REVIEW ARTICLE

Systematic review on bedside electromagnetic-guided, endoscopic, and fluoroscopic placement of nasoenteral feeding tubes

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Background: Nasoenteral tube feeding is frequently required in hospitalized patients to either prevent or treat malnutrition, but data on the optimal strategy of tube placement are lacking.

Objective: To compare the efficacy and safety of bedside electromagnetic (EM)-guided, endoscopic, and fluoroscopic placement of nasoenteral feeding tubes in adults.

Design: Systematic review of the literature.

Patients: Adult hospitalized patients requiring nasoenteral feeding.

Interventions: EM-guided, endoscopic, and/or fluoroscopic nasoenteral feeding tube placement.

Main Outcome Measurements: Success rate of tube placement and procedure- or tube-related adverse events.

Results: Of 354 screened articles, 28 studies were included. Data on 4056 patients undergoing EM-guided (n = 2921), endoscopic (n = 730), and/or fluoroscopic (n = 405) nasoenteral feeding tube placement were extracted. Tube placement was successful in 3202 of 3789 (85%) EM-guided procedures compared with 706 of 793 (89%) endoscopic and 413 of 446 (93%) fluoroscopic procedures. Reinsertion rates were similar for EM-guidance (270 of 1279 [21%] patients) and endoscopy (64 of 394 [16%] patients) or fluoroscopy (10 of 38 [26%] patients). The mean (standard deviation) procedure time was shortest with EM-guided placement (13.4 [12.9] minutes), followed by endoscopy and fluoroscopy (14.9 [8.7] and 16.2 [23.6] minutes, respectively). Procedure-related adverse events were infrequent (0.4%, 4%, and 3%, respectively) and included mainly epistaxis. The tube-related adverse event rate was lowest in the EM-guided group (36 of 242 [15%] patients), followed by fluoroscopy (40 of 191 [21%] patients) and endoscopy (115 of 384 [30%] patients) and included mainly dislodgment and blockage of the tube.

Limitations: Heterogeneity and limited methodological quality of the included studies.

Conclusion: Bedside EM-guided placement of nasoenteral feeding tubes appears to be as safe and effective as fluoroscopic or endoscopic placement. EM-guided tube placement by nurses may be preferred over more costly procedures performed by endoscopists or radiologists, but randomized studies are lacking. (Gastrointest Endosc 2015;81:836-47.)

Hospitalized patients are frequently unable to maintain sufficient oral intake because of the disease itself or as a consequence of treatment. In these patients, nutritional support is indicated because a significantly reduced or absent caloric intake leads to malnutrition, which is known to be associated with increased morbidity, mortality, length of hospital stay, and costs.[1,2]

In patients with a functioning intestinal tract, enteral feeding is preferred over parenteral nutrition, as the latter is associated with significantly increased morbidity and costs.[3–5] Nasogastric feeding may be appropriate in many patients, but in cases of increased risk of aspiration (eg, in patients with severe GERD, gastroduodenal dissociation, gastroparesis, or gastric outlet obstruction), gastroduodenal inflammation, or proximal enteric fistula, nasoenteral feeding is indicated.[6,7] Postpyloric tube placement can be challenging, especially in patients with gastroparesis. Blind

Abbreviations: EM, electromagnetic; RCT, randomized, controlled trial; SD, standard deviation.

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placement is usually unsuccessful and may lead to serious adverse events such as pneumothorax and pneumonia due to inadvertent lung placement in more than 2% of placement attempts.[8] The conventional alternative methods, endoscopy and fluoroscopy, are more successful and much safer, but also relatively bothersome and expensive due to the need for a medical specialist to perform the procedure and patient transportation between the clinical ward and the endoscopy or radiology department. In addition, endoscopic or fluoroscopic placement is frequently delayed due to limited hospital resources, leading to a delay in the start of nasoenteral feeding.

In 2006, a bedside electromagnetic (EM)-guided placement method for nasoenteral feeding tubes was introduced. With the aid of an EM-transmitting stylet at the tip of the feeding tube and a receiver placed in the epigastric region, the path of the tube can be tracked in real-time on a monitor until it has reached its desired position, and the stylet can be withdrawn (Fig. 1). This method may be more patient-friendly and cost-effective compared with endoscopy or fluoroscopy because it can be performed on the ward at the patient's bedside by a specialized nurse. Confirmation of the tube's position on abdominal radiograph is unnecessary because the system was shown to correlate with radiographs in 99.5% of cases and is cleared by the U.S. Food and Drug Administration for placement confirmation.[9] Moreover, repositioning of a tube that has dislodged in the stomach can be done by reinserting the stylet through the tube without the need for a fully repeated procedure.[9–12] However, comparative evidence regarding the various methods of nasoenteral feeding tube placement is lacking.

The aim of this systematic review of the literature is to compare the outcomes of EM-guided, endoscopic, and fluoroscopic nasoenteral feeding tube placement in adults, focusing on efficacy and safety.

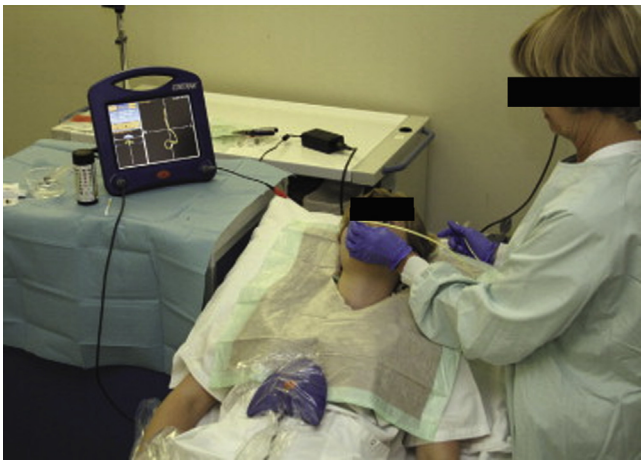

Figure 1. Nasoenteral feeding tube placement under electromagnetic guidance. The electromagnetic signal from the stylet is tracked by the receiver at the patient's epigastric region and reflected as a yellow line on the monitor. Reprinted from Mathus-Vliegen et al.[25]

METHODS

Study selection

A systematic literature search was performed in PubMed, Embase, and the Cochrane Library for studies published between January 1, 2006, and January 3, 2014. This review was performed according to the Preferred Reporting Items for Systematic reviews and Meta-Analyses (PRISMA) guidelines.[13] The search terms used were *electromagnetic*, *endoscopic*, or *fluoroscopic* and *nasoenteral* or *post-pyloric* and *tube(s), feeding,* or *nutrition* and synonyms, restricted to title, abstract, and keywords (see Supplemental Table 1 for the full electronic search strategy, available online at www.giejournal.org). Titles and abstracts and subsequently full-text articles were screened independently by 3 authors (A.G., M.J.P., and T.R.) based on inclusion and exclusion criteria. Disagreement on eligibility was addressed by discussion and consensus. Reference lists of all included papers and PubMed-related articles were screened manually to identify initially missed but relevant studies.

Eligibility criteria

Included were studies concerning EM-guided, endoscopic, and/or fluoroscopic nasoenteral feeding tube placement reporting on the success rate of tube placement (primary outcome) that were available as full text articles in English. Only studies published after the introduction of EM-guided tube placement (2006) were included to increase homogeneity between the study populations, as indications for postpyloric tube placement have changed over time.

Excluded were review articles, editorials, case reports or cohort studies including fewer than 20 patients, animal studies, and studies in children. For some studies, some investigated groups were excluded: those on other than the 3 investigated methods (eg, blind placement, self-advancing tubes, or the use of prokinetics) or on nasogastric tube placement. Results of 2 variations within 1 placement method (eg, transnasal vs transoral endoscopic tube placement) were combined.

Assessment of methodological quality

The methodological quality of all included studies was assessed independently by 3 authors (A.G., M.J.P., and T.R.). Studies were graded according to the Oxford Centre for Evidence-Based Medicine Levels of Evidence.[14] The risk of bias was assessed by using the Cochrane Collaboration's tool and the Newcastle–Ottawa Quality Assessment Scale for randomized, controlled trials (RCTs) and cohort studies, respectively.[15,16]