Tubes, Lines & Drains:
Using chest radiography to assess support devices

Ryan Pouliot, HMS
Gillian Lieberman, M.D.

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Objectives

- To understand the importance & develop familiarity with the radiologic evaluation of commonly utilized support devices
- This presentation will focus on the use of the chest radiograph to recognize the presence of and determine the appropriate or inappropriate placement of endotracheal tubes, enteric tubes, central venous catheters, and chest thoracotomy tubes
A Case...

• You are rotating in the ICU
• Your patient, D.B., is a 38 y.o. man who is recovering from multiple traumatic injuries after being struck by a car while jogging.
• He was recently extubated and has self-removed his NG tube, but is still too lethargic to take adequate PO nutrition
• You place a dohhoff tube and order a plain film to confirm placement
-What is wrong with this picture?

-The dobhoff tube is seen entering the right lung through the right main stem bronchus
- Same patient with dohff now appropriately placed

Image: PACS, BIDMC
Case Continued...

- This was obviously a dramatic example of a dohff incorrectly placed into the right main bronchus
- What about more subtle cases and/or other support devices?
- How do we know if our support devices are correctly placed?
- Let’s examine some additional films from the same patient on arrival to BIDMC
- What support devices do we see in this patient?
- How about placement?

- ETT and NGT in adequate position

Image: PACS, BIDMC
-What has changed?

-Right Subclavian cordis catheter with a kink near distal tip
-Course atypical for placement within SVC, arterial placement cannot be excluded
- Right subclavian catheter has been replaced, now with tip in lower SVC
- Did anything else happen to this patient?

- There is now a right sided thoracotomy tube in place (blue arrows)
Evaluating Endotracheal Tube (ETT) Placement

• Radiographs are routinely taken following endotracheal intubation to ensure proper positioning, especially when the intubation occurs outside of the operating room.
  – Chest radiography is the most practical and widely used imaging modality in the hospital setting
  – Ultrasound is currently being investigated as a rapid, alternative method for ETT tube confirmation, especially in the prehospital setting (look for bilateral “lung sliding” at visceral-parietal pleural interface)

• Malpositioning complicates up to 15% of intubations (up to 20% in the emergent setting), and can be identified on a chest radiograph
Endotracheal Tube Position

• The endotracheal tube (ETT) can be recognized on the radiograph by a thin, opaque line which runs the length of the tube
• When the patient’s head is in the neutral position, the tip of the tube should project within the trachea, approximately 5-7 cm from the carina
• Flexion or extension of the neck may cause the tube to move up to 2 cm!
Evaluating the ET tube

- In addition to position, the endotracheal tube size should be evaluated.
- The tube should be approximately ½ to 2/3 the width of the trachea.
- The cuff should be inflated to fill, but not distend the tracheal lumen.
  - Overinflation may lead to acute tracheal rupture or chronic tracheal stenosis.

Image: Kimberly-Clark HealthCare
Endotracheal Tube Malposition

• Most malpositioned tubes are too deep – into which side?
  – ETT positioned into one of the main stem bronchi can cause hyperinflation and injury (Ptx) to the ipsilateral lung & atelectasis to the contralateral lung

• The ETT may also be positioned to high, causing laryngeal trauma or unintended extubation

• Esophageal intubation is the most concerning malpositioning, possibly with fatal implications. Fortunately, it is generally evident clinically and corrected prior to radiography.
Signs of Esophageal Intubation

• May be quite subtle
• Assess for:
  – Position of ETT relative to tracheal air column
    • Is the tube within the lumen?
  – Excessive gastric air, or air in the esophagus must be closely examined in intubated patients
  – Poor lung inflation may also be evident
-This is a 36 y.o. female status-post thyroidectomy.
-Assess the location of her endotracheal tube

Image: Courtesy Ferris M. Hall, M.D.
The same patient was later extubated, only to develop increased respiratory distress and was subsequently re-intubated. This is her post re-intubation CXR.

The ETT is seen overlying the trachea. The lungs are grossly hypoinflated, and the stomach is massively distended with air.

Image: Courtesy Ferris M. Hall, M.D.
-21 y.o. male, status-post MVA

-Note massively dilated stomach (star), air in the esophagus (arrow), hypoventilated lungs.

-ETT tip is seen to the left of trachea at the level of the clavicles (blue arrow)

Image: Courtesy Ferris M. Hall, M.D.
- This patient had a LUL cancer that was unresectable.
- He was doing “poorly” post-op, and was re-intubated. His ABGs revealed hypoxemia and hypercarbia. This CXR was taken in the PACU.

- The ETT tip is seen to the right of the tracheal column. Esophageal air is evident to the right of the mediastinum. The stomach is massively distended with air, and the lungs are grossly hypoinflated.

Image: Courtesy Ferris M. Hall, M.D.
- ETT tip appears to be in right main stem, however the proximal portion of the ETT is to the left of the trachea.
- Tip of NGT is blocked by ETT cuff
- Stomach and esophagus are markedly distended with air
- Lungs are grossly hypoinflated
- ETT is noted to the left of the tracheal air column
- Again, the lungs are hypoinflated bilaterally and there is air noted within the esophagus and stomach
- Selective intubation of the left main stem bronchus
- Complete opacification of right hemithorax
-ETT in right main stem with notable opacification of left hemithorax

Image: RadsWiki
- Same patient with ETT pulled back, now in proper position

Image: RadsWiki
Tracheostomy Tubes

- Tracheostomy tube tip should lie at approximately the level of the 3rd thoracic vertebra
- Unlike the ETT, the tip should not move with head flexion/extension
- The tube diameter should be approximately 2/3 the tracheal diameter
- The cuff (if present) should not distend the tracheal wall

Image: MDA
- Appropriately placed tracheostomy tube with tip residing between T3-T4.
- Same patient, now with right subclavian line in lower SVC
- Also with small right Ptx (blue arrows) and right sided pigtail thoracotomy catheter (green arrow)
Enteric Tubes

• Commonly used for nutrition, medication administration and decompression
  – For feeding – ideal location with tip in antrum of the stomach or in the duodenum (to decrease risk of aspiration)
  – If being used solely for medications or decompression, gastric placement is adequate
• Imaging is vital to rule out complications, including malposition in the pharynx or esophagus, or in the airway (as seen in our patient).
- Nasogastric tube, seen appropriately coiled within the stomach
-Where is the tip of this NG tube positioned?

-The NG tube is coiled in the esophagus with the tip projecting upward just above the clavicular heads.
-Note the difficulty in assessing NG tube position with overlying leads and wires.
- Where is the tip of the NG tube in this pediatric patient?
- What is this patient's underlying condition?

- This is an example of heterotaxy with the patient's stomach located on the right
- Also noted appropriately placed ETT and right IJ
Central Venous Catheters

• Common in hospitalized patients, especially in the ICU setting
• May be inserted peripherally (i.e. PICC), or more centrally (i.e. subclavian, internal jugular or femoral)
• Tip should lie within the SVC, ideally near the junction of the RA (but not within the RA)
  – This position decreases the risk of catheter tip thrombosis and dysrhythmia
Central Venous Catheters

• Malpositioning is quite common, and chest radiography is needed to confirm placement

• Chest radiographs can also be useful to identify potential complications, such as pneumothorax, hemothorax or hematoma formation
Additional Central Venous Catheters

- Swan-Ganz, or Pulmonary Artery Catheter – tip should be within the left, right or main PA and not extend beyond the pulmonary hilum on chest radiograph
- Umbilical venous catheters – can be utilized in neonatal resuscitation, tip should be located in the IVC beyond the ductus venosus but proximal to the RA
- What is the approach of the central line in this patient?
- Is it placed appropriately?

- What about the patient’s endotracheal tube???

- The line is a right internal jugular with the tip appropriately placed in the upper SVC.
- The patient is rotated, but the ET tube is within the tracheal air column.
-What type of line?
-What is the approach?
-Any other tubes or lines?

-This is a Swan-Ganz catheter from the right IJ
-The ETT is in good position
-An NG tube is also in place
- What type of line?
- Is the placement correct?

- There are left and right sided PICC lines that are both malpositioned.
- The left PICC crosses into the right SCV (blue arrow).
- The tip of the right PICC also terminates in the right SCV.
-Again, identify the support lines and their placement

-There is a left PICC that terminates in the right SCV
-A dual lumen right SC catheter is present
-There is also a feeding tube with tip off the film
- The right sided PICC is looped in the SVC with tip projecting into the right IJ.
- A left sided PICC traverses into the left IJ
- A right sided dual lumen catheter is in satisfactory position
- An NG tube is also in place
-The right sided PICC crosses over into the left SCV
- There is a left IJ terminating in the upper SVC.
- The ETT is in good position (cuff may be slightly overinflated).
- Any other support devices?

- There is an NGT in place as well as a left sided chest tube.
- The Swan-Ganz catheter is in good position.
- There is also an ETT and NGT in adequate position.
Right subclavian catheter, terminating in the SVC
-Right PICC in adequate position with tip in SVC
- A left SC line is present with tip near the junction of the innominate vein and SVC
- An ETT and dohhoff tube are in adequate position
- Right PICC line terminates in the upper SVC
- ETT is slightly high with tip approx 7 cm above the carina
- An NG tube is also in place
-Left subclavian line with tip in lower SVC

Image: PACS, BIDMC
- Left sided Port-A-Cath terminating in lower SVC
- There is also a Pleurx catheter at the base of the left lung
- The Swan-Ganz is in good position with tip in LPA
- ETT and NGT are adequately positioned
- There are upper and lower mediastinal drains (arrows)
-Right IJ with tip in right SCV

Image: Courtesy Mark A, Camacho, M.D.
-An umbilical venous catheter is in place (green arrow), as well as an umbilical arterial catheter (blue arrow)
Chest Tubes

• May be malpositioned in up to 10% of insertions
  – May cause injury to the lung parenchyma, mediastinal structures, upper abdominal organs or the diaphragm and vasculature

• All side holes (can be seen as interruptions in opaque line along tube) must be within the pleural space

• New opacities adjacent to the chest tube may be indicative of pulmonary contusion – caused by injury to the parenchyma
- There are two left sided chest tubes with no evidence of pneumothorax
- An ETT and right IJ are also in adequate position
-Left sided chest tube
-Left sided chest tube with
small apical Ptx
- There are 2 chest tubes on the left.
- An umbilical venous catheter is also visible. Where is the tip located?

- The UVC is seen passing through a PFO into the left atrium.
- Our index patient, seen here with right sided thoracotomy tube
- ETT, NGT and right SC cath are still correctly placed
Conclusions

• Chest radiography is an invaluable and readily available tool for evaluation placement and possible complications of support devices.

• Physicians (and medical students) involved in direct patient care need to be familiar with the identification of support lines and assessment of placement on plain films
Questions?

• Thank you!
References

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