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DEVELOPMENT PATHS OF CLINICAL TOXICOLOGY IN THE ARMED FORCES OF THE REPUBLIC OF KAZAKHSTAN. A LITERATURE REVIEW

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Abstract

Without the development of clinical toxicology, the population is doomed to suffer great losses in the event of the use of chemical weapons or man-made disasters, since the national health structure will not be able to provide the necessary symptomatic and antidote care to the affected people. The development of clinical toxicology is necessary today because of the threat of latent methods of chemical attack, when prevention and chemical control structures become ineffective and the consequences of poisoning with an unknown poisoning agent have to be dealt with.

Қазақстан Республикасы қарулы күштерінде клиникалық токсикологияны дамыту жолдары. Әдебиет шолуы

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Аңдатпа

Химиялық қауіпсіздік ұлттық қауіпсіздіктің бір бөлігі болып табылады. Өз кезегінде, клиникалық токсикология химиялық қауіпсіздіктің бір бөлігі болып табылады және оны дамытпай, химиялық қару немесе техногендік апат жағдайында халық үлкен шығындарға ұшырайды, өйткені елдің денсаулық сақтау құрылымы зардап шеккен адамдарға қажетті симптоматикалық және антидотты көмек көрсете алмайды. Әсіресе, алдын-алу және химиялық күрес құрылымдары тиімді болмаған кезде және улы зат туралы мәліметтер болмаған жағдайда салдар мен күресу қажет болған кезде химиялық шабуылдың жасырын әдістерін қолданудың қазіргі шындықтарында клиникалық токсикологияның дамуы туралы мәселе өткір тұр.

Пути развития клинической токсикологии в вооруженных силах Республики Казахстан. Обзор литературы

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Аннотация

Химическая безопасность является частью национальной безопасности. В свою очередь клиническая токсикология является частью химической безопасности и без ее развития население обречено на огромные жертвы в случае применения химического оружия либо техногенной катастрофы, так как структура здравоохранения страны не сможет оказать необходимую симптоматическую и антидотную помощь пораженным людям. Особенно остро стоит вопрос о развитии клинической токсикологии в сегодняшних реалиях применения скрытых способов химической атаки, когда структуры предупреждения и химической борьбы окажутся не эффективны и нужно будет бороться с последствиями в условиях отсутствия данных об отравляющем веществе.

Ключевые слова:
COVID-19 пандемия,
организация службы
интенсивной терапии

Relevance

The achievement of national security is only possible within the framework of a balanced system of regional and international security. In this regard, "the security system of Kazakhstan should be an integral part of the regional and global security system" [1].

At various stages of the country's development, uneven development of various components of security is noted due to emerging threats or funding deficits. Therefore, one of the strategic tasks is to establish a certain balance that allows for the balanced development of all types of security. For example, until we were faced with the threat of biological security in the form of the spread of coronavirus infection, no one considered the development of this area, and measures taken were actually in the form of reducing departments and abolishing services dealing with this issue. This experience has shown that national security needs to be approached comprehensively. Currently, due to the worsening political situation in the world, we believe that more attention should be paid to chemical security, which should be considered as one of the components of the overall national security system as well as a complex independent system. The identification and detailed elaboration of chemical security threats largely determine the overall state of societal security, the conditions in which it exists, and the development of the environment. Chemical threats can cause harm not only territorially, affecting neighboring countries, but also temporally, leaving their mark on generations of people [2].

Objective: Development of a concept for the advancement of clinical toxicology in the Armed Forces of the Republic of Kazakhstan.

We conducted a search of literature and regulatory acts freely available that provide insights into the organization of chemical safety abroad and in the Republic of Kazakhstan. A search using keywords yielded 2268 results, of which 692 were accessible. The majority of publications were excluded due to their thematic irrelevance to our research. As a result, several publications primarily authored by specialists from the

United States, discussing the organization of toxicological services in different countries, were selected. Only one domestic article corresponded to the search criteria. Additionally, regulatory acts governing the organization of chemical safety in the Republic of Kazakhstan were selected.

Analysis of the global situation

The concept of warfare has evolved since the Second World War, with the popularization of the United States and NATO countries employing local armed conflicts to address political issues. In turn, the emergence of so-called "contactless" and hybrid warfare, starting with the war in Yugoslavia, has led to the development of insurgent movements funded from external sources. The territories occupied by insurgents are not bound by international law, and their pursuit of goals may involve the use of weapons of mass destruction (WMD). Considering the poorly developed infrastructure destroyed by combat operations, as well as the lack of sophisticated production capabilities, it is likely that insurgents will resort to various crude chemical agents and "dirty" radioactive materials.

For example, in Japan, two terrorist attacks occurred (in Matsumoto in 1994 and in the Tokyo subway in 1995) organized by the fanatical religious cult AumShinrikyo (Supreme Truth). The chemical weapon used was sarin. Approximately 70 tons of sarin were produced by the religious cult organization "AumShinrikyo" in Kamikuishiki, Japan, almost legally. Although there were 20 fatalities, the cult instilled fear in millions of people for a prolonged period. These acts of chemical terrorism were unprecedented, and the psychological impact of the chemical attack spread not only in Japan but also worldwide. In addition, over the following decade after the attack in Japan, according to a report from the US Department of Defense, numerous incidents involving biotoxins such as ricin and anthrax occurred [3].

After the September 11, 2001 attacks in the United States, the likelihood of insurgent and terrorist groups such as "Al-Qaeda" using chemical weapons increased significantly. As confirmation of this, in the fall of 2006, "Al-

Qaeda" and its affiliated groups used chlorine gas in combination with traditional car and truck bombings to sow panic in Iraq [4]. They chose this method of intimidation because among chemical, biological, and radiological weapons, the use of chemical substances is more probable due to their ease of production, simple delivery systems, and achievable psychological effect of discrediting authority and creating a sense of vulnerability with a lack of control over the situation [5]. In the case of a targeted conflict, rebels and saboteurs will employ chemical formulas for which there are no developed medical protective measures (MPM). Considering their covert usage, understanding the nature of the poison becomes impossible in our circumstances, making treatment very difficult to accomplish. The most recent example of the use of chemical weapons in such conflicts is the ongoing Syrian civil war [6].

Furthermore, in addition to the covert development of new chemical weapons in many countries that officially do not possess them, dual-use chemical compounds are being produced. There have been precedents where countries, under the guise of agricultural development, demanded expanding the spheres of Vx and norbornene use, and the use of conotoxin as an anesthetic [6]. Additionally, delivery systems, weapon technologies, and precise navigation technologies are being improved. All these features of development pose a complex challenge to Kazakhstan's national security, particularly chemical security.

Chemical security consists of several stages, with the first being measures to prevent attacks, followed by measures to reduce losses and eliminate the consequences. One link in the elimination of consequences is the elimination of medical and sanitary consequences of chemical weapon use, as well as chemical accidents in peacetime, which can be achieved through the development of clinical toxicology.

An example of prevention is the monitoring of dual-use chemicals. The area of interest includes collecting and analyzing the capabilities of neighboring countries in the production of potential chemical weapons and their existing industrial capacities for this purpose, as well as developing indicators of their testing or military use. Controlled items include precursors of specific chemical agents, pathogens used in biological weapons (BW), and dual-use equipment that can be used in chemical weapons. Thus, considering the unstable political situation, particularly in Afghanistan, the threat of the proliferation of

chemical weapons is expected to increase in the coming years due to chemical weapons that are easy to produce, difficult to detect (as insurgents acquire more efficient delivery systems), and can be effectively used for political and psychological pressure.

Measures to reduce losses include studying possible approaches to covert attacks carried out by saboteurs. The covert use of fast-acting and rapidly degrading compounds will result in a flow of affected military personnel and civilians in neighboring areas even after the self-liquidation of the source, discrediting the work of troops in radiological, chemical, and biological protection (RCBP). The lack of information about the properties of the poison will significantly increase the burden on medical facilities with increased bed occupancy over time [6].

In this situation, the actions of medical specialists, particularly the medical service, will be decisive in reducing the number of casualties. The use of pathogenetic and symptomatic therapy becomes especially relevant for managing life-threatening conditions.

Abroad and in Kazakhstan, unlike the structure during the Soviet era, the toxicology service consists of a Poison Control Center, which provides advisory services and collects toxicological information nationwide. Medical assistance to poisoned and affected individuals is provided in therapeutic departments of healthcare facilities or in intensive care units [7].

Nevertheless, debates on the principles of organizing the toxicology service continue in different countries, and even within the European community, there is no unified concept. This is due not only to traditional economic and social problems but also to the historically developed differences in the structure of medical services. The diversity of numerous terms (urgent, emergency, critical, life-threatening, extreme, etc.) indicates significant differences in approaching this issue. In this regard, the United States has taken a significant step forward by adopting the Emergency Medical Treatment and Active Labor Act (EMTALA), contrary to its own healthcare concept [8]. The situation described above is partially characteristic of Kazakhstan, but the medical issues in our country differ in many ways from those in the West.

Analysis of the situation in the Republic of Kazakhstan

Currently, active work is being carried out in our country in the field of chemical safety:

Ratification of 8 international conventions on chemical safety has been completed.

There are key regulatory acts (NPAs) for managing chemical events, including

the Environmental Code of the Republic of Kazakhstan [9], the Law of the Republic of Kazakhstan "On the Safety of Chemical Products" [10], and the Law of the Republic of Kazakhstan "On Civil Protection" [11].

The Commission on Biological Safety [12] was established, but it was abolished in 2017 [13]. In 2020, by the order of the Prime Minister of the Republic of Kazakhstan No. 77-r, the Council on Biological Safety [14] was established.

The Committee for Industrial Development of the Ministry of Industry, the Committee for Environmental Regulation and Control of the Ministry of Ecology, Geology and Natural Resources of the Republic of Kazakhstan, and the Committee for Sanitary and Epidemiological Control of the Ministry of Health of the Republic of Kazakhstan are responsible for the registration and monitoring (analysis) of industrial safety of hazardous production facilities, chemical substances in the atmospheric air, soil, and water bodies. Chemical accidents are investigated with the involvement of the Ministry of Emergency Situations of the Republic of Kazakhstan.

However, the role of the Ministry of Defense of the Republic of Kazakhstan in the structure of the organization for the elimination of chemical disaster consequences is not disclosed.

In Kazakhstan, as well as in most Western countries, the establishment of information and advisory toxicology centers is envisaged [15]. In 2019, a toxicology center was opened based on the Toxicology Department of the Emergency Medical Hospital in Almaty, but it was closed in 2020. Currently, there is no centralized center in the civil healthcare structure where all information would converge and a helpline would operate for the affected individuals, especially for remote healthcare institutions. In addition, in 2021, the toxicology department in the Emergency Medical Hospital was closed. There is no alternative solution to the problem of toxicological assistance. The advantage of domestic toxicology lies in the wide application of physical detoxification methods and the use of inexpensive antidotes. However, a weak aspect remains in laboratory diagnostics, which hinders the determination of the quantitative content of toxic substances in biological fluids.

Within the structure of the Ministry of Health of the Republic of Kazakhstan, there are five toxicology departments, with the largest and most experienced one located in the Almaty Emergency Medical Hospital (EMH).

Among the negative aspects, the country lacks education on toxicological literacy. There is no system for training medical personnel and the population in the specialization of

toxic substances. In most countries, people have the right to know about themselves and the properties of pharmaceutical, household, and industrial products used. Insufficient active planning of response mechanisms by the toxicological service to emergencies related to massive chemical releases worldwide. In the case of mass chemical poisoning resulting from accidents or terrorist operations, a broader network of healthcare institutions, regional healthcare system leadership, and coordination of regional centers should be involved.

There is an ineffective system for accumulation and rational distribution of specific antidotes, especially in cases of group and mass poisonings. Many antidotes are not included in the list of the Kazakhstani National Drug Formulary, and their use is not regulated by a guaranteed volume of free medical assistance, although their application is necessary and life-saving in many poisoning cases (e.g., methylene blue, cytoflavin).

The toxicological service within the Armed Forces of the Republic of Kazakhstan (AF RK) presents a particular situation. In 2020, the Department of Radiological, Chemical, Biological Defense, and Environmental Safety was established within the structure of the Armed Forces [16]. However, despite this, military toxicology has not received proper development.

Currently, within the organization of medical toxicology in the structure of the Military Medical Administration of the Ministry of Defense of the Republic of Kazakhstan (MMU AF RK), there is a toxicologist-epidemiologist. However, there is no toxicological service, toxicology department, or a medical toxicologist unit directly involved in the provision of medical protection, treatment, and rehabilitation of individuals affected by poisoning within the structure of the Armed Forces of the Republic of Kazakhstan.

Taking into account the experience of post-Soviet countries, to address these issues, it is necessary to establish a department of military toxicology based on the Kazakhstan-Russian Medical Institute (there is a methodological teaching base for disaster medicine), and organize a course on "military toxicology" to train military specialists in emergency measures for mass poisoning. Additionally, the department will serve as a scientific and material base for the development of necessary documents for providing emergency assistance in the event of the use of weapons of mass destruction or technological catastrophes.

To organize the toxicological service, we propose the following as the first stage:

1. Appoint the most qualified and

experienced medical officer from the anesthesiology-reanimation doctors, who have professional training in toxicology, as the non-staff clinical toxicologist. This individual should possess in-depth and comprehensive knowledge of their specialty and have organizational abilities. For operational response, the non-staff toxicologist should be subordinated to the Chief Medical Officer of the Garrison (Regional Command, Military Hospital), and for specific matters, to the Chief of Staff of the MMU AF RK.

2. Make the instructions of the Chief Non-Staff Toxicologist regarding medical assistance to victims of toxicological incidents mandatory for the medical personnel and clinical units to follow.

3. Organize the work of the non-staff toxicologist based on the requirements of the legislation of the Republic of Kazakhstan and the guiding documents (orders, directives, instructions) of the Ministry of Defense of the Republic of Kazakhstan and the Chief Military Medical Administration.

4. In their activities, prepare the legal and material framework for establishing the toxicological service, develop proposals for the technical equipment of the service, its structure, and options for forming antidote stocks.

The second stage involves creating a Military Toxicology Center based on the Extracorporeal Detoxification Department of the Military Clinical Hospital of the Ministry of Defense of the Republic of Kazakhstan (equipped with medical equipment), the Military Medicine Center of the Armed Forces of the Republic of Kazakhstan (equipped with diagnostic equipment and instructors), and the Sanitary and Epidemiological Center of the AF RK (equipped with chemical reconnaissance and transport capabilities).

As the third stage, we propose forming mobile toxicological brigades in each Regional Command consisting of the following personnel: Brigade Leader - a doctor specializing in anesthesiology-reanimation (toxicologist), a physician specializing in therapy, an epidemiologist-toxicologist (from the Sanitary and Epidemiological Center of the AF RK) responsible for physical dosimetry and organizing sanitary (special) treatment, a chemical protection officer, a nurse-anesthetist, and a nurse.

The tasks of these brigades would include:

Organizing sanitary treatment of the affected individuals, decontamination, deactivation, and disinfection.

Medical sorting of the affected individuals, including determining the need and order of evacuation to specialized medical defense

organizations and the Ministry of Health of the Republic of Kazakhstan.

Approving the composition of the brigades in Regional Commands and coordinating their presence and assigned roles with the Ministry of Emergency Situations and territorial defense agencies.

Providing medical assistance, including emergency specialized medical interventions.

Coordinating with other medical institutions and formations called upon to respond to the emergency, including providing consultative and methodological assistance.

Assisting in organizing the work regime in medical organizations and formations under conditions of chemical (radioactive) contamination, and conducting individual dosimetric control of their personnel.

The fourth stage is to equip the brigades with analyzers, kits, and antidotes. Due to the problem of supplying antidotes, we propose methods of providing toxicological assistance based on mediator syndromes and extracorporeal detoxification methods: hemosorption, hemodiafiltration, and plasmapheresis (these methods were introduced into the practice of military medicine in the Soviet Union but found a second life in the early 2000s when foreign countries implemented effluent methods in the treatment of acute poisonings). Train toxicological group specialists and non-permanent toxicologists in the treatment of poisonings using drugs registered in the republican drug formulary.

Conclusions

The establishment of a toxicological service within the structure of the military medicine of the Armed Forces of the Republic of Kazakhstan will:

1. Improve the quality of toxicological assistance;
2. Create guidelines for providing toxicological assistance;
3. Establish a coordination center within the structure of the AF RK to provide organizational and methodological assistance in case of mass poisonings;
4. Create mobile toxicological brigades capable of providing assistance in any part of the country within 24 hours;
5. Develop diagnostic methods and antidote therapy and train medical personnel in their application;
6. Continue to improve the stages of patient evacuation and routing depending on the etiology and severity of poisoning;
7. Organize toxicological literacy training in the AF RK.

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