

Esophagectomy for High Grade Dysplasia is Safe, Curative, and Results in Good Alimentary Outcome

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Abstract

Background The increasing adoption of endoscopic therapies and expectant surveillance for patients with high grade dysplasia (HGD) in Barrett's esophagus has created considerable controversy regarding the ideal treatment choice. Confusion may be due, in part, to a limited understanding of the outcomes associated with surgical resection for HGD and extrapolation of data derived from patients undergoing an esophagectomy for invasive cancer. The purpose of our study was to document the perioperative and symptomatic outcomes and long-term survival after esophagectomy for HGD of the esophagus.

Material and Methods The study population consisted of 38 patients who underwent esophagectomy for biopsy-proven HGD between 10/1999 and 6/2005. Three patients were excluded from analysis due to obvious tumor on upper endoscopy. Patients were evaluated regarding ten different foregut symptoms and administered a ten-question appraisal of eating and bowel habits. Outcome measures included postoperative morbidity and mortality, the prevalence of invasive cancer in the esophagectomy specimens, symptomatic and functional alimentary results, patient satisfaction, and long-term survival. Median follow-up was 32 months (range, 7–83).

Results Thirty-day postoperative and in-hospital mortality was zero. Complications occurred in 37% (13/35), and median length of stay was 10 days. Occult adenocarcinoma was found in 29% (10/35) of surgical specimens (intramucosal in four; submucosal in five; and intramucosal in one with a single positive lymph node.) Patients consumed a median of three meals per day, most (76%, 26/34) had no dietary restrictions, and two-thirds (23/34) considered their eating pattern to be normal or only mildly impacted. Meal size, however, was reported to be smaller in the majority (79%, 27/34) of patients. Median body mass index (BMI) decreased slightly after surgery (28.6 vs 26.6, $p>0.05$), but no patient's BMI went below normal. The number of bowel movements/day was unchanged or less in a majority (82%) of patients after surgery. Fifteen of 34 (44%) patients reported loose bowel movements, which occurred less often than once per week in 10 of the 15. One patient had symptoms of dumping. Mean symptom severity scores improved for all symptoms except dysphagia and choking. Four patients developed foregut symptoms that occurred daily. Most patients (82%) required at least one postoperative dilation for dysphagia. Almost all (97%) patients were satisfied. Disease-free survival was 100%, and overall survival was 97% (34/35) at a median of 32 months.

Conclusion Esophagectomy is an effective and curative treatment for HGD and can be performed with no mortality, acceptable morbidity, and good alimentary outcome. These data provide a gold standard for comparison to alternative therapies.

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Introduction

The incidence of esophageal adenocarcinoma continues to increase in Western countries.¹ National Cancer Institute data predict that approximately 15,560 cases of esophageal carcinoma will occur in the USA in 2007, of which approximately 8,000 will be adenocarcinoma.² Barrett's esophagus, characterized by the replacement of normal esophageal squamous mucosa with metaplastic columnar mucosa resembling intestinal epithelium, has long been recognized to be a precursor of esophageal adenocarcinoma.^{3,4} Current thought holds that Barrett's esophagus may progress through the intermediate steps of low-grade and high-grade dysplasia before developing into invasive carcinoma.

High-grade dysplasia (HGD) is a neoplastic process with disease still confined to the epithelium, and its natural history is not well understood. Some cases of HGD progress to invasive malignancy,^{3,4} whereas others may not, although the ability to predict whether and when progression might occur is limited at present. The distinction of HGD from intra-mucosal carcinoma can be difficult, even by experienced gastrointestinal pathologists.^{5,6} In addition, when patients have undergone esophagectomy for the preoperative diagnosis of HGD, occult carcinoma has been detected in a significant percentage of the resected specimens.^{7–33} The presence of Barrett's esophagus with HGD, therefore, has been representative of an unstable esophageal epithelium in transition to carcinoma and a marker of existing carcinoma. For these reasons, HGD has traditionally been an indication for esophagectomy in patients physiologically fit enough to tolerate the operation, as resection is both a prophylactic and potentially curative therapy for esophageal adenocarcinoma.

Esophagectomy has been challenged, however, as the most appropriate therapy for HGD. Critics of this approach cite the magnitude of the procedure, the potential for postoperative morbidity and mortality, and the negative impact on quality of life that foregut reconstruction can impose. Other treatment strategies, including rigorous endoscopic surveillance or a variety of endoscopic mucosal therapies, have arisen as alternatives to esophagectomy for HGD, particularly in patients who are deemed as being at high risk for surgery. Although such modalities hold promise, each less invasive alternative has its own potential risks and limitations that must be weighed against perceived advantages. To make informed comparisons between each of the treatment alternatives for HGD, accurate data regarding the outcomes of esophagectomy for HGD are essential. Toward this end, the purpose of our study was to document the perioperative complications, symptomatic

outcomes, patient satisfaction, and long-term survival after esophagectomy for HGD.

Material and Methods

Study Population

Approval from our institutional review board was obtained before the start of this study. Thirty-eight patients who underwent esophagectomy for biopsy-proven HGD during the years 1999 to 2005 were retrospectively evaluated. Three patients were excluded from evaluation due to obvious malignancy on preoperative upper endoscopy. Of the remaining 35 patients, 5 had small mucosal nodules or irregularities. All patients underwent a mapping biopsy protocol with four-quadrant biopsies taken every 1 cm and additional biopsies taken at the site of any visible mucosal nodularity. Biopsies were examined by two separate pathologists, one typically an expert in the pathology of gastrointestinal dysplasia, to confirm the presence of HGD.

Thirty-three patients (94.3%) underwent an esophagectomy via a transhiatal approach and two (5.7%) through a combined laparotomy and right thoracotomy. Of those patients undergoing transhiatal esophagectomy, 4 (12.1%) were completed using a vagal-sparing technique. All but one patient underwent a cervical incision with cervical esophagogastric anastomosis, regardless of approach. A single patient underwent esophagogastric anastomosis performed in the high intra-thoracic position. All patients, except those undergoing vagal-sparing esophagectomy, underwent either pyloromyotomy or pyloroplasty for gastric drainage.

Outcome Assessment

Outcome was assessed by four primary measures: (1) postoperative morbidity and mortality; (2) alimentary function; (3) patient satisfaction; and (4) long-term survival. Preoperative evaluation, perioperative data, and surgical pathology were collected through retrospective review of both inpatient and outpatient charts. Patients were contacted after esophagectomy via telephone and interviewed regarding current symptoms and changes in symptom frequency. Patients were queried regarding ten different foregut symptoms, which included heartburn, regurgitation, dysphagia, odynophagia, chest pain, epigastric pain, cough, choking, nausea, and vomiting. Symptoms were assigned a standardized symptom severity score (Table 1). Patients were also administered a ten-question appraisal of eating and bowel habits. Specifically, patients were questioned regarding diet quality and meal size, frequency, and pattern. In addition, the number and quality of daily bowel movements were documented. Patients were asked to give an

Table 1 Symptom Severity Score

Score	Description
4	Symptom occurs daily.
3	Symptom occurs less than once per day.
2	Symptom occurs less than once per week.
1	Symptom occurs less than once per month.
0	Asymptomatic.

overall subjective assessment of their outcome. Specifically, they were asked whether they were satisfied with the result of their surgery and whether they would undergo the operation again if given the choice.

Median follow-up after esophagectomy was 32 months (range, 7–83). Follow-up was obtained in 100% of patients. One patient died secondary to a non-cancer related cause before the time of the follow-up questionnaire.

Statistics

The Student's *t* test was used to compare continuous data between individual groups. Chi-square or Fischer exact test was used to compare proportions between individual groups. The Wilcoxon or Mann–Whitney *U* test was used for paired and unpaired, independent, nonparametric data. A *p* value of less than 0.05 defined statistical significance.

Results

Clinical Characteristics and Perioperative Outcome

Thirty-three males and two females with a median age of 64 (range, 41–89) underwent esophagectomy for biopsy-proven HGD. HGD was multi-leveled, defined as positive biopsies taken more than 1 cm apart, in 37% (13/35). All patients had pathologically confirmed Barrett's mucosa. Barrett's was long-segment (≥ 3 cm) in 11% (4/35) and short-segment (< 3 cm) in 89% (31/35).

Thirty-day perioperative and in-hospital mortality was zero. Complications occurred in 13 of 35 patients (37%; Table 2). Three patients (8.5%) developed anastomotic leaks that were self-contained and treated medically with antibiotics and nothing per os. A single patient developed a chyle leak that resolved without surgical intervention. Median length of stay was 10 days (range, 7–74).

Occult adenocarcinoma was found in 29% (10/35) of surgical specimens. Tumor depth was intramucosal in 4 (40%), submucosal in 5 (50%), and intramucular in 1 (10%). The single patient with intramucular tumor had one lymph node positive for cancer. Of those patients without cancer, HGD was found in 21 (84%) and LGD (low grade dysplasia) in 4 (16%). Of those patients with mucosal

irregularity noted on preoperative endoscopy, 60% (3/5) had invasive cancer in their surgical specimen. As importantly, of patients without mucosal irregularity, 23% (7/30) were found to have an occult carcinoma (Table 3).

Symptomatic and Functional Outcome

Mean symptom severity scores improved for all symptoms except dysphagia and choking (Fig. 1). Dysphagia and choking, however, were mild, occurring less often than once per month in 83% (10/12) of these patients. Three patients developed symptoms that occurred daily. Of these patients, one had chest pain and one had epigastric pain. Both described these symptoms as short lasting and occurring at meals. One patient experienced daily dysphagia. Two-thirds (23/34) of patients were taking antacid medications for symptoms of heartburn or regurgitation, all with good relief. Most patients (82%) required at least one postoperative dilation for dysphagia.

Patients consumed a median of three (range, two to eight) meals per day. Two-thirds (23/34) of patients considered their eating pattern to be normal or only mildly impacted (Fig. 2). Most (76%) were able to eat an unrestricted diet. Meal size, however, was reported to be smaller after surgery than before surgery in the majority (79%, 27/34) of patients. Despite this fact, 56% considered their postoperative meal size to be normal, suggesting they were overeating before surgery. Of those who did not consider their meal size to be normal, 11(73%) described their meals as being one-half the size of a TV dinner and 4 (27%) one-fourth the size of a TV dinner. Importantly, those patients consuming meals comparable to one-fourth the size of a TV dinner ate more frequent meals per day (median 4.5, 3–8) compared to the others. Of those patients consuming restricted diets, spicy foods were avoided in two and meats such as steak were avoided in six. Median body mass index (BMI) decreased slightly after surgery (28.6 vs 26.6, $p > 0.05$), but no patient's BMI went below normal.

Patients experienced a median of two (range, one to five) bowel movements per day after esophagectomy. Importantly,

Table 2 Early Postoperative Complications

Complication (13/35, 37%)	
Pneumonia	3
Anastomotic leak	3
Wound infection	2
ARDS	1
Atrial fibrillation	1
Thoracic duct leak	1
Alcohol withdrawal	1
Acute renal failure	1
Ileus	1

Table 3 Occult Carcinoma Found in Those With or Without Endoscopically Detected Esophageal Mucosal Irregularity Within Barrett's Esophagus

	Endoscopic Finding	Pre-operative Biopsy: HGD	Postoperative Pathology: (+) Adenocarcinoma	Tumor Depth/Stage
Visible mucosal irregularity (<i>n</i> =5)	Ulcer (<i>n</i> =1) Nodule (<i>n</i> =4)	100%	60% (<i>n</i> =3)	66% (2/3) Submucosal/I 33% (1/3) Intramucular and node (+) IIB
No visible mucosal irregularity (<i>n</i> =30)	Barrett's only; No ulcer or nodule	100%	23% (<i>n</i> =7)	57% (4/7) Intramucosal/I 43% (3/7) Submucosal/I

tantly, this number was unchanged or less than preoperatively in the majority (82%) of patients. Fifteen of 34 (44%) reported loose bowel movements, which occurred less often than once per week in 10 of the 15 (67%). One patient described symptoms consistent with dumping easily controlled with smaller and more frequent meals.

Almost all (97%, 33/34) patients were satisfied with the results of their operation. Similarly, 97% stated they would undergo the same operation again. One patient was not satisfied because of his inability to eat larger meals, and one patient stated he would choose a less invasive option if given the choice again.

Survival

Disease-free survival was 100% at a median follow-up of 32 months (range, 7–83). One patient, with comorbid heart disease, died 7 months after esophagectomy secondary to a myocardial infarction. This patient had stage IIB esophageal adenocarcinoma, due to involvement of a single lymph node by cancer, but had no evidence of recurrent disease at the time of his death. Overall survival was 97% (34/35).

Discussion

Our data show that esophagectomy can be performed for HGD with no mortality and with acceptable morbidity. Occult carcinoma was detected in 29% of esophagectomy specimens. Symptomatic and functional outcomes were good, with mean symptom scores improving after surgery for all symptoms other than dysphagia or choking. The majority considered their eating habits to be normal or only mildly impacted by surgery. Patient satisfaction was high (97%), with almost all patients stating they would choose surgery again if given the choice. Medium-term survival was excellent, approaching 100% at nearly 3 years follow-up.

Operative Mortality

Critical to the acceptance of esophagectomy as the treatment of choice for HGD is evidence that resection can be

performed with a low rate of mortality and major perioperative complications. If high, mortality and morbidity from surgical intervention can negate any benefit derived from prevention or cure of cancer. Esophagectomy for esophageal carcinoma historically was associated with a high rate of early postoperative mortality.³⁵ Recent results derived from large administrative databases demonstrate operative mortality after esophagectomy far less than what had been previously reported. In a publication regarding outcomes from Veterans Administration hospitals covering 1,777 esophagectomies in 109 facilities from the years 1991–2000,³⁶ 30-day operative mortality was 9.8%. The vast majority (85%) of these procedures, however, were for esophageal carcinoma. In addition, many of the procedures were performed in hospitals with a small institutional or surgeon experience in performing esophagectomy, as the average institution performed only 1.6 esophagectomies per year. The importance of institutional volume was also demonstrated in a report derived from a Medicare database that analyzed esophagectomy outcomes during the time period 1994–1999.³⁷ Mortality after esophagectomy was 20.3% in hospitals where fewer than 2 esophagectomies were performed, compared to 8.4% in hospitals performing more than 19 esophagectomies per year. In fact, of all operations assessed, esophagectomy was found to be

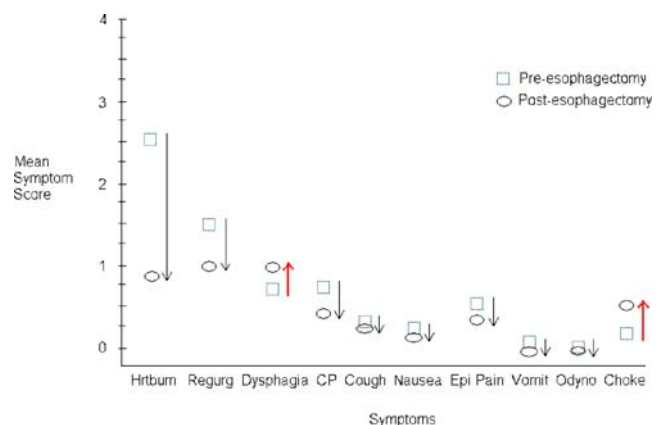


Figure 1 Pre- to postesophagectomy mean symptom scores. An improvement in mean scores was seen for all symptoms except dysphagia and choking.

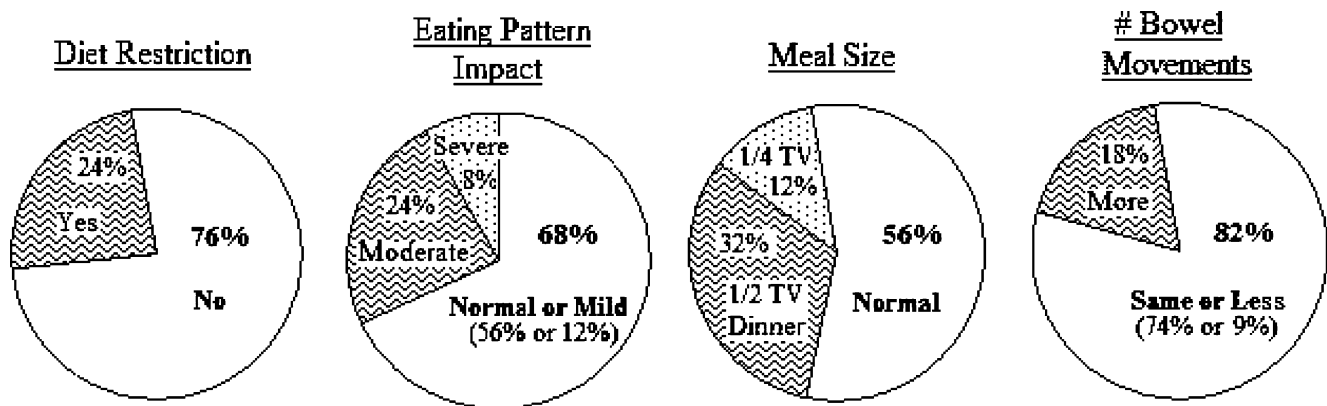


Figure 2 Functional alimentary outcomes after esophagectomy.

among the most sensitive to the influence of institutional procedural volume on operative mortality.

While operative mortality statistics for esophageal cancer have improved over recent decades, the rates of mortality stated above are still unacceptable when considering esophagectomy as prophylaxis for a pre-malignant condition or as potentially curative therapy for early cancer. Recent data from high-volume centers in the USA specializing in esophageal surgery reveal mortality statistics in the 3.5–5% range or lower after esophagectomy for carcinoma (Table 4). Of importance, however, are the numerous reports specifically addressing mortality after esophagectomy for the preoperative diagnosis of HGD (Table 5). Similar to our experience, most centers report an extremely low mortality rate after esophagectomy for HGD, such that the cumulative mortality from all series approximates 1%.

A number of plausible explanations exist for the improved outcomes in patients with the preoperative diagnosis of HGD compared to those undergoing esophagectomy for known invasive esophageal carcinoma. Patients with HGD most assuredly represent a different, and perhaps healthier, patient population than those presenting with esophageal squamous cell carcinoma, for instance, given the divergent risk factors for the two diseases. Lacking cancer and its potential to cause dysphagia and weight loss, patients with HGD typically do not present in a malnourished or immunologically compromised state. Likewise, patients without cancer generally can

and should be optimized for surgical intervention, addressing such issues as cardiopulmonary comorbidities, smoking or alcohol cessation, or general deconditioning, without the time-pressure imposed by a malignancy and its potential physiological and psychological consequences. Neoadjuvant treatment consisting of chemotherapy or combined chemoradiation, with its associated risks and potential for contributing to perioperative complications, is not a consideration in patients lacking proof of invasive cancer.

In some centers, a less aggressive operation may be offered for resection of HGD than what is performed for invasive cancer with its potential for nodal metastasis. For instance, we and others generally perform a transhiatal resection for HGD, sometimes with a vagal-sparing technique. For known or suspected invasive carcinoma, on the other hand, we often consider a more aggressive en bloc esophagectomy that requires the addition of a right thoracotomy with its associated morbidity, particularly the potential for respiratory complications.⁴¹

Of most significance, perhaps, is the ability to optimize patient selection for esophagectomy in the setting of HGD. Given the presence of non-operative management options for HGD, such as mucosal resection/ablation or endoscopic surveillance, esophagectomy can only be justified in patients judged to be at low risk for operative intervention. High-risk patients commonly are managed by less invasive means, as the benefit of surgery may not justify the risk in such

Table 4 Mortality After Esophagectomy for Cancer at US Specialty Centers

Author	Resection Type	Year	Number of cases	Mortality (%)
Swanson et al. ³⁸	TTE	2001	250	3.6
Altorki et al. ³⁹	3-field en bloc	2002	80	5
Portale et al. ⁴⁰	THE/TTE/en bloc	2004	263	4.5
University of Rochester ^a	THE/TTE	2007	244	4.1

THE Transhiatal esophagectomy; TTE transthoracic esophagectomy; MIE minimally invasive esophagectomy

^a Unpublished data

Table 5 Mortality After Esophagectomy for HGD

Author	Year	Number of Cases	Mortality (%)
Hamilton and Smith ¹⁰	1987	5	0
Altorki et al. ¹³	1991	8	0
Pera et al. ¹⁵	1992	18	0
Levine et al. ¹⁶	1993	7	14
Streitz et al. ¹⁷	1993	9	0
Peters et al. ¹⁹	1994	9	0
Edwards et al. ²⁰	1996	11	0
Ferguson and Naunheim ²¹	1997	15	0
Cameron and Carpenter ²²	1997	19	0
Patti et al. ²³	1999	11	0
Nigro et al. ²⁴	1999	14	7
Nguyen et al. ²⁵	2000	12	0
Zaninotto et al. ²⁶	2000	13	0
Headrick et al. ²⁷	2002	54	1.8
Romagnoli et al. ²⁸	2003	21	0
Tseng et al. ²⁹	2003	60	1.7
Reed et al. ³⁰	2005	49	2
Sujendran et al. ³¹	2005	17	0
Moraca and Low ³²	2006	23	0
Rice et al. ³³	2006	111	0
Chang et al. ³⁴	2006	9	0
Williams et al. ^a	2007	35	0
Total	1987–2007	530	0.94%

^a Current study

situations. A low-risk management option typically does not exist for patients diagnosed with potentially operable esophageal carcinoma, as curative endoscopic therapies commonly are not suitable or available and surveillance is not an option. While combined chemoradiation without surgery may be an option in the high-risk patient, whether the risk/benefit ratio of such therapy is better compared to esophagectomy, and whether the patient and his treating oncologists will consider and be able to complete such therapy may be questionable. Esophagectomy may be chosen by the patient and physician as the best treatment option, despite the presence of comorbidities and the risks of intervention.

Functional Outcomes

As esophagectomy for carcinoma historically was associated with low rates of cure, operation was commonly undertaken for short-term palliation of symptoms.³⁴ Traditional outcomes assessment, therefore, focused on cure rates and operative mortality. Esophagectomy for HGD or early invasive carcinoma, on the other hand, is performed with the expectation of long-term survival. As a result, additional outcome measures such as quality of life after esophagectomy have assumed increasing importance.

Little data exist in the literature regarding functional outcomes specifically in patients undergoing esophagectomy for HGD. Headrick et al.²⁷ evaluated the quality of life of 54 patients who underwent esophagectomy for HGD and found that these patients scored better than national norms in role-physical and role-emotional categories with no differences in the categories of bodily pain, health perception, energy/fatigue, physical and social functioning, and mental health. The authors reported reflux in 68%, although symptoms were minimal on medical therapy. Furthermore, while 51% of patients required at least one postoperative dilation for presumed esophagogastric anastomotic stricture, only 38% (18/38) complained of dysphagia. Dysphagia was mild in the majority (83%).

These data are quite similar to what we report in that two-thirds of our patients were taking acid suppressive medications for symptoms of heartburn or regurgitation. Over 80% of our patients, however, required at least one postoperative dilation for presumed esophagogastric anastomotic stricture, although only approximately one-third experienced dysphagia at the time of follow-up assessment and 83% of such individuals had episodes of dysphagia less than once per month.

Chang, et al.³⁴ reported on quality of life in 34 patients undergoing esophagectomy for HGD or adenocarcinoma detected during the course of surveillance for Barrett's esophagus. At a mean follow-up of 46 months, SF-36 (version 2) scores were equal to or better than those of healthy individuals, based on national averages reported in 1998, in all seven areas tested. The most frequently reported postoperative symptoms were reflux (59%), diarrhea (55%), and bloating (45%). The frequency and severity of these symptoms, however, were mild.

We found that patients ate an average of three meals per day after esophagectomy and were able to eat an unrestricted diet in a quantity that, although generally less than what was consumed before surgery, was still deemed to be normal by most. In addition, while there was a trend toward weight loss after surgery (median BMI decreasing from 28.6 to 26.6), the postoperative median BMI was still in the "overweight" category and no patient's BMI diminished below the normal range.

Moraca and Low³² reported on outcomes after esophagectomy for HGD and intramucosal carcinoma. Seventy-nine percent of their patients after esophagectomy reported "normal or insignificantly impacted eating." Similar to our experience, mean BMI decreased from 28.9 to 25.6 ($p=0.003$) as a result of surgery, and no patient was found to be underweight at the time of follow-up. Of those patients completing postoperative SF-36 questionnaires, health-related quality of life (HRQL) scores equaled or exceeded age- and sex-matched norm-based values in seven of eight domains.

While esophagectomy has been associated with the potential for postoperative dumping and diarrhea, an interesting finding in our patient population was that the median number of bowel movements per day after esophagectomy was only two and that 82% of patients reported that this number was equal to or less than the number they experienced before surgery. In addition, in the minority of patients experiencing intermittent loose stools, the frequency was less than once per week in the majority. Only one patient in our cohort experienced symptoms consistent with dumping and was managed with dietary modifications with good results.

Occult Carcinoma

Of the 35 patients who underwent esophagectomy for the preoperative diagnosis of HGD, 29% were found to have occult carcinoma in their surgical specimen. This percentage is consistent with other reports in the literature (Table 6). Our analysis of the available studies dating back to 1983 reveals a 37% incidence of occult carcinoma in the setting of known HGD, without a significant trend toward diminution in recent years. The presence of a visible mucosal nodule in association with HGD was a particularly worrisome finding in that 60% (three out of five patients) had an invasive carcinoma detected in the operative specimen, also consistent with prior reports.^{42–45}

Of particular concern is the fact that 60% of the invasive cancers extended beyond the mucosa, for a prevalence of 17% in all patients undergoing resection for HGD. These data are extremely important when a strategy other than esophagectomy is contemplated for the management of HGD. Tumors limited to the mucosa are associated with only an approximately 5–10% risk of nodal metastasis.⁴⁴ When the tumor invades into the submucosa, however, the risk of nodal metastasis increases substantially to the 30–50% range. Currently available esophageal mucosal resective or ablative procedures, such as endoscopic mucosal resection, photodynamic therapy, or radiofrequency ablation, are best suited for disease limited to the mucosa. Any such therapies are potentially inadequate once tumor has invaded into the submucosa or beyond, not only due to the extent of intramural disease but also because of the potential for lymphatic spread.

Despite the cancer risk, our data demonstrate that esophagectomy for HGD is generally a curative treatment. Disease-free survival at a median of 32 months follow-up in our study was 100%. Limitations of the current data are that follow-up is not available beyond 5 years on average, and we do not know the potential for recurrent intestinal metaplasia, dysplasia, or frank carcinoma in the esophageal remnant over the long term.

Table 6 Prevalence of Occult Cancer After Esophagectomy for HGD

Author	Year	Number of Cases	% Cancer in Resected Specimens
Skinner et al. ⁷	1983	3	67
Schmidt et al. ⁸	1985	2	100
Lee ⁹	1985	2	50
Hamilton and Smith ¹⁰	1987	5	60
Reid et al. ¹¹	1988	4	0
DeMeester et al. ¹²	1990	2	50
Altorki et al. ¹³	1991	8	50
McArdle et al. ¹⁴	1992	3	67
Pera et al. ¹⁵	1992	18	50
Levine et al. ¹⁶	1993	7	0
Streitz et al. ¹⁷	1993	9	22
Ortiz et al. ¹⁸	1996	2	0
Peters et al. ¹⁹	1994	9	55
Edwards et al. ²⁰	1996	11	73
Ferguson and Naunheim ²¹	1997	15	53
Cameron and Carpenter ²²	1997	19	10
Patti et al. ²³	1999	11	36
Nigro et al. ²⁴	1999	14	43
Nguyen et al. ²⁵	2000	12	42
Zaninotto et al. ²⁶	2000	13	23
Headrick et al. ²⁷	2002	54	35
Romagnoli et al. ²⁸	2003	21	38
Tseng et al. ²⁹	2003	60	30
Reed et al. ³⁰	2005	49	37
Sujendran et al. ³¹	2005	17	65
Moraca and Low ³²	2006	23	26
Rice ³³	2006	111	45
Chang et al. ³⁴	2006	9	11
Williams et al. ^a	2007	35	29
Total	1983–2007	548	37.4%

^a Current study

Conclusions

Esophagectomy remains the standard of care for most patients with HGD, once the diagnosis has been established and independently confirmed, although the decision must be individualized. Esophagectomy should be performed only in high-volume centers with a proven track record in terms of operative mortality, morbidity, and functional outcomes. In such settings and with proper patient selection, operative mortality approximates 1% or less, functional outcomes are good with high patient satisfaction, and cure rates are excellent. The benefits of operative intervention appear to justify the risks in such situations.

Esophagectomy is a highly reliable curative therapy for HGD. Alternative treatment options, including emerging technologies, will have to be judged against this modern day standard.

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