Radiographic Confirmation of Feeding Tube Placement: A Diagnostic Tool Identifying Gastrointestinal Anomalies

Hanifi Soylu, MD
Nathan E. Wiseman, MD
Yasser El-Sayed, MD
Man Yi, MD
R. John Baier, MD

Orogastric (OG) and nasogastric (NG) feeding tubes are commonly used in neonatal intensive care units (NICUs) to support enteral feeding, especially in preterm and infants who are not able to feed orally. In addition, they are used for administering medications, sampling gastric contents, and decompressing the stomach. Despite their widespread use in patients of all ages, placement techniques are not well standardized; even a small percentage of placement problems can affect significant numbers of newborns and may result in serious morbidity or mortality. Accurate tube placement is important to ensure safe and effective practice, however, it is not always possible especially in the NICU setting. For verification of feeding tube position, measurement of tube distance at the point it exits the naris or aspirating a small amount of gastric content and evaluating color and pH are common practice. However, the only sure way to document proper NG/OG tube placement before initiation of feedings or medication administration is radiographic confirmation, especially in the pediatric intensive care unit (ICU) setting. However, radiography is not only expensive and time consuming but also precluded from regular use in neonates because of the risks of radiation exposure. Nevertheless, sick neonates frequently have chest and abdominal radiographs for other reasons, which can be used to assess OG/NG position. Abnormally placed feeding tubes on these radiographs may suggest an underlying urgent condition in which feeding is contraindicated. We report two

Abstract

Feeding tubes are commonly used in neonatal intensive care units, and their abnormal position seen on radiographs may indicate underlying serious problems. We recently cared for two infants who presented with clinical deterioration. An abnormally placed feeding tube seen on the chest radiograph revealed underlying serious conditions. The first case was an infant 29 weeks of age who presented with right-sided pneumothorax after birth. By history and a right-side-displaced orogastric (OG) tube, iatrogenic esophageal perforation was diagnosed. The second case was a 16-day-old infant who presented with recurrent vomiting. An OG tube extending into a cystic mass at the right cardiophrenic angle resulted in diagnosis of a herniated stomach with organoaxial-type volvulus, which required surgical repair. Both cases recovered uneventfully. As illustrated in these two rare cases, feeding tube position is not only important for feeding practice, but it also has diagnostic implications in newborn infants.
rare surgical cases in the newborn period to illustrate the role of feeding tube position in the diagnosis.

CASE 1
A 910-g male infant was born at 29 weeks to a 19-year-old G1P0 woman. The pregnancy was complicated by type 2 diabetes and HELLP syndrome. The infant was delivered by cesarean section for fetal heart rate decelerations. Apgar scores were 3, 5, and 9 at one, five, and ten minutes, respectively. Immediately after birth, he was suctioned orally with a silastic catheter and was successfully intubated on the third attempt to administer surfactant therapy and provide mechanical ventilation for respiratory distress. Intubation was followed by insertion of a polyvinyl chloride feeding tube, which was placed according to our guidelines. However, the clinical condition of the baby showed no improvement, and he remained in distress with low oxygen saturation. An anterior posterior (AP) chest and abdomen radiograph was performed to confirm endotracheal and feeding tube placement. On x-ray, the feeding tube is shown entering the upper esophagus and deviating to the right, causing a large right-sided pneumothorax, shifting mediastinal structures to the left (Figure 1). A needle thoracentesis was used to evacuate 30 mL of air from the right side. Reaccumulation of the air required evacuation by chest tube. A follow-up chest radiograph showed no residual air, but the OG tube was still abnormally placed (Figure 2).

By radiologic findings and the history, iatrogenic esophageal perforation (EP) was suspected. The feeding tube was removed, and a contrast study was performed on Day 4 of life. There was a high site of EP with a long blind path to the posterior mediastinum (Figures 3 and 4). An upper gastrointestinal endoscopy revealed an 8 mm tear in the esophagus at the cricopharyngeal junction. The most likely cause of this tear was trauma caused by a difficult intubation, followed by feeding tube insertion through the false passage. However, the infant’s general condition was stable enough to receive feedings through a nasojejunal (NJ) tube, which was inserted by a pediatric surgeon under endoscopic guidance. The perforation site was left to seal spontaneously. The NJ feeding was started with small amounts of breast milk and slowly increased to full feedings without complication. He was extubated to nasal continuous positive airway pressure on Day 7 of life, and no complication was observed. The NJ tube was replaced with an NG tube on Day 18 of life. The infant survived with no residual problem from the EP, and was discharged home from our Level II nursery.

CASE 2
A 16-day-old female infant was admitted for assessment of recurrent episodes of nonbilious vomiting. She was born at 36 and 4/7 weeks of gestation to an 18-year-old primigravid mother following an uncomplicated pregnancy and discharged home on Day 3 of life. The vomiting episodes were present after breastfeeding beginning on day 1 of life; choking was noted during these episodes. Her complaints were attributed to “mucousy” or “regurgitating” baby symptoms. Physical
examination revealed moderate-to-severe dehydration, body temperature of 38°C, and a heart rate of 180 beats per minute with decreased urine output. There was no respiratory distress. Capillary blood gas showed a severe compensated metabolic alkalosis with a pH of 7.46, PCO₂ of 77 mmHg, PO₂ of 65 mmHg, HCO₃ of 54.6 mmol/L, base excess +30 mmol/L, and lactate of 2 mmol/L, which suggested the diagnosis of pyloric stenosis, although the time of presentation was not typical. A chest and abdominal radiograph was performed after OG tube insertion. The OG tube was located abnormally in the right side of the chest after beginning to deviate around the T1 vertebrae. There was an air-containing cystic mass at the right cardiophrenic angle and supradiaphragmatic region. There was minimal intestinal air (Figure 5).

The baby was rehydrated, and, after transportation to our referral center, abdominal ultrasound revealed a liver and spleen of normal echotexture located within the upper abdomen. A mass containing gas and a linear echogenic area was best visualized within the midline upper abdomen and extending into the midline retrocardiac region (Figure 6). Intrathoracic herniation of the stomach was suspected. Surgery was performed, and a herniated whole stomach to the left parahiatal region was determined. Interestingly, the direction of the herniation was toward the right side, which appeared as a rightsided cystic image on the x-ray. Inside of the hernia sac, was an organoaxial gastric volvulus, which was repaired. There was no ischemic area. The infant made an uneventful recovery and was discharged with no sequelae after a 2-week hospital course.

**DISCUSSION**

Techniques for feeding tube placement are not standardized, and nonradiologic verification methods are frequently unreliable, making placement errors common.4 Because there is no visualization in commonly used techniques such as gastric content aspiration, pH of the aspirate, or by auscultation of air bolus, it is not uncommon to find a feeding tube in the esophagus or crossing the midline and extending beyond the pyloric sphincter. In a 2009 study, feeding tube placement was assessed by radiographic images. This study revealed that nearly half of the tubes were placed inaccurately in the esophageal or gastric orifice (7.1 percent), bent or curled in the stomach (35.3 percent), or beyond the pyloric sphincter (5.5 percent).4 Quandt and colleagues reviewed 381 radiographs in neonates, and they found that the most common error (61 percent) was looped or curled tubes in the stomach because of insertion farther than the desired distance.1 Occasionally, spiraling of the tube on a spot image could be a first sign of malrotation.8 Rarely, presence of a gastric
air shadow under the dome of the right hemidiaphragm and a right-sided feeding tube may reveal underlying situs inversus totalis and associated dextrogastria.9

In Case 2, a gastric shadow was visible above the right side of the diaphragm, which contained a feeding tube. However, in the first case, there was a normal gastric shadow at the left despite the OG placed in the opposite side. The combination of visible gastric shadow at the normal location and a feeding tube in abnormal position on the x-ray led us to suspect an EP, which was confirmed by subsequent contrast study. Therefore, it is important to verify whether feeding is safe when a structural or incidental problem is suspected on the x-ray because of a misplaced feeding tube.

The EP is a serious condition in newborns.10 Causes of EP include spontaneous rupture, traumatic injury, foreign body or caustic ingestion (mostly in children), and iatrogenic perforation. Of these, iatrogenic injury from instrumentation and tube insertion caused the most (63 percent) cases in newborns reported in the literature.10,11 By 2003, more than 100 cases had been reported.12 Infants weighing less than 1,500 g have weaker pharyngeal muscular structures and are at increased risk for iatrogenic EP.11,12 Indeed, 80–90 percent of affected newborns are preterms.12 The perforation usually occurs at the pharyngoesophageal junction. There is an anatomical narrowing in this area, and cricopharyngeal muscle shows reflex contraction when any foreign substance is introduced to the esophagus.11,12 Extension of the neck during intubation and compression of the esophagus by cervical vertebrae also makes this area vulnerable to injury during forceful intubation or feeding tube insertion.12–14

The EP presents in the newborn most commonly as difficulty in advancement of the feeding tube, and subsequent attempts result in failure. Therefore, it is mostly confused with esophageal atresia.12 However, a sudden clinical deterioration with respiratory distress, abnormal position of the NG/OG tube on radiographs, and difficulty in advancing the feeding tube may be some of the early indicators of EP.10 Less often, it presents as sudden respiratory distress secondary to a pneumothorax, resulting from communication between the esophagus and thoracic cavity. Finally, EP may rarely present as esophageal pseudodiverticulum secondary to incomplete cervical perforation.14,15 Four important clues indicating EP were suggested by Emil, which were (a) prematurity, (b) traumatic or multiple attempts for intubation or OG tube insertion, (c) bloody aspirate from the “pouch,” and, (d) unusual “blocking” point of the NP or OG tube (too high, too low, variable, or eccentric position).15 Those were present in Case 1 and, most likely, the multiple intubation attempts and subsequent placement of the OG tube were the reasons for the perforation and subsequent tear. The suspected cause of EP was confirmed after identifying a malpositioned NG/OG tube.16 The feeding tube tip was located on the right side of the chest instead of in the stomach on the left, providing the
first important evidence indicating underlying perforation. The feeding tube had most likely passed through the tear and extended down to the diaphragm level. As seen in Figures 3 and 4, there was a visible extraluminal contrast material in the mediastinum. Contrast studies using water-soluble substances help the diagnosis of EP if no obvious findings are seen on chest radiographs. They can also allow the clinician to visualize the exact location of the injury. However, water-soluble contrast may be seen outside the lumen of the esophagus in only 50 percent of cervical and 75–80 percent of thoracic perforations.17 Although, Shah and colleagues did not use contrast studies for diagnosis, it was used prior to commencement of feedings in 5/10 infants, which documented no leak.16 Although endoscopy allows the clinician to directly visualize the area, it also contains risk for worsening the damage.12

Treatment for neonatal EP typically is medical, with broad-spectrum antibiotics, parenteral or gastrostomy feedings, and tube thoracostomy if pneumothorax or pleural effusion is evident.15 Cervical esophageal leaks heal successfully with conservative management because of the location and containment by surrounding tissues.11 Shah and colleagues reported 3/10 deaths; however, they did not feel the deaths were a consequence of EP. In our case, no complication was observed during spontaneous sealing, and the infant was successfully discharged from the hospital. We believe that the risk of injury could be minimized by using proper intubation technique, using the appropriate size of endotracheal tube, and restraining from forceful advancement of the tube. In addition, extra care during placement and suctioning of feeding tubes is very important.

Congenital paraesophageal hiatus hernia is a rare condition in infants and more so when associated with volvulus of intrathoracic stomach, with only about 20 cases reported.18,19 Gastric volvulus is defined as primary when attachment or elongation of gastric fixation is absent or dysfunctional. It is called secondary when adjacent organs such as the diaphragm or spleen cause the volvulus.9 However, for intrathoracic herniation of the stomach to occur as was present in this case, the ligamentous attachments must be lax, and the diaphragmatic hiatus must be enlarged.19

The usual presentation is nonbilious vomiting, failure to thrive, and abdominal distention.8 Typical findings in the chest radiograph include the presence of associated anomalies (such as congenital diaphragmatic hernia or evagination of the diaphragm) and, frequently, an air-filled stomach in the chest. An absence of distal bowel gas has been reported.8 In Case 2, there was an air-containing cystic mass at the right cardiophrenic angle and supradiaphragmatic region, and there was no air shadow in normal left-side position of the gastric bubble. The abdomen was gasless. In addition, the feeding tube was directed to the right side. Our findings were confirmed by an abdominal ultrasound.

Emergent operative treatment is life saving because stomach volvulus can become strangulated and result in necrosis.8 In spite of a long history of vomiting and delay in diagnosis, there were no complications in Case 2, and the infant was discharged from the hospital after operative care. As shown in both cases, feeding tube positioning has diagnostic implications in the newborn period. Both cases in this report were rare and are associated with high mortality and morbidity. Therefore, any malpositioned feeding tube should be evaluated carefully, and the clinician should compare any symptoms with radiographic findings to determine whether other serious conditions may exist to allow for early diagnosis of these life-threatening conditions in newborns.

REFERENCES
About the Authors

Hanifi Soylu, MD, Medical Officer, Neonatology, Winnipeg Regional Health Authority.

Nathan E. Wiseman, MD, Associate Professor of Surgery, University of Manitoba.

Yasser El-Sayed, MD, Medical Officer, Neonatology, Winnipeg Regional Health Authority.

Man Yi, MD, Assistant Professor of Pediatrics and Child Health, University of Manitoba.

R. John Baier, MD, Associate Professor of Pediatrics and Child Health, University of Manitoba.

For further information, please contact:

Dr. Hanifi Soylu
Division of Neonatology
WS-012 Women’s Hospital
735 Notre Dame Ave.
Winnipeg, MB, Canada
R3T 4K8
E-mail: hasoylu@hotmail.com