



CASE REPORT

PHYSIOTHERAPY AND REHABILITATION IN PEDIATRIC INTENSIVE CARE PATIENTS WITH EXTRACORPOREAL MEMBRANE OXYGENATION SUPPORT: 2 CASE REPORTS

Hacer ÖNCÜ^{1*}, Ebru ÇALIK-KÜTÜKÇÜ^{1*}

ABSTRACT

The aim of this study was to summarize and analyze the potential effects of physiotherapy and rehabilitation practices in pediatric patients hospitalized in the pediatric intensive care unit and receiving extracorporeal membrane oxygenation (ECMO) support. ECMO is a life-saving gold standard treatment modality for patients with severe cardiac, respiratory, or combined cardiorespiratory failure that has emerged in recent years. Intensive care unit-acquired weakness (ICU-AW) is a frequently encountered condition in critically ill patients on ECMO due to prolonged intensive care unit hospitalization. Therefore, functional capacity decreases and mortality rates increase due to this weakness. Early mobilization and physical therapy in critically ill patients on ECMO have been proven to be safe practices in bridging to both heart/lung transplantation and recovery. Early mobilization has also been proven to prevent weakness associated with intensive care unit stay, reduce delirium episodes, and reduce the length of stay on mechanical ventilator and consequently reduce the length of hospital stay. Therefore, it is of great importance that early mobilization in ECMO patients is prepared within an individualized program by a team specialized in this field. This study presents 2 patients aged 3 and 10 years with dilated cardiomyopathy who were hospitalized in the pediatric intensive care unit. Whereas boy patient underwent venoarterial ECMO for 150 days, girl patient underwent for 70 days and died at follow-up. 2 patients were admitted to early rehabilitation program by the rehabilitation team as soon as their condition was stable. No joint contracture and pressure sores occurred with the rehabilitation programme applied. The patients could be extubated three times each. In this study, our aim is to contribute to the current literature on physiotherapy and rehabilitation practices applied in two pediatric patients followed in ECMO.

Keywords: Extracorporeal membrane oxygenation (ECMO), intensive care unit, physiotherapy, rehabilitation, early ambulation, case report

ÖZET

Bu çalışmanın amacı, pediatrik yoğun bakım ünitesinde yatan ve ekstrakorporeal membran oksijenasyonu (ECMO) desteği alan pediatrik hastalarda fizyoterapi ve rehabilitasyon uygulamalarının potansiyel etkilerini özetlemek ve analiz etmektir. ECMO, son yıllarda ortaya çıkan ciddi kardiyak, solunumsal veya kombine kardiyorespiratuar yetmezliği olan hastalar için hayat kurtarıcı altın standart bir tedavi yöntemidir. Yoğun bakım ünitesinde yatış süresinin uzaması nedeniyle yoğun bakım ünitesi kaynaklı güçsüzlük (YBÜ-GY), ECMO uygulanan kritik hastalarda sıklıkla karşılaşılan bir durumdur. Dolayısıyla bu güçsüzlüğe bağlı olarak fonksiyonel kapasite azalmakta ve mortalite oranları artmaktadır. ECMO'daki kritik hastalarda erken mobilizasyon ve fizik tedavinin hem kalp/akciğer transplantasyonuna hem de iyileşmeye köprü oluşturmada güvenli uygulamalar olduğu kanıtlanmıştır. Erken mobilizasyonun ayrıca yoğun bakım ünitesinde kalışla ilişkili güçsüzlüğü önlediği, deliryum ataklarını azalttığı ve mekanik ventilatörde kalış süresini ve dolayısıyla hastanede kalış süresini azalttığı kanıtlanmıştır. Bu nedenle, ECMO hastalarında erken mobilizasyonun bu alanda uzmanlaşmış bir ekip tarafından bireyselleştirilmiş bir program dahilinde hazırlanması büyük önem taşımaktadır. Bu çalışmada pediatrik yoğun bakım ünitesinde yatan dilate kardiyomiyopatili 3 ve 10 yaşlarında 2 hasta sunulmuştur. Erkek hastaya 150 gün venoarteriyel ECMO uygulanırken, kız hastaya 70 gün uygulandı ve takipte kaybedildi. 2 hasta durumları stabil olur olmaz rehabilitasyon ekibi tarafından erken rehabilitasyon programına alındı. Uygulanan rehabilitasyon programı ile eklem kontraktürü ve bası yarası oluşmadı. Hastalar üçer kez ekstübe edilebildi. Bu çalışmada amacımız ECMO'da takip edilen iki pediatrik hastada uygulanan fizyoterapi ve rehabilitasyon uygulamaları ile ilgili güncel literatüre katkı sağlamaktır.

Anahtar Kelimeler: Ekstrakorporeal membran oksijenasyonu (ECMO), yoğun bakım ünitesi, fizyoterapi, rehabilitasyon, erken ambulasyon, olgu sunumu

¹Hacettepe University, Faculty of Physical Therapy and Rehabilitation, Department of Cardiorespiratory Physiotherapy and Rehabilitation, 06100 Ankara, Turkey

*Corresponding author e-mail: haceroncu1997@gmail.com

INTRODUCTION

Extracorporeal Membrane Oxygenation (ECMO) is the removal of blood from the body with a pump, oxygenating it, removing carbon dioxide at the same time and returning it to the body. ECMO has two different uses, venovenous or venoarterial. It can be used as an alternative treatment method in newborn, pediatric or adult patients who do not respond to other classical treatments applied in respiratory or heart failure. Although ECMO was initially used only to support the respiratory system, it is now successfully used to support both respiratory and cardiac functions (1). ECMO provides patients with the necessary organ support until recovery or transplantation (2). With the technological developments in recent years, the oxygenators, pumps and circuit design used in ECMO have been improved, leading to a reduction in the complexity and size of the device (3). However, it is still considered a very risky treatment method due to the many known complications such as bleeding, thrombosis, and infection (4). In addition, these patients need rehabilitation due to their long-term stay in the intensive care unit and mechanical ventilation. (5). Patients receiving ECMO support often have decreased cardiorespiratory and musculoskeletal function due to prolonged immobilization (6). Therefore, it is very important to mobilize these patients in the early period. In addition, studies have proven that physiotherapy and rehabilitation interventions to be applied in patients on ECMO is safe and feasible (7). Preventing atelectasis, clearing the airway, ensuring easy weaning from the mechanical ventilator, reducing the length of stay in intensive care and hospitalization and increasing the functional level are among the main goals of physiotherapy and rehabilitation approaches to be applied in patients in ECMO (6). In the literature, it has been reported that physiotherapy and rehabilitation to be applied in the early period in patients on ECMO has ameliorative results (8). But care must be taken in patient selection to achieve positive results (9). Although physiotherapy and rehabilitation practices have been described in patients receiving ECMO support, more detailed information is needed on the application and management of physiotherapy in this patient group (4). The aim of this study was to give information about

the physiotherapy and rehabilitation applications applied in two patients hospitalized in the pediatric intensive care unit.

CASE PRESENTATION

Necessary parental consent was obtained for this study. The first case was a 10-year-old girl. The patient who was hospitalized on 03 Aug 2023 due to dilated cardiomyopathy (arrhythmogenic right ventricular dysphasia), whose ventricular arrhythmia persisted despite antiarrhythmic treatments and was on the transplant list due to milrinone dependence, was admitted to ECMO on 23 Oct 2023 due to hypotensive-bradycardic condition despite multiple inotropic support. When the patient, who had no known disease before, presented with shortness of breath about a year ago, an increase in cardiothoracic ratio/index (CTO) was observed on chest radiography. In cardiology evaluation, her ejection fraction (EF) was evaluated as 35% and cardiomyopathy, inotropic support was given and her EF increased to 47% and she was followed up as an outpatient. In August 2023, her EF decreased to 39% and cardiac magnetic resonance imaging (MRI) revealed findings in favor of fibrosis and she was admitted to our hospital, an advanced center.

The second case was a 3-year-old boy. In the last months of 2022, episodes of abdominal pain and cold sweats after exertion started. On these occasions, the patient described pain in the lower part of the sternum. The symptoms usually occurred in the evening and the patient felt the need to lie down, which resolved spontaneously after a while. There was no history of fatigue or difficulty in breathing before these symptoms. He was hospitalised several times within one month due to these complaints. In early January 2023, he started to complain of cough and fever. The cough woke him up from sleep and was sputum or dry. Ventolin and inhaled adrenaline were administered at the outpatient center and short-term benefit was seen, clarithromycin and alternating antipyretics were recommended. Despite these interventions, cough complaint persisted. Fever persisted for 2 days but responded to antipyretics. On 02 Jan 2023, he was admitted to the external center again with complaints of weakness, decreased nutrition, and bruising on the lips. In the evening hours, his heart rate was found to be 250 beats/min in the external center where he was admitted due to the persistence

of his symptoms, and it was evaluated as Supraventricular Tachycardia (SVT). Adenosine was administered for 4 times, normal sinus rhythm was achieved, but SVT recurred, tachypnea and respiratory distress were present in addition to tachycardia.

He was evaluated as acute lower respiratory tract infection (LRTI), clarithromycin was evaluated as arrhythmogenic. Electrocardiogram (ECG) was compatible with narrow QRS tachycardia. When it recurred despite adenosines, esmolol infusion was started. He was intubated. Amiodorone was started, twice cardioversion was performed, he returned to normal sinus rhythm with cardioversion. On 05 Aug 2023, patient received venoarterial extracorporeal membrane oxygenation (VA-ECMO) after arrest. Physiotherapy and rehabilitation were started when two patients were stable. A physiotherapy and rehabilitation program was individualized according to the patients and applied for at least 30 minutes twice a day for 5 days a week. The content of the rehabilitation program was as follows: passive normal range of motion exercises, chest physiotherapy, in-bed positioning, and splinting was applied. Normal joint movement exercises consisted of upper extremity (finger flexion-extension, wrist flexion-extension, elbow flexion-extension, shoulder flexion-extension up to 90⁰, shoulder abduction-adduction up to 90⁰) and lower extremity (ankle dorsi flexion-extension, knee flexion-extension, hip flexion-extension) movements with 5-10 repetitions, 3 times a day. Chest physiotherapy was applied 3 times a day for 1 minute by percussion after the patient was placed in the postural drainage position. No adverse events were experienced during physiotherapy and rehabilitation practices. The patients were extubated three times with chest physiotherapy. But each time they were re-extubated for ECMO set exchange.

DISCUSSION

This study describes the application of a rehabilitation program consisting of a combination of positioning passive, passive-active, active normal range of motion exercises and chest physiotherapy and mobilization in two patients with ECMO hospitalized in the pediatric intensive care unit.

In a study on physiotherapy and rehabilitation in ECMO, it was stated that there is still a difference between the

applications according to centers on this issue and that there is no protocol in the interventions applied (4).

Other studies in the literature suggest that rehabilitation practices within the program to be implemented in ECMO patients should be performed by an experienced multidisciplinary team consisting of surgeons, nurses, perfusionists, intensive care physicians, respiratory therapists and physiotherapists (10). However, it has been reported that most practice centers are understaffed and therefore the rehabilitation program is not implemented (4). These cases confirm the benefits of physiotherapy and rehabilitation in pediatric patients on ECMO. No adverse events were encountered during the rehabilitation program.

CONCLUSION

As seen in these cases, early physical therapy in pediatric intensive care unit patients with an experienced team specialized in this field after the patient is stable is both reliable and feasible. Rehabilitation also shortens the recovery time of these patients. However, randomized controlled studies in this field are few. Therefore, more studies are needed in this field. With these case reports, it was seen that physical therapy and rehabilitation with ECMO is safe and feasible. Any joint contracture and pressure sores occurred in the patients with the rehabilitation programme applied.

Acknowledgment: None.

Author contributions: HO: Concept, design, data collection and or processing, literature search, writing manuscript. ECK: Supervision, writing manuscript, critical review

Financial Support: This research did not receive any specific grant from funding agencies in the public, commercial, or not-for-profit sectors.

Conflict of Interest: None.

How to cite this article: Öncü H, Çalık-Kütükçü E. Investigation Stress Level, Perception of Social Support, Physiotherapy and Rehabilitation in Pediatric Intensive Care Patients with Extracorporeal Membrane Oxygenation Support: 2 Case Reports. Journal of Hacettepe University Physical Therapy and Rehabilitation. 2024;2(1), 10-13.

REFERENCES

1. Bartlett RH, Roloff DW, Custer JR, Younger JG, Hirschl RB. Extracorporeal life support: the University of Michigan experience. *Jama*. 2000;283(7):904-8.
2. Bréchet N, Hajage D, Kimmoun A, Demiselle J, Agerstrand C, Montero S, et al. Venoarterial extracorporeal membrane oxygenation to rescue sepsis-induced cardiogenic shock: a retrospective, multicentre, international cohort study. *The Lancet*. 2020;396(10250):545-52.
3. A Siddiqui N, Dominguez A, Sharma A, Conrad SA. Technique for circuit exchange in high-risk patients on extracorporeal life support. *Perfusion*. 2023;38(5):963-5.
4. Polastri M, Eden A, Loforte A, Dell'Amore A, Antonini MV, Riera J, et al. Physiotherapy for patients on extracorporeal membrane oxygenation support: How, When, and Who. An international EuroELSO survey. *Perfusion*. 2024;39(1):162-73.
5. Wilcox ME, Jaramillo-Rocha V, Hodgson C, Taglione MS, Ferguson ND, Fan E. Long-term quality of life after extracorporeal membrane oxygenation in ARDS survivors: systematic review and meta-analysis. *Journal of intensive care medicine*. 2020;35(3):233-43.
6. Li H, Chen J, Yu Y, Mao L, Luo L, Zou L, et al. Early physical therapy for a patient affected by coronavirus disease 2019 (COVID-19) on awake veno-venous extracorporeal membrane oxygenation: a case report. *Ann Transl Med*. 2022;10(5):264.
7. Wells CL, Forrester J, Vogel J, Rector R, Tabatabai A, Herr D. Safety and feasibility of early physical therapy for patients on extracorporeal membrane oxygenator: University of Maryland Medical Center experience. *Critical care medicine*. 2018;46(1):53-9.
8. Paton M, Lane R, Hodgson CL. Early mobilization in the intensive care unit to improve long-term recovery. *Critical Care Clinics*. 2018;34(4):557-71.
9. Hodgson CL, Stiller K, Needham DM, Tipping CJ, Harrold M, Baldwin CE, et al. Expert consensus and recommendations on safety criteria for active mobilization of mechanically ventilated critically ill adults. *Critical care*. 2014;18(6):1-9.
10. Abrams D, Javidfar J, Farrand E, Mongero LB, Agerstrand CL, Ryan P, et al. Early mobilization of patients receiving extracorporeal membrane oxygenation: a retrospective cohort study. *Crit Care*. 2014;18(1):R38.