Multi - Detector Computed Tomography in Evaluation of Neck Masses

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Abstract: ***Lump in the neck is rather a common presenting complaint, with wide range of etiopathogenesis and prognosis, it is critical that any neck swelling be diagnosed appropriately and promptly. MDCT was adding to milestones in neck imaging. This Prospective Observational study conducted on 100 patients with neck mass referred to Radio diagnosis department at tertiary care centre. Most patients were found amongst the age group 21 - 30 years (22%). Majority of study cases were Males 58 and females were 42. The incidence of benign and malignant lesions found to be61% and 39% respectively. Most common benign and malignant lesion was found to be benign thyroid lesions 14% and laryngeal carcinoma 8% respectively. In characterization of malignant lesions, commonest finding was heterogeneous enhancement pattern 39%, while in benign lesions, most of the benign lesion showed extension to adjacent neck spaces. Most of benign lesions found in younger age group, while malignant lesions were common in older age group. The study showed sensitivity=96.66%, Specificity=80%, Positive Predictive value=97.75%, Negative Predictive value=72.72% and diagnostic accuracy=86.6%. MDCT helps in accurate detection, precise anatomical localization and characterization of neck masses. Correlation of MDCT with pathological diagnosis found to be statistically highly significant (p<0.05).***

Keywords: Neck, MDCT, masses

1. Introduction

The neck is small but important part of the human body. Important vessels (carotid artery, jugular vein), glands (thyroid, parathyroid), muscles (Diagastric, Sternocleidomastoid, Trapezius, strap muscles, etc.), nerves (vagus, glossopharyngeal, spinal accessory nerve), fatand lymph nodes are amongst the contents of the neck. In everyday practice, lump in the neck is a rather common presenting complaint [1].

The prognosis is determined not only by the location of the lump, but also by the kind of illness (inflammatory or neoplastic) and, in malignant diseases, the stage of the disease and lymph node involvement [2]. The role of imaging in this endeavour can never be over - emphasized [3].

Neck imaging is challenging due to the close proximity of important structures and the complicated deposition of deep cervical fascia (DCF) [4]. Before the introduction of cross sectional imaging, radiologists were limited in their ability to diagnose neck lesions, particularly those affecting the suprahyoid neck's deep regions (SHN). In cross sectional imaging, which depends only on a spatial concept of neck anatomy given in terms of various neck spaces [5]. Smoker WR, Harnsberger, and others pioneered the delineation of the spatial anatomy of the neck [6].

Neck lesions can be assessed using imaging modalities like ultrasound, computed tomography (CT), and magnetic resonance imaging (MRI). While ultrasound can be useful for detecting superficial, it has poor spatial resolution and is sensitive to interobserver variations [7]. MRI is particularly useful in diagnosing neck lesions because of its superior soft tissue delineation and multiplaner imaging capabilities, although it is not suited for claustrophobic patients or those who have specific equipment such as pacemakers or cochlear implants. Furthermore, its availability is not consistent, and the cost is expensive [8, 9, 10].

The various medical disorders can influence these areas, including congenital malformations, infections, inflammations, neoplasms, and traumatic situations [11]. CT is also useful tool for staging head and neck malignancies and determining respectability before surgery [12].

The development of spiral CT represented a watershed moment, and it is now regarded as the "gold standard" for neck imaging [13]. The projection data in spiral CT can be collected in a single breath hold [14]. Furthermore, high - quality three - dimensional and multiplanar pictures, increased contrast enhancement, improved vascular opacification, and lower contrast requirements are only a few of the key benefits of spiral CT in neck imaging [15].

2. Aims and Objectives

Aim: Multi detector computed tomography in evaluation of neck masses

Objectives:

Primary Objective:
1) To assess the potential of multidetector computed tomography for detection, characterization and evaluation of the extent of neck mass.
2) To study the age distribution of neck mass.
3) To classify neck mass into benign and malignant.

Secondary Objective:
To compare sensitivity, specificity, positive predictive value, negative predictive value and accuracy of MDCT for diagnosis of different neck neoplasms.

3. Materials and Method

It is Prospective observational study conducted on 100 patients in Department of Radiodiagnosis at tertiary care centre for the period of 2 years (from October 2019 to October 2021). The study population included the cases with neck mass referred to department of radiodiagnosis for evaluation.

Inclusion criteria: Patients with neck masses referred to Radio - diagnosis department.

Exclusion criteria: Pregnant patients, those with contraindications to MDCT, history of allergy, deranged renal function testand those who were not willing to participate in study

Approval for the study:
Written approval from Institutional Ethics committee, Radiodiagnosis department and related department was obtained. Informed verbal consent from all patients which were included in study was obtained.

Methods of Data Collection and Questionnaire: Predesigned and pretested questionnaire was used to record the necessary information. Questionnaires included general information, such as age, sex, residential address, chief complain, past history, previous investigation, and personal history. The patients having history suggestive of neck mass like hoarseness of voice, palpable lesion in neck, mass seen on indirect laryngoscopy and neck survey revealing neck mass of unknown etiology were included in this study. All these patients were studied by 128 Slices seimenssom atom multi slice multi- detector Computed tomography machine.

All patients were called with at least 4 hour of fasting before the scan. An informed consent was obtained from each patient. The patient was placed on gantry table in supine position, undue extension of neck was avoided. A digital lateral scanogram was obtained. Non enhanced 5x5 mm sections were obtained from base of skull to thoracic inlet. Contrast scans were obtained by injecting Inj. optiscan 350mg 100cc (by applying 1.5ml/kg formula for contrast volume calculation) I. V by pressure injector after delay of 25 seconds. Multiplaner reconstructions were performed whenever applicable.

Data entry and analysis: The data analysis was performed by using percentages in frequency tables, classify benign and malignant neck mass and sensitivity, specificity of MDCT, Correlation of neck mass with various variable $p<0.05$ was considered as level of significance using the Chi - square test.

4. Results and Observations

Table 1: Distribution of cases according to age (N=100)

Age in years	Frequency	Percentage
<10	06	6%
11 - 20	17	17%
21 - 30	22	22%
31 - 40	19	19%
41 - 50	11	11%
51 - 60	10	10%
>60	15	15%
Total	100	100 (100%)

Above table shows that majority of study cases belongs to the age group 21 - 30 years22 (22%) followed by 31 - 40 years age group 19 (19%), 17, 15, 11 and 10 cases in age group 11 - 20, >60, 41 - 50 and 51 - 60 years respectively.

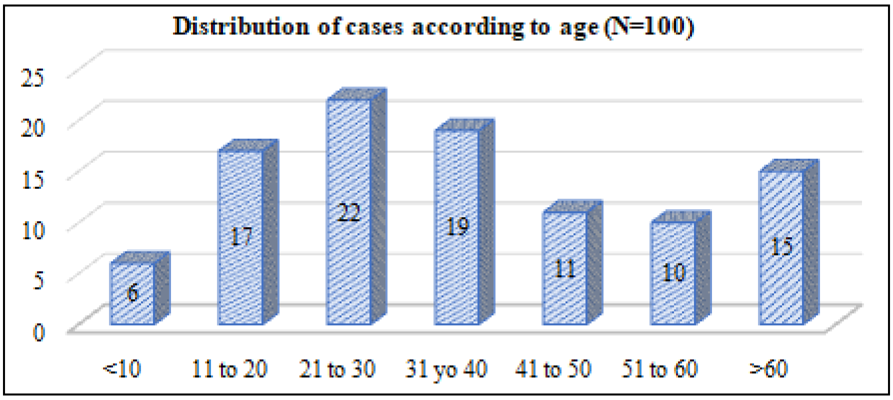

Figure 1: Distribution of cases according to age (N=100)

Table 2: Distribution of cases as per sex (N=100)

Gender	Frequency	Percentage
Male	58	58%
Female	42	42%
Total	100	100 (100%)

Above table shows that majority of study cases were Males contributing 58 % and females 42%

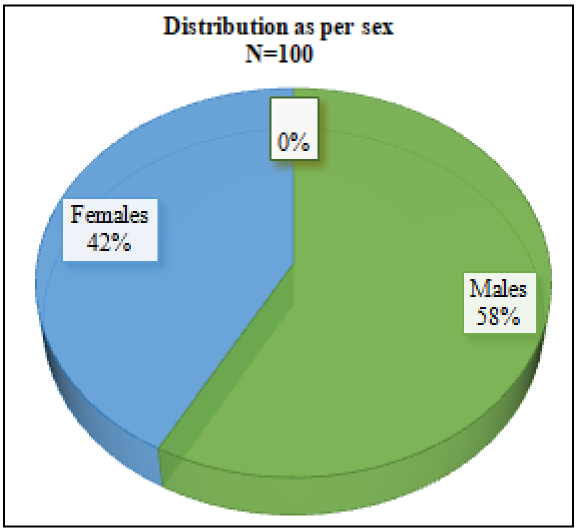

Figure 2: Distribution of cases as per sex (N=100)

Table 3: Distribution neck masses into benign groups according to MDCT characters (N=100)

Benign Lesions (N=61)	MDCT Diagnosis	Percentage
Benign Thyroid lesions	14	14%
Benign/ infective lymphadenopathy	12	12%
Pleomorphic adenoma	07	7%
Brachial cleft cyst	05	5%
Dermoid	05	5%
Schwannoma	03	3%
Lymphatic malformations	04	4%
Nasopharyngeal Angiofibroma	02	2%
Thyroglossal cyst	03	3%
Warthinstumour	03	3%
Paraganglioma	02	2%
Parathyroid adenoma	01	1%
Total	61	61 (100%)

Above table shows that majority of study cases benign thyroid lesions 14, followed by Benign/Infective lymphadenopathy 12, pleomorphic adenoma 7, brachial cleft cyst 5, dermoid 5, schwannoma 3, Lymphatic malformations 4, thyroglossal cyst 3, warthins tumour 3, paraganglioma 2, parathyroid adenoma 1

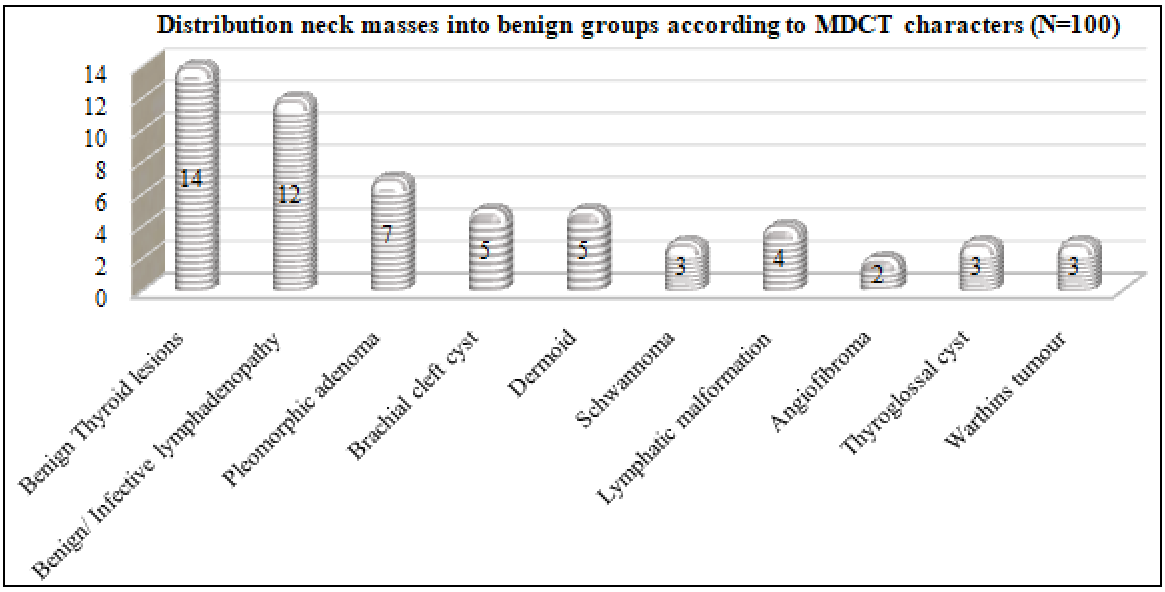

Figure 3: Distribution neck masses into benign groups according to MDCT characters (N=100)

Table 4: Distribution neck masses into Malignant groups according to MDCT characters (N=100)

Malignant Lisions (N=39)	MDCT Diagnosis	Percentage
Metastatic lymph nodes	07	7%
Primary lymphoma	07	7%
Carcinoma soft palate	03	3%
Thyroid malignancy	04	4%
Laryngeal carcinoma	08	8%
Carcinoma tongue	02	2%
Esophageal carcinoma	03	3%
Carcinoma oropharynx	03	3%
Pyriform sinus Carcinoma	02	2%
Total	39	39 (100%)

The above table shows majority of patients with laryngeal carcinoma 8, followed by metastatic lymph nodes and primary lymphoma 7 cases, thyroid malignancy 4, Esophageal carcinoma 3, carcinoma soft palate and carcinoma 3, oropharynx 3 cases, carcinoma tongue 2 and 2 cases with pyriform sinus carcinoma.

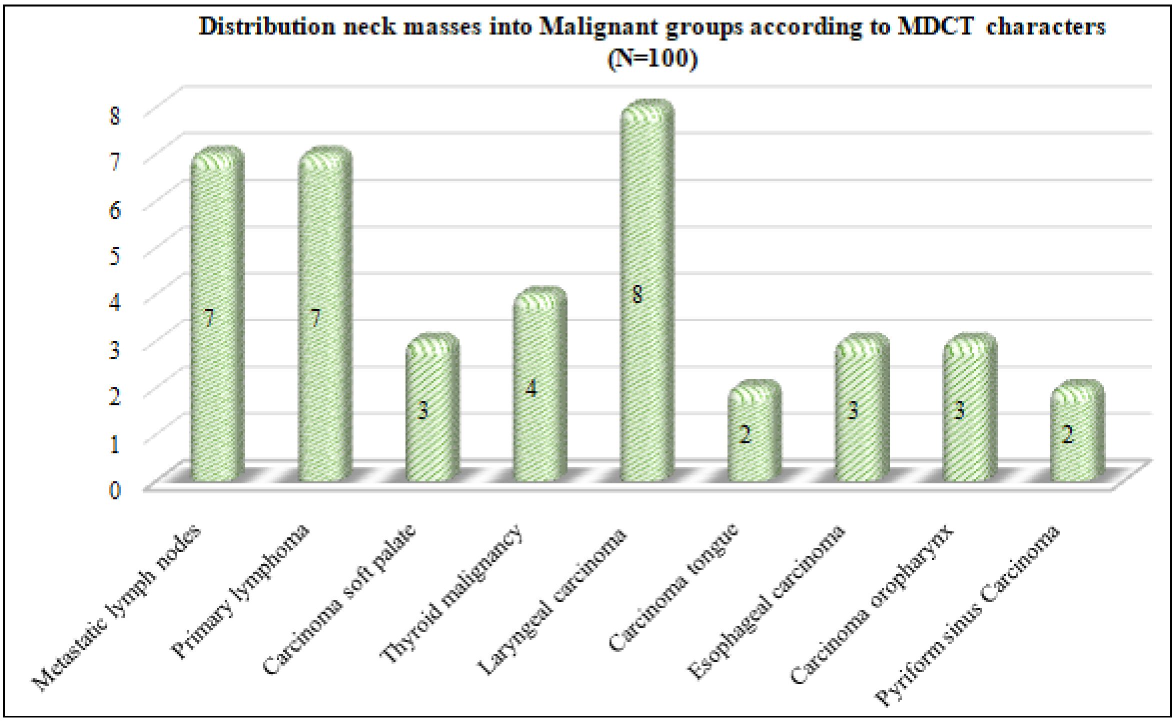

Figure 4: Distribution neck masses into Malignant groups according to MDCT characters (N=100)

Table 5: Distribution of various MDCT characters in between malignant and benign lesions (N=100)

Lesions Characteristic's	Malignant (N=39)		Benign (N=61)		Percentage
	Frequency	%	Frequency	%	
Heterogeneous enhancement	39	90.69%	4	9.30%	43 (9.30%)
Irregular margins	28	77.77%	08	22.23%	36 (36%)
Necrosis	14	58.33%	10	41.67%	24 (24%)
Soft tissue infiltration	32	75%	8	25%	40 (40%)
Bone erosion	8	100%	0	0%	8 (8%)
Vascular invasion	3	100%	0	0%	3 (3%)
Extent to adjacent space	7	41.17%	10	58.82%	17 (17%)

The above table shows all malignant lesions shows heterogeneous enhancement 39, irregular margins found in 28 malignant cases, necrosis 14, soft tissue infiltration found in 32 cases of malignant lesion, bone erosion 8, vascular invasion 3, extent to adjacent space in 7 cases.

Benign lesion characteristics was heterogeneous enhancement 4, irregular margins found in 8 benign cases, necrosis 10, soft tissue infiltration found in 8 cases of benign lesion, bone erosion 0, vascular invasion 0, extent to adjacent space in 10 cases.

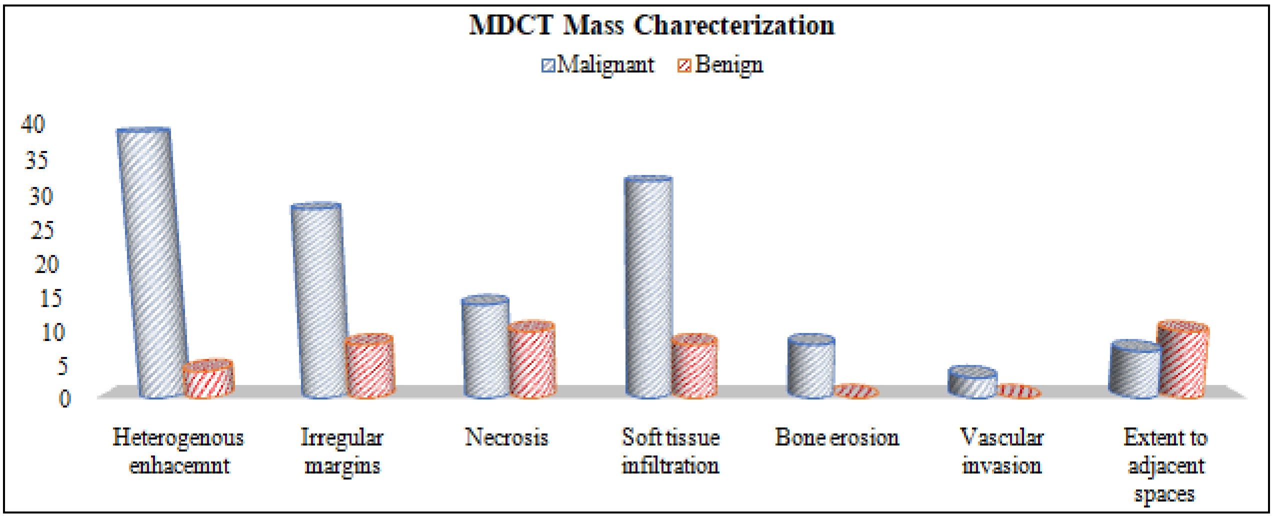

Figure 5: Distribution of various MDCT characters in between malignant and benign lesions (N=100)

Table 6: Association of Benign neoplasms with age (N=100)

Sr. no	Age in years	Benign neoplasms				
		Present	%	Absent	%	Total
1	<10	3	50%	3	50%	6 (6%)
2	11 - 20	16	94.11%	1	5.89%	17 (17%)
3	21 - 30	21	95.45%	1	4.55%	22 (22%)
4	31 - 40	17	89.47%	2	10.53%	19 (19%)
5	41 - 50	1	9.09%	10	90.91%	11 (11%)
6	51 - 60	1	10%	9	90%	10 (10%)
7	>60	2	13.33%	13	86.67%	15 (15%)
	Total	61	61%	39	39%	100 (100%)

Row 1, 2, 3 and 4 pooled together VS Row 5, 6 and 7 pooled together
The Chi - square statistic is = 58.8485, df = 1, p - value is <0.00001.

Significant at p<0.05.

The above table shows association of benign neoplasm with age is statistically highly significant, common in younger age group.

Table 7: Association of Malignant neoplasms with age (N=100)

Sr. no	Age in years	Malignant neoplasms				
		Present	%	Absent	%	Total
1	<10	3	50%	3	50%	6 (6%)
2	11 - 20	1	5.89%	16	94.11%	17 (17%)
3	21 - 30	1	4.55%	21	95.45%	22 (22%)
4	31 - 40	2	10.53%	17	89.47%	19 (19%)
5	41 - 50	10	90.91%	1	9.09%	11 (11%)
6	51 - 60	9	90%	1	10%	10 (10%)
7	>60	13	86.67%	2	13.33%	15 (15%)
	Total	39	39%	61	61%	100 (100%)

Row 1, 2, and 3 pooled together VS Row 4, 5, 6 and 7 pooled together
The Chi - square statistic is = 26.7496, df = 1, p - value is <0.00001. Significant at p<0.05.

The above table shows association of Malignant neoplasm with age is statistically highly significant, common in older age group.

Table 8: MDCT and PATHOLOGICAL correlation

MDCT Diagnosis	Pathological Diagnosis		Total
	Disease	Not Disease	
Positive	87	2	89
Negative	3	8	11
Total	90	10	100

The Chi - square statistic= 54.0347, df=1, p - value is <0.00001. Significant at p <0.05.

The above table shows correlation of MDCT with pathological diagnosis is statistically highly significant at p<0.05.

Table 9: Sensitivity and Specificity of MDCT

Statistics	MDCT in Neck Masses
Sensitivity	96.66%
Specificity	80%
Positive Predictive value	97.75%
Negative Predictive value	72.72%
Accuracy	86.5%

5. Discussion

The imaging has become essential in the characterization and staging of neck pathologies along with detailed physical examination and modern endoscopy[26]. It is non - invasive, not dependent on observer and allows the accurate measurement of tissue attenuation coefficient. However, spiral CT increases the examination quality, reducing the sedation time and lowering the required radiation doses[27].

In CT technology; Multi slice spiral CT using multiple detector rows is the latest development. Use of multiple detector rows allows faster scanning and thinner collimation[28]. Multidetector CT permits rapid scanning of large volumes of tissue during quiet respiration[29]. Spiral CT images are less susceptible to patients motion compared to conventional CT; however image noise is somewhat increased.

In present study table 1 shows Distribution of cases according to age (N=100) majority of study cases belongs to the age group 21 - 30 years, 22 cases (22%) followed by 31 - 40 years age group 19 (19%), 17, 15, 11 and 10 cases in age group 11 - 20, >60, 41 - 50 and 51 - 60 respectively. Similar result found in the study conducted by Chaturvedi A et al (2020) [16] He found that the More than one third of cases were between 40 - 50 years of age (47.5%). His study showed that the mean age was 48.36±13.36 years with range of 16 - 85 years. Another study conducted by Charan I et al (2014) [19] found a similar outcome. He indicated that the average age of the patients who had a neck CT scan was 44.5 ± 1.9 years, with a range of 4 to 86 years. Malignant lesions were found to be more common in people aged 46 to 60. R Kaur and colleagues (2017) [20] He discovered that individuals aged 41 to 50 years old accounted for the bulk of instances for malignant lesions (30%).

Ravi N et al (2015) [22] He found that age range in the study was from 0 years to 80 years. The largest group of patients (22%) was in 41 - 50 years age group and second largest group of patients (18%) was in the age range of 31 - 40 years. Contrast result found in the study conducted by Bagale s et al (2017) [21] He revealed that the Majority of benign lesions of the neck region including the inflammatory, congenital and vascular causes were below the age of 60 years.

Table 2 indicates the gender distribution of cases in the current study (N=100), with males accounting for 58 % of the cases and females accounting for 42 %. Das Runa et al. found a similar finding in their research (2020) [23] He noticed a male preponderance, with 52 % of the patients being males and 48 % females, resulting in a male to female ratio of 1.08: 1. Ravi N et al (2015) [22] found a similar finding in a different study. He discovered that there were 66 men and 34 females in the cases, with a male to female ratio of 1.9: 1.

Charan I et al., (2014) [19] He revealed that incidence of malignant lesions had a 2.5: 1 male - to - female ratio, with males having a greater rate of malignant cases. Manohar B et al (2017) [18] reported a similar finding. His study included a total of 117 patients with neck masses who satisfied the study's criteria; with a male to female ratio of 1: 0.69, there were 69 males (58.97%) and 48 females (41.03%).

Table 3 shows Distribution neck masses into benign groups according to MDCT characters (N=100). The table shows that majority of study cases benign thyroid lesions 14, followed by Benign/ Infective lymphadenopathy 12, pleomorphic adenoma 7, brachial cleft cyst 5, dermoid 5, schwannoma 3, Lymphatic malformations 4, thyroglossal cyst 3, warthins tumour 3, paraganglioma 2, parathyroid adenoma 1. Ravi N et al (2015) [22] He found that the lymph nodal masses accounted for 32 cases, thyroid lesion 20, Vascular Malformations 12, Developmental lesions 8, Inflammatory lesions 8, Salivary gland lesions 6, Nerve sheath tumors 6.

Table 4 shows Distribution neck masses into Malignant groups according to MDCT characters (N=100) majority of patients with laryngeal carcinoma 8, followed by metastatic lymph nodes and primary lymphoma 7 cases, thyroid malignancy 4, Esophageal carcinoma 3, carcinoma soft palate and carcinoma 3, oropharynx 3 cases, carcinoma tongue 2 and 2 cases with pyriform sinus carcinoma. similar result observed in the study conducted by Kaur R et al (2017) [20] He found that the majority of lesions were found in the pharyngeal mucosal space (n=16) with squamous cell carcinoma being the most common pathology.

Table 5 Distribution of various MDCT characters in between malignant and benign lesions (N=100) shows almost all malignant lesions shows heterogeneous enhancement 39, irregular margins28, necrosis 14, soft tissue infiltration 32, bone erosion8, vascular invasion 3, extent to adjacent space 7. Benign lesion characteristics was heterogeneous enhancement 4, irregular margins 8, necrosis 10, soft tissue infiltration 8, bone erosion (No any), vascular invasion (No any), extent to adjacent space 10. Similar result observed in the study conducted byDas Runa et al (2020) [23] He observed that the heterogeneous study enhancement was noted in 42 out of 50 primary lesions, characterized by a CT scan. Infiltration of the soft tissue surrounding the lesion was detected in 29 of the 50 cases. Heterogenous enhancement was identified in 92.3 % of malignant lesions, with bone erosion and vascular invasion occurring in 6 and 2 cases, respectively. In 92.3 % and 88.46 % of malignancies, respectively, irregular margins and soft tissue invasion were seen. Some benign lesions showed heterogeneous enhancement and necrosis. Bone erosion has been discovered to be a very specific characteristic of cancer.

Table 6 Association of Benign neoplasm with age (N=100) shows statistically highly significant result, common in young age group. Similar results were found in the study by Das Runa et al (2020) [23]He found that the significant association at $p<0.05$.

Table 7 Association of Malignant neoplasm with age (N=100) shows statistically highly significant result, common in old age group. Similar result found in the study by Charan I et al (2014) [19]He observed that the significant association at $p<0.05$.

Table 9Sensitivity and Specificity of MDCT shows Sensitivity 96.66%, Specificity 80%, Positive Predictive value 97.75%, Negative Predictive value 72.72% and accuracy of 86.5%. Similar result found in the study conducted by Sahu CD et al (2018) [17]He observed that the Sensitivity, specificity, positive predictive value, and negative predictive value of MDCT scan to differentiation between benign and malignant neck mass in comparison with histopathology was 90.32%, 96.55%, 96.55%, and 90.32%, respectively. Das Runa et al (2020) [23] He observed that the sensitivity of CT in detecting malignant/benign lesions was 92.3% with a specificity of 87.5 %, the positive predictive value of 88.9 % and a negative predictive value of 91.3 % and accuracy 90%. Another study by Kaur R et al (2017) [20] He found that the CT had an excellent correlation with histopathological findings with sensitivity of 96.4%, specificity of 100%, and Positive predictive value of 100% and a negative predictive value of 91.67%.

As compared with our study results; low sensitivity and specificity was reported by Chaturvedi A et al (2020) [16]. He found that the sensitivity and specificity of MDCT for diagnosing benign lesions was 72.2% and 69.6% respectively with positive predictive value of 78.8%; and for malignant lesions sensitivity was 30.4%, specificity was 27.8% and positive predictive value of 21.2%. Low sensitivity was found in the study conducted by Kurabayashi T et al (1997) [24] He revealed that the in their study; 11 malignant lesions out of 53 with a sensitivity of 64%. Liao LJ et al (2012) [25] He did a meta - analytic review of various studies and made a pooled estimate in which sensitivity was 52%, and specificity was 93% for MDCT in detecting malignant lesion.

Table 8 shows Correlation of MDCT with Pathological diagnosis correlation of MDCT with pathological diagnosis is statistically highly significant at $p<0.05$. Similar result found in the study conducted by Sahu CD et al (2018) [17] He observed that the significant association was note between two diagnoses ($P < 0.0001$). Das Runa et al (2020) [23] conducted another study. When comparing both modalities for identifying malignancy, he found a significant ($p <0.001$) association between MDCT diagnosis and pathological diagnosis.

6. Conclusion

Multi - detector computed tomography found to be highly accurate in detection, precise anatomical localization and characterization of neck masses. The correlation of MDCT with pathological diagnosis is statistically highly significant ($p<0.05$). It has high sensitivity and specificity in differentiation of benign versus malignant neck masses which helps in further planning for management (Sensitivity - 96.66%, Specificity - 80%, Positive Predictive value - 97.75%, Negative Predictive value - 72.72% and diagnostic accuracy - 86.5%). Hence, it helps in initial evaluation and preoperative planning to get better prognostication in patients management; with the advantages of improved vascular contrast enhancement and multiplanar three dimensional reconstructions, MDCT should be the modality of choice in evaluation of neck masses.

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