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Clinical and Laboratory Features and Factors Determining the Outcome in Poisoning Children in a Tertiary Pediatric Intensive Care Unit: Eleven Years of Experience

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What is already known on this topic?

- *Acute poisoning in children is an important public health problem responsible for a substantial proportion of pediatric intensive care admissions.*
- *Some studies on this topic have described that children which are visiting the emergency department following intentional or unintentional drug overdose will not require intensive care unit interventions.*
- *Results from cohort studies evaluating poisoning show that determining the cause of poisoning is important for follow-up and treatment decisions.*

What this study adds on this topic?

- *Despite the high prevalence of gastrointestinal symptoms in cases of poisoning, we determined that monitoring these symptomatic patients in the pediatric intensive care unit (PICU) without treatment is often sufficient.*
- *We also showed that antidote therapy before admission to the PICU was strongly associated with the need for treatment in the intensive care unit.*

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ABSTRACT

Objective: This study aimed to evaluate the characteristics of patients admitted to a pediatric intensive care unit for poisoning and the factors associated with their outcomes.

Materials and Methods: Patients who were admitted to the pediatric intensive care unit for poisoning over the 11-year period between January 2010 and December 2020 were retrospectively analyzed. The patients' demographic characteristics, poisoning agent, whether the poisoning was unintentional or intentional (suicide attempt), clinical findings at admission, indication for hospitalization, antidote administered, and supportive and extracorporeal treatments were examined.

Results: During the study period, poisonings accounted for 9.4% (436/4653) of pediatric intensive care unit admissions. Of these, 419 patients with complete records were included in the analysis. Drug poisonings accounted for 81.9% of cases (multiple drugs in 38.5%). The most common drug group was central nervous system drugs (47%). Of the symptomatic patients, 56.5% had central nervous system-related findings and 55% had gastrointestinal findings. Before pediatric intensive care unit admission, 52.7% of the patients received activated charcoal and 7.4% received antidote therapy. In the pediatric intensive care unit, 68.9% of patients received no medical treatment, while 71.5% of those who received medical treatment had organ involvement. Multivariate logistic regression analysis to predict whether patients will require treatment during the intensive care follow-up showed that antidote administration before pediatric intensive care unit admission was associated with the need for medical treatment (odds ratio: 25.6, 95% CI: 6.8-96, $P < .05$). Three patients died, and the mortality rate was 0.72%.

Conclusion: Childhood poisoning is a widespread and important problem. Effective management in pediatric emergency and intensive care units contributes to patient survival without sequelae.

Keywords: Antidote, children, extracorporeal treatments, pediatric intensive care, poisoning

INTRODUCTION

Poisoning is among the most common medical emergencies in children and is responsible for a substantial proportion of pediatric emergency department and pediatric intensive care unit (PICU) admissions. The term poisoning refers to the ingestion of or exposure to a potentially life-threatening substance either by accident or for the purpose of self-harm or suicide. Acute poisoning can be caused by drugs, household chemicals, toxic gases, food and plant chemicals, and bites from toxic animals.[1]

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In the pediatric age group, poisoning most frequently occurs in children under the age of 5 years. These cases are usually accidents, because young children become increasingly mobile and agile during this period and are curious about their environment, which increases the risk of unintentional ingestion of pharmaceutical or chemical agents at home. In contrast, substance abuse and intentional self-harm are more prominent causes of poisoning in adolescents. Although children under the age of 5 comprise the majority of poisoning cases, a very small proportion of deaths are seen in this age group.[2] The overall mortality rate in childhood poisoning has been reported to be 3.9%.[3]

The aim of this study was to determine the demographic characteristics, indications for hospitalization, treatment, and outcomes of patients who were admitted to our PICU for poisoning for a 11-year period.

MATERIALS AND METHODS

Setting and Patients

The pediatric intensive care unit at the Ankara University Children's Hospital contains 20 beds where surgical and medical patients can be followed.. In addition, our pediatric hospital serves as an extracorporeal membrane oxygenation (ECMO) and heart and liver transplantation center.

This is a single-center, retrospective cross-sectional study that included patients between 30 days and 18 years of age who were hospitalized with a diagnosis of poisoning in the 11-year period from January 2010 to December 2020. Of 4653 patients admitted to the unit during the study period, poisoning was recorded as the admitting diagnosis for 436 of those patients. After excluding a total of 17 patients who had food poisoning, were over 18 years of age, or whose records did not indicate the poisoning agent, the final cohort of 419 patients was analyzed (Figure 1). Ethical approval was obtained from the Noninvasive Clinical Research Ethics Committee of Ankara University (Decision number: İ7-513-21).

Data Collection

Information about the patients' demographics, symptoms at admission, physical examination findings, laboratory results, whether the poisoning was unintentional or intentional (attempted suicide), the cause of poisoning and route of exposure, drug number and classification, time from exposure to receiving first aid, treatments received before PICU admission and while in the PICU, length of intensive care stay, and mortality were analyzed.

Definitions

In this study, poisonings were classified as unintentional or suicide attempt, and the causes of poisoning were categorized as drug and nondrug. Cases of drug poisoning were further categorized as single drug or multiple drug, and drugs were classified as those affecting the central nervous system (CNS), cardiovascular system (CVS), analgesic or muscle relaxants, and others. Central nervous system drugs included antiepileptic, antipsychotic, and antidepressant drugs. The "other" group included antibiotics, oral antidiabetic agents, iron, vitamins, antihistamines, colchicine, and unclassified drugs. Toxic gases, cleaning products, pesticides, chemicals, mushrooms, and intoxication by alcohol and substance use were grouped as nondrug causes.

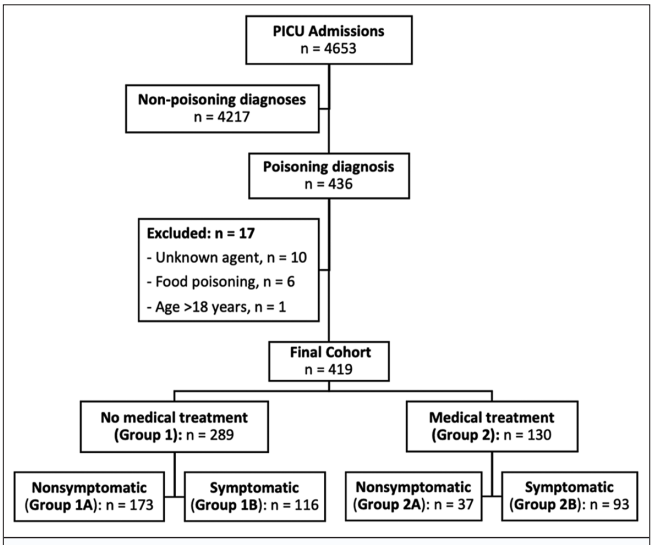

Figure 1. Distribution of patients in the study groups.

Intravenous fluid support administered either by the emergency response team or in the pediatric emergency outpatient clinic was categorized as a pre-PICU intervention in the study data. For all patients admitted to the PICU for intoxication, enteral nutrition was discontinued, and intravenous fluid support was administered in the intensive care unit. Intravenous fluid support given in the intensive care unit was not included as a treatment performed in the PICU in our statistical analyses. Therefore, children who did not receive any intervention other than intravenous fluid support during admission and follow-up in the PICU were included in the no-treatment group (group 1). Patients who had at least one treatment/procedure in the PICU, such as gastric lavage, activated charcoal, alkalization, symptomatic treatment for clinical signs and symptoms, intravenous lipid emulsion (ILE) therapy, antidote therapy, continuous renal replacement therapy (CRRT), therapeutic plasma exchange (TPE), and respiratory support, were included in the medical treatment group (group 2). In addition, patients were further subgrouped as nonsymptomatic (having no organ system involvement at admission or during follow-up in the PICU; groups 1A and 2A) and symptomatic (having involvement of at least one organ system; groups 1B and 2B) (Figure 1).

Statistical Analysis

The data were analyzed using Statistical Package for Social Sciences software version 23.0 (IBM Corp, Armonk, NY, USA). Mean, median, frequency distribution, and percentage values were used as descriptive statistics. Mean ± SD values were analyzed using parametric tests and median (minimum–maximum) values using nonparametric tests. Categorical variables were analyzed using Pearson's chi-square test and Fisher's exact test. Continuous data were tested for normal distribution using visual (histogram and probability graphs) and analytical methods (Kolmogorov–Smirnov/Shapiro–Wilk test). Mann–Whitney *U* test was used to analyze differences in median values for non-normally distributed variables. Univariate logistic regression model strategies were used to identify potential

risk factors for medical treatment in the intensive care unit. The variables which, $P < .25$ were clinically significant in univariate analysis included to the multivariate logistic regression analysis. Hosmer–Lemeshow test was used to assess model fit. $P < .05$ was considered statistically significant.

RESULTS

A total of 419 poisoning cases resulting in PICU admission between January 2010 and December 2020 (11 years) were included in the study (Figure 1).

Poisoning cases accounted for 9.4% (n = 436) of the 4653 patients admitted to the PICU during the study period, representing between 4.5% and 13.7% of total PICU admissions per year (Figure 2).

The cohort included 274 females (65.4%; female/male ratio 1.5:1). The median age of all patients was 117 months (range: 2–215). A significant difference in mean age was observed between the groups, with the children in group 2 being younger (Mann–Whitney *U* test, $P = .048$) (Table 1). Other demographic and clinical characteristics of the patients are summarized and compared by medical treatment group (groups 1 and 2) in Table 1.

When analyzed by age group, the sex distribution among patients aged 0–5 years [52% male (92/177) and 48% female (85/177)] and 6–10 years [44% male (8/18) and 56% female (10/18)] was similar, but females were predominant after the age of 11 [80% female (179/224) and 20% male (45/224)]. The patients' distribution by sex and age groups is shown graphically in Figure 3.

Patients in group 2 had a significantly longer mean time from exposure to receiving first aid (Mann–Whitney *U* test, $P = .0001$) (Table 1).

Before admission to the PICU, vomiting was induced by family in 10 patients (2.4%). Other interventions performed in the hospital before PICU admission included the administration of activated charcoal to 221 patients (52.7%), gastric lavage in 196 patients (46.8%), hydration in 139 patients (33.2%), antidote therapy in 31 patients (7.4%), and alkalization in 4 patients (1%).

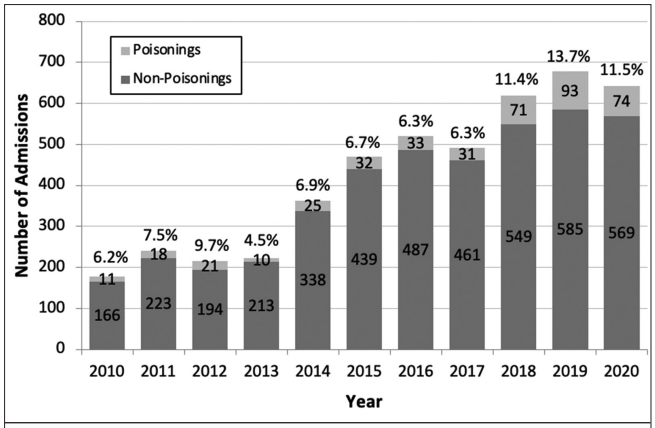

Figure 2. Proportion of poisoning cases among all pediatric intensive care unit admissions by year.

Antidotes given before PICU admission were *N*-acetyl cysteine in 19 patients (61.3%), oxygen in 6 patients (19.4%), silibinin in 3 patients (9.7%), atropine in 2 patients (6.4%), and dextrose in 1 patient (3.2%).

Multivariate logistic regression analysis including pre-PICU interventions (vomiting induced by family, activated charcoal, gastric lavage, alkalization, hydration, and antidote) and the variables of sex, age, and single- or multiple-drug use was performed to predict which group of patients would require treatment in the PICU (group 2). Of the variables included in the model, antidote therapy before PICU admission emerged as a significant predictor of receiving medical treatment while in intensive care (odds ratio: 25.6; 95% CI: 6.8–96; $P < .05$) (Table 2).

Comparison of symptomatic (involvement of at least one organ system) patients showed that drug intoxication was more frequent among symptomatic children who received no medical treatment in the PICU (group 1B) than in patients who received symptomatic treatment in the PICU (group 2B) (chi-square test, $P = .001$). There were no differences between group 1B and group 2B in terms of the type of poisoning (unintentional/intentional), drug number, or drug groups (Table 3).

In terms of organ involvement and clinical symptoms, 118 patients (56.5%) had neuropsychiatric involvement, and altered consciousness was the most common neuropsychiatric sign (n = 36, 17.2%). Convulsions occurred in 17 patients (8.1%) in our cohort. Both altered consciousness and convulsions were significantly more common in group 2B (Chi-square test, $P = .007$ and $P = .0001$). There was no difference between the symptomatic subgroups in terms of other neuropsychiatric findings (Table 3).

A total of 115 patients (55%) had clinical symptoms of gastrointestinal (GI) involvement, but the frequency of GI symptoms did not differ between groups 1B and 2B (Table 3). Cardiovascular system involvement was observed in 36 (17.2%) patients in our cohort. When the symptomatic subgroups were compared, bradycardia and hypotension were more common in group 2B (Chi-square test, $P = .001$ and $P < .05$). There were no other differences in CVS findings between the symptomatic subgroups (Table 3).

Among the patients who received medical treatment in the PICU (group 2, n = 130), 37 patients (28.5%) were asymptomatic (group 2A) and 93 (71.5%) were symptomatic (group 2B). The mean time from exposure to treatment was longer in group 2B than in group 2A (Mann–Whitney *U* test, $P = .001$) (Table 4). A higher proportion of patients in group 2A received a specific antidote to the poisoning agent compared to patients in group 2B (chi-square test, $P < .05$) (Table 4). There was no statistically significant difference between groups 2A and 2B in terms of the frequency of gastric lavage, activated charcoal, alkalization, ILE therapy, CRRT, or TPE in the PICU. As expected, the length of intensive care stay was longer in group 2B than in group 2A (Mann–Whitney *U* test, $P = .0001$) (Table 4).

Three patients (0.72%) in the cohort died. Two were cases of accidental poisoning. Both patients developed severe cardiac

Table 1. Distribution of Patients According to Demographic Characteristics and Treatment Status

Parameter	Total Number of Patients (n = 419)	Group 1 (n = 289)	Group 2 (n = 130)	*P*
Sex (female), n (%)	274 (65.4)	186 (64)	88 (68)	.507*
Body weight (kg), median (range)	37 (6-96)	42 (6-92)	44 (8-96)	**.014****
Age (months), median (range)	117 (2-215)	161 (2-213)	133 (14-215)	**.048****
Age group, n (%)				
0-5 years	177 (42)	133 (46)	44 (34)	
6-10 years	18 (4)	10 (4)	8 (6)	
>11 years	224 (54)	146 (50)	78 (60)	
Season of admission, n (%)				
Spring	119 (28.4)	82 (29)	37 (29)	
Summer	98 (23.4)	70 (24)	28 (21)	
Autumn	91 (21.7)	61 (21)	30 (23)	
Winter	111 (26.5)	76 (26)	35 (27)	
Type of poisoning, n (%)				.39*
Accidental	229 (54.7)	162 (56)	67 (52)	
Intentional (suicidal)	190 (45.3)	127 (44)	63 (48)	
History of intoxication, n (%)	32 (7.6)	24 (8)	8 (6)	.443*
Exposure route, n (%)				
Oral	405 (96.7)	285 (98.5)	120 (92)	
Inhalation	13 (3.1)	3 (1)	10 (8)	
Skin	1 (0.2)	1 (0.5)	0 (0)	
Cause of poisoning, n (%)				.078*
Drug	343 (81.9)	243 (84)	100 (77)	
Non-drug	76 (18.1)	46 (16)	30 (23)	
Number of drugs, n (%)				.9*
Single drug	211 (61.5)	150 (62)	61 (61)	
Multiple drugs	132 (38.5)	93 (38)	39 (39)	
Chronic drug use, n (%)	63 (18.4)	45 (19)	18 (18)	
Non-drug causes, n (%)				**.002***
Chemicals	67 (88.2)	45 (98)	22 (73)	
Toxic gases	9 (11.2)	1 (2)	8 (27)	
Time from exposure to first aid (minutes), median (range)	233 (10-2880)	140 (10-2880)	255 (15-2880)	**.0001****
PICU length of stay (days), median (range)	2 (1-25)	1 (1-7)	2 (1-25)	**.0001****

PICU, pediatric intensive care unit.
Group 1, received no medical treatment in the PICU; Group 2, received symptomatic treatment in the PICU.
*Chi-squared test.
**Mann–Whitney *U* test.
Significant values in statistical analysis.

dysrhythmia and subsequent cardiac arrest due to lighter fluid inhalation (13.5-year-old male) and ingestion of a cleaning agent (40-month-old female) and died during the first day in the PICU despite attempted extracorporeal cardiopulmonary resuscitation. The other fatality was a 12.5-year-old female who committed suicide with colchicine, which was her own prescribed medication.

DISCUSSION

Acute poisoning in children is an important public health problem responsible for a substantial proportion of pediatric intensive care admissions. Clinical course in these patients is variable; the most common reasons for intensive care admission are continuous monitoring of vital signs, close neurological follow-up, early detection of clinical deterioration, and, most importantly, support of vital functions.[4] Determining the cause of poisoning is important for follow-up and treatment decisions. Our comparisons of poisoning cases according to patient demographics, clinical and laboratory findings, and treatment received before and after PICU admission revealed significant differences between patient groups based on medical treatment and presence of symptoms. Despite the high prevalence of GI symptoms in cases of poisoning, we determined that monitoring these symptomatic patients in the PICU without treatment is often sufficient. We also showed that antidote therapy before admission to PICU was strongly associated with the need for treatment in the intensive care unit.

The epidemiology of poisoning is highly variable and depends on many cultural, social, and geographical factors. In previous studies, the frequency of PICU admission in poisoning cases

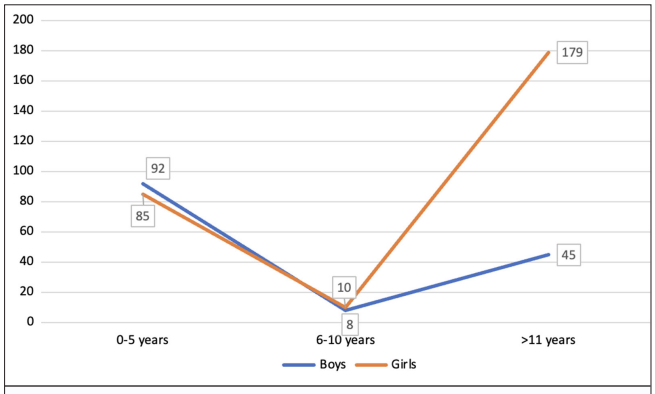

Figure 3. Sex distribution by age group.

was reported to be between 4.6% and 22.3%.[5-7] In our cohort, the rate of intensive care admission in poisoning cases was 9.4% (436/4653). Therefore, our results are consistent with the literature on this subject.

The studies conducted by Güngörer et al[1] and Berta et al[7] reported that females were predominant, both in the emergency department and in intensive care admissions. In a study examining poisoning cases over 23 years, it was reported that children aged 1-5 years represented 56.1% of intensive care admissions and that males predominated in this age group (25.5% in the 13-16 years age group).[8] In our study, 65.4% of the patients were female and 34.6% were male. When analyzed by age distribution, there were slightly more males in the 0-5 years age group (52%), whereas females predominated in the 6-10 years and over 11 years age groups (56% and 80%, respectively).

Antidotes play a critical role in the care of poisoned or overdosed patients. Although general patient management involving supportive interventions rather than specific antidotes has been accepted for poisoning cases, there are still some cases in which the use of specific antidotes would dramatically reverse the progression of toxicity.[9] Akgül et al[10] examined the results of 997 patients and reported that 2% received antidotes in the emergency department. In another study, 353 (20.4%) of 1728 patients who presented to the pediatric emergency department between January 2018 and June 2012 were given the antidote therapy before being admitted to intensive care.[11] In our study, 31 patients (7.4%) received antidotes before PICU admission. When we examined the relationship between pre-intensive care interventions and medical treatment during intensive care, an interesting finding was that patients who received antidote therapy before coming to the hospital or in the pediatric emergency department were in the group who received medical treatment while in the PICU. In addition, antidote therapy was a strong predictor that a patient would require medical treatment in the intensive care unit, unlike other pre-intensive care interventions such as gastric lavage, activated charcoal, alkalization, and hydration. A high proportion of patients in our cohort were symptomatic (n = 209, 49.8%). This may be a reason why the clinicians who first evaluated the patients before PICU admission decided to administer antidotes in the early period.

Table 2. Multivariate Logistic Regression Analysis of Risk Factors for Medical Treatment During Intensive Care

Parameter	Odds Ratio	95% CI		*P*
		Lower	Upper	
Sex	0.88	0.48	1.6	.668
Age (months)	1	0.99	1.07	.138
Number of drugs	1	0.57	1.7	.99
Vomiting induced by family	1.6	0.4	6.5	.53
Gastric lavage	1.4	0.4	5.6	.6
Activated charcoal	0.4	0.1	1.5	.16
Hydration	1.5	0.9	2.6	.162
Alkalization	3.2	0.4	26.4	.27
Antidote	25.6	6.8	96	**<.05**

In terms of organ involvement (being symptomatic) after poisoning, studies have indicated that the GI tract and CNS are most frequently affected.[12,13] Similarly, the most common findings in our study were related to the CNS (56.5%), followed by the GI tract (55%) and CVS (17.2%).

Some authors have stated that not all organ involvement in symptomatic patients is serious and that intensive care is not needed for the involvement of some systems.[5,14,15] Wiersma et al[15] suggested that patients without derangement of the parameters included in their COBRA (cardiac conduction, oxygenation, blood pressure, respiration, and awareness) performance system did not require ICU follow-up. In our study, we also noted that although patients were commonly symptomatic due to GI involvement (55%), GI tract findings were not associated with whether patients received medical treatment in the PICU. We observed that patients with clinical findings such as bradycardia, hypotension, respiratory support, altered consciousness, and convulsions required medical treatment during intensive care follow-up, consistent with the COBRA performance system.

The time between poisoning and hospital admission is very important for performing detoxifying interventions and initiating appropriate treatment. Muley et al[16] reported that a delay of more than 2 hours between poisoning and hospital admission was associated with severe disease and mortality. Similarly, among the patients in our cohort who received medical treatment, those who were symptomatic and required medical treatment in the PICU had longer delay between exposure and hospital admission.

Therapeutic interventions after poisoning can be summarized as preventing or reducing GI absorption of the toxic substance, decontaminating the skin and eyes, administering antidotes, if any, altering the metabolism of toxic substances, accelerating excretion, extracorporeal detoxification methods, and supportive therapy.[17,18]

The use of ILE therapy in toxicology has been increasing in recent years. Although it was previously used only for systemic toxicity caused by local anesthetic agents, it has recently become widely used in cases of lipophilic drug poisoning.[19] Intravenous lipid emulsion is now frequently used in the treatment of neuropsychiatric and cardiovascular drug intoxications.[20,21] Six patients in our cohort received ILE therapy. The

Table 3. Comparison of Clinical Characteristics in Symptomatic Patients

Parameter	Total Symptomatic Patients (n = 209)	Group 1B (n = 116)	Group 2B (n = 93)	*P*
Sex (female), n (%)	152 (72.7)	89 (76.7)	63 (67.7)	.147*
Body weight (kg), median (range)	47 (8–90)	47 (8–90)	45 (8–90)	.938**
Age (months), median (range)	180 (4–213)	153 (4–213)	134 (13–212)	.113**
Type of poisoning, n (%)				.103*
Accidental	97 (46.4)	48 (41.4)	49 (52.7)	
Suicide attempt	112 (53.6)	68 (58.6)	44 (47.3)	
Cause of poisoning, n (%)				**.001***
Drugs	164 (78.5)	101 (87)	63 (67.7)	
Non-drug	45 (21.5)	15 (13)	30 (32.3)	
Number of drugs, n (%)				.680*
Single	97 (59.1)	61 (60.4)	36 (57.1)	
Multiple	67 (40.9)	40 (39.6)	27 (42.9)	
Drug groups, n (%)				
Analgesic+muscle relaxant use	57 (27.3)	32 (27.6)	25 (27)	.295*
CNS medication use	59 (28.2)	41 (35)	18 (19.4)	.119*
CVS drug use	19 (9)	11 (9.5)	8 (8.6)	.725*
Other drug use	29 (14)	17 (14.7)	12 (13)	.718*
Organ involvement, Yes				
GI tract, n (%)	115 (55)	66 (57)	49 (52.7)	
Nausea/vomiting	113 (54)	64 (55.2)	49 (52.7)	.720*
Abdominal pain	22 (10.6)	11 (9.4)	11 (11.8)	.583*
CVS, n (%)	36 (17.2)	14 (12)	22 (23.7)	
Tachycardia	14 (6.7)	9 (7.8)	5 (5.4)	.494*
Bradycardia	9 (4.3)	0 (0)	9 (9.7)	.001*
Hypertension	5 (2.4)	4 (3.4)	1 (1.1)	.384*
Hypotension	20 (9.6)	2 (1.7)	18 (19.4)	.0001*
Respiratory, n (%)	21 (10)	0 (0)	21 (22.6)	.0001*
Neuropsychiatric, n (%)	118 (56.5)	60 (51.7)	58 (62.4)	
Headache	13 (6.2)	4 (3.4)	9 (9.7)	.064*
Altered consciousness	61 (29.2)	25 (21.6)	36 (38.7)	**.007***
Convulsion	17 (8.1)	0 (0)	17 (18.2)	**.0001***
Mydriasis	8 (3.8)	5 (4.3)	3 (3.2)	.735*
Myosis	4 (1.9)	3 (2.6)	1 (1.1)	.631*
Nystagmus	1 (0.5)	1 (0.9)	0 (0)	1*
Ataxia	3 (1.4)	3 (2.6)	0 (0)	.256*
Dystonia	2 (1)	0 (0)	2 (2.2)	.197*
Metabolic, n (%)	21 (10)	3 (2.6)	18 (19.4)	**.0001***
Electrolyte disturbance	7 (3.3)	0 (0)	7 (7.5)	**.003***
Metabolic acidosis	11 (5.2)	3 (2.6)	8 (8.6)	.065*
Hematologic, n (%)	5 (2.4)	1 (0.9)	4 (4.3)	.174*
Time from exposure to first aid (minutes), median (range)	180 (15–2880)	330 (15–2880)	540 (15–2880)	.327**
PICU length of stay (days), median (range)	1 (1–25)	1 (1–7)	3 (1–25)	**.0001****

CNS, central nervous system; CVS, cardiovascular system; GI, gastrointestinal, PICU, pediatric intensive care unit.
Group 1B, symptomatic patients who received no medical treatment in the PICU; Group 2B, symptomatic patients who received medical treatment in the PICU.
*Chi-squared test.
**Mann–Whitney *U* test.
Significant values in statistical analysis.

cause of poisoning was CVS drugs in 3 patients (amlodipine, n = 2; propranolol, n = 1), an antipsychotic in 2 patients (olanzapine), and an antidepressant in 1 patient (amitriptyline). One of the patients in our cohort had persistent signs of severe cardiac depression despite receiving standard treatment for propranolol poisoning and was successfully treated with ILE.[21]

Extracorporeal treatments are a removal method used in poisoning cases where conventional treatments have limited effectiveness. While CRRT and TPE are the methods most commonly used for this purpose, intermittent hemodialysis, hemoperfusion, and ECMO are also included among these treatment modalities.[22] In cases of poisoning, it is important to

Table 4. Comparison of Critical Interventions in Patients Receiving Medical Treatment

Parameters	Received Medical Treatment (n = 130)		*P*
	Asymptomatic (n = 37)	Symptomatic (n = 93)	
Age (months), median (range)	143 (18-213)	136 (7-215)	.112**
Time from exposure to first aid (minutes), median (range)	83 (30-300)	540 (15-2880)	**.001****
Gastric lavage (yes), n (%)	3 (8.1)	4 (4.3)	.405*
Activated charcoal (yes), n (%)	8 (21.6)	15 (16.1)	.459*
Alkalization (yes), n (%)	1 (2.7)	11 (11.8)	.177*
Lipid infusion (yes), n (%)	0 (0)	6 (6.5)	.182*
Antidote (yes), n (%)	29 (78.3)	41 (44)	**.0001***
Continuous renal replacement therapy (yes), n (%)	0 (0)	3 (3.2)	.558*
Therapeutic plasma exchange (yes), n (%)	0 (0)	4 (4.3)	.577*
Extracorporeal membrane oxygenation (yes), n (%)	0 (0)	2 (2.2)	1*
PICU length of stay (days), median (range)	1 (1-4)	3 (1-25)	**.0001****
Survival, n (%)			.558*
Alive	37 (100)	90 (96.8)	
Death	0 (0)	3 (3.2)	

PICU, pediatric intensive care unit.
*Chi-squared test.
**Mann–Whitney *U* test.
Significant values in statistical analysis.

select an extracorporeal treatment specific to the toxin. Agents with high water solubility and low molecular weight, low distribution volume, and low plasma protein binding are maximally removed from the blood by hemodialysis. Therapeutic plasma exchange is a suitable treatment method for toxins with large molecular size (>50 kDa) and high protein binding (>95%).[23] In their review of 14 studies, Jander et al[24] reported that TPE performed together with conventional treatment significantly reduced mortality in patients with mushroom poisoning. The authors stated that TPE is more effective when initiated no later than 36 to 48 hours after mushroom ingestion.[24] Nine patients in our cohort underwent extracorporeal treatment (TPE, n = 4; CRRT, n = 3; ECMO, n = 2). In our study, 3 patients with mushroom poisoning and 1 patient who intentionally overdosed on colchicine were successfully treated with TPE. In our cohort, CRRT was performed for detoxification in 2 patients with theophylline and valproic acid poisoning and as supportive therapy in 1 patient with acute renal failure after lighter fluid poisoning.

In the literature, mortality rates in cases of childhood poisoning generally vary between 0% and 5%.[3,8,12] A mortality rate of 0.4% was reported in a study evaluating poisoning cases admitted to a PICU in the USA, while this rate was 8.9% in another study conducted in children in India.[17,25] In our study, we determined that the poisoning-related mortality rate in our PICU was 0.72% (2 unintentional non-drug poisonings and 1 intentional drug overdose). The fact that most fatal cases were accidental is a reminder of the importance of raising families' awareness of this issue.

This study has some limitations. First, patient data were reviewed retrospectively and therefore, as in other retrospective studies, the effects of socioeconomic status were not analyzed. Second, the actual number of patients who presented to the pediatric emergency department for poisoning during the study period could not be determined. As a result, it was not possible to calculate the PICU admission rate for all poisoning cases seen in the pediatric emergency department of the hospital. Despite these limitations, the study has several strengths. Our study covers a period of 11 years and demonstrates temporal changes in the rate of PICU admissions for poisoning in our hospital over this period. In addition, we determined that although these patients are often symptomatic because of the high prevalence of GI symptoms in poisoning cases, monitoring in the PICU without treatment is usually sufficient. Finally, we showed that receiving antidote before PICU admission was a strong predictor that the patient would require treatment in the intensive care unit.

CONCLUSION

Childhood poisoning constitutes a substantial part of pediatric emergency and intensive care admissions and remains one of the leading causes of preventable morbidity and mortality in children worldwide. Therefore, emergency and intensive care units equipped with adequate supplies of antidotes, sufficient monitoring capabilities, and experienced physicians and assistant health personnel are essential for an effective treatment approach to poisoning cases. Pediatric emergency and intensive care units are the departments primarily responsible for identifying and treating patients presenting for confirmed or suspected poisoning, and they also play a vital role in these patients' survival.

Ethics Committee Approval: Ethical committee approval was received from the Ethics Committee of Ankara University (Approval No: İ7-513-21).

Informed Consent: Informed consent was not required because of the retrospective nature of the study and the analysis used is anonymous clinical data.

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