Heart Rhythm Disorders

How do you quantify risk?

Dr Peter O’Callaghan
Heart Rhythm Consultant, University Hospital of Wales
Hon Senior Lecturer, Cardiff University
Heart Rhythm Disorders

Scale of the Problem

• 1/2 population will have an episode of transient loss of consciousness (T-LOC) at some stage in their life.

• Palpitations = 1/3 all referrals to cardiology

• 1% all A&E attendances due to T-LOC
Heart Rhythm Disorders

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Benign  ←  Fatal (Cardiac Arrest)
Recurrent Transient Loss of Consciousness

T-LOC

Cerebral Hypoperfusion

CV causes

Neurological

NEAD

Transient LOC
Loss of postural tone

Syncope
Syncope

Transient loss of consciousness due to cerebral hypoperfusion

- Reflex (70%)
- Cardiac (10%)
- Postural (20%)

> 90% patients with cardiac syncope have a benign condition with a normal life expectancy

< 10% patients with cardiac syncope have a potentially life-threatening condition
Prognosis – Framingham Heart Study 1971-1998

Adapted from Soteriades E et al. NEJM 2002; 347: 878-85
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Palpitations

An abnormal awareness of the heart beat
Palpitations

An abnormal awareness of the heart beat

Paroxysmal Sustained Tachycardias
- AV node dependent tachycardias
- Atrial tachyarrhythmias
- Ventricular tachyarrhythmias

Ectopies
Palpitations

An abnormal awareness of the heart beat

Paroxysmal Sustained Tachycardias

- AV node dependent tachycardias (Curable!)
  - Atrial tachyarrhythmias
  - Ventricular tachyarrhythmias

Ectopics
Palpitations

An abnormal awareness of the heart beats

Paroxysmal Sustained Tachycardias
  • AV node dependent tachycardias
  • Atrial tachyarrhythmias
  • Ventricular tachyarrhythmias

Ectopics
### CHADS-VASc Score and Stroke Risk

<table>
<thead>
<tr>
<th>Risk factor</th>
<th>Score</th>
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<tbody>
<tr>
<td>Congestive heart failure/LV dysfunction</td>
<td>1</td>
</tr>
<tr>
<td>Hypertension</td>
<td>1</td>
</tr>
<tr>
<td>Age $\geq 75$</td>
<td>2</td>
</tr>
<tr>
<td>Diabetes mellitus</td>
<td>1</td>
</tr>
<tr>
<td>Stroke/TIA/thrombo-embolism</td>
<td>2</td>
</tr>
<tr>
<td>Vascular disease$^3$</td>
<td>1</td>
</tr>
<tr>
<td>Age 65–74</td>
<td>1</td>
</tr>
<tr>
<td>Sex category (i.e. female sex)</td>
<td>1</td>
</tr>
<tr>
<td><strong>Maximum score</strong></td>
<td><strong>9</strong></td>
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### Danish National Registry

<table>
<thead>
<tr>
<th>CHADS-VASc Score</th>
<th>n (%)</th>
<th>Thromboembolism / 100 person years</th>
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<tr>
<td>0</td>
<td>10125 (8.4)</td>
<td>0.8</td>
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<tr>
<td>1</td>
<td>14526 (12.0)</td>
<td>2.0</td>
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<tr>
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<td>3.7</td>
</tr>
<tr>
<td>3</td>
<td>27834 (23.0)</td>
<td>5.9</td>
</tr>
<tr>
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<td>22676 (18.7)</td>
<td>9.3</td>
</tr>
<tr>
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</tr>
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Olsen J.  BMJ On-line First 2011
Assessing Risk in Atrial Tachyarrhythmias (AT, AFL, Afib)

CHADSVASc Score = Annual stroke risk

Oral anticoagulation reduces risk by 2/3

Aspirin confers little benefit (20% reduction)
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Warfarin 2%

Olsen J. BMJ On-line First 2011
Palpitations

An abnormal awareness of the heart beat

Paroxysmal Sustained Tachycardias
- AV node dependent tachycardias
- Atrial tachyarrhythmias
- Ventricular tachyarrhythmias
  - Scar related VT
  - Normal Heart VT

Ectopics
Ventricular Tachycardia (Scar Related VT)
Conduction Velocity dependent on Fibre orientation
Reentry – Scar related VT

Peri-infarct Zone
Peri-Infarct Zone
VT initiation
VT initiation
Reentry – Scar related VT
Atherosclerosis → Myocardial Infarction → SCAR → Pulseless VT/VF Cardiac Arrest

Pathophysiology of Cardiac Arrest
Pathophysiology of Cardiac Arrest

100,000 deaths per year
12% all natural deaths

Q waves on ECG
Scar inversely proportional to Ejection fraction
EF < 35% - Consider primary prevention ICD
Atherosclerosis → Myocardial Infarction → SCAR → Pulseless VT/VF Cardiac Arrest → Pathophysiology of Cardiac Arrest → Syncopal VT
A patient with unexplained syncope and significant structural heart disease should be considered to have survived a life threatening event until proven otherwise.
Palpitations

An abnormal awareness of the heart beats

Paroxysmal Sustained Tachycardias
- AV node dependent tachycardias
- Atrial tachyarrhythmias
- Ventricular tachyarrhythmias

Ectopics
Pathophysiology of Cardiac Arrest

Prior MI

Myocarditis

DCM

Alcohol

SCAR

Ventricular ectopics
Non-sustained VT

Pulseless VT/VF Cardiac Arrest

Scar burden?
Ischaemic burden?
## Ectopics – Risk stratification

<table>
<thead>
<tr>
<th></th>
<th>Low</th>
<th>Higher</th>
</tr>
</thead>
<tbody>
<tr>
<td>Morphology</td>
<td>Unifocal RVOT focus</td>
<td>Multifocal</td>
</tr>
<tr>
<td>Timing</td>
<td>Rest</td>
<td>On exercise</td>
</tr>
<tr>
<td>Frequency</td>
<td>Single &lt; 10%</td>
<td>Couplets Triplets (NSVT) &gt; 10%</td>
</tr>
<tr>
<td>Exercise</td>
<td>Suppresses</td>
<td>Increased frequency</td>
</tr>
<tr>
<td>Exercise capacity</td>
<td>Normal</td>
<td>Reduced</td>
</tr>
<tr>
<td>Echocardiogram</td>
<td>Normal</td>
<td>Abnormal</td>
</tr>
<tr>
<td>ECG</td>
<td>Normal</td>
<td>Abnormal</td>
</tr>
<tr>
<td>FHx ICC</td>
<td>No</td>
<td>Yes</td>
</tr>
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</table>
Causes of SCD by age

Dr Joe Galvin, Mater Hospital
The majority of sudden unexplained deaths < 30 years are due to inherited cardiac conditions ~ 400/year in England.
Heart Rhythm Disorders
Unexplained T-LOC, undocumented tachycardias or ectopic beats

Who is low risk?

• Structurally normal heart

• Normal 12 lead ECG

• No FHx sudden death < 35 years
Heart Rhythm Disorders
Unexplained T-LOC, undocumented tachycardias or ectopic beats

Who is high risk?

• Significant structurally normal heart
• Relevant 12 lead ECG abnormality
• FHx sudden death < 35 years
Low Risk ≠ Zero Risk
Inherited Cardiac Conditions
How do you Quantify Risk?

Case 1
32 year old female
Father died suddenly aged 44
Brother died suddenly aged 12
Gene +
QTc = 465ms

Case 2
32 year old female
Father still alive 56yrs
No FHx sudden death
Gene +
QTc = 540ms

Phenotype expression determines individual risk
Prevent Sudden Death

Chance of Survival from Cardiac Arrest

<table>
<thead>
<tr>
<th>Minutes to Defibrillation</th>
<th>Survival Chance</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>90%</td>
</tr>
<tr>
<td>2</td>
<td>80%</td>
</tr>
<tr>
<td>3</td>
<td>70%</td>
</tr>
<tr>
<td>4</td>
<td>60%</td>
</tr>
<tr>
<td>5</td>
<td>50%</td>
</tr>
<tr>
<td>6</td>
<td>40%</td>
</tr>
<tr>
<td>7</td>
<td>30%</td>
</tr>
<tr>
<td>8</td>
<td>20%</td>
</tr>
<tr>
<td>10</td>
<td>10%</td>
</tr>
</tbody>
</table>
External Defibrillator - 999

First responder AED
Public Access Defibrillator
Implantable Cardioverter Defibrillator

- 6v battery
- Delivers 700v shock
- Defibrillates within 15s onset resulting in a success rate of 99.9%
- PG battery typically lasts 8 years
ICD implantation

Day case procedure
Local anaesthesia
Conscious sedation
Rating a Patient with CAD and Prior MI

Case 1

54 year old man
1 vessel disease – Occluded Mid LAD
Apical infarct
EF = 45%
Rating a Patient with CAD and Prior MI

Case 1

54 year old man
1 vessel disease – Occluded Mid LAD
Apical infarct
EF = 45%

Life rating + 150
Rating a Patient with CAD and Prior MI

Case 1
54 year old man
1 vessel disease – Occluded Mid LAD
Apical infarct
EF = 45%

Life rating + 150

Case 2
54 year old cardiac arrest survivor
1 vessel disease – Occluded mid LAD
Apical infarct
EF = 45%
ICD in situ > 12 months

Decline!
Rating a Patient with CAD and Prior MI

Case 1

54 year old man
1 vessel disease – Occluded Mid LAD
Apical infarct
EF = 45%

Life rating + 150
At risk of future cardiac arrest

Case 2

54 year old cardiac arrest survivor
1 vessel disease – Occluded mid LAD
Apical infarct
EF = 45%
ICD in situ > 12 months

Decline!
99.9% protection from arrhythmic death
Conclusions

• Heart rhythm disorders very common & vast majority are benign (> 90% syncope)

• Heart rhythm disorders cause sudden death which is usually both predictable and preventable

• Atrial tachyarrhythmias should be rated on the basis of CHADSVASc score + anticoagulation status

• Cardiac arrest risk $\propto$ Scar Burden
Conclusions

• Diagnosing heart rhythm problems can be challenging. In contrast, risk stratification is easy!

• Phenotype not genotype determines individual risk.

• Tachycardias are curable. Incurable life-threatening tachycardias can be treated with 99.9% effectiveness.

• Low risk ≠ Zero risk and we frequently assess using suboptimal & incomplete data.
Case Presentation

• 54 year old bus driver
• T-LOC x 1 – RTA
  - Little warning, motionless x 2 min
• No other cardiac symptoms
• No FHx ICC
• DHx – Nil
• SHX – Smokes 20/day
• O/E NAD
• ECG – Subtle Brugada changes & subtle pre-excitation
Case Presentation

- CT brain scan – NAD
- Neurology – Likely to be cardiac not neurological
- Echocardiogram – Normal
- Diagnostic angiogram – Normal
- Adenosine test – Ve (No accessory pathway)
- Ajmaline test – No Brugada ECG
- Prolonged inpatient monitoring NAD

CCTV from the bus!
Incidence of Ventricular Premature Beats

Figure 2. Event-free (death, myocardial infarction) survival in apparently healthy, middle-aged and elderly subjects with (dashed line) and without (solid line) frequent (≥30/hour) VPCs (p = 0.0012).