



# Confirming the position of a nasogastric tube - what does the literature say?

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## Abstract

Nasogastric tubes are a medical device that can be used for a number of purposes. The process of inserting them however can be complicated. Nurses must therefore use an evidence-based approach to confirm the correct position of nasogastric tubes and there are three main techniques described in the literature to do so. To date, one group of authors has published the majority of the studies on these techniques. This paper reviews their work.

## Key Words

nasogastric tube; confirmation of tube position.

## Introduction

Nasogastric (NG) tubes are a commonly used medical device. They serve a number of purposes such as being a route for gastric lavage, gastric decompression or the administration of

medications or nutrition. Their use however can be associated with various complications such as necrosis of the nasal tissue (Lai, Pang, Chan and Lau, 2001), inadvertent intracranial insertion (Arslantas, Durmaz, Cosan and Tel, 2001; Freij & Mullett 1997) or the insertion into the respiratory tract causing pneumonia.

Nurses must therefore use an evidence-based approach for confirming the position of a NG tube. Whilst numerous methods are cited in the literature, there is lack of agreement about which technique is the most reliable. The aim of this paper is therefore to review the most commonly cited evidence for the most popular techniques for determining the anatomical location of a NG tube.

How should the position of a nasogastric tube be confirmed? Table one contains a summary of a small selection of current nursing literature, citing methods for determining the position of

**Table 1: Methods Cited for Determining Location of Tube**

Author	Methods Cited	Supporting Evidence
Black et al. (2001, p.673)	Abdominal x-ray	Nil
Burnham (2000)	Assessing pH of aspirate; if inconclusive, x-ray	Metheny et al. (1990a)
Crisp & Taylor (2001)	Air insufflation with gastric auscultation. Assess pH of aspirate	Metheny et al. (1998a)
Kozier et al. (2000)	Air insufflation with gastric auscultation. Assess pH of aspirate	Nil
Lemone & Burke (2000, p.655)	Assess pH of aspirate Nil	
Lewis et al. (2000, p.1055)	Visualisation of aspirate. Assess pH of aspirate. X-ray visualisation is most accurate.	Nil
Logan (1999, p.1001)	Assess pH of aspirate. Visualisation of aspirate.	Metheny et al. (1993a)
Phipps et al. (2003, p.1057)	Assessing pH of aspirate. Air insufflation with gastric auscultation. Chest x-ray is only foolproof method.	Nil
Smeltzer & Bare (2000, p.838)	Measure tube length. Visualisation of aspirate. Assessing pH of aspirate. X-ray.	Metheny et al. (1994a) Metheny et al. (1993b) Metheny et al. (1990a) Metheny et al. (1990b)
Urden & Stacy (2000, p.63)	X-ray is most reliable way. Assessing pH of aspirate	Metheny et al. (1994b)

a NG tube. It highlights the conundrum faced by clinicians, that being a lack of agreement about the most accurate way of determining a NG tube's location. Schmeiding, Waldman and Desaulles (1997) also encountered this problem when reviewing the literature for their study, which explored the care of patients with a NG tube. Some of the references listed in Table one also do not give supporting evidence for the technique cited, whilst others do not describe the limitations of the recommended techniques.

### Review of the Evidence

There are four main strategies described in the literature for determining the position of a NG tube: x-ray, pH analysis of the aspirate, air insufflation and visualisation of the aspirate. However the amount of empirically based evidence for these proposed techniques presents as surprisingly small for an area of substantial clinical importance. As can be seen in Table one, most of the available research into this issue has been generated by one group of authors (Metheny et al.), who to date have conducted a number of clinical studies into the effectiveness of some of the most commonly utilised assessment methods. A review of the evidence published by Metheny et al. therefore follows. However, the literature regarding the use of x-rays has not been reviewed as it is well accepted as being the 'gold standard' for determining a NG tube's location. Furthermore Registered Nurses (RN) are generally not allowed to order or interpret x-rays, they are also costly and expose the patient to radiation.

#### *pH Analysis of Aspirate*

In 1989 Metheny, Williams, Wiersema, Wehrle, Eisenberg and McSweeney performed a study to test the hypothesis that gastric and intestinal placement of feeding tubes could be differentiated by testing the pH of aspirates from the tubes. The sample included 181 patients of whom 94 had small bore NG tubes and 87 had nasointestinal tubes. Patients receiving antacid preparations were excluded from the study, due to the effect these can have on gastric pH. The equipment used to measure the pH was colour coded pH paper, portable pH meters and glass electrodes. Metheny et al. (1989, p.282) found that there were 'good correlations' between the pH paper and the pH meters and stated that 'it is reasonable to accept pH paper readings as good clinical indicators of gastrointestinal (GI) aspirates' pH value. However in 18% of cases, the pH reading was not consistent with the anatomical location of the tube, leaving the authors (Metheny et al., 1989, p.283) to conclude that 'it is sometimes difficult to apply the pH method to individual cases'.

Neumann and Meyer (1995) also examined the pH analysis method for determining small bore NG tube placement. Over a six month period, 46 patients received 78 nasogastric intubations. NG tube placement was confirmed by the intern who inserted the tube using either the auscultation method, pH analysis or both. X-rays were then performed to determine the actual location of the tube. When the pH of the aspirate was less than or equal to 4, the correct position of the tube was determined with 100% accuracy. However if the pH was greater than 4, the correct identification of the tube's location dropped to 86.4%. In this instance Neumann et al. (1995) recommend a confirmatory x-ray. Whilst the results of this study

support the use of the pH assessment method, they also highlight its limitations, such as its limited ability to assess the gastric pH of patients receiving antacids.

The success of pH assessment of aspirate in determining NG tube placement also seems to depend somewhat upon the clinician's own preference. Metheny et al. (1998b, p.41) state that many barriers exist to the successful inception of pH analysis into practice with common problems including clinicians' inability to extract sufficient aspirate, confusion interpreting results, pH paper availability and the overall preference for the auscultatory assessment method. This is further supported by Neumann et al. (1995, p.294) who suggested that medical officers are often reluctant to comply with the routine for consistently successful gastric aspirations. The problem was reported to be mostly motivational, as only 15% of physicians in their study stated they were unable to aspirate enough fluid.

Acknowledged limitations aside, aspirate pH analysis has been demonstrated by Metheny et al. (1989) and Neumann et al. (1995) to be evidence based. However, this method does not provide a 'foolproof' mechanism for the determination of NG tube position, as it is reliant on a number of confounding variables. Metheny et al. (1989 & 1998b) highlighted those limitations and conclude in recent literature that 'until better methods become available...pH testing offers the greatest non radiographic accuracy in the determination of feeding tube placement' (Metheny & Titler, 2001, p. 43). In contemplating these results, the assessment of NG tube placement by the measurement of aspirate pH has obvious benefit within the clinical environment, although not without limitations.

#### *Auscultation for Assessment of NG Tube Position*

The auscultation of sounds resulting from the insufflation of NG tubes with air, presents as the more 'traditional' method of determining tube position. However published literature has provided substantial argument that the auscultation method has limited clinical value for the confirmation of NG tube position.

In 1990 Metheny et al. (1990a) performed a study to determine the extent to which sounds generated by air insufflated through feeding tubes could be used to predict where in the gastrointestinal tract the tubes' ports ended. The study involved 115 tape recordings of sounds generated by air being insufflated through NG tubes. These sounds were then interpreted by five clinicians with advanced educational preparation. The interpretation involved determining the loudest sounds, identifying pitch variations and presence of peristaltic sounds. The clinicians were told the auscultation site of the sounds but not the tube position. They were also prohibited from discussing the sounds with each other, thus reducing any possibility of inherent bias upon data interpretation and results.

The overall agreement rate amongst the raters was 73.4% for the 115 recordings though only 28 of the 115 taped examples of sounds were correctly identified by the analytical team as being peristaltic in origin. The stability of raters' judgements was also

tested by asking the raters to interpret the same sounds again some months after the original interpretations. The consistency of three of the raters' judgements were 50%, 62.5% and 40%. The overall correct percentage of classification of sounds for all raters was 34.4%. From these results Metheny et al. (1990a) concluded that interpretation of auscultated sounds is ineffective or unreliable for identifying NG tube location in the GI tract. Their study highlights the subjective nature of the interpretation process. Furthermore Metheny et al. (1990a, p.266) suggested this technique has the same opportunity for success as that expected from chance alone.

Neumann et al. (1995) also explored the reliability of the auscultation technique. As described earlier this was done by comparing clinicians' conclusions, based on auscultated sounds, with results from x-rays being used to validate their opinions. Of 16 NG tube placements that were not gastric, 15 were incorrectly identified by auscultation as being gastric. Neumann et al. (1995, p.294) expand on this disturbing result by stating that many observers rely too heavily on auscultation alone. Neumann et al. (1995, p.294) give support to the findings of Metheny et al. (1990a) by concluding that 'one should not rely solely on auscultation for verification' of tube location.

Further published evidence of the sole use of the auscultation technique being unreliable for determining a NG tube's position appears in a scholarly paper generated by Metheny et al. (1998b). In this paper, Metheny et al. (1998b) describe three cases in which clinicians incorrectly confirmed the position of a NG tube using the auscultatory method alone. In all three patients the NG tube was in the respiratory tract and two of these patients died from respiratory complications. When formulating an opinion on the value of auscultation as a singular confirmatory method of assessing nasogastric tube position, one should recall the compelling evidence that auscultation alone simply cannot be relied upon. Combining the clinical cases cited above with the empirical evidence provided by Metheny et al. (1998b) and Neumann et al. (1995), highlights the limitations of this common technique.

#### *Visual Assessment of Aspirate*

The third common technique for determining the position of an NG tube is the visual assessment of aspirate. In 1994 Metheny et al. (1994a, p.282) performed a study 'to describe the visual characteristics of aspirates from feeding tubes situated in the GI tract or inadvertently in the respiratory tract, and to determine the extent to which these characteristics can be used to determine tube position'. The motivation for performing this study was a lack of published evidence identifying the distinguishing characteristics of the various types of aspirates.

Metheny et al. (1994a) aspirated fluid from 880 tubes of which 444 were positioned in the stomach, 428 within the intestinal tract, and a further eight being inadvertently positioned within the tracheobronchial tree and pleural space. The aspirates were then photographed and developed into 106 images, for a convenience sample of 30 RNs to visually interpret and predict tube location. Radiographic diagnosis confirmed the corresponding tube.

position for each aspirate specimen and visual characteristics were determined and recorded from this information. The RNs were employed within acute care facilities, possessed diploma, associate degree, baccalaureate degree or master's qualifications and had an average of 10 years nursing experience. They were given two opportunities to interpret the origin of the aspirates. The first opportunity was based on the photographs alone and produced a success rate of 81.3%.

Following this initial classification session, the RNs were given the same collection of images but were supplied with a list of expected aspirate characteristics. This list had been determined and recorded by the researchers whilst conducting the analysis of the original 880 aspirate specimens. The RNs were then requested to record their impressions again after utilising this list as an aid in the interpretation of the aspirate images. This resulted in a success rate of 90.47%. From this study Metheny et al. (1994a) concluded that the visual assessment of aspirate has limited value in assessing NG tube position due to its subjectivity. A limitation of the visual assessment technique they highlight is that pleural and intestinal aspirates have the potential to present as a yellowish colour and may subsequently be easily misinterpreted. Metheny et al. (1994a) also described tracheobronchial fluid and gastric fluid as being known to have an off white or tan appearance, further compounding interpretation difficulties.

Metheny and Titler (2001) reiterate this opinion in a more recent scholarly paper, advising that this method is of little use in detecting inadvertent NG tube placement within the respiratory tract. They also introduce another limitation for consideration when acknowledging the difficulties of obtaining a sufficient sample of aspirate, that of the oesophagus being known to produce little fluid, hence affecting the ability to adequately conduct a visual analysis (Metheny & Titler 2001, p. 39.) Furthermore, the effect of enteral feedings upon aspirate appearance is also acknowledged to be a limiting factor for this method (Metheny & Titler, 2001, p. 44).

Despite the acknowledged limitations of the visualisation method, Metheny et al. (1994a) nevertheless provide evidence that this method of assessment is of some benefit in helping determine gastric and intestinal placement of tubes. However Metheny et al. (1994a) do not consider it to be reliable in the evaluation of possible respiratory placement of a tube and therefore, should concern arise to the possibility of such an event, radiographic confirmation should always be performed.

#### **Implications**

Although the selection of the literature included in Table one could be considered biased, they are all current texts that nurses and in particular undergraduate students could utilise as sources of information. This is of concern as some of these texts do not include the limitations of the techniques they recommend. Furthermore, if nurses do not have the ability to critically evaluate what they are reading, they may blindly accept published literature as being a sound basis for clinical nursing practice.

This manuscript has primarily focussed on the research of Metheny et al., as to date they are the most widely published authors on the topic. As can be seen in Table one, they are also commonly cited. Their work suggests that pH and visual assessment are useful for determining the location of an NG tube but have limitations and that the auscultation method is unreliable. It is distressing that no single method has been shown to be 100% reliable and yet all these techniques are still commonly used. Perhaps that best advice for confirming the position of an NG tube is to use a combination of all three techniques, be aware of their limitations and if there are any doubts about a tube's location, request an x-ray.

Nurses must not blindly perform any intervention without knowing the evidence supporting its use. The familiar line 'we have always done it that way' undermines the credibility of the profession and more importantly, introduces clinical complacency. Nurses must possess an acute awareness of the need to practice care for which supporting evidence exists.

**Conclusion**

This manuscript has reviewed the evidence primarily provided by one group of authors supporting the three most common techniques for determining the location of an NG tube: pH analysis, visualisation of aspirate and auscultation of insufflated air. There is no evidence that any of these techniques is 100% reliable and each has limitations. Nurses must be aware of the evidence supporting the care they provide.

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