ORIGINAL RESEARCH ARTICLE

Multidetector Computed Tomography and Ultrasound Evaluation of Neck Masses with Pathological Correlation

Shyam. S[1], Parthasarathy K R[2], Vaishnavi R S[3], Prerana A T[4], Kirti Patil[5], Siddesh Kumar M Hiremath[6]

[1]Associate Professor, Department of Radiodiagnosis, SSIMS and RC/ RGUHS, India, [2]Professor and Head of Department, Department of Radiodiagnosis, SSIMS and RC/ RGUHS, India, [3]Junior Resident, Department of Radiodiagnosis, SSIMS and RC/ RGUHS, India, [4]Junior Resident, Department of Radiodiagnosis, SSIMS and RC/ RGUHS, India, [5]Junior Resident, Department of Radiodiagnosis, SSIMS and RC/ RGUHS, India., [6]Assistant Professor, Department of General Surgery, Shri Atal Bihari Vajapyee Medical College & Research Institute/ RGUHS, India

Corresponding author: Dr. Siddesh Kumar M Hiremath, No. 26, 1st main, 2nd Cross, Near Subbhaiah Circle, CKC Garden, Bangalore – 27, India

How to cite this article: . International Journal of Contemporary Medicine Surgery and Radiology. 2022;8(2):B5-B8.

A B S T R A C T

Introduction: Neck imaging has always been a diagnostic challenge. High-resolution sonography being inexpensive and safe has become the initial investigation of choice for neck pathologies; it provides information regarding the origin and extent of the lesion. Computed tomography (CT) has a unique capacity for displaying soft tissue, bone, and airway details and provides critical anatomical information about lesions involving the neck. This study aims to determine the role of USG and CT in neck masses for pre-operative characterization based on location, extent, morphological characteristics and enhancement pattern and to compare USG and CT findings with histopathological diagnosis.

Material and Methods: A total number of 60 adult patients with suspected neck masses were studied in the department of Radiodiagnosis, SSIMS&RC, Davanagere and inputs from Shri Atal Bihari Vajapyee Medical College and Research Institute, over a period of 24 months. Contrast enhanced CT was done using a GE Revolution Multidetector CT scan machine. Post processing techniques (like volume rendered techniques) were applied wherever useful.

Results: The findings on CT were conclusive in nearly 90% of cases. Enhancement patterns and presence/absence of bony invasion were found to be more specific in differentiating benign/malignant nature.

Conclusion: Multi-detector computed tomography is a sensitive diagnostic tool for diagnosing neck masses and differentiating between benign and malignant lesions with high accuracy. The extent of pathology with local/ contiguous spread predicted by CT examination was conclusive.

Keywords: Benign, Malignant, Parathyroid, Thyroid, USG, CT.

INTRODUCTION

The neck is a wide anatomical area extending from the mandible superiorly, manubrium sternum, and clavicles inferiorly, laterally bounded by the anterior border of trapezius muscles on both sides. It encompasses a wide variety of anatomical structures that belong to different organ systems, and thus the swellings in the neck can be caused by innumerable pathological lesions arising from the various anatomical structures lying therein.[1]

High-resolution sonography being inexpensive and safe has become the initial investigation of choice for neck pathologies, it provides information regarding the origin and extent of the lesion. Computed tomography (CT) has a unique capacity for displaying soft tissue, bone, and airway details and provides critical anatomical information about lesions involving the neck. Fine needle aspiration cytology is undertaken using palpation alone, and in case of deep-seated lymph node, can be performed under the guidance of USG & CT. FNAC is a "gold standard" in the selection of the patients for surgery, while HPE is the "gold standard" for diagnosis.[3]

This study is an effort to assess the role of MDCT and High-resolution sonography with pathological correlation in the detection and characterization of neck masses.

This study aimed to evaluate the role of USG and CT in neck masses for pre-operative characterization based on location, extent, morphological characteristics and enhancement pattern to compare USG and CT findings with histopathological diagnosis.

MATERIALS AND METHODS

The present study was conducted in the outpatient clinic of the Department of Radiodiagnosis, SSIMS & RC, Davanagere, from August 2020 to August 2022. Institutional ethical clearance was obtained for the study by the Institutional Review Board

Study design: Prospective observational study.

Study place: Department of Radiodiagnosis, SSIMS& RC, Davanagere.

Study duration: August 2020 to August 2022.

Sample Size: 60

Equipment used- GE Voluson E6.

GE REVOLUTION 128 slice MDCT Scanner.

ISSN (Online): 2565-4810; (Print): 2565-4802 | ICV 2019: 98.48 |

2) Scanning technique:

The imaging protocol by ultrasonography with a high-frequency linear transducer (frequency range 7.5–10.0 MHz) is used for examination of the neck in greyscale and color doppler. The patient is positioned supine with the head extended and a pillow under the shoulders.

Contrast-enhanced CT - Study of neck masses using General Electrical (GE) Revolution 128 slice MDCT machine. The patient's head may be cushioned to avoid motion artifacts during the hot flush of contrast agent injection. Images from the alveolar ridge of the mandible to the lung apex are obtained with a gantry angulation parallel to the body of the mandible. Intravenous contrast enhancement is essential for CT examinations to facilitate both tissue characterization of neck masses and separation of neck masses from normal vascular structures. Administration of a bolus of approximately 80 to 100 ml of high- density iodinated contrast material administered at a rate of 1 to 2 ml/sec and a delay of 80 to 100 sec before image acquisition, followed by a steady rapid drip saline infusion at the same rate. Raw imaging data obtained from MDCT is processed on commercially available work stations for axial, coronal, and oblique multiplanar reformation, volume rendering images reconstructed with 0.625 reconstruction intervals for detailed interpretation

STATISTICAL METHOD

Statistical data analyzed by statistical software version 20 (SPSS) with appropriate tests of significance.

Demographic variables	Subvariables	Frequency (%)
Age	<10	6 (10%)
	11-20	5 (8.3%)
	21-40	19 (31.7%)
	41-60	28 (46.7%)
	>60	2 (3.3%)
Sex	Males	19 (31.6%)
	Females	41 (68.3%)
Total		60 (100%)

Table-1: Demographic distribution of patients

RESULTS

Table 1 shows, the youngest patient in this study was three years old, who presented with neck swelling. The oldest patient was a 70 yr. old male with bilateral multiple neck swellings. The maximum number of patients was seen within the age range 41-60 years, Constituting 46.7%.

The majority of benign neck masses are seen in the age group of 21-40 yrs withfemales predominance

In the USG characteristics of benign non-nodal neck masses, most of the patients with benign non-nodal neck masses have thyroid involvement 20 (33%) which have predominantly isoechoic appearance 9 (45%), with well-defined margins in 19 (95%), 8(40%) patients have a solitary nodular appearance, and another8(40%) showed multinodular appearance. Calcification is seen in 1(5%) patient each with multinodular goiter and nodular colloid goiter. Out of 20 patients with benign thyroid disease, 10 (50%) patients have a solid appearance on USG. Increased vascularity is seen in 2(10%) patients of STN and 1(5%) patient each in MNG, NCG, Hashimoto's thyroiditis. In salivary gland masses, the majority are hypoechoic 5 (83.3%; n= 6). Infection (abscess) is seen in 2 patients with retropharyngeal abscess and one patient with parotid abscess.

The USG characteristics of malignant neck masses shows, Out of 60 patients included in the study, 12 (20%) patients had malignant neck lesions,thyroid malignancies in 8 (13%), laryngeal carcinoma in 3 (5%) patients, and buccal carcinoma in 1 (1.6%) patient. Punctate calcification is seen in 3(5%) patients with papillary carcinoma

The USG characteristics of nodal neck masses shows, all patients with TB lymphadenitis have iso to hypoechoic ill-defined borders suggestive of matting with intranodal necrosis. All patients with reactive lymphadenitisare hypoechoic. One patient with metastasis lymph node showed calcification and intranodal necrosis.

The CT characteristics of benign neck masses shows, Out of 60 patients studied 46(76%) patients had benign lesions out of which 20 patients have benign thyroid lesions (33.3%), 7 (11.6%) patients have salivary gland lesions. The majority of

	Thyroid lesions		Non-thyroid lesions	
	Benign (n=20)	Malignant (n=8)	Benign (n=26)	Malignant (n=6)
Sensitivity	90%	62.5%	84.6%	33.3%
Specificity	92.5%	98%	94.1%	98%
PPV	85.7%	83.3%	91.6%	66.6%
NPV	94.8%	94.4%	86.6%	92%

Table-2: Sensitivity and specificity of USG for the diagnosis of benign and malignant thyroid and non thyroid lesions

	Thyroid lesions		Non-thyroid lesions	
	Benign (n=20)	Malignant (n=8)	Benign (n=26)	Malignant (n=6)
Sensitivity	98%	75%	92.3%	75%
Specificity	95%	96%	97%	98%
PPV	90%	85%	96%	85.7%
NPV	100%	96%	94.2%	96.2%

Table-3: Sensitivity and specificity of CT for the diagnosis of benign and malignant thyroid and non thyroid lesions

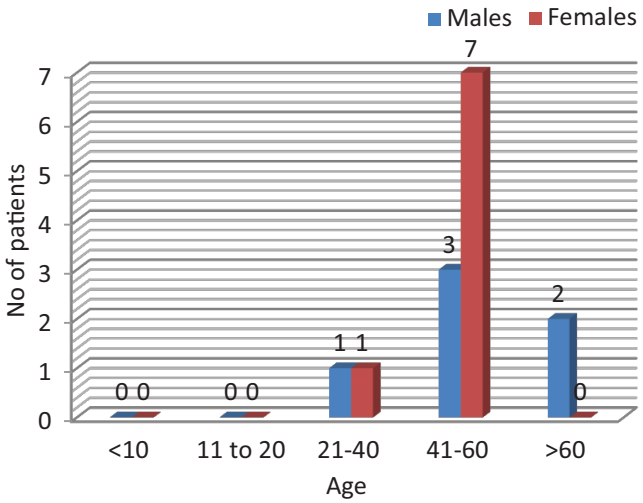

Figure-1: Age and sex distribution of benign neck masses

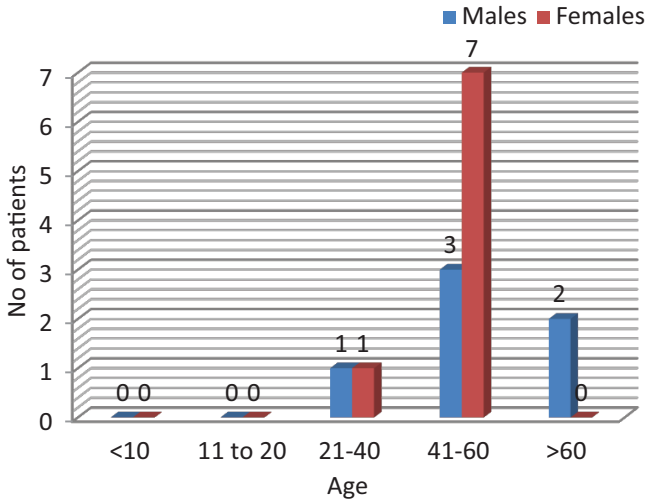

Figure-2: Age and sex distribution of malignant neck masses

benign lesions (n=46) showed heterogeneous enhancement 23 (50%) on contrast administration; necrosis is seen in 4 (6.6%) patients with Tuberculous lymphadenitis, 3 (6%) patients of salivary gland lesions, one (2%) patient with parathyroid adenoma. None of the benign lesions showed bony invasion, one patient with lymphangioma showed vascular encasement, one patient each with MNG, Reidel's thyroiditis, Tuberculous lymphadenopathy, lymphangioma, pleomorphic adenoma, and a retropharyngeal abscess had adjacent space extension

The CT characteristics of malignant neck masses shows, out of 60 patients studied, 14 (23.3%) patients had malignant lesions. Most (92.8%) of the malignant lesions showed heterogeneous contrast enhancement. Necrosis waspresent in 78.5% of the malignant lesions. Vascular invasion is seen in one patient (7.1%) with malignant lesions. Extension into the adjacent space was seen in 6 (42.8%) of malignant lesions.

Table 2 shows, the sensitivity and specificity of USG in detecting benign thyroid lesions in the present study are 90% and 92.5%, respectively. For the detection of malignant thyroid lesions, sensitivity is low, i.e., 62.5% compared to specificity of 98% in our study. Sensitivity for detecting benign lesions other than thyroid is 84.6%, whereas specificity is 94.1%. Malignant lesions of neck other than thyroid show sensitivity and specificity of USG is 33.3% and 98%, respectively.

Table 3 shows, CT has shown a sensitivity of 98 % in detecting benign thyroid lesions with a specificity of 95%, whereas for malignant thyroid lesions, the sensitivity is 75%, and specificity is 96%. These findings are suggestive that CT is more accurate than USG in detecting benign and malignant thyroid lesions.

The sensitivity of CT in diagnosing benign lesions of neck masses other than thyroid is 92.3%, and specificity is 97%. For diagnosing malignant neck masses other than thyroid sensitivity is 75%, specificity is 98%. These findings suggest that CT has more sensitivity than USG in detecting benign and malignant neck masses other than thyroid; however, similar specificity remains the same.

DISCUSSION

Ultrasonography was found to be the preliminary modality for the evaluation of superficial structures of the neck which is opted by clinicians, following which CT or MR imaging was done to decide the further degree and involvement of the disease.

The present study consisted of 60 patients which were included 41 females and 19 males; the maximum number of patients was in the age group of 41 to 60 years. Out of 60 patients studied benign lesions were seen in 46 (76%), and malignant lesions seen in 14 (24%) patients, out of these nodal lesions were 8 (13.3%), and non-nodal lesions were 52 (86%). Whereas, in a similar study done by Ajay K. Gautham et al[4] with a sample size of 50, the following was observed benign nodal lesions seen in 3 (6%), benign non nodal seen in 28 (56%), malignant nodal seen in 16 (32%), malignant non nodal seen in 3(6%).

In the Reena Mathur et al[5] study showed, 34% incidence of neck lesions in visceral space; our study showed a 53.3% incidence among visceral space lesions followed by parapharyngeal space similar to Ramen takuldar et al[6] which showed the Thyroid lesions constituted the majority of neck masses (46%) followed by congenital and salivary gland masses, neurogenic tumors, paragangliomas, and nodal lesions,

In the present study, multi-nodularity was a present in 40% of patients, while 40 % of cases were discovered with solitary nodules. Ultrasound showed 91.6% accuracy in diagnosing benign thyroid lesions in our study with a sensitivity of 90% and a specificity of 92.5%, CT has 98% sensitivity and 95% specificity in diagnosing benign thyroid neck lesions. Venkatachalapthy et al[7] did a similar study, the sensitivity of USG in diagnosing thyroid nodule was 73%, and specificity was 85.3% which is comparable to the present study results.

The present study showed USG has 50% sensitivity and 92.3 % specificity in diagnosing papillary carcinoma of the thyroid, whereas follicular carcinoma of the thyroid has 66% sensitivity on USG. Our study showed overall sensitivity of USG in diagnosing malignant thyroid neck lesions is 62.5 % and a specificity of 98%. Whereas in the Rodrigues et al.study, found that ultrasound showed a sensitivity of 65%, specificity of 86%, in detecting thyroid cancer.

ISSN (Online): 2565-4810; (Print): 2565-4802 | ICV 2019: 98.48 |

In the present study, CT evaluation has demonstrated a sensitivity of 75 % in diagnosing malignant thyroid lesions with a specificity of 96% similar to Mathur R[6], where overall accuracy of CT as 97%.

The salivary glands

The present study had 6 cases of salivary gland pathology diagnosed on USG. Out of two cases of pleomorphic adenoma diagnosed by HPE, only one was detected on USG and on color Doppler is demonstrated as well defined lobulated hypoechoic lesion in the superficial parotid lobe with poor vascularity. This finding was consistent with that seen by Bialek and others [8]. Bozzato et al. [9]noted that no reliable distinct sonomorphological criteria had been defined that enables histological tumor type to be identified.

The present study had only one case of submandibular gland calculi, ultrasound features of which included a heterogeneous gland with hypoechoic collections and calculi in Wharton's duct. This was confirmed by histopathology. Salivary gland calculi occur most commonly in the Wharton's duct.

One case of a parotid abscess was noted involving the superficial lobe, which was hypoechoic. This feature is consistent with parotid abscess described by Bialek and others [8].

Lymph nodes

Ultrasound showed hypoechoic echotexture in all cases of inflammatory nodes 2 (25%), 3 (37%) cases of tubercular nodes, 1 (12%) case of lymphoma, and 1 (12%) cases of metastatic lymphadenopathy. One case of tuberculous lymphadenopathy showed iso-echogenicity All inflammatory nodes displayed oval shape, while metastatic and lymphomatous nodes showed a rounded shape on the US, which was suggestive of malignancy. Matting and un-sharp borders were seen in 3 (37%) tubercular nodes. The above findings were consistent with those described by Chan et al. [10] and Hajek et al. [11]

According to Bruneton et al. [12], ultrasound is of primary value in providing information of an anatomical nature, including the distribution of subclinical nodes, volumetric evaluation, and determination of vascular connection. Our study revealed similar results.

According to Anand et al., the sensitivity and specificity in detecting metastatic nodes was 82% and 92.5%. Our study showed 100% sensitivity and specificity in detecting tubercular nodes based on unsharp borders, matting, displaced vascularity, and clinical features of pulmonary/ extrapulmonary tuberculosis. CT also showed 100% sensitivity and specificity in detecting TB lymph nodes. These findings have also been described by Asai et al. [13] and Chan et al. [10]

CONCLUSION

High-resolution sonography is one of the most useful modalities for the diagnostic evaluation of neck masses in every age group. It provides accurate and reproducible results. In many clinical conditions, it can be used as the first-line modality for evaluating cervical soft tissue masses, especially in young and pediatric populations. CT ensures accurate anatomical localization and lesion characterization in benign lesions. 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. However, histopathology remains the gold standard for diagnosing and confirming the disease.

REFERENCES

1. Branstetter B F, Weismann JL. Normal Anatomy of the Neck CT and MR Imagining Correlation and Radiological Evaluation of the Neck.Radiol Clin of North Am.2003;38(5):925-40
2. Handbook of Head and Neck Imaging by H. Ric Hansberger, 2d ed. Mosby, 1995
3. Baum U, Greess H, Lell M,Noomayr A, Lenz M.Imaging of head and neck tumours-methods: CT,Spiral-CT,Multislice-spiral-CT.Eur J Radiol, 2003;30(3);153-60.
4. Ajay K Goutam, Avadhesh P S Kushwah, Sonjjay Pande. Ultasonography and CT evaluation of neck masses. International Journal of Contemporary Medical Research 2017;4(6):1392-1397.
5. Mathur R, Madhumala M, Gupta A, Repswal R. Role of multidetector ct in evaluation of neck lesions 2016;3(50) :2349-2570.
6. Ramen Talukdar, Rajkumar S Yalawar,CT Evaluation of Neck Masses;e-ISSN: 2279-0853, p-ISSN: 2279-0861. Volume 14, Issue 12 Ver. IX (Dec. 2015), PP 39-49
7. Venkatachalapathy et al, a prospective study of clinical, sonological and pathological evaluation of thyroid nodule, J Biosci Tech, Vol 3 (1), 2012, 474- 478.
8. Bialek E.J, Jakubowski W. Role of Ultrasonography in Diagnosis and Differentiation of Pleomorphic Adenomas. Arch Otolaryngol Head Neck surg. 2003; 129: 929-933.
9. Bozzato A, Zenk J, Greess H et al. Potential of Ultrasound Diagnosis for Parotid Tumours: Analysis of Qualitative and Quantitative Parameters. Otolaryngol Head neck Surg 2007; 137: 642-646.
10. Chan J.M. Shin L.K. Jeffrey R.B. Ultrasonography of Abnormal Lymph Nodes Ultrasound 2007; 23(1): 47-54.
11. Hajek P.C, Salomonowitz E, Turk R D et al. Lymph Nodes of the Neck: Evaluation with US, Radiology 1986; 158: 739-742
12. Bruneton J.N, Roux P, Cramella E. et al. Ear, Nose and Throat Cancer: Ultrasound Diagnosis of Metastasis to Cervical Lymph Nodes, Radiology 1984; 152: 771-773.
13. Asai S, Miyadui H, Suzuki K, Shimanura K, Anda Y. Ultrasonographic Differentiation between tuberculous lymphadenitis and malignant lymph nodes.Journal of ultrasound in medicine.2001; 20(3) : 533-538.

Source of Support: Nil; **Conflict of Interest:** None

Submitted: 25-04-2023; **Accepted:** 29-05-2023; **Published online**: 30-06-2023