

# Enteral feeding tubes: Are insertion techniques and positioning based on anatomical evidence?

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## Abstract

Patients in whom oral energy intake is insufficient for daily needs may develop malnutrition and its complications, such as increased infection rates, increased length of hospitalization, and death. Enteral feeding is beneficial for these patients. However, this therapy is not without complications related to the insertion and placement of enteral feeding tubes. This review aims to identify from the literature different techniques for insertion and the methods used to evaluate the placement of enteral feeding tubes.

## Keywords

Enteral nutrition, nursing, methods

## Introduction

The maintenance of a healthy nutritional status is important in the clinical progress of hospitalized patients. It is known that malnutrition in hospital patients is associated with

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increased hospital infection rates, increased length of hospitalization, and death.<sup>1</sup> To maintain a healthy nutritional status, nutritional support should be sufficient to meet the demands of basal energy expenditure, physical activity, and stress.

If oral intake is not possible or is insufficient, enteral therapy (ET) is the first choice to ensure that more steps of the digestive process remain involved.<sup>2</sup> However, the use of enteral feeding tubes (EFTs) is not without complications. Sorokin and Gottlieb<sup>3</sup> evaluated 2000 insertions in adults and identified that 1.3% of tubes were misplaced; furthermore, two deaths could be directly attributed to improper placement. Ellet et al.<sup>4</sup> reported a complication rate of 4%. In two other studies the prevalence of errors in the placement of tubes ranged from 20.9% to 43.5%.<sup>5,6</sup> Such complications occur mainly because of inadvertent positioning of the EFT in the airway, causing aspiration, pneumothorax, atelectasis, pleural effusion and/or bronchopleural fistula.<sup>3,4</sup> Annually, 1 million tubes are inserted in adult and pediatric patients in the United States.<sup>7</sup> In Brazil, there is no quantification of this procedure. In our institution, Hospital de Clínicas de Porto Alegre, approximately 50 adults and 50 pediatric patients use EF daily, accounting for 13% of all hospitalized patients. The nurse is the professional responsible for the procedure of inserting the EFT.<sup>8</sup> The use of standard techniques and methods of confirmation of the positioning after the insertion of the EFT and before the administration of the feeding are recommended.<sup>8</sup> It is also recommended that the nurse, after the insertion of the EFT and before the administration of the feeding, should assess the positioning of the tube, using different tests at the bedside.

The present study aims to review the literature regarding the techniques of insertion of EFTs as well as the predictive capacity of methods to assess the positioning of the EFT adopted at the bedside.

## Methods

Between April and August of 2010, two independent evaluators (DML and MCSA), following the same criteria and procedures, accessed the PubMed database in search of original articles, on humans, in Portuguese, English, and Spanish. The following terms were adopted as keywords: # # enteral nutrition feeding tube nasogastric intubation # proceeding nurse # method accuracy and their combinations with each other. In the initial stage, the selection of articles was undertaken based on the evaluation of the title, followed by reading of the abstract. This was followed by a consensus between the evaluators, which consisted of reading the complete articles and defining the types of articles to be included in the review. Articles that addressed historical aspects of the subject, identified in references, were also included.

## Results

Feeding tubes were first introduced about 3500 years ago, when the Greeks and the Egyptians practiced rectal feeding of patients.<sup>9</sup> In the sixteenth century, Fabricius ab Aquapendente, professor of anatomy, used a silver tube in the digestive tract of his patients; however, the indication is unknown. In the eighteenth century, John Hunter fed his patients with a hollow soft leather tube inserted into the stomach.<sup>10</sup> In 1800, in

Philadelphia, Philip Syng Physick introduced the idea of using a tube for gastric lavage.<sup>11</sup> In 1822, English surgeon Mr. Jukes adopted a tube called the *stomach pump*, a 2-m-long rubber tube with weight and perforations at the distal extremity.<sup>11</sup> For many years this device was used for gastric emptying and irrigation. Only since 1921 has the use of Levi tubes been widespread.<sup>11</sup> Complications associated with the use of the feeding tubes led to the development of polyethylene, polyvinyl, silicone, and polyurethane feeding tubes.<sup>11</sup> EFTs can be inserted into the stomach or small intestine (duodenum, jejunum, and ileum).<sup>12</sup> There is no consensus regarding the best location for administration, although the stomach is generally preferred.<sup>2</sup> The position of a post-pyloric EFT is indicated by evidence of delayed gastric emptying and/or the presence of gastroesophageal reflux.<sup>13</sup> And, regardless of where the tube is inserted, the most important thing is the proper positioning of the patient and the slow infusion of feed.<sup>10</sup>

In general, the technique of insertion of an EFT consists of (a) positioning the patient at 45 degrees unless this is contraindicated, (b) taking external measurements before tube insertion, and (c) lubricating the tube and bending the head of the patient to facilitate insertion of the EFT.<sup>3,7</sup> Several particularities for the insertion of the EFT are described: (a) standard technique, (b) technique with air insufflation into the stomach, (c) insertion guided by magnetic device and (d) use of prokinetics.

In the standard technique, the patient is first positioned at 45 degrees or as close to this as possible (provided there are no contraindications). External measurements are then taken to determine the size of the EFT to be introduced. The lubricated tube is inserted through a nostril, bending the patient's head to facilitate progression through the pharynx, and 20 ml of air is injected through the tube and the epigastric region auscultated to determine if the EFT is in the stomach. Finally, the EFT is fixed. The most commonly used measurements are from the tip of the nose to the earlobe and from the tip of the nose to the xiphoid process via the earlobe. It is not known where these measurements originated, although they continue to be published in textbooks and taught in undergraduate nursing programs.<sup>7</sup> This measurement dates from 1979, when Hanson<sup>12</sup> sought to determine the relationship between different external measures, including the distance between EFT in the positioning of the distal tip of the tube in 99 cadaver and five living volunteers, obtaining a success rate of 92% in gastric positioning. Thus, the author recommends a 50-cm mark at the distal tip of the EFT and then measure the xiphoid process and the midpoint between the measures, which would determine the position of the EFT in the gastric region.<sup>12</sup>

### *Air insufflation into the stomach*

The technique of air insufflation into the stomach is designed to move the distal tip of the EFT into the duodenum. Salasidis et al.<sup>14</sup> conducted a prospective randomized study in order to estimate the length of EFT required to reach the fourth part of the duodenum. The entire EFT, except for 10 cm, was inserted, and 500 ml of air was insufflated into the stomachs of the patients, who were kept in the right lateral decubitus position. After 2 hours, the patients were placed in the supine position and control radiography was performed.<sup>14</sup> Using this technique, 21 of the 32 tubes were placed successfully, whereas among patients who underwent the standard technique, only 12 of 34 tubes were placed

successfully ( $p < 0.02$ ). The success rate at 24 hours was 25 out of 32 with air insufflation and 16 out of 34 with the standard technique ( $p < 0.02$ ). Out of the 21 tubes inserted into the antrum, body, or fundus of the stomach, three moved into the duodenum the next day, compared with 5 out of 12 tubes initially placed in the pylorus ( $p < 0.075$ ). The authors concluded that the insertion of the EFT is facilitated by air insufflation; however, the presence of abdominal distension makes the use of this technique impossible.<sup>12,14</sup> In children, the pioneers of this technique were Spalding et al.,<sup>15</sup> who compared the technique of air insufflation with one described as standard in 50 children admitted to an intensive care unit. The tubes were placed successfully on the first attempt in 23 out of 25 patients who underwent the air insufflation technique (a success rate of 92%); however, in patients subjected to the standard technique, only 11 out of 25 insertions were successful (a success rate of 44%) ( $p = 0.001$ ). Lenart and Nayak<sup>16</sup> achieved a success rate of 67% using the technique of air insufflation and 40% with administration of metoclopramide in 60 adults. This technique shows a high success rate for the insertion of post-pyloric tubes; however, the associated adverse effects are not described.

### *Magnet-guided tubes*

The technique of inserting magnet-guided tubes requires the use of an external device that is 7.5 cm in diameter and 9 cm in length and works both as a magnet and as a tube; at the distal end has a magnet that is directed by the external device. The study that showed this new technique included 35 adults and described the steps to insert the tube, as follows. Position the external magnet at the right upper quadrant of the abdomen, in the midclavicular line, just below the bottom edge of the costal margin, then insert 25 cm of the EFT into the patient's nostril. During the insertion of the tube, move the external magnet, reproducing what should be the path of the tube to its position. The tube should then be rotated 90 degrees clockwise, leading the outer magnet down to the suprapubic region. The authors achieved a success rate for duodenal insertion of 88% at the first attempt.<sup>17</sup> Boivin et al.<sup>18</sup> used the same technique and the same device in 166 patients and obtained a 60% (93/156) success rate when inserting the tube into the postpyloric region; in contrast, in the case of insertion into the duodenum, the success rate was only 32% (50/156). It is worth considering that the success rate with the standard technique is 92%; thus, it appears that adoption of this device, which also requires additional resources, confers no advantage.

### *Prokinetic agents*

Prokinetic agents stimulate the smooth muscle of the gastrointestinal tract, through the antagonism of dopamine and facilitation of peristalsis, leading to an acceleration of gastric emptying and intestinal transit and, consequently, facilitating the migration of the EFT.<sup>16</sup> In clinical practice, several drugs are used for this purpose, such as metoclopramide, domperidone, and erythromycin.<sup>18–20</sup> In one study, 70 adults were divided into two groups, which received either placebo or intravenous metoclopramide (10 mg), administered immediately after insertion of the EFT. The authors reported a success rate, defined as placement in the postpyloric position, of 60% (21/35) in the metoclopramide

group, compared with 49% (17/35) in the placebo group; however, the difference was not statistically significant.<sup>19</sup> Darell et al.<sup>20</sup> evaluated 105 cases of administration of metoclopramide before the insertion of an EFT and obtained a postpyloric success rate of 54% (32/59) and failure of 46% (27/46), a difference of 8% ( $p = 0.38$ ). Gharpure et al.<sup>21</sup> compared the effectiveness of erythromycin and placebo in 74 critically ill children fitted with an EFT. Among the erythromycin group, the EFT was placed in the postpyloric region in 23 of the 37 patients, whereas in placebo group, 27 of 37 EFTs were postpyloric 4 hours after insertion. However, the evidence is insufficient to say that metoclopramide is superior to placebo in the migration of an EFT.<sup>21</sup>

After the insertion of the EFT and/or prior to administration of the food, it is essential to assess the anatomical positioning of the EFT to minimize mechanical complications. For this reason, different clinical and imaging tests are incorporated into care routines to evaluate the anatomical site of the distal position of the EFT: auscultation of the epigastrium; evaluation of the appearance of residue aspirated; evaluation of the pH aspirated and verification of the presence of bilirubin; capnography; ultrasound; and radiography.

### *Auscultation of the epigastrium*

We found no studies in which the position of the EFT was verified by auscultation of the epigastrium. The technique consists of injecting approximately 15 ml of air through the EFT and epigastric auscultation with a stethoscope.<sup>22</sup> The technique of auscultation is used by nurses at the bedside to confirm that the EFT is not in the respiratory tract. However, this method cannot be used to determine the position of the EFT in the gastrointestinal tract. Metheny et al.<sup>23</sup> recorded 123 auscultations of 85 patients and requested that four nurses indicate the anatomical positioning of the EFT by listening to these recordings. It was reported that it was impossible to distinguish between the gastric and intestinal location of the distal tip of the EFT based on the intensity of the sound.<sup>24,25</sup>

### *Volume and appearance of the aspirated residue*

Evaluation of the volume and appearance of the aspirated residue is another technique used to confirm the position of the EFT. It consists of analysis of the aspirated contents of the EFT. According to Nyqvist et al.,<sup>26</sup> aspiration of the secretion varies depending on the location of the distal tip of the EFT. Metheny et al.<sup>24</sup> present descriptions of the most commonly found characteristics: gastric – green (cloudy), whitish or bloody beige or brown, or still colorless or transparent; intestinal – light yellow or bile stained and generally clear; pleural – light yellow or dyed red (blood). Phipps et al.<sup>27</sup> reported that tracheobronchial aspirate is mainly characterized by the presence of mucus and is whitish, opaque or tan in color. In another study, Metheny et al.<sup>24</sup> described that the analysis of the appearance of the aspirate is not a widely used practice because of the difficulty of obtaining consensus on the actual characteristics of the aspirate. They also reported that the residues from the small intestine are usually smaller than the gastric volume; thus, the increase in the residual volume may signal a displacement of the distal

tip of the EFT from the small intestine to the stomach. The need for material to perform the analysis makes the failure to obtain it a limiting factor. In this sense, Sabry et al.<sup>17</sup> administered 5 ml of water via the EFT in order to aspirate the same amount. However, Darell et al.<sup>20</sup> claim that the aspiration test is useful to highlight the inadvertent placement of the EFT in the bronchi.

### *pH of aspirated residue and presence of bilirubin*

The evaluation of the pH of the residue aspirated and verification of the presence of bilirubin is another method used to infer the location of the EFT, but also requires aspiration of material through the EFT. Reference values of gastric pH are  $\leq 5$  in the stomach and approximately 6.6 in the intestine.<sup>28</sup> Metheny et al.<sup>29</sup> report that the reference values of pH are  $7.35 \pm 0.6$  in the intestine,  $7.73 \pm 0.4$  in the lung, and  $3.9 \pm 0.15$  in the stomach. Bilirubin values range from  $1.28 \pm 0.25$  mg/dl in the stomach and  $0.8 \pm 0.02$  mg/dl in the lungs to  $12.73 \pm 0.91$  mg/dl in the intestine.<sup>29</sup> After excluding the placement of the EFT in the respiratory tract, it is necessary to identify where the distal tip of the EFT is placed; however, no method is 100% accurate.<sup>30</sup>

### *Capnography*

Capnography is a technique widely used in intensive care units for verification of endotracheal tube placement. It is a noninvasive technique that measures the CO<sub>2</sub> exhaled through the tube, with the aid of a device connected to the endotracheal tube. In this way, it can be used to verify the CO<sub>2</sub> exhaled by the EFT, which would suggest a tracheal position.<sup>4,31</sup> Kindopp et al.<sup>31</sup> examined the use of capnography in 25 patients and identified with accuracy all the inadvertent placements of the EFT. Another test that uses CO<sub>2</sub> as the standard is colorimetry, in which a device is inserted into the tip of the EFT and a chemical reaction changes the color of the marker. A purple color indicates that the distal extremity of the tube is not in the respiratory tract and a color yellow indicates that it is.<sup>4,31</sup>

### *Ultrasound*

Ultrasound is usually used in diagnostic tests; however, it has also been used to aid insertion and/or monitoring of the position of the EFT. Hernandez-Socorro et al.<sup>32</sup> compared a manual bedside method of EFT insertion with the technique that used ultrasound in 35 patients. The blind manual method was successful in 9 of 35 (25.7%) patients while the technique using ultrasound was successful in 22 of 35 (84.6%) patients. The average time for placement of the EFT with the manual technique was  $13.9 \pm 7.4$  min (range 5–30 min) and with the technique of ultrasound it was  $18.3 \pm 8.2$  min (rang 5–35). This study demonstrated that ultrasound can be used to evaluate the positioning of the tube, and may replace radiography, thus reducing exposure to radiation.

### *Radiography*

Radiography is the test recommended for identifying the anatomical location of the distal portion of the EFT. However, it is not ideal as it may take some time to perform,

delaying the onset of ET and exposing the patient to radiation. In addition, the EFT can be unintentionally pulled, or even displaced, which would result in the need to perform the technique again on each of these occasions.<sup>23</sup>

## Conclusion

Although the administration of enteral feeding is an important modality in nutritional therapy, the procedures involved in the insertion and positioning of the EFT are incorporated into the practice of nurses without sufficient studies, especially validation studies. Thus, it is necessary to critically evaluate the proposed insertion techniques as well as the techniques proposed for determining the anatomical position of the distal end of the EFT. As the use of EFTs is extremely common, the technique of insertion and positioning should be better grounded scientifically.

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