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$ECCO_2R$ as a bridge to a decision in type II respiratory failure

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Introduction. End-of-life decisions are often time consuming and difficult for everyone involved. In some of these cases extracorporeal life support systems could potentially be used not only as a bridge to treatment but as a tool to buy time to allow patient's participation in decision making and to avoid further futile invasive procedures.

Case report. A previously healthy 53-year-old female patient presented with respiratory failure of unknown cause. In the course of treatment her condition was deemed irreversible and the only option for any chance of long-term survival was a lung transplant. During this whole time the patient's condition was managed with extracorporeal carbon dioxide removal system ($ECCO_2R$). She remained *compos mentis* and expressed the wish to stop all the treatment as the option of lung transplant was not acceptable to her. Treatment was withdrawn and she passed away.

Discussion. In cases of end-of-life decisions, time can play an essential role. Even though extracorporeal life support systems have been conceptualised to be a bridge to treatment, they could be beneficial in a situation when time is needed to make a decision. $ECCO_2R$ has been used as a treatment method in different settings, however, in this case it served as a tool to maintain the patient alive and conscious for a sufficient time for her to participate in decision making.

Conclusions. Our case report demonstrated that $ECCO_2R$ could serve as a bridge to decision in situations when time is limited and the decisions that need to be made are difficult.

Keywords: end of life, extracorporeal support, $ECCO_2R$, respiratory failure

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INTRODUCTION

Medical ethics remain to be a controversial topic in medicine, especially in the Intensive therapy unit (ITU) setting. Europe-wide studies have been conducted aiming to evaluate the intensive care doctors' approach to the ethical issues of end-of-life decisions. Even though there is a lot of debate and progress in understanding the place of patients' autonomy in the decision making in the ITU, the practices among clinicians are still very variable (1). Since these decisions are sensitive, time-consuming and the patients are quite often in an acute and life-threatening situations, extracorporeal life support systems could potentially be used not only as a bridge to treatment but as a tool to buy time to allow patient's decision making and to avoid further futile invasive rocedures.

CASE REPORT

A previously healthy, non-smoker 53-year-old Caucasian female patient presented to the Emergency Department complaining of shortness of breath, a persistent cough, and generalised weakness. All of these symptoms had been getting increasingly worse over the previous year. On initial clinical assessment the patient was awake, oriented, but very drowsy. She was severely short of breath, with pronounced signs of cyanosis. On auscultation there were no clear vesicular sounds anywhere in the chest. Tachycardia was present, with blood pressure within normal ranges. The oxygen saturation (SpO_2) was decreasing down to low 70–75% whenever the patient was taken off supplemental oxygen. The arterial blood gas showed a mixed respiratory failure (Table 1). The initial blood test results (Table 2) and the impression of bilateral infiltrates in the chest x-ray (Fig. 1) were consistent with the diagnosis of severe bilateral bacterial pneumonia.

The patient was admitted to the ITU, antibiotics and the rest of standard medications for treatment of pneumonia were started. High flow oxygen was used to manage the hypoxemia, however, the hypercapnia remained an issue. A high-resolution computed tomography scan of the chest revealed that all of the lung tissue had been severely damaged by multiple bullae, pneumocysts, parietal pneumothoraxes, and, seemingly, connective tissue proliferation with barely any healthy lung tissue remaining (Fig. 2). Since the diagnosis and prognosis were still unclear, the patient was started on an extracorporeal carbon dioxide removal

Table 1. Arterial blood gas analysis results

	pH	pCO_2	pO_2	BE	HCO_3	Lac
30/12/17						
10:21	7.147	11.41	6.02	–2.8	28.9	4.16
15:00	7.22	10.1	18.8	0.3	30.3	1.42
20:00	7.05	16.7	18.7	–0.6	34	2.81
24:00	7.13	12.5	22.7	1	30.6	0.96
Extracorporeal CO_2 removal started						
31/12/2017						
01:00	7.2	10.0	9.6	0.8	31.3	1.92
04:00	7.29	8.7	9.1	2.9	31.1	1.67
05:00	7.3	7.8	10.1	1.1	28.7	1.6
11:00	7.27	8.7	37.4	1.1	29.3	1.08
16:00	7.32	7.2	13.2	0.5	27.3	1.12
1/1/2018						
01:00	7.33	6.9	9.6	1.5	28.2	1.23
05:00	7.29	8.4	8.2	1.7	29.6	1.24

Table 2. Blood test results

	30/12/17	31/12/17	1/12/17		30/12/17	31/12/17	1/12/17
Hg	136	118	105	Potassium	5.0	4.4	4.4
WBC	14.0	18.6	22.6	Urea	7.6	8.7	8.1
RBC	4.6	3.99	3.59	Creatinine	58	63	59
HCT	0.43	0.37	0.33	CRP	24	21	28
PLT	288	195	141	Sodium	141	142	145
PT	11.0	11.9	11.3	Albumin	37	33	32
APTT	25.7	32.0	85.8	Calcium	2.24	2.29	2.23

(ECCO$_2$R) system in order to buy time to make appropriate decisions and manage the constantly worsening hypercapnia. The case was discussed with consultants in specialised respiratory and regional transplant centres. Based on the clinical presentation, laboratory findings, and CT scan results the most likely diagnosis was concluded to be lymphangioleiomyomatosis – a rare condition for which a lung transplant is the only definitive treatment option. Among the wide range of specialists it was agreed that irrespective of the diagnosis and acute management, considering the stage of the patient's lungs, the only treatment option, carrying any chance of long term survival was lung transplant. During this period the oxygen requirements receded to 3–4 l/min via nasal cannula, hypercapnia was managed with the ECCO$_2$R system, and the patient was not in respiratory distress. The ITU team had long, thorough conversations both with the patient and the patient's family. The illness, treatment options, and most likely outcomes were discussed.

After two days of treatment in the ITU, the patient expressed the wish to stop all treatment measures as she did not see any point in continuing. All of the options (including lung transplant) that were offered to her, as far as her long-term outcomes and quality of life were concerned, were not acceptable to the patient. She clearly stated that she was refusing all of the treatment. She also refused to speak to any member from the palliative team. After completing a mental capacity assessment, the patient was deemed to be *compos mentis*. A DNACPR (Do Not Attempt CardioPulmonary Resuscitation) form was signed, all active treatment withdrawn, and the patient was started on the "End-of-Life Pathway". The patient died within an hour, surrounded by her family.

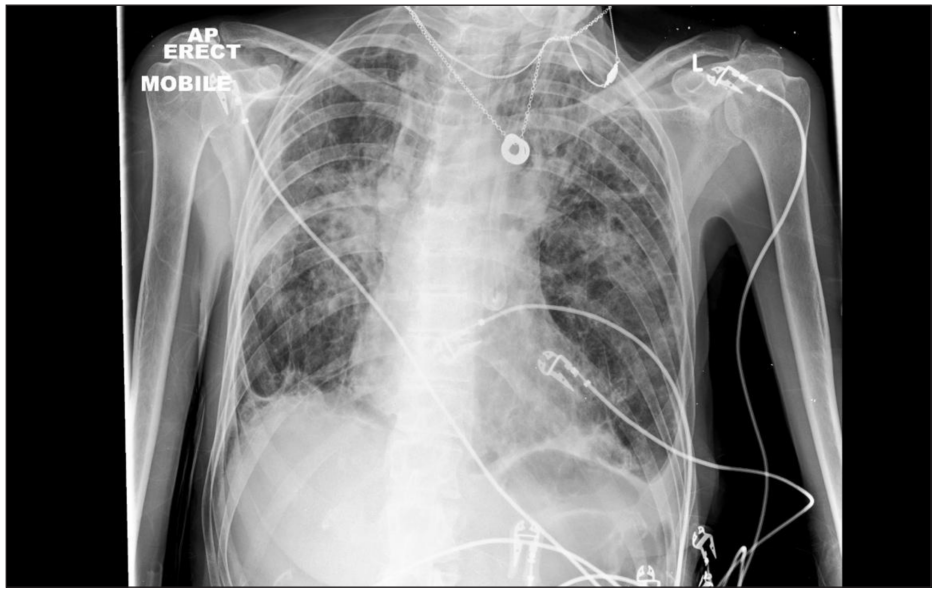

Fig. 1. Chest x-ray on admission

Fig. 2. A slice of the high resolution CT scan of the chest

DISCUSSION

Even though medical ethics clearly state that patient autonomy and beneficence are key in medical practice (2), local customs and legislation still determine the approach of the medical personnel to end-of-life decisions (1). Europe-wide and worldwide withholding of care, withdrawing of care, and similar concepts remain a topic of discussion, especially in critical care. In the United Kingdom, DNACPR is made to be a medical decision, meaning that based on their expertise the medical team decide if DNACPR needs to be signed for a specific patient (3). The right of the patient to maintain autonomy in the end-of-life decision-making is clearly defined in the General Medical Council Ethical guidance recommendations that have been in place since 1 July 2010. Having an official, legally-binding, and nationwide framework for end-of-life practices allows both the patient to maintain their dignity and the clinician to follow the key concepts of medical ethics.

All end-of-life decisions are difficult for everyone involved: the patient, the patient's family members, and the medical team; and they are becoming increasingly common (4). In these instances time can play an essential role. Extracorporeal life support systems, such as ECMO or heart assist devices, have been suggested to be used as a bridge to treatment (for example, a heart or lung transplant). However, the $ECCO_2R$ system was initially conceptualised and produced with the intention to prolong the time before intubation or avoid it altogether in cases of acute exacerbations of chronic type II respiratory failure (5). Sadly, evidence-based research of $ECCO_2R$ being used as a means of symptomatic treatment or a bridge to improvement of condition is limited both in the number of studies and in the sample sizes of those studies. And even in those research publications the results of the studies are unclear and do not necessarily support each other. As far as exacerbations of chronic carbon dioxide retaining conditions go, $ECCO_2R$ can reduce the instance rate of intubation (5, 6) and facilitate extubation (7). However, due to the fact that it is difficult to predict the dynamics of acute respiratory failure in every single case and to choose appropriate patients (8) for $ECCO_2R$ therapy, it remains more of an experimental means of treatment rather than an accepted therapeutic strategy (9), and at present the risk and benefit ration of using it is still unclear (10).

In some progressive respiratory conditions with repeated acute exacerbations the only potential treatment is a lung transplant. As stated by the NHS, lung transplants are not carried out often in the UK due to the lack of donors (11). The number of people waiting for a lung transplant has risen by 46% over the past five years in the UK (12), and considering the fact that the number of organ donors

did not keep up with the rise, around 17% of people listed for a lung transplant have died within a year of being listed (13). For those who have been lucky to receive the lung transplant the median survival rate currently stands at 5.8 years (14). Other quality of life-related outcomes, such as employment status, should be considered as well. For instance, at five years post-transplant, about 40% of patients are not working, 30% are retired, and a little less than 20% are working part- or full-time (14).

In this particular case, the patient presented with a life-threatening hypercapnia of unknown origin. Time was needed to determine the reason of the condition and to formulate a further management plan. Both intubation and aggressive non-invasive ventilation would have been futile, damaging, and would have prevented the patient from being able to participate in the decision-making process. Having the hypercapnia managed with $ECCO_2R$, she had the chance to express her wishes and have a peaceful death. In this case, as reported in a few cases before (15–17), the $ECCO_2R$ system was a successful means to gain time in a difficult situation. Even though it is extremely difficult to design a valid study to investigate the use of $ECCO_2R$ in this setting, further investigations are needed to see if it could possibly become a valid management strategy for conditions involving exacerbations of chronic type II respiratory failure conditions.

CONCLUSSIONS

There is sparse literature of when $ECCO_2R$ could be used in evidence-based manner. However, our case report demonstrates that $ECCO_2R$ could serve as a bridge to decision in situations when time is limited and the decisions that need to be made are difficult. Most importantly, $ECCO_2R$ may allow the patient to participate in the decision making.

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$ECCO_2R$ KAIP PRIEMONĖ PRATĘSTI GYVENIMĄ

Santrauka

Įžanga. Gyvenimo pabaigos sprendimai dažnai sunkūs ir yra ribojami laiko. Kai kada ekstrakorporinės gyvybės palaikymo sistemos galėtų būti taikomos ne kaip priemonės pratęsti gydymą, tačiau kaip laikas priimti sprendimus dalyvaujant pacientui, kad būtų išvengiama tolimesnių beprasmių invazinių procedūrų.

Klinikinis atvejis. Į gydymo įstaigą kreipėsi 53 metų moteris, ji skundėsi ūmiu kvėpavimo nepakankamumu. Pacientei buvo nustatytas nepagydomas plaučių pažeidimas. Vienintelis išgyvenamumą galintis užtikrinti gydymo būdas buvo plaučių transplantacija. Kol buvo atliekama diagnostika ir svarstomos gydymo galimybės, pacientės gyvybę palaikė ekstrakorporinė anglies dioksido šalinimo sistema ($ECCO_2R$), todėl ji visą laiką išliko sąmoninga. Sužinojusi apie gydymo perspektyvas bei plaučių transplantacijos būtinybę, pacientė atsisakė gydymo. Nutraukus gydymą ji mirė.

Diskusija. Priimant gyvenimo pabaigos sprendimus laikas yra labai svarbus. Nors ekstrakorporinės gyvybės palaikymo sistemos buvo kurtos kaip priemonės pratęsti gyvenimą, jos taip pat galėtų būti naudingos, kai reikia laiko priimti sprendimus. $ECCO_2R$ taikytas kaip gydymo metodas įvairiose situacijose, tačiau šiuo atveju jis buvo kaip priemonė, padėjusi išlaikyti pacientę gyvą bei sąmoningą, kad ji pati priimtų savo gyvenimo kokybę ar baigtį lemiančius sprendimus.

Išvados. Šis klinikinis atvejis parodo, kaip $ECCO_2R$ gali būti taikoma kaip priemonė pratęsti gyvenimą sudėtingose situacijose, kai trūksta laiko, o gyvenimo perspektyvą lemiantys sprendimai yra sunkūs.

Raktažodžiai: gyvenimo pabaigos sprendimai, ekstrakorporinės sistemos, $ECCO_2R$, kvėpavimo funkcijos nepakankamumas