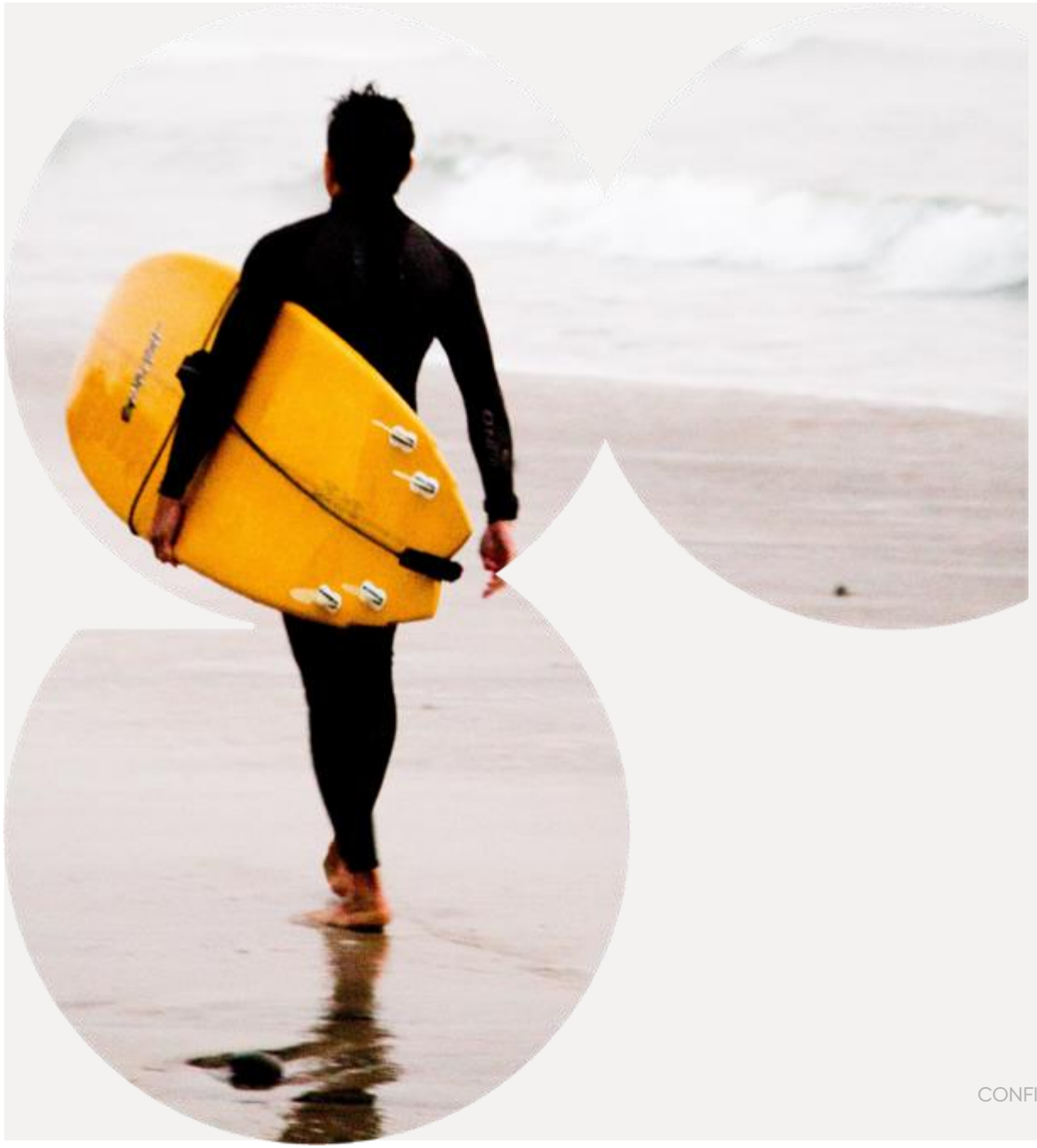
Investigations In Medicine

October 2018

David O'Donnell

Chair Cardiology Genesis Care
Board Director Genesis Care
Head of Electrophysiology Austin Hospital

GenesisCare



Disclosures

- **Fellowship Support**
  - MDT, SJM / Abbott
- **Advisory Board**
  - MDT, Abbott
- **Speakers fees**
  - Lots

- Involved in the design and development of quadripolar leads and multipoint pacing algorithms.
- Involved in a number of investigator initiated studies with MPP.
- Involved in Sync AV development
- Involved in multi-centre adaptive CRT studies.

Palpitations

- A palpitation is what a patient feels
  - Too fast
  - Too slow
  - Too aware – forceful, irregular

- Not all palpitations are from the heart
  - "Most palpitations are not from the heart"

- Not all palpitations are abnormal
  - "Most palpitations are not abnormal"

But

- Mean time from onset of symptoms to diagnosis
  - 13 years (0-93)
- Mean time from first medical assessment to diagnosis
  - 11 years
- Failure to diagnose can lead to
  - Psychological distress
  - Death
  - Injury
  - Cardiac failure
  - Stroke

Mr Swale

- Mr Matt Swale
- 37 year old taxi driver

- Presents following a 90 minute episode of "heart racing" watching TV
- Episode had stopped 1 hour prior to presentation

- 2 year history of infrequent palpitations occurring once every couple of months and lasting 5 – 15 minutes

Working Diagnosis

- Cardiac
  - Supraventricular tachycardia
  - Atrial Fibrillation
  - Sinus Tachycardia
  - Ventricular tachycardia
- Sort of Cardiac
  - POTS
  - Inappropriate Sinus Tachycardia
- Non Cardiac
  - Metabolic
  - Endocrine
  - Psychological

Evaluation in EP

- Symptom Rhythm Correlation
- Need an ECG and haemodynamic assessment at time of presenting symptoms
- Usually doing evaluation remote from episodes

EP Investigations

- ECG

- Monitoring
  - Holter
  - Event Recorder
  - Loop Recorder
  - Wearables

- Electrophysiology Study
- Tilt Table Testing

Investigations needed in EP

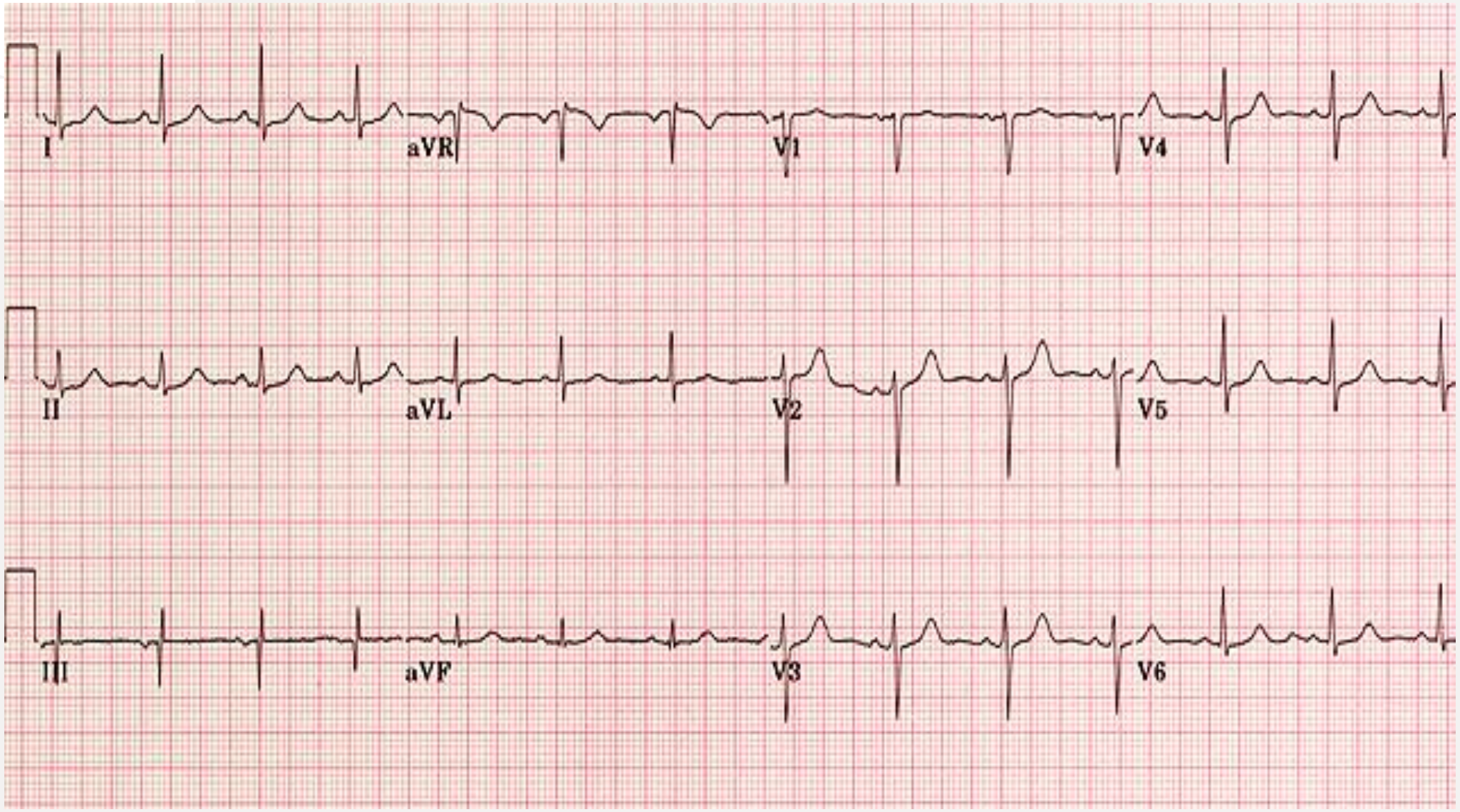
- Cardiac Imaging
  - Echo
  - MRI
  - CT
  - Angiography
- Provocative testing
  - Stress testing
- Non Cardiac Evaluation

ECG

- Yes
  - At rest

  - Provocation
    - Hyperventilation
    - Exercise
    - Posture
    - Pharmacological

ECG 3



GenesisCare

Monitoring

- Telemetry
- Reassurance value clear

- Best done on presentation
  - Yield in syncope low
  - Yield in palpitations better

Telemetry Monitoring

- 512 patients
  - VF = 0
  - VT = 3
  - CHB = 1
  - 2nd Degree block = 3
  - Pause > 3 sec = 9
  - SVT / AF = 49

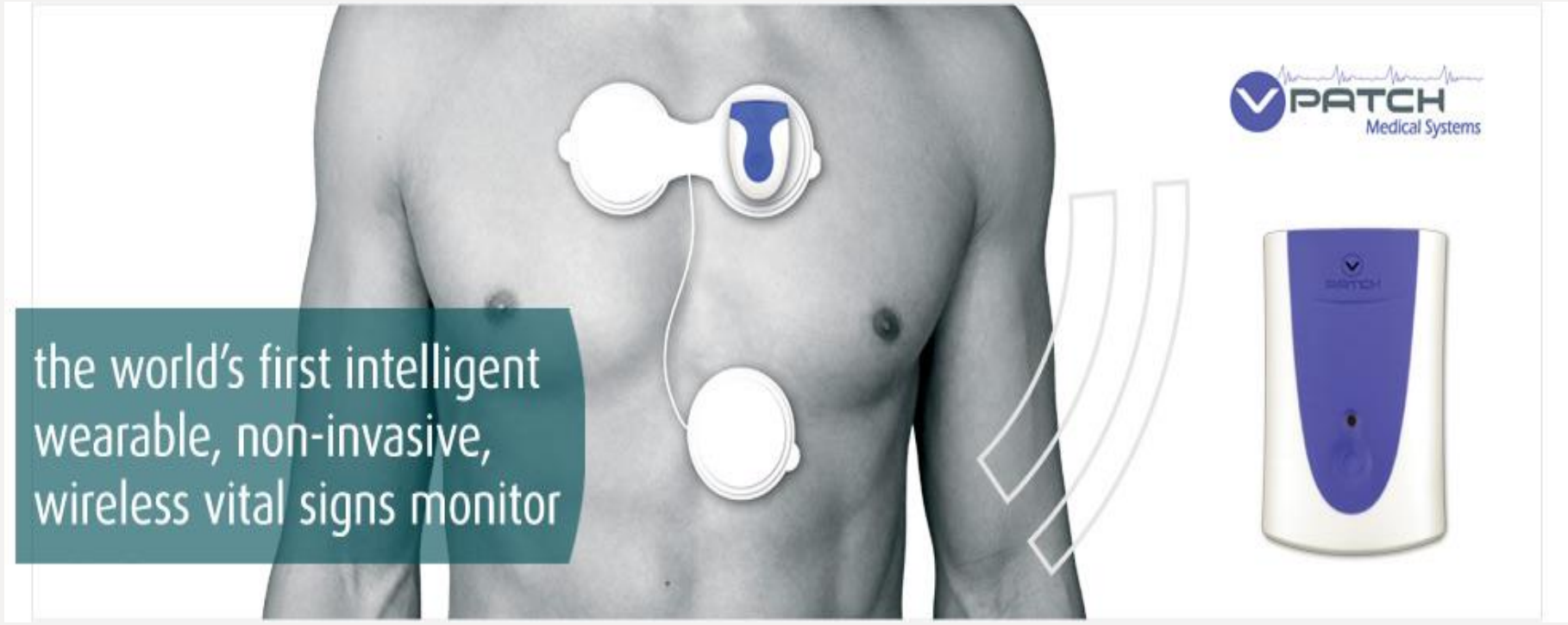
- Significant change in management in < 2%

Monitoring

- Holter - 24 / 48 hours
  - Continuous recording of every beat
  - Artifact can be a problem

- Should be reported by Electrophysiologist, preferably one who knows the patient
- Report is as valuable as pre-existing knowledge of patient and accuracy of diary sheet

- Symptom Rhythm Correlation



GenesisCare

Prolonged Monitoring

- Event recorders – 7 – 14 – 31 days
  - Record when required
    - Automatic
    - Manual
    - Continuous recording option available
  - 20 minute memory pre-event
  - Wireless and Internet capable
  - Artifact can be a problem

Loop recorder

GenesisCare

Monitoring

- Implantable Loop recorders
  - Up to 3 years
  - Automatic detections
  - Manual recording
  - Wireless and home monitoring capable
  - Require procedure and leave scar

Monitoring

- Who should have an implantable Loop recorders.
  - All other investigations non diagnostic

    - And
      - Significant episodes
        - Injury / car accidents

      - Concerning features
        - Family history

Monitoring

- MBS
  - 1 - Recurrent.... Unexplained... Syncope
  - 2 - Embolic stroke uncertain source
- Reassurance? Doctor or Patient
- $3500 + implant costs

Monitoring

- Cryptogenic Stroke? ESUS
  - Now reimbursed
  - Longer you monitor = more AF (Crystal AF)
    - Around 1% per month
  - ?NOAC for all
    - In the absence of detected AF is anticoagulation indicated – Not yet

Wearables

- Fit Bit
- Apple watch
- Health apps

- Heart rate is of limited value
- We need rhythm

Wearables

- APPLE

AliveCor®

GenesisCare

Wearables

- Medical management uncertain
- Medicolegal uncertain
- Patient interaction complicated

Wearables

- The tsunami of information
- Who should see these patients
- How should we investigate
- Is it the same problem?
  - AF
    - Clinical vs device detected
    - Clinical vs wearable detected

GenesisCare

EP study

- Electrical and / or pharmacological maneuvers to induce arrhythmia.
  - Episodic palpitations not captured
    - High index of suspicion for SVT
    - ?Reassurance
  - Prognostic information
    - Inducible VT in poor LV function
    - ERP of accessory pathway
    - Channelopathies
  - Unexplained syncope with structurally abnormal heart.

EP study

- Problems
  - Is induced arrhythmia clinical arrhythmia?
    - Atrial Fibrillation
    - Symptom Rhythm Correlation
  - Substrate for AVNRT in many patients
    - Is it the cause of the symptoms
  - Sedation / anesthetic can reduce inducibility

Mr Swale

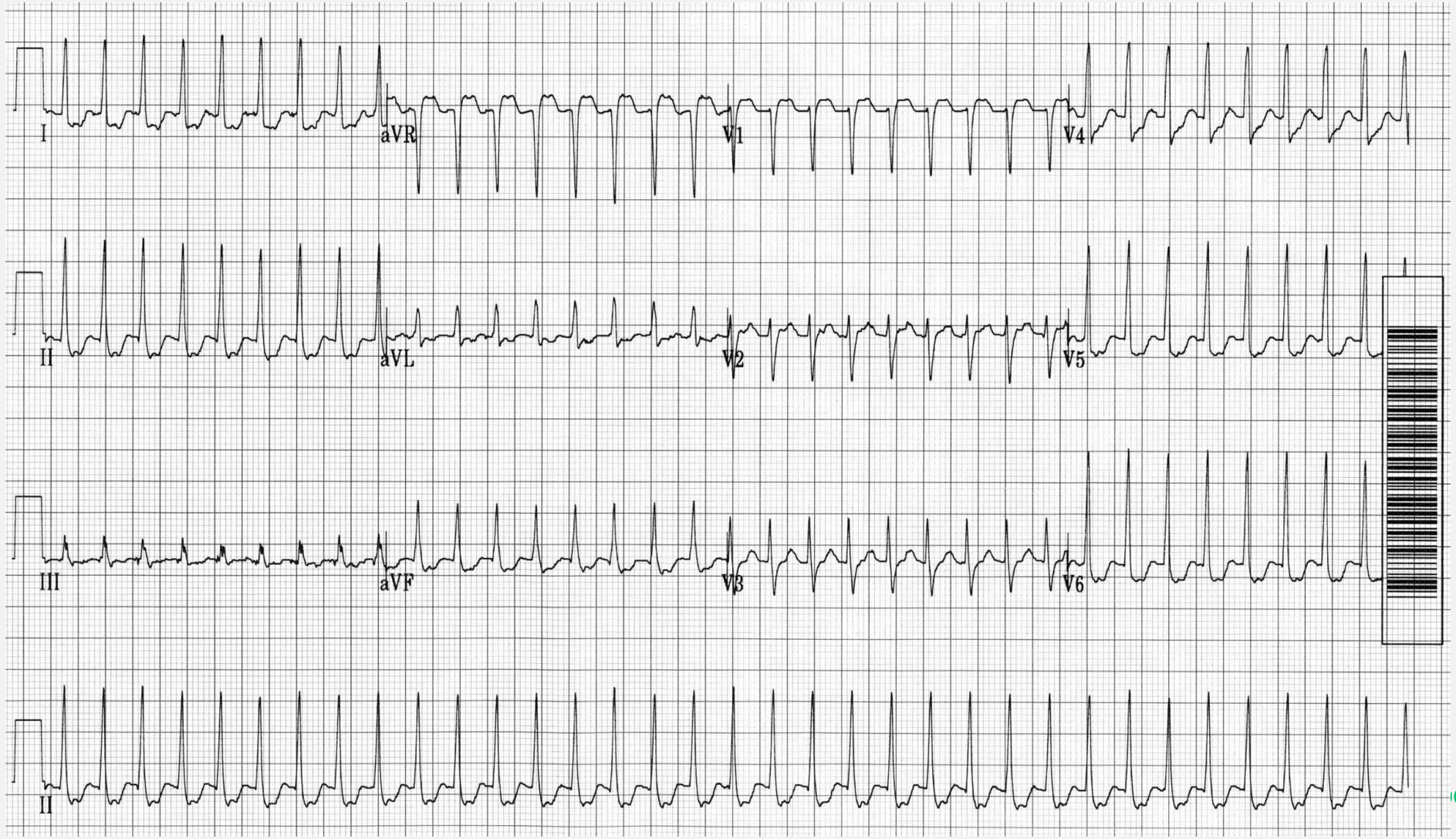
- ECG - Normal
- 24 hour Holter – Normal
- Echocardiogram - Normal
- All the non cardiac evaluations were normal.

- What next? Who do we worry about?

Who to worry about?

- Patients with recurrent symptoms
- Patients with severe symptoms
- Patients with abnormalities on baseline investigations
- Patients with known cardiac abnormalities
- Patients with a family history of sudden cardiac death
- Patients engaged in high level sporting activities
- Patients in “at risk” occupations
- Patients who are or want to become pregnant

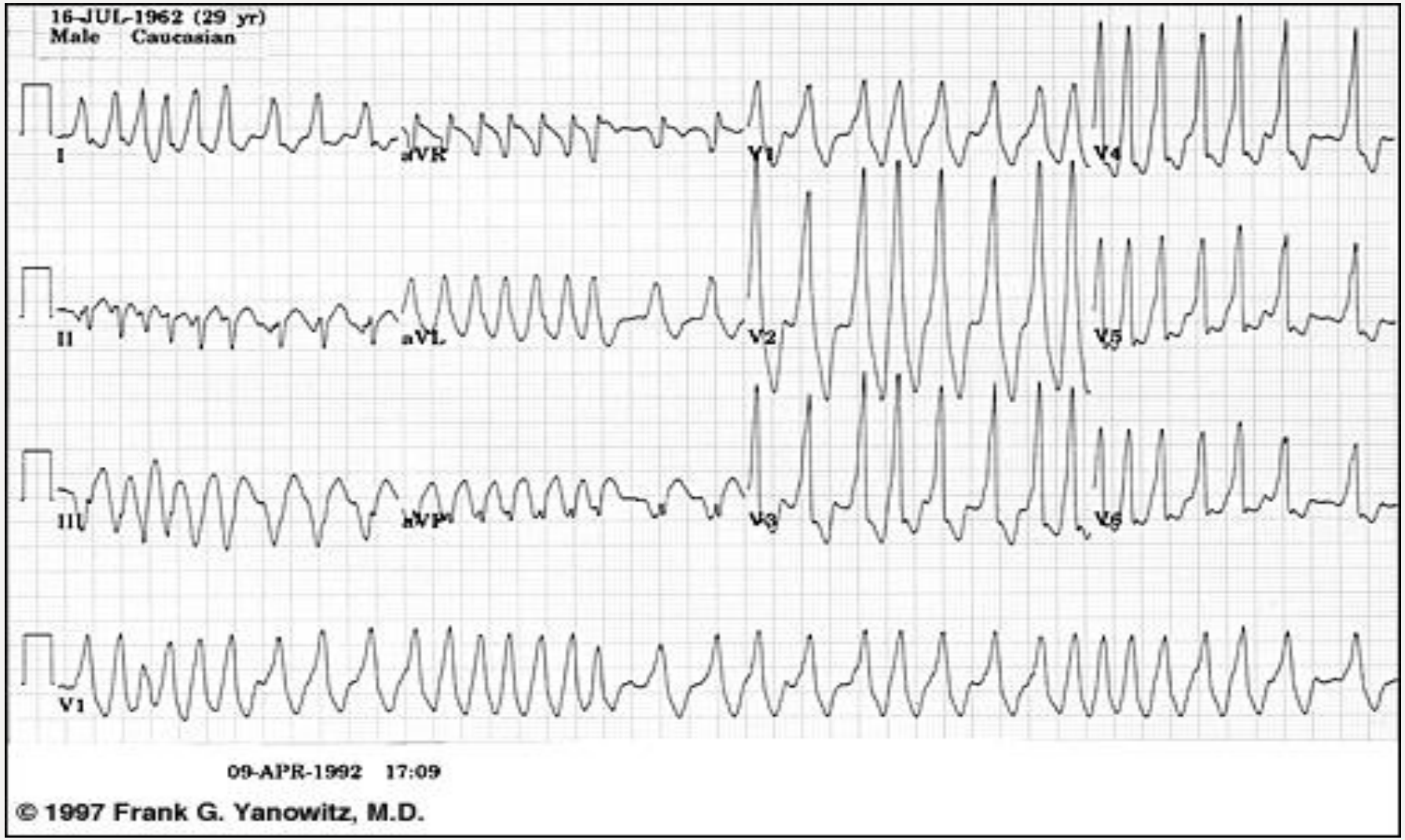
Mr Swale 3 days later



Narrow Complex tachycardias

- SVT
  - AVNRT
  - AVRT (WPW)
  - Atrial Tachycardia

- Atrial Flutter
- Atrial fibrillation
- Sinus tachycardia



GenesisCare

Evaluation of WPW

- Symptoms: Range from asymptomatic to sudden cardiac death
- 40% of patients asymptomatic
- Predominantly orthodromic tachycardia
- ECG Pre-excitation may be variable
  - ECG may show pre-excitation (delta wave)
  - ECG may not show pre-excitation (concealed)
  - Depends on AV node and pathway properties

Why worry about pre-excited AF

Risk of SCD

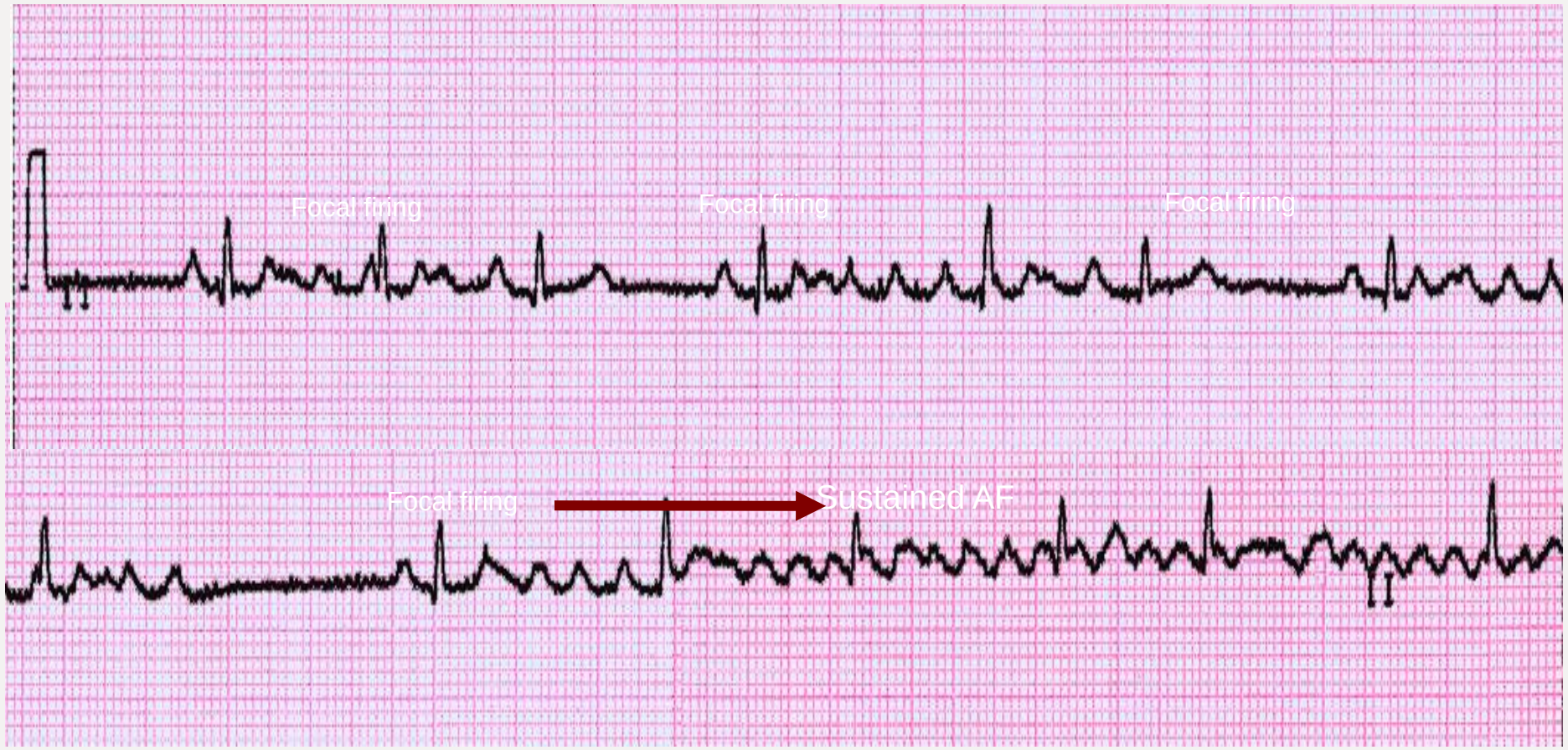
- Risk of VF from rapid conduction of AF
  - AP RP < 240 msec
    - Shortest RR in AF < 240 msec = HR > 250
  - Symptomatic patients

- Risk of VF is low if > 35 years of age and asymptomatic

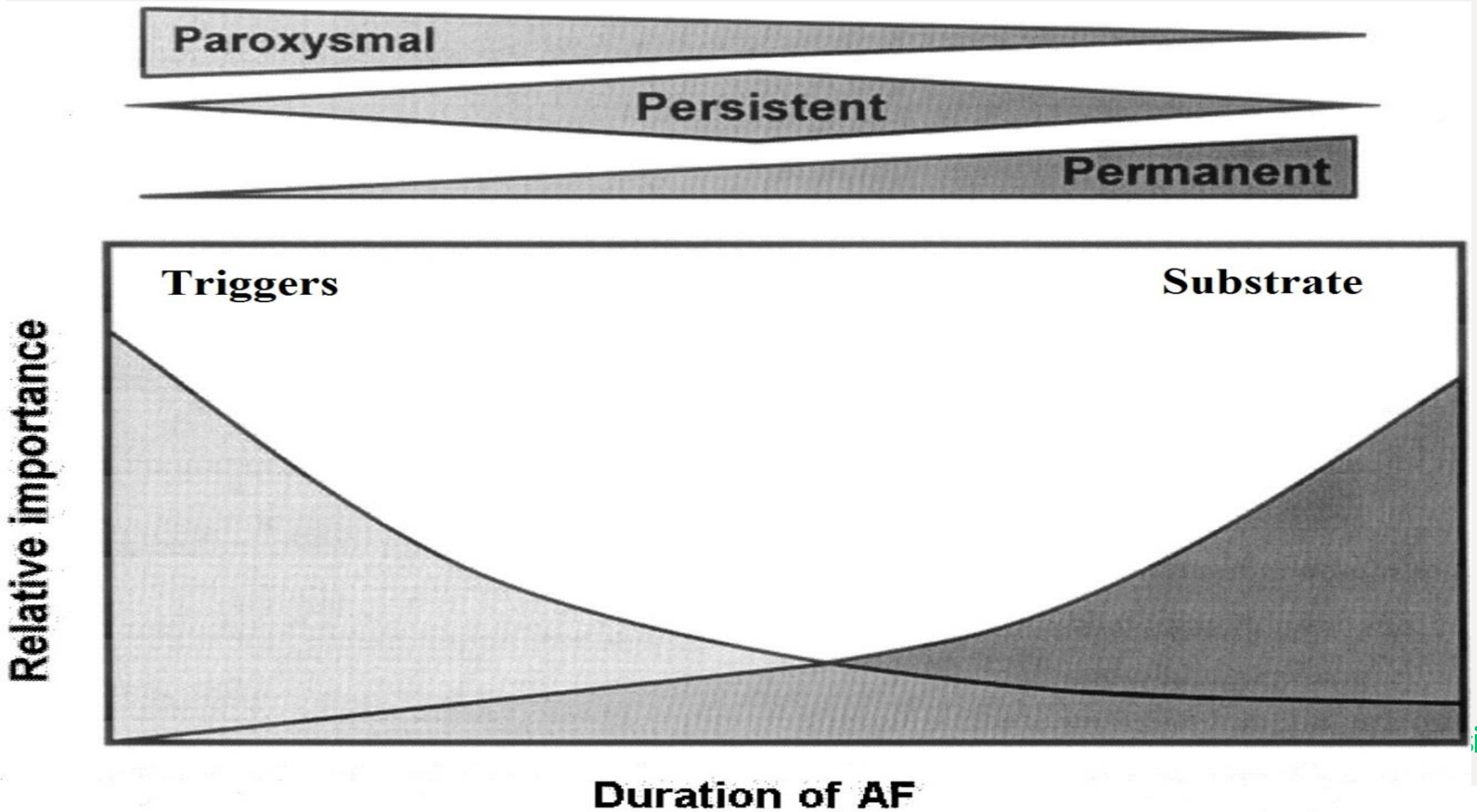
- Role of EST?
- Role of EP study?

Atrial Fibrillation

Mechanisms of Atrial Fibrillation



Triggers vs Substrate



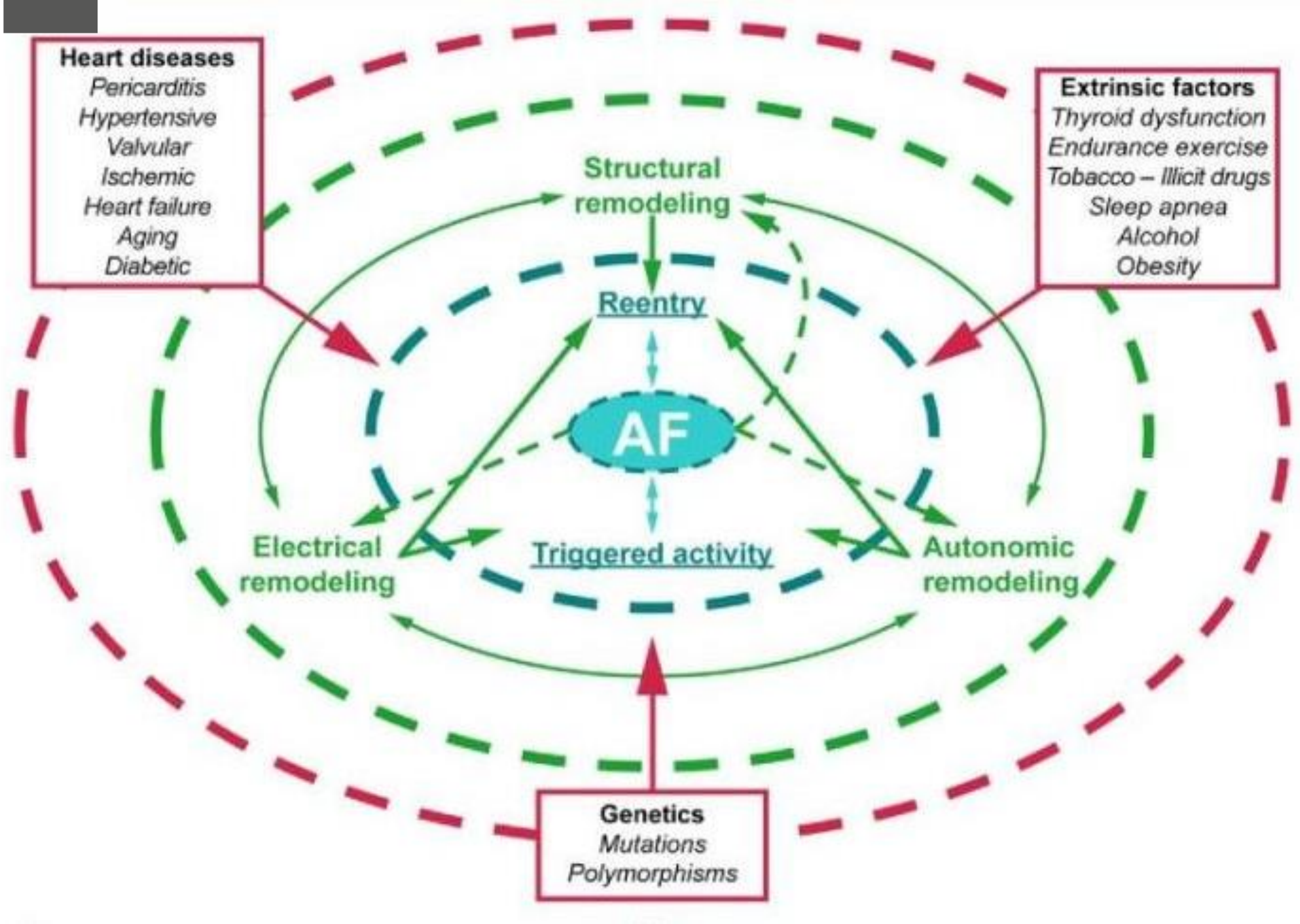
What causes substrate AF

- Anything that causes Left Atrial stretch
- Anything that causes increased LA pressure
- Anything that causes LA fibrosis
- Anything that upsets the autonomic inputs into the LA.

What causes Focal drivers of AF

- Anything that causes Left Atrial stretch
- Anything that causes increased LA pressure
- Anything that causes LA fibrosis
- Anything that upsets the autonomic inputs into the LA.

Exacerbators / Contributors


Heart diseases
Pericarditis
Hypertensive
Valvular
Ischemic
Heart failure
Aging
Diabetic
Extrinsic factors
Thyroid dysfunction
Endurance exercise
Tobacco – Illicit drugs
Sleep apnea
Alcohol
Obesity
Structural remodeling
Reentry
AF
Electrical remodeling
Triggered activity
Autonomic remodeling
Genetics
Mutations
Polymorphisms

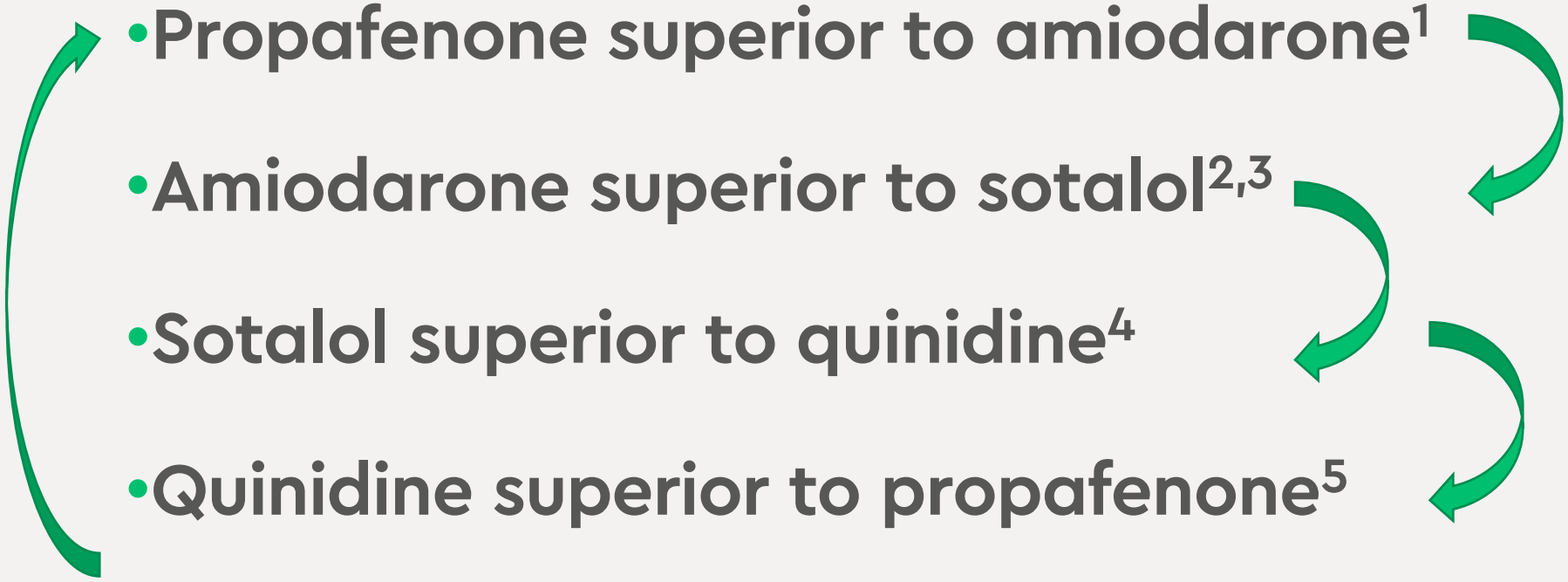
isCare

AF management

- Nothing
- Pharmacological
  - Rate Control
  - Rhythm Control
    - Reversion
    - Maintenance
- Ablation
- Devices

My Favourite EBM Slide

- Head to head
  - Propafenone superior to amiodarone[1]
  - Amiodarone superior to sotalol[2,3]
  - Sotalol superior to quinidine[4]
  - Quinidine superior to propafenone[5]



Medications and AF

- Do not use digoxin to manage AF (Unless you want to follow recent Australian Guidelines)

- B Blockers – don't kill patients
- Amiodarone – mortality neutral

CHA_2DS_2VASc[1]

CHA_2DS_2VASc Score	Annual stroke risk.
0	0.3
1	0.9
2	2.9
3	4.6
4	6.7
5	10.0
6	13.6
7	15.7
8	15.2
9	17.4

On aspirin alone

Risk from Individual Components[1]

	Multivariate Hazard Ratio
C: Congestive Heart Failure	**0.98**
H: Hypertension	1.17
A_2: Age ≥ 75	5.28
D: Diabetes	1.19
S_2: History of Stroke	2.81
V: Vascular Disease	1.14
A: Age 65-74	2.97
Sc: Female Sex	1.17

[1] Swedish Atrial Fibrillation cohort study

CHA_2DS_2VASc

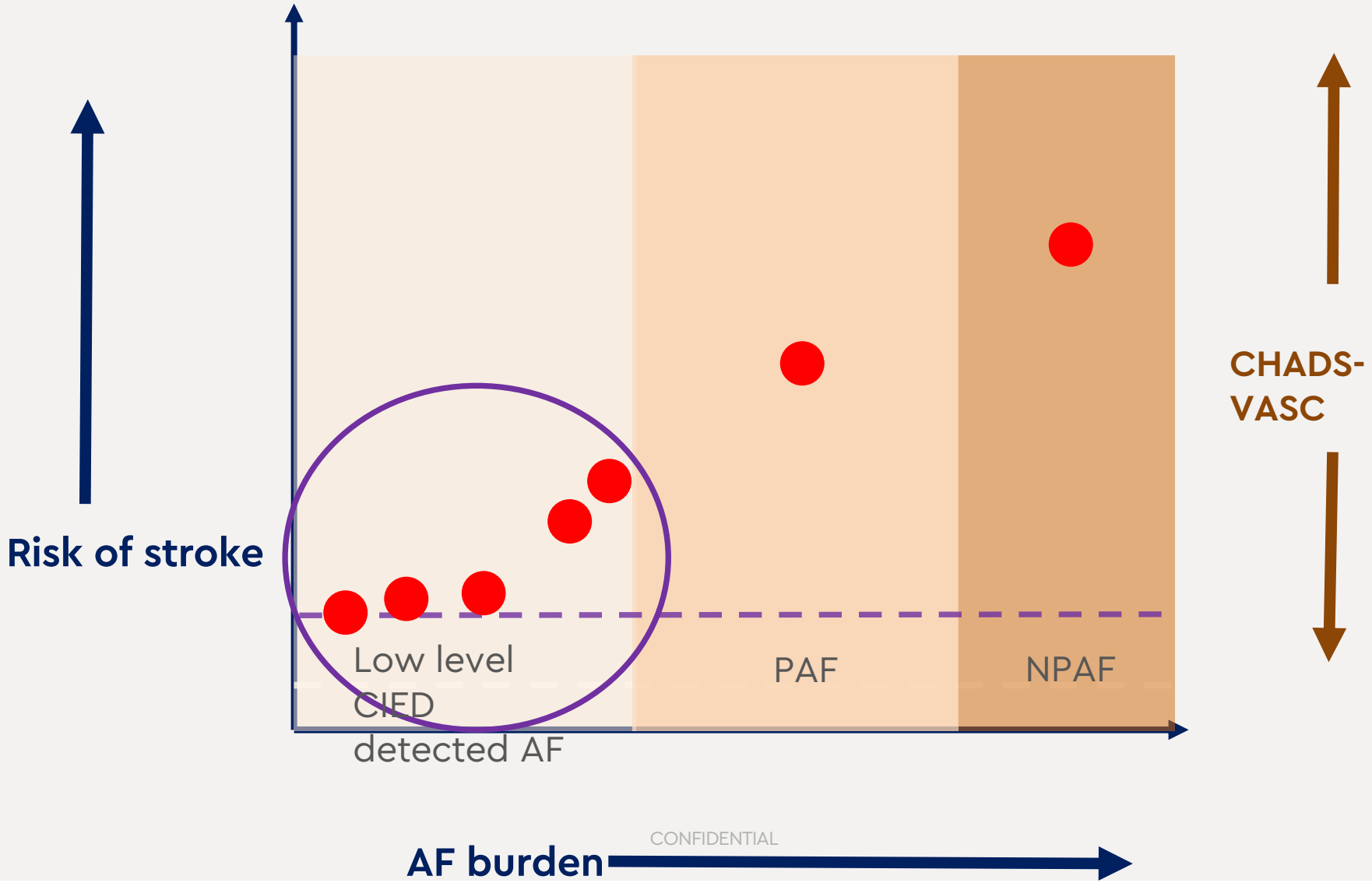
- 55 year old female with hypertension and mild global LV dysfunction
  - $CHA_2DS_2VASc = 3$

HR = 1.31

- 74 year old male with a previous stroke
  - $CHA_2DS_2VASc = 3$

HR = 9.13

Relationship of AF burden and stroke



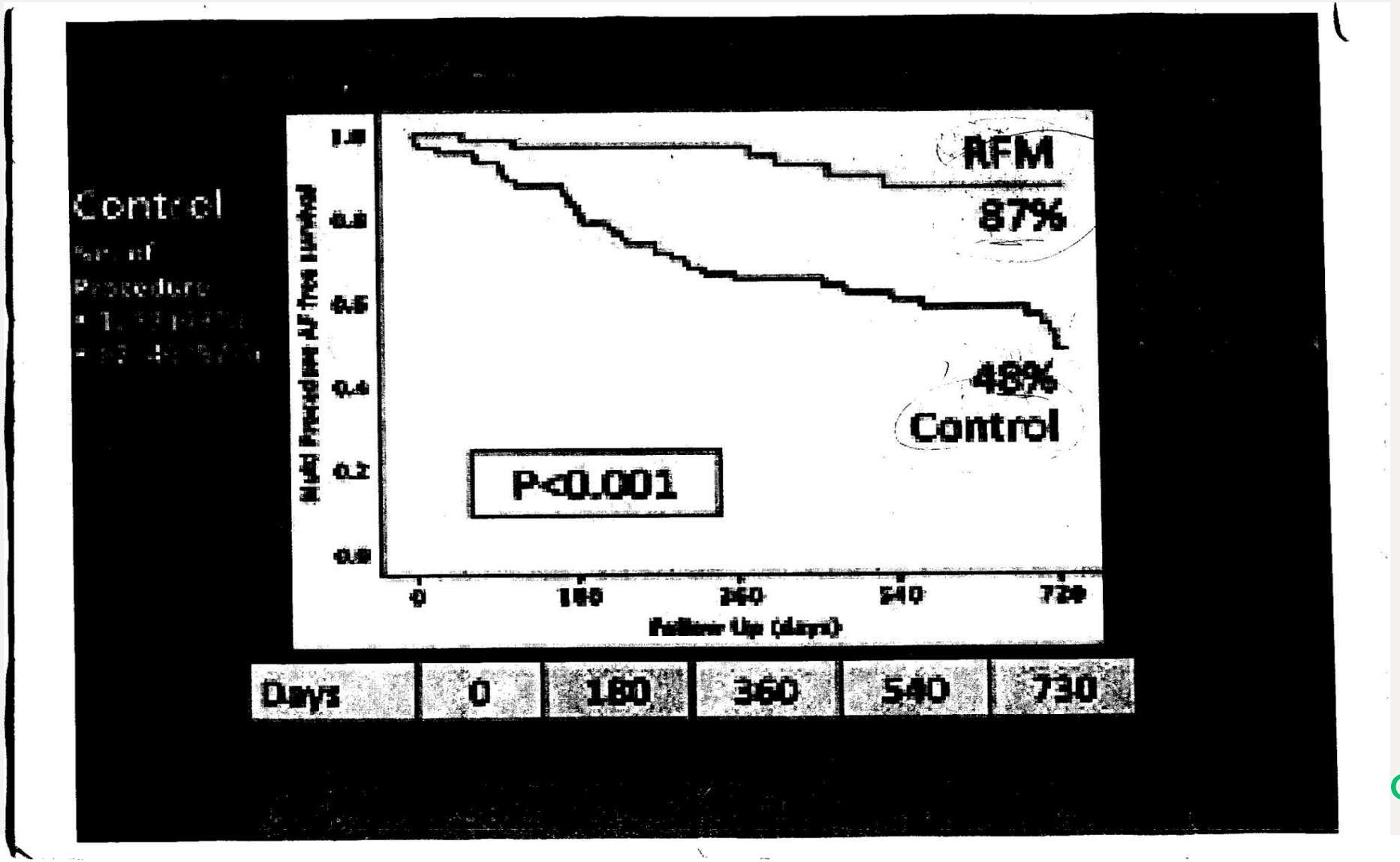
Evidence of increased stroke risk is not the same as evidence of benefit of NOAC or OAC in stroke prevention!!!

Do we need a

CHA_2DS_2-VASc-AF_3?

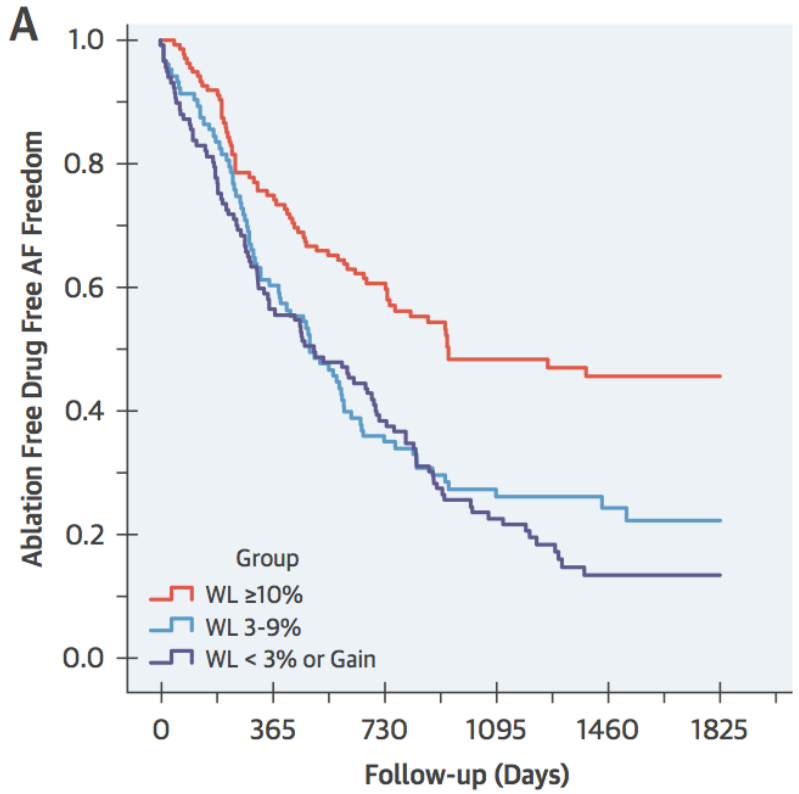
- I don't understand why telling someone to stop smoking, lose weight and exercise regularly is considered drastic. Whilst cutting people open and operating on their heart or putting a very expensive device in or using potentially toxic medications is considered medically conservative!

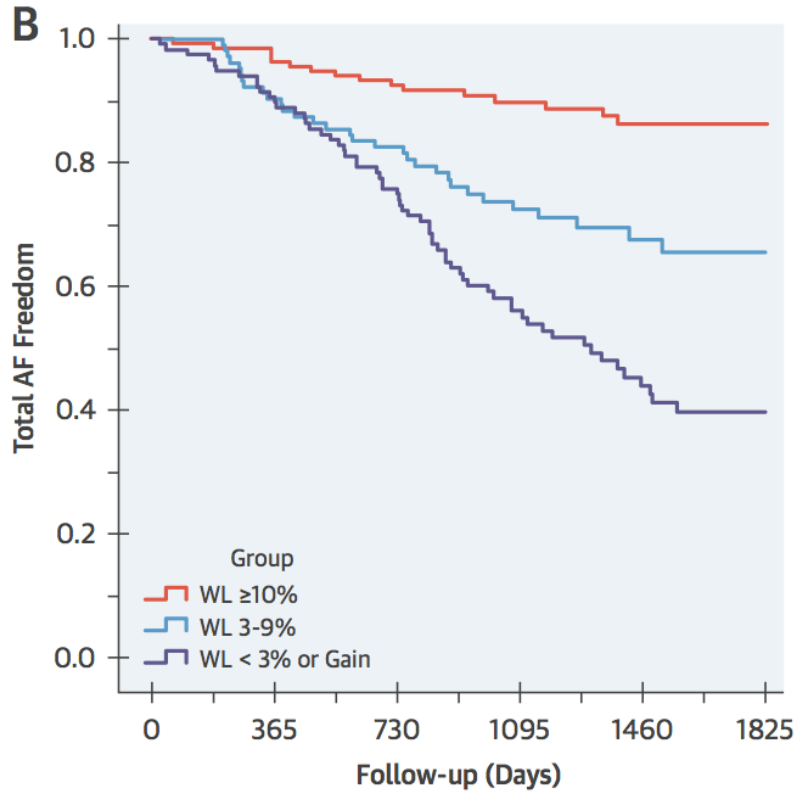
Prash's data



GenesisCare

FIGURE 2 Atrial Fibrillation Freedom Outcome According to Group



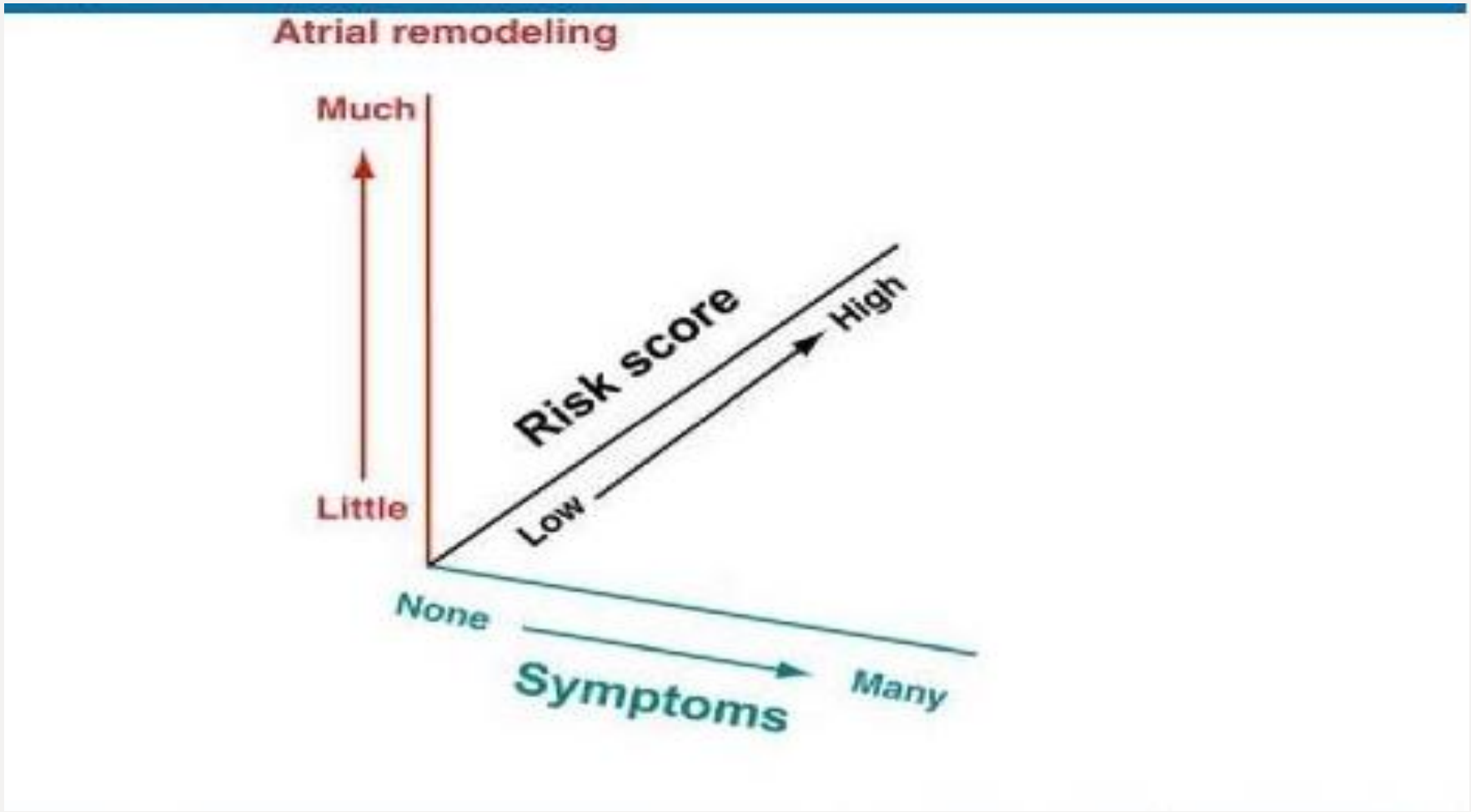


Time (Days)	0	365	730	1095	1460	1825
≥10 WL	135	101	72	42	31	18
3-9% WL	103	62	36	22	13	7
<3% WL or gain	117	66	44	22	11	9

0	365	730	1095	1460	1825
135	130	114	86	67	36
103	93	83	57	35	22
117	105	85	53	32	22

(A) Kaplan-Meier curve for AF-free survival without the use of rhythm control strategies. **(B)** Kaplan-Meier curve for AF-free survival for total AF-free survival (multiple ablation procedures with and without drugs). Abbreviations as in Figure 1.

Which patient and how to manage?



Which patient and how to manage?

- **Significant symptoms, mild atrial remodelling, low - moderate embolic risk**
  - Maintenance of SR should be aim
- **Minimal symptoms, significant remodelling and moderate - high embolic risk**
  - Rate control and anticoagulation

CASTLE AF

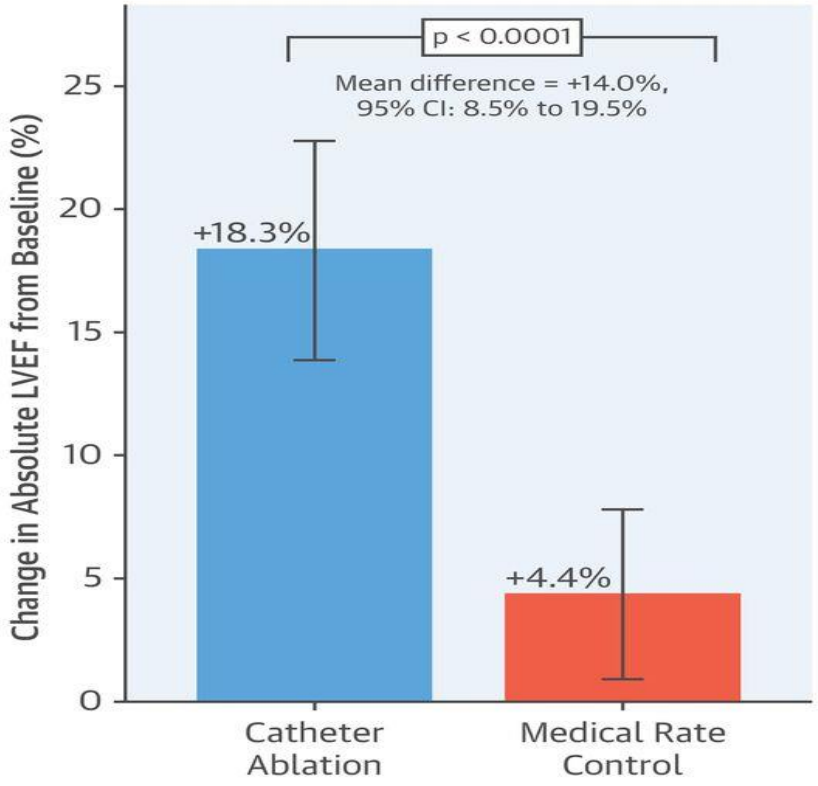
- The game changer?
- AF and LV dysfunction
- AF ablation
  - 47% reduction in mortality
  - 45% reduction in heart failure hospitalizations

- AF ablation for all!!!mera MRI

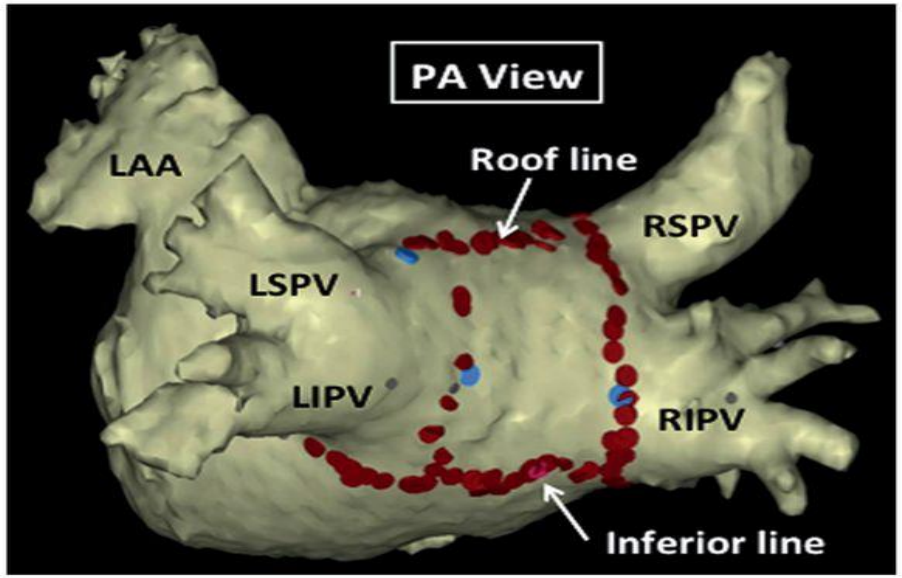
Camera MRI

CENTRAL ILLUSTRATION: Change in Absolute LVEF From Baseline According to Treatment Arm

A Primary Endpoint: Change in LVEF at Baseline and 6 Months by Treatment Arm



B Catheter Ablation Lesion Set in Left Atrium: Pulmonary Vein and Posterior Wall Isolation



Prabhu, S. et al. J Am Coll Cardiol. 2017;70(16):1949–61.

Mrs Jennifer Johns

78 year old female, presents following a syncopal episode this morning

- Watching TV felt a bit strange then woke up on the floor
- No significant injury

- 2 previous dizzy spells, no previous syncope
- No known cardiac history, no cardiac medications

GenesisCare

The only difference between syncope and sudden death is that in one you wake up.

Syncope is serious

- 1 year mortality with primary diagnosis (Kapoor W Medicine 1990;69:160-175)

- Melanoma 2.9%
- Breast Cancer 3.8%
- Acute Myocardial Infarction 6.2%
- Syncope - 9.2 %
- Heart Transplant 9.4%
- Hip fracture 21.2%

Unexplained Syncope

- Is it common?

• < 18 years old	15%	
• Females 18 – 35		18%
• Military 17 – 49	23%	
• > 70 years old	45%	

Syncope Investigations

- ECG
- ECHO

- Monitoring
  - Holter
  - Event Recorder
  - Loop Recorder
- Electrophysiology Study
  - Electrical
  - Pharmacological
- Tilt Table Testing

Test/Procedure	Yield (based on mean time to diagnosis of 5.1 months[7]
History and Physical	49-85%
ECG	2-11%
EP Study without SHD*	11%
EP Study with SHD	49%
Tilt Table Test	11-87%
Ambulatory ECG Monitors: ▪ Holter ▪ External Loop Recorder ▪ Insertable Loop Recorder	 2% 20% 65-88%
Neurological † (Head CT Scan, Carotid)	0-4%

Tilt Table Testing

GenesisCare

Tilt Table Testing

- Technique is vital
  - Passive
  - Active
- Operator interpretation is important
- Positive test is useful
- Negative test is less valuable

- Do not need a positive TTT to diagnose neurocardiogenic syncope

Tilt Table Testing

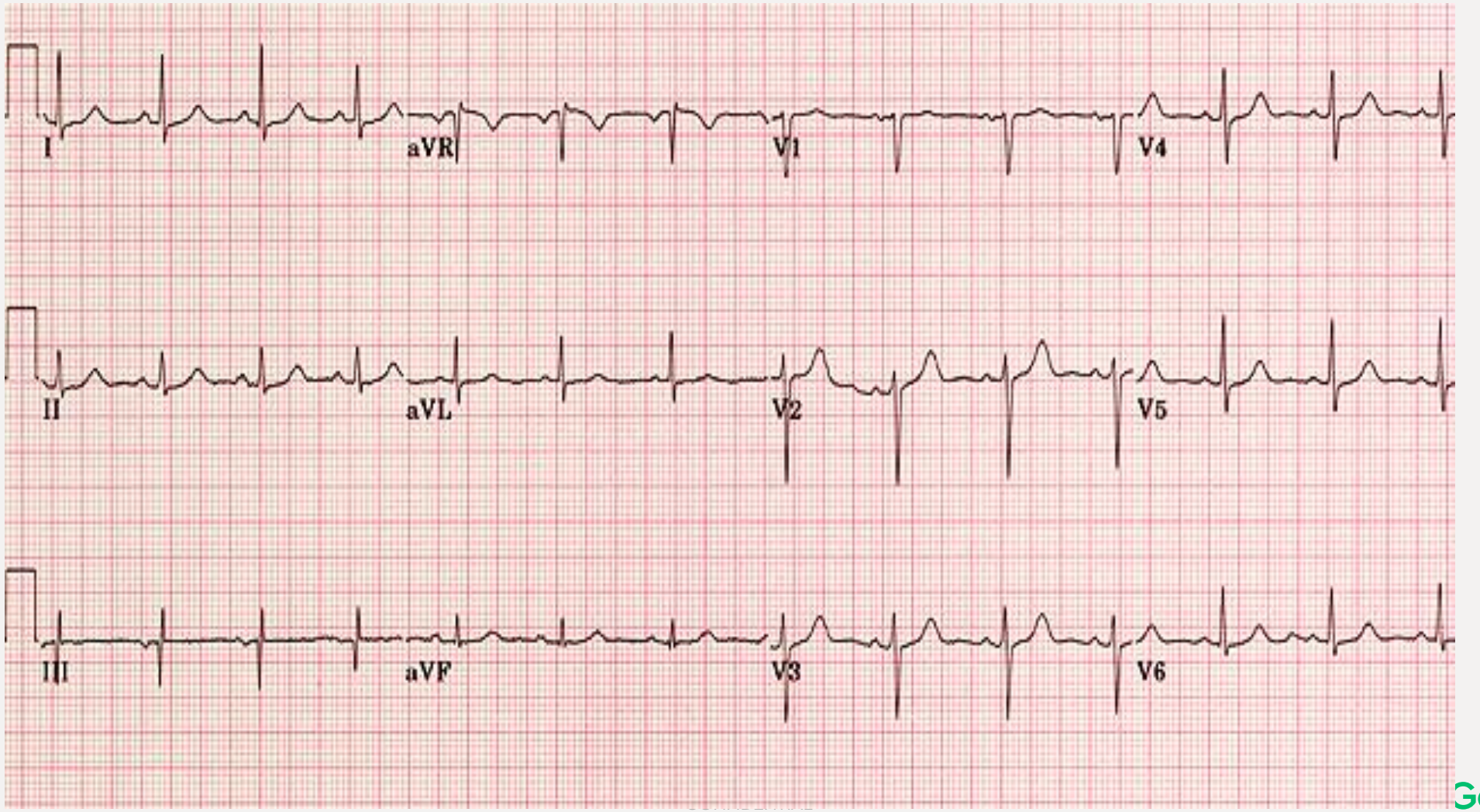
- Indications
  - Unexplained syncope
    - Particularly structurally normal heart
  - Probable NCS
    - To reassure patient / doctor
  - To dictate treatment in suspected NCS
    - Cardio inhibitory vs vaso dilatory - No

Mr Omar Farouque

- 23 year old male with 6 episodes of collapse over 2 years
- Seizure activity noted with each episode

- First seizure clinic
- EEG – Non specific temporal lobe slowing
- CT / MRI – Normal
- Sleep deprived EEG
  - No abnormality
- Referred to arrhythmia clinic

Mr Omar Farouque



GenesisCare

Seizures and Syncope

- Common for arrhythmic patients to have seizures
  - 10% of documented bradycardic syncope is associated with seizure activity

- Common for epilepsy patients to have arrhythmias
  - Bradycardia
  - Tachycardia
  - SUDEP

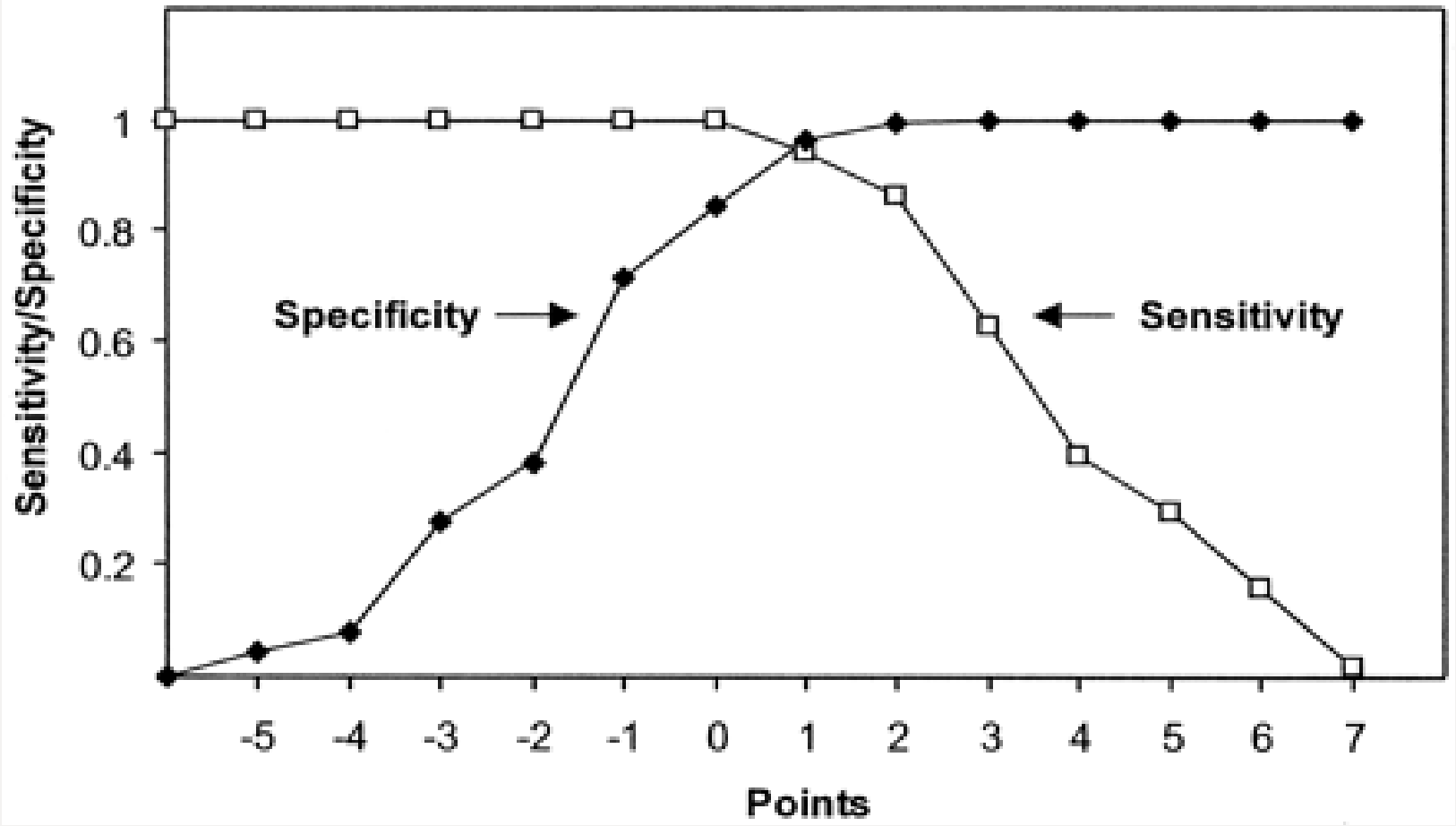
Seizures and Syncope

- Syncope
- Light-headed or blurring of vision prior to the episode
- Syncope occurs in an upright position
- Usually shorter duration.
- Usually not confused after the episode.
- Usually no tongue biting or incontinence

Seizures and Syncope

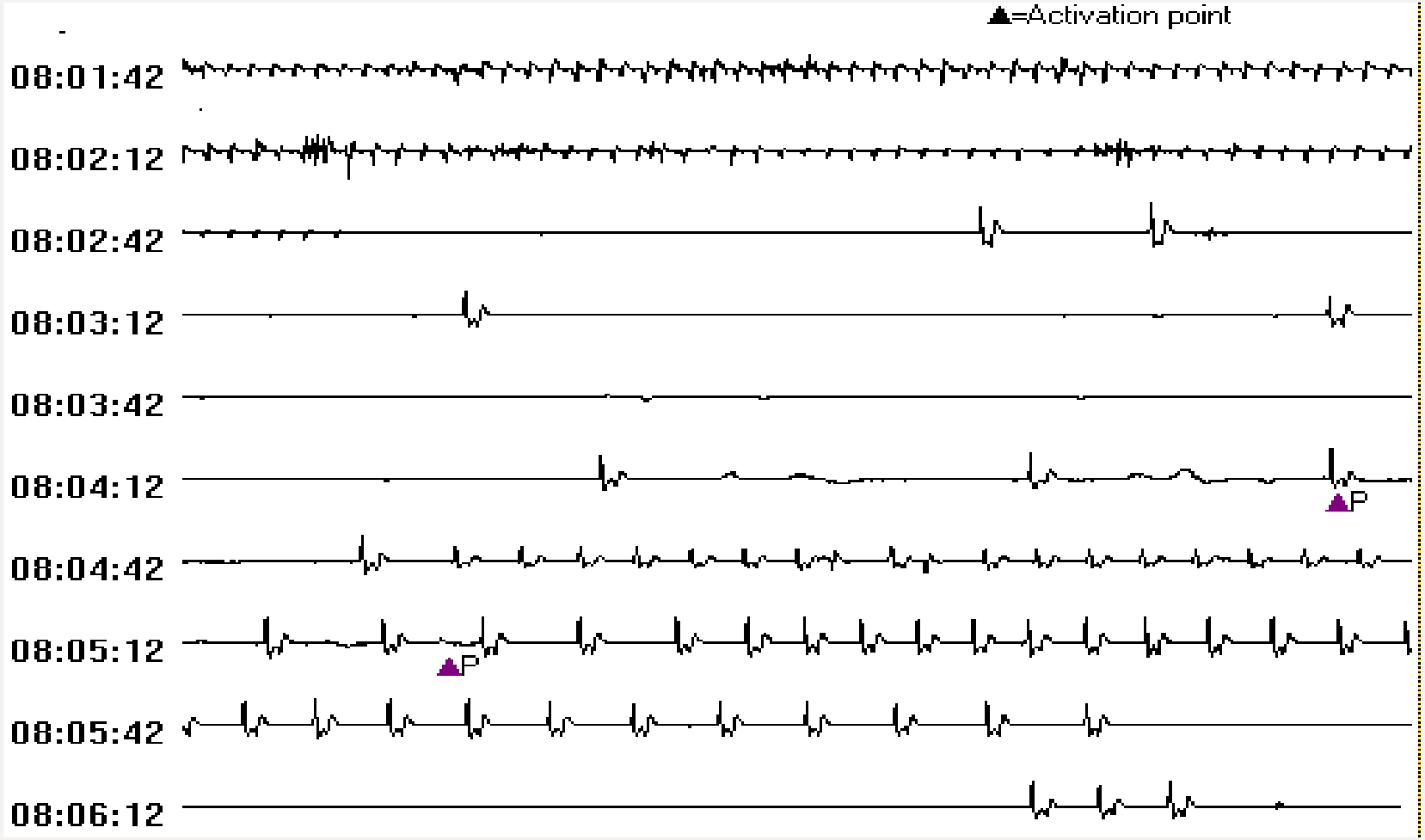
At times do you wake with a cut tongue after your spells?	2
At times do you have a sense of deja vu or jamais vu before your spells?	1
At times is emotional stress associated with losing consciousness?	1
Has anyone ever noted your head turning during a spell?	1
Has anyone ever noted that you are unresponsive, have unusual posturing or have jerking limbs during your spells or have no memory of your spells afterwards? *(Score as yes for any positive response)*	1
Has anyone ever noted that you are confused after a spell?	1
Have you ever had lightheaded spells?	−2
At times do you sweat before your spells?	−2
Is prolonged sitting or standing associated with your spells?	-2

Seizures and Syncope



GenesisCare

Mr Omar Farouque



GenesisCare

POTS

Thank you!