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The Role of Ultrasonography in the Evaluation of Vocal Fold Lesions

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Abstract

Introduction: Since it was first suggested as a practical method of studying the larynx in 1960, ultrasonography has developed into a crucial and widely used diagnostic tool for conditions affecting the head and neck.

Aim of the study: To evaluate the value of high-resolution ultrasonography as an easy, non-invasive method for diagnosing various vocal fold lesions as well as mobility disorders and correlate its findings with those of a laryngoscope examination.

Subjects and Methods: We conducted this study at the Radiology Department in Fayoum University Hospital on thirty patients presenting with different vocal fold lesions for ultrasonographic examination of the head and neck between 2019 and 2021, which was approved by the local research ethical committee at the Faculty of Medicine at Fayoum University.

Results: Vocal cord (VC) lesions without mobility affection were the most common sonographic finding (50%), especially VC polyp (20%), followed by (13.3%) for VC lesions with mobility affection, freely mobile both VC without any lesions during preoperative assessment, and freely mobile VC with mass lesion can't be assessed by ultrasound.

Conclusion: Laryngeal ultrasonography is considered of great value in diagnosing different laryngeal lesions and can be used as a complementary procedure to laryngoscopy or an alternative in some cases. The limitation of laryngeal ultrasound is the calcification of thyroid cartilage with obscuration of distal structures, especially in elderly individuals.

Keywords: Vocal Fold; Vocal Cord; Laryngeal Ultrasound; Laryngoscope; Vocal Fold Paralysis; Vocal Fold Polyp; Vocal Fold Nodule; Vocal Fold Mass; Glottic Carcinoma.

1. Introduction

In today's world, indirect laryngoscopy is extensively used to assess laryngeal lesions with a large, bright, and clear image, allowing for an earlier diagnosis. Although direct laryngoscopy with biopsy under general anesthesia remains the gold standard, not all patients can tolerate the stiff laryngoscope, and it is particularly difficult to conduct in most infants and children [1]. It's also a difficult technique for people who have a sensitive gag reflex, stridor, limited jaw, and neck motion or are allergic to topical xylocaine [2].

Since 1960, ultrasound has been proposed as a feasible way of researching the

larynx and has become a highly important and commonly used diagnostic tool for head and neck illnesses [3]. It is less invasive, less painful, and less expensive than laryngoscopy. Anesthesia is not required for a laryngeal ultrasonographic examination. It is also safe to use during pregnancy, is portable, and can be quickly transferred to immobile patients [4].

In laryngeal examinations, B-mode images have been used to identify mass lesions and nodules at the vocal folds, not only for the actual vocal folds but also for the false vocal folds. It appears to be a suitable approach to examining vocal fold mobility issues because it does not interfere with vocal fold vibration [5].

Preoperative and postoperative evaluation of vocal fold function is critical in patients who undergo parathyroid or thyroid surgical operations. Transcutaneous laryngeal ultrasonography has been presented as an alternative to flexible fiberoptic laryngoscopy as a promising non-invasive approach. Because of the close anatomic relationship between the parathyroid and thyroid glands and the nerves of the larynx, iatrogenic injury to the recurrent laryngeal nerve with subsequent vocal fold paralysis is one of the most commonly encountered complications; therefore, this assessment will detect any preoperative recurrent laryngeal nerve palsy or iatrogenic injury [6].

Lesions of the vocal folds can be benign (non-cancerous) growths such as cysts, polyps, and nodules. Glottic carcinoma is a type of malignant lesion. The glottis is situated caudally to the supra-glottis and extends 1cm below the apex of the laryngeal ventricle, where the real vocal cord (VC) is found. Carcinomas in this area account for 50–70% of laryngeal malignant tumor pathology. Ultrasonography can detect metastases of laryngeal cancer to the lymphatic system of the neck. As a result, a single approach can be used to assess the laryngeal tumor and associated lymph node involvement [7].

The aim of the study was to investigate and identify the value of high-resolution ultrasonography as an easy, non-invasive method for diagnosing various vocal fold lesions as well as mobility disorders, and to correlate its findings with those of a laryngoscope examination.

2. Subjects and methods

2.1. Subjects

The current cross-sectional study was conducted at the Radiology Department in Fayoum University Hospital on thirty patients presenting with different vocal fold lesions for ultrasonographic examination of the head and neck between 2019 and 2021 and approved by the local research ethical committee at the Faculty of Medicine at Fayoum University.

Inclusion criteria

All patients were referred from the E.N.T. outpatient clinic to the radiology department at Fayoum University Hospital for evaluation of vocal fold lesions. All participants signed the consent form to join the study.

Exclusion criteria

Patients with neck scarring or those who declined the consent form were excluded from the study.

2.2. Methods

Patient position

The patient was placed in a supine position with the head in mild extension. A small pillow should be available in cases the

examination requires a hyperextension of the neck.

Technique

All patients underwent laryngeal ultrasound at the radiological department in Fayoum University Hospitals after a laryngoscopy examination at the E.N.T. department. The patients were examined by the ultrasonographic device (logic S 8, G.E. Healthcare) using a linear transducer with variable frequencies (8 to 10 M. Hz) to enable the examination of both deep and superficial structures in the same session.

After applying an adequate amount of gel, the larynx was examined in two perpendicular ultrasonographic windows (axial and sagittal sections). The ultrasonographic transducer was placed transversely over the thyroid cartilage and scanned caudocranially to visualize the vocal folds during quiet breathing. Active movements of the vocal folds were then assessed by asking the patient to pronounce the letter (E).

Doppler imaging was used to distinguish benign from malignant tumors and inflammatory from non-inflammatory lesions. Air was a weak ultrasonic medium that does not allow for the observation of deeper features. Both comet tails and reverberation artifacts are produced by intraluminal air.

Bony structures, such as hyoid bone, show brilliant hyperechoic linear structures with a hypoechoic acoustic shadow beneath. Unless they are calcified, cartilaginous structures (thyroid and cricoid cartilages) are hypoechoic. Muscle and connective tissue show a hypoechoic, striated appearance. Fat and glandular structures are homogeneous and slightly too severely hyperechoic compared to neighboring soft tissues, depending on the fat content of the glandular parenchyma. The air-mucosa contact exhibits a vivid hyperechoic linear appearance.

Cartilaginous calcification was commonly seen in old-age male patients causing posterior acoustic shadowing, which may obscure the lesion or reduce the accuracy of the examination.

2.3. Statistical Analysis

Data was collected and coded to simplify data manipulation before being double-entered into Microsoft Access and analyzed using the Statistical Package for Social Science (SPSS) software version 22 in Windows 7. (SPSS Inc., Chicago, IL, USA) Simple descriptive analysis of qualitative data in the form of numbers and percentages, the arithmetic means as a measure of central tendency, and standard deviations as a measure of the dispersion of quantitative parametric data. Independent samples A t-test was used to compare quantitative measures between two independent groups. A one-way ANOVA test was used to compare quantitative measures among more than two independent groups of quantitative data. The Chi-square test was used to compare two or more qualitative groups. Sensitivity and specificity test for testing a new test with the receiver operating characteristic (ROC) curve. The *P-value< 0.05* was considered statistically significant.

3. Results

The mean age among the study group was 44.3±18.8 years, ranging between 3 and 76 years, with 10 (33.3%) females versus 20 (66.7%) males. For smoking, 13 (43.3%) were smokers versus 17 (56.7%) were non-smokers (Figure 1).

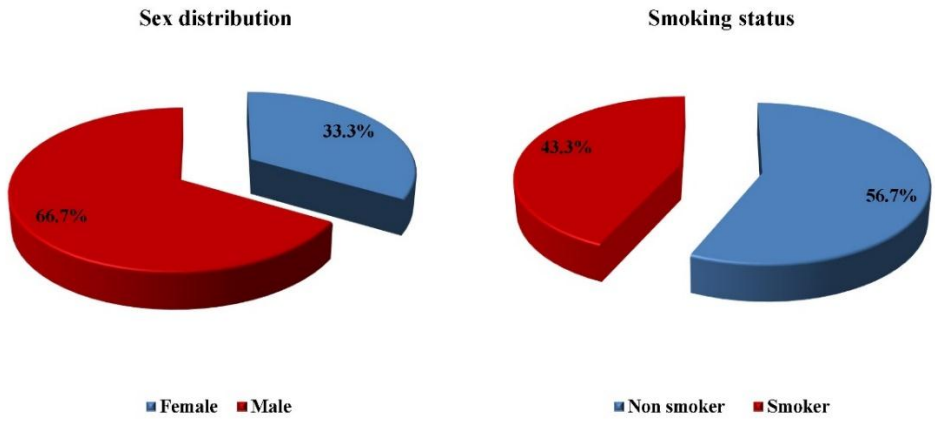

Figure 1: Description of demographic characteristics among the study group. A) sex distribution, B) Smoking status.

The side of the lesions in the included patients was different, as 12 (40%) of cases were on the right VC, 6 (20%) on the left VC, 8 (26.7%) were bilateral, and 4 (13.3%) of them showed no lesions during preoperative assessment (Figure 2).

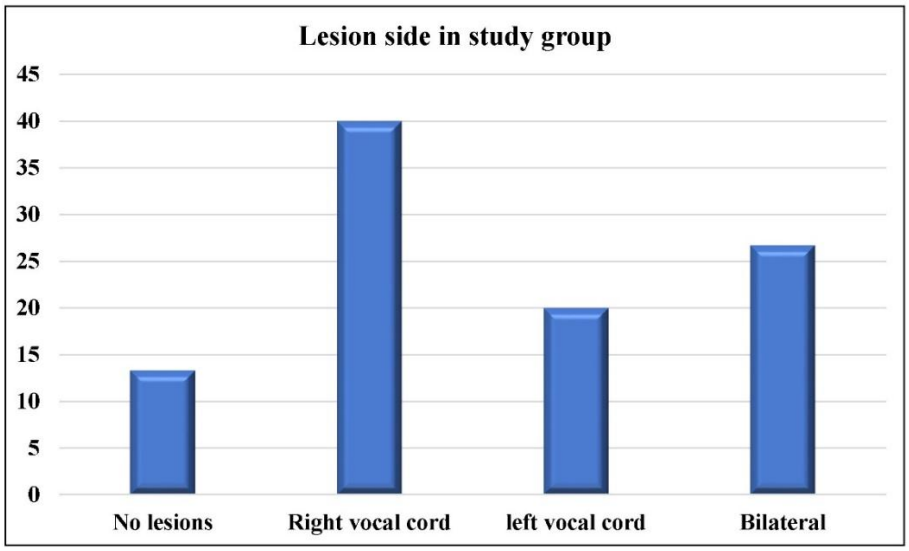

Figure 2: Bar chart showing lesions side in study group.

During preoperative assessment, the most common laryngoscope finding was VC lesions without mobility affection (60%), followed by (13.3%) VC lesions with mobility affection and freely mobile both VCs without any lesions. The most common sonographic finding was VC lesions without mobility affection (50%), particularly VC polyps (20%), followed by (13.3%) for VC lesions with mobility affection, freely mobile both VCs without any lesions during preoperative assessment, and freely mobile both VCs with a mass lesion that cannot be assessed by ultrasound (Table 1). There were no significant statistical variations (*P>0.05*) between laryngoscope and ultrasound in the diagnosis of different VC lesions.

Table 1: Frequency of laryngoscope and ultrasound findings among the study group.

Variables (N=30)		Laryngoscope	Ultrasound	*P-value*
VC lesion without mobility affection		18 (60%)	15 (50%)	0.06
VC lesion with mobility affection		4 (13.3%)	4 (13.3%)	
VC mobility affection without any VC lesion		3 (10%)	3 (10%)	
Freely mobile both VC without any lesions during preoperative assessment		4 (13.3%)	4 (13.3%)	
Freely mobile VC with mass lesion can't be assessed		1 (3.4%)	4 (13.3%)	
Lesions in details				
a) VC lesion without mobility affection				0.8
VC mass	**Suspicious mass**	5 (16.7%)	5 (16.7%)	
	Polyp	6 (20%)	6 (20%)	
	Nodule	2 (6.7%)	0 (0%)	
	Vascular malformation	0 (0%)	1 (3.3%)	
	Laryngeal web	1 (3.3%)	1 (3.3%)	
VC mucosal lesion	**Leukoplakia**	1 (3.3%)	0 (0%)	
	Vocal cord hypertrophy	2 (6.7%)	2 (6.7%)	
	Unhealthy mucosa	1 (3.3%)	0 (0%)	
b) VC lesion with mobility affection (VC mass)		4 (13.3%)	4 (13.3%)	
c) VC mobility affection without any lesions		3 (10%)	3 (10%)	
d) Freely mobile both VC without any lesions during preoperative assessment		4 (13.3%)	4 (13.3%)	
e) Freely mobile VC with mass lesion can't be assessed		1 (3.3%)	4 (13.3%)	

Among the laryngeal ultrasound findings, magnetic resonance imaging (MRI) revealed that 15 (50%) of the cases showed no calcification of the thyroid cartilage, 12 (40%) had limited calcification, and 3 (10%) had extensive thyroid cartilage calcification (Figure 3A).

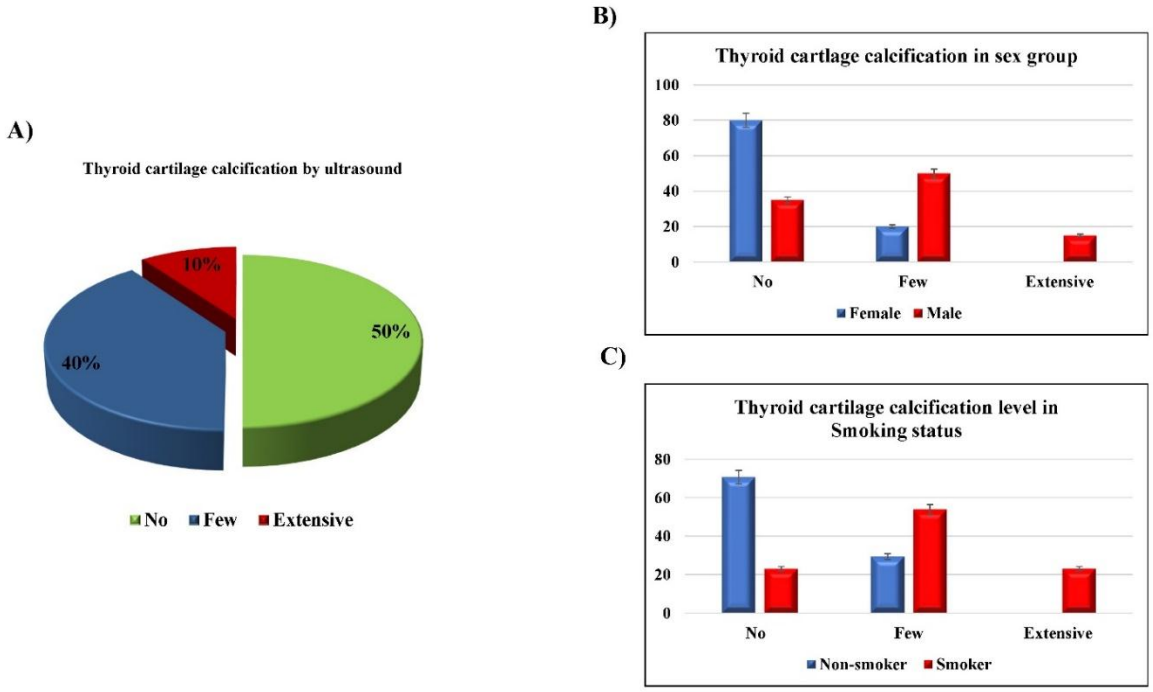

Figure 3: Thyroid cartilage calcifications. A) Bei chart showing thyroid cartilage calcifications level by Ultrasound, B) Sex distribution, C) Smoking status.

Table 2: Comparison of laryngoscope and ultrasound findings in different VC lesion sides.

Variables (N=30)		Lesion side	
		Laryngoscope	**Ultrasound**
VC lesion without mobility affection	RT	8 (66.7%)	7 (58.3%)
	LT	4 (66.7%)	3 (50%)
	Bilateral	6 (75%)	5 (62.5%
VC lesion with mobility affection	RT	2 (16.7%)	2 (16.7%)
	LT	1 (16.7%)	1 (16.7%)
	Bilateral	1 (12.5%)	1 (12.5%)
VC mobility affection without any VC lesion	RT	2 (16.7%)	2 (16.7%)
	LT	1 (16.7%)	1 (16.7%)
	Bilateral	---------	---------
Freely mobile VC with mass lesion can't be assessed	RT	---------	1 (8.3%)
	LT	---------	1 (16.7%)
	Bilateral	1 (12.5%)	2 (25%)
P-value		0.001*	0.001*

**Significant at P<0.05.*

There were significant statistical variations (*P<0.05*) between the different vocal cord lesion types and sides assessed by laryngoscope. There were significant statistical variations (*P<0.05*) between the different VC lesion sides and types assessed by ultrasound. There were significant statistical variations (*P<0.05*) between the patients' sex and different VC lesion detected by laryngoscope. 70% of males showed VC lesions without mobility affection, but females showed a higher percentage of freely mobile both VC without any mass lesion during preoperative assessment (40%) (Table 2).

There were significant statistical variations (*P<0.05*) in the relation of patients' sex group and the different VC lesions detected by ultrasound with a higher percentage of VC mobility affection without any lesions among males and freely mobile both VC without lesions during preoperative assessment among females. Also, there was a significantly higher percentage of extensive thyroid cartilage calcification among males (*P<0.05*) (Table 3, Figure 3).

Table 3: Comparison of laryngoscope and ultrasound findings as regards to sex distribution.

Variables (N=30)		**Sex distribution**	
		Laryngoscope	**Ultrasound**
VC lesion without mobility affection	Female	4 (40%)	5 (50%)
	Male	14 (70%)	10 (50%)
VC lesion with mobility affection	Female	1 (10%)	1 (10%)
	Male	3 (15%)	3 (15%)
VC mobility affection without any VC lesion	Female	---------	---------
	Male	3 (15%)	3 (15%)
Freely mobile both VC without any lesions during preoperative assessment	Female	4 (40%)	4 (40%)
	Male	---------	---------
Freely mobile VC with mass lesion can't be assessed	Female	1 (10%)	---------
	Male	---------	4 (20%)
P-value		0.01*	0.02*
Thyroid cartilage calcifications	No	---------	F: 8 (80%) M:7 (35%)
	Few	---------	F: 2 (20%) M:10 (50%)
	Extensive	---------	F: --------- M:3 (15%)
P-value		---------	0.03*

**Significant at P<0.05.*

There were no significant statistical variations (*P>0.05*) in smoking status between the different VC lesions examined by laryngoscope. There were no significant statistical variations (*P>0.05*) in smoking status among the different VC lesions assessed by ultrasound. However, there was a significantly higher percentage of thyroid cartilage calcification among smokers with a (*P<0.05*) (Table 4 and figure 3C).

Table 4: Comparison of laryngoscope and ultrasound findings as regards to smoking status.

Variables (N=30)		Smoking status	
		Laryngoscope	**Ultrasound**
VC lesion without mobility affection	Yes	9 (69.2%)	6 (46.2%)
	No	9 (52.9%)	9 (52.9%)
VC lesion with mobility affection	Yes	3 (23.1%)	3 (23.1%)
	No	1 (5.9%)	1 (5.9%)
VC mobility affection without any VC lesion	Yes	1 (7.7%)	1 (7.7%)
	No	2 (11.8%)	2 (11.8%)
Freely mobile both VC without any lesions during preoperative assessment	Yes	---	---
	No	4 (23.5%)	4 (23.5%)
Freely mobile VC with mass lesion can't be assessed	Yes	---	3 (23.1%)
	No	1 (5.9%)	1 (5.9%)
P-value		0.2	0.2
Thyroid cartilage calcifications	No	---	Yes: 3 (23.1%) No: 12 (70.6%)
	Few	---	Yes: 7 (53.8%) No:5 (29.4%)
	Extensive	---	Yes: 3 (15%) No: ---
P-value		---	0.005*

**Significant at P<0.05.*

There were no significant statistical variations (*P>0.05*) in age between different lesion types assessed by the laryngoscopy. Also, there were no significant statistical variations (*P>0.05*) in age between the VC lesions assessed by ultrasound. There was a higher mean age among cases with extensive thyroid cartilage calcification (*P<0.05*) (Table 5). There were no significant statistical variations (*P>0.05*) in age sex, lesion side, and smoking status between detailed vocal cord lesions in the study population (Table 6).

Table 5: Comparison of laryngoscope and ultrasound findings as regards to Age.

Variables (N=30)	Age (years)	
	Laryngoscope	**Ultrasound**
VC lesion without mobility affection	42.7±21	42.6±19.2
VC lesion with mobility affection	58.3±12.7	58.3±12.6
VC mobility affection without any VC lesion	44.7±23	44.7±23
Freely mobile both VC without any lesions during preoperative assessment	35.5±2.9	35.5±2.9

Freely mobile VC with mass lesion can't be assessed	50±0		45.2±28.4
P-value		0.4	0.6
Thyroid cartilage calcifications	No	-------	30.7±13.7
	Few	-------	56.2±12.1
	Extensive	-------	64.7±12.8
P-value		-------	<0.001*

**Significant at P<0.05.*

Table 6: Comparison of detailed VC lesions as regards to the age, sex, lesion side, and smoking status in the study population.

Variables (N=30)	Age (years)	Sex		Lesion side				Smoking	
		Male	Female	No	RT	LT	Bilateral	No	Yes
No mass or mucosal lesion	39.4±14.3	3 (15%)	4 (40%)	4 (100%)	2 (16.7%)	1 (16.7%)	0 (0%)	6 (35.3%)	1 (7.7%)
Polyp	36.7±12.1	6 (30%)	1 (10%)	0 (0%)	5 (41.7%)	1 (16.7%)	1 (12.5%)	2 (11.8%)	5 (38.5%)
Nodule	40±48.1	2 (10%)	0 (0%)	0 (0%)	0 (0%)	1 (16.7%)	1 (12.5%)	1 (5.9%)	1 (7.7%)
Suspicious mass	60±11.1	4 (20%)	3 (30%)	0 (0%)	3 (25%)	2 (33.3%)	2 (25%)	4 (23.5%)	3 (23.1%)
Cystic mass	50±0	0 (0%)	1 (10%)	0 (0%)	0 (0%)	0 (0%)	1 (12.5%)	1 (5.9%)	0 (0%)
Web	30±0	1 (5%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	1 (12.5%)	1 (5.9%)	0 (0%)
Mucosal lesion	48.6±15.4	4 (20%)	1 (10%)	0 (0%)	2 (16.7%)	1 (16.7%)	2 (25%)	2 (11.8%)	3 (23.1%)
P-value	0.1	0.3		0.1				0.3	

There were no significant statistical variations (*P>0.05*) in age between different lesion sides. There were significant statistical variations (*P<0.05*) between different sex groups as regards lesion side, with a higher percentage of right-sided lesions among males, but females showed no lesion during preoperative assessment in 40% of cases (Table 7). The ROC curve analysis for the ultrasound in comparison to the laryngoscopy in the diagnosis of different VC lesions revealed a significant sensitivity of 80.8% and a specificity of 100% (AUC=90.4%; CI:76.4-100; *P=0.01*) (Figure 4A).

Table 7: Comparison of lesion sides as regards to age and sex distribution.

Variables (N=30)	Age	Sex

	(years)	Female	Male
No lesion during preoperative assessment	35.5±2.8	4 (40%)	---
Right vocal cord	43.3±17.2	2 (20%)	10 (50%)
Left vocal cord	58.8±14.7	2 (20%)	4 (20%)
Bilateral	39.4±24.3	2 (20%)	6 (30%)
P-value	0.2	0.02*	

**Significant at P<0.05.*

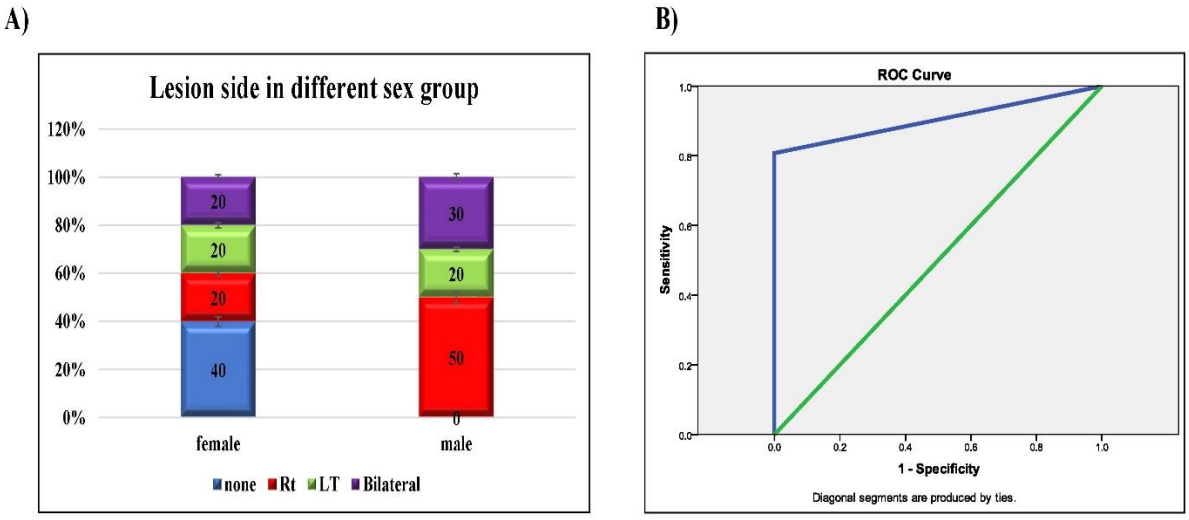

Figure 4: A) Bar chart showing lesion side in different sex groups, B) ROC curve for ultrasound in diagnosis of VC lesions.

Figure 5 depicts an ultrasonographic finding of a fifty-year-old smoker who suffered from hoarseness of voice ten months ago as an example of one of the included patients. Figure 6 depicts the ultrasonography results of a male patient, 25 years old, a smoker, and suffering from a change in voice eighteen months ago. Figure 7 depicts the ultrasonographic findings of a female patient who was 71 years old, diabetic, and experiencing hoarseness of voice one month ago. Figure 8 also shows the ultrasonography findings of a male patient, forty years old, a smoker, and suffering from hoarseness of voice one year ago.

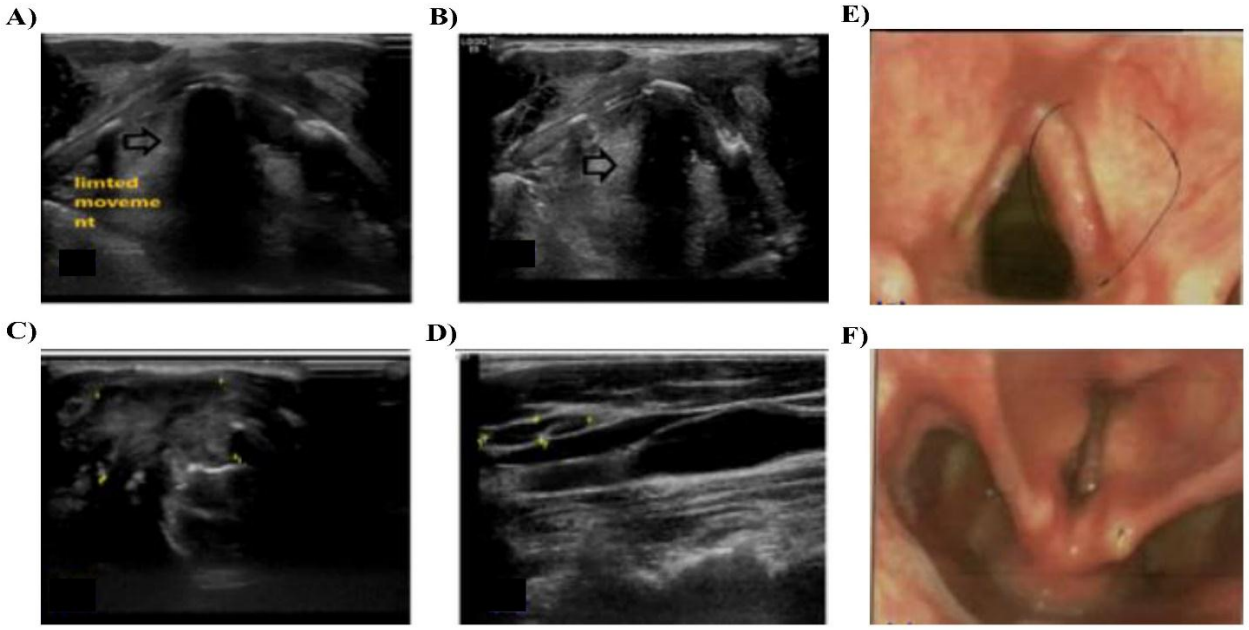

Figure 5: Ultrasonographic example of smoker male. (A&B) right vocal fold limited mobility, (C) ill-defined mass (extra laryngeal right sided soft tissue extension), (D) Small cervical lymph node. (E&F) Laryngoscope showed limited mobility of the right vocal fold with mass arising from it.

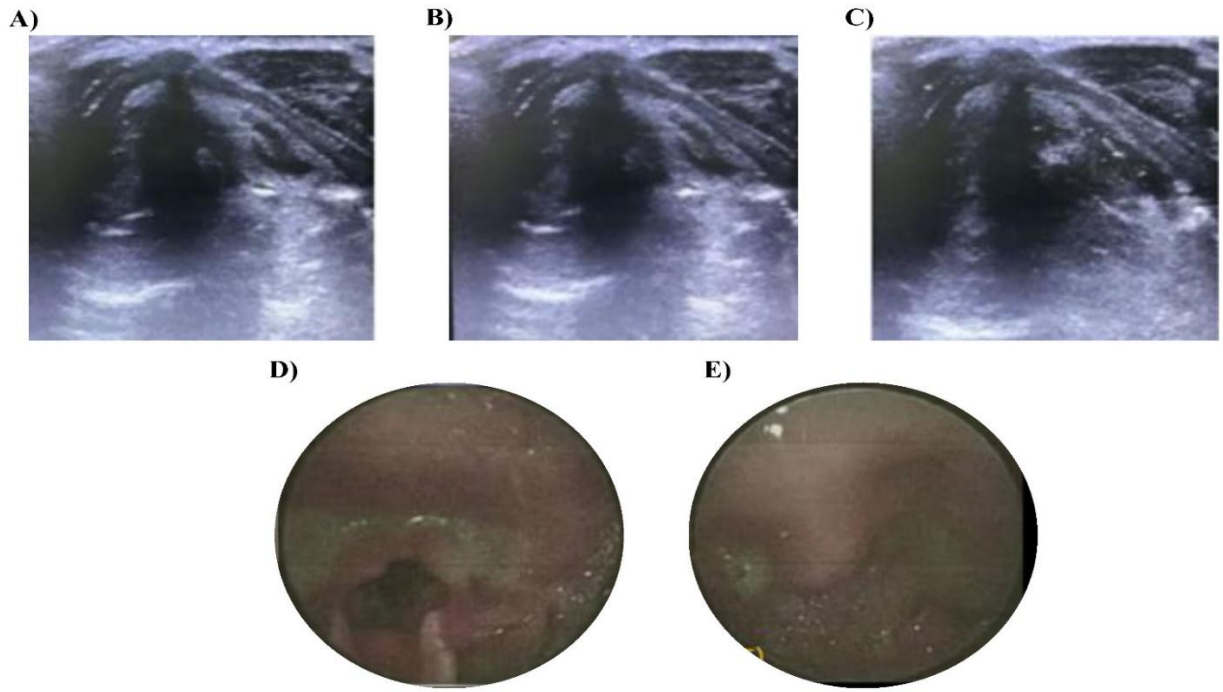

Figure 8: Ultrasonographic example of smoker male showed sequences of movement of vocal folds by U/S; At sequence (A) the left vocal fold is seen at lateral position then in (B) it is seen moved paramedian, (C) the left vocal fold is seen at median position. In all sequences the right vocal fold is seen fixed at the same position. The same appeared at the laryngoscope images (D) during respiration & (E) during phonation.

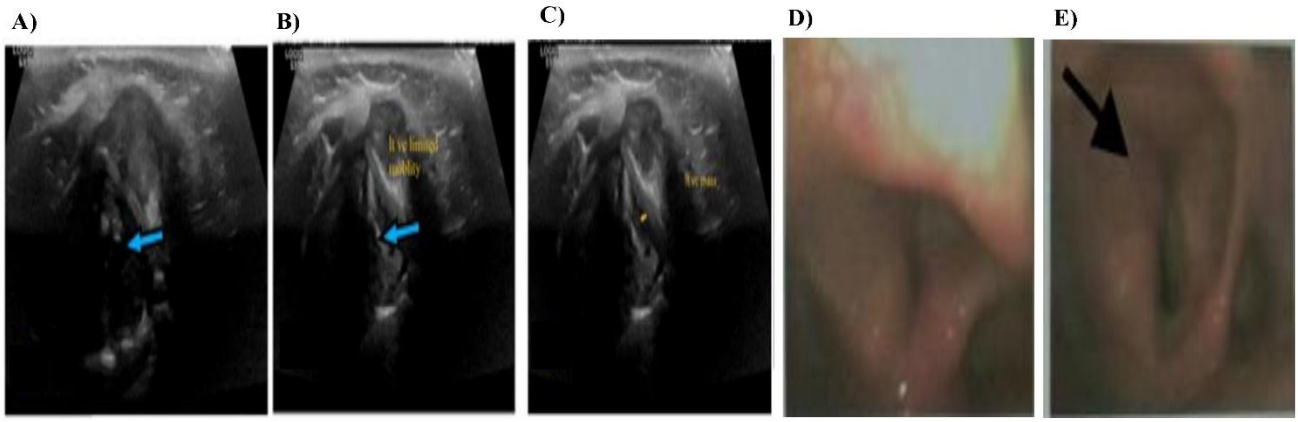

Figure 6: Ultrasonographic example of diabetic female. (A&B) Left vocal fold limited mobility, (C) Left vocal fold isoechoic mass., (D) laryngoscope images showing paralyzed left vocal fold with left vocal fold mass.

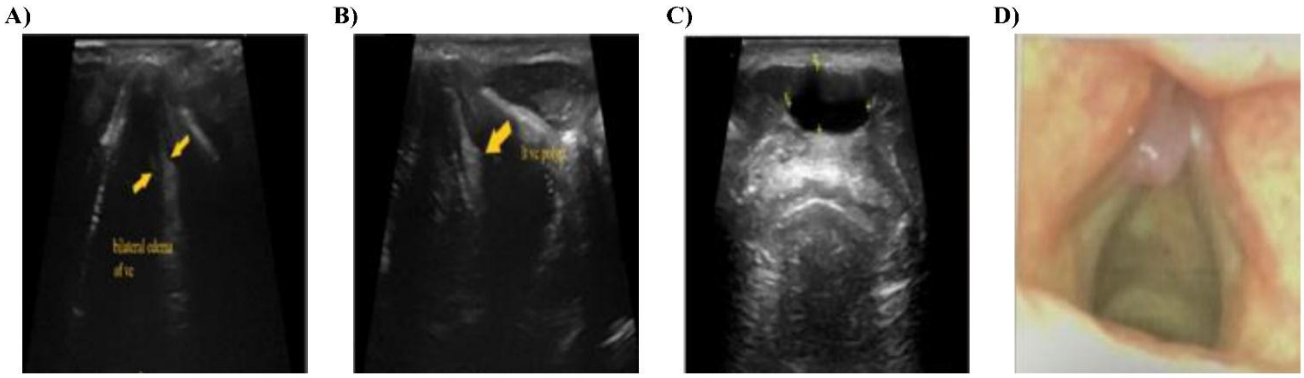

Figure 7: Ultrasonographic example of smoker male. (A) Both vocal fold edema, (B) Left vocal fold polyp, (C) Thyroglossal cyst, (D) Laryngoscope shows left vocal fold polyp with mild diffuse erythema of both vocal folds.

4. Discussion

Laryngeal ultrasound has many advantages, including its simplicity, safety, non-invasiveness, and non-expensiveness [8]. Due to air soft tissue interference between the tissues of the vocal fold edge and glottic air, the free margin of the vocal folds could not be clearly defined [9].

Although there are no known complications from using a fiberoptic laryngoscope, it can still be used to diagnose extraluminal causes (Thyroid, lymph nodes, thyroid cartilage) and hidden laryngeal spaces [10]. Ultrasound can be used if there are patients who cannot tolerate modern endoscopic visualization of the larynx, if a large supraglottic tumor obscures the view from above, or in young children who might otherwise need general anesthesia [11].

The current study consisted of 30 patients, including 19 patients with vocal fold lesions without affection of mobility (6 cases with a polyp, 2 cases with nodules, 5 cases with malignant masses, 1 case with laryngeal web, 2 cases with vocal fold hypertrophy, and 1 case

with vascular malformation). In terms of mobility, four patients have been diagnosed with a vocal fold lesion with limited vocal fold mobility, these lesions are mostly malignant masses, and three patients have limited vocal fold mobility without a mass lesion. Also, there are four patients who have thyroid gland disease and undergo a preoperative assessment of vocal fold mobility by both techniques (ultrasound and laryngoscopy). Laryngoscopy was used as the standard method to which the ultrasound findings were correlated.

However, because vocal fold nodules are too small to be seen by the resolution of the probe and are located along the air-soft tissue interface, ultrasound was not able to diagnose significant laryngeal lesions. This is consistent with Gomaa *et al.,* 2013 [3]. Another study examined a heterogeneous group of adult patients and found ultrasound helpful in identifying lesions greater than 2 mm in size that project into the lumen [11].

The vocal fold polyp is the most common benign neoplasm that is usually unilateral and larger than nodules (more than 3 mm), so they are more accessible by ultrasound [7]. Male patients tended to have more vocal polyps [12]. They also showed that mechanical strain from men's characteristic low-pitched sound production occurs in deeper lamina propria regions, rupturing blood vessels and causing hemorrhage, predisposing them to vocal polyps.

In our study, we diagnosed seven cases as vocal fold polyps; 85% of these patients were male with a mean age of 36 years old. That agreed with other previous studies, where vocal cord polyps were detected in 100% of patients undergoing neck ultrasounds [7, 12]. Vocal fold hypertrophy was found in two patients diagnosed by laryngoscopy and confirmed by ultrasound. Normally vocal fold thickness is between (3-5 mm) [13]. Hypertrophy is diagnosed by ultrasound when vocal folds appear thickened more than 6 mm.

The evaluation of ultrasound to detect some lesions like leukoplakia or ulceration of the vocal fold showed that it cannot diagnose them because leukoplakia and ulceration were superficial mucosal lesions, so the laryngoscopy had the upper hand in the detection of these lesions. That agreed with Khalil *et al.,* 2010 [9].

Laryngeal cancer is a common malignant neoplasm of the head and neck with a high incidence, accounting for 2.4% of new malignancies worldwide every year. Ultrasound is useful in the diagnosis of laryngeal cancer because it can detect the site, size, extent, and nodal affection [14].

In the current study, seven cases of suspicious masses were identified, three of which were diagnosed as nodal affections by ultrasound. Here, ultrasound has an advantage over laryngoscopy in detecting lymph node involvement. That agreed with Shalaby *et al,* 2013 [14].

In one case, ultrasound and laryngoscopy both detected anterior commissure extension, but ultrasound only detected infra-glottic extension in others. Males had a higher incidence of laryngeal cancer than females [15]. Men made up 60% of those diagnosed with a glottic suspicious mass in our study. According to the American Cancer Society's Atlanta 2022 report, the majority of patients diagnosed with laryngeal cancer are 55 or older, with only a small number of patients diagnosed under the age of 55. Patients diagnosed with laryngeal cancer are typically around the age of 66. In our study, the average age for cancer was 60.

Smoking is the leading cause of vocal fold cancer [15], and smokers account for 43% of cases with glottic suspicious mass in this study. The calcification of the thyroid cartilage hampered proper evaluation of the vocal folds [16], as the laryngeal space could not be seen clearly if the thyroid cartilage was calcified. Furthermore, a previous study found that complete anterior calcification of the thyroid

cartilage created an acoustic shadow, making ultrasound evaluation of the larynx difficult, and that males had a higher rate of calcification than females [17].

In the current study, a male aged 70 years old had extensive calcification in the thyroid cartilage, which obscured the diagnosis of a vocal fold lesion, but it was diagnosed by laryngoscopy. Ultrasound has been used to visualize true cord mobility since the late 1980s [18]. This was consistent with other studies. Our findings supported previous research that concluded that laryngeal ultrasound has the same diagnostic ability as laryngoscopy in assessing vocal cord mobility [16, 19]. On laryngoscope and ultrasound examination, seven of the thirty patients in the current study had confirmed vocal fold limited mobility. There were 23 cases (76.7%) with freely mobile vocal folds, and the ultrasound detected all of them, which was consistent with Matta *et al.,* 2014 [20].

In the present study, 14% of VC limited mobility cases are bilateral, while 28% of VC limited mobility cases were on the left side and 57% of VC limited mobility cases were on the right side. According to Javad *et al.*, 2014, the left-sided involvement was the most frequent type (56.82%), the right-sided was 36.36%, and the bilateral paralysis was 6.8% [21]. Preoperative evaluation of recurrent laryngeal nerve function is important in thyroid surgery. Transcutaneous ultrasound may be useful to visualize vocal fold movement at the same time as evaluating thyroid disease because the majority of the thyroid nodules are subjected to ultrasound examination for differential diagnosis and ultrasound-guided fine-needle aspiration. Transcutaneous ultrasound could be a tool to evaluate vocal fold movement in more than 85% of patients with thyroid disease. The success of this evaluation depends on the gender and age of the patient [22].

In our study, both techniques revealed the same result, which was a free mobile vocal fold. Our results revealed 80.8% sensitivity and 100% specificity for ultrasound in the assessment of vocal folds. The study limitations included the small number of patients, who agreed to participate in the study.

Conclusion

The examination of real-time ultrasound is dynamic. It has the advantage of providing the investigator with an instant impression of the functionality and anatomy of the larynx. Laryngeal ultrasonography is thought to be very useful in diagnosing various laryngeal lesions and can be used in addition to or instead of laryngoscopy in some cases. The calcification of thyroid cartilage with obscuration of distal structures, particularly in the elderly, is a limitation of laryngeal ultrasound. Future large-scale multi-center studies are advised to confirm the generalizability of the current study.

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Patient consent: Approval and consent to participate: In-formed written consent from patients who were invited to participate in the research was obtained.

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Availability of data and materials: The datasets used and/or analyzed during the current study are available from the corresponding author on reasonable request

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