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Benefits of Acute Rehabilitation in COVID Recovered Patients and Changes in the Current Treatment Guidelines Related to COVID-19

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ABSTRACT

Objective: Over the past year, clinical focus worldwide has centered on the treatment and prevention of COVID-19. The prevalence of this disease continues unabated; consequently, COVID-19 treatment modalities continue to improve. As a result, there are now more survivors of COVID-19. The expansion of this COVID-19 survivor demographic necessitates attention, specifically regarding patient rehabilitation. The benefits that rehabilitation offers to COVID-19 survivors must be examined, especially as this disease has begun to affect individuals with complex comorbidities.

Design: Observational Prospective Study that followed 60 patients from admission into the Acute Medical Rehabilitation Hospital from the beginning of the pandemic up until March 2021. Data collected were analyzed to determine the benefit of acute rehabilitation in COVID-19 recovered patients in addition to the changes of the current treatment related to COVID-19.

Results: Overall, acute rehabilitation significantly improved patients' Self-Care and Mobility Section GG (GG) outcomes in their overall functional assessment. The average increase in GG overall was 29.45. Patients that only required 10 days or fewer of rehabilitation had an average GG increase of 34.1. Those that required 11-20 days of rehabilitation had an increase in GG of 26.5.

Conclusions: Acute rehabilitation plays a primarily positive role in the outcome of patients with COVID-19. This increase in the GG scores can be attributed to the different therapies provided during their acute inpatient rehabilitation.

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What is Known?

COVID-19 patients, like many other patients, admitted into an acute medical rehabilitation hospital, require a multidisciplinary approach in regaining their functional status. Studies have been published regarding the symptoms experienced by COVID-19 patients, factors that influence the functional outcome in rehabilitation patients with neurological and orthopedic conditions, and different surveillance protocols in COVID-19 patients.

What is New?

This study showed that the lingering symptoms and complications impact rehabilitation when it comes to the long-term clinical impacts of COVID-19 patients. Additionally, patients receive varying levels of treatments before their admission, and thus the rehabilitation must be customized appropriately.

Introduction

COVID-19 was identified at the end of 2019 as a cluster of pneumonia cases in Wuhan, China. To date, there have been more than 33,000,000 cases diagnosed in the United States and more than 597,000 deaths due to COVID-19. Although the majority of patients have mild symptoms or are asymptomatic, there are some that experience severe illness and require hospitalization. It is in these patients that we see the severe sequelae, including acute respiratory distress syndrome (ARDS), coagulopathies including pulmonary embolism (PE) and disseminated intravascular coagulation (DIC), secondary infections such as bacterial cases of pneumonia, myocardial injuries, sepsis, acute kidney injury, multi-organ failure, and secondary hemophagocytic lymphohistiocytosis. Moreover, there has been an increase in the number of patients presenting with post-viral syndrome, leading to a significant impairment in otherwise young and healthy individuals [1]. As such, there is an increased need for post-acute rehabilitation for all these patients. Much of the current literature data concentrates on the pathophysiology, treatment, prognosis, and complications of COVID-19. However, there has been very little published on the importance and benefits of rehabilitation in these patients, especially as this disease has begun to affect individuals with complex comorbidities. We propose that there are benefits to patients receiving rehabilitation as part of their recovery from

COVID-19. We will note the benefits in terms of an overall GG score from admission to discharge.

Methods

This prospective observational study analyzed the data from 60 patients admitted into the Acute Medical Rehabilitation Hospital from the beginning of the pandemic in March 2020 up until March 2021. Written informed consent was obtained from all the participants. The data was collected from admission until discharge and verified by all care team members. Some of the data collected included the following: admission date, length of stay, ability to tolerate treatment/therapy and at which day, presenting symptoms, treatment needed, limitations, complications, GG score at admission, and GG score at discharge.

Of the 60 patients, there were 33 males and 27 females, and all were greater than 60 years of age. In addition to suffering from COVID-19 pneumonia, many of the patients had one or more risk factors, including but not limited to HTN, CKD, diabetes, and chronic lung disease. Inclusion criteria included a recent infection with COVID-19 in addition to no longer having an active infection. Exclusion criteria in this study included an active COVID-19 infection or never having been infected with COVID-19. Bias was eliminated by including all the patients who had a recent infection with COVID-19 in addition to no longer having an active infection in the time between March 2020 and March 2021. Prior to the COVID-19 infection and rehabilitation, all the patients were fully independent individuals. All the patients in the acute medical rehabilitation hospital received the standard of care.

The self-care and mobility section GG was used to help determine the level of disability and indicates the amount of assistance the patient requires to perform activities of daily living (ADLs). The self-care CARE items and the mobility CARE items have been implemented across all post-acute care (PAC) facilities by Medicare. The GG scoring system contains 25 items, 8 of which are self-care CARE items and 15 mobility CARE items. Self-care Care items are as follows: eating, oral hygiene, toilet hygiene, washing upper body, shower/bathe self, upper body dressing, lower body dressing, and putting on or taking off footwear. Mobility CARE items are as follows: the ability to roll left and right, sit to lying, lying to sitting on the side of the bed, sit to stand, chair/bed-to-chair transfer, toilet transfer, car transfer, walk 10 feet, walk 50 feet with two turns, walk 150 feet, walking 10 feet on uneven surfaces, 1 step or curb, four steps, 12 steps, and picking up an object. Each of these tasks is rated on a 1-point scale and ranges from complete dependence (1), substantial/maximal assistance (2), partial/moderate assistance (3), supervision or touching assistance (4), set up or cleanup assistance (5), complete independence (6).

The GG scoring system was chosen because it is standardized across the United States in all aspects of rehabilitation. All patients received individualized therapies customized to their current medical needs and any limitations based on their GG. All patients admitted from March 2020 until March 2021 received care from the same care team members throughout their stay.

This study's objective was to determine the benefit of acute rehabilitation in COVID-19 recovered patients in addition to the changes in the current treatment related to COVID-19. After all the data was gathered, GG differences from admission and discharge were calculated, and it was determined that acute rehabilitation did, in fact, prove beneficial. The average increase in GG score was 29.45, and there were zero declines in GG scores in any of the patients. There were two outliers in the GG scores increase; the first was 1, and the second was 74.

Results

1,148 patients were evaluated as potential participants throughout the year, but only 60 of the patients were confirmed eligible and included in the study. All the patients included participated in their individualized capacity. Many factors contributed to each individual's treatment plan, and these included presenting symptoms, limitations present, and complications. Out of the 60 patients, 31 (55%) were male, and 27 (45%) were female. Table 1 has the top presenting symptoms, limitations, and complications present among all the patients. It is important to note that many patients had multiple presenting symptoms, limitations, and complications that had to be considered when providing them a therapy.

Table 1: Data are n (%). Top presenting symptoms, limitations, and complications encountered in the 60 patients from admission and throughout their stay at the Acute Medical Rehabilitation Hospital

Presenting symptoms	n (%)	Limitations	n (%)	Complications	n (%)
SOB	43 (72%)	Fatigue	50 (83%)	Pneumonia	24 (40%)
Fatigue	29 (48%)	Weakness	29 (48%)	SOB	19 (32%)
Weakness	15 (25%)	SOB with activity	24 (40%)	AKI on CKD	14 (23%)
Fever	14 (23%)	Endurance	7 (12%)	Fatigue	8 (13%)
Cough	13 (22%)	Balance deficits	4 (7%)	Weakness	7 (12%)
Lack of smell/taste	8 (13%)	Pain	4 (7%)	CVA	6 (10%)
Altered mental status	7 (12%)	Anxiety/depression	4 (7%)	Intubation	6 (10%)
Hypoxia	5 (8%)	Tremor	2 (3%)	Hypertension	5 (8%)
Confusion	4 (7%)	Limited ambulation	2 (3%)	Altered mental status	5 (8%)
Myalgia	3 (5%)	Orthostatic Hypertension	2 (3%)	UTI	5 (8%)
Hypotension	3 (5%)	Altered mental status	2 (3%)	Hypoxic encephalopathy	5 (8%)w

Since the beginning of the COVID-19 pandemic, data from 60 patients had been collected and analyzed to determine the benefit of rehabilitation. The top five presenting symptoms among all 60 patients were shortness of breath (SOB) (72%), fatigue (36%), weakness (25%), fever (23%), and cough (22%). The top four limitations noted were fatigue (83%), weakness (48%), SOB with activity (40%), and endurance (12%). The top five complications present were pneumonia (PNA) (40%), SOB (32%), acute kidney injury (AKI) on chronic kidney disease (CKD) (23%), fatigue (13%), and cerebrovascular attack (10%). Of the patients observed

in this study, 50 received some type of additional treatment, and ten did not require any additional treatment besides rehabilitation. The following five were the most common additional treatments: antibiotics (68%), supplemental oxygen (44%), steroids (38%), antivirals (22%), and disease-modifying antirheumatic drugs (DMARDs) (14%).

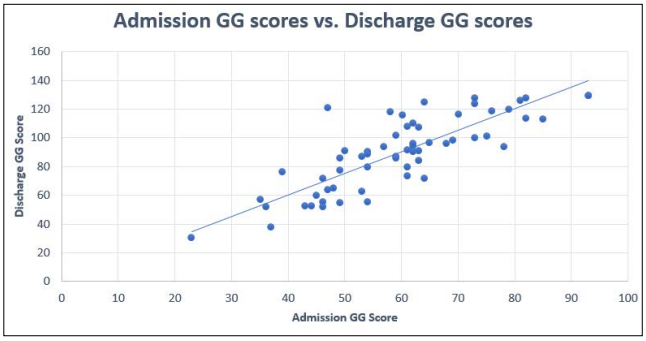
The overall average increase in GG score for the entire data of 60 patients was 29.45 with a standard deviation (SD):16.11, a sum (Σx):1767, variance, (s^2): 259.47, and confidence interval (CI) of 95%: 29.45 ± 4.076. It was then determined that patients that needed ≤ 10 days in the acute rehabilitation had an average GG score increase of 34.2 with a SD:10.6, Σx:923, s^2: 105.23, and CI of 95%: 34.1852 ± 3.869. Patients required anywhere from 11-20 days of rehabilitation had an average GG score increase of 26.5 with standard deviation: 18.48, Σx:874, s2: 341.57, and a 95% confidence interval: 26.4848 ± 6.306, as seen in Table 2.

Additionally, when comparing the data from patients whose GG score was ≤ 60 to those with a GG score ≥61 at the time of admission revealed about a 10-point difference in the average GG score increase. If the initial GG score was ≤ 60, the average increase was 25.5 with a SD: 17.31, Σx:765, s^2: 299.64, and CI of 95%: 25.5 ± 6.194. These patients averaged 13.83 days in rehabilitation. If the initial GG score was ≥ 61, the average increase was 34.4 with a SD: 12.69, Σx:1032, s^2: 161.01, and CI of 95%: 34.4 ± 4.541. These patients averaged 9.77 days in rehabilitation, as seen in Table 2.

Table 2: This table shows the comparison in patients that required 10 or fewer days of rehabilitation compared to those that required anywhere between 11-20 days. Patients that required ≤ 10 days of rehabilitation had an average GG score increase of 34.2, while those requiring 11-20 days had an average GG score increase of 26.5. Additionally, it also compares the patients in regard to their admission GG scores; the first group had an admission score ≤ 60 and the second ≥ 61; the average GG score increase was 25.5 and 34.4 respectively. The standard deviation, count, sum, variance, confidence interval (95%), and p-value were calculated for each set

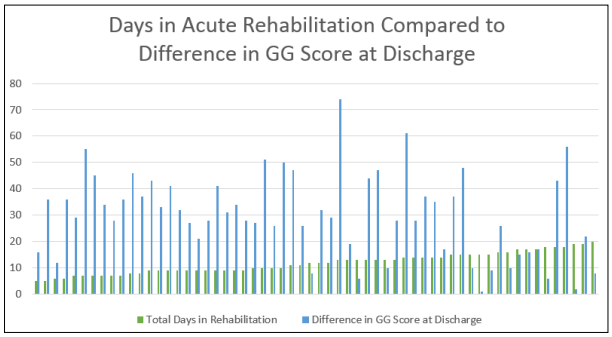
	GG score difference	Standard Deviation, (SD)	Count, (N)	Sum, (Σx)	Variance, (s^2)	Confidence Interval, (CI) 95%	P-value	Average Length of Stay
≤10 days in rehabilitation	34.2	10.26	27	923	105.23	34.1852 ± 3.869	4.50468E-6	--
11-20 days in rehabilitation	26.5	26.5	33	874	341.57	26.4848 ± 6.306	2.08975E-7	--
Admission GG Score ≤ 60	25.5	17.31	30	765	299.64	25.5 ± 6.194	7.2476E-6	13.83
Admission GG Score ≤61	34.4	12.69	30	1032	161.01	34.4 ± 4.541	3.7542E-5	9.77
The overall difference in GG scores	29.5	16.11	60	1767	259.47	29.45 ± 4.076	1.7200E-15	12

Patient's admission GG score was compared to their discharge GG score, and it was determined that there was a strong positive linear relationship between admission GG score and discharge GG scores, as seen in Graph 1. The Pearson Correlation Coefficient (r = 0.82), the T-statistic was 10.79, and the p-value was 1.72E-15. Those patients with higher functional measures at admission were more likely to have higher functional outcomes at discharge.



Graph 1: Admission GG score vs. Discharge GG scores: This graph compares the patient's admission GG score to their discharge GG scores. It was determined that the Pearson correlation coefficient was 0.81699089, the T-statistic was 10.7899, and the p-value was 1.7200E-15. According to the data, there was a strong positive correlation, in addition to a highly statistically significant p-value.

The average increase in GG score within this sample demonstrates that COVID-19 recovered patients benefit from rehabilitation. Overall, patients who needed ≤ 10 days in the acute rehabilitation had an average GG score increase of 34.2; patients that required 11-20 days of rehabilitation had an average GG score increase of 26.5. Graph 2 depicts the increasing number of rehabilitation days compared to the difference in GG score at discharge. The majority of the patients that required ≤ 10 days of rehabilitation, as seen on the graph, had overall better outcomes concerning their GG scores. Patients receiving a transdisciplinary approach with internists, physiatrists, physical therapy, occupational therapy, and speech therapists have an overall increase in their GG score and, resulting, a better quality of life.



Graph 2: Days in Acute Rehabilitation Compared to Difference in GG Score at Discharge: This graph depicts the difference of admission GG score and discharge GG score (blue) in increasing order from the number of days (green) that the patient was in the acute medical rehabilitation hospital. For those patients that required 10 or fewer days (27 patients), there was an average GG score increase of 34.2. For those that required anywhere from 11-20 days (33 patients), the average GG score increase was 26.5.

Discussion

Severe acute respiratory syndrome coronavirus-2 (SARS-CoV-2) was first reported in Wuhan, China, in December 2019. Since the virus's identification, more than 173 million cases of COVID-19 have been confirmed worldwide, along with 3.7 million deaths [2]. In the early stages of the COVID-19 outbreak, the data from Wuhan province suggested that, of the patients hospitalized with COVID-19, 8% had bacterial/fungal co-infecting. The World Health Organization (WHO) initially recommended not prescribing antimicrobials for COVID-19 patients who had a low suspicion for bacterial infection.

Robust test results from treatment studies conducted in the early stages of the pandemic were made available after a period of several months into the pandemic. Until that time, non-evidence-based strategies were implemented to treat the ever-increasing cases of COVID-19 until trials could be completed and data became available for efficacious treatment. Supportive care was administered to patients in the form of supplemental oxygen support and mechanical ventilation when required. However, despite the increased need for post-acute rehabilitation in COVID-19, few papers provide evidence for its benefits.

A recent publication by Olezene et al. discusses the functional outcomes of patients in inpatient rehabilitation following COVID-19 infection. The retrospective study concluded that patients who received rehabilitation had significantly improved from admission to discharge. Following the admission and discharge GG scores in our patients, we also concluded that the multidisciplinary approach in the acute medical rehabilitation hospital was beneficial. All the patients admitted had an overall improvement in their functional status at discharge. The majority of the patients were discharged home, and a limited few were discharged home with home care services. It is important to note that none of the patients were discharged to a skilled nursing facility.

Numerous treatment protocols were postulated and studied to treat COVID-19. While some of these treatments, such as hydroxychloroquine and azithromycin, were not found to be of value, other treatment strategies proved efficacious in treating COVID-19 [3]. results from the RECOVERY trial indicated that Dexamethasone lowered mortality in COVID-19 patients receiving mechanical ventilation or oxygen [4]. Strategies such as self proning, high flow nasal cannulas, and delay of invasive mechanical ventilation were also recommended in treating more severe COVID-19 cases. All these protocols were established and modified into individualized patient rehabilitation throughout their stay.

Presently, we understand that risk factors for the disease included: diabetes, hypertension (HTN), cardiac disease, chronic lung disease, cerebrovascular disease, chronic kidney disease (CKD), immunosuppression, cancer, and being in the age bracket 60 years or older. As seen in this study, all of the patients were 60 years of age and older and had one or more risk factors, including but not limited to HTN, CKD, diabetes, and chronic lung disease.

Current WHO guidelines outline selective and highly monitored use of high-flow nasal oxygen in cases of SARS-CoV-2 patients experiencing hypoxemic respiratory failure [5]. Now, studies relating to the treatment of COVID-19 are investigating the impact of IL-6 inhibition using Tocilizumab. Several mRNA vaccines have become available for SARS-CoV-2, but there is still no universal treatment for patients who have contracted the virus. Current WHO recommendations include conservative fluid management in non-septic patients with COVID-19 and immediate use of empiric antimicrobials in COVID-19 patients diagnosed with sepsis. Masking and social distancing measures are also recommended in the prevention of COVID-19 transmission.

As the understanding of COVID-19 disease progression, comorbidities, transmission has grown (and testing protocols), hospitalizations and intensive care unit (ICU) admissions within the US have fallen from peak pandemic numbers. Strategies relating to treatment timings, monitoring, and prevention protocol have helped lower the number of hospitalization/mortalities resulting from COVID-19. From March 2020 to March 2021, the evaluation of patients and the treatment protocols in acute medical rehabilitation have changed. In addition to the regular rehabilitation protocols, pulmonary rehabilitation was introduced. Closer monitoring of each individual's pulse oximetry, heart rate, blood pressure, electrolytes, lab work, especially in those patients that required hemodialysis, was noted. Tan et al. note that there's an elevated incidence likelihood of post-ICU morbidity, in addition to challenges in the ability to rehabilitate these patients effectively. Therefore, early attention regarding rehabilitation will maximize the patients' overall outcomes [6]. It's important to comment that all of the patients in this study were stable for discharge without active COVID-19 infection from the medical floor before admission at the acute medical rehabilitation hospital.

COVID-19 survivors, especially those with prolonged stays in ICU, tend to have significant functional deficits. The WHO surveyed and found that 63% of countries stated that rehabilitation services were disrupted with the start of the COVID pandemic. Ideally, early rehabilitation in acute hospitals plays an essential role in the prevention of complications. A transdisciplinary approach in which the rehabilitation team and medical team work closely together is essential for critically ill patients. It is crucial to get a defined rehabilitation strategy that builds on a patient's current level of function, the level prior to the illness, and discharge. Nearly 10% of patients that have been hospitalized for COVID-19 will be transferred to an inpatient rehabilitation facility (IRF), while 5% will likely be transferred to a skilled nursing facility (SNF) [7].

IRFs play a significant role in reducing debility through intervention. Smith et al. state that rehabilitation must be distributed strategically in field hospitals so that clinically stable patients who have some type of barrier preventing them from returning home can attain their rehabilitation goals. If it is determined that patients require more rehabilitation, it is then they can be transferred to an IRF such as a Post-Acute Rehabilitation Hospital [8]. Before COVID-19, the transition from an acute care hospital to an IRF was cumbersome and labor-intensive. Ideally, all the practitioners from the varied specialties had to be in agreement with the recommendation to an IRF. Since COVID-19, IRFs have developed new patient screenings for COVID-19 patients different from the traditional rehabilitation patient screenings [9].

Rehabilitation plays a key role when it comes to the long-term clinical impacts of COVID-19 patients. The lingering symptoms of post-acute COVID, fatigue being one of the biggest struggles in this setting, impact rehabilitation. In post-acute rehabilitation, a combination of physiatrists, internists, PT, OT, ST, and respiratory therapists all work together to improve the quality of life. With rehabilitation, patients can return to their homes, communities, work, and regular activities [10]. According to a study by Sheehy titled "Considerations for Post-acute Rehabilitation for survivors of COVID-19" in 2020, progressive treatment plans that focused on function, disability, and return to the prior level of function will help increase overall function and maximize their potential

in recovery. Similar interventions and protocols were observed with COVID-19 patients during this study [11].

The Yale New Haven Health System has outlined a specific approach to caring for patients with COVID-19. There are three primary goals in their multidisciplinary model. The first goal is to provide a comprehensive evaluation of post-COVID-19 complications. The second is to characterize and mitigate pulmonary sequelae of COVID-19. And finally, to address any persistent symptoms experienced by the post-COVID-19 survivors [12]. In the initial assessment, the physician in a rehabilitation hospital, PT, and OT does an initial evaluation to know any subjective symptoms, a neurological screening, mental health screening, pulmonary function test (PFT), and six-minute walking test. In subsequent care of their model, continued PT/OT and any pulmonary rehabilitation is necessary into physician consultation, PFT, and any additional diagnostics involving the heart, lungs, and brain [13]. In addition to physicians, PTs, OTs, and STs, respiratory therapists played a large role in assessing, treating, and monitoring all patients.

Limitations

This study is a prospective observational study, and the lack of a comparison group has its limitations. The 60 patients in this study entered acute rehabilitation from various acute care hospitals around the state. Each of these patients had varying levels of treatments prior to their admission, depending on the hospitals' protocols at the time. In addition, at the beginning of the COVID-19 pandemic, there was a lack of understanding, and as time continued, the standardized treatments and protocols changed. The severity of patient's symptoms at the beginning of the pandemic was also greater than those that developed COVID-19 more recently. This could be attributed to the lack of starting patients with PT and OT early in the acute setting.

Starting in March 2020, patients were being admitted to the hospital with significant impairments in overall function such as impaired range of motion (ROM), bilateral upper extremities (UE), poor activity tolerance, impaired mobility, "COVID toes" impacting their ability to stand/ambulate, fatigue, and shortness of breath with activity. Patients also presented with severe medical complications such as cerebral vascular accident (CVA), pulmonary embolism (PE), or organ failure requiring dialysis. Patients were frequently positioned prone for extended periods of time, which led to impaired ROM bilateral UE impacting overall function with eating, dressing, and transfers. Patients utilized the Bionic Arm Robot for increased ROM, strengthening, and motor control needed for increased independence with activities of daily living (ADLs).

Some significant barriers noted in COVID-19 patients included complex premorbid conditions (such as diabetes, hypertension, cardiovascular conditions), poor family/social support, pain, depression, motivation, poor insight into deficits/cognitive impairments, and isolation. Interventions to overcome these barriers included distributed practice, a bodyweight system for locomotion training, a bionic arm robot, postural exercises, and breathing/singing exercises. Family support/involvement was crucial for overall recovery and improvement in these patients' quality of life. The majority of patients were able to increase overall function and discharge home with continued care in an outpatient OT/PT clinic or home health services.

Conclusions

It is clear that there are significant benefits of acute rehabilitation in patients that have suffered major debilitation secondary to COVID-19 infections. It is important to start PT and OT early in the course of their illness so that they can remain with as much function as possible that they may return to back to their homes, communities, work, and regular day-to-day activities. By starting therapeutic interventions early, patients would like to have a greater GG score and, thus, more likely to have a more significant outcome, as seen in the data with the patients that had higher admission GG scores. Where COVID-19 was originally too novel and low in incidence to report rehabilitation suggestions, its wide prevalence in the current global population necessitates a re-examination of rehabilitation practices to understand the COVID-specific changes that need to be made to the treatment protocol.

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