

ORIGINAL RESEARCH

Computerised Tomographic Evaluation of Laryngeal NeoplasmsNitishkumar Dhanajirao Yeslawath¹**ABSTRACT**

Introduction: The radiologist makes a valuable contribution to the staging of laryngeal cancer and this has a direct influence on treatment planning. Aim is to evaluate hidden areas difficult to view directly such as subglottis hidden by bulky tumour, anterior commissure, submucosal lesions and Non invasivepretherapeutic staging of laryngeal neoplasm is done.

Materials and methods: Study includes a total 46 patients, out of which 41 were male and 5 females ranging from 37 yrs to 85 yrs with laryngopharyngeal neoplasms were evaluated with contrast enhance dynamic computed tomographic examination.

Results: It is identified all instances of cervical lymph nodes involvement in laryngopharyngeal neoplasm. Clinically there were 29 cases of N1 staging;4 of N2 staging;6 cases of N3 staging; According to CT findings there were 26 N1 stage cases; 7 N2 stage and 6 N3 lymph node metastasis of the 7 N2, 3 were upstaged on CT from N1 stage. All the upstaged instances were advanced T4 tumours.All N3 tumours were correctly staged by both CT imaging and clinical examination. Of the 3 cases in which N2 staging was changed 2 were due to transglottictumour and one due to pyriform sinus carcinoma. 1 patient with N3 staging showed internal jugular vein thrombosis not suspected clinically who had underwent radical neck surgery.

Conclusion: Computed Tomography provides detailed information in examination of laryngeal anatomy and pathology and gives excellent details of the extent of laryngopharyngeal neoplasm and help in non invasive staging of carcinoma.

Keywords: Computed Tomography, Staging, Laryngopharyngeal neoplasms

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INTRODUCTION

Sir Godfrey Hounsfield introduced computed tomography in 1972 which revolutionized the diagnostic radiology and up-beated the medical science computed tomography has great importance in laryngeal investigation. Since about 1977¹ computed tomography has become one of the most useful diagnostic modality of laryngopharyngeal lesion. The association of larynx and hypopharynx is very close and their anatomy and location does not allow proper clinical evaluation. This fact is based more on the impairment of the laryngeal function to determine the T-stage that on actual size or location and involvement by primary tumour.

Clinical methods have limitations as they evaluate the mucosa by visualisation that is with indirect and direct laryngoscope but by no way is able to evaluate the exact extent of the pathology deep to the mucosa. The ability of the CT to provide relevant knowledge of the status of deep laryngeal tissues and cartilages, extent if the tumour supplements the clinical laryngoscopic findings.

The routine radiographic modalities are plain film, tomography, barium studies of hypopharynx, contrast laryngography and xero- radiography which have been used in past with limited usefulness as compared to CT. These radiographic investigation tend to duplicate information already obtained by clinical means.² In diagnosis of laryngeal malignancies the role of computed tomography is very important.³

For modern trend of management of laryngeal lesions like partial laryngectomies or irradiation therapy for preservation of ability of swallowing and voice the accurate evaluation of position of tumour and invasion of deep laryngeal tissue and cartilage is extremely important and essential.

Computed tomography has very good imaging characteristics with high spatial and contrast resolution, the excellent 3D anatomic display of the neck, the virtual endoscopy the identification and separation of lymph nodes and blood vessels the non invasive approach, the speed of examination, the good patient tolerance, makes CT the imaging modality of choice in evaluation of the laryngeal pathology. With the help of clinical and endoscopic findings, computed tomography evaluation most appropriately determine the best method of management.

Aim of the study is to evaluate hidden areas difficult to view directly such as subglottis hidden by bulky tumor, anterior commissure, submucosal lesions. To evaluate preepiglottic and paraglottic laryngeal spaces. Non invasivepretherapeutic staging of laryngeal neoplasm.

MATERIALS AND METHODS

This study was carried out during one year period between december 2012 to december 2013 in the department of radiodiagnosis, CT scan section. All the patients were diagnosed cases of laryngeal neoplasms and had been clinically and endoscopically evaluated. the laryngeal neoplasm were staged clinically / endoscopically prior to CT scan study.

The total number of patients studied were 46 out of which 41 were male and 5 females ranging from 37 yrs to 85 yrs of age 46 patients with laryngopharyngeal neoplasms were evaluated with contrast enhance dynamic computed tomographic examination. The CT scanning of all the patients was performed on the GE CTisubsecond (0.8) technical scanner. The scan parameters were 1220 KVp and 300mA. Field of vision (FOV) being 20 cms, all the images were prospectively targeted.

For laryngeal scan all the patients were in supine position with head flat on the scanning table and neck hyperextended 35 to 40 degree. There were taken routinely before starting of scanning for all the patients. This helped in localizing the appropriate plane of scanning based on anatomical landmarks. The plane chosen for laryngeal scanning is parallel to laryngeal ventricle. If the laryngeal ventricle is not identified the CT gantry angle should be adjusted so that the cursor is parallel to C4 -C5 intervertebral disc space or perpendicular to the cervical spine at the appropriate level. All the patients were asked to breathe quietly and resist swallowing, talking, coughing or to hold the tongue between the teeth.

Dynamic contrast enhanced scan were obtained with the injection of 80 ml of 76% water soluble contrast medium to delineate vessels, lymph nodes and tumoral necrosis.

Sections were obtained from the base of the tongue to the trachea. In the precontrast study 5 mm contiguous sections were obtained in axial plane. In the study with contrast, rapid 3 mm contiguous sections were obtained soft tissue structure of the neck are best visualized with window width of approx. 350- 375 HU and window level of 60-70 HU visualization of the changes in the laryngeal skeleton required wider window setting of 2500/250 HU (bone algorithm). Display of all images were done on 256 × 512 pixels and interpreted.

Images were interpreted for laryngeal anatomy and pathology. Compartmentalization of tumor and deep tissue involvement in cases of laryngopharyngeal neoplasm were assessed. All hyaline cartilages were evaluated for presence or absence of neoplastic invasion.

Metastatic lymphadenopathy and vascular involvement were also assessed. All laryngeal carcinomas were staged for primary tumor (T-staging) and nodal status (N-staging)

Classification and staging of laryngeal carcinomas

Classification of laryngeal carcinomas are divided according to the site of origin of the tumor. Three sites were recognized because of their anatomic ease of identification. They are supraglottic, glottic and subglottic. CT protocol for imaging

the nodal disease in laryngopharyngeal neoplasm was as employed for imaging the primary tumour. In this contrast enhanced dynamic CT study is done with thin axial sections (3 mm)

Modified radiological nodal staging guidelines

N0-All nodes <1.5 cm with no central density on CT.

N1: Single ipsilateral node 15 to 29 mm or single ipsilateral node less than 15 mm with central low density on CT.

N2: Single ipsilateral 3-6 cm node or multiple bilateral, ipsilateral or contralateral nodes all less than 6 cm.

N2a: Single ipsilateral 3-6 cm node.

N2b: Multiple nodes all less than 6cm.

N2c: Bilateral nodes none more than 6 cm.

N3: Massive ipsilateral nodes, one or more / . 6 cm.

N3en: Extranodal malignant nodes.

The CT sections were extended to C1 level and upper mediastinum for detecting lymph node metastasis when appropriate. Central lucency with peripheral enhancement, nodal size more than or equal to 1.5 cm nodal confluence were considered as radiological criteria of lymph node metastasis. In this study all N0 nodes not showing central low density were less considered less likely to be metastatic.

RESULTS

The age range of laryngopharyngeal neoplasm was 37 to 85 years in study of 46 patients.

38 out of 41 i.e 92.68 % male patients were chronic smokers.

In transglottic tumours the origin of tumour either from glottis extending to supraglottis to glottis was difficult to determine on CT.

Total number of laryngopharyngeal carcinoma 41, one case may have multiple site involvements so overlap of findings of deep tissue involvement is there. Percentage of getting involved by particular site not comparative % among themselves.

Invasion of cartilage is present in 13 cases out of 42 malignant cases, One case may have multiple site invasion of

Age Groups (in years)	No of cases	Percentage (%)
0-20	0	0
21-40	7	15.21
41-60	21	45.65
61-80	17	36.95
81-100	1	2.17
Sex		
Males	41	89.13
Females	5	10.86
Location		
Supra glottis	7	16.28
Trans glottis	17	39.5
Pyriiform sinus	19	44.2
Table-1: Demographic distribution in laryngopharyngeal neoplasm		

Site	No of cases	Percentage (%)
Pre epiglottic space	7	16.28
Para glottis	27	62.8
Anterior commissure	6	13.95
Cartilages	13	30.23
Sub glottis extension	18	41.90

Table-2: Deep tissue involvement of Laryngohypopharyngeal carcinoma.

Cartilages	No of cases	Percentages (%)
Thyroid	5	11.62
Arytenoid	11	26.62
Cricoid	2	4.75

Table-3: Distribution of neoplastic invasion of cartilages

T staging	Clinical T Staging	CT T- staging
T2	13	10
T3	22	12
T4	7	20

Table-4: Comparison of clinical staging to CT staging

T staging	Clinical nodal staging	CT nodal staging
N2	30	26
N3	4	7
N4	6	7

Table-5: Comparison of clinical nodal staging to CT nodal staging

cartilage.

T1 tumors were not evaluated on CT imaging. There were 42 cases of laryngohypopharyngeal squamous cell carcinoma. In this study all N0 nodes which did show central low density on CT were excluded. None of the patients with squamous lung metastasis as screened on plains X-ray chest.

DISCUSSION

Diagnostic evaluation of larynx is primarily done with endoscopy, but cross sectional imaging plays an indispensable role because it enables one to evaluate the deep structure of the larynx. CT scan provide images with excellent detail of the larynx. Specific sites such as the anterior commissure, laryngeal ventricle and the subglottic region are difficult to examine endoscopically, in the presence of an adjacent exophytic tumour. Areas such as pre-epiglottic space, the paraglottic space and the laryngeal skeleton cannot be evaluated endoscopically. Feasibility of voice sparing partial laryngectomies like supraglottic laryngectomy and vertical hemilaryngectomy or radiation therapy for treatment of laryngeal cancer depends on accurate T- staging and inferior tumour extent in relation to the potential lines of resection.

In this study, we evaluate a total number of 46 patients with CT of laryngopharyngeal lesions. There were 41 male and female patients ranging between 37 to 85 years. In the study by Zbaven Pet al⁴ there were 39 males and 1 female with

mean age of 62 years (range 44-87 years)

In study by Sulfaro A et al⁵ there were 60 male patients and 6 female patient. There mean age was 60 years (range 41 to 80 years). These findings correlate with our study. We have evaluated 46 cases of laryngohypopharyngeal neoplasm with CT imaging in this study of the 46 cases of laryngopharyngeal neoplasm 42 (91.30) were squamous cell carcinoma and 4 (8.69%) were, 2 -chondromas: 1 abscess: 1 cyst. Of the 42 laryngopharyngeal, carcinoma, 23 (55%) were laryngeal carcinoma and 19 (45%) were pyriform sinus carcinomas.

In our study, there were 17 transglottic carcinoma and 6 subpraglottic carcinoma. Of the 17 transglottic tumour 14 (33%) of 42 laryngoplasms neoplasms) showed subglottic extension due to very late presentation of patients in advanced stage.

Zbaren P et al⁴ evaluated 40 cases of laryngeal carcinoma in which 15 were transglottic 6 glottosupraglottic and 5 supraglottic. There were 27 (73 %) case of subglottic extension of 37 cases. Dullevud R et al⁵ carried out CT in 51 laryngeal tumour. In 33 there were glottic, 14 supraglottic and 4 subglottic.

In the series of Gamsu G et al^{7,8} there were 7 glottis tumours, 5 supraglottic and 10 transglottic of the total 25 patients studied. In 3 patients tumour arose from pyriform sinus 7 patients (28%) had subglottic extension. In our study, the preepiglottic space is invaded in 8 (19.04%) cases in which 7 were due to transglottic tumour and one supraglottic tumour of the total 42 laryngopharyngeal carcinoma. In remaining 36 cases the normal preepiglottic fat density was noted.

Zbaren P et al⁴ evaluated 40 patients CA larynx CT assessment of preepiglottic space invasion was in 9 (22.5%); cases. Gamsu et al⁷ evaluated 25 patients with CA larynx on CT. There were 7 (28%) patients that showed preepiglottic space invasion not seen on laryngoscopic examination. CT assessment of the preepiglottic space was better evaluated due to imaging technique (this slices) extensive preepiglottic space invasion are considered unfavourable for radiotherapy. In our study the paraglottic space invasion was diagnosed in 30 (71.4%) of 42 cases of laryngopharyngeal carcinoma. Of these 14 were due to only carcinoma pyriform sinus. CA pyriform sinus invaded more commonly the paraglottic space because of its anatomic proximity. Through the paraglottic space the tumour spread to supraglottic or subglottic level without being recognized on endoscopy and also the incidence of lymph node metastasis becomes higher.

Zbaren P et al⁴ evaluated 29 (78.4%) cases of paraglottic space invasion of the 37 cases studied. This is in accordance with our 71.4% of paraglottic space invasion. In this study anterior commissure involved in 6 (14.28%) cases of 42 laryngopharyngeal carcinoma. All the cases were transglottic tumours. Zbaren P et al⁴ evaluated 19 (51.3%) of the 37 cases with involvement of anterior commissure. The failure to clinically and endoscopically identify destruction of laryngeal cartilages with extralaryngeal spread leads to staging errors. Thus many T4 lesions were clinically understaged. In our study 13 (31%) of 42 laryngohypopharyngeal

geal carcinoma showed cartilage invasion, 2 (5%) showed invasion arytenoid and cricoid cartilage, 5 (11.8%) showed both arytenoids and thyroid cartilage invasion that does not changed the T staging.

In study of Sulfaro A et al⁵ cartilaginous skeleton invasion was found in 34 of 68 patient (5%). Out of 34 there were 29 (57%) cases of 51 due to laryngeal carcinoma and 5 (29%) of 17 due to hypopharyngeal carcinoma. Gamsu G et al⁸ demonstrated 6 (24%) patients of destructions of thyroid cartilage of the 25 patients on CT. 5 of 6 were extensive transglottic tumours. The correct estimation of T-staging by clinical method is not proper, in recognizable percentage of cases, it fails to estimate correctly.

According to CT findings, there were, T2 were 11 (26.2%); T3 were 12 (28.6%); T4 were 20 (47.6%) in primary tumours. Thus in 13 cases the primary tumour staging were upstaged from T3 to T4 only by CT imaging i.e. 31% of the cases there was change of T staging at CT of laryngohypopharyngeal neoplasms overlooked on endoscopy. The accuracy of clinical staging being 30 (71%) of 42 cases. All 13 T4 tumours which were upstaged showed cartilage invasion with extra laryngeal growth erosion and sclerosis (only sclerosis was not considered as a sign of invasion in thyroid cartilage).

Zbaven P et al⁴ evaluated 40 cases. There were 10 T2, 28 were T3 and 2 as T4 tumour on clinical endoscopic examination. According to CT findings 6 were T2, 22 were T3 and T4 tumours. Thus there were 10 cases that were upstaged of 40 cases i.e. 25% upstaging was done by CT imaging. In this series the accuracy of clinical staging was 57.5% and CT staging was 80% and combined clinical and CT staging was 80%.

Dulleved R et al⁶ assessed 66 patient of Ca larynx and compared CT and endoscopic findings. CT alone understaged in 10.6% of cases, all were superficial spreading carcinomas. CT worsened the staging in 22.7% of, all of them deep invasions overlooked in 10 (15.1%) of 66 patients. Sulfaro A et al⁵ studied 66 patients and found accuracy of clinical Vs CT staging for laryngeal carcinoma to be 58.8% Vs 70.6% whereas combined accuracy of clinical staging and CT staging was 88.2%.

In our study the high percentage of T4 tumours 48% on CT imaging were due to late presentation of carcinoma. Both clinical and CT imaging enhances the accuracy pretherapeutic staging.

In our study, malignant involvement of lymph nodes considered by analysing these indicators.

- Central lucency with peripheral enhancement.
- Nodal confluence.
- Nodal size, more than 1.5 cm

Intravenous contrast medium was useful for anatomic delineation of nodes and not for identification of malignancy. Clinically there were 29 cases of N1 staging; 4 of N2 staging; 6 cases of N3 staging; According to CT findings there were 26 N1 stage cases; 7 N2 STAGE AND 6 N3 lymph node metastasis of the 7 N2, 3 were upstaged on CT from N1 stage. All the upstaged instances were advanced T4 tumours.

Kolbenstvedt A et al⁹ studied 6 T4 tumours for evaluation of lymph node metastasis. In this series lymph node, metastasis were diagnosed on CT in 4 patients among the 6, T4 supraglottic tumours. The N stage was changed by CT from N0 to N1 in one patient, from N0 to N2 in one patient. The tumour staging and nodal status in our study is comparable to other studies.^{10,11}

Thus CT is an excellent adjuvant modality with laryngoscopic findings for accurate pretherapeutic staging of laryngohypopharyngeal neoplasm and cartilage involvement by neoplasm have important pretherapeutic implication.

CONCLUSIONS

Computed Tomography provides detailed information in examination of laryngeal anatomy and pathology and gives excellent details of the extent of laryngohypopharyngeal neoplasm. Application of proper and correct technique of the CT scanning helps in obtaining maximum information. Properly done window settings enable to evaluate laryngeal soft tissues and cartilage compartmentalization of the lesion assesses the structure involved. CT is non invasive, well tolerated, rapid and safe method of investigation of laryngohypopharyngeal neoplasm.

REFERENCES

1. Mancuso AA, Hanafee WN, Julliard JF et al: The role of CT in the management of cancer of larynx. *Radiology* 1977;124:243 – 244.
2. Mancuso AA, Calcaterra TC, Hanafee WN: CT of the larynx. *RCNA* 1978;16:195 -208.
3. Horowitz BL, Woodson GE, Bryan RN: CT of the laryngeal tumors. *RCNA* 1984;22:265 – 279.
4. Zbaren P, Becker M, Lang H: Pretherapeutic staging of laryngeal carcinoma. *Cancer* 1996; 77:1263 – 1273.
5. Sulfaro A, Barzan L, Lutman M et al: T – staging of laryngohypopharyngeal carcinoma. *Arch. of Otolaryngol. Head Neck Surgery* 1989;115:613 – 620.
6. Dullerud R, Johansen JG, Dahl T et al Influence of CT on tumour classification of laryngeal carcinomas. *Acta Radiol.* 1992;33:314-318.
7. Gamsu G, Webb WR, Moss AA et al: CT in carcinoma of larynx and pyriform sinus: Value of phonation scans. *AJR* 1981;136:577 – 584.
8. Gamsu G: The larynx and pyriform sinus. In Moss AA, Gamsu G, Genant HK Editors: *computed tomography of the body with MRI* 2nd Edition WB Saunders Co. 343-394, 1992.
9. Kolbenstvedt A et al: CT in T1 carcinoma of the larynx. *Acta Radiol* 30 467 – 469, 1989.
10. Madison MT, Remley KB, Mitchell SL et al: Radiologic diagnosis and staging of head and neck squamous cell carcinoma. *RCNA* 1994;32:163 – 180.
11. Mafee MF, Schild JA, Capek V et al: CT of larynx: Correlation with anatomic and pathologic studies in cases of laryngeal carcinoma. *Radiology* 1983;147:123 – 128.