

*Current Concepts***EVALUATION OF PATIENTS WITH PALPITATIONS**

PETER ZIMETBAUM, M.D., AND MARK E. JOSEPHSON, M.D.

PALPITATIONS are one of the most common problems of outpatients who present to internists and cardiologists. Although usually benign, they are occasionally a manifestation of potentially life-threatening conditions. The physician's fear of missing a treatable condition may lead to the inappropriate use of expensive tests with little diagnostic and therapeutic value. The following discussion will describe the common presentations of palpitations and offer a guide to rational diagnostic testing.

COMMON PRESENTATIONS: SYMPTOMS AND ASSOCIATED CIRCUMSTANCES**Symptoms**

Palpitations are described in a myriad of ways, but some specific symptoms are common and useful for narrowing the differential diagnosis.

Flip-Flopping in the Chest

The heart seems to stop and then start again, producing a pounding or flipping sensation. This type of palpitation is generally caused by premature contraction of the atrium or ventricle. The sensation that the heart has stopped results from the pause following the premature contraction, and the pounding or flipping sensation results from the forceful contraction following the pause.

Rapid Fluttering in the Chest

A feeling of rapid fluttering in the chest may result from atrial or ventricular arrhythmias, including sinus tachycardia. The rhythm of the palpitations may indicate the probable mechanism.

Pounding in the Neck

A pounding feeling in the neck is caused by the dissociation of atrial and ventricular contractions so that the atria contract against closed tricuspid and mitral valves, producing cannon A waves. Cannon A waves are perceived as neck pulsations and, when

rapid and regular, may be seen as a bulging in the neck (sometimes termed a "frog sign"¹). The sensation of rapid and regular pounding in the neck is most typical of reentrant supraventricular arrhythmias, particularly atrioventricular nodal tachycardia. Atrioventricular nodal tachycardia is the most common form of paroxysmal supraventricular tachycardia and is three times as common in women as in men.² In the typical form of atrioventricular nodal tachycardia, the atria and ventricles are activated simultaneously at an average rate of 160 to 180 beats per minute.

Atrioventricular dissociation can also result from ventricular premature contractions called ventricular premature depolarizations. In these cases only one or a few pounding sensations are felt in the neck, and the rhythm is often more irregular and less sustained than with atrioventricular nodal tachycardia. Palpitations caused by ventricular premature depolarizations with cannon A waves are also often described as a feeling of being unable to catch one's breath.

Circumstances

The circumstances during which palpitations occur are often helpful in identifying their cause.

Palpitations Associated with Anxiety or Panic Reactions

In palpitations associated with anxiety or panic, it is frequently difficult for the patient to discern whether the feeling of anxiety or panic preceded or resulted from the palpitations. Panic disorder was diagnosed as the cause of palpitations in 20 percent of patients in one study.³ The same authors have shown that many patients who frequently report palpitations have a history of panic attacks.⁴ Although there is good evidence that psychiatric disorders are a common cause of palpitations, this diagnosis should not be accepted until true arrhythmic causes have been excluded.^{5,6}

In a recent study of 107 consecutive patients with electrophysiologically documented reentrant supraventricular tachycardia, there was a median of 3.3 years between the initial presentation to a physician and the definitive diagnosis of supraventricular tachycardia; 67 percent of the patients met the criteria for panic disorder of the *Diagnostic and Statistical Manual of Mental Disorders* (fourth edition, revised).⁷ Of the 59 patients in whom supraventricular tachycardia was not recognized at the initial medical evaluation, 32 received a diagnosis of panic, stress, or anxiety disorder, and 65 percent of these were women. As these findings indicate, there is a regrettable tendency to ascribe palpitations to anxiety, particularly when they occur in young women (Fig. 1).

Palpitations during Periods of Catecholamine Excess

The idiopathic ventricular tachycardias, particularly those arising from the right ventricular outflow

From the Cardiovascular Division, Department of Medicine, Beth Israel Deaconess Medical Center and Harvard Medical School, Boston. Address reprint requests to Dr. Zimetbaum at the Cardiovascular Division (GZ-435), Beth Israel Deaconess Medical Center, 330 Brookline Ave., Boston, MA 02215.

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tract, occur in the setting of catecholamine excess, such as during exercise. Patients with this group of disorders have structurally normal hearts with ventricular tachycardias that most commonly arise from the right ventricular outflow tract. These disorders most often present during the second and third decades of life as palpitations, dizziness, or syncope.⁸ Supraventricular tachycardias, particularly atrial fibrillation, may be induced during exercise or at the termination of exercise when the withdrawal of catecholamines is coupled with a surge in vagal tone. This relative increase in vagal tone after exercise may be associated with the development of atrial fibrillation in some patients, particularly athletic men in the third to the sixth decade of life.⁹

Catecholamine excess may also occur during emotionally startling experiences. Patients with the long-QT syndrome, an inherited abnormality of myocardial repolarization, characteristically present with palpitations due to polymorphic ventricular tachycardia during periods of emotional stress or vigorous exercise.¹⁰ Inappropriate sinus tachycardia is a recently recognized, extremely rare disorder that manifests as palpitations during minimal exertion or with emotional stress. This arrhythmia is characterized by inappropriate increases in sinus rates. It is most frequently seen in young women and may result from a hypersensitivity to beta-adrenergic stimulation.¹¹

Palpitations Associated with Position

In patients with atrioventricular nodal tachycardia, the arrhythmia often appears when they stand up straight after bending over and may end when they lie down. The patients also note a pounding sensation while they are lying in bed, particularly when in the supine or left lateral decubitus position. This symptom may be the result of premature beats, which occur more frequently at slow heart rates, as when a person is resting in bed.

Palpitations Associated with Syncope or Near-Syncope

Dizziness, presyncope, or syncope may accompany palpitations and should prompt a search for ventricular tachycardia. It is important to recognize that short runs of nonsustained ventricular tachycardia can result in syncope as well as palpitations. Occasionally, syncope will occur with supraventricular tachycardia, particularly at the beginning of the tachycardia. This type of syncope is believed to result from acute vasodilation, rapid heart rate with low cardiac output, or both.^{12,13}

DIAGNOSTIC EVALUATION

The diagnostic evaluation of all patients with palpitations should include a detailed history taking, physical examination, and 12-lead electrocardiography. The history should include information on the characteristic presentations described above as well as the patient's age at the onset of palpitations. A patient who has had rapid palpitations since childhood is most likely to have a supraventricular tachycardia, particularly one that uses a bypass tract, although atrioventricular nodal tachycardia is also possible. Other types of paroxysmal supraventricular tachycardia, such as atrial tachycardia or atrial fibrillation, are distinctly less likely until patients are older. Occasionally, idiopathic ventricular tachycardias begin in adolescence, as do symptoms of the congenital long-QT syndrome.

It is critical that the patient give a detailed description of his or her symptoms. In particular, the examiner must elicit the rate and degree of regularity of the palpitations. The examiner should ask the patient to tap out the rhythm with his or her fingers. It is helpful for the physician to provide examples of rapid and regular rhythms, rapid and irregular rhythms, slow and regular rhythms, and slow and irregular rhythms. Rapid and regular rhythms are suggestive of paroxysmal supraventricular tachycardia or

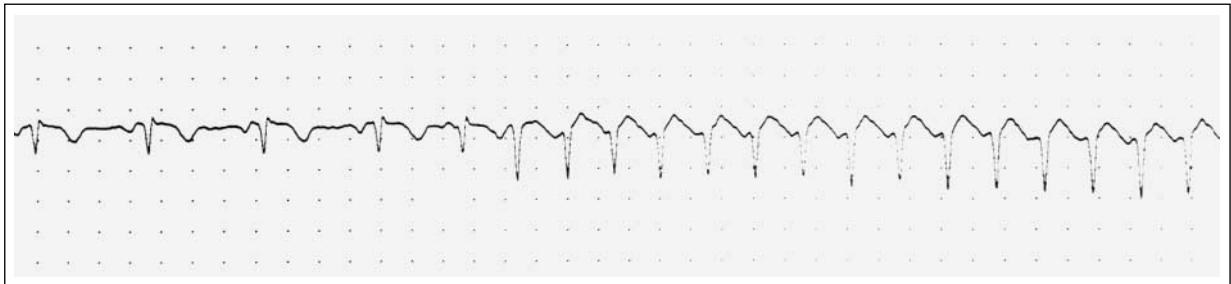


Figure 1. Continuous-Loop Event-Recorder Strip from a 35-Year-Old Woman with a Six-Year History of Palpitations Ascribed to Panic Disorder.

The rhythm strip shows the initiation of a narrow complex supraventricular tachycardia. At electrophysiologic study, a bypass tract was identified and eliminated by radio-frequency ablation. The patient has had no further palpitations or panic attacks.

ventricular tachycardia. Rapid and irregular rhythms suggest atrial fibrillation, atrial flutter, or tachycardia with variable block.

The mode of onset and termination of the palpitations sometimes indicates their cause. Palpitations described as abrupt in onset and termination may be caused by supraventricular or ventricular tachycardias. Patients often become adept at terminating their own palpitations with carotid-sinus massage or other vagal maneuvers, such as the Valsalva maneuver. This mode of termination is suggestive of supraventricular tachycardias, particularly atrioventricular nodal tachycardia or those using a bypass tract.

Physical Examination

Although a physician rarely has an opportunity to examine a patient during an episode of palpitations, the physical examination is useful in defining potential cardiovascular abnormalities that could serve as a substrate for arrhythmias. A notable example is the midsystolic click of mitral-valve prolapse. Virtually every type of supraventricular arrhythmia, as well as ventricular premature depolarizations and nonsustained ventricular tachycardia, has been described with mitral-valve prolapse, and palpitations are nearly ubiquitous in this disorder.¹⁴

The harsh holosystolic murmur heard along the left sternal border that increases when the Valsalva maneuver is performed suggests hypertrophic obstructive cardiomyopathy. Atrial fibrillation is a common cause of palpitations in this disorder, but it is also associated with ventricular tachycardia. Signs of dilated cardiomyopathy and congestive heart failure raise the possibility of ventricular tachycardia as well as atrial fibrillation.

The physical examination can be very useful in evaluating patients with chronic atrial fibrillation and palpitations. Although palpitations may not be present at rest, when the ventricular response is slow, a brisk walk down the corridor may unmask a poorly controlled ventricular response and resultant palpitations.

Twelve-Lead Electrocardiography

In a patient with normal sinus rhythm, 12-lead electrocardiography helps narrow the differential diagnosis of palpitations (Table 1). The electrocardiogram should be scrutinized for the presence of a short PR interval and delta waves, which suggest ventricular preexcitation and the substrate for supraventricular tachycardia (the Wolff-Parkinson-White syndrome). Marked left ventricular hypertrophy with deep septal Q waves in I, L, and V₄ through V₆ suggests hypertrophic obstructive cardiomyopathy. Left ventricular hypertrophy with evidence of left atrial abnormality (as indicated by a terminal P-wave force in V₁ more negative than 0.04 msec and notched in lead II) suggests a likely sub-

TABLE 1. ELECTROCARDIOGRAPHIC CLUES TO THE CAUSE OF PALPITATIONS.

ELECTROCARDIOGRAPHIC FINDINGS	SUGGESTED CAUSE
Short PR interval, delta waves	Atrioventricular reentrant tachycardia*
P mitrale, left ventricular hypertrophy, atrial premature depolarizations	Atrial fibrillation
Ventricular premature depolarizations, left bundle-branch block with positive axis†	Idiopathic ventricular tachycardia, right ventricular outflow tract type
Ventricular premature depolarizations, right bundle-branch block with negative axis†	Idiopathic ventricular tachycardia, left ventricular type
Q waves	Ventricular premature depolarizations, nonsustained or sustained ventricular tachycardia
Complete heart block	Ventricular premature depolarizations, polymorphic ventricular tachycardia
Long QT interval	Polymorphic ventricular tachycardia
Inverted T wave in V ₂ , with or without epsilon wave	Arrhythmogenic right ventricular dysplasia‡

*Atrioventricular reentrant tachycardia is supraventricular tachycardia using a bypass tract.

†These findings are for patients without structural heart disease.

‡Arrhythmogenic right ventricular dysplasia is an inherited cardiomyopathy of the right ventricle characterized by inverted T waves in the right precordial leads (V₁ through V₃) and epsilon waves (fragmented-QRS morphology).

strate for atrial fibrillation. The presence of Q waves characteristic of a prior myocardial infarction warrants a more extensive search for nonsustained or sustained ventricular tachycardia.

Occasionally, a 12-lead electrocardiogram will show isolated atrial and ventricular ectopy. The morphology of the ventricular premature beats, particularly in patients with normal hearts, may suggest that one of the two types of idiopathic ventricular tachycardia is present. Prolongation of the QT interval and abnormal T-wave morphology may suggest the presence of the long-QT syndrome. It is important to recognize that any bradycardic rhythm can be accompanied by ventricular premature depolarizations and palpitations. In particular, complete heart block can be associated with ventricular premature depolarizations as well as prolonged QT intervals and torsade de pointes.

The diagnosis should be clear in the few patients in whom an arrhythmia correlating with palpitations is captured on a 12-lead electrocardiogram. Further clues to the diagnosis of dysrhythmias by electrocardiography are beyond the scope of this discussion but are well described in many reviews.²

Diagnostic Testing

We recommend further diagnostic testing for three groups of patients: those in whom the initial

diagnostic evaluation (history, physical examination, and electrocardiogram) suggests an arrhythmic cause, those who are at high risk (defined below) for an arrhythmia, and those who remain anxious to have a specific explanation for their symptoms. We divide our patients with palpitations into those at high risk for an arrhythmia and those at low risk. Patients considered at high risk are those with organic heart disease or any myocardial abnormality that can lead to serious arrhythmias. These disorders of the heart muscle include scar formation from myocardial infarction, idiopathic dilated cardiomyopathy, clinically significant valvular regurgitant or stenotic lesions, and hypertrophic cardiomyopathies. These disorders have all been shown to be associated with the development of ventricular tachycardia.¹⁵ We also inquire about a family history of arrhythmia, syncope, or sudden death from cardiac causes as risk factors for cardiomyopathy or the long-QT syndrome. Low-risk patients are those without a potential substrate for arrhythmias.

We pursue an aggressive approach to diagnosis in high-risk patients that begins with ambulatory monitoring devices and ultimately invasive electrophysiologic testing if clinically significant arrhythmias are recognized or are suspected but not recorded by ambulatory monitoring devices (Table 2). In low-risk patients, we proceed to ambulatory monitoring only if the history or electrocardiogram is suggestive of a sustained arrhythmia or the patient needs the reassurance of a documented benign cause for his or her palpitations.

Ambulatory Monitoring Devices

Ambulatory electrocardiographic monitoring devices are the most important tools for the diagnosis of palpitations. The Holter monitor is a 24-hour monitoring system that records and saves data continuously. The device is worn for one or two days while the patient keeps a diary recording the time and characteristics of symptoms. Continuous-loop event recorders continuously record data but save the data only when the patient manually activates the monitor. When the monitor is activated, it saves the data for the preceding and subsequent two minutes (or for other periods, as programmed). Continuous-loop recorders have proved more cost effective and efficacious than Holter monitors for the evaluation of palpitations.^{17,18} They can be used for longer periods than Holter monitors and are therefore more likely to record data during palpitations, since most patients with palpitations do not have them every day. A monitoring period of two weeks is sufficient to make a diagnosis in the vast majority of patients with palpitations and is less costly than the standard monitoring period of one month.¹⁹

In summary, the evaluation of patients with palpitations should begin with a history taking, physical

TABLE 2. INDICATIONS FOR TREADMILL EXERCISE TESTING AND INVASIVE ELECTROPHYSIOLOGIC EVALUATION IN THE DIAGNOSTIC WORKUP OF PATIENTS WITH PALPITATIONS.

TEST AND INDICATION	POSSIBLE DIAGNOSES
Treadmill exercise testing* Symptoms during or following exercise	Supraventricular tachycardia, atrial fibrillation; idiopathic ventricular tachycardia; ventricular premature depolarizations
Electrophysiologic testing† Documented rapid pulse without electrocardiographic documentation of the cause	Any tachyarrhythmia
Palpitations preceding a syncopal episode	Ventricular tachycardia; less commonly, supraventricular tachycardia

*In lieu of formal exercise testing, we often ask patients to wear continuous-loop event recorders during daily exercise.

†Recommendations for electrophysiologic evaluation of patients with palpitations are taken from the report of the American College of Cardiology–American Heart Association Task Force.¹⁶

examination, and 12-lead electrocardiography. If there is no evidence of heart disease and the palpitations are unsustained and well tolerated, ambulatory monitoring or reassurance is recommended. If the palpitations are sustained or poorly tolerated, an electrophysiologic study, with or without prior ambulatory monitoring, is indicated. If the initial evaluation suggests heart disease and the palpitations are unsustained, ambulatory monitoring is again recommended. If the palpitations are sustained and poorly tolerated and there is evidence of heart disease, an electrophysiologic study, with or without preceding ambulatory monitoring, is warranted.

MANAGEMENT

The management of most sustained supraventricular or ventricular arrhythmias causing palpitations involves referral to a specialist trained in the pharmacologic and invasive electrophysiologic management of arrhythmias. Most types of supraventricular tachycardias and many types of ventricular tachycardias are now curable with radio-frequency ablation.¹⁶

The most challenging cases of palpitations are those due to benign atrial or ventricular ectopy or associated with normal sinus rhythm. Most patients with palpitations who undergo ambulatory monitoring are found to have one of these conditions (Table 3).^{17,19,20} Normal sinus rhythm is found in up to one third of patients with palpitations who undergo evaluation. Ventricular premature contractions and non-sustained ventricular tachycardia are also found in a substantial proportion of patients with palpitations, and in patients with structurally normal hearts, they are not associated with increased mortality.²¹ We attempt to reassure patients with these benign diagnoses that these rhythms are not life-threatening.

TABLE 3. PERCENTAGE OF PATIENTS WITH PALPITATIONS IN WHOM VARIOUS CONDITIONS WERE DIAGNOSED BY CONTINUOUS EVENT RECORDERS.

CONDITION	STUDY		
	KINLAY ET AL. ¹⁷ (N = 100)	ZIMETBAUM ET AL. ¹⁹ (N = 105)	ZIMETBAUM ET AL. ²⁰ (N = 408)
	percent		
Sinus rhythm	35	18	39
Ventricular premature depolarizations	12	20	36
Atrial premature depolarizations	0	8	13
Atrial fibrillation	6	17	2
Ventricular tachycardia	0	2	1
Sinus tachycardia	29	7	5
Supraventricular tachycardia	18	10	4

In the rare cases in which the atrial or ventricular ectopy proves incapacitating, we initiate treatment with beta-blocking medications. We generally do not recommend other antiarrhythmic medications, such as quinidine, flecainide, or sotalol, because of the associated risks of proarrhythmia. We generally do not recommend radio-frequency ablation of isolated ventricular ectopy. However, on rare occasions, ventricular bigeminy can produce palpitations with fatigue and near-syncope on exertion because of a slow effective heart rate and low cardiac output. Radio-frequency ablation may be considered in this circumstance if the ventricular ectopy has uniform morphologic features and occurs incessantly.

The management of inappropriate sinus tachycardia deserves special mention. The diagnosis of inappropriate sinus tachycardia can be made after secondary causes, such as hyperthyroidism or anemia, have been excluded and the patient has undergone electrophysiologic testing to rule out other forms of supraventricular tachycardia that may mimic sinus tachycardia, such as right atrial tachycardia and sinus-node reentry.²² The first line of therapy is pharmacologic treatment with beta-blockers or calcium-channel blockers. If this strategy fails, radio-frequency ablation or modification of the sinus node can be attempted. However, these treatments are often unrewarding and may result in serious complications, such as complete destruction of the sinus node, requiring permanent pacing, or paralysis of the phrenic nerve.²²

In the vast majority of outpatients with palpitations, the cause of the palpitations is benign, and extensive and costly investigation is not warranted. At-

tention to characteristics that identify patients at high risk for serious causes of palpitations will help define the much smaller percentage of patients with palpitations who require more extensive diagnostic testing and management of their condition.

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