ORIGINAL RESEARCH

COVID-19 Intensive Care Survivors: Extubation to Discharge

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Introduction

Reports on the care of COVID-19 inpatients post-ICU critical illness and disposition are limited. Delivering essential, standard of care, rehabilitative services to promote safe disposition has been challenging in patients diagnosed with COVID-19 given the lack of clinical practices guidelines, infection control protocols, high demands on institutional resources, and associated fear or stigma. Periodic surges during the pandemic have overwhelmed hospital capacity in many regions including Los Angeles. Prioritizing resource allocation to allow for safe and expedient discharge of patients maximizes inpatient bed availability. We describe the post-ICU course of intubated COVID patients during the first 6 months of the pandemic, a time when there was ongoing evolution in the management of COVID-19. We assessed the duration of care and identified areas for targeted improvement.

Methods

This retrospective study was conducted in Los Angeles County, California at Harbor-UCLA Medical Center, part of the safety-net hospital network to more than 700,000 residents. Patient demographics and clinical data were obtained through chart review. This study was approved by the institutional review board at the Lundquist Institute for Biomedical Innovation.

Participants

All adult patients over 18 years of age diagnosed with COVID-19 (positive nasopharyngeal SARS-CoV-2 PCR) from March 13, 2020 to August 31, 2020 and admitted to the ICU requiring mechanical intubation were included. ICU management was at the discretion of the treating physician based on national guidelines. During the first 6 months of the pandemic, patients were often intubated very early in their disease course compared to patients who were hospitalized later in the pandemic during the winter surge from December 2020-February 2021. Treatment options included remdesivir from mid-May until July 29, 2020 and dexamethasone after June 16, 2020.

A COVID-19 multidisciplinary team rounded daily from March 13 to May 31, 2020. The goals were to promote rapid institutional learning, encourage consistency in clinical care, and navigate complex issues, including barriers to discharge.

Results

Demographic Characteristics

There were 118 patients with COVID-19 admitted to the ICU; 89 (75.4%) who received mechanical ventilation. Of those intubated, 47 (52.8%) died and 13 (14.6%) were transferred to other hospitals. Twenty-nine patients (32.5%) were successfully extubated and discharged from the same hospital and comprising the study sample (Figure 1).

The mean age was 56 years and mainly of non-Caucasian and/or Hispanic/Latinx ethnicity with underlying comorbidities (Table 1). Most of patients were admitted from home (86.2%) with normal baseline functional status (82.7%). The number of patients admitted to the ICU and number of deaths across the two-month period were similar, Table 2.

Post-Extubation Hospital Course

The median length of hospital stay post-extubation was 5 days; range 2-41 days, Table 3. Twenty patients (69%) were discharged home, with two additional patients on hospice. The remaining were transferred to step down care facilities, Figure 1.

Eighteen (62%) patients were discharged on room air, requiring a median of 5 days to wean off supplemental oxygen. Four patients required tracheostomy, of which 3 patients were weaned to trach collar and 1 patient required mechanical ventilation on stable settings. These four patients were discharged to either a SNF or long-term acute care facility.

Six (20.7%) patients developed delirium persisting a median of 5 days. Post extubation dysphagia was infrequent, with 25 patients transitioning to full diet in 1 day. Three patients required nasogastric tube or gastrostomy tube at time of discharge. One patient had subacute cerebral infarcts and no seizures were noted. Mental health assessments were not consistently documented.

No patients received early mobilization therapy while in the ICU. Post-extubation, 17 (58.6%) patients received inpatient physical therapy with median time to ambulation of 3 days. By discharge, 10 (34%) patients ambulated independently and

another 10 (34%) patients were discharged home with a walker and/or family support.

Discussion

Prioritizing safe and expedient disposition for patients is especially important during surges when hospitals are operating over their capacity and bed availability is scarce. In this retrospective case series, despite the physical challenges of recovering from ARDS and the social barriers to disposition, most patients who survived critical illness due to COVID-19 were able to recover to a safe disposition. However, our patients received active interventions and advocacy for care by a COVID-19 multidisciplinary team. The median time from extubation to discharge was less than 8 days, with no readmissions over 2 months to a Los Angeles County hospital. While our small study is descriptive, the length of stay is shorter compared to other non-COVID cohorts of ARDS survivors (9-13 days).[1,2]

Residual pulmonary deficits are common following critical illness with COVID-19.[3] In our cohort, 60% of patients were discharged on room air. While the data associated with intermittent self-proning and incentive spirometers are limited to temporarily improving oxygenation,[4,5] we encouraged these interventions in the post-extubation period. Tracheostomy was generally avoided in our ICU management with uncertainty of long-term prognosis and infection control precautions.

Early mobilization in the ICU improves physical functional outcomes, duration of delirium, and ventilator-free days.[6,7] Due to isolation precautions, limited PPE, and the initial limited understanding of infectivity, physical/occupational therapy in the ICU and post-acute settings was deferred early in the pandemic. Nurses and medical providers performed initial assessments of mobility and daily exercises. Truncating the frequency of nursing interventions impeded basic early mobility measures, such as converting beds to chair position or use of bedside commodes rather than bedpans. Anecdotally, use of 4-person rooms with post-ICU COVID-19 patients demonstrated the benefit of patient comradery and shared experience to help motivate them in the absence of family or friends. PT is now routinely involved with active promotion of safety utilizing PPE.[8] In this cohort, 70% of patients were able to ambulate independently or with a device at discharge.

Neuropsychological and vascular complications are common in the setting of severe COVID-19 infection. Delirium was noted in 20% of our patients, likely an underestimate based on chart review alone. Limitations of early mobilization, family absence, and decreased frequency of nursing reorientation complicate standard of care treatment and likely prolonged hospitalization. Dysphagia and aspiration are also common in ARDS post-extubation.[9] Conversely, the majority of our patients tolerated a full diet within 3 days.

Disposition from a safety-net institution is often difficult. Oxygen requirements and isolation precautions related to COVID-19 increased disposition challenges in our study population with the high prevalence of homelessness, crowded and/or multigenerational households, and limited access to personal protective gear and sanitizing supplies. Adherence to social distancing and home isolation often were not possible, thus delaying discharge. County facilitated temporary quarantine and isolation medical shelters were used when feasible. Furthermore, many SNFs initially declined COVID-19 patients due to variable infection control policies, limited capacity and/or inadequate staffing. Due to these challenges, some patients who were recommended rehabilitation services were discharged home instead. Home health services were limited, increasing the rehabilitation burden on patients and families.

Our study has several limitations. It is a single center with a small number of extubated patients. This is an inherent limitation with the poor prognosis of patients with COVID-19 requiring intubation. Survival bias and the younger, healthier baseline status is likely a large explanation to our lower incidence of ARDS-related complications and readmissions. The multidisciplinary team approach was a crucial aspect to our understanding, advocacy, and consistent management of our patients. However, this required participation and dedicated time, which may not be available elsewhere. Lastly, secular changes in the standard of care for patients with COVID-19 prevented a uniform cohort. The care of our cohort was based on early management strategies during the first 6 months of the pandemic. Notably, the approach to mechanical ventilatory support evolved dramatically. In the initial phase of the pandemic, early intubation was encouraged to prevent further progression of lung injury.[10] As understanding of the pathophysiology of COVID-19 expanded, patients hospitalized with severe COVID-19 later in the pandemic were supported with non-invasive ventilatory measures and those who required intubation, likely represented a sicker baseline and more complicated post-ICU course compared to our cohort. Also, initiation of dexamethasone was adapted after June 2020 and improved mortality in critically ill patients. The effect on the post-ICU course is unclear.

In summary, patients who are extubated with post-COVID-19 related ARDS can recover to a safe disposition with a relatively short recovery period, without substantial setbacks or readmissions, in our hospital which provided consistent active interventions and advocacy for care and safe disposition. Establishing protocols, adapting typical team roles, and deterring stigma/refusal of care related to risk of infection through education are imperative for optimal patient care, decreasing hospital room utilization, and maintaining safe disposition.

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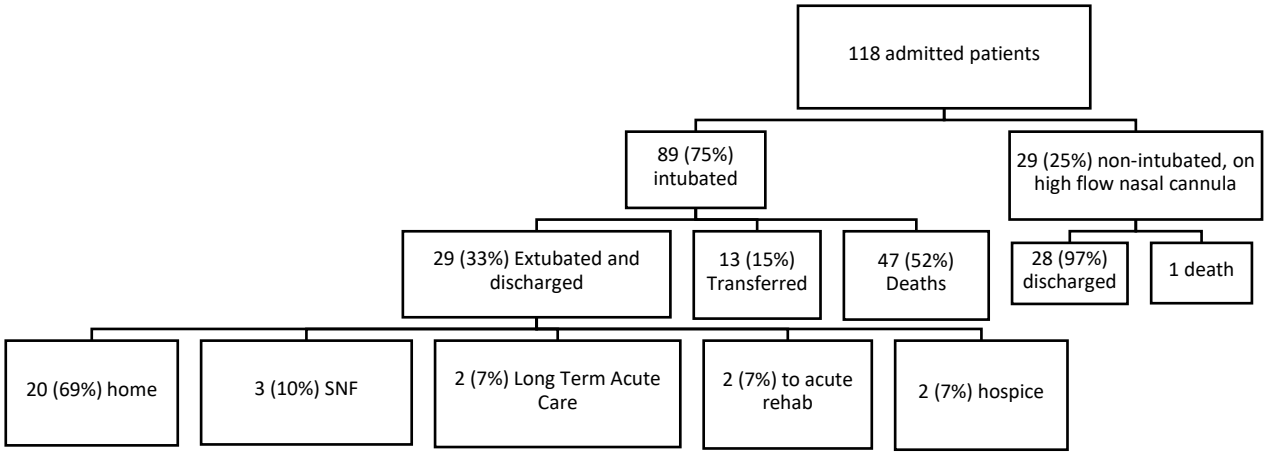
Competing Interests

The authors declare no competing interests.

Figures and Tables

Inclusion Criteria Flow Chart (Figure 1):



Demographics (Table 1)

	N = 29
Age (years), mean (range)	55.8 (21-87)
Female	16 (55.2%)
Race/Ethnicity	
Hispanic or Latinx	16 (55.2%)
Filipino	5 (17.2%)
Black or African American	5 (17.2%)
White	2 (6.9%)
South Asian	1 (3.4%)
Comorbidities	
Obesity	15 (51.7%)
Diabetes	11 (37.9%)
Hypertension	10 (34.5%)
Chronic pulmonary disease (asthma, COPD)	3 (10.3%)
Multiple comorbidities	15 (51.7%)
Baseline Functional Status (average Karnofsky score) *	87 (40-100)
Baseline Cognitive Function	
No history of cognitive impairment	25/29 (86.2%)
History of dementia	4 (13.8%)
Location prior to admission	
Home	25 (86.2%)
Skilled Nursing Facility	4 (13.8%)

*25/29 (86.2%) patients independent with activities of daily living; 2 patients were wheelchair bound, and 2 patients were bedbound at baseline

Table 2

Time Epoch	
March 1 – April 30, 2020	
Total admitted to ICU	35
Total intubated	35
Total death	12
Transferred	8
Included in this study (n = 29)	15 (51.7%)
May 1 – June 30, 2020	
Total admitted to ICU	44
Total intubated	26
Total death	17
Transferred	3
Included in this study (n = 29)	6 (20.7%)
July 1 – August 31, 2020	
Total admitted to ICU	40
Total intubated	30
Total death	17
Transferred	2
Included in this study (n = 29)	8 (27.6%)

Outcomes (Table 3)

	N = 29
ICU Course	
Time Intubated, median days (range)	9 (4-38)[*]
Prone	8 (27.6%)
Paralysis	6 (20.7%)
Secondary Infections[†]	17 (58.6%)
Hospital Course	
Length of hospitalization (median days, range)	18 (6-129)
Days from Extubation to Discharge (median days, range)	5 (2-41)
Respiratory status	
Weaned off supplemental O2	18 (62.1%)
Days until O2 weaned off (median days, range)	5 (1-25)
Discharged on supplemental O2	7 (24.1%)
Tracheostomy	4 (13.8%)
Delirium	6 (20.7%)
Resolution of delirium (median days, range)	5 (5-45)[‡]
Physical Mobility	
PT/OT Involvement	17 (58.6%)
Patients who achieved self-ambulation prior to discharge (including use of assistive devices)	20 (68.9%)
Time to self-ambulation (median days, range)	3 (1-16)
Patients who required assistive devices at discharge and/or assistance	10 (52.6%)
Karnofsky score at time of discharge	70 (20-100)
Speech Therapy	
Patients who tolerated PO diet[§]	25 (86.2%)
Days until patient can tolerate full PO diet (median, range)	1.0 (1-10)
Discharge Location	
Home	20 (69.0%)
Skilled Nursing Facilities (SNF)	3 (10.3%)
Long Term Acute Care	2 (6.9%)
Hospice	2 (6.9%)
Acute Rehab	2 (6.9%)

[*]Patients with tracheostomy were considered "extubated" after liberation from ventilator and transitioned to trach collar, or if on minimal ventilatory settings (CPAP 8/5)

[†]Secondary infections included community acquired pneumonia (6); hospital/ventilator associated pneumonia (8); bacteremia with *Klebsiella* (2), *Stenotrophomonas* (1), and *Pseudomonas* (1); acute cholangitis (2); pulmonary aspergillosis (1)

[‡]One patient excluded because persistently delirious until time of discharge to hospice

[§]2 patients discharged with NG-tube, 2 patients had gastrostomy tube placed

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