Shedding Light on Blackouts

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Syncope is defined as a sudden temporary loss of consciousness with spontaneous recovery. Syncope affects 12% to 48% of the population at some point during their lives (most people do not seek medical attention).[1,2] Syncope is responsible for 3% of emergency department visits and 1% of hospital admissions, and consumes significant health-care resources.[3,4]

After initial assessment, diagnosis remains unclear in 50% of patients. These patients require testing for a clinical diagnosis, however, only 60% of those tested will be diagnosed. The remaining 40% (20% of the total) will remain unexplained. Standard textbooks provide long lists of causes of syncope (some of which include up to 200 causes). Rather than memorize (and as quickly forget) this huge differential diagnosis, it is helpful to deduce a likely cause based on categories that form a diagnostic flow chart (Figure 1). Despite the broad differential diagnosis, the vast majority of syncopal spells are cardiovascular in origin, explained in large part by vasovagal syncope and, to a lesser degree, arrhythmia. A simple probabilistic approach would suggest the most common causes of syncope are bradyarrhythmias in the elderly, and vasovagal in the young.

Since syncope resolves spontaneously for most patients, the pieces of the puzzle are often difficult to put back together. This situation leads to great frustration for patients and family and, to a lesser degree, physicians. Even after thorough investigation, including neurologic and cardiovascular testing, the cause of syncope is unexplained in 26% to 41% of patients.[1,5,6] The major obstacles to diagnosis are the periodic and unpredictable frequency of events, and the high spontaneous remission rate.

Physiologic monitoring during spontaneous syncope constitutes a seldom-achieved gold standard in its diagnosis. This standard is frequently unattainable, so clinicians must rely on clinical assessment and abnormal laboratory results to make inferential diagnostic and therapeutic decisions. Many of the tests routinely performed in patients with syncope are of very low yield, or provide inconclusive results that require considerable clinical judgment to interpret. Examples of the latter include borderline abnormalities on a routine electroencephalogram (EEG) or asymptomatic bradycardia in the elderly patient. Recent advances in long-term monitoring techniques have added powerful tools to the diagnostic armamentarium, particularly in the field of arrhythmia detection.

What's the initial evaluation?

The most powerful tool in assessing the patient with syncope is the history and physical examination. In a series of 433 patients with previous syncope, the history provided a diagnosis in 32% and provided a diagnosis that was confirmed with testing in an additional 5%.[1] The

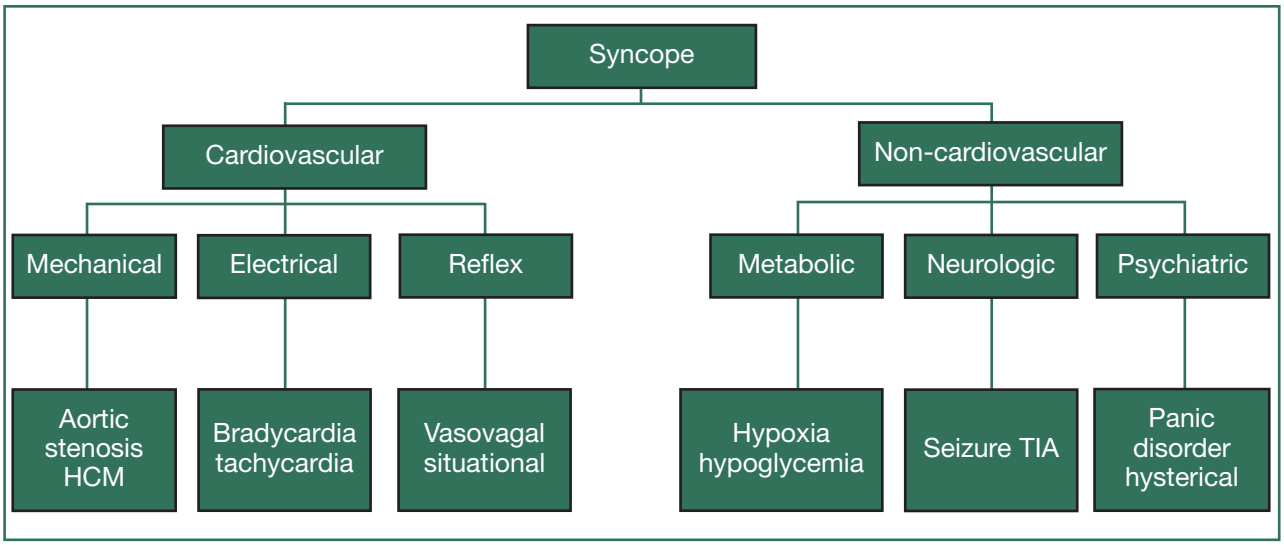

Figure 1. Flow chart indicating the broad categories of diagnoses in patients presenting with syncope. Two common examples are given for each category. Hypertrophic cardiomyopathy, transient ischemic attack—vertebrobasilar.

Table 1

Historical clues in patients with syncope

General questions

- Duration and frequency
- Circumstances
- Time to return to normal
- Prodrome
- Drug history
- Duration of unresponsiveness

Vasodepressor

- Warm, diaphoretic prodrome
- Upright posture
- Return to normal within minutes
- Averted syncopal spells
- Childhood fainting

Arrhythmia

- Sudden loss of consciousness
- Palpitations

Seizure

- Aura
- Post-ictal state
- Tonic-clonic movements
- Tongue biting
- Incontinence

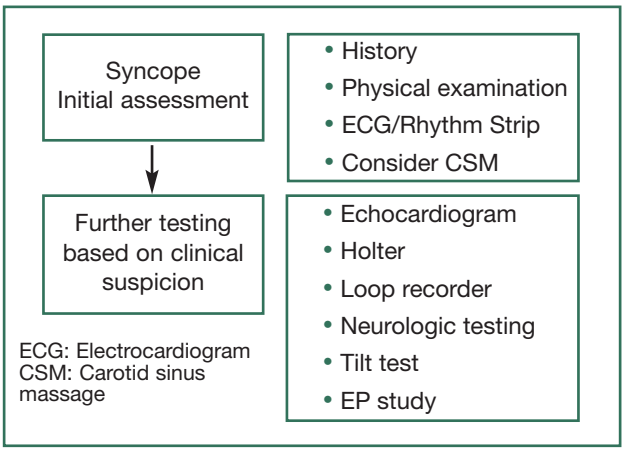

Figure 2. Flow chart of basic approach to the patient with syncope.

combination of all subsequent testing provided a diagnosis in only 22%. Key historical clues include several points (Table 1). Additional history from an observer can be invaluable.[7] A drug history focusing on recent changes and hypotensive agents is also important.

Additional clues may point to a specific diagnosis. Vasovagal syncope is usually associated with:

- the upright position,
- "near miss" episodes averted by sitting or lying down,

- a prodrome of warmth and diaphoresis, and
- a return to "normal" within a few minutes after regaining consciousness.

The physical examination is often more useful in ruling out causes of syncope than ruling them in. Blood pressure should be obtained when patients are lying down, as well as when they are standing. When there is a strong index of suspicion for orthostatic hypotension or vasovagal syncope, standing blood pressure should be measured for up to three minutes. The cardiovascular examination should focus on signs of obstructive etiologies, such as aortic stenosis. A brief neurologic examination is indicated, particularly when there is an index of suspicion that the event may have a primary neurologic etiology.

What are the preliminary investigations?

An electrocardiogram (ECG) is an inexpensive and accessible test. It should be performed in all patients with syncope presenting for assessment, unless a clear diagnosis (such as vasovagal syncope) can be made from the history. The ECG will often help to rule in or out significant structural heart disease, which may influence subsequent management. Further testing after initial clinical and electrocardiographic assessment should be dictated by clinical suspicion (Figure 2). If carotid hypersensitivity is suspected, carotid sinus massage (CSM) should be performed by applying firm pressure to the carotid bulb after ruling out a carotid bruit. Some clinicians prefer to rub the carotid bulb instead of applying steady pressure. Ideally, this is performed during ECG monitoring in the supine and upright position. The upright position has been reported to markedly increase the sensitivity of the test.[8] Care must be taken to avoid patient injury in the event of a symptomatic response. In our institution, we perform upright CSM with a patient strapped to our tilt table. Greater than the seconds of asystole or hypotension associated with symptoms constitutes a positive test. Routine use of any test from this point forward leads to low yields and difficult interpretation. Examples of poor diagnostic yields are routine echocardiography (3%), routine blood work, and EEG (1%).[1,9,10] Other tests of low yield without published diagnostic yields include stress testing, cardiac and cerebral angiography, carotid Doppler, and brain imaging.

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Table 2
Newer tools for arrhythmia diagnosis in patients with syncope

External loop recorder

- 2 electrodes on chest with leads attached to "pager" style belt recorder
- Removed for exposure to water
- Can be worn for weeks or even months
- Stores last 4-18 minutes of single lead ECG
- Memory "frozen" by patient or observer after syncope
- ECG transmitted by telephone to diagnostic lab

Insertable loop recorder

- 6 x 2 x 0.7 cm device implanted in the left pectoral region
- Records single lead ECG for up to 14 months
- Stores up to last 40 minutes of ECG, or multiple events
- Memory "frozen" by patient or observer after syncope
- Downloaded by standard pacemaker programmer
- New autodetect version increases yield

ECG: Electrocardiogram

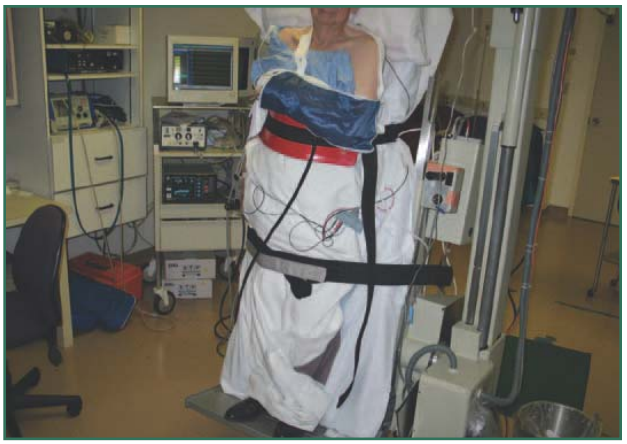

Figure 3. The patient is strapped to a motorized table to permit elevation to 80°. An intravenous is inserted and blood pressure is monitored through a continuous Doppler recording device.

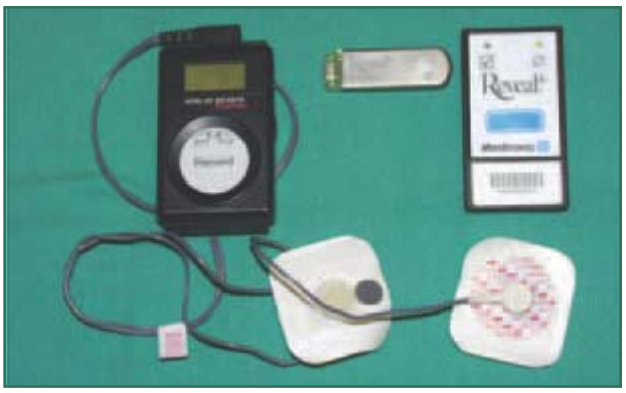

Figure 4. External and implanted loop recorders.

Cardiovascular testing

Ambulatory monitoring

Holter monitoring and in-hospital telemetry are frequently used to obtain a rhythm profile in patients with syncope. The yield of this approach is surprisingly low given its widespread use. The overall diagnostic yield is 21%, suggesting reasonable test performance.[2] Unfortunately, this involves monitoring during actual spontaneous syncope in only 2% to 4% of patients, with presyncope occurring in 13% and an asymptomatic arrhythmia considered contributory in the remaining patients. This suggests that Holter monitoring rarely provides a conclusive symptom-rhythm correlation, but often sheds indirect light on the possible cause of syncope. This is not surprising, given the infrequent and unpredictable nature of syncope. Recent advances in long-term monitoring technology promise to enhance our ability to obtain a symptom-rhythm correlation.

Tilt table testing

Tilt table testing is performed by placing the patient on a motorized table with a footboard which is capable of tilting the patient 60° to 80° (Figure 3). After application of ECG monitoring leads and an automated continuous or intermittent blood pressure monitoring device, the

patient is tilted up and monitored. The purpose of tilt testing is to monitor the patient's response to upright posture and subsequent venous pooling, attempting to reproduce the symptoms experienced during spontaneous syncope. In effect, tilt testing is a form of orthostatic "stress test".

The absence of a gold standard diagnostic test for vasovagal syncope makes assessment of tilt testing difficult. In patients where a clinical diagnosis of vasodepressor syncope is made, the tilt test is positive in approximately 70%, with 10% to 20% of normals demonstrating a positive test.[11] In the context of this modest test performance, tilt testing is indicated in patients with an intermediate probability of vasovagal syncope, where a positive test confirms a clinical diagnosis, and a negative test points the investigation in a different direction. For example, tilt testing would be reasonable in a 50-year-old woman with hypertension who has recurrent sudden loss of consciousness, with one episode occuring while seated. A positive test may reproduce her symptoms and facilitate advising the patient regarding preventative measures, but a negative test may prompt further investigation into an arrhythmic cause. A tilt test would not be indicated in a 85-year-old man with recurrent micturition syncope, or in a 70-year-old man with recurrent sudden loss of consciousness while lying down. In both of these cases, the result of the test is unlikely to influence the clinical diagnosis.

Electrophysiologic testing

Electrophysiologic (EP) testing involves insertion of temporary transvenous pacing and recording catheters, measurement of conduction intervals to assess possible bradycardias, and pacing and extrastimulus techniques to induce tachycardias. EP testing is indicated in patients with syncope who have structural heart disease when non-invasive testing does not yield a diagnosis.[12] Because of concern that the cause may have been ventricular arrhythmia, patients with significant structural heart disease should be considered to have a life-threatening etiology for syncope until proven otherwise. The main purpose of EP testing in this context is to attempt to induce ventricular tachycardia. The essential limitation of this technique is the need to extrapolate a cause for spontaneous syncope from abnormal test results. Electrophysiologic testing frequently yields results that require significant clinical correlation to interpret. This may include the induction of non-sustained ventricular arrhythmias; ventricular fibrillation induced by multiple closely coupled extrastimuli; or sustained brady and tachyarrhythmias, which do not reproduce the patient's spontaneous symptoms. Nonetheless, EP testing should be considered in patients where a life-threatening ventricular arrhythmia is part of the differential diagnosis.

Is there any new monitoring technology?

Conventional ambulatory monitoring techniques, including Holter monitoring and telemetry, are limited by the unpredictability and infrequency of recurrent symptoms. Recent advances in long-term cardiac arrhythmia monitoring have shown great promise in this difficult population (Table 2). The external loop recorder continuously records a single lead ECG, storing up to 18 minutes of recordings in its memory (Figure 4). It requires the application of two skin electrodes attached to leads that plug into a pager-style recording device. After spontaneous symptoms occur, the patient activates an event button, which freezes the previous recorded information, which can subsequently be downloaded manually or by phone. The leads and recording device can be worn for weeks, or even months, at a time. Long-term compliance with this device can be problematic because of electrode and skin related problems, and waning patient motivation in the absence of a recurrence. Compliance can be enhanced by patient education and careful, routine followup. Compliance is also more likely when patients require a definitive diagnosis and treatment before being permitted to drive or return to work. A recent prospective, randomized trial at our centre has shown the superiority of these devices over Holter monitoring in patients with syncope and presyncope.[13] The external loop recorder has become the initial diagnostic test of choice in patients with syncope or presyncope where an arrhythmia is suspected.

Prolonged monitoring with an implantable loop recorder (Figure 4) comes closer to the gold standard of physiologic monitoring during spontaneous symptoms, and provides a powerful tool in patients with recurrent syncope who are willing to undergo a minor surgical procedure to get to the bottom of the problem. Devices with automatic rate detection parameters have recently been introduced, further increasing diagnostic yield.[14,15] Further development of implantable monitoring technology will include smaller devices, user-friendly data storage and retrieval systems, and monitoring of other physiologic parameters, such as blood pressure. A recent 60-patient, single-centre trial has shown the device to be superior to a conventional workup with tilt and electrophysiologic testing, both with respect to diagnostic yield and cost-effectiveness.[16,17]

Is driving dangerous?

The issue of patients with syncope and driving can be contentious and painful for both the patient and the physician. The law varies from province to province. In many situations, the physician is mandated by law to notify the Ministry of Transportation if the patient has a condition that may influence their ability to drive a vehicle. The Ministry then collects information and renders a decision regarding driving. The Canadian

Take-home message

- Syncope usually has a cardiovascular cause.
- Most diagnoses are made based on a careful clinical history.
- Syncope in the context of structural heart disease should be treated as potentially life-threatening.
- An external loop recorder is the test of choice in patients when syncope is suspected to be caused by an arrhythmia.

Net Reading

1. Syncope.com: *www.syncope.com*
2. Patient Education Pages: *www.londoncardiac.ca/pages/educate.htm*

Cardiovascular Society is about to publish its revised guidelines on cardiac patients and driving, which is likely to influence the CMA guidelines and provincial policy-makers. Patients who have unexplained syncope (especially with little warning) should not drive until a diagnosis is obtained. If a definitive therapy, such as a pacemaker is initiated, patients may return to driving within a week. If therapy requires followup to determine its efficacy, then a longer period of time is necessary. Awareness of provincial law is important, since clinicians have been found partially liable in cases where patients were not advised about the dangers of driving.

In closing...

Syncope remains a challenging problem despite a large armamentarium of investigative tools. The initial clinical assessment remains the cornerstone of the diagnostic approach. Many of the conventional investigative tools used in this disorder are low yield unless guided by the patient's presentation. Recent advances in loop recorder technology represent significant steps forward in attaining the gold standard of physiologic monitoring during spontaneous symptoms. CME

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