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Role of multidetector computed tomography in assessment of laryngeal cancer: Experiences from 31 cases

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ABSTRACT

Aims. To compare the efficacy of computed tomography from endoscopic examination in diagnosing and staging laryngeal carcinoma.

Methods. From February 2019 to July 2020, we conducted a retrospective study on patients with laryngeal carcinoma. After receiving a clinical diagnosis of laryngeal masses, patients underwent indirect laryngoscopy evaluation before being referred for computed tomography (CT) scans. A postimaging biopsy was undertaken via direct laryngoscopy. Imaging features of the tumor, such as size, level of invasion, and tumor staging, were analyzed.

Results. The mean age was 61±11, with 90% of male patients. The risk of laryngeal cancer for those patients who were active smokers (93.5%) and alcohol consumers (67.7%). The most common symptom was hoarseness (93.5%). In CT image, more than half of the cancers were carcinoma of the glottis (29%) and two regions, supraglottis and glottis (22.6%), while the less common cancers were the subglottic (3.2%) and all three regions (9.7%) carcinoma, especially true vocal cord (67.7%) is the most common site starting carcinoma. The percentage of tumor spreading to paraglottic space and pre-epiglottic space was 50% and 30.6%, respectively. The most common stage of laryngeal cancer in CT was the T3 stage (35.5%). Compared to laryngoscopy, there is a weak agreement (Kappa=0.518) in staging in laryngeal cancer in CT.

Conclusion. MDCT is better in staging of laryngeal cancer in the T3 and T4 stages as compared to laryngoscopy.

Key word: Laryngeal carcinoma, MDCT, CT, endoscopy

INTRODUCTION

Laryngeal cancer is one of the most prevalent tumors of the respiratory system [1-3]. According to the National Center for Health Statistics 2022, laryngeal cancer ranks second in the total number of respiratory cancers in the United States [4]. Laryngeal cancer has an incidence rate mortality rate were 2.0 and 1.0 per 100,000 worldwide, as reported by GLOBOCAN 2020 [5].

Imaging is used to assess laryngeal malignancies, clinical evaluation, and endoscopic biopsies. The choice of care methods for patients with laryngeal malignancies is highly impacted by the integration of radiological findings and endoscopic examination, which greatly enhances the therapeutic staging accuracy of these cases [6].

When it comes to predicting neoplastic infiltrations, computed tomography (CT) findings of tumor extension in the extra-laryngeal soft tissues and erosions of the inner cortex of the arytenoid, cricoid, and thyroid cartilages highly correlate with histological testing. For patients with primary and post-radiochemotherapy recurrent advanced-stage laryngeal cancer, CT demonstrated a high degree of diagnostic accuracy in assessing laryngeal cartilage infiltrations before surgery. Therefore, to shorten the time patients must wait to begin therapy, CT examination for laryngeal carcinoma staging should be chosen over magnetic resonance imaging (MRI) in patients with severe obstructive respiratory distress [7].

Currently, many imaging techniques are used to evaluate the clinical stage of head and neck cancer patients in general and larynx in particular, especially multidetector computed tomography (MDCT) and MRI. However, not all health facilities are equipped with MRI machines. Nowadays, MDCT is almost common in most health facilities. Therefore, we carry out this study to apply MDCT in clinical practice to accurately diagnose and stage laryngeal cancer, helping to choose the right treatment method for the patient and avoiding recurrence later. Furthermore, according to the literature currently in circulation, there are specific advantages to endoscopic examination over CT when it comes to diagnosing and staging laryngeal cancer. In this study, we examined the

diagnostic and staging capabilities of computed tomography of the larynx with endoscopic examination for laryngeal cancer.

MATERIALS AND METHODS

A retrospective was conducted on patients with laryngeal carcinoma at Hue Central Hospital from February 2019 to July 2020. Imaging information is stored in the original medical record and the PACS system. The study was approved by the research ethics committees of Hue Central Hospital.

The inclusion criterion was patients who had histologically confirmed diagnoses of primary laryngeal carcinoma. The exclusion criteria were the patients who had any prior or current treatment modality, hypopharyngeal cancer or hypopharyngeal cancer spreading to the larynx, and contraindications of CT.

After receiving a clinical diagnosis, individuals with laryngeal masses underwent indirect laryngoscopy evaluation before being referred for CT scanning. Laryngoscopy was used directly for the biopsy. The tumor's imaging characteristics were examined, including its location, degree of invasion, and stage.

A 32-detector row helical CT scanner (GE, USA) was used for all CT exams. Its specifications were as follows: 110 kV tube voltage, 0.625 mm pixel size, 200 mm field of view, 1 mm thickness and reconstruction intervals, 85 mAs current exposure time, 1 s rotation time, 128×0.6 mm beam collimation, 1 mm pitch, and 131 s/3 reconstruction kernel. After 60 seconds of intravenous contrast media injection, patients had both contrast-enhanced and unenhanced images. A 40-ml bolus of saline solution was given after an iopromide dose of 1-1.5 ml/Kg (Ultravist 300 mg/ml) was given using a power injector at a flow rate of 3–4 mL/s. The field of view reached the thoracic inlet from the base of the skull. Following processing, axial, sagittal, and coronal planes orientated on the glottic plane were used to create 1 mm-thick slice.

RESULTS

There were 31 patients diagnosed with primary laryngeal carcinoma at Hue Central Hospital from February 2019 to July 2020. The mean age was 61 ± 11, with 90.3% male and 83.9% of patients aged over 51. The risk of laryngeal cancer for those patients who were active smokers (93.5%), and alcohol consumers (67.7%). The most common symptom was hoarseness (93.5%). CT images revealed carcinoma distributed mainly in the glottis and two regions supraglottis and lottis, accounting for 29% and 22.6%, respectively (Figure 1 and Figure 2). Tumors in all 3 regions of the larynx accounted for 9.7% (Table 1). The paraglottic space (50%) and the pre-epiglottic space (34.6%) were the most common sites of invasion (Figure 3 and Figure 4). Thyroid cartilage and infrahyoid muscles were uncommon, with a rate of 7.7% (Table 2). T3 was the most common stage in our study (35.5%), followed by T2 (25.8%) and T1 (19.4%). The percentage of T4 was 6.5%, and 4 patients (12.9%) did not detect any lesions on CT (Table 3).

According to our study, 4 tumors (12.9%) at the T0 stage on CT scan were upgraded to T1 and T2 stages on endoscopy. In addition, 5 tumors (16.7%) in the T2 stage on endoscopic upgrade to T3 on CT and 2 tumors (6.5%) in stage T3 on endoscopic upgrade to T4 on CT were found (Table 4). The agreement of tumor on staging (T) between CT and endoscopic examination was weak (Kappa=0.518).

DISCUSSION

In our study, 31 patients were recruited. Middle and elderly patients still accounted for the majority (83.9%) with a mean age of 61±11, similar to the results of Larbcharoensub study (62 ± 10) [8] or Abdel Tawab (58 ± 11) [9]. Most patients were male (90,3%), similar to the results of Dechaphunkul (92.3%) [10] or Markou (98.6%) [11]. There was a big gender difference in our study because the percentage of men who smoke and drink alcohol was much higher than women, resulting in a high risk of laryngeal cancer in men. They were the main risk factors in our study, with 93.5% of patients smoking and 67.7% of patients drinking alcohol, similar to the study of

many authors, including Dechaphunkul [10] or Wang [12] with the rate of active smokers and alcohol consumers were 83.2%, 58.4% or 75%, 55% respectively.

In our study, the tumor was mainly distributed in the glottis at 29%, followed by the two regions supraglottis and the glottis accounting for 22.6%. 4 cases (12.9%) were not detected any finding by CT. This result is quite similar to Sarkar, with the most common site of disease being glottis (42.4%) [13], followed by transglottis involvement in 36.3%. But unlike Kashyap's study, the tumors were mainly distributed in the two regions, hypraglottis and glottis or all three regions with a rate of 70.8% and 16.7%, respectively [14]This result showed that our study focuses on tumors at an early stage, which had not yet invaded other larynx regions. Besides, there were 4 cases that were not detected by CT, possibly because the size of these tumors is small, tumor cells are confined to the mucosa, and they did not invade deeply, so the CT scan could not be detected.

In our study, most tumors tended to invade the paraglottic space and then the pre-epiglottis space with the rate of 50% and 34.6%, respectively, with 2 cases accounting for 11. 1% invades thyroid cartilage and infrahyoid muscles. This rate is also quite similar to Sharkawy ‘s study that showed the invasion into the paraglottic space accounted for 63.3%, and the pre-epiglottis space was 23.3% [15]This is because the spread of tumors is facilitated through open areas of loose connective tissue; areas composed of loose collagen and reticulin fibers are easily invaded by tumors, such as the paraglottic space or pre-epiglottis space. Laryngeal cartilages are relatively resistant to tumor invasion, often demonstrating extensive tumor spread along and around the laryngeal cartilage surfaces before invasion.

Compared with some studies, our results are quite similar when the T3 stage accounts for the highest percentage. However, in our study, the cancer was mainly in stages T2 and T3, while the remaining studies focus on stages T3 and T4. This may be due to the small tumor size, our patients were distributed in the early stage when the tumor had not invaded widely (Table 5).

On comparing the site diagnosis of laryngeal carcinoma on endoscopy and CT, 4 patients (12.9%) could not identify lesions on CT compared with endoscopy because the tumors were changed in the mucosa. Similarly, on endoscopy, there was 1 case of tumor in the glottis spreading to the supraglottis, but the CT was not detected. There were 2 cases in which the tumor grew in many regions of the larynx and could not be detected on endoscopy because the bulky tumor and even normal cords could hide the subglottic area, which makes it difficult for endoscopic examination to determine whether the tumor had invaded the subglottis.

On comparing the stage of laryngeal carcinoma on endoscopy and CT, a CT scan is a poor tool in identifying early mucosal changes like mucosal edema and mucosal thickening, whereas they can be picked up with relative ease by endoscopic examination if present (4 tumors (12.9%) at T0 stage on CT scan were upgraded to T1 and T2 stage on endoscopy)

If the preepiglottic and/or paraglottic spaces are implicated, accurate evaluation of the preepiglottic and paraglottic spaces is essential for proper staging of the progression of supraglottic cancers into T3 tumors. When staging transglottic cancers accurately, the paraglottic space is crucial. Through evaluation of vocal cord mobility, which is challenging in large supraglottic tumors (5 tumors (16.7%) in T2 stage on endoscopic were upgraded to T3 on CT), endoscopy could provide insight into paraglottic space invasion.

T4 tumors are underdiagnosed on endoscopy (2 tumors, or 6.5% of the total) at stage T3 on endoscopic evaluation and are upgraded to T4 on CT. T4 tumors invade through the outer cortex of thyroid cartilage, cricoid cartilage, and tissues beyond the larynx. In this case, the laryngeal cartilage invasion can be detected well using CT.

There was a weak agreement of tumor staging ability (T) between CT and endoscopic examination (Kappa=0.518). The combination of endoscopy and CT resulted in significantly improved staging accuracy (80%).

Our study mainly compares the characteristics and values of computed tomography and endoscopic examination in laryngeal cancer, so it is limited that it has not been compared with the surgery, which is the gold standard of invasive assessment and staging. Therefore, we continue to do more research on this research in the future.

CONCLUSION

The accurate diagnosis and staging of laryngeal tumors are essential for appropriate treatment planning. Regarding large tumors, CT is a more accurate for determining subglottic involvement than endoscopy. When it comes to evaluating T3 and T4 tumors, MSCT is better than laryngoscopy. The evaluation of T1 and T2 lesions is better accomplished by laryngoscopy than by MSCT. A key factor in improving the diagnosis and treatment of laryngeal malignancies is the combined evaluation of the tumor using endoscopy and CT scanning.

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Disclosure statement

All the authors have no conflicts of interest relevant to this article.

Ethical approval

The study was approved by the research ethics committees of Hue Central Hospital. 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.

Informed consents

Written informed consent was obtained from the patients included in the study.

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Table 1. Site distribution of carcinoma in CT (n=31)

Site	Number	Percentage
No finding detected	4	12.9
Glottis	9	29.0
Supraglottis and glottis	7	22.6
Supraglottis	4	12.9
Glottis and subglottis	3	9.7
Supraglottis, glottis and subglottis	3	9.7
Subglottis	1	3.2

Table 2. Structure invasion of carcinoma in CT (n=31)

Structure	Number	Percentage
Paraglottic space	13	50.0
Pre epiglottic space	9	34.6
Thyroid cartilage	2	7.7
The infrahyoid muscles	2	7.7

Table 3. T staging of carcinoma by CT (n=31)

T Stage	Number	Percentage
T0	4	12.9
T1	6	19.4
T2	8	25.8
T3	11	35.5

T4	2	6.5

Table 4. Comparison of stage (T) on CT versus endoscopy (n=31)

T staging		MDCT					
		T0	T1	T2	T3	T4	n
Endoscopy	T1	3	6	0	0	0	9
	T2	1	0	8	5	0	14
	T3	0	0	0	6	2	8
	n	4	6	8	11	2	31
Kappa = 0.518							

Table 5. T staging between our study and others

T staging	Our study (%)	Louay El-Sharkawy [15]	Kashyap [14]	Aniruddha Sarkar [13]
T0	12,9	6.7	0	0
T1	19,4	13.3	12.5	9
T2	25,8	10	12.5	18.2
T3	35,5	46.7	50.0	30.3
T4	6,5	23.3	25.0	42.4
n	31	30	24	33

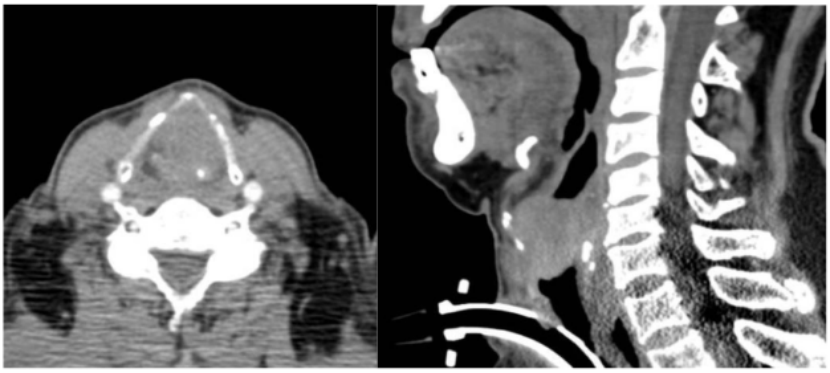

Figure 1. Male 83-year-old patient. Computed tomography in axial and sagittal plane showed the large tumor extended in all 3 regions of the larynx. Pathology showed squamous cell carcinoma

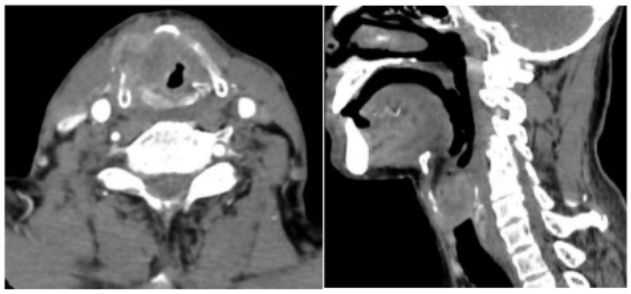

Figure 2. Male 72-year-old patient. Computed tomography in axial and sagittal plane showed the large tumor in the glottis invading the paraglottic space, thyroid cartilage and the infrahyoid muscles. Pathology showed squamous cell carcinoma

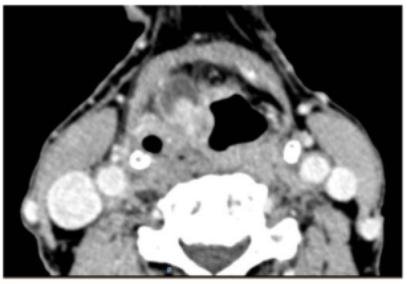

Figure 3. Male 64-year-old patient. Computed tomography in axial showed the tumor in the right vocal cord invaded the right paraglottic space. Pathology showed squamous cell carcinoma.

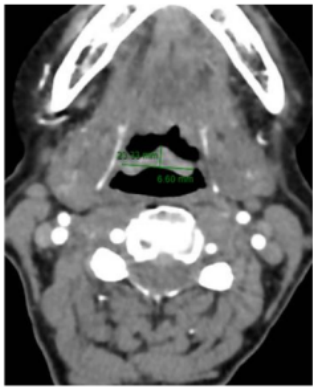

Figure 4. Female 74-year-old patient. Computed tomography in axial showed tumor in the epiglottis. Pathology showed squamous cell carcinoma.