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ROMA
Centro Congressi
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9ª Edizione

30 Settembre
1 Ottobre
2022

CRYOABLATION IN AF: 2022 NEWS

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Policlinico Agostino Gemelli IRCCS Roma

Agenda Cryo News

- Cryoballon as initial treatement of AF: State of the art
- Meta-analysis RFA vs AAD; CRYo vs AAD
- Predictors of acute and mid-term success: BMI - Gender difference- Anatomy-Case Volume
- The clock is ticking for Cryo ?: nuove tecnologie

East Afnet 2022

ESC European Society of Cardiology

European Heart Journal (2022) **00**, 1–18
https://doi.org/10.1093/eurheartj/ehac471

FASTTRACK CLINICAL RESEARCH
Arrhythmias

Attaining sinus rhythm mediates improved outcome with early rhythm control therapy of atrial fibrillation: the EAST-AFNET 4 trial

Lars Eckardt [1,2†], Susanne Sehner[3†], Anna Suling[3], Katrin Borof[4], Guenter Breithardt [1,2], Harry Crijns [5], Andreas Goette [2,6], Karl Wegscheider [2,3,7], Antonia Zapf[3,7], John Camm [8], Andreas Metzner [4,7], and Paulus Kirchhof [2,4,7,9*]

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Received 6 July 2022; revised 10 August 2022; accepted 12 August 2022

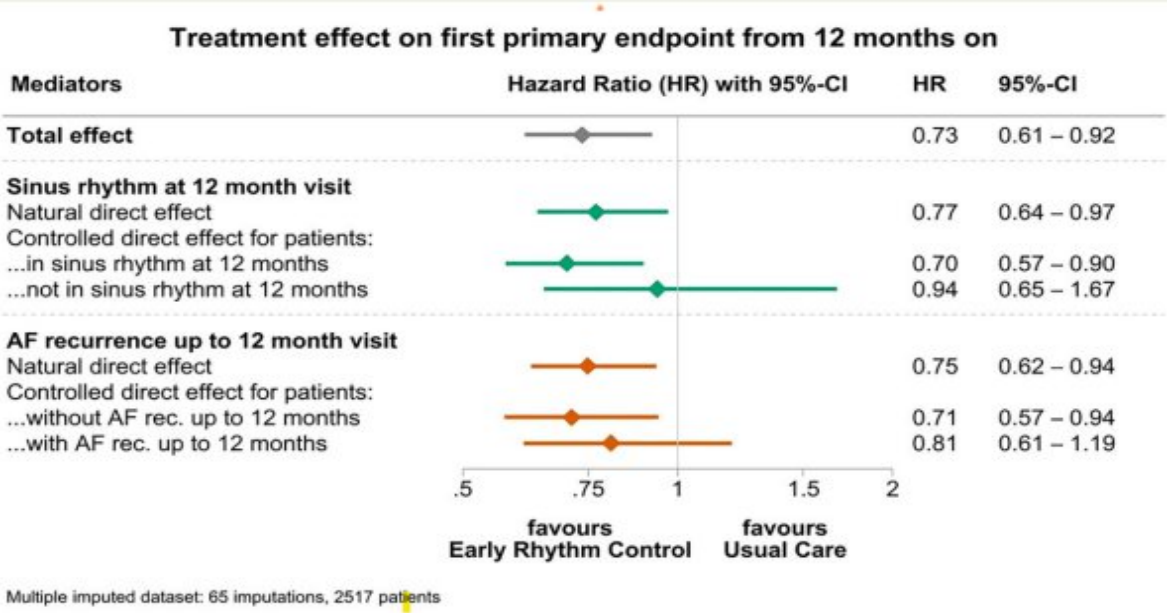

Figure 2 Strong mediating and moderating effect of sinus rhythm at 12 months on the first primary outcome of the EAST-AFNET 4 trial. The presence of sinus rhythm at 12 months explains about 81% of the effect of early rhythm control on the first primary outcome, a composite of cardiovascular death, stroke, or hospitalization for heart failure, or acute coronary syndrome. This can be appreciated in the first horizontal line in the graph (natural effect). There is hardly any effect of early rhythm control in patients who are not in sinus rhythm at the 12-month visit, visible in lack of a controlled direct effect in patients not in sinus rhythm at 12 months. Atrial fibrillation recurrence at any time up to the 12-month visit, in contrast, only explains 31% of the effect of early rhythm control, due to the small differences between the effects of the two subgroups (controlled effect in patients without AF recurrence and patients with AF recurrence). The analysis is adjusted for baseline characteristics that may confound the treatment effects on the mediator or the mediator effect on the outcome. Total effect indicates the adjusted treatment effect on the outcome; natural direct effect indicates the adjusted treatment effect due to the observed distribution of the mediator; controlled direct effect indicates the adjusted treatment effect for subgroups of patients with and without sinus rhythm or with and without atrial fibrillation recurrence at 12 months.

JOURNAL OF THE AMERICAN COLLEGE OF CARDIOLOGY VOL. 78, NO. 9, 2021

THE PRESENT AND FUTURE

JACC STATE-OF-THE-ART REVIEW

Cryoballoon Ablation as Initial Treatment for Atrial Fibrillation

JACC State-of-the-Art Review

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FIRST LINE CRYOBALLOON ABLATION in PAROXYSMAL AF

TABLE 1 Study Characteristics

	Cryo-FIRST	EARLY-AF	STOP-AF First
Design	Prospective, multicenter, randomized	Prospective, multicenter, randomized	Prospective, multicenter, randomized
Setting (number of centers)	Australia, Europe, Latin America (20)	Canada (18)	United States (24)
Enrollment	2014-2018	2017-2018	2017-2019
Blanking period	90 days from cryoablation procedure or AAD initiation	90 days from cryoablation procedure or AAD initiation	90 days from cryoablation procedure or AAD initiation
Follow-up duration	12 months	12 months	12 months
Primary outcome	Any recurrence of atrial tachyarrhythmia (AF, AT, AFL) lasting longer than 30 seconds	Any recurrence of atrial tachyarrhythmia (AF, AT, AFL) lasting longer than 30 seconds	Any recurrence of atrial tachyarrhythmia (AF, AT, AFL) lasting longer than 30 seconds
Key secondary outcomes	• Quality of life (AFEQT) • Symptoms • Health care use • Adverse events	• Quality of life (AFEQT, EQ5D) • Symptoms • Health care use • Adverse events	• Quality of life (AFEQT) • Health care use • Adverse events

AF = atrial fibrillation; AFEQT = Atrial Fibrillation Effect on QualiTy-of-life; AFL = atrial flutter; AT = atrial tachycardia; Cryo-FIRST = Catheter Cryoablation Versus Antiarrhythmic Drug as First-Line Therapy of Paroxysmal Atrial Fibrillation; EARLY-AF = Early Aggressive Invasive Intervention for Atrial Fibrillation; STOP-AF First = Cryoballoon Catheter Ablation in an Antiarrhythmic Drug Naive Paroxysmal Atrial Fibrillation.

FIRST LINE CRYOBALLOON ABLATION

TABLE 3 Rhythm Monitoring Protocols and Arrhythmia Detection

	Cryo-FIRST	EARLY-AF	STOP-AF First
Primary outcome	Any recurrence of atrial tachyarrhythmia (AF, AT, AFL) lasting longer than 30 seconds	Any recurrence of atrial tachyarrhythmia (AF, AT, AFL) lasting longer than 30 seconds	Any recurrence of atrial tachyarrhythmia (AF, AT, AFL) lasting longer than 30 seconds
Monitoring protocol and adherence	7-day Holter every 3 months (94% adherence)	Implantable loop recorder with daily transmissions (100% adherence)	24-h Holter at 6 and 12 months (87% adherence) Weekly patient-activated transtelephonic event recorder (81% adherence)
Freedom from documented atrial tachyarrhythmia	82.2% ablation 67.6% AAD	57.1% ablation 32.2% AAD	79.8% ablation 64.6% AAD
Absolute risk reduction	14.6%	24.9%	15.2%
Relative risk (95% confidence interval)	0.50 (0.29-0.86)	0.63 (0.51-0.78)	0.57 (0.36-0.91)

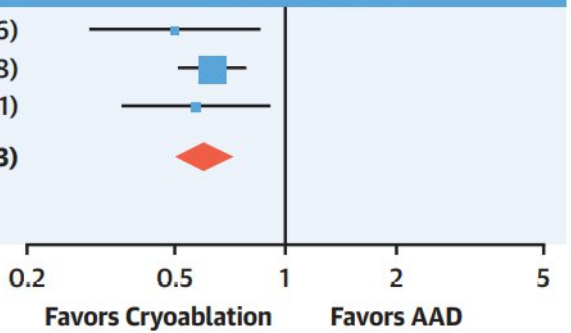
Abbreviations as in Tables 1 and 2.

FIRST LINE CRYOBALLOON ABLATION_ POOLED ANALYSIS

FIGURE 2 Atrial Tachyarrhythmia Recurrence

A Any Atrial Tachyarrhythmia

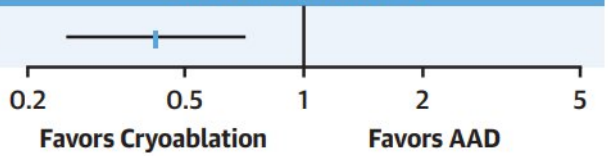
Study	Cryoablation Events	Cryoablation Total	AAD Events	AAD Total	Weight	Risk Ratio M-H, Random, 95% CI
Cryo-FIRST	16	107	33	111	11.6%	0.50 (0.29-0.86)
EARLY-AF	66	154	101	149	73.0%	0.63 (0.51-0.78)
STOP-AF First	21	104	35	99	15.3%	0.57 (0.36-0.91)
Total (95% CI)		**365**		**359**	**100.0%**	**0.61 (0.51-0.73)**
Total events	103		169			



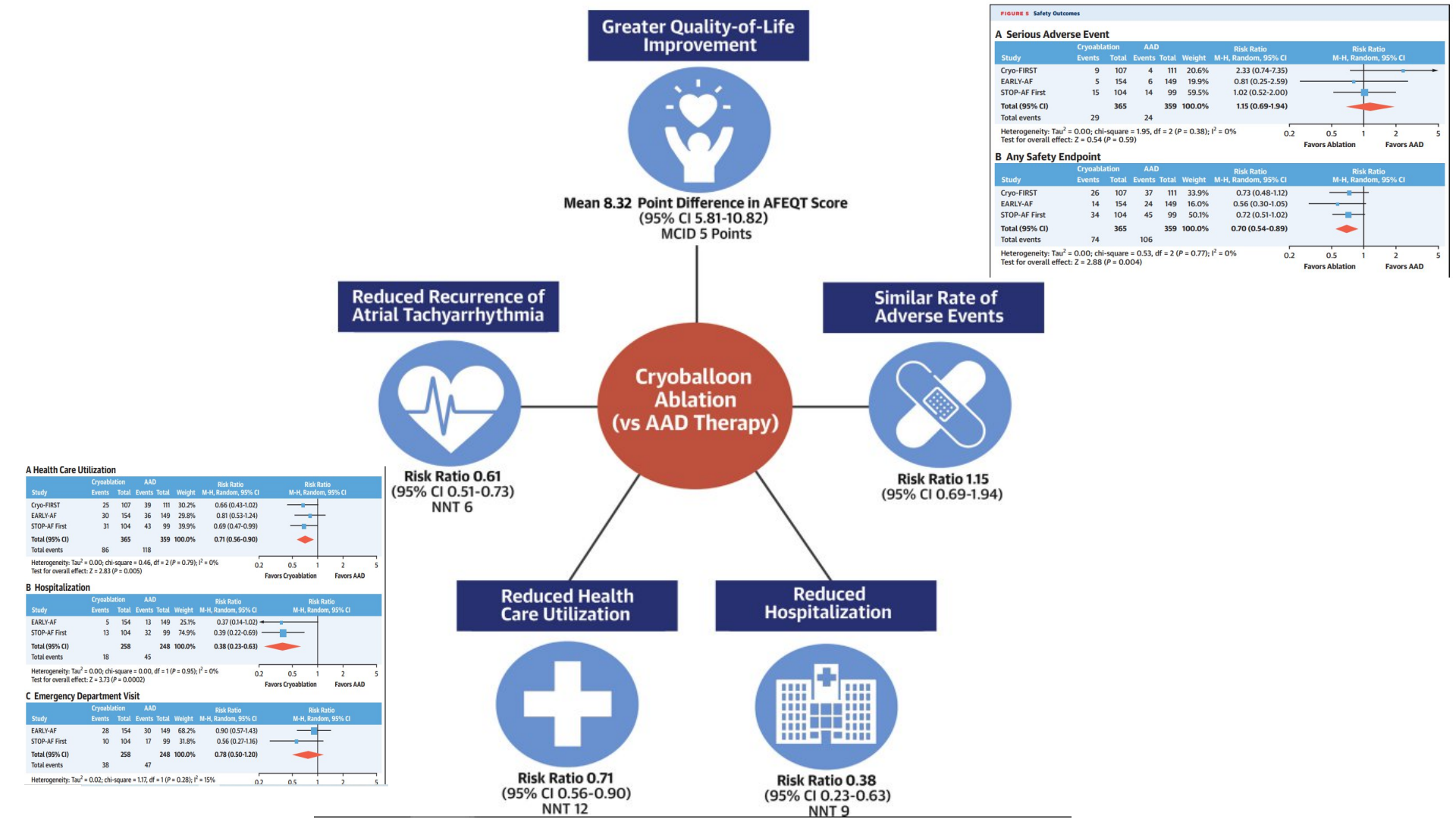
Heterogeneity: $Tau^2 = 0.00$; chi-square = 0.72, df = 2 ($P = 0.70$); $I^2 = 0\%$
Test for overall effect: Z = 5.38 ($P < 0.00001$)

B Symptomatic Atrial Tachyarrhythmia

Study	Cryoablation Events	Cryoablation Total	AAD Events	AAD Total	Risk Ratio M-H, Random, 95% CI
EARLY-AF	17	154	39	149	0.42 (0.25-0.71)



(A) Any atrial tachyarrhythmia. **(B)** Symptomatic atrial tachyarrhythmia.



A Health Care Utilization

Study	Cryoablation Events	Cryoablation Total	AAD Events	AAD Total	Weight	Risk Ratio M-H, Random, 95% CI
Cryo-FIRST	25	107	39	111	30.2%	0.66 (0.43-1.02)
EARLY-AF	30	154	36	149	29.8%	0.81 (0.53-1.24)
STOP-AF First	31	104	43	99	39.9%	0.69 (0.47-0.99)
Total (95% CI)		**365**		**359**	**100.0%**	**0.71 (0.56-0.90)**
Total events	86		118			

Heterogeneity: $Tau^2 = 0.00$; chi-square = 0.46, df = 2 ($P = 0.79$); $I^2 = 0\%$
Test for overall effect: Z = 2.83 ($P = 0.005$)

Risk Ratio M-H, Random, 95% CI: 0.2, 0.5, 1, 2, 5
Favors Cryoablation | Favors AAD

B Hospitalization

Study	Cryoablation Events	Cryoablation Total	AAD Events	AAD Total	Weight	Risk Ratio M-H, Random, 95% CI
EARLY-AF	5	154	13	149	25.1%	0.37 (0.14-1.02)
STOP-AF First	13	104	32	99	74.9%	0.39 (0.22-0.69)
Total (95% CI)		**258**		**248**	**100.0%**	**0.38 (0.23-0.63)**
Total events	18		45			

Heterogeneity: $Tau^2 = 0.00$; chi-square = 0.00, df = 1 ($P = 0.95$); $I^2 = 0\%$
Test for overall effect: Z = 3.73 ($P = 0.0002$)

Risk Ratio M-H, Random, 95% CI: 0.2, 0.5, 1, 2, 5
Favors Cryoablation | Favors AAD

C Emergency Department Visit

Study	Cryoablation Events	Cryoablation Total	AAD Events	AAD Total	Weight	Risk Ratio M-H, Random, 95% CI
EARLY-AF	28	154	30	149	68.2%	0.90 (0.57-1.43)
STOP-AF First	10	104	17	99	31.8%	0.56 (0.27-1.16)
Total (95% CI)		**258**		**248**	**100.0%**	**0.78 (0.50-1.20)**
Total events	38		47			

Heterogeneity: $Tau^2 = 0.02$; chi-square = 1.17, df = 1 ($P = 0.28$); $I^2 = 15\%$

Risk Ratio M-H, Random, 95% CI: 0.2, 0.5, 1, 2, 5

FIGURE 5 Safety Outcomes

A Serious Adverse Event

Study	Cryoablation Events	Cryoablation Total	AAD Events	AAD Total	Weight	Risk Ratio M-H, Random, 95% CI
Cryo-FIRST	9	107	4	111	20.6%	2.33 (0.74-7.35)
EARLY-AF	5	154	6	149	19.9%	0.81 (0.25-2.59)
STOP-AF First	15	104	14	99	59.5%	1.02 (0.52-2.00)
Total (95% CI)		**365**		**359**	**100.0%**	**1.15 (0.69-1.94)**
Total events	29		24			

Heterogeneity: $Tau^2 = 0.00$; chi-square = 1.95, df = 2 ($P = 0.38$); $I^2 = 0\%$
Test for overall effect: Z = 0.54 ($P = 0.59$)

Risk Ratio M-H, Random, 95% CI: 0.2, 0.5, 1, 2, 5
Favors Ablation | Favors AAD

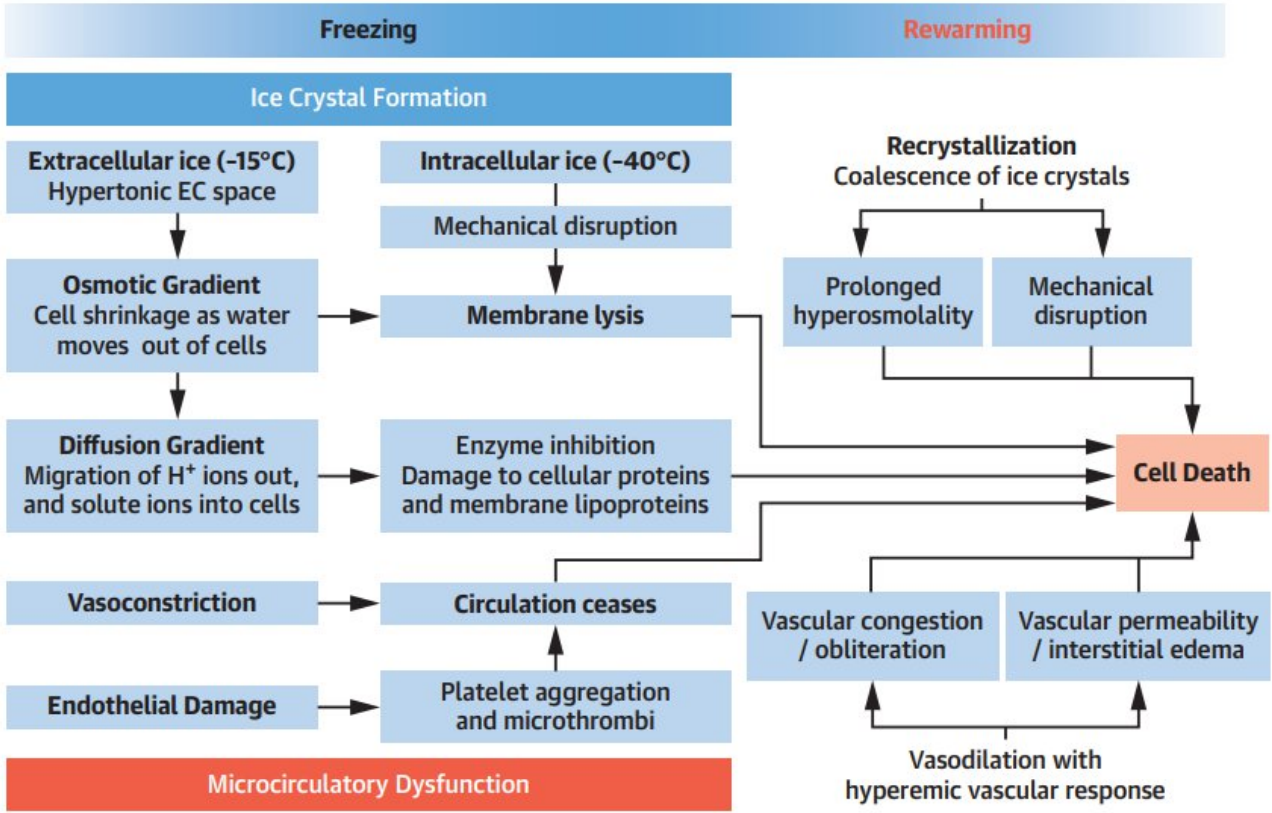
B Any Safety Endpoint

Study	Cryoablation Events	Cryoablation Total	AAD Events	AAD Total	Weight	Risk Ratio M-H, Random, 95% CI
Cryo-FIRST	26	107	37	111	33.9%	0.73 (0.48-1.12)
EARLY-AF	14	154	24	149	16.0%	0.56 (0.30-1.05)
STOP-AF First	34	104	45	99	50.1%	0.72 (0.51-1.02)
Total (95% CI)		**365**		**359**	**100.0%**	**0.70 (0.54-0.89)**
Total events	74		106			

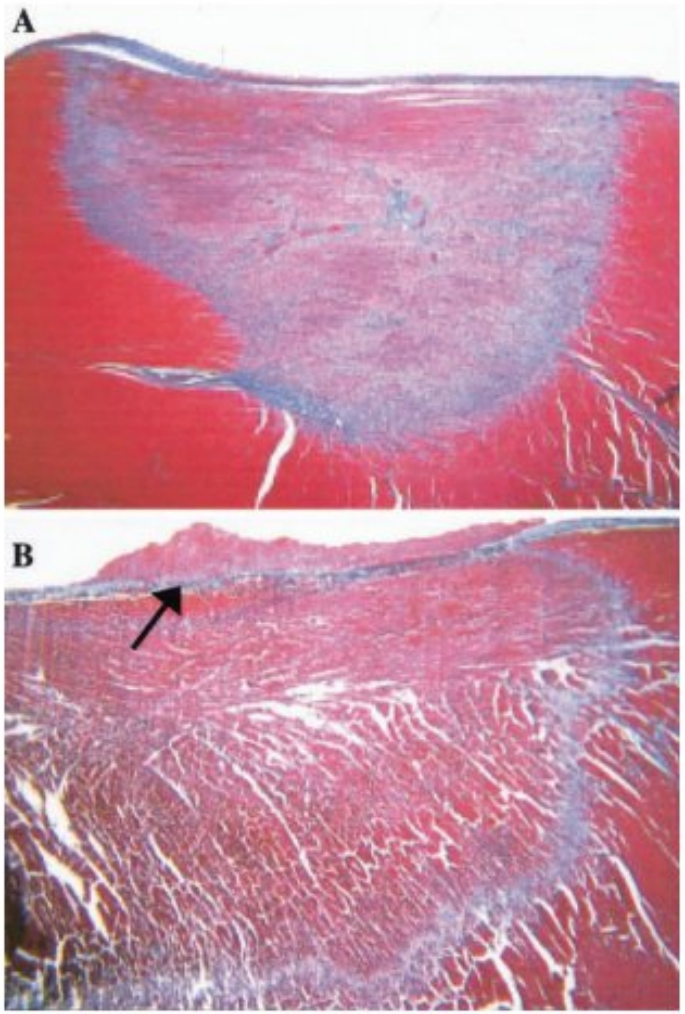
Heterogeneity: $Tau^2 = 0.00$; chi-square = 0.53, df = 2 ($P = 0.77$); $I^2 = 0\%$
Test for overall effect: Z = 2.88 ($P = 0.004$)

Risk Ratio M-H, Random, 95% CI: 0.2, 0.5, 1, 2, 5
Favors Ablation | Favors AAD

FIGURE 1 Lesion Formation With Cryothermal Ablation



Cryoablation leads to cellular injury caused by a combination of ice crystal–induced osmotic stress, with subsequent membrane lysis and enzyme inhibition **(left top)**, as well as ischemic cell death caused by microcirculatory failure **(left bottom)**. Rewarming exacerbates this injury caused by ice crystal coalescence **(right top)** and hyperemic vascular response **(bottom right)**. EC = extracellular; H^+ = hydrogen ion; IC = intracellular.



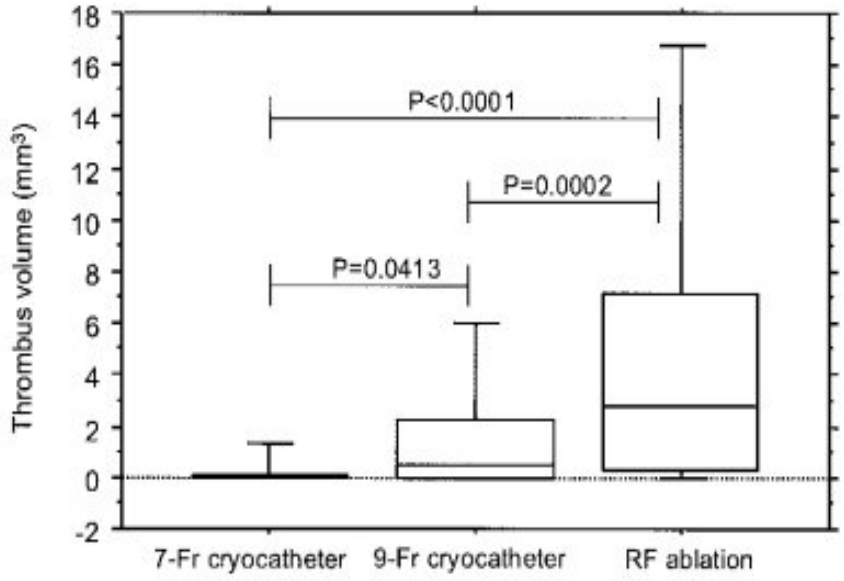


Figure 3. Thrombus volume with RF ablation and 7F and 9F cryoablation.

Inflammatory response in RFA >>Cryo

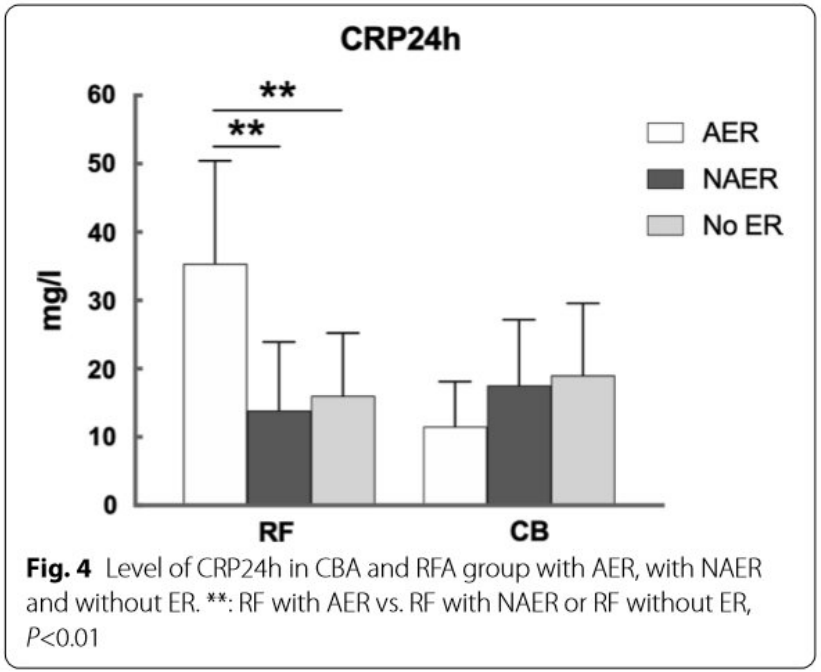


Fig. 4 Level of CRP24h in CBA and RFA group with AER, with NAER and without ER. **: RF with AER vs. RF with NAER or RF without ER, $P<0.01$

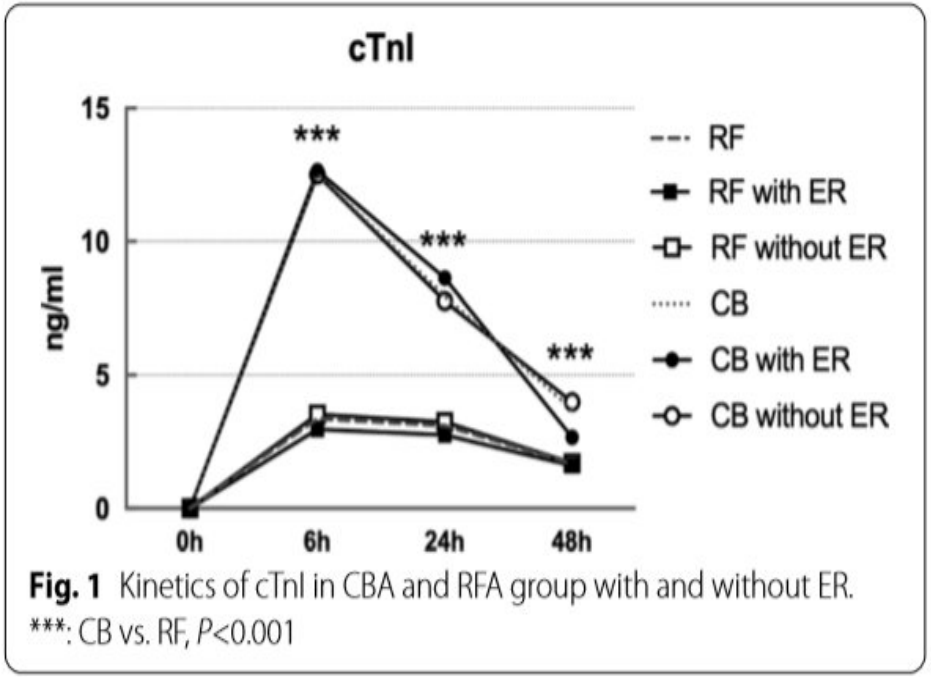
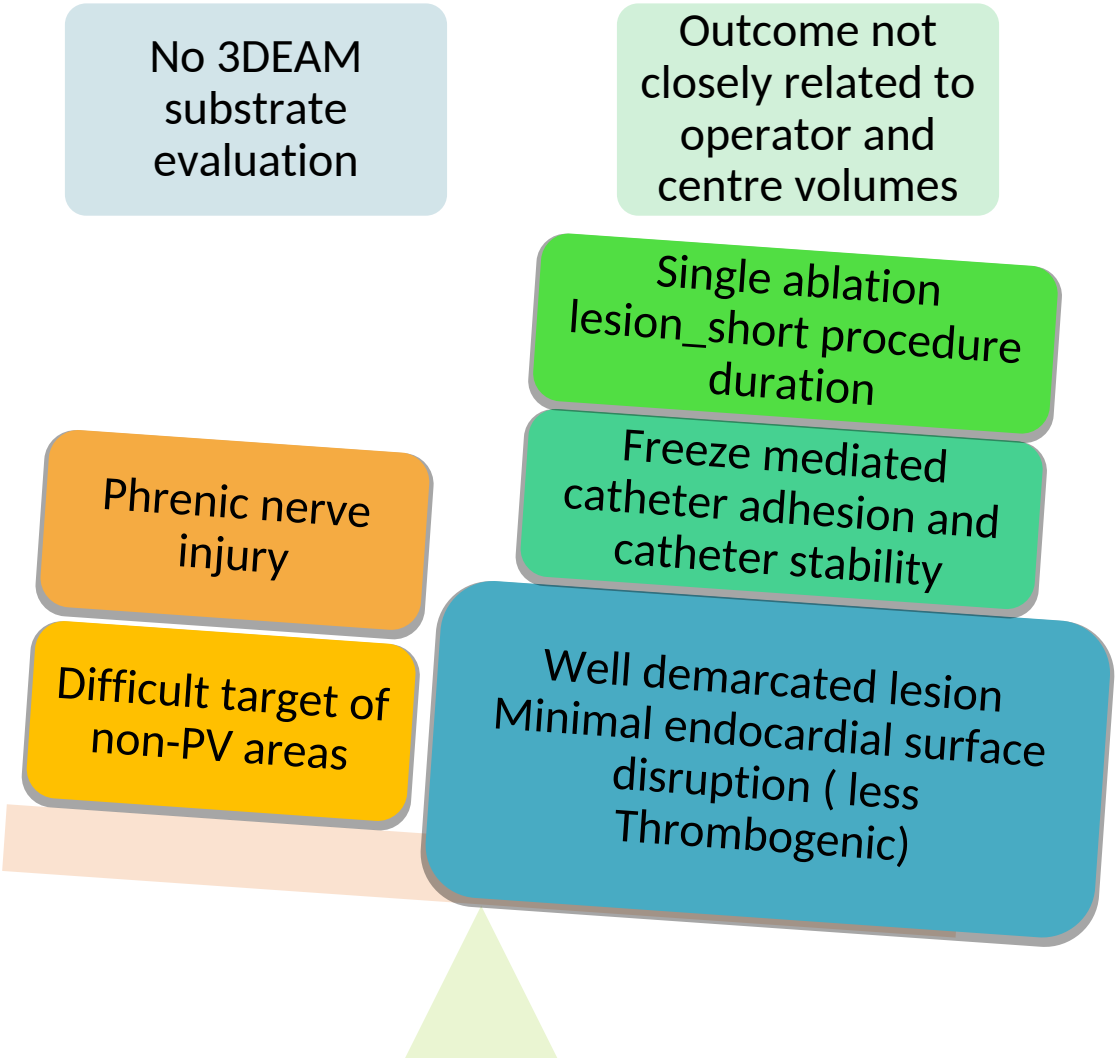


Fig. 1 Kinetics of cTnI in CBA and RFA group with and without ER. ***: CB vs. RF, $P<0.001$

Wei *et al. BMC Cardiovascular Disorders* (2022) 22:400
https://doi.org/10.1186/s12872-022-02816-1


No 3DEAM substrate evaluation
Outcome not closely related to operator and centre volumes
Single ablation lesion_short procedure duration
Freeze mediated catheter adhesion and catheter stability
Phrenic nerve injury
Difficult target of non-PV areas
Well demarcated lesion
Minimal endocardial surface disruption (less Thrombogenic)

Safety and Efficacy of Cryoablation

Arctic Front was the first anatomical balloon technology using cryo energy on the market. The balloon featured four jets.

Arctic Front Advance™ features improved temperature uniformity with EvenCool™ cryo technology (8 jets), enabling more contiguous lesions.*

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Safety: collateral damage (nerve injury)

Efficacy: freeze cycles applied ± time to isolation (TTI) monitoring

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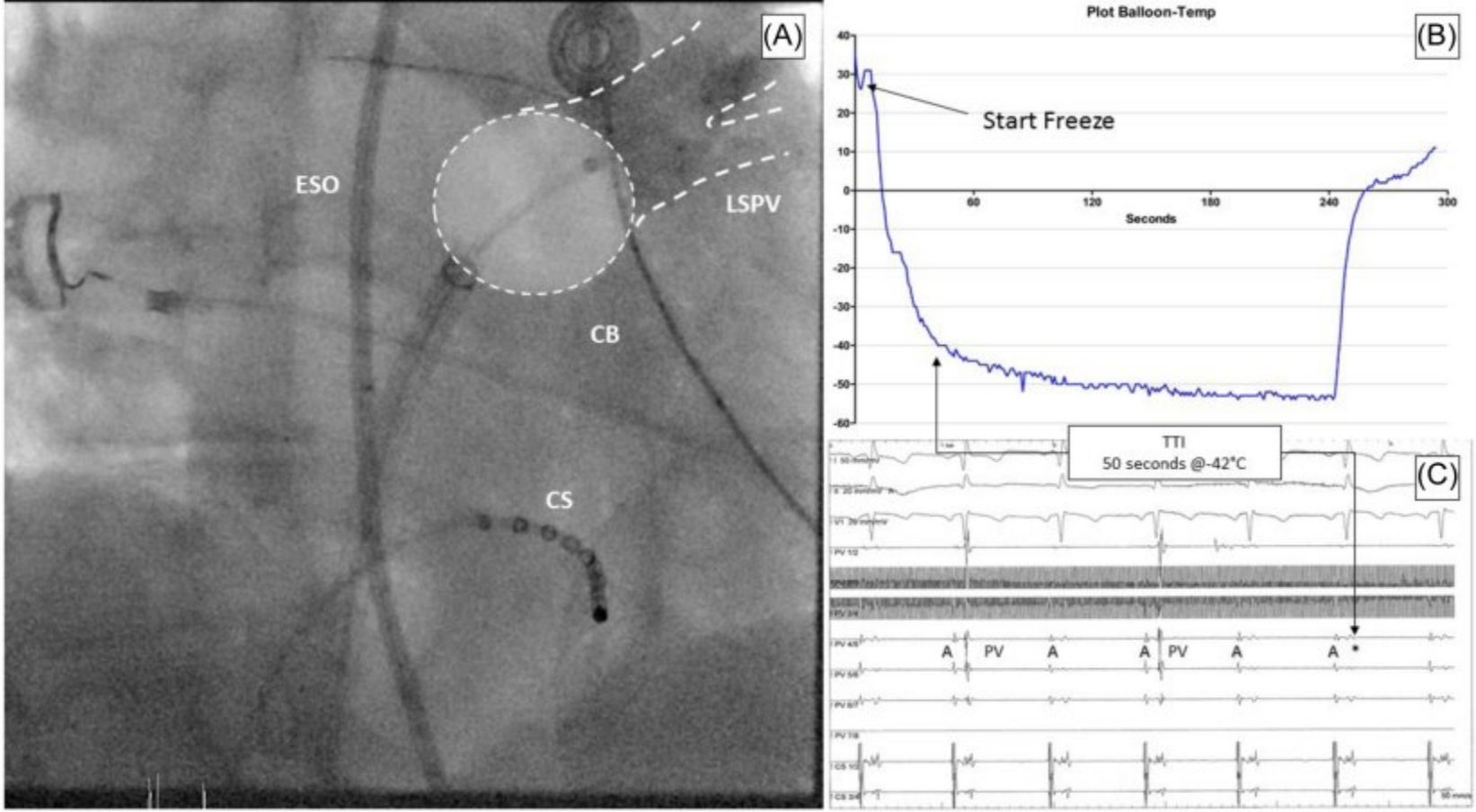
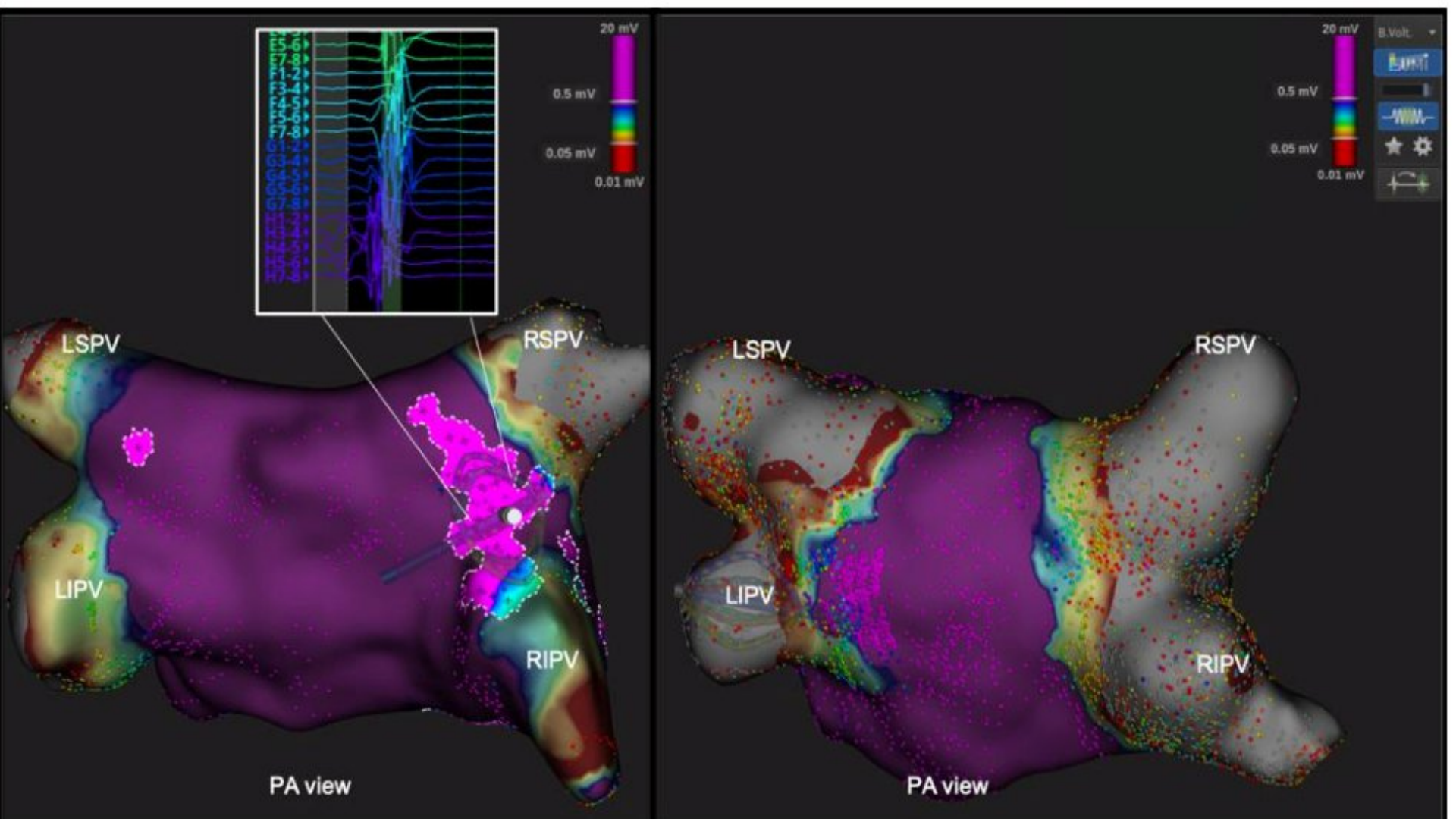


FIGURE 1 Example of a PVI with the CB. (A) A fluoroscopic RAO view of a CB occlusion at left superior pulmonary vein. (B) The relative temperature curve of the CB-application. (C) The intracardiac recordings with the moment of isolation. A, atrial signal; CB, cryoballoon; CS, coronary sinus catheter; ESO, esophageal probe; LSPV, left superior pulmonary vein; PV, pulmonary vein signal; RAO, right anterior oblique view; TTI, time to isolation


20 mV
0.5 mV
0.05 mV
0.01 mV
LSPV
RSPV
LIPV
RIPV
PA view
20 mV
0.5 mV
0.05 mV
0.01 mV
LSPV
RSPV
LIPV
RIPV
PA view

Meta-analysis of AF treatment strategies

Received: 16 September 2021 | Revised: 27 October 2021 | Accepted: 22 November 2021

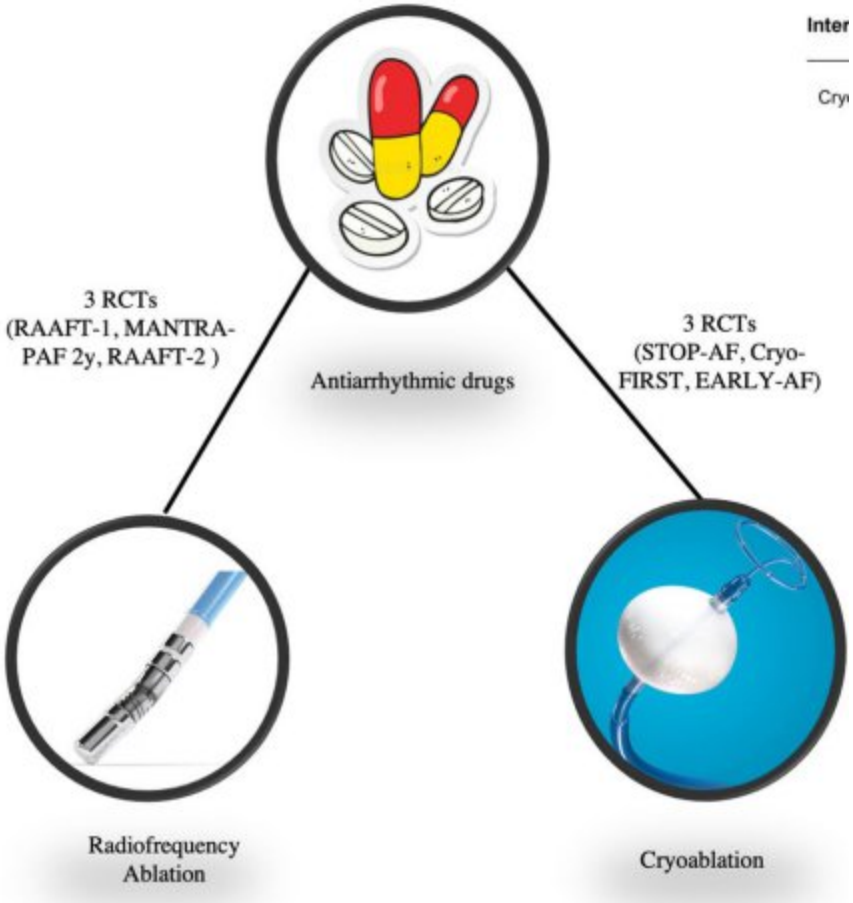
DOI: 10.1111/jce.15308

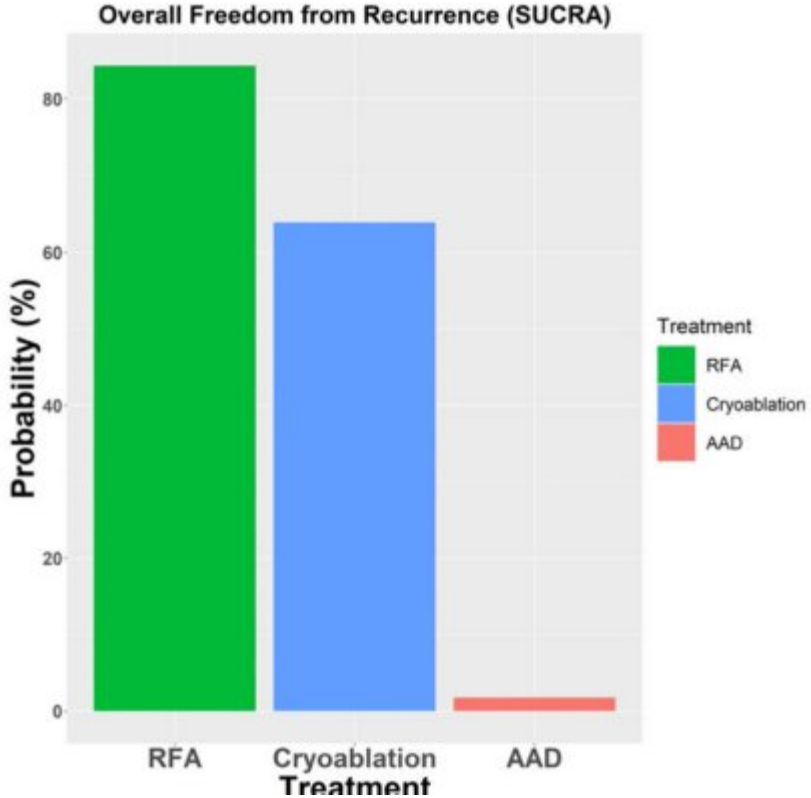
ORIGINAL ARTICLES

WILEY

Bayesian network meta-analysis comparing cryoablation, radiofrequency ablation, and antiarrhythmic drugs as initial therapies for atrial fibrillation

Mahmoud Elsayed MD[1] | Omar M. Abdelfattah MD[2] | Ahmed Sayed MD[3] | Rohan Madhu Prasad MD[4] | Amr F. Barakat MD[5] | Islam Y. Elgendy MD[6] | Jason Andrade MD[7] | Thomas Jared Bunch MD[8] | Amit Thosani MD[9] | Walid I. Saliba MD[10] | Oussama M. Wazni MD[10] | Ayman A. Hussein MD[10]


3 RCTs
(RAAFT-1, MANTRA-PAF 2y, RAAFT-2)
Antiarrhythmic drugs
3 RCTs
(STOP-AF, Cryo-FIRST, EARLY-AF)
Radiofrequency Ablation
Cryoablation

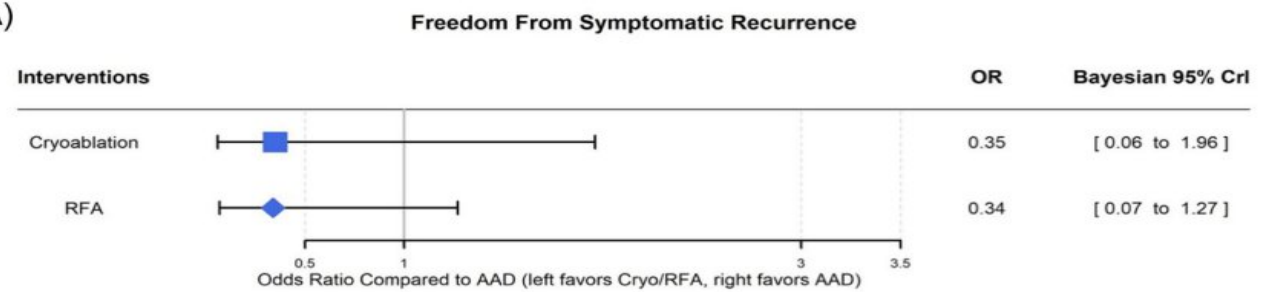

Overall Freedom from Recurrence (SUCRA)
Probability (%)
0
20
40
60
80
RFA
Cryoablation
AAD
Treatment
Treatment
RFA
Cryoablation
AAD

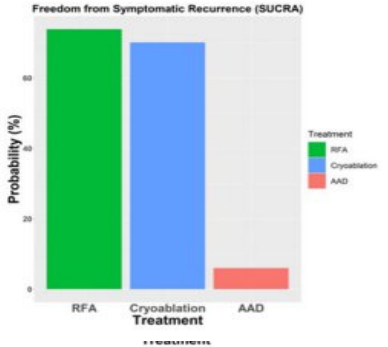
Bayesian Meta-analysis

RFA Trials on Paroxysmal+ persistent Af

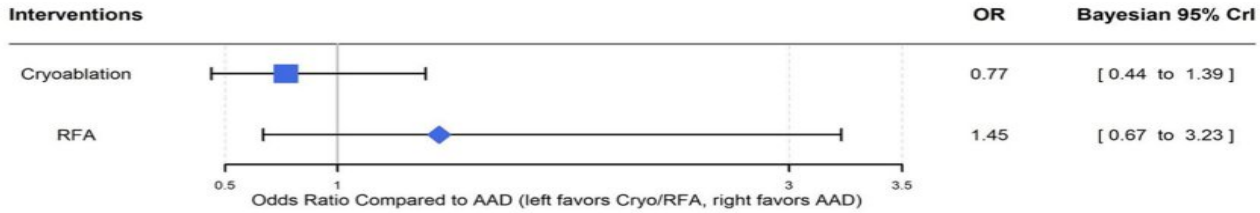
Cryo trials on Paroxysmal Af

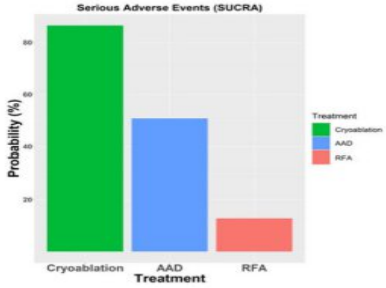
(A)


Freedom From Symptomatic Recurrence
Interventions
OR
Bayesian 95% CrI
Cryoablation
0.35
[0.06 to 1.96]
RFA
0.34
[0.07 to 1.27]
0.5
1
3
3.5
Odds Ratio Compared to AAD (left favors Cryo/RFA, right favors AAD)

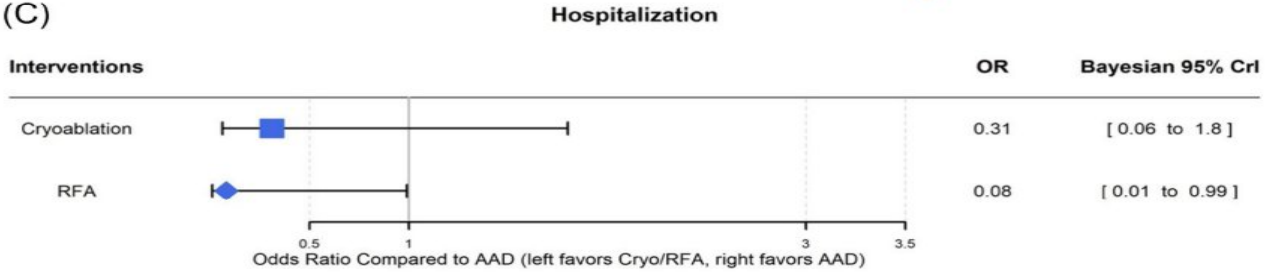

Freedom from Symptomatic Recurrence (SUCRA)
Probability (%)
Treatment
RFA
Cryoablation
AAD

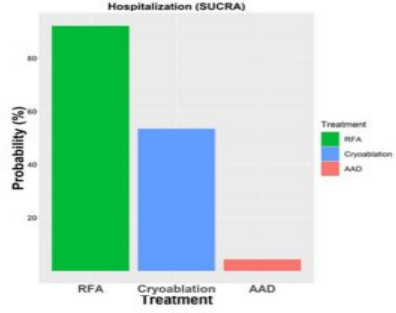
(B)


Serious Adverse Events
Interventions
OR
Bayesian 95% CrI
Cryoablation
0.77
[0.44 to 1.39]
RFA
1.45
[0.67 to 3.23]
0.5
1
3
3.5
Odds Ratio Compared to AAD (left favors Cryo/RFA, right favors AAD)


Serious Adverse Events (SUCRA)
Probability (%)
Treatment
Cryoablation
AAD
RFA

(C)


Hospitalization
Interventions
OR
Bayesian 95% CrI
Cryoablation
0.31
[0.06 to 1.8]
RFA
0.08
[0.01 to 0.99]
0.5
1
3
3.5
Odds Ratio Compared to AAD (left favors Cryo/RFA, right favors AAD)


Hospitalization (SUCRA)
Probability (%)
Treatment
RFA
Cryoablation
AAD

Take-home messages from metanalysis

- ✓ Reduction of overal recurrence rate with cryoAblation and RFA as first line therapy compared to AAD
- ✓ Cryoablation is likely a safer procedure compared to RFA
- ✓ Lower rates of hospitalization with ablation (especially RFA) compared to AAD

Which AF patients would benefit more from CryoAblation?

- Only Paroxysmal Afib?
- Gender (male?)
- BMI
- Age
- Veins Anatomy

ESC European Society of Cardiology

Europace (2022) **24**, 226–233
doi:10.1093/europace/euab281

CLINICAL RESEARCH
Ablation for atrial fibrillation

Cryoballoon vs. radiofrequency catheter ablation: insights from NOrwegian randomized study of PERSistent Atrial Fibrillation (NO-PERSAF study)

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Received 23 September 2021; editorial decision 27 October 2021; accepted after revision 28 October 2021; online publish-ahead-of-print 19 November 2021

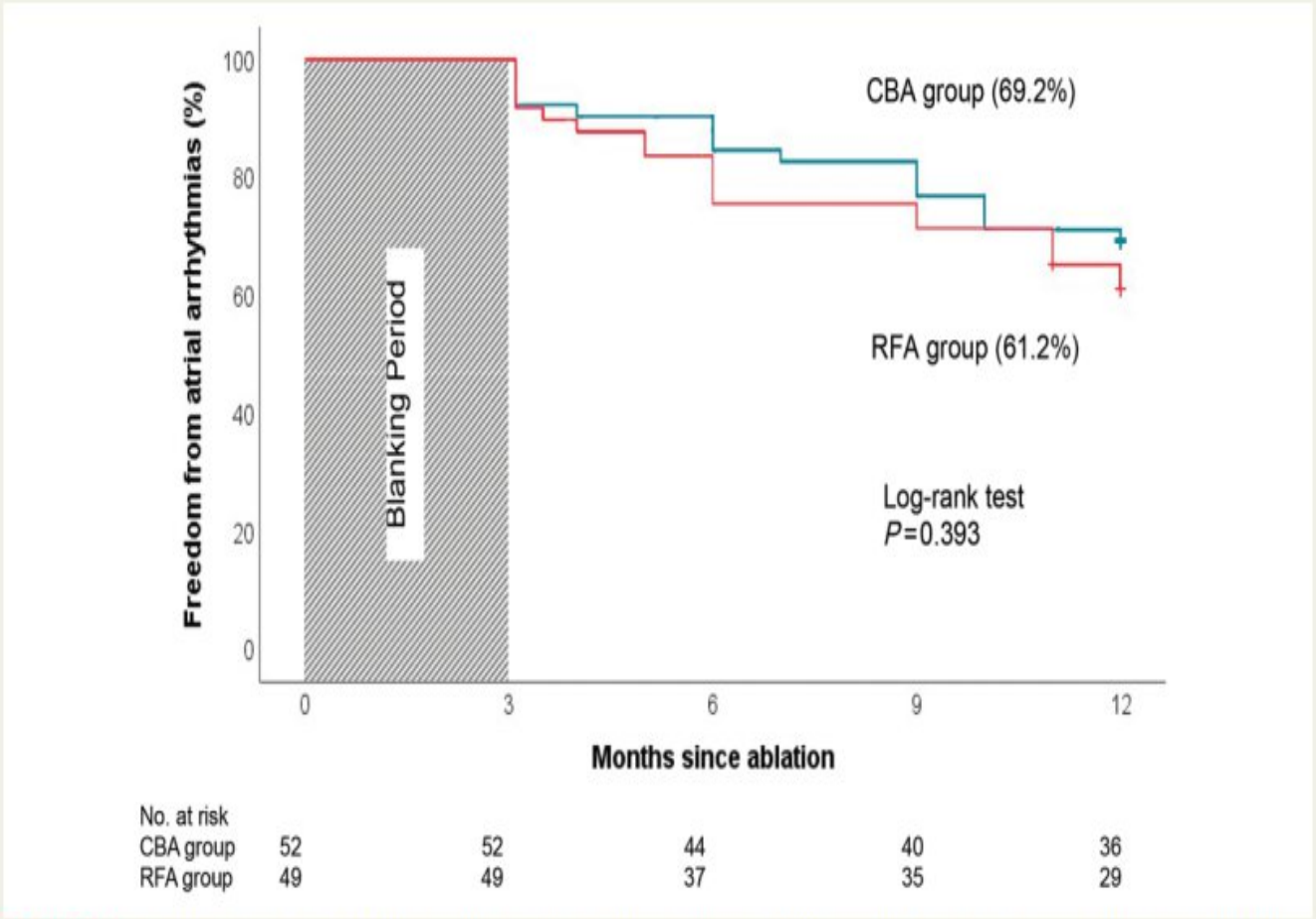

Figure 2 Kaplan–Meier survival curve of freedom from atrial arrhythmias. There is no difference of freedom from atrial tachyarrhythmias between CBA (blue) and RFA (red) groups during a 12-month follow-up. CBA, cryoballoon ablation; RFA, radiofrequency ablation.

Phrenic nerve palsy 1 /52 pts (2%) in the CBA group,

PV stenosis 1/49 pts(2%) in the RFA group.

Gender difference in Cryo

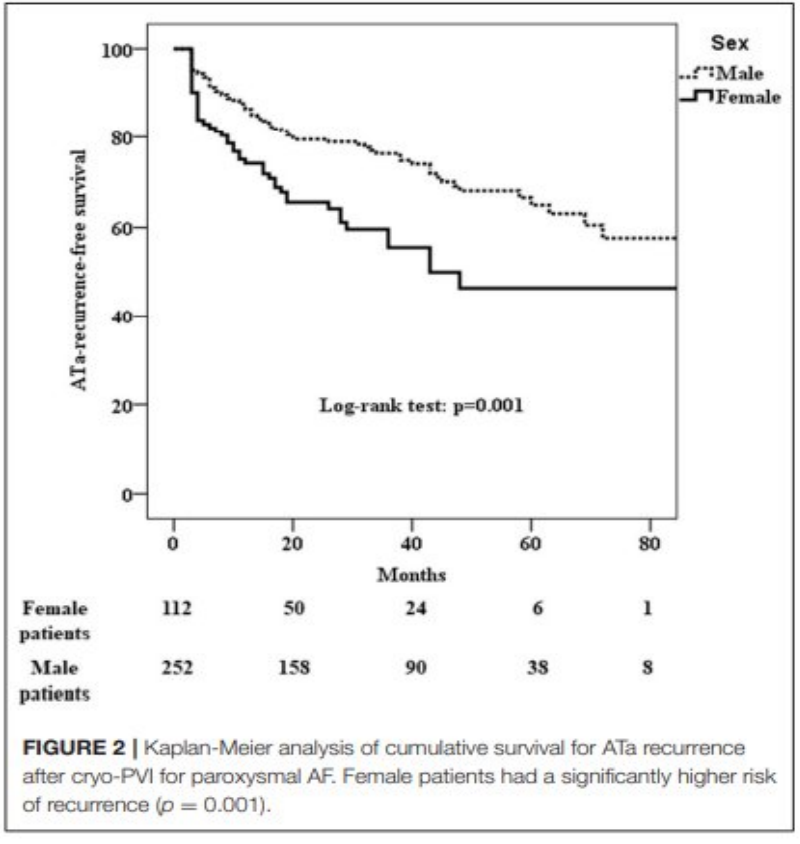

FIGURE 2 | Kaplan-Meier analysis of cumulative survival for ATa recurrence after cryo-PVI for paroxysmal AF. Female patients had a significantly higher risk of recurrence ($p = 0.001$).

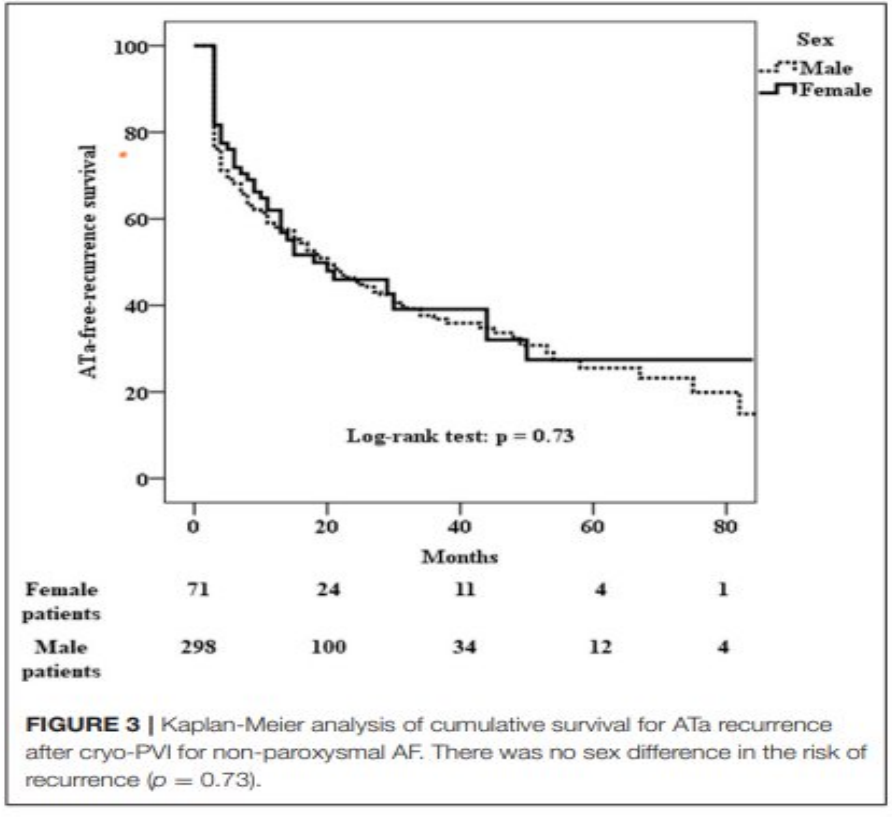

FIGURE 3 | Kaplan-Meier analysis of cumulative survival for ATa recurrence after cryo-PVI for non-paroxysmal AF. There was no sex difference in the risk of recurrence ($p = 0.73$).

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TABLE 4 | Predictive factors (multivariate analysis) of ATa recurrence after an index cryo-PVI for paroxysmal AF.

	Paroxysmal AF $n = 364$	
	HR [95%CI] in a multivariate analysis	***p***
Female sex, n (%)	**1.87 [1.28; 2.73]**	**0.001**
Height (m)	0.16 [0.01; 2.24]	0.17
Body surface area (m^2)	0.99 [0.33; 2.91]	0.98
Structural heart disease, n (%)	0.74 [0.44; 1.24]	0.26
LA volume index (ml/m^2)	1.01 [1.00; 1.02]	0.052

AF, atrial fibrillation; ATa, atrial tachyarrhythmia; LA, left atrium.
The bold values indicate the values of $p < 0.05$.

TABLE 6 | Predictive factors (multivariate analysis) of ATa recurrence after index cryo-PVI for non-paroxysmal AF.

	Patients with non-paroxysmal AF $n = 369$	
	HR [95%CI] in a multivariate analysis	***p***
Body mass index (kg/m^2)	**1.03 [1.003; 1.07]**	**0.03**
Long-standing persistent AF, n (%)	**2.03 [1.38; 2.98]**	**<0.001**
Hypertension, n (%)	1.18 [0.86;1.61]	0.30
LA area (cm^2)	1.03 [0.99;1.08]	0.19
LA volume (ml)	0.99 [0.98;1.01]	0.37
LA volume index (ml/m^2)	**1.01 [1.007; 1.02]**	**<0.001**
Accessory vein, n (%)	**1.67 [1.06; 2.61]**	**0.03**

AF, atrial fibrillation; ATa, atrial tachyarrhythmia; LA, left atrium.
The bold values indicate the values of $p < 0.05$.

openheart

Characteristics of anatomical difficulty for cryoballoon ablation: insights from CT

from CT. *Open Heart* 2022;**9**:e001724. doi:10.1136/openhrt-2021-001724

Takahiro Hayashi ,[1,2] Masato Murakami,[2] Shigeru Saito,[2] Kiyotaka Iwasaki[1]

Table 2 Anatomical predictors of acute success

Anatomy	CT analysis
LSPV	1. Left lateral ridge <4.7 mm, OR (95% CI) 4.86 (1.43 to 16.50), p=0.011.[7] 2. Ovality ≧50.5%, OR (95% CI) 9.44 (2.19 to 40.7), p=0.003.[7] 3. PV ostium-bifurcation distance ≧26.1 mm, OR (95% CI) 5.98 (1.65 to 21.7), p=0.006.[7]
LIPV	1. Position from non-coronary cusp (<16.875 mm), OR (95% CI) 5.78 (−1.77095 to −0.09474), p=0.027.[8]
RSPV	1. PV angle at vertical section, OR (95% CI) 1.17 (1.09 to 1.27), p<0.0001.[9]
RIPV	1. PV ostium-bifurcation distance ≦10.4 mm, OR (95% CI) 10.1 (3.0 to 34.3), p<0.001.[7] 2. PV angle at cross section (<105°), OR (95% CI) 23.80 (−3.15528 to −0.53622), p=0.002.[8] 3. PV position from non-coronary cusp (<1.250 mm), OR (95% CI) 12.14 (−2.77301 to −0.23160), p=0.014.[8] 4. PV angle at vertical section, OR (95% CI): 1.12 (1.01 to 1.23), p=0.0136.[9]

LIPV, left inferior pulmonary vein; LSPV, left superior pulmonary vein; PV, pulmonary vein; RIPV, right inferior pulmonary vein; RSPV, right

Table 4 Anatomical predictors of complications

Outcome	CT analysis
Phrenic nerve injury	1. RSPV-RPCB distance: 10.7±2.1 mm at PNI group, 17.4±3.8 mm at no PNI group (p<0.0001).[15] 2. RSPV area: 154±12 mm^2 at PNI group, 126±15 mm^2 at no PNI group: OR (95% CI) 1.03 (1.01 to 1.04), p<0.001.[16] 3. RSPV-LA angle: 154±12° at PNI group, 126±15° at no PNI group: OR (95% CI) 1.2 (1.1 to 1.3), p<0.001.[16] 4. RIPV area: 297±95 mm^2 at PNI group, 194±52 mm^2 at no PNI group: OR (95% CI) 1.02 (1 to 1.03), p=0.001.[16] 5. Carina width (7.5±2.1 mm in group 3, 9.8±2.8 mm in group 2 plus group 3, p<0.0001).[17]
Oesophageal injury	1. The distance between oesophagus and LIPV ostium was not statistically different in two group (3.5±3.3 mm in injury +group, 8.1±7.0 mm in injury –group, p=0.078).[18] 2. Left atrium-aorta distance (+1 SD increase) (OR (95% CI) 0.430 (0.219 to 0.841), p=0.013).[19]
Pulmonary vein stenosis	1. A larger PV ostium (OR (95% CI) 1.773 (1.137 to 2.765), p=0.01).[20] 2. A larger pulmonary vein ostium preprocedure diameter (OR (95% CI) 1.250 (1.090 to 1.434), p=0.001).[21] 3. A larger pulmonary vein ostium preprocedure area (OR (95% CI) 1.006 (1.002 to 1.011), p=0.006).[21]
Haemoptysis	1. LMB-LSPV distance (OR (95% CI) 2.676 (1.121 to 4.843), p<0.001).[22]

LMB, left main bronchus; PNI, phrenic nerve injury; PV, pulmonary vein; RIPV, right inferior pulmonary vein; RPCB, right peri-cardiophrenic bundles; RSPV, right superior pulmonary vein.

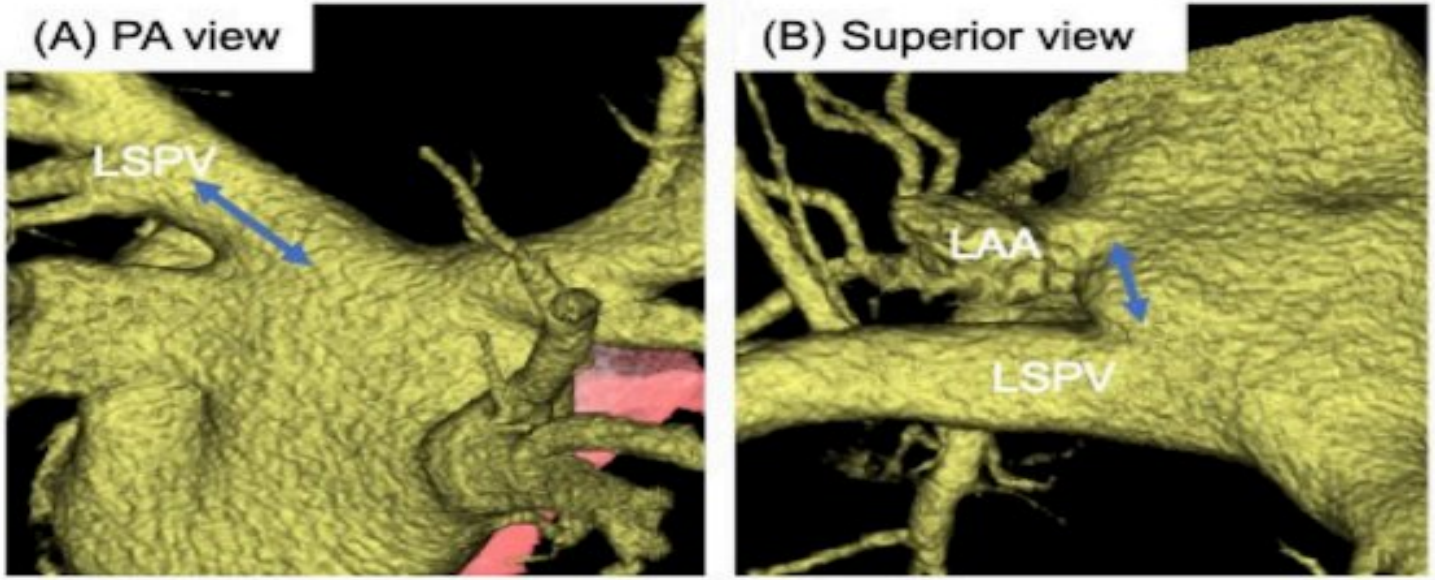
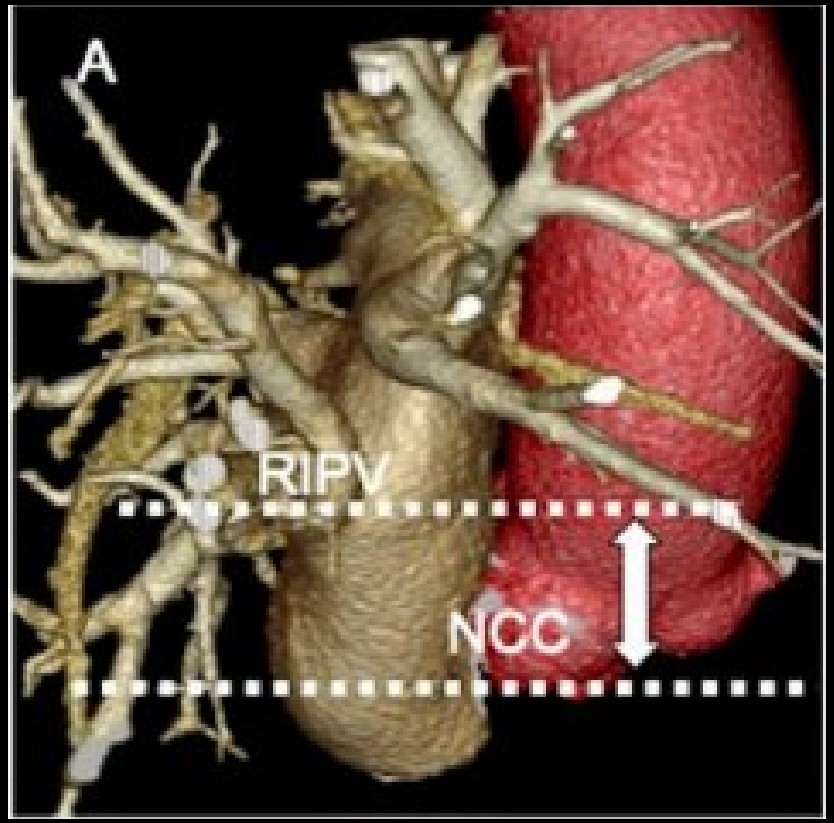


Figure 2 A CT analysis of the left superior pulmonary vein and left lateral ridge. (A) PA view: LSPV ostium-bifurcation distance. (B) Superior view: length of the left lateral ridge. LAA, left atrial appendage; LSPV, left superior pulmonary vein; PA, posterior-anterior.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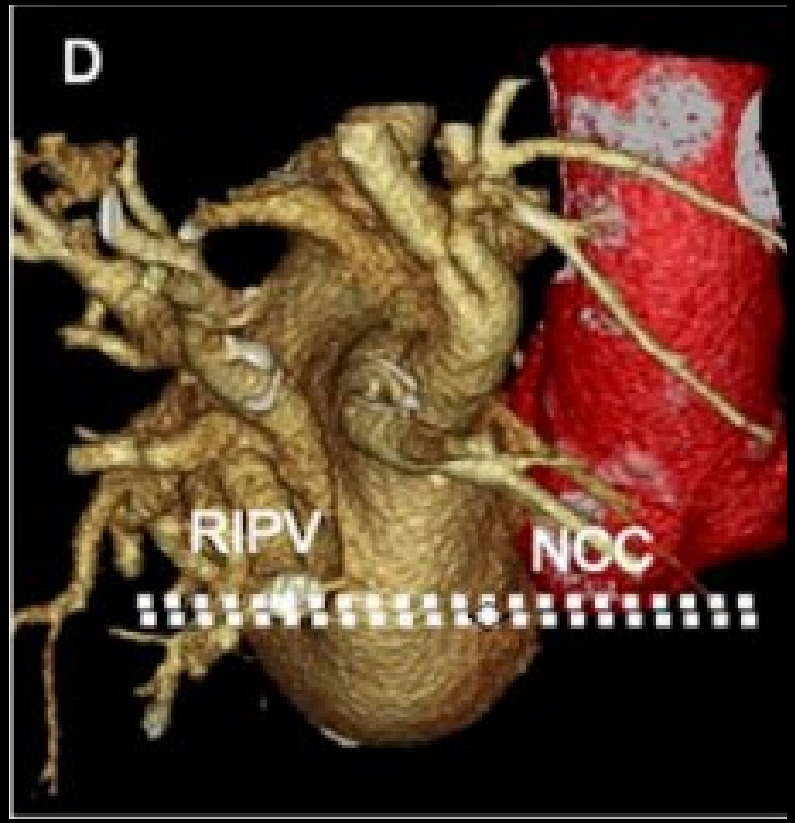
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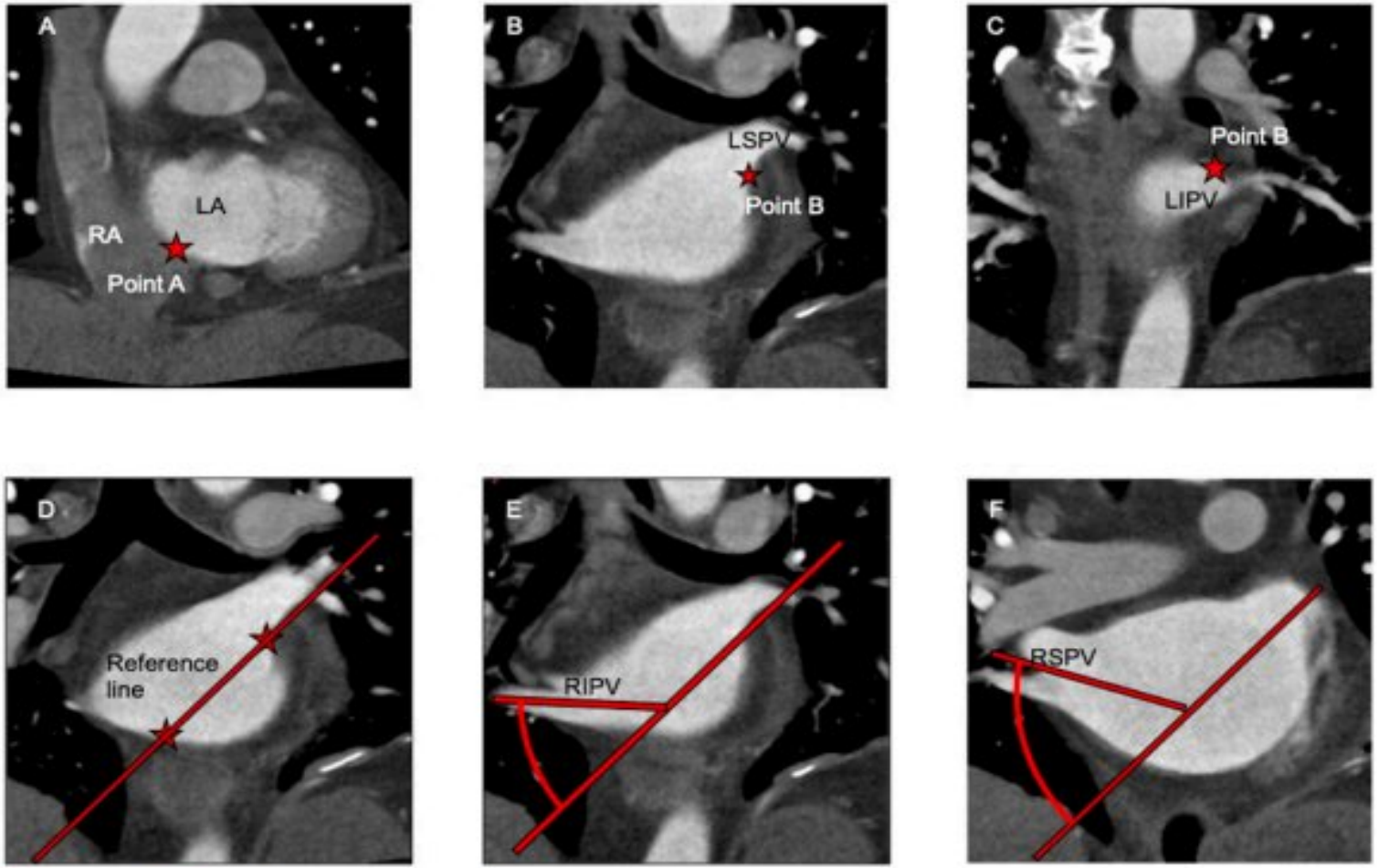
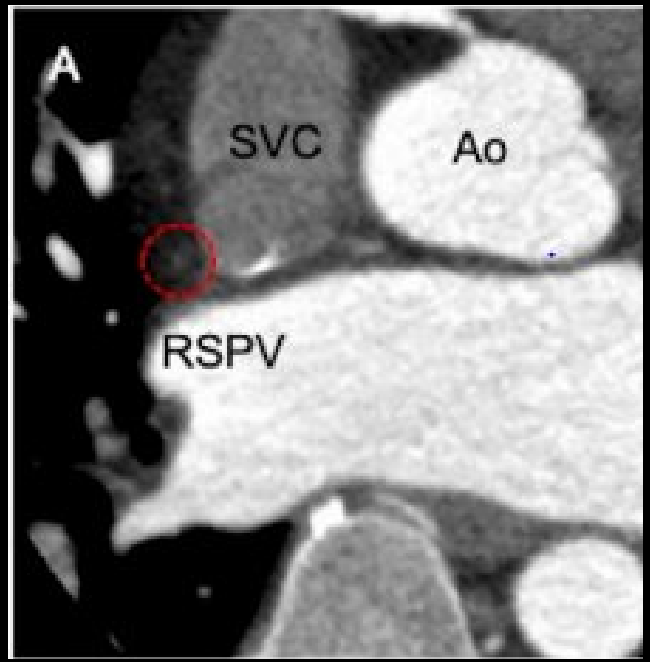


Figure 3 A process for measuring pulmonary vein angle.

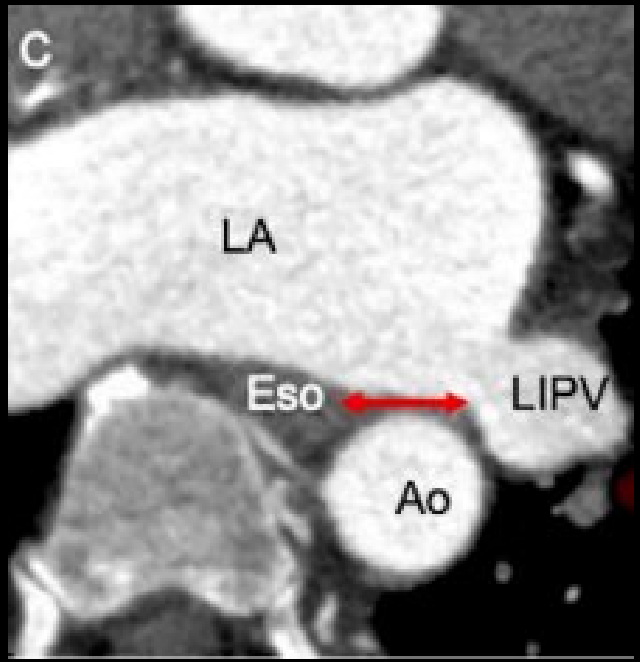
Table 3 Anatomic predictors of mid-term or long-term success about AF recurrence

Anatomy	CT analysis
LSPV	–
LIPV	1. PV dorsal-caudal comparing to dorsal-cranial orientation (HR 3.447, 95% CI 1.180 to 10.070, p=0.024).[10] 2. PV ventral-caudal to dorsal-cranial orientation (HR 3.391, 95% CI 1.088 to 10.571, p=0.035).[10]
RSPV	1. RSPV diameter: 21.6±2.8 mm at AF recurrence group vs 15.8±2.1 mm at no AF recurrence group (p<0.001).[11]
RIPV	1. RIPV-TS frontal angle (°): 45±17° at persistent RIPV isolation group vs 30±14° at RIPV reconnection group.[12]
A score for predicting unfavourable left atrium and PV anatomy	1. Score consists of RSPV ovality index >1.32, LSPV ovality index >1.2, RSPV antral circumference >69.1 mm, RIPV antral circumference >61.38 mm, RSPV >22.7°, LA diameter and right middle PV.[13] 2. Score of ≥4 predicted needs for longer cryoenergy ablation.[13]
No association between anatomy and AF recurrence	1. No relationship with anatomy (PV ovality, the presence of anatomical variants (right middle PVs, common ostia), shared carina nor carina width).[14.]

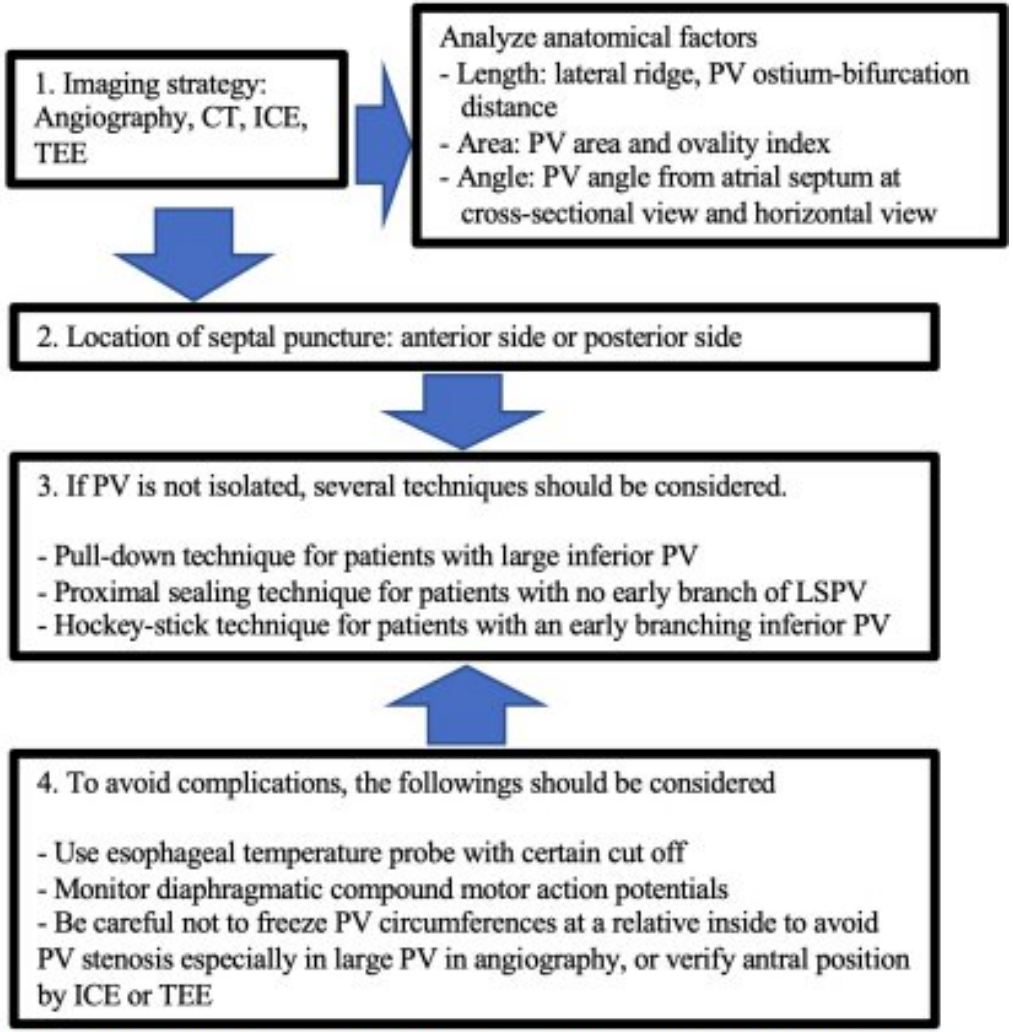
AF, atrial fibrillation; LIPV, left inferior pulmonary vein; LSPV, left superior pulmonary vein; PV, pulmonary vein; RIPV, right inferior pulmonary vein; RSPV, right superior pulmonary vein.



Distance between Right phrenic nerve and RSPV



Distance between oesophagus space and LIPV



Flow chart for Cryoablation

DOI: 10.1111/jce.15500

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Case volume and procedural outcomes in ablation for atrial fibrillation: Practice makes perfect?

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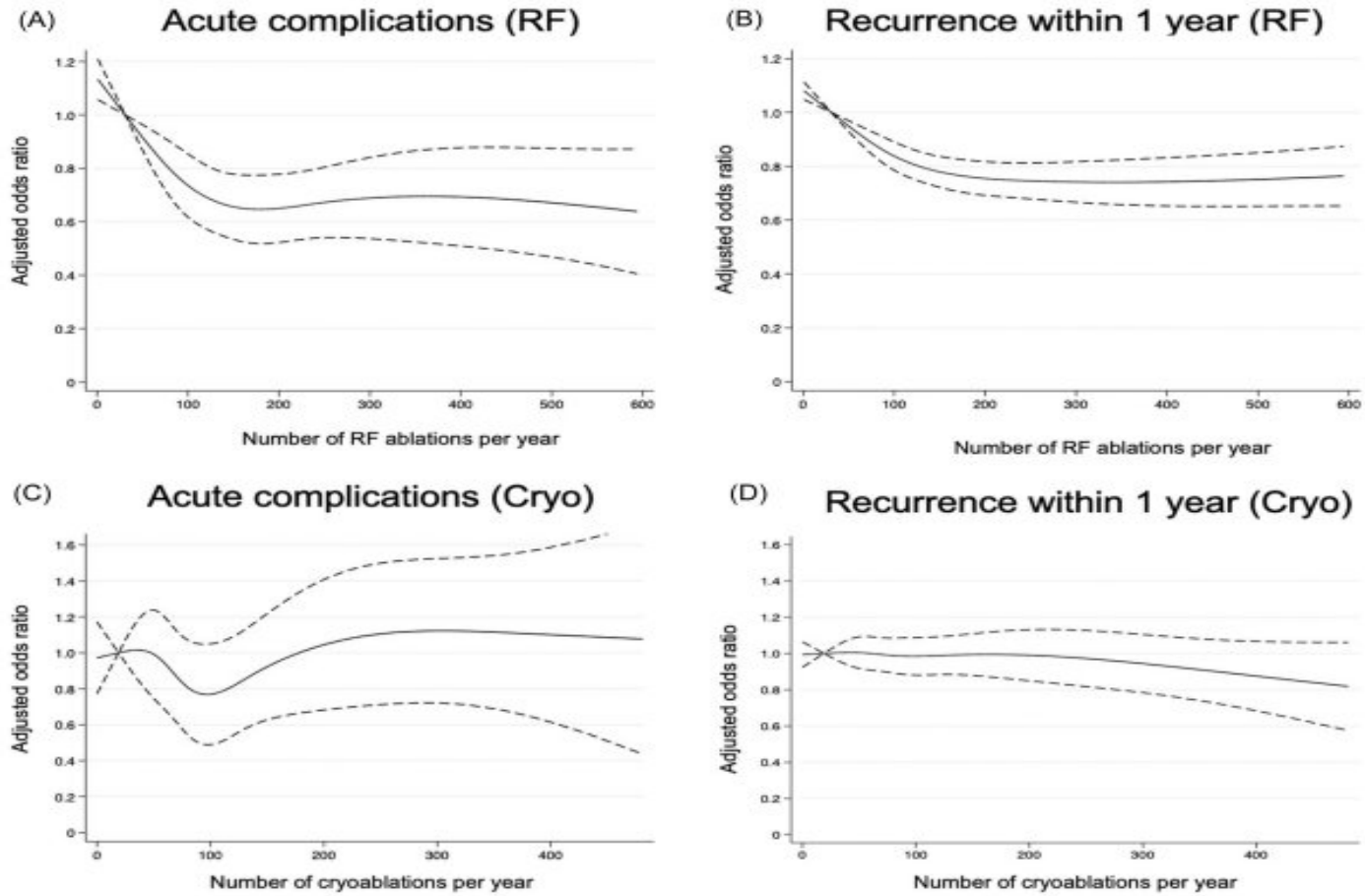

FIGURE 2 Outcome analysis according to ablation technology: radiofrequency ablation (A and B) and cryoballoon ablation (C and D). The graphs show the adjusted odds ratios (solid line) with 95% confidence intervals (dashed lines) for acute complications (A and C) and the 1-year success off antiarrhythmic drugs (B and D). Cryo, cryoballoon ablation; RF, radiofrequency ablation.

BMI impact on paroxysmal AF

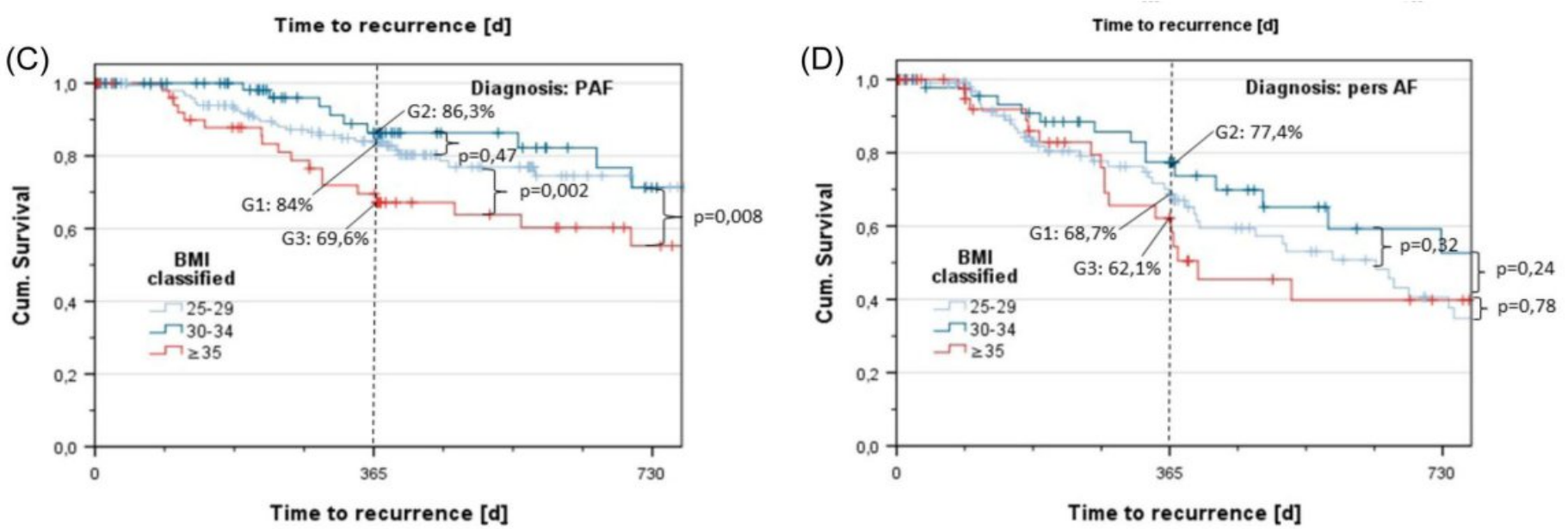

FIGURE 3 Kaplan Meier survival analysis Kaplan–Meier survival analysis. (A) Comparison of atrial fibrillation (AF) free survival among the BMI groups. (B) Comparison between paroxysmal and persistent AF. (C) Comparison of AF free survival in paroxysmal AF patients divided BMI groups. (D) Comparison of AF survival in persistent AF patients divided per BMI.

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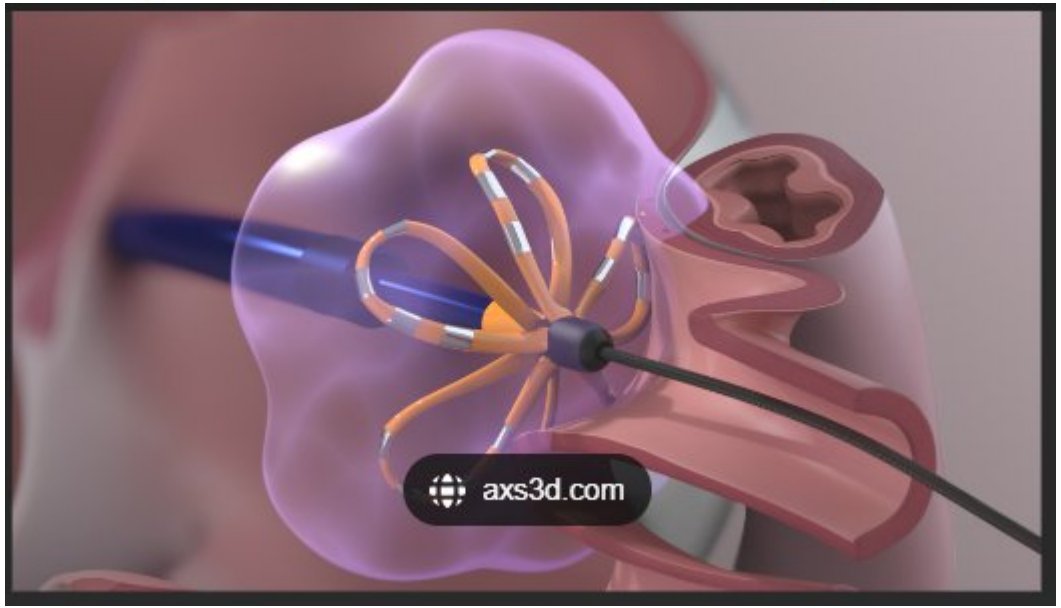
The clock is ticking for cryoablation as treatment option for atrial fibrillation ?



Cryoballoon technologies

Received: 3 August 2021 | Revised: 8 October 2021 | Accepted: 22 October 2021

DOI: 10.1111/jce.15288

ORIGINAL ARTICLE

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The established and the challenger: A direct comparison of current cryoballoon technologies for pulmonary vein isolation

Fabian Moser MD[1] | Laura Rottner MD[1] | Julia Moser MD[1] | Ruben Schleberger MD[1] | Marc Lemoine MD[1] | Paula Münkler MD[1] | Leon Dinshaw MD[1] | Paulus Kirchhof MD[1,2] | Bruno Reissmann MD[1] | Feifan Ouyang MD[1] | Andreas Rillig MD[1] | Andreas Metzner MD[1]

Cryocure study

JACC: CLINICAL ELECTROPHYSIOLOGY VOL. 8, NO. 8, 2022

INNOVATIONS IN CLINICAL ELECTROPHYSIOLOGY

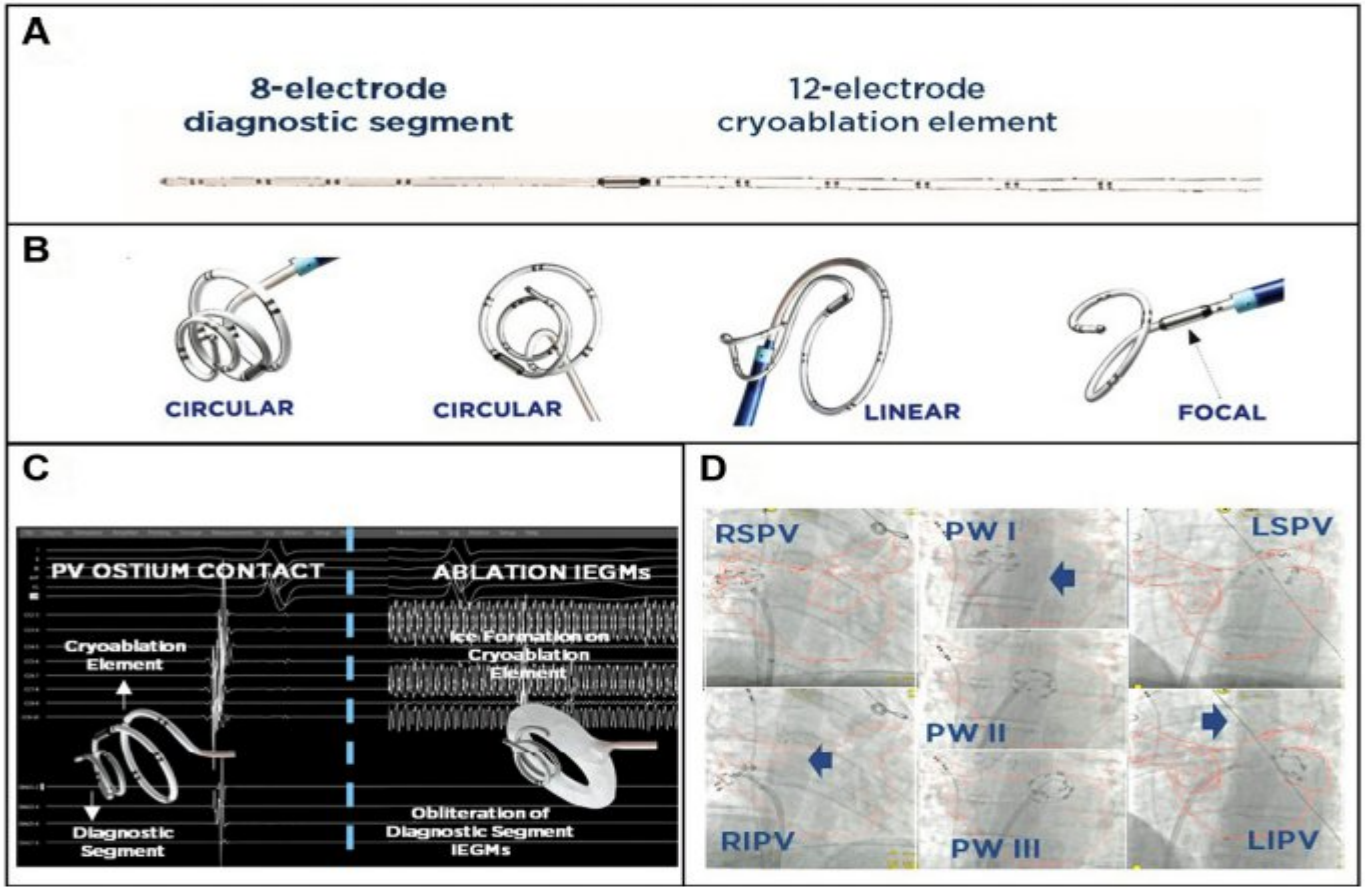
CATHETER ABLATION - ATRIAL FIBRILLATION

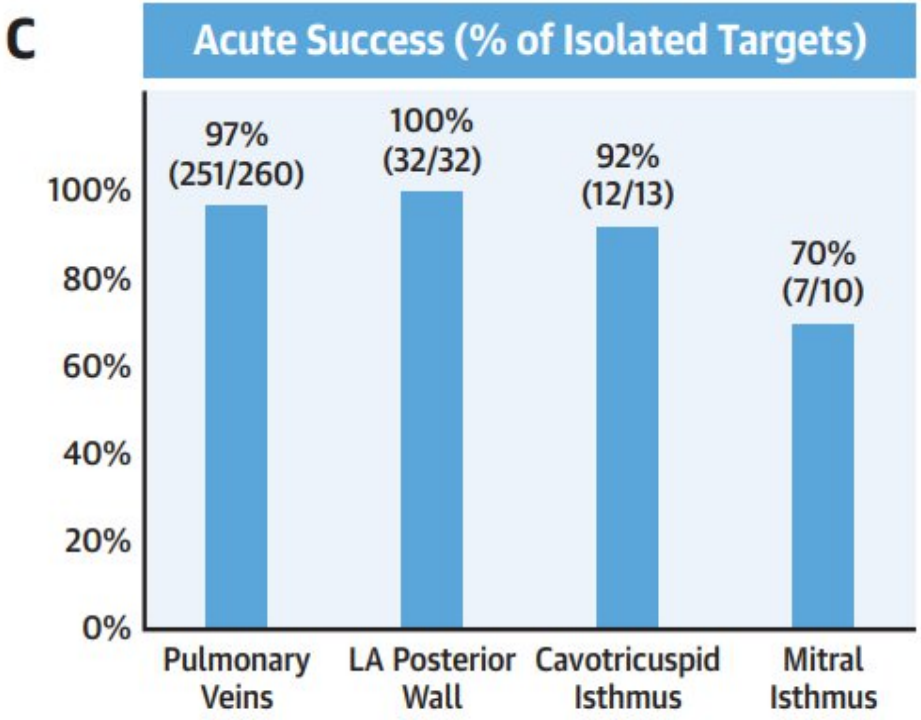
Ultra-Low Temperature Cryoablation for Atrial Fibrillation: Primary Outcomes for Efficacy and Safety

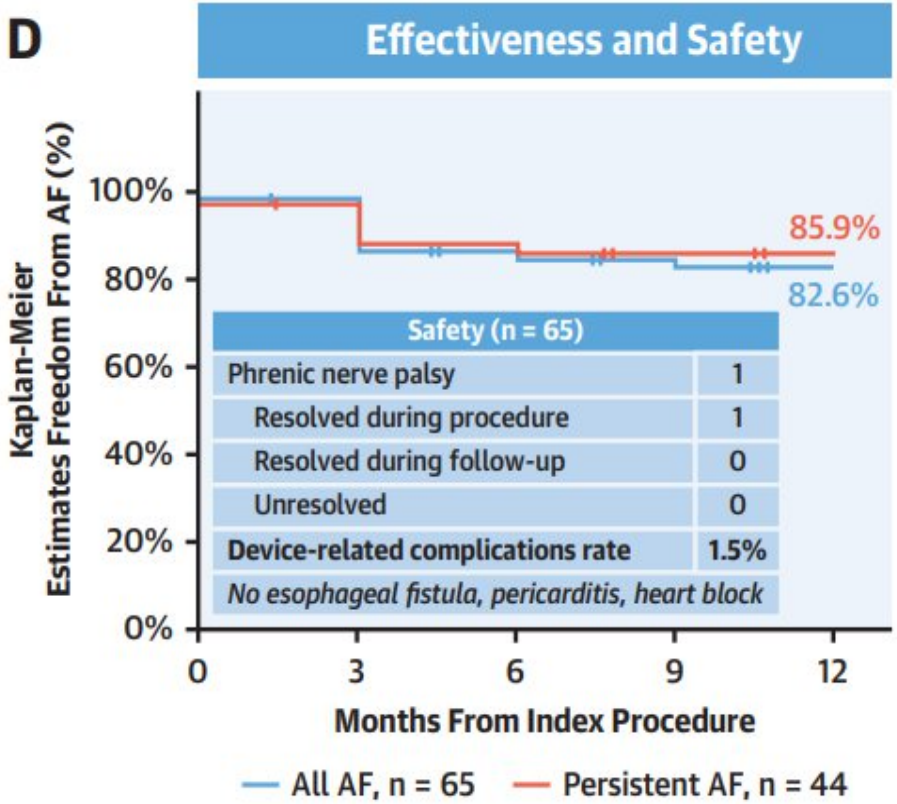
The Cryocure-2 Study

Tom De Potter, MD,[a] Martijn Klaver, MD,[b] Alex Babkin, PhD,[c] Konstantinos Iliodromitis, MD, PhD,[d] Meleze Hocini, MD, PhD,[e] Jim Cox, MD, PhD,[c] Lucas Boersma, MD, PhD[b,d]

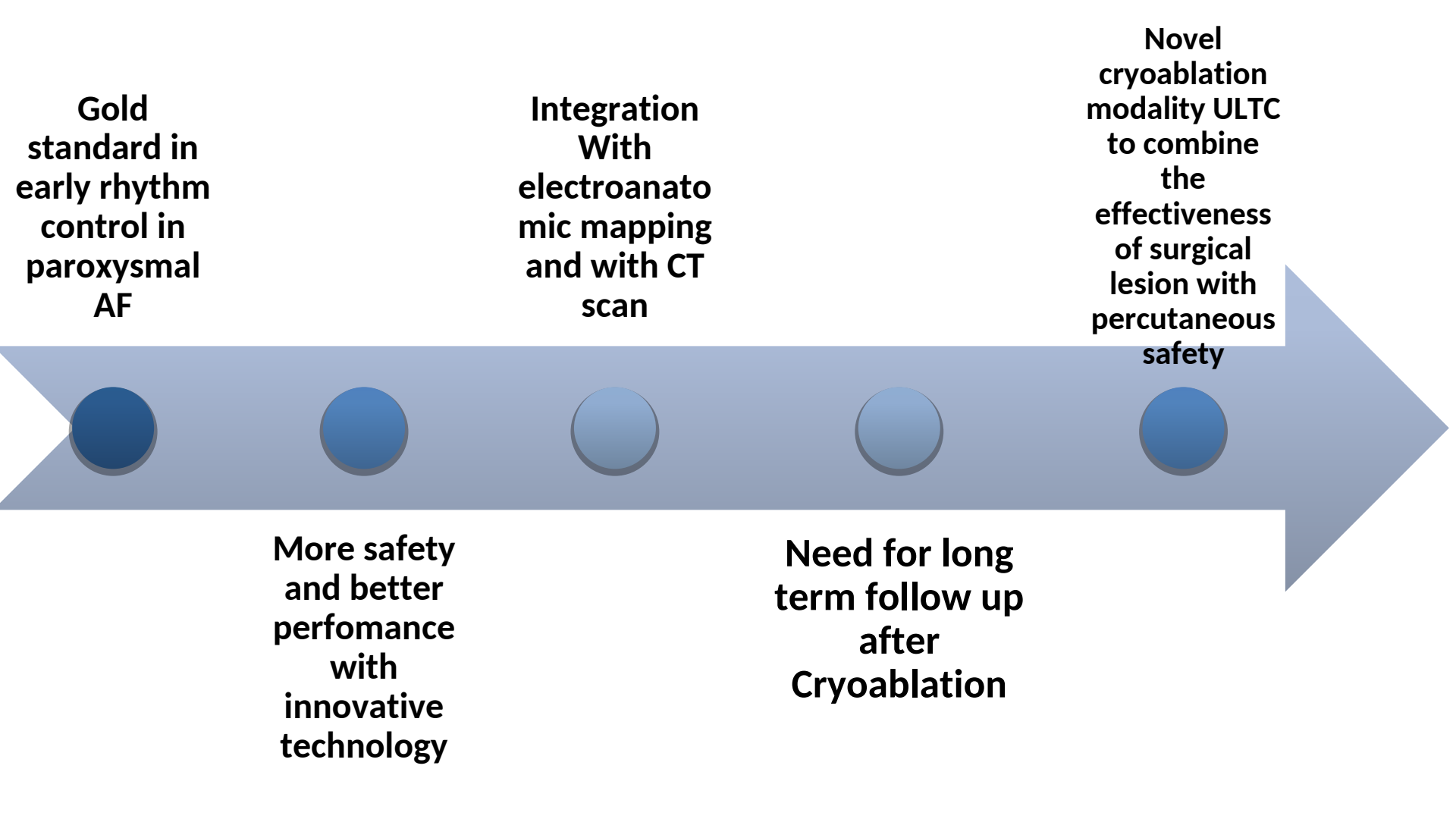
FIGURE 1 Ultra-Low Temperature Cryoablation Catheter Design and Clinical Utilization







De Potter T. et al. J Am Coll Cardiol EP. 2022:8(8):1034-1039.


Gold standard in early rhythm control in paroxysmal AF
More safety and better perfomance with innovative technology
Integration With electroanatomic mapping and with CT scan
Need for long term follow up after Cryoablation
Novel cryoablation modality ULTC to combine the effectiveness of surgical lesion with percutaneous safety

PLACE

PLATFORM OF LABORATORIES FOR ADVANCES IN CARDIAC EXPERIENCE

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