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Original Article

Role of Multidetector Computed Tomography Scan in Evaluation of Neck Mass

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Abstract

Introduction: Neck masses are frequently encountered in general population and hospitals. It is important to differentiate a malignant neck lesion from a benign lesion. Early and precise diagnosis helps in choosing the line of management.

Aims and Objectives: To determine sensitivity and specificity of multidetector computed tomography (MDCT) scan in the differentiation of benign and malignant neck mass in comparison with histopathological diagnosis.

Materials and Methods: Hospital based observational prospective cross-sectional study was conducted in the Department of Radio diagnosis, Pt. JNM Medical College Raipur, and associated Dr. BR Ambedkar Hospital Raipur (C.G.) from January 2016 to September 2017 on 60 patients of all age who presented with neck mass. Contrast-enhanced scans using non-ionic contrast media (60–80 ml at the rate of 3 ml/s) were performed spirally.

Result: In our study, 60 patients of neck masses were included. MDCT was diagnosed 31 (51.7%) patient of neck mass as benign neck mass and 29 (48.3%) patient of neck mass as malignant, however, on histopathology 29 (48.3%) patient of neck mass were diagnosed as a benign and 31 (51.7%) patient of neck mass were diagnosed as a malignant. 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. Significant association was note between two diagnoses ($P < 0.0001$).

Conclusion: MDCT had high sensitivity and specificity in differentiation of benign versus malignant neck mass lesion which helps in the further planning of management of these lesions but requires histopathology for better management.

Key words: Benign neck masses, Malignant neck masses, Multidetector computed tomography

INTRODUCTION

Neck masses are frequently encountered in general population and hospitals. Neck masses are broadly divided into two groups - nodal masses and non-nodal masses. Nodal masses may be neoplastic or reactive in nature. Non-nodal masses include congenital, inflammatory, neural, neoplastic, vascular, and mesenchymal origin.

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It is important to differentiate a malignant neck lesion from a benign lesion. Early and precise diagnosis helps in choosing the line of management (surgical/conservative) depending on the type of lesion and location which help in reducing the morbidity and mortality. Hence, the imaging modality that we use should have high sensitivity and specificity.

Clinical examination alone is limited in its ability to accurately assess the extent and size of head and neck tumors, especially or submucosal extension of disease and extent of nodal metastasis.[1]

Plain radiography and ultrasonography are initial imaging modalities, but they have their own limitations.

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Recent studies have reported that advances in cross-sectional imaging now allow detailed evaluation of anatomy and pathology of the neck.[2] Nowadays computed tomography (CT) is very important diagnostic imaging modality performed in patients in whom the presence of a head and neck mass is either evident or suspected.[3]

CT has found an increasing application in the evaluation of neck masses both congenital and acquired, and is currently one of the most powerful and versatile imaging procedures for the evaluation of neck masses.[4] Multislice spiral CT provides volumetric helical data, thereby permitting optimal multiplanar and three-dimensional reconstructions and isotropic imaging rapid scan acquisition reduces motion artifacts, as well as permits phonation studies. Imaging during phonation and/or Valsalva maneuver to assess vocal cord mobility in pathologies involves hypopharynx and larynx.

CT provides critical anatomical information about lesions involving the neck. It is also important to define the site of origin, extent and characterization of the lesion on contrast administration it helps in differentiation between benign and malignant neck mass. In malignant lesions, CT can determine the extent of the disease allowing accurate planning for surgery and radiation ports.

This study is an effort to assess the role of multidetector CT (MDCT) to the differentiation between benign and malignant neck mass and thus helps in deciding further course of management.

MATERIALS AND METHODS

Hospital based observational prospective study with cross-sectional data collection was conducted in the Department of Radio diagnosis, Pt. JNM Medical College Raipur and associated Dr. BR Ambedkar Hospital, Raipur (C.G.), after taking clearance from ethical committee from January 2016 to September 2017 on 60 patients of all age who presented with neck mass. In our study patient having complains of neck mass and incidentally diagnose neck mass on MDCT scan was included. Patient unwilling to take part in the study, pregnant women, patient with deranged renal function test, patient with neck masses on radiotherapy and post-operative patient of neck masses was excluded. Informed written consent was taken. The patient was kept on empty stomach for 4–6 h before performing the scan and check for renal function test. Supine with the neck mildly hyperextended so that the palate was roughly perpendicular to the tabletop. When possible patients were scanned with quiet breathing and swallowing suspended using SIEMENS SOMATOM 128-slice single source definition AS + MDCT and non-ionic contrast media (60–80 ml at the rate of 3 ml/s) contrast-enhanced scans were performed spirally. Scanning covered the region from the base of the skull to the 4th thoracic vertebra using 2-mm section thickness and 1 mm increment. Tube voltage was approximately 120 kV, and tube current was approximately 150 mAs/slice.

Statistical Methods

Fischer's exact test or Chi-square test was used to analyze the significance of the difference between frequency distribution of the data. Student's *t*-test was used to compare between two categorical variables. $P < 0.05$ was considered as a statistically significant.

RESULT

The number of patients included in this study was 60. Histopathological analysis of these lesions revealed 29 (48.3%) benign lesions and 31 (51.7%) malignant lesions.

Our study included 60 patients of all age. The peak age incidence of breast mass lesion was 50–60 years and overall male to female ratio were 1.6:1.

In our study, neck swelling (90%) was most common clinical complaint. In our study, out of 60 patient there was 16 (36.36%) patient had nodal masses and 44 (73.33%) had non-nodal masses. Out of 16 nodal masses, there were 10 (62.5%) metastatic nodal masses, 5 (31.25%) lymphomas, 1 (6%) tubercular lymphadenopathy, and 1 (6%) were other. In our study mean maximum short axis diameter for metastatic nodal masses 5.11 cm, for nodal masses of lymphomas 3.11 cm and tubercular nodal masses 1 cm.

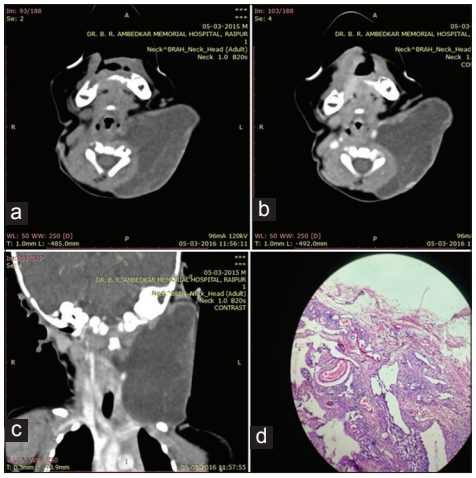

Figure 1: Case 1 - Cystic Hygroma: 6-month-old baby came with complaint of left side neck swelling. (3a) Axial non contrast image shows well defined cystic lesion. (3b and c) Axial and coronal post-contrast image shows nonenhancing well defined cystic lesion with maintain fat plane with surrounding structure. Computed tomography final diagnosis was benign cystic lesion likely cystic hygroma. (3d) H and E (×10) stain section shows large irregular vascular space lined by flattened epithelial cell

In all nodal masses, 75% was multiple and 25% was single. In present study, 11 (78.57%) malignant and 1 (50%) benign nodal masses shows necrosis, 11 (78.57%) malignant and all benign nodal masses shows heterogeneous enhancement and 3 (21.42%) malignant nodal masses shows homogeneous enhancement, 11 (78.57%) malignant and 1 (50%) benign nodal masses shows extra capsular spread, and 10 (71.42%) malignant and 1 (50%) benign nodal masses shows loss of fat plane with adjacent structure.

In our study out of 60 patients, 44 patients have non-nodal mass.

In the present study, all benign and 2 malignant non-nodal masses had well define border, 15 (88.23%) malignant non-nodal masses had ill-defined border and ill-defined border not found in benign non-nodal masses. All cystic non-nodal masses were benign.

In our study one benign lesion was hyperdense on plain CT, 9 (33.33%) benign and 12 (70.58%) malignant non-nodal masses were heterogeneous on plain CT, one benign lesion shows homogenous enhancement, 10 (37.03%) benign and 16 (94.11%) malignant non-nodal masses had heterogeneous enhancement, all nonenhancing non-nodal lesions were benign, 6 (22.22%) benign, and 1 (5.88%) malignant non-nodal masses shows peripheral enhancement.

In present study 7 (25.92%) benign and 14 (82.35%) malignant non-nodal masses had necrosis 14 (82.35%) malignant non-nodal masses had infiltration of the adjacent structure [Figures 1 and 2].

In our study, 60 patients of neck masses were included. MDCT was diagnosed 31 (51.7%) patient of neck mass as benign neck mass and 29 (48.3%) patient of neck mass as malignant, however, on histopathology 29 (48.3%) patient of neck mass were diagnosed as a benign and 31 (51.7%) patient of neck mass as a malignant.

Sensitivity, specificity, positive predictive value, and negative predictive value of MDCT scan to differentiation between benign and malignant neck mass in comparison with histopathology were 90.32%, 96.55%, 96.55%, and 90.32%, respectively. Association of histopathological diagnosis with diagnosis on CT scan was analyzed using Chi-square test. Significant association was note between two diagnoses ($P < 0.0001$).

DISCUSSION

Imaging plays a major role in diagnosis and planning treatment of patients with neck masses. The radiologist must have a thorough knowledge of the modalities and techniques available to select the most efficient imaging protocol to solve the diagnostic problem. According to James Haynes *et al.*, contrast enhanced CT (CECT) is the initial diagnostic test of choice in adult neck masses.

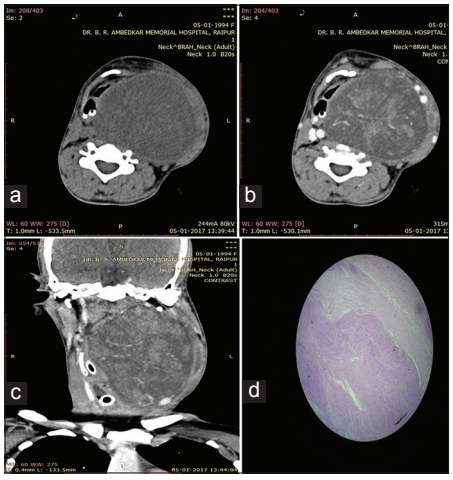

Figure 2: Schwannoma: Case - 2 23-year-old female came with complaint of left side neck swelling and difficulty in breathing. (4a) Axial non contrast image shows well defined heterogeneous noted in the left side of neck. (4b and c) Axial and coronal post-contrast image shows well defined heterogeneously enhancing lesion with maintain fat plain with surrounding structure. Computed tomography final diagnosis is benign lesion likely peripheral nerve sheath tumor. (4d) H and E stain (×4) shows alternative band of Antoni A and Antoni B area composed of spindle cell

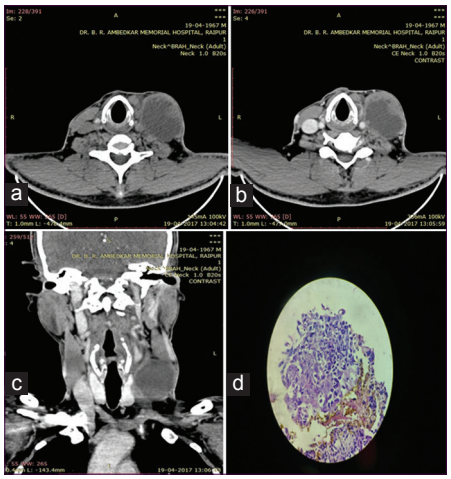

Figure 3: Case - 3 metastatic squamous cell carcinoma: 50-year-old male came with complaint of the left side neck swelling. (5a) Axial plain image shows rounded heterogeneously hypodense lesion noted at Left III and IV level. (5b and c) Axial and coronal post-contrast image shows rounded heterogeneous enhancing lesion with central area of necrosis with infiltration of sternocleidomastoid muscle noted in Left III and IV level. Computed tomography final diagnosis was malignant nodal mass. (5d) H and E (×10) stain section shows solid sheet of malignant cell which is pleomorphic, having high N: C ratio and coarse chromatin

In our study, 60 patients with clinically palpable neck masses were evaluated using CECT and the masses divided in two broad category-nodal neck masses and non-nodal neck masses.

Nodal masses were evaluated in term of size, shapes, numbers, necrosis, enhancement pattern, extracapsular spread, and fat plane with an adjacent structure.

Non-nodal masses were evaluated in term of margins (well-defined and ill-defined), plain CT appearances of masses (cystic, hypodense, hyperdense, isodense, and heterogeneous), enhancement pattern (homogeneous, heterogeneous, nonenhancing, and peripheral enhancement), necrosis, infiltration, and calcification.

In our study, 60 patients were included of all age. Maximum numbers of patients were age group 50–60 years that is 13 patients out of the 60.

Out of the 60 patients were included in the study, 37 (61.6%) were males and 23 (38.33%) were females. The overall male to female ratio was 1.6:1.

In our study, neck swelling was most common clinical complaint. Out of 60 patients, 54 (90%) having neck swelling and other clinical complains includes pain (23.33%), dysphagia (6%), fever (6%), and dyspnea (3.33%). Many patients had more than one complaint.

Most common neck masses in our study were non-nodal neck masses. In our study out of 60 patient, there was16 (36.36%) patient had nodal masses and 44 (73.33%) had non-nodal masses.

Out of 16 nodal masses, there were 10 (62.5%) metastatic nodal masses, 5 (31.25%) lymphomas, 1 (6%) tubercular lymphadenopathy, and 1 (6%) were other.

In our study, all nodal masses have maximum short axis diameter more than >8–9 mm for Level II and >7–8 mm for rest of neck. With mean maximum short axis diameter for metastatic nodal masses 5.11 cm, for nodal masses of lymphomas 3.11 cm and for tubercular nodal masses 1 cm. Van den Brekel *et al.* suggested a minimal axial diameter of 8–9 mm in Level II and 7–8 mm for the rest of neck.[5]

All malignant nodal masses (metastatic and lymphomas) were spherical in shape, however, in benign one was oval/bean shape and one was a spherical shape.

In all nodal masses, 75% was multiple and 25% was single [Table 1].

10 (100%) out of 10 metastatic nodal masses, 1 (25%) out of 4 nodal masses of lymphoma, and 1 (50%) out of 2 benign nodal masses were shows necrosis [Table 1].

In our study, all metastatic nodal masses, all benign nodal masses and 25% of nodal masses of lymphoma shows heterogeneous enhancement, however, 75% nodal masses of lymphoma were shown homogeneous enhancement [Table 1].

In our study 9 out of 10 metastatic nodal masses, 2 out of 4 nodal masses of lymphoma and 1 out of benign nodal masses were shows extracapsular spread. 8 out of 10 metastatic nodal mass, 2 out of 4 nodal mass of lymphoma

Table 1: MDCT characteristics of various nodal masses

Characteristics	Number of cases (%)				
	Metastatic (*n*=10)	Lymphoma (*n*=4)	Tubercular (*n*=1)	Other (*n*=1)	Total (*n*=16)
Size					
>8–9 mm for Level II and>7–8 mm for rest of neck	10 (100)	4 (100)	1 (100)	1 (100)	16 (100)
<8–9 mm for Level II and<7–8 mm for rest of neck	-	-	-	-	-
Shape					
Spherical	10 (100)	4 (100)		1 (100)	15 (93.75)
Oval/bean shape			1 (100)		
Number					
Single	4 (40)	-			4 (25)
Multiple	6 (60)	4 (100)	1 (100)	1 (100)	12 (75)
Necrosis	10 (100)	1 (25)	-	1 (100)	12 (75)
Enhancement					16 (100)
Homogeneous	-	3 (75)	-		3 (18.75)
Heterogeneous	10 (100)	1 (25)	1 (100)	1 (100)	13 (81.25)
Peripheral	-	-			
Extracapsular extension	9 (90)	2 (50)	-	1 (100)	12 (75)
Loss of fat plane with adjacent structure	8 (80)	2 (50)	-	1 (100)	11 (68.75)

MDCT: Multidetector computed tomography

and 1 out of benign nodal masses were shows loss of fat plane with adjacent structure [Table 1 and Figure 3].

In our study out of 60 patients, 44 patients have non-nodal mass. Out of 44 patients, non-nodal mass of 29 patients had well-defined border in which non-nodal mass of 27 patients appears as benign and non-nodal masses of 2 patients appears as malignant on histopathology. Hence, well-defined border more common in benign lesion but can occurs in malignant lesion [Table 2].

15 patients of non-nodal masses (out of 44) have ill-defined border. All 15 patients diagnosed as malignant on histopathology. In our study ill-defined border was only occurs in malignant lesion [Table 2].

13 out of 44 patients of non-nodal masses were purely cystic which appears benign on histopathology. In our study, purely cystic lesion was benign [Table 2].

On plain scan, one hyperdense lesion was found in our study which diagnosed as benign on post-operative follow-up. Hence, hyperdense lesion on plain scans more likely benign [Table 2].

21 non-nodal masses (out of 44) were appears heterogeneous in density on plain CT. On histopathology, 9 were appears benign and 12 were appears malignant. Hence, heterogeneous lesion on plain CT can be benign or malignant [Table 2].

There was one homogeneously enhancing non-nodal mass lesion noted in CECT (out of 44) which was diagnosed as a fusiform aneurysm on digital subtraction angiography [Table 2].

Out of 44 non-nodal neck masses 26 were appears heterogeneous on CECT neck. On histology 10 non-nodal neck masses diagnose as a benign and 16 non-nodal neck masses diagnose as a malignant [Table 2].

10 non-nodal neck masses (out of 44) were nonenhancing on CECT neck. On histopathology, all nonenhancing lesions were diagnosed as a benign. Hence, nonenhancing lesions were more likely benign [Table 2].

There were peripheral enhancements seen in 7 non-nodal neck masses in which 6 diagnosed as benign and 1 diagnosed as a malignant on histopathology [Table 2].

Out of 44 non-nodal neck masses, 21 were shows necrosis on CECT neck in which 7 was diagnose as a benign and 14 was diagnose as a malignant on histopathology. Necrosis was more common in malignant lesion but can also occur in benign [Table 2].

14 non-nodal masses neck (out of 44) was shows infiltration of adjacent structure in which all non-nodal masses of neck were diagnosed as a malignant on histopathology [Table 2].

In our study, 60 patients of neck masses were included. MDCT was diagnosed 31 (51.7%) patient of neck mass as benign neck mass and 29 (48.3%) patient of neck mass as malignant, however, on histopathology 29 (48.3%) patient of neck mass were diagnosed as a benign and 31 (51.7%) patient of neck mass as a malignant [Table 3].

In correlation with histopathology, MDCT was wrongly diagnosed 3 patients as a benign which was diagnosed as a malignant on histopathology and 1 patient as malignant which was diagnosed as a benign on histopathology.

Table 2: MDCT characteristic of non-nodal mass

Characteristics	Benign*	Malignant*	Total
	Number of case *n*-27 (%)	Number of case *n*-17 (%)	Number of case *n*-44 (%)
Margin			
Well defined	27 (100)	2 (11.7)	29 (65.90)
Ill defined	0 (0)	15 (88.23)	15 (34.09)
Density on plain CT			
Cystic	13 (48.14)	0 (0)	13 (29.54)
Hyperdense	1 (3.7)	0 (0)	1 (2.27)
Hypodense	4 (14.81)	6 (35.29)	10 (22.7)
Isodense	0 (0)	0 (0)	0 (0)
Heterogeneous	9 (33.33)	12 (70.58)	21 (47.72)
Enhancement			
Homogeneous	1 (3.70)	0 (0)	1 (2.27)
Heterogeneous	10 (37.03)	16 (94.11)	26 (59.09)
Non-enhancement	10 (59.09)	0 (0)	10 (22.27)
Peripheral	6 (22.22)	1 (11.76)	7 (15.9)
Necrosis	7 (25.92)	14 (82.35)	21 (47.72)
Infiltration	0 (0)	14 (82.35)	14 (31.81)
Calcification	4 (14.81)	3 (17.6)	7 (15.90)

*Benign and malignant diagnosed on histopathology. MDCT: Multidetector computed tomography, CT: Computed tomography

Table 3: Diagnostic significance of MDCT scan for benign and malignant neck mass

CT diagnosis	Histopathology diagnosis		Total
	Benign	Malignant	
Benign	28	3	31
	90.3%	9.7%	100.0%
Malignant	1	28	29
	3.4%	96.6%	100.0%
Total	29	31	60
	48.3%	51.7%	100.0%

MDCT: Multidetector computed tomography, CT: Computed tomography

Sensitivity, specificity, positive predictive value, and negative predictive value of MDCT scan to differentiation between benign and malignant neck mass in comparison with histopathology were 90.32%, 96.55%, 96.55%, and 90.32%, respectively. Association of histopathological diagnosis with diagnosis on CT scan was analyzed using Chi-square test. Significant association was note between two diagnoses ($P < 0.0001$).

Sensitivity, specificity, positive predictive value, and negative predictive value of our study were high, however, less than to the previous study. This may be due to low sample size and variability in duration of lesion when was CT done as compare to the previous study.

Previous study results show:

Gupta *et al.*, 45 patients with neck masses were prospectively evaluated using multislice spiral CT. The accuracy of multislice CT for predicting the benign or malignant nature of the mass, and its extent was found to be very high, i.e., 97%, and 100%, respectively, and the accuracy for predicting the final diagnosis was 62%.[4]

Shrestha *et al.*, this was a hospital-based, prospective study conducted in the Department of Radio diagnosis, Kasturba Medical College, Mangalore, from 2005 to 2008. A hundred consecutive patients referred for CT scan examination presenting with complaints related to the involvement of neck spaces or presence of palpable neck masses was enrolled in this study considering histopathology as the gold standard, the sensitivity of CT in detecting malignant/benign lesions was 96.5% with a specificity of 100%. The positive predictive value was 100% and the negative predictive value 95.2%.[6]

Charan *et al.*, an observational prospective study was conducted in 100 patients with clinically suspected neck lesions or patients who were referred for CT scan for further characterization The sensitivity and specificity of the study are 95.7% and 77.5%, respectively, with positive predictive value and negative predictive value of 90.4% and 88.9%, respectively. Accuracy was found to be 90% ($P < 0.001$).[7]

Ravi 100 patients with neck masses were evaluated using MDCT. Non-contrast and contrast enhanced CT examination of all the patients was carried out. Thus, the accuracy of the newer multislice CT for predicting the benign or malignant nature of the mass and local extent of the mass lesion was found to be very high, i.e., 98% and 100%, respectively. However, CT was 76% accurate in predicting the final pathological diagnosis.[8]

CONCLUSION

MDCT had high sensitivity and specificity in the differentiation of benign versus malignant neck mass lesion which helps in the further planning of management of these lesions but requires histopathology for better management.

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