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Safety in nasogastric tube placement through POCT

pH testing has become an evidence-based standard of care for nasogastric tube placement and should be routine practice to minimise potential complications

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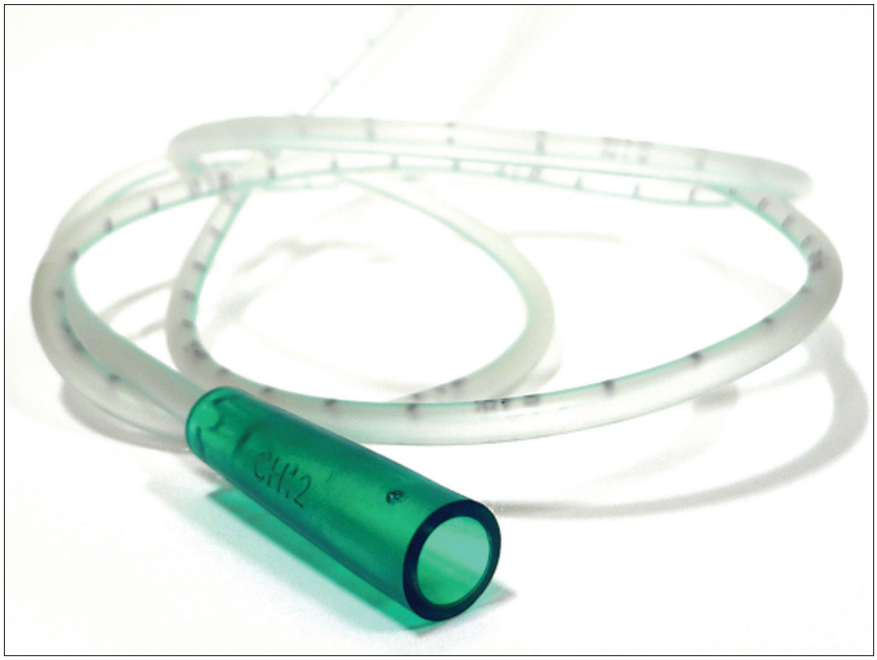
Placement of nasogastric tubes is a commonly done procedure both in critical care and emergency room settings. Although usually safe, nasogastric tube placement can be associated with significant complications. These are usually the result of inadvertent placement in the lung, pleural space, upper airway, or even the sinuses. Most series note an overall complication rate associated with tube placement of 2–3%.

Risk factors for incorrect tube placement include diminished mental status and decreased cough or gag reflexes. In addition, critically ill, uncooperative and debilitated patients as well as those with maxillofacial craniofacial trauma are at risk. It should be noted that placement of an endotracheal tube does not provide absolute protection from nasogastric tube misplacement.

A variety of methods have been utilised over the years to document proper placement of nasogastric tubes. These include X-ray imaging, ultrasound, auscultation, carbon dioxide measurement and analysis of gastric aspirate. Bilirubin, pepsin, trypsin and pH have all been measured in gastric aspirate to document tube placement.[1]



"The RightSpot™ pH Indicator offers accurate determination of gastric aspirate pH while minimising operator exposure"

Auscultation involves injecting air into the nasogastric tube with a syringe while using a stethoscope to listen for rushing air over the stomach. It has been demonstrated that auscultation cannot definitively differentiate between a tube in the stomach, lung or bronchial tree. Auscultation also cannot detect when

ports are in the oesophagus, which may lead to aspiration. Thus, auscultation alone should not be used as sole confirmation of adequate nasogastric tube placement.

A point-of-care method known as bubbling utilises observation of bubbles when the end of the feeding tube is placed underwater. This has been thought to indicate that bubbles will appear if the distal end of the tube is misplaced in the pulmonary tree. It has been demonstrated that the absence of bubbles does not absolutely rule out pulmonary placement and that bubbling may occur even with gastrointestinal tract placement. Thus this method has poor sensitivity and poor specificity and is not clinically useful.

Radiographic confirmation of nasogastric tube placement is generally considered the gold standard. Traditionally, a chest X-ray has been utilised; however, fluoroscopy can be used, if available. Barriers to routine use of radiographic confirmation include cost, X-ray exposure and availability. In addition, X-rays may be misinterpreted.

Direct endoscopy can be utilised for placement confirmation; however, this is obviously not a routine point-of-care methodology.

In clinical practice, the most commonly used techniques for nasogastric tube placement confirmation are radiographic evaluation and measurement of aspirate pH. If the nasogastric aspirate pH is less than four, it is generally accepted that tube placement is accurate without radiographic confirmation. The latter has been endorsed by regulatory agencies and has been adopted as evidence-based best practice for determination of correct nasogastric tube placement. Both the American Association of Critical Care Nurses and the UK National Patient Safety Agency endorse pH testing for this purpose.[2,3] Lower overall hospital costs have been reported for patients with pH assisted tube placement. Other point-of-care tests have not found a significant place in clinical practice.

Determination of gastric aspirate pH can be done at the bedside or point-of-care using indicator paper, a pH electrode, or a recently developed device utilising indicator paper in a closed system (RightSpot™ pH Indicator). Use of a pH meter at the bedside requires careful calibration and quality control. Use of standard indicator paper obviates some of these concerns, however, both of these techniques require handling gastric aspirate and possible exposure of the operator to this bodily fluid. The RightSpot™ pH Indicator (Figure 1) offers the simplicity of indicator paper methodology in a closed disposable package. The pH indicator is placed between the proximal end of the nasogastric tube and a syringe used for aspiration.

The RightSpot™ pH indicator was recently validated in a study of 21 patients undergoing general anaesthesia, endotracheal intubation and placement of a nasogastric tube.[4] Measurements were made simultaneously using an intragastric pH electrode and external pH electrode, and the RightSpot™ pH indicator.

"The RightSpot™ pH Indicator is simple to use and requires no additional instrumentation or equipment"

Contingency analysis of RightSpot™ pH indicator versus directly measured intragastric pH was highly significant ($p \leq 0.001$). Sensitivity for RightSpot™ pH indicator determination was 1.0 (95% CI 0.71–1.0) and specificity 0.83 (95% CI 0.36–0.99). The positive predictive value for RightSpot™ pH indicator was 0.92 (95% CI 0.62–0.99) with negative predictive value 1.0 (95% CI 0.47–1.0).

When compared to aspirate pH measured by external pH electrode and a laboratory pH meter, a significant relationship was seen ($p \leq 0.009$). The positive predictive value for the RightSpot™ pH indicator was 1.0 (95% CI 0.29–0.99) and negative predictive value was 0.75 (95% CI 0.19–0.99). This corresponds to a sensitivity of 0.91 and specificity of 1.0.

Results for the *in vitro* validation also revealed a significant relationship between RightSpot™ pH indicator determinations and actual pH of clear buffer solutions ($p \leq 0.001$) with sensitivity of 1.0 (95% CI 0.88–1.0), specificity of 1.0 (95% CI 0.78–1.0), positive predictive value of 1.0 (95% CI 0.88–1.0) and negative predictive value of 1.0 (95% CI 0.78–1.0).

This study validated use of the RightSpot™ pH indicator when compared to direct intragastric pH measurement as well as an external pH meter on gastric aspirate. A high degree of sensitivity, specificity and predictive value was demonstrated. Thus, this device offers an efficient, accurate and potentially safer method pH facilitated to placement than conventional techniques.

In conclusion, no perfect bedside point-of-care test exists to validate nasogastric tube placement. Excellent insertion technique followed by aspirate pH determination has high sensitivity and specificity for nasogastric tube placement validation. This methodology has been endorsed widely as standard of care. In some cases, a complimentary methodology, such as radiographic confirmation, may be required. ✦

References

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