Selective management of intrathoracic anastomotic leak after esophagectomy

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Objective: We sought to analyze our experience with management of intrathoracic anastomotic leak after esophagectomy.

Methods: All patients who had intrathoracic anastomotic leaks after esophagectomy were reviewed. Management and factors affecting outcome were analyzed.

Results: From March 1993 through February 2003, 761 patients had esophagectomy with intrathoracic anastomosis at our institution. Forty-eight (6.3%) patients had an anastomotic leak; one refused authorization to review his medical record and was excluded from further analysis. Twenty-four (51.1%) patients had a contained leak. Twenty-seven (57.4%) patients were managed nonoperatively. Twenty (42.6%) patients required surgical intervention that included primary anastomotic repair in 14 patients, reinforcement of the anastomosis with viable tissue in 6 patients, and esophageal diversion in 2 patients. A single reoperation was done in 15 patients, and 5 patients had 2 reoperations. Median hospitalization in the reoperative group was 31 days (range, 15-97 days) and 20 days (range, 10-42 days) in the nonoperative group ($P = .0037$). Four (8.5%) patients died. Cause of death was sepsis in 2 patients and multiorgan failure and myocardial infarction in 1 patient each. At follow-up (median, 8 months; range, 1-120 months), 10 (58.8%) patients in the reoperative group were eating a normal diet and 5 (29.4%) patients required at least one dilatation compared with 20 (76.9%) patients in the nonoperative group who were eating a normal diet and 9 (34.6%) who required at least one dilatation. A noncontained leak had an adverse effect on long-term survival ($P = .04$).

Conclusion: Intrathoracic anastomotic leak after esophagectomy is associated with significant morbidity and mortality. Contained leaks often can be managed nonoperatively. When surgical management is required, esophagogastric continuity can often be maintained in the majority of patients. Long-term functional results are satisfactory and similar in both the reoperative and nonoperative groups. However, a noncontained leak adversely affected long-term survival.

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Inrathoracic esophagogastric anastomotic leak after esophagectomy is a significant cause of morbidity and mortality.¹⁻² Although many leaks can be managed nonoperatively, a significant number still will require reoperation.^{2,3} The optimal method of surgical management, however, remains controversial, with opinions ranging from esophageal diversion⁴ to primary repair.⁵ The purpose of this study is to review our recent experience with the management of intrathoracic anastomotic leak after esophagectomy.

Patients and Methods

From March 1, 1993, to February 28, 2003, 761 patients underwent esophagectomy with intrathoracic esophagogastric anastomosis at the Mayo Clinic, Rochester, Minnesota. An anastomotic leak was identified in 48 (6.3%) patients. One patient refused authorization to review his medical records for this project and was excluded from further analysis. In the remaining 47 patients the leak was confirmed either by radiographic contrast examination or at the time of reoperation. The medical records of these 47 patients were retrospectively reviewed for age, sex, chemoradiation therapy, details of the surgical procedure, pathologic findings, diagnosis and management of the esophageal leak, outcome, and long-term survival. An anastomotic leak was defined as disruption of the esophagogastric anastomosis, the gastric staple line, or both, identified by radiographic contrast examination, operative exploration, or both.^{6,7} An anastomotic leak was considered contained when no communication existed with the pleural cavity and only minimal extension into the mediastinal space occurred; otherwise, the leak was considered noncontained. Operative mortality was defined as any death occurring during the first 30 postoperative days or during the same hospitalization. Outcome analysis for late mortality began at either hospital discharge or 30 days after esophagectomy, whichever occurred first. Because there were only 4 hospital deaths in the cohort, there is no assessment of risk factor association with this outcome. Overall patient survival was estimated by the method of Kaplan and Meier.⁸ The date of esophagectomy was the starting point, and the date of death or last follow-up was the end point. The associations of continuous variables with survival were evaluated with Cox proportional hazards models.⁹ The α level was set at .05 for statistical significance. The Mayo Clinic College of Medicine Institutional Review Board approved this study.

Clinical Findings

There were 47 patients (42 men and 5 women) in the study. The median age was 63 years and ranged from 27 to 81 years. Indication for esophagectomy was malignancy in 40 (85.1%) patients, Barrett disease with high-grade dysplasia in 4 (8.5%) patients, achalasia in 2 (4.3%) patients, and a peptic stricture in 1 (2.1%) patient. The cancer was located at the gastroesophageal junction in 33 patients, the distal esophagus in 6 patients, and the upper thoracic esophagus in 1 patient. The cell type was adenocarcinoma in 37 patients and squamous cell carcinoma, leiomyosarcoma, and melanoma in 1 patient each. The cancer was classified as stage 0 in 1 patient, stage I in 5 patients, stage IIA in 13 patients, stage IIB in 2 patients, stage III in 15 patients, stage IVA in 3 patients, and

stage IVB in 1 patient. Nine (19.1%) patients received neoadjuvant chemoradiation therapy. Associated conditions were present in 32 (68.1%) patients and included coronary artery disease in 16 (34.0%) patients, chronic obstructive pulmonary disease in 8 (17.0%) patients, diabetes mellitus in 8 (17.0%) patients, alcoholism in 8 (17.0%) patients, and peripheral vascular disease in 7 (14.9%) patients. Twenty-nine (61.7%) patients were chronic smokers. Thirteen (27.7%) patients had a prior upper abdominal surgical procedure that included an esophageal antireflux procedure in 6 patients and a gastric bypass, pyloroplasty, staging laparotomy, modified Heller myotomy, gastrostomy, choledochoduodenostomy, and endoscopic mucosectomy in 1 patient each.

The esophagectomy was performed through an Ivor Lewis approach in 46 (97.9%) patients and a left thoracoabdominal approach in 1 (2.1%) patient. Our surgical technique for esophagectomy has been previously described.¹⁰ The stomach was mobilized and was used as a conduit to reestablish gastrointestinal continuity in all cases. The anastomosis was hand sewn in 2 layers in 27 (57.5%) patients and in 1 layer in 19 (40.4%) patients. A linear stapling device was used in 1 (2.1%) patient. The anastomosis was reinforced with pleura in 17 patients, omentum in 6 patients, and mediastinal fat in 1 patient. A pyloromyotomy was performed in 44 (93.6%) patients, and a pyloroplasty was performed in 1 (2.1%) patient. Two (4.2%) patients had no drainage procedure. A feeding jejunostomy was placed in 11 (23.4%) patients. Other concomitant procedures were performed in 17 patients and included lung resection in 8 patients, liver biopsy in 3 patients, cholecystectomy in 2 patients, and removal of a gastrostomy catheter, splenectomy, lysis of adhesions, and appendectomy in 1 patient each. The pulmonary resections included a wedge excision in 6 patients and a lobectomy in 2 patients. Four patients had intraoperative radiation therapy. One patient had a positive microscopic esophageal margin.

Results

Fifteen (31.9%) patients with esophageal leaks were asymptomatic. Signs and symptoms were present in the remaining 32 (68.1%) patients and included pleural effusion in 27 patients, leukocytosis in 25 patients, shortness of breath in 19 patients, fever in 16 patients, chest pain in 8 patients, hypotension in 6 patients, atrial dysrhythmias in 6 patients, bilious drainage from the chest tube in 6 patients, hydro-pneumothorax in 6 patients, vomiting in 4 patients, subcutaneous emphysema in 4 patients, and renal failure in 2 patients.

Forty-five (95.7%) patients underwent diagnostic evaluation that included oral contrast examination in 37 (78.7%) patients, computed tomography (CT) of the chest with oral contrast in 23 (48.9%) patients, and both in 15 (31.9%) patients. Nineteen (40.4%) of these patients had an initial negative contrast examination result before a subsequent examination demonstrated the leak, with the diagnosis being made on the basis of repeat oral contrast examination in 11 patients, CT in 4 patients, and clinical findings and intraoperative examination in 2 patients each. The median

TABLE 1. Group characteristics of 26 patients admitted to the intensive care unit

	Reoperative, no. (%)	Nonoperative, no. (%)
Sepsis	8 (17.0)	3 (6.4)
Dysrhythmia	7 (14.9)	5 (10.6)
Renal failure	5 (10.6)	0
Myocardial infarction	1 (2.1)	0
Mechanical ventilation	16 (34.0)	2 (4.3)
Tracheostomy	5 (10.6)	0
Inotropic support	8 (17.0)	2 (4.3)
Hemodialysis	4 (8.5)	0

time interval from the initial negative study result to diagnosis of the leak was 5 days (range, 0-9 days).

Overall, esophageal contrast examination demonstrated the leak in 42 (93.3%) of the 45 patients. The leak was limited to the mediastinum in 28 (62.2%) patients. Twenty-four of these mediastinal leaks were localized and considered contained; the remaining 4 were diffuse and therefore considered noncontained. The leak extended into the pleural space in 14 (33.3%) patients and involved the right pleural cavity in 12 patients, the left pleural cavity in 1 patient, and both cavities in 1 patient; all were considered noncontained. Overall, contrast examination revealed that the leak was contained in 24 patients and noncontained in 18 patients. The median time interval from esophagectomy to diagnosis of the anastomotic leak was 7 days (range, 3-18 days), with 13 patients given diagnoses more than 10 days postoperatively. Fourteen patients had oral intake initiated, and 4 patients were discharged from the hospital before the leak was diagnosed.

Eleven patients with esophageal leaks underwent immediately reoperation, 9 because of large noncontained leaks after contrast examination and 2 without any preoperative imaging studies because of copious bilious drainage from the chest tubes. The remaining 36 patients were initially managed conservatively after diagnosis of the leak by withholding oral diet and instituting both supplemental nutrition and broad-spectrum antibiotics. Contrast examinations were repeated at 1 week, and oral intake was gradually resumed if the leak decreased or resolved. Ten patients failed conservative management, and 9 underwent reoperation. Indications for reoperation were noncontained leaks in 6 patients and gastric outlet obstruction, chylothorax, and empyema in 1 patient each. The tenth patient had a non-contained leak that rapidly made him septic. Reoperation was advised, but the patient and family refused permission to proceed. This patient subsequently died of multiorgan failure 15 days after esophagectomy.

Twenty-seven patients, including the patient who died, were managed entirely nonoperatively. Fifteen patients

were asymptomatic. The remaining 12 patients were symptomatic, and 4 had a noncontained leak. Three were considered adequately drained by the chest tubes, and the fourth patient (described above) refused surgical therapy and died of sepsis. At the time of hospital dismissal, 25 of these 27 patients had begun oral intake. Median time interval to oral intake was 13 days (range, 5-29 days).

Twenty (42.6%) patients required surgical intervention, 11 immediately after diagnosis and 9 after failure of conservative management. Reoperations were performed at a median of 10.5 days after esophagectomy (range, 3-31 days) and 1 day (range, 0-26 days) after the diagnosis of anastomotic leak. All patients in the reoperative group had symptomatic leaks. Indications for reoperation were large non-contained leaks in 14 patients, persistent bile drainage in 3 patients, gastric outlet obstruction in 1 patient, chylothorax in 1 patient, and empyema in 1 patient. At reoperation, the source of leak was at the anastomosis in 14 patients and at the gastric conduit staple line in 2 patients. These 2 leaks were adjacent to the anastomosis. In 4 patients no leak was identified at surgical exploration, although all had a leak confirmed by oral contrast examination. The esophagus was viable in all patients. The gastric conduit was viable in 18 patients, partially necrotic in 1 patient, and completely necrotic in another patient. The leak was closed primarily after debridement in 8 patients, and the anastomosis was taken down and redone in 6 patients. Esophageal diversion with gastric conduit resection and cervical esophagostomy was performed in 2 patients, both as a result of extensive gastric necrosis, which precluded reanastomosis. The repaired anastomosis was reinforced with pleura in 4 patients and omentum and serratus anterior muscle in 1 patient each. The anastomosis of the 4 patients without an identifiable leak was not redone but was also reinforced with pleura. Concomitant procedures performed included empyema drainage with decortication in 3 patients and right upper lobectomy, bronchus intermedius repair, and thoracic duct ligation in 1 patient each. In 1 patient the thoracotomy wound was left open and packed with gauze after reoperation.

Five patients required a second reoperation at a median of 16 days (range, 2-25 days) after the first reoperation. Indications for the second reoperation were abdominal eventration, empyema, chylothorax, cholecystitis, and delayed thoracotomy wound closure. No patient required a second reoperation for recurrent leakage. Three of the patients undergoing reoperation died, 2 of sepsis and 1 of a myocardial infarction. Seventeen patients were dismissed from the hospital, and 12 had begun oral intake. The median time interval to oral intake was 21 days (range, 11-43 days).

Overall, 26 (55.3%) of the 47 patients required admission to the intensive care unit. Group characteristics of these 26 patients are listed in Table 1. Median hospitalization for

the reoperative group was 31 days (range, 15-97 days) compared with 20 days (range, 10-42 days) for the nonoperative group ($P = .0037$).

Follow-up was complete in all 43 survivors and ranged from 1 month to 10 years (median, 8 months). Fourteen patients required anastomotic dilatation, 5 (29.4%) in the reoperative group and 9 (33.3%) in the nonoperative group. Oral intake was possible in 30 patients, 10 (58.8%) in the reoperative group and 20 (76.9%) in the nonoperative group. Two patients required additional operations during follow-up. One patient who had esophageal diversion underwent 2 operations, an inferior mesenteric artery endarterectomy 7 months after the original esophagectomy and a successful colonic interposition 1.5 months after the endarterectomy. This patient, however, is currently on a waiting list for kidney transplantation. The other patient required a pyloroplasty for gastric outlet obstruction 6.8 years after the original esophagectomy. Twenty-two patients are currently alive (10 in the reoperative group and 12 in nonoperative group). One patient who had esophageal diversion died 4.5 months after hospital discharge before intestinal continuity was reestablished.

Overall 5-year survival was 25.7% (95% confidence interval [CI], 8.4%-43.2%). The only factor that affected survival was the presence of a noncontained leak. Five-year survival in the noncontained leak group was 15.0% (95% CI, 2.8%-30.4%) compared with 32.5% (95% CI, 15.9%-66.5%) in the contained group ($P = .04$, Figure 1). Sex, age, operation versus conservative management, presence of symptoms, sepsis, and need for inotropic support had no significant effect on long-term survival.

Discussion

Although intrathoracic anastomotic leak occurs in less than 10% of patients,^{2,3,11} it is one of the most feared complications of esophageal resections because of its associated high morbidity and mortality.^{1-7,12,13} In the present study esophageal leaks occurred in 6.3% of our patients. Others have reported similar rates.⁶ The presentation of intrathoracic esophageal leak ranges from patients who are asymptomatic to those with circulatory collapse and multiorgan system failure. The severity of presentation is largely dependent on whether pleural space contamination and gastric necrosis occur.¹¹

Some esophageal anastomotic leaks are suspected clinically, but most are ultimately diagnosed by radiographic esophageal contrast examination.¹⁴ In our study initial contrast swallow examination failed to document the leak in nearly half of the patients. Repeat oral contrast swallow or CT with oral radiographic contrast, however, was more sensitive in leak detection. These methods detected leaks in 40% of our patients that were not previously detected by contrast swallow examination. Others have reported similar findings.^{2,3,15} Some investigators have recommended en-

Figure 1. Probability of survival in 43 patients who were dismissed from the hospital after esophageal anastomotic leak. The **continuous line** represents the group with a contained leak. The **broken line** represents the group with a noncontained leak. Zero time on the abscissa represents the date of esophagectomy. **Vertical bars** on the curve represent 95% CIs.

doscopy for both diagnosis of the leak and assessment of gastric conduit viability,^{3,11} although we have not routinely used endoscopy for fear of enlarging the perforation and spreading the infection.

The management of intrathoracic anastomotic leaks should be individualized and guided by the severity of the symptoms and the magnitude of the leak. Asymptomatic patients and some symptomatic patients, especially those with small contained leaks,¹⁴⁻¹⁶ often can be managed conservatively. In these patients supportive care should be instituted, and the contrast examination should be repeated in 5 to 7 days before oral intake is resumed.

Surgical intervention is indicated for symptomatic, non-contained, intrathoracic, esophageal anastomotic leaks and for those leaks for which conservative management has failed. In our series 1 of 4 patients with symptomatic non-contained leaks who were managed nonoperatively died. Therefore, patients with noncontained leaks that are septic should be rapidly resuscitated and immediately explored. At exploration, the pleural cavity and mediastinum should be widely debrided and drained.³ Additional intraoperative management will depend on the extent of viability of the esophagus and gastric conduit and on the overall medical condition of the patient. Some surgeons advocate esophageal diversion by resection of the gastric conduit with cervical esophagostomy and delayed reestablishment of intestinal continuity.^{3,4} However, this approach commits the patient to a prolonged and potentially hazardous intestinal reconstruction.¹⁵⁻¹⁷ Our preference has been a selective approach to the surgical management of patients with esophageal leaks. Most of these patients can be managed with a lesser surgical procedure that preserves intestinal continuity. If the leak is identifiable and the gastric conduit is healthy, the inflamed margins of the leak can be excised, and the anastomosis can be closed. If the gastric conduit is

partially necrotic, resection of the necrotic stomach and reanastomosis might be possible. We believe that the repair should then be reinforced with healthy well-vascularized tissue, such as omentum, pleura, pericardium, or pedicled muscle flap. Authors have recommended placement of either a silicone stent across the repair or a T-tube across the leak, with the T-limb acting as a chest thoracostomy drainage system.¹⁸ We, however, have not used either approach. In our opinion esophagogastric resection and diversion should be reserved for patients with necrosis of the gastric conduit that precluded reanastomosis or for those with profound sepsis and severe hemodynamic instability. Two of our patients required esophageal diversion, and only one survived long enough to be reconstructed.

Successful management of patients with an esophageal anastomotic leak is often associated with the development of an anastomotic stricture during long-term follow-up, and many of these patients will require subsequent dilatation.^{11,17,19,20} Long-term functional results achieved with either reoperative or conservative management are similar, with nearly identical rates of stricture formation requiring dilatation and similar tolerance of oral intake.

In summary, intrathoracic anastomotic leak after esophagectomy is associated with significant morbidity and mortality. Initial radiographic contrast swallow examination fails to diagnosis many of these leaks. Contained leaks often can be managed nonoperatively. When surgical management is required, esophageal diversion is not necessary in the majority of patients, and esophagogastric continuity can often be maintained. Long-term functional results are satisfactory and similar in both the reoperative and nonoperative groups. However, a noncontained leak adversely affects long-term survival.

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Discussion

Dr Richard F. Heitmiller (Reisterstown, Md). As an introduction, I would like to acknowledge the Mayo Clinic's high-volume experience and long-term expertise with transthoracic approaches to esophageal resection and reconstruction. Their results have set the benchmark standards for these difficult operations. I also congratulate the authors for being willing to report their complications. Despite our best efforts, anastomotic complications continue to occur, and we can all learn from your experience. Overall, postesophagectomy safety and outcome are reported to be equivalent, regardless of the esophagectomy technique used. On the other hand, the effect of an anastomotic leak on a patient's postoperative course varies greatly depending on whether the anastomosis is located in the neck or the chest. Even though leaks might be an infrequent occurrence, they persist despite all our attempts to prevent them. In this study the authors report a 6% leak rate. The rate of leakage did not seem to be related to the specific anastomotic technique. The effect of an intrathoracic esophageal leak is dramatic. In your study the mortality was 8.5% overall and 15% in the reoperative group. The hospital stays for the operative and nonoperative groups, respectively, were 31 and 21 days. Given these results, has your group considered moving the anastomosis to the neck by using either a transhiatal or, if you feel a thoracotomy is essential, a 3-incision approach? Why even deal with this complication? A cervical anastomotic leak is much easier to deal with. The diagnosis of cervical leaks is easy, and treatment involves bedside drainage. Because it is my practice to routinely use an adjuvant jejunostomy tube, patients can be managed as outpatients, with cervical wound dressings and enteral feedings. This keeps the length of hospital stay short, only minimally longer than that of a patient who has an uncomplicated outcome. In my opinion oral contrast studies, especially those with video or cine techniques, have been very accurate at diagnosing anastomotic leaks. I

do not recall having any patient have a clinical leak after a negative initial study, although I know this is reported to occur. Your experience with oral contrast evaluation of the intrathoracic anastomosis is different than mine in the evaluation of cervical anastomosis. You report an overall successful diagnosis of anastomotic leak by oral contrast in 93% of patients. However, 40% of your patients had an initial negative study result, and the median time from initial study to the diagnosis of a subsequent leak was 5 days. It is not clear to me how an intrathoracic anastomosis anatomically would change the sensitivity of an oral contrast study. The surgical principles for managing free intrathoracic leaks are clearly outlined in your study: re-explore, assess esophagogastric viability, debride the leak site as needed, reclose, consider secondary coverage, and provide adequate chest drainage. You do not recommend resection or diversion methods unless there is gastric conduit ischemia. I would agree with this policy. Diversion of a previously resected esophagus is difficult, and redo reconstructions are complex and take time. Because most of your patients had esophageal cancer, it is important to restore normal swallowing function promptly.

My questions are as follows: What is your management plan for contained leaks? When do you feed these patients? How do you provide nutritional support? You have a long hospital stay for these contained leaks. It seems more conservative than what I would think necessary.

Dr Crestanello. Well, regarding the management plan for the contained leaks, it depends on whether those patients are symptomatic. Patients who are asymptomatic with a contained leak are usually treated conservatively. Most of the time, the treatment is successful. However, we have to recognize that given the high failure rate in the identification of the leak by the oral contrast examination, even though we might an initial study that shows a contained leak, if the patient remains septic, we should persevere and try to repeat the studies (gastrograffin or CT with contrast) to rule out a noncontained leak. Regarding the nutritional support, a significant proportion of these patients, approximately 60%, had feeding jejunostomies that were placed at the same time as the original operation. Therefore the nutritional support in those cases was ensured through this feeding jejunostomy. For the remaining patients, the nutrition was provided through parenteral nutrition.

Dr Heitmiller. When are contrast studies routinely performed after esophagectomy? How is that test done? Is it a standard barium swallow? Is it using video esophagography?

Dr Crestanello. The study that is currently performed in the Mayo Clinic is a gastrograffin swallow at 4 to 7 days postoperatively. This is followed immediately by a thin barium examination if no leak is present. A video swallow is performed when aspiration is suspected.

Dr Heitmiller. Can you comment on the difference in survival, the long-term survival in the free leak versus the contained leak? Is that difference related to the upfront difference in mortality, or is there something related to that event that leads to long-term survival differences?

Dr Crestanello. There is clearly a difference in the hospital mortality in patients who have contained and noncontained leaks. Perhaps there is something associated with the biology of those patients that determined that they had a noncontained leak that made them more inclined to have a worse survival. But we do not

have an explanation to completely account for that difference in the survival. However, if you look at the survival curves, they are pretty much parallel, and the difference in survival is mostly associated with the initial mortality.

Dr Heitmiller. This study spanned 10 years' time. Were there any trends that you observed, and what are the lessons learned for your group? Is there anything that you have learned that might reduce the length of stay or reduce the incidence of anastomotic leaks in the future?

Dr Crestanello. The incidence of anastomotic leak is pretty much consistent—has been consistent throughout the years—and the changes have been related to the performance of the anastomosis. Some of the surgeons changed from doing a single-layer anastomosis to doing a double-layer anastomosis. And regarding the intraoperative management of these patients who have esophagogastric resections, more of the surgeons have decided to do a feeding jejunostomy.

Dr Mark J. Krasna (Baltimore, Md). We have a very similar experience, somewhat smaller, with intrathoracic anastomoses. There are 2 things that we have found, and I would like to ask you to answer each of them. Number one, we believe that patients who have an intrathoracic anastomosis have better early postoperative function in terms of their swallowing ability. Do you find that, and is that the reason that the Mayo Clinic currently still does intrathoracic anastomoses?

Dr Crestanello. Absolutely.

Dr Krasna. When both you and Dr Heitmiller were talking about the survival curves, in a recent study that we are doing on this exact topic that is not yet published, one of the striking findings was that patients who had early intrathoracic leaks actually had a worse cancer-free survival, and I wonder if you have any of those data, Juan, because I think Dr Heitmiller's question is a very good one. You might be affecting the patient's overall immune status, and therefore you are seeing more patients come back with cancer, or perhaps in retrospect these patients actually had cancer along wherever the leak occurred, and you had incomplete resections. Have you looked at either of those questions?

Dr Crestanello. Regarding the swallowing function in patients who had intrathoracic anastomosis versus a cervical anastomosis, our belief is, as you say, that the swallowing function is better in the patients who had an intrathoracic anastomosis compared with the patients who had a cervical anastomosis. The rate of stricture is less in the chest compared with in the neck. Regarding the cancer-free survival in this group of patients compared with the overall group of patients who had esophageal cancer, I cannot tell you the results because we have not looked at that. However, if you compare the overall survival of this group of patients with the overall survival of all the patients who had Ivor Lewis esophagectomies, it is not different.

Dr Thomas M. Egan (Chapel Hill, NC). Could you clarify for us what you mean by patients requiring operation? It seems to me that they require drainage if they leak, but that does not necessarily have to be done through an operation. Was this a choice to operate on them, or did they have to be operated on to establish good drainage?

Dr Crestanello. Well, we believe that symptomatic patients who have a noncontained leak need to undergo operation. Percutaneous drainage of a collection might be an option, but because

we have not attempted that modality in our patients, I cannot comment on it. The patients who had a noncontained leak who were symptomatic and underwent operations, there is a very high mortality, approximately 25%, 1 of 4 patients. As for the drainage, there were 4 patients who had noncontained leaks, and they were

initially managed conservatively. As we said, “conservative” is having drainage of the pleural cavity by chest tubes, either the chest tubes that were placed at the operation or new chest tubes. However, the sepsis in those patients in our experience did not resolve, and eventually, they required surgical intervention.

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