J Rehabil Med 2012; 44: 922–925

ORIGINAL REPORT

PREDICTIVE FACTORS FOR REMOVAL OF PERCUTANEOUS ENDOSCOPIC GASTROSTOMY TUBE IN POST-STROKE DYSPHAGIA

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Objective: **To investigate predictive factors for percutaneous endoscopic gastrostomy (PEG) removal, thereby minimizing unnecessary PEG insertion in post-stroke dysphagia.**
Design: **Retrospective cohort study.**
Patients: **A total of 49 patients who undertook PEG tube insertion for post-stroke dysphagia.**
Methods: **Patients were divided into a removal group ($n=8$) and a sustaining group ($n=41$) depending on the presence of a PEG tube. Patients' demographic data, nutritional status, Charlson's Comorbidity Index (CCI), and video-fluoroscopic swallowing study findings at the time of PEG insertion were compared between the 2 groups.**
Results: **Eight out of 49 patients (16.3%) removed the PEG tube at a mean of 4.8 months after the insertion. Demographic data, nutritional status, and CCI were comparable between the 2 groups before tube insertion. Video-fluoroscopic swallowing study findings in the removal group showed a lower prevalence of premature bolus loss (50.0% vs 73.2%; $p=0.032$), aspiration (37.5% vs 80.6%; $p=0.012$) and pharyngeal trigger delay (12.5% vs 74.2%; $p=0.010$) than those in the sustaining group.**
Conclusion: **The absence of aspiration or pharyngeal trigger delay in video-fluoroscopic swallowing study findings at the time of PEG insertion may be a predictive factor for eventual removal of PEG tubes. Identification of removal factors will assist in determining PEG insertion.**

Key words: dysphagia; stroke; gastrostomy; prognosis.

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Submitted February 26, 2012; accepted July 11, 2012

INTRODUCTION

Dysphagia is one of many common symptoms in post-stroke patients and has been reported in 29–81% of stroke patients (1, 2). Although most patients recover from swallowing difficulties, a proportion of patients experience persistent dysphagia and are at risk of many complications, such as malnutrition, aspiration pneumonia, delayed functional recovery, and consequently increased mortality (1, 3–6).

Percutaneous endoscopic gastrostomy (PEG) is widely used to provide nutritional support in patients with continuing swallowing difficulties because of its safety and endurability (7). However, PEG entails procedure-related risks. Therefore, minimizing unnecessary PEG procedures by identifying predictive factors for weaning PEG tubes is an important issue when treating post-stroke dysphagia.

Previous studies have reported associations between clinical factors and swallowing parameters. It has been suggested that unilateral stroke, absence of aspiration during swallowing, and age less than 53 years are positive predictive factors for regaining oral feeding in patients with stroke (8). One study proposed younger age, higher Functional Independence Measure (FIM) score and shorter duration from onset to admission to rehabilitation hospital (9). However, another study reported that no single variable was independently associated with PEG removal (10). Thus, the predictive factors for weaning the PEG tube are not yet clear.

The aim of the present study was to investigate predictive factors for PEG removal, thereby minimizing unnecessary PEG insertion in post-stroke dysphagia.

PATIENTS AND METHODS

All patients who underwent PEG tube insertion at our department from January 2003 to December 2010 were initially screened ($n=181$). Among them, 63 patients undertook PEG insertion for post-stroke dysphagia. Sixteen patients were further excluded due to lack of information on their functional scales or Videofluoroscopic Swallowing Study (VFSS) findings. The final 49 patients were divided into two groups: a removal group ($n=8$) and a sustaining group ($n=41$), depending on the presence of a PEG tube on 31 December 2010. All patients whose tubes were removed were able to recover their oral feeding.

Patients' demographic data regarding age, sex, and body mass index (BMI) on the day before PEG insertion were obtained by reviewing medical records. In order to evaluate pre-PEG functional status, modified Barthel index (MBI), Mini-Mental Status Examination (MMSE) and Clinical Dementia Rating (CDR) scale data at the time of admission for PEG were reviewed. Data regarding blood urea nitrogen (BUN), creatinine, albumin, haemoglobin (Hb), C-reactive protein (CRP), HbA1c, and serum glucose levels were also gathered retrospectively from previous laboratory results in order to evaluate patients' nutritional status and general medical condition. The patients' history of hypertension, diabetes mellitus, pneumonia, and the pres-

Table I. *Patients' demographic data, past medical history and stroke profiles*

	Sustaining group ($n=41$)	Removal group ($n=8$)	p-value
Demographic data			
Age, years, mean (SD)	69.3 (10.9)	70.6 (11.9)	0.432
Female sex, *n* (%)	17 (41.5)	3 (37.5)	0.579
BMI, kg/m^2, mean (SD)	20.9 (3.2).	21.1 (2.7).	0.943
Medical history			
Hypertension, *n* (%)	28 (68.3)	4 (50.0)	0.273
Diabetes mellitus, *n* (%)	17 (41.5)	3 (37.5)	0.579
History of pneumonia, *n* (%)	24 (58.5)	7 (87.5)	0.122
Charlson's Comorbidity Index	3.5 (3–10)	4.0 (3–8)	0.464
T-cannula in situ, *n* (%)	18 (43.9)	4 (50.0)	0.524
Stroke profiles			
Lesion location, *n* (%)			
Bilateral	11 (26.8)	4 (50.0)	0.227
Left	15 (36.6)	2 (25.0)	0.696
Right	15 (36.6)	2 (25.0)	0.696
Stem involvement	8 (19.5)	2 (25.0)	0.659
Recurrent	16 (39.0)	2 (25.0)	0.693
Lesion type, *n*			
Haemorrhagic, *n* (%)	19 (46.3)	2 (25.0)	0.438
Infarction, *n* (%)	22 (53.7)	6 (75.0)	0.438

SD: standard deviation; BMI: body mass index.

ence of T-cannula at the time of PEG insertion were recorded. And Charlson's Comorbidity Index (CCI) at the time of PEG insertion was calculated by retrospective chart review. Stroke profiles and presence of oral phase delay, premature bolus loss, decreased laryngeal elevation or epiglottic folding, aspiration, vallecular residue, pyriform sinus residue, pharyngeal trigger delay, and abnormal upper oesophageal sphincter (UES) relaxation, based on the VFSS findings before insertion of the PEG tube, were also collected.

Approval for use of patients' data was granted by the Institutional Review Board of (our blinded) hospital.

Variables were analysed using SPSS 18.0 software package. The significance level was set at $p=0.05$. Continuous variables, such as age, BMI age, BMI and CCI were compared by Mann-Whitney *U* test, and presented as means (standard deviations (SDs)). For comparison of categorized variables between the 2 groups, such as CCI, clinical dementia scale, Pearson's χ^2 or Fisher's exact tests, were used. Multiple logistic regression analysis was used to evaluate the probability of significance of each variable.

RESULTS

Among the included 49 patients, 8 (16.3%) were able to remove the PEG tubes, and the mean duration from PEG insertion to removal was 4.8 months (range 68–276 days). The interval between stroke onset and PEG insertion was 367 days (range 38–1,215 days) in the removal group and 289 days (range 14–4,529 days) in the sustaining group. These results were comparable between the two groups ($p=0.223$).

In our hospital, every stroke patient undertakes swallowing screening examination using a bedside swallowing test or VFSS within 72 h after admission, and is then followed up every 1 week to 3 months according to the initial findings of the swallowing screening examination.

The mean duration from stroke onset to the first VFSS study was 314 days (range 10–6,309 days). However, there were 3 outliers who had been followed up initially through other hospitals, and who self-referred to our dysphagia clinic for further evaluation and management. The duration from stroke onset to VFSS in our clinic for these 3 patients was 1,182, 6,309 and 1,273 days, respectively. After excluding these 3 outliers, the mean duration from the stroke onset to initial VFSS (not including bedside swallowing examination test) was 144 days (range 10–872 days).

Table I shows the patients' demographic data, medical history and the stroke profiles of each group. Mean ages were 70.6 (SD 11.9) and 69.3 years in the removal group and the sustaining group ($p=0.432$). Other profiles also showed no significant differences between the two groups (Table I).

The patients' functional scales and laboratory findings evaluated on the day before PEG insertion are shown in Table II. MBI, MMSE and CDR scores were 26.4 (SD 32.3), 13.5 (SD 12.2) and 1.7 (SD 1.4) in the removal group, and 13.1 (SD 19.1), 7.6 (SD 8.9) and 2.4 (SD 1.0) in the sustaining group, respectively, and were comparable between the two groups. Other profiles were also comparable between the two groups (Table II).

Findings of VFSS performed before the PEG insertion are shown in Table III. In some patients, the pharyngeal phase (in 14 patients) or premature bolus loss (in 10 patients) could not

Table II. *Functional scales and laboratory findings of the patients*

	Sustaining group ($n=41$)	Removal group ($n=8$)	p-value
Functional scales			
Modified Barthel Index, mean (SD)	13.1 (19.1)	26.4 (32.3)	0.103
Mini-Mental State Examination, mean (SD)	7.6 (8.9)	13.5 (12.2)	0.167
Clinical dementia rating, median (range)	3.0 (0–3)	1.7 (0–3)	0.234
Laboratory findings			
Blood urea nitrogen, mg/dl, mean (SD)	19.3 (10.0)	21.8 (10.0)	0.532
Abnormal creatinine, *n* (%)	0 (0.0)	0 (0.0).	1.000
Albumin, g/dl, mean (SD)	3.5 (0.4)	3.7 (0.4)	0.432
Haemoglobin, g/dl, mean (SD)	12.3 (1.6).	12.1 (1.0).	0.681
C-reactive protein, mg/dl, mean (SD)	1.8 (2.8)	1.0 (1.4)	0.505
HbA1c, %, mean (SD)	6.4 (0.9)	7.3 (1.6)	0.262
Serum glucose, mg/dl, mean (SD)	115.5 (39.9)	98.2 (18.9)	0.344

SD: standard deviation.

Table III. *Videofluoroscopic findings of the patients*

	Sustaining group ($n=41$) *n* (%)	Removal group ($n=8$) *n* (%)	*p*-value
Oral phase delay	33 (80.5)	7 (87.5)	0.543
Premature bolus loss	30 (73.2)	4 (50.0)	0.032*
Decreased laryngeal elevation or epiglottic folding	28 (96.9)	7 (100.0)	0.806.
Aspiration	23 (80.6)	2 (37.5)	0.012*
Vallecular residue	23 (80.6)	3 (37.5).	0.055
Pyriform sinus residue	17 (58.1)	3 (37.5).	0.332
Pharyngeal trigger delay	20 (74.2)	1 (12.5)	0.010*
Abnormal UES relaxation	3 (9.4)	2 (37.5).	0.244

*$p<0.05$.
UES: upper oesophageal sphincter.

be evaluated because of severe oral phase delay. Premature bolus loss, aspiration and pharyngeal trigger delay were more prevalent in the sustaining group than in the removal group (50.0% vs 73.2%, $p=0.032$; 37.5% vs 80.6%, $p=0.012$; 12.5% vs 74.2%, $p=0.010$, respectively; Table III).

Correlational analysis between premature bolus loss, aspiration and pharyngeal trigger delay was performed (Table IV). There was weak correlation between premature bolus loss and aspiration ($p=0.029$; $R^2=0.369$), and between premature bolus loss and pharyngeal trigger delay ($p=0.008$; $R^2=0.440$). However, no specific correlation was observed between aspiration and pharyngeal trigger delay ($p=0.134$; $R^2=0.258$). Finally, multiple logistic regression analysis adjusting for age and CCI (Table V) was performed, and absence of aspiration (odds ratio (OR) = 11.4, $p=0.045$) and absence of pharyngeal trigger delay (OR = 15.1, $p=0.036$) were identified as independent predictive factors for PEG removal.

DISCUSSION

The objectives of this study were to identify predictive factors for PEG removal in patients with post-stroke dysphagia and to suggest guidelines to avoid or minimize unnecessary performance of PEG insertion. The current study suggested a higher probability of PEG tube removal in those without aspiration and pharyngeal trigger delay at the time of PEG insertion. This result is in close agreement with those of the earlier study, which demonstrated aspiration during VFSS as

Table IV. *Spearman's rank correlation*

		Premature bolus loss	Aspiration	Pharyngeal trigger delay
Premature bolus loss	R^2	1.000	0.369*	0.440**
	p-value	0.000	0.029	0.008
Aspiration	R^2	0.369*	1.000	0.258
	p-value	0.029	0.000	0.134
Pharyngeal trigger delay	R^2	0.440**	0.258	1.000
	p-value	0.008	0.134	0.000

*$p<0.05$; **$p<0.01$.

Table V. *Multiple logistic regression analysis*

	Odds ratio	95% CI	*p*-value
Age	1.046	0.903–1.212	0.545.
CCI	1.530	0.752–3.113	0.241.
Absence of aspiration	11.361	1.054–122.4	0.045*
Absence of pharyngeal trigger delay	15.070	1.187–191.3	0.036*

*$p<0.05$.
CI: confidence interval; CCI: Charlson's Comorbidity Index.

a negative predictor for gastrostomy removal (8). It also corresponds with the results of Han et al.'s study (11), in which poor VFSS was associated with long-term persistent dysphagia after stroke. Older age has been established as a major negative predictive factor for weaning tubes (8, 9, 12, 13). Our interpretation demonstrates that more tube procedures are performed in older patients than in younger patients because they are more threatened with severe malnutrition or complications of pneumonia. In the same context, younger patients who consider PEG insertion usually have severe and potentially irreversible dysphagia. This may explain why age, which has been shown to be a tube removal predictor in other studies, was not found to be a predictor in our study.

Previous studies have also proposed that higher functional status, represented by higher FIM or favourable performance status, preserved renal function and unilateral stroke are predictive factors for weaning gastrostomy tubes (8, 9, 13). In the current study, although MBI was relatively higher in the removal group than in the sustaining group, this was not statistically significant ($p=0.103$). In our patients, the mean duration from stroke onset to initial VFSS was 144 days, suggesting their relatively lower functional status, taking into account that most of our patients undertook the initial bedside swallowing test within 72 h after admission, and the initial VFSS within 2 weeks after the initial bedside swallowing test (our hospital record from May 2009 to May 2010 shows that the mean interval between the initial bedside swallowing test and the initial VFSS was 9.2 days (SD 7.2)). In addition, in our oriental culture, patients and their families are very reluctant to accept the PEG procedure.

As for the stroke profiles, statistical significance in the involved stroke side was not observed in either group.

This study indicates that absence of aspiration and absence of pharyngeal trigger delay may be independent predictive factors for PEG tube weaning. Thus, it is justified to perform a VFSS when making a decision on PEG insertion.

Although the aim of this study was to avoid or minimize unnecessary PEG insertion, intermittent oro-esophageal catheterization can be used as an alternative method of circumventing continuous nasogastric tube feeding, or as a transient method of moving from nasogastric tube feeding to oral diet commencement in acute stroke patients (14). This method could prevent aspiration pneumonia caused by direct swallowing training using foods while the nasogastric tube is still inserted, and might improve swallowing function by simulating the swallowing process using an orally inserted tube. However,

this method is limited to patients with intact cognition who can understand the procedure, and thus application of this procedure very limited.

There are some limitations to be considered in our study. First, as the study was retrospective, the data collection had inherent limitations. Another limitation was the small sample size. Records of PEG insertions for past years were reviewed, but only a few patients who had PEG tubes removed were found. In the same context, our observation period was also insufficient. A longer observation period might have distinguished more predictive factors for weaning tubes.

In conclusion, absence of pharyngeal trigger delay and aspiration in VFSS performed at the time of PEG insertion may be independent predictive factors for removal of PEG tubes in the future. Therefore, it is beneficial to perform a VFSS for determining whether to perform PEG insertion.

The results of this study may allow the early identification of factors that contribute to removal of PEG, and therefore provide useful clinical information on whether PEG should be used, thus minimizing unnecessary PEG insertions.

ACKNOWLEDGEMENTS

This study was supported by an independent research grant to N. J. Paik from DaeWoong Pharmaceutical Co., Ltd. None of the authors have a connection with this company.

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