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CASE REPORT

Air sanitary transport using ECMO in the treatment of ARDS – case study

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ABSTRACT

In justified cases, the Polish Medical Air Rescue allows transport of a patient with medical equipment which is not standard medical equipment of the Air Transport Team. In the case at hand, a patient diagnosed with ARDS depended on extracorporeal therapy with an oxygenator. Extracorporeal membrane oxygenation (ECMO) is successfully used in the world and more and more frequently in Poland. It can also be administered using an aircraft of the Polish Medical Air Rescue. Necessity to involve many personnel members and resources indicates the complexity of the described transport of the patient. The authors demonstrate a case of a 22-year-old female patient who one and a half months ago was found unconscious at home following a suicidal attempt (status post aspiration, overdose of the Ketrel drug). Due to the absence of other possible treatments, a decision was made in the hospital to transport the patient to a centre a with higher referral level. Thanks to proper logistics, equipment and protection of the personnel, the Polish Medical Air Rescue transported the patient 260 km in a straight line during ECMO.

KEY WORDS: Polish Medical Air Rescue, ECMO, HEMS, air transport, ARDS.

INTRODUCTION

In justified cases, the Polish Medical Air Rescue (PMAR) allows transport of a patient with medical equipment which is not standard medical equipment of the Air Transport Team. In certain cases, the risk of air transport always needs to be taken into account due to the resulting surgery-related limitations and technical restrictions [1]. Acute respiratory distress syndrome (ARDS) is a life-threatening condition where, regardless of its cause, the key role is played by damage to the alveolar–capillary barrier leading to diffuse alveolar damage. As a result of an uncontrolled inflammatory process, the surfactant is destroyed and its production is limited. The insufficiency of the surfactant leads to the collapse of the pulmonary alveoli and further increase in the permeability of the alveolar–capillary barrier, which results in the emergence of areas of swelling and alveolar atelectasis. Interalveolar septa are also affected. The consequences of the above damage are disturbances in gas exchange leading to hypoxemia, reduced lung compliance and pulmonary hypertension.

In the case at hand, a patient diagnosed with ARDS depended on extracorporeal therapy with an oxygenator. Extracorporeal membrane oxygenation (ECMO) is successfully used in the world and more and more frequently in Poland. It can also be administered using an aircraft of the PMAR. The necessity to involve many personnel members and resources indicates the complexity of the transport of the patient.

CASE STUDY

Female patient aged 22. History of depression. One and a half months earlier she was found unconscious at home – probably for 2 days. Originally a suicidal attempt by overdosing on the Ketrel drug, status post aspiration in consequence. For 45 days, the patient has been dependent on extracorporeal therapy. The patient has been intubated through mouth and subject to sedation (Fentanyl, Midanium, Propofol, Esmeron). The patient was connected to a ventilator in the PSV (APRV) mode with PEEP of 15 cm H_2O, PIP of 15; the respiratory rate generated by the ventilator – 20. The patient with collapsed lungs. Ventilated with 100% oxygen. SpO_2 94%. The patient was stable in terms of circulation following the placement of a continuous infusion of Levonor. Parameters: Arterial blood pressure 110/60 and heart rate 90. Diuresis maintained, normal. The patient with persistent anaemia. Haemoglobin at 8.8. 9.8 on the day of transport. Leukocytes at 32,000. Blood platelets at 91,000.

Persistent fever of up to 38 °C treated with antibiotic therapy and the cooler function available in the ECMO device. The Polish Medical Air Rescue Operations Centre gave the patient the NACA score (severity of trauma or disease) of 5 – acute danger. Moreover, the transport of the patient was classified as burdened with a high risk of death. All treatments available in the ordering hospital were exhausted, the target hospital was indicated as a hospital with a higher referral level and the physicians attending to the patient signed the necessary declarations, as a result of which the transport was accepted for execution.

On 29 December 2015, the patient was transported to a hospital with a higher referral level, from Warsaw to Zabrze. Distance to be covered by an ambulance – 310 km, time – ca. 3 h 15 min (the distance in a straight line – 260 km). The transport mission from the collection of the patient from the ordering hospital to the handover of the patient to the target hospital tool 2 hours 15 minutes in total in the bed-to-bed transport mode. The duration of the flight from Warsaw to Katowice – 30 min. Subsequently, transport by ambulance directly to Zabrze. For a patient in a severe condition connected to multiple life support devices, air transport is frequently the optimal way of transferring the patient to another hospital, particularly if the hospital is several hundred kilometres away [2]. The patient in such a severe condition required a lot of involvement, peace, professionalism and precision from the aircraft crew when they provided care during the flight and every time they moved the patient between means of transport so that the equipment worked without any interruption.

The mere preparation for the transport by the Polish Medical Air Rescue required a prior 2-day analysis of the meteorological conditions (due to the winter season), direct involvement of 2 medical dispatchers of the Polish Medical Air Rescue Operations Centre in proper planning, preparation and coordination of the transport involving a properly secured (proper number of power supply sockets and possibility to mount the necessary equipment) and prepared ambulance in the airfield in Katowice. To achieve the desired effect of the transport of a patient in a severe condition, it was necessary to make several dozen phone calls of several minutes each. The technical personnel of the Polish Medical Air Rescue was also involved in the preparation of the transport: they verified the possibility of generating proper current intensity to maintain all devices fully prepared without the need for relying on rechargeable batteries, which frequently fail or discharge quickly.

The aviation dispatchers of the Polish Medical Air Rescue Operations Centre dealt with continuous analysis of the meteorological conditions, coordination of allowing an ambulance in the airfield and procurement of a heated up bus being the optimal place for the patient to be moved into. During the transport, ECMO, non-standard equipment of the Polish Medical Air Rescue was used, properly mounted inside the aircraft (Figure 1). A ventilator and monitoring system (ECG curve, pulse oxymetry) were used and infusion in four infusion pumps (Propofol, Midanium, Fentanyl, Levonor) was administered. A higher amount of medical oxygen needed to be secured as well.

Figure 1. Equipment of the Polish Medical Air Rescue

TERMS OF ORDERING AIR SANITARY TRANSPORT

A formal prerequisite for accepting air sanitary transport by the PMAR is a carefully filled in written order for paid air sanitary transport issued by the ordering party and handed over to the Operations Centre. Having analysed the order and taken the operating conditions into account, the medical dispatcher of the Polish Medical Air Rescue Operations Centre (PMAR OC) contacts the ordering physician (who attends to the patient) in order to prepare a medical report which finally qualifies the patient for transport.

The medical dispatcher or a physician of the PMAR can ask the attending physician for the results of laboratory testing and imaging diagnostics, the case report form from the stay in the current department and previous discharge summaries. Each and every time, the attending physician ordering air sanitary transport is obliged to take into consideration the ratio of risks and benefits for the patient's health. The PMAR strives to transport patients warranting intensive care in the bed-to-bed system. Moreover, it is also recommended that peripheral or central intravenous needle insertions, arterial lines, drains, catheters and drainage systems are secured for the duration of the transport. The number of infusions in infusion pumps has to be reduced to the maximum of two. It is recommended to stop infusions of antibiotics, preparations not administered in continuous infusion for maintaining the vital functions. It is justifiable to perform laboratory testing (blood glucose, electrolytes, arterial-blood gas, blood count). Patients who do not show a chance of surviving the transport, patients in cardiac arrest, patients in the second stage of labour and patients who can be a threat to the successful completion of the mission.

ADMINISTRATION OF ECMO IN A SANITARY AIRCRAFT

Extracorporeal membrane oxygenation is a technique consisting in the oxygenation of blood and elimination of CO_2 in an oxygenator under extracorporeal circulation [3]. Therefore, a range of complications can develop which can lead to dramatic exacerbation of the patient's condition, including their death, in the air transport setting. Possible ECMO complications related to the patient include bleeding (including tamponade and pleural haematoma), infections, embolic complications, neurologic complications, insufficiency of organs (kidneys, heart, liver), barotrauma and metabolic disorders. Possible complications related to the ECMO devices and circuit include consequences of imperfect circuit deaeration, shifting or removal of the cannula, failure of the oxygenator (wear and tear, coagulation), circuit interruption (disconnection, damage), failure of the heater-cooler device , failure of the pump, perforation of the atrium with the cannula [4]. Taking the above possible complications into account, limitations from the aircraft transport setting have to be realised. In the case at hand, to eliminate the threat of some of the complications, the ordering physician (anaesthesiologist) and a perfusionist participated in the transport in addition to the crew of the Polish Medical Air Rescue.

CONCLUSIONS

The history of the case at hand proves that the transport of a patient under ECMO by a sanitary aircraft is possible [5]. Nevertheless, the organisation of the transport requires a range of non-standard preparations. The quantity and advancement of equipment, limited space in the aircraft cabin and admission of additional specialist onboard restricts the possibility to transport obese patients and even limits the transport only to patients of lean physique weighing not more than 70 kg.

Disclosure statement

The authors did not report any potential conflict of interest.

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