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Comparison of Accuracy of Contrast Enhanced Computed Tomography with Accuracy of Non-Contrast Magnetic Resonance Imaging in Evaluation of Local Extension of Base of Tongue Malignancies

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ABSTRACT

Diagnosis of base of tongue malignancy can be obtained through clinical examination and biopsy. Magnetic Resonance Imaging (MRI) and Computed Tomography (CT) are used to detect its local extension, nodal spread and distant metastases. The main aim of study was to compare the accuracy of MRI and contrast enhanced CT in determining the local extent of base of tongue malignancy. Twenty five patients, biopsy proven cases of squamous cell carcinoma of base of tongue were taken. 1.5 Tesla Magnetic Resonance Unit with T2 weighted axial, coronal image; T1 weighted axial, coronal image; and STIR (Short tau inversion recovery) axial and coronal images were used. 16 slice Computed Tomography unit with non-contrast and contrast enhanced images were used. Accuracy of CT to detect midline crossing: 50%; accuracy of MRI to detect midline crossing: 100%; accuracy of CT to detect anterior extension: 92%; accuracy of MRI to detect anterior extension: 100%; accuracy of CT to detect tonsillar fossa invasion: 83%; accuracy of MRI to detect tonsillar fossa invasion: 100%; accuracy of CT to detect oro pharyngeal spread: 83%; accuracy of MRI to detect oro pharyngeal spread: 100%; accuracy of CT to detect bone involvement: 20%; accuracy of MRI to detect bone involvement: 100%. MRI proved to be a better investigation than CT, in terms of evaluation of depth of invasion, presence of bony involvement, extension to opposite side, anterior half of tongue, tonsillar fossa, floor of mouth or oropharynx.

Keywords: Base of Tongue Tumour, Magnetic Resonance Imaging, Contrast Enhanced Computed Tomography

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INTRODUCTION

The base of tongue is considered as a part of oropharynx and is not the part of oral tongue. It is the posterior most located portion of the tongue. It is a site of the posterior opening of the oral cavity. Symptoms of base of tongue tumour are also occult with most common symptom being dysphagia and neck swelling secondary to lymph node enlargement. So, patients generally present in advanced stage of the disease. Malignancy in base of tongue can spread in any direction. Superiorly, it can involve nasopharynx; anteriorly, it can involve anterior tongue; antero-inferiorly, it can involve floor of mouth; posteriorly, it can involve oropharynx, hypo pharynx, larynx,

oesophagus and hyoid bone. Thus accurate diagnosis and staging of the base of tongue tumour is of utmost importance before the treatment is initiated.

Aims and Objectives

The main aim of the study was to evaluate base of tongue malignancy by contrast enhanced Computed Tomography (CECT) and Magnetic Resonance Imaging (MRI) and to compare their accuracy to detect extension of the primary lesion to nasopharynx, anterior aspect of tongue, floor of mouth, oropharynx, hypo pharynx, larynx, oesophagus, hyoid bone and mandible.

MATERIALS AND METHODS

Twenty five histopathologically proven cases of squamous cell carcinoma of base of tongue were evaluated by CECT and MRI from 25th January 2017 to 24th November 2017 at Shri Guru Gobind Singh Government Hospital, Jamnagar, Gujarat, India.

Inclusion criteria:

- Patients presenting with ulcerative lesion, neck pain, neck welling, dysphagia, odynophagia, trismus, in base of tongue.

Exclusion criteria:

- Cardiac Pacemaker
- Metallic implants
- Claustrophobia
- Non co-operative patient
- Past history of allergic reaction to contrast media used in computed tomography.

Machines used and images obtained were as below:

- 1.5 Tesla Magnetic Resonance Unit with T2 weighted axial and coronal image; T1 weighted axial and coronal image; and STIR (Short tau inversion recovery) axial and coronal images.
- 16 slice Computed Tomography unit with non-contrast and contrast enhanced images.

RESULTS AND DISCUSSION

Age, sex, symptoms distribution, appearance of the lesion on plain CT, post contrast CT and on various sequences of MRI like T2 weighted, T1 weighted and STIR sequence is mentioned in table 1. Thus, the most common age group for base of tongue malignancy was 51-60 years, it was more common in males, the most common symptoms were dysphagia and neck swelling, most of the lesions appeared hypodense on plain CT and showed heterogeneous post contrast enhancement, appeared hyperintense on T2WI, STIR and hypointense on T1WI. Comparison of CECT and MRI in determining accurate local extension of the lesion is mentioned in table 2. Thus, our study shows that local staging of the patient is not significantly changed when we use CECT or MRI. However, table two shows that non contrast MRI is better than contrast enhanced CT in determining the local extension of the lesion as well as for early detection of bony involvement.

Comparing accuracy of contrast enhanced CT versus accuracy of non-contrast MRI:

- Crossing midline –
  - Accuracy of CT: 50%
  - Accuracy of MRI: 100%
- Anterior extension –
  - Accuracy of CT: 92%
  - Accuracy of MRI: 100%
- Tonsillar fossa –
  - Accuracy of CT: 83%
  - Accuracy of MRI: 100%
- Pharyngeal spread –
  - Accuracy of CT: 83%
  - Accuracy of MRI: 100%
- Bone involvement
  - Accuracy of CT: 20%
  - Accuracy of MRI: 100%

The base of tongue is a part of oropharynx, whereas the anterior tongue including the root of the tongue are the parts of oral cavity [1]. Tongue is made up of four pairs of intrinsic muscles and four pairs of extrinsic muscles. Intrinsic muscles include superior longitudinal, inferior longitudinal, vertical and transversus muscle. Extrinsic muscles include genioglossus, geniohyoid, hyoglossus, styloglossus and palatoglossus muscle [1]. Part of the tongue anterior to the circumvallate papillae is known as the mobile tongue and part of the tongue posterior to it is known as the base of the tongue [1]. It is important to differentiate root of the tongue from base of tongue [1]. Root of the tongue includes lingual septum, bilateral genioglossus and geniohyoid muscles whereas the base of the tongue includes only the posterior lymphatic tissue. Also, the root of the tongue is considered the part of oral cavity, whereas the base is a part

of oropharynx [1]. The base of the tongue is bounded anteriorly by the circumvallate papillae, laterally by the glosso-tonsillar sulci [2]. It is covered by the lymphoid tissue forming the lingual tonsil. Posteriorly, the base of the tongue is connected to the anterior aspect of suprahyoid epiglottis by median and bilateral lateral glosso epiglottic folds [2]. The incidence of base of tongue malignancy is increasing. Risk factors for the same are alcohol, tobacco, positive family history, geographical location which is more prone to develop cancer, older age, environmental exposure to certain carcinogens like polycyclic aromatic hydrocarbons, welding fumes, asbestos, nutritional deficiencies and certain infectious agents like Human Papilloma Virus and certain fungi [3]. As per one study conducted in Denmark, the incidence of base of tongue cancer increased from 5.4% per year to 8.1% per year between 2000 to 2010. This sudden rise had been attributed to Human Papilloma Virus infection [4]. Base of the tongue is a clinically silent region; the tumours over here tend to spread with deep infiltration [5]. It is not possible thoroughly to determine the total extent of the lesion in base of tongue by clinical examination alone. Malignancy in base of tongue can spread in any direction. Superiorly, it can involve nasopharynx; anteriorly, it can involve anterior tongue; antero-inferiorly, it can involve floor of mouth; posteriorly, it can involve oropharynx, hypo pharynx, larynx, oesophagus and hyoid bone. Alternatively, the tumour may by primarily in the tonsillar fossa or supra glottis or in other portions of pharynx which has shown local extension to involve base of the tongue. The first draining lymph node is jugulodiagastric lymph node followed by mid and lower jugular nodes. If there is anterior extension, submandibular and sub-mental lymph nodes will also be involved [5]. The most common presenting symptom will be dysphagia followed by neck swelling due to cervical metastases. Other symptoms which may be encountered are odynphagia, trismus, painful ulcer etc [3]. On imaging, MRI is better than CT for differentiating various tongue muscles [2]. The identification of muscles on CT is based on the analysis of adjacent fatty planes and vessels [2]. On MRI, different muscles of tongue can be easily distinguished since they do not have equal fat content within it, so each has different signal intensity on non-contrast T1 weighted image [2]. For the purpose of bone evaluation, breech in the cortex is better appreciated on CT than on MRI. However, CT cannot detect early marrow invasion in absence of any cortical break, where in MRI plays a pivotal role [2]. Also sometimes, CT produces many artefacts due to dental amalgam which we do not get on an MRI. Another important prognostic factor is the depth of tumour invasion which can be studied better on MRI than CT. For detecting the true depth of tumour invasion, a line is drawn along the alveolar process; the length of the tumour perpendicular to the above mentioned line gives the true depth of invasion. Depth of invasion is the most important prognostic factor for complete cure and to detect chances of recurrence. Tumour extension to the floor of mouth is well depicted on coronal images. Involvement of base of tongue and pharyngeal extension is well depicted on sagittal images [5]. Most of the squamous cell carcinomas appear hyperintense on T2WI, hypointense on T1WI and are not suppressed on STIR (Short term inversion recovery) sequence. On CT, most of the lesions appear hypodense with mild heterogeneous contrast enhancement. MRI is better in follow up cases to evaluate response to treatment. On follow up MRI, the challenge is to differentiate residual or recurrent tumor from post irradiation granulation tissue. Such evaluation is primarily the function of MRI because the CT attenuation of tumor and fibrous tissue are similar. On MRI images, mature scar tissue does not enhance and exhibits dark signal on T2W images, an appearance that is readily distinguished from tumor tissue. Correlated with pathologic findings, the signal intensity of T2 weighted images was most helpful in distinguishing viable from nonviable tumor tissue [6]. Following measures facilitate in distinguishing residual or recurrent lesion from fibrous tissue: A) Ideally, post radiotherapy baseline MRI is performed for comparison with future follow up studies. This should be delayed for 3-4 months after the completion of radiotherapy to allow for total resolution of slowly progressing tumors and acute post irradiation reactive/oedematous changes. Progressively growing masses or tissue thickening should be deemed as recurrent tumor whereas regressive change points to a resolving post irradiation reaction or a contracting scar. B) When previous scans are unavailable, detection of an obviously positive lymph node is a reliable sign of recurrence [6]. C) Otherwise, studying the lesion's morphology may be helpful [6]. It has been proposed that a recurrent tumor usually presents as a lobulated lump with mass effect, whereas post

irradiation changes are usually a more diffuse process, giving rise to asymmetry with straight and smooth margins. There criteria however should be considered and should not be regarded as the sole determinants of tumor recurrence. When feasible, PET scan technique with 18 – fluorodeoxyyglucose / thallium – 201 scanning / MR Spectroscopy can be helpful to measures metabolic activity of the mass in question. It can distinguish a recurrent tumor by its high metabolic rate from post irradiation scar tissue [6].

Diagnostic Check List for Ct and MRI Reporting for Local Staging

- Clinical profile: It forms the base line for the CT and MRI reporting. Whether patient is a fresh candidate for initial assessment (no histopathological report done/available), histopathologically proven case, post-operative, post irradiation, post chemotherapy or a combination of these.
- Assessment of density and contrast enhancement characteristics on plain and contrast enhanced CT and signal characteristic of primary tumors on T1 weighted, T2 weighted and STIR sequences. Measurement of tumor length, depth of invasion and side to side extents given (AP X CC X ML). The exact location and epicentre of primary lesion with involvement of intrinsic and extrinsic muscles of tongue.
- The relation of tumor with median lingual septum. Whether it reaches upto midline or not, deviates it or crosses it to involve contralateral half of tongue.
- The relation of the lesion with root of the tongue (muscular sling formed at origin of genioglossus and geniohyoid). The condition of floor of the mouth (mylohyoid), sublingual fat and submandibular space. Also lingual artery involvement /engulfment is to be looked for. The boundaries with tonsillar fossa, retromolar trigone laterally and vallecula, epiglottis, lateral oro-pharyngeal wall and pyriform fossa (hypo pharynx) postero-inferiorly should be depicted.
- For the sake of completion of evaluation, hard palate, soft palate, nasopharynx, maxillary sinus, ethmoidal sinus, frontal sinus, orbit and optic nerve, infra-temporal fossa and pterygoid muscles are assessed.
- Additional changes are mentioned in relation to post-operative appearance, post irradiation reactive/oedematous changes which gives clue for detection of recurrent /residual tumor in future follow up MRI.
- Look for lytic or sclerotic destruction of bone which is better depicted on CT than MRI.
- If the present CT/MRI is a follow up study, then a special remark is made regarding the change in size and extent of primary lesion, in comparison to most recent previous CT/MRI. This will conclude whether the present scan shows improvement, deterioration or a stable disease.

CONCLUSION

Due to its superior soft tissue contrast resolution and its multiplanar capability, MRI is is better in evaluation of base of tongue malignancy than CT. Also no beam artefact from amalgam or other dental material is noted on MRI as is seen on CT.

MRI is highly sensitive in detecting early stage of base of tongue malignancy. Incidence of surrounding tissue involvement with invasion of intrinsic and extrinsic muscles of tongue was quite high in malignant tongue lesions.

MRI is better than CECT in detection of local extension as tissue contrast between tumor and normal musculature is higher on T2W images. With plain T1W images, lesion often is better seen than post contrast images, because of fibrofatty natural contrast in oral tongue.

MRI can accurately give the depth of tumor invasion which correlates with the likelihood of cervical nodal metastases. The pre-operative decision as to whether to perform elective neck dissection can, therefore be based on tumor thickness.

Marrow infiltration of mandible / hyoid bone is better depicted with MRI as compared to CT. However, CT scan is better for depicting bone erosions / cortical breech.

In post treatment evaluation (Post-operative, radiotherapy, chemotherapy) imaging, MRI has potential advantage to diagnose recurrent / residual lesion. Also, contrast between post irradiation fibrosis and recurrent tumour is improved on T2W images.

Table 1:

Patient	Age (In years)	Male (M) / Female (F)	Most common symptom	Appearance on plain CT	Post contrast Enhancement on contrast enhanced CT	Appearance on MRI (Hyper: ↑)(Hypo: ↓) (Iso: ═)
1	42	M	Dysphagia	Hypodense	Heterogeneous	↑: T2, STIR,↓: T1
2	51	F	Neck swelling	Hypodense	Heterogeneous	↑: T2, STIR,↓: T1
3	55	M	Dysphagia	Hypodense	Heterogeneous	↑: T2, STIR,↓: T1
4	42	M	Dysphagia	Hypodense	Heterogeneous	↑: T2, STIR,↓: T1
5	56	M	Dysphagia	Hyperdense	Heterogeneous	↑: T2, STIR,↓: T1
6	43	M	Dysphagia	Hypodense	Heterogeneous	=: T1,↓: T2 ↑ : STIR
7	57	M	Neck swelling	Hypodense	Heterogeneous	↑: T2, STIR,↓: T1
8	65	M	Neck swelling	Isodense	Homogeneous	↑: T2, STIR,↓: T1
9	58	M	Dysphagia	Hypodense	Heterogeneous	↑: T2, STIR,↓: T1
10	46	M	Neck swelling	Hypodense	Heterogeneous	↑: T2, STIR, ═:T1
11	63	M	Neck swelling	Hypodense	Heterogeneous	↑: T2, STIR,↓: T1
12	60	M	Neck swelling	Hypodense	Heterogeneous	↑: T2, STIR,↓: T1
13	48	M	Neck swelling	Hypodense	Heterogeneous	↑: T2, STIR,↓: T1
14	62	M	Dysphagia	Isodense	Homogeneous	↑: T2, STIR, ═:T1
15	56	M	Neck swelling	Hypodense	Heterogeneous	↑: T2, STIR,↓: T1
16	53	M	Dysphagia	Hypodense	Heterogeneous	↑: T2, STIR,↓: T1
17	39	M	Neck swelling	Hypodense	Heterogeneous	↑: T2, STIR, ═:T1
18	52	M	Dysphagia	Isodense	Homogeneous	↑: T2, STIR,↓: T1
19	51	F	Neck swelling	Hypodense	Heterogeneous	↑: T2, STIR,↓: T1
20	46	M	Dysphagia	Hypodense	Heterogeneous	↑:STIR═ :T2,↓: T1
21	55	M	Dysphagia	Hypodense	Heterogeneous	↑: T2, STIR,↓: T1
22	56	M	Neck swelling	Isodense	Heterogeneous	↑: T2, STIR,↓: T1
23	27	M	Neck swelling	Hypodense	Heterogeneous	↑: T2, STIR,↓: T1
24	39	F	Dysphagia	Hypodense	Heterogeneous	↑: T2, STIR,↓: T1
25	38	M	Neck swelling	Hypodense	Heterogeneous	↑: T2, STIR,↓: T1

Table 2:

Extension of lesion and TNM staging	No. of patients (%) [On CECT]	No. of patients (%) [On MRI]
Crossing midline	6 (24)	12 (48)
Anterior extension to involve posterior 1/3rd and anterior 2/3rd of tongue	12 (48)	13 (52)
Tonsillar fossa	15 (60)	18 (72)
Oro-pharyngeal spread	15 (60)	18 (72)
Bone involvement	1 (4)	5 (20)
Stage T1	0 (0)	0 (0)
Stage T2	7 (28)	6 (24)
Stage T3	9 (36)	10 (40)
Stage T4a	5 (20)	5 (20)
Stage T4b	4 (16)	4 (16)

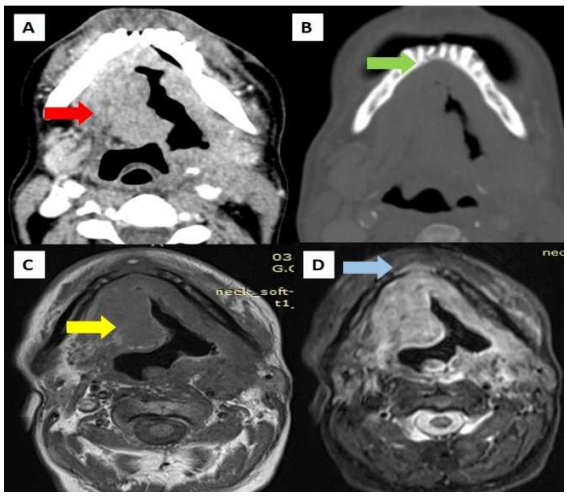

Figure 1: IMAGING FINDINGS: A large irregularly marginated soft tissue density lesion with heterogeneous enhancement on CECT (1A), hyperintense on STIR (1D) and iso to hypointense on T1WI (FIGURE 1C). The lesion involves almost entire tongue including base of tongue extending into floor of mouth, bilateral tonsillar fossa, crossing midline with oro-pharyngeal spread. Mandibular involvement is better depicted on MRI as marrow infiltration of mandible in its midline noted on T1WI and STIR (1D, blue arrow) axial image as compared to cortical erosion on corresponding CT (1C, green arrow) image

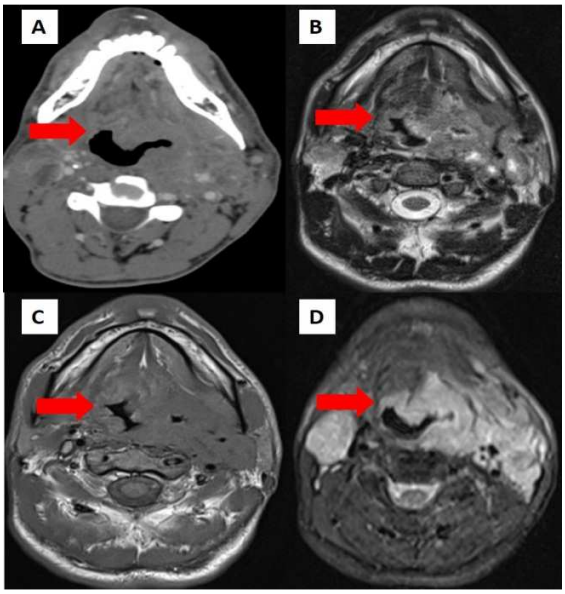

Figure 2: IMAGING FINDINGS: Well-defined soft tissue density lesion with heterogeneous enhancement on CECT (2A), hyperintense on T2WI (2B), STIR (2D) and hypointense on T1WI (2C). The lesion is centred on left base of tongue, crossing midline (which is not depicted on CECT but is clearly depicted on corresponding MRI image) with inferior extension to involve median and left lateral glosso-epiglottic folds, left vallecula, lateral extension to involve left lateral pharyngeal wall and involvement of left parapharyngeal space

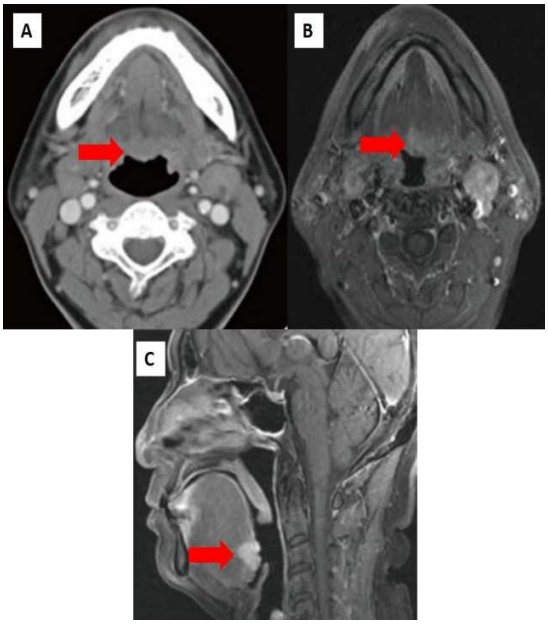

Figure 3: IMAGING FINDINGS: A well-defined soft tissue density lesion, homogeneously enhancing on post contrast MRI image (3B, 3D) is noted centred on base of tongue (not depicted on CECT (3A), but clearly depicted on corresponding MRI image)

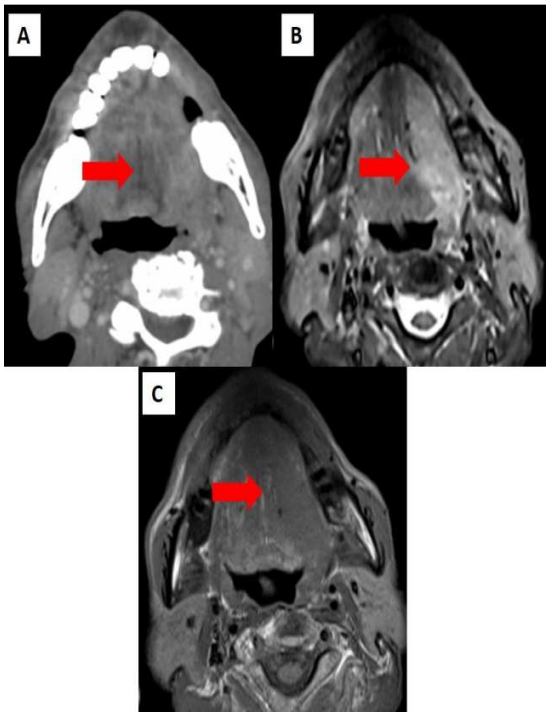

Figure 4: IMAGING FINDINGS: Well-defined soft tissue density lesion heterogeneously enhancing on CECT (4A), hyperintense on STIR (4B) and hypointense on T1WI (4C) involving left base of tongue with anterior extension. The anterior extension is not well depicted on CECT, as it is depicted on corresponding MRI images

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