InEurHeart

Computed Tomography-Guided Catheter Ablation for Ventricular Tachycardia

Frederic Sacher[1] , Tobias Reichlin[2] , Mathieu Le Bloa[3] , Gregoire Massoulie[4] , Xavier Waintraub[5], Philippe Maury[6], Daniel Scherr[7] , Romain Tixier[1], Benoit Guy-Moyat[8], Josselin Duchateau[1], Christian Meyer[9], Maxime Sermesant[10], Melanie Gunawardene[11], Noemie Bronnec[1] , Aurore Georget[12], Sanna Azzouz[13], Estelle Gandjbakhch[5], Nicolas Derval[1], Michel Haissaguerre[1], Roland Tilz[14], Mélèze Hocini[1], Thomas Deneke[15] , Thomas Pambrun[1], Maureen Rutten-van Molken[13], Helmut Pürerfellner[16], Florian Englert[17], Elena Sauer[15], Pierre Jais[1], Antoine Benard[12], Hubert Cochet[1]

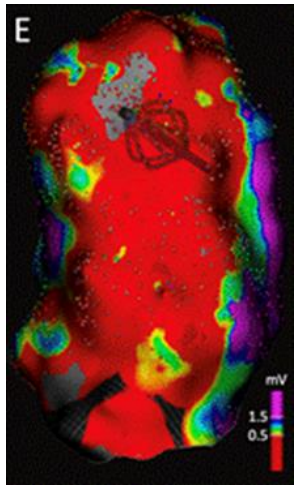
1. IHU LIRYC - CHU/Univ Bordeaux, Pessac, France; 2. Inselspital Bern, Bern, Switzerland; 3. CHU Vaudois, Lausanne, Switzerland; 4. CHU de Clermont-Ferrand, Clermont-Ferrand, France; 5. Pitié-Salpêtrière University Hospital, Paris, France; 6. HOPITAL RANGUEIL TOULOUSE, Toulouse, France; 7. Medical University of Graz, Austria, Graz, Austria; 8. CHU Limoges, Limoges, France; 9. Division of cardiology, EVK Düsseldorf, Dusseldorf, Germany; 10. Université Côte d'Azur, Inria Epione Team, Sophia Antipolis, France; 11. Asklepios center, Hamburg, Germany; 12. USMR, pôle de santé publique, CHU de Bordeaux, Bordeaux, France; 13. Erasmus School of Health policy and Management (ESHPM), Erasmus University Rotterdam, The Netherlands; 14. Department of Rhythmology, German Center for Cardiovascular Research (DZHK), Lubeck, Germany; 15. Rhönklinikum Campus, Bad Neustadt, Germany; 16. Ordensklinikum Linz Elisabethinen, Linz, Austria; 17. German Heart Center, München, Germany.

NCT: 05225935

VT ablation

Conventional VT ablation

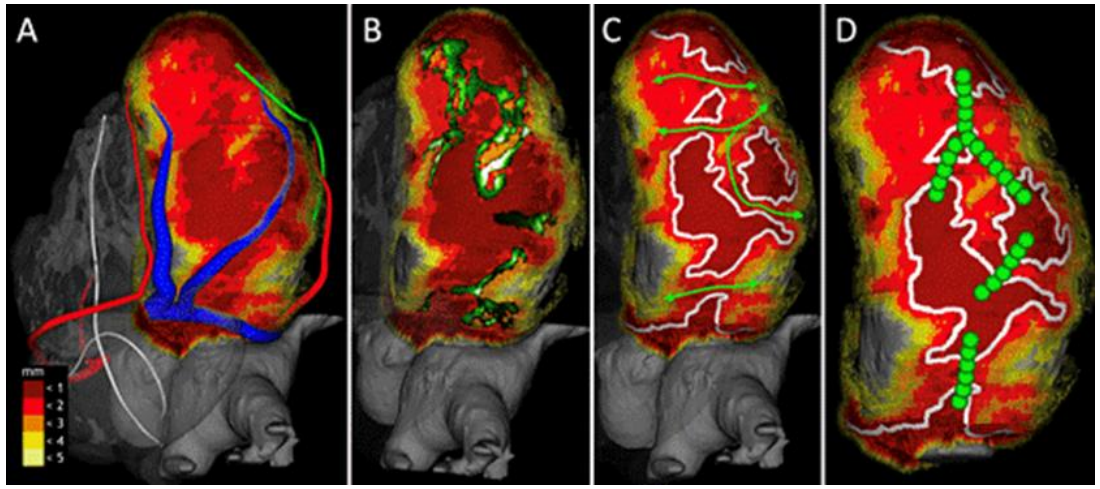
Identification of targets with invasive catheter mapping owing to operator experience



- No images
- Free to use any catheters/strategy
- Final endpoint > non-inducibility

CT-guided VT ablation

Identification of targets with non-invasively with CT-Scan and inHEART modelization



- Merging
- Ablation of isthmii identified by CT-Scan (40-50W with at least 10g & ≥45sec)
- Inducibility when all isthmii have been targeted > if inducible > target the VT

- **Main objective:**

To compare conventional vs CT-guided VT ablation strategy in term of procedure duration, efficacy, safety and cost

Komatsu Y et al. Circulation AE 2013; Berte B et al. J Interv Card Electrophysiol. 2020; Englert F et al. Clin Res Cardiol. 2024

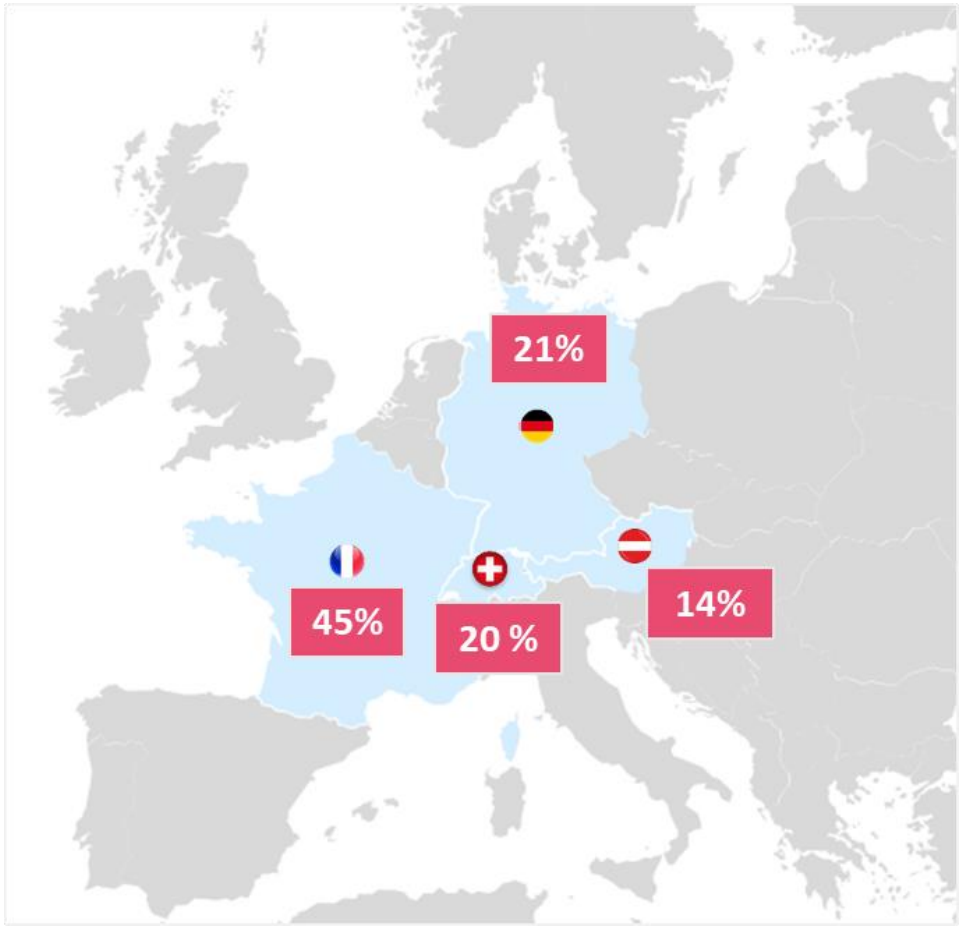
Methods

Institutional multicentric, prospective, single-blinded randomized clinical trial, Funded by EIT-Health.

113 patients

14 Clinical sites

4 countries



France:
- ✓ **Bordeaux University Hospital (Pr. Frédéric Sacher)**
- ✓ Toulouse University Hospital (Pr. Philippe Maury)
- ✓ Clermont-Ferrand University Hospital (Dr. Grégoire Massoullié)
- ✓ Paris University Hospital (Dr. Xavier Waintraub)
- ✓ Limoges University Hospital (Dr. Benoît Guy-Moyat)

Germany:
- ✓ **Rhön-Klinikum AG, Bad Neustadt (Pr. Thomas Deneke)**
- ✓ Evangelisches Krankenhaus Düsseldorf (Pr. Christian Meyer)
- ✓ Technical University of Munich (TUM) (Pr. Isabel Deisenhofer)
- ✓ Asklepios Kliniken Hamburg GmbH (Pr. Stephan Willems)
- ✓ Universitäres Herzzentrum Lübeck (Pr. Roland Tilz)

Austria:
- ✓ **Medical University of Graz (Pr. Daniel Scherr)**
- ✓ Ordensklinikum Linz GmbH (Pr.Dr. Helmut Pürerfellner)

Switzerland:
- ✓ **Inselspital Bern (Pr. Tobias Reichlin)**
- ✓ Vaudois University Hospital, Lausanne (Dr. Mathieu Le Bloa)

inEurHeart Workflow

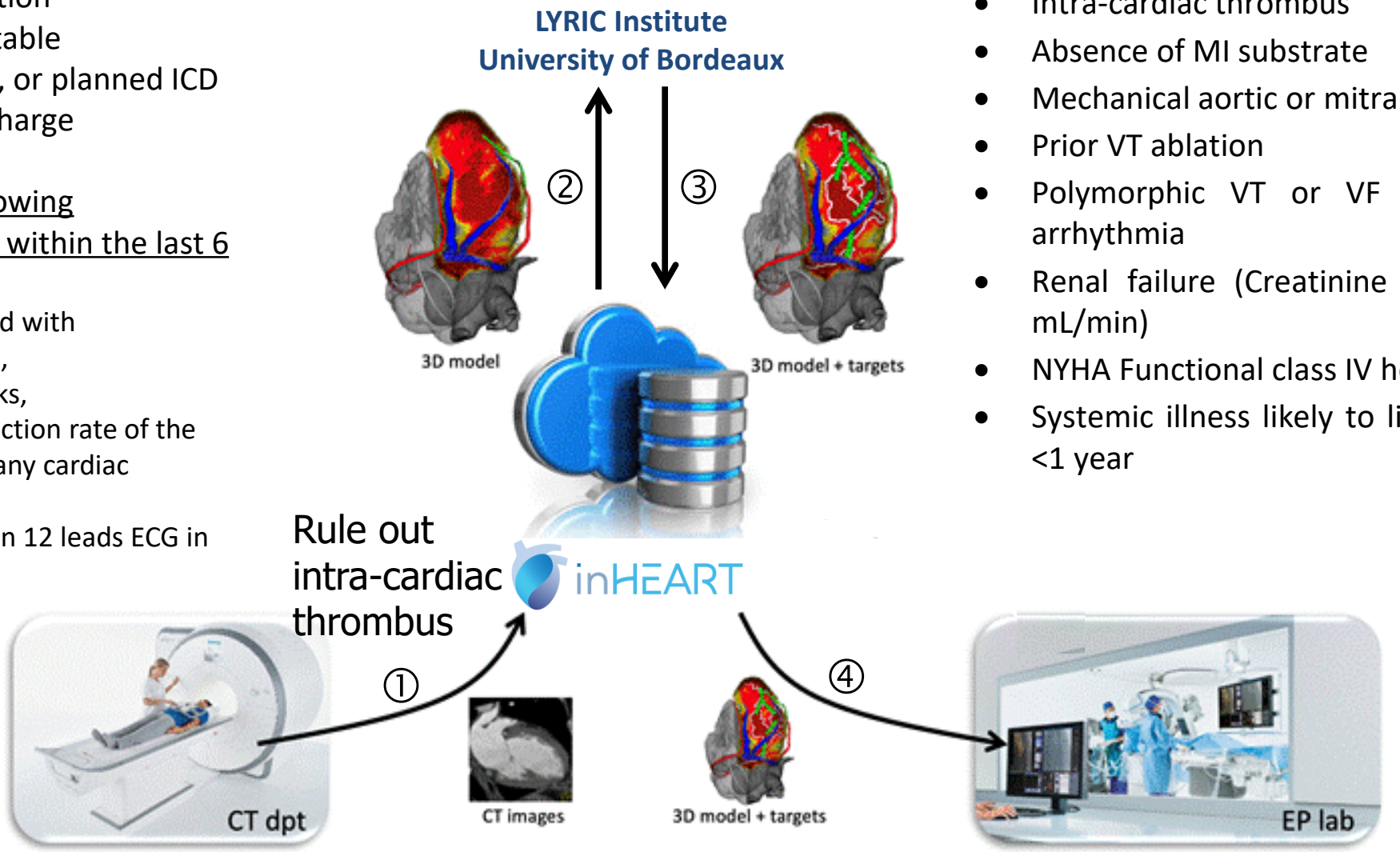
Inclusion criteria

- Indication for de-novo VT ablation
- Prior myocardial infarction
- Presence of an implantable cardioverter defibrillator, or planned ICD implantation before discharge

- And

- <u>At least one of the following monomorphic VT events within the last 6 months:</u>

A: ≥3 episodes of VT treated with antitachycardia pacing (ATP),
B: ≥1 appropriate ICD shocks,
C: sustained VT below detection rate of the ICD documented by ECG or any cardiac monitor,
D: Sustained VT recorded on 12 leads ECG in the absence of ICD



Exclusion criteria

- Active myocardial ischemia
- Intra-cardiac thrombus
- Absence of MI substrate
- Mechanical aortic or mitral valve
- Prior VT ablation
- Polymorphic VT or VF as presenting arrhythmia
- Renal failure (Creatinine clearance <30 mL/min)
- NYHA Functional class IV heart failure
- Systemic illness likely to limit survival to <1 year

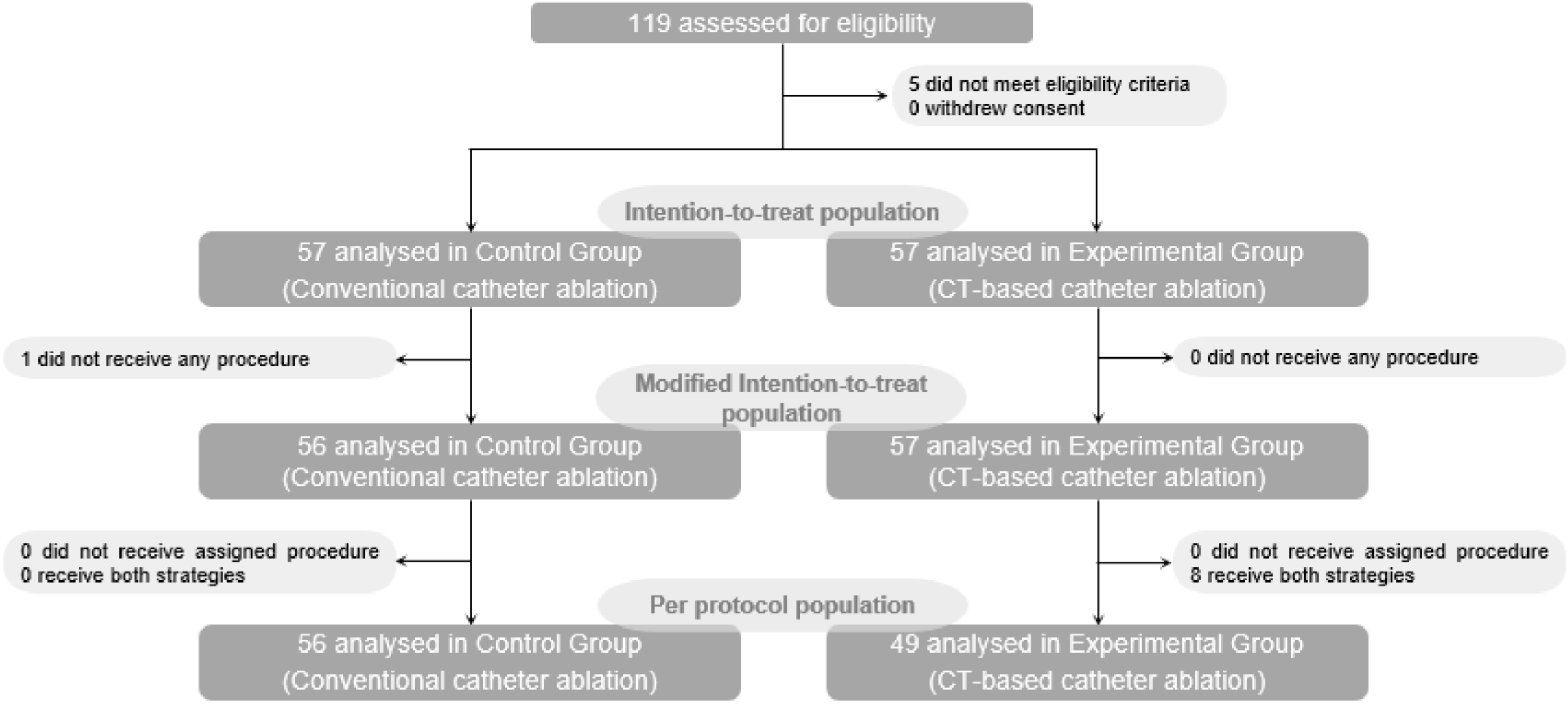
inEurHeart Workflow – CT guided arm

- **Importing images**
- **Merging**
- **Ablation of the identified isthmus**
- **EP Study**

  If negative: stop there

  If positive: map and ablate the induced VT

inEurHeart – Flowchart



inEurHeart – Baseline population

	Conventional VT ablation (n=56)	CT-guided VT ablation (n=57)
Age – years, mean ±SD	65.4 ±9.1	63.8 ±8.5
Male – no. (%)	50 (89.3)	53 (93.0)
BMI, mean ±SD	27.8 ±4.0	29.6 ±4.9
Diabetes– no. (%)	21 (39.6)	25 (43.9)
HTA - no. (%)	36 (67.9)	35 (61.4)
History of stroke/TIA – no. (%)	6 (11.3)	5 (8.8)
History of AF or A Flutter – no. (%)	12 (22.6)	14 (24.6)
CHADS-VASc risk score – mean, ±SD	3.4 ±1.7	3.3 ±1.2
Duration since myocardial infarction, months - mean, ±SD	183.6 ±126.7	165.1 ±125.8
Prior cardiac arrest – no. (%)	7 (13.2)	14 (24.6)
LVEF – %, mean, ±SD	34.5 ±11.2	35.2 ±11.4
History of electrical storm – no. (%)	23 (41.8)	21 (36.8)
Amiodarone use – no. (%)	31 (55.4)	35 (61.4)
Dysthyroisdism – no. (%)	7 (13.2)	11 (19.3)

InEurHeart – Procedure

	Conventional VT ablation (n=56)	CT-guided VT ablation (n=57)
General anesthesia – no. (%)	21 (38.9)	21 (40.4)
Use of high density mapping catheter – no. (%)	51 (91.1)	14 (25.5)
Contact Force ablation catheter – no. (%)	51 (91.1)	52 (91.2)
Number of anatomical isthmus identified on CT– mean, ±SD	2.9 ±1.3	3.2 ±1.3
Non inducibility after CT ablation – no. (%)	NA	43 (75.4)
Any VT inducible at the end of the procedure – no. (%)	16 (33.3)	8 (17)
X-ray Duration (min)	12.8 ±9.6	12.5 ±13.1
Total RF duration – mean, ±SD	36.6 ±19.5	44.4 ±19.4
Major AE (grade 3≤) related to the procedure	2 (3.6)	1 (1.8)

InEurHeart – primary endpoint

Procedure duration definition:

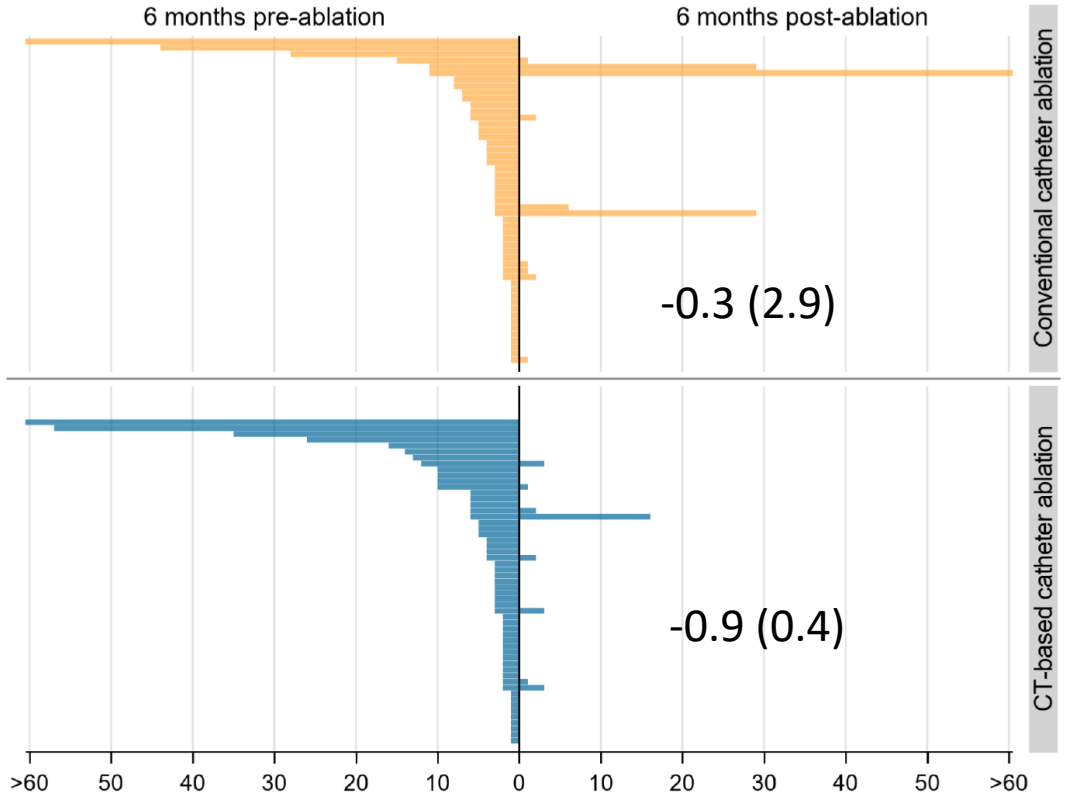
Time between first catheter introduction to last RF application

	Total (n=113)	Conventional VT ablation (n=56)	CT guided VT ablation (n=57)	Adjusted percentage difference
Mean procedure duration in ITT in min (SD)	134.4 (52.0)	148.8 (50.6)	120.3 (49.8)	-19.1% [-31.7 ; -6.6] p=0.0027
Mean procedure duration per protocole in min (SD)	129.3 (49.7)	148.8 (50.6)	107.1 (38.3)	-28.0% p<.0001

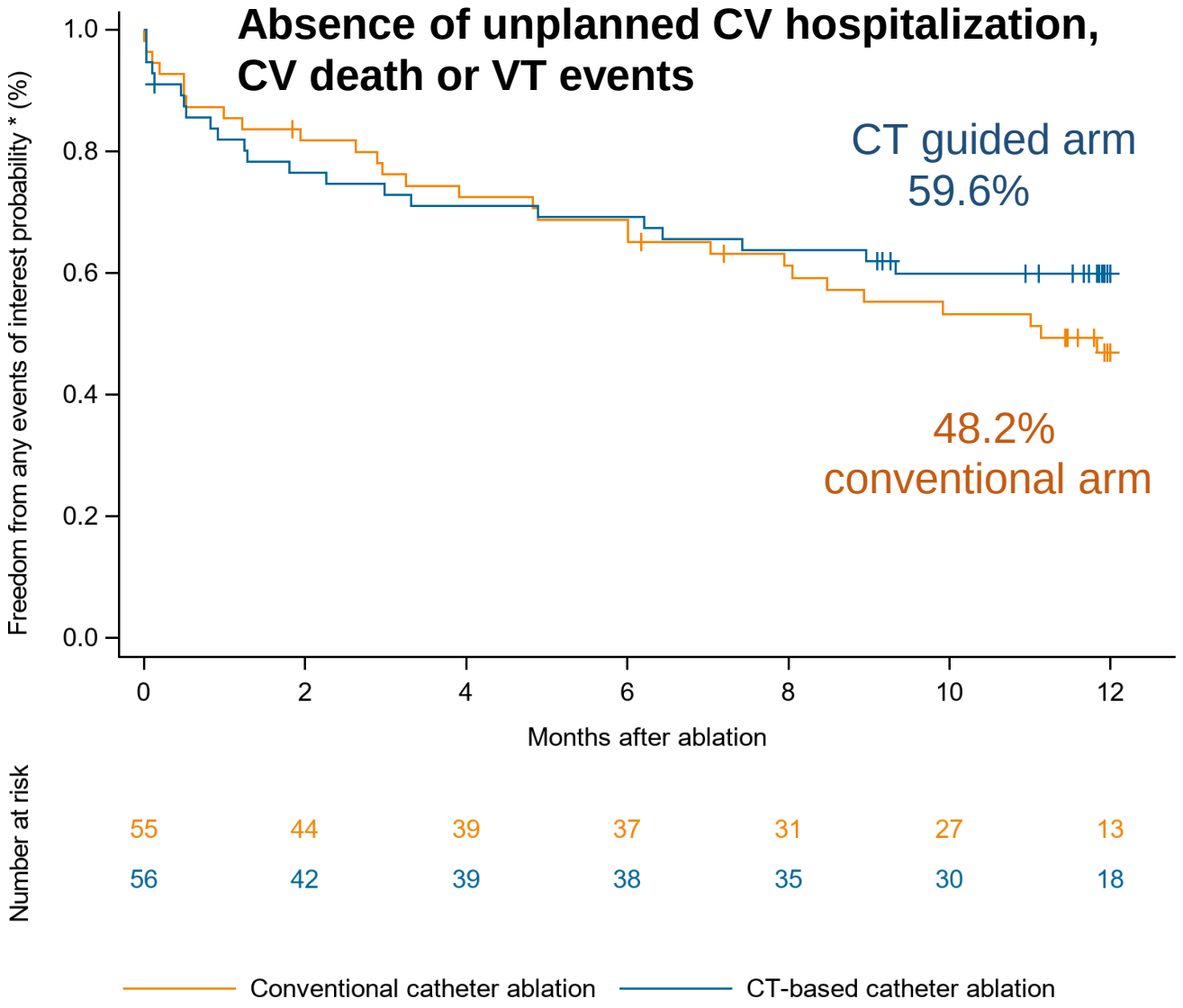
InEurHeart – secondary endpoints

	Total (n=113)	Conventional VT ablation (n=56)	CT guided VT ablation (n=57)	Stat
Absence of recurrence at one year (ITT)	80 (72.1%)	37 (67.3%)	43 (76.8%)	+ 9.5% NS
Absence of recurrence at one year (per-protocole) with CF catheter	74/101 (73.3%)	33/50 (66.0%)	41/51 (80.4%)	+ 14.4% NS

Reduction of VT burden



InEurHeart – secondary endpoints



* Events of interest = Unplanned hospitalizations due to cardiac reasons, cardiovascular-related death and VT events

Procedural cost

- in french public health system
- without GA
- without housing
- assuming a cost for image modelisation €1250

	Conventional	CT guided	Adjusted difference
Personal cost	€ 545,17	€ 392,39	€ 152,78
Material cost	€ 5 562,82	€ 5 069,90	€ 492,92
Total cost	**€ 6107,99**	**€ 5462,29**	**€ 645,7 (-10.6%)**

Conclusions

<u>Digital twin of the infarct scar based on cardiac CT scan to guide VT ablation allows:</u>

- A **reduction of procedure duration** by 19% (28% when the protocol was followed)
- **Without increased procedural risk**
- With **a one year VT free rate of 76.8%** vs **67.3%** in the conventional group (NS)
- Procedural cost reduced by 10% in the CT-guided group.

Acknowledgement to the participating clinical sites

Prof. Frédéric SACHER
Prof. Hubert COCHET
Prof. Pierre JAIS
Dr. Romain TIXIER
Dr. Josselin DUCHATEAU
Noémie BRONNEC

Prof. Philippe MAURY
Dr. Anne ROLLIN
Dr. Hubert DELASNERIE
Céline RABADEUX
Valérie VIDIS

Dr. Grégoire MASSOULLIE
Prof. Romain ESCHALIER
Prof. Lucie CASSAGNES
Dr. Antoine BOUDIAS
Dr. Frédéric JEAN
Emilie VAZEILLE-LOLLIVIER
Ouarda LAMALLEM

Dr. Xavier WAINTRAUB
Pr. Estelle GANDJBAKHCH
Dr. Guillaume DUTHOIT
Dr. Nicolas BADENCO
Dr. Thomas CHASTRE
Dr. Mikaël LAREDO
Dr. Sonia MARAKCHI
Maryse SEDJI
Hayet IDDIR

Dr. Benoît GUY-MOYAT
Elodie BEC
Valérie PRADEL

Prof. Thomas DENEKE
Dr. Elena ENE
Dr. Karin M. NENTWICH
Dr. Artur BERKOVITZ
Dr. Lukas LEHMKUHL
Laura BENKERT
Denise GERLACH

Prof. Christian MEYER
Dr. Fares-Alexander ALKEN
Dr. Bahram WAFAISADE
Dr. Ernan ZHU
Katharina SCHERSCHEL

Thank you

Prof. Tobias REICHLIN
Prof. Laurent ROTEN
Dr. Oscar GALUSKA
Dr. Antonio MADAFFARI
Dr. Jens SEILER
Corinne JUFER

Prof. Helmut PÜRERFELLNER
Dr. Martin MARTINEK
Dr. Michael DERNDORFER
Dr. Georgios KOLLIAS
Carina GUTENBRUNNER
Barbara BICHLER
Eva STRAUSS

Dr. Mathieu LE BLOA
Dr. Patrizio PASCALE
Dr. Etienne PRUVOT
Dr. Cheryl TERES
Sandrine SALZMAN
Nathalie DUFOUR

Prof. Isabel DEISENHOFER
Dr. Florian ENGLERT
Dr. Felix BOURIER
Dr. Fabian BAHLKE
Dr. Tilko REENTS
Dr. Sarah LENGAUER
Dr. Monika HOFMANN
Dr. Nico ERHARD
Sabine BRANDHORST

Prof. Stephan WILLEMS
Dr. Melanie GUNAWARDENE
Dr. Omar ANWAR
Dr. Nele GEßLER
Dr. Jens HARTMAN
Dr. Mario JULARIC
Dr. Rahim WAHEDI
Dr. Arso ZAHIR-AKKRA
Patrice OUATTARA
Claudia KALKOWSKI
Johanna STENDER

Prof. Roland TILZ
Dr. Christian HEEGER
Dr. Sorin POPESCU
Dr. Bettina KIRSTEIN
Jordanka NACEVA
Claudia BREITHAUPT
Alexandra KAZUBSKI
Mirco KÜCHLER

Prof. Daniel SCHERR
Dr. Ursula ROHRER
Dr. Martin MANNINGER
Lucia ANDRECS
Corinna MAGG
Nina THONHOFER

inEurHeart project received funding from EIT Health co-funded by the European Union