Diagnostic Utility of Multidetector CT in Neck Masses: Insights from a Tertiary Care Centre in Chennai

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ABSTRACT

Introduction:
Neck lesions are frequently encountered in both medical and surgical outpatient departments, necessitating precise localization and characterization for optimal treatment planning. Multidetector computed tomography (MDCT) offers significant advantages, including high-speed imaging, thin-slice collimation, and multiplanar reformation capabilities. These features, combined with its widespread availability, have made MDCT the diagnostic modality of choice for neck lesions. This study aims to evaluate the role of MDCT in detecting, characterizing, and assessing the extent of neck masses. Our findings underscore the efficacy of MDCT in providing detailed anatomical and pathological insights, thereby supporting clinicians in devising targeted therapeutic approaches for patients with neck lesions.

Objectives: This study aimed to evaluate the effectiveness of computed tomography (CT) in identifying and delineating the borders of neck masses. Additionally, it examined whether CT offers supplemental information beyond clinical examination by revealing the depth of tumor extension.

Methods: Our institution enrolled 45 patients with suspected neck masses for a study utilizing contrast-enhanced computed tomography (CECT). The CECT images were analyzed both before and after the administration of a non-ionic intravenous contrast agent. The researchers concentrated on evaluating the enhancement patterns, signs of local invasion into adjacent tissues, involvement of nearby bones, and potential vascular invasion by the lesions.

Results: The study evaluated the capability of MDCT to differentiate between malignant and benign neck lesions, with histological examination confirming the diagnosis in all 45 cases (17 malignant and 28 benign). MDCT misclassified one case of mandibular osteosarcoma (a malignant bone tumor) as osteomyelitis (bone infection), resulting in a single false negative. Despite this, MDCT demonstrated a high diagnostic accuracy of 97.5%.

1. Introduction

The neck, with its intricate anatomical structure extending from the base of the skull to the thoracic inlet, is prone to various masses. These masses can result from a range of causes, including congenital or acquired conditions, as well as inflammatory, vascular, or neoplastic origins.**[1]**

Diagnosing neck masses can be challenging, but the advent of cross-sectional imaging has revolutionized their evaluation. Traditionally classified by triangles, the neck is now divided into twelve spaces by the cervical fascia. Assigning a tumor to a specific neck space helps narrow differential diagnoses, as different areas contain distinct soft tissues. CT scans are particularly advantageous due to their ease of use, rapid scanning, and ability to image specific regions like the pterygopalatine fossa. Technological advancements have further enhanced the role of CT in evaluating head and neck lesions.**[1-3]**

CT has become an essential tool for evaluating neck masses due to its ability to display both osseous and soft tissue details. Spiral CT allows rapid scanning during quiet respiration, minimizing motion artifacts compared to conventional CT. Volumetric helical data supports optimal multiplanar and 3D reconstructions. Multislice spiral CT (MSCT) enhances the evaluation of tumor dissemination, lymph node metastases, and functional imaging of the larynx and hypopharynx in both transverse and coronal planes. The rapid acquisition of volumetric data, reconstructed into thin, overlapping images, minimizes motion artifacts and partial volume averaging. Proper timing between contrast injection and image acquisition maximizes the diagnostic benefits of intravenous contrast agents.**[4]**

The primary goal of head and neck imaging is to accurately assess the extent of disease, which informs optimal surgical and therapeutic planning. This evaluation involves determining the size, location, and spread of tumors into adjacent vascular and visceral structures, which is essential for effective treatment.**[5]** Additionally, nodal staging plays a critical role in detecting abnormal lymph nodes that may not be palpable during a physical examination. Accurate localization of these nodes using a standardized classification system allows for consistent interpretation and application by multidisciplinary teams, including radiologists, surgeons, radiation oncologists, and pathologists.**[6]**

Both CT and MRI are commonly used to evaluate deep and submucosal spaces of the head and neck, each with its own set of advantages and limitations. MRI offers superior soft tissue contrast resolution, which is particularly useful for assessing delicate structures like the brain and nerves. It also does not require iodinated contrast agents and is highly sensitive to detecting perineural and intracranial disease. However, MRI has certain drawbacks, including lower patient tolerance, limitations in individuals with pacemakers or metallic implants, and susceptibility to artifacts from motion or other factors.**[7]**

On the other hand, CT is faster, generally better tolerated by patients, and widely available. However, it has lower soft tissue contrast resolution compared to MRI and requires the use of iodinated contrast agents and exposes the patient to ionizing radiation. Despite these drawbacks, CT remains a crucial tool in head and neck imaging due to its speed, accessibility, and utility in detecting bone involvement, especially in trauma or tumor staging.**[7-8]**

2. Objectives

A. ****To evaluate the diagnostic efficacy of Multidetector Computed Tomography in delineation of Neck Masses****:

The primary aim of this objective is to assess the accuracy and effectiveness of Multidetector Computed Tomography (MDCT) in identifying, characterizing, and defining the borders of neck masses. MDCT, with its advanced imaging capabilities, can provide high-resolution images that allow for clear visualization of both soft tissue and bony structures. This enables precise localization and delineation of tumors, which is critical for determining their size, location, and involvement with adjacent tissues. By evaluating MDCT's diagnostic efficacy, the study aims to determine how effectively this imaging modality distinguishes between benign and malignant lesions and whether it provides detailed anatomical information essential for treatment planning. MDCT's ability to offer rapid, multi-planar reconstructions and three-dimensional imaging is particularly valuable in complex anatomical areas like the neck, where tumors may have varied extensions, making their accurate identification and characterization crucial for patient management.

B. **To assess whether Computed Tomography complements Clinical Examination by delineating the deep extension of tumors and identifying metastatic cervical lymphadenopathy**:

This objective focuses on determining whether CT imaging can enhance the findings of a clinical examination by revealing deeper aspects of tumor involvement and identifying metastatic spread to cervical lymph nodes, which may not be detected through physical examination alone. Clinical examination is limited by factors such as the size and depth of tumors, and in some cases, the ability to palpate lymph nodes can be restricted, especially in deeper or smaller metastases. CT can provide detailed cross-sectional images, helping clinicians visualize the full extent of a tumor's invasion into surrounding tissues, including vascular structures, nerves, and deep muscular planes, which are not always palpable. Additionally, CT's ability to detect lymph node involvement, even when nodes are small or deep, allows for more accurate staging of cancer, which is essential for developing a comprehensive treatment plan. By complementing clinical findings with imaging data, CT enhances the overall diagnostic accuracy and provides a more complete understanding of the disease's extent, leading to better-informed decisions regarding surgical, radiological, and oncological interventions.

3. Methods

3.1 Study Population:

This cross-sectional study involved 45 patients who presented with clinical signs suggestive of neck masses or had neck lesions previously identified by ultrasound. All patients experienced a palpable neck lump and neck discomfort. They underwent further evaluation using a 32-slice Siemens Somatom GO. Now CT scanner to obtain a detailed image. A preliminary diagnosis was made after the CT scan and was later compared with histopathological findings or surgical results, whenever available, to confirm diagnostic accuracy.

3.2 Inclusion Criteria:

1. All patients referred for CT imaging of neck masses, irrespective of age or gender.
2. Patients presenting with palpable neck lumps.
3. Patients with neck lumps identified through ultrasound.

3.3 Exclusion Criteria:

1. Patients who did not provide valid consent.
2. Pregnant women, due to radiation risks.
3. Patients with known allergies to intravenous contrast agents.
4. Patients with altered renal parameters, as contrast agents cannot be administered.
5. Patients with a history of trauma.

To reduce risks, patients were instructed to fast for four hours prior to the CT scan. Informed consent was obtained after explaining the potential risks of contrast dye administration.

A planning scan (topogram) was first taken with patients in a supine position and their head extended. Axial CT sections were acquired with thin slices (5 mm) from the base of the skull to the thoracic inlet. These slices were later reconstructed into even thinner 1 mm slices. Following the initial scan, a contrast-enhanced study was performed. A non-ionic, iodine-based contrast agent (CONTRPAQUE®) was injected intravenously at a dose of 50-60 ml (1 ml/kg body weight) with a concentration of 300 mg/ml.

After the contrast injection, detailed images were taken in different planes (sagittal and coronal) using 1 mm slices. Special techniques were applied to enhance specific features as needed. Radiologists reviewed the scans using settings tailored for different tissues (mediastinum and bone windows). Pathological lesions were analyzed based on size, location, enhancement patterns, calcification, necrosis, fat, spread into surrounding tissues, venous thrombosis, and bony involvement.

This approach enabled comprehensive assessment of neck masses, guiding the diagnosis and subsequent treatment decisions.

The data acquired was analyzed using graphs, tables, statistical formulas, and Excel sheets.

4. Results

Table 1: Age Distribution - Demographic Profile (N=45)

Age in years	Frequency	Percentage
<10	4	8.88%
11-20	2	4.44%
21-30	5	11. 11%
31-40	6	13.33%
41-50	3	6.66%
51-60	15	33.33%
61-70	8	17.77%
>70	2	4.44%
Total	**45**	**100%**

Source: primary data.

In the present study maximum percentage of patients were in the age group of 51-60years (33.3%) followed by 61-70 years(17.7%).

Table 2: Gender Distribution Of Neck Lesions (N=45)

Gender	No. of cases	Percentage
Male	25	55.56%

Female	20	44.44%
Total	**45**	**100%**

Source: primary data.

The present study show male preponderance (55.56%) with male to female ratio of 1.25:1

Table 3: Sensitivity And Specificity Of MDCT For Diagnosis Of Neck Lesions (N=45)

Lesions according to space	**Positive**		**Negative**		**Total**
	True	**False**	**False**	**True**	
Submandibular space	6	0	0	39	45
Masticator space	4	0	1	40	45
Parapharyngeal space	6	0	0	39	45
Carotid space	1	0	0	41	45
Parotid space	3	0	0	42	45
Pharyngeal mucosal space	3	0	0	42	45
Retropharyngeal space	1	0	0	44	45
Posterior cervical space	1	0	0	44	45
Visceral space	19	0	0	26	45

Source: primary data.

In the present study 44 out of 45 cases were correctly characterized by Computed tomography. One case of mandibular osteosarcoma was wrongly diagnosed as osteomyelitis.

Table 4: MDCT Of Neck Lesions – Correlation With Final Diagnosis

Lesions according to space	**Sensitivity**	**Specificity**	**PPV**	**NPV**	**Accuracy**
Submandibular space	100	100	100	100	100
Masticator space	100	100	100	97.6	97.8
Parapharyngeal space	100	100	100	100	100
Carotid space	100	100	100	100	100
Parotid space	100	100	100	100	100
Pharyngeal mucosal space	100	100	100	100	100

Retropharyngeal space	100	100	100	100	100
Visceral space	100	100	100	100	100

Source: primary data.

5. Discussion

Out of the 45 patients enrolled in the study, 28 had benign lesions, and 17 had malignant lesions. This division reflects the common clinical presentation of neck masses, with both benign and malignant etiologies frequently encountered. The study found that malignant lesions tended to exhibit rapid growth and severe symptoms early on, which often prompted patients to seek medical care more quickly. In contrast, benign lesions typically grew more slowly and did not cause as intense or early symptoms. These differences in presentation emphasize the importance of early detection and accurate differentiation between benign and malignant conditions.

The study also observed an age-related trend in the distribution of benign and malignant neck lesions. Most of the benign lesions (89%) occurred in patients under the age of 60, while the majority of malignant lesions (82%) were found in patients over 50. This was similar to a study done by Mehrotra et al. (2005) **[9]** and Otto et al. (1990) **[10]**. This suggests a correlation between increasing age and a higher prevalence of malignancy, which may be linked to long-term exposure to carcinogenic risk factors. Among the most common risk factors in the study population were tobacco use, betel nut chewing, and smoking, all of which are known to increase the risk of developing head and neck cancers. This observation aligns with the known epidemiology of head and neck cancers, where chronic exposure to these carcinogens plays a significant role in cancer development.**[11]**

The study also found that men were more likely to have malignant neck lesions, with a male-to-female ratio of 2:1. This is consistent with the literature, which suggests that smoking and alcohol consumption, both of which are more prevalent in men, are major risk factors for head and neck cancers.**[12]** The higher incidence of malignant lesions in men highlights the need for targeted prevention and early detection strategies in this population.

Among the malignant neck lesions identified in the study, laryngeal carcinoma and hypopharyngeal carcinoma were the most common, each accounting for 29.4% of the cases. These two types of cancer are known for their aggressive nature and their potential to spread to surrounding tissues.**[13]** The identification of these cancers through MDCT is crucial for staging and treatment planning, as accurate delineation of tumor borders and the involvement of adjacent structures helps guide surgical and therapeutic interventions.

Necrosis, or the presence of dead tissue, was observed in 64.7% of the malignant lesions. This finding is significant because necrosis is often a hallmark of aggressive tumor behavior and can be used to differentiate malignant from benign lesions. In contrast, benign lesions generally do not exhibit necrosis to the same extent.**[13]**

Bony involvement was another key factor assessed in the study. Malignant lesions showed a significantly higher rate of bony involvement (29.4%) compared to benign lesions (7.1%). This difference further supports the aggressive nature of malignant tumors, as they tend to invade surrounding structures, including bones. Interestingly, benign lesions, such as mandibular osteomyelitis, demonstrated bony expansion and remodeling, which suggests a reactive process rather than a destructive one. In contrast, malignant lesions, such as hypopharyngeal carcinoma, mandibular osteosarcoma, and nasopharyngeal carcinoma, exhibited bony erosion, indicative of the destructive nature of these cancers.**[13,14]**

6. Conclusion

In conclusion, MDCT plays a crucial role in the evaluation of neck lesions, offering detailed imaging that aids in distinguishing between benign and malignant masses. It helps delineate lesion extent, detect bony involvement, and identify features like necrosis, critical for assessing malignancy. The study emphasizes MDCT's ability to improve diagnostic accuracy, guide treatment planning, and facilitate early detection, particularly in populations at risk due to age and lifestyle factors. This enhanced diagnostic capability empowers physicians and surgeons to make more informed decisions, ultimately improving patient outcomes by enabling timely, precise interventions for neck lesions.

Refrences

1. Franz J. Wippold II. Neck; Computed Body Tomography with MRI Correlation , Lee, Joseph K. T, Sagel, Stuart S, Stanley, Robert J, Heiken, Jay P 4th Edition volume I .2006 Lippincott Williams & Wilkins: 145 -215.
2. Wippold FJ. 2nd, Head and Neck Imaging: The Role of CT and MRI. J Magn Reson Imaging 2007; 25(3): 453 -65.
3. Stanley E. Thawley M.D, Mokhtar Gado M.D, Thomas R. Fuller M.D. Computerized tomography in the evaluation of head and neck lesions.The Laryngoscope March 1978; 88(3) :451 -9
4. Martinez CR, Gayler B, Kashima H, et al. Computed tomography of the neck. Radiographics 1983; 3: 9 -40.
5. Lell M, Baum U, Koester M, Nömayr A, Greess H, Lenz M.Radiologe. The morphological and functional diagnosis of the head- neck area with multiplanar spiral CT 1999 Nov; 39(11):932 -8.
6. Baum U, Greess H, Lell M, Nömayr A, Lenz M. Imaging of head and neck tumors-methods: CT, spiral-CT, Multislice- spiral-CT. Eur J Radiol. (2000) Mar; 33(3):153 -60.
7. H Greessa ,A Nömayra, B Tomandlb, M Blankc, M Lella, M Lenza.2D and 3D Visualisation Of Head And Neck Tumors From Spiral-Ct Data (2000) European Journal Of Radiology March 2000 ; 33(3): 170-177 .
8. Alberico RA, Husain SH, Sirotkin I. Imaging in head and neck oncology.(2004) Surg Oncol Clin N Am. 2004 Jan;13(1):13-35.

9. Ravi Mehrotra, Mamata Singh et al .Trends of prevalence and pathological spectrum of head and neck cancers in North India. Indian journal of cancer 2005; 42 (2): 89-93
10. Otto RA, Bowes AK. Neck masses: benign or malignant? Sorting out the causes by age-group. Postgrad Med. 1990 Jul; 88(1):199-204.
11. Park, K. (2015) Park's Textbook of Preventive and Social Medicine. 23rd Edition, OTHERS, India.
12. Beynon RA, Lang S, Schimansky S, Penfold CM, Waylen A, Thomas SJ, Pawlita M, Waterboer T, Martin RM, May M, Ness AR. Tobacco smoking and alcohol drinking at diagnosis of head and neck cancer and all-cause mortality: Results from head and neck 5000, a prospective observational cohort of people with head and neck cancer. Int J Cancer. 2018 Sep 1;143(5):1114-1127. doi: 10.1002/ijc.31416. Epub 2018 Apr 23. PMID: 29607493; PMCID: PMC6099366.
13. Kumar, V., Abbas, A. K., & Aster, J. C. (2017). Robbins Basic Pathology (10th ed.). Elsevier - Health Sciences Division.
14. CT and MRI of the Whole Body, 5th ed, 2-Vol. set. AJNR Am J Neuroradiol. 2009 Aug;30(7):e103–4. doi: 10.3174/ajnr.A1609. PMCID: PMC7051543.