OBJECTIVES: To determine the 30- and 90-day outcomes of COVID-19 patients receiving tracheostomy and percutaneous endoscopic gastrostomy (PEG).

DESIGN: Retrospective observational study.

SETTING: Multisite, inpatient.

PATIENTS: Hospitalized COVID-19 patients who received tracheostomy and PEG at four Boston hospitals.

INTERVENTIONS: Tracheostomy and PEG placement.

MEASUREMENTS AND MAIN RESULTS: The primary outcome was mortality at 30 and 90 days post-procedure. Secondary outcomes included continued device presence, place of residence, complications, and rehospitalizations. Eighty-one COVID-19 patients with tracheostomy and PEG placement were included. At 90 days post-device placement, the mortality rate was 9.9%, 2.7% still had the tracheostomy, 32.9% still had the PEG, and 58.9% were at home.

CONCLUSIONS: More than nine-in-10 patients in our population of COVID-19 patients who underwent tracheostomy and PEG were alive 90 days later and most were living at home. This study provides new information regarding the outcomes of this patient population that may serve as a step in guiding clinicians, patients, and families when making decisions regarding these devices.

KEY WORDS: critical care outcomes; gastrostomy; severe acute respiratory syndrome coronavirus 2 infection; tracheostomy

Since emerging in December 2019, the severe acute respiratory syndrome coronavirus 2 (COVID-19) virus has caused significant morbidity and mortality (1). A subset of individuals with COVID-19 become critically ill and receive interventions such as tracheostomy and percutaneous endoscopic gastrostomy (PEG) devices (2, 3). We now understand some outcomes of critically ill patients with COVID-19; however, many are largely undiscovered (4–6). As a result, patients/families, and clinicians lack data to aid in decision-making.

Prior work has examined outcomes of other critically ill patients receiving tracheostomy. In a prospective cohort study, patients with acute respiratory distress syndrome (ARDS) had a post-tracheostomy 28-day mortality of 23.4% and 90-day mortality of 30.8% (7–10). By oxygenation criteria, most patients with COVID-19 receiving mechanical ventilation meet ARDS criteria (11, 12). However, whether patients with COVID-19 have similar outcomes is unknown.

As medical teams guide patients and their caregivers through decisions regarding tracheostomy and PEG placement, they must weigh the risks and
benefits by considering mortality and impact on quality of life. These considerations often include whether the patient will be able to live at home, and if they can expect prolonged dependence on the device (13, 14).

We examined short-term outcomes of patients with COVID-19 who received tracheostomy and PEG within an integrated healthcare network in Boston, Massachusetts. We hope to contribute to the scaffolding for decision-making regarding placement of these devices.

METHODS

Study Design

This was a multisite retrospective observational chart review study approved by the Mass General Brigham (MGB) Institutional Review Board (Number 2020P002350). Informed consent was waived.

Selection of Participants

We included patients hospitalized with symptomatic COVID-19 infection confirmed via polymerase chain reaction testing who had subsequent tracheostomy and PEG placement due to primary COVID-related complications at four MGB institutions (Massachusetts General Hospital, Brigham and Women’s Hospital, Faulkner Hospital, and Newton Wellesley Hospital) between February 1, 2020, and August 19, 2020.

We identified patients for inclusion retrospectively through our system’s Research Patient Data Repository (RPDR), a clinical medical record registry (15). This registry allowed us to identify all patients hospitalized that met the above criteria by retrieving patients with International Classification of Diseases, 10th Revision codes for device placement and positive COVID test result during the specified time period. Investigators confirmed study eligibility by reviewing the charts of identified patients.

Data Collection

We obtained demographics and medical comorbidities from RPDR, gathering remaining data through manual chart review.

We determined continued device presence, mortality, and patient location by chart review 30 and 90 days from device placement and only counted the outcome if clearly documented. In situations lacking conclusive evidence to indicate the outcome at the time point, reviewers did not extrapolate data from prior or subsequent chart documentation. We determined the number of days a patient spent in the ICU, the number of days between intubation and device insertion and the continued need for ventilatory support at discharge through clinical documentation.

We measured complications and rehospitalizations occurring within 90 days post-device placement. Rehospitalizations included admission in the MGB system or any hospital with Care Everywhere, a functionality of the Epic Systems Corporation Electronic Health Record (Epic Systems, Verona, WI) that shares medical records between hospitals. Indication for rehospitalization was determined from the admission history. Discharge summaries were reviewed for complications.

Two investigators, a nurse practitioner (K.S.) and a physician (S.B.K.), reviewed all charts independently. Investigators compared data every 10 charts for the first 50 charts and at completion of data collection to track discrepancies. Upon completion of chart review, a larger group of six investigators met and reconciled discrepancies.

Data Analysis

We used descriptive statistics to analyze baseline demographics, time from intubation to device placement, 30- and 90-day device presence, mortality rate, and place of residence. We calculated a weighted Charlson Comorbidity Index (CCI) for each patient based on individual medical comorbidities (16–18).

RESULTS

Baseline Characteristics

Eighty-one patients with COVID-19 underwent device placement during the study period with tracheostomy and PEG. Table 1 displays baseline characteristics. The mean age was 59.6 years (sd, 12.4 yr) and 72.8% were men. White non-Hispanic patients were most represented (44.4%), followed by Black patients (18.5%). Most were primary English-speaking (54.3%), followed by primary Spanish-speaking (37%). The
The greatest number of patients had a CCI of 1–2 (40.7%), followed by a score of greater than or equal to 5 (30.9%). Diabetes with (24.7%) and without (54.3%) complications, renal disease (35.8%), chronic lung disease (30.9%), cerebrovascular disease (24.7%), and mild liver disease (21%) were frequently represented in these scores.

**Time to Device Placement and Discharge Outcomes**

Patients spent an average of 35.8 days (sd, 14.1 d) in the ICU. On average, patients underwent tracheostomy placement 22.7 days (sd, 8.7 d) after intubation. Thirty-four patients (42%) had tracheostomy removal prior to hospital discharge. Of the patients with tracheostomy still in place at discharge, 7 (17.1%) still required ventilatory support.

**Thirty- and 90-Day Outcomes**

At 30 days post-device placement, 35.5% of patients continued to have a tracheostomy in place. This decreased to 2.7% of patients at 90 days. Information about tracheostomy device presence was missing for 7.9% and 9.6% of patients at 30 and 90 days, respectively. Continued PEG presence was observed in 71 patients (93.4%) at 30 days and 24 patients (32.9%) at 90 days. Six-point 6% and 12.3% of patients were missing information about PEG device presence at 30 and 90 days, respectively. At 30 days post-device placement, five patients had died (6.2%). Among those living, the most frequent patient location was a facility (44.7%) compared with the hospital (35.5%) and home (10.5%). At 90 days post-device placement, eight patients had died (9.9%). Among those living, the most frequent patient location was home (58.9%) compared with a facility (23.3%) and the hospital (5.5%). At 30 and 90 days, 7.9% and 12.3% of patients, respectively, had an unknown location.

**Characteristics of Deceased Patients and Those Subjects at Home at 90 Days**

Eight patients died (9.9%) within 90 days of device placement. Most of the deceased were male (75.0%) and 50.0% had a CCI score greater than or equal to 5. The most frequent comorbidities were diabetes.
and renal disease (62.5%). In comparison, 43 patients were living at home at 90 days. These patients were mostly male (70%), and 21 (46.7%) had a CCI of 1–2. Only 11 patients (24.4%) had a CCI score greater than or equal to 5. The most frequent comorbidities for these patients were diabetes without complications (46.5%), renal disease (30.2%), and mild liver disease (30.2%).

Complications and Rehospitalizations

Of the 81 study patients, 70 (86.4%) had no documented complications. Nine patients (11.1%) had tracheostomy complications including bleeding (5), pneumothorax (2), tracheal stenosis (1), and infection (1). Six patients (7.4%) had PEG complications including bleeding (5) and infection (1). Eleven patients (13.6%) were rehospitalized within 90 days. Indications for rehospitalization included hypervolemia (1), dislodged tracheostomy (1), multifocal pneumonia (1), urinary tract infection (4), small bowel obstruction (2), gastrointestinal bleed (1), and cholecystostomy tube malfunction (1). Number of rehospitalizations within 90 days for the total study group ranged from 0 to 2, with a mean of 0.2 per patient.

DISCUSSION

Tracheostomy and PEG placement are common interventions for patients with sustained critical illness. COVID-19 has challenged providers, patients, and their caregivers to make decisions regarding these interventions, with little information regarding outcomes. Considering this, our study presents several notable findings. For this group, mortality rate 90 days after undergoing these interventions was low (9.5–9.9%). Additionally, most patients were living at home at 90 days (58.9%).

To date, this is the only study examining 90-day mortality and place of residence in this patient population. Our study demonstrates several unique outcomes. The patients are notably different than the population typically served by our hospital system. Just under 50% identified a language other than English as their primary language. In comparison, for patients admitted at Massachusetts General Hospital in 2018, 9% identified as non-English speaking (19). These findings are consistent with other COVID-19 studies, showing racial and ethnic minority groups disproportionately impacted (20). The burden of chronic critical illness on minority patients, likely due to healthcare inequities, requires further exploration.
The study population is younger than expected. The mean age of 59.6 years represents a younger population than other studies of ICU patients with COVID-19 (5, 6). This may reflect a selection bias of the clinical teams for patients likely to benefit from device placement, potentially leading to better outcomes.

PEG tube placement is often required for enteral nutrition after tracheostomy. While there was not a specific policy directing these interventions be provided in tandem, we saw that these interventions were almost exclusively being done together during the spring 2020 COVID surge in our setting. While our study was unable to explore the reasoning for this, it may be due to the desire to reduce COVID positive patient operating room time and limit clinician exposure early in the pandemic.

During the 2020 spring surge, patients were initially intubated at different clinical thresholds than typical practice, including lower oxygen requirements. This practice could have resulted in prolonged periods of intubation for patients with mild disease, leading to inflated survival statistics. Additionally, calculated mortality could have been artificially low as a result of the lack of any treatment with an effect on survival, leading to early deaths initially and selecting for a population to receive interventions that survived.

As clinicians, patients, and caregivers contemplate placement of these devices, they ask how long the device will be needed. Unexpectedly, almost all tracheostomies were removed at 90 days, with only 2.7% remaining. Additionally, the mortality rate for this group was far lower (9.9%) than 90-day mortality after tracheostomy for critically ill patients with non-COVID ARDS (30–40%) (21, 22). This divergence in outcomes may suggest differences in pathophysiology that are currently poorly understood.

Notably, while descriptive statistics hint at trends, our sample size was not large enough to draw statistically significant comparisons in terms of comorbidities. We chose to focus on the CCI score rather than measures of acute illness drawing on evidence that preadmission diagnoses are more predictive of mortality than acute measures of illness (23).

The strengths of this study include its multi-institution inclusion, robust chart review, and low number of missing data. The retrospective observational study design limited data collection to that documented and reported in the medical record. Findings may be limited in generalizability as they are collected from a single health system. In addition, the data are subject to the selection bias of the critical care teams and surgeons making decisions regarding these interventions. Care practices have evolved since the beginning of the pandemic, possibly influencing these outcomes, and may limit the applicability and reproducibility of these data. A notable limitation of this study is the lack of comparison group. During the time period, these data were gathered early in the COVID-19 pandemic, we did not expect the same frequency of accurately comparable patients with COVID-related ARDS who were intubated for a long period but did not undergo tracheostomy placement to create a comparison; as such, we chose a cross-sectional report of these data.

CONCLUSIONS

To date, this is the only exploration of 90-day mortality, complications, and place of residence for patients with COVID-19 who receive tracheostomy and PEG. While more studies are needed to clarify the role of critical care interventions for patients with COVID-19, we hope this study serves as a first step in providing clinicians with needed data to assist in decision-making. Additional studies are needed to identify factors that influence these outcomes and to further explore the impact of these interventions on patient quality of life.

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1 Division of Palliative Care and Geriatric Medicine, Department of Medicine, Massachusetts General Hospital, Boston, MA.
2 Division of Palliative Medicine, Department of Medicine, Brigham and Women’s Hospital, Boston, MA.
3 Department of Psychosocial Oncology and Palliative Care, Dana-Farber Cancer Institute, Boston, MA.
4 Department of Data Science, Dana-Farber Cancer Institute, Boston, MA.
5 Division of Renal Medicine, Department of Medicine, Brigham and Women’s Hospital, Boston, MA.
6 Division of Pulmonary and Critical Care Medicine, Department of Medicine, Brigham and Women’s Hospital, Boston, MA.
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