

The Accuracy of Endoscopic Ultrasound for Restaging Esophageal Carcinoma after Chemoradiation Therapy

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BACKGROUND. Endoscopic ultrasound (EUS) is an accurate staging modality for esophageal malignancy. Studies have determined that EUS does not retain this accuracy after chemoradiation and that it should not be used as a restaging tool for esophageal carcinoma. In this study, the authors examined their experience with esophageal carcinoma and restaging after neoadjuvant therapy with EUS.

METHODS. A retrospective chart review was conducted that included 83 patients with locoregional esophageal adenocarcinoma who were treated with chemoradiation under protocol. All patients underwent surgical resection. EUS was performed for restaging, and the results were compared with findings at surgical pathology using the TNM classification system.

RESULTS. All 83 patients identified underwent surgery. There were 77 males, and the mean patient age was 59 years. At restaging, the tumor status (T classification) was assessed correctly by EUS in 22 of 83 patients (29%). The sensitivity of EUS for the individual T classifications were 0% for T0 tumors, 19% for T1 tumors, 27% for T2 tumors, 52% for T3 tumors, and 0% for T4 tumors. In 19 of 83 patients, the tumor classification was correct, whereas 42 of 83 patients were over classified, and 15 of 83 patients were under classified when the EUS results were compared with the surgical pathology results. The lymph node status (N classification) was assessed correctly by EUS in 41 of 83 patients. The sensitivity of EUS for N classification was 48% for N0 disease and 52% for N1 disease. Twenty-two patients were restaged with residual disease according to the EUS results but had no evidence of residual tumor or lymph node involvement according to the surgical pathology results.

CONCLUSIONS. EUS did not retain its usefulness as a restaging modality after neoadjuvant chemoradiation for esophageal adenocarcinoma when the standard TNM classification system was used. *Cancer* 2004;101:940–7.

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Esophageal carcinoma continues to be a significant cause of mortality and morbidity in the United States. The role of endoscopic ultrasound (EUS) in the initial evaluation of esophageal carcinoma has become well established. EUS is superior to computed tomography (CT) for staging esophageal carcinoma with respect to locoregional disease.¹ EUS can improve the management of patients with esophageal carcinoma by offering a better definition of the tumor, which can lead to better clinical management and overall outcome. EUS has the ability to identify the intrawall layers of the esophagus, which have been shown to correspond histologically to the component layers of the esophageal wall. EUS is used widely in the regional assessment of esophageal carcinoma using the TNM classification system.²

Several series have reported an EUS accuracy > 85% for determining T classification and > 75% for determining N classification in patients who underwent surgical resection without neoadjuvant therapy.^{1,3,4}

Several authors have investigated the beneficial role of neoadjuvant chemoradiation therapy (CRT) in patients with potentially resectable esophageal adenocarcinoma to improve long-term survival.^{5,6} Local preoperative staging of esophageal carcinoma with EUS is important in selecting better candidates for surgery and in determining which patients have potentially resectable disease. Studies have continued to support the utility of EUS in the initial staging of esophageal carcinoma. However, controversy remains over the role of EUS in restaging esophageal adenocarcinoma after neoadjuvant CRT.⁷ Several studies initially indicated that EUS may be accurate for determining the extent of local tumor infiltration (T classification) and the presence of lymph node metastases (N classification) after CRT, but those findings were disputed by several more recent studies.^{8, 9} The objective of this retrospective study was to assess the accuracy of EUS for restaging esophageal adenocarcinoma using the TNM classification system² in patients with potentially resectable disease who underwent CRT prior to surgical resection.

MATERIALS AND METHODS

The primary criteria for inclusion in this study were that patients had EUS examinations after neoadjuvant CRT and that they underwent surgical resection of the tumor. All patients had a pre-CRT EUS examination with five exceptions: Those five patients were staged with CT scans and were deemed to have locoregional disease with no evidence of distant disease or involvement of celiac lymph nodes. The patients also had to have seen an oncologist and surgeon who deemed the patient a candidate for chemotherapy and potential surgical resection and would be the referral source for the EUS. Only patients with esophageal adenocarcinoma were studied, and patients with squamous cell carcinoma (SCC) were not included.

This study was a retrospective chart review of patients who were diagnosed with esophageal adenocarcinoma. Data was collected from patient records and included endoscopy and pathology reports. Eighty-three patients with esophageal adenocarcinoma were identified who had EUS examinations after neoadjuvant CRT and subsequently underwent surgical resection. The EUS results after CRT, endoscopy and biopsy results, and pathology finding on surgical specimens were analyzed. All patients either had adenocarcinoma in the distal esophagus or had tumors that crossed the gastroesophageal junction into the

cardia of the stomach and were deemed gastroesophageal junction (GEJ) tumors.

All patients received hyperfractionated radiation therapy, typically up to a total of 45 grays. Patients received concurrent chemotherapy in the form of cisplatin and 5-fluorouracil-based regimens with the addition of paclitaxel and CPT-11 under protocol.

After the completion of CRT, the patient was restaged by esophagogastroduodenoscopy (EGD) and EUS. In all patients, the interval between the completion of CRT and the restaging EUS examination was > 10 days. The endoscopist was able to converse with patients at the restaging examination and had access to previous EUS staging results. After the restaging examination, all patients underwent surgery within 14 days.

Patients were excluded if there was EUS or radiologic evidence of metastatic disease or if they were deemed nonsurgical candidates due to comorbid illnesses or staging. At the time of initial staging, routine EGD was performed before EUS. The EGD was performed using a Pentax EG-2931 or EG-2731 endoscope. All patients received parenteral meperidine and midazolam to achieve adequate sedation during the procedure. EUS was performed using either the Olympus GF-UM130, GF-UM20, or MH-908 radial echoendoscopes (Olympus America, Inc., Melville, NY). Images were obtained with scanning frequencies of 7.5 megahertz (MHz) and 12 MHz, depending on tumor size and thickness and to allow optimal visualization of local lymph nodes.

Tumor staging was determined by EUS using the 1997 American Joint Committee on Cancer (AJCC) TNM classification system (see Table 1).^{2,10} Lymph nodes were classified as malignant based on established sonographic criteria (see Table 2). Malignant lymph nodes appeared as large (> 1 cm), round, hypoechoic structures with a discrete border often directly adjacent to an esophageal mass.^{11,12} Depending on the TNM classification, the patient was given the appropriate Roman numeral staging group (see Table 3²); and, according to changes in this number, the patient's overall tumor stage was followed. EUS-guided fine-needle aspiration (FNA) of regional lymph nodes was not performed during the period of this study.

Patients with involvement of the celiac lymph nodes were included if the tumor extended across the esophagogastric junction, because this defined N1 disease (regional lymph node disease); however, patients were not included if the tumor was confined to the lower thoracic esophagus and if the celiac lymph nodes were positive, because this would denote M1a disease (metastasis in the celiac lymph nodes if the tumor was located in the lower thoracic esophagus),

TABLE 1
Definitions from the TNM Classification System for Esophageal Carcinoma according to American Joint Committee on Cancer Guidelines^a

TNM classification	Definition
TX	Tumor cannot be assessed
T0	No evidence of primary tumor
Tis	Carcinoma in situ
T1	Tumor invades submucosa or lamina propria
T1a	Tumor invades lamina propria
T1b	Tumor invades submucosa
T2	Tumor invades muscularis propria
T3	Tumor invades adventitia
T4	Tumor invades adjacent structures
NX	Regional lymph nodes cannot be assessed
N0	No regional lymph nodes involved
N1	Regional lymph nodes present
MX	Distant metastasis cannot be assessed
M0	No distant metastasis
M1a	Metastasis in the celiac lymph nodes if the tumor is in the lower one-third of the esophagus
M1a	Metastasis in the cervical lymph nodes if the tumor is in the upper one-third of the esophagus
M1b	Nonregional lymph nodes and/ or other distant metastasis

^a See Fleming et al.²

TABLE 2
Endoscopic Ultrasound Criteria for the Assessment of Lymph Nodes^a

Criteria	Benign	Malignant
Size (width)	< 10 mm	> 10 mm
Shape	Elongated	Round
Border	Irregular	Smooth
Echogenicity	Hyperechoic	Hypoechoic

^a See Bhutani et al.¹¹ and Catalano et al.¹²

and patients with metastatic disease were not included in this study.

Resected surgical specimens and endoscopic biopsies were analyzed by an experienced gastrointestinal oncopathologist at our institution. Tumors were staged according to the AJCC TNM classification system.² If no tumor cells were seen in the specimen, then the tumor was classified as pT0. Similarly, if no tumor cells were seen in the lymph node obtained from the surgical specimen, then the N classification was pN0. The extent of CRT effects seen within the esophagus on histologic examination was also noted. No standardized reporting system was used to document these CRT effects, but the depth of their involvement into the esophageal wall was recorded.

The overall accuracy of EUS tumor staging and restaging was calculated and compared with the gold

TABLE 3
Definition of Group Staging for Esophageal Carcinoma in Accordance with American Joint Committee on Cancer Guidelines^a

Stage grouping	T classification	N classification	M classification
Stage 0	Tis	N0	M0
Stage I	T1	N0	M0
Stage IIA	T2	N0	M0
	T3	N0	M0
Stage IIB	T1	N1	M0
	T2	N1	M0
Stage III	T3	N1	M0
	T4	N1	M0
Stage IV	Any T	Any N	M1
Stage IVA	Any T	Any N	M1a
Stage IVB	Any T	Any N	M1b

^a See Fleming et al.²

standard of surgical pathology. Standard descriptive statistics were calculated to summarize the procedure, including the proportion of patients correctly classified with respect to T classification, N classification, and both T and N classification.

RESULTS

All 83 patients identified underwent neoadjuvant CRT and surgical resection. There were 77 male patients, and the mean patient age was 59 years. Initial TNM classification² and group staging by EUS prior to CRT were as follows: T0N0M0, 0 patients (no evidence of primary tumor, no regional lymphadenopathy, and no distant metastases; Stage 0); T1N0M0, 0 patients (tumor invading into the esophageal lamina propria or submucosa, no regional lymphadenopathy, and no distant metastases; Stage I); T1N1M0, 2 patients (tumor invading into the esophageal lamina propria or submucosa, regional lymphadenopathy present, and no distant metastases; Stage IIB); T2N0M0, 8 patients (tumor invading into the esophageal muscularis propria, no regional lymphadenopathy, and no distant metastases; Stage IIA); T2N1M0, 4 patients (tumor invading into the esophageal muscularis propria, regional lymphadenopathy present, and no distant metastases; Stage IIB); T3N0M0, 17 patients (tumor invading into the esophageal adventitia, no regional lymphadenopathy, and no distant metastases; Stage IIA); T3N1M0, 46 patients (tumor invading into the esophageal adventitia, regional lymphadenopathy present, and no distant metastases; Stage III); and T4N0M0, 1 patient (tumor invading into structures adjacent to the esophagus, no regional lymphadenopathy, and no distant metastases; Stage III). An initial EUS examination was not performed in five patients.

TABLE 4
Comparison of Restaging Endoscopic Ultrasound Results and Surgical Pathology by T Classification^a

Restaging EUS T classification	Surgical T classification (no.)				
	T0	T1	T2	T3	T4
T0	0	2	1	0	0
T1	0	3	0	1	0
T2	11	5	3	11	0
T3	8	5	6	16	1
T4	1	0	0	1	0
TX	3	1	1	2	0

EUS: endoscopic ultrasound.

^a This table includes the surgical T classification for patients with TX disease.

Staging for those five patients was accomplished with CT scans, which revealed only locoregional disease. EUS restaging was performed in all 83 patients after CRT. Tumors were downstaged in 34 patients (41%), unchanged in 34 patients (41%), and upstaged in 10 patients (12%) by EUS. Table 4 shows that the T classification was assessed correctly by EUS in 22 patients (29%). The proportion of individual T classifications by EUS that were correct were 0% for T0 tumors, 19% for T1 tumors, 27% for T2 tumors, 52% for T3 tumors, and 0% for T4 tumors when comparing results from the EUS restaging examination with the findings at surgical pathology. Nineteen of 83 patients (25%) were assigned the correct group stage by restaging EUS, 42 patients (55%) were over staged, and 15 patients (20%) were under staged (see Table 5). The remaining 7 of 83 patients were classified with TX tumors. This represented treatment effects; and, at the time of the EUS examination, the endosonographer felt that changes within the wall were secondary to CRT effects rather than residual tumor, to the extent that a true T classification could not be assigned to the tumor. These seven patients were not included in the final analysis comparing restaging EUS results with surgical pathology results, but they were studied separately with close attention to the assessment made by the pathologist regarding the degree of treatment effects within the surgical specimen. The outcomes of patients with TX tumors are listed in Table 5. In three patients, there was no tumor present. In the other 4 patients the T classification ranged from T2 to T3, and 1 patient had N1 disease.

Nineteen of 22 patients who had no residual tumor at surgical staging (22 of 83 patients) were over staged by the restaging EUS examination. The other three patients were classified with TX tumors. Of those 19 patients, 10 patients had T2 tumors, 8 patients had T3 tumors, and 1 patient had a T4 tumor. Of 15 patients

who were under staged by the restaging EUS examination, none were deemed unresectable, but their tumors clearly were larger at the time of resection compared with their size during the EUS examination. One patient had T0N1M0 disease (no evidence of tumor, regional lymphadenopathy present, and no distant metastases; Stage IIB) according to the final pathology results. For this patient, the initial classification was T3N1M0; and, at the restaging EUS examination after CRT, it was T2N1M0.

Table 6 shows the accuracy of the restaging EUS examination for predicting the N classification of the tumor. N classification was assessed correctly by EUS in 41 patients (49%). The sensitivity of EUS for N classification was 48% for N0 disease and 52% for N1 disease.

After CRT, an EGD was performed concurrently with the restaging EUS examination. We evaluated the utility of post-CRT EGD with biopsy to reassess the presence of esophageal carcinoma. Biopsies were performed in 70 of 83 patients. Of these, adenocarcinoma was detected in only 15 patients; and 12 of those 15 patients had true-positive surgical pathology results. In the three patients who had false-positive biopsy results, the restaging EUS examination had indicated the presence of tumor (T4N1M0, T2N1M0, and T2N0M0). Therefore, combining EGD and EUS had little impact on overall accuracy. In the remaining 56 patients, the biopsies did not reveal any evidence of malignancy. In those biopsies, the findings ranged from ulceration to treatment effects and granulation tissue. Among those 56 patients, adenocarcinoma was found in 46 patients at final surgical pathology. There were only 10 patients who truly had negative biopsy results compared with the surgical pathology results. Therefore, post-CRT biopsies had a poor sensitivity and negative predictive value. The sensitivity of EGD and biopsy in detecting residual disease compared with postsurgical pathology was 9 of 62 tumors (15%), and the specificity was 16 of 21 tumors (76%). The negative predictive value was 9 of 14 tumors (64%), and the positive predictive value was 16 of 69 tumors (23%).

DISCUSSION

The objective of the current study was to demonstrate whether EUS could restage esophageal adenocarcinoma accurately after CRT compared with surgical findings. It is clear from the results that EUS does not retain its accuracy, and it should be regarded as an unreliable tool for the purpose of restaging esophageal adenocarcinoma. In our review, it was found that neither the T classifications nor the N classifications determined by EUS after CRT were accurate. The overall

TABLE 5
Breakdown of Restaged Endoscopic Ultrasound Results in Relation to Each Stage and the Corresponding Findings at Surgical Pathology^a

Post-CRT EUS TNM classification	No. of patients	Group stage	Surgical pathology, TNM classification (no.)	A	B	C
T0N0M0	2	Stage 0	T1N0M0 (1), T1N1M0 (1)	0	0	2
T1N0M0	2	Stage I	T3N1M0 (1), T1N0M0 (1)	0	1	1
T2N0M0	17	Stage IIA	T0N0M0 (7), T1N0M0 (3), T3N0M0 (4), T3N1M0 (2), T3N1M1 (1)	10	4	3
T3N0M0	13	Stage IIA	T0N0M0 (1), T1N0M0 (2), T1N1M0 (1), T2N1M0 (1), T3N0M0 (3), T3N1M0 (3), T0N0M1 (1), T3N1M1 (1)	3	3	7
T1N1M0	2	Stage IIB	T1N0M0 (1), T1N1M0 (1)	1	1	0
T2N1M0	13	Stage IIB	T0N0M0 (3), T1N0M0 (1), T2N0M0 (2), T3N0M0 (3), T0N1M0 (1), T1N1M0 (1), T2N1M0 (1), T3N1M0 (1)	9	3	1
T0N1M0	1	Stage IIB	T2N0M0 (1)	1	0	0
T3N1M0	23	Stage III	T0N0M0 (7), T1N0M0 (1), T2N0M0 (5), T3N0M0 (2), T4N1M0 (1), T3N1M0 (6), T3N1M1 (1)	15	7	1
T4N1M0	2	Stage III	T0N0M0 (1), T3N0M0 (1)	2	0	0
T3N0M1	1	Stage IV	T1N0M0 (1)	1	0	0
TXN0	5	—	T0N0M0 (2), T3N0M0 (1), T1N0M1 (1), T3N1M1 (1)	—	—	—
TXN1	2	—	T0N0M0 (1), T2N0M0 (1)	—	—	—

CRT: chemoradiation therapy; EUS: endoscopic ultrasound.

^a The numbers in column A represent results that were overstaged by EUS in relation to surgical pathology, the numbers in column B represent results that were staged correctly by EUS, and the numbers in column C are results that were understaged by EUS.

TABLE 6
Comparison of Restaged Endoscopic Ultrasound Results and Surgical Pathology Results by N Classification

Posttreatment EUS N classification	Pathologic N classification: No. (%)	
	N0	N1
N0	28 (48)	12 (48)
N1	30 (52)	13 (52)

EUS: endoscopic ultrasound.

accuracy of the T classification for determining the response of esophageal carcinoma to CRT was 29%. This finding is similar to that found in other studies.^{8,9}

The inaccuracy of restaging EUS is highlighted further by the finding that EUS could not predict pathologic T0N0M0 disease in 22 patients, which is disconcerting, especially because 10 of those patients were classified with T2 tumors, and 8 patients were classified with T3 tumors. Why is there such a discrepancy between histology and EUS imaging? The reason for this discrepancy is related to the changes that chemotherapy and radiation have on the intrawall layers of the esophagus: changes that EUS imaging is not sensitive enough to distinguish from viable tumor. Such changes involve inflammation and fibrosis, which lead to image artifacts on EUS.¹³ Of the 22 patients who had pT0N0M0 disease, all but 1 had pathology reports indicating that there were severe treatment effects. Treatment effects typically were re-

ported as ulceration, chronic inflammation, fibrosis, or vascular involvement that extended anywhere from the mucosa to the adventitia. In the seven patients who were classified with TX tumors, the pathologist confirmed that there were severe treatment effects, with ulceration and fibrosis in five patients and with adenocarcinoma present in two of those five patients. In the other two patients, no treatment effects were reported, but adenocarcinoma was found at the level of the adventitia in both patients. Therefore, EUS clearly has difficulty in differentiating neoplastic involvement from inflammation and fibrosis. Conversely, 3 patients were classified with T0 tumors at the restaging EUS examination but were reclassified with T1 or T2 tumors at surgery. Again, this is disconcerting, in that the restaging EUS examination documented no disease or even treatment effects, but there was obvious disease in the surgical specimen. In these three patients, the pathologist did not note any changes consistent with treatment effects within the specimen.

The differentiation of muscularis propria involvement alone (T2 classification) from invasion through the muscularis propria into the adventitia (T3 classification) can be subtle and difficult with EUS.¹⁴ EUS is least accurate in identifying true T2 tumors. A T2 tumor can extend to the very boundary of the muscularis propria, whereas a T3 tumor only needs to cross this boundary into the subadventitia to become a non-T2 tumor.¹⁵ This difference occurs over a very short distance and can lead to the over classification of

T2 tumors and the under classification of T3 tumors. This differentiation is made even more difficult after CRT because of the resultant peritumor inflammation and fibrosis, which can distort the intrawall layers of the esophagus. The impact on restaging is that true T2 tumors may be over classified, because adventitial involvement may be seen that, in fact, represents only inflammatory changes, whereas what are believed to be T3 tumors actually may be only T2 tumors that were classified as T3 because of scarring from radiation (rather than tumor) in the adventitia layer.⁷ In our study, the sensitivity of EUS in determining the correct T classification was only 27% for T2 tumors and 52% for T3 tumors.

In this study, we wanted to reevaluate the usefulness of the TNM classification system² as the primary tool for documenting tumor changes after therapy. The conclusions of this study, however, are similar to the results reported previously.^{11,16} Laterza et al. found that the overall accuracy of restaging EUS after CRT was poor, similar to what we found in the current study. The majority of patients in their study also were over staged during the restaging EUS examination, similar to our patients, especially in patients who achieved a complete response and in patients who had minimal disease.^{17,18} Some studies have advocated defining the tumor by its size and cross-sectional area, rather than using the TNM classification system, as the primary means for following tumor response to therapy. Isenberg et al. concluded that EUS after CRT was not accurate when using the TNM classification system but found that, if the maximal cross-sectional area was measured and followed, then this proved to be more useful.¹⁹ A response to therapy was defined as a reduction of cross-sectional area by 50%, and this was validated by Chak and colleagues, who also showed a survival benefit for patients who achieved this level of response.^{16,18,20} Bowrey et al. evaluated a similar group of patients and found the same inaccuracies and unreliability of EUS for restaging esophageal carcinoma after CRT that we found. Their conclusion was to use the maximum tumor depth, in millimeters, as the measure to follow when monitoring response to CRT.²¹

In the current study, EUS-guided FNA (EUS-FNA) was not used in the staging of malignant appearing lymph nodes, although its usefulness has been established.¹¹ EUS can recognize changes in the echogenicity and anatomy of lymph nodes, but this is not always enough. Unless the malignant component in the lymph node causes significant inflammation, low levels of tumor burden within a lymph node will go undetected. This can hinder the accuracy of EUS for initial staging and restaging. We could have increased

the strength of this study by performing EUS-FNA of suspected lymph nodes after CRT to see whether any tumor cells still were present. In our study, N classification was assessed correctly by EUS in only 41 of 83 patients. The sensitivity of EUS was 48% for detecting a true N0 lymph node and 52% for detecting an N1 lymph node. EUS-FNA of nonregional or distant lymph nodes was evaluated by Giovannini et al., who showed there is an advantage to performing this procedure, because it increases the accuracy of staging.²¹ Our inclination is to use EUS-FNA on a lymph node only when the information gained truly will affect the management of the patient, and not when it will affect only their prognosis, likelihood of responding to therapy, or outcome. Typically, all patients classified with T1N1M0, T2N0M0, T2N1M0, T3N0M0, T3N1M0, T4N0M0, or T4N1M0 disease (Stages IIA through III) will be treated the same in terms of receiving neoadjuvant therapy prior to undergoing surgery if their disease is deemed resectable. Patients who are classified with T1N0 disease will tend to go directly to surgery. The only scenario in which lymph node status truly is important is in ruling in or ruling out metastatic disease. Because, in our group of patients, tumors were located either in the distal esophagus or in the GEJ, the most important factor was whether the celiac lymph nodes were involved. According to the AJCC criteria, a patient is deemed to have metastatic disease if the tumor is confined to the thoracic esophagus, if it does not cross the GEJ, and if the celiac lymph nodes are positive. However, if the tumor involves and crosses the GEJ, and if the celiac lymph nodes are positive, then, according to our interpretation, this still would be locoregional disease. EUS-FNA, therefore, should be performed when there is a suspicious appearing celiac lymph node and the tumor is confined to the esophagus. Determining celiac lymph node positivity by EUS-FNA may not always be necessary, even given this scenario, if the endosonographic appearance of the lymph node is strongly suggestive of malignant involvement and meets established criteria for predicting positivity.¹¹ Another factor to consider prior to performing EUS-FNA of a lymph node is to ensure that the path of the needle does not pass through the primary tumor itself, because this will contaminate the results. In all 83 patients in the current study, there was no scenario that lent itself to absolutely requiring an EUS-FNA performed on a lymph node.

In the current study, we included only patients with esophageal adenocarcinoma and not patients with SCC. It is unlikely that excluding patients with SCC had any significant effect on the outcome of this study, because it was reported previously that the

accuracy of EUS in restaging such patients after CRT was as unreliable as it is for patients with adenocarcinoma.¹⁷

The time between completing CRT and performing the restaging examination was not standardized. Although all examinations were performed after at least 10 days, it is unclear whether there should have been a longer interval to allow some of the effects of the acute inflammatory effects of CRT within the esophageal wall to dissipate prior to performing the restaging EUS examination. There are no clear guidelines or indications regarding the optimal interval between the end of therapy and performing the restaging EUS examination.

Where does this leave EUS as an imaging modality after CRT? Although we found that EUS may not be accurate for restaging esophageal adenocarcinoma, others found that it was very useful for detecting disease recurrences at the surgical anastomosis after patients underwent esophageal resection.³ Clearly, the immediate treatment effect has a deleterious effect on EUS imaging; however, once sufficient time is given for such changes to resolve, then EUS appears to regain its usefulness. In a study by Catalano et al., it was found that EUS was more sensitive than upper endoscopy and CT scans for the evaluation of disease recurrence in patients with esophageal carcinoma.²² In a similar study by Fockens et al., EUS was performed at 6-month intervals after patients underwent resection for carcinoma of the esophagus and the gastric cardia: Those authors found that EUS was accurate in the early detection of locoregional recurrent disease.²³

The results of the current study suggest that restaging esophageal adenocarcinoma with EUS using the standard T classification and N classification criteria was not accurate or reliable after CRT. At our institution, a restaging EUS examination after CRT for esophageal carcinoma still is requested, which suggests that knowing the tumor response to CRT is desirable. With improved imaging of the esophageal wall either with echoendoscopes that have higher resolution capabilities or with modalities such as optical coherence tomography,²⁴ this study should be repeated to reexamine the data and the outcomes.

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