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ROLE OF ULTRASONOGRAPHY AND DOPPLER IN EVALUATION OF NECK MASSES

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ABSTRACT

Background: Neck masses are any swellings or enlargements in the region between inferior border of mandible and clavicle[1]. Neck masses are a common cause of diagnostic dilemma to clinicians. [2] The differential diagnosis of swelling in the neck is broad and extensive and includes both malignant and benign etiologies.[3,4] Sonography is the initial imaging modality after clinical examination for evaluation of neck masses. It is widely available and easily tolerated by the patients [1]

Aim & Objective:1. To identify the sonographic and doppler characteristics of neck masses.2 To identify the organ of origin of neck masses. 3. To characterize the neck mass as benign and malignant. 4. To determine the accuracy of ultrasound in diagnosing neck masses.

Methods: Prospective observational study. **Study setting:** Department of Radiodiagnosis at tertiary care center. **Study population:** Patient with complaints of neck swelling. **Sample size: 100**

Results: Out of 100 patients with neck lesion maximum patients were found amongst the age group of <30 with 31 (31 %) no. of cases. 26 (26 %) cases were found amongst age group 41 to 50. Number of patients found in age group 31 to 40 were 23 (23 %), 51 to 60 were 13 (13 %) and >60 were 7 (7 %). Out of 100 patient's maximum no. of cases 58 (58 %) were Females and rest were Males 42 (42 %). Out of 49 cases of thyroid 30 were malignant and 19 were benign. Out of 24 cases of lymph nodes ,15 were malignant and 9 were benign. 9 out of 12 lesions in submandibular space were benign and 3 were malignant. 3 out of 4 parotid gland lesions were benign and 1 was malignant. All the cases of parathyroid gland were benign. Lesions in Interfacial plane of neck, Suprasternal location, Floor of mouth, carotid space, Supraclavicular location ,midline neck in strap muscle and in visceral space were all benign. Out of 100 Patients RI <0.7 was present in 28(28 %), RI >0.7 was

present in 24 (24 %) and in 48 (48 %) it was not applicable due to absent vascularity. Sensitivity 81 %, Specificity 92%,Diagnostic accuracy 86%

Conclusions: Ultrasonography is a useful modality for diagnostic evaluation of neck masses in every age group. It is simple, non-invasive and inexpensive diagnostic imaging modality. It provides accurate and reproducible results.

Keywords: *Ultrasonography, FNAC, Sensitivity, Specificity, Doppler parameter*

INTRODUCTION:

Neck masses are any swellings or enlargements in the region between inferior border of mandible and clavicle [(1).] Neck masses are a common cause of diagnostic dilemma to clinicians. [(2)] The differential diagnosis of swelling in the neck is broad and extensive and includes both malignant and benign etiologies.[(3,4)]

Thyroid gland pathology which manifests as a neck swelling is most frequent cause of neck masses and the carcinoma that has metastasized to cervical lymph nodes comprise the second most prevalent source of neck masses[(3)]

Sonography is the initial imaging modality after clinical examination for evaluation of neck masses. It is widely available and easily tolerated by the patients [(1)]

It has several advantages over other modalities as it is harmless, uses no ionizing radiations, easy to use, unaffected by metallic artefacts, causes no health problems, may be repeated as often as necessary. It is relatively inexpensive and easily reproducible[(5)]

It is helpful in delineating the presence of multiple lymph nodes and the course of resolution of infectious diseases. It is used in cases of oral carcinoma to observe the presence of regional lymph node metastasis. Ultrasound is also helpful in detecting sialolithiasis and in the diagnosis of conditions involving the salivary gland.[(6)]

Characteristics of Ultrasonography (USG):

1. To determine location of palpable neck mass (example thyroid or extra thyroid).

2. To characterize benign or malignant lesion features.

3. To confirm whether the lesion is solid or cystic

4. To determine extent of known malignancy.

5. To determine residual or recurrent and metastatic carcinoma.

6. To detect nonpalpable masses.
7. To guide fine needle aspiration of neck masses
8. To provide the information about the site of origin and infiltration into the soft tissue or vessels and mass effect.
9. To determine the vascular nature of the lesion with the help of color doppler. [1,7]

On the basis of the sonographic findings selection of additional imagining modalities including CT and MRI imaging can be applied. In view of this, the pre-operative evaluation of neck masses is crucial to distinguish between benign and malignant lesions so as to avoid unnecessary biopsies or surgeries in the vast majority of patients who have benign lesions. In addition to facilitating the diagnosis of clinically apparent lesions, the wide spread use of ultrasonography has result in uncovering a multitude of clinically unapparent lesions, while differentiating majority of them which are benign from malignant nodules.

Owing to the complex anatomy of the neck a comprehensive knowledge of regional anatomy and recognition of the patterns of disease presentation are vital to arriving at a meaningful differential diagnosis . To permit early recognition of neck pathology, detailed anatomic correlation is mandatory. Current imaging permits a detailed analysis of the complex anatomy in this region and is the key to understanding many of its disorders including mass lesions.[8]

The present study aims to determine the role of USG and doppler in diagnosing patients with neck soft tissue swellings as well as differentiating benign and malignant swellings.

The advent of color doppler sonography has added a new dimension to diagnostic accuracy. It can be extremely valuable in demonstrating the vascular nature of the neck masses.

After obtaining ethical committee clearance from institute, the study was conducted in the department among 100 patients to determine the USG findings of various soft tissue swellings in the neck region.

AIMS AND OBJECTIVES

Primary objectives:

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

Secondary objectives:

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

MATERIAL AND METHODS

The present study titled ‘’ROLE OF ULTRASONOGRAPHY AND COLOR DOPPLER IN EVALUATION OF NECK MASSES’’: AN OBSERVATIONAL STUDY has been carried out in department of Radiodiagnosis at tertiary care centre.

Approval from institutional ethics committee was taken prior to the commencement of the study. Informed consent was taken from each participating patient.

Study design: Present study is observational study.
Study period: May 2021-March 2022
Study population: Patient with complaints of neck swelling.
Sample size: A total of 100 patients diagnosed with various neck swellings attending the OPD of multidisciplinary tertiary care center.

Method of selection of study population: All the patient with the complaints of neck swelling and fulfilling the following criteria.

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 examination was performed with high-resolution transducers on Philips Affiniti 30G ultrasound equipment using high frequency L-12-5 MHz probe.

A systemic examination protocol was followed. The patient was examined in supine position with neck extended. A small pad placed under shoulder to provide better exposure of neck particularly in patients with short stocky habitus. The USG examination begins with the examination of thyroid gland where instrument is adjusted and frequency and gain is optimized. The examination then continued to evaluate suprahyoid and infrahyoid neck spaces and then to the status of lymph nodes followed by evaluation of cervical esophagus. Color Doppler USG was performed as and when required.

The lesions were assessed on the basis of site, number of lesions, shape of the lesion, margins internal consistency, echogenicity, calcifications and internal vascularity.

Site of the lesion was assessed on the basis of organ of origin and location within spaces and soft tissue of neck.

The number of lesions were assessed as solitary, multiple (more than 1) or diffuse enlargement of organ. Shape of the lesion was classified as taller than wider, wider than taller, round or oval. Round and oval shape predominantly assessed in lymph nodal masses. Taller than wider (Anteroposterior dimension more than transverse dimension) and wider than taller (transverse dimension more than anteroposterior dimension) were assessed in non-nodal masses.

Margins of the lesion were described as well defined, ill defined (more than 50% of its border is not clearly demarcated), irregular, lobulated or with local invasion. Internal consistency of the lesion was assessed as solid, predominantly solid (<50% cystic changes), cystic, predominantly cystic (>50% cystic changes) or mixed solid cystic (50% solid and 50% cystic). Echogenicity were defined as anechoic, hypoechoic, isoechoic, hyperechoic compared to the organ of origin or adjacent muscles. Hetero-echoic echogenicity were noted when the lesion

showed mixed echoes.

Calcifications when present were characterized as comet tail artifacts, microcalcifications (tiny calcifications <1mm without shadowing), macrocalcifications (>1mm) which includes coarse as well as curvilinear, and "rim" calcifications. Presence of both internal, perilesional (surrounding the lesion) or absent vascularity on Doppler was documented. In cases with internal vascularity, it was defined as central, peripheral or mixed (both central and peripheral). Resistive index (RI) were calculated in lesions with internal vascularity as > 0.7 or < 0.7

All the above features were used to differentiate benign and malignant lesions of neck.
The results of ultrasonography were compared with FNAC as and when required and diagnostic accuracy of USG calculated considering FNAC as reference standard.

INFORMED CONSENT

Informed Consent has been taken after detail explanation to patient and patients relatives.

STATISTICAL ANALYSIS

Data was entered in windows excel format and presented with the help of frequency and percentage tables. Association among the study groups is assessed with the help of chi-square test using OpenEPI statistical software version 3.01. P value less than 0.05 was taken as significant. Graphical representation is done in MS excel 2010.

ETHICAL CLEARANCE

This study was conducted after proper permission of ethical committee.

OBSERVATION AND RESULTS

The observations and results of the present study are as follows

Table No. 1: Distribution of cases according to Age

Age (Years)	Number of Cases (N)	Percentage (%)
≤ 30	31	31 %
31 to 40	23	23 %
41 to 50	26	26 %
51 to 60	13	13 %
>60	7	7 %
Total	**100**	**100 %**

Table no. 1 shows the age distribution of patients with neck lesion. Out of 100 patients with neck lesion maximum patients were found amongst the age group of <30 with 31 (31 %) no. of cases. 26 (26 %) cases were found amongst age group 41 to 50. Number of patients found in age group 31 to 40 were 23 (23 %), 51 to 60 were 13 (13 %) and >60 were 7 (7 %)

Graph No. 1: Distribution of cases according to Age

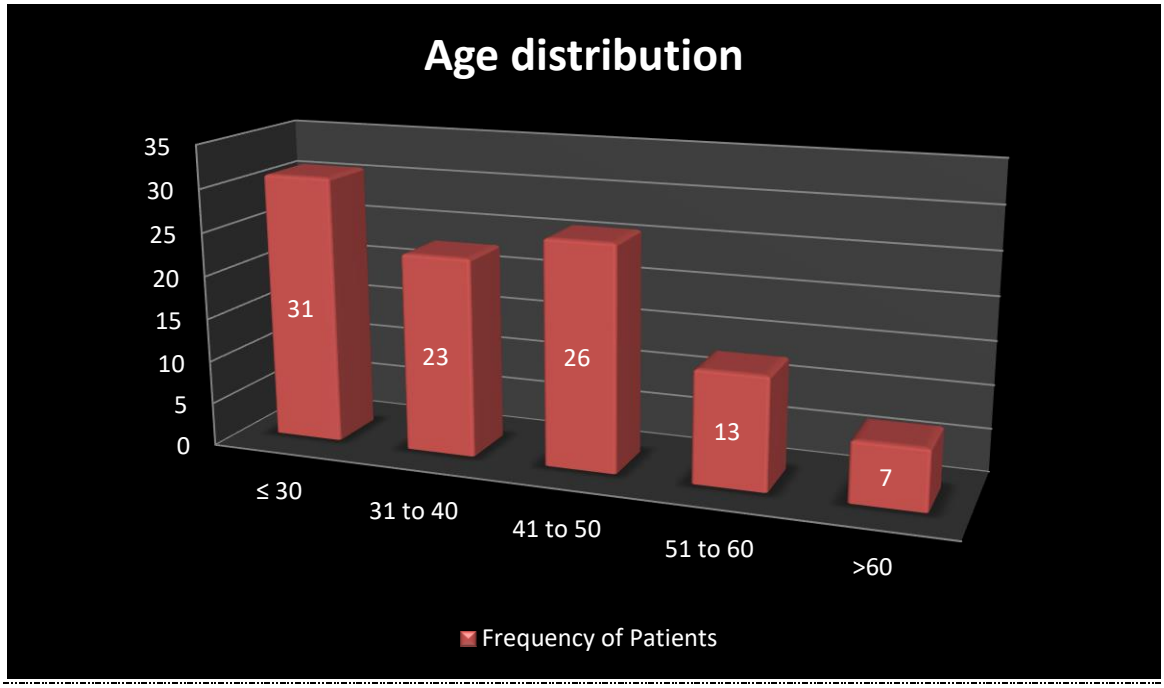

Table No. 2: Distribution of cases according to Sex

Sex	Number of Cases (N)	Percentage (%)
Male	42	42 %
Female	58	58 %
Total	**100**	**100 %**

Table No. 2 shows Distribution of cases of neck lesion according to Sex. Out of 100 patient's maximum no. of cases 58 (58 %) were Females and rest were Males 42 (42 %).

Graph No. 2: Distribution of cases according to Sex

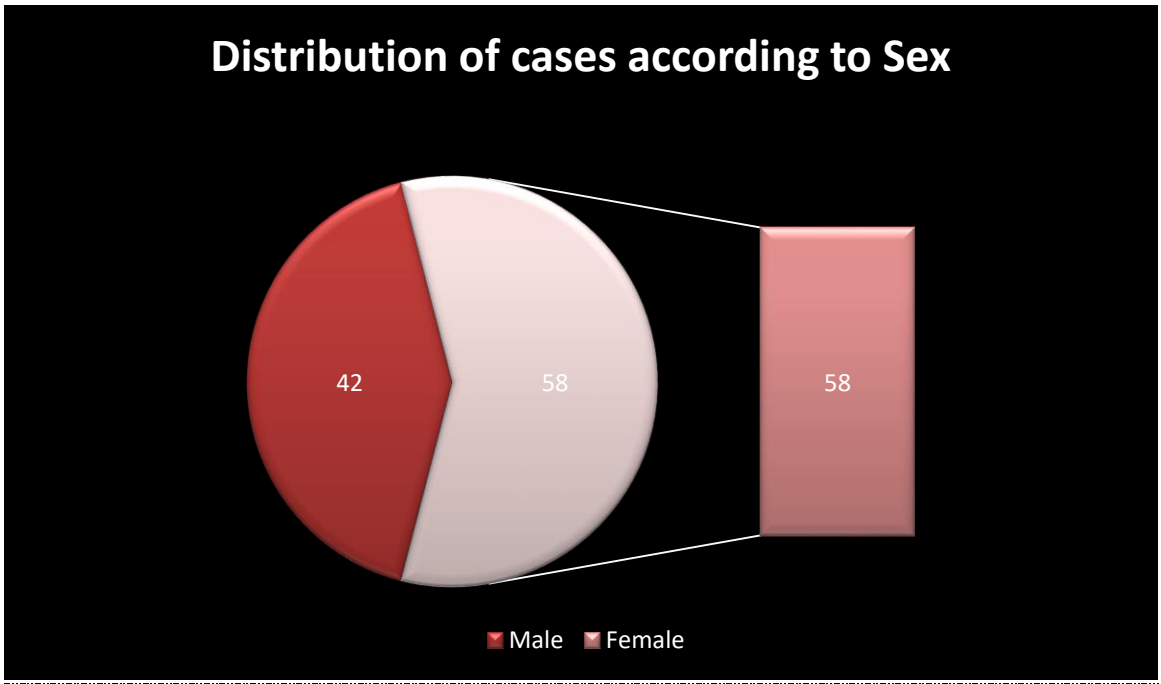

Table No. 3: Distribution of cases according to Site of Mass

Sr. No.	Site of Mass	Benign N(%)	Malignant N(%)	Total N(%)
1	**Thyroid**	19(39%)	30(61%)	49(49 %)
2	**Parathyroid**	2(100%)	0(0%)	2(2%)
3	**Lymph Node**	9(37%)	15(63%)	24(24%)
4	**Anterior cervical space**	1(100%)	0(0%)	1(1%)
5	**Submandibular space**	9(75%)	3(25%)	12(12%)
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**	3(75%)	1(25%)	4(4%)
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	50(50%)	50(50%)	100

Table No. 3 shows Distribution of cases of neck lesion according to Site of Mass. Out of 100 patients of neck lesion maximum 49 (49 %) cases showed thyroid lesions. Parathyroid lesion were found in 2 (2 %), Lymph node lesion in 24 (24 %), Parotid in 4 (4 %), submandibular space in 12(12%), Interfacial plane of neck in 1 (1 %),

Suprasternal location in 1 (1 %), Floor of mouth in 1 (1 %), Supraclavicular in 1(1 %), Carotid space in 2 (2 %), Midline neck within strap muscle in 1 (1 %), Visceral Space in 1 (1 %),

Out of 49 cases of thyroid 30 were malignant and 19 were benign. Out of 24 cases of lymph nodes ,15 were malignant and 9 were benign. 9 out of 12 lesions in submandibular space were benign and 3 were malignant. 3 out of 4 parotid gland lesions were benign and 1 was malignant. All the cases of parathyroid gland were benign. Lesions in Interfacial plane of neck, Suprasternal location, Floor of mouth, carotid space, Supraclavicular location ,midline neck in strap muscle and in visceral space were all benign.

Graph No. 3: Distribution of cases according to Site of Mass

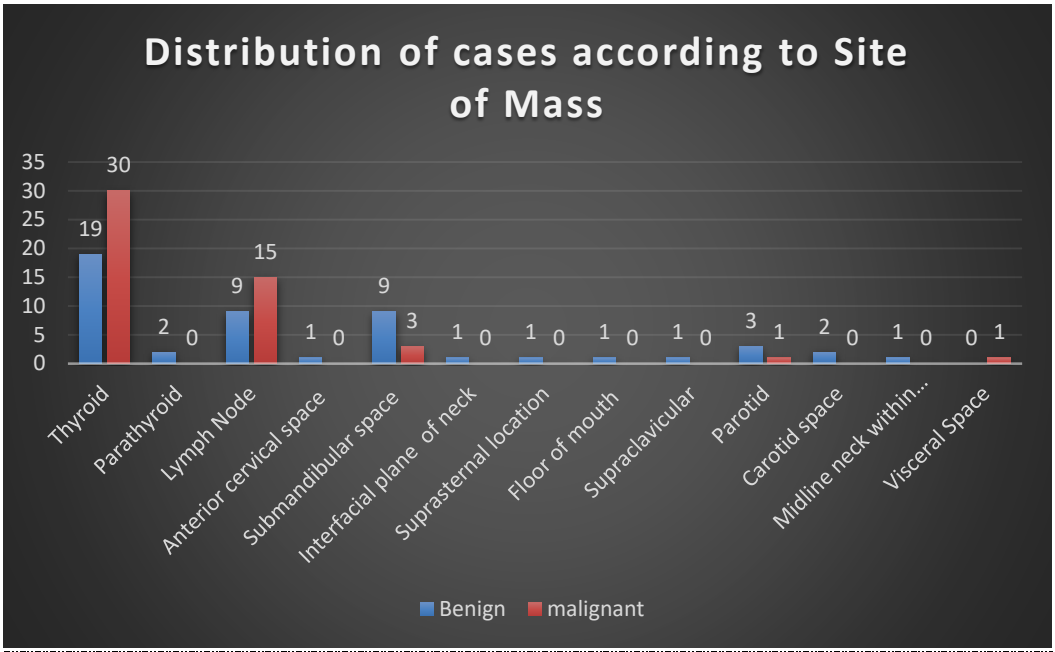

Table No. 4 Distribution of cases according to Dopler Parameter

Resistive Index	BENIGN N (%)	MALIGNANT N (%)	Total N (%)
<0.7	**17(61%)**	**11(39%)**	**28(28%)**
>0.7	**02(8%)**	**22(92%)**	**24(24%)**

NA	**31(65%)**	**17(35%)**	**48(48%)**
Total	**50(50%)**	**50(50%)**	**100**

Table No. 4 Shows Distribution of cases of neck lesion according to Doppler Parameter. Out of 100 Patients RI <0.7 was present in 28(28 %), RI >0.7 was present in 24 (24 %) and in 48 (48 %) it was not applicable due to absent vascularity.

Out of 28 cases with RI < 0.7 , 17 were benign and 11 were malignant. Out of 24 cases with RI >0.7 , 22 were malignant and 2 were benign.

Graph No. 4: Distribution of cases according to Doppler Parameter

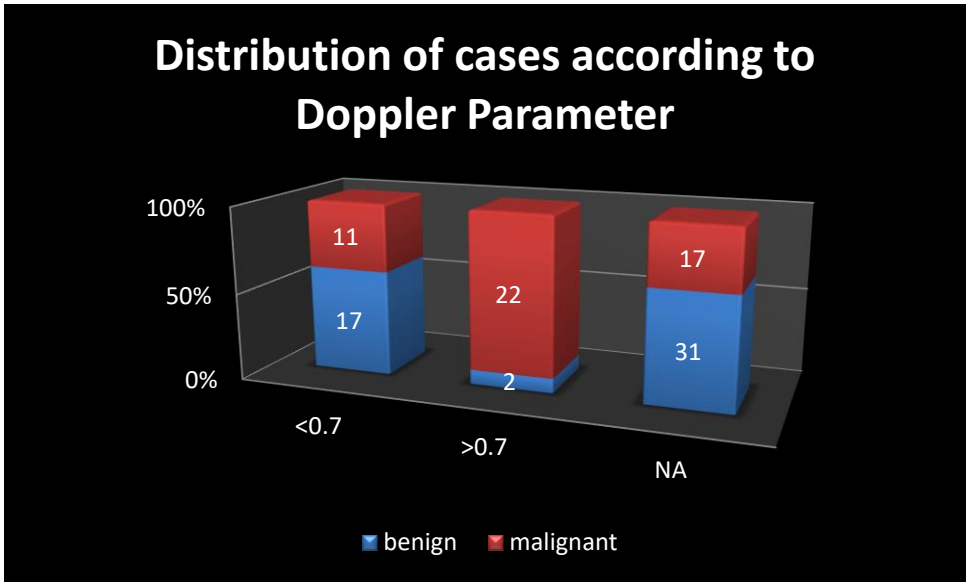

Table No. 5: Correlation of USG and FNAC Findings

Sr. No.	USG Finding	FNAC Finding		Total
		Benign	**Malignant**	
1	**Benign**	47	3	50
2	**Malignant**	11	39	50

Total	58	42	(100 %)
Sensitivity 81 % Specificity 92% POSITIVE PREDICTIVE VALUE (PPV) 94% 95% CI NEGATIVE PREDICTIVE VALUE (NPV) 78% DIAGNOSTIC ACCURACY: 86%			

DISCUSSION

In the present research we studied 100 patients, clinically diagnosed with neck swelling attending to the tertiary care centre and medical college where the study was conducted.

In **Table no. 1** we showed the age distribution of patients with neck lesion. Out of 100 patients with neck lesion maximum patients were found amongst the age group of <30 with 31 (31 %) no. of cases. 26 (26 %) cases were found amongst age group 41 to 50. Number of patients found in age group 31 to 40 were 23 (23 %), 51 to 60 were 13 (13 %) and >60 were 7 (7 %) .In a similar study by **Subramanyam.N et al**[7] found the most common age range between 21-40 years and next common age group was 41-60 year old.

Another study by **Md Atik bijapur et al** [9] the most common age range were between 21-40 years and 41 to 60 years. Study done by **Ajay K Goutam et al** [8]showed maximum numbers of patients in the age group 21-30years. A study done by **Akriti Rastogi et al** [3] showed maximum patients in the age group of 21-30 years with frequency of 27 %, 31-40 years with 22 % and 41- 50 years with 21 %. Study done by **Naaz F et al** [10] showed Maximum number of cases between 30-39 year age group (30%) followed by 20-29 year age group (20%). A study done by **Mantri G. et al**[6] showed most of the cases clustered between 31 and 60 years of age group.

In **Table No. 2** we showed Distribution of cases of neck lesion according to Sex. Out of 100 patient's maximum no. of cases 58 (58 %) were Females and rest were Males 42 (42 %). In the similar study by **Md Atik bijapur et al** [9] showed that out of 60 patients 37 (62 %)were female and 23 (38%)were males. In a study done by **Akriti Rastogi et al** [3] there were 71% females and 29% males out of 100 patients. In a Study done by **Naaz F et al** [10] the incidence of male to female was 24% and 76% respectively.

In **Table No. 3 we have** showed the Distribution of cases of neck lesion according to Site of Mass. Out of 100 patients of neck lesion maximum 49 (49 %) cases showed thyroid lesions. Lymph node lesion in 24 (24 %), Parathyroid lesion were found in 2 (2 %), Parotid in 4 (4 %), submandibular space in 12(12%), Interfacial plane of neck in 1 (1 %), Suprasternal location in 1 (1 %), Floor of mouth in 1 (1 %), Supraclavicular in 1(1 %), Carotid

space in 2 (2 %), Midline neck within strap muscle in 1 (1 %), Visceral Space in 1 (1 %)..In similar study done by **Md Atik bijapur et al** [9] showed the most common lesions encountered were those arising from the thyroid and lymph node pathologies. **Subramanyam.N et al**[7] in their study also showed that the most common lesions were 36 out of 100 patients arising from thyroid followed by lymph nodes seen in 20 out of 100 patients.

In a Study done by **Naaz F et al**[10] maximum number of patients 80% (40 patients) had swelling in the region of thyroid. **Ajay K Goutam et al**[8] showed maximum number of cases arisig from lymph nodes (38%) followed by thyroid lesions (20 %). In a study done by **Akriti Rastogi et al**[3] most common lesions were thyroid (42%) followed by lymph nodes (16 %). A study done by **Mantri G. et al** [6] showed most common 35 out of 100 lesions were from thyroid.

In Table No. 4 we showed Distribution of cases of neck lesion according to Dopler Parameter. Out of 100 Patients RI <0.7 was present in 28(28 %), RI >0.7 was present in 24 (24 %) and in 48 (48 %) it was not applicable due to absent vascularity. Out of 28 cases with RI < 0.7 , 17 were benign and 11 were malignant. Out of 24 cases with RI >0.7 , 22 were malignant and 2 were benign. **Manoj kumar et al**[11] in their study showed out of 43 malignat lesion 33 were having RI > 0.73 and 10 were < 0.73;out of 148 benign lesions 126 were eith RI < 0.73 and 22 were with > 0.73

Table No. 5 showed shows comparison of cases of neck lesion according to USG and FNAC Finding. Out of 100 Patients 39 (39%) were diagnosed with Malignant lesion by USG and also confirmed on FNAC. 47(47%) patients were diagnosed with benign lesion by USG and also confirmed on FNAC. However, 3 malignant lesions were wrongly diagnosed as benign lesions with USG and 11 benign lesions were wrongly diagnosed as malignant on USG.Sensitivity of USG in diagnosing Benign and malignant lesions was 81% with a Specificity 92 % PPV 94% NPV 78%. Therefore, the diagnostic accuracy was 86%. **Ajay K Goutam et al**[8] in their study showed that Ultrasound made a correct diagnosis in 38 out of 50 cases, having a diagnostic accuracy of 76.0%. **Naaz F et al**[9] showed showed diagnostic accuracy of USG in diagnosing benign thyroid lesions was 88% In case of other neck swellings the diagnostic value of USG as confirmed by FNAC was 100%.

CONCLUSION

Based on our results we concluded that:

Ultrasonography is a useful modality for diagnostic evaluation of neck masses in every age group. It is simple, non-invasive and inexpensive diagnostic imaging modality. It provides accurate and reproducible results.

Based on the characteristics of lesion it can be differentiated into benign and malignant lesion. It is very helpful in differentiating solid from cystic lesion, the location, extent, consistency and relationship of neck swellings to adjacent structures. Ultrasound can be used as first line investigation in evaluation of thyroid gland, salivary gland and lymph nodal lesions and also for evaluating cervical soft tissue masses especially in young and pediatric populations.

Ultrasonography highly accurate for diagnosing benign and malignant lesions of neck. It is also useful to guide the FNAC of neck lesions.

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