Management of Esophageal Perforation

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Perforation of the esophagus remains a major surgical problem. Controversy persists concerning appropriate treatment of this condition, which has diverse causes. Changes in surgical practice in recent years, including the availability of total parenteral nutrition, more powerful and selective antibiotics, and improvement in surgical techniques for long-term esophageal reconstruction led to a reconsideration of the principles for managing esophageal perforation. Experience with 48 esophageal perforations in 47 patients during the past decade is reviewed to assess the current success rate with an aggressive approach to this serious condition.

Patients

Among the 47 patients, 40 were treated at the University of Chicago Hospitals and Clinics and 7 at the Johns Hopkins Hospital. Forty-four of the patients were treated personally by the authors and the remaining 3 by colleagues. In 38 instances we were responsible for the initial treatment of the patient after the diagnosis of esophageal perforation. Ten other patients received initial treatment for perforation at other institutions and were referred to us for further treatment. In each case the details of the initial perforation and treatment were known.

Twenty-eight of the patients were male and 19 female. Thirty-six were white and 11 black. Their ages ranged from 6 weeks to 80 years. Two of the patients were children; 10 were aged 20 to 50 years, 22 were aged 51 to 60 years and 13 were aged 61 to 80 years.

Timing of Treatment

Review of the clinical records ascertained the cause of perforation, the time and nature of initial treatment, the outcome, and subsequent operative therapy. In 23 patients the initial treatment was given less than 24 hours after the onset of symptoms of perforation. In 24 patients treatment was not given until more than 24 hours after the onset of symptoms. One patient received no specific treatment. Of the patients receiving treatment within 24 hours, 15 made a full recovery without complication. This was a significantly greater success rate (p < 0.05) than the uncomplicated recovery of 9 of the 24 patients who received treatment more than 24 hours after perforation. The time factor is of critical importance in managing perforation of the esophagus and must be taken into account when various types of treatment are proposed.

Causes of Perforation and Death

The causes of the 48 esophageal perforations are listed in Table I. Ten deaths (21 per cent) occurred within 30 days of perforation or as a direct result of perforation and its subsequent correction. Since 10 patients had already survived the initial treatment for perforation before being referred to us and none of them died subsequently, the mortality rate, corrected to account for the patients who received initial treatment at our institution, was 26 per cent (10 deaths in 38 perforations). The underlying disease leading to the perforation effects the therapeutic choices.

Types of Treatment Used

Several types of treatments were used. Primary closure consisted of thorough exploration of the region of perforation, cervical, thoracic or abdominal; identification of the disrupted edges of the mucosa; debridement of necrotic mucosa and muscle; and precise approximation of the mucosa and submucosa, generally using a single layer of interrupted or running 5-0 monofilament wire suture. Appropriate drainage of the chest, neck or abdomen was employed. This approach was used in 12 early and 3 late perforations.

Drainage alone referred to management by appropriate chest tube drainage or drains placed in the cervical fascial spaces or region of the hiatus if the perforation was intraabdominal. Indwelling nasoesophageal or nasogastric tubes, gastrostomy or feeding jejunostomy was generally used. There was no specific attempt to close the perforation or divert...
the esophageal contents in patients managed by drainage alone. This was the method chosen in three early and five late perforations.

Resection was the initial treatment in four early and five late perforations. After esophagectomy, including the perforated portion of the esophagus, a primary anastomosis, esophagogastrostomy, was performed in three patients. In six patients a cervical esophagostomy and closure of the cardia with a feeding gastrostomy was performed after resection.

Eleven patients (two early and nine late) were treated by diversion of the esophagus, which included a side or end cervical esophagostomy with drainage of the intrathoracic esophagus, ligation or division and oversewing of the cardia, and feeding gastrostomy.

Two patients were treated initially by an indwelling Mousseau-Barbin tube for tracheoesophageal fistula, and one patient was treated by an endoluminal nasoesophageal tube and a feeding jejunostomy. In one patient the initial procedure was substernal colon bypass, and one patient received no treatment. The use of these types of treatment in each diagnostic category is discussed.

**Instrumental Esophageal Perforation**

Instrumental disruption of the esophagus occurred in 16 patients in four settings. Five patients had a perforation resulting directly from esophagoscopy. In four the rigid esophoscope was employed, and in one the flexible esophagoscope was the cause of perforation. The exact incidence of endoscopic esophageal perforation is not known because the total number of endoscopies performed by the operators responsible for the perforations is not known. However, the senior author was responsible for two perforations occurring among a total of 670 esophagosopies performed during the 10 years covered by this review, an incidence of 0.3 per cent.

Four perforations occurred during pneumatic bag forceful dilatation of the esophagus for achalasia. The incidence of this complication has been reported to be approximately 5 per cent [1]. As a result, all pneumatic dilatations at our institution are scheduled so that a member of the surgical team is available when dilatation is performed. This insures prompt early operation when rupture occurs. This team approach has proved effective for the safe use of pneumatic dilatation in the treatment of achalasia.

Three perforations occurred during endoscopic bougie. The diagnosis ultimately proved to be carcinoma in two patients and a benign stricture in one. Perforations occurred during intraoperative dilatation of strictures in four patients. It is standard practice at our institution to include intraoperative dilatation in the management of benign strictures. If a stricture can be successfully dilated to a no. 40 to 60 French bougie, then a primary antireflux repair is performed. If the dilatation is difficult, additional procedures are often necessary. In each of these four patients the stricture proved difficult to dilate. In one primary resection and colon interposition was performed, and in the other three patients the perforation was closed by converting it into a transverse esophagotomy and including the repair within a fundoplication.

In 13 patients the diagnosis was made early after instrumental perforation; primary closure was accomplished in 10, drainage alone in 2 and a diversion in 1. In the latter patient, an unresectable carcinoma had been perforated by bougination. In three patients the diagnosis was not made within the first 24 hours and delayed surgery was performed. Primary closure was attempted in one and drainage alone in two. Among these 16 patients there was one death from aspiration pneumonia in a patient with massive gastroesophageal reflux who aspirated during anesthesia for drainage of a cervical perforation. Late strictures developed in three patients and late fistulas in three. One patient required late drainage of chronic empyema. In two patients, the fistulas healed spontaneously during prolonged treatment with total parenteral nutrition supplemented by jejunostomy tube feedings. Four patients later required a reconstructive procedure including resection of the fistula or stricture and colon interposition in three and intraoperative dilatation of a stricture and antireflux repair in one.

When instrumental perforation occurs, the diagnosis should generally be made early. In any patient who complains of persistent chest or epigastric pain several hours after endoscopy, perforation should be suspected and a contrast radiographic study performed. When early diagnosis of the perforation is
made, prompt surgical treatment should relieve the underlying esophageal disease, if possible, as well as close the perforation. The underlying cause of instrumental esophageal perforation was achalasia in five patients, reflux stricture in four, carcinoma in two, previous esophagogastrostomy in two, a foreign body in one, reflux in one and newborn intubation in one. When achalasia is the underlying disease, we prefer to close the perforation primarily and then perform formal myotomy in a location away from the perforation at the cardia. The myotomy is carried into the stomach and a formal antireflux repair is made to buttress both the closure of the perforation and the myotomy.

When the underlying cause is stricture, this should be dealt with by resection, transverse or patch closure, or dilatation and antireflux repair. If a carcinoma is perforated at endoscopy, resection should be performed promptly if possible. Otherwise a diversion procedure followed by radiation therapy is performed. When the underlying diagnosis is gastroesophageal reflux, an antireflux repair should be done at the time of early closure of the perforation.

Neoplastic Perforation

Perforation of an esophageal neoplasm may occur spontaneously or during radiation therapy and may cause a chronic mediastinal abscess, free perforation into the pleura or a tracheoesophageal fistula. Thirteen such patients are included in these series. Three patients died as a result of perforation, but the remaining 10 were able to be treated for the perforation and underwent further treatment. They survived 4 to 16 months after perforation and died from metastatic disease.

Malignant perforation into the mediastinum or pleura developed in five patients, spontaneously in two and during radiation therapy in three. Resection of the entire perforation and abscess cavity and adjacent tissues was performed in two patients, but one died 1 month later. Drainage alone was performed in one patient, who died from tube erosion of the aorta several weeks later. One patient was treated by substernal colon bypass and interruption of the cervical esophagus; she lived for 10 months after the procedure. The final patient in this group lived 4 months after a diversion procedure and additional x-ray therapy.

Eight patients presented with a malignant tracheoesophageal fistula, which occurred spontaneously in two and during radiation therapy in six. Two were treated with initial success by the insertion of a Mousseau-Barbin tube that closed off the fistula. This was poorly tolerated by one patient, who later underwent substernal colon bypass and lived for 4 months after the initial perforation. Six patients were treated by diversion; one died postoperatively from severe pneumonia and sepsis. The remaining five patients survived for 4 to 16 months and were able to undergo radiation treatment for the malignant fistula; three of them were able to resume an oral solid food diet with the use of an extracorporeal esophagogastric tube [2]. The other patients in this group could not adjust to the use of the cervical tube and preferred to maintain their nutrition by gastrostomy feedings with a collection bag applied to the cervical stoma for saliva. It is clear from this experience that perforation of an esophageal neoplasm indicates an incurable condition; however, the patients can undergo palliative treatment and expect some prolongation of life and a return to home surroundings.

Postoperative Esophageal Rupture

In 10 patients perforation occurred in the esophagus or an esophageal replacement after surgery in the region. This report does not include leaks from esophageal anastomoses, which represented another type of diagnostic and therapeutic problem. In three patients the esophageal rupture occurred after a hiatal hernia or antireflux repair. In only one patient was the injury suspected at the time of surgery. In one patient the perforation was recognized promptly when it occurred 8 days after a Mark IV repair. Primary closure was performed, reinforced by a pedicle of adjacent diaphragmatic muscle. The patient recovered uneventfully. In the other two patients the diagnosis was not recognized initially. Primary closure was attempted in one but a chronic fistula resulted, requiring later resection and colon interposition. In the second patient primary resection and esophagogastrostomy was performed, but leakage occurred and a subsequent colon interposition was necessary.

In three patients disruption occurred after a venous infarction of colon interposition. In these patients the diagnosis was not recognized until 7 to 17 days after the interposition, and resection of the infarcted colon segment alone was performed. One patient chose to continue with the extracorporeal esophagogastroduodenal tube for the remaining 18 months of his life. A second patient later underwent successful jejunal interposition, and the third patient died from sepsis.

In two patients rupture of an esophagomyotomy occurred, and in a third patient rupture developed after radical pneumonectomy that included resection of a portion of esophageal muscle. In one patient perforation occurred 1 week after myotomy for severe
esophageal spasm, while he was eating his first solid meal. The diagnosis was initially missed and the patient was subsequently treated by drainage alone but died from overwhelming fungal infection. The second patient underwent a repeat esophagomyotomy after an initial myotomy that was not carried into the stomach and failed to relieve dysphagia from achalasia. Again a late diagnosis of esophageal perforation was made, and evidence of a lower mediastinal abscess was found at resectional surgery. The patient subsequently underwent a colon interposition, which also infarcted, and died as indicated earlier. The third patient, who had undergone radical pneumonectomy and radiation therapy, was treated by diversion. The fistula persisted into the pneumonectomy space, and the patient died approximately 1 month later.

The final patient in this group had undergone Collis gastroplasty as a third operation for complications of gastroesophageal reflux. The patient had previously undergone splenectomy. Eight days after surgery, sudden symptoms of esophageal perforation occurred, and barium swallow examination showed disruption of the gastroplasty tube. This was resected and proved necrotic. The patient had an uneventful recovery and later underwent successful colon interposition.

In the management of ruptured esophagus after previous esophageal surgery, the diagnosis may be missed because it is not suspected. Another postoperative complication such as pulmonary embolus or myocardial infarction may be initially blamed for the symptoms. If the perforation is diagnosed promptly, it may be possible to perform primary repair, particularly if the original esophagus remains intact. However, if the rupture occurs in the reconstructed esophagus, it is likely that an inadequate blood supply is the cause. Resection should be the first treatment, with later reconstruction planned after the patient has recovered.

### Spontaneous or Traumatic Perforation

In six patients, Boerhaave’s syndrome, blunt chest trauma or a gunshot wound accounted for esophageal perforation. In two patients with a bullet wound of the esophagus, the diagnosis was made promptly; primary closure was performed successfully in one. In the other patient diversion was necessary because of the extent of damage to the esophagus. A fistula developed but healed spontaneously, and colon interposition was later performed successfully.

In the three patients with Boerhaave’s syndrome and one patient with blunt trauma causing esophageal rupture, the diagnosis was delayed longer than 24 hours. Primary closure was attempted in one patient but broke down; chronic empyema and bronchoesophageal fistula developed, which later required esophagectomy and decortication. Diversion was accomplished successfully in one patient; later the ligation of the cardia was successfully removed and the pharyngostomy closed. In one patient late resection was performed, and subsequent drainage of empyema was necessary; the patient eventually died from multiple pulmonary emboli. The final patient in this group was treated by drainage alone, which resulted in a chronic esophagopleural fistula. This was treated later by decortication and closure of the fistula.

This experience emphasizes the importance of early diagnosis, as three of the four patients who underwent late treatment developed serious complications and one died. Primary closure is the procedure of choice when the diagnosis is made early after spontaneous or traumatic esophageal perforation.

### Other Causes of Perforation

In two patients perforation occurred from acid peptic ulceration of the esophagus. In one patient the Zollinger-Ellison syndrome had been diagnosed, for which the patient was scheduled to undergo elective surgery at the time of perforation. Initially drainage alone was performed, but the large volume of acid solution exiting from the chest tube necessitated early emergency total gastrectomy. The esophagus was left in situ and sepsis continued, resulting in the patient’s death from acute pericarditis. In the second patient a benign tracheoesophageal fistula developed above an esophagogastric anastomosis performed for resection of carcinoma. In this case the patient was mistakenly thought to have a malignant fistula after resection, and no treatment was given. At autopsy a benign esophageal ulcer was found eroding into the trachea.

In one case of severe lye ingestion, a tracheoesophageal fistula developed in the early postingestion period. This was treated initially by esophageal suction and jejunal tube feedings. Esophagectomy and colon interposition were performed later.

### Results of Immediate Versus Delayed Treatment

Table II summarizes the results of treatment given within 24 hours after perforation. When primary closure of the perforated esophagus was possible, successful healing occurred without complication in 9 of 12 patients. The remaining three patients de-
TABLE II  Results of Initial Treatment Within 24 Hours After Perforation

<table>
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<tr>
<th></th>
<th>No. of Patients</th>
<th>Success</th>
<th>Complications</th>
<th>Deaths</th>
<th>Secondary Operations</th>
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<tr>
<td>Primary closure</td>
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<td>9</td>
<td>3</td>
<td>0</td>
<td>3</td>
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<tr>
<td>Drainage</td>
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<td>2</td>
<td>1</td>
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<tr>
<td>Resection</td>
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<td>3</td>
<td>1</td>
<td>0</td>
<td>3</td>
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<tr>
<td>Diversion or Intubation</td>
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<tr>
<td>Total</td>
<td>23</td>
<td>15</td>
<td>7</td>
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<td>8</td>
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TABLE III  Results of Initial Treatment Later Than 24 Hours After Perforation

<table>
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<tr>
<th></th>
<th>No. of Patients</th>
<th>Success</th>
<th>Complications</th>
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<th>Secondary Operations</th>
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</thead>
<tbody>
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<td>3</td>
<td>0</td>
<td>3</td>
</tr>
<tr>
<td>Drainage</td>
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<tr>
<td>Resection</td>
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<td>0</td>
<td>3</td>
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</tr>
<tr>
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<td>0</td>
<td>2</td>
</tr>
<tr>
<td>Total</td>
<td>24</td>
<td>10</td>
<td>8</td>
<td>7</td>
<td>10</td>
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Developed fistulas or strictures and required secondary operations. A similarly high success rate was obtained from initial resection of the esophagus, when necessary, followed by reconstruction. Only drainage alone failed to give satisfactory results as initial treatment for early perforation. This experience emphasizes that a definitive procedure can be successfully accomplished in most patients with esophageal perforation if the initial treatment is given shortly after perforation. The overall mortality in this group was less than 10 percent.

When initial treatment was given more than 24 hours after perforation, the results were quite different (Table III). Primary closure or drainage alone resulted in no uncomplicated successes. Fistulas or strictures developed in six patients, and two died. Resection, if possible, or diversion or endoluminal intubation was necessary in 16 patients, resulting in 5 deaths (31 percent); one fistula and one abscess occurred as nonfatal complications. Taking into account that eight patients in this group had been referred to us after they had survived initial delayed treatment, the corrected mortality for the treatment of delayed perforation in our hands was 7 of 16 patients or 44 percent.

Recently, several reports have advocated drainage alone for ruptured esophagus, with reliance on antibiotics and total parenteral nutrition to support the patients during recovery [3,4]. These ancillary methods were used in conjunction with drainage alone in eight patients in our series, but four of them died, and the remaining patients had serious complications from this approach. Drainage alone for esophageal perforation, whether diagnosed early or late, cannot be advocated as a safe or effective method of treating this condition.

Secondary Operations

Among the 38 patients surviving the initial treatment for esophageal perforation, 19 later required secondary operations including colon interposition in 11 and jejunal interposition in 1, to replace the resected or diverted esophagus. Other operations performed included antireflux repair, total gastrectomy, decortication, reversal of the diversion and resection of the esophagus in one patient each, and late drainage of empyema in two patients. After the secondary operations there were two deaths, one after necrosis of a colon interposition and one in a patient who underwent total gastrectomy for the Zollinger-Ellison syndrome after drainage of a perforated esophageal ulcer.

Summary

Early diagnosis of esophageal perforation is critical. The importance of performing sufficient surgery at the first procedure whenever possible is emphasized. If early primary closure cannot be achieved, then the initial therapeutic method of choice is resection or diversion followed by reconstruction. Drainage of the perforated esophagus alone does not appear to be satisfactory treatment. Our experience indicates that later elective surgery for the management of patients undergoing successful initial resuscitation from esophageal perforation may be accomplished with an acceptable mortality rate.

References