Research Article

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The Structure and Organization of Medical Care for Victims with Thermal injury in Emergency Situations

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INTRODUCTION Based on the Ministry of Emergency Situations data megapolises note an annual increase of the emergency situations (ES). The increase of an urban population in Russia up to 73% results in considerable human victims in big cities due to thermal injuries among others.

The aim of the present research is to analyze the structure of ES victims and the efficiency of the organization of a medical care for victims with thermal injuries in Moscow in 2016–2018.

MATERIAL AND METHODS We have held a retrospective analysis of 113 cases of patients of a Burn Center of Sklifosovsky Research Institute for Emergency Medicine of the Moscow Health Department, and have studies the data of an automated informational analytical system named "Emergency Medicine" for 2016 2018.

RESULTS For an absolute number of victims, fires are on the third place among different emergencies in Moscow, but on the pre-hospitalization stage, the biggest number of deaths are registered (38,2%). The number of patients with thermal injuries reaches 31% among all the patients in hospitals. We note a multi-factor and a combined character of injuries characterized by a high mortality rate (9,8%).

CONCLUSION A present system of medical help for patients with thermal injuries, from the moment of ES fact to the hospitalization to multidisciplinary treatment-and-prophylactic organizations having an experience of specialized medical services, is a reliable and effective element of the health system.

Keywords: disaster medicine, emergency, burn injury, specialized medical care

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AIAS, Automated Information and Analytical System
EMC, Emergency Medical Care
EMERCOM (Russian abbrev.: MchS), the RF Ministry of Emergencies, The Ministry of the Russian Federation for Civil Defense, Emergencies and Elimination of Consequences of Natural Disasters
EMIAS, a united medical information and analytical system
EMR, electronic medical record
EMS, Emergency Medical Service
ES, emergency situation
ICU, Intensive Care Unit
TII, thermal inhalation injury
TsEMP, Scientific and Practical Center for Emergency Medical Care of the Moscow Health Department

INTRODUCTION

Organizing the medical care for victims with thermal injury sustained in emergency situations (ES) associated with fires and explosions remains an important problem of disaster medicine, since the elimination of their consequences requires the involvement of a significant amount of material resources, as well as intensive work of employees of all levels of health care system [1]. According to L.Welling et al. (2005), mortality among victims with thermal injury in emergency situations varies from 1.4% to 50% [2]. For example, during the cafe fire in the "De Hemel" in Volendam (Netherlands) (2001), it was 5.3% [3]. Among the victims of the fire at the Lame Horse Club in Perm (2009), the overall mortality rate reached 16.2% [4]. In the explosion of a fuel truck in Kenya in 2009, the assistance was provided to 89 victims, but 45 patients (50.6%) died [5]. It is known that the timely provision of specialized medical care is the basis for reducing the severe consequences of injuries and mortality [6, 7]. Currently, a two-stage scheme of work in emergencies has been adopted: the provision of primary care to patients with thermal, inhalation trauma, and the evacuation to a specialized hospital [4]. In Moscow, the Emergency Response Teams of the Scientific and Practical Center for Emergency Medical Care of the Moscow Health Department (TsEMP), at the initial stage of care, the primary triage of casualties with combined trauma (skin integument burns, inhalation trauma, poisoning by combustion products, mechanical trauma, etc.) is performed. According to the RF Ministry of Emergencies (EMERCOM), an increase in the number of emergencies is observed in the Russian Federation. So, in 2018, there were 3.5% more emergencies than in 2017. In 2018, the number of victims increased by 57.9%, and the number of deaths increased by 28.96% compared to 2017. In the general structure of emergencies, one of the first places belongs to fires and explosions associated with ignition (fire). in 2018, the number of burn injuries in the Russian Federation increased by 3.5%, and the number of deaths increased by 1.1% compared to 2017. It is noted that most of the fires (58.1%) occur in large cities [8].

The aim of the study was to assess the effectiveness of the existing structure and organization of rendering medical care for victims with thermal injury in emergency situations in Moscow.

MATHERIAL AND METHODS

To assess the prevalence of thermal injury in emergencies, the materials of the automated information and analytical system (AIAS) "Disaster Medicine of the city of Moscow" of the Scientific and Practical Center for Emergency Medical Care of the Moscow Health Department for the previous 3 years were used. We reviewed the medical records of 133 patients with thermal injury sustained in emergency/an accident, who were admitted in the N.I. N.V. Sklifosovsky Research Institute for Emergency Medicine in the period 2016–2018. The mean age of admitted patients with thermal injury in the period 2016–2018 was 44.3 ± 19.3 years. There were 79 (59.3%) men were, and 54 (40.7%) women among the injured. All patients were transported by means of the Emergency Medical Care (EMC) channel under conditions designated as “Emergencies”.

The medical response measures to eliminate the consequences of the emergencies on the territory of the city are carried out by the Emergency Medical Service (EMS), established by Order No. 412 of 09/14/1990 issued by the Main Medical Directorate of the city of Moscow (currently the Moscow Health Department), a functional association of forces and means of city health care system involved in the elimination medical consequences of emergencies.

During the period of the medical response to eliminate the consequences of an emergency, all medical organizations of Moscow Health Department involved in the EMS structure, come under the operational subordination of the head EMS institution, namely TsEMP. In their activities, they use the disaster classification generally accepted in our country as presented in Appendices Nos. 4 and 5 of the Russian Federation Health Ministry Order No. 131 issued 23.04.2002 "On approval of the instructions for filling out the registration forms of the Disaster Medicine Service" [9].

RESULTS

In the event of an emergency, TsEMP emergency response teams and EMC teams are dispatched to the scene. TsEMP provides the information support, coordination of the activities of medical organizations, and interaction with emergency non-medical services involved in the emergency response. For the recent 3 years, according to the data contained in the AIAS "Disaster Medicine of the city of Moscow", fires have ranked second (25.2%) in the structure of emergencies occurring in the city. Data on the structure of emergency situations are presented in Table 1.

Table 1

The structure of emergencies accompanied by medical losses in the territory of Moscow

Types of emergencies	2016 r.	2017 r.	2018 r.	Total	
	Abs.	Abs.	Abs.	Abs.	%
Transport accidents	739	722	642	2103	33.0
Fires	724	481	402	1607	25.2
Technological accidents	48	30	24	102	1.6
Non-fire collapse	6	6	6	18	0.3
Other technogenic (natural and technological)	41	194	88	323	5.1
Biological-social	247	262	1068	1577	24.8
Social	175	188	221	584	9.2
Natural	14	12	25	51	0.8
Total	1994	1895	2476	6365	100

At the same time, according to the absolute number of victims in various emergencies on the territory of Moscow, fires rank third (14.3%), conceding to the total number of victims of transport accidents, and emergencies of a biological and social nature (39.8%, and 25.9%, respectively). The distribution of the casualty numbers resulted from various emergencies over the past 3 years is presented in Table. 2.

Table 2

The number of people injured as a result of emergencies on the territory of Moscow

Types of emergencies	Number of victims of emergency situations				
	2016 r.	2017 r.	2018 r.	Total	
	Abs.	Abs.	Abs.	Abs.	%
Transport accidents	1941	1918	1898	5757	39.8
Biological-social	1057	1101	1588	3746	25.9
Fires	769	715	586	2070	14.3
Social	555	561	704	1820	12.6
Non-fire collapse	15	21	54	90	0.6
Technological accidents	115	64	44	223	1.5
Other technogenic (natural and technological)	41	199	88	328	2.3
Natural	319	76	38	433	3.0
Total	4812	4655	5000	14467	100

However, in emergencies associated with fires, the greatest number of deaths at the prehospital stage was recorded, which characterizes the severity of the sustained injuries (Table 3). Thus, the mortality rate in the prehospital period in case of fires (38.2%) is 2 times higher than that in emergencies associated with transport accidents (18.6%).

Table 3

The structure of deaths during the prehospital period as a result of emergencies in Moscow

Types of emergencies	Number of deaths due to emergencies				
	2016 r.	2017 r.	2018 r.	Total	
	Abs.	Abs.	Abs.	Abs.	%
Fires	142	154	121	417	38.2
Biological-social	14	8	364	386	35.3
Transport accidents	84	55	64	203	18.6
Non-fire collapse	2	3	1	6	0.5
Technological accidents	18	2	5	25	2.3
Other technogenic (natural and technological)	–	–	1	1	0.1
Natural	12	–	1	13	1.2
Social	19	10	12	41	3.8
Total	291	232	569	1092	100

According to AIAS of Moscow Health Department EMS, the structure of victims of the emergencies associated with fires has been represented as follows: only 32.6% of casualties had an isolated skin injury; in 46.7% of cases, the casualties had clinical signs of thermal inhalation injury (TII) associated with poisoning with carbon monoxide and combustion products; 18.7% were the patients with combined injury who simultaneously sustained thermal injury with mechanical injury, poisoning with carbon monoxide and combustion products and TII; in 2% of cases, the victims received various types of mechanical injuries, without burn injury. The data are presented in Fig. 1.

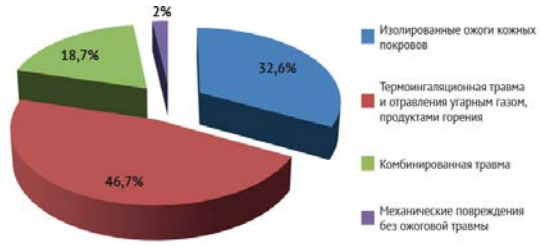
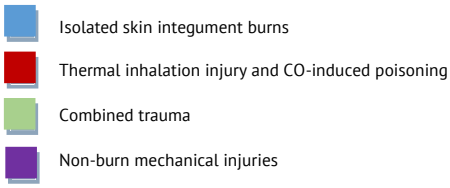


Fig. 1. Characteristics of fire injuries



The Department of Acute Thermal Injuries of N.V. Sklifosovsky Research Institute for Emergency Medicine is one of the institutions included in the structure of the Service to provide specialized medical care to victims of thermal injury. The main stages of the burn center work with the injuried under emergency conditions are the following:

- Preparation for receiving the burn injuried;
- Admission and re-triage;
- Placement, examination, and choosing the treatment tactics;
- Seeing all those self-referred or transferred from other medical organizations.

In total, for the period of 2016–2018, 428 patients were delivered to N.V.Sklifosovsky Research Institute for Emergency Medicine, 389 of whom (90.9%) were hospitalized; 134 patients with thermal trauma (burns, TII, poisoning with combustion products and carbon monoxide) were delivered from fires and emergencies, which made 31% of the total number of all casualties brought from the emergencies to the Institute (Fig. 2). The Burn Center hospitalized 133 patients.

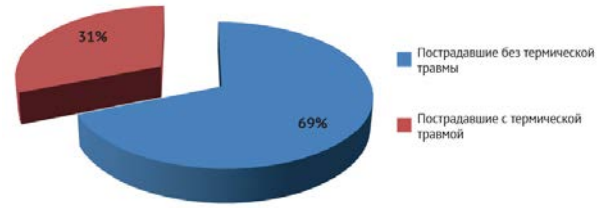
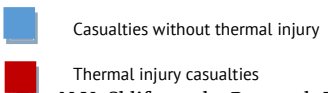


Fig. 2. The structure of patients admitted to the N.V. Sklifosovsky Research Institute for Emergency Medicine in Emergencies (2016–2018)



The N.V. Sklifosovsky Research Institute for Emergency Medicine has a specially designed operational plan for working in emergency situations, which specify the sequence of actions of the duty shift teams and the arriving employees in stages. First of all, the beds are vacated in the Burn Intensive Care Units (ICUs) via transferring patients to the hospital ward “for extended indications”. In emergency situations, additional 25 beds are deployed in the hospital. Four additional beds are deployed in the ICU. From the Burn Department, 30% of patients can be transferred to reserve beds in other departments of the Institute, and, if necessary, to other hospitals in the city (Moscow Healthcare Department Order No. 571 dated July 29,

2008 "On the procedure for organizing medical care for patients with thermal injuries in the city of Moscow"). Reservation of beds in adjacent units (according to the plan) and checking the minimum stock of equipment (airway ventilation equipment), medicines and dressings, availability of linen, care products, etc. is carried out.

Channels of admission are the following: 95.5% by EMC, 4.5% are self-referrals or transfers from other health care institutions. When analyzing the delivered casualties qualified as "mass admissions" over the resent 5 years, we have found that no more than 18 victims were admitted to the Emergency Departments of the Institute simultaneously. Meanwhile, in the usual routine work, N.V. Sklifosovsky Research Institute for Emergency Medicine can render urgent(acute) care simultaneously up to 20 patients and casualties.

The existing order, therefore, allows attending to a "mass admission" without ceasing regular work. As a rule, the most experienced combustiologist surgeon with experience in emergency situations is assigned to the medical triage position. The work with medical records is one of the most common causes of the patient delayed in the Admission Department. Since 2018, the United Medical Information and Analytical System (EMIAS) has been operating at N.V. Sklifosovsky Research Institute for Emergency Medicine. This system has been shown to be effective in identifying a patient even with some missing documents.

At the in-hospital stage, certain patients are assigned to each doctor, which forms personal responsibility. The presence of a burn center in the structure of a multidisciplinary hospital with a round-the-clock diagnostic and laboratory service allows a timely examination of patients and the involvement of consultants of related specialties. The implementation of electronic medical records (EMR) in the EMIAS system allows you to quickly assign examinations and consultations and receive their results. Since specialists from different departments can access patient's EMR at the same time, an online consultation in real time becomes possible.

Basic patient routing schemes:

– casualties with predominant thermal burns received treatment in the Burn Center;

– those who were initially admitted to the "anti-shock room", having a combined injury, were transferred to the general Intensive Care Unit where surgical interventions were performed, followed by the patient's transfer to the burn center;

– in TII and poisoning with combustion products, those who were admitted to the Toxicological Intensive Care Unit after examination were transferred to the Endotoxicosis Department or to the Burn Center.

When analyzing the medical records of the thermal injury patients admitted to the Burn Center from the sites of emergencies, we found that the injury profiles of the casualties differed from those reported for the whole city of Moscow, was noted:19.5% had only skin integument injury (isolated skin integument injury was found in 32.6%, according to AIAS of Moscow Health Department EMS), 34.6% had clinical signs of TII in combination with poisoning with carbon monoxide and combustion products (46.7% of cases, according to AIAS of Moscow Health Department EMS), 15% had a combined trauma: skin integument burns in combination with TII, poisoning with combustion products, musculoskeletal system injury, traumatic brain injury, etc. (18.7%, according to AIAS Moscow Health Department EMS). In 21.8% of cases, in the medical records from N.V.Sklifosovsky Research Institute of Emergency Medicine, only poisoning with combustion products and carbon monoxide was seen, isolated TII in 9.1% (these nosological forms were not recorded separately). The data are presented in Fig. 3.

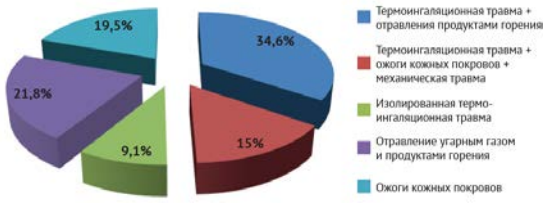
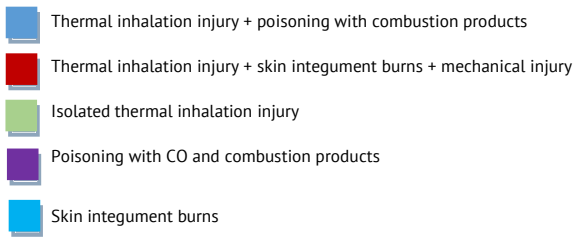


Fig. 3. Distribution of victims according to the injury nature



The obtained data have confirmed our opinion on the need to re-triage of the victims of emergencies upon their admission to a medical institution. The presence of three Admission (i.e. Emergency) departments - central, toxicological, and that of the Burn Center - in the structure of N.V. Sklifosovsky Research Institute for Emergency Medicine allows for effective triage of victims. The surgeon-combustiologist of the medical triage post of the Central Admission Department determines the optimal routing of casualties in accordance with the type of injury, the severity of patient's condition and directs the patient to the operating room, intensive care unit, hospital ward, diagnostic wards or to the rooms of the emergency department to provide outpatient care.

According to our data, in 60.9% of cases, EMC teams delivered 3 or more patients at the same time, and during the period under study, the maximum number of admitted patients with thermal injury did not exceed 10.

The mean age of patients with thermal injury was 44.3 ± 19.3 years. Male patients accounted for 59.3% (n=79), and women did for 40.7% (n=54) of the injuried. The majority of those delivered (71.4%) were admitted to the ICUs of the Institute. The ICU patient flow distribution was as follows: 64.2% were initially hospitalized to the Burn ICU, 17.9% to the anti-shock room and Toxicological ICU.

The mean length of stay among hospitalized patients in mass admissions was 29.3 ± 6.39 days. Mortality among burn patients hospitalized to N.V.Sklifosovsky Research Institute for Emergency Medicine did not exceed 9.8%.

DISCUSSION

Due to the increased share of the urban population in the Russian Federation from 15 to 73% over the past 100 years, the risk of emergencies has significantly increased in large cities, and as a result, has materialized; all that has been accompanied by significant medical losses. The presence of the Emergency Medical Service within the structure of the Moscow Health Department responsible for the medical response to emergencies makes it possible to timely coordinate the work of both EMC system and all hospitals involved in admitting casualties of emergencies. The presence of a burn center in the structure of a medical institution makes it possible to make a repeated accurate triage (after a primary EMC triage) of casualties, a timely diagnosis of the underlying disease and its complications, as well as to provide specialized medical care in full.

CONCLUSION

The existing structure and organization of rendering medical care to the casualties with thermal injury sustained in case of emergencies in Moscow makes it possible to provide a timely specialized treatment to the burned, being a reliable and effective element of the health care system.

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