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Role of MDCT neck in evaluation of neck masses: Our experience

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Abstract

A mass in the neck in adults is a common entity that we customarily encounter in our clinical practice. Diagnosis of these neck masses can be challenging owing to the intricate anatomy and physiology, with a myriad of presenting complaints. Neck masses can be due to multiple causes classified as congenital (eg cystic hygroma), lymphadenopathy, inflammatory or neoplastic (malignant or benign). Various imaging modalities have been applied for the evaluation such as plain x-rays, contrast studies such as lymphogram, xerography and oesophagogram etc. However, these are neither sensitive nor specific in diagnosing the aetiology of neck masses. CT being non-invasive and non-operator dependent depicts excellent quantification of tissue attenuation coefficients and is exceedingly useful in defining both the osseous and soft-tissue extent of the lesion. With the upcoming of newer generation Multidetector CT Scanners (MDCT) have made tremendous improvements in scanning time, tissue resolution and quality of three dimensional (3D) reconstructions. The aim of this study is to evaluate the role of MDCT in neck masses.

Keywords: computed tomography; Neck masses; Lymphadenopathy; MDCT

1. Introduction

A mass in the neck in adults is a common entity that we customarily encounter in our clinical practice. Diagnosis of these neck masses can be challenging owing to the intricate anatomy and physiology, with a myriad of presenting complaints. Hence, it is the foremost priority of the radiologists to analyze the neck masses based on various aetiological, pathological and prognostic points of view[1,2].

The earliest evidence of mass in the neck was found in literature as early as 500 B.C. It was Hippocrates who was aware of this, and coined the term "scrofula"[3]. Over 1.5% of our country's population is suffering from tuberculosis involving various systemic organs. It is known that 1.5% of Indian population is affected with tuberculosis. Cervical tuberculous lymphadenopathy is still the most common cause of persistent cervical lymph node enlargement in the developing countries[4].

Neck masses can be due to multiple causes classified as congenital (eg cystic hygroma), lymphadenopathy, inflammatory or neoplastic (malignant or benign). Various imaging modalities have been applied for the evaluation such as plain x-rays, contrast studies such as lymphogram, xerography and oesophagogram etc. However, these are neither sensitive nor specific in diagnosing the aetiologyof neck masses [6].

CT being non-invasive and non-operator dependent depicts excellent quantification of tissue attenuation coefficients and is exceedingly useful in defining both the osseous and soft-tissue extent of the lesion. With the upcoming of newer generation Multidetector CT Scanners (MDCT) havemade tremendous improvements in scanning time, tissue resolution and quality of three dimensional (3D) reconstructions.[2]

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MRI clearly depicts the major vessels of the neck without added contrast. T1 weighted sequences have the best spatial resolution and give a strong signal from fat in the tissue planes. T2-weighted protocols are useful for showing muscle invasion. Gadolinium-enhanced images improve delineation of margins in many lesions. Fat suppression techniques improve the conspicuity of the soft tissue lesions embedded in the adipose tissue [3,4] .

Early treatment of local recurrence thus can result in good palliation, often lasting several years,which is of incalculable value to these patients.[5] Owing to the complex anatomy of the neck a comprehensive knowledge of regional anatomy and data from CT and MRI stand in need for the recognition of the patterns of disease presentation which is crucial in arriving at a meaningful differential diagnosis. To permit early recognition of neck pathology, detailed anatomic correlation is mandatory. Current imaging permits a detailed analysis of the intricate anatomy in this region and is the key to grasp many of its disorders including mass lesions [3].

It is well known that CT scan and MRI are common imaging techniques that are used for identification and characterization of different aetiologies of neck masses. These two imaging modalities can provide indispensable information about the depth of extension, and help identify incidental lesions in the disparate areas of the neck.

There are very few studies available evaluating the role of MDCT in neck masses. Hence, we set out to perform this study to shed some light on the same.

2. Material and methods

The study was carried out as prospective cross-sectional observational study in the Department of Radio-diagnosis, Sharda hospital, Greater Noida, UP. Patients in the age group of 13-80 years of age with palpable and suspected non palpable neck masses and those with symptoms pertaining to neck or with lesions detected on ultrasound study were included in the study. Those with deranged renal parameters (s.creatinine>1.5 mg/dL), allergy to contrast, pregnancy and cases of trauma were excluded.

A detailed history and general, physical and systemic local examination findings was recorded from the patient's medical records when the patient arrived at the department.

CT Scanner 128 SLICED CT OPTIMA WIPRO GE HEALTHCARE was used for this study. Fasting for 4 -5 hours prior to examination was advised . Prior kidney function tests was performed. Informed written consent was taken

2.1. Computed tomography

2.1.1. Patient position

Supine with neck mildly hyperextended so that the hard palate will be roughly perpendicular to the table top. Patient was scanned whenever possible in quiet breathing and swallowing suspended. Special maneuverers like mouth blowing, E phonation was administered during the study as and when required.

CT scan was performed in all patients with the use of 128 sliced CT scanner with appropriate slice thickness from the region of base of skull to the lung apices using collimation. Images was viewed in all 3 planes on AW Volume Share 7 workstation. Exact plan of study was individualized in each case according to the protocol. A plain tomogram was taken as a guide to study. Unenhanced and contrast enhanced (using non-ionic contrast material) scans was performed sequentially. Multi -planar reconstructions was created in both coronal and sagittal planes. All images were reconstructed with bone algorithm to detect any bone and cartilage invasion.

2.2. Evaluation of the mass

CT findings that was recorded was the location, origin and extent of lesion, as well as the size, shape, margins (well defined/irregular). Attenuation Pattern (fat, fluid, soft tissue enhancement, necrosis, calcification), any incidental findings, venous thrombosis, bony involvement and metastasis were also observed for. If histopathology report was available, the findings were correlated.

2.3. Statistical analysis

- Data was coded and recorded in MS Excel spreadsheet program. SPSS v23 (IBM Corp.) and was used for data analysis.

- Diagnostic accuracy of MDCT scan was calculated for the validity of study based on sensitivity, specificity, positive predictive value, negative predictive value .
- Chi-squared tests was used for group comparisons.
- Statistical significance was kept at $p < 0.05$.

3. Results

As per the inclusion criteria, 30 study participants were selected for the purposes of this study. Of this, the average age of the participants was found to be 48.9+/- 4.5 years.

In this study, we found that the distribution of males and females was nearly equivalent i.e Males 56.67%. There was a myriad of complaints in the patients, apart from having a neck swelling on examination. Most of the patients presented with dysphagia (n=9, 30%), followed by neck swelling (n=8, 26.67%). The duration of complaints was variable in these patients, with an average of 211.2 days. Most of the patients analyzed by CT had chronic symptoms, which correlated with the global statistics.

Physical findings in patients with neck mass can be variable, with the most common finding being cervical lymphadenopathy (n=17).

Several additional findings are noted additionally on CT that help in diagnosing the underlying condition, as well as planning intervention in the form of FNAC/biopsy. The most common finding was cervical lymphadenopathy (18/30).

The HU in the additional characteristics helps us identify the aetiology. The maximum HU was noted for cervical lymphadenopathy (814 HU).

The most common histopathology finding in our patients was Squamous cell carcinoma(n=8).

The sensitivity of MDCT for evaluating neck masses was found to be 90.15%, while specificity was 89.66%, and accuracy was found to be 89.79%.

4. Discussion

Imaging plays a major role in diagnosis and planning the treatment in patients with neck masses. The radiologist must have a thorough knowledge and expertise of all the modalities and techniques available to select the most efficient imaging protocol to solve the diagnostic problem [7].

Age of the patients included in the present study ranged from 18-80 years. Maximum number of patients was in the age group 40-50 years. The overall male to female ratio was 1.2:1. All the patients presented with neck swelling. Pain was the most common symptom associated with swelling. Fever, hoarseness and dysphagia were other associated symptoms.

The study comprised of nodal and non-nodal masses. Out of 30 cases studied, 12 cases (40%) had benign lesions and 18 (60%) cases had malignant lesions. Clinical diagnosis was in agreement with the final diagnosis in 21 (70%) of 30 cases. CT made a reliable diagnosis in 28 out of 30 cases, having a diagnostic accuracy of 93.33%.

Nodal masses constituted 43.33% of the total number of cases. These included nodal metastases from aero digestive malignancies (38.5%), nodal metastases with unknown primary (30.7%), lymphoma (23.1%) and tubercular adenopathy (7.7%). Out of 13 nodal masses, 12 were malignant (92.3%) and 1 was benign (7.7%). We observed 12 cases of metastatic lymphadenopathy. All the nodal masses were histopathologically proven to be cases of squamous cell carcinoma of different grades, anaplastic carcinoma, carcinoma ex pleomorphic adenoma or adenocarcinoma. In 9 cases the primary site was the aerodigestive tract. Out of these 9, 3 cases had oropharyngeal carcinoma and in 6 cases larynx was the primary site. 4 cases were labeled as nodal metastases from unknown primary as the primary site could not be delineated even after detailed clinical examination and investigations. The nodal metastases were assessed in terms of location in relation to the Imaging-Based nodal levels as proposed by Som P, Curtin H et al [8-10] and nodal size (short axis diameter), number, echopattern, features of necrosis, enhancement pattern, conglomeration, extra nodal spread, calcification and vascular invasion.

In our study, metastasis was suspected when a lymph node was greater than 1.5 cm in maximum diameter either in the jugulodigastric region (level II) or in the submandibular triangle (level I) or, when a node was greater than 10 mm (1 cm) in greatest diameter elsewhere in the neck. According to King AD et al [11] necrosis on CT was defined as a focal area of low attenuation with or without a surrounding rim of enhancement. They also concluded that MR imaging is comparable to CT for the detection of necrosis. We used the same criteria to determine necrosis. Necrosis was seen on both USG and CT in 8 cases.

The presence of extranodal tumour extension was identified as an irregular nodal margin with infiltration around and obliteration of the adjacent fat planes in our study. We detected extranodal tumour extension spread in 2 cases both on both USG and CT. King AD et al in their study concluded that there was no significant difference between CT and MR for either sensitivity or specificity for the detection of ENS. Vessel wall invasion was suggested when more than 270 degree of the arterial circumference was surrounded by the tumour and was seen in 3 cases on the basis of criteria suggested by Yousem et al[12]. In 3 out of the 9 cases oropharynx was the primary site. All 3 cases were tonsillar fossa masses with tongue base invasion. The extent of the lesions was defined and any additional findings like bone erosion, prevertebral muscle invasion and involvement of adjacent spaces were noted. In 6 cases of larynx was the primary site, predominantly supraglottic carcinoma. The lesions show transglottic spread with invasion of the thyroid cartilage.

2 cases were diagnosed as Non-Hodgkin's lymphoma and 1 case as Hodgkin's lymphoma. All 3 cases showed multiple lymph nodes involving multiple levels on USG and CT and on CT the lymph nodes were homogenously enhancing. 2 cases with Non-Hodgkin's lymphoma had associated mediastinal lymphadenopathy. One of them showed pleural effusion. One case of Non-Hodgkin's lymphoma showed marrow signal intensity changes in multiple cervical and thoracic vertebrae suggestive of lymphomatous involvement. Lee YY et al [13] described neck nodal involvement in Hodgkin's and Non-Hodgkin's lymphoma, as involvement of multiple deep chain lymph nodes which can be unilateral or bilateral and of varying sizes. Nodal necrosis was found in 5% with Hodgkin's disease and 13% with non-Hodgkin's lymphoma, even with extensive disease in their study.

1 case of tubercular adenopathy in a 19 year old female presented with bilateral cervical lymphadenopathy and parenchymal lesion on Chest X ray and reactive Mantoux. On CT, the tubercular lymph nodes (1 case) had the appearance of bilateral conglomerate nodal mass with rim enhancement (on CT) and preservation of fascial planes around them. Necrotic mediastinal nodes with left lobe consolidation were seen in the chest. These findings were in accordance with those described by Vaid S et al. [7]

2 cases of salivary gland pathology were observed in the present study which comprised of tumours in both cases. All cases were seen involving the major salivary glands. One of these was a known case of pleomorphic adenoma post parotidectomy. Yousem et al [14] observed that nearly 80% of benign parotid neoplasms are pleomorphic adenomas. They also mentioned that pleomorphic adenomas occur most commonly in middle-aged women. However, in our study all cases were males. This could be because of variation in demographic factors. 2 of the cases were seen involving the superficial lobe of the parotid gland which has been reported to be the most common site of involvement. Koral K et al [15] in their study have reported that the tumour is almost always solitary and multiple or bilateral pleomorphic adenomas are rare. All cases appeared as heterogeneously enhancing, well defined lobulated lesions on CT. Mori T et al [16] in their study suggested that no one MR finding distinguished pleomorphic adenomas from other parotid tumours and that the MR findings of a complete capsule, lobulated contour, or high T2 signal intensity have a predictive value of 74% for the diagnosis of pleomorphic adenoma. 1 case was of adenoid cystic carcinoma of the parotid was diagnosed in this study. It was a 45 year old male with unilateral Warthin tumour of the parotid gland. Teymoortash A et al [17] in their study described a preponderance of these tumours in elderly males and observed bilateral tumours in 12.3% of the cases. Minami M et al [18] in their study observed that even MR findings such as bilaterality and multiplicity, well-defined margins, and predominantly intermediate signal intensity on T1W and T2W images with focal areas of high signal intensities on T1W images suggest Warthin tumour, but are not pathognomonic. A definitive diagnosis therefore requires a tissue diagnosis. Kim KH et al [19] in their study concluded that both CT and MRI showed a similar level of accuracy in evaluation of salivary gland tumours, and showed a considerable tendency of misdiagnosis. Also that imaging features of a salivary gland mass can support a clinical diagnosis but cannot alone make a definitive histological diagnosis.

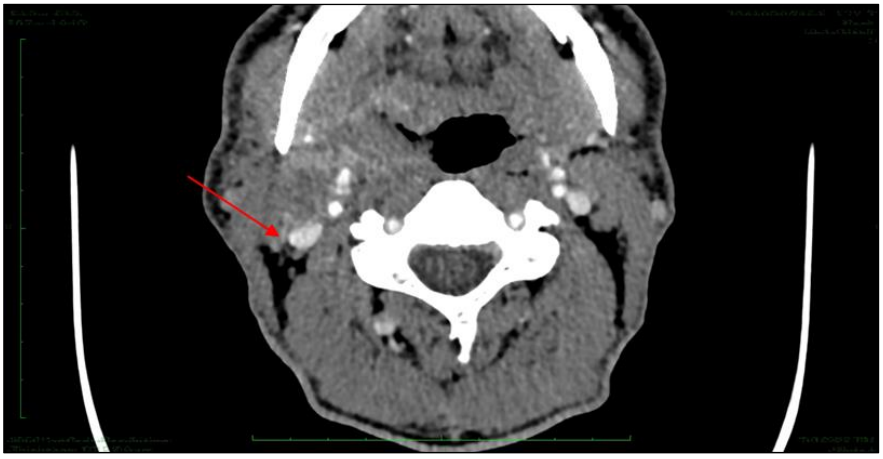

Figure 1 Features are suggestive of heterogeneous enhancing mass lesion in left supraglottic region involving the pyriform fossa mostly neoplastic

Figure 2 left submandibular gland with sialoadenitis and sialolithiasis

Figure 3 Features suggestive of a large irregularly peripheral enhancing lesion with central non enhancement, suggestive of a benign cystic lesion maybe lymphocoele

1 case was diagnosed to be an intermuscular abscess in the sternocleidomastoid muscle. On CT the muscle was bulky with a rim enhancing abscess seen. The abscess was drained under ultrasound guidance and patient was given antibiotics. R Garg et al [20] described parotid tuberculosis as a rare lesion with non-specific imaging findings. 1 case was diagnosed as a was diagnosed as a thyroglossal cyst on CT as a well-defined cystic lesion with thin non enhancing walls. In our study, 1 case was diagnosed as masses of developmental origin which was thyroglossal cyst (1 case). Naidu SI et al [21] have mentioned that cases presenting in adulthood often follow trauma or a preceding upper respiratory infection. 1 case was diagnosed as a thyroglossal cyst in a female patient. Ahuja et al [22] in their study have described thyroglossal cysts as midline or near-midline lesion, most commonly occur near the hyoid bone. On CT, the cyst contents usually have a mucoid attenuation. If the cyst occurs just caudal to the hyoid bone, it lies at the level of the thyrohyoid membrane of the larynx, stretching and bowing this membrane, so that on imaging the cyst appears to lie in the pre-epiglottic space of the larynx as was seen in our case During surgery however the cyst was seen to remain outside the larynx and was separated from the larynx without entering the larynx itself.

In our study, one case of abscess in the intermuscular space was diagnosed in a patient presenting with painful swelling with fever, leucocytosis and neutrophilia. Abscess showed complete rim enhancement on CT. Few discrete level V lymph nodes were also noted. The abscess was drained and patient was given antibiotics. There was no evidence of abscess on follow up ultrasound. Freling N et al [23] In their study, concluded that as adequate clinical assessment is possible in such cases; imaging is only needed to delineate the extent of the infective process.

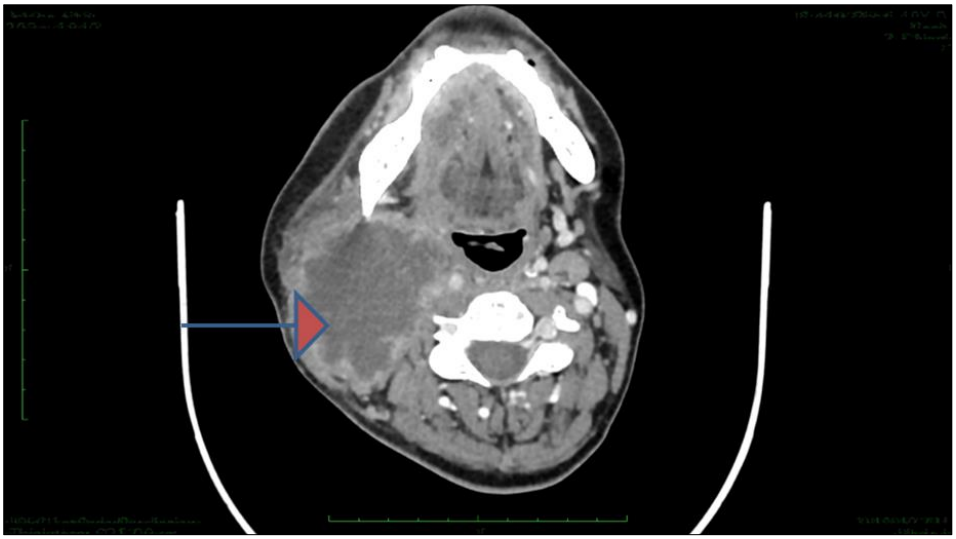

Figure 4 Large irregular peripheral enhancing mass with central non-enhancement in right cervical region most likely conglomerate of necrotic lymph nodes- lymphoma/TB

5. Conclusion

MDCT of the neck is an easily available, cost effect and quick modality to evaluate neck masses of any aetiology. In case of neoplastic masses especially, it allows for characterization of the lesion, identification of the plane and the extent of spread. This helps in treatment and surgical planning. Apart from this, the information can also be used for guiding biopsies and even mapping the area for radiotherapy.

MDCT of neck masses, in case of infectious and inflammation swellings, it helps in targetted biopsies from solid tissue rather than liquefied or hemorrhagic centers.

MDCT is also a good imaging modality for traumatic swellings as well as congenital lesions

Compliance with ethical standards

Disclosure of conflict of interest

No conflict of interest.

Statement of informed consent

Informed consent was obtained from all individual participants included in the study.

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