Chapter 51: Syncope

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This chapter addresses the following Geriatric Fellowship Curriculum Milestones: #29, #42, #54

LEARNING OBJECTIVES

Learning Objectives

- Understand the presentation of syncope and that syncope can mimic falls.
- Describe the common subtypes and differential diagnosis of syncope.
- Discuss risk stratification and how risk stratification drives management.
- Detail pathophysiology of common syncope subtypes in older patients and their management.
- Discuss the challenges for recognition and management of syncope in the oldest old such as frailty, unwitnessed events, medications, and cognitive impairment.

Key Clinical Points

1. **Syncope is a common symptom throughout life; however, presentation is more frequent as people age and in the context of comorbidity and multiple medications.**
2. **Cardiac causes of syncope become more common with advanced aging.**
3. **Etiology in the older patient is often multifactorial.**
4. **Presentation in the older patient may result in patients presenting with falls rather than transient loss of consciousness (T-LOC).**
5. **Age-related physiologic changes including altered baroreflex sensitivity may result in coexistent supine hypertension coupled with hypotensive syndromes.**
6. **The prevalence of hypotensive and bradyarrhythmic syndromes increases due to age-related physiologic changes and/or cardiovascular medications.**
7. **Modification of cardiovascular and psychotropic medications is often needed to address syncope in older patients.**
8. **Additional challenges in the older patient include frailty, unwitnessed events, polypharmacy, cognitive impairment, and coexistence of multiple causes of syncope.**

DEFINITION

Syncope is a transient loss of consciousness (T-LOC) due to transient global cerebral hypoperfusion, and is characterized by rapid onset, short duration, and spontaneous complete recovery. T-LOC is a term that encompasses all disorders characterized by self-limited loss of consciousness, irrespective of mechanism. By including the mechanism of unconsciousness, that is transient global cerebral hypoperfusion, the current syncope definition excludes other causes of T-LOC such as epileptic seizures and concussion as well as certain common syncope mimics such as psychogenic pseudosyncope.

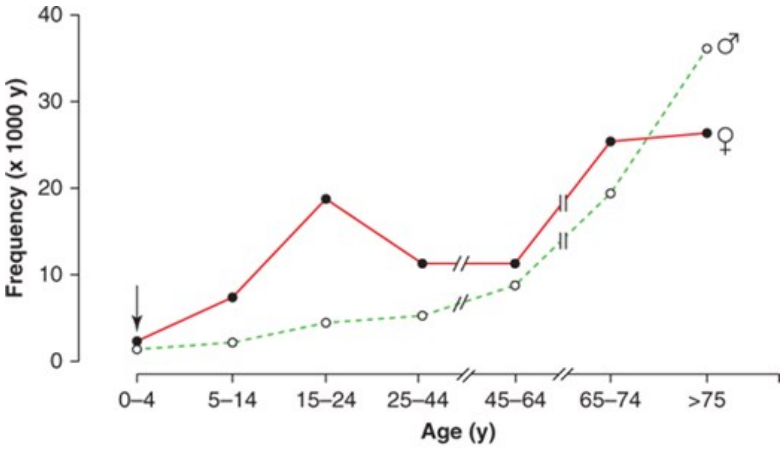
EPIDEMIOLOGY

Syncope is a common symptom, experienced by up to 30% of healthy adults at least once in their lifetime. Syncope accounts for 3% of emergency department visits and 1% of medical admissions to a general hospital. Syncope is the seventh most common reason for emergency admission of patients over 65 years. The cumulative incidence of syncope in long-term care facilites is close to 23% over a 10-year period with an annual incidence of 6% and recurrence rate of 30%, over 2 years. The age of first faint, a commonly used term for syncope, is less than 25 years in 60% of persons, but 10% to 15% of individuals have their first faint after age 65.

Syncope due to a cardiac cause is associated with higher mortality rates irrespective of age. In patients with a noncardiac or unknown cause of syncope, older age, a history of congestive cardiac failure, and male sex are important prognostic factors of mortality. It remains undetermined whether syncope is directly associated with mortality or is merely a marker of more severe underlying disease. **Figure 51-1** details the age-related difference in prevalence of benign vasovagal syncope compared to other causes of syncope.

Figure 51-1.

Frequency of the complaint fainting as reason for encounter in general practice in the Netherlands. Data are obtained from the general practitioners' transition project. It concerns an analysis of 93,297 patient-years. The arrow around 1 year is to indicate that a small peak occurs between 6-18 months. (From Wieling W, Ganzeboom KS, Krediet CT, Grundmeijer HG, Wilde AA, van Dijk JG. Initial diagnostic strategy in the case of transient losses of consciousness: the importance of the medical history. *Nederlands tijdschrift voor geneeskunde*. 2003;147(18):849–854.)



The Irish Longitudinal Study on Ageing (TILDA [www.tilda.ie]) is a population-based study of adults 50 years and over that incorporated questions on syncope and falls in addition to a broad spectrum of health, social and economic questions. A number of community-dwelling adults, mean age 62, range 50 to 106 years, were asked whether they experienced fainting in their youth, throughout their life, or over the past 12 months. A total of 23.6% had one or more episodes in the previous 12 months of which 4.4% were syncope and 19.2% were falls (**Table 51-1**). Although the prevalence of syncope rose with age, the increase in falls was much more remarkable, in particular the increase in nonaccidental or unexplained falls was most striking. Unwitnessed syncope most commonly presents as nonaccidental or unexplained falls, supporting the rising prevalence of atypical syncope wth advancing years.

TABLE 51-1

PREVALENCE OF SYNCOPE AND FALLS IN A POPULATION STUDY (n = 8572)—THE IRISH LONGITUDINAL STUDY OF AGEING (TILDA)

PREVIOUS YEAR %	50–64 Y	65–74 Y	75^{+} Y	TOTAL
Syncope	4.1	4.7	4.8	4.4
Falls	17.5	19.5	24.4	19.2
Nonaccidental/unexplained falls	7.6	9.4	11.6	8.9

The General Practitioners' Transition Project in the Netherlands demonstrated that the age distribution of patients presenting to their general practioner with syncope shows a peak in females at 15 years and a second peak in older patients (see **Figure 51-1**). The Framingham Offspring study similarly demonstrates a bimodal peak of first syncope in mid-teens and the second occurring over 70 years.

The true prevalence of syncope is underestimated due to the pheonomen of amnesia for T-LOC. Amnesia has been reported in patients with vasovagal syncope (VVS) and carotid sinus syndrome (CSS), but is likely to be present in all causes of syncope. The overlap between syncope and falls also leads to underreporting.

PATHOPHYSIOLOGY

The temporary cessation of cerebral function that causes syncope results from transient and sudden reduction of blood flow to parts of the brain (brainstem reticular activating system) responsible for consciousness. The predisposition to vasovagal syncope starts early and lasts for decades. Other causes of syncope are uncommon in young adults, but much more common as people age.

Regardless of the etiology, the underlying mechanism responsible for syncope is a drop in cerebral oxygen delivery below the threshold for consciousness. Cerebral oxygen delivery, in turn, depends on both cerebral blood flow and oxygen content. Any combination of chronic or acute processes that lowers cerebral oxygen delivery below the "consciousness" threshold may cause syncope. Age-related physiologic impairments in heart rate (HR), blood pressure (BP), cerebral blood flow, and blood volume control, in combination with comorbid conditions and concurrent medications account for the increased incidence of syncope in the older person. Blunted baroreflex sensitivity manifests as a reduction in the heart rate response to hypotensive stimuli. Older adults are prone to reduced blood volume due to excessive salt wasting by the kidneys as a result of a decline in plasma renin and aldosterone, a rise in atrial natriuretic peptide and concurrent diuretic therapy. Low blood volume together with age-related diastolic dysfunction, leading to low cardiac output coupled with inadequate heart rate responses to stress, increases susceptibility to orthostatic hypotension (OH) and VVS. Cerebral autoregulation which maintains a constant cerebral circulation over a wide range of blood pressure changes is altered in the presence of hypertension and possibly by aging—the latter is still controversial. In general it is agreed that sudden mild to moderate declines in blood pressure can markedly affect cerebral blood flow and render an older person particularly susceptible to presyncope and syncope. Syncope may thus result either from a single process that markedly and abruptly decreases cerebral oxygen delivery or from the accumulated effect of multiple processes, each of which contributes to reduced oxygen delivery.

Causes of Syncope in Older People

Reflex syncope and OH are the most frequent causes of syncope in all age groups and clinical settings and responsible for the majority of episodes in younger patients. However, cardiac causes of syncope, structural and arrhythmic, become more common in older patients and are responsible for one-third of syncope in patients attending the emergency room and chest pain unit. The prevalence of unexplained syncope varies according to diagnostic facilities and age from 9% to 41%. In the older patient, history may be less reliable and multiple causes of syncope may also be present (**Table 51-2**). Multimorbidity and polypharmacy are more common in older patients with syncope and can add to the complexity of identifying an attributable cause of events (**Tables 51-2** and **51-3**).

TABLE 51-2

CAUSES OF SYNCOPE

Reflex syncopal syndromes

- Vasovagal faint (common faint)
- Carotid sinus syncope
- Situational faint
  - Acute hemorrhage
  - Cough, sneeze
  - Gastrointestinal stimulation (swallow, defecation, visceral pain)
  - Micturition (postmicturition)
  - Postexercise
  - Pain, anxiety
- Glossopharyngeal and trigeminal neuralgia

Orthostatic

- Aging
- Antihypertensives
- Autonomic failure
  - Primary autonomic failure syndromes (eg, pure autonomic failure, multiple system atrophy, Parkinson disease with autonomic failure)
  - Secondary autonomic failure syndromes (eg, diabetic neuropathy, amyloid neuropathy)
- Medications (see **Table 51-3**)
- Volume depletion
  - Hemorrhage, diarrhea, Addison disease, diuretics, febrile illness, hot weather

Cardiac arrhythmias

- Sinus node dysfunction (including bradycardia/tachycardia syndrome)
- Atrioventricular conduction system disease
- Paroxysmal supraventricular and ventricular tachycardias
- Implanted device (pacemaker, ICD) malfunction
- Drug-induced proarrhythmias

Structural cardiac or cardiopulmonary disease

- Cardiac valvular disease
- Acute myocardial infarction/ischemia
- Obstructive cardiomyopathy
- Atrial myxoma
- Acute aortic dissection
- Pericardial disease/tamponade
- Pulmonary embolus/pulmonary hypertension

Cerebrovascular

- Vascular steal syndromes

Multifactorial

TABLE 51-3

DRUGS THAT CAN CAUSE OR CONTRIBUTE TO SYNCOPE

DRUG	MECHANISM
Diuretics	Volume depletion
Vasodilators Angiotensin-converting enzyme inhibitors Calcium channel blockers Hydralazine Nitrates α-Adrenergic blockers Prazosin	Reduction in systemic vascular resistance and venodilation
Other antihypertensive drugs α-Methyldopa Clonidine Guanethidine Hexamethonium Labetalol Mecamylamine Phenoxybenzamine β-Blockers	Centrally acting antihypertensives
Drugs associated with torsades de pointes Amiodarone Disopyramide Encainide Flecainide Quinidine Procainamide Sotalol	Ventricular tachycardia associated with a prolonged QT interval
Digoxin	Cardiac arrhythmias
Psychoactive drugs Tricyclic antidepressants Phenothiazines Monamine oxidase inhibitors Barbiturates	Central nervous effects causing hypotension; cardiac arrhythmias
Alcohol	Central nervous system effects causing hypotension; cardiac arrhythmias

Multifactorial Etiology

Previously up to 40% of patients with recurrent syncope remained undiagnosed despite extensive investigations, particularly among older patients who have limited cognitive impairment and for whom a witnessed account of events is often unavailable. More recently, diagnostic yield for all ages has

improved with application of clinical guidelines. The high frequency of unidentified causes in clinical studies may occur because patients failed to recall important diagnostic details, because of the stringent diagnostic criteria used in clinical studies or, probably most often, because the syncopal episode resulted from a combination of chronic and acute factors rather than from a single obvious disease process. Indeed, a multifactorial etiology likely explains the majority of cases of syncope in older persons who are predisposed because of multiple chronic diseases and medication effects superimposed on the age-related physiologic changes described earlier. Common factors that, in combination may predispose to, or precipitate, syncope include anemia, chronic lung disease, congestive heart failure, and dehydration. Medications that may contribute to, or cause, syncope are listed in **Table 51-3**.

Individual Causes of Syncope

Common causes of syncope are listed in **Table 51-2**. The most frequent individual causes of syncope in older patients are neurally mediated syndromes including CSS, orthostatic hypotension, and postprandial hypotension as well as arrhythmias including both tachyarrhythmias and bradyarrhythmias. These disease processes are described in the next section. Disorders that may be confused with syncope and which may, or may not, be associated with loss of consciousness are listed in **Table 51-4**.

TABLE 51-4

DIFFERENTIAL DIAGNOSIS OF SYNCOPE IN THE OLDER PERSON

CONDITIONS WITH LOC/PARTIAL LOC[a]	CONDITIONS WITHOUT LOC
• Epilepsy	• Cataplexy
• Metabolic disorders including hypoglycemia, hypoxia, hyperventilation with hypocapnia • Vertebrobasilar TIA[b]	• Drop attacks • Falls • TIA (anterior circulation)
• Intoxication (alcohol, medication overdose—sedatives/analgesics)	

[a]LOC, loss of consciousness.

[b]TIA, transient ischemic attack.

PRESENTATION

Presentation in this age group is challenging, and recognition is often the first step to optimizing management and care of these patients. To start with, syncope in the older patient is underrecognized, particularly in acute care settings because the presentation is frequently atypical. The older patient is less likely to have a warning or prodrome prior to syncope, commonly has amnesia for loss of consciousness, and frequently experiences an unwitnessed event, thus presenting with a fall rather than T-LOC. These events are typically described as nonaccidental (not a trip or slip) or unexplained falls. Therefore, history alone cannot be relied upon when assessing the older patient. Injurious events such as fractures and head injuries are also more common, further emphasizing the importance of thorough early investigations and diagnosis.

The underlying mechanism of syncope is transient cerebral hypoperfusion. In some forms of syncope there may be a premonitory period in which various symptoms (eg, light-headedness, nausea, sweating, weakness, and visual disturbances) offer warning of an impending syncopal event. Often, however, loss of consciousness occurs without warning or recall of warning. Recovery from syncope is usually accompanied by almost immediate restoration of appropriate behavior and orientation. Amnesia for loss of consciousness occurs in many older individuals, especially in those with cognitive impairment. The postrecovery period may be associated with fatigue of varying duration. In young patients, nausea, blurred vision, and sweating predict noncardiac syncope, only dyspnea predits cardiac syncope in older patients.

Syncope and falls are often considered two separate entities with different etiologies. Recent evidence suggests, however, that these conditions may not always be distinctly separate. In older adults, determining whether patients who have fallen have had a syncopal event can be difficult. At least half of syncopal episodes are unwitnessed and older patients may have amnesia for loss of consciousness. Amnesia for loss of consciousness has been observed in 30% of patients with CSS who present with falls and a quarter of all patients with CSS irrespective of presentation. Emerging evidence suggests a high incidence of falls in addition to traditional syncopal symptoms in older patients with sick sinus syndrome and atrioventricular conduction disorders. Thus, syncope and falls may be indistinguishable and may, in some cases, be manifestations of similar pathophysiologic processes.

EVALUATION

The initial step in the evaluation of syncope is to consider whether there is a specific cardiac or neurologic etiology or whether the etiology is likely multifactorial. The starting point for the evaluation of syncope is a careful history and physical examination. A witness account of events is important to ascertain when possible. Three key questions should be addressed during the initial evaluation: (1) Is loss of consciousness attributable to syncope?, (2) Is heart disease present or absent?, and (3) Are there important clinical features in the history and physical examination, which suggest the etiology?

Differentiating true syncope from other "nonsyncopal" conditions associated with real or apparent loss of consciousness is generally the first diagnostic challenge and influences the subsequent diagnostic strategy. A strategy for differentiating true and nonsyncope is outlined in **Figures 51-2 and 51-3**. The presence of heart disease is an independent predictor of a cardiac cause of syncope, with a sensitivity of 95% and a specificity of 45%.

Figure 51-2.

Syncope in relation to real and apparent loss of consciousness.

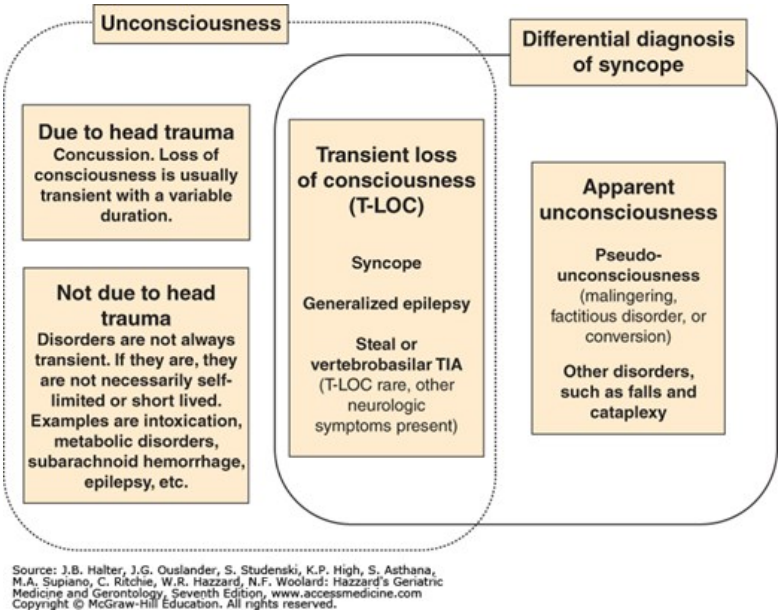
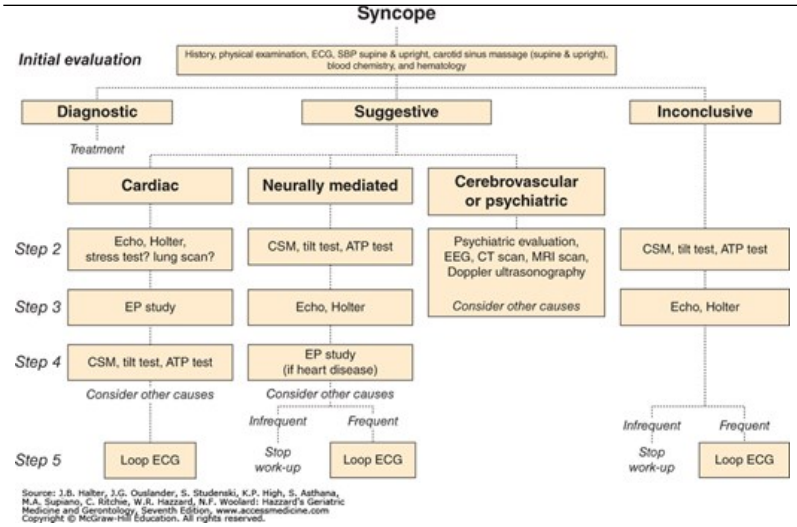


Figure 51-3.

An approach to the evaluation of syncope for all age groups. ATP test, adenosine provocation test; CSM, carotid sinus massage; CT, computed tomography; Echo, echocardiogram; ECG, electrocardiogram; EEG, electroencephalogram; EP study, electrophysiologic study; MRI, magnetic resonance imaging; SBP, systolic blood pressure.



Patients frequently complain of dizziness alone or as a prodrome to syncope and unexplained falls. Four categories of dizzy symptoms—vertigo, dysequilibrium, light-headedness, and others have been recognized. These symptom categories have neither the sensitivity nor specificity in older, as in younger, patients. Dizziness, however, may more likely be attributable to a cardiovascular diagnosis if associated with pallor, syncope, prolonged standing, palpitations, or the need to lie down or sit down when symptoms occur.

Initial evaluation may lead to a diagnosis based on symptoms, signs, or electrocardiogram (ECG) findings. Under such circumstances, no further evaluation is needed and treatment, if any, can be planned. More commonly, the initial evaluation leads to a suspected diagnosis (see **Figure 51-3**), which needs to be confirmed by directed testing. If a diagnosis is confirmed by specific testing, treatment may be initiated. On the other hand, if the diagnosis is not confirmed, then patients are considered to have unexplained syncope and should be evaluated following a strategy such as that outlined in **Figure 51-3**. It is important to attribute a diagnosis, if possible, rather than assume that an abnormality known to produce syncope or hypotensive symptoms is the cause. In order to attribute a diagnosis, patients should have symptom reproduction during investigation and preferably alleviation of symptoms with specific intervention. It is not uncommon for more than one predisposing disorder to coexist in older patients, rendering a precise diagnosis difficult. In older persons treatment of possible causes without clear verification of attributable diagnosis may often be the only option.

An important consideration in patients with unexplained syncope is the presence of structural heart disease or an abnormal ECG. These findings are associated with a higher risk of arrhythmias and a higher mortality at 1 year. In these patients, cardiac evaluation consisting of echocardiography, stress testing, and tests for arrhythmia detection such as prolonged electrocardiographic and loop monitoring or electrophysiologic study are recommended. The most alarming ECG sign in a patient with syncope is probably alternating complete left and right bundle branch block, or alternating right bundle branch block with left anterior or posterior fascicular block, suggesting trifascicular conduction system disease and intermittent or impending high-degree atrioventricular (AV) block. Patients with bifascicular block (right bundle branch block plus left anterior or left posterior fascicular block, or left bundle branch block) are also at high risk of developing high-degree AV block. A significant problem in the evaluation of syncope and bifascicular block is the transient nature of high-degree AV block and, therefore, the long periods required to document it by ECG.

In patients without structural heart disease and a normal ECG, evaluation for neurally mediated syncope should be considered. The tests for neurally mediated syncope consist of tilt testing and carotid sinus massage.

The majority of older patients with syncope are likely to have a multifactorial etiology and thus both predisposing and precipitating causes should be sought in the history, examination, and laboratory evaluation, particularly if the initial evaluation does not suggest an obvious single cause.

The presentation, evaluation, and management of other common etiologies of syncope are presented in the following sections. These etiologies may occur as the sole cause of a syncopal episode or as one of multiple contributing causes.

ORTHOSTATIC HYPOTENSION

Pathophysiology

Orthostatic or postural hypotension (OH) is arbitrarily defined as either a 20 mm Hg fall in systolic blood pressure or a 10 mm Hg fall in diastolic blood pressure on assuming an upright posture from a supine position. OH implies abnormal blood pressure homeostasis and is a frequent observation with advancing age. Prevalence of postural hypotension varies between 4% and 33% among community-living older persons depending on the methodology used. Higher prevalence and larger falls in systolic blood pressure have been reported with increasing age and often signify general physical frailty. Prevalence of OH in the older-aged community-dwelling adults is 30% and increases to more than 50% in hospitalized geriatric patients making its diagnosis highly relevant. OH is an important cause of syncope, accounting for 14% of all diagnosed cases in a large series. In a tertiary referral clinic dealing with unexplained syncope, dizziness and falls, 32% of patients over age 65 had orthostatic hypotension as a possible attributable cause of symptoms.

A recent population-based study which employed beat-to-beat measurement of orthostatic blood pressure demonstrated a significant age gradient for abnormalities in orthostatic blood pressure such that in 7% of 50- to 55-year-olds, systolic and diastolic blood pressure failed to stabilize by 2 minutes after standing compared with 41% of those 80 years old and older. Failure of stabilization was associated with falls, depression, and global cognitive impairment.

Aging

The heart rate and blood pressure responses to orthostasis occur in three phases: (1) an initial heart rate rise and blood pressure drop, (2) an early phase of stabilization, and (3) a phase of prolonged stabilization. All three phases are influenced by aging. The maximum rise in heart rate and the ratio between the maximum and the minimum heart rate in the initial phase decline with age, implying a relatively fixed heart rate irrespective of posture. Despite a blunted heart rate response, blood pressure and cardiac output are adequately maintained on standing in active, healthy, well-hydrated, and normotensive older persons because of decreased vasodilatation and reduced venous pooling during the initial phases and increased peripheral vascular resistance after prolonged standing. However, in older persons with hypertension, cardiovascular disease or receiving vasoactive drugs, these circulatory compensatory adjustments to orthostatic stress are disturbed, rendering them vulnerable to develop postural hypotension. More recent research suggests that the velocity of the initial orthostatc heart rate response at 10 and 20 seconds predicts mortality and morbidity.

This age-related gradient may reflect autonomic dysfunction, increased arterial stiffness, and muscle pump defects. Traditionally, OH is defined as a reduction in systolic BP of at least 20 mm Hg or in diastolic BP of at least 10 mm Hg within 3 minutes of standing. Orthostatic intolerance (OI) refers to symptoms and signs with upright posture due to circulatory abnormality. Syndromes of OI that may cause syncope include initial OH where symptoms of light-headedness/dizziness or visual disturbance are experienced seconds after standing; classic OH where dizziness, presyncope, fatigue, weakness, palpitations, visual and hearing disturbances are experienced; delayed OH where there is a prolonged prodrome frequently followed by rapid syncope; delayed OH and reflex syncope where a prolonged prodrome is always followed by syncope; reflex syncope triggered by standing where there is classic prodrome and triggers always followed by syncope; and postural orthostatic tachycardia syndrome where there is symptomatic HR increase and instability of BP without syncope. Many older patients with OH also have postprandial hypotension. Causes of OH include volume depletion or disturbance of the autonomic nervous system resulting in failure in vasoconstrictor compensatory mechanisms induced by upright posture.

Hypertension

Hypertension further increases the risk of hypotension by impairing baroreflex sensitivity and reducing ventricular compliance. Hypertension increases the risk of cerebral ischemia from sudden declines in blood pressure. Older persons with hypertension are more vulnerable to cerebral ischemic symptoms even with modest and short-term postural hypotension, because the threshold for cerebral autoregulation is altered by prolonged elevation of blood pressure. In addition, antihypertensive agents may impair cardiovascular reflexes and further increase the risk of orthostatic hypotension.

Medications

Drugs (see **Table 51-3**) are important causes of OH. Ideally establishing a causal relationship between a drug and OH requires identification of the culprit medicine, abolition of symptoms by withdrawal of the drug, and rechallenge with the drug to reproduce symptoms and signs. Rechallenge is often omitted in clinical practice in view of the potential serious consequences. In the presence of polypharmacy, which is common in the older person, it becomes difficult to identify a single culprit drug because of the synergistic effect of different drugs and drug interactions. Thus all drugs should be considered as possible contributors to orthostasis.

Other Conditions

A number of nonneurogenic conditions are also associated with postural hypotension. These conditions include myocarditis, atrial myxoma, aortic stenosis, constrictive pericarditis, hemorrhage, diarrhea, vomiting, ileostomy, burns, hemodialysis, salt-loosing nephropathy, diabetes insipidus, adrenal insufficiency, fever, and extensive varicose veins. Volume depletion for any reason is often a common sole, or contributing, cause of postural hypotension, and, in turn, syncope.

Primary Autonomic Failure Syndromes

Three distinct clinical entities—namely pure autonomic failure (PAF), multiple system atrophy (MSA) or Shy-Drager syndrome (SDS), and autonomic failure associated with idiopathic Parkinson disease (IPD)—are associated with orthostatic hypotension. PAF, the least common condition and a relatively benign entity, was previously known as idiopathic orthostatic hypotension. This condition presents with orthostatic hypotension, defective sweating, erectile dysfunction, and bowel disturbances. No other neurologic deficits are evident and resting plasma norepinephrine levels are low. MSA is the most common among these syndromes and has the poorest prognosis. Clinical manifestations include features of dysautonomia and motor disturbances due to striatonigral degeneration, cerebellar atrophy, or pyramidal lesions. Additional neurologic deficits include muscle atrophy, distal sensorimotor neuropathy, pupillary abnormalities, restriction of ocular movements, disturbances in rhythm and control of breathing, life-threatening laryngeal stridor, and bladder disturbances. Psychiatric manifestations and cognitive defects are usually absent. Resting plasma norepinephrine levels are usually within the normal range, but fail to rise on standing or tilting.

The prevalence of orthostatic hypotension in Parkinson disease rises with advancing years and with the number of medications prescribed. Cognitive impairment, in particular abnormal attention and executive function, is more common in Parkinson disease with orthostatic hypotension suggesting a possible causal association with hypotension including watershed hypoperfusion and infarction. Orthostatic hypotension in Parkinson disease can be due to autonomic failure and/or side effects of antiparkinsonian medications.

Secondary Autonomic Dysfunction

Autonomic nervous system involvement is seen in several systemic diseases. A large number of neurologic disorders are also complicated by autonomic dysfunction which may involve several organs leading to a variety of symptoms in addition to orthostatic hypotension including anhidrosis, constipation, diarrhea, erectile dysfunction, urinary retention, urinary incontinence, stridor, apneic episodes, and Horner syndrome. Among the most serious and prevalent conditions associated with an orthostasis due to autonomic dysfunction are diabetes, multiple sclerosis, brainstem lesions, compressive and noncompressive spinal cord lesions, demyelinating polyneuropathies (Guillain-Barre syndrome), chronic renal failure, chronic liver disease, and connective tissue disorders.

Presentation

The clinical manifestations of orthostatic hypotension are due to hypoperfusion of the brain and other organs. Depending on the degree of fall in blood pressure and cerebral hypoperfusion, symptoms can vary from dizziness to syncope associated with a variety of visual defects, from blurred vision to blackout. Other reported ischemic symptoms of orthostatic hypotension are nonspecific lethargy and weakness, suboccipital and paravertebral muscle pain, low backache, calf claudication, and angina. Several precipitating factors for orthostatic hypotension have been identified including speed of positional change, prolonged recumbency, warm environment, raised intrathoracic pressure (coughing, defecation, micturition, physical exertion), and vasoactive drugs.

Evaluation

The diagnosis of orthostatic hypotension involves a demonstration of a postural fall in blood pressure after active standing. Reproducibility of orthostatic hypotension depends on the time of measurement and on autonomic function. The diagnosis may be missed on casual measurement during the afternoon. The procedure should be repeated during the morning after first maintaining supine posture for at least 10 minutes. Sphygmomanometer measurement will detect hypotension which is sustained. Phasic blood pressure measurements are more sensitive for detection of transient falls in blood pressure. Where possible these methods should be employed. Active standing is more appropriate than head-up tilt because the former more readily represents the physiologic α-adrenergic–mediated vasodilation due to calf muscle activation. Once a diagnosis of postural hypotension is made, the evaluation involves identifying the cause or causes of orthostasis mentioned earlier.

Management

The goal of therapy for symptomatic orthostatic hypotension is to improve cerebral perfusion. There are several nonpharmacologic interventions that should be tried in the first instance. These interventions include patient education regarding avoidance of precipitating factors for low blood pressure, maintaining adequate volume status, and application of graduated pressure from an abdominal support garment or from stockings (**Table 51-5**). Medications known to contribute to postural hypotension should be eliminated or reduced. There are reports to suggest benefit from implantation of cardiac pacemakers, in a small number of patients, by increasing heart rate during postural change. However, the benefits of tachypacing on cardiac output in patients with maximal vasodilatation are short lived, probably because venous pooling and vasodilation dominate. A large number of drugs have been used to raise blood pressure in orthostatic hypotension, including fludrocortisone, midodrine, ephedrine, desmopressin (DDAVP), octeotride, erythropoeitin, and nonsteroidal anti-inflammatory agents. Fludrocortisone (9α-fluorohydrocortisone), in a dose of 0.1 to 0.2 mg, causes volume expansion, reduces natriuresis, and sensitizes α-adrenoceptors to norepinephrine. In older people, the drug can be poorly tolerated in high doses and for long periods. Adverse effects include hypertension, cardiac failure, depression, edema, and hypokalemia. Midodrine is a directly acting sympathomimetic vasoconstrictor of resistance vessels. Treatment is started at a dose of 2.5 mg three times daily and requires gradual titration to a maximum dose of 30 mg/day. Adverse effects include hypertension, pilomotor erection, gastrointestinal symptoms, and central nervous system toxicity. Side effects are usually controlled by dose reduction. Midodrine can be used in combination with low-dose fludrocortisone with good effect. DDAVP has potent antidiuretic and mild pressor effects. Intranasal doses of 5 to 40 μg at bedtime are useful. The main side effects are hyponatremia and water retention. This agent can also be combined with fludrocortisone with synergistic effect. The drug treatment for orthostatic hypotension in older persons requires frequent monitoring for supine hypertension, electrolyte imbalance, and congestive heart failure. One option for treating supine hypertension which is most prominent at night is to apply a nitroglycerine patch after going to bed, remove it in the morning, and take midrodrine with or without fludrocortisone 20 minutes before rising. This is effective provided that the older person remains in bed throughout the night. Nocturia is therefore an important consideration. In order to identify these coexistent diurnal BP variations of supine hypertension and morning orthostasis, 24-hour ambulatory BP monitoring is the preferred investigation. Postprandial hypotension, due to splanchnic vascular pooling often coexists with orthostatic hypotension in older patients.

TABLE 51-5

MANAGEMENT OF ORTHOSTATIC HYPOTENSION IN OLDER PERSONS

- Identify and treat correctable causes
- Reduce or eliminate drugs causing orthostatic hypotension (see **Table 51-3**)
- Avoid situations that may exacerbate orthostatic hypotension
  - Standing motionless
  - Prolonged recumbency
  - Large meals
  - Hot weather
  - Hot showers
  - Straining at stool or with voiding
  - Isometric exercise
  - Ingesting alcohol
  - Hyperventilation
  - Dehydration
- Wear waist-high custom-fitted elastic stockings and an abdominal binder
- Participate in physical conditioning exercises
- Controlled postural exercises using the tilt table
- Avoid diuretics and eat salt-containing fluids (unless congestive heart failure is present)
- Drug therapy
  - Caffeine
  - Fludrocortisone
  - Midodrine
  - Desmopressin
  - Erythropoietin

VASOVAGAL SYNCOPE

Pathophysiology

The normal physiologic responses to orthostasis, as described earlier, are an increase in heart rate, rise in peripheral vascular resistance (increase in diastolic blood pressure), and minimal decline in systolic blood pressure, to maintain an adequate cardiac output. In patients with vasovagal syncope, these responses to prolonged orthostasis are paradoxical. The precise sequence of events leading to vasovagal syncope is not fully understood. The possible mechanism involves a sudden fall in venous return to the heart, rapid fall in ventricular volume, and virtual collapse of the ventricle due to vigorous ventricular contraction. The net result of these events is stimulation of ventricular mechanoreceptors and activation of Bezold-Jarisch reflex leading to peripheral vasodilatation (hypotension) and bradycardia. Several neurotransmitters, including serotonin, endorphins, and arginine vasopressin, play an important role in the pathogenesis of vasovagal syncope possibly by central sympathetic inhibition, although their exact role is not yet well understood.

Healthy older persons are not as prone to vasovagal syncope as younger adults. Due to an age-related decline in baroreceptor sensitivity, the paradoxical responses to orthostasis (as in vasovagal syncope) are possibly less marked in older persons. However hypertension, atherosclerotic cerebrovascular disease, cardiovascular medications, and impaired baroreflex sensitivity can cause inappropriate autonomic responses during prolonged orthostasis (in which blood pressure and heart decline steadily over time) and render older persons susceptible to vasovagal syncope. Diuretic or age-related contraction of blood volume further increases the risk of vasovagal syncope.

Presentation

The hallmark of vasovagal syncope is hypotension and/or bradycardia sufficiently profound to produce cerebral ischemia and loss of neural function. Vasovagal syncope has been classified into cardioinhibitory (bradycardia), vasodepressor (hypotension), and mixed (both) subtypes depending on the blood pressure and heart rate response. In most patients, the manifestations occur in three distinct phases: a prodrome or aura, loss of consciousness, and postsyncopal phase. A precipitating factor or situation is identifiable in most patients. Common precipitating factors include extreme emotional stress, anxiety, mental anguish, trauma, physical pain or anticipation of physical pain (eg, anticipation of phlebotomy), warm environment, air travel, and prolonged standing. The commonest triggers in older individuals are prolonged standing and vasodilator medication. Some patients experience symptoms in specific situations such as micturition, defecation, and coughing. Prodromal symptoms include extreme fatigue, weakness, diaphoresis, nausea, visual defects, visual and auditory hallucinations, dizziness, vertigo, headache, abdominal discomfort, dysarthria, and paresthesias. The duration of prodrome varies greatly from seconds to several minutes, during which time some patients are able to take actions such as lying down to avoid an episode. Older patients may have poor awareness or recall for prodromal symptoms. The syncopal period is usually brief during which some patients develop involuntary movements—usually myoclonic jerks but tonic-clonic movements also occur. Thus, vasovagal syncope may masquerade as a seizure. Recovery is usually rapid but older patients can experience protracted symptoms such as confusion, disorientation, nausea, headache, dizziness, and a general sense of ill health.

Evaluation

Several methods have evolved to determine an individual's susceptibility to vasovagal syncope such as Valsalva maneuvres, hyperventilation, ocular compression, and immersion of the face in cold water. However these methods are poorly reproducible and lack correlation with clinical events. Using the strong orthostatic stimulus of head-upright tilting and maximal venous pooling, vasovagal syncope can be reproduced in a susceptible individual. Head-up tilting as a diagnostic tool was first reported in 1986 and since then validity of this technique in identifying susceptibility to neurocardiogenic syncope has been established. Subjects are tilted head up for 40 minutes at 70 degrees. Heart rate and blood pressure are measured continuously through out the test. A test is diagnostic or positive if symptoms are reproduced with a decline in blood pressure of greater than 50 mm Hg or less than 90 mm Hg. This may be in addition to significant heart rate slowing. As with CSS, the hemodynamic responses are classified as vasodepressor, cardioinhibitory, or mixed. The cardioinhibitory response is defined as asystole in excess of 3 seconds or heart rate slowing to less than 40 beats/min for a minimum of 10 seconds. Orthostatic hypotension, vasovagal syncope, and carotid sinus hypersensitivity (CSH) may overlap particularly in older patients.

The sensitivity of head-up tilting can be further improved by provocative agents that accentuate the physiologic events leading to vasovagal syncope. One agent is intravenous isoproterenol, which enhances myocardial contractility by stimulating β-adrenoreceptors. Isoproterenol is infused, prior to head-up tilting, at a dose of 1 μg/min and gradually increased to a maximum dose of 3 μg/min to achieve a heart rate increase of 25%. Although the sensitivity of head-up tilt testing improves by about 15%, the specificity is reduced. In addition, as a result of the decline in β-receptor sensitivity with age, isoproterenol is less well tolerated, less diagnostic, and has a much higher incidence of side effects. The other agent that can be used as a provocative agent and is better tolerated in older persons is sublingual nitroglycerin, which, by reducing venous return due to vasodilatation can enhance the vasovagal reaction in susceptible individuals. Nitroglycerin provocation during head-up tilt testing is thus preferable to other provocative tests in older patients. The duration of testing is less, cannulation is not required, and the sensitivity and specificity are better than for isoproterenol.

Because syncopal episodes are intermittent, external loop recording will not capture events unless they occur approximately every 2 to 3 weeks. Implantable loop recorders can aid diagnosis by tracking brady- or tachyarrhythmias causing less frequently occuring syncope. To date no implantable blood pressure monitors are available with the exception of intracardiac monitors that are not recommended for diagnosis of a benign condition such as vasovagal syncope.

Management

Avoidance of precipitating factors and preventative actions such as lying down during prodromal symptoms, have great value in preventing episodes of vasovagal syncope. Withdrawal or modification of culprit medications is often the only necessary intervention in older persons. Doses and frequency of antihypertensive medications can be tailored by information from 24-hour ambulatory monitoring. Older patients with hypertension who develop syncope—either orthostatic or vasovagal—while taking antihypertensive drugs, present a difficult therapeutic dilemma and should be treated on an individual basis.

Many patients experience symptoms without warning, necessitating drug therapy. A number of drugs are reported to be useful in alleviating symptoms. Fludrocortisone (100–200 μg/day) works by its volume-expanding effect. Recent reports suggest that serotonin antagonists such as

fluoxetine (20 mg/day) and sertraline hydrochloride (25 mg/day) are also effective although further trials are necessary to validate these findings. Midodrine acts by reducing peripheral venous pooling and thereby improving cardiac output and can be used either alone or in combination with fludrocortisone but with the caution. Elastic support hose, relaxation techniques (biofeedback), and conditioning using repeated head-up tilt as therapy have been adjuvant therapies. Permanent cardiac pacing is beneficial in some patients who have recurrent syncope due to cardioinhibitory responses.

POSTPRANDIAL HYPOTENSION

The effect of meals on the cardiovascular system was appreciated from postprandial exaggeration of angina that was demonstrated objectively by deterioration of exercise tolerance following food ingestion. Postprandial reductions in blood pressure manifesting as syncope and dizziness were subsequently reported, leading to extensive investigation of this phenomenon. In healthy older subjects, systolic blood pressure falls by 11 to 16 mm Hg, and heart rate rises by 5 to 7 beats/min 60 minutes after meals of varying compositions and energy content. However the change in diastolic blood pressure is not as consistent. In older persons with hypertension, orthostatic hypotension and autonomic failure, the postprandial blood pressure fall is much greater and without the corresponding rise in heart rate. These responses are accentuated if the energy and simple carbohydrate content of the meal is high. In the majority of fit as well as frail older persons, most postprandial hypotensive episodes go unnoticed. When systematically evaluated, postprandial hypotension was found in over one-third of nursing home residents. Postprandial physiologic changes include increased splanchnic and superior mesenteric artery blood flow at the expense of peripheral circulation and a rise in plasma insulin levels without corresponding rises in sympathetic nervous system activity. Vasodilator effects of insulin and other gut peptides, including neurotensin and vasoactive intestinal peptide (VIP) contribute to hypotension. The clinical significance of a fall in blood pressure after meals is difficult to quantify. However, postprandial hypotension is causally related to recurrent syncope and falls in older persons. A reduction in simple carbohydrate content of food, its replacement with complex carbohydrates or high protein, high fat, and frequent small meals are effective interventions for postprandial hypotension. Drinking 500 mL of water is also effective. Drugs useful in the treatment of postprandial hypotension include fludrocortisone and indomethacin, octreotide, and caffeine. Given orally along with food, caffeine prevents hypotensive symptoms in fit as well as frail older persons but should preferably be given in the mornings as tolerance develops if it is taken throughout the day.

CAROTID SINUS SYNDROME AND CAROTID SINUS HYPERSENSITIVITY

Pathophysiology

Carotid sinus syndrome is an important but frequently overlooked cause of syncope and presyncope in older persons. Episodic bradycardia and/or hypotension resulting from exaggerated baroreceptor-mediated reflexes or CSH characterize the syndrome. The syndrome is diagnosed in persons with otherwise unexplained recurrent syncope who have CSH. The latter is considered present if carotid sinus massage produces asystole exceeding 3 seconds (cardioinhibitory), or a fall in systolic blood pressure exceeding 50 mm Hg in the absence of cardioinhibition (vasodepressor) or a combination of the two (mixed).

Epidemiology

Up to 30% of the healthy older population have carotid sinus hypersensitivity. The prevalence is higher in the presence of coronary artery disease or hypertension. Abnormal responses to carotid sinus massage are more likely to be observed in individuals with coronary artery disease and in those on vasoactive drugs known to influence carotid sinus reflex sensitivity such as digoxin, β-blockers, and α-methyldopa. Other hypotensive disorders such as vasovagal syncope and orthostatic hypotension coexist in one-third of patients with carotid sinus hypersensitivity. In centers that routinely perform carotid sinus massage in all older patients with syncope, carotid sinus syndrome is the attributable cause of syncope in 30%. This frequency needs to be interpreted within the context that these referral centers evaluate a preselected group of patients who have a higher likelihood of carotid sinus syndrome than the general population of older persons with syncope. The prevalence in all older persons with syncope is unknown.

Carotid sinus syndrome is virtually unknown before the age of 50; its incidence increases with age thereafter. Males are more commonly affected than females and the majority have either coronary artery disease or hypertension. Carotid sinus syndrome is associated with appreciable morbidity. Approximately half of patients sustain an injury, including a fracture, during symptomatic episodes. In a prospective study of falls in nursing home residents, a threefold increase in the fracture rate in those with CSH was observed. Indeed, CSH can be considered as a modifiable risk factor for fractures of the femoral neck. Carotid sinus syndrome is not associated with an increased risk of death. The mortality rate in patients with the

syndrome is similar to that of patients with unexplained syncope and the general population matched for age and sex. Mortality rates are similar for the three subtypes of the syndrome.

The natural history of CSH has not been well investigated. In one study, the majority (90%) of persons with abnormal hemodynamic responses but without syncopal symptoms, remained symptom free during a follow-up over 19 + 16 months while half of those who presented with syncope had symptom recurrence. More recent neuropathologic research suggests that CSH is associated with neurodegenerative pathology at the cardiovascular centre in the brain stem.

Presentation

The syncopal symptoms are usually precipitated by mechanical stimulation of the carotid sinus such as head turning, tight neckwear, neck pathology, and by vagal stimuli such as prolonged standing. Other recognized triggers for symptoms are the postprandial state, straining, looking or stretching upwards, exertion, defecation, and micturition. In a significant number of patients no triggering event can be identified. Abnormal response to carotid sinus massage (see below) may not always be reproducible, necessitating repetition of the procedure if the diagnosis is strongly suspected.

Evaluation

Carotid sinus massage

Carotid sinus reflex sensitivity is assessed by measuring heart rate and blood pressure responses to carotid sinus massage. Cardioinhibition and vasodepression are more common on the right side. In patients with cardioinhibitory carotid sinus syndrome, over 70% have a positive response to right-sided carotid sinus massage either alone or in combination with left-sided carotid sinus massage. There is no fixed relationship between the degree of heart rate slowing and the degree of fall in blood pressure.

Carotid sinus massage is a crude and unquantifiable technique and is prone to intra- as well as interobserver variation. More scientific diagnostic methods using neck chamber suction or drug-induced changes in blood pressure can be used for carotid baroreceptor activation, but are not validated for routine clinical use. The recommended duration of carotid sinus massage is from 5 to 10 seconds. The maximum fall in heart rate usually occurs within 5 seconds of the onset of massage.

Complications resulting from carotid sinus massage include cardiac arrhythmias and neurologic sequelae. Fatal arrhythmias are extremely uncommon and have generally only occurred in patients with underlying heart disease undergoing therapeutic rather than diagnostic massage. Digoxin toxicity has been implicated in most cases of ventricular fibrillation. Neurologic complications result from either occlusion of, or embolization from, the carotid artery. Several authors have reported cases of hemiplegia following carotid sinus stimulation, often in the absence of hemodynamic changes. Complications from carotid sinus massage however are uncommon. In a prospective series of 1000 consecutive cases, no patient had cardiac complications and 1% had transient neurologic symptoms that resolved. Persistent neurologic complications were uncommon, occurring in 0.04%. Carotid sinus massage should not be performed in patients who have had a recent cerebrovascular event or myocardial infarction (MI).

Symptom reproduction during carotid sinus massage is preferable for a diagnosis of carotid sinus syndrome. Symptom reproduction may not be possible for older patients with amnesia for loss of consciousness. Spontaneous symptoms usually occur in the upright position. It may thus be worth repeating the procedure, with the patient upright on a tilt table, even after demonstrating a positive response when supine. This reproduction of symptoms aids in attributing the episodes to CSH, especially in patients with unexplained falls who deny loss of consciousness. In one-third of patients a diagnostic response is only achieved during upright carotid sinus massage.

Management

No treatment is necessary in persons with asymptomatic carotid sinus hypersensitivity. There is no consensus, however, on the timing of therapeutic intervention in the presence of symptoms. Considering the high rate of injury in symptomatic episodes in older persons as well as the low recurrence rate of symptoms, it is prudent to treat all patients with a history of two or more symptomatic episodes. The need for intervention in those individuals with a solitary event should be assessed on an individual basis, taking into consideration the severity of the event and the patient's comorbidity.

Treatment strategies in the past included carotid sinus denervation achieved either surgically or by radioablation. Both procedures have largely been abandoned. Dual-chamber cardiac pacing is the treatment of choice in patients with symptomatic cardioinhibitory carotid sinus syndrome. Atrial

pacing is contraindicated in view of the high prevalence of both sinoatrial and atrioventricular block in patients with carotid sinus hypersensitivity. Ventricular pacing abolishes cardioinhibition but fails to alleviate symptoms in a significant number of patients because of aggravation of a coexisting vasodepressor response or the development of pacemaker-induced hypotension, referred to as the pacemaker syndrome. The latter occurs when ventriculoatrial conduction is intact as is the case for up to 80% of patients with the syndrome. Atrioventricular sequential pacing (dual chamber) is thus the treatment of choice and because this maintains atrioventricular synchrony, there is no risk of pacemaker syndrome. With appropriate pacing, syncope is abolished in 85% to 90% of patients with cardioinhibition.

In a report of cardiac pacing in older fallers (mean age of 74) who had cardioinhibitory carotid sinus hypersensitivity, falls during 1 year of follow-up were reduced by two-thirds in patients who received dual-chamber systems. Syncopal episodes were reduced by half. Over half of the patients in the aforementioned series had gait abnormalities and three-quarters had balance abnormalities which would render individuals more susceptible to falls under hemodynamic circumstances, thus further suggesting the multifactorial nature of many falls and syncopal episodes.

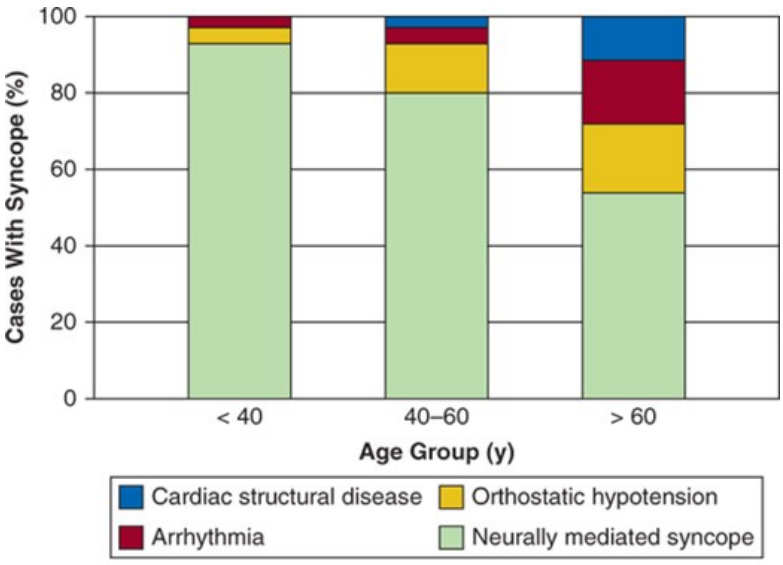
Treatment of vasodepressor carotid sinus syndrome is less successful due to poor understanding of its pathophysiology. Ephedrine has been reported to be useful, but long-term use is limited by side effects. Dihydroergotamine is effective but poorly tolerated. Fludrocortisone, a mineralocorticoid widely used in the treatment of orthostatic hypotension, is used in the treatment of vasodepressor carotid sinus syndrome with good results but its use is limited in the longer term by adverse effects. A recent small randomized controlled trial suggests good benefit with midodrine (an α-agonist). Surgical denervation of the carotid artery may be a valid treatment option in refractory situations.

CARDIAC SYNCOPE

One-third of cases of syncope in the older patient are caused by cardiac disorders (**Figure 51-4**). There is a higher morbidity and mortality associated with cardiac syncope. Cardiac syncope is characterized by little or no prodrome, occurrence when supine or during exercise and association with palpitations or chest pain. However, the older patient may not recall these symptoms. Heart disease is an independent predictor of cardiac syncope—sensitivity 95% and specificity 45%. The prevalence of cardiac disease, including structural heart disease and arrhythmias, rises dramatically with age. Cardiac syncope should be considered when the surface ECG is abnormal or left ventricular systolic dysfunction is present.

Figure 51-4.

Causes of syncope by age. (From Parry SW, Tan MP. An approach to the evaluation and management of syncope in adults. *BMJ*. 2010;340:c880.)



Investigation

The gold standard for the diagnosis of cardiac syncope is symptom rhythm correlation—that is, contemporaneous HR and rhythm recording during syncope. Cardiac monitoring may also identify diagnostic abnormalities, such as asystole in excess of 3 seconds and rapid supraventricular (SVT) or ventricular tachycardia (VT). The absence of an arrhythmia during a recorded syncopal event excludes arrhythmia as a cause unless the patient has a dual diagnosis. In patients over 40 years with recurrent unexplained syncope who do not have structural heart disease or abnormal ECG, the attributable cause of syncope is bradycardia in over 50%.

Cardiac Monitoring

Prompt hospital admission or intensive monitoring is recommended when cardiac disease is present in the setting of syncope (**Table 51-6**). Although telemetry or in-patient monitoring is indicated if the patient is at high risk of a life-threatening arrhythmia based on the ECG abnormalities detailed in **Table 51-6**, the diagnostic yield from telemetry is low—16% in one series.

TABLE 51-6

TASK FORCE FOR THE DIAGNOSIS AND MANAGEMENT OF SYNCOPE OF THE EUROPEAN SOCIETY OF CARDIOLOGY

RECOMMENDATIONS	CLASS[a]	LEVEL[b]
Syncope due to cardiac arrhythmias must receive treatment appropriate to the cause	I	B
Cardiac pacing		
• Pacing is indicated in patients with sinus node disease in whom syncope is demonstrated to be due to sinus arrest (symptom—ECG correlation) without a correctable cause	I	C
• Pacing is indicated in sinus node disease patients with syncope and abnormal CSNRT	I	C
• Pacing is indicated in sinus node disease patients with syncope and asymptomatic pauses ≥ 3 s (with the possible exceptions of young trained persons, during sleep and in medicated patients)	I	B
• Pacing is indicated in patients with syncope and second-degree Mobitz II advance or complete AV block	I	B
• Pacing is indicated in patients with syncope, BGBB, and positive EPS	IIa	C
• Pacing should be considered in patients with unexplained syncope and BBB	IIb	C
• Pacing many be indicated in patients with unexplained syncope and sinus node disease with persistent sinus bradycardia itself asymptomatic	III	C
• Pacing is not indicated in patients with unexplained syncope without evidence of any conduction disturbance		
Catheter ablation		
• Catheter ablation is indicated in patients with symptom—arrhythmia ECG correlation in both SVT and VT in the absence of structural heart disease (with exception of atrial fibrillation)	I	C
• Catheter ablation may be indicated in patients with syncope due to the onset of rapid atrial fibrillation	IIb	C
Antiarrhythmic drug therapy		
• Antiarrhythmic drug therapy, including rate control drugs, is indicated in patients with syncope due to onset of rapid atrial fibrillation	I	C
• Drug therapy should be considered in patients with symptom—arrhythmia ECG correlation in both SVT and VT with catheter ablation cannot be undertaken or had failed	IIa	C
Implantable cardioverter defibrillator		
• ICD is indicated in patients with documented VT and structural heart disease		
• ICD is indicated when sustained monomorphic VT is induced at EPS in patients with previous myocardial infarction		
• ICD should be considered in patients with documented VT and inherited cardiomyopathies or channelopathies		

[a]Class of recommendation.

[b]Level of evidence.

AV, atrioventricular; BBB, bundle branch block; CSNRT, corrected sinus node recovery time; ECG, electrocardiogram; EPS, electrophysiologic study; ICD, implantable cardioverter defibrillator; SVT, supraventricular tachycardia; VT, ventricular tachycardia.

Diagnostic yield from Holter monitoring is only 1% to 2% in unselected populations. Incidental arrhythmias are much more common in older persons, for example, atrial fibrillation occurs in one in five men over 80 years. External loop recorders have a higher diagnostic yield in older patients; however, some older patients may have difficulty operating the devices, therefore automated arrhythmia detection is preferred. Normal ambulatory ECG (Holter or external loop or otherwise) in the absence of symptoms does not exclude a causal arrhythmia and monitoring for longer intervals is imperative to

capture rhythm during symptoms. Diagnostic rates are much higher in older patients using the implantable loop recorder (ILR)—up to 50% in patients with syncope and unexplained falls. Early insertion of ILRs in the older person is important to consider in view of the disproportionately high number of cardiac causes of syncope in this group. This approach is also more cost-effective. Difficulties with ILRs include inability to activate the device, particularly if patients have cognitive impairment, however, automated recordings and remote monitoring have much improved diagnostic yield.

Echocardiography

Echocardiography (echo) should be performed in syncope patients in whom a structural abnormality is suspected. The prevalence of structural cardiac abnormalities increases with age. The test is of most benefit in older patients with aortic stenosis and to evaluate ejection fraction. Cardiac arrhythmias are evident in up to 50% of patients with an ejection fraction of less than 40%.

Ambulatory BP Monitoring

Patterns of blood pressure behavior including postprandial hypotension, hypotension after medication ingestion, orthostatic and exercise-induced hypotension, and supine systolic hypertension can be readily identified by this investigation. Modification of timing of meals and medications is guided by BP patterns.

Exercise Stress Testing

Exercise stress testing is indicated to investigate cardiac disease and in patients who present with exercise-induced syncope. It is not always possible in older patients who may alternatively require angiography to investigate cardiac status.

Electrophysiologic Study

Electrophysiologic study is indicated in the older nonfrail patient with syncope when a cardiac arrhythmia is suspected. Diagnosis is based on confirmation of an inducible arrhythmia or conduction disturbance. The benefit is dependent on pretest probability based on the presence of organic heart disease or an abnormal ECG.

Electrophysiologic study has the advantage of providing both diagnosis and treatment in the same session (transcatheter ablation). It is most effective for identification of sinus node dysfunction in the presence of significant sinus bradycardia of 50 beats/min or less, prediction of impending high-degree AV block in patients with bifascicular block, inducible monomorphic VT (in patients with previous MI), and inducible SVT with hypotension in patients with palpitations.

Management

Management of cardiac syncope is dependent on specific cardiac diagnosis as outlined in **Table 51-6**.

CHALLENGES IN THE OLDER PATIENT

Frailty

Because people are living longer, frailty and prefrailty are more commonly encountered in clinical practice. Frailty is associated with a reduction in the ability to respond to stressors and an increased vulnerability to adverse outcomes. There is no consensus on how best to operationalise or define frailty but two types of definitions have emerged as the most commonly used constructs: The Cumulative Burden Index as proposed where frailty is defined as an accumulation of health conditions and deficits and the “Biological Syndrome Model” as proposed by Fried (see Chapter 46). A person is deemed to be frail if they present with three or more of poor grip strength, slow walking speed, low levels of physical activity, exhaustion, and unintentional weight loss. Frailty is a predictor of falls, hospitalization, disability, and death.

Unwitnessed Events

In the older adult a witness account may not be available for falls or syncopal events in up to 40% of patients.

Polypharmacy

Polypharmacy is more common with advancing age. Some of the most frequently prescribed syncope-related medications used in combination are are antihypertensives, antianginals, antihistamines, antipsychotics, tricyclic antidepressants, and diuretics. These medications cause bradycardia, QT interval prolongation, orthostatic hypotension, and vasovagal syncope. Drug interactions can also cause syncope particularly in the older patient with multiple comorbidity and polypharmacy. A temporal association between onset or change of medication and symptoms may be evident although progression of age-related physiologic changes may cause syncope even with long-standing established medications.

The TILDA study reported an increased risk and frequency of syncope with use of tricyclic antidepressants. The side effect most frequently reported is hypotension, but bradycardia and tachycardia have also been reported.

Cognition

Cognitive impairment rises with age—20% of people over 80 have established dementia rising to 40% over 90 years. Cognitive impairment is characterized by memory problems, attention difficulties, and executive dysfunction—hence compliance with cardiac monitoring systems may be compromised.

Cognitive impairment is particularly high in older patients with CSH. Likewise, patients with some subtypes of dementia such as Lewy body dementia and Alzheimer dementia have a higher prevalence of syncope, OH, and CSH. Establishing a causal relationship between symptoms and arrhythmia or hypotension is particularly difficult in these patients—given that the history is not reliable and events are often unwitnessed. There is emerging evidence that low blood pressure may cause or exaggerate cognitive dysfunction, possibly because cerebral hypoperfusion is associated with cerebral damage via small vessel arteriosclerosis and cerebral amyloid angiopathy, as well as exaggerated white matter disease.

Dual Diagnosis

In the older patient multiple causes of syncope may be present including cardiac (bradyarrhythmias, SVT tachyarrythmias, ventricular tachyarrhythmias, long QT) and reflex syncope or autonomic impairment (see **Table 51-2**). Attribution of cause in the context of multiple abnormalities is not always possible and treatment of all possible causes is recommended. In one series of patients with syncope, mean age 67 ± 18, 23% had a dual diagnosis. The principal predictors of dual diagnosis were advanced age and treatment with α-receptor blockers and benzodiazepines. The most frequent dual diagnoses were OH and vasovagal syncope—2.8% had a triple diagnosis, and these were the oldest old.

Focal Neurology With Syncope

Transient ischemic attacks (TIAs) or stroke and syncope are considered mutually exclusive presentations. However, one recent series reported that 5.7% of syncope patients experienced focal neurologic events at the time of syncope or presyncope. Awareness of this phenomenon is important to prevent misdiagnosis of stroke and inappropriate increase of antihypertensive medications, which would further exacerbate hypotensive symptoms.

SUMMARY

The prevalence of syncope rises with age and is challenging because of atypical presentation, overlap with falls, and poor recall of events. Older patients are less likely to have a prodrome, may have amnesia for loss of consciousness, and may have unwitnessed events. Cardiac causes and dual pathology are more common and compliance with newer monitoring technologies is inadequate. Consequently, morbidity and mortality are higher than in younger patients. A high index of suspicion for cardiovascular causes of falls and dual pathology will increase diagnosis and early intervention.

Syncope is a common symptom in older adults due to age-related neurohumoral and physiologic changes plus chronic diseases and medications that reduce cerebral oxygen delivery through multiple mechanisms. Common individual causes of syncope encountered by the geriatrician are orthostatic hypotension, carotid sinus syndrome, vasovagal syncope, postprandial syncope, sinus node disease, atrioventricular block, and ventricular tachycardia. Algorithms for the assessment of syncope are similar to those for young adults, but the prevalence of ischemic and hypertensive disorders and cardiac conduction disease is higher in older adults and the etiology is more often multifactorial. A systematic approach to syncope is needed with the goal being to identify either a single likely cause or multiple treatable contributing factors. Management is then based on removing or reducing the predisposing or precipitating factors through various combinations of medication adjustments, behavioral strategies, and more invasive interventions in select cases such as cardiac pacing, cardiac stenting, and intracardiac defibrillators. It is often not possible to clearly attribute a cause of syncope in

older persons who frequently have more than one possible cause and pragmatic management of each potential etiology is recommended.

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