Use of Percutaneous Endoscopic Gastrostomy Feeding Tubes and Functional Recovery in Stroke Rehabilitation: A Case-Matched Controlled Study

Masayuki Iizuka, MD, Mike Reding, MD


Objective: To compare the morbidity, mortality, and functional recovery of patients who require percutaneous endoscopic gastrostomy (PEG) placement for the management of dysphagia after stroke.

Design: Retrospective case-matched controlled study.

Setting: Acute stroke rehabilitation inpatient unit.

Participants: Patients (N=193) who were admitted for stroke rehabilitation with a PEG tube in place from January 1, 1993, to December 31, 2002, were matched with 193 case controls without PEG. Patients and controls were within 90 days of stroke onset, and were matched for age, sex, type of stroke, FIM instrument score, duration from onset to stroke unit admission, and year of admission.

Interventions: Not applicable.

Main Outcome Measures: Length of rehabilitation hospital stay, improvement in FIM scores, FIM efficiency score, need for transfer back to acute care hospital, diagnosis for which transfer was required, final discharge destination, and survival status.

Results: Significant differences were found between the 2 groups, PEG versus control, respectively, in the following variables: FIM efficiency (.42±.57 vs .56±.55, P=.016); need for transfer back to acute hospital (58/193 vs 23/193, P=.001); and survival status dead/alive (14/179 vs 3/190, P=.006). Nonsignificant differences were as follows: length of rehabilitation hospital stay (46.9±24.8d vs 43.3±19.7d, P=.11), improvement in total FIM score from admission to discharge (16.9±17.9 vs 21.0±15.5, P=.72), and final discharge destination home/institutional care (96/83 vs 101/89, P=.93). Pneumonia was the most frequent reason for transfer to acute care for patients with PEG.

Conclusions: Patients who meet criteria for admission to a stroke rehabilitation unit and who have a PEG in place are at increased risk for medical complications and death. Those who survive, however, show similar functional recovery and rate of home discharge as case-matched controls.

Key Words: Dysphagia; Gastrostomy; Nutrition; Rehabilitation; Stroke.

PERCUTANEOUS ENDOSCOPIC gastrostomy (PEG) was first introduced in 1980 and has become an established procedure recommended for patients with persistent dysphagia after stroke who are unable to maintain safe oral nutrition and hydration.1 Norton et al2 performed a prospective randomized comparison of PEG versus nasogastric tube (NGT) feeding after acute dysphagic stroke. Thirty patients with persisting dysphagia 14 days after acute stroke were randomly assigned to PEG (16 patients) versus NGT feeding (14 patients). Mortality at 6 weeks was significantly lower in the PEG group, with 2 deaths compared with 8 deaths in the NGT group. Patients with PEG were more likely to have received the total amount of prescribed feeding and showed statistically greater improvement in nutritional state as well as discharge rate at 6 weeks.2

Functional recovery after PEG insertion, however, has not been well described and remains controversial. Wanklyn et al3 retrospectively evaluated all stroke patients who received a PEG in their hospitals during a 30-month period. The duration of time between stroke onset and PEG insertion was highly variable (range, 12–131d; median, 26d). Twenty-one of 37 (56.8%) patients had died by the time of final assessment. The median survival was 53 days (range, 2–528d) with only 12 patients (32.4%) surviving more than 3 months.3 A larger retrospective study by James et al4 assessed 126 patients who had a PEG inserted for acute dysphagic stroke. The median time from stroke to PEG insertion was 22 days (range, 4–189d). At follow-up, 72 (57.1%) patients had died and 41 (32.5%) patients had resumed oral intake. The median survival was 305 days, with 79 (62.7%) patients alive at 3 months and 59 (46.8%) alive at 1 year. Teasell et al5 assessed 523 stroke patients with percutaneous gastrojejunostomy tubes who were admitted to an inpatient rehabilitation unit. Criteria required for admission were, however, not well described. There were no deaths during the study period (1y poststroke). All patients except 1 were discharged to home, and 75% eventually recovered sufficient swallowing function to permit removal of the tube.6 The favorable outcome reported by Teasell5 supports the utility of PEG feeding, at least for patients with rehabilitation potential.

More information is needed concerning the impact of dysphagia, severe enough to require PEG placement, on medical complications and on functional recovery of patients meeting criteria for inpatient stroke rehabilitation. We therefore conducted a case-matched controlled study of patients with versus those without PEG placement who met criteria for inpatient rehabilitation to assess differences in relevant outcomes. We
hypothesized that PEG placement, although indicating that patients are at increased risk of medical complications and death, would allow survivors to achieve functional recovery and home discharge rates similar to case-matched controls.

METHODS

A total of 2755 admissions were accepted to our freestanding stroke rehabilitation unit from January 1, 1993, to December 31, 2002. Patients were screened before acceptance onto the stroke rehabilitation unit and had to fulfill the following criteria: (1) be deemed medically stable, (2) be able to engage in at least 3 therapy sessions per day, and (3) have a reasonable expectation of making functional gains. Initial rehabilitation programs for patients requiring PEG placement usually focus on low-level physical therapy, occupational therapy, speech-language therapy, and dysphagia management strategies, such as mat and pregait activities, stand-pivot transfer techniques, wheelchair sitting tolerance and posture, oral motor exercises, and the ability to signal bowel and bladder needs. Such patients are easily fatigued and often require programs dispersed throughout the day with frequent rest periods.

Admission and discharge patient data were recorded prospectively in a computerized hospital record by rehabilitation team members who were unaware of the study hypothesis. Data accuracy and security were checked routinely by the medical records department. The diagnosis of stroke was based on World Health Organization criteria, with confirmatory neuromuscular medicine and laboratory records department. Data accuracy and security were checked routinely by the team members who were unaware of the study hypothesis.

A case-matched control without PEG was identified for each of the 193 PEG patients. Case-matched controls were selected from the 2755 admissions meeting the previously mentioned inclusion criteria. Matching was performed by prioritizing each of 6 variables in the following order, from highest to lowest priority: (1) sex, (2) duration from onset to stroke unit admission (interval poststroke) ≥5 days, (3) total FIM instrument score on admission ≥5, (4) age ≥5 years, (5) diagnosis (ischemic vs hemorrhagic), and (6) year of admission. A case-matched control fulfilling all criteria could not be found for 79 PEG patients. In such cases, the lowest-priority matching variables were sequentially eliminated until a match was obtained. The number of eliminated variables required for each match was as follows: no variables eliminated for 114 matches, 1 variable for 42 matches, 2 variables for 26 matches, 3 variables for 8 matches, and 4 variables for 3 matches. The case-matched control group was called the control group. Once matches were identified, we checked the location of the lesion as a potential confounding variable in the PEG versus control groups. No significant differences in lesion location were present: right hemisphere, 58 versus 59; left hemisphere, 75 versus 88; bilateral hemisphere, 27 versus 25; infratentorial, 17 versus 7; and combined supra- and infratentorial, 16 versus 14.

The following outcome parameters of interest were compared for the PEG and control groups: (1) length of stay (LOS) on the rehabilitation unit; (2) change in FIM score from rehabilitation hospital admission to discharge; (3) FIM efficiency score, which was calculated by dividing the change in FIM score by the LOS; (4) need and reason for transfer back to acute care hospital from illness while on the rehabilitation unit; (5) final discharge destination (home or institutional care); and (6) death either on the rehabilitation unit or after transfer back to an acute care hospital. The FIM was used to score disability because it is a widely used component of the Uniform Data Set, and it is well validated. We also assessed features unique to the PEG group: (1) duration from stroke onset to PEG placement, (2) presence of PEG tube at final discharge, and (3) discharge destination for patients who still required supplemental hydration or feeding via PEG at the time of rehabilitation hospital discharge.

Categoric data and linear data were analyzed by using the chi-square statistic and analysis of variance, respectively. Analysis of covariance (ANCOVA) was used to assess the effects of covariables on outcomes of interest for the 2 study groups. Statistical inferences were said to be significant if the 2-tailed probability statistic was less than .05. All variances are listed as standard deviations (SDs). Statistical analyses were performed with StatView, Version 5.0.1, for Windows.

RESULTS

Table 1 shows demographic features for the PEG and control groups. No significant differences were found between the 2 groups in the following variables: sex, age, diagnosis, and interval poststroke. Admission total FIM scores were, however, significantly lower for the PEG group ($P = .041$). The total FIM score contains 1 item that scores eating ability on a 1- to 7-point scale. Patients who require PEG feeding score 1 point (totally dependent) for this FIM item. When the admission total FIM score was divided into its 3 subcomponents—FIM activities of daily living (ADLs), FIM motor, and FIM cognitive—only the FIM ADL subcore differed significantly for the PEG and control groups ($P = .003$). Ottenbacher et al have reported that the SD for test-retest reliability of the FIM is ±4.7. Therefore, the difference (average, 3.7 units) in admission total FIM score between the groups in our study is probably not clinically significant. As a precaution, we used ANCOVA to correct for this small but statistically significant difference whenever we compared improvement in total FIM and its subcomponents for the 2 groups. The interval from stroke onset

Table 1: Demographic Features of PEG and Control Groups

<table>
<thead>
<tr>
<th>Variable</th>
<th>PEG Group</th>
<th>Control Group</th>
<th>$P$</th>
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</thead>
<tbody>
<tr>
<td>Sex</td>
<td>Male</td>
<td>117</td>
<td>117</td>
</tr>
<tr>
<td></td>
<td>Female</td>
<td>76</td>
<td>76</td>
</tr>
<tr>
<td>Age (y)</td>
<td>71.2 ± 10.7</td>
<td>71.0 ± 10.8</td>
<td>.80†</td>
</tr>
<tr>
<td>Diagnosis</td>
<td>Ischemic</td>
<td>164</td>
<td>165</td>
</tr>
<tr>
<td></td>
<td>Hemorrhagic</td>
<td>29</td>
<td>28</td>
</tr>
<tr>
<td>Interval poststroke (d)</td>
<td>31.8 ± 17.1</td>
<td>29.9 ± 17.2</td>
<td>.29†</td>
</tr>
<tr>
<td>FIM score on admission</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>ADL$^a$</td>
<td>16.3 ± 9.1</td>
<td>19.1 ± 9.1</td>
<td>.003†</td>
</tr>
<tr>
<td>Motor$^b$</td>
<td>9.2 ± 6.2</td>
<td>8.4 ± 4.6</td>
<td>.17†</td>
</tr>
<tr>
<td>Cognitive$^c$</td>
<td>14.5 ± 7.6</td>
<td>16.0 ± 7.4</td>
<td>.063†</td>
</tr>
<tr>
<td>Total</td>
<td>39.7 ± 18.7</td>
<td>43.4 ± 17.6</td>
<td>.041†</td>
</tr>
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</table>

NOTE. Values are mean ± SD or the number of patients.

*aStudent $t$ test.

†Mann-Whitney $U$ statistic.

$^a$ADL component of FIM is the summation of self-care and sphincter control scores.

$^b$Motor component of FIM is the summation of transfer and locomotion scores.

$^c$Cognitive component of FIM is the summation of communication and cognitive scores.
to last follow-up averaged 78.7 (range, 5–175) and 73.2 (range, 9–122) days for PEG and control groups, respectively (Student t test, P = .075).

Table 2 shows the number of patients requiring transfer to acute care, overall mortality while on the rehabilitation unit or after transfer, and final discharge destination among survivors. There was a 2.5-fold greater frequency of transfer for the PEG versus the control group and a 4.7-fold greater frequency of death. Both groups, however, showed a similar frequency of home discharge for survivors. More than half the patients in both groups were able to return home with family. Details and statistical significance are listed in table 2.

The reasons for transfer to acute care hospital in the PEG versus the control group were as follows: pneumonia (15 vs 0), cardiac events (15 vs 2), stroke progression (9 vs 2), deep vein thrombosis or pulmonary embolism (7 vs 5), gastrointestinal tract bleed (5 vs 5), and other causes (3 vs 9). Additionally, 4 of 193 (2.1%) patients with PEG were transferred because of infection at the PEG site. Pneumonia, cardiac events, and stroke progression were significantly more frequent among patients in the PEG group (χ² test, P < .001, P = .001, P = .03, respectively).

Table 3 compares the LOS, FIM efficiency, and FIM efficiency subscores for the 2 study groups. LOS did not differ significantly for the 2 groups. FIM efficiency and FIM efficiency subscores were each evaluated by using ANCOVA to correct for differences in baseline admission FIM scores. All subscores except the FIM efficiency for cognition differed significantly for the 2 groups, with lower efficiency scores seen for the PEG group.

FIM efficiency scores focus on the rate of recovery. Change in FIM scores measure functional improvement and are perhaps better suited to compare rehabilitation benefits across groups with different medical comorbidities and different expected rates of recovery. Improvements in total FIM scores and subscores (except the FIM motor subscores) were similar for the 2 study groups. The mean improvements in total FIM score and FIM subscores for the PEG versus the control group were as follows: total FIM score, 16.9 ± 17.9 versus 21.0 ± 15.5 (P = .72); FIM ADL subscore, 8.0 ± 9.6 versus 9.9 ± 8.7 (P = .93); FIM motor subscore, 5.8 ± 6.9 versus 7.4 ± 5.2 (P < .001); and FIM cognitive subscore, 2.8 ± 2.5 versus 3.7 ± 5.2 (P = .15).

The median interval from stroke onset to PEG placement was 13.5 days (range, 1–68d). PEG tubes were removed in 35 (18.1%) patients and were still in place but no longer being used except to supplement oral hydration in 119 (61.7%) patients by the time of final discharge. PEG tube feeding was still required for 39 (20.2%) patients at the time of final discharge. Of the 35 patients from whom PEG tubes were removed, 27 and 8 patients were discharged to home and to institutional care, respectively. The final discharge destinations of the 158 patients who still had PEG tubes in place were as follows: home, 69; institutional care, 75; and death, 14.

**DISCUSSION**

Our results show lower FIM efficiency but comparable overall functional recovery among survivors in both study groups. Medical complications (pneumonia, cardiac events, stroke progression) and death were significantly more frequent among patients in the PEG group.

Pneumonia was the most common reason for transfer to acute care. Pneumonia prophylaxis is an important management issue for dysphagic patients. Our PEG protocol incorporates the following measures: (1) use of an infusion pump to regulate flow, (2) increments in flow rate limited to 25 to 30mL·h⁻¹·d⁻¹, (3) gastric distension and backflow pressures are assessed by disconnecting the PEG tube every 4 hours and stopping for 2 hours if more than 25mL of backflow is obtained, (4) elevation of the head of the bed to 30° during and for 1 hour after tube feeding, (5) frequent position changes, (6) chest percussion and postural drainage, and (7) use of inhaled bronchodilator to facilitate clearance of tracheobronchial secretions. Even with these precautions, PEG placement did not prevent pneumonia, a finding consistent with other reports. Aspiration of oral secretions or gastroesophageal reflux may still occur. Nosocomial pneumonia because of poor nutrition may also affect risk for pneumonia. Albumin levels, a marker for nutritional status at the time of rehabilitation hospital admission, were significantly lower in our PEG group than in the controls (3.11 ± 0.39 vs 3.28 ± 0.45; Student t test, P < .001).

It is not apparent why the PEG group showed a higher frequency of cardiac events and stroke progression. Cardiac events were detected by symptoms (chest pain, diaphoresis, syncope, hypotension) and/or electrocardiographic findings (ST/T changes, arrhythmia). Three of 15 patients in the PEG group, who were transferred to acute care for suspected cardiac events, were found not to have had myocardial infarction. Four of the 15 died at the acute care hospital. One of 9 patients transferred to acute care for suspected stroke progression (ie, worsening neurologic symptoms) was found not to have had another stroke. Three of the 9 patients transferred to acute care for suspected stroke progression died. Reasons for the increased frequency of cardiac events and stroke progression among our PEG patients are speculative. It is possible that aspiration-related tracheobronchitis caused atypical chest pain, tracheal irritation with vagal stimulation, or secondary hypoxia, which may have precipitated cardiac or cerebrovascular symptoms.

**Table 3: LOS and FIM Efficiency**

<table>
<thead>
<tr>
<th>Variable</th>
<th>PEG Group</th>
<th>Control Group</th>
<th>P*</th>
</tr>
</thead>
<tbody>
<tr>
<td>LOS (d)</td>
<td>46.9 ± 24.8</td>
<td>43.3 ± 19.7</td>
<td>.11</td>
</tr>
<tr>
<td>FIM efficiency</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>ADL</td>
<td>0.20 ± 0.31</td>
<td>0.27 ± 0.30</td>
<td>.047</td>
</tr>
<tr>
<td>Motor</td>
<td>0.15 ± 0.21</td>
<td>0.21 ± 0.19</td>
<td>.010</td>
</tr>
<tr>
<td>Cognitive</td>
<td>0.08 ± 0.15</td>
<td>0.09 ± 0.15</td>
<td>.061</td>
</tr>
<tr>
<td>Total</td>
<td>0.42 ± 0.57</td>
<td>0.56 ± 0.55</td>
<td>.016</td>
</tr>
</tbody>
</table>

NOTE. Values are mean ± SD. *P values for FIM efficiency were calculated using ANCOVA, with admission scores as a covariable.

†FIM efficiency is (FIM score on final discharge – FIM score on admission)/LOS (d).

**Table 2: Complications Requiring Transfer Back to Acute Care Hospital, and Final Discharge Destination for Survivors**

<table>
<thead>
<tr>
<th>Variable</th>
<th>PEG Group</th>
<th>Control Group</th>
<th>P*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Transfer to acute care hospital</td>
<td>58/193 (30.1)</td>
<td>23/193 (11.9)</td>
<td>&lt;.001</td>
</tr>
<tr>
<td>Death at acute care hospital</td>
<td>14/193 (7.3)</td>
<td>3/193 (1.6)</td>
<td>.006</td>
</tr>
<tr>
<td>Discharge to home for survivors</td>
<td>96/179 (53.6)</td>
<td>101/190 (53.2)</td>
<td>.93</td>
</tr>
</tbody>
</table>

NOTE. Values are the number (%) of patients. *χ² statistic.
PEG site infection severe enough to require transfer back to acute care was uncommon (2.1%) in our study and was similar to that reported by others.\textsuperscript{13,14}

The mortality rate of 7.3% for the PEG group in our study was much lower than that reported by others. We found only 2 reports that described their mortality rates (67.6% and 37.3% at 3mo) for patients with PEG placement for management of acute dysphagic stroke.\textsuperscript{3,4} Our relatively low mortality probably reflects selection bias favoring patients with greater rehabilitation potential. All our PEG patients who died (n = 14) still had their PEG in place at the time of death. Need for continued PEG usage is probably an independent marker for medical frailty. Ongoing nutritional management, hydration, and aggressive supportive care are required for these patients.

There are currently no evidence-based data to indicate when to convert from NGT to PEG feeding. PEG placement is better tolerated and safer for long-term nutritional support than is NGT feeding.\textsuperscript{2} The invasive nature of PEG placement and the sometimes rapid recovery of oral feeding, however, argue for temporary use of NGT feeding after stroke. There was no correlation between the timing of PEG placement and any of our outcome parameters: medical complications, mortality, improvement in FIM or FIM subscores, or length of rehabilitation hospital stay. Initiating PEG feeding as soon as it becomes apparent that nonoral feeding will be needed for more than 2 to 4 weeks seems prudent.\textsuperscript{14,15} A prospective randomized study comparing early versus delayed PEG placement for management of nonoral feeding poststroke is warranted.

We observed that home discharge rates were similar (53.6% and 53.2%, respectively) for survivors in the PEG and control groups. FIM efficiency was significantly lower in the PEG group. Improvements in total FIM scores and in 2 of 3 FIM subscores, however, were comparable for survivors in both groups. Additionally, a substantial number of patients regained swallowing function after PEG placement. PEG tubes were removed in 35 (18.1%) of our patients and were still in place but used only to supplement oral hydration in 119 (61.7%) by the time of final discharge. Thirty-nine (20.2%) patients in the PEG group were discharged still requiring PEG feeding. Teasell et al\textsuperscript{5} reported that 75% of their patients resumed oral feedings within 1 year of discharge. Of our 144 survivors discharged with PEG tubes in place, 69 (47.9%) were discharged home. This is important prognostic information for dysphagic patients and their families. Families will often decline PEG placement because they view it as an effort to prolong life without significant hope of functional recovery. Our data do not support such a pessimistic assessment for patients who meet criteria for admission to an inpatient stroke rehabilitation unit.

CONCLUSIONS

Patients who meet criteria for admission to an inpatient stroke rehabilitation unit, with PEG placement, are at increased risk for medical complications and death. Those who survive, however, show functional recovery and rate of home discharge similar to case-matched controls.

References