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Role of Ultrasound and Computed Tomography in the Detection and Characterization of Neck Masses

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Abstract: ***A neck mass is a frequently encountered entity in clinical practice. Because of its complex anatomy and physiology, neck diseases manifesting as neck swelling can vary from etiological, pathological, and prognostic points of view. Despite a vast array of aetiologies, the most common neck masses are congenital lesions, lymphadenopathy, and neoplasia, both benign and malignant. Imaging studies form an integral part of the diagnostic workup and management of neck masses. It allows one to identify true disease versus pseudo masses, to show the exact location, and predict the nature of the lesion. The study is an effort to assess the role of ULTRASOUND and Computed Tomography in the detection and characterization of neck masses and deciding further course of management.***

Keywords: Neck masses, High - resolution Ultrasonography, Computed Tomography

1. Introduction

The neck is a compact and vital portion of the human body and a wide anatomical area extending from the mandible superiorly to the manubrium sterni and clavicles inferiorly, laterally bounded by the anterior border of trapezius muscles on both sides. The contents of the neck vary from blood vessels, Glands, muscles, and lymph nodes. A lump in the neck is a very common presenting complaint in routine practice. Because of its complex anatomy and physiology, neck diseases manifesting as neck swelling can vary from etiological, pathological, and prognostic points of view. The neck, being an exposed area, most of the swellings are easily observed leading to early diagnosis and treatment. Imaging studies form an integral part of the diagnostic workup and management of neck masses. It allows one to identify true disease versus pseudo masses, shows the exact location, and predicts the nature of the lesion. Mostly benign, neck masses can be malignant sometimes and lead to fatal complications like airway compression, vascular compromise, or metastatic spread of lesions to the adjacent structure.

High - resolution ultrasound isthe most sensitive, safe, non - invasive, and cost - effective modality for imaging of neck pathology. The nature of tissue character is better visualized. The advent of colour Doppler sonography has added a new dimension to diagnostic sonography. It is useful in differentiating congenital cysts from solid lymph nodes, and solid from cystic masses. Interventional procedures such as USG - guided FNAC and abscess aspiration can be done.

Evaluation of neck masses with CT scanning is the most sensitive and reliable means to evaluate deep neck pathology, and when used with contrast can delineate vascularity.

The study is an effort to assess the role of ULTRASOUND and CT scan in the detection and characterization of neck masses and deciding further course of management.

Aims and Objectives

1) To evaluate the role of ULTRASOUND and CT in neck masses for pre - operative characterization based on location, extent, morphological characteristics, and enhancement pattern.
2) To know the origin or site of attachment of the lesion.
3) Outlining the extent in terms of involvement of adjacent structures, vessels, and possible lymphadenopathy.
4) For USG – guided procedures like FNAC, aspiration
5) To compare the morphological features of neck masses by USG and CT for better characterization of a lesion

2. Materials and Methods

This was a prospective observational type of study. The study will be conducted on as many patients with complaints of neck masses who are referred to the department of radio - diagnosis, G. G Government hospital, Jamnagar during the period of January 2022 to December 2022. In the present study, we divide neck masses according to thyroidal and non - thyroidal neck masses and non - thyroidal neck masses are further divided into nodal neck masses and non - nodal neck masses. All patients referred to the department of radio diagnosis are examined by ultrasound and color doppler. The rest of the radiological modalities will be used according to the need for further evaluation, before evaluating a patient informed consent will be obtained from the patient or guardian.

Methods of collecting data:

Clinical: all patients will be subjected to detailed clinical history as outlined in proforma.
Radiological investigation: Ultrasound and CT scan of neck masses.
Pathological investigation: Cytological findings and histopathological findings

Description of tools:

Ultrasonography Machine: Samsung RS 80: Curvilinear and Linear Probe
CT scan machine: Dual - source 16 slice computed tomography scanner (BRIGHT SPEED, GE HEALTH CARE, UK).

Inclusion Criteria

1) Patients present with a clinically palpable neck mass.
2) Patients who were referred to the radiology department for ultrasound or/CT scan investigation and would have lesions, will be included in the study.

Exclusion Criteria

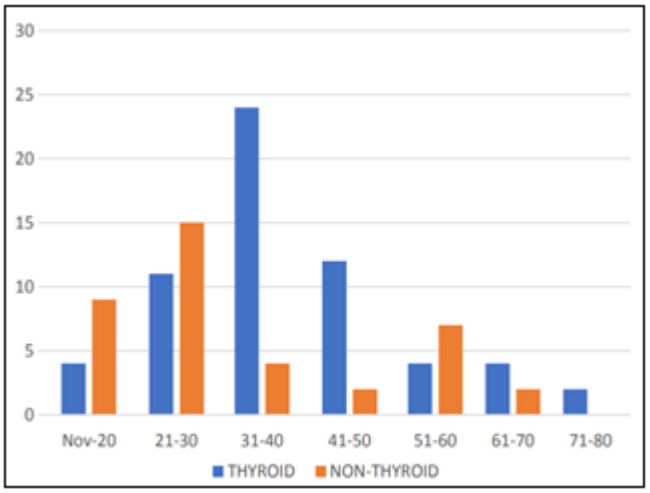
1) Post - operative patients.
2) Patients with contraindications to intravenous contrast.
3) Pregnant female

3. Observations and Results

This study was an observational and prospective study. All Patients that came to the radiology department with clinical suspicion of neck masses were studied and out of the 100 cases of neck masses, 61 cases involves the thyroid gland and the rest of the 39 cases are non – thyroidal pathology. Out of 100 cases of neck masses 65 % were female and 35 % were male. Maximum number 28 % of patients were within the age group 31 - 40 years. Out of the 61 cases of thyroid diseases, 45 were female and 16 were male which clearly shows a predilection for thyroid diseases in females. Most of the patients (24 %) were within the age group of 31 - 40 years. Out of the 39 cases of non - thyroid diseases 19 were male and 20 were female anda maximum number of 15% of patients were within the age group 11 - 20 years.

Table 1: Age distribution (Total no. of cases 100)

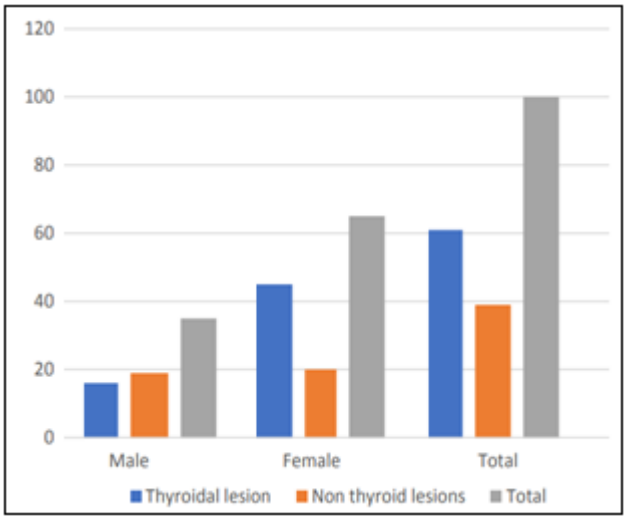
Age Group	Thyroid	Non- thyroid	Total
11- 20	4	9	13
21- 30	11	15	26
31- 40	24	4	28
41- 50	12	2	14
51- 60	4	7	11
61- 70	4	2	6
71- 80	2	0	2
	61	39	100



Maximum no. of patients were in 31 - 40 years group

Table 2: Sex distribution (Total no. of cases 100)

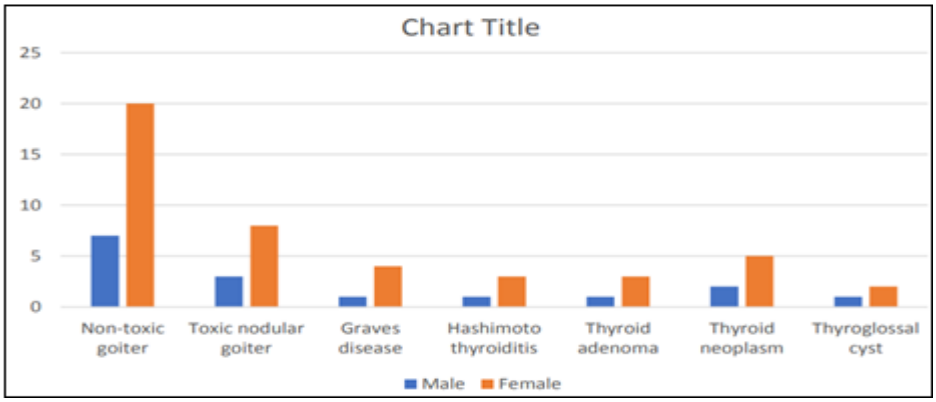
	Thyroidal Lesion	Non- thyroid Lesions	Total	Percentage (%)
Male	16	19	35	35
Female	45	20	65	65
	61	39	100	100



The overall sex ratio was M: F =1: 1.8 and in thyroidal cases it was found to be higher, M: F =1: 2.8

Table 3: Incidence of various thyroid diseases by pathologic examination. (Total no. of cases: 61)

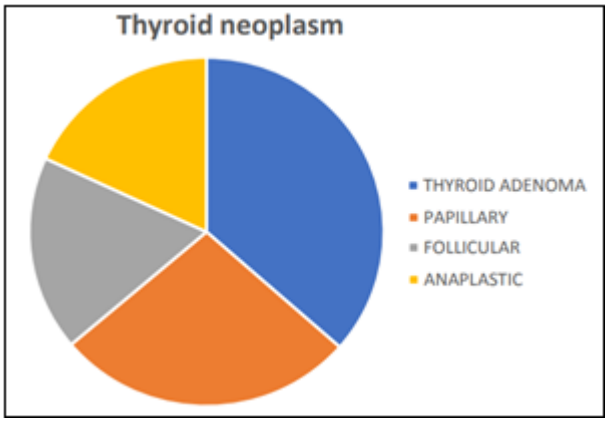
Pathology	Male	Female	Total	Percentage
Nonn- toxic goiter	7	20	27	44
Toxic Nodular Goiter	3	8	11	18
Graves disease	1	4	5	8
Hashimoto thyroiditis	1	3	4	6.5
Thyroid adenoma	1	3	4	6.5
Thyroid Neoplasm	2	5	7	12
Thyroglossal Cyst	1	2	3	5
Total	16	45	61	100



The largest group comprised of non - toxic goitre followed by toxic nodular goitre.

Table 4: No. of thyroid neoplasm as found at pathologic examination

No.	Pathology Distribution	No. of cases			Percentage (%)
		M	F	Total	
1	Thyroid Adenoma	1	3	4	100
2	Maligant Lesions	2	5	7	100
	• Papillary	1	2	3	42.8
	• Follicular	1	1	2	28.6
	• Anaplastic	1	1	2	28.6



Out of 11 cases of 11 thyroid neoplasm 4 cases are follicular adenoma and 7 cases are malignant pathology. Papillary carcinoma of thyroid gland is most common malignant variety of thyroid gland.

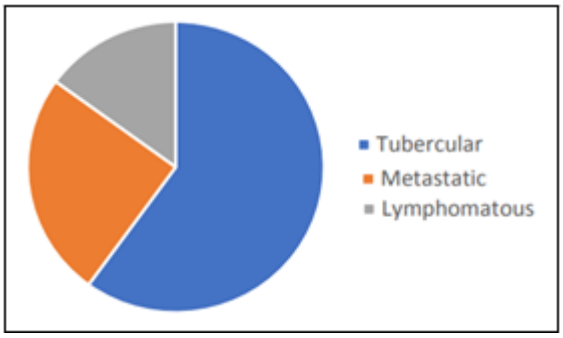
Table 5: USG features of the malignant thyroid lesions (Total no. of cases: 07)

S. No. Pattern	USG features	No. of patients		
		Papillary ca.	Follicular ca.	Anaplastic ca.
1	Echopattern			
	• Hypoechoic	00	02	02
	• Hyperechoic	00	00	00
	• Isoechoiec	03	00	00
2	Calcification			
	• Coarse	00	01	00
	• Rim	01	00	00
	• Micro- calcification	01	00	01
3	Nodularity			
	• Solitary Nodules	02	02	00
	• Multinodular	01	00	00
4	Vascularity of Lesion			
	• Internal	03	02	02
	• Peripheral	00	00	00
	• Avascular	00	00	00
5	Margins			
	• Well Defined	01	01	00
	• Ill Defined	02	01	02
6	Cystic Degeneration	01	00	00

Micro calcification is seen in 43% of malignant thyroid lesion however it is absent in benign neoplasm.

Table 6: Distribution of pathologies in lymphnodal masses (Total number of cases: 20)

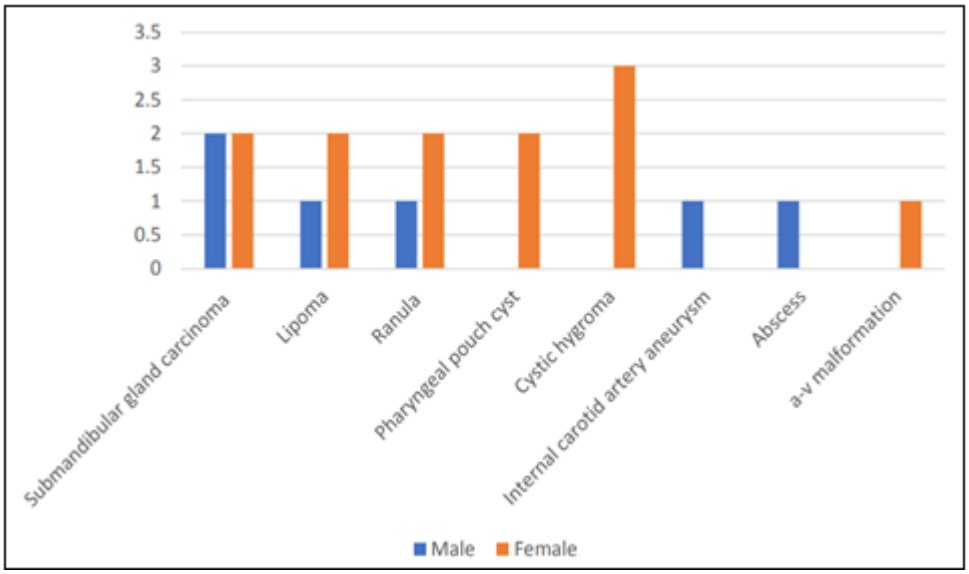
Pathology	No. of cases	Percentage
Tubercular	12	60
Metastatic	05	25
Lymphomatous	03	15
Total	20	100



Among lymph node masses 60% of cases are constituted by tubercular etiology, being the highest.

Table 7: Distribution of pathologies in non - lymph nodal masses (total no. cases 19)

Pathology	Male	Female
Submandibular Gland Carcinoma	2	2
Lipoma	1	2
Ranula	1	2
Pharyngeal Pouch cyst	0	2
Cystic Hygroma	0	3
Internal Carotid artery aneurysm	1	0
Abscess	1	0
a- v malformation	0	1
Swannoma	1	0



Benign neoplastic lesions (lipoma) were found in 3 patients of age group of 30 to 50 years. All were well - defined hyperechoic lesions in the subcutaneous plane on USG.

4. Discussion

In our study, the largest numbers of patients were in the 31 - 40 years of age group, accounting for 39.3 %. Female preponderance was noted in patients and the overall sex ratio was M: F - 1: 2.8. A similar female preponderance in thyroid diseases was noted by Solbiati et al in 1985[2], Brander et al in 1991[3] in their respective study groups. In our study there was a higher incidence of all thyroid diseases in females. Solbiati et al in 1985[2] had also observed similar female ponderance in both benign and malignant thyroid nodular lesions.

Most common pathology observed in the present study was hyperplastic goiter 38 (62.2%) out of 61 patients of thyroidal disease. Among them the majority were 71 % nontoxic while 29 % counted for toxic nodular goitre. A variable incidence has been reported in various literature. Solbuti et al in 1992[2], reported hyperplasia of thyroid as the commonest thyroid pathology Simeone et al in 1982[4] reported follicular adenoma as the commonest thyroid pathology in their study group.

Papillary carcinoma was the commonest primary thyroid malignancy encountered in this study comprising of 42.8 % cases. The majority of the lesions had solid consistency. The other authors reporting such an appearance include simeone et al 1982[4], Hatabu et al 1991[5].

In our study of tubercular lymphadenopathy was found in young patients (15 to 35 years).91% of the lymph nodes are centrally hypoechoic which appears to be necrotic. Peripheral enhancement is seen in the 41.6% of patients and 50% of patients shows heterogenous enhancement on CT (in 7 cases of CT scan done). These observations of our study of tubercular lymphnodal masses are comparable with studies of Engin G et al. in 2000 & Joshua et al in 2007.

Characteristic of Maligant Lesion	In our Study	In study by Solbiati
Consistency- Solid	6	2
Cystic	1	0
Ecopattern- Hypoechoic	4	2
Isoechoic	3	0
Calcification- Coarse	1	1
Rim	1	0
Microcalcification	2	2

The majority of malignant thyroid lesions were found to be solid in consistency predominant cystic components were noted in one case. A higher percentage of solid component in malignant lesions has been reported in many studies Solbiati et al 1985. Simeone et al 1982, Predominant echo pattern observed in malignant lesions was hypoechoeic similar observations has been documented by various authors Solbiati et al 1985a`, Simeone et. Al 1982.

In our study of tubercular lymphadenopathy was found in young patients (15 to 35 years).91% of the lymph nodes are centrally hypoechoic which appears to be necrotic. Peripheral enhancement is seen in the 41.6% of patients and 50% of patients shows heterogenous enhancement on CT (in 7 cases of CT scan done). Homogenous enhancement was found in 8.3% of casesand observations of our study of tubercular lymph nodal masses are comparable with studies of Engin G et al. in 2000[6]& Joshua et al in 2007[7].

In our study, 4 cases of the submandibular gland carcinoma was observed which were 2 case appears well defined, rounded, hypoechoeic lesion, another 2 submandibular gland carcinoma on each side was observed which were well defined hypoechoeic in echo texture with minimal internal vascularity which was similar as Rapids AD et. al 2004[8].

In our study, only benign neoplastic lesions were found in 3 patients of age group of 30 to 50 years. All were well defined hyperechoic lesions in subcutaneous plane on USG, and on CT. USGand CT can reliably depict the nature of lipomatous lesion in neck region. Our findings are consistent with studies of Munk PL et al.1997[9]& Kransdorf MJ et al 2002[10].

5. Conclusion

High - resolution sonography and color doppler is a useful modality for the diagnostic evaluation of neck masses in every age group. High - resolution sonography can differentiate benign from malignant thyroid nodules in most of the cases and is better than CT scan in differentiating benign from malignant. High resolution USG is recommended as the primary imaging modality in the evaluation of thyroid diseases. It has a high sensitivity and specificity in the diagnosis of thyroid diseases.

CT scan plays an important role in evaluating thyroid masses with substernal or retro tracheal extension which can't be adequately imaged by high resolution USG. CT ensures accurate anatomical localization and lesion characterization in benign lesions and superior to sonography in staging of thyroid malignancies in malignant tumors, it is useful for staging and provides essential information about the tumor extent that directly affects the surgical approach necessary for curative resection.

So, here we conclude that, although high - resolution ultrasound is the primary imaging modality in the diagnostic evaluation of neck masses, the role of computed tomography in the evaluation of retrosternal thyroid masses and staging of malignancies is indisputable.

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