

Debate: Ablation should be the first line therapy for patients with appropriate ICD shocks



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# Avoiding Shocks Is Important



**To Reduce Pain  
and Anxiety  
and Increase De  
vice Acceptance  
1**



**To Reduce Health  
care Burden and Improve Pati  
ent Quality of Li  
fe<sup>1</sup>**



**Avoiding Shoc  
ks Improve Sur  
vival/Heart Fail  
ure<sup>2</sup>**

# Cause of ICD shock

## Appropriate Shock

- Ventricular Fibrillation
- Monomorphic VT
- Polymorphic VT

## Unnecessary Shock

- Non-sustained VT
- Slow VT?

## Inappropriate Shock

- A fib/AFL
- SVT
- Sinus tachycardia
- T wave oversensing
- Wide QRS
- Lead problem
- External noise (EMI)

# VT ablation for ICD patient

- Effectiveness of AAD
- Prophylactic VT ablation
- VT ablation for slow VT, NSVT, or frequent VPC
- VT ablation for VT storm

# Rationale for VT ablation

- OPTIC study, 412 patients
- % of patient receiving shock:
  - Beta blocker 38.5%
  - Sotalol 24.3%
  - Amiodarone + Beta blocker 10.3%
- Rate of drug discontinuation:
  - Beta blocker 5.3%
  - Sotalol 23.5%
  - Amiodarone + Beta blocker 18.2%

# *The* NEW ENGLAND JOURNAL *of* MEDICINE

ESTABLISHED IN 1812

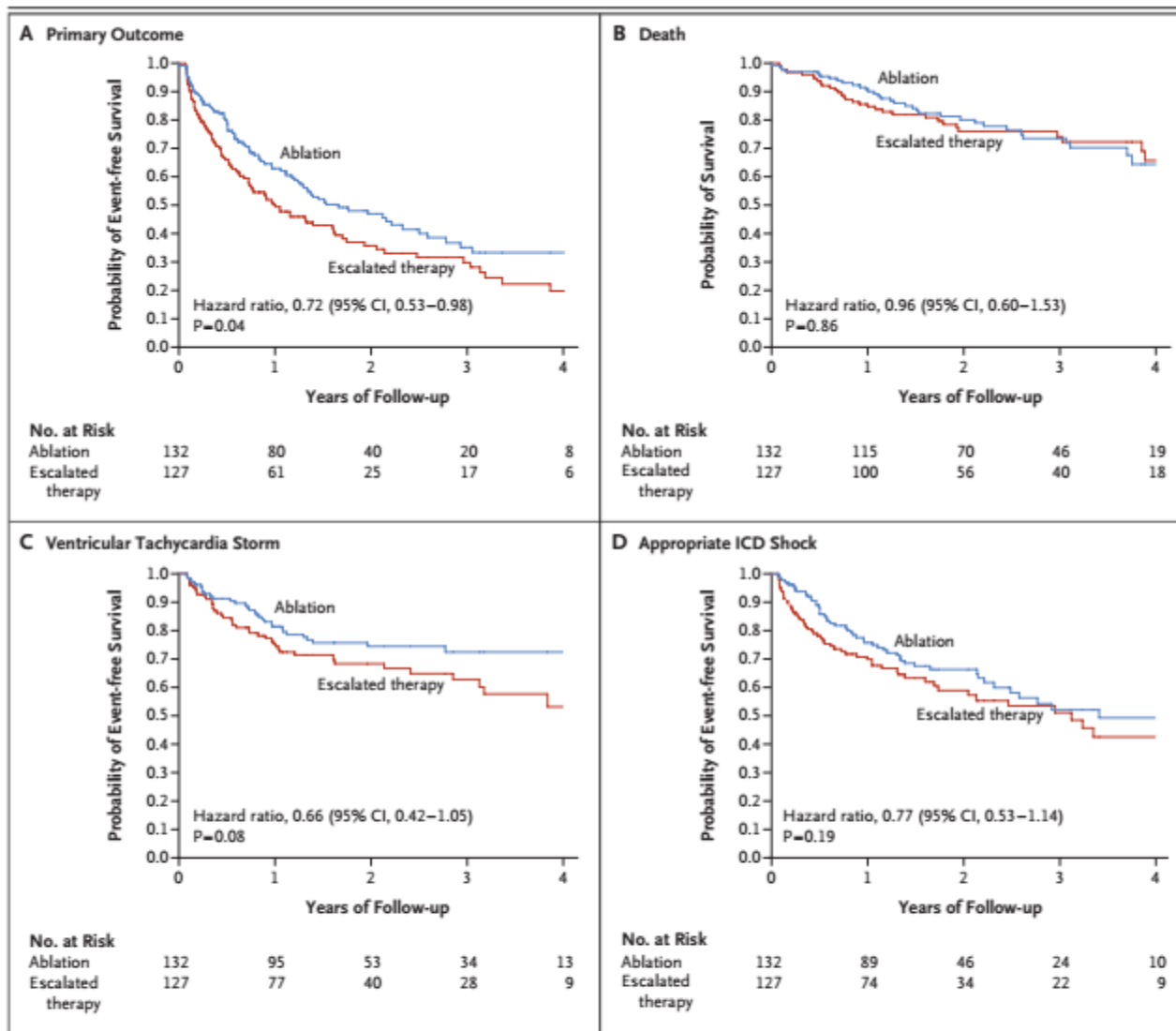
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## Ventricular Tachycardia Ablation versus Escalation of Antiarrhythmic Drugs

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multicenter, randomized, controlled trial for ischemic cardiomyopathy and an ICD  
259 patients, 28 months follow up



**Figure 1. Primary Outcome and Its Components.**

Panel A shows survival free from the primary outcome — death at any time or ventricular tachycardia storm or appropriate shock from an implantable cardioverter–defibrillator (ICD) after the 30-day treatment period — among patients treated with catheter ablation or escalated antiarrhythmic drug (AAD) therapy. Rates of death were similar in the two groups (Panel B). The significantly lower rate of the primary outcome in the ablation group was driven by lower rates of ventricular tachycardia storm (Panel C) and appropriate ICD shock (Panel D).

- During 28 months of follow-up, catheter ablation resulted in a 28% relative risk reduction in the composite endpoint of death, VT storm, and appropriate ICD shock ( $p = 0.04$ ). In a subgroup analysis, patients having VT despite amiodarone had better outcomes with ablation as compared to increasing amiodarone dose or adding mexiletine.



- Antiarrhythmic drugs are limited by incomplete efficacy and an unfavorable adverse effect profile. Catheter ablation can be effective but acute complications and long-term VT recurrence risk necessitating repeat ablation should be recognized. A shared clinical decision process accounting for patients' cardiac status, comorbidities, and goals of care is often required.

# Prophylactic VT ablation

- SMASH VT study (2007)
  - 128 pts, 22.5 months follow up
  - Substrate-based approach with mapping in sinus rhythm
  - Survival free from ICD therapy
  - Reduced incidence of ICD therapy in ablation group versus ICD only
- 
- VTACH study (2010)
  - 110 pts, 22.5 months follow up
  - Pace mapping +/- entrainment mapping +/- substrate modification
  - Longer time to recurrence of VT/VF in ablation group versus control group

# Prophylactic VT ablation

- SMS study (2017)
  - 111 pts, 2.3 year follow up
  - ICMF with LVEF<40%
  - Pace mapping +/- entrainment mapping +/- substrate modification
  - No difference in time to first recurrence of VT/VF between ablation and control group
  - ICD shock burden was 50% lower in ablation group

# **EHRA/HRS Expert Consensus on Catheter Ablation of Ventricular Arrhythmias**

*Developed in a partnership with the European Heart Rhythm Association (EHRA), a Registered Branch of the European Society of Cardiology (ESC), and the Heart Rhythm Society (HRS); in collaboration with the American College of Cardiology (ACC) and the American Heart Association (AHA)*

“The task force members felt that ablation should generally be considered relatively early, before multiple recurrences of VT and repeated courses of drug therapy.”

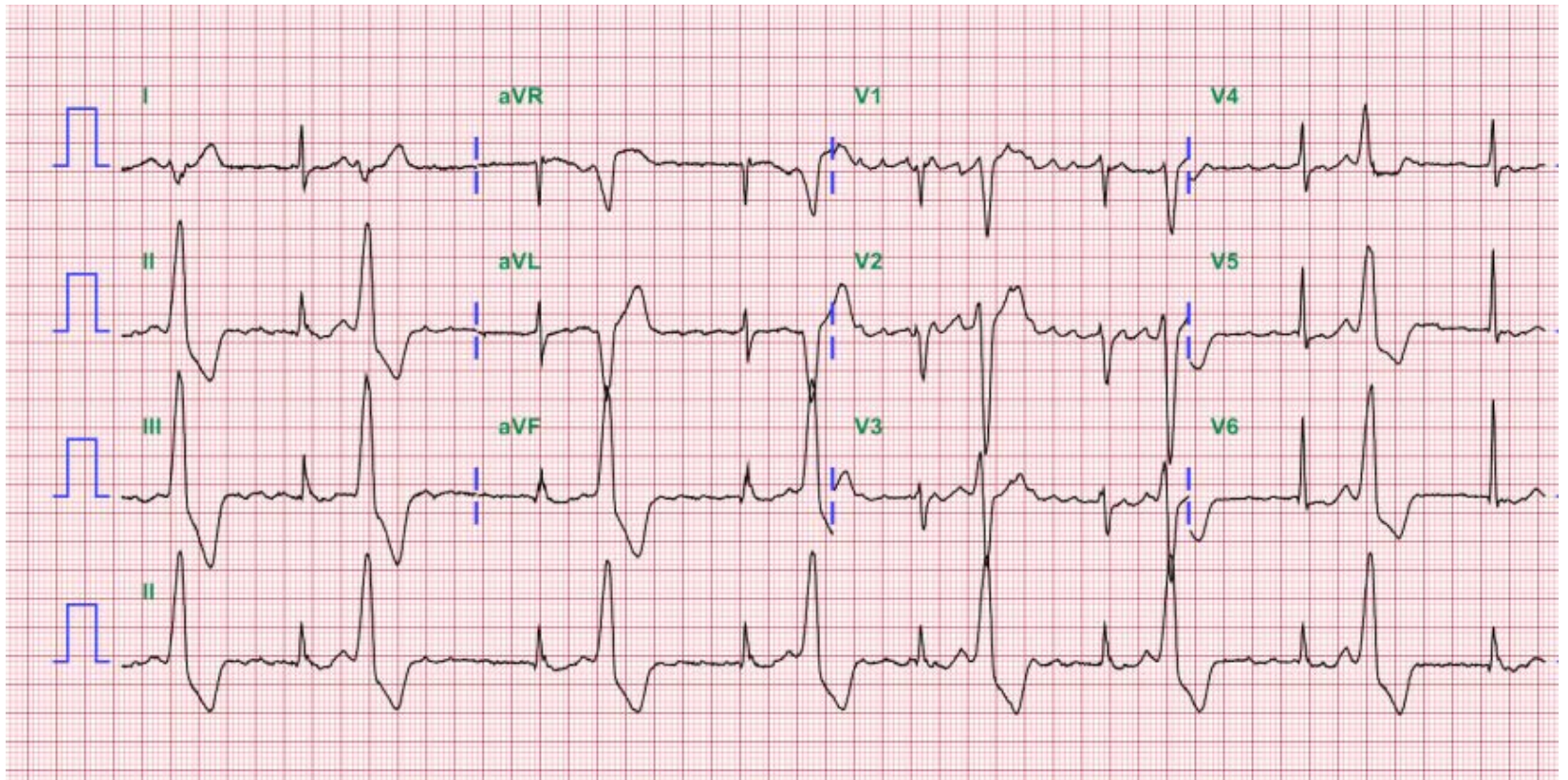
# Real World...

- EHRA Research Network survey
  - most operators performed ablation for recurrent shocks or electrical storm, with prophylactic ablation rarely performed.
  - uncertainty of the impact of VT ablation on disease progression, functional status and mortality

# VT ablation for slow VT, NSVT, or frequent VPC

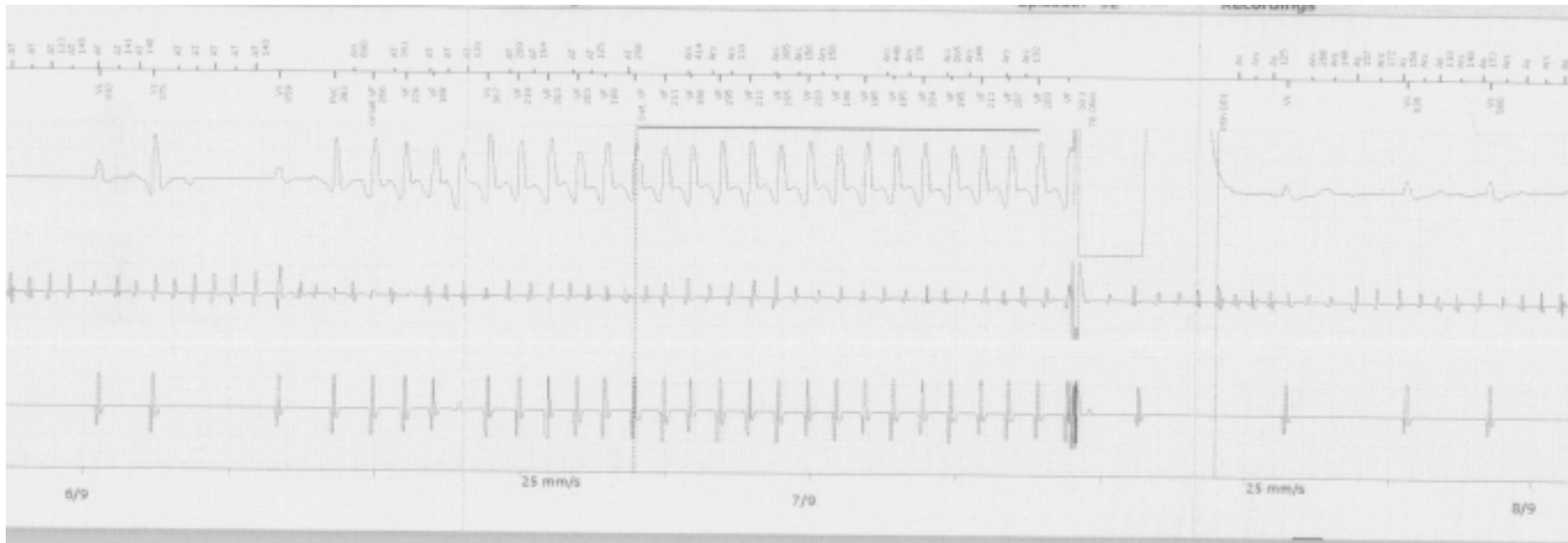
- 증례 1
- M/ 51
- 자는 도중 새벽 2시경 무호흡상태로 발견되어 부인에 의해 CPR, 구급차가 와서 심실세동 확인 후 AED 사용 후 ROSC
- CAG 상 no significant stenosis with provocation test
- LVEF 45%
- Holter 상 VPC 17%

# ECG during F/U after ICD



# ICD shock

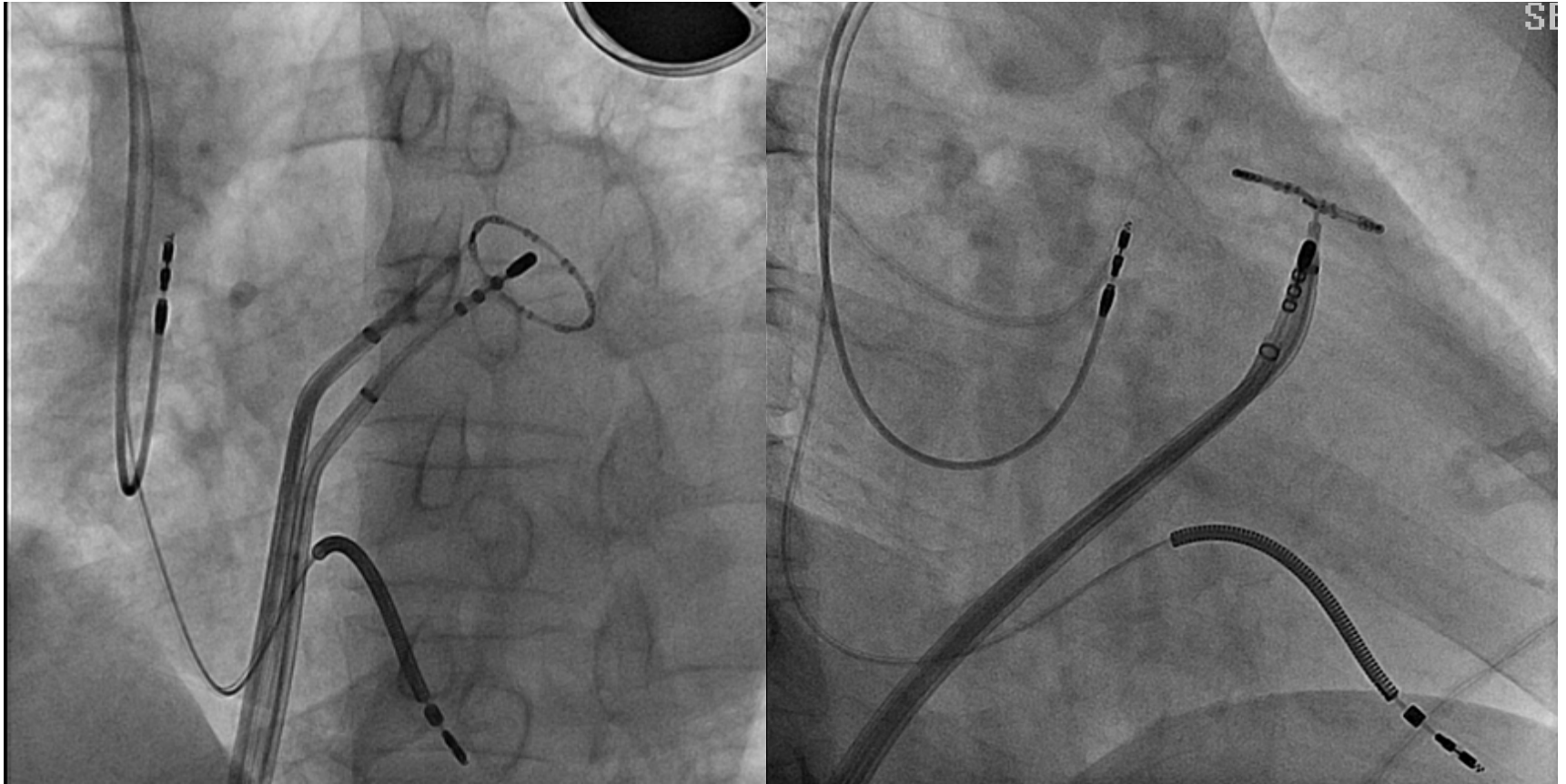
- ICD 5개월 후 운전도중 아찔함을 느낌
- ICD shock 4차례



VF zone 222bpm 16 out of 20



# Ablation at RVOT septum



No VPC on Holer, No ICD shock for 2 years

## 증례 2

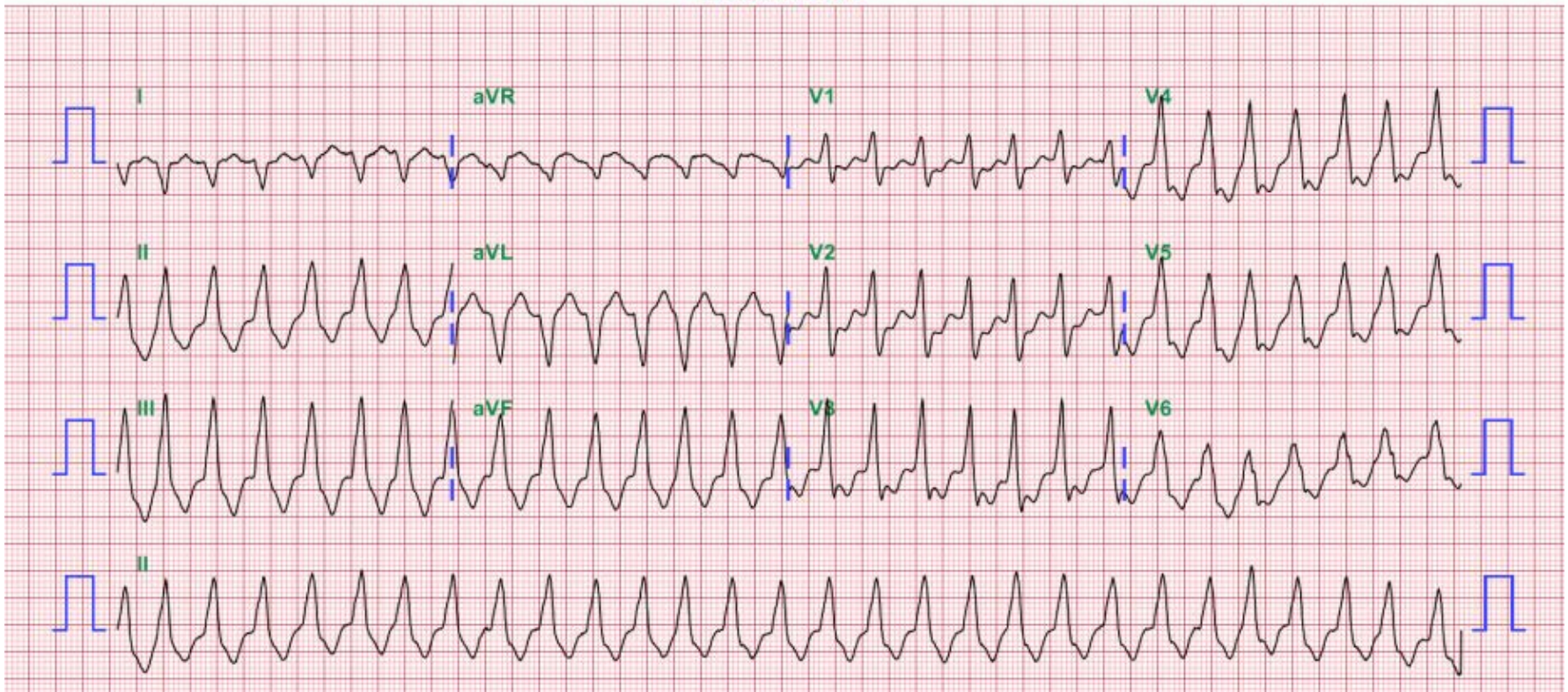
- M/76
- 20년 부터 DCMP, severe LV dysfunction 진단하에 F/U 중인 환자로, VT 진단하에 입원치료함.
- 원인 감별위해 CAG 시행하였으며, significant stenotic lesion 이 있어, ischemia 에 의한 VT 를 배제할 수 없는 상황이었음.
- CABG 시행하였으며, 수술 직 후 및 48시간 이후에도 sustained VT (monomorphic, but various QRS morphology) 가 발생하여, ICD implant 함
- LVEF 28%

# 내원시

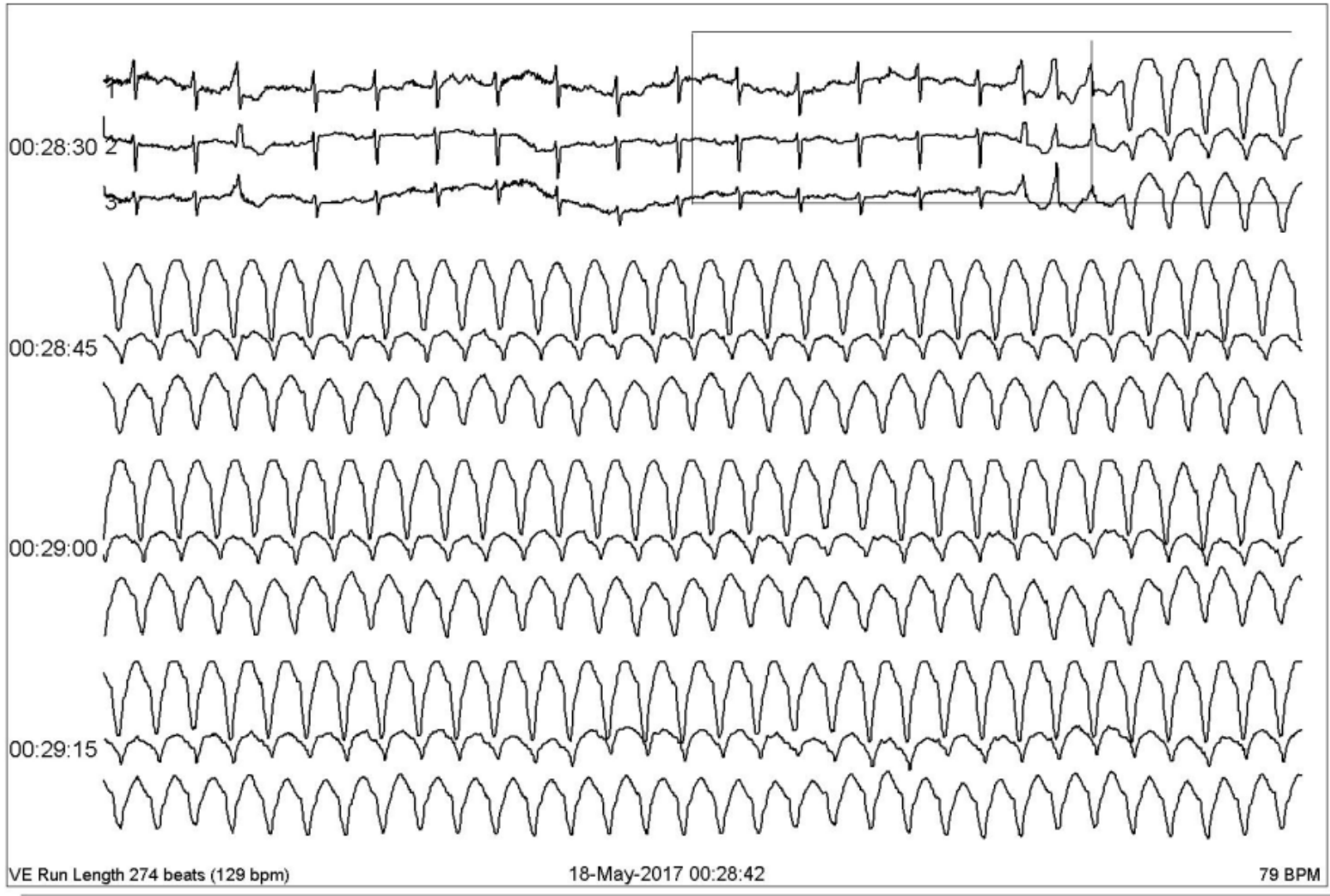
Rate	172	<b>EXTREME TACHYCARDIA WITH WIDE COMPLEX, NO FURTHER RHYTHM ANALYSIS ATTEMPTED</b>
RR	349	<b>BASELINE WANDER IN LEAD(S) V1,V2,V3,V5</b>
PR interval		
QRSD	155	
QT	316	
QTc	535	
..... AXIS .....		
P	Ind	
QRS	108	
T	-81	

[ PID : 200521330 / Date : 2017-04-28 ]

- ABNORMAL ECG -



# CABG 2주후 130 bpm



# 5 months later

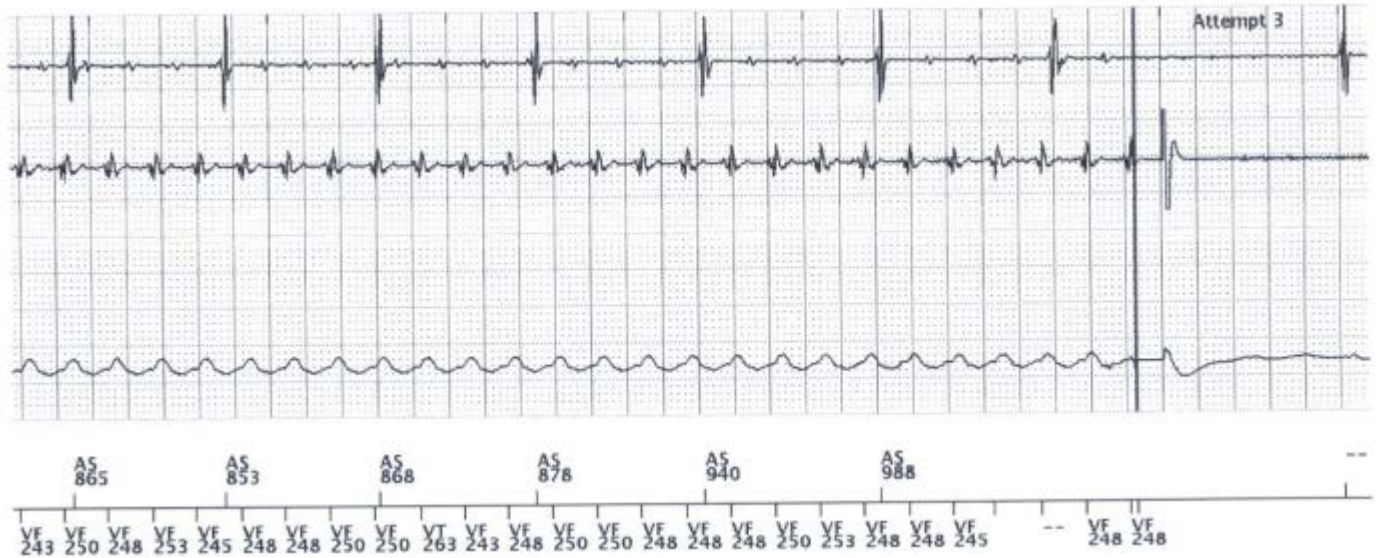
## ■ Tachy-Setting

Zone	Monitor	VT-1	VT-2	VF
On/Off		On	On	On
Detection Rate (bpm)		120	180	230
Detection Duration		6sec	6sec	1sec
SVT discrimination Onset			Off	
SVT discrimination Stability			On	
SVT discrimination Morphology			On	
Monitor only		Yes	No	No

## ■ Event

- Atrial High Rate : No
- Ventricular High rate : Yes

Number of total VHR episodes	147
Number of NonSustained VHR	104
Number of diverted therapy episode	2
Number of total ATP therapy	4
Number of total shock therapy	4
Response to Therapy	Successful Shock : 4 Unsuccessful Shock : 0 successful ATP Therapy : 0 Unsuccessful ATP Therapy : 4



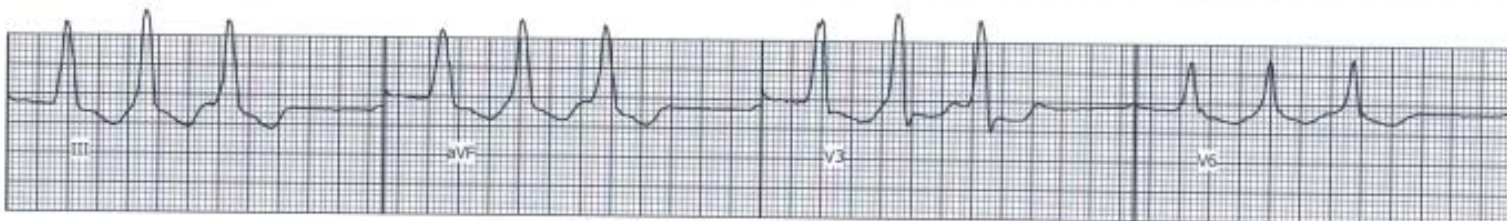
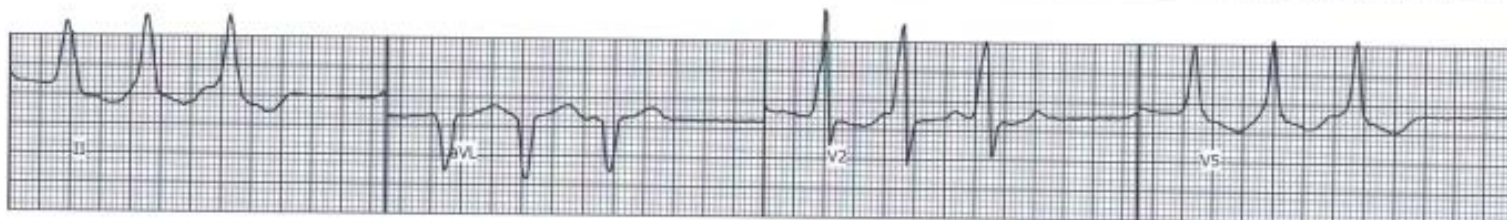
# Ablation for slow VT

Age: 76 Years  
Gender: Male  
Height:

Weight:  
Vent Rate (BPM): 111  
RR (msec): 538

PR (msec): 139  
QRS dur (msec): 147  
QT / QTC (msec): 423 / 576

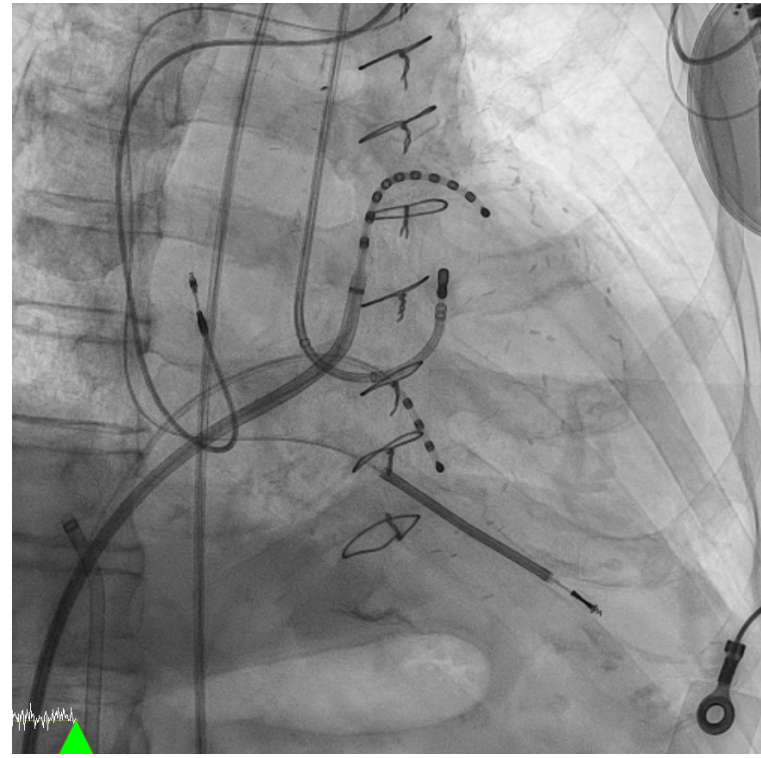
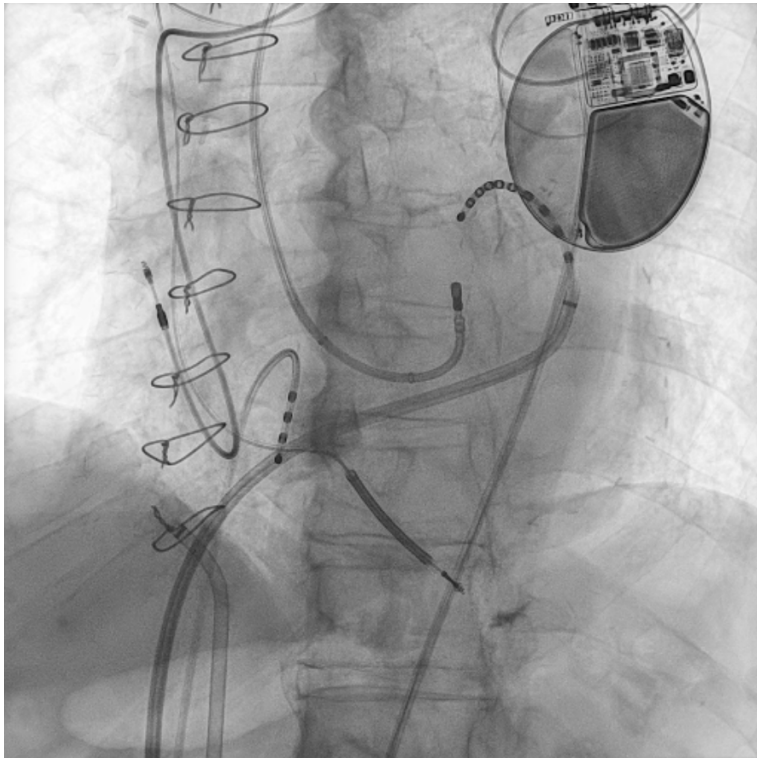
Display speed: 25 mm/sec  
Display Scale: 15 mm/mV



CardioLab v6.5

GE Medical Systems

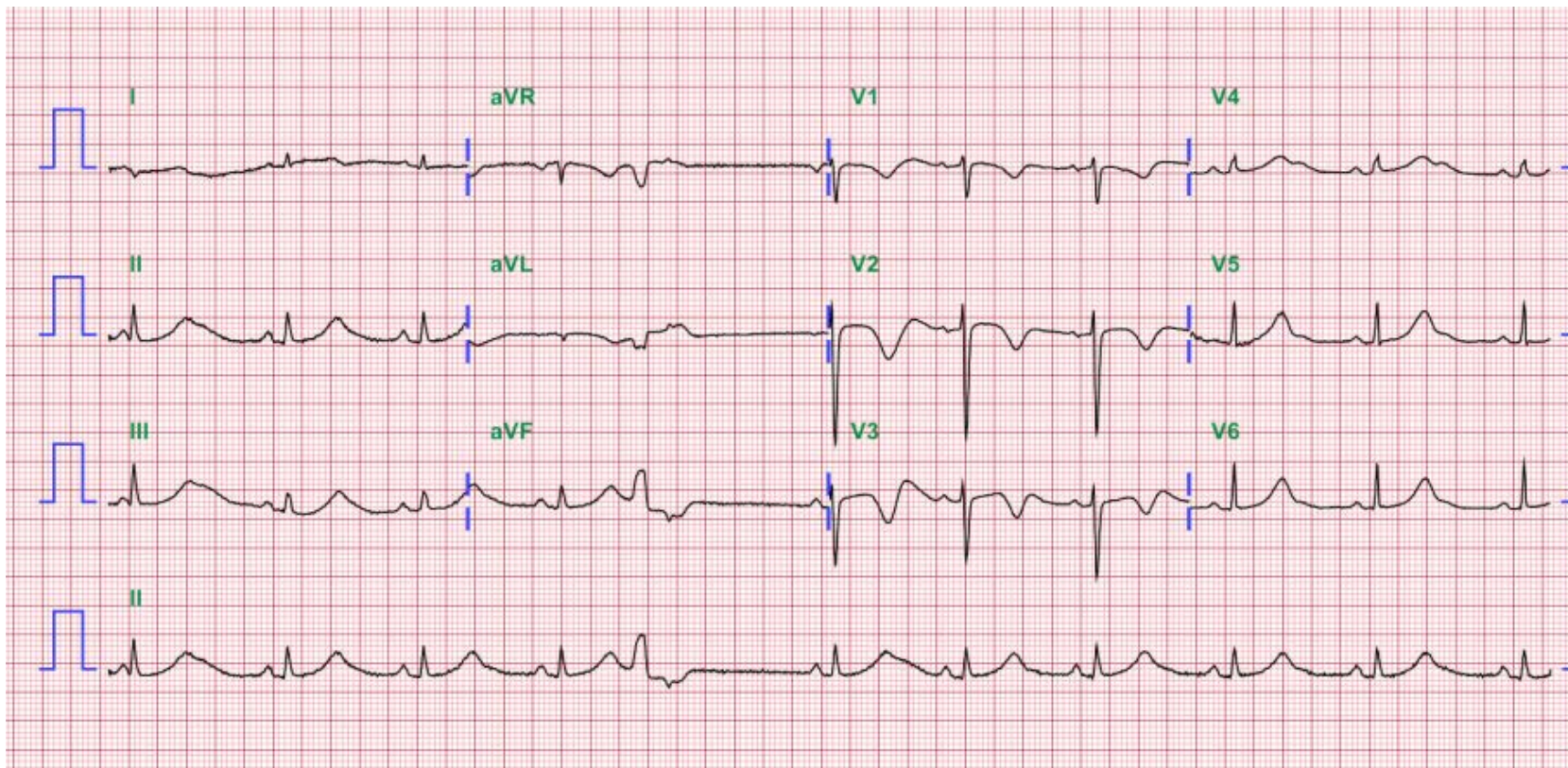
# Ablation at LV summit (beneath the aortic valve)



VPC appeared again after procedure, but slow VT

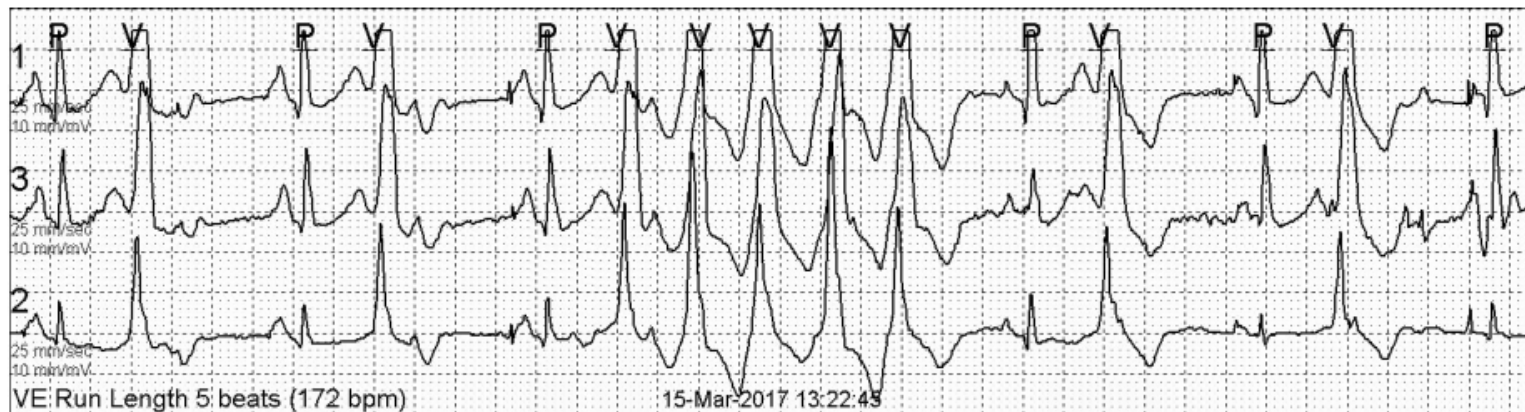
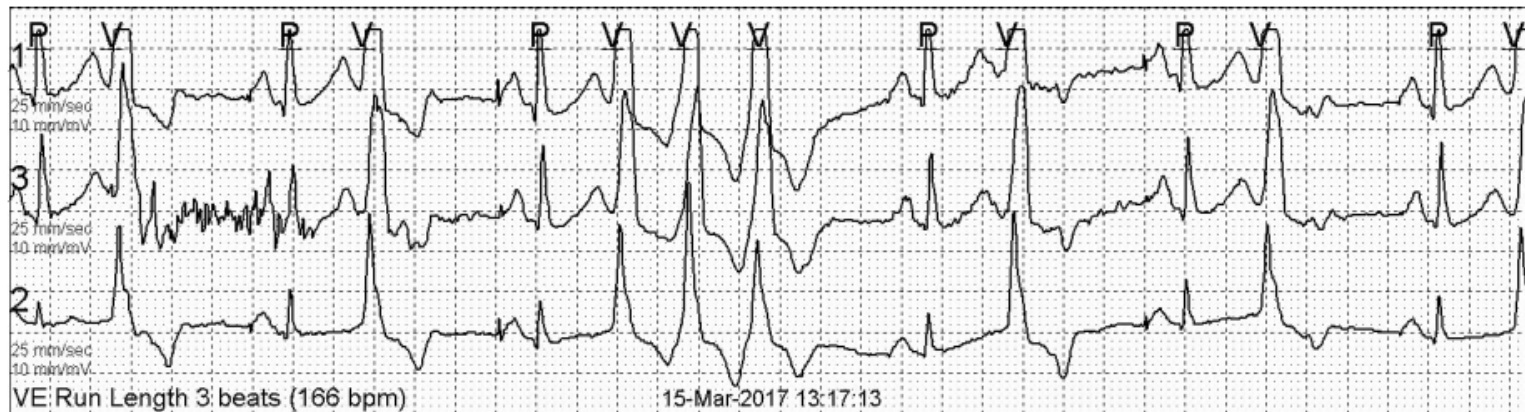


- 증례 3
- F/36
- 집에서 침대에 앉아 쓰러져 있어 보호자  
bystander CPR 119 VF/post resuscitation care 후 VF/  
long QT syndrome 진단하에 ICD 권유 받음

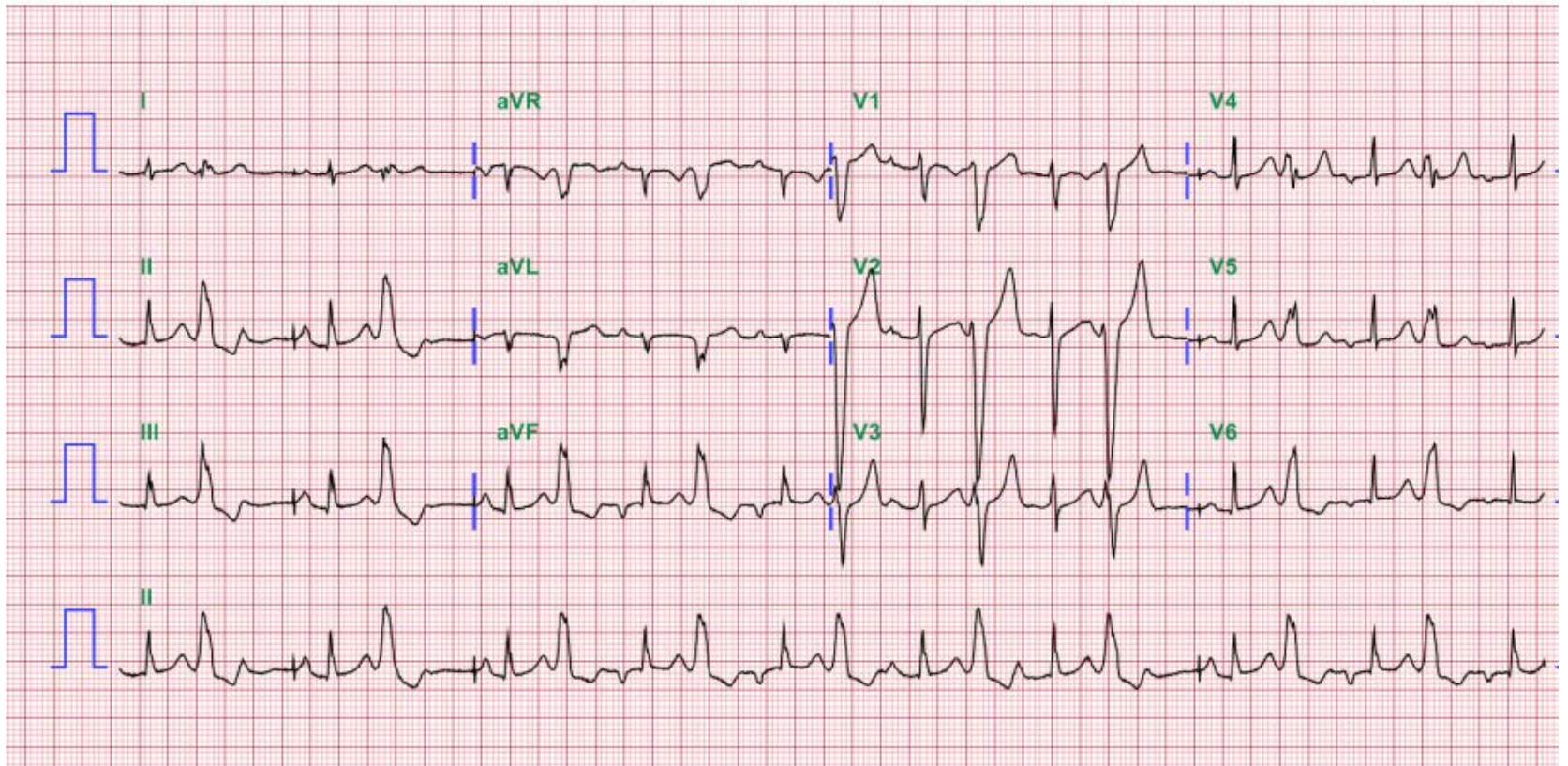


# 4 months after ICD and beta blocker

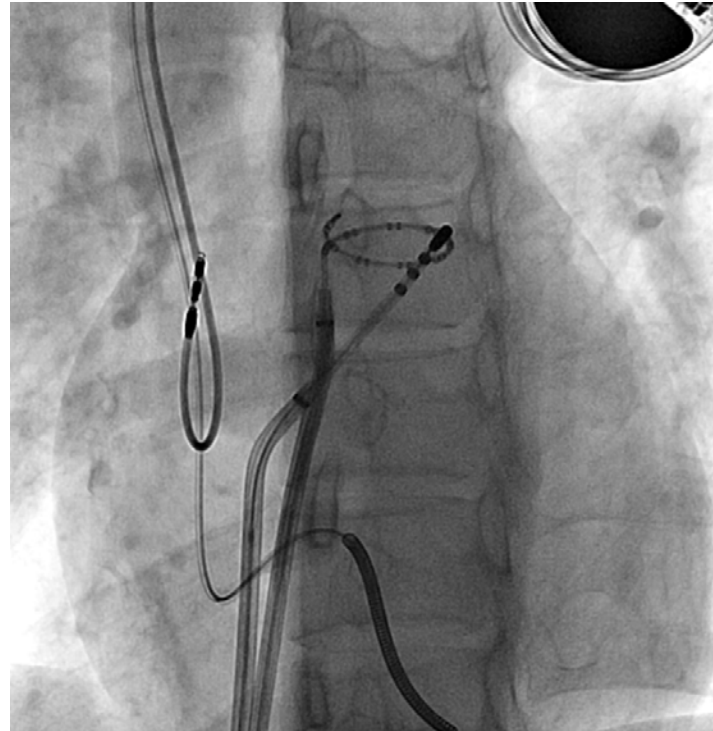
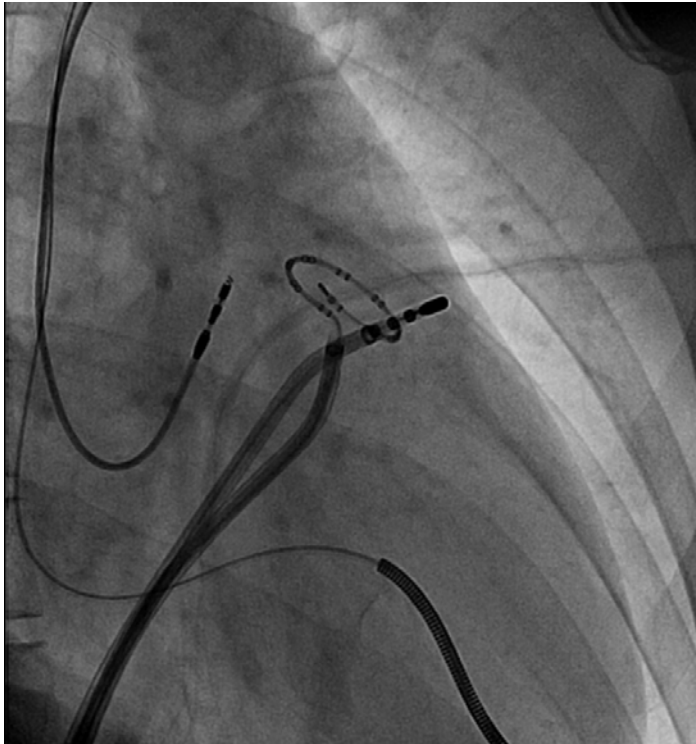
VPC 28%, NSVT+



# VPC- bigeminal, R on T

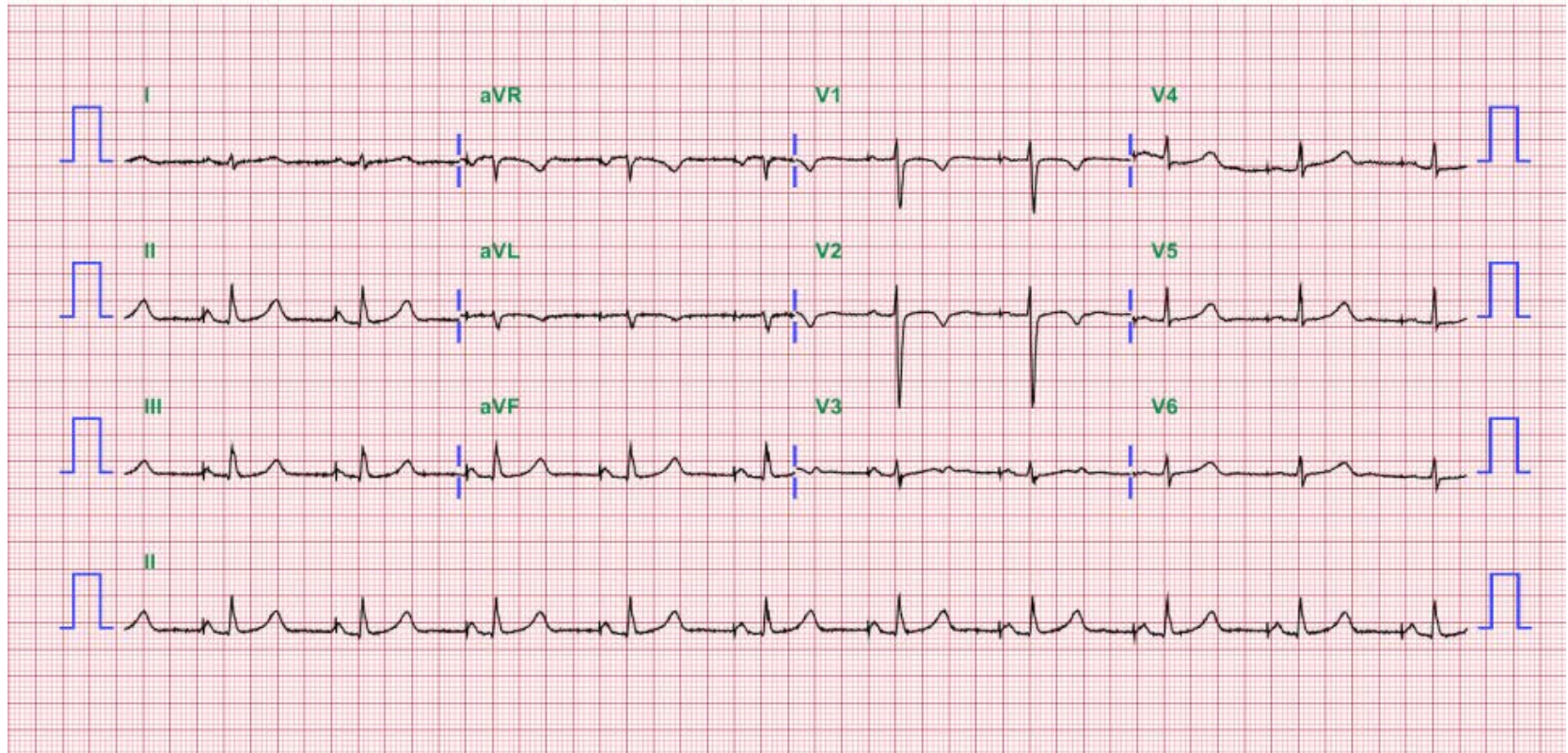


No ICD shock as yet,  
VPC ablation at RVOT septum and  
free wall



No VPC after ablation

Follow up for 1 year without shock



# VT ablation for slow VT, NSVT, or frequent VPC

- ICD shock therapy settings for slow VT should not be done to avoid incessant shock.
- VPC, NSVT and Slow VT could be permitted without therapy, because it usually did not clinical deterioration.
- Ablation for VPC, NSVT and slow VT could be beneficial for ICD shock reduction and patient prognosis.

# Ongoing Trial

- AAD versus Ablation after ICD implantation and appropriate programming –Vanish 2 trial
- catheter ablation either immediately after an appropriate ICD shock, or to delay ablation until an arrhythmic storm – PARTITA trial
- to assess the impact of prophylactic VT ablation prior to ICD implantation compared to ICD implantation and best medical care until a third appropriate shock and catheter ablation –BERLIN VT trial



# My Conclusion

- ICD 환자에서 VT ablation 은 마지막 수단으로 여겨지는 경우가 많다.
- ICD shock이 잦을 것으로 예상되는 환자에게 예방적 또는 조기에 VT ablation 을 하는 것이 ICD shock을 줄이고 환자의 예후를 좋게 할 수 있다.
- ICD programming optimization, VT ablation 의 기술 (imaging, ablation strategy, mapping and ablation tool) 이 발전하고 있지만, 어떤 환자에게 가장 큰 혜택을 줄 수 있는지는 명확하지 않다.

Rebuttal

# Rebut





Europace (2013) **15**, 820–826  
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**CLINICAL RESEARCH**

*Sudden death and ICDs*

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# Clinical relevance of slow ventricular tachycardia in heart failure patients with primary prophylactic implantable cardioverter defibrillator indication

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**P1376 | BEDSIDE**

**Appropriate ICD therapy for slow-rate VT predicts increased risk of appropriate therapy for high-rate VT/VF in the MADIT-RIT trial**

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## Major Clinical Trials in VT Ablation

Reference	Patient group	No. patients	Ablation strategy	Primary endpoint	Follow up	Clinical outcome
Reddy et al., 2007 (SMASH-VT)*	ICM (ablation and ICD versus ICD alone)	128	Substrate-based approach with mapping in sinus rhythm	Survival free from ICD therapy	22.5 ± 5.5 months (mean)	Reduced incidence of ICD therapy in ablation group versus ICD only
Kuck et al., 2010 (VTACH)*	ICM (ablation and ICD versus ICD alone)	110	Pace mapping ± entrainment mapping ± substrate modification	Time to first recurrence of VT/VF	22.5 months (SD: 9.0)	Longer time to recurrence of VT/VF in ablation group versus control group
Kuck et al., 2017 (SMS)*	ICM with LV EF <40 % (ablation and ICD versus ICD alone)	111	Pace mapping ± entrainment mapping ± substrate modification	Time to first recurrence of VT/VF	2.3 ± 1.1 years (mean)	No difference in time to first recurrence of VT/VF between ablation and control groups
Di Biase et al., 2015 (VISTA)	ICM (clinical ablation versus substrate-based ablation)	118	Activation and entrainment mapping; clinical VT, haemodynamically-stable/mappable VT targeted (clinical group) Ablation empirically extended throughout scar based on substrate map + target abnormal potentials in SR (substrate group)	Recurrence of VT	12 months	Extensive substrate-based ablation superior to ablation targeting only clinical and stable VTs
Dinov et al., 2014 (HELP-VT)	ICM and NICM (ICM versus NICM patients undergoing VT ablation)	227	Activation and entrainment mapping to locate possible exit sites and critical isthmuses; complete elimination of all clinical and non-clinical stable monomorphic VT	VT-free survival	1 year	Improved VT-free survival at 1 year in patients with ICM compared to patients with NICM
Sapp et al., 2016 (VANISH)	ICM (patients with ICM and ICDs who have VT randomised to ablation or escalated drug therapy)	259	Activation mapping. All induced VTs targeted for ablation. If unstable VT or VF, induced substrate-based approach used for ablation	Composite of death, VT storm or appropriate ICD shock	27.9 ± 17.1 months (mean)	Lower rate of the composite primary outcome of death, VT storm or appropriate ICD shock in patients undergoing catheter ablation versus escalated drug therapy

- Should patients with structural heart disease undergoing ICD implantation be considered for prophylactic substrate ablation in the absence of VT?
- What is the appropriate ablation strategy and endpoint in an individual patient?
- At what point in a patient's history is a catheter intervention for VT appropriate?



- There is evidence for the effectiveness of both catheter ablation and antiarrhythmic drug therapy for patients with myocardial infarction, an implantable defibrillator, and VT. If sotalol is ineffective in suppressing VT, either catheter ablation or initiation of amiodarone is a reasonable option. If VT occurs despite amiodarone therapy, there is evidence that catheter ablation is superior to administration of more aggressive antiarrhythmic drug therapy.