The predictive role of dynamic study of the swallowing (DSS - VFSS) and neuroimaging: a retrospective observational study of patients with neurogenic dysphagia

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Purpose

Dysphagia consists in an altered deglutitive act causing a difficult progression of the alimentary bolus to the patient. It is connected to malnutrition, dehydration and aspiration pneumonia, which increase the mortality and morbidity for the dysphagic patient. Aspiration is a term that has been defined as the inhalation of the bolus beyond the level of the vocal folds. This latter is commonly identified as the main risk factor for aspiration pneumonia, which is fatal in the 50% of these patients [1,2,3]. Different neurologic diseases are related to dysphagia such as stroke, dementia, head trauma and progressive neurodegenerative diseases [1,3,4]. The swallowing is commonly coordinated by the Central Pattern Generator (CPG), which is a neuronal network located in the brainstem with input coming the sensory stimuli and the cortex, amygdala and cerebellum. The CPG guides the motor neurons that drives the deglutition. Older people use more areas of the cortex during swallowing, suggesting that cerebral input is necessary for the swallowing [4]. The gold standard for the aspiration assessment is the dynamic study of the swallowing (DSS), mostly known as video-fluoroscopic swallowing study (VFS); this latter has a role in determining the swallowing therapy [1,5]. Current literature supports that the rehabilitative approaches are related to reduced pneumonia incidence [3,6]. Percutaneous endoscopic gastrostomy (PEG) is performed to provide nutrition to patients with swallowing difficulties in long term therapy or when oral-nutrition appears unsafe and unefficient [4,5]. The American Society for Clinical Nutrition and Metabolism published a guideline on the use of PEG, which placement should be an interdisciplinary team choice [4].

DSS consists in an X-ray tube and a flat panel for digital acquisition of frames, connected with a storage system. The recording is taken while the patient is swallowing oral boluses of contrast medium in different consistencies (liquid, semisolid and solid). Main observations during DSS are usually get in the lateral plane. The frames acquired can be later analyzed allowing quantitative, temporal and spatial measurements [1]. Once dysphagia has been diagnosed, the main aspects of deglutition which needed to be evaluated are the efficacy, that is the patient's ability to be adequately nourished and hydrated; and the safety, intended as the patient's ability to swallow with no complications [1,4]. Signs of impairment in the oral stage efficacy are the difficulty to form the bolus and push it backward. The oral stage safety depends on tongue-soft palate seal, which deficiency results in the early bolus falling into the hypopharynx before the triggering of the oropharyngeal swallow response while the airways are still open, leading to a predeglutitive aspiration. Signs of insecure deglutition during the pharyngeal stage are penetrations and aspirations [1]. Penetration refers to the entering of contrast medium into the laryngeal vestibule over the vocal cords. Aspiration indicates when the contrast medium goes beyond the vocal cords into the trachea (Fig. 1) [1, 4]. A delayed closure of the laryngeal vestibule and a slow opening of the upper esophageal sphincter are typically present in aspiration. Sometimes penetration and aspiration may also be a result from an insufficient protection of airways, because of an inappropriate epiglottic

tilt. Furthermore, vallecular and piriform residues may lead to aspiration when the patient inhales after the swallowing. Thereafter, DSS can distinguish if aspiration is associated with an impaired glossopalatal seal (predeglutitive aspiration), an altered triggering of the swallow or impaired deglutitive airway protection (laryngeal elevation, epiglottic tilt and closure of vocal folds) or an ineffective pharyngeal clearance (post-swallowing aspiration) [1]. The goal of our study was to determine the predictive role of DSS in the therapeutic approach to dysphagic patients.

Images for this section:

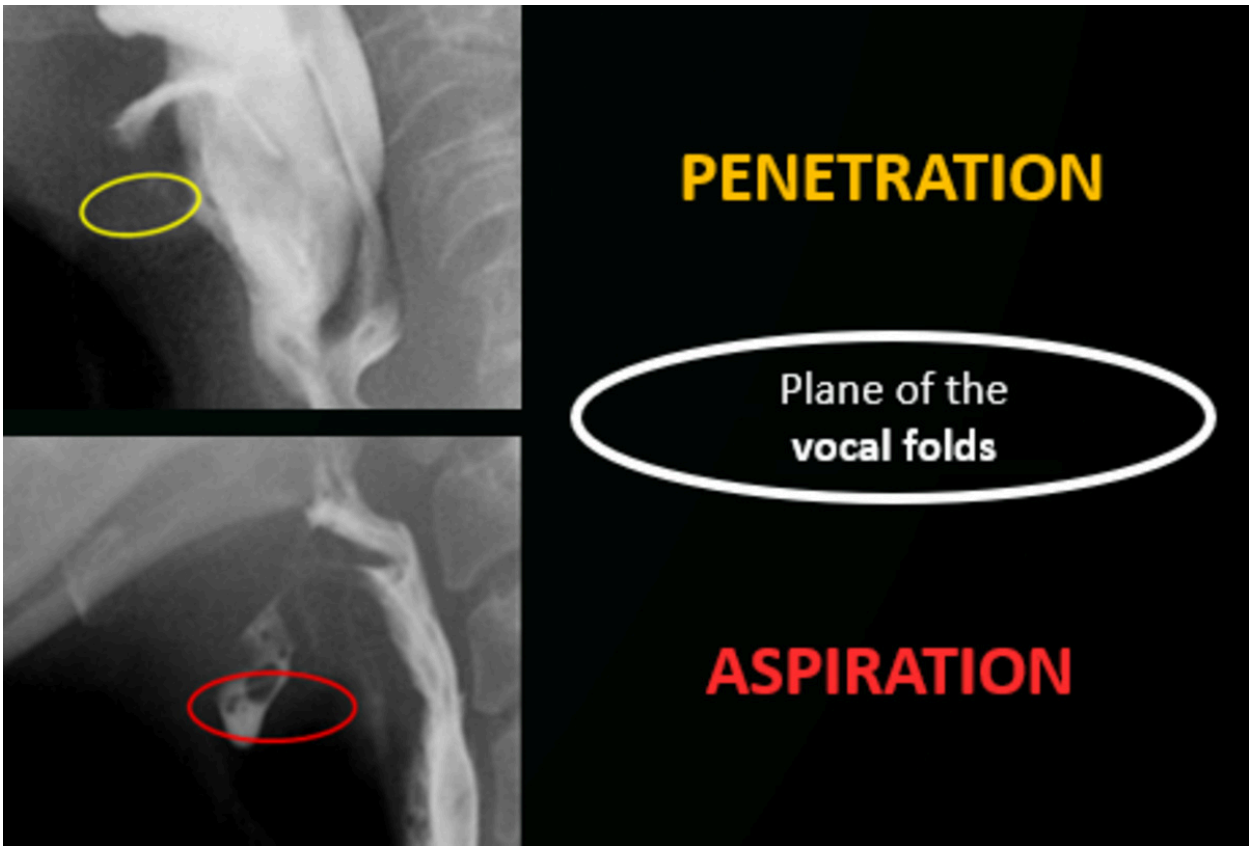

Fig. 1: Both the two frames show the presence of contrast medium in the airways during a dynamic study of the swallowing. In the upper image, the finding at the exam was the penetration, because the bolus remains over the level of the vocal folds. Instead, in the bottom image, a case of aspiration is shown, being the contrast medium beyond the vocal folds. The circles mark the level of the vocal folds.

Methods and materials

The analysis was conducted by examining retrospectively a sample of 47 patients with proved neurologic dysphagia undergoing to DSS at the University of Ferrara from August 2012 to August 2017. All our patients were considered able to benefit from rehabilitation with a speech-language therapist. The chosen therapeutic approach and the DSS recommendation based on aspiration parameter were evaluated applying the Fisher's exact test; all the other alterations of the swallowing revealed by our radiological examination were investigated as well. Parameters assessed by DSS were: premature spillage, oral regurgitation, esophageal regurgitation, nasal regurgitation, vallecular and pyriform sinuses residue, penetration / aspiration classified according to the Rosenbek scale, mobility or spasm of the palatine veil, incontinence of the bolus, epiglottic tilt evaluation, spasm of the Upper esophageal sphincter (UES), time of transit of the bolus in the Upper esophageal sphincter (UES) and in the Lower esophageal sphincter (LES). By analyzing the clinical history and the Head CT and/or MRI reports of the patients, those factors responsible for the rehabilitation failure, and then made the PEG treatment necessary, were investigated. According to the neurologic imaging, a group was attributed to every patient: A to those with a cerebral lesion, B to those with an exclusive brainstem lesion, C in patients with cerebellar lesions and D when the injury was in more than one of these areas. Moreover, the sample was divided according to the etiology of dysphagia: stroke, neurodegenerative disease and traumatic-another origin. When PEG was performed within a year, days of time-lapse from DSS were analyzed. MedCalc software was used to assess differences between the aforementioned groups, applying ANOVA and Fisher's Exact Tests.

Results

The association between the encephalic lesions and the outcome (rehabilitation vs PEG) was examined, looking independent of the DSS in the D group; these latter in fact were generally treated with PEG likely not responsive to rehabilitation therapy. Furthermore, a significant result at Fisher's exact Test was shown for the outcome of the D group vs A+B +C group (p-value =0,033), independently if aspiration at DSS was found (Fig.2). Another positive result (p-value=0,0489) according to the aspiration parameter and outcome was demonstrated in patients with limited brain injury (i.e. A, B and C groups), while it was negative on the total sample (Fig.3). No evidence of statistic relation was revealed between the other DSS parameters and the treatment outcome in the patients with or without aspiration. Only the aspiration parameter got a significative result at Fisher test for the outcome, exclusively when the D group was excluded.

The days that lapse between DSS and PEG performed considering a one-year limit were analyzed in 13 patients (Fig.4); a longer interval was considered unrelated to our DSS examination. The sample mean of the lapse is of 86,5 days, with a wide spectrum from 10 to 177. These intervals were tested with ANOVA (p-value = 0,899), not showing a significant difference between the brain lesion groups(Fig.5).

No correlation with age was found (Fig. 6).

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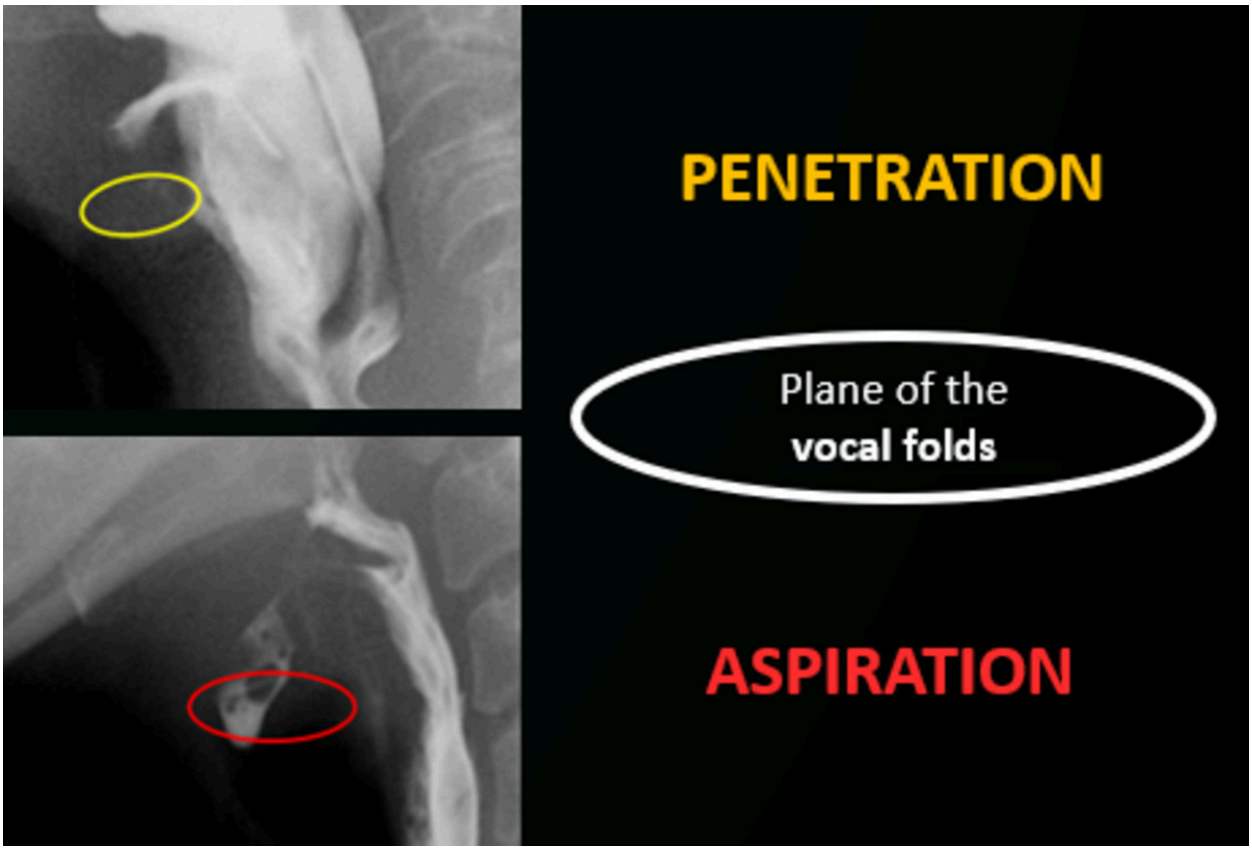

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OUTCOME	REHAB.	PEG	Total
D	1	10	11
A+B+C	17	19	36
Total	18	29	47
Fisher test		SIGNIFICANT p-value=0.033	

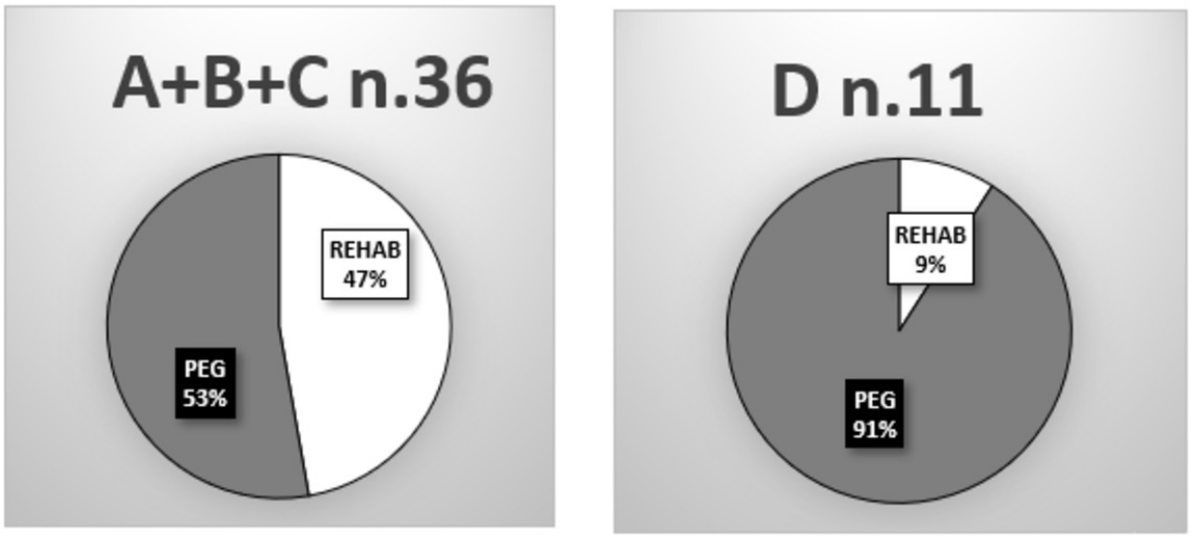

Fig. 2: The therapeutic outcome of the D group is compared to the rest of patients with more limited injury: a statistically significant difference in the therapeutic choice between groups has been shown at Fisher test as reported in the table. The pie charts show how in the D group a greater part of patients was treated with PEG, independently from the aspiration finding at DSS; in the rest of the patients, it occurred in half of the cases.

ASPIRATION (WITHOUT D GROUP)	REHAB.	PEG	Total
ASP. NEGATIVE (ASP-)	13	8	21
ASP. POSITIVE (ASP+)	4	11	15
Total	17	19	36
Fisher test		SIGNIFICANT p-value = 0.0489	
% with ASP./Tot.	23,5%	57,9%	41,7%

Fig. 3: Statistical association between aspiration at DSS and treatment by excluding D group results in a significant Fisher exact Test, conversely to the whole sample.

No. of patients	SAMPLE	MEDIA	DS	MEDIAN
13		86,5	63,2	51

No. of patients	NEURO-IMAGING	MEDIA	DS	MEDIAN	ASPIRATION	
					A-	A+
8	GROUP A	91,1	73,7	84,5	4	4
2	GROUP B	92	80,6	92	1	1
3	GROUP D	70,3	35,2	51	3	

No. of patients	ASPIRATION	MEDIA	DS	MEDIAN	LESION GROUP			
					A	B	C	D
8	ASP-	79,1	67	50	4	1		3
5	ASP+	98,2	62,1	127	4	1		

No. of patients			MEDIA	DS	MEDIAN
4	GROUP A	ASP+	85,5	63,7	84,5
4		ASP-	96,7	92,3	100

No. of patients	ETIOLOGY	MEDIA	DS	MEDIAN	ASPIRATION	
					ASP-	ASP+
4	TRAUMA/ POST-SURGERY	80,8	59,6	76,5	1	3
6	STROKE	49,3	41,1	42	5	1
3	NEURODEGENERATIVE	168,3	14,2	176	2	1

Fig. 4: Media, deviation standards and median of days between PEG placement and DSS examination during the previous year in 13 patients depending on the type of neurologic injury (GROUP A-B-C-D), the aspiration finding (positive=ASP+ and negative=ASP-) and the medical history (traumatic-post-surgical injury, stroke and neurodegenerative).

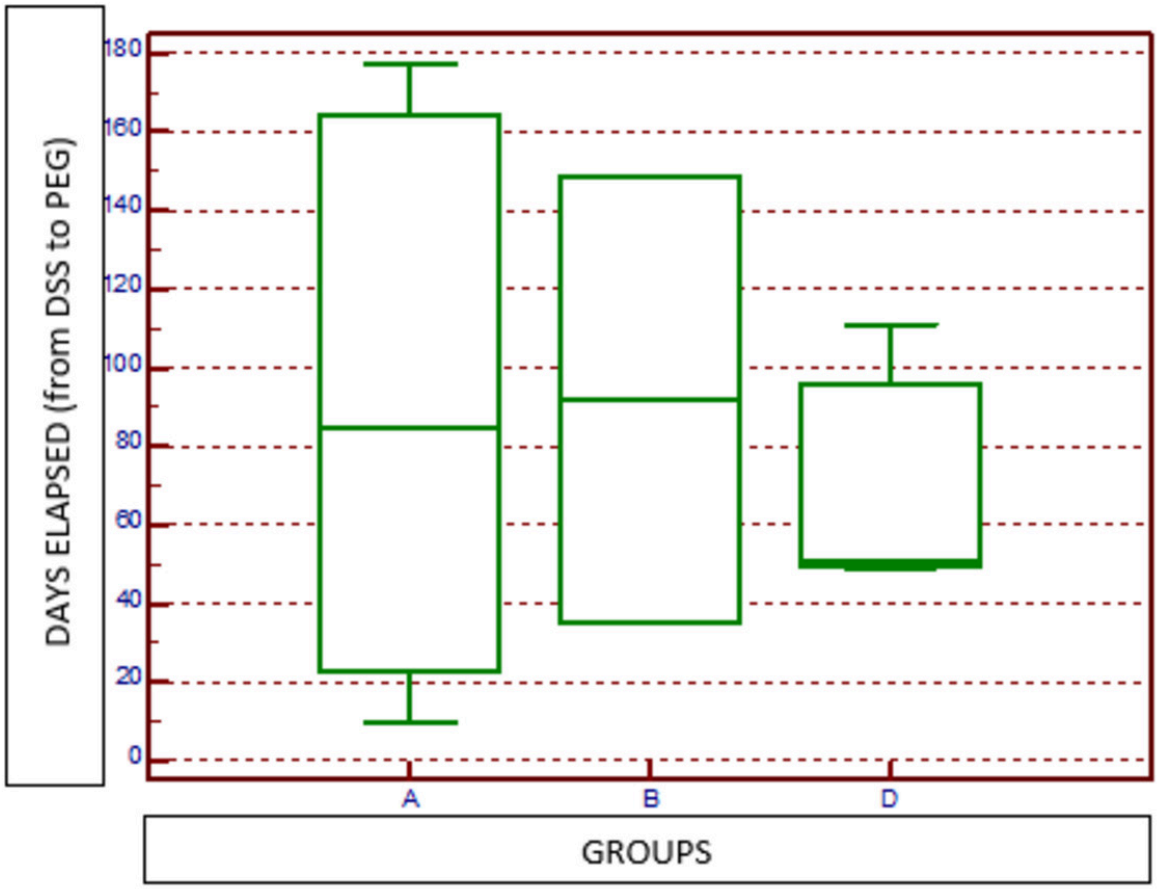

Fig. 5: In the patients with an interval between PEG and DSS less than one year, the D group compared to the other groups presents a lower mean; no significant result was found at the ANOVA test.

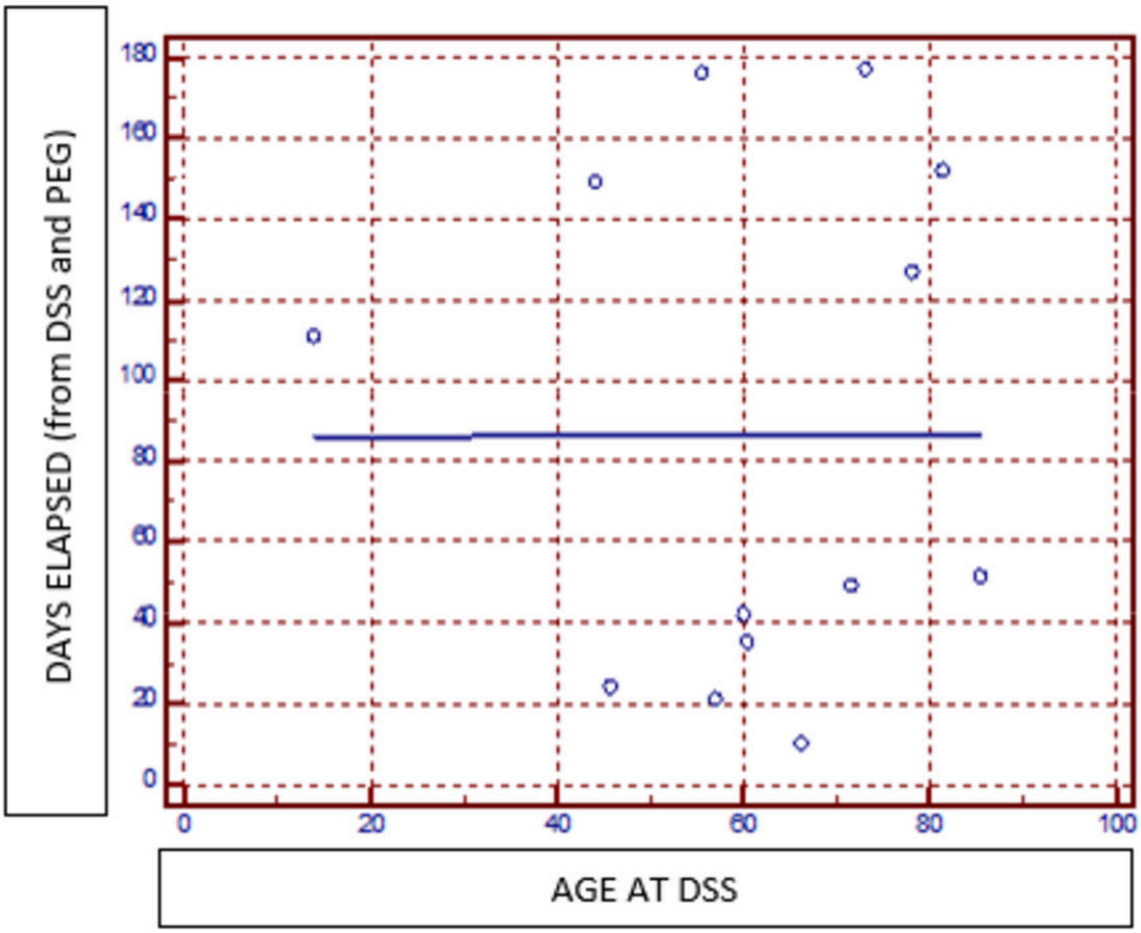

Fig. 6: The horizontal line in the scatter plot shows that in our sample the age does not influence the time lapse between the DSS examination and the PEG placement.

Conclusion

The diffuse cerebral lesion (like in the D group) appeared the most predictive variable, independently from bolus inhalation, that played a role in compromising the effectiveness of the rehabilitative outcome in our sample; age, etiology or other alterations found at DSS were not significant.

In those patients without aspiration and with limited injuries to the brainstem (B group) or the cerebrum (A group), the rehabilitation resulted successful in half of the cases.

The time-lapse between DSS and PEG performed results shorter in those with diffuse brain lesions (D group; n=3), but even more in those with stroke, maybe underlying harder conditions to manage with only rehabilitation.

In conclusion, the DSS identifies patients with neurologic dysphagia where it is correct to perform the PEG treatment from those which, instead, may benefit more from rehabilitation always in a contest of integrated information.

Personal information and conflict of interest

L. Perrucci; Ferrara/IT - nothing to disclose Z. Ferrante; Ferrara/IT - nothing to disclose A. Carnevale; Ferrara/IT - nothing to disclose A. Biagi; Ferrara/IT - nothing to disclose M. Giganti; Ferrara/IT - nothing to disclose R. Galeotti; Ferrara (FE)/IT - nothing to disclose P. Campioni; Ferrara/IT - nothing to disclose

References

[1] L. Rofes e V. Arreola, «Diagnosis and Management of Oropharyngeal Dysphagia and Its Nutritional and Respiratory Complications in the Elderly,» Gastroenterology Research and Practice, 2011; DOI:10.1155/2011/818979.

[2] N. Jaffer and F. WingFai, «Fluoroscopic evaluation of oro-pharingeal dysphagia: anatomy, tecnique and common etiologies,» American Journal of Roentgenology, vol. 1, n. 204, p. 49-58, 2015; DOI:10.2214/AJR.13.12374.

[3] L. Sura, A. Madhavan, G. Carnaby and M. Crary, «Dysphagia in the elderly: management and nutritional considerationS,» Clinical Interventions in Aging, n. 7, pp. 287-298, 2012; DOI: 10.2147/CIA.S23404.

[4] L. W. Baijens, P. Clavé, P. Cras and O. Ekberg, «European Society for Swallowing Disorders - European Union Geriatric Medicine Society white paper: oropharyngeal dysphagia as a geriatric syndrome,» Clinical interventions in aging, n. 11, p. 1403-1428, 2016; DOI: 10.2147/CIA.S107750.

[5] L. Changhyun and J. Im, «Risk factors for complications and mortality of percutaneous endoscopic gastrostomy: a multicenter, retrospective study,» Surgical endoscopy, n. 27, pp. 3806-3815, 2013; DOI 10.1007/s00464-013-2979-3.

[6] S. Teramoto, K. Yoshida and N. Hizawa, «Update on the pathogenesis and management of pneumonia in the elderly-roles of aspiration pneumonia,» Respiratory Investigations, vol. 5, n. 53, pp. 178-184, 2015; DOI: 10.1016/ j.resinv.2015.01.003.