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Complications of Acute Toxicity following Ingestion of Disinfectants and Sterilisers During COVID-19 Pandemic

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Abstract

Background: During COVID-19 pandemic there was increased use of disinfectants and sterilizers worldwide. **Aim:** to assess the prevalence and severity of complications of acute toxicity following ingestion of sterilisers and disinfectants during COVID19 pandemic and compares them to those before the pandemic.

Methods: A hospital-based observational retrospective cohort study was done for all patients admitted in Poison Control Center -Sin Shams University Hospitals (PCC -ASUH) following overdose of sterilizers or disinfectants from 1/3/2019 to 1/3/2021. cases were sub-grouped into group I including cases admitted before COVID outbreak in Egypt and group II cases admitted during COVID outbreak in Egypt.

Results: High significant difference was found regarding age, gender, route, and manner of poisoning, with lower median age and a higher incidence of male cases recorded among the second group. There was predominance of Na hypochlorite poisoned cases in both groups, especially in the first (76.3%) compared to the second group (60.8%), followed by methanol. A higher incidence was recorded among group II cases regarding grade IV coma, shock, tachycardia, and respiratory distress. Statistically significant higher incidence of ICU admission (40%), longer duration of hospital stay, and a higher in-hospital mortality (10.8%) were also recorded among group II cases compared to group I.

Conclusion: Higher incidence of accidental poisoning with disinfectants and sterilizers mainly Na Hypochlorite and methanol especially among children was recorded during COVID 19 pandemic with more complications and longer duration of stay compared with non-pandemic period. **Recommendations:** Proper storage of disinfectants and sterilizers used at homes and cautions must be taken to avoid using of methanol instead of ethanol.

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Key words COVID-19, Disinfectants

Introduction

Coronavirus disease 2019 (COVID-19) outbreak is a worldwide emergency, as its rapid spread and high mortality rate has caused severe disruptions. (Huang et al. ,2020). In December 2019, a series of acute atypical respiratory disease occurred in Wuhan, China. This rapidly spread from Wuhan to other areas. It was soon discovered that a novel coronavirus was responsible. The novel coronavirus was named as the severe acute respiratory syndrome coronavirus-2 (SARS-CoV-2, 2019-nCoV) due to its high homology (~80%) to SARS-CoV-2, which caused acute respiratory distress syndrome (ARDS) and high mortality during 2002–2003 (Yuki et al., 2020).

The COVID-19 pandemic has called for the increased use of disinfectants and sterilizers worldwide both for personal and environmental decontamination to aid in holding back transmission of the SARS-CoV-2 virus. The increased use was noted in public facilities, hospitals, and even common households (Dewey et al., 2021).

The process of disinfecting removes harmful organisms from objects. This is usually done by applying chemical sprays or wipes. Disinfectants can kill most viruses and fungi, with the majority of commercial products also marketed as effective against the COVID-19 virus when used as directed. Disinfectants are generally composed of one or more active substances which have the required disinfectant action. They may also contain diluents or solubilizing agents, surfactants, foam regulators, pH regulators sequestering agents, and sometimes perfumes. Many disinfectants are used alone or in combinations (e.g., hydrogen peroxide and peracetic acid) in the health-care setting. These include alcohols, chlorine and chlorine compounds, formaldehyde, glutaraldehyde, ortho-phthalaldehyde, hydrogen peroxide, iodophors, peracetic acid, phenolics, and quaternary ammonium compounds. Misuse or overdose of these chemicals causes various complications to humans; ingestion of small amount causes gastrointestinal irritation, while ingestion of large amount causes mucosal erosions, some chemicals cause central nervous system depression. Other chemicals may cause metabolic acidosis, hypothermia, arrhythmias, and other complications (Gormley et al 2012; Ghafoor et al., 2021; Rutala & Weber, 2021).

On the other hand, chemical sterilizers destroy all microorganisms on the surface of an article or in a fluid to prevent disease transmission associated with the use of that item so, sterilization removes all microorganisms including those that aren't harmful. Sterilization is common in medical facilities, but it may also be helpful for businesses and schools that want to

get rid of germs in entire rooms. Examples include glutaraldehyde hydrogen peroxide and hypochlorite (bleach) which needs 24 hours to act as a sterilizer (Rutala & Weber, 2021).

Aim of the work

This study aims to assess the prevalence and severity of complications of acute toxicity following ingestion of sterilisers and disinfectants during COVID19 pandemic and compares them to those before the pandemics.

Materials and Methods

The present study was planned as a hospital-based observational retrospective cohort study.

Study group:

All patients of both sex who were admitted to Poison Control Center -Sin Shams University Hospitals (PCC -ASUH) following overdose of sterilizers or disinfectants in the period from 1/3/2019 to 1/3/2021 were included in this study. Diagnosis was based on history and /or clinical picture suggestive of overdose with sterilizers or disinfectants. Based on the possibility of alteration in measured parameters, patients with history of medical disease were excluded

Data:

The current study was approved by general director of PCC-AUH and the Research Ethics Committee of Faculty of Medicine Ain Shams University. Anonymized data were collected from medical records with consideration of confidentiality issues. Recorded data were tabulated and statistically analyzed using standard SPSS (Standard Package for Social Science) software package, version 20 (Chicago. IL).

On March 2020, the World Health Organization (WHO) declared COVID-19 a pandemic and the first official cases of COVID-19 were recorded in Egypt (WHO Health Emergency Dashboard; Worldometer). Accordingly, cases were sub-grouped into 2 groups:

Group I: included cases admitted to PCC-ASUH before COVID outbreak in Egypt (1/3/2019 to 29/2/2020)

Group II: included cases admitted to PCC-ASUH during COVID outbreak in Egypt (1/3/2020 to 1/3/2021)

Results

Although group II cases (130 cases) slightly outnumbered those in group I (122 cases), a highly significant difference was found between the two studied groups regarding age and gender distribution. The median age for group II cases was 4 years compared to 17 years of age for group I cases. Predominance of male cases was found in both groups however higher incidence was recorded among group II cases (70.8%) compared to group I (58.2%) (Table1).

A high significant difference was found regarding the route of intoxication and manner of poisoning between the two studied groups; While oral route was more recorded among group I cases (69.7%), mixed oral and inhalation mode was more presented in group II (61.5%). Accidental intoxication that occurred outside home was prominent among group II cases (62,8%). On the other hand, group I cases were mostly due to deliberate self-poisoning (70.5%) which occurred at home (Table1).

Regarding type of toxic agent, Na hypochlorite was the commonest followed by methanol, ethanol, and phenol. The incidence of Na hypochlorite poisoning was statistically different among the two groups, accounting for 76.2% of cases in group I compared to 60.8% in group II. Similarly, there was a significant difference between the two groups in cases of methanol poisoning with a higher incidence recorded among group II cases (26.2%) compared to13.9% in group I(Table1).

Clinical Evaluation:

Absence of neurological manifestations was recorded among the majority of cases in the two studied groups with statistically higher prevalence among group I cases (82.8%). Though recorded in a minority of cases, there were statistically significant differences between group I and II regarding coma grade IV (1.6% and 8.5% respectively), blindness (0% and 5% respectively) and dilated pupils (3%and 5% respectively). On the other hand, no significant difference was found between group I and II regarding cases presented with disequilibrium, drowsiness, blurred vision, extrapyramidal manifestations, and seizures (Table 2).

Statistical analysis revealed a significant increase in the incidence of shock (10%) among group II cases compared to group I. A statistically significant higher incidence of tachycardia (13.8%) and respiratory distress (21.5%) were recorded among group II cases. Conversely, both course crepitations (5.7%) and hypokalemia (13%) were recorded more among group I (Table 2).

Although more gastrointestinal manifestations were recorded in group II cases, there was no significant difference between the two studied groups. Moreover, neither ABG analysis nor renal function tests had significant differences between them (Table 2).

Methods of treatment:

A variety of therapeutic modalities were employed according to type of substance and clinical presentation including emergency airway management (oxygen therapy± endotracheal intubation), antidotes, modalities used in cases with acid-base disturbances (including mechanical ventilation, hemodialysis, nebulizer, and steroids). No significant difference between group I and II was recorded regarding methods of treatment (table 3).

Hospital disposition /Outcome:

Admission to the inpatient unit was noted among both study groups, however significantly higher incidence was reported among group I (75.4%) compared to 54.65% in group II. On the other hand, ICU admissions were significantly higher among group II cases (40%) compared to 23% of group I cases (Table 4).

Longer duration of stay was linked to group II (IQR=2 days) with high significant difference compared to group I (IQR=one day). Statistically significant difference was also found as regards the recorded in-hospital mortality. Higher mortality was associated with group II cases (10.8%) versus 4.1% in group I (Table 4).

Table (1): Statistical Analysis of age, gender, and data of intoxication among the two studied groups

		Group 1 N=122	Group 2 N= 130	Test value	P -value	Sig.
Age	Median	17(2-35)	4(2-22)	-2.731	0.006	HS
	Range	1-66	0.75-55			
Gender	Female	51(41.8%)	38(29.2%)	4.355*	0.037	S
	Male	71(58.2%)	70.8%)			
Route of administration	Mixed	36 (29.5%)	80 (61.5%)	26.134*	0.000	HS
	Oral	85 (69.7%)	49 (37.7%)			
	Inhalation	1 (0.8%)	1 (0.8%)			
Mode	Accidental	36 (29.5%)	81 (62.3%)	27.222	0.000	HS
	Suicidal	86 (70.5%)	49 (37.7%)			
Place	Out of home	36 (29.5%)	81 (62.3%)	27.222	0.000	HS
	Home	86 (70.5%)	49 (37.7%)			
Toxin	Na hypochlorite	93 (76.3%)	79 (60.8%)	6.943*	0.008	HS
	Na hypochlorite inhalation	0 (0.0%)	1 (0.8%)	0.942*	0.331	NS
	Methanol	17 (13.9%)	34 (26.3%)	5.822*	0.015	S
	Ethanol	9 (7.4%)	13 (10.0%)	0.543*	0.461	NS
	Phenol	3 (2.5%)	3 (2.3%)	0.006*	0.938	NS

Mann-Whitney test, *: Chi-square test, N = Number, NS= Non-significant: P-value > 0.05, Significant =S: P-value <0.05, Highly significant =HS: P-value < 0.01

Table (2): Statistical Analysis of clinical manifestations among the two studied groups

Clinical manifestations		Group I		Group II		Test value*	P-value	Sig.
		N= 122	%	N= 130	%			
Neurological manifestations	Normal	101	82.8	91	70.0	5.673	0.017	S
	Coma I	3	2.5	2	1.5	0.274	0.600	NS
	Coma II	4	3.3	2	1.5	0.276	0.365	NS
	Coma III	1	0.8	2	1.5	0.820	0.599	NS
	Coma IV	2	1.6	11	8.5	5.987	0.014	S
	Disequilibrium	6	4.9	3	2.3	1.245	0.264	NS
	Dilated pupil	0	0	5	3.8	4.787	0.028	S
	Drowsy	1	0.8	2	1.5	0.276	0.599	NS
	Blurred vision	3	2.5	5	3.8	0.394	0.530	NS
	Blind	0	0	5	3.8	4.787	0.028	S
	Extrapyramidal	1	0.8	1	0.8	0.002	0.964	NS
	Seizures	0	0	1	0.8	0.942	0.331	NS
GI manifestations	Vomiting	91	74.6	84	64.6	2.951	0.086	NS
	Dysphagia	46	37.7	35	26.9	3.354	0.067	NS
	Hematemesis	5	4.1	11	8.5	2.015	0.156	NS
CVS manifestations	Normal	116	95	97	74.6	27.014	1.000	NS
	Shock	3	2.5	13	10.0	6.019	0.014	S
	Tachycardia	3	2.5	18	13.8	18.192	0.000	HS
	Bradycardia	0	0	2	1.5	1.892	0.168	NS
Respiratory manifestations	Normal	102	83.6	99	76.2	2.166	0.141	NS
	RD	7	5.7	28	21.5	13.138	0.000	HS
	Coarse crepitation	7	5.7	1	0.8	5.054	0.024	S
	Rhonchi	4	3.3	2	1.5	0.820	0.365	NS
	Wheezes	2	1.6	0	0	2.148	0.142	NS
Potassium	Normal	109	89.3	127	97.7	7.376*	0.007	HS
	Hypokalemia	13	3	3	2.3			
Renal function	Normal	119	97.5	129	99.2	1.150*	0.283	NS
	Impaired	3	2.5	1	0.8			
ABG	Normal	91	74.6	91	70	1.287*	0.526	NS
	Metabolic Acidosis	23	18.9	32	24.6			
	Respiratory Acidosis	8	6.6	7	5.4			

Mann-Whitney test, *: Chi-square test, N = Number, NS= Non-significant: P-value > 0.05, Significant =S: P-value <0.05, Highly significant =HS: P-value < 0.01

Table (3): Statistical Analysis of methods of treatment among the two studied groups

		Group I		Group II		Test value	P-value	Sig.
		N= 122	%	N= 130	%			
Emergency Treatment	No	112	91.8	123	94.6	0.791*	0.374	NS
	Oxygen, ETT	10	8.2	7	5.4			
Antidotes	No	115	94.3	117	90	1.565	0.211	NS
	Yes	7	5.7	13	10			
Acid base disturbances	No	101	82.8	106	81.5	0.067*	0.795	NS
	Hemodialysis	8	6.6	9	6.9	0.013*	0.909	NS
	Mechanical Ventilation	9	7.4	12	9.2	0.283*	0.594	NS
	Nebulizer	3	2.5	3	2.3	0.006*	0.938	NS
	Steroids	1	0.8	0	0	1.070*	0.300	NS

Mann-Whitney test, *: Chi-square test, N = Number, NS= Non-significant: P-value > 0.05, Significant =S: P-value <0.05, Highly significant =HS: P-value < 0.01, ETT=endotracheal intubation

Table (4): Statistical Analysis of methods of treatment among the two studied groups

		2019 group		2020 group		Test value	P-value	Sig.
		N= 122	%	N= 130	%			
Place of admission	ICU	28	23	52	40	12.442*	0.002	HS
	Inpatient	92	75.4	71	54.6			
	Observation	2	1.6	7	5.4			
Duration of stay	Median (IQR)	1 (1 – 2)		2 (1 – 3)		-4.074	0.000	HS
	Range	1 –25		1 –15				
In hospital mortality	No	117	95.9	116	89.2	4.018*	0.045	S
	Yes	5	4.1	14	10.8			

Mann-Whitney test, *: Chi-square test, N = Number, NS= Non-significant: P-value > 0.05, Significant =S: P-value <0.05, Highly significant =HS: P-value < 0.01

Discussion

The COVID-19 pandemic has called for the increased use of disinfectants worldwide to mitigate virus burden both in public settings and common households. Extensive use of disinfectants during the pandemic has raised questions on the potential of their misuse and overuse. The present study evaluated and compared the incidence of complications among cases admitted to PCC-AUH due to use of those chemicals during and before COVID -19 pandemic.

When comparing the 2020 with the 2019 data in the present study, a modest increase in the prevalence of the total number of exposures to sterilizers and disinfectants is noted. This agrees with Dewey et al.,2021 who related the increased use of disinfectants worldwide to prevent viral spread. However, further analysis showed significant increase in incidence among children (median age=4years) via mixed oral and inhalation route with accidental mode of toxicity. On the other hand, before the COVID era, the majority of cases were among adolescence where intoxications were mainly suicidal and through oral route.

Rosenman et al,.2021 assumed that with more disinfecting being performed, a greater number of cleaning product containers will be present in homes and workplaces where young children can access them. Accidental exposure due to atypical packaging was also highlighted by Cook and Brooke ,2021 who reported increased pediatric poisoning in UK, France, and UAE. The age group of most concern was linked to hand-mouth activity, walking acquisition and tendency to explore the immediate environment. In older children, unintentional poisoning accidents often result from misuse and failure to follow safety standards (Sahar et al.,2021).

Increased incidence of mixed oral and inhalation route by disinfectants and sterilizers in 2020 cases in the current study, can be related to increased use of disinfectant mixtures posing an increased risk of poisoning mainly in children. This practice was observed during the Covid-19 health crisis with wrong assumption of increasing the virucidal effectiveness of the disinfectants used (Sahar et al.,2021).

Increased accidental intoxications in public settings during COVID -19 period (62,8% of group II cases) was found in the present study. These results are consistent with published data by Cook and Brooke ,2021 who reported increased incidence of pediatric poisoning in relation of public places mainly in schools and hospitals.

Predominance of male cases was found in both groups with higher incidence COVID period (70.8% of cases) compared to group I (58.2%). Variation of sex distribution of poisoning cases in different geographic regions and time periods can be explained in view of the combined influences of socioeconomic, cultural, and behavioral factors in the general population (Z'gambo et al.,2016).

Sodium hypochlorite topped the list of causative agents in both period of the study followed by methanol, ethanol, and phenol. Further analysis of incriminated products in 2020 showed a significant increase in cases of methanol poisoning (26.2%) compared to13.9% in 2019.

These results reflect the surge in the purchase and use of household cleaning products and sanitizers during COVID-19). High demands, reduced supplies and economic impacts of the pandemic reportedly resulted in people buying cheaper alternatives, lower-quality alcohol products, counterfeit and non-standardized hand sanitizers containing methanol. This coincided with the rapid spread misleading suggestions via social media suggesting the oral use of household cleaning agents and alcoholic beverages to disinfect the mouth and prevent COVID-19 infection. This misinformation caused a steep increase in the inappropriate use of bleaches, cleaning products and hand sanitizers (Cook and Brooke ,2021; Mahdavi et al.,2021; Mousavi-Roknaba et al.,2021).

Analysis of the clinical data of recorded cases in the present study showed statistically significant higher incidence of neurological involvement among cases received during covid pandemic; namely coma grade IV, dilated pupils and blindness. Similarly, the incidence of respiratory distress, hypotension, and tachycardia, were more evident among group II cases compared to group I. Additionally gastrointestinal manifestations and arterial blood gases abnormalities (in the form of metabolic acidosis and respiratory acidosis) were also recorded among both groups.

Presentations frequently recorded during COVID-19 pandemic in the current study coincide with the increased incidence of methanol intoxications. In the early stages of methanol toxicity, mild inebriation misrepresents the severity of the situation, which is revealed as methanol is metabolized into formic acid its toxic metabolites. Formate is a mitochondrial toxin, inhibiting cytochrome oxidase which interferes with oxidative phosphorylation leading to metabolic acidosis with an elevated anion gap. Methanol causes visual impairment, which may progress to “snowfield vision” or total blindness in severe poisoning. Moreover, vasodilation combined with vomiting often leads to hypotension. Methanol can also cause respiratory distress through direct respiratory center depression and indirect by causing severe metabolic acidosis which causes shock and multisystem organ failure (Wiener,2019; Pressman,2020; Mahdavi et al.,2021; Nekoukar et al.,2021).

Conversely, both course crepitations and hypokalemia were more pronounced among group I. These observations can be attributed to sodium hypochlorite which was the most prevalent disinfectant involved in poisoning in pre- covid era.

Regarding hospital disposition and outcome, more ICU admissions, longer duration of stay and higher recorded in-hospital mortality were significantly reported among group II cases.

These findings reflect increased critically ill patients or those likely to decompensate among cases recorded during covid. Critical care units assure both intensive monitoring and the provision of timely care necessary for such cases. In cases of methanol intoxication, the primary goals for extended ICU admissions include the need of intubation and mechanical ventilation, hemodialysis, and antidotal therapy which are commonly necessary for patients with severe poisoning. Poor prognosis is also associated with end-organ toxicity, and severe acidemia. Additionally, the recorded increased frequency of poisoning cases in children who may be more liable for complications especially by alcohol-based products (Wiener,2019; Ghafoor et al., 2021).

Conclusion

Higher incidence of accidental poisoning with disinfectants and sterilizers mainly with Na Hypochlorite and methanol especially among children was recorded during COVID 19 pandemic with more medical complications and longer duration of stay at PCC-ASU compared with non-Pandemic period.

Recommendations

Proper storage of disinfectants and sterilizers used at homes and cautions must be taken to avoid using of methanol instead of ethanol.

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مضاعفات السمية الحادة بعد تناول المطهرات والمعقمات أثناء جائحة COVID-19

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الملخص العربي

كان هناك زيادة في استخدام المطهرات والمعقمات في جميع أنحاء العالم خلال جائحة كوفيد-19.

الهدف من الدراسة: تقييم مدى انتشار وشدة مضاعفات التسمم الحاد بعد تناول المعقمات والمطهرات أثناء جائحة كوفيد-19 ومقارنتها بتلك التي كانت موجودة قبل الجائحة.

الطرق: تم إجراء دراسة جماعية رصدية بأثر رجعي قائمة على الملاحظة في المستشفى لجميع المرضى المقبولين في مركز علاج التسمم بمستشفيات جامعة عين شمس بعد تناول جرعة زائدة من المعقمات أو المطهرات في الفترة من 2019/3/1 إلى 2021/3/1 وقد تم تقسيم الحالات إلى مجموعتين فرعيتين الأولى تضم الحالات المقبولة قبل تفشي فيروس كورونا في مصر و الثانية الحالات المقبولة أثناء تفشي فيروس كورونا في مصر.

نتائج الدراسة: وجد اختلافاً كبيراً فيما يتعلق بالعمر و الجنس و طرق و أنواع التسمم حيث تم تسجيل متوسط أعمار أقل ونسبة أعلى من الذكور بين حالات المجموعة الثانية.كانت حالات التسمم بهيبوكلوريت الصوديوم الأكثر شيوعاً فى المجموعتين خاصة في الأولى(٧٦,٣٪) مقارنة بالمجموعة الثانية (٦٠,٨٪) يليها الميثانول. تم تسجيل حدوثاً أعلى فيما يتعلق بالغيبوبة من الدرجة الرابعة والصدمة و ارتفاع ضربات القلب وضيق التنفس بين حالات المجموعة الثانية. كما ارتبطت حالات المجموعة الثانية ارتباطاً ذو دلالة إحصائية فيما يتعلق بدخول وحدة الرعاية المركزة (٤٠٪) و مدة الإقامة الأطول وارتفاع معدل الوفيات أثناء الإقامة بالمستشفى (١٠,٨٪) مقارنة بالمجموعة الأولى

الخلاصة: تم تسجيل ارتفاع حالات التسمم العرضي بالمطهرات والمعقمات بشكل رئيسي باستخدام هيبوكلوريت الصوديوم والميثانول خاصة بين الأطفال خلال جائحة كوفيد- 19 مع المزيد من المضاعفات الطبية ومدة الإقامة الأطول مقارنة بالفترة غير الوبائية.

وتوصى هذه الدراسة بالتخزين السليم للمطهرات والمعقمات المستخدمة في المنازل ويجب أخذ الحذر لتجنب استخدام الميثانول بدلا من الإيثانول.

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