18F-FDG PET/CT Findings of Perineural Involvement in Head and Neck Malignancies

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Introduction - Aim
Perineural invasion (PNI) is the process of neoplastic invasion of nerves and is an under-recognized route of metastatic spread. It is emerging as an important pathologic feature of many malignancies, particularly in head and neck cancers, associated with decreased survival, increased and earlier recurrence. PNI status often significantly affects surgical strategies and adjuvant treatments in head and neck cancers. MRI has been the gold standard imaging modality for the evaluation of PNI. FDG PET/CT has been increasingly used for staging and restaging head and neck cancers. Beyond locoregional disease and lymph node metastatic characterization, different PET imaging patterns suggesting PNI can also be identified. Our goal is to demonstrate different examples of PNI visualized by PET/CT and the correlation with other cross-sectional imaging modalities, such as CT and MRI.

Materials and Methods
We identified cases of head and neck cancer patients from our institution with suspected or established perineural involvement. All patients underwent a whole body PET/CT study and afterwards a separate head and neck component. 90 mins after IV injection of 481-555 MBq (13-15 mCi) of 18F FDG, a Phillips Gemini TF-16 Time of Flight PET/CT scanner: Oral or IV contrast was not used and low-dose CT was acquired for attenuation correction and localization only. Our algorithm for interpreting the head and neck part of the PET/CT studies included careful review of PET only images in all three planes and in maximum intensity projection (MIP), and correlation with CT images.

Key points
- PNI is a poor prognostic indicator in head neck malignancies.
- Asymmetric FDG uptake in the head and neck should be always evaluated in all 3 planes and MIP on PET-only images.
- FDG PET/CT patterns can suggest PNI and could be described as such.
- Increased awareness of such patterns can be helpful in the evaluation and cross-sectional correlation of cases suggestive of PNI.

Proposed Algorithm
- Review of the MIP of the head and neck.
- Review of PET-only images in the axial, coronal and sagittal plane. Asymmetry is noted.
- Focus of asymmetric FDG uptake get also identified in the other planes and their projection is recognized frontal, linear etc.
- Findings are correlated with CT portion of PET/CT and other available modalities.

References
3. Radiology Anatomy Atlas Viewer
http://www.srl.com/radiology/RAAViewer/

Case 1: Inferior Alveolar n.
Case 2: Hypoglossal n.
Case 3: Maxillary n.

Key points
- Case 4: 49 yo male with radiation-induced malignant histiocytoma of the right jaw and skull base, status post right hemimandibulectomy, and remote history of squamous cell carcinoma of the tongue 13 years before, treated with primary external beam radiation without chemotherapy.
- PET/CT study performed for restaging shows an FDC-avid right maxillary sinus mass involving the mandible, as well as a linear focus of uptake extending from the base of the tongue to the base of the skull, concerning for perineural spread along the hypoglossal n. Perineural involvement was confirmed with subsequent biopsy.

Case 4: Trigeminal Ganglion
Case 5: Mandibular n.
Case 6: Mental n.
Case 7: Inferior Alveolar n.

Key points
- Case 5: 76 yo female with history of SCCA of the right lower lip, with involvement of the mental nerve and intracranial progression (same patient as case 6). PET/CT shows the extension along the mandibular nerve. MRI: Same findings.
- Case 7: 54 yo male with history of squamous cell carcinoma of the right tongue base, status post definitive chemoradiation more than 2 years before. PET/CT for evaluating recurrence showed a large focus of FDG uptake in the right tongue base, suspicious for tumor recurrence, as well as a linear focus of uptake extending from the base of the tongue to the base of the skull, concerning for perineural spread along the hypoglossal n. Perineural involvement was confirmed with subsequent biopsy.

Case 7: Inferior Alveolar n.

Key points
- Case 6: 79 yo female with biopsy proven meningioma of the skull base and infratemporal fossa. She underwent PET/CT for staging, which showed a linear focus of moderate uptake (SUV max = 3.67). Corresponding to a soft tissue mass along the right foramen ovale and 2nd and 3rd branch of the trigeminal n. MRI showed gross involvement of the right V3 foramen ovale with no significant enlargement of the foramen. A large amorphous component of the mass is seen contiguous in the right infratemporal fossa.

Case 8: Inferior Alveolar n.

Key points
- Case 8: 76 yo female with history of SCCA of the right lower lip, with perineural extension along the mandibular ramus of the trigeminal nerve. PET/CT shows the initial extension to the mandibular ramus of the mandible in the site of the primary tumor in the right lower lip. MRI: Focal area of low signal in the right lip, suspicious for perineural involvement.