ORIGINAL INVESTIGATION

Diagnostic Patterns and Temporal Trends in the Evaluation of Adult Patients Hospitalized With Syncope

Luis A. Pires, MD; Jangadeesh R. Ganji, MD; Regina Jarandila, RN; Robert Steele, MD

Background: Syncope is a common clinical problem that is often difficult and expensive to diagnose. We examined diagnostic patterns and trends and use of specialty consultations in the evaluation of syncope.

Methods: We retrospectively reviewed the medical records of consecutive adult patients hospitalized with the principal diagnosis of syncope (*International Classification of Diseases, Ninth Revision,* code 780.2) during 1994 and 1998 at 2 community teaching hospitals.

Results: A total of 649 patients (57% female) with a mean (±SD) age of 68 ± 15 years were identified in 1994 (n = 451) and 1998 (n = 198). Three hundred forty-one patients (53%) underwent at least 1 neurologic test, including brain computed tomographic (CT) scan (n = 283), electroencephalography (n = 253), carotid Doppler echocardiography (n = 185), and brain magnetic resonance imaging (n = 10). Only brain CT scan and electroencephalography yielded diagnoses in 5 (2%) and 6 patients (2%), respectively with history consistent with seizures or stroke. Cardiovascular tests providing the highest diagnostic yields (postural blood pressure check in 52 [30%], head-up tilt-table test in 32 [24%], and electrophysiologic study in 5 [16%]) were used in 176 (27%), 132 (20%), and 31 patients (5%), respectively. Differences in the use of some tests were noted at the participating hospitals and over time (1994 vs 1998). The total number of diagnosed cases was similar for patients undergoing evaluation by primary care physicians alone (65/103 [63%]), compared with cardiology (48/85 [56%]), neurology (29/48 [60%]), or both (81/141 [57%]). After a mean (±SD) length of stay of 5 ± 4 days, 320 (49%) of 649 cases remained undiagnosed.

Conclusions: Despite a reduction in the use of some tests (eg, brain CT scan and carotid Doppler) over time, lower-yield neurologic tests were overused and higher-yield cardiovascular tests were likely underused. The untargeted, seemingly random use of specialty evaluations did not seem to contribute to an increase in the overall number of diagnosed cases. Increased use of specific tests directed by history and results of physical examination may improve diagnostic yield and decrease the cost of evaluating syncope.

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From the Division of Cardiology, Department of Medicine, St John Hospital and Medical Center, Sinai-DMC, and Wayne State University School of Medicine, Detroit, Mich.

SYNCOPE, DEFINED as sudden loss of consciousness and postural tone from which the patient recovers spontaneously, is common,[1,2] often disabling,[3] potentially life threatening,[4] and difficult and expensive to diagnose.[5,6] Data from the early 1980s showed that in nearly half of these patients, the cause of syncope is not determined after initial, often extensive, investigations.[1,4-8] More recently, the use of the head-up tilt-table (HUTT) test and electrophysiologic study (EPS) has reduced the proportion of undiagnosed cases to 10% to 26%.[9-11] However, these tests are useful only in properly selected cases and are best guided by a careful history and results of physical examination.[12,13] The undirected use of any of the available diagnostic tests is generally of low yield and not cost-effective. For instance, for many years routine neurologic testing has been a mainstay in the evaluation of syncope, although such tests (eg, electroencephalography [EEG]) are rarely helpful in those without focal neurologic signs or a history suggestive of seizure.[1,5,14] Given the high prevalence of syncope[1,2] and its economic impact,[6,15,16] a cost-effective evaluation is highly desirable. However, despite expert recommendations,[6,12-14] it is unclear whether the diagnostic approach of patients with syncope has changed significantly.

The goals of this study were to assess patterns, temporal trends, and results of specialty consultations in the examination of consecutive adult patients hospitalized with the diagnosis of syncope at 2 community teaching hospitals during 1994 and 1998.

PATIENTS AND METHODS

PATIENT POPULATION

Included in this study were consecutive adult patients (aged ≥18 years) with the principal diagnosis of syncope admitted during two 12-month periods (1994 and 1998) to 2 community teaching hospitals with separate staff except for cardiac electrophysiology. Patients were identified through a retrospective review of medical records of all patients who were assigned a principal diagnosis of syncope (*International Classification of Diseases, Ninth Revision,* code 780.2) at the time of admission. Patients undergoing initial evaluation at another institution and transferred for a specific predetermined diagnostic test (eg, EPS) were excluded.

DATA ANALYSIS

Diagnostic tests and procedures, including frequency of use and diagnostic yields, and the use of specialty evaluations (cardiovascular and neurologic) were obtained directly from the patients' medical records. A test or procedure was considered diagnostic when the result, alone or combined with the history of the patient's syncope, explained the cause of syncope. We used documented details about the patients' history and results of physical examination with the results of diagnostic tests to arrive at the final diagnoses, based on previously described criteria[1,4] and presented in the following 4 broad categories[8]: vasovagal/psychogenic, neurologic, cardiac (arrhythmic and mechanical), and drug/metabolic. Vasovagal syncope was diagnosed in patients with typical prodromal symptoms and/or a positive HUTT finding.[17] A psychogenic diagnosis (eg, hysteria) required confirmation by a psychiatric consultant. Neurologic causes of syncope required specific clinical presentations plus confirmation by a staff neurologist. For seizure, the patient had to have had witnessed seizurelike activities and/or postictal states, with or without a positive EEG finding, and focal findings on examination in case of stroke/transient ischemic attack. Arrhythmic syncope was based on documented (eg, symptomatic arrhythmia recorded using telemetry monitoring) or presumed (eg, induced sustained ventricular tachycardia during EPS) arrhythmic events. Mechanical cardiac causes of syncope (eg, aortic stenosis) and acute myocardial infarction required compatible clinical presentations plus supportive documentation, eg, typical echocardiographic features and elevations in cardiac enzyme levels, respectively. Drug/metabolic causes of syncope included, eg, severe hypoglycemia, alcohol intoxication, or orthostatic hypotension. Orthostatic hypotension was implicated as the cause of syncope when there was a decrease in systolic blood pressure of greater than 20 mm Hg associated with dizziness or syncope, at the patient's bedside or during HUTT.

To evaluate practice patterns between hospitals, we compared the results among patients hospitalized in 1994 at Sinai-DMC and St John Hospital, Detroit, Mich. In assessing practice trends, we compared the findings from patients admitted in 1994 vs 1998 at St John Hospital only.

Numerical data were compared by t, χ^2, or Fisher exact test, and data are presented as mean±SD. $P<.05$ was considered statistically significant.

RESULTS

PATIENT CHARACTERISTICS

A total of 649 patients were identified during the 1994 (n=451) and 1998 (n=198) periods. In 1994, 252 patients were admitted at Sinai-DMC and 199 at St John Hospital; in 1998, 198 patients were hospitalized at St John Hospital. The patients' clinical characteristics are shown in **Table 1**. Patients undergoing evaluation at St John Hospital in 1994 and 1998 were older, on average, than those admitted at Sinai-DMC in 1994 (71 vs 62 years; $P<.01$) and had a higher incidence of coronary artery disease (36% [1994] and 34% [1998] vs 20%; $P<.01$); otherwise the patient groups shared similar clinical characteristics (Table 1).

FREQUENCY AND RESULTS OF DIAGNOSTIC TESTS

Table 2 depicts the types, frequency, and results of neurologic and cardiovascular diagnostic tests and procedures used in the evaluations in all 649 patients. Three hundred forty-one (53%) patients underwent at least 1 neurologic test, including brain CT scan, EEG, carotid Doppler, and brain magnetic resonance imaging (MRI) in 283 (44%), 253 (39%), 185 (29%), and 10 patients (2%), respectively. These tests identified some type of abnormalities in 31 (11%), 44 (17%), 19 (10%), and 3 cases (30%), respectively. Abnormal findings on brain CT scan (atrophy in 11, old infarct in 15, and acute infarct in 5), EEG (generalized or focal slowing in 38 and epileptiform discharge in 6), carotid Doppler (≥70% arterial stenosis in 19), and brain MRI (nonspecific atrophy in 3) were not diagnostic in any of the patients whose clinical presentations were inconsistent with stroke/transient ischemic attack or seizure (Table 2).

When we included continuous telemetry (performed in all patients), all of the 649 patients underwent at least 1 cardiovascular test, accounting for an average of 2.2 tests per patient. Continuous telemetry (649 [100%]), Holter monitoring (193 [30%]), and echocardiography (277 [43%]) yielded diagnoses in only 7 (1%), 6 (3%) and 3 cases (1%), respectively (Table 2). Postural blood pressure (BP) check, HUTT, and EPS were performed less frequently (in 27%, 20%, and 5% of patients, respectively), but the findings were more often abnormal (and diagnostic), ie, in 43% (30%), 31% (24%), and 45% (16%) of patients, respectively (Table 2). Stress testing and cardiac catheterization, performed generally to rule out ischemia in 10% and 2% of patients, respectively, yielded no definitive diagnosis (Table 2). Carotid sinus pressure, performed in 24 of 31 cases during EPS, was nondiagnostic in all cases; in the remaining 625 patients (96%), the procedure was not performed or the results were not recorded.

In addition, all 649 patients underwent routine blood tests, chest roentgenography, and electrocardiography.

Table 1. Clinical Characteristics of the Study Patients*

	Total (N = 649)	1994		1998, St John Hospital (n = 198)
		Sinai-DMC (n = 252)	St John Hospital (n = 199)	
Mean age, y	68 ± 15	62 ± 18	71 ± 16	71 ± 14
Male	279 (43)	98 (39)	89 (45)	92 (46)
Female	370 (57)	154 (61)	110 (55)	106 (54)
Previous syncope	279 (43)	121 (48)	88 (44)	79 (40)
Receiving ≥1 cardiovascular active drugs†	379 (58)	136 (54)	118 (59)	120 (61)
Medical history				
CAD	190 (29)	51 (20)	71 (36)	68 (34)
Myocardial infarction	46 (7)	20 (8)	11 (6)	5 (3)
Previous CABG	17 (3)	7 (3)	4 (2)	6 (3)
Heart failure	56 (9)	23 (9)	13 (7)	20 (10)
Hypertension	290 (45)	105 (42)	89 (45)	96 (48)
Diabetes	91 (14)	36 (14)	24 (12)	31 (16)
Stroke or TIA	59 (9)	24 (10)	13 (7)	22 (11)
Seizure	25 (4)	11 (4)	6 (3)	8 (4)
Implanted pacemaker	14 (2)	6 (2)	3 (2)	5 (3)

*Unless otherwise indicated, data are given as number (percentage) of patients. CAD indicates coronary artery disease; CABG, coronary artery bypass graft; and TIA, transient ischemic attack. Both hospitals were located in Detroit, Mich.

†Mostly for control of hypertension, angina, and/or heart failure, and excluding anticoagulants.

Table 2. Frequency and Results of Various Diagnostic Tests*

Tests	Frequency	Abnormal Results†	Yield‡
Neurologic, No. (%)			
Brain CT scan	283 (44)	31 (11)	5 (2)§
Electroencephalography	253 (39)	44 (17)	6 (2)§
Carotid Doppler	185 (29)	19 (10)	0
Brain MRI	10 (2)	3 (30)	0
Cardiovascular, No. (%)			
Postural BP check	176 (27)	75 (43)	52 (30)
Continuous telemetry	649 (100)	43 (7)	7 (1)
Holter monitoring	193 (30)	30 (16)	6 (3)
Echocardiography	277 (43)	74 (27)	3 (1)
Stress testing	68 (10)	8 (12)	0
Cardiac catheterization	12 (2)	6 (50)	0
Head-up tilt-table test	132 (20)	41 (31)	32 (24)
Electrophysiologic study	31 (5)	14 (45)	5 (16)

*Tests were used in the evaluation of syncope in the 649 patients hospitalized at both hospitals in 1994 and 1998. CT indicates computed tomographic; MRI, magnetic resonance imaging; and BP, blood pressure.

†Indicates any 1 or more abnormalities among total number of performed tests.

‡Indicates when identified abnormal findings alone explain the cause of syncope, based on the total number of performed tests.

§Among only 34 patients with history and physical examination consistent with acute stroke (n = 20) or seizure (n = 14).

Four patients received a diagnosis of acute myocardial infarction on the basis of elevated cardiac enzyme levels and typical electrocardiographic changes; and 2 patients received a diagnosis of pulmonary embolism on the basis of findings of ventilation-perfusion scans and pulmonary angiography performed in 17 (3%) and 2 patients (0.3%), respectively.

COMPARISON OF EVALUATION PATTERNS BETWEEN HOSPITALS

The results and diagnostic yield of the tests used in the assessment of patients admitted in 1994 at Sinai-DMC (n=252) and St John Hospital (n=199) are compared in **Table 3**. Brain CT scan was used more frequently at St John Hospital than at Sinai-DMC (61% vs 38%; $P<.01$); EEG was used more frequently at Sinai-DMC (46% vs 32%; $P=.01$); but use of carotid Doppler (33% vs 35%; $P=.34$) and brain MRI (0.4% vs 0.5%; $P=.43$) was equivalent at both hospitals. The diagnostic yields of neurologic tests were equally low at both hospitals (Table 3). Among cardiovascular tests, postural BP was determined less frequently (6% vs 41%; $P<.001$) but the findings were more often abnormal (60% vs 37%; $P<.01$) at Sinai-DMC than at St John Hospital; otherwise all tests were equally used and identified comparable abnormal and diagnostic findings among patients at both hospitals (Table 3). The hospital length of stay was longer for patients hospitalized at St John Hospital compared with Sinai-DMC (5.8±4.1 vs 4.5±2.9 days; $P<.01$).

TRENDS IN EVALUATION

Comparisons of diagnostic evaluation and results among patients at St John Hospital in 1994 vs 1998 are shown in **Table 4**. Fewer brain CT scans (33% vs 61%; $P<.01$) and carotid Doppler (17% vs 35%; $P<.01$) were performed in 1998 compared with 1994, but a similar proportion of patients underwent EEG (37% vs 32%), and there was a trend toward an increase in the use of brain MRI (4% vs 0.5%). These tests were of comparably low diagnostic yields in patients undergoing evaluation in 1994 and 1998 (Table 4). A smaller proportion of patients underwent echocardiography (23% vs 51%; $P<.01$) and more underwent Holter monitoring (35% vs 24%; $P<.01$) in 1998 compared with 1994. The other cardiovascular tests, including HUTT and EPS, were used with equal frequencies during both periods, uncovering a comparable number of nonspecific and diagnostic abnormal findings during 1994 and 1998 (Table 4). The length of stay was similar for patients undergoing evaluation in 1994 and 1998 (5.8±4.1 vs 5.2±2.9 days).

FINAL DIAGNOSIS AND USE OF SPECIALTY EVALUATIONS

After a mean length of stay of 5.1±3.6 days (range, 1-28 days), the cause of syncope was established or, in some cases, presumed, in only 329 cases (51%). Among the 329 diagnosed cases, 71 (22%) were vasovagal/psychogenic, 63 (19%) were cardiac (ventricular tachycardia [n=24], supraventricular tachycardia [n=5], bradyarrhythmia [n=21], myocardial infarction [n=8], severe aortic stenosis [n=2], hypertrophic cardiomyopathy [n=1], pulmonary embolism [n=2]), 34 (10%) were neurologic (stroke/TIA [n=20] and seizures [n=14]), and 161 (49%) were drug/metabolic (**Table 5**). The categorical breakdown of causes of syncope reflected the types of specialty evaluations. There were more cardiac

Table 3. Comparison of Diagnostic Tests and Results*

	Sinai-DMC (n = 252)			St John Hospital (n = 199)		
	Frequency	Abnormal Result	Yield†	Frequency	Abnormal Result	Yield†
Neurologic, No. (%)						
Brain CT scan	96 (38)	8 (8)	2 (2)	122 (61)‡	14 (11)	1 (1)
Electroencephalography	116 (46)	8 (7)	2 (2)	64 (32)‡	5 (8)	2 (3)
Carotid Doppler	83 (33)	7 (8)	0	69 (35)	8 (12)	0
Brain MRI	1 (0.4)	0	0	1 (0.5)	0	0
Cardiovascular, No. (%)						
Postural BP check	15 (6)	9 (60)	5 (33)	82 (41)‡	30 (37)	21 (26)
Continuous telemetry	252 (100)	7 (3)	3 (1)	199 (100)	4 (2)	1 (0.5)
Holter monitoring	76 (30)	9 (12)	2 (3)	47 (24)	6 (13)	2 (4)
Echocardiography	129 (51)	22 (17)	2 (2)	102 (51)	52 (51)	1 (1)
Stress testing	22 (9)	2 (19)	0	11 (6)	2 (18)	0
Cardiac catheterization	4 (2)	3 (75)	0	2 (1)	1 (50)	0
Head-up tilt-table test	51 (20)	18 (35)	15 (29)	42 (21)	10 (24)	8 (19)
Electrophysiologic study	6 (2)	3 (50)	1 (17)	10 (5)	5 (50)	2 (20)

*Includes patients hospitalized at Sinai-DMC and St John Hospital, Detroit, Mich, in 1994. Abbreviations are given in the first footnote to Table 2.
†Based on the total number (frequency) of performed tests. *P* values were nonsignificant for all test yields.
‡$P<.05$ comparing frequency of tests.

Table 4. Comparison of Diagnostic Evaluation in Patients by Year*

	1994 (n = 199)			1998 (n = 198)		
	Frequency	Abnormal Result	Yield†	Frequency	Abnormal Result	Yield†
Neurologic, No. (%)						
Brain CT scan	122 (61)	14 (11)	1 (1)	65 (33)‡	9 (14)	1 (2)
Electroencephalography	64 (32)	5 (8)	2 (3)	73 (37)	31 (42)	2 (3)
Carotid Doppler	69 (35)	8 (12)	0	33 (17)	4 (12)	0
Brain MRI	1 (0.5)	0	0	8 (4)	2 (25)	0
Cardiovascular, No. (%)						
Postural BP check	82 (41)	30 (37)	21 (26)	79 (40)	36 (46)	26 (33)
Continuous telemetry	199 (100)	4 (2)	2 (1)	198 (100)	6 (3)	2 (1)
Holter monitoring	47 (24)	6 (13)	2 (4)	70 (35)	15 (21)	2 (3)
Echocardiography	102 (51)	52 (51)	1 (1)	46 (23)‡	20 (43)	0
Stress testing	11 (6)	2 (18)	0	35 (18)	4 (11)	0
Cardiac catheterization	2 (1)	1 (50)	0	6 (3)	2 (33)	0
Head-up tilt-table test	42 (21)	10 (24)	8 (19)	39 (20)	12 (31)	9 (23)
Electrophysiologic study	10 (5)	4 (40)	1 (1)	15 (8)	7 (47)	3 (20)

*Includes patients hospitalized at St John Hospital, Detroit, Mich, in 1994 and 1998. Abbreviations are given in the first footnote to Table 2.
†Based on the total number (frequency) of performed tests. *P* values were nonsignificant for all test yields.
‡$P<.05$ comparing frequency of tests.

causes among those patients seen by cardiologists (37%) compared with those undergoing evaluation by other specialties (8%-18%) and, similarly, more neurologic causes (34% vs 2%-13%) among patients seen by neurologists. Vasovagal/psychogenic (13%) and drug/metabolic causes (69%), which are more readily determined using histories and results of physical examinations, were generally identified by primary care physicians. Specialty consultations from cardiology, neurology, or both were obtained in 181 (28%), 92 (14%), and 151 patients (23%), respectively, whereas 225 patients (35%) were examined and treated solely by primary care physicians. Of the 424 patients (65%) seen by at least 1 specialty consultant, the causes of syncope were established in 208 (49%) compared with 121 (54%) of the 225 patients treated solely by primary care physicians.

The length of stay was longer (6 vs 5 days; $P<.05$) for patients undergoing evaluation by neurologists compared with the other groups (Table 5). During the 1994 period, 174 (69%) of 252 patients at Sinai-DMC compared with 116 (58%) of 199 at St John Hospital underwent at least 1 specialty evaluation. A smaller proportion of patients treated at St John Hospital in 1998 was seen by consultants compared with 1994 (98/198 [49%] vs 116/199 [58%]; $P=.04$).

COMMENT

MAIN FINDINGS

In this select but relatively large adult patient population hospitalized with syncope, we found that despite a

Table 5. Final Diagnosis and Subcategories Based on Specialty Consultations*

	Total	Primary Care Only	Specialty Consultations†		
			Cardiology	Neurology	Both
No. of patients	**649** (100)	225 (35)	181 (28)	92 (14)	151 (23)
Age, mean ± SD, y	68 ± 15	69 ± 15	68 ± 16	64 ± 22‡	64 ± 19‡
Length of stay, mean ± SD, d	5.1 ± 3.6	4.9 ± 3.7	4.9 ± 3.5	5.8 ± 4.4‡	4.9 ± 3.4
No cause found	**320** (49)	104 (46)	98 (54)	54 (59)	64 (42)
Cause found	**329** (51)	121 (54)	83 (46)	38 (41)	87 (58)
Vasovagal or psychogenic	**71** (22)	16 (13)	22 (27)	6 (16)	27 (31)
Cardiac	**63** (19)	13 (11)	31 (37)§	3 (8)	16 (18)
Neurologic	**34** (10)	8 (7)	2 (2)	13 (34)§	11 (13)
Drug or metabolic‖	**161** (49)¶	84 (69)	28 (34)	16 (42)	33 (38)

*Includes all 649 patients hospitalized in 1994 and 1998. Unless otherwise indicated, data are given as number (percentage) of patients.
†In some cases, patients were admitted to cardiology service.
‡$P<.01$ vs the other groups.
§$P<.01$ vs identified cardiac and neurologic causes by other physician groups.
‖Includes orthostatic hypotension.
¶$P<.01$ vs similar causes identified by other groups.

reduction in the use of some low-yield diagnostic tests (eg, brain CT scan and carotid Doppler) during the study periods (1994 and 1998), the approach to patient evaluation did not change appreciably. Neurologic testing, despite its traditionally low diagnostic yield, was commonly used, whereas cardiovascular tests providing the highest diagnostic yields were used relatively infrequently at both participating hospitals.

HISTORICAL EVALUATION OF SYNCOPE

The evaluation and management of syncope have changed considerably in the past 2 decades. In the early 1980s, several investigators showed that the causes of syncope were often not identified, even after extensive testing.[1,4-8] Such findings in turn led to the use of other diagnostic modalities, such as EPS and HUTT, which have had great impact in patient evaluation when used in properly selected groups.[9-11,13] Whereas in earlier investigations the cause of syncope remained unknown in approximately 50% of cases, the use of EPS and HUTT have made it possible to diagnose as many as 90% of cases.[9-11] Unfortunately, despite the high cost of syncope evaluation,[6,15,16] our findings suggest insignificant changes in the pattern of evaluation. For example, neurologic tests, most notably brain CT scan, EEG, and carotid Doppler, which have been a mainstay in patient evaluation for many years, are still commonly used, although they are of low diagnostic yield in unselected patients.[1,4-8,13,14,18,19] In patients without focal neurologic findings or history consistent with (primary) seizures, these tests are of limited use.[13,14] Among current patients, abnormal findings on brain CT scans (11%) and EEG (17%) were rarely diagnostic (in 2% of cases for each modality). Similarly, carotid Doppler, performed in 185 patients (29%), was not diagnostic in any of the 19 patients (10%) with abnormal findings. To our knowledge, no study has examined the usefulness of carotid Doppler in patients with syncope, although in a study of syncope patients who had received permanent pacemakers, occlusive disease of uncertain significance was found in 3 of 46 cases.[18] Our findings regarding the pattern of use and the diagnostic yield of various neurologic tests are similar to those of previous reports.[19,20] In a study of 297 consecutive patients (mean age, 69 years) admitted in 1993-1994, Blanck et al[19] reported that 1 or more neurologic tests, which accounted for 15% of the total diagnostic charges, were performed in more than 50% of cases, yielding a possible diagnosis in only 3 cases. Nyman et al[16] also found a similarly high use of low-yield neurologic tests in elderly patients with recurrent syncope undergoing evaluation in 1993. In a later study involving patients admitted in 1995-1996, Stetson and colleagues[20] reported similar results, ie, nearly half of 100 randomly selected patients (from a total of 901) underwent some neurologic testing (brain CT scan, 40%), the results of which did not identify any cause of syncope. Blanck and colleagues[19] noted that neurology consultations were obtained in only 53 patients (18%), indicating that most tests were requested by physicians other than neurologists. We noted a similar pattern, especially with respect to the use of brain CT scan (approximately 50% ordered by emergency department physicians) and carotid Doppler. One would expect that having a neurologist, far more capable of uncovering pertinent historical facts and focal neurologic abnormalities from a given patient, would reduce unnecessary tests; unfortunately, current and past data[19] suggest that this may not be the case. In addition to being costly,[15,19] an overemphasis on neurologic testing and diagnoses can lead to a delay in the identification (and proper treatment) of previously unrecognized cardiovascular causes of syncope.[21] The length of stay was also longer (6 vs 5 days; $P<.05$) among patients who underwent neurologic evaluation, although other factors may have accounted for the difference. Encouraging, however, is the fact that fewer patients underwent brain CT scans (33% vs 61%; $P<.01$) and carotid Doppler (17% vs 35%; $P<.01$) in 1998 compared with 1994. On the other hand, there was no change in frequency of use of EEG (37% vs 32%), and there was a trend toward a greater use of brain MRI, probably reflecting its more widespread availability.

Cardiovascular testing, in addition to providing a greater diagnostic yield,[1,4-13,19,20] also helps to identify high-

risk patients[1,4,5,7,8] who would benefit most from a more aggressive workup and appropriate treatment.[22,23] Like neurologic testing, cardiovascular testing is best guided by the findings of history and physical examination.[12,13] Tests and procedures, especially postural BP check, HUTT, and EPS, which have had the greatest impact in the evaluation of syncope, are often underused.[15,16,19,20] Our results show a similar pattern, ie, abnormal findings on postural BP check, HUTT, and EPS were diagnostic in 30%, 24%, and 16% of cases, respectively, but were performed in 27%, 20%, and 5%, respectively, of all patients (Table 2). Determination of orthostatic hypotension is important, since it may account for approximately 15% of syncope in elderly patients,[1,4] particularly those taking certain drugs, as was the case with our patients (Table 1). Similarly, we encountered only rare instances (3%) in which carotid sinus pressure was performed (or reported), yet the procedure is fairly safe[24] and often diagnostic,[20] and carotid sinus hypersensitivity may be responsible for a significant proportion of syncope (and unexplained falls) in older patients.[25] On the other hand, Holter monitoring and echocardiography were performed in 30% and 43% of our patients, respectively, although, as with our patients (1% and 3%, respectively), they are rarely diagnostic.[26,27] However, echocardiography may provide important data about the presence or absence of structural heart disease, which has an impact on the patient's prognosis and the selection of additional diagnostic tests (notably, EPS).[5,6,12,13]

ETIOLOGY OF SYNCOPE

As in previous reports involving some patients undergoing evaluation nearly 2 decades ago,[1,4-8] the present study did not identify the causes of syncope in 49% of the cases. However, the distribution of causes is essentially unchanged, except for a higher and lower proportion of drug/metabolic- (49%) and vasovagal/psychogenic-related causes (22%), respectively, among our patients. These discrepancies likely represent differences in patient population (older in our population) and the inclusion, in our classification, of orthostatic hypotension under drug/metabolic causes, largely because cardiovascular-active drugs (taken by 58% of our patients) were often the causes of syncope. Cardiac (19%) and neurologic (10%) causes, including their subcategories, were comparable to the results of previous reports of 7% to 49% and 3% to 32%, respectively.[1,4-8]

SPECIALTY EVALUATION

We found no difference in the total number of diagnosed cases among patients undergoing evaluation solely by primary care physicians compared with those seen by neurology and cardiovascular specialists (49% vs 54%). Our findings are similar to those of Mascioli and colleagues,[28] who found interdisciplinary cooperation useful in facilitating quicker evaluation but not in increasing the number of diagnosed cases of syncope. On the other hand, Vloka et al[29] found patients seen by specialists twice more likely to have a diagnosis of the causes of their syncope. These discrepant results might reflect the limited role of untargeted specialty evaluations or, in some cases, appropriate triaging by the referring physicians; the retrospective nature of our study precluded a determination of which factor played a greater role. Clearly, fewer of our patients required neurologic testing and, since nearly half had some form of structural heart disease or history suggestive of vasovagal syncope, more patients may have received a diagnosis by means of specialized cardiovascular tests such as EPS and HUTT.[12,13] However, in the absence of patient outcome data, the relative merit of any specific test cannot be made with certainty. In many cases in which the cause of syncope is readily determined from results of history and physical examination, estimated at up to 50%,[4-6,12] specialty testing is required to confirm a suspected diagnosis (eg, the use of EPS to establish suspected ventricular tachycardia).

STUDY LIMITATIONS

Aside from its retrospective nature, our results involved patients undergoing evaluation at 2 centers only, and the findings may not reflect widespread practice patterns. However, past data involving patients from different centers indicated similar results, namely a reliance on the use of low-yield neurologic tests and low use of higher-yield cardiovascular tests such as EPS and HUTT.[18-21] Our findings do not explain why these patterns persist. Since our data were collected retrospectively, the established diagnoses or lack thereof, often dependent on the quality of documented data, may have been biased or incorrect in some cases. We also did not examine the value of newer diagnostic modalities[30] that may have been used after hospital discharge in some of our patients. Our evaluation was also restricted to hospitalized patients, and considerable differences might exist in the diagnostic approach to hospitalized vs nonhospitalized patients with syncope.

CONCLUSIONS

The present data indicate that, although there were some differences in the pattern (between hospitals) and trend (different times) of evaluation of syncope, assessment of such patients seems to remain largely unchanged. Neurologic testing, which is rarely diagnostic, remains a common practice, whereas more useful cardiovascular tests are used infrequently. A focused evaluation guided by history, results of physical examination, and use of specific tests in properly selected cases may improve diagnostic yield and reduce cost. Elimination of routine neurologic testing in unselected patients alone could lead to considerable cost savings.

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Corresponding author and reprints: Luis A. Pires, MD, Cardiac Electrophysiology, St John Hospital and Medical Center, 22101 Moross, Detroit, MI 48236 (e-mail: luis.pires@stjohn.org).

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