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The impact of FDG-PET in the management of patients with salivary gland malignancy

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Objective: The aim of this study was to evaluate the impact of FDG-PET in the management of patients with salivary gland malignancy. ***Patients and Methods:*** We performed 45 FDG PET studies in 31 patients with salivary malignant tumors, using PET (33 studies) and PET/CT (12 studies). Patients comprised 21 males and 10 females with a mean age of 69 y (range 38–89). Nineteen patients had a single study, ten patients had 2 and two patients had 3 studies. Twelve studies were performed for initial staging and 33 studies for restaging. Four patients of the initial staging group were restaged with PET after therapy. Histology consisted of 8 adenocarcinomas, 8 squamous cell carcinomas, 4 adenoid cystic carcinomas, 4 carcinoma ex pleomorphic adenomas, 2 mucoepidermoid carcinomas, 2 poorly differentiated carcinomas, 1 salivary duct carcinoma, 1 lymphoepithelial carcinoma and 1 melanoma. PET findings were reviewed with the clinical and radiologic findings and the impact of PET on staging and patient management was determined. ***Results:*** In the initial staging group, all 12 primary lesions (100%) showed positive FDG uptake (5 squamous cell carcinomas, 2 adenocarcinomas, 2 poorly differentiated carcinomas, 1 carcinoma ex pleomorphic adenoma, 1 salivary duct carcinoma, 1 lymphoepithelial carcinoma). Three patients (25%) had FDG positive distant disease (liver, bone, lymph nodes); surgery was canceled and therapy changed to chemoradiation. One patient (9%) with no FDG uptake in the neck nodes avoided a planned neck dissection. In the restaging group (33 studies in 23 patients), 5 patients (22%) had FDG positive distant disease, which changed the treatment from surgery to chemoradiation or other. A second primary lesion was detected in one patient (4%). One patient (4%) with clinically suspected recurrence was able to avoid other invasive procedures because of the negative PET. Overall, FDG PET resulted in a major change in management in 11 of 31 patients (35%). ***Conclusion:*** This study shows that FDG PET has a significant impact on the management of patients with salivary malignant tumors in both the initial staging and restaging.

Key words: FDG-PET, salivary gland malignancy, patient management

INTRODUCTION

POSITRON EMISSION TOMOGRAPHY (PET) is a powerful imaging modality that can visualize biochemical and physiologic alterations throughout the body in a single imaging session. Fluoro-deoxyglucose (FDG)-PET has now been accepted in the initial staging of cancer, management of recurrent cancer, and therapy monitoring. Major head and neck malignant lesions consist of squamous cell carcinomas and lymphomas of nasopharynx, oral cavity and larynx. Accurate staging such as the identification of distant metastasis and nodal disease is critical to determine the appropriate therapeutic approach and prognosis.[1,2] Normal physiological uptake in the head and neck region is common, and often mimics or hides tumors.[3] For salivary gland malignancies, the pathology is different, and the utility of FDG-PET for salivary tumors is now being evaluated.[4–6] The aim of this study is to evaluate the

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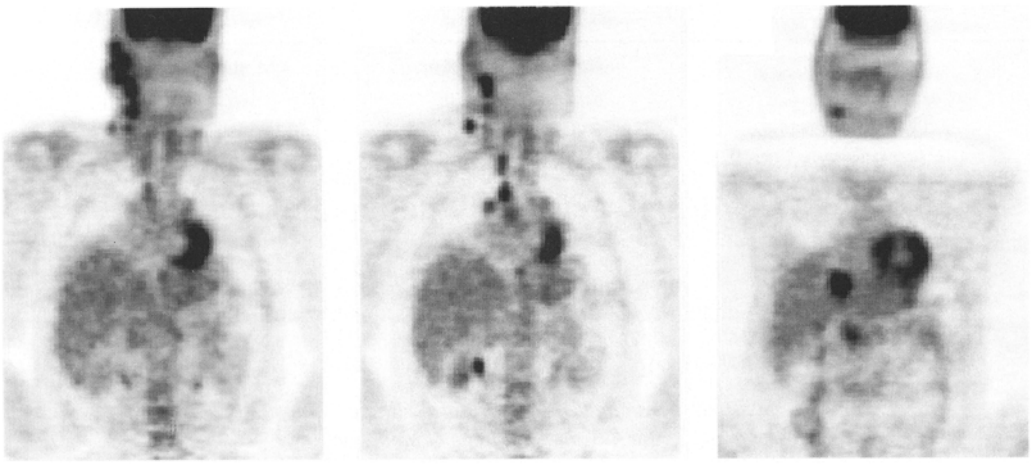

Fig. 1 FDG-PET images of 38 y.o. male with right parotid adenocarcinoma for initial staging. Primary right parotid tumor and neck and mediastinal lymph nodes are demonstrated. A focal uptake is also seen in the liver, that was confirmed as adenocarcinoma by biopsy.

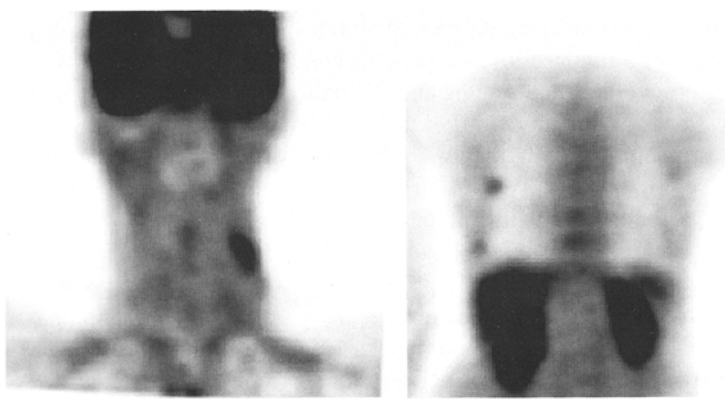

Fig. 2 FDG-PET images of 79 y.o. female with history of carcinoma of ex pleomorphic adenoma of left parotid gland, post radiation therapy for restaging. Local recurrence in left neck and rib metastases are demonstrated.

impact of FDG-PET in the management of patients with salivary gland malignancy.

PATIENTS AND METHODS

This study is approved by Institutional Review Board of University of Iowa.

Patient population

We performed 45 FDG PET studies in 31 patients with salivary tumors (27 parotid, 4 submandibular), using PET (33 studies) and PET/CT (12 studies). Patients included 21 males and 10 females with a mean age of 69 y (range 38–89). Nineteen patients had a single study, ten patients had 2 and two patients had 3 studies. Eleven studies were performed for initial staging and 33 studies for restaging/follow up. Four patients of the initial staging group were restaged with PET after therapy. Seven patient studies were performed only for initial staging, and 20 patient studies only for restaging. Histology consisted of 8 adenocarcinomas, 8 squamous cell carcinomas, 4 adenoid cystic carcinomas, 4 carcinoma ex pleomorphic adenomas, 2 mucoepidermoid carcinomas, 2 poorly differentiated carcinomas, 1 salivary duct carcinoma, 1 lymphoepithelial carcinoma and 1 melanoma.

Patient preparation and PET imaging

Patients were asked to fast for at least 4 h before the injection of FDG. Blood glucose level was confirmed to be below 150 mg/dl. FDG was produced with a 17 MeV Scandatronix cyclotron in our PET center. After the injection of 370–555 MBq FDG, the patients relaxed supine in a bed to avoid unnecessary physiologic uptake. The muscle relaxant, Alprazolam (0.5–2 mg of Xanax) was orally given. PET studies were done with Siemens HR+, and PET/CT studies were done with Siemens Biograph.

Table 1 Summary of the results. The percentages in lines show the ratio in each subgroup (staging group and restaging group). The bottom line (Total 11 (35%)) shows the total number of the patients whose treatment was altered and its overall percentage in this study

	Number of patients	FDG-PET findings	Changes in treatment
Initial staging	3 (25%)	distant metastasis	from surgery to chemoradiation
	1 (9%)	no FDG uptake in contralateral neck	from bilateral neck dissection to ipsilateral neck dissection
	4 (34%)		
Restaging	5 (22%)	distant metastasis	from surgery to chemoradiation
	1 (4%)	second primary detection	surgery of second primary
	1 (4%)	no FDG uptake in recurrence-suspected area	cancellation of invasive procedure
	7 (30%)		
	Total 11 (35%)		

PET findings were corrected with clinical and radiologic findings, and the impact of PET on staging and patient management was determined.

RESULTS

For initial staging, all 12 primary lesions showed positive FDG uptake (5 squamous cell carcinomas, 2 adenocarcinomas, 2 poorly differentiated carcinomas, 1 carcinoma ex pleomorphic adenoma, 1 salivary duct carcinoma, 1 lymphoepithelial carcinoma). Three patients had FDG positive distant disease (liver, bone, lymph nodes); surgery was canceled and therapy changed to chemotherapy and radiation (Fig. 1). The liver lesion was confirmed by biopsy. The bone metastasis and lymph nodes metastases were confirmed by CT. One patient who showed no FDG uptake in the neck nodes avoided a planned neck dissection. For restaging, 7 patients had FDG positive distant disease, which resulted in recommendation to change their treatment from surgery to chemotherapy and/or radiation (Fig. 2). Four additional CT scans were performed to confirm these metastatic lesions. A second, unsuspected, primary lesion was detected in one patient with parotid mucoepidermoid carcinoma, and confirmed as a tongue squamous cell carcinoma at surgery. Overall, FDG PET resulted in a major change in management in 11 of 31 patients (35%) (Table 1).

DISCUSSION

Computed tomography (CT), magnetic resonance imaging (MRI) and ultrasound (US) are the standard imaging modalities for the evaluation of patients with salivary tumors. With CT and MRI, tumor or lymph node size and contrast-enhancement pattern are used to distinguish between benign and malignant lesions, but are not very specific. After surgery, anatomical distortion makes it difficult to distinguish residual or recurrent tumor from postoperative changes. Similarly, after radiation and/or chemotherapy, there may be little initial change in tumor morphology although the tumor may have been significantly affected by the therapy. On the other hand, FDG-PET uptake is based on tumor metabolism. It is essentially independent of tumor location and size. FDG uptake in tumors is proportional to the metabolic rate of viable tumor cells, which have increased demand for glucose. The diagnostic accuracy of FDG-PET for detecting lymph node metastases is superior to that of conventional modalities, with sensitivity and specificity of up to 90% and 94%, respectively, compared with CT values of up to 82% and 85%, and MR imaging values of up to 88% and 79%. PET imaging is consistently more accurate compared to CT and MRI for the detection of recurrence and monitoring of therapy response.[2] Salivary gland tumors are relatively rare and account for less than 3% of all tumors. Twenty to 30% of parotid tumors and 40 to 60% of submandibular tumors are malignant. Like other head and neck tumors, morphologic imaging modalities are commonly used for evaluation of these lesions. Nuclear medicine techniques, including ^{99m}Tc-pertechnetate and gallium scintigraphy have been used to characterize these lesions.[7] Only a limited literature has addressed the utility of FDG-PET for salivary tumors.[4–6] According to these studies, FDG-PET is not helpful in differentiating benign from malignant salivary lesions.

In this study, we focused on the impact of FDG-PET on the management of patients with salivary tumors. The advantage of FDG-PET is that it can image the whole body at one time and can detect unsuspected lesions not seen with other imaging modalities. It provides more accurate evaluation of the primary site, possible recurrence, lymph nodes, and distant metastases which frequently results in changing patient management. In our study, FDG-PET found positive distant disease in 10 patients (32%) which resulted in a change of therapy from surgery to chemotherapy and/or radiation. One patient (3%) with no FDG uptake in the neck nodes avoided a planned neck dissection. A second primary lesion was detected in one patient (3%). Overall treatment was altered in 35% of the patients according to the PET findings.

In conclusion, this study shows that FDG-PET has a significant impact on the management of patients with salivary tumors in both initial staging and restaging.

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