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ORIGINAL RESEARCH

Role of contrast enhanced computed tomography in the characterization of various laryngeal masses

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ABSTRACT

Aims and objectives:

1. To study the role of computed tomography in evaluation of various laryngeal masses.
2. To study the staging of the laryngeal carcinoma.

Materials and Methods: 50 patients with laryngeal lesions on laryngoscopy referred to the Department of Radiodiagnosis and Imaging for CECT Neck were included in the study. **Results:** Overall sensitivity of CECT for diagnosis of benign lesions were 78% and malignant lesions were found to be 100% showing its high predictive values in diagnosing malignant lesions with significant p value<0.001. CECT Neck is valuable in staging of the laryngeal tumors where either patients may present too early which result in no staging or too late to present during the T3,T2 stages. **Conclusions:** Cross-sectional imaging with contrast-enhanced computed tomography (CT) allows excellent depiction of the intricate anatomy of the larynx and the characteristic patterns of submucosal tumor extension. CT helps in localization, characterization of mass, its nature, size, enhancement pattern and relation with surrounding structures along with assessment of lymphadenopathy which aids in diagnosis, management and surgical approach and post operative follow up.

INTRODUCTION

Contrast Enhanced Computed tomography (CT) is the most commonly used imaging technique for evaluating laryngeal masses because it is widely available, provides a high level of information, has a fast scanning time, and benefits from recent technological improvements like multidetector CT (MDCT).Computed tomography (CT) is essential for differentiating between a T3 and T4 lesion, as larynx sparing chemoradiation is not recommended for T4 lesions.[1]

Laryngeal Pathologies refer to abnormalities or disorders that affect the larynx, which is commonly known as the voice box.

Laryngeal illnesses can be classified into four primary categories: traumatic, inflammatory, congenital, and neoplastic lesions. These are additionally divided into supraglottic, glottic, and subglottic categories.

Benign Tumors

The described conditions include voice cord nodules, papillomatosis, and non-epithelial or non-mesenchymal tumors.

Malignant tumors

Squamous cell carcinoma accounts for about 1% of all diagnosed cancers and is the most common kind of laryngeal malignancy. Squamous cell carcinoma is classified into four categories based on its origin: supraglottic, glottic, subglottic, and transglottic (involving two or more gaps).

Computed tomography (CT) is an invaluable technique for precisely identifying the precise position, characteristics, dimensions, enhancing pattern, and interaction of a mass with its surrounding

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structures , therefore helps in staging of laryngeal tumors (T and N staging). This information is vital for the diagnosis, management, and planning of surgical techniques, as well as for targeting biopsies and monitoring post-operative development.

MATERIAL AND METHODS

Cross sectional, Observation study was done in 50 patients for evaluation of laryngeal lesions for a period of 2 years and contrast enhanced computed tomography was done.

IMAGING TECHNIQUE

Multi Detector Computed Tomography imaging was performed on PHILIPS MACHINE 64 slice MDCT machine. Imaging technique was plain CT followed by the oral and IV contrast. The contrast used will be Omnipaque. Omnipaque is iohexol which is a non-ionic, water soluble radiographic contrast medium. Images were acquired before the contrast and following contrast administration. Multi planar reformation and 3D reconstruction was done where ever necessary. In the study, data obtained was subjected to quantitative statistical analysis in terms of sensitivity, specificity, true predictive value, false predictive value and p value. Valid conclusions regarding the characterization of various benign and malignant laryngeal masses were drawn.

RESULTS

Diagnosis of lesions based on CECT findings

Diagnosis	Frequency	Percentage
Vocal cord cyst-Benign	1	2%
Polyp	7	14%
Vocal nodule–Benign	3	6%
Glottic Ca-Malignancy	13	26%
Supraglottic Ca-Malignancy	21	42%
Infraglottic Ca-Malignancy	2	4%
Post Radiotherapy changes	3	6%
Total	**50**	**100%**

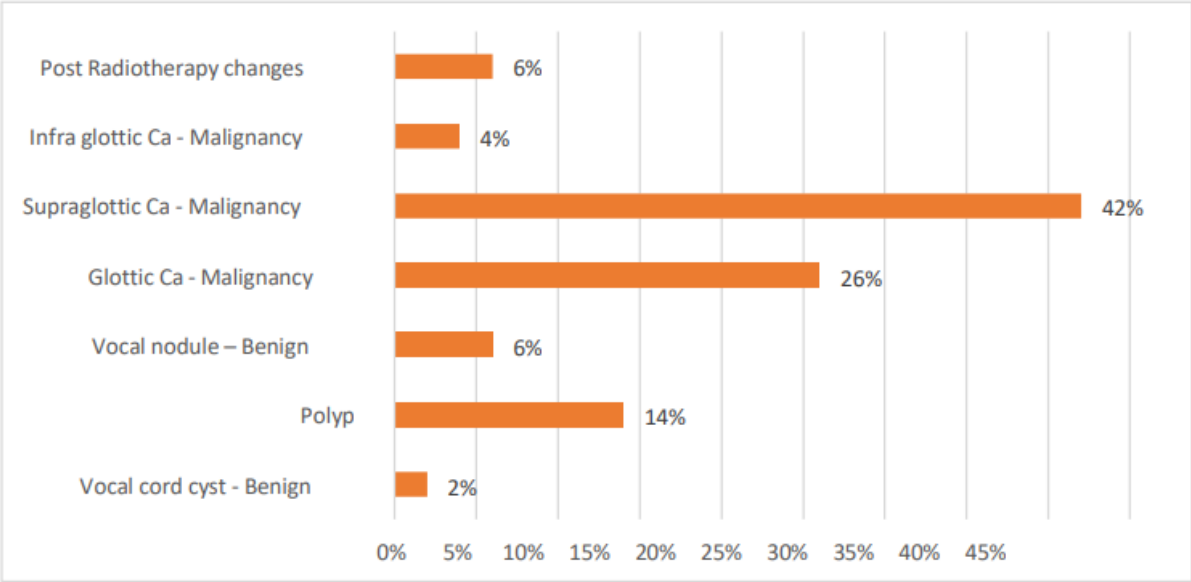

FIGURE1: DIAGNOSIS OF LESIONS BASED ON CECT FINDINGS

Table 1/Figure 1 shows the diagnosis of lesions based on CECT findings with majority 42% having supra glottic carcinoma followed by 26% having glottic carcinoma,14% polyp 6% radiotherapy changes and vocal nodule,4% with infra glottic carcinoma and 2% with benign vocal cord cyst.

DIAGNOSIS BASED ON HISTOPATHOLOGICAL FINDINGS

Histopathological findings	Frequency	Percentage
Cyst	1	2%
Schwannoma-Benign	1	2%
Polyp	5	4%
Nodule	**3**	6%
Laryngeal Papilloma-Benign	3	6%

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Well diff SCC-Malignancy	17	34%
Mod diff SCC-Malignancy	13	26%
Poorly diff SCC-Malignancy	5	10%
Post radiotherapy changes	2	4%
Total	**50**	**100%**

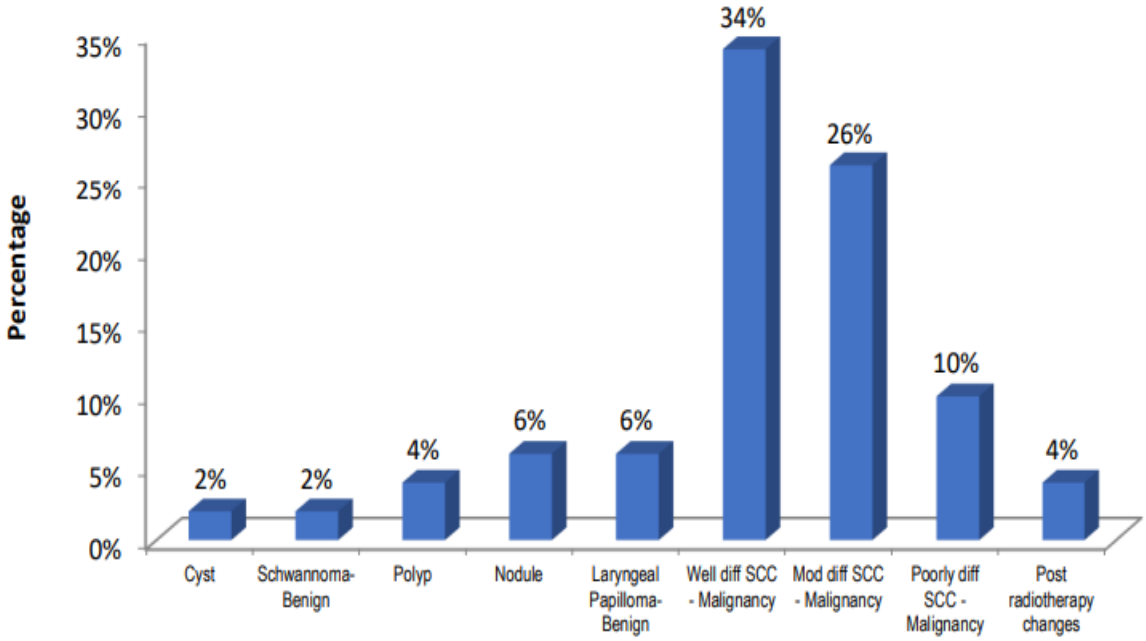

FIGURE 2: DIAGNOSIS BASED ON HISTOPATHOLOGICAL FINDINGS

Table 2/Figure 2 shows the diagnosis based on histopathological findings with majority34% having Well diff SCC-Malignancy followed by 26% with Mod diff SCC - Malignancy, 10% with Poorly diff SCC Malignancy,6% with nodule and laryngeal papilloma,4% polyp and Post radiotherapy changes,2% with cyst and schwannoma.

TABLE 3: CORRELATION IN DETERMINING POLYP BASED ON CECT FINDINGS AND FOLLOW-HISTOPATHOLOGICAL FINDINGS

Polyp	**Histopathological Findings**		**Total**
CECT	**Present**	**Absent**	
Present	5	2	7
Absent	0	43	43
Total	**5**	**45**	**50**

Diagnosis	**Sensitivity**	**Specificity**	**PPV**	**NPV**	**p-value**
Polyp	100%	95%	71%	100%	0.000*

Table 3 shows the Correlation in determining Polyp based on CECT findings and follow histopathological findings which shows 100% of sensitivity and NPV,95% of specificity and 71% of PPV with highly significant p value.

TABLE 4: CORRELATION IN DETERMINING NODULE BASED ON CECT FINDINGS AND FOLLOW-HISTOPATHOLOGICAL FINDINGS

Nodule	**HistopathologicalFindings**		**Total**
CECT	**Present**	**Absent**	
Present	3	0	3
Absent	0	47	47
Total	**3**	**47**	**50**

Diagnosis	**Sensitivity**	**Specificity**	**PPV**	**NPV**	**p-value**
Nodule	100%	100%	100%	100%	<0.001*

Table 4 shows the Correlation in determining Nodule based on CECT findings and follow histopathological findings which shows 100% of sensitivity, NPV, specificity and PPV with highly significant p value.

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TABLE 5: CORRELATION IN DETERMINING CYST BASED ON CECT FINDINGS AND FOLLOW-HISTOPATHOLOGICAL FINDINGS

Cyst	Histopathological Findings		
CECT	**Present**	**Absent**	**Total**
Present	1	0	1
Absent	0	49	49
Total	**1**	**49**	**50**

Diagnosis	Sensitivity	Specificity	PPV	NPV	p-value
Cyst	100%	100%	100%	100%	<0.001*

Table 5 shows the Correlation in determining Cyst based on CECT findings and followhistopathological findings which shows 100% of sensitivity, NPV, specificity and PPV with highly significant p value.

TABLE 6: CORRELATION IN DETERMINING MALIGNANT LESIONS BASED ON CECT FINDINGSAND FOLLOW UP HISTOPATHOLOGICAL FINDINGS

Malignant lesions	Histopathological Findings		
CECT	**Present**	**Absent**	**Total**
Present	3	0	3
Absent	0	47	47
Total	**3**	**47**	**50**

Diagnosis	Sensitivity	Specificity	PPV	NPV	p-value
Malignant lesions	100%	93%	97%	100%	<0.001*

Table 6 shows the Correlation in determining Malignant lesions based on CECT findings and follow up Histopathological findings which shows 100% of sensitivity and specificity, NPV, 95% of PPV with highly significant p value.

TABLE 7: CORRELATION IN DETERMINING POST RADIOTHERAPY CHANGES BASED ON CECT FINDINGS AND FOLLOW-UP HISTOPATHOLOGICAL FINDINGS

Post Radiotherapy changes	Histopathological Findings		
CECT	**Present**	**Absent**	**Total**
Present	2	1	3
Absent	0	47	47
Total	**2**	**48**	**50**

Diagnosis	Sensitivity	Specificity	PPV	NPV	p-value
Post Radiotherapy changes	100%	98%	66%	100%	<0.001*

Table 7 shows the Correlation in determining Post Radiotherapy changes based on CECT findings and follow up Histopathological findings which shows 100% of sensitivity and NPV, 66%% of PPV,98% of specificity with highly significant p value.

TABLE 8: STAGING OF LARYNGEAL MASSES

Stage	Frequency	Percentage
T1N0M0- STAGE1	4	8%
T2N0M0-STAGE2	5	10%
T2N1M0- STAGE3	5	10%
T3N0M0-SATGE3	5	10%
T3N1M0- STAGE3	7	14%
T3N2M0-STAGE4	3	6%
T3N3M0-SATGE4	2	4%
T4N1M0-STAGE4	1	2%
T4N2MO-STAGE4	2	4%
T4N3MO-STAGE4	1	2%
NA	15	30%
Total	50	100%

Table 8 shows different staging of laryngeal masses of study participants with majority30% without any staging as they were radiologically diagnosed as benign changes. Among the rest 70%, 34% cases have T3 tumors, 20% have T2 tumors, 8% have T4 tumors and T1 tumors each. Overall, 34% of STAGE 3,18% of STAGE 4,10% of

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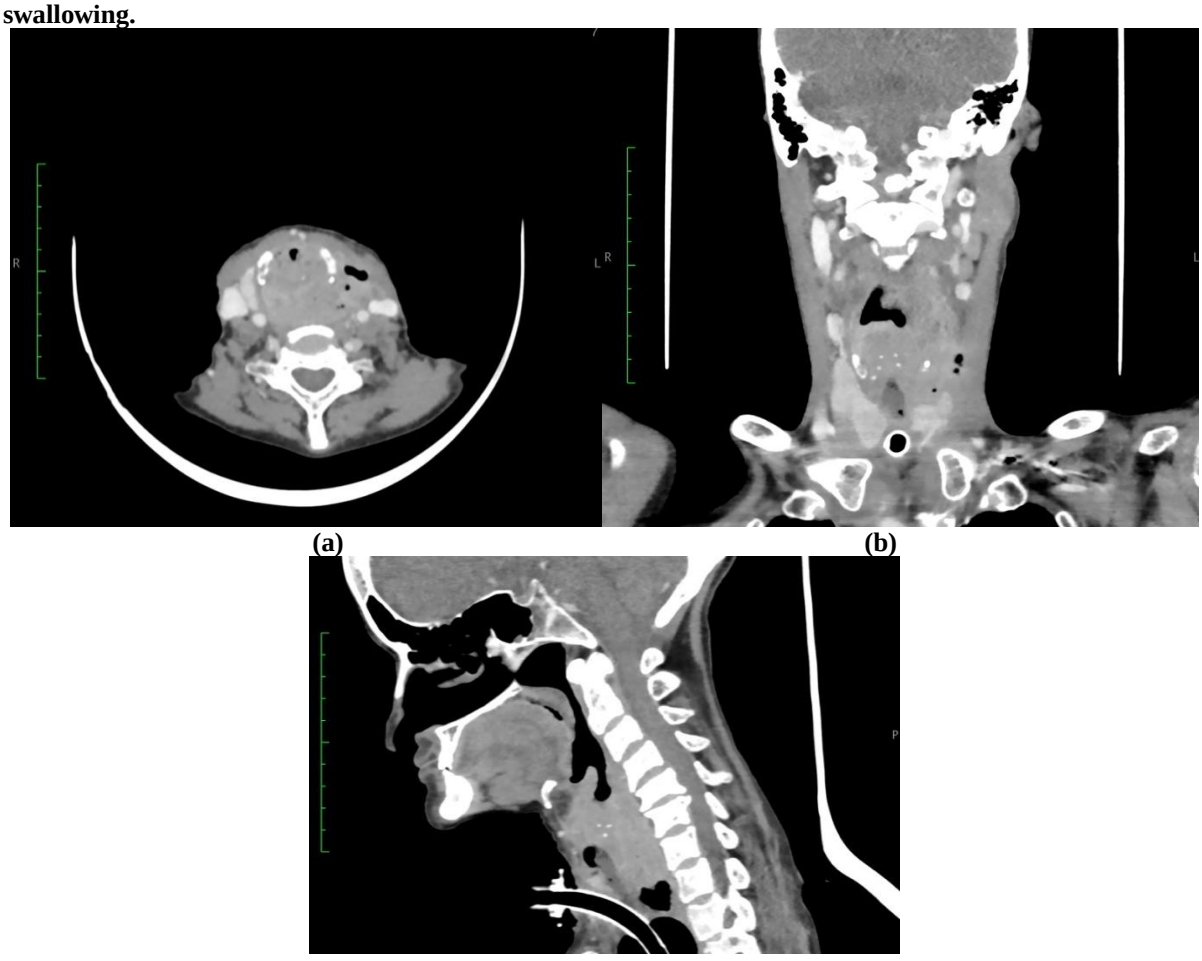
STAGE 2, 8% of STAGE 1 were diagnosed.

CASE 1
FIGURE SOWING CA GLOTTIS WITH SUPRA AND SUB GLOTTIC EXTENSION – STAGE IV b
62y/M presenting with difficulty in breathing, voice change, swelling in the neck and difficulty in swallowing.



(a) **(b)**

(c)

Fig.A: Axial CECT neck showing Large heterogeneously enhancing soft tissue density mass involving glottis with supra and subglottic extensions causing near complete occlusion of trachea. Image shows involvement of pre-para glottic and prevertebral fat planes
Fig.B: Coronal reformatted image showing mass extending left laterally to involve left thyroid lamina and left lobe of thyroid with few air foci seen extending into lateral neck space.
Fig.C: Sagittal reformatted image near complete occlusion of laryngeal airway with tracheostomy tube in- situ and pent up secretions noted proximally. The mass is seen involving esophagus and prevertebral space.

DISCUSSION

Diagnosis based on histopathological findings in the study showed with majority 34% having Well diff SCC - Malignancy followed by 26% with Mod diff SCC - Malignancy,10% with Poorly diff SCC - Malignancy,6% with nodule and laryngeal papilloma,4% polyp and Post radiotherapy changes,2% with cyst and schwannoma. Similar findings was seen in study done by Dinesh Kumar Sharma et al in which 50% were well differentiated SCC, 26.6% were moderately differentiated SCC and 10% were poorly differentiated.[5]

The study showed the Correlation in determining Polyp based on CECT findings and follow-histopathological findings which shows 100% of sensitivity and NPV,95% of specificity and 71% of PPV with highly significant p value(<0.000). Similar study was done by Braut et.al which showed a statistically significant difference of IMP3 IHC staining between the pathohistological groups for polyps of vocal cord (P = 0.003) was recorded.[6]

Correlation in determining Cyst based on CECT findings and followhistopathological findings in the study showed 100% of sensitivity, NPV, specificity and PPV with highly significant p value(<0.001).

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KVS Kumar Chowdary study showed similar findings in his study.[7]

The study showed the Correlation in determining Malignant lesions based on CECT findings and follow up Histopathological findings which shows 100% of sensitivity and specificity, NPV,95% of PPV with highly significant p value(<0.001).The study done by Anis et al showed similar correlation with significant P = 0.0018 value.[8]

Different staging of laryngeal masses of study participants in this study showed with majority 30% without any staging and among the rest 70%, 34% cases have T3 tumors, 20% have T2 tumors, 8% have T4 tumors and T1 tumors each. whereas, Jaipuria B et al showed in his study that 17% had T3 tumors, while 83% had T4a lesions.[9]

SUMMARY AND CONCLUSION

50 study participants were studied for their role of contrast enhanced computed tomography in the characterization of various laryngeal masses and to study the staging of the laryngeal carcinoma. Cross-sectional imaging techniques like as CT provide a straightforward and precise assessment of the subglottic and deep extension.

The Correlation in determining Polyp, Nodule, Cyst, Malignant lesions, Post Radiotherapy changes based on CECT findings and follow-histopathological findings all resulted in highly significant association with p value of <0.001.

Different staging of laryngeal masses of study participants showed majority 30% without any staging and among the rest 70%, 34% cases have T3 tumors, 20% have T2 tumors, 8% have T4 tumors and T1 tumors each. Hence while considering stages of laryngeal masses either patients may present too early which result in no staging or too late to present during the T3,T2 stages. Cross-sectional imaging with contrast-enhanced computed tomography (CT) allows excellent depiction of the intricate anatomy of the larynx and the characteristic patterns of submucosal tumor extension. CT helps in localization, characterization of mass, its nature, size,enhancement pattern and relation with surrounding structures along with assessment of lymphadenopathy which aids in diagnosis, management and surgical approach and post operative follow up.

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