Clinical Practice Guideline:
Gastric Tube Placement Verification
Full Version
[Formerly known as Emergency Nursing Resource (ENR)]

In patients having gastric tubes inserted in the emergency department setting, which bedside technique is best for confirmation of accurate placement immediately after tube insertion compared to radiograph?

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Publication Date: December 2010, Title Edited March 2013

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Background/Significance

Gastric tube (GT) placement is a common bedside procedure performed by registered nurses in the emergency department (ED). Although often considered an innocuous procedure, gastric tube placement can result in serious and even lethal complications such as, misplacement of the gastric tube into the pulmonary system resulting in respiratory distress or death. The standard of care requires verification of the placement of the gastric tube prior to its use in order to minimize complications. Radiographic verification is considered the preferred method of confirmation (Leschke, 2004) and is considered the "gold standard" by many, especially for feeding tubes (Araujo-Preza, Melhado, Gutierrez, Maniatis, & Castellano, 2002; Ellet, 2004; Elpern, Killeen, Talla, Perez, & Gurka, 2007; Kearns & Donna, 2001; Metheny, 2007). However, bedside methods are commonly used as a proxy for radiographic verification when large bore GTs are inserted because of the associated cost, time delay, and radiation exposure. In addition, a radiographic test cannot be performed by the bedside nurse. It has been well documented for almost 20 years that a common bedside method (auscultation) is often inaccurate; however, it is still widely practiced. This Clinical Practice Guideline (CPG) aims to evaluate various bedside gastric tube placement verification methods as an alternative to radiography.

Methodology

This CPG was created based on a thorough review and critical analysis of the literature following ENA's Guidelines for the Development of Clinical Practice Guidelines. Via a comprehensive literature search, all articles relevant to the topic were identified. The following databases were searched: PubMed, eTBLAST, CINAHL, Cochrane - British Medical Journal, Agency for Healthcare Research and Quality (AHRQ; www.ahrq.gov), and the National Guideline Clearinghouse (www.guidelines.gov). Searches were conducted using the key words nasoenteral tubes, tube placement determination, gastric tubes, gastric tube placement confirmation, gastric tube placement, and nasoenteral tubes + catheters and tubes. Initial searches were limited to English language articles on human subjects from 2005 – October, 2010. This five year search limit was found to be inadequate so the time frame was expanded to 1994 and a specific search was performed for Metheny's publications because of the seminal nature of her work. In addition, the reference lists in the selected articles were scanned for pertinent research findings. Research articles from emergency department settings, non-ED settings, position statements and guidelines from other sources were also reviewed.

Articles that met the following criteria were chosen to formulate the CPG: research studies, meta-analyses, systematic reviews, and existing guidelines relevant to the topic. Other types of article were also reviewed and provided as additional information. The CPG authors used standardized worksheets, including Evidence-Appraisal Table Template, Critique Worksheet and AGREE Work Sheet, to prepare tables of evidence ranking each article in terms of the level of evidence, quality of evidence, and relevance and applicability to practice. Clinical findings and levels of recommendations regarding patient management were then made by the Clinical Practice Guideline Development Committee according to the ENA's classification of levels of recommendation for practice, which include: Level A High, Level B. Moderate, Level C. Weak or Not recommended for practice (See Table 1).

Table 1. Levels of Recommendation for Practice

Level A recommendations: High • Reflects a high degree of clinical certainty • Based on availability of high quality level I, II and/or III evidence available using Melnyk & Fineout-Overholt grading system (Melnyk & Fineout-Overholt, 2005) • Based on consistent and good quality evidence; has relevance and applicability to emergency nursing practice • Is beneficial
Level B recommendations: Moderate • Reflects moderate clinical certainty • Based on availability of Level III and/or Level IV and V evidence using Melnyk & Fineout-Overholt grading system (Melnyk & Fineout-Overholt, 2005) • There are some minor or inconsistencies in quality evidence; has relevance and applicability to emergency nursing practice • Is likely to be beneficial.
Level C recommendations: Weak • Level V, VI and/or VII evidence available using Melnyk & Fineout-Overholt grading system (Melnyk & Fineout-Overholt, 2005) - Based on consensus, usual practice, evidence, case series for studies of treatment or screening, anecdotal evidence and/or opinion • There is limited or low quality patient-oriented evidence; has relevance and applicability to emergency nursing practice • Has limited or unknown effectiveness

Not recommended for practice
• No objective evidence or only anecdotal evidence available; or the supportive evidence is from poorly controlled or uncontrolled studies
• Other indications for not recommending evidence for practice may include:
  ○ Conflicting evidence
  ○ Harmfulness has been demonstrated
  ○ Cost or burden necessary for intervention exceeds anticipated benefit
  ○ Does not have relevance or applicability to emergency nursing practice
• There are certain circumstances in which the recommendations stemming from a body of evidence should not be rated as highly as the individual studies on which they are based. For example:
  ○ Heterogeneity of results
  ○ Uncertainty about effect magnitude and consequence
  ○ Strength of prior beliefs
  ○ Publication bias

Evidence Table and Other Resources

The articles reviewed to formulate the CPG are described in the Evidence Table. Other articles relevant to GT placement were reviewed to serve as additional resources (Other Resources Table).

Summary of Literature Review

Gastric Tubes

Gastric tubes may be inserted nasally, i.e. nasogastric tubes, or orally, i.e. orogastric tubes. Regardless of the insertion route all are GTs so this term will be used throughout the document. The main reasons for inserting a GT in the emergency department are to decompress the stomach and remove stomach contents; to prevent aspiration and minimize nausea/vomiting; or to instill liquids or medications (Christensen, 2001). Two categories, large and small bore gastric tubes have been designed to meet these treatment needs. For example, large bore GTs are considered for short term use and aid in the removal of stomach contents and the instillation of liquids or medications. In contrast, small bore GTs, also known as feeding tubes, remain in place for a longer period of time and are reserved for the instillation of enteral nutrition, liquids and medications. Thus, large bore GTs, not feeding tubes, are typically inserted in the emergency department.

Treatment needs guide the decision about the location of the tip of the gastric tube. A large bore gastric tube is inserted via the nose or mouth and guided into the stomach. Whereas, a small bore gastric tube is advanced through the stomach into the small intestine. Because anatomical changes associated with growth and development occur; patient age and size are also considered when determining the depth of insertion and size of the gastric tube selected (Cincinnati Guidelines, 2009).

Although most studies of gastric tube bedside verification methods focus on small bore feeding tubes; the limited numbers of studies conducted in emergency department settings using large bore gastric tubes are also included in this review. The most common bedside verification methods can be categorized as non-aspirate or aspirate.

Non-Aspirate Methods

Non-aspirate methods include auscultation, carbon dioxide detection, transillumination, and magnectic detection; whereas, aspirate methods are: visual characteristics, pH, bilirubin, and enzyme tests.

Auscultation

The ausculatory method involves instillation of air into the tube while simultaneously listening with a stethescope for a sound of air over the epigastric region. Auscultation alone continues to be used by nurses currently caring for neonates (Cincinnati Guidelines, 2009), pediatric patients (de Boer, 2009) and adults (Nursing, 2006) despite its proven unreliability as a single verification method (Ellett, 2005; Metheny, 1994; Neuman, 1995; Metheny, 1999; Yardley & Donaldson, 2010). Results from a 2006 on-line survey of 1,600 nurses indicated that 65% used the auscultation verification method most of the time (Nursing). Guidelines published by Cinncinnati Children's Hospital (2009) reported only 60-80% reliability with auscultation as a single verification method. An American Association of Critical Care Nurses (AACN) practice alert in 2007 suggested abandoning the ausculatory method for gastric tube placement verification due to its unreliability. Thus, pursuit of a reliable, valid, bedside verification method for gastric tube placement has led researchers to investigate methods other than auscultation.

Carbon Dioxide Detection Monitoring

Misplacement of the gastric tube into the pulmonary system warrants immediate and accurate detection. Studies using CO_2 detection methods (CO_2 monitoring/capnography) were conducted to identify a method that detects gastric tube misplacement (Burns et al., 2006; Elpern et al., 2007). Burns and colleagues (2006) reported 100% agreement between colorimetry and capnography in the identification of CO_2 when the gastric tube was placed inside an endotracheal tube (in situ). Further, 130 adult medical intensive care unit patients underwent large bore GT placement and insertion failure or GT misplacement, was correctly identified by capnography, in 52 patients (a rate of 27%) (Burns, et al. 2006). Gastric tube insertion failures were associated with nasal insertion route ($p = 0.03$) and among spontaneously breathing/non-intubated patients ($p = 0.01$). The small number of misplaced GTs limits the generalizability of the study results.

Capnometry and air insufflations/auscultation were compared to abdominal radiograph for accuracy in detecting misplaced GTs during initial insertion in 91 adult critical care and telemetry patients (Elpern, 2006). Elpern and colleagues reported a 100% success rate in placing the GT into the stomach. However, when compared with abdominal radiographs, 16% of correctly placed GTs via capnography were false positives (indicated to be in the pulmonary track but actually in the GI tract) and there were 5% false positive results with air insufflation/auscultation (Elpern, 2007). While a false positive reading does not immediately jeopardize patient safety, it does require the use of additional verification methods to ensure tube location. Study limitations included sample size, adult-only study population, and false positive readings.

Further research is needed to determine the role of carbon dioxide detection in GT placement. Carbon dioxide detection and monitoring equipment is commonly found in the emergency department because of its use with endotracheal intubation and sedation, however its use with GT placement in the emergency department remains under studied. Interestingly, two GT verification algorithms (Cincinnati, 2009; Metheny, 2001) do not include the carbon dioxide detection method. Instead, both of these algorithms suggest the nurse listen for air movement and/or observe for respiratory distress signs and symptoms to detect the misplacement of the GT.

Transillumination and Magnetic Detection

Research has also been conducted to determine the feasibility of using transillumination or magnetic detection for GT placement verification. One study utilized a fiberoptic method for GT placement verification (Rulli, 2007). A flexible fiberoptic cable was inserted into the GT of 16 patients, 8 adults and 8 children, who were undergoing a surgical procedure. Transillumination of the epigastric abdominal area was used to indicate correct placement of the GT. Gastric tube placement was confirmed in 100% of the patients. While the study was highly relevant; limitations included small sample size, lack of commercially available equipment, and the operating room practice setting.

Magnetic detection was used to detect position of GT in 88 volunteer subjects, aged 18-75 years (Tobin, 2000). A commercial feeding tube was modified to substitute a magnet for the tungsten weights in the tip of the GT. Prototype magnet detectors determined real-time GT location, orientation and depth of distal end of the feeding tube. Gastric tubes were determined, by fluoroscopy, to be below the diaphragm 100% of the time. A prospective blinded trial of 134 patients compared four GT verification methods: electromagnetic technique, auscultation, aspiration and pH (Kearns & Donna, 2001). Electromagnetic and aspiration method identified tubes above the diaphragm. Electromagnetic method

successfully identified GT placement 90% of the time compared to 53% successful placement using aspiration. Several study limitations included lack of commercially available equipment for both GT and magnetic field detector, laboratory setting, and lack of testing of misplacement of GT in the pulmonary system.

Ultrasound

Ultrasound is clinically feasible because many EDs now have bedside ultrasound units, but research is necessary to validate this method for large-bore GTs in the ED setting. There are limited data emerging regarding the use of ultrasound for confirmation of gastric and feeding tube placement in adults (Nikandros, Skampas, Theodorakopulou, Ioannidou, Theotokas, & Armaganidis, 2006; Vigneau, Baudel, Guidet, Offenstadt, & Maury, 2005). While this technique looks promising for verification of feeding tube placement, there are no data on the use of this verification method for large bore GTs in the ED setting.

Aspirate Methods

Tests evaluating aspirate content offer an alternative method for verifying GT placement. Visual inspection and biochemical markers such as: pH, bilirubin, and enzymes were the most frequent aspirate methods used to study GT placement. Visual inspection of aspirate involved differentiating appearance of the aspirate obtained from the stomach, small intestine, and lung contents. Metheny and colleagues (1994) reported that critical care nurses were able to differentiate between gastric and intestinal aspirate appearances 90.47% of the time ($p < 0.01$); yet were unable to distinguish between gastric and pulmonary aspirate. Reliable verification methods are needed to determine tube misplacement into the pulmonary system since this is the most common and potentially lethal site for misplacement.

Several studies investigated the biochemical markers of pH, bilirubin, pepsin, and trypsin for GT placement (Cincinnati, 2009; Ellett, 2005; Kearns & Donna 2001; Metheny, 1989, 1994, 1997, 1999; Metheny & Titler, 2001; Phang, Marsh, Barlows, & Schwartz, 2004; Stock, Gilbertson & Babl, 2008; Taylor & Clemente, 2005). Small bore feeding tubes were utilized in all studies. A combination of small bore feeding tubes and large bore GT for decompression were utilized in the Stock, Gilbertson, & Babl, 2008 study and the Cincinnati, Guidelines also address large bore tubes. In addition, study populations often included patients receiving acid inhibiting medications.

Biochemical marker threshold values varied among the studies ranging from a gastric pH value of less than 3.9 to 7 and bilirubin less than 5 to differentiate GT placement in the stomach versus the pulmonary system. Participants in these studies received acid suppressive therapy and tube feedings-both of which influence gastric pH. Reliability of pH testing to determine tube placement within the gastrointestinal tract ranged from 84% (Stock, Gilbertson, & Babl, 2008) to 97% (Metheny, 2000), compared to bilirubin test reliability of 91% (Metheny, 1999), pepsin enzyme reliability of 91.2% and trypsin enzyme reliability of 91.8% (Metheny, Stewart, Smith, & Yan, 1997). Study results reported an alteration in pH test results for patients receiving acid suppression medication. In fact, Taylor and Clemente (2005) reported a 58% reduction in pH confirmation of GT placement for patients receiving acid inhibiting medications.

Research in 2000 by Metheny and colleagues, reported the combined test results of pH greater than 5 and bilirubin less than 5 successfully identified 98.6% of the 141 cases as gastric placement. Laboratory-

based testing of bilirubin, pepsin and trypsin, limit their use as bedside point of care methods. There is limited information using urine bilirubin test strips for the purpose of bedside verification (Metheny, Stewart, Smith, & Yan, 2000) while bedside testing of gastrointestinal enzymes awaits development.

Combined Non-Aspirate and Aspirate Methods

Algorithmic Approach

The rate of GT placement accuracy increases when combining non-radiological verification methods rather than reliance on a single bedside verification method (Cincinnati, 2009; Metheny, 2001). Metheny (2001) recommends an algorithm for GT placement verification. Metheny's algorithm for newly inserted large-bore GT begins with auscultation followed by pH and visual inspection of aspirate. The Cincinnati guidelines (2009) also use an algorithm consisting of non-aspirate and aspirate verification methods of auscultation, visual, and pH testing. Study results indicated GT placement achieved a probable accuracy of 97-99% when using auscultation, visual aspirate inspection, and aspirate pH testing (Cincinnati, 2009). There is evidence to support use of a combination of methods of bedside verification for GT placement; however additional research is needed to determine which methods are the most accurate and in what sequence they should be used.

Description of Decision Options/Interventions and the Level of Recommendation

Conclusion and recommendations about initial GT placement bedside verification methods in the emergency department:

- Auscultation as a single verification method is unreliable in determining GT placement (Not recommended)
- There is insufficient evidence to support the use of carbon dioxide detection methods as a single GT placement bedside verification method (Level C: Weak)
- There is insufficient evidence to support the use of transillumination and magnetic detection methods along with equipment and laboratory setting limitations (Level C: Weak)
- There is sufficient evidence to support pH testing of GT aspirates a component of a multiple method bedside verification approach (Level B: Moderate)

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Acknowledgement

ENA would like to acknowledge the 2010 Institute for Emergency Nursing Research (IENR) Advisory Council for the review of this document. Members of the IENR Advisory Council include:

Susan Barnason, PhD, RN, APRN-CNS, CEN, CCRN, FAHA
Cynthia Dakin, PhD, RN
Gordon Gillespie, PhD, RN, PHCNS-BC, CEN, CPEN, CCRN, FAEN
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Mary Kamienski, PhD, RN, APN, CEN, FAEN, ENA Board of Directors Liaison

ENA also acknowledges Jill Walsh, DNP, RN, ENA Chief Nursing Officer, for the support of this project and the assistance of Leslie Gates in coordinating the work of the Committee.