



# Is this left ventricular hypertrophy?

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ECG Education articles use real cases to illustrate the importance of knowledge about ECGs in relation to clinical situations in general practice. Management is not discussed.

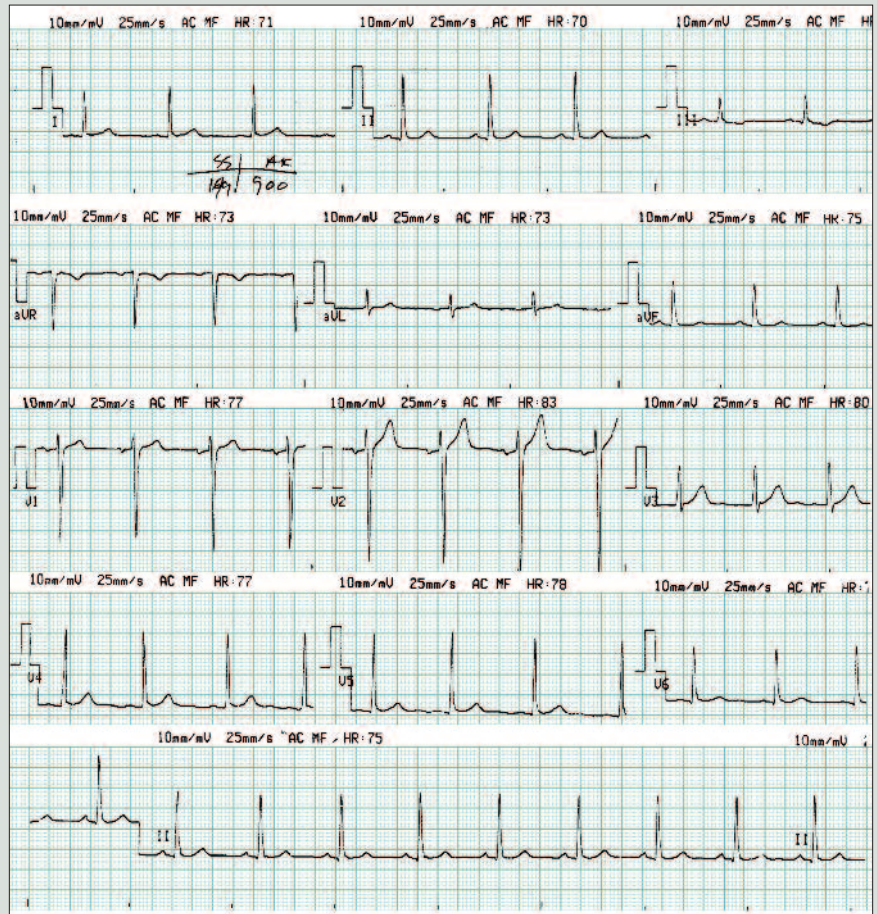
**A 36-year-old man new to your practice presents complaining of recent palpitations and feeling unwell. You see him immediately.**

**He tells you that he felt there was something 'strange' about today and that a couple of hours ago he rang his mother and girlfriend to tell them he loved them. Twenty minutes ago, while sitting in his car in traffic, he felt a fluttering in his chest that he thought was a fast heart rate. He immediately felt anxious and had trouble trying to breathe deeply to relax, but he had no chest discomfort or pain. Ten seconds later, the sensation was gone and he came straight to the nearest doctor (you).**

**He is taking no medications and has no medical problems. A brief examination of his cardiovascular and respiratory systems shows he is quite stable clinically, apart from being slightly hypotensive (100/50 mmHg). His pulse rate is 75 beats per minute and regular. He feels normal again now but is very anxious when you take the following ECG.**

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### Q1. Is this ECG normal?

This ECG is not normal. There are deep S waves in leads V1 and V2 that are of possible significance. The total height of the S wave in lead V2 plus the R wave in lead V5 is abnormal at 42 mm. Because of these changes, the ECG cannot be considered normal, despite showing a sinus rhythm of 75 beats per minute (normal).

### Q2. What is the possible significance of the deep S waves?

The deep S waves could represent septal hypertrophy or possibly concentric left ventricular hypertrophy (LVH). These abnormalities could be a sign of cardiomyopathy. Aortic valve stenosis can produce LVH and low blood pressure, but this patient does not have a murmur

(‘systolic crescendo-decrescendo murmur’ is typical of aortic stenosis). Because the patient’s blood pressure is so low, the changes are unlikely to be due to early hypertensive LVH. Under Scott’s criteria for LVH in the chest leads only, the total height of the S wave in V2 plus the R wave in V5 is 42 mm (over the 35 mm that is considered the cut-off for normal). Under the Sokolow-Lyon index, the total height of the S wave in V1 plus the R wave in V5 is 44 mm (over the cut-off of 35 mm considered normal).

### Q3. What are the common criteria used in the diagnosis of LVH?

Four of the several well-established ECG-criteria used for the diagnosis of LVH are Scott’s criteria, the Sokolow-Lyon index, Framingham criteria and the Cornell Voltage criteria.

### Scott's criteria

#### Chest leads:

S in V1 or V2 plus R in V5 or V6, more than 35 mm

R in V5 or V6 more than 26 mm

R plus S in any V lead, more than 45 mm

#### Limb leads:

R in I plus S in III, more than 25 mm

R in aVL, more than 7.5 mm.

### Sokolow-Lyon index

S in V1 plus R in V5 or V6, more than or equal to 35 mm; and/or

R in aVL, more than or equal to 11 mm.

### Framingham criteria

R in aVL, more than 11 mm

S in V1 to V3, more than 25 mm

S in V1 or V2 plus R in V5 or V6, more than 35 mm

R in V1 plus S in III, more than 25 mm.

### Cornell Voltage criteria

Designed to correlate with the cardiac echocardiographic findings in LVH.

Men: S in V3 plus R in aVL, more than 28 mm

Women: S in V3 plus R in aVL, more than 20 mm.

### Q4. What ECG signs are there in patients who have cardiomyopathy?

There are many types of cardiomyopathy so often the changes seen may be nonspecific. Changes associated with left atrial hypertrophy (M-shaped P waves more than 0.12 seconds in duration in lead II) and ventricular hypertrophy are likely to be present in hypertrophic cardiomyopathy and glycogen storage diseases. In other types of cardiomyopathy, flat or inverted T waves are common, as are low voltage QRS complexes and abnormal Q waves (more than 0.04 seconds duration or 25% or more of the R wave height). Axis changes, bundle branch blocks and intraventricular conduction defects are also common, as are arrhythmias (especially ventricular ectopics, atrial fibrillation or flutter, and ventricular tachycardias).

### Q5. What types of cardiomyopathy are there?

Cardiomyopathies may be divided into intrinsic (primary) and extrinsic (secondary) types. 'Intrinsic' refers to the disease of the cardiac muscle itself as the cause of the cardiomyopathy; 'extrinsic' refers to the underlying pathology being directly unrelated to the cardiac muscle.

Examples of intrinsic cardiomyopathy types are:

- dilated cardiomyopathy (most commonly intrinsic and idiopathic, but may be extrinsic due to excessive alcohol consumption, malnutrition, pregnancy, viruses, heredity, toxins and chemotherapy)
- hypertrophic cardiomyopathy (usually inherited, rare)
- restrictive cardiomyopathy (rare, infiltrative disease such as amyloidosis, haemochromatosis and sarcoidosis)
- Takotsubo cardiomyopathy.

Examples of extrinsic cardiomyopathy types are:

- atherosclerotic coronary artery disease
- hypertensive
- valvular
- endocrine causes (hyperthyroidism, diabetes, acromegaly)
- toxic effects (alcohol, chemotherapy)
- neuromuscular (muscular dystrophy)
- metabolic (sarcoidosis, amyloidosis, haemochromatosis)
- nutritional.

### Q6. What investigations would be indicated to clarify the possible abnormality on this ECG?

Echocardiography should be arranged as soon as possible as this is the definitive diagnostic test for cardiomyopathy. This will also confirm any other abnormalities, such as ventricular hypertrophy or valvular disease. A Holter monitor or



Figure. An example of an ECG showing left ventricular hypertrophy and strain pattern (not the patient discussed). Courtesy of Associate Professor M. Kilborn, Sydney, NSW.

trans-telephonic event monitor may add more information about possible arrhythmias and correlation of rhythm with symptoms. Thyroid function tests, a full blood count and measurement of electrolytes are advised (and other blood tests depending on the patient's past history and examination).

A consultation with a cardiologist would be indicated at patient request if these results were abnormal or if further symptoms occurred.

### Outcome

The patient had an urgent echocardiogram the same day, and the result was normal. A 24-hour Holter monitor study was organised and this too showed no abnormality. Thyroid function tests and other blood tests were normal. The 'palpitations' were presumed to be due to a short run of ectopic beats as there has as yet been no recurrence. In this case, the ECG abnormality was – fortunately – a variation of normal. **CT**

### Key points

- Always review ECGs yourself.
- Look for abnormalities other than those directly related to symptoms the patient is presenting with.
- In this case, several specialists called the ECG normal until their attention was drawn to the possible voltage abnormality. Everyone concentrated on the patient's rhythm and possible palpitations.