

## ORIGINAL RESEARCH

# Dysphagia in patients with coronavirus disease undergoing orotracheal intubation

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**Abstract**

**Objective:** To assess the incidence and the risk factors for the development of dysphagia in patients with coronavirus disease 2019 (COVID-19) undergoing orotracheal intubation.

**Study Design:** Prospective cohort study.

**Methods:** In this prospective cohort study, we evaluated consecutive patients diagnosed with COVID-19 and underwent orotracheal intubation were evaluated. During hospitalization, extubated patients were classified as dysphagic and nondysphagic based on bedside functional assessment of swallowing. Patients discharged from hospital were asked to complete the Eating Assessment Tool-10 (EAT-10) questionnaire, followed by an endoscopic examination to identify laryngotracheal lesions, and a fiberoptic endoscopic evaluation of swallowing (FEES). The food consistencies used for FEES were moderately thick, extremely thick, thin, and regular.

**Results:** Based on the functional assessment of swallowing, performed a mean of 5.3 days and a median of 4 days after extubation, the incidence of dysphagia in patients with COVID-19 undergoing orotracheal intubation was 53.6%. In the late evaluation, performed a mean of 102 days after extubation, 12.8% of patients had an EAT-10 score >2. Orotracheal intubation (OTI) duration and tracheostomy were risk factors for the development of dysphagia. There was an association between EAT-10 > 2 and the presence of laryngotracheal lesion, with no difference between lesion type and EAT score >2.

**Conclusions:** The incidence of dysphagia varied according to the time of assessment, being higher the earlier the assessment after extubation. OTI duration and tracheostomy were risk factors for the development of dysphagia, and the presence of laryngotracheal lesions demonstrated an association with dysphagia.

**Level of Evidence:** 3.

**KEYWORDS**

COVID-19, dysphagia, endotracheal intubation, larynx, SARS-CoV-2

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## 1 | INTRODUCTION

In December 2019, a new disease caused by the severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) emerged and spread around the world, and coronavirus disease 2019 (COVID-19) was declared a pandemic on March 11, 2020 by the World Health Organization.<sup>1,2</sup> SARS-CoV-2 is an RNA virus that can cause symptoms including fever, cough, myalgia, fatigue, odynophagia, and dysphagia.<sup>3-5</sup> The severe form of the disease is characterized by acute respiratory distress syndrome (ARDS), which leads to the need for respiratory support using orotracheal intubation (OTI) and mechanical ventilation.<sup>1</sup>

Early OTI is the most recommended first-line intervention for patients infected with SARS-CoV-2 who develop ARDS. This procedure has the potential to trigger acute and chronic symptoms resulting from injury from the endotracheal tube (ETT). OTI is a risk factor for the development of dysphagia, characterized by dysfunctional coordination between swallowing and breathing, which makes patients susceptible to aspiration of saliva and other secretions.<sup>2,6,7</sup>

The assessment of swallowing efficiency is extremely important in COVID-19 survivors because these patients are prone to develop respiratory complications.<sup>8</sup> The objective of this study, therefore, was to assess the incidence of and risk factors for the development of dysphagia in patients with COVID-19 undergoing OTI.

## 2 | METHODS

This study was approved by the Institution's Research Ethics Committee under protocol number 38470620.0.0000.5463. A prospective cohort study of consecutive patients undergoing OTI and diagnosed with COVID-19 using real-time polymerase chain reaction test (RT-PCR) and admitted to a tertiary hospital from March 1 to October 31, 2020, was performed.

OTI was performed by the institution's rapid response team, which was composed of members of the anesthesiology team. All patients undergoing OTI were evaluated for outcomes, including death or extubation, followed by evaluation from the dysphagia team, which was composed of speech-language pathologists specialized in dysphagia from the institution's department of speech-language pathologists. Patients extubated and evaluated by the dysphagia team during hospitalization were classified as dysphagic or nondysphagic based on bedside functional assessment of swallowing, that was restricted from invasive methods to reduce the exposure of the dysphagia team in the pandemic. Functional evaluation of swallowing included the initial administration of homogeneous creamy foods, followed by fractionated liquefied creamy foods, and then solid foods.<sup>9,10</sup>

Patients discharged from hospital were called for outpatient follow-up to complete the Eating Assessment Tool-10 (EAT-10)<sup>11,12</sup> questionnaire, followed by endoscopic examination (video flexible rhino-pharyngo laryngoscopy and video-laryngoscopy) for diagnosis

of laryngotracheal lesions and fiberoptic endoscopic evaluation of swallowing (FEES). Patients with an EAT-10 score >2 underwent FEES. All patients who participated in this stage of the study completed the informed consent for the videoendoscopy exams.

Patients underwent laryngotracheal endoscopic examination using a flexible rhino-laryngoscope (11101 RP2, Karl Storz SE & Co., Tuttlingen, Germany) and a laryngeal endoscope (8706 CA, Karl Storz SE & Co.). The monitor used was the Tele Pack X LED Karl Storz system (Endoscope, TP 45-1 06/2014/EW-PT, Karl Storz SE & Co.). The tests were recorded on a flash drive (SanDisk Ultra USB 3.0 64 GB, SDCZ48-064G; SanDisk, Milpitas, CA, USA). Laryngotracheal endoscopy stages included static assessment of the larynx (supraglottis, glottis, and subglottis) and trachea during inspiration, maximum phonation time, and emission of the vowels /e/ and /i/. Videos for the diagnosis of laryngotracheal lesions were independently analyzed by three laryngologists who were blinded to patient data. The food consistencies used for FEES were moderately thick (IDDSI—Level 3), extremely thick (IDDSI—Level 4), thin or liquid (IDDSI—Level 0), and regular (IDDSI—Level 7).<sup>13</sup> The administered volumes were 3, 5, 10, and 15 ml. The parameters analyzed included saliva stasis in the valleculae and piriform recesses and, after three successive swallows, the presence of laryngeal penetration, laryngotracheal aspiration, and food residue at the base of the tongue, valleculae, and piriform recesses. Videos for the diagnosis of swallowing disorders were analyzed by a multidisciplinary team comprising two laryngologists and a speech-language pathologist specialized in dysphagia, who were all blinded to patient data.

Patients who presented with dysphagia before COVID-19 diagnosis, those unable to undergo testing, and those absent a COVID-19 RT-PCR laboratory diagnosis were excluded. The pre-existing dysphagia was identified through patient self-report. The following data were collected to evaluate the included patients: age; sex; comorbidities (systemic arterial hypertension, diabetes mellitus, and obesity); ETT size; OTI duration (days); tracheostomy; need for reintubation; time between extubation and assessment by the speech-language pathologists team (days); patient classification into dysphagic and nondysphagic; length of hospital stay; length of intensive care unit (ICU) stay; length of ICU stay after extubation; length of hospital stay after extubation (days); and, finally, presence of laryngotracheal lesion(s). Laryngotracheal lesions were classified as inflammatory (hyperemia and granulomas) and scarring (stenoses).

The data collected formed a database developed in a spreadsheet (Excel for Windows, Microsoft Corporation, Redmond, WA, USA) and statistical analysis was performed using STATA release 11 (StataCorp, LLC, College Station, TX, USA). The variables evaluated are presented in tables with absolute and relative frequency distribution. Associations were analyzed using Pearson's chi-squared test or Fisher's exact test, when necessary. Statistical significance of mean differences between quantitative variables was verified using the unpaired Student's *t*-test. The binary logistic regression test was used to analyze the correlation between continuous and categorical variables and outcomes. The results were considered statistically significant when the *p* value was <.05.

## 3 | RESULTS

During the study period, 1357 patients diagnosed with COVID-19 by molecular nasal swab RT-PCR were admitted. OTI was required in 421 (31%) patients for mechanical ventilation. Patients undergoing OTI experienced the following outcomes: death ( $n = 249$  [59.1%]); extubation followed by assessment from the dysphagia team ( $n = 112$  [26.6%]); and extubated but not evaluated during hospitalization by the dysphagia team ( $n = 60$  [14.3%]). It was not possible to assess all patients due to the high demand caused at the beginning of the pandemic, which overloaded health services. The group of extubated patients ( $n = 172$ ) had a mean ( $\pm$ SD) age of  $60.5 \pm 13.5$  years (19–94 years), with a male to female ratio of 1:1. The mean age of male patients was  $58 \pm 14.3$  years (19–89 years), and  $63 \pm 12.3$  years (21–94 years) for females, with a statistically significant difference ( $p = .015$ ).

Speech-language pathologist therapy evaluation was performed between 1 and 24 days after extubation (mean of 5.4 days, median of 4 days), with a mean of 5.3 days and a median of 4 days for the dysphagia group and a mean of 5.6 days and a median of 4 days for non-dysphagia group ( $p = .609$ ). Among extubated patients evaluated by the speech-language pathologists, 53.6% were classified as dysphagic ( $n = 60$ ). Patients with dysphagia had a mean age of  $62.9 \pm 10.7$  years (33–89 years) and those without dysphagia had a mean age of  $58.9 \pm 14.2$  years (19–82 years), without a statistically significant difference (Table 1).

The mean OTI duration for dysphagic patients was  $12.6 \pm 7.9$  days (range, 3–36 days), and  $10.4 \pm 8.4$  days (range, 3–39 days) for nondysphagic patients. OTI duration (days) was an important risk factor for the development of dysphagia (Table 1). Tracheostomy was performed in six (5.4%) patients among those who were extubated and evaluated by the speech-language pathologist team ( $n = 112$ ), all of whom were considered dysphagic (Table 2), which was statistically significant ( $p = .019$ ). Dysphagic patients experienced a statistically

**TABLE 1** Binary logistic regression test for assessing the risk of dysphagia in COVID-19 patients undergoing OTI

Variables	OR	95% CI	p-value
Age (years)	1.0219	(0.9972–1.0472)	.083
Sex	1.3606	(0.7250–2.5534)	.338
OTI duration (days)	1.0518	(1.0072–1.0983)	.009
Tube size (mm)			.469
7.0 vs. 7.5	4.8293	(0.5740–40.6280)	
7.0 vs. 8.0	5.4643	(0.6629–45.0394)	
7.0 vs. 8.5	4.5	(0.3740–54.1474)	
7.5 vs. 8.0	1.1315	(0.5786–2.2128)	
7.5 vs. 8.5	0.9318	(0.2122–4.0915)	
8.0 vs. 8.5	0.8235	(0.1932–3.5106)	

Abbreviations: CI, confidence interval; COVID-19, coronavirus disease 2019; OR, odds ratio; OTI, orotracheal intubation.

increased length of hospital stay, ICU stay, ICU stay after extubation, and hospital stay after extubation (Table 3).

In outpatient evaluation, 94 (54.7%) patients were re-evaluated and completed the EAT-10 questionnaire,<sup>11,12</sup> followed by videolaryngoscopy for the diagnosis of laryngotracheal lesions. The group of patients discharged from hospital and not examined accounted for 45.3% of the sample ( $n = 78$ ). Reasons for absence included not being possible to contact 34 (19.8%) patients, 24 (14%) were unable to attend, 15 refused evaluation (8.7%), and 5 died after hospital discharge (2.9%). Patients who were discharged from the hospital and were not evaluated due to impossibility of contact (19.8%) represented a random loss and possibly would not interfere in the results. Patients who refused to participate represented a small portion of the sample (8.7%). At this stage of the study, the mean age of patients with COVID-19 undergoing OTI was 60.5 years. Outpatient evaluation was performed between 25 and 185 days, with a mean of 102 days and a median of 93 days. Laryngotracheal lesions were evident in 37 (39.4%) patients, with 23 (62.2%) inflammatory and 14 (37.8%) scarring. In the inflammatory lesion group, four (17.4%) patients had an EAT-10 score  $>2$  and, in the scarring lesion group,

**TABLE 2** Characteristics of COVID-19 patients undergoing OTI evaluated by the speech-language pathologist team

Variables	Dysphagia		p-value
	Yes, N (%)	No, N (%)	
Sex			.597
Male	33 (56)	26 (44)	
Female	27 (51)	26 (49)	
Comorbidities			
SAH	33 (52)	30 (48)	.775
DM	12 (48)	13 (52)	.149
Obesity	16 (53)	14 (47)	.976
Tube size (mm)			.972
7.0	1 (50)	1 (50)	
7.5	22 (51)	21 (49)	
8.0	34 (55)	28 (45)	
8.5	3 (60)	2 (40)	
OTI duration (days)			.096
<5	6 (35)	11 (65)	
5–10	25 (50)	25 (50)	
>10	29 (64)	16 (36)	
Tracheostomy			.019
Yes	6 (100)	0 (0)	
No	54 (51)	52 (49)	
Need for reintubation			.411
Yes	6 (67)	3 (33)	
No	54 (52)	49 (48)	

Abbreviations: COVID-19, coronavirus disease 2019; DM, diabetes mellitus; N, number of patients evaluated; OTI, orotracheal intubation; SAH, systemic arterial hypertension.

**TABLE 3** Consequence of dysphagia at different moments of hospitalization in COVID-19 patients undergoing OTI

Moment	Dysphagia		p-value
	Yes, mean ± SD	No, mean ± SD	
Length of hospital stay (days)	36.8 ± 18.7	29.7 ± 17.5	.040
Length of ICU stay (days)	16.7 ± 11.1	12.6 ± 10.2	.049
Length of ICU stay after extubation (days)	4 ± 4.8	2.5 ± 2.1	.034
Length of hospital stay after extubation (days)	24.4 ± 13.5	19.3 ± 12.7	.043

Abbreviations: COVID-19, coronavirus disease 2019; ICU, intensive care unit; OTI, orotracheal intubation.

four (28.6%) had an EAT-10 score >2. Administration of the dysphagia questionnaire (i.e., EAT-10) revealed that, of the 94 patients undergoing OTI, 12 (12.8%) had an EAT-10 score >2. In this group, eight patients had a diagnosis of laryngotracheal injury, with an association between an EAT-10 >2 and the presence of laryngotracheal injury ( $p = .038$ ). However, there was no statistical difference between lesion type (i.e., inflammatory or scarring) and EAT score >2 ( $p = 0.423$ ).

Of the 12 patients with EAT-10 score >2, 9 (75%) were re-evaluated and underwent FEES a mean of 27.2 days after administration of the questionnaire. In this sample, only one 75-year-old patient (evaluated 134 days after extubation) exhibited changes in FEES, including vocal fold immobility in paramedian position due to stenosis in the posterior region of the glottis, saliva stasis in the valleculae and piriform recesses, hypopharynx and epiglottis hypesthesia, early escape, laryngeal penetration, and laryngotracheal aspiration of liquids (5 ml), and residue in the piriform recesses with fine creamy and solid food consistencies. Five days after hospital discharge from COVID-19 treatment, this patient required readmission to treat an episode of pneumonia. The reasons for the absence of three (25%) patients who were not evaluated at this stage included inability to contact ( $n = 1$ ), clinical inability to attend the test ( $n = 1$ ) and moved to another state ( $n = 1$ ).

## 4 | DISCUSSION

The incidence of dysphagia in patients undergoing OTI varies widely (3%–83%), which may be explained by the use of different study methods, time of patient assessment, diagnostic methods, and population heterogeneity (trauma, stroke, acute myocardial infarction, and postoperative period).<sup>6,14,15</sup> Thus, the literature emphasizes that patients undergoing prolonged OTI and with risk factors for dysphagia and aspiration should undergo early speech-language pathologists assessment.<sup>16</sup> Because it is a noninvasive, rapid, and low-cost assessment method, it widely used as the only means of assessing dysphagia in some hospitals.<sup>17</sup> In the present study, patients with COVID-19 undergoing OTI were evaluated early after extubation (mean of 5.4 days, median of 4 days), with an incidence of swallowing disorders of 53.6%. This sample only included COVID-19 patients to avoid heterogeneity and to reduce the risk for variable incidence of dysphagia due to other OTI indications. When assessed later, dysphagia was

observed in 12.8% of COVID-19 patients undergoing OTI. In outpatient evaluation, it was possible to evaluate 54.7% of the patients in a mean of 102 days after extubation, with 16.9% not being present due to physical disability or death after hospital discharge.

Male patients experienced a more severe course of COVID-19 at an earlier age than females ( $p = .015$ ). This disease behavior may be related to hormonal factors and the higher prevalence of comorbidities in males (hypertension, smoking, and coronary artery disease).<sup>18–22</sup> The onset of dysphagia can be triggered by the aging process.<sup>23–26</sup> In the literature, the correlation of age as a risk factor for the development of dysphagia after OTI is controversial for non-COVID patients.<sup>7,14,27–31</sup> In this study, elderly COVID-19 patients undergoing OTI did not have a higher risk for developing dysphagia than younger patients.

Increased OTI duration and the length of ICU stay are associated with a higher incidence of swallowing disorders.<sup>32–36</sup> Reinforcing the literature, in this study, COVID-19 patients with a prolonged OTI duration (Table 1) and ICU stay (Table 3) had a higher risk for developing dysphagia. Tracheostomy is a common procedure, usually performed between seven and 10 days in patients undergoing prolonged OTI to prevent laryngotracheal injury.<sup>37–39</sup> In the context of COVID-19, there is a tendency to delay tracheostomy due to the higher risk for contaminating health professionals during the procedure and in aftercare.<sup>37,40–43</sup> Rouhani et al. analyzed 41 COVID-19 patients undergoing tracheostomy due to prolonged OTI and reported altered EAT-10 scores in 30% of patients after 2 months of follow-up.<sup>44</sup> In the present study, 100% of COVID-19 patients undergoing tracheostomy due to prolonged OTI, with bedside functional assessment of swallowing, on average 2.6 days after extubation, exhibited dysphagia (Table 2), with a statistically significant difference ( $p = .019$ ). These different incidences can be explained by the different methods used to assess dysphagia and the time of assessment after extubation.<sup>28</sup>

Patients developing swallowing disorders during ICU stay are more likely to experience adverse health events such as poor nutritional intake, dehydration, aspiration pneumonia, and death. In addition, dysphagia leads to a prolonged length of hospital stay and increases morbidity and mortality rates.<sup>4,45,46</sup> The presence of dysphagia predicted an increased length of hospital stay, ICU stay, ICU stay after extubation, and hospital stay after extubation (Table 3). This indicates that dysphagic patients are more susceptible to develop complications, which delays hospital discharge and increases health care costs.<sup>28,47–50</sup>

The association between dysphagia and laryngeal findings in COVID-19 patients treated in the ICU remains poorly described in the literature. In a recent study, Osbeck Sandblom et al. reported that 76% of COVID-19 patients with dysphagia admitted to the ICU exhibited compromised vocal fold movement and that 60% had vocal fold hyperemia and edema in the arytenoid region.<sup>51</sup> In the present study, 39.4% of COVID-19 patients undergoing OTI exhibited laryngotracheal lesions, 62.2% inflammatory and 37.8% scarring, on average, 102 days after extubation. This sample demonstrated an association between laryngotracheal injury and swallowing disorders ( $p = .038$ ) regardless of the type of injury ( $p = .423$ ). Therefore, laryngotracheal injuries affect the mechanics, aerodynamics, and protective reflexes of the upper airways.<sup>29,52-54</sup> This emphasizes the importance of monitoring dysphagic patients after hospital discharge, especially those developing laryngotracheal lesions after OTI because they are more prone to experience microaspirations and recurrent pneumonia.

During the COVID-19 pandemic, health services should be prepared for the adequate assessment and treatment of patients with oropharyngeal dysphagia. Thus, it is necessary to consider swallowing disorder complications and care of health professionals exposed to the risk for aerosol contamination.<sup>55</sup> FEES is an adequate method and is considered to offer adequate sensitivity and specificity for diagnosing dysphagia.<sup>56-58</sup> In this study, there was a need to balance the risks and benefits of aerosol exposure, and FEES was performed as the last assessment method. On average, 129.2 days after extubation, only one patient exhibited persistent laryngeal penetration and laryngotracheal aspiration.

The context of the COVID-19 pandemic represents a limitation for video-endoscopy. Thus, it was not possible to evaluate patients at specific times (e.g., 90, 120, and 180 days). However, it was possible to verify that the diagnosis of laryngotracheal lesions in patients with COVID-19 undergoing OTI had an association with swallowing disorders or EAT-10 score  $>2$ .

## 5 | CONCLUSION

The incidence of dysphagia varied according to the time of assessment, and was more prevalent the earlier the assessment after extubation. OTI duration and tracheostomy were risk factors for the development of dysphagia, and the presence of laryngotracheal lesions demonstrated an association with dysphagia, regardless of lesion type (i.e., inflammatory or scarring).

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### CONFLICT OF INTEREST

The authors declare no conflict of interest.

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