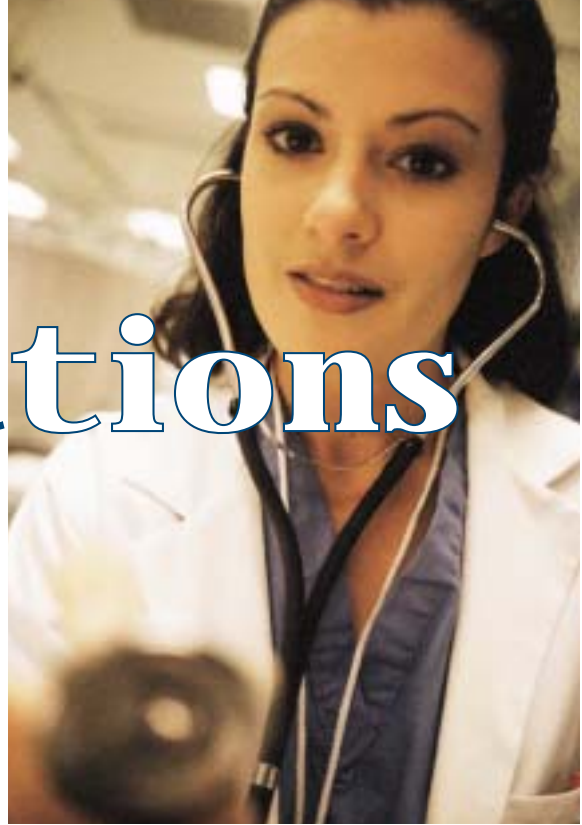


# A Clinical Approach to Palpitations



The management of patients with palpitations presents a challenge for the primary-care physician. This article provides background information needed in diagnosing and treating a patient suffering from this condition.

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Primary-care physicians are frequently faced with the assessment of a patient with palpitations. Potential obstacles to such an assessment are numerous, ranging from issues of definition to difficulty documenting cardiac rhythm during spontaneous symptoms. Fortunately, most episodes of palpitations have a benign and self-limiting course. Structural heart disease must be considered as a potential underlying cause and appropriately investigated. Once the cardiac rhythm is established during symptoms,

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## Case

S.L., a 51-year-old woman, presented with palpitations. She has no history of coronary artery disease (CAD) and no symptoms of angina. She has a history of mild hypertension, which has not required medication. There is no history of diabetes or high cholesterol, no significant family history of heart disease and she is a non-smoker. She is taking l-thyroxine for a history of hypothyroidism. There are no other comorbidities and no family history of arrhythmia or sudden death.

S.L. has a six-month history of palpitations, described as “thumping” in the central chest, associated with “skips.” There is no associated chest pain, but she describes feeling “breathless” with the palpitations.

There is no history of presyncope, sustained palpitations, or symptoms of congestive heart failure. Episodes occur several times daily, especially at night before falling asleep. No clear initiating factors are identified, but the palpitations seem to occur more often at rest and do not tend to occur during exercise. They are especially bothersome during times of stress.

Physical examination reveals a 51-year-old woman who appears well. Her heart rate is 70 beats per minute (bpm) and regular. Blood pressure is 140/85 mmHg with no postural change and the respiratory exam is normal. The cardiovascular exam is normal, with no evidence of congestive heart failure, a normal apical impulse, and no abnormal heart sounds or murmurs.

Her electrocardiogram (ECG) shows sinus rhythm at 65 bpm, with no conduction abnormalities, no evidence of structural heart disease, ischemia or infarct. There are two paroxysmal ventricular contractions (PVCs) which are monomorphic and have a predominantly positive deflection in the inferior leads and V4 to V6.



**Question:** *How would you proceed with diagnostic workup for this patient?*

**Discussion on page 36**

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Table 1

## Key Historical Features in Patients With Palpitations

### Description

- Quality
- Onset: sudden or gradual
- Rate
- Regularity

### Precipitating or Alleviating Factors

- Activity
- Position

### Location

### Duration and Frequency

treatment can be considered. Treatment options may also provide a challenge, with issues including efficacy, potential for proarrhythmia, and duration of therapy. The following review will present a structured approach to the patient presenting with palpitations.

## *History*

### *Description*

Although subjective in nature, several key features of a patient's description can help with diagnosis and should be elicited during the history (Table 1). It is of primary importance to determine if the patient is describing a sustained tachycardia or an infrequent or intermittent change in rhythm. It is often useful to ask the patient if the sensation resembles racing or skipping. Second, determining if the symptoms have an abrupt (paroxysmal) or gradual onset or offset is also helpful.

Finally, the rate and regularity of sustained palpitations should be determined. This is often facilitated by asking the patient to tap a finger in a manner reflecting his/her symptoms. A description of recurring brief episodes of "flipping" or "pounding" in the chest can be a clue that premature beats are responsible. A separate discussion of benign atrial and ventricular ectopy will take place later in this article.

The exact location of "pounding" should be clarified, as this sensation may arise in the chest or neck. A pounding feeling in the neck can be a clue to contraction of the right atrium against a closed tricuspid valve. The physical exam correlate of this symptom is a cannon A wave in the jugular venous pulse. Such a finding occurs in the presence of some premature atrial or ventricular contractions, as well as atrioventricular (AV) dissociation due to atrial flutter, AV nodal re-entrant tachycardia (AVnRT), and ventricular tachycardia. Other symptoms accompanying palpitations also should be documented. The presence of angina, dyspnea, presyncope or syncope arising after the onset of palpitations, may suggest hemodynamic instability resulting from an arrhythmia.

### *Duration and Circumstances*

The age at onset of palpitations and the duration of symptoms can also help with diagnosis. The length of episodes of palpitations can range from seconds to days. Longer episodes of "heart racing" may represent sustained arrhythmias, rather than isolated extra beats. The frequency of episodes should also be elicited. Circumstances preceding the onset of palpitations represent an important element of the history. This includes level of physical activity, anxiety and body position. Other specific trig-

Table 2

## Patients With Palpitations Who Should be Considered for Referral to a Specialist

### Patient Characteristics

- Underlying coronary artery disease
- Underlying congestive heart failure

### Symptom Characteristics

- Sustained tachycardia documented by electrocardiogram
- Non-sustained palpitations that do not respond to conservative measures
- Atrial fibrillation that does not respond to conservative measures

gers, such as drinking cold liquids, bending down to pick something up, or a stressful situation, may also be identified by the patient.

Termination of symptoms should also be discussed. Some patients with AV nodal dependant tachycardia have learned that maneuvers which affect AV node refractoriness (*i.e.*, Valsalva's maneuver), changes in breathing and pressure on the neck can terminate symptoms. Anxiety-induced sinus tachycardia may be relieved by relaxation.

### Warning Signs

A key underlying theme in the patient with palpitations is to determine if structural heart disease is present. The presence of heart disease "ramps up" the process of evaluation and greatly increases the potential need for referral and treatment (Table 2). Further history should be sought regarding documentation or symptoms of coronary disease, coronary risk factors and family history of palpitations, arrhythmia, and sudden death. Palpitations within the context of established coronary artery disease (CAD) or congestive heart failure (CHF) should be taken seriously, with a thorough workup and consideration of referral to a cardiologist. Comorbidities affecting cardiac rate or rhythm should be considered, including diabetes, anemia, infection,

thyroid disease, renal impairment, electrolyte imbalances, inflammatory disorders, and neurological disorders (*i.e.*, Parkinson's disease). Historical information should be elicited regarding stress, and whether episodes are accompanied or preceded by anxiety.

### Physical Examination

The physical exam may elicit some clues to the source of palpitations, but typically provides little insight. The patient's current heart rate and its regularity should be documented. An irregular heart rate may suggest atrial fibrillation or frequent ectopy. Blood pressure should be assessed, as hypertension may be associated with atrial fibrillation (AF). Any evidence of structural heart disease should be sought, including elevated jugular venous pressure, precordial lifts, abnormal apical impulse, and extra heart sounds or murmurs. Such abnormalities are not suggestive of any specific arrhythmia, but necessitate the exclusion of ventricular tachycardia or AF and a rigorous evaluation for underlying heart disease.

### Electrocardiogram

A 12-lead electrocardiogram (ECG) is an

## Approach to Palpitations

Table 3

### Work-up of the Patient with Palpitations

Phase of Work-up	Investigations
<b>Initial</b> All patients	<ul style="list-style-type: none"> <li>• History</li> <li>• Physical exam</li> <li>• Electrocardiogram</li> </ul>
<b>Secondary</b> Symptom rhythm correlation when an arrhythmia is suspected (most patients)	<i>Frequent Symptoms</i> <ul style="list-style-type: none"> <li>• Holter</li> </ul> <i>Infrequent Symptoms</i> <ul style="list-style-type: none"> <li>• Transtelephonic monitor</li> <li>• Loop recorder</li> </ul>
<b>Additional</b> Directed by initial work-up	<i>Appropriate Laboratory Investigations</i> <ul style="list-style-type: none"> <li>• Thyroid function</li> <li>• Renal function</li> <li>• Electrolytes</li> </ul> <i>Chest X-ray</i> <i>Cardiac work-up as necessary</i> <ul style="list-style-type: none"> <li>• Echocardiogram</li> <li>• Treadmill test</li> </ul>

important element of the initial assessment of palpitations. Documentation of the underlying problem may rarely be possible, especially if AF or frequent premature beats are documented. More often, the utility of the ECG is in helping the search for a fixed structural or electrical abnormality.

Evidence of coronary disease necessitates the consideration of ventricular ectopy or tachycardia. The presence of voltage criteria for left ventricular hypertrophy (LVH) suggests hypertension and possible cardiomyopathy, necessitating further assessment. P-wave abnormalities may suggest atrial changes as a cause of intermittent atrial fibrillation (*i.e.*,

mitral stenosis, pulmonary hypertension). Electrical abnormalities may also suggest a cause of palpitations. A delta wave suggests Wolff-Parkinson-White syndrome, which may be associated with AV reentrant tachycardia or AF. A long corrected QT interval may occur on the basis of coronary disease, medications, electrolyte disturbances, or congenital syndromes and predispose to torsades de pointes.

### Further Diagnostic Work-up

Beyond history, physical, and ECG, further work-up of the patient with palpitations is based on clinical suspicion (Table 3). Prior to further testing, a diagnosis may be reached in up to 40% of patients presenting with palpitations.<sup>1</sup> If a cardiac arrhythmia is suspected, the logical next step is to obtain a symptom rhythm correlation during spontaneous symptoms. If a patient experiences symptoms during ECG, then symptom-rhythm correlation is present and further investigation is only warranted to assess arrhythmia burden or underlying structural heart disease. This is rarely the case, however, and some form of continuous monitoring is usually considered.

Holter monitoring is the most commonly ordered, yet least effective monitoring technique. Holter monitors record a continuous two-lead rhythm strip for 24 to 48 hours (Figure 1, top). Documentation of symptoms and activities in a patient diary is essential, since this is the key to symptom-rhythm correlation. Analysis of Holter data provides the reader with histograms of heart rate over the course of the recording, timing and morphology of premature beats, and runs of tachycardia. Statistics regarding these events are also provided. Holter monitoring, therefore, is useful in a patient with frequent symptoms that

are likely to occur during the 24 to 48-hour monitoring period, or in the patient with a known arrhythmia, requiring further study. An example of the latter would be assessment for rate control of AF.

Although a patient's heart rate may appear to be well controlled during a brief clinic visit, Holter monitoring may reveal poor rate control with particular activities or at certain times of the day. In a patient with frequent palpitations, initial diagnosis may be made using a Holter monitor, but symptoms often do not occur during monitoring.

If Holter monitoring is unsuccessful at obtaining a symptom-rhythm correlation, many primary-care physicians will reassure patients with a minor symptom burden, or refer patients with ongoing problematic symptoms to specialists. Recent advances in monitoring technology have greatly enhanced the ability to obtain a symptom-rhythm correlation (Table 4). A patient-activated rhythm transmitter is a hand-held device with recording electrodes. The device is applied to the skin over the heart when spontaneous symptoms occur (Figure 1, right). This device is also called a transtelephonic recorder. After the patient records a one-minute single lead ECG rhythm strip with the device, he/she can transmit the recorded signal to a receiving station using any analog phone, with technology similar to that of a fax machine. The data can be stored on a computer or printed out directly for interpretation (Figure 2). Because the device

Table 4

### Newer Tools for Arrhythmia Diagnosis in Patients with Palpitations

#### Transtelephonic Recorder (see Figure 1, right)

- Four electrodes on the housing of the device
- Hand-held device — no attached leads
- Must be with patient during symptoms
- Applied to the skin over the heart during symptoms
- Activation button followed by one to four minutes of recording
- Stores one or multiple single lead rhythm strips
- Data can be transmitted by the patient by phone — similar to a fax

#### External Loop Recorder (see Figure 1, left)

- Two electrodes on chest with leads attached to a "pager" style belt recorder
- Removed for exposure to water
- Can be worn for weeks, or even months
- Stores last four to 18 minutes of single lead electrocardiogram
- Memory "frozen" by patient or observer after syncope
- Electrocardiogram transmitted by telephone to diagnostic lab

Figure 1



Photograph of monitoring technologies used in patients with palpitations. At the top is a Holter monitor, connected to five electrodes. On the right is a patient-activated rhythm transmitter. Some newer models are more compact. On the left is an external loop recorder with two electrodes. In the center is an implanted loop recorder, capable of continuous recording for 14 months.

does not involve skin electrodes or leads, the patient can use the device for weeks at a time, thereby prolonging the period of monitoring, and significantly increasing the ability to obtain a symptom rhythm correlation. Compared to Holter monitoring, this method is more successful and cost-effective for determining the cause of palpitations, and is the testing modality of choice in patients with infrequent palpitations.<sup>2</sup> Unfortunately, this technology is unavailable in many areas, in large part because of the lack of, or poor levels of, reimbursement. The use of these devices is likely to grow as demand for them increases.

In patients where continuous prolonged monitoring is desirable, loop recorders may be useful. External loop recorders continuously record a single lead ECG *via* two electrodes adhered to the chest (Figure 1, left). The monitor portion of the device is clipped to the patient's belt like a pager and can be worn during usual daily activities. Up to three events can be recorded by pressing a button on the monitor, each consisting of a snapshot of the rhythm three to five minutes before, and one to three minutes after the button is pressed. Recordings can then be transmitted to the physician *via* telephone line for assessment, and the patient can clear the device's memory for continued use. Accessibility, however, is a limiting factor, as these monitors are not widely available outside of tertiary-care centres. An implantable loop recorder is also in use, predominantly in patients with syncope. An important goal for the near future is the introduction of rhythm transmitters and loop recorders to accessible locations, including private laboratories and non-urban centers.

### *Additional Testing*

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Further testing of the patient with palpitations is directed by the initial clinical assessment. A complete blood count will indicate anemia or infection as potential causes of sinus tachycardia. Electrolytes should be assessed and corrected as necessary. Renal and thyroid function may be assessed if indicated.

A normal echocardiogram is useful, since a normal study in the presence of a normal ECG allows reassurance that the cause of palpitations is almost always benign.

If there is uncertainty about the presence of underlying structural heart disease, echocardiography should be performed. Exercise treadmill testing with continuous 12-lead ECG monitoring is useful in patients with exercise-induced palpitations. Suggestion of CAD from initial workup should prompt consideration of stress-testing or angiography.

Electrophysiologic (EP) testing is a catheter-based procedure, involving the use of temporary transvenous pacing and recording. Detailed information can be collected regarding the nature of conduction through various cardiac tissues. Arrhythmias can be initiated by pacing techniques and location of re-entrant circuits can be identified and potentially eliminated by radioablation. EP testing is indicated in patients with frequent episodes of documented tachycardia who are seeking a cure.

### *Outcome*

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In spite of the various means of attempting to document an underlying cause for palpitations, success may remain elusive. Although descriptions of palpitations are useful in guiding diagnostic measures, they do not accu-

rately suggest a diagnosis. In a study of 190 patients, a diagnosis was found in 84%, half of which were reached after history, physical, ECG and laboratory investigations.<sup>1</sup> Nearly half of patients had a documented cardiac source, and one-third were related to psychiatric issues. One-year mortality was very low, at 1.6%. The one-year risk of stroke, a danger of untreated AF, was 1.1%. This illustrates the low prevalence of underlying structural heart disease among patients who present with palpitations.

## Differential Diagnosis and Treatment

Potential underlying causes of palpitations can be grouped into cardiac and non-cardiac etiologies (Table 5). Cardiac causes include frequent ectopic beats and tachycardias. Chronic tachycardia should be treated because of the risk of tachycardia-induced cardiomyopathy. Organized rapid atrial rhythms also may degenerate to AF due to “tachycardia-induced tachycardia,” which introduces additional problems unique to AF.

Sinus tachycardia should prompt a search for an underlying cause, such as hyperthyroidism, anemia, occult bleeding, infection, inflammatory disorders, and anxiety. Antiarrhythmic medications or beta blockers should not be prescribed to slow the rate of sinus tachycardia until a rigorous set of investigations has ruled out potential underlying causes. Primary sinus tachycardia is exceedingly rare and remains a diagnosis of exclusion.

AVnRT is more common in women and usually occurs in patients aged > 20.

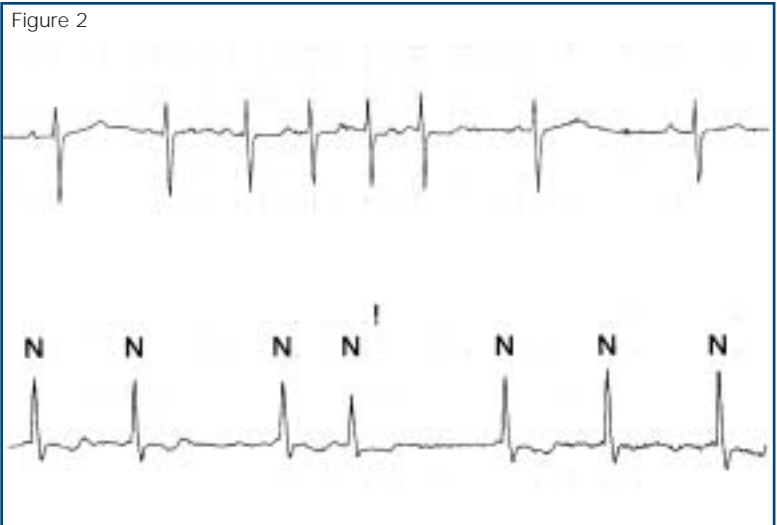


Figure 2 Rhythm strip from a patient-activated rhythm transmitter. The top panel shows sinus rhythm with a run or atrial ectopy, often called a salvo. This patient subsequently had atrial fibrillation documented (bottom panel), with a resolution of irregular palpitations after initiation of antiarrhythmic drug therapy.

Medications that affect conduction through the AV node, such as calcium channel blockers (CCBs) or beta blockers, are often effective. Alternatively, electrophysiology testing

and ablation may be an option. Patients with AV re-entrant (bypass tract-mediated) tachycardia are often younger than those with AVnRT, with a slightly higher prevalence among males. Treatment may be attempted using medications that affect the electrical properties of either the bypass tract (*i.e.*, flecainide or propafenone) or the AV node (using CCBs or beta blockade). EP study and ablation of the accessory pathway is also an alternative.

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Table 5

### Etiology of Palpitations

#### Cardiac

- Benign atrial or ventricular ectopy
- Sinus tachycardia
- Atrial fibrillation
- Atrial flutter
- Atrial tachycardia
- Wolff-Parkinson-White syndrome
- Atrioventricular nodal re-entrant tachycardia
- Long QT syndrome
- Ventricular tachycardia

#### Non-cardiac

- Anxiety
- Anemia
- Infection
- Electrolyte imbalance
- Diabetes
- Thyroid disease
- Renal impairment
- Autonomic dysfunction

vention of thromboembolism. This involves use of warfarin in most patients with a risk factor for stroke (age > 65, hypertension, diabetes, history of transient ischemic attack or stroke, or history of CHF), with a target international normalized ratio (INR) of two to three. The second goal is to obtain rate control by blocking the AV node pharmacologically. This usually involves use of beta blockers or centrally-acting CCBs to alleviate symptoms from rapid rates. In general, an attempt should be made to convert new onset AF to sinus rhythm. This can be done immediately if the duration of AF is < 48 hours, otherwise, cardioversion (electrical or medical) must be preceded by four weeks of anticoagulation.

Maintenance of sinus rhythm often requires the use of antiarrhythmic agents such as propafenone, sotalol, and amiodarone. If it is not possible to achieve sinus rhythm (as is often the case with long-standing AF), then beta blockers or CCBs should be administered for rate control.

### *Benign Ectopy*

Isolated atrial and ventricular ectopy is extremely common and, at times, symptomatic.

Patients may describe the sensation of an associated “skip” that may reflect the tendency of the heart to pause after a premature contraction. This missed beat is often followed by a strong or forceful beat that is described as painful (Figure 3). These ectopics typically arise from several locations, including the *crista terminalis*, pulmonary veins and right ventricular outflow tract.

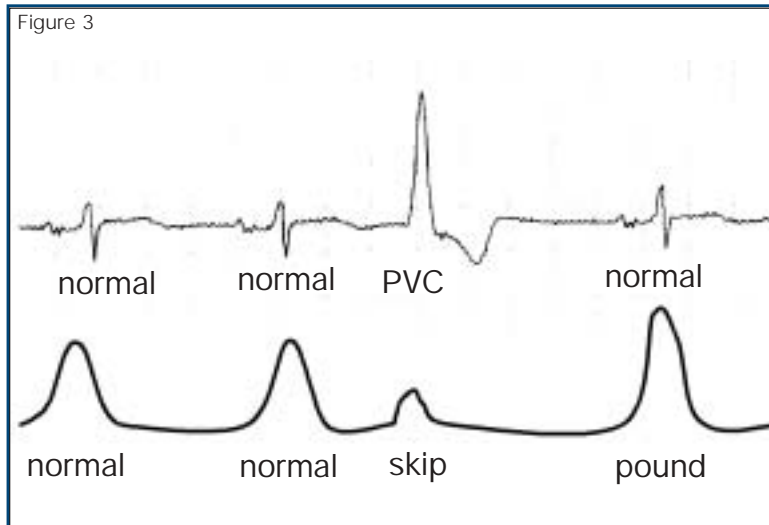
There is absolutely no need to investigate or treat patients with a structurally normal heart, even those with several hundred ectopics per day. Sustained rhythms from the same locations are often more symptomatic and warrant consideration of treatment similar to any other benign sustained tachycardia. Holter monitoring studies suggest isolated atrial and ventricular ectopy is a “normal” finding, associated with an excellent prognosis. The frequency of ectopy is increased by caffeine, stimulants, stress or anxiety. Echocardiography is warranted to rule out underlying structural heart disease. If structural heart disease is identified, treatment may be warranted in consultation with a cardiologist. In the presence of benign ectopy, reassurance is usually sufficient. If the patient is strongly in favour of treatment, low-dose beta blockers are often helpful.

## Non-Cardiac Causes


Non-cardiac causes of palpitations are associated with sinus rhythm and normal heart rate, or sinus tachycardia (ST). Investigation of ST is described above. Patients with palpitations who clearly demonstrate sinus rhythm at a normal rate (during symptoms) may be among those with a heightened awareness of cardiac activity.<sup>3,4</sup> Studies have identified characteristics common to this segment of the population, including a low level of physical activity and a high prevalence of panic disorder.<sup>3</sup> Management of such patients presents a challenge. Anxiety should be considered a contributing factor, and a healthy amount of aerobic exercise, if lacking, may be beneficial. Prognosis for these patients is the same as for the general population, and awareness of cardiac rhythm has not been found to coincide with awareness of arrhythmia.<sup>4</sup> At the least, the documentation of sinus rhythm during palpitations allows reassurance of the patient regarding prognosis.

## Conclusion

The management of patients with palpitations presents a challenge for the primary-care physician. However, a thorough history and physical examination, along with ECG and appropriate laboratory investigations, will provide a diagnosis in up to 40% of patients. For the remainder of patients, documentation of cardiac rhythm during spontaneous symptoms is essential. A summary algorithm is provided in Figure 4. While making this goal



ECG rhythm strip and schematic illustrating benign ventricular ectopy. The premature ventricular contraction occurs prior to complete ventricular filling, resulting in an early low amplitude pulse seen on the pressure tracing. This is often described by the patient as a skip or flipping of the heart action in the chest. The subsequent pause is associated with a marked rise in pulse amplitude because of prolonged ventricular filling and post extrasystolic accentuation. This forceful beat is often the source of complaint from the patient, who describes a pounding or painful thump.

more realistic, newer technologies, such as patient-activated rhythm transmitters, tend to remain under-used. Increased use of current diagnostic options, along with constantly emerging therapies, will continue to reduce the challenge of work-up and management of patients with palpitations. 

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## Case Discussion

On the basis of the history, physical exam and ECG, it is unlikely that underlying heart disease is playing a role, or that S.L.'s palpitations represent a dangerous arrhythmia. The palpitations are most likely due to ectopy. The morphology of the PVCs on the ECG suggest they originate in the right ventricular outflow tract. This is the most common site of origin for benign ectopic beats. It remains important, however, to monitor the rhythm for a period of 24 hours to document the rhythm during symptoms and to quantify the ectopic beats. It is also important to determine whether ectopy is monomorphic or polymorphic, since a finding of polymorphic ectopy warrants further measures to exclude CAD. An echocardiogram is warranted if abnormalities are detected upon physical examination or ECG. An echocardiogram was ordered for S.L., therefore, given her history of hypertension. Thyroid indices were checked in light of the history.

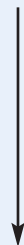
A 24-hour Holter monitor showed sinus rhythm at a mean rate of 65 with no episodes of tachycardia. The lowest heart rate was 45 bpm at 3 a.m. and the highest 114 bpm at 2 p.m. There were frequent ventricular ectopic beats (873 over 24 hours), all with the same morphology. The patient indicated symptoms 10 times, all coinciding with ectopic beats. The echocardiogram was normal, with no structural abnormalities and normal wall motion. The thyroid-stimulating hormone (TSH) was normal.

S.L. was reassured regarding the benign nature of her palpitations and therapeutic options included no therapy *versus* low-dose beta blockade or calcium channel blockade. She felt her symptoms were severe enough to warrant some form of therapy and low-dose beta blockers were prescribed. Six months later, her symptoms are infrequent and tolerable.

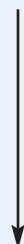
Figure 4

## Summary Algorithm for the Approach to the Patient with Palpitations

### Palpitations



- Initial Assessment**
- History
  - Physical
  - ECG



### Symptom Rhythm Correlation

- Holter monitor
- Transtelephonic monitor
- Loop recorder



### Additional Testing Based on Clinical Suspicion

- Blood work
- Stress test
- Echocardiogram

ECG: electrocardiogram

The key points are to obtain a thorough history, resting ECG and establish a symptom rhythm correlation.