Target volume delineation – primary head and neck sites

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Road Map of each site

- Anatomy – different subsites
- Disease visualization on CECT scan
- Target delineation – primary GTV, CTV, PTV
- Nodal delineation with each primary site
Oral cavity – subsites

- Lip
- Buccal mucosa
- Anterior tongue
- Floor of mouth
- Alveolus
- Hard palate
- RMT
Normal Oral Radiological Anatomy

Hard palate

Cheek

Tongue

Imaging – CECT axial scans; MRI complimentary, better soft tissue resolution
Oral lesions - Gross Target

Gross Target volume – Gross palpable or radiological disease

We now need to expand and draw the CTV!
Primary oral target delineation

Primary CTV = Original GTV + 1.5 cm margin depending upon anatomical barriers

CTV & PTV expansion in CC, AP, ML directions

CTV to PTV expansion – 3-5mm. No editing
In general, CTV is an anatomy-clinical concept

- Tumor site
- Size/ stage
- Differentiation
- Morphology

Therapeutic CTV -T: high risk
Prophylactic CTV-P: Low risk
### How site determines the oral CTV-T?

<table>
<thead>
<tr>
<th>FOM Muscles</th>
<th>Gland</th>
<th>bone</th>
<th>tongue</th>
<th>Tonsil</th>
<th>Misc</th>
</tr>
</thead>
<tbody>
<tr>
<td>FOM</td>
<td>Geniogl, geniohyoid b/l</td>
<td>S/mandi, s/l I/L</td>
<td>Part of mandible (if +ve)</td>
<td>partly</td>
<td>-</td>
</tr>
<tr>
<td>Tongue</td>
<td>Adj. FOM</td>
<td>-</td>
<td>Ant &amp; BOT</td>
<td>GT sulcus; ATP</td>
<td></td>
</tr>
<tr>
<td>BM</td>
<td>-</td>
<td>S/mandi I/L</td>
<td>-</td>
<td>-</td>
<td>GBS (CC); ITF; lip; RMT</td>
</tr>
</tbody>
</table>

*Eisbruch et al, 2002. vol12(3);238-249*
Prophylactic CTV delineation of LN oral cancers

- Ipsilateral level I-III suffice in a lateraled N0 lesion eg. Buccal mucosa
- Midline crossing tumors – include both sides I-III
- Anterior tongue lesions- include level IV
- Level II LN + - include ipsilateral level V also
- Bilateral LN – Treat each site according to N stage
- Hard fixed LN – may need to include the adjacent area
Oropharynx - subsites

- Base tongue
- Tonsil
- Soft palate
- Lateral Pharyngeal wall
Oropharynx – Normal Radiological anatomy

[Image showing normal radiological anatomy of the oropharynx, highlighting the Tonsil and Base Tongue]
How does the tumor spread (CTV-T) in oropharynx?

Harari, 2004
Oropharyngeal GTV on CT scan

Ca. Base tongue
Primary oropharyngeal target delineation

Primary CTV = Original GTV + adequate margin depending upon anatomical barriers

CTV & PTV expansion in CC, AP, ML directions

CTV to PTV expansion –3-5mm. No editing

CTV to include
Ant tongue
TL sulcus
Tonsil
LPW
PES (if invaded)

Gregoire et al. Rays: 28(3);217-224,2003
An example

Tonsillar fossae
T4-N1-M0

- soft palate
- retro-molar trigone
- parapharyngeal space
- glosso-tonsillar sulcus
- BOT
- sub-mandibular gland
- post-floor of mouth

Dasine, 2004
## How site determines the orophnx CTV-T?

<table>
<thead>
<tr>
<th></th>
<th>Palate</th>
<th>BOT</th>
<th>Tonsil</th>
<th>Bone</th>
<th>Muscles</th>
<th>Misc</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Tonsil</strong></td>
<td>Soft palate</td>
<td>Part/full</td>
<td>total</td>
<td>Adv cases</td>
<td>Pterygoid I/l</td>
<td>Adj. BM; PPS</td>
</tr>
<tr>
<td><strong>BOT</strong></td>
<td>-</td>
<td>√</td>
<td>TLS</td>
<td>-</td>
<td>-</td>
<td>S/h epiglottis (inf growth)</td>
</tr>
<tr>
<td><strong>SP</strong></td>
<td>SP</td>
<td>-</td>
<td>Superior part</td>
<td>-</td>
<td>Pterygoid in adv cases</td>
<td>Pterygopalate fossa</td>
</tr>
<tr>
<td><strong>PPW</strong></td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>Entire mucosa; PPS</td>
</tr>
</tbody>
</table>

Eisbruch et al, 2002. vol12(3);238-249
**Prophylactic CTV delineation of LN – oropharyngeal lesions**

- Bilateral neck to be include Ib to IV (ipsilateral) and II-IV (contralateral)
- Include Retropharyngeal LN in LN + and Postpharyngeal wall tumors.
- Level II LN + - include ipsilateral level V also
- Bilateral LN – Treat each site according to N stage
- Hard fixed LN – may need to include the adjacent area
# Larynx and Hypopharynx

<table>
<thead>
<tr>
<th>Site</th>
<th>Subsite</th>
<th>Structure</th>
</tr>
</thead>
<tbody>
<tr>
<td>Larynx</td>
<td>Supraglottis</td>
<td>Epiglottis</td>
</tr>
<tr>
<td></td>
<td></td>
<td>A E Fold</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Arytenoid</td>
</tr>
<tr>
<td></td>
<td></td>
<td>False cord</td>
</tr>
<tr>
<td></td>
<td>Glottis</td>
<td>True cord</td>
</tr>
<tr>
<td></td>
<td>Subglottis</td>
<td></td>
</tr>
<tr>
<td>Hypopharynx</td>
<td></td>
<td>Pyriform Sinus</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Postcrioid</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Post Phx wall</td>
</tr>
</tbody>
</table>
Normal radiological anatomy – Larynx and hypopharynx region

Hyoid

Epiglottis

Vallecula

Glossopiglottic Fold

Epiglottis

Pharyngoepiglottic Fold

Sub mandibular

Gland
Normal radiological anatomy – Larynx and hypopharynx region

Hyoid bone

Pyriform sinus

Pre-epiglottic space
Normal radiological anatomy – Larynx and hypopharynx region

AE fold

Thyroid cartilage

PFS
Normal radiological anatomy – Larynx and hypopharynx region

False cord
Arytenoid
Crico-are joint
Cricoid cartilage
Normal radiological anatomy – Larynx and hypopharynx region

Vestibule

Pyriform sinus

Para glottic space

Posterior Commissure
Normal radiological anatomy – Larynx and hypopharynx region

Ant. commissure

True Vocal cord
Normal radiological anatomy – Larynx and hypopharynx region

Cricoid

Cricopharyngeal region
Normal radiological anatomy – Larynx and hypopharynx region

Trachea
Thyroid gland

CCA  IJV

Cricoid cartilage
Normal radiological anatomy - Larynx and hypopharynx region
Carcinoma Larynx
GTV-CTV-PTV in carcinoma larynx

PTV
CTV
GTV

Ca. Larynx
Primary target delineation - larynx

Primary CTV = Original GTV + adequate margin depending upon anatomical barriers

CTV to include — PES, PGS, AEF, Vallecula (if suprohyoid ds)
Hyoid (if complete PES), Pre Lx Ms & fat (if involved), Longus capitis (if involved)

Gregoire et al. Rays: 28(3); 217-224, 2003

CTV & PTV expansion in CC, AP, ML directions

Anatomical barrier may
be edited from CTV
Bone
Air

CTV to PTV expansion –3-5mm. No editing
Prophylactic CTV delineation of LN – laryngeal primary (except T1N0)

• Include Level II-IV bilaterally
• In subglottic extension include level VI
• Level II LN + - include ipsilateral level V also
• Bilateral LN – Treat each site according to N stage
• Hard fixed LN – may need to include the adjacent area
Hypopharyngeal cancer - as seen on CT scan

Ca. Pyriform

Ca. Postcricoid
Primary target delineation - hypopharynx

Primary CTV = Original GTV + adequate margin depending upon anatomical barriers

CTV to include
- PGS
- AEF
- Thyroid cartilage (if PGS)
- Cricoid (if arytenoid)
- PPW (if Lat/Post wall)
- VC (if PGS/PC)

Gregoire et al. Rays: 28(3);217-224,2003

CTV & PTV expansion - CC, AP, ML

CTV to PTV expansion –3- 5mm. No editing
How site determines the adv Larynx-hypophnx CTV?

<table>
<thead>
<tr>
<th></th>
<th>Larynx</th>
<th>PFS</th>
<th>vallecula</th>
<th>Space &amp; Ms</th>
<th>Cartilage</th>
<th>Misc</th>
</tr>
</thead>
<tbody>
<tr>
<td>Larynx</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>PES, PGS</td>
<td>Thyroid</td>
<td>Tracheostomy</td>
</tr>
<tr>
<td>PFS</td>
<td>I/L hemiLx; PPW</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>Submucosal; I/L Thyroid</td>
</tr>
</tbody>
</table>

Eisbruch et al, 2002. vol12(3);238-249
Prophylactic CTV delineation of LN – hypopharyngeal primary

- Include Level II-IV bilaterally
- In PFS and esophageal extension include level VI
- Include Retropharyngeal LN in LN + and Postpharyngeal wall tumors.
- Level II LN + - include ipsilateral level V also
- Bilateral LN – Treat each site according to N stage
- Hard fixed LN – may need to include the adjacent area
Normal structures to be delineated in all sections

- Spinal cord + Margin (PRV)
- Parotid glands
Changing patterns of failure in HN cancers

- With Conventional RT- Failures proportionate

Mendenhall says
- Previously unappreciated tumor spread e.g parotid LN
- Questioned the zeal to spare parotid in level II LN+
- Risk of radiological miss
- Prudent to give conventional RT in bilateral Level II LN+

*Mendenhall et al*  
*IJROBP*:2009;73(3),645-646.
Conclusions

- Knowledge of anatomy, radiological anatomy (normal and abnormal (GTV)) required.

- Delineation is an important link in treatment.

- CTV- determined by patterns of spread and is bounded by natural barriers i.e. bone & air. It should be guided by conventional treatment portals.

- PTV- set up errors of HN site(s) at your centre.
Conclusions

- Worst complication is tumor recurrence
- Generous target delineation, high quality imaging and understanding patterns of failure
- Need for consensus for primary targets facilitating consistent selection & delineation

Lee et al, IJROBP, 2004.57:49-60