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Original Article

Determining hematological indices in patients admitted to a poisoning referral center: A 10-year cross-sectional study

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Abstract

Objective: Poisoning is one of the most common methods of suicide in developing countries. We assessed the frequency of impaired hematological indices in patients with acute poisoning.

Methods: The present study was a cross-sectional retrospective. Using the census sampling method, all patients who had attempted suicide by poisoning and were admitted from 2013 to 2023 were included in this study. Different variables, including age, gender, hematological index on admission, hospital stay, and outcome (mortality), were recorded in a data-gathering form. ANOVA and chi-square or Fisher's exact tests were used for analysis.

Results: This study was conducted on 48186 patients, 53.4% of whom were male. The average age of the patients was 34.92 (±13.23). Of all patients, 6% had anemia, 15.1% leukocytosis, 15% higher than average hemoglobin, and 9.1% lower than average platelet count. White blood cell (WBC) count was higher (mean difference = 3741.85, SD = 151.35, 95% CI = 3445.21–4038.5) in deceased patients, while platelet count was significantly lower in deceased patients (mean difference = 17.19, SD = 2.57, 95% CI = 12.14–22.24) ($P < 0.001$). Anemia correlated with more extended hospital stay by an average of 1.61 days (SD = 0.27, 95% CI = 0.98–2.24) compared to patients with normal hemoglobin. Thrombocytopenia also correlated with more extended hospital stays by an average of 1.38 days (SD = 0.21, 95% CI = 0.88–1.89).

Conclusion: The frequency of abnormal hematological indices was not high in patients with acute poisoning. Deceased patients had higher WBC and lower platelet counts compared to surviving patients. Patients with anemia and thrombocytopenia had more extended hospital stays.

Keywords: Attempted suicide, Poisoning, Hemoglobin, Platelets, White blood cells

Introduction

Suicide is a global problem, and 80 000 people die by suicide every year; in other words, every 40 seconds, one person takes their life (1). Overall, suicide makes up about 1.4% of premature deaths globally. Suicide rates have increased all over the world by 60% in the last 45 years; however, its rate has declined in Western countries, with 78% of all suicides happening in low- and medium-income countries (2-4). The method of suicide is dependent on age, socioeconomic situation of the patient, and their country of origin, with the most common methods overall being hanging, poisoning, and gunshots (5,6).

Poisoning is a prominent way of suicide in China, Pakistan, and Sri Lanka (5). Gender plays a significant role in this regard. Men attempt suicide more than women, and the rate of successful suicide is 30 times higher in men compared to women (7,8). Patients with older age are also at a higher risk of suicide. People older than 45 show a significantly higher risk of suicide compared to younger people (9). Aside from the demographic characteristics of the patients, other significant risk factors exist for suicide. The most notable is a history of psychological disorders. Those with a history of psychological disorders compromise 60–98% of all suicide attempts, with depression, substance abuse, and psychosis being the most common (10). Systemic diseases are also risk factors for suicide. Terminal diseases such as cancer, HIV, multiple sclerosis, epilepsy, lupus, and end-stage renal disease increase suicide risk significantly (11). Terminal diseases such as cancer, HIV, multiple sclerosis, epilepsy, lupus, and end-stage renal disease also significantly increase suicide risk (12). Other systemic diseases also affect both

the rate and prognosis of suicide attempts. Anemia has previously been shown to cause fatigue and depression (13), and sickle cell disease has also been linked with depression. Thrombocytopenia has been previously shown to correlate with fatigue, problems in cognition and decision-making, and low mood (14-17).

While studies have been done to link the abnormalities in blood parameters and their deficiencies with depression and cognition dysfunction, their role as risk factors for suicide is still not clear. Therefore, in a cross-sectional study, we assessed the rate of abnormal hematological indices (hemoglobin level, platelet count, and white blood cell [WBC] count) in patients with acute poisoning. The investigation of biomarkers can be essential for diagnosing and managing patients. On the other hand, the cost-effectiveness and availability of tests for these biomarkers can play an important role. Laboratory indices, including hematologic indices, are among the factors used today to diagnose and manage patients with many diseases. Information on hematological indices in patients who have committed suicide by poisoning is limited. Therefore, we have investigated this issue in this study.

Methods

This cross-sectional retrospective study was conducted at Khorshid Hospital, the leading regional referral center for poisoned patients (Isfahan, Iran). The selection of patients was based on the census sampling method. Patients older than 20 years with acute poisoning who had attempted suicide by poisoning and were admitted to Khorshid Hospital from 21 March 2013 to 20 March 2023 were included in the study (poisoning was defined based on the International Classification of Diseases, 10th revision (ICD-10-CM with diagnosis code T14.91). The exclusion criteria were poisoning by substances that affect hematological indices (colchicine, iron, lithium, monoamine oxidase inhibitors, organophosphates, phenytoin, heparin, etc.), more than 20% of necessary data missing in patient files, admission during the COVID-19 pandemic (since it interferes with lab findings in the patient), and bleeding during hospital stay.

The data under review in this study were extracted from patient medical records and entered into a data spreadsheet by a medical research assistant after selecting the patients based on the inclusion and exclusion criteria. The demographic information of the patients, such as age, gender, comorbidities, and the medication/toxin used for suicide, were all recorded. Clinical information such as symptoms and vital signs at the time of admission, hospital stay duration, treatments used, and outcome of poisoning were also recorded. Finally, patient lab data, most importantly, complete blood count (CBC) with differentiation, were extracted from the files. Uniform handling of the collected data was ensured by reaching a consensus during team meetings.

Qualitative data is reported as frequency (%) and quantitative data as mean ± SD. All data were analyzed using SPSS® for Windows® software (version 25). The normality of data was assessed using the Kolmogorov-Smirnov test. The means of variables were compared using a two-way repeated-measure analysis of variance (ANOVA) or independent t-test. We used the chi-square and Fisher's exact tests to analyze qualitative data. The Kruskal-Wallis test was used to analyze data based on gender. Statistical significance was defined as $P < 0.05$.

Results

Among the 48 186 included patients, most were male (53.4%). Based on the results, the percentage of intensive care unit (ICU) admission, death, and average age was higher in males than females, and this difference was statistically significant ($P < 0.01$). However, the average duration of hospitalization was higher in females compared to males ($P < 0.05$) (Table 1). The difference in frequency of dialysis and length of hospital stay was insignificant between genders.

The most common kind of poisoning was multi-drugs in 24 856 (51.3%), opioids in 6693 (13.8%), and benzodiazepines in 5590 (11.6%) patients. While most of the patients were normal in their lab findings, leukocytosis was observed in 15.1%, leukopenia in 0.3%, anemia in 6%, polycythemia in 15%, thrombocytopenia in 9.1%, and thrombophilia in 0.7% of the patients. Table 2 shows the average hematology parameters of the patients. In addition to the average, each parameter's lowest and highest number is specified (Table 2).

Table S1 compares different variables, including gender, ICU admission, hematological laboratory findings, and death in different years (see Supplementary file 1).

Neither anemia nor polycythemia was correlated with a higher risk of death. However, anemic patients had a longer hospital stay duration by an average of 1.61 days (SD = 0.27, 95% CI = 0.98–2.24) compared to patients with normal hemoglobin ($P < 0.05$). Thrombocytopenia and thrombophilia were not correlated with any adverse outcome either, even though platelets were, on average, 17.19 (SD = 2.576, 95% CI = 12.141–22.241) lower in deceased patients ($P < 0.001$). Thrombocytopenic patients had more extended stays in the hospital by an average of 1.38 days (SD = 0.216, 95% CI = 0.881–1.895). On average, the WBC count was also significantly higher in deceased patients by 3741.85 (SD = 151.35, 95% CI = 3445.21–4038.5). However, leukocytosis or leukopenia did not correlate with adverse effects during hospital stay. ICU admission rates and the need for hemodialysis were also similar between the groups, with no significant difference in lab findings.

A comparison of different variables concerning gender in different years has been shown in Table S1.

Table 1. Comparison of different variables in patients concerning gender

	Total patients (N = 48 186)	Male, n = 25 743 (53.4%)	Female, n = 22 443 (46.6%)	*P* value
ICU admission, No. (%)	1005	716 (71.3%)	289 (28.7%)	0.001
Death, No. (%)	769	573 (74.5%)	196 (25.5%)	0.001
Dialysis, No. (%)	267	193 (72.2%)	74 (27.8%)	0.102
Age, mean years (±SD)	69.66	36.09 (±14)	33.57 (±12.15)	0.001
Hospital stay, mean days (±SD)	6.83	3.14 (±38.82)	3.69 (±41.69)	0.131

ICU: intensive care unit.
The results are presented as number (%); frequency distribution was analyzed with Fisher's exact* or chi-square tests where appropriate. The independent t-test was used for mean comparison.

Table 2. Hematological laboratory findings of the patients

	Mean (±SD)	Minimum	Maximum	Skewness	Kurtosis	Median
RBC, cells/μL	4.83 (±0.619)	1.01	7.32	0.88	0.07	4.8
Platelet, 1000/μL	230.84 (±68.01)	20	671			
WBC, n/μL	9241.6 (±4050.27)	300	15500	3.62	67.71	8.4
Hemoglobin, g/dL	13.96 (±2)	3.2	20.3	0.57	-0.15	13.9
Hematocrit, %	41.06 (±5.88)	9	59	0.57	-0.15	40.87

RBC, red blood cell; WBC, white blood cell.

Discussion

This study evaluated the frequency of impaired hematological indices, including hemoglobin levels, platelet count, and WBC count, in patients with acute poisoning. We found that 6% of all patients admitted to the emergency room for poisoning were anemic, 15% had higher than average hemoglobin, 15.1% had leukocytosis, and 9.1 had lower than average platelet counts. Our study showed that while leukocytosis or leukopenia did not correlate with adverse effects during the hospital stay, platelet counts were significantly lower in deceased patients, and WBC counts were significantly higher. Anemia and thrombocytopenia also correlated strongly with more extended hospital stays, while leukocytosis and leukopenia did not. The need for hemodialysis or ICU admission also did not correlate with impaired hematological findings (18).

The relationship between anemia and suicide or depression is not clear. While Eizadi-Mood et al showed that anemia is not correlated with higher suicide risk (19) and only affects hospital stay, Li et al showed that anemia is directly linked with late-life depression (20). Some studies have shown the effect of iron regulation on the cognitive and motor function of the brain (21), while others have highlighted the role of anemia in postpartum depression (22). Overall, the prevalence of anemia seems to be in line with other extensive studies done on Iranian populations (23). While we failed to find any link between anemia and suicide, we did find that anemia increases patient hospital stays. Numerous studies have shown a link between lower levels of serum hemoglobin and more extended hospital stays (24,25), a finding which is echoed in our study as well. Anemia and thrombocytopenia are two factors that can affect patients' clinical symptoms.

The reduction of hemoglobin and platelets can aggravate patients' clinical conditions. The difference in the results of the present study with previous studies can be due to the poisoning of patients with different drugs. The mechanism of the effect of drugs on hematological parameters is different, which can be a reason for the discrepancy between the results of this study and previous studies. We also excluded the patients who had taken toxins/medications that may cause abnormalities in hematological parameters, which may be the reason for the difference between the included patients in our study and other studies.

While we found platelet count to be significantly lower in deceased patients, the difference does not seem clinically significant, as the 12 000 difference in platelet count between 240 000 and 228 000 does not lead to any clinical difference. Studies on platelet count and depression on suicide attempts are lacking at best. Ragolsky et al showed that low platelet count correlates with suicidal ideation (26), while Orum et al showed that patients with violent suicide attempts have significantly higher platelet counts (27). Studies point towards inflammation being a risk factor for suicide and depression, a marker of which is high platelet count in the blood (28,29). While our study population did not show different platelet numbers from the norm established by Persian cohort studies (30), they did show a longer hospital stay duration. A high WBC is a good indicator of inflammation. WBC proliferation and recruitment pathways become more active in inflammation, leading to an increased number of WBC in the blood, and we have established before that inflammation could be correlated with depression, suicidal ideation, and self-harm thoughts. Establishing a prevalence rate for leukocytosis is extremely difficult, and

we could not make conclusions about the link between WBC count and suicide in our study population. We suggest that more studies with control groups be done to shed more light on this matter.

Based on the results, the percentage of ICU admission, death, and average age was higher in males than in females, and this difference was statistically significant. Previous studies have shown that the evaluation of hematological indices can be used as a diagnostic and prognostic factor (31). The study of Lionte et al showed that using hematological indices can be suitable as a prognostic factor for hospitalization and ICU admission (32). Although mortality was higher in males, the length of hospital stay was higher in females. The different types of ingested toxins/medications and differences in drug metabolism may be responsible for this difference between genders, which was not evaluated in our study and needs future studies.

Conclusion

In conclusion, the abnormality in hematological indices was not high in acute poisoning cases. Higher WBC and lower platelet counts were observed in the deceased compared to surviving patients. Patients with anemia and thrombocytopenia had more extended hospital stays. While the average age, ICU admission, and mortality were higher in men, the length of hospital stay was longer in women.

Limitations

Although the sample size was adequate, the study was retrospective. Also, association between the type of toxin or drug and laboratory indices has not been evaluated. In addition, changes in hematological indices during hospitalization, which may have shown the relationship between these parameters and mortality and hospitalization more clearly, were not monitored in our study. Considering the above limitations, comparing all variables and considering different substances and routes of exposure are suggested for future studies.

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Authors' Contribution

Data curation: Shiva Samsamshariat, Arman Otroshi, Ali Mohammad Sabzghabaee.
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Competing Interests

None.

Data Availability Statement

The datasets generated and analyzed during the current study are not publicly available to ensure the anonymity of the patients who attempted suicide but are available from the corresponding author upon reasonable request.

Ethical Approval

This research was conducted following the ethical standards of the Ethics Committee of Isfahan University of Medical Science (IR.MUI.MED.REC.1402.306) and the 1964 Helsinki Declaration.

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Supplementary Files

Supplementary file 1 contain Table S1.

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