



Syncope

Erica Flores, PGY-5

Learning Objectives

- + Recognize the different etiologies of patients presenting with syncope
- + Describe appropriate testing and management of patients presenting with syncope

Syncope

- + 1/3 of US experience ≥ 1 episode during lifetime
- + >1 million patients per year in U.S.
- + 3% of emergency room visits
- + 1-6% of hospital admissions

Syncope: Definition



- + A transient, self-limited loss of consciousness, usually leading to falling
- + The onset is relatively rapid, and the subsequent recovery is spontaneous, complete and usually prompt
- + Mechanism:
 - + Transient global cerebral hypo-perfusion

Transient Loss of Consciousness

+ Non-traumatic

- + Syncope
- + Seizure
- + Intoxication
- + Metabolic

+ Traumatic

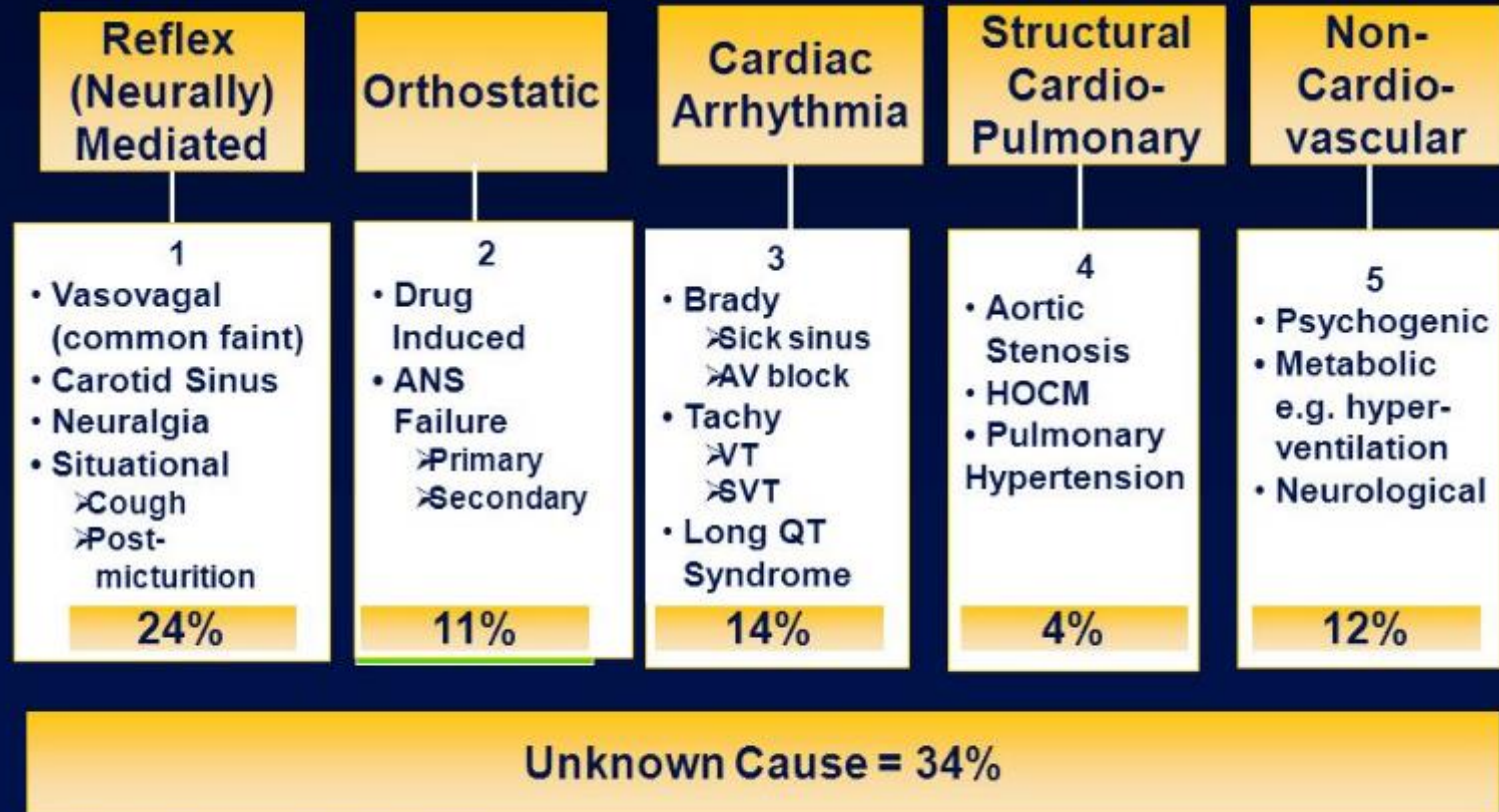
- + Concussion

+ TLOC Mimics

- + Psychogenic/pseudo-seizure
- + Drop attacks
- + Cataplexy

- + There are 2 main reasons to evaluate a patient with syncope:
 - + To assess the prognostic risk, including death, severe adverse events and syncope recurrence
 - + To identify a specific cause of the loss of consciousness to apply an effective mechanism-specific treatment strategy
- + Defining the mechanism is a pre-requisite for finding a specific therapy to prevent recurrences

Syncope - Etiology



Diagnostic Algorithm

+ Initial Evaluation

+ History and Physical

+ 4 Questions:

+ 1. Did the patient suffer "true" TLOC?

+ 2. Was TLOC due to syncope or some other cause?

+ 3. Is heart disease present?

+ 4. Does the medical history (including observations by witnesses) suggest a specific diagnosis?

+ Assessment of patients with a short-term high risk features

+ Laboratory and Provocative Tests

Syncope Testing

+ Routine

- + CBC, Electrolytes, glucose
- + ECG
 - + Presence of Q wave, bundle branch block/IVCD, sinus bradycardia (<50bpm), NSVT
- + Orthostatics
- + Carotid sinus massage

+ Elective

- + Echocardiogram
- + Holter monitor
- + Ambulatory continuous blood pressure monitor
- + Ambulatory event recorder
- + Implantable event recorder
- + Tilt table testing
- + Electrophysiologic testing
- + Neurologic Testing
- + Endocrinology Testing
- + Other cardiac testing

18 Year Old Female presents with syncope

- + An 18 year-old woman presents to the emergency department with an episode of “passing out.” She states that she was having a “few beers” with friends and did not have much to eat. She reports experiencing occasional lightheadedness while drinking alcohol, especially when moving from a supine to standing position but has never before lost consciousness. The patient last remembers getting up from a chair, and then waking up on the floor surrounded by friends. The patient’s roommate witnessed the event and upon questioning states that the patient may have had a seizure, as she made jerking movements while unconscious. The patient lost consciousness for several seconds, well under 1 minute in duration. She did not lose bladder or bowel function, did not bite her tongue, and was fairly well oriented upon awakening. She hit her head and sustained a scalp laceration. Physical examination reveals dry mucous membranes, but otherwise normal. Supine HR is 90 bpm, which increases to 120 bpm while standing.

All of the following are reasonable approaches to managing this patient except?

- + A. Measure levels of electrolytes, blood urea nitrogen and creatinine
- + B. Obtain IV access and hydrate the patient with normal saline
- + C. Perform a CT scan of the head
- + D. Perform a pregnancy test
- + E. Perform a urine toxicology screen

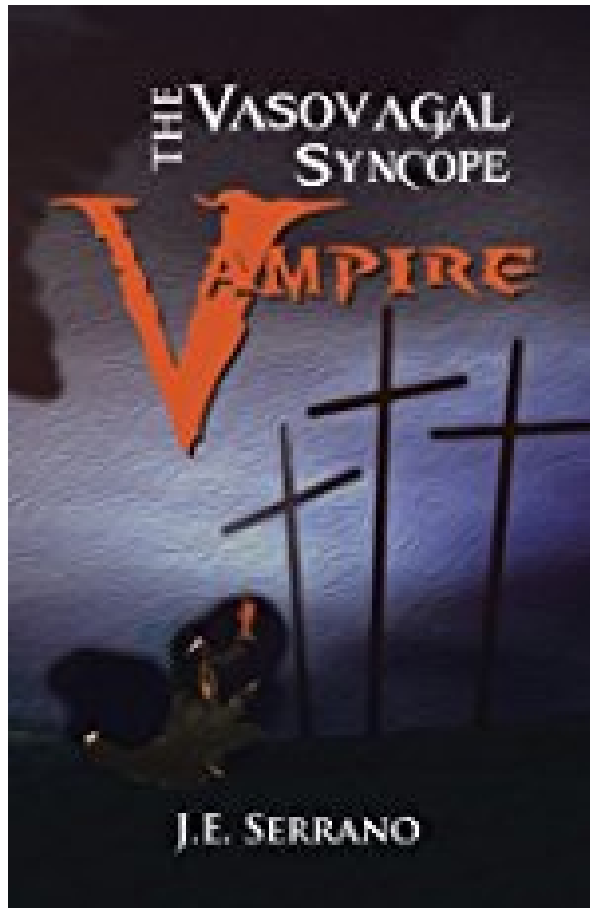
- + Answer C.
- + Etiology likely vasovagal
- + Since pregnancy can be associated with presyncope and syncope it is reasonable to obtain
- + Patient with syncope can have myoclonic jerking but it is distinctly different from tonic-clonic seizure activity

Neurally mediated causes of syncope

- + Vasovagal
- + Carotid sinus hypersensitivity
- + Situational faint
 - + Cough, sneeze; Micturition
- + Post-exercise
 - + Usually a form of vasovagal syncope
- + Glossopharyngeal and trigeminal neuralgia
- + Gastrointestinal stimulation (swallow)



Vasovagal



- + Classical vasovagal syncope is diagnosed if syncope is precipitated by:
 - + emotional distress (such as fear, severe pain, instrumentation, blood phobia) or prolonged standing
 - + associated with typical prodromal symptoms due to autonomic activation (intense pallor, sweating, nausea, feeling of warmth, odd sensation in the abdomen, and lightheadedness or dizziness).
- + Mechanism
 - + Emotional stress, decreased VR, or vasodilation-> increased SNS-> hyperdynamic LV obliteration-> myocardial mechanoreceptor activation-> vagal reflex-> vasodilation and bradycardia

Carotid Sinus Hypersensitivity

- + Abnormal response to carotid massage in patients over age 50
- + Carotid sinus syndrome- Spontaneous
 - + Syncope occurs when carotid sinus is stimulated (ie head rotation, head extension, shaving, or wearing a tight collar)
- + Carotid sinus syndrome- Induced
 - + Induced during carotid massage
 - + Marker of disease of the sinus or AV nodes

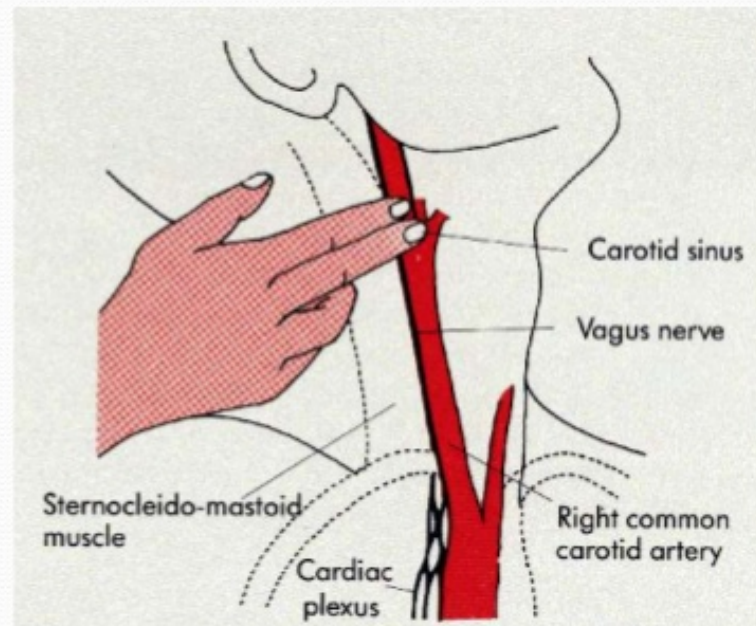


Carotid Sinus Massage

- + Perform in all patients over 50 years of age if not clearly vasovagal or orthostatic or syncope is recurrent
- + Contraindications:
 - + Carotid bruit
 - + History of stroke
- + Method
 - + Apply firm pressure over each carotid bifurcation for 10 seconds
 - + Perform at the bedside
 - + Can perform in supine and erect positions in tilt table testing

Carotid Sinus Massage

Stimulation of carotid sinus triggers baroreceptor reflex and increased vagal tone, affecting SA and AV nodes

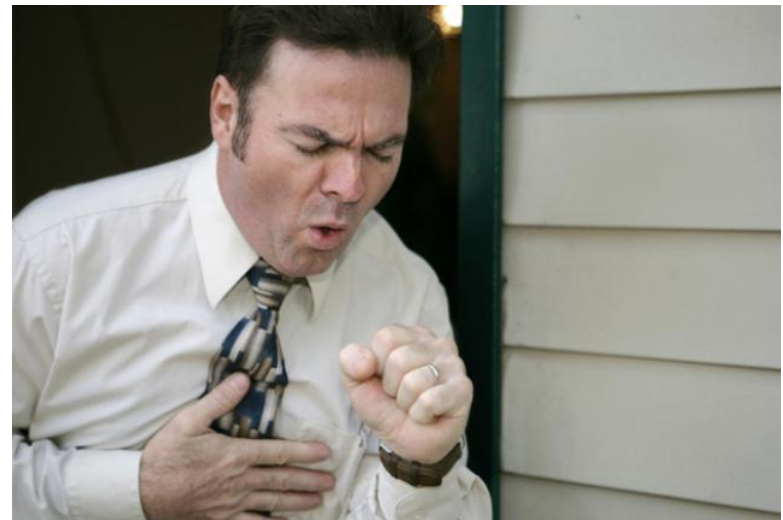


Abnormal response to carotid sinus massage

- + Vasodepressor response: Systolic BP decreased by at least 50mmHg
- + Cardioinhibitory response: sinus or AV block causes a pause of 3 or more seconds
- + Mixed vasodepressor and cardioinhibitory response

Situational Syncope

- + Situational syncope is diagnosed if syncope occurs during or immediately after specific triggers:
- + Gastrointestinal stimulation (swallow, defecation, visceral pain)
- + Micturition (post-micturition)
- + Post-exercise
- + Post-prandial
- + Cough, sneeze
- + Others (e.g., laughing, brass instrument playing, weightlifting)



Treatment- Neurally Mediated

- + Patient education, reassurance, instruction
- + Salt/Volume
 - + Increased dietary salt, increased volume intake (gatorade)
- + Physical Maneuvers
 - + Leg crossing, with lower body muscle tensing or squatting
- + Support hose
- + Pharmacologic trials

Treatment- Carotid Sinus hypersensitivity

- + Permanent Pacing

- + Class I

- + Recurrent syncope caused by carotid sinus stimulation in the absence of any drug that depresses the sinus node or AV conduction

- + Class IIa

- + Recurrent syncope without clear, provocative events with a hypersensitive cardioinhibitory response

How should this patient be managed?

- + A. Admit the patient to a monitored unit for observation
- + B. Admit the patient to a monitored unit and perform an EEG
- + C. Discharge the patient with a Holter monitor
- + D. Discharge the patient after alcohol cessation counseling, and instruct her to be careful when moving from a supine to standing position

- + (E) Discharge patient after alcohol cessation counseling, and instruct her to be careful when moving from a supine to standing position.
- + The treatment of syncope is very specific to the underlying cause. In this patient with vasovagal syncope, the physician should be supportive and focus on alcohol cessation, keeping well hydrated, and taking caution when moving from a supine/sitting position to a standing position.
- + Also, if there are any presyncopal symptoms, patients should be instructed to assume a supine position immediately. In general, these actions will help to treat most patients diagnosed with vasovagal syncope.

Table 3 Short-Term High-Risk Criteria That Require Prompt Hospitalization or Early Intensive Evaluation

ESC Guidelines (1)	Canadian Cardiovascular Society Position Paper (29)
Severe structural or coronary artery disease (heart failure, low ejection fraction, or previous myocardial infarction)	Heart failure and history of cardiac disease (ischemic, arrhythmic, obstructive, valvular)
ECG features suggesting arrhythmic syncope (nonsustained ventricular tachycardia, bifascicular block, inadequate sinus bradycardia (<50 beats/min) or sinoatrial block, pre-excited QRS complex, ECG findings suggesting an inherited disease)	Abnormal ECG (any bradyarrhythmia, tachyarrhythmia, or conduction disease; new ischemia or old infarct)
Clinical features suggesting arrhythmic syncope (syncope during exertion or supine position, palpitations at the time of syncope, family history of sudden cardiac death)	Hypotension (systolic blood pressure <90 mm Hg)
Important comorbidities: <ul style="list-style-type: none">• Severe anemia• Electrolyte disturbance	Minor risk factors deserving urgent specialist assessment: age >60 years, dyspnea, anemia (hematocrit <0.30), hypertension, cerebrovascular disease, family history of sudden death <50 years, syncope while supine, syncope during exercise, syncope with no prodromal symptoms

Indications for hospitalization

- + History of heart failure, low ejection fraction, or coronary artery disease
- + An electrocardiogram suggestive of arrhythmia
- + Family history of sudden death
- + Lack of prodromes; occurrence of physical injury, exertional syncope, syncope in a supine position, or syncope associated with dyspnea or chest pain



Question

- + The following factors are associated with noncardiogenic syncope **except**:
- + A. Young age
- + B. Isolated syncope without underlying CV disease
- + C. Normal examination and ECG
- + D. Abrupt onset
- + E. Symptoms consistent with a vasovagal cause

+ Answer D.

+ An abrupt onset of syncope, particularly with exertion or while supine, is more consistent with cardiogenic mechanism. All the other factors are more suggestive of a noncardiac mechanism.

+ Factors suggestive of a cardiac mechanism include:

+ CAD, CHF, older age, abrupt onset, serious injuries, abnormal cardiac examination, structural heart disease, and an abnormal ECG (presence of Q wave, BBB, sinus bradycardia)

Question

- + All of the following are neurally mediated reflex syncopal syndromes **except**:
- + Vasovagal
- + Postmicturition
- + Gastrointestinal stimulation (swallow, defecation, visceral pain)
- + Carotid sinus
- + Parkinson disease with autonomic failure

+ **Answer e.**

+ Parkinson disease with autonomic failure typically results in orthostatic syncope. Answers **a** to **d** are all neurally mediated reflex syncopal syndromes. Other causes of neurally mediated reflex syncope include: acute hemorrhage, cough, sneeze, postexercise glossopharyngeal and trigeminal neuralgia, and a situational faint.

Orthostatic Hypotension

+ Normal Physiology

- + Upon standing, 25-30% of blood pools in the venous system of LE-> decreased VR and SV
- + Reflex is to increase sympathetic tone, peripheral and splanchnic vasoconstriction, and increase in HR (CO reduced but BP maintained since $BP = CO \times PVR$)

+ Orthostatic hypotension due to autonomic failure

+ Definition

- + Drop in SBP of 20mmHg or more; or a drop in DBP of 10mmHg or more after 30 seconds to 5 minutes of upright posture
- + Autonomic dysfunction suggested when heart rate fails to increase along with the drop in blood pressure

Orthostatic Hypotension Scenarios

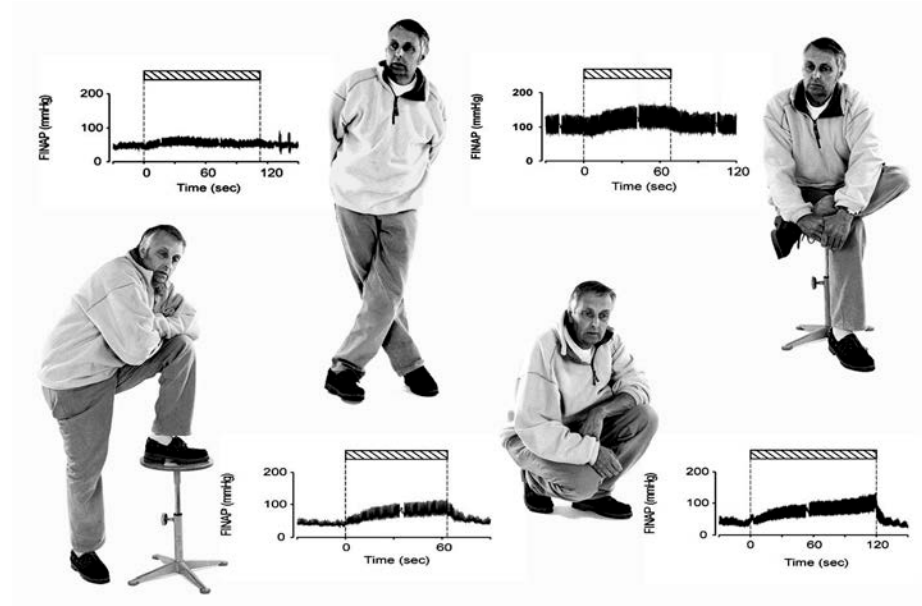


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- + Clinical Features
 - + After standing up
 - + After a meal
 - + Temporal relationship with start of a medication leading to hypotension or changes of dosage
 - + Prolonged standing especially in crowded, hot places
 - + Presence of autonomic neuropathy or Parkinsonism
 - + After exertion

Management

- + Education, salt and fluids
- + Stop offending drug
- + Physical counterpressure maneuvers
 - + Leg crossing, with lower body muscle tensing or squatting
- + Support hose



22 Year Old Man presents with syncope

- + A 22 y/o man presents with an episode of syncope. He is previously healthy and had no prior medical or cardiac problems. He is a telephone repair man and is concerned as he needs to climb the poles during his work. His episode occurred on a hot day at work when he hurt his hand with a hammer. There was some mild nausea but then he passed out completely without warning, coming to after several seconds. His workup has included a normal EKG and normal labs.

What is the next step in management?

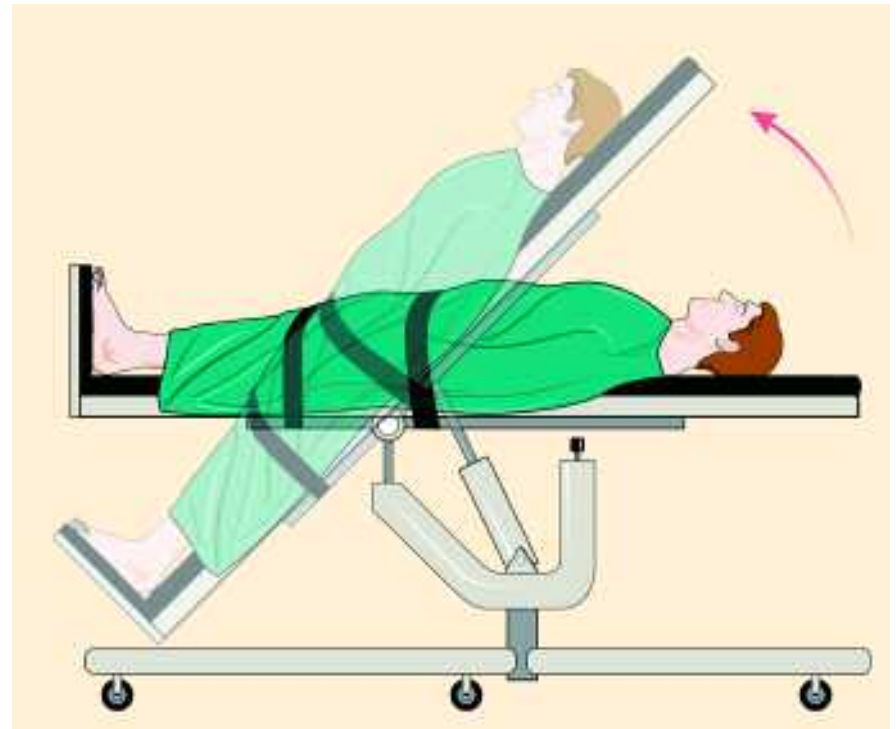
- + A. EP Testing
- + B. Implantable loop recorder
- + C. Tilt table testing
- + D. Reassurance, continue observation

+ Answer C. Tilt table testing

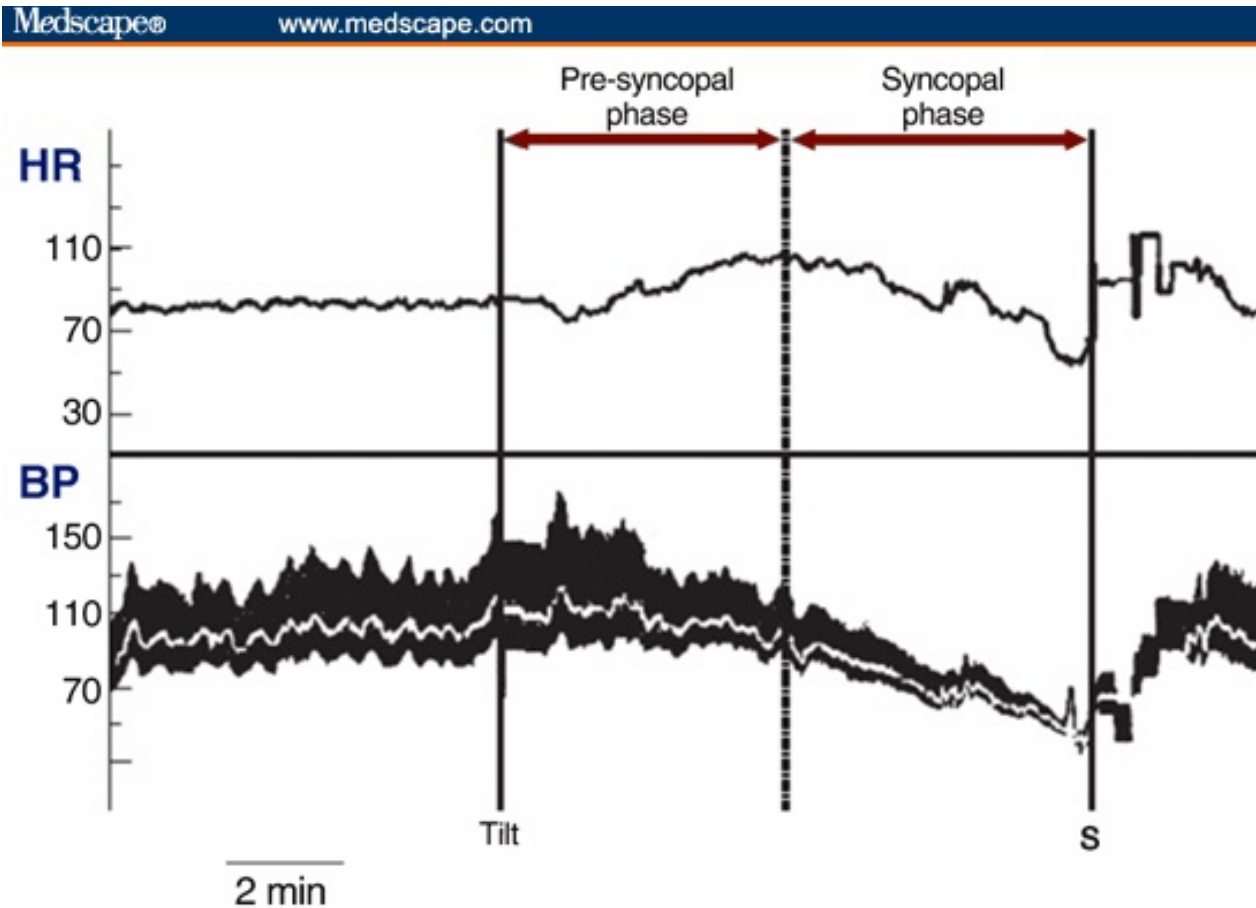
+ High risk occupation

TTT Mechanism

- + Upright posture during the test decreases venous return and reduces LV filling
- + Increased force of contraction due to increased sympathetic stimulation
- + Mechanoreceptors in the ventricles respond to the increased force of contractions resulting in reflex parasympathetic discharge causing hypotension, bradycardia or both



TT Results



Tilt Table Testing Indications

+ Class I

- + Unexplained single episode in high risk setting (occurrence of, or potential risk for, physical injury of with occupational implications)
- + Recurrent, without organic heart disease
- + With heart disease, after cardiac causes have been excluded
- + When it will be of clinical value to demonstrate susceptibility to neurally-mediated syncope to the patient

TTT Indications

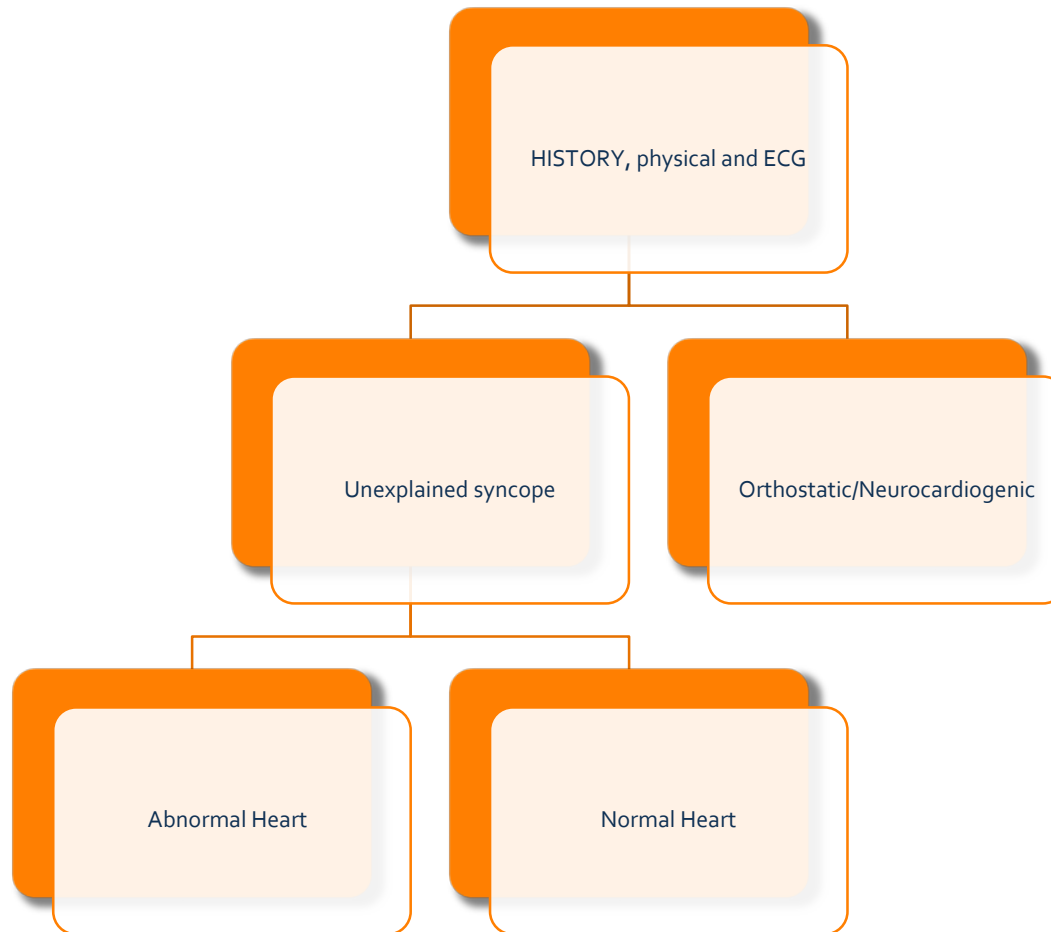
+ Class II

- + When an understanding of the hemodynamic pattern may alter the therapeutic approach
- + For differentiating syncope from jerking movements from epilepsy
- + For evaluating patients with recurrent, unexplained falls
- + For assessing recurrent pre-syncope or dizziness

+ Class III

- + Assessment of treatment
- + Single episode without injury and not in high risk setting
- + Clear-cut clinical vasovagal features leading to a diagnosis when demonstration of a neurally mediated susceptibility would not alter treatment

Diagnostic Approach



+ A 76 year old man is evaluated during a routine follow-up examination for htn, and he mentions having had a syncopal event a few weeks earlier. He was standing in line at the grocery store and lost consciousness without any preceding symptoms. He estimates that the duration of the episode was less than a minute, and he drove himself home. He has had two other syncopal events in the last 3 years, one while sitting, and one during a walk. He has intermittent episodes of lightheadedness that do not have obvious triggers and are not related to positional changes. He is otherwise asymptomatic with no chest pain, dyspnea, orthopnea, edema or palpitations. His only daily medication is lisinopril.

+ What to do next?

- + No orthostatic changes
- + Physical exam- no murmurs, no carotid bruits
- + Carotid pressure does not result in bradycardia
- + What do to next?
- + ECG and echo are normal
- + Next?
- + Exercise stress test is normal

- + Which of the following diagnostic test is most likely to yield useful results for this patient?
- + A. 24-hour ambulatory monitoring
- + B. Event monitoring
- + C. Implantable loop recorder
- + D. EP study

+ Answer C.

+ Evaluate recurrent syncope in a patient with a structurally normal heart

Syncope Testing

+ Routine

- + CBC, Electrolytes, glucose
- + ECG
 - + Presence of Q wave, bundle branch block/IVCD, sinus bradycardia (<50bpm), NSVT
- + Orthostatics
- + Carotid sinus massage

+ Elective

- + Echocardiogram
- + Holter monitor
- + Ambulatory continuous blood pressure monitor
- + Ambulatory event recorder
- + Implantable event recorder
- + Tilt table testing
- + Electrophysiologic testing
- + Neurologic Testing
- + Endocrinology Testing
- + Other cardiac testing

ECG Monitoring

- + Holter monitoring
 - + For patients with frequent syncope or pre-syncope ($\geq 1/\text{wk}$)
- + External loop recorders
 - + Patients who have intermittent symptoms (every 4 weeks or less)

Implantable/Injectable Loop Recorders

- + Class I
 - + Patients with recurrent syncope of unknown etiology, absence of high risk for mortality or morbidity, ILR can be considered before EPS
 - + High risk patients without a diagnosis after comprehensive evaluation
- + Class II
 - + Patients with reflex syncope with frequent recurrence and trauma before pacemaker is considered for possible intermittent bradycardia





From: New Concepts in the Assessment of Syncope

J Am Coll Cardiol. 2012;59(18):1583-1591. doi:10.1016/j.jacc.2011.11.056

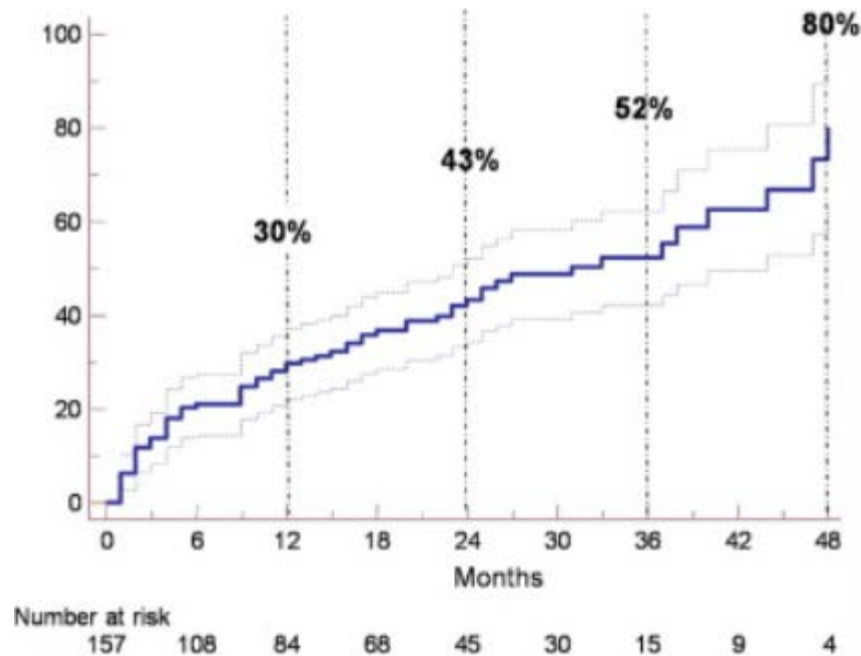


Figure Legend:

Time-Dependent Cumulative Diagnostic Yield of ILR

The actuarial curve with its 95% confidence intervals is presented. ILR = implantable loop recorder.

75 year old man presents with syncope

- + A 75 y/o male had 1 brief episode of unresponsiveness when he was watching TV at night. His wife noted that he did not respond to her calling for approximately 10-20 seconds. He was unable to recall the event after he regained consciousness. His past history is significant for CAD and HTN. A recent echo from 2 months ago showed an EF of 40% with anterior wall akinesis. He is currently taking atenolol 50mg QD and ASA 81 mg QD. His physical examination was noted for a low grade holosystolic murmur along the left sternal border; there was no orthostatic hypotension; carotid sinus massage induced a 2.5 sec pause without any symptoms.

What would you do next?

- + A. Exercise thallium scan to assess ischemia
- + B. Electrophysiology testing
- + C. ICD implantation
- + D. Loop recorder for long term monitoring
- + E. Continue observation

- + Answer B. Electrophysiology testing
- + CAD, Prior MI, EF>35%
- + Suspect Ventricular arrhythmia

+ All of the following clinical characteristics are associated with cardiogenic syncope and should prompt referral for an invasive EP study except:

- + A. Age >65 years**
- + B. History of CHF**
- + C. Bundle branch block**
- + D. History of ventricular arrhythmias**
- + E. Recurrent unexplained falls in a 70-year-old patient**

+ Answer e.

+ Answers a to d are all considered high risk characteristics for cardiogenic syncope. If any of these are present, the rate of spontaneous ventricular tachyarrhythmia or death is between 4% and 7% in 1 year. If 3 or more are present, this rate increases to 58% to 80%. Recurrent unexplained falls in an elderly patient should first be assessed with tilt table testing unless other high risk features are present.

Electrophysiology Testing

+ Class I

- + The initial evaluation suggests an arrhythmic cause of syncope
 - + BBB suspect AV conduction system disease
 - + CAD, prior MI, EF > 35% -> suspect ventricular arrhythmia
 - + Brugada syndrome, ARVC, and HCM
 - + Palpitations suspect intermittent tachycardia

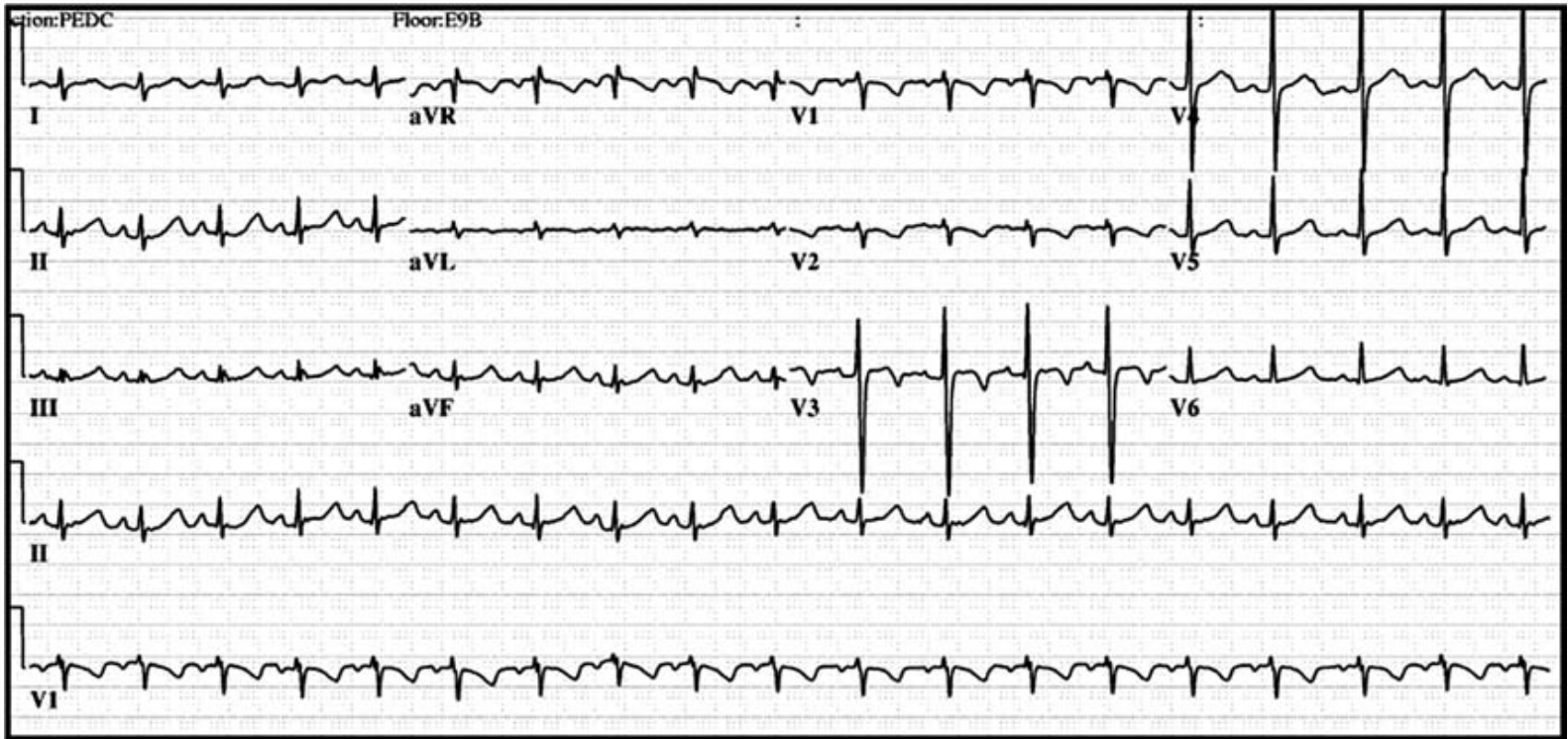
+ Class II

- + High-risk occupations exclude a cardiac cause of syncope
- + To evaluate documented arrhythmia mechanism

+ Class III

- + Normal ECG, no heart disease, no palpitations

- + A 16-year-old female was admitted to the CCU after an aborted sudden cardiac death. The patient was awakened to answer a telephone call and suddenly collapsed. The fall was witnessed and a rapid 911 call allowed the paramedics to arrive within 5 minutes. The patient was in VF and was successfully defibrillated with one shock. She remained comatose and was intubated and transported to the hospital.
- + On physical exam she was intubated and withdrew to painful stimuli. Her pupils were dilated, but reactive to light symmetrically. Her past medical history is remarkable for 3 brief fainting episodes. She was not using any prescription medication. The mother denied knowledge of substance abuse. Her family history is notable for a sister who died suddenly at the age of 20.



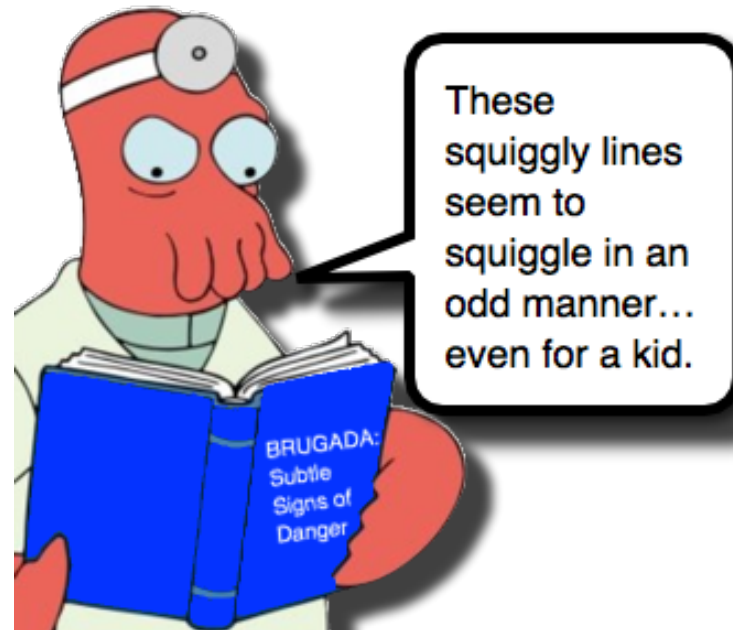
- + What is the most likely diagnosis at this time?
- + HCM
- + Brugada syndrome
- + Idiopathic VF
- + RVOT tachycardia
- + Long QT syndrome

Answer

- + Long QT syndrome
- + **Answer e.**
- + The most likely diagnosis is long QT syndrome. The prolonged QT > 480 msec, history of syncope, and family history of sudden death in a relative < 30 years of age yield a Moss and Schwartz score of 4.5 (see Table for scoring criteria), which places her at high risk of long QT syndrome. Although both Brugada syndrome and idiopathic VF present with sudden death, the clinical circumstance surrounding the arrest, gender of the patient, and ECG make these diseases less likely. RVOT tachycardia is typically not associated with sudden death. HCM often presents with exertional symptoms.

Syncope due to Cardiac Arrhythmia

- + Sinus node dysfunction
 - + Sinus bradycardia <40 beats/min or repetitive sinoatrial blocks or sinus pauses >3 s
- + Atrioventricular conduction system disease
 - + Second-degree Mobitz II or third-degree atrioventricular block
- + Alternating left and right bundle branch block
- + Paroxysmal supraventricular and ventricular tachycardias
- + Inherited syndromes (eg LQTS, SQTS, Brugada, CPVT, ARVD, HCM, LVNC)
- + Pacemaker or ICD malfunction with cardiac pauses



Clinical Features of Cardiac Causes

6 EKG Findings that will Kill Your Patient with Syncope

H **A** **P** **P** **Y**

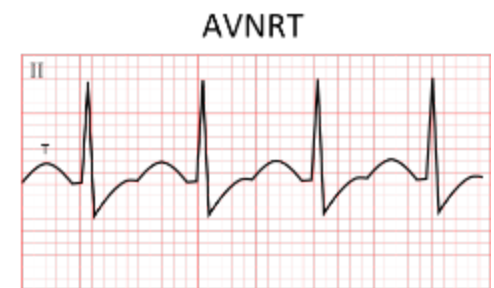
HOCH ACS Prolonged QT MPN Brugada PE



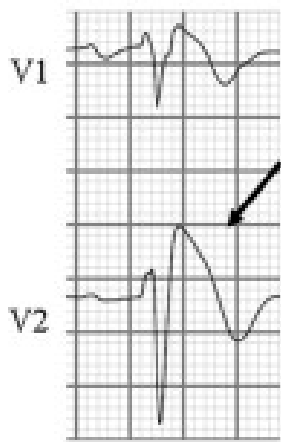
- + Essential elements of the history
 - + Significant coronary artery disease, prior myocardial infarction
 - + Congestive heart failure
 - + Older age
 - + Abrupt onset; during exertion; supine; palpitations
 - + Family history of premature, unexpected sudden death
 - + Serious injuries
- + Essential elements of the physical
 - + Abnormal cardiovascular exam-> elevated neck veins, S3 gallop, murmurs, LE edema
 - + Heart rate, regularity
 - + Neurological exam-> residual side effects

Treatment of Supraventricular Tachyarrhythmias

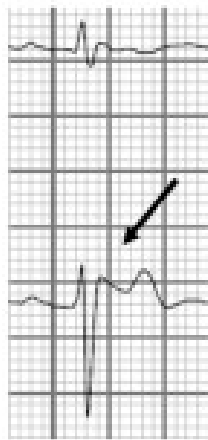
- + AVRT/AVNRT
 - + Ablation
- + Atrial flutter
 - + Ablation
- + Atrial fibrillation
 - + Pharmacologic therapy
 - + Ablation
 - + Pacemaker



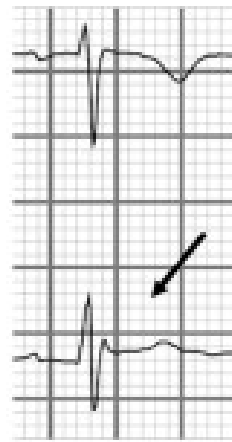
Treatment of Ventricular Tachyarrhythmias



Type 1:
Coved type
ST-segment
elevation



Type 2:
saddle-back type
ST-segment
elevation



Type 3:
Saddle-back type
"ST-segment
elevation"

- + Ischemic or Dilated CM
- + Channelopathies (LQTS/Brugada)
 - + Discontinue offending drugs
 - + Beta-blockers
 - + ICD
- + Outflow Tract Tachycardias
 - + Ablation
- + Arrhythmogenic Dysplasia
 - + ICD

- + A 77-year-old man presents with increasing symptoms of dyspnea and chest discomfort on exertion over the past 6 mos. He had two episodes of near syncope while climbing stairs. No prior cardiac history.
- + BP 130/50 mmHg and pulse 70 bpm ; JVP normal; LV sustained and displaced; S₄ present
- + 2/6 SEM at the base with mid peak ; 2/6 diastolic decrescendo murmur
- + Echocardiography: Moderately dilated LV cavity size ; Mild LVH ; Mild LA enlargement ; Aortic valve calcified ; Mean aortic valve gradient 40 mmHg ; AR probably mild

+ What would you do now?

+ A. TEE

+ B. Coronaries then AVR

+ C. Cardiac catheterization with arterial-venous gradient, CO, root and coronary angiography

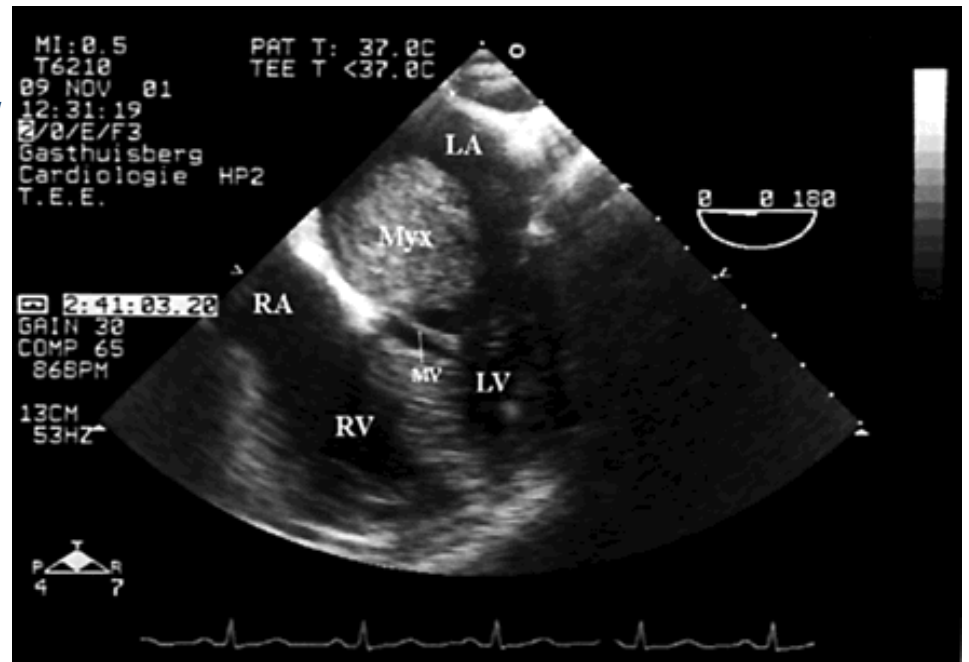
+ D. Medical observation

Answer

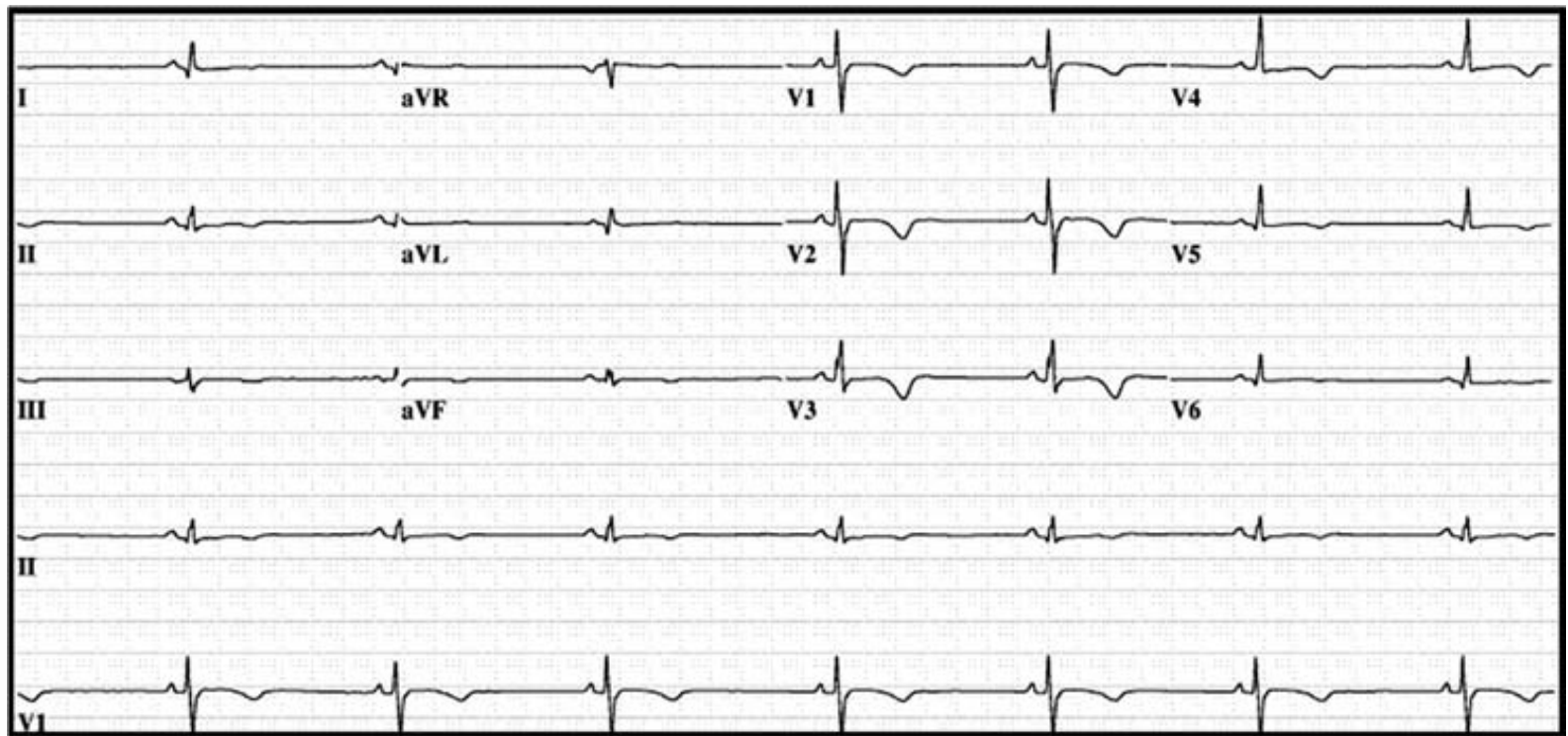
- + Answer b.
- + This gentleman has increasing symptoms. Based on the physical examination he has at least moderate AS and moderate to severe AR. The echocardiogram shows severe AS.

Structural Cardiac Causes

- + Cardiac valvular disease
- + Acute myocardial infarction/ischemia
 - + 2/2 neural reflex bradycardia-vasodilation, arrhythmias
- + Obstructive cardiomyopathy
 - + Exertional syncope (increased obstruction, greater demand)
- + Atrial myxoma
 - + Obstruction to flow
- + Acute aortic dissection
- + Pericardial disease/tamponade
- + Pulmonary embolus/pulmonary hypertension
 - + Neural reflex, inadequate flow on exertion



+ A 32-year-old male is referred to you by his primary care provider after an episode of syncope. The patient was briskly walking with friends when he suddenly passed out with recovery after falling to the ground. The patient takes no medication and does not use illicit drugs. A family history is notable for a father who died suddenly while shoveling snow at the age of 45. The physical examination is consistent with a healthy male with no distinct abnormalities. His ECG is displayed on the next page. An echocardiogram shows mild-to-moderate RV enlargement with a mild reduction in systolic function.



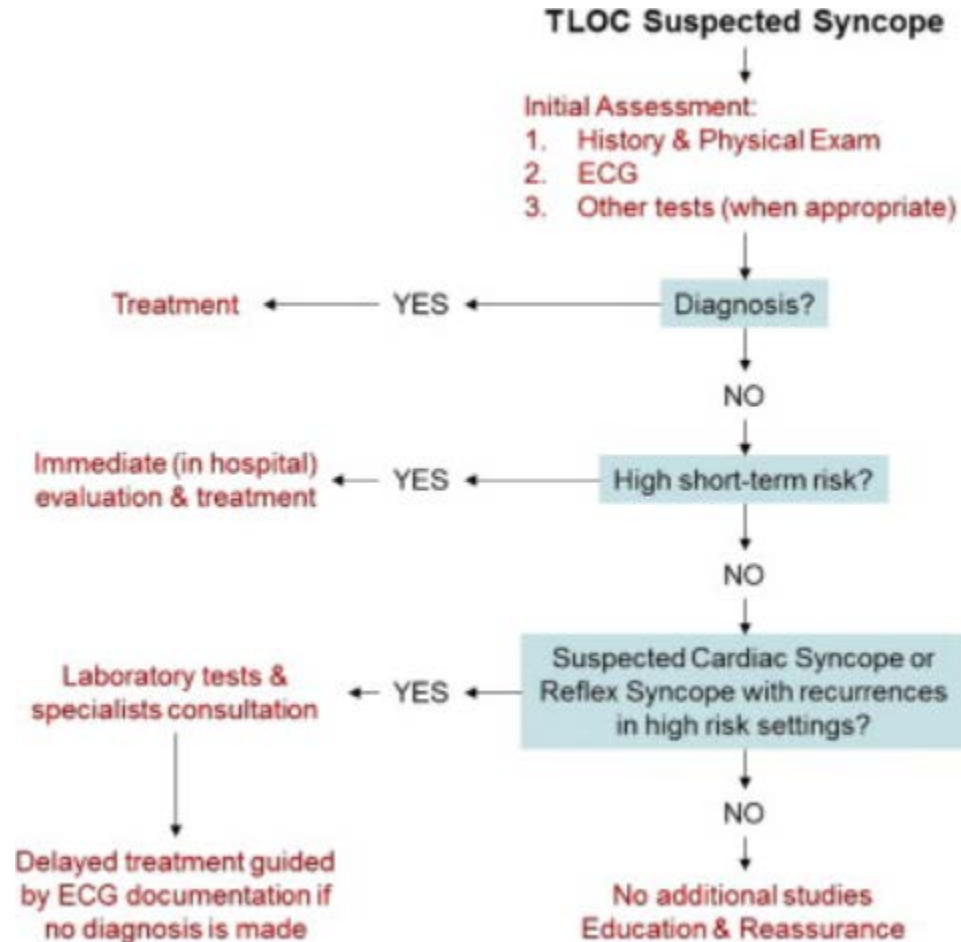
- + The history, examination, and tests are most suggestive of what disease process?
- + **Arrhythmogenic RV dysplasia**
- + **RVOT tachycardia**
- + **HCM**
- + **Long QT syndrome**
- + **Vasovagal syncope**

+ **Answer a.**

- + The patient's early presentation, family history of sudden death, ECG suggestive of RV disease (T wave inversion in leads V₂–V₄), and echocardiogram consistent with RV abnormalities are consistent with arrhythmogenic RV dysplasia. The echocardiogram is not consistent with HCM. The RV structural disease is more consistent with arrhythmogenic RV dysplasia in comparison to RVOT tachycardia.

Figure 2

The Diagnostic Algorithm of a Patient Presenting With TLOC of Suspected Syncopal Nature





Thank You!