Predictors of Oral Feeding Resumption after Stroke in a Rehabilitation Hospital: A Retrospective Study

Irene Calvo, MD,* Nicole Pizzorni, MD,* Giulia Gilardone, MD,* Flavia Mayer, MD,† Nicola Vanacore, MD,† Valentina Buraschi, SLT,* Marco Gilardone, MD,* and Massimo Corbo, MD*

Background: Dysphagia is common after stroke, requiring exclusive enteral feeding in 20% of patients. Recovery of oral feeding is associated with increased quality of life, better functional outcomes, and decreased mortality rates. However, evidence is heterogeneous and not conclusive on which factors are predictive of oral feeding recovery for stroke patients in rehabilitation units. *Aim*: To investigate predictors of complete oral feeding recovery. *Design*: Retrospective study. *Setting*: Intensive inpatient rehabilitation hospital. *Population*: Poststroke dysphagic individuals with enteral feeding. *Methods*: Retrospective chart review of demographic, clinical, rehabilitation, and swallowing factors. Univariate analysis and multivariate regression analysis were used to compare variables between the oral feeding recovery group and the enteral feeding group at discharge. *Results*: One hundred thirty-nine patients were included in the analysis. A total of 61.9% of the sample population resumed complete oral intake at discharge. There were statistically significant differences between the 2 groups in Functional Independence Measure cognitive score, clinical swallow evaluation, and instrumental swallow evaluation at admittance, and dysphagia rehabilitation. Multiple logistic regression analysis identified the absence of aspiration signs with liquids associated with a higher probability of the resumption of complete oral feeding (odds ratio [OR] 3.57; 95% confidence interval [CI] 1.07-11.89). Age between 73 and 79 years (OR .96; 95% CI .01-.58), the presence of aspiration and/or penetration (OR .22; 95% CI .07-.72), and the presence of residue (OR .14; 95%CI .04-.43) during fiberoptic endoscopic evaluation of swallowing presented lower probability of returning to complete oral feeding. *Conclusion*: Several demographic and swallowing characteristics predicted oral feeding recovery. Absence of dysphagia signs documented on fiberoptic endoscopic evaluation of swallowing was the strongest predictor of complete oral feeding resumption.

Key Words: Dysphagia—stroke—rehabilitation—oral feeding—enteral feeding

Introduction

Dysphagia is one of the most common consequences of stroke. Prevalence rates range between 19% and 81% depending on the method of evaluation, the lesion location and the time period elapsed from the occurrence of the stroke.[1,2] While swallowing function is one of the first functions to recover,[3] many patients may have persistent dysphagia in the subacute and rehabilitation phases. Studies indicated the presence of dysphagia in 3%-17% of patients, a month post stroke[4] and a prevalence range of 28%-59% in rehabilitation units.[5]

The presence of dysphagia increases morbidity and mortality in stroke patients, and is associated with poor

From the *Department of Neurorehabilitation Sciences, Casa di Cura del Policlinico, Milano, Italy; and †National Center for Disease Prevention and Health Promotion, National Institute of Health, Roma, Italy.

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Address correspondence to Nicole Pizzorni, MD, Servizio di Foniatria e Logopedia, Casa di Cura del Policlinico, Via Giuseppe Dezza 48, 20144 Milano, Italy. E-mails: nicole.pizzorni@virgilio.it, nicole.pizzorni@unimi.it.

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functional outcome, aspiration pneumonia, malnutrition, and dehydration.[3,6] When a patient is not able to eat and drink safely by mouth, enteral feeding is recommended to provide adequate nutritional support.[7] While 20% of stroke patients may require enteral tube feeding during the acute phase, 8% require long-term enteral tube feeding for more than 6 months.[8] Tube feeding through a nasogastric tube (NGT) should be used for short-term (2-3 weeks) nutritional support. After that time a percutaneous endoscopic gastrostomy (PEG) tube should be used.[7] However, tube feeding is not the endpoint of dysphagia management and care.[9] Rehabilitation of dysphagia includes a series of exercises and methods targeting the swallowing function that can be used with tube-fed patients. Literature reports oral feeding recovery in rehabilitation settings in 31%-87% patients.[5] Identifying which factors are predictive of improved swallowing outcomes is important as recovery of oral feeding is associated with an increased quality of life,[10] better functional outcomes,[11] and decreased mortality rates.[12] Moreover, the presence of oral feeding predictors may help the clinical decision-making process in determining whether to convert NGT feeding to a more permanent and invasive PEG feeding, thus avoiding unnecessary PEG procedures.[13] Furthermore, individuals who recover complete oral feeding are more likely to be discharged to their home, while patients who continue enteral feeding are more likely to be discharged to long-term rehabilitation or skilled nursing facilities.[5,14] Therefore, knowledge regarding predictive factors would improve patient care in personalizing dysphagia management and the patient's clinical pathway.[10]

Numerous studies have investigated the predictive factors for tube removal in stroke survivors after dysphagia.[3,6,11,12,14-16] Factors investigated are heterogeneous across different studies. Most are related to demographic data, stroke characteristics, comorbidities, functional scales, laboratory findings, and findings at bedside and instrumental swallow evaluations. Moreover, findings are inconsistent and not definitive. In addition, few studies reported information about the presence of swallowing rehabilitation[5,11] and none, to our best knowledge, investigated the role of different types of dysphagia rehabilitation on the recovery of oral feeding. A recent systematic review of the literature[10] investigating factors associated with PEG removal included 6 retrospective studies. The review found that there was no consensus regarding the majority of the predictors and factors across the included studies. Patient age and the absence of aspiration on video fluoroscopic swallow evaluation (VFSS) were the only 2 factors reported to be significant in more than 1 study. Absence of aspiration was the strongest predictor of tube removal across all studies. However, not all of the studies reviewed included the performance of an instrumental swallowing assessment and none reported on the use of fiberoptic endoscopic evaluation of swallowing (FEES). The use of FEES, as opposed to VFSS, has been shown to assist clinicians in the visualization of pharyngeal and laryngeal anatomy and in the assessment of swallowing residues.[17] Furthermore, limited information is available on patients' care and treatment received between tube feeding placement and recovery of oral feeding.

The aim of this study was to explore factors and predictors associated with the complete recovery of oral feeding in poststroke dysphagic patients with enteral nutrition feeding that had been admitted to a subacute rehabilitation setting. In particular, we aimed to investigate whether the presence of aspiration and penetration detected by FEES and different types of swallowing rehabilitation were associated with oral feeding recovery. We hypothesized that the presence of signs of dysphagia assessed by FEES would be a negative predictor of oral feeding recovery, while being exposed to intensive swallowing rehabilitation would predict the resumption of complete oral feeding.

Methods

Population

This is a retrospective cohort study that included all patients consecutively admitted to the Department of Neurorehabilitation Sciences, Casa Cura del Policlinico, a subacute intensive inpatient rehabilitation hospital in Milan, between January 1, 2010 and December 31, 2016. The study was approved by the local Ethical Committee and conducted according to the Declaration of Helsinki. At the time of admission, all patients signed a consent form on the use of demographic and personal data for research purposes.

Inclusion criteria: stroke diagnosis, dependence on enteral tube feeding at admission or within 1 week of admission date, age older than 18 years.

Exclusion criteria: patients who discontinued the rehabilitation period due to death or transfer to other hospitals, presence of a subdural hematoma, other neurologic diseases.

Procedures and Setting

All patients were screened at admission by a certified Speech and Language Pathologist (SLP), to establish the presence of dysphagia and to decide on a diet level. The swallowing function was investigated with the Bilancio Logopedico Breve (BLB),[18] a clinical screening tool currently used in clinical practice at Casa di Cura del Policlinico. The BLB consists of 12 items which assess oral motor skills, normal and pathological reflexes, dentition, oral preparatory phase, laryngeal excursion, oral residues, and indirect signs of aspiration with swallowing trials of liquid and puree consistencies. BLB total score ranges from 0 (severe dysphagia) to 26 (within normal limits); each item has a different score range (0-1, 0-2, or 0-3), and there is no cutoff to distinguish normal function from pathological function (see Appendix I). After the swallowing screening, the necessity of complete dependence on enteral tube feeding was documented and prescribed by the physician

in charge of the case. The screening was followed by a multidisciplinary evaluation carried out by a SLP and a phoniatrician. When the patient was able to sustain small swallow trials of one or more consistencies, an instrumental evaluation of swallowing was performed through FEES. The procedure involved the phoniatrician and a SLP; the patient was asked to swallow water, pudding, and, if deemed safe, a biscuit. Patients did not undergo FEES if they were drowsy, lethargic or not able to swallow small quantities of any consistency.

Swallowing rehabilitation was carried out with 2 different clinical pathways, according to the clinical condition of the individual patient and their ability to participate in active rehabilitation sessions. Dysphagia rehabilitation was defined as direct interventions carried out by a SLP, with a frequency of at least 2 sessions per week and active participation from the patient. Swallowing trials, oral motor exercises, swallowing exercises, compensatory strategies, texture modifications of food and fluids, and thermal-tactile stimulation of swallowing were implemented depending on the patient's needs.

Dysphagia monitoring was defined as indirect or direct interventions, carried out by a SLP, with a frequency of less than 2 sessions per week. Active participation of the patient was not necessary. The SLP evaluated the clinical conditions and checked for signs of readiness for oral trials, provided oral care and passive thermal-tactile stimulation to the face and oral area.

All patients were assisted by a multidisciplinary team including a physician with expertise in internal medicine (neurology or geriatrics), a physiatrist, a SLP, a phoniatrician, a physical therapist, an occupational therapist, and a neuropsychologist.

Data Collection

Demographic and clinical characteristics were retrospectively collected from chart review. Demographic data included age, gender, time elapsed from stroke onset to hospital admission, and length of stay in the rehabilitation hospital. Stroke characteristics such as stroke type (ischemic, hemorrhagic, or both), stroke localization (infratentorial, supratentorial, or both), and stroke lateralization (left side, right side, or bilateral) were collected. Clinical data collected at admission were: type of tube feeding (NGT or PEG); Functional Independence Measure (FIM) score, used for both cognitive and motor functions; and Body Mass Index (BMI) score from measured weight and height. Data regarding the presence and degree of swallowing impairment were collected using the BLB total score and single items scores. FEES findings, if performed, included the presence of penetration/aspiration, the presence of residues in the valleculae and/or in the pyriform sinuses, and the presence of premature spillage with swallowing trials of 1 or more consistencies. Information on the type and frequency of swallowing rehabilitation was also collected (dysphagia rehabilitation versus dysphagia monitoring). BMI, FMI, and BLB total scores at discharge were recorded. The outcome of this study was the complete recovery of oral feeding at discharge, defined as the removal of enteral feeding support.

Analyses

Clinical factors between the group who resumed complete oral feeding and the group who continued total enteral feeding at discharge were compared using an unpaired t test for continuous variables and a chi-square for categorical variables.

A logistic regression analysis was used to investigate the predictive factors of recovery of oral feeding. Age, gender, and all variables statistically significant in the univariate analysis ($P < .05$) were included. The time elapsed from stroke onset to hospital admission was also included in the multivariate analysis as a potentially relevant clinical factor, even though it was not statistically significant at the univariate analysis ($P = .30$). Statistical analysis was performed with STATA version 12 (STATA Corp. Texas).

Results

Study Sample Characteristics

Among the 7195 patients admitted to in-patient rehabilitation in the 7-year study period, 358 were poststroke patients with enteral nutrition feeding (4.97%). One hundred sixty-three patients met the inclusion criteria. Figure 1 illustrates the inclusion process.

Included and excluded individuals were compared in terms of age, gender, type of stroke, stroke location, and the time elapsed from stroke onset to hospital admission. The 2 groups differed in stroke location ($P = .04$) and the time elapsed from stroke onset to hospital admission ($P < .01$; Table 1).

A total of 50.9% of the study sample was female. The mean age was 75.8 years (SD 10. 9) and the age range was 36-93 years. A total of 83.4% of the patients were admitted with a temporary feeding tube, while only 16.5% presented a more permanent way of enteral feeding through a PEG or PEJ. A total of 61.9% of the sample resumed complete oral intake at discharge, while 38.1% retained some form of enteral nutrition.

Tables 2-6 present the results of the univariate analysis between the group that resumed oral feeding and the enteral nutrition group.

Demographic and Clinical Characteristics at Admission

Differences between the 2 groups (the group that resumed oral feeding and the enteral nutrition group) were statistically significant in the FIM median cognitive score ($P < .01$), and in the BLB median total score ($P < .01$). Analyzing every BLB item, 2 items were significantly different between the 2 groups: the swallow reflex delay ($P = .02$) and the water swallow test ($P = .03$; Table 2).

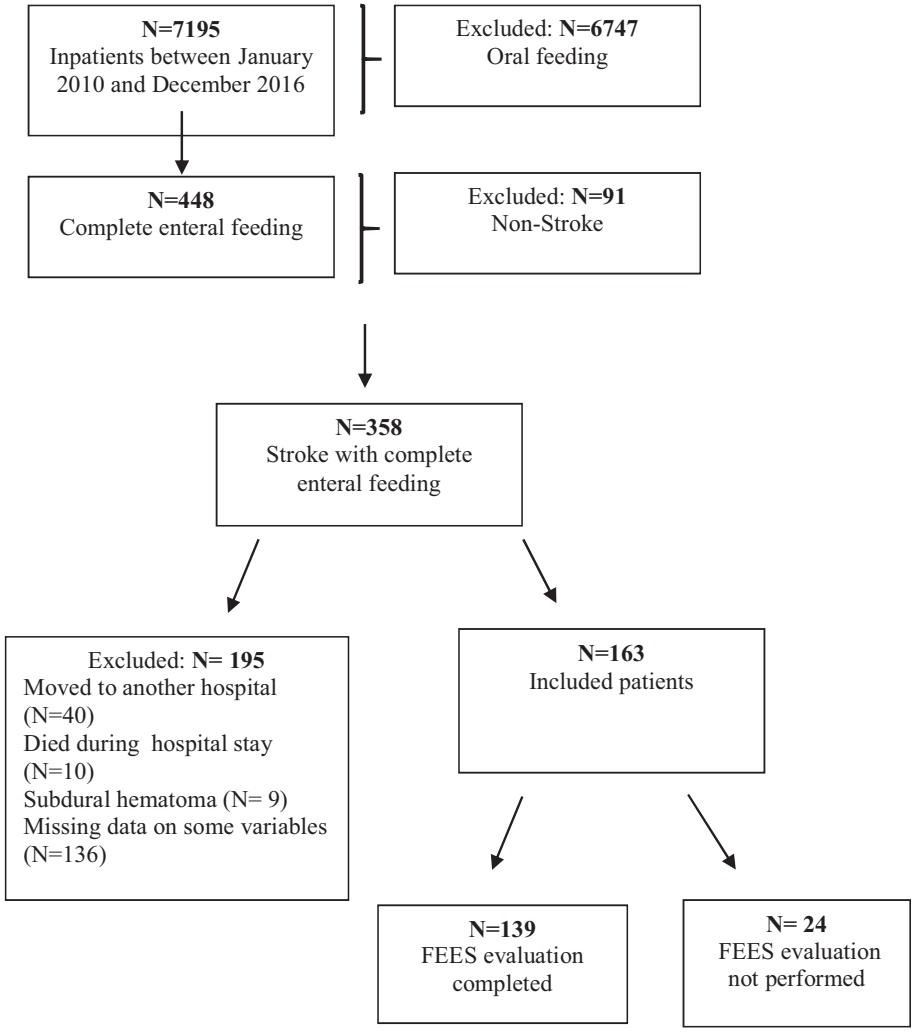

Figure 1. *Flow chart of the inclusion process.*

Stroke Characteristics

Overall, the mean time from the occurrence of the stroke to hospital admission was 26 days (DS 35.5). The stroke type was ischemic in 65.6% of the sample, hemorrhagic in 32.5%, and both ischemic-hemorrhagic in 1.8%. Localization of the stroke was supratentorial in 87.1% of the sample, infratentorial in 7.9%, both infratentorial and supratentorial in 4.9%. A total of 50.3% of the sample population presented a left hemisphere stroke, 38.6% a right hemisphere stroke, and 11% a bilateral stroke. The stroke location was the only stroke factor found to be significantly different between the 2 groups ($P < .01$; Table 3).

Clinical Pathway

The mean length of stay in the hospital was 68 days (DS 25.7). A total of 85.2% of the patients were deemed able to undertake FEES. A total of 90.1% of the sample had received dysphagia rehabilitation, 9.2% received dysphagia monitoring, while 2 patients did not receive swallowing therapy. Table 4 reports the differences between the group who resumed oral nutrition and the group who continued enteral nutrition at discharge: the ability to undertake FEES ($P < .01$) and the access to dysphagia rehabilitation ($P < .01$) were significantly different between the 2 groups.

FEES Findings

FEES was deemed safe and feasible in 139 patients; FEES' findings are reported in Table 5. The presence of penetration and/or aspiration ($P = .01$) and the presence of residues ($P < .01$) were significantly different between the 2 groups.

Characteristics of Patients at Discharge

Table 6 reports the BMI, FIM, and BLB total scores at discharge. The dichotomized FIM score ($P < .01$) and the BLB total score ($P < .01$) were significantly different between the 2 groups.

Table 1. *Characteristics of included and excluded patients*

	Excluded patients N (%) 195 (54.5%)	Included patients N (%) 163 (45.5%)	*P* Value
Age, years in quartiles			
<=71	53 (56.3)	41 (43.6)	.30
72-79	61 (61)	39 (39)	
79-83	45 (50.7)	44 (49.4)	
>=83	36 (48)	39 (52)	
Gender			
Male	92 (54.1)	78 (45.8)	.80
Female	103 (54.8)	85 (45.2)	
Stroke type			
Ischemic	107 (50)	107 (50)	.10
Hemorrhagic	83 (61)	53 (39)	
Both	5 (62.5)	3 (37.5)	
Stroke location			
Supratentorial	171 (54.6)	142 (45.3)	**.04**
Infratentorial	6 (31.6)	13 (68.4)	
Both	18 (69.3)	8 (30.7)	
Time from stroke onset, days in quartiles			
<=10	38 (39.6)	58 (60.4)	<**.01**
11-16.5	43 (51.8)	40 (48.2)	
16.5-30	56 (60.9)	36 (39.1)	
>30	58 (66.7)	29 (33.3)	

$p < 0.05$ are reported in bold.

Predictors of Complete Oral Feeding Recovery

Table 7 shows the results of the predictive model for oral feeding recovery on the subgroup of 139 patients who received FEES evaluation, as the aspiration/penetration and residue variables were available only for that group. Patients without any signs of aspiration during the water swallow test (odds ratio [OR] 3.57; 95% confidence interval [CI] 1.07-11.89) had a higher probability of resuming complete oral feeding. Patients who were between 73 and 79 years of age (OR .96; 95% CI .01-.58), patients with evidence of aspiration and/or penetration (OR .22; 95% CI .07-.72), and with the presence of residues (OR .14; 95% CI .04-.43) at FEES had a lower probability of returning to complete oral feeding.

Since we conducted the analyses only for patients with FEES, we compared patients with FEES (N = 139) and patients without FEES (N = 24) in terms of age, gender, type of stroke, stroke location, and the time elapsed from stroke onset to hospital admission. No statistically significant differences were observed (data not shown). Only 3 out of 24 patients who did not have FEES resumed complete oral feeding at discharge.

Discussion

This study investigated predictors of oral feeding recovery after stroke and enteral nutrition in an intensive rehabilitation hospital. Dysphagia and malnutrition are common consequences of stroke, and provide risk of comorbidities and mortality. The presence of enteral nutrition is often a key point in determining the clinical care path for individuals with stroke and dysphagia after the intensive rehabilitation period. Predicting the modality of nutritional intake will help determine the rehabilitation outcome. Moreover, determining predictors of oral feeding recovery is useful in providing timely information to patients and their caregivers in preparation of patients' discharge and their return home.

In this study, 61.9% of the 163 patients included had recovered swallowing function and complete oral feeding by discharge. Previous studies in rehabilitation settings with sample sizes smaller than 80[3,6,11-14,16,19] reported rates ranging from 16.3%[16] to 62.5%.[13] Studies with sample sizes larger than 100 showed the same variability in recovery of oral feeding rates. Nakadate showed a 69.2% recovery rate in their sample of 107 stroke rehabilitation patients with enteral feeding;[5] Krieger found that 46.9% of their 143 tube-fed patients regained oral feeding,[20] while Lin reported that only 25.9% of their 181 stroke patients removed PEG at discharge.[21] However, Maeshima identified complete oral feeding recovery in 78.4% of 334 stroke patients with NGT and PEG.[22]

This study found several predictors of oral feeding recovery after stroke in a rehabilitation setting. Age as a continuous variable was not significant; however, the quartile of age between 73 and 79 years, compared to the age class greater or equal to 72, was associated with a lower likelihood of oral feeding resumption. Other studies

Table 2. *Characteristics of patients at admission*

	Resume of oral feeding group N (%) 101 (62%)	Enteral nutrition group N (%) 62 (38%)	*P* Value
Age, years in quartiles			
<=71	30 (73.2)	11 (26.8)	.286
72-79	24 (53.3)	21(46.7)	
79-83	24 (63.2)	14(36.8)	
>=83	23 (59)	16 (41)	
Gender			
Male	45 (57.7)	33 (42.3)	.282
Female	56 (65.9)	29 (34.1)	
Tube feeding type at admission			
SNG	88 (65.2)	47 (34.8)	.063
PEG	13 (46.4)	15 (53.6)	
BMI, quartiles			
<=20.46	24 (58.5)	17 (41.5)	.810
20.46-22.61	27 (67.5)	13 (32.5)	
22.61-26.18	24 (58.5)	17 (41.5)	
>26.18	26 (63.4)	15 (36.6)	
FIM total score			
<=27	49 (57.65)	36 (42.35)	.236
>27	52 (66.7)	26 (33.3)	
FIM motor			
<=14	52 (59.1)	36 (40.9)	.413
>14	49 (65.3)	26 (34.7)	
FIM cognitive			
<=12	44 (52.4)	40 (47.6)	**<.01**
>12	57 (72.15)	22 (27.85)	
BLB total score			
<=15	45 (50)	45 (50)	**<.01**
>15	56 (76.7)	17 (23.3)	
BLB oral motor skills			
0	18 (50)	18 (50)	.40
1	43 (64.2)	24 (35.8)	
2	33 (66)	17 (34)	
3	7 (70)	3 (30)	
BLB voluntary cough			
0	38 (52.8)	34 (47.2)	.06
1	42 (65.6)	22 (34.4)	
2	21 (77.8)	6 (22.2)	
BLB pathological reflexes			
0	7 (53.9)	6 (46.1)	.50
1	94 (62.7)	56 (37.3)	
BLB gag reflex			
0	44 (58.7)	31 (41.3)	.60
1	37 (62.7)	22 (37.3)	
2	20 (69)	9 (31)	
BLB dentition			
0	32 (56.1)	25 (43.9)	.20
1	33 (58.9)	23 (41.1)	
2	36 (72)	14 (28)	
BLB lip closure during swallowing			
0	9 (42.9)	12 (57.1)	.06
1	24 (55.8)	19 (44.2)	

(*Continued*)

Table 2. (*Continued*)

	Resume of oral feeding group N (%) 101 (62%)	Enteral nutrition group N (%) 62 (38%)	*P* Value
2	68 (68.7)	31 (31.3)	
BLB oral preparatory phase			
0	13 (50)	13 (50)	.09
1	27 (54)	23 (46)	
2	35 (66)	18 (34)	
3	26 (76.5)	8 (23.5)	
BLB swallow trigger			
0	10 (45.5)	12 (54.5)	**.02**
1	31 (52.5)	28 (47.5)	
2	40 (70.2)	17 (29.8)	
3	20 (80)	5 (20)	
BLB laryngeal excursion			
0	9 (42.9)	12 (57.1)	.07
1	34 (58.6)	24 (41.4)	
2	58 (69)	26 (31)	
BLB oral residues			
0	19 (48.7)	20 (51.3)	.08
1	11 (55)	9 (45)	
2	71 (68.3)	33 (31.7)	
BLB signs of aspiration with liquid trials			
0	33 (50)	33 (50)	**.03**
1	24 (70.6)	10 (29.4)	
2	44 (69.9)	19 (30.1)	
BLB signs of aspiration during puree trials			
0	19 (46.3)	22 (53.7)	.40
1	8 (36.4)	14 (63.6)	
2	35 (35)	65 (65)	

$p < 0.05$ are reported in bold.

Table 3. *Stroke characteristics*

	Resume of oral feeding group N (%)	Enteral nutrition group N (%)	*P* Value
Stroke type	101 (62)	62 (38)	
Ischemic	66 (61.7)	41 (38.3)	.50
Hemorrhagic	34 (64.15)	19 (35.85)	
Both	1 (33.3)	2 (66.7)	
Stroke side			
Left	51 (60)	34 (40)	.30
Right	44 (67.7)	21 (32.3)	
Bilateral	6 (46.15)	7 (53.85)	
Stroke location			
Supratentorial	95 (66.9)	47 (33.1)	<**.01**
Infratentorial	5 (38.5)	8 (61.5)	
Both	1 (12.5)	7 (87.5)	
Time from stroke onset, days in quartiles			
<=9	32 (72.7)	12 (27.3)	.30
set-14	26 (63.4)	15 (36.6)	
15-27	22 (55)	18 (45)	
>27	21 (55.3)	17 (44.7)	

$p < 0.05$ are reported in bold.

Table 4. *Clinical pathway of patients*

	Resume of oral feeding group N (%) 101 (62%)	Enteral nutrition group N (%) 62 (38%)	*P* Value
Length of stay, days in quartiles			
<=56	28 (60.9)	18 (39.1)	.953
56-63	27 (62.8)	16 (37.2)	
64-72	20 (58.8)	14 (41.2)	
>72	26 (65)	14 (35)	
Dysphagia therapy			
Rehabilitation	100 (68)	47 (32)	**<.01**
Monitoring	1 (6.7)	14 (93.3)	
No	0	2 (1.3)	
FEES			
Yes	98 (70.5)	41 (29.5)	**<.01**
No	3 (12.5)	21 (87.5)	

$p < 0.05$ are reported in bold.

Table 5. *Dysphagia findings on FEES − subgroup analysis*

	Resume of oral feeding group N (%) 98 (70.5)	Enteral nutrition group N (%) 41 (29.5)	*P* Value
Penetration/aspiration			
Yes	22 (51.2)	21 (48.8)	.01
No	76 (79.2)	20 (20.8)	
Residue			
Yes	15 (42.9)	20 (57.1)	**<.001**
No	83 (79.8)	21 (20.2)	
Premature spillage			
Yes	66 (70.2)	28 (29.8)	.90
No	32 (71.1)	13 (28.9)	

$p < 0.05$ are reported in bold.

Table 6. *Characteristics of patients at discharge*

	Resume of oral feeding group N (%) 101 (62%)	Enteral nutrition group N (%) 62 (38%)	*P* Value
BMI, quartiles			
<=20.01	21 (52.5)	19 (47.5)	.075
20.01-22.53	31 (75.6)	10 (24.4)	
22-53-25.56	22 (52.4)	20 (47.6)	
>25.56	27 (67.5)	13 (32.5)	
FIM total score			
<=45, n (%)	38 (45.8)	45 (54.2)	**<.001**
>45, n (%)	62 (78.5)	17 (21.5)	
BLB total score			
<=19, n (%)	34 (49.3)	35 (50.7)	**<.001**
>19, n (%)	62 (93.9)	4 (6.1)	

$p < 0.05$ are reported in bold.

Table 7. *Predictors of oral feeding resumption*

Predictors	N	% resume oral feeding	Adjusted OR			
			OR	95% CI		*P* Value
Gender						
Men	73	75.3	1.00	-		-
Women	66	64.6	3.15	.98	10.16	.05
Age in quartiles						
<=72	38	73.6	1.00	-		-
73-79	37	64.8	.96	.01	.58	.01
80-83	32	71.8	.40	.06	2.57	.34
>83	32	71.8	.16	.02	1.07	.05
FIM cognitive score						
<=12	63	65	1.00	-		-
>12	76	75	1.3	.38	4.91	.62
FIM motor score						
<=14	70	70	1.00	-		-
>14	69	71	3.67	.87	15.5	.07
Time from stroke to admission, days in quartiles						
<=9	40	77.5	1.00	-		-
10-14	36	72.2	.60	.15	2.36	.47
15-27	34	64.7	.60	.15	2.30	.45
>27	29	65.5	.34	.06	1.89	.22
Stroke location						
Infratentorial	13	38.5	1	-		-
Supratentorial	120	76.7	4.1	.82	21.15	.08
Both	6	16.7	.21	.10	4.80	.33
BLB swallow trigger						
0	16	62.5	1.00	-		-
1	49	63.3	.58	.10	3.28	.53
2	53	75.5	.60	.10	3.46	.57
3	21	81	.62	.06	6.31	.69
BLB signs of aspiration with liquid trials						
0	55	60	1.00	-		-
1	32	75	3.74	.84	16.66	.08
2	52	78.8	3.57	1.07	11.89	**.03**
Aspiration/penetration						
No	96	79.1	1.00	-		-
Yes	43	51.2	.22	.07	.72	**.01**
Residue						
No	104	79.8	1.00	-		-
Yes	35	42.9	.14	.04	.43	**<.01**

$p < 0.05$ are reported in bold.

have found a younger age to be a predictor of oral feeding resumption,[3,12,13,20,22] and an older age as a negative predictor.[5,21] However, a recent systematic review by Wilmskoetter et al[10] did not find a consensus among the included studies as to whether age was a predictor of tube feeding removal after stroke, and discordant findings were reported in other studies.[14,16] The lack of clarity regarding age as a significant predictor for tube removal is consistent with research on the impact of age on stroke outcome in general. However, it is still unclear whether age is directly related to stroke outcome.[10]

In this study, gender was not a variable associated with the resumption of oral feeding. Nonetheless, female gender variable was close to reach statistically significance in the multivariate analysis. To the best of our knowledge, only 1 study reported gender as predictor of dysphagia outcome after stroke, showing females having higher chances of oral feeding resumption.[20] Conversely, many studies have showed female gender to be associated with greater stroke severity and poorer functional outcome than male gender.[23-25] However, reasons for these disparities are still unclear.[25]

Dysphagia is usually more frequently associated with infratentorial stroke locations than supratentorial ones.[1,26] However, consistent with previous studies,[6,12] stroke location was not a significant predictor of oral feeding resumption in this study.

Regardless of stroke location, dysphagia screening in stroke patients is part of the current best clinical- and evidence-based practice,[27] and is recommended by a large number of clinical guidelines.[28,29] This study is the first to investigate predictive properties of BLB, a dysphagia screening tool that is widely used in Italian clinical practice. In the present study, BLB score at admission was significantly higher in the oral feeding resumption group than in the enteral feeding group. In addition, BLB score at discharge differed significantly between the 2 groups, with the oral feeding resumption group presenting higher BLB scores. Moreover, the analysis of every BLB item, swallow trigger and signs of aspiration with liquid trials demonstrated significantly different scores in the 2 groups, with the oral feeding resumption group presenting less swallow trigger delay and fewer signs of aspiration with liquids. In the multivariate analysis, swallow trigger delay was not a significant factor. Yi[16] found that patients without pharyngeal trigger delay on VFSS had a higher probability of PEG removal than patients with documented pharyngeal trigger delay. As in our study swallow trigger delay was registered only in clinical assessment, it is possible that the subjective nature of the evaluation biased the result. However, the absence of aspiration signs with liquid trials was found to be a significant predictor of the resumption of oral feeding. This finding holds an important clinical relevance: as clinicians do not always have access to instrumental evaluation, they are forced to rely on swallowing screening or clinical evaluation in deciding on the safety of oral intake and on the diet level of stroke patients. Only 1 other study has investigated clinical swallowing evaluation as a possible predictor of oral feeding recovery after stroke. Ikenaga found that the Dysphagia Disorder Survey, a 7-point scale describing levels of dysphagia severity and which evaluates the risk of aspiration,[30] was a significant independent factor in predicting the recovery of oral feeding in stroke convalescent patients.[6] Several studies have investigated the accuracy of the water swallow test (a clinical screening tool investigating patients' ability to drink 90 mL of water without interruptions and without signs of aspiration) in detecting the presence of aspiration in stroke patients.[31,32] Even though the accuracy of the BLB in detecting aspiration has not been established, our findings seem to indicate that absence of overt signs of aspiration during liquid trials may predict recovery of swallowing function.

The use of instrumental examination is considered the gold standard for the diagnosis of dysphagia and aspiration,[7,29] and FEES and VFSS have long been considered both valuable and complementary.[33] In this study, being enough alert, compliant and clinically stable to undertake a FEES was significantly higher in the oral feeding resumption group. It was possible to conduct FEES in 85.2% of the sample, whereas in the other 14.8%, the clinical conditions of the patient would not make it feasible enough. Moreover, instrumental evaluations are the only methods to assess the presence or absence of penetration, aspiration, and/or residues. In this study, evidence of penetration/aspiration and the presence of residues during FEES were significantly associated with a lesser likelihood of oral feeding resumption. This finding is consistent with other studies, where absence of aspiration on VFSS was the strongest predictor and factor for tube feeding removal.[10,12,15,16,21] In addition, the presence of residues observed during FEES was a predictor of a lesser likelihood of oral feeding resumption at discharge in this study. Similarly, Lin found residue in valleculae or pyriform sinuses on VFSS to be independently associated with tube feeding dependency at discharge in stroke patients with dysphagia.[21] These findings highlight the importance of conducting an instrumental evaluation in patients with enteral feeding, and may support clinicians in advocating access to VFSS and FEES.

There is evidence that early rehabilitation may improve swallowing outcomes in patients after stroke,[34,35] even though the optimal time to begin rehabilitation has not yet been determined.[36] Our study included patients in the rehabilitation phase, with a mean distance from stroke onset to rehabilitation admission of 26 days (SD 35.2). Time elapsed from stroke onset to rehabilitation admission was not found to be a predictor of oral feeding recovery in 163 patients in this study. Other studies showed that in their samples of 72[6] and 107 stroke patients,[5] individuals who recovered swallowing function were admitted earlier to rehabilitation than those who continued enteral tube feeding. However, in both studies, the time elapsed between stroke onset to rehabilitation admission was not found to be a significant predictor at multivariate analysis. It is possible that the time elapsed between stroke onset and rehabilitation admission does not reflect the functional status of the patient or stroke severity, but rather depends on administrative factors like the availability of hospital beds. Moreover, in our study, we did not collect information on whether patients had some rehabilitation at the acute care hospital that might have influenced the results.

FIM score indicates the functional ability of stroke patients and is used to track changes in functional status after a rehabilitation period. Previous studies reported FIM score at rehabilitation admission[20] and FIM gain at an acute care hospital[22] as predictors of oral feeding recovery in stroke rehabilitation. In particular, Ikenaga[6] and Oto[3] found FIM cognitive score at rehabilitation admission to be a significant independent predictor of oral feeding recovery. In this study, FIM cognitive score at admission was not a significant predictor of oral feeding recovery. However, consistent with other studies,[20,22] patients who recovered oral feeding presented higher FIM scores at discharge. Yoon showed that in a cohort of 47 stroke patients, the change in FIM score was predictive of being discharged PEG-free, even though baseline FIM score was not found to be a significant predictor.[11] A general improvement in cognitive and motor functions

may lead to improved oral feeding outcome, as independent feeding is associated with improved nutritional intake.[37]

Even though limited evidence is available to determine the effect of swallowing therapy on feeding outcome in dysphagic patients,[38] dysphagia rehabilitation is advised in current stroke management guidelines.[39,40] Few studies which have investigated predictors of oral feeding recovery have reported information on swallowing rehabilitation,[5,14] and none, to our knowledge, have investigated whether the access to swallowing therapy predicts the recovery of complete oral feeding in stroke dysphagic individuals. In this study, we aimed to investigate whether dysphagia rehabilitation and dysphagia monitoring were predictive factors for the resumption of oral feeding. Almost all patients who resumed oral feeding at discharge received dysphagia rehabilitation therapy; almost all patients who continued enteral feeding received dysphagia monitoring. This finding may support the belief that dysphagia rehabilitation with direct swallowing interventions, that is repetitive and administered at regular intervals impacts swallowing recovery, as it respects neuroplasticity principles of "repetition matters," "specificity matters," and "intensity matters."[41] However, even though dysphagia rehabilitation might seem a strong predictor, it was not possible to include the 2 variables in the multivariate analysis for collinearity reasons. The 2 groups of patients, those that recovered oral feeding versus those that continued enteral tube feeding, may represent 2 different populations in relation to stroke severity, even though at admission, clinical characteristics were different only for FIM cognitive scores. Moreover, the decision to undertake a rehabilitation intervention or a monitoring intervention was made by the clinician based on the patient's responsive state, alertness, and clinical conditions. Therefore, this result may reflect a greater stroke severity present in the enteral feeding group. Future studies could investigate whether clinical indicators of alertness, such as the Glasgow Coma Scale,[42] are predictive of oral feeding resumption.

This study presents several limitations. Firstly, the retrospective nature of the study highlighted a lack of standardized reporting in medical charts that resulted in several missing data. Analysis on the excluded patients revealed differences in stroke characteristics with included patients; therefore, results of this study may not be generalizable to a wider population of individuals with stroke and enteral feeding in different rehabilitation settings. Moreover, the BLB swallowing subtest, even though widely used in our clinical practice, has not yet been validated as a dysphagia screening tool; therefore, generalization of these findings to other screening tools is not warranted. This is the first study to investigate predictors of oral feeding resumption with FEES; however, no validated scales were used to assess signs of dysphagia during FEES.

Future studies are needed to confirm these findings with a prospective study utilizing more standardized swallowing measures and considering change in FIM scores. Moreover, future studies could include information on the nutritional status of the patients, not only on the functional swallowing outcome. Furthermore, this study highlighted a considerable lack of standardization in medical chart reporting that limited data collection and the generalization of results. Therefore, it is desirable that more accurate chart reporting be implemented for both clinical and research purposes.

Conclusions

This study investigated factors associated with the recovery of complete oral feeding in poststroke patients admitted to a rehabilitation hospital with enteral nutrition. Absence of aspiration signs with liquid trials was associated with greater chances of recovery. The presence of aspiration and residues on FEES and being between 73 and 79 years of age were associated with lower chances of oral feeding recovery. Absence of dysphagia signs documented on FEES was the strongest predictor of complete oral feeding resumption. Therefore, access to instrumental swallowing evaluation is critical in predicting the recovery of oral feeding in stroke patients.

Disclosures

All authors have no financial and nonfinancial conflict of interest to disclose.

Appendix I

BLB swallowing subtest

- Oral motor skills (0-3)
- Voluntary cough (0-2)
- Pathological reflexes (0-1)
- Gag reflex (0-2)
- Dentition (0-2)
- Lip closure during swallowing (0-2)
- Oral preparatory phase (0-3)
- Swallow trigger (0-3)
- Laryngeal excursion (0-2)
- Oral residues (0-2)
- Signs of aspiration with liquid trials (presence of wet voice and/or coughing) (0-2)
- Signs of aspiration with puree trials (presence of wet voice and/or coughing) (0-2)

Total score: /26

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