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# The Role of Multi-Detector-Computed Tomography in Staging of Laryngeal Cancer

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## Abstract

**Background:** An accurate staging of laryngeal carcinoma is vital to decide the treatment options.Imaging play integral part in staging of laryngeal cancer with computed tomography (CT) being among the most used modalities.With advance in CT manufacturing and widespread use of multidetector CT (MDCT), more accurate and dependable clinical application would be expected.

**Objective:** To evaluate the role of MDCT in the staging of laryngeal cancer and to compare the efficacy of MDCT in assessing laryngeal cancer with respect to clinical and histopathological TNMstaging.

**Patients and methods:** Twenty-four patients with endoscopically proven laryngeal carcinoma underwent MDCT examination during the period between February 2013 and October 2013at CT unit of Middle Euphrates Neurocenter in Al-Sadder Medical city, Al-Najaf city. Clinical and histopathological records of all patients were reviewed and compared with MDCT findings.

**Results:** Twenty-four patients were included, with male to female ratio of 3:1 (18 males, 6 females) with mean age of 62.58±12.98 years. Fifty percent (12) of cases were at TNM stage 3, while stage 2 and stage 4 constituted 25% (6 cases) for each equally.There was statistically significant relation between stage of the tumor and volume. Male gender had statistically significant association with higher TNM stage while clinical presentation had not.

**Conclusion:** MDCT has a crucial role in estimation of the TNM stage of laryngeal carcinoma.The TNM stage of the laryngeal carcinoma tends to be upgraded when following MDCT findings are present:heterogenous density of the mass, presence of cartilage destruction, presence of anterior commissure involvement and larger volume of the mass. However, presence of extra laryngeal extension on MDCT may have no significant relation to a higher TNM stage.

**Keywords:** Laryngeal carcinoma; Multiple detector computed tomography; Density of the mass, Cartilage invasion

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## Introduction

Laryngeal carcinoma is the eleventh-most common form of cancer among men worldwide and is the second-most common malignancy of the head and neck [1]. The assessment of the laryngeal tumor is based upon inspection and palpation, when possible, and by both indirect mirror examination and direct endoscopy [2,3]. Examination under anesthesia should be performed to best assess the extent of the tumor, to look for synchronous primary tumors, and to take biopsies [2]. Imaging studies, including computed tomography (CT), magnetic resonance imaging (MRI), and positron emission tomography (PET), may augment the physical exam and evaluation, particularly for assessing the degree of local invasion, involvement of regional lymph nodes, and the presence of distant metastases and second primary malignancies [4]. Ideally, imaging should take place prior to biopsy, which may distort anatomy and create a false positive finding on PET scanning [4,5]. Multiple detector computed tomography or (MDCT) scanning is a rapid, painless diagnostic procedure that combines the use of computers and X-rays. Multiple images are acquired in a sequence by a rotating x-ray tube. The patient is lie still on a table for approximately 5 to 15 min, depending on the area of concern being covered. Images are acquired by the detectors that pick up the X-ray that passes through patient body. The images are reconstructed for the assessment. For Head and Neck cancers, it is particularly useful in upstaging cancers that have deeper local invasion or infiltration into adjacent structures that is difficult to detect on physical examination [6].

## Patients and Method

A cross sectional descriptive randomized study included 24 patients with laryngeal carcinoma, conducted in the period from February 2013

to October 2013 at CT unit of Middle Euphrates in Al-Sadder Medical city, Al-Najaf governorate. All patients were proved to have laryngeal carcinoma by histopathological examination, and they were referred by otolaryngologists for evaluation of the larynx and neck by MDCT. All CT examinations were carried out using Philips, brilliance 64 multidetector helical CT scan with the following parameters: KV 120, MAS 300 m. As, slice thickness 0.9 mm and time 12 sec. Patient was in supine position during examination with head inrest and they asked to stop breathing and swallowing then scanner gantry parallel to radiographic baseline.

Non-enhanced CT examination were done first for all patients, then repeated after intravenous administration of iodinated contrast material. Images of CT were reviewed by the same specialist radiologist and radiological finding include cartilage destruction, tumor density, enhancement, volume, extra laryngeal extension and anterior commissure involvement were recorded. All data were subjected to statistical analysis.

## Results

This study included 24 patients with laryngeal carcinoma. The mean age of patients was 62.58±12.98 years, 18 of them were male while six patients were female as shown in the figure (Figure 1).

All patients with histopathological findings of squamous cell carcinoma of the larynx. Seventy five percent of patients had hoarseness of voice at time of diagnosis while twenty five percent are aphonic as shown in the figure (Figure 2).

Regarding density of the mass of laryngeal cancer when examined with MDCT, half of cases (50%) showed heterogenous density, while the remaining presented as either with homogenous hypodense mass or isodense mass (25% for each) as shown in the figure (Figure 3).

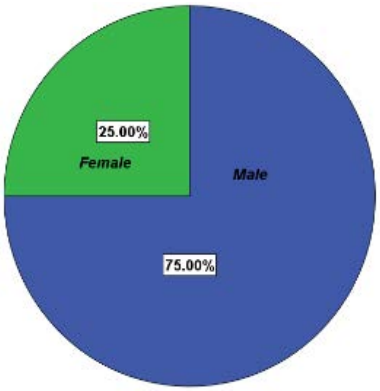


**Figure 1:** Gender distribution.

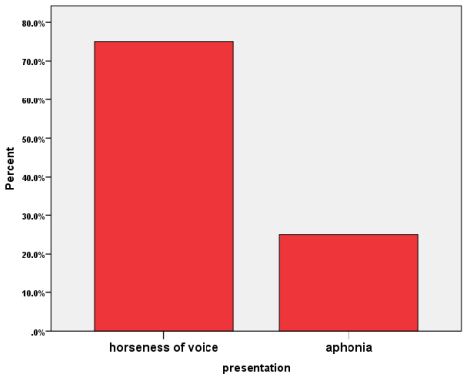


**Figure 2:** Presenting symptom at time of diagnosis.

Regarding other radiological features that were included in the study, following results were in the below figure (Figure 4):

- 58% of patients had cartilage destruction.
- Based on size & abnormal enhancement, lymph node involvement was seen only in 22% of patients at time of diagnosis.
- Extralaryngeal involvement was detected in (18%) of cases.
- In most of patients (91%), laryngeal cancer was involving the anterior commissure.

Based on the findings of the examination we are able to divided the studied patients according to TMN classification into 12 patients (50%) with stage 3, while stage 2 and stage 4 constituted the other half with equal distribution (6 for each) as demonstrated in the below figure (Figure 5).

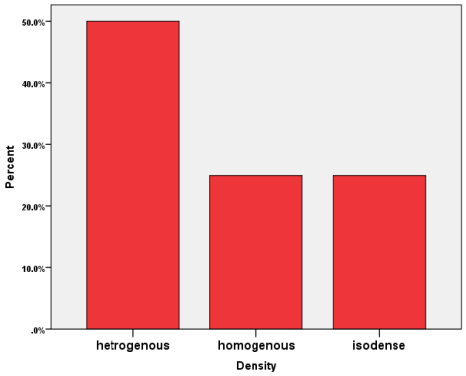


**Figure 3:** Distribution of laryngeal masses according to their CT density.

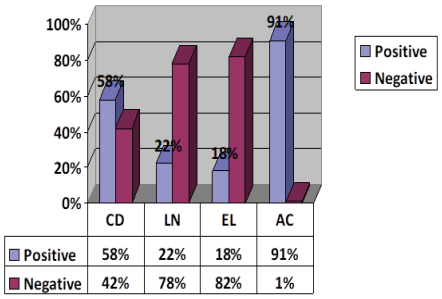


**Figure 4:** Presence of cartilage destruction (DC), lymph node (LN), extra laryngeal extension (EL) and anterior commissure involvement.

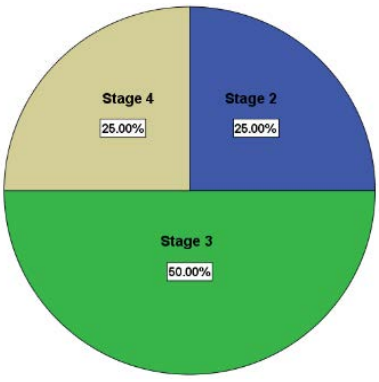


**Figure 5:** Distribution of TNM stages of laryngeal carcinoma.

Mean volume of tumor that measured by MDCT was 14.3±7.4 $cm^3$.

By correlating TNM staging of laryngeal carcinoma with the volume of tumor measured on CT, there was statistically significant relation (p value less than 0.005) between stage of the tumor and volume so that with the larger the volume the higher TNM stage as seen in table (Table 1).

Regarding clinical presentation, there was no significant difference whether the patient had hoarseness of voice or aphonia and stage of disease in the table (Table 2).

The density of the laryngeal mass showed significant effects on stage of disease so there was significant difference between homogenous density which is found in stage 2 and 4 while heterogenous and isodense mostly in stage 3 as seen in table (Table 3).

In the below table, cartilage destruction was seen in 58% of cases, mostly in stage 3 and 4 with a significant difference from those with negative cartilage destruction who were mostly in stage 2 (Table 4).

There was no significant difference between positive and negative extralaryngeal involvement and stage of disease (Table 5).

**Table 1:** Relation between TNM stage and volume of laryngeal tumor measured on MDCT.

| | Mean volume $Cm^3$ | Std. Deviation | P value |
|---|---|---|---|
| Stage 2 | 6.0667 | 5.37128 | 0.002 |
| Stage 3 | 16.3333 | 7.16600 | |
| Stage 4 | 18.6500 | 1.14630 | |

**Table 2:** Relation between clinical presentation and stage of laryngeal carcinoma.

| | | Stage | | | P value |
|---|---|---|---|---|---|
| | | II | III | Iv | |
| Clinical presentation | Hoarseness of voice | 6(33.3%) | 8(44.4%) | 4(22.2%) | 0.264 |
| | Aphonia | 0(0.0%) | 4(66.7%) | 2(33.3%) | |
| Total | | 6(25.0%) | 12(50.0%) | 6(25.0%) | |

**Table 3:** Relation between density of tumor and stage of disease.

| | | Stage | | | P value |
|---|---|---|---|---|---|
| | | II | III | Iv | |
| Density | Heterogenous | 2(16.7%) | 8(66.7%) | 2(16.7%) | 0.031 |
| | Homogenous | 4(66.7%) | 0(0.0%) | 2(33.3%) | |
| | Isodense | 0(0.0%) | 4(66.7%) | 2(33.3%) | |
| Total | | 6(25.0%) | 12 (50.0%) | 6(25.0%) | |

**Table 4:** Relation between cartilage destruction and stage of disease.

| | | Stage | | | P value |
|---|---|---|---|---|---|
| | | II | III | Iv | |
| Cartilage destruction | Positive | 0(0.0%) | 10(71.4%) | 4(28.6%) | 0.003 |
| | Negative | 6(60.0%) | 2(20.0%) | 2(20.0%) | |
| Total | | 6(25.0%) | 12(50.0%) | 6(25.0%) | |

**Table 5:** Relation between extra laryngeal extension of tumor and TNM stage.

| | | Stage | | | P value |
|---|---|---|---|---|---|
| | | II | III | Iv | |
| Extra Laryngeal extension | Positive | 0(0.0%) | 2(50.0%) | 2(50.0%) | 0.301 |
| | Negative | 6(30.0%) | 10(50.0%) | 4(20.0%) | |
| Total | | 6(25.0%) | 12(50.0%) | 6(25.0%) | |

## Discussion

CT and MR imaging are widely used for the staging of head and neck cancer including laryngeal carcinoma 7. In this study higher prevalence of laryngeal carcinoma is in males than females with a statistically significant difference (p value <00.5) in the disease stage where higher stages (3 and 4) were seen in male and the lower stage (2) in female. This may be due to higher prevalence of smoking in male relative to females in our population. Clinical presentation of patients with laryngeal carcinoma, whether hoarseness of voice or aphonia, seems to have little effects on staging as there was no statistically significant difference. The Interesting finding in this study was that homogeneity of the laryngeal mass has significant effects on stage so that homogenous masses tend to be at lower stage and vice versa for heterogeneous ones. This can be explained on base that higher stage tumor mass may develop areas of necrosis as result of the rapid growth outweighing its blood supply. There was high prevalence of cartilage destruction (58%) in the current studied sample. Most of cases with cartilage destruction seen were found to have significantly higher stage 3 or 4 and this may be due to that the CT defined cartilage destruction more clearly and this would raise the stage of laryngeal cancer [8]. Preda L et al. studied 72 patients with laryngeal and hypopharyngeal tumor and they found that MDCT estimate of tumor volume is an effective and reproducible method [9]. Regarding the CT measured volume of the tumor mass, there was statistically significant correlation between TNM stages and volume of tumour detected by CT scan with the mean volume of tumor measured was approximately 6.1 $cm^3$ in stage I, 16.3 $cm^3$ in stage II and finally 18.7 $cm^3$ in stage III. This correlation supports the findings of many recent studies regarding significance of tumor volume in prediction of tumor stage. In one study of 71 patients with T3 head and neck carcinoma involving different subsites found that T3-stages tumor of the head and neck show considerable variability of tumor volumes. Incorporation of tumor volume data may further define the TNM staging system [10]. This is supported by Hamilton et al. who study of 47 patients of laryngeal cancer and they found that there is significant and independent relationship between CT determined tumor volume and local recurrence in moderately advance laryngeal tumor based on these results CT should therefore become a routine part of the staging system for T2 tumor and above [11]. Practically, tumor is measured by either two or three perpendicular maximum diameters of the mass. The result of this measurement may not reflect the real size of the mass. Using the method applied in this study can offer a simple and more geometrically accurate assessment of the mass that is correlated with the TNM stage and may be even more reproducible and reliable for follow-up and monitoring of the disease. In current study, based on structural and radiological criteria (size, shape, necrosis and abnormal enhancement), lymph node involvement was seen only in 22% of patients at time of diagnosis but with considerationthat normal sized L.N. could be metastatic and on the other hand, enlarged L.N. could be benign (for example reactive) in nature,this is important limitation [12]. Thus, another imaging including US, MRI and more currently functional (PET) are better than CT in evaluating LN [13]. In contrary to what is expected, this study found no statistically significant effects ofpresence of extralaryngeal extension of tumor mass with increasing stage. So, tumors can be at high stage (3 & 4) without having that extralaryngeal component. Mafee et al. studied 7 patients with laryngeal carcinoma and they found that CT accurately demonstrates the anatomic location and gross size of laryngeal tumor [14].

The prevalence of anterior commissural involvement which is a CT finding that would raise the stage of disease, was very high in current study (91% of patients).

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## Conclusion

Laryngeal cancers are more likely to have higher TNM stage when MDCT shows: heterogenous density of the mass, presence of cartilage destruction, presence of anterior commissural involvement, larger volume of the mass. Presence of extralaryngeal extension on MDCT is not necessarily associated with higher stage of tumor. Clinical presentations whether aphonia or hoarseness of voice have no significant effects on staging.

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