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ORIGINAL RESEARCH

Swallowing and Voice Outcomes in Patients Hospitalized With COVID-19: An Observational Cohort Study



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Abstract

Objective: To evaluate the presentations and outcomes of inpatients with coronavirus disease 2019 (COVID-19) presenting with dysphonia and dysphagia to investigate trends and inform potential pathways for ongoing care.

Design: Observational cohort study.

Setting: An inner-city National Health Service Hospital Trust in London, United Kingdom.

Participants: All adult inpatients hospitalized with COVID-19 (N=164) who were referred to Speech and Language Therapy (SLT) for voice and/or swallowing assessment for 2 months starting in April 2020.

Interventions: SLT assessment, advice, and therapy for dysphonia and dysphagia.

Main Outcome Measures: Evidence of delirium, neurologic presentation, intubation, tracheostomy, and proning history were collected, along with type of SLT provided and discharge outcomes. Therapy outcome measures were recorded for swallowing and tracheostomy pre- and post-SLT intervention and Grade Roughness Breathiness Asthenia Strain Scale for voice.

Results: Patients (N=164; 104 men) aged 56.8±16.7 years were included. Half (52.4%) had a tracheostomy, 78.7% had been intubated (mean, 15±6.6d), 13.4% had new neurologic impairment, and 69.5% were delirious. Individualized compensatory strategies were trialed in all and direct exercises with 11%. Baseline assessments showed marked impairments in dysphagia and voice, but there was significant improvement in all during the study ($P<.0001$). On average, patients started some oral intake 2 days after initial SLT assessment (interquartile range [IQR], 0-8) and were eating and drinking normally on discharge, but 29.3% (n=29) of those with dysphagia and 56.1% (n=37) of those with dysphonia remained impaired at hospital discharge. A total of 70.9% tracheostomized patients were decannulated, and the median time to decannulation was 19 days (IQR, 16-27). Among the 164 patients, 37.3% completed SLT input while inpatients, 23.5% were transferred to another hospital, 17.1% had voice, and 7.8% required community follow-up for dysphagia.

Conclusions: Inpatients with COVID-19 present with significant impairments of voice and swallowing, justifying responsive SLT. Prolonged intubations and tracheostomies were the norm, and a minority had new neurologic presentations. Patients typically improved with assessment that enabled treatment with individualized compensatory strategies. Services preparing for COVID-19 should target resources for tracheostomy weaning and to enable responsive management of dysphagia and dysphonia with robust referral pathways.

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There is a wide range of symptomatic severity in coronavirus disease 2019 (COVID-19),¹ and a significant proportion of hospitalized patients require intensive care unit (ICU) admission, with reports varying from 12% to 32%.¹⁻³ There is an association between COVID-19 and dysphonia and dysphagia, with studies demonstrating dysphagia in 90% of patients admitted to a

COVID-19 rehabilitation facility⁴ and in more than 70% of critically ill COVID-19 patients after extubation.⁵

Mechanisms placing COVID-19 patients at risk of dysphagia include multilevel damage to the swallowing network.⁶ Dyspnea affects more than half of COVID-19 patients³ and could compromise airway protection from disruption to the tight temporal coupling between respiration and swallowing.⁷ Furthermore, the high incidence of critical illness in COVID-19 is a risk factor for swallowing difficulties⁸ and ICU-acquired weakness, resulting

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from disuse, sedation, or neuromuscular blocking agents may affect the swallowing musculature.⁹ More than half of all critically ill patients who require intubation develop swallowing difficulties,¹⁰ and a longer duration of intubation significantly increases the risk of dysphagia at hospital discharge.¹¹ COVID-19 patients admitted to the ICU require a longer median duration of mechanical ventilation than non-COVID-19 viral pneumonia,³ suggesting an increased risk of dysphagia in this cohort.

One-quarter of inpatients with mild-moderate COVID-19 present with dysphonia, likely due to upper airway inflammation.¹² The rates of dysphonia among those with more severe illness and who have required critical care are unknown but are likely to be higher. Intubation has a significant effect on laryngeal anatomy and function. A systematic review of 775 non-COVID-19 extubated patients found that 76% presented with dysphonia.¹³ The effects of intubation, coupled with the COVID-19 inflammatory process is therefore likely to result in significant dysphonia. In addition, prone ventilation has been recommended in patients with severe COVID-19.¹⁴ The effect of proning on the potential for increased laryngeal and oral trauma, and subsequently voice and swallowing, are unknown.

Reports of neurologic manifestations of the disease are common. Studies have shown that encephalitis, demyelination, neuropathy, and cerebrovascular disease are linked with the disease.¹⁵⁻¹⁷ Therefore, the secondary effect of neurologic impairment from COVID-19 on voice and swallowing mechanisms needs consideration.

In other pathologies, dysphagia is known to be associated with an increased risk of pneumonia, dehydration, malnutrition, length of stay, dependency, and mortality.¹⁸ Both dysphagia and dysphonia have significant effect on quality of life.^{18,19} It is therefore essential that the effect of COVID-19 on these functions is understood so management can be targeted appropriately.

There is emerging evidence about the association of COVID-19 and dysphagia and dysphonia, but what is not known is the trajectory of these conditions and outcomes after management with speech and language therapy (SLT). Therefore, the aims of this study were to evaluate the presentations and outcomes of inpatients referred to SLT with COVID-19, to investigate trends, and to inform potential pathways for ongoing care. It was hypothesized that high rates of significant dysphagia and dysphonia would be identified, which would be associated with prolonged intubation and would be worse in prone patients. It was anticipated that the majority of patients would have ongoing SLT needs on discharge from the hospital, including a proportion of those who had tracheostomies not being weaned. Determining this information will help plan resources and service delivery for future caseloads of patients with COVID-19.

List of abbreviations:

COVID-19	coronavirus disease 2019
FEES	fiberoptic endoscopic evaluation of swallowing
FOIS	Functional Oral Intake Scale
GRBAS	Grade Roughness Breathiness Asthenia Strain
ICU	intensive care unit
IQR	interquartile range
SLT	speech and language therapy
TOM	therapy outcome measures

Methods

Study design

A prospective single-center observational cohort study was conducted of all adult inpatients with confirmed COVID-19 who were referred to a 7-day per week SLT service at a central London National Health Service Trust from April 1 to May 31, 2020.

A local policy is followed in which all patients with tracheostomy, dysphonia, head and neck cancer, brainstem pathology, coughing on saliva, and/or preexisting dysphagia are referred to SLT for swallowing assessment. For all other patients, the 3-ounce water swallow test²⁰ is completed by nursing staff, and patients are referred to SLT if they fail. An electronic referral system is in place, and SLT staff also attended daily board rounds and handovers to identify new referrals.

The exclusion criteria were patients who contracted nosocomial COVID-19, those who were not referred to SLT for swallowing or voice assessment, and pediatric referrals. The Trust Quality Improvement and Clinical Audit Committee approved the study (reference no. 10928).

Data collection

Data were collected from the medical record on demographics; length and number of intubations; length of time prone; presence of tracheostomy and time to decannulation; evidence of neurologic impairment (from SLT/multiprofessional assessment and any reported brain imaging); presence of delirium (positive result on the Confusion Assessment Method for the ICU²¹); time on SLT caseload; type of assessment/intervention required and delivered by SLT; baseline and outcome measures for voice, swallowing, and tracheostomy; and discharge destination.

SLT intervention

Patients received a clinical swallowing and perceptual voice assessment. Established definitions for types of intervention for dysphagia were used: direct exercises (exercise programs aimed at improving muscle strength and function) and compensatory strategies (recommendations to improve airway protection, including postural changes and modification of bolus volume, consistency, and rate of presentation).²² The intervention was determined after clinical and/or instrumental assessment by specialist SLT staff (RCSLT Competency Level C/D).²³ Direct exercises were recommended for oropharyngeal weakness, and compensatory strategies were individualized to benefit airway protection and swallow efficiency during assessment. Patients with tracheostomy were seen for individualized weaning plans along with physiotherapy colleagues, ensuring multidisciplinary agreement regarding readiness for decannulation. The specialist outpatient voice team delivered refresher training to inpatient therapists in perceptual voice assessments and established a specific referral pathway for outpatient voice follow-up.²⁴ Patients with dysphonia were given vocal hygiene recommendations and education, including leaflets with advice on how to reduce the risk of vocal cord trauma, strain, and aggravating any existing laryngeal injury. All patients were seen as frequently as was considered appropriate by the managing therapist (daily if required).

Outcome measures

Validated outcome measures were used, including the Functional Oral Intake Scale (FOIS),²⁵ Grade Roughness Breathiness Asthenia Strain Scale (GRBAS) for voice,²⁶ and Therapy Outcome Measures (TOM)²⁷ for swallowing and tracheostomy. FOIS ranges from 1 (nothing by mouth) to 7 (total oral diet with no restrictions), dysphagia TOM ranges from 0 (profound dysphagia) to 5 (no evidence of dysphagia), tracheostomy TOM ranges from 0 (cuff up all the time) to 5 (decannulated), and GRBAS ranges from 0 (normal) to 3 (severe).

Baseline measures for voice and swallowing were taken on initial assessment, defined as the first point at which patients could participate in a clinical swallowing examination and/or perceptual voice assessment. Patients were not assessed until extubated and sufficiently alert for assessment. Due to risks from aerosol generation, local guidance at the time was to avoid tracheostomy cuff deflation on mechanical ventilation.²⁸ Airway protection and voice were therefore assessed when patients were able to self-ventilate.

Outcomes for tracheostomy and dysphagia were measured at the final SLT session when the patient was discharged from inpatient SLT. This could be when they were discharged home and referred for community follow-up due to ongoing goals or when it was determined that they had no further goals from SLT (ie, when they were decannulated and had a fully functional swallow [FOIS 7] with no further rehabilitation indicated). Outcomes for dysphonia were measured once their voice had returned to normal (GRBAS 0) or on their final SLT session prior to discharge home. Those with dysphonia at discharge were offered referral to a specific outpatient COVID-19 pathway. When a patient died or transferred to another inpatient facility prior to recovery of function, baseline measures were included but outcome measurement was not possible.

Data analysis

Results are presented as means \pm SD and medians (interquartile range [IQR]), depending on type and distribution. Data were analyzed descriptively and with relevant statistical tests. The Wilcoxon signed ranks test was used to compare FOIS, GRBAS, and TOM scores pre- and post-SLT intervention. The McNemar test was used to compare the proportion of patients presenting with dysphonia or dysphagia pre- and post-SLT intervention. Differences in time intubated between those with and without ongoing dysphonia or dysphagia on discharge were compared using the independent Student *t* test. Differences in the GRBAS scale and dysphagia TOM between those who were prone and not prone were compared using the Mann–Whitney *U* test. A *P* value of $<.05$ was deemed significant.

Results

During the study, 164 patients with COVID-19 were referred to SLT. Demographics and baseline clinical details are shown in [table 1](#). The numbers of patients prone was recorded, but the length of time prone could not be determined. Patient flow through the study is shown in [figure 1](#).

Patients were on the inpatient SLT caseload for a median of 11 days (range, 6–20d) and 93.3% (n=153) had been discharged by the end of data collection. Discharge destinations are shown in

[table 2](#). More than one-third (37.3%, n=57) completed their SLT goals and were discharged from SLT prior to being transferred elsewhere or discharged from the hospital. In this group, SLT intervention to resolution of impairment lasted 14 days (range, 8–21d). All patients with dysphonia at hospital discharge (n=37) were offered referral to the specific COVID-19 pathway for voice follow-up; 9 (24.3%) of these patients declined.

It was not possible to assess some baseline and outcome parameters for all patients due to patient transfer, medical status, delirium, death, and/or tracheostomy cuff status (precluding

Table 1 Demographics and baseline clinical and referral information

Demographics	N = 164
Age, mean \pm SD (range), y	56.8 \pm 16.7 (20-96)
Sex, n (%)	
Female	60 (36.6)
Male	104 (63.4)
Any comorbidity, n (%)	141 (86.0)
No. of comorbidities, median (IQR)	2 (1-3)
Categories, n (%)	
Hypertension	56 (34)
Diabetes	47 (29)
Respiratory	37 (23)
Body mass index \geq 30	22 (13)
Cardiac	17 (10)
Dementia	15 (9)
Chronic kidney disease	13 (8)
Cancer	13 (8)
Other neurologic diagnosis*	11 (7)
Stroke	6 (4)
Other, including alcohol, smoking, and mental health	85 (52)
Reason for referral, n (%)	
Tracheostomy weaning, swallowing, and communication	85 (51.8)
Swallowing only	53 (32.3)
Swallowing and voice	13 (7.9)
Swallowing and communication	12 (7.3)
Communication only	1 (1.6)
Seen by SLT on critical care	127 (77.4)
Days from referral to first SLT contact, mean \pm SD	0 \pm 0.6
Intubated during admission, n (%)	129 (78.7)
Intubations/patient, median (IQR)	1 (1-1)
No. of intubations per patient, n (%)	
1	111 (86.0)
2	15 (11.6)
3	2 (1.6)
Unknown	1 (0.8)
Time intubated, mean \pm SD, d	15 \pm 6.6
Tracheostomy in situ, n (%)	86 (52.4)
Prone during admission, n (%)	59 (36.0)
Presented with delirium during admission, n (%)	114 (69.5)

* Parkinson disease (n=2), epilepsy (n=1), glioblastoma multiforme (n=1), meningioma (n=1), human immunodeficiency virus encephalopathy (n=1), transient ischemic attack (n=1), neuro-sarcoid (n=1), small vessel disease (n=1), subarachnoid hemorrhage (n=1), and diabetic neuropathy (n=1).

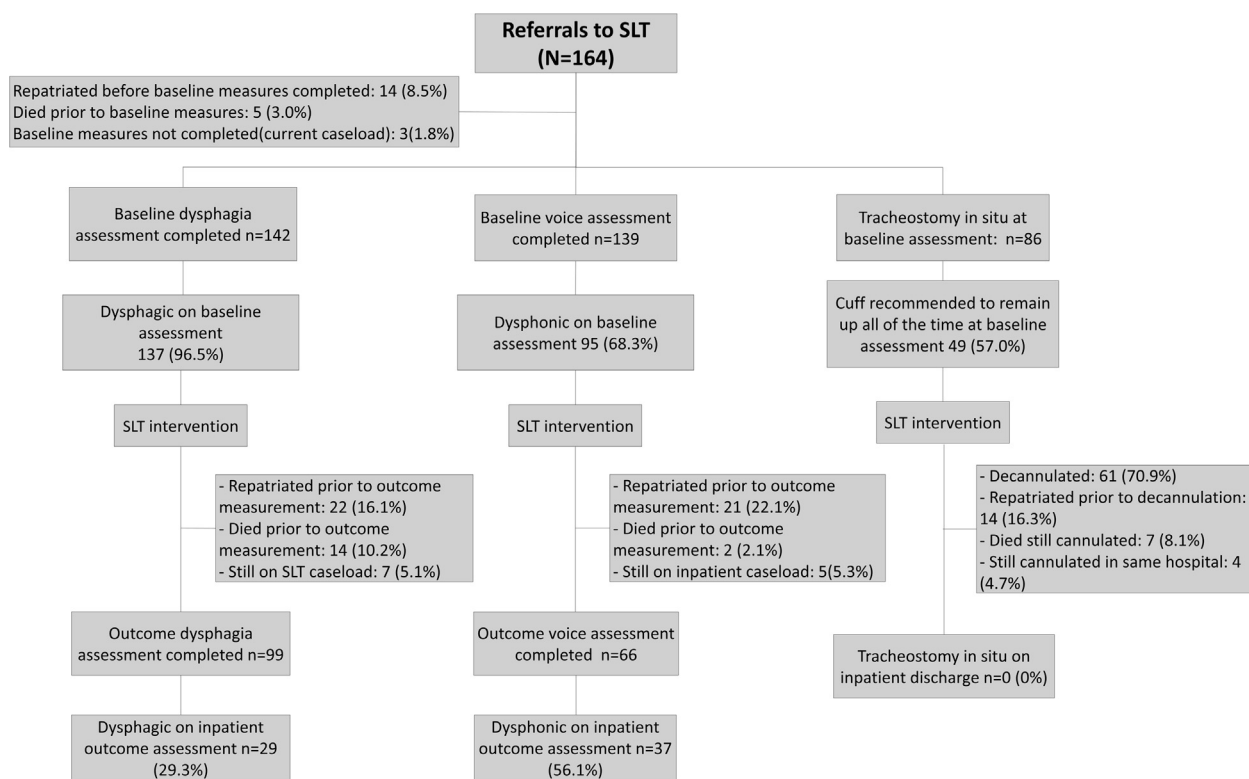


Fig 1 Patient flow and outcomes.

assessment of voice). Therefore, different sample sizes are described for different parameters (see fig 1). The Ear, Nose, and Throat team reviewed 11 patients, with diagnoses inclusive of cord palsies/paresis (n = 3), granuloma (n = 5), and edema (n = 3).

Fiberoptic endoscopic evaluation of swallowing (FEES) was indicated in 26.8% (n = 44) of patients. However, none could be conducted due to the National advice against conducting therapist-led endoscopy that was in place at the time.²⁹ A minority (4.3%, n = 7) had a videofluoroscopy. All patients with dysphagia received clinical swallowing assessment, which informed

management. Individualized compensatory strategies were recommended to all of these patients, including postural changes and modification of bolus volume, consistency, and rate of presentation to enable timely and safe return of oral intake. Specific direct dysphagia exercises aimed at muscle strengthening were indicated for 11% (n = 18). More than three-quarters (76.2%, n = 125) commenced oral intake during the SLT episode of care, with a median time from initial assessment to starting oral intake of 2 days (range, 0-8d).

The majority (70.9%) of the 86 tracheostomized patients were decannulated during the study, with no failed decannulations. Median time with a tracheostomy was 19 days (IQR, 16-27d). No patients were discharged home with a tracheostomy (see fig 1). There were 41 paired observations for the tracheostomy TOM outcome measure, with a median initial TOM of 0 (range, 0-1) and a median discharge TOM of 5 (P < .00001).

There were significantly fewer patients with dysphonia at outcome than on initial assessment (P < .0001) (see fig 1). There were 66 paired (initial vs outcome) observations for voice, with a median initial GRBAS of 2 (range, 0-3) and outcome GRBAS of 0 (range, 0-1) (P < .00001). Of the 95 patients presenting with dysphonia at initial assessment (see fig 1), 94% (n = 90) had been intubated and 57.4% (of the 61 previously intubated patients assessed at outcome) remained dysphonic at discharge from hospital. Prevalence of dysphonia at initial assessment in the 105 previously intubated patients who had a voice assessment was 85.7% (n = 90). Of the 5 patients with dysphonia with no intubation history, 2 resolved by hospital discharge, 1 had died, and 2 had ongoing mild dysphonia. In those who had been intubated, there was no significant difference in length or number of intubations between patients with dysphonia that resolved during

Table 2 Neurological function and discharge destination

Measure	n (%)
Assessment of neurologic function	142 (86.5)
New neurologic impairment	19 (13.4)
Category of neurological impairment	
Stroke	4 (2.8)
Cranial nerve impairment	9 (6.3)
In absence of stroke	8 (5.6)
Cognitive/cognitive-communication impairment	9 (6.3)
In absence of stroke/other neurologic signs	4 (2.8)
Destination on discharge	
Met all SLT goals	57 (37.3)
Other hospital transfer	36 (23.5)
Voice pathway referral	25 (16.3)
Community SLT referral for dysphagia	12 (7.8)
Voice pathway + community referral	3 (2.0)
Deceased	20 (13.1)
Still on inpatient caseload	11 (6.7)

their inpatient stay (mean, 14.6±6.8d) vs those with ongoing dysphonia (14.9±6.3d) ($P=.54$). There was no difference in frequency of dysphonia or severity on initial or final assessment between those patients who were prone when intubated ($n=59$; median outcome GRBAS, 1; IQR, 0-1.5) and those not prone ($n=50$; outcome GRBAS, 1; IQR, 0-1).

Outcome measures on discharge from hospital for presence and severity of dysphagia were possible on 99 patients, 70.7% ($n=70$) of whom had fully resolved. There were significantly fewer patients with dysphagia on outcome than on initial assessment ($P<.0001$) (see [fig 1](#)). Of those who were still dysphagic ($n=29$), 9 (31%) had been intubated, with a mean intubation time of 11.4 days (7.0d) compared with 66 (94%) of those who had resolved, with a mean intubation time of 14.1 days (7.0d). The difference in intubation time was not significant. Of those who had persistent dysphagia, 4 (13.8%) had premonitory swallowing problems and 10 (34%) had a previous neurologic diagnosis, compared with 10.3% ($n=7$) of those patients who had resolved. Of those with persistent dysphagia who had not been intubated, 70% ($n=14$) had either preexisting dysphagia or a neurologic diagnosis. Outcome measurement for swallowing was only possible in 20 patients who had been prone, but there was no difference in dysphagia TOM score between those who had been prone (median TOM, 5; IQR, 4-5) and those who had not been prone ($n=86$; median TOM, 5; IQR 3-5). Further outcome measures are shown in [table 2](#).

Discussion

This study evaluated the presentations and outcomes of inpatients referred to SLT with COVID-19. It was hypothesized that there would be high rates of significant dysphagia and dysphonia associated with intubation and this was proven. Most patients referred for swallowing input had a high and constant risk of aspiration and were nil by mouth after initial assessment, and more than two-thirds presented with dysphonia. The average length of intubation was long, far exceeding the time known to increase the risk of dysphagia and dysphonia.^{11,16} In addition, the need to see patients in critical care and for tracheostomy weaning was high.

Despite this high SLT need, there was a general trajectory of improvement, with most patients resuming some oral intake within 2 days of SLT input. Indeed, the hypothesis that the majority of patients would have ongoing SLT needs on hospital discharge was not supported for dysphagia. Only one-third had any ongoing dysphagia at the end of their inpatient stay, which is consistent with postextubation dysphagia after acute respiratory distress syndrome.¹⁰ Furthermore almost all had completed their SLT goals at hospital discharge, with fewer than 10% requiring SLT community follow up for swallowing.

Of note, the majority of patients who had persistent dysphagia in the absence of intubation had a history of neurologic dysfunction and/or preexisting dysphagia, suggesting that the most important mechanisms at play are intubation or premonitory impairment. The study hypothesis that patients with persistent dysphagia would have had a longer intubation time than those who resolved was not proven, but notably the numbers were too small for reliable statistical testing. In addition, all intubated patients in the study had prolonged intubations, surpassing the duration at which the additional risk from intubation time plateaus (6d).¹¹

Contrastingly, and supportive of the study hypothesis, more than half of patients remained dysphonic on discharge from hospital, requiring referral for ongoing follow-up and justifying the establishment of robust pathways of care. The majority of patients with dysphonia had been intubated, and for longer than 5 days, which is known to risk laryngeal injury and vocal impairment.¹³ As such, this finding is not surprising considering that resolution of postextubation dysphonia can take weeks to months.³⁰ Promisingly, and contrary to the a priori hypothesis, proning did not appear to affect the prevalence of dysphonia or dysphagia, but further studies are indicated to assess whether length of time prone has an effect. Only 2 patients were discharged from hospital with dysphonia without an intubation history, suggesting that other factors may be influencing the development of dysphonia in a small minority, with laryngeal irritation from persistent coughing being one potential mechanism.

More than half of the patients referred to SLT had a tracheostomy, yet contrary to the study hypothesis there was good success in weaning, with the majority decannulated. Although intensive multiprofessional input is required in any tracheostomy wean, it is encouraging that the average wean was 19 days, which is reasonable in the context of other patient cohorts,³¹ and no patients required discharge from hospital while still cannulated.

FEES is a routine part of dysphagia management. However, at the time of the study, national guidelines prohibited its use due to concerns about infection control.²⁸ It was surprising that only a small proportion were identified as needing FEES, which may have been skewed by therapists adapting decision making while knowing it was inaccessible. In usual practice, FEES is conducted with all tracheostomized patients who are on mechanical ventilation to enable safe and early return to oral intake in the context of reduced airway protection and patient vulnerability. The small number identified as needing FEES may also reflect the change in practice based on the guidance at the time to avoid cuff deflation during mechanical ventilation.²⁸ Incorporating FEES would have been best practice and tracheostomy weaning and/or return to full oral diet may have been expedited if instrumental assessments were readily available.

A responsive SLT service was achieved, with the majority of patients seen on the day they were referred. All patients had individualized management plans to support recovery from dysphagia and dysphonia and to guide the tracheostomy wean where appropriate. Normally, setting up patients on specific direct exercise programs to support rehabilitation from dysphagia is standard. In this cohort, however, exercises were only indicated in a small minority, with patients instead receiving compensatory strategies. This may have been related to the paucity of instrumental assessment to guide physiological rehabilitation. In addition, the high incidence of delirium is likely to have impeded establishing therapy programs. The frequency of delirium is comparable to findings from other COVID-19 studies.³² In any case, the majority of patients improved from significant levels of impairment, suggesting that adopting a responsive individualized approach to care met the needs of the majority. This is consistent with the findings of Lima et al,⁷ who found more rapid resolution in swallowing function in postextubation COVID-19 patients than non-COVID patients, with an emphasis on assessment and compensatory strategies, suggesting that weakness may not be the main cause for dysphagia in this patient group.

Study limitations

This study focused only on inpatients presenting to the hospital and, as the hospital Trust has a large critical care capacity, the sample was skewed toward the more severe end of the COVID-19 population. However, given that only a small proportion had ongoing needs upon leaving the hospital despite being from this more severe sample, our findings are encouraging.

Only patients referred to SLT were included in this study and therefore prevalence data for the impairments described in the COVID-19 population as a whole is not represented. It is possible that dysphonia or milder deficits could have been overlooked by patients and ward staff. However, robust systems of screening and referral were in place, with high physical presence on the wards to facilitate referrals as needed. One-quarter of patients were transferred to other inpatient facilities with ongoing SLT needs and 13% died, leading to missing outcome data. Following up patients at other institutions was beyond the scope of this study, but it is considered that the numbers on which outcome measures were obtained are reasonable to further understanding of patient trajectory.

In the absence of readily available instrumental assessment, outcomes were based on clinical assessment rather than “criterion standard” examinations. In addition, due to priorities dictated by the pandemic and the need for infection risk management, measurements were taken by the treating therapists, leading to a risk of observer bias. However, validated measures were used to increase reliability and all therapists were highly trained and experienced in their use.

The original aim was to collect the number and duration of proning episodes. However, this level of detail was not consistently documented in the medical record, reflecting the rapid introduction of this treatment. Similarly, grade of intubation is normally recorded very reliably, but intubations were frequently occurring on the medical wards or before patients were transferred to the Trust, so this information was not included. A more challenging intubation could lead to increased effect on swallowing and voice, and this should be considered in future work.

This study did not collect patient-related outcome measures, which would have been invaluable for determining individuals’ perceptions of their outcomes. This was again due to the rapidly developing clinical context and enforced priorities among which the study was set up and also the high incidence of delirium. It was also beyond the scope of this study to capture longer term outcomes and further work is warranted, especially considering the high rate of intubation and any long-term effect this may have on the airway.

Conclusions

COVID-19 presents a large burden of severe dysphagia and dysphonia, requiring considerable SLT resource to meet patients’ needs. However, with appropriate specialist care, a significant proportion improve and the caseload reflects a postcritical illness cohort, with the effect of intubation on voice and swallowing seemingly paramount. Services adapting to COVID-19 need to allow for concentrated input for tracheostomy weaning and to provide proactive and responsive management to optimize patient outcome, with robust referral pathways on discharge, especially to meet the needs of patients with new voice impairments. Further studies of this cohort are indicated to determine long-term outcomes.

Keywords

COVID-19; Deglutition disorders; Dysphagia; Dysphonia; Rehabilitation; Speech language pathology; Tracheostomy

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