Abstract

Background: Laryngeal examination with rigid endoscopy has the advantages of producing large, bright images. Unfortunately, few patients with a sensitive gag reflex, patients with limited jaw or neck mobility, or suffering from stridor may not tolerate Laryngeal endoscopic examination. It is also difficult in most infants and children. High-frequency Ultrasonography (HFUS) may provide an alternative diagnostic tool. Objective: This study was carried out to evaluate the use of the high-resolution laryngeal ultrasound in the diagnosis and assessment of vocal cord lesions.

Patients and Methods: 242 patients, known to have a vocal cord lesion pre-examined with rigid laryngoscopy and 125 non-smoker volunteers compose the control group. Both groups were examined using ultrasound to see which structures could be detected and describe the lesions in which HFUS can help. HFUS was helpful in describing vocal cord lesions as nodules (25.2%), polyps (16.1%) and cord masses (11.2 %) was clearly described, vocal cord mobility is another useful implementation of ultrasound, while posterior lesions in the arytenoids as edema (47.5% ) was difficult to demonstrate.

Conclusion: High-resolution laryngeal ultrasound can be used for assessment of vocal cord lesions and mobility special experience has to be gained prior to its general application.

Key words: Vocal cords lesions, laryngoscopy, high resolution neck ultrasound

Introduction

Manuel Garcia first used a dental mirror to visualize vocal cords in 1854. Then, different methods were used successfully for the diagnosis and treatment of many laryngeal diseases. Rigid endoscope was used in otolaryngology outpatient departments for laryngeal evaluation with the advantages that the image is larger, brighter, and clearer, which allowing earlier diagnosis.

Laryngeal endoscopes are made with several viewing angles, including 0°, 30°, 70°, 90°, and 120°. Each laryngoscope angle allows preferential visualization of specific regions during laryngeal examination. Unfortunately, not all patients can tolerate the rigid laryngoscope especially those with a sensitive gag reflex, patients with limited jaw or neck mobility or patients suffering from stridor. It is also difficult in most infants and children.

Ultrasound became a very important widely used diagnostic tool for the head and neck diseases. However, it was rarely used in the diagnosis of laryngeal diseases. This omission is related to the problem of visualization of laryngeal structures and thus performing a complete laryngeal sonographic examination due to the acoustic extinction of the ultrasound by the ossified laryngeal cartilages.

Ultrasoundography is generally considered as a “safe” imaging modality for the diagnosis during pregnancy. During the last several years high-frequency ultrasound became a new diagnostic tool with small, flexible ultrasound transducers. This study was carried out to detect the value of the high-resolution laryngeal ultrasound in the diagnosis and assessment of vocal cords lesions.

Patients and Methods

This cross sectional descriptive study was conducted in Otolaryngology Department, Suez Canal University Hospitals, Ismailia, Egypt. The study group consisted of 242 patients with a diagnosis of a vocal cord lesion from the history, examination and rigid laryngoscope with the exclusion of patients less than 6 years old or those with previous laryngeal operation.

The control group included 125 non-smoker volunteers without any laryngeal symptoms and with normal laryngoscopic appearance. This group was examined using High Resolution Laryngeal Ultrasound to acquaint the normal sonographic appearance of vocal cords.
Patients and volunteers in both groups were subjected to a full history and examination and they all had an indirect rigid laryngoscopy, using Carl Storz (Hopkins) rigid laryngoscope 5.8mm and angled 70° with photo documentation and video recording by using Watec 221 S camera with the application of lidocaine 10% spray on the soft palate and the posterior pharyngeal wall. High Resolution Laryngeal Ultrasound was done using General Electric Voluson 730- Expert Machine and Philips hd 11 xe both with small linear probe of 6-12 MHz frequency and with a high resolution monitor and thermal page printer.

All subjects lied supine with neck slightly extended. Gel was applied on the examination linear probe. External identification of the thyroid cartilage was done and the examination started by putting the probe transversely on the mid part of the thyroid cartilage. The probe was moved upwards and downwards until the imaging of the vocal folds was clearly obtained.

The vocal cords were examined during 2 phases: quiet breathing which allowed better assessment of vocal cords and their lesions and during phonation (long E) to allow the best sonographic assessment of the vocal cords mobility.

**Statistical Analysis:** Data analyzed using SPSS program, statistical package for social sciences. Sensitivity and specificity of the laryngeal US were calculated.

**Results**

The 125 non-smoker normal volunteers (the control group) with normal laryngoscopic appearance were examined using High Resolution Laryngeal Ultrasound to acquaint the normal sonographic appearance of vocal cords. Examining of the larynx was done through the mid portion of the thyroid cartilage to identify both vocal cords, which appeared echogenic. In addition, thyroid lamina, anterior commissure, vocal process of the arytenoids, and glottic chink were identified during normal quiet breathing and phonation (prolonged E). The free margins of vocal cords were not well defined. The posterior parts of the vocal cords also not clearly identified (Figure 1).

![Figure 1](image1.png)

**Figure 1:** shows normal anatomy of the larynx at the level of vocal folds by ultrasound: 1=skin and subcutaneous tissues, 2=strap muscles, 3=lamina of the thyroid cartilage, 4=right vocal fold, 6=anterior commissure, 7=glottic chink.

Judging the mobility of the vocal cords necessitated that the probe should be exactly horizontal during imaging so the range of mobility of the vocal cords was clearly visible. While with probe (10 MHz frequency), calcified thyroid cartilage has interfered with good assessment of the vocal cords.

The study group included 242 patients with mean age 42.5 years ± 16.4 (64 females and 178 males) attending to the Otalaryngology outpatient clinic, Suez Canal University hospital, Ismailia, Egypt, during the period from July 2006 to January 2009.

The most common presenting symptom was hoarseness of voice reported among all cases then chronic cough (45.2%) followed by dysphagia (14.3%), then choking attacks (9.5%) and finally stridor in (8.6%). Indirect laryngoscopy revealed that 115 patients (47.5%) had an interarytenoid edema, 61 patients (25.2%) with vocal nodules, 39 patients (16.1%) had a unilateral vocal polyp while 27 patients (11.2%) had glottis masses (Table 1).

<table>
<thead>
<tr>
<th>Indirect Laryngoscopy Findings</th>
<th>Number</th>
<th>Percentage</th>
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<tbody>
<tr>
<td>Polyp</td>
<td>39</td>
<td>16.1%</td>
</tr>
<tr>
<td>Glottic mass</td>
<td>27</td>
<td>11.2%</td>
</tr>
<tr>
<td>Nodule</td>
<td>61</td>
<td>25.2%</td>
</tr>
<tr>
<td>Interarytenoid edema</td>
<td>115</td>
<td>47.5%</td>
</tr>
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**Table 1:** shows the distribution of laryngeal lesions as detected by laryngoscope among the study group patients.

Unilateral vocal polyp appears as an isoechoic relative to the vocal cord substance, its size measured with the machine cursor ranged from 2.7 to 9 mm. This was better seen in prolonged EE (Figure 2,3).
Vocal cord nodules could not be identified by U/S (Figure 4). Glottic mass appears as heterogeneous lesion. However, cases having glottic masses with extension to the anterior commissure with infiltration of the thyroid cartilage were clearly identified (4 cases out of the 27 cases) (Figure 5,6).

The visibility of a vocal cord mass in U/S depends on the size of the mass which ranged from 0.27 to 1.71 cm with a mean of 0.59 cm±0.06, while all of the vocal nodules and interarytenoid edema were not visible. The laryngeal U/S specificity and sensitivity to detect glottis masses and vocal cord polyps were both 100% but its sensitivity was 0% in detecting vocal nodules and interarytenoid edema. Laryngeal U/S could not detect any surface ulceration.

<table>
<thead>
<tr>
<th>Total</th>
<th>Laryngoscope</th>
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<tr>
<td></td>
<td>Sluggish mobility</td>
</tr>
<tr>
<td>(78.6%)</td>
<td>0 (0%)</td>
</tr>
<tr>
<td>(21.4%)</td>
<td>(21.4%)</td>
</tr>
<tr>
<td>(100%)</td>
<td>(21.4%)</td>
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Table 2: shows the relation between mobility of vocal folds as detected by laryngoscope vs. U/S.

Surface ulceration was not detected in any case. Interarytenoid edema could not be detected as the arytenoid and interarytenoid area could not be identified by U/S (Figure 7).

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Table 2: shows the relation between mobility of vocal folds as detected by laryngoscope vs. U/S.
Assessment of the vocal cords mobility shows similar results in both techniques. In the study group, 78.6% cases had bilaterally mobile cords by laryngoscopy and U/S, while 21.4% had a sluggish mobility by both techniques (Table 2).

Discussion

Huang and his colleagues, 2007, showed that laryngeal ultrasonography at frequencies ranging from 10 to 30 MHz is useful in the diagnosis of diseases of the vocal cords. Anesthesia is not necessary in laryngeal US examination in addition; it is non-invasive, painless, and much less expensive than other techniques. In this study, the high-resolution laryngeal US could detect masses larger than 2 mm in size with utilization of a high frequency probe (10 MHz) but could not detect smaller masses less than 2 mm in size.

During studying the normal sonographic anatomy of the vocal folds, the free margin of the vocal fold could not be well demarcated, due to the air-soft tissue interface between the glottic air and the tissues of the margin of the vocal cords. In conforming with our study, Garel, 1997, stated that the air-soft tissue interface would make it impossible to delineate the margin of the vocal cord.

In addition, the calcification of the thyroid cartilage interfered with good assessment of the vocal folds which is supported by Youssef, 2001, who reported that the laryngeal space can be well seen if the thyroid cartilage was not calcified, whereas the laryngeal space was not clearly seen due to complete calcification of the thyroid cartilage. Garel, 1999, stated that complete anterior calcification of the thyroid cartilage created an acoustic shadow, which made it hard to analyze the larynx. The arytenoid and interarytenoid areas were not identified because we use a high frequency probe (10MHz) which gave a high-resolution image to the superficial tissues but its resolution and clarity greatly diminished as we went deep. This might explain the inability of US to diagnose the interarytenoid edema.

Laryngeal ultrasound was found to be unable to detect 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. Schade and his colleagues, 2006 tried to prove whether results of laryngeal ultrasonography are better than those of laryngeal endoscopy or if there are any additional advantages when using ultrasonography. Minor changes were difficult to detect in their cohort of patients. US could only detect a mass of the vocal fold larger than 2 mm which is in agreement with our study. They concluded that ultrasonography is useful in cases of larger laryngeal lesions, while there was no advantage in the detection of small processes.

Sheth et al, 1999, reported that US is a good technique in space occupying lesions of the larynx. The pedunculated polyps were not identified during breathing but could be identified only during phonation as they become entrapped between the vocal folds and become stabilized as the US could not detect any moving mass clearly.

On the other hand, we found that sessile polyps were identified either during phonation or during quiet breathing. US could detect tissue texture differentiation. Laryngeal polyps displayed isoechoic texture while laryngeal masses displayed heterogenous texture. In contrast to our results, Garel, 1999, stated that the US could give very good tissue differentiation without being specific except for cystic lesions.

The evaluation of ultrasound to detect vocal cord ulceration showed that ulceration was not detected by ultrasound and hence laryngoscope had the upper hand in this issue because the ulcers are usually very superficial which may make the air-soft tissue interface obliterate it. The ultrasound has the same diagnostic ability with the laryngoscope in the assessment of the vocal cord mobility (100% sensitivity & specificity).

In agreement with our results, Vats, 2004, reported that US is useful in the diagnosis of vocal cords mobility. In addition, El-Hennawi et al, 2003, concluded that sonography, with special precautions, showed the modality of choice for assessment of patients with bilateral vocal cord paralysis.

Ultrasound has an advantage over laryngoscopy in detecting thyroid cartilage infiltration for cancer glottis as Schade, 2006, stated that US could identify thyroid cartilage infiltration. In addition, Gryczynski, 1995, stated that ultrasonography is effective in detection of metastases of laryngeal carcinoma to lymphatic system of neck. Other authors noted that high resolution US is a sensitive, simple and inexpensive method for evaluating laryngeal cancers and sub-clinical cervical lymph node and metastasis. So, assessment of the laryngeal tumor and its lymph nodes affection can be performed by one technique and at the same time. In conclusion, high resolution US is an effective and accurate diagnostic tool for the proper assessment of the vocal cord lesions and mobility and thyroid cartilage infiltration in cases with laryngeal tumors, but is less effective in vocal cord ulcers and small lesions with inability to diagnose the deep interarytenoid lesions. It is non-invasive, available, visible and less expensive than most of the other tools.
References