

# Diverse trends witnessed in assessing laryngeal lesions while comparing transcutaneous laryngeal ultrasound & videolaryngoscopy

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## Author's Contribution

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## ABSTRACT

**Objective:** To determine the accuracy of Transcutaneous Laryngeal Ultrasound (TLUS) and Video Laryngoscopy (VL) taking Direct Laryngoscopy (DL) as Gold Standard for assessment of laryngeal pathologies.

**Methodology:** This cross sectional Comparative clinical study recruited a sample of 24 cases of either gender, requiring laryngeal examination prospectively using convenience sampling from otolaryngology outpatients of Capital Hospital, Islamabad, Pakistan from March 2018 to August 2018. Patients fulfilling the selection criteria were subjected to Video Laryngoscopy under local anesthesia, Transcutaneous Laryngeal Ultrasound followed by Direct Laryngoscopy under general anesthesia and findings recorded. Diagnostic values of both VDL and TLUS versus DL and presented with frequency, percentage, sensitivity, specificity, PPV and NPV and Accuracy Rate. Mc Nemar test was used to evaluate the statistical significance and P value <0.05 was considered as significant.

**Results:** The study sample revealed 54.2% males and 45.8% females with a mean age of 46.79 + 25.34 years. Hoarseness was the commonest presentation (58.3%) and Laryngeal Polypi was the more frequent pathology noted (25%). VL had a sensitivity of 87.50%, the specificity of 37.50%, PPV of 73.7%, NPV of 60% and Accuracy rate of 70.83%. While TLUS revealed a sensitivity of 43.80%, the specificity of 70.80%, PPV of 100%, NPV of 47.15% and Accuracy rate of 62.50%.

**Conclusion:** Video Laryngoscopy with a higher Accuracy and sensitivity compared to Transcutaneous Laryngeal Ultrasound, is a more accurate examination for assessment of Laryngeal lesions.

**Key Words:** Accuracy Rate, Direct Laryngoscopy, Laryngeal Pathologies, Sensitivity, Transcutaneous Laryngeal Ultrasound, Video Laryngoscopy.

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## Introduction

A number of symptoms demand laryngeal examination. Respiratory distress, dysphagia, and change in voice including hoarseness <sup>1</sup> are common clinical presentations of laryngeal pathologies attending the speech, neurology,

oncology, pediatrics and medical clinics and require an otolaryngologist's consultation <sup>2</sup>. Etiologies necessitating laryngeal examination range from a simple infection to tumors with the common etiologies being laryngitis, benign and malignant tumors, vocal cord palsy etc. <sup>3</sup>

Laryngeal pathologies are a common occurrence but comparatively difficult to diagnose, being hidden from the naked eye. Historically Indirect Laryngoscopy (IDL) and Direct Laryngoscopy (DL) were the only options available.

Video Laryngoscopy (VL) has revolutionized vocal examination being a rapid, low risk diagnostic test<sup>4</sup> with options of flexible or rigid endoscopic examination. It is superior to IDL for diagnostic purposes.<sup>5</sup> In addition to common laryngeal pathologies, it has also been used to differentiate between essential and dystonic voice tremor syndromes.<sup>6</sup>

Transcutaneous Laryngeal Ultrasound (TLUS) also has a role in the examination of the larynx. In study Matta IR et al. reported an accurate diagnosis of vocal cord palsy by ultrasound (US) in all cases except those in which laryngeal cartilage calcification was present and concluded that US was useful in cases who are uncooperative and sensitive to xylocaine, limiting laryngoscopy<sup>7</sup>

Kelly and Cook highlighted the need for research involving VL compared to DL.<sup>8</sup> Also while concluding in their study on the use of laryngeal ultrasound compared to fiberoptic laryngoscopy in vocal cord palsy Matta IR et al, recommended research on other laryngeal disorders.<sup>7</sup> In developing countries like Pakistan, though US are available all over the country even in basic health units, however facility for VL are still lacking in most places. Therefore, this study was conducted to determine the accuracy of transcutaneous laryngeal ultrasound and video laryngoscopy taking DL as Gold Standard for assessing laryngeal pathologies. This study has importance since there is a dearth of literature comparing VL and TLUS with no study from this part of the world. This may help clinicians in making better diagnostic use of available modalities and for research purposes.

## Methodology

In this cross sectional comparative clinical study, a sample of 24 cases was recruited with prospective data collection and convenience sampling technique after obtaining ethical approval from Institutional Research Committee. Sample size of 27 cases was calculated using OpenEpi online calculator using formula  $n = [DEFF * Np(1-p)] / [(d2/Z21-\alpha/2*(N-1)+p*(1-p)]$ , taking confidence level of 99% and hypothesized % frequency of 1%. Study was conducted at otolaryngology and radiology outpatient clinics of Capital Hospital PGMI, Islamabad

over a period of six months from 1<sup>st</sup> March 2018 to 31<sup>st</sup> August 2018, after taking approval of the institutional ethical committee of the hospital.

The study sample comprised of cases of both genders with an age range of 8 to 85 years who presented to otolaryngology outpatients with complaints justifying laryngeal examination. Cases who did not consent for inclusion in the study, those allergic to xylocaine, those unfit for general anesthesia or those in whom VL, TLUS and DL could not be performed because of any reason were excluded from the study.

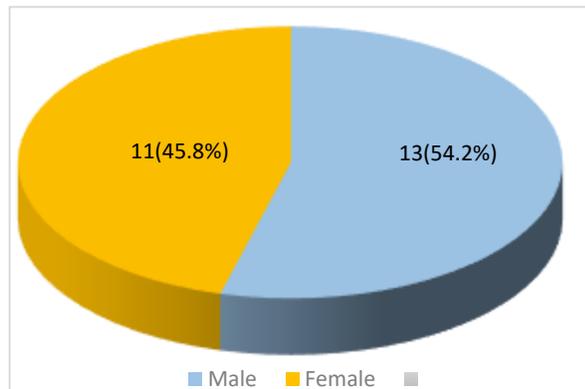
After taking detailed history including demographic information and informed consent, patients fulfilling the selection criteria were subjected to VL under local anesthesia using 4% xylocaine spray, followed by TLUS and DL under General Anesthesia.

Video Laryngoscopy was done using Atmos Hopkin's rod Laryngoscope with handle, zoom, Director of View 70°, Dia.10mm, working length 190 mm with a complete visual system including Atmos Cam 31 – with image memory, High resolving 1/3" CCD Camera with high light sensitivity, following 4% lignocaine spray in the oral cavity. Larynx was examined after passing the scope trans-orally to the pharynx, while the tongue was held by the examiner and findings noted from the video monitor and photograph taken in interesting cases and diagrammatic sketch was drawn for record by the researcher. Following this patient was referred to the Radiology Department for TLUS, without providing the VL examination record. US was performed using Toshiba Xario Ultrasound Machine model UICW-660A using Linear High Resolution (7.5 MHz to 11 MHz) probes. This was followed by admission in wards for DL under general anesthesia and no VL record in the file, to keep the surgeon unaware of the findings. After necessary preparation and after taking consent, the patient was subjected to DL and findings were noted.

Data and test results of the three tests were entered in MS Excel and tabulated and analyzed using SPSS 23. Age was presented by Mean + SD and Gender was presented by frequency and percentage. Sensitivity, Specificity, PPV, NPV and Accuracy rate were calculated for all the three tests and their values compared taking DL as Gold standard. Mc Nemar test was used to evaluate statistical significance and P value <0.05 was considered as significant. The data obtained compared with both the national and international literature and deductions were made which were then discussed.

## Results

Out of the present study population comprising of N=24 cases fulfilling the selection criteria 54.2% (n=13) were male and 45.8% (n=11) were females with male to female ratio of M: F =1.18:1 (Figure I). The mean age of the sample population was 46.79 + SD 25.34 years with an age range of 8 to 85 years.

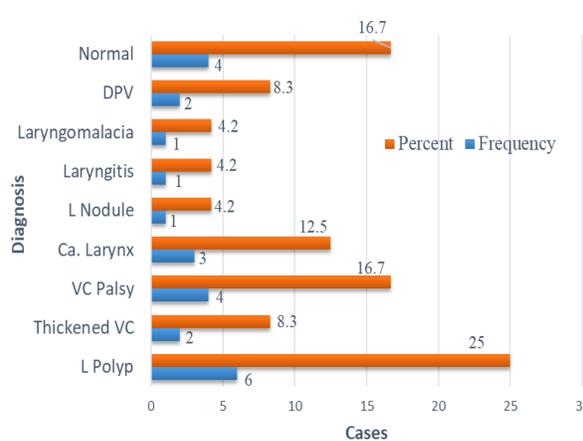


**Figure 1. Gender Distribution of Study Population. (n = 24)**

The commonest presentation was Hoarseness in 14(58.3%) cases. VL detected pathologies in 19 (79.2%) cases, while Ultrasonography detected pathologies in 7 (29.2%) pathologies, compared to the gold standard DL examination which positively picked up 16(66.7%) pathologies of the total of 24 cases (Table I).

Figure 2 reveals that the commonest pathology detected was laryngeal polyp in 6(25%) cases, followed by Vocal cord palsy in 4 (16.7%) cases and Carcinoma Larynx in 3 (12.5%) cases. Disphonia plica ventricularis was diagnosed in 2 (8.3%) cases and this was the pathology which was only diagnosed on VL.

		n(%)	Cumulative Percent
<b>Clinical Presentation</b>	No Symptom	1(4.2)	4.2
	Hoarseness	14(58.3)	62.5
	Change in Voice	7(29.1)	91.6
	F.B sensation	1(4.2)	95.8
	Choking	1(4.2)	100
<b>VDL</b>	Positive	19(79.2)	79.2
	Negative	5(20.8)	100
<b>U/S</b>	Positive	7(29.2)	29.2
<b>Gold Standard DL</b>	Negative	17(70.8)	100
	Positive	16(66.7)	66.7
	Negative	8(33.3)	100



**Figure 2: Diagnostic Profile of Sample Population. (n=24)**

Statistical analysis revealed that compared to gold standard test (DL), VL had a sensitivity of 87.50%, the specificity of 37.50%, PPV of 73.7% and NPV of 60%. Mc Nemar test revealed a p-value of 0.453 indicating that the difference between VL and DL was statistically not significant and the Accuracy rate of VL was noted to be 70.83%.

Table II reveals that the commonest pathology detected was laryngeal polyp in 6(25%) cases, followed by Vocal cord palsy in 4 (16.7%) cases and Carcinoma Larynx in 3 (12.5%) cases. Disphonia plica ventricularis was diagnosed in 2 (8.3%) cases and this was the pathology which was only diagnosed on VL.

Compared to DL, TLUS revealed a sensitivity of 43.80%, Specificity of 70.80%, PPV of 100% and NPV of 47.15%. Mc Nemar test revealed a p-value of 0.004 which shows a statistically significant difference between the two tests also, a low Accuracy Rate of 62.50% was noted for TLUS.

## Discussion

The current study compared both Video Laryngoscopy and Transcutaneous Laryngeal Ultrasound with Gold Standard Test of Direct Laryngoscopy. Statistical analysis revealed that compared to gold standard test (DL), VDL had a sensitivity of 87.50%, the specificity of 37.50%, PPV of 73.7%, NPV of 60% and the Accuracy rate of VDL was noted to be 70.83%. Compared to the current study in which 70° Hopkins rod Laryngoscope was used for VL, Hameed A et al. used Fibreoptic video laryngoscopy (FOL) in 100 patients and picked vocal cord palsy, except in two cases where DL was required and reported that it was safe and non-invasive.<sup>9</sup> Similarly

**Table II: Diagnostic Accuracy of Video Laryngoscopy and Transcutaneous Laryngeal Ultrasound taking Direct Laryngoscopy as Gold Standard. (n = 24)**

		Gold Test (Direct Laryngoscopy)			Accuracy Rate	
		Pathology	Normal	Total		
Video laryngoscopy	Pathology	Count	a) True +ve 14	b) False +ve 5	19	
		% within VDL	73.7% (PPV)	26.3%	100%	Mc Nemar Test (P-Value) =.453
		% within DL	87.50% (Sensitivity)	62.50%	79.20%	
	Normal	Count	c) False -ve 2	d) True -ve 3	5	
		% within VDL	40%	60%(NPV)	100%	Accuracy Rate [a+d/(a+d+b+d) x 100= 70.83%
		% within DL	12.50%	37.50% (Specificity)	20.80%	
<b>Total</b>	16	8	24			
Transcutaneous Laryngeal Ultrasound	Pathology	Count	a) True +ve 7	False +ve 0	7	
		% within VDL	100%(PPV)	0%	100%	Mc Nemar Test (P-Value) = .004
		% within DL_D	43.80% (Sensitivity)	0.00%	29.20%	
	Normal	Count	c) False -ve 9	d) True -ve8	17	
		% within VDL	52.9%	47.15% (NPV)	100%	Accuracy Rate [a+d/(a+d+b+d) x 100= 62.50%
		% within DL_D	56.30%	100.00% (Specificity)	70.80%	
<b>Total</b>	16	8	24			

the sensitivity of 69.2% and specificity of 96.1% compared to DL biopsy<sup>10</sup>, and sensitivity of 70.6% and specificity of 96.7% were reported<sup>11</sup> in other studies.

In the current study, compared to DL, TLUS revealed an overall low sensitivity of 43.80%, Specificity of 70.80%, PPV of 100%, NPV of 47.15% and had a low Accuracy Rate of 62.50%. In contrast, Khalil T et al. reported that TLUS had a sensitivity and specificity of 100%, for detecting lesions and masses in the glottis, while 0% sensitivity was noted for detection vocal nodules, edema in inter-arytenoid area and superficial ulcerations. They also noted that ultrasound could not detect the mass of fewer than 0.27 cm.<sup>12</sup> On the other hand, Rai AK et al in their study concluded TLUS to have a limited role except growths involving larynx (78.7%), polyps and vocal cord paralysis (66.67% each).<sup>13</sup>

On the other side of the spectrum, in a study Sakthivel P et al. reported the sensitivity of endoscopy with white light alone for detection of laryngeal cancers was 82.6% however when it was combined with Narrow band imaging sensitivity was 100% indicating the importance of US.<sup>14</sup> Rai AK et al. reported that US is valuable in detecting laryngeal growth, vocal cord polyp, vocal cord nodule, vocal cord palsy/paralysis, chronic laryngitis, and Reinke's edema with a frequency of 78.57%, 66.67%, 10%, 66.67%, and 17.64% respectively and concluded that in comparison to laryngoscopy, the role of US is limited except in laryngeal lesions such as laryngeal growth and vocal cord polyp, hence it can augment rather than replace laryngoscopy.<sup>13</sup>

The current study revealed that VL is more accurate as regards identification of laryngeal pathologies with an accuracy rate of 70.83% compared to 62.50% for TLUS. Also, VL was more sensitive with a sensitivity of 87.50% compared to 43.80% for TLUS. On the other hand, TLUS has more specificity of 100% compared to 37.50% for VL. In contrast in a study by Shah MK et al for the assessment of vocal cords mobility TLUS compared to VL revealed a sensitivity of 75%, the specificity of 95.1%, PPV of 60% and NPV of 97.5%.<sup>15</sup> Also, de Miguel M et al noted good results for the detection of vocal cord mobility by TLUS with a sensitivity of 93.3%, the specificity of 96.1%, PPV of 82.3% and NPV of 98.6%.<sup>16</sup> The lower sensitivity and accuracy in our study is reflected by the fact that all types of cases are included in the current study, while the study by Shah MK et al<sup>15</sup> and Miguel M et al.<sup>16</sup>, focused on the assessment of vocal cord mobility only. Also, a review article da Costa BOI et al. revealed that controversial diagnostic ability of TLUS of larynx.<sup>17</sup>

Costa BOI et al concluded that US was a viable, useful noninvasive tool for the assessment of laryngeal function, especially the following thyroidectomy.<sup>17</sup> Also Hassoon TA et al, Concluded that TLUS should not be replaced for laryngoscopy for the assessment of vocal cords for pts undergoing thyroid surgery.<sup>18</sup> This indicates that TLUS is more effective and indicated in certain situations. Huang H et al. in their study reported consistent results for US and FOL and reported that the US has good sensitivity (96.3%), specificity (84.6%), PPV (92.9%), and NPV (91.7%) for diagnosis of laryngomalacia<sup>19</sup>. Also,

Ongkasuwan J et al. reported agreement with Stroboscopy and excellent Sensitivity (100%) and specificity (87%) for laryngeal ultrasound for identification of vocal fold nodules.<sup>20</sup>

Klinge K et al, in their study involving laryngeal examination in children both by VL and TLUS revealed that TLUS was a useful diagnostic investigation both to identify structures of the laryngeal structures and the movement of the vocal folds in children which was possible in > 80% cases.<sup>21</sup> However young children were not included in the current study.

Limitation of Study: The limitation of study was small sample size, since patients had to undergo all the three procedures and we had to exclude any case who refused consent, in which any procedure could not be done because of any reason.

## Conclusion

We conclude that with a high sensitivity and accuracy rate Video Laryngoscopy was a more accurate test, however, the importance of Transcutaneous Laryngeal Ultrasound cannot be undermined and where necessary both should be performed.

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