From COVID-19 Respiratory Failure to Bilateral Lung Transplantation: Acute Rehabilitation Outcomes and Challenges

Alice Ye, MD[1,2]; Punit M Patel, DO[1,2]; Ankit Bharat, MBBS[3]; Matthew Oswald, MD[2,4]; Daniel Goodman, MD, MS[2,4]
[1]Northwestern McGaw Medical Center, Chicago, IL; [2]Shirley Ryan AbilityLab, Chicago, IL; [3]Department of Surgery, Northwestern Medicine, Chicago, IL;
[4]Department of PM&R, Northwestern Medicine, Chicago, IL

Introduction

We present a case of severe COVID-19 infection in a young female adult, who required bilateral lung transplantation. This case was chosen not only for its novelty -- as one of few lung transplants performed after COVID-19 infection -- but also to demonstrate the multidisciplinary and interspecialty nature of successful rehabilitation from post-intensive care syndrome (PICS) from COVID-19 infection.

Acute Hospital Course

Our patient is a 28-year-old female who presented to the ED with high fevers, respiratory distress, and several weeks of malaise. Her medical history was significant for neuromyelitis optica with mild right-sided weakness and recent immunosuppressant treatment. Over a 67-day ICU stay (see below), she spent majority of the course in recurrent shock, with severe coagulopathy, and under heavy sedation for ICU delirium and agitation.

After lung transplantation, she began verticalization therapy, tolerating elevation to 41° up to 20 minutes with significant postural weakness. By admission to AIR, she was decannulated and on room air.

In total, she underwent:

- 41 days of VVECMO
- 52 days of ventilator support
- 4 days of CVVH for persistent kidney injury

Acute Inpatient Rehabilitation Course

Prior to hospitalization, she functioned independently in the community. She presented to AIR with tetraparesis, minimal endurance, and mild dysphagia, requiring moderate to maximal assistance for activities and mobility.

Her case required extensive collaboration between her transplant team and the physiatry team regarding immunosuppressant titration, surveillance imaging, and care coordination to support her recovery.

After 22 days, she progressed to supervision for ambulation and bathing and independence for all other tasks, ultimately transitioning home with family (see Tables 1 and 2).

	9-Jul	10-Jul	20-Jul	21-Jul	27-Jul	28-Jul
BBS		26	40			48
6MWT		92 ft	656 ft			1,090 ft
Grip Strength						
Left Hand	16 lb			20.7 lb	24 lb	
Right Hand	19.7 lb			23.3 lb	25.3 lb	

Table 1. Therapy assessments. BBS = Berg Balance Scale; 6MWT = 6-minute walk test.

	Admission	Discharge
Self Care	24/42 (57.1%)	40/42 (95.2%)
Eating	5	6
Oral Hygiene	5	6
Shower, Bathe Self	3	4
Upper Body Dressing	3	6
Lower Body Dressing	3	6
Footwear On/Off	2	6
Toileting Hygiene	3	6
Transfers	9/18 (50.0%)	16/18 (88.9%)
Chair, Bed to Chair Transfer	3	6
Toilet Transfer	3	6
Tub/Shower Transfer Assist	3	4
Locomotion		
Walk 10 Feet	3	4
Walk 50 Feet w/2 Turns	--	4
4 Steps	--	4

Table 2. AIR initial and discharge quality indicator levels. 01=Dependent; 02=Maximal Assist; 03=Moderate Assist; 04=Supervision/Touch; 05=Set-Up/Clean-Up; 06=Independent.

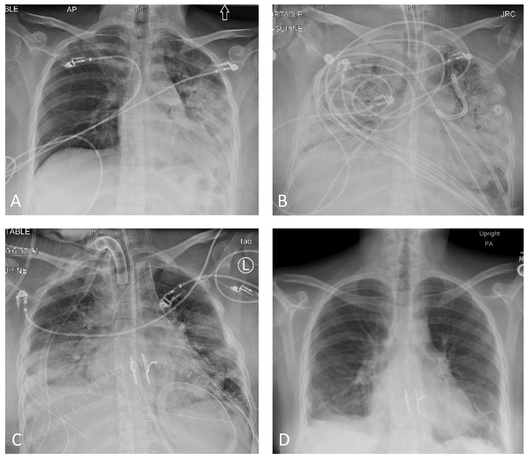


Figure 1. A) Initial chest x-ray (CXR) on 4/26; B) pre-transplant CXR on 6/5; C) post-transplant CXR on 6/6; D) surveillance CXR from AIR on 7/27.

Discussion

To our knowledge, this was the first patient in the United States to undergo lung transplantation for COVID-19-induced respiratory failure. As more individuals are infected and recover, inpatient physiatrists must become familiar with the cardiopulmonary,[1,2] cognitive,[3] and neurologic impairments[4,5] from severe COVID-19 cases as well as recovery from advanced treatments such as lung transplantation.

Our patient received cardiopulmonary re-conditioning exercises, with a focus on diaphragmatic breathing strategies for re-training respiratory muscles and energy conservation. She had minimal if any cognitive deficits on screening but had fluctuating weakness and pain from her prior neurologic condition, possibly associated with nociplastic changes from PICS,[6] as well as therapy-limiting surgical site pain.

Recent expert consensus on COVID-19 recovery recognize that COVID-19 survivors after critical care will face not only physical impairments, but also psychological injury from the primary disease as well as from PICS.[6] Up to 30% of all COVID-19 survivors may need psychological support. We were able to initiate psychosocial supports early as well as tailor therapy toward vocational training.

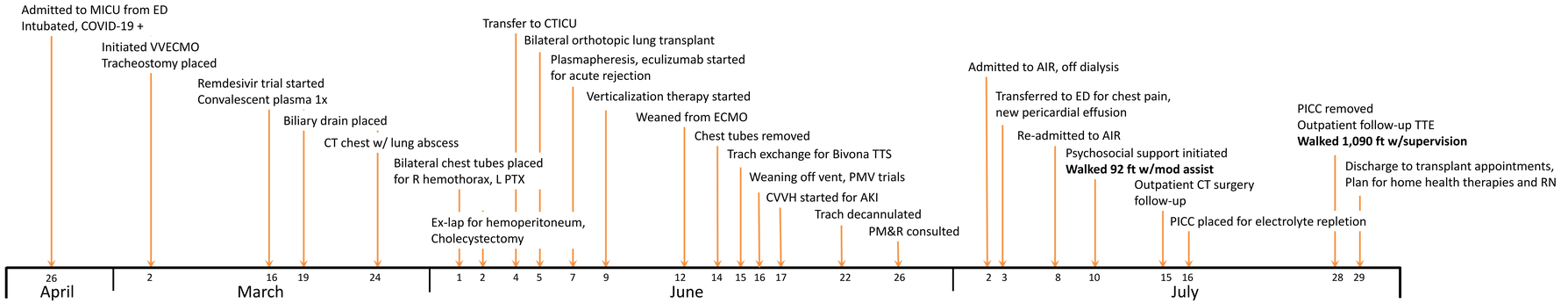
Unfortunately, research on the impact of rehabilitation on PICS recovery is limited, with insufficient data to comment on the benefits of early ICU mobilization for recovery or on the benefits of exercise after ICU discharge for quality of life.[7,8] While our case is one of many patients that clinically show the necessity for AIR for safe recovery and transition home, it remains understandably difficult to create trials that measure this benefit.

Conclusion

At the time of this patient's presentation, there were no guidelines for rehabilitation following COVID-19 infection or lung transplantation related to severe COVID-19 infection. Inpatient rehabilitation teams will need to learn how to optimize outcomes for this population. Fortunately, we have a long history of adapting models of care to meet the needs of new patient populations. As part of that team, physiatrists serve a crucial role for interdisciplinary and interspecialty communication to ensure safe and effective recovery.

Patient Timeline

VVEMCO = venovenous extracorporeal membranous oxygenation
CVVH = continuous venovenous hemofiltration



Acknowledgements

To the patient who provided written consent for this poster and graciously trusted us to share her case.

References

1. Hermann M, Pekacka-Egli A, Witassek F, et al. Feasibility and Efficacy of Cardiopulmonary Rehabilitation After COVID-19. Am J Phys Med Rehabil. Oct 2020;99(10):856-869.
2. Wang TJ, Chau B, Liu M, et al. Physical Medicine and Rehabilitation and Pulmonary Rehabilitation for COVID-19. Am J Phys Med Rehabil. Sep 2020;99(9); 769-774.
3. Carda S, Invernizzi M, Bavikatte G, et al. COVID-19 pandemic. What should Physical and Rehabilitation Medicine specialists do? A clinician's perspective. Eur J Phys Rehabil Med. Aug 2020;56(4):515-524.
4. Khan AR, Farooqui MO, Jatoi NN, et al. Neurological Manifestations of SARS-CoV-2: A Narrative Review. The Neurologist. Dec 2020;26(1):15-19.
5. Maury A, Lyoubi A, Peiffer-Smadja N, et al. Neurological manifestations associated with SARS-CoV-2 and other coronaviruses: A narrative review for clinicians. Rev Neurol. Dec 2020;(20):30732-3.
6. Barker-Davies RM, O'Sullivan O, Prathima Senaratne KP, et al. The Stanford Hall consensus statement for post-COVID-19 rehabilitation. Br J Sports Med. Aug 2020;54(16):949-959.
7. Connolly B, Salidbury L, O'Neill B, et al. Exercise rehabilitation following intensive care unit discharge for recovery from critical illness. Cochrane Database Syst Rev. Jul 2015;15(6).
8. Doiron KA, Hoffman TC, Beller EM. Early intervention (mobilization or active exercise) for critically ill adults in the intensive care unit. Cochrane Database Syst Rev. Mar 2018;3(3).