# Heart Rhythm Disorders

# How do you quantify risk?

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## 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

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Benign - Fatal (Cardiac Arrest)

# Recurrent Transient Loss of Consciousness T-LOC





Transient loss of consciousness due to cerebral hypoperfusion



# Prognosis – Framingham Heart Study 1971- 1998



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

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An abnormal awareness of the heart beat

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Paroxysmal Sustained Tachycardias

- AV node dependent tachycardias
- Atrial tachyarrhythmias
- Ventricular tachyarrhythmias

An abnormal awareness of the heart beat

Paroxysmal Sustained Tachycardias

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An abnormal awareness of the heart beats

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## CHADS-VASc Score and Stroke Risk

Risk factor	Score
Congestive heart failure/LV dysfunction	1
Hypertension	I.
Age ≥75	2
Diabetes mellitus	· · · · · · · · · · · · · · · · · · ·
Stroke/TIA/thrombo-embolism	2
Vascular disease <sup>a</sup>	1
Age 65-74	- I
Sex category (i.e. female sex)	1
Maximum score	9

Lip G et al. The Euro Heart Survey on AF. Chest 2010; 137: 263-72.

# **Danish National Registry**

CHADS-VASc Score	n (%) 121,280 (100)	Thromboembolism / 100 person years
0	10125 (8.4)	0.8
1	14526 (12.0)	2.0
2	22115 (18.2)	3.7
3	27834 (23.0)	5.9
4	22676 (18.7)	9.3
5	14213 (11.7)	15.6
6	6927 (5.7)	19.7
7	2327 (1.9)	21.5
8	467 (0.4)	22.4
9	70 (0.1)	23.6

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)

# **Danish National Registry**

CHADS-VASc Score	n (%) 121,280 (100)	Thromboembolism / 100 person years	Warfarin
0	10125 (8.4)	0.8	
1	14526 (12.0)	2.0	
2	22115 (18.2)	3.7	
3	27834 (23.0)	5.9	2%
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#### Olsen J. BMJ On-line First 2011

An abnormal awareness of the heart beat

Paroxysmal Sustained Tachycardias

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

# Ventricular Tachycardia (Scar Related VT)



# Conduction Velocity dependent on Fibre orientation



# Reentry – Scar related VT



## Peri-Infarct Zone



# VT initiation





# VT initiation



## Reentry – Scar related VT







Pathophysiology of Cardiac Arrest







An abnormal awareness of the heart beats

# Paroxysmal Sustained TachycardiasAV node dependent tachycardias

- Atrial tachyarrhythmias ightarrow
- Ventricular tachyarrhythmias ightarrow

# Ventricular Ectopics Benign or Marker of Disease?





# Ectopics – Risk stratification

	Low	Higher
Morphology	Unifocal RVOT focus	Multifocal
Timing	Rest	On exercise
Frequency	Single < 10%	Couplets Triplets (NSVT) > 10%
Exercise	Suppresses	Increased frequency
Exercise capacity	Normal	Reduced
Echocardiogram	Normal	Abnormal
ECG	Normal	Abnormal
FHx ICC	No	Yes

## Causes of SCD by age



Dr Joe Galvin, Mater Hospital

## Causes of SCD under 30 years



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 $\neq$ 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



# 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

### Case 1

54 year old man

1 vessel disease – Occluded Mid LAD

Apical infarct

EF = 45%

### Case 1

54 year old man

1 vessel disease – Occluded Mid LAD

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Life rating + 150

Case 1

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1 vessel disease – Occluded Mid LAD

Apical infarct

EF = 45%

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### Case 2

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

Decline!

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**



Data from Kostis JB. Circulation. 1981;63(6):1353.



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

#### Sajadieh et al Am J Cardiol 2006;97:1351-1357