Dr. Azad Ghuran MB ChB, MRCP, MD, FESC
Consultant Cardiologist

www.hertslondoncardiology.co.uk

1

Do ECGs leave you like this…

2

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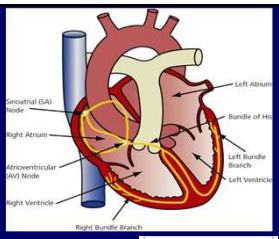
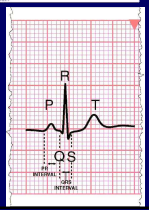
What they all mean..

- SA node activation - not seen on ECG
- Atrial depolarization - **p wave**
- Atrial repolarisation - not seen on ECG
- AV node activation - not seen on ECG
- His-Purkinje depolarisation - not seen on ECG
- Depolarisation of ventricles - **QRS complex**
- Repolarisation of ventricles – **T wave**





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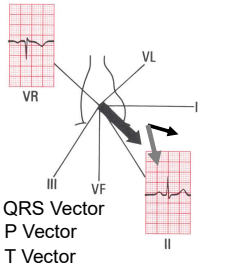
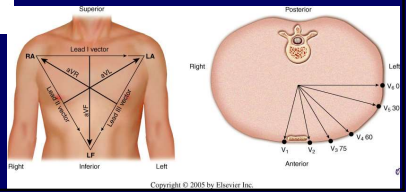


QRS Vector
P Vector
T Vector

CARDIAC VECTORS



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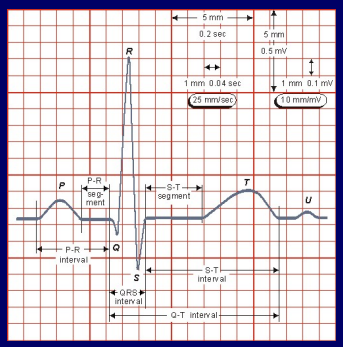

PR interval
Normal 3 to 5 small squares
(0.12 to 0.2s)

QRS interval
Normal up to 3 small squares
(0.12s)

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Resting ECG

- Rate
- Rhythm
- Axis
- P waves
- PR interval
- QRS complexes
- ST segments
- T Waves
- QT interval….

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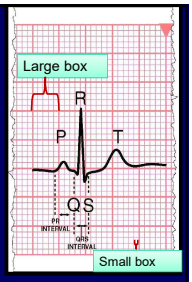
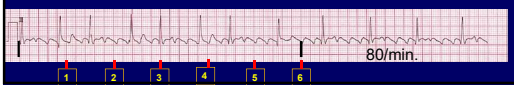
Rate

- 1500 divided by the number of small boxes between two R waves
  1500/25 (small boxes) = 60 beats/min
- 300 divided by the number of large boxes between two R waves
  300/5 (large boxes) = 60 beats min.
- Count the number of cardiac cycles in 6 seconds and multiple this by 10. (irregular rhythm – AF)



- Normal 60-100
- > 100 is tachycardia
- < 60 is bradycardia



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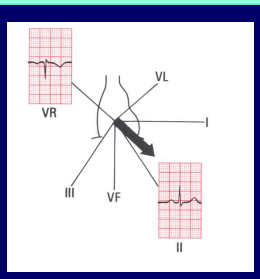
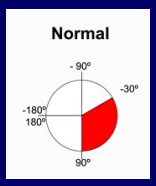
Normal Frontal QRS axis

The cardiac axis refers to the *general direction in which the heart depolarises.*





Taken from: The ECG made Easy. J R Hampton

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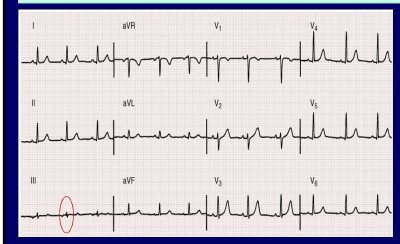
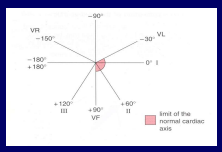
Frontal QRS axis

- Identify the lead with the most equiphasic/isoelectric QRS
  - Frontal axis is at right angles to this
- Limb lead II usually holds the clue!





If leads I & II are positive - Normal axis

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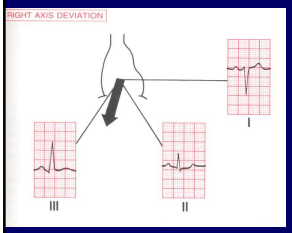
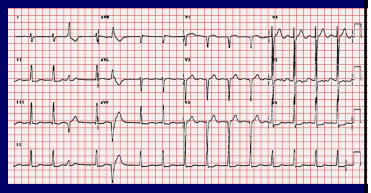
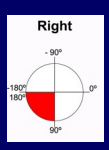
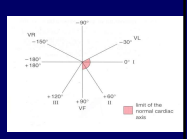
Right axis deviation









If lead II & III are positive
and I negative - Right Axis deviation

Taken from: The ECG made Easy. J R Hampton

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Causes of Right Axis Deviation

- Normal finding in children and tall thin adults
- Pulmonary Embolus
- Right ventricular hypertophy
- Chronic lung disease (with or without pulmonary hypertension)
- Valvular disese (right side)
- MI
- Left Posterior Hemiblock
- Wolff-Parkinson-White syndrome - left sided accessory
- Congenital Disease
  - Atrial Septal Defect
  - Ventricular Septal Defect

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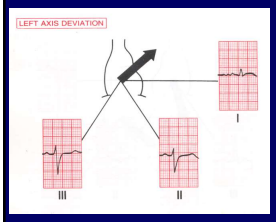
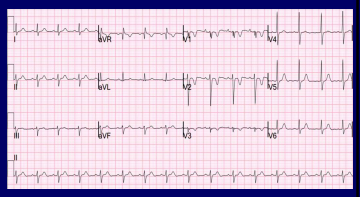
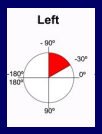
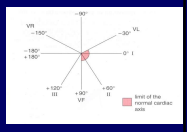
Left axis deviation





If lead I is positive and II and III negative - Left Axis deviation





Taken from: The ECG made Easy. J R Hampton

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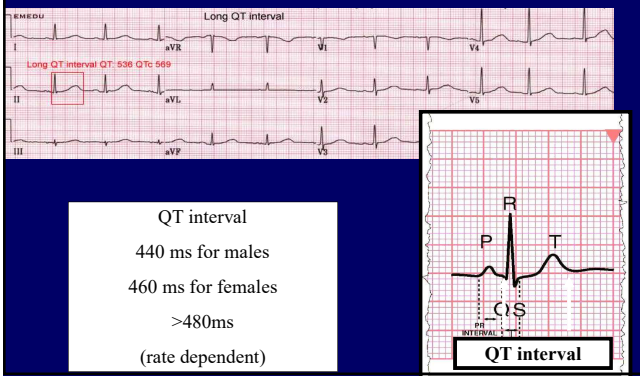
Causes of Left Axis Deviation

- Left ventricular dilation/hypertrophy
- Hypertension
- Valve disease (left side): aortic stenosis, regurgitation, mitral regurgitation
- Left Anterior Hemiblock
- MI
- Emphysema
- Hyperkalaemia
- Wolff-Parkinson-White syndrome - right sided right sided accessory pathway
- Congenital Disease
  - Tricuspid Atresia
  - Septal defects, ostium Primum ASD

14



QT interval

440 ms for males

460 ms for females

>480ms

(rate dependent)

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Arrhythmias

Sinus Arrhythmia

Autonomic Modulation During Respiration

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Sinus Bradycardia

HR less than 60 beats / min.

- Drugs
- Hypothyroidism
- Hypothermia
- Sick Sinus Syndrome
- Heart Block
- Athletes
- Obstructive Jaundice
- Typhoid fever (relative)

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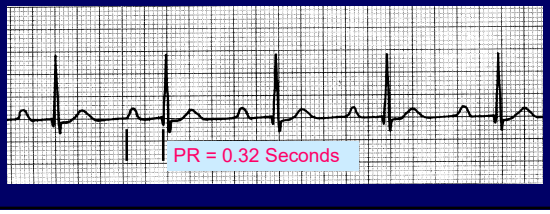
Heart Block

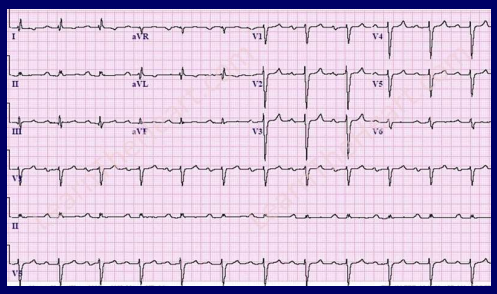
Conduction problems in the AV node/His Bundle

First Degree

PR Interval Prolonged (> 0.2 ms)



18



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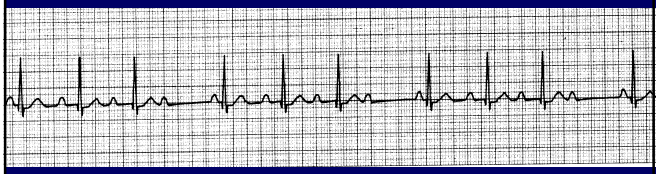
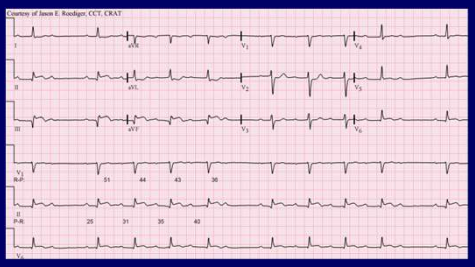
Second Degree Heart Block

(1) Mobitz Type I (Wenckebach)



- PR interval lengthens, followed by a non conducted P wave.
- The next conducted beat has a shorter PR interval than the preceding conducted beat

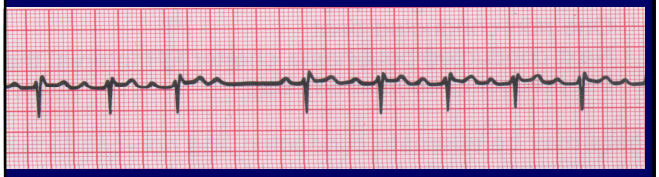
20



21

Second Degree Heart Block

(2) Mobitz Type 2

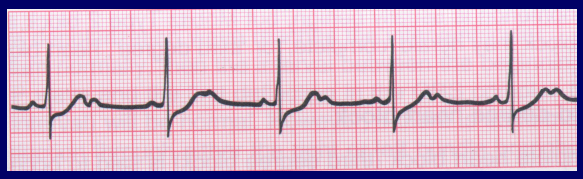


- Constant PR interval with an occasional non conducted P wave

22

Second Degree Heart Block

2:1 Advanced Heart Block



23

Second Degree Heart Block
Advanced Heart Block

Various conducted and non conducted sinus beats in different ratios

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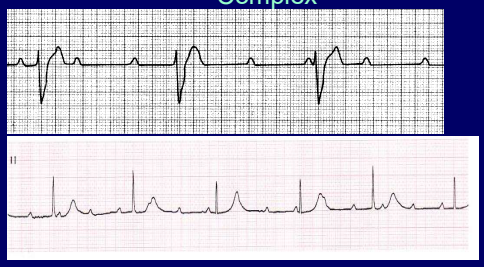
Third Degree/Complete Heart Block With Wide QRS Complex



- Atrio-ventricular dissociation
- Escape rhythm can be narrow complex (junctional escape) or broad complex (ventricular in origin)

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Treatment of Heart Block

Type of HB	Treatment Option
First degree	Observe
Second Degree	
• Wenckebach	Observe/PPM
• Mobitz Type 2	Observe/PPM
• Advanced HB	PPM
Third Degree	PPM

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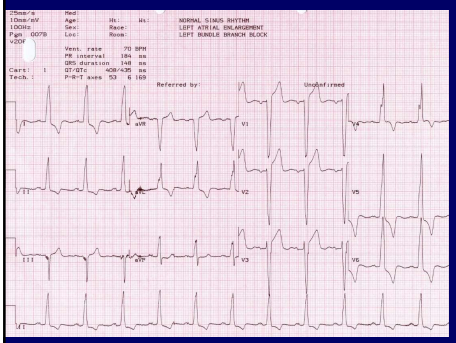
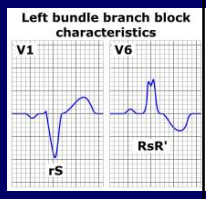
LBBB- William





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Causes of LBBB are:

- Cardiomyopathy
- Acute/previous myocardial infarction
- Hypertension
- Septal defects
- Left ventricular hypertrophy
- Primary disease of the cardiac electrical conduction system
- Left sided valve disease (aortic valve stenosis/regurgitation, mitral regurgitation
- Myocarditis, Lyme disease
- Post cardiac surgery
- Rarely occur in structurally normal heart

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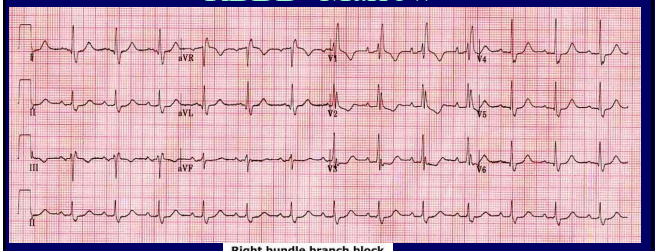
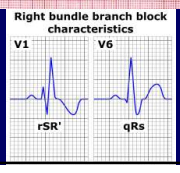
RBBB -Marrow





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Causes of RBBB are:

- Can occur without heart disease
- Cardiomyopathy
- Acute/previous myocardial infarction
- Pulmonary hypertension
- Atrial septal defects
- Pulmonary emboli
- Right ventricular hypertrophy/dilatation
- Right sided valve disease (pulmonary stenosis/regurgitation, triscupid regurgitation
- Primary disease of the cardiac electrical conduction system
- Ischaemic heart disease
- Myocarditis, Lyme disease
- Ebstein's anomaly

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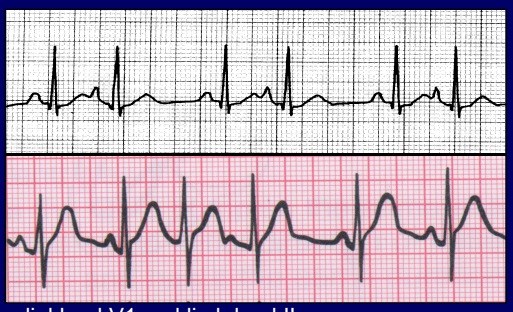
Supraventricular Ectopics

Atrial Extrasystoles/Supraventricular ectopics



Precordial lead V1 and limb lead II

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Thank you very much for referring this pleasant 49-year-old lady for a cardiology opinion. She started having palpitations three months before Christmas which she described as a pounding and fluttering sensation that lasted a few seconds, with the pattern repeating itself throughout the day. Her symptoms have increased in frequency to the point that she was reviewed in the A & E Department of The Lister Hospital on the 11th of November 2018. Her ECG according to her discharge letter showed atrial ectopic beats. Since then, her symptoms have improved and she now gets symptoms every few days. There have been no recent infections. She drinks up to two cups of coffee a day and three cups of tea. She consumes up to one bottle of wine a week. She is currently menopausal.

Her past medical history includes anxiety, ear problems as a child, and a fracture of her 12th thoracic vertebrae following a fall.

Her current medication consists of Citalopram 10 mg daily.

Her father died at 71 years with alcohol-related liver disease. Her mother is alive at 75 years and suffers with osteoporosis.

She lives with her partner and has an 11-year-old son. She does not smoke. She works as a solicitor.

On examination, pulse 59 beats per minute and regular. JVP was not elevated. Blood pressure 110/78 mmHg and 106/78 mmHg. Heart sounds S1 plus S2. Her chest and abdomen were unremarkable.

Her ECG showed normal sinus rhythm with normal conduction indices and waveform morphology.
Her recent full blood count, U&Es, calcium, magnesium, CRP, D-dimer, liver function tests and thyroid function tests were normal.

Her symptoms most likely stem from ectopic beats, which fortunately are improving. For completeness, I have arranged for her to have a 48-hour ECG and an echocardiogram. I will try to retrieve copies of her ECG from The Lister Hospital.

Yours Sincerely,

04/01/2019

Dr Azad Ghuran MB ChB (Edin), MRCP, MD (Edin), FESC
Consultant Cardiologist

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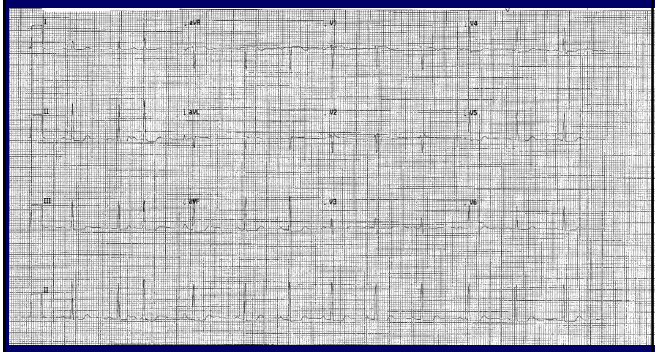

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This 72 year old lady is awaiting a hip replacement. She was diagnosed with atrial fibrillation during her pre-op assessment and the GP has been requested to organise an urgent cardiology assessment prior to her postponed surgery.

Mrs [redacted] is asymptomatic. Her pulse rate is 84, but irregular. Blood pressure is 148/83 and she has no symptoms of CCF.

Mrs [redacted] has a longstanding history of bronchiectasis for which she is under the care of the respiratory team.

I enclose a copy of her regular medications. Her CHADSVASc score was 2 indicating anticoagulation but in view of her pending surgery, I have deferred the decision until she sees you.

Yours sincerely

Approved but not signed to avoid delay

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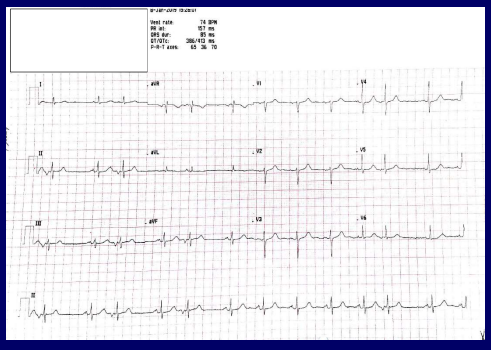

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Atrial Fibrillation

- Individual muscle fibres contract independently and without coordination (micro-reentry circuits)
- Absence of P waves

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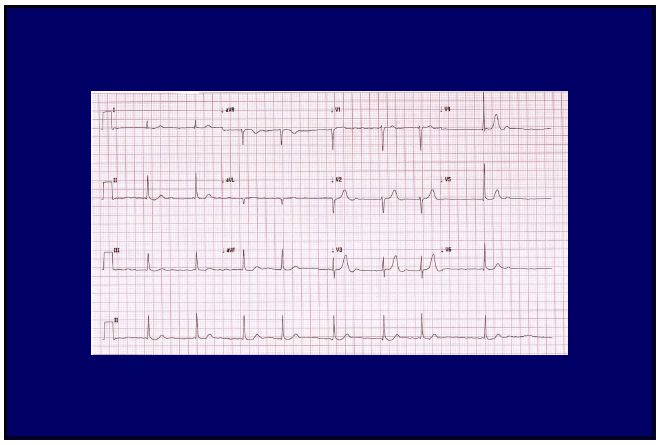

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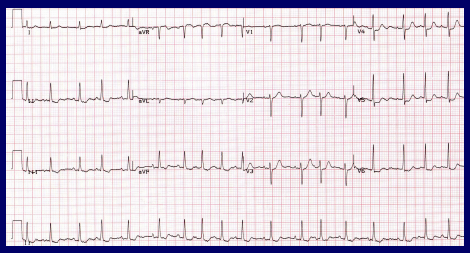
Multifocal atrial rhythm
Mutifocal atrial tacyhcardia



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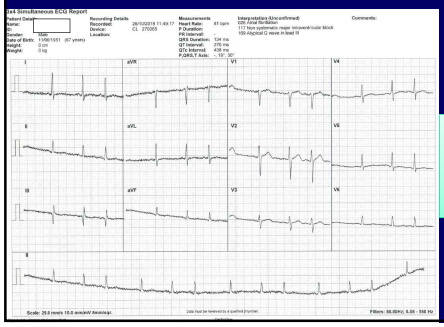
I would be grateful if you could see this 67 year old man with PMH and medication as attached.

He attended the local Treatment Centre recently and was found to have an irregular heart beat. An ECG done at the surgery today confirms that he is in AF. I have commenced him on Apixaban 5 mg bd, and would be very grateful if you could see him for advice on further management.



- PR bleeding
- Rectal adeocarcinoma
- Awaiting Surgical resection
- Apixiban discontinued

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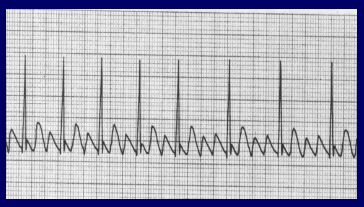
Atrial Flutter



Saw tooth appearance of baseline (macro-reentry circuit between the lateral wall of the right atrium and the interatrial septum).

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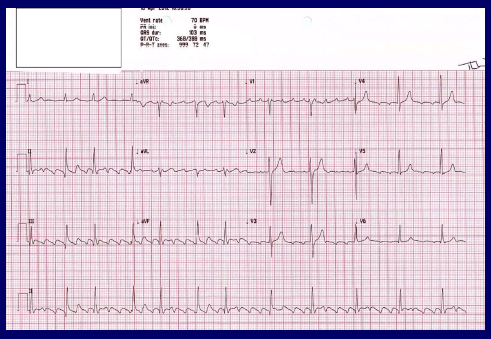

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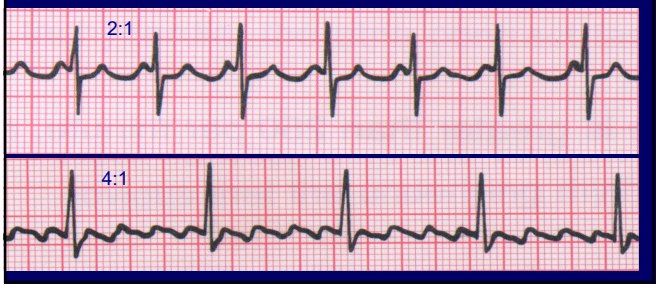
Atrial Flutter

The AV node cannot conduct atrial rates greater than 200 beats/ min. Atrial rates higher than 200 beats/min can result in AV block



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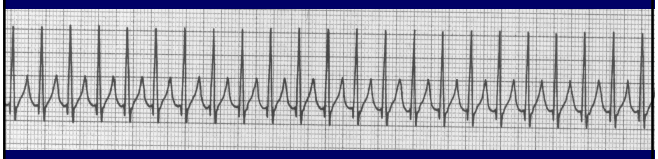
AVNRT Tachycardia



Regular Narrow Complexes

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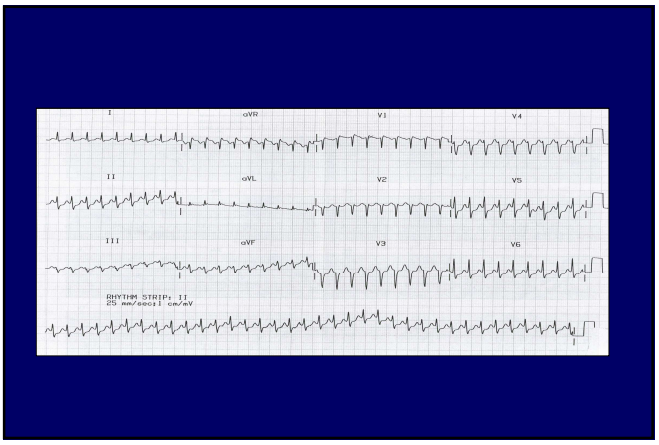

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Junctional (AVNRT) Tachycardias

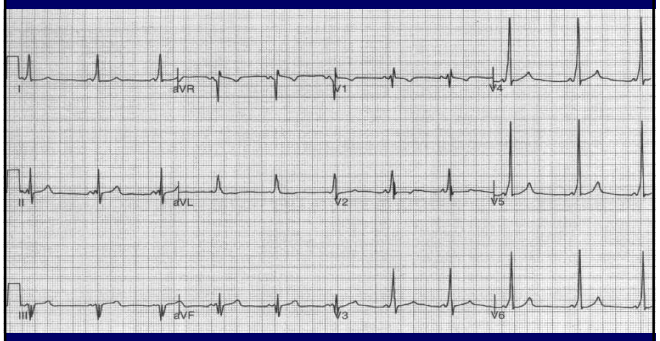
<u>Treatment</u>

- Vagotonic manoeuvres
- Pharmacological
  - Adenosine
  - Verapamil
  - Beta Blockers
  - Class 1, II and III antiarhythmic drugs

CSM
Coughing
Valsalva

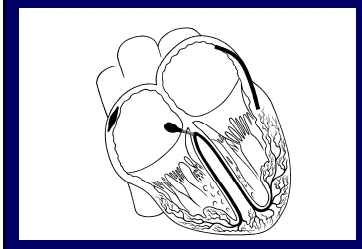
45

WPW



46

AV Re-entrant tachycardia (WPW)



- Accessory connection between the atrial and ventricular myocardium.
- Left sided pathway is the most common.
- Initial abnormal ventricular depolarisation (Delta waves).

47

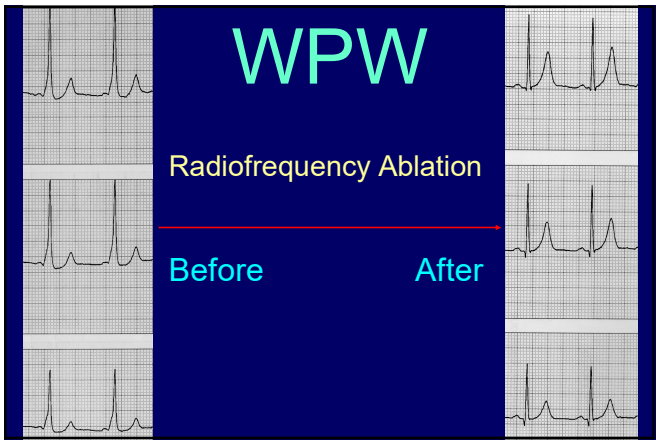
WPW

(1) Short PR interval

(2) Delta Waves

(3) Abnormal Q waves

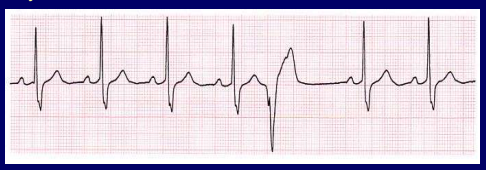
48



49

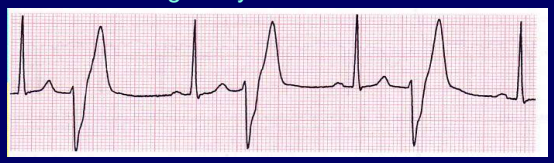
Ventricular ectopics

How many? Alternative focus? Runs of VE's? Salvos, bigeminy, trigeminy?



50

Ventricular bigeminy



Ventricular trigeminy

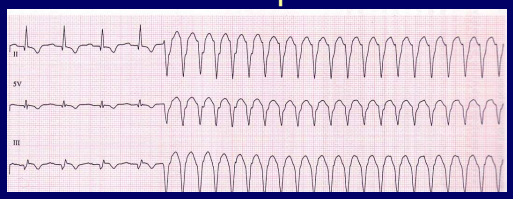
51

Ventricular ectopics

- Hypertension with left ventricular hypertrophy
- Acute myocardial infarction
- Heart failure (HF)
- Myocarditis
- Hypertrophic/Dilated cardiomyopathies
- Congenital heart disease
- Idiopathic ventricular tachycardia
- Recreational drugs
- Chronic obstructive pulmonary disease and other pilmonary diseases
- Sleep apnea
- Endocrinopathies (thyroid, adrenal or gonadal abnormalities)
- Nicotine, alcohol, sympathomimetic agents (eg, beta-agonists, decongestants, antihistamines) or illicit drugs (eg, cocaine, amphetamines).

52

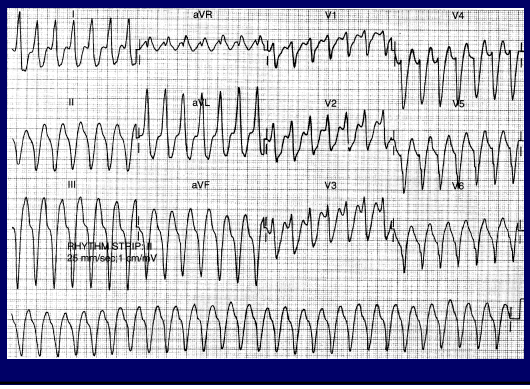
Monomorphic VT



- Regular, rapid succession of ventricular ectopic beats each with the same appearance
- Wide complexes (> than 120 ms)
- AV dissociation (independent p waves, fusion beats and capture beats)

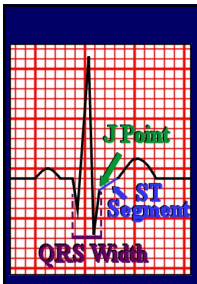
53

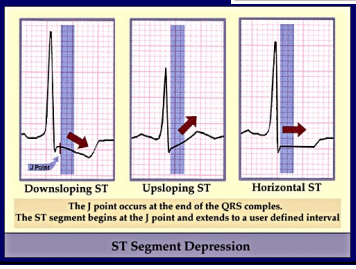
MVT



54

ST depression





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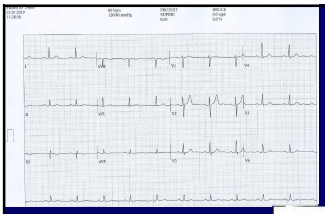
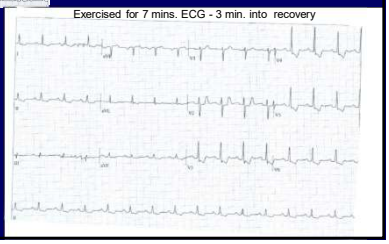
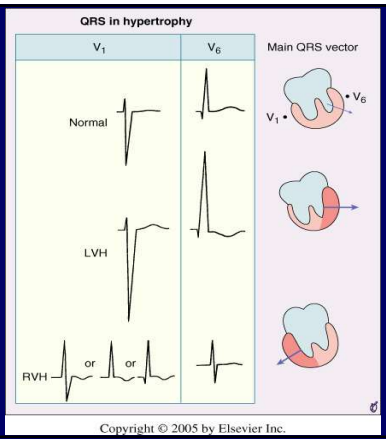


73 yr old surgeon, self referred for an ETT

Exercised for 7 mins. ECG - 3 min. into recovery



56



57

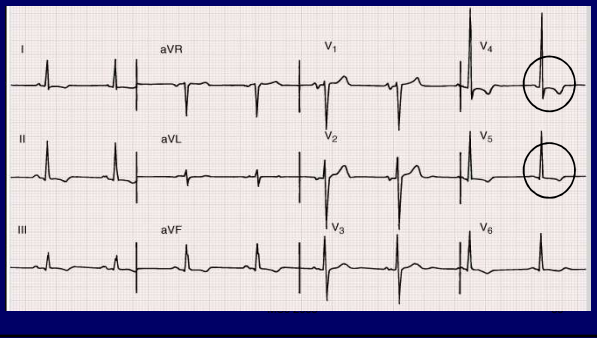
ECG Voltage Criteria for LVH

- Sokolow + Lyon *(Am Heart J, 1949;37:161)*
  - S V1+ R V5 or V6 > 35 mm
- Cornell criteria *(Circulation, 1987;3: 565-72)*
  - SV3 + R avl > 28 mm in men
  - SV3 + R avl > 20 mm in women
- Romhilt + Estes + Estes *(Am Heart J, 1986:75:752-58)*
  - Point score system
- Framingham criteria *(Circulation,1990; 81:815-820)*
  - R avl > 11mm, R V4 > 11mm, R V4-6 > 25mm
  - S V1-3 > 25 mm,
  - S V1 or V2 + 3 > 25 mm
  - R V5 or V6 > 35 mm,
  - R I + S III > 25 mm

Established by autopsy, echo and now MRI data

58

LVH with 'Strain' pattern



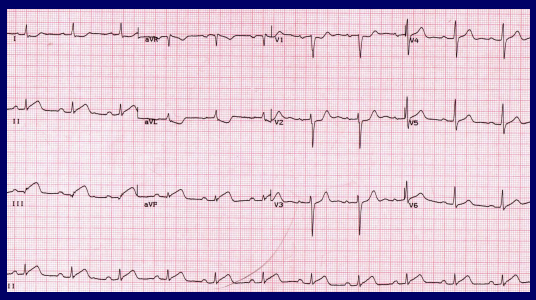
59

Diagnosis of MI on ECG

- 1mm of ST elevation in 2 or more consecutive limb leads (e.g. II,III,aVF)
- 2mm of ST elevation in 2 or more consecutive chest leads
- New LBBB
- (Also on of chest pain / positive cardiac enzyme)

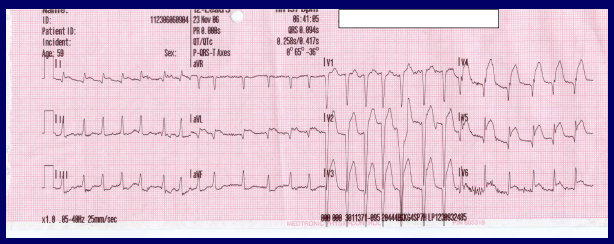
60

Inferior MI



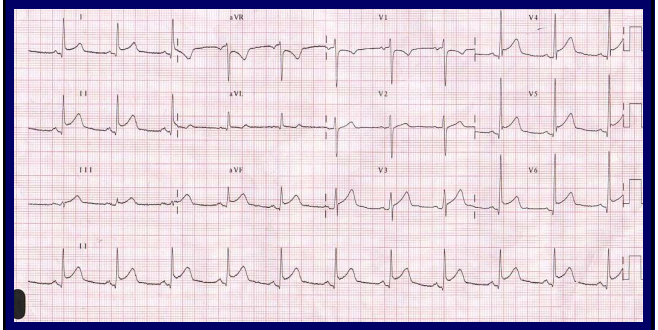
61

Anterior MI



62

Pericarditis



63

30.04.2014

This pleasant, young 32 year old lady from Quatar came to see me for a cardiology review with a history of syncope. She has a tendency to "faint" which started around seventeen years of age, usually around when blood is taken. She also gets dizzy in the morning when she gets out of bed and stands up quickly. She generally returns to bed and has to lie down for approximately ten minutes before she feels better. She had one episode whilst sitting, when she did not eat breakfast and suddenly felt light-headed, dizzy, sweaty and then lost consciousness for a few seconds. She quickly recovered.

She was complaining of palpitations which she describes as a big beat/missed beat that lasts for seconds. This occurs approximately once a week. She has never had any sustained rapid palpitations. She provided me with a dossier of her previous medical reports which she has had done in Qatar. I was able to find the reports from a cardiologist in 2011 around the time she was complaining of palpitations and dizziness. He felt she may have sick sinus node disease based on a 24 hour tape. I was able to review this 24 hour tape and this showed marked sinus arrhythmia with an appropriate diurnal variation of her heart rhythm. She has also had an echocardiogram in 2012 which was reported as normal and another 24 hour tape in May 2012 which was also normal. She had an exercise tolerance test in June 2012 during which she had a normal chronotropic and blood pressure response. She clearly does not have sick sinus node disease. She has always had a tendency to low blood pressure.

Her past medical history incudes an appendicectomy. She is on no regular medication.

64

30.04.2014

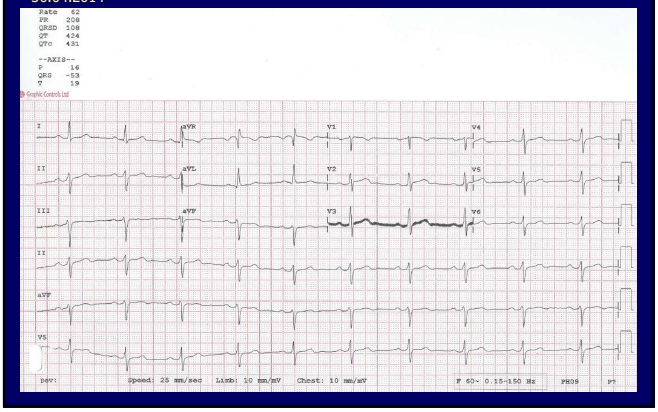
Her father died at the age of 72 with stomach cancer and her mother is alive at the age of 62 and suffers with diabetes mellitus. She has one brother aged 38 who is diagnosed as having epilepsy. He also suffers with "fainting episoses" and interestingly also has nocturnal seizures. I understand his seizures usually occur when he is sick, upset, afraid or nervous. This happens twice a year. [redacted] does not smoke and works as a secretary.

On examination pulse 62 beats per minute, regular, JVP not elevated. Lying blood pressure 107/64 mm Hg., standing at one minute 112/69 mm. Hg., pulse rate 67 beats per minute. Standing at three minutes 109/68 mm. Hg., pulse rate 70 beats per minute. Heart sounds S1 plus S2 plus a soft mild (1/6) systolic murmur at the left sternal edge and apex. Her chest and abdomen were unremarkable. Her ECG today showed sinus rhythm with left axis deviation and normal QRS morphology and conduction indices. In her medical dossier, I was able to find an ECG dated 24th June, 2012 which showed a secondary R wave in lead V1 and 2 mm J point elevation in lead V2 with a biphasic T wave. There was also an ECG from the 1st May, 2012 which was similar. I therefore repeated her ECG with leads V2 and V3 in the second intercostal space and this did not show any major difference. She had some blood tests done in June 2013 which showed normal Us and Es, full blood count, glucose, liver function tests. Her cholesterol was 6.14 mmol/L with a triglyceride of 1.2 mmol/L. I could not see a thyroid function test.

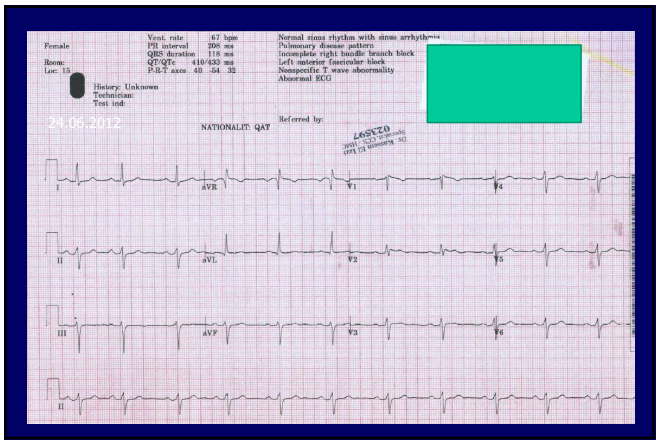
The majority of this lady's symptoms are related to her low blood pressure and most likely neurocardiogenic (vasovagal) syncope. I have asked her to increase her salt and fluid intake and I have also taught her counter pressure manoeuvres to perform when she feels light-headed or dizzy. I was quite intrigued given her ECG and her brother's history and I have asked her to send me a copy of her brother's ECG if possible. She is due to return to Qatar in due course. I would like to review her again when she next visits the United Kingdom and we can always consider performing a 24 hour tape, a repeat echocardiogram and possibly a tilt test. I have also asked her to ensure that a thyroid function test has been checked in the past for completeness. She will need to have a repeat fasting lipid profile at some point in the future and in the first instance I have recommended she makes some lifestyle changes by altering her diet.

65

30.04.2014



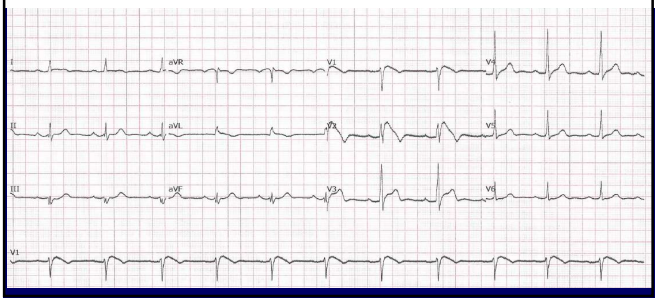
66



67

Brother's ECG - Brugada syndrome

PS She was able to send me a copy of her brother's ECG. This is indeed very interesting as it showed a 5 mm. J point elevation with cove shape ST elevation and T wave inversion in lead V2. Based on this ECG pattern I think Brugada syndrome needs to be excluded and I have informed both [redacted] and her sister who accompanied her today that I would like to see her brother as soon as possible or alternatively for him to see a reputable Cardiologist/Electrophysiologist in Qatar.



68

I reviewed this pleasant 39-year old gentleman today for a cardiology opinion. I met his sister [redacted] in April 2014, when she was reviewed with symptoms consistent with neurocardiogenic syncope. Fatima's ECG showed a secondary R wave in lead V1 and 2 mm J point elevation in lead V2 with a biphasic T wave. She informed me about her brother [redacted] who also had recurrent syncopal episodes and I asked her to send me a copy of his ECG. This showed a type 1 Brugada pattern and I suggested that he was reviewed by a cardiologist in Qatar.

[redacted] has a history of recurrent syncope usually precipitated by blood letting, emotional stress, during exam times, diarrhea illness and pain. His first episode occurred around nine years old after jumping and hurting his pelvic bone. He knows when he is going to have an episode as he feels dizzy, weak, diminutive hearing, vision goes fuzzy with a black cloud and he then loses consciousness for approximately 1-2 minutes. He can abort a syncopal episode if he lays flat. On regaining consciousness, he feels exhausted and "not right" for up to three hours. He has two-three episodes a year. He admits that his fluid intake is poor.

At age 28 years, he had one episode when he awoke at night feeling exhausted analogous to his symptoms when he has a syncopal episode.

23/12/15

69

There was one episode witnessed by his mother at age 29 years when he had a syncopal episode in the evening associated with "going stiff", "shaking" and tongue biting.

In 2005 (age 29 years) whilst studying in Manchester, he was investigated by a neurologist with a cerebral MRI scan and an EEG with visual stimulation, which were both unremarkable.

He has had pyrexial illnesses without a worsening of any syncopal episodes.

He has been investigated in Qatar by a few cardiologists. His echocardiogram has been reported as normal. He underwent an exercise tolerance test on the 4th August 2015 using the BRUCE protocol. He exercised for 13:02 minutes achieving 94% of his maximum predicted heart rate and a workload of 15.2 METS. There was an appropriate BP and chronic response. There were no arrhythmias. Interestingly, the J point elevation improved at peak exercise. A 24-hour ECG analysis (4th August 2015) was unremarkable with a minimum heart rate of 42 beats/minute, maximum 121 beats/minute and a mean of 74 betas/minute. He had a tilt test (13th August 2015), which was positive at 22 minutes after GTN provocation with a period of unrecordable BP and asystole. Apparently, he was given CPR during the asystolic period. Full blood count, renal function, liver function, thyroid function, calcium, glucose and cholesterol were all nremarkable.

He is on no current medication, although he was recommended fludrocortisone, which he stopped after one dose.

His father died of stomach cancer and his mother is alive and suffers with Diabetes Mellitus. Apart from one sister (Fatima) with syncope, there is no history of sudden unexpected death.

He is married, has one daughter and is expecting another child. He works as a drilling engineer.

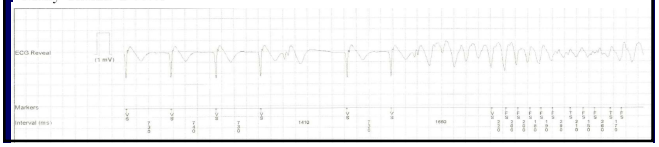
Examination: weight 48kg, height 1.63m. Pulse 69 beats/minute, regular. Lying BP 120/80 mm Hg, standing at 1 minute 110/80 mm Hg, and standing at 3 minutes 110/80 mm Hg. Heart sounds S1+S2. His chest was clear..

70

4th August 2016

To: aghuran2@yahoo.co.uk

Hey Doctor. It was Thursday around 01:30 am I was sleep on bed and all of a sudden opened my eyes and I knew it's coming. I was still and I did not move a finger, all I did is praying for it to go away but it hit me so fast. During the episode I was telling my self to wake up but it was like I want to wake up then I die then I wake up then I die was like this for duno maybe 10 or more times. I opened my eyes later on vomiting and kicking and swinging my Arms around. It was really trying. I meet three Docs here and all were surprised how I survive episodes like these. I appreciate your following and support. I will advice you with any new things
Many Thanks Doctor



71

Case 2

Patient's NHS number: 4022182164
Our ref: PDB/ja

26.01.2012

Consultant Cardiologist
The Lister Hospital
Corey Mill Lane
Stevenage, Herts.

EAST & NORTH HERTS NHS TRUST
3-2-12
03 FEB 2012
CONTACT CENTRE
LISTER

Dear Colleague [redacted]

I would be grateful for an urgent appointment for this 69 year old gentleman. He presented to me two weeks ago with an increasing six week history of ankle swelling and shortness of breath. It started after a coach trip. He had had similar problems with Felodipine in the past that caused swelling. I examined him and sent him for an ECG and some blood tests. He has returned today for his ECG which shows that he has gone into atrial flutter with a ventricular rate of approximately 60. He is otherwise stable. His blood tests were normal apart from a slightly raised BNP of 135.

I have discussed him with the medical registrar on call today at the Lister who luckily happened to be a cardiologist. He was incredibly helpful and advised me that the patient was safe to stay at home and be seen as an urgent outpatient with the proviso that if he deteriorated dramatically he was to attend A & E.

The patient has a history of essential hypertension and a history of a high risk of primary heart disease. He is on Aspirin since the recommendation by your colleague today, the other medication list is attached. He has no documented allergies. He had an ECG in September last year. I enclose a copy of this which is normal. He was not in flutter at this point.

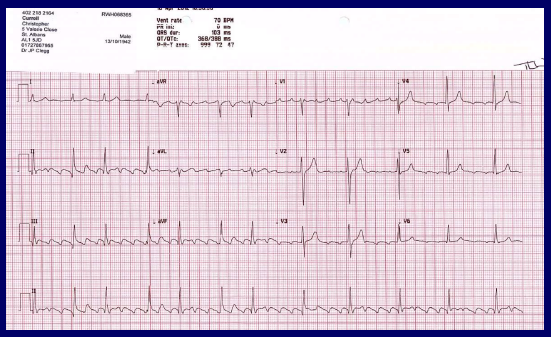
I would be very grateful for your urgent attention.

Yours sincerely

OPA letter sent 13/2/12 11.50

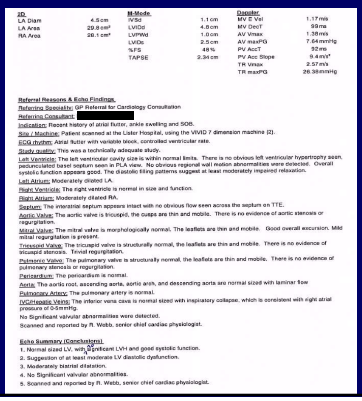
72

Case 2



73

Case 2



2D
LA Diam 4.8 cm
LA Area 29.8 cm²
RA Area 20.1 cm²

M-Mode
IVSd 1.1 cm
LVIDd 4.8 cm
LVPWd 1.0 cm
LVIDs 2.5 cm
%FS 48 %
TAPSE 2.34 cm

Doppler
MV E Vel 1.17 m/s
MV DecT 99 ms
MV Vmax 1.38 m/s
AV maxPG 7.64 mmHg
PV AccT 92 ms
PV Acc Slope 9.4 m/s²
TR Vmax 2.57 m/s
TR maxPG 26.38 mmHg

Referral Reasons & Echo Findings
Referring Speciality: GP Referral for Cardiology Consultation
Referring Consultant:
Indication: Recent history of atrial flutter, ankle swelling and SOB.
Site / Machine: Patient scanned at the Lister Hospital, using the VIVID 7 dimension machine (2).
ECG rhythm: Atrial flutter with variable block, controlled ventricular rate.
Study quality: This was a technically adequate study.
Left Ventricle: The left ventricular cavity size is within normal limits. There is no obvious left ventricular hypertrophy seen. Apical akinesis of the basal septum seen in PLA view. No obvious regional wall motion abnormalities were detected. Overall systolic function appears good. The diastolic filling patterns suggest at least moderately impaired relaxation.
Left Atrium: Moderately dilated LA.
Right Ventricle: The right ventricle is normal in size and function.
Right Atrium: Moderately dilated RA.
Septum: The interatrial septum appears intact with no obvious flow seen across the septum on TTE.
Aortic Valve: The aortic valve is tricuspid, the cusps are thin and mobile. There is no evidence of aortic stenosis or regurgitation.
Mitral Valve: The mitral valve is morphologically normal. The leaflets are thin and mobile. Good overall excursion. Mild mitral regurgitation is present.
Tricuspid Valve: The tricuspid valve is structurally normal, the leaflets are thin and mobile. There is no evidence of tricuspid stenosis. Trivial regurgitation.
Pulmonic Valve: The pulmonary valve is structurally normal, the leaflets are thin and mobile. There is no evidence of pulmonary stenosis or regurgitation.
Pericardium: The pericardium is normal.
Aorta: The aortic root, ascending aorta, aortic arch, and descending aorta are normal sized with laminar flow
Pulmonary Artery: The pulmonary artery is normal.
IVC/Hepatic Veins: The inferior vena cava is normal sized with inspiratory collapse, which is consistent with right atrial pressure of 0-5mmHg.
No Significant valvular abnormalities were detected.
Scanned and reported by R. Webb, senior chief cardiac physiologist.

Echo Summary (Conclusions)
1. Normal sized LV, with significant LVH and good systolic function.
2. Suggestion of at least moderate LV diastolic dysfunction.
3. Moderately biatrial dilatation.
4. No Significant valvular abnormalities.
5. Scanned and reported by R. Webb, senior chief cardiac physiologist.

74

Case 2

Re: [redacted]

Thank you for referring this gentleman whom I met for the first time in the Cardiology Department today. I understand appropriately five weeks ago he noted he was becoming more short of breath on exertion with associated ankle swelling and an ECG done at your Practice showed typical atrial flutter. There was no associated chest pain or tightness.

An ECG done in September 2011 was essentially normal. Felodipine in the past has caused ankle swelling but after reducing the dose his symptoms had improved. He is quite an active gentleman and can walk up to five miles in a day on a weekly basis.

His past medical history includes hypertension, prostatectomy, sigmoidoscopy and resection of benign polyps, Augmentin-induced hepatitis and a vasectomy. His cholesterol was previously elevated at 5.1 and he was unable to tolerate a statin but due to dietary changes his cholesterol is now 4.2 mmol/l.

His current medication consists of aspirin 75 mg daily, lisinopril 20 mg daily, atenolol 50 mg daily, felodipine MR 5 mg daily, doxazosin 8 mg daily.

His father had Parkinson's disease. He does not smoke and drinks up to five units of alcohol a week.

Examination: Pulse 84 beats per minute, JVP not elevated. Blood pressure 138/73. Heart sounds, chest and abdomen were unremarkable. There was no ankle oedema. He scores 2 on the CH2DS2-VASc score and his HAS-BLED score equals 1.

In conclusion this gentleman has new onset typical atrial flutter and I will arrange to start him on warfarin and also cardiovert him. Once his INR has been therapeutic for more than three weeks we can arrange DC cardioversion. I have routinely given him appointment for five months' time to assess him following his DC cardioversion.

Thanks once again for your referral and should you have any queries please do not hesitate to contact me.

Yours sincerely

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Case 3

Re: [redacted]

I would be grateful if you could send this 75 year old lady an appointment to see you. She complains of her heart keeping "skipping a beat". This happened in May and lasted 10 hours.

The most recent episode was on 31st July 2010. It started at 6.00 am and she felt quite weak and had difficulty getting upstairs. Her heart was racing. She attended Lister Casualty who started her on Bisoprolol 1.25 mg daily and suggested referral for an echo and 24 hour tape.

I enclose a copy of her past medical history, but as far as her cardiovascular system is concerned, the only history of note is essential hypertension for which she takes Amlodipine 5 mg daily. I also enclose a copy of her drug sensitivities and of note here is that she had a severe drug hypersensitivity reaction to Carbamazepine, with abnormal LFT's and FBC.

I would be grateful for your help with her further investigation and management.

With best wishes.

Yours sincerely

76

Case 3

[redacted] 77 year old lady

Thank you very much for referring this patient whom I saw for the first time [redacted] Hospital today. She has been having palpitations for a few years which she describes as irregular and a mixture of fast and slow beats that usually occur late in the evening and resolves by the early hours of the morning. These tend to occur every two months. In addition she also gets shorter episodes of palpitations which last a few seconds. On 31st July she had an episode of palpitations with a mixture of pauses and quick beats which made her feel generally weak, faint and sweaty. By the time she arrived to the A&E Department she was in sinus rhythm and she was commenced on Bisoprolol 1.25mg daily and Aspirin 75mg daily. It was suggested she be referred for further cardiac investigations. Since commencing Bisoprolol she has not had any further symptoms although it has only been two weeks.

Her past medical history includes hypertension, trigeminal neuralgia, hay fever, varicose vein operations, cervical spondylosis and subtotal hysterectomy for fibroids.

Her current medication consists of Aspirin 75mg daily, Amlodipine 5mg daily, Fexofenadine prn, Monetasone nasal spray and Omeprazole 20mg daily. She had a significant allergic reaction to Carbomazepine causing a rash, abnormal liver function test, low blood count. Lisinoprol in the past also caused a swollen tongue. She drinks up to one unit a week and does not smoke.

Examination: pulse 60 beats per minute regular. Blood pressure 156/62. JVP not elevated. Heart sounds, chest and abdomen were unremarkable. Her dorsalis pedis arteries were bilaterally palpable. ECG showed normal sinus rhythm with normal conduction indices and a heart rate of 56 beats per minute. I contacted the [redacted] to get her blood results

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Case 3

which showed normal full blood count and U&Es. Unfortunately her thyroid function test was not arranged.

This lady's history is highly suggestive of paroxysmal atrial fibrillation but we need to document this with an ECG. I have arranged for her to have a 24 hour tape as well as an echocardiogram. I have also arranged to check her thyroid function test and liver function test as a baseline should we ever need to commence Amiodarone in the future. I have asked her to continue her current medication for the time being as I did not want to increase her Bisoprolol dose further given her sinus bradycardia of 56 beats per minute. The next investigation of choice would be an event recorder and I have asked her to attend either your practice or the A&E department should she have a prolonged episode of palpitations so that we can document her heart rhythm at the time.

I have arranged to review her again in six weeks' time.

Thank you once again for your referral.

Yours sincerely,

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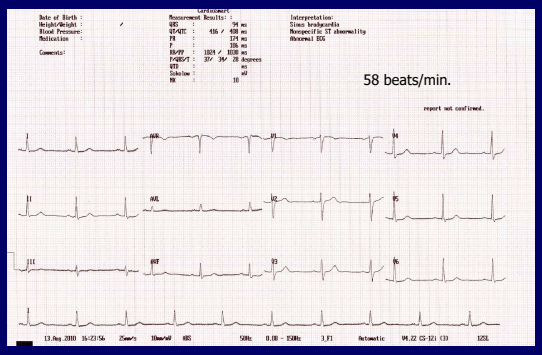
Case 3



79

2D

LA Area	26.7 cm²
Ao Diam SVals	2.62 cm
LA Diam	4.17 cm
LVIDd subcostal	5.50 cm

M-Mode

IVSd	0.9 cm
LVIDd	5.6 cm
LVPWd	0.9 cm
LVIDs	2.9 cm
%FS	48 %
Ao Diam	2.7 cm
LA Diam	4.4 cm
LA/Ao	1.65
TAPSE	2.33 cm

Doppler

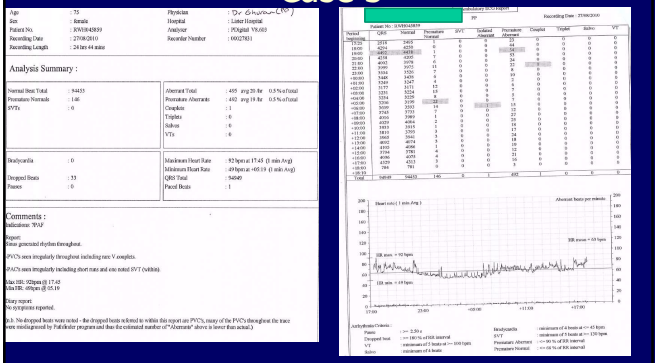
MV E Vel	0.72 m/s
MV A Vel	0.74 m/s
MV E/A Ratio	0.96
AV Vmax	1.38 m/s
AV maxPG	7.58 mmHg
P Vein S	0.69 m/s
P Vein D	0.43 m/s
P Vein S/D Ratio	1.60
PV AccT	118 ms
PV Acc Slope	7.6 m/s²
TR Vmax	2.47 m/s
TR maxPG	24.36 mmHg
E'	0.04 m/s

Referral Reasons
Dr Ghuran
PP

Echo Findings
LV - LV is mildly dilated in all views. No LVH. Good systolic function. No RWMA. Mild diastolic dysfunction.
MV - Normal structure. Thin and mobile. No stenosis. Mild regurgitation, - vena contracta <0.3cm.
AoV - Tri-leaflet. Thin and mobile. No stenosis. No regurgitation.
LA - Mild to moderately dilated.
RA - Normal size.
IAS - Appears intact with no inter-atrial shunt detected on TTE.
RV - Normal size. Good systolic function.
TV - Normal structure. No stenosis. Mild regurgitation.
PV - Normal structure. No stenosis. Physiological whiif of regurgitation.
IVC - Normal size with normal inspiratory collapse. Suggestive of RAP of 0-5mmHg.
Ascending aorta, Aortic arch and Descending aorta normal size with laminar flow.
Pericardium - Unremarkable.

80

Case 3



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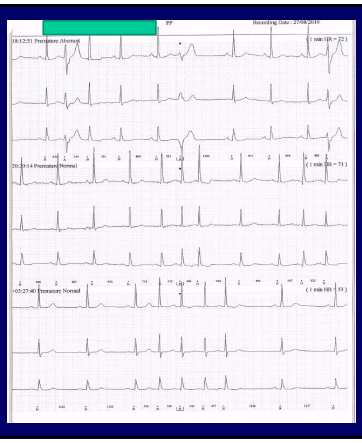

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Case 3

Diagnoses:

1. Palpitations – need to exclude paroxysmal atrial fibrillation/atrial tachyarrhythmias
2. Hypertension
3. Trigeminal neuralgia
4. Hay fever
5. Cervical spondylosis
6. Subtotal hysterectomy for fibroids
7. Previous varicose vein operation
8. CHA2DS2-VASc = 3, HASBLED score = 1

Since this lady was last reviewed three months ago she has had one episode of palpitations two months ago lasting five hours. She described the palpitations as an irregular beat, pauses and a mix of fast beats and was associated with tightness.

Examination: pulse 64 beats per minute, blood pressure 142/58.

I will appreciate if you can increase her Bisoprolol to 2.5mg daily and I will also arrange for her to have a two week event recorder.

Once we have documented that she is having episodes of atrial fibrillation then she will need to be anti-coagulated with warfarin. I have arranged to review her again in three months' time.

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Case 3

84

Diagnoses:

1 Palpitations – atrial tachyarrhythmias
2 Hypertension
3 Trigeminal neuralgia
4 Hay fever
5 Cervical spondylosis
6 Subtotal hysterectomy for fibroids
7 Previous varicose vein operation
8 CHA2DS-VASc score = 3, HASBLED score = 1

[redacted] has now had her event recorder during which she had three episodes of heart flutter, two of which correlated with single ectopic beats and the other one showed sinus rhythm. There were asymptomatic episodes of an atrial tachycardia up to eight beats. I am not sure whether her heart flutters are reminiscent of her long episodes of palpitations and I will review the situation when she next attends clinic.

She is predisposed to having atrial fibrillation and should she have any prolonged episodes of palpitations then she knows that she really needs to attend your surgery or the nearest A&E Department for an ECG recording.

In the meantime she should continue with her medication which consists of Bisoprolol 2.5mg daily, Amlodipine 5mg daily, Fexofenadine prn, Omeprazole 20mg daily, Aspirin 75mg daily and Naproxen 500mg prn.

Please feel free to contact me should you have any queries.

Yours sincerely,

85

[redacted]

Diagnoses:

1 Confirmed paroxysmal atrial fibrillation
2 Hypertension
3 Trigeminal neuralgia
4 Hay fever
5 Cervical spondylosis
6 Subtotal hysterectomy for fibroids
7 Previous varicose vein operations
8 CHA2DS-VASc score = 4 HAS BLED score = 2
9 Severe allergic reaction to Carbamazapine, Lisinopril caused a swollen tongue

I reviewed [redacted] today in clinic. I understand 27th February 2011 she had an epistaxis episode which was initially treated at Lister Hospital and her Aspirin was discontinued. She was also noted to be hypertensive and her Amlodipine dose was increased. She subsequently underwent needle cauterisation by Mr Quinn.

On 12th April she had palpitations and she went to the A&E department at Lister Hospital where they diagnosed atrial fibrillation and the Bisoprolol dose was increased to 5mg daily. I note some blood tests showed a magnesium of .69 and potassium of 6.7. Because of ankle swelling the Amlodipine dose was decreased to 5mg daily. She has been referred to the anti-coagulation clinic for commencement of Warfarin.

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Examination today: pulse 60 beats per minute, regular. Blood pressure 150/64, 147/67, 147/67. Now that her nose has been cauterised I am happy for her to commence Warfarin. Once Warfarin has been commenced her Aspirin can be discontinued.

I will appreciate if you can continue to monitor her blood pressure and if necessary commence an angiotensin blocker and not an ACE inhibitor given her previous reaction to Lisinopril.

ECG today confirmed sinus rhythm. I reviewed her ECG from 12th April which confirmed atrial fibrillation with a ventricular rate of 114 beats per minute. As her magnesium was a little low I have asked her to reduce her Omeprazole to 10mg daily. There is an association of too much acid suppression resulting in a reduction in magnesium absorption which itself can precipitate ectopic beats and possibly arrhythmias. She should continue the rest of her other medication which consists of Bisoprolol 5mg daily, Aspirin 75mg daily(until commenced on Warfarin), Amlodipine 5mg daily, iron sulphate, Mometasone nasal spray and Simvastatin 40mg daily. Her cholesterol level should be treated according to current primary prevention guidelines.

I will review her again in six months' time (4th November 2011).

Yours sincerely,

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Case 6

Thank you very much for referring this pleasant 44-year-old lady with a history of palpitations. She has had palpitations for over 10 years, but over the past year, her symptoms have worsened. Her palpitations can occur at any time, are fast, regular, and can last a few minutes. She can terminate her episodes by "bearing down" which is analogous to a Valsalva manoeuvre. She sometimes experiences a heavy pressing pain during her palpitation symptoms. Her symptoms are variable and can occur once a week or every few weeks. She is able to jog two times a week without any exertional symptoms although she has experienced her palpitations whilst jogging. She drinks up to two cups of coffee a day and up to 3 units of alcohol a week. There are no risk factors for ischemic heart disease however, she is unsure of her cholesterol level.

Her past medical history includes tonsillectomy, appendectomy, previous bilateral fractures of the wrists, arthroscopy of both knees, and an anterior cruciate ligament repair of the left knee. She had a normal mammogram in September 2014.

She is on no regular medication.

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Case 6

Her father is alive at age 72 and suffered with TB as a child. Her mother is alive at age 67 and has asthma and thyroid issues.

She is married with two children, ages 8 and 15. She works as an accountant.

Examination: pulse 58 beats per minute, regular. JVP not elevated. Blood pressure 130/80. Heart sounds S1 plus S2, plus a grade 2/6 systolic murmur in the aortic area and the left sternal edge. Her chest and abdomen were unremarkable. Her ECG showed normal sinus rhythm with a ventricular rate was 58 beats per minute. There was normal conduction indices and waveform morphology.

This lady's history of palpitations is suggestive of an organized arrhythmia and probably a supraventricular tachyarrhythmia. I have arranged for her to have a one week event recorder, an echocardiogram, as well as an exercise tolerance test. I have also arranged some baseline blood tests. I will review her afterwards with the results of these investigations.

Thanks very much for your referral and should you have any queries, please do not hesitate to contact me.

Yours Sincerely,

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Case 6

Diagnoses:

1. Palpitations – need to exclude a supraventricular tachyarrhythmia.
2. Appendicectomy
3. Bilateral wrist fractures.
4. Anterior cruciate ligament repair of the left knee.

I reviewed [redacted] today in clinic following the recent investigations. Her haemoglobin, platelets, and white cell count were all normal. The MCV was mildly elevated at 102.9 fL (80-99). Her U&E's, calcium, glucose, and thyroid function tests were normal. Her total cholesterol is 3.1 mmol/L, HDL 1.6 mmol/L, triglycerides 0.5 mmol/L, LDL cholesterol 1.27 mmol/L. Her liver function tests were normal apart from a mildly elevated alkaline phosphatase of 142 IU/L (35-105).

Her echocardiogram showed a structurally normal heart. She underwent an exercise tolerance test where she exercised to 10 minutes, 40 seconds on the Bruce protocol, achieving a workload of 12.9 mets and 106% of her maximum predicted heart rate. The test was discontinued because of fatigue. She had an appropriate chronotropic and blood pressure response. There were no significant ECG changes and there were no arrhythmias. During her one week event recorder, she had no palpitation symptoms. However, there was one episode when she felt she had some chest pain and breathlessness, however, her ECG showed sinus rhythm with a ventricular rate of 97 beats per minute. There were short asymptomatic salvoes of supraventricular ectopic beats up to four beats.

[redacted] remains well with no history of any palpitation symptoms since August. She has invested in an AliveCor ECG monitor, which she can use with her iPhone. If she has any further palpitation symptoms that are prolonged, she will make a recording and email it to me. I would appreciate if you can repeat her full blood count and liver function tests (monitoring her MCV and alkaline phosphatase, respectively), and arrange further investigations if required. I would like to review her in three months' time.

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Case 6

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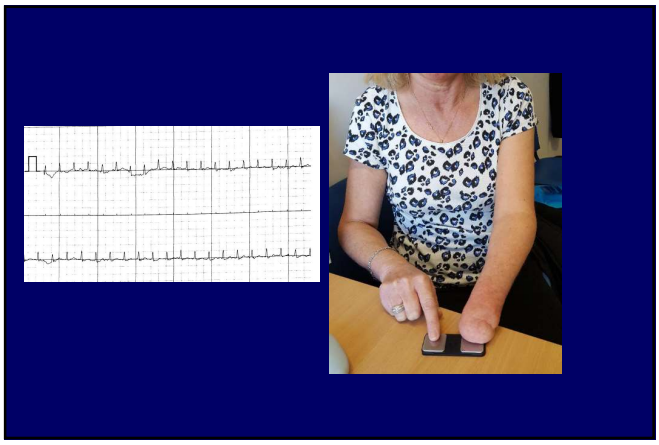

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Case 7

Thank you very much for referring this pleasant 71-year-old lady. On 6th May 2015, whilst playing badminton, she suddenly noticed that her heart was racing and did not settle. She felt lightheaded and felt that she could not breathe easily. There were no associated pre-syncopal or syncopal symptoms, chest pain or tightness. She described her palpitations as fast and irregular. She managed to drive home and her blood pressure machine recorded a systolic blood pressure of 100 mmHg and a pulse of 142 beats per minute. I believe there were some error messages initially trying to record her pulse rate (this is not unusual in the setting of atrial tachyarrhythmias). Her blood pressure is normally around 130/60. Her symptoms lasted for approximately 3 hours and gradually resolved. She has experienced no further subsequent symptoms or previous symptoms prior to this episode. She plays badminton twice a week and is quite active.

In 2011, after six immunization injections, prior to flying to South Africa, she woke the following morning with shortness of breath, and subsequently had a 24-hour tape and echocardiogram at the Hammersmith Hospital. These investigations, we believe

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Case 7

were reported as normal. Her past medical history includes a partial oophorectomy for a non-malignant growth.

She takes aspirin 75 mg occasionally. Her mother died at age 67 years with a stroke. She is married with one daughter, age 52. She is an ex-smoker since 1999 and drinks up to 7 drinks of alcohol a week. There is no significant caffeine intake. She is a retired social worker.

Examination: Pulse 62 beats a minute, regular. JVP is not elevated. Blood pressure 106/80. Heart sounds, S1 plus S2. Chest and abdomen were unremarkable. ECG shows normal sinus rhythm with normal conduction indices and wave form morphology.

I understand you have done some blood tests and I will appreciate if you can send me a copy of these results.

Her history is very suggestive of paroxysmal atrial fibrillation, which needs to be excluded. I have arranged for her to have an echocardiogram and exercise tolerance test given that her symptoms were precipitated during exertion. I was considering arranging a 24-hour tape; however, she is self-funding and the diagnostic yield, given that she has had no further symptoms is likely to be low. I have showed her an ECG monitor that she can use with her iPhone. Alternatively, she can purchase a separate device that can record a single lead ECG whenever she has symptoms. The costs of these devices are considerably less than the cost of arranging a 24-hour tape and would be more useful given that her symptoms occur sporadically. I will review her in due course.

Thank you very much for your referral. If you have any queries, please do not

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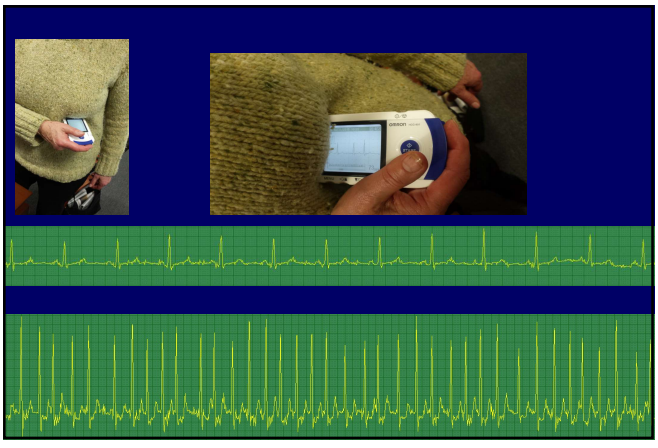

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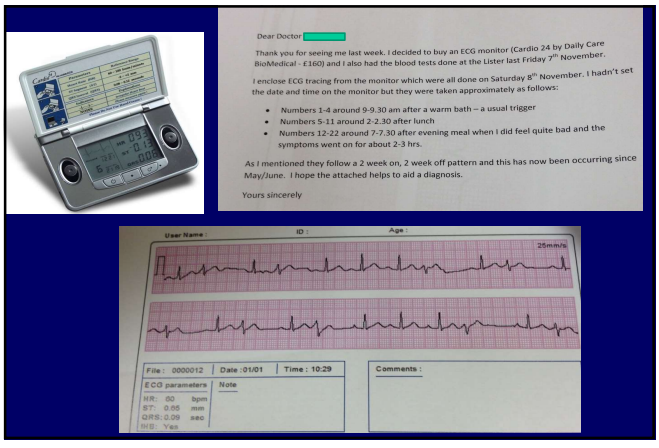

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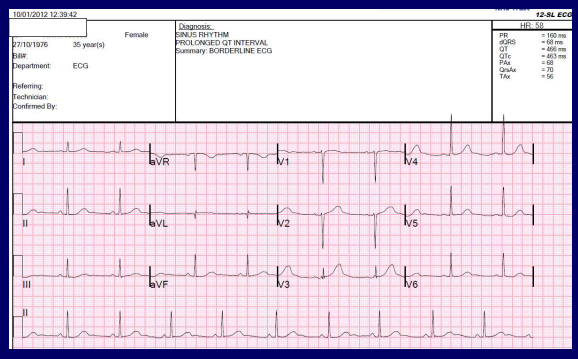
Case 7A



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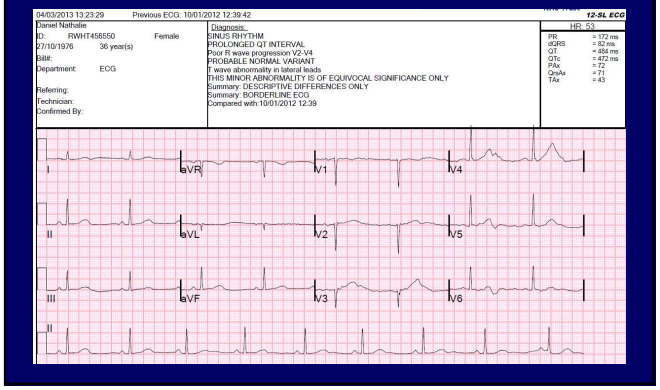
Case 7A



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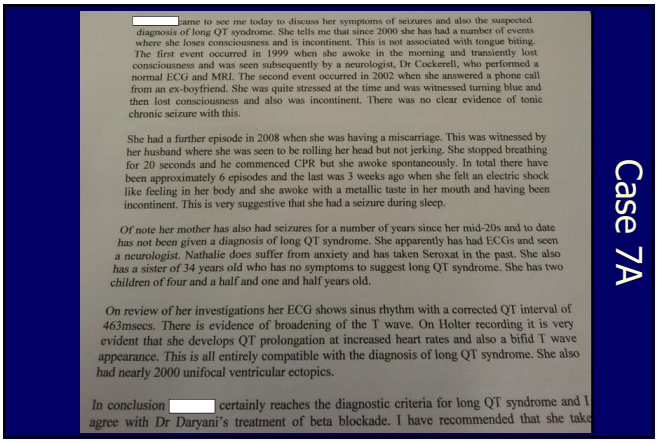

[redacted] came to see me today to discuss her symptoms of seizures and also the suspected diagnosis of long QT syndrome. She tells me that since 2000 she has had a number of events where she loses consciousness and is incontinent. This is not associated with tongue biting. The first event occurred in 1999 when she awoke in the morning and transiently lost consciousness and was seen subsequently by a neurologist, Dr Cockerell, who performed a normal ECG and MRI. The second event occurred in 2002 when she answered a phone call from an ex-boyfriend. She was quite stressed at the time and was witnessed turning blue and then lost consciousness and also was incontinent. There was no clear evidence of tonic chronic seizure with this.

She had a further episode in 2008 when she was having a miscarriage. This was witnessed by her husband where she was seen to be rolling her head but not jerking. She stopped breathing for 20 seconds and he commenced CPR but she awoke spontaneously. In total there have been approximately 6 episodes and the last was 3 weeks ago when she felt an electric shock like feeling in her body and she awoke with a metallic taste in her mouth and having been incontinent. This is very suggestive that she had a seizure during sleep.

Of note her mother has also had seizures for a number of years since her mid-20s and to date has not been given a diagnosis of long QT syndrome. She apparently has had ECGs and seen a neurologist. Nathalie does suffer from anxiety and has taken Seroxat in the past. She also has a sister of 34 years old who has no symptoms to suggest long QT syndrome. She has two children of four and a half and one and half years old.

On review of her investigations her ECG shows sinus rhythm with a corrected QT interval of 463msecs. There is evidence of broadening of the T wave. On Holter recording it is very evident that she develops QT prolongation at increased heart rates and also a bifid T wave appearance. This is all entirely compatible with the diagnosis of long QT syndrome. She also had nearly 2000 unifocal ventricular ectopics.

In conclusion [redacted] certainly reaches the diagnostic criteria for long QT syndrome and I agree with Dr Daryani's treatment of beta blockade. I have recommended that she take

Case 7A

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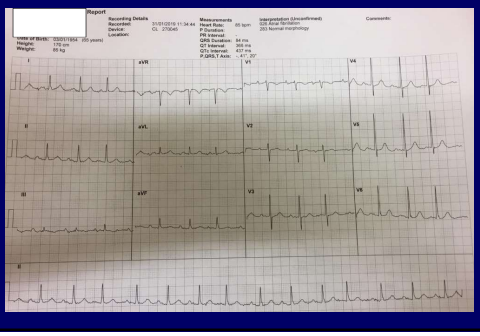
Correspondence from a GP:
Asymptomatic 64 yr Old heavy drinker
Irregular pulse – looks like ectopic beats as preceding p waves



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Summary

- ECGs are easy (ish)
- Just use a system
- You only get good at ECGs by reading hundreds and thousands
- NEVER EVER believe what the automated machine say… you are better than a computer!

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