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Role of Multi-Slice Computed Tomography and Magnetic Resonance Imaging in Evaluation of Laryngeal Tumors

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Abstract

Background: Imaging of laryngeal tumors is crucial for evaluation, preparing, treatment and for ensuring proper follow-up. Computed tomography and magnetic resonance imaging are the main imaging tools. Each modality showed its own advantages for assessment of local, regional or distant staging.

Aim of Study: The aim of this study was to evaluate the role of multi slice computed tomography and magnetic resonance imaging in diagnosis of laryngeal tumors.

Material and Methods: This prospective study included (30) patients in different age groups who were highly suspected with laryngeal tumors or known to be having laryngeal tumor. Patients were referred by Oto Rhino Laryngology (ORL) Department of Tanta University Hospital to the CT Unit & MRI Units of the Diagnostic Radiology & Medical Imaging Department, Tanta University Hospitals. All cases were subjected to full history, complete physical examination, radiological & medical imaging examination at which all cases were exposed to CT scanning of the neck while only 22 cases of them performed additional MRI examination of the neck. Further endoscopic examination and histopathological correlation were done. Data was analyzed by using SPSS.

Results: MRI showed higher accuracy than CT as regards to pathological T staging of laryngeal tumors 244 that showed 86.4% for MRI while 66.7% for CT. Both CT and MRI were equal in evaluation of certain areas as anterior commissure and pyriform sinus while MRI showed higher accuracy in evaluation of other laryngeal subsites namely preepiglottic, paraglottic spaces, posterior commissure, epiglottis, vocal cords, thyroid cartilage extralaryngeal spread.and metastatic lymphadenopathy with the total accuracy higher in MRI than in CT.

Conclusion: MRI could be considered a helpful diagnostic method for pre and post-therapeutic staging of laryngeal tumors specially early glottic lesions and the combined utility of CT and MRI could help to overcome the disadvantages and improve the accuracy specially about thyroid cartilage assessment and T staging of laryngeal carcinomas.

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Key Words: *Laryngeal tumors – SCC – Glottic – MSCT – MRI.*

Introduction

TUMORS of the larynx either benign or malignant constitute about 25% of all head and neck tumors and about 1-5% of all malignancies diagnosed annually. Laryngeal cancer is the second most common respiratory cancer after lung cancer. Its incidence is increasing over time in much of the world and this increase is generally accepted to be related to changes in tobacco and alcohol consumption **[1,2]**.

Integration of endoscopic findings with cross-sectional imaging to assess the submucosal, paralaryngeal spaces, extralaryngeal spread and cartilaginous invasion of these tumors improves the T staging accuracy and influences the treatment decisions in these patients. Imaging also provides information about the nodal disease, systemic metastases, any synchronous tumors and recurrent disease **[3-5]**.

Computed Tomography (CT) used to be the examination of choice that is performed for the evaluation of pathological laryngeal lesions due to its wide accessibility, shorter scanning time as nearly free of movement artifacts, aimed especially for patients who require immediate diagnosis (large obstructive lesions) or for uncooperative patients **[6]**.

Magnetic Resonance (MR) imaging with use of various sequences has been shown to be more accurate than CT in specific situations such as assessing soft tissue, cartilaginous invasion, preepiglottic space and tongue base invasion **[7]**.

MR imaging creates geometric distortion at the edges of the field of view and susceptibility artifacts

at interfaces between bone and air. MRI is more sensitive than CT in the diagnosis of cartilaginous invasion [8], however, most institutions continue to use CT as the primary cross-sectional modality as advances in high-resolution multi-slice CT have kept CT competitive with MRI [9].

Patients and Methods

This prospective study included (30) patients in different age groups who were highly suspected with laryngeal tumors. Patients were referred by Oto Rhino Laryngology (ORL) Department of Tanta University Hospital to the CT Unit & MRI Units of the Radiodiagnosis Department, Tanta University Hospitals, during the period from May 2016 to December 2017. Ethics Committee approval and informed consents were obtained. Privacy & confidentiality of all patient data were guaranteed. All data provision were monitored and used for scientific purpose only.

The selection criteria were:

Any patient who was suspected clinically by laryngeal complaint (e.g. hoarseness of voice, difficulty of swallowing, neck swelling) and/or known to be having a laryngeal tumor.

Exclusion criteria:

- *Medical exclusion criteria:*
  - Impaired renal excretory function (calculated GFR less than 30ml/ minute/1.73m^2).
  - History of allergy to contrast media.
  - Patient who refuses the examination.
- CT exclusion criteria: Pregnancy.
- *MRI exclusion criteria:*
  - Patients with intraocular metalic foreign body.
  - Patients with MR non compatible intracranial clips of arterial brain aneurysms, cochlear implants or cardiac pacemakers.
  - Claustrophobia.

All patients were subjected to the following:

1- Informed consent obtained from all patients.

2- Proper history taking.

3- Clinical examination: This was done at the ORL Department and included.

4- Laboratory investigations: Full blood screen and biochemical profile.

5- Radiological and medical imaging examinations: All the patients were subjected to CT examination of the larynx while 22 patients were subjected to MR examination within maximum interval of 6 days.

Technique of CT examination of the larynx:

Evaluation of laryngeal tumors requires a contrast enhanced CT study of the neck. Images of the neck were obtained, examination was done for all patients in CT Unit, Diagnostic Radiology Department using multi detector CT (GE optima 660 128 slice) followed by injection of an iodinated contrast agent (total dose 35-40g, 1ml/kg body weight). The contrast was injected by an automated power injector.

Patient preparation and positioning:

The patient lied in supine position with neck hyperextended, breathing quietly and is asked to refrain from coughing or swallowing.

Following acquisition of the lateral scout view, axial slices were obtained from the skull base to the aortic arch with the acquisition plane parallel to the plane of hyoid bone, to obtain scans parallel to the true vocal cords. The raw axial image dataset is reconstructed with a section thickness of about 0.75mm to obtain high quality sagittal and coronal reformatted images. A 512 X 512 matrix is used with a small field of view (FOV) between 16 X 16 cm was appropriate to cover the lymph nodes. All images were reviewed in soft tissue and bone windows.

Technique of MR imaging of the larynx:

MR imaging was done for 22 patients in MRI Unit, Diagnostic Radiology Department, Tanta University Hospitals. MRI scans were performed using high field MRI scanners (GE Signa Explorer 1.5-T closed magnet) using anterior neck coil. A combination of multi-planar non contrast T1-weighted, T2-weighted and T2-weighted fat saturation images with post contrast T1 fat-suppressed images were routinely used. It is important to take the T1 and T2 sections at the same levels. A section thickness of 4mm is preferred with an interslice gap of 0-1mm.

Patient preparation and positioning:

All patients were examined supine with the use of neck surface coil and immobilized in comfortable position.

Pulse sequence and scanning plane:

A scout T1 weighted sagittal image view to verify precise position of patient and act as a localizer of subsequent slices.

Magnetic resonance imaging protocol included:

Pre-contrast imaging:

A- An axial thin section T1W SE and T2W FSE images are obtained covering the larynx from the base of the tongue to the first tracheal ring, the scan orientation was parallel to the laryngeal ventricle.

- Axial T 1 WI (TR/TE=400-600/10-20m/sec).
- Axial T2WI (TR/TE=2000-4000/100-120 m/sec).
- Typical imaging parameters for standard examination:
  - Section thickness of 4mm.
  - Interslice gap of 0.5-1mm.
  - A field of view (20 X 20cm).
  - An acquisition matrix of 256 X 192.

B- Coronal and/or axial FLAIR images (TR/TE/ Inversion time (TI)=4000-6000/140/1200).

C- Sagittal T 1 W SE images were performed with sagittal sections in the true midline localized from axial pre-contrast scan.

Post-contrast imaging:

Post-contrast axial, coronal and sagittal fat saturated T1 WI study was done after injection of gadolinium-based contrast agents as Magnevist (0.1 ml/Kg).

6- Endoscopic examination was done for all patients and was carried under general anesthesia for direct examination, biopsy and histopathological examination.

7- Pre therapeutic staging: The tumor was staged according to TNM classification based on the combined clinical, radiological and histopathological data.

Results

This study included 30 patients who were highly suspected to have laryngeal tumors; 26 males and 4 females with age ranges from 40 years to 75 years (mean age 60.6 years). The affection with laryngeal tumors was predominant in males representing 86.7% of the total number of cases, shown in (Table 1).

The 30 patients in our study presented clinically by variety of symptoms, 18 patients presented mainly by hoarseness of voice, 10 patients with difficult painful swallowing or dysphagia while only 2 patients presented by neck swelling. In our study, hoarseness of voice was the main presenting symptom in 18 patients (60%), followed by dysphagia in 10 patients (33.3%) while only 2 patients (6.7%) presented by neck swelling.

Table (1): Age and gender distribution of the studied patients.

Characteristics	(No=30)	
	N.	(%)
Age (in years):		
40-<50	2	6.7
50-<60	8	26.7
60-<70	14	46.7
70-<80	6	20.0
Mean ± S.D	60.6±9.3	
Range	40-75	
Gender:		
Male	26	86.7
Female	4	13.3

Out of 30 patients in our study, 22 patients had performed combined CT and MRI followed by laryngoscopic examination, the remained 8 patients had performed CT only. Histopathological examination was done for all 30 cases.

In our study; 28 cases were histopathologically confirmed to be neoplastic (28/30) representing 93.3% of cases while only 2 cases showed inflammatory conditions (2/30) 6.7% of cases as shown in (Table 2).

Table (2): Aetiological classification according to histopathology of the 30 patients in our study.

Aetiology	N.	(%)
Neoplastic	28	93.3
Non-neoplastic:		
Inflammatory	2	6.7
Non inflammatory		
Total	30	100.0

Out of the 28 patients who had been proved histopathologically to be neoplastic lesions; 26 patients showed primary laryngeal neoplasms (26/28) while only 2 patients showed metastatic deposits (2/28).

Primary laryngeal tumors were the most common type encountered in our study (26/28 patients) representing 92.85% of cases while metastatic deposits represented only 7.15% (2/28 cases): 1 from NHL and 1 from metastatic HCC.

The 28 patients diagnosed with laryngeal neoplasms were further classified according to the regional area of involvement into: 8 patients had transglottic carcinoma, 8 patients had glottic with supraglottic carcinoma, 6 patients had glottic carcinoma only and 6 patients with supraglottic carcinoma only.

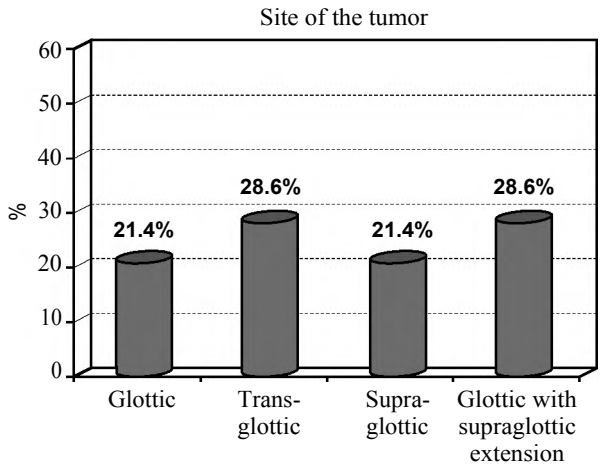

Fig. (1): The site of the tumor among the studied patients.

Transglottic and glottic with supraglottic extension of the tumors were the most common regions affected in our study, each represented 28.6% of cases. Glottic involvement noted in 78.6% of cases, No cases showed subglottic carcinoma only.

The histological findings showed 20 cases with squamous cell carcinoma, 2 cases with carcinoma in situ, 2 cases with adenocarcinoma, 2 with chondrosarcoma and 2 with metastatic deposits as shown in (Table 3).

Table (3): Histological classification of the 28 patients with laryngeal neoplasms.

Origin of the tumor	Histopathological diagnosis	N.	(%)
Primary laryngeal tumor (total 26)	Squamous cell carcinoma	20	71.6
	Adenocarcinoma	2	7.1
	Chondrosarcoma	2	7.1
	Carcinoma in situ	2	7.1
Metastatic laryngeal tumor (total 2)	NHL	1	7.1
	Metastatic HCC	1	
Total		28	100.0

Histopathological staging was done for 26 patients diagnosed with primary laryngeal neoplasms according to TN staging system. M staging wasn't included in our study.

Histopathological T staging of 26 cases with primary malignant laryngeal neoplasms; 2 cases showed carcinoma in situ, 4 cases with T1, 8 cases with T2, 4 cases with T3 and 8 cases with T4.

Histopathological N staging that was done for 15 cases (12 cases by block neck dissection while 3 cases by selective neck dissection, the other 15 cases showed non necessary neck dissection or nodal biopsy); 11 cases were N0 (no nodal involvement) and 4 cases with N1 (metastatic LNs sized less than 3cm).

In our study, the most frequent pathological T stage was T2 & T4 representing 30.8% for each while the most frequent N stage was N0 representing 73.3%.

CT examination of the neck was done for all 30 patients. CT findings were compared to histopathological staging of those patients as shown in (Table 4).

Table (4): Tumor T-staging by CT compared to histopathology.

Histopathology	CT						
	T0	Tis	T1	T2	T3	T4	Total
T0	2	0	0	0	0	0	2
Tis	2	0	0	0	0	0	2
T1	0	0	4	0	0	0	4
T2	0	0	0	8	0	0	8
T3	0	0	2	0	0	2	4
T4	0	0	0	2	0	6	8
Secondary tumor	0	0	2	0	0	0	2
Total	6	0	6	10	0	8	30

CT accurately staged 20 patients from the 30 patients underwent both CT & histopathological T-staging (20/30). The total accuracy was 66.7%. CT misdiagnosed 2 cases, over-staged 2 cases and under-staged 6 cases. CT couldn't detect the 2 cases with carcinoma in situ and was reported as normal study.

CT nodal staging was done for 15 cases; preoperative findings were correlated with postoperative histopathological data to obtain N staging accuracy of CT in those patients as shown in (Table 5).

Table (5): Tumor nodal (N-staging) by CT compared to histopathology.

Histopathology	CT		
	N0	N1	Total
N0	10	1	11
N1	1	3	4
Total	11	4	15

CT accurately staged 13 patients from the 15 patients who underwent both CT & histopathological N-staging (13/15) giving accuracy of 86.7%. CT overstaged 1 case and understaged 1 case.

For assessment of the tumor extension by CT, CT findings were collected and classified according to the parts involved and the results were compared to histopathological findings as shown in (Table 6).

Table (6): CT findings and regional tumoral infiltration in comparison to histopathological findings in 28 patients with laryngeal neoplasms.

Regional involvement	No. of cases		
	By CT	By pathology	Accuracy %
Pre-epiglottic space	3	4	75
Paraglottic space	4	5	80
Anterior commissure	5	6	83.3
Posterior commissure	2	3	66.6
Pyriform sinus	6	7	85.7
Epiglottis	4	5	80
True vocal cords	14	16	87.5
Thyroid cartilage	5	7	71.4
Subglottic region	6	7	85
Extra-laryngeal	5	6	83.3

CT showed accuracy 71.4% in detection of the thyroid cartilage invasion, 75% in detection of pre-epiglottic space infiltration, 80% of paraglottic space infiltration, 83.3% in detection of infiltration of anterior commissure, 85.7% in extension to pyriform sinus, 85% in subglottic extension, 83.3% in extra-laryngeal spread and 86.7% in metastatic lymph nodes.

Statistical analysis of the collected data was done to obtain CT sensitivity and specificity.

MRI diagnosed 26 cases from the 30 cases while misdiagnosed 2 cases giving sensitivity of 92.9% while properly diagnosed the 2 true negative cases on histopathology giving specificity of 100%.

Table (7): Agreement Sensitivity and specificity for CT compared with histopathology in detection of laryngeal tumors.

	Histopathological diagnosis			Sesitivity %	Specificity %	PPV %	NPV %
	Positive	Negative	Total				
CT:							
Positive	26	0	26	92.9%	100.0%	100.0%	50.0%
Negative	2	2	4				
Total	28	2	30				

PPV: Positive Predictive Value. NPV: Negative Predictive Value.

Pre and post-contrast MRI of the neck were done for 22 patients. MR findings were compared to histopathological staging of those patients.

Table (8): Tumor T-staging by MRI compared to histopathology.

Histopathology	MRI					
	Tis	T1	T2	T3	T4	Total
Tis	2	0	0	0	0	2
T2	0	1	7	0	0	8
T3	0	0	0	3	1	4
T4	0	0	0	1	7	8
Total	2	1	7	4	8	22

MRI accurately staged 19 patients from 22 patients while understaged 2 cases and overstaged 1 case from who underwent MRI-T staging (19/22) giving accuracy of 86.7%.

Table (9): Tumor N-staging by MRI compared to histopathology.

Histopathology	MRI		
	N0	N1	Total
N0	11	0	11
N1	0	4	4
Total	11	4	15

Pre-operative MRI findings were correlated with post-operative histopathological data to obtain N staging accuracy of MRI in 15 patients.

MRI accurately staged 15 patients from 15 patients who underwent MRI-N staging (15/15) giving accuracy of 100%.

For assessment of the tumor extension by MR, MRI findings were collected and classified according to the parts involved and the results were compared to post-operative pathological findings.

Table (10): MR findings and regional tumoral infiltration in comparison to histopathological findings in 22 patients with laryngeal neoplasms.

Regional involvement	No. of cases		
	By MR	By pathology	Accuracy %
Pre-epiglottic space	4	4	100%
Paraglottic space	4	4	100%
Anterior commissure	5	6	83.3
Posterior commissure	3	3	100
Pyriform sinus	6	7	85.7
Epiglottis	4	4	100
True vocal cords	14	14	100
Thyroid cartilage	6	7	85.7
Subglottic region	6	6	100
Extralaryngeal	5	5	100

MR showed accuracy 85.7% in detection of the thyroid cartilage invasion, 100%% in detection of pre-epiglottic space infiltration, 100% of paraglottic space infiltration, 83.3% in detection of infiltration of anterior commissure, 85.7% in extension to pyriform sinus, 100% in subglottic extension, 100% in extralaryngeal spread and 100% in metastatic lymph nodes.

Statistical analysis of the collected data was done to obtain MR sensitivity and specificity.

MRI diagnosed 21 cases from the 22 cases while misdiagnosed 1 case giving sensitivity of 95.5%, while specificity of MR couldn't be calculated on statistical basis due to absence of negative cases proved by histopathology among 22 cases who were subjected to MR.

The overall CT and MR findings were collected and classified according to the regional infiltration and compared with the histopathological findings in all patients of our study:

For proper evaluation of accuracy of CT and MRI in regional tumoral infiltrations, findings were collected and classified then were compared to pathological findings in 22 patients who underwent both imaging modalities as shown in (Table 12).

Both CT and MRI were equal in evaluation of certain areas as anterior commissure and pyriform sinus while MRI showed higher accuracy in evaluation of other laryngeal subsites namely preepiglottic, paraglottic spaces, posterior commissure, epiglottis, vocal cords, thyroid cartilage extralaryngeal spread and metastatic lymphadenopathy.

Table (11): Agreement sensitivity, specificity and accuracy for MRI compared with histopathology in detection of laryngeal tumors.

	Histopathological diagnosis			Sesitivity %	Specificity %	PPV %	NPV %
	Positive	Negative	Total				
MRI:							
Positive	21	0	21	95.5%		100.0%	–
Negative	1	0	1				
Total	22	0	22				

PPV : Positive Predictive Value.
NPV : Negative Predictive Value.

Table (12): Total CT and MR findings in comparison to histopathology for accurate regional tumoral infiltration evaluation in 22 patients who performed combined CT & MRI.

Regional involvement	No of cases (in 22 cases)			Accuracy %	
	By CT	By MR	By pathology	CT	MR
Pre-epiglottic space	3	4	4	75%	100%
Paraglottic space	3	4	4	75%	100%
Anterior commissure	5	5	6	83.3	83.3
Posterior commissure	2	3	3	66.6	100
Pyriform sinus	6	6	7	85.7	85.7
Epiglottis	3	4	4	75	100
True vocal cords	12	14	14	85.7	100
Thyroid cartilage	5	6	7	71.4	85.7
Subglottic region	5	6	6	83.3	100
Extralaryngeal	4	5	5	80	100

Illustrated cases:

Case (1): Glottic carcinoma in situ:

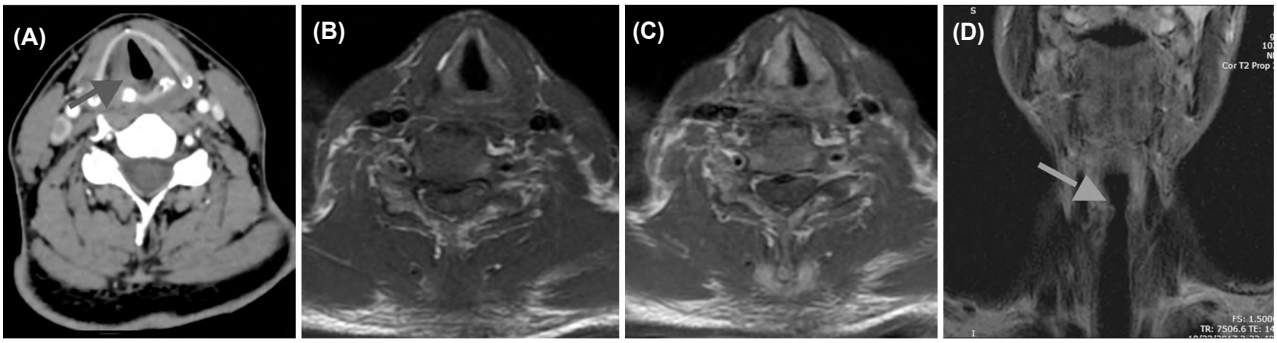

Fig. (2): (A,B,C and D), Male patient aged 70 years smoker, presented by hoaresness of voice. (A) Post-contrast CT Axial view at the glottic level, (B) Axial pre-contrast T1WI (C) Axial post-contrast T1WI (D) Coronal T2 WI FSE. Post-contrast CT showed no significant abnormality and was reported as normal study. MRI revealed minimal thickening of the right vocal cord is noted (B and D) with relative homogenous post-contrast enhancement of both vocal cords (C). Endoscopic biopsy and histopathology revealed carcinoma in situ.

Case (2): Glottic SCC:

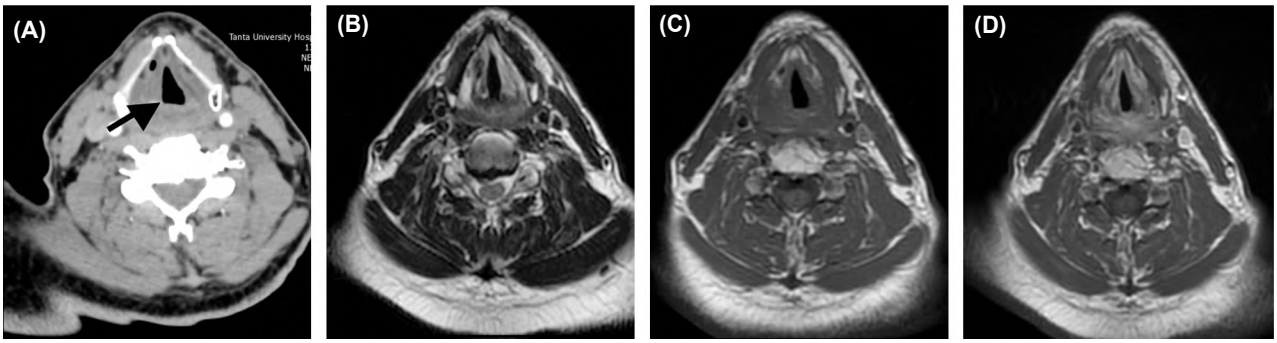

Fig. (3): (A, B, C and D); A Male patient aged 55 years presented with hoarsness of voice. (A) Post-contrast CT axial view at the glottic region, (B) Axial T1-weighted image. (C) Axial T2-weighted image. (D) Axial post-contrast T1-weighted image. CT neck with contrast revealed asymetrical right vocal cord thickening (arrow), no invasion of thyroid cartilage, anterior or posterior commissures. (A) On MRI mild thickening of the right vocal cord is noted (arrow) with preserved fat signal of the ipsilateral paraglottic space (B) A note is done for the homogenous signal of the vocal cord at normal side when compared to heterogeneous signal on the affected side (C) with relative enhancement of both vocal cords that seen slightly heterogeneous on the right side (D).

Case (3): Metastasis of the thyroid cartilage:

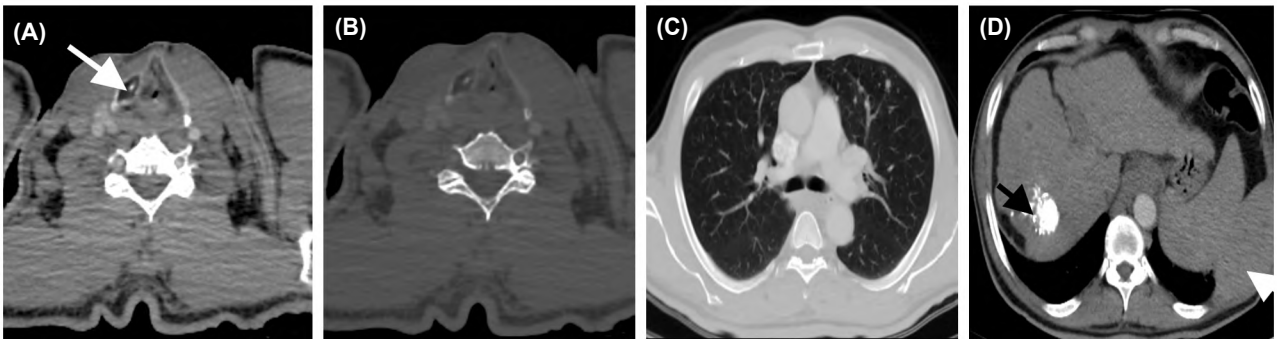

Fig. (4): Post-contrast CT of the Neck, Chest & Abdomen) (A, B, C and D) A Male patient aged 70 years, known case of metastatic hepatocellular carcinoma underwent Trans-Arterial Chemoembolization (TACE). (A) Axial views, soft window at glottic level, (B) Bone window at the same level. (C) Axial CT Chest cuts (lung window) (D) Upper abdomen cuts revealed an expansile hypodense lesion noted at the right lamina of the thyroid cartilage (A,B), the chemo-embolized hepatic focal lesion (black arrow) is seen at upper abdomen cuts (D), with a metastatic rib lesion at the left 8^{th} rib (white arrow), multiple pulmonary nodules scattered at both lungs (C) (arrow).

Discussion

Laryngeal cancer is the most common cancer of the upper aerodigestive tract and the second most common cancer of the respiratory tract after lung cancer. Squamous Cell Carcinoma (SCC) is the most common cancer of the larynx and accounts for 90% of malignant laryngeal tumors. Supraglottic SCC after glottic SCC is the second most common malignant tumor of the larynx **[10]**.

In the present study, it was found that the majority of patients were in fifth and sixth decades of life with mean age of 60.9 years. This agreed with Jian et al., **[11]** in their study with mean age of 61.5 years.

This study was done on 30 patients, 26 males (86.7%) and 4 females (13.3%) with male to female ratio 6.5:1, this agreed with Brady et al., **[12]** who reported male predominance in different laryngeal neoplasms with male to female ratio 6.9:1.

As regard clinical presentation, in this study 18 patients (60%) complained mainly of hoarseness of voice, 10 patients (33.3%) complained of dysphagia and 2 patients (6.7%) presented with neck swelling. This agreed with Allegra et al., **[13]** who reported hoarseness of voice as the most common symptoms in different laryngeal neoplasms.

In this present study, 93.3% of the laryngeal lesions were neoplasms (28/30) where as 6.7% (2/30) were non-neoplastic lesions. Primary neoplasms were the most common neoplasms representing 92.85% of total number of cases (26/28).

As regards to the site of the tumors at different laryngeal compartments: 28.6% of patients had transglottic extension: 28.6% had glottic with supra glottic extension, 21.4% had glottic only and 21.4% had supra glottic only. Glottic involvement is noted in 78.6% of cases. However, Hazem et al., **[14]** in their study that was carried out on 295 patients with laryngeal SCC reported that and the most common tumors were glottic-supraglottic (62.4%), transglottic (20.7%), glottic only (10.8%), supraglottic only (5.1%), and finally subglottic (1.0%), which is a rare subsite for laryngeal cancer.

As regards to the histological diagnosis: 71.6% of the primary laryngeal tumors were of squamous cell type (SCCs), 7.1% were chondrosarcomas while 7.1% were adenocarcinomas and 7.1% were CIS, this agreed with Warner et al., **[15]** who reported in their study the histologic predominance of squamous cell carcinomas in all head and neck tumors.

As regards to pathological (T) staging of the primary laryngeal tumors: 30.8% were found to be T2, 30.8% were T4, 15.3% were stage T1, 15.3% were stage T3 and 7.8 were Tis (carcinoma in situ), Jian et al., **[11]** also found in their study that pathological T2 constituted 38.4% followed by T3 while T4 stage represented 15.7%.

As regards to N (nodal) staging 73.3% were stage N0 (no nodal involvement) while 26.7% were stage N1 (nodal size less than 3cm), this matched with Maziar et al., **[10]** who found that the rate of cervical nodal metastasis in laryngeal cancer specially supraglottic type varied from 16.7% to 54.5% in T1 and T4 patients, respectively, but there was no statistically significant association between tumor grade and cervical lymph node metastasis.

Computed Tomography (CT) used to be the examination of choice that is performed for the evaluation of pathological laryngeal lesions due to its wide accessibility, shorter scanning time as nearly free of movement artifacts, aimed especially for patients who require immediate diagnosis (large obstructive lesions) or for uncooperative patients **[6]**.

Computed tomography is also a good tool for the evaluation of the cartilaginous skeleton of the larynx and the extra-laryngeal soft tissues as well but its diagnostic accuracy is lower than MR, which is important for surgery planning and for the assessment of the prognosis of radiotherapy Precise differentiation of soft tissues, especially in the area of pharynx and larynx, is limited due to lower soft tissue contrast and also influenced by many artifacts as dental restorations **[16]**.

According to pathological T staging, the T staging accuracies of CT and MRI were 66.7% and 86.4% respectively, this matched with Jian et al., **[11]** who reported in their study that T staging accuracies of CT and MRI were 57.69% and 88.46% respectively, where a significant difference between both modalities was revealed by (McNemar's test) (p<0.01).

Whereas the nodal (N) staging accuracies of CT and MRI in our study were 86.7% (13/15) and 100% (15/15) respectively. However, Rubia et al., **[17]** reported that diagnostic accuracy of MDCT in nodal staging of head and neck tumor was 95.3% in their study.

Magnetic Resonance Imaging (MRI) characterized by significantly higher soft tissue resolution and possibility of multi-planar imaging in comparison to CT, which enables better assessment of the

range of pathological lesions, and the evaluation of submucosal spread of pathological processes. In MRI the patient is not exposed to ionizing radiation, and therefore, can be used for monitoring disease development and treatment efficacy **[7,16]**.

The main limitations of MRI were the relatively long scanning time, which increases the possibility of the occurrence of movement artifacts, especially in patients with advanced lesions or obstruction of the airways. Others include artifacts associated with pulsatile movements of vessels, swallowing, and, above all, patient's breathing during scanning. It also required the cooperation and education of the patient-shallow breathing during scanning, as well as with holding cough and swallowing **[16]**.

Our study revealed that MRI was more accurate than CT scan in T staging of laryngeal tumors, MRI showed a higher sensitivity (95.5%) and a higher accuracy (86.4%) compared to (92.9%) and (66.7%) of CT, however, the results of MRI especially DWI scan was more likely to be influenced by examination time and movements such as breathing and swallowing. For patients with obstructive dyspnea or low compliance, large artifacts could be seen on MRI that was noted in 4 of our 22 patients who underwent MR examination (2 patients were uncooperative, 1 patient with irregular breathing due to large obstructive mass and 1 with tracheostomy tube inserted), causing incorrect interpretation of tumor extension.

Both Magnetic Resonance Imaging (MRI) and Computed Tomography (CT) can be used to assess cartilage invasion preoperatively. CT and MRI each have their unique strengths and weaknesses. MRI provides good contrast between different soft tissues, which makes it superior in distinguishing between soft tissue and tumour. However, cartilage invasion is easily overestimated, since it is hard to distinguish from peri-tumoral inflammation **[18]**.

This prospective study evaluated the role CT and MRI in the evaluation of different laryngeal tumors specially cancers as the proper evaluation of mucosal and submucosal areas that would change the stage of the disease and the choice of therapeutic approach. In particular, MRI showed an accuracy of 100% in assessing areas such as paraglottic, pre epiglottic spaces as well as extra-laryngeal spread and metastatic lymph nodes. In our study, CT staging was accurate in 66.7% of cases, while the MRI was accurate in 86.7% of cases as in comparison to histopathological data.

The comparison of diagnostic accuracy of CT (in 28 cases) and MRI (in 22 cases) for different laryngeal subsites such as PES, PGS, ATC, TC were compared to results of Aniruddha et al., **[19]**.

In Pre-Epiglottic Space (PES) involvement: Diagnostic accuracy of CT and MRI were 75% and 100% respectively while Aniruddha et al., **[19]** reported that diagnostic accuracy were relatively higher in CT than MRI (CT 94.7% while 89.5% for MRI).

In Para-Glottic Space (PGS) involvement: Diagnostic accuracy of CT and MRI were 80% and 100% respectively while Aniruddha et al., **[19]** reported that diagnostic accuracy were relatively higher in MRI than CT (CT 89.5% while 94.7% for MRI).

In anterior commissure (ATC) involvement: Diagnostic accuracy of CT and MRI were the same 83.3% for each while Aniruddha et al., **[19]** reported that diagnostic accuracy were slightly higher in MRI than CT (CT 84.2% while 89.5% in MRI).

In Thyroid Cartilage (TC) invasion: Diagnostic accuracy of CT and MRI were 71.4% and 85.7% respectively while Aniruddha et al., **[19]** reported that diagnostic accuracy of CT 78.9% while 84.2% for MRI.

Conclusion:

Each of the two imaging techniques has their own advantages and disadvantages on determining the local infiltration and extension of tumors. Combined utility of CT and MRI could help to overcome the disadvantages and improve the accuracy specially about thyroid cartilage assessment and T staging of laryngeal carcinomas.

MR imaging has several advantages with respect to multi-slice CT and few limitations (artifacts related to movement). MRI allows a multiparameter analysis (T1 weighted, T2 weighted, DWI, and post contrast acquisition). This multiparameter approach amplifies the contrast resolution, even though MRI is more expensive, longer, and not always feasible for patients compared to CT scan (poor compliance, any contraindications), based on the above considerations, we believe that MRI could be considered the investigation of choice in the clinical evaluation of laryngeal tumors specially early glottic lesions for the planning of therapeutic interventions, because of its high sensitivity and elevated degree of diagnostic accuracy.

Recommendations:

MRI should be considered the preliminary imaging modality in evaluation of different laryngeal tumors specially early glottic tumors. CT

examination alone could be used as an alternative in few circumstances when MR is not feasible.

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دور التصوير بالآشعة المقطعية متعددة المقاطع والرنين المغناطيسى فى تقييم آورام الحنجرة

تمثل الآورام السرطانية للحنجرة حوالى ٢٥٪ من آورام الرآس والرقبة وحوالى ١-٥٪ من إجمالى الآورام التى يتم تشخيصها سنويا على مستوى العالم كما يعد سرطان الحنجرة ثانى آكثر آنواع السرطان شيوعا فى الجهاز التنفسى بعد سرطان الرئة ويمثل سرطان الخلايا الحرشفية التى تنشآ من سطح الغشاء المخاطى الغالبية العظمى من مختلف آنواع آورام الحنجرة ويتم تشخيص هذه الآورام بشكل آساسى عن طريق الفحص بالمنظار الحنجرى. ومع ذلك، فشلت الفحوصات السريرية والفحص بالمنظار فى الكشف إنتشار تلك الآورام السرطانية عبر هيكل الحنجرة إلى خارجها مما يؤدى إلى التقليل المرحلى لتلك الآورام المتقدمة سريريا.

والتكامل بين نتائج المناظير وفحوصات التصوير الطبى متعددة المقاطع لتقييم الإنتشار تحت الطبقة الطلائية وآنسجة حول وخارج الحنجرة آو إنتشار تلك الآورام إلى غضاريف الحنجرة يؤدى بدوره إلى تحسين التقييم المرحلى للورم وخيارات العلاج للمريض. التصوير الطبى آيضا يعطى معلومات آكثر دقة عن إمتداد الورم إلى العقد الليمفاوية والإنتشار فى آجهزة الجسم الآخرى وآى ورم متزامن آو إرتداد للورم.

يعتبر التصوير الطبى لآورام الحنجرة آمر بالغ الآهمية فى التشخيص والتقييم والمتابعة لضمان تقديم آفضل خطة علاجية للمريض مما يؤدى إلى تقليل المضاعفات والوصول إلى آعلى معدلات الشفاء كما تساعد فى تحديد آنسب مو قع لآخذ العينة لتآكيد التشخيص.

التصوير بالآشعة المقطعية متعددة المقاطع والرنين المغناطيسى من آهم آدوات التشخيص المكمل لدور المنظار الحنجرى ولكل فحص منهما دواعيه ومزاياه الخاصة فى المساهمة فى التشخيص الآولى والتقييم المراحلى للورم داخل الحنجرة آو إلى خارجها عبر مختلف الآنسجة المحيطة آو البعيدة عن الورم الآصلى.

يعد التصوير بالآشعة المقطعية متعددة المقاطع هو المعيار الرئيسى الحالى فى تشخيص وتقييم آورام الحنجرة وذلك لقصر زمن الفحص مما يقلل من العيوب الناتجة عن الحركة ويمكنه من تقييم الآحبال الصوتية بدقة. ويتميز آيضا بالمقاطع قليلة السمك وإعادة تركيب المقاطع المطابق تقريبا للواقع وهذا ضرورى لتوفير الوقت وتقليل التعرض للإشعا ع والتمكين من التصوير ثلاثى الآبعاد والذى من شآنه المساعدة فى تقليل العلاج التداخلى الغير ضرورى. يحتاج آيضا إلى إستخدام مواد التباين فيما يعرف بالصبغات حتى يضيف تمايز آعلى دقة بين الآنسجة الطبيعية والمرضية ولكنه يتطلب دقة تزامنية مرحلية. وبالرغم من كل تلك المميزات فإن الآشعة المقطعية تفتقر إلى الدقة فى التمييز بين هياكل الآنسجة الرخوة وإمتدادات الآورام وهذا قد يؤدى إلى عدم الدقة فى رسم الحدود الإجمالية للورم.

وعند مقارنة النتائج المختلفة آظهر الرنين المغناطيسى دقة عالية مقارنة بالآشعة المقطعية فى تقييم آورام الحنجرة خاصة فى تحديد إنتشار تلك الآورام عبر غضاريف الحنجرة المختلفة وإنتشارها فى آنسجة الرقبة والعقد الليفاوية وقدرته العالية فى التمييز بين مختلف آنوا ع الآنسجة الرخوة مما آدى إلى التحديد الدقيق فى رسم الحدود الإجمالية للورم.

وجد آن من العيوب الرئيسية للرنين المغناطيسى فرط حساسيته لحركة المريض وبعض آنوا ع الآجهزة ذات الخواص المغناطيسية مثل آجهزة تنظيم ضربات القلب وبعض آنوا ع الصمامات القلبية والآجهزة الإلكترونية المزروعة. لا ينصح آيضا فى المرضى الذين يعانون من رهاب الآماكن المغلقة.

ومن خلال تحليل نتائج هذه الدراسة إتضح الآتى:

يتفوق الرنين المغناطيسى فى الحالات التى يستطيع فيها المريض التعاون آثناء الفحص حيث يمكن من خلال التصوير بالرنين المغناطيسى آخذ مقاطع تشريحية فى إتجاهات متعددة بطريقة مباشرة بالإضافة لقدرته الفائقة على التفريق بين الآنسجة.

يسمح الفحص بالرنين المغناطيسى برؤية العضلات الداخلية للحنجرة والتى تعتبر مهمة فى تحديد الإمتداد السرطانى.

بالإضافة إلى ذلك فإن التصوير عن طريق الرنين المغناطيسى آكثر دقة من الآشعة المقطعية فى تحديد مدى الإمتداد السرطانى إلى داخل غضاريف الحنجرة.