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Diagnostic yield of device interrogation in the evaluation of syncope in an elderly population

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ABSTRACT

Background: Device interrogation has become a standard part of the syncope evaluation for patients admitted with permanent pacemakers (PPM) or implantable cardiac defibrillators (ICD), although few studies have shown interrogation yields clinically useful data. The purpose of this study is to determine the diagnostic yield of device interrogation as well as other commonly performed tests in the workup of unexplained syncope in patients with previously implanted PPMs or ICDs.
Methods: We retrospectively reviewed records of 88 patients admitted to our medical center for syncope with previously implanted pacemakers between January 1, 2005 and January 1, 2015 using ICD-9 billing data.
Results: Pacemaker interrogation demonstrated an arrhythmia as the cause for syncope in 4 patients (4%) and evidence of device failure secondary to perforation in 1 patient (1%). The cause of syncope was unknown in 34 patients (39%). Orthostatic hypotension was the most commonly identified cause of syncope (26%), followed by vasovagal syncope (13%), autonomic dysfunction (5%), ventricular arrhythmia (3%), atrial arrhythmia (2%), congestive heart failure (2%), stroke (2%), and other less common causes (8%). History was the most important determinant of syncope (36%), followed by orthostatic vital signs (14%), device interrogations (4%), head CT (2%), and transthoracic echocardiogram (1%).
Conclusions: Device interrogation is rarely useful for elucidating a cause of syncope without concerning physical exam, telemetry, or EKG findings. Interrogation may occasionally yield paroxysmal arrhythmias responsible for syncopal episode, but these rarely alter clinical outcomes. Interrogation appears to be more useful in patients with syncope after recent device placement.

1. Introduction

Syncope, defined as the transient and abrupt loss of consciousness due to inadequate cerebral perfusion, accounts for up to $2.4 billion in Medicare expenditures, with an average cost of hospitalization of $5000 [1,2]. Given an expansive differential diagnosis, physicians often order numerous tests with low diagnostic yield [3–6]. Several studies have found that commonly performed tests, in particular electrocardiograms, telemetry, cardiac enzymes, head CT, and carotid ultrasounds, rarely lead to a definitive diagnosis or affect patient management [5–8]. In addition to these tests, device interrogation is performed almost universally in patients with ICDs or PPMs to assess for malfunction or new arrhythmias, despite little evidence to suggest its efficacy in the absence of concerning history, physical, or electrocardiogram findings. Only one other study has evaluated the etiology of syncope in patients with PPMs and found malfunction rarely occurs, comprising 4.9% of cases [9]. Furthermore, no study has assessed the utility of ICD interrogation in patients presenting with unexplained syncope. The aim of this study is to determine the diagnostic yield of device interrogation in patients presenting for hospital admission with syncope and prevalence of various causes of syncope among patients with previous device placement.

2. Methods

2.1. Study design and inclusion criteria

The study was approved by the Institutional Review Board of the University of Connecticut Health Center. We examined the electronic medical records of patients admitted to University of Connecticut Health Center between January 1, 2005 and January 1, 2015 with a previously implanted PPM or ICD and a diagnosis of syncope. We identified patient records by querying the billing database using *International Classification of Diseases, Ninth Revision* (ICD-9) code for syncope (780.2) as

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primary or non-primary diagnosis code for inpatient admission, along with ICD-9 codes for presence of pacemaker (V45.01) or the presence of ICD (V45.02) within inpatient or outpatient records. We identified 353 patients using the aforementioned ICD-9 criteria. After reviewing the records of all patients, 265 patients were excluded for the following reasons: syncope led to device placement during that admission (181 patients), syncope prior to device placement (32 cases), no description of syncopal episode in discharge summary (45 cases), no device interrogation on record (5 cases) and ICD discharge as presenting symptom (2 cases). As we sought to assess the utility of device interrogation for unexplained syncope, patients with ICD discharge at presentation were excluded from the study as the presumptive etiology of syncope is a ventricular arrhythmia and device interrogation is the standard of care. Eighty-eight patients met criteria for inclusion in the study. If patients were admitted multiple times for syncope, only the most recent discharge summary was used for analysis.

2.2. Data collection

A standardized data collection form was used to abstract data from patient records. Data was abstracted from discharge summaries, cardiology notes, electrophysiology notes, device interrogation reports, laboratory results, and imaging reports. Collected data included patient age and gender, duration of hospitalization, prior history of syncope, admission chief complaint, estimated duration of syncopal episode, other medical conditions, orthostatic findings, and cardiac enzymes. Other collected information included findings from head CT, transthoracic echocardiogram (TTE), carotid Doppler, and computed-tomography angiogram (CTA) of the chest. For each patient, results from any device interrogation during the admission were recorded. We recorded the presence of arrhythmia during the syncopal episode, type of arrhythmia, and whether there was lead malfunction, depleted battery, ICD discharge, or changes to pacemaker settings. Etiology of syncope was ascertained from discharge summary. If a definitive diagnosis was not suggested in the discharge summary, the cause was recorded as unknown. The component of the history, physical exam, or test result that lead to the diagnosis was recorded for each patient.

2.3. Statistical analysis

Statistical analysis was performed using Microsoft Excel. Yields were reported as percentages. 30 records were re-reviewed blindly and compared to previously collected results to assess for inter-rater reliability.

3. Results

3.1. Patient characteristics

Characteristics for the 88 patients included in the study are presented in Table 1. Median age for our cohort of patients was 84 (±10.3) years, with ages ranging from 39 to 99. Fifty-eight percent of patients were male and 56% had a history of syncope prior to admission. Seventy-three percent of patients in the study had a PPM, while the remaining 27% had an ICD. The most common reasons for device implant were sinus node disease (57%), followed by AV nodal disease (31%), ventricular arrhythmia (7%), primary prevention for cardiomyopathy (5%), and cardiac resyncronization therapy (1%). The most common other medical conditions affecting patients were hypertension (53%), coronary artery disease (46%), structural heart disease (43%), and heart failure (42%). Of particular note, some patients had previous medical history which helped elucidate the etiology of syncope, including history of prior stroke or transient ischemic attack (15%), aortic stenosis (6%), and autonomic dysfunction (4%).

Table 1
Characteristics of patients included in the study ($n = 88$).

Median age	84 ± 10.3
Male	58%
Female	42%
Prior history of syncope	56%
Device characteristics	**N (%)**
Pacemaker	64 (73)
ICD	24 (27)
Reason for device implant	**N (%)**
Sinus node disease[a]	50 (57)
AV node disease[b]	27 (31)
Ventricular arrhythmia	6 (7)
Primary prevention for cardiomyopathy	4 (5)
Cardiac resynchronization therapy	1 (1)
Other medical conditions	**N (%)**
Hypertension	49 (53)
Coronary artery disease	43 (46)
Structural heart disease	40 (43)
Heart failure	39 (42)
Hyperlipidemia	35 (38)
Diabetes mellitus	23 (25)
Dementia	19 (20)
Prior stroke/transient ischemic attack	14 (15)
Hypothyroidism	11 (12)
Cancer	9 (10)
Aortic stenosis	6 (6)
Autonomic dysfunction	4 (4)

[a] Includes sick sinus syndrome, tachy-brady syndrome, and non-specific bradycardia.
[b] Includes 1st degree heart block, 2nd degree heart block, trifascicular block, and complete heart block.

3.2. Diagnostic testing

Tests for syncope were performed based on patient's presentation and history at the discretion of the admitting team. Non-contrast head computed-tomography was performed in 55 patients (63%), yielding 3 abnormal results (5%). Two abnormal results were secondary to stroke and 1 secondary to subdural hemorrhage. Carotid Doppler was performed in 11 patients (12%), and did not yield abnormal results in any patients. Transthoracic echocardiogram (TTE) was performed in 51 patients (58%), with newly abnormal results in 4 patients (8%). TTE was critical in establishing etiology of syncope in 2 patients, including one patient with a pericardial effusion from a perforated right ventricular lead after recent device implant and another patient with critical aortic stenosis. CT angiogram of the chest was performed in 6 patients (6%), identifying pulmonary embolism in 2 patients (33%). Pulmonary embolism led to syncope in one patient and was an incidental in the other patient.

3.3. Device interrogation

Results from device interrogations are presented in Table 2. Fourteen device interrogations (16%) yielded arrhythmias. Of these arrhythmias, 4 (29%) occurred during a syncopal event, whereas 10 (71%) were not temporally related to the syncopal episode. The following arrhythmias occurred during syncopal events: 2 atrial arrhythmias with ventricular high-rate (1 atrial fibrillation and 1 atrial flutter) and 2 ventricular arrhythmias (1 sustained rapid polymorphic ventricular tachycardia and 1 monomorphic ventricular tachycardia). Only 1 of the 4 arrhythmias altered clinical management. Specifically, the patient with sustained polymorphic ventricular tachycardia had an implanted PPM that was replaced with an ICD during the same hospitalization. This patient did not have evidence of structural heart disease before or during the hospitalization. The following arrhythmias identified from interrogation were

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