

Original Article

Diagnostic Performance of Computed Tomography in Laryngeal Carcinoma and its Extension

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Abstract

Background: Laryngeal carcinoma is a common malignant neoplasm of the head and neck with high incidence of new malignancies worldwide every year. Several imaging techniques including magnetic resonance imaging (MRI) and computed tomography (CT) scans are widely used to detect laryngeal carcinoma. Of them, CT scan is relatively cheaper, easily available and sensitive in the evaluation of laryngeal carcinoma. **Objective:** To find out the diagnostic performance of CT scan in laryngeal carcinoma and its extensions. **Methodology:** This cross-sectional study was carried out in the department of Radiology and Imaging, Dhaka Medical College Hospital, Dhaka, during the period of July, 2016 to June, 2018 for a period of 2(two) years. A total of 50 samples were included purposively. The enrolled patients were attending outpatient department (OPD) or admitted in indoor and referred to the Radiology and Imaging department for CT scan. All the enrolled cases had laryngectomy and resected tissues were sent for histopathological examination. Data collection was done by the principal investigator and a preformed questionnaire was used during data collection. Following completion of data collection, it was analyzed by SPSS 20.0. **Results:** Age range of the patients was from 18 to 84 years, with the mean age of 61.2 years + 13.4 years standard deviation and a male-female ratio of about 7.3:1. By multidetector CT scan, majority (32, 64.00%) of the tumours were found confined in a specific area with no extension, followed by 12 (24.00%) involving both supraglottic and glottic region. On the other hand, by histopathology, almost all (47, 94.00%) of the cases were found malignant and majority of the malignant cases (31, 65.96%) were found without nodal metastasis. Validity tests of CT in the diagnosis of laryngeal carcinoma revealed sensitivity, specificity, accuracy and positive predictive values of 97.9%, 66.7%, 96% and 97.9% respectively. In case of nodal metastases, the sensitivity, specificity, accuracy and positive predictive value were 93.8%, 97%, 96% and 93.8% respectively. **Conclusion:** Contrast enhanced CT scan has good role in detecting nodal metastases, but had complementary role in detecting laryngeal carcinoma.

Key Words: Laryngeal carcinoma, Computed tomography, Metastasis

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Introduction:

The larynx connects the pharynx to trachea of the respiratory tract and is located in the anterior aspect of the neck. It is composed of cartilaginous tissue and plays a

vital role in the respiratory tract by allowing air to passage through it. It is also an organ of phonation. Both benign and malignant conditions can affect the larynx; however, it is the most common site for primary malignant tumour in head and neck regions.¹

Laryngeal carcinoma represent approximately 1-2% of all cancers worldwide.²

The laryngeal carcinoma is usually found in adults with a peak incidence in the 5th to 6th decades of life,³ and is considerably more common in male with a higher male female ratio in the higher incidence area.⁴ No single specific aetiologic factor has been cited for laryngeal carcinoma, but some factors have been found closely associated with increased incidence of carcinoma of larynx. Among the factors, smoking, drinking alcohol, tobacco chewing habits were found as the most important.⁵ A higher incidence of laryngeal cancer has been reported from Asian population. In a study in Dhaka Medical College Hospital, Dhaka, it was seen that 35.32% of all body cancers was in the head and neck region and carcinoma of the larynx was the commonest (31.58%).¹

Carcinoma of the larynx interferes with most vital functions in the sufferers like voice, respiration and swallowing by virtue of its anatomical location, local infiltration and direct extension.⁶ There is a tendency for squamous cell carcinoma of larynx to metastasize to cervical lymph nodes via embolization. Supraglottic area of larynx has rich lymphatics and so are associated with early metastasis to cervical lymph nodes. Common levels of neck nodes are jugulodigastric (level II) and mid jugular (level III) lymph nodes.⁷ While this is less common with glottic/subglottic tumours.

In laryngeal carcinoma, computed tomography (CT) scanning in combination with clinical examination has been shown to give a better representation of disease extent than clinical examination alone when compared with a pathologic specimen.⁸

Beiler et al⁹ offers a careful retrospective clinicopathologic analysis of the accuracy of pretreatment CT scanning to predict cartilage invasion and extra-laryngeal cancer spread. The capability of CT scan for evaluating deep laryngeal areas, submucosal tissues, laryngeal cartilages and lymph nodes makes it a valuable preoperative diagnostic technique in evaluating patients with laryngeal carcinomas. Correlations of CT signs and histopathologic findings were determined.

The diagnostic accuracy of CT in laryngeal carcinoma observed with sensitivity and specificity for supraglottic mucosa, glottic mucosa and subglottic mucosa were 100%, 100% and 100% respectively for sensitivity, and 83%, 85% and 86% respectively for specificity.¹⁰ In case of cartilage destruction, sensitivity and specificity was found as 89%

and 80% respectively, and in case of peri-epiglottic space (PES) involvement, sensitivity and specificity were 100% and 53%.

The clinical implications of findings of Du et al¹¹ are critically important, since they showed that multidetector CT scan had a positive predictive value of 78% and a negative predictive value of 100% for detection of invasion through cartilage, with sensitivity being 100% and specificity 96%.

The objective of this study was to determine the diagnostic accuracy, including sensitivity, specificity, positive predictive value and negative predictive value of CT in evaluation of laryngeal carcinoma.

Methodology:

It was a cross-sectional study, carried out in the department of Radiology and Imaging, Dhaka Medical College Hospital (DMCH), Dhaka, from July 2016 to June 2018 for a period of 2 years. A total of 50 patients with suspected laryngeal carcinoma, attending department of ENT and Head-Neck Surgery, and referred to the department of Radiology and Imaging, DMCH for computed tomography (CT) scan of neck were included. All the patients underwent laryngectomies, after which laryngeal tissues were sent to department of Pathology for histopathological evaluation of laryngeal carcinoma and the reports were collected and compiled in data sheet. The patients were evaluated by CT findings and histopathological examination reports.

Multidetector CT (MDCT) scan was performed in the department of Radiology and Imaging with HITACHI 128 slice CT scanner. Both pre- and post-contrast scan was obtained with the patients in supine position during breath hold. The area included from base of the skull to the arch of aorta using 2.5 mm collimation, 1.5 mm pitch, 120 kvp, 150 mAS. Scans were obtained using 4 mm thick axial section. In selected cases, such as glottis tumours, 2 mm sections were obtained for further definition of the lesion present. The CT examination was interpreted on hard copy. Axial, coronal and sagittal images of soft tissue and bone window images were obtained. Injectable contrast (Iopamidol- 370 mg/ml strength as a 100ml bolus infusion) was used to facilitate detection of metastatic lymph nodes. Validity of the MDCT scan was detected considering histopathology results as gold standard and calculated using the standard formulae for sensitivity, specificity, positive predictive and negative predictive values.

Results:

Ages of the enrolled patients were from 18 to 84 years with the mean age of 61.2 years ± 13.4 years standard deviation. Male female ratio was 7.3:1.

By computed tomography (CT) scan, about two-thirds of the cases (32/50, 64.00%) were suspected as carcinoma of larynx without lymphadenopathy and additional 15(30.00%) as carcinoma with lymphadenopathy. The remaining 3(6.00%) were suspected as benign lesions. (Table I)

Table I: Diagnosis of the laryngeal tumours by computed tomography (CT) scan (n=50)

CT diagnosis	Frequency	Percentage (%)
Suspected carcinoma without lymphadenopathy	32	64.00
Suspected carcinoma with lymphadenopathy	15	30.00
Suspected benign	3	6.00

Considering histopathological findings of the cases, almost all (47, 94.00%) of the suspicions were diagnosed as carcinoma of larynx and remaining 3(6.00%) as benign lesions. Among the carcinoma larynx cases, majority (31, 65.96%) had no nodal metastasis and about one-third (16, 34.04%) were found having nodal metastases. (Table II)

Table II: Diagnosis of laryngeal tumours by histopathology (n=50)

Histopathological diagnosis	Frequency	Percentage (%)
Carcinoma of larynx	47	94.00
Carcinoma without nodal metastasis	31	65.96
Carcinoma with nodal metastasis	16	34.04
Benign	3	6.00

By computed tomography (CT) scan, majority of the cases (32/50, 64.00%) were found confined in a specific area with no extension, while 12(24.00%) cases were found involving both supraglottic and glottic regions and only 4(8.00%) cases had extensions in all three areas of the larynx. (Table III, Figure 1, Figure 2)

Table III: Extension of the lesions of suspected Laryngeal carcinoma cases to the surrounding structures by computed tomography (CT) scan (n=50)

Type of extension found by CT scan	Frequency	Percent
No extension of lesion	32	64.00
Supraglottic & glottic	12	24.00
Transglottic	4	8.00
Glottic & subglottic	2	2.00



Figure 1: Axial NECT scan of neck showing mixed density mass involving left vocal cord compressing the air column

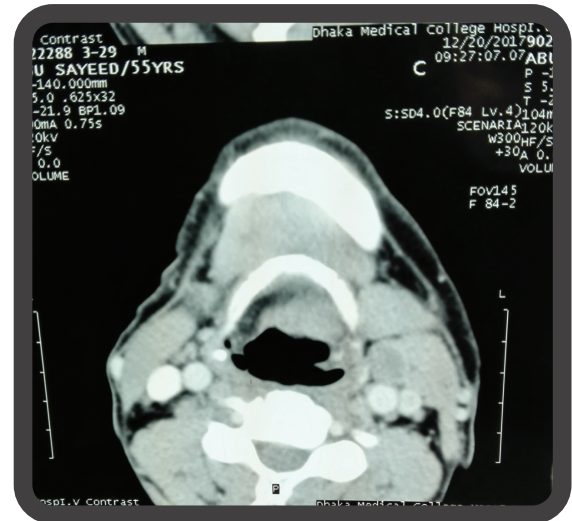


Figure 2 : Axial CECT scan of neck showing left sided cervical lymphadenopathy

Considering histopathology as gold standard, there was 46(97.87%) true positive identifications for carcinoma larynx with 1(2.13%) false positive, and 2(66.67%) true negatives with 1(33.33%) false negative result by multidetector CT (MDCT) scan. (Table IV)

Table IV: Relationship between histopathology and multidetector CT (MDCT) scan results

Histopathology results	MDCT scan results for malignancy	
	Positive	Negative
Malignant (n=47)	46 (97.87%)	1(2.13%)
Non-malignant (n=3)	1(33.33%)	2(66.67%)

Validity tests of MDCT diagnosis revealed sensitivity of 97.9% and specificity of 66.7% with 96.0% accuracy and 97.9% positive predictive value. (Table V)

Table V: Diagnostic accuracy of multidetector computed tomography (MDCT) in assessing laryngeal carcinoma

Validity tests	Percentage (%)
Sensitivity (TP/TP+FN)	97.9
Specificity (TN/TN+FP)	66.7
Accuracy (TP+TN/TP+TN+FP+FN)	96.0
Positive predictive value (TP/TP+FP)	97.9
Negative predictive value (TN/FN+TN)	66.7

TP=true positive, FP=false positive, TN=true negative, FN=false negative

Histopathology detected 34(68.00%) patients had no nodal involvement and remaining only 16(32.00%) had nodal involvement. Comparing with histopathology results, MDCT showed 15(93.75%) true positive cases of laryngeal carcinoma with nodal involvement and 33 (97.06%) true negatives. Only 1(2.94%) case was false positive and 1(6.25%) yielded false negative result. (Table VI)

Table VI: Relation between CT scan and histopathology results for nodal involvement

Histopathology results showing nodal involvement	Multidetector CT scan showing nodal extension	
	Present	Absent
Yes (n=16)	15 (93.75%)	1 (6.25%)
No (n=34)	1 (2.94%)	33 (97.06%)

Taking histopathology results as gold standard, the sensitivity and specificity of MDCT to detect nodal extension were 93.8% and 97.0% respectively with 96.0% accuracy.

Table VII: Diagnostic accuracy of multidetector computed tomography in assessing nodal extension of the laryngeal carcinoma cases

Validity tests	Percentage (%)
Sensitivity (TP/TP+FN)	93.75
Specificity (TN/TN+FP)	97.0
Accuracy (TP+TN/TP+TN+FP+FN)	96.0
Positive predictive value (TP/TP+FP)	93.8
Negative predictive value (TN/TN+FN)	97.0

TP=true positive, TN= true negative, FP=false positive, FN=false negative

Discussion

In this study, it was observed that mean age of the included patients was 61.2 years \pm 13.4 years standard deviation and age ranges from 18 years to 84 years. In one study in Bangladesh by Mahfuz et al¹² found the age of the patients ranged from 30 to 79 years (54 \pm 10.49).

Regarding the extension of the lesion, it was observed that majority (32, 64.00%) of the tumours were confined in a specific area with no extensions, while 12 cases (24.00%) involved both supraglottic and glottic region and only 8.00% had extension in all three areas of larynx. Kazkayasi et al¹³ showed that tumour extension between laryngeal mucosal surfaces and its cartilaginous framework and invasion to the extra-laryngeal tissue planes was most important for classification of a lesion and for decision making about treatment choice.

Among the suspected 50 cases, 47(94.00%) were diagnosed as laryngeal carcinoma with only 3(6.00%) as benign tumours. Among the laryngeal carcinoma cases, majority (31, 65.96%) were found having no nodal metastasis and remaining 16(32.00%) had nodal metastases. Diagnostic accuracy of MDCT for sensitivity, specificity, accuracy, positive predictive value and negative predictive value were 97.9%, 66.7%, 96.0%, 97.9% and 66.7% respectively. Comparing with histopathology findings, MDCT scan detected 15(93.75%) cases with nodal extension. In a study in China, Li et al¹⁴ found almost similar findings of majority of patients (85.0%) having laryngeal cancer.

Using histology as the gold standard, Li et al¹⁴ determined that the multidetector CT (MDCT) scan had a positive predictive value (PPV) of 78% and negative predictive value (NPV) of 100% for invasion into surrounding tissues. Atlanoglu et al¹⁵ observed sensitivities of CT assessment for supraglottic mucosa, glottic mucosa and subglottic mucosa of 100%, 100% and 100% respectively with corresponding specificities of 83%, 85% and 86% respectively.

In the current study, it was observed that majority (34, 68.0%) patients had no nodal involvement and only 16(32.00%) patients were found having nodal involvement. In Bangladesh, Mahfuz et al¹² found that nodal involvement was 38.71% in cases of supraglottic carcinoma. Raitiola et al¹⁶ observed nodal involvement as 52.53% in supraglottic carcinoma. In another study by Thabet et al¹⁷ found only 6.0% patients demonstrated histological evidence of paratracheal nodal metastases (larynx, 20%, postericoid/cervical oesophageal region, 43%), which are comparable with the current study. Chu et al¹⁸ found approximately 30%

of all laryngeal cancers arose in the supraglottic region. Lymph node metastases were common and affected the pre- and para-tracheal nodes. The sensitivity and specificity of CT to detect nodal disease using these criteria were 90% and 75% respectively.¹³ In our study, the sensitivity and specificity of CT to detect nodal disease were 93.8% and 97% respectively with 96% accuracy and 93.8% positive predictive value, which matches previous studies mentioned above.

A large study including countrywide specimen can overcome the limitations of the present study including a small number of cases at one institution.

Conclusion:

The current study revealed high sensitivity, accuracy and positive predictive value of computed tomography in the diagnosis of laryngeal carcinoma in pre-operative discrimination and subsequent. From the present study findings, it could be concluded that computed tomography is a useful modality in the diagnosis of laryngeal carcinoma and its extension.

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