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Türk Hijyen ve Deneysel Biyoloji Dergisi

Evaluation of extracorporeal treatment methods in poisoned patients admitted to a university hospital

Bir üniversite hastanesine başvuran zehirlenme olgularına uygulanan ekstrakorporeal tedavi yöntemlerinin değerlendirilmesi

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ABSTRACT

Objective: This study aims to describe characteristics of poisonings in patients who were treated with extracorporeal methods between January 01, 2011 and December 31, 2017 in Dokuz Eylul University Drug and Poison Information Center (DEUDPIC).

Methods: This cross-sectional and descriptive study included patients who received extracorporeal treatment for poisoning. The data were obtained from the hospital automation system, extracorporeal treatment unit forms, and DEUDPIC forms. The severity was classified using the Poisoning Severity Score, and Glasgow Coma Scores (GCS) were recorded. Statistical analyses involved Kolmogorov-Smirnov tests for normality, Student's t-test for parametric comparisons, and Mann-Whitney U test for non-parametric data. Risk factors for mortality in specific common drug toxicities are determined using logistic regression analysis. Analyses were conducted using SPSS-24.

Results: A total of 75 cases participated in the study. The mean age was 51.5±19.7 years, with 60% of

ÖZET

Amaç: Bu çalışmanın amacı, 01 Ocak 2011-31 Aralık 2017 tarihleri arasında Dokuz Eylül Üniversitesi Tıp Fakültesi İlaç ve Zehir Danışma Merkezine (DEÜTF-ZDM) danışılan ve ekstrakorporeal tedavi yöntemleri uygulanan zehirlenme olgularının değerlendirilmesidir.

Yöntem: Bu kesitsel ve tanımlayıcı çalışma, zehirlenme nedeniyle ekstrakorporeal tedavi yöntemi uygulanan hastaları kapsamaktadır. Veriler, hastane otomasyon sistemi, ekstrakorporeal tedavi ünitesi formları ve DEÜTF-ZDM kayıt formlarından elde edilmiştir. Zehirlenme şiddeti, Zehirlenme Şiddet Skoru kullanılarak sınıflandırılmış, hastaların Glasgow Koma Skoru (GKS) kaydedilmiştir. Normalite analizi için Kolmogorov-Smirnov testi, parametrik veriler için Student-t testi ve parametrik olmayan veriler için Mann-Whitney U testi uygulanarak gerçekleştirilmiştir. En sık görülen zehirlenmelerde mortaliteyi etkileyen risk faktörlerini belirlemek için lojistik regresyon analizi uygulanmıştır. Verilerin analizi, SPSS-24 yazılımı kullanılarak yapılmıştır.

Bulgular: Çalışmaya 75 hasta dahil edildi. Ortalama yaş 51.5±19.7 yıl olup, %60'ı erkekti. En

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cases being male. Methanol (37.3%), lithium (18.7%), carbamazepine (10.7%), and digoxin (6.7%) caused the most poisonings, respectively. Extracorporeal treatment was used for "increasing the elimination of the substance exposed" in 74.7% of the cases for "renal support" in 25.3%, and the method was hemodialysis in all. Specific antidote treatment was applied to 29.3% of all cases and 67.9% of methanol poisonings. The most common complication of hemodialysis was hypotension (28%). A majority of the patients (73.3%) necessitated intensive care unit support. Three patients recovered with sequelae (4%), and 21 (28%) died. Among patients who suffered from methanol poisoning, pH<7.00, serum creatinine (SCr)>1.2 mg/dL, and lower GCS were associated with mortality in univariate analysis. In the multivariate regression analysis, the sole independent predictor of mortality was found to be the GCS (OR 0.62, 95% CI 0.39-0.99, p=0.05).

Conclusion: Despite adequate hemodialysis, mortality rate is high in the setting of common drug poisonings. A low GCS is the only independent predictor of mortality in the setting of methanol poisoning.

Key Words: Poisonings, methanol, hemodialysis, toxicity

fazla zehirlenmelere neden olan maddeler sırasıyla metanol (% 37,3), lityum (% 18,7), karbamazepin (% 10,7) ve digoksin (% 6,7) olarak tespit edildi. Ekstrakorporeal tedavi, vakaların %74,7'sinde "maruz kalınan maddenin eliminasyonunu artırmak" için, %25,3'ünde "renal destek" için kullanıldı ve tüm hastalara uygulanan yöntem hemodiyalizdi. Spesifik antidot tedavisi, tüm olguların %29,3'üne ve metanol zehirlenmelerinin %67,9'una uygulandı. Hemodiyalizin en sık komplikasyonu hipotansiyondu (%28). Hastaların çoğunluğunda (%73,3) yoğun bakım ünitesi ihtiyacı vardı. Üç hasta (%4) sekelle iyileşirken, 21 hasta (%28) hayatını kaybetti. Metanol ile zehirlenen hastalarda, pH<7.00, serum kreatinin (SCr)>1.2 mg/dL ve düşük GCS tek değişkenli analizde mortalite ile ilişkilendirildi. Çok değişkenli regresyon analizinde, mortalitenin tek bağımsız belirleyicisi GCS olarak bulundu (OR 0.62, %95 CI 0.39-0.99, p=0.05).

Sonuç: Yeterli hemodiyalize rağmen, ilaç zehirlenmelerinde ölüm oranı yüksektir. Düşük GCS, metanol zehirlenmesi durumunda ölüm oranının tek bağımsız belirleyicisidir.

Anahtar Kelimeler: Zehirlenme, metanol, hemodiyaliz, toksisite

INTRODUCTION

Poisonings are common health problems that may cause morbidity and mortality. According to the annual reports of the American Association of Poison Control Centers (AAPCC), the number of poisoning cases in 2022 was more than two million on average (1). In poisoning, extracorporeal therapy methods can be applied to increase the excretion of the substance from the body in cases when the level of the ingested agent in the blood is too high and/or there is insufficiency in the elimination organs. Extracorporeal therapy methods can be classified as intermittent hemodialysis, peritoneal dialysis, intermittent hemofiltration/hemodiafiltration, hemoperfusion, exchange transfusion, therapeutic plasma exchange, continuous renal replacement therapy, and extracorporeal membrane oxygenation (2-6). These methods can be used for both the removal of toxic agents and renal support. Lithium, ethylene glycol, methanol, valproic acid, salicylate, carbamazepine, theophylline, and tricyclic antidepressants are the most common poisonings in which extracorporeal therapy methods are used (7-9). AAPCC 2022 report shows that extracorporeal therapy methods are used in 0.13% of the poisoning

cases (1). However, in our country, there is limited data on the type and frequency of extracorporeal decontamination methods and for which poisoning agents they are applied, and the outcomes of poisoning cases.

This study aimed to find out the characteristics of hospital admission, demographic data, poisoning characteristics, clinical signs and symptoms, extracorporeal therapy and non- extracorporeal therapy methods applied, clinical follow-up and outcomes in poisoning cases who were consulted to Dokuz Eylul University Drug and Poison Information Center (DEUDPIC) between January 01, 2011 and December 31, 2017 and in whom extracorporeal therapy methods were applied. Determination of factors related to mortality in the common subgroup of toxicities is provided.

MATERIAL and METHOD

The study included cases admitted to Dokuz Eylul Hospital between January 01, 2011, and December 31, 2017, for poisoning, who were 18 years old and older and who had undergone extracorporeal therapy for treatment. Patients younger than 18 years of age and patients whose medical records were not accessed were excluded from the study.

DEUDPIC is a center working for the diagnosis and treatment of poisoning cases admitted to Dokuz Eylul University Hospital for detection, evaluation, prevention, and risk analysis. DEUDPIC records each case on a registration form. Data from registration forms, Probel Hospital Information Management System, and Extracorporeal Treatment Unit patient medical records were used in this investigation.

A nephrologist guided DEUDPIC to treat poisoning patients with hemodialysis. Drug blood levels were measured at the hospital before and after hemodialysis. The "Poisoning Severity Score" (PSS) was utilized to grade all DEUDPIC patients who had extracorporeal therapy as asymptomatic (0), mild (1), moderate (2), severe (3), or death (4) (10). In addition, Glasgow Coma Scores of the patients at the time of admission were evaluated (11).

Kolmogorov-Smirnov tests were performed for normality analysis. Categorical variables are presented as percentages, numeric variables are given as mean±standard deviation or median with the range, as appropriate. In the comparison of means, Student's t-test was used in parametric measurements, while the Mann-Whitney U test was used in non-parametric measurements. Chi-square test and Fisher's exact test were used to compare the numerical variables. Predictors of mortality were determined by using logistic regression analysis. Age, sex, and factors that were significantly associated with mortality in univariate analysis were included in the multivariate model. Results are shown as odds ratios (OR) with a 95% confidence interval. The data were analysed with SPSS-24 (SPSS INC., Chicago, IL, USA) software.

The study was approved by the Non-Interventional Research Ethics Committee of Dokuz Eylul University (Date: 04.10.2018 and Number: 2018/24-19).

RESULTS

Between 2011 and 2017, extracorporeal therapy was applied to 75 of the 831 (9.03%) poisoning cases consulted to DEUDPIC. Median age of the patients was 50 (18-88) years, and 60.0% were male. Acute poisoning (58.7%) was statistically significantly higher when compared with other types of poisoning (25.3% were chronic and 16.0% were acute on chronic) ($p<0.001$). It was found that 58.7% of the poisonings were unintentional, while 41.3% were intentional. It was determined that 40.0% of the female cases and 42.2% of the male cases had taken the agent intentionally ($p=0.848$). The rate of intentional exposure in the 18-49 age group was found to be statistically significantly high when compared with those aged 50 years and older (62.2% and 21.1%, respectively, $p<0.001$). The most common route was oral (97.3%) in all poisonings.

The most common agents causing poisoning in

cases treated with extracorporeal therapy were methanol (37.3%), lithium (18.7%), carbamazepine (10.7%), and digoxin (6.7%), respectively. It was found that 74.7% (56 cases) of all cases had been exposed to a single agent, while 22.7% (17 cases) had been exposed to more than one agent. Two (2.7%) cases were exposed to unknown agents (Table 1).

Table 1. Demographic and clinical characteristics of all patients

Characteristics	Female n=30 (%40.0)	Male n=45 (%60.0)	Total n=75 (100.0)
Age (year) (median, min-max)	50 (18-88)	49 (18-82)	50 (18-88)
Time of admission (hour)			
0-12	8	10	18
13-24	1	6	7
24<	3	6	9
Unknown	18	23	41
Type of poisoning			
Acute	9 (20.5)	35 (79.5)	44 (100.0)
Chronic	13 (68.4)	6 (31.6)	19 (100.0)
Acute on chronic	8 (66.7)	4 (31.6)	12 (100.0)
Route of poisoning			
Peroral	30 (41.1)	43 (58.9)	73 (100.0)
Inhalation	-	1 (100.0)	1 (100.0)
Unkown	-	1 (100.0)	1 (100.0)
Reason of poisoning			
Intentional	12 (38.7)	19 (61.3)	31 (100.0)
Unintentional	18 (40.9)	26 (59.1)	44 (100.0)
Unknown	-	-	-
GCS (median, min-max)	15 (3-15)	15 (3-15)	15 (3-15)
Toxin			
Single	21 (37.5)	35 (62.5)	56 (100.0)
Multiple	8 (47.1)	9 (52.9)	17 (100.0)
Methanol	2 (7.2)	26 (92.8)	28 (100.0)
Lithium	10 (66.7)	5 (33.3)	15 (100.0)
Carbamazepine	5 (62.5)	3 (37.5)	8 (100.0)
Digoxin	5 (100.0)	-	5 (100.0)
Metformin	3 (75.0)	1(25.0)	4 (100.0)
Others	4 (30.8)	9 (69.2)	13 (100.0)
Unknown	1 (50.0)	1 (50.0)	2 (100.0)
PSS			
Asymptomatic	1 (50.0)	1 (50.0)	2 (100.0)
Mild	10 (55.6)	8 (44.4)	18 (100.0)
Moderate	8 (40.0)	12 (60.0)	20 (100.0)
Severe	11 (31.4)	24 (68.6)	35 (100.0)

Table 1 (cont.). Demographic and clinical characteristics of all patients

Characteristics	Female n=30 (%40.0)	Male n=45 (%60.0)	Total n=75 (100.0)
Age (year) (median, min-max)	50 (18-88)	49 (18-82)	50 (18-88)
Clinical sign and symptoms			
Central nervous system	22 (39.3)	34 (60.7)	56 (100.0)
Acid-base disorders	13 (29.5)	31 (70.5)	44 (100.0)
Gastrointestinal system	12 (54.5)	10 (45.5)	22 (100.0)
Urinary system	12 (57.1)	9 (42.9)	21 (100.0)
Visual system	2 (14.3)	12 (85.7)	14 (100.0)
Cardiovascular system	3 (42.9)	4 (57.1)	7 (100.0)
Respiratory system	1 (16.7)	5 (83.3)	6 (100.0)
Reason of haemodialysis			
Remove the toxin or metabolite	19 (33.9)	37 (66.1)	56 (100.0)
Renal support	11 (57.9)	8 (42.1)	19 (100.0)
Complications associated with haemodialysis			
Hypotension	4 (19.0)	17 (81.0)	21 (100.0)
Clot formation in the catheter	4 (22.2)	14 (77.8)	18 (100.0)
Catheter-associated problems before dialysis	2 (66.7)	1 (33.3)	3 (100.0)
Nausea-vomiting	1 (50.0)	1 (50.0)	2 (100.0)
Catheter-associated problems after dialysis	1 (100.0)	-	1 (100.0)
Fever	-	1 (100.0)	1 (100.0)
Specific antidote therapy	2 (9.5)	19 (90.5)	21 (100.0)
Mechanical ventilation need	2 (10.5)	17 (89.5)	19 (100.0)
Admission			
Intensive care unit	19 (34.5)	36 (65.5)	55 (100.0)
Medical ward	11 (55.0)	9 (45.0)	20 (100.0)
Duration of hospital stay (median, min-max)	3 days (3 hours-84 days)	3 days (15 hours-53 days)	3 days (3 hours-84 days)
Outcome			
Alive	23 (42.6)	31 (57.4)	54 (100.0)
Dead	7 (33.3)	14 (66.7)	21 (100.0)

GCS: Glasgow Coma Scale; PSS: Poisoning Severity Score
Percentages are calculated by row.

Median time elapsed from exposure to hospital admission was 23.4±33.5 hours, and 24.0% of admissions occurred within the first 12 hours. Clinical signs and symptoms of the patients at admission were classified according to PSS. While 2.7% (2 cases) of patients were asymptomatic, 24.0% (18 cases) had mild, 26.7% (20 cases) had moderate, and 46.7% (35 cases) had severe clinical signs and symptoms. The mean GCS at admission was 11.4±4.5.

Overall, the most common symptoms and findings were related to central nervous system complaints (74.7%), acid-base disorders (58.7%), and gastrointestinal system (29.4%) complaints, respectively. While the most common central system symptom was orientation-cooperation disorder (26 cases, 34.7%), it was followed by unconsciousness (14 cases, 18.7%), speech disorder (5 cases, 6.7%), tendency to sleep (5 cases, 6.7%) and other (6 cases, 8.0%) signs and symptoms. Acidosis (pH<7.35) was found in 58.7% (44 cases) of all cases.

The extracorporeal therapy method applied to all patients was "hemodialysis" (100.0%). Indications for hemodialysis were to increase the elimination of the exposed agent (74.7%, 56 cases) and renal support (25.3%, 19 cases).

Serum lithium, carbamazepine, digoxin, theophylline, phenytoin, ethanol, and blood carboxyhaemoglobin levels for carbon monoxide could be measured. Drug levels were monitored in 34 patients (45.3%) before hemodialysis and in 32 patients (42.7%) after hemodialysis. While all drug levels measured before hemodialysis treatment were toxic, 84.4% were found to decrease to non-toxic levels after hemodialysis.

No complications developed during hemodialysis in 36 patients (48.0%), and at least one complication was found to develop in 34 patients (45.3%). It was not known whether complications developed in five patients (6.7%). The most common complications related with hemodialysis were hypotension (28.0%), clot formation in the catheter (24.0%), and catheter-associated problems before hemodialysis (4.0%).

All patients received supportive care in addition to hemodialysis. Twenty-two (29.3%) patients received specific antidote treatment. Nineteen of these were suffering from methanol intoxication. Twenty (26.7%) of the patients were hospitalized in the medical ward, 55 (73.3%) needed intensive care support, and 19 (34.5%) of these who needed intensive care received respiratory support with mechanical ventilation. The number of male patients who required mechanical ventilation was found to be statistically higher when compared with female patients (p<0.002). Median duration of hospital stay was 3 days (3 hours - 84 days). Forty-one (54.7%) patients were discharged with complete recovery, 8 (10.7%) refused treatment and were lost to follow-up, and 2 (2.7%) were transferred to another hospital. Three (4.0%) of the cases recovered with sequelae, and 21 (28.0%) died (Figure 1). Except for the cases whose deaths were reported, the others were stated as "alive" (Table 1). It was found that the most common poisoning agent in the patients who died was methanol (52.4%), followed by digoxin (23.9%), lithium (9.5%), phenytoin (4.8%), tramadol (4.8%), and verapamil (4.8%), respectively.

Patients with methanol poisoning

The mean age of methanol poisonings was 51.1±12.9 (18-71) years. 60.7% of the cases were aged 50 years and older. The number of male cases was higher than the number of female cases (92.9% and 7.1%, respectively). It was found that 25.0% of methanol poisonings were intentional, while 75.0% were unintentional. The relationship between the reason of poisoning and gender was analysed, and it was determined that none of the female patients were exposed to methanol intentionally, while this rate was 26.9% in male patients. The time of admission was 32.5±24.5 hours in methanol poisoning. According to hospital records, discharge with wellness, leaving the hospital or voluntary discharge, discharge with sequelae, and transfer to another hospital were grouped as "survival group" (n=17, 60.7%). The cases whose deaths were reported in hospital records were considered the "non-survival group" (n=11, 39.3%). Clinical follow-up and results of the cases poisoned by methanol are shown in Tables 2 and 3.

The mean of GCS at admission was 10.95±4.72, and it was found that all the patients with <8 GCS at the time of admission died. The most common clinical sign and symptom after acidosis (pH<7.35) (96.0%) was related to the central nervous system (71.4%). The most common central nervous system symptom

was orientation-cooperation disorder (10 cases, 35.7%), followed by unconsciousness (5 cases, 17.9%), seizure (3 cases, 10.7%), syncope (1 case, 3.6%), agitation (1 case, 3.6%) and others (2 cases, 7.1%).

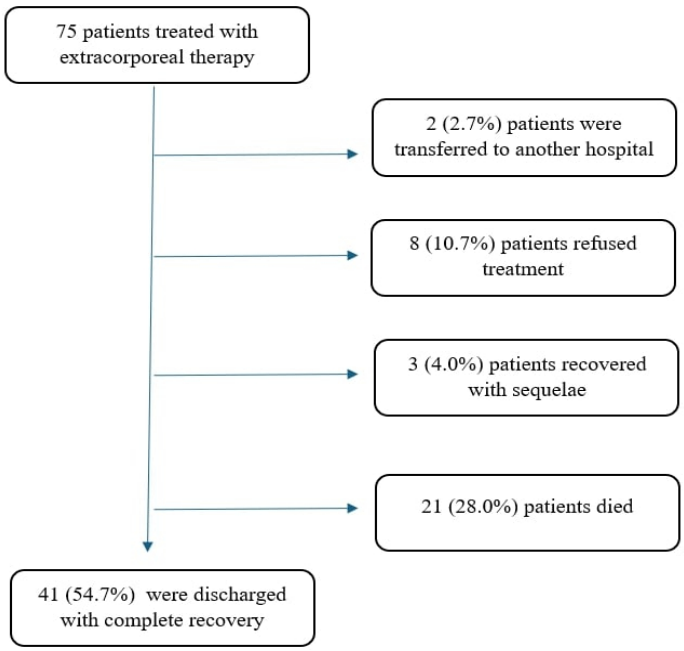

Figure 1. Follow-up and outcome characteristics of poisoning cases.

Table 2. Demographic and clinical characteristics of methanol poisonings

Characteristics		Survival group n (%)	Non-survival group n (%)	x2	*p**
Age (year)	<50 (n=11)	10 (90.9)	1 (9.1)	6.925	**0.016**
	≥50 (n=17)	7 (41.2)	10 (58.8)		
Gender	Female (n=2)	2 (100.0)	0 (0.0)	1.394	0.505
	Male (n=26)	15 (57.7)	11 (42.3)		
Time of admission (hour)	≤24 (n=8)	5 (62.5)	3 (37.5)	2.864	0.209
	>24 (n=6)	6 (100.0)	0 (0.0)		
Reason of poisoning	Intentional (n=7)	6 (85.7)	1 (14.3)	2.446	0.191
	Unintentional (n=21)	11 (52.4)	10 (47.6)		
GCS	<8 (n=7)	0 (0.0)	7 (100.0)	12.320	**0.001**
	≥8 (n=15)	12 (80.0)	3 (20.0)		
PSS	0-1-2 (n=9)	7 (77.8)	2 (22.2)	0.249	1.619
	3-4 (n=19)	10 (52.6)	9 (47.4)		
pH	<7.00 (n=12)	4 (33.3)	8 (66.7)	6.601	**0.019**
	≥7.00 (n=16)	13 (81.3)	3 (18.8)		

Table 2 (cont.). Demographic and clinical characteristics of methanol poisonings

Characteristics		Survival group n (%)	Non-survival group n (%)	x2	*p**
Mechanical ventilation need					
	Yes (n=12)	4 (33.3)	8 (66.7)	4.812	**0.028**
	No (n=13)	10 (76.9)	3 (23.1)		
Comorbidity					
	Yes (n=19)	11 (57.9)	8 (42.1)	0.197	1.000
	No (n=9)	6 (66.7	3 (33.3)		
Complications associated with haemodialysis					
	Yes (n=19)	7 (77.8)	2 (22.2)	1.619	0.249
	No (n=9)	10 (52.6)	9 (47.4)		
Specific antidote therapy					
	Yes (n=19)	14 (73.7)	5 (26.3)	4.169	0.095
	No (n=9)	3 (33.3)	6 (66.7)		
Admission					
	Intensive care unit (n=25)	14 (56.0)	11 (39.3)	2.174	0.258
	Medical ward (n=3)	3 (100.0)	0 (0.0)		

GCS: Glasgow Coma Scale; PSS: Poisoning Severity Score
**: Chi-square test and Fisher's exact test.*
Survival group (n=11): discharged with wellness + discharged voluntarily + discharged with sequelae + leaved the hospital + transferred to another hospital
Non-survival group (n=18): Cases whose deaths were reported in hospital records

Table 3. Characteristics of methanol poisonings

Characteristics	Survival group Median (min-max)	Non-survival group Median (min-max)	*p*¥
Age (year)	46 (18-66)	59 (48-71)	**0.007**
pH	7.08(6.77-7.30)	6.82 (6.75-7.21)	**0.008**
HCO_3 (mmol/L)	8.1(5.3-23.4)	5.8(4.7-9.5)	**0.003**
SCr (mg/dL)	0.89 (0.57-17.87)	1.41 (0.82-1.95)	**0.005**
GCS	15 (8-15)	7 (3-15)	**0.001**

SCr: Serum Creatinine
GCS: Glasgow Coma Scale
¥: Mann-Whitney U test.
Survival group (n=11): discharged with wellness + discharged voluntarily + discharged with sequelae + leaved the hospital + transferred to another hospital
Non-survival group (n=18): Cases whose deaths were reported in hospital records

Patients who survived had more optimal values of pH, HCO3, and better levels of GCS compared to those who died ($p<0.05$). Patients who experienced mortality were older and had higher levels of serum creatinine ($p<0.05$). Predictors of mortality among patients who had methanol intoxication are shown in Table 4. In univariate analysis, pH<7.00, SCr level >1.2 mg/dl, and lower GCS were associated with mortality among patients who suffered from methanol intoxication. In the multivariate regression analysis, the sole independent predictor of mortality was found to be the GCS (OR 0.62, 95% CI 0.39-0.99, p=0.05).

Table 4. The results of the univariate and multivariate analysis on the factors associated with mortality in methanol poisoning

Variable	Univariate analysis			Multivariate analysis		
	OR	**95% CI**	***p***	**OR**	**95% CI**	***p***
Age	1.14	1.03-1.26	0.014	1.09	0.94-1.27	0.268
Female sex	N/A	-	-	-	-	-
HCO_3	0.54	0.29-1.02	0.058	-	-	-
pH<7.00	8.67	1.53-49.2	0.015	0.94	0.04-24.9	0.971
pH<7.10	4	0.66-24.3	0.132	-	-	-
SCr>1.2	5.69	1.08-30	0.040	3.29	0.1-108	0.504
GCS	0.65	048-0.89	0.006	**0.62**	**0.39-0.99**	**0.050**

SCr: Serum Creatinine
GCS: Glasgow Coma Scale

DISCUSSION

In this study, 75 patients who were treated with extracorporeal therapy for poisoning in a 7-year period were evaluated. The number of patients was lower than reported studies in other countries (12-14), but it was higher than reported studies in Turkey (2,15-19) (Table 5). These other countries in the literature reflect the data of the national databases of each country, while the present study is the evaluation of only the poisoning cases admitted to Dokuz Eylul University Faculty of Medicine hospital in Izmir.

In a large number of studies in the literature, it has been reported that the number of women is higher than that of men in poisoning cases (1,2,15,16,20,21). In the present study, it was found that 60% of the cases were male. This difference from the literature can be due to the fact that only poisoning cases with severe clinical signs and symptoms that required the administration of the extracorporeal therapy method were included in the present study. In studies conducted by Jon B. Cole et al. and Ghannoum et al. in which poisoning cases that applied the extracorporeal therapy method, the number of male cases was found to be higher (52.5% and 53.9%, respectively) (14,22), similar to the present study. Similarly, in a large number of studies in the literature, it has been reported that most of the cases poisoned with methanol are men (76-92%) (23-25). Emma Kuusela et al. found that 82.1% of the methanol and ethylene glycol poisoning cases that were treated with hemodialysis were male (19,26). In line with the literature, it was found that 60% of all poisoning cases that applied extracorporeal therapy and 92.9% of the methanol poisoning cases were male in the present study.

There are conflicting results regarding the reasons of poisoning in various studies. In a study conducted in Iran, it was reported that more than half of the poisonings were intentional (suicide attempt, misuse) (27). Similarly, the 2014 Drug and Poison Information Center report also showed that intentional poisonings were frequent (approximately 67%) (2). However, the 2022 AAPCC report and 2017 annual report of the Israel Poison Information Center showed that unintentional poisonings were more frequent (76% and 74%, respectively) (1,20). Jon B. Cole et al. reported that 61% of the poisoning cases that applied extracorporeal therapy were unintentional (22). Similarly, it was found in the present study that approximately 60% of the cases had been exposed to the poisoning agent unintentionally.

Table 5. Studies reporting poisoning cases treated with extracorporeal therapy

Authors	Year	City/Region	Period	Number of patients treated with extracorporeal therapy
National				
Aydin B. *et al.*[2]	2017	İzmir/Turkey	1 year	2
Aydin K. *et al.*[15]	2020	Kayseri/Turkey	1 year	9
Baydin A. *et al.*[18]	2005	Samsun/Turkey	3 years	21
Canakci SE. *et al.*[16]	2018	Aydin/Turkey	3 years	14
Mutlu M. *et al.*[17]	2010	Black Sea Region/Turkey	5 years	2
Orhan U. *et al.*[19]	2022	Adana/Turkey	5 years	55
International				
Campion GH. *et al.* [12]	2019	New York City/USA	16 years	502
Darracq MA. *et al.* [13]	2012	California/USA	10 years	90
Ghannoum M. *et al.* [14]	2015	United States	29 years	40.258
		United Kingdom	2 years	343
		Denmark	9 years	481
		Canada	24 years	2709

In a study conducted by Holubek et al. in a 21-year-long period, it was stated that hemodialysis had an increasing trend in the choice of extracorporeal therapy method in poisoning cases, whereas the haemoperfusion method was preferred with a decreasing frequency (28). In an 11-year-long period study by Darracq et al., the most commonly preferred extracorporeal therapy method was hemodialysis; neither hemodialysis nor hemoperfusion and hemofiltration showed any temporal increase (13). Data from Turkey showed that the most preferred extracorporeal therapy method in poisoning patients was hemodialysis (42.85%), followed by hemoperfusion (35.72%), plasmapheresis (14.28%), and hemofiltration (7.15%) (16). In the present study, it was found that the extracorporeal therapy method chosen for poisoning cases in Dokuz Eylul University hospital was hemodialysis for all patients, while methods such as hemofiltration, hemoperfusion, hemodiafiltration, or plasmapheresis were not preferred as an extracorporeal therapy method in any of the patients. The reason why hemodialysis was preferred over other extracorporeal therapy methods can be explained by the increase in the efficacy of hemodialysis treatment with the developments in technology, higher molecular weights becoming a suitable indication for hemodialysis, and the increase in the tolerability of hemodialysis by patients (28). Our results are consistent with the literature regarding the reason for hemodialysis treatment (13). The reason of applied hemodialysis treatment was “to increase the elimination of the agents exposed to” in 74.7% of the patients, and it was “renal support” in 25.3%. This result shows that hemodialysis may be preferred in cases of poisoning not only to increase the elimination of the active agent, but also for renal support in cases such as the development of renal failure related to the poisoning agent.

Among the non-extracorporeal therapy methods administered to the patients, it was determined that all cases received supportive treatment, and

approximately one-third (29.3%) were treated with specific antidote treatment. It was found that there were 34 cases poisoned with agents for which a specific antidote can be used (methanol, digoxin, and tramadol), and specific antidote treatment was administered to 19 (55.8%) of these cases. All of the cases that were treated with a specific antidote were methanol poisoning cases. Zakharov et al. reported that specific antidote (ethanol and/or fomepizole) was used in 90% of the methanol poisonings (23), while this rate was reported as 80% by Thanacoody et al (29). Paasma et al. reported the rate of fomepizole use as 16% and ethanol use as 84.0% (30). In the present study, it was found that 19 (67.9%) of the cases poisoned with methanol were administered specific antidote treatment (ethanol and/or fomepizole). The reason for the lower rate of antidote treatment can be explained by the difficulty in accessing specific antidotes in our country.

According to the data in Turkey, the rate of need for follow-up and treatment in the intensive care unit varies between 2.4% and 47% in poisoning cases (16,31-34). This rate is 1.5% in the United States of America (1), 0.9% in Israel (20), 15.3% in Iceland (35), 0.7% in Paris (36), and 2.23% in Iran (37). In none of these studies were cases included that would be severe enough to require extracorporeal therapy. In the study conducted by Ghannoum et al., poisoning cases in which extracorporeal therapy was applied were evaluated, and the need for follow-up, monitoring, and treatment in the intensive care unit was reported as 78.5% in the USA and 84.4% in Canada (14). Similarly, in the study conducted in Aydin, this rate was reported as 85.7% (16). In the present study, it was found that most of the cases (73.3%) developed a need for follow-up and treatment in the intensive care unit.

In research conducted, the rate of death varies between 4.6% and 35.0% in patients who applied extracorporeal therapy (14,16,38,39). The reason for this wide range may be that the clinical findings and treatment-related complications vary depending on the exposure agents in poisoning cases treated with extracorporeal therapy. In this study, which analysed poisoning cases in which the extracorporeal therapy method was applied, the mortality rate was found to be 28.0% (21 cases), in parallel with the literature.

Emma Kuusela et al. found that increased anion gap and low pH, bicarbonate levels, and low GCS and need for mechanical ventilation at admission to hospital in cases poisoned with methanol were correlated with 90-day mortality (6). Similarly, low pH, low GCS, insufficient hyperventilation, respiratory arrest, duration of hospital admission longer than 24 hours, presence of seizures, and coma at admission have been associated with poor prognosis or mortality (24,25,30,40). In this study, in line with the literature, age, GCS, presence of need for mechanical ventilation, serum levels of pH, HCO3, and SCr at hospital admission were associated with mortality in methanol poisoning. Low GCS, pH<7.00, and SCr >1.2 mg/dL were found to be a predictor factors of mortality in methanol poisoning.

In addition to being retrospective, cross-sectional, and descriptive, this study had several limitations. Standard record forms and hospital automation systems from previous dates may have caused data loss. A university hospital planned this study, thus, its results cannot be extrapolated nationwide. Multi-center studies are needed to gather data on extracorporeal treatment in poisonings in our nation.

In conclusion; DEUDPIC was consulted regarding 75 poisoning cases that applied extracorporeal therapy. The extracorporeal therapy method administered to all of the cases was hemodialysis, and the most frequent poisoning agent was found as methanol. It was found that approximately three-quarters of the patients were monitored in the intensive care unit, the majority of these patients were methanol poisoning cases, and 28% of all cases died. It is noteworthy that the age, GCS, presence of need for mechanical ventilation, serum levels of pH, HCO3, and SCr at hospital admission are factors associated with mortality in cases of methanol poisoning. Low GCS, pH<7.00, and SCr>1.2 mg/dL are factors predicting mortality in methanol poisoning. Monitoring these parameters may be helpful for clinicians in the management of methanol poisonings.

ETHICS COMMITTEE APPROVAL

* The study was approved by the Non-Interventional Research Ethics Committee of Dokuz Eylul University (Date: 04.10.2018 and Number: 2018/24-19).

CONFLICT OF INTEREST

The authors declare no conflict of interest.

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