Imaging in the diagnosis of oropharyngeal cancer: update & clinical impact

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Imaging in a possible/presumed palatine tonsillar $T1N0$ SCC

How Imaging may influence treatment planning?

- confirm/upstage T class
- rule out un-detected nodal metastases
- rule out distant metastases/second primary neoplasms
- identify prognostic factors imaging-related (other than TNM)
- confirm response to non-surgical treatment
- detect local/regional recurrences
<table>
<thead>
<tr>
<th>Tumor Stage</th>
<th>Description</th>
</tr>
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<tbody>
<tr>
<td>T1</td>
<td>Tumor 2 cm or less in greatest dimension</td>
</tr>
<tr>
<td>T2</td>
<td>Tumor more than 2 cm but not more than 4 cm in greatest dimension</td>
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<tr>
<td>T3</td>
<td>Tumor more than 4 cm in greatest dimension</td>
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<tr>
<td>T4a</td>
<td>Tumor invades the larynx, deep/extrinsic muscle of tongue, medial pterygoid, hard palate, or mandible</td>
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<tr>
<td>T4b</td>
<td>Tumor invades lateral pterygoid muscle, pterygoid plates, lateral nasopharynx, or skull base or encases carotid artery</td>
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</table>
Question 1. True T1?

- Assessment of adjacent structures involvement (growth limited to pharyngeal walls)
- Spread beyond the posterior pharyngeal lining (parapharyngeal/retropharyngeal extent)
- MR > CT

- 166 untreated pts with SCC of the tonsil. 81.9% received preoperative induction chemotherapy. 30.7% underwent postoperative RT.

7 variables (univariate analysis)

- increasing T classification;
- positive margins of resection;
- poor clinical response to induction chemotherapy;
- tumor spread to the posterior pillar, posterior pharyngeal wall, and contralateral soft palate;
- invasion of the junction between the tonsil and soft palate.
Constrictor &/or stylopharyngeal mm invasion

<table>
<thead>
<tr>
<th></th>
<th>21 pts</th>
<th>MR vs histology</th>
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<tr>
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<tr>
<td>TN</td>
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<td>12/21</td>
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<tr>
<td>FP</td>
<td></td>
<td>0/21</td>
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<tr>
<td>FN</td>
<td></td>
<td>1/21</td>
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<td>Sensitivity (%)</td>
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<td>Specificity (%)</td>
<td>100</td>
<td></td>
</tr>
<tr>
<td>PPV (%)</td>
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<tr>
<td>NPV (%)</td>
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<td>Pts 32</td>
<td>MR vs histology</td>
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<tr>
<td>TP</td>
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<tr>
<td>TN</td>
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<tr>
<td>FP</td>
<td>2/22</td>
<td></td>
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<tr>
<td>FN</td>
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<td>PPV (%)</td>
<td>80</td>
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<tr>
<td>NPV (%)</td>
<td>100</td>
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</table>

Buccinator muscle invasion
Question 2. True N0?

- Detect signs suggesting N+ in normal sized nodes
- Detect micrometastatic foci (< 3mm) within normal sized nodes
- **F-FDG PET-CT > Morphological imaging (MR, CT, US)**
Diffusion Weighted-MR Imaging

- 32 patients, clinically suspected for recurrent head and neck cancer after surgery or radiation therapy.

- ADC value of $1.30 \times 10^{-3}$ mm²/s threshold: SE (84%), SP (90%), PPV (94%), NPV (76%).

- 26 patients suspected for persistent disease after radiotherapy the ADC values < HNSCC than nontumoral tissue SE 94.6% and SP 95.5% (Vandecaveye 2007)

- Compared to FDG-PET DW-MRI yielded fewer FP results at the primary site and at N;

- DWI-MRI identified subcentimetric nodal metastases not recognized by FDG-PET.

DWI-MR Imaging, sub-centimetric nodes

- 301 lymph nodes, pathologic matching.

- Optimal ADC $b_{0-1000}$ threshold of $0.94 \times 10^{-3}$ mm$^2$/sec,
  - 84% sensitivity, 94% specificity, and 91% accuracy for differentiation of malignant versus benign status of each lymph node
  - 94% sensitivity, 97% specificity, and 97% accuracy for differentiation at each neck level were achieved.

- DW imaging sensitivity 76%, specificity 94.0% for detection of subcentimeter nodal metastases.

Vandecaveye Radiology 2009
Box-whisker plots of ADCb0-1000 values for 4-9-mm lymph nodes

Vandecaveye, V. et al. Radiology 2009;251:134-146
Nasopharyngeal undiff. carcinoma
Follow up MR 11 months after RT
18F-FDG PET/CT for detecting nodal metastases in patients with oral cancer staged N0 by clinical examination and CT/MRI.


- Prospective study, 31 pts with oral cancer and N0 by clinical exam or CT/MR.
- 13 of 765 dissected lymph nodes harbored metastases.
- 3 FN on CT-PET: metastases smaller than 3 mm or inability to distinguish between primary tumor and adjacent metastasis.
- SE, SP 67% and 85% on the basis of neck sides and 67% and 95% on the basis of number of nodal levels, respectively.
- If a decision regarding the need for neck dissection had been based solely on PET/CT, 3 FN necks would have been undertreated, and 4 FP necks would have been overtreated.
The retro(lateral)pharyngeal node(s)
Retropharyngeal nodes (RP) in squamous cell carcinoma of oropharynx: incidence, localization, and implications for target volume


- Retrospective analysis of CT studies of 208 pts with oropharyngeal SCC.
- RP adenopathies present in 16% of all pts and in 23% of pts with nodal disease in other neck sites.
- Ipsilateral involvement of Level II and contralateral involvement of Level III predicted for involvement of the ipsilateral RP nodes on multivariate analysis (p < 0.05).
- A solitary ipsilateral RP node was present in 3 (9%) of 34 patients with RP nodes; 2 of these 3 patients had a primary posterior pharyngeal wall tumor. No patients presented with a solitary contralateral RP node.
Prognostic influence of retropharyngeal lymph node metastasis in squamous cell carcinoma of the oropharynx


- Pts treated between 1984 and 2003: by RT alone (84.1%), by surgery with postoperative RT in 11.5%, and by concomitant CT in 4.4%.

- Retropharyngeal node involvement was present in 34 (16%) pts.

- At 5 years, patients with retropharyngeal adenopathy had significantly more regional recurrences (45% vs. 10%, p = 0.004).

- Involvement of retropharyngeal lymph nodes significantly (relative risk 4.29 [95% confidence interval 3.33-5.25], p = 0.01) and independently predicted regional recurrence in multivariate analysis.

- Disease-specific survival was significantly lower in the retropharyngeal node positive group (38% vs. 58%, p = 0.03).
Question 3. True M0? Other synchronous neoplasms?

- Detect distant metastasis
- Differentiate primary pulmonary NSCC from M+
- F-FDG PET-CT > CT
Imaging in a possible/presumed advanced tongue base SCC
Imaging in a possible/presumed advanced tongue base *SCC*

How Imaging may influence treatment planning?

- confirm/upstage T class
- precise deep tumor extent
- rule out un-detected contralateral nodal metastases
- detect extracapsular spread
- rule out distant metastases/second primary neoplasms
- confirm response to non-surgical treatment
- detect local/regional recurrences
Question 1. Deep extent?

- Assessment of tongue base invasion
- Spread beyond tongue base
- Assess T class
- MR > CT
Oropharyngeal SCC: pre-treatment evaluation

Clinical examination
- duration of symptoms
- referred otalgia
- Trismus
- infiltrating vs exophytic lesion
- comorbidities (!)

Imaging (MR/CT)
- soft tissue extension
- mandibular involvement
- pterygoid muscles and plates
- styloid muscles
- hypoglossal nerve(s)
- lingual arterie(s)
- nasopharyngeal extension
Tumor limited to tongue base
## Oropharyngeal SCC: mandibular involvement

<table>
<thead>
<tr>
<th></th>
<th>OPG*</th>
<th>CT#</th>
<th>PET°</th>
<th>SPECT*</th>
<th>MR</th>
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<tbody>
<tr>
<td>Sensitivity</td>
<td>50%</td>
<td>96%</td>
<td>95%</td>
<td>95%</td>
<td>93%</td>
</tr>
<tr>
<td>Specificity</td>
<td>94%</td>
<td>87%</td>
<td>48%</td>
<td>72%</td>
<td>93%</td>
</tr>
<tr>
<td>PPV</td>
<td>91%</td>
<td>89%</td>
<td>65%</td>
<td>79%</td>
<td>88%</td>
</tr>
<tr>
<td>NPV</td>
<td>63%</td>
<td>95%</td>
<td>93%</td>
<td>93%</td>
<td>96%</td>
</tr>
</tbody>
</table>

* : Imola et al., Laryngoscope 2001  
#: Mukherji et al., AJR 2001  
°: Zieron et al., Head Neck 2001  
^: Bolzoni, Maroldi et al., Arch Otolaryngol Head Neck Surg 2004
Question 2. ECS? Contra-lateral N+?

Evaluation of the impact of addition of PET to CT and MR scanning in the staging of patients with head and neck carcinomas


- In conclusion, although PET has got a higher sensitivity in detecting nodal disease, it has only slightly improved the classification of N+ necks. The findings of this study cast doubt on the merit of routine addition of PET to the current investigative protocols for HNSCC patients.
Question 3. Residual/Recurrent disease?

- Identify residual nodal/primary viable tumor after CT/RT
- Distinguish local recurrence from post-treatment changes
- Assess local extent
- F-FDG PET-CT > MR > CT
PET for surveillance of head and neck cancer


- 103 pts (HNSCC), 118 post-treatment PET
- We correlated PET results with surgical pathology and clinical outcome in the subsequent 6 months.
- Locoregional persistent/recurrent SCC: PET SE 82%, SP 92%, PPV 64%, NPV 97%.
- Detection of distant metastases, PET SE 89%, SP 97%, PPV 85%, NPV 98%.
- A negative PET is highly reliable for all sites. However, a positive PET in the head and neck region is unreliable because of a high false-positivity rate.
PET-CT vs. c.e. CT after ChemoRT for advanced oropharyngeal SCC

- c.e. CT > accuracy in detecting disease at the primary site after treatment (85.7%).
- c.e. CT < accuracy for residual N+ (59.3% vs. 74.1%).
- For evaluating the neck, PET-CT and contrast-enhanced CT demonstrated 100% NPV, but the PPV was 36.3% and 26.6%, respectively.

Chen Head and Neck 2006
MR in the Postoperative Assessment of Oral-Oropharyngeal Cancer: Is There a Role?

- AHNS Annual Meeting 2006
- R. Maroldi; I. Moraschi; A. Bolzoni; P. Nicolai - University of Brescia, Italy
- 36 pts, mean f-up 38 mos, 121 MR exams, 19 rec in 16 pts
- SE 87.5%, SP 90%, PPV 87.5%, NPV 90%
- 4/8 rec detected by MR first treated by salvage treatment
- 1/8 rec detected by clinical examination had salvage surgery
Summary

- Imaging precisely delineates the involvement of structures within & surrounding the oropharynx
- DWI-MRI may add important information to morphology-data obtained by “conventional” Imaging
- Sub-centimetric nodal metastasis is a challenge, DWI-MRI is promising