

Inpatient Rehabilitation After COVID-19 Hospitalization in a Patient With Lung Transplant

A Case Study

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Abstract: Severe acute respiratory syndrome coronavirus 2, also known as coronavirus 2019 (COVID-19), has impacted the lives of many older individuals, with those with comorbidities having the highest risk of severe disease. Specifically, immunosuppression and chronic obstructive pulmonary disease are two important risk factors. This case report describes the rehabilitation course of a 62-yr-old woman with a history of a double lung transplant for chronic obstructive pulmonary disease in 2016 who contracted a severe COVID-19 infection. After nearly a month in the intensive care unit, she underwent a 10-day course of inpatient rehabilitation and regained substantial independence and was able to return home only needing supervision. Although other cases in the rehabilitation literature have documented successful rehabilitation after COVID-19 infection, this transplant-related case required intensive coordination of care to meet goals and achieve success for the patient. Because of the limited numbers of studies, this information may prove valuable in future considerations for candidates of inpatient rehabilitation.

Key Words: Inpatient Rehabilitation, COVID-19, Lung Transplant, Case Report

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Severe acute respiratory syndrome coronavirus 2, also known colloquially as the 2019 novel coronavirus or COVID-19, has led to a pandemic with global impact. Since first appearing, progress has been made in understanding the effects of the virus. Some studies cite that nearly 80%–90% of cases have been asymptomatic.¹ Further studies suggest though that nearly 10% of cases present with dyspnea, hypoxemia, or radiographic evidence of changes to lung parenchyma.^{1–3} Although the effects of the virus are still incompletely understood, those older than 60 yrs and those with comorbidities like obesity and diabetes, chronic obstructive pulmonary disease, and cardiovascular

disease are predisposed to more severe affliction and higher rates of complication.⁴ Specifically, COVID-19 has been shown to upregulate angiotensin-converting enzyme 2 receptors, causing severe symptoms including damage to the lungs, weakened immunity, and increased production of mucous.⁵ With these effects, COVID-19 can be particularly worrisome for patients with underlying respiratory diseases and those who are chronically immunosuppressed.⁶ Studies show that there is a positive association with immunosuppression and severe presentations of COVID-19 requiring intensive care unit (ICU) level care.⁶ Given the increasing incidence of the virus, it is anticipated that hospitalizations due to COVID-19 will also increase. For patients severely affected, their course often includes prolonged intubation, acute respiratory distress syndrome, and resultant critical illness polyneuropathy/myopathy.⁷ It is estimated that many of these patients will require intensive rehabilitation after their hospitalization in an inpatient rehabilitation setting; this would be tailored to the most common etiology of their functional deconditioning and components of critical illness myopathy/polyneuropathy.^{7,8} This case report describes the rehabilitation course of a 62-yr-old woman with a history of double lung transplant for end-stage chronic obstructive pulmonary disease in 2016 who had a prolonged, medically complicated hospitalization due to severe COVID-19 infection. This unique case describes the particular importance and specific considerations that must be considered during a post-COVID-19 inpatient rehabilitation admission. This study conforms to all CARE guidelines and reports the required information accordingly (see Supplemental Checklist, Supplemental Digital Content 1, <http://links.lww.com/PHM/B277>).

CASE PRESENTATION

At the age of 58 yrs, 4 yrs before her admission in 2020, the patient in this case underwent a double lung transplant because of end-stage chronic obstructive pulmonary disease. She remained on immunosuppressive medications, including everolimus, tacrolimus, and prednisone. She also required 2-liter nightly oxygen supplementation. At this time, she was receiving care for hypertension, diabetes mellitus type II, gastroesophageal reflux disease, and anxiety. Before her hospitalization, she was fully independent with all activities of daily living and instrumental activities of daily living. In July 2020, the patient tested positive for COVID-19 after exposure to family members. A few days after exposure, she reported to an outside hospital with dyspnea, and the patient reported concern that she would start to deteriorate because of her immunosuppression. On admission, she had normal vital signs with the exception of using 1 liter of oxygen to maintain saturation above 90%. She was hospitalized for 5 days, completed a

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Consent: Patient consent was obtained for presentation of this case.

Christian Nicolosi is in training.

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course of dexamethasone and remdesivir, and was ultimately discharged home on her baseline nocturnal oxygen requirement of 2 liters. Five days after discharge, she returned to the emergency department with a fever of 100.4°F, a heart rate of 108, and tachypnea with a respiratory rate of 38. She also had hypoxia with an 84% oxygen saturation level on room air, ultimately requiring 2–3 liters of oxygen. She remained positive for COVID-19 on hospital day (HD) 0. She was readmitted and found to have new bilateral infiltrates on chest x-ray (Figs. 1A and B). Her respiratory failure progressed requiring intubation on HD2. On HD14, a repeat chest x-ray demonstrated worsening opacification that was concerning for a right lower lobe infiltrate (Fig. 1C), and she was diagnosed with acute respiratory distress syndrome. Because of inability to wean from the ventilator, she underwent tracheostomy on HD20. Unfortunately, she also developed acute renal failure requiring continuous renal replacement therapy. Despite these medical barriers, she started mobilizing with physical and occupational therapy, to address her fatigue and significant lack of endurance. She required maximal assistance for all bed transfers and for dressing. She was also evaluated by speech and language pathology owing to moderate oropharyngeal dysphagia on HD24 while still critically ill and fully dependent. Before hospitalization, she was fully independent and did not require the use of any assistive device. After 36 days of being intubated, she was successfully extubated to 2 liters nasal canula and eventually transferred to the floor on HD36. Her renal recovery lagged her respiratory improvement, limiting therapies due to hypertension, headaches,

and hemodialysis scheduling conflicts. Initial therapy on the floor was limited by fatigue and deconditioning.

On HD38, her activity tolerance improved such that she was admitted to inpatient rehabilitation for a clinical diagnosis of critical illness polyneuropathy/myopathy with an oxygen requirement ranging from room air to 2 liters nasal canula. On admission, her examination revealed 4–/5 strength on bilateral hip flexors, and significant proximal weakness demonstrating 2+ /5 gluteus maximus strength and 3/5 gluteus medius strength. She also had 4/5 strength on bilateral elbow flexion and extension. She underwent initial evaluations with speech and language pathology, physical therapy, and occupational therapy using the Quality Indicator for inpatient rehabilitation facilities. The Quality Indicator describes functional outcomes on a scale from 1 to 6, with a score of 1 representing complete dependence and a score of 6 demonstrating complete independence, which can be achieved with or without an assistive device. The patient's functional deficits on admission are as documented in Table 1. Her rehabilitation course was unique in its complexity of care needs requiring a dedicated multidisciplinary team. First, she required a modified therapy schedule to accommodate her decreased endurance and activity tolerance at the beginning of her stay and her need for at least thrice weekly dialysis. Her comorbid depression and anxiety presented additional difficulty, especially as related to “air hunger,” which she had experienced before lung transplantation. Ultimately, both were improved by titrating her home sertraline dose of 100 to 150 mg daily and maintaining psychotherapy.

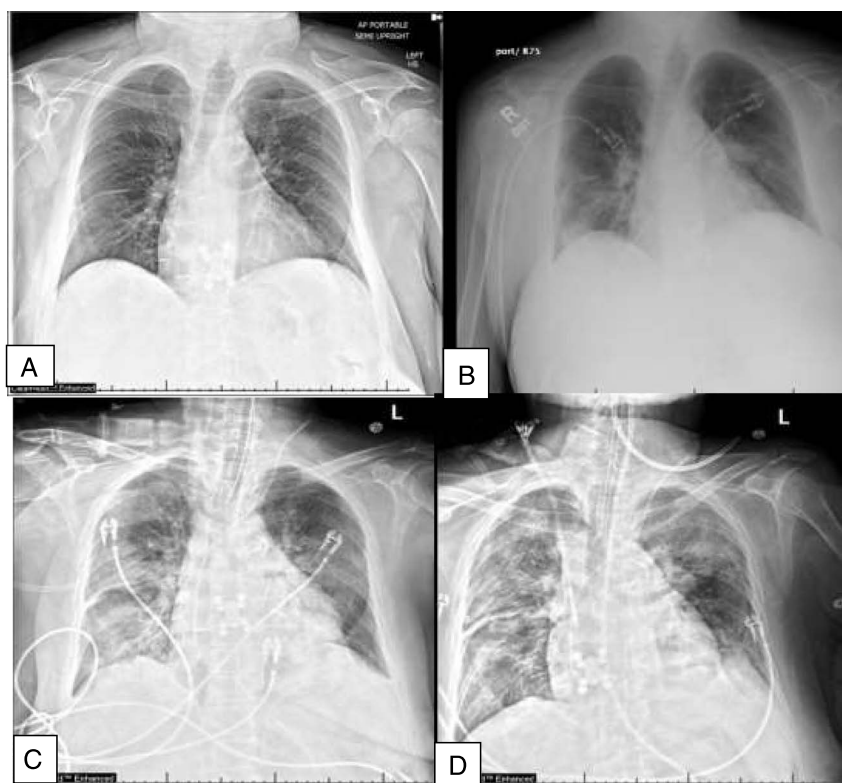


FIGURE 1. Radiographic imaging at various time points throughout hospitalization. (A) Findings 5 days before readmission, with findings indicating no cardiopulmonary processes. (B) Chest x-ray on hospital day 0, with worsening multifocal opacities greatest in the right lower lobe. (C) Imaging on day 5, which shows worsening opacities with concern for underlying infection and edema. (D) Imaging on day 13, which is consistent with worsening bilateral airspace opacities raising concern for acute respiratory distress syndrome.

TABLE 1. Admission and discharge functional measures

	Admission	Discharge
Self-care		
Eating	5	6
Oral hygiene	4	6
Bathing	4	6
Dressing—upper	5	6
Dressing—lower	4	6
Speech		
Expression of speech	3	4
Understanding	4	4
Transfers		
Sit to lying	4	6
Lying to sitting on edge of bed	4	6
Sit to stand	4	6
Bed, chair, wheelchair transfers	4	6
Toilet	4	6
Locomotion		
Walk (10 ft)	4	6 ^a
Walk (50 ft with two turns)	4	6 ^a
Walk (150 ft)	NA	6 ^a
Walk (10 ft uneven surface)	4	6 ^a
Stairs (4 steps)	4	6
Stairs (12 steps)	NA	4

^aUse of assistive device.

With regard to work with therapy, she was evaluated by speech and language pathology due to pharyngeal dysphagia, characterized by delayed swallowing initiation, which increased the risk of aspiration. Furthermore, the patient demonstrated mild cognitive communication deficits with executive function, higher-level attention skills, and delayed recall, all identified as possible barriers to learning new tasks and carryover between therapy sessions. Fortunately, these were compensated with the use of educational per oral trials and the use of cognitive aides such as medication lists and a logbook. She quickly improved with self-care tasks after working with occupational therapy. Physical therapy was impacted by bouts of dyspnea and hypoxia that occurred with moderate activity. This, atop her premorbid anxiety related to “air hunger,” existent since before lung transplantation, proved a difficult barrier to surmount. She ultimately progressed to ambulating over 1000 ft with a front wheel walker but still had difficulty with stairs because of lack of strength and endurance. Education on heart rate and oxygen saturation related to activity and energy conservation were paramount during therapy. During her 10-day rehabilitation stay, the patient progressed from needing moderate assistance with all activities of daily living and ambulation to being independent (see Table 1). Multidisciplinary planning allowed successful sooner-than-expected discharge with intermittent supervision from her family to her son’s home, where the stairs had fewer steps as compared with her own home (5 vs 12). Although she would still be required to navigate stairs with five steps upon entering the house, she had assistance at most times of the day because of her son’s and her daughter-in-law’s schedules. Timely and effective communication among physical medicine and rehabilitation, nephrology, psychology, and the lung transplant team promoted a

successful transition with assured close follow-up. Had she not had the option of returning home with her son, she may have had a more prolonged rehabilitation course or not have been able to discharge directly home. Two weeks after discharge from inpatient rehabilitation, she reports that she is doing well at home and continues to work with physical therapy, occupational therapy, and speech and language pathology on an outpatient basis.

DISCUSSION

This case describes a patient with a history of double lung transplant who underwent acute hospitalization and rehabilitation for severe COVID-19 pneumonia and acute respiratory distress syndrome, with a course complicated by acute renal failure without meaningful recovery requiring ongoing hemodialysis, as well as severe anxiety and depression. Although a diagnosis of critical illness myopathy cannot be confirmed without electromyographic studies, the patient’s clinical picture was consistent with critical illness myopathy given that she had a prolonged hospitalization in the ICU, flaccid and symmetric proximal muscle weakness, and normal sensation. Furthermore, she received steroids, which has been cited as a possible contributing factor to critical illness myopathy in the ICU.⁹ She did not undergo electromyographic testing to confirm the diagnosis while being an inpatient given that testing would not have changed her treatment course. This patient underwent a prolonged acute care time course with 38 days in the ICU. During this time, she underwent early mobilization by the acute care therapy team, which has been shown to improve overall hospitalization time, including time in acute rehabilitation.¹⁰ Remarkably, despite her prolonged critical illness, she progressed quicker than expected through her rehabilitation phase of hospitalization, which likely is unique to COVID patients.

After a 10-day course in the acute inpatient rehabilitation unit, the patient regained much of her independence and was able to return home with intermittent in-home supervision. Although there are documented cases of rehabilitation after COVID-19 hospitalization, none have described this in patients with a history of lung transplant and renal disease as in this unique case. Specifically, this patient’s coexisting renal disease and history of lung transplant required careful coordination of care between a variety of disciplines. She was seen daily by the lung transplant team who monitored her immunosuppressive medications in the setting of acute infection and received dialysis three times per week under the care of the renal team. As a result, she was placed on a modified therapy schedule that allowed her to receive at her allotted 3 hrs of therapy per day to be averaged over 7-day period rather than allocated strictly daily. Flexibility of her therapy and nursing team was key to accommodate this.

Select cases have documented the success of rehabilitation after COVID-19-related hospitalization, including a case of a 65-yr-old man who was supported with mechanical ventilation. This patient’s rehabilitation began in the ICU while intubated, with passive range of motion and eventually standing exercises once extubated. He continued to work on balance and endurance until he was discharged home. Similar to the patient in this case, this study demonstrated that early mobilization in

the ICU and subsequent inpatient rehabilitation were successful in optimizing function.¹¹ Similar to the female patient in this case, early mobilization in the ICU by the acute care therapy team led to an overall decreased hospitalization time, including time in acute rehabilitation, further demonstrating the importance of rehabilitation early in the recovery process.

A case series documented four patients with previous lung transplants who acquired severe disease from COVID-19.¹² Although the course of these patients was described, no information regarding rehabilitation to address functional deficits or recovery was provided.

An important distinction when comparing the above cases with the patient in this case is that whereas other cases in the rehabilitation literature have documented success after COVID-19 infection, none to the authors' knowledge have done so in the lung transplant community. Likewise, although COVID-19 infection has been documented in the lung transplant community, none have documented the rehabilitation course of these individuals. Because of the limited numbers of studies, this information may prove valuable in future considerations for candidates of inpatient rehabilitation. Particularly, the quicker-than-expected timeline of improvement even for such a complicated patient can help when counseling future inpatient candidates on the duration of admission and expectations especially as it relates to activity tolerance and endurance despite likely ongoing oxygen requirement. Past research has documented recovery time among deconditioned patients in the acute rehabilitation setting.¹³ When compared with the patient in this case, these patients were typically 10 yrs older and spent an average of two more days in acute rehabilitation. In addition, it is very helpful for the rehabilitation team to understand this shorter time

course as it means that more early focus must be placed on coordinating posthospitalization care.

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