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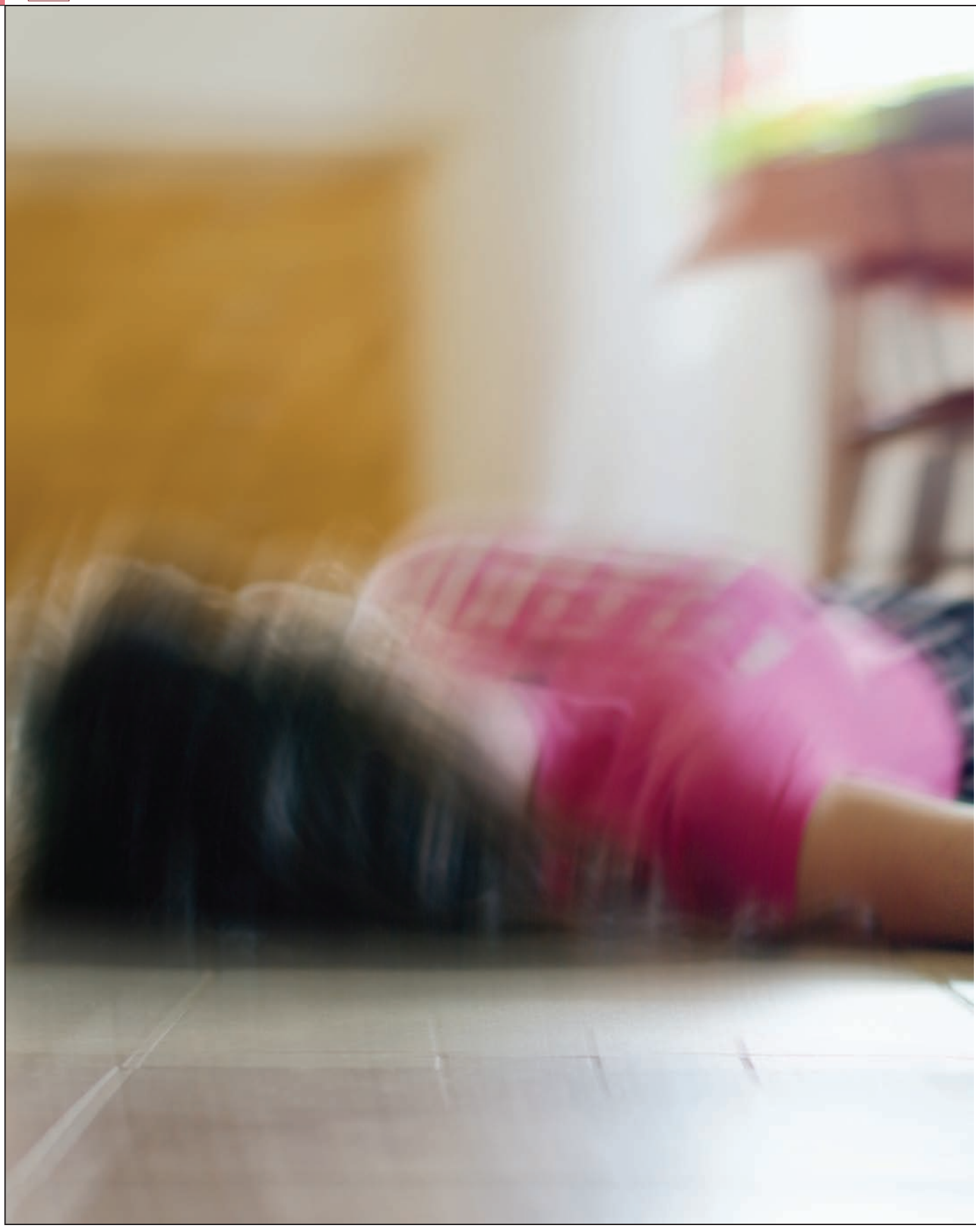

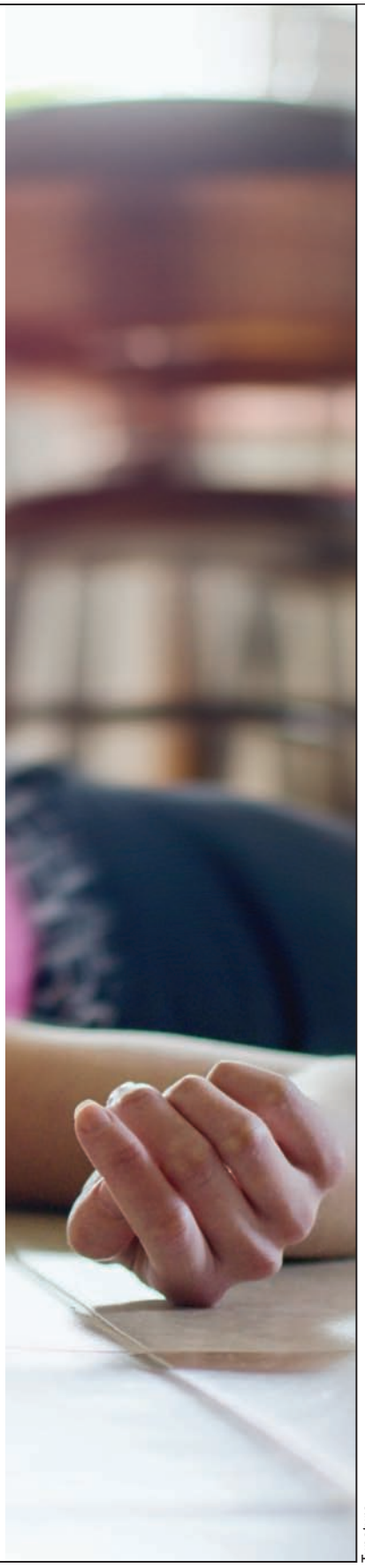

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Current best practices in emergency evaluation and management of syncope

Abstract: Syncope is a common medical presentation that can cost the US healthcare system up to $2.4 billion dollars annually. Much of this cost can be mitigated with proper evaluation and management in the urgent care setting, as well as appropriate use of a risk stratification system.

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Syncope is a common complaint among patients seeking immediate medical care in a multitude of different settings. In the ED alone, syncope accounts for approximately 740,000 visits annually with up to 460,000 of these patients being admitted or placed in observation.[1-3] Syncope is defined as a transient loss of consciousness typically caused by decreased blood flow to the brain followed by complete recovery.[4,5] It is characterized by a rapid onset and a short duration.[6] Syncope itself often poses a challenging case for most hospital providers, as patients are typically asymptomatic upon presentation and have a rather low rate of etiologic diagnosis. Patients with syncope frequently undergo significant diagnostic testing, often with minimal diagnostic yield and thus unclear benefit.[7-11] Hospitalizations for syncope average about $5,300 per admission or $2.4 billion dollars annually in the US, and often fail to identify the etiology of the syncopal episode.[1,4,8,11-13]

Clinical predictors for syncope

Syncope can result from a number of different causes, including a vasovagal response, orthostatic hypotension, cardiac abnormalities, medication issues, neurologic ailments, or even idiopathic causes.[4,9] Most often, the cause of syncope is benign, self-limiting, and most commonly attributed to a vasovagal response or orthostatic hypotension.[5,6,9,12,14] It is essential to initially distinguish between true syncope and other causes of transient loss of consciousness such as seizures or traumatic causes including falls or concussions. Once this determination is made, the provider must further distinguish between benign causes and potentially worrisome conditions such as cardiac or neurologic syncope.[4,12,14] Most morbidity and mortality associated with syncope is related to cardiac causes.[12,14]

Reflex or neurally-mediated syncope is typically defined as syncope occurring in the absence of heart disease or trauma caused by exposure to an unpleasant circumstance.[12,15,16] Vasovagal syncope is the most common type of reflex syncope and may occur in situations such as prolonged sitting or standing especially in hot or crowded places or following sudden exposure to pain or unpleasant sights, sounds, emotions, or smells. Reflex syncope can also occur with head rotation or carotid sinus pressure due to tight collars, neck ties, or tumors, or after eating or

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exertion. It typically presents concurrently with a long history of recurrent syncope or a long duration between episodes. Vasovagal syncope often has a prodrome of signs and symptoms such as diaphoresis, warmth, nausea, vomiting, and pallor.[12,15-17]

Orthostatic or postural hypotension typically occurs after standing up and is often associated with vasodepressive medications and/or volume depletion, prolonged standing, especially in crowded or hot places, or standing after exertion. It can also occur in the presence of autonomic nervous system dysfunction due to lesions of central or peripheral autonomic nerves, such as Parkinson disease, and can cause concurrent symptoms such as dizziness or headaches.[12,15-17]

Cardiac syncope is typically associated with higher morbidity or mortality than reflex syncope or orthostatic hypotension. Underlying heart disease is a significant independent marker of cardiac causes of syncope with 95% sensitivity.[6,12,13] Likewise, absence of heart disease excludes a cardiac cause of syncope in 97% of patients.[12] Patients over the age of 60 are more at risk for experiencing cardiac syncope.[6,13]

Cardiac syncope occurs due to a cardiac cause, such as an arrhythmia or structural heart disease, can occur during effort or while supine, and will typically include an abnormal ECG reading, palpitations before the event, or chest pain.[12,15,16] Cardiac syncope should be suspected in anyone with a history of structural heart disease, an abnormal ECG reading, or a family history of sudden cardiac death (SCD) or inherited conditions.[12] Cardiac syncope occurring days to weeks after a myocardial infarction (MI) is particularly worrisome.[12] ECG readings indicative of cardiac syncope can include atrioventricular blocks, tachyarrhythmias, or new-onset atrial fibrillation.[6,12] Of note, persons with myotonic and muscular dystrophies often have higher rates of left ventricular dysfunction and arrhythmias.[12]

Evidence-based clinical practice recommendations

Current guidelines suggest that the initial workup for patients with syncope should include a complete history and physical exam, orthostatic BP measurement, and an ECG.[4,5,8,10-12,14,18] Health history alone can provide a reasonable explanation of syncopal episodes in 40% to 70% of cases, especially in cases of reflex syncope or orthostatic hypotension.[4,5,12,14]

During the history, the NP should inquire about the details of the syncopal event and assess for associated symptoms including chest pain, shortness of breath, and abdominal complaints. This should include how many syncopal episodes they have experienced, and the amount of time they have been experiencing them. The history should also assess for new medications such as beta-blockers, nitrates, diuretics, or antiarrhythmics as possible contributors.[4,19] Medical history, especially of cardiac disease, as well as family history should also be evaluated. Family history of SCD is a dangerous predictor.[4] Age is also a factor to consider during the history, in that the etiology of syncope can be identified in over a quarter of patients under age 65 by history alone, as opposed to only 5% of those over age 65.[12] Older patients with syncope often have periods of retrograde amnesia undermining the potential to adequately recall preceding events in history taking.[12] A thorough physical exam including a neurologic and cardiopulmonary exam, which includes evaluation for a murmur, should follow the history.[4,11,15]

Patients with concurrent clinical characteristics suggestive of syncope related to a neurologic etiology may warrant additional imaging, such as a head CT or other neurologic imaging. Associated features suggestive of a neurologic etiology can include symptoms such as confusion, amnesia, focal neurologic deficit, or severe headache, and risk factors include serious head injuries or usage of anticoagulant medications.[9]

All patients that present for syncope evaluation should receive an ECG to evaluate for bundle-branch blocks, prolonged corrected QT interval (QTc), cardiomyopathy patterns, or other abnormalites.[4,11,14,15] Bradycardia, dysrhythmias, and AV blocks should also get additional workup.[4] ECGs together with a history and physical exam can help make the appropriate diagnosis in 63% of cases, with a diagnostic accuracy of 88%.[14] When available, ambulatory ECGs can be invaluable in diagnosing suspected arrhythmias in patients with syncope.[12,19] However, this often requires a significant timeline of usage for sufficient diagnostic yield. Use of a standard Holter monitor for 24 to 48 hours offers useful data in 1% to 5% of cases, whereas use of an insertable cardiac monitor for up to 36 months offers useful data in 30% to 50% of cases.[12]

Lab work may be indicated to rule out various potential causes of syncope in patients who have additional symptoms such as pallor, tachycardia, hypoxia, or tachypnea. This may include a complete blood cell count for anemia or a D-dimer for suspected pulmonary embolism.[11,15] A troponin lab test may also be

indicated, but only when an ECG shows acute ischemic changes.[11] Additional testing can include a tilt-table test, which can further help evaluate for orthostatic or vasovagal syncope.[17]

Older patients typically require further evaluation following syncopal episodes, as additional diagnostics are often indicated including cardiac workups with continuous ECG and BP monitoring, and evaluation of medication changes.[5] Advanced age and cardiovascular comorbidities are independent predictors for poor outcomes, and thus admission.[13,17]

Risk stratification

Risk stratification schemes have been suggested to aid in clinical decision-making. These are primarily focused on ED triage, but can offer practice guidelines in outpatient scenarios as well.[11,12,14,18] The American College of Cardiology (ACC), the American Heart Association (AHA), and Heart Rhythm Society (HRS) produced a guideline for evaluation and management of patients with syncope in 2017 that recommends usage of these schemes, but urges due diligence, as these tools have been tested with specific study populations.[8,9,17,19] This limits generalizability to diverse populations.[12] Clinical judgment by experienced practitioners often performs just as well as risk stratification tools.[12,14,19] Which risk stratification tool is most effective has thus not been established.[12]

The goal of risk stratification is to determine the type of syncope and the patient's risk factors for a future cardiac event.[11,19] This can further be translated into which patients are safe for discharge from an outpatient setting, and which patients require additional inpatient admission and assessment. This is typically performed by categorizing patients into low-risk, intermediate-risk, and high-risk groups.[13,15] Serious outcomes are almost nonexistent in the low-risk group and rare in the intermediate-risk group, compared with the high-risk group.[12,13,15] The ACC/AHA/HRS guideline recommends evaluating both the short-term and long-term risk of patients with syncope. In general, short-term risk involves evaluating the cause of syncope and reversibility of the underlying etiology, whereas long-term risk involves evaluating the efficacy of treatment, as well as underlying disease processes such as cardiac disease or terminal illnesses. Current best evidence-based practice suggests grouping short-term risk data into ED outcomes and up to 30 days following the event, while long-term risk data would take into account up to 1 year of follow-up.

Patients under the age of 50 with no previous history of heart disease, no significant comorbidities related to syncope, and no family history of SCD who present with symptoms consistent with reflex syncope, and have a normal cardiovascular exam and ECG can safely be identified as low-risk.[11,13,15] Most patients with reflex or orthostatic syncope are low-risk.[11,15] Recurring syncope with a typical vasovagal prodrome in younger ages is also considered a low-risk factor, as well as syncope related to dehydration which would indicate orthostatic hypotension, or syncope triggered by head rotation or carotid sinus pressure.[4,11,15] Vasovagal syncope has been shown to have no significant association with mortality based on the Framingham Heart Study, nor does it have significant associated morbidity.[12,14,19] Multiple syncopal episodes over many years shows survivability, and thus a lower mortality/morbidity risk.[12] Greater than 6 syncopal episodes was found to be associated with a negative electrophysiology study in one study, while greater than 4 syncopal episodes in the preceding year was a predictor of psychiatric illnesses such as depression, panic disorder, or substance use disorder in another study.[12] This should not include repeated syncopal episodes over a 6 month period, however. Based on risk stratification, as well as practice guidelines by the ACC/AHA/HRS, patients classified as low-risk are deemed safe for continued evaluation and treatment in the outpatient setting.[17,19]

The goal of risk stratification is to determine the type of syncope and the patient's risk factors for a future cardiac event.

Patients at intermediate risk include those of any age with a history of heart disease, such as heart failure, a low ejection fraction, or a previous MI, that are otherwise in stable condition. These patients may have stable comorbidities related to syncope, but no family history of SCD, and symptoms that are not suggestive of reflex syncope. Furthermore, they should not have any physical findings or ECG abnormalities suggestive of a high-risk condition.[13] Recent syncope is generally more concerning than remote syncope.[12] Long QT syndrome is often a significant, dangerous prognostic characteristic.[12] The ACC/AHA/HRS guideline recommends a structured ED observation protocol for these patients.[17,19] However,

after ED observation and once cleared of any serious medical conditions, these patients can typically be discharged for outpatient follow-up.[15,19]

High-risk patients are patients of any age that exhibit one or more of any high-risk factors, including actively decompensated heart disease such as heart failure, aortic stenosis, coronary artery disease, presence of an implantable cardioverter defibrillator, other actively decompensated comorbidities, or a family history of SCD. Additionally, patients exhibiting one or more high-risk signs or symptoms including syncope during exertion or while supine, palpitations, chest pain, new-onset abdominal pain or headache, strong systolic ejection murmur, or an abnormal ECG showing heart block, inadequate sinus bradycardia, prolonged QTc, or significant ECG change associated with cardiac disease are considered high-risk. Syncope associated with exertion, such as during athletic events, has significantly more worrisome etiology than that of postexertional or nonexertional syncope.[12] Abnormal vital signs including hypotension or bradycardia, general pallor, evidence of bleeding (such as gastrointestinal), anemia, or hypoxia indicative of pulmonary embolism are also high-risk factors.[4,6,11,13,15] Warning signs and symptoms found to be present in a cohort of young patients with SCD included syn-

Comparison of risk stratification tools

Risk Score	Scoring Categories	Scoring	Accuracy	Validation
Canadian Syncope Risk Score[15,22]	-Vasovagal prodromes -History of heart disease -Abnormal BP -Elevated troponin level -Abnormal QRS and QTc on ECG -ED diagnosis of vasovagal versus cardiac syncope	-Scored: -3 to 11 -Scores >4 show high or very high risk of death or serious adverse events within 30 days	-SE = 97.8% -SP = 44.3%	Externally validated in ED setting
FAINT score[15,23]	-History of heart failure -History of cardiac arrhythmia -Initial abnormal ECG -Elevated BNP -Elevated high-sensitivity troponin T	-Scored 0-6 -Scores >0 associated with higher risk of death and serious cardiac outcomes.	-SE = 96.7% -SP = 22.2%	Internally validated, but not externally validated in ED setting
Boston Syncope Rule[16,21]	-ACS symptoms -Worrisome cardiac history -Family history of SCD -Valvular disease -Signs of conduction disease -Volume depletion -Persistent abnormal vital signs -Primary CNS event	-Scored 0-8 -Scores >0 are considered high-risk.	-NPV = 100% -PPV = 44% -SE = 97% -SP = 62%	Externally validated in ED setting
San Francisco Syncope Rule[15,16]	-Abnormal ECG -Dyspnea -Hematocrit <30% -Hypotension (<90 mm Hg) -History of heart failure	-Scored 0-1 -Scores >0 are identified as high-risk.	NPV = 99% PPV = 25% SE = 96% SP = 62%	Externally validated in ED setting
OESIL rule[16,21]	-Abnormal ECG -Age >65 -No prodrome -Cardiac history	-Scored 0-4 -Scores >1 are considered high-risk.	NPV = 99% PPV = 32% SE = 97% SP = 73%	Externally validated in ED setting
$CHADS_2$[16]	-History of heart failure -History of hypertension -Age >75 -History of diabetes -Prior stroke/TIA	-Scored 0-6 -Scores >0 are considered high-risk.	NPV = 93% PPV = 41% SE = 82% SP = 67%	Externally validated in ED setting

ACS = Acute Coronary Syndrome, CNS = Central Nervous System, NPV = Negative Predictive Value, OESIL = Osservatorio Epidemiologico sulla Sincope nel Lazio, PPV = Positive Predictive Value, SCD = Sudden Cardiac Death, SE = Sensitivity, SP = Specificity

cope, dyspnea, chest pain, and palpitations.[12] High-risk patients require inpatient admission for evaluation and treatment.[4,11,17]

Poorly supported but commonly ordered tests

Despite a lack of evidence supporting the practice, patients with syncope often undergo detailed neuroimaging such as CT scans and MRIs, even without neurologic findings. This often leads to unnecessary radiation exposure, increased length of stay, and increased healthcare expenditures with no clear benefit.[8,9] In fact, neuroimaging of more than 1,000 patients who presented to the ED with syncope who did not have neurologic signs or symptoms found no significant neurologic findings in any of these patients.[9,11] The ACC/AHA/HRS guideline states that there is minimal benefit associated with neuroimaging for patients with syncope who do not have neurologic signs or symptoms or head injury.[8,9,17]

Chest X-rays and echocardiograms were additionally found to have low diagnostic yield in patients that do not present with cardiac history, abnormal physical exam, or abnormal ECGs. Echocardiograms, however, are performed in up to 91% of patients presenting with syncope.[8,10,11] Madeira et al. reviewed six studies evaluating the diagnostic yield of echocardiograms in patients with syncope.[10] Of these studies, the percentage of patients with normal cardiac history, physical exam, and ECG who were found to have significant cardiac abnormalities on echocardiogram was 0% in three studies, 2% in two studies, and 4% in one study.[10] As such, an echocardiogram is only indicated in patients with syncope with suspected structural heart disease, abnormal cardiac biomarkers, signs/symptoms suggestive of a cardiac etiology, or abnormal ECG.[10,17] Electrophysiology studies are rarely indicated, and generally only offer useful data in the event of underlying structural heart disease.[12]

Recommendations

Proper utilization of urgent care centers offers a significant potential option for cutting healthcare expenditures through evaluation of syncopal episodes and determination of which patients require additional evaluation. While syncope was initially believed to require significant evaluation in the ED, recent evidence suggests that many patients can be appropriately evaluated and managed in the outpatient setting. If every nonemergent patient that presented to an ED was initially seen in an urgent care center, the healthcare system could save up to $4.4 billion dollars annually.[20] By extension, proper evaluation in an ED fast-track may also achieve significant healthcare cost savings. In fact, syncope alone has been identified as one of the leading diagnoses denied by the Centers for Medicare and Medicaid Services for payment.[1] Syncopal admissions alone cost the healthcare system close to $2.5 billion dollars per year, primarily related to in-depth and broad diagnostic testing completed in an attempt to identify each episode's etiology.[1-3,5,7,13] Much of this cost can be attributed to expensive diagnostic testing with arguably low diagnostic yield.[13,14] A study, including 11 academic EDs in the US, of over 3,500 patients age 60 or older who presented with syncope or presyncope reported significant healthcare costs, with individual test costs ranging from $13.50 for troponin testing ($44,000 total) to $500 for an echocardiogram ($672,000 total) to $5,414 for electrophysiology studies ($238,000 total). When the cost per abnormal test was calculated, there was a large cost increase for most tests—for example, the cost per abnormal troponin test was over $1,000.[7]

Knowing the different risk factors is a significant first step in appropriately managing patients with syncope from an outpatient standpoint. Of note, expert practitioners' clinical judgments perform just as well as a risk stratification tool.[12,14] For providers who are not as comfortable managing patients with syncope, a risk stratification tool can offer guidance to ensure appropriate management. The Boston Syncope Pathway, which has a negative predictive value of almost 100%, has only been validated in an ED setting but is a possible option for risk stratification in the outpatient setting (see *Boston Syncope Pathway*).[4] Other options include the $CHADS_2$ score, the FAINT score, the San Francisco Syncope Rule, Osservatorio Epidemiologico sulla Sincope nel Lazio (OESIL) rule, and the Canadian Syncope Risk Score.[11,16,18,21] The Boston Syncope Rule, OESIL, or the $CHADS_2$ score could be appropriate in outpatient settings if validated for that purpose, as none of these require lab work, and each has a negative predictive value of 93% or greater in ED settings (see *Comparison of risk stratification tools*).[16] Further research should be performed, however, on which tool could best be applied to and validated in an outpatient or urgent care setting.

Patients at low or intermediate risk can likely be safely discharged after a period of observation with appropriate follow-up as evidenced by two separate, large studies called the SEEDS study and EDOSP study.[4,11,13,24,25] This is based on an appropriate and thorough history, physical exam, and screening ECG.[4,11] Without high-risk factors, the cause is likely benign. If the patient is young and has recurrent syncope without high-risk factors, the patient can be scheduled for a nonemergent echocardiogram in an outpatient setting with management inclusive of beta-blockers, compression stockings, or fludrocortisone.[4] While these treatments will not often be initiated in an urgent care setting, with close primary care contact, they can at least be identified and discussed with the primary care provider for future follow-up. Patients with high-risk factors will require additional inpatient evaluation.[4,11] They should be rapidly identified and transferred to the hospital via a safe transport route.[19]

Decreasing unnecessary ED visits for syncope will decrease overall healthcare expenditures and better focus the use of these resources for patients with syncope who are at high risk. Healthcare providers should be advocating for the appropriate utilization of urgent care centers and primary care settings for the initial evaluation of syncope.

Boston Syncope Pathway*

-All patients require an orthostatic BP measurement.
-Positive tests indicate the potential need for a cardiology consult or hospital admission.

Signs or symptoms of acute coronary syndrome (ACS)	a. Prodromes: Chest pain, shortness of breath, ECG changes, or signs of cardiac ischemia. b. Workup: Stress testing, stress echocardiogram, and/or admission if obvious signs of cardiac ischemia.
Worrisome cardiac history	a. History of: Coronary artery disease, Q waves on ECG, hypotrophic or dilated cardiomyopathy, congestive heart failure, left ventricular dysfunction, ventricular tachycardia/fibrillation, permanent pacemaker, implantable cardioverter/defibrillator, or prehospital use of antiarrhythmic medication. b. Workup: Echocardiogram and telemetry.
Family history of sudden death	a. Family history (of a first-degree relative) of: Sudden death, hypertrophic cardiomyopathy, Brugada syndrome, or long QT syndrome. b. Workup: Echocardiogram, telemetry, and ambulatory ECG monitoring.
Valvular heart disease	a. Prodromes: History of heart murmur, or heart murmur on initial examination that has not been recently evaluated (in the past 6 months). b. Workup: Echocardiogram, telemetry, and ambulatory ECG monitoring.
Signs of conduction disease	a. Prodromes: Tachy- or bradyarrhythmia on ECG, QT interval longer than 500 ms, Brugada syndrome, Wolff-Parkinson-White syndrome, multiple syncopal episodes over the last 6 months, palpitations, or syncope occurring during exercise. b. Workup: Telemetry and ambulatory ECG monitoring. Also consider echocardiogram and stress testing.
Volume depletion	a. Prodromes: GI bleeding history or evidence of GI bleeding based on hemoccult stool testing, history of hematocrit <30%, or clinical signs of dehydration that remain uncorrected. b. Rehydrate and/or follow GI bleeding pathway, admit if unable to rehydrate or as indicated.
Greater than 15 minutes of abnormal vital signs without need for interventions	a. Prodromes: Respiratory rate >24, BP <90 mm Hg, oxygen saturation <90%, sinus heart rate <50 or >100 bpm. b. Workup: Telemetry and echocardiogram
Central nervous system symptoms or neurologic concerns†	a. Prodromes: Headache, neurologic symptoms, neurologic deficit, anticoagulation usage b. Workup: Head CT—if CT is found to be abnormal, neurology or neurosurgery consultation is necessary.

Adapted with permission from Oren J. Mechanic, MD, MPH. Based on model of Boston Syncope Pathway.[1]

*Currently only validated for use in ED setting

†Not intended for use with patients with strokes or TIAs

CT = computed tomography, GI = gastrointestinal, bpm = beats per minute

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