88 Syncopal Attacks

Stephan U. Schuele

Definition

Syncope is defined as a transient loss of consciousness and postural tone caused by cerebral hypoperfusion with spontaneous recovery (McKeon et al. 2006).

Classification

The differential diagnosis when facing a patient who had a sudden transitory loss of consciousness *and* tone should focus on syncope as the by far most frequent cause. However, epileptic seizures, psychogenic events, and less frequently migraine, transient ischemic attacks (TIAs), or severe vestibular dysfunction may mimic syncope.

The term *seizure* is often used for epileptic and nonepileptic seizure-like events, a terminology which goes back to the time of Henri Gastaut who classified syncope as an *anoxic cerebral seizure* and distinguished such seizures from epileptic and psychogenic seizures based on their highly characteristic ictal EEG findings (*Fig. 88-1*). In patients with loss of consciousness caused by an epileptic seizure the surface scalp EEG demonstrates with all likelihood sustained epileptiform discharges. Preservation of normal awake background in an unresponsive patient on the other hand, is highly indicative of a psychogenic nonepileptic seizure. During syncopal events triggered by the oculovagal reflex which leads to a transient asystole, Gastaut described the invariable appearance of bilateral synchronous slow waves after cessation of the heart for 7–13 s, occurring usually simultaneous with the loss of consciousness and tone (Gastaut and Fischer-Williams 1957; Brenner 1997). This is followed by a reduction in amplitude and frequency of brain waves eventually leading to the disappearance of electrocerebral activity and "flattening" of the EEG after 14 or 15 s. The EEG changes resolve in reverse order with 3–5 s of bilateral slowing before the baseline awake background returns. Clinically, the majority of patients with syncopal events show an initial, brief loss of postural tone around the time they loose consciousness, followed a few seconds later by tonic and myoclonic jerks (Lempert et al. 1994; Lempert 1996). Witnesses of syncopal events tend to stress the collapse of muscle tone, and only prominent convulsive movements are usually mentioned in lay accounts and may not even be retrievable with more specific questioning. However, based on detailed video analysis of syncopal events, tonic posturing or myoclonic jerks are the rule rather than the exception.

Syncopal attacks can be classified into *neurally mediated syncope* (the so-called vasovagal, neurocardiogenic, or reflex-mediated syncope), *cardiogenic syncope* (either from arrhythmia or structural heart disorders), and *other causes* (including orthostatic hypotension, neurologic disorders with autonomic dysfunction, or medication induced syncope) – *Table 88-1*. *Pseudosyncope* is a common clinical presentation of nonepileptic psychogenic events which often present with flaccid immobility and partial unresponsiveness (Benbadis and Chichkova 2006). On very rare occasions, epileptic seizures triggered by asystole and anoxia ("anoxic epileptic seizure") or vice versa and syncopal events triggered by epileptic seizures ("ictal asystole") occur.

Clinical Manifestation

The incidence of syncope is estimated at 6.2 per 1,000 patient years, and the lifetime prevalence of syncope might be close to 50% (Soteriades et al. 2002). According to the Framingham study, the most frequently identified cause of syncope is vasovagal (21.2%), cardiac (9.5%), and orthostatic (9.4%). History and witness report of the event are paramount for the diagnosis and mandatory to stratify the need for further workup.

Situational Trigger

The first clinical clue is the situation in which the event occurred (*Table 88-1*). Long periods of sustained upright position, a warm environment, physiological stress (e.g., repeated kneeing during prayer at church, crowded and humid places), valsalva maneuvers, and specific situations such as micturition or defecation, postprandial state, coughing (*Fig. 88-2*), or a medical procedure (venipuncture) are common circumstances for a neurally mediated syncope to occur.

Aura/Prodrome

Both seizures and syncope may be preceded by distinct symptoms that can be useful in the diagnosis (McKeon et al. 2006). Syncope is often associated with lightheadedness, nausea, sweatiness, pallor, and even palpitations, or chest pain. Visual or auditory phenomena are often described, and visual symptoms may present as blurry vision, darkening of the visual field, bright lights, or colored vision. Auditory symptoms may occur as a decrease of the

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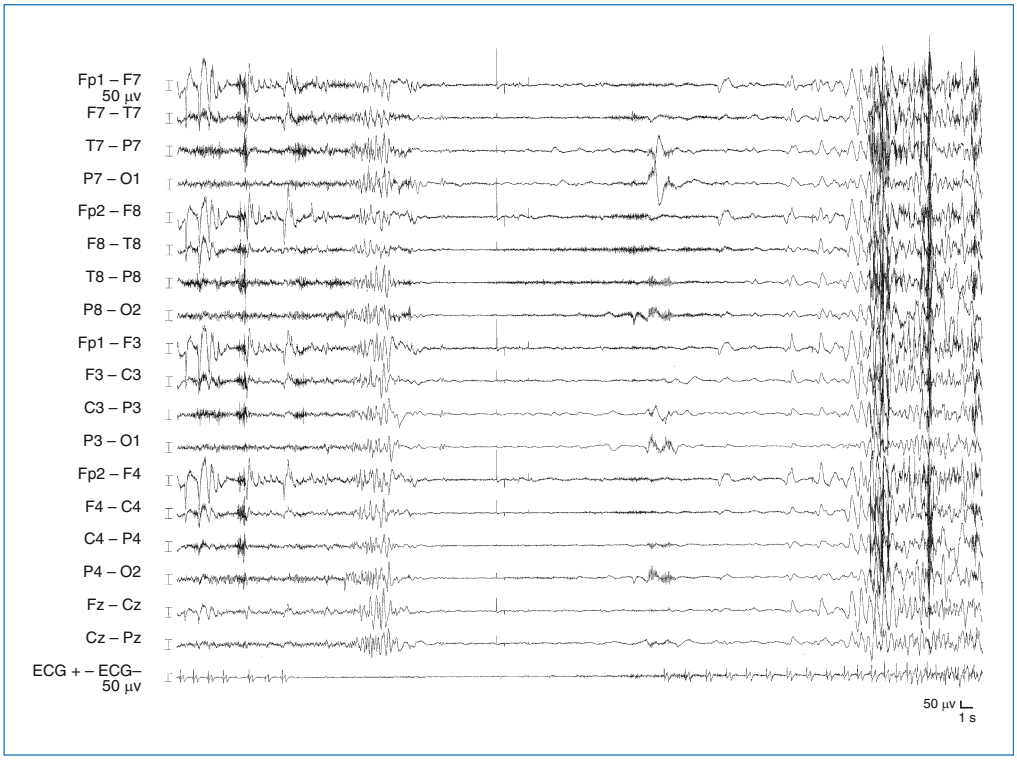

Figure 88-1. Vasovagal Asystole. An 18-year-old female presented with a 4-year history of "blackouts" followed by convulsive activity lasting around a minute. She had a total of 15 events. The episodes are preceded by a brief "weak" feeling before she passes out. The figure (60 s page, LF 1 Hz, HF 70 Hz) shows an asystole of 28.4 s duration during tilt table testing, preceded by a progressive bradycardia. About 5 s after onset of asystole, there is high voltage generalized slowing for about 3–4 s, followed by diffuse attenuation for 30 s. About 9 s after the heart resumes beating, high voltage generalized slow waves are seen, first isolated and then continuous, with superimposed irregular muscle artifact clinically representing myoclonic jerks.
Note: EEG findings during syncope are very distinct but have been on occasion confused with frontal lobe seizures which can show a similarly abrupt attenuation, but without the short-lasting bilateral synchronous slowing at the beginning and end of the event and the rapid restitution of an awake background

surrounding noise or the sensation of tinnitus. Syncope patients are often able to describe a "fainting" sensation and that they are "about to pass out." Patients with recurrent syncope may become aware of these symptoms and are often successful in avoiding falls by sitting or laying down on the ground which may even abort the loss of consciousness (the so-called presyncopal event).

Witness Report

By definition, patients become amnesic for the syncopal event. A small percentage may remember the early part of the collapse (e.g., buckling of their knees or the sensation of being about to fall), but do not remember actually hitting the ground. Patients with syncope or seizures may notice loss of bowel and bladder control or tongue bite after they regain consciousness.

The witness account is crucial for the diagnosis and should be separated from the patient's own recollection. Preservation of consciousness in a patient who reports being unable to move and remembers falling is usually a good indicator of nonphysiologic, psychogenic events. In the case of syncope, the witness may notice pallor and sweatiness followed by sudden loss of postural tone, collapse, and spontaneous recovery. During detailed observation, tonic posturing, gaze deviation, and multifocal myoclonus are seen in up to 90% of patients during syncopal events. These motor symptoms are thought to be due to an anoxia induced dysfunction of neurons in the medullary reticular formation.

Epileptic seizures are usually not associated with falls unless the patient trips or progresses into a generalized convulsion, which is often accompanied by an initial scream followed by tonic–clonic movements. Sudden unconsciousness in combination with loss of body tone due to an epileptic fit, also known as atonic seizure, is rare and predominantly seen with symptomatic generalized epilepsies in children, and is occasionally reported in patients, after longstanding temporal lobe epilepsy (Schuele et al. 2007). Witnesses tend to overestimate the duration of both seizures and syncope, but even a rough estimate can be helpful. Typical syncopal episodes last less than 20 s and are followed by almost immediate spontaneous recovery. Epileptic seizures tend to

Table 88-1. Distinguishing features of syncope and seizure based on history

	Situation	Prodrome/aura	Event	Recovery
Syncope				
Neurally mediated	Standing Micturition Coughing Fear, stress	~75% have aura Lightheadedness Sweating Fainting	 LOC Collapse	
Cardiogenic	Exercise induced Supine Nocturnal	Palpitations ~ 50%, no aura [Del Rosso et al. (2008)]	Usually brief and subtle tonic or myoclonic movements	Within seconds
Seizure				
Typical	Random occurrence	*Specific sensation* Olfactory Epigastric rising Déjà or jamais vu	Staring, unresponsive Automatism Tonic–clonic (½–1 min)	Within minutes Confusion Todd, aphasia
Rare	*Reflex epilepsy*	*Autonomic aura* Tachycardia Bradycardia	*Loss of tone* Atonic seizure Ictal asystole *Falls* Mostly due to generalized tonic clonic seizure	

last between 0.5 and 1.5 min, with confusion and sleepiness after the event and on occasion, with transient postictal deficits (e.g., Todd's paresis and postictal aphasia).

Etiology

Neurally mediated syncope results from reflex-mediated sudden changes in vascular tone and/or heart rate, hence the term *vasovagal* syncope (Table 88-2). The vasovagal reflex can be triggered by central mechanisms (sudden fear, pain, etc.) or activation of the peripheral autonomic system through receptors in the cardiac ventricles or other organs (such as the bladder, esophagus, respiratory tract, and the carotid sinus) (Kapoor 2000).

Cardiogenic syncope is caused by arrhythmia or structural heart disease. Bradyarrhythmia can be related to sinus node disease or atrioventricular conduction block; tachyarrhythmia is seen with paroxysmal supraventricular tachycardia and ventricular tachycardia and fibrillation. Drugs and electrolyte abnormalities are common causes of syncope secondarily to cardiac rhythm changes. Over 90% of patients with ventricular fibrillation show evidence of ischemic heart disease. Young patients, however, in particular with a family history of syncopal events, may have one of the inherited ventricular dysrrhythmia syndromes: long or short QT syndrome, Brugada syndrome, or catecholaminergic polymorphic ventricular tachycardia (Crompton and Berkovic 2009). Attacks due to transient complete heart block or short episodes of ventricular fibrillation can be brief and abrupt without warning and can occur from any posture (e.g., arrhythmogenic syncope is common in bed). Long QT attacks may be triggered by fear, exercise, or sleep. Sometimes ventricular tachyarrhythmia occurs with normal QT intervals on ECG. Syncope due to structural heart disease is seen with aortic or mitral stenosis, intracardiac tumors, or ischemic or hypertrophic cardiomyopathy. In patients with cardiomyopathy, palpitations, chest pain, shortness of breath, extreme fatigue, or other features may be present. Aortic stenosis and hypertrophic cardiomyopathy are especially prone to exercise-induced syncopal events. Mitral valve prolapse and aortic stenosis may present with episodic alteration of awareness due to fluctuating cardiac output or associated arrhythmia without actually progressing into a full syncopal event with loss of tone. A variety of other causes leading to syncope are triggered by orthostatic hypotension (Table 88-2).

Pathophysiology

Syncope is caused by an abrupt interruption of the energy supply to the cerebral cortex (Hainsworth 2004). This occurs most often from a drop in systemic arterial pressure. In exceptional situations, sudden changes in arterial oxygen pressure cause sudden hypoxemia (e.g., during aircraft decompression) and can lead to syncope.

Decrease in systemic blood pressure can be caused by reduced cardiac preload due to low blood volume, excessive orthostatic venous pooling, or tachyarrhythmia (>150–180 bpm). Cardiac output may be reduced due to bradyarrhythmia (<30–35 bpm) or cardiac outflow obstruction. Cerebral perfusion can be selectively affected by stenosis of the intra- or extra-cerebral arteries or cerebral vasoconstriction due to

hypocapnia or other triggers of cerebral vasospasm. Additionally, a combination of these factors may also contribute to syncope such as a valsalva maneuver (powerful effort to exhale against a closed glottis), and forceful, repeated coughing that increases intrathoracic pressure and limits venous return to the heart while increasing vagal tone at the same time (Fig. 88-2).

In vasovagal syncope, the hypotension is related to a transient sympathetic withdrawal and the bradycardia is thought to be provoked by an abnormal vagal tone (Lewis 1932), leading either to a predominantly vasodepressor, cardioinhibitory or mixed syncopal event. Medullary autonomic centers involved in the baroreflex (which normally allows us to compensate orthostatic stress) represent a common pathway for centrally or peripherally triggered vasovagal syncope. In rare cases, epileptic seizures may activate the central autonomic network and trigger bradycardia or asystole (seen in <0.5% of patients monitored for epilepsy), which occurs mostly in patients with temporal lobe epilepsy (Fig. 88-3a, b) (Britton and Benarroch 2006). A direct pathway from the cortex to the heart has been postulated to trigger ictal asystole, and concerns that this could lead to permanent cardiac arrest and sudden unexplained death in epilepsy have been raised. However, recent findings suggest that the bradycardia and asystole during epileptic seizures resemble heart rate changes during vasovagal reactions, and that both are mediated through brain stem autonomic centers leading to a transient increase of vagal tone and cardioinhibition (Fig. 88-4) (Schuele et al. 2008).

Vasovagal syncope tends to be short, lasting between 10 and 20 s, but asystoles lasting over a minute in duration have been described. The exact mechanisms leading to the predictable spontaneous recovery after vasovagal syncope are not well defined. One can assume that the loss of consciousness and cerebral inactivation from the hypoperfusion terminate either the initial emotional trigger or abolish the high vagal tone mediated through the brain stem, or both. Other compensatory mechanisms seem to play a role in terminating the vasovagal cascade, since sinus rhythm often recovers during presyncopal events, particularly with supine positioning and improved cardiac preload. A similar self-terminating mechanism has been described in ictal asystole as well: the cerebral hypoperfusion may actually terminate the ictal discharge which initially triggered the cerebral autonomic activation (Schuele et al. 2009).

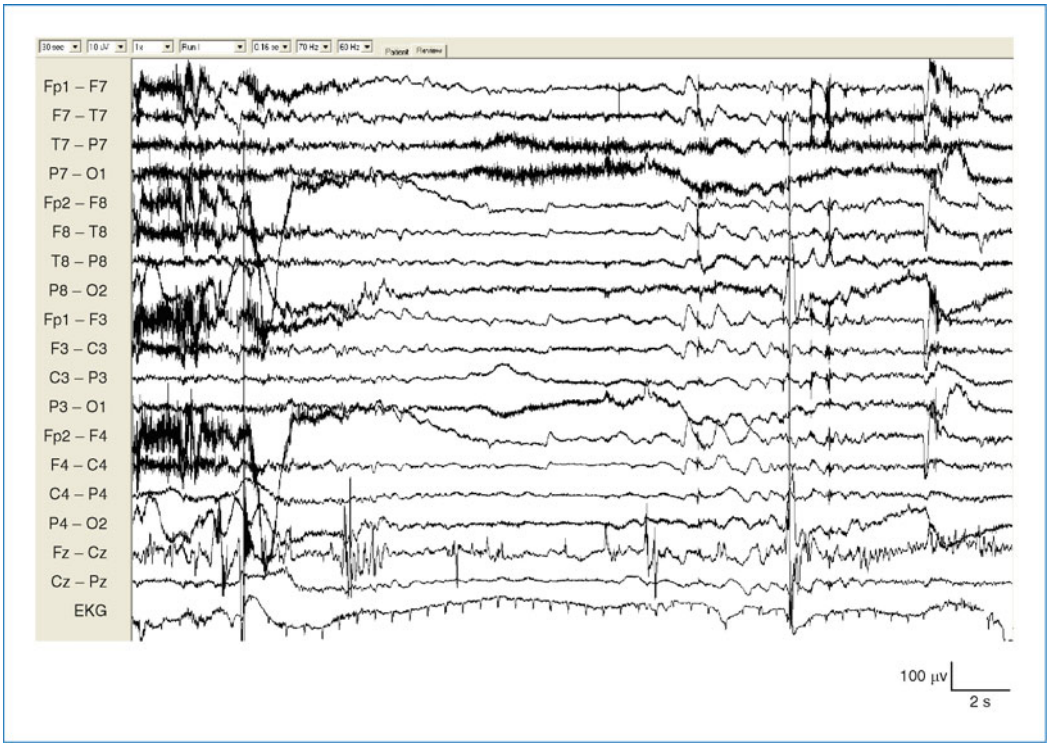

Figure 88-2. Tussive Syncope. A 72-year-old right-handed male with a history of severe obstructive pulmonary disease presented with episodic blackouts and falls triggered by coughing. The figure (30 s page, 0.1–70 Hz, 10 µv/mm) starts 10 s after the onset of a coughing bout. Cessation of posterior background and a brief burst of diffuse delta slowing lasting 2–5 s can be seen. This is followed by a diffuse attenuation of EEG activity for approximately 10 s, followed by generalized slowing and return of alpha activity within 5–6 s. Clinically, the initial slowing coincides with loss of body tone and the second slowing with a series of brief myoclonic jerks. Note: The ECG shows tachycardia of 100–110 beats/min with the onset of coughing, suggesting reduction of preload to the heart caused by the sudden rise in intrathoracic pressure rather than a vagal activation

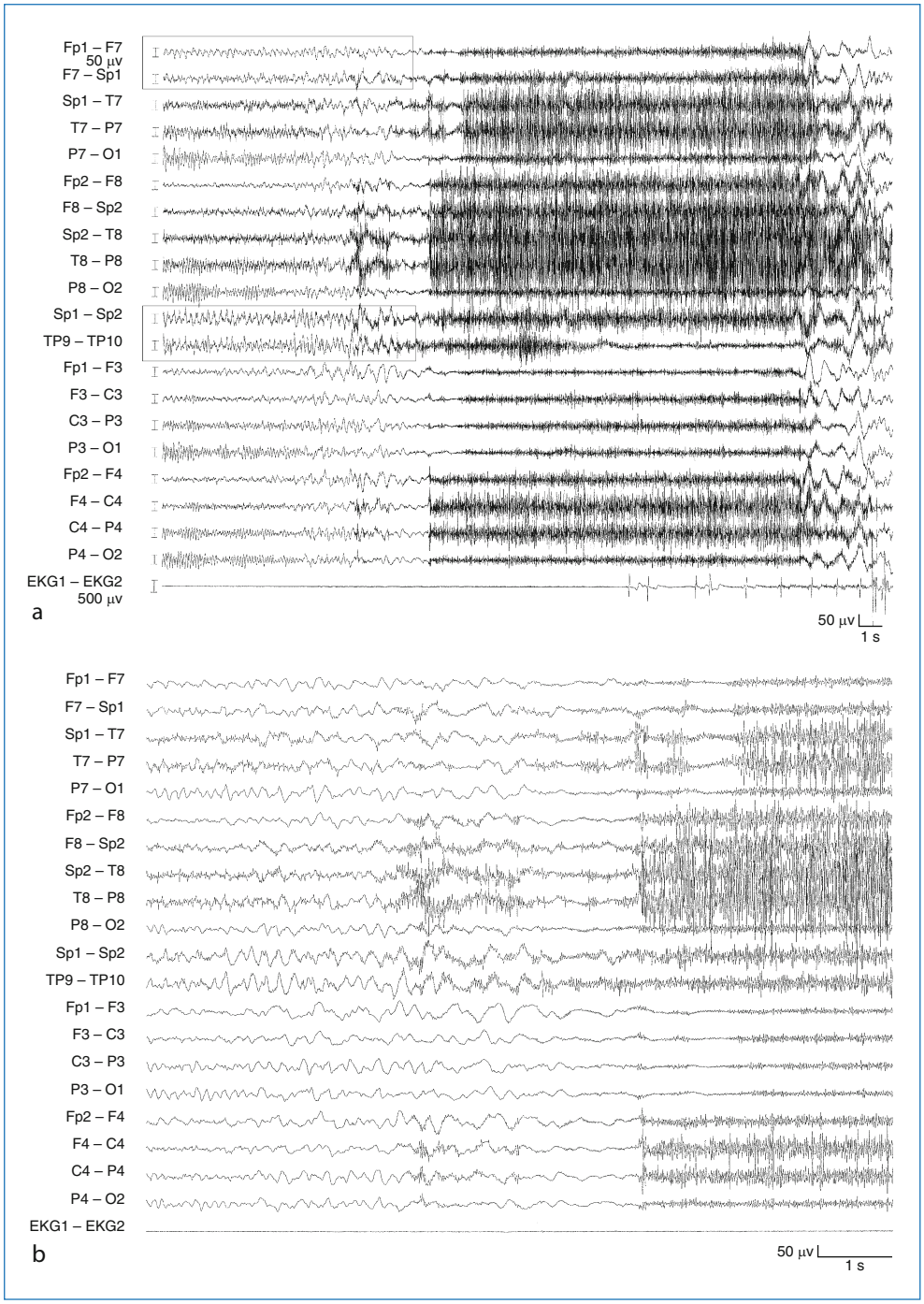

Figure 88-3. (**a**) Ictal Asystole. A 54-year-old female presented with an asystole of 23.4 s duration (30 s page, 1–70 Hz). The figure begins 3.5 s after onset of cessation of heart rate. About 10 s after beginning of the asystole and 6.5 s into the shown tracings, the posterior background disappears and diffuse generalized slowing is seen for 4–5 s, followed by background suppression for about 15 s. About 7 s after spontaneous recovery of heart rate, there is again a brief period of generalized slowing before the posterior alpha activity returns (not shown). The overall EEG pattern is very similar to that seen in *Fig. 88-1*
The abrupt onset of tonic EMG artifact coincides with the background suppression. The loss of tone and consciousness (on video) precedes the tonic stiffening and coincides with the initial diffuse slowing on EEG. Note: A rhythmic theta activity is seen at the beginning of the page over the left anterior temporal region consistent with a left temporal electrographic seizure. Note the phase reversal over F7 on the bipolar chain and the sharply contoured negativity over SP1 and TP9 (referenced to the contralateral side). The temporal slowing becomes more irregular after the first 5–6 s and disappears with the occurrence of the bilateral slowing and EEG attenuation. *SP:* sphenoidal electrode. (**b**) Ictal Asystole. Same patient, same event (10 s page, 1–70 Hz). The figure begins 8.5 s after onset of asystole. The left temporal slowing has already become more irregular, as seen in the first 3–4 s of the page. In the middle of the page, a generalized delta slowing emerges and the left temporal slowing resolves. In the last third of the page, diffuse background attenuation coincides with muscle artifact during tonic posturing. Note: The anoxia–ischemia triggered by the asystole appears to terminate the ictal activity and an EEG pattern very similar to the one seen during vasovagal syncope emerges

Table 88-2. Classification of syncopal attacks

Neurally mediated/Vasovagal syncope		
	Peripheral	*Central*
Cardioinhibitory, vasodepressive or mixed	Cough, swallow Micturition, defecation Postprandial Hair brushing, stretching Carotid sinus syndrome Glossopharyngeal or trigeminal neuralgia	Fear, smell Cerebral syncope Breath holding "Ictal bradycardia or asystole"
Cardiogenic syncope		
Cardiac arrhythmia	*Tachyarrhythmia* Supraventricular tachycardia Long QT Short QT Brugada syndrome Catecholaminergic polymorphic ventricular tachycardia Arrhythmogenic right ventricular dysplasia *Bradyarrhythmia* Sinus node disease Atrioventricular block	
Structural cardiac or cardiopulmonary disease	*Intrinsic* Valvular heart disease (aortic stenosis) Acute myocardial ischemia Hypertrophic cardiomyopathy Left atrial myxoma *Extrinsic* Pericardial disease/tamponade Pulmonary embolism/pulmonary hypertension	
Orthostatic syncope		
	Systemic: volume depletion, e.g., hemorrhage, diarrhea, dehydration Neurogenic: autonomic failure, e.g., pure autonomic failure, multiple system atrophy, secondary to e.g., neuropathy, drugs, alcohol Cardiogenic: postural intolerance, e.g., postural orthostatic tachycardia syndrome	

Diagnostic Procedures

All patients who present with syncope should have a basic evaluation consisting of

Basic testing done routinely:

- History and witness report
- Physical examination [presence of structural heart is 95% sensitive and 45% specific for a cardiac cause of syncope (Alboni et al. 2001)]
- Standard 12-lead ECG
- Basic labs (urine toxicology)
- Echocardiography (if there is any question whether the heart is normal)

Advanced testing is often done for the following indications:

- EEG and MRI: for patients with suspected epilepsy or when a reliable witness account is not available
- Video EEG monitoring: for patients with unclear and frequent (weekly) events
- Tilt table testing: in patients with recurrent unexplained falls or blackouts, particularly if triggered by upright positioning. Tilt table can be combined with video EEG monitoring if the differential includes epileptic or nonepileptic seizures.
- Genetic testing: in younger patients with a family history of syncope or prolonged QT interval on ECG
- Holter monitoring: in patients with suspected cardiac arrhythmia and normal routine ECG

Cardiology consultation and invasive testing is indicated for selected patients:

- Implantable Loop Recorder: for patients with infrequent, unexplained blackouts when conventional testing failed to reveal a diagnosis
- EP studies: high-risk patients with known cardiac disease

Differential Diagnosis

The differential diagnosis of possible presyncopal events ("lightheadedness" or "dizziness") can be extremely wide, but a more specific description ("sweaty," about to pass out), situational triggers, past medical

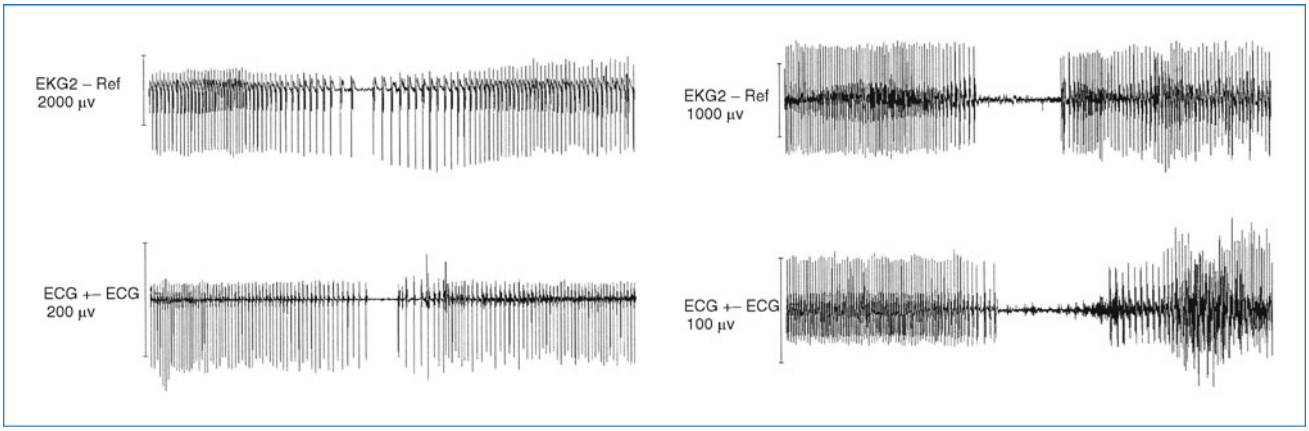

Figure 88-4. ECG in Vasovagal and Ictal Asystole. The duration of each tracing is 2 min. The upper row shows two patients with ictal asystole with a cessation of the heart for 5.3 s (left) and 22.0 s (right). The lower row shows two patients with vasovagal asystole with cardiac arrest of 8.1 s (left) and 28.4 s (right). Reproduced with permission Schuele et al. (2008)

history, and physical findings can often help to narrow the possibilities.

The differential diagnosis of syncope depends on history and witness account:

Box 88-1

Epileptic seizures:

- Sudden loss of consciousness and body tone:
  - Atonic seizure (mostly in children)
  - Ictal asystole (rare, <0.1% of epilepsy patients, mostly with temporal lobe epilepsy)
- Convulsive syncope: generalized tonic–clonic seizure
- Unwitnessed falls with loss of consciousness: in the absence of a discriminating aura or situational trigger

Nonepileptic psychogenic seizures:

- Sudden loss of mobility, flaccid posture, often with partial responsiveness and memory for the event: "Pseudosyncope"

Nonepileptic drop attacks:

- Definition: Sudden spontaneous falls while standing or walking, with complete recovery in seconds or minutes. There is no loss of consciousness and the event is remembered (Sheldon 1960).
- Etiology: Sudden otolithic dysfunction (e.g., Ménière's disease), Recurrent Vertebrobasilar TIAs (e.g., due to vertebrobasilar stenosis, subclavian steal), Basilar artery migraine.

Prognosis

An increased mortality risk has been demonstrated after cardiac and neurological causes of syncope especially in the elderly (Soteriades et al. 2002). Younger patients with vasovagal syncope on the other hand have a benign prognosis not associated with an increased risk of death (Grubb 2005).

Management

The management of syncope depends on the underlying cause. An implantable pacemaker or cardiac defibrillator can be lifesaving for patients with underlying heart disease or electrophysiologic abnormalities associated with ventricular arrhythmias. Patients with intracranial vertebrobasilar stenosis may benefit from medical prophylaxis or stent placement and surgical intervention.

The following treatment options have been recommended for neurally mediated syncope (Grubb 2005):

Box 88-2

Basic symptomatic treatment:

- Increased fluid (>2 L) and salt intake (~7 g)
- Isometric contraction exercises, "tilt training" (based on anecdotal evidence)

Medical treatment options:

- Midodrine 2.5–10 mg three times daily
- Fludrocortisone 0.1–0.2 mg daily
- Beta-blockers (metoprolol 50 mg one to two times daily)
- SSRI (paroxetine 20 mg daily, escitalopram 10 mg daily)

Surgical treatment options (for patients with cardiac syncope):

- Cardiac pacemakers
- Implantable cardiac defibrillators

Pacemaker treatment is usually not indicated for patients with vasovagal syncope. Controlled studies did not show any benefit of pacemaker therapy for patients with vasovagal asystole in terms of event frequency or time to first recurrence (Connolly et al. 2003). Implantable cardiac defibrillators are indicated for patients with cardiac syncope after electrophysiological studies demonstrated a high risk for sudden cardiac death.

Driving restrictions depend on the underlying cause and legislator. In general, patients with suspected epilepsy or cardiac syncope or unclear loss of consciousness should be restricted from driving, whereas patients with situational syncope usually do not carry an increased risk for another event while driving.

Related Topics

► Imitators of Epileptic Seizures: Overview
► Pathophysiology of Termination of Seizures

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