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Prospective Assessment of B-Mode Ultrasonography, Doppler, and Elastography in Distinguishing Benign and Malignant Etiologies of Cervical Lymphadenopathy

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Abstract:
Background: Because cervical lymphadenopathy can have a variety of etiologies, including benign and malignant disorders, it can be difficult to diagnose. To distinguish between benign and malignant lymph nodes, imaging modalities such B-mode ultrasonography (USG), Doppler, and elastography are being used more and more. The purpose of this study was to evaluate the utility of Doppler, elastography, and B-mode ultrasonography in differentiating between benign and malignant cervical lymphadenopathy.
Methods: 95 individuals who first presented with cervical lymphadenopathy were included in a prospective analysis. The lymph nodes were described using elastography, Doppler, and B-mode ultrasonography. For comparison, histopathological examination acted as the gold standard.
Findings: The research demonstrated that discriminating between benign and malignant lymph nodes may be accomplished with differing degrees of sensitivity, specificity, positive predictive value, and negative predictive value using B-mode ultrasonography, Doppler, and elastography techniques. Doppler yielded a sensitivity of 74.36% and a specificity of 92.86%, whilst B-mode ultrasonography had a sensitivity of 79.49% and a specificity of 96.43%. The results of elastography showed a 92.3% specificity and 89% sensitivity. When B-mode ultrasonography and elastography were combined, the results showed higher sensitivity (89.74%) and specificity (98.21%) than when the modalities were used separately.
Conclusion: In summary, B-mode ultrasonography, Doppler, and elastography methods provide important information on cervical lymphadenopathy. When used in tandem, they improve diagnostic precision and give medical professionals useful instruments for differentiating between benign and malignant lymph nodes and directing the right course of treatment. Larger studies and more investigation are necessary to confirm these results and improve diagnostic methods.
Keywords: cervical lymphadenopathy, B-mode ultrasonography, Doppler imaging, elastography, diagnostic accuracy.

Introduction:

Cervical lymphadenopathy, the enlargement of lymph nodes in the neck region, poses a significant diagnostic challenge in clinical practice. It is a common clinical finding, often encountered in both primary care and specialty settings. The differential diagnosis for cervical lymphadenopathy is broad, ranging from benign inflammatory conditions to malignant neoplasms. While many cases are self-limiting or benign in nature, it is imperative to promptly identify and differentiate malignant etiologies to ensure timely intervention and improve patient outcomes [1-3].

Conventional diagnostic approaches for cervical lymphadenopathy include clinical examination, laboratory investigations, and imaging studies. Among these, imaging plays a crucial role in providing detailed anatomical information and assessing the structural and functional characteristics of lymph nodes. B-mode ultrasonography, Doppler imaging, and elastography have emerged as valuable imaging modalities in the evaluation of cervical lymphadenopathy due to their non-invasive nature and ability to provide real-time information [4-6].

B-mode ultrasonography, also known as grayscale ultrasonography, allows for high-resolution imaging of lymph node morphology, including size, shape, margins, and internal echogenicity. Doppler imaging complements B-mode ultrasonography by providing information on vascular flow within lymph nodes, which can be indicative of neoplastic infiltration or inflammation. Elastography, a relatively newer technique, evaluates tissue stiffness or elasticity, which can aid in distinguishing between benign and malignant processes based on differences in tissue composition [4-7].

Despite the potential of these imaging modalities, their diagnostic accuracy in discriminating between benign and malignant causes of cervical lymphadenopathy remains uncertain. Previous studies have reported variable results, and there is a need for further research to elucidate the role of each modality and explore the potential synergies between them [7-10].

Therefore, this prospective study aims to systematically evaluate the diagnostic performance of B-mode ultrasonography, Doppler imaging, and elastography in distinguishing between benign and malignant etiologies of cervical lymphadenopathy. By rigorously assessing the strengths and limitations of each modality and their combination, we aim to provide valuable insights that can inform clinical decision-making and improve patient care.

Materials and Methods:

The study was conducted at a tertiary care center, specifically in the department of Radiodiagnosis. Patients referred to the department with suspected or diagnosed cervical lymphadenopathy were enrolled in the study. All participants underwent ultrasonography (USG) examination, followed by histopathological correlation for confirmation of diagnosis.

Methodology:

This observational study spanned a total of 18 months and was conducted within the department of Radiodiagnosis at the tertiary care center. The sample size calculation was based on the fact that approximately 68% of cervical lymphadenopathies are attributed to tuberculosis. Thus, considering a confidence level of 95%, the minimum sample size required was determined to be 95 patients.

Selection of Participants:

Inclusion criteria comprised patients presenting with unilateral or bilateral cervical lymphadenopathy referred for USG and/or histopathological examination. This included individuals with head and neck malignancies accompanied by enlarged cervical lymph nodes, those with cervical lymph node metastasis of unknown primary malignancy, and suspected

cases of pulmonary or extra-pulmonary tuberculosis with lymphadenopathy. Patients with reactive lymphadenopathy failing to regress after initial management were also included.
Exclusion criteria encompassed cases of cervical lymph nodal malignancy that had undergone chemotherapy or radiotherapy, patients who had previously undergone diagnostic interventions (e.g., fine-needle aspiration cytology or biopsy) for cervical lymphadenopathy, and individuals currently undergoing or completed treatment such as anti-tubercular drugs.

Consent, Patient Examination, and History Taking:

Patients providing written consent after comprehensive explanation of procedures underwent detailed clinical history-taking and examination for lymphadenopathy.

Imaging Technique:

Patients were positioned supine on the examination bed with a pillow placed beneath their shoulders and were instructed to slightly extend their neck. Using a high-frequency linear probe (L3-12) on a LOGIQ TM P9 XDclearTM (GE Healthcare) ultrasound machine operating at 7-11 Hz, B-mode ultrasonography was performed. Scanning followed a predetermined sequence, covering levels Ia, Ib, II, III, IV, V, and VI on both sides of the neck. The number of nodes in each level was recorded. Lymph nodes were categorized according to established criteria for shape, border, echogenic hilum, echogenicity, intranodal necrosis, calcification, and eccentric cortical hypertrophy. Additionally, Doppler evaluation was conducted to assess vascularity patterns, and elastography was performed to evaluate tissue stiffness. Elasticity values were compared to a predetermined cutoff for malignancy.

USG-guided FNAC/Biopsy:

Following imaging evaluation, patients underwent USG-guided fine-needle aspiration cytology (FNAC) or biopsy. Histopathological reports were obtained and compared to imaging findings for correlation and analysis.

Results

Table 1: Comparison of Histopathological Examination with Ultrasound and Elastography Techniques

This table compares the effectiveness of B-mode ultrasonography, colour Doppler, and elastography in identifying malignant and benign cervical lymph nodes based on histopathological examination. It shows that elastography demonstrates the highest sensitivity in identifying malignant nodes at 44%, followed by B-mode ultrasonography at 38%, and colour Doppler at 35%. However, B-mode ultrasonography and colour Doppler exhibit higher specificity in identifying benign nodes at 62% and 65%, respectively, compared to elastography at 56%.

Table 2: Comparison of Ultrasound, Colour Doppler, and Elastography in Characterizing Cervical Lymph Nodes:

This table evaluates the role of ultrasound, colour Doppler, and elastography in characterizing cervical lymph nodes as either benign or malignant. It indicates that elastography shows the highest percentage (56%) of correctly characterizing nodes as benign, followed by colour Doppler (65%) and B-mode ultrasonography (62%). Conversely, elastography also exhibits the highest percentage (44%) of correctly characterizing nodes as malignant, followed by B-mode ultrasonography (38%) and colour Doppler (35%).

Table 3: Assessment of Role of Ultrasonography, Colour Doppler, and Elastography in Characterizing Cervical Lymph Nodes as Benign & Malignant:

This table provides a comprehensive assessment of the effectiveness of ultrasonography, colour Doppler, and elastography in distinguishing between benign and malignant cervical lymph nodes. It shows that all three diagnostic techniques have higher accuracy in identifying benign nodes compared to malignant nodes. Colour Doppler has the highest percentage

(65%) of correctly identifying benign nodes, while elastography demonstrates the highest percentage (44%) of correctly identifying malignant nodes.

Table 4: Accuracy of Radiological and Elastographic Methods:

This table presents the sensitivity, specificity, positive predictive value (PPV), and negative predictive value (NPV) of B-mode ultrasonography, colour Doppler, radiological diagnosis (combined B-mode and Doppler), and elastographic diagnosis in distinguishing between benign and malignant cervical lymph nodes. It highlights that the combined radiological diagnosis has the highest sensitivity (89.74%) and specificity (98.21%), followed by elastographic diagnosis with a sensitivity of 89% and specificity of 92.3%. Both B-mode ultrasonography and colour Doppler exhibit lower sensitivity and specificity compared to the combined radiological and elastographic diagnosis.

Table 5: Comparison of Benign vs. Malignant Nodes in B-Mode and Doppler Diagnosis:

This table compares the distribution of benign and malignant nodes as diagnosed by B-mode ultrasonography and colour Doppler. It indicates that B-mode diagnosis categorizes 62% of nodes as benign and 38% as malignant, while Doppler diagnosis categorizes 65% as benign and 35% as malignant. This suggests that colour Doppler tends to classify a higher percentage of nodes as benign compared to B-mode ultrasonography.

Table 6: Comparison of Benign vs. Malignant Nodes in Combined Radiological and Elastographic Diagnosis:

This table compares the distribution of benign and malignant nodes as diagnosed by the combined radiological (B-mode and Doppler) and elastographic diagnosis. It shows that the combined diagnosis classifies 56% of nodes as benign and 44% as malignant. This indicates a slightly higher proportion of nodes diagnosed as benign compared to malignant, suggesting the effectiveness of the combined approach in accurately characterizing cervical lymph nodes.

Discussion

The results of this investigation highlight the usefulness of numerous imaging modalities in distinguishing between benign and malignant cervical lymphadenopathy, such as B-mode ultrasonography, color Doppler, and elastography. Key features of the study population were identified by the descriptive analysis, including the distribution of the study population's age and gender as well as the shape, echogenicity, border, hilum, necrotic/cystic areas, calcification, eccentric cortical hypertrophy, and matting/edema of the lymph nodes [1,4,5].

The accuracy of identifying benign and malignant nodes was shown to differ when comparing histological investigation with ultrasound and elastography techniques. Color Doppler demonstrated marginally lower sensitivity and specificity than B-mode ultrasonography, which yielded encouraging findings with a sensitivity of 79.49% and a specificity of 96.43%. In contrast, elastography showed lesser specificity (92.3%) and better sensitivity (89%) when compared to B-mode ultrasonography. The greatest sensitivity (89.74%) and specificity (98.21%) were found in the combined radiological diagnosis, suggesting that integrating various imaging modalities may have a synergistic impact [5-8].

Importance of the Results:

The results of this investigation have a number of clinical practice ramifications. First of all, they propose that B-mode ultrasonography is still a useful diagnostic technique for the preliminary evaluation of cervical lymphadenopathy, offering crucial information to medical professionals. B-mode ultrasonography is very helpful in ruling out malignancy due to its high specificity, which helps inform subsequent therapeutic decisions. Furthermore, combining B-mode ultrasonography with elastography and color Doppler improves diagnostic precision and makes it easier to distinguish between benign and malignant nodes [9–10].

The results also demonstrate how complimentary various imaging modalities are when assessing cervical lymphadenopathy. While elastography offers important insights into tissue stiffness, color Doppler adds functional information regarding vascularity, and B-mode ultrasonography provides precise anatomical information. Through the integration of many modalities, healthcare professionals can acquire a thorough comprehension of lymph node shape, vascularity, and flexibility, leading to more precise diagnosis and treatment planning [11–15].

Limitations of the Study:

Notwithstanding the insightful information this study offered, a number of limitations must be noted. First off, the findings' generalizability could be constrained by the study population's sample size. A more comprehensive comprehension of the diagnostic potential of various imaging modalities would be possible with a bigger and more varied sample. Furthermore, bias and confounding variables may be introduced by the retrospective nature of the study design, which could affect the outcomes. The results of this study need to be validated by bigger sample sizes and consistent techniques in future prospective investigations.

Moreover, there are intrinsic limits when using histological investigation as the gold standard for diagnosis. The pathologist's level of expertise can influence the subjective interpretation of histopathology. Furthermore, it might not always be possible to get histopathological samples, especially in situations where the lymph nodes are small or difficult to access. Future studies could examine non-invasive alternatives such core needle biopsy or fine-needle aspiration cytology (FNAC) for diagnosis confirmation.

Prospective Courses:

Based on the results of this investigation, a number of directions for further research can be identified. First of all, longitudinal studies that monitor the evolution of cervical lymphadenopathy over time may offer important insights into the disease's natural history and shed light on variables linked to the advancement or regression of the illness. Furthermore, comparative studies assessing how cost-effectively various imaging modalities diagnose and treat cervical lymphadenopathy should guide resource allocation and clinical decision-making [10,11,15].

Furthermore, the accuracy and efficiency of lymph node evaluation may be further enhanced by developments in imaging technology, such as the creation of new contrast agents or the incorporation of artificial intelligence (AI) algorithms. AI-based image processing has the potential to decrease interobserver variability, automate the interpretation of imaging studies, and enable faster and more precise diagnosis. To fully utilize these technological developments and integrate them into clinical practice, radiologists, oncologists, pathologists, and engineers must work together.

Conclusion

To sum up, this study offers insightful information about the diagnostic value of elastography, color Doppler, and B-mode ultrasonography in differentiating between benign and malignant cervical lymphadenopathy. The greatest chance for an accurate diagnosis and the best possible patient care is provided by the integration of numerous imaging modalities, each of which has advantages and disadvantages of its own. Future research can further increase our understanding of cervical lymphadenopathy and patient outcomes by resolving the study's limitations and pursuing new research directions.

References

1. Rajendra, R. A., Varatharajaperumal, R. K., Renganathan, R., Kasi Arunachalam, V., Mehta, P., & Cherian, M. (2021). Estimation of Accuracy of B-Mode Sonography and

Elastography in Differentiation of Benign and Malignant Lymph Nodes With Cytology as Reference Standard: A Prospective Study. *Cureus, 13*(3), e14147. https://doi.org/10.7759/cureus.14147

2. Vineela, E., Sakalecha, A. K., & Narayanrao Suresh, T. (2022). Role of Sonoelastography in Differentiating Benign From Malignant Cervical Lymph Nodes and Correlating With Pathology. *Cureus, 14*(3), e22984. https://doi.org/10.7759/cureus.22984
3. Kanagaraju, V., Rakshith, A. V. B., Devanand, B., & Rajakumar, R. (2019). Utility of Ultrasound Elastography to Differentiate Benign from Malignant Cervical Lymph Nodes. *Journal of Medical Ultrasound, 28*(2), 92–98. https://doi.org/10.4103/JMU.JMU_72_19
4. Rohan, K., Ramesh, A., Sureshkumar, S., Vijayakumar, C., Abdulbasith, K. M., & Krishnaraj, B. (2020). Evaluation of B-Mode and Color Doppler Ultrasound in the Diagnosis of Malignant Cervical Lymphadenopathy. *Cureus, 12*(8), e9819. https://doi.org/10.7759/cureus.9819
5. Yang, J. R., Song, Y., Jia, Y. L., & Ruan, L. T. (2021). Application of multimodal ultrasonography for differentiating benign and malignant cervical lymphadenopathy. *Japanese Journal of Radiology, 39*(10), 938–945. https://doi.org/10.1007/s11604-021-01131-7
6. Çetin Tunçez, H., Murat Koç, A., Hilal Adıbelli, Z., Zeynep Arslan, F., Argon, A., & Yücel Oğuzdoğan, G. (2023). Diagnostic Efficacy of Ultrasonography, Doppler Ultrasonography and Elastography in the Evaluation of Suspected Malignant Lymph Nodes. *Journal of Ultrasonography, 23*(92), 1–9. https://doi.org/10.15557/JoU.2023.0001
7. Fujiwara, T., Nakajima, T., Inage, T., Sata, Y., Sakairi, Y., Tamura, H., ... Yoshino, I. (2019). The combination of endobronchial elastography and sonographic findings during endobronchial ultrasound-guided transbronchial needle aspiration for predicting nodal metastasis. *Thoracic Cancer, 10*(10), 2000–2005. https://doi.org/10.1111/1759-7714.13186
8. Elgendy, A., Elhawary, E., Shareef, M. M., Romeih, M., & Ebeed, A. (2022). Ultrasound Elastography in the Diagnosis of Malignant Cervical Lymphadenopathy in Children: Can It Replace Surgical Biopsy? *European Journal of Pediatric Surgery, 32*(4), 321–326. https://doi.org/10.1055/s-0041-1729900
9. Rohan, K., Ramesh, A., Nagarajan, K., Abdulbasith, K. M., Sureshkumar, S., Vijayakumar, C., ... Srinivas, B. H. (2021). Evaluation of Acoustic Radiation Force Impulse Imaging in Differentiating Benign and Malignant Cervical Lymphadenopathy. *Journal of Medical Ultrasound, 30*(2), 87–93. https://doi.org/10.4103/JMU.JMU_10_21
10. Belotta, A. F., Gomes, M. C., Rocha, N. S., Melchert, A., Giuffrida, R., Silva, J. P., & Mamprim, M. J. (2019). Sonography and sonoelastography in the detection of malignancy in superficial lymph nodes of dogs. *Journal of Veterinary Internal Medicine, 33*(3), 1403–1413. https://doi.org/10.1111/jvim.15469
11. Islam Sheikh, N., Babar, M., Zahoor, A., Idrees, Z., Naseem, S., & Fatima, S. (2021). The Pattern of Superficial Lymphadenopathy on Fine Needle Aspiration Cytology in Clinical Practice in Islamabad. *Cureus, 13*(8), e17075. https://doi.org/10.7759/cureus.17075
12. Kang, H. J., Seo, M., Sohn, Y. M., Yun, S. J., Min, S. Y., You, M. W., & Yeon, E. K. (2019). Comparison of Diagnostic Performance of B-Mode Ultrasonography and Shear Wave Elastography in Cervical Lymph Nodes. *Ultrasound Quarterly, 35*(3), 290–296. https://doi.org/10.1097/RUQ.0000000000000464

13. Shi, J., Jiang, J., Chang, W., Chen, M., & Zhang, Q. (2019). [Multi-class discrimination of lymphadenopathy by using dual-modal ultrasound radiomics with elastography and B-mode ultrasound]. *Chinese Journal of Biomedical Engineering, 36*(6), 957–963. PMID: 31875369
14. Hashmi, A. A., Naz, S., Ahmed, O., Yaqeen, S. R., Irfan, M., Kamal, A., & Faridi, N. (2020). Utility of Fine Needle Aspiration Cytology in the Evaluation of Lymphadenopathy. *Cureus, 12*(12), e11990. https://doi.org/10.7759/cureus.11990
15. Trosini-Désert, V., Jeny, F., Maksud, P., Giron, A., Degos, V., & Similowski, T. (2019). Contribution of endobronchial ultrasound elastography to the characterization of mediastinal lymphadenopathy: A single-center, prospective, observational study. *Respiratory Medicine Research, 76*, 28–33. https://doi.org/10.1016/j.resmer.2019.08.001

Tables

Table 1: Comparison of Histopathological Examination with Ultrasound and Elastography Techniques

Diagnostic Method	Malignant Nodes Identified (%)	Benign Nodes Identified (%)
B-mode Ultrasonography	38	62
Colour Doppler	35	65
Elastography	44	56

Table 2: Comparison of Ultrasound, Colour Doppler, and Elastography in Characterizing Cervical Lymph Nodes

Diagnostic Technique	Objective 1 (%)	Objective 2 (%)
B-mode Ultrasonography	-	38
Colour Doppler	-	35
Elastography	-	44

Table 3: Assessment of Role of Ultrasonography, Colour Doppler, and Elastography in Characterizing Cervical Lymph Nodes as Benign & Malignant

Diagnostic Technique	Benign (%)	Malignant (%)
B-mode Ultrasonography	62	38
Colour Doppler	65	35
Elastography	56	44

Table 4: Comparison of Histopathological Examination with Ultrasound Diagnosis

Histopathological Diagnosis	Malignant (%)	Benign (%)
Malignant	34	66
Benign	5	95

Table 5: Comparison of Histopathological Examination with Doppler Diagnosis

Histopathological Diagnosis	Malignant (%)	Benign (%)
Malignant	34	66
Benign	13	87

Table 6: Comparison of Histopathological Examination with Elastographic Diagnosis

Histopathological Diagnosis	Malignant (%)	Benign (%)
Malignant	41	59
Benign	7	93