Educational Forum

Pediatric Lines and Tubes: What Radiologists must Know

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ABSTRACT

Radiographs are very useful for evaluation of various support and monitoring devices in pediatric patients. This review article focuses on the ideal locations of the tips of these tubes and catheters, as well as the consequences of malpositioning. Clinical outcome of patients can be affected by the placement of these support devices. Thus, the radiologist has an important role in detecting such malpositioned devices for prompt revisions or removal.

Keywords: Line and Tubes, Endotracheal tube, Nasogastric tube, V-P shunt, Umbilical vein catheter, Umbilical artery catheter.

INTRODUCTION

Different support devices are used in pediatric patients, and the list continues to grow. The challenge to the radiologist is to maintain a current understanding of each of these devices.[1] Identify various support devices on pediatric radiographs. Review landmarks for optimal positioning of support apparatus and know the possible aberrant positioning and potential associated complications; Guide the clinical team for proper repositioning of the support apparatus[2, 3]

Nasogastric tube:

MATERIAL AND METHODS

After prospective review of the radiographs of the pediatric wards and critical care units for 2 months where support devices are routinely used most of them showed correct placement and positioning of the devices. However, in a few cases, abnormal / incorrect insertion or placement was found in the post-insertion /application check radiographs. They were later corrected placed and repeat radiographs were taken. These cases are mentioned as below.

The nasogastric tube (NG tube) is also recognized on the chest radiograph. The tube should be seen to pass well below the diaphragm into the stomach.

Figure-1 A. Normal position of NG tube **B. Tip of NG tube in duodenal**

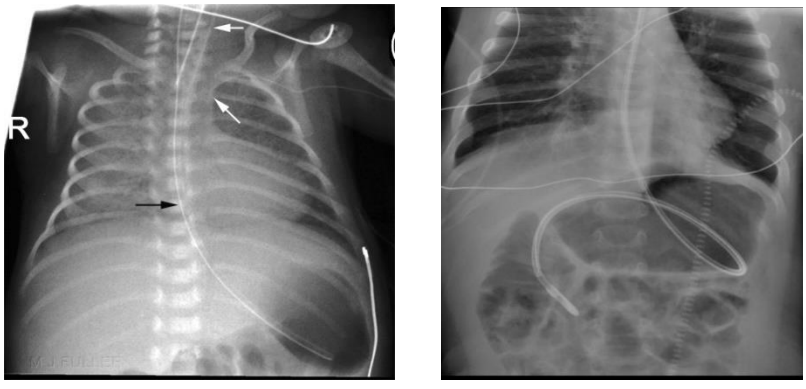


Table-1: Normal and aberrant position of nasogastric tube

Normal Position	Common Positioning Errors	Important Complications
• Roughly vertical/midline course down esophagus • Tip and all side holes distal to GE junction • Distal position depends on function	• Coiled tube, or distally in duodenum • Proximal/marginal • Kinked tube • Pulmonary placement	• Aspiration • Pulmonary contusion/laceration • Pneumothorax • Esophageal/gastric perforation

Endotracheal tube:

The tip of the endotracheal tube should be in the trachea between the thoracic inlet and carina. It may vary with neck flexion and extension, neck extension causes cephalad (upward) motion of the ETT while with head flexion, the ETT will move caudally (downward).

Figure-2: A. ET Tube tip between thoracic inlet and carina, approximately 1 cm above carina: Optimal. B. ET Tube tip in right main stem bronchus: Aberrant

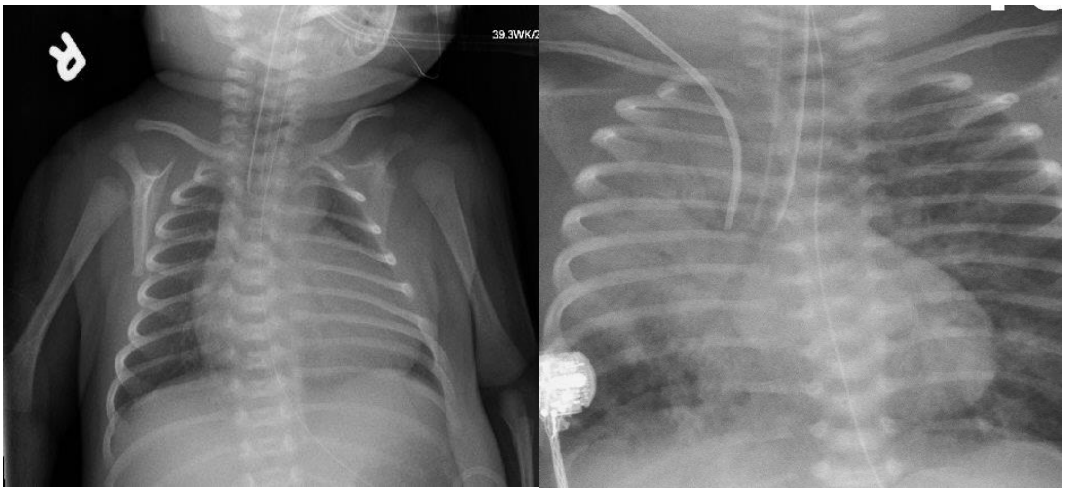


Table-2: Normal and aberrant position of ET tube

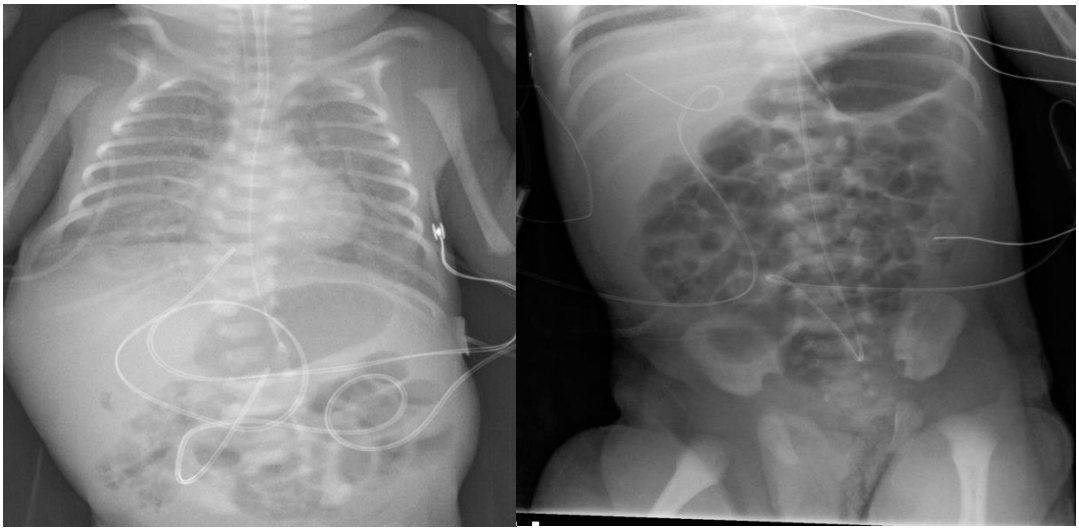
Normal Position	Common Positioning Errors	Important Complications
• At least 2 cm above carina • At or below medial ends of the clavicle • Varies ±2 cm with neck movement	• Too high • Main stem bronchus intubation • Esophageal intubation	• Spontaneous extubation • Aspiration, Atelectasis, Pneumothorax • Gastric/esophageal injury or perforation

Umbilical vein catheter: Umbilical venous catheters are commonly used in neonates for vascular access. The single umbilical vein ascends intra-abdominally from the umbilicus to join the left portal vein. Therefore, the umbilical venous catheter follows an anterior and cephalad course when in the umbilical vein, but then courses posteriorly into the liver in the left portal vein following a superior direction in the ductus venosum. The ideal position of the tip of the umbilical catheter is at the IVC/ right atrial junction.

Table-3: Normal and aberrant position of umbilical vein catheter

Normal Position	Common Positioning Errors	Important Complications
• Tip is at the junction of the IVC and right atrium or in the lower right atrium	• Pass from the IVC into the SVC, RA, through patent foramen ovale into LA or pulmonary vein. • Coiling within umbilical recess Passage to the left or right portal veins, or low positioning within the ductus venosus.	• Perforate the vessel wall and cause a hematoma or fluid collection. • In the chest, UVCs can perforate the left or right atrial wall.

Figure-3: A. UVC tip at Inferior cavoatrial junction- Optimal. B. UVC tip in hepatic vein or right branch of portal vein- Aberrant



Umbilical artery catheter:

Umbilical arterial catheters are frequently used for arterial blood gas sampling and monitoring of the blood pressure.

Ideally it should be at level of D6-10 vertebrae. So, this should be placed away from the major vessels orifices in the aorta.

Figure-4: Normal position of Umbilical artery catheter

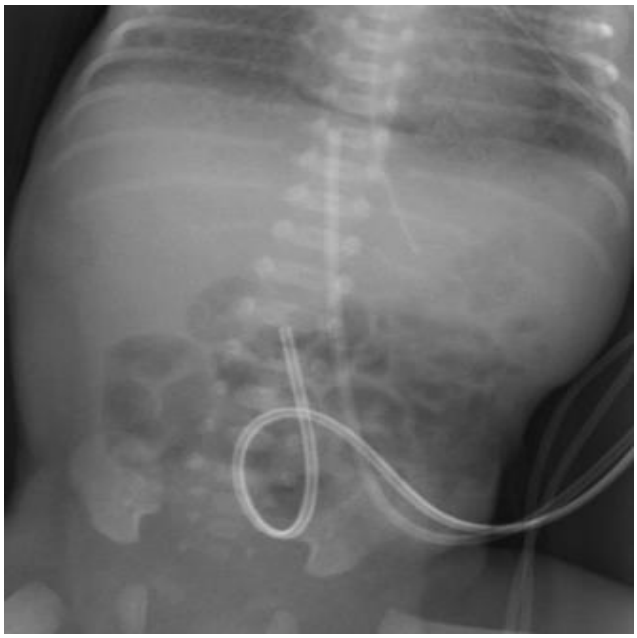


Table-4: Normal and aberrant position of umbilical artery

Normal Position	Common Positioning Errors	Important Complications
• The umbilical artery catheter should be at the level of the D6-D10 vertebrae (high position) or at the level of the L3-4 vertebrae (low position) acceptable	• Ensure that its tip is away from the origins of vessels supplying vital organs • The carotids in the high position • Renal vessels in the low position).	• Thrombosis • Ischemia • Vessel perforation

V-P shunt:

A ventriculo-peritoneal (VP) shunt is a cerebral shunt used to treat hydrocephalus. The shunt removes excess cerebrospinal fluid.

Ideal position is depending of shunt is under the skin or into peritoneal cavity or into pleural cavity.

Figure-5: A. Ventriculopleural Shunt tip in left mediastinal pleural space: Optimal, B. Ventriculoperitoneal Shunt catheter tip in right labia: Aberrant

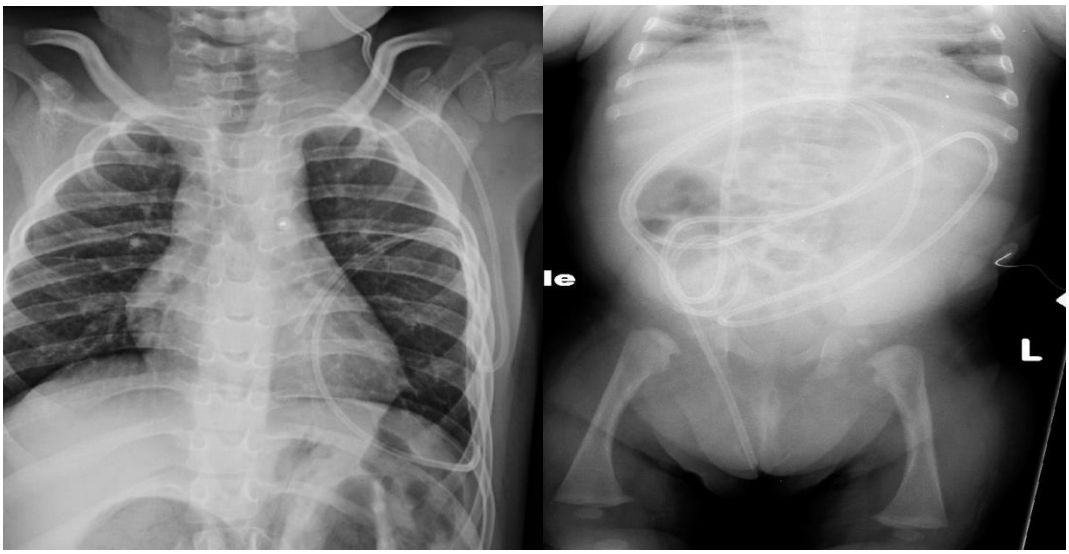


Table-5: Normal and aberrant position of V-P shunt

Normal Position	Common Positioning Errors	Important Complications
• The distal catheter is tunneled under the skin and into the peritoneal cavity.	• Malposition in abdominal cavity	• Disconnections /breaks, migration, leakage, shunt over drainage and slit-ventricle syndrome.

DISCUSSION AND CONCLUSION

Radiologists play a central role in the evaluation of thoracic lines and tubes in children with the help of only portable radiography. It is essential for radiologists to be familiar with a wide range of medical devices used in the care of children to confirm appropriate position and diagnose malposition and help to reduce complications.

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