ÖZGÜN ARAŞTIRMA / ORIGINAL RESEARCH

DOI: 10.17944/mkutfd.1101321
MKÜ Tıp Dergisi 2022;13(47):399-404

Evaluation of patients admitted to the emergency room with the claim of being exposed to chemical gas in Northwest Syria

Burak Çelik[1], Bahadır Karaca[2], İsmail Tayfur[3]

[1] Kırşehir Training and Research Hospital, Emergency Department, Kırşehir, Türkiye
[2] Sancaktepe Şehit Prof. Dr. İlhan Varank Training and Research Hospital, Emergency Department, İstanbul, Türkiye
[3] University of Health Sciences, Sancaktepe Sehit Prof. Dr. İlhan Varank Training and Research Hospital, Department of Emergency Medicine, İstanbul, Türkiye

Abstract

Evaluation of patients admitted to the emergency room with the claim of being exposed to chemical gas in Northwest Syria

Objective: In this study, it was aimed to evaluate the patients who applied after being affected by chemical gas in Northwest Syria, to examine the treatment results, and to raise awareness about chemical gas attacks.
Method: The study included 43 patients who applied to the emergency department of our hospital, who felt an odor similar to the smell of onion and garlic and were sick. Our research is a retrospective study. Retrospective data were collected from the files of patients admitted after gas exposure. Statistical analyzes of the study were performed using Statistical Package for Social Sciences version 25.0 software for Windows. P-value below 0.05 in all statistical analyzes were interpreted as statistically significant.
Results: All 43 patients were male. The mean age was 24.86 ∓ 8.81 years. Vital signs at the time of application; mean blood pressure 97.23 ∓ 5.61 mmHg, fever 37.2 ∓ 0.57 °C, heart rate 99.28 ∓ 9.89 / min, oxygen saturation 96.43 ∓ 1.53 %. In total, three patients had convulsions. Twenty patients had agitation and spasm sensation, twelve patients had redness of the eyes and 42 patients had complaints of shortness of breath. According to the results, it was determined that the pulse values of the patients at the second admission were higher than the pulse values at the first admission and their oxygen saturation was lower ($p<0.05$). The mean fever values and oxygen saturations of the patients who applied for the second time were lower than the patients who did not apply for the second time ($p<0.05$).
Conclusion: Awareness, rapid decontamination, and symptomatic treatment are thought to be very important in minimizing the devastating effects of chemical attack agents.
Keywords: CBRN, Chemical Gas Exposure, Emergency Medicine, Syria

Öz

Kuzeybatı Suriye'de kimyasal gaz maruziyeti iddiasıyla acil servise başvuran hastaların değerlendirilmesi

Amaç: Bu çalışmada, Suriye'nin kuzeybatısında kimyasal gazdan etkilendikten sonra başvuran hastaların değerlendirilmesi, tedavi sonuçlarının incelenmesi ve kimyasal gaz saldırıları konusunda farkındalık yaratılması amaçlanmıştır.
Yöntem: Çalışmaya hastanemiz acil servisine başvuran, soğan ve sarımsak kokusuna benzer bir koku hisseden ve rahatsızlanan 43 hasta dahil edildi. Araştırmamız retrospektif bir çalışmadır. Veriler gaz maruziyeti sonrasında başvuran hastaların dosyalarından geriye yönelik tarandı.
Bulgular: Kırk üç hastanın tamamı erkekti. Ortalama yaş 24.86∓8.81 yıldı. Başvuru anında vitaller; ortalama kan basıncı 97,23∓5,61 mmHg, ateş 37,2∓0,57°C, kalp hızı 99,28∓9,89/dakika, oksijen saturasyonu %96,43±1,53. Toplamda 3 hastada konvülzyon vardı. Yirmi hastada ajitasyon ve kasılma hissi, on iki hastada gözlerde kızarıklık ve 42 hastada nefes darlığı şikâyeti vardı. Hastaların ikinci başvurudaki nabız değerlerinin ilk başvurudaki nabız değerlerinden yüksek olduğu ve oksijen satürasyonlarının daha düşük olduğu saptandı ($p<0.05$). İkinci kez başvuran hastaların ortalama ateş değerleri ve oksijen satürasyonları ikinci kez başvurmayan hastalara göre daha düşüktü ($p<0.05$).
Sonuç: Kimyasal saldırı ajanlarının yıkıcı etkilerini en aza indirmede farkındalık, hızlı dekontaminasyon ve semptomatik tedavinin çok önemli olduğu düşünülmektedir.
Anahtar Kelimeler: Acil Servis, KBRN, Kimyasal Gaz Maruziyeti, Suriye

Nasıl Atıf Yapmalı: Çelik B, Karaca B, Tayfur İ. Evaluation of patients admitted to the emergency room with the claim of being exposed to chemical gas in Northwest Syria. MKÜ Tıp Dergisi. 2022;13(47):399-404. https://doi.org/10.17944/mkutfd.1101321

Sorumlu Yazar/Corresponding Author: Burak Çelik
Email: burakcelik57@hotmail.com
ORCID iD: 0000-0002-6746-4083

Geliş/Received: 10 Nisan 2022
Kabul/Accepted: 14 Ekim 2022

INTRODUCTION

Chemical agent weapons are toxic chemicals resistant to weather conditions that can be used to neutralize or kill living things by disrupting their life functions. In addition, chemical weapons can be used to create economic damage, fear, and chaos in society (1).

After injuries with chemical agents, signs, and symptoms usually occur in systems such as the eyes, respiratory system, skin, and digestive system. Systemic effects occur in the whole body when the chemical agent acts on the organism (1,2). These effects may vary depending on the type of chemical agent.

Different agents have been used for chemical attacks since 600 BC. There are written sources that various mushrooms were used to poison the drinking water of the enemy soldiers and honey containing grayanotoxin was used to poison their food (3). In addition, the use of Greek fire as a caustic agent is known to be the earliest known example of chemical agents (4). It has been shown that the first chemical attack detected and confirmed in archaeological excavations so far was in Syria. In these excavations, the remains of the use of sulfur dioxide gas created and pumped in the tunnels during the Roman-Persian war were found (4,5).

In addition to the fact that the history of chemical attacks started in Syria, when we look at the recent past, it is seen that the last examples of chemical attacks were also in Syria (6-10). It has been shown that the use of mustard gas, which was seen in the Iran-Iraq war in the 1980s in the Middle East and to which more than 100 thousand people were exposed, was also used by different terrorist groups in Syria in the recent past (11).

Sulfur mustard [bis - (2-chloroethyl) sulfide] is a chemical weapon in the incendiary warfare agents group. It was discovered by Frenchman Despretz at the beginning of the 19th century. It was intensified by the German chemist Victor Meyer towards the end of the 19th century (12,13). It was a potential chemical weapon.

Sulfur mustard was first used as a chemical weapon in the First World War. It is also known as “Mustard Gas” (MG) because of its pungent smell reminiscent of mustard. MG is resistant to outdoor conditions, is less affected by external factors such as temperature, rain, and wind, and can stay for a long time in the open area where it is used. When exposed, there are usually no symptoms other than a pungent garlic odor. Although the effect of MG varies according to its concentration and whether personal protective equipment is used, symptoms may not be seen for hours in the latent period (13-15).

MG is a cytostatic, mutagenic, cytotoxic, and caustic agent. It primarily affects the eyes, respiratory system, and skin (16). The first symptoms are stinging in the eyes, tearing, redness in the eyes, pain or burning sensation in the nose and nasal passages (12). It then enters the systemic circulation and affects the entire organism.

In the Syrian Civil War, which started in 2013, non-state actors especially in northern Syria have used MG extensively (6-10). However, although there have been studies on mustard gas in the recent past, it is quite limited (12).

In this study, it was aimed to retrospectively evaluate the patients who applied to Azez Vatan Hospital in Northwest of Syria, which provides services within the scope of humanitarian aid, after being affected by chemical gas.

METHOD

Study Design

The study included 43 patients who applied to the emergency department of Azez Vatan Hospital in Northwest of Syria at around 8:15 pm on 02.12.2020, who felt an odor similar to the smell of onion and garlic and were sick. Retrospective data were collected from the files of patients admitted after gas exposure. All age and gender groups were included in the study. All patients were male. This research is a retrospective study. Before the start of the study, approval was obtained from the Ethics Committee of Hatay Mustafa Kemal University for non-interventional research (Date of meetings: 06/05/2021 number of decisions: 20) and the hospital management. In addition, the study was conducted in accordance with the “Declaration of the World Medical Association on the Ethical Principles of Helsinki”.

Details of the event that caused the injury

On 02.12.2020 at 8:15 pm, 43 patients who felt an odor similar to the smell of onion and garlic and became ill applied to the emergency department. In a field close to the local security forces campsite, a security personnel smelled onions and garlic after opening the lid of an old metal box he could not identify, after which he passed out at the scene. 6 people who went to the aid of the patient, who appeared to have fainted, also fainted at the scene. After the odor spread, other security personnel at the campsite also experienced fainting and agitation.

Law enforcement officers ensured the safe area at the scene and did not let anyone nearby. AFAD (Afet ve Acil Durum Yönetimi Başkanlığı), a Turkish state aid organization, determined that when they arrived at the scene, they did not smell and when they measured, there could be a trace amount of Sulfur Mustard (Mustard Gas).

Patient application process and prognosis

The patients were brought to the emergency department by ambulances and civilian vehicles. The clothes of the patients were quickly removed and the patients were washed with plenty of soapy water. The patients were dressed in new clothes. Eyewash was done for those with burning and stinging complaints, and salbutamol and steroid were used for those with respiratory distress. Supportive treatments were applied for the symptoms. The agitation of the patients with agitation regressed after decontamination. However, convulsions developed in two patients and were controlled with diazepam IV therapy.

At the first admission, 43 patients were brought, two of these patients had convulsions and were followed up in the intensive care unit. 41 patients whose symptoms improved, were discharged after four hours of follow-up. However, at the eighth hour of exposure, eighteen patients applied to the emergency department again with similar complaints and one more patient had convulsions. All of the patients who applied for the second time and were treated symptomatically were hospitalized in the ward. The patient who had seizures was also followed up in the intensive care unit. All hospitalized patients' complaints and symptoms regressed after 24 hours of follow-up. All patients were discharged.

Statistical Analysis

Statistical analyzes of the study were performed using Statistical Package for Social Sciences version 25.0 software for Windows (IBM SPSS Statistics for Windows, Version 25.0. Armonk, NY: IBM Corp., USA).

Normality assumption for quantitative variables was tested with Kolmogorov-Smirnov and Shapiro-Wilk tests. For the univariate analyzes of the variables in the study, Fisher-Freeman Halton Exact, Chi-square, independent t-test, and Paired t-test were used, depending on the type of variable and the availability of the assumptions. The explanatory statistics of the variables are given as Mean∓ Standard Deviation and the frequencies are given as n (%). Cases with a p-value below 0.05 in all statistical analyzes were interpreted as statistically significant.

RESULTS

The mean age of 43 patients admitted to the emergency department with chemical gas exposure was 24.86 ∓ 8.81 years. Descriptive statistics of vital signs of patients admitted to the emergency department are summarized in Table 1.

Of the patients who received first aid and treatment, 41 were discharged, and then eighteen were re-admitted to the emergency department. Comparative statistics of patients who applied to the hospital for the second time and those who did not apply for the second time are given in Table 2. Of the patients who did not apply for the second time, 32.0% came to the emergency department by ambulance and 68.0% by civilian vehicles. All of the patients who applied for the second time came by ambulance.

The mean fever values and oxygen saturations of the patients who applied for the second time were lower than the patients who did not apply for the second time ($p<0.05$).

The complaints of burning and stinging sensation in the eyes, feeling of fainting, and shortness of breath were proportionally higher in the patients who applied for the second time ($p<0.05$). The feeling of contraction was less in the patients who applied for the second time compared to the patients who did not apply for the second time ($p<0.05$).

The number of patients who had convulsions at the first admission was two. In addition, one of the patients who applied for the second time had a convulsion.

The vital findings of the patients who applied to the emergency department for the second time, at the first and second applications are summarized in Table 3. According to these results, it was determined that the pulse values of the patients at the second admission were higher than the pulse values at the first admission and their oxygen saturation was lower ($p<0.05$).

No abnormal values were found in the hemogram and biochemistry tests of the patients. No abnormal images were found in the chest radiographs of patients with shortness of breath or examination findings. CT examinations of the patients could not be performed because there was no computerized tomography device within the hospital's facilities.

In the first approach for all patients, clothes were removed as a decontamination procedure. The patients were washed with warm water and put on new clothes. Eye irrigation was performed with 0.9% NaCl saline, and patients with dyspnea were given inhaled salbutamol and budesonide in addition to oxygen support. 0.9% NaCl saline was given to the patients who had intravenous access. IV diazepam was administered to patients with convulsions during their follow-up and their seizures were controlled.

DISCUSSION

In many conflict zones, it has been seen that the remains of bombs or explosive weapons harm people even years later. The same is true for chemical weapons, and this study demonstrated exposure by accidental activation of an ancient chemical agent.

The person exposed to the chemical or biological agent should be removed from the scene immediately. In case of exposure to substances that are resistant to dispersion, such as

Table 1. Distribution of vital signs of patients on first admission to the emergency department (n=43)

Variables	Mean ∓ Standard deviation
Blood Pressure	97.23 ∓ 5.61 mmHg
Fever	37.2 ∓ 0.57 ° C
Pulse	99.28 ∓ 9.89/ min
Oxygen Saturation	96.43 ∓ 1.53 %

Table 2. Comparative descriptive statistics of patients who applied to the emergency department for the second time and those who did not apply for the second time

	Not applying for the second time		Second time Applicant		p
	Mean∓SD		Mean∓SD		
Age	24.44 ∓ 8.61		25.44 ∓ 9.31		0.717*
Vitals					
Blood Pressure (mmHg)	98.52 ∓ 6.53		95.44 ∓ 3.45		0.076*
Fever (°C)	37.41 ∓ 0.52		36.94 ∓ 0.55		0.007*
Heart rate (/ min)	97.40 ∓ 7.43		101.89 ∓ 12.31		0.144*
Oxygen Saturation (%)	96.82 ∓ 1.93		95.89 ∓ 1.03		0.048*
	n	%	n	%	
Total	25	8.1	18	41.9	
Form of arrival					
Ambulance	8	32.0	18	100.0	0.000#
Civil vehicle	17	68.0	0	0.0	
Symptoms					
Burning/Stinging/sensation in the eyes	6	9.7	6	16.2	0.037&
Feeling faint	11	17.7	11	29.7	
Contraction sensation	18	29.0	2	5.4	
Shortness of breath	25	40.3	17	45.9	
Seizure	2	3.2	1	2.7	
Physical examination findings					
Dyspnea and Eye Redness	3	12.0	0	0.0	0.177&
Pharyngeal hyperemia	0	0.0	1	5.6	
Postictal state	2	8.0	1	5.6	
Ral in the lung	0	0.0	1	5.6	
Usual	23	92.0	15	83.3	
Inpatient service					
Service	0	0.0	17	94.4	0.000&
Intensive care unit	2	8.0	1	5.6	
Discharge	23	92.0	0	0.0	

*: Independent t test, #: Chi-Square, &: Fisher-Freeman Halton Exact, SD: Standart Deviation

Table 3. Comparison of first application values and second application values of patients who applied for the second time (n=18).

	First Application	Second Application	p*
Blood Pressure (mmHg)	95.44 ∓ 3.45	98.11 ∓ 14.54	0.481
Fever (°C)	36.94 ∓ 0.55	37.11 ∓ 0.62	0.091
heart rate (/ min)	101.89 ∓ 12.31	114.78 ∓ 13.80	0.000
Oxygen Saturation (%)	95.89 ∓ 1.93	94.17 ∓ 1.75	0.002

*: Paired t test

mustard gas, people should be removed from the environment. All clothing should be removed and free of lipophilic agents by decontamination. If possible, decontamination kits should be used, if these kits are not available, washing and rinsing should be done with plenty of soapy water. It should not be neglected during decontamination as there may be accumulation, especially in the body fold areas. Eye irrigation should be done with saline, if possible, alternatively with plenty of water (13).

In this study, people who were exposed to chemical gas were transferred to the hospital, and decontamination was performed immediately. The whole body was washed with soapy water, the eyes were irrigation, and supportive treatments with saline.

In Syria, the weather can reach -10 °C in winter and +40 °C in summer (17). There may have been a decrease in the effect of the chemical agent with the variable moisture balance. It made us think that the chemical agent released in the open air spread over a wide area with the effect of the wind and affected many people, but its effect decreased when it was diluted in the open area. However, thick military clothing may have provided protection for the patients' skin, while respiratory and corneal exposure may have caused patients' symptoms.

In the case series of Sezigen et al. conducted with patients who came to Turkey from Syria, similar symptoms were observed in this study, except for skin lesions (18). The limitation of our study may be that the patients were not followed up in the hospital for more than 24 hours, and skin lesions could not be detected. However, there were no later admissions to the hospital due to skin lesions.

In the cases observed in the Iran-Iraq war and in the case series created by Sezigen et al. from patients who came to Turkey from Iraq, there was information that patients felt the smell of garlic (13,19). In this study, patients also stated

that they felt an onion-garlic-like odor. However, the first symptoms were fainting, feeling of faintness, and agitation. The previous experience of war and chemical attack may have caused the patients to have high fears and anxieties, and this may have caused them to present with these symptoms as the first finding in the latent period. However, the concerns that come with these experiences can be effective in reaching decontamination and treatment quickly. In the study of Kılıc et al., patients did not remove their clothes for a long time and it was learned that skin lesions appeared (11). All the clothes of the cases in this study were removed and the patients were washed with plenty of soapy water and new clothes were put on. Healthcare workers were also routinely wearing their protective equipment in the emergency department due to COVID-19 precautions and approaching patients by paying attention to masks and distance. In this event, the presence of health personnel ready to intervene with protective equipment for patients exposed to chemical agents has created an advantage for health workers in terms of occupational safety.

In the reviews in the literature; Shoes and all clothes of victims exposed to chemical agents should be removed and placed in a biohazard waste bag, and this biohazard waste bag should be repackaged into a biohazard waste bag (18). All these biohazard garbage bags should also be stored in an isolated area outside the hospital if possible. In this study, the clothes were sent to the CBRN waste department outside the hospital in double-layer bags.

It is stated that there is a symptom-free period in case of exposure to mustard gas. The relationship between exposure to mustard gas and the onset of symptoms; The total amount of mustard gas absorbed is related to the total exposure time and exposure route (19). Kehe et al. state that the onset of mustard gas symptoms complies with Haber's law, and it is stated that exposure to higher doses of mustard gas shortens the asymptomatic delay (12,20). Although no definite time was given for the latent period in the cases in this study, symptoms began to appear shortly after exposure and the patients were brought to the emergency department quickly.

The complaints of burning and stinging sensation in the eyes, contraction sensation, and shortness of breath of the patients included in the study were seen in parallel with the literature. However, symptoms such as convulsions and fainting were detected differently from the literature. A study similar to ours in terms of its effects on the central nervous system was conducted by Kehe et al. In this study on the treatment processes of twelve Iranians who were victims of the 1984-1985 Iran-Iraq war in Germany, it was seen that all of the patients were apathetic and depressed as central nervous system symptoms. However, it was recorded that these findings regressed after two weeks (12).

In the study of Balali-Mood et al., it was shown that the effects of exposure to mustard gas can be seen differently depending on the exposure dose. At an exposure of 50 mg/ min/ m^3, the symptoms begin with burning in the eyes and respiratory symptoms, while skin lesions are added to the symptoms when the exposure dose increases exponentially. As the exposure dose increases, eye and skin lesions become more severe, and respiratory distress increases (19). In this study, although there were symptoms in the respiratory system and eyes, the absence of skin lesions suggests an exposure of less than 100 mg/ min /m^3.

CONCLUSION

It was seen in the literature that there were attacks with chemical agents in Northwest Syria. It is known that in many conflict zones, the remains of bombs or explosive weapons harm people even after many years. The same can be seen for chemical agent weapons. In this study, too, an accidental activation of an ancient chemical agent was found. However, the awareness and experience of the population of the region on this issue enabled the treatment to be started quickly. As a result of this study, it is thought that rapid decontamination and symptomatic treatment are important in minimizing the destructive effects of chemical attack agents.

ACKNOWLEDGEMENT

Peer-Review

Both externally and internally peer reviewed.

Conflict of Interest

The authors declare that they have no conflict of interests regarding content of this article.

Support Resources

The authors report no financial support regarding content of this article.

Is previously presented?

Some part of this study was presented as oral/poster presentation at "1st Turkey Emergency Medicine Symposium" held in 24-27 March 2022, entitled as "Evaluation of Emergency Applications After Chemical Attack Agent Exposure: A Mustard Residue in Northwest Syria".

Ethical Declaration

Ethical permission was obtained from the Non-Interventional Clinical Trials Ethics Committee of Hatay Mustafa Kemal University Tayfur Ata Sökmen Faculty of Medicine for this study with date 06.05.2021 and number 20 and Helsinki Declaration rules were followed to conduct this study.

Authorship Contributions

Concept: BÇ, BK, İT, Design: BÇ, BK, İT, Supervising: BÇ, BK, İT, Financing and equipment: BÇ, BK, İT, Data collection and entry: BÇ, BK, İT, Analysis and interpretation: BÇ, BK, İT, Literature search: BÇ, BK, İT, Writing: BÇ, BK, İT, Critical review: BÇ, BK, İT

Thanks

The authors would like to thank Prof. Dr. Özkan Görgülü (Kırşehir Ahi Evran University, Faculty of Medicine, Biostatistics and Medical Informatics Department) for his assistance in the statistical analysis of the study.

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