Ablation of polymorphic VT and VF

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The substrate of polymorphic VT & VF

Structural Heart Disease
- Ischemic Cardiomyopathy
- Dilated Cardiomyopathy
- Hypertrophic Cardiomyopathy
- ARVD
- Valvular Heart Disease
- Infiltrative Disorders
- Congenital Heart Disease

“Normal” Heart
- Long QT syndrome
- Brugada Syndrome
- Short QT syndrome
- Abnormal Repolarisation
- Idiopathic VF
- Catecholaminergic Polymorphic VT
Recurrent polymorphic VT causing “electrical storm” not due to ongoing acute ischemia is rare but is seen in idiopathic ventricular fibrillation, long-QT syndromes, Brugada syndrome, and myocardial infarction.
VT is often initiated by premature beats from 1 or a few foci that can be ablated if they occur with sufficient frequency to be located. Most appear to originate from the Purkinje system and have sharp presystolic potentials recorded from the focus. Less frequently, an RVOT focus is a trigger.
Successful ablation requires the presence of spontaneous ectopic beats for mapping. Electrical storms can wax and wane with long periods of quiescence. Immediate transport of the patient to the laboratory when the arrhythmia is active is warranted if ablation is to be attempted.
Figure 4. Recordings from a patient with idiopathic ventricular fibrillation and electrical storm are shown.

Arrhythmogenic role of Purkinje fibers

« Polymorphic ventricular arrhythmias most likely arise in subendocardial Purkinje fibers which develop spontaneous diastolic depolarization and abnormally prolonged action potential duration »

Wit. 1975
Mapping and Ablation of Triggers Applied to Patients with Repetitive VF

VF not preceded by monomorphic VT
Mapping Strategy

Based upon the earliest endocardial activity of VPB origin

- Opportunistic procedural timing during an arrhythmia period
- Conventional catheters
- RV and LV approach (retrograde or transseptal)
Mapping Strategy

✓ **Purkinje** origin defined by sharp potential preceding wider muscle potential both during VPB and SR

✓ **Muscle origin:** absence of Purkinje activity during ectopy
Patient Selection

A. Multiple episodes of VF/Polymorphic VT
B. Unresponsive to medication
C. Experiencing multiple shocks unresponsive to ICD reprogramming
D. Frequent VPBs at the time of the procedure

Mapping Strategy
Based on the earliest endocardial activity of VPB origin

Purkinje origin: high frequency (sharp) potential preceding a lower frequency muscle potential both during SR and VPB activity
Morphology of Initiating Beats

- RVOT: 145±13 ms
- RV Purkinje: 142±9 ms
- LV Purkinje: 116±14 ms
RV Purkinje Beats
Initiation of VF by Purkinje Repetitive Beats

Rapid sustained activity (CL: 221±26 ms)
What to do in the absence of arrhythmia in the EP lab?

- Pacing maneuvers:
  - burst
  - extrastimuli

- Pharmacological induction
  - Isoproterenol
  - Adenosine
Ablation Without Ectopy At The Time Of Mapping
NECESSITY TO AVOID RBBB DURING ABLATION

Purkinje

RB prox
Ablation of idiopathic VF

Follow up

- 29 patients (13 men)
- 60 months with ICD
- RF applications: 14 min, procedural duration: 138 min, fluoroscopy: 28 min
- Origin:
  - Left Purkinje (11 pts), Right Purkinje (10 pts), both (3 pts)
  - RVOT (4) patient
  - Myocardium (1 patient)
- Slight QRS changes in SR in 6
Ablation of idiopathic VF
Follow up

- No VF or polymorphic VT in 25/29 pts (86%)

- One patient with quinidine, 5 with Bblockers and 3 with Verapamil

- Time to recurrence: 4 months (range 4 to 42)

- Of the 4 patients with recurrence:
  - 3 were re-ablated, without recurrence
  - One is treated with quinidine
Role of Purkinje fibers in ischemic heart disease

- Of 29 patients with documented VF initiation, 8 were refractory to medical management and were ablated.

- Monomorphic PVCs initiated VF in all 29 identified patients.

- In all patients, Purkinje origin of ectopies (at the scar border)

Marrouche. JACC 2004;43:1715–20
Role of Purkinje fibers in ischemic heart disease

- Follow-up of 10 months
- One patient had a single VF episode recurrence
- There was no recurrence of VF storm.

Marrouche. JACC 2004;43:1715–20
ECG Following a Storm of 11 VF in Brugada Sd

Demonstration By ICD Of VF Initiation
VF ASSOCIATED WITH BRUGADA OR LQT SYNDROME

- Follow-up: 17 ± 17 months under ICD monitoring

- Brugada syndrome (7 patients): Importance of RVOT(5/7) Elimination of VF or polymorphic VT
  6/7 patients

- LQT syndrome (5 patients): 3/5 from left Purkinje. No VF or polymorphic VT in 3/5 patients – 1 patient died of a non cardiac cause (AIDS) and one sudden death.
Prevention of Ventricular Fibrillation Episodes in Brugada Syndrome by Catheter Ablation Over the Anterior Right Ventricular Outflow Tract Epicardium

Koonlawee Nademanee, MD; Gumpanart Veerakul, MD; Pakorn Chandanamattha, MD; Lertlak Chaotawee, MD; Aekarach Ariyachaipanich, MD; Kriengkrai Jirasirirojanakom, MD; Khanchit Likittanasombat, MD; Kiertijai Bhuripanyo, MD; Tachamong Ngarmukos, MD

Substrate mapping ➔ Epicardial RVOT

Circulation 2011;123:1270-9
Failures in VF Ablation

- Absence of spontaneous or priorly documented (12 lead) initiating ectopy

- Multiple ectopic morphologies >3
Immediate cardioversion is the primary treatment of polymorphic VT & VF!

Catheter ablation of ventricular tachycardia is recommended

1. For symptomatic sustained monomorphic VT necessitating frequent ICD therapies despite antiarrhythmic drug therapy or when antiarrhythmic drugs are not tolerated or not desired (especially when VT recurrences fulfil definition of ES).
2. For control of recurrent symptomatic or incessant monomorphic VT not suppressible by antiarrhythmic drug therapy, regardless whether VT is stable or unstable, or multiple VTs are present.
3. For bundle branch re-entrant or interfascicular VTs.
4. For recurrent sustained polymorphic VT and VF refractory to antiarrhythmic therapy when there is a suspected trigger that can be targeted by ablation.
Conclusions

- Primary VF (not preceded by monomorphic VT) is characterized by dominant triggers from the distal Purkinje system or RVOT whatever the substrate.

- Primary Idiopathic VF can be eliminated in 86% by RF ablation indicating a possible cure of VF.

- Catheter ablation can be a life saving procedure in some patients with incessant VF.
Conclusions

Idiopathic and post-infarct VF is mainly (>80%) initiated by triggers from the distal Purkinje network, while in patients with the Brugada syndrome VF is mostly initiated from the RVOT.

FV / Polymorphic VT ablation is an opportunistic ablation, with a need to get a 12-lead ECG documentation of VF initiation or at least VPBs.

Primary idiopathic VF can be eliminated in > 80% by RF ablation indicating a possible cure of idiopathic VF. Catheter ablation may be a lifesaving procedure in some patients with incessant VF.
Thank you