ECG's common abnormalities and approach to diagnosis

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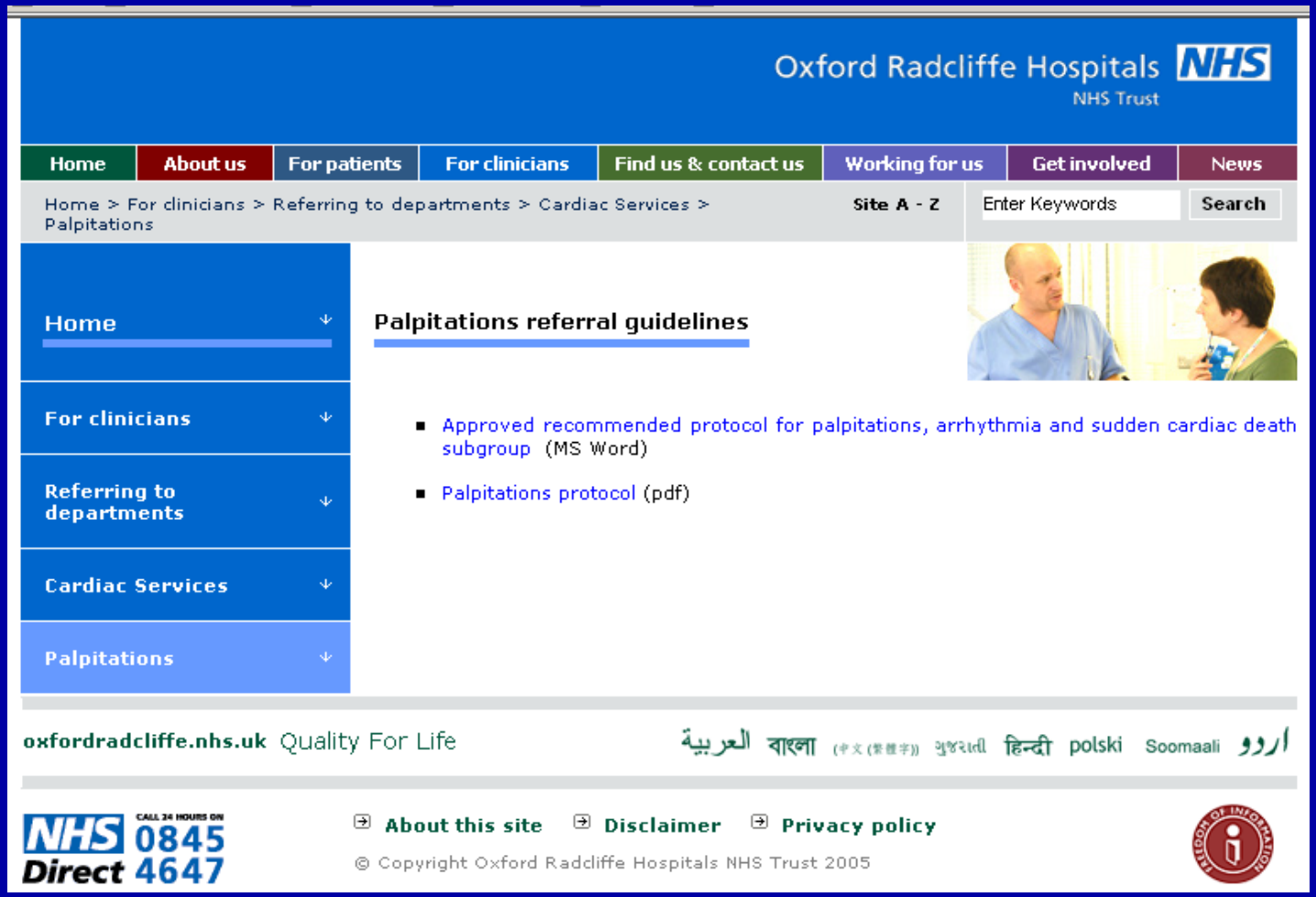
Approach to the patient with palpitations

http://orhtest.oxnet.nhs.uk/forclinicians/referrals/cardiac/palpitations/palpitations.aspx



Causes of palpitations

- Awareness of sinus rhythm
- Ectopics
- SVT (AVNRT, AVRT)
- Atrial fibrillation
- Atrial Flutter
- Ventricular tachycardia

Awareness of sinus tachycardia

- Rate usually <120
- Slow onset and offset.
- May be associated with exercise
- Watch out for
  - Anaemia
  - Hypertension
  - Hyperthyroidism

What to ask - 1

- Sudden onset and offset – SVT
- Fast and totally irregular – AF
- Pause and thump – ectopics
- Associated symptoms
  - Syncope
  - Chest pain
  - Breathlessness
- Relationship to exercise

What to ask - 2

- Coffee and alcohol consumption
- History of hypertension, cardiomyopathy, valvular or ischaemic heart disease
- FH of sudden death or arrhythmias
- Drugs eg salbutamol

Features of benign ectopic activity

- Pause and thump pattern.
- At rest
- Relieved by exercise
- No associated chest pain syncope or breathlessness
- No family history
- Normal ECG and examination

What to do with benign ectopy

- Reassure
- Reduce alcohol, caffeine, asthma inhalers etc
- Relaxation therapy?
- Avoid drug therapy if possible

Higher risk patients

- Associated with structural heart disease, valvular, ischaemia, cardiomyopathy, left ventricular hypertrophy
- Associated syncope, chest pain, dyspnoea
- Exacerbation with exercise, exercise induced syncope
- FH of sudden death or non ischaemic cardiomyopathy
- Abnormal ECG

High risk electrocardiograms

Conditions associated with potentially fatal arrhythmias

- Ischaemic cardiomyopathy
  - Wide QRS, low ejection fraction
- Long QT syndrome
- Brugada syndrome
- Right Ventricular Dysplasia
- Dilated cardiomyopathy
- Hypertrophic cardiomyopathy
- WPW

Congenital Long QT

- Jervell and Lang Neilsen syndrome
  - Congenital deafness and malignant arrhythmias in infancy
- Romano Wards syndrome
  - Autosomal dominant inheritance

Many molecular defects identified

Acquired long QT syndromes

- Anti arrhythmic agents (Class I and III)
- Antibiotics (macrolides, imidazoles)
- Histamine receptor antagonists
- Diuretics (indapamide)
- Cholinergic agonists (cisapride)
- Opiates
- Poisons (arsenic, organophosphates)
- Metabolic (hypokalaemia, hypomagnesaemia, hypocalcaemia)
- Bradyarrhythmias
- Starvation
- Nervous system injury

Brugada Syndrome

- Familial (40%), autosomal dominant inheritance with incomplete penetrance.
- Incidence 5-66 per 10,000.
- 8:1 predominance of males, average age 40.
- Mutation in SCN5A – gene encoding for α subunit of the sodium channel.
- Recurrence rate of ventricular fibrillation 40% at 3 years follow up.

Wilde et al European Heart Journal 2002; 23: 1648-1654

Are symptoms present at the time of the consultation?

YES

NO

Perform a 12 lead ECG including long rhythm strip if necessary:

Diagnosis

- *Sinus rhythm* – reassure. Look for systemic causes of heart beat awareness (stress, thyrotoxicosis, infection etc)
- *Ectopic beats* – reassure, especially if no other cardiac issues. No treatment required for the ectopics.
- *Atrial fibrillation/flutter* – treat and refer according to usual protocols (thromboprophylaxis, rate vs rhythm control etc)
- *Supraventricular or ventricular tachycardia* – attempt vagal manoeuvres if appropriate. Direct referral to A&E if persistent tachycardia

Are there high-risk indicators that would prompt referral anyway? e.g.

- Syncope
- Family history of sudden cardiac death at a young age
- Major structural heart disease
- Chest pains or breathlessness
- Major ECG abnormality
- Heart murmur

YES

Refer to cardiology outpatients

Low risk patients without high risk features at the time of presentation

Can the diagnosis be made from the description?

YES

NO

Diagnosis

- ***Sinus rhythm*** (*gradual onset and offset, basically regular although rate may vary slightly, able to count rate (<160 bpm), no significant compromise*) – reassure. Look for systemic causes of heart beat awareness (stress, thyrotoxicosis, infection etc)

- ***Ectopic beats*** (*Missed, skipped, strong or weak "extra beats". Often worse at rest*) – Reassure, especially if no other cardiac issues. No treatment required for the ectopics.

- ***Atrial fibrillation*** (*Irregularly irregular, usually faster than sinus rate, may have sudden onset and offset*) – May wish to confirm diagnosis with investigations. Refer and treat according to usual protocols (thromboprophylaxis, rate vs rhythm control etc)

- ***Supraventricular or ventricular tachycardia*** (*Sudden onset and offset, very rapid i.e. too fast to count, additional symptoms of breathlessness, chest tightness and dizziness)* – **Refer to Cardiology OP**

Standard screening tests

Resting 12 lead ECG
FBC and TFTs

Investigate further to correlate rhythm with symptoms

- If symptoms have a long duration (many hours) attend GP surgery or A&E for 12 lead ECG during next episode

- If symptoms short-lived but frequent (>2-3 times per week) use a 24 hour Holter monitor

- If symptoms short-lived and infrequent (<1 a week) use an Event monitor or transtelephonic recorder.

When rhythm documented during symptoms, use adjacent **Diagnosis** box for guidance.
If unable to correlate rhythm with symptoms, reassure. No need to refer. Further investigation can be deferred unless symptoms change or high risk factors develop.

24 hour tape findings in healthy individuals

Sinus arrhythmia	50% in young
Sinus pauses (>1.75 sec)	28% in young
Mobitz 1	4-6%
Atrial premature beats	56-64%
– >100/24 hours	2%
Ventricular ectopy	50-54%
– >50/24 hours	2-6%

T
Long-term follow-up of asymptomatic healthy subjects with frequent and complex ventricular ectopy.

A Kennedy HL; Whitlock JA; Sprague MK; Kennedy LJ; Buckingham TA;
U Goldberg RJ

S N Engl J Med 1985 Jan 24;312(4):193-7.
O

We conclude that the long-term prognosis in asymptomatic healthy subjects with frequent and complex ventricular ectopy (bigemini, trigemini, couplets) is similar to that of the healthy U.S. population and suggests no increased risk of death.

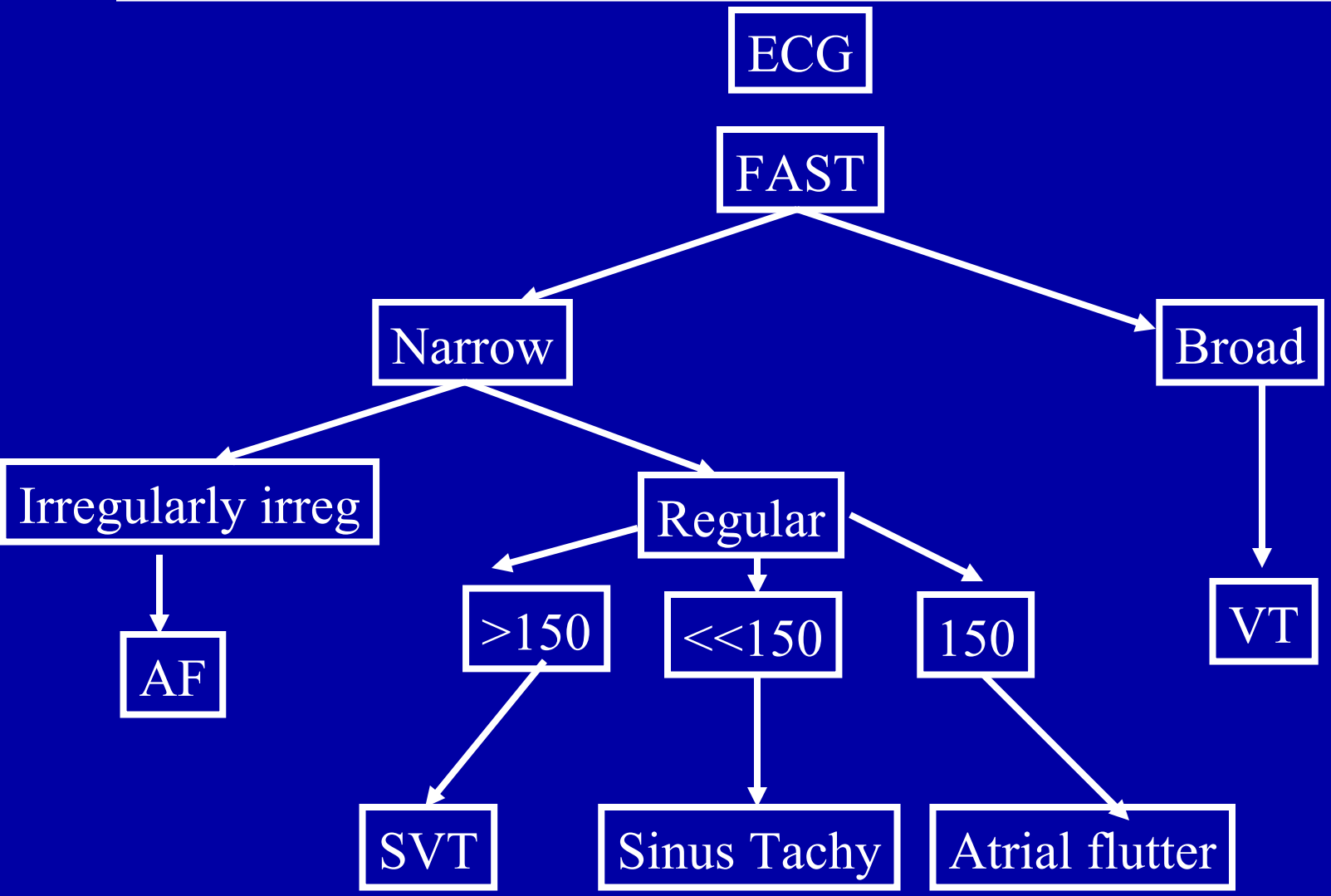
Findings on holter monitoring

- Ventricular ectopics
  - Unifocal -
    - normal ECG and examination no cardiac history – ignore.
    - Abnormal resting ECG (excluding findings of ectopics)
  - Bigemini –
    - Asymptomatic normal resting ECG – reassure
    - Abnormal resting ECG - discuss
    - Syncope – discuss
  - Multifocal –
    - Asymptomatic normal resting ECG – reassure
    - Abnormal resting ECG
    - Syncope – discuss
  - Ventricular tachycardia - refer cardiology
- Atrial ectopics
  - Benign – reassure
- Asymptomatic AF
  - Echo
  - Manage according to CHADS2
- Asymptomatic SVT
  - Normal resting ECG – reassure
  - Abnormal resting ECG ? Review possibility of WPW

Findings on Holter monitoring - 2

- Pauses
  - < 3seconds – ignore
  - >3 seconds
    - Symptoms of palpitations consider SSS
    - History of syncope – consider longer recording
    - Associated with symptoms – refer
    - Asymptomatic - nocturnal? Daytime - discuss
- 1st degree heart block
  - Asymptomatic – reassure
  - History of syncope – consider more prolonged recording.
- Mobitz type 1 (progressive PR prologation)
  - Asymptomatic – ignore
  - Symptoms of palpitations – ignore
  - Symptoms of syncope – consider more prolonged recording
- Mobitz type 2 (2:1, 3:1 etc)
  - Asymptomatic and nocturnal probably benign – discuss
  - Symptoms of syncope – refer
  - Symptoms of palpitations – discuss
- Mobitz type 3
  - Refer
- Nodal rhythm
  - Asymptomatic – probably benign
  - Palpitations – consider SSS
  - Syncope - refer

The simple approach to tachyarrhytmias



Some common problems

- Blocks/Axis changes
- LBBB and RBBB
- Incidental ST elevation
- LVH
- Q waves
- ST elevation

Using beta blockers in conduction disease

- Contraindications to starting
  - Heart block second degree or more
  - Trifascicular block
  - LBBB and first degree heart block (not LBBB alone)
- Indications for withdrawal/reduction in therapy on 12 lead ECG
  - Symptomatic bradycardia (<50)
  - Second degree heart block
  - Trifascicular block with a history of syncope
  - Asymptomatic trifascicular block (depends on indication) – consider 24 hour tape

Indications for referral for assessment of conduction abnormalities prior to anaesthesia

- Second degree or third degree heart block
- Symptomatic sinus bradycardia
- Trifascicular block (requires 24 hour tape)

NOT

- First degree heart block
- Left anterior hemiblock
- Left bundle branch block (may require referral if new in its own right)
- Right bundle branch block
- Asymptomatic sick sinus syndrome

Bundle Branch Block

- Left bundle branch block should always be regarded as pathological
- Partial left bundle branch block - not a conventional term should be:
  - Left anterior hemiblock (left axis deviation)
  - Left posterior hemiblock (right axis deviation)
  - Left anterior hemiblock nis quite common in the elderly
- Right bundle branch block is not necessarily pathological and partial right bundle branch block (QRS duration <120 msec) is a normal variant

Right Bundle Block

- Associations
  - Right heart failure
  - Pulmonary hypertension
  - Atrial septal defect
  - Pulmonary embolism
- Benign finding
  - No increased incidence of coronary disease in asymptomatic patients
  - Slight increased incidence of progression to AV block (4 fold risk)

Abnormal axis

Right axis

- Right ventricular dominance
- Reversed arm electrodes
- Dextrocardia
- Wolff Parkinson white syndrome
- Left posterior hemiblock

Left axis

- Left anterior hemiblock
- Inferior wall myocardial infarction
- Emphysema
- WPW
- Apical pacing or apical ectopic

Left ventricular hypertrophy does not change the axis

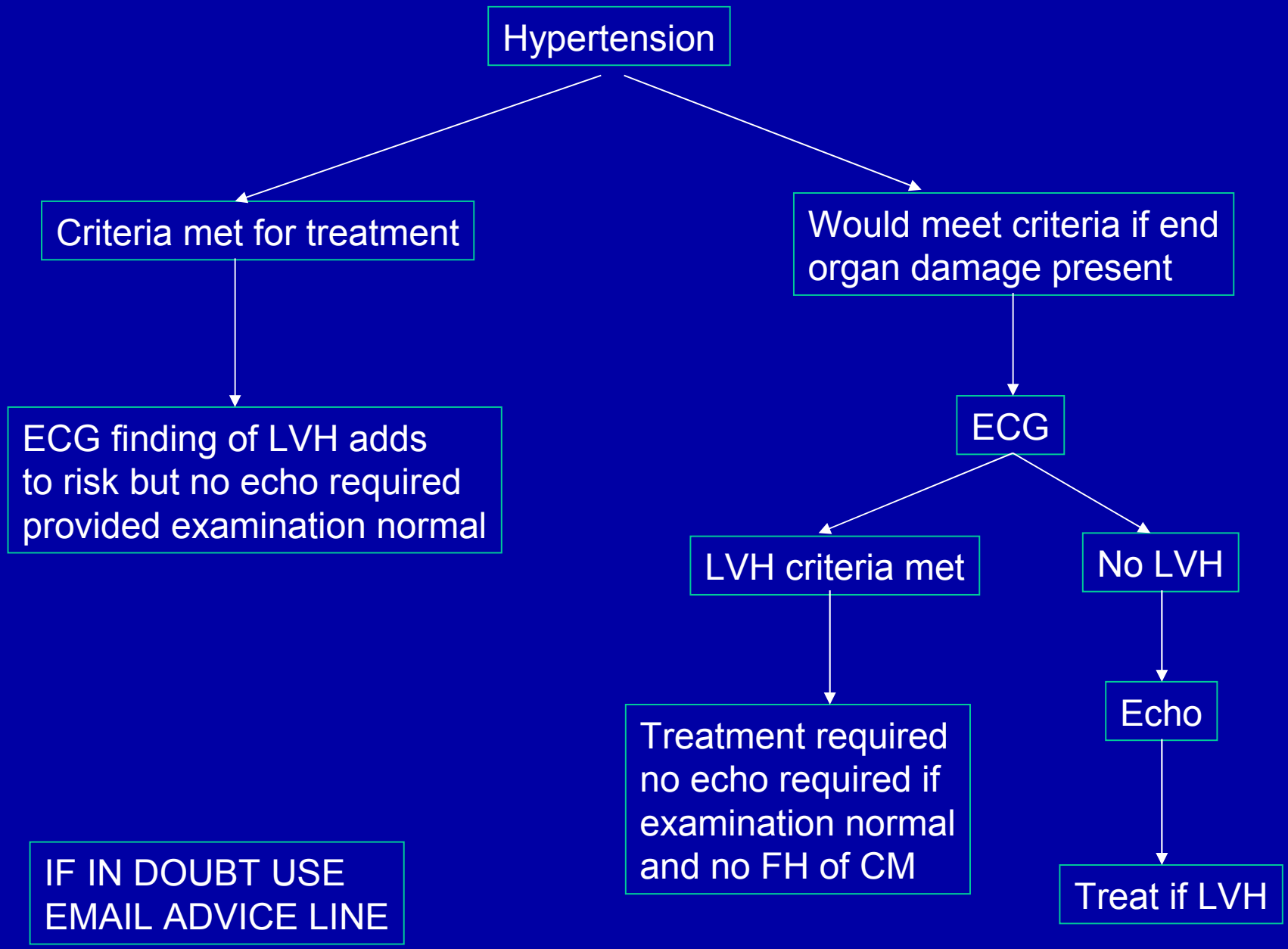
ST Changes

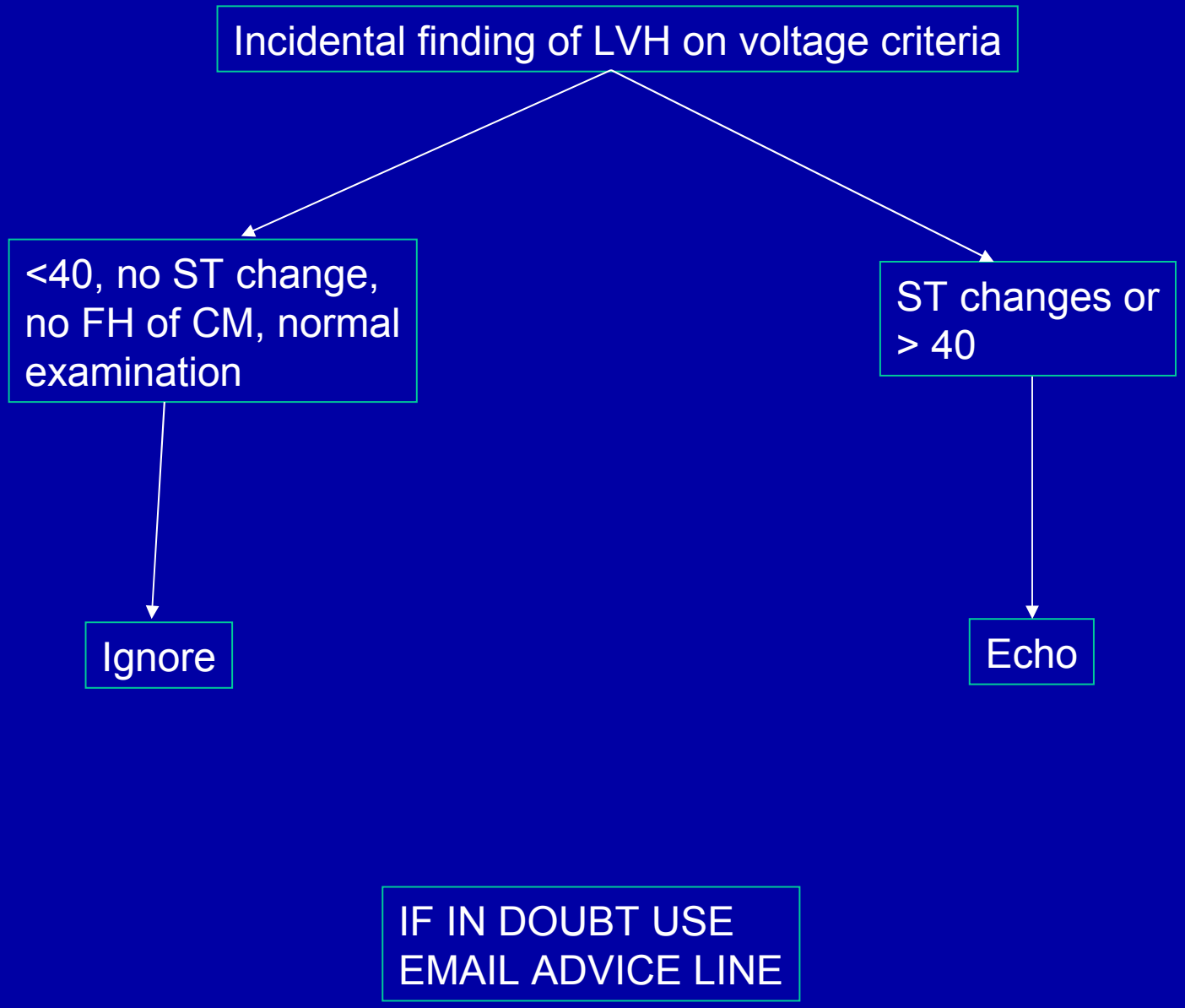
Abnormalities that can lead to ST elevation in the right precordial leads

- Right or left bundle branch block, LVH
- Acute myocardial infarction
- Acute myocarditis
- Right ventricular ischaemia or infarction
- Dissecting aortic aneurysm
- Acute pulmonary thrombosis
- Hetrocyclic antidepressent overdose
- Duchenne, Friedrichs ataxia
- Hypercalcaemia, hyperkalaemia
- Cocaine intoxication
- Arrhythmogenic right ventricular dysplasia
- Brugada syndrome
- LQTS – type 3

Assessing for left ventricular hypertrophy

- The ECG is not a sensitive marker for left ventricular hypertrophy
- The presence of left ventricular hypertrophy on an ECG is important in assessing target organ damage in guidelines for the management of hypertension.


Hypertension
Criteria met for treatment
Would meet criteria if end organ damage present
ECG finding of LVH adds to risk but no echo required provided examination normal
ECG
LVH criteria met
No LVH
Treatment required no echo required if examination normal and no FH of CM
Echo
Treat if LVH
IF IN DOUBT USE EMAIL ADVICE LINE


Incidental finding of LVH on voltage criteria
<40, no ST change, no FH of CM, normal examination
ST changes or > 40
Ignore
Echo
IF IN DOUBT USE EMAIL ADVICE LINE

Ventricular hypertrophy

- R = muscle depolarising towards the electrode
- S = muscle depolarising away from the electrode
- Usually leads with tall R waves have small S waves except where
  - The lead is at 90 degrees to the electrical axis
  - There is biventricular hypertrophy

ECG criteria for LVH
Apply to those over 40 years

Voltage

- (S in V1) + (R in V5 or 6) ≥ 35 mm
- (S in V1or 2) or (R in V5 or 6) ≥ 30mm
- R or S in limb leads ≥ 20 mm
- R in I + S in III ≥ 25 mm

Strain Pattern

- ≥ 1mm asymmetric T wave inversion not taking digoxin

What is a pathological Q wave? Rule of 4's

- Wide >0.04sec
- Deep > 4mm
- More than a 1/4 of the subsequent 'R' wave.
- In a lead where large Q waves are not usually seen.
- Present in multiple adjacent leads

The Q wave in lead III

- A Q wave in lead III alone may be positional and a normal finding
- Q waves which are 25 % of the depth of the succeeding R wave, and which last for more than 20 ms require assessment.
- They may not be pathological in lead III if there are no accompanying Q waves in aVF and II repeat the ECG on deep inspiration these Q waves may disappear