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Pediatric syncope: Clinical and demographic findings from a neurological outpatient cohort

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ABSTRACT

Objective: Syncope, a temporary loss of consciousness caused by cerebral hypoperfusion, is often benign but can signal serious neurological or cardiac issues. We retrospectively analyzed pediatric syncope cases in this study.

Material and Methods: We analyzed 514 patients aged 6–18 years who presented with syncope to a pediatric neurology outpatient clinic.

Results: Most patients (36.7%) had a single episode, though recurrent cases were also common. The primary triggers were prolonged standing (17.2%) and sudden postural changes (14.4%). Prodromal symptoms such as dizziness, visual disturbances, and nausea were reported in 69.5% of cases. Electroencephalography (EEG) was performed in 72.2% of patients, revealing epileptiform activity in 27 individuals. EEG requests increased significantly in patients with recurrent syncope episodes ($p<0.010$). Cranial MRI was performed in 37.5% of the patients, and abnormalities were detected in 16.6%, most commonly arachnoid cysts. However, no statistically significant correlation was found between MRI utilization and the frequency of syncope episodes. Final diagnoses were predominantly vasovagal syncope (75.6%), followed by psychogenic syncope (10.3%), seizures (8.75%), cardiogenic syncope (4.5%), and hypoglycemia (0.85%).

Conclusion: These results highlight the mostly benign nature of pediatric syncope, with vasovagal syncope as the most frequent diagnosis. EEG is useful for identifying underlying epilepsy, while neuroimaging should be reserved for selected cases.

Keywords: Children, EEG, syncope, vasovagal syncope

INTRODUCTION

Syncope is a clinical disorder defined by abrupt onset, brief duration, spontaneous recovery, and reversible loss of postural tone and consciousness. The duration may range from several seconds to one or two minutes. Presyncope is defined as the presence of prodromal symptoms without actual loss of consciousness. Syncope is relatively common in children and adolescents, and should not be overlooked (1-4).

The fundamental pathophysiological mechanism of syncope is temporary cerebral hypoperfusion. Common causes of syncope in children encompass benign conditions such as vasovagal syncope, orthostatic hypotension, and breath-holding episodes. Although rare, syncope may occasionally be the initial manifestation of serious underlying cardiac or neurological conditions (5,6). Certain symptoms observed in individuals before syncope may assist in identifying the underlying etiology. Prodromal symptoms including dizziness, lightheadedness, transient visual loss, hot flushes, and pallor are primarily associated with vasovagal syncope; nevertheless, palpitations, chest pain, or loss of consciousness during physical exercise need the elimination of cardiac etiologies (5). In neurological syncope, involuntary jerks and contractions accompanied by abrupt and significant loss of muscle tone may be detected (7,8).

Syncope, a prevalent reason for visits to pediatric neurology outpatient clinics, is perceived as a distressing event for both the patient and the family, despite typically not signifying a serious illness (9,10). Our study sought to retrospectively assess the clinical and demographic attributes of patients presenting to the pediatric neurology outpatient clinic with syncope complaints.

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MATERIALS and METHODS

This retrospective analysis included patients who presented with syncope to the pediatric neurology outpatient clinic of Ankara Etlik City Hospital between January 2023 and December 2024. The demographic features, frequency of syncope, prodromal symptoms, triggering factors, comorbidities, diagnostic procedures, laboratory findings, and final diagnoses of the patients included in the study were retrospectively retrieved from the hospital data system.

A total of 603 patients diagnosed with the code 'syncope' were identified in the hospital data system. After identifying patients with the ICD code for syncope, individual electronic medical records were manually reviewed to confirm that each event met the clinical criteria for syncope. Patients with incomplete data or with episodes that did not meet diagnostic criteria for syncope were excluded. Following file analyses, 514 patients were identified who met the inclusion criteria. Fifty-seven patients with incomplete data were omitted from the study, and 32 patients were excluded because their events did not fulfill the criteria for syncope.

Syncope was defined as a transient loss of consciousness associated with loss of postural tone, with rapid onset and spontaneous recovery, attributed to cerebral hypoperfusion. Presyncope was defined as a state in which patients experienced prodromal symptoms such as dizziness or visual dimming without actual loss of consciousness.

Statistical analysis

Statistical analyses were performed using the NCSS 2007 program (Kaysville, Utah, USA). The data distribution was assessed using the Shapiro-Wilk test in addition to descriptive statistical methods (mean, standard deviation, minimum, and maximum). A comparison between qualitative data sets was undertaken, with chi-square analysis being implemented as a statistical method. Significance was assessed at the $p < 0.050$ levels.

RESULTS

A total of 514 participants participated in our study. Among the patients, 194 (38%) were male and 320 (62%) were female. The average age was 12.86±3.47 years. The demographic information of the patients is presented in Table I. Upon analysis of the syncope occurrences, it was noted that the predominant category comprised patients with a single episode of syncope. Among the 514 patients, 337 (65.5%) experienced true syncope, while the remaining 177 (34.5%) had presyncope episodes without actual loss of consciousness. Upon analysis of the triggering variables, it was shown that 218 patients (42.4%) exhibited no identifiable triggering factor. Among the remaining patients, the predominant causes were prolonged standing, rapid postural changes, and active infections, in that order. Prodromal symptoms were absent in 157 patients (30.5%) and present in 357 patients (69.5%). The predominant prodromal symptoms included dizziness and visual obscuration; nevertheless, several patients indicated experiencing multiple prodromal symptoms. Among patients who experienced loss of consciousness, the majority (n=157; 30.5%) reported a duration of less than 1 minute, with the most common being under 10 seconds (n=104; 20.3%). Additionally, 80 patients (15.6%) reported a duration between 1 and 2 minutes. Laboratory investigations—including complete blood count, metabolic panel, vitamin B12 and D levels, and iron studies—were unremarkable in 70% (n = 358) of the patients.

Table I: Demographic characteristics

Variables	Value
Age (years)*	12.86±3.47 (6-18)
Gender†	
Male	194 (38)
Famele	320 (62)
Number of syncope†	
1	189 (36.70)
2	150 (29.20)
3	78 (15.20)
4	27 (5.20)
5	25 (4.90)
>5	45 (8.80)
Triggering factor†	
Prolonged standing	88 (17.20)
Sudden standing up	74 (14.40)
Presence of infection	24 (4.67)
Hunger	23 (4.51)
Emotional stress	18 (3.50)
Pain	13 (2.50)
Exercise	8 (1.43)
Others	37 (7.20)
Prodromal symptom†	
Dizziness	166 (32.22)
Transient visual loss	181 (35.19)
Nausea	61 (11.97)
Palpitations	20 (3.93)
Sweating, hot flushes	16 (3.19)
Fading	13 (2.6)
Loss of consciousness†	
Yes	337 (65.5)
No	177 (34.5)

**: mean*±SD (range), *†: n(%)*

Electroencephalography (EEG) was conducted in 371 patients (72.2%), while 143 patients (27.8%) did not undergo the procedure. Abnormalities were not detected in the EEGs of 344 out of 371 patients who underwent the procedure. Abnormal epileptic abnormalities were identified in the EEG of the remaining 27 patients. Generalized epileptic discharges were detected in 15 patients, while focal epileptic discharges were detected in 12 patients. These patients received an epilepsy diagnosis based on their medical history and EEG findings. Among the 45 patients diagnosed with seizures, 27

Table II: EEG findings and final diagnoses of patients with seizures

EEG Findings	Epilepsy diagnosed	No epilepsy	Total
Abnormal	27	0	27
Normal	7	11	18
Total	34	11	45

Table III: Neuroimaging findings

Neuroimaging Findings	n (%)
Arachnoid cyst	16 (45.7)
Nonspecific findings	7 (20)
Venous anomaly	4 (11.1)
Cystic formations other than arachnoid cyst	3 (8.7)
Sinusitis	1 (2.9)
Cerebellar ectopia	1 (2.9)
Optic glioma	1 (2.9)
Chiari malformation	1 (2.9)
Bifrontal polymicrogyria	1 (2.9)
Total	36 (100)

had abnormal EEG findings consistent with epilepsy. In the remaining 18 patients, although EEG results were normal, the clinical history supported a seizure diagnosis. Of these, 7 had recurrent episodes fulfilling epilepsy criteria, 4 had febrile seizures, and 7 were classified as first afebrile seizures. Forty-five patients remain under the supervision of pediatric neurology. The patients' data are presented in Table II.

Neuroimaging was not conducted in 321 patients (62.2%), while cranial magnetic resonance imaging (MRI) was performed in the remaining 193 patients. Thirty-six patients exhibited abnormal imaging results. Table III presents the neuroimaging results. The predominant neuroimaging observation was an arachnoid cyst. The second most prevalent results, including millimetric gliotic foci and ventricular asymmetry, were categorized as nonspecific.

When all patients were evaluated as a result of history, laboratory and neuroimaging findings, 389 patients (75.6%) were diagnosed with vasovagal syncope, 53 patients (10.3%) with psychogenic syncope, 45 patients (8.75%) with seizure, 23 patients (4.5%) with cardiogenic syncope and 4 patients (0.85%) with syncope caused by hypoglycaemia. In the vasovagal syncope cohort, the largest among the patients, 268 individuals (68.9%) underwent EEG, while 136 individuals (35%) underwent cranial MRI. One hundred eight patients (27.8%) underwent both procedures.

Cardiogenic syncope was diagnosed based on abnormal findings in physical examination, electrocardiography (ECG), and/or echocardiography. Prodromal symptoms were typically absent or minimal, in line with the expected clinical course of cardiogenic syncope. All cardiology evaluations were conducted by pediatric cardiologists. In the assessment of 23 patients diagnosed with cardiogenic syncope following ECG, echocardiography, and Holter monitoring, long QT syndrome was identified in 7 patients, arrhythmia in 6 patients, ventricular extrasystole (VES) in 6 patients, second-degree atrioventricular (AV) block in one patient, one patient presented with multiple ventricular septal defects (VSD), and one patient exhibited mitral valve prolapse.

The EEG and cerebral MRI were evaluated according to the quantity of syncope patients. The request rate for EEG was 60.8% during the initial syncope, and this rate escalated with the frequency of syncopes, achieving statistical significance ($p<0.001$). The MRI request rate was 27.5% following the initial syncope, and this rate escalated with the frequency of syncopes; however, statistical significance was not detected.

DISCUSSION

This study retrospectively evaluated the clinical and demographic characteristics of patients admitted to the pediatric neurology outpatient clinic for syncope. The average age of the 514 patients in our study was 12.86 years, with a standard deviation of 3.47 years; 62% of the patients were female. Literature indicates that the incidence of syncope rises during adolescence and is more prevalent among girls (1,6).

Analysis of syncope episode frequency revealed that 36.7% of patients experienced syncope only once, while recurrent cases represented a notable proportion as well. Prolonged standing, sudden standing, and the presence of infection were the most frequently reported triggering factors (11). The vasovagal mechanism is the predominant cause of syncope in childhood and adolescence, and these findings align with existing literature (12,13).

In this study, 69.5% of patients exhibited prodromal symptoms. Dizziness, transient visual loss, and nausea were the most frequently reported symptoms, particularly associated with vasovagal syncope (14). Prodromal symptoms may serve as a significant indicator in distinguishing the etiology of syncope. In cardiogenic syncope, the prodromal period is notably brief, while patients experiencing seizures typically report little to no prodromal period. In the majority of cases involving psychogenic syncope, the prodromal phase resembles that of vasovagal syncope. However, individuals experiencing vasovagal syncope typically regain consciousness quickly, while those with psychogenic syncope require a longer duration for recovery of consciousness (15-17).

Diagnostic tests play a crucial role in patient evaluation. In our clinic, EEG was conducted in 72.2% of patients, revealing a significant increase in the request rate for EEG as the frequency of syncope episodes rose ($p<0.001$). EEG is commonly

requested in instances of suspected seizure activity. Our study identified epileptiform abnormalities in 27 out of 371 patients who underwent EEG, leading to a diagnosis of epilepsy in these individuals. Seizures were diagnosed in 18 patients initially considered to have epilepsy based on clinical evaluation, despite normal EEG results. The findings indicate a clinical overlap between epilepsy and syncope, highlighting the utility of EEG as a diagnostic tool in suspected cases (18,19).

Analysis of neuroimaging evaluations revealed that 37.5% of patients had cranial MRI. Despite the rise in MRI requests correlating with an increase in syncope occurrences, no statistically significant difference was seen ($p>0.001$). Pathological abnormalities were identified in 16.6% of patients who underwent imaging, with arachnoid cysts and nonspecific gliotic alterations being the most prevalent results. Previous studies suggest that brain MRI often has limited diagnostic value in children presenting with syncope. In most cases, especially when the neurological examination is normal and the clinical history is typical, MRI findings are either unremarkable or incidental. Therefore, neuroimaging is usually recommended only for selected patients—those with unusual symptoms, abnormal neurological signs, or when there is a specific concern for an underlying structural cause. This approach helps avoid unnecessary procedures and focuses resources where they are most likely to be helpful (13,19-21).

The most common diagnosis was vasovagal syncope, consistent with previous literature, followed by psychogenic syncope as the second most frequent diagnosis. The majority of patients with psychogenic syncope had a history of at least two syncopes, and the mean number of syncopes was significantly greater than that of the remaining population. Forty-five individuals diagnosed with seizures and/or epilepsy were recorded in the system as experiencing syncope upon their clinic visit. The patients received a diagnosis of seizure or epilepsy following an assessment that included medical history, physical examination, and EEG findings. Cardiogenic syncope and hypoglycemia were the least prevalent categories. While cardiological causes are prevalent in adults, they are infrequent in children (22, 23).

First limitation of this study is the reliance on ICD codes to initially identify patients, which may introduce classification bias. Although manual chart reviews were conducted to confirm the diagnosis, retrospective data collection is inherently limited by the accuracy and completeness of medical records. Additionally, the absence of long-term follow-up data prevents the assessment of recurrence rates and long-term outcomes. Future prospective studies with extended follow-up periods could provide more comprehensive insights into pediatric syncope management.

CONCLUSION

In conclusion, our study demonstrates that syncope in childhood and adolescents primarily arises from benign etiologies, and unnecessary investigations can be avoided. EEG is a crucial diagnostic instrument for suspected seizures, although neuroimaging assessments should be conducted with greater selectivity. Despite the retrospective design of our study and the absence of long-term follow-up data, it offers insights that could enhance clinical practice in the management of pediatric syncope. Future extensive investigations may yield more accurate guidelines for the therapy of pediatric syncope.

Ethics committee approval

This study was conducted in accordance with the Helsinki Declaration Principles. The study was approved by Ankara Etlik City Hospital (15/04/2025, reference number: AEŞH-badek2-2025-008).

Contribution of the authors

Study conception and design: MD, YD; data collection: SS; analysis and interpretation of results: MD, ÖP, ÖPE; draft manuscript preparation: MD All authors reviewed the results and approved the final version of the article.

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Conflict of interest

The authors declare that there is no conflict of interest.

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