MULTIDETECTOR CT EVALUATION OF NECK MASSES

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ABSTRACT

BACKGROUND

By the introduction of cross-sectional imaging, a new dimension in evaluation of neck lesions has evolved. The main reason for head and neck imaging is to evaluate the true extent of disease to best determine surgical and therapeutic options.

To find out the role of multidetector computed tomography in the evaluation of neck lesions with respect to localization and characterization of neck lesions, with respect to anatomical plane delineation, extension to adjacent structures and bony involvement.

The objectives of this study were- 1) To localize and characterize neck lesions with respect to anatomical delineation, extension to adjacent structures and bony involvement. 2) To correlate the findings of MDCT with final diagnosis.

MATERIALS AND METHODS

Data will be collected from patients with neck lesions referred to Sri Lakshmi Narayana Institute of Medical Sciences, Puducherry.

RESULTS

Out of 30 cases studied, 12 (40%) were of benign aetiology and 18 (60%) were of malignant aetiology. Most of the patients were below the age group of 40 years except for a case of thyroglossal cyst in a 42-year-old male patient.

Most of the malignant lesions of the head and neck region in this series including maxillary space carcinomas and pharyngeal mucosal space carcinomas, visceral space carcinomas and metastatic lymph nodes were above the age of 45 years except for 4 cases.

CONCLUSION

From this study, we conclude that, Multidetector Computed Tomography of the neck has improved the localization and characterization of neck lesions. The most important advantage lies in its ability to detect bony lesions.

KEYWORDS

Multidetector CT, Neck Spaces, Neck Masses, Thyroid Carcinoma.

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BACKGROUND

Neck is a conical space that is situated between the base of skull up to the thoracic inlet. It is divided into suprahyoid and infrahyoid part by the hyoid bone.[1] Traditionally the neck used to be classified based on triangles. But with the advent of cross-sectional imaging the concept of neck spaces has come into picture. The neck is divided into twelve spaces by the superficial and deep cervical fascia.

CT with its unique capacity to display osseous and soft tissue details has become an indispensable tool in the evaluation of patients with neck mass.[2]

Spiral-CT is standard for imaging neck tumours. Secondary coronal reconstructions of axial scans are helpful in the evaluation of the small of the tongue base or palate crossing midline. Multi slice-spiral-CT allows almost isotropic imaging of the head and neck region and improves the assessment of tumour spread and lymph node metastases in arbitrary oblique planes. The rapid acquisition results in volumetric data set, reconstructed to a stack of thin and overlapping native images, thus reducing partial volume averaging and motion artefacts. Furthermore, full advantage of intravenous contrast agent is accomplished by optimal imaging between the injection and image acquisition.

Aims and Objectives

To find out the role of Multidetector computed tomography in the evaluation of neck lesions with respect to-

a) Localization and characterization of neck lesions with respect to anatomical plane delineation, extension to adjacent structures and bony involvement.
b) To correlate the findings of MDCT with final diagnosis.

MATERIALS AND METHODS

Source of Data

Data will be collected from patients with neck lesions referred to Sri Lakshmi Narayana Institute of medical sciences, Puducherry.

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Imaging was done with Siemens Somatom Scope 32 Slice.

Method of Collection of Data

- **Study Design -** A prospective co-relational study will be conducted over a period of two years on 30 patients with neck lesions. They will be evaluated with MDCT and findings will be co-related with surgical specimen/ biopsy where ever applicable.
- **Sensitivity and Specificity -** Research hypothesis and statistical methods will be framed in consultation with the biostatistician.

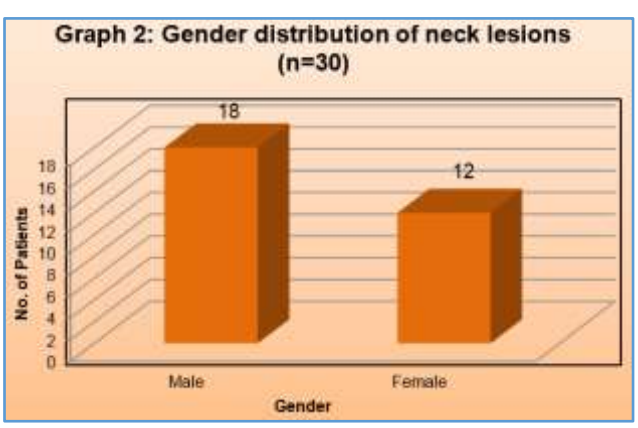
Inclusion Criteria

1. Patients presenting with palpable neck masses.
2. Neck lesions detected on ultrasound.
3. Patients presenting with symptoms relating to neck area.

Exclusion Criteria

- Cases of trauma will be excluded from the study.
- Patients with neck lesions but in whom contraindications to contrast administration were present such as contrast hypersensitivity or high renal parameters.
- Moribund patients.

Study Design: A prospective correlation study to find the efficiency of spiral CT in the evaluation of neck lesions.



RESULTS

Age distribution according to the aetiologies

Out of 30 cases studied 12(40%) were of benign aetiology and 18 (60%) were malignant aetiology. Most of the benign lesions of the neck was below the age of 50 years except for a case of parotid space abscess which is diagnosed in 52-year-old male patient.

Most of the developmental of neck were below the age group of 40 years except for a case of thyroglossal cyst in a 42-year-old male patient.

Most of the malignant lesions of the head and neck region in this series including maxillary space carcinomas and pharyngeal mucosal space carcinomas and visceral space carcinomas and metastatic lymph nodes were above the age of 45 years except for 4 cases, where in (3) thyroid carcinomas was diagnosed at the age of 40, 42 and 44 years respectively, (1) case of minor salivary gland tumour of the pharyngeal mucosal space who was 37 years female patient.

In the present study malignant lesions prevailed among male population with a male to female ratio of 1.6:1. Equal incidence of benign lesions among females was noted with a female to male ratio of 1:1.

Lesion	Number	%
Larynx	2	11.11
Thyroid	5	27.77
Oral Cavity	1	5.55
Lymph nodes	1	5.55
Nasopharynx	4	22.22
Parotid	1	5.55
Maxillary sinus	2	11.11
Others	2	11.11
Total	18	100.00

Table 1. Among the Malignant Lesions (n=18)

Most common malignant lesion in this series were thyroid carcinoma followed by nasopharyngeal carcinoma.

Neck Lesion	Frequency	%
Masticator Space	2	6.66
Buccal Space	1	3.33
Parotid Space	4	13.33
Parapharyngeal Space	3	10
Retropharyngeal Space	2	6.66
Anterior cervical Space	1	3.33
Carotid Space	1	3.33
Submandibular Space	2	6.66
Visceral Space	7	23.33
Pharyngeal Mucosal Space	6	20
Posterior Cervical Space	1	3.33

Table 2. Distribution of Neck Mass According to Space (n=30)

The most common lesion in the current series was in visceral space followed by pharyngeal mucosal space.

Most (88.88%) of the malignant lesions showed heterogeneous contrast enhancement. Necrosis was present in 66.66% of the malignant lesions and 33.33% of the benign lesions. Bony involvement was seen in 6 cases (27.7%) of the malignant lesions. Vascular involvement in the form of jugular vein thrombosis was seen in 16.66% of

malignant lesions. Extension into the adjacent space was seen in 8 (77.7%) of malignant lesions and in 3 (33.3%) cases of benign lesions. None of the malignant cases in this study had distant metastasis.

Lesions According to Space	Positive		Negative		Total
	True	False	True	False	
Submandibular Space	1	1	0	28	30
Masseteric Space	2	0	0	28	30
Buccal Space	1	0	0	29	30
Parapharyngeal Space	3	0	0	27	30
Carotid Space	1	0	0	29	30
Parotid Space	4	0	0	26	30
Pharyngeal Mucosal Space	5	0	1	24	30
Retropharyngeal Space	2	0	0	28	30
Anterior Cervical Space	1	0	0	29	30
Posterior Cervical Space	1	0	0	29	30
Visceral Space	7	0	0	23	30

Table 3. Sensitivity and Specificity of MDCT for Diagnosis of Neck Lesions (n=30)

In the present study 28 out of 30 cases were correctly characterized by Computed tomography giving an accuracy of 96%. One case of lymphoma was wrongly diagnosed as metastasis and another case of minor salivary gland tumour was inaccurately diagnosed as benign haemangioma.

Lesions according to Space	Sensitivity	Specificity	PPV	NPV	Accuracy	P value
Submandibular Space	100	96.55	50	100	96, 67	<0.001
Masseteric Space	100	100	100	100	100	<0.001
Buccal Space	100	100	100	100	100	<0.001
Parapharyngeal Space	100	100	100	100	100	<0.001
Carotid Space	100	100	100	100	100	<0.001
Parotid Space	100	100	100	100	100	<0.001
Pharyngeal Mucosal Space	83.33	100	100	96	96.67	<0.001
Retropharyngeal Space	100	100	100	100	100	<0.001
Anterior cervical Space	100	100	100	100	100	<0.001
Visceral Space	100	100	100	100	100	<0.001

Table 4. MDCT Neck Lesions – Correlation with Final Diagnosis

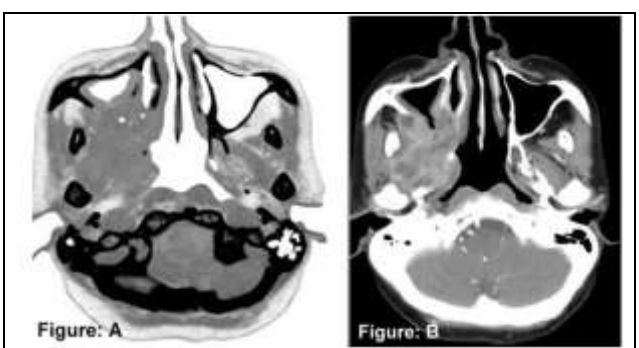


Figure 1. Maxillary Sinus Carcinoma

Axial pre and post contrast images showing heterogeneously enhancing mass involving most of the right maxilla, the right palate and a major portion of the right zygomatic arch with bone erosion and necrosis.

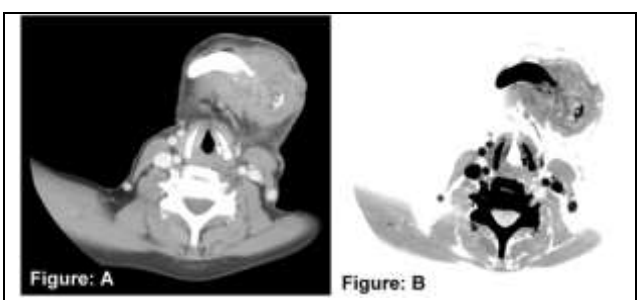


Figure 2. Buccal Carcinoma

Axial pre-& post-contrast CT images showing heterogeneously enhancing mass arising from floor of mouth on left side with invasion of adjacent mandible on skin.

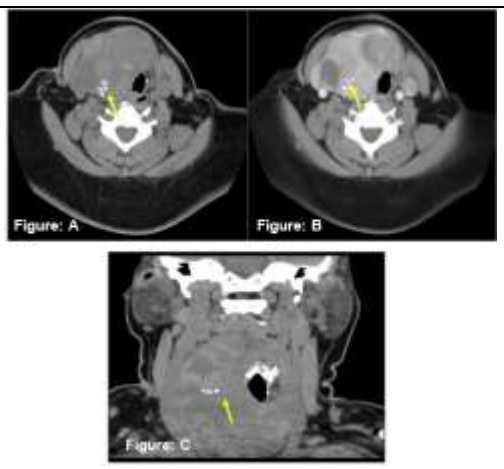


Figure 3. Papillary Thyroid Carcinoma

Axial and coronal reformatted pre and post contrast CT images showing homogenous enhancing right thyroid mass with few calcifications and extension beneath the sternum.

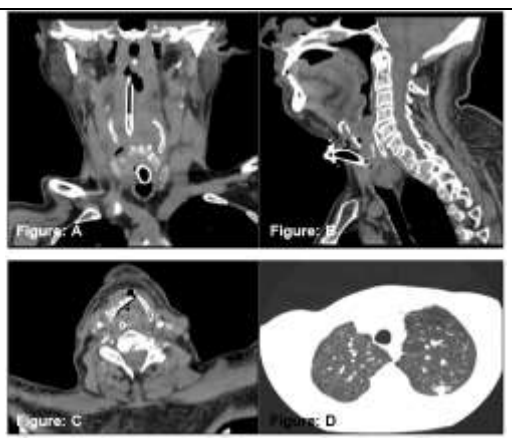


Figure 4. Laryngeal Carcinoma

Plain & contrast CT multiplanar reconstructed images showing advanced laryngeal glottic carcinoma showing heterogeneous enhancement with supra & infraglottic extension, thyroid cartilage destruction and spiculated metastatic lung nodule in apicoposterior segment of left upper lobe.

Figure 5. Nasopharyngeal Carcinoma

Axial plain, contrast enhanced & coronal reformatted CT images showing heterogeneously enhancing mass in the mucosal space on right side extending into right nasal cavity, pre-vertebral space, masticator space with bone erosion.

DISCUSSION

In the present study an attempt has been made to study the importance of the CT scan in evaluation of neck lesions. This includes studying the usefulness of CT scan not only in identifying the lesion but also in delineating the extensions of the lesion. The computed tomographic scans of 30 patients who were found to have lesions of neck were analysed with available similar studies. Out of 30 cases studied 12 (40%) were of benign aetiology and 18 (60%) were of malignant aetiology.

Most of the malignant lesions of the head and neck region in this series including maxillary space carcinomas and pharyngeal mucosal space carcinomas and visceral space carcinomas and metastatic lymph nodes were above the age of 45 years except for 4 cases, where in (3) thyroid carcinomas was diagnosed at the age of 40, 42 and 44 years respectively,[1] case of minor salivary gland tumour of the pharyngeal mucosal space who was 37 years female patient. A study done by Otto RA et al[3] states that most of the benign lesions of neck occur in paediatric and young adults group and most of the malignant conditions occur in the elderly.

In another study done by Ravimerhotra et al 2005[4] showed that the prevalence of head and neck malignancy was highest in patients belonging to the 50-59 years age group.

The most common malignant lesion in the neck in the present study was thyroid carcinoma (27.77%) followed by nasopharyngeal carcinoma (22, 22%) and laryngeal and maxillary carcinomas (6.66%).

In another study by Hasan Altumbabic et al 2008[5] laryngeal cancers were most common (26.1%) followed by cancers of oropharyngeal region.

Regarding the CT characteristics of benign and malignant neck lesions: Necrosis was present in 66.6% of the malignant lesions and 33.33% of the benign lesions.
In a study by C. Eskey et al 2000[6] states that necrosis is more frequently seen in malignant lesions.

Bony involvement was seen in 6 cases (27.7%) of the malignant lesions and in no case (0) of benign lesions.
Malignant lesions (buccal carcinoma, nasopharyngeal carcinoma, adenoid cystic carcinoma, maxillary carcinoma and laryngeal carcinoma) caused bony erosion.

The present study correlated with the study conducted by Janakarajah et al 1984[7] who states that benign tumours are slow growing and show bony expansion than bony destruction whereas malignant lesions and chronic granulomatous infections shows bony destruction.

Extension into the adjacent space was seen in 14 (77.77%) of malignant lesions and in 4 (33, 33%) cases of benign lesions.

The study by Janakarajah et al 1984 states that intracranial and intraorbital extension is more common in malignant lesions but are also seen in infection.

In the present study, out of a total of 30 cases, 2 cases were localized to have masticator space involvement and were secondary to maxillary sinus carcinoma. The sensitivity and specificity of masticator space lesions were 100% and 100% respectively and positive predictive value is 100% and accuracy of 100%. A study done by F. Galli et al 2010 correctly identified the space in 96% of the lesions and characterized the lesions in 93% of cases.

In the present study, out of 30 cases, 1 case of buccal space lesions was encountered, and CT accurately diagnosed it with sensitivity and specificity of 100% and 100% respectively and positive predictive value is 100% and accuracy of 100. In a study done by Kurabayashi et al 1997 using the criteria of ill-defined margins, violation of fascial planes and aggressive bone destruction for the, diagnosis of malignancy only 7 out of 11 malignant tumours were correctly diagnosed with a sensitivity 64% and they concluded that CT was useful in demonstrating the presence and location of the mass in buccal space and however the value of CT in differentiating malignant and benign lesions in buccal space is limited.

In the present study 6 cases of pharyngeal mucosal lesions were diagnosed.

A case of adenoid hypertrophy and four cases of nasopharyngeal carcinoma were correctly diagnosed. One false positive case which we encountered in this study was a case of pharyngeal mucosal space minor salivary gland tumour which was wrongly diagnosed as haemangioma. There was linear enhancement of the lesion and hence was wrongly diagnosed haemangioma but histo-pathologically was proved as minor salivary gland tumour.

Simental A, Carrau R.: Cummings C et al,[8] 2005. States that minor salivary gland tumours accounts for 6% of all head and neck malignancies and low grade minor salivary gland tumours are well defined and show unpredictable enhancement pattern that may be similar to benign masses like haemangiomas. In our case linear enhancement of the tumour thought as flow voids found in haemangiomas. Other case of lymphoma was falsely diagnosed as metastasis due to diffuse homogenous enhancement of the mass and destruction of the adjacent mandible.

In the present study 2 cases of laryngeal carcinomas were encountered. All cases of laryngeal carcinoma were accurately diagnosed with 100% sensitivity and specificity.
In a retrospective study by Katsantonis G.P et al 1986[9] the accuracy of preoperative staging by high-resolution CT. The accuracy of CT staging for glottic carcinoma was 75%. The accuracy of CT staging increased in the supraglottic and transglottic lesions, to become superior to the clinical staging, the preoperative staging accuracy was 91.4% for supraglottic carcinoma and 87.5% for transglottic carcinoma. Higher accuracy of laryngeal carcinoma in our series could be because of the use of Spiral CT in this study. Keberle M, Sandstede J, et al 2003[10] conducted a study to evaluate 3d MPR reconstructions in staging of laryngeal and hypopharyngeal carcinomas and concluded that coronal and sagittal MPR provided a better topographical visualization of the tumour in 14 of 42 (33%) of the patients, and influenced the therapeutic strategy in 8 of 42 (19%) of the patients and concluded that besides the 3-mm axial slices, coronal and sagittal MPR can improve the topographical visualization of laryngo-pharyngeal tumours and are recommended for preoperative MSCT of laryngeal and/or hypopharyngeal carcinomas.

Bone Involvement

MDCT has the capability to delineate the bone erosion or destruction with the highest accuracy in the imaging modalities. In the present study

MDCT detected both bony expansion and bony destruction in patients which were confirmed post-operatively. The sensitivity and specificity of CT to detect bone erosion or destruction was 100%. This is where the MDCT has definite advantage over the MRI. When malignant mass causes bone destruction, CT and MRI can be used as complimentary to each other, without the bias to one modality.

With regard to individual aetiologies there was an overall accuracy of 96% accuracy in diagnosing neck lesions.

In general, with the evolution of MDCT, and the use of coronal and sagittal reformatted images the sensitivity of localizing neck mass has gone up. Although both computed tomography (CT) and Magnetic Resonance Imaging (MRI) can accurately diagnose tumours and inflammation, multidetector CT (MDCT) now appears to be the preferred initial modality for evaluating a patient with a palpable neck mass because of easy availability, rapid acquisition and less cost.

Both MDCT and MRI can be used for initial diagnosis of a primary head and neck malignancy and for staging of cervical lymph nodes. The rapid image acquisition of MDCT reduces physiologic motion and produces a higher consistent image quality compared with MRI.

On the other hand, MRI is superior to CT for soft tissue characterization. MRI is also superior to CT for detecting perineural spread, which is important for initial staging for a variety of skull base tumours. Addition of sequences such as short tau inversion recovery (STIR) may further increase sensitivity of MRI to lymphadenopathy.

Advanced CT and MRI techniques, such as perfusion and diffusion imaging are being investigated for possible applications such as differentiating benign from malignant lymph nodes and tumour response.

Although MDCT alone is used for depiction of neck masses, combined PET/CT is more accurate than PET or CT alone for the depiction of malignancy in the head and neck. Radiologist confidence was substantially higher with the combined modality.

CONCLUSION

- From this study we conclude that, Multidetector Computed Tomography of the neck has improved the localization and characterization of neck lesions.

- Accurate delineation of disease by CT scan provides a reliable pre-operative diagnosis, plan for radiotherapy ports and post treatment follow up.
- The most important advantage lies in its ability to detect bony lesions (erosions and expansion).
- Recently developed Multidetector CT (MDCT) enables thinner collimation with use of MPR, MIP and SSD images which improves the localization of the neck lesions.
- Since CT is fast, well tolerated, and readily available, it can be used for initial evaluation, preoperative planning, biopsy targeting, and postoperative follow-up and reserve MRI as a complimentary imaging modality or for those tumours that may have higher chance of perineural spread.
- However, histopathology still remains the gold standard as CT is not 100% accurate.

Summary

- Among the neck lesions the most common were thyroid carcinomas (16.6%) followed by nasopharyngeal carcinomas (13.33%) and laryngeal, maxillary malignancy.
- Malignant lesions were more common in the elderly age group of >60 years with a male to female ratio of 1.6:1.
- The most common space involvement was visceral space (23.33%) followed by pharyngeal mucosal space (20%).
- MDCT has 96% accuracy in diagnosing neck lesions.
- MDCT has 100% accuracy in predicting bony involvement in head and neck cancers.
- Thus, MDCT has an excellent accuracy in localizing and characterizing neck lesions.

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