Ultrasonography and laryngoscopic findings are similar in detecting laryngeal lesions

Original Article

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ABSTRACT

Aims: There is a growing need for alternative maneuvers for diagnosing laryngeal diseases. The objective of this study is to evaluate laryngeal ultrasound as an alternative to laryngeal endoscopy in diagnosis and assessment of various laryngeal lesions.

Materials and Methods: This prospective study was conducted at the E.N.T. outpatient clinic of Minia University Hospital. The study included 50 patients (28 males and 22 females) with laryngeal lesions. Patients were examined by direct laryngoscopy and then were examined by using high resolution ultrasonography.

Results: No significant differences between direct laryngoscopy (DL) and ultrasonography diagnosis results. By DL, bilateral vocal fold nodule was diagnosed in 14 cases. However, ultrasound diagnosed only 11 cases of them. 16 cases were diagnosed with left or right vocal fold polyp and the ultrasound diagnosed 15 cases of them. 10 patients were diagnosed as glottal mass and the ultrasound diagnosed only 8 cases of them. For vocal fold cyst, four cases were diagnosed by both DL and ultrasound. Also, for Reinke's edema, four cases were diagnosed by both DL and ultrasound. One case was diagnosed as Laryngeocele by both maneuvers. One case was diagnosed as Laryngeoscleroma by DL while it was not diagnosed by ultrasound.

Conclusion: Ultrasonography could be used effectively as an alternative technique to direct endoscopy in diagnosis of different laryngeal lesions.

Key Words: Ultrasonography, laryngoscopy, laryngeal lesions.

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INTRODUCTION

The larynx has a small size and mobility in different planes making its study difficult[1]. Generally, the examination of the vocal cords and other internal laryngeal structures are most commonly performed by an indirect laryngoscope but this may not be tolerated by some patients especially children, old population, patients with a sensitive gag reflex, patients with neck or jaw diseases and patients suffering from stridor[2,3].

Nowadays, indirect laryngoscopy is widely used for the assessment of laryngeal lesions with a large, bright and clear image, which allows earlier diagnosis, although direct laryngoscopy under general anesthesia with biopsy remains to be the gold standard[4,5]. However, not all patients can tolerate the rigid laryngoscope and it is also difficult to perform in most infants and children[2]. Even during laryngoscopy, the exact extension of the laryngeal tumor, its infiltration and invasion of the laryngeal skeleton can sometimes be difficult to assess[6].

The usage of ultrasound for evaluation of laryngeal disorders was studied intensively for the last 20 years. Ultrasound was widely used as a diagnostic tool for head and neck diseases. However, it was rarely used in the diagnosis of laryngeal diseases[7]. Ultrasound was found to be useful for real time evaluation, not only for the true vocal folds (VF), but also for the false vocal folds and the vocal fold movement[8]. Laryngeal ultrasonography at frequencies ranging from 10 to 30 Mhz is useful in the diagnosis of diseases of vocal cords[9]. Also, laryngeal ultrasound was found to be effective in detecting vocal cord nodules, polyps, cysts, Reinke's edema, laryngeal masses and vocal fold mobility[10,11]. Importantly, anesthesia is not necessary in laryngeal ultrasonographic examination. In addition, it is a non-invasive, painless and much less expensive than other techniques[11]. Additionally, Rubin *et al*.[12], reported that laryngeal ultrasonography has been applied for normal and pathological examination in infants and children, in whom, for example, it allows for 'easy subglottic examination' of cricoid hypertrophy, subglottic hemangiomas, laryngeal stenosis and laryngeal paralysis.

The aim of this study was to evaluate laryngeal ultrasound as an alternative to laryngeal endoscopy in diagnosis and assessment of various laryngeal lesions.

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SUBJECTS AND METHODS

This study was a prospective study conducted at the E.N.T. outpatient clinic of Minia University Hospital during the period between December 2015 to July 2016. The study included 50 patients (28 males and 22 females) with laryngeal manifestations. The study was approved by the Clinical Research Ethics Committee of the Faculty of Medicine, Minia University. Informed consent was obtained all the study participants. Children with age less than 6 years old, patients with previous laryngeal operation and with recent history of laryngeal infection were excluded from this study.

Methods

All patients were subjected to the following:

1. Full history taking (name, age, sex….).
2. Full E.N.T. examination.
3. Routine laboratory investigations (CBC, liver function tests, ….)
4. Direct laryngoscopy: by using (rigid laryngoscope; Henke-Sass, Wolf Angle 908 Camera Lemke Mc 305).
5. High resolution ultrasonography: A radiologist examined the patients by ultrasonography. Patients lied supine with neck slightly extended and gel was applied on the linear probe. The examination started by putting the probe transversely on the mid part of the thyroid cartilage and the external identification of the thyroid cartilage was done. By moving the probe upwards and downwards, the imaging of the laryngeal areas was clearly obtained. Laryngeal ultrasonography was done in two phases: The first was during quiet breathing which allowed better assessment of the vocal cords and their lesions and the second was during phonation by instructing the patient to say (long E) to allow the best sonographic assessment of vocal cord mobility.

Ultrasonography was performed with a TOSHIBA nemio XG US Machine (Toshiba Medical Corporation, Ltd., Tokyo, Japan) equipped with a 7.5 MHz probe for the visualization of the laryngeal structure. The probe was placed on the cricothyroid membrane with a transverse view of the larynx. The standard scanning plane was predetermined: it contains several landmarks, including the VF, false vocal folds, thyroid cartilage and arytenoids cartilage. VF surrounding soft tissues and the air passage were observed.

(Fiureg 1) shows direct laryngoscopy (DL) of bilateral glottic mass in 32 years old patient. Bilateral glottic mass taking all length of both VFs, whitish in color, irregular surface, reaching to anterior commissure. Both ventricular bands are hypertrophied and sharing in phonation. There is an irregularity of interarytenoid region. (Figure 2) shows the intraoperative view of the same case. Right (RT) true vf is swellon with normal mucosa and small white patch in the anterior 1/3. Only middle 1/3 of left (LT) true vf could be seen with normal mucosa. RT and LT ventricular folds are hypertrophied. (Figure 3) shows the ultrasound view of the same case. Both true & false vfs are thickened more noted on RT side and thick anterior commissure.

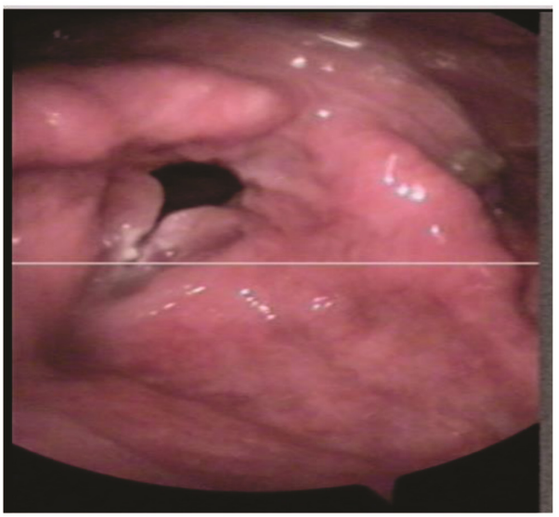

Fig. 1: Direct laryngoscopy of a case with bilateralglottic mass

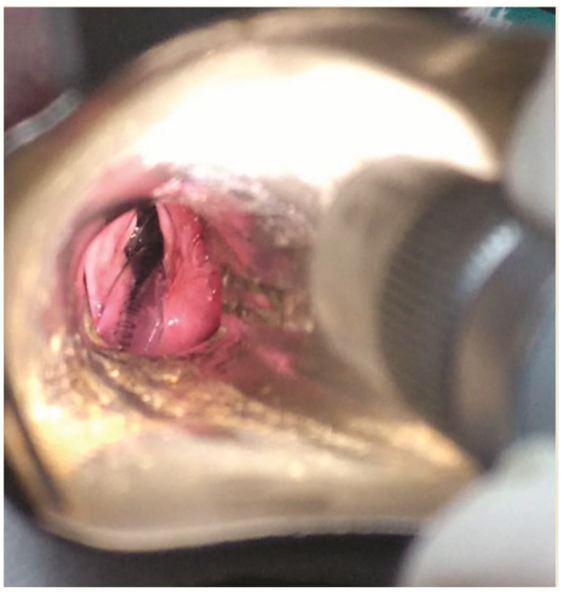

Fig. 2: Intraoperative view of the same case shown in Figure 1

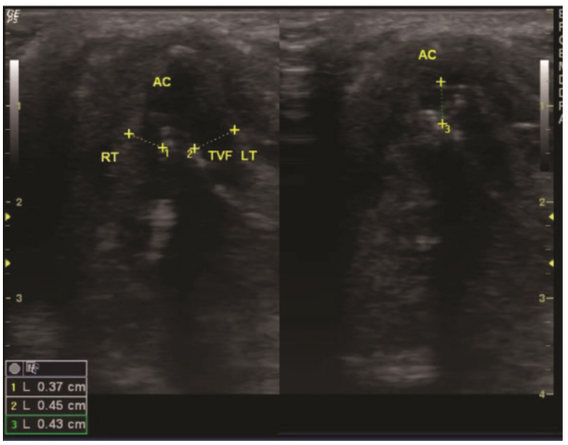

Fig. 3: Ultrasound view of the same case shown in Figures 1 and 2

(Figure 4) shows DL of vocal fold polyp in a 32 years old patient. (Figure 5) shows an intraoperative view of the same case (vocal fold polyp). (Figure 6) shows an ultrasound view of the same case.

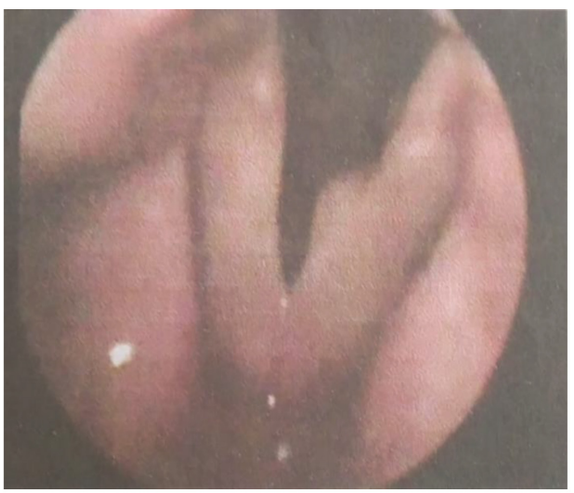

Fig. 4: Direct laryngoscopy of a case with of vocal fold polyp

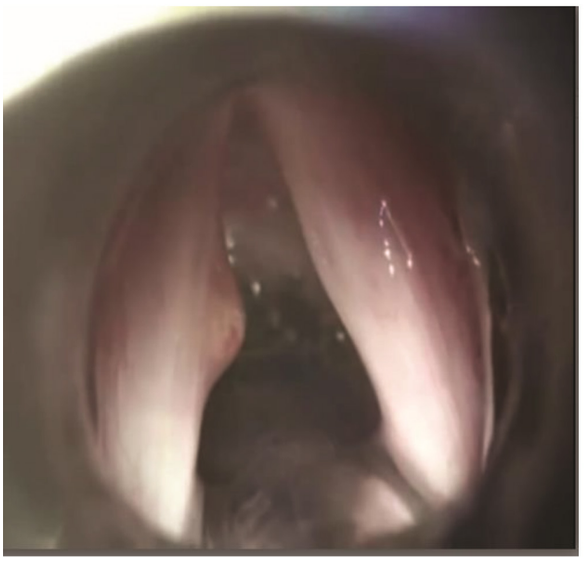

Fig. 5: Intraoperative view of the same case fold polyp shown in Figure 4

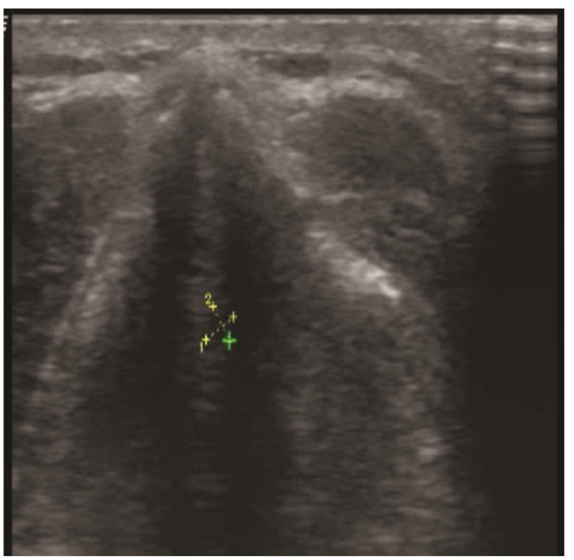

Fig. 6: Ultrasound view of the same case shown in Figures 4 and 5

Statistical analysis of the data was performed by using SPSS version 22 software package. Data are presented in the form of frequency and percentage. Comparison was performed by chi-square ($\chi 2$) test. A *P-value* <0.05 was considered significant.

RESULTS

The results showed that the mean age of all studied patients was 41.7 years with a range from 10 to 75 years. The results revealed that there were no significant differences between DL and ultrasonography results regarding diagnosis. By direct laryngoscopy, bilateral vocal fold nodule was found in 14 cases. However, ultrasound diagnosed only 11 cases (78.5%) of them. 16 cases were diagnosed with left or right vocal fold polyp by DL while the ultrasound diagnosed 15 cases (93.7%) of them. 10 patients were diagnosed as glottal mass BL while the ultrasound diagnosed 8 cases (80.0%) of them. For vocal fold cyst, 4 cases were diagnosed by both DL and ultrasound. Also, for Reinke's edema, 4 cases were diagnosed by both DL and ultrasound. One case was diagnosed as Laryngeocele by both maneuvers. One case was diagnosed as laryngeoscleroma by DL while it was not diagnosed by ultrasound. These slight differences between DL and ultrasound were not statistically significant (Table 1).

Table 1: Comparison between direct laryngoscopy and ultrasonography results in diagnosis

Diagnosis	Maneuver		*P. value* (Sig.)
	Direct laryngoscopy N (%)	Ultrasonography N (%)	
Bilateral vocal fold nodule	14 (28.0%)	11 (22.0%)	0.488 NS
Left or right vocal fold polyp	16 (32.0%)	15 (30.0%)	0.828 NS
Glottal mass	10 (20.0%)	8 (16.0%)	0.601 NS
Vocal fold cyst	4 (6.0%)	4 (8.0%)	1.0 NS
Reinke's edema	4 (8.0%)	4 (8.0%)	1.0 NS
Laryngeoscleroma	1 (2.0%)	0	0.314 NS
Laryngeocele	1 (2.0%)	1 (2.0%)	1.0 NS

NS Not Significant.

There was a significant difference between DL and ultrasonography in diagnosing the thickened form of true vf (RT; 10 cases in ultrasonography vs. no cases in DL). Also, the same result was found in true vf (LT; 9 cases in ultrasonography vs. no cases in DL) as shown in (Table 2). However, no significant differences were found between the two maneuvers regarding site and size of lesion.

Table 2: Comparison between direct laryngoscopy and ultrasonography results in diagnosis of true vfs, ventricular folds and anterior commissure.

Diagnosis		Maneuver		*P. value* (Sig.)
		Direct laryngoscopy N (%)	Ultrasonography N (%)	
True vf (right)	Swelling	29 (58.0%)	21(42.0%)	0.109 NS
	Thickened	0 (0)	10 (20.0%)	<0.001**
True vf (left)	Thickened	0 (0)	9 (18.0%)	0.001**
	Mass form	6 (12.0%)	2 (4.0%)	0.140NS
Ventricular folds	Free	44 (88.0%)	37 (74.0%)	0.050*
(right)	Thickened	2 (4.0%)	9 (18.0%)	0.025*
Ventricular folds	Free	43 (86.0%)	37 (74.0%)	0.133NS
(left)	Thickened	2 (4.0%)	9 (18.0%)	0.025*
Anterior	Free	41(82.0%)	35 (70.0%)	0.160NS
Commissure	Mass form	7 (14.0%)	1 (2.0%)	0.026*

NS Not Significant. * Significant (p<0.05). ** highly significant (p<0.01).

There were significant differences between the two maneuvers in diagnosing free and thickened ventricular folds (right and left), while there was no significant difference between direct laryngoscopy and ultrasonography in mobility of vfs (right and left. Regarding anterior commissure, there was a significant difference between the two maneuvers in diagnosing thickened and mass form. Also, there was no significant difference between DL and ultrasonography regarding aryepiglottic fold and pyriform fossa. Regarding subglottic area, there was a significant difference between DL and ultrasonography (4 cases could not be seen by DL).

The results showed that in right true vf, there was a significant difference between both DL and intraoperative results versus ultrasonography in diagnosing thickened form (ultrasonography diagnosed a higher number in thickened form than both DL and intraoperative). Also, the same trend of results was found in true vf (left). Regarding ventricular folds (right and left), there was no significant difference between both DL and intraoperative results versus ultrasonography. Regarding aryepiglotic fold and subglottic area, there was no significant difference among the three maneuvers. In anterior commissure, there was a significant difference between both DL and intraoperative results versus ultrasonography in diagnosing thickened form (ultrasonography diagnosed higher number in thickened form than both DL and intraoperative). In pyriform fossa, there was a significant difference between both DL and intraoperative results versus ultrasonography (3 cases could not be seen by ultrasonography).

Also, there were some additional findings found by ultrasound in studied cases. In this regard, laryngeal airway

was found patent and centralized in 32 cases (64.0%) while two cases (4.0%) were shifted by mass and 13 cases (26.0%) were encroachment of LA by mass and three cases (6.0%) were not assessed. For strap muscle, 50 cases (100.0%) were free. For cervical lymph nodes, 46 patients (92.0%) were free and the remaining four cases (8.0%) were enlarged. For paralayngal space, 46 patients (92.0%) were free and the remaining four cases (8.0%) were not free. For cartilaginous framework, 47 cases (94.0%) were free and three cases (6.0%) were calcified.

DISCUSSION

During the last several years, high frequency ultrasound became an effective diagnostic tool with small, flexible ultrasound transducers[13]. Also, ultrasound has the same diagnostic accuracy as laryngoscopy in the detection of vocal cord mobility[14]. The data present herein revealed that there were no significant differences between DL and ultrasonography results regarding diagnosis.

The present results revealed that there were no significant differences between DL and ultrasonography results regarding diagnosis.

There were slight differences between DL and ultrasound that were not statistically significant and this means that the two maneuvers had almost the same good result of diagnosis and that ultrasonography could be an alternative maneuver to DL in diagnosis. The present results agreed with those of Gomaa *et al*.[3], who found that ultrasonography was helpful in describing various laryngeal lesions, vocal fold polyps, glottic cancer, epiglottic enlargement and one patient had laryngocele. Also, they found that ultrasonography was highly significant in diagnosing subglottic lesions and also vocal fold mobility can be demonstrated by ultrasound. But, the authors reported that interarytenoid lesions and small laryngeal lesions as vocal fold nodules were difficult to be described.

In the same theme, these results are in agreement with those of Moanes *et al*.[15], who found that laryngeal ultrasound was found to be valuable in detecting vocal cord nodules in, polyps, cysts, Rienk's edema and laryngeal masses and they concluded that laryngeal ultrasound is considered of a great value in diagnosing different laryngeal lesions. Also, Khalil *et al*.[16], detected vocal cord polyp in all cases included in the study by ultrasound, but in contrast to our study they could not detect vocal cord nodules in any of the patients. They concluded that diagnosis of vocal cord lesions is an added implementation of ultrasound.

The slight difference between DL and ultrasound in diagnosing vocal fold nodule in our study may be due to the small size of the nodules, which make it difficult to be detected by ultrasound. These data agreed to some extent with that of others[3, 16], who reported that laryngeal ultrasound was found to be incapable of detecting the vocal cord nodules because it is too small to be detected by the resolution of the probe and they lie along the air-soft tissue interface.

In our study, one case of laryngeocele was diagnosed by DL and detected accurately with ultrasound. This results agreed with the findings of Hazem *et al*.[6], who reported that ultrasonography is a valuable tool for detecting laryngeocele.

High-resolution laryngeal ultrasound can be used for assessment of vocal fold lesions, tumors, and mobility. Ultrasonography was considered an effective diagnostic tool for the proper assessment of the vocal fold mobility rather than other diagnostic modalities because of its real-time ability and noninvasive nature, although it is less effective in vocal cord ulcers and small lesions because of the limitation of the air–mucosa interface[6]. Also, Wail *et al*.[17], found that laryngeal ultrasound was found to be effective in detecting vocal cord nodules in 27.3% of patients, polyps and cysts in all patients, Reinke's edema in 60% of patients and laryngeal masses in 78.6% of patients. The authors concluded that laryngeal ultrasound is considered of great value in diagnosing different laryngeal lesions.

In the present study, there is a slight difference between the two maneuvers in diagnosing vocal fold polyp and this may be due to the calcification of the laryngeal cartilage. Also, the difference between DL and ultrasound results in detecting glottal mass, we think that it can be attributed to the same reason. These findings agreed with the findings of Garel *et al*.[18], who reported that the little use of ultrasound in diagnosis of true vocal fold pathologies perhaps because of the often stated conception that "the anterior laryngeal calcification" makes analyzing of the larynx impossible. Also, Youssef *et al*.[19], found that the calcification of the thyroid cartilage interfered with good assessment of the vocal folds. Another reason was indicated by Hazem *et al*.[6], who suggest that this is a limitation of the air-mucosa interface.

Moanes *et al*.[15], reported that the free margins of the vocal fold could be well demarcated while the free margins and the posterior part of the vocal cord were not clearly identified due to the air-soft tissue interface between the glottic air and the tissues of the margins of the vocal cords, and this is consistent with the study of Garel *et al*.[18].

The data present in this study show that there was a significant difference between DL and ultrasonography in diagnosing the thickened form (10 cases in ultrasonography vs. no cases in DL). The same result was recorded in true vf (left), (9 cases in ultrasonography vs. no cases in DL). These results are expected because the ultrasound can assess the thickness while DL cannot and this is one of the

additional advantages of using ultrasound as compared to DL. These results agreed with two other reports[6,17].

Our data indicated that the results of DL and intraoperative maneuvers were almost the same as compared to ultrasound results. The present data showed that there was a significant difference between DL and intraoperative results as compared to ultrasound results in diagnosing free and thickened ventricular folds (right and left), while there was no significant difference between DL and ultrasonography in mobility of vfs (right and left) and anterior commissure aryepiglottic fold, arytenoid cartilage and subglottic area and this means that high accuracy of using ultrasonography in detecting mobility of vfs, anterior commissure, aryepiglottic fold, arytenoid cartilage and subglottic area with no differences as compared to DL. Also, the present results agreed with those of others[6,17].

CONCLUSION

Ultrasonography could be used effectively in diagnosis of different laryngeal lesions and it is superior in the diagnosis of small subglottic lesions and very useful in cases of larger laryngeal lesions. Ultrasonography does not require special training or extensive settings and can be learned and performed easily. Ultrasound maneuver could be an effective and alternative technique to direct endoscopy in patients with a sensitive gag reflex and patients with neck or jaw diseases. Ultrasonography is a non invasive modality, available at almost all institutions, inexpensive, easily reproducible method of examining the larynx in infants and children, painless, with no anesthesia and can be used safely during pregnancy.

CONFLICT OF INTEREST

There are no conflict of interest

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