Ventricular Tachycardia

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Definition

- Tachyarrhythmia of >100 bpm lasting for more than 3 beats and arising distal to the bundle of His
- Sustained: >30secs
- Sustained: <30secs
VT is heterogeneous

- In aetiology
- In mechanism
  - Focal
  - Micro-reentrant
  - Macro-reentrant
- In prognostic implication
  - Life threatening
  - Benign
- In ease of therapy
Ventricular Tachycardia

- **Monomorphomic**
  - Scar VT
  - DCM
  - ARVC
  - ‘Idiopathic’
    - Outflow tract VT
    - Fascicular VT
    - Other focal VTs
  - Bundle branch reentry

- **Polymorphomic**
  - Torsades de pointes
    - LQTS
    - Drugs
  - Catecholaminergic PMVT
  - Ischaemia
Objectives

- Recognition of VT
- Diagnosis of VT in the EP lab
- Mechanisms of VT
- Specific subtypes
  - Identification and management
Recognition of VT: Differential diagnosis of a BCT

• VT

• SVT with broad complex conduction
  – Fixed bundle branch block
  – Rate related aberration

• Pre-excited tachycardias
VT: Recognition
VT vs SVT: RBBB

V1: RSr'
Suggests VT

V6: S > R

rSR'
Suggests SVT

R > S

Griffith et al. Lancet 1994
VT vs SVT: LBBB

**V1:**
- Notched S wave: VT
- Time to nadir of S wave: >80ms: VT
- >80ms

**V6:**
- No Q wave: SVT
- Q wave: VT

Griffith et al. Lancet 1994
VT Localisation

- RBBB: LV origin
- LBBB: RV or right septal origin
- Frontal Axis:
  - Inferior: outflow tract
  - Superior: inferior wall
  - North-west: lateral LV
- Chest lead transition:
  - QS V6: apical
  - V1 +ve: posterior origin
  - Q V1: septal origin
VT: Recognition in the EP lab

• Induction and termination from the ventricle
  – Fascicular VT may start from atrial pacing
• V-A dissociation helps
  – Rare SVTs may in theory show this
    • AVNRT with upper common pathway block
    • Nodo-fascicular pathway
• His signal absent or HV interval short
  – Exception: bundle branch reentrant VT
• Reset tachycardia from V without affecting A
Often its easy...
But what about this?...

BCT

55yo male
1V CAD
Palpitations

SR
Cardiac Rhythm Management
Leeds General Infirmary

SR
HV: 60ms

Tachy:
HV: 43ms
VT in structural heart disease

http://www.wikidoc.org/index.php/ST_Elevation_Myocardial_Infarction_Histopathology
Scar VT is a re-entrant arrhythmia
EP Study as a prognostic tool?

- All data applies to ischaemic heart disease and scar VT
- Inducibility of VT correlates with recurrence
- Inducibility and suppression by AADs correlates with prognosis
Figure 3. Kaplan–Meier Estimates of the Rates of Cardiac Arrest or Death from Arrhythmia According to Whether the Patients Received Treatment with a Defibrillator.
VT Ablation in Structural Heart Disease

• When:
  – late?
  – early?

• How?
  – electrogram based?
  – substrate based?
  – endocardial
  – epicardial
VT Ablation

• Targeted
  – Aim for diastolic potential guided by entrainment mapping
  – Haemodynamically stable VT only

• Substrate ablation
  – Delineate scar zone, usually with a 3-D mapping system
  – Ablate round border zone guided by pace or activation mapping

• Ablation of late potentials
  – LAVA
VT Ablation

Multicentre Thermocool VT Ablation Study: Stevenson et al Circulation 2008 118:2773

Graph showing the number of VT events before and after ablation, with a median reduction from 11.5 to 0 events, N = 142, P < 0.0001.
Prophylactic VT Ablation

SMASH-VT

Reddy et al NEngJMed 2007 357:2657

VTACH

Kuck et al Lancet 2010 375:31-40
Outflow Tract VT
Repetitive Monomorphic VT
RV Outflow VT

- Focal
- Automatic, cAMP mediated
- ?Abnormal sensitivity to catecholamines
- Often exertional or post-exertional
- Differential diagnosis: ARVC
LVOT VT

Lead I

aVR

V1

V4
Outflow Tract VT

Kumagai et al JCE 2008 19:495-501
<table>
<thead>
<tr>
<th></th>
<th>RVOT Tachycardia</th>
<th>ARVD</th>
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<tbody>
<tr>
<td>Family History of arrhythmias or sudden cardiac death</td>
<td>No</td>
<td>Frequently Autosomal dominant</td>
</tr>
<tr>
<td>RV Function</td>
<td>Normal except possible RVOT abnormalities</td>
<td>Usually RVEF; may be normal with localized wall motion abnormalities</td>
</tr>
<tr>
<td>Baseline ECG</td>
<td>Normal</td>
<td>T wave inverted in one or more precordial leads from V2-V5. Epsilon waves present-30%</td>
</tr>
<tr>
<td>Arrhythmias</td>
<td>PVBs, repetitive monomorphic VT exercise or emotional induced VT</td>
<td>PVBs, Sustained monomorphic VT, Ventricular fibrillation (uncommon)</td>
</tr>
<tr>
<td>QRS morphology of ventricular ectopy</td>
<td>LBBB-inferior axis</td>
<td>LBBB-inferior or superior axis</td>
</tr>
<tr>
<td>Origin of Arrhythmia</td>
<td>RVOT-focal</td>
<td>RVOT, RV apex, subtricuspid area</td>
</tr>
<tr>
<td>Mechanism of arrhythmia</td>
<td>cAMP Triggered activity</td>
<td>Microreentry</td>
</tr>
<tr>
<td>Response to therapy</td>
<td>Acutely: Vagal maneuvers, adenosine, beta blockers, verapamil</td>
<td>Chronic: Beta blockers or verapamil, + type 1 AA drugs</td>
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<tr>
<td></td>
<td>RF ablation</td>
<td>Seldom curative; may modify substrate to permit AA drugs to be effective.</td>
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<td>Prognosis</td>
<td>Usually curative</td>
<td>Excellent</td>
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<td>1% Yearly mortality</td>
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**Notes:**
- RVOT: Right Ventricular Outflow Tract
- VT: Ventricular Tachycardia
- PVBs: Progressive Ventricular Bigeminy
- LBBB: Left Bundle Branch Block
- AA: Anti-Arrhythmic
Idiopathic LV VT
Idiopathic LV VT

• Re-entrant mechanism involving Purkinje system of LV
• Commonly left posterior fascicle
  – More rarely anterior
• Usually young people with normal hearts
• Terminates with verapamil
• Prophylaxis with beta-blockers or verapamil
• Often initiates with A pacing
• Readily ablatable
Idiopathic LV VT: Ablation
Bundle branch re-entry

- Not common
- Usually in structural heart disease
  - Cardiomyopathy
  - Myotonic dystrophy
- Pre-existing bundle branch block
- Tachycardia of similar morphology
  - Usually left bundle
Bundle branch re-entry
Intracardiac characteristics

- Each V electrogram preceded by a His potential
- H-V in tachycardia same or longer to that in SR
- Spontaneous variations in tachycardia cycle length preceded by identical change in H-V
- Terminates with block in the H-P system

- Ablation of RBBB curative
Bundle branch re-entry
Summary

• Recognition of VT
  – Surface ECG
  – Intracardiac signals

• Subtypes of VT
  – Scar VT
  – Outflow tract VT
  – Fascicular VT
  – Bundle branch VT