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Retrospective evaluation of patients admitted to the emergency department due to drowning

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Abstract

Retrospective evaluation of patients admitted to the emergency department due to drowning

Introduction: Drowning is a preventable process that can result in respiratory failure and death, and often occurs accidentally. In this study, it was aimed to evaluate the demographic characteristics and clinical course of the patients admitted to our emergency department in a district neighbouring a lake due to drowning.
Methods: Demographic characteristics, time of presentation, swimming ability, accident mechanism, predisposing factors, Glasgow coma scores (GCS), treatment, discharge, hospitalisation decisions, and mortality status of all patients admitted to our emergency department between January 2018 and January 2023 were recorded retrospectively from patient files and the digital automation system.
Results: Twenty (66.7%) patients were male and 10 (33.3%) were female; the patients wereaged between 6 months and 59 years, with a mean age of 14.06 years. An analysis of the site of incident revealed that 26 cases (86.6%) drowned in the lake and 4 cases (13.3%) drowned in a water canal. When we analysed the predisposing factors, it was found that one of the cases drowned after an accidental fall while walking on the rocks and one of the cases drowned after having chest pain and syncope. Among the cases with a GCS of 3, 1 of them died in the intensive care unit after 12 hours, 3 of them recovered with tracheostomy sequelae, and the remaining 14 cases died in the emergency department. Mortality was not observed in any of the 12 cases with a GCS of 14 or above. Fourteen cases died in the emergency department, 11 were referred to the intensive care unit, and 5 cases were discharged after emergency department follow-up. When we classified the patients according to Szpilman's clinical classification system, 8 cases were classified as Grade1, 4 cases as Grade 2, 16 cases as Grade 5, and 2 cases as Grade 6.
Conclusion: Raising awareness of families with children and increasing the necessary safety measures in water canals in summer months and in lakes is believed to reduce drowning-induced mortality. In addition to preventing drowning cases, providing the public with first aid training for drowning and healthcare professionals with appropriate assessment, intervention, and treatment algorithms may further reduce mortality.

Keywords: Drowning, Emergency Department, Retrospective Evaluation, Lakeside

INTRODUCTION

As per the recommendation of the World Health Organization (WHO), drowning was defined at the World Congress on Drowning, which was held in Amsterdam in 2002, as a process resulting from submersion/diving into a liquid medium, which progress when any liquid that prevents a person from breathing blocks that person's airway and breathing is impaired (1). Although it is a preventable public health problem as one of the causes of death resulting from unintentional injury with serious economic and health effects (2) while it is a type of accident causing a large number of deaths in our country (3), it is still an important but underrated universal public health problem (4).

Drowning is a completely preventable, acute, unexpected disaster that affects both adults and children. It is the third most common cause of accidental injuries, which is responsible for 7% of injury-related deaths (5). According to the data provided by WHO, drowning is one of the leading

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causes of death among children aged 5-14 years (6). Although the exact number is unknown, many new drowning cases occur each year in our country, particularly in summer months (7). In a domestic study, it was reported that 26.6% of drowning cases that took place between 2007 and 2011 occurred in sea, while the remainder occurred in natural or human-made fresh water environments such as rivers, lakes, and irrigation canals (3).

Factors such as duration of hypoxia, water temperature, timing and effectiveness of cardiopulmonary resuscitation, age of the victim, and the presence of comorbidities are important predictors of prognosis in drowning cases (8). In drowning cases, morbidity occurs due to anoxia and hypothermia, which culminate into metabolic acidosis as the common final pathway (9). Health outcomes of drowning survivors have longstanding effects, reaching up to severe injury to the brain or other organs (10). The remaining life of a drowning-survivor child with drowning-induced neurological deficit is deeply affected and long-term medical care may be needed. In a study it was reported that even 22% of children discharged without neurological sequela after a nonfatal drowning incident developed behavioral problems, communication problems, and learning disabilities at some point during their five-year follow-up (11).

Szpilman et al (12) developed the Szpilman clinical scoring, aiming to predict patient outcomes by evaluating them using vital signs and physical examination findings according to the scoring system at the accident scene.

In this study, it was aimed to assess the demographic features and clinical outcomes of drowning cases admitted to our district emergency department located near a lake.

METHOD

In this study, the information of male and female patients from all age groups who were admitted to a Secondary State Hospital's Emergency Service after 'drowning' between 01.01.2018 and 01.01.2023 was accessed from the hospital data automation system. The study included patients with adequate records regarding their age, sex, ability to swim, day of admission, month and season of admission, accident mechanism, predisposing factors, admission to the emergency department, Glasgow coma score (GCS), treatment-hospitalization-referral status, mortality status, and Szpilman classification at admission. GCS was divided into three subgroups according to the score obtained by the patients on admission to the emergency department in order to evaluate the mortality relationship significantly (13). At the same time, Szpilman's clinical classification was grouped into 2 subgroups to examine the relationship with mortality. Patients who did not meet the inclusion criteria and those whose medical information, especially vital signs could not be accessed were excluded.

Ethical approval

The design of the study was in line with the criteria of Helsinki Declaration. It was approved by Health Sciences University, Van Training and Research Hospital Clinical Studies Ethics Committee Chairmanship (Date and Decision

Statistical analysis

Statistical analyses were carried out with SPSS (IBM SPSS Statistics v.27) statistical software package. Frequency tables and descriptive statistics were used to interpret the findings. Categorical variables were expressed as % (percentage). Comparison of categorical variables was carried out using Chi-square test. Satistical significance was set at $p<0.05$.

RESULTS

A total of 30 patients were enrolled. The distribution of their demographic characteristics was shown on Table 1. Examining the age and gender distribution of the cases reveals that most victims are male (n = 20, 66.7%) and the 2–12 years age group was predominant (n=15, 50%) (Table 1).

Table 1. Distribution of the demographic characteristics of the patients

Variable (N=30)	n	%
Sex		
Female	10	33,3
Male	20	66,7
Age Distribution		
0-2	5	16,7
2-12	15	50
12-18	3	10
18-65	5	16,7
Over 65	2	6,7

The patient distribution with respect to ability to swim, temporal distribution of the cases, accident mechanism, and predisposing factors were shown on Table 2. A few patients (n=9, 30%) admitted to the emergency department due to drowning were able to swim, while the majority (n=9, 70%) were unable to swim. An analysis of the the temporal distribution of the cases revealed that 19 (63.3%) patients were admitted on weekdays and 11 (36.7%) presented on weekends. It was also observed that drowning cases (n=22, 73.3%) occurred predominantly in the summer months. When the predisposing factors were closely examined, drowning in a lake was found to be common (n=24, 80%).

The data on the vital signs of patients who were admitted to the emergency department due to drowning were shown on Table 3. According to Glasgow Coma Scale, the patients were grouped into three groups. There were more cases with a GCS

Table 2. Distribution of the cases by the ability to swim, temporal distribution of admissions, accident mechanism, and predisposing factors

Variable (N=30)	n	%
Ability to swim		
Present	9	30
Absent	21	70
Daily distribution of cases		
Weekdays	19	63.3
Weekend	11	36.7
Monthly Distribution of cases		
August	7	23.3
October	1	3.3
September	2	6.7
June	8	26.7
May	3	10.0
July	9	30.0
Seasonal distribution of cases		
Spring	5	16.7
Fall	3	10.0
Summer	22	73.3
Accident mechanism		
Acute Coronary Syndrome	1	3.3
Accident	29	96.7
Predisposing Factors		
Acute Coronary Syndrome in Lake	1	3.3
Drowning in Lake	24	80.0
Falling off the cliffs	1	3.3
Drowning in irrigation canal	3	10,.0
Falling into irrigation canal	1	3.3

between 3-5 (n=18, 60%) than those with a GCS between 10-15 (n=12, 40%). Of the patients presented to the emergency department, 13 patients died despite interventions, 11 were referred to the intensive care unit, and 5 were discharged. Fifteen out of a total of 30 patients died. Among the 15 survivors, 12 recovered without sequela. A mortality analysis by age revealed that those who died were mostly older than 12 years of age. According to the Szpilman classification, 12 patients had a score of 1-3, and 18 patients had a score of 3-6. Chi-square test of independence was performed to examine the relationship between mortality and sex, ability to swim, GCS, and Szpilman classification, the results of which were shown on Table 4. Mortality and sex were not significantly correlated ($p>0.05$). However, mortality and the ability to swim were significantly correlated ($p=0.014$). Death occurred

Table 3. Glasgow Coma Score, prognosis, mortality status, and Szpilman classification of the patients

Variable (N=30)	n	%
Glasgow Coma Score		
3-5	18	60.0
5-10	0	0
10-15	12	40.0
Treatment-hospitalization -referral status		
Deceased at emergency department	13	43.3
Admission to adult ICU	1	3.3
Deceased at scene	1	3.3
Referred to pediatric ICU	10	33.3
Discharge	5	16.7
Mortality status		
Survived	15	50
Deceased	15	50
Mortality status Detailed		
Recovery without sequela	12	40
Recovery with sequela (Tracheostomized)	3	10
Deceased	15	50
Szpilman classification		
1	8	26.7
2	4	13.3
3	0	0
4	0	0
5	16	53.3
6	2	6.7
Szpilman classification2		
1-3	12	40
3-6	18	60

in 88.9% of patients who could swim and 33.3% of those who could not. Mortality and Glasgow Coma Score were significantly correlated ($p<0.01$). Whereas 83.3% of patients with a GCS of 3-5 died, none of those with a GCS of 10-15 died. This suggests that mortality rate increased in patients with a lower GCS and it decreased in those with a high GCS. Mortality and Szpilman classification were also significantly correlated ($p<0.01$). No death occurred for a Szpilman score of 1-3 whereas 83.3% of patients with a Szpilman score of 3-6 died.

On Table 5, sex, ability to swim, GCS, and Szpilman classification of the surviving cases as well as the deceased were examined in detail.

Table 4. Examination of the correlations between mortality and sex, ability to swim, Glasgow Coma Score, and Szpilman classification

Variable (N=30)	Mortality				Statistical analysis* Likelihood
	No		Yes		
	n	%	n	%	
Sex					
Female	5	50	5	50	χ^2=0
Male	10	50	10	50	**p=1**
Ability to swim					
Present	1	11.1	8	88.9	χ^2=7.778
Absent	14	66.7	7	33.3	**p=0.014**
Glasgow Coma Score					
3-5	3	16.7	15	83.3	χ^2=16.806
10-15	12	100	0	0	**p<0.001**
Szpilman classification					
1-3	12	100	0	0	χ^2=16.806
3-6	3	16.7	15	83.3	**p<0.001**

Table 5. Examination of the correlations between mortality and sex, ability to swim, Glasgow Coma Score, and Szpilman classification

Variable (N=30)	Mortality						Statistical analysis* Likelihood
	Recovery without sequela		Recovery with sequela		Deceased		
	n	%	n	%	n	%	
Sex							
Female	4	40	1	10	5	50	χ^2=0.257
Male	8	40	2	10	10	50	**p=1**
Ability to swim							
Present	1	11.1	0	0	8	88.9	χ^2=6.999
Absent	11	52.4	3	14.3	7	33.3	**p=0.022**
Glasgow Coma Score							
3-5	0	0	3	16.7	15	83.3	χ^2=32.839
10-15	12	100	0	0	0	0	**p<0.001**
Szpilman classification							
1-3	12	100	0	0	0	0	χ^2=32.839
3-6	0	0	3	16.7	15	83.3	**p<0.001**

DISCUSSION

Drowning is one of the common and preventable causes of death, both around the world and in our country. Approximately 1000 people die as a result of drowning each year in our country (3,4). In this study, it was aimed to evaluate both the demographic features and the clinical outcomes of patients who presented to our emergency department due to drowning, and to raise the awareness of the regional people of drowning; it demonstrated that a great majority (66.7%) of drowning accidents affected males. Another study from Turkey reported that 84% of drowning victims were men (3). Two international studies reported from China and Iran also found similar results, reporting a greater percentage of men (13,14). This shows that men suffer more drowning accidents. This may be attributed to men showing a more dangerous behavior pattern in water, spending more time in water than women, and having more desire to swim alone, whereas women prefer to swim in safer environments (such as swimming in places with lifeguards nearby, swimming close to the shore) than men.

In this study, it was determined that drowning cases were mostly 2-12 years old. In a study conducted on drowning cases in Diyarbakir province, deaths mostly occurred in the 0-10 years age group, followed by 11-20 and 21-30 years age groups (15). In a study conducted by Dia L et al (13) from China, it was reported that the age groups with the highest frequency of drowning cases were found to be 5-9 and 10-14 years age groups. Morgenstern et al (16) from the USA found that for each adult person that is killed by drowning, 3.1 children are killed by drowning. A study reported from the United Kingdom revealed that 81% of all hospitalized drowning cases were 0-4 years old (17). In this study, it was determined that the age group highlighted is also similar. Accumulation of drowning cases in the childhood and young adulthood years can be explained by a lower ability to perceive danger and having a greater tendency to perform dangerous acts in these years of life. Adolescent children, particularly boys, are at increased risk of drowning due to their tendency of participating in more risky water activities and showing off their closed ones and families with their swimming abilities.

It was found that 70% of patients who presented to our emergency department after a drowning accident were unable to swim. No matter what the onset is, the ability to swim and drowning were not directly correlated. Even people who are very good at swimming may drown (4). The higher percentage of patients that were unable to swim can be attributed to the larger proportion of children in our group.

An analysis of the temporal distribution of the admitted cases showed that 63.3% of them presented to the emergency department on weekdays, which was believed to be due to a smaller number of people swimming during working hours, which may lead to underdetermining of drowning cases. A closer look at the seasonal distribution of the cases revealed that 73.3% of the cases occurred in summer. Studies published from our country have also reported that drowning cases frequently occurred in summer (18,19), paralleling to this study.

A retrospective South African study found that drowning accidents were more frequent in public holidays and summer (20). A study spanning four years which examined drowning cases by season and month found that the cases mostly occurred in summer months and also hot regions (21). Similar findings were obtained in another study reported from China (13). We believe that the cases mostly occurred in summer because this season is traditionally the holiday season, and people commonly prefer swimming for cooling off and having fun. Considering the geographical and socioeconomic status of our district located nearby a lake, we think that residents of the area prefer the lake for entertainment and holidays instead of traveling distant holiday resorts.

In this study, it was found that our results were inconclusive regarding predisposing factors and accident mechanisms, largely because of limited data due to the inability to obtain sufficient data from retrospectively scanned records.

According to the Glasgow Coma Score measured at the time of emergency department admission, the patients were grouped into two groups. There were 18 (60%) patients with a score of 0-5, and 12 (40%) patients with a score of 10-15. Thirteen patients who presented to the emergency department died despite interventions, 11 were sent to intensive care unit, and 5 were discharged. A total of 15 patients out of 30 died. Recovery without any sequela were observed in 12 of 15 patients that survived the incident. A domestic study concluded that, among those with a GCS above 14 at the time of hospital admission, the prognosis was good and no death occurred whereas those with a GCS of 4 or lower had a worse prognosis (22). Ballesteros et al (21) found that a GCS of 5 or lower was directly correlated to mortality among 43 cases followed at an intensive care unit after successful cardiopulmonary resuscitation. In another study conducted in Germany, a GCS below 3-5 was one of the poor prognostic indicators in drowning cases (23). In this study, it was found that, in line with the literature data, a GCS of 5 or lower was decisive in predicting a worse prognosis. It was also found that 83.3% of patients with a GCS of 3-5 died whereas none of those with a GCS of 10-15 died. These data indicate that the mortality rate increased in those with a low GCS while it decreased in those with a higher GCS.

According to the Szpilman classification in which patients were classified by the clinical presentation at admission, 12 patients had of score of 1-3 and 18 patients had a score of 3-6. Söyüncü et al (22) reported that all patients with a Grade 6 Szpilman score. In a study published in the Korean Journal of Pediatrics, it was found that Szpilman clinical scoring system might be as useful as consciousness level in predicting mortality according to clinical parameters at admission (24). In this study, it was also found that there was a significant correlation between mortality and Szpilman classification ($p<0.001$). According to the Szpilman classification, no patient with a score of 1-3 died whereas 83.3% of patients having a score of 3-6 died.

Limitations of the study

In this study dealt with parameters with low statistical significance owing to its small-scale and retrospective design. Since the scores of the scoring systems were calculated from the recorded data, we believe that prospective studies would be more beneficial for studying the subject more comprehensively. In addition, drowning cases occurring in sea were excluded by the study since we only reviewed drowning cases that occurred in lakes or irrigation canals.

CONCLUSION

Drowning, which is one of the preventable accidents, is a significant public health issue. Although children are particularly at risk, necessary safety measures and trainings should be specifically planned for different age groups. Clinical signs at emergency department admission and Szpilman classification are helpful in predicting the prognosis and mortality risk of drowning victims. It is important that citizens living in settlements located geographically near to lakes are trained about and made aware of drowning, and that healthcare staff working in hospitals' emergency services have a good grip of the current literature and practical applications on this subject.

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Peer-Review

Both externally and internally peer reviewed.

Conflict of Interest

The authors declare that they have no conflict of interests regarding content of this article.

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Ethical Declaration

Ethical permission was obtained from the Health Sciences University Van Training and Research Hospital Clinical Studies Ethics Committee Chairmanship approved the study (Date and Decision No. 04. 10. 2023, 2023/ 21-05) and Helsinki Declaration rules were followed to conduct this study.

Authorship Contributions

Concept: FB, MÇ, Design: FB, MÇ, Supervising: FB, MÇ, Financing and equipment: FB, MÇ, Data collection and entry: FB, MÇ, Analysis and interpretation: FB, MÇ, Literature search: FB, MÇ Writing: FB, MÇ, Critical review: FB, MÇ

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