

CLINICAL IMAGE

Neurally adjusted ventilatory assist catheter entering the pleural cavity

M. Kant¹, M. Hol², P.E. Spronk¹

Departments of ¹Intensive Care and ²Radiology, Gelre Hospitals, Apeldoorn, the Netherlands

Correspondence

M. Kant - matthijs.kant1@gmail.com

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Introduction

Placement of a nasogastric tube (NGT) is common practice to feed the patient, reduce aspiration risk in patients with bowel obstruction, or preoperatively for decompression of the stomach. Insertion is simple and in most cases uneventful. However, misplacement occurs in 2% of the cases^[1] and can lead to severe complications such as nasopharyngeal trauma, pneumonia during inadvertent feeding, or even pneumothorax, pleural effusion and empyema,^[2] resulting in death in 0.3% of the cases. We describe a case where experienced nurses misplaced an oesophageal tube despite being careful and performing the procedure *lege artis*.

Case presentation

A 65-year-old male, with a history of atrial fibrillation, hypertension and an unspecified cardiomyopathy, was recently diagnosed with a pancreatic process suspected to be mucinous cystic carcinoma and scheduled for a Whipple (pancreaticoduodenectomy) procedure. However, the process developed quickly and obstructed the bile ducts causing cholangiosepsis. The patient was admitted to the intensive care unit (ICU) requiring noradrenaline, renal replacement therapy and invasive ventilation. After 14 days of mechanical ventilation, a tracheal cannula was inserted. Subsequently, a neurally adjusted ventilatory assist (NAVA) catheter was introduced to facilitate ventilation and weaning from the ventilator. The catheter was introduced using forward head flexion and the nurse reported no resistance. According to protocol, the pH of the aspirate was checked to confirm correct placement. The pH of the aspirate was >7 and therefore a chest radiograph was performed to check the position of the inserted catheter. The catheter was inadvertently misplaced in the right bronchus with the tip projecting over the right upper lung field. Computed tomography was performed and confirmed the malposition of the NAVA catheter in the right lower bronchus, subsequently perforating the right lower lobe of the lung, entering the

pleural cavity with the tip toward the apex. 3D images of the computed tomography were reconstructed (*figure 1*). A video of the reconstructed 3D images can be seen in ESM-1. No leakage of air was observed on the ventilator, suggesting that the catheter itself plugged the perforation. The surgeon on duty was consulted. Surgical or thoracoscopic removal of the NAVA catheter was not considered beneficial over manual removal to avoid pneumothorax. Despite careful manual removal of the NAVA catheter, a tension pneumothorax developed with subsequent asystole cardiac arrest. Cardiopulmonary resuscitation was performed and chest tubes were placed both laterally and ventrally with rapid return of spontaneous circulation. The patient awoke with a good neurological status without any sequelae. After three days the chest tubes were successfully removed. Despite this full recovery, the patient passed away nine days later due to recurrent cholangitis related to the mucinous cystic carcinoma and the decision to withhold escalating interventions.

Discussion

Various methods are used to reduce the risk of misplacement of oesophageal tubes, including lateral neck pressure, forward head flexion, Magill forceps, visualisation with pharyngoscopy and oesophageal guide-wire-assisted insertion.^[3,4,5] When a NGT is inserted, a checklist or flowchart should be used to verify the correct position (example in *figure 2*). Stomach auscultation is commonly performed, but is not a reliable method for checking correct placement of an NGT.^[6] The first step should include checking the aspirate for acidic pH of 5.5 or below. If the pH is above 5.5 and the patient is awake, the patient is asked to swallow some lemonade. Lemonade lowers the pH of the stomach and has a striking colour. If the lemonade can be aspirated from the NGT, then the position is correct. Checking the pH of the aspirate with the lemonade should confirm this. In cases in which the pH test is inconclusive, a chest X-ray



Figure 1. 3D reconstruction of the CT images

should be obtained. Another available test is capnography of the placed tube, which has a high specificity and sensitivity rate for detecting misplacement of the NGT.^[2] Nevertheless, even when following protocols and guidelines, complications may occur. Marderstein et al. reduced the rate of pneumothorax induced by NGT placement from 0.38% to 0.09% by inserting the tube blindly to 35 cm and confirming the location with a chest X-ray.^[7] After confirmation of correct positioning, the tube is inserted further. However, this method is time-consuming and every patient is exposed to two chest X-rays. In our case, two experienced ICU nurses inserted the NGT according to the guidelines. The aspirate was above a pH of 5.5 and the patient was not able to drink because he was sedated, so the lemonade test was not an option. A chest X-ray was performed and showed misplacement of the NGT in the right bronchus. Usage of one of the other methods for determining the placement of the NGT was not useful since the perforation of the lung already had occurred. No signs of misplacement were visible

on the ventilator. The nurse reported no resistance when inserting the NGT probably due to the katabolic state of the patient caused by the sepsis. Regarding the removal of the NGT, careful considerations were made. Surgical or thoracoscopic removal of the NGT would not reduce the risk of developing pneumothorax. Also surgical removal would lead to longer recovery times. This case illustrates the misplacement of an NGT causing iatrogenic pneumothorax and cardiac arrest even though the insertion of the NGT was performed according to the guidelines. No literature regarding the risk of misplacement using different types or sizes of NGTs is available so it is not clear if the NAVA catheter has a higher risk of misplacement compared with a regular NGT. To avoid cases like this, one may suggest using Marderstein's approach^[7] of obtaining a chest-X-ray after insertion of the NGT for 35 cm in sedated patients on a ventilator, or perform capnography in selected katabolic fragile patients in the ICU. Further research to develop methods to avoid misplacement of a NGT is warranted.

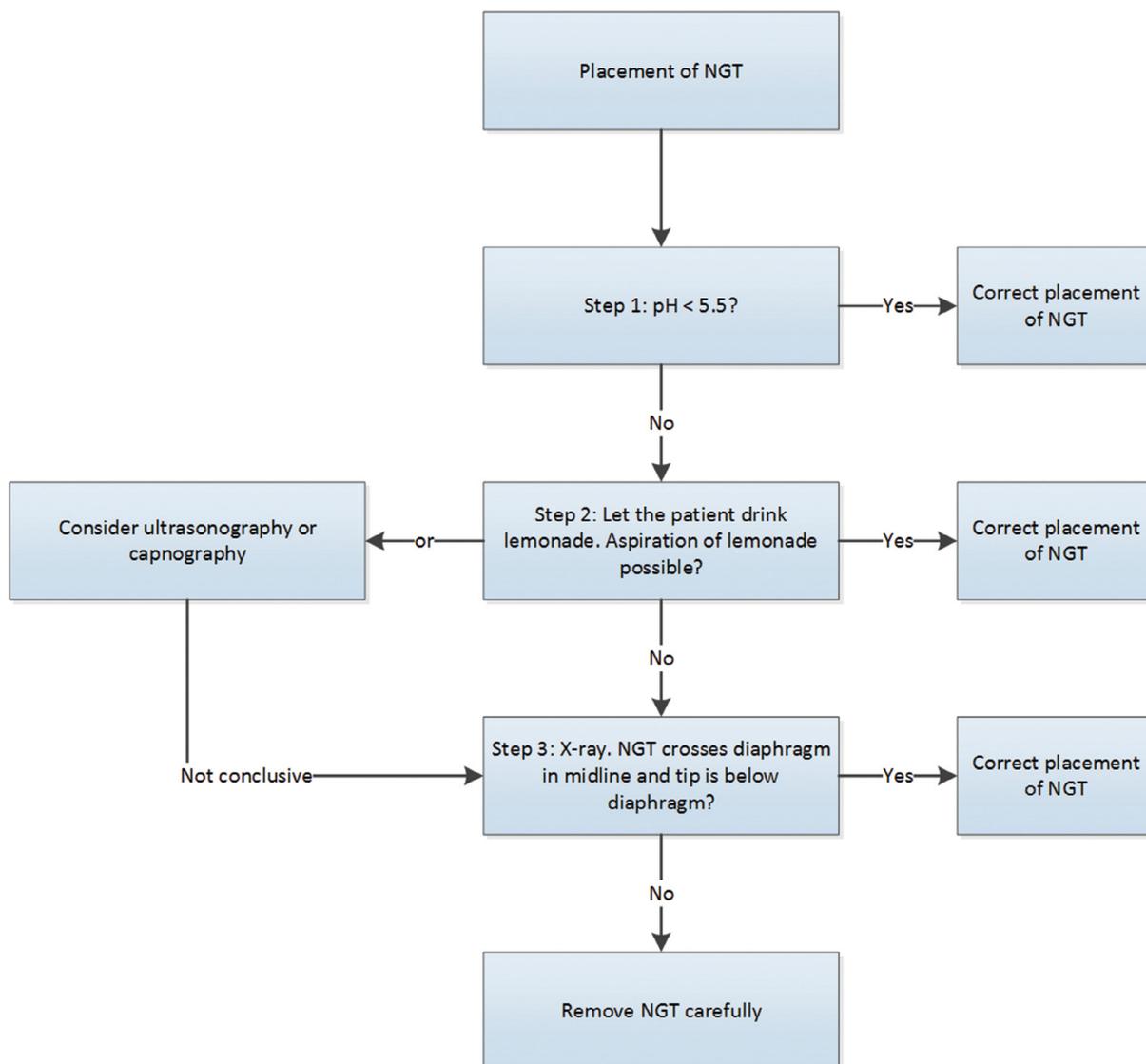


Figure 2. The flowchart to confirm correct placement of a nasogastric tube

Disclosures

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Written informed consent was obtained from the patient’s family for the publication of this case report.

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Video 1.
A video of the reconstructed 3D images



https://www.nvic.nl/sites/nvic.nl/files/19-91_Kant_video_1.mp4