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Evaluation of Demographic, Clinical and Para clinical Characteristics of Children Admitted with Syncope in Shahid Motahhari Hospital from 2012 to 2020

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Abstract

Background: This study aimed to evaluate the precipitating factors, demographic characteristics, clinical and radiological manifestations, as well as the electroencephalographic, echocardiographic, electrocardiographic (ECG), and laboratory findings in children experiencing syncope; in addition the recurrence rates were assessed from 2010 to 2020.

Methods: This cross-sectional, retrospective study involved the collection of demographic information (age, sex, weight, and height), clinical signs (analyzed through the clinical course and available medical history), laboratory data, echocardiographic findings, electroencephalogram results, ECG readings, and brain imaging (CT or MRI) for children diagnosed with syncope at Motahari Hospital in Urmia, Iran, over a ten-year period from 2010 to 2020.

Results: A total of 61 children with syncope were included in the study, with a mean age of 8.3 years. Laboratory analyses, including Complete Blood Counts (CBC) and serum electrolytes, were within normal limits. The electroencephalogram did not demonstrate any significant abnormalities. The majority of subjects reported that syncope occurred while in a standing position.

Conclusion: Our findings suggest that there is no evident correlation between clinical and paraclinical findings and the occurrence of syncope. Nonetheless, additional assessments, including ECG, electroencephalography, and routine blood tests, may be essential for identifying potential serious underlying causes of syncope. The results of these investigations can guide clinicians in implementing further diagnostic and therapeutic measures.

Key Words: Children, Para clinical Findings, Signs and Symptoms, Syncope.

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1- INTRODUCTION

Syncope is defined as a transient loss of consciousness due to a reversible impairment of brain function, often resulting from a decrease in cerebral blood flow, leading to a rapid and sudden fall of the individual. It is a relatively common phenomenon in children, particularly during adolescence, and can induce considerable anxiety among parents, teachers, and peers. Approximately 15% of children will experience at least one episode of syncope before reaching adulthood, resulting in numerous visits to emergency departments and subsequent hospitalizations. This condition is frequently encountered in pediatric emergency settings (1).

The etiology of syncope in children is diverse, encompassing disorders of the autonomic nervous system as well as cardiac, neurological, psychological, and metabolic conditions. While transient syncope events in this population are often benign, they may occasionally indicate a more serious and potentially life-threatening underlying cause (2). Syncope in children younger than six years is relatively uncommon, with exceptions typically involving convulsive disorders, breath-holding spells, or rare primary cardiac arrhythmias. Cardiac syncope, in particular, poses a significant risk to life (3).

Diagnosing the etiology of syncope can be challenging, often resulting in the necessity for hospitalization, multiple consultations, and extensive diagnostic evaluations. Common causes include vasovagal syndrome (also known as neurocardiogenic syncope), arrhythmias, structural heart diseases, and orthostatic hypotension. Notably, vasovagal syndrome remains the most prevalent cause of syncope and is typically regarded as a benign condition (4). Conversely, cardiac dysrhythmia is a relatively rare cause of syncope in pediatric populations, while orthostatic hypotension tends to be more prevalent among older adults (3, 5). Additional conditions that may result in syncope include head trauma, seizures, cerebrovascular accidents (stroke), and disorders of the inner ear, dehydration, hypoglycemia, breath-holding spells, anemia, brain tumors, and vascular abnormalities such as aneurysms (5). Research indicates that cardiac causes, non-cardiac causes, and unknown etiologies account for approximately 30%, 40%, and 30% of syncope cases, respectively (6). Furthermore, other studies have revealed that around 3% of children initially diagnosed with syncope were later found to have an underlying seizure disorder (7).

The differential diagnosis of syncope in children encompasses serious conditions, including cardiac dysrhythmias and ventricular outflow tract obstructions, which warrant careful consideration, though being less common in pediatric populations than in adults (8). The symptoms reported by the patient before and after the syncope, along with the observations of bystanders during the event, can significantly assist in elucidating the underlying cause in the majority of cases (8). Electrocardiography (ECG) is recommended as a screening tool for atypical cardiac causes, particularly in instances with an undetermined initial diagnosis (9). It is essential to recognize that syncope is not a standalone disease but rather a symptom indicative of an underlying disorder; although it is often benign, it can occasionally signify a more serious condition that may lead to fatal outcomes (10). In cases of sudden cardiac death among children, it is estimated that approximately 8% had experienced a prior syncope episode (11). When syncope occurs during physical exertion, it may indicate a serious and potentially life-threatening underlying condition (12). A thorough evaluation is warranted for

patients who experience syncope during exercise or have a family history of syncope, sudden cardiac death, myocardial disease, or arrhythmias (13). Estimates suggest that about 1-2% of children with syncope possess an underlying disorder, highlighting the necessity of careful evaluation to enable healthcare providers to identify individuals with significant health concerns (12).

The diagnosis of syncope is predominantly clinical, and laboratory investigations, particularly in patients presenting with the neurogenic subtype, yields a limited diagnostic value. A comprehensive review of the patient's history is the most critical step in this context, significantly enhancing efficiency and reducing costs for both the patient and the healthcare system (11).

Based on a thorough history, physical examination, and a normal electrocardiogram, vasovagal syncope can often be diagnosed in the majority of patients. Additional diagnostic measures, such as echocardiography and ambulatory electrocardiogram monitoring (e.g., Holter monitoring), may be considered for those suspected of having primary cardiac abnormalities. Management strategies are contingent upon the underlying disorder. In evaluating vasovagal syncope, an inquiry into factors affecting systemic blood pressure is essential, and treatment typically involves increasing salt and water intake. For cardiac etiologies, prompt referral to a pediatric cardiologist is essential. In cases where non-proximal epileptic events are suspected, consultation with a psychologist or child psychiatrist may be necessary to identify and address underlying stressors. The primary objective in managing vasovagal syncope is to prevent recurrent episodes, thereby enhancing the patient's quality of life, alleviating mental stress, and minimizing school absenteeism through behavior modifications and lifestyle changes, with medication as a secondary option (10).

To date, there has been a limited amount of research on pediatric syncope within the country, with the majority of existing literature comprising case reports. This study aims to investigate the demographic, clinical, and paraclinical characteristics of children hospitalized with a diagnosis of syncope. Additionally, we will examine the factors that predispose these children to syncope, with the intent of identifying potential targets for intervention that may help prevent future episodes.

2- MATERIALS AND METHODS

Upon receiving ethical approval from the Ethics Committee of Urmia University of Medical Sciences, the study incorporated all children diagnosed with syncope at Shahid Motahari Hospital in Urmia between the years 2012 and 2020. The patients who did not meet the inclusion criteria were excluded from the study. Data collected from the patients' records encompassed demographic characteristics (age, gender, weight, and height), along with clinical symptoms and examinations based on the evaluation of the disease course and medical history. Furthermore, laboratory data, interpretations of echocardiograms, electroencephalograms, and electrocardiograms were reviewed. In cases where computed tomography (CT) scans or Magnetic Resonance Imaging (MRI) of the brain had been conducted, reports were obtained from the hospital's system. If reports were unavailable, data were accessed through the hospital's Picture Archiving and Communication System (PACS) and evaluated by a radiologist or pediatric neurologist. All findings were diligently recorded, compiled into a checklist, and entered into the relevant patient files. Descriptive statistics for qualitative variables were presented using tables and graphs, reflecting frequency and percentage

distributions. For quantitative variables, central tendency and dispersion indices were employed. Additionally, statistical tables and graphs were utilized to illustrate the data as necessary.

3- RESULTS

A total of 61 cases were analyzed. The mean age of the children was 8.3 ± 3.16 years, with an age range spanning from 1 to 14 years. In 9 instances, the weight of the child was not recorded in the files; however, the average weight of the remaining 51 children was 31.2 ± 13.8 kg, with a weight range of 10 to 90 kg.

Table1 presents laboratory data, including serum creatinine levels, serum urea levels, blood platelet counts, hemoglobin counts, and white blood cell counts (WBCs). The mean serum creatinine level among the children was 0.62 ± 0.10 mg/dL, with values ranging from 0.4 to 0.9 mg/dL. Additionally, the mean blood urea nitrogen (BUN) level for the children in the study was 12.31 ± 4.16 mg/dL, with a recorded range of 4 to 25 mg/dL. Both serum creatinine and BUN levels were found to be within the normal range for the age group under investigation.

Table 1: Descriptive statistics of the participants' laboratory data

Variable	Mean±SD	Minimum	maximum
Serum cr (mg/dl)	0.62±0.1	0.4	0.9
BUN(mg/dl)	12.31±4.16	4	25
Plt count(*103 per micro liter)	64.98±257.32	111	442
Hb(gr/dl)	12.53±0.91	10.5	14.9
WBCs count (per micro liter)	8120.85±2682.59	2000	15800

The mean levels of platelets, hemoglobin, and white blood cells (WBCs) in the 61 hospitalized children diagnosed with syncope were 257.32 ± 64.98 thousand per microliter (ranging from 442 to 111 thousand), 12.53 ± 0.91 g/dL (with values ranging from 10.5 to 14.8 g/dL), and 8120.85 ± 2682.59 cells per microliter (ranging from 2000 to 15800 cells per microliter), respectively. In the majority of cases, the hematological parameters of the patients were within the normal range for their age group.

An electroencephalogram was conducted for all 61 hospitalized children diagnosed with syncope, yielding no specific pathological findings indicative of neuroconvulsive disorders in any of the cases (100%). Additionally, among the 61 children studied, 15 underwent a brain CT scan. In 14 of these cases, no pathological abnormalities were identified; however, one case revealed arachnoid opacity measuring 35 x 45 mm in the left middle arachnoid cavity, situated anterior to the temporal lobe, without exerting a compressive effect on the temporal lobe itself.

MRI imaging was performed on 15 children, revealing no pathological findings in 13 cases. In one instance, evidence of sinusitis was noted, while another case exhibited an arachnoid cyst. Overall, there was no substantial evidence from the brain imaging or electroencephalogram data to support a pathological finding that could explain the disorder of consciousness.

In the cardiac assessments, all patients underwent an Electrocardiogram (ECG) at the time of hospitalization. Analysis of the available ECGs revealed an average corrected QT (QTc) interval of 0.39 ± 0.02 milliseconds, with a range of 0.3 to 0.44 milliseconds. The mean heart rate among the patients was 82 ± 8.6 beats per minute

(ranging from 50 to 105 beats per minute). No evidence suggestive of Wolff-Parkinson-White (WPW) syndrome was identified in any of the ECGs obtained. In a majority of cases, the electrocardiograms did not present any abnormal findings; however, one case exhibited a prolonged PR interval indicative of first-degree heart block, while another case demonstrated sinus bradycardia.

Echocardiography was conducted on 55 out of the 61 children in the study. Of these, 43 echocardiograms did not reveal any pathological findings. In two cases, mild Tricuspid Regurgitation combined with Pulmonary Insufficiency (TR+PI) was noted, while two additional cases exhibited mild Tricuspid Regurgitation (TR) and two cases showed mild Pulmonary Insufficiency (PI). Furthermore, one instance of Patent Foramen Ovale (PFO), abnormal pulmonary flow, small Patent Ductus Arteriosus (PDA), and minimal Mitral Regurgitation (MR), as well as one case involving both Atrial Septal Defect (ASD) and Ventricular Septal Defect (VSD) were identified. As illustrated in Figures 3-4, impaired consciousness, vertigo, and blurred vision emerged as the three most common complaints among hospitalized children diagnosed with syncope. Additionally, in 11 cases, the associated symptoms had a documented history of recurrence, while in another 11 cases, symptoms recurred multiple times.

Among the 61 children hospitalized with syncope, short-term amnesia was observed in two cases, attributed to the inability to recall events surrounding the syncope. Additionally, one case exhibited hyperreflexia, while two cases demonstrated temporary atony, rendering the child unable to walk. Furthermore, one case presented with tachycardia and tachypnea, and two cases were suspected of conversion disorder. No other focal neurological findings were documented in the remaining cases.

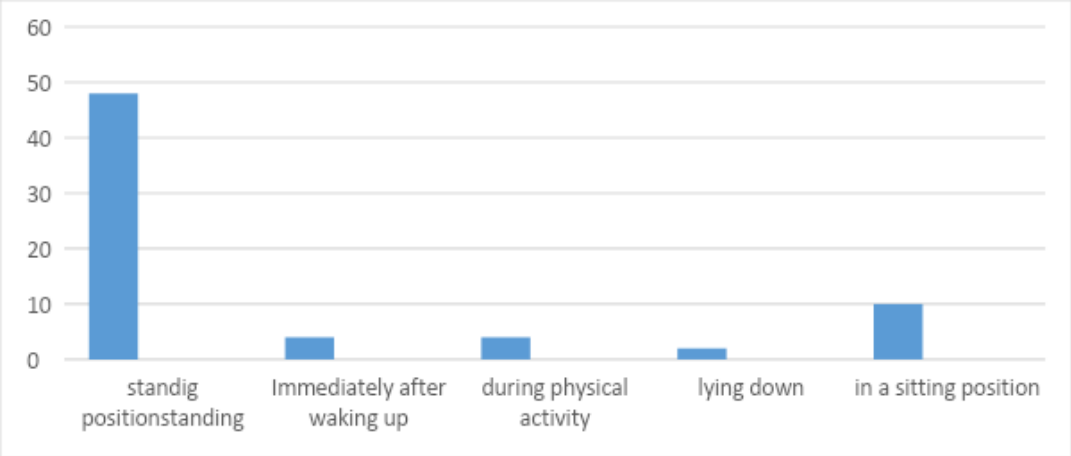

Fig. 1: Position of patients during the attack

Table 2: Frequency of clinical symptoms in the hospitalized children with syncope

Clinical manifestation	Impaired consciousness	Vertigo	Vomiting	Blurred vision	Lightheadedness	Nausea
Number of patient	46	38	15	17	14	10
percent	75.4%	62.3	24.6	27.8	23	16.4

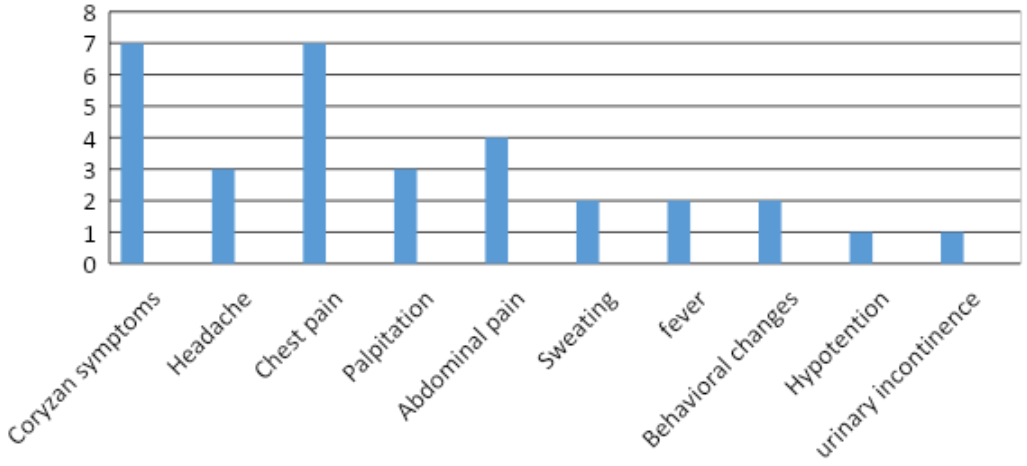

Fig. 2: Symptoms associated with an attack

4- DISCUSSION

Syncope is defined as a transient inability to maintain bodily position, resulting from reversible generalized hypoperfusion of the brain, which manifests as a temporary loss of consciousness. Typically, syncope is characterized by a complete and spontaneous recovery of short-term alertness. In children and adults, vasovagal syncope accounts for approximately 60-70% of cases. Additionally, psychogenic factors contributing to pseudocollapse, termed psychogenic pseudo-syncope, are recognized as non-physiological causes that occur without cerebral hypoperfusion. This phenomenon is classified under conversion disorders and is estimated to occur in about 9 to 11 percent of cases.

This retrospective study aimed to examine the demographic, clinical, and paraclinical characteristics of pediatric patients hospitalized with a diagnosis of syncope at Motahari Hospital between 2019. Additionally, the investigation sought to identify the underlying factors and comorbidities that contribute to the likelihood of syncope episodes in children, with the ultimate goal of informing strategies for preventing or mitigating the occurrence of initial or recurrent syncope attacks in this population.

Notably, there is a scarcity of research on this topic at both the national and provincial levels, highlighting the need for more comprehensive studies. The current study, which drew from a 9-year sample of all pediatric cases hospitalized for syncope at the provincial referral hospital, provides a valuable opportunity for generalizability to the broader population.

The demographic analysis of the present study revealed that the mean age of children hospitalized with a diagnosis of syncope at Motahri Hospital of Urmia over a 9-year period was 8.3±3.16 years, with a range of 1-14 years.

A comparison of the demographic characteristics of the present study with those of previous studies reveals some notable similarities. For instance, the mean age of 8.3±3.16 years in the present study is comparable to the mean age of 10.3 years reported by Massin et al., although the proportion of girls in the present study (59%) was higher than that reported by Massin et al. (42%)(2). In contrast, the study by Zhang et al. found a higher proportion of boys (55%) and a slightly older mean age (12 years)(17). Overall, the existing literature suggests that there is no clear difference in the incidence of syncope between boys and girls.

Regarding the laboratory findings, the present study concurs with the results of Demari et al. in that the initial laboratory data were not diagnostic, and most serum parameters were within normal ranges for all patients (7). Furthermore, the Electroencephalogram (EEG) results in the present study were unremarkable, with no evidence of seizure activity in any of the patients. This finding is consistent with the results of DeMario et al., who reported only one case of epilepsy among the EEGs performed (7). The studies by Ozme and Massin also failed to detect any pathological findings on EEG. These results collectively suggest that EEG is not a useful diagnostic tool for identifying the underlying cause of syncope in pediatric patients (2,6).

Numerous studies have emphasized the importance of cardiovascular system evaluation in patients presenting with syncope (6, 7, 14). In accordance with these findings, the present study identified mild to moderate valve dysfunction in some cases through echocardiography, highlighting the necessity of comprehensive cardiac examinations in patients with syncope. However, the results of the present study diverged from those of Ismaili et al., who reported a 5.6% incidence of prolonged QT interval, whereas no cases of prolonged QT interval were detected in the present study. Notably, only one case with a first-degree atrioventricular block was identified (19).

The neuroimaging findings in the present study were also consistent with those of the previous research. Specifically, all brain Computed Tomography (CT) scans and Magnetic Resonance Imaging (MRI) studies were non-diagnostic and non-pathological. Similarly, Zhang et al. and Demario et al. reported no pathological or diagnostic findings on brain imaging studies (7,17). These results collectively suggest that neuroimaging may not be a valuable diagnostic tool in the evaluation of pediatric patients with syncope, and that other diagnostic modalities, such as cardiac evaluation, may be more informative.

A comparative analysis of the present study with that of Hegazy et al. reveals some notable differences in the triggers and associated symptoms of syncope. While Hegazy et al. found that the most common triggering position for syncope was post-exercise, the present study identified prolonged standing as the most common precipitating factor (14).

In contrast to Hegazy et al.'s study, which reported palpitations as the most common symptom associated with syncope, the present study found that chest pain, coryza-like symptoms, and abdominal pain were the most frequently recorded symptoms. Additionally, rare but clinically significant symptoms such as hyperreflexia, atony, and short-term amnesia were also observed (14). These findings highlight the importance of a thorough clinical history, including the elucidation of pre- and post-syncopal symptoms, in accurately diagnosing the underlying causes of syncope. A comprehensive understanding of the symptom complex associated with syncope is essential for guiding diagnostic evaluations and informing management strategies.

5- CONCLUSION

In conclusion, the present study provides a comprehensive characterization of the clinical and paraclinical features of pediatric syncope. Notably, the majority of cases did not exhibit distinct clinical or paraclinical findings, nor did they reveal the underlying pathophysiological mechanisms. Nevertheless, complementary investigations, including electrocardiograms, electroencephalograms, and routine blood tests, are essential in uncovering potentially life-threatening underlying

causes of syncope. These diagnostic tools are considered a crucial first step in the evaluation of pediatric syncope, informing decisions regarding the need for further, more targeted investigations. The findings of this study underscore the importance of a systematic and multidisciplinary approach to diagnosing the causes of syncope in children, with the ultimate goal of guiding effective management and preventing adverse outcomes.

6- ETHICAL CONSIDERATIONS

This study was approved by Urmia University of Medical Sciences, with the ethical code of IR.UMSU.REC.1399.382.

7- ACKNOWLEDGMENTS

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8- CONFLICT OF INTEREST

Here we claim that there has been no conflict of interest in any part of evaluating the patients or thereafter in publishing this case report.

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