ORIGINAL RESEARCH PAPER

Radio-Diagnosis

UTILIZATION OF ULTRASONOGRAPHY AND DOPPLER TECHNIQUES FOR ASSESSING NECK MASSES

KEY WORDS:
Ultrasonography, FNAC, Sensitivity, Specificity, Doppler parameter

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ABSTRACT

Background: Neck masses refer to any swellings or enlargements located in the area between the inferior border of the mandible and the clavicle.[1] For patients with neck lesions, a thorough clinical history and physical examination often help in forming a preliminary diagnosis. Imaging studies are then used to refine and confirm the diagnosis, as well as to assess the extent of the lesion.[2]The most common cause of neck swelling is thyroid gland pathology, while metastatic carcinoma to cervical lymph nodes is the second most frequent source. After clinical examination, ultrasound (US) is commonly utilized to assess neck structures as the first imaging technique due to their relatively superficial location, making them easily accessible for ultrasound examination.[2] **Aim & Objectives:** 1.To determine the sonographic and doppler characteristics of neck masses. 2.To ascertain the organ of origin of neck masses. 3.To categorize the neck mass as benign and malignant. 4.To evaluate the accuracy of ultrasound in diagnosing neck masses. **Methods:** Prospective observational study. **Study setting:** Department of Radiodiagnosis, BMCRI. **Study population:** Patient with complaints of neck swelling. **Sample size:** 100 **Results:** In a study of 100 patients with neck lesions, the highest number of cases was found in the age group under 30, accounting for 29 cases (29 %).The age group of 41 to 50 had 25 cases (25 %), while 21 cases (21%) were in the 31 to 40 age group. There were 16 cases (16%) in the 51 to 60 age group, and 9 cases (9%) were found in those over 60. Regarding gender, 57 patients (57%) were female and 43 patients (43 %) were male.Among the 48 thyroid cases, 27 were malignant and 21 were benign. In the 22 cases of lymph node lesions, 9 were malignant, while 13 were benign. Of the 11 lesions in the submandibular space, 7 were benign and 4 were malignant. For the parotid gland, 4 out of 5 lesions were benign, and 1 was malignant. All parathyroid gland lesions were benign. Lesions found in the interfascial plane of the neck, suprasternal area, floor of the mouth, carotid space, supraclavicular area, midline neck in strap muscles, and visceral space were all benign. Out of the 100 patients, 31 (31 %) had a Resistive Index (RI) of less than 0.7, while 22 (22%) had an RI greater than 0.7. In 47 patients (47%), the RI was not applicable due to the absence of vascularity. The study reported a sensitivity of 87.1%, specificity of 89.47 %, and diagnostic accuracy of 88 %. **Conclusions:** Our findings suggest that ultrasonography is an effective tool for the diagnostic evaluation of neck masses across all age groups. It is a straightforward, non-invasive, and cost-effective imaging technique, offering precise and consistent results. Ultrasonography allows for differentiation between benign and malignant lesions based on their characteristics.

INTRODUCTION

Neck masses refer to any swellings or enlargements located in the area between the inferior border of the mandible and the clavicle.[1] For patients with neck lesions, a thorough clinical history and physical examination often help in forming a preliminary diagnosis. Imaging studies are then used to refine and confirm the diagnosis, as well as to assess the extent of the lesion.[2]

Neck masses often present a diagnostic challenge for clinicians, as the range of potential causes is broad and includes both malignant and benign conditions. [3,4] The most common cause of neck swelling is thyroid gland pathology, while metastatic carcinoma to cervical lymph nodes is the second most frequent source.[3]

After clinical examination, ultrasound (US) is commonly utilized to assess neck structures as the first imaging technique due to their relatively superficial location, making them easily accessible for ultrasound examination.[2] Sonography offers several advantages over other imaging methods: it is safe and easy to perform, does not use ionizing radiation, poses no health risks, and can be repeated as needed. Additionally, it is relatively cost-effective and provides consistent results.[5]

Although the ultrasound appearance of many lesions can be nonspecific, a thorough analysis of their features often aids in making an accurate diagnosis or, at the very least, helps to narrow down the differential diagnosis. Doppler assessment of the vascularity in solid neck masses is a crucial aspect of the differential diagnosis, as it helps identify highly vascular lesions, offering the surgeon valuable preoperative insights.[2]

Various uses of Ultrasonography (USG) in evaluation of neck masses include:

- Assessing the location and extent of the lesion.
- Assessing morphology of the lesion(differentiate solid masses from cystic lesions.)
- Characterizing features of benign or malignant lesions.
- Detecting non-palpable masses.
- Guiding fine needle aspiration of neck masses.

Based on sonographic findings, additional imaging techniques such as CT and MRI may be employed. Therefore, thorough pre-operative evaluation of neck masses is essential for differentiating between benign and malignant lesions, helping to prevent unnecessary biopsies or surgeries in the majority of patients with benign conditions.[7]

Aims And Objective Of The Study:

Primary Objectives:

1. To determine the sonographic and doppler characteristics of neck masses.
2. To ascertain the organ of origin of neck masses.

Secondary Objectives:

1. To categorize the neck mass as benign and malignant.
2. To evaluate the accuracy of ultrasound in diagnosing neck masses.

Methodology

A Prospective observational study was conducted on 100 patients who presented with complaints of neck swelling in hospitals attached to BMCRI.

Inclusion Criteria:

1. All patients with palpable neck swelling.
2. Patients of all age groups.

Exclusion Criteria:

1. Swelling caused by trauma or fracture
2. Primary swellings arising from bone.
3. Apical chest lesions with extension into neck.

Imaging Protocol:

The ultrasonography was conducted using high-resolution transducers on a Samsung Rs80evo ultrasound system with a high-frequency L-5-8 MHz probe. A systematic examination protocol was adhered to, with the patient positioned supine and the neck extended.

To enhance neck exposure, especially in patients with a short, stocky build, a small pad was placed under the shoulders.

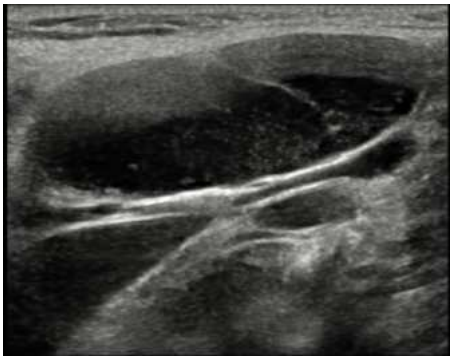
The ultrasound examination began with the thyroid gland, with adjustments made to the frequency and gain for optimal imaging. The evaluation then progressed to the suprahyoid and infrahyoid neck spaces, followed by an assessment of lymph nodes and the cervical esophagus. Color Doppler ultrasonography was utilized as necessary.

The lesions were evaluated based on their location, number, shape, margins, internal consistency, echogenicity, calcifications, and internal vascularity.

EVALUATION OF LESIONS	
Number	Solitary. Multiple (more than one), or Diffuse organ enlargement.
Shape:	Taller than wide. Wider than tall. Round. Oval.
Margins	Well-defined. Poorly defined (more than 50% of the boundary is unclear). Irregular. Lobulated. Involving adjacent structures.
Internal Consistency	Solid. Predominantly solid (less than 50% cystic components). Cystic. Predominantly cystic (more than 50% cystic). Mixed (50% solid and 50% cystic).
Echogenicity:	Anechoic, hypoechoic, isoechoic, or hyperechoic compared to the surrounding organ or nearby muscles. Lesions with mixed echo patterns were noted as hetero-echoic.
Calcifications:	Comet tail artifacts. Microcalcifications(tiny calcifications less than 1 mm without shadowing). Macrocalcifications (larger than 1 mm), including coarse and curvilinear types.Rim calcifications.
Vascularity:	Internal, perilesional or absent flow. For lesions with internal blood flow:Classified as central, peripheral, or mixed. The resistive index (RI) was calculated for lesions with internal vascularity, classified as either greater than 0.7 or less than 0.7.

These features were used collectively to help distinguish between benign and malignant neck lesions.

The site of each lesion was determined according to its organ of origin and its specific location within the neck's soft tissue and spaces.



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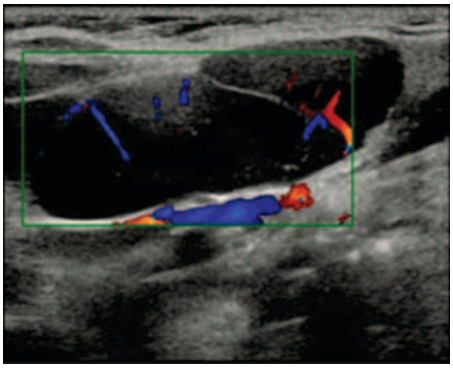

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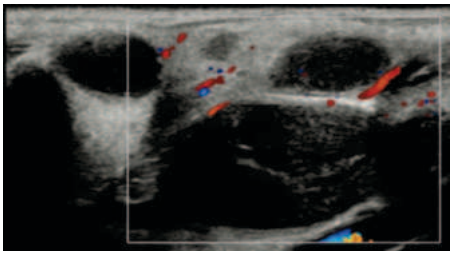
Figure 1(A and B): Lymph node in the jugular group showed increased vascularity and on FNAC it was found to be hodgkin lymphoma



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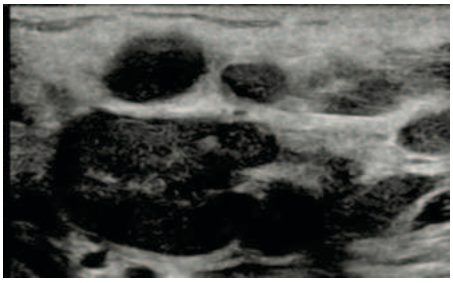

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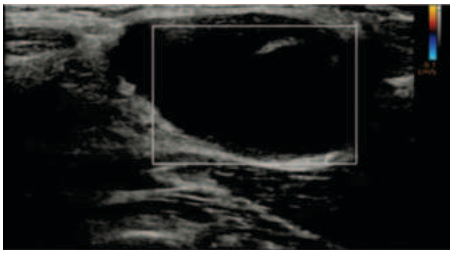
Figure 2(A and B): Matted left upper jugular lymph nodes was found in a patient with normal preserved fatty hilum .On FNAC was found to be a case of reactive lymphadenopathy



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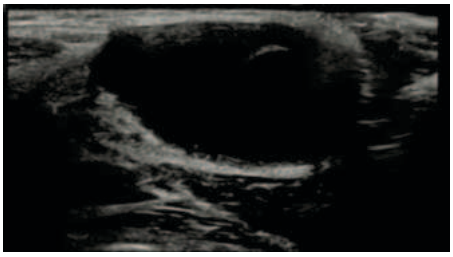

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Figure 3(A and B): Necrotic cervical lymphadenopathy-On FNAC was found to be necrotising lymphadenopathy.

Duration Of The Study: 1 year

All the data collected were coded and entered in Microsoft Excel sheet which was re-checked and analyzed using SPSS statistical software version 22.

OBSERVATIONS AND RESULTS:
The observations and results of the present study are as follows:

Age Distribution:
The median age of presentation was 21 years.

Table 1: Age Distribution

Age-no(%)	
≤30 years	29
31-40 years	21
41-50 years	25
51-60 years	16
>60 years	9
Total	100

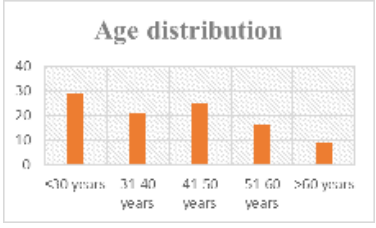

Table 2: Sex distribution:

Table No. 3 Distribution of cases according to site of mass:

Sr. No.	Site of mass	Benign (N%)	Malignant (N%)	Total (N%)
1	**Thyroid**	21 (43.7%)	27 (56.3%)	48 (48%)
2	**Parathyroid**	3 (100%)	0 (0%)	3 (3%)
3	**Lymph node**	13 (59.1%)	9 (40.9%)	22 (22%)
4	**Anterior cervical space**	3 (100%)	0 (0%)	3 (3%)
5	**Submandibular space**	7 (63.6%)	4 (36.4%)	11 (11%)
6	**Interfacial plane of neck**	1 (100%)	0 (0%)	1 (1%)
7	**Suprasternal location**	1 (100%)	0 (0%)	1 (1%)
8	**Floor of mouth**	1 (100%)	0 (0%)	1 (1%)
9	**Supraclavicular**	1 (100%)	0 (0%)	1 (1%)
10	**Parotid**	4 (80%)	1 (20%)	5 (5%)
11	**Carotid space**	2 (100%)	0 (0%)	2 (2%)
12	**Midline neck within strap muscle**	1 (100%)	0 (0%)	1 (1%)
13	**Visceral space**	0 (0%)	1 (100%)	1 (1%)
	Total	58	42	100

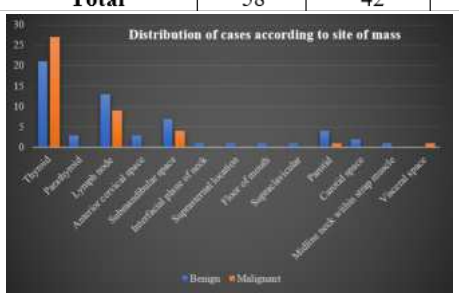

Table No. 4 Distribution of cases according to doppler parameters

Resistive Index(RI)	Benign N(%)	Malignant N(%)	Total N(%)
<0.7	22 (71%)	9 (29.0%)	31 (31%)
>0.7	3 (13.6%)	19 (18.3%)	22 (22%)
NA	33 (70.2%)	14 (29.7%)	47 (47%)
Total	58 (58%)	42 (42%)	100

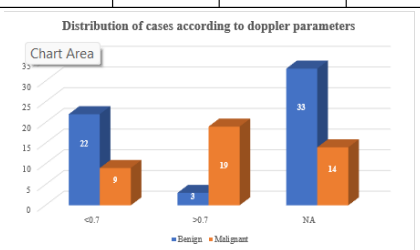

Table No 5: Correlation of USG and FNAC findings

Sr. No.	USG finding	FNAC Finding		Total
		Benign	Malignant	
1	Benign	54	4	58
2	Malignant	8	34	42
	Total	62	38	100

Statistic	Value	95% CI
Sensitivity	87.10%	76.15% to 94.26%
Specificity	89.47%	75.20% to 97.06%
Positive Likelihood Ratio	8.27	3.26 to 21.01
Negative Likelihood Ratio	0.14	0.07 to 0.28
Positive Predictive Value	93.10%	84.17% to 97.17%
Negative Predictive Value	80.95%	68.81% to 89.12%
Diagnostic Accuracy	88.00%	79.98% to 93.64%

DISCUSSION:

In this study, 100 patients with clinically diagnosed neck swelling were examined at BMCRI.

Table 1 presents the age distribution of patients with neck lesions. Among the 100 patients, the majority (29 %) were below 30 years of age. The next largest group was those aged 41 to 50 years, accounting for 25 % of cases. Patients aged 31 to 40 years made up 21 %, while those aged 51 to 60 years and over 60 years constituted 16 % and 9 %, respectively. A similar study by Subramanyam N. et al.[6] found that the most frequent age group was 21-40 years, followed by 41-60 years.

Table 2 presents the distribution of neck lesion cases based on sex. Among the 100 patients, the majority were females, comprising 57 cases (57%), while the remaining 43 cases (43%) were males.In a study by Akriti Rastogi et al.,[9] the gender distribution included 71% females and 29% males out of 100 patients. In contrast, a study by Naaz F. et al.[10] reported a male-to-female ratio of 24% to 76%.

Table 3 presents the distribution of neck lesion cases according to the site of the mass. Among the 100 patients with neck lesions, the majority—48 cases (48%)—had thyroid lesions. Lymph node lesions were found in 22 cases (22%), while parathyroid lesions were present in 3 cases (3%). Parotid lesions were identified in 5 cases (5 %), and lesions in the submandibular space were observed in 11 cases (11%). Additionally, lesions were detected in the interfacial plane of the neck (1%), suprasternal region (1%), floor of the mouth (1%), supraclavicular area (1%), carotid space (2%), midline neck within the strap muscle (1%), and visceral space (1%).

In a similar study conducted by Md Atik Bijapur et al. [11], the most frequently encountered lesions were those originating from thyroid and lymph node pathologies. Subramanyam N. et al. [6] also observed in their study that the majority of lesions were thyroid-related, accounting for 36 out of 100 cases, followed by lymph node lesions in 20 out of 100 patients.

Table 4 shows distribution of cases according to doppler parameters. Out of the 100 patients, 31 (31 %) had a Resistive Index (RI) of less than 0.7, while 22 (22%) had an RI greater than 0.7. In 47 patients (47%), the RI was not applicable due to the absence of vascularity.

Table 5 presents a comparison of neck lesion cases based on USG and FNAC findings. Among 100 patients, 34(34 %) were identified as having malignant lesions through USG, which were subsequently confirmed by FNAC. Additionally, 54 (47%) patients were diagnosed with benign lesions through both USG and FNAC. However, there were instances of misdiagnosis: 4 malignant lesions were incorrectly identified as benign on USG, and 8 benign lesions were misdiagnosed as malignant using USG.

The sensitivity of USG in detecting benign and malignant lesions was 87.10 %, with a specificity of 89.47 %, a positive predictive value (PPV) of 93.1 %, and a negative predictive value (NPV) of 80.95 %, resulting in an overall diagnostic accuracy of 88 %. Ajay K. Goutam et al. [12] reported in their study that ultrasound achieved correct diagnoses in 38 out of 50 cases, with a diagnostic accuracy of 76.0%. Similarly, Naaz F. et al. [10] found that USG had a diagnostic accuracy of 88% for identifying benign thyroid lesions. For other types of neck swellings, the diagnostic accuracy of USG, as verified by FNAC, was 100%.

CONCLUSION:

Our findings suggest that ultrasonography is an effective tool for the diagnostic evaluation of neck masses across all age groups. It is a straightforward, non-invasive, and cost-effective imaging technique, offering precise and consistent results. Ultrasonography allows for differentiation between benign and malignant lesions based on their characteristics. It is particularly valuable in distinguishing solid from cystic lesions, as well as assessing the location, extent, consistency, and relationship of neck swellings to nearby structures. It serves as a primary investigative method for evaluating thyroid gland, salivary gland, and lymph node lesions, and is especially useful for examining cervical soft tissue masses in both young and pediatric populations. Additionally, ultrasonography demonstrates high accuracy in diagnosing benign and malignant neck lesions and is a valuable aid in guiding FNAC procedures for neck lesions.

REFERENCES:

1. NARAYAN BIKRAM THAPA, Ultrasound in Diagnosis of neck masses journal of Nepal Health Research Council, Vol 4 no.1 April 04 2016 page 17,18.
2. Szyma□ska A, Szyma□ski M, Go□□bek W, Drelich-Zbroja A,Jargie□□o T.Doppler ultrasound appearance of neck tumors.J Ultrason 2018; 18: 96–102.
3. Rastogi A, SHARMA K,GAUBA N.An evaluation of efficacy of ultrasound in diagnosis of neck swellings. Int.J Otorhinolaryngology Head Neck Surg 2018;4:169-75
4. Chandak R, Degwekar S, Bhowte RR, Motwani M, Banode P, Chandak M,et al. An evaluation of efficacy of ultrasonography in the diagnosis of head and neck swellings. Dentomaxillofac Radiol 2011;40:213-21.
5. Shah JS, Asrani VK. Clinical applications of ultrasonography in diagnosing head and neck swellings. J Oral MaxillofacRadiol 2017;5:7-13
6. Subramanyam.N.Reliability of ultrasonography in neck masses evaluation. IOSR Journal of dental and medical sciences (IOSR-JDMS), Vol.16,no,10,2017, pp.33-40
7. Dr Anubhav Shukla, Dr Sachin Bagale, Dr Pooja Mehta M D. Role of ultrasonography and doppler in evaluation of neck masses. International Journal of Education and Science Research Review 2022;9(5): 284–98
8. Ajay K Gautam ,Avadhesh P S Kushwah, Sonjjay Pande. Ultrasonography and CT evaluation of neck masses. International journal of contemporary medical research 2017;4(6):1392-1397
9. Rastogi A, SHARMA K,GAUBA N.An evaluation of efficacy of ultrasound in diagnosis of neck swellings. Int.J Otorhinolaryngology Head Neck Surg 2018;4:169-75
10. Naaz F et al, Role of ultrasonography in the diagnosis of neck mass; J M e d A l l i e d S c i 2 0 1 8 ; 8 (2) : 6 6 - 7 2.
11. Mohamed Atik Ahemad et'al, ROLE OF HIGH RESOLUTION ULTRASOUND AND DOPPLE IN THE EVALUATION OF NECK MASSES WITH HISTOPATHOLOGICAL CORRELATION, international journal of medicaland applied sciences:vol 4 suppl 5;2015.
12. Ajay K Gautam ,Avadhesh P S Kushwah, Sonjjay Pande. Ultrasonography and CT evaluation of neckmasses. International journal of contemporary medical research 2017;4(6):1392-1397