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ORIGINAL ARTICLE

Percutaneous endoscopic gastrostomy site metastases in head and neck cancer: use of FDG PET-CT

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PURPOSE
To retrospectively evaluate the utility of positron emission tomography-computed tomography (PET-CT) in the diagnosis of percutaneous endoscopic gastroscopy (PEG) site metastases in head and neck cancer.

MATERIALS AND METHODS
From the database of 250 patients of head and neck cancer who were referred for PET-CT over 2 years (from January 2005 to January 2007), 6 patients who had PEG tube placement were considered for the study. Imaging was performed on a GE Discovery ST PET-CT system after intravenous injection of 370 MBq (10 mCi) of ^{18}F-fluorodeoxyglucose (FDG).

RESULTS
Intense FDG uptake with an associated soft tissue mass was seen at the PEG site in 3 patients and mild uptake was seen in 2 patients. Biopsy revealed PEG site metastases in 2 patients, abscess in 1 patient, and granulation tissue in 1 patient. Intense uptake with an associated soft tissue mass suggested the diagnosis of metastasis. Stranding of the peristomal fat seen on the CT component of the PET-CT indicated an infective/inflammatory pathology. PET-CT findings showed local recurrence in 3 patients and disseminated metastases (excluding the PEG site) in 1 patient.

CONCLUSION
The functional information provided by PET combined with the morphologic detail of CT can improve characterizing of the stoma site abnormality and help in distinguishing recurrence from infective/inflammatory changes. Whole body combined PET-CT is a useful modality for evaluating gastrostomy site metastases and for detecting coexisting local recurrences and distant metastases in head and neck cancer patients. In addition it can detect early asymptomatic recurrences at the gastrostomy site.

Key words: • *positron emission tomography* • *gastrostomy* • *head and neck cancer* • *neoplasm* • *metastasis*

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Diminished oral intake in patients of head-neck cancer on multimodality treatment leads to difficulty in meeting optimal nutritional requirements. The use of percutaneously placed gastric feeding tubes is now well accepted for meeting the caloric need of such patients. Gauderer and Ponsky first introduced the percutaneous endoscopic gastrostomy (PEG) technique in 1980; the utility and safety of PEG was subsequently validated in 19 patients with head and neck cancer by Ruppin and Lux in 1986 (1). PEG site metastasis is an uncommon but documented complication of this procedure. Preyer and Thul (2) in 1989 reported the first case of upper aerodigestive tract cancer metastatic to a PEG site. Since then, a few more case reports have been added to the literature. Adelson and Ducic (3), while reporting a single instance of PEG site metastasis, reviewed the prior 21 cases reported in literature up to 2002. A Medline search did not reveal any prior descriptions of PEG site metastases of head-neck cancer evaluated with positron emission tomography (PET).

PET using the radiolabeled glucose analogue fluorodeoxyglucose (FDG) is used in the initial evaluation and in the detection of recurrences of various types of cancer, including colon, lung, and head-neck cancer (4). PET allows for the visualization of metabolically active tissues and is useful in the detection of head-neck tumor lymph node involvement (5). It is used for initial staging, for defining regional or distant nodal disease, for localizing unknown primary tumors, and for identifying recurrent disease (5–7). However, lack of precise anatomical resolution, which is necessary for surgical and radiotherapeutic planning, limits its usefulness as a single diagnostic modality (5, 6). Positron emission tomography-computed tomography (PET-CT) is a recent imaging modality that allows simultaneous image acquisition and co-registration of metabolic and anatomical data, expanding the benefits of PET or CT alone (5, 6). This report described the patterns of FDG uptake and the associated morphological findings at the PEG site and how PET-CT can be useful in detecting metastases at this location.

Patients and methods

This was a retrospective evaluation of PET-CT findings in head-neck cancer patients with PEG tube placement who were referred for PET-CT. Review of the database of the previous 2 years (from January 2005 to January 2007) indicated that 250 patients with head-neck cancer were referred for PET-CT.

Six patients had PEG tube placed for enteral alimentation and were considered for the study (1 female and 5 males, aged 50 to 72 years, average 60 years). Squamous cell carcinoma was the underlying malignancy in all 6 patients. Primary disease was located in the tongue in 4 patients and in the buccal mucosa in 2 patients. All patients had

undergone surgery with or without radiation therapy earlier for treatment of the primary tumor. The clinical data of these patients are summarized in Table 1.

The ethics committee of our institute does not require patient consent for retrospective review of imaging studies.

Patient preparation and PET-CT imaging protocol

All patients were asked to fast for 4–6 hours prior to the study; blood glucose levels were checked and confirmed to be less than 150 mg/dL. The studies were performed 1 hour following intravenous administration of 370 MBq (10 mCi) of ^{18}F-FDG, during which patients were asked to rest. Patients were asked to drink 750 mL of water soluble iodinated oral contrast to opacify the bowel for the CT component of the study. No intravenous iodinated contrast was administered. Patients were positioned supine with their arms at their sides and were asked to breathe normally during image acquisition.

Imaging was performed on a Discovery ST PET-CT system (GE Healthcare, Milwaukee, Wisconsin, USA). It combines a 16-slice CT scanner with a dedicated PET (BGO plus crystal, dimensions 3.8 mm × 3.8 mm × 3.8 cm).

A CT was performed over 5 to 7 bed positions from the skull base to the midthigh level using multislice (16 slice) CT component of the system. CT parameters included 140 kV, 110 mA, 0.8 s/rotation, pitch of 1.75:1, FOV 50 cm, length of scan 1.0 to 1.6 m, 0.625 spatial resolution and slice thickness of 3.75 mm.

This was followed immediately by acquisition of PET data in the same anatomic locations with 15.4 cm axial FOV acquired in 2D mode with 2 to 3 min/bed position.

The total acquisition time accumulating between 100 and 150 million useful events varied between 15 and 20 minutes.

Image reconstruction and interpretation

CT data obtained was used for attenuation correction of PET images, and images were reconstructed using a standard vendor-provided reconstruction algorithm, which incorporated ordered subset expectation maximization. Image fusion was performed using coordinate based fusion software and subsequently reviewed at a workstation (Xeleris, GE Healthcare, Milwaukee, Wisconsin, USA) that provided multiplanar reformatted images and displayed PET images, CT images, and PET-CT fusion images.

Studies were interpreted independently by a nuclear medicine specialist and a radiologist. The CT data was used for anatomical localization and corroboration of the PET findings. Abnormal increased FDG uptake at locoregional sites in the head-neck as well as the distant sites (including the PEG site) was noted.

The maximum standardized uptake values (SUVs) were automatically generated according to the following equation:

$$SUV_{max\ (bw)} = C_{tis}/D_{inj}/bw$$

where $SUV_{max\ (bw)}$ is the maximum SUV normalized for the body weight, C_{tis} is tissue concentration expressed as megabecquerels per milliliter, D_{inj} is injected dose expressed as megabecquerels and bw is body weight expressed as kilograms. The results of the PET-CT data were compared with histopathological findings.

Results

The indications for PET-CT study for the 6 patients included in the study group are described in Table 2.

Of the 6 patients in the study group, 3 (patients 1, 2, and 5) had clinical and histopathological evidence of locoregional recurrence and were referred for restaging. In all 3 cases, the PET-CT findings were consistent with disease recurrence (local site and neck nodes). Two patients (patients 4 and 6) presented with symptoms (facial pain and earache) related to the primary site in the head-neck region. One patient (patient 3) presented with PEG site pain and swelling.

The PET-CT findings and the histopathological results from the PEG site are summarized in Table 2. Of the 6 cases, 5 showed some form of FDG uptake (intense or mild) at the PEG

Table 1. Clinical data of patients

Patient (age, sex)	Primary site of tumor	Stage at diagnosis of primary tumor	Surgery performed	PEG technique	Histology and tumor differentiation	Symptoms related to PEG site
1 (F, 50)	Tongue	T3N2M0	Wide excision Right MND, Left SOHD	Pull	SCC Moderately differentiated	Ulcerated bleeding mass
2 (M, 62)	Buccal mucosa	T2N0M0	Marginal followed by extended mandibulectomy for local recurrence. Bilateral SOHD	Pull	SCC Poorly differentiated	No symptoms
3 (M, 52)	Buccal mucosa	T2N2M0	Marginal mandibulectomy Right MND	Pull	SCC Well differentiated	Swelling and pain
4 (M, 68)	Tongue	T2N2M0	Wide excision Right MND	Pull	SCC Moderately differentiated	No symptoms
5 (M, 57)	Tongue	T3N2M0	Hemiglossectomy Bilateral MND	Pull	SCC Moderately differentiated	No symptoms
6 (M, 72)	Tongue	T3N2M0	Hemiglossectomy Bilateral MND	Pull	SCC Well differentiated	No symptoms

F, female; M, male; MND, modified neck dissection; SOHD, supraomohyoid neck dissection; PEG, percutaneous endoscopic gastrostomy; SCC, squamous cell carcinoma.

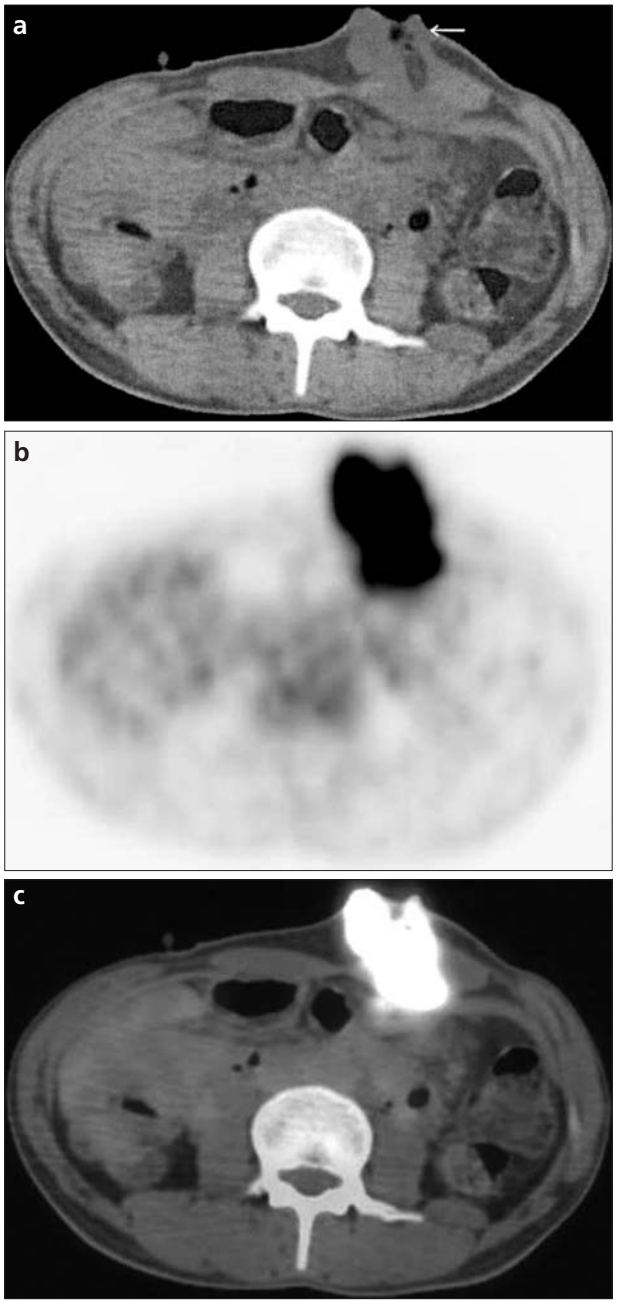

Figure 1. a-c. 50-year-old woman operated for squamous cell carcinoma of the tongue who had an ulcerated bleeding mass at the percutaneous endoscopic gastrostomy (PEG) site. Biopsy revealed metastasis. Non–contrast-enhanced CT **(a)** shows a soft tissue mass at the PEG site in the anterior abdominal wall *(arrow)*. PET image **(b)** shows intense FDG uptake corresponding to the soft tissue at the PEG site. Combined functional and morphological information seen on fusion PET-CT image **(c)**.

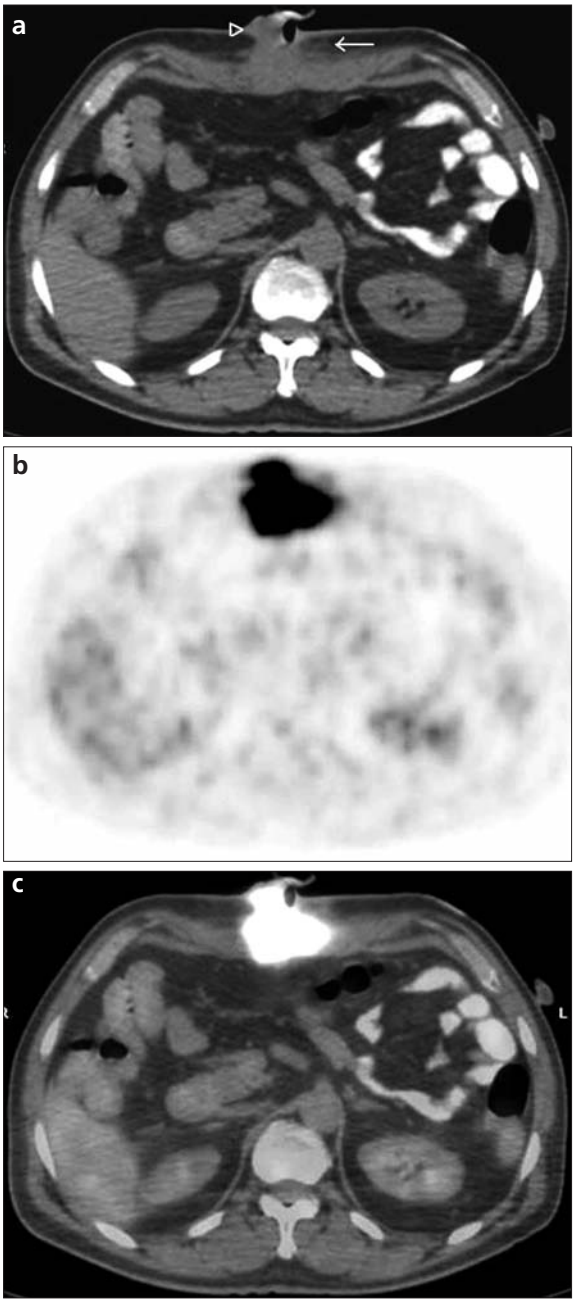

Figure 2. a-c. 52-year-old man operated for squamous cell carcinoma of the buccal mucosa who presented with symptoms of swelling and pain at the percutaneous endoscopic gastrostomy (PEG) site. Biopsy revealed an abscess. Non-enhanced CT image **(a)** shows a soft tissue mass at the PEG site *(arrow head)* associated with fat stranding in the abdominal wall *(arrow)*. PET image **(b)** shows intense FDG uptake at the PEG site. Fusion PET-CT image **(c)**.

site. Intense FDG uptake at the PEG site was observed in 3 patients (patients 1, 2, and 3). In each, an associated soft tissue mass was seen on the CT component of the study. Biopsy of the soft tissue lesions revealed disease recurrence in 2 patients (Fig. 1) and an abscess in the third patient (patient 3). In this patient, the soft tissue mass was accompanied by changes of inflammatory fat stranding in the peristomal region of the anterior abdominal wall (Fig. 2).

Mild FDG uptake was observed at the PEG site in 2 patients (patients 4 and 6). One had mild associated soft tissue thickening at the stoma site. Biopsy of the region revealed granulation tissue. No corresponding morphological abnormality was evident at the PEG site in the second patient.

Of the 3 patients with locoregional recurrence, 2 had PET-CT findings suggesting recurrence at the PEG site (in-

tense FDG uptake with associated soft tissue mass). No abnormal FDG uptake was seen at the PEG site in the third patient. Only one had symptoms related to the PEG site (swelling, ulcerated bleeding, mass). The patient with abscess at the PEG site had no other area of abnormal focal FDG concentration to suggest locoregional recurrence or distant metastases.

One patient who presented with local pain (earache) showed evidence of local recurrence as well as disseminated metastases to the bones and lungs (patient 4). Although there was focal FDG uptake seen at the PEG site, no further diagnostic tests were carried out as the intensity of uptake was mild (not indicative of disease) and because there was no associated morphological abnormality.

In the other patient (patient 6) with local symptoms (facial pain), PET-CT showed no evidence of disease locally or at distant sites. However, focal soft tissue thickening was noted at the PEG site, which showed mild increase in FDG concentration (Fig. 3). Histopathological examination revealed granulation tissue.

Thus in 4 patients, abnormal findings at PEG site suggested by PET-CT studies were validated histopathologically. PET-CT could detect locoregional disease in 3 patients, PEG site metastases in 2 patients, disseminated metastases (lungs and bones) in one patient, and PEG site abscess in 1 patient.

Discussion

Head and neck squamous cell carcinomas are locally invasive and have a predilection to metastasize to regional lymph nodes rather than spreading hematogenously. Distant metastases usually occur late during the course of the disease. The frequency of distant metastases varies extensively according to the literature, ranging between 4% and 26% in clinical studies (8–11) and between 37% and 57% in autopsy studies (12–14).

Some authors have found that the factor that influenced the appearance of distant metastases was failure of treatment at local or regional level (15, 16).

Abdominal wall metastasis is an uncommon complication of PEG tube placement in patients with head and neck cancer. The mode of tumor spread to the gastrostomy site remains controversial. Three different mechanisms have been proposed that may play a role in the development of PEG site metastases. Direct implantation of tumor cells by surgical instruments to the PEG site from the upper aerodigestive tract cancer is one of the common mechanisms proposed (17–22). Desquamation of malignant cells into the gastrointestinal tract with resultant implantation at the surgically disturbed PEG site is the second explanation proposed (17–20). The third mechanism is hematogenous spread, in which malignant cells travel via the blood stream to distant sites (23). Endoscopic tube placement which involve both *pull* and *push* techniques entail passage of the gastrostomy tube through the oropharynx and oesophagus and can result in direct contact between the tumor and the tube (24). All reported cases of PEG site metastases used the pull method of PEG tube placement (3, 22, 23). Pickhardt et al. (25) have discussed the advantages of percutaneous radiologic gastrostomy tube placement, in which direct contact of the tube with the primary tumor is avoided.

All the cases in our study including those with PEG site metastases had undergone PEG tube placement using the pull technique, which is the most frequently used technique in literature.

PET imaging with FDG is a functional imaging modality that studies changes in tumor metabolism which precede morphological changes. Addition of the anatomic information provided by CT improves lesion localization and characterization, thereby increasing the diagnostic accuracy of PET. PET-CT has been found to be useful in detection of abdominal wall and port site metastases and has been studied in colorectal cancer (26).

In 3 patients in our study intense FDG uptake was found at the PEG site

Table 2. PET-CT indications and findings

Patient	Indication for PET-CT	Interval after PEG (months)	PET findings at PEG site FDG uptake	CT findings at PEG site Size	Histopathology PEG site	Other sites
1	Restaging after local recurrence	9	Intense (SUV 11)	Soft tissue mass 4.5 cm	Metastases	Local recurrence Neck nodes
2	Restaging after flap recurrence	15	Intense (SUV 14.5)	Soft tissue mass 2.5 cm	Metastases	Flap recurrence
3	Pain, swelling at PEG site	11	Intense (SUV 9.5)	Soft tissue mass 3.5 cm Fat stranding	Abscess	No abnormality
4	Headache, earache	12	Mild (SUV 1.8)	No abnormality	Biopsy not Performed	Local recurrence Metastases to lungs & bones
5	Restaging after local recurrence	9	No FDG uptake	No abnormality	Biopsy not Performed	Local recurrence Neck nodes
6	Facial pain	7	Mild (SUV 3.0)	Mild soft tissue thickening 1.2 cm	Granulation tissue	No abnormality

PET-CT, positron emission tomography-computed tomography; PEG, percutaneous endoscopic gastrostomy; FDG, fluorodeoxyglucose; SUV, standardized uptake value.

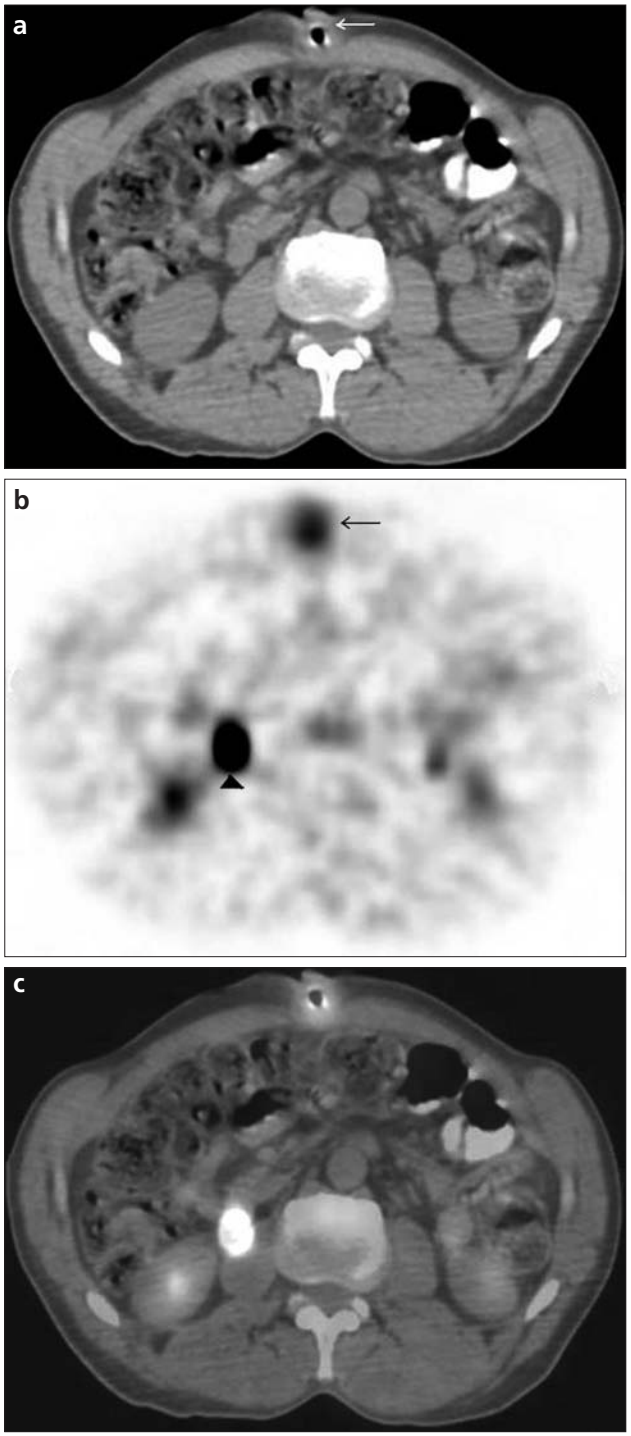

Figure 3. a-c. 72-year-old man operated for squamous cell carcinoma of the tongue had no symptoms related to the percutaneous endoscopic gastrostomy (PEG) site. Non–contrast-enhanced CT image **(a)** shows mild soft tissue thickening at the PEG site *(arrow)*. PET image **(b)** shows mild uptake at the PEG site *(arrow)*. Focal physiological uptake is seen in the right ureter *(arrow head)*. Fusion PET-CT image **(c)**. Biopsy from the soft tissue thickening showed granulation tissue.

accompanied by soft tissue masses that were evident on CT images. In 2 of these, biopsy from the PEG site soft tissue revealed the presence of metastasis. In the third case, the histopathological diagnosis was abscess. Increased FDG uptake at stoma sites is observed frequently. Physiological uptake in the intestine and uptake in inflammatory and granulation tissue is also commonly seen; this uptake is mild to moderate in intensity. Intense FDG uptake along with the presence of a corresponding morphological abnormality (like a soft tissue mass) raises the suspicion of tumor. Proper characterization of the soft tissue abnormality can also help in differentiating inflammatory or infective changes from tumor. Presence of subcutaneous fat stranding or fluid collection favours the possibility of abscess/infection. Similar finding of a FDG avid soft tissue lesion at the PEG site with accompanying inflammatory fat stranding was seen in one of the cases in this study, suggesting the diagnosis of an abscess. Physiological intestinal uptake and peristomal inflammatory/granulation tissue uptake is generally mild and not accompanied by a soft tissue mass lesion. The findings of hazy and mildly increased soft tissue on diagnostic CT scan are nonspecific and cannot be reliably distinguished from granulation tissue (27). Lobulated soft tissue seen at the PEG site should certainly arouse suspicion. Thus, in addition to the intensity of FDG uptake, the anatomic information provided by the CT component of PET-CT helps differentiate viable tumor from physiological and inflammatory changes.

PET-CT is now being increasingly used in head and neck cancer for initial staging, monitoring response to treatment, and long term surveillance. In the setting of surveillance, many studies have shown that FDG PET-CT has a relatively high sensitivity for detecting recurrence at primary site and regional lymph nodes as well as distant metastases. PET-CT scans performed either at regular intervals (every 6 months for the first 18 months and annually thereafter) or based upon clinical suspicion have a reasonable chance of detecting recurrence, and this may be of particular value when a potentially curable salvage treatment such as surgery or reirradiation is available (28).

Both cases in our study in which PEG site metastases were proven histopathologically had evidence of locoregional recurrence. The possibility of stomal metastases is higher in presence of coexisting recurrence at local or distant sites, since they are known to occur in biologically aggressive tumors. PET-CT showed locoregional recurrence in 4 patients. Of these 4 patients, 2 had metastases to the PEG site as well, and one had distant metastases to the lungs and bones. Thus in 3 patients, there was a change in

treatment plan from a locoregional salvage therapy to a systemic form of treatment such as palliative chemotherapy. In one patient, no abnormality was detected at the PEG site though he had evidence of local recurrence on PET-CT, which was subsequently treated with local radiation therapy. PET-CT is a useful modality to look for distant metastatic disease as well as to confirm local recurrence whenever there is a clinical suspicion.

Though both cases of stomal metastases in our group had coexisting local recurrence, stomal metastases may occur as a solitary finding (29, 30). In such cases PET-CT is a useful imaging modality not only to better characterize the stomal lesions but also to look for disease at local and distant sites before deciding upon a treatment plan. Clinical presentation of gastrostomy site metastasis is delayed till the soft tissue mass becomes large enough to produce symptoms such as bleeding, ulceration, or obstruction. In the event of such a clinical presentation, imaging (ultrasonography or CT scan) of the abdominal site will be performed. A subset of patients who might benefit are those in whom PET-CT detects PEG site metastases in the absence of symptoms related to the stoma (as was seen in one of the patients in our group). It remains to be seen whether PET-CT can detect an early, asymptomatic PEG site metastasis before it becomes morphologically evident in the form of an ulcerated, bleeding mass. The uncommon occurrence of this condition would be major limiting factor in conducting a larger study, but with increasing use of PET-CT as an oncologic imaging modality and with rising incidence of head and neck cancer, it is certainly conceivable in the near future.

Metastases from head and neck cancer to PEG sites used for nutritional support are relatively uncommon events, seen almost always with the *pull* technique of PEG tube placement. The metabolic information provided by PET combined with the anatomical detail of CT can characterize the stoma site abnormality better and help differentiate inflammatory/granulation tissue from tumor. Whole body combined PET-CT with FDG is a useful modality for evaluating PEG site metastases, as well as detecting coexisting local recurrences and distant metastases in head and neck cancer patients. PET-CT has a clear potential for detecting early asymptomatic stomal metastases.

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