The American Journal of Surgery (2012) 204, 958–962

The American Journal of Surgery®

The Southwestern Surgical Congress

Safe, timely, convenient, and cost-effective: a single-center experience with bedside placement of enteral feeding tubes by midlevel providers using fluoroscopic guidance

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KEYWORDS:
Nasoenteric feeding tube placement;
Fluoroscopic guidance;
Enteral feeding;
Nutrition support;
Midlevel practitioner;
Critical illness

Abstract

BACKGROUND: Enteral feeding tube placement has been performed by nurses, gastroenterologists using endoscopy, and interventional radiologists. We hypothesized that midlevel providers placed feeding tubes at bedside using fluoroscopy safely, rapidly, and cost-effectively.

METHODS: We retrospectively analyzed bedside feeding tube placement under fluoroscopy by trained nurse practitioners. We compared charges for this method with charges for placement by other practitioners.

RESULTS: Nurse practitioners placed 632 feeding tubes in 462 patients. Three hundred seventy-nine placements took place in mechanically ventilated placements. Ninety-seven percent of tubes were positioned past the pylorus. The mean fluoroscopy time was 0.7 ± 1.2 minutes. The mean procedure time was 7.0 ± 5.1 minutes. All tubes were placed within 24 hours of the request. There were no complications. Institutional charges for tube placement were $149 for nurse practitioners, $226 for gastroenterologists, and $328 for interventional radiologists.

CONCLUSIONS: The placement of feeding tubes under fluoroscopy by nurse practitioners is safe, timely, and cost-effective.

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The importance of nutrition support in surgical patients is widely accepted.[1] Enteral feeding is associated with a lower cost,[2] the maintenance of gut integrity, immune function,[3,4] and reduced infection risk[5–7] compared with intravenous nutrition. The ideal location within the gastrointestinal tract for feeding (gastric vs postpyloric) has been controversial.[8–10] A recent meta-analysis suggested advantages to postpyloric feeding in terms of a shorter time required to meet feeding goals, decreased gastroesophageal reflux, a reduced incidence of ventilator-associated pneumonia, and increased caloric and protein delivery.[11] Postpyloric feeds may be better tolerated,[12] particularly in patients with pancreatitis, increased aspiration risk, or abnormal gastric emptying.[8,13]

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Manuscript received March 13, 2012; revised manuscript June 11, 2012

0002-9610/$ - see front matter Published by Elsevier Inc.
http://dx.doi.org/10.1016/j.amjsurg.2012.07.025

With these considerations in mind, it is standard practice within our institution to use postpyloric feeding tube placement in critically ill surgical patients who require nutritional support and who lack contraindications for postpyloric placement.

Nasoenteric tubes may be placed at the bedside by a nurse with the placement confirmed by nonradiographic methods such as auscultation or measurement of the pH of aspirated fluid. These methods are limited by poor reliability, prolonged placement times, and the risk of tube misplacement (most commonly into the airway).[14] Malpositioning in the tracheobronchial tree occurs in 2% of blind tube placements,[15] and the risk is higher in obtunded patients and patients with an impaired gag reflex. The presence of a cuffed endotracheal tube does not decrease the risk of feeding tube placement in the airway.[15,16]

Feeding tube placement by gastroenterologists and interventional radiologists offers the advantage of direct visual confirmation of tube placement at the time of the procedure, thus improving reliability and minimizing the risk of tube malpositioning. However, these methods may entail drawbacks including delayed placement because of scheduling limitations and resource availability and the need for patient transport to the gastroenterology or interventional radiology suite. Placement by gastroenterologists or interventional radiologists may also be associated with higher charges than placement by the bedside nurse. We have attempted to overcome some of these limitations through the use of specially trained nurse practitioners to provide prompt, reliable bedside placement of postpyloric nasoenteric feeding tubes under direct fluoroscopic visualization. Our study was designed to evaluate whether this approach had proved practical and cost-effective in comparison with alternatives.

Materials and methods

Initially, one acute care nurse practitioner was trained in bedside nasoenteric tube placement using fluoroscopy by an interventional radiologist and an attending surgeon; this individual then trained other nurse practitioners. Proficiency, as measured by the ability to independently place the tube and confirm placement fluoroscopically, was typically achieved after 3 to 5 supervised placements. The procedure used an 8-F Frederic-Miller feeding tube (Cook Medical Inc, Bloomington, IN) with a wire guide. A portable C-arm was used for direct visualization of tube positioning, obviating the need for a postplacement radiographic study.

This study is a retrospective analysis of data that were collected for all feeding tubes placed by nurse practitioners for the 23-month period spanning December 2009 through October 2011. For each tube placement in the series, an electronic procedure note recorded final tube positioning, total fluoroscopic time, and the occurrence of complications (defined as misplacement in the respiratory tract, bleeding requiring transfusion, perforation of the gastrointestinal tract, or aspiration during placement). An additional data field, the total procedure time, was incorporated into the procedure note starting in April 2011 and is reported for the final 192 placements in the series. The total procedure time was defined as starting from the time the nurse practitioner first touched the patient and ending when the tube was confirmed to be correctly positioned. Additional data were obtained from the medical record including demographics, admitting service, the occurrence of a major surgical procedure during the hospitalization, requirement for mechanical ventilation, days to first feeding tube placement, and the occurrence of death before hospital discharge.

At the conclusion of data collection, we compared professional charges using current procedural terminology (CPT) codes and basic facility/supply charges for nurse practitioner tube placements versus potential placement by a gastroenterologist using endoscopy or by an interventional radiologist. Institutional review board approval was obtained before the commencement of data collection.

Results

The study population consisted of 462 patients in whom 632 feeding tubes were placed (Table 1). Trauma surgery was the admitting service for the largest proportion of patients (n = 152, 32.9%); it was closely followed by general surgery (n = 136, 29.4%). Most study patients underwent a major surgical procedure during their hospitalization (n = 352, 76.2%). Most tube placements occurred within the first

Table 1 Patient population (N = 462)

Category	Number of patients	Percentage
Male	288	62.3
Admitting service		
Cardiothoracic surgery	97	21.0
General surgery	136	29.4
Trauma surgery	152	32.9
Other	77	16.7
Major surgical procedure during hospitalization*	352	76.2
Survival	378	81.8
Days to feeding tube placement		
Less than or equal to 7 d	334	72.3
Greater than 7 d	128	27.7
Number of feeding tubes placed		
1 placement	339	73.4
Greater than 1 placement	123	26.6

*Major surgical procedures required general anesthesia and involved craniotomy, spinal column procedures, thoracotomy, median sternotomy, laparotomy, third-degree burn debridement, or major orthopedic procedures.

Table 2 Procedure details

Final location of nasoenteric feeding tube	Number of placements	Percentage
Stomach	19	3.0
Proximal duodenum	225	35.6
Distal duodenum	210	33.2
Ligament of Treitz	178	28.2
Fluoroscopy and procedure time	n	Time (min)
Fluoroscopy time	632	0.7 ± 1.2
Procedure time*	192	7.0 ± 5.1

*The procedure time was measured starting at the time the nurse practitioner first touched the patient and ending when the tube was confirmed to be in the correct position.

7 days of hospitalization (n = 334, 72.3%). Among placements that occurred after hospital day 7 (n = 128, 27.7%), almost all were repeat placements after intentional or inadvertent removal. Of the study population, 84 patients (18.2%) died before hospital discharge, reflecting illness severity in the study population.

Most tube placements took place in the surgical intensive care unit (ICU) (n = 456, 72.2%), with the remainder of placements occurring in the burn trauma ICU or in the surgical intermediate care unit. Most patients were mechanically ventilated at the time of placement (n = 379, 60.0%). Almost all (97%) placements were confirmed to be postpyloric, with 178 (28.2%) at or beyond the ligament of Treitz (Table 2). Gastric feeds were instituted in patients in whom postpyloric placement was not achieved. The total fluoroscopy time averaged 0.7 ± 1.2 minutes (n = 632), and the average total procedure time, which was recorded in the 192 most recent cases, was 7.0 ± 5.1 minutes. All feeding tube placements took place within 24 hours of the initial request by the treating provider. No complications related to feeding tube placement were observed during the study.

Table 3 presents charges derived from CPT codes for practitioner/professional charges and basic hospital facility and supply charges to compare the economics of tube placement by nurse practitioners with placement by gastroenterologists or interventional radiologists. Placement by nurse practitioners resulted in lower charges compared with placement by gastroenterologists or interventional radiologists ($149 vs $226 and $328, respectively).

Comments

This retrospective review of data shows that trained nurse practitioners in an intensive care setting can place nasoenteric feeding tubes at the bedside using fluoroscopy in a manner that is safe, timely, convenient, and cost-effective in comparison with alternatives. In terms of safety, no complications related to feeding tube placement occurred during the study period. Additionally, patients were not exposed to the risks of transport for off-unit procedures.

In this study, 97% of feeding tubes were placed beyond the pylorus, and the mean procedure time was 7.0 minutes. These results are comparable with results reported in the literature. Foote et al,[17] in a randomized trial evaluating endoscopic versus fluoroscopic placement of feeding tubes in 43 patients, reported a success rate of postpyloric tube positioning of 96% under endoscopy and 94% under fluoroscopy. These authors reported a mean successful placement time of 15.2 minutes for endoscopic placement by gastroenterologists and 16.2 minutes for fluoroscopic placement by radiologists. Welpe et al[18] also examined bedside fluoroscopic-guided placement of feeding tubes by ICU staff and reported a success rate of 84% with a median time of 17 minutes for bedside placement by ICU physicians. Fang et al,[19] in a prospective study of endoscopic versus fluoroscopic feeding tube placement in 100 consecutive ICU patients, showed successful placement in 90% of patients with both methods. The reported mean procedure time in this series was 12.8 minutes for endoscopic placement by gastroenterologists versus 19.3 minutes for fluoroscopic placement by radiologists.[19] Although the total procedure times were only collected for the final 192 placements in this series, there did not appear to be an improvement in procedure times during the time period in which these 192 observations were recorded (ie, procedure times did not become shorter over time when this cohort was divided into temporal quartiles for analysis).

For tube placement by either gastroenterologists or interventional radiologists, it has been the authors' experience that scheduling considerations can delay the procedure. In contrast, all nasoenteric tubes placed by the nurse practitioners in this series occurred within 24 hours of the initial provider request. Non-bedside placement methods also raise concerns with regard to resource use and the risks of off-unit patient transport. Most patients in this study were mechanically ventilated at the time of feeding tube placement,

Table 3 Patient charges associated with nasoenteric feeding tube placement

	Radiology ($)*	Gastroenterology ($)†	Nurse practitioner ($)
Facility/supply charge	0	115	115
Professional charge	106	111	34
Fluoroscopy charge	222‡	0	0
Total direct charges	328	226	149

*CPT code 43752.
†CPT code 44373.
‡Facility/supply charges are incorporated into fluoroscopy charge reported under radiology.

and the transport of these patients to the radiology or gastroenterology suites would have been complex and labor intensive. Bedside placement by nurse practitioners eliminates these increased resource requirements. There are also difficult to quantify but nevertheless real risks associated with off-unit transport for critically ill patients. If these patients undergo acute physiologic decompensation during travel for an off-unit procedure, it is less likely that a full cohort of critical care practitioners and associated resources will be immediately available. Furthermore, patient transports frequently leave the remaining patients in the unit with reduced nursing and respiratory therapy staff because of the patient transport.

Throughout this large series, no complications occurred because of feeding tube placements by nurse practitioners. When this is considered along with the timeliness of tube placement, the elimination of additional resource requirements for off-unit travel, and the elimination of off-unit travel risks, the argument for bedside placement of feeding tubes by trained nurse practitioners is convincing. When economic factors are considered, the argument for the use of this method grows stronger. The 632 tube placements performed by nurse practitioners represented charges of $149 per placement (total $94,168). The same number of placements performed by gastroenterologists in an endoscopy suite would have represented charges of $142,832, whereas having radiologists perform these tube placements in an interventional radiology suite would have totaled $207,296. Each placement by a nurse practitioner in lieu of a gastroenterologist could generate a reduction of approximately 34% in charges, whereas placement by a nurse practitioner in lieu of an interventional radiologist could result in a charge reduction of approximately 55%. Note that these estimates represent professional and basic facility/supply charges only. They do not take into account any additional cost savings that accrue by virtue of avoiding off-unit transport.

The data presented herein specifically address charge differentials as distinct from costs. With regard to costs, there exists an extensive body of literature documenting the cost differential associated with the use of midlevel providers rather than physicians to perform clinical procedures that fall within the scope of practice of appropriately trained midlevel practitioners. In the surgical critical care area specifically, Cohn et al[20] surveyed US level I and level II trauma center directors in a broad-ranging study of staffing requirements and compensation. This study documented a mean compensation (salary plus bonus, exclusive of call stipends) of between $238,000 and $375,000 annually for surgeons practicing in the trauma/critical care area versus $80,000 to $82,000 annually for midlevel providers in the same field.[20] Although compensation may vary between institutions, the cost advantage of using midlevel providers in lieu of physicians to perform routine procedures is apparent.

This study has several limitations. First, this was a retrospective study and not a prospective, randomized controlled trial. Second, the study took place within a single academic medical center, and the findings may not be generalizable to other settings. Third, the charge data quoted herein apply within our institution and may vary in different institutional circumstances. Furthermore, we did not examine actual charges but rather potential charges, and we did not examine costs. Finally, a larger sample size would afford the opportunity to define the incidence of rare but potentially serious complications.

Conclusions

This study shows that trained critical care nurse practitioners can provide timely and safe bedside postpyloric placement of nasoenteric feeding tubes under fluoroscopy in critically ill surgical patient populations. There are potential economic advantages associated with using this approach and few obvious disadvantages. Future analyses should also quantitate the marginal costs and incremental risks of off-unit patient transport for nonbedside feeding tube placement.

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Discussion

Dr David Ciesla (Tampa, FL): This was a very well presented and nicely written article. It reminds me of a number of recent reports that look at the use of midlevel providers to perform procedures that are historically performed by physicians. This article is essentially a large retrospective case series although the title would imply that there is a comparison going on. I just have a couple of questions. The first would be, at the outset, the authors acknowledge that postpyloric tube feeding is somewhat controversial. This is not a study of gastric versus postpyloric tube feeds, but I would wonder what are the indications for putting postpyloric tubes in their patient populations? Essentially, is this a standard practice for all patients needing enteral access in this institution? The second question is that the fluoroscopy and the procedure times were only available in 30% of the cases. I would wonder even though they looked favorable, what steps did the authors take to ensure that this sample of the population was representative of the whole? Maybe they were recorded because they were so short. Finally, the title implies that this is a cost-effective procedure, and yet only the charge data are provided. From the insurer's point of view, I am sure they consider this cost-effective because they are being charged up to a third less for the same service. Without actual cost data, can you explain how we can use this charge data to support the claim that it is cost-effective? I think it is very nicely presented and timely. I agree with the principles that we can train nurse practitioners and that we are all using them. I just want to ensure that the claims that we are making in our articles are supported by the data that we are presenting.

Dr Tricia B. Hauschild (Salt Lake City, UT): Thank you for your thoughtful review of our article and your interesting questions. With regard to your first question, postpyloric feeding is a standard approach within our institution. We do recognize that there has been quite a bit of controversy about this in the literature. In our review for this article, I thought the Canadian clinical trials group meta-analysis published by Heyland was fairly convincing, showing a lower aspiration risk and better feeding tolerance with postpyloric feeding. There certainly is room for debate, but within our institution postpyloric feeding was the goal for all patients requiring enteral nutrition support in the absence of a clear contraindication to doing so. With regard to your second question, the fluoroscopy time actually was recorded for the entire case series. The time variable that was only recorded for 192 cases or 30% of cases was the procedure time at the bedside, measuring from when the practitioner first touched the patient and ending at the time the feeding tube position was confirmed to be in the correct position. We did look at our fluoroscopy times divided out by chronologic quartile to see if there was any significant difference over time. In other words, were the practitioners becoming more proficient and faster at performing the procedure? We did not see any significant difference from the first quartile through the last cortile. We infer from this that there was likely a similar pattern with regard to the procedure time, but I do acknowledge it is a valid criticism that we cannot say exactly what the procedure times at the bedside were for the earlier cases. In response to one of the points that you brought up with regard to this question, the 192 that were reported were simply chronologically the last 192 rather than a cherry-picked selection of the 192 fastest cases. Finally, with regard to your question on charge versus cost, I think that is a really interesting point. In doing this analysis, we found out that most of the difference in charges is related to the professional charge (in other words, professional charge for a nurse practitioner versus a gastroenterologist or an interventional radiologist). We do see that the charges are substantially reduced using a midlevel practitioner, and we believe that the cost data will also follow this pattern. Our next step is a formal cost analysis taking this into account as well as trying to quantify some of the other costs of the procedure.

Dr Shanu Kothari (LaCross, WI): Do you know how many patients if any in this series had surgically altered foregut such as an esophagogastrectomy or hiatal hernia or periesophageal hernia repair, and what is your institution's policy on patients with surgically altered foreguts on who places these types of tubes?

Dr Haushild: That is an excellent question. Unfortunately, I do not have precise data to talk about the number of patients who had a surgically altered foregut. However, those patients were not excluded from this protocol. We do routinely use the nurse practitioners to place nasoenteric tubes in these types of patients. Within our surgical ICU, we do have a full-time attending surgical critical care physician who is available in the event the nurse practitioner is placing a tube and the anatomy on fluoroscopy appears to be something unusual or unexpected. They are able to actually halt the procedure at that point and confirm that yes, indeed, the tube should be going in this direction. I think that that would be an interesting substudy to look at going forward—procedure times and so on for those patients versus patients without a surgically altered foregut.