PET/CT of the Head and Neck: Uses and Abuses; Pitfalls and Problem Cases

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Disclosures

• None
Objectives

- Controversial topics in PET/CT
- Literature validation (evidence-based)
- Audience-response questions
Outline

• Introduction
• SCC staging
• SCC monitoring & surveillance
• Other histologies
• Pitfalls
• Audience-response cases
Potential Benefits of PET/CT

• Stage more accurately
• Adjust treatment modalities
• Find recurrence earlier
• Identify incurable disease
Potential downsides of PET/CT

• Wasted expense
• Inconvenience
• Poor third-party reimbursement
Question #1: Is PET/CT better than PET alone?

Conclusions: PET vs. PET/CT

• PET/CT is better than PET or CT alone

• A combined scanner is better than post-hoc fusion

• Note: Much of the current literature is based on PET alone.
Question #2: SCC Staging

• Which patients need radiologic staging?

• Is PET/CT better than conventional imaging?

• Usually know T-stage, deciding on nodal and distant disease screening
Does SCC need to be screened for distant mets?

- Screening with chest CT (n=109)
  - 19% with distant mets
  - 8% with undiscovered mets found within 12 months

Does SCC need to be screened for distant mets?

• Screening with chest CT (n=189)
  – 19% with additional tumor
  – 6% with synchronous primaries

Which patients need to be screened?

- High risk patients (n=101)
  - ≥ 4 nodes
  - Zone IV nodes
  - Bilateral nodes
  - N3
  - Recurrence
  - 2nd primary

Which patients need to be screened?

- Practice survey
  - nodal metastases
  - mutilating surgery
  - locoregional recurrence
  - advanced T-stage
  - second primary tumor

Effect of T-stage on radiologic staging

- T1 - probably doesn’t need staging
- T3/4 - probably needs staging
- T2 - ?
Is PET/CT better for staging?

- 36 patients with prior CT neck&chest
  - 13% upstaged
  - 11% Rx changed

Is PET/CT better for staging?

• 36 patients with prior CT or MR
  – 31% altered therapy
  – 50% early tumors
  – 25% advanced tumors

Upstaging with PET/CT
Conclusion: PET/CT for staging

• If a patient requires staging, or screening for distant mets, PET/CT is the modality of choice.
Patient AS

- 43y/o male
- Zone II neck mass, o/w neg PE
- FNA shows SCC
- CT neck/chest: neg.
- Pan-endo: neg.
- Blind tongue base biopsy: neg.
PET for Unknown Primary

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<td>Bohuslavizki, 2000</td>
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<td>Jungehulsing, 2000</td>
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<td>Johansen, 2002</td>
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<td>Fogarty, 2003</td>
<td>1 / 21</td>
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<td>Miller, 2005</td>
<td>8 / 26</td>
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Totals: 79 / 274 = 29%
Conclusion: PET/CT in unknown primary

• Finds 20% - 30% primary tumors above and beyond traditional search

• Is a supplement, not a substitute, for endoscopy and biopsy
Patient SW

- 69y/o male
- 2cm supraglottic SCC
- Clinically N0 neck
- CT: no neck nodes
- Do we need to do a neck dissection?
# PET in the N0 neck

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<td>Schoder</td>
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<td>Myers</td>
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Conclusion: The N0 neck

- PET/CT is not sufficiently accurate to preclude neck dissection in the clinically N0 neck.
Patient RD

- 74 y/o male
- Buccal cancer treated with chemoradiation 2 years ago
- Now with 1cm hard mass in surgical bed on routine clinical f/u
Patient RD
Second primary in H&N recurrence

- 41 patients suspected of recurrence
- 12 abnormal PET in chest
- 10 true positive for 2nd primary

Conclusion: Restaging

- PET/CT is useful for restaging recurrences
  - Nodal disease
  - Distant metastases
  - 2nd primaries
Patient RW

- 56y/o male
- T4 N2a tongue base SCC
- Chemoradiation
- Planned neck dissection
- Can PET/CT avoid neck dissection?
Patient RW

staging scan

5 months after Rx
Deferring planned neck dissection

- 43 patients with N2 or N3 SCC
- Chemoradiation
- PET/CT at 8-10 weeks
- PPV = 70% ; NPV = 97%

Deferring planned neck dissection

- 21 neck dissections, various N-stage
- Chemoradiation
- PET/CT at 8-12 weeks
- PPV = 33%; NPV = 92%

Brkovich VS et al. The role of positron emission tomography scans in the management of the N-positive neck in head and neck squamous cell carcinoma after chemoradiotherapy. Laryngoscope 2006; 116:855-8
Deferring planned neck dissection

- 53 patients, N2a or worse
- Radiation +/- chemo
- PET at various times
- PPV = 43%; NPV = 100%

Deferring planned neck dissection

- 39 patients
  - N+ neck
  - Residual nodal mass at 8 weeks after therapy

- PET at 12 weeks
  - NPV = 97%

Conclusion: Planned neck dissection

- PET/CT can prevent unnecessary surgery
- High NPV (no false negatives) allows confident exclusion of residual cancer.
Question #3: Surveillance

- How soon after treatment should the patient get a PET/CT?
- How frequently are surveillance PET/CTs needed?
- When can you stop?
How soon after therapy?

• 103 patients
  < 1 month -- sensitivity = 55%
  > 1 month -- sensitivity = 95%

• Early scans
  – Low sensitivity (few viable cells)
  – Low specificity (inflammation from Rx)

How soon after radiation therapy?

• Compare 4 weeks to 8 weeks after therapy

• 28 patients
  – 3 false negative
  – 1 false positive
  – All errors occurred between 4 and 8 weeks

• 100% accuracy after 8 weeks

How frequently?

• No published data

• At Univ. of Pittsburgh
  – 2 mo
  – 5 mo
  – 8 mo
  – 14 mo
Patient CS

• 60y/o female

• T3 N1 SCC hypopharynx

• Chemoradiation

• PET/CTs negative for 2 years

• Can we stop surveillance?
Patient CS

19 mo

26 mo
Conclusion: Ending surveillance

• There will always be some patients who recur after concluding radiographic surveillance

• Most recur within 1 year

• Currently, we use 14 months with negative PET/CT scans
Question 4: Other histologies

• Is PET/CT useful for
  – salivary tumors?
  – thyroid cancer?
  – lymphoma?
  – melanoma?
Patient SA

• 53y/o female

• h/o lymphoma, renal cell carcinoma
  – both in remission

• PET/CT for surveillance
Patient SA

Histology: benign oncocytoma

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Patient EW

- 31y/o female
- Medullary thyroid carcinoma
  - In remission 3 years
- Elevated calcitonin
  - Obtain PET/CT
Patient EW

Histology: medullary thyroid carcinoma
PET/CT for glandular tumors

• Variable PET uptake
  – Malignancies can be cold
  – Benign entities can be hot

• If a tumor is known to be FDG-avid, it can be followed with PET/CT

Patient CR

- 28y/o female

- Papillary thyroid carcinoma, tall cell variant
  - Thyroidectomy
  - Neck dissections (bilateral zone 4, zone 6)
  - Radioiodine

- Elevated thyroglobulin

- Next test
Patient CR
PET/CT for thyroid carcinoma

• Differentiated thyroid carcinoma
• Treated
• Elevated thyroglobulin
• Negative radioiodine scan
PET/CT for lymphoma and melanoma

• Clearly beneficial for staging, assessing response, and surveillance
PET/CT for lymphoma
Patient BC

- 76y/o female
- 2cm SCC alveolar ridge
- Segmental mandibulectomy
  - Fibular graft
- PET/CT at 5 months
Patient BC
Pitfall: Mandibular Reconstruction

- FDG uptake may *rise* temporarily as bone healing advances
- Use physical exam for resection site
- Reserve PET/CT for nodal or distant mets
Patient CD

• 54y/o female

• SCC tonsil, T2 N2b

• Staging PET/CT
  – confirms clinical stage
  – 8mm thyroid nodule, hot on PET
Patient CD
Pitfall: Incidental thyroid nodule

- Conventional imaging
  - Ignore nodules <1cm
  - Unless malignant features

- Hot nodules on PET
  - All deserve tissue sampling


Kim TY et al. 18F-fluorodeoxyglucose uptake in thyroid from positron emission tomogram (PET) for evaluation in cancer patients: high prevalence of malignancy in thyroid PET incidentaloma. Laryngoscope. 2005 Jun;115(6):1074-8.
Pitfall: Cystic neck mass

• 5 consecutive cases
  – Cystic neck mass
  – No evident primary

• PET misleading in all 5 cases
  – 3 false neg; 2 false pos
  – CT suggests correct diagnosis in all 5

Case Review
Classification of increased FDG

- Physiologic
- Inflammatory
- Neoplastic
- Artifactual
Case #1

- 47y/o female

- Squamous cell carcinoma, right tongue
  - Multiple ipsilateral nodes

- Resection, neck dissection, chemoradiation

- 8 months after Rx, enlarging R neck mass
Case #1

A. Physiologic
B. Inflammatory
C. Neoplastic
D. Artifactual
Case #1 - more images
Case #1 - more images

A. Physiologic
B. Inflammatory
C. Neoplastic
D. Artifactual
Case #1 - Answer

Physiologic uptake
in the anterior scalene muscle
Case #1 - Discussion
Case #1 - Discussion

• Altered physiology after neck dissection
  – Sacrifice of CN11 (spinal accessory nerve)
  – Atrophy of trapezius
  – Hypertrophy of levator scapulae
  – Novel patterns of muscle uptake

• Re-learn muscular anatomy
Case #1 - other muscles
Case #1 - other muscles
Case #2

- 78 y/o female
- Left neck mass
- FNA: worrisome for unspecified malignancy
Case #2

A. Physiologic
B. Inflammatory
C. Neoplastic
D. Artifactual
Case #2 - Answer

Metastasis to Virchow’s node
Case #2 - Discussion

• Virchow’s Node
  – Lower left neck
  – Bottom of internal jugular chain
  – Receives mets from chest & abdomen
  – May bypass intervening nodal stations
  – Classically, GI malignancies
Case #3

- 85y/o male

- Squamous cell carcinoma L gingiva
  - Marginal mandibulectomy
  - Node dissection L
  - Chemoradiation

- Surveillance PET/CT at 8 months
Case #3

A. Physiologic
B. Inflammatory
C. Neoplastic
D. Artifactual
Case #3 - Answer

Recurrent squamous cell carcinoma in the retromolar trigone
Case #3 - Discussion

- FDG uptake in the absence of CT abnormality
  - Must be explained
  - Recommend inspection / biopsy
  - Lingual denervation - CN 12
Case #4

- 46y/o male
- Medullary thyroid carcinoma, in remission
- Elevated calcitonin
Case #4

A. Physiologic
B. Inflammatory
C. Neoplastic
D. Artifactual
Case #4 - Answer

Medullary thyroid carcinoma
metastatic to T3 vertebral body
Case #4 - Discussion

- Malignancy can mimic physiologic or inflammatory patterns
- Use additional modalities to clarify
Case #5

• 73y/o female

• Adenoid cystic carcinoma of the R maxilla
  – Resected and reconstructed

• Now with R face pain
Case #5

A. Physiologic
B. Inflammatory
C. Neoplastic
D. Artifactual
Case #5 - Answer

Infratemporal abscess
Case #5 - Discussion

• Use comparisons wisely
  – Change in morphology

• Remember the lessons of the pre-PET era
Case #6

- 59y/o male

- L tonsil squamous cell carcinoma
  - Tonsillectomy, L neck dissection
  - Radiation

- Surveillance PET/CT scan
Case #6

A. Physiologic
B. Inflammatory
C. Neoplastic
D. Artifactual
Case #6 - Answer

Asymmetric physiologic uptake in the submandibular glands
Case #6 - Discussion

• Glandular uptake
  – May be asymmetric
  – Fused images often helpful
  – Uptake affected by surgery, radiation
Case #7

• 65y/o female

• Epiglottic carcinoma
  – Chemoradiation

• Surveillance PET/CT scan
Case #7

A. Physiologic
B. Inflammatory
C. Neoplastic
D. Artifactual
Case #7 - Answer

Aspiration pneumonia
Case #7 - Discussion

- Aspiration pneumonia is common in H&N cancer patients
- Diagnose by location
Case #8

• 66y/o female

• T2 N1 squamous cell carcinoma R tongue
  – partial glossectomy, R neck dissection
  – chemoradiation

• Surveillance PET/CT
Case #8

A. Physiologic
B. Inflammatory
C. Neoplastic
D. Artifactual
Case #8 - Answer

Hypertrophic palatine tonsil
Case #8 - Discussion

• Waldeyer’s ring has variable physiologic FDG uptake
  – False positives
  – False negatives

• Caveat: Second primaries are common and *should* be suggested
Case #8 - Comparisons
Case #8 - Comparisons
Case #9

• 43y/o male

• R neck mass
  – FNA - squamous cell carcinoma

• CT scan, endoscopy, physical exam neg.
Case #9

A. Physiologic
B. Inflammatory
C. Neoplastic
D. Artifactual
Case #9 - Answer

Squamous cell carcinoma of the right tongue base
Case #9 - Discussion

• 30% of unknown primaries can be detected with PET/CT

• Interpret with high sensitivity, low specificity
Case #10

- 53y/o female
- h/o lymphoma, renal cell carcinoma
  - both in remission
- PET/CT for surveillance
Case #10

A. Benign
B. Inflammatory
C. Malignant
D. Artifactual
Case #10 - Answer

Benign oncocytoma of the parotid gland
Case #10 - Discussion

- Glandular tumors have variable PET uptake
  - Malignancies can be cold
  - Benign entities can be hot

- If a tumor is *known* to be FDG-avid, it can be followed with PET/CT
Case #11

- 76y/o female
- 2cm SCC alveolar ridge
- Segmental mandibulectomy
  - Fibular graft
- PET/CT at 5 months
Case #11
Case #11

A. Physiologic  
B. Inflammatory  
C. Neoplastic  
D. Artifactual
Case #11 - Answer

Physiologic uptake
in healing bone
Case #11 - Discussion

- Healing bone grafts are a source of false-positive PET/CT

- Expect increased uptake at margins for several months

- This finding does not exclude malignancy
Case #12

- 61y/o male
- L supraglottic carcinoma with extensive L neck mets
- Chemoradiation
Case #12

A. Physiologic
B. Inflammatory
C. Neoplastic
D. Artifactual
Case #12 - Answer

Asymmetric physiologic uptake in the unparalyzed true vocal cord
Case #12 - Discussion

• Be aware of the effects of treatment on FDG physiology

• “Asymmetry” may represent abnormality on either side, not necessarily the side of increased uptake
Case #13

- 57y/o male

- Esthesioneuroblastoma
  - No mets
  - Resected, radiation

- Surveillance PET/CT
Case #13

A. Physiologic
B. Inflammatory
C. Neoplastic
D. Artifactual
Case #13 - Answer

Retropharyngeal nodal metastasis
Case #13 - Discussion

- Give particular attention to regions that are not amenable to clinical inspection

- Know drainage pathways
Case #14

• 55y/o male

• Supraglottic carcinoma

• Staging PET/CT
Case #14
Case #14

A. Benign
B. Inflammatory
C. Malignant
D. Artifactual
Case #14 - Answer

Benign thyroid adenoma
Case #14 - Discussion

• Most FDG-avid solitary thyroid nodules are benign

• Up to 20% malignant
  – Merit biopsy