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BRIEF REPORT

Post–Intensive Care Syndrome Among Survivors in a Safety Net Hospital in South Bronx: A Comparison of Patients With and Without Coronavirus Disease 2019

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Comparison of post–intensive care syndrome between critically ill survivors with or without coronavirus disease 2019 (CovP and CovN, respectively) showed that fewer CovP were able to return to work full time at >1 year and none at <1 year after discharge and that the majority of CovP survivors were able to work part time during both evaluation periods compared to CovN.

Keywords. COVID-19; post–intensive care syndrome; sepsis.

Advances in the management of sepsis have led to a substantial population of survivors. Prognosis of these survivors following discharge varies, with half of the patients recovering, a third dying within the first year, and one-sixth remaining with severe persisting impairments [1]. These patients with post–intensive care syndrome (PICS) have a higher incidence of new cognitive and functional impairments and mental health issues, including anxiety, depression, and posttraumatic stress disorder (PTSD), along with a higher risk of rehospitalization within 90 days [1]. More than 1200 patients with coronavirus disease 2019 (COVID-19) infection were hospitalized in our New York City public hospital in the Bronx between 1 March and 1 May 2020, with 23% of patients being critically ill and managed in conventional intensive care units (ICUs) or Flex ICUs due to severe sepsis or acute respiratory distress syndrome. The majority of these patients received mechanical ventilation. It has been described among different cohorts from New York City that the fatality rate in patients with COVID-19 and mechanical ventilation during the early surge of the pandemic was as high as 80%; our hospital did not differ from this rate [2]. The survivors of COVID-19 infection are likely to suffer long-lasting morbidity, which may be comparable to other non–COVID-19–related sepsis survivors. Data on the long-term impact of COVID-19 infection are evolving as the pandemic is now transitioning to the endemic state.

Our prospective study aims to compare PICS between survivors of mechanically ventilated COVID-19 infection and similar non–COVID-19–related sepsis survivors.

METHODS

This is a single center study including all mechanically ventilated adult patients with and without COVID-19 infection who were discharged alive from January to September 2020. Following institutional review board approval, a validated survey to assess functional limitations, new medical conditions, mental health status, quality of life, and rehospitalizations was administered via telephone to consenting patients after discharge. The validated survey included the Patient Health Questionnaire 9 (PHQ-9), General Anxiety Disorder 7 (GAD-7), PTSD score, and Karnofsky Performance Status scale as well as other questions that focused on describing functional ability, change in consistency of diet, rehospitalization, worsening of comorbidities, new-onset cardiovascular problems, ability to return to work (part time and full time), and new need of assistance for activities of daily living (ADLs) or instrumental activities of daily living (IADLs). The study population was divided for analysis into <1 year postdischarge and >1 year postdischarge. For analysis, patients reporting a Karnofsky score of <70 were considered unable to carry out normal activities without signs and symptoms of disease and requiring a varying amount of assistance with inability to do active work. Descriptive statistics including χ^2 test for categorical variables and *t* test for continuous variables were used, and multiple logistic regression was performed to determine odds ratio (OR).

RESULTS

Three hundred nine mechanically ventilated patients were discharged alive in the study period (132 with COVID-19 infection [CovP] and 177 without COVID-19 infection [CovN]). Nineteen (11%) patients in the CovN cohort and 9 patients (7%) in the CovP cohort died within 1 year of discharge.

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With a 46% response rate, our study cohort included 70 patients in the CovN group and 52 patients in the CovP group.

Table 1 describes the baseline characteristics of patients interviewed <1 year from discharge (15 CovP and 43 CovN). The CovP cohort had higher rate of obesity and median Charlson Comorbidity Index compared to CovN. Patients who were CovP had new functional decline (OR, 2.5; $P = .13$), required help with ADLs/IADLs (OR, 3.12; $P = .06$), and had an increased likelihood for Karnofsky score <70 (OR, 3.1; $P = .06$) (Table 2). They also had a higher incidence of new cognitive impairment, speech difficulty, and a decrease in executive function compared to CovN. A decreased risk of rehospitalizations (OR, 0.12; $P = .025$) and aspiration pneumonia (OR, 0.37; $P = .35$) was seen in the CovP compared to CovN patients. The CovP cohort had less depression (OR, 0.79; $P = .05$), less anxiety (OR, 0.70; $P = .05$), and higher PTSD (OR, 6.46; $P = .09$) compared to CovN. None of the CovP patients were able to return to work full time at <1 year, with majority able to return part time/per diem. Thirty-seven percent of CovN patients were unable to return to work ($P < .001$).

Thirty-seven CovP and 27 CovN patients were contacted after 1 year of discharge (Table 1). Both the CovP and CovN patients in this group were comparable except for increased length of mechanical ventilation and stay in the CovP subgroup. CovP patients had reduced likelihood of functional decline (OR, 0.68; $P = .37$), Karnofsky score <70 (OR, 0.58; $P = .32$), and assistance with ADLs/IADLs (OR, 0.78; $P = .65$) compared to CovN. New cognitive improvement (OR, 1.16; $P = .8$) and new speech difficulty (OR, 1.11; $P = .87$) remained higher in CovP after 1 year. CovP patients had reduced likelihood for rehospitalizations (OR, 0.68; $P = .54$), aspiration pneumonia (OR, 0.457; $P = .4$), and worsening comorbidities (OR, 0.35; $P = .05$) compared to CovN (Table 2). None of the participants in either subcohort had new-onset depression or anxiety, whereas PTSD was lower in the CovP subgroup (OR, 0.25; $P = .05$) at >1 year. Only 11% of CovP patients were able to return to work full time after 1 year in comparison with 33% of CovN, and 35% of CovP patients were unable to return to work at all ($P = .003$).

Using return to work full time as reference, multiple logistic regression analysis demonstrated COVID-19 infection as an

Table 1. Baseline Characteristics of Coronavirus Disease 2019 (COVID-19)–Positive and COVID-19–Negative Patients Who Survived Intensive Care Unit Stay and Were Interviewed at <1 or >1 Year

	<1 y				>1 y			
Characteristic	Overall (n = 59)	COVID-19 Positive (n = 44)	COVID-19 Negative (n = 15)	*P* Value	Overall (n = 63)	COVID-19 Positive (n = 26)	COVID-19 Negative (n = 37)	*P* Value
Time to survey, y, median (IQR)	0.75 (0.63–0.86)	0.72 (0.63–0.86)	0.80 (0.64–0.87)	.183	1.44 (1.37–1.48)	1.49 (1.21–1.60)	1.44 (1.40–1.47)	.645
Age, y, median (IQR)	57.0 (50.0–63.0)	56.5 (47.3–63.0)	57.0 (54.0–62.0)	.979	58.0 (47.0–65.0)	59.5 (50.5–68.0)	56.0 (42.5–64.0)	.222
Male sex	29 (49.2)	20 (45.5)	9 (60.0)	.330	19 (30.2)	10 (30.8)	9 (24.9)	.229
BMI, kg/m^2, median (IQR)	30.0 (25.2–36.0)	29.1 (24.3–33.8)	34.4 (29.7–48.8)	.003	31.7 (27.2–35.9)	30.2 (22.4–35.1)	32.3 (28.9–35.9)	.189
CCI score, median (IQR)	4.0 (2.0–7.0)	4.0 (1.3–7.0)	7.0 (2.0–15.0)	.073	3.0 (1.0–5.0)	3.0 (2.0–5.3)	2.0 (0.0–5.0)	.116
Hypertension	27 (45.8)	24 (54.5)	3 (20.0)	.020	43 (68.3)	17 (65.4)	26 (70.3)	.682
Diabetes mellitus	20 (33.9)	16 (36.4)	4 (26.7)	.493	31 (49.2)	12 (46.2)	19 (51.4)	.685
COPD	26 (44.1)	19 (43.2)	7 (46.7)	.814	12 (19.0)	7 (26.9)	5 (13.5)	.182
Chronic kidney disease	13 (22.0)	7 (15.9)	6 (40.0)	.052	8 (12.7)	5 (19.2)	3 (8.1)	.192
Liver disease	2 (3.4)	2 (4.5)	0 (0.0)	.401	2 (3.2)	1 (3.8)	1 (2.7)	.659
HIV	2 (3.4)	2 (4.5)	0 (0.0)	.401	3 (4.8)	2 (7.7)	1 (2.7)	.368
Seizure disorder	2 (3.4)	2 (4.5)	0 (0.0)	.401	2 (3.2)	2 (7.7)	0 (0)	.166
CHF	8 (13.6)	7 (15.9)	1 (6.7)	.367	12 (19)	10 (38.5)	2 (5.4)	.001
Prior mental illness	11 (18.6)	10 (22.7)	1 (6.7)	.168	6 (9.5)	4 (15.4)	2 (5.4)	.186
Length of stay, d, median (IQR)	15.0 (6.0–28.0)	13.0 (5.0–25.8)	15.0 (14.2–58.0)	.117	15.0 (4.0–26.0)	3.0 (2.0–8.0)	23.0 (16.0–30.8)	.001
Length of mechanical ventilation, d, median (IQR)	4.0 (3.0–9.0)	4.0 (3.0–8.0)	5.0 (3.0–14.0)	.174	9.0 (3.0–17.0)	3.0 (2.0–6.3)	14.0 (9.0–29.0)	.001
Apache score on ICU admission, median (IQR)	14.0 (10.0–21.0)	14.5 (10.5–20.8)	12.0 (3.0–24.0)	.166	12.0 (6.0–18.0)	8.0 (6.0–12.0)	15.0 (6.0–20.0)	.124

Data are presented as No. (%) unless otherwise indicated.

Abbreviations: BMI, body mass index; CCI, Charlson Comorbidity Index; CHF, congestive heart failure; COPD, chronic obstructive pulmonary disease; COVID-19, coronavirus disease 2019; HIV, human immunodeficiency virus; ICU, intensive care unit; IQR, interquartile range.

Table 2. Comparison of Outcomes Between Coronavirus Disease 2019 (COVID-19)–Positive and COVID-19–Negative Survivors of Intensive Care Unit Stay, Stratified by Time After Discharge

	<1 y				>1 y			
Outcome	COVID-19 Positive (n = 15)	COVID-19 Negative (n = 43)	OR (95% CI)	*P* Value	COVID-19 Positive (n = 37)	COVID-19 Negative (n = 27)	OR (95% CI)	*P* Value
New functional decline	9 (60)	16 (37)	2.5 (.76–8.44)	.131	22 (60)	19 (70)	.62 (.22–1.77)	.371
Karnofsky/quality of life	9 (60)	14 (33)	3.1 (.92–10.46)	.067	23 (62)	20 (74)	0.58 (.19–1.71)	.319
New cognitive deficiency	5 (33)	10 (23)	1.7 (.46–5.97)	.445	15 (41)	10 (37)	1.16 (.42–3.22)	.777
New speech difficulty	4 (27)	8 (19)	1.59 (.40–6.31)	.509	6 (16)	4 (15)	1.11 (.28–4.40)	.879
New decline in executive function	3 (20)	6 (14)	1.54 (.33–7.13)	.580	8 (22)	8 (30)	0.66 (.21–2.04)	.466
New attention deficit	3 (20)	9 (21)	0.94 (.22–4.08)	.939	5 (14)	6 (22)	0.55 (.15–2.02)	.366
Requires new help with IADLs/ADLs	9 (60)	14 (33)	3.12 (.92–10.46)	.067	13 (35)	11 (41)	0.78 (.28–2.19)	.648
Readmission	1 (7)	16 (37)	0.12 (.01–1.01)	.051	6 (16)	6 (22)	0.68 (.19–2.39)	.545
Worsening comorbidities	2 (13)	9 (21)	0.58 (.11–3.06)	.522	8 (22)	12 (44)	0.35 (.12–1.03)	.056
New cardiovascular events	3 (20)	3 (7)	3.33 (.59–18.71)	.171	5 (14)	4 (15)	0.89 (.22–3.72)	.882
New depression	0	9 (21)	0.79	.999	0	0	…	
New anxiety	1	10 (21)	0.79	.999	0	0	…	
New PTSD	2 (13)	1 (2)	6.46 (.54–77.14)	.140	3 (8)	7 (26)	0.25 (.06–1.09)	.065
New soft/liquid diet	3 (20)	3 (7)	3.33 (.59–18.71)	.171	0	2 (7)	0.93	.999
New aspiration pneumonia	1 (7)	7 (16)	0.37 (.04–3.26)	.369	2 (5)	3 (11)	0.46 (.07–2.95)	.410
Return to work	…	…		<.001	…	…	…	.003
Full time	0	15 (35)	…		4 (11)	9 (33)	…	
Part time	10 (67)	6 (14)	…		5 (14)	7 (26)	…	
Per diem	3 (20)	6 (14)	…		15 (40)	0	…	
None	2 (13)	16 (37)	…		13 (35)	11 (41)	…	

Data are presented as No. (%) unless otherwise indicated.

Abbreviations: ADLs, activities of daily living; CI, confidence interval; COVID-19, coronavirus disease 2019; IADLs, instrumental activities of daily living; OR, odds ratio; PTSD, posttraumatic stress disorder.

independent predictor factor of ability to return to work part time when adjusted to multiple confounders (Supplementary Table 1 and 2).

DISCUSSION

Our comparative study of mechanically ventilated sepsis survivors interviewed before and after 1 year of discharge demonstrated higher odds, though not statistically significant, of new functional decline, assistance with ADLs/IADLs, cognitive impairment, reduced executive function, and speech difficulty in the CovP cohort at <1 year; these impairments were not observed in the cohort interviewed after 1 year. Rehospitalizations consistently remained higher in the CovN cohort during both time periods. Remarkably, new-onset depression and anxiety were absent in both cohorts after 1 year of discharge, though CovN patients were more likely to have depression/anxiety at <1 year. However, our most remarkable observation was the significant difference between the 2 cohorts in the ability to return to work; although overall fewer CovP patients were able to return to work full time at >1 year and none at <1 year, this cohort was predominantly able to return to work part time during both evaluation periods compared to CovN. The inability to work at all was higher among CovN patients in both time periods.

Survivorship after ICU and hospital discharge is a major burden to families and healthcare due to short- and long-term physical, cognitive, and mental health impact leading to high rates health care utilization. The inability to return to work in the same capacity, along with the decline in cognition and executive function, is a risk to steady income for our minority low-income community in the South Bronx. While COVID-19 singularly impacted the return to work, the disability appears to be dynamic and unpredictable with the possibility of more people with disabilities over time as the pandemic continues. Though there is much to learn, our findings are similar to a previous Dutch study demonstrating persistent physical, mental, and cognitive impairments among patients with 1-year survival following ICU treatment for COVID-19 [2]. While the Americans with Disabilities Act requires employers to reasonably accommodate people with disabilities, an unprecedented problem like long COVID will need systemic solutions including more funding to expand Medicaid and other programs. There is also an overarching need to prepare and educate our population to the long-term impact of COVID-19 infection and acknowledge their inability to return to pre–

COVID-19 jobs/careers. Innovative rehabilitative pathways for patients discharged from the ICU will ensure early recognition of the sequelae and direct appropriate treatment to improve their physical and mental functional status [3].

Limitations of our study include single-center design and small sample size, which can impact the generalizability. Though we used validated surveys, there is a potential for reporting bias simply by nature of the design.

CONCLUSIONS

Our hospital, a regional safety-net hospital in the South Bronx, had been at the epicenter of the pandemic and serves a low-socioeconomic, minority-predominant population. While the data recovered are part of the ongoing discovery of the short- and long-term impact of COVID-19 infection, our findings help to define PICS secondary to COVID-19 infection as a separate category from non–COVID-19 infections. There is an evident need to provide individualized care, counseling, and education to patients who find themselves with new cardiovascular conditions, cognitive decline, and new functional baselines as they continue to recover. Early rehabilitation and timely allocation of adequate resources and support to the affected population, including revision of federal/state benefits programs, would be a step in the right direction.

Supplementary Data

Supplementary materials are available at *Open Forum Infectious Diseases* online. Consisting of data provided by the authors to benefit the reader, the posted materials are not copyedited and are the sole responsibility of the authors, so questions or comments should be addressed to the corresponding author.

Notes

Author contributions. V. M., V. P.-G., M. G., and N. C. designed the study. S. O. H., V. P.-G., M. R., N. P., M. A., S. G. F., J. N., S. E., and A. H. interviewed the participants. Data were analyzed by V. P.-G., V. S., and A. A. and interpreted by V. M., V. P.-G., S. O. H., V. S., and A. A. The manuscript was written by V. S., S. O. H., and V. M. and reviewed by all co-authors.

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Patient consent. Verbal consent to participate was obtained from participants prior to administering the telephonic questionnaires.

Potential conflicts of interest. The authors: No reported conflicts of interest.

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