Imaging of Locally Advanced Squamous Cell Carcinoma of Oral Cavity

Poster No.: R-0042
Congress: 2015 ASM
Type: Educational Exhibit
Authors: S. Sharma, S. Thulkar, N. K. Shukla, S. V. S. Deo, S. D. Gupta; New Delhi/IN
Keywords: Staging, CT, MR, Oncology, Neoplasia
DOI: 10.1594/ranzcr2015/R-0042

Any information contained in this pdf file is automatically generated from digital material submitted to EPOS by third parties in the form of scientific presentations. References to any names, marks, products, or services of third parties or hypertext links to third-party sites or information are provided solely as a convenience to you and do not in any way constitute or imply RANZCR's endorsement, sponsorship or recommendation of the third party, information, product or service. RANZCR is not responsible for the content of these pages and does not make any representations regarding the content or accuracy of material in this file.

As per copyright regulations, any unauthorised use of the material or parts thereof as well as commercial reproduction or multiple distribution by any traditional or electronically based reproduction/publication method is strictly prohibited.

You agree to defend, indemnify, and hold RANZCR harmless from and against any and all claims, damages, costs, and expenses, including attorneys' fees, arising from or related to your use of these pages.

Please note: Links to movies, .ppt slideshows, .doc documents and any other multimedia files are not available in the pdf version of presentations.
Learning objectives

To assess the comparative role of MRI and CT in preoperative evaluation of locally advanced (clinical stage III and IVA) squamous cell carcinoma (SCC) of oral cavity.

Background

Head and neck carcinomas account for 5% of all cancers, with approximately half of those arising from the oral cavity [1]. Globally, the annual estimated incidence for oral cavity cancers is approximately 275,000, with oral cavity carcinomas constituting up to 25% of all new cancers in high-risk countries like India and Pakistan [2]. Squamous cell carcinomas (SCCs) account for over 90% of all oral cavity cancers. They are commoner in men than women, typically affecting individuals with a long history of tobacco and alcohol abuse. Heavy drinking-smokers have a high risk of developing SCC being 6 to 15 times greater than abstainers [3]. The deleterious effects of alcohol and tobacco appear to be synergistic.

The diagnosis of oral cavity cancer is typically known at imaging; the mucosal extent is best evaluated through visual inspection and manual palpation. Preoperative imaging is essential for tumor staging and appropriate treatment planning. Radiological evaluation ensures accurate staging and provides essential information about tumour extent, which directly affects the surgical approach required for curative resection or radiation therapy [4]. Carefully performed and interpreted imaging can assist in determining the depth of invasion, involvement of critical structures, including bone and the internal carotid artery, and the presence of lymph node metastases. Surgical resection with 1-cm tumor-free margins is the primary treatment for oral cavity carcinomas [5]. Positive surgical margins are strongly associated with poor prognosis and loco-regional recurrence [5].

MRI is generally recommended as the modality of choice in preoperative evaluation of SCC of the oral cavity. It provides superior information about local T-Staging but may be limited in demonstrating superficial lesions. CT scan is more freely available and has its own advantages and limitations. To our knowledge no study that directly compares MDCT and MRI for evaluation of the locally advanced disease (stage III and IV A, [AJCC Cancer Staging Manual, 2002]); so we undertook this study to determine preferred imaging modality of choice to pre-operatively investigate these patients.
The study was carried out in the Radiology Section, Dr. B. R. Ambedkar Institute Rotary Cancer Hospital, All India Institute of Medical Sciences, New Delhi.

**Material and Methods:**

Twenty eight consecutive patients (22M, 6F) with biopsy proven primary SCC of the oral cavity having Stage III, IVA disease were prospectively evaluated. Cancer locations were: buccal mucosa (10, 35%), lower alveolus (8, 29%), upper alveolus (2, 7%), retromolar trigone (3, 11%) and tongue (5, 18%). All patients underwent CT and MRI for radiological staging. Histopathology and operative findings were used as gold standard. Six (5 unresectable & 1 poor surgical risk) patients who were not operated were excluded from analysis. Of these 14 well differentiated, 13 moderately differentiated and one poorly differentiated squamous cell carcinoma.

Mean age was 49 years.

Age range was 23-65 years.

**Inclusion criteria:**

- Pathologically proven SCC of the oral cavity, which were locally advanced (Stage III and IV A)

**Exclusion criteria:**

- Early (Stage I, II) and large inoperable (Stage IV B and C) disease.
- Recurrent or residual tumour
- Oro-pharyngeal carcinoma.
- Co-morbidities which preclude surgery/ general anesthesia (viz., renal failure, advanced COAD, cardiac abnormalities, uncontrolled DM).
- Contraindications to MRI.
- No consent.

**CT**

It was performed on 4 slice MDCT. Region from skull base to clavicles was included. Axial sections (3-5 mm) were acquired with the scan plane parallel to the hard palate.
Reconstruction of CT data was done in soft tissue and bone algorithm. Additionally, coronal and sagittal or shaded surface display (SSD) images were reconstructed when required. Iodinated contrast medium was administered in all patients intravenously.

**MRI**

It was performed on 1.5 tesla. Head and neck coils were used. Images were acquired in multiple planes. Standard spin echo and/or gradient echo sequences were employed with or without fat suppression. T1W, T2W fat suppressed and post gadolinium-DTPA contrast enhanced fat suppressed images were acquired in axial and coronal planes. These sequences were also obtained in sagittal planes in case of tongue carcinoma or when needed. Additional T1W sequence of small FOV, low SNR and with 'puffed cheek' maneuver was done in axial and coronal planes to better localize the tumour when needed.

During CT and MRI scanning, patients breathed quietly and avoided swallowing.

**Image analysis for CT and MRI** Images were reviewed to assess the largest tumour dimension, depth, thickness, local soft tissue extent, neurovascular invasion, bone involvement and lymph node metastases.

The following radiological criteria were used for assessment of cervical nodal metastases [6,7]-

1. Nodes with a short axis diameter (SAD) of 11mm or more in the subdigastric region and 10 mm or more in the rest of the nodal site.
2. Nodes with a long axis diameter (LAD) of 15mm or more.
3. Groups of three or more lymph nodes of 9 or 10 mm in the subdigastric region, and 8 or 9 mm in the rest of the nodal site.
4. All nodes, irrespective of size, showing irregular enhancement, necrosis or extra capsular spread and or were surrounded by a rim of enhancing viable tumour or lymph node.

Muscle involvement was considered when there was either its direct infiltration or loss of fat plane with the adjacent mass lesion and showed increased bulk or signal abnormality on MRI.

The following radiological criteria [6,7] were used for bone involvement-

1. Mandibular cortical invasion -

MRI and CT: Defect of the cortical bone adjacent to the tumour mass.
2. Bone marrow involvement -
MRI: Abnormal signal intensity of bone marrow* contiguous to the cortical defect
CT: Trabecular disruption contiguous to the cortical defect

3. Inferior alveolar canal involvement
MRI and CT: Marrow involvement reaching the inferior alveolar canal

(*Hypointense on T1W and hyperintense on T2FS image, with enhancement following contrast administration)

Based on image analysis all the patients were assigned TNM stage as the follows-

**TNM Classification (AJCC 2002):**

**T - Primary tumour**

T1 - < 2cm.
T2 - 2 - 4cm.
T3 - >4 cm.
T4 - Tumour invades adjacent structures (skin, cortical bone etc)
T4a: invasion of skin / bone / muscle (operable)
T4b: invasion of masticator space/ pterygoid plate/ encasement of internal carotid (inoperable)

**N - Neck Nodes**

N0 -No Lymphnodes
N1 -Ipsilateral, single, <3 cm
N2a -Ipsilateral, single, 3-6 cm
N2b -Ipsilateral, multiple, <6 cm
N2c -Bilateral/ contralateral, <6 cm
N3 -LN >6 cm

**M - Distant Metastasis**
M0 - No distant metastasis
M1 - Distant Metastasis

Stage I - T1 N0 M0
Stage II - T2 N0 M0
Stage III - T3 N0 M0, T1-T3 N1 M0
Stage IV A - T4a N0/1 M0, Any T N2 M0
Stage IV B - Any T, N3 M0 / T4b, any N M0
Stage IV C - Any T Any N M1

**Surgery**

After clinical staging and pre anesthetic check-up, patients were operated within 4 weeks after completion of imaging work-up.

Wide local excision of the primary tumour along with ipsilateral modified neck dissection (MND) type I was performed in all patients. Contralateral supraomohyoid neck dissection or MND type III was also performed if indicated. After excision of the primary tumour, separate samples were taken from all the margins of the resected site. The primary tumour, margins and level wise nodes were sent for histopathological examination (HPE).

**Final Analysis**

Imaging, surgical and histopathological findings were recorded on a proforma and evaluated. Results of the radiological findings were correlated with the histopathology and intraoperative findings which served as a standard of reference.

The mean time interval between CT and surgery was 12 days (range, 2-28 days) and between MRI and surgery was 9 days (range, 2-17 days). The mean time interval between CT and MRI was 4 days (range, 0-21 days). The findings were correlated with surgical and histopathological findings in all the operated cases.

Of the total 28 evaluated patients, 22 patients underwent surgery. Six were not operated as five of them had advanced disease on imaging while one was a poor surgical candidate. Since surgical benefit was doubtful in these six cases, they were recommended alternate therapy (chemotherapy and/or radiotherapy). These cases were excluded from analysis as imaging findings were not confirmed by surgery and pathology.
### Comparative yield of CT versus MRI in the assessment of tumour spread:

<table>
<thead>
<tr>
<th>Tumour spread</th>
<th>Sensitivity (%)</th>
<th>Specificity (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>CT</td>
<td>MRI</td>
</tr>
<tr>
<td>Local tumour</td>
<td>81</td>
<td>96</td>
</tr>
<tr>
<td>extension</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Muscle invasion</td>
<td>91</td>
<td>97</td>
</tr>
<tr>
<td>Bone invasion</td>
<td>100</td>
<td>100</td>
</tr>
<tr>
<td>Nodal metastases</td>
<td>61</td>
<td>61</td>
</tr>
</tbody>
</table>

Preoperative imaging changed the clinical management in five patients by unequivocally demonstrating unresectability. These were thought to be resectable clinically.

Prior local clinical examination proved vital for accurate image interpretation, especially for cancers at tongue, lip and palate.

A 'puffed cheek' maneuver proved highly desirable, both for CT and MRI.

### Fig 1: (a-f) Carcinoma right buccal mucosa

Axial CECT image (a) shows soft tissue thickening (red asterisk) involving the right buccal mucosa with loss of fat planes with masseter muscle (white asterisk). RMT (arrow) and adjacent bones appear free. Unlike in CECT image, RMT is seen to be clearly involved (arrow) on axial - T1W (b), T2W FS (c) and T1W post contrast FS (d) MR images. On coronal - T1W (e) and T2W FS (f) MR images the craniocaudal extent of the tumour is well delineated. Incidental right maxillary sinus polyp is noted. On surgery, RMT was found to be involved.

### Fig 2: (a-f) Carcinoma right buccal mucosa

On axial CECT image (a), the neoplastic lesion in right buccal mucosa is involving the ipsilateral RMT and medial pterygoid muscle (yellow arrow). Soft tissue density seen in the right maxillary molar teeth region (blue arrow) is due to the edentulous alveolar socket. But axial T1W MR image (b) shows that the medial pterygoid muscle is free (yellow arrow). Bone window of axial CT (c) and coronal reformatted image (d) obtained by dedicated dental software shows the bone to be intact. On coronal CECT (e) and T1W
post contrast FS MR (f) images the mass is seen to extend from the lower GB sulcus (blue arrow) (e) to upper GB sulcus level (blue arrow) (f) but both the sulci are free of tumour.

**Fig 3: (a-f) Carcinoma lower alveolus (central arch region)**

Axial CECT image (a) shows large mass (yellow arrow) at the central mandibular arch region with involvement of the floor of mouth. On a higher section (not shown) the geniohyoid muscle was found to be involved. Shaded Surface Display (SSD) projection of CT (b) shows mandibular destruction with pathological fracture. T1W (c) and T2W FS (d) axial MR images show the bony destruction and muscle involvement similar to CT.

The surgical resection of the tumour included a margin of two teeth on either side. This resection appeared to be adequate intra-operatively (f), but on HPE showed involvement of marrow of the resected margins of the left sided ramus. In retrospect, this bone marrow involvement was apparent (yellow arrow) on axial T1W image (e) at a higher level. Therefore the patient had to be reoperated.

**Fig 4: (a-f) Carcinoma left lower alveolus**

An ulceroinfiltrative growth is well seen on clinical photograph (a) involving left lower alveolus. MR spectroscopy image (b) shows a choline peak within the growth. Axial CECT (c) and T2W FS MR (d) images showing full thickness mandibular erosion and involvement of mylohyoid (yellow arrow) muscle (floor of mouth). Sagittal and coronal reconstruction of CECT data (e, f) clearly show the location of the lesion involving the alveolus (yellow arrow) (e) and lower GB sulcus (yellow arrow) (f), exemplifying the usefulness of 'puffed cheek' maneuver.

On surgery, the lesion had destroyed the mandible and was hanging inside the oral cavity but the mylohyoid muscle was free.

**Fig 5: (a-f) Carcinoma oral tongue.**

Axial CECT image (a) shows an ill defined asymmetric soft tissue thickening in the posterior tongue and fullness of the right parapharyngeal space (white asterisk). Axial T2W FS MR image (b) shows a hyperintense mass that is well delineated and is reaching up to the midline lingual septum. Posterior third of the tongue and right parapharyngeal space appear free. The T2 differential hyperintensity seen in the molar tooth region (blue curved arrow) is due to accumulated saliva. Further, at a lower level the T2W FS image (c) shows involvement of the ipsilateral lingual neurovascular bundle (red arrow) (NVB). Note that the contra lateral NVB is intact (open arrow). The medial pterygoid muscle that appeared infiltrated (yellow arrow) on axial images (c) was free (yellow arrow) on coronal image (d) and surgery. In the sagittal T2W image (e) the mass is involving the genioglossus muscle (black asterisk) and the geniohyoid muscle (yellow arrow) sheath.
On axial PET-CT fusion image (f) the mass shows intense uptake. A large Level 2 lymph node (white arrow) is well seen on axial T2W FS images (b, c) and shows intense uptake on PET-CT fusion image (f).

**Fig 6: (a-f) Carcinoma left upper alveolus**

Carcinoma is seen in the upper alveolar region on axial CECT image (a), axial T2W (c) and T1W post contrast FS MR (d) images. The lesion is in close contact with the origin of lateral pterygoid muscle (yellow arrow). However, no signal intensity changes seen in the muscle. Bone window of axial CT image (b) shows suspicious maxillary bone erosion bilaterally likely due to periodontal disease. On coronal CT image with 'puffed cheek' (e) tumour is seen involving the upper alveolus and upper GB sulcus (yellow arrow). On coronal T2W image the involvement of hard palate on the left side is well appreciated (f) (yellow arrow).

**Fig 7: (a-d) Carcinoma retromolar trigone**

Axial CECT image (a) shows subtle asymmetrical soft tissue thickening involving the left RMT region (arrow). No border of mass could be delineated on CT. In contrast to CT images; axial T1W (a), T2W FS (b) and T1W post contrast FS (c) MR images clearly demonstrate the margins of the tumour in the RMT (arrow). Parapharyngeal space and medial pterygoid muscle were free in this case on imaging and surgery. This case exemplifies the usefulness of MRI in tumours at RMT region.

**Fig 8: (a-d) Cases considered unresectable on imaging**

(a): Carcinoma left lower alveolus shows extensive involvement of left gingivo-buccal region, RMT and masticator space (yellow arrow).

(b): Carcinoma left RMT shows nodal lesion in the paravertebral location (yellow arrow) with vertebral body destruction.

(c): Carcinoma left upper alveolus shows mass lesion causing destruction of lateral wall of the left maxillary sinus extending into the maxillary antrum (yellow arrow). (d) Carcinoma tongue showing enhancing lesion with necrotic area involving right lateral border of tongue and extending into posterior third of the tongue i.e., oropharynx (yellow arrow).

**Images for this section:**
Conclusion

Overall diagnostic performance of CT and MRI were comparable for evaluation of locally advanced SCC of oral cavity. However, MRI should to be a preferred modality, for cancers of oral tongue and retro molar trigone, while CT appears to be a better choice for cancers of alveolus and buccal mucosa. MRI is more accurate for assessing local tumour extension, muscle infiltration and nodal involvement. For assessment of bone, invasion both CT and MRI are comparable. The assessment of cancers of floor of mouth and gingivo-buccal sulcus could be fallacious if axial or coronal images alone are interpreted. Orthogonal planes must be used in these locations.

Personal information

References