Original Article

The Evaluation of Syncope in a Predominantly Black Population: Focus on Neuroimaging

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Abstract

Background: Current guidelines do not support the routine use of computed tomography (CT) scan of the head in the diagnostic workup of syncope. There is a lack of research to support whether these guidelines apply to the Black population. **Aims:** This study aims to evaluate the yield of neuroimaging in the evaluation of Syncope in a predominantly Black patient population and to test whether current guidelines based on studies conducted in other populations hold true in this group. **Material and Methods:** A retrospective review of records of 151 patients admitted to a University Hospital with Syncope from 2011 to 2014 was performed. Data collected include CT head, magnetic resonance imaging of the brain, magnetic resonance angiogram, electroencephalogram, and orthostatic vital signs. Demographic data, admitting service, and comorbid conditions were identified. Syncope was classified as cardiogenic, orthostatic, vasovagal, situational, or undetermined. Statistical analysis was performed to determine which diagnostic tools were useful in identifying the potential causes of syncope. Data analysis was conducted using the Statistical Analysis System software 9.3 (SAS Institute, Cary, NC) and Statistical Analysis and Graphics (NCSS 9.0.7, Kaysville, UT). **Results:** One hundred and twenty eight (84.8%) of the patients were Black. The average age was 56.62 ± 18.78 standard deviation and 68.2% (103) were female. One hundred and fourteen patients (75.5%) had a CT brain. Five out of 114 patients had an acute abnormality on CT (4.4%). Only 1 of these 5 patients had an abnormality that was related to syncope. CT brain ($P = 0.978$) was not found to be predictive of underlying etiology of syncope despite high frequency of use. **Conclusions:** CT head was not useful in determining the etiology of syncope in a predominantly Black population. Current guidelines and studies conducted in other populations have detected similar findings.

Keywords: Blacks, CT scan, neuroimaging, syncope

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Introduction

Syncope is defined as a transient loss of consciousness caused by transient global cerebral hypoperfusion. It is further characterized by rapid onset, short duration, and spontaneous complete recovery.[1] Syncope is common both in the community and in emergency care visits.[2-5] Often, it is both a traumatic experience for the patient and a diagnostic challenge for the physician.

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Depending on the choice of investigations, syncope evaluation may be costly with low diagnostic yield.[6] A few studies have shown the insignificant value of neuroimaging in the diagnosis of syncope, however, it is often used indiscriminately to avoid missing conditions such as stroke, brain tumors, and subarachnoid hemorrhage.[7] The recommendations of the European

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Society of Cardiology, American College of Cardiology, and[1,8] the American College of Physicians[9] advise against routine neuroimaging in syncope, however, these guidelines are based on studies in heterogeneous populations. There is a paucity of research into the diagnostic approach to syncope in the Black population, even though these patients have been shown to have worse outcomes when presenting with unexplained syncope.[10]

The primary objective of this study is to evaluate the approach to the evaluation of syncope at a University Hospital with a predominantly Black patient population. We also aim to establish the utility of various investigations in identifying the etiology of syncope, with an emphasis on neuroimaging.

Methods and Materials

Using International Classification of Diseases, Ninth Revision codes (ICD-9), patients admitted with a diagnosis of syncope from 2011 to 2014 at a University Hospital were identified. A retrospective review of the initial history and physical progress notes, as well as discharge summaries was performed.

Patients were excluded from the study if the diagnosis after initial assessment was not documented by the physician as syncope even though the chart was coded as syncope. A total of 151 patients were included in the final analysis. Wherever relevant, the results of diagnostic testing done on that admission were reviewed, including electrocardiogram (ECG), computed tomography (CT) scan of the head, magnetic resonance imaging (MRI) of the brain, magnetic resonance angiography (MRA), electroencephalogram (EEG), orthostatic vital signs, and tilt table testing. Patients were further characterized according to the age, gender, admitting service, and comorbid conditions including hypertension, diabetes, cardiac disease, psychiatric disorder, pulmonary disease, and seizure disorder. The final diagnoses were grouped into the following classes of syncope, that are, cardiogenic, orthostatic, vasovagal, situational, and undetermined.

Statistical analysis

We conducted descriptive statistics to assess the clinical and demographic factors of the participants. For continuous variables, we calculated the mean and standard deviations (SDs); for categorical variables, we obtained the counts (%). We evaluated the relationship between syncope and CT scan of the head classification among the participants. We provided the count of the participants for the different syncope and CT scan classifications. We also evaluated differences in the participant characteristics by CT scan. For categorical variables, we obtained the counts (%) and evaluated significant differences using the Chi-square and Fisher's exact test. A student's *t*-test was used for continuous variables to assess significance for any difference. We conducted a multivariate logistic regression analysis to predict potential factors associated with syncope classification. We considered *P* value less than 0.05 to be statistically significant and calculated confidence intervals (CI) at the 95% level. Data analysis was conducted using the Statistical Analysis System software 9.3 (SAS Institute, Cary, NC) and Statistical Analysis and Graphics software (NCSS 9.0.7, Kaysville, UT).

Results

We collected data on 151 patients who met the ICD-9 criteria for syncope at the time of hospital discharge. The average age was 56.62 ± 18.78 (SD), of which 68.2% were females. The ethnic breakdown of our study population revealed that 128 (84.8%) were Black, 8.61% White, Hispanic, and other comprised 3.3%.

With respect to chronic medical conditions, 92 (60.9%) had hypertension, 47 (31.1%) had cardiac disease, 32 (21.19%) had diabetes mellitus, 32 had psychiatric disorders, 31 (20.67%) had pulmonary disease and 10 (6.62%) had seizure disorder.

With respect to diagnostic evaluation, 147 (98%) patients had an ECG, 114 (75.5%) had a CT of the head, 66 (43.71%) had orthostatic vital signs done after admission, 23 (15.2%) had orthostatic vital signs done in the emergency room. EEG, MRA, and MRI are also listed in Table 1.

Significantly, despite extensive work-up in most cases, only 65 (43.05%) patients had an underlying etiology of syncope diagnosed at the time of hospital discharge. Only 5 out of 114 patients had an acute abnormality on CT head (4.4%). Out of these 5 patients, acute abnormalities unrelated to the cause of syncope were noted in 4 (four). The other patient was diagnosed with subarachnoid hemorrhage. Fifty one of the 114 patients who underwent a CT head had chronic pathology detected (44.7%). CT head was normal in the other 58 patients who underwent CT imaging as part of diagnostic evaluation (50.9%). Of the 114 patients receiving a CT of the head, no cause for syncope was found for 65 whereas 28 patients were found to have vasovagal syncope. Twelve patients were found to have orthostatic hypotension [Table 2].

Table 3 compares characteristics of patients who underwent CT imaging to those who did not have CT imaging. There was no significant statistical difference in

Table 1: Characteristics of participants (*n*=151)

Characteristics	*n* (%)
Age, mean (SD) years	56.62 (18.78)
Gender (female)	103 (68.21)
Hypertension	92 (60.93)
Cardiac disease	47 (31.13)
Diabetes	32 (21.19)
EEG	29 (19.21)
ECG	147 (98.00)
MRA	5 (3.31)
MRI	14 (9.27)
Orthostatic vital signs in ECA	23 (15.23)
Orthostatic vital signs on Floor	66 (43.71)
Pulmonary disease	31 (20.67)
Seizure disorder	10 (6.62)
Psychiatric disorder	32 (21.19)
Syncope diagnosis	65 (43.05)
Race	
Black	128 (84.77)
White	13 (8.61)
Hispanic	5 (3.31)
Other	5 (3.31)

SD = Standard deviation, EEG = Electroencephalogram, MRA = Magnetic resonance angiography, MRI = Magnetic eesonance imaging

Table 2: Syncope by computerized tomography scan classification (*n*=114)

Syncope classification	CT scan classifications (%)		
	Acute pathology (*n*=5)	Chronic pathology (*n*=51)	Normal (*n*=58)
Cardiac	0 (0.00)	3 (5.88)	1 (1.72)
Orthostatic	0 (0.00)	5 (9.80)	7 (12.07)
Situational	0 (0.00)	2 (3.92)	1 (1.72)
Undetermined	3 (60.00)	31 (60.78)	31 (53.45)
Vasovagal	1 (20.00)	9 (17.65)	18 (31.03)
Other	1 (20.00)	1 (1.96)	0 (0.00)

CT = Computerized tomography

any of the characteristics (demographic, chronic medical conditions, subtype of syncope). Of most significance, there was no difference in determining an etiology of syncope between the patients who underwent CT head compared to those who did not (42.8 vs. 43.24%).

Table 4 examines the diagnostic modalities and demographic factors, as well as their statistical accuracy in predicting whether an underlying etiology of syncope would be determined. Only orthostatic vital sign measurement in the emergency room of diagnostic interventions was found to be statistically significant (Odds ratio (OR): 4.98, *P* Value: 0.005). Hypertension (OR: 2.81, *P* value 0.031) also was found to be predictive. Orthostatic vital signs on floor (0.112) and CT head (0.978) were not found to be useful in finding an underlying etiology of syncope despite their high frequency of use (43.71% and 75.5%, respectively).

Table 3: Characteristics of participants by computerized tomography scan

Characteristics	CT scan on head (%)		*P*
	Yes (*n*=114)	No (*n*=37)	
Age	58.27 (18.16)	51.54 (19.98)	0.058
Female	77 (67.54)	26 (70.27)	0.757
Hypertension	74 (64.91)	18 (48.65)	0.078
Cardiac disease	81 (71.05)	23 (62.16)	0.310
Diabetes	23 (20.35)	9 (24.32)	0.609
Pulmonary disease	26 (23.01)	5 (13.51)	0.216
Seizure disorder	8 (7.02)	2 (5.41)	1.000*
Psychiatric disorder	24 (21.05)	8 (21.62)	0.941
Syncope classification			
Cardiac	4 (3.51)	2 (5.41)	0.956*
Orthostatic	12 (10.53)	4 (10.81)	
Situational	3 (2.63)	0 (0.00)	
Undetermined	65 (57.02)	21 (56.76)	
Vasovagal	28 (24.56)	9 (24.32)	
Other	2 (1.75)	1 (2.70)	
Syncope diagnosis	49 (42.98)	16 (43.24)	0.978

*Fisher exact test, CT = Computerized tomography

Table 4: Predictive factors of syncope diagnosis

	Syncope diagnosis			
	OR	95% CI		*P*
Age	0.99	0.97	1.01	0.289
Sex (male vs. female)	0.51	0.23	1.15	0.106
Hypertension	2.81	1.10	7.22	0.031
Cardiac disease	0.96	0.41	2.23	0.919
Diabetes	0.63	0.25	1.58	0.324
Psychiatry	0.98	0.40	2.40	0.971
Pulmonary disease	1.27	0.52	3.09	0.604
Seizure disorder	0.79	0.17	3.69	0.765
EEG	0.42	0.15	1.15	0.090
CT scan in head	0.99	0.42	2.34	0.978
Orthostatic vital signs in emergency room	4.98	1.63	15.23	0.005
Orthostatic vital signs on floor	1.81	0.87	3.77	0.112

OR = Odds Ratios, OR was obtained using Logistic Regression Model, CI = Confidence Interval, EEG = Electroencephalography, CT = Computerized tomography

Discussion

The evaluation and management of patients with syncope is one of the most controversial and challenging issues in the Clinical practice of Medicine.[11,12] Recent guidelines by major societies do not support the use of excessive laboratory and radiological workup in patients with syncope unless clinically warranted,[1,8,9] however,

these recommendations are often lost in clinical practice. Our data shows that a large percentage of patients received CT scans, whereas a significant number had EEGs, MRI/MRAs, all of which had a minimal diagnostic yield.

In our study, the most useful modality in establishing an underlying cause of syncope was measurement of orthostatic vital signs in the emergency room. Measurement of orthostatic vital signs after admission was not useful in diagnosing postural orthostatic tachycardia syndrome (POTS) ($P = 0.112$). The probable explanation for this finding is routine aggressive intravenous hydration in the emergency room prior to inpatient admission. Strikingly, only 15% of patients in our study had orthostatic vital signs measured in the emergency room, which raises a serious quality concern because this goes against expert guidelines.

Various retrospective and prospective studies have examined the value of diagnostic testing in syncope. In a study conducted to evaluate the yield of diagnostic tests and its impact on cost in adult patients with syncope presenting to a community hospital, postural blood pressure measurement had the highest diagnostic yield at 58.7%, whereas history taking diagnosed 19.7% of cases. Telemetry, ECG, radionuclide stress test, echocardiography, and troponin measurement had a less than 5% whereas chest X-ray, carotid ultrasonography, 24-hour Holter monitoring, head CT, and brain MRI did not lead to a diagnosis in any of the patients. Surprisingly, only 1.9% of the money spent in the evaluation of syncope was effective in leading to a definitive diagnosis.[7] Among 81 patients followed in a neurology clinic in Spain for syncope, epileptic seizures made up 10% and the other 90% were due to non-neurological causes. The usefulness of neuroimaging and vascular studies was nil.[13] In a retrospective study involving 649 patients with syncope, among whom 283 underwent head CT scan for the evaluation, CT contributed in diagnoses only in 5 (2%) of the patients whose history was also consistent with seizure and stroke. MRI was performed for 10 patients with no diagnostic yield. In that study, cardiovascular tests provided the highest diagnostic yields.[14]

In a study that identified 44 patients who had their head CT scans performed for syncope, only 1 patient showed evidence of infarction in the posterior circulation, 19 patients had normal CT scan and 24 patients has abnormal findings unrelated to the ED (Emergency Department) presentation.[7] This supports obtaining current guidelines that recommend neuroimaging only when warranted. Physicians tend to overuse the low yield neurologic tests and underuse the higher-yield cardiovascular tests. Specific tests should be guided by the findings of history and physical examination.[15] This would eventually result in improved diagnostic yield, decreased cumulative exposure to radiation,[16] and a decrease in the cost of evaluating syncope.[6]

The above suggests a need for quality improvement and for prospective studies to assess the approach to syncope by physicians and to determine the reasons for utilizing tests which have no benefit, yet incur substantial costs. Quality measures should be implemented to ensure that staff perform orthostatic vital signs routinely and ensure that the correct techniques are employed to avoid false negative readings.

The limitations of this study include the solitary site of patient recruitment (lower generalizability), reliance on accurate ICD coding, small sample size, and the exclusion of investigations such as tilt table testing. The strengths of this study lie in the unique patient population (ethnic minorities in which similar studies are minimal), the use and availability of EMR (Electronic Medical Records) to confirm accuracy of data, and the reproducible findings consistent with previous studies and clinical guidelines.

Conclusion

This study is clinically relevant because it highlights a continued practice of unnecessary neuroimaging in syncope, which is unsupported by clinical research and guidelines. It demonstrates that the low yield of neuroimaging in syncope is also applicable to the Black population. Unnecessary CT scans increases the risks of radiation exposure and its associated long-term side effects. The findings of this study should prompt quality improvement measures aimed at reducing the use of low yield diagnostic modalities in syncope, ultimately leading to reduced health care expenditure and decreased length of stay.

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Conflicts of interest

There are no conflicts of interest.

References

1. Task Force for the Diagnosis and Management of Syncope; European Society of Cardiology (ESC); European Heart Rhythm Association (EHRA); Heart Failure Association (HFA); Heart Rhythm Society (HRS), Moya A, *et al*. Guidelines for the diagnosis and management of syncope (version 2009). Eur Heart J 2009;30:2631-71.
2. Chen L, Chen MH, Larson MG, Evans J, Benjamin EJ, Levy D. Risk factors for syncope in a community-based sample (the Framingham Heart Study). Am J Cardiol 2000;85:1189-93.

3. Ganzeboom KS, Mairuhu G, Reitsma J, Linzer M, Wieling W, van Dijk N. Lifetime cumulative incidence of syncope in the general population: A study of 549 Dutch subjects aged 35–60 years. J Cardiovasc Electrophysiol 2006;17:1172-6.
4. Lemonick, David M. Evaluation of syncope in the emergency department. Am J Clin Med 2010;7:11-9.
5. Ruwald MH, Hansen ML, Lamberts M, Hansen CM, Højgaard MV, Køber L, *et al*. The relation between age, sex, comorbidity, and pharmacotherapy and the risk of syncope: A Danish nationwide study. Europace 2012;14:1506-14.
6. Johnson PC, Ammar H, Zohdy W, Fouda R, Govindu R. Yield of diagnostic tests and its impact on cost in adult patients with syncope presenting to a community hospital. South Med J 2014;107:707-14.
7. Giglio P, Bednarczyk EM, Weiss K, Bakshi R. Syncope and head CT scans in the emergency department. Emerg Radiol 2005;2:44-6.
8. Strickberger SA, Benson DW, Biaggioni I, Callans DJ, Cohen MI, Ellenbogen KA, *et al*. AHA/ACCF Scientific Statement on the evaluation of syncope: From the American Heart Association Councils on Clinical Cardiology, Cardiovascular Nursing, Cardiovascular Disease in the Young, and Stroke, and the Quality of Care and Outcomes Research Interdisciplinary Working Group; and the American College of Cardiology Foundation: In collaboration with the Heart Rhythm Society: Endorsed by the American Autonomic Society. Circulation 2006;113:316-27.
9. Choosing wisely an initiative of the American Board of Internal Medicine. (Accessed April 12, 2016, at: http://www.choosingwisely.org/clinician-lists/american-college-physicians-brain-imaging-toevaluate-simple-syncope/).
10. Pratap B, Bastawrose J, Pamidimukala C, Patel D, Kalamkar P, Lingannan A, *et al*. African-American patients presenting with unexplained syncope have significantly worse 1-year outcome when compared to non-African Americans. Circ Cardiovasc Qual Outcomes 2014;7:A376.
11. Gauer RL. Evaluation of Syncope. Am Fam Physician 2011;84:640-50.
12. Krahn AD, Klein GJ, Yee R, Hoch JS, Skanes AC. Cost implications of testing strategy in patients with syncope: Randomized assessment of syncope trial. J Am Coll Cardiol 2003;42:495-501.
13. Pérez A, Medrano V, Martínez-Menéndez B, Mas F. A descriptive analysis of 81 patients referred to a neurology clinic for syncope. Rev Neurol 2001;33:315-8.
14. Pires LA, Ganji JR, Jarandila R, Steele R. Diagnostic patterns and temporal trends in the evaluation of adult patients hospitalized with syncope. Arch Intern Med 2001;161:1889-95.
15. Alboni P, Brignole M, Menozzi C, Raviele A, Del Rosso A, Dinelli M, *et al*. Diagnostic value of history in patients with syncope with or without heart disease. J Am Coll Cardiol 2001;37:1921-8.
16. Griffey RT, Sodickson A. Cumulative radiation exposure and cancer risk estimates in emergency department patients undergoing repeat or multiple CT. AJR Am J Roentgenol 2009;192:887-92.