

Diagnostic Patterns in the Evaluation of Patients Presenting with Syncope at the Emergency or Outpatient Department

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Purpose: Patterns of syncope evaluation vary widely among physicians and hospitals. The aim of this study was to assess current diagnostic patterns and medical costs in the evaluation of patients presenting with syncope at the emergency department (ED) or the outpatient department (OPD) of a referral hospital. **Materials and Methods:** This study included 171 consecutive patients with syncope, who visited the ED or OPD between January 2009 and July 2009. **Results:** The ED group had fewer episodes of syncope [2 (1-2) vs. 2 (1-5), $p=0.014$] and fewer prodromal symptoms (81.5% vs. 93.3%, $p=0.018$) than the OPD group. Diagnostic tests were more frequently performed in the ED group than in the OPD group (6.2 ± 1.7 vs. 5.3 ± 2.0 ; $p=0.012$). In addition, tests with low diagnostic yields were more frequently used in the ED group than in the OPD group. The total cost of syncope evaluation per patient was higher in the ED group than in the OPD group [823000 (440000-1408000) won vs. 420000 (186000-766000) won, $p<0.001$]. **Conclusion:** There were some differences in the clinical characteristics of patients and diagnostic patterns in the evaluation of syncope between the ED and the OPD groups. Therefore, a selective diagnostic approach according to the presentation site is needed to improve diagnostic yields and to reduce the time and costs of evaluation of syncope.

Key Words: Syncope, diagnosis, cost-benefit analysis

INTRODUCTION

In the general population, syncope is frequently encountered during daily activities. It is defined as a transient loss of consciousness due to transient global cerebral hypoperfusion.¹⁻³ It occasionally leads to serious medical problems such as severe physical injury or sudden cardiac death.^{4,5} Diverse diseases and factors are involved in the occurrence of syncope. Therefore, it is often difficult to diagnose the exact cause of syncope and often requires great expense to do so.^{1,2,6-8} Despite recently proposed clinical guidelines for the diagnosis of syncope,^{2,8,9} current patterns in the evaluation of patients with syncope vary widely among physicians and

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hospitals.⁵ Recently, there have been several reports that a standardized-care pathway significantly improves diagnostic yields and reduces the rate of hospital admission and overall medical costs.^{3,5,10} Nevertheless, there were no clinical data available to evaluate the diagnostic patterns and medical costs in patients with syncope in South Korea.

The aim of this study was to assess the current diagnostic patterns and diagnostic yields of several tests, as well as overall medical costs in patients presenting with syncope at the emergency department (ED) or the outpatient department (OPD).

MATERIALS AND METHODS

Study population

Consecutive patients with syncope, who visited the ED or OPD of Samsung Medical Center, in Seoul, Korea, between January 2009 and July 2009, were included in the study. Patients were excluded from the study if they did not have true syncopal episodes. A total of 171 patients were enrolled for this study. Of 171 patients, 62 were excluded from the assessment of diagnostic yields and medical costs of syncope evaluation because they did not undergo further diagnostic evaluations after the first visit. Two patients were also excluded from the assessment because their causes of syncope were previously diagnosed before the first visit. Three other patients were also excluded for both the aforementioned reasons. Therefore, 104 patients were eligible for the assessment of diagnostic yields and medical costs of syncope evaluation. The study was approved by the Regional Committee for Ethics in Medical Research.

Evaluation of syncope

Patients who visited the ED or OPD with syncopal episodes were being evaluated without established, standardized guidelines for syncope evaluation. At the ED, emergency physicians first investigated the cause of syncope through history taking, physical examinations, blood tests, chest X-ray (CXR) and electrocardiography (ECG). Thereafter, they contacted either a fellowship neurologist or cardiologist, who then decided on the admission or referral to OPD of patients. Neurologists performed a neurologic physical exam as well as brain computerized tomography (CT) and magnetic resonance imaging (MRI), if needed, at the ED. However, specific tests such as electroencephalography were performed in the OPD by referred professional doctors. Specific cardiol-

ogical tests such as the head-up tilt test (HUTT), the treadmill test (TMT), and Holter monitoring were also electively performed by referred professional doctors in the OPD.

Classification of the causes of syncope

Diagnosis was established based on previously described criteria:^{2,9} neural mediation, orthostatic hypotension, cardiac arrhythmia, as well as structural, cardiac, cerebrovascular and unknown causes of syncope.

Statistical analysis

Statistical comparisons of continuous variables between the groups were made using the t-test or the non-parametric test for normal and abnormal distributions, respectively. Comparison between proportions was made using the Pearson's Chi-square test. When the data had normal distributions, they were presented as mean±SD. For abnormal distributions, median (inter-quartile range) was used. A *p*-value of <0.05 was considered statistically significant. SPSS software for Windows (version 17.0, SPSS, Chicago, IL, USA) was used for all statistical analyses.

RESULTS

Clinical characteristics of total study subjects

A total of 171 patients were identified from January 1, 2009 to July 31, 2009. Seventy-six patients (44.4%) were male. The mean age (±SD) of the patients was 42.3 (±17.9) years. Hypertension was the most common underlying disease (n=31, 18.1%). Twenty-nine patients (17.0%) had a family history of syncope. The median number [interquartile ranges (IQR)] of syncope was 2 (1-4). The median duration of syncope was 60 seconds (10-180). In addition, 150 (87.7%) of these 171 patients had prodromal symptoms. Twenty-five patients (14.6%) showed seizure-like movement during a syncopal episode. Physical injury developed in 77 (45.1%) patients during syncopal episodes, 9 (5.3%) of whom experienced major traumas such as fractures or cerebral concussion. Of 171 patients, 56 (32.8%) had previously been evaluated for syncope. Interestingly, the cause of syncope was diagnosed in only 5 (2.9%) of these 56 patients. Eighteen patients (10.5%) were admitted to the hospital for the evaluation of syncope or major traumas following a syncopal episode. Sixty-five patients (38.0%) did not visit the outpatient clinic to complete the evaluation of syncope (Table 1). Common prodromal symptoms were dizziness (49.1%),

nausea (34.5%), visual change (25.7%), and cold sweating (24.6%) (Table 2).

Comparison of clinical characteristics between the ED and OPD groups

The ED group had less frequent episodes of syncope [2 (1-2) vs. 2 (1-5), $p=0.014$], fewer prodromal symptoms (81.5% vs. 93.3%, $p=0.018$), fewer previous evaluations of syncope (16.0% vs. 47.8%, $p<0.001$), and more frequent follow-

up loss before completing the evaluation of syncope (49.4% vs. 27.8%, $p=0.004$) than the OPD group (Table 1).

The ED group showed fewer prodromal symptoms, such as pallor (6.2% vs. 20.0%, $p=0.008$), palpitation (1.2% vs. 20.0%, $p<0.01$) and abdominal pain (3.7% vs. 14.4%, $p=0.018$) than the OPD group (Table 2).

Causes of syncope in total study subjects

The most common cause of syncope was a neurally mediated

Table 1. Clinical Characteristics of Study Subjects

Variable	Total	ED	OPD	<i>p</i> value
No. of enrolled patients	171 (100)	81 (47.4)	90 (52.6)	
Gender				
Male	76 (44.4)	39 (48.1)	37 (41.1)	0.355
Age at enrollment (yrs)	42.3±17.9	42.7±18.7	41.9±17.3	0.761
Underlying disease				
Diabetes mellitus	14 (8.2)	7 (8.6)	7 (7.8)	0.837
Hypertension	31 (18.1)	16 (19.8)	15 (16.7)	0.601
Hyperlipidemia	21 (12.3)	10 (12.3)	11 (12.2)	0.980
Structural heart disease	14 (8.2)	6 (7.4)	8 (8.9)	0.724
History of neurological disease	6 (3.5)	2 (2.5)	4 (4.4)	0.685
History of arrhythmia	14 (8.2)	3 (3.7)	11 (12.2)	0.052
Family history of syncope	29 (17.0)	17 (21.0)	12 (13.3)	0.183
Number of syncope (median, IQR)	2 (1-4)	2 (1-2)	2 (1-5)	0.014
Duration of syncope (seconds, median, IQR)	60 (10-180)	60 (13-176)	60 (8-210)	0.414
Prodromal symptoms	150 (87.7)	66 (81.5)	84 (93.3)	0.018
Seizure-like activity	25 (14.6)	12 (14.8)	13 (14.4)	0.945
Injury	77 (45.1)	35 (43.2)	42 (46.7)	0.650
Major*	9 (5.3)	5 (6.2)	4 (4.4)	0.737
Minor†	68 (39.8)	30 (37.0)	38 (42.2)	0.489
No. of patients, evaluated before	56 (32.8)	13 (16.0)	43 (47.8)	<0.001
Admission	18 (10.5)	11 (13.6)	7 (7.8)	0.217
Follow-up loss before diagnosed	65 (38.0)	40 (49.4)	25 (27.8)	0.004

ED, emergency department; OPD, outpatient department; IQR, interquartile ranges.

Data are presented as n (%) or mean±SD or interquartile ranges.

*Major injury: fracture, cerebral concussion.

†Minor injury: bruise, laceration, scratch, etc.

Table 2. Comparison of Prodromal Symptoms between the ED and OPD Groups

Symptoms (%)	Total (n=171)	ED (n=81)	OPD (n=90)	<i>p</i> value
Dizziness	84 (49.1)	40 (49.4)	44 (48.9)	0.949
Nausea	59 (34.5)	28 (34.6)	31 (34.4)	0.986
Visual change	44 (25.7)	17 (21.0)	27 (30.0)	0.178
Cold sweating	42 (24.6)	15 (18.5)	27 (30.0)	0.082
Chest discomfort	25 (14.6)	7 (8.6)	18 (20.0)	0.05
Pallor	23 (13.5)	5 (6.2)	18 (20.0)	0.008
Palpitation	19 (11.1)	1 (1.2)	18 (20.0)	<0.001
Weakness	17 (9.9)	5 (6.2)	12 (13.3)	0.118
Abdominal pain	16 (9.4)	3 (3.7)	13 (14.4)	0.016
Headache	11 (6.4)	5 (6.2)	6 (6.7)	0.895

ED, emergency department; OPD, outpatient department.

ed etiology, which was identified in 59 patients (55.7%). Orthostatic hypotension was identified in 15 patients (14.2%). However, the cause of syncope was not identified in 22 patients (20.8%) even though they underwent further diagnostic evaluations after the first visit (Table 3).

Comparison of causes of syncope between the ED and OPD groups

The ED group showed a lower proportion of neurally mediated syncope (48.8% vs. 61.9%, $p=0.187$) and a higher proportion of orthostatic syncope (22.0% vs. 9.5%, $p=0.078$) than the OPD group. However, there was no statistically significant difference in the cause of syncope between the ED and OPD groups (Table 3).

The median duration for the diagnosis of syncope was

shorter [4 (1-28) vs. 35 (17-44) days; $p<0.001$] in the ED group than in the OPD group. However, the mean number of tests performed was larger (6.2 ± 1.7 vs. 5.3 ± 2.0 ; $p=0.012$) in the ED group than in the OPD group (Table 3).

Diagnostic yields of tests for syncope evaluation

The following methods were used to evaluate the patients: ECG in 99.0%, blood tests in 83.7%, HUTT in 78.8%, echocardiography in 59.6%, and CXR in 59.6% of the patients. However, the diagnostic yields of these tests were very low except for HUTT. HUTT showed a higher diagnostic yield (61%) than the other tests. Carotid sinus massage and orthostatic blood pressure measurement, which are simple and important diagnostic tools, were used in only 0.96% and 31.7% of the patients, respectively. Moreover,

Table 3. Comparison of the Causes of Syncope between the ED and OPD Groups

	Total (n=104)	ED (n=41)	OPD (n=63)	<i>p</i> value
Final diagnosis				
Neurally mediated	59 (55.7)	20 (48.8)	39 (61.9)	0.187
Orthostatic	15 (14.2)	9 (22.0)	6 (9.5)	0.078
Arrhythmia	3 (2.8)	0	3 (4.8)	0.277
Structural cardiac	4 (3.8)	3 (7.3)	1 (1.6)	0.298
Cerebrovascular	1 (0.9)	1 (2.4)	0	0.394
Unexplained syncope	22 (20.8)	8 (19.5)	14 (22.2)	0.741
Days for diagnosis (median, IQR)	25 (3-41)	4 (1-28)	35 (17-44)	<0.001
Number of tests performed	5.6±1.9	6.2±1.7	5.3±2.0	0.012

ED, emergency department; OPD, outpatient department; IQR, interquartile ranges.

Data are presented as n (%) or mean±SD or interquartile ranges.

Table 4. Patterns and Results of Diagnostic Tests in Syncope Evaluation (n=104)

Tests performed	Frequency (%)	Abnormal result (%)	Diagnostic yield (%)
Postural BP check	33 (31.7)	15 (45.5)	5 (15.2)
Blood test	87 (83.7)	39 (44.8)	5 (5.7)
ECG	103 (99.0)	28 (27.2)	1 (1.0)
Echocardiography	62 (59.6)	14 (22.6)	2 (3.2)
HUTT	82 (78.8)	53 (64.6)	50 (61.0)
Carotid sinus massage	1 (0.9)	0 (0)	0 (0)
Holter recording	45 (43.3)	17 (37.8)	3 (6.7)
EPS	7 (6.7)	3 (42.9)	1 (14.3)
CAG	6 (5.8)	3 (50)	2 (33.3)
TMT	32 (30.8)	5 (15.6)	1 (3.1)
Stress echocardiography	0 (0)	0 (0)	0 (0)
EEG	9 (8.7)	2 (22.2)	0 (0)
Brain CT	25 (24.0)	7 (28.0)	1 (4.0)
Brain MRI & MRA	19 (18.2)	6 (31.5)	0 (0)
Carotid Doppler	4 (3.8)	1 (25)	0 (0)
CXR	62 (59.6)	8 (12.9)	0 (0)
ILR	0 (0)	0 (0)	0 (0)

BP, blood pressure; ECG, electrocardiogram; HUTT, head-up tilt test; EPS, electrophysiologic study; CAG, coronary angiography; TMT, treadmill test; CT, computerized tomography; MRI, magnetic resonance imaging; MRA, magnetic resonance angiography; CXR, chest X-ray; ILR, implantable loop recorder; EEG, electroencephalography.

expensive tests with low diagnostic yields, such as brain CT and MRI, were performed in 24.0% and 18.2% of the patients, respectively. Invasive tests, such as coronary angiography and electrophysiologic studies were performed in only 5.8% and 6.7% of all patients, respectively. However, they showed higher diagnostic yields (33.3% and 14.3%) than the other tests. Implantable loop recorders were not used to evaluate the cause of syncope in any of the patients in the study population (Table 4).

Comparison of frequently performed tests between the ED and OPD groups

Commonly used diagnostic tests were different between the ED and OPD groups. In the ED group, ECG, blood test, CXR, postural blood pressure measurement, and brain CT were more commonly used. However, HUTT, echocardiography, Holter recording, and TMT were more commonly used in the OPD group (Fig. 1).

Medical costs for syncope evaluation in total study subjects

The median medical cost for diagnostic tests per patient was 461000 (267000-777000) won. The median total cost, which included the costs for diagnostic tests, outpatient clinic visit, and hospitalization, was 550000 (272000-1056000)

won (Table 5).

Comparison of medical costs of syncope evaluation between ED and OPD groups

Although there was no statistical significance, the cost per patient for diagnostic tests demonstrated a tendency to be more expensive in the ED group than the OPD group [549000 (392000-806000) won vs. 440000 (217000-715000) won, $p=0.123$]. Moreover, the total cost per patient was higher in the ED group than in the OPD group [823000 (440000-1408000) won vs. 420000 (186000-766000) won, $p<0.001$] (Table 5).

DISCUSSION

Our results showed that some clinical characteristics of patients with syncope were significantly different between the ED and OPD groups. The ED group had less frequent episodes of syncope [2 (1-2) vs. 2 (1-5), $p=0.014$]; fewer prodromal symptoms, especially chest discomfort, pallor, palpitation and abdominal pain (81.5% vs. 93.3%, $p=0.018$); and fewer previous evaluations of syncope (16.0% vs. 47.8%, $p<0.001$). These differences in clinical characteristics could be related with different causes of syncope between the two

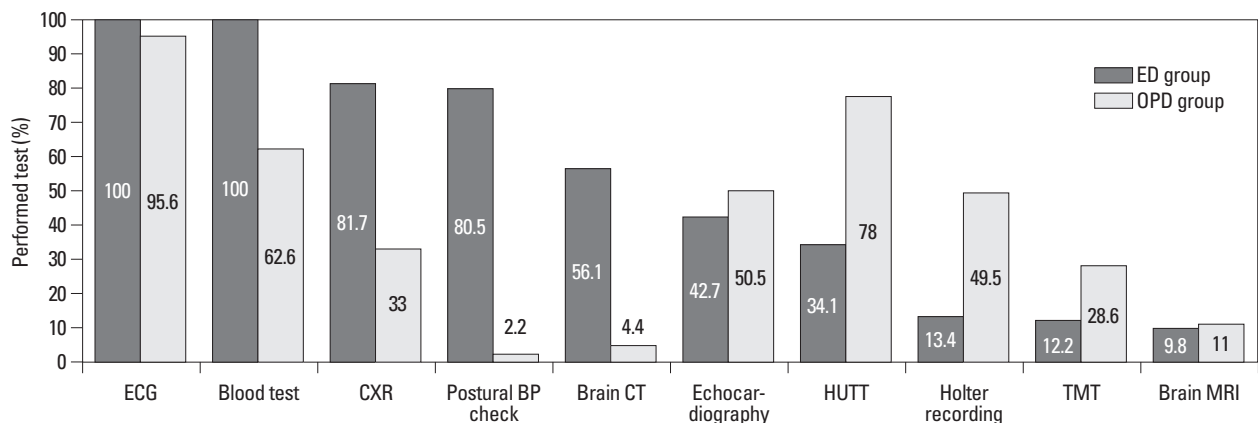


Fig. 1. Comparison of frequently performed tests between the ED and OPD groups (n=171). ED, emergency department; OPD, outpatient department; BP, blood pressure; ECG, electrocardiogram; HUTT, head up tilt test; TMT, treadmill test; CT, computerized tomography; MRI, magnetic resonance imaging; CXR, chest X-ray.

Table 5. Medical Costs for Syncope Evaluation (n=104)

	Total (n=104)	ED (n=41)	OPD (n=63)	p value
Costs for diagnostic tests per patient, ×1000 won (median, IQR)	461 (276-777)	549 (392-806)	440 (217-715)	0.123
Total costs per patient, ×1000 won (median, IQR)	550 (272-1056)	823 (440-1408)	420 (186-766)	<0.001

IQR, interquartile ranges; ED, emergency department; OPD, outpatient department. Data are presented in interquartile ranges.

groups. Particularly, there was an increased tendency for neurally mediated syncope in the OPD group than in the ED group (61.9% vs. 48.8%, $p=0.187$). In contrast, orthostatic syncope was more frequently documented in the ED group than in the OPD group (22.0% vs. 9.5%, $p=0.078$).

In our study, diagnostic evaluation was more difficult to discern in the ED group because they had greater follow-up loss before completing evaluation of syncope (49.4% vs. 27.8%, $p=0.004$) than the OPD group.

Tests with low diagnostic yields were commonly performed on the study population. Simple but important tests, such as carotid sinus massage and orthostatic blood pressure measurement, were not frequently used. Moreover, expensive tests with low diagnostic yields, such as brain CT and MRI, were performed on 24.0% and 18.2% of the patients, respectively. Invasive tests, such as coronary angiography and electrophysiologic study, were performed only in 5.8% and 6.7% of the patients, respectively; however, they showed higher diagnostic yields (33.3% and 14.3%, respectively) than other tests. Interestingly, the implantable loop recorder, which is a very useful tool for diagnosing unexplained syncope, was not used in this study.

In the comparison between the ED and OPD groups, ECG and echocardiography were performed in patients at a similar proportion between the 2 groups. However, useful tests with high diagnostic yields, such as HUTT, were performed more frequently in the OPD group. In contrast, expensive tests with low diagnostic yield, such as brain CT, were performed more frequently in the ED group. In other words, the overall efficiency of tests performed was lower in the ED group than in the OPD group.

The costs for diagnostic tests per patient did not show statistically significant difference between the ED and OPD groups [549000 (392000-806000) won vs. 440000 (217000-715000) won, $p=0.123$). However, there was a tendency for greater expense in the ED group. Moreover, the total costs per patient were higher in the ED group than in the OPD group [823000 (440000-1408000) won vs. 420000 (186000-766000) won, $p<0.001$]. This was likely influenced by expensive testing such as brain CT which was performed more frequently in the ED group and higher admission rates although there was no statistical significance.

Nevertheless, Sheldon, et al.¹¹ reported that historical features can distinguish vasovagal syncope from syncope of other causes with very high sensitivity and specificity. Just 28 patients (47.5%) among 59 neurally mediated syncope patients in this study were able to be diagnosed based on

quantitative history alone. This may be a result of insufficient documentation of patient medical history.

Several previous studies have assessed the diagnostic yields of tests and medical costs for the evaluation of syncope patients.^{1,12,13} Pires, et al.¹ reported that neurologic tests with low diagnostic yields were overused and cardiovascular tests with high diagnostic yields were underused. Steinberg and Knilans¹² showed that only 4% of tests performed were helpful in diagnosing the cause of syncope in pediatric populations and that the average costs for the evaluation of syncope per patient reached almost 7000 U.S. dollars. Brignole, et al.¹⁴ revealed that the average costs for the evaluation of syncope were 1753 euros, which was nearly 5 times more expensive than that of our study population.

In order to make syncope evaluation systematic, several studies have published guidelines for the evaluation of syncope.^{2,3,5,8-10,14,15} In these studies, the efficacy of a guideline-based evaluation of patients with syncope was assessed in terms of diagnostic yields and medical costs. They concluded that the guideline-based approach improved overall clinical results, such as diagnostic yields, duration of hospital stay and medical costs of syncope management. Brignole, et al.¹⁴ performed a prospective systematic guideline-based evaluation on patients referred to the EDs of 11 general hospitals. In their study, a high compliance rate to the guidelines of 86% was noted. A definite diagnosis was established in 98% of the patients, hospitalization was appropriate in 25% of the patients, and the median in-hospital stay (IQR) was 5.5 (3-9) days. The EGSYS-2 group established a standardized care pathway for syncope patients according to the guidelines of the European Society of Cardiology (ESC) and compared the data to syncope patients who were not managed according to this pathway.⁵ Overall, the standardized-care group had a lower hospitalization rate, shorter in-hospital stay and fewer tests performed per patient than the general-care group. Neurally mediated and orthostatic syncope were diagnosed more frequently, whereas fewer patients had a diagnosis of unexplained syncope when evaluated according to the standardized-care pathway. The mean costs per patient and the mean costs per diagnosis were 19% and 29% lower in the standardized-care group than the general-care group, respectively. Ammirati, et al.¹⁰ demonstrated that the use of a syncope unit based on the 2004 ESC guidelines allows for improved management of patients with syncope. Shen, et al.¹⁵ have shown that the syncope unit significantly improves diagnostic yields in the ED

and reduces hospital admission rates and the total length of hospital stay without affecting recurrent syncope and all-cause mortality among intermediate-risk patients.

The medical costs of syncope evaluation are cheaper in South Korea than in Western countries. In addition, the proportion of unknown origin after diagnostic evaluation of syncope was higher in South Korea than in Western countries, because most patients were not evaluated by standardized guidelines and implantable loop recorders were not used in the evaluation of syncope.

In conclusion, there were some differences in the clinical characteristics of patients presenting at the ED and the OPD. Diagnostic patterns in the evaluation of syncope were also different between both groups. Therefore, a selective diagnostic approach according to the presentation site is needed to improve diagnostic yields and to reduce the time and costs of evaluation of syncope.

Study limitations

This study was performed at a single tertiary referral hospital rather than in the community. Therefore, the results of this study may not sufficiently reflect the current patterns of syncope evaluation throughout South Korea.

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