Clinico-radiological Co-relation of Carcinoma Larynx and Hypopharynx: A Prospective Study

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Received: 10 April 2017 / Accepted: 19 July 2017 / Published online: 22 July 2017
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Abstract The successful management of laryngeal and hypopharyngeal cancers requires accurate diagnosis, staging, assessment of patient wishes, and the selection of the most appropriate treatment for the individual patient. Imaging plays an important complementary role to clinical examination and endoscopy in the evaluation of laryngeal and hypopharyngeal cancers. The combined information allows the disease to be staged accurately. To correlate carcinoma larynx and hypopharynx clinically and radiologically and to know the accurate pre-therapeutic stage of the disease. A total of 50 cases were included in this study. After clinical TNM staging, CT scan was done to know the real extent of tumor, volume and nodal status. After that, TNM staging was revised based on radiological findings. The number of people who had been upstaged and downstaged after CT evaluation was measured. There were total of 50 cases of carcinoma larynx and hypopharynx in this study. There were 26 (52%) cases of carcinoma larynx and 24 (48%) cases of carcinoma hypopharynx. There were significant changes in T stage after radiological evaluation. Major changes were observed in T2 and T3 stages. Majority of cases (17) were having N1 disease after radiological evaluation. On comparing clinical and radiological staging of neck nodes, it was observed that upstaging occurred mainly in N0. Overall after radiological evaluation, 48% of our cases were upstaged, 48% remained in same stage and 4% were downstaged. By combining both clinical and radiological evaluation in laryngeal and hypopharyngeal cancers, a correct pre therapeutic staging

can be obtained and thereby prompt treatment can be given.

Keywords Carcinoma larynx · Carcinoma hypopharynx · Clinical staging · Radiological staging · CT scan · Upstage · Downstage

Introduction

Larynx and hypopharynx are structurally and functionally integrated structures. Since these organs are concerned with three main functions as respiration, swallowing and phonation, malignancies in these areas can hamper the quality of life. A large variety of malignancies may occur in the larynx and hypopharynx, among this 85–95% are squamous cell carcinoma. The successful management of these carcinomas requires accurate diagnosis, pre therapeutic staging, assessment of patient wishes, and the selection of the most appropriate treatment for the individual patient. As the treatment depends mainly on the stage of the disease, an accurate pre therapeutic staging is absolutely necessary. Imaging plays an important complementary role to clinical examination and endoscopy in the evaluation of laryngeal and hypopharyngeal cancers. The mucosal extent of the tumor and cord mobility is best assessed with endoscopy but cross sectional imaging is required to determine sub mucosal extent and invasion of adjacent structures. The combined information allows the tumor to be classified according to the relevant T staging [1]. CT, MRI and PET scans are the available cross-sectional imaging modalities. CT is the most commonly used investigation in our nation as it is less expensive, faster, easily available, less susceptible to motion artifact and suitable for patients with implanted electrical devices when

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compared to MRI [2]. The effect of pre treatment CT scanning on 'T' classification of laryngeal tumors and hypopharyngeal tumors found that the use of CT resulted in alterations of tumor stages. It also gives idea about the nodal status too. Accurate pre therapeutic staging helps in deciding the proper treatment plans.

Materials and Methodology

Materials

This is a cross-sectional study conducted in the Department of ENT of a tertiary care hospital for a study period of 1.5 years from January 2013 to July 2014. Fifty patients with newly diagnosed carcinoma of larynx and hypopharynx were included in the study. Recurrent, residual cases and the already diagnosed cases who have received neo adjuvant chemotherapy were excluded from the study.

Methodology

Initially every case underwent a detailed head and neck examination including indirect laryngoscopy. After getting an informed consent, detailed evaluation of the larynx and hypopharynx and biopsy was done by direct endoscopic examination either under LA or GA. Clinical TNM staging based on this information was made. Once biopsy is confirmed, CT scan was done to know the real extent and volume of tumor, and nodal status. This is followed by revision of TNM staging based on radiological findings. The cases that have been upstaged and downstaged based on tumor, nodal and metastases status were analysed individually and then the change in composite stage was studied. The reason for upstaging/down staging in each case was also noted. Percentage of each was calculated. Effect of radiological evaluation on TNM staging was thus analyzed. Data obtained was entered in MS Excel spread sheet and analyzed using SPSS software.

Results

There were total of 50 cases of carcinoma larynx and hypopharynx in this study which included 26 (52%) cases of carcinoma larynx and 24 (48%) cases of carcinoma hypopharynx. In carcinoma larynx group, 15 (58%) cases were glottic carcinoma and 11 (42%) were supraglottic. Isolated cases of carcinoma subglottis were not observed. In hypopharyngeal carcinoma group, there were 14 patients (58%) with carcinoma pyriform fossa and 10 patients (42%) with postcricoid carcinoma. Posterior pharyngeal carcinoma was not observed. When all subsites were

combined together, glottis was the commonest site involved which contributed to 30% of cases followed by carcinoma pyriform fossa (28%). All these 50 cases were considered for clinico-radiological comparison.

Study of age distribution revealed that maximum incidence was in the age group 61–70 years (56%) followed by 51–60 years (24%). Youngest patients were two 35 years old females with post cricoid malignancy. The study showed that among each subsites, maximum incidence occurred in 7th decade (p value 0.034). Among 50 patients, 5 were females who had post cricoid malignancies. We could find that in our study, 84% had addictions and habituations. The most common addiction observed in the study was smoking (46%) alone followed by smoking and alcoholism (20%). The carcinoma glottis was strongly associated with smoking and carcinoma pyriform fossa with synergistic effect of smoking and alcoholism (p value = 0.003).

T Staging

After proper clinical and endoscopic examinations patients were staged accordingly. 30% (15 cases) of patients belonged to early stage disease (T1 and T2), 42% (21 cases) belonged to T3 and 28% (14 cases) to T4a stage. The subsite wise T-stage distribution after clinical evaluation is showed in Table 1.

After radiological evaluation, it was found that majority (29 cases, 58%), were in T4a stage instead of T3, followed by 9 cases (18%) in T3 and 5 cases (10%) in T4b group. Table 2 shows the subsite wise T-stage distribution after radiological evaluation.

On subsite analysis, only 20% of glottic carcinoma, 21% of PFF carcinoma and 10% of PCA carcinoma were in

Table 1 Subsite wise T-stage distribution after clinical evaluation

Subsite	T1	T2	T3	T4a
Glottis (Total: 15)	2	5	6	2
Supraglottis (Total: 11)	0	2	4	5
PFF (Total: 14)	3	2	4	5
PCA (Total: 10)	0	1	7	2

Table 2 Subsite wise T-stage distribution after radiological evaluation

Subsite	T1	T2	T3	T4a	T4b
Glottis (Total: 15)	2	1	4	8	0
Supraglottis (Total: 11)	0	0	0	11	0
PFF (Total: 14)	3	0	4	5	2
PCA (Total: 10)	0	1	2	4	3

early stage. All 14 cases of supraglottic carcinoma (100%) were in T4a stage after radiological evaluation, and 90% of PCA carcinoma and 79% of PFF carcinoma were in advanced T-stage.

Change in T Stage

There were significant changes in T stage after radiological evaluation. Major changes were observed in T2 and T3 stages. In T2, 8 out of 10 (80%) cases were upstaged, 3 were to T3 and 5 were to T4a. In T3, 15 out of 21 (71%) cases have been upstaged, of these 13 (87%) cases were upstaged to T4a and 2 cases (13%) to T4b stage. Three cases of T4a disease were upstaged to T4b and one case of T4a was downstaged to T3 stage.

The extension of disease into the paraglottic space picked up by CT scan changed the clinical T2 stage to T3. This happened in 3 cases, 2 cases of glottic carcinoma and one case of carcinoma PFF. Here the paraglottic space was involved without extralaryngeal disease or laryngeal cartilage involvement. The involvement of the laryngeal cartilages and the extralaryngeal disease upstaged the disease to T4a, prevertebral involvement and carotid artery involvement to T4b.

In our study, the pre-epiglottic space was involved in 14% and paraglottic space was involved in 48% of cases. Laryngeal cartilage involvement was seen in 64% of cases. The laryngeal cartilages were infiltrated in 91% of supraglottic carcinoma. The most commonly involved cartilage was thyroid cartilage. Isolated thyroid cartilage involvement was seen in 36%. In 12%, thyroid cartilage was involved along with arytenoid and in 8% along with cricoid cartilage. In one case, isolated cricoid cartilage involvement was seen.

Prevertebral involvement was seen in three cases, all of them were having postcricoid carcinoma. Carotid artery was encased in two cases of carcinoma pyriform fossa.

Thus, after radiological evaluation, based on T staging, 54% has been upstaged, 44% with no change and 2% downstaged. Table 3 shows the clinicoradiological co-relation based on T-stage. The change in the T-stage based on subsite and the change occurred is depicted in Table 4.

On analyzing the change in T-stage with respect to the subsite, post cricoid carcinomas were upstaged in 70%, followed by supraglottis, glottis and pyriform fossa. Figure 1 shows this.

N Staging

On clinical examination, majority of the patients had no nodal disease (42%). After radiological evaluation, 68% remain unchanged, only 30% were upstaged. The upstaging was mainly from N0 to N1. The clinico-radiological correlation of “N” status is given in Table 5.

M Staging

After clinical examination, none of the patients had distant metastases. But one case of cervical vertebral metastasis was picked up by radiological study.

Composite Staging

Clinical examination showed 22 patients (44%) in stage III disease, 19 (38%) in stage IVA and 4 (8%) in stage IVB. 5 (10%) patients were in early stage disease and there were no patients in stage IVC.

After radiological staging, majority i.e. 31 cases (62%) were in Stage IVA followed by 9 cases (18%) of stage III and 7 cases (14%) of stage IVB. Two cases (4%) were in Stage I and 1 case (2%) was in stage IVC.

Change in Composite Staging

A change in composite staging was then analysed and it revealed that after radiological evaluation, cases in stage I remained in stage I itself and all the 3 cases in stage II were upstaged. Of these, 2 cases were upstaged to stage III due to paraglottic space invasion and 1 case to stage IVA.

A significant difference was observed in stage III. Out of 22 stage III cases, 15 cases were upstaged to stage IVA and one to stage IVB after evaluation by CT scan. Six cases remained in stage III itself. The major factor which resulted in this change was the laryngeal cartilage invasion. Clinical

Table 3 Clinicoradiological co-relation based on T-stage

	Radiological T1	Radiological T2	Radiological T3	Radiological T4a	Radiological T4b
Clinical T1	5	0	0	0	0
Clinical T2	0	2	3	5	0
Clinical T3	0	0	6	13	2
Clinical T4a	0	0	1	10	3
Clinical T4b	0	0	0	0	0

Table 4 Change in the T-stage based on subsite

Subsite	Change in stage	Number
Glottis	T2 to T3	2
	T2 to T4a	2
	T3 to T4a	4
Supraglottis	T2 to T4a	2
	T3 to T4a	4
Pyriform fossa	T2 to T3	1
	T2 to T4a	1
	T3 to T4a	2
	T4a to T4b	2
Post cricoid area	T3 to T4a	4
	T3 to T4b	2
	T4a to T4b	1

evaluation was more accurate in stage IVA. In 17 cases of stage IVA, 14 cases showed no change, 4 cases upstaged to stage IVB and 1 case down staged to stage III. Figure 2 illustrates the clinicoradiological co-relation with regard to composite staging and was statistically significant with *p* value of 0.001.

On analyzing the change in composite stage with respect to the subsite, upstaging was seen 60% of post cricoid carcinomas, 55% of carcinoma supraglottis, 53% of

carcinoma glottis and 29% of carcinoma pyriform fossa. This is well explained in Fig. 3.

The addition of radiological evaluation to clinical evaluation upstaged 48% cases and downstaged 4% cases. There was no change in 48% of cases.

Discussion

The treatment of laryngeal and hypopharyngeal carcinomas depends mainly on the stage of the disease and so accurate pre therapeutic staging is absolutely necessary. The staging criteria for laryngeal and hypopharyngeal carcinoma proposed by the International Union Against Cancer (UICC) and the American Joint Committee on Cancer (AJCC) are identical and is based on all information available prior to treatment, including findings at physical examination, endoscopy, biopsy and cross-sectional imaging. The guidelines of both the UICC and the AJCC and several other studies recommend the use of cross-sectional imaging to improve the accuracy of pre therapeutic staging of laryngeal and hypopharyngeal carcinomas [3–5] because several characteristics of the primary tumor used for staging cannot be determined without imaging which includes invasion of the PES, the PGS, the laryngeal cartilages, the extra-laryngeal tissues, the prevertebral space, mediastinal

Fig. 1 Subsite wise change in ‘T’ stage **Table 5** Clinico-radiological correlation of ‘N’ status

	Rad N0	Rad N1	Rad N2a	Rad N2b	Rad N2c	Rad N3
Clin. N0	13	5	0	1	2	0
Clin. N1	0	12	0	0	1	0
Clin. N2a	0	0	0	0	0	0
Clin. N2b	0	0	0	5	3	1
Clin. N2c	0	0	0	0	3	0
Clin. N3	0	0	0	1	0	3

Fig. 2 Clinico-radiological correlation of composite staging

Fig. 3 Subsite wise change in composite stage

structures, and encasement of the carotid [5]. Pre and para glottic space and oesophageal involvement can upstage the tumors to T3 stage whereas laryngeal cartilage involvement and extra-laryngeal disease to T4a stage. Prevertebral or mediastinal extension and invasion of the carotid artery will make tumors to fall into T4b stage. It also gives idea about the operability of the metastatic neck node. So radiological imaging is mandatory before deciding the treatment in case of upper aero digestive tract malignancies like carcinoma larynx and hypopharynx.

The ideal radiographic modality for this complicated anatomic region should display the 3D relationship of soft tissue and bony structures and provide information necessary to distinguish normal anatomy from pathologic disease. CT, MRI and PET scans are the available cross-

sectional imaging modalities. Even though staging accuracy of MRI in carcinoma larynx and carcinoma hypopharynx are slightly higher, CT is the most commonly used investigation in our nation as it is less expensive, faster, easily available, less susceptible to motion artefact and suitable for patients with implanted electrical devices when compared to MRI. Contrast administration makes it possible to distinguish neoplasm and metastatic disease from adjacent structures and to estimate the location, size, vertical limits and deep extension of the tumour [2]. The role of PET in improving the T-staging of laryngeal and hypopharyngeal cancer is limited because of its intrinsic limitation of spatial resolution and its inability to adequately assess lesions of small volume.

The purpose of our study was to accurately stage the disease based on clinical and radiological findings and we used CT as the imaging modality. We had a total of 50 cases of carcinoma larynx and hypopharynx, 26 cases of carcinoma larynx and 24 cases of carcinoma hypopharynx. Initially all the patients underwent proper clinical and endoscopic examinations and clinical TNM staging was made based on this information. Then CT scan was done to know the real extent and volume of tumor, and nodal status. This is followed by revision of TNM staging based on radiological findings.

There were significant changes in T stage after radiological evaluation. Major changes were observed in T2 and T3 stages. In T2, 80% cases were upstaged, 38% to T3 and 62% to T4a. In T3, 71% cases have been upstaged, of these 87% cases to T4a and 13% to T4b stage. The involvement of the laryngeal cartilages and the extralaryngeal disease upstaged the disease to T4a, prevertebral and carotid artery involvement to T4b. The extension of disease into the paraglottic space picked up by CT scan changed the clinical T2 stage to T3. Thus, after radiological evaluation, based on T staging, 54% has been upstaged, 44% with no change and 2% downstaged.

On clinical examination, majority of the patients had no nodal disease (42%). After radiological evaluation, 68% remain unchanged, only 30% were upstaged. The upstaging was mainly from N0 to N1. One case of cervical vertebral metastasis was picked up by radiological study.

On analyzing the composite staging, after radiological evaluation, cases in stage I remained in stage I itself and all the 3 cases in stage II were upstaged. A significant difference was observed in stage III. Out of 22 stage III cases, 15 cases were upstaged to stage IVA and one to stage IVB after evaluation by CT scan. Six cases remained in stage III itself. The major factor which resulted in this change was the laryngeal cartilage invasion. Clinical evaluation was more accurate in stage IVA. In 17 cases of stage IVA, 14 cases showed no change, 4 cases upstaged to stage IVB and 1 case down staged to stage III.

The addition of radiological evaluation to clinical evaluation upstaged the TNM staging in 48% cases. There was downstaging in 4% cases and no change in 48% of cases. With respect to the subsite, upstaging was seen 60% of post cricoid carcinomas, 55% of carcinoma supraglottis, 53% of carcinoma glottis and 29% of carcinoma pyriform fossa.

Prehn et al. [6] compared tumor clinical stages of 81 head and neck cancer patients based solely on physical-examination findings with those obtained with the addition of CT findings and found that 44 patients (54%) had a change in assigned clinical stage and carcinomas of hypopharynx were the most likely to change stage (90%) on the basis of CT findings. This finding was comparable

with our results. In a retrospective study on 90 patients with primary laryngeal cancer, Champion et al. [7] found that disease in 15 (17%) of 90 patients was reclassified into a new TNM stage after pretherapeutic CT.

In another study by P. Zbaren, M. Becker, H. Lang, 45 consecutive patients with neoplasms of the larynx, treated surgically, were included in a prospective pretherapeutic staging protocol that included indirect laryngoscopy, direct microlaryngoscopy, contrast-enhanced computed tomography (CT) and Gd-DTPA-enhanced magnetic resonance imaging (MRI). The histologic findings were then compared with clinical findings, CT and MRI. These findings showed that clinical evaluation failed to identify tumor invasion of the laryngeal cartilages and extralaryngeal soft tissues, resulting in a low staging accuracy (55%) and many pT4 tumors were clinically understaged. The combination of clinical/endoscopic evaluation and either CT or MRI resulted in a significantly improved staging accuracy (80 vs 87%, respectively). These results underline the usefulness of radiological evaluation for pre therapeutic staging. One of the major drawbacks of our study is that we could not include the pathological staging to calculate the accuracy of radiological evaluation.

This effort on clinicoradiological correlation was done in view of the increased incidence of residual and recurrent diseases in our tertiary care centre. Most of these residual and recurrent diseases presented in advanced stage and so curative salvage procedure could not be contemplated. Increased residual and recurrent disease may be due to the inadequate primary treatment that too because of inaccurate pre therapeutic staging. So by combining both the clinical and radiological evaluation, a correct pre therapeutic staging can be obtained there by giving prompt treatment.

Conclusion

We have found CT imaging to be a valuable tool in the evaluation of laryngeal and hypopharyngeal carcinomas. In this study, 48% of patients had upstaging in TNM staging after CT imaging, with both tumor and nodal staging affected. CT had its most striking impact in patients with post cricoid carcinomas, in whom an increase in stage was noted in 60%. The additional information provided by the incorporation of CT findings into pretherapeutic staging exerts a strong impact on the treatment recommendations for patients with laryngeal and hypopharyngeal carcinomas.

Compliance with Ethical Standards

Conflict of interest All authors declare that they have no conflict of interest.

Ethical Approval All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards. This article does not contain any studies with animals performed by any of the authors.

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