International Journal of Medical and Health Research
www.medicalsciencejournal.com
ISSN: 2454-9142
Received: 03-03-2021, Accepted: 21-03-2021, Published: 19-04-2021
Volume 7, Issue 4, 2021, Page No. 22-27

Role of multidetector CT in evaluation of neck masses

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Abstract

Aim: To evaluate and correlate role of Multidetector CT in evaluation of neck masses.

Material and Method: The study was carried out at the Department of Radiodiagnosis and Imaging, N.S.C.B. Subharti Medical College on 55 patients presenting with neck masses and they were subjected to Multidetector CT evaluation. The patients were informed about the radiation exposure in the examination. The patient's progress was followed up clinically with repeat serial Multidetector CT scans when necessary. The cytopathological and/or histopathological examination reports of all patients were collected from the pathology department and were used as a gold standard for comparison. Diagnostic statistics such as sensitivity, specificity, positive predictive value, negative predictive value and accuracy has been used to find the correlation of CT scan with final diagnosis.

Results: The final diagnosis was confirmed by Histopathology /FNAC and non-nodal masses accounted for 51% of total neck masses (28/55) and nodal masses accounted for 49% of the total neck masses (27/55). The p value for lesions imaged using CT was statistically significant i.e. <0.01 which implied that there was a strong correlation of the imaging finding on MDCT vs. FNAC/Histopathology.

Conclusion: We conclude that MDCT has a high diagnostic sensitivity for detecting both benign and malignant masses, Specially of the pharynx and larynx and has equal sensitivity for detecting extra nodal spread.

Keywords: MDCT, neck mass, benign, malignant

Introduction

The neck encompasses a wide variety of anatomical structures which 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 within.[1] Swellings of the head and neck may be attributed to various reasons that include odontogenic, non-odontogenic, inflammatory, cystic, vascular malformations, benign and malignant lesions. The evaluation of head and neck lumps can often present a major problem thereby posing a challenge to the clinician in arriving at a diagnosis. Neck Masses are any swellings or enlargements of the structures in the area between the inferior border of mandible and clavicle.[2] Many techniques besides clinical approach are readily available to the clinician to help with the diagnosis.[3] The role of Ultrasound (USG) in evaluation of neck region is becoming increasingly important due to the availability of high – frequency (7.5 to 15 MHz) probes, which permit visualization of more subtle anatomical and pathological details. It is a safe reliable method of examination that causes little patient discomfort.[4] There is extensive literature on its application in thyroid and parathyroid diseases also.[5] Ultrasonography thus is a simple investigative technique in the diagnosis of various lesions. However, ultrasound lacks the ability for precise evaluation of the complex anatomy of the neck and is poor in assessment, evaluation and preoperative staging of head and neck malignancies, Specially in the deep spaces of neck.

Neck imaging has always been a diagnostic challenge due to its complex anatomy. Multi-Detector row Computed Tomography (MDCT) is an important imaging modality for characterization and pre-surgical evaluation of neck masses. Computed tomography is often the first diagnostic imaging examination performed in patients in whom the presence of a head/neck mass is either evident or suspected. This process includes evaluation of the size, location, and extent of tumor infiltration into surrounding vascular and visceral structures. Multi-slice spiral computed tomography (CT) provides volumetric helical data, thereby permitting optimal multiplanar and 3D reconstructions. Rapid scan acquisition reduces motion artefacts, as well as permits phonation studies. [6]

Magnetic Resonance Imaging is extremely useful in assessment of neck lesions due to its excellent soft tissue delineation and multiplanar imaging capabilities [7] but is limited by its availability and high cost. Moreover, it requires patient to remain still for a longer duration which sometimes is not possible in painful neck masses and may require sedation in pediatric patients. Because of these drawbacks, ultrasound and Computed Tomography has emerged as an important modality for diagnosis of neck lesions. Hence the present study was undertaken to assess the role of Multidetector Computed Tomography (MDCT) in detection and characterization of neck masses and help in deciding further course of management.

Material and Methods

The study was carried out at the Department of Radiodiagnosis and Imaging, N.S.C.B. Subharti Medical College and done on patients presenting with neck masses attending both the OPD and IPD, admitted in various wards of Chatrapati Shivaji Subharti hospital, Meerut attached to N.S.C.B Subharti Medical College, Meerut. They were subjected to Multidetector CT evaluation. Study was conducted on 55 sample patients (selected by random sampling) with complaint of clinically palpable neck mass during period of October 2018 to August 2020. Patients who have presented with a clinically palpable neck mass and patients across all age groups were included in the study. Post-operative patients, patients with contraindications to intravenous administration of contrast medium, pregnant females and patients lost to follow up were excluded from the study.

The study protocol for all procedures was approved by the Institutional Review Board for Ethical Clearance of Chatrapati Shivaji Subharti Hospital. All patients were asked to sign a written consent form prior to commencement of the study and were informed regarding the hazards of radiation as well as regarding adverse effects of IV contrast agents. The data was collected by a preformed structured interviewer-administered questionnaire that was pretested with modifications made prior to its use in the study. The patients were interviewed that requests for the demographic, socioeconomic status, medical history and previous history of taking any medications and supplements. The Patients progress was followed up clinically and with repeat serial Multidetector CT scans when necessary.

Investigations

- T3, T4 and TSH (only in patients of a thyroid swelling found on clinical examination)
- Hb, TLC, DLC, ESR
- Blood sugar, blood urea, serum creatinine
- Multi Detector CT with or without IV contrast

Multidetector CT examinations was done on Phillips Ingenuity Core 128, multidetector CT. Axial sections were taken. Coronal and Sagittal reformatting was done. The patient was placed supine and breath holding instructions conveyed to him via the operator.

The cytopathological and/or histopathological examination reports of all patients were collected from the pathology department and were used as a gold standard to compare with Multidetector CT diagnosis.

Statistical Analysis

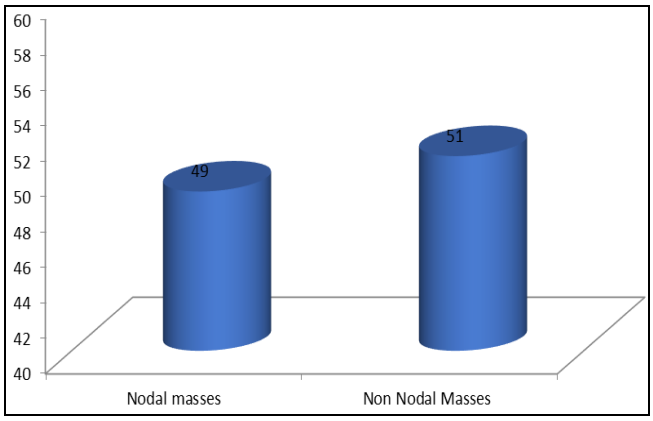
Sensitivity, specificity, and predictive values were calculated on collected data. Kappa statistics were used to analyze data and findings were interpreted with other studies. Chi square test has been used to find the significance of association of MDCT scan findings with the final diagnosis. Diagnostic statistics such as sensitivity, specificity, positive predictive value, negative predictive value and accuracy has been used to find the correlation of CT scan with final diagnosis.

Results

There was male preponderance accounting for 62% of cases with females accounting for 38% of the total cases. The study group comprised of patients ranging from 6 to 79 years of age. The maximum number of patients was seen in the age groups of 41-50 (27%) and 51-60 (27%). The final diagnosis was confirmed by Histopathology /FNAC and non-nodal masses accounted for 51% of total neck masses (28/55) and nodal masses accounted for 49% of the total neck masses (27/55) as shown in table 1.

Table 1: Distribution of nodal and non-nodal masses

Nodal masses (N=27)	N	%
Aero Digestive Malignancies	17	63
Unknown Primary Site	6	22
Tonsillar Abscess with Nodal mass	1	4
Mucoepidermoid carcinoma of parotid gland	1	4
Retropharyngeal Abscess with Nodal mass	1	4
Lymphoma	1	4
Non-Nodal masses (N=28)		
Salivary gland lesions	7	25
Thyroid masses	14	50
Masses of Developmental origin	3	11
Masses of mesenchymal origin	3	11
Masses of Vascular origin	1	4



Graph 1: Distribution of nodal and non-nodal masses

In the study it was concluded that out of the total cases (N=55), 40% (N=22) of the lesions were of malignant etiology with rest 60% (N=33) lesions of benign etiology. Out of the nodal masses (N=27), 66 % (N=18) lesions were of malignant etiology and 33% (N=9) of lesions were of benign etiology. Among the non-nodal masses (N=28), 14% (N=4) of the lesions were of malignant etiology and 85 % (N=24) cases were of benign etiology as shown in table 2.

Table 2: Benign vs Malignant Masses

Final diagnosis (N=55)	Non Nodal Masses (N= 28)	Nodal Masses (N=27)	Total
Benign lesions	24	9	33
Malignant lesions	4	18	22

MDCT accurately diagnosed 5 out of 5 cases of multi nodular goitre,4 out of 4 cases of colloid nodules, 6 out of 6 cases of squamous cell carcinoma of buccal mucosa, 3 out of 3 cases of pharyngeal squamous cell carcinoma, 4 out of 4 cases of transglottic squamous cell carcinoma, 4 out of 4 cases of squamous cell carcinoma of the base of tongue, 2 out of 2 cases of papillary carcinoma thyroid, 3 out of 3 cases of lipoma, 1 out of 1 case each of hashimoto's thyroiditis, submandibular abscess, medullary carcinoma thyroid, parotid abscess, thyroid abscess, hemangioma of the sternocleidomastoid muscle, 2nd branchial cleft cyst,

lymphangioma, sialolithiasis with sialadenitis, Warthin's tumor, tonsillar abscess, retropharyngeal abscess and fibromatosis colli, 3 out of 3 cases of lymphadenopathy with an unknown primary etiology, 1 out of 2 cases of pleomorphic adenoma (1 case of pleomorphic adenoma of the right submandibular gland was false negative- diagnosed as sialadenitis), 2 out of 4 cases of tubercular lymphadenopathy (2 cases were false negative- diagnosed as lymphadenopathy due to unknown etiology) and 1 out of 1 case of lymphoma were diagnosed on MDCT (1 case was false negative- which was initially diagnosed as tubercular lymphadenopathy (table 3).

Table 3: Final Diagnosis (HPE) vs Multidetector CT

HPE Findings	N=55	CT			
		TP	FP	FN	TN
Multinodular goiter	5	5	0	0	0
Colloid Nodule	4	4	0	0	0
Hashimoto's Thyroiditis	1	1	0	0	0
Squamous cell carcinoma buccal mucosa	6	6	0	0	0
Squamous cell carcinoma base of tongue	4	4	0	0	0
Pharyngeal squamous cell carcinoma	3	3	0	0	0
Transglottic squamous cell carcinoma	4	4	0	0	0
Submandibular abscess	1	1	0	0	0
Medullary carcinoma thyroid	1	1	0	0	0
Papillary carcinoma thyroid	2	2	0	0	0
Parotid abscess	1	1	0	0	0
Thyroid Abscess	1	1	0	0	0
Mucoepidermoid carcinoma of parotid	1	1	0	0	0
Hemangioma	1	1	0	0	0
Second branchial cleft cyst	1	1	0	0	0
Fibromatosis Colli	1	1	0	0	0
Sialolithiasis with Sialadenitis	1	1	0	0	0
Lipoma	2	2	0	0	0
Lymphangioma	1	1	0	0	0
Pleomorphic adenoma	2	1	0	1	0
Warthins tumor	1	1	0	0	0
Tonsillar Abscess	1	1	0	0	0
Retropharyngeal Abscess	1	1	0	0	0
Lymphoma	1	0	0	1	0
Tubercular Lymphadenopathy	4	2	0	2	0
Lymphadenopathy (Unknown Primary)	3	3	0	0	0

TP: true positive, FP; False Positive, FN: False Negative TN: True Negative

The study showed distribution of cases in different spaces of neck. The most common space involved were visceral and pharyngeal mucosal space i.e. 22% (N=13) each of the total cases which included the thyroid gland lesions and masses of the pharynx and the larynx. Second most common space involved were the submandibular and perivertebral spaces comprising 14%(N=8) each of the total cases with salivary gland lesions and buccal squamous cell carcinoma in submandibular space and nodal masses, masses of developmental origin and masses of mesenchymal origin mostly involving the perivertebral space. Third most common space involved were the parotid space comprising 7% (N=4) followed by retropharyngeal space, masticator space, sublingual space, parapharyngeal space and the buccal space with 4% (N=2) of the total cases. Carotid space was least commonly involved with 2% (N=1) of the total cases as shown in table 4.

Table 4: Distribution of masses according to neck space

Neck Space	N	%
Masticator Space	2	4
Pharyngeal Mucosal Space	12	22
Submandibular Space	8	14
Retropharyngeal Space	2	4
Carotid Space	1	2
Sublingual Space	2	4
Parapharyngeal Space	2	4
Parotid Space	4	7
Visceral Space	12	22
Buccal Space	2	4
Perivertebral Space	8	14
Total	55	100

In the study it was seen that the level III lymph nodes were the most commonly involved accounting for 31% of the cases followed by the level IIb- 27%, level IIa- 22%, level Ib- 15%, level IV- 13%, level Ia – 11%, level VI – 7%, level V- 5% with level VII being the least common lymph node station, accounting for 2% of cases as shown in table 5.

Table 5: Distribution of involved lymph node stations

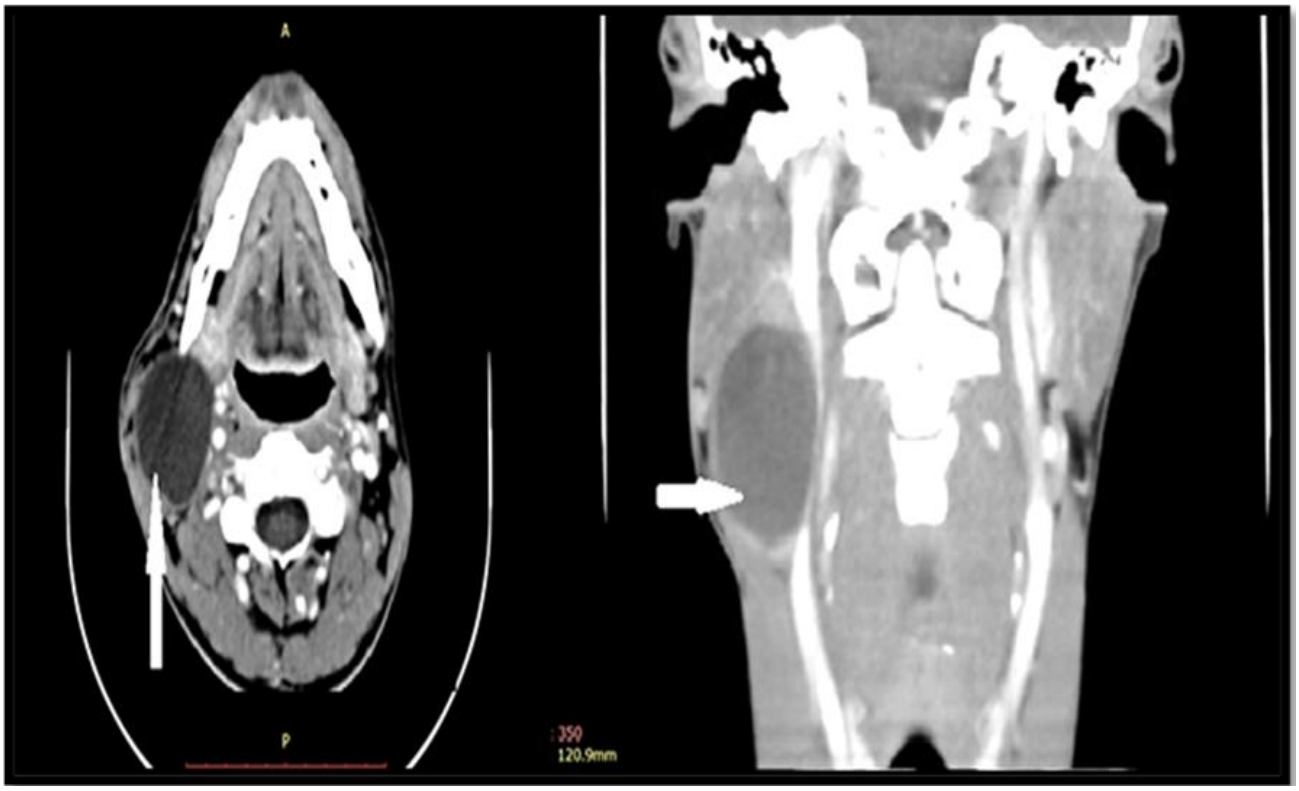
Lymph Node levels	N	%
Ia	6	11
Ib	8	15
IIa	12	22
IIb	15	27
III	17	31
IV	7	13
V	3	5
VI	4	7
VII	1	2

The p value for lesions imaged using CT was statistically significant i.e. <0.01 which implied that there was a strong correlation of the imaging finding on MDCT vs. FNAC/Histopathology. The p value for lesions imaged using USG was not statistically significant i.e. >0.01 which implied that there was not a strong correlation of the imaging finding on USG vs. Histopathology (Biopsy/ FNAC) as shown in table 6.

Table 6: Comparison of diagnostic efficacy of MDCT in relation to HPE

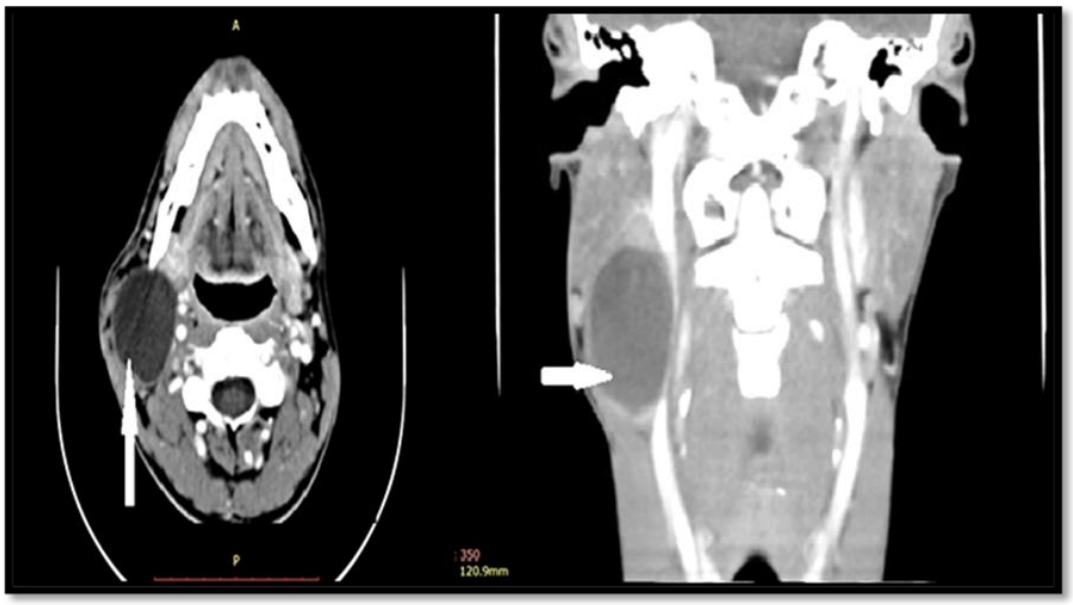
Parameters	MDCT
Sensitivity%, 95% CI	97.20% (83.78% to 99.92%)
Specificity%, 95% CI	82.30% (61.22% to 95.05%)
True Predictive Value%, 95% CI	88.50% (76.04% to 94.98%)
Negative Predictive Value%, 95% CI	95.00% (73.23% to 99.25%)
Diagnostic Efficacy%, 95% CI	90.91% (80.05% to 96.98%)

Fig 1: Postcontrast MDCT images of same patient showed a nodule in the superficial part of the left parotid gland, which was well defined, homogenous, hyperdense to the rest of the gland, rounded with no necrosis, calcification, or infiltration of the adjacent structures. Postoperative histopathology confirmed final diagnosis of pleomorphic adenoma of left parotid.



a **b**

Fig 2 a & b: CECT axial and coronal images demonstrated a second branchial cleft cyst which was well-defined ovoid with no internal content in the right submandibular region, which was abutting the carotid vessels.



a **b**

Fig 3a and b: CECT axial images show multiple nodal masses in the left cervical region at level IIa and level III showing internal necrotic changes which on FNAC were confirmed of tubercular etiology.

Discussion

Neck masses are frequently encountered in routine clinical practice and comprise a wide pathological spectrum with patients regularly presenting with a lump in the neck. A strict protocol for diagnosis should be followed of which radiology is a crucial pillar. Importance of MDCT lies in its superior accuracy and the excellent anatomical Detail it provides of the complex anatomy of the neck.

In our study, overall male to female ratio was 1.6:1 indicating that the males outnumbered the females which was in accordance with study done by Preetam *et al* [8]. where male to female ratio was 1.2:1. Maximum number of patients was in the age group of 41-50 & 51-60 years which was in accordance to study done by Chandra Dev Sahu *et al*.[9] where maximum numbers of patients were age group 50–60 years. (13 out of 60 cases)

Nodal masses comprised 27 out of 55 cases in our study, accounting for 49% of the cases. Most common cause of metastatic adenopathy was from aerodigestive tract malignancies (63%), lymphadenopathy from unknown primary site (22%) and single cases of nodal masses were due to tonsillar abscess, retropharyngeal abscess, lymphoma and metastasis from mucoepidermoid carcinoma of the parotid gland (4%) each. Out of the 27 nodal masses, 18 (66.6%) were found to be malignant and 9 (33.3%) were benign. This was in accordance with study done by Ajay K Gautam *et al* [10] where nodal masses comprised 38% of the total cases (19 out of 50) with aero digestive malignancies being the most common cause of nodal mass of the neck and in contradistinction of study done by Vijay Pratap *et al* [11] where inflammatory masses were the most common cause of nodal masses where nodal masses comprised of 42% of the total cases.

In our study, non-nodal masses comprised of 28 out of 55 cases- 51% of total cases. Similar results were obtained by study done by Ajay K Goutam *et al* [10] where 62% cases (31 out of 50) and Chandra Dev Sahu *et al* [9] where 73% cases (44 out of 60) were non nodal masses. In our study thyroid masses were found to be the most common cause of non-nodal masses accounting for 50% (N=14) of non-nodal masses followed by the salivary glands-25% (N=7) with masses of developmental and mesenchymal origin accounting for 11% (N=3) of total non-nodal masses each and a mass of vascular origin (Hemangioma of the sternocleidomastoid muscle) accounting for 4% (N=1) of the total non-nodal masses.

In present study, MDCT had a sensitivity 97.20% and specificity of 82.30% and diagnostic efficacy of 92.91%. Similar results were observed by Umme Iffat Siddiqua *et al* [12] in a study of 57 cases where the sensitivity was 94.60%, specificity was 95%, and diagnostic efficacy of 94.7%, Chandra Dev Sahu *et al* [13] in a study of 60 cases where the sensitivity was 90.32%, specificity was 96.55%, and diagnostic efficacy of 95 % and Ravi N. *et al* [97] in a study of 100 cases where the sensitivity was 89.34%, specificity was 93.87% and diagnostic efficacy was 90.9%.

Conclusion

MDCT can be used as an independent modality for lesions which appear benign as well as malignant. Such lesions should be followed up with guided biopsies and in case of malignancy on Biopsy/FNAC. Guided Biopsy/FNAC with CT is also feasible for lesions in the deep spaces of neck where blind biopsy/USG guided biopsy is not feasible. However, a larger series of study combined with Contrast Enhanced MR Imaging which provides better soft tissue detail and allows evaluation of perineural spread will better elucidate correlation between radiological findings and clinical outcome in patients presenting with palpable neck swellings.

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