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Characteristics of Dysphagia in Patients with COVID-19 in the Acute Care Setting—A Retrospective Study

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ABSTRACT

Background: During the Coronavirus Disease 2019 (COVID-19) pandemic, assessment of swallowing disorders by speech-language pathologists in the acute care setting was a challenge, resulting in limited reports on acute COVID-19 dysphagia. This study aimed to report on the characteristics of dysphagia as a direct consequence of acute COVID-19 infection.

Methods: Study staff carried out a retrospective review, approved by the local ethics board, of patients who were admitted to an acute care urban hospital with a primary diagnosis of acute COVID-19 and received a flexible endoscopic evaluation of swallowing (FEES) during their acute phase of illness from March 2020 to May 20, 2022 (15 months). Data extraction included the Penetration Aspiration Scale (PAS) score for each bolus consistency, prolonged intubation, advanced age, laryngeal trauma, presence of secretions, and use of high-flow nasal cannula at the time of the FEES. Statistics were calculated according to variable and distribution type.

Results: The study cohort consisted of 15 patients: 14 of 15 patients (93%) exhibited abnormal PAS scores (PAS 3-8) on at least 1 bolus on the FEES. A total of 66.6% (n = 10/15) aspirated (PAS 6-8), but notably, 46.7% (n = 7/15) silently aspirated (PAS 8). Most (n = 50%) aspiration events occurred during the swallow, and top reasons for aspiration included laryngeal trauma (n = 30%) and incoordination (n = 30%).

Conclusion: This study suggests that patients with acute COVID-19 are at risk for silent aspiration. Clinical implications of these findings suggest that patients with COVID-19 would benefit from formal instrumental swallowing assessment to prevent negative sequelae of dysphagia during acute illness.

Keywords: Acute care, COVID-19, dysphagia, FEES, PAS

Introduction

The Coronavirus Disease 2019 (COVID-19) from the Severe Acute Respiratory Syndrome Coronavirus 2 (SARS-CoV-2) virus was declared a global pandemic on March 11, 2020, by the World Health Organization. The most common symptoms of the virus included cough, fever, and shortness of breath; however, other reported symptoms consisted of weakness, malaise, respiratory distress, muscle pain, sore throat, and loss of taste and/or smell. Symptoms varied from mild to severe, with severe disease progression characterized by the development of acute respiratory failure (ARF), sometimes requiring mechanical ventilation.[1] The rapid transmission and novelty of this virus overwhelmed healthcare systems, forcing medical institutions to adapt diagnostic and therapeutic techniques to best manage the disease and negative sequelae. With the novelty of the COVID-19 infection, little was known about the

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dysphagia presentation in those with this virus, making assessment, treatment, and prognostication challenging for acute care speech-language pathologists (SLPs). During the pandemic, flexible endoscopic evaluation of swallowing (FEES) exams were deemed high-risk aerosolizing procedures, resulting in the placement of hospital-mandated barriers and inability to perform them.[2] Additionally, there were barriers to carrying out Modified Barium Swallow (MBS) exams due to the risks of viral exposure and transmission during transport to the radiology suite.[3] Therefore, very little knowledge was gained about what characterized dysphagia in COVID-19, as instrumental exams were difficult, if not prohibited, from being carried out during the pandemic.

The available literature relating COVID-19 with dysphagia research is still emerging, largely consisting of postacute phase dysphagia or laryngeal injury observations, with limited dysphagia-specific pathophysiology findings during the acute phase of disease.[4] Sandblom et al's[5] observational clinical study of COVID-19 FEES exams in the intensive care unit (ICU) revealed impaired oropharyngeal swallowing and abnormal laryngeal findings. A majority of patients presented with pooling secretions, at least 1 instance of silent aspiration, and vallecular and hypopharyngeal residue. Laryngeal pathology in most of the cohort was documented, characterized by impaired vocal cord movement, vocal fold erythema, and arytenoid edema. Lagier et al[6] evaluated patients in the early stage of recovery from severe COVID-19 (>14 days following discharge from ICU) using MBS. Findings included a very high prevalence of swallowing disorders: silent aspiration was present in 80% of patients (16/20) with additional findings of delayed pharyngeal swallow initiation, impaired bolus propulsion due to base of tongue and pharyngeal weakness, and incomplete laryngeal vestibule closure.[6]

What is more, patients with COVID-19 pose several risk factors for the development of dysphagia. It could be expected that COVID-19 patients who exhibit shortness of breath would present similarly to those with other respiratory diseases, such as chronic obstructive pulmonary disease (COPD). Dysphagia in COVID-19 may be characterized like COPD (poor respiratory–swallow coordination due to a brief apneic period during deglutition that puts patients at risk for aspiration),[7,8] but this would require investigation. Coronavirus Disease 2019 patients often demonstrated ARF, sometimes requiring intubation. Post-extubation dysphagia is well characterized by mechanical deficits in the setting of laryngeal injury, polyneuropathy, and disuse atrophy that lead to impaired secretion management, respiratory muscle weakness and reduced cough integrity, dysphonia, and upper and lower esophageal dysfunction.[9-12] Sensory deficits secondary to prolonged intubation (>48 hours) increase the risk for aspiration without a sensory response (silent).[13] The incidence of dysphagia in extubated patients with COVID-19 has been reported to be 56%, with 25% identified as silent aspirators,[4] compared to 41% and 36%, respectively, in the non-COVID-19 extubated population.[9] Age is another factor that could increase the likelihood of dysphagia in the setting of COVID-19. The association between advanced age plus prolonged intubation with dysphagia is well-known, and patients aged 55 years or older were determined to be independent risk factors for post-extubation dysphagia.[14] Other literature has suggested a relationship between neurologic injury and COVID-19, with implications involving swallowing which is a highly complex process, involving brainstem, cortical, and subcortical regions. Brain magnetic resonance imaging was used to illustrate in people with COVID-19 an unusual pattern of microbleeds predominately affecting the corpus callosum and subcortical regions but also localized to other regions including internal capsule and middle cerebellar peduncles.[15,16]

Dysphagia is therefore most certainly a likely outcome of acute COVID-19. However, specific characteristics of dysphagia in the acute stages of this disease are still unknown, given the difficulty in carrying out evaluations during the pandemic. This study aimed to evaluate not only aspiration events as a consequence of a COVID-19 infection but also the characteristics of the presenting dysphagia during the acute phase of the disease. It was hypothesized that silent aspiration would occur in the majority of the sample of participants with acute COVID-19.

MAIN POINTS

- *This study found that participants with acute Coronavirus Disease 2019 (COVID-19) infections are at an increased risk for dysphagia, particularly silent aspiration.*
- *Aspiration occurred mostly during the swallow and appeared to be due to laryngeal trauma and incoordination.*
- *The constellation of symptoms in acute COVID-19 dysphagia appears to present similarly to that of the acute respiratory failure (ARF) and post-extubated populations.*
- *Therefore, it is proposed that the management of dysphagia in this population can reliably follow pre-existing best clinical practice utilized in both ARF and neurological populations.*

Material and Methods

Our study was retrospective in nature, utilizing data extracted from FEES examinations during the COVID-19 pandemic. Inclusion criteria was defined as (1) admission to the urban, large tertiary medical center with primary admission diagnosis of polymerase chain reaction (PCR)-confirmed COVID-19 and (2) participation in a FEES exam within 4 weeks of the admission from March 2020 to May 2024. Demographic and co-variate information was collected from the electronic medical record (EMR) for each patient and included age categorized as advanced age (>65 years), history of prolonged intubation (>48 hours) due to COVID-19 during the admission, laryngeal trauma per the EMR, presence of secretions on the FEES, and use of high-flow nasal cannula (HFNC) at the time of the FEES. Exclusionary criteria were defined as the presence of baseline dysphagia per EMR, postacute COVID-19 status (diagnosis of COVID-19 for longer than 4 weeks and removal of enhanced precautions), incidental COVID-19 diagnosis, presence of a tracheostomy tube, and altered mental status prohibiting patients from participating in a FEES. Baseline dysphagia was defined as prior EMR documentation of impaired oropharyngeal swallow function due to a chronic, not acute, illness. Additionally, patients with medical conditions commonly associated with dysphagia were excluded, given the increased likelihood of dysphagia for other reasons (e.g., progressive neurological disorders, neuromuscular disorders, neurovascular disorders, current or remote head and neck cancer). Flexible endoscopic evaluation of swallowing exams were able to be carried out on acutely and actively contagious COVID-19 patients while under enhanced droplet and contact precautions utilizing the FEES box barrier to contain particles.[17,18]

The FEES exam protocol included the administration of ice chips, thin or thick liquids (per International Dysphagia Diet Standardization Initiative [IDDSI] Levels 2 or 3), pureed solids, and a cracker, all dyed with green or white food dye to enhance visualization. Notably, different boluses and volumes were trialed based on clinical judgment and in efforts to maximize patient safety and thoroughly assess swallowing ability under different conditions, so not all boluses were presented in every case. Diet recommendations and textured diet recommendations were extracted from the EMR (e.g., regular solids, ground solids, pureed solids, and recommendations of IDDSI levels[19] for liquids).

Rosenbek's Penetration Aspiration Scale (PAS) score, an 8-point scale used to characterize the depth and response to airway invasion, was extracted from FEES documentation in the EMR for each bolus.[20] The worst PAS score was used for each bolus. For re-reviews of the PAS scores, all eligible FEES exams were downloaded from nCare and Vault Stream servers, a password-protected medical content management system that provides storage and access to recorded clinical images and videos (©Olympus America nCare, 2024). Bolus swallows on the downloaded FEES videos were reviewed by 2 blinded SLPs who rated the worst PAS scores for each bolus consistency utilizing QuickTime Player for frame-by-frame review. Instances of disagreement between expert raters and EMR scores were settled using a tertiary expert reviewer, and the mode PAS score was used in these instances. Raters also rated the timing of penetration/aspiration events as occurring before (prior to whiteout), during (occurred during whiteout), or after (occurring after whiteout) the swallow. Further, raters labeled the reason for aspiration as being caused by a delayed swallow (penetration/aspiration events happening before the whiteout period on FEES), laryngeal trauma (defined as poor airway protection during the swallow, requiring the presence of poor glottic closure), or discoordination (poor control of the bolus transitioning from the oral to pharyngeal stage and disorganized/missequences swallowing events).

Confirmed worst PAS scores for each bolus consistency were categorized into 3 groups:

1. Presence of abnormal PAS scores or presence of penetration/aspiration (PAS 3-8);
2. Presence of aspiration (PAS 6-7); and
3. Presence of silent aspiration (PAS 8).

Co-variates included prolonged intubation (>48 hours), advanced age (>65 years), the presence or absence of laryngeal trauma per the EMR, the presence or absence of secretions as seen on the FEES, and the presence or absence of HFNC at the time of the FEES. In order to determine the statistical significance between each association, the mid-*P* exact test and *P*-values from each chi-squared test for independence were evaluated. The mid-*P* exact test was performed to provide a *P*-value for data with limited sample size. A one-sample proportion *t*-test was performed to determine the proportion of abnormal PAS scores and the abnormal PAS score related confidence interval. A continuity correction was applied to each test in order to account for the small sample size. Subsequently, chi-squared tests were conducted to identify associations between silent aspiration (PAS 8) and abnormal penetration or non-silent aspiration (PAS 3-7).

Post-discharge data were collected via the EMR from follow-up SLP evaluation/treatment notes or physician reports of resolved versus persistent complaints. Information regarding persistent dysphagia complaints and/or new complaints related to dyspnea, dysphonia, or long-COVID symptoms was collected. All study activities were approved by the Ethics Committee of Boston University (Approval no.: H-42640; Date: 31/05/2022) who deemed informed consent from patients to be waived under an exemption study. Retrospective research was approved by the Institutional Review Board (IRB) on May 31, 2022, and they determined that the study qualified for an exemption determination under the policies and procedures of the Human Research Protection Program (http://www.bumc.bu.edu/ohra/hrpp-policies/hrpp-policies-procedures/#10.2.4) under category 9, and Waiver of HIPAA Authorization for Research approved under 45 CFR164.512 (i) (2) (ii).

Results

A total of n = 19 participants met inclusion criteria and n = 4 met at least 1 exclusion criteria, leaving the final cohort of n = 15 participants. Ages ranged from 35 to 82 years (median of 64 and mode 80 years). Among the 15 participants, n = 7 (47%) were of advanced age (>65 years), n = 11 (73%) underwent prolonged intubation (>48 hours), n = 9 (60%) exhibited laryngeal trauma, and n = 4 (27%) were on HFNC. Seven of the 11 prolonged intubations (64%) lasted >6 days; and notably, n = 9/11 prolonged intubation participants demonstrated laryngeal trauma (82%), including edema, vocal fold hemorrhaging, ulcerative and/or traumatic lesions, and glottic stenosis. Three of the total 15 participants (20%) presented with baseline laryngeal secretions on the FEES. See Table 1 for the outline of frequencies.

Figure 1 demonstrates the distribution of PAS scores across bolus consistencies. From the sample of 15 participants, 93.3% (n = 14/15) demonstrated abnormal PAS scores (3-8). A total of 66.6% (n = 10/15) aspirated (PAS 6-8), but notably, 46.7% (n = 7/15) *silently* aspirated (PAS 8). A total of 57.1% (n = 8/14) demonstrated persistent deep penetration (PAS 5) of thin liquids (IDDSI Level 0) and 28.6% (n = 4/14) demonstrated persistent deep penetration (PAS 5) of thickened liquids (IDDSI Levels 2 or 3). No aspiration of solids was recorded; however, 38.5% (n = 5/13) exams revealed shallow penetration (PAS 3) and 7.7% (n = 1/13) exams revealed deep penetration (PAS 5) of pureed solids (IDDSI Level 4); 33.3% (n = 3/9) exams revealed deep penetration of regular texture solids (PAS 5). Associations between silent aspiration and co-variates did not result in statistically significant differences, as all *P*-values were greater than .05.

Aspiration occurred *before* the swallow in n = 2/10 aspiration events (20%), *during* the swallow in n = 5/10 events (50%), and *after* the swallow in n = 3/10 events (30%) (Figure 2). Raters indicated that the primary reason for aspiration was due to incoordination in n = 3/10 events (30%), laryngeal trauma in n = 3/10 events (30%), and delayed swallow initiation in n = 1/10 events (10%) (Figure 3). Following the

Table 1. Frequencies of Study Co-variates.

Characteristic	N (%)
Age (>65)	7 (47)
Intubated >2 days	11 (73)
Laryngeal trauma	9 (60)
Secretions on FEES	3 (20)
On HFNC at the time of FEES	4 (27)

FEES, flexible endoscopic evaluation of swallowing; HFNC, high-flow nasal canula.

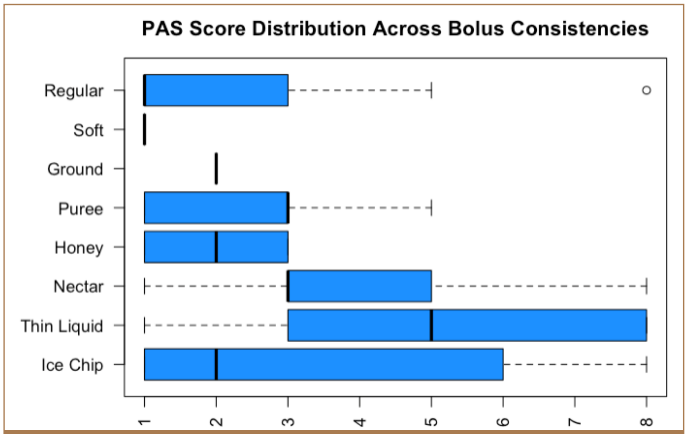

Figure 1. Distribution of Penetration Aspiration Scale scores across bolus consistencies.

FEES, SLP recommendations included a modified diet for 14/15 participants (93.3%) and 1 was nil per os, requiring alternative means of nutrition (n = 1/15, 6.7%). One participant received a recommendation for moderately thickened liquids (IDDSI Level 3).

Following hospital discharge, the chart review for each study participant revealed that n = 4/15 study participants (26.6%) continued to report chronic breathing issues in the setting of restrictive lung disease secondary to their COVID-19 infection. Notably, EMRs for n = 5/15 participants (33.3%) suggested resolution of dysphagia, dysphonia, and dyspnea complaints.

Discussion

This study investigated aspiration events and characteristics of dysphagia in participants with a primary admission to acute care for a COVID-19 infection. Dysphagia was present in over 90% of participants, as evidenced by abnormal airway invasion scores (PAS 3-8) as seen on FEES during the acute stage of COVID-19. More specifically, 66.6% of the participants aspirated, either with a cough response or silently (PAS 6-8), and all participants who aspirated had at least one documented instance of silent aspiration, supporting the hypothesis that silent aspiration would occur frequently in participants with acute COVID-19. There was some question about the timing of aspiration and if it might occur frequently before the whiteout period on FEES, as there is some evidence for a potential delay in swallow onset especially in COVID and/or extubated participants with altered mental status.[21,22] Airway invasion secondary to delayed swallow initiation could also be suggestive of a neurological component. Newer research has shown that microbleeds and white matter changes to the brain may occur from a COVID-19 infection,[15,16] which therefore suggests possible neurological causes for dysphagia. However, in the sample of acutely ill COVID-19 participants, it was found that only a few (20%) participants aspirated before the swallow and expert raters determined there was a delayed swallow in only 10% of aspiration events. The exclusion of those with altered mental status or reduced mentation for oral trials and FEES participation could explain why one did not see as many aspiration events before the swallow. Rather, half of the sample (50%) was observed to aspirate during the swallow. These findings go hand in hand with expert raters' classification of the reasons for aspiration: laryngeal trauma was one of the leading reasons.

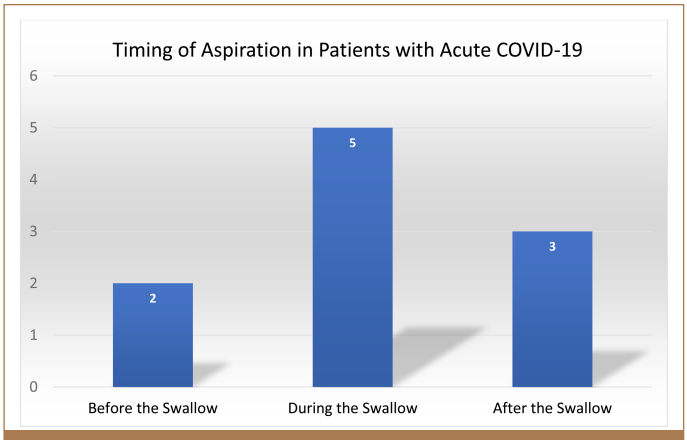

Figure 2. Timing of aspiration in participants with acute COVID-19 as seen on flexible endoscopic evaluation of swallowing from n = 10 observations of aspiration.

The sample of acutely ill COVID-19 participants also demonstrated a high incidence (82%) of laryngeal trauma characterized by edema, vocal fold hemorrhaging, ulcerative and/or traumatic lesions, and glottic stenosis. As expected, it resulted in subsequent impaired airway protection during swallowing on the FEES exams. Prolonged intubation has a well-linked association with laryngeal injury and subsequent post-extubation dysphagia.[12,14,23-25] There was some question about the emergent intubation situations of ARF in the setting of COVID-19, as placement of endotracheal tubes (ETTs) during medical emergencies can cause more trauma than a planned intubation. No data were collected on ETT size, but larger sizes have been shown to cause more laryngeal damage.[26,27] It would be difficult to differentiate a dysphagia presentation due to solely intubation injury versus dysphagia due to just COVID-19. One possible solution would be to isolate COVID-19 cases who were not intubated, which was not possible for this study's sample. During the height of the pandemic, many people with ARF from COVID-19 were intubated, with estimates ranging from 30% to 50%.[28] The time frame for the study's data did not include the period when proning and extracorporeal membrane oxygenation without intubation became more common practices, which was in subsequent waves of the pandemic.[29,30] The majority of the sample experienced intubation, and while intubation injury is likely the driving factor of the dysphagia presentation, a substantial rate of swallowing incoordination was noted as well.

Approximately one-third of the sample demonstrated dysphagia due to incoordination, which likely presents similarly to those with other respiratory diseases, such as COPD. Such dysphagia is characterized like COPD: brief laryngeal vestibular closure, slowed and less complete movements of swallowing structures, and poor respiratory-swallow coordination of inhale versus exhale after the swallow.[7,8,31] Clinicians should expect to see these characteristics of dysphagia presentation in COVID-19 patients, as there is an association between respiratory diseases and oropharyngeal dysphagia.[32,33]

We further investigated associations between dysphagia and other common factors such as advanced age and prolonged intubation. Despite statistical insignificance between advanced age and prolonged intubation, 71% of the sample who silently aspirated were over the age of 65, and 85.7% of participants who aspirated had also

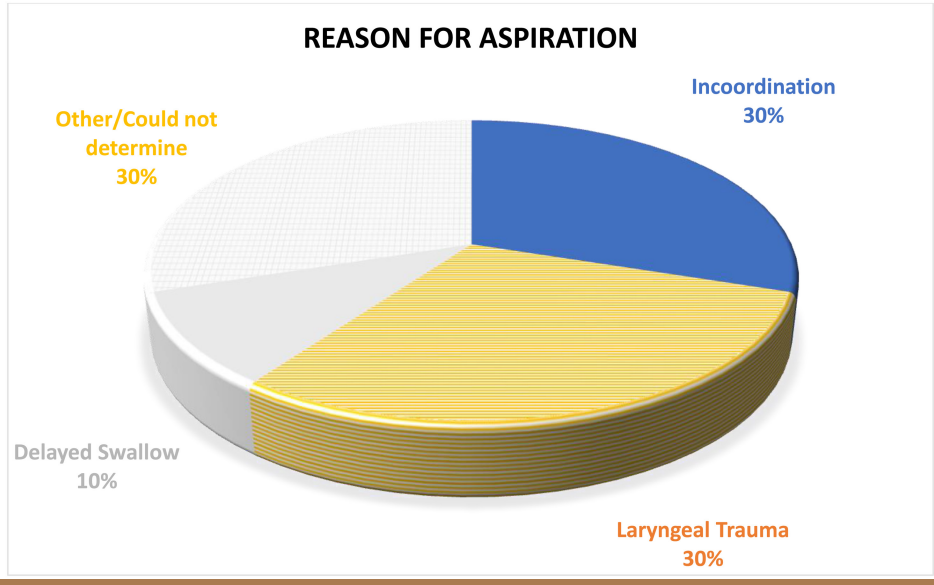

Figure 3. Primary reason for flexible endoscopic evaluation of swallowing–detected aspiration in n = 10 instances of aspiration in acute COVID-19 cases, per expert raters.

experienced prolonged intubation of over 48 hours. Advanced age and prolonged intubation are known risk factors for dysphagia, and herein the majority of the sample with dysphagia was documented as also having the presence of these risk factors.[14,23,27,34] This is consistent with the extant literature, which highlights advanced age and prolonged intubation as predictors of post-extubation dysphagia.[13,14] Reflecting on the COVID-19 pandemic and those who were most susceptible to severe outcomes from the virus, the United States Centers for Disease Control and Prevention reported that COVID-19 in those aged over 65 years had more than 60 times higher risk of death than younger ages.[35,36] This informs acute care dysphagia evaluations for COVID-19 participants, and the conclusion is that those with advanced age in combination with history of intubation in acute COVID-19 will have a high likelihood of not only dysphagia but also aspiration and should receive instrumental evaluations to ensure safe swallowing recommendations.

Regarding post-discharge dysphagia, it was found that about 33% of participants reported resolution of dysphagia. This seems logical, with the causes of dysphagia being driven by mainly acute-phase deficits. It was suspected that with resolution of the acute symptoms and recovery from interventions such as intubation, COVID-19 dysphagia may resolve spontaneously. However, it is possible that other etiologies could drive more chronic dysphagia, such as exacerbation of reflux, permanent injuries such as vocal fold immobility, globus sensation, breathing disorders, and any neurological injury. Golan et al[37] reported that post-COVID dyspnea, cognitive difficulties, anxiety, extreme fatigue, and other debilitating symptoms are often less responsive to traditional SLP treatments.[37] With respect to long-COVID dysphagia, and the multifactorial etiology of the dysphagia in addition to each individual's comorbidities, prognosticating rehabilitative potential for this population is still a challenge. The suggestion is that the sooner dysphagia specialists can evaluate swallowing function and recommend a safe oral diet, the better the expected dysphagia prognosis and the earlier it will be possible to safely discharge a patient to the next level of care.

Clinical Implications

This study found that participants with acute COVID-19 infections are at an increased risk for dysphagia, particularly silent aspiration. The characteristics of penetration/aspiration varied greatly, but primarily resulted in FEES-detected aspiration during the swallow and were likely due to laryngeal trauma and incoordination. Given the high occurrence of both non-silent and silent aspiration in the sample, concern for dysphagia in acute COVID-19 should warrant a full instrumental workup to inform diet recommendations in efforts to prevent negative sequela of aspiration. Overall, the constellation of symptoms in acute COVID-19 dysphagia appears to present similarly to that of the ARF and post-extubated populations. Therefore, it was proposed that the management of dysphagia in this population can reliably follow pre-existing best clinical practice utilized in both ARF and neurological populations with close attention to a potential delayed swallow initiation, impaired sensory response to aspiration, and laryngeal injury.

Study Strengths

We report on swallowing dysfunction in a difficult-to-study population of acutely ill COVID-19 participants. It was sought to identify a very specific presentation of participants with dysphagia due to COVID-19. Strengths of the study include inclusion and exclusion criteria to identify a homogeneous group of acutely ill COVID-19 participants to avoid as many confounders as possible; participants were not included if they had a presence of baseline dysphagia, presence of a tracheostomy tube, or severe disease or altered mental status. Expert ratings were harnessed to determine the characteristics of dysphagia to better understand the presentation of dysphagia in COVID-19. Further, the timing of airway invasion and impact of laryngeal pathology on swallow ability was further elaborated, which has not been reported in such a way in previous studies.

Study Limitations

Our primary limitation is a small sample size which may be reflective of (1) the reduced SLP referrals during the height of the pandemic,

(2) site-specific patient population with a lower socioeconomic status and reduced health literacy (i.e., more mortality or declining full dysphagia workup), and (3) multiple medical comorbidities (meeting exclusionary criteria). Participants who were inappropriate for an oral diet due to most severe disease or altered mental status were not included in dysphagia analysis, and therefore it is possible that more severe cases were missed. Another limitation could be the lack of a standard FEES protocol (definition of drops of colored food dye or reliable administration of textures and consistencies across exams) largely due to clinical decision-making and to maximize patient safety, a constraint associated with the retrospective nature of this study. Further co-variates were not collected which may have been useful for analysis (e.g., bedside evaluation findings including vocal quality, overt signs of aspiration, 3-ounce water swallow challenge findings, and brain or chest imaging). Lastly, statistical limitations were also evident, including the use of chi-squared test for small sample size, but this was adjusted for with mid-*P* exact tests.

Data Availability Statement: *The data that support the findings of this study are available on request from the corresponding author.*

Ethics Committee Approval: *This study was approved by Ethics Committee of Boston University (Approval No.: H-42640; Date: 31/05/2022).*

Informed Consent: *N/A.*

Peer-review: *Externally peer-reviewed.*

Author Contributions: *Concept – E.M., C.S.; Design – C.S.; Supervision – J.M.P.; Data Collection and/or Processing – E.M., C.S.; Analysis and/or Interpretation – A.C., E.M., S.A., A.G.; Literature Search – C.S.; Writing – E.M., C.S.; Critical Review – J.M.P.*

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