Original Article

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Role of Ultrasound in Analysis of Vocal Cord Movements in Comparison with Laryngoscopy

Nagaraj Murthy[1], Dimple Bhatia[2]

[1]Professor, Department of Radiology, JSSAHER, Mysore, [2]Senior Resident, Department of Radiology, JSSAHER, Mysore.

Abstract

Background: Ultrasound is a real time, dynamic imaging modality, useful in evaluating the movement of anatomical structures. It is a non-invasive and cheap imaging technique which can be utilized as a primary tool/ as an alternate tool to laryngoscopy in assessing the vocal cord movements in suspected cases of Vocal cord palsy. **Aims & objectives:** To evaluate the utility of ultrasound in diagnosis of vocal cord movements in suspected cases of Vocal cord palsy. To compare the results with fibreoptic laryngoscopy findings. **Subjects and Methods:** A prospective comparative study done on 73 clinically suspected cases of vocal cord palsy. Vocal cord movements were assessed on ultrasound and results were compared with findings of flexible fibreoptic laryngoscopy. **Results:** Out of 73 cases of clinically suspected vocal cord palsy, 42 cases were diagnosed with reduced / absent movement of vocal cords on ultrasound. In 3 cases ultrasound was not able to diagnose vocal cords palsy due to excessive laryngeal cartilage calcification. Unilateral vocal cord palsy was noted in 36 patients and bilateral vocal cord palsy in 9 patients. **Conclusion:** Ultrasound is reliable, non-invasive and cheap modality to asses vocal cord movements. Compared to fibreoptic laryngoscopy it has high sensitivity and specificity in diagnosing vocal cord palsy.

Keywords: Vocal Cord Palsy, Laryngeal Ultrasound, Fibreoptic Laryngoscopy.

Corresponding Author: Dr. Dimple Bhatia, Senior Resident, Department of Radiology, JSSAHER, Mysore.

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Introduction

Phonation is controlled by vocal cords and the muscles that are responsible for vocal cord motion are innervated by the recurrent laryngeal nerves, branch of vagal nerve. Vocal cord paralysis can occur due to pathology along the course of the vagal or recurrent laryngeal nerve. Lesion affecting the recurrent laryngeal nerves or the extra-cranial portion of vagal nerves results in isolated Vocal cord palsy.

Most common causes of Vocal cord palsy are surgery, malignancy, idiopathic, endo-tracheal intubation and trauma. A review of more than 800 patients showed that iatrogenic injury by mediastinal / neck surgery is the most important cause of vocal cord palsy.[1] Paralysis of the left vocal cord is more common compared to right side.[2]

Around 40% of unilateral vocal cord palsy and half of bilateral vocal cord palsy are due to surgical trauma. Bilateral vocal cord palsy is commonly associated with thyroid surgery, while unilateral vocal cord palsy with surgeries other than thyroid. Traumatic injury, most frequently intubation related, causes about 6 % of all unilateral vocal cord palsy. Less common causes are central nervous system disease, infection, inflammation, radiation therapy, and aortic aneurysm.[3]

Symptoms of vocal cord palsy are hoarseness, vocal fatigue, loss of vocal pitch, shortness of breath and aspiration.[4] Hoarseness of voice is the predominant presenting symptom accounting for more than 70% cases in most of the studies. Approximately 30–40 % of patients with unilateral vocal cord palsy are asymptomatic and palsy is incidental finding on laryngoscopy / ultrasound.[5-7]

Ultrasound is useful in head and neck imaging, including laryngeal disorders.[1] It is widely available, cost-effective and with no risk of radiation. Although flexible laryngoscopy is considered gold standard in diagnosing laryngeal disorders, ultrasound can play an important role in patients with augmented gag reflux, pregnancy and small children. Since it does not interfere with vocal cord vibration, ultrasound is useful in assessing vocal cord mobility disorders. According to Tarek Khalil et al Vocal cord palsy can be reported with 100% diagnostic accuracy on ultrasound.[4]

Subjects and Methods

It is a comparative prospective study conducted in JSS hospital Mysore between Feb 2018 & March 2019, over a period of 12 month. Seventy three consecutive clinically suspected cases of Vocal cord palsy, which were posted for fibreopticlayngoscopy were included in the study. GE Voluson Ultrasound equipment in the department of Radio-diagnosis was used for the study. High resolution linear probe of 9-12MHz was used to interrogate the vocal cords. The study was approved by the institutional ethical

committee.

Vocal cord movements were recorded during breathing and phonation. Entire larynx and para-pharyngeal area was scanned to identify any associated pathology. The results were compared with fibreoptic laryngoscopy findings and statistical analysis done.

Results

Out of the 73 patients, who were included in the study, 41 were males and 32 were females. Out of the 73 patients clinically suspected of vocal cord palsy, 45 (61.64%) cases were diagnosed to have vocal cord palsy on fibreoptic laryngoscopy. Ultrasound was able to diagnose the same in 42 (93.33%) cases and failed to do so in 3 (6.67%) cases, compared to fibreoptic laryngoscopy, due to excessive cartilage calcification.

In our study the most common age group affected was above 60yrs group and second common was 50-60yrs [Table1]

Table 1: Shows age group affected.

Age	Numbers	Percentage
20-30yrs	3	6.7%
30-40yrs	5	11.1%
40-50yrs	11	24.4%
50-60yrs	12	26.7%
60yrs and above	14	31.1%

Out of the 73 suspected cases 41 were males, making up 56.2% of the cases out of which only 26(57.77%) patients were diagnosed with vocal cord palsy. Total 32(43.8%) of the suspected cases were females out of which 19(42.22%) were confirmed cases. [Table2]

Table 2: Shows the sex distribution of Vocal cord palsy.

Sex	Number investigated	Number diagnosed
Female	32 (43.8%)	19(42.22%)
Male	41(56.2%)	26(57.77%)

The most common presentation was hoarseness of voice, which was seen in 38 cases (84.4%). Second most common presenting symptom was noisy breathing seen in 33(73.3%) which was followed by reduced vocal intensity and pitch, which was present in 17 (37.8%) of the cases. Choking and dyspnea were noted 31.1% and 20.0% of the cases, respectively. [Table3]

Table 3: Shows the most common presenting symptoms of vocal cord palsy.

Symptoms	Numbers	Percentage
Hoarseness of voice	38	84.4%
Noisy breathing	33	73.3%
Reduced vocal intensity and pitch	17	37.8%
Choking	14	31.1%
Dyspnea	9	20.0%

In our study of 73 patients with clinically suspected of vocal cord palsy, 45 (61.6%) cases had confirmed palsy on fibreoptic laryngoscope examination, which was considered as gold standard. No vocal cord palsy was noted in 28(38.4%) cases. [Table4]

Table 4: Shows number and percentage of confirmed v/s suspected cases of vocal cord palsy.

Vocal cord palsy	Numbers	Percentage
Yes	45	61.6%
No	28	38.4%

Out of the 45cases with vocal cord palsy, 16 (35.55%) cases had malignancy while 12 (26.66%) cases had history of surgery or trauma. And 10 (22.22%) cases with Vocal cord palsy were Idiopathic. Other causes like infection/ inflammation, tracheal intubation, aortic aneurysm and CNS pathology were attributed to other 7 cases.

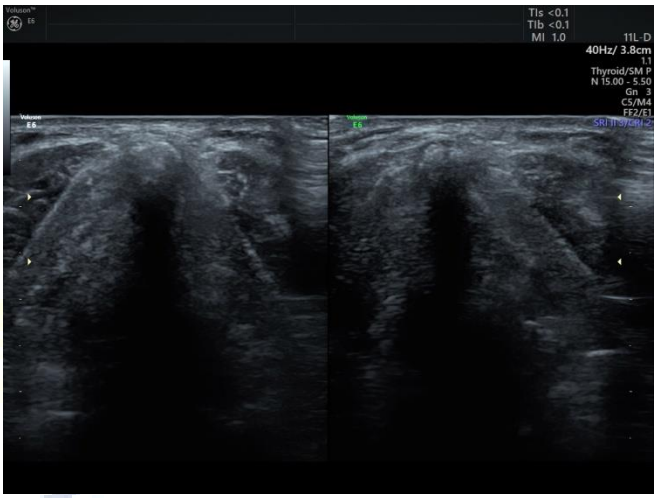

Figure 1: Bilateral vocal cord palsy.

Table 5: Shows causes of unilateral and bilateral vocal cord palsy.

Cause	Unilateral Vocal cord palsy	Bilateral Vocal cord palsy
Malignancy	14	2
Surgery / trauma	9	3
Idiopathic	7	3
Others	6	1
Total	36	9

Figure 2: Left side vocal cord palsy.

In our study 36 (80%) cases had unilateral Vocal cord palsy, out of which 19 (42.22%) were on left side and 17(37.77%) on right side, while 9 (20%) patients had bilateral Vocal cord palsy.

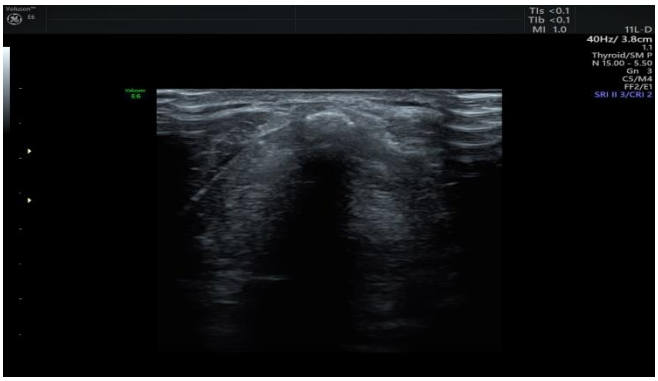

Figure 3: Right side vocal cord palsy.

Sensitivity of our study in diagnosing the vocal cord palsy using ultrasound is 93.33%, while Specificity is 100%.

Discussion

Laryngoscopy is considered gold standard in evaluation of vocal and valvular functions of the glottis.[8-12] Ultrasound is being used for diagnosing laryngeal pathologies since 1960.[13] Echoes from the free margins of the vocal cords were discovered by Tamura et al. in 1973.[14] Larynx was effectively visualized by Noyekin 1977, using ultrasonography.[15] Since late 1980s ultrasound is being used for visualization of true cord mobility.[16,17] In 2007, Huang et al. reported the use of high frequency ultrasound probes in evaluation of vocal cord disorders.[18] Non-invasive nature of ultrasound was stressed by Vats et al. to diagnose vocal fold paralysis in children.[19]Hannavi et al. claimed ultrasound as the modality of choice in diagnosing bilateral vocal cord paralysis.[20]

Air and mucosal interface in the larynx appears as white line on B mode imaging.[21] The cords will be seen as triangular, hypoechoeic structures with their apex lying behind the thyroid lamina and bases towards the hyperechoeic arytenoid cartilages.[22] Echogenicity of the cord is due to muscular part of the cords. The false cords are hyperchoeic due to fat and mucous glands.[16]

Laryngeal ultrasound is less utilized due to artefacts caused by calcification of laryngeal cartilages.[22-25] Hence oblique transverse plane are used to bypass the ossified thyroid cartilage.[26] However, in children and young patients calcification of the thyroid cartilage is not an issue.

Out of 25 patients only in 2 patients ultrasound was not useful according to Matta, et al.[3] In our study out of 45 patients with vocal cord palsy, ultrasound failed to diagnose palsy only in 3 patients due to acoustic interference from calcified laryngeal cartilages.

According to Toutounchi, et al. change in voice/hoarseness was noted in 97.8% and aspiration was seen in 37.8% of patients, while in our study hoarseness was seen in 84.4% and aspiration / choking was seen in 31.1% of the patients.

Bilateral palsy was observed in 6.82%, while on left side it was 56.82% and 63.36% on right side by Toutounchi, et al. In the present study 20% of cases had bilaterally vocal cord palsy, while 42.22% was on left side and 37.77% on right side.

Cause of palsy was idiopathic in 31.11%, tumors in 31.11%, surgery in 28.89% and others in 2.2% according to Toutounchi, et al. In our study the cause was 22.22% idiopathic, 26.66% trauma/surgery and 35.55% malignancy.

Sensitivity of our study is 93.33%, while the Specificity is 100%. However cent percent sensitivity and specificity in diagnosis of vocal cord mobility using ultrasonography was claimed by Tarek Khalil et al.[4] Cord mobility can be assessed in patients with thyroid disorders, who undergo ultrasound as part of their clinical work-up in the same sitting.[27,28]

The ultrasound is radiation free, non-invasive, cheap, widely available, portable as well as convenient in pediatric age group and in pregnancy.[34,35] Patient discomfort / requirement of anesthesia is absent in this modality.[29]

Amis et al are of the opinion that in future laryngeal ultrasound may be extended to diagnose subglottic stenosis, post extubation stridor, laryngeal tumors, epiglottitis, laryngeal papillomatosisetc with some innovative changes like the concave ultrasound probe.[26]

Conclusion

Laryngeal ultrasound is a simple, cost effective, non-invasive & widely available modality to image Vocal cords. It has the advantage of visualizing vocal cords in real time during respiration and normal phonation. Associated pathologies of the neck also can be evaluated in the same sitting. It is invaluable, when fibreoptic laryngoscopy is contraindicated or is not available and in uncooperative patients.

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