Case Report

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Aeromedical Evacuation of Newborns: a Brief Review of the Literature Data and a Clinical Case of Moscow Territorial Scientific and Practical Center of Disaster Medicine

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ABSTRACT The issues of medical evacuation by ambulance transport are still widely discussed by specialists. The authors of the article analyzed, using a clinical case as an example, the capabilities of the aviation medical brigade in the conditions of the city of Moscow, as well as the interaction of all emergency services of the metropolis in an emergency situation.

Keywords: transportation of newborns, aeromedical brigades, emergency, metropolis

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AMB — aeromedical brigade
ARCDM "Zaschita" —All-Russian Centre for Disaster Medicine "Zaschita" of Health Ministry of the Russian Federation
CCH —City Clinical Hospital
MV — mechanical ventilation
EMERCOM — The Ministry of the Russian Federation for Civil Defence, Emergency Situations and Elimination of Consequences of Natural Disasters
CPR —cardiopulmonary resuscitation
CNS — central nervous system
CEMP —Moscow Territorial Scientific and Practical Center of Disaster Medicine of the Moscow Healthcare Department

INTRODUCTION

One of the tasks of the Moscow State Budgetary Healthcare Institution of a special type "Moscow Territorial Scientific and Practical Center of Disaster Medicine of the Moscow Healthcare Department" (hereinafter referred to as CEMP) is the provision of emergency medical care and medical evacuation of pediatric patients. An infrequent, but difficult and responsible mission is the transportation of premature babies and newborns with severe perinatal pathology.

The infant mortality rate in Russia in 2019 decreased compared to 2018, but remains quite high, amounting to 4.9 cases per 1,000 live births. At the same time, child mortality in Russia is 3.5 times less than infant mortality [1]. Currently, the CEMP aeromedical brigades (AMBs) are on duty around the clock on 3 light ambulance helicopters EC145 which have all the necessary medical equipment, including for cardiopulmonary resuscitation (CPR), and, if necessary, can be used for the transport of newborns, even extremely premature and in severe clinical status [2].

Literature Review. There is limited evidence in the scientific medical literature regarding the provision of emergency medical care to newborns by Helicopter Emergency Medical Service (HEMS). However, primary and secondary (interhospital) transportation of children in the first year of life is indicated in the structure of departures of medical helicopter crews in most countries of the world using HEMS.

Thus, according to a nationwide population study of emergency patients evacuated by helicopter service in Denmark from 2014 to 2018, 0.3% of 4639 patients were children of the first month of life [3].

A thorough retrospective analysis of neonatal air transport of term and preterm infants was carried out by Polish authors for the period from 2012 to 2018. The average age of the patients was 37.53 days, the average body weight was 3121.18 grams; the average travel time was 49.92±27.70 minutes with the average distance of 304.27±93.05 km. At the same time, the average time from the moment the call was received to the transfer of the patient in the incubator to the perinatal center was 269.16 minutes. The medical helicopters of the Polish Emergency Medical Service are equipped with four transport incubators, the transportation of newborns was carried out by an EC135 helicopter. The main diagnoses of HEMS evacuated newborns were congenital heart disease which accounted for more than two-fifths of all the cases (41.28%), with more than half of the transported infants (54.59%) being full-term.

The authors note that transported patients most often required intubation, mechanical ventilation (MV) and oxygen therapy. As for the medications, antibiotics, prostaglandin E1, glucose, furosemide and vitamins were most often used (glucose and vitamins in the group of premature babies, prostaglandin E1 and furosemide in the group of full-term newborns). Information on the survival rate of evacuated infants was not provided [4].

An analysis of 187 air transports of critically ill newborns in Sweden demonstrated the stability of the main vital signs of the transported; not a single death during the evacuation itself was recorded; out of 37 cases of daily hospital mortality, not a single death was directly related to transportation. The main indications for using a medical helicopter to transport newborns were hypothermia after perinatal asphyxia and respiratory failure during preterm birth [5].

A study conducted in the Netherlands analyzed 201 cases of CPR interventions for pediatric patients by the Rotterdam HEMS medical team between 2008 and 2014. In 7 cases, CPR was performed on newborns, in 4 of them the infant survived and was discharged from the hospital. The authors noted a more qualified performance of complex manipulations for the life support of pediatric patients (intubation, intraosseous and (or) intravenous access) by HEMS specialists compared to ground emergency medical workers [6].

The number of cases of newborn treatment with the participation of HEMS is greatly influenced by the geographical and socio-economic characteristics of the country. Thus, according to a 5-year analysis of the medical helicopter service performance in Richards Bay (rural areas of South Africa), 21.6% of 1429 flights were carried out to transport newborns [7], while the average time of arrival at the scene was significantly longer (48 minutes, interquartile range 35–64 minutes) compared with adults and pediatric patients.

C.H. Mize et al. give an example of successful resuscitation and the exogenous surfactant administration by specialists of a helicopter crew in the Kingdom of Bhutan. The infant was born at 28 weeks and had a low body weight (950 g); shortly after birth, he developed respiratory distress syndrome which prompted a medical helicopter call. Subsequently, the baby with his mother was transported by a helicopter to a perinatal center, and 3 weeks later he was discharged in a satisfactory condition. For the state of Bhutan with the population

distributed among small villages in the mountainous terrain of the eastern Himalayas, medical evacuation is the only way to provide medical care for severe perinatal pathology [8].

Romanian authors [9], evaluating the statistics on emergency transfers of newborns with sepsis, emphasize the risks of air transportation: vibration, noise, height differences, repeated medical examination, and make a conclusion that it is necessary to correctly determine the primary hospital, taking into account the clinical profile and severity of the child's condition, and regardless of territorial remoteness in order to exclude secondary interhospital transfers.

A study by X. Moors et al. describes rare cases of perimortal caesarean sections performed by HEMS specialists in the Netherlands between 1995 and 2019. Out of 7 cases, 6 newborns were delivered alive to the hospital, of which three survived in the hospital; in all the cases the mothers died either at the scene or in the hospital. In 3 surviving newborns, the time from maternal cardiac arrest to the onset of caesarean section was 13, 14, and 21 minutes [10].

A clinical case

By a crew of the Federal State Budgetary Institution “All-Russian Centre for Disaster Medicine “Zaschita” of the Federal Medical and Biological Agency (hereinafter - ARCDM “Zaschita”) on a special "Rostov-on-Don - St. Petersburg" flight of an aircraft of the Ministry of the Russian Federation for Civil Defence, Emergency Situations and Elimination of Consequences of Natural Disasters (hereinafter - EMERCOM) in 2019, 5 children from the self-proclaimed republics of Donbass were transported under the humanitarian assistance programme aimed at the reunification of the people of Donbass. Four of them were of an early age, including two children on a ventilator, and one 12-year-old child in a stable moderate condition.

At 15:30, the dispatch service of the CEMP received information about emergency landing of the EMERCOM aircraft at Domodedovo Airport due to circulatory arrest of a premature boy (delivery by emergency caesarean section on July 31, 2019 due to premature detachment of the normally located placenta). The newborn had a severe combined congenital pathology which necessitated prolonged MV, infusion therapy and nutritional support from the first minutes of his life.

This information was received by the CEMP AMB via mobile communication in flight: the AMB was returning from the previous call to the deployment post.

At 15:35, clarification of the information by the CEMP senior doctor: the child is on board the aircraft, CPR is effective.

At 15:45, the report of the CEMP AMB responsible: “Above the place, we observe the EMERCOM aircraft on the taxiway and two units of ambulance vehicles.”

At 15:47, a CEMP AMB helicopter landed in close proximity to the EMERCOM aircraft and the ARCDM “Zaschita” ambulance vehicles.

ARCDM “Zaschita” employees handed over to the CEMP AMB the child - the premature boy aged 4 months 6 days (gestational age at the time of cesarean delivery - 27 weeks) in extremely serious condition. The preliminary reports of successful in-flight CPR at 9,000 meters have been confirmed; the severity of the condition, according to the conclusion of the CEMP AMB doctor at the time of the examination, was due to the syndrome of mediastinal dislocation.

The clinical diagnosis:

The underlying combined pathology:

I. Intrauterine infection: mixed pneumonia (intrauterine + ventilator-associated), mediastenitis. Neoplasm of the mediastinum, lymph nodes?

II. Bronchopulmonary dysplasia, a new form.

Complications of the underlying pathology:

Superior vena cava syndrome. Stage IIA circulatory insufficiency. Type 3 respiratory failure. Status of prolonged MV.

Associated pathology:

Perinatal hypoxic-ischemic damage to the central nervous system (CNS), recovery phase, depression syndrome. Interatrial septal aneurysm. 2nd degree thymomegaly. Hemangioma of the thymus? Bilateral dropsy of the testicles. Prematurity - 27 weeks. Postconceptual age - 45 weeks.

The peculiarities of the diagnostic formulation are due to the insufficient patient assessment at the time of the examination and the need for his speedy medical evacuation because of his extremely severe clinical status.

The CEMP AMB doctor made a decision on the medical evacuation of the child to a specialized hospital in Moscow to clarify the diagnosis and work out the further strategies of managing the patient; the relevant information was transferred to the CEMP senior doctor. The implementation of the adopted decision was

hampered by the onset of the dark time of the day: after 17:00 landing is possible only on illuminated areas. In this regard, the landing was requested on the helipad of the City Clinical Hospital (CCH) named after. M.E. Zhadkevich, where the ambulance helicopter with the newborn was sent by order of the CEMP deputy director.

During the flight, the patient was diagnosed with electromechanical dissociation - asystolic arrest successfully stopped by the timely use of the standard CPR complex against the background of the initial intensive therapy, including MV in the mode of normoventilation / normocapnia, intravenous fluid therapy and "aggressive" sedation with benzodiazepines and barbiturates. Vasopressor and inotropic support was not performed.

At 17:05, the helicopter landed at the site of the CCH named after. M.E. Zhadkevich, where the child was transferred to the CEMP team of anesthesiologists and resuscitators and transported by ground special transport to a specialized (with the department of angiography and intervention cardiology and relevant specialists) hospital. On the way, due to the anatomical and physiological features of the premature baby with severe congenital pathology, it became necessary to switch him from the mechanical to manual ventilation, and the CEMP team successfully coped with this task.

At the time of writing this article, the child was being treated in the specialized hospital.

DISCUSSION AND CONCLUSIONS ON THE CLINICAL CASE

This clinical observation clearly illustrates the possibility of effective interaction between emergency (both medical and related) services of different administrative subordination, but at the same time raises new questions:

1) **Status of CEMP AMB and other AMBs.** A team that accepts patients in need for support or restoration of vital functions from an intensive care team of any subordination must have a legal status not lower than a special visiting / advisory anesthesiology and resuscitation team.

2) **Liability.** The authors may not be interested in this issue; nevertheless, the question exists: What is better – to switch patients from one ventilator to another, to shift from one shield to another or unify the equipment of all emergency medical teams?

3) **A disappointing conclusion.** At least in the practice of AMBs, everybody has to be responsible for their area of work.

4) **The diagnosis remains unclear.** The severity of the condition is due to serious ischemic-hypoxic damage to the CNS and pulmonary heart failure in the premature baby with severe congenital pathology, intrauterine infection, gross central hemodynamic impairment, superior vena cava syndrome, intracranial hypertension.

All of the above makes it necessary to remind once again of the need for effective collegial interaction between different departments of critical care medicine and adequate interaction with non-medical services.

Another important problem: the volume of medical care in the interaction of the AMBs with other units of emergency medical services. On the one hand, given the time constraints, inherent in the work of AMBs (bans on departure, the possibility of worsening weather conditions, the onset of darkness during the planned medical evacuation to a specialized hospital with an impromptu landing site) and the impossibility of stopping the aircraft in flight to ensure patient safety in case of a sharp deterioration in their condition, it is legitimate to insist on the maximum possible preparation of the injured and sick for air transportation before AMB arrival.

We adhere to this strategy whenever possible during the medical evacuation of somatic patients or single victims transferred by ambulance teams, as well as during interhospital transfers (especially from intensive care units).

On the other hand, during the first minutes of multiple casualty incidents (when the information from the related services should be transmitted to AMBs), it is practically impossible to implement this principle, among other things, due to the lack of medical personnel and equipment at the scene. In this case, a question comes to the fore: WHAT IS MORE IMPORTANT – high-quality early treatment or evacuation to a safe place of the largest possible number of viable victims?

The AMB experience in the 2000s does not give an unequivocal answer to this question; the experience of battlefield medicine also cannot be unconditionally accepted because of the above humanitarian reasons.

CONCLUSION

Air ambulance can be effectively used to transport newborns, even those in severe clinical condition and potentially requiring cardiopulmonary resuscitation. The presence of new Troitsk and Novomoskovsk administrative districts annexed to Moscow with a relative distance from large perinatal centers, as well as the interaction of CEMP with medical institutions in the neighboring regions, serve as an additional factor in favor of using ambulance helicopters for this purpose.

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