

## Things We Do For No Reason: Echocardiogram in Unselected Patients with Syncope

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The “Things We Do for No Reason” (TWDFNR) series reviews practices that have become common parts of hospital care but which may provide little value to our patients. Practices reviewed in the TWDFNR series do not represent “black and white” conclusions or clinical practice standards, but are meant as a starting place for research and active discussions among hospitalists and patients. We invite you to be part of that discussion.

Syncope is a common cause of emergency department (ED) visits and hospitalizations. Echocardiogram is frequently used as a diagnostic tool in the evaluation of syncope, performed in 39%-91% of patients. The diagnostic yield of echocardiogram for detecting clinically important abnormalities in patients with a normal history, physical examination, and electrocardiogram (ECG), however, is extremely low. In contrast, echocardiograms performed on patients with syncope with a positive cardiac history, abnormal examination, and/or ECG identify an abnormality in up to 29% of cases, though these abnormalities are not always definitively the cause of symptoms. Recently updated clinical guidelines for syncope management from the American College of Cardiology now recommend echocardiogram only if initial history or examination suggests a cardiac etiology, or the ECG is abnormal. Universal echocardiography in patients with syncope exposes a significant number of patients to unnecessary testing and cost and does not represent evidence-based or high-value patient care.

### CLINICAL SCENARIO

A 57-year-old woman presented to the ED after a syncopal episode. She had just eaten dinner when she slumped over and became unresponsive. Her husband estimated that she regained consciousness 30 seconds later and quickly returned

to baseline mental status. She denied chest pain, shortness of breath, or palpitations. Her medical history included hypertension and hypothyroidism. Her medication regimen was unchanged.

Vital signs, including orthostatic blood pressures, were within normal ranges. A physical examination revealed regular heart sounds without murmur, rub, or gallop. ECG showed normal sinus rhythm, normal axis, and normal intervals. Chest radiograph, complete blood count, chemistry, pro-brain natriuretic peptide (pro-BNP), and troponin were within normal ranges.

### BACKGROUND

Syncope, defined as “abrupt, transient, complete loss of consciousness, associated with inability to maintain postural tone, with rapid and spontaneous recovery,”<sup>1</sup> is a common clinical problem, accounting for 1% of ED visits in the United States.<sup>2</sup> As syncope has been shown to be associated with increased mortality,<sup>3</sup> the primary goal of syncope evaluation is to identify modifiable underlying causes, particularly cardiac causes. Current guidelines recommend a complete history and physical, orthostatic blood pressure measurement, and ECG as the initial evaluation for syncope.<sup>1</sup> Echocardiogram is a frequent additional test, performed in 39%-91% of patients.<sup>4-8</sup>

### WHY YOU MAY THINK ECHOCARDIOGRAM IS HELPFUL

Echocardiogram may identify depressed ejection fraction, a risk factor for ventricular arrhythmias, along with structural causes of syncope, including aortic stenosis, pulmonary hypertension, and hypertrophic cardiomyopathy.<sup>9</sup> Structural heart disease is the underlying etiology in about 3% of patients with syncope.<sup>10</sup>

Prior guidelines stated that “an echocardiogram is a helpful screening test if the history, physical examination, and ECG do not provide a diagnosis or if underlying heart disease is suspected.”<sup>11</sup> A separate guideline for the appropriate use of echocardiogram assigned a score of appropriateness on a 1-9 scale based on increasing indication.<sup>12</sup> Echocardiogram for syncope was scored a 7 in patients with “no other symptoms or signs of cardiovascular disease.”<sup>12</sup> Only 25%-40% of patients with syncope will have a cause identified after the history, physical examination, and ECG,<sup>13,14</sup> creating diagnostic uncertainty that often leads to further testing.

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Additional Supporting Information may be found in the online version of this article.

Received: April 7, 2017; Revised: June 24, 2017;

Accepted: June 26, 2017

Published online first October 18, 2017.

2017 Society of Hospital Medicine DOI 10.12788/jhm.2864

**TABLE.** Studies Reporting Transthoracic Echo Results in Patients with Syncope and Normal ECG, History, and Physical Examination<sup>a</sup>

| Lead Author           | Year | Study Design         | Population (n)   | Setting  | Methods  | Definition of Abnormal ECG  | Outcome Measures  | Results   |
|-----------------------|------|----------------------|--|--|--|---|---|---|
| Recchia <sup>4</sup>  | 1995 | Retrospective Cohort | Adult patients admitted to the hospital for syncope over 6-month period (128 patients; 38 with normal history, exam, and ECG had TTE)  | Single tertiary care center in Midwest                   | Charts reviewed for all patients admitted with syncope. Excluded patients with:<br>Near-syncope<br>Known cause of syncope<br>Seizure<br>Prior syncope referred for electrophysiological testing  | Q waves<br>Bundle branch block<br>PVC<br>Arrhythmia<br>Mobitz II or higher                            | TTE with findings that explained syncope  | 0/38 TTE results explained syncope  |
| Sarasin <sup>15</sup> | 2002 | Prospective Cohort   | Adult patients presenting to the ED with unexplained syncope after initial history, physical, and ECG who underwent echocardiogram over 18-month period (155 patients, 67 with normal history and ECG) | Single university ED in Switzerland                      | All patients underwent TTE, carotid massage, 24-hour Holter monitor, tilt-table testing, and electrophysiology testing if indicated. Those with vs without abnormal initial ECG and/or cardiac history were compared.  | Arrhythmia<br>Any nondiagnostic finding except nonspecific ST and T wave changes                      | TTE with diagnostic findings for syncope<br>Severe AS<br>HOCM<br>Severe PAH<br>Myxoma or thrombus with outflow obstruction  | 0/67 patients with normal history and ECG had a relevant abnormality on TTE; 24/88 patients with abnormal history and/or ECG had abnormal TTE   |
| Mendu <sup>5</sup>    | 2009 | Retrospective Cohort | Consecutive adults older than 65 admitted for syncope over 5-year period (2106 admissions)   | Single tertiary care center in Northeast                 | Charts reviewed for all diagnostic tests performed on consecutive elderly patients hospitalized with syncope. Patients were stratified as positive (n = 807) or negative (n = 1299) for the SFSR; positive if patient had congestive heart failure, hematocrit <30%, abnormal ECG, shortness of breath, or systolic blood pressure <90 mmHg. | Not defined   | Diagnostic test results that affected management or determined etiology of syncope  | 821/2109 patients (39%) had echo. 10/488 (2%) of those negative for SFSR had echo that affected management, 4 (1%) had result that determined etiology. 26/333 (8%) of those positive for SFSR had echo that affected management and 9 (3%) had result that determined etiology |
| Anderson <sup>6</sup> | 2012 | Retrospective Cohort | Adults admitted to ED observation unit over 18-month period (323 patients; 267 with normal ECG, 235 of whom had TTE)   | Single urban, university-affiliated ED in North Carolina | Charts reviewed for consecutive patients admitted to a syncope observation unit. Patients could not enter unit with any of the following:<br>Unstable VS<br>New ECG ischemic changes + Cardiac markers<br>Abnormal neurologic exam<br>Trauma<br>Seizures<br>Abnormal CT head<br>Acute GI bleed   | Arrhythmias<br>PACs or PVCs<br>Pacing<br>Second- or third-degree AV block<br>Left bundle branch block | Structural abnormalities on TTE<br>Moderate to severe valvular regurgitation, stenosis, or diastolic dysfunction<br>Severe LVH<br>EF <45%<br>Septal wall motion abnormalities | 0/235 of those with normal ECG and TTE done had an abnormality; 7/35 of those with abnormal ECG and TTE done had an abnormality   |

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## WHY ECHOCARDIOGRAM IS NOT NECESSARY IN ALL PATIENTS

Several studies have found that transthoracic echocardiogram has an extremely low diagnostic yield in patients with no cardiac history and a normal physical examination and ECG<sup>4,8,15</sup> (Table). A prospective study by Sarasin et al.<sup>15</sup> identified 155 patients with unexplained syncope after an initial ED evaluation. All patients underwent echocardiogram, carotid massage, 24-hour Holter monitor, tilt-table testing, and electrophysiology testing if indicated. Patients were stratified by the presence of ECG abnormalities, de-

defined as any arrhythmia or finding other than nonspecific ST and T wave abnormalities, or abnormal cardiac history, defined as documented coronary artery disease, valvular disease, or cardiomyopathy. None of the 67 patients with normal ECG and a negative cardiac history had findings on echocardiogram to explain syncope.

Recchia et al.<sup>4</sup> performed a retrospective review of 128 patients admitted to a single center with syncope. Charts were reviewed for abnormal cardiac history, including coronary artery disease and congestive heart failure, and ECG abnormalities, defined as Q waves, any bundle branch block,

**TABLE. Studies Reporting Transthoracic Echo Results in Patients with Syncope and Normal ECG, History, and Physical Examination<sup>a</sup> (continued)**

| Lead Author        | Year | Study Design         | Population (n)  | Setting                                    | Methods  | Definition of Abnormal ECG  | Outcome Measures   | Results   |
|--------------------|------|----------------------|---|--|--|---|--|---|
| Chang <sup>7</sup> | 2016 | Retrospective Cohort | Adult patients admitted to hospital for syncope over 1-year period (468 patients; 321 with normal ECG, 192 of whom had TTE)         | Single tertiary care hospital in Northeast | Charts reviewed for all patients admitted with syncope. Those with normal vs abnormal ECG were compared.   | Arrhythmias<br>Q waves<br>Ischemic changes<br>Second- or third-degree AV block<br>Paced rhythm<br>QTc >500<br>Left bundle branch block<br>Bifascicular block<br>Abnormal axis | TTE with abnormal findings<br>EF <45%<br>Severe PAH<br>Moderate to severe regurgitation or stenosis<br>Severe LVH<br>Wall motion abnormalities<br>HOCM with outflow obstruction<br>Tamponade | 8/192 patients with normal ECG and TTE done had a new abnormality (all were EF <45% and did not clearly explain syncope); 27/93 patients with abnormal ECG and TTE done had abnormality |
| Han <sup>8</sup>   | 2017 | Retrospective Cohort | Adults presenting to ED for syncope over 1-year period (241 patients; 126 with none of predefined risk factors, 47 of whom had TTE) | Tertiary care ED in South Korea            | Consecutive patients with syncope were evaluated for following risk factors:<br>Prodromal chest pain or palpitations<br>Prior cardiac history<br>Abnormal CK-MB and/or BNP<br>Abnormal ECG<br>Outcomes were compared for those with vs without risk factors. | Sinus bradycardia<br>Arrhythmias<br>PAC or PVCs<br>Second- or third-degree AV block<br>LVH<br>Q waves<br>Ischemia related ST and T wave abnormalities<br>QTc prolongation     | TTE with abnormal findings:<br>Moderate to severe regurgitation, stenosis, or diastolic dysfunction<br>HOCM with outflow obstruction<br>PAH<br>Wall motion abnormalities                     | 1/47 patients without risk factors had abnormal TTE; 27/97 patients with risk factors had abnormal TTE  |

<sup>a</sup>The studies by Anderson et al. and Chang et al. evaluated only for normal versus abnormal ECG.

NOTE: Abbreviations: AS, aortic stenosis; AV, atrioventricular; BNP, brain natriuretic peptide; CK-MB, creatine kinase-MB; CT, computed tomography; ECG, electrocardiogram; ED, emergency department; EF, ejection fraction; GI, gastrointestinal; HOCM, hypertrophic obstructive cardiomyopathy; LVH, left ventricular hypertrophy; PAC, premature atrial contraction; PAH, pulmonary arterial hypertension; PVC, premature ventricular contraction; QTc, corrected QT interval; SFSR, San Francisco Syncope Rule; TTE, transthoracic echocardiogram; VS, vital signs.

ventricular ectopy/arrhythmia, supraventricular arrhythmia, or Mobitz II or higher atrioventricular block. Of the 38 patients with a normal cardiac history, examination, and ECG who underwent echocardiogram, none had findings that explained syncope.

Mendu et al.<sup>5</sup> performed a single-center, retrospective study of the diagnostic yield of testing for syncope in 2106 consecutive patients older than 65 admitted over the course of 5 years. They retrospectively applied the San Francisco Syncope Rule (SFSR), which patients met if they had congestive heart failure, hematocrit <30%, abnormal ECG, shortness of breath, or systolic blood pressure <90 mm Hg. There were 821 patients (39%) who underwent echocardiogram. Among the 488 with no SFSR criteria, 10 patients (2%) had echocardiogram results that affected management, and 4 patients (1%) had results that helped determine the etiology of syncope.

Anderson et al. studied 323 syncope patients in a single ED observation unit over 18 months.<sup>6</sup> Patients with high-risk features, including unstable vital signs, abnormal cardiac biomarkers, or ischemic ECG changes, were excluded from the unit. The initial ECG was considered abnormal if it contained arrhythmia, premature atrial or ventricular contractions, pacing, second- or third-degree heart block, or left bundle branch block. Of the 235 patients with a normal ECG who underwent echocardiogram, none had an abnormal study.

Chang et al.<sup>7</sup> performed a retrospective review of 468 patients admitted with syncope at a single hospital. Charts were reviewed for ECG and echocardiogram results. Abnormal ECGs were defined as those containing arrhythmias, Q waves, ischemic changes, second- and third-degree heart block, paced rhythm, corrected QT interval (QTc) >500 ms, left bundle branch or bifascicular block, Brugada pattern, or abnormal axis. Among 321 patients with normal ECGs, echocardiograms were performed in 192. Eleven of those echocardiograms were abnormal: 3 demonstrated aortic stenosis in patients who already carried the diagnosis, and the other 8 abnormal echocardiograms revealed unexpected left ventricular ejection fractions <45% or other nonaortic valvular pathology. None of the findings were felt to be the cause of syncope.

Han et al.<sup>8</sup> performed a retrospective cohort study of all syncope patients presenting to a single ED over the course of 1 year. Patients were stratified as high risk if they had chest pain, palpitations, a history of cardiac disease (defined as prior arrhythmia, heart failure, coronary artery disease, or structural heart disease), abnormal cardiac biomarkers, or an abnormal ECG (defined as sinus bradycardia, arrhythmia, premature beats, second- or third-degree heart block, ventricular hypertrophy, ischemic Q or ST changes, or abnormal QT interval). Patients with none of those symptoms or findings were considered low risk. Of those categorized as

low risk (n = 115), 47 underwent echocardiogram, only 1 of which was abnormal.

Across studies, the percentage of patients with a normal cardiac history, examination, and ECG with new, significant abnormalities on echocardiogram was 0% in 3 studies (n = 340),<sup>4,6,15</sup> 2% in 1 study (10/488 patients),<sup>5</sup> 2.1% in 1 study (1/47 patients),<sup>8</sup> and 4.2% in 1 study (8/192 patients).<sup>7</sup> The 11 echocardiograms with significant findings in the studies by Mendu et al.<sup>5</sup> and Han et al.<sup>8</sup> were not further described. The 8 patients with abnormal echocardiograms reported by Chang et al.<sup>7</sup> had depressed left ventricular ejection fraction or nonaortic valvular disease that did not represent a definitive etiology of their syncope. Given the cost of \$1,000 to \$2,220 per study,<sup>16</sup> routine echocardiograms in patients with a normal history, examination, and ECG would thus require \$60,000 to \$132,000 in spending to find 1 new significant abnormality, which may be unrelated to the actual cause of syncope.

### SITUATIONS IN WHICH ECHOCARDIOGRAM MAY BE HELPFUL

The diagnostic yield of echocardiogram is higher in patients with a positive cardiac history or abnormal ECG. In the prospective study by Sarasin et al.<sup>15</sup> a total of 27% of patients with a positive cardiac history or abnormal ECG were found to have an ejection fraction less than or equal to 40%. Other studies reporting percentages of abnormal echocardiograms in patients with abnormal history, ECG, or examination found rates of 8% (26/333),<sup>5</sup> 20% (7/35),<sup>6</sup> 28% (27/97),<sup>8</sup> and 29% (27/93).<sup>7</sup> It should be noted that not all of these abnormalities were felt to be the cause of syncope. For example, Sarasin et al.<sup>15</sup> reported that only half of the patients with newly identified depressed ejection fraction were diagnosed with arrhythmia-related syncope. Chang et al.<sup>7</sup> reported that 6 of the 27 patients (22%) with abnormal ECG and echocardiogram had the cause of syncope established by echocardiogram.

Finally, some syncope patients will have cardiac biomarkers sent in the ED. Han et al.<sup>8</sup> found that among patients with syncope, those with abnormal versus normal echocardiogram were more likely to have elevated BNP (70% vs 23%) and troponin (36% vs 12.4%). Thus, obtaining an echocardiogram in patients with syncope and abnormal cardiac biomarkers may be reasonable. It should be noted, however, that while some studies have suggested a role for biomarkers in differentiating cardiac from noncardiac syncope,<sup>17-20</sup> current guidelines state that the usefulness of these tests is uncertain.<sup>1</sup>

### WHAT YOU SHOULD DO INSTEAD OF ECHOCARDIOGRAM FOR ALL PATIENTS

Clinicians should carefully screen patients with syncope for abnormal findings suggesting cardiac disease on history, physical examination, and ECG. Relevant cardiac history includes known coronary artery disease, valvular heart disease, arrhythmia, congestive heart failure, and risk factors for cardiac syncope (supplemental Appendix). The defini-

tion of abnormal ECG varies among studies, but abnormalities that should prompt an echocardiogram include arrhythmia, premature atrial or ventricular contractions, second- or third-degree heart block, sinus bradycardia, bundle branch or fascicular blocks, left ventricular hypertrophy, ischemic ST or T wave changes, Q waves, or a prolonged QTc interval. New guidelines from the American College of Cardiology state, "Routine cardiac imaging is not useful in the evaluation of patients with syncope unless cardiac etiology is suspected on the basis of an initial evaluation, including history, physical examination, or ECG."<sup>1</sup>

### RECOMMENDATIONS

- All patients with syncope should receive a complete history, physical examination, orthostatic vital signs, and ECG.
- Perform echocardiogram on patients with syncope and a history of cardiac disease, examination suggestive of structural heart disease or congestive heart failure, or abnormal ECG.
- Echocardiogram may be reasonable in patients with syncope and abnormal cardiac biomarkers.

### CONCLUSIONS

While commonly performed as part of syncope evaluations, echocardiogram has a very low diagnostic yield in patients with a normal history, physical, and ECG. The patient described in the initial case scenario would have an extremely low likelihood of having important diagnostic information found on echocardiogram.

*Do you think this is a low-value practice? Is this truly a "Thing We Do for No Reason?" Share what you do in your practice and join in the conversation online by retweeting it on Twitter (#TWDFNR) and liking it on Facebook. We invite you to propose ideas for other "Things We Do for No Reason" topics by emailing TWDFNR@hospitalmedicine.org.*

Disclosure: The authors have no conflicts of interest relevant to this article.

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