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# Management of esophageal perforation in infants resulting from transesophageal echocardiogram probes☆

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ABSTRACT

Iatrogenic esophageal perforation in infants is an uncommon though recognized complication resulting from the insertion of a transesophageal echocardiogram (TEE) probe into the oropharynx. Infants requiring TEE are almost universally affected by underlying cardiac disease; thus, minimizing unnecessary interventions is the goal. We reviewed our institution's experience with esophageal perforation resulting from TEE probes in order to define effective management strategies. After IRB approval, we conducted a 12-year retrospective review of our institution's experience with esophageal perforation in infants resulting from TEE probes. During our study period, 3322 infants had a TEE probe placed. Four infants (age range 2–120 days) sustained an esophageal perforation from a TEE probe, indicating that the incidence at our institution is 0.12%. Evaluation with contrast esophagram or direct laryngoscopy confirmed the presence of perforation in all cases. Management consisted of broad-spectrum antibiotics and nothing per os. One patient developed a pseudodiverticulum, which regressed spontaneously. There were no other complications resulting from perforation. Transesophageal echocardiogram probe insertion in infants with cardiac anomalies can lead to esophageal perforation. These patients can be managed non-operatively with broad-spectrum antibiotics and nothing per os. Oral feeding may resume once the perforation is healed on esophagram.



Esophageal perforation in early infancy is a relatively infrequent complication. Thus, the literature on the subject is limited to sporadic case reports and small series. Esophageal perforation has been described following traumatic insertion of a nasogastric tube, endotracheal tube, and transesophageal echocardiogram (TEE) probe [1–11]. Although perforation resulting from nasogastric or endotracheal tube intubation is well characterized [12], only 1 report has described esophageal perforation due to TEE probe insertion [13].

Complications associated with iatrogenic esophageal perforation can be devastating and include pneumothorax, pneumomediastinum with associated infection, pseudodiverticulum formation and esophageal obstruction [4]. Treatment ranges from conservative strategies consisting of broad-spectrum antibiotics to thoracotomy with primary repair, but no standardized treatment regimen exists in the medical literature. Because most infant perforations result from feeding tube insertion, non-surgical treatment is an accepted management strategy. However, feeding tubes (3–4 mm in diameter) cause a relatively small perforation, whereas TEE probes (6–15 mm in diameter) cause much larger perforations with more dramatic implications. Most infants requiring a TEE have complicated cardiac anomalies, and therefore carry a high risk for operative mortality. Thus, additional surgery should be avoided if possible. Since reports of TEE perforation and its management are limited, we reviewed our institutional series in an effort to better describe management strategies and outcomes. Following IRB approval (IRB# 12–077), we performed a retrospective review of patients with esophageal perforations managed at our tertiary referral center between 2001 and 2012. During this period, 3322 infants had a TEE probe placed and 4 infants suffered a perforation (incidence = 0.12%). All 4 patients had evidence of esophageal perforation either by direct visualization or extravasation of contrast on esophagram. Their cases are presented below.



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## 1. Case reports

### 1.1. Case 1

A newborn full term female (weight 3.1 kg) was taken to the operating room for a truncus arteriosus repair. A TEE probe was placed prior to the procedure, and upon removal, the probe was noted to be blood tinged. An esophagram demonstrated extravasation of contrast from the left lateral cervical esophagus, collecting in the paratracheal region and extending up into the naso- and hypo-pharynx in a retrograde fashion (Fig. 1). Endoscopy was deferred given the critical condition of the infant resulting from his cardiac anomalies. A nasogastric tube was inserted under fluoroscopic guidance and the patient was placed on broad-spectrum antibiotics. Repeat esophagram 1 week later indicated a persistent leak. Distal enteric feeds were started, and repeat esophagram 2 weeks following perforation demonstrated no further leak. Antibiotics were discontinued and the patient was started on oral feeds. Total hospital length of stay was 23 days, and 9 month follow-up revealed appropriate weight gain and tolerance of an oral diet.

### 1.2. Case 2

A 3 day-old full term male (weight 3.0 kg) was taken to the operating room for repair of transposition of the great arteries and ventricular septal defect. Intraoperative TEE probe placement proved difficult and postoperatively blood was suctioned from the oropharynx. An esophagram on postoperative day 6 identified an esophageal perforation along the left anterolateral wall at the level of the thoracic inlet. Extravasation of contrast extended to the paraesophageal mediastinal region. The neonate was placed on broad-spectrum antibiotics and total parenteral nutrition (TPN) was started. Repeat esophagram 1 week later demonstrated resolution of the leak, but also primary aspiration. Antibiotics were discontinued and post-pyloric tube feeds were initiated. He subsequently underwent a Nissen fundoplication with gastrostomy feeding tube placement for gastroesophageal reflux disease. He was discharged on day of life 27 and at 12 month follow-up was gaining appropriate weight with gastrostomy tube feeds.

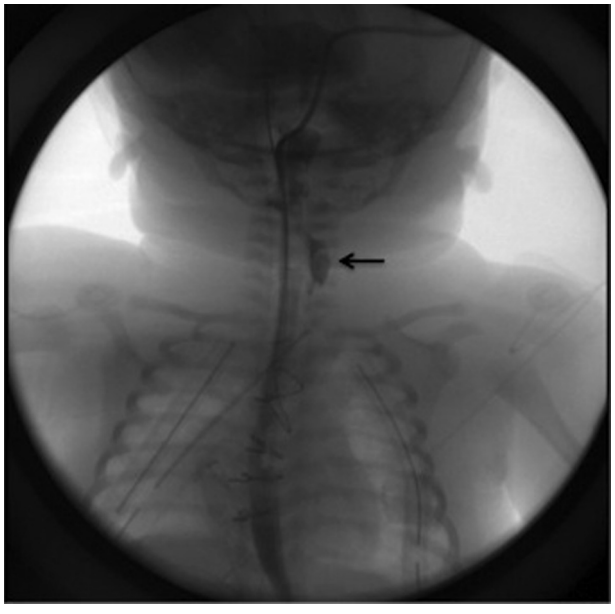

**Fig. 1.** Esophagram of a neonate with esophageal perforation. Anteroposterior view of extravasation of contrast from the cervical esophagus collecting within the paratracheal region (arrow).

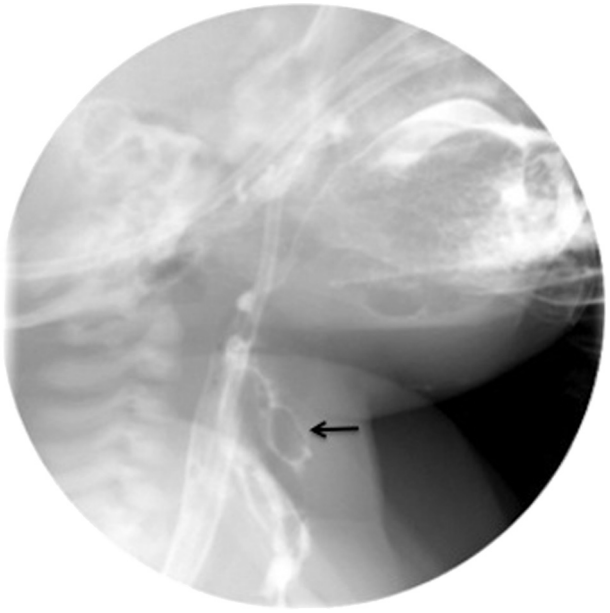

**Fig. 2.** Pseudodiverticulum following esophageal perforation. Lateral view of an esophagram performed 10 days after esophageal perforation. Arrow points to a pseudodiverticulum arising from the cervical esophagus.

### 1.3. Case 3

A 4 month-old ex-32 week premature male with trisomy 21 and a complete atrioventricular septal defect was taken to the operating room for a complete repair (weight at time of operation: 4.5 kg). A TEE probe was placed for cardiac monitoring and postoperatively blood was noted in the oropharynx. Intra-operative direct laryngoscopy identified a perforation with blood draining from the posterior distal oropharynx/cervical esophagus. The patient was placed on broad-spectrum antibiotics and nasogastric tube feeds. On postoperative day 2, an esophagram demonstrated resolution of the leak and antibiotics were discontinued. On postoperative day 4, feeds were initiated and he was discharged home in stable conditions on hospital day number 8.

### 1.4. Case 4

A 3 day-old full term female (weight 3.3 kg) with hypoplastic left heart syndrome was taken to the operating room for a stage I Norwood procedure, and a TEE probe was placed intraoperatively. Her postoperative course was complicated by persistent hemoptysis. An esophagram on postoperative day 10 identified a pseudodiverticulum arising from the posterolateral right wall of the cervical esophagus below the pharyngeal constrictor muscles with a mediastinal collection (Fig. 2). She was started on broad-spectrum antibiotics and nasogastric tube feeds. One week later, repeat esophagram noted marked attenuation of the defect, and at 3 months of age, follow-up esophagram identified only a small outpouching adjacent the right piriform sinus.

## 2. Discussion

Traumatic esophageal perforation is a rare complication of TEE probe insertion; however, sequelae can be grave and in some

cases lead to infant death [5,14]. The esophagus, which lacks a serosal layer and is surrounded by loose connective tissue, is particularly susceptible to perforation. The majority of foregut perforations occur at locations of anatomic narrowing, the most common of which is proximal to the cricopharyngeal constrictor muscles at the level of the introitus [15], and all 4 of our cases occurred at this level. To reduce the frequency of perforation, we recommend adequate probe lubrication, direct laryngoscopy to guide the probe into the proximal esophagus, and careful manipulation without excessive pressure. There is a disagreement as to whether prematurity and low birth weight predispose infants to perforations [16–18]. Our series of injuries all occurred in larger infants weighing over 3 kg with ages adjusted to full term. The absence of injuries in the low birth weight and premature infants is likely a reflection of our selection bias for probe placement as we consider children <2.5 kg to be a relative contraindication to TEE placement. Thus, we view patient selection to be an important variable.

We found that diagnosis is generally made upon removal of the TEE probe, which is evident by bloody secretions in the oropharynx or nasogastric tube. Additional exam findings that should heighten suspicion for esophageal perforation include cervical crepitus, pneumomediastinum, subcutaneous emphysema, and retropharyngeal gas [13]. Though these signs suggest esophageal perforation, they are not diagnostic, and esophagram and direct visualization remain the gold standards for diagnosis. In fact, we excluded 2 patients from this series who had oropharyngeal bleeding but no perforation on esophagram. A study performed by Greene et al. in which a flexible endoscope was placed in 50 children who previously had a TEE probe inserted found abnormalities ranging from petechiae to mucosa erosion in 64% [16]. Thus, it is entirely possible that some small perforations go unnoticed.

Management strategies must also be considered in this frail population as esophageal perforation occurs in the setting of enteric and respiratory tract flora. Bacterial contamination of the mediastinum and pleural cavity can be dire [11], and we recommend that treatment be instituted promptly. In doing this, we were able to avoid invasive therapies in all 4 cases reported. We did manage two patients with collections extending into the mediastinum but neither with recognized pleural extravasation. In both cases, broad-spectrum antibiotics and distal feeding or TPN were sufficient in preventing further complications. In all cases, an operation was averted.

## 3. Conclusion

Though this remains a small case series, our experience suggests that non-operative management with broad-spectrum antibiotics and nothing per os is a safe and effective treatment strategy in infants with TEE induced esophageal perforation.

## Conflict of interest statement

The authors have no conflict of interest to report.

## Consent

Written informed consent was obtained from the patient for publication of this case report and accompanying images.

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