**Title:**Comparative Evaluation of Flexible Nasopharyngolaryngoscope (FNPLS) with Laryngeal Ultrasound for Assessment of Pediatric Dysphonia

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**Abstract:**This study assesses the diagnostic accuracy of ultrasound compared to laryngoscopy in identifying laryngeal disorders, such as laryngomalacia, valleculae cysts, vocal cord nodules, and vocal cord paralysis. The sensitivity and specificity of ultrasound were calculated for each condition, highlighting its potential as a diagnostic tool. While results showed high accuracy for most conditions, limitations were noted in detecting vocal cord paralysis.

*Keywords:* Laryngeal Ultrasonography, Dysphonia, Hoarseness, Children, Flexible Laryngoscope

**Introduction:**Laryngoscopy is the gold standard for diagnosing laryngeal disorders; however, it is invasive and requires specialized skills. Ultrasound has emerged as a non-invasive alternative with potential diagnostic utility. This study examines the sensitivity and specificity of ultrasound in detecting common laryngeal disorders to determine its feasibility as a reliable diagnostic tool.

* **Methods:**A total of 36 participants were evaluated using both laryngoscopy and ultrasound. Participant demographic data, including gender, race, and age, were also analyzed. FNPLS was used as the reference standard, and sensitivity, specificity, positive predictive value (PPV) and negative predictive value (NPV) of LUS were calculated.Kappa statistics were applied to assess agreement between the modalities.P value of < 0.05 was considered for statistical significance.

**Results:**

* Demographics: Among the participants, 69.4% were male, and 83.3% identified as Malay. The mean age was 3.24 years (range: 0-14).
* Laryngomalacia: Sensitivity and specificity were 90% and 93.75%, respectively. Ultrasound demonstrated high accuracy in identifying true cases and minimizing false positives.
* Valleculae Cysts: Both sensitivity and specificity reached 100%, suggesting ultrasound as a perfect diagnostic tool for this condition.
* Vocal Cord Nodules: Sensitivity and specificity were 90% and 92.31%, respectively, confirming ultrasound’s effectiveness in identifying this condition with minimal false positives.
* Vocal Cord Paralysis: Sensitivity was 25%, while specificity was 100%. This indicates that ultrasound effectively ruled out false positives but was less accurate in detecting true cases.
* Overall agreement yielded a Kappa coefficient of **0.770 (CI: 0.544 to 0.997)**, indicating substantial agreement according to standard interpretative benchmarks. The result was statistically significant (z = 6.663, p < .001)

**Discussion:**Ultrasound (US) has shown significant promise as a diagnostic tool for laryngeal disorders, offering notable advantages for clinical application. This study revealed high sensitivity and specificity for detecting laryngomalacia (90% and 93.75%, respectively) and valleculae cysts (both 100%). Similarly, US was effective in diagnosing vocal cord nodules, achieving 90% sensitivity and 92.31% specificity. However, its performance was less reliable for vocal cord paralysis, with a sensitivity of only 25%. These results highlight the utility of ultrasound for conditions with high diagnostic accuracy while emphasizing the need for refinement in its application for less easily detected disorders.

Comparison with prior research underscores ultrasound’s growing potential in pediatric otolaryngology. For instance, Shirley et al. (2019) reported an overall sensitivity of 87% and specificity of 100% for laryngeal ultrasound in diagnosing pediatric dysphonia and stridor, alongside high diagnostic accuracy for vocal cord nodules and laryngomalacia (area under the ROC curve of 0.91 and 0.87, respectively). Likewise, Marinone Lares et al. (2024) demonstrated a sensitivity of 80.95% for vocal fold immobility (VFI), which improved to 93.33% for unilateral cases, though bilateral VFI remained challenging to diagnose.

One of the key strengths of ultrasound is its non-invasive nature and accessibility, making it particularly advantageous for patients who cannot tolerate laryngoscopy. Marinone Lares et al. emphasized its utility in non-surgical populations, broadening its potential applications beyond high-risk groups. Despite these strengths, barriers such as the lack of standardized protocols and specialized training continue to limit its widespread adoption in clinical settings.

Our findings align with these observations, corroborating ultrasound’s high diagnostic accuracy for specific conditions while highlighting its limitations. The low sensitivity for vocal cord paralysis in this study mirrors challenges noted by Shirley et al., who attributed missed cases to the difficulty of identifying subtle abnormalities during quiet breathing. Addressing these limitations will be crucial to fully realizing the diagnostic potential of ultrasound.
Efforts to improve ultrasound’s diagnostic reliability should focus on enhancing its sensitivity for conditions with lower detection rates, such as vocal cord paralysis. Incorporating quantitative metrics, such as vocal fold-arytenoid angles, has been suggested in previous studies to increase precision. Additionally, targeted training initiatives and the development of standardized guidelines are essential to overcoming current barriers, ensuring consistent and accurate application of ultrasound across clinical settings.

**Conclusion**
Ultrasound represents a valuable diagnostic tool for laryngeal disorders, with excellent sensitivity and specificity for many conditions. However, further research is necessary to enhance its performance in detecting vocal cord paralysis and to establish standardized methodologies. With continued development, ultrasound could become a cornerstone of pediatric otolaryngology diagnostics.

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