Pediatric esophageal perforation

Although esophageal perforation in children is associated with a spectrum of disease different from the one in adults, management is essentially the same for both groups. Over the past 11 years, 12 patients ranging in age from 2 days to 10 years were treated for 13 perforations. Perforation in the adult is associated with a high mortality rate. All children in this series survived. Injury was secondary to instrumentation in 10 cases and three resulted from the chronic erosion of a trapped foreign body. Of the 10 acute perforations, five occurred 12 days to 5 months after lye ingestion. Anastomotic narrowing was a factor in three other cases. Seven of the acute perforations involved the thoracic esophagus and were associated with a high morbidity rate. Management consisted of operative as well as nonoperative approaches. Consideration must be given to several clinical variables including location, cause, predisposing factors, underlying illnesses, associated injury, and promptness of medical attention.


Esophageal perforation in children is associated with a different spectrum of disease from that found in adults. Contributing factors include the ingestion of foreign bodies and caustic agents and anastomotic strictures secondary to the repair of congenital defects. The management of esophageal perforations includes nonoperative treatment, drainage, and primary repair of the lesion. No large series of pediatric patients has been reported which might indicate that children should be managed differently from adults. We have reviewed the records of children with esophageal perforation at the Children’s Memorial Hospital in Chicago.

Patients

During the period from January, 1965, to March, 1976, 12 patients were treated for 13 esophageal perforations. There were four girls and eight boys, ranging in age from 2 days to 10 years. Perforation was secondary to instrumentation in 10 cases, and three others resulted from pressure erosion by a foreign body. Two of the acute perforations were managed nonoperatively; the rest underwent a variety of procedures. All children survived, though morbidity was often significant. We have not included two infants previously reported who were successfully managed conservatively for hypopharyngeal perforations secondary to oral or nasal intubations.

Table I lists the pertinent clinical and treatment data on our patients. The most common setting for an acute esophageal perforation was a recent lye stricture which required esophagoscopy and dilatation. The signs of perforation in these five patients developed within a few hours and consisted of fever, tachypnea, and tachycardia. Plain roentgenograms demonstrated pneumomediastinum or pneumothorax in four children and a Lipiodol swallow revealed the leak in the fifth. Drainage by an extrapleural mediastinotomy via the posterior approach was performed in three cases. The following case histories illustrate the potential consequences of esophageal perforation in this group of patients.

Case reports

Case I. F. M., at 34 months of age, required esophageal dilatations for a middle third stricture 2 months after swallowing a liquid drain cleaner. At home that evening he developed a fever of 102°F in association with tachypnea and tachycardia. Plain roentgenograms demonstrated pneumomediastinum or pneumothorax in four children and a Lipiodol swallow revealed the leak in the fifth. Drainage by an extrapleural mediastinotomy via the posterior approach was performed in three cases. The following case histories illustrate the potential consequences of esophageal perforation in this group of patients.

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Table I. Acute perforation

<table>
<thead>
<tr>
<th>Patient, age</th>
<th>Mechanism</th>
<th>Location</th>
<th>Signs, symptoms</th>
<th>Roentgenographic data</th>
</tr>
</thead>
</table>

**Predisposing factor: lye stricture:**

- J. N., 19 mo. (9/66)
  - Esophagoscopy, dilatation (12 days post ingestion)
  - Mid-esophagus
  - 102° F., tachypnea, tachycardia
  - Pneumomediastinum

- J. D., 16 mo. (12/66)
  - Dilatation (third) (13 days post ingestion)
  - Mid-esophagus
  - 101° F., tachypnea, tachycardia, irritability
  - Perforation into left extrapleural space (Lipiodol)

- F. M.,* 32 mo. (10/70)
  - Dilatation (first) (2 mo. post ingestion)
  - Mid-esophagus
  - 102° F., tachypnea, tachycardia, cervical crepitus
  - Right pneumothorax

- 44 mo.
  - Dilatation (esophagocolonic anastomosis)

- A. T., 35 mo. (9/72)
  - Esophagoscopy (5 mo. post ingestion)
  - Distal esophagus
  - Hematemesis, blood on scope
  - Right hydropneumothorax

- W. P., 30 mo. (7/73)
  - Dilatation (1 mo. post ingestion)
  - Distal esophagus
  - Hematemesis, grunting respiration, lethargy
  - Pneumomediastinum

**Predisposing factor: congenital defect:**

- D. B.,* 3 wk.
  - Dilatation (3 wk. post TEF repair)
  - Mid-esophagus
  - Blood on dilator, tachypnea, cyanosis
  - Tension pneumothorax

- L. C.,* 2½ yr.
  - Dilatation (post repair of previous TEF anastomosis perforation)
  - Mid-esophagus
  - 102° F., chest pain
  - Pneumomediastinum

**Predisposing factor: none**

- K. W.,* 10 yr.
  - Esophagoscopy (achalasia)
  - Lower cervical esophagus
  - Fever, cervical crepitus
  - Pneumomediastinum

- J. S.,* 2 days
  - Nasal catheter (diagnostic)
  - Hypopharynx
  - Excessive salivation, choking on feedings, fever, mild resp. distress
  - Hypopharyngeal perforation (contrast)

*See case history.

Dias. He also had cervical crepitus and diminished breath sounds over the right hemithorax (Fig. 1). Management consisted of tube drainage of the right side of the chest followed by evacuation of an empyema at thoracotomy 1 week later. At this time repair of the perforation was attempted. Parenteral hyperalimentation was begun the following day and continued for a month. Two weeks following the thoracotomy, an esophagogram revealed an esophagobronchial fistula. He was discharged 1 month after the perforation. One month later, the esophagopulmonary fistula was repaired by suturing the esophageal defect and covering it with a pleural flap. Subsequent to this operation, the child developed Hemophilus influenzae meningitis. Because of a persistent stricture of the distal two thirds of the esophagus, a right colon interposition was performed almost 3 months after repair of the esophagopulmonary fistula. One year following discharge the esophagocolonic anastomosis was perforated at dilatation (Fig. 2). This was treated by cervical drainage and subsequently revised 3 years later.

Instrumental perforation of strictures occurred in two children whose esophagus was being dilated for congenital lesions.
CASE 2. Perforation occurred in a 3 week-old baby, D. B., who had undergone repair of an esophageal atresia and fistula at 2 days of age. He swallowed poorly and had a narrow anastomosis, which at 10 days of age would admit only a size 12 bougie. This was progressively dilated until a size 20 bougie was introduced at 3 weeks of age. He became tachypneic and mottled almost immediately and a tension pneumothorax was seen on chest roentgenogram. Because of continued air leak with tube decompression, the child was operated upon. A 3 mm. longitudinal tear at the site of the previous anastomosis was repaired and covered with a pleural flap. He subsequently tolerated dilatations sufficient to effect a widely patent anastomosis.

CASE 3. L. C., a 2½-year-old boy, had in addition to a repaired esophageal atresia and fistula a congenital stricture of the middle third of the esophagus. The stricture had been dilated, perforated, and immediately repaired at another hospital a year prior to his admission to the Children’s Memorial Hospital. Six hours after dilatation with a Tucker bougie he developed chest pain and fever. A chest roentgenogram revealed a pneumomediastinum but no pneumothorax. A Lipiodol swallow demonstrated a small leak which was contained within the lower mediastinum. He was treated with intravenous antibiotics and 5 days later was started on gastrostomy feedings. By 10 days an esophagogram revealed spontaneous closure of the tear.
Two other instrumental perforations are illustrated by the following cases.

**Case 4.** The esophagus of K. W., a 10-year-old girl with achalasia of the esophagus, was perforated during esophagoscopy for evaluation of dysphagia. She became febrile and developed subcutaneous emphysema. A Lipidol swallow demonstrated a large leak into the posterior mediastinum. Despite immediate intravenous fluids and antibiotics, she became toxic and developed a right pleural effusion. After 5 days of nonoperative management, a foul-smelling mediastinal and cervical abscess was drained through the neck. For the next week saliva drained from the wound, which then closed spontaneously. Six months later she underwent a Heller esophagomyotomy at another hospital and is now able to swallow normally.

**Case 5.** A 2-day-old infant, J. S., was transferred to the Children's Memorial Hospital because of excess salivation and choking with feedings, fever, and mild respiratory distress. A physician had attempted to pass a flexible catheter through the baby's nasopharynx. Roentgenograms demonstrated a leak of contrast material posterior to the esophagus (Fig. 3) which resulted from a transverse tear in the mucosa of the hypopharynx. It was possible to pass a soft catheter under direct vision beyond the perforation into the stomach. The infant was fed through this tube for 10 days, after which time roentgenograms revealed spontaneous closure of the perforation. Subsequent to this injury, she is able to swallow formula normally.

Children with chronic foreign body perforation often develop respiratory symptoms rather than dysphagia (Table II). Two patients had a cough and the third developed frank respiratory distress and dysphagia. All three patients were febrile, two with fevers over 103°F. The dates of ingestion of the foreign bodies were not known in all cases; however, the onset of symptoms occurred after 3 weeks to 6 months in two children. Roentgenograms demonstrated an esophagobronchial fistula in one child. Endoscopy was performed in each case but attempts to remove the foreign body proved unsuccessful. Two patients required thoracotomy for removal of the objects and a third underwent a neck exploration for retrieval and drainage. The case histories of two patients are presented to illustrate the problem of chronic foreign body perforation.
CASE 6. B. J., a 22-month-old girl, was known to have swallowed a penny 1 year prior to her admission to the Children’s Memorial Hospital. The parents complained that she had a persistent cough dating to 6 months after the ingestion. At the time of admission the temperature was 103°F but the physical examination was normal. A chest roentgenogram revealed a round foreign body at the level of the suprasternal notch, lying between the trachea and esophagus, a soft tissue mass pushing the trachea slightly anterior (Fig. 4). There was no roentgenographic evidence of fistula formation to the trachea. Endoscopy revealed granulation tissue in the proximal esophagus, but no foreign body could be seen. The esophageal perforation site was exposed through a small supravacular incision just lateral to the right sternocleidomastoid muscle. A penny was removed from within a pocket of dense fibrous reaction and the neck was closed with a small drain after esophageal instillation of methylene blue failed to reveal a persistent fistula.

CASE 7. An 8-year-old boy, K. B., was admitted from the emergency room after a foreign body was seen on a chest roentgenogram taken to evaluate a persistent respiratory tract infection. The child had ingested a coin 3 weeks earlier and had been operated on at 1 day of age for esophageal atresia with tracheal fistula. On admission he had a right lower lobe pneumonitis and temperature of 99.6°F. A barium esophagogram revealed a right esophagobronchial fistula. At bronchoscopy only an edge of the coin could be seen in the wall of the trachea adjacent to the right upper lobe bronchus and the coin could not be removed. A week of chest physiotherapy, ultrasonic nebulization, and antibiotics were administered to prepare the child for thoracotomy. At operation the area of the perforation was located and, after removal of the coin, the defects in the esophagus and right mainstem bronchus were repaired with fine nonabsorbable sutures and separated by a pleural flap. The child was given nothing by mouth and alimented by gastrostomy feedings; however, 10 days later, a recurrent tracheoesophageal fistula was demonstrated on barium swallow. Management consisting of continued gastrostomy feedings resulted in spontaneous closure of the fistula several weeks later. He is now 2 years postoperative and doing well.

Discussion

The management of esophageal perforation is still controversial. In addition to the location of the perforation, other factors to be considered are the type of perforation, the existence of intrinsic esophageal disease, and whether the perforation involves normal, scarred, or neoplastic tissue. The time interval between perforation and institution of therapy and the general health and age of the patient are important. The over-all mortality rate is up to 40 percent in some series. In addition to iatrogenic causes, perforation of the esophagus in the pediatric age group has occurred spontaneously and secondary to ingestion of foreign bodies and caustic agents.

Numerous articles have appeared presenting various approaches to the management of esophageal perforation. Nonoperative management has been advocated; however, others report a higher mortality rate with this approach. Perforation of the cervical esophagus, pharynx, or hypopharynx may be managed nonoperatively. Surgical drainage was unnecessary in two of the three patients in this series as well as in two reported previously. Drainage of the cervical esophagus is performed whenever a patient fails to respond to antibiotics and oral restriction.
The management of thoracic esophageal perforation has been a more controversial subject. The decision regarding operative versus nonoperative management depends upon the clinical situation and past history of the patient. Patients with perforation of lye strictures are frequently manageable nonoperatively. It has been theorized that the local peri-esophageal cicatrix associated with the stricture greatly limits the mediastinal contamination. This can be applied only to those patients whose scarring has had sufficient time to be substantial. Four of our five patients in this category were within 2 months of acute injury at the time of perforation. Two patients managed with tube thoracostomy developed empyemas, even though one had a diverting cervical esophagostomy and gastrostomy. Both patients experienced considerable morbidity requiring further surgery. Both patients would have been better managed by open thoracotomy immediately. Three patients presenting with pneumomediastinum after lye stricture perforation were drained by posterior, extrapleural mediastinotomy, an empyema resulting in one. These patients experienced less morbidity with prompt drainage.

Two patients perforated through previous operative sites presented with pneumothorax in one and pneumomediastinum in the other. A thoracotomy for drainage and primary repair was performed in the former, being only 3 weeks after tracheoesophageal fistula repair. The latter patient was managed nonoperatively and promptly improved. We assumed his perforation was small and contained in periesophageal scar tissue.

Children with caustic strictures who suffer a perforation are unlikely to have a salvageable esophagus. Consideration should be given to cervical esophagostomy, division of the esophagus below the diaphragm, and a gastrostomy. Later some form of esophageal bypass would be indicated.

In three other patients, perforation of the esophagus occurred secondary to chronic erosion by foreign bodies. In each case surgical removal was necessary. One patient required treatment for an esophagotracheobronchial fistula, the primary repair of which proved unsuccessful.

Conclusion

Management of pediatric patients after esophageal perforation must be individualized, taking into consideration the location and nature of injury, history of previous esophageal damage, association of pneumothorax or hydrothorax, and general health of the patient. They may, in general, be managed with the same procedures that have been successful in adults, with excellent results. Nonoperative management is possible for cervical perforations and perforations of the thoracic esophagus after chronic peri-esophageal scarring has been established. Immediate drainage is performed for perforations through a normal or only recently damage esophagus. Association of pneumothorax or hydrothorax requires open drainage of the pleural space and mediastinum. Primary repair may be attempted with an unscarred esophagus; however, success is unlikely if direct suture is attempted with a scarred esophagus or when significant delay of

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Table II. Erosion perforation

<table>
<thead>
<tr>
<th>Patient, age</th>
<th>Foreign body</th>
<th>Location</th>
<th>Signs, symptoms</th>
<th>Predisposing factor</th>
<th>Radiographic data</th>
</tr>
</thead>
<tbody>
<tr>
<td>D. P., 9 mo. (8/66)</td>
<td>Metallic button</td>
<td>Upper thoracic esophagus</td>
<td>102.6° F., tachycardia, dysphagia</td>
<td>None</td>
<td>Foreign body in retro-trach. location</td>
</tr>
<tr>
<td>B. J.,*22 mo. (2/74)</td>
<td>Penny (known ingestion)</td>
<td>Thoracic inlet</td>
<td>103° F., persistent cough</td>
<td>None</td>
<td>Foreign body in retro-trach. location</td>
</tr>
<tr>
<td>K. B.,* 8 yr. (2/74)</td>
<td>Coin (known ingestion)</td>
<td>Midesophagus</td>
<td>99.6° F., cough tachycardia</td>
<td>Tracheoesophageal fistula repair at 1 day of age</td>
<td>Foreign body in mediastinum Esophagotracheobronchial fistula RLL pneumonitis</td>
</tr>
</tbody>
</table>

*See case history.
operative management has occurred. Management of chronic foreign body perforation usually requires only removal of the object and drainage of the site. Adjacent structures may be involved, however, requiring more extensive repair.

REFERENCES


