內科學誌 2006 ：17 ：52-60

Transpyloric Tube Feeding for 506 Consecutive Patients with Delayed Gastric Emptying

Hsuan-Hwai Lin, Tsai-Yuan Hsieh, Heng-Cheng Chu, Der-Min Wu[1], You-Chen Chao, and Wei-Kuo Chang

Division of Gastroenterology, Department of Internal Medicine, Tri-Service General Hospital, National Defence Medical Center, Taipei, Taiwan, Republic of China

[1]School of Public Health, National Defence Medical Center, Taipei, Taiwan, Republic of China

Abstract

Purpose ： Transpyloric tube feeding could provide early enteral nutrition; minimize cost; and reduce the risk of potential aspiration pneumonia to the patient with delayed gastric emptying. The aim of this study was to report the results of patients who received transpyloric tube feeding and to determine what kind of underlying disorders would get the most benefit from the transpyloric tube feeding. Methods ： We retrospectively reviewed the patients who underwent transpyloric tube feeding from January 1996 through December 2001 at our hospital. Demographic characteristics, underlying disorders, base-line nutrition status, complications, hospital mortality, and durability of transpyloric tube feeding, daily caloric intake of 506 patients were obtained. Logistic regression analysis was used to compare the hospital mortality rate of patients who had different underlying disorders with adjustment for potentially confounding variables. Results ： The patients' mediate age was 73 years; 70.7% were male and 53.1% ICU patients. The most underlying disorders associated with delayed gastric emptying in these patients were infectious diseases in 211 (41.7%). There was a trend towards higher survival in those groups that could convert to nasogastric (NG) tube feeding or oral diet than the others (χ^2=125.9, p<0.001). In subgroup analysis, neurological disorders group was associated with lower mortality rate (35.6%, p<0.01) and higher percentage switched to oral or NG feeding than other groups (60.0%, p<0.01). When adjusted for potentially confounding variables, neurological disorders group was associated with lower mortality rate compared with infectious disorders, diabetes mellitus, and malignancy of upper gastrointestinal tract (odds ratio: 2.39, 3.55, and 7.11; p=0.03, 0.01, and <0.01). Conclusions ： Patients who have neurological disorders can get the most benefit from the transpyloric tube feeding. (J Intern Med Taiwan 2006; 17: 52-60)

Correspondence and requests for reprints : Dr. Wei-Kuo Chang
Address : Division of Gastroenterology, Department of Medicine, Tri-Service General Hospital, No. 325, Sec 2, Cheng-Kung Rd., Neihu 114, Taipei, Taiwan, Republic of China

Key Words : Transpyloric tube feeding, Enteral nutrition, Delayed gastric emptying, Neurological disorders

Introduction

Enteral tube feeding has been developed for patients with a functioning gastrointestinal tract but who are unable to take food by mouth. It can be accomplished using a nasogastric (NG) tube. However, if there is a problem with delayed gastric emptying, transpyloric tube feeding is indicated[1]. This mode of feeding has been developed as a method to overcome delayed gastric emptying by delivering nutrients distal to the stomach. Some authors have designed studies to demonstrate the benefits of transpyloric tube feeding in specific patient groups. For example, among head-injured patients transpyloric tube feeding increased caloric intake and markedly reduced the incidence of infections and days of stay in an intensive care unit (ICU)[2]. Early transpyloric tube feeding after surgery reduced the number of days of total parenteral nutrition (TPN) in trauma patients[3]. Among patients with severe diabetic gastroparesis, transpyloric tube feeding improved diabetic control and gastric emptying[4]. However, these studies included small numbers of patients and failed to elucidate what kind of underlying disorders would get the most benefit from this mode of feeding.

In this study, we investigated the outcomes of transpyloric tube feeding for 506 consecutive patients with delayed gastric emptying. We recorded the demographic characteristics, the effectiveness of delivery of nutrition and the underlying disorders of the patients. We found that patients with neurological disorders received the most benefit from transpyloric tube feeding.

Materials and methods

Patients

We studied 506 patients who had been placed on transpyloric feeding in a university teaching hospital between 1996 and 2001. We collected data based on each patient's demographic characteristics, the underlying disorders, base-line nutrition status (serum albumin and transferrin levels, and total lymphocyte count), complications (vomiting, diarrhea, constipation, abdominal distention or aspiration pneumonia), in-hospital mortality, the durability of transpyloric tube feeding, and final way of nutrition support (while patients discharged). We also estimated the total caloric requirement of patients. We used the Harris —Benedict equation[5] to determine basal energy expenditure (BEE). Total caloric requirements equaled the BEE multiplied by the sum of stress and activity factors[6]. These patients had received NG tube feeding initially, and their residual gastric volume was checked every eight hours. If the residual gastric volume reached 250 mL more than the amount delivered, or if the patient's daily enteral caloric intake was lower than 400 kcal per day, or if there was obvious presence of nutritional formula or gastric contents in the aspirate from the endotracheal tube, our gastroenterology and nutrition service was consulted to evaluate whether transpyloric tube feeding was indicated. Gastroenterologists then applied transpyloric tubes. Before inserted the transpyloric tube, parental nutrition was administered to prevent the large negative energy balance.

Procedure

All patients received a 12 French, 114-cm long, polyurethane feeding tube with a distal tungsten-weighted tip (ENtube™, Rusch Inc., Duluth, Georgia, USA), placed endoscopically[7]. Prior to the procedure, two 3.0-nylon initial suture ties were made through the hole within the end of a feeding tube. Three knots were made at 1-cm intervals on both sides of the sutures. At the time of the procedure, the outer wall of the feeding tube was lubricated with mineral oil. The feeding tube was flushed with water, loaded with a stylet, inserted through the nostril, and then passed into the stomach. Subsequently, a gastroscope (GIF 200, Olympus, Tokyo, Japan) was in-

troduced into the stomach. A biopsy forceps was then passed via the biopsy channel of the endoscope and used to grasp the suture firmly. The feeding tube was dragged through the pylorus down into the second, third, or fourth portion the duodenum. After the gastroscope was passed as far as possible beyond the pylorus, the biopsy forceps holding the suture at the tip of the feeding tube was extended even further. At this point, the biopsy forceps was opened to release the suture. While keeping the stylet in place to stiffen the feeding tube and applying some pressure to prevent its retrograde migration, the endoscope was withdrawn slowly back into stomach and out of the patient's mouth. Once the procedure was completed, the stylet was removed. The procedure was performed in an endoscopy suite or, for a critically ill patient, at the bedside. Following this procedure and prior to initiating feedings, an abdominal roentgenogram (Figure 1) was obtained to confirm the correct position of the feeding tube.

The North American consensus summit on aspiration in the critically ill patient [8] was used to classify pneumonia as "possible", "probable", and"definitive". "Possible pneumonia' is classed as the development of acute symptoms, a new or worsening infiltrate on chest radiographs, and a clinical course consistent with pneumonia in a patient who — for whatever reason — does not undergo bronchoscopy to obtain quantitative cultures. "Probable pneumonia" is diagnosed when positive bronchoscopy specimens and quantitative culture by bronchoalveolar lavage or protected specimen brush add to the latter criteria. Finally, "definitive pneumonia" is defined when there are positive results of pleural fluid cultures, rapid cavitation of lung infiltrate as determined by computed tomography scans and histopathological demonstration of pneumonia during biopsy or autopsy. In this study, chest roentgenograms were obtained weekly after the feeding tube insertion. If a new or worsening infiltration was detected on the chest roentgenogram and there was a clinical course consistent with pneumonia in a patient, we suspected aspiration pneumonia.

Serum albumin was determined enzymatically (Olympus AU600, Olympus Co. Ltd, Shizuoka, Japan). Serum transferrin was analyzed by rate nephelometry on a Beckman IMMAGE instrument (Beckman Instrument, Brea, California). Blood total lymphocyte counts were analyzed by standard clinical methods (Coulter Counter model GENS, Coulter Corporation, Hialeah, FA, USA).

Statistical Analysis

All statistical analyses were performed using the SPSS software, version 10.0. Chi squared (χ^2) and Fisher's exact tests were used to analyze the relationships between categorical variables. Paired t-tests and one-way analysis of variance were used to analyze the relationships between categorical and continuous variables. A multiple logistic regression approach was used to examine the association between demographic characteristics, underlying disorders, and outcome. All reported *P* values are two-tailed, and $P < 0.05$ was assumed statistically significant for all tests.

Results

Patients ranged in age from 4 to 94 years with a median of 73 years. There were 148 females and 358 males. Two hundred sixty-nine (53.1%) patients admitted to our ICU received transpyloric feeding tube placement at the bedside; two hundred thirty-seven (46.9%) were admitted to the general ward and received the procedure in our endoscopy suite. Underlying disorders associated with delayed gastric emptying in these patients were assorted into four groups (Table 1). The most common group was of infectious disorders (n = 211, 41.7%, including pulmonary infection, urinary tract infection, and other infectious disorders), followed by neurological disorders (n = 135, 26.7%, including cerebral hemorrhage, infarction, head injury, and other neurological disorders), diabetes mellitus (n = 65, 12.8%), and malignancy of the upper gastrointestinal tract (n = 56, 11.1%). Thirty-nine patients (7.7%) had other underlying disorders. Age, sex, percentage of patients at-

Table 1.Patients' base-line characteristics in each group

Group	Neurological disorders (n = 135)	Infectious disorders (n = 211)	Diabetes mellitus (n = 65)	Malignancy of GI tract (n = 56)	*P*-value
Age (M ± D, year)[+]	64.3 ± 20.9	69.2 ± 16.1	71.1 ± 12.5	67.7 ± 13.8	0.02
Gender (M/F)	105 / 30	153 / 58	38 / 27	37 / 19	0.03
General ward/ICU	61 / 74	74 / 137	37 / 28	44 / 12	< 0.01
Durability (M ± D, day)	20.7 ± 20.9	25.4 ± 40.3	20.5 ± 26.3	19.8 ± 36.1	0.47
Caloric requirement (M ± D, Kcal/day)[±]	1857 ± 334	1746 ± 268	1695 ± 188	1739 ± 266	0.01
Enteral Caloric intake (M ± Kcal/day)[*] [ǂ]	843 ± 815	662 ± 668	607 ± 550	388 ± 457	0.01
Albumin (M ± D, g/dL)[*]	2.95 ± 0.50	2.83 ± 0.55	2.84 ± 0.52	2.79 ± 0.79	0.59
Transferrin (M ± D, mg/dL)[*]	119.6 ± 30.2	95.7 ± 22.7	101.6 ± 39.4	79 ± 28.9	0.92
Total lymphocyte count (M ± D, count/ μL)[*]	1161 ± 895	1092 ± 761	1204 ± 881	1133 ± 610	0.88

GI, gastrointestinal; M ± D, mean ± standard deviation; ICU, intensive care unit; M, male; F, female

[*]Data was obtained three days prior transpyloric tube feeding.

[+]$P = 0.01$ for the difference between neurological and infectious disorders. $P < 0.01$ for the difference between neurological disorders and diabetes mellitus.

[±]$P < 0.01$ for the difference between neurological and infectious disorders. $P < 0.01$ for the difference between neurological disorders and diabetes mellitus. $P = 0.05$ for the difference between neurological disorders and malignance of GI tract.

[ǂ] $P = 0.03$ for the difference between neurological and infectious disorders. $P = 0.03$ for the difference between neurological disorders and diabetes mellitus. $P < 0.01$ for the difference between neurological disorders and malignance of GI tract. $P = 0.01$ for the difference between infectious disorders and malignance of GI tract.

Table 2.Clinical outcomes of patients receiving transpyloric tube feeding*

Final way of nutrition support	Alive (%)	Mortality (%)	Total
Oral	38 (92.7)	3(7.3)	41
Nasogastric tube feeding	118 (55.9)	93 (44.1)	211
Transpyloric tube feeding	55 (28.0)	119(67.8)	174
Parenteral nutrition	0 (0.0)	80 (100.0)	80
Total	211 (41.7)	295 (58.3)	506

[*] $\chi^2 = 125.9$, df = 3, $P<0.001$

tending the ICU, enteral caloric intake three days before transpyloric feeding, and caloric requirement were significantly different between the four groups ($P < 0.05$). The four groups were similar for the durability of the transpyloric tube, baseline serum albumin and transferrin levels, and total lymphocyte counts.

The average durability of the tube was 22.8 days. The tube was inadvertently removed by the patient or by the staff during routine care in 25.3% of patients and 24.1% of them experienced clogged tubes. Two hundred eleven patients (41.7%) converted to NG tube feeding and 41 patients (8.1%) could switch to an oral diet. Two hundred eleven patients were discharged from the hospital alive and 295 patients (58.1%) died from underlying disorders. Eighty patients could not convert to enteral nutrition and all died. There was a trend towards higher survival in those groups that could convert to NG tube feeding or oral diet than the others, and this was statistically

Table 3.Patients' outcomes and complications

Group	Neurological disorders (n = 135)	Infectious disorders (n = 211)	Diabetes mellitus (n = 65)	Malignancy of GI tract (n = 56)	*P*-value
Mortality	35.6%	65.4%	66.2%	83.9%	<0.01
Final way of nutrition support					<0.01
Oral or NG feeding (%)	81 (60.0)	98 (46.4)	30 (46.2)	17 (30.4)	
Transpyloric tube feeding or TPN (%)	54 (40.0)	113 (53.6)	35 (53.8)	39 (69.6)	
Complications					
Vomiting (%)	21 (15.6)	15 (7.1)	11 (16.9)	14 (25.0)	<0.01
Diarrhea (%)	71 (52.6)	106 (50.2)	28 (43.1)	21 (37.5)	0.20
Constipation (%)	28 (20.7)	35 (16.6)	7 (10.8)	12 (21.4)	0.29
Abdominal distention (%)	14 (10.4)	32 (15.2)	6 (9.2)	11 (19.6	0.21
Aspiration pneumonia (%)	1 (0.7)	10 (4.7)	5 (7.7)	1 (1.8)	0.56

GI, gastrointestinal; NG, nasogastric; TPN, total parenteral nutrition

significant ($\chi^2 = 125.9$, df = 3, $P < 0.001$; Table 2).

The mortality rate was significantly lower among patients with neurological disorders (35.6%, $P < 0.01$; Table 3) and significantly more of these patients switched to oral or NG feeding (60%, $P < 0.01$; Table 3). The common complications associated with transpyloric feeding tubes were diarrhea (39.7%), constipation (19.6%), abdominal distention (13%), and vomiting (12.8%). Seventeen patients (2.4%) developed possible aspiration pneumonia four weeks after the tube insertion and all died. There were no differences in the incidence of complications between groups, except for vomiting ($P < 0.01$; Table 3, infectious disorder group significantly low).

A multiple logistic regression model was used to identify a subset of covariates as independent risk factors for mortality (Table 4). Older patients and those in the ICU showed a significantly higher mortality rate than younger and general ward patients. Patients who could switch to oral or NG feeding showed significantly lower mortality than those who could not. Gender, durability of the tube, caloric requirement, base-line enteral caloric intake, and complications were not significant factors (Table 4). Although patients with two or more complications had a higher risk of mortality, this did not reach statistical significance (Table 4). When adjusted for potentially confounding variables, the neurological disorder group of patients showed a significantly lower mortality rate than those with infectious disorders, diabetes mellitus or gastrointestinal tract malignancies (Table 4).

Fig.1.Abdominal plain film of the patient receiving the transpyloric tube placement

We recorded daily enteral caloric intakes before transpyloric feeding tube placement and on the first, third, seventh, 14th, 21st, and 28th day after insertion of the feeding tube (Fig. 2). The BEE of those patients

Table 4.Factors associated with patients' mortality

Factors	Odds ratio	95% CI	*P*-value
Age, year	1.04	1.022-1.062	<0.01
Gender			
Male (reference)			
Female	1.35	0.618-2.962	0.45
Ward			
General (reference)			
ICU	2.59	1.321-5.082	<0.01
Durability	0.99	0.896-1.006	0.47
Caloric requirement	1.00	0.999-1.001	0.85
Base-line enteral caloric intake	1.00	1.000-1.001	0.63
Switch to oral or NG feeding			
Yes (reference)			
No	6.55	3.487-12.309	<0.01
Complications			
No (reference)			
One complication	1.10	0.528-2.282	0.80
Two or more complications	1.47	0.625-3.448	0.38
Underlying disorders			
Neurological disorders (reference)			
Infectious disorders	2.39	1.112-5.154	0.03
Diabetes mellitus	3.55	1.322-9.525	0.01
Malignancy of GI tract	7.11	2.195-23.002	<0.01

ICU, intensive care unit; GI, gastrointestinal; CI, confidence interval; NG, nasogastric

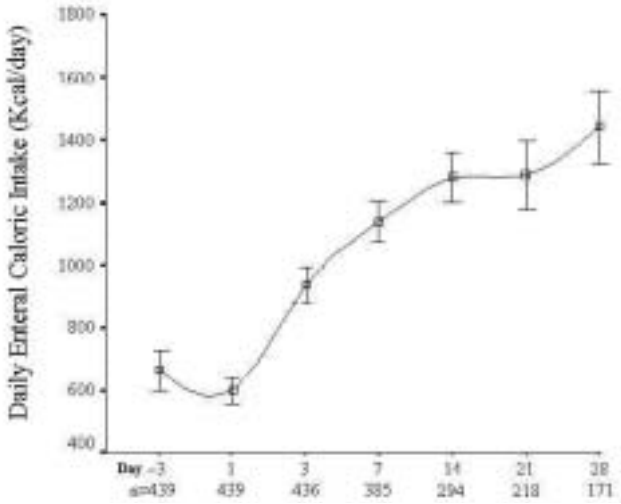

Fig.2.Daily enteral caloric intake for patients receiving transpyloric tube feeding. Daily enteral caloric intake increases progressively and reaches the 70% of mean total caloric requirement at the day 14. Each point and vertical bar represented the mean ± 95% confidence intervals.

was measured using Harris — Benedict equations [9]. Total caloric requirements equaled the BEE multiplied by the sum of stress and activity factors [6]. The mean total caloric requirement was 1783 ± 294 kcal/day (range 1200–2600). Mean enteral caloric intake was 0.33 ± 0.29, 0.53 ± 0.37, 0.63 ± 0.37, 0.74 ± 0.42, 0.73 ± 0.48, and 0.83 ± 0.48 of total caloric requirement on days 1, 3, 7, 14, 21, and 28 respectivel

Discussion

Poor nutrition affects every factor of patient outcome, from the cost of therapeutic intervention and rate of complications to the length of hospitalization and mortality rates [10]. Nutritional status is a key factor in the overall immune function and a patient's ability to mount a stress response. Underfeeding a patient may lead to increased nosocomial infection, poor wound healing, respiratory muscle dysfunction, and respiratory failure. Overfeeding patients may increase their physiological stress and lead to hyperlipidemia, azotemia, hyperglycemia, fluid overload, hepatic dysfunction, and respiratory compromise [10]. Estimates of BEE in the critically ill have been derived traditionally from the Harris — Benedict equa-

tion to determine caloric requirements and avoid complications associated with both overfeeding and underfeeding.

Acutely ill patients often develop large gastric residual volumes during NG feeding from delayed gastric emptying. Transpyloric tube feeding was introduced to solve this problem[11]. Montecalvo et al[12]. demonstrated that transpyloric feeding led to better nutrient delivery than the simpler method of gastric feeding. They found that 47% of patients with NG tubes achieved their daily feeding rate goal versus 61% in the transpyloric group; the latter also showed greater improvements in prealbumin levels and increased their total caloric intake. Kortbeek et al[13]. recently showed that transpyloric feeding significantly reduced the time required to achieve the feeding goal. Davies et al[11]. showed that gastric residual volumes were lower when patients were fed transpylorically. Kearns et al[14]. also demonstrated that small-intestinal feeding produced significantly increased caloric delivery (30%) versus gastric feeding in endotracheally intubated patients. Although we did not design the present study to evaluate gastric versus transpyloric feeding, all of our patients had received NG tube feeding before commencing transpyloric tube feeding. The mean enteral caloric intake on day three with transpyloric feeding was higher than before (943 vs. 603 kcal, $P < 0.001$).

Gastrointestinal complications such as nausea, vomiting, abdominal distention, cramps, and diarrhea are common during enteral nutrition[15]. Depending on the definition used, diarrhea occurs in 21% to 72% of patients receiving enteral nutrition[16]. In this study, 39.7% of the patients developed diarrhea. Common causes of diarrhea include concomitant medications (e.g., sorbit-containing medication and prokinetic agents), underlying illnesses predisposing to malabsorption, and pseudomembranous colitis [17,18]. Tube feeding-related causes may include enteral feeding formula content (e.g., fiber or lactose content) and administration technique. Diarrhea by itself is not an indication to stop tube feeding; slowing the rate of infusion, diluting the formula, adding bulking agents, or reviewing the drug regimen may provide relief[17]. Stool examination and an assay for detection of the Clostridium difficile toxin are appropriate when pseudomembranous colitis is suspected. On the other hand, constipation is a problem of bedridden patients and it occurred in 19.6% of our patients. Fiber-containing formulas (e.g., Jevity or Ultracal), blended preparations, or laxatives can minimize this complication[18].

The risk of potentially lethal aspiration in patients receiving gastric tube feeding has long been recognized[19]. The prevalence of aspiration pneumonia in the literature varies from 4% to 95% of patients being fed via NG tubes[20]. This variation is because of the lack of criteria for the definitions of the source of aspiration, of the contamination of the aspirate and of aspiration pneumonia itself[21]. The incidence of possible aspiration pneumonia in our study was 3.4% and this was lower than in previous reports of NG tube feeding. Transpyloric feeding seemed to be associated with a reduction in aspiration pneumonia. Heyland et al[22]. measured the presence of microaspiration by radiolabeled food and found a decreased frequency and quantity of aspiration in those patients fed with transpyloric feeding tubes. However, some authors [14,23,24,25] believe that there is no significant difference in the incidence of pneumonia. Therefore, we still need a further prospective randomized controlled study to evaluate if transpyloric feeding really reduces the incidence of aspiration pneumonia.

Providing early enteral nutrition to critically ill patients has been associated with an improved outcome. It is generally well accepted that enteral feeding has a number of benefits compared with parenteral nutrition. Not the least of these benefits is maintaining the intestinal brush border anatomy and limiting the possibility of intestinal mucosal bacterial translocation[26]. Boulton-Jones et al[27]. demonstrated that transpyloric feeding could be successfully used to maintain enteral nutrition in patients who would otherwise require parental nutrition. The complications

that are associated with enteral feeding are generally less severe than are those associated with TPN. In addition, a comparison of the costs between these two methods of feeding at our institution reveals that enteral nutrition was significantly cheaper to provide and maintain. More specifically, the cost of providing the endoscopic placement procedure, roentgenogram, and 22 days of standard enteral nutrition (the average longevity of the transpyloric tubes placed in this study) for one patient was calculated to be approximately $431. By comparison, the cost of providing central line placement, roentgenograms, and 22 days of TPN (using 1.5L of standard solution) for one patient was calculated to be $1432.

In conclusion, we have reported our experience with transpyloric tube feeding placement in acutely ill patients who experienced problems with delayed gastric emptying. Most of the patients received transpyloric tube feeding in our ICU, and there was a trend towards higher survival in patients that could switch from transpyloric to NG tube feeding or oral diet than if they continued transpyloric feeding or TPN. The chance of survival is clearly better once delayed gastric emptying has improved. Thus, the gastrointestinal tract plays a unique physiological role in critically ill patients because it can be considered as a target or a source of injury.

From subgroup analysis, patients with neurological disorders had a lower mortality rate and more switched to oral or NG feeding than in the other groups. However, we had a problem to define the degree of disease severity of all patients because there was no standard method to evaluate various diseases. We did not know if the patients presenting with neurological disorders were associated with milder disease severity. Therefore, we classified disease severity according to those patients who survived in our ICU and adjusted the differences using the logistic regression model. When we adjusted the potentially confounding variables, the neurological disorders group was associated with lower mortality rate than the other groups. Our findings indicated that patients with neurological disorders are likely to gain the most benefit from transpyloric tube feeding.

In summary, transpyloric tube feeding in this series provided early enteral nutrition, minimized cost and reduced the risk of patients developing aspiration pneumonia. If delayed gastric emptying develops in critically ill patients, transpyloric tube feeding is a valuable therapeutic option, especially for patients who have neurological disorders.

References

1. Stroud M, Duncan H, Nightingale J. Guidelines for enteral feeding in adult hospital patients. Gut 2003; 52 :s1-12.
2. Grahm TW, Zadrozny DB, Harrington T. The benefits of early jejunal hyperalimentation in the head-injured patient. Neurosurgery 1989; 25: 729-35.
3. Nicholas JM, Cornelius MW, Easley KA, et al. A two institution experience with 226 endoscopically placed jejunal feeding tubes in critically ill surgical patients. Am J Surg 2003; 186: 583-90.
4. Devendra D, Millward BA, Travis SP. Diabetic gastroparesis improved by percutaneous endoscopic jejunostomy. Diabetes Care 2000; 23: 426-7.
5. El-Solh AA. Clinical approach to the critically ill, morbidly obese patient. Am J Respir Crit Care Med 2004; 169: 557-561.
6. Barak N, Wall-Alonso E, Sitrin MD. Evaluation of stress factors and body weight adjustments currently used to estimate energy expenditure in hospitalized patients. JPEN J Parent Ent Nutr 2002; 26: 231-8.
7. McClave SA, Chang WK. Techniques in enteral access. In: Gregory G. Ginsberg, eds. Clinical Gastrointestinal Endoscopy. Pheladelphia: Elsevier Saunders; 2005; 349-66.
8. McClave SA, DeMeo MT, Maloney JP, et al. North American Summit on Aspiration in the Critically Ill Patient: consensus statement. JPEN J Parent Ent Nutr 2002; 26 :S80-5.
9. Harris JA, Benedict FG. A biometric study of basal metabolism in man. Pub no. 279. Washing ton DC: Carnegie Inst., 1919.
10. McClave SA, Lowen CC, McConnell JW, et al. Are patients fed appropriately according to their caloric requirements? J Parent Ent Nutr 1998; 22: 375-81.
11. Davies AR, Froomes PR, Nyulasi I, et al. Randomized comparison of nasojejunal and nasogastric feeding in critically ill patients. Crit Care Med 2002; 30: 586-590.
12. Montecalvo MA, Steger KA, Fitzpatrick GF, et al. Nutritional outcome and pneumonia in critical care patients randomized to gastric versus jejunal tube feedings. Crit Care Med 1992; 20: 1377-87.
13. Kortbeek JB, Haigh PI, Doig C. Duodenal versus gastric feeding in ventilated blunt trauma patients: a randomized controlled trial. J Trauma 1999; 46: 992-6.
14. Kearns PJ, Chin D, Kirsch CM, et al. The incidence of ventila-

tor-associated pneumonia and success in nutrient delivery with gastric versus small intestinal feeding: a randomized clinical trial. Crit Care Med 2000; 28: 1742-6.
15. Drickamer MA, Cooney LM Jr. A geriatrician's guide to enteral feeding. J Am Geriatr Soc 1993; 41: 672-9.
16. ASPEN Board of Directors and the Clinical Guidelines Task Force. Guidelines for the use of parenteral and enteral nutrition in adult and pediatric patients. J Parent Ent Nutr 2002; 26 Suppl 1: 1SA-138SA.
17. Pfau PR, Rombeau JL. Nutrition. Med Clin North Am 2000; 84: 1209-1230.
18. DeWitt RC, Kudsk KA. Enteral nutrition. Gastroenterol Clin North Am 1998; 27: 371-86.
19. Olivares L, Segovia A, Revuelta R. Tube feeding and lethal aspiration in neurological patients: A review of 720 autopsy cases. Stroke 1974; 5: 654–7.
20. Kirby DF, Delegge MH, Fleming CR. American Gastroenterological Association technical review on tube feeding for enteral nutrition. Gastroenterology 1995; 108: 1282-301.
21. Gomes GF, Campos AC, Vieira MC, et al. The nasogastric feeding tube as a risk factor for aspiration and aspiration pneumonia. Curr Opin Clin Nutr Metab Care 2003; 6: 327-33.
22. Heyland DK, Drover JW, Lam M, et al. Effect of post-pyloric feeding on gastroesophageal regurgitation and pulmonary microaspiration: Results of a randomized controlled trial. Crit Care Med 2001; 29: 1495–501.
23. Collard HR, Saint S, Matthay MA. Prevention of ventilator-associated pneumonia: an evidence-based systematic review. Ann Intern Med 2003; 138: 494-501.
24. Marik PE, Zaloga GP. Gastric versus post-pyloric feeding: a systematic review. Crit Care 2003; 7: R46-51.
25. Gopalan S, Khanna S. Enteral nutrition delivery technique. Curr Opin Clin Nutr Metab Care 2003; 6: 313-7.
26. Hallstrom CK, Jacobs BR. Optimal method of postpyloric tube placement still unclear. Crit Care Med 2003; 31: 315-6.
27. Boulton-Jones JR, Lewis J, Jobling JC, Teahon K. Experience of post-pyloric feeding in seriously ill patients in clinical practice. Clin Nutr 2004; 23: 35-41.

小腸管灌營養治療於胃排空延遲的病患

林煊淮　謝財源　朱恆成　吳德敏[1]　趙有誠　張維國

三軍總醫院　胃腸科
[1] 國防醫學院　公衛系

摘　要

目的：小腸管灌營養可以提供早期腸道營養，減少醫療之花費及降低吸入性肺炎的危險。本研究的目的在探討，接受小腸管灌的病患中哪一類的患者可得到最大的好處。方法：我們回溯性的分析從1996年1月至2001年12月，在我們醫院接受小腸管灌管的病患。紀錄506位病患的基本資料、診斷、 潛在的疾病、基礎營養狀況、住院中死亡率、小腸管灌的天數、和每日的卡熱攝取量。邏輯式回歸分析用來比較住院中死亡率與潛在的疾病的關係並調整可能的干擾因子。 結果：病患年齡的中位數爲73歲；70.7%爲男性；53.1%爲ICU病患；胃排空延遲最常見的潛在性疾病爲感染症 (41.7%)。病患如果其胃排空功能能夠恢復，可接受鼻胃管管灌或由口進食，相較於持續胃排空延遲的患者有較低的死亡率 (χ^2 =125.9, p < 0.001)。在子群體分析中發現，神經性疾患者有較低的死亡率 (35.6%, p < 0.01) 和有較高的機會將小腸管灌變成鼻胃管管灌或由口進食 (60.0%, p < 0.01) 。當我們調整可能的干擾因子，神經性疾患者和感染症、糖尿病及非胃腸道之惡性腫瘤相比較有較低的死亡率 (OR分別爲2.39, 3.55, 7.11; p分別爲0.03, 0.01, < 0.01)。結論：於潛在性疾病爲神經性疾患之病患經小腸管灌相較於感染症、糖尿病及非胃腸道之惡性腫瘤有較低的死亡率。