comparison of Rate Control and Rhythm Control in Patients with Atrial Fibrillation

The Atrial Fibrillation Follow-up Investigation of Rhythm Management (AFFIRM) Investigators*

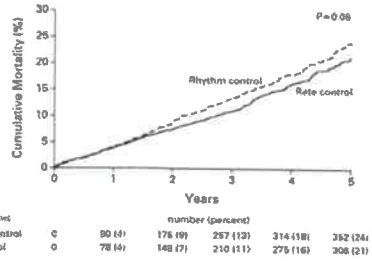
TABLE 1. BASE-LINE CHARACTERISTICS OF THE PATIENTS.*

CHARACTERISTIC	OVERALL (N = 4060)	RATE-CONTROL GROUP (N = 2027)	RHYTHM-CONTROL GROUP (N = 2033)	P VALUE
Age — yr	69.7±9.0	69.8±8.9	69.7±9.0	0.82
Female sex — no. (%)	1594 (39.3)	823 (40.6)	771 (37.9)	0.08
Ethnic minority group — no. (%)	461 (11.4)	241 (11.9)	220 (10.8)	0.28
Predominant cardiac diagnosis — no. (%)				0.29
Coronary artery disease	1059 (26.1)	497 (24.5)	562 (27.6)	
Cardiomyopathy	194 (4.8)	99 (4.9)	95 (4.7)	
Hypertension	2063 (50.8)	1045 (51.6)	1018 (50.1)	
Valvular disease	198 (4.9)	98 (4.8)	100 (4.9)	
Other	42 (1.0)	23 (1.1)	19 (0.9)	
No apparent heart disease	504 (12.4)	265 (13.1)	239 (11.8)	
History of congestive heart failure — no. (%)	939 (23.1)	475 (23.4)	464 (22.8)	0.64
Duration of qualifying atrial fibrillation ≥2 days — no. (%)	2808 (69.2)	1406 (69.4)	1402 (69.0)	0.80
First episode of atrial fibrillation (vs. recurrent episode) — no. (%)†	1391 (35.5)	700 (35.8)	691 (35.3)	0.74
Any prerandomization failure of an antiarrhythmic drug — no. (%)	713 (17.6)	364 (18.0)	349 (17.2)	0.51
Size of left atrium normal — no. (%)‡	1103 (35.3)	549 (35.3)	554 (35.3)	0.98
Left ventricular ejection fraction — %§	54.7±13.5	54.9±13.1	54.6±13.8	0.74
Normal left ventricular ejection fraction — no. (%)‖	2244 (74.0)	1131 (74.9)	1113 (73.2)	0.29

EVOLUTION IN MANAGEMENT: AFFIRM TRIAL

TABLE 2. DRUGS USED IN THE RATE-CONTROL GROUP AND THE RHYTHM-CONTROL GROUP.*

DRUG	RATE-CONTROL GROUP		RHYTHM-CONTROL GROUP	
	USED DRUG FOR INITIAL THERAPY	USED DRUG AT ANY TIME	USED DRUG FOR INITIAL THERAPY	USED DRUG AT ANY TIME
	no. of patients (%)			
Rate control				
Data available	1957	2027	1266	2033
Digoxin	949 (48.5)	1432 (70.6)	417 (32.9)	1106 (54.4)
Beta-blocker	915 (46.8)	1380 (68.1)	276 (21.8)	1008 (49.6)
Diltiazem	583 (29.8)	935 (46.1)	198 (15.6)	610 (30.0)
Verapamil	187 (9.6)	340 (16.8)	56 (4.4)	204 (10.0)
Rhythm control				
Data available	1265	2027	1960	2033
Amiodarone	2 (0.2)†	207 (10.2)	735 (37.5)	1277 (62.8)
Sotalol	1 (0.1)†	84 (4.1)	612 (31.2)	841 (41.4)
Propafenone	2 (0.2)†	45 (2.2)	183 (9.3)	294 (14.5)
Procainamide	0	30 (1.5)	103 (5.3)	173 (8.5)
Quinidine	2 (0.2)†	14 (0.7)	92 (4.7)	151 (7.4)
Flecainide	0	29 (1.4)	88 (4.5)	169 (8.3)
Disopyramide	0	7 (0.3)	42 (2.1)	87 (4.3)
Moricizine	0	2 (0.1)	14 (0.7)	35 (1.7)
Dofetilide	0	5 (0.2)	0	13 (0.6)



No. of Deaths	number (percent)				
Rhythm control	0	80 (4)	176 (9)	257 (13)	314 (16)	352 (24)
Rate control	0	78 (4)	148 (7)	210 (11)	275 (16)	308 (21)

- Cross over rate- 14.9% vs. 37.5% (P<0 001)
- AC could be discontinued in sinus rhythm
- No survival advantage over the rate-control strategy
- lower risk of adverse drug effects, with the rate-control strategy
- Anticoagulation should be continued in this group of high-risk patients.

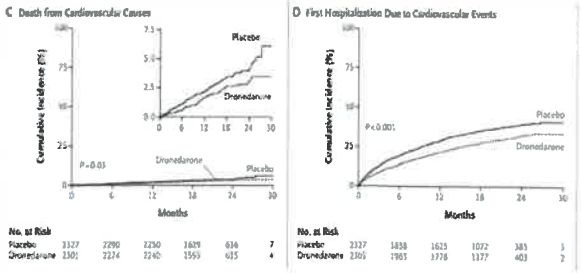
EVOLUTION IN MANAGEMENT: ATHENA

ORIGINAL ARTICLE

Effect of Dronedarone on Cardiovascular Events in Atrial Fibrillation

Stefan H. Hohnloser, M.D., Harry J.G.M. Crijns, M.D., Martin van Eickels, M.D., Christophe Gaudin, M.D., Richard L. Page, M.D., Christian Torp-Pedersen, M.D., and Stuart J. Connolly, M.D., for the ATHENA Investigators*

- Multicenter trial
- N=4628 patients
- Dronedarone 400 mg BID vs placebo
- **Reduced incidence of hospitalization for CV events or death**



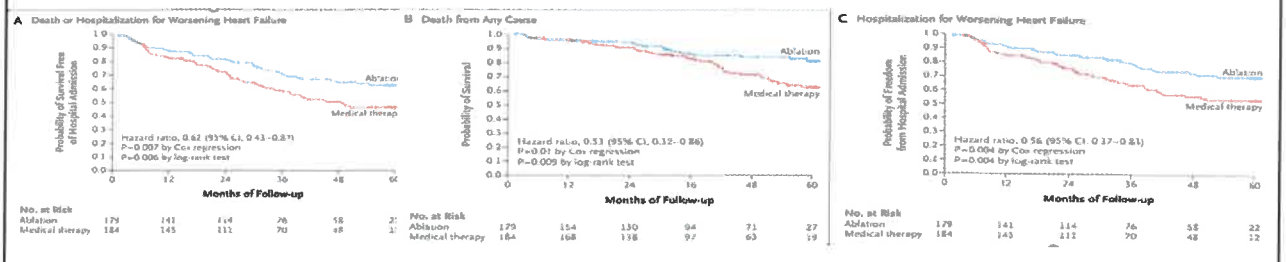
EVOLUTION IN MANAGEMENT: CASTLE-AF TRIAL

ORIGINAL ARTICLE

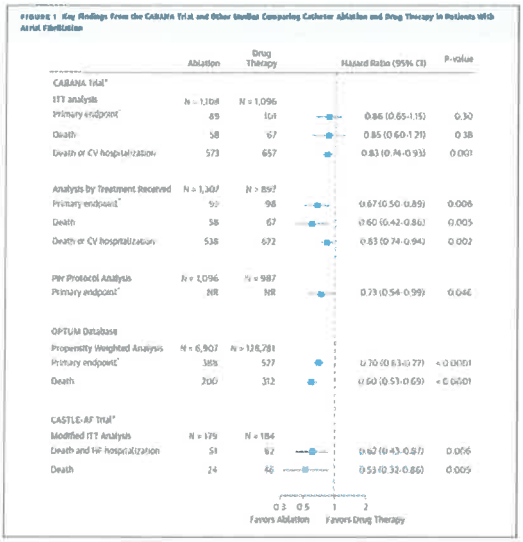
Catheter Ablation for Atrial Fibrillation with Heart Failure

Nassir F. Marrouche, M.D., Johannes Brachmann, M.D., Dietrich Andresen, M.D., Jürgen Siebels, M.D., Lucas Boersma, M.D., Luc Jordaens, M.D., Béla Merkely, M.D., Evgeny Pokushalov, M.D., Prashanthan Sanders, M.D., Jochen Proff, B.S., Heribert Schunkert, M.D., Hildegard Christ, M.D., et al., for the CASTLE-AF Investigators*

- Catheter ablation for AFib in patients with heart failure
- Significantly lower rate of a composite end point of death from any cause or hospitalization for worsening heart failure vs medical therapy



EVOLUTION IN MANAGEMENT



EVOLUTION IN MANAGEMENT: EAST-AFNET

The NEW ENGLAND JOURNAL of MEDICINE

ESTABLISHED IN 1812 OCTOBER 1, 2020 VOL. 383 NO. 14

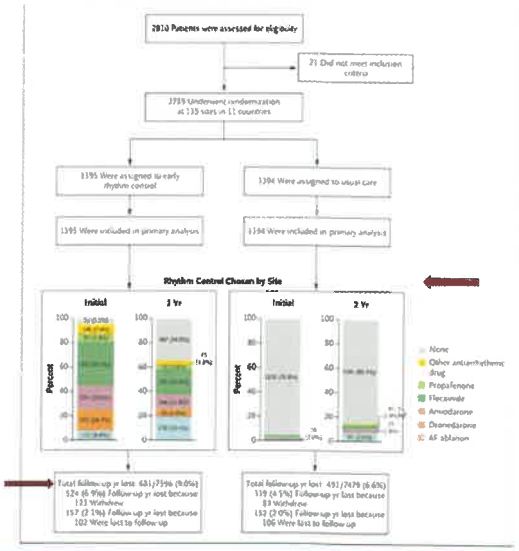
Early Rhythm-Control Therapy in Patients with Atrial Fibrillation

P. Kirchhof, A.J. Camm, A. Goette, A. Brandes, L. Eckardt, A. Elvan, T. Fetsch, I.C. van Gelder, D. Haase, L.M. Haegeli, F. Hamann, H. Heidbüchel, G. Hindricks, J. Kautzner, K.-H. Kuck, L. Mont, G.A. Ng, J. Rekosz, N. Schoen, U. Schotten, A. Suling, J. Taggeselle, S. Themistoclakis, E. Vettorazzi, P. Vardas, K. Wegscheider, S. Willems, H.J.G.M. Crijns, and G. Breithardt, for the EAST-AFNET 4 Trial Investigators*

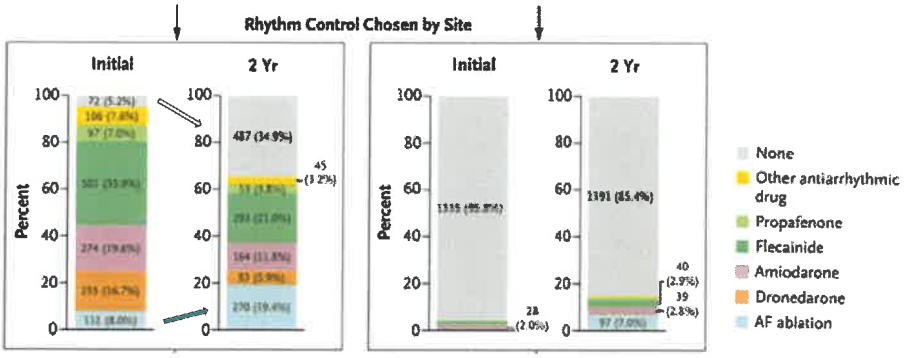
Is a strategy of early rhythm-control therapy that includes atrial fibrillation ablation associated with better outcomes in patients with early atrial fibrillation than contemporary, evidence-based usual care?

EVOLUTION IN MANAGEMENT: EAST-AFNET

- Multicenter, parallel-group, randomized, open, blinded-outcome-assessment trial.
- N= 2789
- 135 sites (11 European countries between July 2011-December 2016)
- Enrolled median of 36 days after first diagnosis of Afib
- Median follow up of 5.1 yrs



EVOLUTION IN MANAGEMENT: EAST-AFNET



- Flecainide was most commonly used (35.9%)
- Poor adherence to antiarrhythmics (5.2%>> 34.9% at 2yrs)
- 8% AF ablation at study onset

EVOLUTION IN MANAGEMENT: EAST-AFNET

Trial Interventions

- Anticoagulation and treatment of cardiovascular conditions mandated in all patients
- **Early rhythm control:**
  - Antiarrhythmic drugs, AF ablation, Cardioversion of persistent atrial fibrillation
  - Early rhythm-control group transmitted a patient-operated single-lead ECG twice per week and when symptomatic
- **Usual care group** initially treated with rate-control therapy without rhythm-control therapy.
  - Rhythm-control therapy was used only to mitigate uncontrolled atrial fibrillation–related symptoms during adequate rate-control therapy

Outcome Measures

- Primary Outcome:
  - Composite of CV death , stroke , or hospitalization with worsening of heart failure or acute coronary syndrome
  - Number of nights spent in the hospital per year.
- Secondary outcomes:
  - Each component of the first primary outcome, rhythm, left ventricular function, quality of life, atrial fibrillation–related symptoms and cognitive function

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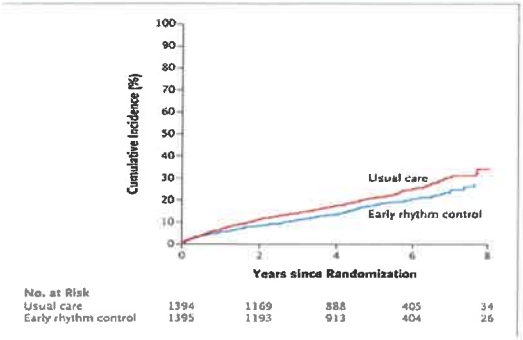
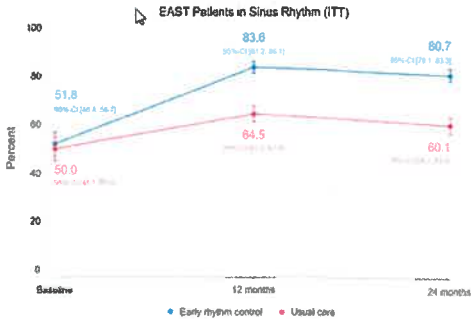
EVOLUTION IN MANAGEMENT: EAST-AFNET





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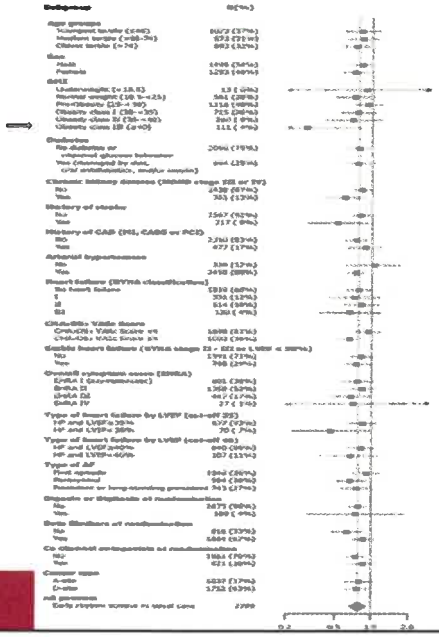
EVOLUTION IN MANAGEMENT: EAST-AFNET

Table 2. Efficacy Outcomes.*

Outcome	Early Rhythm Control	Usual Care	Treatment Effect
First primary outcome — events/person-yr (incidence/100 person-yr)	249/6399 (3.9)	316/6332 (5.0)	0.79 (0.66 to 0.94)†
Components of first primary outcome — events/person-yr (incidence/100 person-yr)			
Death from cardiovascular causes	67/6915 (1.0)	94/6988 (1.3)	0.72 (0.52 to 0.98)‡
Stroke	40/6813 (0.6)	62/6856 (0.9)	0.65 (0.44 to 0.97)‡
Hospitalization with worsening of heart failure	139/6620 (2.1)	169/6558 (2.6)	0.81 (0.65 to 1.02)‡
Hospitalization with acute coronary syndrome	53/6762 (0.8)	65/6816 (1.0)	0.83 (0.58 to 1.19)‡
Second primary outcome — nights spent in hospital/yr	5.8±21.9	5.1±15.5	1.08 (0.92 to 1.28)§
Key secondary outcomes at 2 yr			
Change in left ventricular ejection fraction — %	1.5±9.8	0.8±9.8	0.23 (−0.46 to 0.91)¶
Change in EQ-5D score‖	−1.0±21.4	−2.7±22.3	1.07 (−0.68 to 2.82)¶
Change in SF-12 Mental Score**	0.7±10.6	1.6±10.1	−1.20 (−2.04 to −0.37)¶
Change in SF-12 Physical Score**	0.3±8.5	0.1±8.2	0.33 (−0.39 to 1.06)¶
Change in MoCA score	0.1±3.3	0.1±3.2	−0.14 (−0.39 to 0.12)¶
Sinus rhythm — no. of patients with feature/total no. (%)	921/1122 (82.1)	687/1135 (60.5)	3.13 (2.55 to 3.84)††
Asymptomatic — no. of patients with feature/total no. (%)‡‡	861/1159 (74.3)	850/1171 (72.6)	1.14 (0.93 to 1.40)††

EVOLUTION IN MANAGEMENT: EAST-AFNET



-No major differences in subgroup analysis
-Obesity Class III (BMI>40) patients appear to do much better with early rhythm control

EVOLUTION IN MANAGEMENT: EAST-AFNET

Table 3. Safety Outcomes.*

Outcome	Early Rhythm Control (N=1395)	Usual Care (N=1394)
	number (percent)	
Primary composite safety outcome	231 (16.6)	223 (16.0)
Stroke	40 (2.9)	62 (4.4)
Death	138 (9.9)	164 (11.8)
Serious adverse event of special interest related to rhythm-control therapy	68 (4.9)	19 (1.4)
Serious adverse event related to antiarrhythmic drug therapy		
Nonfatal cardiac arrest	1 (0.1)	1 (0.1)
Toxic effects of atrial fibrillation–related drug therapy	10 (0.7)	3 (0.2)
Drug-induced bradycardia	14 (1.0)	5 (0.4)
Atrioventricular block	2 (0.1)	0
Torsades de pointes tachycardia	1 (0.1)	0
Serious adverse event related to atrial fibrillation ablation		
Pericardial tamponade	3 (0.2)	0
Major bleeding related to atrial fibrillation ablation	6 (0.4)	0
Nonmajor bleeding related to atrial fibrillation ablation	1 (0.1)	2 (0.1)
Other serious adverse event of special interest related to rhythm-control therapy		
Blood pressure–related event†	1 (0.1)	0
Hospitalization for atrial fibrillation	11 (0.8)	3 (0.2)
Other cardiovascular event	5 (0.4)	1 (0.1)
Other event	1 (0.1)	3 (0.2)
Syncope	4 (0.3)	1 (0.1)
Hospitalization for worsening of heart failure with decompensated heart failure	3 (0.2)	0

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EAST-AF NET

Key considerations

- Loss to follow up and cross-over rates
  - 9% vs 6.6% loss to follow up in early rhythm control vs rate control
  - 7% of patients in rate control arm received AF ablation by 2yrs
- 90% of patients continued AC
- Serious Adverse effect rate 4.9% (ERC) vs 1.4% (Rate)
- Sinus rhythm assessed by EKG not continuous monitoring
  - Possible overestimation?
- Relatively low AF ablation rate
  - 8% at onset and 20% by 2yrs
- Trend towards reduced hospitalization with rhythm control

Conclusion

- A strategy of early rhythm-control therapy which includes AF ablation was associated with a lower risk of adverse cardiovascular outcomes than usual care among patients with early atrial fibrillation and cardiovascular conditions

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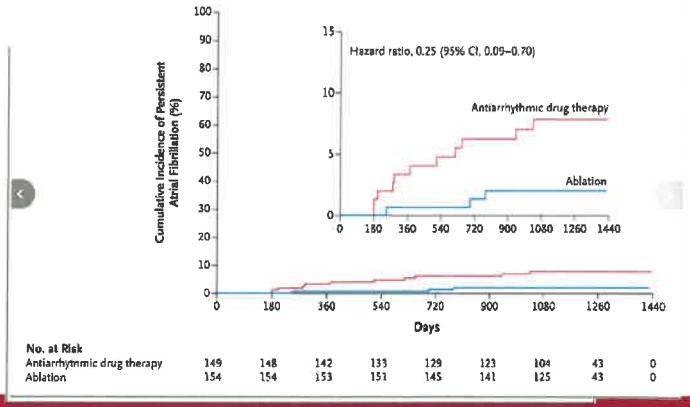
EVOLUTION IN MANAGEMENT

ORIGINAL ARTICLE

Progression of Atrial Fibrillation after Cryoablation or Drug Therapy

Authors: Jason G. Andrade, M.D., Marc W. Deyell, M.D., Laurent Macle, M.D., George A. Wells, Ph.D., Matthew Bennett, M.D., Vidal Essebag, M.D., Ph.D., Jean Champagne, M.D., ns , for the EARLY-AF Investigators* Author Info



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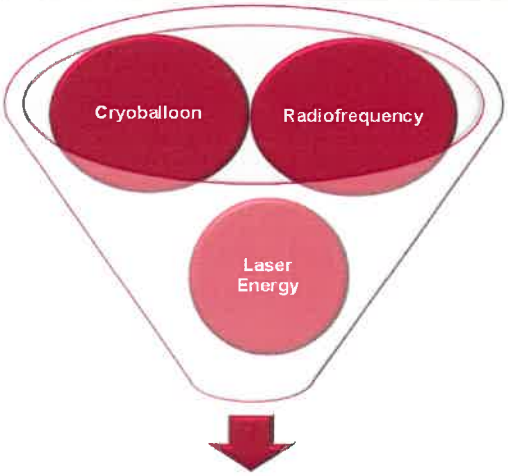
CATHETER ABLATION: SAFETY CONSIDERATIONS

Thermal Ablation Modalities



Tissue Indiscrimate Destructive Effects

- Stroke
- Pulmonary vein stenosis
- Phrenic nerve palsy
- Pericardial tamponade
- Atrio-esophageal fistula

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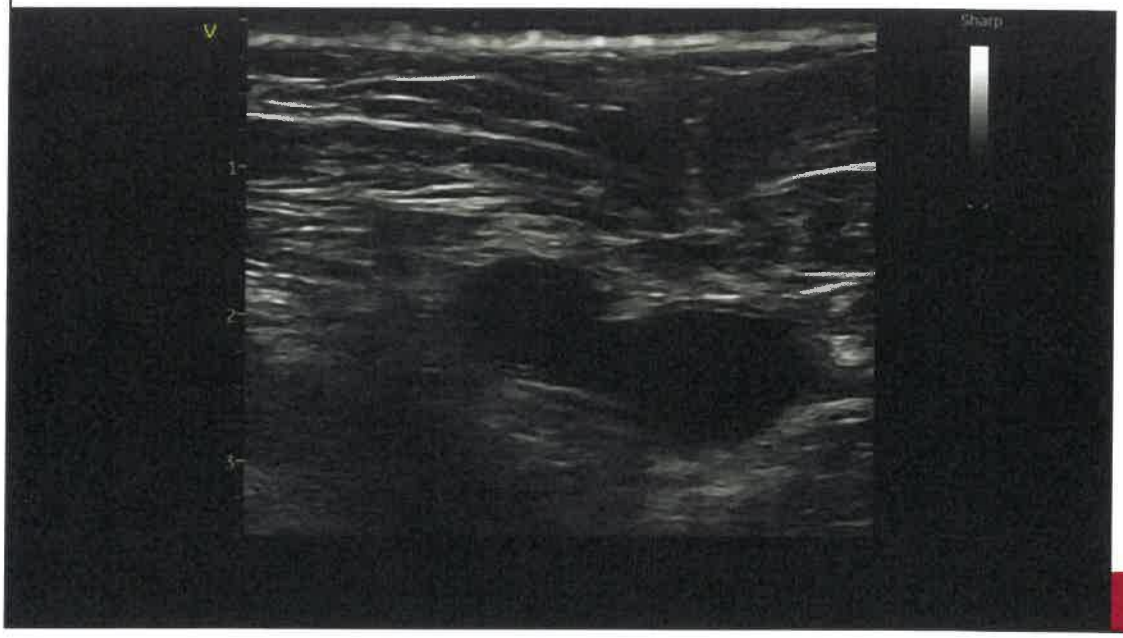
AF ABLATION WORKFLOW



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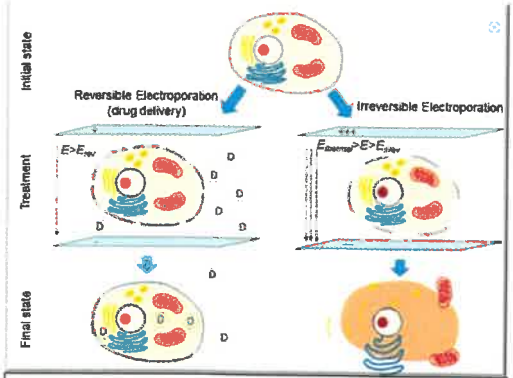
PULSED FIELD ABLATION

- Ultra-rapid electrical pulses to generate strong electrical fields with resultant irreversible nanoscale pore formation
  - Mechanism of cellular death
- Preclinical and Clinical studies have displayed **preferential tissue ablation**
  - Optimized voltage amplitude, phasic waveforms and pulse sequences
  - Avoid damage to pericardiac structures



Lopez-Alonso et al

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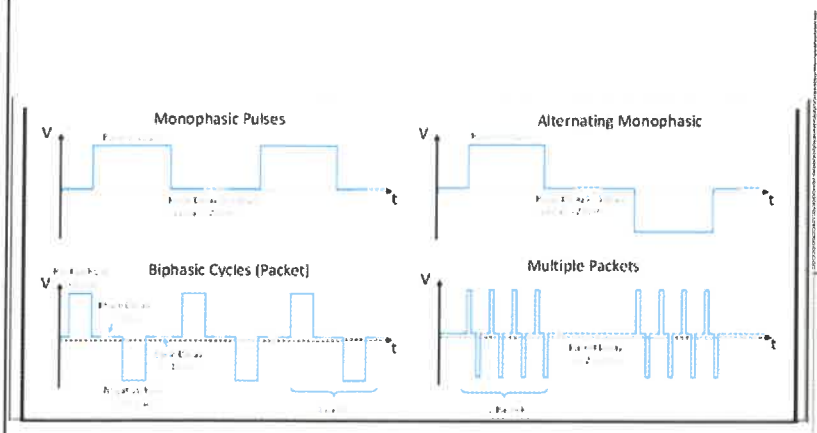
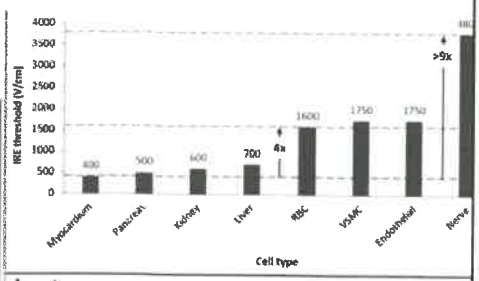
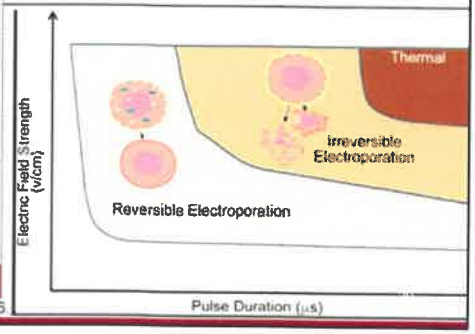
PULSED FIELD ABLATION: BIOPHYSICS

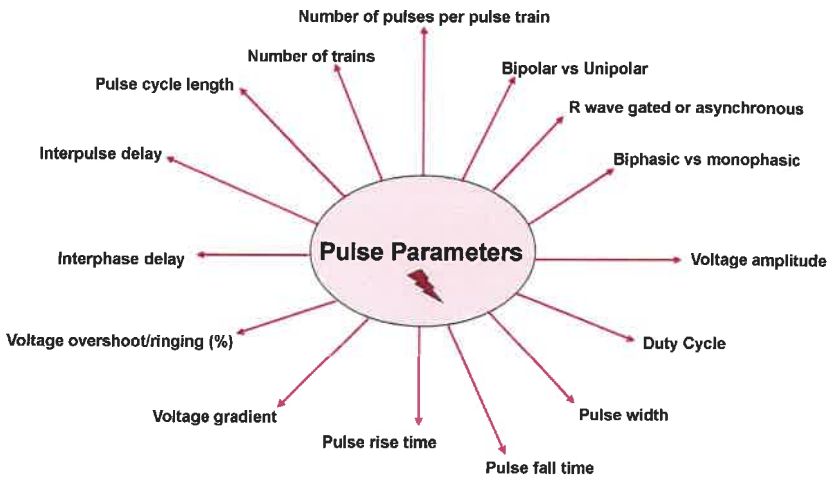






Verma, A., Asivatham, S. J., Deneke, T., Castellvi, Q., & Neal, R. E. (2021). Primer on pulsed electrical field ablation: understanding the benefits and limitations. *Circulation: Arrhythmia and Electrophysiology*, *14*(9), e010086

PULSED FIELD ABLATION: BIOPHYSICS



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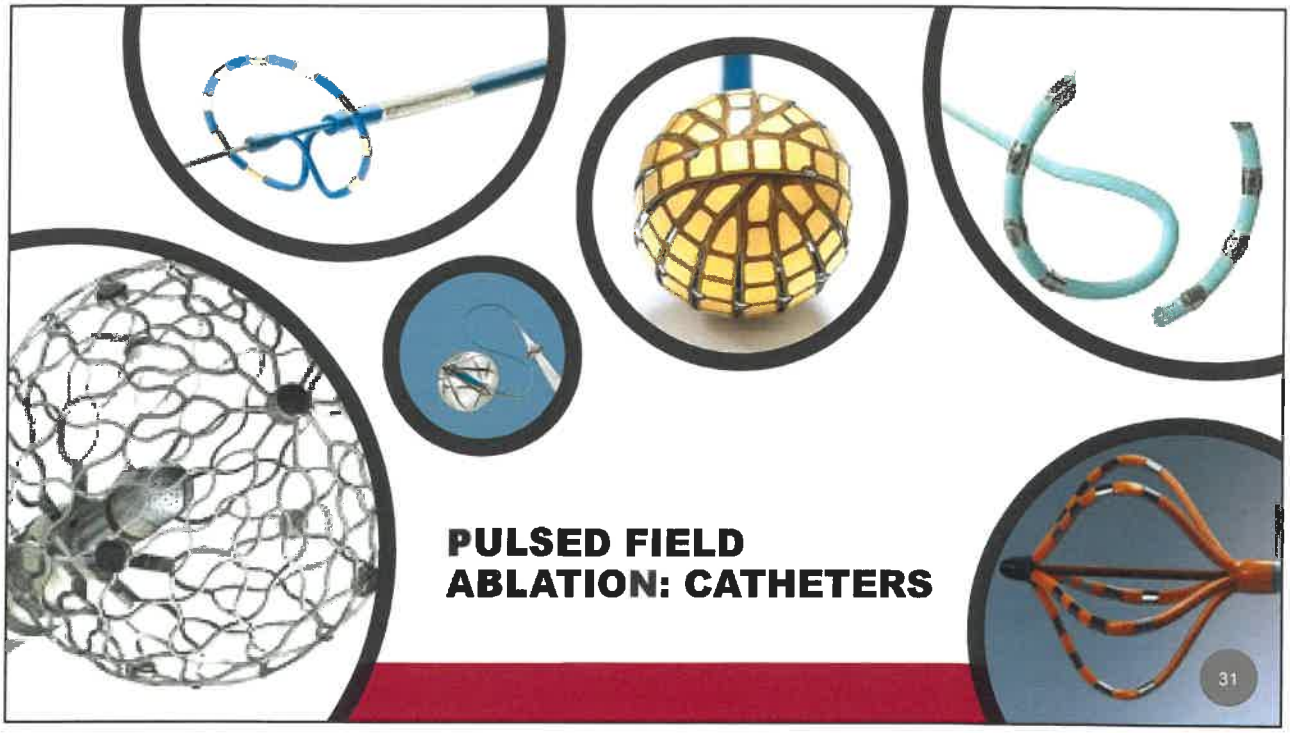

PRECLINAL: PENTASPLINE CATHETER

Original Investigation

Pulsed Field Ablation for Pulmonary Vein Isolatio Atrial Fibrillation

Vivek Y. Reddy MD [a, b], Petr Neuzil MD, PhD [a], Jaco Jan Petru MD [a], Moritoshi Funosako MD [a], Hubert Coch MD [a], Milan Chovanec MD [a], Srinivas R. Dukkipati MD [a]

JACC: Clinical Electrophysiology
Volume 7, Issue 5, May 2021, Pages 614-627

Pulsed Field Ablation Fibrillation: 1-Year Ou PEFCAT, and PEFCAT

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Original Investigation

Pulsed Field Ablation in Patients With Persistent Atrial Fibrillation

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- Demonstrated safety and efficacy of PFA for Atrial Fibrillation
- Total sample size <150 pts

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BACKGROUND

Pulsed Field Ablation

- Thermal ablation (RF / Cryo) is largely tissue indiscriminate
  - As the thermal (heat / cold) wave propagates, all tissues are ablated
  - Potential for damage to adjacent tissues:
    - Esophagus → AE fistula, Gastroparesis
    - Phrenic nerve → Diaphragmatic paralysis
    - Pulmonary Vein → PV Stenosis
- Pulsed Field Ablation: Instead of thermal energy, damages by electroporating tissue
  - Preclinical indicate an important degree of preferentiality to myocardial tissue ablation
  - *MANIFEST-PF* Registry (>1,500 patients undergoing PFA): No evidence of esophageal damage or PV stenosis, and only rare phrenic nerve paralysis (<1 in 1000)

VY.Reddy, P.Neuzil, J.Koruth, et al, *J Am Coll Cardiol* 74:315–26 (2019)
M.Turagam, P.Neuzil, B.Schmidt...VY.Reddy, *Circulation* 148:35–46 (2023)

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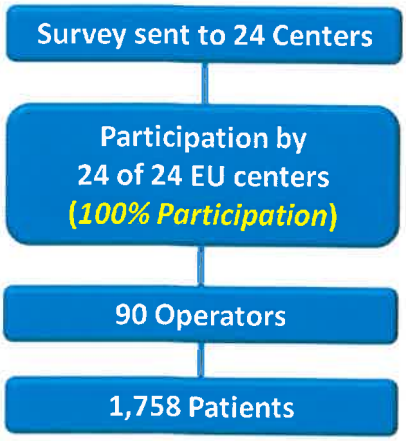
MANIFEST-PF STUDY

Goal

- To assess the "real world" performance of the pentaspline PFA catheter:
  - How is it being used?
  - Acute effectiveness
  - Safety: in particular, rare esophageal effects and other unforeseen PFA-related complications



Ekanem, E., Reddy, V. Y., Schmidt, B., Reichlin, T., Neven, K., Metzner, A., ... & MANIFEST-PF Cooperative. (2022). Multi-national survey on the methods, efficacy, and safety on the post-approval clinical use of pulsed field ablation (MANIFEST-PF). *Europace*, *24*(8), 1256-1266.

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MANIFEST-PF STUDY

	Data (%)
General Anesthesia / Intubation (%)	17.8%
Deep Sedation / No Intubation (%)	82.1%
No. of Transeptal Punctures, n (%)	1 (100%)
Procedure Time (minutes), mean (min-max)	65 (38-215)
Fluoroscopy Time (minutes), mean (min-max)	13.7 (4.5-33)
Same Day Discharge (%)	15.8%

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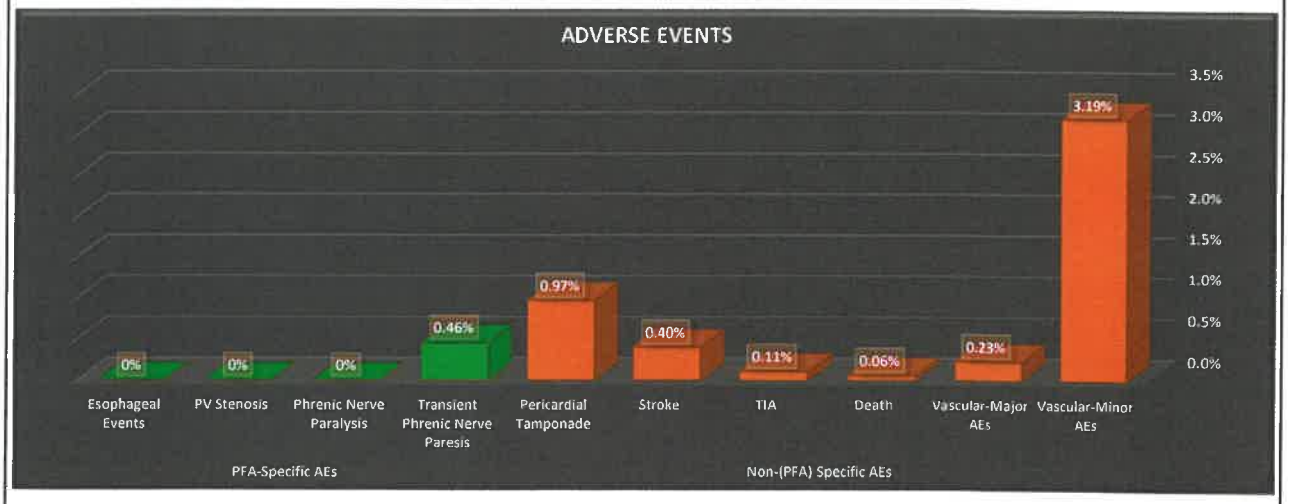
MANIFEST-PF STUDY



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  - Preclinical indicate an important degree of preferentiality to myocardial tissue ablation
  - *MANIFEST-PF* Registry (>1,500 patients undergoing PFA): No evidence of esophageal damage or PV stenosis, and only rare phrenic nerve paralysis (<1 in 1000)
- But:
  1. Rem: with cryoballoon ablation, we initially thought that atrio-esophageal fistula couldn't happen → only observed after a couple thousand patients were treated
  2. Unforeseen PFA-related AEs may only manifest after thousands of procedures

VY.Reddy, P.Neuzil, J.Koruth, et al, *J Am Coll Cardiol* 74:315–26 (2019)
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MANIFEST-17K STUDY

Goals

1. Assess whether PFA truly demonstrates a clinically-important degree of preferentiality to myocardial tissue ablation
   - ➢ Esophageal damage, Pulmonary vein stenosis, Phrenic nerve injury
2. Assess if PFA is associated with other unusual adverse events

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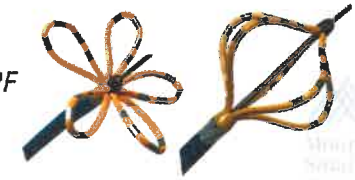
METHODS

MANIFEST-17K

- Retrospective observational study of centers performing PFA after EU regulatory approval of the **pentaspline PFA catheter** (Farawave, Boston Scientific Inc, Marlborough, MA)
  - Contacted **all** 116 centers (Europe, Israel) performing clinical PFA cases to treat AF
- Data form sent to all sites willing to participate
  - Primarily center-level data
  - But additional queries sent to obtain additional details about certain AEs (eg, coronary spasm, deaths, etc)
- Excluded the initial patients already reported in *MANIFEST-PF*
  - Excluded 1,758 patients at the original 24 *MANIFEST-PF* sites



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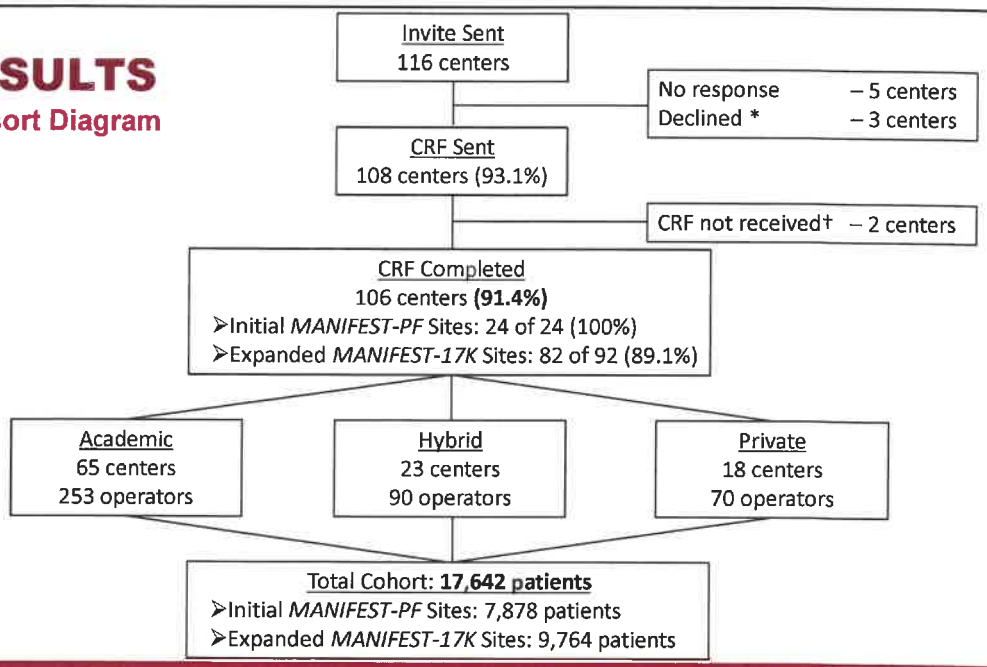
RESULTS

Consort Diagram



* 2 centers declined due to time required for regulatory approval, 1 center declined due to lack of research staff.
† 1 center could not provide data within specified time frame, 1 center was not reachable after initial correspondence.

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RESULTS

Baseline Patient Characteristics

	Full *MANIFEST-17K* Cohort (N=17,642)
Demographic	
Age (years), Mean (min-max)	64 (11-96)
Female (%)	34.7
Indication for ablation	
Paroxysmal atrial fibrillation (%)	57.8
Persistent atrial fibrillation (%)	35.2
Longstanding persistent atrial fibrillation (%)	5.6
Atrial flutter/atrial tachycardia (%)	1.4
Sedation	
General anesthesia (%)	46.9
Deep Sedation/no intubation (%)	53.1

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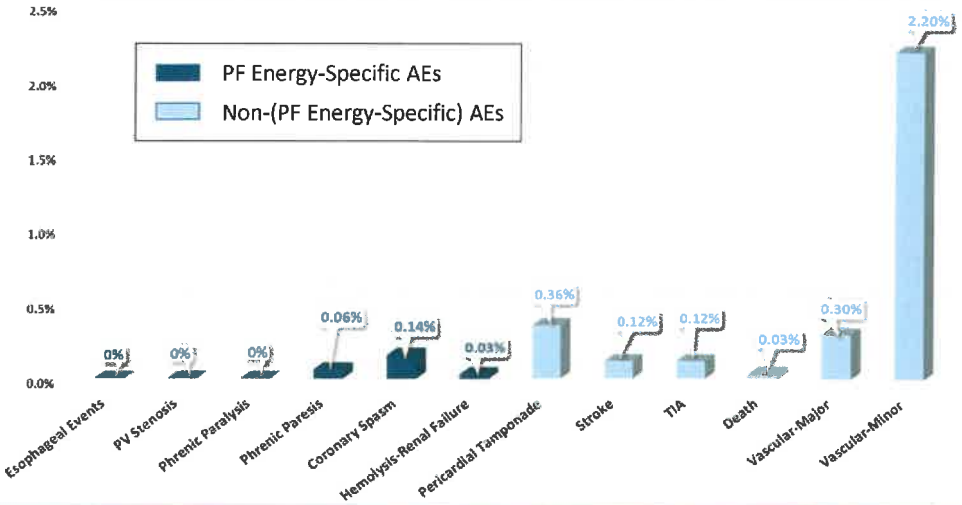
RESULTS

Complications Rates Partitioned by Relationship to Pulsed Field Energy



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RESULTS

Major and Minor Complications

	Full Patient Cohort from All *MANIFEST-17K* Sites 106 Sites (N=17,642)
Major Adverse Events	**173 (0.98%)**
Death †	5 (0.03) †
Stroke	22 (0.12)
Esophageal fistula or dysmotility	0 (0)
Pulmonary vein stenosis	0 (0)
Phrenic nerve injury (persistent) ‡	0 (0) ‡
Pericardial tamponade †	63 (0.36) †
Percutaneous intervention	56 (0.32)
Surgical intervention †	7 (0.04) †
Vascular complication (with intervention)	53 (0.30)
Coronary artery spasm	25 (0.14)
Myocardial Infarction	0 (0.0)
Hemolysis-Renal Failure (hospitalization)	5 (0.03)
Other (thrombosis)	1 (0.006)

† One patient requiring surgical intervention for tamponade subsequently died and is thus counted in both categories.
‡ Persistent injury is defined as being present beyond hospital discharge, while transient injury has recovered by discharge.

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RESULTS

Major and Minor Complications

	Full Patient Cohort from All *MANIFEST-17K* Sites 106 Sites (N=17,642)
Minor Adverse Events	**567 (3.21%)**
Transient Ischemic Attack	21 (0.12)
Phrenic nerve palsy (transient) ‡	11 (0.06) ‡
Pericardial effusion (no intervention)	59 (0.33)
Pericarditis	30 (0.17)
Vascular complications (no intervention)	388 (2.20)
Hemolysis-Renal Failure (no hospitalization)	1 (0.006)
Other complications	57 (0.32)

‡ Persistent injury is defined as being present beyond hospital discharge, while transient injury has recovered by discharge.

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RESULTS

Coronary Artery Spasm

	Coronary Spasm N = 25 (0.14%)
Type of Spasm:	
Proximity-Related Spasm *	22 (88%)
Generalized Spasm †	3 (12%)
EKG changes	23 (92%)
Hypotension	5 (20%)
Acute Clinical sequelae	4 (16%)
Chest Pain	2 (8%)
Ventricular Fibrillation	2 (8%)
IV Nitroglycerin Administered	21 (84%)

* Spasm occurring during PFA adjacent to a coronary artery, either during mitral isthmus or cavotricuspid isthmus ablation.
† Spasm occurring during conventional PV application remote from the location of a coronary artery.

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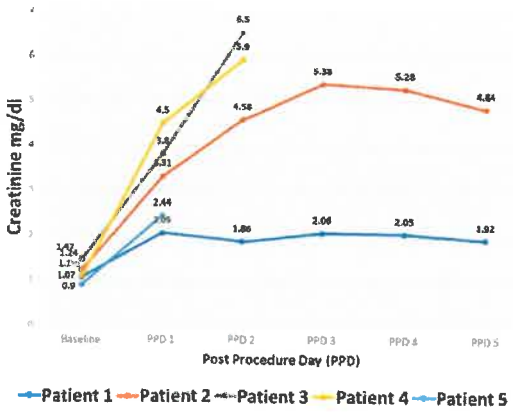
RESULTS

Hemolysis →Acute Renal Failure Requiring Hemodialysis

- Occurred in 5 pts (0.03%)
  - All had Persistent AF
  - Baseline Creatinine
    - ➢ Normal in 3 pts
    - ➢ Mildly elevated in 2 pts (1.2 & 1.5 mg/dl)
- PFA lesion set was complex in all pts
  - PVI, posterior wall ablation, mitral/CTI lines
  - Total PF lesions/procedure: 143±27
- Transient hemodialysis was utilized for all patients with significant improvement in renal function by the time of hospital discharge
  - Renal function normalized in all in follow-up



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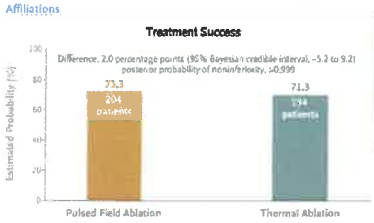
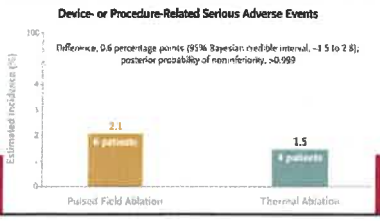
FDA APPROVED CATHETERS

ORIGINAL ARTICLE

Pulsed Field or Conventional Thermal Ablation for Paroxysmal Atrial Fibrillation

Authors: Vivek Y. Reddy, M.D., Edward P. Gerstenfeld, M.D., Andrea Natale, M.D., William Whang, M.D., Frank A. Cuoco, M.D., Chinmay Patel, M.D., Stavros E. Mountantonakis, M.D., , for the ADVENT Investigators* Author Info & Affiliations





Pulsed Field Ablation for the Treatment of Atrial Fibrillation: PULSED AF Pivotal Trial

Atul Verma, David E. Haines, Lucas V. Boersma, Nitesh Sood, Andrea Natale, Francis E. Marchlinski, Hugh Calkins, Prashanthan Sanders, Douglas L. Packer, Karl-Heinz Kuck, Gerhard Hindricks, Birce Onal, Jeffrey Cerkvenik, Hiroshi Tada, David B. DeLurgio and on behalf of the PULSED AF Investigators

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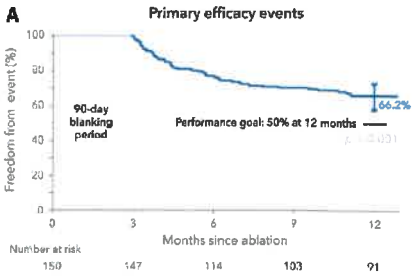

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THANK YOU