Evaluation of Spectrum of Neck Masses on MDCT and Tissue Diagnosis Correlation

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ABSTRACT

INTRODUCTION: The neck is a part of the body that has many vital structures in a relatively small region with complex anatomy. Various pathologies of the neck may present as neck swellings. The mass may be first noticed by the patient, other individual or by the physician as an incidental finding during physical examination. With the improvement of CT imaging techniques, shorter examination time, higher resolution imaging, Multidetector CT is particularly useful in evaluation of neck masses. AIM OF STUDY: To assess the role of MDCT in neck masses for characterization of nature of lesion (benign or malignant) and organ of origin and to Correlate with tissue diagnosis wherever possible. MATERIALS AND METHODS: Patients presenting with clinical suspicion of neck masses and referred for MDCT neck to the Department of Radio-diagnosis and Imaging, DMCH, Ludhiana were included in this study. RESULTS: 18.9% patients were in 31-40 years age group. Mean age for malignant lesions was 58.3 years. Most common space involved was visceral space (48.9%) and the most common diagnosis was benign thyroid nodule(s) (30%). Many of malignant lesions showed ill-defined margins (68.18%), necrosis (62.5%), heterogeneous enhancement (68.2%), bony infiltration (20.8%), obliteration of fat planes (8.3%), metastasis (45.8%), involvement of adjacent neck spaces (37.5%), vascular involvement in form of internal jugular vein thrombosis (8.3%) of cases. In diagnosing malignant lesions, CT had a sensitivity of 95.83%, specificity of 96.30%, positive predictive value of 92.00%, negative predictive value of 98.11% and accuracy of 96.15%. CONCLUSION: MDCT has high accuracy for characterization of a lesion as benign or malignant. It provides the best possible contrast of soft tissue (with the choice of appropriate delay, contrast agent volume, flow rate and scanning time), visualization of vascular structures, extent of lesion, bone and airway details, thus helps in making diagnosis and deciding further course of management.

Key words: MDCT; neck masses; biopsy; benign; malignant; thyroid

INTRODUCTION

Neck masses are frequently encountered in patients of any age and present a diagnostic dilemma for the clinicians . The most desirable need of the clinician is an appropriate modality for immediate and precise analysis of neck masses.[1] Accurate and early diagnosis helps in deciding the line of management (surgical/conservative) depending on the type of lesion and its location which helps in reducing morbidity and mortality. Multidetector Computed tomography (MDCT) is the most powerful and versatile imaging technique for the evaluation of the neck masses. Neck masses have diverse origins and etiologies. These masses are broadly categorized into two groups- nodal masses and non-nodal masses.[2] Etiologies depending on the onset of symptoms can be acute (e.g., infectious), subacute (e.g., malignancies), or chronic (e.g., thyroid disorders).[2] Neck masses are also found in the pediatric population. In children (0-15 years age group) inflammatory lesions are more common than congenital masses and in young adults (16-40 years), congenital lesions are more common than neoplastic lesions. [3] With the introduction of cross-sectional imaging, the traditional cervical triangle method of organizing the anatomy of the neck has been replaced by a system that divides the neck into spaces, which are defined by cervical fascial planes.[4] The two main fascial layers of the head and neck are superficial and deep layers. The superficial cervical fascia (SCF) consists of the subcutaneous well-defined layer of relatively loose connective tissue covering the head, face, and neck.[5] The deep cervical fascia (DCF) of fascia colli travels along the neck below the skull base and encloses the muscles of the neck, as well as the mandible and the muscles of mastication and deglutition. It is subdivided into superficial layer (investing fascia), middle layer (visceral fascia) and deep layer (prevertebral fascia).[6] The neck is compartmentalized into parotid space, masticator space, submandibular space, sublingual space, buccal space, retropharyngeal space, pharyngeal mucosal space, parapharyngeal space, carotid space, visceral space,perivertebral space, posterior cervical space and anterior cervical scpace.[7]

AIMS & OBJECTIVES

- To assess the role of MDCT in neck masses for characterization of nature of lesion and organ of origin
- Correlation with tissue diagnosis wherever possible.

MATERIALS AND METHODS

This prospective study was conducted over a period of one and a half year from 1st Jan 2018 to 30th June 2019 on patients with clinical suspicion of neck masses referred to the Department of Radiodiagnosis and Imaging, DMC & Hospital, Ludhiana. All patients were subjected to 128 slice MDCT neck on MDCT scanner (Somatom definition AS).MDCT was performed with the patient supine in quiet respiration. I.V. contrast study using nonionic water soluble contrast medium was done following plain study.

<u>Inclusion criteria</u>:

- All patients with clinical suspicion of neck masses
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<u>Exclusion criteria</u>:

- Patients already diagnosed by biopsy
- Postoperative patients
- Pregnant females

RESULTS

Total 90 patients with clinical suspicion of a neck mass underwent computed tomography. Out of 90 patients, 78 patients underwent tissue diagnosis. In present study 52.2% of the patients were males and 47.8% were females. The male to female ratio was 1.09:1.The malignancy rate was found to be higher in males (17 out of 24, 70.8%). Most of the patients were aged between 31 to 40 years (18.9%). The mean age was found to be 42.30 +_20.5 years .Neck swelling was the commonest symptom (90%) followed by fever (25.6%). In this study, visceral neck space involvement was commonly noted (48.9%). The involvement of other spaces is as depicted in Table 1. In visceral space (n=43) majority of lesions were of benign etiology (27 out of 43, 62.7%). In parotid space (n=13) majority of lesions were of benign etiology (7 out of 13, 53.8%). In carotid space (n=10), malignant lesions and infective/inflammatory lesions were found in equal numbers. In posterior cervical space (n=6) majority of the lesions were infective/inflammatory (4 out of 6, 66.7%) (Table 2).

In this study, well defined margins were noted in 74.4% of the patients and 25.6% of the patients had ill-defined margins. Most of the lesions with well-defined margins on CT (85.2%) were benign in nature with only 14.7% being malignant. Majority of the malignant lesions (15 out of 24, 62.5%) had ill-defined margins on CT. Hypodense attenuation was noted in 65.6% of total lesions. 37.5% malignant lesions on final diagnosis were heterogenous in attenuation, while 54.16% of malignant lesions were hypodense on plain scan. None of the malignant lesions were hyperdense. Benign lesions showed all types of attenuation with majority (64.8%) of them being hypodense (Table 3).

In this study, solid consistency was noted in 63.3% of the patients, 26.7% of the cases had cystic consistency and 10% lesions were mixed solid-cystic consistency. Calcification was present in 17.8% of patients. Presence of calcification was noted in 16 cases, out of which, majority of the cases were benign (87.5%), while 2 cases were malignant (12.5%). In this study, contrast enhancement was seen in 92.2% of the patients, out of which heterogeneous enhancement was seen in 57.8% of total patients. 66.7% malignant lesions on final diagnosis showed heterogenous enhancement, while 33.3% of malignant lesions showed homogenous enhancement. None of the malignant lesions were non-enhancing or peripherally enhancing. Benign lesions consisted of all types of enhancement patterns, with majority (62.9%) showing heterogenous enhancement (Table 4).

In present study necrosis was present in 32.3% of total cases, Out of which 62.5% of malignant lesions showed necrosis. Adjacent neck spaces were involved in 17.8% of patients (16 out of 90). Out of which Involvement of adjacent neck spaces was identified in 37.5 % of malignant lesions and 5.5% of benign lesions. Vascular involvement was noted in 4 patients (4.4%), out of which, 2 cases (2.2%) were malignant (oropharyngeal carcinoma and thyroid lymphoma) and 2 cases (2.2%) were of benign etiology (abscesses). Bony/ cartilage involvement was seen in 5.6% of cases (5 out of 90). All of them were proven to be malignant on tissue diagnosis. Obliteration of fat planes was noted in 2.2% of patients (2 out of 90). Both of these cases were proved to be malignant on tissue diagnosis. Air pockets were found in 2.2% of cases (2 out of 90). Both the cases were diagnosed as abscess. Mass effect was present in 42.2% of the patients. Metastasis was found in 12.2% of the cases (11 out of 90). Lymphadenopathy was found in 30 cases, out of which 12 (40%) were benign in nature and 18 (60%) were malignant. Out of 30 cases with lymphadenopathy, tissue diagnosis was done for 26 cases. Out of these, 10 cases were of benign etiology and 16 were proven to be malignant. CT showed sensitivity of 100%, specificity of 90% and accuracy of 96.15% in diagnosing malignant lymphadenopathy (Table 5). In this study, benign lesions were diagnosed in (43.3%) patients with majority of cases being goitre (30.0%). The next common diagnosis was infection (27.8%). The most common malignant lesion diagnosed was lymphoma (8.9%). (Table 6)

Number of cases identified as benign and malignant on CT were 64 and 26 respectively. Out of 90 patients, 78 patients underwent tissue diagnosis. Number of cases diagnosed as benign and malignant on tissue diagnosis were 54 and 24 respectively. CT diagnosed 96.2% (52 out of 54) of the benign cases and 95.8% (23 out of 24) of the malignant cases accurately while only 3.8% (3 out of 78) of the total cases were inaccurately assessed. Number of cases identified as benign on CT were 53, out of which 52 were proven to be benign on pathological analysis. Hence sensitivity of CT to diagnose a benign lesion is 96.30%, specificity is 95.83%, positive predictive value is 98.11%, negative predictive value is 92.00% and accuracy is 96.15%. Number of cases reported malignant on CT were 25, out of these 23 were malignant on tissue diagnosis. Hence sensitivity of CT to diagnose a malignant lesion is 95.83%, specificity is 96.30%, positive predictive value is 92.00%, negative predictive value is 98.11% and accuracy is 96.15%.

Table 1: Location - Neck space involvement

Location	No. of cases	Percentage
Masticator space	0	0.0%
Buccal space	0	0.0%
Sublingualspace	4	4.4%
Submental space	0	0.0%
Submandibular space	2	2.2%
Carotid space	12	13.3%
Parotid space	14	15.6%
Parapharyngeal space	0	0.0%
Visceralspace	4	48.9%
Pharyngeal mucosal space	0	0.0%
Retropharyngeal space	4	4.4%
Perivertebral space	1	1.1%
Posterior cervical space	6	6.7%
Total	90	100.0%

Table 2: Distribution of etiologies in various neck spaces (N=78)

Location	Benign	Malignant	Infective/Inflammatory	Total
Sublingual space	1	0	0	1
Parotid space	7	1	5	13
Superficial cervical space	2	0	1	3
Retropharyngeal space	0	1	0	1
Submandibular space	0	0	1	1
Carotid space	0	5	5	10
Visceral space	27	15	1	43
Posterior cervical space	0	2	4	6

Table 3: Comparison of CT attenuation with tissue diagnosis

Variable		Tissue diagnosis				Total
		Benign		Malignant		
		No.	% Age	No.	% Age	
Attenuation	Hypodense	35	72.9%	13	27.1%	48
	Heterogeneous	17	65.4%	9	34.6%	26
	Isodense	1	33.3%	2	66.7%	3
	Hyperdense	1	100.0%	0	0.0%	1
Total		54	69.2%	24	30.8%	78

Table 4: Comparison of enhancement pattern with tissue diagnosis

Variable		Tissue diagnosis				Total
		Benign		Malignant		
		No.	% Age	No.	% Age	
Enhancement	Homogeneous	4	33.3%	8	66.7%	48
	Heterogeneous	34	68.0%	16	32.0%	26
	Nonenhancing	7	100%	0	0.0%	3
	Peripheral enhancement	9	100.0%	0	0.0%	1
Total		54	54	69.2%	24	30.8%

Table 5: Presence of lymphadenopathy

Variable		Tissue diagnosis				Total
		No.	%age	No.	%age	
Lymphadenopathy	Benign	9	100%	0	0%	9
	Malignant	1	5.9%	16	94.1%	17
Total		10	38.5%	16	61.5%	26

Table 6: CT Diagnosis

CT Diagnosis	Subgroup	No. of cases	Percentage
Infection	Abscess	15	16.7%
	Parotitis	2	2.2%
	Lymphadenitis	8	8.9%

	Total	25	27.8%
Benign lesions	Pleomorphic adenoma	2	2.2%
	Other benign parotid lesions	4	4.4%
	Parathyroid adenoma	1	1.1%
	Branchial cyst	2	2.2%
	Lipoma	2	2.2%
	Goitre	27	30.0%
	Ranula	1	1.1%
	Total	39	43.3%
Malignant lesions	Lymphoma	8	8.9%
	Thyroid carcinomas	6	6.7%
	Parotid carcinoma	1	1.1%
	Laryngeal carcinoma	4	4.4%
	Hypopharyngeal/oropharyngeal carcinomas	5	5.6%
	Metastatic lymphadenopathy	2	2.2%
	Total	26	27.8%
Total		90	100.0%

Table 7: Tissue diagnosis

Tissue Diagnosis	Subgroup	No. of cases	Percentage
Infection	Abscess	6	7.7%
	Parotitis	2	2.5%
	Granulomatous/ suppurative lymphadenitis	7	8.9%
	Reactive lymphadenitis	2	2.5%
	Total	17	21.7%
Benign lesions	Pleomorphic adenoma	2	2.5%
	Myoepithelioma parotid	1	1.3%
	Hemangioma parotid	1	1.3%
	Warthin's tumour	1	1.3%
	Other benign parotid lesion	1	1.3%
	Parathyroid adenoma	1	1.3%
	Branchial cyst	1	1.3%
	Lipoma	2	2.5%
	Hashimoto's thyroiditis	2	2.5%
	Multinodular goitre	15	19.2%
	Benign follicular nodule thyroid	9	11.5%
	Sublingual dermoid cyst	1	1.3%
	Total	37	47.4%
Malignant lesions	Lymphoma	8	10.2%
	Follicular carcinoma thyroid	1	1.3%
	Other thyroid carinomas	5	6.4%
	Parotid carcinoma	1	1.3%

	Laryngeal carcinoma	3	3.8%
	Hypopharyngeal/ oropharyngeal carcinomas	5	6.4%
	Metastatic lymphadenpathy	1	1.3%
	Total	24	30.7%
Total		78	100%

Figure 1: Multinodular goitre
(a) Axial and (b) coronal CECT images. Asymmetrical nodular enlargement of both lobes and isthmus of thyroid showing heterogeneous enhancement. Multiple foci of chunky calcification seen within.

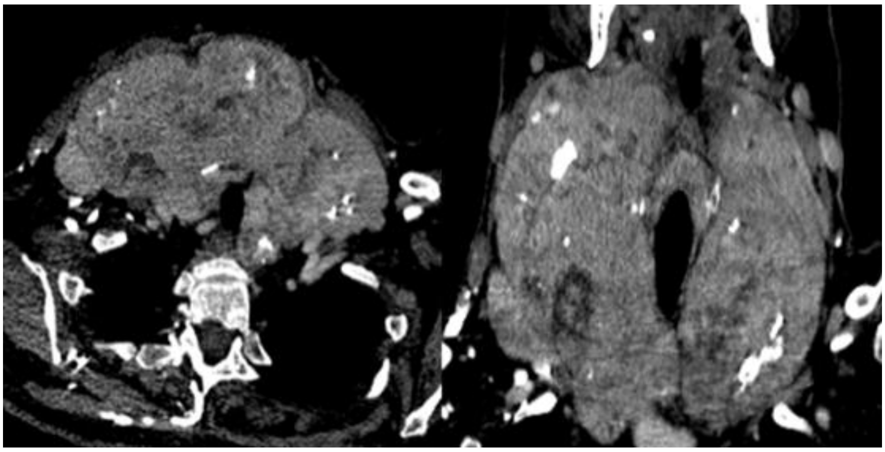

Figure 2: Retropharyngeal abscess
(a) and (b) axial CECT images. Peripherally enhancing collection in retropharyngeal space causing displacement of carotid sheath vessels laterally and narrowing of the airway.

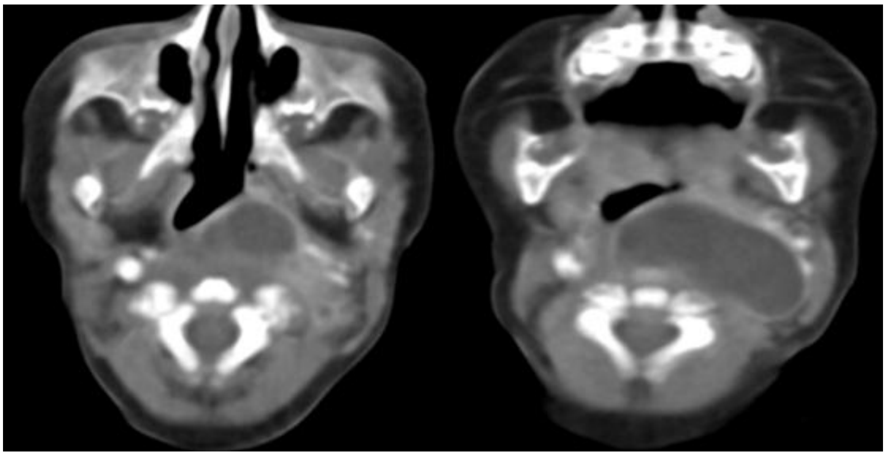

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Figure 3: Lymphoma
(a), (b), (c), and (d) axial contrast enhanced CT images. Enlarged homogeneously enhancing discrete and confluent lymph nodes at level II, level III, level IV and level V left side.

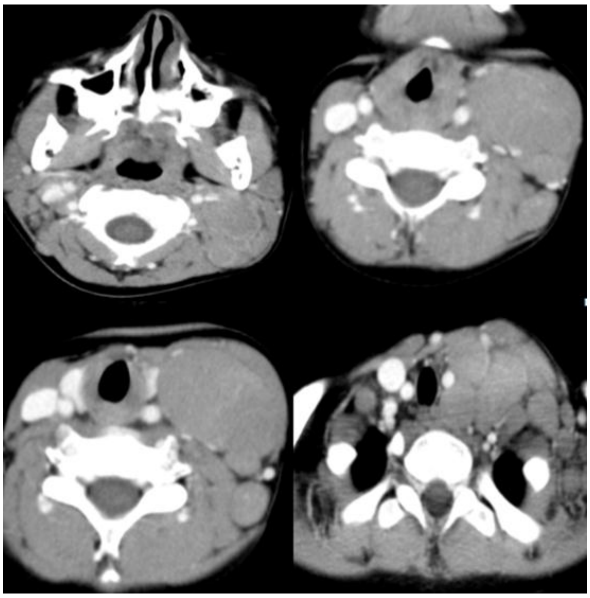


Figure 4 : Branchial cleft cyst
(a), (b) Axial , (c) coronal and (d) sagittal CT images. Well defined fluid attenuation nonenhancing lesion involving left parotid gland extending inferiorly along anterior border of sternocleidomastoid muscle.

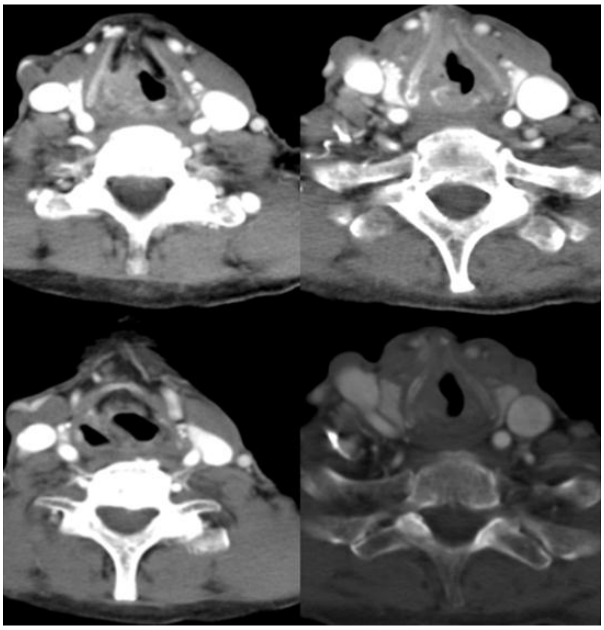


Figure 5: Pleomorphic adenoma
(a)Non contrast and (b) contrast enhanced axial CT images show a well defined homogeneously enhancing lesion involving superficial lobe of right parotid gland.

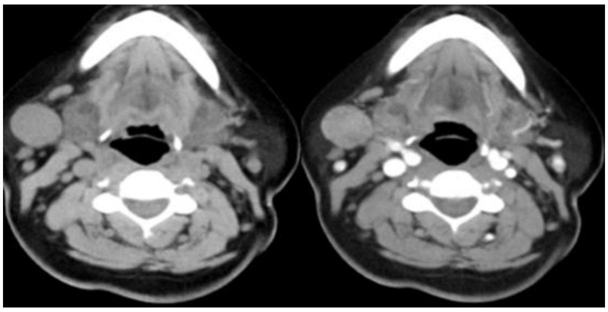


Figure 6: Laryngeal carcinoma
(a),(b),(c) axial contrast enhanced CT images show ill defined heterogeneously enhancing lesion involving right false and true vocal cords and right aryepiglottic fold causing mild narrowing of airway. (d) axial bone window shows focal erosion of thyroid cartilage on right side.

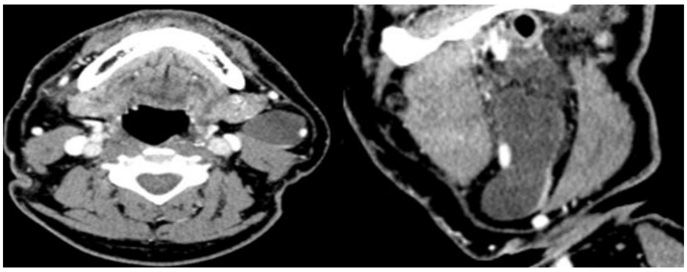
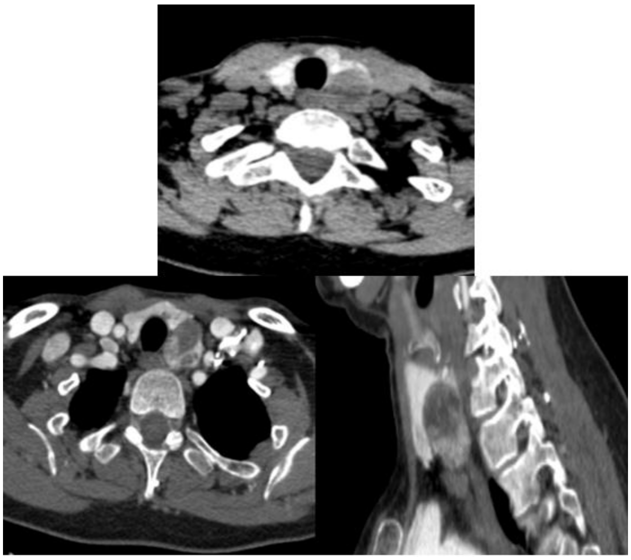


Figure 7: Parathyroid adenoma
(a) Non contrast axial CT image shows low attenuation lesion posterior to left lobe of thyroid gland.
(b) Axial and (c) sagittal contrast enhanced CT images. Heterogeneously enhancing lesion posterior to the left lobe of thyroid. Degree of enhancement is less than that of thyroid gland.



DISCUSSION

In this study, slight male preponderance was noted with male to female ratio of 1.09:1 which was similar to study done by Bhattacharjee A et al[8] (2004) and Mehrotra R et al[9] (2005). The mean age for malignant lesion in our study was 58.3 years, similar to study done by Merhotra R et al[9] in which malignancy was highest in patients belonging to 50-59 years age group. CT findings revealed visceral neck space, parotid space and carotid space involvement in 48.9%, 15.6% and 13.3% of cases respectively. Majority of patients had visceral neck space involvement. This could be attributed to higher incidence of thyroid lesions in present study. Among the neck lesions, the most common lesion encountered was benign thyroid nodule(s) (30%) similar to study done by Patnaik S et al[10] and Ezzat et al[11].(Fig 1) The next common diagnosis in our study was infection (27.8%) with infective lesions and abscesses noted in a subset of 15 patients (16.7%). (Fig 2) The most common malignant lesion diagnosed was lymphoma (8.9%) followed by thyroid carcinomas (6.7%) in our study. (Fig 3) Majority of the malignant lesions (15 out of 22, 68.18%) had ill-defined margins on CT which is in agreement to study done by Thakkar DK et al[12]. (Fig 4) Evidence of necrosis was found in 62.5% of malignant lesions and 24.07% of benign lesions similar to study by C. Eskey et al (2000) [13] which states that necrosis is more frequently seen in malignant lesions. 68.2% malignant lesions on final diagnosis showed heterogeneous enhancement, while 31.8% of malignant lesions showed homogenous enhancement. None of the malignant lesions were non-enhancing or peripherally enhancing which is in agreement with the study done by Mathur R et al[14]and Balakrishnan K[15] .

Bony infiltration was found in 20.8% of malignant cases and none of the benign cases. Study conducted by Janakarajah N et al (1984)[16] stated that benign tumours are slow growing and show bony expansion than bony destruction whereas malignant lesions and chronic granulomatous infections show bony destruction. In our study, obliteration of fat planes noted in 8.3%, metastasis in 45.8%, involvement of adjacent neck spaces in 37.5%, vascular involvement in form of internal jugular vein thrombosis was noted in 8.3% of the malignant cases similar to study by Talukdar R et al[17].

In the current study 75 out of 78 cases were correctly characterized by computed tomography giving an accuracy of 96.15%. Three cases were wrongly diagnosed. A case of reactive lymphadenitis was wrongly diagnosed as lymphoma as it was showing homogeneous enhancement with no evidence of necrosis or calcification. Another case of benign thyroid lesion was wrongly diagnosed as malignant as the lesion showed heterogeneous enhancement with presence of osseous metastasis. On further work up, the primary was found to be renal cell carcinoma. Third, was a case of follicular neoplasm with papillary atypia of thyroid gland wrongly diagnosed as colloid goitre as there was a well defined lesion showing heterogeneous enhancement with no involvement of adjacent spaces, vascular involvement, obliteration of fat planes, bony infiltration and metastasis. CT diagnosed malignant lymph nodes with 100% sensitivity and 90% specificity and an accuracy of 96.15%. Out of 78 cases, 13 (16.7%) parotid space lesions were encountered; out of which (41.1%) were of benign tumors (e.g. pleomorphic adenoma, Warthins tumor, hemangioma, myoepithelioma, branchial cleft cyst) which revealed well-defined margins and homogeneous enhancement. (Fig 5 and 6)

In 2 cases (15.4%) of parotitis, enlarged heterogeneously enhancing parotid gland was identified. In 3 cases (23.07%) of parotid abscesses, CT revealed thick peripheral enhancement with central necrosis. One case (4.3%) of parotid carcinoma was also encountered. 6 out of 78 lesions (7.6%) were detected in posterior cervical space out of which 2 cases (33.3%) were of lymphoma and 3 cases were of granulomatous/reactive lymphadenopathy which is comparable with a study by Geoffrey D parker et al[18], which showed that most common lesion in the posterior cervical space is the lymph nodes. 43 out of 78 lesions (55.1%)were detected in visceral space. The benign pathologies (62.7%) found were multinodular goitre, benign follicular nodules thyroid gland, Hashimoto's thyroiditis, parathyroid adenoma.(Fig 7) The malignant pathologies (34.9%) found were thyroid carcinoma, thyroid lymphoma, hypopharyngeal carcinoma, laryngeal carcinoma and oropharyngeal carcinoma. One case (2.3%) of thyroid abscess was encountered. Thus in our study, in visceral space, thyroid gland pathologies were most commonly encountered. 10 out of 78 lesions (12.8%) were identified in the carotid space out of which 5 cases were of benign lymphdenopathy and 5 cases were of malignant lymphadenopathy. 3 out of 78 cases (3.8%) were identified in superficial cervical space. Out of these two cases were of lipoma and one was case of abscess. One case (1.3%) of dermoid was diagnosed in sublingual space, one case (1.3%) of lymphoma identified in retropharyngeal space and one case (1.3%) of lymphadenitis detected in submandibular space.

CONCLUSION

To conclude MDCT of neck has high accuracy for characterization of a lesion as benign or malignant with the ability to detect bony lesions (erosions or expansion). With the advantages of improved vascular contrast enhancement and multiplanar three dimensional reconstructions, MDCT should be one of the modality of choice in evaluation of neck masses.

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