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Microendoscopic Nasointestinal Feeding Tube Placement in Mechanically Ventilated Patients with Gastroparesis

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Gastroparesis often precludes gastric enteral nutrition (EN) in critically ill patients. Our aim was to determine the feasibility of bedside microendoscopic placement of nasointestinal feeding tubes to facilitate enteral nutrition in critically ill patients with poor gastric emptying. Nine mechanically ventilated patients with proven gastroparesis underwent 10 nasointestinal intubations using a microendoscope. These were compared with 35 patients who underwent pH sensor-guided intubation. Blind pH-guided intubation was faster than microendoscopic placement (21.4 ± 10.7 v 32 ± 11.6 min, $P = 0.016$) and cheaper in terms of disposables [£87 ($132) vs £222 ($337) per intubation, $P < 0.0001$]. Depth of placement (postpyloric: 64% vs 50% including 32% vs 50% reaching duodenum part 3, 4, or jejunum, both NS) was similar. We conclude that microendoscopy failed to improve transpyloric intubation due to poor visualization of gastrointestinal anatomy and difficulty maneuvering the tube–endoscope ensemble. However, when successful, transpyloric placement was always deep, permitting immediate and full EN. To date, the technique and equipment is not superior to pH-guided placement and is not suitable for use by personnel with minimal training.

KEY WORDS: enteral nutrition; gastroparesis; microendoscope.

Achieving enteral nutrition (EN) in critically ill patients is associated with fewer major complications, reduced hospital stay, and major cost savings (1–3). Unfortunately poor gastric emptying is common in critically ill patients, resulting in partial or total gastroparesis in 70% and 10% of patients respectively (4). This limits the efficacy of nasogastric (NG) EN. Meeting nutritional requirements with total parenteral nutrition (TPN) may increase morbidity and treatment cost compared to EN (5, 6). As small intestinal function usually remains adequate in these circumstances, it is desirable to attempt transpyloric EN in patients with gastroparesis (7).

Intestinal access can be achieved via nasointestinal tube or jejunal catheter. Nasointestinal intubation is a safe procedure but spontaneous transpyloric passage of feeding tubes is difficult to achieve in the ICU population (8, 9). Intubation often only reaches the proximal duodenum, predisposing to tube tip migration or feed reflux into the stomach.

Of the more complex techniques, jejunostomy placement necessitates laparotomy, which, as an additional procedure, carries inherent risks (10). Fluoroscopic placement may be successful in about 90% but requires a C-arm fluoroscope or the risk and time of transport of the patient to the radiology department and a significant radiation dose (11). Endoscopy with or without fluoroscopy or ultrasound has been used to place nasointestinal, percutaneous endoscopic gastrostomy/jejunal (PEG/J), or direct PEG/J tubes (12, 13). However, conventional endoscopy entails availability of an expert endoscopist and use of a relatively large-bore endoscope that may raise intracranial pressure in brain-trauma patients or cause bradycardia.

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In contrast to the above, intestinal placement using a microendoscope inserted through the feeding tube has resulted in 100% immediate transpyloric placement, 73% reaching the third part of the duodenum or beyond (14). The present study tested the efficacy of a new technique for nasointestinal tube placement. Use of a microendoscope utilizes direct vision of anatomical landmarks to increase placement success, aiming to reduce the procedure time and obviate the need for radiographic position confirmation. It was hoped that if the microendoscope technique proved to be technically simple, then ICU staff could in future use it with minimal training.

MATERIALS AND METHODS

Frenchay Hospital Ethics committee approval was granted prior to commencement of the study. Consecutive patients admitted to Frenchay hospital ICU were commenced on the routine NG feeding protocol. NG feeding started at 30 ml/hr, increasing by 30 ml every 4 hr up to their estimated requirement providing the 4-hr gastric residual remained <120 ml. Failure of NG feeding was defined as gastric residuals ≥400 ml/24 hr on two consecutive days or not reaching full NG feeding due to large gastric residual volumes by day 5. These patients underwent endoscopic nasointestinal intubation. Exclusion criteria included: adequate oral intake likely within 24 hr or moribund.

We used a 2.5-mm endoscope (Mitsubishi Cables Ltd.) inserted through the outer (gastric) lumen of a 2-component
Q1 double-lumen tube (16FG outer gastric, 9FG inner intestinal, Tyco Healthcare) to provide direct vision and guidance (Figure 1). The outer tube–endoscope ensemble was placed in the stomach by standard technique (15) but using direct vision to safeguard the intubation route. On visualizing the pylorus, facilitated by air insufflation and using a xenon light source, the endoscope alone was advanced to its maximum extent, a guidewire (4 m Tiger wire, Wipak Medical) was placed through the endoscope channel and the endoscope withdrawn over the wire. The 9FG intestinal tube was then advanced over the wire. Q2
When the feeding tube had been placed to the same depth as the endoscope, the wire was withdrawn.

Results from this group were compared with historical intubation of 35 patients at risk from poor gastric emptying using a pH sensor-guided tube (2). The pH sensor-guided tube was placed in the stomach by standard technique (15). Gastric position was confirmed by a pH ≤ 4; none of the patients had acid suppression. The tube was then gradually advanced until pH suddenly increased to ≥ 6. At this point it was assumed that the tip had reached the duodenum and it was attempted to advance the tube ≥10 cm to reach the third part of the duodenum or beyond. For both techniques, abdominal radiograph was obtained immediately after intubation, and tube position was confirmed by a radiographer, blinded to the purpose of the study, and compared with endoscopy interpretation.

Data collected included: patient demography and clinical details, use of prokinetic drugs, and details of intubation procedure. The difference between the two procedures in placement success and cost were tested using two-tailed Fisher's exact test and Mann-Whitney, respectively, using Stata 6.0.

RESULTS

When compared to microendoscopic placement, the pH-guided group were younger, had predominantly traumatic injury, had faster intubation, no difference in the depth of placement, and reduced cost in terms of disposables (Tables 1 and 2). The cost difference would have increased by including the cost of the reusable endoscope and guidewire. Microendoscopic prediction of tube position (compared with radiograph) was only correctly positive in 60% and correctly negative in 40%. When successful, all endoscopic intubations reached the third part of the duodenum or beyond (15–67 cm beyond the pylorus). Intestinal placement failed because gastrointestinal

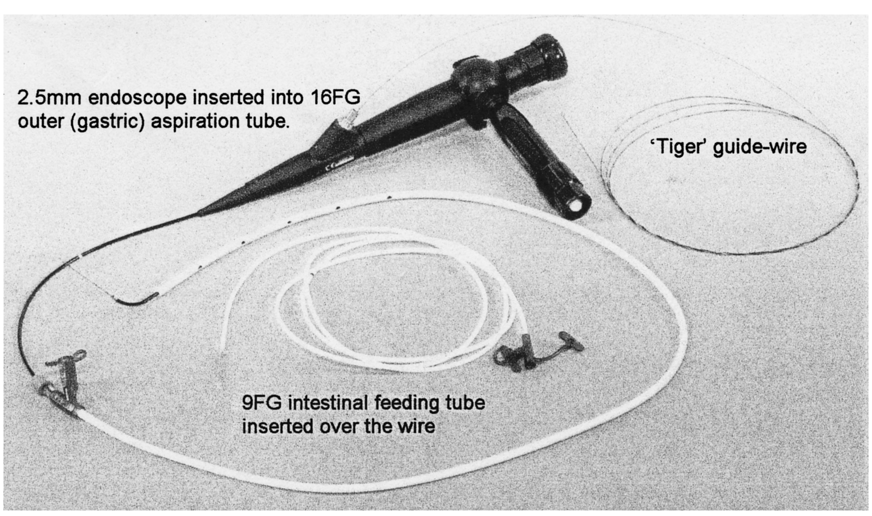

Fig 1. Microendoscope–double lumen feeding tube ensemble.

TABLE 1. DEMOGRAPHY AND CLINICAL CONDITION OF pH-GUIDED AND MICROENDOSCOPIC PLACEMENT GROUPS

	Placement		
Factor	*pH guided*	*Microendoscopic*	*P*
N	35	10	
Age (yr)	32 ± 18.4	64.8 ± 15.9	<0.0001
Condition (%)			
Trauma	80	10	
Burn	17	0	
Gastrointestinal surgery	3	40	
Cardiopulmonary	0	30	
Intracranial haemorrhage	0	20	

anatomy was difficult to visualize and the endoscope–tube ensemble was difficult to maneuver. The median (%) of nutritional requirement delivered in the endoscope group, successful versus unsuccessful/no intubation, was: 6% (0–29) vs 0% (0–102) at baseline vs 96% (76–102) and 6% (0–52) after intubation.

DISCUSSION

Nasointestinal intubation appeared to fail due to short endoscope focus depth (50 mm) and inability to clear debris from the lens, both of these limiting visualization of gastrointestinal anatomy. NG tube drainage of gastric contents might reduce this problem but could interfere with endoscope movement. In addition, the flexible endoscope–tube ensemble made maneuvering difficult. However, when successful, transpyloric placement always reached the third part of the duodenum or beyond permitting immediate delivery of full EN. Endoscopic placement averaged 11 min slower than that under pH guidance, which may be undesirable in unstable critically ill patients. A further "cost" was the 60 min of equipment transport/disinfection/preparation. Disposable costs are more than double that of pH-guided intubation per patient. The number of times the endoscope [purchase cost: £7600 ($11600)] and guidewires [£90 ($140)] may be reused, and therefore their cost, have yet to be determined.

TABLE 2. INTUBATION TIME, DEPTH OF PLACEMENT, AND DISPOSABLE COST FOR pH-GUIDED AND MICROENDOSCOPIC PLACEMENT GROUPS

	Placement		
Factor	*pH guided*	*Microendoscopic*	*P*
Intubation time (minutes)	21.4 ± 10.7	32 ± 11.6	0.016
Placement depth (%)			
Transpyloric (all)	64	50	NS
Duodenum part 3, 4, or jejunum	32	50	NS
Cost [£ ($) (tube, x-ray, disinfection)]	87 (132) (47%)	222 (337) (41%)	<0.0001

The groups were not matched possibly influencing intubation success. Nasointestinal intubation was performed where there was a risk (pH) versus proven poor gastric emptying (endoscope). In addition, patients with head injuries were excluded from the endoscope group until the technique proved to be quick and unlikely to raise intracranial pressure. However, these differences should not have affected the techniques of intubation employed. This study suggests that a larger study might usefully define the exact role of the nasointestinal intubation method.

To date no method of bedside nasointestinal tube placement has been shown to be both reliable and reproducible. Several methods have been used to improve placement success. Positioning the patient on their right side has been used to help weighted tubes gravitate towards the pylorus (16, 17). Alternatively rotational corkscrewing of the tube using a guidewire bent to 30° 2–3 cm proximal to the tip achieved success in 91% (18) but requires a high level of expertise. The mean procedure time of 40 min and bent guidewire may be hazardous where patients are clinically unstable or at risk of esophageal perforation, respectively. Using tubes with tip pH-sensors to detect passage from the stomach to duodenum are associated with 50–97% success (7, 19–21). The single-tip pH sensor offers accurate diagnosis of transpyloric passage but may give a false "duodenal pH" if the tube coils back towards the esophagus, and it does not aid navigation of the stomach lumen. Sonographic and magnet-assisted placement achieved transpyloric position in 85% and 60%, respectively, but again appeared to be highly dependent on the expertise of the operator (22, 23).

We did not achieve the level of success of a similar study by Grathwohl et al (14). Endoscope functionality (current versus Grathwohl: diameter 2.5 vs 2.2 mm, length 1.35 vs 1.0 m, bidirectional deflection 180° vs 120°, field of vision 90° vs 70°, 2–50 mm focus for both) and tubes used (current versus Grathwohl: length 0.95 vs 1.0 m, outside diameter 5 vs 4 mm) were similar between studies. However, in contrast to the current study, problems with anatomical visualization due to gastrointestinal fluids or debris were not reported (14). Grathwohl et al (14) did not cite problems steering the endoscope and achieved successful transpyloric placement in 100% within a shorter procedure time (current versus Grathwohl: 32 ± 3.7 vs 18 ± 3.7 min, $P = 0.015$). Their use of a shorter endoscope may have increased rigidity and therefore ability to steer the endoscope. Otherwise, factors such as patient groups, equipment and techniques appear similar. The procedure was performed by a single consultant gastroenterologist with extensive experience in therapeutic and gastrointestinal endoscopy amounting to over 1000 procedures per annum. Despite this, the equipment and technique necessitated a significant learning curve. It is therefore unlikely the current equipment/technique could be used with minimal training by ICU staff.

Modifications of the technique and equipment are essential before this technique becomes an efficient means of bedside nasointestinal intubation. Gastroparesis, without ileus, is common in ICU patients. Nasointestinal feeding would improve nutritional and enteral drug delivery, obviate the need for TPN or starvation, and is associated with a reduction in major complications (2). This could translate into improved clinical outcome and major cost-savings in this population. From the current study, equipment problems of poor visualisation may be improved by gastric drainage and enhanced optics. Maneuverability may be improved by increased stiffness of the microendoscope. There continues to be a need for a new, simple, and reliable bedside technique for nasointestinal intubation.

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QUERIES

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