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Tracheostomy and Dysphagia in Patients with COVID-19. Its Impact on the Decannulation Process

Traqueostomía y disfagia en pacientes con COVID-19. Su impacto en el proceso de decanulación

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ABSTRACT

Introduction: Patients with severe COVID-19 pneumonia may require orotracheal intubation, prolonged mechanical ventilation, and tracheostomy. The presence of a tracheostomy cannula does not contribute by itself to the development of dysphagia, but the frequency of dysphagia in these patients is high and with risk of aspiration.

Objective: To describe the prevalence of oropharyngeal dysphagia in patients who required tracheostomy after prolonged mechanical ventilation secondary to COVID-19, assessed by an instrumental method. As a secondary objective, to evaluate the association between the presence of dysphagia and clinical-demographic variables, the duration of invasive mechanical ventilation, days of artificial airway, presence of laryngeal injuries, and length of stay in the Intensive Care.

Methods: Observational, longitudinal, retrospective study conducted at the Hospital Juan A. Fernández, Autonomous City of Buenos Aires (CABA), Argentina. Tracheostomized patients diagnosed with COVID-19 were consecutively included in the study. The presence of dysphagia was assessed by an endoscopic study of swallowing at the time of decannulation.

Results: A total of 69 tracheostomized patients undergoing decannulation were included in the study. 65 of these patients were evaluated through swallowing endoscopy, and 50 were diagnosed with dysphagia (76.9 %). The median number of tracheostomy days was 32. When comparing tracheostomy days between the group without dysphagia (median of 21 days) and the group with dysphagia (median of 36 days), statistically significant differences were reported between both groups (p=0.015).

Conclusion: Oropharyngeal dysphagia was prevalent in this cohort of COVID-19 patients. A significant association was found between patients with more tracheostomy days until decannulation and the development of dysphagia.

Key words: Covid-19; Decannulation; Swallowing; Dysphagia; Laryngeal injuries

RESUMEN

Introducción: Los pacientes con neumonía grave por COVID-19 pueden requerir intubación orotraqueal, ventilación mecánica prolongada, y traqueostomía. La presencia de una cánula de traqueostomía no implica por sí misma el desarrollo de disfagia, pero la frecuencia de disfagia en estos pacientes es alta con riesgo de aspiración.

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Objetivo: Describir la prevalencia disfagia orofaríngea en pacientes que requirieron traqueostomía luego de ventilación mecánica prolongada secundaria a COVID-19, valorada mediante un método instrumental. Como objetivo secundario, evaluar la asociación entre la presencia de disfagia y variables clínico-demográficas, duración de la ventilación mecánica invasiva, días de vía aérea artificial, presencia de lesiones laríngeas y días de estadía en terapia intensiva.
Métodos: Estudio observacional, longitudinal y retrospectivo, realizado en el hospital Juan A. Fernández, CABA, Argentina. Se incluyeron de manera consecutiva pacientes con diagnóstico de COVID-19 traqueostomizado. La presencia de disfagia se valoró mediante estudio endoscópico de la deglución al momento de la decanulación.
Resultados: Un total de 69 pacientes traqueostomizado en proceso de decanulación ingresaron al estudio. De ellos, 65 pacientes fueron analizados y evaluados mediante endoscopía de la deglución y 50 se diagnosticaron con disfagia (76,9 %). La mediana de días de traqueostomía fue de 32; al comparar los días de traqueostomía entre el grupo sin disfagia (mediana 21 días) y el grupo con disfagia (mediana 36), se observaron diferencias estadísticamente significativas entre ambos grupos (p=0,015).
Conclusión: La disfagia orofaríngea fue prevalente en esta cohorte de pacientes con COVID 19. Los pacientes que tuvieron más días de traqueostomía hasta la decanulación se asociaron significativamente con el desarrollo de disfagia.

Palabras claves: Covid19; Decanulación; Deglución; Disfagia; Lesiones laríngeas

INTRODUCTION

The tracheostomy (TQT) is one of the most frequently performed procedures in the Intensive Care Unit (ICU), with a prevalence of 10 to 15 % of ventilated patients in a multipurpose unit.[1,2] The most common indications include prolonged mechanical ventilation, facilitating access for proper bronchial hygiene, and prevention of laryngeal injuries secondary to orotracheal intubation (OTI), also as treatment for upper airway obstruction.[3] As an advantage, we can say that it facilitates oral feeding, phonation, patient well-being, and reduces the use of sedatives.[4]

On March 11, 2020, the World Health Organization (WHO) declared coronavirus disease 2019 (COVID-19) as a pandemic[5]; approximately 1 every 5 infected people required hospitalization, while 1 every 10 could be admitted to the ICU. Most of these patients required OTI and invasive mechanical ventilation (IMV) due to acute respiratory distress syndrome.[6,7]

Williams et al point out that TQT rates during the pandemic range from 16 % to 61 %, significantly higher than before the pandemic. Additionally, according to the Argentine study SATICOVID, approximately one-quarter of patients on IMV were tracheostomized.[8,9]

Although the TQT itself does not imply the development of dysphagia, it occurs in 11 % to 93 % of tracheostomized patients. The presence of the TQT cannula causes the cessation of the translaryngeal airflow, leading to laryngeal desensitization, glottic closure lack of coordination, and disuse atrophy of the swallowing muscles, which can result in dysphagia.[10.11]

There is growing evidence that the chronicity and severity of the underlying disease, the comorbidities, and recent intubation are determining factors of dysphagia in this patient population; therefore, it should be diagnosed and treated to prevent severe respiratory complications, severe nutritional compromise, even death.[12]

The decannulation of patients with prolonged TQT is not simple, and particularly patients with marginal respiratory reserve and dysphagia are at higher risk of decannulation failure.[13]

The primary objective of this study was to describe the prevalence of oropharyngeal dysphagia in patients who required TQT following prolonged mechanical ventilation secondary to COVID-19, assessed through an instrumental method using a fiberoptic endoscopic evaluation of swallowing (FEES). This study can be performed at the patient's bedside and allows for the evaluation of laryngeal and pharyngeal structures, laryngo-

pharyngeal sensitivity, saliva management, and swallowing of different food consistencies.[14]

A secondary objective was to evaluate the association between the presence of dysphagia and clinical-demographic variables, duration of IMV, days with artificial airway (AA), presence of laryngeal injuries, and length of stay in the ICU.

MATERIALS AND METHODS

This study was conducted in the ICU of the Hospital General de Agudos Dr. Juan A. Fernández (HGAJAF), in the Autonomous City of Buenos Aires, Argentina, from May 2020 to December 2021. The study design was observational, retrospective, and cross-sectional.

Patients older than 18 years admitted to the HGAJAF who had a diagnosis of COVID-19 at hospital admission were consecutively included. Those patients required mechanical ventilation (MV) and TQT, and once they were weaned off, they were referred by the treating medical team to begin the decannulation process.

The following demographic and clinical data were recorded: age, sex, personal history, and days of OTI, TQT and IMV. Additionally, the length of stay in the ICU was calculated.-

The blue dye test was performed when the patient was able to breath spontaneously without ventilatory support for at least 12 hours. This moment was considered the start of the decannulation process, and the result was recorded as positive or negative.

At the time of decannulation, the following elements were evaluated: the presence of delirium using the CAM-ICU tool (Confusion Assessment Method for the Intensive Care Unit); the maximal expiratory pressure (Pemax) with a manometer and through the TQT cannula with the balloon inflated; peak cough flow (PCF) with occlusion of the TQT cannula and with an oronasal mask; and the peripheral muscle strength using the Medical Research Council (MRC) scale.

The fiberoptic endoscopic evaluation of swallowing (FEES) was performed on all patients at the time of decannulation, according to the technique described by Langmore.[15]

The study was conducted by an intensive care physician and a kinesiologist using a disposable flexible videoscope (Ambu® aScope™). Initially, anatomical structures, vocal cord mobility, and glottic closure were evaluated. Then, sensitivity was assessed by touching the epiglottis, arytenoid folds, and vocal cords with the tip of the endoscope. During this phase, the presence of supraglottic and glottic laryngeal injuries was recorded. Posterior commissure ulcers, which are common due to the positioning of the endotracheal tube over the posterior glottic commissure, were not considered for analysis.

For the evaluation of saliva, the Murray scale[16] was used, considering a grade 3 as a risk of aspiration. Semi-solid and blue-colored liquid foods were then administered in three different volumes: 5, 10, and 15 ml, recording each consistency with the penetration-aspiration scale (PAS).[17] The PAS scale was stratified as follows for analysis: a score of 1, where the material does not enter the airway, was considered normal (score 1); scores 2 to 5 (penetration) were grouped and given a value of 2 (score 2), and scores 6 to 8 (aspiration) were grouped with a value of 3 (score 3). Patients who did not complete the food test due to high aspiration risk, difficulty performing swallowing tasks, or inability to follow simple commands were given a score of 0 (zero), and these patients were considered to have dysphagia. Therefore, patients with scores of 0, 2, and 3 were considered to have dysphagia.

Additionally, a trans-tracheostomy evaluation was performed by removing the TQT cannula and inserting the endoscope through the stoma in a cephalic direction to observe the subglottic region and the inferior surface of the vocal cords. This method was used to assess the presence of subglottic lesions.

The study was recorded for review by the evaluation team, and the data were entered into a database for subsequent analysis.

Patients diagnosed with dysphagia received treatment until resolution and/or hospital discharge. Those patients who still had dysphagia at the time of hospital discharge were reevaluated through clinical assessment and/or video fluoroscopy to document this variable.

Statistical analysis

Continuous variables that assumed a normal distribution were reported as mean and standard deviation (SD). Otherwise, the median and interquartile range (IQR) were used. To determine the sample distribution of continuous variables, statistical tests (Shapiro-Wilk test) and graphical methods (histograms and quantile-quantile plots) were used. Two groups were formed based on the presence or absence of dysphagia, as evaluated instrumentally through the FEES. To compare continuous variables, the Student's t-test or the Mann-Whitney U test was used, as appropriate. For the comparison of categorical variables, the Chi-square test or Fisher's exact test was used, as appropriate. A p-value <0.05 was considered significant. Data analysis was performed using IBM SPSS for Macintosh, version 26.0 (IBM Corp., Armonk, NY, USA).

RESULTS

Sample characteristics

A total of 69 tracheostomized patients undergoing decannulation were included in the study. 4 subjects were excluded for the following reasons: 1 for data loss and 3 for not having been evaluated by the FEES. (**Figure 1**)

Table 1 describes the characteristics of the 65 subjects included in the analysis. The median age was 60 years (IQR 50-70), and 18 (27.7 %) were women. Arterial hypertension and obesity were the most prevalent comorbidities.

Dysphagia

A total of 65 patients were evaluated with the FEES, 50 of which were categorized as having dysphagia (76.9 %). During the evaluation with semi-solids, dysphagia was observed in 34 subjects (52.3 %); of the 55 patients evaluated with this consistency, 6 (10.9 %) presented silent aspiration. During the evaluation with

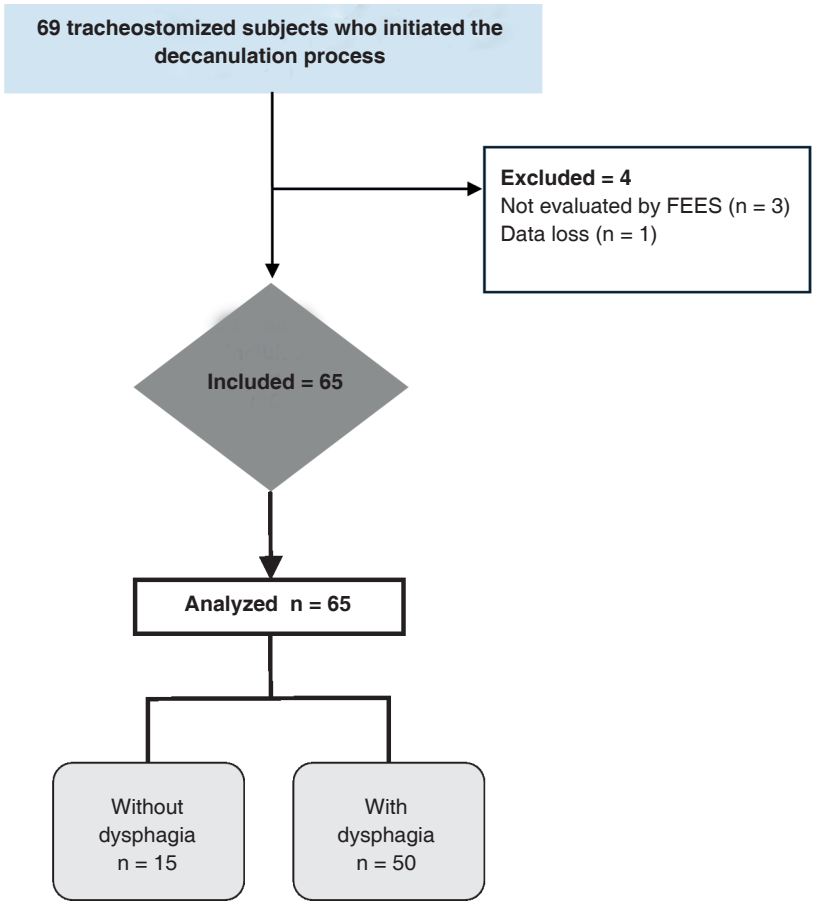

Figure 1. Flow diagram. FEES (fiberoptic endoscopic evaluation of swallowing)

liquids, dysphagia was observed in 47 subjects (72.3 %). Of the 57 patients evaluated with liquids, 17 (29.82 %) presented silent aspiration. **Figure 2** shows the frequency of dysphagia with the consistencies evaluated.

In relation to the evaluation of the presence of saliva, the median score on the Murray saliva scale was 1 point (IQR 1-2). In the group without dysphagia, it was 1 point (IQR 0-1), and in the group with dysphagia, it was 1 point (IQR 1-2) (p=0.009).

The median age of patients without dysphagia was 51 years (IQR 43-60), while for those with dysphagia, it was 62 years (IQR 51.5-70.25) (p=0.045).

The median number of days of IMV was 40.5 (IQR 32.25-48). Comparing the days of IMV between the group without dysphagia [median 41 days (IQR 29-46)] and the group with dysphagia [median 40 days (IQR 32-48)], no statistically significant differences were observed between the two groups (p=0.726).

The median number of days of OTI was 18 (IQR 16.5-21.5). Comparing the days of OTI between the group without dysphagia [median 20 days (IQR 17-27)] and the group with dysphagia [median 18 days (IQR 15-21)], no statistically significant differences were observed between the two groups (p=0.14).

The median number of days of TQT was 32 (IQR 21-60.5). Comparing the days of TQT between the group without dysphagia [median 21 days (IQR 17-33)] and the group with dysphagia [median 36 days (IQR 21 - 63.75)], statistically significant differences were observed between the two groups (p=0.015).

TABLE 1. Characteristics of participants at the time of the evaluation

Variables	All (n = 65)	Without dysphagia (n = 15)	With dysphagia (n = 50)	P value
Females, n (%)	18 (27.7)	6 (40)	12 (24)	0.323
Age, median (IQR), years	60 (50-70)	51 (43-60)	62 (51.5-70.25)	0.045
History, n (%)				
Hypertension	15 (23.1)	1 (6.7)	14 (28)	0.159
Cardiac patients	5 (7.7)	1 (6.7)	4 (8)	0.990
Respiratory patients	7 (10.8)	0 (0)	7 (14)	0.188
Neurologic patients	2 (3.1)	0 (0)	2 (4)	0.990
Diabetes	9 (13.8)	2 (13.3)	7 (14)	0.990
Obesity	22 (33.8)	6 (40)	16 (32)	0.757
Psychiatric patients	4 (6.2)	0 (0)	4 (8)	0.566
Other	21 (32.3)	7 (46.7)	14 (28)	0.214
PP, median (IQR) cycles*	1 (0 - 2)	1 (0 - 6)	1 (0 - 2)	0.804
PCF, median (IQR), L/m†	150 (110-192.5)	190 (115-275)	140 (100-170)	0.086
Pemax, median (IQR), CmH_20 ‡	54 (42-65)	52 (46.25-58.5)	60 (40-70)	0.647
MRC, mean (SD), score§	35 (13.2)	40.3 (11.4)	33.1 (13.4)	0.082

References: IQR (interquartile range); PP (prone position); PCF (peak cough flow); Pemax (maximal expiratory pressure); MRC (Medical Research Council).
* (n = 60); † (n = 50); ‡ (n = 29); § (n = 54).

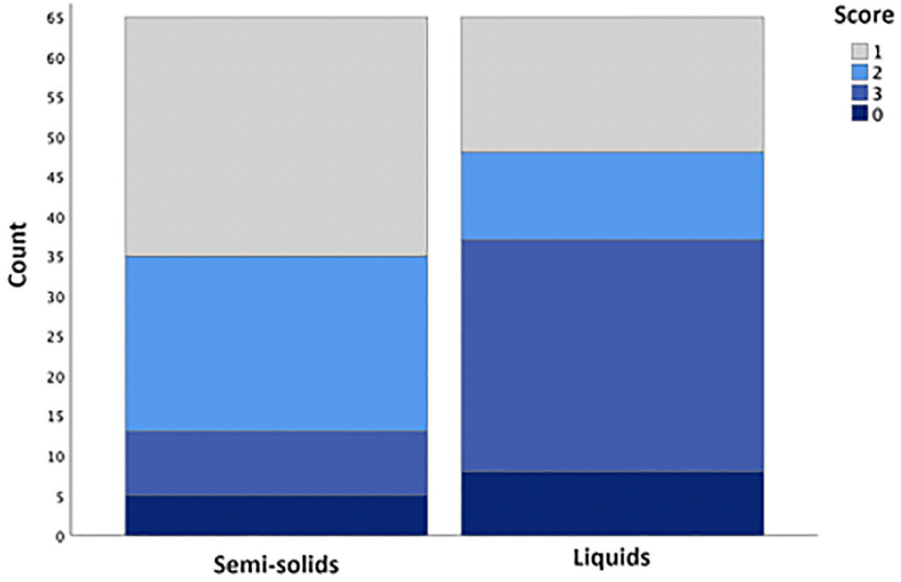

Figure 2. Frequency of dysphagia for semi-solids and liquids

Relationship between the length of stay in the ICU and dysphagia

The median number of days in the ICU was 48 (IQR 38-68.5). Comparing the days of ICU between the group without dysphagia [median 51 days (IQR 37-53)] and the group with dysphagia [median 47.5 days (IQR 38-84.5)], no statistically significant differences were observed between the two groups (p=0.544).

Relationship between the duration of the decannulation process and dysphagia

Regarding the days from the first result of the blue dye test to the removal of the TQT cannula, information was obtained for a total of 61 subjects. The median number of days of the decannulation process was 7 days (IQR 3.5-30). In patients without dysphagia, the median number of days until decannulation was 4.5 days (IQR 3 - 7), compared to 11 days (IQR 4-34) days in the group with dysphagia, showing a statistically significant difference between the two groups (p=0.017).

Laryngeal injury

A total of 41 patients (63.1 %) showed at least one laryngeal injury. Of the 41 cases with laryngeal injury, 31 (75.6 %) had dysphagia, and of the 24 cases without laryngeal injury, 19 (79.2 %) had dysphagia. This relationship was not statistically significant (p=0.74) **(Figure 3)**.

Decannulation failure and dysphagia upon hospital discharge

Two patients failed decannulation (3.07 %). One patient had to undergo a new tracheostomy three weeks after decannulation due to bilateral vocal cord paralysis. One patient required the placement of a Montgomery T-tube due to subglottic stenosis.

At the time of hospital discharge, a swallowing reevaluation was performed on 63 subjects. Dysphagia persisted in twelve of them (19 %).

DISCUSSION

76.9 % of tracheostomized patients with COVID-19 presented with dysphagia for semi-solid and/or liquid consistency at the time of the endoscopic evaluation of swallowing, prior to decannulation. These results are consistent with those of other studies where dysphagia was evidenced using the FEES.[18,19] The prevalence of dysphagia was higher with liquids than with semi-solids, possibly because liquids require greater coordination and synchrony during the pharyngeal stage of swallowing.

Among the patients who could be evaluated with food and showed aspiration, a considerable percentage corresponded to silent aspiration (PAS scale: 8 points). It was 11 % for semi-solid consistency and 30 % for thin liquids. Studies published by Sandblom and Boggiano et al report higher rates of silent aspiration in these cohorts with COVID-19 and TQT.[18,19]

We believe this may be due to the sensory alterations that occur in tracheostomized patients. In this regard, the use of the FEES plays a key role in the timely detection of these events, guiding the rehabilitation plan.

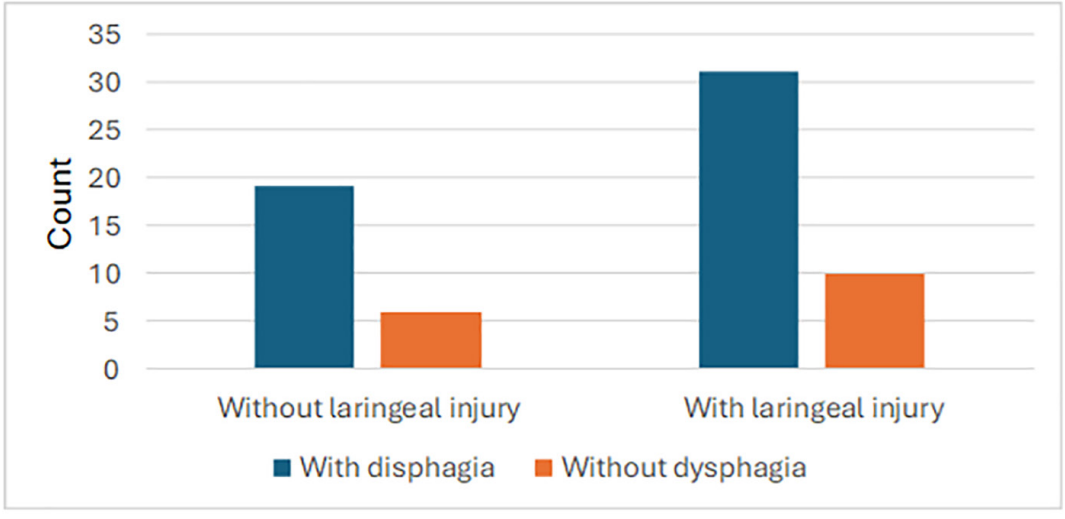

Figure 3. Bar chart with absolute frequencies of dysphagia according to the presence or absence of a laryngeal injury.

Dysphagia is a common comorbidity following critical illness associated with malnutrition, increased risk of aspiration and pneumonia, longer ICU stays, compromised quality of life, and increased long-term mortality risk.[21]

Specifically, in tracheostomized patients, the prevalence of dysphagia prior to the pandemic ranged widely from 11 % to 93 %.[12]

This frequency variability is due to the different evaluation methods used, the criteria for defining dysphagia, and the heterogeneity of the patient populations under evaluation.[19] Therefore, it is difficult to compare the prevalence of dysphagia in this cohort of COVID-19 patients with previous data being so variable.

The relationship between dysphagia and TQT remains a topic of controversy. Available evidence indicates that dysphagia is common in tracheostomized patients, but it does not allow us to infer a causal relationship.[12] There are factors related to the underlying disease or the reason for the TQT, and factors triggered by the presence of an AA, muscle disuse atrophy, disorders in the coordination of breathing and swallowing, alterations in the level of consciousness, all of which impact the airway protection mechanisms. [21]We assume that apart from these factors there are the effects of the COVID-19 virus on the central and peripheral nervous systems, where it has been reported that it could affect sensory and motor functions linked to the swallowing function. Future research is necessary to determine the true impact of the SARS-CoV-2 virus within the physiopathological mechanism of oropharyngeal dysphagia.[22,23]

In our study, the median age was 60 years with a higher percentage of male sex, and a median of 18 days of OTI, similar to the reported data.[24,25] Arterial hypertension and obesity were the most prevalent comorbidities, as reported by the study conducted in Argentina by Estenssoro et al.[9]

We observed a statistically significant difference in the age of the patients when comparing the group with and without dysphagia. The prevalence of swallowing disorders increases with age due to the natural aging process on the oropharyngolaryngeal structures.[26] In elderly tracheostomized patients, functional reserve and the number of days of TQT should be considered as important factors when evaluating the oral intake, as it was evidenced that tracheostomized patients over 70 years old take longer to achieve a safe swallowing process.[21] In the study by González Lindh et al, similar results were observed in patients with very similar ages (64 vs. 53), not being able to demonstrate a significant association between these differences in age range and dysphagia.[27]

In our study, patients with more TQT days were associated with the presence of dysphagia (36 vs. 21 days; p: 0.015 %). Lindh et al observed similar results in a series of 14 patients with COVID-19; although dysphagia was diagnosed clinically. [27] On the other hand, in a series of non-neurological critically ill patients, Romero et al reported that the group with dysphagia experienced a significant delay in the removal of the TQT cannula (50+/-12 vs. 31+/-20; p= 0.01). The interesting aspect of this study is that it demonstrates the presence of dysphagia evaluated through the FEES, even at the beginning of the decannulation process.[28] As mentioned previously, we cannot establish an association or causality, but when dysphagia is present, it could somehow influence the number of TQT days.

Of the 41 patients who showed laryngeal injuries through the FEES, 31 (75.6 %) had dysphagia. We did not find a statistically significant association between laryngeal injuries and the presence of dysphagia, coinciding with the results of our previous study.[29] In the study by Rohuani et al, an association was found between laryngeal injuries evaluated by the FEES and swallowing abnormalities using the self-administered EAT 10 (Eating Assessment Tool) questionnaire.[30] We consider that laryngeal injuries would affect swallowing safety in terms of penetration and/or aspiration.

The decannulation failure rate was 3.07 % (n=2/65), similar to that reported in the multicenter Argentine study DECANULAR conducted on a heterogeneous sample of patients.[31] One of these patients required OTI and connection to IMV due to poor secretion management, and one patient required a new tracheostomy as a consequence of an airway injury. We have not found other research evaluating decannulation failure in COVID-19.

In our study, 19 % of patients presented with dysphagia at the time of hospital discharge, similar to the results reported by the Boggiano study.[19] These patients were followed up on an outpatient basis and via telecommunication until their dysphagia resolved.

As limitations of our study, we can mention that we were unable to access the necessary data

to calculate the total percentage of COVID-19 patients requiring TQT in the ICU of our institution. Therefore, only the subgroup of patients who successfully disconnected from mechanical ventilation and followed the decannulation protocol was analyzed.

CONCLUSION

Oropharyngeal dysphagia was prevalent in this cohort of COVID-19 patients. A significant association was found between patients with more TQT days until decannulation and the development of dysphagia. The use of an instrumental assessment method allowed us to make an early diagnosis and plan the treatment individually.

Conflict of interest

Authors have no conflicts of interest to declare.

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