Best Practice

Evidence-based information sheets for health professionals

Methods for determining the correct nasogastric tube placement after insertion in adults

Recommendations

- It is recommended to use capnography or colorimetric capnometry for identification of feeding tube placement in mechanically ventilated adult patients. **(Grade A)**

- Spring gauge pressure manometer might be used to differentiate GI from respiratory placement of feeding tubes in non-mechanically ventilated patients **(Grade B)**

- Magnet-tracking system might be used to determine gastrointestinal feeding tube placement. **(Grade B)**

- Sonography might be used for verifying weighted-tip NG tubes (WNGTs) placement. **(Grade B)**

- Visual inspection of aspirate and auscultation are unreliable indicators of correct placement and should not be relied upon. **(Grade B)**

Information Source

This Best Practice information sheet has been derived from a systematic review published in 2009 in JBI Library of Systematic Reviews. The full text of the systematic review report[2] is available from the Joanna Briggs Institute (http:// www.joannabriggs.edu.au).

Background

Nasogastric (NG) tubes are frequently used in the clinical setting for the management of patients who require decompression of the gastrointestinal (GI) tract, diagnosis and assessment, nutritional support and medication administration.[3] The insertion and management of NG tubes are procedures primarily undertaken by nurses, however there is a wide variation in practice.

The use of NG tubes is associated with respiratory (pulmonary aspiration), gastrointestinal (diarrhoea, constipation, nausea and vomiting), tube related (nasopharyngeal trauma/ ulceration, nasal ulcers, tube occlusion, tube displacement/ dislodgement, tube related perforation), and metabolic (dehydration, electrolyte alterations) complications.[4-6] Insertion of the NG tube is a complex procedure and

requires skills and expertise as placement errors could lead to potentially major complications.[4,6-7]

Researchers have reported that in adults, tube placement errors vary from 1.3-50%.[8] Assessment of tube position is an important care component to minimize the risks of NG tube related complications and provide for optimal patient safety and comfort.

A variety of bedside methods have been used either individually or in combination to assess NG tube placement. These include observing for cough and choking, auscultation of air insufflated through the tube, aspiration of fluid, visual inspection of the aspirates, testing of aspirates for pH or concentrations of bilirubin, pepsin or trypsin, observing for bubbling when the tip of the tube is held under water, testing the ability to speak, the use of magnetic detection, spring gauge pressure manometer, capnography, colorimetric capnometry or radiography.

Objectives

The purpose of this Best Practice Information Sheet is to present the best available evidence that support decisions pertaining to methods for determining the correct nasogastric (NG) tube placement after insertion.

Grades of Recommendation

These Grades of Recommendation have been based on the JBI-developed *2006 Grades of Effectiveness*[1]

Grade A Strong support that merits application

Grade B Moderate support that warrants consideration of application

Grade C Not supported

Quality of the research

Twenty-six trials were included in the systematic review.[2]

Methods to differentiate respiratory from GI placement

Sensitivity and specificity of colorimetric capnometry or capnography in differentiating respiratory from GI tube placement.

The results of the review indicate that the use of capnography or colorimetric capnometry is an effective method in differentiating between respiratory and GI tube placement for adult patients. A colorimetric device was found in one study to be as accurate as capnography for detecting CO_2 during the placement of NG tubes. The pooled results for sensitivity, specificity, positive and negative likelihood ratios were 0.99, 1.00, 129.62 and 0.05 respectively.

Colorimetric capnometry

Three trials evaluated the diagnostic accuracy of the colorimetric capnometry to differentiate between respiratory and GI placement in 156 feeding tubes. All three trials reported high sensitivity and specificity of the colorimetric capnometry in detecting airway intubation and high agreement with the reference standard radiological technique.

Capnography

Three trials with a total of 140 observations, determined the sensitivity and specificity of capnography in correctly differentiating between respiratory and GI tube placement. In one trial, the capnographs clearly detected the locations of the tubes that were placed in the bronchus which were confirmed by radiography. Capnography was also able to identify tubes located in the esophagus and in the oral cavity but was unable to differentiate between the two. The authors therefore recommended obtaining one radiograph after tube placement to ascertain final position prior to feeding.

Capnography versus colorimetric capnometry in verifying tube placement

A trial compared the use of a portable capnograph with a disposable colorimetric CO_2 indicator in detecting inadvertent respiratory intubation among 130 mechanically ventilated adult patients (195 gastric tube insertions) in the intensive care unit. The results demonstrated a sensitivity: 1.00 (95% CI 0.93-1.00), specificity: 1.00 (95% CI 0.97-1.00), PPV: 1.00, NPV: 1.00, positive likelihood ratio: 283.35 (95% CI 17.81-4508.75) and negative likelihood ratio: 0.01 (95% CI 0.00-0.15). The authors concluded a colorimetric device was as accurate as capnography for detecting CO_2 during placement of NG tubes.

Sensitivity and specificity of biochemical measurements in differentiating between respiratory and GI tube placement

Four studies made use of a variety of cut-off points based on the biochemical measurement parameters of feeding tube aspirates for differentiating respiratory from GI placement of feeding tubes. One trial used pH alone. No sensitivity and specificity data were reported in this study and it was concluded by the authors that an acidic pH value (preferably 4 or less) obtained from a newly inserted feeding tube was a reasonable indicator of gastric versus respiratory placement. Two studies used a combination of pH and bilirubin. One study concluded that the cut-off of pH >5 and a bilirubin <5 mg/dl could be used to diagnose respiratory placement. In the second study a pH >5 and a bilirubin <5 mg/dl successfully identified all respiratory cases. One study used pH, pepsin and trypsin. The criterion for lung placement (pH >6, pepsin <100 microgram/ml, trypsin < 30 microgram/ml) was successful in determining all respiratory samples.

Other methods to differentiate between respiratory and GI tube placement

Spring gauge pressure manometer

One study investigated the diagnostic accuracy of a spring gauge pressure manometer to differentiate GI from respiratory placement of feeding tubes in 46 non-mechanically ventilated patients. The reference standard used was radiography. Findings demonstrate that the spring gauge pressure manometer is 100% sensitive and specific in identifying tube location.

Auscultation

A study conducted to determine the sensitivity and specificity of using auscultation of insufflated air in differentiating between gastric and respiratory placement reported the results of three patients with misplaced tubes as determined by X-ray. The results indicate that auscultation is not a reliable method to differentiate gastric and respiratory placement.

Visual inspection of aspirates

One study investigated the use of visual inspection of feeding tube aspirates in identifying feeding tube location in the respiratory or GI tracts. It was concluded that observation of the visual characteristics of feeding tube aspirates is of little value in differentiating between respiratory and GI placement.

Methods to differentiate between gastric and intestinal placement

Sensitivity and specificity of biochemical measurements in differentiating gastric from intestinal placement

Nine studies made use of a variety of cut-off points in differentiating gastric from intestinal placement of feeding tubes. When determining the effectiveness of these parameters, studies either evaluated a single test (pH or bilirubin) or a combination (pH and bilirubin; pH, pepsin and trypsin). Six studies used pH alone, two a combination of pH and bilirubin, and one a combination of pH, pepsin and trypsin. One study also reported the effectiveness of using bilirubin alone in the verification of tube placement. There is insufficient evidence to determine the optimal cut-off pH value to differentiate between gastric and intestinal placements. A cut-off of a pH < 5 and a bilirubin <5 mg/dl was used to predict gastric placement and successfully identified 98.6% of the 141 cases as gastric placement. This cut-off misclassified two of the 141 as gastric cases. With the criterion (pH ≤ 6, pepsins ≥ 100 microgram/ml, trypsin ≤30 microgram/ml) used for predicting gastric placement 91.2% of gastric and 91.5% of intestinal cases were correctly classified.

Visual inspection of aspirates

Evidence shows that the visual characteristics of tube aspirates could not be used solely to determine the feeding tube location as the colour, clarity, and consistency could be changed as a result of enteral feeding, bleeding or obstruction in the GI tract.

Auscultation

Two studies involving a total of 116 patients were included which investigated the effectiveness of auscultating insufflated air to differentiate between gastric and intestinal placement. The findings from these two studies indicate that auscultation to verify tube placement is unreliable.

Other methods to determine the gastric placement of NG tubes

Sonography

One study investigated the accuracy of sonography for verifying weighted-tip NG tubes (WNGTs) placement in 33 ICU patients. Of the 35 WNGTs, 34 were visualized by sonography in the GI tract, and all were confirmed by radiography (Sensitivity: 0.97; 95% CI 0.83-1.00).

Magnetic detection

Three studies involving a total of 34 healthy volunteers and 134 patients investigated the accuracy of magnetic detecting devices or magnet-tracking system to determine gastrointestinal feeding tube placement. The reference standard used was either radiography, fluoroscopy or esophageal manometry. The sensitivity of using magnetic detection to determine feeding tube location within the GI tract is high with a value of 1.00 in two studies. The third study demonstrated that the magnetic detection method was 100% sensitive in detecting misplaced tubes, although was unable to determine the exact location of the tubes.

pH testing of aspirates

In one trial, pH of 4 was able to accurately identify the location of only 56% of all NG feeding tubes when compared with the reference standard radiography. The sensitivity of the pH test to identify misplaced tubes was 0.82, specificity was 0.55, LR+ was 1.8 (95% CI 1.4-2.4), and LR- was 0.3 (95% CI 0.1-1.0).
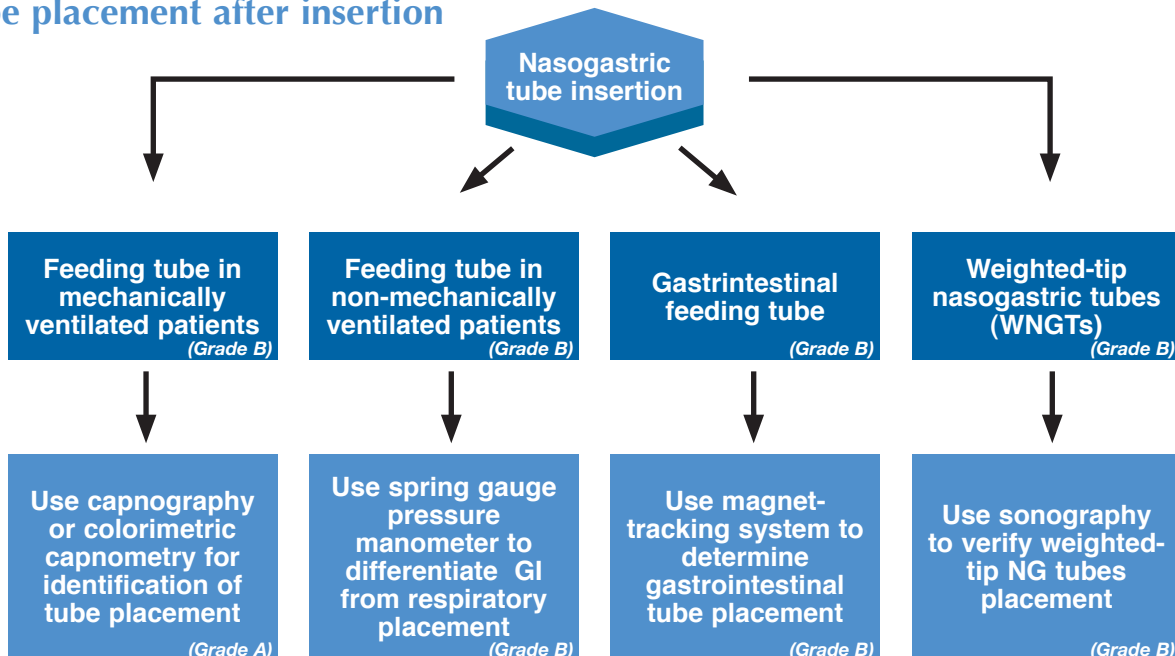
Visual inspection of aspirates

The diagnostic accuracy of visual inspection of aspirates was investigated in a trial (n=365 observations) and the findings indicated that the location of only 50% of the feeding tubes were correctly identified using this method. Specificity of this method to detect position of the misplaced feeding tubes was reported to be 0.48.

Auscultation

The diagnostic accuracy of auscultation for determining feeding tube location was investigated in two studies. In one study involving 78 nasoenteral tube placement in 46 patients the sensitivity was 0.98 and specificity was 0.06, the positive predictive value was 0.80 and negative predictive value was 0.50. In a study involving 134 patients and 365 observations, the auscultation method was able to identify accurately the location of 84% of all tubes. Sensitivity was 0.45, specificity was reported to be 0.85, LR+ was 3.1 (95% CI 1.6-2.9), and LR- was 0.6 (95% CI 0.4-1.1).

Methods for determining the correct nasogastric tube placement after insertion

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                          Nasogastric
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Feeding tube in mechanically ventilated patients (Grade B)	Feeding tube in non-mechanically ventilated patients (Grade B)	Gastrintestinal feeding tube (Grade B)	Weighted-tip nasogastric tubes (WNGTs) (Grade B)
Use capnography or colorimetric capnometry for identification of tube placement (Grade A)	Use spring gauge pressure manometer to differentiate GI from respiratory placement (Grade B)	Use magnet-tracking system to determine gastrointestinal tube placement (Grade B)	Use sonography to verify weighted-tip NG tubes placement (Grade B)

Acknowledgements

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References

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Evidence-based Practice
evidence, context, client preference judgement

This *Best Practice* information sheet presents the best available evidence on this topic. Implications for practice are made with an expectation that health professionals will utilise this evidence with consideration of their context, their client's preference and their clinical judgement.[16]