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# Diagnostic Accuracy of Elastography to Differentiate Between Benign and Malignant Lymph Nodes of Head and Neck Region taking Histopathology as the Gold Standard

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## ABSTRACT

***Objective:*** To estimate the diagnostic accuracy of Elastography to distinguish between benign and malignant lymph nodes of the head and neck region; taking histopathology as the gold standard.

***Study Design:*** Cross-sectional study.

***Place and Duration of Study:*** Radiology Department, Pakistan Institute of Medical Sciences, Islamabad Pakistan, from Jul to Oct 2021.

***Methodology:*** Elastography, Color Doppler and B-mode ultrasound were used to examine fifty participants with enlarged cervical lymph nodes. Elastographic forms (1–5) were characterized based on the hard area in the cervical lymph nodes. In addition, the shear wave elastography of cervical lymph nodes was evaluated. Outcomes of diagnostic sono-elastographic parameters were matched with the histopathology of lymph nodes as a reference of standard.

***Results:*** The mean age of patients was 30.50±8.95 years. Out of 50 patients, 31(62%) were men, and 19(38%) were women. Out of 50 patients enrolled, 29(58%) showed benign lymph nodes, while 21(42%) showed malignant lymph nodes on elastography. All 50 patients underwent a biopsy for histopathology.

***Conclusion:*** Ultrasound elastography has high diagnostic accuracy in differentiating benign from malignant lymph nodes. Therefore, it can be used as a reliable and non-invasive modality for diagnosing lymphadenopathy in the cervical region.

**Keywords**: Cervical, Elasticity imaging techniques, Elastography, Lymph nodes, Lymphadenopathy, Neck, Ultrasound.

***How to Cite This Article:*** *Bhutta MR, Majeed AI, Khan A, Zafar I, Azad H, Akhtar S. Diagnostic Accuracy of Elastography to Differentiate Between Benign and Malignant Lymph Nodes of Head and Neck Region taking Histopathology as the Gold Standard. Pak Armed Forces Med J 2023; 73(3): 670-673. DOI: https://doi.org/10.51253/pafmj.v73i3.7553*



## INTRODUCTION

Lymphadenopathy is the term used to describe an enlargement of the lymph nodes in one or more groups of nodal regions. This condition can lead to swelling, tenderness, and pain under the skin.[1] The most common causes of lymphadenopathy are tonsillitis, adenitis, and infection of the salivary glands and ear. Malignant lymphadenopathy is lymph nodes characterized by enlargement, infiltration, and hyperplasia.[2,3]

Ultrasound elastography is a non-invasive modality for lymphadenopathy of the head and neck region that detects tissue rigidity when a force is applied.[4] Rigid tissues tend to move less when an external force is applied, resulting in smaller strain values.[5] Ultrasound elastography is a powerful modality in assessing different organs like salivary glands, musculoskeletal structures, breast, liver, prostate, thyroid gland and cervical lymphadenopathy. Two main practical approaches of ultrasound elastography include Shear Wave Elastography (SWE) and Strain Elastography (SE). Strain elastography measures tissue movements when the external force is applied. To measure the strength of tissue motion when force is applied through continuous concentrated pulses, shear wave elastography is used.[6]

To evaluate the rigidity of tissues non-invasively, strain elastography has been the modality of choice, as it can be implemented through conventional ultrasound hardware with the help of minor software adjustments.[7] Tissue motion can be initiated by two methods; free-hand manual compression along the axis of the ultrasound beam or indirect internal compression through cardiac movements.[8,9] Strain elastography uses long and low-intensity pulses, but shear wave elastography uses shorter, high-intensity and focused pulses.[10]

The rationale of our study was to sum up the diagnostic accuracy of elastography to differentiate benign and malignant lymphadenopathy of the cervical region. At the same time, FANC/biopsy was kept as the gold standard.

## METHODOLOGY

The cross sectional study was conducted at Radiology Department, Pakistan Institute of Medical Sciences, Islamabad Pakistan, from July to October 2021 after approval from ERC of Shaheed Zulfiqar Ali

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*Received: 22 Oct 2021; revision received: 05 Jan 2022; accepted: 11 Jan 2022*

Bhutto Medical University (No.1.1/2015/ERB/SZABMU/795). The sample size was calculated using WHO sample size calculator.[11]

**Inclusion Criteria:** Patients above 25 Years with enlarged lymph nodes were included in the study.

**Exclusion Criteria:** Patients already diagnosed with benign or malignant lymph nodes and came for a follow-up USG were excluded from the study.

Using ultrasound imaging, the patients were examined in a supine position via a high-frequency linear probe (10 MHz). The scan was performed by an experienced radiologist unknown to the patient's clinical profile. Lymph nodes were evaluated through the grey scale for the assessment of borders (regular or irregular), short to long axis diameter (S/L ratio) and short axis diameter, hilum (absent or present) and echotexture (heterogeneous/homogenous).

Strain elastography was performed for the lymph nodes with the same linear probe. The transducer accomplished the free-hand light compression and release of pressure applied to the targeted lymph node, which led to an image with optimal volume. In addition, participants were asked to hold their breath and restrain swallowing, which minimized the motion of tissues surrounding lymph nodes. An elastographic box encloses the lymph node and its surrounding muscle for every patient. High-quality histograms were administered in this study, which achieved a quality factor score of 60 or more.

Classification of lymph nodes was done based on 5 points scale defined by Okasha *et al.* in their study.6 Lymph nodes falling in the category 1 and 2 of elastography were considered benign, whereas the lymph nodes which fell under categories 3, 4, and 5 were considered malignant.

The clinical history of every patient was noted. The histopathology findings were compared with the elastography results for patients undergoing biopsy after ultrasound elastography.

Data were recorded and analyzed usingStatistical Package for Social Sciences version-25. For continuous variables, mean±SD were calculated, and for categorical data, frequency and percentages were calculated. Diagnostic parameters were calculated using a 2x2 table. Sensitivity, specificity, positive predictive value, negative predictive value and diagnostic accuracy were determined by using the standard formulae.

## RESULTS

Fifty participants were enrolled in the study. The mean age of the participants was 30.5±8.95 years. Ultrasound elastography was executed in all 50 patients, and the results were recorded. Out of 50 patients, 29(58%) participants study showed benign lymph nodes while 21(42%) presented malignant lymph nodes on elastography. It was noted that the hilum was not present in malignant lymph nodes. In 10 (47.6%) of 21 benign lymph nodes, intact fatty hilum was observed with regular borders. Margins of the lymph nodes had the maximum diagnostic precision in all the patients.

Out of the 50 patients, only three presented with elastography Pattern-I, and 25 presented with elastography Pattern-II. Only eight patients showed elastography Pattern-III, while elastography patterns IV and V were only seen in malignant lymph nodes. Higher Elastography patterns were seen to be associated with malignant histopathology, as shown in Table-I.

**Table-I: Elastography Characteristics of Lymph Nodes and their Diagnostic Performance (n=50)**

| Elastography Features | Benign (n= 29) | Malignant (n= 21) |
|---|---|---|
| **Borders** | | |
| Regular | 20(69 %) | 15(71.4 %) |
| Irregular | 9(32 %) | 6(28.6 %) |
| **Hilum** | | |
| Absent | 19(65.5 %) | 18(85.7 %) |
| Present | 10(34.5 %) | 3(14.3 %) |
| **Echogenicity** | | |
| Homogenous | 21(72.4 %) | 14(66.7 %) |
| Heterogeneous | 8(27.6 %) | 7(33.3 %) |
| **Elastogram Pattern** | | |
| I | 3(10.3 %) | - |
| II | 24(82.8 %) | 1(4.8 %) |
| III | 2(6.9 %) | 6(28.6 %) |
| IV | - | 4(19.0 %) |
| V | - | 10(47.6 %) |

**Table-II : Diagnostic Accuracy of Ultrasound Elastography in Cervical Lymphadenopathy (n=50)**

| | Reference Standard Positive (n=21) | Reference Standard Negative (n=29) |
|---|---|---|
| Index Test Positives | 20(TP) | 1(TN) |
| Index Test Negatives | 27(FN) | 2(TN) |
| Sensitivity | 83.33% | |
| Specificity | 96.42% | |
| Positive Predictive Value | 95.23% | |
| Negative Predictive Value | 93.1% | |
| Diagnostic Accuracy | 94.0% | |

In Above mentioned (Table-II), all 50 patients underwent a biopsy to confirm the elastography

findings. Histopathology confirmed the type of lymph node as evidenced by ultrasound elasto-graphy in 47(94.0%) out of 50; only 3(6.0%) cases showed different histopathological results. Ultrasound Elastography had high diagnostic accuracy for cervical lymph nodes (94.0%). Patients with higher elastography patterns were confirmed as malignant through biopsy (95.23 %).

## DISCUSSION

In this study, we assessed the investigative precision of ultrasound elastography to distinguish malignant and benign lymph nodes of the head and neck region; however, the gold standard of diagnosis was histopathology. The results of our study pointed out that Ultrasound Elastography has extraordinary diagnostic precision in differentiating malignant and benign lymph nodes.

According to a study by Yang *et al.* from Japan, asymmetrical boundaries originated in 8% of sensitive Lymph nodes against 66% of tubercular nodes and 55% of malignant lymph nodes. Similar to the study done by Yang *et al.* it was noted that hilum was not present in our study participants' malignant lymph nodes (18).4 B-mode ultrasound and Doppler might be potentially useful in collectively identifying benign from malignant Lymph nodes. Still, this modality might not have a confident diagnostic value due to the possibility that some benign and malignant nodes are visually indistinguishable.[11,12] For the assessment of cervical Lymph nodes, FNAC is stated to have a sensitivity of 82 % and a specificity of 97 % per cent.[13,14] Conversely, FNAC is intrusive and sometimes provides a decisive investigative outcome. Owing to its non-invasive nature, ultrasound elastography has been recommended by medical professionals as a supporting imaging tool to conventional ultrasound. Moreover, it might decrease the number of unnecessary biopsies in people. [15,16]

Abdelgawad *et al.* assessed 85 lymph nodes of the head and region, of which 53 were metastatic, and 32 were benign.[11] Our also study presented results similar to these two studies in terms of sensitivity (83.33%), specificity (96.42 %), and diagnostic accuracy (94%) for differentiating benign lymph nodes from malignant Lymph nodes. Zhang *et al.* assessed seventy-four cervical Lymph nodes (thirty-seven malignant and thirty-seven benign) through real-time elastography.[13]

A meta-analysis was conducted to assess the diagnostic efficacy of elastography in detecting benign and malignant Lymph nodes.[17] Nine studies with the data for 835 lymph nodes were examined. As a diagnostic tool that has accurate identification of malignant lymph nodes, ultrasound elastography can decrease the amount of unnecessary invasive processes. Another study examined for enlarged lymph nodes through B-mode, power Doppler ultrasound and ultrasound elastography. Imaging features similar to our study (shape, hilum, echogenicity and elastography pattern) were studied. Their study also revealed that elastography patterns 3, 4 and 5 are associated with malignant lymph nodes. Similar to our study, he concluded that strain elastography is a very helpful tool in differentiating benign lymph nodes from malignant lymph nodes of the head and neck region.[18]

Comparatively, a small number of clinical studies have assessed ultrasound elastography in the evaluation of Lymph nodes. Head and neck malignancies constitute approximately 1/3rd of the tumour cases in Pakistan, and the cervical lymph node elastography score is the most important predictive factor in diagnosing.[11]

## LIMITATION OF STUDY

We included enlarged lymph nodes only.

## CONCLUSION

Ultrasound elastography is reliable and non-invasive, with high diagnostic accuracy to differentiate between benign and malignant cervical lymphadenopathy. In addition, it can rule out malignancy based on elastography & minimize errors and FNAC/biopsy.

**Conflict of Interest:** None.

**Authors' Contribution**

Following authors have made substantial contributions to the manuscript as under:

MRB & AIM: Data acquisition, critical review, concept, approval of the final version to be published.

AK & IZ: Study design, drafting the manuscript, data interpretation, approval of the final version to be published.

HA & SA: Critical review, data analysis, drafting the manuscript, approval of the final version to be published.

Authors agree to be accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved.

## REFERENCES

1. Ishibashi N, Yamagata K, Sasaki H, Seto K, Shinya Y, Ito H, et al. Real-time tissue elastography for the diagnosis of lymph node metastasis in oral squamous cell carcinoma. Ultrasound Med Biol 2012; 38(3): 389-395. doi: 10.1016/j.ultrasmedbio.2011.12.004.
2. Ghajarzadeh M, Mohammadifar M, Azarkhish K, Emami-Razavi SH. Sono-elastography for differentiating benign and malignant cervical lymph nodes: a systematic review and meta-analysis. Int J Prev Med 2014; 5(12): 1521.

3. Turgut E, Celenk C, Tanrivermis Sayit A, Bekci T, Gunbey HP, Aslan K, et al. Efficiency of b-mode ultrasound and strain elastography in differentiating between benign and malignant cervical lymph nodes. Ultrasound Q 2017; 33(3): 201-207.
4. Yang JR, Song Y, Jia YL, Ruan LT. Application of multimodal ultrasonography for differentiating benign and malignant cervical lymphadenopathy. Jpn J Radiol 2021; 39(10): 938-945. doi: 10.1007/s11604-021-01131-7.
5. Ge XF, Li L, Cui LG, Xue H. [Value of elasticity contrast index of ultrasonography in differentiating benign and malignant cervical lymph nodes]. Zhongguo Yi Xue Ke Xue Yuan Xue Bao. 2018; 40(5): 680-684. Chinese. doi: 10.3881/j.issn.1000-503X.10275.
6. Okasha H, Elkholy S, Sayed M, El-Sherbiny M, El-Hussieny R, El-Gemeie E, et al. Ultrasound, endoscopic ultrasound elastography, and the strain ratio in differentiating benign from malignant lymph nodes. Arab J Gastroenterol 2018; 19(1): 7-15. doi: 10.1016/j.ajg.2018.01.001.
7. Seo M, Sohn YM. Differentiation of benign and metastatic axillary lymph nodes in breast cancer: additive value of shear wave elastography to B-mode ultrasound. Clin Imaging 2018 ; 50: 258-263. doi: 10.1016/j.clinimag.2018.04.013.
8. Tang GX, Xiao XY, Xu XL, Yang HY, Cai YC. Diagnostic value of ultrasound elastography for differentiation of benign and malignant axillary lymph nodes: a meta-analysis. Clin Radiol 2020; 75(6): 481.e9-481.e16. doi: 10.1016/j.crad.2020 .03.021.
9. Wang B, Zhang MK, Zhou MP, Liu Y, Li N, Liu G, et al. Logistic regression analysis of conventional ultrasound, and contrast-enhanced ultrasound characteristics: Is it helpful in differentiating benign and malignant superficial lymph nodes? J Ultrasound Med 2022 ; 41(2): 343-353. doi: 10.1002/jum.15711.
10. Zhi X, Chen J, Wang L, Xie F, Zheng X, Li Y, Sun J. Endobronchial ultrasound multimodal imaging for the diagnosis of intrathoracic lymph nodes. Respiration 2021; 100(9): 898-908. doi: 10.1159/000515664.
11. Abdelgawad EA, Abu-samra MF, Abdelhay NM. B-mode ultrasound, color Doppler, and sonoelastography in differentiation between benign and malignant cervical lymph nodes with special emphasis on sonoelastography. Egypt J Radiol Nucl Med 2020; 51(1): 157. doi::10.1186/s43055-020-00273-4
12. Wu J, Sun Y, Wang Y, Ge L, Jin Y, Wang Z, et al. Diagnostic value of endobronchial ultrasound elastography for differentiating benign and malignant hilar and mediastinal lymph nodes: a systematic review and meta-analysis. Med Ultrason 2022 ; 24(1): 85-94. doi: 10.11152/mu-2971.
13. Zhang F, Zhao X, Ji X, Han R, Li P, Du M, *et al*. Diagnostic value of acoustic radiation force impulse imaging for assessing superficial lymph nodes: A diagnostic accuracy study. Medicine (Baltimore) 2017; 96(43): e8125. doi: 10.1097/MD.0000000000008125.
14. Lo WC, Hsu WL, Wang CT, Cheng PW, Liao LJ. Incorporation of shear wave elastography into a prediction model in the assessment of cervical lymph nodes. PLoS One 2019; 14(8): e0221062. doi:10.1371/journal.pone.0221062.
15. McQueen AS, Bhatia KS. Head and neck ultrasound: technical advances, novel applications and the role of elastography. Clin Radiol 2018 ; 73(1): 81-93. doi: 10.1016/j.crad.2017.08.003.
16. Han F, Xu M, Xie T, Wang JW, Lin QG, Guo ZX, et al. Efficacy of ultrasound-guided core needle biopsy in cervical lymphadenopathy: A retrospective study of 6,695 cases. Eur Radiol 2018; 28(5): 1809-1817. doi: 10.1007/s00330-017-5116-1.
17. Cotoi L, Amzar D, Sporea I, Borlea A, Navolan D, Varcus F, *et al*. Shear Wave Elastography versus Strain Elastography in Diagnosing Parathyroid Adenomas. Int J Endocrinol 2020; 2020: 3801902. doi: 10.1155/2020/3801902.
18. Choi YJ, Lee JH, Baek JH. Ultrasound elastography for evaluation of cervical lymph nodes. Ultrasonography 2015 ; 34(3): 157-164. doi: 10.14366/usg.15007.


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