Comparative Study between Laryngeal Ultrasonography and C.T Scan of Various Laryngeal Lesions

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Abstract

Background: Different methods were used for diagnosis of many laryngeal diseases. Ultrasound became a very important, widely used diagnostic tool for head and neck diseases.

Objectives: The aim of this study is to evaluate laryngeal ultrasound as an alternative to C.T scan in diagnosis of different laryngeal diseases.

Patients and Methods: A prospective study which was carried out between April 2012 and October 2012 in Radiodiagnosis and Otorhinolaryngology Departments, Zagazig University Hospital, Egypt. It included 2 groups of patients, control group (12 patients) and study group (54 patients). Individual of the control group who were undergoing neck ultrasound for thyroid swelling were subjected to laryngeal ultrasound only while patients of the study group were subjected to both laryngeal ultrasound and C.T scan of the neck.

Results: Laryngeal ultrasound was found to be valuable in detecting vocal cord nodules in (27.3%), polyps (100%), cysts (100%), Rienk’s oedema (60%) and laryngeal masses (78.6%) and these results were comparable that of C.T scan.

Conclusion: Laryngeal ultrasound is considered of a great value in diagnosing different laryngeal lesions and can be used as an alternative or complementary to C.T scan.

Key Words: Laryngeal lesions – Laryngeal ultrasound – Computed tomography – High frequency ultrasound.

Introduction

DIFFERENT methods were used successfully for the diagnosis of many laryngeal diseases [1]. Rigid endoscope was used in otolaryngology outpatient departments for laryngeal evaluation with the advantage that the image is larger, brighter and clearer which allows earlier diagnosis [2].

Unfortunately, not all patients can tolerate the rigid laryngoscope especially those with a sensitive gag reflex, patients with limit of jaw or neck mobility or patients suffering from stridor. It is also difficult in most infants and children [3,4].

Even during laryngoscopy the exact extension of laryngeal tumor, its infiltration and invasion of the laryngeal skeleton can sometimes be hard to assess. Thus, laryngoscopy alone may not be sufficient in some cases to judge the extent of infiltrative processes or measure the exact infiltration of a tumor. For this reason computed tomography (C.T) as well as magnetic resonance imaging (MRI) are often used to supplement laryngoscope as an additional imaging tool in the estimation of tumor extension and size [5].

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 disease. This omission is related to the problem of visualization of laryngeal structures and thus performing a complete laryngeal sonographic examination due to acoustic extinction of the ultrasound by the ossified laryngeal cartilages [6].

During the last several years high-frequency ultrasound became an effective diagnostic tool with small, flexible ultrasound transducers [7].

Ultrasonography is generally considered as a safe non invasive imaging modality for the diagnosis during pregnancy and reliable for infants and children [8].

Patients and Methods

This study was performed in the Otorhinolaryngology and Radiology Departments, Zagazig University hospitals over a period from April 2012 and October 2012. Patients included in this prospective study were divided into control and study
groups. Individual of the control group included 12 patients who were undergoing neck ultrasound for thyroid swelling were subjected to laryngeal ultrasound only to identify the normal sonographic appearance of the different laryngeal structures.

The study group included 54 patients with different laryngeal lesions. These patients were previously diagnosed by indirect rigid laryngoscope using Hopkins rod rigid laryngoscope 70O (Carl Storz) with photo documentation and video recording using camera (Carl Storz). Patients diagnosed to have laryngeal mass by rigid indirect laryngoscope underwent direct laryngoscope under general anesthesia, biopsies were taken for histopathological diagnosis. Every patient included in the study group was subjected to both C.T scan of the larynx and laryngeal ultrasonography.

High resolution ultrasound was done using (General Electric with small linear probe of 7.5 Mhz frequency and Laser page printer) to conduct the laryngeal ultrasound, the examined patient 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 upward and downward until the imaging of the different laryngeal structures and laryngeal lesions were obtained. Laryngeal ultrasonography was done in 2 phases: Quiet breathing which allowed better assessment of the vocal cords and their lesions and during phonation by instructing the patient to say (long E) to allow the best sonographic assessment of vocal cord mobility. Then every patient in the study group underwent CT scan of the larynx to assess the laryngeal lesion, then the findings of both radiological modalities were compared for every patient.

**Technique of C.T of the neck and larynx:**

Dual CT scanner was used (General Electric, High speed Dual system). The patient lie on the table in the supine view with the neck slightly extended. The study was performed with the patient breathing quietly. Contiguous or overlapping sections were obtained through the neck. The display slice thickness was 3mm. The gantry angle was parallel to the hyoid bone. All studies were reconstructed in soft tissue algorithm. Additional reconstruction with a suitable edge enhancing algorithm or technique to improve bone and cartilage depiction was obtained in patients with a history of tumor. Intravenous contrast was administrated with amount of 50ml of non iodinated contrast through automatic injector with a rate of 3ml/Second. The neck was evaluated with scans from the skull base to the top of aortic arch. For studies specifically performed to evaluate for vocal cord palsy, the inferior extent of the C.T examination must include the right subclavian artery in right vocal cord palsy or (the aortopulmonary window in left vocal cord palsy). Very thin sections (1.0 to 1.5) with multi-planar reconstructions limited to the larynx may be helpful for evaluating patients for vocal cord neoplasms. Scans obtained during phonation or Valsalva maneuver may be useful in assessing laryngeal function.

**Results**

The control group included twelve individuals who were normal, non smoker with normal laryngoscopic appearance. High resolution neck ultrasonography was performed for every individual included in the control and our aim was to identify the normal sonographic appearance of the laryngeal structures. Both vocal cords were easily identified and appeared echogenic, thyroid lamina, anterior commissure, vocal process of the arytenoid cartilage and the glottic space were also identified during phonation and normal breathing. The free margins and the posterior part of the vocal cords were not clearly identified (Fig. 1).

As regards the vocal cords mobility, the range of mobility were clearly visible in most of the individuals, but they were not clearly identified in three of them (25%) as the thyroid cartilage was calcified in them. Fifty four patients were included in the study group, they were 38 males and 16 females, their ages ranged from 21 to 68 years (mean 44.5 years) Variable symptoms were seen in the patients included in the study group, hoarseness of voice was the most common presenting symptom as it was seen in 100% of the patients, then chronic cough in 27.8% of them, followed by dysphagia in 22.2% of them, then choking attacks in 18.5% of patients and finally stridor in 16.7% (Table 1).

The indirect laryngoscopic examination of the patients included in this study showed laryngeal mass (whether benign or malignant) in 14 patients, vocal cord nodules in 11 patients (unilateral in 3 and bilateral in 8), vocal cord polyp in 14 patients (sessile in 5 and pedunculated in 9), vocal cord cyst in 6 patients, Rienk’s oedema in 5 patients and chronic laryngitis in the form of vocal cord thickening and interarytenoid oedema in 4 patients.

Every patient included in the study group was subjected to both C.T scan of the larynx and laryn-
geal ultrasonography and the results of imaging findings were presented in (Table 3).

By reviewing these results, it has been found that: In the subgroup of patients who were diagnosed to have vocal cord nodules (n=11), The vocal cord nodule was not seen by ultrasonography in 8 patients, but it was seen in 3 patients (27.3%), when the same patients underwent C.T scan of the larynx, the vocal cord nodule was detected in only one patient (9.1%) (Table 3).

In the subgroup of patients who were diagnosed to have vocal cord polyp (n=14), the vocal cord polyp was seen in all patients (100%) by ultrasonography, but it was seen in 12 patients (85.7%) when larynx C.T scan was performed to the same patients (Table 3). In the 2 patients in whom vocal cord polyp was not seen using C.T scan, the vocal cord polyp was small sessile polyp.

Six patients were diagnosed to have vocal cord cyst. In these patients the cyst was seen in all cases (100%) when they were subjected to laryngeal ultrasound but when the same patients were subjected to C.T scan of the larynx, the vocal cord cyst was seen in 5 patients (83.3%) and it was not detected in one patient in him the cyst was small in size that measured 4mm (Table 3).

Rienk’s oedema was diagnosed in 5 patients, when laryngeal ultrasound was performed in these patients, Rienk’s oedema was detected in 3 patients (60%) while after performing C.T scan of the neck it was detected in only 2 cases (40%) in the form of thickened vocal cord (Table 3).

Four patients were diagnosed to have chronic laryngitis in the form of interarytenoid oedema and vocal cord thickening. Signs of chronic laryngitis were not detected in any of these cases after performing laryngeal ultrasound (zero%) but thickened cord was detected in 2 cases (50%) in C.T scan cuts (Table 3).

Fourteen patients with laryngeal masses were included in this study. There were 3 cases with supraglottic mass, 5 cases with glottic mass and 6 cases with transglottic mass. The visibility of laryngeal mass in ultrasonography depends on the size of the mass which ranged about 32 to 8mm, with a mean of 20mm. Laryngeal mass was visible in 11 out of 14 cases (78.6%) when performing laryngeal ultrasound and it was detected in 12 out of 14 cases (85.7%) when performing C.T scan of the larynx.

![Fig. (1): Normal sonographic appearance of the larynx at the level of the vocal cord. Vocal folds by ultrasound: A=Skin and subcutaneous tissues, B=Strap muscles, C=lamina of the thyroid cartilage, D=Right vocal fold, F=Anterior commissure, G=Glottic chink.](image)

![Fig. (2): (a) Axial C.T image showing anterior laryngeal polyp and (b) The lesion seen by ultrasound.](image)
Fig. (3): (a) Axial CT image showing a supraglottic mass and (b) The mass seen by ultrasound.

Fig. (4): (a) Axial C.T image showing a left cord nodule and (b) The nodule seen by ultrasound.

Fig. (5): Diffuse laryngeal edema seen by US (a) and C.T (b).
Table (1): Distribution of the presenting symptoms.

<table>
<thead>
<tr>
<th>Symptoms</th>
<th>Number</th>
<th>Percentage %</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hoarsness of voice</td>
<td>54</td>
<td>100</td>
</tr>
<tr>
<td>Chronic Cough</td>
<td>15</td>
<td>27.8</td>
</tr>
<tr>
<td>Dysphagia</td>
<td>12</td>
<td>22.2</td>
</tr>
<tr>
<td>Chocking</td>
<td>10</td>
<td>18.5</td>
</tr>
<tr>
<td>Stridor</td>
<td>9</td>
<td>16.7</td>
</tr>
</tbody>
</table>

Table (2): Results of indirect laryngoscopic examination.

<table>
<thead>
<tr>
<th>Laryngeal lesion</th>
<th>Numbers</th>
<th>Percentage %</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nodules</td>
<td>11</td>
<td>20.1</td>
</tr>
<tr>
<td>Polyps</td>
<td>14</td>
<td>25.9</td>
</tr>
<tr>
<td>Cysts</td>
<td>6</td>
<td>11.1</td>
</tr>
<tr>
<td>Masses</td>
<td>14</td>
<td>25.9</td>
</tr>
<tr>
<td>Rienk's oedema</td>
<td>5</td>
<td>9.3</td>
</tr>
<tr>
<td>Chronic laryngitis</td>
<td>4</td>
<td>7.4</td>
</tr>
</tbody>
</table>

Table (3): Results of laryngeal US and C.T scan of the larynx for the cases of the study group.

<table>
<thead>
<tr>
<th>Laryngeal lesions</th>
<th>Ultrasonography</th>
<th>CT</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Percentage</td>
<td>Numbers</td>
</tr>
<tr>
<td>Vc.Nodule (n=11)</td>
<td>27.3</td>
<td>3</td>
</tr>
<tr>
<td>Vc.Polyp (n=14)</td>
<td>100</td>
<td>14</td>
</tr>
<tr>
<td>Vc.Cyst (n=6)</td>
<td>100</td>
<td>6</td>
</tr>
<tr>
<td>Rienk's oedema</td>
<td>60</td>
<td>3</td>
</tr>
<tr>
<td>Chronic laryngitis</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Laryngeal mass</td>
<td>78.6</td>
<td>11</td>
</tr>
</tbody>
</table>

Discussion

Ultrasonography has been posited as a possible mode for investigation of the larynx since 1960 [9]. By 1973, echoes from the free margins of the true vocal folds could be unequivocally identified [10].

By the late 1980, ultrasound was found to be useful for real time examination, not only for the true vocal folds, but also for the false vocal folds and the vocal fold movement [11]. Huang and his colleagues, 2007, showed that laryngeal ultrasonography at frequencies ranging from 10 to 30Mhz is useful in the diagnosis of diseases of vocal cords [12]. Anaesthesia is not necessary in laryngeal ultrasonographic examination in addition, it is non invasive, painless and much less expensive than with other techniques [13].

The use of the laryngeal ultrasound has been applied to normal and pathological findings in infants and children where for example, it allows for "easy subglottic examination" of cricoid hypertrophy, subglottic haemangiomas, laryngeal stenosis and for laryngeal paralysis [14]. Garel et al. [15] postulated that, the little use of ultrasound in diagnosis of true vocal fold pathologies may be due to the general interest in other more sophisticated imaging modalities, including three dimensional computed tomography scanning and magnetic resonance imaging and perhaps because of the often stated conception that "the anterior laryngeal calcification" makes analyzing of the larynx impossible. In this study, while studying the normal sonographic anatomy of the vocal folds, 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., 1997 [16] Also the thyroid lamina, anterior commisure, vocal process and arytenoid cartilage were also identified during phonation and normal breathing while studying the normal sonographic anatomy of the larynx in this study.

As regards the vocal cord mobility, it was clearly visible in most volunteers, except in 3 of them (25%) as the thyroid cartilage was calcified in these three volunteers, our finding was consistent with that of Youssef, 2001 who reported that the laryngeal spaces can be well seen if the thyroid cartilage was not calcified [17].

In this study it has been found that vocal cord nodules were detected in 3 patients (27.3%) while by using C.T scan of the larynx they have been detected in only one patient (9.1 %), on the other hand vocal cord polyps were detected in 100% of cases using laryngeal US and detected in 85.7% of cases using C.T scan of the larynx, by analysis of the results of laryngeal ultrasonography revealed that, it is comparable to some extent with the results of Khalil et al. [18] who detected vocal cord polyp in all cases included in his study, but in contrast to this study they could not detect vocal cord nodules in any of the patients. (vocal cord nodules were detected using laryngeal US in 3 patients in this study).

By comparing the results of ultrasonography and C.T scan examination in this study, it has been found that the results of both imaging modalities are comparable to a great extent, also the laryngeal ultrasound was more valuable than C.T scan in detecting vocal cord polyps, nodules, cysts and Rienk's oedema, but C.T scan results were better in detecting signs of chronic laryngitis as vocal
cord thickening was detected in 2 cases (50%) in C.T scan cuts but could not be detected by using laryngeal ultrasound (Table 3).

In cases with laryngeal masses included in this study, the lesion was detected in 85.7% of cases using C.T scan neck and in 78.6% of cases using laryngeal us, so we can say that C.T scan is superior to laryngeal us in detecting laryngeal masses but laryngeal us is of value in detecting this type of laryngeal lesions.

The result of this study agree with that of Huce et al., who stated that laryngeal ultrasonography can be a non-invasive complementary technique for pre therapeutic staging of laryngeal carcinoma [19].

Ultrasonography is a non invasive modality, available at almost all institutions, not expensive, easily reproducible method of examining the larynx in infants and children, can be used safely during pregnancy in contrast to scan, portable and can be easily transferred to patients with difficult mobilization.

Conclusion:

Laryngeal ultrasound is considered of a great value in diagnosing different laryngeal lesions and can be used as an alternative or complementary to C.T scan especially when CT scan is not available or its use is difficult or carry a risk to the patient.

References