



PRACTICE

RATIONAL TESTING

Investigating palpitations: the role of Holter monitoring and loop recorders

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A 62 year old man complains of palpitations four times in the last week. He felt his heart beating very fast and was short of breath. Symptoms were variable in their timing and duration, however two episodes followed alcohol intake. On direct questioning, he did not have chest pain or syncope. He is on amlodipine for hypertension. On examination, his blood pressure is 160/90 mm Hg; his heart rate is regular at 82 beats/min. Heart sounds and respiratory examination are normal.

Palpitations are a common presentation in primary care and can be distressing. In a patient presenting with palpitations, note the type and severity of symptoms, the timing of palpitations, and comorbid medical conditions. Suggestions for history and examination are in box 1.

Key differential cardiac, metabolic, and psychiatric diagnoses for palpitations are shown in box 2. There is a lack of robust data on possible aetiology in patients presenting with palpitations to primary care. In a prospective evaluation of 184 patients referred to a cardiac clinic for palpitations, around one third were diagnosed with arrhythmias. The remainder experienced stress related symptoms and had either extrasystoles or an awareness of sinus rhythm.⁴ In a prospective study in 190 patients presenting with palpitations to a tertiary medical centre in the United States, 43% received a cardiology and 31% a psychiatric cause of their palpitations⁵; the remaining participants were found to have non-cardiac aetiologies.

What is the next investigation?

Here we discuss which investigations are most common and useful.

Basic tests

Initial blood tests might include a full blood count, thyroid, and kidney function tests, blood sugars, and electrolytes. These tests

give an indication of common metabolic causes of arrhythmias. Hyperthyroidism and thyrotoxicosis have been associated with atrial fibrillation and ventricular arrhythmias.⁶ Electrolyte imbalance (calcium, potassium, and sodium) and kidney failure can predispose to arrhythmias.

To investigate possible cardiac causes, offer to perform a 12 lead electrocardiogram (ECG). Many common arrhythmias such as atrial fibrillation/flutter and atrioventricular blocks can be readily diagnosed on analysis of the resting ECG results. Additionally, predisposing arrhythmogenic conditions can also be detected, such as abnormalities of repolarisation, a short PR interval, and a long QT.⁷ Most patients are in sinus rhythm when the ECG is done; however this does not exclude the presence of an arrhythmia.

Holter monitoring

A Holter monitor is a portable battery operated device typically fixed to the patient's belt or hung around his neck. It continuously records ECG results from two or three leads using electrodes on the skin for 24 hours, 48 hours, or up to two weeks with newer devices.⁸

Guidelines from the American College of Cardiology/American Heart Association recommend Holter monitoring in patients with palpitations and syncope (in any groups), near syncope (episodic dizziness or lightheadedness in patients with known cardiac disease), and recurrent palpitations⁹ if the resting ECG is normal.

The duration of monitoring is determined by the frequency of palpitations.⁹ For patients who experience daily symptoms, a 24 hour Holter monitor is adequate, whereas 48 hour recording is advisable for near daily symptoms. Seven day monitoring is required for patients with infrequent weekly symptoms. Patients

What you need to know

Palpitations are a common presentation in primary care, but more than half of cases are harmless (eg, extrasystoles)

Assess frequency and severity of symptoms, perform a physical examination and a 12 lead resting electrocardiogram (ECG), and order blood tests

Refer the patient to a cardiologist if an arrhythmia or a conduction disorder is diagnosed on the resting ECG, if the patient is known to have a cardiac disease, or if palpitations are associated with chest pain, syncope, or lightheadedness

Offer Holter monitoring to patients if the resting ECG is normal, and adapt its duration to the frequency of symptoms

Box 1: What to consider in history and examination for palpitations

Frequency and regularity—Palpitations that last for a few seconds and occur randomly and episodically are often due to premature beats. Rapid and irregular palpitations are commonly reported in atrial fibrillation

Associated symptoms—Ask about dizziness and loss of consciousness, which might suggest idiopathic ventricular tachycardia in patients with structurally normal hearts¹

Precipitating factors—Ask if palpitations are precipitated by exercise or substances such as caffeine, alcohol, or cocaine. Supraventricular arrhythmias can be induced by exercise and might occasionally appear at the end of intense physical activity²

Comorbid medical conditions—A coexisting psychiatric illness might indicate the likelihood of anxiety, whereas a history of heart disease might suggest arrhythmias

Cardiovascular examination—Murmurs or abnormal heart sounds might reveal valvular or structural heart disease. Look for signs of congestive heart failure³

Box 2: Differential diagnoses of palpitations*Cardiac*

Extrasystoles (atrial, ventricular)

Arrhythmias

Structural heart disease (valvular heart disease, cardiomyopathy)

Non-cardiac

Metabolic disorders (thyrotoxicosis, hypoglycaemia, pheochromocytoma)

Medication induced (vasodilators, anticholinergic drugs)

Central nervous system stimulants (caffeine, cocaine, amphetamines)

Psychiatric disease (panic attacks, generalised anxiety disorder, depression)

might be asked to keep a diary of their symptoms to improve correlation with abnormalities in heart rhythm.

Cardiologists analyse the output of Holter monitoring using specific software and write a report. Figure 1⇓ shows a sample report. Typically, the following parameters are given in the report:

- Heart rate (maximal, minimal, and average)
- Frequency of atrial and ventricular extrasystoles
- RR interval
- Changes in ST segment
- Arrhythmias if any
- Representative samples of the ECG tracing at different times during the recording.

Holter monitoring can be used for several prognostic and diagnostic purposes, for example in known cardiac patients with an increased risk of arrhythmia and in some neurology patients. It is also used to monitor the progress of those with known arrhythmia. Box 3 outlines these uses.

Other ambulatory monitoring options

If initial Holter monitoring records no arrhythmia, a second Holter monitoring is not recommended. Instead, loop recorders that allow longer monitoring than Holter devices should be considered. Figure 2⇓ lists key features of these devices.

Guidance from the American College of Cardiology/American Heart Association, the European Society of Cardiology, and the

UK's National Institute for Health and Care Excellence recommends monitoring with loop recorders in patients with recurrent episodes of syncope or palpitations where a cardiac cause is suspected, and where the 12 lead ECG and Holter monitoring have not established a diagnosis. Evidence suggests greater diagnostic yield with longer monitoring offered by these devices, however information on patient acceptability and impact on clinical outcomes is lacking.

Two types of loop recorders are used: external loop recorders and implantable loop recorders.¹⁴ These are both usually available in specialist centres or secondary care. The decision to perform one or another is driven mainly by frequency of symptoms, ability of the patient to trigger the recording, and availability of the device.¹⁵ Figure 3⇓ shows the process of choosing an appropriate monitoring strategy based on symptoms.

External loop recorders, also called cardiac event recorders, can be helpful for infrequent palpitations with up to four weeks between symptoms. The recorder can be activated by the patient when symptoms occur, but newer devices can monitor continuously. Prospective studies in patients with palpitations show that the likelihood of diagnosing an arrhythmia with longer monitoring using an external loop recorder ranged from 66% to 83% as compared with ~39% with 48 hour Holter monitoring.^{15 16} However, these results should be viewed with caution in the absence of a meta-analysis including head to head comparison of both devices.

Personal mobile technology is increasingly used to perform external loop monitoring. Patients can obtain a recording by attaching a device to their smartphone and resting their fingers

Box 3: Indications of Holter monitoring to detect arrhythmias in patients without palpitations or syncope

High risk cardiac patients such as the those with recent myocardial infarction and a low left ventricular ejection fraction, hypertrophic cardiomyopathy, arrhythmogenic right ventricular cardiomyopathy, or congenital heart disease^{10,11}

Monitoring of previously diagnosed arrhythmias after treatment or intervention

Detection of occult atrial fibrillation in patients presenting with stroke of uncertain aetiology¹²

Monitoring rate control in patients with treated atrial fibrillation¹³

Detection of new onset arrhythmias in selected patients under pro-arrhythmogenic drugs

Patients with pacemakers or implantable cardioverter defibrillators where dysfunction is suspected, especially when new symptoms such as syncope or palpitations appear

on the monitor when symptoms occur. Immediate interpretation is possible using an application downloaded from the internet.

Implantable loop recorders are pen drive sized devices inserted under the skin and are capable of recording events for as long as three years. They are of value in patients with infrequent unexplained syncopes, and allow correlation to a potential arrhythmia. In an observational study of 85 patients with unexplained syncope and normal 24 hour ambulatory or in-hospital ECG monitoring, an implantable loop recorder was able to detect arrhythmia in 42% of the patients during a mean period of 10.5 months.¹⁷ There were no sudden deaths during follow-up however, which questions use of this costly and invasive monitoring. These findings were recently confirmed by a systematic review of four randomised studies in 579 adults with unexplained syncope.¹⁸ Implantable loop recorders led to higher rates of diagnosis compared with conventional monitoring, which included physician follow-up or use of external loop recorders. However, there was no evidence of a difference in long term mortality or quality of life in the two groups.

Although the diagnostic yield of an external loop recorder might be lower than implantable loop recorders, external loop recorders are preferred as a non-invasive first approach.

When to refer**Consider urgent or immediate referral**

Refer patients with palpitations to a cardiology clinic if any of these are present:

- A history of cardiac disease or premature death in the family, or
- an abnormal resting 12 lead ECG or
- palpitations associated with occasional chest pain, syncope, or lightheadedness.

Immediate referral to the emergency department is advised in patients with persistent chest pain, symptoms of congestive heart failure, or injury caused by a loss of consciousness.

Evaluate in primary care

In all other circumstances, evaluate the patient in primary care as described above. Patients with palpitations are often unnerved by irregular heartbeats and have concerns that their heart could stop at any moment. In patients with a normal resting ECG, explain that monitoring for a longer duration might be needed to detect abnormalities in heart rhythm which could be causing episodic symptoms. Offer Holter monitoring for a duration adapted to the frequency of symptoms.

In most patients who have a normal physical examination and resting ECG and no history or suspicion of cardiac disease the Holter report might show extrasystoles or sinus tachycardia. Reassure the patient that these are unlikely to be serious.

A secondary referral to a cardiologist is advised when an arrhythmia or a severe conduction disorder is detected on Holter monitoring. Common conditions include atrial fibrillation and flutter, atrial tachycardia, atrioventricular nodal re-entrant tachycardia, ventricular tachycardia, second or third degree atrioventricular blocks, a long QT interval, and a long RR interval. Most of these pathologies warrant further cardiac evaluation with tests such as echocardiogram, stress test, and clinical electrophysiology study. Explain to the patient that his heart might be beating in an irregular fashion and further specialised diagnostic assessment is necessary.

Case outcome

The patient's ECG showed a normal sinus rhythm at a rate of 80 beats/min. 48 hour Holter monitoring was advised because of the recurrence of his symptoms on a near daily basis and a history of hypertension. The report showed two episodes of paroxysmal atrial fibrillation lasting between 10 and 20 minutes each (fig 2⇓). The blood results were unremarkable.

His doctor initiated anticoagulation and referred him to a cardiologist who performed an echocardiogram that revealed the presence of left ventricular hypertrophy with a ventricular mass of 125 g/m² without wall motion abnormalities, and left ventricular ejection fraction of 62% (normal range 55% to 70%). His antihypertensive drug treatment was intensified with the addition of an angiotensin receptor blocker to his existing treatment. An anti-arrhythmic medication (amiodarone) was added for paroxysmal atrial fibrillation, and the anticoagulation treatment was continued.

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CAK was responsible for the idea and conception of the article. JAS and CAK drafted the article. FH provided the clinical presentation of the hypothetical patient to a non-cardiology clinic. All authors revised the manuscript and approved the final version. CAK is the guarantor.

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Patient consent not required.

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How patients were involved in the creation of this article

A patient with arrhythmia who has had monitoring with Holter and loop recorders reviewed this paper. She agrees it is important to stress that not all arrhythmias can be detected on typical Holter recording, and further monitoring with loop recorders might be needed. She also shared how some patients might not like to wear such a monitor, particularly for extended periods of time. In response to her comments, we shared more information on these devices and specific indications for their use, which the general practitioner might discuss with their patients.

Education into practice

Think about the last time you referred a patient presenting with palpitations to a specialist without asking for a Holter monitor first. How frequently were they suffering from extrasystoles or panic attacks that could have been managed in primary care?

Have you had patients inquire about Holter monitoring? How would you explain to them about the test, when it is to be used, and the results?

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Figures

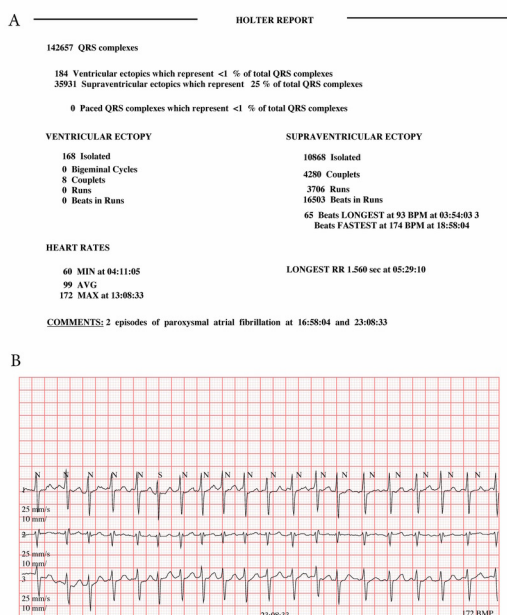


Fig 1 Holter monitoring report showing A) general summary of the recorded information and concluding on the presence of two episodes of paroxysmal atrial fibrillation. B) representative 3-lead ECG of atrial fibrillation in the same patient




Device type	Holter monitoring 	External loop recorders 	Implantable loop recorders 
Frequency of symptoms	Daily, near-daily	Weekly	Rare (almost monthly)
Recording time	24 hours, 48 hours or one week	Up to four weeks	Up to three years
Availability and cost	Usually available in primary and secondary care. Less expensive	Available only in specialised cardiac centres. More expensive than Holter monitoring	Available only in specialised cardiac centres. More expensive compared with other monitoring strategies
Patient convenience/practicality	Non-invasive. No action needed from the patient	Non-invasive. Patients need to activate the recorder when symptoms occur	Minimally invasive procedure
Use and limitations	Suitable for patients with frequent symptoms. Limited recording capacity	Higher likelihood of detecting arrhythmias due to prolonged monitoring as compared with Holter monitoring. Not suitable for syncope or in other conditions when patients cannot activate the device. ECG data can be transmitted continuously over wireless network to a remote monitoring system for evaluation	Minimally invasive procedure. Both automatic and patient activation methods supported

Fig 2 Ambulatory devices for electrocardiogram (ECG) monitoring

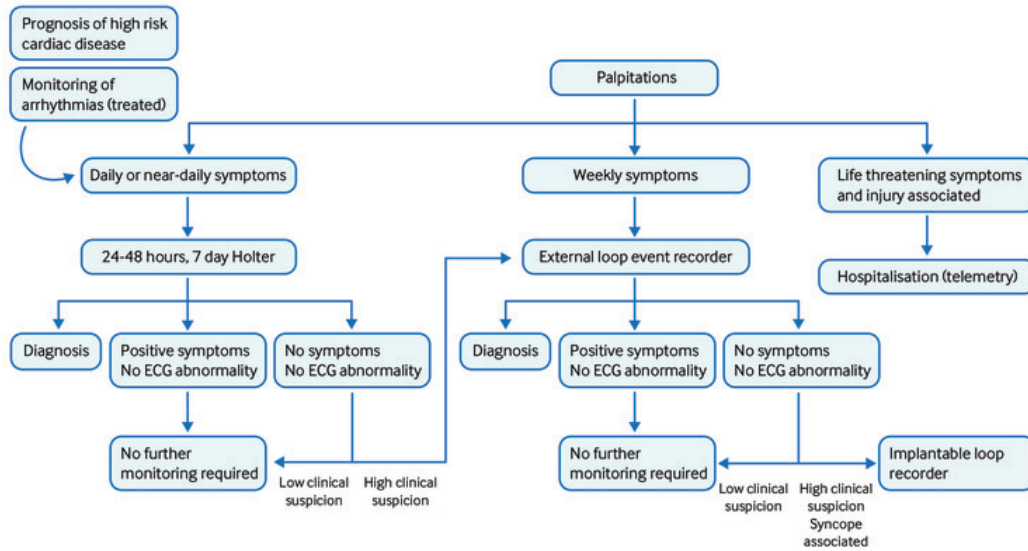


Fig 3 Comprehensive use of different electrocardiogram recording strategies for the diagnosis of palpitations⁹ (Based on American College of Cardiology/American Heart Association Committee on Clinical Intracardiac Electrophysiologic and Catheter Ablation Procedures)