

IMAGING

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Proper Placement of Tubes on Chest Radiographs

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ABSTRACT

A variety of tubes are placed by the advanced practice provider including endotracheal tubes, nasogastric tubes, feeding tubes, and chest tubes. Recognizing the proper placement of these tubes is critical to prevent complications and allow for intended use including ventilation, nasogastric drainage, providing enteral nutrition, and drainage of air or fluid from the pleural space. The advanced practice provider must be aware of the anatomical landmarks that help indicate correct positioning for safe use and proper functioning of these tubes. This article will discuss how to assess for proper placement of endotracheal, nasogastric, and chest tubes. **Key words:** chest tube, endotracheal tube, feeding tube, nasogastric tube, tube placement

THE ENDOTRACHEAL TUBE (ETT) is placed into the trachea for ventilation. The distal end of the ETT is typically angled or in a diagonal fashion. There is a continuous radiopaque stripe along the entire length of the tube. There are no side holes on an ETT. The diameter of the ETT should be roughly half to two-third the width of the trachea. The tip of the ETT should be between 3 and 5 cm above the carina, with the head

in a neutral position, or roughly half the distance between the medial borders of the clavicles and the carina. The patient's head must be in a neutral position to assess the appropriate placement. Movement of the patient's head with flexion or extension can move the ETT either upward or downward approximately 2 cm, respectively. The carina can be found by first identifying the right (or left) main stem bronchus and following it proximally where it meets the opposite main stem bronchus.

The most common error with ETT placement is when it is advanced too far into the wider, more proximal, right main stem bronchus (see Figure 1). Incorrect intubation of the right bronchial tree can lead to over-inflation of the right lung with an increased risk of right-sided pneumothorax, along with left-sided atelectasis, from lack of aeration of the left lung.

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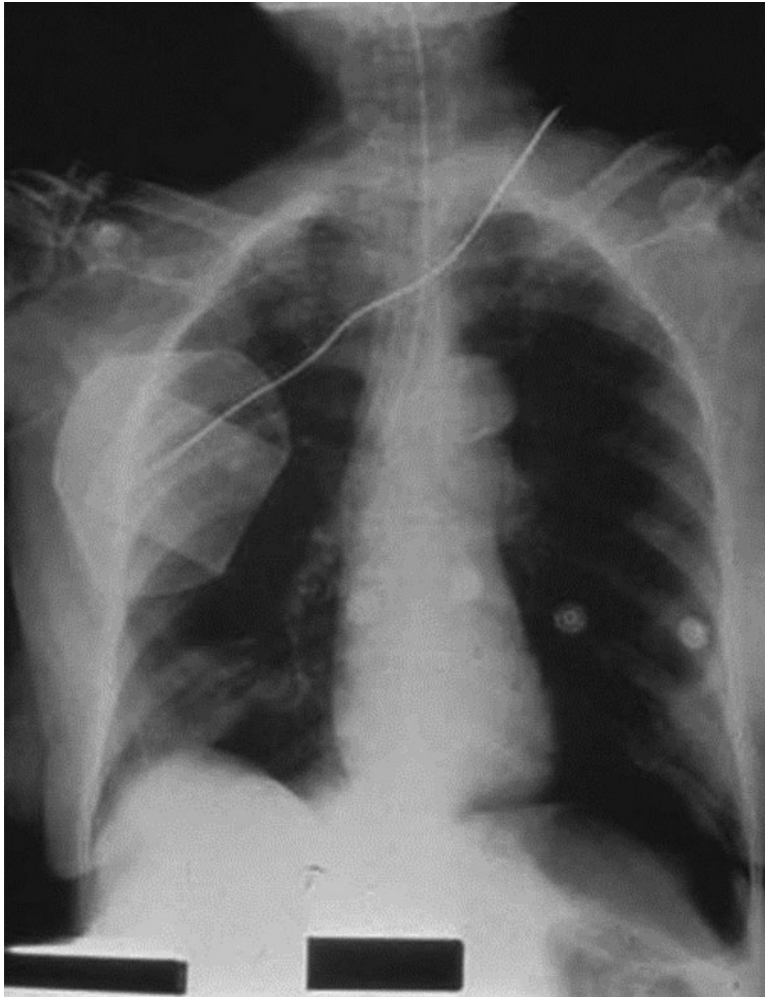


Figure 1. Right main stem intubation resulting in left-sided tension pneumothorax, right mediastinal shift, deep sulcus sign, and subpulmonic pneumothorax. From *Pneumothorax Imaging*, by F. A. Al-Hameed, S. Sharma, and B. Maycher, 2017. Retrieved from <https://emedicine.medscape.com/article/360796-overview>. Copyright 2017 by Medscape Drugs & Diseases, WebMD LLC. Reproduced with permission.

Conversely, if the ETT is not advanced far enough into the trachea, the patient is at an increased risk for accidental extubation and aspiration. Tubes placed in the larynx or the pharynx can lead to permanent damage to the vocal cords. If the ETT is accidentally placed in the esophagus, the patient will quickly become hypoxic and hypercapnic without being adequately ventilated. There are additional ways to detect whether the ETT is improperly placed in the esopha-

gus, including the absence of breath sounds on auscultation, lack of chest rise, and increasing distention of the stomach with attempts to ventilate.

NASOGASTRIC TUBES

Nasogastric tubes (NGTs) are used to temporarily provide patients with nutrition, administer medication, and allow for decompression and drainage of gastric contents.

There are numerous different sizes and types of NGTs, most have multiple side holes that extend from approximately 10 cm from the distal tip. The indication for the NGT should be considered when assessing for proper placement. If the NGT is primarily being used for administration of enteral feeds or medications, ideal placement is distal to the pylorus to help prevent aspiration. When the NGT is placed for decompression of the stomach and removal of gastric contents, the distal tip should be 10 cm past the esophageal gastric (EG) junction. The EG junction is located at the left cardiophrenic angle, identified by where the left hemidiaphragm meets the left side of the thoracic vertebral bodies. The NGT is the most commonly malpositioned tube and a chest or abdominal radiograph to confirm correct placement must always be obtained before usage. A systematic review of 14 national guidelines published from 2015 to 2018 unanimously agreed

that radiography is the most accurate testing method (Metheny, Krieger, Healey, & Meert, 2019). Radiography is considered the gold standard for NGT placement confirmation (Fan, Tan, & Ang, 2017). Routine confirmation with auscultation and radiography may provide unreliable confirmation; thus, one must be aware of the limitations of these methods as complications may still occur (Nejo, Oya, Tsukasa, Yamaguchi, & Matsui, 2016). Most commonly, the NGT can coil in the pharynx, esophagus, or back out of the stomach. Another error with NGT insertion is tracheal or bronchial placement (see Figure 2), which could lead to pneumonia, bronchial perforation, or pneumothorax.

CHEST TUBES

A chest tube is typically a wider bore tube that has side holes to allow air or fluid to drain from the pleural space. The tube has a



Figure 2. An older man admitted to the intensive care unit postoperatively. Note the right-sided pneumothorax induced by the incorrectly positioned small-bowel feeding tube in the right-sided bronchial tree. Marked depression of the right hemidiaphragm is noted, and mediastinal shift is to the left side, suggestive of tension pneumothorax. The endotracheal tube is in a good position. From *Pneumothorax Imaging*, by F. A. Al-Hameed, S. Sharma, and B. Maycher, 2017. Retrieved from <https://emedicine.medscape.com/article/360796-overview>. Copyright 2017 by Medscape Drugs & Diseases, WebMD LLC. Reproduced with permission.

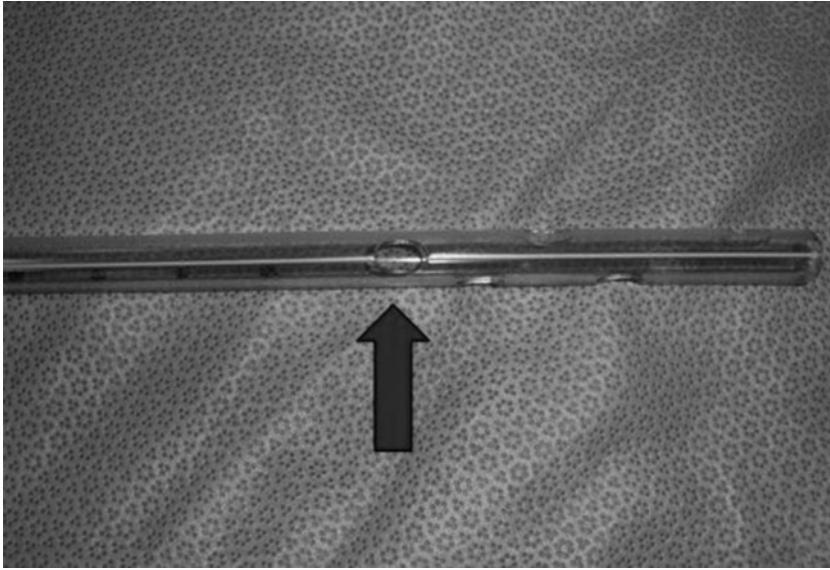


Figure 3. Make certain that the most proximal hole is inside the thoracic cavity. This hole crosses the radiopaque line on the tube (shown) and aids in detecting its proper placement on chest radiograph. From *Tube Thoracostomy Insertion*, by S. L. Melendez and M. A. Silverberg, 2012. Retrieved from <https://reference.medscape.com/features/slideshow/tubethoracostomy>. Copyright 2012 by Medscape Drugs & Diseases, WebMD LLC. Reproduced with permission.

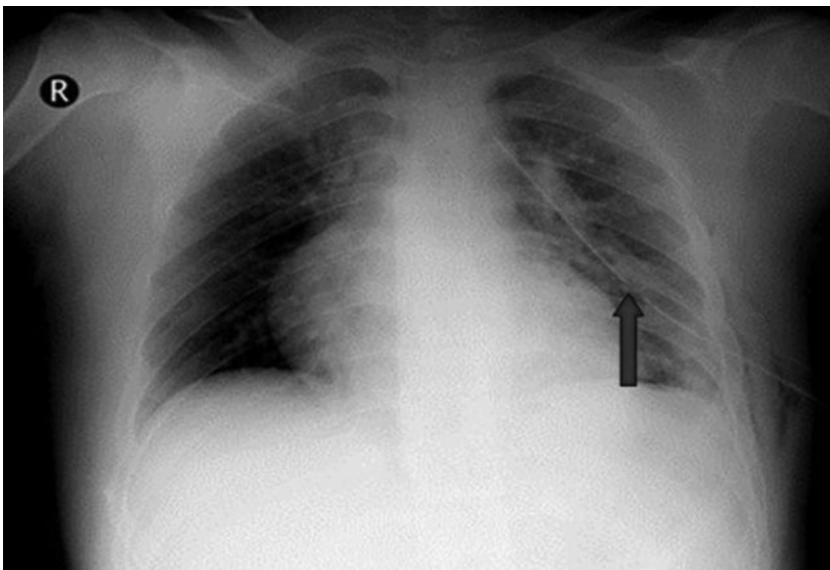


Figure 4. Confirm tube placement on chest radiograph (shown). Notice that the most proximal hole (arrow) is in the thoracic cavity and is seen as an interruption in the white line of the chest tube. From *Tube Thoracostomy Insertion*, by S. L. Melendez and M. A. Silverberg, 2012. Retrieved from <https://reference.medscape.com/features/slideshow/tubethoracostomy>. Copyright 2012 by Medscape Drugs & Diseases, WebMD LLC. Reproduced with permission.

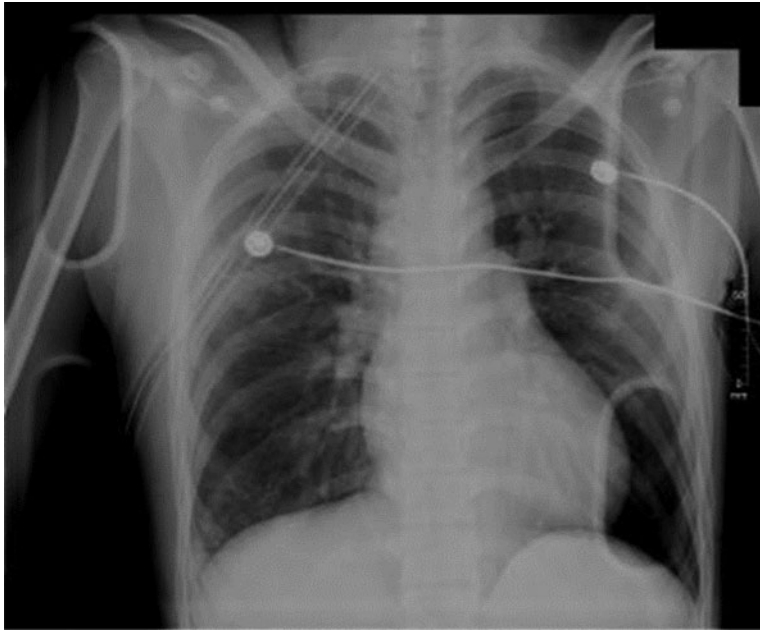


Figure 5. Chest tube in good position. From *Tube Thoracostomy*, by G. Z. Shlamovitz, 2018. Retrieved from <https://emedicine.medscape.com/article/80678-overview>. Copyright 2018 by Medscape Drugs & Diseases, WebMD LLC. Reproduced with permission.

radiopaque stripe that breaks at the site of the side holes and all side holes must lie within the thoracic cavity to allow the chest tube to function properly (see Figures 3 and 4).

Positioning of the chest tube should correlate with the indication for placement. A chest tube placed for a pneumothorax should lie superior and anterior for drainage of air trapped in the pleural space, whereas tubes placed to drain a pleural fluid collection should be more inferior and posterior within the thoracic cavity (see Figure 5).

A chest radiograph must be obtained immediately after placement to ensure that the tube is within the pleural space. Reviewing the film will help identify malposition of the chest tube, which may include placement in an interlobar fissure, placement of the chest tube into the lung parenchyma, or insertion into the subpleural space (the potential space between the parietal pleura and the chest wall). If the chest tube is not advanced, with one or more of the side holes outside the pleural space, a persistent air leak will be

present. Other complications includes placement of the chest tube into the chest wall or into the abdominal cavity.

CONCLUSION

Advanced practice providers are often in a position to confirm proper placement of a variety of tubes on chest radiograph including ETTs, NGTs, and chest tubes. Being familiar with landmarks and correct locations where the tubes should be placed can avoid untoward patient complications.

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