Original Article

Comparative Study of Demographic and Toxico-Clinical Factors of Patients with Acute Poisoning Admitted to General Intensive Care Unit versus Specific Intensive Care Unit for Poisoning Cases

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Abstract

Background: There is no dedicated specific intensive care unit (ICU) for poisoning cases due to the small number of poisoned patients in some poisoning centers and patients may hospitalized in the general ICU. In this study, we compared the outcome of hospitalization in poisoning and general ICU, in matched patients to demographical and toxico-clinical factors.

Materials and Methods: This historical cohort study was conducted from September 2020 to January 2022 in the general and poisoning ICUs of Khorshid Hospital affiliated to the University of Medical Sciences, Isfahan, Iran. Patient characteristics, clinical, and toxicological information as well as the therapeutic measures and outcome were collected from hospital medical records and analyzed.

Results: Totally, 178 (60.1% male and 39.9% female) patients met inclusion criteria. Medicines (56.2%) and opioids (25.3%) followed by pesticides (14%) were the most common substances. Suicide was the type of exposure in 78.7% of the cases. Most patients suffered from lung (19.1%) and kidney (15.2%) injuries. The mortality rate was 23.6%. The median length of hospital stay (P-value < 0.001) and duration of ventilator usage was higher (P-value < 0.001) in general ICU compared to specific ICU for poisoning cases. No significant difference with respect to demographic, toxico-clinical variables and mortality rate was found between the two groups.

Conclusion: Among poisoned patients admitted to ICU, reported mortality rate was relatively high. Patients who hospitalized in the specific ICU for poisoning cases have lower length of hospital stay and duration of mechanical ventilation compared to general ICU.

Keywords: Intensive care units, mortality, poisoning

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Submitted: 23-Apr-2022; **Revised:** 20-May-2022; **Accepted:** 24-May-2022; **Published:** 30-May-2023

Introduction

Acute poisoning is one of the medical emergencies that requires prompt diagnosis and treatment.[1] Early detection of poisoning, careful monitoring and standard treatment can reduce complications and mortality. In poisoning emergencies, clinical outcomes are influenced by many factors such as the dose of drug/toxin used, the duration of exposure, and the patient's previous state of health.[2] The incidence of poisoning is increasing due to changes in lifestyle and social behavior,[3]

Access this article online

Quick Response Code:

Website: www.advbiores.net

DOI: 10.4103/abr.abr_125_22

How to cite this article: Nemati K, Mirzaee N, Babak A, Eizadi-Mood N. Comparative study of demographic and toxico-clinical factors of patients with acute poisoning admitted to general intensive care unit versus specific intensive care unit for poisoning cases. Adv Biomed Res 2023;12:142.

and considering advances in technology and community development nowadays pharmaceuticals, chemical substances and natural toxins are easily accessible in many countries, therefore the risk of poisoning for the general population increases every day.[4]

Most patients with acute poisoning only need supportive measures and recover without major events, however, a significant number of these patients will require intensive care unit (ICU).[5] In a study, 21% of all poisoned patients seeking medical care were admitted to the ICU.[6] In another study conducted from 2008 to 2018, acute poisoning patients accounted for about 2.7% of ICU admissions.[7] According to a published study in 2019, a patient with at least one of the following criteria was admitted to the ICU: Glasgow coma scale (GCS) less than 15, hypotension, bradycardia or tachycardia, high lactate level, acidic or alkaline pH.[8] In another study, respiratory failure, age more than 55 and a GCS less than six were the predictors for ICU admission. Also, ICU admission for patients poisoned with alcohol, carbon monoxide, arsenic and cyanide and those who have systolic blood pressure ≥130 mmHg were unnecessary.[9] The mortality rate of acute poisoning patients admitted to the ICU is estimated from 2.7 to 11.1% in various studies.[6,7,10]

One factor that distinguished poisoned ICU patients from other ICUs is the lower mortality rate in these patients. It has been reported that severe poisoning cases have a good prognosis, usually after a short period of hospitalization and receiving ICU care.[11] In a recent study conducted in Canada, mortality rate of 5.1% was reported for patients admitted to ICU due to acute intoxication.[12] In another study, which found that 21% of poisoned patients seeking treatment were admitted to the ICU, the mortality rate among these patients was estimated at 1.9%.[13] Significant proportion of acute poisonings occur among young adults that have no medical comorbidity; therefore as expected most patients can survive without complications. In many studies of the ICU patient population, all patients are admitted in one place and poisoned patients are not evaluated separately. In-hospital resource allocation, a lot of budget and expertise directed toward ICU because of its vital role in taking care of acutely ill patients. Care of critical patients in the ICU is a major and costly element in modern health care. Clinicians, hospital managers, policy makers, and researchers are concerned about high costs, increased demand, and variation in priorities in the ICU. Therefore, it is necessary to understand the variability of disease severity, cost and efficacy of ICU care among admitted patients.[14,15] It seems that epidemiological assessment of critical patients admitted to the ICU is essential to meet the current and future needs of the health care system. However, few studies have been published in this area.

In some poisoning emergency centers, there is a specific ICU for hospitalization of poisoning cases. However, there is no dedicated specific ICU for poisoning cases due to the small number of poisoned patients in some other hospitals. Also, patients with acute poisoning who need ICU admission sometimes admitted to the general ICU due to the lack of an empty bed in specific ICU for poisoning cases. Since the personnel of general ICU may not be very familiar with the poisoned patients in terms of the poisoning process, types of treatments and necessary cares, there will be a possibility of differences in patients' outcomes. Therefore, in this study, we compared the demographic, toxico-clinical variables and outcome of patients with acute poisoning admitted to the general ICU versus those hospitalized in the specific ICU for poisoning cases.

Materials and Methods

This was a historical cohort study that performed on poisoned patients who admitted to the poisoning emergency center of Khorshid Hospital, a poisoning referral center in Isfahan province, in the central part of Iran.

Patients with acute poisoning hospitalized in the specific ICU for poisoning cases and the general ICU from September 2020 to January 2022 were included in the study. Exclusion criteria included positive PCR test or history of symptomatic and confirmed Covid-19, referral from other hospitals or medical centers, and comorbidities including cirrhosis, chronic kidney failure required dialysis, severe heart failure and severe pulmonary insufficiency. Also Patients who transferred to other hospitals were excluded.

After admission of patients to the poisoning emergency room, they were managed under supervision of medical toxicologists. Based on local protocol and after intensive care unit specialist consultations, some patients transferred to the specific poisoning ICU. Indications for ICU admission were based on local protocol and consist of hemodynamic instability and low GCS score and were not different between two ICUs. In the absence of an empty bed in specific ICU for poisoning cases, patients were hospitalized in the general ICU of hospital. Patients received the necessary treatments in the both ICUs by medical toxicologists and intensive care unit specialist. Information of patients collected and recorded in the data collection form. The variables that were examined were: age, gender, occupation, marital status (single, married), addiction (opioids, stimulants), history of underlying disease (hypertension, diabetes, ischemic heart disease, liver, renal, pulmonary), type of poisoning agent, type of exposure (suicide, accidental, abuse) and route of poisoning (ingestion, injection, skin, inhalation, combined), clinical signs depending on the organs involved (central nervous system (CNS), renal, hepatic, pulmonary, cardiovascular), vital signs upon arrival and admission to the ICU, treatment measures (gastric lavage, charcoal administration, antidote, hemodialysis), interval between poisoning and hospitalization, intubation and duration of ventilator connection, duration of hospitalization, and outcome (recovery, death). Then the different variables compared between two groups of patients based on ICU admission (general versus specific for poisoning cases).

Patients were enrolled through convenient sampling method. Based on the sample size calculation, the sample size was determined 96 cases for each group.

$N = 2 (Z_\alpha + Z_\beta)^2 \bar{P} (1-\bar{P})/d^2$; $Z_\alpha = 1.96$, $Z_\beta = 0.84$, P = 2.7%, d = 7%, n = 96

The data analyzed using SPSS software (IBM Corp. IBM SPSS Statistics, Version 26.0. Armonk, NY). Qualitative data are reported with frequency/percentage and quantitative data with mean/standard deviation. Chi-square/Fisher exact test was used to compare qualitative variables in the two groups and independent t-test (or Mann-Whitney test if variable distribution is not normal) was used to compare quantitative variables. According to Shapiro-Wilk test, quantitative data such as length of hospital stay, time interval between exposure and admission to hospital duration of ventilator use and age were not normally distributed (*P* value < 0.001), Therefore comparison of these variables between two groups performed using Mann-Whitney U test. *P* value less than 0.05 indicates statistical significance.

Results

One hundred and seventy-eight patients were included in the study. According to the exclusion criteria and the selected sample size, 96 patients had to be admitted to each group.

Fourteen patients were excluded from the groups in the general ICU because of missing data, therefore the results of 82 patients in the general ICU and 96 patients in the poisoning ICU were compared.The mean age of patients admitted was 41.53 ± 17.99 and 37.34 ± 17.51 in specific and general ICU, respectively (*P*-value > 0.05). The median of the poisoned ICU was 38.5 and the minimum and maximum values were 13 and 93 years old, respectively and also the median of the general ICU was 32.66 and its minimum and maximum values were 13 and 84 years old, respectively. According to Table 1, most patients (60.1%) are male, selfemployment (37.1%) and married (52.8%). Less than half of the patients (39.3%) suffered from addiction. Mental health and previous attempt to suicide have been reported in a way that most patients had no documented psychiatric problems (68.5%) based on history taking about previous psychiatry visit or hospitalization and after psychiatric consultation. Also, most of the families of patients had no psychiatric problems (98.9%) and no desire to commit suicide (96.1%). The majority of patients had no history of underlying disease (71.3%).Most of the toxic agent was medicines (56.2%) and was consumed by ingestion (94.4%) and intentionally (78.7%). Endotracheal intubation was performed in 32.6%. Finally, the result of patients' treatment was mostly recovery (76.4%). [Table 2]

According to the Mann–Whitney *U*-test [Table 3], length of hospital stays and duration of mechanical ventilation use showed a significant difference (*P*-values < 0.001). The frequency of morality in patients with respect to different substances in two ICUs has been shown in Table 4. Mortality was observed more in poisoning with pesticides and alcohols (methanol).

Discussion

In this study, we compared epidemiological, demographic toxico-clinical variables, management and outcome between patients admitted in the general ICU versus those admitted in the specific ICU for poisoning cases. The results showed the most common substances were medicines, opioids and pesticides in both groups. Worldwide, poisoning with drugs and pesticides is a major cause of morbidity and mortality. Because of variations in cultural and socioeconomic factors, the pattern of poisoning in many aspects has differences from region to region through the world and even within a country.[16,17]

In our study, most of the patients in both groups were men with the mean age of 40 and older. In a study in France, the mean age of patients with severe intoxication was 46 years, and 57% of them were male. It was also reported that 50% of patients had a history of previous psychiatric disorder.[18] In another study in China, 53.96% of patients with acute poisoning were women and 59.23% of patients were 40 years and older.[19] The mean age of poisoning patients was 26.21 years and 50.3% of them were women in a 10-year study conducted.[20] Finally, Masoumi *et al.*[21] reported, the mean age of poisoning cases was 26.5 years and 54.7% of patients were female. Although the frequency of poisoning cases may differ in various societies, it is not significant between different genders.

Parallel to several previous studies in different countries, medicines were the most prevalent toxin in our study.[16,22,23] This can be attributed to the common availability of these agents. Opioids were in second place among the poisoning agents in this study. In some of recent surveys, opioid intoxication was an important reason for annual mortality in many parts of Iran.[24,25] Nafei *et al*.[26] also illustrated that among xenobiotic, opioids were the most frequent cause of acute poisoning. This finding can be attributed to the easy availability of opioids in Iran because of opium production in the neighboring country, Afghanistan, and sociocultural factors in this region. The high rate of opioid poisoning is similar to other geographical areas.[12]

In our study, 67.4% of patients were intubated. This is similar to Ahuja *et al.*'s[27] study of 67 patients, that 43 (64%) needed intubation, and in Lam *et al*.'s study in Hong Kong, that 67.9% of patients were mechanically ventilated.[28] But in Sulaj *et al.*'s[29] study, 31.4% of patients underwent intubation. The difference may be due to toxicity severity which has not been evaluated in studies. The majority of patients had no history of underlying disease (71.3%). Most patients suffered from lung (19.1%) and kidney (15.2%) injuries. This relationship in patients can be considered in line with the significant duration of ventilator use.

Among all studied variables, only job and previous history of psychiatric diseases was statistically significant between the

Table 1: Demographic characteristics and clinical manifestations of patients admitted in different ICUs

Variables	Poisoning ICU ($n=96$)	General ICU ($n=82$)	Total ($n=178$)	*P*
Gender				
Male	56 (58.3)	51 (62.2)	107 (60.1)	0.35
Female	40 (41.7)	31 (37.8)	71 (39.9)	
Job				
Self-employment	34 (35.4)	32 (39.0)	66 (37.1)	0.03
Housekeeper	29 (30.2)	15 (18.3)	44 (24.7)	
Student	12 (12.5)	11 (13.4)	23 (12.9)	
Retired	8 (8.3)	4 (4.9)	12 (6.7)	
Unemployed	8 (8.3)	19 (23.2)	27 (15.2)	
Government employee	5 (5.2)	1 (1.2)	6 (3.4)	
Marital status				
Married	55 (57.3)	39 (47.6)	94 (52.8)	0.43
Single	37 (38.5)	39 (47.6)	76 (42.7)	
Divorced	4 (4.2)	4 (4.9)	8 (4.5)	
Addiction				
Yes	42 (43.8)	28 (34.1)	70 (39.3)	0.19
No	54 (56.3)	54 (65.9)	108 (60.7)	
Mental illness				
Yes	22 (22.9)	34 (41.5)	56 (31.5)	0.008
No	74 (77.1)	48 (58.5)	122 (68.5)	
History of previous suicide				
Yes	22 (22.9)	22 (26.8)	44 (24.7)	0.54
No	74 (77.1)	60 (73.2)	134 (75.3)	
Family mental illness				
Yes	1 (1.0)	1 (1.2%)	2 (1.1)	0.91
No	95 (99.0)	81 (98.8)	176 (98.9)	
Family suicide				
Yes	3 (3.1)	4 (4.9)	7 (3.9)	0.54
No	93 (96.9)	78 (95.1)	171 (96.1)	
History of underlying disease				
Diabetes	7 (7.3)	1 (1.2)	8 (4.5)	0.16
Cardiovascular disease	9 (9.4)	15 (18.3)	24 (13.5)	
Liver disease	1 (1.0)	1 (1.2)	2 (1.1)	
Lung disease	5 (5.2)	8 (9.8)	13 (7.3)	
Hypothyroidism	2 (2.1)	2 (2.4)	4 (2.2)	
Not Seen	72 (75.0)	55 (67.1)	127 (71.3)	

Data are presented as number (percent);); ICU, Intensive care unit

two groups. Accessibility to different substances may changes with respect to different jobs. In addition, the frequency of mental illness was higher in the patients hospitalized in general ICU. Previous mental illness may have correlation with severity of toxicity as demonstrated in some studies. The mortality rate in our study was 23.6%, that no significant difference was detected between the two study groups (i.e., patients admitted to poisoning and general ICU (in this regard. Mehrpour *et al.*[23] reported an approximately 19.5% mortality rate in the patients hospitalized in the General ICU. In another study, similar rate of mortality was reported in ICU poisoned patients (19.5%).[23] However, two recent studies in Canada and Hong Kong have reported mortality rates of 5.1% and 3%, respectively, in General ICU poisoned patients.[9,30] We can suggest some reasons in explaining this difference. Our study was conducted in a referral poisoning center for province, so it's likely that more severe cases were referred and admitted to our center. In addition, ICU admission criteria are not the same all over the world and because of low number of ICU beds, cases of severe and life-threatening poisonings are admitted to our hospital ICU, while some poisoning centers may admit all poisoned patients to the ICU, regardless of symptom severity degree upon arrival.[31]

Our results showed that the length of hospital stays and duration of mechanical ventilation in poisoning ICU were significantly lower than general ICU. As the personnel of specific ICU for poisoning cases may be very familiar with the poisoned patients for different types of treatments such as antidotes, extracorporeal elimination techniques, the trend of poisoning during hospitalization and necessary cares, this result may be explained.

Table 2: Comparison of the frequency of poisoning agents, route of exposure, type of poisoning, and outcome in different ICUs

Variables	Poisoning ICU (*n*=96)	General ICU (*n*=82)	Total (*n*=178)	*P*
Poisoning agent				
Pesticides	12 (12.5)	13 (15.9)	25 (14)	0.44
Medicines	58 (60.4)	42 (51.2)	100 (56.2)	
Opioids	21 (21.9)	24 (29.3)	45 (25.3)	
Stimulants	2 (2.1)	0 (0.0)	2 (1.1)	
Alcohols	3 (3.1)	3 (3.7)	6 (3.4)	
Route of exposure				
Ingestion	93 (96.9)	75 (91.5)	168 (94.4)	0.24
Injection	0 (0.0)	1 (1.2)	1 (0.6)	
Inhalation	3 (3.1)	6 (7.3)	9 (5.1)	
Type of poisoning				
Suicide	74 (77.1)	66 (80.5)	140 (78.7)	0.72
Accidental	5 (5.2)	5 (6.1)	10 (5.6)	
Misuse	17 (17.7)	11 (13.4)	28 (15.7)	
Treatment				
Gastric lavage	28 (29.2)	24 (29.3)	52 (29.2)	0.98
Activated charcoal prescription	43 (44.8)	32 (39.0)	75 (42.1)	0.43
	44 (45.8)	51 (62.2)	95 (53.4)	0.02
Antibiotics				
Hemodialysis	20 (20.8)	14 (17.1)	34 (19.1)	0.52
Endotracheal Intubation	61 (63.5)	59 (72.0)	120 (67.4)	0.23
Plasmapheresis	5 (5.2)	5 (6.1)	10 (5.6)	0.797
Antidote	13 (13.5)	13 (15.9)	26 (14.6)	0.66
Injured organ				
Lung	15 (15.6)	19 (23.1)	34 (19)	0.914
Kidney	14 (14.6)	13 (15.9)	27 (15.2)	
GI	4 (4.2)	3 (3.7)	7 (3.9)	
CNS	6 (6.3)	4 (4.9)	10 (5.6)	
Cardiac	3 (3.1)	2 (2.4)	5 (2.8)	
Liver	3 (3.1)	3 (3.7)	6 (3.4)	
Not seen	51 (53.1)	38 (46.3)	89 (50)	
Mortality	22 (22.9)	20 (24.4)	42 (23.6)	

Data are presented as number (percent); GI, Gastrointestinal; CNS, central nervous system;); ICU, Intensive care unit

Table 3: Comparison of patients in two ICUs in terms of hospitalization time, hospital arrival time and ventilator use time

Variables	Duration of hospitalization (Day)	Duration of arrival at the hospital after poisoning (Hour)	Duration of ventilator use (Day)	Age
Total				
SD±Mean	5.98 (6.15)	6.74 (7.52)	3.53 (6.12)	39.66 (17.97)
Median	4	5	1	35.5
Minimum	0.00	0	00	13
Maximum	54	48	45	93
poisoning ICU**				
Mean (SD)	4.32 (5.69)	7.24 (8.20)	2.01 (4.84)	41.53 (17.99)
General ICU**				
Mean (SD)	7.93 (6.22)	6.18 (6.59)	5.32 (6.24)	37.34 (17.51)
*P**	0.001>	0.195	0.001>	1.05

*A P value less than 0.05 is statistically significant. **Data represents as mean (SD); ICU, Intensive care unit

Our study had some limitations. In terms of external validity and generalization, our research data were from a single center, although this hospital is the main poisoning referral center in the province. Moreover, in our study, no follow-up data were evaluated concerning the outcomes after hospital discharge. Also, we did not categorized patients based on poisoning severity at admission.

Table 4: Comparison of morality in poisoning with different substances in two ICUs

Variables	Poisoning ICU		General ICU		Total		*P*
	Cases	mortality	Cases	mortality	Cases	mortality	
Pesticides	12	5 (41.7)	13	5 (38.5)	25	10 (40.0)	0.096
Medicines	58	11 (19.0)	42	8 (19.0)	100	19 (19.0)	
Opioids	21	4 (19.0)	24	6 (25.0)	45	10 (22.2)	
Stimulants	2	0 (0.0)	0	0 (0.0)	2	0 (0.0)	
Methanol	3	2 (66.7)	3	1 (33.3)	6	3 (50.0)	
Total	96	22 (100)	82	20 (100)	178	42 (100)	

Data are presented as number (percent); ICU, Intensive care unit

Conclusion

In our study, medicines were the most common causes of poisoning. Opioids and pesticides were in the second and third place. However, mortality was observed more in poisoning with pesticides and alcohols (methanol). The most type of poisoning was suicide. Also, the overall mortality rate was high. No significant difference was detected between the two study groups in mortality rate and other toxico-clinical variables between the two groups, however, the length of hospital stays and duration of mechanical ventilation in the poisoning ICU were significantly lower compared to general ICU. Therefore, with respect to cost/benefit, we may suggest to consider specific ICU with trained personnel for poisoning cases in the hospitals especially, when the number of patients with acute poisoning is high.

Ethical approval and consent to participant

Ethics approval for the study was given by the ethics committee of the Isfahan University of Medical Sciences (IR.MUI.MED.REC 1400.770). All methods were carried out in accordance with relevant guidelines and regulations (declaration of Helsinki). Informed consent was obtained from all subjects and also from their next of kin in case of participants who have died.

Acknowledgments

We would like to thank the colleagues and personnel of the Clinical Toxicology Department and archive staff of Khorshid hospital for their valuable technical help and general support.

Financial support and sponsorship

The research was supported financially by the Isfahan University of Medical Sciences.

Conflicts of interest

There are no conflicts of interest.

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