

# «Ablation von strukturellen Kammertachykardien – wann und wie»

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## Interessenskonflikte

- Keine

## Inhalt

- Monomorphe ventrikuläre Tachykardie
- Ziel der Behandlung von ventrikuläre Tachykardien
- Wen?
  - Ischämisch
  - 'Nicht-ischämisch'
- Wann?
- Take home messages



**ESC**

European Society  
of Cardiology

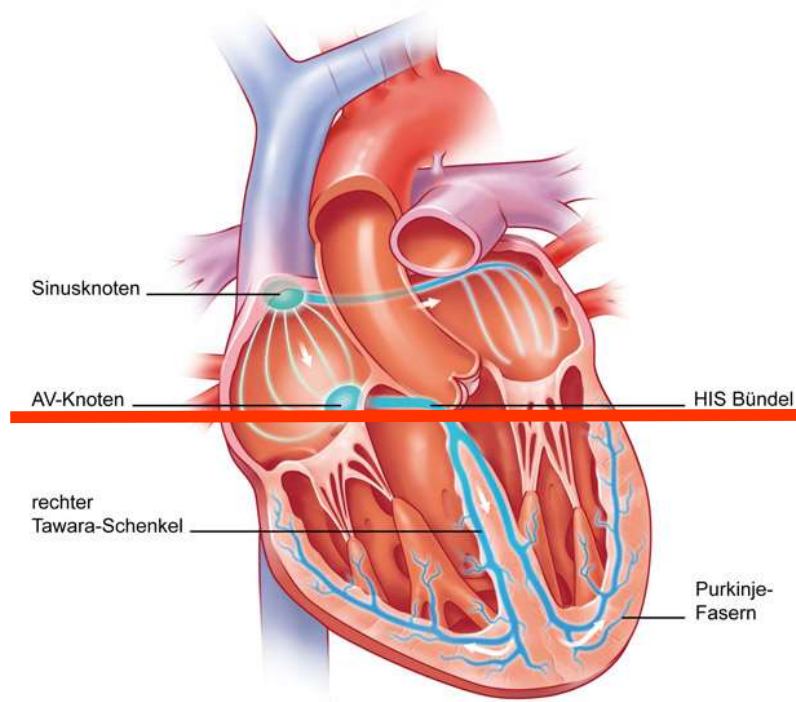
European Heart Journal (2022) **43**, 3997–4126  
<https://doi.org/10.1093/eurheartj/ehac262>

**ESC GUIDELINES**

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# **2022 ESC Guidelines for the management of patients with ventricular arrhythmias and the prevention of sudden cardiac death**

## Ventrikuläre vs supraventrikuläre Tachykardien



### Supraventrikuläre Rhythmusstörungen

- AVNRT
- AVRT
- AT
- Flattern
- VHF

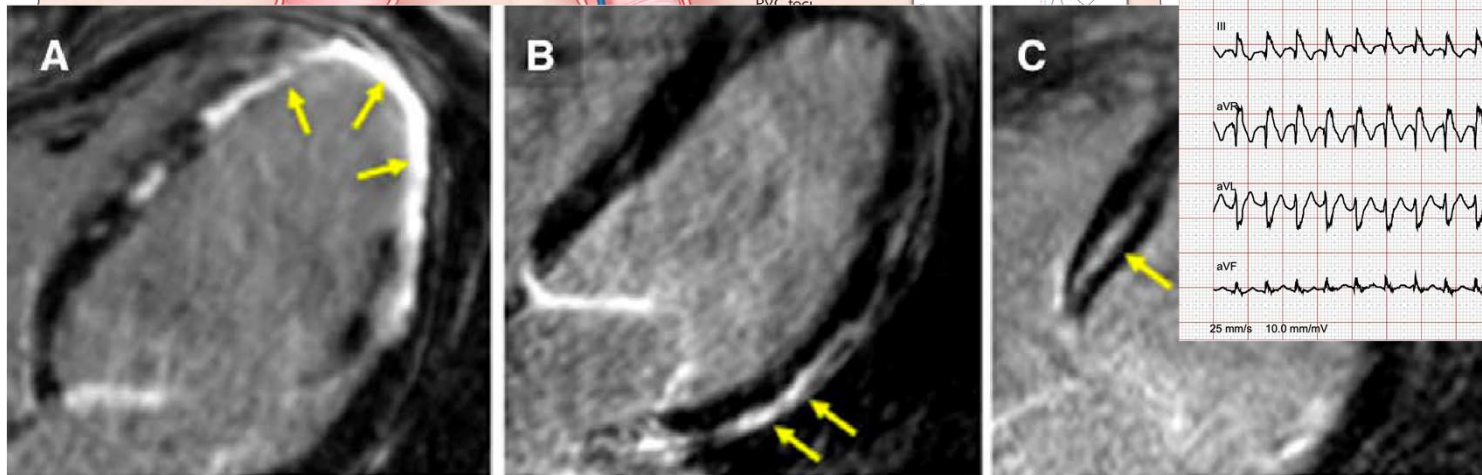
### Ventrikuläre Rhythmusstörungen

- VT

## Ätiologie von monomorphen ventrikuläre Tachykardi

- Idiopathische VT

- Substrat-assoziierte VT



M Mahida, Circulation  
 2017



Ziel der Behandlung *strukturellen* ventrikulären Tachykardien: Prävention von ...

- Plötzlichem Herztod

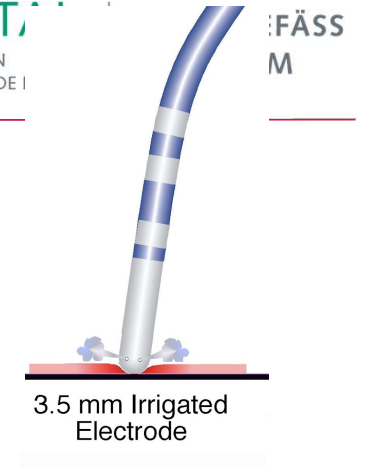
- Herzinsuffizienzmedikamente  
(Klasse IA)
- ICD (Klasse IA)
- CRT (Klasse IA-IIb)
- Antiarrhythmika
  - Amiodaron (Klasse IIA) und Sotalol

- Ventrikuläre Tachykardien (und ICD Shocks)

- Herzinsuffizienzmedikamente
- Antiarrhythmika
  - Amiodaron (Klasse IIA), Sotalol  
(Klasse IIA), Flecainid, etc.
- **Katheterablation (IB-IIb)**



Wen?



## Fundamental unterschiedliche arrhythmogene Substrate

### Ischämisch

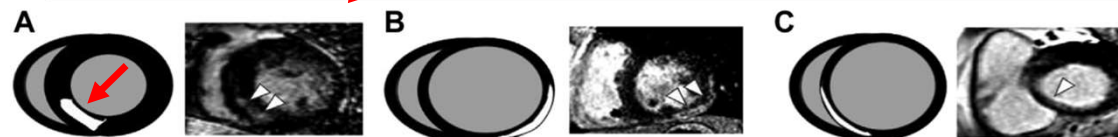


### Myokarditis

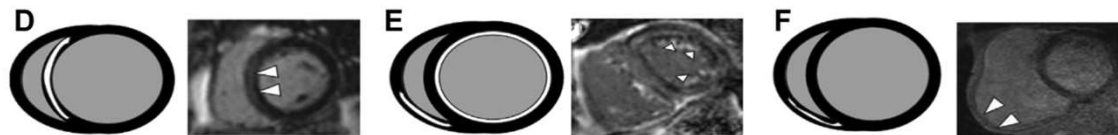
### Nicht-ischämisch

### Sarkoidose

HCM

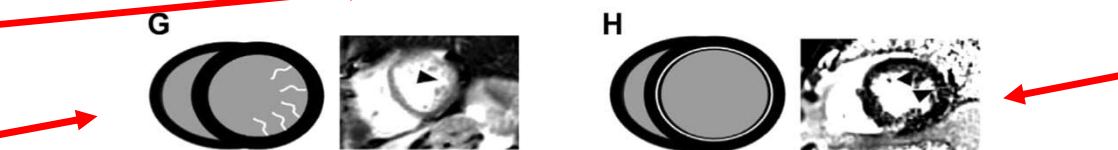


DCM



ARVC

Amyloidose

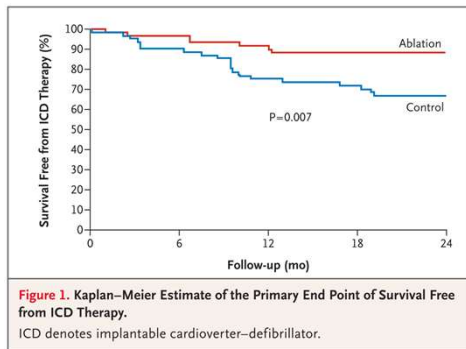


Non-  
compaction

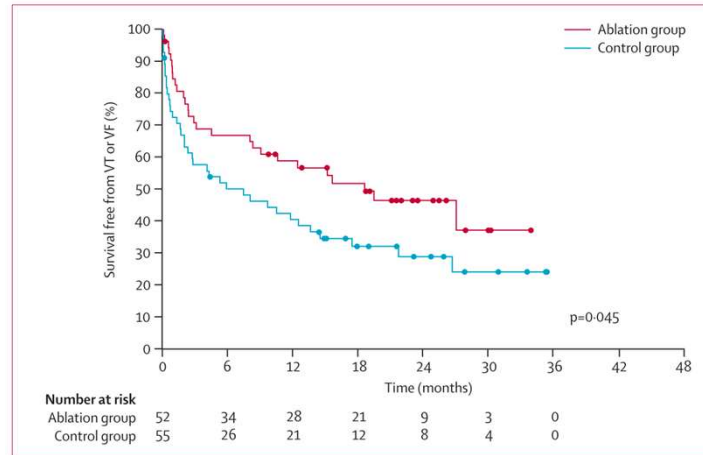
Hypertensiv

Adaptiert nach Chery, JACC EP 2024

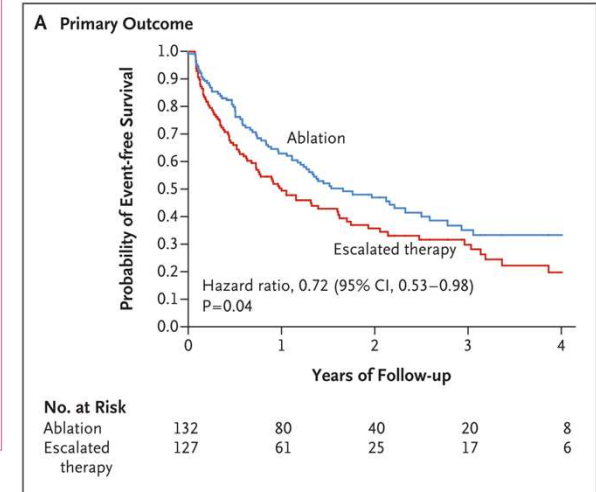
# Ischämische Herzkrankheit



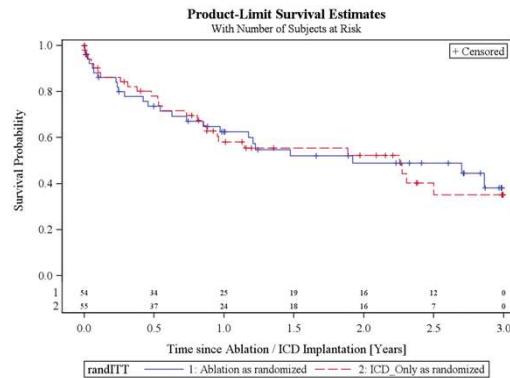
SMASH-VT,  
NEJM 2007



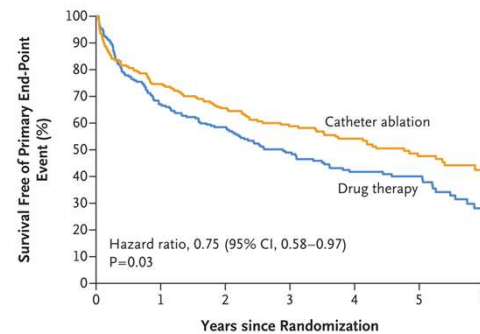
VTACH, Lancet 2010



VANISH, NEJM 2015



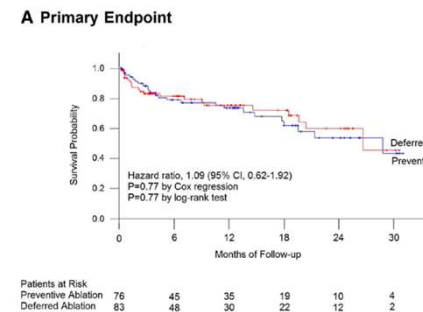
SMS, Circ A&E  
2017



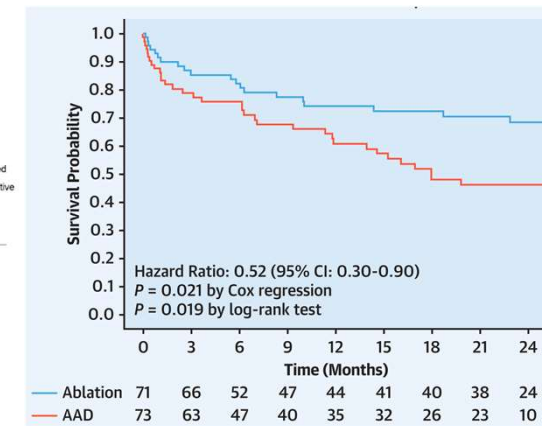
VANISH2, NEJM 2024

No. at Risk

|                   |     |     |     |    |    |    |    |
|-------------------|-----|-----|-----|----|----|----|----|
| Catheter ablation | 203 | 149 | 129 | 95 | 75 | 48 | 24 |
| Drug therapy      | 213 | 142 | 123 | 81 | 57 | 37 | 13 |

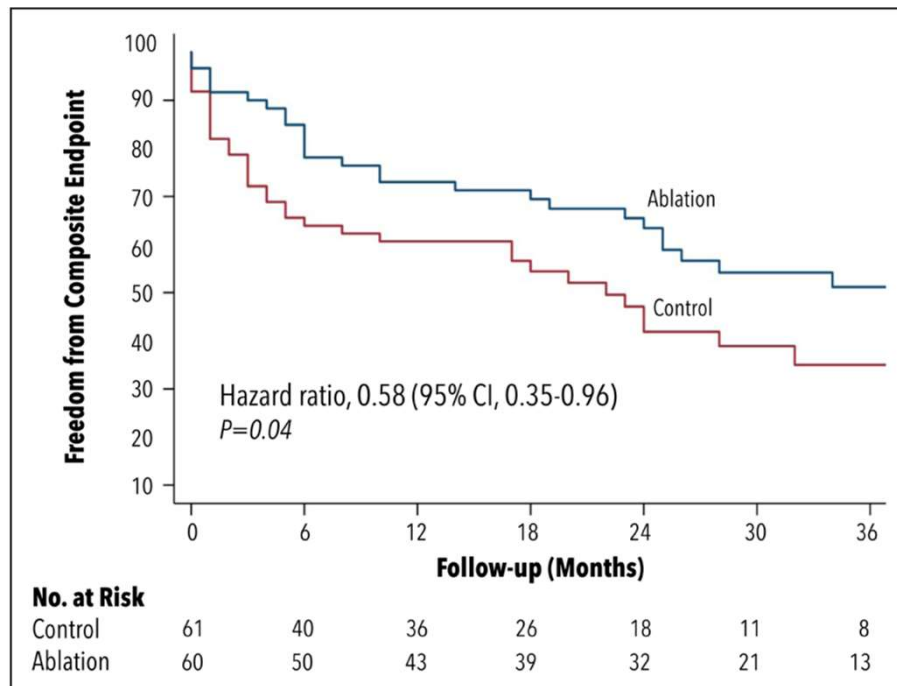


BERLIN-VT,  
Circulation 2018



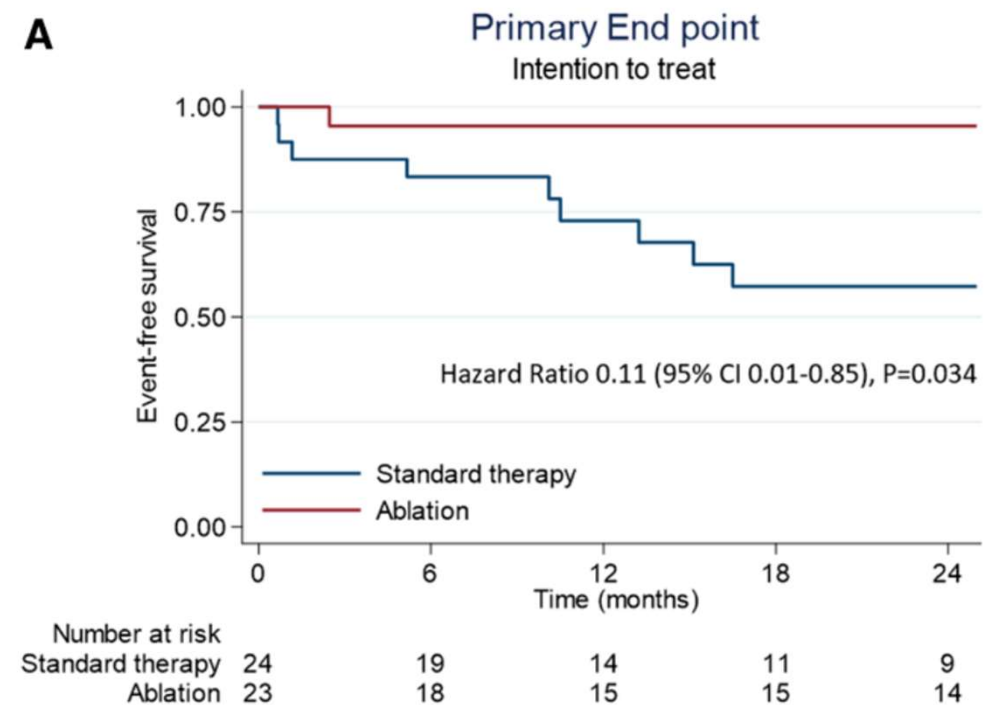
SURVIVE-VT, JACC 2022

## (Auch) Nicht-Ischämische Herzkrankheit



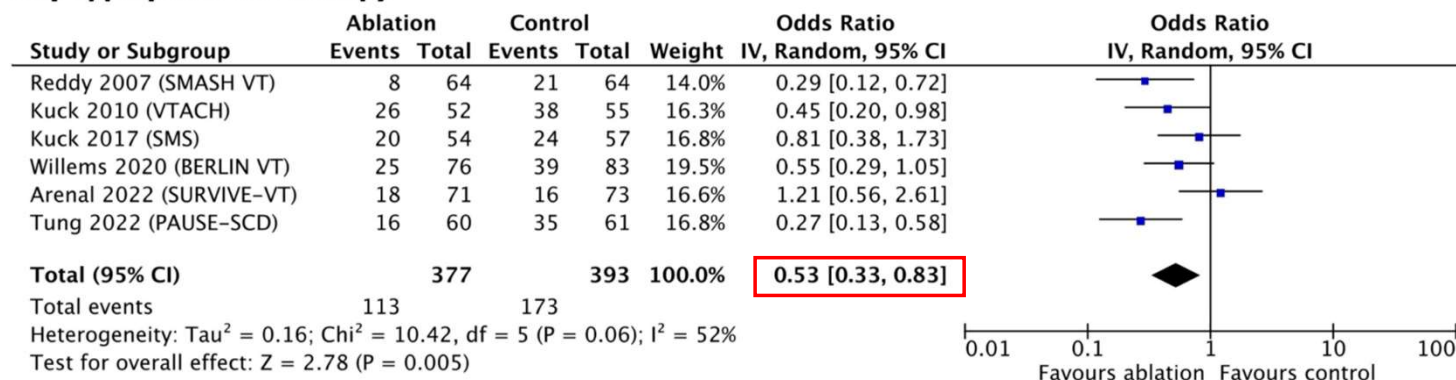
PAUSE-SCD, Circulation 2022

**A**

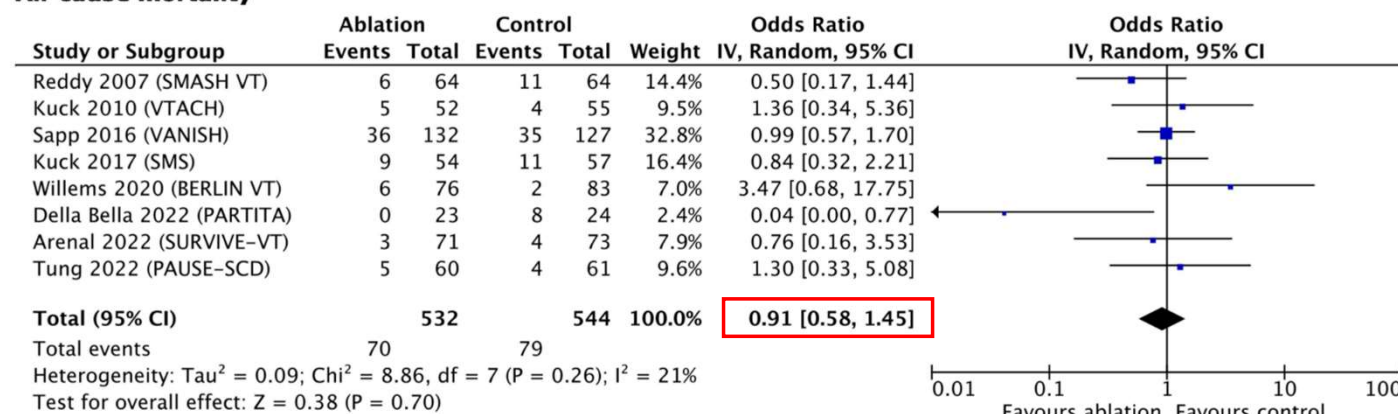


PARTITA, Circulation  
2022

### Any appropriate ICD therapy



### All-cause mortality



Shalghanov, Front  
Cardiovasc Med 2022

## Empfehlungen

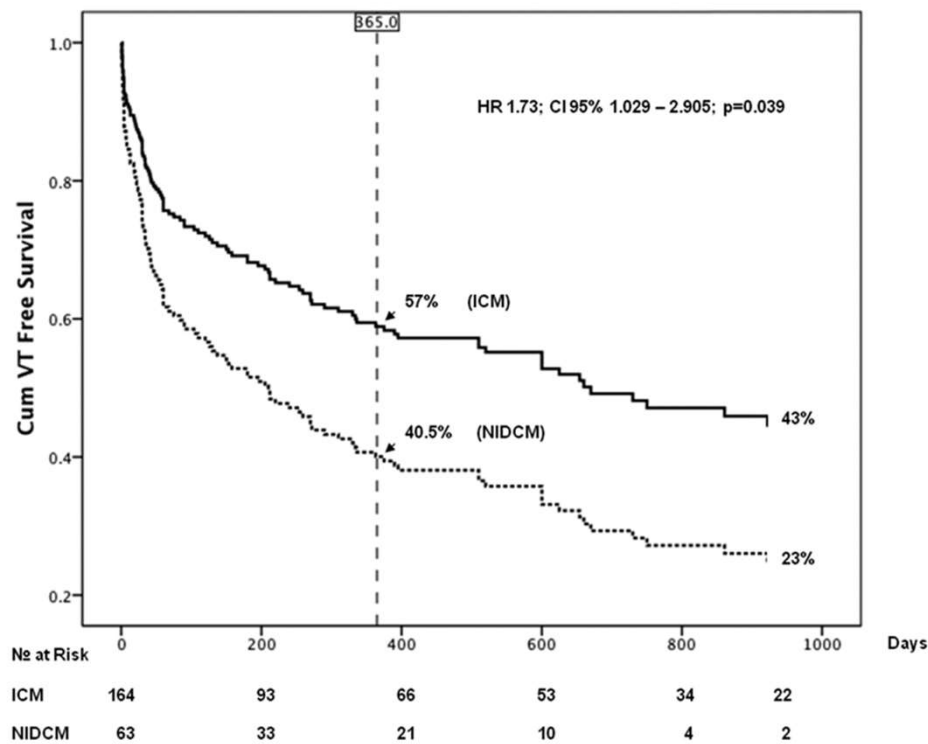
In patients with **CAD** and recurrent, symptomatic SMVT, or ICD shocks for SMVT despite chronic amiodarone therapy, catheter ablation is recommended in preference to escalating AAD therapy.<sup>471</sup>

**I**

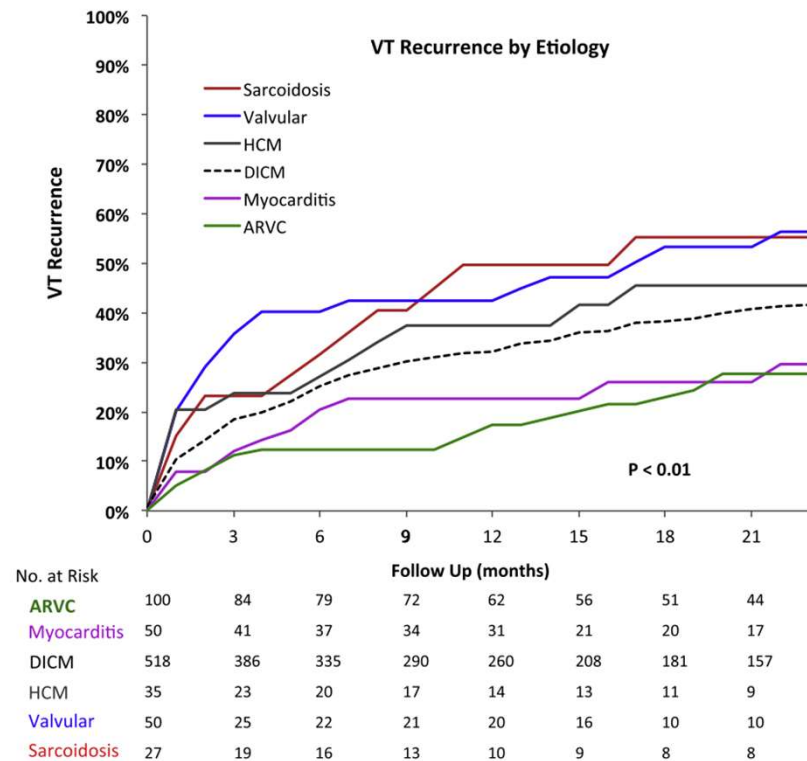
**B**

IB bis IIB

‘Nicht-ischämische Kardiopathie’ ist mit einer höheren VT-Rezidivrate assoziiert



Dinov, Circulation 2013



Vaseghi, JACC EP 2018



## Empfehlungen

In patients with **CAD** and recurrent, symptomatic SMVT, or ICD shocks for SMVT despite chronic amiodarone therapy, catheter ablation is recommended in preference to escalating AAD therapy.<sup>471</sup>

**I**

**B**

Catheter ablation in specialized centres should be considered in patients with **DCM/HNDCM** and recurrent, symptomatic SMVT or ICD shocks for SMVT, in whom AADs are ineffective, contraindicated, or not tolerated.<sup>481,497,664,669</sup>

**IIa**

**C**

Catheter ablation, performed in specialized centres, should be considered in **post-myocarditis** patients with recurrent, symptomatic SMVT or ICD shocks for SMVT in whom AADs are ineffective, not tolerated, or not desired.<sup>752,801,802</sup>

**IIa**

**C**

In patients with **ARVC** and recurrent, symptomatic SMVT or ICD shocks for SMVT despite beta-blockers, catheter ablation in specialized centres should be considered.<sup>482,709,714</sup>

**IIa**

**C**

Catheter ablation in specialized centres may be considered in selected patients with **HCM** and recurrent, symptomatic SMVT or ICD shocks for SMVT, in whom AAD are ineffective, contraindicated, or not tolerated.<sup>753,754</sup>

**IIb**

**C**

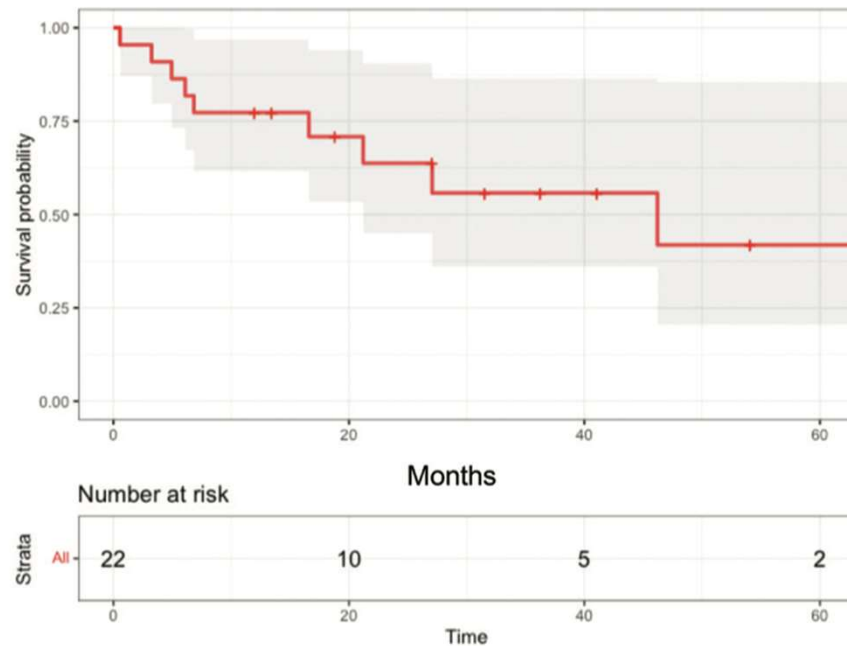
Catheter ablation, in specialized centres, may be considered in cardiac **sarcoidosis** ICD-recipients with recurrent, symptomatic SMVT or ICD shocks for SMVT, in whom AADs are ineffective, contraindicated, or not tolerated.<sup>839,841,842</sup>

**IIb**

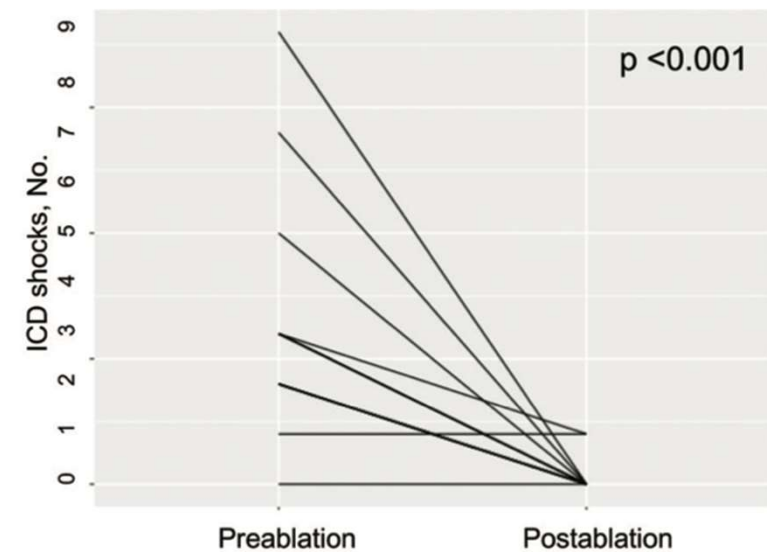
**C**

## Amyloidose

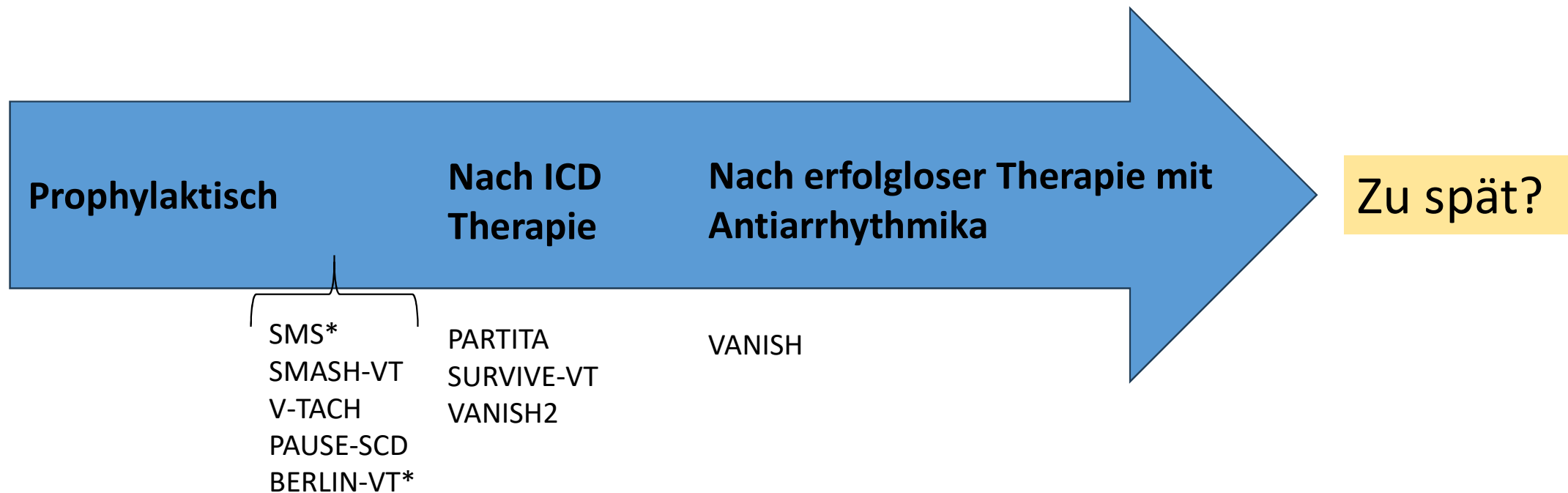
### **A** Primary Efficacy Outcome *Survival Free From Recurrent Sustained VT/VF*



### **B** ICD Shocks in the 6 months Before and After Ablation



Wann?

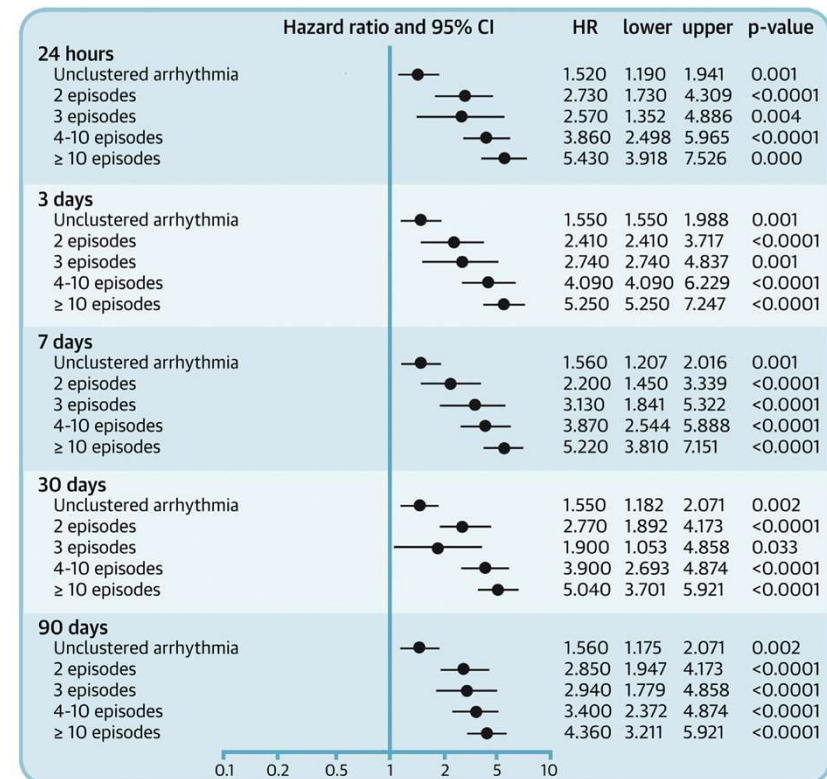


*\*Neutrales Resultat*

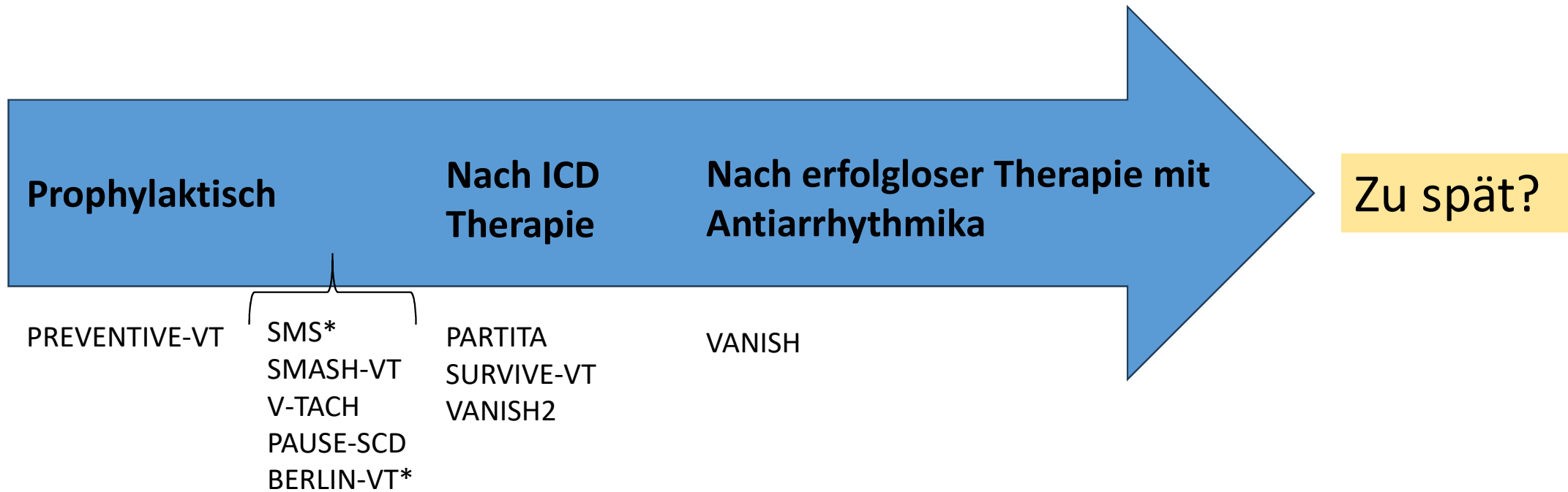
Adaptiert nach Siontis HRS 2025

## VT 'Clustering'

- Was wenn VT gehäuft auftritt?
- 1764 ICD-Träger:innen inklusive 463 mit VT-Episoden
- 68% ICM
- LVEF 23%



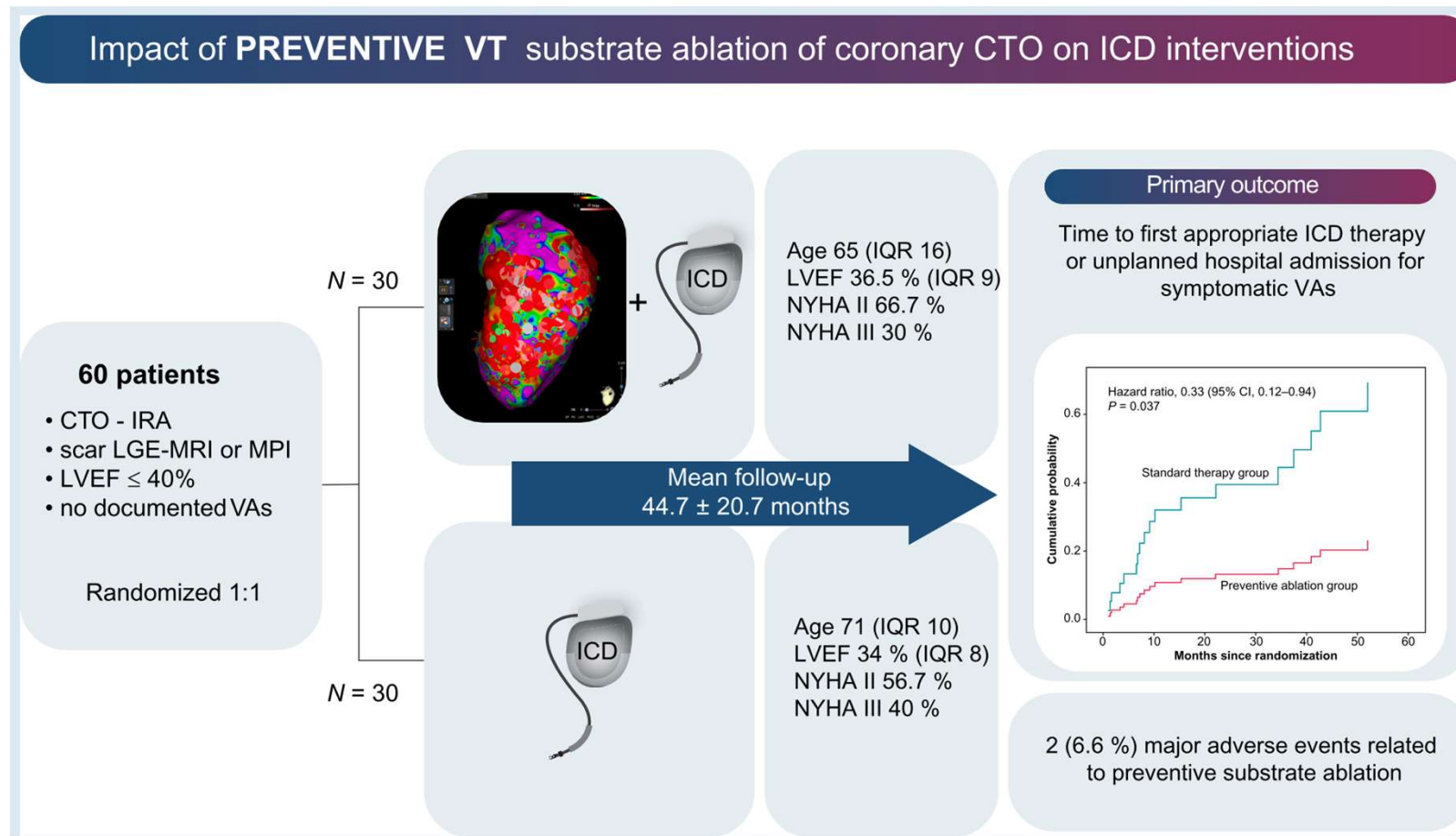
HR for mortality vs no VT patients; Elsokkari JACC EP 2020



*\*Neutrales Resultat*

Adaptiert nach Siontis HRS 2025

## Wann? Vor der ersten VT-Episode?



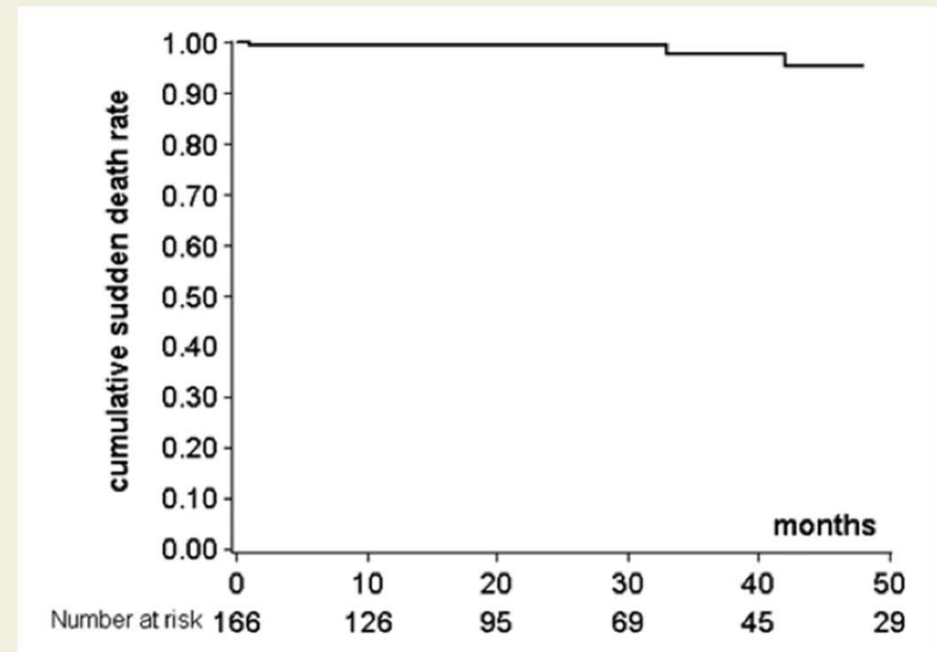
PREVENTIVE-VT,  
Europace 2024



## VT-Ablation ohne ICD-Implantation?

- VT-Ablation bei 139 Patient:innen
- ICM 55%, ARVC 19%, 'sonst NICM'

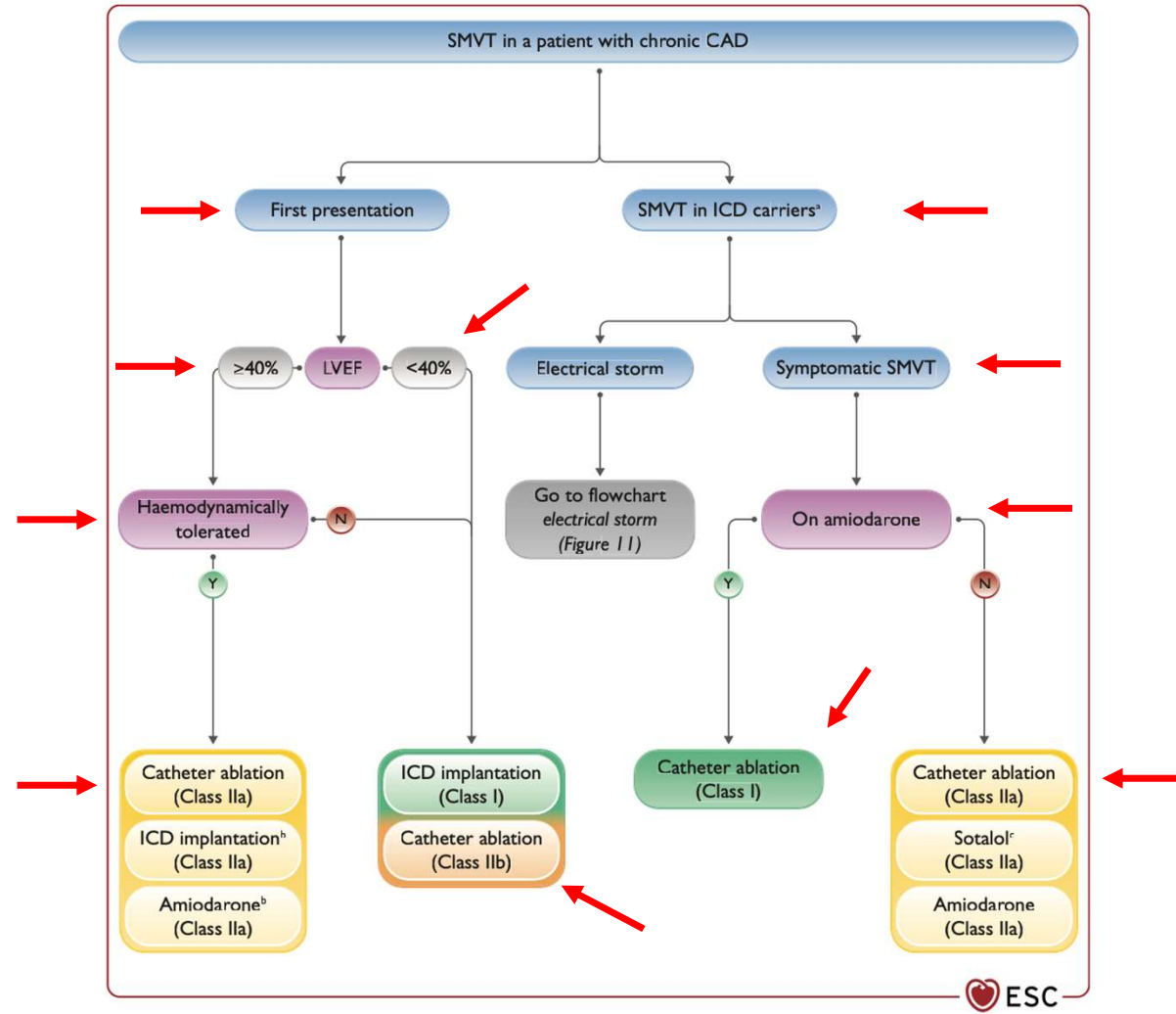
|                   |                 |     |
|-------------------|-----------------|-----|
| LVEF (%)          | 50 ± 10 (31–73) |     |
| LVEF >30 and <45% | 50 patients     | 30% |
| LVEF ≥45 and <55% | 63 patients     | 38% |
| LVEF ≥55%         | 53 patients     | 32% |



**Figure 2** Actuarial survival curves for sudden death.

Maury, EHJ 2014

# Ischämische Herzkrankheit



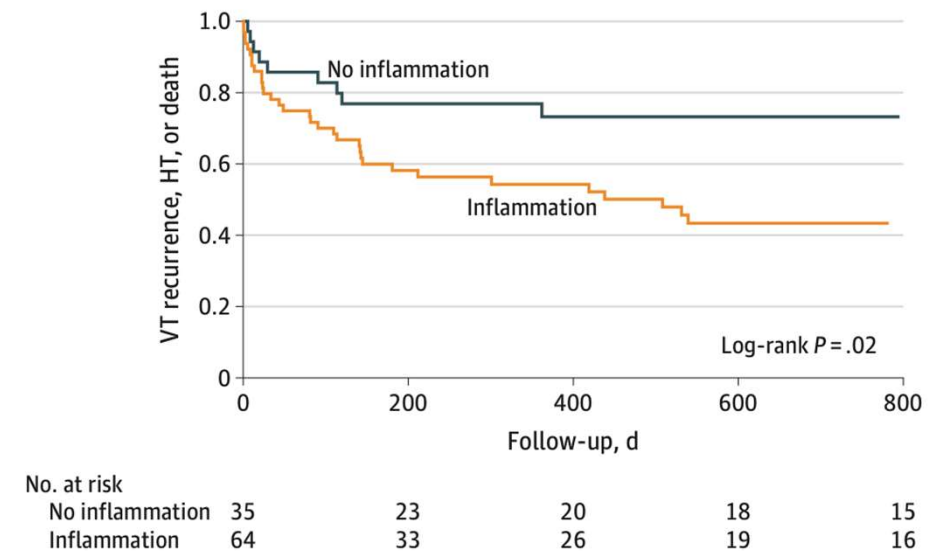
## Timing von VT-Ablation bei 'nicht-ischämischer' Herzkrankheit

- Diagnostische Aufarbeitung kritisch
  - Herz-CT? Herz-MRI? FDG-PET?
  - Genetische Untersuchung?

## Imaging vor VT-Ablation

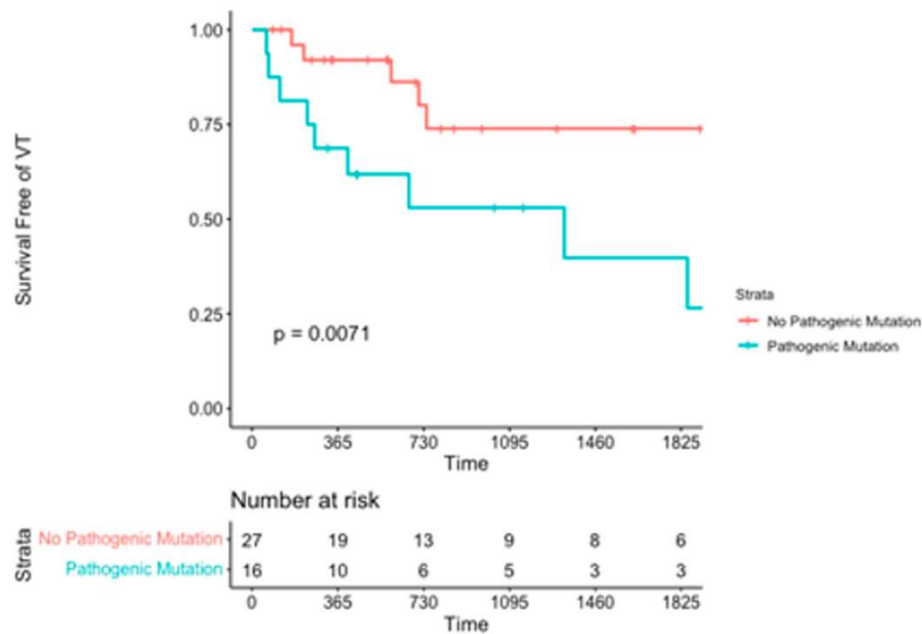
- ARVC und post-myokarditische VT mit gutem Outcome
- Grösse der Narbe? Midmyokardiale Narbe?
  - Welcher Endpunkt ist realistisch?
- Hinweise auf aktive Inflammation?

**B** Inflammation vs no inflammation subgroup

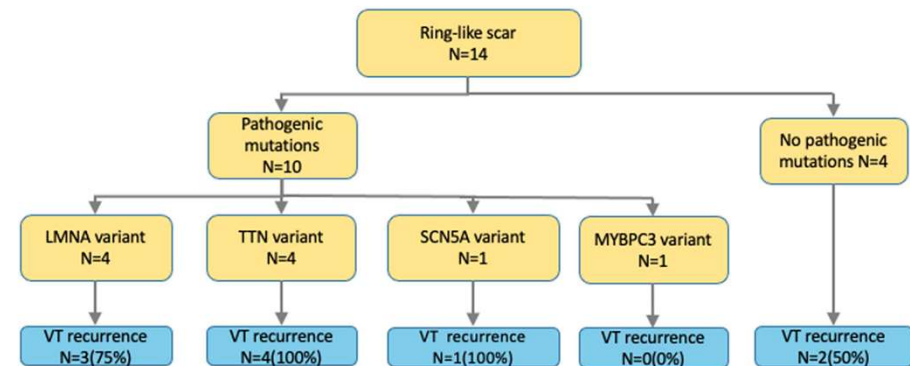


Siontis, JAMA Card 2021

## Hohe Rezidivraten



### + Herz-MRI



Kovacs, JCE 2023

VT-Ablation wann?

Nach Ausbau der  
Herzinsuffizienztherapie!

## Sterbeursache nach VT-Ablation

| Event                      | AAD Group<br>(n=127)<br>No. (%) | Catheter Ablation Group<br>(n=132)<br>No. (%) | P    |
|----------------------------|---------------------------------|-----------------------------------------------|------|
| Death                      | 35 (27.6)                       | 36 (27.3)                                     | 1.0  |
| Non-Cardiac Death          | 8 (6.3)                         | 12 (9.1)                                      | 0.49 |
| → Cardiovascular Death     | 26 (20.5)                       | 24 (18.2)                                     | 0.75 |
| Myocardial Infarction      |                                 | 1 (0.8)                                       | 1.0  |
| → Congestive Heart Failure | 19 (15.0)                       | 17 (12.9)                                     | 0.72 |
| Ventricular Arrhythmia     | 5 (3.9)                         | 3 (2.3)                                       | 0.50 |
| Stroke                     |                                 | 1 (0.8)                                       | 1.0  |
| Other Cardiovascular       | 1 (0.8)                         |                                               | 0.49 |
| ICD-Related Death          | 2 (1.6)                         | 2 (1.5)                                       | 1.0  |
| Unknown Cause of Death     | 1 (0.8)                         |                                               | 0.49 |

VANISH, NEJM 2015

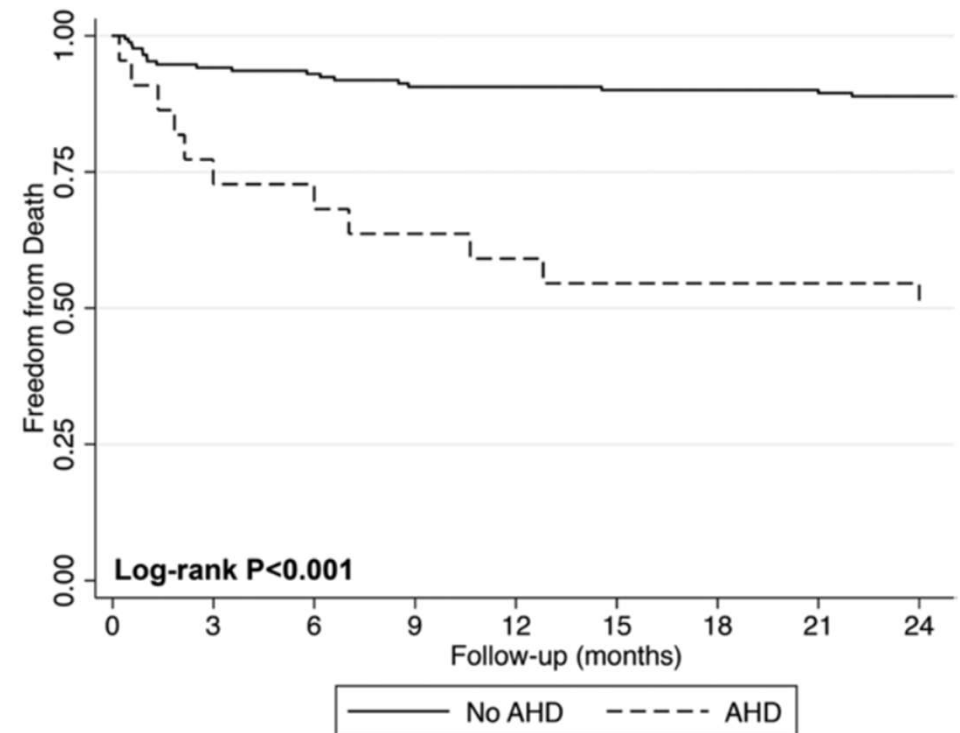
| Event                           | Catheter Ablation<br>N=203 | Antiarrhythmic<br>N=213 |
|---------------------------------|----------------------------|-------------------------|
| <b>Fatal Events</b>             |                            |                         |
| Non-cardiac death               | 14 (6.9%)                  | 26 (12.2%)              |
| → Cardiovascular death          | 29 (14.3%)                 | 25 (11.7%)              |
| Unexpected cardiovascular death | 3 (1.5%)                   | 4 (1.9%)                |
| Myocardial infarction           | 1 (0.5%)                   | 2 (0.9%)                |
| → Congestive Heart Failure      | 12 (5.9%)                  | 12 (5.6%)               |
| Post CV Intervention            | 2 (1.0%)                   | 1 (0.5%)                |
| Ventricular Arrhythmia          | 3 (1.5%)                   | 1 (0.5%)                |
| Post non-CV surgery             | 0                          | 3 (1.4%)                |
| Stroke                          | 3 (1.5%)                   | 0                       |
| Other Cardiovascular            | 5 (2.5%)                   | 2 (0.9%)                |
| Unknown cause of death          | 2 (1.0%)                   | 3 (1.4%)                |

VANISH2, NEJM 2024



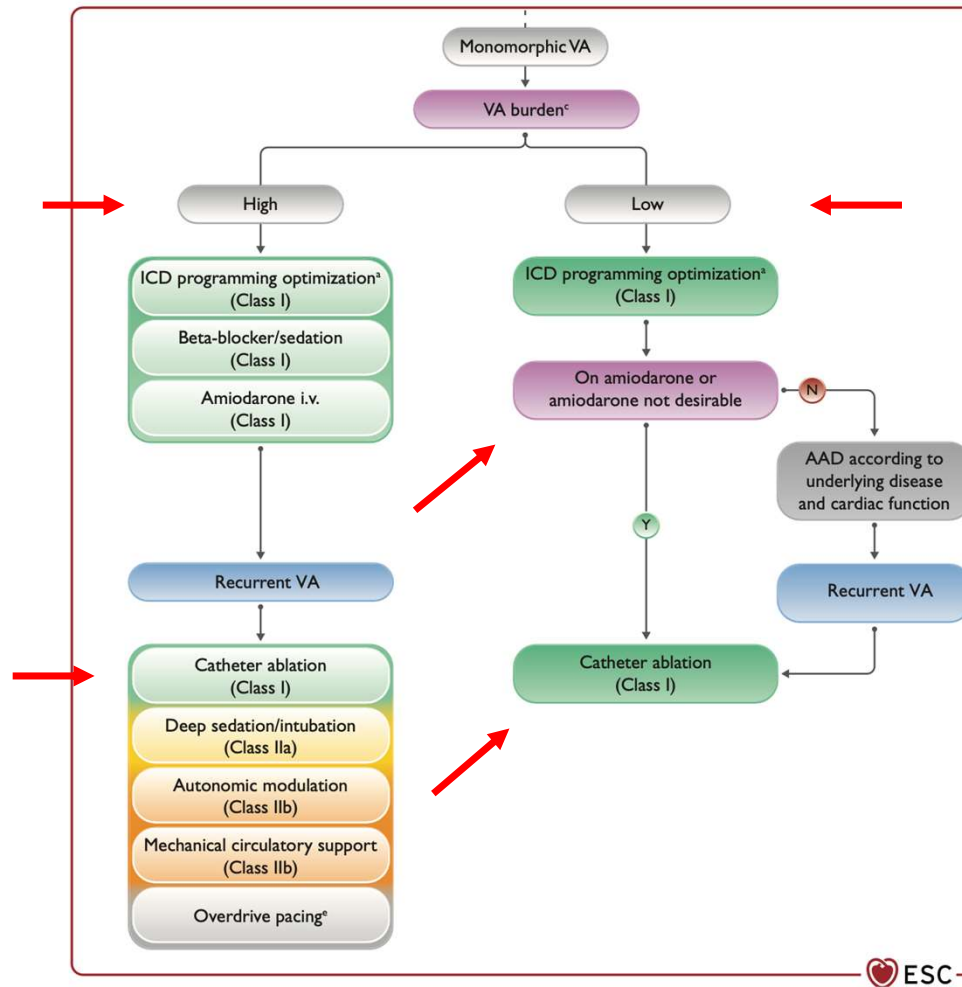
## Optimale Herzinsuffizienztherapie ESSENTIELL

- 193 Patient:innen
- LVEF 35%
- 56% ICM
- 47% ES
- 22/193 mit akuter hämodynamischer Dekompensation während dem Eingriff



# Dringende Indikationen für VT-Ablation

## Electrical storm

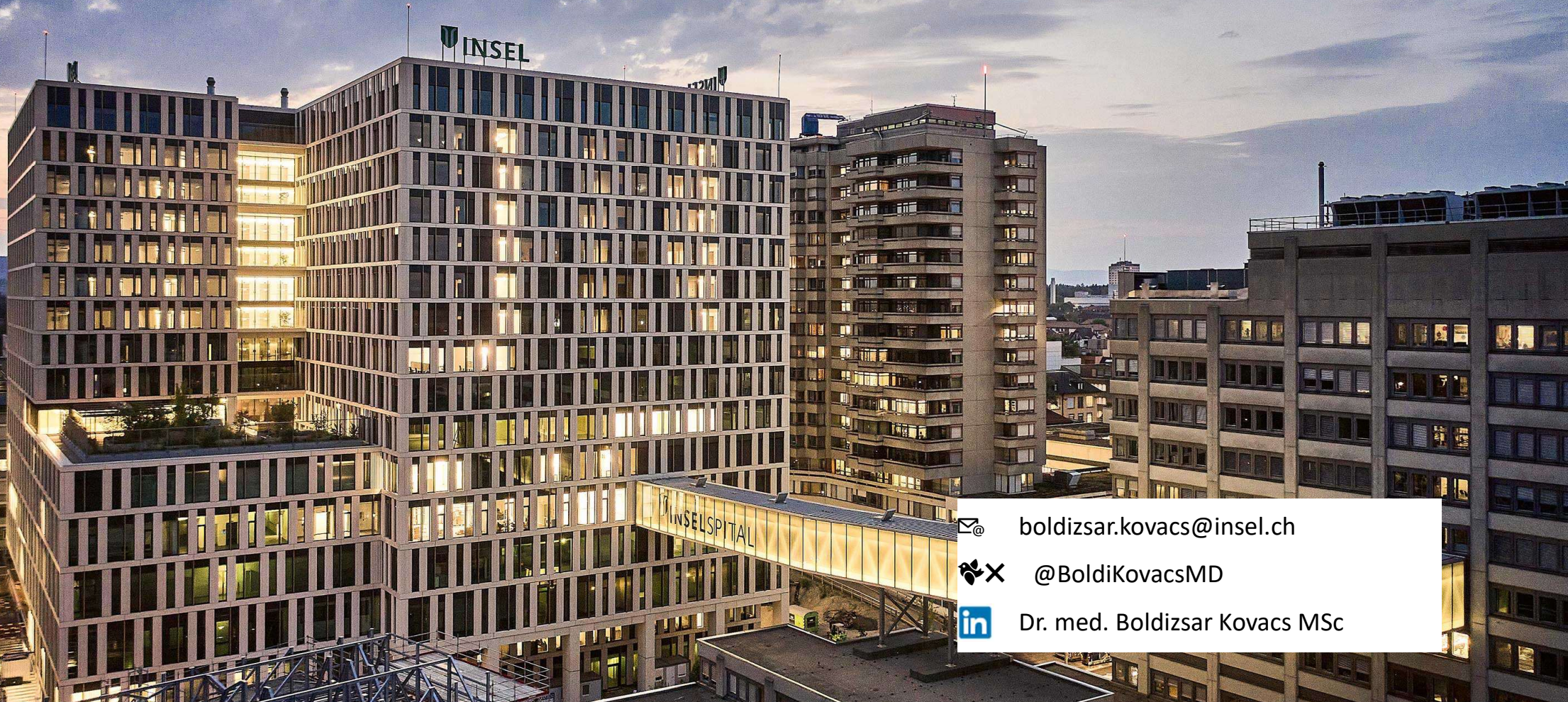


## Take home messages

- VT-Ablation bei ischämischer Herzkrankheit sehr gut etabliert mit gutem Outcome
- Erfolg einer VT-Ablation bei 'nicht-ischämischer' Herzkrankheit ist v.a. vom Phänotyp und klinischer Konstellation abhängig
- «Prophylaktische» VT-Ablation in der Zukunft indiziert?
- Bei gehäuften ventrikulären Tachykardien und insb. ICD-Therapien, frühe Ablation notwendig



# Danke für die Aufmerksamkeit!



[boldizsar.kovacs@insel.ch](mailto:boldizsar.kovacs@insel.ch)



[@BoldiKovacsMD](https://twitter.com/BoldiKovacsMD)



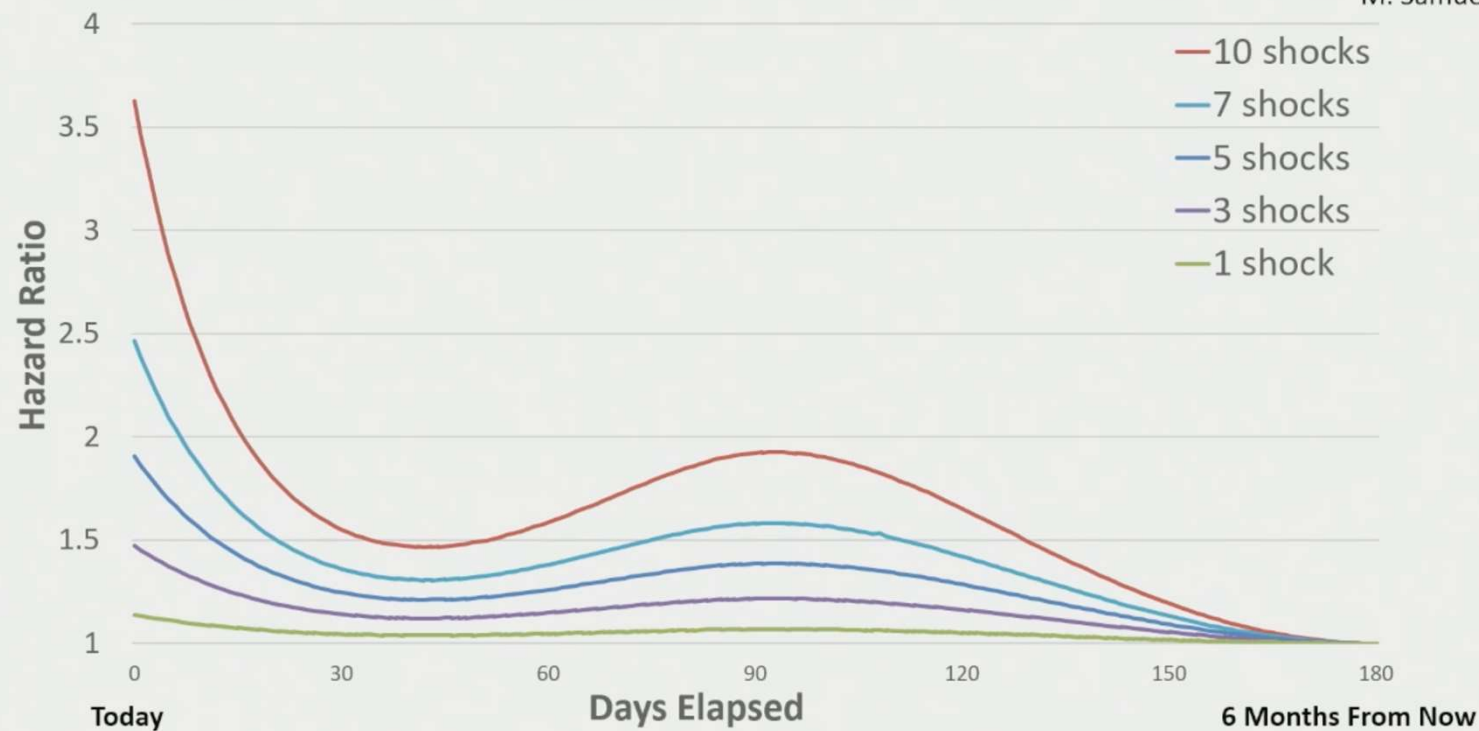
Dr. med. Boldizsar Kovacs MSc



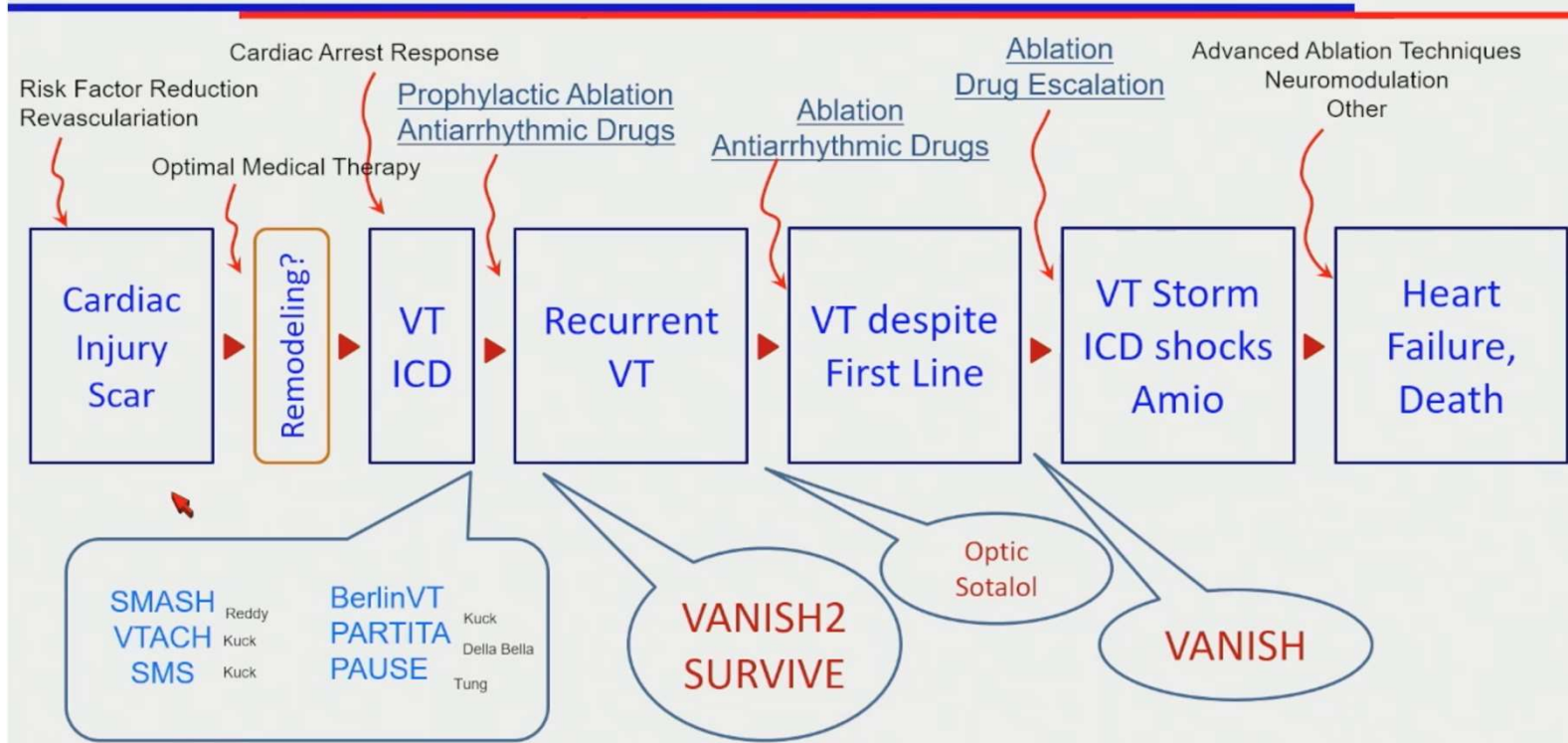
## Backup Folien

## Time Relationship Between Shocks and Risk of Death

M. Samuel



## Clinical Course of VT Patients: Opportunities for Intervention





Was wenn die Katheterablation nicht möglich ist oder nicht erfolgreich ist?

- Neue Energieformen (Elektroporation = 'pulsed field ablation')
- Herzbestrahlung ('stereotactic arrhythmia radioablation')
- etc

## Kongenitale Herzkrankheiten

In patients with CHD and recurrent, symptomatic SMVT or ICD shocks for SMVT not manageable by medical therapy or ICD reprogramming, catheter ablation performed in specialized centres should be considered.<sup>c 899–901</sup>

**IIa**

**C**

In patients with repaired TOF who present with SMVT or recurrent, symptomatic appropriate ICD therapy for SMVT, catheter ablation performed in specialized centres is recommended.<sup>899–901</sup>

**I**

**C**

In patients with repaired TOF with SMVT who are undergoing surgical or transcatheter pulmonary valve replacement, pre-operative catheter mapping and transection of VT-related anatomical isthmuses before or during the intervention should be considered.<sup>888,893,894</sup>

**IIa**

**C**

In patients with repaired TOF with a preserved biventricular function and symptomatic SMVT, catheter ablation or concomitant surgical ablation performed in specialized centres may be considered as an alternative to ICD therapy.<sup>899,901</sup>

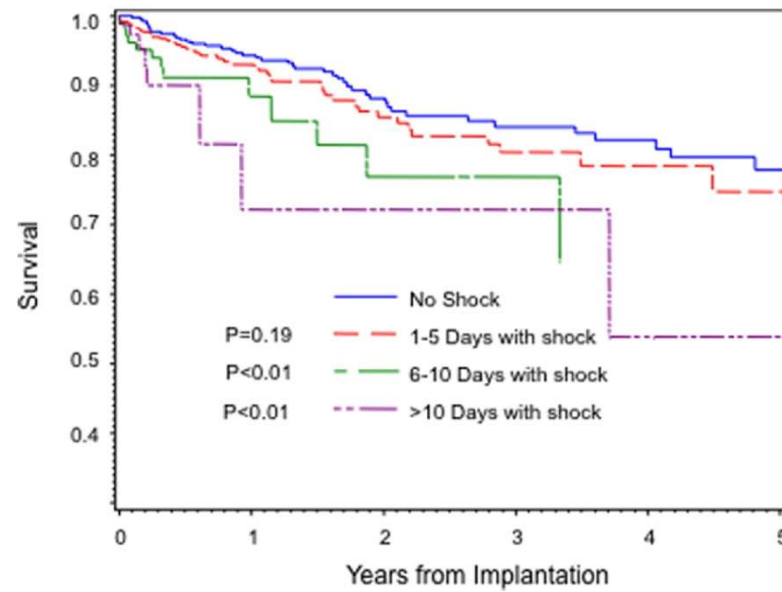
**IIb**

**C**

Catheter ablation of triggering PVCs and/or RVOT epicardial substrate should be considered in BrS patients with recurrent appropriate ICD shocks refractory to drug therapy.<sup>1010–1015</sup>

**IIa**

**C**

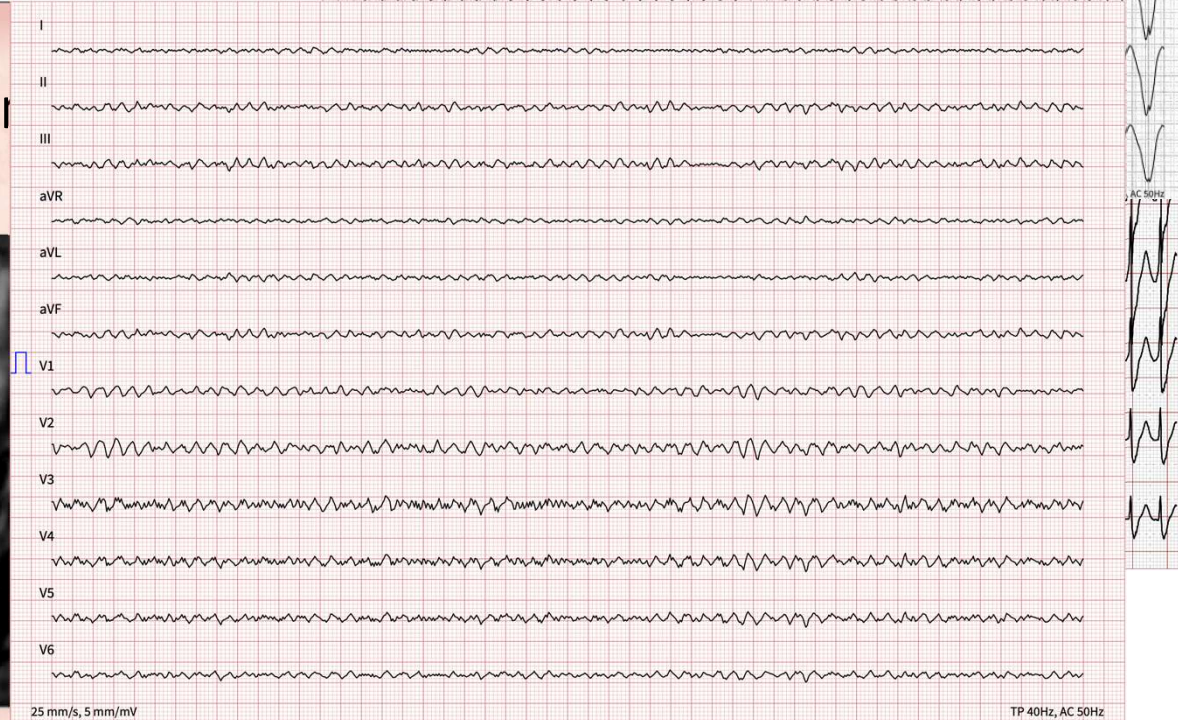
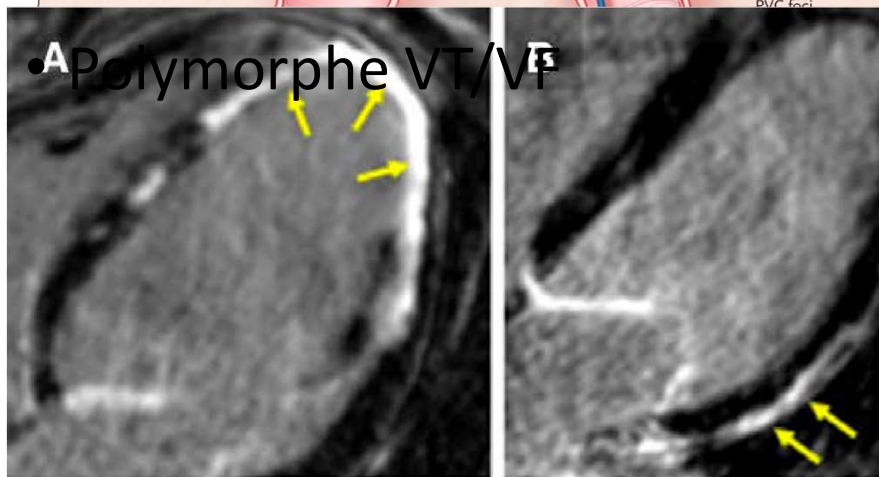
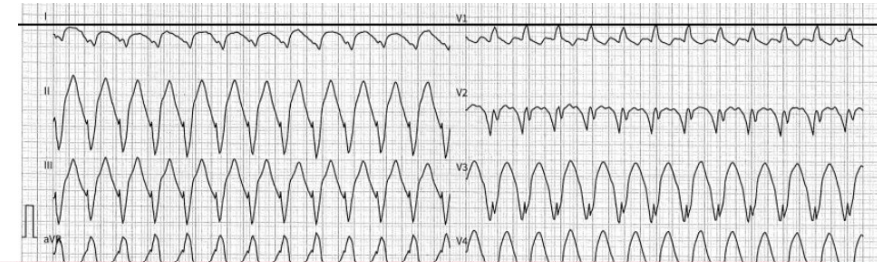


Shock or no shock, Larsen Heart Rhythm 2011

## Ätiologie von ventrikuläre Tachykardien

- Idiopathische und monomorphe VT

- Substrat-assoziierte und monomorphe VT





## 4.4 Ventricular Arrhythmia in Ischemic Heart Disease

### Recommendations for catheter ablation of VAs in patients with IHD

| COR | LOE  | Recommendations                                                                                                                                                                                                                                                                                            | References                      |
|-----|------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------|
| I   | B-R  | 1. In patients with IHD who experience recurrent monomorphic VT despite chronic amiodarone therapy, catheter ablation is recommended in preference to escalating AAD therapy.                                                                                                                              | <a href="#">S4.4.1</a>          |
| I   | B-NR | 2. In patients with IHD and recurrent symptomatic monomorphic VT despite AAD therapy, or when AAD therapy is contraindicated or not tolerated, catheter ablation is recommended to reduce recurrent VT.                                                                                                    | <a href="#">S4.4.2–S4.4.4</a>   |
| I   | B-NR | 3. In patients with IHD and VT storm refractory to AAD therapy, catheter ablation is recommended.                                                                                                                                                                                                          | <a href="#">S4.4.5–S4.4.9</a>   |
| IIa | C-EO | 4. In patients with IHD and recurrent monomorphic VT, in whom AADs are not desired, catheter ablation can be useful.                                                                                                                                                                                       |                                 |
| IIb | A    | 5. In patients with IHD and an ICD who experience a first episode of monomorphic VT, catheter ablation may be considered to reduce the risk of recurrent VT or ICD therapies.                                                                                                                              | <a href="#">S4.4.10–S4.4.14</a> |
| IIb | C-LD | 6. In patients with prior myocardial infarction and recurrent episodes of symptomatic sustained VT for whom prior endocardial catheter ablation has not been successful and who have ECG, endocardial mapping, or imaging evidence of a subepicardial VT substrate, epicardial ablation may be considered. | <a href="#">S4.4.15–S4.4.19</a> |



## 4.5 Nonischemic Cardiomyopathy

### Recommendations for catheter ablation of VT in nonischemic cardiomyopathy (NICM)

| COR | LOE  | Recommendations                                                                                                                                                                                                               | References              |
|-----|------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------|
| I   | B-NR | 1. In patients with NICM and recurrent sustained monomorphic VT for whom antiarrhythmic medications are ineffective, contraindicated, or not tolerated, catheter ablation is useful for reducing recurrent VT and ICD shocks. | S4.5.1–S4.5.6           |
| I   | B-NR | 2. In patients with NICM and electrical storm refractory to AAD therapy, catheter ablation is useful for reducing recurrent VT and ICD shocks.                                                                                | S4.5.7–S4.5.9           |
| IIa | B-NR | 3. In patients with NICM, epicardial catheter ablation of VT can be useful after failure of endocardial ablation or as the initial ablation approach when there is a suspicion of an epicardial substrate or circuit.         | S4.5.4, S4.5.10–S4.5.13 |
| IIa | B-NR | 4. In patients with cardiac sarcoidosis and recurrent VT despite medical therapy, catheter ablation can be useful to reduce the risk of VT recurrence and ICD shocks.                                                         | S4.5.14–S4.5.18         |
| IIa | C-EO | 5. In patients with NICM and recurrent sustained monomorphic VT for whom antiarrhythmic medications are not desired, catheter ablation can be useful for reducing recurrent VT and ICD shocks.                                |                         |
| IIb | B-NR | 6. In patients with NICM related to lamin A/C (LMNA) mutations and recurrent VT, catheter ablation may be considered as a palliative strategy for short-term arrhythmia control.                                              | S4.5.19                 |