ORIGINAL ARTICLE

RAMR 2017;1:241-249
ISSN 1852 - 236X

Incidence of Post-extubation Swallowing Disorders at the Critical Care Unit, by means of Fiberoptic Evaluation

Correspondence
Martín Lugaro
Marmartinlugaro@gmail.com

Authors: Lugaro Martín C.[1,2], Ríos Fernando[2,3], Lauria Verónica[1], Jimenez Silvia[1], Benito Mori Lilia[1], Schoon Pablo[1]

[1]Hospital General de Agudos "Prof. Dr. Luis Güemes", Haedo, Buenos Aires
[2]Sanatorio Las Lomas, San Isidro, Buenos Aires
[3]Hospital Nacional "Profesor Alejandro Posadas", Haedo, Buenos Aires

Abstract

Introduction: The Fiberoptic Endoscopic Evaluation of Swallowing (FEES) is a technique that allows the study of the physiology of swallowing. This technique can be applied at the patient's bedside, making it a very attractive choice for the critical care unit (CCU), since it is not necessary to transfer the patient to another place in order to carry out the evaluation.

Objective: Feasibility to carry out the FEES at the patient's bedside at the CCU and assess the incidence of swallowing disorders in extubated patients.

Materials and Methods: Comparative, prospective, analytical cohort study conducted 24 hours after extubation for a period of 6 months, including consecutively all the patients who received mechanical ventilation for a period ≥ 48 hours. The enrollment began in March, 2015.

Results: 31 patients were included in the protocol. The incidence of swallowing disorders in extubated patients who required mechanical ventilation (MV) was 58%, 95% CI [confidence interval] (0.407-0.735) with 18 patients presenting disorders out of 31 evaluated cases. The significant differences between the groups of patients with and without swallowing disorders defined by the FEES were: the post-extubation time until the FEES, the capacity to tolerate the FEES at upright sitting position (90°) vs. semi-upright sitting position (60°), the abnormality of the Langmore scale and the abnormal movement of the vocal cords. The complication registered in both groups was the presence of oxygen saturation < 90%.

Conclusion: This study shows that the implementation of the FEES as a method for detecting swallowing disorders (at the patient's bedside) is safe.

Key words: Fiberoptic evaluation, intensive care, extubation

Introduction

Patients admitted to the critical care unit (CCU) who require invasive mechanical ventilation (IMV) will be exposed to laryngeal and tracheal lesions, as a consequence of the admission cause (example: serius injury) and also the presence of the orotracheal tube, expressed as edema, erythema or ulcers, among other lesions[1,2]. We should also add the lesions caused by endoscopies, tracheal aspirates, catheters and other procedures that may affect the patient's swallowing, once he/she is extubated, in a transitory or even in a permanent manner.

The normal swallowing process is the coordinated action of a group of structures located in the head, neck and thorax that implies a sequence of events in which some functional sphincters open to allow the progression of the bolus, transporting it from the mouth to the esophagus, and then close in order to avoid false paths and protect the airway. This complex dynamic neuromuscular activity

depends on a group of physiological behaviors controlled by the activity of the central and peripheral nervous systems, causing the triggering of the swallowing reflex[3,4]. The final objective of this process is the nutrition of the individual. The failure of this process is called dysphagia.

Dysphagia is a subjective feeling of difficulty in making the food travel from the mouth to the stomach. The term dysphagia comes from two Greek words, "*dys*" (difficulty) and "*phagia*" (eat). It may be caused by an organic disorder or functional difficulty and affects patients of all ages, from babies to the elderly. Oropharyngeal dysphagia includes swallowing disorders of oral, pharyngeal, laryngeal and upper esophageal sphincter origin. It involves almost 80% of diagnosed dysphagias. It is a symptom that includes two important concepts: laryngeal penetration, involving the entry of food up to the laryngeal vestibule, above the level of the vocal cords, and aspiration, defined as the entry of food to the larynx, below the level of the vocal cords[3,4].

The fiberoptic endoscopic evaluation of swallowing (FEES) is a technique that allows the study of the physiology of swallowing, the estimation of risk of aspiration, and guidance on the most secure way to feed the patient in order to avoid complications associated with swallowing disorders. It can be applied at the patient's bedside, for approximately 20 minutes, by trained personnel, who can evaluate various consistencies and progressive amounts of different kinds of food, making this technique a very attractive choice for the CCU, since it is not necessary to transfer the patient to another place, as for example the X-ray room, to carry out the evaluation.

The objective of this study is the feasibility of the FEES as a tool to evaluate swallowing at the CCU and to know the incidence and types of swallowing disorders at the CCU. To a lesser degree, we will assess the Gugging Swallowing Screen[5] (indirect method for detecting swallowing disorders) using the FEES for comparative purposes.

Materials and Methods

Design: comparative, prospective, analytical cohort study conducted 24 hours after extubation for a period of 6 months, including consecutively all the patients who received mechanical ventilation for a period ≥ 48 hours. The enrollment began in March, 2015.

The study was conducted at the CCU of the Hospital General de Agudos "Prof. Dr. Luis Güemes", Haedo, Buenos Aires. The hospital is a polyvalent center of reference for referral of patients with trauma and acute neurologic disease.-

Primary Objective

1. Feasibility to carry out the FEES at the patient's bedside at the CCU.
2. Incidence of swallowing disorders in extubated patients.

Secondary Objective

Also the GUSS (Gugging Swallowing Screen)[5] will be evaluated as a method for detecting swallowing disorders in relation to the disorders found with the FEES. The largest group of patients is the one with neurologic diseases that would imply a greater risk of suffering swallowing disorders, so we will mainly analyze swallowing disorders in that group. All the central nervous system events (examples: ischemic or hemorrhagic stroke, subarachnoid hemorrhage, head trauma, convulsions, central nervous system surgeries, etc.) were considered as neurologic diseases.

Sample Size

For a prospective cohort assuming an incidence of 38%, with 80% power and a 0.05 alpha level, the N of patients to be included is 30.

Inclusion Criteria

Patients who required MV ≥ 48 hr and ≥ 24 hr post-extubation.

Exclusion Criteria

Presence of delirium at the moment of the study (evaluated with the CAM-ICU scale [Confusion Assessment Method for the Intensive Care Unit])[6]; pregnant women; limitation of therapeutic efforts; basilar skull fracture; denial of the patient or his/her family to participate in the study; tracheostomized patients during this hospitalization or previous tracheal disease (patients with history of tracheotomy present a higher probability of suffering swallowing disorders); presence of facial trauma or any other disease that prevents or contraindicates the insertion of the fribroscope through the nose.

Evaluation Technique of the FEES

The evaluation of swallowing was carried out 24 hr after extubation, with a maximum period of 96 hr post-extubation. Before the FEES procedure, we used the indirect GUSS (Gugging Swallowing Screen) scale. In patients with an indirect GUSS scale score ≥ 4, we carried out the FEES (Appendix 1 and 2)[5]. In patients with scores below 4, we re-evaluated 48 hr later, in order to objectify whether the indirect GUSS scale score had been modified and meet the criteria for the FEES. If the score was still below 4, the FEES wasn't carried out in that patient (Figure 1). The device we used was an Olympus® BF Type P20D fibrobronchoscope with 5 mm diameter, 2.2 mm working channel and 55 cm length.

Description of the FEES technique (Figure 1): the patient was placed on the bed in an upright sitting position at 90°. If it was not possible, he/she was seated at 60°. Before inserting the device through one of the patient's nostrils, we evaluated whether it was necessary to put up to 10 ml of lidocaine 2% gel in order to make the patient more comfortable (it does not affect the sensitivity of the study)[7,8]. Once the fibrobronchoscope was inserted, we continued until we could see the larynx. We recorded any anatomic alteration, stimulated the superior laryngeal nerve (aryepiglottic fold) in order to generate the cough reflex[9] under stimulation and finally, we used the Basal Secretion Scale of Langmore (Appendix 3)[3] in order to assess the management of salivary retention. Subsequently, always observing the larynx, we began with the intake of semi-solid foods (firm yoghurt with blue vegetal dye) in increasing concentrations (1/3 of a teaspoon, 1/2 tablespoon, and 1 tablespoon until reaching 5 tablespoons). If there wasn´t any procedure alteration, we proceeded with liquids and simultaneously recorded the GUSS scale according to the semi-solid food section. For the liquid food intake evaluation, we used increasing amounts of water with blue vegetable dye (3–5–10-20 cm^3). If

APPENDIX 1. GUSS scale. Indirect swallowing test

	YES	NO
Surveillance:	1 ☐	0 ☐
Cough and/or throat clearing:	1 ☐	0 ☐
Saliva swallowing:		
• Successful swallowing	1 ☐	0 ☐
• Sialorrhea	0 ☐	1 ☐
• Changes in the voice (snores, gurgly, weak)	0 ☐	1 ☐

APPENDIX 2. GUSS scale. Direct swallowing test

	1 semi-solid	2 Líquid	3 Solid
SWALLOWING:			
• Not possible	0 ☐	0 ☐	0 ☐
• Delayed (> 2 sec.) (Solids > 10 sec.)	1 ☐	1 ☐	1 ☐
• Successful swallowing	2 ☐	2 ☐	2 ☐
COUGH (involuntary): (before, during and after swallowing, up to 3 minutes post-swallowing)			
• Yes	0 ☐	0 ☐	0 ☐
• No	1 ☐	1 ☐	1 ☐
SIALORRHEA:			
• Yes	0 ☐	0 ☐	0 ☐
• No	1 ☐	1 ☐	1 ☐
CHANGES IN THE VOICE: (listen before and after swallowing. The patient should say /O/).			
• Yes	0 ☐	0 ☐	0 ☐
• No	1 ☐	1 ☐	1 ☐
TOTAL	(5)	(5)	(5)
	1-4: Conduct a more thorough investigation 5: Continue with liquids	1-4: Conduct a more thorough investigation 5: Continue with solids	1-4: Conduct amorethorough investigation 5: Normal
TOTAL SCORE: (Indirect and direct swallowing tests)			____(20)

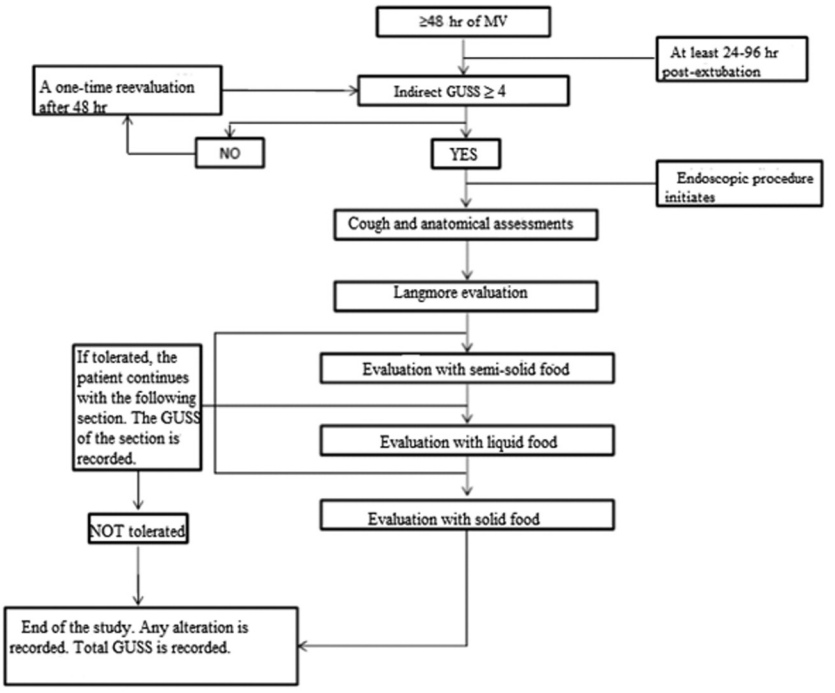

Figure 1. Flow chart.

APPENDIX 3. Basal Secretion Scale of Langmore

0	Normal (wet)
1	Accumulation outside the laryngeal vestibule at some point
2	Transitory accumulation in the vestibule with occasional overflowing that the patient may dilute
3	Evident and constant saliva retention in the vestibule which can't be diluted

the patient tolerated the procedure, we continued with the evaluation of solid food intake, recording the GUSS scale score according to the liquid section. In the evaluation with solid foods we used a sufficient amount of bread crumb for the patient to form a bolus and try to swallow it. Like in the other stages of the procedure, we recorded the GUSS scale. Every stage (semi-solid/liquid/solid) had a maximum GUSS scale value of 5 points, with a total of 15 points in the direct evaluation, and a maximum of 5 points in the indirect evaluation (previously done), resulting in the final GUSS score[1, 5]. If the patient presents a swallowing disorder, the cause that motivated the end of the study by direct visualization must be recorded and qualified according to the modified Rosembeck Scale detailed below[10, 11]: 1) Subsequent effusion, which has to do with the presence of the food bolus at the hypopharynx (pyriform sinus) for more than 2 seconds before beginning the pharyngeal stage of swallowing; 2) Residues: persistence of food in the pharyngeal walls, pyriform sinus o valleculas after swallowing; 3) Laryngeal penetration: food entry to the laryngeal vestibule above the level of true vocal cords; 4) Aspiration: food goes beyond the level of true vocal cords, up to the trachea; 5) Reflux: food regurgitation from the esophagus, back to the larynx-pharynx. At the end of the study, the GUSS score must be recorded. In case of doubt about aspiration in one of the stages, the endoscope will proceed through the glottic area, going through the vocal cords, in order to evaluate whether there was aspiration or not.

During the procedure we looked for bronchospasms, presence of O2 saturation by pulse oximetry < 90%, nose bleeding, hypotension or any other complication that could have arisen.

For the statistical analysis, continuous data are expressed as mean value and standard deviation or median and ranges, according to distribution. Categorical data are expressed as frequency and percentage. For the comparison of mean values,

we used the Student's Test or Mann-Whitney Test, as applicable. For categorical data, we used the Square Chi Test or Fisher's Exact Test. We carried out measures of association with Odds Ratio and 95% confidence intervals. P values below 0.05 of two-tailed test were considered as significant.

Results

During the months of the study, 218 patients were admitted to the CCU. 31 patients were included in the protocol (Figure 2). The FEES could be completed in all the patients. The general characteristics of the patients are presented in Table 1.

The incidence of swallowing disorders in extubated patients who required MV was 58%, 95% CI (0.407-0.735) with 18 cases of swallowing disorder out of 31 evaluated cases.

Table 2 shows the characteristics of patients with and without swallowing disorders, where the only significant difference is the presence of shock within the group with swallowing disorder.

Table 3 shows the characteristics of these two groups of patients regarding the results of the FEES. We found significant differences in the post-extubation time when we were doing the FEES, in the upright sitting position at 90° versus the semi-upright sitting position at 60°, the abnormality in the Langmore scale and the abnormal movement of the vocal cords. The only complication we observed in both groups was the saturation < 90% that didn't encourage the suspension of the study, for it was corrected in all the cases with supplementary O_2, with no differences among patients with and without swallowing disorders. We did not observe bronchospasm, nose bleeding, hypotension nor any other complication.

Tables 4 and 5 show the different anatomic alterations and the alterations by the Langmore scale found in patients, divided in groups.

The alterations observed according to the Rosembeck scale modified by the FEES in the 18 patients who presented alterations were: aspiration in 8 patients, laryngeal penetration in 4 patients, residues in 4 patients and esophageal reflux in 2 patients. The alterations were presented in the following stages: before the evaluation with semi-solid food, 4 patients; in the semi-solid food stage, 9 patients; in the liquid food stage, 5 patients, and no alterations in the solid food stage.

Regarding the correlation between the FEES and the GUSS, the presence of swallowing disorders by FEES has a significant correlation with a GUSS score ≤ 14 (table 6), with a Kappa value of 0.867, p <0.001. The GUSS value ≤ 14 for detecting swallowing disorders has 100% sensitivity and 98% specificity.

The analysis of the subgroup of patients with neurologic diagnosis shows a higher presence of comorbidities, masculine gender and sensory deterioriation (evaluated by the Glasgow score),

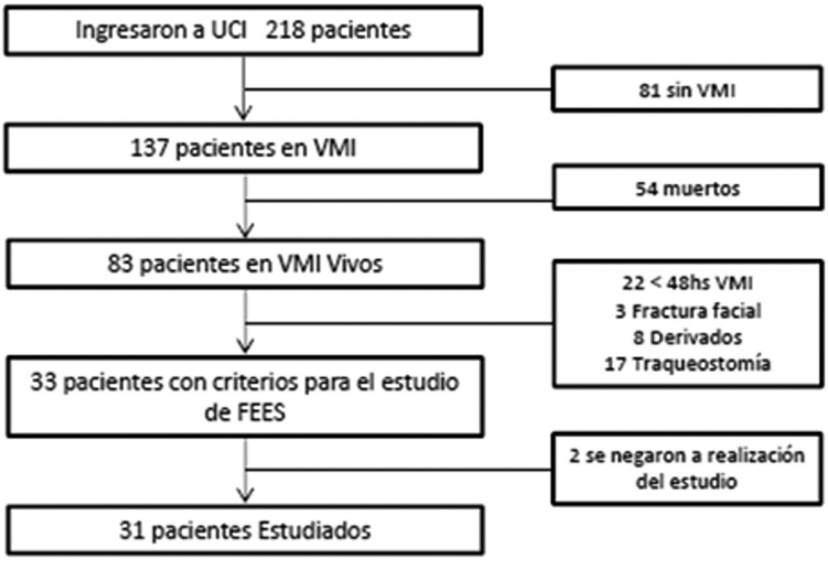

Figure 2

TABLA 1. Risk factors and characteristics

	Total number of patients (N° 31)
Admission for non-neurological causes	18
Medical	8
Surgical	10
Admission for neurological causes	13
Medical	6
Surgical	7
Age£ (years)	50 (16-88)
Masculine gender (n)	22 (71%)
Stay at the CCU£ (days)	13 (3-52)
APACHE I¥	19 ± 8
Comorbiditie	
– Cardiological	12
– Respiratory	5
– Neurological	3
– Neoplasic	2
– Abdominal	4
– DBT	4
Invasive mechanical ventilation£ (days)	6 (2-20)
Shock	13
Emergency OTI	24
Need for a new OTI	10
CA	4
Nosocomial infection	15
Delirium	11
Glasgow score£	12 (3-15)
Uses of drugs	
– Sedatives	21
– Muscle relaxants	6
– Corticosteroids	11

£median and ranges; ¥mean and standard deviation; DBT: diabetes; OTI: orotracheal intubation; CA: cardiac arrest

whereas in the group of patients without neurologic diagnosis a greater use of sedatives (P 0.029) was registered. The incidence of swallowing disorders wasn´t significant: 50% in the non-neurologic group (9/18) and 69% in neurologic patients (9/13) p 0.284.

Discussion:

MV is a treatment used in critically ill patients for numerous causes. The consequent invasion of the airway and anatomic sites where the orotracheal tube goes through exposes them to suffer multiple lesions, anatomical and/or functional. For example, the appearance of swallowing disorders is significantly important, since it complicates nutrition and consequently the patient's rehabilitation. We should focus on the fact that the impact of the swallowing disorder arises from a complex interaction between the severity of the clinical condition and the general condition of the patient. That is why there are important variations in the literature about the morbidity and mortality of swallowing disorders according to the study population. Therefore, dysphagia, with potential aspiration and its consequent pneumonia is one of the most serious complications to be avoided in this type of patients.

TABLE 2. Difference between risk factors and characteristics between patients with and without swallowing disorders

	With swallowing disorder (N° 18)	Without swallowing disorder (N° 13)	p
Age£ (years)	45 (16-88)	51 (17-82)	0.828
Masculine gender (n)	13	9	0.856
Stay at the CCU£ (days)	9 (3-36)	14 (3-36)	0.293
APACHE II¥	18±8.6	20±7.6	0,679
Comorbidities			
– Cardiological	7	5	0.981
– Respiratory	2	3	0.371
– Neurological	3	0	0.121
– Neoplasic	1	1	0.811
– Abdominal	1	3	0.151
– DBT	3	1	0.462
Invasive mechanical ventilation£ (days)	5 (2-11)	7.5 (2-20)	0.125
Shock	11	2	0.011
Emergency OTI	16	8	0.072
Need for a new OTI	6	4	0.880
CA 3	1	0.462	
Nosocomial infection	11	4	0.095
Delirium	7	4	0.641
Glasgow score£	14 (3-15)	9.5 (3-15)	0.226
Uses of drugs			
– Sedatives	14	7	0.160
– Muscle relaxants	3	3	0.656
– Corticosteroids	7	4	0.641

£median and ranges; ¥mean and standard deviation; DBT: diabetes; OTI: orotracheal intubation; CA: cardiac arrest

TABLA 3. Patient classification according to the FEES results

	Without swallowing disorder (13)	With swallowing disorder (18)	p
Post-extubation hours£	48 (24-144)	7 (24-84)	0.038
Study conducted in patients in an upright sitting position at 90°	11	9	0.047
Anatomical alteration	10	15	0.656
Abnormal Langmore†	6	16	0.010
Abnormal VC movement	2	12	0,005
Reflejo tusígeno al contacto conservado	13	17	0.388
Complications	2	3	0.924
Duration of procedure in minutes£	14 (10-20)	15 (8-20)	0.650

£median and ranges; †We considered any value > 0 as abnormal; VC: vocal cords

TABLA 4. Anatomical alterations

	Edema	Granuloma	Erythema	Ulcer
Without swallowing disorder	10	4	1	2
With swallowing disorder	15	2	1	3

TABLA 5. Alterations according to Langmore scale

	0	1	2	3
Without swallowing disorder	7	6	0	0
With swallowing disorder	2	5	6	5

TABLA 6. Sensitivity and specificity of GUSS versus FEES

	Altered FEES	Normal FEES	
GUSS (0-14)	18	1	PPV= 95%
GUSS (15-20)	0	12	NPV= 100%
	100% sensitivity	92% specificity	

PPV: positive predictive value; NPV: negative predictive value

The frequency of dysphagia at the CCU presents great variability depending on the patient's history, the reason for admission and the moment of the evaluation. Conservative opinions suggest that at least 20% of all extubated patients who present respiratory insufficiency could develop swallowing disorders[12]. Studies with ≥ 48 hr of MV, such as the one of Barker et al [13] showed that in patients with cardiac arrest, there were 51% swallowing disorders (130 out of 254 patients), like the study of Ajemian et al[14] , which reported 56% of swallowing disorders (27/48 patients). At the CCU, endoscopic evaluations of Leder et al[15] showed 33% of swallowing disorders in critically traumatized patients post MV, and the evaluation of El Solh et al[16] reported that 44% of the patients aspirated (37 out of 84 patients). They were elderly patients evaluated by FEES who presented a critical condition and required MV.

There aren't numerous series in Argentina regarding the incidence of swallowing disorders in the post-extubation period, and there isn't much published experience in FEES at the CCU. That is why we believe this study brings new knowledge within a delicate topic not thoroughly investigated in our country. The first important fact is the incidence of swallowing disorders of 58%, which is higher than expected (38%). This incidence is similar to previously cited studies of other countries, taking into account the fact that the patients evaluated in this study were critically

ill, with hospitalizations of approximately 2 weeks with MV, and were prematurely evaluated.

Patients who presented swallowing disorders were evaluated first (median of 27 hr) in comparison with patients without swallowing disorders (median of 48 hr) (see Table 3). This could be the cause for such a high percentage, but we can't discard the laryngeal dysfunction or edema as origin[14]. Basing on this, we recommend in the future the implementation of the FEES 48 hr post-extubation in order to discard this group of patients.

Conducting the study in an upright sitting position at 90° seemed to have a protective effect, in comparison with the position at 60°, though probably the patients who tolerated the 90° position were the ones with a better general condition, since that position mostly generated pain or discomfort or the individual simply didn't have the necessary muscle tone to remain seated.

Aspiration is one of the main causes of in-patient pneumonia, so it is important to know about it to avoid complications. The consensus of "The North American Summit on Aspiration in the Critically Ill Patient"[17] where aspiration is evaluated, estimates that it is suffered by 45% of normal individuals during sleep, 70% of patients with impaired consciousness, from 0 to 40% of patients with enteral feeding and between 50 and 75% of patients with MV. In our study, 8 of the 18 patients with swallowing disorders aspirated (44% of patients with disorders and 25% of evaluated patients).

Both studies are important, but one of the advantages of the FEES, compared to the video swallowing exam is the possibility to observe anatomic anomalies of the upper aerodigestive tract and laryngeal lesions, very common in patients during the post-extubation period. The study of Tadié et al[2] assessed the laryngeal anatomy of 136 patients. Lesions were observed in 73% of the patients, with the edema as the most common one, representing 59%. In the same study, the mobility of the vocal cords was affected in 19% of the patients under evaluation. In our work we detected 80% of anatomic anomalies (25/31 patients), with the edema as the most common one, but not related to swallowing disorders. The abnormal mobility of the vocal cords was important, with 45% compromise (14/31 patients), and affected patients presented a higher percentage of swallowing disorders.

Through direct visualization, in our study we also used the Langmore scale. The alteration of the scale (with values > 0), was related to swallowing disorders. All the patients with values of 2 and 3 (which have to do with the accumulation of secretions with overflowing that may dilute at some moment or not, respectively) presented swallowing disorders in 100% of the cases. That is why a high score in the scale would predict a swallowing disorder.

Regarding the comparison of the FEES with the GUSS, we find certain values similar to those of the study of Tralp M et al[5], where a GUSS value ≤ 14 presented 100% sensitivity (just like our study) and 69% specificity (less than our study). This shows that GUSS is a good predictor to assess swallowing with the limitations of being an indirect method. For more information about the clinical evaluation and decision making, we suggest the book of Campora H et al, 2012 ed.[4]. We do not expand on it due to limited space.

With reference to study limitations, the comparison with another method of similar value, such as the video swallowing exam, is pending, especially considering that many studies regard it as the gold standard. Another limitation is the number of patients evaluated for the analysis of subgroups, such as neurologic patients. The study was limited to a fixed time period. Probably, if there were more patients under evaluation, the tendency to have greater probabilities of suffering swallowing disorders in neurologic patients could result in a significant value.

Apart from the objective of this study, it provides new information about the laryngeal pathology, swallowing disorders and the implementation of evaluation protocols post MV in order to feed the patient safely and avoid complications during spontaneous ventilation. It also provides information about an Argentinian center, our epidemiology and resources to solve problems based on the limitations presented by us.

Conclusion

This study shows that the implementation of the FEES as a method for detecting swallowing disorders at the patient's bedside is safe. There is high incidence of swallowing disorders in the post-extubation period, affecting more than 50% of the evaluated patients. More studies are needed in order to determine in a reliable way that the FEES is the method for evaluating post-extubation swallowing.

Conflict of interest: this article was written with the Research Scholarship of the AAMR (Argentinian Association of Respiratory Medicine).

References

1. Radhakrishnan, S., U.K. Menon, and A. Anandakuttan, A combined approach of bedside clinical examination and flexible endoscopic evaluation of swallowing in poststroke dysphagia: A pilot study. Ann Indian Acad Neurol, 2013. 16(3): p. 388-93.
2. Tadie, J.M., et al., Post-intubation laryngeal injuries and extubation failure: a fiberoptic endoscopic study. Intensive Care Med, 2010. 36(6): p. 991-8.
3. Mª Mercedes Velasco, V.A., Pere Clavé, Carolina Puiggrós., Abordaje clínico de la disfagia orofaríngea: diagnóstico y tratamiento. Nutrición Clínica en Medicina, 2007. 1(3): p. 172 - 202.
4. Cámpora H, F.A., Evaluación y tratamiento de las alteraciones de la deglución. Re8v Am Med Resp, 2012. 3: p. 98 - 107.
5. Trapl, M., et al., Dysphagia bedside screening for acute-stroke patients: the Gugging Swallowing Screen. Stroke, 2007. 38(11): p. 2948-52.
6. Tobar, E., et al., [Confusion Assessment Method for diagnosing delirium in ICU patients (CAM-ICU): cultural adaptation and validation of the Spanish version]. Med Intensiva, 2010. 34(1): p. 4-13.
7. Lester, S., et al., The effects of topical anesthetic on swallowing during nasoendoscopy. Laryngoscope, 2013. 123(7): p. 1704-8.
8. Kamarunas, E.E., et al., Effects of topical nasal anesthetic on fiberoptic endoscopic examination of swallowing with sensory testing (FEESST). Dysphagia, 2014. 29(1): p. 33-43.
9. Aviv, J.E., et al., The safety of flexible endoscopic evaluation of swallowing with sensory testing (FEESST): an analysis of 500 consecutive evaluations. Dysphagia, 2000. 15(1): p. 39-44.
10. Rosenbek, J.C., et al., A penetration-aspiration scale. Dysphagia, 1996. 11(2): p. 93-8.
11. Gonzalo Nazar M, A.O.T., Andrés Godoy M, José Miguel Godoy M, Inés Fuentealba M, Evaluación fibroscópica de la deglución. Revista de otorrinolaringología y cirugía de cabeza y cuello, 2008. 68(2): p. 131-142.
12. Skoretz, S.A., H.L. Flowers, and R. Martino, The incidence of dysphagia following endotracheal intubation: a systematic review. Chest, 2010. 137(3): p. 665-73.
13. Barker, J., et al., Incidence and impact of dysphagia in patients receiving prolonged endotracheal intubation after cardiac surgery. Can J Surg, 2009. 52(2): p. 119-24.
14. Ajemian, M.S., et al., Routine fiberoptic endoscopic evaluation of swallowing following prolonged intubation: implications for management. Arch Surg, 2001. 136(4): p. 434-7.
15. Leder, S.B., S.M. Cohn, and B.A. Moller, Fiberoptic endoscopic documentation of the high incidence of aspiration following extubation in critically ill trauma patients. Dysphagia, 1998. 13(4): p. 208-12.
16. El Solh, A., et al., Swallowing disorders post orotracheal intubation in the elderly. Intensive Care Med, 2003. 29(9): p. 1451-5.
17. McClave, S.A., et al., North American Summit on Aspiration in the Critically Ill Patient: consensus statement. JPEN J Parenter Enteral Nutr, 2002. 26(6 Suppl): p. S80-5.