Combined PET/CT: Physiologic/Anatomical Atlas of F-18 Fluorodeoxyglucose Uptake on PET Imaging in the Head and Neck

University of Pittsburgh, Pittsburgh, PA

Purpose
In patients with head and neck cancer, PET with [F-18]fluorodeoxyglucose (FDG) is both more sensitive and specific than CT or MR imaging for detection of both primary and recurrent neoplasm. On PET alone, however, limited spatial resolution and lack of anatomical landmarks hinder accurate tumor localization, particularly in the head and neck. In addition, variable uptake of FDG in normal structures such as the nasal turbinates, pterygoid muscles, extraocular muscles, the parotid and submandibular glands, and lymphoid tissue of the adenoids and upper Waldeyer’s ring may confuse interpretation and result in false positives (1). Although FDG uptake in primary neoplasms is usually greater than that observed in even the most metabolically active of normal structures (1), overlap between tumor and physiologic uptake may confound interpretation. A new device, the combined PET/CT tomograph, permits acquisition of coregistered high-resolution anatomical and FDG-PET images in the same session. Our purpose was to map metabolic (FDG uptake) data to normal anatomic structures in the head and neck on combined PET/CT images to provide an atlas of physiologic uptake of FDG in the head and neck.

Materials & Methods
PET and CT imaging were performed on the prototype combined CTI (Siemens) PET/CT scanner which comprises an ECAT ART PET scanner, and a Somatom AR.SP CT scanner. We have performed over 180 whole-body combined FDG PET/CT studies for a variety of oncologic indications since July 1998. The PET/CT was performed approximately 1 hour following a 6–7 mCi iv. injection of FDG, with acquisition of helical CT data (pitch 1.6) immediately preceding acquisition of 3D emission data (10 min per bed position; 2–5 bed positions/subject). In 30 subjects, the CT was performed with dynamic injection of iv contrast (90 cc Optiray). The PET images were corrected for attenuation using coefficients obtained by scaling the CT numbers from the CT images to the PET energy (511 keV) (2). The helical CT scan was reconstructed into 512 x 512 images with a slice thickness of 3.4 mm to match that of the PET scan. Images were evaluated by two neuroradiologists for the purpose of describing the pattern of physiologic FDG uptake and localizing it to specific normal anatomical structures on the co-registered CT.

Results
Areas of physiologic uptake were localized to a variety of normal tissues including lymphoid tissue (tonsils, adenoids), skeletal muscle (muscles of mastication, prevertebral muscles, scalenes), salivary glands (parotid and submandibular), and mucosa (nasal turbinates, nasopharynx, paranasal sinuses). Patterns of distribution of FDG uptake were variable, often reflected patient activity (e.g., talking) during the FDG uptake phase, and could be influenced by...
measures to alter muscle contraction (e.g., cervical collar). Asymmetric superphysiologic uptake was localized to the true vocal cord contralateral to a paralyzed vocal cord (3).

**Conclusion**

We present an atlas of physiologic FDG uptake in the head and neck derived from a large patient sample imaged on the prototype combined PET/CT scanner. Recognition of variable patterns of physiologic uptake in the head and neck that can be definitively localized to normal anatomical structures likely will enhance the accuracy of interpretation in head and neck PET imaging.

**References**


David Townsend is a consultant with CTI PET Systems, Knoxville, TN.