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Iatrogenic Esophageal Injuries: Evidence-Based Management for Diagnosis and Timing of Contrast Studies After Repair

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Leakage from gastroesophageal repair is considered a major complication and is often associated with increased hospital stay, morbidity, and mortality. Management of these patients is variable among surgeons. Cases managed by the thoracic surgical service from March 1, 2010 to March 1, 2011 were retrospectively reviewed. Eight patients met criteria for inclusion: 4 were repaired primarily, 2 by debridement with diversion, and 2 by Ivor-Lewis resection and reconstruction. Esophograms were completed between 1 and 7 days postoperatively. Of the 8 patients treated, there was 1 mortality (12%) due to fungal mediastinitis. Soluble contrast imaging revealed 2 leaks (25%), 1 contained and 1 diffuse, which was the only mortality. Changes in clinical status, even minor, require contrast imaging of the esophagus to assess repair integrity. Timing of contrast study is variable in the literature, averaging 5 to 14 days. A conservative time frame is 7 days, unless any clinical suspicion of an esophageal leak exists.

Key words: Esophagus – Perforation – Esophogram

Leakage from a gastrointestinal repair or anastomosis is considered a major complication and is often associated with increased hospital stay, morbidity, and mortality. The management of thoracic esophageal perforations may be infrequently encountered and, according to the literature, the management of these perforations is variable.[1] This article discusses our experience with iatrogenic esophageal perforations with an emphasis on the diagnosis, operative, and postoperative management. A discussion on imaging studies and the timing of these studies is the primary focus of the present article, and the recommendations are made by evidence-based recommendations. The ultimate purpose is that surgical and nonsurgical physicians may use the content as a guide in the management of patients with esophageal

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Table 1 Demographics, injury, and repair

Patient	Age (y)	Sex	Mechanism of injury	Type of repair
1	44	Female	EGD	Primary
2	60	Male	EGD	Primary
3	74	Male	Delayed lap-band	Debridement
4	86	Female	Diaphragmatic hernia repair	Ivor-Lewis
5	52	Female	Lap-band-hiatal hernia repair	Debridement, cervical esophagostomy
6	47	Male	Lap-band	Primary
7	73	Male	Repeat hiatal hernia repair	Primary
8	65	Female	Re-op 3rd hiatal hernia repair	Ivor-Lewis

EGD, esophagogastroduodenoscopy.

perforations to help improve clinical outcomes in this subset of very ill patients.

Patients and Methods

All patients managed by the thoracic surgical service include cases diagnosed, consulted, and/or treated from March 1, 2010 to March 1, 2011. These patients were retrospectively reviewed. Expedited Institutional Review Board approval was obtained for this retrospective chart review study. Inclusion criteria required iatrogenic esophageal injury; spontaneous Boerhaave cases were excluded. Eight patients qualified for inclusion. Ages ranged from 44 to 86 years (mean 63 years). There were 5 men and 3 women in the cohort. The mechanism of injury ranged from esophagogastroduodenoscopy, hiatal hernia repair, diaphragmatic hernia repair, and lap band placement. Surgical repair included primary debridement and repair, diversion and drainage, and resection (Table 1). All patients were intubated with a double lumen endotracheal tube. Central venous and arterial lines were placed by anesthesia. The patients were positioned for thoracotomy with abdominal access by a modified lateral decubitus position on an inflatable bean bag. A standard posterior-lateral thoracotomy was performed, surgical debridement, repair or resection were performed as indicated. Two thoracic drains were placed before closure of the chest. A second laparotomy incision was made and a gastrostomy decompression tube was placed. Feeding jejunostomy tubes were also placed in all patients. If primary repair was not feasible, a diverting cervical esophagostomy was performed.

Table 2 Postoperative days to esophagram

Patient	Postop to Esophogram (d)	Leak	Mortality
1	1	No	No
2	5	No	No
3	7	Contained	No
4	7	No	No
5	7	Diffuse	Yes
6	3	No	No
7	5	No	No
8	7	No	No

The timing for operation to contrast imaging ranged from 1 to 7 days (mean 5 days) (Table 2). There was 1 mortality (12%) in the 8 patients, occurring in a post-lap-band patient, who developed fungal mediastinitis.

Contrast imaging was completed in the radiologic department using soluble contrast media. Two patients exhibited a repair leak (25%). A small, contained leak was noted in the diaphragmatic hernia patient. The second leak occurred in the post-lap-band patient and was extensive, revealing a delayed repair disruption. This patient required additional surgical intervention and died as a result of mediastinitis and irreversible sepsis. All surviving patients were discharged to home or to a rehabilitation center for continued care. Of the patients who were not amenable to primary esophageal repair, an esophageal diversion procedure was carried out. This consisted of two major components. The first was gastrostomy drainage to divert all gastric secretions and prevent gastroesophageal reflux. The second was the creation of a cervical esophagostomy. This procedure is completed by a cervical incision at the medial border of the sternocleidomastoid muscle; the carotid artery and jugular vein are retracted medially allowing access to the cervical esophagus. A proximal nasogastric tube is helpful to guide in the identification of the esophagus. An esophagostomy is made and the opening is suspended to the skin with nonabsorbable suture. A drainage bag is helpful in collecting secretions.

Results

Recognition and the early diagnosis of distal esophageal perforations have led to a decline in

mortality associated with this problem. Aggressive and definitive surgical management has been adopted by many physicians. Kiernan *et al*,[2] in a retrospective five year review of 48 distal esophageal perforations, recommend aggressive definitive surgical management in both early and late diagnosed patients. Patients (25/48) who were diagnosed $\leq$ 24 hours after admission had a 92% survival rate, which increased to 96% if combined with aggressive surgical management. Patients diagnosed $\geq$ 24 hours in hospital had a survival rate of 82.6%, and, when combined with aggressive surgical management, increased to 92.3%. In this particular paper, surgical recommendations were varied from debridement with diversion, debridement with primary repair or flap, transhiatal resection, and Ivor Lewis thoraco-abdominal approach. Postrepair contrast swallowing studies were completed on all survivors; the timing for the study was not discussed in the manuscript. Functional swallowing studies were completed in 92% (42/44) of the patients. Twenty-one of 23 patients (91.3%) reported good to excellent swallowing function.

Three surgical techniques were used to repair or treat the eight iatrogenic esophageal perforations: primary repair, debridement, and debridement with diversion. Three patients underwent primary repair which involves direct suture closure reinforced with variable regional tissue with concurrent correction of underlying esophageal pathology, elimination of any contamination and potential pleural space. Debridement involves removal of edematous mucosal edges to expose healthy tissue. Prior to repair, further longitudinal incision of the muscle layer is required to completely visualize the entire mucosal defect.[3,4] All perforations are repaired in two layers. Interrupted silk or polyglactin sutures are used to close the mucosa and submucosa while the muscle layer is closed with interrupted silk sutures only.[3,5] Pleural tissue, intercostal muscle[3,6] or diaphragmatic tissue[2,5] are used as reinforcement to supplement the initial suture and prevent potential postoperative leak. Irrigation of the pleural spaces and mediastinum follow, with subsequent placement of one or two drainage tubes in the thoracotomy incision prior to closure.[5]

The Ivor-Lewis technique, performed on two patients, combines a laparotomy with a right thoracotomy in two phases.[3] Laparotomy and mobilization of the stomach based on the right gastric and right gastroepiploic arteries constitute the first phase.[3] Minimally invasive techniques for the first phase involve placement of five abdominal laparoscopic ports to visualize the abdomen, rule out disease, and mobilize the stomach and retract the liver.[7] The second phase involves a right thoracotomy, esophageal resection and esophagogastric anastomosis within the thoracic cavity.[3] Because the fundus of the stomach has increased ischemic vulnerability, Pennathur *et al*[7] suggest creation of the esophagogastric anastomosis such that the tip of the fundus is not used. The anastomosis is buttressed with previously mobilized omental tissue to prevent postoperative leak.

The University of Michigan reported[8] on its primary esophageal repair experience. The authors reported a 20%–32% leakage rate at the site of primary repair; contained leaks were managed conservatively, and major leaks required delayed esophagectomy. They did not report on postrepair imaging studies or time to imaging.

Long[9] discusses in his 2006 paper a review of current imaging studies. A plain chest radiograph can be helpful in diagnosing esophageal perforation in about 90% of cases, if the following are present: pneumomediastinum with subcutaneous emphysema, and mediastinal air-fluid levels with left-sided pleural effusion. However they also suggest a confirmatory contrast esophagram. They also discussed utilizing a water-soluble agent like Gastrografin as an initial study, which has a 60%–75% sensitivity rate. A barium study has a 90% sensitivity rate but can cause severe mediastinal inflammation. A contrast-enhanced CT scan of the chest may also assist in the diagnosis of perforation. The authors did not discuss recommendations as far as timing for postrepair esophograms in these surgical patients.

An extensive systematic literature review was completed by Bruce *et al*[10] and published in 2001. They completed a systematic review of the published literature on anastomotic leaks, radiographic definitions, and measurements of the leaks. Ninety-seven studies were reviewed, and 56 separate definitions of anastomotic leak were identified at three sites: upper gastrointestinal, hepato-pancreatobiliary and lower gastrointestinal. They concluded that there was no universally accepted definition of anastomotic leak, measurement of leaks or timing to contrast examination. Of the 33 studies specific for upper gastrointestinal evaluation, there was a wide range of timing for an esophageal contrast examination. The range for imaging was between 4 and 14 days, without any consensus between the authors as far as timing of the study.

Devenney-Cakir *et al*[11] briefly discuss the potential role of imaging in follow-up management of

esophageal perforations. They conclude that a postoperative CT can be performed if there is a change in patient symptoms or if catheter output draining the abscess ceases; however, they do not mention the timing of symptom onset or imaging.

In a 2002 study by Sung *et al*, [5] 6 out of 20 patients (30%) requiring anastomosis for iatrogenic esophageal perforation developed postrepair esophageal leaks. These 6 patients represent 43% of 14 total patients who underwent surgical repair after 24 hours had elapsed from initial diagnosis. Five were contained and healed with conservative management, and one developed a fistula necessitating reoperation with successful reinforcement by a diaphragmatic flap. Timing of discovery of leaks was not mentioned, but Sung *et al* documented no evidence of postoperative leaks by esophagography in a postoperative range of 7 to 10 days. Morbidity rate for repair occurring after 24 hours was more likely (64%) than repairs occurring within 24 hours of diagnosis. Mortality rate was 7%; one patient with Boerhaave syndrome died secondary to ongoing sepsis and multi-organ failure.

Regarding iatrogenic esophageal perforations during laparoscopic adjustable gastric banding (LAGB) surgery, there is variability among authors about the timing and necessity of postoperative contrast study. For example, following review of a postoperative esophageal leak secondary to orogastric intubation during LAGB surgery, Soto *et al*[12] strongly recommend a Gastrografin swallow on the first postoperative day for all bariatric procedures. Nehoda *et al*[13] initially suggest imaging with a water-soluble contrast agent such as a jopamidol swallow (JS) at a concentration of 612.4 mg/ml and computer tomography if JS is not confirmatory in suspected postoperative cases. However, in their 2001 study, JS failed to detect post-LAGB esophageal leaks in 2 out of 4 patients (50%). Thus, they suggest that unless postoperative complications are suspected, a routine early postoperative liquid contrast study is not required.

As far as imaging studies, there is much diversity among authors. Swanson *et al*[14] in a retrospective study advocate the use of high-density barium contrast (250% weight/volume). They found 46 leaks in patients studied from 1998 to 2002. Twenty-three (50%) were detected with a water-soluble contrast agent, and 23 (50%) were detected with high-density barium. They conclude that the use of a high-density barium study should be done if no leaks are found on the water-soluble contrast study.[6]

However, Gray *et al*[15] caution that the use of high-density barium contrast is not without possible complications.[6] They reported two fatalities associated with the use of this contrast agent. The aspiration of the high-density contrast material can cause an acute pulmonary reaction with profound inflammation[6,15] and fatal hypoxemia.[15]

Vogel *et al*[16] disagree with the use of Gastrografin, stating that when used in the chest, Gastrografin shows a blurred picture and does not reveal the perforation well. They further recommend the use of oral barium contrast used for CT scans. Seventeen out of 47 cases reviewed were iatrogenic thoracic esophageal perforations and were conservatively treated initially with placement of chest tubes and/or nasogastric chest tubes. CT and UGI radiologic examinations were performed 2 days after tube placement to evaluate healing. In this study, nonspecific radiologic studies were performed frequently based on the fever status and overall clinical condition of the patient. Eight patients with concurrent pneumonia required frequent CT scans after chest tube placement to rule out persistent fluid collections as the cause of recurrent fevers. One patient out of the 17 underwent primary repair for an early iatrogenic perforation and subsequently died, representing the only mortality among all iatrogenic thoracic esophageal perforations; 4 others were treated with surgical drainage and survived. Timing of postoperative imaging study was not mentioned specifically.

In conclusion, esophageal perforation carries a significant morbidity and mortality with estimated rates of 72% for Boerhaave syndrome, 19% for iatrogenic, and 7% for traumatic perforations. Morbidity and mortality are directly attributed to the overwhelming inflammatory response to gastric contents in the mediastinum. Of interest, the negative intrathoracic pressure may exacerbate injury by drawing material out of the esophagus.[17] Early detection is paramount in reducing the effects of the perforation; however, current literature is vague on managing patients who are diagnosed intraoperatively (procedure perforation) and have been repaired at the same setting.

We recommend based on our experience that any change in clinical status, even minor, requires contrast imaging of the esophagus in order to assess integrity of the repair. Clinical changes may include fever, mediastinal pain, marked and acute leukocytosis, new or persistent pleural effusion with or without particulates, newly detected air leak from the chest drains, or anorexia. As far as postoperative timing of the contrast study, the literature supports anywhere from 5 to 14 days postrepair; a conservative time frame would be about 7 days postrepair.

If repair is not possible, the use of a diversion procedure is recommended. In our experience, a cervical esophagostomy as initially described by Ware[18] is simple and easily performed, allowing diversion of oropharyngeal secretions. Rigberg *et al*[19] reviewed their experience with this technique and found that the survivability of esophageal perforation, with diversion in the face of ongoing sepsis, was 72%. They also reported that 67% of the patients who survived underwent later reconstruction.

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