

CASE REPORT

# Down the wrong road – a case report of inadvertent nasogastric tube insertion leading to lung laceration and important pearls to avoid complications

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## ABSTRACT

Nasogastric tube (NGT) insertion is a common procedure performed by residents and nursing staff to access the stomach. Although an apparently simple procedure, it is associated with technical difficulties and complications if proper care is not taken during insertion. We present a case of a 79-year-old female with multiple comorbidities who had a percutaneous enteral gastrostomy tube removed due to infection of an insertion site wound and a NGT was inserted for feeding. A few minutes post-insertion the patient developed shortness of breath and a drop in oxygen saturation. An immediate chest X-ray showed the NG tube traversing along the course of the trachea and the right main bronchus into the right upper abdomen with right-sided pneumothorax. The NG tube was immediately removed and a right chest drain inserted. Subsequent imaging showed right-sided pneumothorax with evidence of lung laceration and underlying lung collapse and diaphragmatic injury. The patient underwent a prolonged course of hospitalisation due to hospital-acquired pneumonia before being discharged upon clinical improvement. We highlight the fact that a simple and routine procedure such as NGT insertion can have devastating complications if due care is not taken. Along with a literature review, we provide and compare different methods to confirm correct placement of a NGT. The article also discusses important pearls for practising physicians and nursing staff to avoid such complications. Owing to the frequency of the procedure in hospitals and long-term care units, appropriate awareness among medical staff is necessary.

Keywords: inadvertent nasogastric tube insertion tracking, nasogastric tube, percutaneous enteral gastrostomy tube, pneumothorax, complications

## INTRODUCTION

Nasogastric tube (NGT) insertion is a common procedure performed by residents and nursing staff to access the stomach. Although an apparently simple procedure, it comes with its share of complications if proper care is not taken during insertion. We report such an inadvertent placement of the NG tube leading to lung laceration and diaphragmatic injury. Complications post-NGT insertion have been described before, but lung laceration due to the insertion has rarely been reported. We provide a review of the reported complications, various techniques reported in the literature to confirm correct insertion and important pearls to minimize complications.

## CASE WITH IMAGES

A 79-year-old female with multiple comorbidities and on percutaneous enteral gastrostomy (PEG) feeding for the preceding four years was admitted with suspected PEG tube site infection. After cultures from the site revealed methicillin-resistant *Staphylococcus aureus* (MRSA), the PEG tube was removed and a small-bore NGT–Dobhoff tube was inserted by a resident physician for feeding. After initial resistance was observed by the performing physician, the procedure was continued until the tip of the tube was 50 cm from the incisors. Correct placement was checked by auscultation over the epigastrium and a chest X-ray was performed to confirm the correct position of the tube. A few minutes post-insertion, while awaiting X-ray to confirm tube position, the patient developed shortness of breath and desaturation. Resuscitation was started and an immediate chest X-ray showed the NG tube traversing along the course of the trachea and right main bronchus into the right upper abdomen with right-sided pneumothorax (Fig. 1A). The patient's family was notified of the inadvertent event and the NG tube was immediately removed and a right chest tube inserted. Chest X-ray after removal of the tube showed right-sided pneumothorax with right basal consolidation (Fig. 1B). CT scans revealed right-sided pneumothorax and evidence of lung laceration and underlying lung collapse (Fig. 2A). Focal discontinuity

in the right diaphragm was noted in coronal views of CT scans suggesting the occurrence of diaphragmatic injury (Fig. 2B).

The chest tube was removed after four days, but the patient underwent a prolonged period of hospitalization due to hospital-acquired pneumonia before being discharged upon clinical improvement.

## DISCUSSION

Nasogastric tube placement is a commonly performed procedure for diagnostic and therapeutic purposes. Perhaps the most common use of such tubes is for formula feeding and administering medications. Although relatively safe, a number of complications have been reported in the literature. Reviews have shown that adverse events arising as a result of NG

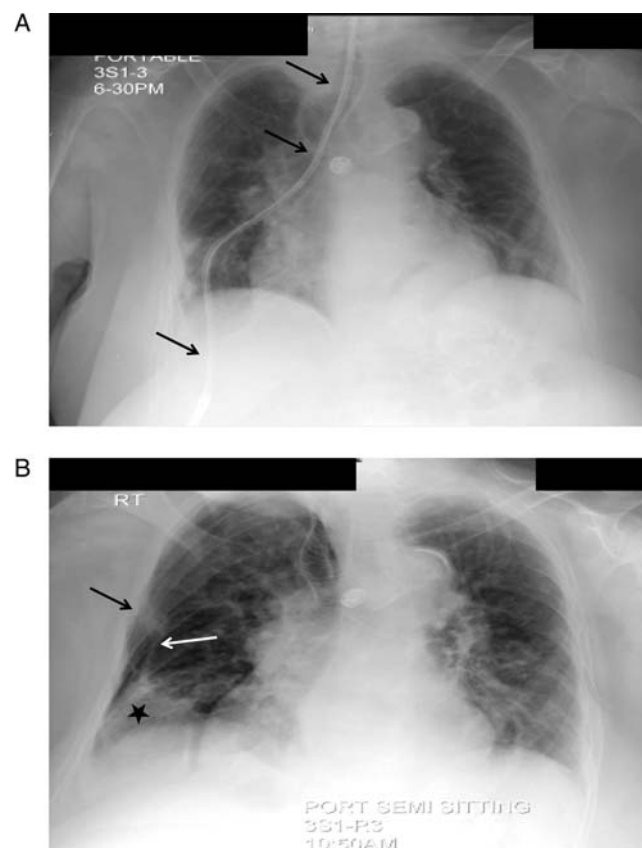
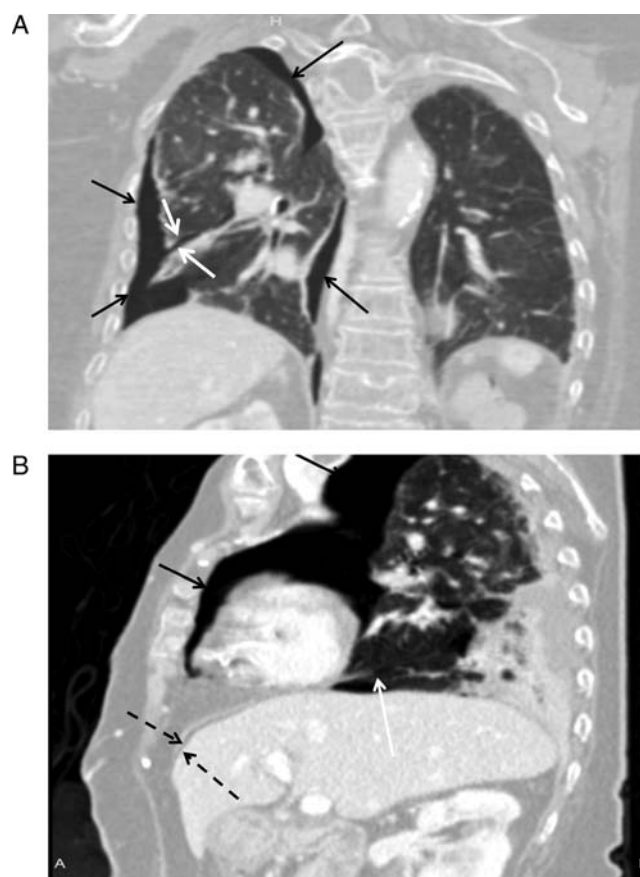


Figure 1. (A) Frontal portable chest X-ray 1 shows an abnormal location of the nasogastric tube (black arrows). The NGT is observed as traversing along the course of the trachea and right main bronchus and is further seen to overlap the right upper abdomen. (B) Frontal portable chest X-ray 2. Imaging performed after removal of the NGT shows the appearance of mild right-sided pneumothorax (black arrow). Note the displaced pleural line (white arrow) and the appearance of a patch of right basal consolidation (star).



**Figure 2.** (A) CT scan image of a chest coronal reformation lung window. It shows mild pneumothorax (black arrows). Note a linear dark line traversing the lung parenchyma (short white arrows) likely representing the site of iatrogenic lung laceration. This is a sagittal reformatted image. (B) CT scan image of a mediastinal window. It shows a thin continuous diaphragmatic slip anteriorly (black dashed arrows) which is discontinuous in the centre (white arrow), representing the site of diaphragmatic injury. The presence of pneumothorax is shown (black arrows).

tube insertions are not routinely recorded in risk management databases.<sup>1</sup> Rassias reported a 2% incidence of tracheopulmonary complications with an associated 0.3% fatality among 740 tube insertions.<sup>2</sup> Pleural placement causing severe pneumothorax has also been reported.<sup>3</sup> A rare instance of cranial placement of a NG tube<sup>4</sup> and colonic perforation due to a NG tube insertion<sup>5</sup> are also reported in the literature. The index case details a NGT traversing the right main stem bronchus into the right upper abdomen. The resultant complications included right-sided pneumothorax requiring a chest tube and right lung laceration with underlying collapse. The case emphasizes that physicians need to be circumspect during

NG insertion and aware of the expectant complications. It also highlights the need for confirmatory evidence of correct tube placement and tells us that any resistance during insertion should be handled with caution. Passing the tube up to 50 cm should not be considered as evidence of successful insertion.

### Proposed methods to confirm correct placement

A number of methods to assess correct placement of a NG tube have been used in the past. These include gastric pH testing, CO<sub>2</sub> detection by capnography, auscultation over the epigastrium, bilirubin or enzyme testing of gastric aspirate, detecting bubbling by placing open ends of the tube under water and chest X-ray imaging. A study comparing these methods recommended against three practices commonly used for tube verification due to the lack of evidence advocating their use and their potential for causing serious harm.<sup>6</sup> These practices included auscultation, aspirate inspection, and placing tubes underwater to assess "bubbling".

#### *Auscultation over the epigastrium*

The practice of listening to an audible "air pop" over the epigastrium after air insufflation falsely leads clinicians to assume correct gastric placement of a feeding tube, and this is strongly not advised. Thoracoabdominal sound transmissions lead to misinterpretation even in cases of pulmonary placement. One study reported 20% false positive gastric confirmations by auscultation following NGT placement.<sup>7</sup>

#### *Radiography*

Obtaining an X-ray of the chest/upper abdomen to confirm the position of the NG tube after insertion provides for an objective means of confirming correct positioning. It is easy to perform and minimizes errors, allowing for a fast response time for inadvertent NGT placement. Multiple national level organizations have recommended obtaining radiographic confirmation of the position of all blindly inserted feeding tubes. But these recommendations are not implemented adequately and auscultation is widely used despite recommendations to the contrary.

A two-step protocol proposed by Roubenoff and Ravich comprising radiographic confirmation of the tube after blind advancement to 30 cm and another

radiograph after advancing to the desired length found a decreased incidence of NGT inserted pneumothorax.<sup>8</sup> It failed to gain widespread acceptance due to its time-consuming nature and lack of cost-effectiveness.

#### ***pH aspirate and bilirubin***

Measuring the pH of NG tube aspirate can give an indication of correct tube placement. A pH < 3.9 indicated gastric placement of the tube. This has shown to be a reliable method of confirming NG tube position.<sup>9</sup> However, achlorhydria and antacid therapy can lead to false high pH results due to the gastric contents. Empyema of infected respiratory secretions can give false low pH results. Bilirubin levels measured using the calorimetric strip test are significantly lower in the lungs and gastric sites when compared to intestinal sites. An approach combining these two methods was proposed by Metheny et al.,<sup>10</sup> to confirm complications arising from inadvertent placement. A pH value less than 5 and bilirubin level less than 5 mg/dl identified 98% of gastric cases. A pH value greater than 5 and a bilirubin level less than 5 mg/dl identified 100% of respiratory cases. A pH value greater than 5 and a bilirubin level greater than 5 mg/dl identified nearly 88% of intestinal cases.

#### ***Capnography***

This method utilizes a capnometer to measure CO<sub>2</sub> levels released from the NG tube after insertion to detect any inadvertent placement into the lungs. Araujo et al., applied this method to the two-step approach of Roubenoff and Ravich, where a disposable calorimetric CO<sub>2</sub> detector confirmed tube position at 30 cm and was later advanced to 50 cm. The position was later confirmed by radiography. They reported 100% sensitivity and specificity rates among 53 insertions.<sup>11</sup>

#### ***Endoscopy***

Small caliber endoscopes can be used through a transnasal approach in cases of difficult or prior failed insertions. Here, the feeding tube is passed over a guidewire, which is inserted through the endoscope channel.<sup>12</sup>

### **Important pearls to avoid complications**

Careful patient selection is of utmost importance before inserting such tubes by excluding patients with facial trauma or nasal surgery. Topical anaesthesia in

the form of lidocaine gel or lidocaine spray (swish and swallow method) significantly reduces pain during insertion and is helpful in successful nasogastric intubation.<sup>13,14</sup> No statistical difference was found in nasal pain scores between lidocaine gel or spray, but global discomfort was less with lidocaine gel usage.<sup>13</sup>

If concern arises about incorrect placement of the tube, the patient can be asked to speak if conscious during insertion. If the patient is able to speak, then it can be assumed that the tube is not passing through the vocal cord or lungs. Of course, these techniques are not evidence-based and only serve to guide physicians. Various techniques and maneuvers are conventionally taught to increase chances of successful insertion and minimize complications. A study comparing various techniques of insertion of NG tubes concluded that head flexion with lateral neck pressure is the easiest technique that has a high success rate and fewest complications.<sup>15</sup> Any resistance felt during insertion should serve as a warning to the physician of an expectant complication. The procedure should either be abandoned or expert advice taken. The two-step approach proposed by Roubenoff and Ravich<sup>8</sup> could also be adopted in such a situation.

Finally, correct placement of the tube should always be confirmed with radiography. Locating the tip of the tube after passing the diaphragm in the midline and checking the length to support the tube present in the stomach are methods to confirm correct tube placement. Any deviation at the level of carina may be an indication of inadvertent placement into the lungs through the right or left bronchus. Deviation of the tube to the right after passing the diaphragm may indicate passing of the tube in the posterior lobe of the right lung. A lateral X-ray and a radiology consult should be taken in such an event. In both these cases, the tube should be immediately withdrawn.

### **CONCLUSIONS**

Nasogastric tube insertion, a routine bed-side procedure on medical and surgical wards is associated with its share of complications. Careful patient selection, experience in the insertion technique, awareness regarding potential complications and methods to avoid them can help minimize these adverse events. Head flexion while the tube passes through the epiglottis is a useful technique to guide

safe passage. Proper placement should always be confirmed using radiography. Auscultation after air

insufflation is an unreliable method to confirm correct placement of nasogastric tubes.

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