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Research Article

Imaging in benign and malignant mass lesions of the tongue

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ABSTRACT

Background: The purpose of this study was to determine the value of CT or MR imaging in demonstrating benign, malignant, congenital and iatrogenic mass lesions of the tongue. Although the vast majority of tongue masses are squamous cell carcinomas, a variety of unusual lesions may affect the tongue. Thus the characteristics and extent of these unusual lesions may be recognized only on cross sectional CT or MR images. In this article we describe the imaging findings of the various lingual masses, provide radio-pathological correlation and discuss the role of CT and MRI in diagnostic work-up of these uncommon lesions in clinical practice.
Methods: Twenty nine patients with mass lesions in tongue were prospectively examined for a period of seven months from March to October 2014 with CT or MR imaging after physical examination. The imaging protocol includes contrast enhanced axial, coronal and sagittal images acquired with 64 slice GE VCT. MR imaging protocol includes three plane contrast-enhanced and non-contrast-enhanced T1-weighted turbo spin-echo sequences, T2-weighted turbo spin-echo sequences, T1-weighted fat saturated images (T1-FATSAT). Diffusion weighted imaging (DWI) and gradient imaging (GRE) acquired with GE 16 channel 1.5 Tesla MRI. The findings were further compared with surgical and histopathological results.
Results: Among the twenty nine patients who were examined with CT or MRI six patients were found normal. The rest of the twenty three patients who had positive findings on imaging include seventeen squamous cell carcinoma (SCC), one thyroglossal duct cyst, two venous malformations, one hemangioma, one case of lipoma and macroglossia.
Conclusions: Though MR is the sensitive imaging modality for tongue evaluation, CT is most commonly used in preoperative assessment and post-operative surveillance. CT and MRI provide good anatomic detail, precise delineation of the extent of mass lesions and their relation to surrounding structures. In addition, MR imaging is helpful when flow void is identified, it can further characterize the type of flow present. Angiography is valuable for delineating feeding and draining vessels and in defining the hemodynamic of vascular lesions.

Keywords: Tongue, Computed tomography, Magnetic resonance imaging

INTRODUCTION

Oral cavity imaging and interpretation especially that of the tongue is a complex process due to its anatomy and overlapping pathologies. In this article we discuss a brief outline of the anatomy of tongue, optimum imaging techniques, CT and MRI imaging of benign and malignant pathologies of the tongue are described.

METHODS

Twenty nine patients with mass lesions in tongue were prospectively examined for a period of seven months

from March to October 2014 with CT or MR imaging after physical examination. The imaging protocol includes contrast enhanced axial, coronal and sagittal images acquired with 64 slice GE VCT. MR imaging protocol includes three plane contrast-enhanced and non-contrast-enhanced T1-weighted turbo spin-echo sequences, T2-weighted turbo spin-echo sequences,T1-weighted fat saturated images (T1 -FATSAT) Diffusion weighted imaging (DWI) and gradient imaging (GRE) acquired with GE 16 channel 1.5 Tesla MRI. The findings were further compared with surgical and histopathological results.

Image acquisition is done in axial plane with puffed cheek to separate the buccal and gingival surfaces of the oral cavity. This technique requires the patient to breathe uniformly through pursed lips while breathing normally. It is useful in delineating the lateral extension and avoids overestimation of the mass lesions. Image reconstruction is done in both coronal and sagittal planes with both soft tissue and bone algorithms. Intravenous contrast increases the accuracy of diagnosing various pathologies and evaluating cervical lymph nodes.

RESULTS

Among the twenty nine patients who were examined with CT or MRI six patients were found normal. The rest of the twenty three patients who had positive findings on imaging include seventeen squamous cell carcinoma (SCC), one lipoma, one macroglossia, one thyroglossal duct cyst, two venous malformations and one hemangioma (Figure 1).

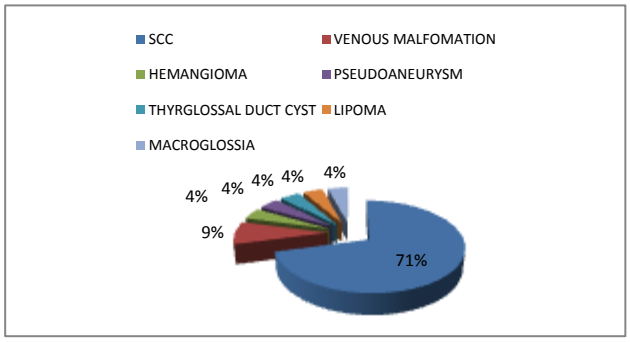

Figure 1: Pie chart demonstrating the various pathologies diagnosed on imaging.

Among the patients with positive findings, seventeen patients had malignant lesions and rest of the six patients had benign lesions (Figure 2).

In our study, we observed that acquired lesions were common in patients above 40 years of age, predominantly in males and the congenital lesions were seen in patients less than 40 years of age, predominantly in females (Figure 3).

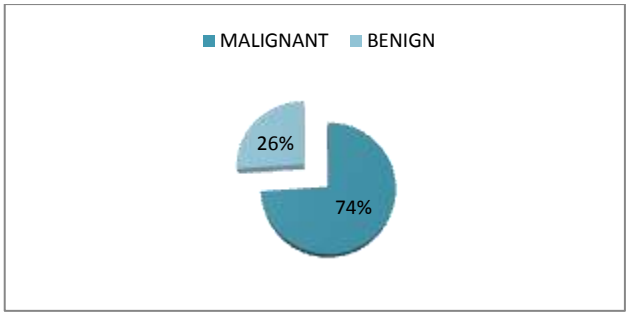

Figure 2: Pie chart representing percentage of benign and malignant lesions of the tongue.

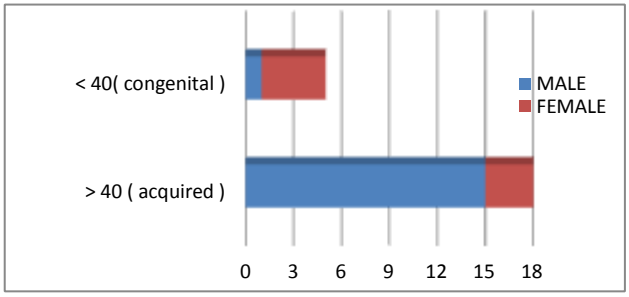

Figure 3: Demographic distribution of the various pathologies based on age and gender.

Among the diagnosed case of SCC ten patients were above 60 years of age, five patients above 40 years of age and two patients above 20 years of age. Twelve patients had association with etiological factors like tobacco chewing, smoking and alcohol. SCC had a more male predilection with an incidence of 72% among males and 28% among females. Interestingly in our study we found that the 76% of SCC were on the left side of the tongue and 24% on the right side, the reason for this is unknown. We also found that the lateral and anterior two third of the tongue is the most common site for SCC in the tongue. In two patients the lesions crossed the mid line and another two patients the lesion caused hyoid bone erosion. Four patients of SCC had retro molar trigone extension and one patient developed pseudoanuerysm following biopsy.

Histopathological examination confirmed seventeen squamous cell carcinoma and one thyroglossal duct cyst. The vascular lesions were diagnosed as hemangioma, venous malformations and pseudo aneurysm of lingual artery depending on clinical and imaging findings and managed with embolization under radiological guidance. The other cases of lipoma and macroglossia were diagnosed on clinical and imaging findings and no further management was done.

DISCUSSION

Normal tongue

Oral cavity consists of lips anteriorly, mylohyoid muscles, alveolar mandibular ridge and the teeth

inferiorly, gingivobuccal region laterally, circumvalate papillae, tonsillars pillars and soft palate posteriorly, hard palate, maxillary alveolar ridge and the teeth superiorly.[1] Tongue consists of midline lingual septum and hyoglossus membrane acting as a supporting skeleton. Intrinsic muscles of tongue are superior and inferior longitudinal, transverse, vertical and oblique muscles. Extrinsic muscles are genioglossus, hyoglossus, palatoglossus and styloglossus muscle allowing attachment of tongue to hyoid bone, mandible and styloid process of skull base.[2,3] All muscles of tongue are innervated by hypoglossal nerve traversing between mylohyoid and hyoglossus muscle except palatoglossus which is supplied by pharyngeal plexus. Sensory supply to anterior two third of tongue is by lingual nerve which courses adjacent to hypoglossal nerve. Posterior one third of tongue is supplied by glossopharyngeal nerve. Special sensory taste fibers course with the lingual nerve and coalesce to form the chordatympnai nerve, which joins the facial nerve after traversing the middle ear[4] (Figure 4a,4b and 4c).

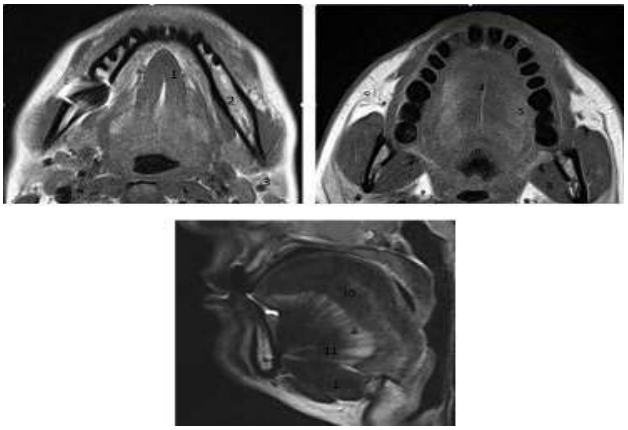

Figure 4: Normal anatomy tongue Axial and Sagittal T1W MR images: The following keys are used in images 1- mylohyoid ; 2-mandible; 3- retromolar trigone ; 4 - lingual septum; 5 -intrinsic muscles; 6 - uvula ; 7- mylohyoid ; 8- medial pterygoid ; 9- buccal pad of fat ; 10- genioglossus ; 11 – geniohyoid.

Squamous cell carcinoma

Squamous cell carcinoma (SCC) of oral cavity is commonly seen in gingivo buccal region, tongue and retro molar trigone. The tongue is the second most common site for SCC of oral cavity. The prevalence of SCC is rising in India and the western countries due to excessive tobacco and alcohol abuse. The age adjusted incidence in India is 20/100000 population[5] with a male preponderance. A lesser percentage of tongue SCCs are associated with HPV infection.[5] The most common location for SCC in tongue is the lateral border of tongue followed by the ventral surface.[6] Clinically SCC usually presents as ulcers which can be biopsied and diagnosed with ease. The main concern of imaging is to stage the lesion.

Staging for the SCC of the oral cavity is T0, no evidence of a primary tumour; T1, greatest diameter of the primary tumour is less than 2 cm; T2, greater than 2 cm but less than 4 cm in diameter; T3 primary tumour greater than 4 cm; T4 a massive tumour more than 4 cm in diameter with deep invasion involving the antrum, pterygoid muscles, base of tongue or skin of the neck. The American Joint Committee on Cancer and the International Union against Cancer (UICC) use the staging system as mentioned above. In early stages, assessing tumor thickness is important as thickness greater than 4 mm has been associated with cervical nodal metastasis.[7]

The lateromedial thickness taken in axial MR plane is used as the precise measurement for assessing the tumors from the lateral border of the tongue.[8-11] Another study by Okura et al established that a tumour with thickness > 9.7 mm as a significant predictor for nodal metastasis.[8]

The other predictors for staging the tumor is to assess the involvement of muscles with or without crossing the midline, extension into floor of mouth, valleculae, pre epiglottic space and the hyoid bone.[9-11] The involvement of valleculae, pre epiglottic space and hyoid bone indicates relative contra indication for surgical resection.

The level I and level II neck nodes are commonly involved in SCC. Skip metastasis to level III, IV, contra lateral level I and II lymph nodes is also seen. Metastatic lymph nodes appear enlarged, round and show necrosis. Circumferential contact of lymphnode with the carotid artery for greater than 270 degree precludes the resectability of node.[16]

Contrast enhanced CT depicts moderately enhancing heterogenous mass lesion[17] (Figure 5a, 5b). Heterogeneity of tumour increases with the size which also indicates the degree of necrosis. Erosions of the bone indicates cortical bone invasion. Medullary bone involvement can be visualized as a hyper dense area replacing the normal fat in CT.[18]

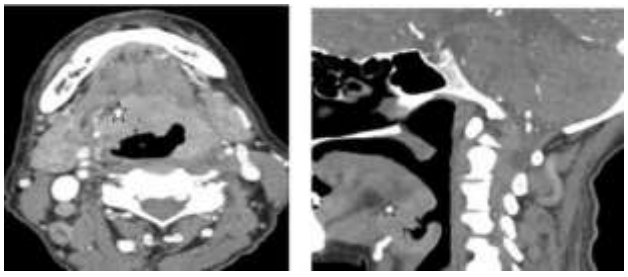

Figure 5: Squamous cell carcinoma of posterior one third of tongue: Contrast enhanced axial and reformatted saggital images of the neck at the level of the tongue shows an infiltrative mass lesion involving the posterior one third of the tongue.

Non contrast T1 weighted images provide good details on cortical erosion and bone marrow invasion. Contrast enhanced T1 weighted imaging aides in assessment of marrow invasion, perineural spread, soft tissue extent, tumour thickness and necrotic lymphnodes.[19] T2 weighted imaging delineates the involvement of extrinsic muscle and floor of mouth.[7] STIR and DWI sequences are of great importance in visualizing lymphnodes whereas the latter is an added advantage in assessing subcentimetric lymph node.

Interestingly, one of our cases showed a pseudo aneurysm of the lingual artery following biopsy of the tongue (Figure 6a and 6b).

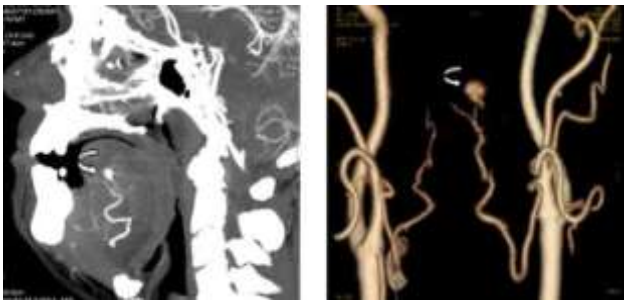

Figure 6: Pseudoaneurysm of lingual artery post biopsy: Contrast enhanced saggital reformatted maximum intensity projection and volume rendered images of the tongue shows a pseudo aneurysm of the lingual artery (curved arrow) following biopsy of the tongue.

Lipomas

Lipoma is the most common benign mesenchymal soft tissue tumor.[20] It can very rarely occur in the oral cavity with an incidence 1-4%.[21-23] Most patients are above 40 years of age with no sex predilection.[24] In tongue, it usually presents as a long-standing soft nodular asymptomatic swelling covered by normal mucosa. Oral intramuscular/infiltrating lipoma arises from the deeper tissues of the tongue[25] and is characterized by their invasion into the muscular tissue. Primary differential diagnosis for intramuscular lipoma is liposarcoma; thereby warranting the need for characterization and delineation of the lesion. MRI shows T1 hyper intense, T2 hyper intense signals with loss of signal in all fat suppressed sequences, apart from delineation of the anatomical details (Figure 7a, 7b and 7c). CT shows a well-defined lesion with hypoattenuation of fat. Ultrasound shows a well-defined mass which is hyper echoic than muscle and shows linear echogenic striations paralleling the skin surface.[18]

Macroglossia

It is a condition characterized by diffuse enlargement of tongue[26] which causes the resting tongue to protrude beyond the alveolar ridge of the teeth. There are numerous causes associated with macroglossia. In children it is seen with down syndrome, hypothyroidism, MPS, Beckwith-Wiedemann syndrome and congenital duplication.[27,28] The main role of MRI is to rule out any pathology within the tongue. MR imaging of macroglossia shows enlarged tongue with signal intensities corresponding to normal tongue muscles (Figure 8a and 8b).

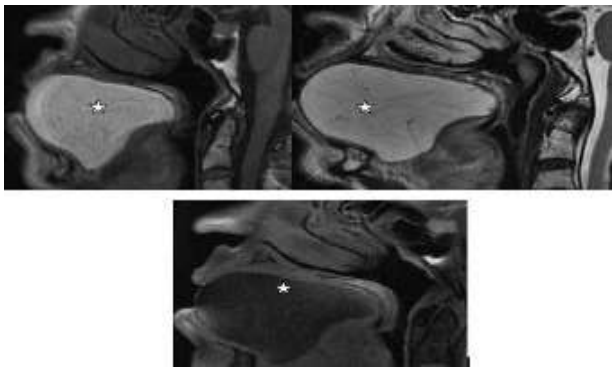

Figure 7: Tongue lipoma: Saggital sections of magnetic resonance imaging of tongue in T1, T2 and T1 Fat suppression(FATSAT) images shows a large well defined fat containing lesion(asterix) replacing the whole tongue suggestive of lipoma of the tongue.

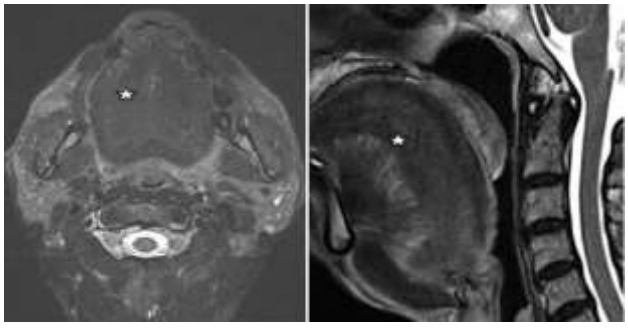

Figure 8: Macroglossia: axial and saggital T2 images of the tongue shows an enlarged tongue (asterix)seen occupying the oral cavity with normal sized mandible representing macroglossia.

Thyroglossal duct cyst

Thyroglossal duct cyst is a common cyst of the neck and arises from the remnant of thyroglossal duct which extends from the foramen caecum to the hyoid bone. The mean age of presentation of thyroglossal duct cyst is 21 years[29] with base of tongue being the most common location. CT imaging depicts a well-defined non enhancing low attenuating midline mass (Figure 9a and 9b), which shows high T2 signal and low T1 signal intensity on MRI. No restriction is seen on DWI.[30] The wall of the thyroglossal duct cyst can be thick and shows rim enhancement on post contrast CT/MR images when the cyst is infected.[31,32]

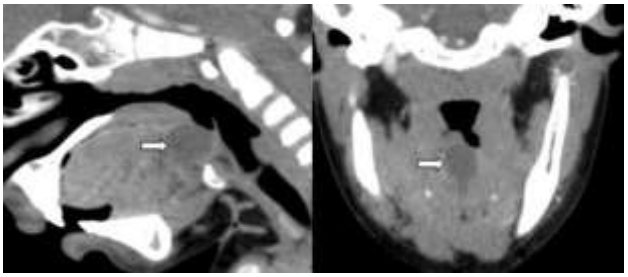

Figure 9: Foramen caecum thryoglossal duct cyst: Saggital and coronal reformatted CT images of the oropharynx shows a well defined non enhancing cystic lesion which is in midline involving the supra hyoid region of the neck representing thyroglossal cyst (right arrow).

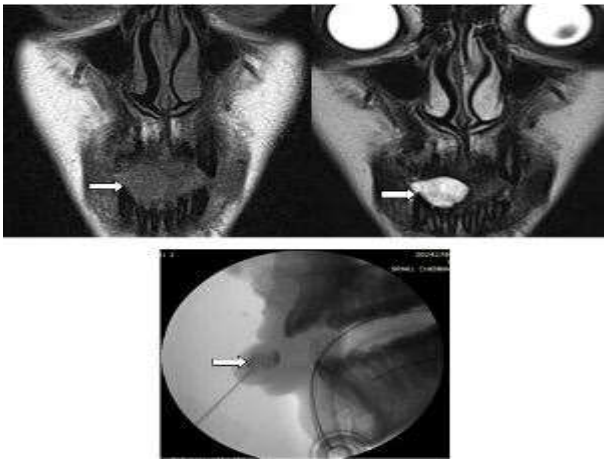

Figure 10: Hemangioma of tongue: Coronal T1 and T2 MR images of the tongue shows a well defined T1 hypointense and T2 heterogenously hyperintense lesion in tip of the tongue representing hemangioma (right arrow) which is treated by direct puncture embolization.

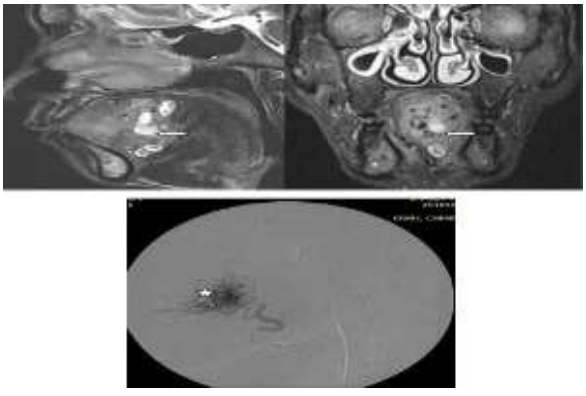

Figure 11: Venous malformation of tip of the tongue: Sagittal and coronal T2 MR images of the tongue shows a well defined heterogenous lesion with cystic spaces and flow voids representing venous malformation in the dorsal tongue (left arrow) which is confirmed by digital subtraction angiography (asterix).

Vascular malformations

Vascular malformations are divided into hemangioma and vascular malformations based on the growth and histological differences. Vascular malformations are sub categorized into high flow lesions such as arteriovenous malformations and low flow lesions like lymphatic and venous malformation. Of these, lymphatic and venous malformations relatively contribute more to soft tissue masses which present at birth.[26] Venous malformation shows T2 hyper intense venous lakes with flow voids within representing phleboliths[33,34] (Figure 10a, 10b and 10c). lymphatic malformations are of two types namely micro or macro cystic malformations. Macro-cystic type may be uni /multi locular T2 hyper intense cystic mass with fluid level within. But micro-cystic type appears as area of high signal intensity on T2-weighted imaging. High flow malformations are usually confirmed by angiography, which shows an abnormal arterial supply to the tongue with abnormal prominent vascular blush. Hemangioma demonstrates intense T1-weighted signals, heterogeneous high signal on T2-weighted imaging and shows prominent enhancement with absence of signal voids (Figure 11a, 11b and 11c). High T1 signals representing fatty replacement are seen in involuting hemangioma.[33,34]

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