

# ACTUAL PROBLEMS OF MEDICAL EVACUATION АКТУАЛЬНЫЕ ПРОБЛЕМЫ МЕДИЦИНСКОЙ ЭВАКУАЦИИ

<https://doi.org/10.33266/2070-1004-2021-4-67-72>  
UDC [614.88:613.693]:616-08-039.74:615.816

Original article  
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## PECULIARITIES OF RESPIRATORY SUPPORT IN PATIENTS WITH SEVERE PATHOLOGY DURING AIR AMBULANCE EVACUATION

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**Abstract.** The aim of the study is to identify and to analyze the features of respiratory support in patients with severe acute respiratory failure when performing air ambulance evacuation by light class helicopters by specialists of aeromedical teams. *Materials and methods.* We used materials containing data on the frequency and peculiarities of ventilator usage and tracheal intubation during emergency medical care for patients with acute respiratory failure over the last 5 years (2016–2020). During this period emergency medical care was provided to 53579 patients, 298 of whom were in extremely severe and serious condition requiring ventilator usage and tracheal intubation.

The following methods were used in the study: historical, statistical, analytical.

*Results of the study and their analysis.* Trauma prevailed among nosological forms in patients with acute respiratory failure. Artificial lung ventilation with tracheal intubation should be started before the patient is transported to the helicopter cabin.

During air ambulance evacuation of patients with acute respiratory failure by helicopter of light class, doctors should take differentiated approach to the choice of type and mode of respiratory support and of method of airway patency assurance.

**Key words:** acute respiratory failure syndrome, air ambulance evacuation, artificial lung ventilation, aviation medical teams, patients with severe pathology, respiratory support, tracheal intubation

**Conflict of interest.** The authors declare no conflict of interest

**For citation:** Gumenyuk S.A., Potapov V.I., Sheptunov G.V., Sysoev A.Y. Peculiarities of respiratory support in patients with severe pathology during air ambulance evacuation. *Meditsina katastrof* = Disaster Medicine. 2021;4:67-72 (In Russ.). <https://doi.org/10.33266/2070-1004-2021-3-67-72>

<https://doi.org/10.33266/2070-1004-2021-4-67-72>  
УДК 614.88:613.693:616-08-039.74:615.816

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## ОСОБЕННОСТИ ВЫПОЛНЕНИЯ РЕСПИРАТОРНОЙ ПОДДЕРЖКИ У ПАЦИЕНТОВ С ТЯЖЕЛОЙ ПАТОЛОГИЕЙ ВО ВРЕМЯ ПРОВЕДЕНИЯ САНИТАРНО-АВИАЦИОННОЙ ЭВАКУАЦИИ

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**Резюме.** Цель исследования – выявление и анализ особенностей выполнения специалистами авиамедицинских бригад (АМБр) респираторной поддержки у пациентов с тяжелой формой острой дыхательной недостаточности (ОДН) во время проведения санитарно-авиационной эвакуации вертолетами легкого класса.

*Материалы и методы исследования.* В работе использованы материалы, содержащие данные о частоте и особенностях выполнения искусственной вентиляции легких (ИВЛ) и интубации трахеи при оказании экстренной медицинской помощи (ЭМП) пациентам с тяжелой формой ОДН за последние 5 лет (2016–2020). За этот период ЭМП была оказана 53579 пациентам, из которых 298 находились в крайне тяжелом и тяжелом состоянии, потребовавшем выполнения ИВЛ и интубации трахеи.

При выполнении исследования применялись следующие методы: исторический, статистический, аналитический.

*Результаты исследования и их анализ.* Анализ результатов исследования позволил сделать следующие выводы:

1. У пациентов с острой дыхательной недостаточностью среди нозологических форм преобладает травма.
2. Искусственную вентиляцию легких с интубацией трахеи необходимо начинать до транспортировки пациента в салон вертолета.
3. Во время проведения санитарно-авиационной эвакуации пациентов с острой дыхательной недостаточностью на вертолете легкого класса врачи АМБр должны дифференцированно подходить к выбору вида и режима респираторной поддержки и способа обеспечения проходимости дыхательных путей.

**Ключевые слова:** авиамедицинские бригады, интубация трахеи, искусственная вентиляция легких, пациенты с тяжелой патологией, респираторная поддержка, санитарно-авиационная эвакуация, синдром острой дыхательной недостаточности

**Конфликт интересов.** Авторы статьи подтверждают отсутствие конфликта интересов

**Для цитирования:** Гуменюк С.А., Потапов В.И., Шептунов Г.В., Сысоев А.Ю. Особенности выполнения респираторной поддержки у пациентов с тяжелой патологией во время проведения санитарно-авиационной эвакуации // Медицина катастроф. 2021. №4. С. 67–72. <https://doi.org/10.33266/2070-1004-2021-4-67-72>

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## Introduction

In acute respiratory failure the respiratory support in pre-hospital period is an important issue [1, 2]. It is due to the fact that patients with acute respiratory failure often apply for emergency medical aid. Also, there are some peculiarities characteristic for this syndrome — rapid increase in severity of the condition, requiring a comprehensive intensive care including respiratory support [3-5].

The experience, presented in works of several authors, shows that in severe forms of acute respiratory failure artificial lung ventilation with tracheal intubation is an indispensable element of treatment [6, 7].

There is still an opinion that tracheal intubation is a "gold standard" allowing to provide recovery and patency of airways. The effectiveness of tracheal intubation in comparison with other methods of ensuring airway patency in terms of prevention of aspiration complications and dislocation of airway tube is particularly noteworthy. Also tracheal intubation provides an opportunity to optimize respiratory support and to use instrumental methods of diagnosis and treatment in the hospital period (sanation bronchoscopy) [8, 9].

At the same time there is a point of view according to which tracheal intubation is not always safe and not always feasible. The dependence of this technique efficiency on the level of professional training has been noted [10, 11].

An important role in providing emergency medical care to patients with acute respiratory failure is played by medical professionals in the prehospital period. The decisions they make, the promptness of the actions of emergency medical team personnel, and the rapidity of medical evacuation affect not only the patient's condition, but also his/her prognosis [12-14].

Air ambulance evacuation in emergency situations, including rapid delivery of medical workers to the scene of the event and medical evacuation of the injured, testify to the advantage of air ambulance helicopters over other vehicles [15-18].

The long-term experience of aviation medical teams of the Moscow Scientific and Practical Center for Emergency Medical Care shows that in megapolis conditions, in particular in emergency situations, in congested highways and complicated traffic, the use of an air ambulance helicopter staffed by qualified medical specialists and equipped with

modern medical equipment allows successful emergency evacuation of the injured [19, 20].

In the light-class air ambulance helicopter cabin, performing intubation is an extremely difficult task. At the same time, performance of artificial lung ventilation with tracheal intubation is a life-saving manipulation, which cannot be postponed.

As A.L. Ershov and other authors fairly mention in their works, in prehospital period when performing tracheal intubation, there is a high probability of making a mistake and of encountering difficulties. These authors also emphasize that it is not always possible to comply with the standards of tracheal intubation in prehospital period in contrast to the hospital period [4, 7, 10, 15]. Difficulties of performing respiratory support in emergency victims and patients with severe acute respiratory failure prompted this study to explore the possibilities of improving the effectiveness of emergency medical care and of immediate evacuation of patients with severe pathology by light-class ambulance helicopter.

**The aim of the study** was to reveal and to analyze the peculiarities of respiratory support in the patients with severe acute respiratory failure when performing air ambulance evacuation by light class helicopters.

**Materials and methods of the study.** The data on the frequency and peculiarities of artificial lung ventilation and tracheal intubation during emergency medical care for patients with severe acute respiratory failure over the past 5 years (2016-2020) were used in this work. During this period of time, emergency medical care was provided to 53579 patients, of whom 298 were in extremely severe and severe condition that required artificial lung ventilation and tracheal intubation.

The following methods were used: historical, statistical, analytical.

**Results of the study and their analysis.** Data on the severity of patients and victims in emergency situations during the last 5 years (2016-2020) are presented in Table 1.

Observing the data in Table 1 we can see that the proportion of patients who were in extremely severe and serious condition was on average 9.1%, the proportion of patients on artificial lung ventilation was 0.5%.

Frequency of artificial lung ventilation by the Emergency Medical Center and ambulance teams is presented in Table 2.

Таблица 1 / Table No. 1

**Структура контингента больных и пострадавших в ЧС по степени тяжести состояния в 2016–2020 гг., чел./%**  
Structure of the contingent of patients and victims of emergencies by severity 2016-2020, people/%

Степень тяжести состояния / Severity	2016	2017	2018	2019	2020	Итого
Крайне тяжелое на ИВЛ / Extremely severe on ventilator	27/0,3	34/0,3	28/0,2	42/0,4	45/0,4	176/0,3
Тяжелое на ИВЛ / Severe on ventilator	14/0,1	19/0,2	23/0,2	33/0,3	33/0,2	122/0,2
<b>Всего на ИВЛ / Total on ventilator</b>	<b>41/0,4</b>	<b>53/0,5</b>	<b>51/0,4</b>	<b>75/0,7</b>	<b>78/0,6</b>	<b>298/0,5</b>
Крайне тяжелое / Extremely severe	61/0,7	36/0,4	37/0,3	89/0,9	54/0,5	277/0,5
Тяжелое / Severe	595/6,7	684/6,9	754/6,0	1223/12,5	1068/8,5	4324/8,1
<b>Всего в крайне тяжелом и тяжелом состоянии / Total, in extremely severe and severe condition.</b>	<b>656/7,4</b>	<b>720/7,3</b>	<b>791/6,3</b>	<b>1312/13,4</b>	<b>1122/9,0</b>	<b>4601/8,6</b>
<b>Всего, в т.ч. на ИВЛ / Total, including on ventilator</b>	<b>697/7,8</b>	<b>773/7,8</b>	<b>842/6,7</b>	<b>1387/14,1</b>	<b>1200/9,6</b>	<b>4899/9,1</b>

From Table 2 it follows that in 85.6% of cases medical evacuation of ventilated patients was performed by emergency medical center teams, including 47.0% of cases – by air ambulance teams.

Of 140 cases of ventilator-assisted ambulance evacuations, 33 cases involved interhospital evacuations and 107 cases were flights to a primary call to an emergency victim or patient.

The structure of diseases and injuries in patients who were ventilated during air ambulance evacuations in 2016-2020 is shown in the figure.

The figure shows that the most frequently – on average, in 51% of cases – artificial lung ventilation was performed in patients with trauma (polytrauma, combined trauma).

A much smaller proportion (12% on average) were patients with acute cerebral circulation disorder.

Compared to 2016-2019, the proportion of patients with pneumonia increased in 2020, averaging 13% of the total number of patients who were ventilated.

The aeromedical teams consisted of physicians trained in anesthesiology and resuscitation and of a paramedic.

All air medical teams were equipped with one of the following artificial lung ventilation devices: Medumat Standard A, Medumat Transport (Weinmann Emergency, Germany); Oxylog 2000, Oxylog 3000+ (Draeger, Germany); Rulmonetic LTV-1200 (Sage Fusion, USA); Ambu bags for manual artificial lung ventilation. In one case, specialists of the aviation medical team used "Stephan 120 Mobil" apparatus, which allows invasive respiratory support for newborns with body weight <5 kg. The doctors had at their disposal the tools necessary to perform tracheal intubation and noninvasive artificial lung ventilation. The oxygen supply in 2 and 5 L cylinders was sufficient for respiratory support.

The type and mode of respiratory support was chosen depending on the severity of the patient's condition, taking into account: degree of consciousness impairment, severity of respiratory failure, tendency to deterioration and

nosological unit that caused the development of critical condition.

One of the peculiarities of respiratory support in the practice of helicopter aviation medical teams is more stringent requirements for the choice of respiratory support and the method of providing patency of upper airways, than in case of transportation by ambulance or by fixed wing air ambulance. This is due to the fact that the space in the helicopter cabin is limited, making it difficult to perform such manipulations as tracheal intubation, pleural puncture, venous catheterization, and also making it impossible to stop en route to perform additional manipulations. When preparing patients for transportation the doctors of helicopter aviation medical teams have to follow more aggressive tactics in comparison with the doctors of "ground" teams, including anesthesiology-resuscitation teams, or doctors of "big" sanitary aviation, and often in comparison with the doctors of intensive care units of hospitals.

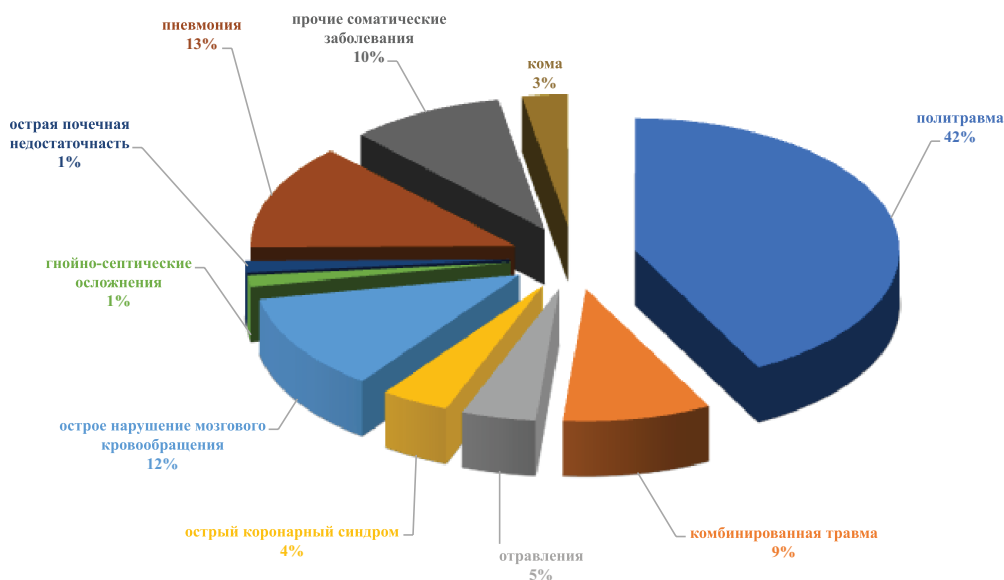
Thus, patients with depression of consciousness to the level of soporus or deeper (12 points or less on the Glasgow coma scale), as a rule, were transferred to artificial lung ventilation using sedation, analgesia, myorelaxation and tracheal intubation before transportation: in the hospital calling the air medical team to transfer the patient to the specialized hospital; in the cabin of the ambulance team car; immediately after the patient arrived on board the helicopter (before starting the engines); sometimes – at the scene of the event. We follow the same tactics when providing emergency medical care to patients and victims with unstable hemodynamics, severe acute respiratory failure and immediate threat of circulatory arrest. Even if at the time of the initial examination by the aviation medical team the patients are clearly conscious and external respiratory function seems to be adequate.

In those cases where emergency team or in-patient clinics provided adequate upper airway patency and pulmonary ventilation prior to the arrival of the air medical brigade, there was usually no need for endotracheal tube

Таблица 2 / Table 2

**Частота проведения медицинской эвакуации пациентов на ИВЛ бригадами ЦЭМП и СМП в 2016-2020 гг., чел./%**  
Frequency of medical evacuation of patients on ventilator by emergency medical care center and ambulance teams in 2016-2020, people

Бригады, проводившие медицинскую эвакуацию Teams that performed medical evacuations	2016	2017	2018	2019	2020	Итого / Total
Авиа медицинские бригады / Air medical teams	29/70,7	26/49,0	28/54,9	42/48,0	21/26,9	140/47,0
Бригады ЦЭМП / Emergency medical care center teams	7/17,1	18/34,0	20/39,2	20/32,0	46/59,0	115/38,6
Бригады СМП / Ambulance teams	5/12,2	9/17,0	3/5,9	13/20,0	11/14,1	43/14,4
<b>Всего / Total</b>	<b>41/100,0</b>	<b>53/100,0</b>	<b>51/100,0</b>	<b>75/100,0</b>	<b>78/100,0</b>	<b>298/100,0</b>



**Рисунок.** Доля пациентов с указанной патологией в общем числе больных и пострадавших, находившихся на ИВЛ во время проведения санитарно-авиационной эвакуации авиамедицинскими бригадами ЦЭМП, %  
**Figure.** Proportion of patients with the above pathology in the total number of patients who were on ventilation during air ambulance evacuation by air medical teams of the Center for Emergency Medical Care, %

replacement. The exceptions were cases of increasing upper airway obstruction, for example, in thermoinhalation trauma, when the emergency team specialist used methods of providing upper airway patency that did not protect the subclavian space — esophagolaryngeal tube, Combi Tube type airway, S-airway.

In cardiac pathology preference is given to noninvasive artificial lung ventilation in CPAP mode (continuous positive airway pressure) with the use of hermetically fitting face mask. It allows, firstly, to save the verbal contact with the patient; secondly, to reduce the traumatic nature of respiratory support, which can cause such complications as fatal disorders of heart rhythm and conduction, accompanied by a critical fall in hemodynamics — ventricular fibrillation, paroxysmal ventricular tachycardia without pulse, complete transverse AV-blockade, etc, in patients with cardiac profile (for example, in acute coronary syndrome).

In invasive artificial ventilation, orotracheal intubation was preferred. Through endotracheal tube placed nasotracheally or tracheostomy, we performed artificial lung ventilation during interhospital transfers (continuous artificial lung ventilation), and conicotomy — on site when it was impossible to provide upper airway patency by other means. Esophagolaryngeal tubes and Combi Tube were used by specialists of aviation medical teams while performing cardiopulmonary resuscitation and medical care in difficult conditions at the scene of an emergency.

When choosing a mode of artificial lung ventilation we usually give preference to modes with preservation of spontaneous breathing elements as they are more physiological (SIMV, P-SIMV). And only when it is impossible to achieve adequate ventilation by these methods and there is a need for myoplegia (uncompensated seizure syndrome, high oxygen cost of breathing in acute pulmonary heart failure) or administration of muscle relaxants before

tracheal intubation we used regimens of forced artificial lung ventilation without preservation of spontaneous breathing elements.

In some patients who were clinically dead and required cardiopulmonary resuscitation, respiratory support was provided by Ambu bag.

Machine assisted lung ventilation was performed in these patients after cardiac recovery. In 13 patients in whom resuscitation measures were ineffective (9% of the total sample), artificial lung ventilation was performed exclusively with Ambu bag, in the remaining cases artificial lung ventilation was used.

In all cases artificial lung ventilation was preceded by tracheal intubation.

Out of 141 patients in the analyzed group, 117 were delivered to the hospital, in 24 of them death was registered in the presence of the team. The total mean duration of artificial lung ventilation performed by emergency team specialists was (61±35.9) minutes. When 24 patients in whom artificial lung ventilation was performed as part of cardiopulmonary resuscitation were excluded from this sample, the average duration of artificial lung ventilation increased to (85±19.7) min — this is the time from tracheal intubation to transfer of the patient to the hospital.

### Conclusion

1. In patients with acute respiratory failure, trauma prevailed among nosological forms.
2. Artificial ventilation with tracheal intubation should be started before the patient is transported to the helicopter cabin.
3. During air ambulance evacuation of patients with acute respiratory failure by light class helicopter, doctors of aviation medical teams should differentiate the choice of type and mode of respiratory support and method of ensuring airway patency.

- Shelukhin D.A., Pavlov A.I., Ershov A.L. Extracorporeal Membrane Oxygenation for Patients with Severe Respiratory Failure. Case Report: First Time in Russia Inter-Hospital Aeromedical Transportation of the Patient with Severe Acute Respiratory Failure on Extracorporeal Membrane Oxygenation. *Mediko-Biologicheskie i Social'no-Psikholo-gicheskiye Problemy Bezopasnosti v Chrezvychaynykh Situatsiyakh* = Medico-Biological and Socially-Psychological Problems of Safety in Emergencies. 2015;3:24-34 (In Russ.).
- Gellerfors M., Fevang E., Bäckman A., et al. Pre-Hospital Advanced Airway Management by Anaesthetist and Nurse Anaesthetist Critical Care Teams: a Prospective Observational Study of 2028 Pre-Hospital Tracheal Intubations. *Brit. J. Anaesth.* 2018; 120;5:1103–1109.
- Kulik A.I., Pikovsky V.Yu. Respiratory Support in Complex Intensive Therapy of Cardiogenic Shock at the Prehospital Stage. *Skoraya Meditsinskaya Pomoshch* = Emergency Medical Care. 2015;16;3:31-37. <https://doi.org/10.24884/2072-6716-2015-16-3-31-37> (In Russ.).
- Ershov A.L., Shchurov A.Yu. Emergency Mechanical Ventilation in Russian Megapolis Ambulance Practice. *Skoraya Meditsinskaya Pomoshch* = Emergency Medical Care. 2016;17;2:27-32. <https://doi.org/10.24884/2072-6716-2016-17-2-27-32> (In Russ.).
- Piegeler T., Roessler B., Goliash G. Evaluation of Six Different Airway Devices Regarding Regurgitation and Pulmonary Aspiration during Cardio-Pulmonary Resuscitation (Cpr) – a Human Cadaver Pilot Study. *Resuscitation.* 2016;102:70-74.
- Pikovskiy V.Yu., Kulik A.I., Barklaya V.I., Adelyanov M.R. Respiratory Support in Intensive Therapy of Cardiac Pulmonary Edema at the Prehospital Stage. *Skoraya Meditsinskaya Pomoshch* = Emergency Medical Care. 2016;17;1:9-14. <https://doi.org/10.24884/2072-6716-2016-17-1-9-14> (In Russ.).
- Ershov A.L., Miroshnichenko A.G., Boykov A.A., Shchurov A.Yu. Epidemiology and Outcomes of Acute Respiratory Failure at the Stage of Emergency Medical Care in St. Petersburg. *Skoraya Meditsinskaya Pomoshch* = Emergency Medical Care. 2018;19;1:48-54. <https://doi.org/10.24884/2072-6716-2018-19-1-48-54> (In Russ.).
- Kozyrev D.V., Khupov M.T. Sanitary Aviation Evacuation with Use of Light Helicopters in Megapolis Environment. *Meditsina katastrof* = Disaster Medicine. 2017;1:31-33 (In Russ.).
- Xu R., Lian Y., Li W.X. Airway Complications During and After General Anesthesia: a Comparison, Systematic Review and Meta-Analysis of Using Flexible Laryngeal Mask Airways and Endotracheal Tubes. *PLoS One.* 2016;11;7:e0158137.
- Ershov A.L. Airway Management During Out of Hospital Acute Respiratory Insufficiency. *Skoraya Meditsinskaya Pomoshch* = Emergency Medical Care. 2018;19;3:62-69. <https://doi.org/10.24884/2072-6716-2018-19-3-62-69> (In Russ.).
- Tarpgaard M., Hansen T. M., Rognas L. Anaesthetist-Provided Pre-Hospital Advanced Airway Management in Children: a Descriptive Study. *Scand. J. Trauma Resusc. Emerg. Med.* 2015;27:23-61.
- Gorbachev V.I., Lkhov A.V., Gorbacheva S.M. About Respiratory Support In Patients With Severe Stroke Forms Prehospital. *Skoraya Meditsinskaya Pomoshch* = Emergency Medical Care. 2018;19;3:56-61. <https://doi.org/10.24884/2072-6716-2018-19-3-56-61> (In Russ.).
- Gumenyuk S.A., Fedotov S.A., Potapov V.I., Teryaev V.G., Agafonov S.A., Retrospective Multifactor Analysis of Activity of Aeromedical Teams of Territorial Center for Disaster Medicine of Moscow. *Meditsina Katastrof* = Disaster Medicine. 2019;1:47–49. DOI: 10.33266/2070-1004-2019-1-47-49 (In Russ.).
- Ershov A.L. Respiratory Support at Prehospital Stage of Emergency Medical Care: Current Status, Problems and Prospects of Development. *Skoraya Meditsinskaya Pomoshch* = Emergency Medical Care. 2017;18;4:53-59. <https://doi.org/10.24884/2072-6716-2017-18-4-53-59> (In Russ.).
- Gumenyuk S.A., Fedotov S.A., Potapov V.I., Sheptunov G.V. Aviamedical Teams in the Conditions of Megapolis: Work Experience, Problems, Prospects. *Kafedra Travmatologii i Ortopedii* = Department of Traumatology and Orthopedics. 2018;1:5-8 (In Russ.).
- Hernandez Dominguez O., Grigorian A., Lekawa M., et al. Helicopter Transport Has Decreased Over Time and Transport from Scene or Hospital Matters. *Air Medical Journal.*
- Шелухин Д.А., Павлов А.И., Ершов А.Л. Экстракорпоральная мембранная оксигенация у пациентов с тяжелой дыхательной недостаточностью и первый опыт ее применения во время авиационной медицинской эвакуации в России // Медико-биологические и социально-психологические проблемы безопасности в чрезвычайных ситуациях. 2015. № 3. С. 24–34.
- Gellerfors M., Fevang E., Bäckman A., et al. Pre-Hospital Advanced Airway Management by Anaesthetist and Nurse Anaesthetist Critical Care Teams: a Prospective Observational Study of 2028 Pre-Hospital Tracheal Intubations // *Brit. J. Anaesth.* 2018. V.120, No. 5. P. 1103–1109.
- Кулик А.И., Пиковский В.Ю. Респираторная поддержка в комплексе интенсивной терапии кардиогенного шока на догоспитальном этапе // *Скорая медицинская помощь.* 2015. Т. 16, № 3. С. 31–37. <https://doi.org/10.24884/2072-6716-2015-16-3-31-37>.
- Ершов А.Л., Щуров А.Ю. Искусственная вентиляция легких при оказании скорой медицинской помощи в мегаполисе России // *Скорая медицинская помощь.* 2016. Т. 17, № 2. С. 27–32. <https://doi.org/10.24884/2072-6716-2016-17-2-27-32>.
- Piegeler T., Roessler B., Goliash G. Evaluation of Six Different Airway Devices Regarding Regurgitation and Pulmonary Aspiration during Cardio-Pulmonary Resuscitation (Cpr) — a Human Cadaver Pilot Study // *Resuscitation.* 2016. V. 102. P. 70–74.
- Пиковский В.Ю., Кулик А.И., Барклая В.И., Адельянов М.Р. Респираторная поддержка в комплексе интенсивной терапии кардиогенного шока на догоспитальном этапе // *Скорая медицинская помощь.* 2016. Т. 17, № 1. С. 9–14. <https://doi.org/10.24884/2072-6716-2016-17-1-9-14>.
- Ершов А.Л., Мирошниченко А.Г., Бойков А.А., Щуров А.Ю. Частота выявления острой дыхательной недостаточности среди пациентов скорой помощи Санкт-Петербурга и результаты выездов к ним // *Скорая медицинская помощь.* 2018. Т. 19, № 1. С. 48–54. <https://doi.org/10.24884/2072-6716-2018-19-1-48-54>.
- Козырев Д.В., Хупов М.Т. Санитарно-авиационная эвакуация с использованием легких вертолетов в условиях мегаполиса // *Медицина катастроф.* 2017. № 1. С. 31–33.
- Xu R., Lian Y., Li W.X. Airway Complications during and after General Anesthesia: a Comparison, Systematic Review and Meta-Analysis of Using Flexible Laryngeal Mask Airways and Endotracheal Tubes // *PLoS One.* 2016. V. 11. P. e0158137.
- Ершов А.Л. Обеспечение проходимости дыхательных путей при острой дыхательной недостаточности вне стационара // *Скорая медицинская помощь.* 2018. Т. 19, № 3. С. 62–69. <https://doi.org/10.24884/2072-6716-2018-19-3-62-69>.
- Tarpgaard M., Hansen T.M., Rognas L. Anaesthetist-Provided Pre-Hospital Advanced Airway Management in Children: a Descriptive Study // *Scand. J. Trauma Resusc. Emerg. Med.* 2015. V. 27. P. 23–61.
- Горбачёв В.И., Лохов А.В., Горбачёва С.М. К вопросу о респираторной поддержке больных с тяжелыми формами инсульта на догоспитальном этапе // *Скорая медицинская помощь.* 2018. Т. 19, № 3. С. 56–61. <https://doi.org/10.24884/2072-6716-2018-19-3-56-61>.
- Гуменюк С.А., Федотов С.А., Потапов В.И. и др. Ретроспективный многофакторный анализ работы авиамедицинских бригад территориального центра медицины катастроф г. Москвы // *Медицина катастроф.* 2019. № 1. С. 47–49. DOI:10.33266/2070-1004-2019-1-47-49.
- Ершов А.Л. Респираторная поддержка в условиях скорой медицинской помощи: современное состояние проблемы и перспективы развития // *Скорая медицинская помощь.* 2017. Т. 18, № 4. С. 53–59. <https://doi.org/10.24884/2072-6716-2017-18-4-53-59>.
- Гуменюк С.А., Федотов С.А., Потапов В.И., Шептунов Г.В. Авиамедицинские бригады в условиях мегаполиса: Опыт работы, проблемы, перспективы // *Кафедра травматологии и ортопедии.* 2018. № 1. С. 5–8.
- Hernandez Dominguez O., Grigorian A., Lekawa M., et al. Helicopter Transport Has Decreased Over Time and Transport from Scene or Hospital Matters // *Air Medical Journal.* 2020.

2020;39;4:283-290/04.006. URL: <https://doi.org/10.1016/j.amj.2020.04.06>.

17. Birmingham Lauren E., Richner G., Moran M., et al. Timeliness of Care for Injured Patients Initially Seen at Freestanding Emergency Departments. *Quality Management in Health Care*. 2020;29;2:95-99. DOI: 10.1097/QMH.0000000000000252.

18. Gumenyuk S.A., Fedotov S.A., Potapov V.I., Sysoev A.Yu. Work Experience of the Aviation Medical Teams of the Scientific and Practical Center for Emergency Medical Care of the Department of Healthcare of the City of Moscow in 2015-2019. *Mediko-Biologicheskie i Social'no-Psikhologicheskiye Problemy Bezopasnosti v Chrezvychaynykh Situatsiyakh* = Medico-Biological and Socially-Psychological Problems of Safety in Emergencies. 2020;4:60-68. DOI 10.25016/2541-7487-2020-0-4-60-68 (In Russ.).

19. Potapov V.I., Fedotov S.A., Gumenyuk S.A., Tolstykh A.N. Improving the Organization of Medical Assistance to Victims with Injuries as a Result of Crisis and Emergency Situations in Moscow. *Dostizheniya Rossiyskoy Travmatologii i Ortopedii* = Achievements of Russian Traumatology and Orthopedics. Mater. of XI All-Russian Congress of Traumatologists-Orthopedists. In 3 vol. Vol. II. Section 1. *Organizatsionnyye Aspekty Travmatologii i Ortopedii* = Organizational Aspects of Traumatology and Orthopedics. St. Petersburg, 2018. P. 70-71 (In Russ.).

V. 39, No. 4. P. 283-290 / 04.006. URL: <https://doi.org/10.1016/j.amj.2020.04.06>.

17. Birmingham Lauren E., Richner G., Moran M., et al. Timeliness of Care for Injured Patients Initially Seen at Freestanding Emergency Departments // *Quality Management in Health Care*. 2020. V.29, No. 2. P. 95-99. DOI: 10.1097/QMH.0000000000000252.

18. Гуменюк С.А., Федотов С.А., Потапов В.И., Сысоев А.Ю. Опыт работы авиамедицинских бригад научно-практического центра экстренной медицинской помощи департамента здравоохранения города Москвы в 2015–2019 гг. // *Медико-биологические и социально-психологические проблемы безопасности в чрезвычайных ситуациях*. 2020. № 4. С. 60–68. DOI 10.25016/2541-7487-2020-0-4-60-68.

19. Потапов В.И., Федотов С.А., Гуменюк С.А., Толстых А.Н. Совершенствование организации оказания медицинской помощи пострадавшим с травмами в результате кризисных и чрезвычайных ситуаций в Москве // *Матер. XI Всероссийского съезда травматологов-ортопедов «Достижения российской травматологии и ортопедии»*, Санкт-Петербург, 11–13 апреля 2018 г. Т. 1. Организационные аспекты травматологии и ортопедии. СПб., 2018. Т. 1. С. 70–71.

The material was received 07.07.21; the article after peer review procedure 08.11.21; the Editorial Board accepted the article for publication 13.12.21  
Материал поступил в редакцию 07.07.21; статья принята после рецензирования 08.11.21; статья принята к публикации 13.12.21