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Clinical findings of speech therapy swallowing assessments in patients with oropharyngeal dysphagia following orotracheal intubation

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ABSTRACT

Introduction: Endotracheal intubation has been associated with oropharyngeal dysphagia. The aim of this study was to identify the prevalence of oropharyngeal dysphagia among patients in an intensive care unit (ICU) by comparing patients requiring orotracheal intubation with those who did not undergo this procedure.

Methods: This is a cross-sectional study that analyzed the medical records of 681 patients admitted to the ICU of Hospital de Clínicas de Porto Alegre between 2014 and 2017; inclusion criteria were patients aged 18 years and older who had been assessed by the hospital's Speech Therapy Service. Patients who had undergone tracheostomy, who had incomplete medical records or multiple speech-language assessments were excluded.

Results: A total of 380 patients were included in the statistical analysis: 97 (25.5%) had not undergone orotracheal intubation (Group 1), 229 (60.3%) had undergone orotracheal intubation once (Group 2), and 54 (14.2%) had undergone orotracheal intubation on 2 or more occasions (Group 3). Regarding the Functional Oral Intake Scale (FOIS), 61.1% of patients in Group 3 received a FOIS I classification ($p = 0.020$), whereas 16.5% of patients from Group 1 received a FOIS V. Concerning their outcomes, 40.7% of patients in Group 3 died ($p = 0.006$), and 82.5% of patients in Group 1 were discharged from the ICU. Considering the severity of oropharyngeal dysphagia according to the Dysphagia Risk Evaluation Protocol (PARD), no statistically significant association was observed between groups ($p = 0.261$).

Conclusions: In this study, the prevalence of oropharyngeal dysphagia was higher in patients who had undergone orotracheal intubation in the ICU.

Keywords: *Dysphagia; Critical care; Artificial breathing; Intensive care unit; Intubation*

INTRODUCTION

Critically ill intensive care unit (ICU) patients present a variety of factors that increase the risk of aspiration, such as a decreased level of consciousness, excessive sedation and analgesia, a supine resting position, and the insertion of trach, nasointestinal, or endotracheal tubes[1]. In the presence of one or more of these factors, oropharyngeal dysphagia is a common complication that can occur due to neurological, psychogenic, or mechanical impairment, with characteristics that vary from silent to symptomatic. In symptomatic oropharyngeal dysphagia, patients may complain of coughing, choking, or a wet-sounding voice; these signs and symptoms are also frequently perceived by assisting staff or caregivers. Silent aspiration may occur due to a lack of sensation and, thus, an absence of complaints or protective reflexes, hampering the early detection of this disorder[2]. Studies show that, in 44%–87% of cases, patients requiring endotracheal tubes present varying degrees of dysphagia[1,3].

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Since it is an invasive procedure, orotracheal intubation damages the mucosa of the oral cavity, pharynx, larynx, and trachea[4]. It is known that endotracheal tubes, due to their abrasion effect on the mucosa, cause dysphagia and supraglottic edema and decrease laryngeal sensitivity[5]. The swallowing reflex is also compromised when there is damage to the peripheral and bulbar innervation. Aspiration resulting from dysphagia occurs in 14–56% of patients who received mechanical ventilation for 48 hours or more[6]. Traumatic emergency intubations can cause abrasions and/or lacerations during placement of the tube. The tube caliber and high cuff pressures can also result in higher impact injuries such as paralyses and paralyses, which can alter the motor patterns and sensitivity of affected structures[7]. These injuries can happen during the orotracheal intubation period or permanently persist after intubation[8]. Padovani and colleagues[1] report that injuries can occur due to trauma during tube placement and also by agitation of the patient while intubated. Recovery from these injuries begins shortly after extubation, that is, with the removal of the tube[9].

Patients with dysphagia may present complications such as impaired nutritional status, dehydration, and pulmonary infections[6]. The rate of aspiration pneumonia in these patients is high and the chance of death is 3 times higher than that in patients without dysphagia[10].

The need for intensive care of critically ill patients in the ICU requires joint and interprofessional work. In these cases, the speech therapist acts in the early detection of swallowing disorders in order to prevent the occurrence of aspiration. Aspiration of food or secretions into the lower airways causes breathing difficulties and increases patients' length of stay. When aspiration occurs, the patients' general conditions may deteriorate, rendering them unstable and increasing the probability of death[11,12].

The present study aims to identify the prevalence of oropharyngeal dysphagia in ICU patients by comparing those without endotracheal tubes to those who received treatment with endotracheal tubes and mechanical ventilation.

METHODS

This was a cross-sectional study based on the analysis of medical records of patients admitted to the ICU at Hospital de Clínicas de Porto Alegre — an excellence center for the care of critically ill adult patients — between 2014 and 2017; during their stay, patients were treated by the hospital's Speech Therapy Service. Data collection only began after approval by the Scientific Research Ethics Committee of Hospital de Clínicas de Porto Alegre under CAAE No. 80602917.3.0000.5327. The patients' medical records were made available by the coordination of the hospital's Technology and Information Group. This study did not require an informed consent form, as no direct interventions were performed. Institutional terms for the use of data were signed and approved.

We included information on patients of both sexes, aged over 18 years old, who were admitted to the ICU between 2014 and 2017; these patients should have also undergone a clinical swallowing assessment by the Speech Therapy Service. Owing to the convenient sampling technique, no sample size calculations were performed. Medical records containing information on tracheostomy placement, duplicate assessment requests, and evaluations at other hospital units, as well as those lacking necessary data, were excluded from our analysis.

Data were collected considering the following variables: sex, age, weight, height, body mass index (BMI), underlying disease, ICU diagnosis, duration of endotracheal intubation, reintubation, number of extubations, ratio of reintubation, duration of second endotracheal intubation, tube size, and feeding pathway before speech therapy assessment. In addition, we collected data on the first clinical speech therapy assessment regarding the Functional Oral Intake Scale (FOIS)[13], the degree of dysphagia according to the Dysphagia Risk Evaluation Protocol (PARD)[14], and vocal performance according to the RASAT scale[15]. Information concerning oral preparation, elevation of the larynx, wet-sounding voice, multiple swallows, cervical auscultation, throat clearing, coughing, gagging, or changes in vital signs was also collected. Finally, we extracted data regarding the gross outcome of the patient (hospital discharge or death).

Quantitative variables were described by means and standard deviations (SDs), and categorical variables were reported by absolute and relative frequencies. We used a one-way analysis of variance (ANOVA) to compare means and a chi-squared test with analysis of adjusted residuals when comparing proportions. A non-parametric test was used due to a non-normal sample distribution (Shapiro-Wilk statistical significance). Depending on the type of variable, the one-way ANOVA test was performed. The significance level was established at 5% ($p < 0.05$). Statistical analyses were performed using the SPSS software, version 20.0.

RESULTS

We analyzed a total of 681 medical records of adult patients who were admitted to the ICU at Hospital de Clínicas de Porto Alegre from 2014 to 2017. According to the inclusion criteria, 380 patients were selected. These were separated into 3 groups: Group 1 comprised 97 (25.5%) patients who did not

require orotracheal intubation during their ICU stay; Group 2 comprised 229 (60.3%) patients who had an orotracheal tube insertion and were intubated for at least 48 hours; and Group 3 comprised 54 (14.2%) participants with 2 or more orotracheal tube insertions.

It is important to highlight that Group 3 (≥ 2 orotracheal tube insertions) included patients on whom reintubation had to be performed at any period of the ICU stay and not only patients on whom attempts at extubation had failed.

The study flowchart is shown in Figure 1, with the sample description in Table 1. The average age of the patients was 62.1 (SD = ± 15.4) in Group 1, 61.9 (SD = ± 15.1) in Group 2, and 60.7 (SD = ± 14.9) in Group 3.

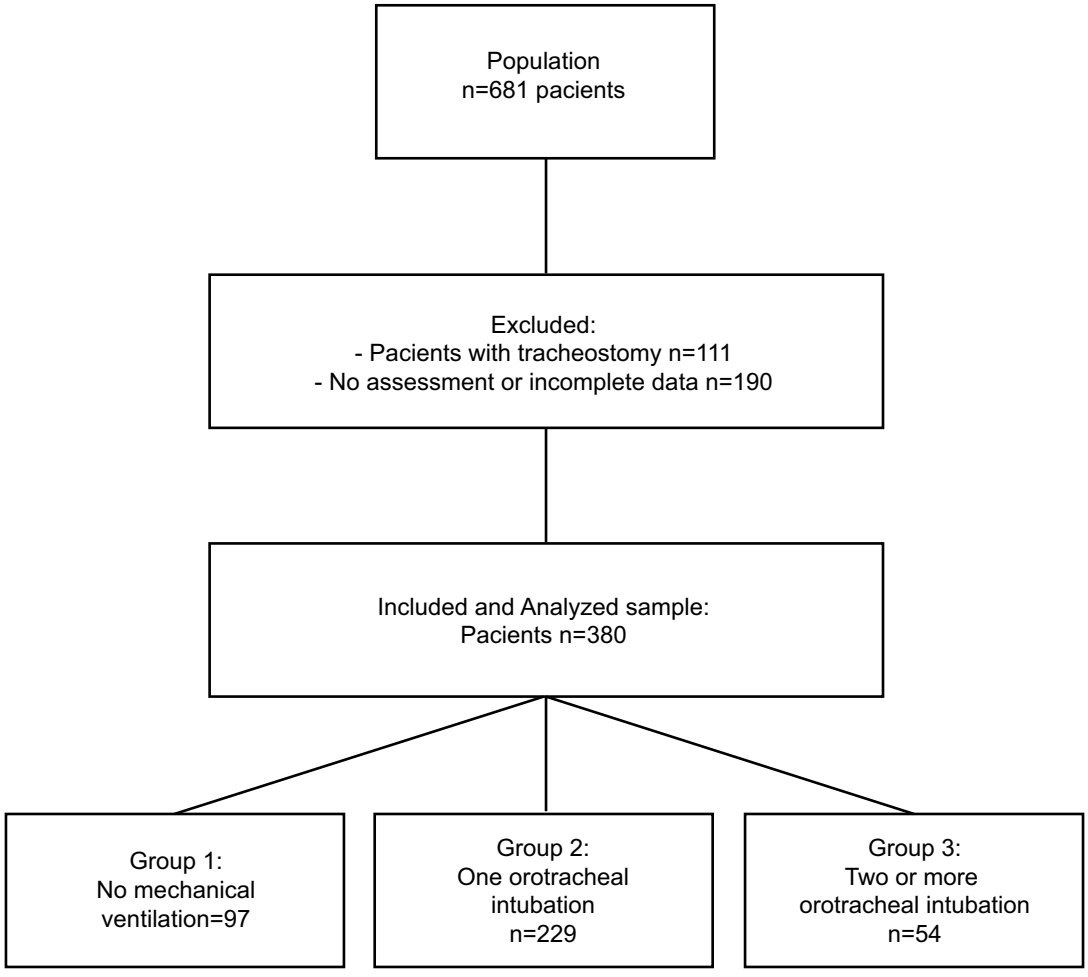


Figure 1: Study follow-up flowchart.

Table 1: Sample.

	Group 1 No mechanical ventilation n = 97	Group 2 1 intubation n = 229	Group 2 ≥ 2 intubations n = 54	p
Sex, male – n (%)	55 (56.7)	133 (58.1)	26 (48.1)	0.415
Age – mean ± SD	62.6 ± 15.4	61.9 ± 15.1	60.7 ± 14.9	0.762
BMI – mean ± SD	26.5 ± 7.0	27.4 ± 8.6	25.3 ± 7.0	0.180
Duration of mechanical ventilation – md (25–75)	-	5 (2–8)	4 (3–6)	
ETT number – n (%)		n=74 (100)	n=26 (100)	0.669
≤7		5 (6.9)	1 (3.8)	
7.5		8 (11)	1 (3.8)	
≥8		60 (82.1)	21 (84.6)	
Underlying disease – n (%)				0.105
Stroke	41 (42.3)	41 (17.9)	6 (11.1)	
Heart failure	13 (13.4)	32 (14.0)	17 (31.5)	
Neoplasms	7 (7.2)	35 (15.3)	6 (11.1)	
Chronic obstructive pulmonary disease	4 (4.1)	19 (8.3)	5 (9.3)	
HIV	2 (2.1)	9 (3.9)	6 (11.1)	
Sepsis	1 (1.0)	11 (4.8)	3 (5.6)	
Chronic kidney disease	2 (2.1)	4 (1.7)	4 (7.4)	
Other	27 (27.8)	78 (34.1)	17 (31.5)	
ICU diagnosis – n (%)				**0.000**
Stroke	**43 (44.3)***	39 (17.0)	6 (11.1)	
Neoplasms	4 (4.1)	**30 (13.1)***	6 (11.1)	
Heart failure	13 (13.4)	21 (9.2)	3 (5.6)	
Acute respiratory failure	3 (3.1)	23 (10.0)	**9 (16.7)***	
Sepsis	4 (4.1)	7 (3.0)	4 (7.4)	
Chronic kidney disease	0 (0.0)	3 (1.3)	**5 (9.3)***	
Guillain-Barré syndrome	**4 (4.1)***	2 (0.9)	0 (0.0)	
Other	26 (26.8)	**104 (45.4)***	21 (38.9)	

BMI: Body mass index; md: median; ETT: endotracheal tube; HIV: human immunodeficiency virus; ICU: intensive care unit. The one-way ANOVA compared means between groups regarding age and BMI. The other variables were analyzed using the chi-squared test with adjusted residuals at a significance level of 5%. *The statistical significance level was set at 5% after residual adjustments ($p < 0.05$).

We analyzed patient diet before the speech and swallowing assessment ($p = 0.001$) and verified that patients who did not undergo orotracheal intubation and mechanical ventilation had already been feeding orally or had not been following a non per os (NPO) regimen before the swallowing evaluation. On the other hand, patients with a history of 2 or more orotracheal tube insertions had been feeding exclusively via an alternative feeding route (Table 2).

Table 2: Feeding profile prior to speech-language pathologist evaluation.

Feeding route n (%)	No mechanical ventilation n = 97	One orotracheal intubation n = 229	Two or more orotracheal intubations n = 54	p
Oral	**29 (29.9)***	31 (13.5)	3 (5.6)	**0.001**
Oral + nasogastric tube	14 (14.4)	31 (13.5)	7 (13.0)	
Nasogastric tube	49 (50.5)	161 (63.6)	**43 (79.6)***	
Gastrostomy	0 (0.0)	1 (0.4)	0 (0.0)	
NPO	**5 (5.4)***	4 (1.7)	0 (0.0)	
Jejunostomy	0 (0.0)	1 (0.4)	1 (1.9)	

NPO: non per os. Statistical analysis was performed with a non-parametric test. The chi-squared test was used to compare groups with a precise p value.

* The statistical significance level was set at 5% after residual adjustments ($p < 0.05$).

Regarding vocal impairment, 75 (69%) patients in Group 1 did not present vocal symptoms, while 18 (41.9%) patients in Group 2 presented some degree of vocal impairment (p = 0.004). Changes such as vocal intensity and quality, as well as any degree of hoarseness, breathiness, asthenia, roughness, tension, or instability were considered.

Patient awareness at the moment of assessment was also analyzed (p = 0.011), and we observed that 194 (87%) patients in Group 2 were alert while 12 (22.2%) patients in Group 3 presented decreased alertness and a degree of drowsiness that required stimulation by the staff in order to maintain patient awareness.

Clinical evaluations by the speech-language pathologist are detailed in Table 3. Statistical significance and association were established for the wet-sounding voice variable (p = 0.012). This symptom was more rarely present in patients of Group 1 and was more frequent in Group 3. An association was also established for the presence of the cough reflex after swallowing in Group 3, as well as for changes in vital signs (such as decreased SpO_2) and in respiratory and/or heart rates. An absence of the cough reflex was identified in Group 2.

Table 3: Clinical findings of SLP evaluations.

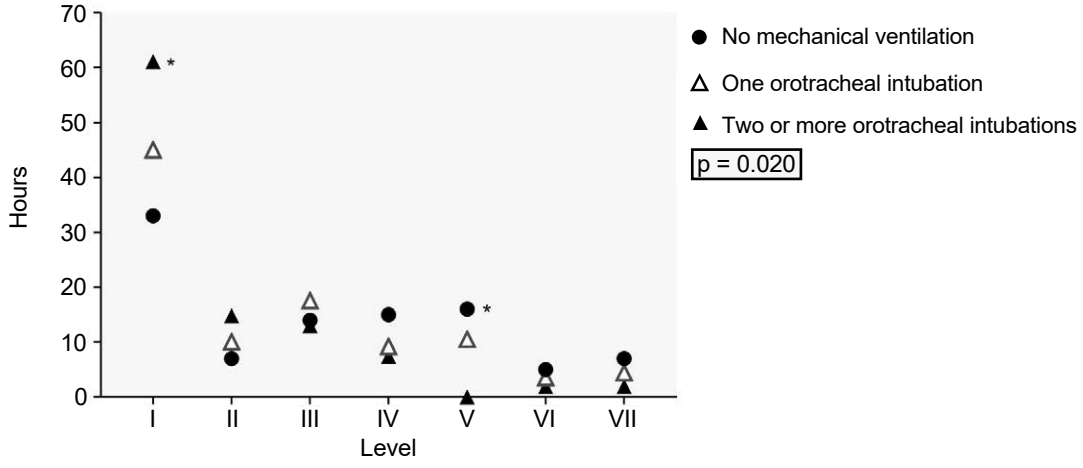
Variable – n(%)	No mechanical ventilation	One orotracheal intubation	Two or more orotracheal intubations	p
Gag reflex	n = 89	n = 205	n = 43	0.408
Absent	76 (85.4)	185 (90.2)	38 (88.4)	
Present	13 (14.6)	20 (9.8)	6 (11.6)	
Preparatory oral phase	n = 89	n = 206	n = 43	0.790
Impaired	45 (50.6)	111 (53.8)	19 (44.2)	
Normal	44 (49.4)	95 (46.1)	24 (55.8)	
Larynx elevation	n = 89	n = 203	n = 43	0.551
Impaired	58 (65.2)	71 (35)	18 (41.9)	
Normal	31 (34.8)	132 (65)	25 (58.1)	
Wet voice	n = 89	n = 204	n = 43	0.012
Absent	**73 (82.0)***	139 (68.1)	25 (58.1)	
Present	16 (18.0)	65 (31.9)	**18 (41.9)***	
Multiple swallows	n = 89	n = 203	n = 43	0.363
Absent	59 (66.3)	120 (59.1)	23 (53.5)	
Present	30 (33.7)	83 (40.9)	20 (46.5)	
Cervical auscultation	n = 89	n = 186	n = 40	0.063
Normal	67 (75.3)	125 (67.2)	21 (52.5)	
Impaired	22 (24.7)	61 (32.8)	19 (47.5)	
Throat clearing	n = 89	n = 186	n = 40	0.742
Absent	77 (86.5)	157 (84.4)	36 (90)	
Present	12 (13.5)	29 (15.6)	4 (10)	
Cough	n = 89	n = 215	n = 43	**0.013**
Absent	55 (61.8)	**130 (60.5)***	16 (37.2)	
Present	34 (38.2)	85 (39.5)	**27 (62.8)***	
Changes in vital signs	n = 89	n = 203	n = 43	**0.047**
Absent	78 (87.6)	182 (89.7)	33 (76.6)	
Present	11 (12.4)	21 (10.3)	**10 (23.3)***	
Choking	n = 89	n = 203	n = 43	0.424
Absent	71 (79.8)	172 (84.7)	35 (81.4)	
Present	18 (20.2)	31 (15.3)	8 (18.6)	

SLP: speech-language pathologist. The chi-squared test was used to compare groups, with analysis of adjusted residuals. An asymptotic p value was adopted for all variables.

*Statistical significance level set at 5% (p < 0.05).

Regarding the FOIS, after the evaluation, we observed a statistical significance (p = 0.020) in Group 3 since 33 (61.1%) patients received a FOIS I score, that is, they should not receive oral feeding. Sixteen (16.5%) patients in Group 1 were assessed as being apt for oral feeding with a multiple-consistency diet, albeit with special preparation or compensations (FOIS V). However, when comparing only the groups with orotracheal intubation (Groups 2 and 3) and considering Group 1 (no orotracheal intubation) as reference, no statistical difference (p = 0.098) was found. The corresponding data are presented in Figure 2.

Regarding the severity of oropharyngeal dysphagia according to the PARD classification (Figure 3), no statistically significant association (p = 0.261) was observed between groups. Nonetheless, higher frequencies of severe oropharyngeal dysphagia were observed in Groups 3 and 2, with a total of 24 (44.4%) and 74 (32.3%) patients, respectively.



*Statistically significant association according to a chi-squared test with residuals adjusted to 5% significance (p<0.05).
FOIS I: No oral intake.
FOIS II: Tube dependent with minimal/inconsistent oral intake.
FOIS III: Tube supplements with consisten oral intake.
FOIS IV: Total oral intake of a single consistency.
FOIS V: Total oral intake of multiple consistencies requiring special preparation.
FOIS VI: Total oral intake with no special preparation, but must avoid specific foods or liquids.
FOIS VII: Total oral intake with no restrictions.

Figure 2: Functional Oral Intake Scale (Fois).

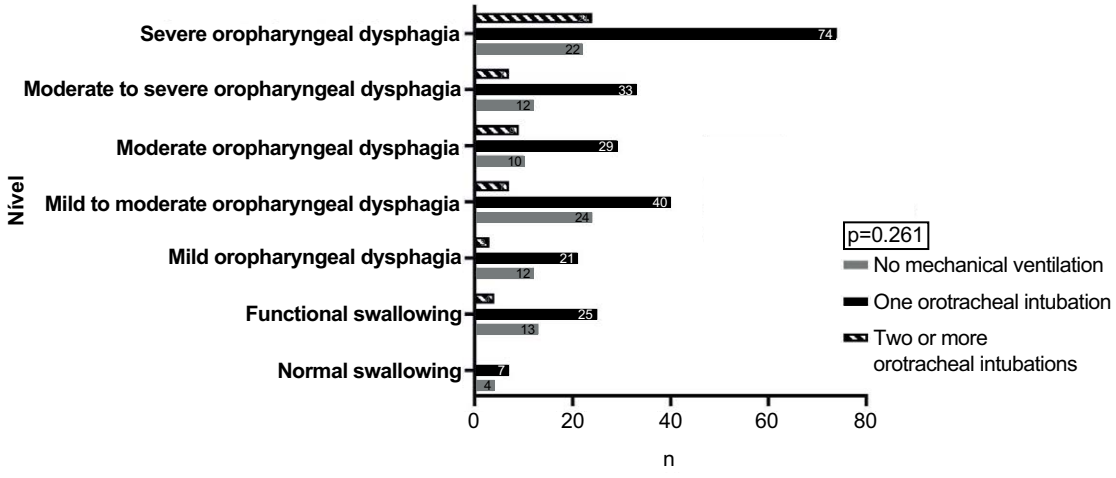
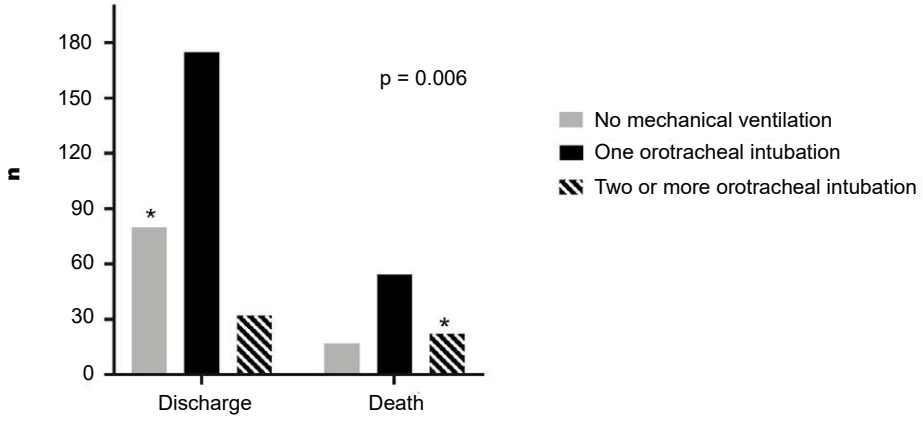


Figure 3: Dysphagia Risk Evaluation Protocol (Pard): oropharyngeal dysphagia degree classification.
The chi-squared test was used to compare groups, with analysis of adjusted residuals at a 5% statistical significance.

We observed a statistically significant difference regarding patient outcomes (p = 0.006) (Figure 4). Results showed that 22 (40.7%) patients with a history of 2 or more orotracheal tube insertions had died, while 80 (82.5%) patients who did not undergo orotracheal intubation were discharged from the ICU. These data were not related with the independent variables present in this study and no severity scores at ICU admission were obtained due to difficulties in accessing this information.



*Statistical significance level set at 5% after a chi-squared test with residual adjustment (p < 0.05).

Figure 4: Outcomes.

After statistical analysis of the 3 groups, a new proportion comparison was performed — this time disregarding data from Group 1 (no orotracheal intubation). When comparing Groups 2 and 3, which comprised patients subjected to orotracheal intubation, no statistical differences were observed; thus, between these groups, the FOIS classification and dysphagia severity (PARD) scores were indistinguishable.

DISCUSSION

The epidemiological profile of ICU patients may vary according to their clinical state and the type of care provided. The ICU where this study was performed does not provide care to trauma patients, hence the most prevalent underlying diseases are neurological diseases and those of the circulatory and respiratory systems.

No statistical significance was found between groups regarding the severity of oropharyngeal dysphagia. However, it is important to emphasize that severe swallowing problems were more frequent in patients in the orotracheal intubation groups (Groups 2 and 3). This corroborates several studies[16-18], since a long duration of mechanical ventilation and history of previous reintubation are associated with the development of post-extubation dysphagia[5].

Previous research has similarly demonstrated a high incidence of oropharyngeal dysphagia in patients subjected to orotracheal intubation and highlighted the relationship between a higher degree of severity and cases of prolonged tracheal intubation. However, these data are variable and consist of low-quality evidence[7]. The severity of post-extubation oropharyngeal dysphagia has been associated with the duration of orotracheal intubation and orofacial myofunctional deficits, which in turn cause dysfunctions in the oral preparatory phase such as longer oral transit times and decreased tongue and lip strength[17].

Dysphonia has been a common finding in patients after extubation. The impact of the endotracheal tube has been studied for many years and has been related to laryngeal lesions, mainly arytenoid edema, granulomas, ulcerations, and subglottic stenosis[18]. Laryngeal changes may be associated with penetration and aspiration due to deficiencies in glottic closure, one of the lower airway protective mechanisms[19]. Notably, laryngeal lesions due to orotracheal intubation are related to its duration, emergency status, and tube size. These criteria should be considered upon individual assessment and rely on recommendations for sizes above 8 mm in men and above 7 mm in women[20,21].

Clinical signs and symptoms of oropharyngeal dysphagia (eg, coughing, choking, or a wet-sounding voice) are not always present. Here, we must note that the standard recommendation for the safe initiation of oral feeding in patients who have been intubated is 24 hours after extubation, given

spontaneous improvement in swallowing function[5]. A study that analyzed patient swallowing performance, in which the penetration and aspiration scales were used to evaluate patients at 2, 4, and 24 hours after extubation[22], concluded that oral feeding after extubation could be started sooner. However, greater safety and protection of the airway were observed when oral feeding was introduced after 24 hours; moreover, this longer minimal waiting period resulted in less restricted diets. Therefore, the reintroduction of oral feeding before 24 hours post-extubation may lead to laryngeal penetration and/or aspiration, essentially increasing the risk of bronchopneumonia.

A wet-sounding voice is one of several cardinal parameters observed during clinical evaluations and is indicative of the presence of foreign content in the glottic region. The absence of vocal alterations after swallowing is considered to provide reasonable assurance that laryngeal aspiration and/or penetration is absent. Even so, this clinical sign is understood to be at best a clue, as evidence from acoustic measurement studies has demonstrated a moderate sensitivity and specificity and that the auditory perception of vocal alterations may not necessarily correlate to actual laryngeal penetration and/or aspiration[23,24].

Our study demonstrated vocal changes in patients who underwent orotracheal intubation. These vocal alterations can last for a few days after extubation or be permanent. Vocal complications are related to prolonged intubation (longer than 48 hours), endotracheal tube size[25], patient agitation, poor endotracheal tube positioning, poor humidification of the inspired air, and local infection[26-29]. The most prevalent changes are hoarseness and breathiness, loss of voice, throat clearing, sore throat, and vocal fatigue due to the association of injuries such as changes in the vocal fold mucosa and functional deficiencies (eg, changes in glottic coaptation during phonation)[26,27]. Vocal changes are common in ICUs; however, they are little studied and require more attention by speech therapists and intensive care professionals.

Changes in vital signs were observed in Group 3. During the functional swallowing assessment, pulse oximetry was used as a simple monitoring measure[1,30]. The SpO_2 analysis is based on the hypothesis that food aspiration would cause a bronchospasm reflex, thereby reducing ventilatory perfusion and resulting in oxygen desaturation[14,31]. However, it should be emphasized that SpO_2 levels should not be used individually as predictive signs of food aspiration, but rather be evaluated together with other clinical findings.

In addition to the unfavorable outcome, the presence of oropharyngeal dysphagia has been associated with greater patient comorbidity after discharge. Studies show that symptoms of dysphagia can last between 6 months and 5 years[32] and can be predictors of death[33]. Among other aspects, a 45% increase in hospital care costs was found in postoperative cardiac patients with dysphagia[34]. In addition, the patients' ICU stay could lead to psychological changes such as post-traumatic stress, anxiety, and depression[35], all of which may be aggravated by the presence of dysphagia.

Studies have suggested that reintubation demands are linked to an increased likelihood of death and a worse outcome due to new complications and comorbidities[36,37]. In our study, we observed a difference among groups regarding the discharge and death outcomes (Figure 4). However, information on the severity of patients' illnesses at the time of ICU admission was not obtained during data collection. Moreover, the death outcome was not statistically analyzed for a correlation with possible confounding and interaction variables.

Other studies[38,39] have concluded that the presence of a full-time speech therapist at the ICU is not a reality at all hospitals and emphasized the importance of creating sensitive protocols for screening for post-extubation dysphagia. These protocols should enable any member of an interdisciplinary team to assess the risk of aspiration and the need to consult a speech therapist[38,39]. In addition to identifying a risk of aspiration, the multidisciplinary team must be familiar with the predictive factors for oropharyngeal dysphagia[40].

The present study has several limitations and biases. Among them, we note the different types of diseases that can change the biomechanics of swallowing, thus confounding the real impact of orotracheal intubation on this function. For this purpose, a homogeneous sample would be necessary. However, we chose to maintain these participants in our research because we believe this sample composition reflects the reality of populations in clinical practice. Another aspect is that clinical evaluations were not performed by the same speech therapist, and results may present differences due to the subjective nature of the assessment. It is important to note that, as this was a retrospective study, the collected data refer to clinical examinations, without the benefit of objective swallowing examination results. Furthermore, additional studies with larger patient samples are needed to highlight the real impact of orotracheal intubation on swallowing, with a view to implementing safe practices.

We emphasize that our study was conducted within the practical realm of experience of speech therapy pathologists at a specific Brazilian ICU. It is known that, for consistent scientific evidence and generalization of results and data, the follow-

up of assumptions and bias control criteria must be satisfied.

Considering the data obtained in this study, it was not possible to reject the hypothesis that groups did not differ in the degree of oropharyngeal dysphagia. Even though no statistical significance was found between groups, it is clear that the prevalence of oropharyngeal dysphagia is high in patients who have undergone orotracheal intubation in the ICU.

Proper diagnosis and treatment of dysphagia in this population are essential to prevent the occurrence of aspiration pneumonia, which prolongs length of stay, increases hospital costs, and can lead to comorbidities and even death.

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