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Ambulatory electrocardiographic monitoring

This article forms part of our 'Tests and results' series for 2011 which aims to provide information about common tests that general practitioners order regularly. It considers areas such as indications, what to tell the patient, what the test can and cannot tell you, and interpretation of results.

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What is ambulatory electrocardiographic monitoring?

Ambulatory electrocardiographic monitoring (AECG) involves electrically monitoring a person's cardiac rhythm over a period of time while they go about their day-to-day activities. The different types of AECG are: Holter monitors, event recorders, and implantable loop recorders (ILRs).

What are the indications?

- Palpitations of unclear cause despite clinical history and electrocardiogram (ECG)
- Syncope or presyncope where an arrhythmia (bradycardia or tachycardia) is suspected as the underlying cause.

Rarely AECG is indicated when pacemaker malfunction is suspected, in postmyocardial infarction, and for follow up of arrhythmia on drug therapy.[1]

The frequency and suspected arrhythmia should dictate the choice of investigation (*Figure 1, Table 1*). For patients with frequent symptoms (daily palpitations) a 24 hour continuous recording (Holter monitor) is appropriate – this is rarely indicated for syncope unless the frequency of events is less than weekly, although in this case, hospitalisation should be considered.[2] For patients with less frequent symptoms, an event recorder or ILR is more cost effective.

Holtor monitoring can be ordered by general practitioners, without specialist review, and performed at most pathology laboratories. Event recorders are fitted at specialist cardiac laboratories and can also be ordered by GPs. Implantable loop recorders are not currently rebateable on the Medicare Benefits Schedule (MBS), and are usually ordered by cardiologists.

When is it contraindicated?

Ambulatory electrocardiographic monitoring is contraindicated if it will delay appropriate hospitalisation or a more appropriate procedure. For example, AECG should not be part of the initial investigation of intermittent stable angina; a stress test would be more appropriate. It is also contraindicated in patients who have syncope and high risk features; inpatient admission is appropriate (*Table 1*). The diagnostic yield from each test is variably low (*Table 1*); the pretest probability should define the method of AECG.

Where does it fit in a diagnostic approach?

Clinical history and examination is paramount in the workup of a patient with palpitations or syncope as it will direct the correct investigation. For example, syncope (which is transient loss of consciousness due to cerebral hypoperfusion) has many causes (*Table 2*), and only 6–37% of syncope is attributed to cardiac causes.[3]

A baseline 12-lead ECG should be performed before AECG. Basic blood tests: full blood examination (FBE), urea, electrolytes and creatinine (UEC), calcium, magnesium and phosphate (CMP), and thyroid function test (TFT) should be considered, and in practice are often ordered before AECG.

Echocardiography or stress test/angiography should generally be performed before AECG if there is suggestion of structural or coronary heart disease.

What should I tell my patient?

The patient attends the laboratory to have the monitor fitted. Usually a full 12-lead ECG will be performed before applying the device. To ensure a good quality trace, skin preparation may be required (eg. shaving). Five ECG leads are positioned on the chest for a Holter monitor and two leads for an event recorder (*Figure 2*). The monitor/recorder (about the size of a mobile telephone) is carried on a belt or neck strap. Holter monitor leads stay attached for 24 hours, hence patients cannot shower during the test. Patients wearing an event recorder need to be educated in the reapplication of the electrodes, as the recorder is worn for 1–4 weeks and is taken off for showering. The cutaneous electrodes can cause skin rash/irritation. The ILR is roughly the size of a USB stick (*Figure 3*) and is positioned subcutaneously in the precordial region under local anaesthetic in a minor day surgical procedure performed by a cardiologist.

Out-of-pocket costs to the patient vary: there is a MBS rebate for Holter and event monitors; currently there is no MBS rebate for ILRs; however, public hospitals or private health insurance will usually absorb the cost of an ILR.

Hoes does it work?

Holter monitoring continually records an ECG tracing on three channels for 12–48 hours. The patient activates a button to correlate timing of symptoms with the ECG. The entire recording is analysed by a cardiac technician and physician skilled in the interpretation of AECGs.

Event recorders are activated either prospectively (the device is applied by the patient when palpitations occur), or more commonly, retrospectively. The retrospective event recorder (also called external loop recorder) is worn continuously and records over 5–15 minute cycles, which are stored for analysis only if the patient activates the device. The device also automatically stores rhythms beyond programmable upper and lower rate limits. The information can be remotely monitored by transtelephonic transmission.

Event recorders cannot be activated by syncopal patients; hence real time continuous telemetry device is indicated (essentially an event recorder that continuously records).

Implantable loop recorders operate on the same principle as retrospective loop recorders and have a battery life of around 36 months. These devices can both be automatically activated or patient triggered.

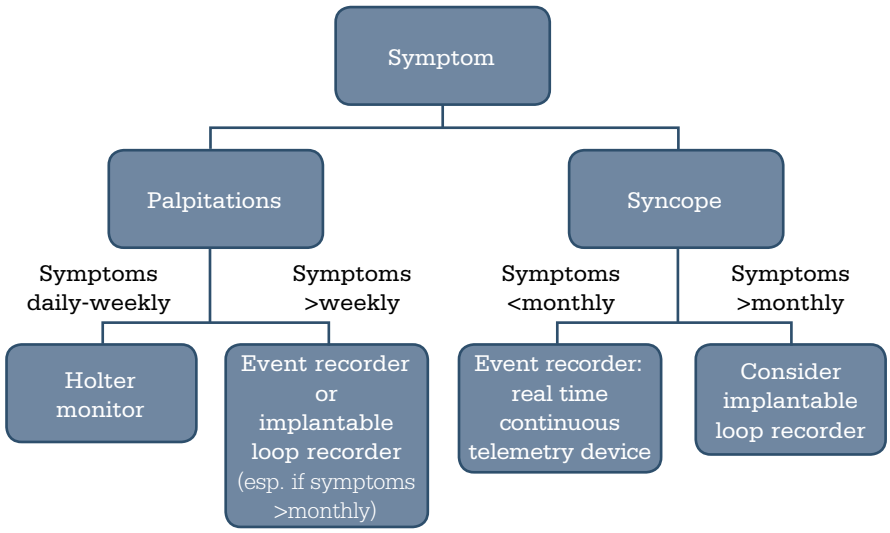


Figure 1. Indications for ambulatory electrocardiography

What do the results mean?

Ambulatory electrocardiographic monitoring reports provide considerable information. Some key features include:

- trends: average heart rates; slowest and fastest heart rhythms; number of pauses >2 seconds and longest pause; total number of atrial and ventricular premature contractions/couplets/triplets; episodes and longest runs of supraventricular tachycardia (SVT) or ventricular tachycardia (VT). An example is shown in *Figure 4*

Table 1. Types of ambulatory electrocardiographic monitoring[3,4]

Type of monitoring	Indication (frequency of symptoms)	Duration of test	Yield (syncope; arrhythmia)	Comment
In hospital monitoring	High risk features*	5 days (average syncope admission)	16%	High cost, reserved for high risk
Holter monitor	Daily (mainly for palpitations)	12–48 hours (can be extended to ~2 weeks)	Syncope <20% Arrhythmia ~35%	Low cost but expensive per diagnosis
Event recorder	Weekly to monthly	Week to month	Syncope ~60% Arrhythmia ~80%	Patient compliance required
Implantable loop recorder	More than monthly	36 months (battery longevity)	Syncope ~80% Arrhythmia 73%#	Minor surgical procedure, high initial cost; overall cost effective

* Structural, congenital or coronary heart disease. Clinical or ECG features suggesting cardiac/arrhythmic syncope (eg. syncope during exertion or supine, absence of external factors or family history of sudden cardiac death

The yield for implantable loop recorders where palpitations are infrequent (less than one event per month) and where external loop recorder yield is ~20%

- bradycardia: consider cardiology referral as a pacemaker may be indicated in patients with symptomatic bradyarrhythmia (eg. daytime heart rate <40 bpm; pauses >3 seconds; second degree [Mobitz II], advanced or third degree atrioventricular [AV] block)
- tachycardia: consider cardiology review for institution of appropriate anti-arrhythmic therapy ± further diagnostic/management tests (eg. transthoracic echocardiography, stress test, catheter ablation). If atrial fibrillation (AF) is detected, anticoagulation should be considered in correlation with cardio-embolic risk
- runs of nonsustained or sustained ventricular tachycardia warrant cardiology review
- Heart rate variability may be reported and can indicate chronotropic intolerance/sinus node dysfunction.

Table 2. Classification of syncope[3]

Reflex	Orthostatic	Cardiac
Vasovagal	Volume depletion	Bradycardia: • sinus node dysfunction (including tachybrady syndrome) • atrioventricular conduction defects • device malfunction
Situational (eg. micturition syncope)	Drug induced (eg. alcohol, vasodilators)	Tachycardia: supraventricular or ventricular
Carotid sinus syncope	1° autonomic failure (eg. multiple system atrophy)	Drug induced bradycardia or tachycardia
Atypical (without apparent cause)	2° autonomic failure (eg. diabetes)	Structural heart disease (eg. aortic stenosis, hypertrophic obstructive cardiomyopathy

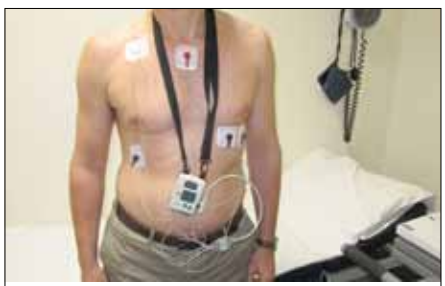
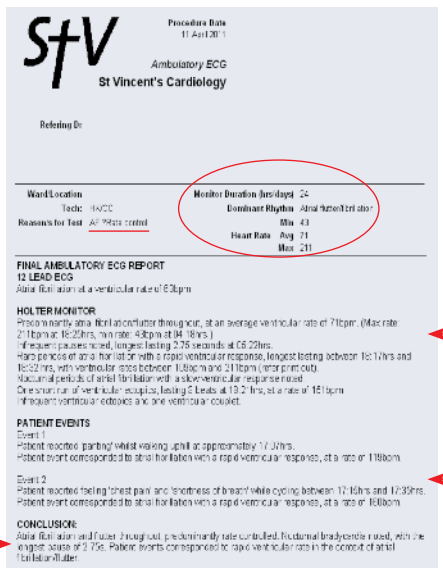


Figure 2. Patient wearing a Holter monitor
Note: 'Event' button (centre of monitor) that the patient depresses if symptoms develop

Figure 3. Implantable loop recorder: Medtronic Reveal® device



The report body will include a comment on ectopy. Infrequent ectopics and one couplet in this case are of limited significance.

Conclusion summarises important findings. In this case, the nocturnal pause is not significant.

The report body comments on the dominant rhythm, rate and pauses. In this case episodes of AF with rapid ventricular response correlate with symptoms; increasing rate control mediation would be indicated.

Figure 4. Example of AECG report with comments

What don't the results tell you?

Arrhythmia does not always occur during the monitored period (*Table 1*). Ambulatory electrocardiographic monitoring is not designed to detect cardiac ischaemia and it does not record ambulatory blood pressure.

What are the next steps if the test is negative or inconclusive?

If Holter monitor is negative, consider an event record as this has a higher diagnostic yield. If AECG is negative with high risk clinical or ECG features, consider cardiology referral. For example, bradyarrhythmia may be the suspected cause of syncope in those with trifascicular block; or SVT may be the likely diagnosis in those with rapid onset and offset of brief palpitations.

Artificial 'noise' (eg. from lead movement during walking) makes computer – and physician – analysis inaccurate, potentially causing false positives and false negatives. Attention to appropriate skin preparation, ECG lead placement and patient education can minimise noise in AECG tracings.

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