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A cross-sectional study on the diagnostic accuracy of color doppler, b-mode and elastography with FNAC correlation in the evaluation of cervical lymphadenopathy

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Abstract
Conventional ultrasound is used as an imaging modality for differentiation between benign and malignant lymph nodes, but with different accuracy, sensitivity, and specificity between different studies. This cross-sectional study evaluates the diagnostic accuracy of B-mode ultrasound, color Doppler, and elastography in identifying cervical lymphadenopathy, with fine-needle aspiration cytology (FNAC) as the reference standard. The study aims to determine the sensitivity, specificity, and overall efficacy of these imaging modalities in differentiating benign from malignant lymph nodes. By correlating imaging findings with FNAC results, the research explores the potential of non-invasive techniques to enhance diagnostic precision in clinical practice. The findings highlight the complementary roles of imaging modalities in improving diagnostic confidence, aiding early intervention, and reducing unnecessary invasive procedures.

Keywords: B mode, colour doppler ultrasound, cervical lymph nodes, Real-Time Elastography (RTE), ultrasonography, elastography, Fine Needle Aspiration Cytology (FNAC)

Introduction

Among the most frequent causes for mass in neck and head region is cervical lymphadenopathy. Reactive, tuberculosis, metastasis and lymphoma are more common in cervical lymphadenopathy cases [1]. Although clinical examination remains important in daily practice, though it is often inadequate for differentiating between benign and malignant cause that is essential for predicting outcomes and planning future treatments [2]. In evaluation of cervical lymphadenopathy, imaging plays an important role mainly in distinguishing between benign and malignant etiology. Almost all diagnostic imaging modalities (CT, MRI, USG) have been found to have superior diagnostic accuracy as compared to physical examination. Ultrasonography has long been utilized to assess cervical lymph nodes. The addition of color Doppler has further increased diagnostic accuracy [3]. Wider accessibility, availability of high frequency probes with greater resolution, no radiation issues and real time examination in multiple planes with feasibility for USG guided aspiration cytology/histopathology whenever needed are few of advantages of USG [3]. Real time elastography being a new noninvasive imaging technique that compares local tissue displacement from US signals before and after a compressive force is applied in order to evaluate tissue elasticity. Under the compression of a transducer stiff tissues show less deformation (strain) than soft tissues. Several studies have shown the value of US elastography in distinguishing between malignant and benign lesions in the breast, prostate, liver, thyroid, and cervix because malignant tissues are often stiffer than their benign counterparts [4]. Ultrasound elastography (USE) for neck and head cancer diagnosis has been the subject of several research in recent years. Although FNAC is the most effective technique for distinguishing benign from malignant tumors, it is time-consuming and minimally intrusive and therefore ultrasonography, Doppler and elastography can be used in this to discriminate benign and malignant masses [5]. Due to insufficient data pertaining to the diagnostic accuracy of Ultrasonography, Doppler and Elastography with FNAC correlation in evaluation of cervical lymph nodes, this study is taken.

Material and methods: This study was a cross-sectional analytical study conducted for 18 months in department of radio diagnosis KVG medical college and hospital, Sullia. Prior to patient enrollment, informed permission was sought and approval from the Institute Human Ethics Committee (IEC). All patients who were presenting cervical lymphadenopathy clinically were included in the study. Patients under the age of 18 years and patients with bleeding tendency were not involved. All study patients underwent FNAC after B mode Ultrasonography, Doppler and Elastography. Ultrasonography, Doppler will be done on OPD basis using Phillips Affinity model 70G machine. Elastography will done using Phillips Affinity modelmodel 70 G machine. Ultrasound, doppler and elastography will be performed consequently in the patients with thyroid masses, with the patient lying down in supine position with an elevation given under the neck to provide proper visualization. In a B mode ultrasound examination, the parameters assessed were short-axis diameter (SAD), short-axis/long-axis diameter ratio (S/L), presence or absence of echogenic hilum and well defined or ill-defined borders. In color doppler ultrasound examination, the vascular pattern of a cervical node was categorized as hilar, peripheral or mixed (showing both hilar and peripheral flow patterns). Real time elastography, tissue elasticity was assessed by comparing local tissue displacement from US signals before and after applying a compressive in force. US-guided FNAC/biopsy was performed in all nodes.

Statistical analysis: All data will be collected and kept confidential and entered into excel sheet and will be utilized for further analysis. As this is a cross sectional study, sensitivity, specificity, positive predictive value, negative predictive value, Cohen kappa and all analysis will be calculated using EPI INFO SOFTWARE VERSION 7. and final conclusion will be drawn after comparing with FNAC.

Diagnosis on FNAC	Frequency	Percentage
AIDS-related lymphadenopathy	03	3.00%
Atypical mycobacterial tuberculosis	03	3.00%
Autoimmune disease (Rheumatoid arthritis)	01	1.00%
Autoimmune disease (Sjogren syndrome)	01	1.00%
Castleman disease	01	1.00%
Kaposi sarcoma	01	1.00%
Kimura disease	01	1.00%
Lymphoma	05	5.00%
Metastatic (Parotid carcinoma)	02	2.00%
Metastatic (buccal carcinoma)	03	3.00%
Metastatic (colonic carcinoma)	01	1.00%
Metastatic (laryngeal carcinoma)	05	5.00%
Metastatic (liver carcinoma)	01	1.00%
Metastatic (lung carcinoma)	01	1.00%
Metastatic (esophageal carcinoma)	02	2.00%
Metastatic (pharyngeal carcinoma)	02	2.00%
Metastatic (Sino nasal carcinoma)	05	5.00%
Metastatic (submandibular carcinoma)	02	2.00%
Metastatic (thyroid carcinoma)	03	3.00%
Metastatic (tongue carcinoma)	04	4.00%
Metastatic carcinoma(nasopharyngeal carcinoma)	01	1.00%
Reactive lymphadenitis	43	43.00%
Tubercular	09	9.00%
TOTAL	**100**	**100.00%**

Fig 1: Distribution of cases according to diagnosis on FNAC

Validity parameters	B-Mode USG	Color Doppler	Elastography
Sensitivity	85.19%	83.33%	88.33%
Specificity	72.73%	85.00%	90.00%
Positive predictive value	71.88%	89.29%	92.98%
Negative predictive value	85.71%	77.27%	83.72%
Diagnostic accuracy	78.33%	84.00%	89.00%

Fig 2: Validity parameters of USG B-mode, color Doppler and elastography in diagnosing benign lesions taking FNAC as gold standard

Validity parameters	B-Mode USG	Color Doppler	Elastography
Sensitivity	84.00%	83.33%	90.00%
Specificity	82.35%	85.00%	88.33%
Positive predictive value	86.00%	89.29%	83.72%
Negative predictive value	89%	77.27%	92.98%
Diagnostic accuracy	79.23%	84.00%	89.00%

Fig 3: Validity parameters of USG B mode, Doppler and elastography in diagnosing malignant lesions taking FNAC as gold standard

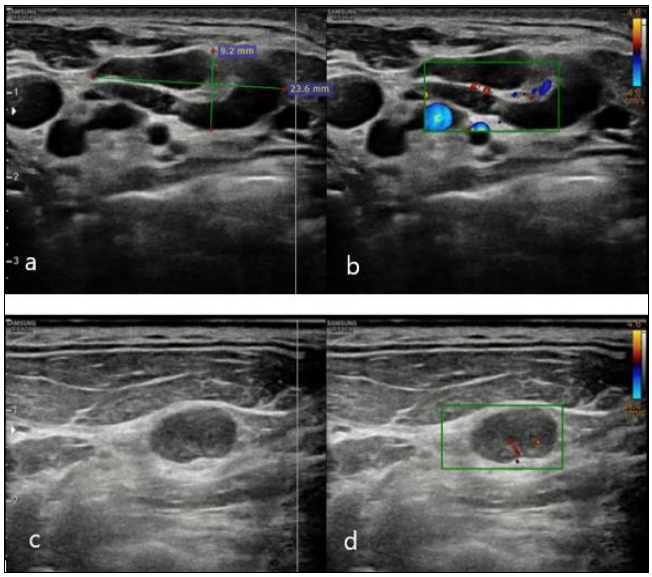

Fig 1: (a) B-mode image showing oval shaped lyph node with clear margins and maintained echogenic fatty hilum. (b) Color Doppler image showing central hilar vascularity. USG features were suggestive of reactive lymphadenitis which was proven on FNAC. (c) B-mode image showing oval shaped heterogenous lymph node with loss of fatty hilum. (d) CDUS shwoing central and peripheral vascularity. USG features were suggestive of tubercular lymph node which was proven on FNAC

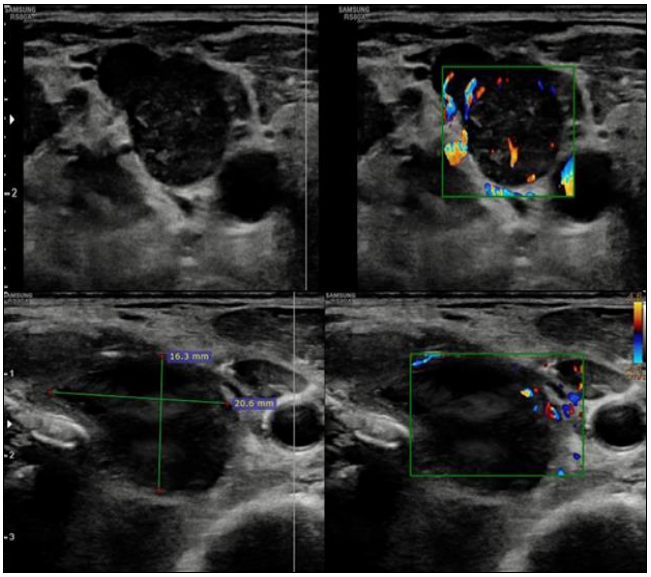

Fig 2: (a) B-mode image showing round lymph node with intranodal necrosis. (b) Color Doppler image showing mixed vascularity. Imagining features were suggestive of malignant lymph node which was conformed on FNAC. (c) B-mode and (d) CDUS images of lymph node showing intranodal necrosis with loss of fatty hilum and peripheral vascularity. Imaging features were suggestive of malignant lymph node which was confirmed on FNAC as metastasis from squamous cell carcinoma.

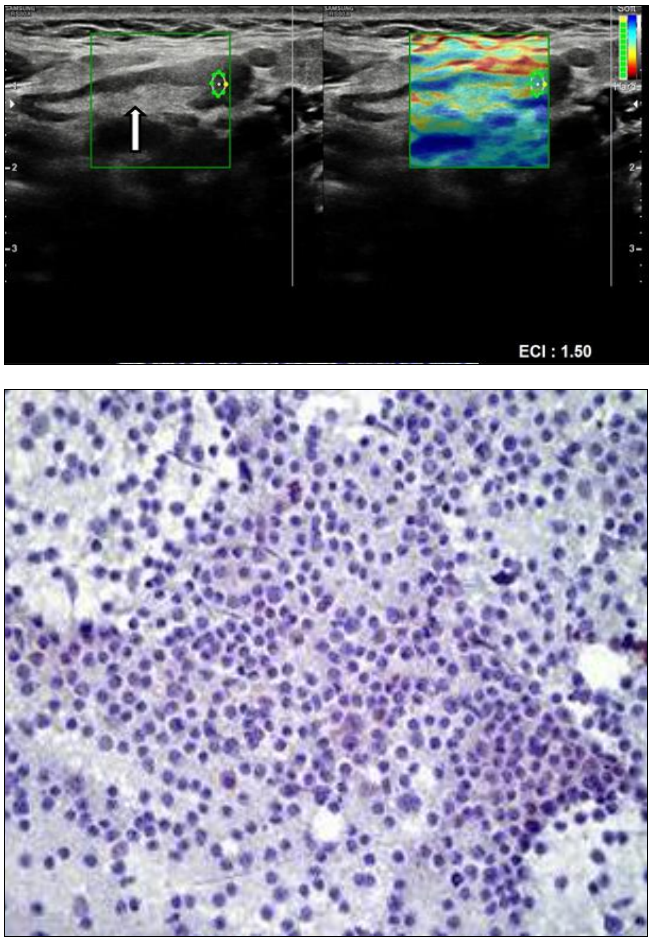

Fig 3: 30 years old female patient came with cervical lymphadenopathy. (a) B-mode image showing oval shaped lymph node with maintained fatty hilum. (b) Strain ratio of 1.5 was noted on elastography. B-mode and elastography findings were suggestive of reactive lymph node. (c) On FNAC, ultrasound diagnosis was proved as reactive lymphadenitis

Results

The study's inclusion and exclusion criteria led to the inclusion of 90 patients in total. The study patients' male to female ratio (37 vs. 63) was not comparable. All patients ranged in age from 14 to 75 years old, with an average age of 46.26±19.56 years.

Discussion

Cervical lymph node enlargement may appear in various situations, and it is not always easy to differentiate its cause. Cervical lymphadenopathy can occur in benign granulomatous disorders like tuberculosis (TB) and malignant diseases like lymphoma and metastatic carcinoma. The cause of cervical lymphadenopathy can be ascertained with the aid of ultrasound. Since ultrasound makes it easier to see the structures of the neck, it is the preferred test for evaluating cervical lymphadenopathy. Ultrasonography provides important details about the location, size, shape, margins, calcification, necrosis, and morphology of the lymph nodes.

The advent of color Doppler ultrasound and spectral Doppler provides additional information regarding the vascularity within the lymph node, which helps differentiate between benign and malignant lymphadenopathy. When these lymph nodes are detected early, they can be appropriately diagnosed and treated.

Elastography is a cutting-edge non-invasive imaging method that assesses tissue elasticity, rather than anatomy, through the use of ultrasonography, magnetic resonance imaging, X-rays, optical signals, and acoustic signals. Sonoelastography, in particular, is becoming increasingly popular due to its speed, affordability, ease of use, and accessibility. Tissue elasticity, a mechanical property that determines a tissue's resistance to displacement under pressure, can indicate its stiffness, hardness, deformability, or compressibility. This property varies between different types of tissue and can also change in response to pathology. Stiffer tissues tend to deform less in response to the same amount of pressure, resulting in less strain compared to more compliant tissues [6, 7, 8]. Hence, the present study was conducted to assess the diagnostic accuracy of B mode, color Doppler, and elastography with FNAC correlation in the evaluation of cervical lymphadenopathy. We studied all the ultrasound criteria for every node, including shape, margin, echogenicity, hilar presence, presence or absence of other features like necrosis, calcification.

We included 100 cases presenting to our institute with suspected cervical lymphadenopathy. All subjects underwent color Doppler, B mode and elastography. Out of 100 patients, 67 were males, and 33 were females.

In the present study, it can be seen that elastography had the highest sensitivity (88.33%), specificity (90%), positive predictive value (92.98%), negative predictive value (83.72%), and diagnostic accuracy (89%) as compared to color Doppler and B mode in diagnosing benign lesions. Elastography had the highest sensitivity (90%), specificity (88.33%), positive predictive value (83.72%), negative predictive value (92.98%), and diagnostic accuracy (89%), as compared to color Doppler and B mode diagnosing malignant lesions. We concluded in our study that elastography is an excellent technique for evaluating cervical lymph nodes, Compression was usually applied with help of probe against underlying anatomical structures.

Limitations

Relatively smaller sample size was a drawback in our study. We need larger sample size to generalize the study findings.

Conclusion

Elastography has a higher diagnostic accuracy compared to traditional B-mode ultrasonography and color Doppler in the evaluation of cervical lymph nodes. Combining high-resolution ultrasonography and color Doppler is a useful initial investigation to identify lymph nodes and distinguish between malignant and non-malignant (reactive and tubercular) nodes. Ultrasonography is useful in detecting abnormal nodes and can assist in guiding fine needle aspiration cytology (FNAC). Diagnostic results from ultrasound should be correlated with FNAC to confirm the nature of the nodes (malignant, reactive, or tubercular).

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