Original Article

Results of comprehensive dysphagia evaluation and delayed oral intake following esophagectomy

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Background: Dysphagia with or without aspiration are potential problems for patients following esophagectomy. We have adopted a strategy of routine post-discharge modified barium swallow study (MBSS) after esophagectomy in concert with our Speech and Language Pathology (SLP) Department to identify patients with dysphagia or aspiration persisting beyond the immediate post-operative period. We performed a cohort study of these patients at our institution.

Methods: Patients who underwent esophagectomy and postoperative MBSS from 2011–2016 were identified from an institutional database. Patients were typically discharged home on tube feedings, taking nothing by mouth. MBSS was usually performed in a delayed fashion unless there was clinical suspicion of leak. Logistic regression analyses were performed to assess factors associated with perioperative outcomes.

Results: A total of 50 consecutive patients were identified. Median age was 66 years (range, 36–85). The Ivor Lewis technique was performed in 45 patients (90%) and 43 resections were completed minimally invasively. Anastomotic leak rate was 6% and aspiration pneumonia rate was 14%. MBSS was performed median 17 days after resection; 8 patients demonstrated radiographic evidence of dysfunctional oropharyngeal swallow mechanism with or without aspiration. Weekly swallow treatment by our SLP department improved aspiration/dysphagia at median 5.5 weeks. On multivariate analyses, only age ≥70 was associated with aspiration and/or dysphagia on MBSS, and only aspiration was associated with pneumonia.

Conclusions: Older age is independently associated with dysphagia with or without radiographic aspiration on MBSS. Aspiration pneumonia was associated with frank aspiration events or findings of dysphagia/aspiration on MBSS. With a standardized interdisciplinary approach to post-operative swallow dysfunction, swallow therapy is effective to safely restart oral intake after esophagectomy.

Keywords: Esophageal cancer; esophagectomy; deglutition; deglutition disorders; outcomes

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Introduction

Esophageal cancer is considered by many to be a disease of the elderly, with the peak age of incidence after age 65 years (1). As an upper gastrointestinal malignancy, unintentional weight loss of at least ten percent is experienced by a majority of patients prior to diagnosis, with corresponding increased risk of relative malnutrition (2). Pre-operative chemoradiation therapy is offered to patients with clinical staging of T2 or higher or any nodal involvement (3). Administration of neoadjuvant therapy has not been associated with increased operative morbidity (4). However, declines in muscle mass and an increased prevalence of sarcopenia have been documented at completion of neoadjuvant chemoradiation (5,6).

Historical studies have demonstrated an increasing risk of aspiration to be associated with advancing age (7). Etiological factors associated with dysfunction of the swallow mechanism include loss of muscle mass, demyelination of associated nerves, cerebrovascular events, and neurocognitive decline (8). Major surgical procedures such as esophagectomy may further impair this loss of function at least temporarily (9-11). Of the diagnostic tests available to detect impaired swallowing, modified barium swallow study (MBSS) is often the initial test of choice given its high sensitivity and specificity and relatively good safety profile (12). Inconclusive MBS studies may prompt fiberoptic endoscopic evaluation of swallowing (FEES), which has slightly better sensitivity and specificity at the cost of being an invasive test with its attendant risk of complications (1).

Aspiration pneumonia is a significant cause of morbidity and mortality in the hospitalized patient (13). The combination of factors including upper gastrointestinal malignancy, major oncologic resection, baseline malnutrition from unintentional weight loss, pre-operative chemoradiation therapy, and age-related changes of the swallowing mechanism may lead to significantly increased risk of apparent and silent aspiration following esophagectomy. Due to these concerns, we adopted a strategy of delayed oral intake following esophagectomy along with a multidisciplinary approach to evaluation of dysphagia post-operatively using routine MBSS in the presence of a speech therapist. We evaluated our institutional cohort of esophagectomy patients to assess the prevalence of dysphagia and risk of post-operative aspiration on routine post-discharge MBSS prior to restarting oral intake. We present the following article in accordance with the STROBE reporting checklist (available at https://aoe.amegroups.com/article/view/10.21037/aoe-20-28/rc).

Methods

Retrospective medical record review was performed of a prospectively-maintained database of all patients who underwent esophagectomy for esophageal adenocarcinoma with curative intent from 2011 to 2016. Data collected included patient demographics (age, sex), operative characteristics (approach to esophagectomy), pre-operative therapy, and post-operative outcomes (length of stay, complications and readmission within thirty days). Specific complications such as anastomotic leak, chylothorax, and aspiration pneumonia were identified from the medical records. Major complications were those that required invasive procedures or resulted in impaired organ function. The institutional review board at City of Hope National Medical Center approved this study with a waiver of informed consent (IRB 15188). All study procedures conformed to the provisions of the Declaration of Helsinki (as revised in 2013).

Our institutional approach to esophagectomy involves a minimally invasive approach when feasible. The Ivor Lewis approach is preferred for distal esophageal and gastroesophageal junction tumors, while the McKeown (three-hole) technique is performed for mid-esophageal and proximal tumors. A feeding jejunostomy tube is placed routinely. Post-operatively, the patients are kept *nil per os* with a 16- or 18-French nasogastric tube in place in order to decompress the gastric conduit. Jejunostomy tube feeds are initiated on post-operative day two and slowly titrated to goal over the next few days. The nasogastric tube is maintained until tube feeds are tolerated by the patient at nutritional goal. Per our practice, the patient is discharged home on continued *nil per os* status with tube feeds via jejunostomy at nutritional goal. A clinical swallow assessment followed by a MBSS is performed as an outpatient on the day the patient returns for the two-week (approximate) post-operative appointment. If the swallow study shows appropriate passage of the contrast bolus without impaired swallow or evidence of aspiration and the patient is doing clinically well, he/she is advanced to a full liquid diet, followed by a mechanical soft diet, with routine follow-up thereafter. Results of the post-operative MBSS were evaluated in relation to clinical factors.

Table 1 Patient demographics

Characteristic	Patients (n=50)
Median age, years [IQR]	66 [58–73]
Female sex [%]	10 [20]
Neoadjuvant therapy [%]	39 [78]
Operative approach [%]	
Ivor Lewis	45 [90]
McKeown	5 [10]
Surgical technique [%]	
Minimally invasive	43 [86]
Minimally invasive, converted to open	3 [6]
Open	4 [8]
T stage [%]	
pT0	13 [26]
pT1	20 [40]
pT2	7 [14]
pT3	10 [20]
N stage [%]	
pN0	31 [62]
pN1	10 [20]
pN2	6 [12]
pN3	3 [6]

IQR, interquartile range.

Statistical analysis

Statistical analysis was performed using SAS (Cary, NC). Categorical variables were summarized using counts and percentages, with group differences across aspiration status (no *vs.* yes) assessed using the Pearson's χ^2 test. Continuous variables were expressed using median values with interquartile range (IQR). Univariate and multivariate logistic regression were used to identify factors associated with the development of aspiration, with results expressed as odds ratios (OR), 95% confidence intervals (CI), and P values. A P value of <0.05 was considered as significant.

Results

A total of 50 consecutive patients who underwent esophagectomy at our institution between 2011 and 2016 were identified. Median age was 66 years (IQR 58–73). Ten patients (20%) were female. Overall, 39 patients (78%) received neoadjuvant therapy, 38 of whom underwent chemoradiation and one who chemotherapy alone. Ivor Lewis esophagectomy with intrathoracic anastomosis was performed in 45 patients (90%); the others were McKeown approaches with cervical anastomosis. Forty-six operations were attempted by minimally invasive approach, with 93.5% success (n=3 conversions). Pathologic staging was complete for all patients. Seventeen patients (34%) had lesions of stage T2 or greater and 19 patients (38%) had nodal involvement (*Table 1*).

Post-operative median length of stay was 8 days (IQR 7–10). Aspiration pneumonia was diagnosed in 7 patients (14%) based on clinical assessment, bronchoscopy, microbiologic testing, and/or radiographic imaging. Anastomotic leak was identified in 3 patients (6%) and chylothorax in 3 patients (6%). Evidence of dysphagia with or without aspiration was identified on MBSS in 3 inpatients (6%) and an additional 8 outpatients (16%), making the overall aspiration rate 22% (11 patients). One inpatient aspiration event occurred in the setting of conduit necrosis, another with altered mental status, and the third had delayed conduit emptying.

Six patients (12%) were readmitted within thirty days; three were readmitted as interfacility transfers for aspiration pneumonia, two with a tracheostomy in place from the index admission and the third patient had been reintubated prior to re-initiation of oral intake. One patient with a tracheostomy eventually underwent MBSS without abnormal findings, while the other ultimately died before undergoing formal swallow evaluation. The third patient who was readmitted had previously undergone MBSS without frank dysphagia or aspiration but was considered high risk and had been maintained *nil per os* on jejunostomy feeds. Of the remaining three readmissions, two were for conduit leaks (one anastomotic, one gastric), and one for robotic port site hemorrhage. The overall major complication rate within thirty days was 36%, with no mortality (*Table 2*).

MBSS was performed in all but one patient who remained quite debilitated following esophagectomy, ultimately dying before formal swallow evaluation was deemed appropriate. Studies were completed at median 17 days (IQR 13–19). Twelve of 49 patients (24.5%) underwent esophagram (with concurrent MBSS) prior to discharge, six to evaluate persistent leukocytosis, one for delayed conduit

Table 2 Post-operative outcomes

Characteristic	Patients (n=50)
Length of stay, days, median [IQR]	8 [7–10]
Any major complication [%]	18 [36]
Aspiration pneumonia	7 [14]
Aspiration event as an inpatient	3 [6]
Anastomotic leak	3 [6]
Chylothorax	3 [6]
30-day readmission [%]	6 [12]

IQR, interquartile range.

Table 3 Results of modified barium swallow study

Characteristic	Patients (n=50)
Patient underwent MBSS, overall (%)	49 (98.0)
MBSS, post-operative day, median [IQR]	17 [13–19]
Underwent MBSS prior to discharge (%)	12 (24.5)
Aspiration or dysphagia (%)	1 of 12 (8.3)
Aspiration or dysphagia on MBSS (%)	8 (16.3)
Ivor-Lewis (%)	6 of 45 (13.3)
McKeown (%)	2 of 5 (40.0)
Able to resume oral diet with speech rehab (%)	8 (100.0)
Time to resolution of MBSS findings, median	5.5 weeks

MBSS, modified barium swallow study; IQR, interquartile range.

emptying, one for concerning cervical incision drainage, and four for surgeon preference. Radiographic evidence of dysphagia, as indicated by oropharyngeal dysfunction such as reduced laryngeal closure, incomplete epiglottic deflection, or reduced hyolaryngeal excursion, with or without aspiration at any bolus consistency was identified on MBSS in 8 patients (16.3%). Two of the 5 McKeown esophagectomy patients had findings of dysphagia and/or aspiration on their first MBSS (*Table 3*). With the initiation of weekly swallow treatment, swallow function improved on subsequent evaluation at median 5.5 weeks. Eventually, all 8 patients were able to restart oral diet. Meanwhile, the 3 patients with aspiration events while an inpatient underwent inpatient swallow treatment, with no evidence of dysphagia or aspiration on post-discharge MBSS.

Univariate and multivariate logistic regression were used to identify patient, disease, or treatment factors associated with post-operative aspiration and/or dysphagia at any point (*Table 4*). Age ≥70 years was associated with increased risk of aspiration and/or dysphagia in both the univariate (OR 6.00, 95% CI: 1.35–26.64; P=0.0185) and multivariate analysis (OR 7.91, 95% CI: 1.40–44.68; P=0.0192). T stage of T2 or greater was associated with decreased rates of aspiration/dysphagia in chi-square analysis, but was not significant in the multivariate model (OR 0.14, 95% CI: 0.01–1.74; P=0.1273). When considering only aspiration as diagnosed on MBSS, the number of events was too small to perform a similar analysis.

Univariate and multivariate logistic regression were used to identify patient, disease, or treatment factors associated with post-operative aspiration pneumonia (*Table 5*). Dysphagia with or without aspiration as identified on MBSS combined with overt post-operative aspiration events were associated with aspiration pneumonia on both univariate (OR 6.9, 95% CI: 1.3–37.6, P=0.027) and multivariate (OR 14.6, 95% CI: 1.4–155.8, P=0.026) analyses.

Discussion

This study demonstrated that 17% of patients who underwent esophagectomy were diagnosed with radiographic deficits of oropharyngeal swallow with or without evidence of aspiration on routine MBSS at median seventeen days following operation. These results are in line with those of Berry *et al.*, who found a 12% rate of post-operative aspiration in esophagectomy patients routinely evaluated with MBSS (14). In our series, none of the eight patients with aspiration on MBSS had developed an aspiration event or subsequent pneumonia as an inpatient. Meanwhile, all three patients with gross aspiration events in the early post-operative phase had resolution of aspiration by the time of MBSS evaluation. All patients were salvaged with weekly swallow therapy in conjunction with the institutional Speech and Language Pathology Department, eventually being cleared to resume oral intake. The only predictor of post-operative aspiration and/or dysphagia on multivariate analysis was age ≥70 years (OR 7.9, 95% CI: 1.4–44.7; P=0.019). Age has been identified as an independent predictor of increased aspiration and overall morbidity following esophagectomy (14,15). Oropharyngeal dysphagia is very common in older persons, affecting more than half of older nursing home residents. Many comorbid

Table 4 Univariate and multivariate logistic regression with aspiration diagnosed at any point as the outcome variable

Variables	Subgroup	N [%]	Univariate		Multivariate	
			OR (95% CI)	P value	OR (95% CI)	P value
Age group	<70	30 [60]	1.00 (reference)	–	1.00 (reference)	–
	≥70	20 [40]	6.0 (1.35–26.6)	0.019	7.9 (1.40–44.7)	0.019
Sex	Male	40 [80]	1.00 (reference)	–	1.00 (reference)	–
	Female	10 [20]	3.1 (0.70–14.2)	0.14	3.0 (0.44–20.0)	0.26
Cervical anastomosis	No	45 [90]	1.00 (reference)	–	1.00 (reference)	–
	Yes	5 [10]	2.7 (0.39–18.4)	0.32	2.0 (0.16–25.7)	0.59
Neoadjuvant chemotherapy	No	11 [22]	1.00 (reference)	–	1.00 (reference)	–
	Yes	39 [78]	0.38 (0.09–1.67)	0.20	0.79 (0.12–5.23)	0.81
Pathologic T stage	<T2	33 [66]	1.00 (reference)	–	1.00 (reference)	–
	≥T2	17 [34]	0.14 (0.02–1.24)	0.077	0.14 (0.01–1.74)	0.13
Pathologic N stage	N0	31 [62]	1.00 (reference)	–	1.00 (reference)	–
	N1	19 [38]	0.54 (0.12–2.35)	0.41	1.02 (0.16–6.34)	0.98

OR, odds ratio; CI, confidence interval.

Table 5 Univariate and multivariate logistic regression with aspiration pneumonia as outcome variable

Variables	Subgroup	N [%]	Univariate		Multivariate	
			OR (95% CI)	P value	OR (95% CI)	P value
Age group	<70	30 [60]	1.00 (reference)	–	1.00 (reference)	–
	≥70	20 [40]	2.3 (0.45–11.4)	0.33	0.81 (0.10–6.82)	0.85
Sex	Male	40 [80]	1.00 (reference)	–	1.00 (reference)	–
	Female	10 [20]	1.6 (0.17–14.9)	0.69	5.2 (0.23–121.3)	0.30
Cervical anastomosis	No	45 [90]	1.00 (reference)	–	1.00 (reference)	–
	Yes	5 [10]	1.6 (0.15–17.1)	0.69	6.4 (0.25–166.2)	0.26
Neoadjuvant chemotherapy	No	11 [22]	1.00 (reference)	–	1.00 (reference)	–
	Yes	39 [78]	1.8 (0.20–16.9)	0.60	5.5 (0.29–103.1)	0.25
Pathologic T stage	<T2	33 [66]	1.00 (reference)	–	1.00 (reference)	–
	≥T2	17 [34]	0.75 (0.13–4.32)	0.74	0.88 (0.09–8.47)	0.91
Pathologic N stage	N0	31 [62]	1.00 (reference)	–	1.00 (reference)	–
	N1	19 [38]	1.3 (0.25–6.39)	0.78	1.3 (0.17–9.91)	0.79
Any aspiration	No	43 [86]	1.00 (reference)	–	1.00 (reference)	–
	Yes	7 [14]	6.9 (1.25–37.6)	0.027	14.6 (1.37–155.8)	0.026

OR, odds ratio; CI, confidence interval.

conditions that cause dysphagia become more common with age, but physiologic changes, such as loss of muscle mass, decreased tissue elasticity, and reduction of saliva production also contribute to dysphagia in older patients (16). In our study, the only predictor of post-operative aspiration pneumonia was overt clinical aspiration or dysphagia/aspiration as identified on MBSS.

The approach to esophagectomy potentially contributes to post-operative aspiration risk. Transhiatal or McKeown esophagectomy entail cervical incision, dissection, and anastomosis. Meanwhile, Ivor Lewis esophagectomy does not involve manipulation of the upper esophageal anatomy. Ben-David and colleagues evaluated twenty-seven patients after McKeown esophagectomy with a formal swallow study, finding that twelve patients (44.4%) had gross or silent aspiration; of note, two patients (7.4%) were diagnosed with post-operative pneumonia (17). To further evaluate the etiology of swallowing difficult after esophagectomy with cervical anastomosis, Kim *et al.* studied forty-seven patients after McKeown resection with videofluoroscopy and kinematic analysis (18). The authors found that compared to healthy controls, esophagectomy patients with aspiration on videofluoroscopy had significantly reduced movement of the hyoid, epiglottis, and pharynx on swallowing. Some of the effect was thought to be associated with temporary post-operative superior laryngeal nerve palsy. In our study, although the subset was small and did not reach statistical significance, we did find evidence of aspiration and/or dysphagia in 40% of the McKeown patients versus 13.3% of the Ivor Lewis patients.

Contrary to head and neck cancer patients, neoadjuvant therapy has not been shown to be independently associated with increased risk of aspiration following esophagectomy (11,14). In our study population, administration of neoadjuvant treatment was not associated with increased risk of impaired swallowing on MBSS.

A significant body of literature has evaluated the potential benefit of swallow rehabilitation in head and neck cancer patients following chemoradiotherapy. A meta-analysis by Wall and colleagues pooled nineteen studies and identified specific deficits, such as base of tongue and epiglottis dysfunction, that are particularly prevalent in this patient population (19). Our institutional Speech and Language Pathology Department providers were able to improve the swallowing function for all nine patients who demonstrated aspiration and/or dysphagia on their first MBSS with weekly swallow treatment sessions at a median time of 5.5 weeks after resection. The therapy was both compensatory and rehabilitative. Compensatory strategies aim to keep patients safe when eating. These include dietary and postural modifications, like the chin tuck maneuver, to avoid aspiration. Rehabilitative strategies focus on recovering the natural swallowing mechanics. Although there is little data regarding the efficacy of any of these individual strategies in the post-esophagectomy setting, there have been multiple studies demonstrating efficacy in patients after acute stroke (20).

As individual studies have demonstrated improved swallow function with post-treatment intervention, interest has shifted to prophylactic pre-habilitation programs (21,22). Significantly improved speech and swallow outcomes have been shown, usually dependent on compliance with the prescribed treatment regimen (23,24). Building on previous analyses, recently published United Kingdom national guidelines recommend pre- and post-treatment speech and swallow programs as a standard component of the care of head and neck cancer patients (25,26). The actual benefit of such programs is yet to be determined in the esophagectomy population. One patient in our cohort suffered a recurrent laryngeal nerve palsy after Ivor Lewis esophagectomy. He did not have aspiration on MBSS, but was considered high risk for aspiration based on fluoroscopy findings. He underwent vocal cord injection and recovered full swallow function after 8 weeks of dysphagia therapy.

Evaluation of the reconstructed upper gastrointestinal tract is critical for multiple reasons: to determine the presence of anastomotic leak or stricture, to assess gastric conduit emptying, and to identify signs of impaired swallow function. Some institutions may utilize swallow studies primarily to evaluate anastomotic integrity while ignoring the physiologic aspect of swallowing. Our institutional protocol focuses on both the physical conduit as well as the functional outcome of reconstruction following esophagectomy. By doing so, we may reduce the risk of aspiration pneumonia with its attendant morbidity in the intermediate postoperative phase of recovery, meaning after discharge and prior to first follow-up appointment. In the era of enhanced recovery (ERAS) pathways, many institutions have adopted a strategy of early feeding after esophagectomy. However, our approach has resulted in a median length of stay of 8 days while identifying patients at risk for aspiration. The full value of routine post-operative functional swallow assessment paired with pre- and/or post-operative speech and swallow therapy, particularly in elderly candidates for esophagectomy, would be best assessed in a

prospective manner.

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Footnote

Reporting Checklist: The authors have completed the STROBE checklist. Available at https://aoe.amegroups.com/article/view/10.21037/aoe-20-28/rc

Data Sharing Statement: Available at https://aoe.amegroups.com/article/view/10.21037/aoe-20-28/dss

Conflicts of Interest: All authors have completed the ICMJE uniform disclosure form (available at https://aoe.amegroups.com/article/view/10.21037/aoe-20-28/coif). LE has research grants from Astrazeneca, managed by City of Hope. JYK serves as an unpaid editorial board member of *Annals of Esophagus* from June 2020 to May 2022. The other authors have no conflicts of interest to declare.

Ethical Statement: The authors are accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved. The institutional review board at City of Hope National Medical Center approved this study with a waiver of informed consent (IRB 15188). All study procedures conformed to the provisions of the Declaration of Helsinki (as revised in 2013)

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