Title: Investigating the Efficacy of Sucralfate in the Treatment of Oral Paraquat Poisoning: A Randomized Double-Blind Clinical Trial

Running Title: The Effectiveness of Sucralfate in the Treatment of Oral Paraquat Poisoning

Authors: Shafea Jafar Zoofaghari[1,*], Gholamali Dorooshi[2], Rokhsareh Meamar[1], Arman Otroshi3, Farzad Gheshlaghi[4], Marjan Mansourian[5], Nastaran Izadi-mood[1]

1. *Assistant Professor, Department of Clinical Toxicology, Clinical Toxicology Research Center, Isfahan University of Medical Sciences. Isfahan, Iran.*
2. *Department of Clinical Toxicology, Clinical Toxicology Research Center, Isfahan University of Medical Sciences. Isfahan, Iran.*
3. *Assistant Professor, Forensic Medicine, Department of Clinical Toxicology, Clinical Toxicology Research Center, Isfahan University of Medical Sciences. Isfahan, Iran.*
4. *Professor, Forensic Medicine, Department of Clinical Toxicology, Clinical Toxicology Research Center, Isfahan University of Medical Sciences. Isfahan, Iran.*
5. *Professor, Biostatistics, Department of Epidemiology and Biostatistics, Applied Physiology Research Center, Cardiovascular Research Institute, Isfahan University of Medical Sciences. Isfahan, Iran.*

***Corresponding Author:** Shafea Jafar Zoofaghari, Assistant Professor, Department of Clinical Toxicology, Clinical Toxicology Research Center, Isfahan University of Medical Sciences, Isfahan, Iran. Email: shafeajafarzoofaghari@yahoo.com

To appear in: **Iranian Journal of Toxicology**

Received date: 2022/08/14

Revised date: 2022/11/03

Accepted date: 2022/11/06

Please cite this article as:

Zoofaghari SJ, Dorooshi G, Meamar R, Otroshi A, Gheshlaghi F, Mansourian M, et al. (In Press). Investigating the Efficacy of Sucralfate in the Treatment of Oral Paraquat Poisoning: A Randomized Double-Blind Clinical Trial. *Iranian Journal of Toxicology.* Just Accepted publication Aug. 16, 2022. Doi: http://dx.doi.org/10.32598/IJT.17.1.1025.1

DOI: http://dx.doi.org/10.32598/IJT.17.1.1025.1

ABSTRACT

Background: There is a high prevalence of intentional paraquat poisoning especially for suicide reported from many part of the world, with its negative effects on the lungs, kidneys, heart, and digestive system. This study was planned, aimed at investigating the efficacy of sucralfate in the treatment of oral paraquat poisoning with respect to its clinical outcomes.

Methods: A randomized double-blind clinical trial was conducted on 70 patients, suffering from oral paraquat poisoning. These patients were divided into two groups of 35 each. Subsequently, gastric lavage was performed for each patient in the control and treatment groups with 5g sucralfate mixed in tap water in the treatment group, but with tap water alone in the controls. The patients' hemodynamic and laboratory parameters were evaluated and recorded, on admission and the hospital discharge dates. In addition, the patients' final clinical outcome, including survival or death was also recorded.

Results: The results of the present study revealed that the patients' hemodynamic parameters, coagulation factors, renal and liver laboratory findings did not differ significantly between the two groups ($P>0.05$). Moreover, 45.7% and 31.4% of the patients died in the control and treatment groups, respectively ($P>0.05$).

Conclusions: The sucralfate administration did not have a significant effect on the patients' hemodynamic and laboratory parameters. The survival of patients in the treatment group was slightly higher than those in the control group. Also the patients in the treatment group had less pulmonary and renal complications in the long-term than those in the control group.

Keywords: Clinical outcomes; Liver, lungs and renal complications; Paraquat toxicity; Sucralfate; Suicide

INTRODUCTION

Paraquat (1,1′-Dimethyl-4,4′-bipyridinium dichloride) is one of the major chemical compounds from the bipyridines family, and is widely used in agriculture as a non-selective herbicide. Notably, it is a classic toxin to the pulmonary system [1]. Acute paraquat consumption causes such symptoms as liver, lungs, heart, and kidneys failure within few days to weeks, and may lead to death within 30 days. The chances of survival for those exposed to this toxin for long periods of time are very negligible. Chronic exposure to paraquat can result in pulmonary injury, kidneys and heart failure, and esophageal stricture [2]. Also, accidental deaths and suicides caused by paraquat consumption are relatively common [3].

Considering the high rate of mortality in various parts of the world, restrictions on the use of paraquat were initially believed to reduce the likelihood of unwanted exposure and accidental contact. However, it attracted higher attention for suicidal ideas, such that 93% of the deaths caused by paraquat poisoning have occurred for suicides in the developing countries [4]. A major reason is that paraquat is widely available and relatively inexpensive. As little as one teaspoonful of the paraquat may cause death that occurs up to 30 days after its ingestion. The lethal dose has been estimated by THE World Health Organization (WHO) at 30-50 mg/kg for humans; however, the lowest fatal dose has been recorded to be 17 mg/kg in case studies and can even be lower for children. In order to treat paraquat poisoning, several successful cases of using cyclophosphamide (Endoxan) have been reported [5, 6].
Sucralfate, the main source of aluminum (Al), sucrose, and sulfate, is aluminium salt of sucrose octasulfate, has chemical formula of C12H30Al8O51S8.8 (H3AlO3). Sucralfate contains 18-22% Al and 8.5 to 12.5% sulfur (S), is a white, odorless, and tasteless powder. Also, it is accompanied by moisture, and is almost insoluble in water, ethanol, or chloroform, while it is slightly soluble in acidic media. It binds to sucrose octasulfate that is negatively charged, and adheres to proteins in wounds, creating a protective coating against stomach acid, pepsin, and bile salts [7]. Moreover, sucralfate suspension is easily obtainable in the form of sucralfate-sorbitol in water. This suspension, when passing through the gastrointestinal (GI) tract, has a large contact surface over the mucosa, thus increasing its bioavailability. During the treatment of GI injury caused by paraquat poisoning, sucralfate suspension is useful as an anti-acid agent and to inhibit gastric acid secretion. It forms a gel-like substance on the mucosal surface of the stomach, and blocks the direct erosion of the ulcer by the gastric acid and pepsin [8].

The protective role of sucralfate is based on two putative mechanisms. First, sucralfate covers the wound surface and prevents it from penetration and erosion by gastric acid, pepsin and bile [9]. Second, it binds to the wound surface and stimulates the release of endogenous prostaglandin E, somatostatin, and other immune cytokines [10]. The significant therapeutic effects of sucralfate have been reported recently by two studies on the inflammatory response, and the pulmonary and renal injuries in rats poisoned with paraquat [7, 11]. However, findings from clinical research on this subject are scarce.

Aim of the Study: Considering the high mortality rate of taking paraquat for suicidal purposes in the developing countries, we planned this study to investigate the effect of sucralfate on the clinical outcomes in patients with paraquat poisoning.

MATERIALS and METHODS

This study was designed as a randomized double-blind clinical trial. The study population included patients with paraquat poisoning referred to the Clinical Toxicology ward at Khorshid Hospital in Isfahan, Iran, over a 27-month period (Sept. 2019 to Dec. 2021). The study sample size was 70 patients, divided randomly into two groups of 35 each. The sample size of 70 patients was selected based on sample size formula comparing the two groups, at 95% confidence level and test power of 80%. The standard deviation for pulmonary injury, based on wet-to-dry lung volume ratio, and between the two groups were 0.95 and 0.20, respectively, with the error level being 0.5. These values were consistent with those reported by a previous study [7].

There were five criteria for the patients entering into the study: ***a)*** being at the age of 18 years old or higher, ***b)*** patients poisoned with paraquat through oral route, ***c)*** having a positive diagnostic urine test of dithionite, ***d)*** poisoning occurred no longer than 24 hours prior to admission, and ***e)*** receiving the patients' consent to participate in the study. Patients were excluded from the study if they had coagulation disorders or seizures, decreased consciousness, and were discharged from the emergency room on their own consent.

Upon review and approval of the study protocol by the Ethics Committee of Isfahan University of Medical Sciences, a written consent was reviewed and signed by each patient, or the spouse or a relative. A total of 70 patients were recruited into the study. Then, the patients were divided into two groups of 35 each, using random allocation software (Figure 1). The officially issued approval and clinical trial codes, respectively, were: IR.MUI.RESEARCH.REC.1399.021; and IRCT20200507047344N1 by the University officials.

Upon patients' admission to the hospital, their demographic characteristics, such as age, gender, and time of poisoning were recorded. Then, gastric lavage was performed for the subjects in the treatment group, with 5g of sucralfate (Tehran Daroo Pharmaceutical Co.) dissolved in two liters of water. The same procedure was performed for the control group, except the gastric lavage was done with tap water only, i.e., without sucralfate.

Other common treatments, such as administration of corticosteroids, N-acetylcysteine (NAC), vitamins C and E, and hemodialysis were performed for the patients, as appropriate. In order to ensure blinding of the study, the same volumes of sucralfate and tap water were prepared in advance, with the containers labeled with a letter A or B, and handed over to the researcher immediately before starting the gastric lavage.

The patients' vital signs, including systolic and diastolic blood pressure (SBP, DBP), pulse rate (PR), respiratory rate (RR), body temperature (Temp.), and arterial oxygen saturation percentage (SpO_2) were recorded immediately upon admission to the hospital's ER unit. These tests were performed identically on the third day and the discharge day from the hospital. Also, routine blood parameters, such as PTT, INR, PT, Cr, BUN, AST, and ALT were evaluated for each patient, and recorded on the first, third, fifth, seventh, and hospital discharge days. The patients' standard clinical outcome, including description of their health and the specific decision for their discharge from the hospital, or the fatal outcomes were recorded accurately. For patients who survived, chest x-ray, lung CT scan, and kidneys and liver function tests were performed as a follow-up procedure at the first and second months after discharge, and the results were recorded.

Finally, the collected data were entered into SPSS software, version 26, for the subsequent statistical analyses. Means ± standard deviations (SD) or frequency percentages were used to tabulate the data. The results of the Kolmogorov-Smirnov test to indicate the normal data distribution, and those from independent samples *t*-test were used to compare the quantitative means of variables between the two groups at the follow-up sessions. Moreover, the repeated measure ANOVA was used to compare the means of quantitative variables over time in each group. Further, Chi-squared tests were run to compare the frequency distribution of the qualitative data. The significance level of <0.05 was considered in all statistical analyses.

RESULTS

In this study, there were 27 (77.1%) male and 8 (22.9%) female patients with the mean age of 34.03 ±14.32 years old in the control group. In the sucralfate group, there were 25 male (71.4%) and 10 female (28.6%) patients with the mean age of 37.97 ±16.18 years old (P>0.05). The durations from getting poisoned to the hospital admission were 655.17 ±1653.44 and 456.36 ±664.25 minutes, respectively, for the control and sucralfate groups. The difference was not statistically significant between the two groups (P>0.05). See Table 1.

Examination of the patients' hemodynamic parameters indicated that the two groups were not significantly different in terms of their SBP, DBP, PR, RR, SpO_2, and Temp upon admission to the hospital (P>0.05). Further, these parameters were still not significantly different between the two groups on the third day of hospitalization and the hospital discharge day (P>0.05). Also, no significant change was found in any of these parameters, except for SpO_2, over time from patients' hospital admission to their discharge day (P>0.05). Both groups had a significant increase in their SpO_2 levels over the above-mentioned time period (P<0.05). See Table 2.

In addition, the laboratory parameters, such as coagulation factors (PTT, INR, PT), renal factors (Cr, BUN), and liver factors (AST, ALT) were not significantly different between the two groups on the first, third, fifth, seventh, and hospital discharge days (P>0.05). Moreover, these parameters did not change significantly in either group over time between the admission and the hospital discharge days (P>0.05). See Table 3.

Finally, the study findings indicated that 16 (45.7%) patients in the control group and 11 (31.4%) in the sucralfate group died. However, there was no significant difference between the two groups in terms of their treatment outcome (P>0.05). After a 2-month follow-up of the discharged patients, three cases of gastrointestinal complications, one case of kidney dysfunction, i.e., long-term increase in creatinine, and four cases of pulmonary injury, i.e., interstitial fibrosis, occurred in the control group. These numbers contrasted with only two cases of kidney disorder, one case of pulmonary injury, and no GI complications in the sucralfate group. See Table 4.

DISCUSSION

Based on the study findings, the majority of paraquat-poisoned patients were men with the mean age of 30-40 years old. The outcome of prescribing sucralfate to treat the patients demonstrated that administering this drug did not significantly increase or decrease any of the patients' hemodynamic parameters. Moreover, other laboratory parameters, including coagulation, kidneys and liver factors did not differ significantly between the two groups during the study

follow-up period. In this regard, Junboa, *et al.* (2017), who investigated the effect of sucralfate administration in paraquat-poisoned rats, showed that gastric lavage with sucralfate effectively reduced the inflammatory response, the pulmonary and renal injuries, and improved the survival rate of the rats. [7].

Junboa, *et al*. (2017) evaluated the effect of sucralfate on the cytokines in paraquat-poisoned rats and found that after treatment, the rats' signs and symptoms improved, and the mortality rate reduced. In that study, the cytokine levels decreased, including transforming growth factor (TGF)-β1, interleukin (IL)-10, and tumor necrosis factor (TNF)-α [11].

By comparing the results of previous studies with those of the current research, it is worth mentioning two points. First, the current study was conducted on humans, while the previous studies were performed on mice. Second, although no significant differences were found between the two groups with or without receiving sucralfate, the percentage of the survived patients in the sucralfate group was higher than that in the controls. Moreover, the percentage of recovery without complications was higher in the sucralfate group. There were three cases of gastrointestinal complications, one case of increased creatinine, and four cases of lung interstitial fibrosis in the control group. These data contrasted with two cases of increased creatinine, one case of lungs interstitial fibrosis, and no GI complications in the sucralfate group.

Indeed, previous studies have indicated that the protective effect of sucralfate goes beyond serving as a simple mechanical barrier. By coating the gastric and duodenal mucosa, sucralfate prevents the penetration and erosion of gastric acid, pepsin, or bile acid into the tissues. It also causes the release of endogenous prostaglandin E, somatostatin, and other cytokines [9, 10]. Interestingly, one gram of sucralfate neutralizes 2.5 mmol/L of hydrochloric acid [7]. Another study has reported that sucralfate promotes the secretion of mucus and bicarbonate in the GI tract, strengthens the tissue barrier, prevents the proliferation of *Helicobacter pylori* (HP) from destroying the mucosa, preserves the integrity of the tissue, and facilitates the repair process of the ulcers [8, 12].

Therefore, it appears that sucralfate plays an effective role in protecting the gastric tissues and managing the treatment process. The poisoned patients may be at risk of death up to 30 days after getting intoxicated with paraquat. Actually, the epithelial cells in the pulmonary alveoli selectively concentrate paraquat [13]. Its sudden discharge can lead to the death of fibroblasts in the lungs, leading ultimately to the patient suffocation [9]. In the current study, only one case of pulmonary complications was observed in the sucralfate group. Therefore, this implies that sucralfate plays a protective role in the pulmonary and digestive systems.

Although the small sample size reduced the power of the current study, conducting it in humans should be considered as its strengths. Further, due to the lack of ample data from human studies, we recommend that further research be conducted on this subject in order to collect definitive data that will help researchers to develop effective steps towards better treatment of the poisoned patients with fewer complications.

CONCLUSIONS

Based on the results of the present study, hemodynamic and coagulation parameters, renal, and liver factors were not significantly different among the paraquat-poisoned patients with or without a subsequent sucralfate intervention. Although the sucralfate group had a higher survival rate and lower incidence of renal and pulmonary complications, there was no statistically significant differences in the clinical outcomes between the two groups.

Name of the institution where the work was done: Clinical toxicology ward of Khorshid Hospital in Isfahan, Iran.

Conflict of interests: The authors declared no conflict of interest with any internal or external entities.

Funding: This research was financially supported by a research grant (No.: 198204), provided by Isfahan University of Medical Sciences, Isfahan, Iran.

Acknowledgements: We appreciate the patients who participated in this study and the medical staff of Khurshid Hospital who provided assistance to this research project.

Ethical Considerations: This study was approved by the Ethics Committee of Isfahan University of Medical Sciences (Code: IR.MUI.RESEARCH.REC.1399.021).

Authors' Contributions: SH.Z: Conceptualization; data collection; Investigation; writing the original draft; review and editing; project administration; supervision. GH.D, R.M, and A.O, F.GH, M.M, and N.I: Conceptualization; methodology; review and editing.

REFERENCES

1. Gawarammana IB, Buckley NA. Medical management of paraquat ingestion. *British Journal of Clinical Pharmacology*. 2011;72(5):745-757.
2. Dinis-Oliveira RJ, Sousa C, Remiao F, Duarte JA, Navarro AS, Bastos ML, Carvalho F. Full survival of paraquat-exposed rats after treatment with sodium salicylate. *Free Radical Biology and Medicine*. 2007;42(7):1017-1028.
3. Clark DG, McElligott TF, Hurst EW. The toxicity of paraquat. *Occupational and Environmental Medicine*. 1966;23(2):126-132.
4. Som A, Chopra R. Ingestion of Tetramethylethylenediamine in a Suicide Attempt. *The American Journal of Gastroenterology*. 2018; 1;113: 4-10.
5. Kanchan T, Bakkannavar SM, Acharya PR. Paraquat poisoning: analysis of an uncommon cause of fatal poisoning from Manipal, South India. Toxicology international. 2015;22(1):30-35.
6. Shadnia S, Ebadollahi-Natanzi A, Ahmadzadeh S, Karami-Mohajeri S, Pourshojaei Y, Rahimi HR. Delayed death following paraquat poisoning: three case reports and a literature review. *ToxicologyResearch.* 2018;7(5):745-753.
7. Junbo Z, Yongtao Y, Hongbo L, Fenshuang Z, Ruyun L, Chun'ai Y. Experimental study of sucralfate intervention for paraquat poisoning in rats. *Environmental Toxicology and Pharmacology*. 2017; 53:57-63.
8. Cohen MM, Bowdler R, Gervais P, Morris GP, Wang HR. Sucralfate protection of human gastric mucosa against acute ethanol injury. *Gastroenterology*. 1989;96(2):292-298.
9. Masuelli L, Tumino G, Turriziani M, Modesti A, Bei R. Topical use of sucralfate in epithelial wound healing: clinical evidence and molecular mechanisms of action. *Recent Patents on Inflammation &Allergy Drug Discovery*. 2010;4(1):25-36.
10. Park SH, Cho CS, Lee OY, Jun JB, Lin SR, Zhou LY, *et al*. Comparison of prevention of NSAID-induced gastrointestinal complications by rebamipide and misoprostol: a randomized, multicenter, controlled trial-STORM STUDY. *Journal of Clinical Biochemistry and Nutrition*. 2007;40(2):148-155.
11. Junbo Z, Yongtao Y, Hongbo L, Fenshuang Z, Ruyun L, Chun'ai Y. Experimental study of sucralfate intervention for paraquat poisoning in rats. Environmental Toxicology and Pharmacology. 2017 Jul 1;53:57-63.
12. Louw JA, Zak J, Lucke W, Roux EL, Jaskiewicz K, Winter T, *et al*. Triple therapy with sucralfate is as effective as triple therapy containing bismuth in eradicating Helicobacter pylori and reducing duodenal ulcer relapse rates. *Scandinavian Journal of Gastroenterology*. 1992;27(sup191):28-31.
13. Robert MK, Joseph St. Geme. Nelson Textbook of Pediatrics. 2-Volume Set, 21st Edition. *Elsevier*; Amsterdam, Netherland. 2019.
14. Waller DG, Sampson A, Hitchings A. Medical pharmacology and therapeutics E-Book. *Elsevier Health Sciences.* Amsterdam, Netherland. 2021.

FIGURE

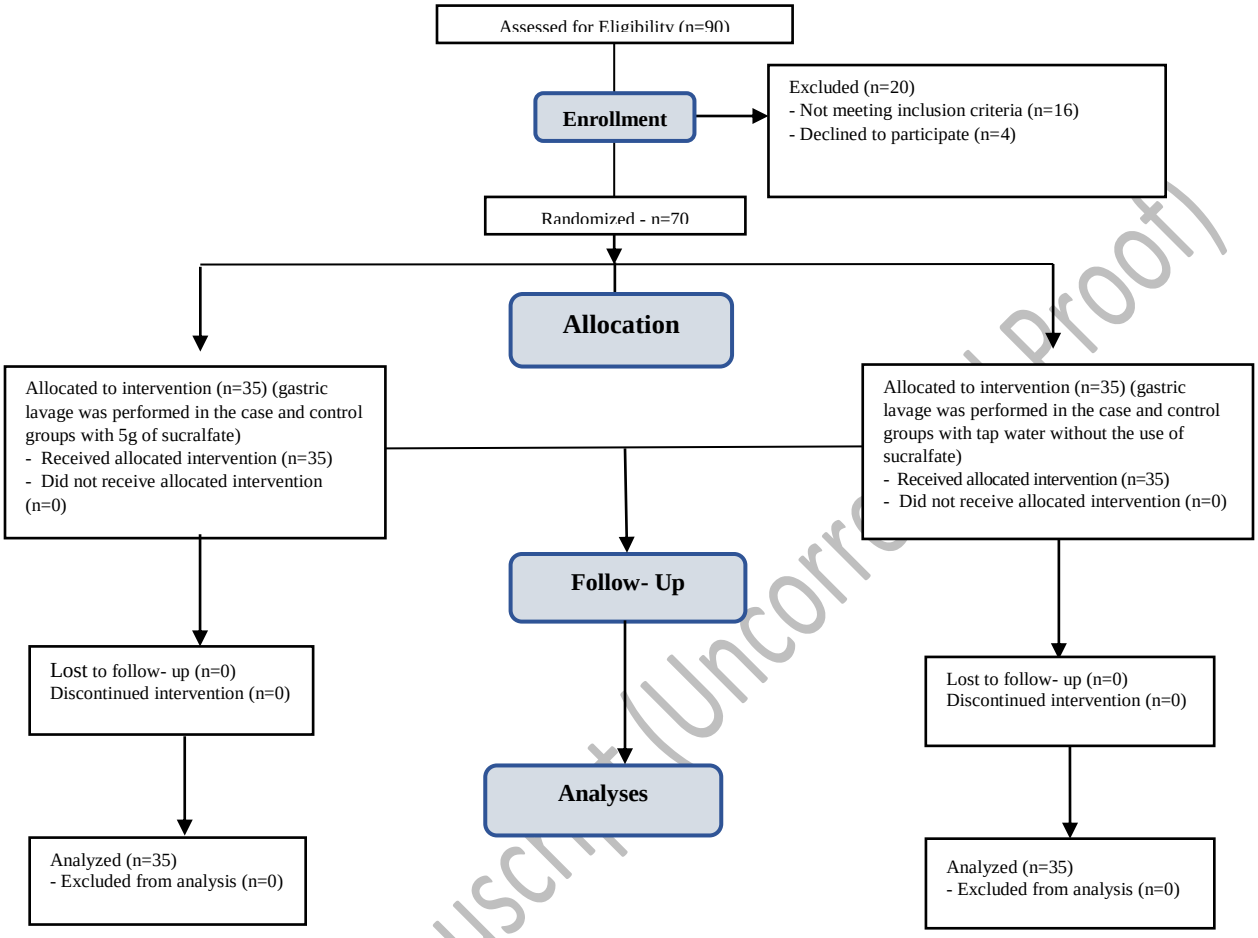

Figure 1: Flowchart of the patients' recruitment.

TABLES

Table 1: Basic characteristics of the poisoned patients in the study groups.

Characteristics	Control Group (n=35)	Sucralfate Group (n=35)	*P*-value
Gender:			
- Male	27 (77.1%)	25 (71.4%)	0.785
- Female	8 (22.9%)	10 (28.6%)	
Age (year)	34.03 ±14.32	37.97 ±16.18	0.284
Poisoning time before referral (minute)	655.17 ±1653.44	456.36 ±664.25	0.528

Table 2: Mean hemodynamic parameters of poisoned subjects in the study groups.

Hemodynamic Parameters	Follow-up time	Control Group (n=35)	Sucralfate Group (n=35)	*P*-value[1]
SBP	Baseline	123.23±18.84	122.06±23.20	0.817
	Third day	124.09±12.34	122.39±10.73	0.651
	Discharge	120.91±16.30	120.57±16.07	0.933
P-value[2]		0.952	0.804	
DBP	Baseline	72.03±14.57	72.34±15.60	0.931
	Third day	73.95±14.00	72.44±13.76	0.737
	Discharge	74.30±10.93	73.27±9.47	0.690
P-value[2]		0.816	0.738	
PR	Baseline	91.06±16.46	91.17±17.41	0.978
	Third day	84.90±17.49	84.39±17.54	0.927
	Discharge	93.58±26.82	93.55±27.04	0.997
P-value[2]		0.193	0.206	
RR	Baseline	18.00±2.85	17.26±1.85	0.200
	Third day	21.00±14.19	21.82±15.27	0.866
	Discharge	21.69±21.84	22.33±22.52	0.909
P-value[2]		0.550	0.312	
SPO2	Baseline	91.48±9.37	93.28±3.99	0.454
	Third day	89.94±12.58	90.40±10.96	0.878
	Discharge	94.69±7.97	95.26±4.53	0.713
P-value[2]		0.043	0.046	
Temperature	Baseline	36.97±0.20	36.95±0.22	0.691
	Third day	36.98±0.32	36.99±0.32	0.903
	Discharge	37.07±0.60	37.05±0.58	0.886
P-value[2]		0.909	0.745	

1: The significance level obtained from the independent samples *t*-test to compare the mean of the variables between the two studied groups in each of the examined times.

2: The significance level obtained from the analysis of repeated measures ANOVA to compare the changes of the variables in each of the two groups over time.

Table 3: Mean laboratory parameters for the poisoned subjects in the study groups.

Laboratory Parameter	Follow-up Time	Control Group (n=35)	Sucralfate Group (n=35)	*P*-value[1]
PTT	First day	38.03±19.09	36.10±17.15	0.671
	Third day	69.37±41.36	70.65±42.56	0.928
	The fifth day	57.25±40.38	55.49±36.66	0.922
	Seventh day	56.73±39.25	60.65±41.46	0.864
	Discharge	48.00±34.94	46.29±33.18	0.849
P-value[2]		0.584	0.580	
INR	First day	1.28±0.45	1.25±0.44	0.800
	Third day	1.42±0.45	1.40±0.46	0.862
	The fifth day	3.61±3.44	3.61±3.70	1.000
	Seventh day	3.22±3.19	3.08±3.47	0.939
	Discharge	1.87±1.68	1.58±0.66	0.398
P-value[2]		0.146	0.164	
PT	First day	9.32±5.32	9.03±4.99	0.824
	Third day	9.52±6.36	8.81±6.27	0.739
	The fifth day	15.37±14.07	11.40±6.35	0.448
	Seventh day	15.79±12.92	12.82±11.24	0.670
	Discharge	32.84±11.87	11.04±8.19	0.337
P-value[2]		0.330	0.344	
Cr	First day	1.78±1.87	2.05±2.85	0.649
	Third day	1.85±1.02	1.68±0.7	0.563
	The fifth day	4.69±10.33	4.76±10.75	0.987
	Seventh day	1.84±1.47	1.98±1.51	0.847
	Discharge	3.18±4.12	3.51±4.64	0.769
P-value[2]		0.471	0.475	
BUN	First day	18.98±22.15	15.13±8.41	0.346
	Third day	20.59±15.81	16.35±6.16	0.305
	The fifth day	19.31±13.63	22.18±20.82	0.697
	Seventh day	21.19±14.82	21.21±15.84	0.998
	Discharge	28.11±24.22	27.61±24.47	0.939
P-value[2]		0.110	0.101	
AST	First day	71.64±112.93	55.04±72.45	0.480
	Third day	111.85±113.17	74.70±79.31	0.361
	The fifth day	93.22±126.56	96.54±132.46	0.954
	Seventh day	87.56±164.26	96.25±173.37	0.917
	Discharge	114.10±167.18	104.55±136.68	0.811
P-value[2]		0.383	0.358	
ALT	First day	61.38±105.62	37.98±39.39	0.238
	Third day	136.55±226.40	104.46±155.49	0.582
	The fifth day	144.53±237.94	144.98±249.82	0.997
	Seventh day	158.11±266.98	173.75±280.97	0.908
	Discharge	174.45±318.88	148.46±290.98	0.745
P-value[2]		0.095	0.312	

1: The significance level obtained from the independent samples *t*-test to compare the mean of the variables between the two studied groups in each of the examined times.

2: The significance level obtained from the analysis of repeated measures ANOVA to compare the changes of the variables in each of the two groups over time.

Table 4: Frequency distribution of the clinical outcomes of the poisoned subjects.

Outcome	**Control Group** (n=35)	**Sucralfate Group** (n=35)	***P*-value**
Survived	19 (54.3%)	24 (68.6%)	0.326
Not Survived	16 (45.7%)	11 (31.4%)	