Nasogastric Tube Placement

Rupert Allen, Clinical Lead Dietitian ICU and Gastroenterology, University College London Hospitals NHS Foundation Trust

Introduction

Nasogastric Tube Feeding (NGT) is the most common form of tube feeding in the United Kingdom. It is the first choice in patients who require artificial nutrition support with a working gastro-intestinal tract. It is regularly used in both hospital and in the community setting to ensure that patients receive adequate nutrition and hydration.

The aim of this article is address the risks and complications associated with NGT placement, the recent National Patient Safety Agency (NPSA) alerts and the alternatives to current NGT techniques.

NGT placement

NGT insertion is a medical procedure not without risk. Sorokin *et al*[1] documented a number of cases where NGTs enter the respiratory tract. Serious consequences of these cases include pneumothorax and pneumonia. Other consequences have been documented to include pulmonary effusion, empyema, hydrothorax and potential death. Risks of NGT insertion are not confined to the respiratory tract. Reports of placement of NGTs into the oesophageal wall and subsequent perforation have been documented, especially in neonates and in premature infants.[2] Similarly, although rare and complicated by anatomy and surgery, there have been reports of NGTs being inserted into the brain and parietal lobe.[2, 3] Other complications include: haemothorax, pharyngeal dissection, bronchopleural fistula, tracheoesophageal fistula, epistaxis, pneumomediastinum and pulmonary haemorrhage.[4]

While placement of tubes can result in the complications above, trained and appropriate insertion techniques help to ensure accurate placement (for example via radiology or endoscopy). This is particularly relevant in patients who have altered anatomy (for example oesophageal pouch) or those following neurological, head and neck surgery.

The displacement or migration of NGTs is a common problem. Kesek *et al* documented 28 of 73 (38%) patients having dislodged NGTs.[5] Displaced NGTs can result in the aspiration of enteral feed into the lungs. The formula itself can seriously impair gas exchange and cause asphyxia. The presence of micro-organisms can then increase the probability of aspiration-related pneumonia.[6, 7]

Due to the risks associated with misplaced NGTs, the UK National Patient Safety Agency (NPSA) issued a Patient Safety Alert in February 2005[8] following 11 deaths and a case of serious harm. This alert highlighted action required by the NHS (NHS acute trusts, PCTs and local health boards in England and Wales), with deadlines for implementation and completion.

In 2009, feeding into the lung via a misplaced NGT became a Never Event in England.[9] However, between 2009 and 10 there were 41 Never Events reported to the NPSA where a misplaced NGT (or orogastric tube) was not detected prior to use.[10]

A second NPSA alert was issued in March 2011,[11] following a further 21 deaths and 79 cases of harm reported to the National Reporting and Learning System between September 2005 and March 2010.

Confirmation of NGT placement

X-ray is considered the 'gold standard' for ensuring that an NGT is in the correct position. The NPSA recommends that all NGT should be radio-opaque throughout their entire length. This may help reduce error and misinterpretation as some tubes may only have a radio-opaque band along the length of the tube, or just a radio-opaque tip. The NGT should also have length markings throughout its length. This can be especially useful to determine whether the external portion of the tube has moved, and thus indicate whether displacement has occurred. Length of the tube should be checked prior to starting each feed or following any coughing, retching or vomiting which may physically dislodge the tube.

The use of X-ray is complicated, requires trained and experienced investigators, is time-consuming, cost-prohibitive, and poses additional risk to the patient from moving the patient to radiology.[12] In addition, repeated X-ray and the risk of radiation exposure have meant that other methods of confirming placement have been considered.

> A pH between 1 and 5.5 does not necessarily confirm gastric placement as the tube may be within the oesophagus.

Several methods of confirming tube placement are considered unreliable indicators for gastric placement:[8]

1) Auscultation of air insufflated through the feeding tube ('whoosh' test)

This involves the rapid injection of air into the NGT, and ausculating over the epigastrum. Gurgling of air was considered indicative of air entering the stomach. There have been reports of this method falsely confirming the position of the NGT in the stomach. There has also been a report of this method failing to detect inadvertent placement of an NGT in the brain.[3,13] It has also been documented that more than one clinician listening to the same air insufflation, have falsely confirmed placement in the stomach.[14]

2) Testing acidity and alkalinity of NGT aspirate using blue litmus paper

The Medicines Healthcare Products Regulatory Agency (MHRA) issued an alert in 2004, advising staff to stop using blue litmus paper in testing the acidity or alkalinity of the NGT aspirate.[8] Blue litmus paper turns red if in contact with an acidic solution, and blue if in contact with an alkaline solution. It is not sensitive enough to distinguish between gastric or respiratory contents.

3) Interpreting the absence of respiratory distress as an indicator of correct positioning

The majority of patients with misplaced NGTs do not exhibit any symptoms, and therefore this cannot be used as a reliable method of ensuring placements.[15]

Other methods which are unreliable include monitoring for bubbling at the end of the tube and observing the appearance of the NGT aspirate. This is because gastric content can look similar to respiratory secretions and similarly the stomach may contain air which could falsely indicate respiratory placement.[8]

While no current bedside placement of NGT is completely reliable, there is evidence to suggest that an aspirate with a pH between 1 and 5.5 can reliably exclude pulmonary placement. Metheny *et al* in 1989,[16] hypothesised that pH testing could be used to differentiate between respiratory and gastric placement. Although not proven in the mentioned article this led to further studies. In 1993, Metheny *et al*[17] demonstrated that 85 per cent of gastric aspirates had a pH of between 0 and 6, while those aspirates taken from tubes placed in the respiratory tract had pH > 6.5. This was further supported in 1998[18] when, of the 275 aspirates taken from tubes in the respiratory tract, none had a pH between 0 and 5. In a more recent study, Turgay and Korshid (2010) showed that 90 per cent of tubes could be confirmed with a pH of < 5.[19]

A pH between 1 and 5.5 does not necessarily confirm gastric placement as the tube may be within the oesophagus. If there is concern that this is the case then X-ray confirmation should be performed.[11]

PH testing, however, is not without its difficulties. It may be difficult to obtain an aspirate from the NGT, prompting the use of X-ray. Suggestions for obtaining an aspirate are detailed in **Table One**. Patients may also be on acid-inhibiting medications, which one would expect to affect gastric aspirates. Metheny[17] showed that, of the 15 per cent of gastric aspirates with a pH > 6, only 35 per cent were on acid inhibitors. In addition the use of acid-inhibiting medication did not statistically affect gastric or small bowel pH.

It is also considered that pH may be affected by enteral feeding formulations, which tend to have a pH closer to neutral. Withholding the feed in these circumstances for an hour may allow pH to return to normal. However, this further interrupts enteral feeding, and may require longer periods if patients have slowed gut motility (for example in critically ill patients).[20]

As identified previously, no one method of confirming NGT placement is without complications. The first-line method of pH testing is not without its limitations, and the role of X-ray as the gold standard has a number of cost and safety implications. There have been further technologies used to try and assess tube placement.

1) Capnometry

In a study of 53 mechanically ventilated patients, carbon dioxide was measured using an end-tidal carbon dioxide detector at the proximal end of the feeding tube. This demonstrated 100 per cent specificity and 100 per cent sensitivity compared to X-ray.[21]

However, its use is limited to patients who are intubated and mechanically ventilated, and thus its use in practice is limited.

2) Electromagnetic imaging system

The role of an electromagnetic imaging system, such as the CORTRAK system (Merck Serono), is an emerging new technology in the effective placement of enteral feeding tubes.

This system uses a conventional feeding tube (of which different lengths are available), but has a guide wire that incorporates an electromagnetic transmitter. This generates an electromagnetic signal from the tip of the stylet of the feeding tube. This signal is then detected by a receiver which is placed on the patient's chest in line with the xyphoid process. This receiver detects the movement of the feeding tube and displays this on a computer screen.

This can therefore be used to track the path of the enteral tube down the oesophagus and into the stomach. Through this 'real-time' system it is clear when the path of the tube deviates into a bronchus, or when the tube becomes lodged or coils in the oesophagus. An advantage of the CORTRAK system is that the guide wire (with electromagnetic tip) can be reinserted into the enteral tube should the tube become dislodged, thus allowing tube replacement and position confirmation at the bedside. It also can be used for positioning tubes post-pylorically, as the receiver is able to detect depth changes as the tube passes into the duodenum.

Table One: Obtaining Aspirate

Source: http://www.nrls.npsa.nhs.uk/resources/?entryid45=59794

Action	Rationale
Inject air (1-5ml for infants and children, 10-20ml for adults) using a 20ml or 50ml syringe. Wait for 15-30 minutes and try again.	Injecting air through the tube will dispel any residual fluid (feed, water or medicine) and may also dislodge the exit-port of the nasogastric feeding tube from the gastric mucosa. Using a large syringe allows gentle pressure and suction; smaller syringes may produce too much pressure and split the tube (check manufacturers guidelines). Polyurethane syringes are preferable to other syringes. It is safe practice to use nasogastric tubes and enteral syringes that have non luer connectors.
Advance the tube by 1-2cm for infants and children or 10-20cm for adults.	Advancing the tube may allow it to pass into the stomach if it is in the oesophagus.
	If the patient is alert, has intact swallow and is perhaps only on supplementary feeding and is thus eating and drinking during the day, ask them to sip a coloured drink and aspirate the tube. If you get the coloured fluid back then you know the tube is in the stomach.

An early study in 2004 compared use of the CORTRAK device and X-ray verification in determining small bowel placement. The CORTRAK device was found to be 100 per cent specific and 83 per cent sensitive to small bowel placement.[22] A further study compared insertion of NGTs via CORTRAK and conventional recommendations (i.e. pH testing followed by X-ray if required). The investigators found that 100 per cent of tubes inserted through CORTRAK were successfully placed. In addition, they were able to show a cost saving if X-ray confirmation had been avoided.[23] Further evidence[24] demonstrates that delays in feeding due to X-ray confirmation can average 50 minutes compared to an average NGT insertion with CORTRAK of 0.48 minutes. More experienced users have been shown to be able to insert tubes faster, making this a practical bedside technique.[25]

There are limitations to the system. The enteral tubes themselves are considerably more expensive than standard enteral tubes. While X-ray and endoscopy savings have been demonstrated this initial cost often deters some clinicians. Like other techniques, placement is more successful when placed under a trained individual, and therefore a degree of training is likely to be required.

Conclusion

Naso-gastric tube placement is an invasive procedure not without risk. Over the past six years the NPSA has reported on deaths and harm secondary to misplaced naso-gastric tube insertion. The role of pH testing, as a first line method of assessing NGT placement, is reliable but not without difficulties. Likewise the 'gold standard' using X-ray is more costly, delays feeding and exposes patients to radiation. Emerging technology such as CORTRAK is a reliable alternative in ensuring correct placement of naso-gastric tubes. The CORTRAK system represents advantages, particularly in post-pyloric tube placement, by reducing the risks and costs related to the use of X-rays.[26]

At UCLH we are currently undergoing a trial of CORTRAK for naso-jejunal tube insertion on the Critical Care Unit. If successful there may be scope to use it for NGTs as well, potentially reducing the use of X-rays across the critical care unit in particular.

"Over the past six years the NPSA has reported on deaths and harm secondary to misplaced naso-gastric tube insertion."

References: **1.** Sorokin R, Gottlieb JE (2006). Enhancing Patient Safety During Feeding-Tube Insertion: A Review of More Than 2000 Insertions. Journal of Parenteral and Enteral Nutrition; 30: 440-445. **2.** Metheny NA, Meert KL, Clouse RE (2007). Complications Relating to Feeding Tube Placement. Current Opinion in Gastroenterology; 23: 178-182. **3.** Metheny NA (2002). Inadvertent Intracranial Nasogastric Tube Placement. American Journal of Nursing; 102 (8): 25-27. **4.** Baskin WW (2006). Acute Complications Associated with Bedside Placement of Feeding Tubes. Nutrition in Clinical Practice; 21: 40-55. **5.** Kesek DR, Åkerlind L, Karlsson T (2002). Early Enteral Nutrition in the Cardiothoracic Intensive Care Unit; 21 (4): 303-307. **6.** Metheny NA et al (2006). Tracheobronchial Aspiration of Gastric Contents in Critically Ill Tube-Fed Patients: Frequency, Outcomes and Risk Factors. Critical Care Medicine; 34 (4): 1007-1015. **7.** Metheny NA (2006). Preventing Respiratory Complications of Tube Feedings: Evidence Based Practice. American Journal of Critical Care; 15: 360-369. **8.** National Patient Safety Agency (2005). Reducing Harm Caused by the Misplacement of Nasogastric Feeding Tubes: Patient Safety Alert 05. Accessed online: http://www.nrls.npsa.nhs.uk/resources/?EntryId45=59794 (March 2011). **9.** National Patient Safety Agency (2009). Misplaced Naso or Orogastric Tubes Not Detected Prior to Use. Accessed online: http://www.nrls.npsa.nhs.uk/resources/collections/never-events/core-list/misplaced-naso-or-orogastric-tube-not-detected-prior-to-use (March 2011). **10.** National Patient Safety Agency (2010). Never Events Annual Report 2009/10. Accessed online: http://www.nrls.npsa.nhs.uk/resources/?EntryId45=83319 (March 2011). **11.** National Patient Safety Agency (2011). Reducing the Harm Caused by Misplaced Nasogastric Feeding Tubes in Adults, Children and Infants: Patient Safety Alert NPSA/2011/PSA002. Accessed online: http://www.nrls.npsa.nhs.uk/resources/?entryid45=129640 (March 2011). **12.** Ackerman MH, Mick DJ (2006). Technologic Approaches to Determining Proper Placement of Enteral Feeding Tubes. AACN Advanced Critical care; 17(3): 246-249. **13.** American Association of Critical Care Nurses (2005). Practice Alert: Verification of Feeding Tube Placement. Accessed online: http://classic.aacn.org/aacn/practicealert.nsf/files/VOFTP/$file/verification%20of%20feeding%20tube%20placement%2005-2005.pdf (March 2011). **14.** Metheny NA, et al (1990). Effectiveness of the Auscultatory Method in Predicting Feeding Tube Location. Nursing Research; 39(5): 262-267. **15.** Rassias AJ, Ball PA, Corwin HL (1998). A Prospective Study of Tracheopulmonary Complications Associated with the Placement of Narrow-bore Enteral Feeding Tubes. Critical Care; 2: 25-29. **16.** Metheny NA, et al (1989). Effectiveness of pH Measurements in Predicting Feeding Tube Placement. Nursing Research; 35(5): 280-285. **17.** Metheny NA, et al (1993). Effectiveness of pH Measurements in Predicting Feeding Tube Placement: An Update. Nursing Research; 42(6): 324-331. **18.** Metheny NA et al (1998). Testing Feed Tube Placement: Auscultations vs. pH Method. American Journal of Nursing; 98(5): 37-42. **19.** Turgay AS, Khorshid L (2010). Effectiveness of the Auscultatory and pH Methods in Predicting Feeding Tube Placement Journal of Clinical Nursing; 19: 1553–1559. **20.** May S (2007). Testing Nasogastric Tube Positioining in the Critically Ill: Exploring the Evidence. British Journal of Nursing 2007, 16(7):414-418. **21.** Araujo-Preza et al (2002). Use of Capnometry to Verify Feeding Tube Placement. Critical Care Medicine 2002, 30(10):2255-2259 **22.** Ackerman M et al (2004). The Effectiveness of the CORTRAK Device in Avoiding Lung Placement of Small Bore Enteral Feeding Tubes. American Journal of Critical Care 2004; 13: 268. **23.** Lei K et al (2007). Using CORTRAK Magnetic Device to Faciltate Early Enteral Nutrition in Critically Ill Patients. Critical Care 2007, 11 Suppl 2: 151. **24.** Rao MM et al (2008). Use of CORTRAK – an Electromagnetic Sensing Device in Placement of Enteral Feeding Tubes. Proc Nutr Soc.; 67(OCE): E109. **25.** Taylor SJ, Manara AR, Brown J (2010). Treating Delayed Gastric Emptying in Critical Illness: Metoclopramide, Erythromycin, and Bedside (Cortrak) Nasointestinal Tube Placement. Journal of Parenteral and Enteral Nutrition; 34(3): 289-294. **26.** Windle EM et al (2009). Implementation of an Electromagnetic Imaging System to Facilitate Nasogastric and Post-pyloric Feeding Tube Placement in Patients With and Without Critical Illness. Journal of Human Nutrition and Dietetics; 23(1): 61-68.