ORIGINAL RESEARCH

Contrast Enhanced Computed Tomographic Evaluation of Carcinoma Larynx

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ABSTRACT

Objectives: To determine accuracy of CECT scan in staging carcinoma of larynx in comparison to clinical and operative findings. We also compared clinical and radiological staging and highlight its usefulness in treatment options in these patients. **Materials and methods:** A total of 34 cases of laryngeal cancer were included in this study which was performed over period of 18 months from January 2017- June 2018. CECT findings were analysed with regard to location of tumour, extent of tumour, spread of tumour to adjacent structures, spread to cartilage, lymph nodal disease, and distant bony/ lung metastasis and findings were correlated with either clinical follow up or surgical findings (whichever applicable). **Results:** Majority of the participants were males and had a positive history of consumption of tobacco and/or alcohol. Lymphadenopathy was the commonest clinical presentation. Supraglottic tumours were the commonest followed by glottic and subglottic tumours. Tumours staged clinically showed a lesser severity as compared with radiological staging. Majority of cancers were staged as T3 and above radiologically with nodal staging of majority of patients as N2b and above. When M stage was considered, all the tumours were staged as Mx clinically and radiologically. **Conclusion:** CECT study should be recommended as the imaging modality of choice in evaluation of laryngeal cancers.

KEYWORDS: Contrast Enhanced Computed Tomographic, Carcinoma, Larynx

INTRODUCTION

Laryngeal cancers comprise nearly one fourth of all head and neck cancers (HNC).[1] In India, the incidence of laryngeal cancer is approximately 1.26 to 8.18 / 100,000 population and constitutes about 3 to 6% of all cancers in men. The five-year survival is dismal and is <30%.[2] These cancers usually present in adults (aged between 50 to 70 years) with a strong male preponde-rance. Squamous cell carcinomas (SCC) compromise >90% of laryngeal cancers.

Important risk factors for laryngeal cancer are alcohol consumption and tobacco smoking.[1,3] Majority of SCCs are easily seen on endoscopy. The Clinical and endoscopic evaluation may fail to evaluate the exact extension of laryngeal carcinomas, such as extension to the subglottic region and anterior commissure, usually hidden by bulky tumors.[4] Deep tumor extension such as infiltration into pre-epiglottic and paraglottic spaces and extralaryngeal structures also cannot be evaluated by endoscopy.[1]

Cross-sectional imaging can evaluate submucosal spread and in addition can also look for locoregional extent malignancy, thus improving the T-stage accuracy and affect treatment decision. Imaging can evaluate nodal disease. Furthermore, imaging can show distant metastases, presence of other synchronous tumors or recurrent disease.[5] Contrast-enhanced computed tomography (CECT) can depict laryngeal anatomy and evaluate submucosal tumor invasion1. CECT also plays a significant role in the post-treatment evaluation for tumor recurrence. Currently, CECT is considered an integral tool in the evaluation of laryngeal 2 malignancies. CECT plays an important role in differentiating a T3 from T4 lesion as organ preservation (chemoradiation) is not recommended for T4 lesion6. CECT can be considered as a standard imaging modality for evaluation of carcinoma of the larynx because of its easy availability, inherent high spatial resolution, and faster acquisition time. CECT can directly evaluate the penetration of tumor into the laryngeal soft tissues and cartilages.

As there is a paucity of literature from rural India, this study is being taken up to evaluate the structural and functional information obtained from CECT of the larynx.

This study was performed to evaluate the accuracy of CECT neck in the diagnosis of laryngeal tumor and to compare clinical and radiological staging and highlight its usefulness in treatment options in these patients.

Objectives: The objectives of the study are:
1. To determine the accuracy of CECT scan in staging carcinoma of the larynx in comparison to clinical and

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operative findings.
2. To compare clinical and radiological staging and highlight its usefulness in treatment options in these patients.

MATERIALS AND METHODS

Source of data: This was an observational study that was conducted on 34 patients with laryngeal cancer who were referred to Department of Radio-Diagnosis at R.L. Jalappa Hospital and Research Center attached to Sri Devaraj Urs Medical College, Kolar; for a CECT neck. This study was conducted over a period of 18 months from Jan 2017 to June 2018. All the patients who underwent CECT neck for laryngeal cancer were screened for the study.

Inclusion Criteria: All patients referred to our department for CECT scan of the neck for laryngeal carcinoma diagnosed by endoscopy and biopsy.

Exclusion Criteria: Patients who had previous radiation therapy or surgery for laryngeal carcinoma.

Method of collection of data: The study was approved by the institutional review Board of the institution. Informed consent was taken from all the patients for their willingness to participate in the study. A detailed clinical history was recorded, which included a history of hoarseness of voice, alcohol, tobacco chewing before imaging. CECT neck was performed and the disease was staged as per TNM staging8. The findings were compared with clinical, endoscopic/ operative findings (Figure 1).

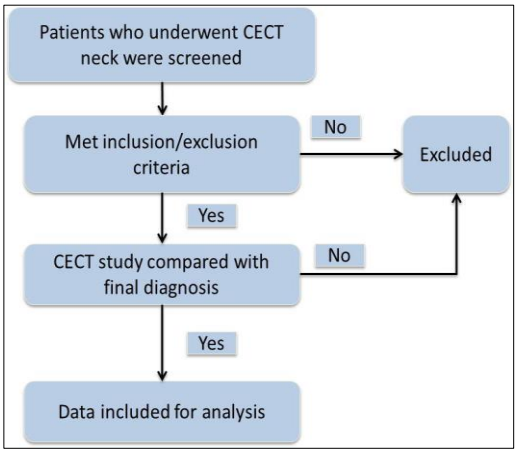

Figure 1. Study schematic.

CT Protocol: Scanning technique: Spiral CECT of the neck was performed on Siemens ® Somatom Emotion 16 slice CT scanner (Figure 2). As per our protocol, axial sections taken from the level of the base of the skull to T4 vertebral body in supine position with quiet breathing / Valsalva maneuver . No specific patient preparation was needed. The slice thickness used was 3.0 mm, which was reformatted to 0.75 mm and multiplanar reconstructions were done in sagittal and coronal planes.
CT parameters used:

- Tube voltage: 130 kVp

Figure 2. SIEMENS® SOMATOM EMOTION 16® CT scanner used in the study

- Tube current: Calculated by the CT scan with CARE Dose 4D® automated exposure control (AEC)
- Contrast study performed using non-ionic contrast (Iopromide), given at a dose of 1.25 to 1.5mg/kg body weight with a rate of 3.5 to 4 mL/s using a pressure injector.

Image Assessment: The images were transferred to work station (Myrian ® or Osirix ®), and studies were reported by two radiologists with 10 years and 5 years of experience respectively in reporting CECT neck studies. Soft tissue window was used to assess tumour location, spread and to evaluate lymph nodal status. Bone window reconstruction was used to evaluate bony and cartilage involvement (thyroid, cricoid and arytenoid cartilage). The images were assessed independently by the two radiologists, who were blinded to each other's findings. In case of any ambiguity, the images were discussed by the radiologists together and a consensus arrived for final diagnosis. The data was analyzed for the location of tumor , the extent of tumor , the spread of tumor to adjacent structures, spread to cartilage, lymph nodal involvement, and distant bony/ lung metastasis (if any).

Statistical Analysis: Descriptive and inferential statistical analysis was done in the present study. Categorical data was represented in the form of frequencies. Chi-square was used as a test of significance. P value <0.05 was considered as statistically significant. Data was entered into Microsoft excel data sheet and was analyzed using SPSS® version 22 software.

RESULTS

In our study, we screened a total of 93 patients who underwent CECT neck study for evaluation of head and neck cancers. Of these, 47 patients were excluded as these patients had cancer of oral cavity (n = 41), hypopharynx (n = 4), carcinoma lip and carcinoma nasopharynx (n = 1 each). Of the remaining 46 patients, 11 patients who underwent CECT neck for larynx were lost to follow/up or did not present for treatment. One patient did not give consent for the study, leaving with 34

patients who were included in the final analysis (Figure 3). Figure 3. Flow chart showing the screening of individuals for the study.

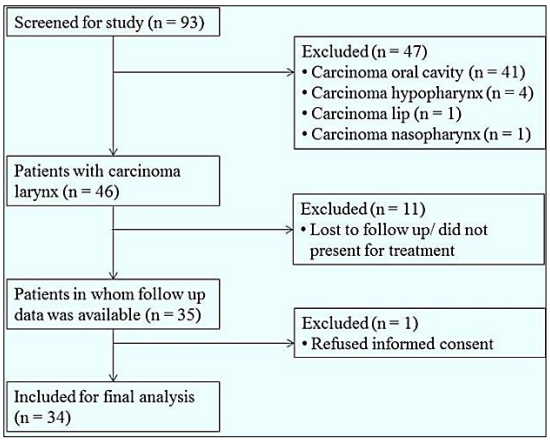

Figure 3. Flow chart showing screening of individuals for the study

In our study, there were a total of 34 patients with 20 males (58.8%), showing a slight male preponderance. The mean age of patients was 57.44 ± 10.38 years (mean ± SD). The median age of patients was 56 years (range 41 to 85 years). The mean age of males was 60.3 ± 10.5 years (mean ± SD) and the mean age of females was 53.35 ± 8.7 years (mean ± SD). The difference in mean age among men and women was statistically significant (P<.05). The most common age group of patients involved was 61 to 70 years (n = 12; 35.3%) followed by 41 to 50 years and 51 to 60 years (n = 10 each; 29.4%) (Table 1).

Age group (years)	Number		Percentage	
	Male	Female	Male	Female
41-50	3	7	8.8	20.6
51-60	7	3	20.6	8.8
61-70	8	4	23.5	11.8
71-80	1	0	2.9	0.0
>80	1	0	2.9	0.0
Total	20	14	58.8	41.2

Table 1. Age Group and Gender Distribution of Patients

In our study, lymphadenopathy was the most common clinical presentation with patients complaints of neck swelling and was seen in 27 patients (n = 79.4%) followed by dysphagia (n = 22; 64.7%) and lastly change in voice / hoarseness of voice (n = 15; 44.1%) (Figure 4).

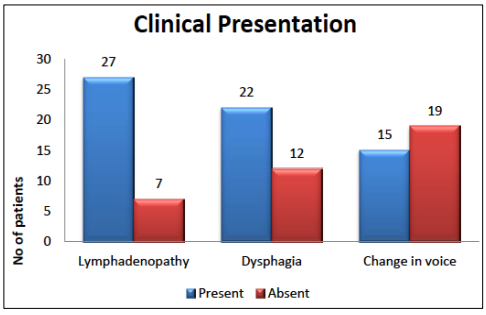

Figure 4. Clinical presentation in patients with laryngeal cancer

History of tobacco consumption (smoking cigarette, beedi, use of gutka, zarda, khaini) was the most common habits and was seen in 17 patients (50%) followed by history of alcohol with tobacco consumption in nine patients (26.5%) and alcohol consumption was seen in only two patients (5.9%). There were six patients who did not have any addictions known to increase risk of carcinoma larynx (17.6%) (Table 2).

Habits	Number	Percentage
Alcohol (n = 2)	2	5.9
Tobacco (n = 17)	17	50.0
Alcohol + Tobacco (n = 9)	9	26.5
No habits (n = 6)	6	17.6
Total	34	100

Table 2. Patient Habits.

In our study, supraglottic cancers were the most common cancer both clinically and radiologically (n = 25 and n = 23 respectively). Clinically there were eight cases of glottic cancers (23.5%) and one case of subglottic cancers (2.9%). Radiologically, ten cancers were diagnosed as glottic cancers (29.4%) and one case as subglottic cancer (2.9%) (Figure 5).

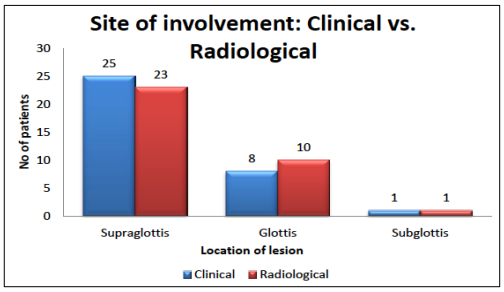

Figure 5. Site of involvement: Clinical versus radiological.

On T staging, the most common stage clinically was stage T3 (n = 23; 67.64%) followed by T2 in six patients (17.64%) and least in T4 (n = 5; 14.7%). These findings were contrasting when the tumours were staged radiologically. Majority of tumours on CECT were in stage T4 (n = 21; 61.76%). Out of these, 13 patients were staged with T4a (38.24%) and remaining eight tumours were staged T4b (23.53%). There were 11 patients with stage T3 (n = 32.35%) and two tumours was staged T2 (5.88%). As can be seen in Figure 6, tumours staged clinically showed a lower T staging as compared with radiological staging, with most of tumours being on more severe side of spectrum.

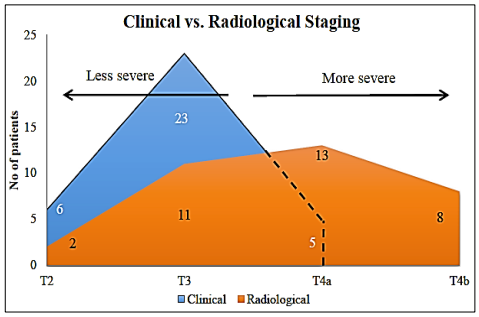

Figure 6. Clinical vs radiological staging.

When we compared clinical and radiological staging of six clinically staged T2 lesions, only two tumours were staged T2 (33.33%) and four tumors were staged T3 (66.67%). Of 23 clinically staged T3 tumours, seven were staged as T3 radiologically (30.43%), 10 tumours were upstaged to T4a (43.48%) and six tumours were upgraded to T4b (26.09%). Of five T4 tumours, three tumours were classified as T4a (60%) and two tumours as T4b (40%) (Table 3). As expected none of the tumours were down staged by CECT examination in our study.

		Radiological				
Clinical	T Stage	T2	T3	T4a	T4b	Total
	T2	2 (33.34)	4 (66.67%)	0 (0%)	0 (0%)	6
	T3	0 (0%)	7 (30.43%)	10 (43.48%)	6 (26.09%)	23
	T4	0 (0%)	0 (0%)	3 (60%)	2 (40%)	5
	Total	2	11	13	8	34

Table 3. Clinical and Radiological T-Staging.

Clinically, eight cases were diagnosed with N0 of which radiologically four were diagnosed with N0, two cases were diagnosed with N1 and one patient each were diagnosed as N2a and N2b. Clinically, there was one case diagnosed as Nx, which was radiologically staged as N0. There were nine cases with clinically diagnosed N1 of which five cases were staged radiologically as N2a and four cases as N2b. There were eight cases, which were clinically staged as N2a of which six cases were upstaged radiologically as N2b and remaining two patients were staged as N2c. Similarly, there were eight cases clinically diagnosed as N2b of which six cases were upstaged to N2c and remaining two cases as N3 (Table 4). Radiologically, there were five cases staged as N0, two cases as N1, six cases as N2a, 11 cases as N2b, eight cases as N2c and two cases as N3.

Clinical Staging	Radiological Staging							
	N0	N1	N2a	N2b	N2c	N3	Nx	Total
N0	4	2	1	1	0	0	0	8
N1	0	0	5	4	0	0	0	9
N2a	0	0	0	6	2	0	0	8
N2b	0	0	0	0	6	2	0	8
Nx	1	0	0	0	0	0	0	1
Total	5	2	6	11	8	2	0	34

Table 4. Clinical and Radiological Nodal Staging

The most common site involved was beyond larynx (extralaryngeal spread) in 24 patients (70.6%) followed by extension to inner cortex of thyroid margin and soft tissue of neck including deep extrinsic muscles of tongue in 23 patients each (67.65%), Vallecula and post cricoid region in 20 patients each (n = 20; 58.82%), pre-epiglottic in 19 patients (55.88%), medial wall of pyriform sinus and vocal cord fixation in 15 patients each (44.12%). The least common extensions were to extension beyond thyroid cartilage in 13 patients (38.24%), carotid artery encasement in seven patients (50.6%), extension to prevertebral space in five patients (11.76%), extension to trachea and esophagus in four patients each (11.76%) and lastly mediastinal extension was reported in three patients (8.82%) (Table 5).

	Site involved	No of patients	%
Laryngeal	Inner cortex of thyroid margin	23	67.65
	Paraglottic space	20	58.82
	Pre-epiglottic space	19	55.88
	Medial wall of pyriform sinus	15	44.12
	Vocal cord fixation	15	44.12
Extralaryngeal	Beyond larynx	24	70.59
	Soft tissue of neck including deep extrinsic muscles of tongue	23	67.65
	Vallecula	20	58.82
	Post cricoid region	20	58.82
	Extension beyond thyroid cartilage	13	38.24
	Strap muscles	11	32.35
	Carotid artery encasement	7	20.59
	Prevertebral space	5	14.71
	Trachea	4	11.76
	Esophagus	4	11.76
	Mediastinum	3	8.82

Table 5. Laryngeal and Extralaryngeal Sites Involved

In our study majority of cancers were staged as T3 and above radiologically with nodal staging of majority of patients as N2b and above. When M stage was considered, all the tumours were staged as Mx clinically and radiologically. Ideally, a metastatic work up is required for M staging, which was beyond the scope of this study.

DISCUSSION

Imaging plays an important role in The evaluation and staging of head and neck cancers, with CT and MRI being the work-horse of imaging. There are various factors that affect treatment planning, which include stage and type of malignancy, presence of comorbidities, and patient's informed preference. Perhaps the most important part is the accurate staging of disease in the management of laryngeal cancer. The TNM staging developed by the American Joint Committee on Cancer (AJCC) incorporates tumour size and extension (T), lymph nodal staging (N) and metastatic spread of tumour (M) into its classification. This is a widely accepted tumour classification system as it helps to standardize tumour staging and treatment planning.[7] In our study, we staged laryngeal cancers based on the TNM staging developed by AJCC (2017 8th edition).[8] In our study, the mean age of patients was 57.44 ± 10.38 years (mean ± SD). The median age of patients is 56 years (ranged from 41 to 85 years). The mean age of males was 60.3 ± 10.5 years (mean ± SD) and the mean age of females was 53.35 ± 8.7 years (mean ± SD), the difference of which was statistically significant (P<.05). Our findings are similar to data reported in various studies.[9,10,11,12] A study in Southern India in 23 patients reported a median age of 56

years (48 to 64 years) in their study on laryngeal and hypopharyngeal cancers.[9] Similarly, a western study in which 120 patients with laryngeal and hypopharyngeal cancers reported that the mean age of patients was 65.3 ± 9.9 years (range 44.2 to 92.2 years).[10] Similarly, Wu et al. in their study on 26 patients with laryngeal observed that the median age of patients was 61.5 years (range 46 to 81 years).[11] Chauhan et al. in their study on laryngeal carcinoma in North India reported a mean age of 58.85 ± 10.3 years (range 37 to 81 years).[12] The most common age group of males in our study was 51 to 60 years (n = 8; 23.5% of total study population) followed by 51-60 years (20.6% of total study population) followed by age groups of 41 to 50 years in three patients (8.8%) and one case was observed in the age groups of 71 to 89 and >80 years. Among females, the most common age group was 41 - 50 years (20.6% of total patient population; and 50% of females) and the remaining patients were distributed in the age group of 51-60 and 61 to 70 years, which explains the relatively younger age group of women in our present study. Our data are similar to findings reported by Mattoo et al., who in their study on 25 patients with newly diagnosed laryngeal cancer in North India showed that most common age group to be affected was 61 to 70 years (n = 10; 40%) followed by 51 to 60 year age group (n = 7; 28%). Their study included predominantly rural population.[13] Considering the similar population, we feel that patients in rural set up tend to present late with mostly advanced findings.

In our study, males constituted 58.8% of total sample size (n = 20) and females constituted the remaining 31.2% (n = 14). Our findings are different from the observations made by various studies, where males constituted more than 80% of cases[12,13,14] and some studies, reporting complete male population.[11] Koopman et al. in their study reported that males constituted 86% (n = 103 out of 120) of the study size10. A similar trend was also reported by Chauhan et al.12 and Matoo et al.[13] who reported 92% of males in their study (n = 60 of 65 patients and n = 23 of 25 patients respectively). The differences could be due to patient population. Koopman et al. study was conducted in Germany10 and Ryu et al. study was conducted in Korea[14], which is a different patient population. Similarly, In the study by Jaipuria et al.9 was performed in southern India in an urban/semiurban setup and study by Sarkar et al.[15] was performed in North India in urban setup . Many of our patients had carcinoma supraglottis with AE fold involvement. Tobacco chewing among women could have contributed to carcinoma in these patients. In our study, lymphadenopathy was the most common complaint in nearly 80% of patients followed by dysphagia in nearly 2/3rd of patients and hoarseness of voice was seen in about 44% of patients. Mattoo et al. reported hoarseness of voice has been in about 50% of cases with laryngeal cancer, which is similar to our findings.[13] A similar observation was also made by Chauhan et al. in their study with hoarseness present in about 50% of the patients12. Ryu et al. also observed vocal cord fixation, indicative of change of voice in 43% of their patients[14], which is consistent with our study.

However, in western countries, studies have reported hoarseness of voice as the primary complaint in more than 85% of cases with neck swelling seen in hardly 15% of patients, which is contrary to our findings.[15] It is possible that in elderly patients hoarseness of voice may not be noticeable and these patients may present with neck swelling or dysphagia due to tumour growth. Other associated symptoms may include stridor in advanced disease, difficulty in breathing, etc.[12,13] Furthermore, it has been observed in some studies that complaints such as dysphagia and neck swelling are indicative of advanced disease with hoarseness of voice being seen as in initial symptom, which may probably explain our findings.[12] Hoarseness of voice is a primary complaint in glottic tumors, and supraglottic or subglottic tumors, may not present with hoarseness of voice/change of voice until the late stages.[12,13] Furthermore, it is also believed that these tumors may present with other complaints such as neck swelling or dysphagia.[13] As we have a few cases of glottic tumors, the reduced percentage of hoarseness of voice may be expected. We have observed that in India supraglottic cancers are more common. They present late in the disease as hoarseness of voice sets in late. In contrast, studies have shown glottic cancers to be common in Western countries (due to smoking). They present early in the course as hoarseness of voice sets in early in the disease. This may also explain the number of supraglottis cancers seen in our study.

In our study, history of tobacco consumption was the most common habit and was seen in 17 patients (50%) followed by the history of alcohol with tobacco consumption in nine patients (26.5%) and alcohol consumption was seen in only two patients (5.9%). Overall tobacco consumption was seen in more than 3/4th of patients followed by alcohol consumption in more than 30% of patients. There were six patients who did not have any habits predisposing for laryngeal cancer. Our findings are similar to data from other studies.[12,13,15] Sarkar et al. reported smoking in 48% of the population followed by both smoking and alcohol consumption in 35% of patients and lastly tobacco chewing in 16% of patients. All the patients in their study had at least one risk factor.[15] Similarly, Matoo et al. have reported a history of smoking in 60% of the cases followed by alcoholism in 8% and exposure to alcohol, fungicide/ pesticide in remaining of the patients.[13] A high incidence of smoking and a combination of smoking and alcohol consumption has also been reported by Chauhan et al.[12] These findings are similar to that in our study as well. Although the exact etiology of laryngeal cancer is not completely understood, it has been hypothesized that exposure of laryngeal mucosa to a variety of inhaled and ingested carcinogens significantly enhances the risk of carcer.[12] It is believed that during cigarette smoking the large particles as well as fine and ultrafine particles deposited on the laryngeal mucosa cause irritation of mucosa and induces permanent morphological changes. Furthermore, the habit of cigarette smoking also increases the risk of oxidative DNA damage caused by a generation of free radicals by pulmonary alveolar macrophages (due

to epigenetic modification of histones through methylation, acetylation etc.), which are activated by cigarette smoking. Furthermore, it is believed that alcohol consumption increases cancer risk as it can enhance the topical absorption of carcinogens deposited on the mucosa by smoke16. Data from various studies have shown that alcohol consumption is an independent risk factor for developing laryngeal cancers and has a synergistic effect on smoking. Data also shows that alcohol consumption also increases the risk of supraglottis cancer when compared with glottic/subglottic tumour considering its anatomical proximity to the pharynx, which increases its exposure to both oral and inhaled agents (such as smoking and alcohol).[13,17]

In our study, supraglottic cancers were the most common cancer both clinically and radiologically (n = 25 and n = 23 respectively). Clinically there were eight cases of glottis cancers (23.5%) and one case of subglottic cancers (2.9%). Radiologically, ten cancers were diagnosed as glottis cancers (29.4%) and one case as subglottic cancer (2.9%). Our findings are different from those reported in the literature. We have observed that a majority of laryngeal cancers in our study was supraglottic followed by glottis and lastly subglottic. Data has shown that glottic cancers are the most common laryngeal tumors encountered in clinical practice with up to 2/3rd of laryngeal cancers being glottic cancers.[1,13,15,18] There are however few studies which have shown supraglottis as most common site for laryngeal cancer.[12,14] Chauhan et al. reported 69% of laryngeal as supraglottic in their study followed by glottis in 27.69% and glottic in 3.07%.[12] Although the reason for this is not completely understood, we believe that the consumption of alcohol and tobacco in many of our patients could have resulted in this variation.[17]

On T staging, the most common stage clinically was stage T3 (n = 23; 67.64%) followed by T2 in six patients (17.64%) and least in T4 (n = 5; 14.7%). These findings were contrasting when the tumors were staged radiologically.

Majority of tumors on CECT were in stage T4 (n = 21; 61.76%). Out of these, 13 patients were staged with T4a (38.24%) and the remaining eight tumors were staged T4b (23.53%). There were 11 patients with stage T3 (n = 32.35%) and two tumors was staged T2 (5.88%). Tumors staged clinically showed a lesser stage as compared with radiological staging, with most of tumors being on the higher stage. Our findings are similar to that reported by Matoo et Al. , who in their study found that majority of tumors (n = 17; 68%) were clinically staged as Stage T2 followed by remaining eight patients as stage T3 (32%). Many of the tumors were upstaged on CECT study with only 48% cases being staged T2 (n = 12), 11 cases were staged as T3 (44%) and two cases were staged as T4 (8%), showing an increasing trend to upstage the disease on CECT study.[13] A similar observation was also made by Ryu et al. in the study, who observed that CECT upstaged 6 of 46 pT3 cases, all cases of pT2 cases, while downstaging of 7 out of 40 pT4 cases.[12] It has been shown that clinically, evaluation of thyroid cartilage involvement may be less accurate and this could be one of the reasons for upstaging of cancers on imaging. The primary pitfall concerning CECT neck study is its usefulness in determining laryngeal cartilage involvement.[9,14,15,19] It is believed that CECT study may overestimate cartilage invasion due to underlying inflammatory changes in the thyroid cartilage due to surrounding malignancy.[10] Studies have shown CT has variable predictive value in the evaluation of laryngeal cartilage invasion ranging from 44% to 80%. The sensitivity of CT scan for evaluation of cartilage invasion lies between 46 to 66% with a specificity of 84 to 94%.[10] Ryu et al. have also shown that CT has sensitivity and specificity of 72% and 84% respectively for diagnosing thyroid cartilage penetration with an accuracy of 81%, positive predictive value (PPV) of 70% and negative predictive value (NPV) of 85%. CT has sensitivity, specificity, PPV, NPV and accuracy of 50%, 94%, 63%, 90%, and 87% respectively for diagnosing arytenoid cartilage destruction and sensitivity, specificity, PPV, NPV and accuracy of 100%, 83%, 50%, 100%, and 86% for diagnosis of cricoid cartilage destruction.[14] In our study, tumors with advanced stages were not operated and were given chemotherapy / radiotherapy CT/RT) and therefore the exact estimate could not be ascertained. However, we found that 13 patients (38.2%) had extension beyond thyroid cartilage and this resulted in lower ambiguity in staging the tumors.

The most common site involved was beyond larynx (extra-laryngeal spread) in 24 patients (70.6%) followed by extension to inner cortex of thyroid margin and soft tissue of neck including deep extrinsic muscles of tongue in 23 patients each (67.65%), vallecula and post-cricoid region in 20 patients each (n = 20; 58.82%), pre-epiglottic in 19 patients (55.88%), medial wall of pyriform sinus and vocal cord fixation in 15 patients each (44.12%). The least common extensions were extension beyond thyroid cartilage in 13 patients (38.24%), carotid artery encasement in seven patients (50.6%), extension to pre-vertebral space in five patients (11.76%), extension to trachea and esophagus in four patients each (11.76%) and lastly mediastinal extension was reported in three patients (8.82%).

Ryu et al. also found similar observations in their study with the paraglottic extension in 70 cases of 94 patients (74.5%), pre-epiglottic extension in 62 patients (65%), the extralaryngeal spread in 30 patients (31.9%.)[14] In our study, eight cases were diagnosed clinically as N0 of which radiologically four were diagnosed with N0, two cases were diagnosed with N1 and one lesion each was diagnosed as N2a and N2b. Clinically, there was one case diagnosed as Nx, which was radiologically staged as N0. There were nine cases with clinically diagnosed N1 of which five cases were staged radiologically as N2a and four cases as N2b. There were eight cases, which were clinically staged as N2a of which six cases were upstaged radiologically as N2b and the remaining two patients were staged as N2c. Similarly, there were eight cases

clinically diagnosed as N2b of which six cases were upstaged to N2c and the remaining two cases as N3. Radiologically, there were five cases staged as N0, two cases as N1, six cases as N2a, 11 cases as N2b, eight cases as N2c and two cases as N3. Matoo et al. also reported similar findings in their study on clinical and radiological N staging. They observed that radiological staging shall invariably upstage some of the clinical lymph nodal staging . They did not report a single case where the N staging was downgraded on imaging.[13] Lymph nodal staging is important and has been considered as a prognostic predictor. CT has been shown to have a sensitivity and specificity of 90% and 75% respectively for evaluation of nodal staging. It has been shown that the presence of a unilateral nodal disease is suggestive of 50% reduction in long term survival, whereas bilateral nodal involvement further reduces long term survival by 75%. Furthermore, it has also been shown that extra-nodal spread results in ten-fold increase in the risk of recurrence and shortens survival rate by half1. We did not observe any cases of distant metastasis in our study.

Our study had certain limitations. Firstly, the final histopathological findings could not be correlated in all the patients, as patients staged T4b were treated with palliative therapy and the radiological findings could not be compared with histopathological reports. Secondly, the study population has a tendency to present late during the stage of the disease and this may not be reflective of the general population.

CONCLUSION

To conclude laryngeal cancers are common in India and many patients present late in the course of the disease. It is therefore important to determine the location and the extent of the lesion (T staging), which is considered as the most important factor guiding treatment and management plans. Evaluation of nodal spread and distant spread are important to assess risk for recurrence. CECT plays an important role in determining the location, the extent, spread and invasion of surrounding structures, which help in the accurate staging of disease. CECT study should be recommended as the imaging modality of choice in the evaluation of laryngeal cancers.

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