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DZHK
DEUTSCHES ZENTRUM FÜR HERZ-KREISLAUF-FORSCHUNG E.V.

EMB Meeting Berlin 18.01.2019

Optimum Time-Point of VT Ablation: Prophylactic VT ablation - Hints from current studies (BERLIN-VT, VANISH 2)

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Universitäres Herzzentrum Hamburg

Conflict of Interest

Lecture fees/grants

Biosense Webster, Boehringer Ingelheim, Bayer

Boston Scientific, St. Jude Medical, Sanofi-Aventis,

Bristol-Myers Sqibb, Daiichi Sankyo.

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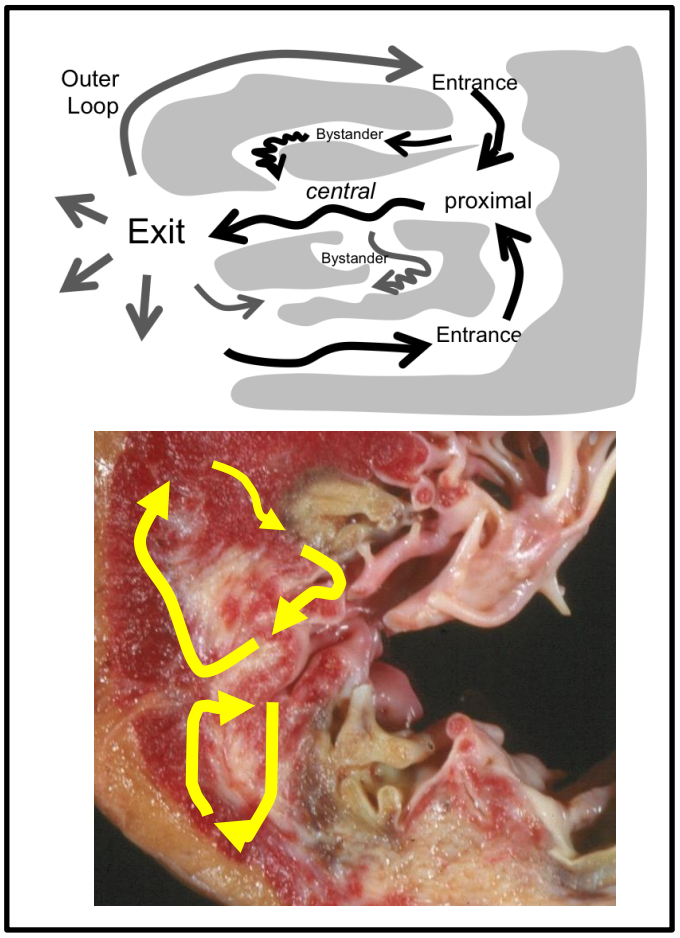
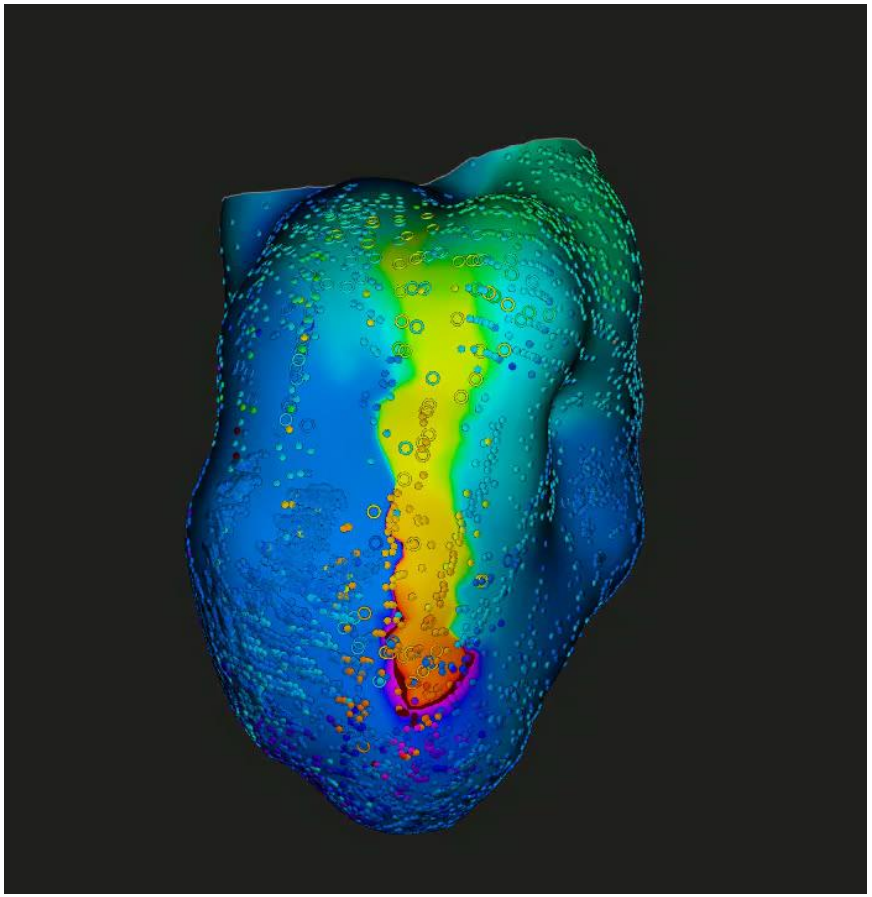
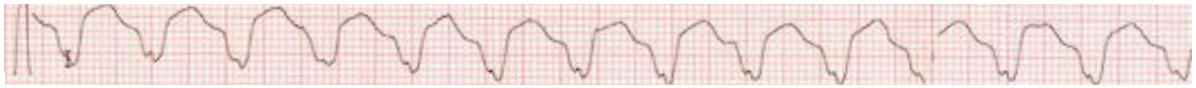
Early VT Ablation ?







Modified from Schaeffer and Stevenson JCE. 2017;1–10;
Courtesy Prof. Stevenson

Anter E et al. Circulation. 2016;134:314-327

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Early VT Ablation ?

Rationale

Strategies & Data

Arguments for early VT Ablation

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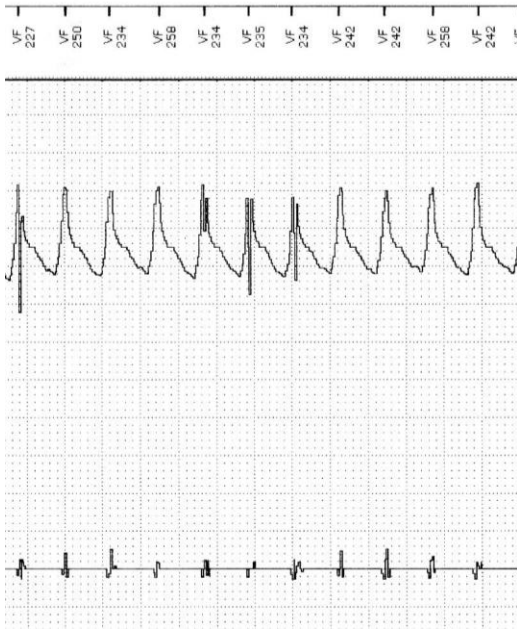
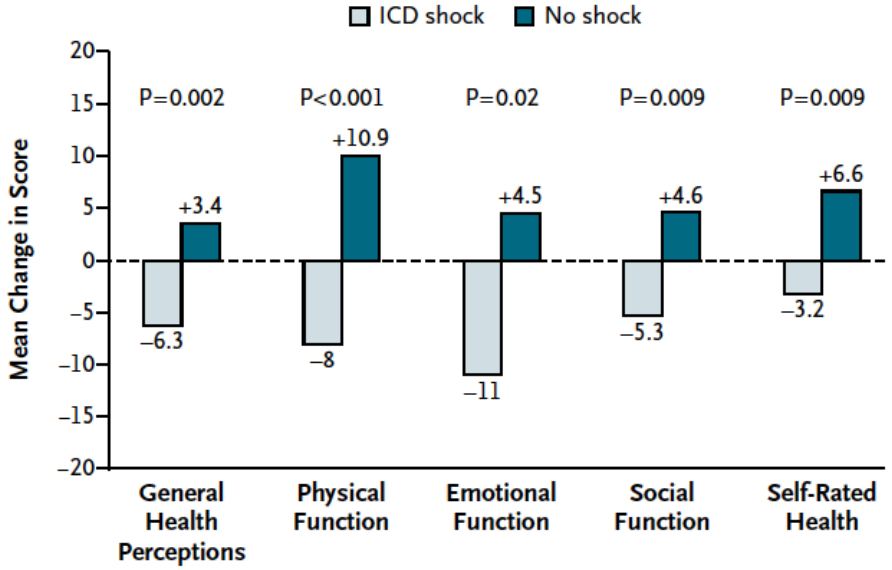
Consequence of ICD Schocks



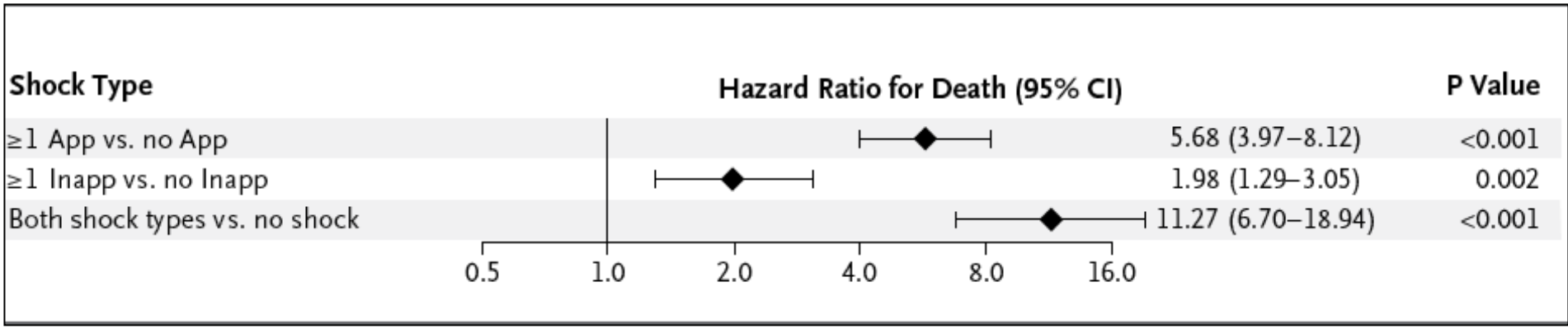
Consequence of ICD Schocks

Relevant with Regard to Quality of Life & Prognosis

"The Sudden Cardiac Death in Heart Failure Trial" SCD HeFT-Trial



Mark DB et al. N Engl J Med 2008; 359:999-1008



Poole JE et al. N Engl J Med 2008; 359: 1009

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Early VT Ablation ?

		n=	ICD Indi-cation	Design	FU (m.)	PE	Red. of ICD tx.	Red. of shock	Red. of inapp. shock	Mortality
MADIT-RIT (Moss A.)	2012 NEJM	1500	PP	1:1:1 High rate (≥ 200 bpm) vs. delayed (60/12sec) vs. conventional	14	Reduction of inappr. ICD-tx	+	+ (inappr. shock)	+ (high rate group)	+ (both groups)
ADVANCE III (Gasparini M)	JAMA 2013	1902	PP+SP	1:1 random. long (30-40 Intervalls) vs. standard	12	Reduction of ICD-tx	+	+ (inappr. shock)	+	+/-
PROVIDE (Saed M.)	JCE 2014	1670	PP	1:1 random. late, high, long detection vs. standard	18	Time to first shock	+	+ (inappr. shock)	+	+
DECREASE (Schwab JO)	AHA 2013	540	PP	1:1 random. higher detection (187/240 bpm) vs. conventional group (171/214 bpm)	12	inappr. ICD tx spontaneous VT/VF	+ (inappr. shock)	+ (inappr. shock)	+	+/-

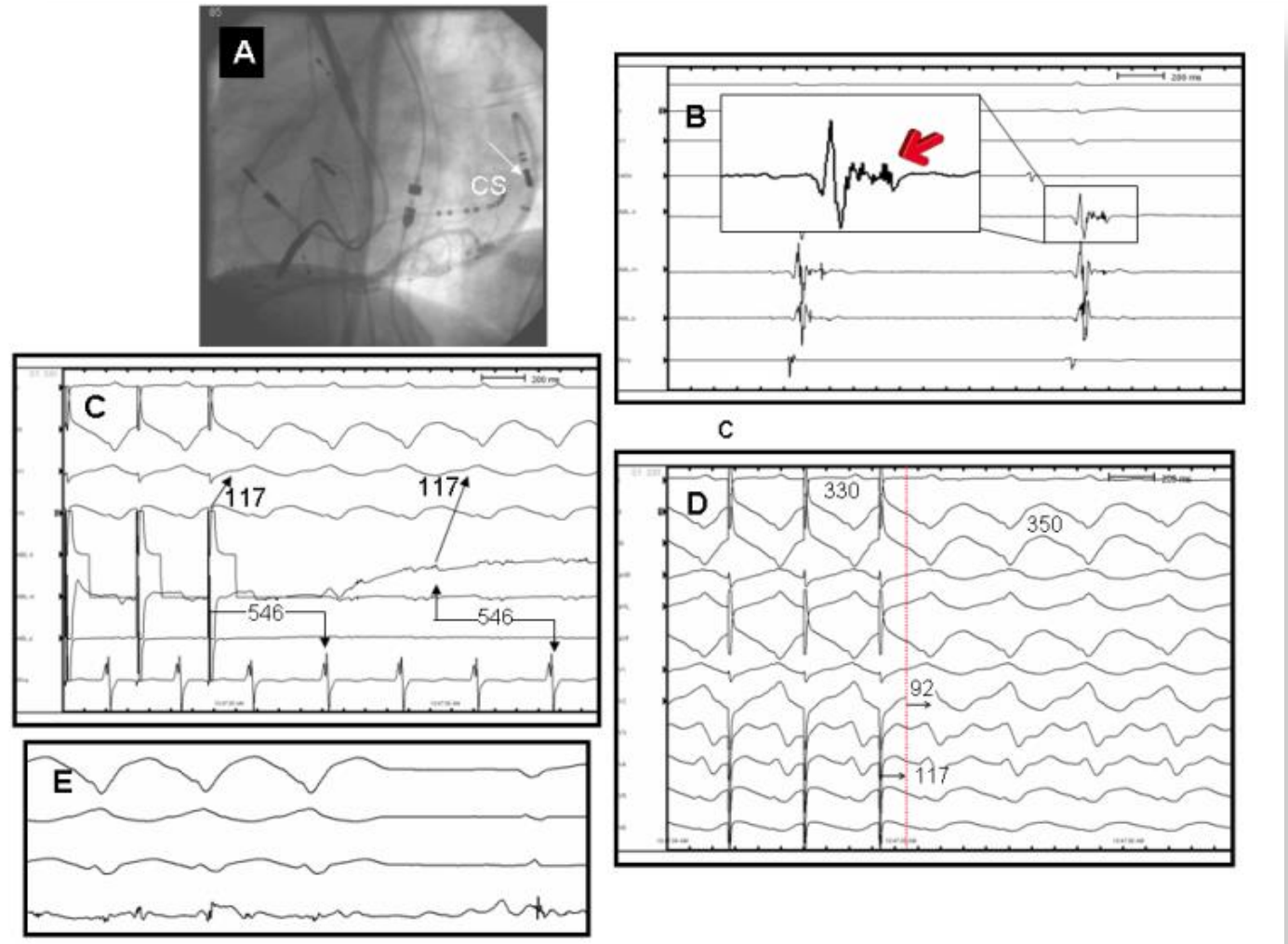
Early VT Ablation ?

Rationale

Strategies & Data

Arguments for early VT Ablation

Mapping Strategies



Scheinman, de Bakker, Stevenson et al. „VT Mapping“

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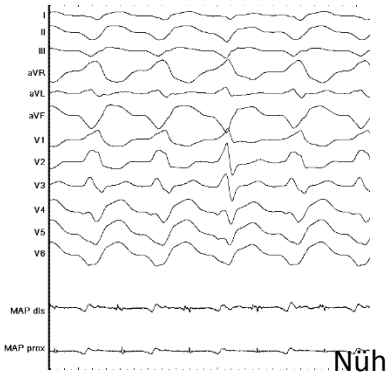
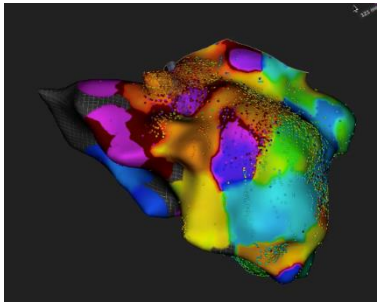
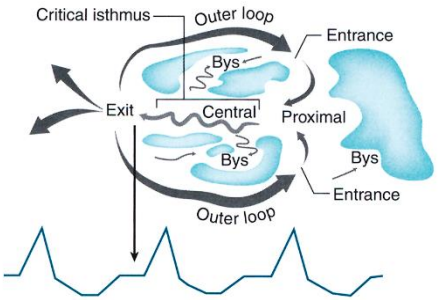
Early VT Ablation ?

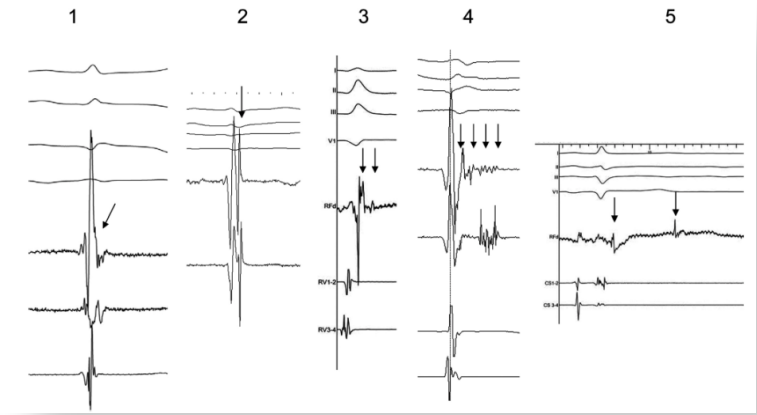
Entrainment- and Activation-Mapping (VT)





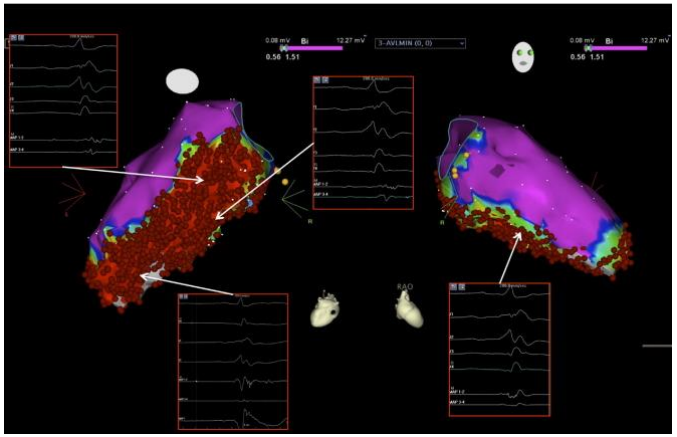


Nührich J . et al. 2017;28:1058-1067



Jais, Haissaguerre et al. „LAVA ablation“

Substrate-Mapping (Sinus rhythm)



Di Biase L et al. J Am Coll Cardiol 2012;60:132–41

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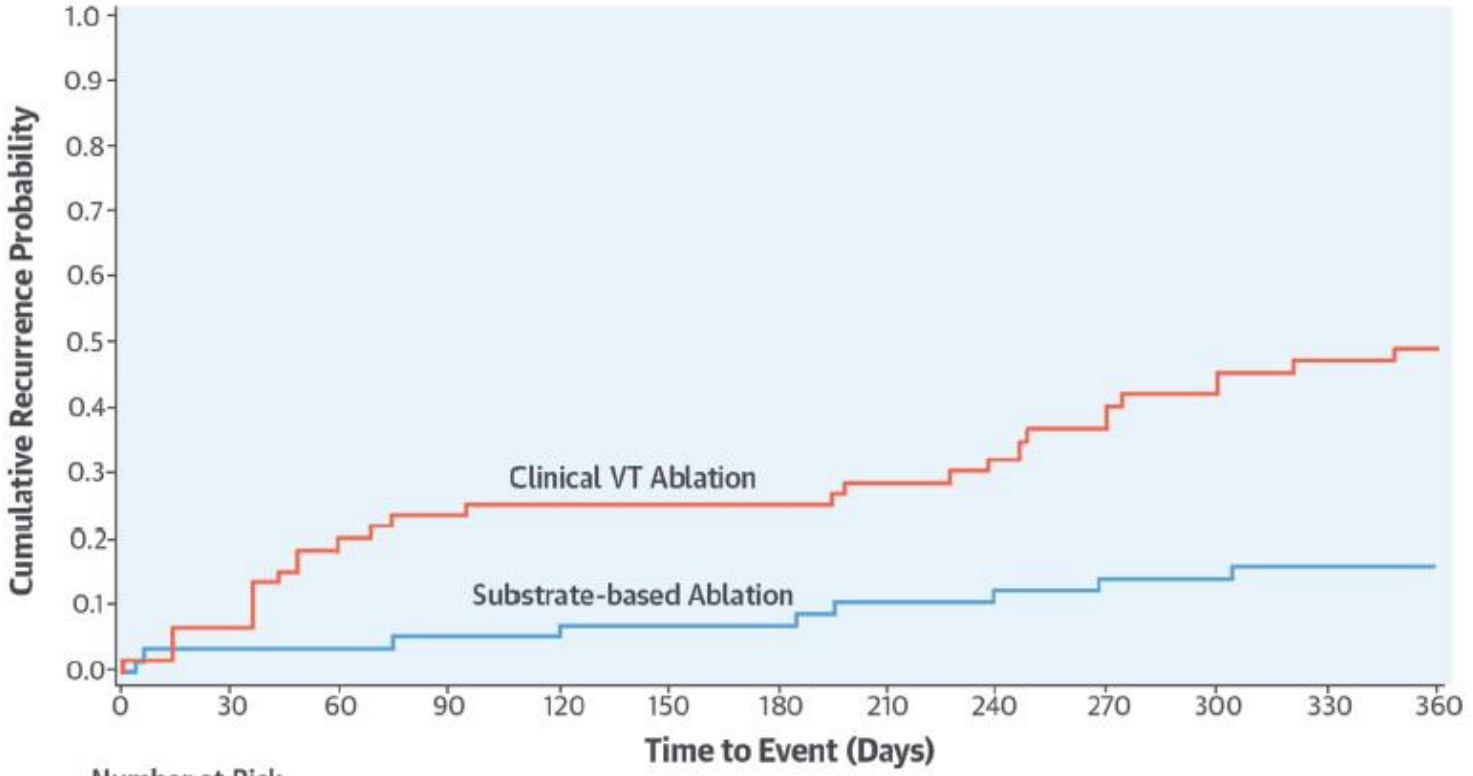
Substate vs VT – based Approach

Risk for VT recurrence



Number at Risk

Ablation Strategy													
Substrate-based	58	56	56	55	55	54	54	52	51	50	50	49	49
Clinical Stable VT	60	56	48	46	45	45	45	43	41	38	35	32	31

Di Biase, L. et al. J Am Coll Cardiol. 2015; 66(25):2872-82.

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Meta-Analysis of random. VT-Ablation studies

Meta-analysis of catheter ablation as an adjunct to medical therapy for treatment of ventricular tachycardia in patients with structural heart disease

Jaya Mallidi, MD, MHS,* Girish N. Nadkarni, MD, MPH,* Ronald D. Berger, MD, PhD, FHRS,†
Hugh Calkins, MD, FHRS,† Saman Nazarian, MD*†

- Pooled data from 5 randomized VT ablation studies including 457 patients

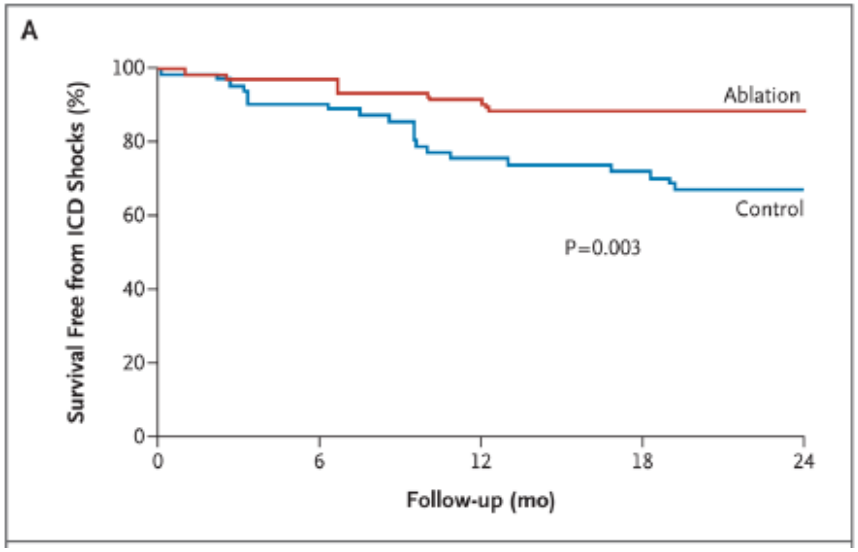
Heart Rhythm 2011;8:503

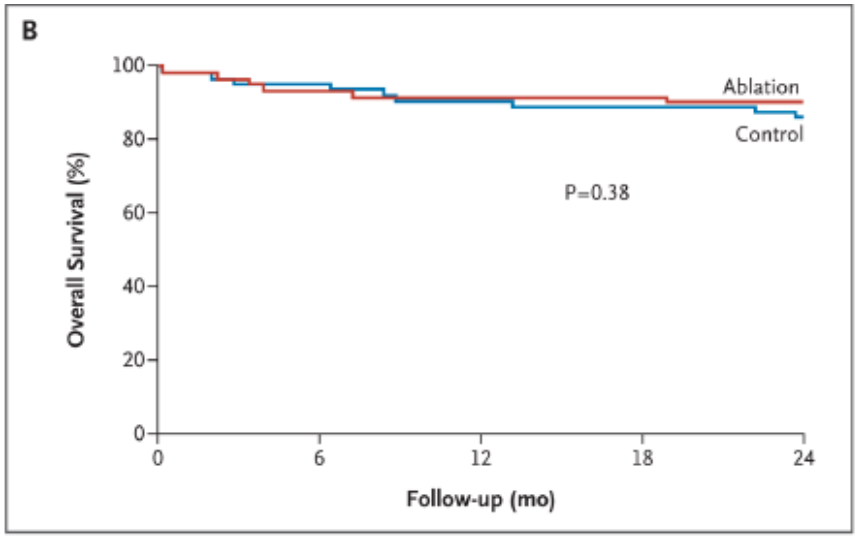
Early VT Ablation ?

SMASH-VT:

- N = 128 Pat. remote MI
- ICD Indication (most sec. Prevention) – hemodynamically unstable VT / VF
- no AAD
- 1:1 Randomization ICD vs. Ablation + ICD

- ≈ 2 Years FU 33% vs. 12% adequate Schocks





Reddy VY et al. N Engl J Med. 2007 December 27; 357(26): 2657–2665

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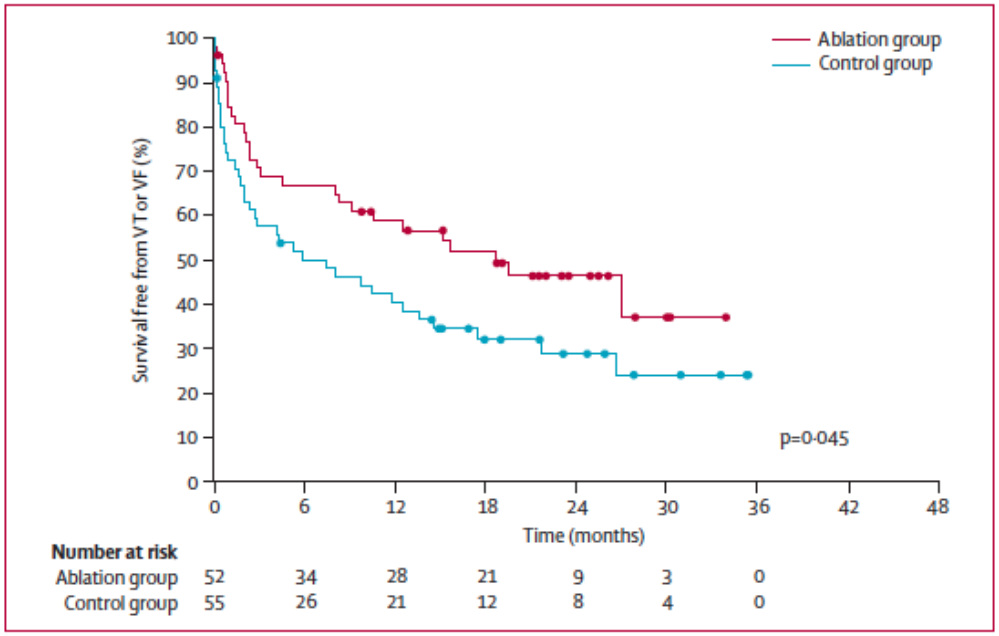
Early VT Ablation ?

VTACH:

- N = 110 Pat. remote MI
- Stable VT + EF ≤ 50%
- ICD vs. Ablation + ICD (1:1)
- ≈ 2 Years FU

- less Hospitalisations



	ICD + Ablation (n=52)	ICD (n=55)	
Time to first VT/VF (months)	15.9±1.7	11.3±5.9	p=0.045
Adequate ICD Intervention	50%	69%	p=0.051
Adequate ICD- Therapy / Pat / Year	7.1±16.3	58.3±263.5	p=0.013
Adequate ICD-Schocks / Pat. / Year	0.6±2.1	3.4±9.2	p=0.018

Modified from Kuck KH … Willems S et al. Lancet 2010; 375: 31–40

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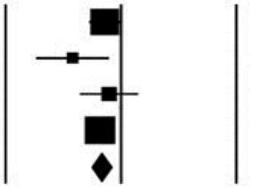
Early VT Ablation ?

Meta Analysis of Random. Trials (n= 457 Pat, 5 random. Studies)
Ablation vs. med. Therapy

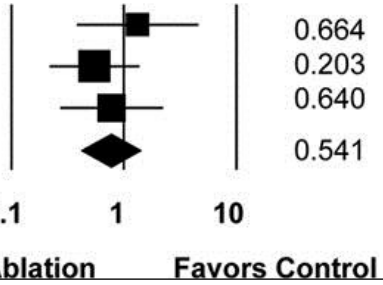
Relative risk for VT recurrence

Study	No of VT recurrences / Total patients: Ablation	Control	Relative risk and 95% CI	p-Value	Weight %
Kuck et al, 2010	26 / 52	38 / 55	0.72 (0.52,1.00)	0.051	35.9
Reddy et al, 2007	8 / 64	21 / 64	0.38 (0.18,0.80)	0.010	20.4
Schreieck et al, 2004	9 / 19	12 / 20	0.79 (0.44,1.43)	0.435	11.4
Epstein et al, 1998	36 / 73	24 / 32	0.66 (0.48,0.89)	0.007	32.4
Overall (95% CI)			0.64 (0.52, 0.79)	0.000	



Relative mortality risk

Study	Number of deaths / Number of patients: Ablation	Control	Relative risk and 95% CI	p-Value	Weight %
Kuck et al, 2010	5 / 52	4 / 55	1.32 (0.38, 4.66)	0.664	23.66
Reddy et al, 2007	6 / 64	11 / 64	0.55 (0.21,1.39)	0.203	43.13
Niwano et al, 2008	9 / 58	4 / 20	0.78 (0.27, 2.25)	0.640	33.21
Overall (95% CI)			0.76 (0.41, 1.38)	0.541	

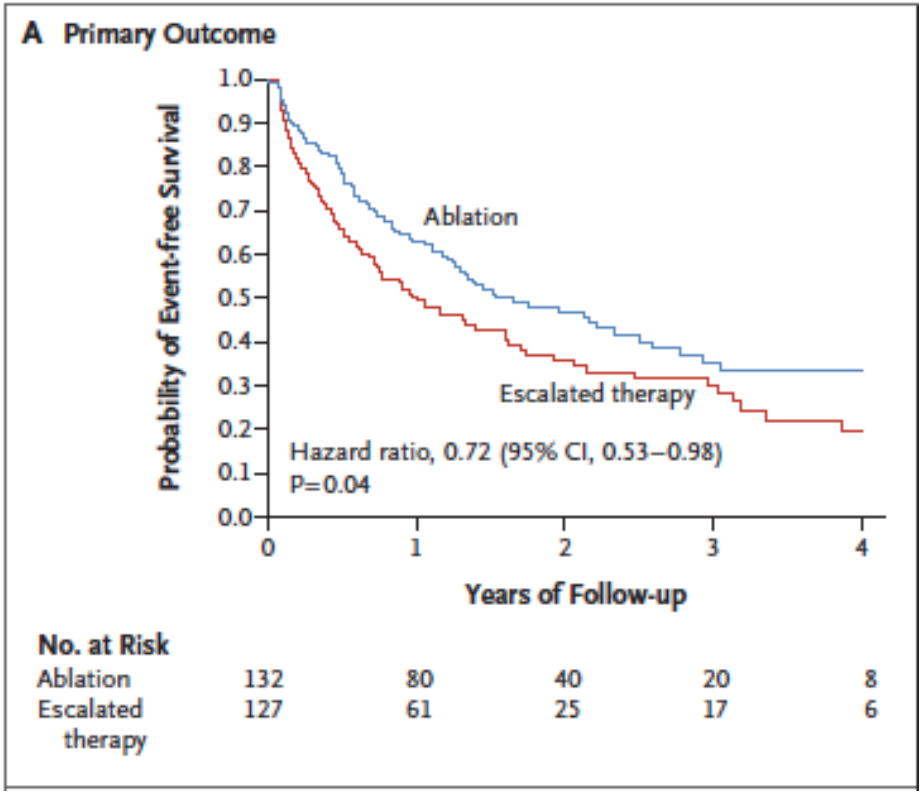


Mallidi J et al. Heart Rhythm 2011;8:503

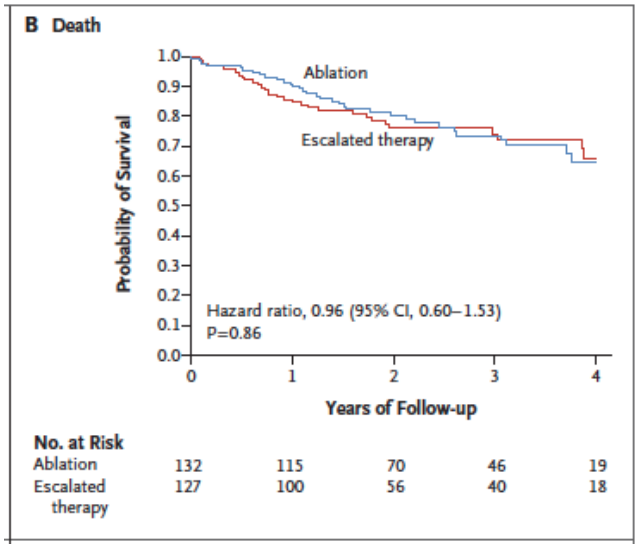
Early VT Ablation ?

VANISH:

- 259 Pat. remote MI , ICD
- VT despite med. Therapy
- Ablation vs. intensified Med. Therapy (1:1)
- ≥ 2 Jahre mean FU
- Mean EF 31%
- Death: HF or other cause, rarely VT assoc.



Composite primary outcome:
Death, VT storm, app. ICD therapy



Sapp J at al. N Engl J Med 2016;375:111-21.

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Early VT Ablation ?

2015 ESC Guidelines

Radiofrequency catheter ablation at a specialized ablation centre followed by the implantation of an ICD should be considered in patients with recurrent VT, VF or electrical storms despite complete revascularization and optimal medical treatment.	**IIa**	C	261–267

Priori S et al. Eur Heart J 2015;36:2793-2867

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Early VT Ablation ?

2015 ESC Guidelines

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Priori S et al. Eur Heart J 2015;36:2793-2867

2017 AHA/ACC/HRS

COR	LOE	Recommendations
I	B-R B-NR	**2. In patients with prior MI and recurrent episodes of symptomatic sustained VT, or who present with VT storm and have failed or are intolerant of amiodarone (LOE: B-R) (S7.1.3-4) or other antiarrhythmic medications (LOE: B-NR) (S7.1.3-5—S7.1.3-9), catheter ablation is recommended (S7.1.3-10—S7.1.3-12).**
IIb	C-LD	**3. In patients with ischemic heart disease and ICD shocks for sustained monomorphic VT or symptomatic sustained monomorphic VT that is recurrent, or hemodynamically tolerated, catheter ablation as first-line therapy may be considered to reduce recurrent VA (S7.1.3-10,S7.1.3-11).**

Al Khatib S et al. ACC/AHA/HRS GL 2017

Early VT Ablation ?

Rationale

Strategies & Data

Arguments for early VT Ablation

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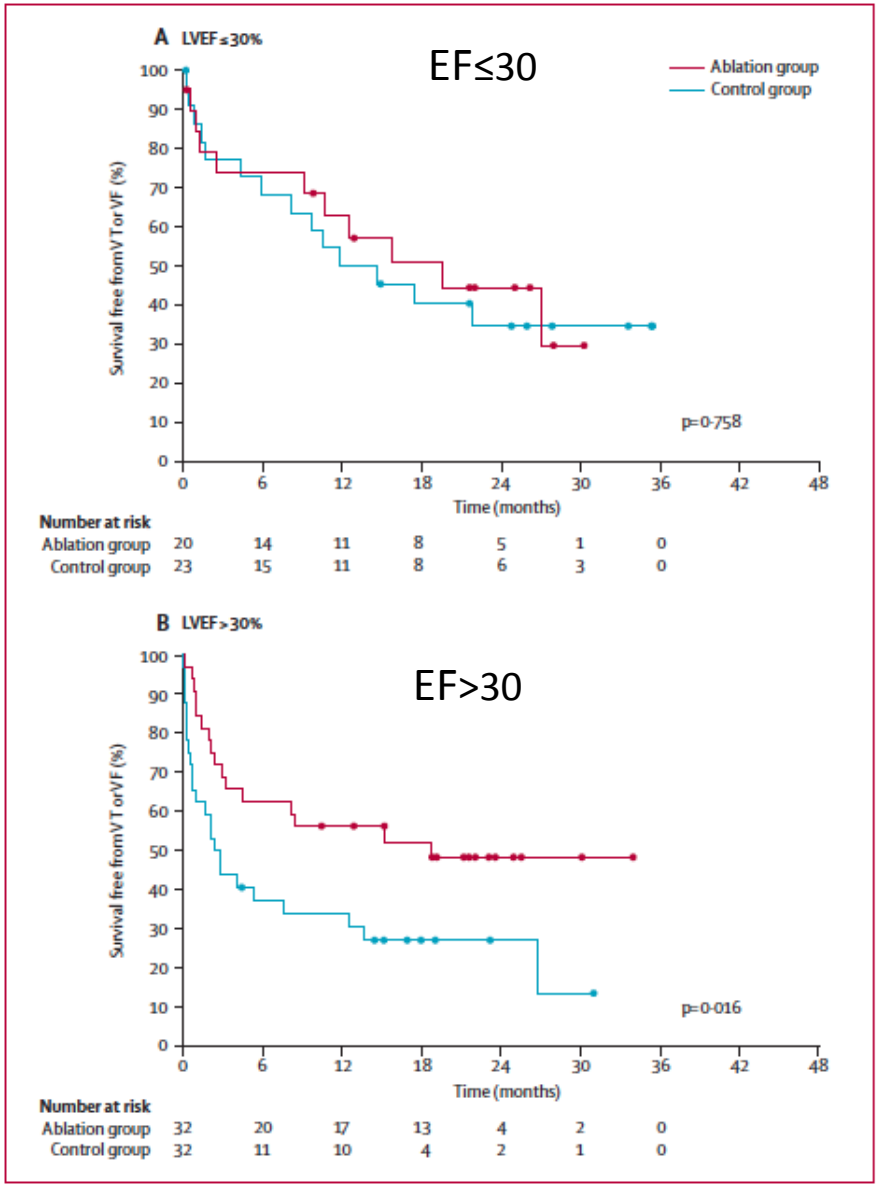
Early VT Ablation ?

VTACH:

- N = 110 Pat. remote MI
- Stable VT + EF ≤ 50%
- ICD vs. Ablation + ICD (1:1)
- ≈ 2 Years FU

- less Hospitalisations

- **Largest Benefit EF >30%**



Kuck KH et al. Lancet 2010; 375: 31–40

Early VT Ablation ?

Ablation without ICD?!

European Heart Journal (2014) 35, 1479–1485
doi:10.1093/eurheartj/ehu040

CLINICAL RESEARCH
Arrhythmia/electrophysiology

Radio-frequency ablation as primary management of well-tolerated sustained monomorphic ventricular tachycardia in patients with structural heart disease and left ventricular ejection fraction over 30%

Retrospective Study:

- 166 Pat, 8 Centers
- SHD EF>30% + hemodyn. tol. VT
- Ablation without „back-up“ ICD
- Follow-up: 32 Mon.

Overall Mortality

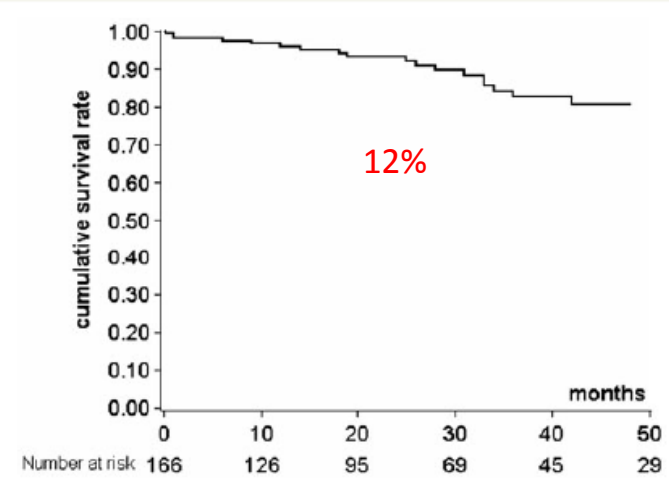


Figure 1 Actuarial survival curve for all-cause mortality.

SCD

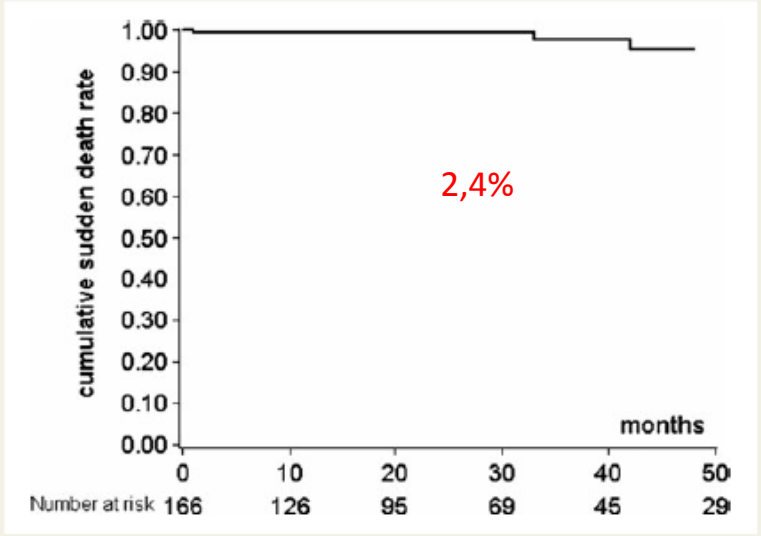
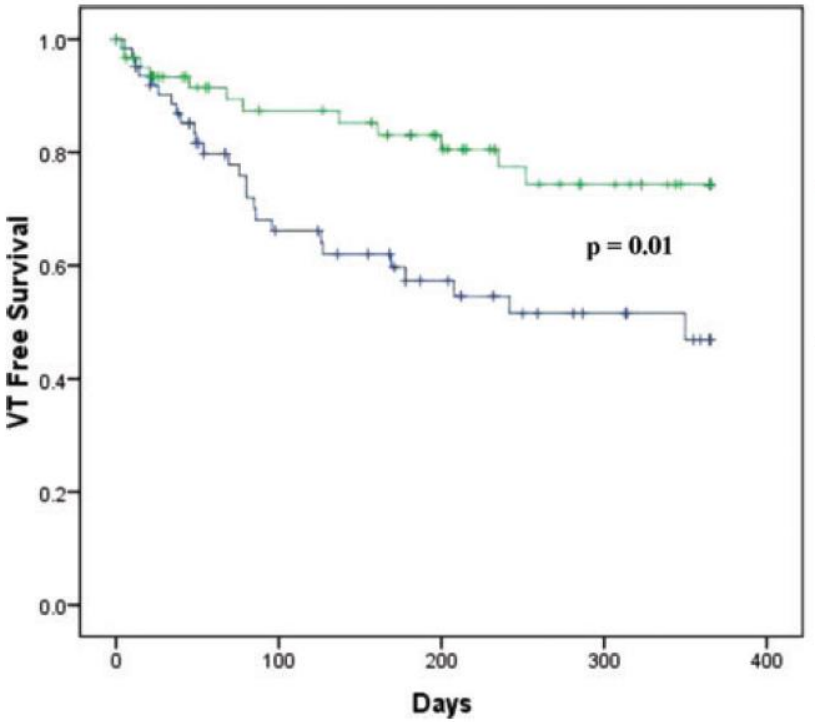


Figure 2 Actuarial survival curves for sudden death.

Maury P et al. European Heart Journal (2014) 35, 1479–1485

Early VT Ablation ?



(n=36)

(n=62)

	Hazard Ratio	95% CI	P Value
Age (per 1 year increase)	1.02	0.99–1.04	0.3
LVEF (per 1% increase)	0.97	0.95–0.99	0.02
Ischemic cardiomyopathy	0.77	0.40–1.47	0.4
Early referral*	0.37	0.14–0.84	0.02
VT storm	1.57	0.81–3.04	0.2
Shocks in preceding month (per 1 shock increase)	1.00	0.98–1.03	0.9
ATP in preceding month (per 1 ATP increase)	1.02	0.99–1.06	0.1
Amiodarone >/ = 400 mg daily preablation	1.79	0.66–2.42	0.5
Amiodarone dose reduced following ablation	1.55	0.76–3.17	0.2
Clinical VT hemodynamically tolerated	0.56	0.29–1.10	0.1
Number VTs targeted (per 1 increase)	0.90	0.75–1.08	0.3
Endocardial ablation only	1.03	0.47–2.24	0.9
Procedural success	0.36	0.14–0.93	0.03

Frankel, DS et al. J Cardiovasc Electrophysiol, Vol. 22, pp. 1123-1128, October 2011

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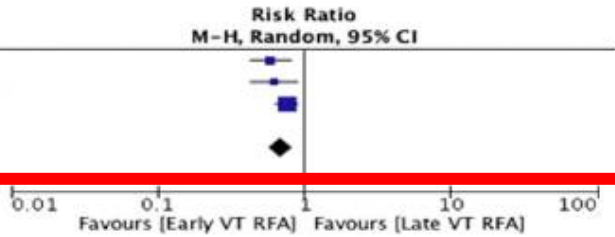
Early VT Ablation ?
(n=980, 3 Studies, VT & SHD)

FIGURE 2 Forest Plot Reporting the M-H Risk Ratio for Outcomes in Early Versus Late VT Ablation

A VT Recurrence

Study or Subgroup	Early Events	Early Total	Late Events	Late Total	Weight	Risk Ratio M-H, Random, 95% CI
Dinov et al, 2014	28	75	143	225	25.4%	0.59 [0.43, 0.80]
Frankel et al, 2011	17	36	47	62	18.8%	0.62 [0.43, 0.90]
Romero et al, 2017	93	201	230	381	55.8%	0.77 [0.65, 0.91]
Total (95% CI)		**312**		**668**	**100.0%**	**0.69 [0.58, 0.82]**
Total events	138		420			

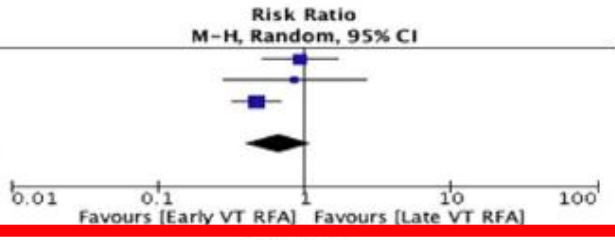
Heterogeneity: Tau² = 0.01; Chi² = 2.71, df = 2 (P = 0.26); I² = 26%
Test for overall effect: Z = 4.13 (P < 0.0001)



B Total Mortality

Study or Subgroup	Early Events	Early Total	Late Events	Late Total	Weight	Risk Ratio M-H, Random, 95% CI
Dinov et al, 2014	12	75	38	225	35.3%	0.95 [0.52, 1.72]
Frankel et al, 2011	4	36	8	62	16.1%	0.86 [0.28, 2.66]
Romero et al, 2017	28	201	112	381	48.6%	0.47 [0.32, 0.69]
Total (95% CI)		**312**		**668**	**100.0%**	**0.67 [0.40, 1.12]**
Total events	44		158			

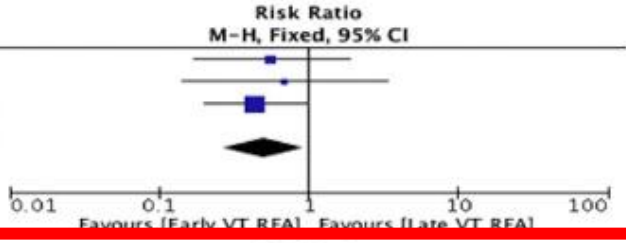
Heterogeneity: Tau² = 0.11; Chi² = 4.18, df = 2 (P = 0.12); I² = 52%
Test for overall effect: Z = 1.52 (P = 0.13)



C Acute Complications

Study or Subgroup	Early Events	Early Total	Late Events	Late Total	Weight	Risk Ratio M-H, Fixed, 95% CI
Dinov et al, 2014	3	75	16	225	24.7%	0.56 [0.17, 1.88]
Frankel et al, 2011	2	36	5	62	11.3%	0.69 [0.14, 3.37]
Romero et al, 2017	7	201	30	381	64.0%	0.44 [0.20, 0.99]
Total (95% CI)		**312**		**668**	**100.0%**	**0.50 [0.27, 0.93]**
Total events	12		51			

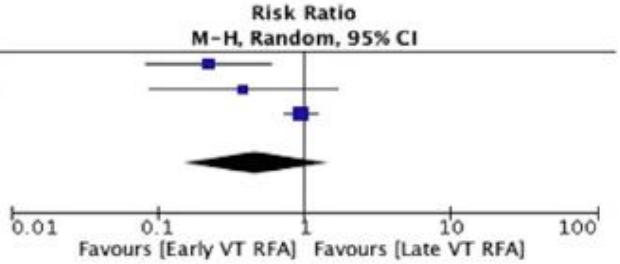
Heterogeneity: Chi² = 0.28, df = 2 (P = 0.87); I² = 0%
Test for overall effect: Z = 2.21 (P = 0.03)



D Acute Recurrence

Study or Subgroup	Early Events	Early Total	Late Events	Late Total	Weight	Risk Ratio M-H, Random, 95% CI
Dinov et al, 2014	4	70	58	225	32.7%	0.22 [0.08, 0.59]
Frankel et al, 2011	2	36	9	62	24.8%	0.38 [0.09, 1.67]
Romero et al, 2017	61	201	122	381	42.6%	0.95 [0.73, 1.22]
Total (95% CI)		**307**		**668**	**100.0%**	**0.47 [0.15, 1.44]**
Total events	67		189			

Heterogeneity: Tau² = 0.75; Chi² = 10.05, df = 2 (P = 0.007); I² = 80%
Test for overall effect: Z = 1.32 (P = 0.19)



Romero et al. JACC Clin Electrophysiol. 2018 Mar;4(3):374-382.

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VANISH II

The VANISH-2 study: a randomized, blinded, multicenter study to evaluate the efficacy and safety of polidocanol endovenous microfoam 0.5% and 1.0% compared with placebo for the treatment of saphenofemoral junction incompetence.

Todd KL 3rd[1], Wright DI[2]; VANISH-2 Investigator Group.

VANISH II

Ablation vs AA as initial VT treatment

Hypothesis:
catheter ablation will, in comparison to antiarrhythmic drug therapy reduce the **composite outcome** of death at any time, appropriate ICD shock after 14 days, ventricular tachycardia storm after 14 days or treated sustained ventricular tachycardia below the detection rate of the ICD for patients with prior myocardial infarction and sustained monomorphic ventricular tachycardia.

Inclusion Criteria: prior MI and sus VT (no AA)

- Start 2016 - 2022
- N = 366

ClinicalTrials.gov Identifier: NCT02830360

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BERLIN VT Study

Preventive aBlation of vEntricular tachycaRdia in patients with myocardiaL INfarction

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BERLIN VT Study

Preventive aBlation of vEntricular tachycaRdia in patients with myocardiaL INfarction

Study objectives

Primary objective:

- Evaluate the impact of prophylactic VT ablation on all-cause mortality and unplanned hospital admission for congestive heart failure or symptomatic VT/VF when compared to VT ablation after the third ICD shock

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BERLIN VT Study

Preventive aBlation of vEntricular tachycaRdia in patients with myocardiaL INfarction

Study objectives

Primary objective:

- Evaluate the impact of prophylactic VT ablation on all-cause mortality and unplanned hospital admission for congestive heart failure or symptomatic VT/VF when compared to VT ablation after the third ICD shock

Secondary objectives:

- Observe the rate and occurrence of ventricular arrhythmias, relating events, and the resulting intervention triggered by the ICD
- Assess the rate and occurrence of cardiac morbidity and mortality
- Determine accumulated changes in quality of life during the first 12 months

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BERLIN VT Study

Preventive aBlation of vEntricular tachycaRdia in patients with myocardiaL INfarction

Inclusion Criteria:

- History of remote myocardial infarction
- Left ventricular ejection fraction ≥ 30 to ≤ 50 %
  Documentation of sustained ventricular tachycardia (VT)
- Implantable cardioverter-defibrillator (ICD) indication for secondary prevention

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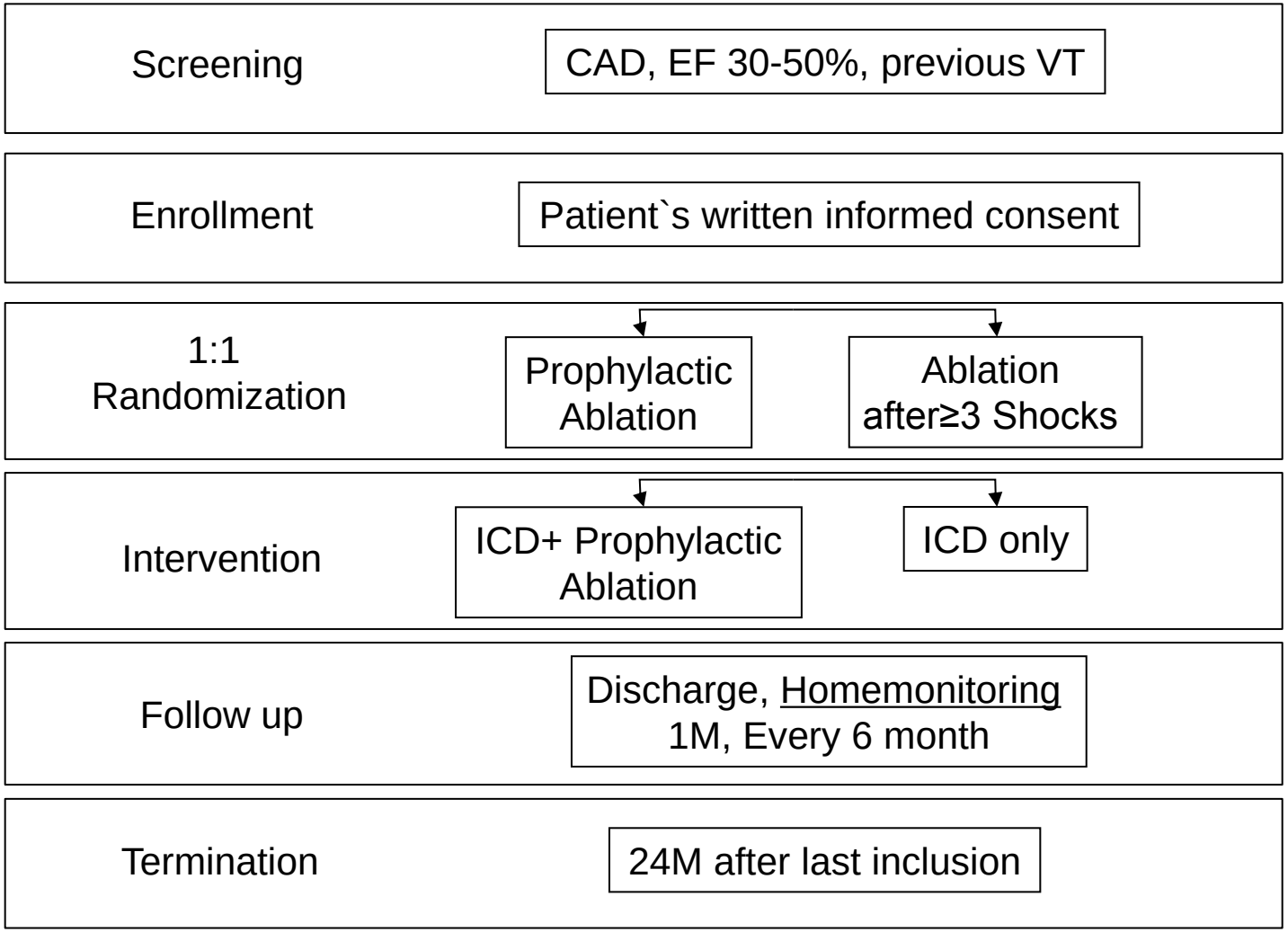
BERLIN VT Study

(n=208, FPI 07/2015)



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BERLIN VT Study

Interim analyses

1st Interim analysis - March 2018

- 141 patients enrolled (68%)
- 34 endpoints confirmed
- Outcome: continue trial as designed

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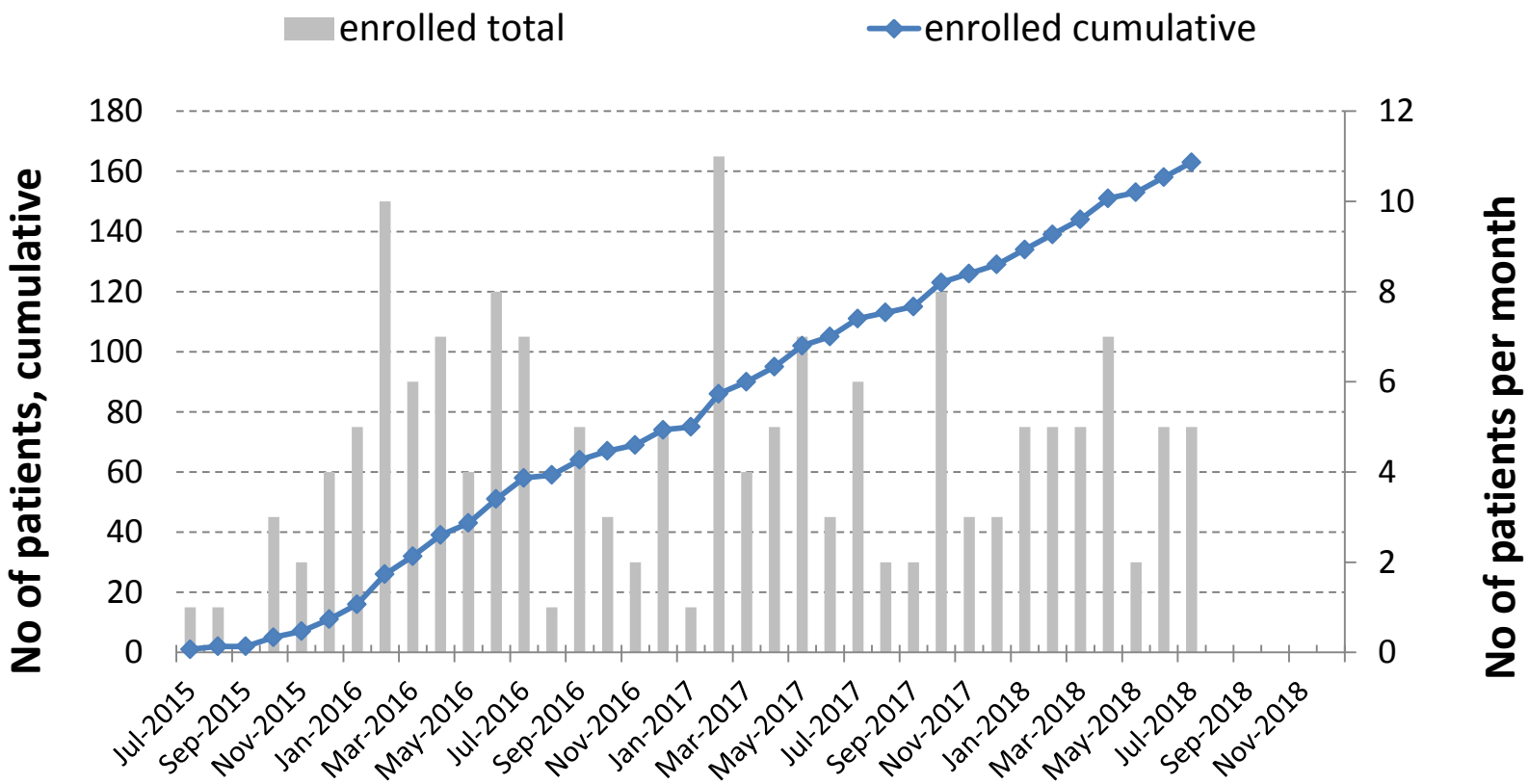
BERLIN VT Study

No. of patients enrolled 163 | 78% *(by Jul 19, 2018)*



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BERLIN VT Study

Interim analyses

1st Interim analysis - March 2018

- 141 patients enrolled (68%)
- 34 endpoints confirmed
- Outcome: continue trial as designed

2nd Interim analysis - July 2018

- 159 patients enrolled (76%)
- 43 endpoints confirmed
- Outcome: stop the study for **futility** in line with the predefined stopping criteria ($p > 0{,}51$)

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BERLIN VT Study

Characteristics of study population

Demography (n=161)	
Gender	**88 % male**
Age [years]	**65.9 ± 9.6 (mean ± SD)**
BMI [kg/m^2]	**29.1 ± 5.4 (mean ± SD)**
NYHA class (n=161)	
I	27 %
II	51 %
III	22 %
IV	0 %
LVEF [%] (n=157)	**41 ± 6 (mean ± SD)**

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BERLIN VT Study

Characteristics of study population

Antiarrhythmic medication (n=161)	
Class I	1 %
Amiodarone	33 %
Sotalol	0 %
Calcium Channel Blocker (Verapamil type)	2 %
Digoxin / Digitoxin	3 %
Other antiarrhythmic	4 %

Concomitant medication (n=161)	
Betablocker	73 %
Ca ChannelBlocker (Nifedipin type)	9 %
Digoxin/Digitoxin	2 %
ACE-I/ARBs	66 %
Diuretics	49 %
Aldosterone blockers	24 %
Statins	68 %
Anticoagulation treatment	40 %
Platelet aggregation inhibitor	58 %
Other cardiovascular	9 %

BERLIN VT Study

Futility

Reaching the primary objective is very unlikely since the difference between the two treatment arms is not as strong as originally assumed

It does NOT mean…

… there was an issue with the safety

… the two treatment options are equivalent regarding the primary endpoint

→ there could be a difference, but the study is not designed to show it with statistical significance

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Early VT Ablation in SHD ?

- **Consequence of ICD schock:**
  - negative QOL & Mortality -> „optimal“ Programing
- **Catheter Ablation in isch VT:**
  - upto 70% VT freedom (12 Mon) in isch. VT
  - Reduction of VT recurrence, better than AA, no impact on mortality
- **„Early“ Ablation:**
  - Positive effect in non-randomized observations
- **Future:**
  - Earlier than so far - “prophylactic“? -> improve technologies

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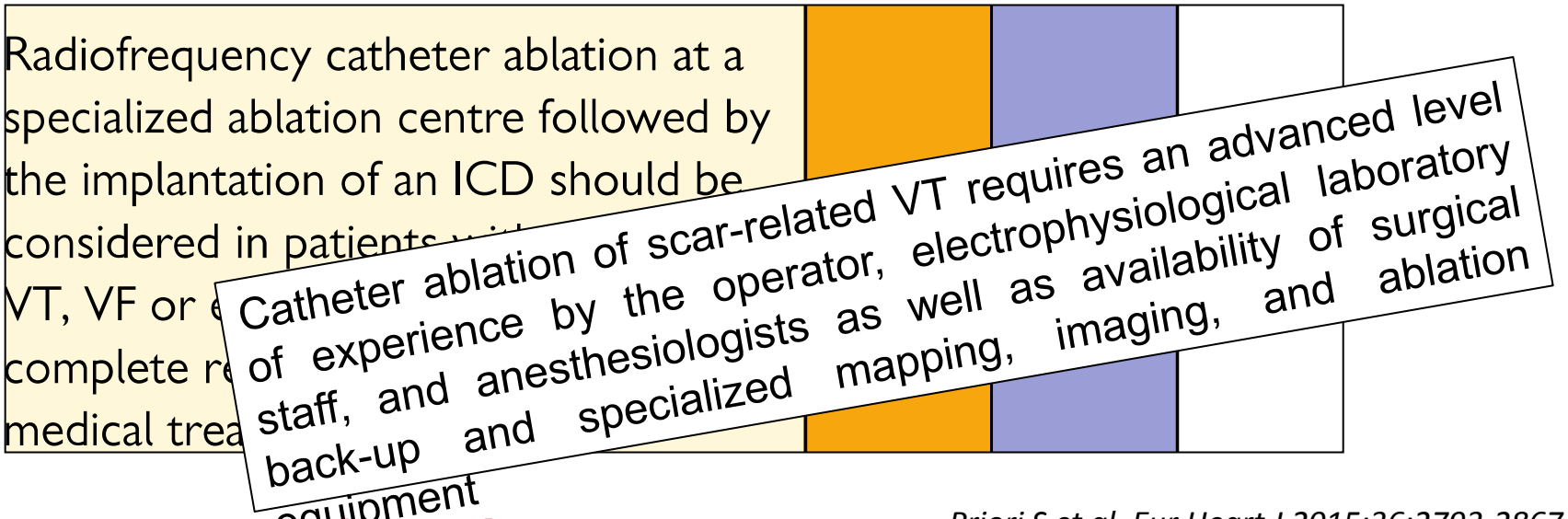
Early VT Ablation ?

2015 ESC Guidelines



Priori S et al. Eur Heart J 2015;36:2793-2867

2017 AHA/ACC/HRS

COR	LOE	Recommendations
I	B-R B-NR	**2. In patients with prior MI and recurrent episodes of symptomatic sustained VT, or who present with VT storm and have failed or are intolerant of amiodarone (LOE: B-R) (S7.1.3-4) or other antiarrhythmic medications (LOE: B-NR) (S7.1.3-5—S7.1.3-9), catheter ablation is recommended (S7.1.3-10—S7.1.3-12).**
IIb	C-LD	**3. In patients with ischemic heart disease and ICD shocks for sustained monomorphic VT or symptomatic sustained monomorphic VT that is recurrent, or hemodynamically tolerated, catheter ablation as first-line therapy may be considered to reduce recurrent VA (S7.1.3-10,S7.1.3-11).**

Al Khatib S et al. ACC/AHA/HRS GL 2017

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BERLIN VT Study

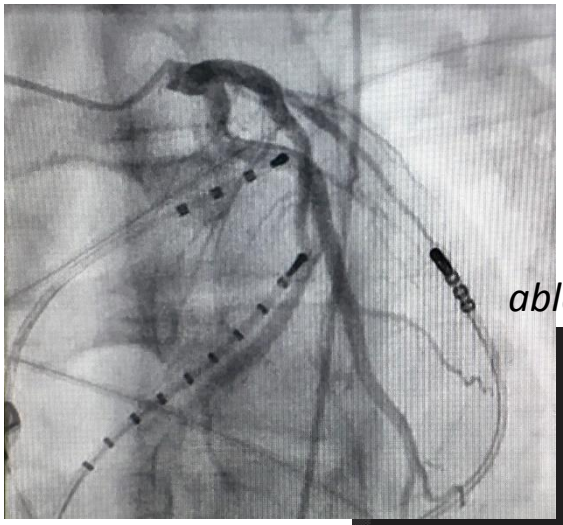
Statistical design

Estimated Hazard Ratio: 0.53

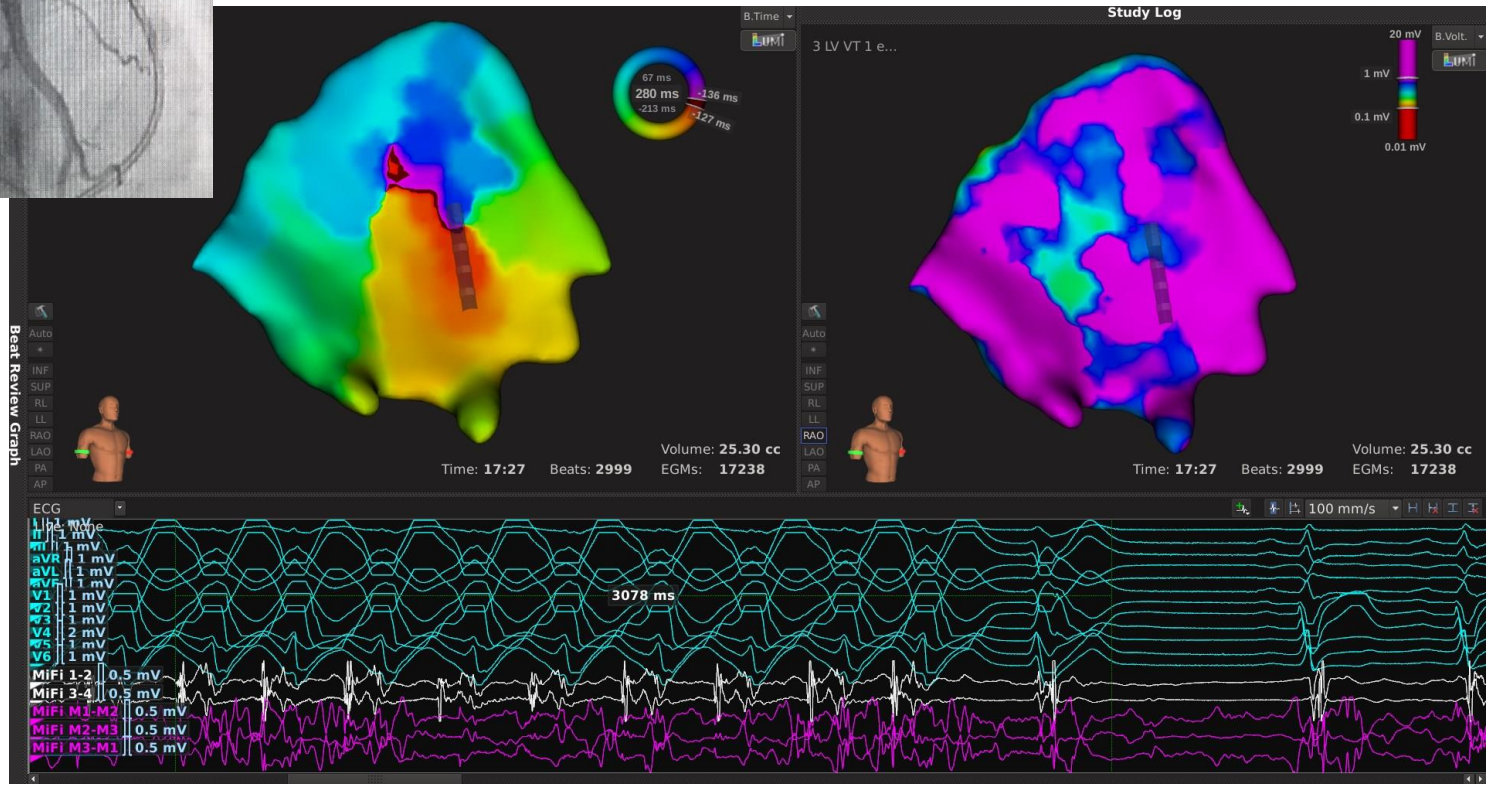
85 primary endpoint events needed for final analysis

3 interim analyses planned to stop the study for success or futility (after 21, 42 and 63 events)

Ablation of VT



ablation catheter



Termination at critical isthmus site within 3 s after start of ablation impulse

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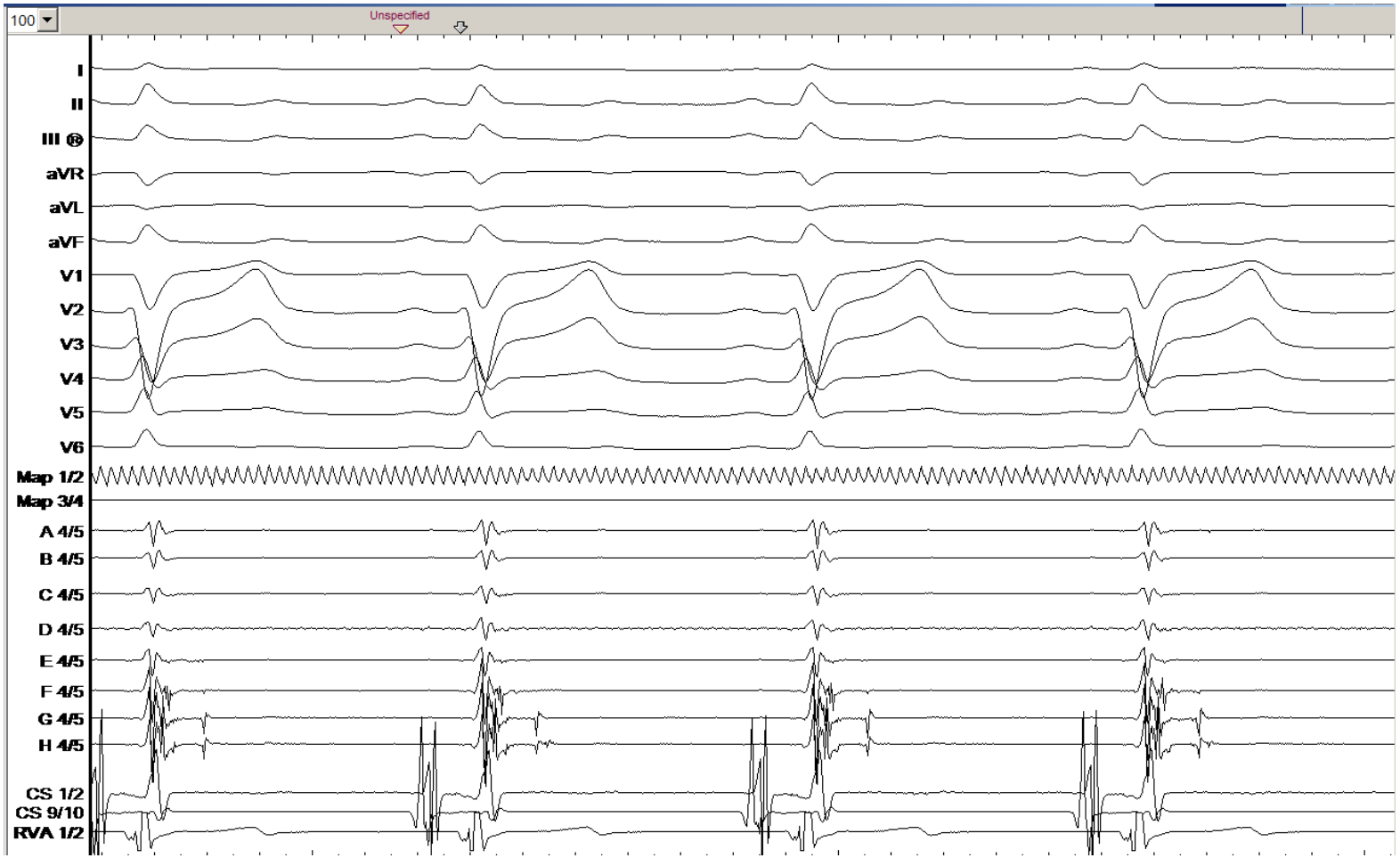
DZHK
DEUTSCHES ZENTRUM FÜR HERZ-KREISLAUF-FORSCHUNG E.V.

Characteristics of study population (3/4)

Non-cardiac history (n=161)

Hypertension	81 %
COPD	12 %
Stroke	17 %
Liver and/or kidney disease	20 %
Vascular disease	25 %
Diabetes mellitus	29 %
PAOD	11 %
Renal insufficiency	17 %
Peripheral artery embolism	2 %
Sleep apnoe	3 %
Other	45 %

Substrate mapping



Substrate mapping reveals further late potentials in more basal area of VT 1 isthmus


STAR WARS
THE FORCE AWAKENS

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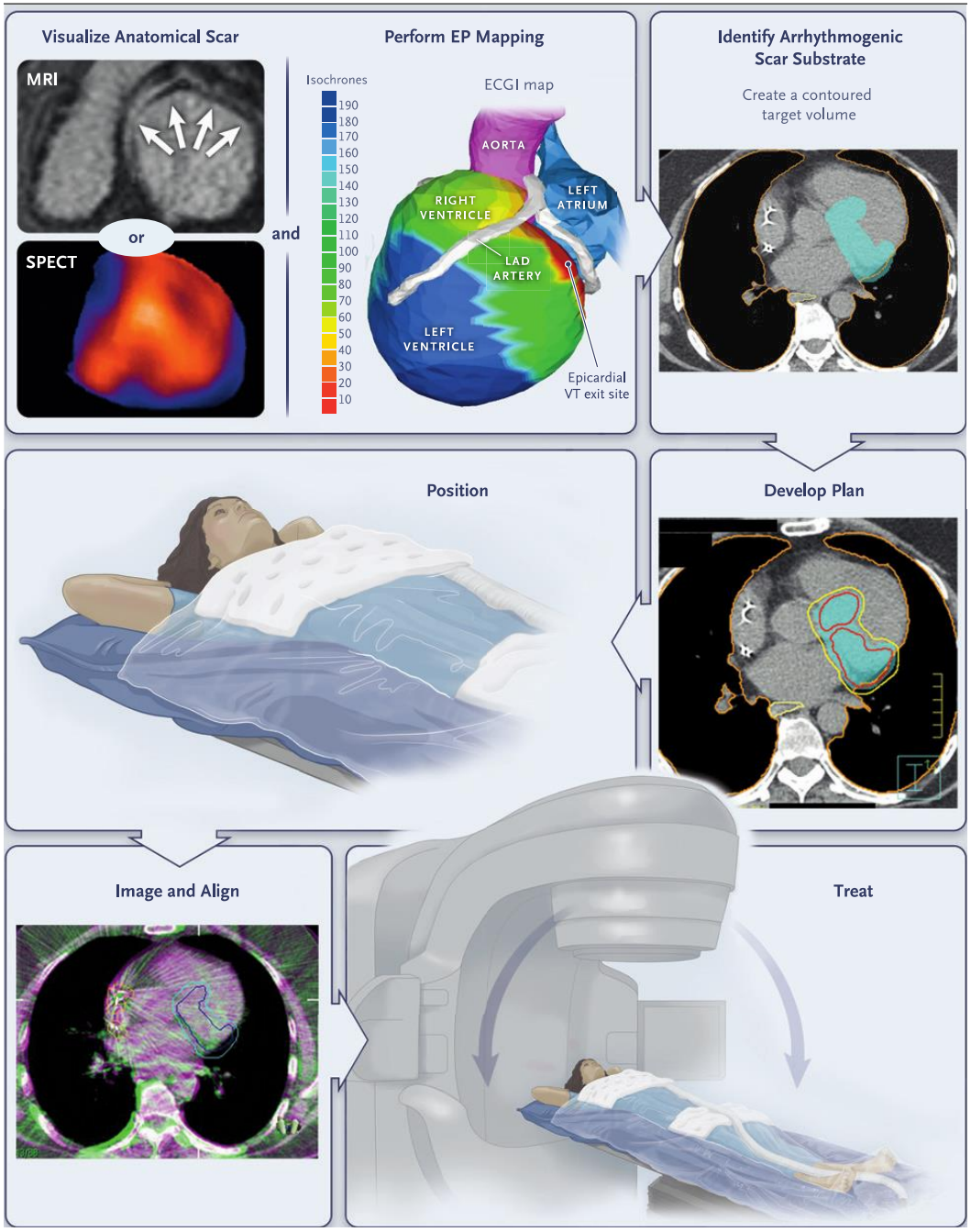

Cuculich PS et al. N Eng J Med 2017; 377::2325

Characteristics of study population (2/4)

Atrial Fibrillation (n=161)

History of AF

Yes	29 %
No	71 %

Current type of AF

Paroxysmal	56 %
Persistent	33 %
Longstanding persistent	2 %
Permanent	9 %

ICD models (n=163)

VR-T	49 %
VR-T DX	18 %
DR-T	26 %
CRT-D	7 %

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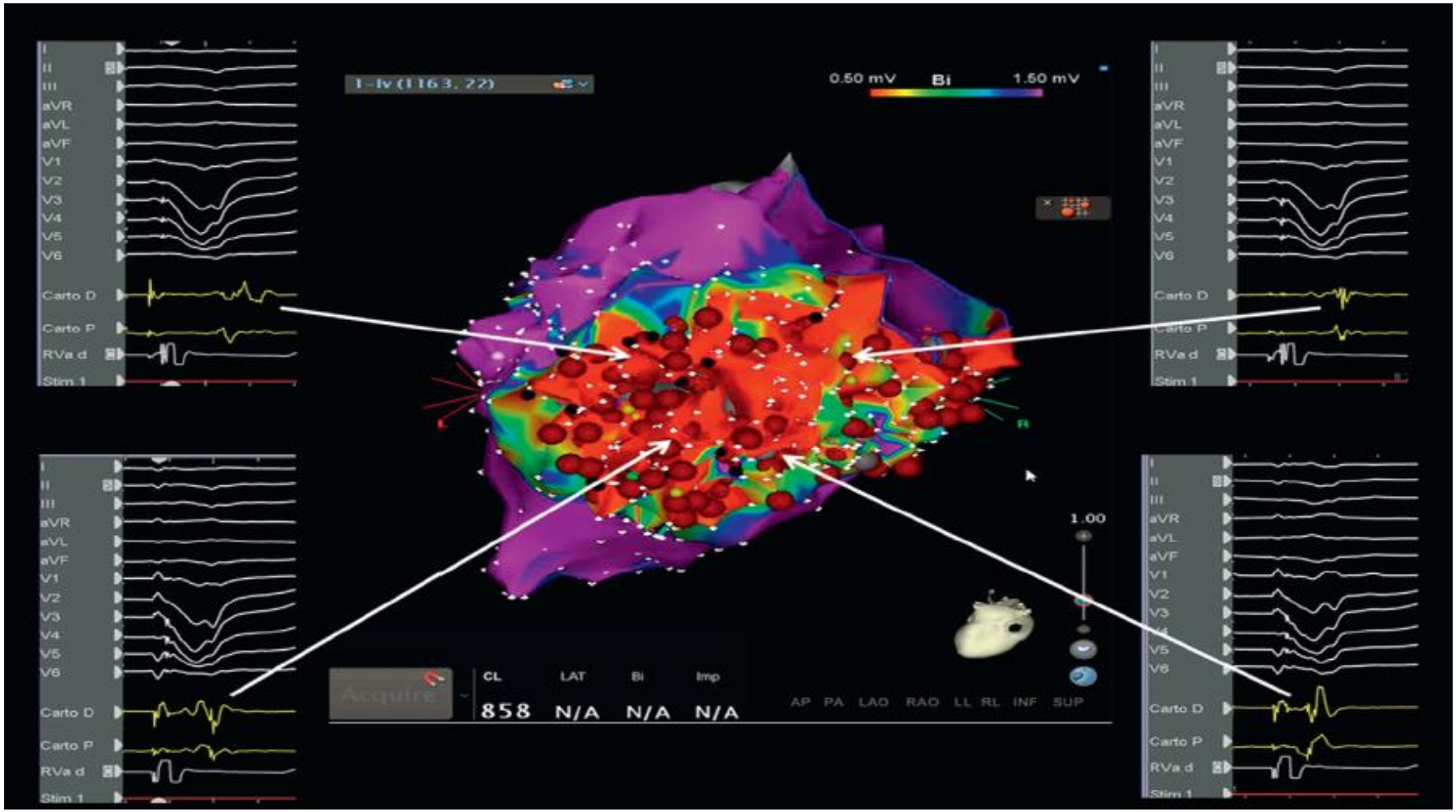
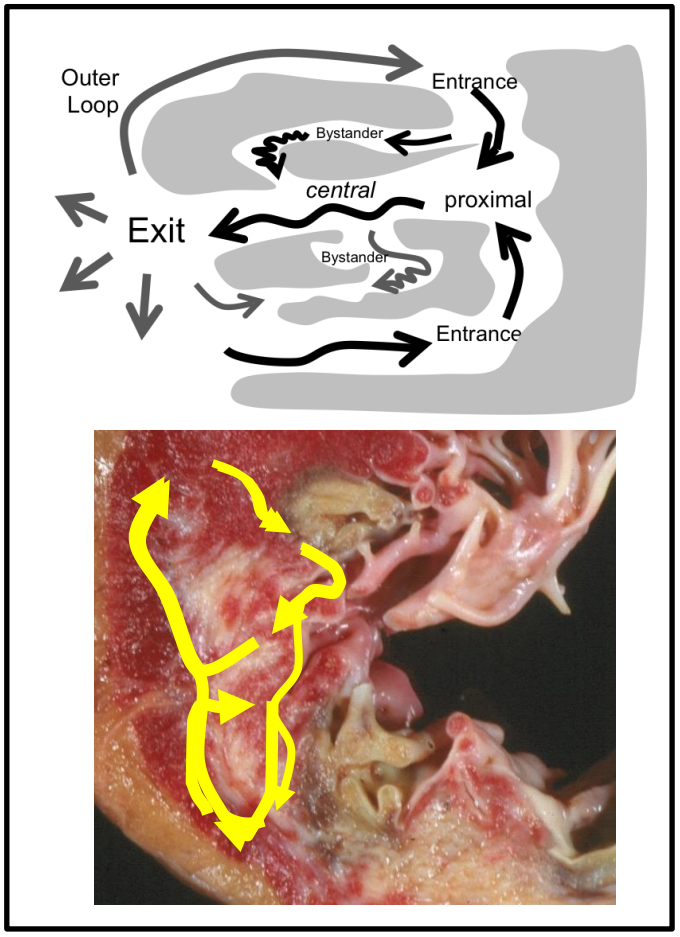
Substate vs VT – based Approach

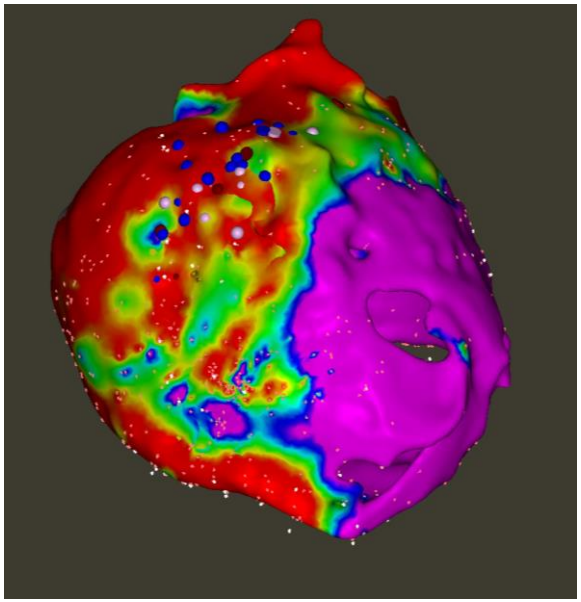


Di Biase L et al., J Am Coll Cardiol 2015;66:2872

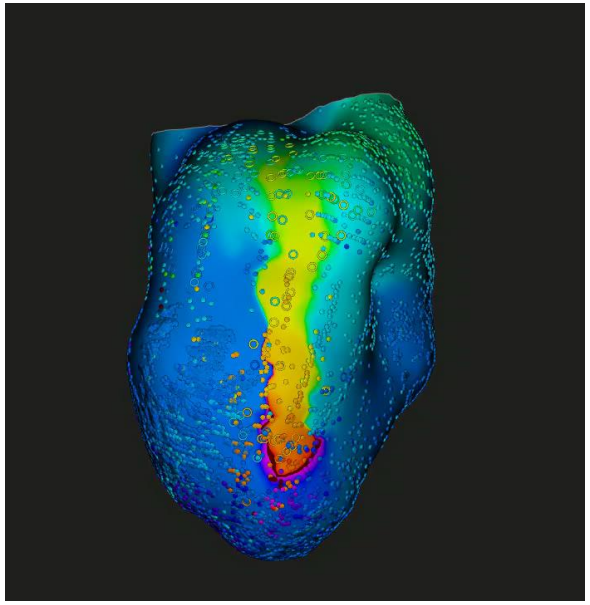
Mechanismen ventrikulärer Arrhythmien - Reentry



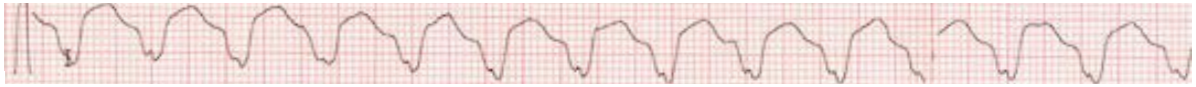
Voltage map (ARVD)



Aktivierungs-map (ICMP)



„Elektroanatomisches Substrat“



Modified from Schaeffer and Stevenson JCE. 2017;1–10;
Courtesy Prof. Stevenson

Anter E et al. Circulation. 2016;134:314-327

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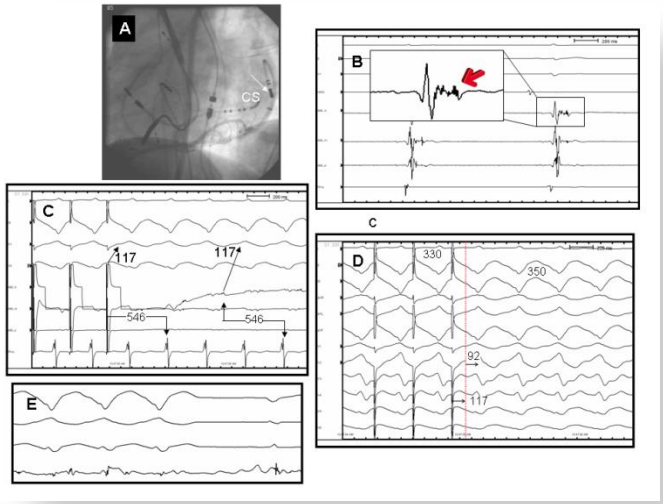
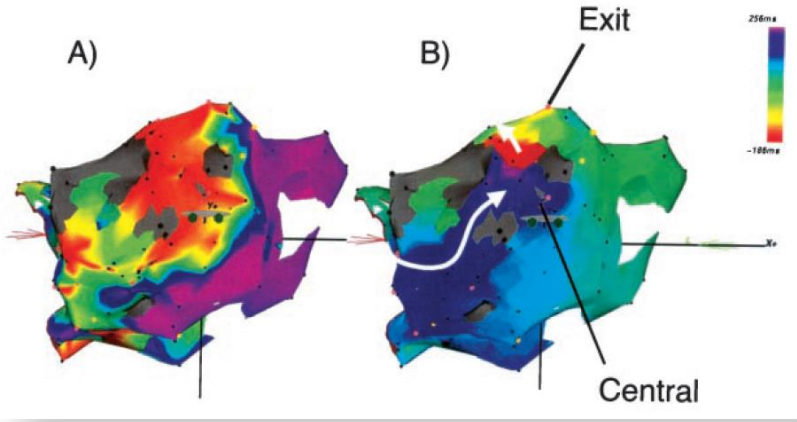
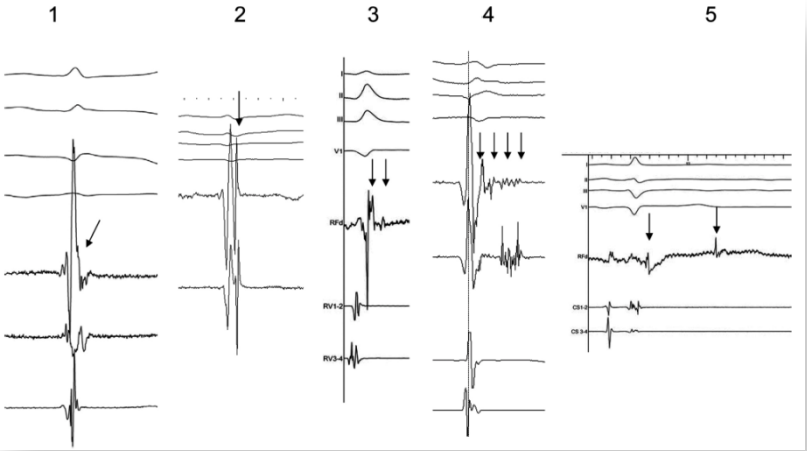
Mapping Strategien



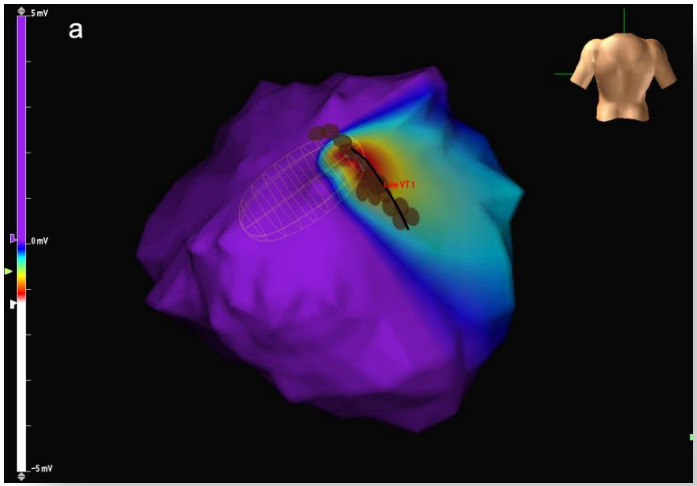
Scheinman, de Bakker, Stevenson et al. „VT Mapping“



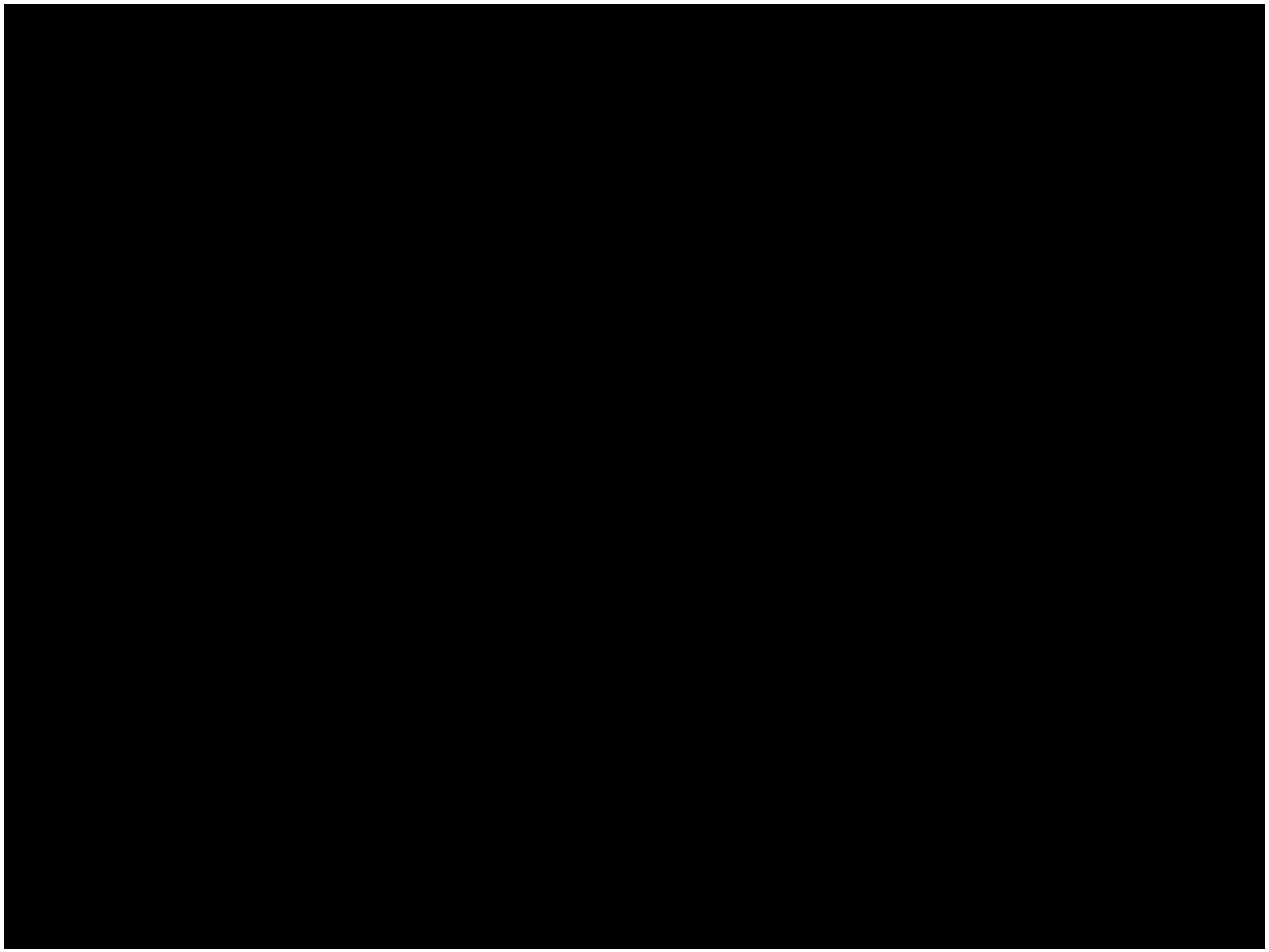
Soejima, Stevenson et al. „Unexcitability“



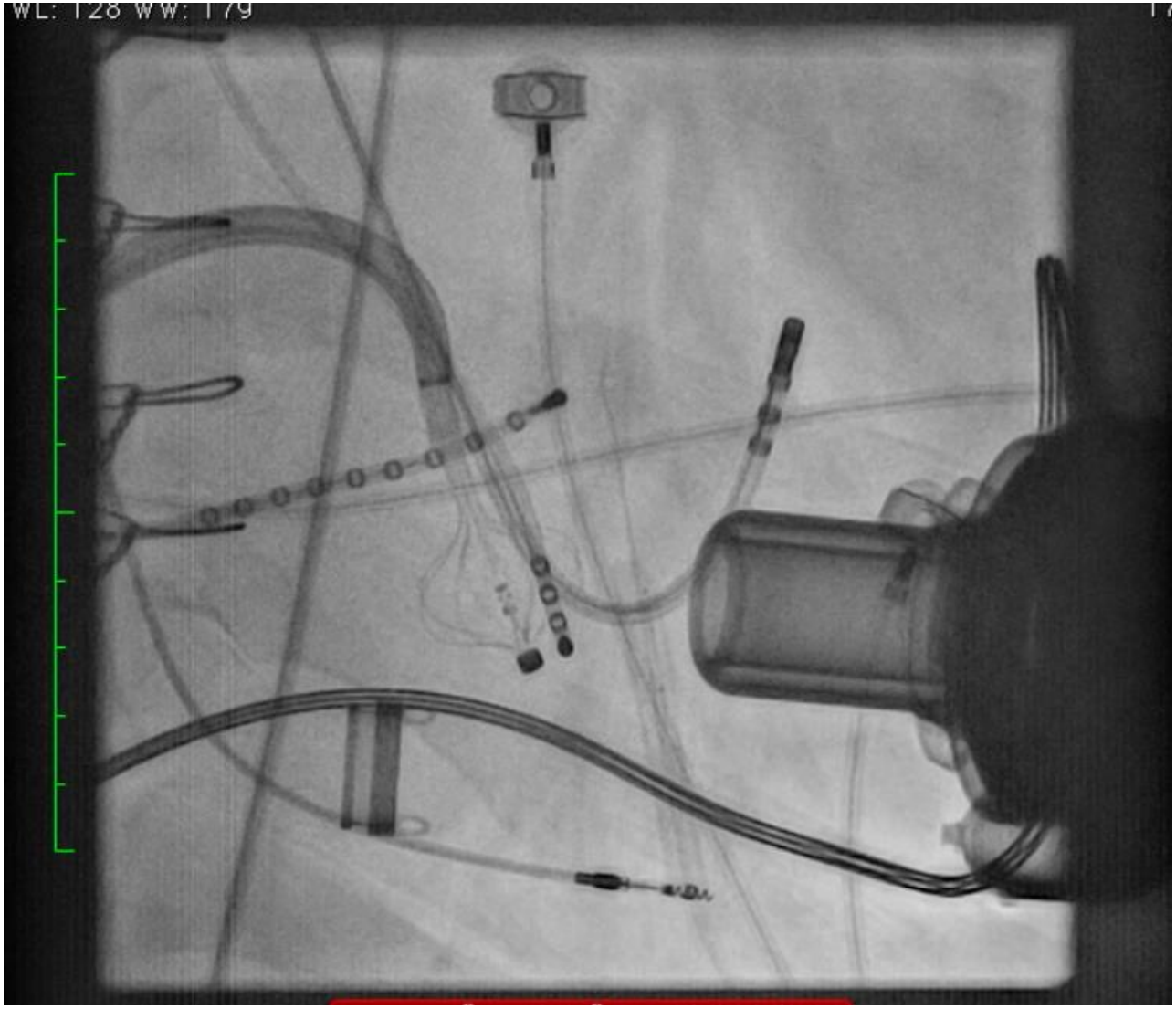
Jais, Haissaguerre et al. „LAVA ablation“



Schilling et al. , Klemm, Willems et al. „Non-contact Mapping“



Nührich J . et al. 2017;28:1058-1067


WL: 128 WW: 179

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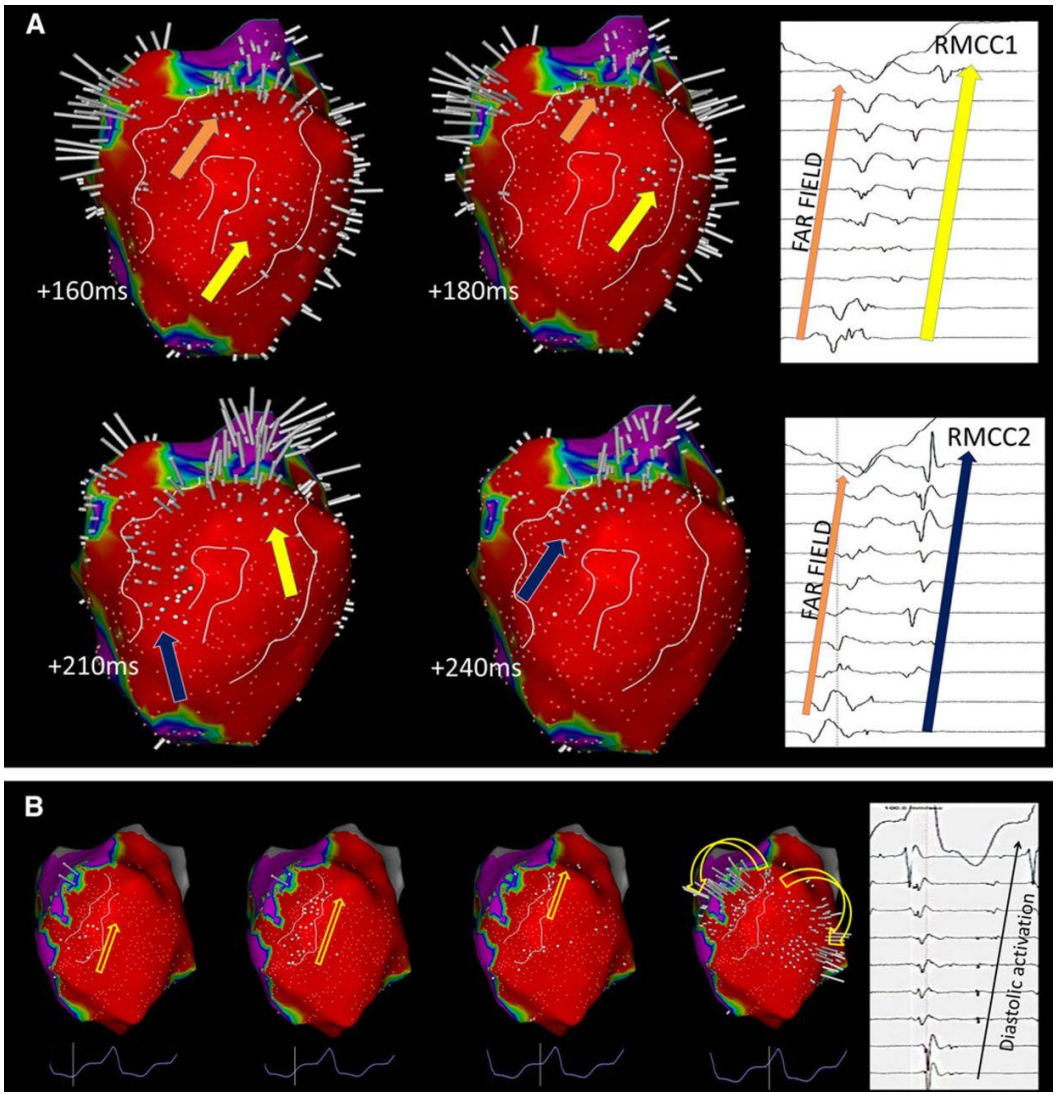
Ripple Mapping in Post-Infarct VT

Direction of Ripple mapping conducting channel (RMCC) activation



Luther V et al. Circ Arrhythm Electrophysiol. 2016;9:e004072

SMS –VT Study

Baseline Patient Demographics

	Ablation (n=54)	ICD Only (n=57)	Total (N=111)
Age, y	68.4±7.7	65.9±8.4	67.1±8.1
Male sex, n (%)	47 (87)	46 (81)	93 (84)
Diagnosis at enrollment, n (%)			
Spontaneous unstable VT	37 (69)	36 (63)	73 (66)
Syncope with unstable VT inducible	12 (22)	17 (30)	29 (26)
Cardiac arrest with unstable VT inducible	4 (7)	3 (5)	7 (6)
Cardiac arrest and syncope with unstable VT inducible	1 (2)	1 (2)	2 (2)
Mean LVEF	32.0±6.9	30.4±7.3	31.2±7.1
LVEF ≤30%	22/52 (42)	27 (47)	49 (45)
LVEF ≤20%	7/52 (14)	10 (18)	17 (16)
LVEDD, mm	61.1±7.5	62.4±7.6	61.8±7.6
Previous percutaneous revascularization, n (%)	23/50 (46)	25 (46)	48 (46)
Previous surgical revascularization, n (%)	21/51 (41)	24 (43)	45 (42)
Previous MI, n (%)	49/51 (96)	56 (98)	105 (97)
Years between MI and randomization, n (%)	11.1±6.6	8.6±7.8	9.8±7.3
Rate of documented VT, beats per min	196±46	206±42	201±44
Amiodarone at enrollment, n (%)	16 (30)	20 (35)	36 (32)
β-Blockers at enrollment, n (%)	49 (91)	52 (91)	101 (91)

ICD indicates implantable cardioverter–defibrillator; LVEDD, left ventricular end-diastolic diameter; LVEF, left ventricular ejection fraction; MI, myocardial infarction; and VT, ventricular tachycardia.

Kuck KH et al., Circ Arrhythm Electrophysiol 2017;10:e004422

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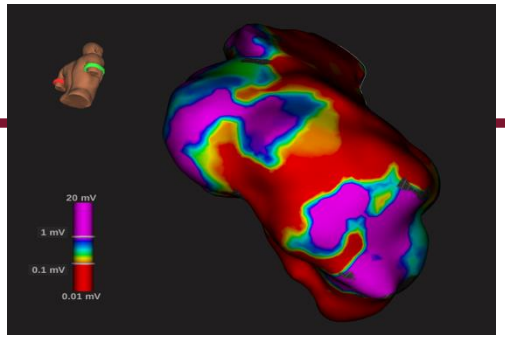
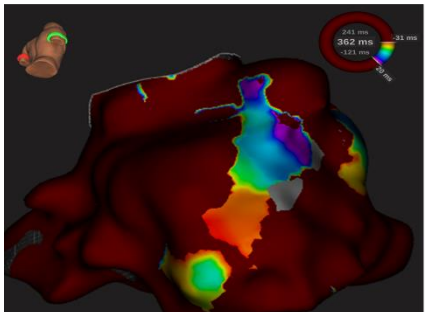
High density VT mapping





- sinus rhythm (n=20)
- substrate map (basket catheter)
  uni-/bipolar voltage + isochronal activation
- EGM review
- additional mapping (single tip catheter)
- late potential analysis

Nührich J et al. under review for publication

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Procedural data

	n= 22
Procedure duration (min)	201 ± 11
Fluoroscopy duration (min)	20.7±1.6
Radiofrequency duration (min)	25.5±4
VT induction	16/22
Ongoing VT	2/22
Haemodynamically unstable	8/28 VTs
Mapping time substrate	33±4
Mapping time activation	9±2
Covered CL	82±5%
Mapping points substrate	10937±1923
Mapping points activation	6740±1140

Nührich J et al. under review for publication

Substrate-Based Ablation Versus Ablation Guided by Activation and Entrainment Mapping for Ventricular Tachycardia: A Systematic Review and Meta-Analysis

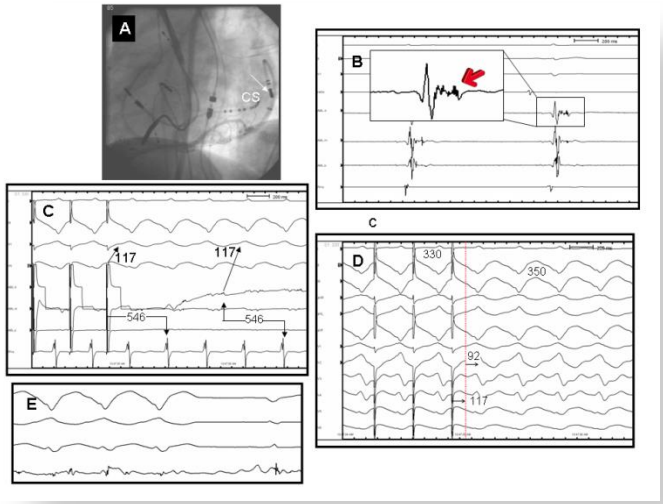
SAURABH KUMAR, B.Sc.(MED)/M.B.B.S., Ph.D.,* SAMUEL H. BALDINGER, M.D.,†
JORGE ROMERO, M.D.,* AKIRA FUJII, M.D.,* SAAGAR N. MAHIDA, M.D.,*
USHA B. TEDROW, M.D., M.Sc.,* and WILLIAM G. STEVENSON, M.D.*

From the *Cardiovascular Division, Brigham and Women's Hospital, Boston, Massachusetts, USA; and †Bern University Hospital and University of Bern, Bern, Switzerland

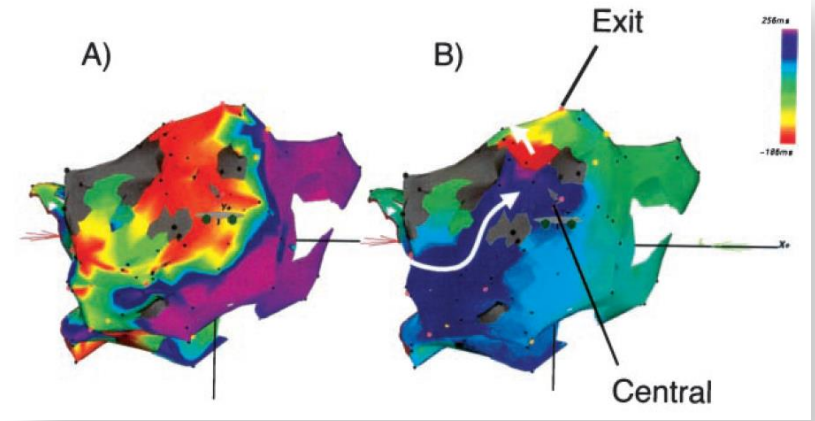
- Pooled data from 6 VT ablation studies (1 random.) including 403 patients with 18 months mean FU

(J Cardiovasc Electrophysiol, Vol. 27, pp. 1437-1447, December 2016)

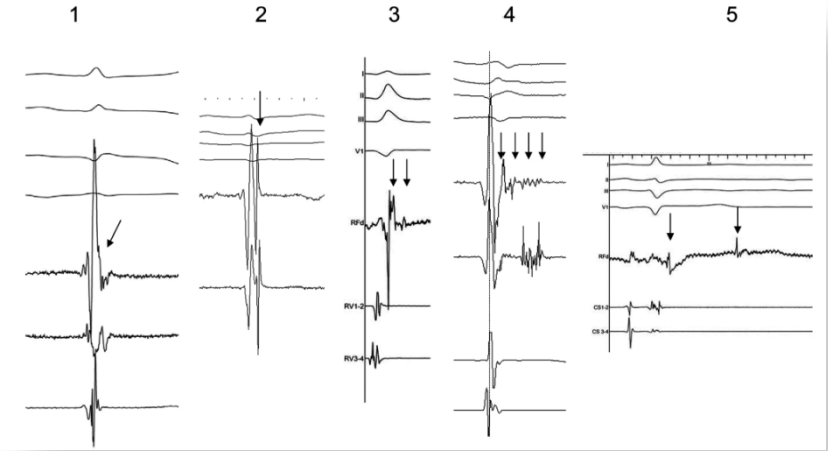
Mapping Strategien



Scheinman, de Bakker, Stevenson et al. „VT Mapping“



Soejima, Stevenson et al. „Unexcitability“



Jais, Haissaguerre et al. „LAVA ablation“

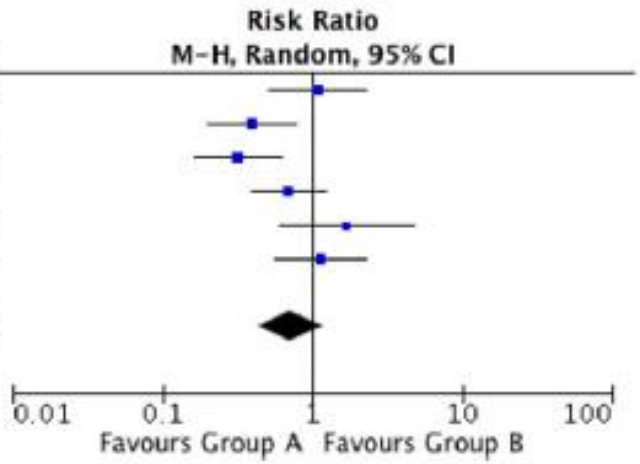
Substate vs VT – based Approach

Relative risk for VT recurrence

Study or Subgroup	Group A Events	Group A Total	Group B Events	Group B Total	Weight	Risk Ratio M-H, Random, 95% CI
Bunch et al. 2012	9	18	6	13	16.3%	1.08 [0.51, 2.29]
Di Biase et al. 2012	8	43	23	49	17.2%	0.40 [0.20, 0.79]
Di Biase et al. 2015	9	58	29	60	17.8%	0.32 [0.17, 0.62]
Makimoto et al. 2015	15	50	15	35	19.3%	0.70 [0.40, 1.24]
Ventura et al. 2007	6	14	4	16	12.1%	1.71 [0.60, 4.86]
Volkmer et al. 2006	11	24	8	20	17.2%	1.15 [0.57, 2.29]
Total (95% CI)		**207**		**193**	**100.0%**	**0.72 [0.44, 1.18]**
Total events	58		85			

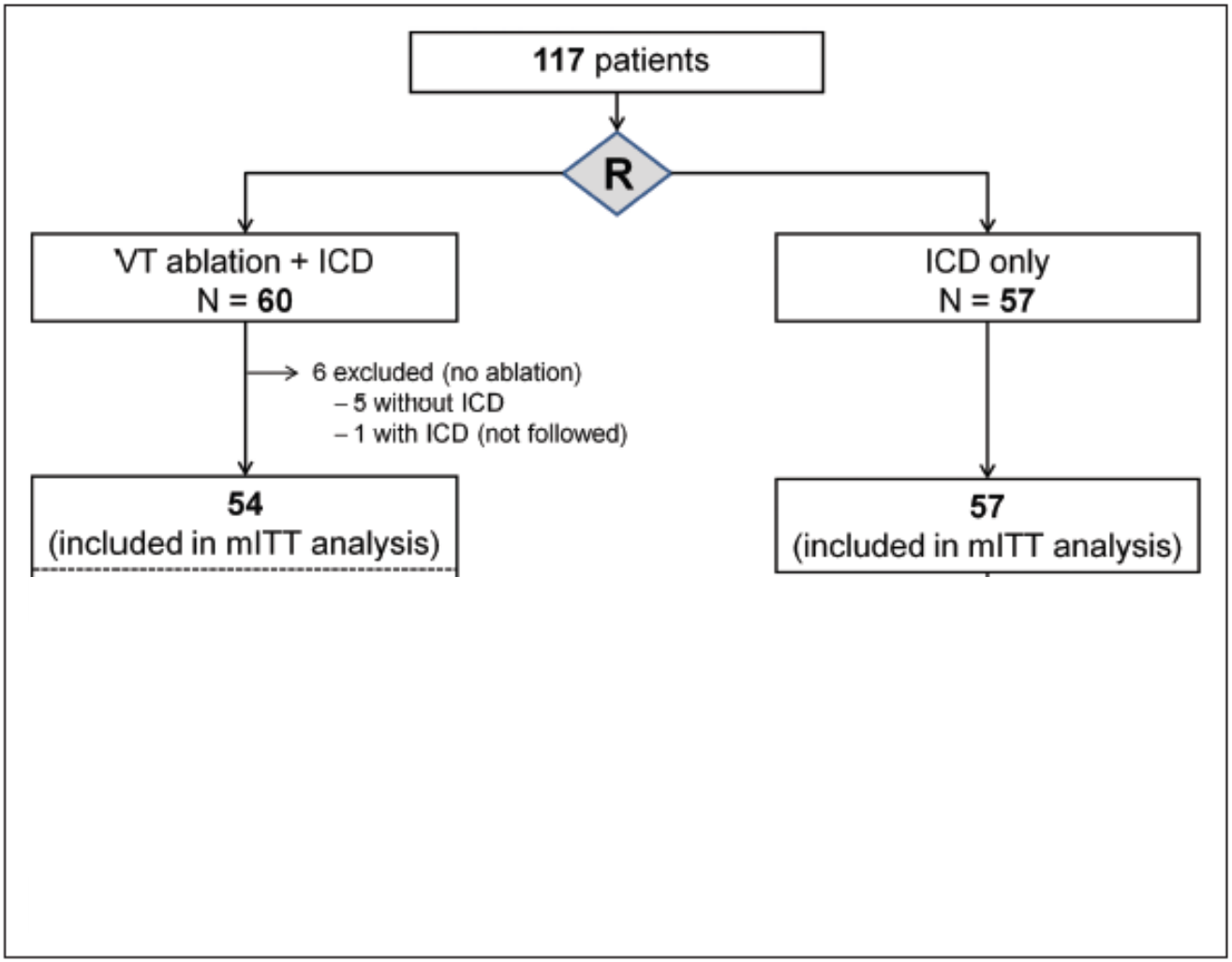
Heterogeneity: $Tau^2 = 0.25$; $Chi^2 = 14.50$, df = 5 (P = 0.01); $I^2 = 66\%$

Test for overall effect: Z = 1.30 (P = 0.19)



Kumar S et al., J Cardiovasc Electrophysiol 2016;27:1437

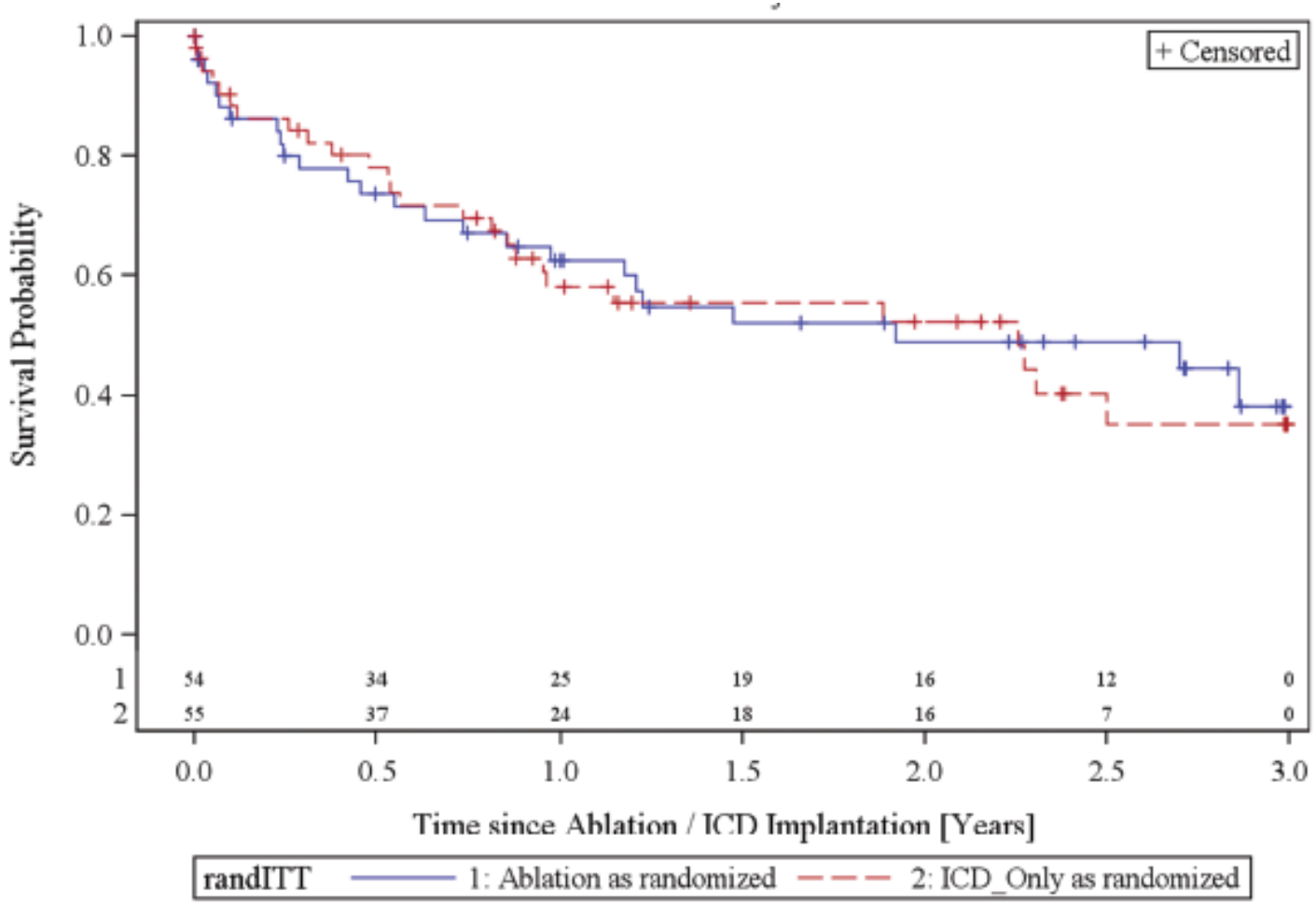
SMS –VT Study



Kuck KH et al., Circ Arrhythm Electrophysiol 2017;10:e004422

SMS –VT Study

Primary Endpoint (first VT/VF)



Kuck KH et al., Circ Arrhythm Electrophysiol 2017;10:e004422

SMS –VT Study

Endpoints

	Ablation (n=54)	ICD Only (n=57)	Hazard Ratio (95% CI)*	Hazard Ratio (95% CI)†	*P* Value‡
Spontaneous VT/VF episodes	2.8±6.0	8.1±19.1	0.43 (0.22–0.85)	…	0.015
Patients with spontaneous VT/VF (primary end point)	25	26	…	0.95 (0.55–1.64)	0.84
Spontaneous episodes with ATP or shock	2.8±6.4	12.9±34.6	0.34 (0.18–0.65)	…	0.001
Patients with ATP or shock	27	30	…	0.91 (0.54–1.53)	0.71
VT/VF episode with ATP or shock	1.8±4.8	7.6±18.6	0.33 (0.15–0.69)	…	0.004
Patients with VT/VF episode and ATP or shock	20	24	…	0.81 (0.45–1.47)	0.49
Spontaneous episodes with shock	0.7±2.8	2.1±6.1	0.36 (0.15–0.90)	…	0.028
Patients with shock	13	20	…	0.62 (0.31–1.25)	0.18
VT/VF episodes with shock	0.6±2.8	1.2±4.1	0.44 (0.14–1.34)	…	0.15
Patients with VT/VF episode and shock	8	14	…	0.55 (0.23–1.32)	0.18
VT/VF episodes with ATP or shock or >30 s	2.0±5.0	7.6±18.6	0.35 (0.17–0.74)	…	0.006
Patients with VT/VF episode and ATP or shock or >30 s	21	24	…	0.87 (0.48–1.56)	0.64
Death	9	11	…	0.82 (0.34–1.97)	0.65
Hospital readmission	0.6±1.1	0.7±1.1	0.97 (0.73–1.29)	…	0.82
Patients with hospital readmission	21	25	…	0.83 (0.46–1.50)	0.54
Serious adverse events	1.0±1.2	1.1±1.4	0.95 (0.75–1.20)	…	0.67
Patients with serious adverse events	34	33	…	1.10 (0.67–1.78)	0.71
Electrical storm	0.1±0.4	0.3±1.0	0.69 (0.24–1.97)	…	0.49
Patients with electrical storm	4	7	…	0.60 (0.18–2.06)	0.42
Syncope	0.1±0.3	0.1±0.3	1.00 (0.29–3.40)	…	0.99
Patients with syncope	4	4	…	1.08 (0.27–4.33)	0.91
Death, syncope, or electrical storm	0.3±0.6	0.5±1.2	0.79 (0.47–1.30)	…	0.35
Patients with death, syncope, or electrical storm	12	17	…	0.73 (0.35–1.52)	0.40

Values are given as medians (interquartile range) or n (%). ATP indicates antitachycardia pacing; CI, confidence interval; VF, ventricular fibrillation; and VT, ventricular tachycardia.

*Time to all events.

†Time to first event.

‡For hazard ratio.

Kuck KH et al., Circ Arrhythm Electrophysiol 2017;10:e004422

Gründe für Nicht-Erreichen des PE

Impact of Substrate Modification by Catheter Ablation on Implantable Cardioverter–Defibrillator Interventions in Patients With Unstable Ventricular Arrhythmias and Coronary Artery Disease

Results From the Multicenter Randomized Controlled SMS (Substrate Modification Study)

Karl-Heinz Kuck, MD; Roland Richard Tilz, MD; Thomas Deneke, MD; Boris A. Hoffmann, MD; Rodolfo Ventura, MD; Peter Steen Hansen, MD; Markus Zarse, MD; Stefan H. Hohnloser, MD; Josef Kautzner, MD; Stephan Willems, MD; for the SMS Investigators

- ICD Programming: SMASH-VT ?, SMS 60msec > VT CL
- CA: 3 vs 10 centres, Endpoint (substrat Mod. in SMASH- VT vs. non inducibilty in SMS VT)
- 6 pat. (10%) in SMS – VT without VT Ablation
- Pat. inclusion > 7 years !

(*Circ Arrhythm Electrophysiol*. 2017;10:e004422. DOI: 10.1161/CIRCEP.116.004422.)

Universitäres Herzzentrum Hamburg

VT/PHT Guideline Update 2017

N= 1500
ICD zur Primärprävention

The NEW EN

ORIGINAL ARTICLE

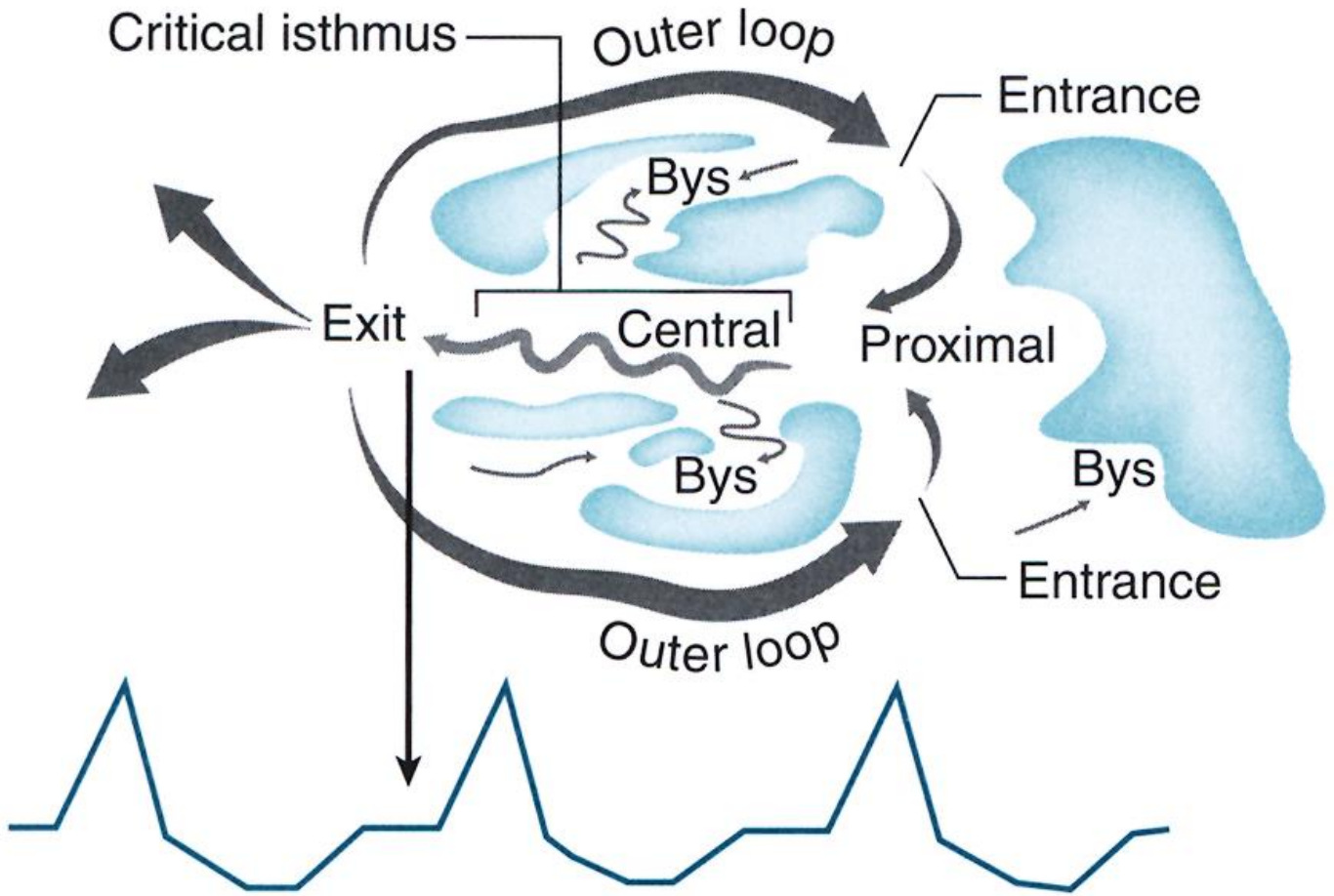
Reduction in Inappropriate Therapy and Mortality through ICD Programming

Arthur J. Moss, M.D., Claudio Schuger, M.D., Christopher A. Beck, Ph.D., Mary W. Brown, M.S., David S. Cannom, M.D., James P. Daubert, M.D., N.A. Mark Estes III, M.D., Henry Greenberg, M.D., W. Jackson Hall, Ph.D.,* David T. Huang, M.D., Josef Kautzner, M.D., Ph.D., Helmut Klein, M.D., Scott McNitt, M.S., Brian Olshansky, M.D., Morio Shoda, M.D., David Wilber, M.D., and Wojciech Zareba, M.D., Ph.D., for the MADIT-RIT Trial Investigators†

This article was published on November 6, 2012, at NEJM.org.

N Engl J Med 2012.
DOI: 10.1056/NEJMoa1211107

Mapping of stable VT



courtesy of William Stevenson

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- N = 111 pts. with CAD (EF ≤ 40%), clin. unstable VT (or SCD/Syncope with inducible unstable VT)
- Random. to ICD only vs ICD + VT Abl.
- Prim. EP: Time to first VT/VF

(*Circ Arrhythm Electrophysiol*. 2017;10:e004422. DOI: 10.1161/CIRCEP.116.004422.)

Only primary endpoint data collected so far was analyzed

→ primary endpoint will most likely not yield significant difference

There might be significant differences regarding secondary endpoints

→ analysis currently ongoing

→ results will be available by beginning of 2019