Case Report

Role of dual time fluorodeoxyglucose (FDG) positron emission tomography-computed tomography in identifying co-existing inflammatory and malignant disease: Who holds it (FDG) longer?

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ABSTRACT

18-fluorodeoxyglucose positron emission tomography-computed tomography (PET-CT) is an integral part of imaging in the follow-up of head and neck malignancies. Very often distinguishing inflammatory/infective from malignant recurrence cannot be made confidently with standard uptake value (SUV) alone, as inflammatory lesions have shown to have a very high SUV, and in some cases both can co-exist. In such doubtful cases, dual time PET-CT (3–5 h delayed) is of paramount importance in confidently differentiating inflammatory/infective from a malignant cause.

Keywords: Dual time positron emission tomography-computed tomography, head and neck, inflammatory malignant, squamous cell carcinoma

INTRODUCTION

Apart from the physical examination, endoscopy, computed tomography (CT) and magnetic resonance imaging; positron emission tomography (PET) CT has evolved to become an integral component in the management of patients with head and neck pathologies. In head and neck, PET-CT is commonly used in the staging, treatment response assessment and follow-up of head and neck squamous cell carcinoma, lung, breast and colonic malignancies. Moreover, surgery related anatomical distortion and artifacts from metals and prosthesis can complicate the imaging interpretation where fused fluorodeoxyglucose (FDG) PET offers higher accuracy than PET or CT alone.

CASE REPORT

A 63-year-old female, case of carcinoma right alveolus (stage IV a moderately differentiated squamous cell carcinoma, underwent right segmental mandibulectomy with the right level I–IV selective neck dissection and flap reconstruction. She completed a course of postoperative concurrent chemo-radiation therapy (volumetric modulated arc therapy technique) with weekly cisplatin. She came 5 months later with history of fever, swelling and redness in the submental and right submandibular region.

Contrast-enhanced computed tomography neck [Figure 1] showed diffuse soft tissue swelling in right buccal space, parotid spaces and infra-temporal fossa. Multiple tiny rim enhancing lesions are noted in the subcutaneous fat of submandibular, carotid space on the right side. No erosion of body of mandible or bone graft. Possibility of inflammatory etiology with abscess was suggested. Exploration was done under general anesthesia, and pus was evacuated, sent for cytology and culture and sensitivity. Culture grew pseudomonas aeruginosa. She was put on antibiotics after debridement. Patient presented 1-month later with gaping wound with pus and severe neck and cheek pain.

Positron emission tomography-computed tomography scan done showed increased abnormal FDG (uptake in the soft tissues of masticator, submandibular, carotid, submental space

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and infra-temporal fossa. Delayed scan done 3 h later showed retention of FDG in the masticator space [Figure 2a] and infra-temporal fossa [Figure 2b] suggesting metabolically active recurrent malignancy.

Tru-cut biopsy done from the masticator space showed areas of hemorrhage, inflammation [Figure 3] and nests of atypical squamous cells suggesting recurrence [Figure 4a and b] A month later she succumbed to her illness.

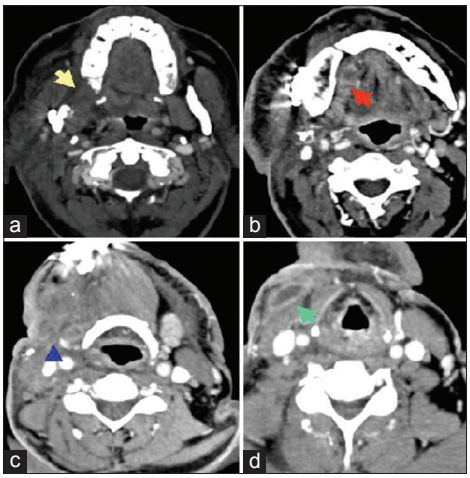

Figure 1: (a) Soft tissue swelling in right masticator space (yellow arrow). (b) Floor of mouth (red arrow). (c) Submandibular space (blue arrow head). (d) Tiny abscess superficial to right sternocleidomastoid (green arrow)

DISCUSSION

Introduction

While dealing with follow-up cases of head and neck malignancies, distinguishing inflammatory/infectious from a malignant recurrence can be challenging. A lesion with standard uptake value (SUV) max > 2.5–3 is considered suspicious for malignancy.[1] However, there might be considerable variation with inflammatory lesion, which can demonstrate high SUV in the range of malignant lesions. There are reports of infectious lesion reaching SUV as high as 6.69.[2] In cases with an ambiguity of recurrence versus inflammatory/infective etiology, SUV at single time point alone will not be reliable enough to be able to confidently rule out the possibility of underlying malignancy. In such cases, the use of dual time PET-CT will be of prime importance in confidently characterizing a lesion as malignant.[3]

Physiology

Benign and malignant lesions exhibit a variable pattern of FDG uptake over time. Malignant cells express an increased numbers of glucose transporters (Glut1).[4] The rate limiting step of FDG retention in cells is that of metabolic trapping through phosphorylation of FDG. Unless FDG-6-phosphate is dephosphorylated by glucose-6-phosphatase, the former would be unable to leave the cell. Furthermore, most of the actively proliferating tumor cells have a low level of glucose-6-phosphatase. Thus, increased ratio of hexokinase/phosphatase in tumors contribute to the accumulation of FDG.[4,5]

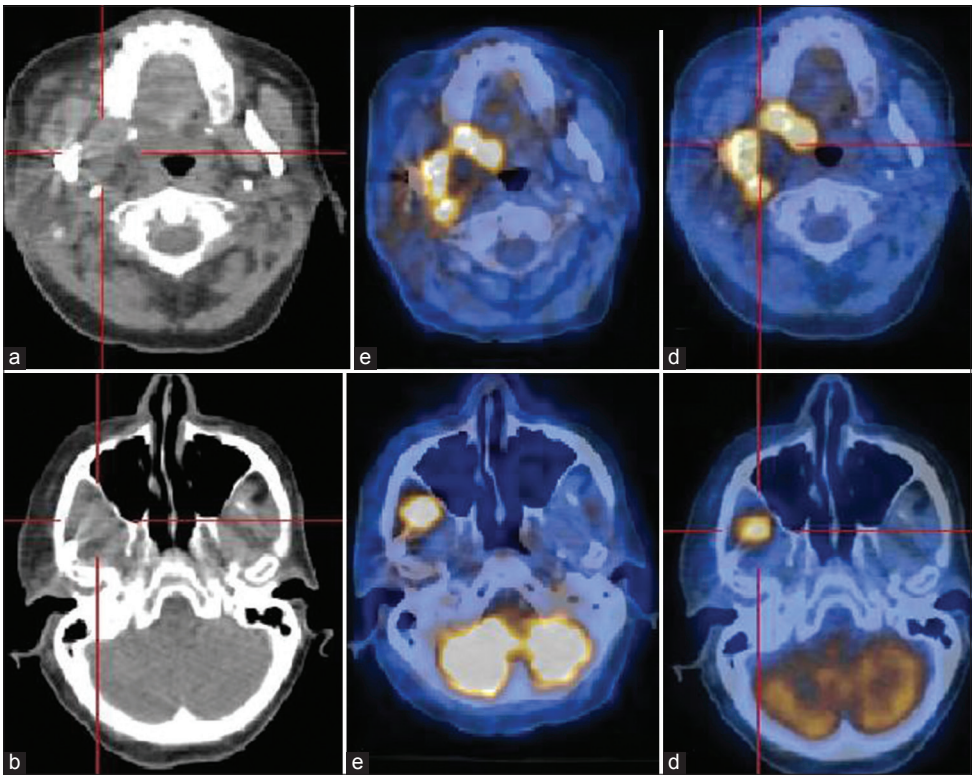

Figure 2: (a) Abnormal increased fluorodeoxyglucose (FDG) uptake noted in the soft tissue in the masticator space with early image (e) with a maximum standard uptake value (SUV) 8.4, retention of tracer in delayed image (d) with maximum SUV max 11.4. (b) Abnormal increased focal FDG uptake noted in infra-temporal fossae (SUV max early (e) = 8.0 and delayed (d) = 9.2)

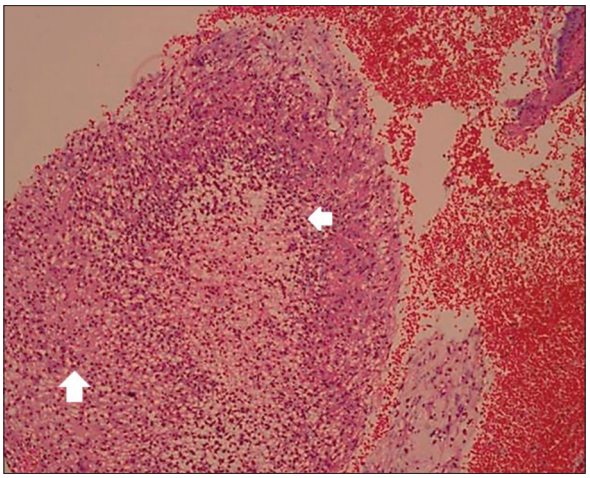

Figure 3: Areas of co-existing inflammation with granuloma formation marked with white arrows (×10)

Mononuclear cells that represent the major cell type in inflammation and infection, express high level of glucose-6-phosphatase.[4,6] Thus, FDG-6-phosphate can be rapidly dephosphorylated and cleared from the cell after reaching a certain limit. Thus, malignant cells would retain the FDG for a longer time while inflammatory/infective lesions would lead to a washout of FDG over a period of the short time.

Degree of neo-angiogenesis, necrosis, and hypoxia are other factors that can complicate the pattern of uptake of FDG.

Role of dual time fluorodeoxyglucose positron emission tomography computed tomography

Fluorodeoxyglucose uptake in inflammatory lesion increases gradually uptil 60 min and thereafter it decreases gradually.[7] Several studies have suggested higher sensitivity for malignancy detection when the delayed images are taken at 3–5 h.[8] Thus, the time interval between early and delayed scans in dual time PET-CT is of prime importance in distinguishing an inflammatory/infection process from a malignant etiology.

CONCLUSION

Positron emission tomography-computed tomography is of valuable importance in imaging patients with head and neck malignancies. It has the advantage of combining anatomical localization through cross-sectional imaging with computerized tomography as well understanding the metabolic activity of underlying lesion with FDG-PET. In our case, though the initial suspicion was of infective sequalae, and the importance of role of dual time PET-CT was underlined, as the retention of FDG-PET helped us identify an underlying recurrence and

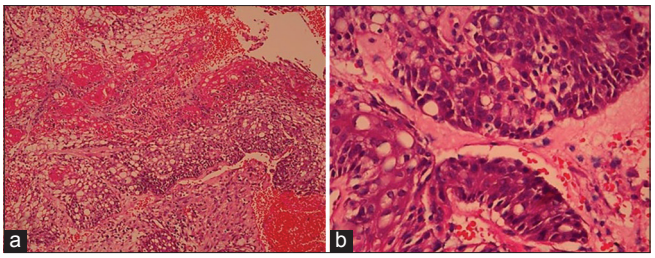

Figure 4: (a) ×10 image showing invasive alveolar carcinoma. (b) ×40 image showing invasive alveolar carcinoma

the histopathology confirmed the co-existence of both infective as well as tumor recurrence. Thus, in follow-up of patients with malignancy dual time PET-CT will aid in differentiating inflammatory/infective causes from underlying recurrence and to rule out co-existing entities. Malignant cells would retain the FDG for a longer time while inflammatory/infective lesions would lead to a washout of FDG over a period of the short time.

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