Original Article

Evaluation of Computed Tomography Scans of Neck Masses and Their Histopathological Correlation

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ABSTRACT

A cross-sectional, comparative study was conducted in the Department of Radiology & Imaging, Shaheed Suhrawardy Medical College Hospital, Dhaka, Bangladesh, between July and December of 2019, to assess the diagnostic usefulness of multi-detector computed tomography scans in the evaluation of neck mass by comparing with histopathological reports. A total of 40 patients were enrolled in the study. All relevant data was collected from history sheet of the patients and investigation reports. Computed Tomography findings and histopathological diagnosis were recorded in a pre-designed structured data collection sheet. Then histopathology reports were compared with computed tomography (CT) scan findings. The most common age group was 40-70 years (45%), followed by 15-40 years (35%) and <15 years (12.5%). A male predominance was observed with male-female ratio of 2.33:1. Based on CT scans, 14 patients were diagnosed as benign lesions such as thyroglossal duct cyst 1case, abscess 2 cases, tubercular lymphadenopathy 2 cases, reactive lymphadenopathy 1 case, multinodular goiter 3 cases, thyroid cyst 1 case, hemangioma 1 case, pleomorphic adenoma 2 cases and carotid body tumor 1 case. The rest 26 cases were diagnosed as malignant: carcinoma larynx 5 cases, metastatic lymphadenopathy 3 cases, carcinoma thyroid 2 cases, parotid carcinoma 3 cases, submandibular gland malignant tumor 1 case, carcinoma tonsil 2 cases, nasopharyngeal carcinoma 4 cases, hypopharyngeal carcinoma 1 case, carcinoma base of tongue 2 cases and lymphoma 3 cases. Based on histopathology reports, 13 patients were diagnosed as having benign pathology like thyroglossal duct cyst 1case, abscess 3 cases, tubercular lymphadenopathy 2 cases, reactive lymphadenopathy 1 case, multinodular goiter 2 cases, thyroid cyst 1 case, pleomorphic adenoma 2 cases and carotid body tumor 1 cases. Remaining 27 cases were diagnosed as malignant which included carcinoma larynx 5 cases, metastatic lymphadenopathy 4 cases, carcinoma thyroid 2 cases, parotid carcinoma 3 cases, submandibular gland malignant tumor 1 case, carcinoma tonsil 2 cases, nasopharyngeal carcinoma 4 cases, hypopharyngeal carcinoma 1 case, carcinoma base of the tongue 2 cases and lymphoma 3 cases The present study showed that CT scans were significantly precise to differentiate between benign and malignant neck masses with 92.6% sensitivity, 92.3% specificity and 92.5% diagnostic accuracy. Our study demonstrated that computed tomography scan proved to be a useful tool for assessing and characterization of neck mass as either benign or malignant.

Keywords: *Neck mass, computed tomography scan, histopathology, malignancy.*

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INTRODUCTION

The head and neck possess a complex anatomy and contains many small anatomic structures that are closely spaced.[1] This necessitates a thorough understanding of normal spatial relationships and anatomical variants for the diagnosis of lesions. Cancer of the head and neck, which includes cancers of the larynx, nasal passages and nose, oral cavity, pharynx, salivary glands, buccal regions, and thyroid, is the sixth most frequent cancer worldwide.[1] A mass

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in the neck is a common clinical problem that presents in patients of all ages. With regard to age, the neck masses were classified into three groups: paediatric (≤15 years old), young adults (16–40 years of age), and older adults (≥40 years old).[2]

Application of computed tomography (CT) scans in the evaluation of neck masses has gained popularity in different clinical settings. Provision of better visualization using computed tomography (CT) helps clinicians with key information relating to both diagnosis and prognosis and ensures improved management in modern medicine.[3] It is currently recognized as one of the most powerful and versatile imaging procedure for the evaluation of neck masses.[3,4] Spiral computed tomography or multidetector computed tomography (MDCT) permits the rapid scanning of large volumes of tissue during quiet respiration and it is less susceptible to patient motion when compared to the conventional computed tomography.[5,6] Volumetric helical data permits the optimal multiplanar and 3D reconstructions. Spiral-CT is standard one for imaging neck tumours. Secondary coronal reconstructions of axial scans are very helpful in the evaluation of the crossing of the midline by small tumors of the palate or tongue base. Multislice spiral CT allows almost isotropic imaging of the head and neck region and also improves the assessment of tumor spread and lymph node metastases in arbitrary oblique planes. Multislice CT scan has a special feature in defining the critical relationships of tumor and lymph nodes metastases and for functional imaging of the hypopharynx and larynx, not only in the transverse plane but also in the coronal plane.[5,6]

In the last decade, along with other malignancies the prevalence of head-neck malignancy has increased much in our country, as we observed in our day to day practice. However, at the same time, diagnostic modalities for the diagnosis of neck mass lesions have been advanced all over the world. Considering the low-economic condition of the vast majority of our population we must design some diagnostic procedures that would be very accurate in differentiating between benign and malignant as well as affordable. Computed tomography (CT) Scan is often the first-line imaging tool used as it is readily available, relatively cheaper than magnetic resonance imaging (MRI) and is rapidly acquired.[3,7] Therefore, we proposed this study to evaluate neck masses using CT scans and compare to histopathological diagnosis (as gold standard), which would determine the efficacy of CT scans in such lesions. The results will help our radiologists especially who are working in the oncoradiology units gain more information and confidence in early detection and management of neck mass lesions.

METHODS

This cross-sectional, comparative study was conducted in the Department of Radiology & Imaging of Shaheed Suhrawardy Medical College Hospital, Dhaka, Bangladesh, between July and December of 2019. All the patients with clinically suspicious neck masses who underwent computed tomography (CT) scan followed by a biopsy and histopathological examination by biopsy were our study population. For sample size estimation, we considered that head and neck cancer was 3% among the total cancer cases in the UK in 2014. In adults, however, a malignant tumor may be expected in more than 50% cases. Considering such incidence rate of neck mass 50% with 5% significance level and 5% marginal error, our sample size was estimated 42.6.[8] However, we adopted a convenience sampling technique. We included all the patients with clinically suspected neck masses who underwent multidetector computed tomography (CT) scans and surgical biopsy for histopathological examination (within the study period). However, patients who did not give consent, or unable to undergo computed tomography scanning (e.g., pregnancy, hypersensitivity to contrast medium) and sugical biopsy were excluded from the study. Finally, a total of 40 patients were enrolled in the study.

The study was performed with 16 slice multidetector CT scanner (TOSHIBA, Activion 16, made in Japan). After taking axial pre-contrast scan, post-contrast scanning was done. Contrast agent was a non-ionic iodinated compound named iopamiro 370 given at a dose of 1ml/kg body weight. Arterial phase starts 20-35 sec. after the start of injection of contrast medium and venous phase starts 70-80 sec. after injection and delayed phase was at about 1 to 3 minutes. These three phases were evaluated according to the lesions.[1,9]

CT criteria of benign lesions: These were characterized by: i) the presence of a well defined margin, ii) a density less than that of muscle, iii) coarse globular or rim like calcification, iv) displaced but maintained

fat plane and v) homogenous contrast on post-contrast studies.

CT criteria of inflammatory lesions (benign): These were characterized by: i) ill defined margin, ii) a density less than that of muscle, iii) presence of necrosis, iv) perilesional blurred fat plane, v) heterogeneous or peripheral thick rim enhancement and vi) lymphadenopathy with benign criteria enlarged size (>1cm) but oval contour, presence of hilum, well defined margins with no infiltration of surrounding structures, no loss of fat planes and usually no necrosis.

CT criteria of malignant lesion: These were characterized by: i) an ill-defined margin, ii) a density equal to or more than that of muscle, iii) presence of necrosis, iv) blurring of fat plane, v) eterogeneous enhancement, and vi) lymphadenopathy with malignant criteria like enlarged size (>1cm), rounded contour, absence of hilum, eccentric cortical thickening, necrosis, ill-defined margins with infiltration of surrounding structures and loss of fat planes and infiltration into surrounding tissue and bones or cartilage erosion.

Postoperative resected tissues were examined histopathologically in the Department of Pathology of the same institution. Relevant data was collected from history sheet of the patients and investigation reports. Computed Tomography findings and histopathological diagnosis were recorded in a pre-designed structured data collection sheet. Then the histopathology reports were compared with computed tomography (CT) scan findings.

Collected data was scrutinized, compiled, coded and entered into the computer. Statistical analysis was done by using MS-Excel sheet. Then data was presented as frequency and percentages. For the validity of study outcome, sensitivity, specificity, positive predictive value, negative predictive value and accuracy of CT scans in the diagnosis of neck masses were estimated after confirmation of diagnosis by histopathology reports accordingly.

RESULTS

A total of 40 patients with neck masses were included in this study. Among them, 5 patients were below 15 years (12.5%), 14(35%) belonged to the 15-40 years age group, 18(45%) were in the 40-70 years age group, and 3(7.5%) aged >70 years. A male predominance was observed (male-female ratio was 2.33:1) (Table-I). Based on CT scans, 14 patients were diagnosed as benign lesions such as thyroglossal duct cyst 1case, abscess 2 cases, tubercular lymphadenopathy 2 cases, reactive lymphadenopathy 1 case, multinodular goiter 3 cases, thyroid cyst 1 case, hemangioma 1 case, pleomorphic adenoma 2 cases and carotid body tumor 1 case. The rest 26 cases were diagnosed as malignant: carcinoma larynx 5 cases, metastatic lymphadenopathy 3 cases, carcinoma thyroid 2 cases, parotid carcinoma 3 cases, submandibular gland malignant tumor 1 case, carcinoma tonsil 2 cases, nasopharyngeal carcinoma 4 cases, hypopharyngeal carcinoma 1 case, carcinoma base of tongue 2 cases and lymphoma 3 cases (Table-II, Fig.1-3). Based on histopathology reports, 13 patients were diagnosed as having benign pathology like thyroglossal duct cyst 1case, abscess 3 cases, tubercular lymphadenopathy 2 cases, reactive lymphadenopathy 1 case, multinodular goiter 2 cases, thyroid cyst 1 case, pleomorphic adenoma 2 cases and carotid body tumor 1 cases. Remaining 27 cases were diagnosed as malignant which included carcinoma larynx 5 cases, metastatic lymphadenopathy 4 cases, carcinoma thyroid 2 cases, parotid carcinoma 3 cases, submandibular gland malignant tumor 1 case, carcinoma tonsil 2 cases, nasopharyngeal carcinoma 4 cases, hypopharyngeal carcinoma 1 case, carcinoma base of the tongue 2 cases and lymphoma 3 cases (Table-III). The sensitivity of CT scan to evaluate neck masses was found 92.6% and specificity was 92.3%. Diagnostic Accuracy was found 92.5%, whereas positive predictive value was 96.2% and negative predictive value was 85.7% (as estimated from Table-IV).

Table-I: *Age and sex distribution of the patients (N=40)*

Variables	Frequency	Percentage
Age group (in years)		
<15	5	12.5
15-40	14	35.0
40-70	18	45.0
>70	3	7.5
Sex		
Male	28	70.0
Female	12	30.0

Table-II: *Diagnosis of neck masses based on CT scans (N=40)*

Findings	Frequency	Percentage
Benign (n= 14)		
Thyroglossal duct cyst	1	2.5
Abscess	2	5
Tubercular lymphadenopathy	2	5
Reactive lymphadenopathy	1	2.5
Multinodular goiter	3	7.5
Thyroid cyst	1	2.5
Hemangioma	1	2.5
Pleomorphic adenoma	2	5
Carotid body tumor	1	2.5
Malignant (n=26)		
Carcinoma larynx	5	12.5
Metastatic lymphadenopathy	3	7.5
Carcinoma thyroid	2	5
Parotid carcinoma	3	7.5
Submandibular gland malignant tumor	1	2.5
Carcinoma tonsil	2	5
Nasopharyngeal carcinoma	4	10
Hypopharyngeal carcinoma	1	2.5
Carcinoma base of tongue	2	5
Lymphoma	3	7.5

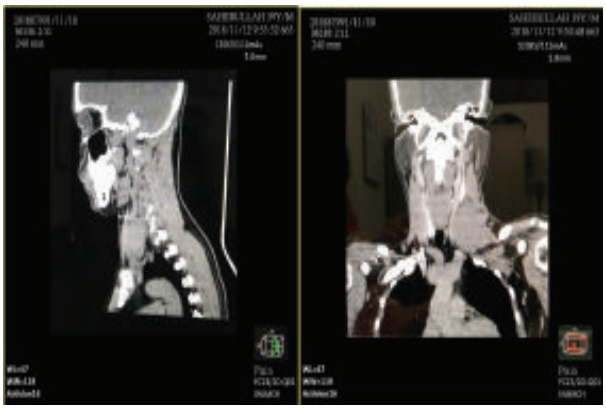

Fig. 1: *Post-contrast sagittal and coronal CT scans showing left cervical lymphadenopathy.*

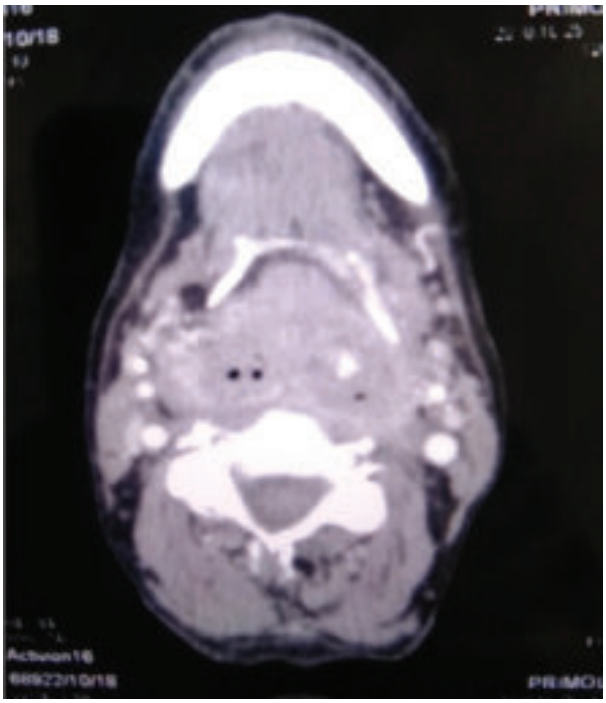

Fig. 2: Axial post-contrast CT scan of neck showing large mixed density mass at glottic and supraglottic part of larynx.

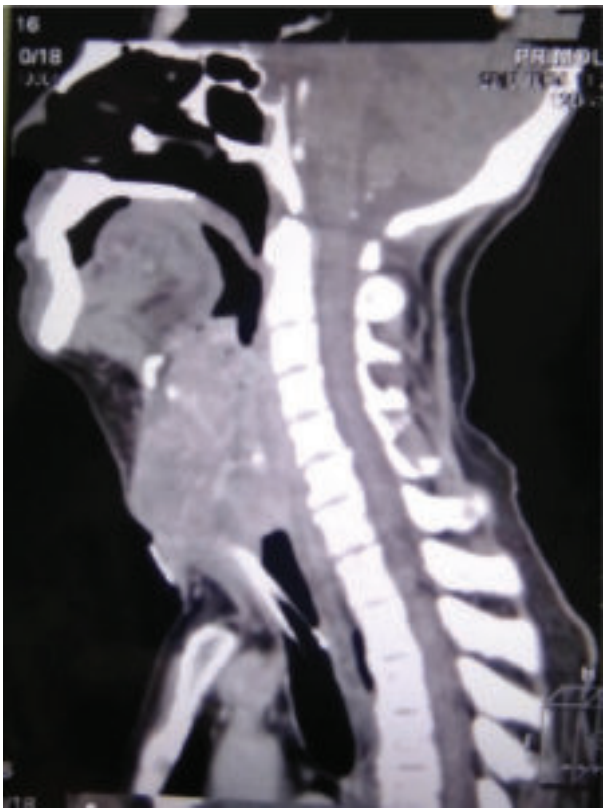

Fig. 3: Sagittal post-contrast CT scan of neck showing large laryngeal growth (Ca-larynx).

Table-III: *Diagnosis of neck masses based on histopathological examination (N=40)*

Findings	Frequency	Percentage
Benign (n= 13)		
Thyroglossal duct cyst	1	2.5
Abscess	3	7.5
Tubercular lymphadenopathy	2	5
Reactive lymphadenopathy	1	2.5
Multinodular goiter	2	5
Thyroid cyst	1	2.5
Hemangioma	0	0
Pleomorphic adenoma	2	5
Carotid body tumor	1	2.5
Malignant (n=27)		
Carcinoma larynx	5	12.5
Metastatic lymphadenopathy	4	10
Carcinoma thyroid	2	5
Parotid carcinoma	3	7.5
Submandibular gland malignant tumor	1	2.5
Carcinoma tonsil	2	5
Nasopharyngeal carcinoma	4	10
Hypopharyngeal carcinoma	1	2.5
Carcinoma base of tongue	2	5
Lymphoma	3	7.5

Table-IV: *CT scans and histopathological correlation of benign versus malignant lesions (N=40)*

CT scan	Histopathological diagnosis		
diagnosis	Malignant	Benign	Total
Malignant	25	1	26
Benign	2	12	14
Total	27	13	40

Sensitivity 92.6%, Specificity 92.3%, Diagnostic accuracy 92.5%, Positive predictive value 96.2%, Negative predictive value 85.7%

DISCUSSION

In this study, a total of 40 patients were enrolled and their age was ranging between 2 and 82 years. The most common age group was 40–70 years (45%), followed by 15–40 years (35%) and <15 years (12.5%). A study done by Shrestha et al. reported that 29% of the patients of neck masses belonged to the age group 51–60 years, followed by 41–50 years and 61–70 years respectively.[10] Another study done by Charan et al. reported that the majority of patients with neck mass malignancy was found in the 46–60 years age group (29%), followed by 31–45 years age group (24%).[11] A previous study done by Siddiqua et al. found that most of the patients were in the was in 51–60 years age group (26.3%), followed by 41–50 years age group (17.5%).[12] All those findings are quite similar to our results.

A male predominance was noted in the present study. 28(70%) were male and 12(30%) were female (male-female ratio was 2.33:1). Kaur et al., Siddiqua et al., and Vazquez et al. also observed a male predominance in their studies (male-female ratio were reported as 2:1, 1.9:1 and 2.1:1 respectively),[3,12,13] which are also in congruence with our study finding. However, Balakrishnan observed that malignant lesions prevailed among male population with a male to female ratio of 1.6:1, while an equal incidence was observed in benign lesions with a male to female ratio of 1:1.[14] These findings are lower than that of our observation.

We observed in our study that the sensitivity of CT scan in diagnosis of neck masses was 92.6%, while its specificity was 92.3%, diagnostic accuracy 92.5%, positive predictive value 96.2%, negative predictive value 85.7%. Kaur et al. found sensitivity of CT 96.4%, specificity of 100%, positive predictive value of 100% and a negative predictive value of 91.67%.[3] Shrestha et al. reported 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%.[10] Siddiqua et al. reported 94.6% sensitivity and 95% specificity, while positive predictive value was 97.2%, negative predictive value 90.5% and diagnostic accuracy 94.7%.[12] Vazquez et al. reported 91.4% diagnostic accuracy of CT scans.[13] Begum et al. reported that CT in the diagnosis of laryngeal carcinoma showed 97.9% sensitivity, 66.7% specificity, 96% accuracy and 97.9% positive predictive value.[15] Those findings are more or less similar to our results. We also observed that CT scans can ensure accurate anatomical localization and characterization of lesion as benign and malignant. Moreover, in malignant tumors, it plays a very useful

role for staging and provide essential information about the tumor extent that directly affects the surgical approach necessary for curative resection. Our findings are also supported by several previous studies.[12,13]

However, our study has some limitations. We did not evaluate the inter-reader variability between radiologists in the interpretation of the CT scan images. Moreover, patients were recruited from a single centre in Dhaka city; we could recruit a small sample due to time and budget constraint. Therefore, further studies with larger sample and longer duration involving more hospitals from different regions of the country are recommended to obtain more precise results.

CONCLUSION

To summarize, computed tomography (CT) scan definitely plays a major role in the evaluation of neck masses both in adult and paediatric patients; it has an excellent correlation with postoperative histopathological diagnosis. It also assists in the pretreatment planning in neck masses, by better defining the local extension of infiltrating tumours, and detecting local and distant metastasis. Such diagnostic and prognostic information helps clinicians determine the relative value of surgical intervention as well as chemo- and radiotherapy, in selecting patients who might be benefited from adjuvant treatment, and also in identifying patients at high risk for recurrence to be followed up more closely.

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