Reducing Hospital Morbidity and Mortality Following Esophagectomy

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Background. **Esophagogastrectomy (EG) is a formidable operation with significant morbidity and mortality rates. Risk factor analyses have been performed, but few studies have produced strategies that have improved operative results. This study was performed in order to identify prognostic variables that might be used to develop a strategy for optimizing outcomes after EG.**

Methods. **The records of all patients (n = 379) who underwent EG patients at a tertiary medical center between 1996 and 2002 were retrospectively reviewed. Thirty-day morbidity and mortality were determined, and multivariable logistical regression analysis assessed the effect of preoperative and postoperative variables on early mortality.**

Results. **Operations included Ivor Lewis (n = 179), transhiatal (n = 130), and other approaches (n = 70). Operative mortality was 5.8%; 64% experienced complications, including respiratory complications (28.5%), anastamotic strictures (25%), and leak (14%). Increasing age, anastomotic leak, Charlson comorbidity index 3, worse swallowing scores, and pneumonia were associated with increased risk of mortality by univariate analysis. However, only age ($p = 0.002$) and pneumonia ($p = 0.0008$) were independently associated with mortality by multivariable analysis. Pneumonia was associated with a 20% incidence of death. Patients with pneumonia had significantly worse deglutition and anastomotic integrity on barium esophagogram compared with patients without pneumonia ($p < 0.001$, Mann-Whitney rank sum test).**

Conclusions. **Morbidity and mortality of EG are significant, but most complications, including anastomotic leak, are not independent predictors of mortality. The most important complication after EG is pneumonia. Strategies to decrease postoperative mortality should include careful assessment of swallowing abnormalities and predisposition to aspiration by cineradiography or fiberoptic endoscopy. After EG, acceptable pharyngeal function and airway protection should be verified before resuming oral intake.**

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Esophagogastrectomy (EG) is the mainstay of therapy for malignancy of the esophagus and gastroesophageal junction, as well as for many benign esophageal disorders [1]. However, esophageal resection is associated with considerable morbidity and mortality. While advances in perioperative management strategies have improved early morbidity, complications of EG continue to be appreciably higher than other similarly complex operations such as pancreatectomy, gastrectomy, and hepatectomy [2–4]. Furthermore, as the average 5-year survival for esophageal cancer patients is still only 25% [5], the impact of surgical complications on quality of life cannot be overstated, particularly when the consideration of limited life expectancy exists [6, 7].

Several studies have assessed preoperative and perioperative risk factors for morbidity following EG [8–10]. Although these studies have provided useful information with regard to risk stratification, the resulting models have not been subsequently validated and have not found widespread practical application in altering treatment algorithms for patients with esophageal disease. In addition, Dimick and colleagues [4] reviewed the statewide Maryland experience with two high-risk surgeries, EG and hepatectomy, in order to relate the effects of postoperative complications to hospital expenditures. They concluded that quality improvement measures are most effectively instituted after identifying "the most important complications" [4]. However, they define the most important complications as those leading to the highest resource utilization, not necessarily those associated with the highest mortality.

Given the consistently elevated rates of complications after EG, the purpose of this study was to identify variables associated with morbidity and mortality that might be addressed in a strategy to improve the outcome of patients after esophageal resection. In approaching this question, we detailed perioperative, procedural, and postoperative factors in a consecutive series of EG pa-

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Table 1. Preoperative and Postoperative Variables Evaluated

Preoperative Variables	Postoperative Variables
Age	Intensive care unit stay
Sex	Hospital length of stay
Primary diagnosis	Discharge status
Clinical stage	Pathologic stage
Induction therapy	Stricture formation
Tobacco history	Need for reoperation
Weight loss	Respiratory complications
Coronary artery disease	Anastomotic leak
Hypertension	Wound infection
Cerebrovascular disease	Myocardial infarction
Diabetes mellitus	Arrhythmia
Renal insufficiency	Hearseness
Hematocrit	Other infection
Prothrombin time	Other complication
Serum albumin	

tients, using multiple surgical techniques for a variety of esophageal disorders. These factors were then related statistically to observed postoperative mortality, to identify the preoperative conditions or postoperative factors associated with increased mortality.

Patients and Methods

Following local Institutional Review Board approval on April 9, 2002, the Duke University Medical Center Perioperative Services Database was queried for all ICD-9 codes linked with esophageal resection between January 1, 1996 and December 31, 2002. Retrospective chart reviews were performed to document demographics, diagnosis, perioperative condition, specific resection approach, and postoperative course. Postoperatively, a care pathway was utilized, which standardized nursing and pulmonary care issues. The timing of esophagogram ranges from postoperative day 4 to 7, on the discretion of the surgeon, and the discharge from hospital expected from postoperative day 7 to 10. Table 1 lists the preoperative and postoperative variables specifically recorded. The influence of preoperative comorbidities on postoperative morbidity and mortality was based on the Charlson comorbidity index, a weighted index of 19 conditions found to significantly influence survival in cancer patients and given a score based on the relative mortality risk [11]. The score can be divided into four comorbidity grades: 0, 1 to 2, 3 to 4, and 5 or more. In this manner, diagnoses more likely to be associated with postoperative morbidity are given progressively higher point values. Patients were considered to have a comorbid condition if a listed disorder was mentioned in the records or if the patient was treated for it. All forms of coronary artery disease (myocardial infarction, angina, coronary artery bypass grafting, and percutaneous transluminal coronary angioplasty) are given a value of 1. Application of the Charlson score is proven to accurately predict complications in patients with nonsmall cell lung cancer undergoing surgical treatment, and the Charlson score was more predictive of adverse postoperative events than were individual variables [12].

Any complication prolonging or otherwise altering the postoperative course was recorded along with all postoperative deaths. Pneumonia was defined as a febrile illness plus the presence of a new pulmonary infiltrate. Importantly, pleural effusions and atelectasis were not listed as pulmonary complications unless specific intervention was required to treat the disorder, such as a new chest tube thoracostomy, therapeutic bronchoscopy, endotracheal reintubation, or readmission to the intensive care unit. Patients routinely underwent barium esophagography to assess the integrity of the neoesophagus before resuming an oral diet. Each study was reviewed retrospectively for both esophageal function and structural integrity, and esophagograms were graded on a four-point scale, as described by Martin and coworkers [13], such that 1 = normal study, 2 = delayed emptying, 3 = aspiration or reflux to the pharyngeal level, and 4 = gross leak.

Multivariable logistical regression analysis was used to identify associations between the preoperative, operative, and postoperative variables with mortality following EG. Thirty-day morbidity and mortality were determined and are presented as mean ± standard deviation. All continuous variables were compared using a two-way analysis of variance, while dichotomous variables were compared by the χ^2 method. Early survival was modeled by censoring patients who were operative survivors. The Cox proportional hazards method assessed univariate and multivariable determinants of early death by backward and forward stepwise logistical regression. Swallowing scores among patients with pneumonia were compared to the scores among patients free of pneumonia using the Mann-Whitney rank sum test. All statistical analysis was performed using Statistica (Statsoft, Tulsa, OK). Statistical significance was considered to occur at p less than 0.05.

A total of 379 patients underwent EG in the 7-year period. The mean age was 60.3 ± 11 years, and most were males (307 males, 72 females). The average Charlson score was 1.88 ± 1.5, and 32% (121/379) had a score greater than or equal to 3. Weight loss more than 5% was experienced by 41% of patients (154/379) before surgery, and 60% of patients (226/379) had a significant tobacco abuse history. Finally, 44% of patients (167/379) underwent induction therapy for carcinoma of the esophagus before esophagectomy.

The majority of study patients underwent resection for a neoplastic process [Table 2]. The most common underlying diagnosis was adenocarcinoma (n = 228), followed by squamous cell carcinoma (n = 70), and Barrett's esophagus with high-grade dysplasia (n = 37). Patients with malignancy were clinically stage 0 or I in 22.1%; stage II in 51.7%; stage III in 18.8%; and stage IV in 5.1%. Preoperative staging was uncertain in 2.4%. Benign disorders requiring resection were rarely encountered in this cohort, and these were most commonly end-stage peptic strictures of the distal esophagus (n = 17) or achalasia (n = 11). Six cases of esophageal perforation

Table 2. Preoperative Diagnoses

Neoplasia	
Adenocarcinoma	228
Squamous cell carcinoma	70
Barrett's metaplasia	37
Other neoplasia	6
Total	341 (90%)
Benign	
Gastroesophageal reflux disease	17
Achalasia	11
Boerhaave's syndrome	6
Other benign	4
Total	38 (10%)

were encountered, none of which were iatrogenically induced.

The number of esophageal resections performed each year steadily increased over the first several years of the evaluation until reaching a plateau of approximately sixty cases per year in the last three years of the review. As the number of procedures performed per year increased, a broader array of EG techniques was also utilized. Ivor Lewis EG was performed most commonly (n = 179) and represented the overwhelming majority of resections in the first several years of the study. However, in the latter three years of evaluation, transhiatal resection (n = 135) displaced the Ivor Lewis operation as the most commonly employed resection technique. Other resection types remained relatively stable in number throughout the study period, including left thoracotomy procedures (n = 35); McKeown, or Akiyama, resections (n = 15); and resections of the distal esophagus performed transabdominally (n = 9). The stomach was used as the conduit for esophageal reconstruction in all but five cases, which involved colonic interposition. A variety of associated procedures were also performed along with EG, the most common being feeding jejunostomy tube placement (n = 305), followed by pyloromyotomy or pyloroplasty (n = 227).

The mortality rate of EG in this series was 5.8% (22/379). However, 64% of patients (200/379) experienced at least one complication following EG (Table 3). The mean intensive care unit stay was 4 days (range 0 to 139 days), while the mean hospital length of stay was 15 days (range 5 to 149 days). Importantly, the median length of stay was 10 days, and 74.9% of patients were discharged from the hospital within 14 days of EG.

In addition, 34% (129/379) patients required secondary procedures after initial esophagectomy. The most common procedure was dilatation for postoperative stricture (n = 73), which were typically performed several weeks after EG. Fourteen patients (3.7%) required tracheostomy, 9 patients (2.4%) required reexploration to control a large anastomotic leak, and 8 patients (2.1%) were explored for wound dehiscence. Postoperative stricture formation was found to be significantly related to transhiatal esophagectomy compared with other types of resection ($p = 0.006$), and postoperative leaks were significantly related to the performance of handsewn anastamosis compared with stapled anastamosis ($p < 0.001$).

Table 3. Complication of Esophagectomy

Complication	Number (%)
Stricture	95 (25.1)
Pneumonia	60 (15.8)
Anastomotic leak	53 (14)
Arrhythmia	52 (13.7)
Wound infection	45 (11.9)
Empyema/effusion	40 (10.6)
Reintubation	23 (6.1)
Sepsis	21 (5.5)
Ventilator dependence	18 (4.7)
Urinary tract infection	46 (4.2)
Deep venous thrombosis/pulmonary embolus	9 (2.4)
Wound debiscence	8 (2.1)
Recurrent laryngeal nerve injury	8 (2.1)
C. difficile colitis	7 (1.8)
Ethanol withdrawal	6 (1.6)
Gastrointestinal bleeding	6 (1.6)
Myocardial infarction	4 (1.1)
Stroke	3 (0.79)
Chylothorax	3 (0.79)
Tracheoesophageal fistula	3 (0.79)
Pancreatitis	2 (0.53)
Pericardial effusion	2 (0.53)

Results

When preoperative, procedural, and postoperative variables were analyzed by univariate means, age as a continuous variable ($p = 0.003$), anastomotic leak ($p = 0.03$), pneumonia ($p = 0.0005$), Charlson comorbidity index score greater than or equal to 3 ($p = 0.05$), and swallowing scores of 3 or 4 ($p = 0.012$) were each associated with increased mortality following esophageal resection. However, when evaluated by multivariable analysis, only age ($p = 0.002$) and pneumonia ($p = 0.0008$) were independently associated with mortality (Table 4). In fact, the development of pneumonia was associated with a 20% incidence of death, compared with a 3.1% incidence of death among patients free of pneumonia. Pneumonia was the principal cause of death in 12 of 22 deaths (54.5%), and respiratory failure secondary to pneumonia was prominent in 18 of 22 deaths (81.8%).

Finally, postoperative barium esophagography studies were evaluated and graded on a scale ranging from a normal study (n = 252), to delayed gastric emptying (n = 44), to frank aspiration (n = 38) or leak (n = 35). Patients with a normal swallow study or delayed gastric emptying developed pneumonia in 8.8% of cases, whereas 38.6% of patients with swallow studies showing aspiration or leak developed pneumonia. Patients who developed pneumonia had significantly worse swallowing studies compared with those patients who were free of pneumonia, as determined by the Mann-Whitney rank sum test ($p < 0.001$).

Table 4. Statistical Association of Preoperative and Postoperative Variables With Mortality

		Univariate Analysis	Multivariable Analysis	
Variable	β	p Value	p Value	HR (95% CI)
Pneumonia	1.53	0.0005	0.0008	4.28 (1.81–10.1)
Age	0.066	0.003	0.002	1.065 (1.02–1.11)
Swallow score	0.018	0.012	NS	
Leak	1.06	0.031	NS	
Charlson score	0.89	0.05	NS	
Preoperative albumin	0.78	0.07	NS	
Weight loss	−0.54	0.25	NS	
Female sex	0.43	0.4	NS	
Induction therapy	0.15	0.75	NS	

CI = confidence interval; HR = hazard ratio; NS = not significant.

Comment

Since its introduction, esophageal resection has been notable for high rates of morbidity and mortality, prompting Cooper to state, "No area of thoracic surgery is more challenging. . . than that of esophageal resection and reconstruction" [14]. Fortunately, advances in perioperative and postoperative care have improved survival following esophageal resection [2, 15], but these figures remain consistently elevated compared with those for other complex surgeries [3, 4]. In addition, since most esophageal resections are performed to treat malignancy, complications can greatly impact quality of life among patients with already poor long-term prognoses. Therefore, improvements in esophagectomy outcomes continue to be of high importance in the management of esophageal disorders and have the potential to drastically change the outlook for patients being considered for esophagectomy.

Multiple factors are implicated in the etiology of postesophagectomy complications. For instance, high-volume centers of esophageal surgery have consistently reported significantly lower complication rates than low-volume centers [3, 16]. In addition, several well-designed studies have investigated which variables most likely predict complications after EG [8–10], some resulting in predictive formulae to assess the individual patient's risk for morbidity after ER [9, 10]. For instance, using the Department of Veterans Affairs National Surgical Quality Improvement Program database, Bailey and colleagues [8] recently evaluated nearly 1800 patients before and after EG and related preoperative, intraoperative, and postoperative variables with morbidity and mortality. Factors independently associated with postoperative complications included induction therapy, diabetes, increased age, and intraoperative blood transfusions, among others. Another study retrospectively reviewed 269 EG patients by multivariate analysis of 30 preoperative and eighteen postoperative variables, concluding that the most accurate model for predicting overall mortality is comprised of age, intraoperative blood loss, and postoperative requirement for inotropic support and respiratory complications [9]. Similarly, Bartels and associates [10] found that a composite score incorporating preoperative functional status and cardiac, respiratory, and hepatic function was more accurate in predicting mortality from EG than was assessment of the individual factors.

However, these efforts have produced few practical suggestions for altering the manner in which EG is approached, except to stratify risk. Furthermore, only Bartels and coworkers [10] have demonstrated beneficial application of risk stratification; no other reports have verified the usefulness of these data toward improving patient outcomes. Finally, because many reports of esophagectomy outcomes originate from single centers using one resection technique to treat a single disease process, these data often have limited generalizability [17, 18].

Therefore, this study was performed to determine current morbidity and mortality rates of EG in a consecutive series of patients using multiple modern resection techniques. Preoperative, procedural, and postoperative variables were statistically related to postoperative mortality to identify the greatest influences on short-term results. We have identified pneumonia to be the major factor associated with early death after EG. Although increasing age was also independently predictive of mortality, several studies have recently demonstrated that esophagectomy can be performed safely and successfully in elderly patients [19, 20]. The present study is also unique in correlating postesophagectomy swallowing abnormalities with pneumonia, implying that the most important complication after esophagectomy may be preventable. This identification allows clinicians to take proactive steps toward improving short-term results of EG. Importantly, despite the high rate of complications identified in this study, most of these, including anastamotic leak, are managed effectively without affecting operative mortality. In summary, these data imply that efforts to improve operative mortality of esophagectomy are best focused on reducing the number and severity of postoperative pulmonary complications.

Respiratory insufficiency is widely recognized as a major problem after esophagectomy, and aspiration pneumonia is the most common complication of esophagectomy [8]. The present study is consistent with previ-

ous reports of approximately 25% respiratory complications after esophageal resection [2, 5, 8]. Strikingly, respiratory complications are the cause of deaths in nearly two of three postesophagectomy mortalities [21], and our data support these figures.

Pulmonary morbidity of esophagectomy have been associated with increased age, tobacco abuse, malnutrition, host immune deficiency, baseline pulmonary dysfunction, and diminished performance status [22–24]. In addition, Tandon and colleagues [25] recently determined that low preoperative body mass index, surgeon experience, duration of operation, and, most importantly, anastamotic leak were associated with development of the adult respiratory distress syndrome after esophagectomy. Acute lung injury was also associated with intraoperative hypoxemia and hypotension, which is thought to simulate an ischemia and reperfusion injury with the release of soluble, proinflammatory mediators and activation of circulating neutrophils. Esophagectomy is often accompanied by a systemic inflammatory reaction with particularly deleterious effects on the lung [24, 26], and this might explain the observations that key intraoperative events are associated with increased morbidity and mortality postoperatively [8, 25]. Furthermore, this milieu renders the lung extremely susceptible to pulmonary edema, and improved esophagectomy results have been reported with tight intravenous fluid restrictions [27].

Swallowing disorders are also major causes of postesophagectomy pulmonary complications. As our swallow study data suggest, esophagectomy patients are at high risk for aspiration, particularly in the early postoperative period when transient diminished airway protection occurs in 47% to 67% of patients after transhiatal resection [28, 29]. Abnormal deglutition after esophagectomy may be due to injury of the recurrent laryngeal nerve [30], which may produce vocal cord paralysis and aspiration in up to 50% of patients after surgery [31–34]. In the current series, only 2.1% of patients were demonstrated to have injury of the recurrent nerve.

Detection of subtle swallowing abnormalities can be difficult; bedside clinical evaluation of swallowing is inaccurate in up to 60% of patients who demonstrate aspiration during more stringent assessment [35], and standard barium swallow examination also fails to identify patients with clinically silent aspiration [33]. Videofluoroscopy (modified barium swallow), fiberoptic endoscopic evaluation of swallowing, and fiberoptic endoscopic evaluation of swallowing with sensory testing provide better assessment of swallowing abnormalities and allow more informed clinical decision-making with regard to appropriate dietary recommendations [33]. A major advantage of fiberoptic examination over other methods of swallowing evaluation is that it more reliably evaluates swallowing over a protracted period of time when the patient is more likely to experience pharyngeal phase fatigue [36].

Several treatment options exist for swallowing abnormalities identified after esophagectomy, each promoting compensatory strategies to prevent aspiration. For instance, the chin tuck maneuver closes the laryngeal vestibule, and aligns the epiglottis to a more protective position over the airway. Using the chin tuck maneuver in postesophagectomy patients, Lewin and associates [34] eliminated aspiration in 81% of patients who were known to aspirate. Other strategies include multiple swallows to handle a food bolus, breath holding during swallowing, and throat clearing and coughing after swallowing [37]. Finally, early vocal cord medialization has been revealed to reduce the incidence of pneumonia in unilateral VCP resulting from thoracic surgery [38].

The present study is limited in several respects. Because the study is retrospective in nature some desirable information was not consistently available. For instance, pulmonary function tests (PFT) were not widely available, prohibiting assessment of the relationship between pulmonary functions tests (PFTs) and postoperative respiratory complications. However, recent studies have demonstrated that patients with base line pulmonary dysfunction as defined by PFTs, experience increased postoperative pulmonary complications [8, 21, 24]. Similarly, intraoperative details such as estimated blood loss, length of operations, and hemodynamic instability are not included in this review. Again, other studies have provided comprehensive details regarding the effect of intraoperative events on postoperative complications [8, 25]. Next, a limited number of variables were tested as predictors of mortality since the sample size limited statistical evaluation of all possible variables. However, we focused on those variables appearing to have the greatest affect on postoperative morbidity. Finally, a prospective study is required to validate the efficacy of various measures to reduce the occurrence and severity of pulmonary complications after esophagectomy.

Conclusions

Based on these data, the primary goal of postoperative esophagectomy care should be prevention of pulmonary complications, including aspiration events and pneumonia. Preoperative identification of patients predisposed to aspiration would allow interventions therapy to lessen the impact of swallowing disorders after esophagectomy. Patients should also begin an aggressive chest physiotherapy and exercise program preoperatively. Smoking cessation before esophagectomy is imperative. Postoperatively, normal swallowing mechanisms should be verified through the use of fiberoptic examination or videofluoroscopy before the patient resuming oral intake. A prospective trial is needed to validate the success of these suggestions in reducing pulmonary morbidity after esophagectomy.

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DISCUSSION

DR CAROLYN E. REED (Charleston, SC): That was a very beautifully presented series, and I want to thank the authors for allowing me to see a draft of the text. I think there are several important points in this paper that will be readily apparent to people that do have the opportunity to read the published text.

You have shown us that pneumonia, or respiratory failure at least, predominantly figures in mortality, and this is very similar to our experience at MUSC, where almost all our deaths were due to either pneumonia or adult respiratory disease syndrome. I believe the most important point of your paper is the correlation of abnormal swallowing with the development of pneumonia, especially subtle abnormalities that are not clinically apparent.

I have three questions for you. In your text, you describe some techniques that you are using to discover these subtle abnor-

malities, particularly a test called video endoscopic evaluation of swallowing with sensory testing. I wonder if you would describe a little bit your techniques used to address abnormal swallowing in those cases where vocal cord injury is not apparent?

Second, we have been impressed by the increased risk of pneumonia in patients undergoing induction therapy. Would you comment on your experience?

And third, there has been a suggestion that proinflammatory mediators associated with one-lung ventilation may play a role in the development of pneumonia. Did you see a difference between the transthoracic and transhiatal approach?

DR ATKINS: Thank you, Dr Reed, for you comments, and we certainly have enjoyed your contributions to the field and to similar work.

Taking the questions in order, the FEEST exam is based on the techniques of a fiberoptic endoscopic evaluation of swallowing, but this particular method also delivers a pulse of air to the pharyngeal region which allows one to sensitively detect abnormalities in pharyngeal sensation as might occur after surgical manipulation of the pharynx or upper esophagus. Sensory abnormalities have been shown in several studies to compound the effects of any kind of motor dysfunction that might result from esophagectomy, and so this is probably the most sensitive method for detecting swallowing abnormalities preoperatively or postoperatively.

With regard to induction therapy, as the slide showed, approximately 40% of the patients underwent induction therapy prior to esophagectomy, and there was no difference in the pulmonary complication rates of patients who had induction therapy versus those who did not have induction therapy. There have been a couple of reports in the literature which described increased pulmonary complications in patients who received super high doses of radiation therapy, above 60 Gy, for instance, but we did not see that, and certainly did not typically use extra high doses of radiation therapy.

Lastly with regard to the proinflammatory response, it has been suggested on numerous occasions that a proinflammatory response might be established as the result of an ischemia-reperfusion injury due to prolonged operative times, for instance, prolonged use of single lung ventilation, and increased blood loss. The need for blood transfusion intraoperatively has also been associated with the promulgation of a proinflammatory response.

We did not see any difference with regard to complication rates from the transthoracic or the transhiatal approaches to esophagectomy, and certainly did not measure variables such as serum cytokines or bronchoalveolar lavage cytokines, which might more sensitively detect a proinflammatory response in the lung.

DR ROBERT J. CERFOLIO (Birmingham, AL): This is an important series—Dr. Reed, we share your experience and have also found a higher incidence of pneumonia in our induction patients. Dr. Atkins, are you sure that your pneumonias are not aspiration pneumonias—I fear that many of ours are from silent aspiration—I fear that we are missing them. We have tried to minimize this problem with by leaving an NGT for 4 days, we elevate the head at the bed at all times, we use prokinetic agents like Reglan on all patients form day 1, we avoid any significant diet for a few weeks after surgery and use home jejunal feedings at night, we have switched from a pyloromyotomy to a pyloroplasty and we avoid neck dissection and do an Ivor Lewis—despite all these steps we still have a significant problem with aspiration pneumonia—can you help us prevent this problems better?

DR ATKINS: I totally agree with regard to the major etiologic factor in pneumonia being aspiration. We didn't want to specifically label pneumonia as aspiration pneumonia in all cases, but in reviewing these charts the vast majority would appear to be due to aspiration, and, as you mentioned, silent aspiration can be particularly difficult; 60% of patients with identified swallowing abnormalities and aspiration are not picked up at the bedside.

But what we typically do is many of those measures that you mentioned, including head of the bed elevation, vigorous pulmonary toilet after surgery. It is also important for the patient to stop smoking and begin a chest PT program preoperatively. But one of the most important things that we found is the introduction or the evaluation of a speech pathologist postoperatively, which is done before the barium esophagogram, and that allows us to more specifically define the patients at risk for aspiration.

For instance, if the patient is at a moderate to high risk for aspiration as determined by the speech pathologist's evaluation, then we will simply forego the barium swallow until an adequate amount of time has subsided to allow this vocal cord palsy, which is often the case, to subside or get better.