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ORIGINAL ARTICLE

Diagnostic accuracy of multislice CT scan in the detection of cervical lymph node metastasis in head and neck squamous cell carcinoma taking histopathology as gold standard.

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ABSTRACT… Objective: To determine the diagnostic accuracy of multislice computed tomography (MSCT) in the detection of cervical lymph node metastasis in patients with head and neck squamous cell carcinoma, taking histopathology as the gold standard. **Study Design:** Cross-sectional study. **Setting:** Department of Radiology, Liaquat National Hospital, Karachi. **Period:** 31st May 2023 to 30th November 2023. **Methods:** A total of 252 patients with biopsy-proven head and neck squamous cell carcinoma were included in the study. Contrast-enhanced multislice computed tomography was performed in a craniocaudal direction. Cervical lymph nodes were considered positive for metastasis based on predefined radiological criteria. During surgery, lymph nodes were excised and sent for histopathological examination. A 2×2 contingency table was used to calculate sensitivity, specificity, positive predictive value (PPV), negative predictive value (NPV), and overall diagnostic accuracy of MSCT. Post-stratification analysis was also performed. **Results:** Among the study population, 70.2% were male and 29.8% were female. Central necrosis was observed in 54% of lymph nodes, spherical shape in 32.9%, conglomeration of three or more lymph nodes in 34.1%, and extracapsular spread in 26.6% of cases. Multislice CT demonstrated a sensitivity of 93.8%, specificity of 95.1%, PPV of 95.3%, NPV of 93.6%, and an overall diagnostic accuracy of 94.4%. **Conclusion:** Multislice computed tomography showed high sensitivity, specificity, and diagnostic accuracy for detecting cervical lymph node metastasis in head and neck squamous cell carcinoma, supporting its role as a reliable preoperative imaging modality.

Key words: Cervical Lymph Node Metastasis, Diagnostic Accuracy, Head and Neck Cancer, Histopathology, Multislice Computed Tomography.

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INTRODUCTION

Head and neck squamous cell carcinoma (HNSCC) is ranked among the most prevalent malignant tumors around the world and is still a principal contributor to the morbidity and mortality associated with cancer. This is especially true for South Asian populations.[1] The disease often disseminates via the lymphatic system, and the presence of metastases to the cervical lymph nodes is among the most significant prognostic variables, influencing decisions regarding treatment, and determining the prognosis and survival. Therefore, effective preoperative evaluations of lymph node involvement are crucial, as the lymph node metastases greatly compromise a patient's overall survival and predisposes them to a greater risk of disease recurrence. Early and accurate identification of metastatic lymph nodes is essential for proper surgical planning to prevent the neck from being either over treated or under treated.[2] Multiple imaging techniques are used routinely for the assessment of cervical lymph nodes in cases of HNSCC. These techniques include ultrasound, magnetic resonance imaging, and in some cases, positron emission tomography, and computed tomography. In most cases, contrast enhanced multislice computed tomography (MSCT) is the most cost effective, and has the greatest availability.[3] It affords high spatial resolution and is able to provide outstanding anatomical detail. A number of studies have indicated that MSCT has considerable importance in the assessment of lymph nodes for the presence of metastatic disease, and has identified and described a number of characteristics essential for determining the presence of malignancy within

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lymph nodes to include enlargement, altered shapes, presence of central necrosis, extranodal extension of metastases, and amalgamation of lymph nodes to form a single conglomerate lymph node. However, there is still some variability in reported diagnostic accuracy, and such technological advances should not rely solely on size criteria, as that can lead to false negative or false positive results.[4]

It is indeed universally documented that MSCT is effective in assessing cervical lymph node metastases. The authors acknowledge that there is still some modern data from local settings and the surrounding landscapes, as well as from the local settings, where disease patterns, risk profile, and tumor biology are likely disparate.[5] The varying rates of tobacco use and betel nut chewing, coupled with late disease presentation, are likely to influence the imaging and the performance of the diagnosis. Thus, the purpose of the study was to evaluate the accuracy of multi-slice computed tomography in identifying cervical lymph node metastasis in patients with head and neck squamous cell carcinoma, using histopathology as the gold standard and carried out in a local tertiary care hospital.

METHODS

This research was designed as a cross-sectional diagnostic accuracy study to ascertain how accurate multislice computed tomography (MSCT) is in identifying metastatic lymph nodes in patients with head and neck squamous cell carcinoma (HNSCC).[6] A cross-sectional design was most suitable to simultaneously assess the imaging findings of a study population with a determined histopathology outcome to allow for accurate determination of the diagnostic parameters including sensitivity, specificity, positive predictive, and negative predictive values.

This study was conducted in the Department of Radiology Liaquat National Hospital, Karachi, a tertiary care teaching hospital.

The study was conducted from 1st June 2023 to 30th November 2023. This period was selected to ensure that there was adequate enrollment, as well as consistency in imaging protocols, interpretations, and histopathology evaluations throughout the study.

Out of the 252 patients in the research, sample size computations were performed through sensitivity and specificity estimation techniques with 95% confidence and 5% margin of error. The calculations were based on previously reported sensitivity, specificity, and prevalence estimates of cervical lymph node metastasis in head and neck squamous cell carcinoma. This sample size was reasonable enough to ascertain reliable estimates on the diagnostic accuracy of multislice computed tomography.[7]

Non-probability consecutive sampling was performed to recruit patients meeting the eligibility criteria during the entire duration of the study. All consecutive patients with biopsy-proven head and neck squamous cell carcinoma and referrals for multislice computed tomography were included in the study. This sampling method minimized selection bias and ensured the representation of normal clinical practice.[8]

Inclusion Criteria

A total of patients of both genders aged 15 to 75, with biopsy-approved diagnosis of head and neck squamous cell carcinoma, were participants in the study. Only patients who underwent contrast-enhanced multiline computed tomography of the neck and were later surgically respected and submitted to histopathological study of the cervical lymph nodes were eligible. Participation was limited to patients for whom both imaging and histopathological evidence were available to enable exact comparisons.[9]

Exclusion Criteria

Some patients who had had radiotherapy in the head or neck area had to be excluded because radiotherapy is known to change the shape of lymph nodes. People whose medical history indicated hypersensitivity to indicated contrast agents, serious long-term kidney disease, or who would be in a dangerously high state of anxiety if placed in a closed magnetic resonance imaging scanner were also excluded from the research study. Participants who had primary cancers unrelated to head and neck cancer, who could not be contacted for subsequent

assessments, and who did not receive surgical exception of the lymph node were also excluded.

We got permission from the Institutional Ethical Review and the College of Physicians and Surgeons Pakistan (0915-2023-LNK-ERC) to get some written consent from the patients. To do this, each patient had to get a neck, contrast-enhanced, multi-slice CT scan done with a Toshiba Aquilion multi-slice CT scanner. The imaging was done from the head down to the thoracic inlet, after an iodine-based CT contrast was given intravenously (10). The images were done with a quick breath hold, and the images were interpreted by a radiologist consultant. The radiologist was supposed to have at least five years of experience. The cervical lymph nodes were examined by the radiologist based on certain radiological criteria they had predetermined for the nodes to be per the definition of metastatic involvement. Lymph nodes were removed during the surgery, along with adjacent tissues based on clinical judgment, and were sent for gross and microscopic pathology examination, which was the standard of comparison.

Data / Statistical Analysis

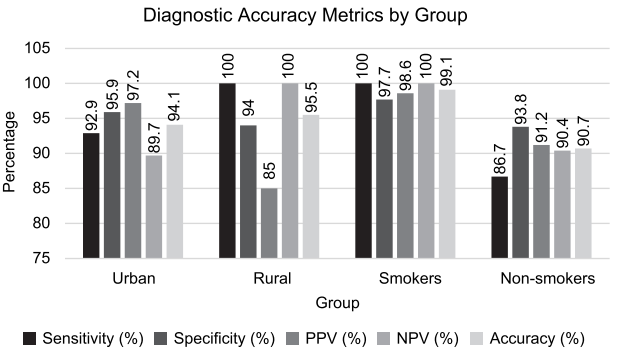
Data was inputted and analyzed with the Statistical Package for Social Sciences software version 25. For determining the distribution of the continuous variables, the Shapiro-Wilk test was performed. For the variables that followed a normal distribution, the mean and standard deviation were used. If the continuous variables were not normally distributed, the median and interquartile range were used. Values for categorical variables were summarized and presented as counts and percentages. Measures of diagnostic accuracy (sensitivity, specificity, positive and negative predictive values, and overall accuracy) were derived from a 2×2 contingency table because we used histopathology as the gold standard. Post-stratification analysis of potential effect modifiers (age, sex, ethnicity, duration of the illness, smoking status, and size of the lymph node) was done for stratification.

RESULTS

This study, which received ethical approval, included 252 patients with head and neck squamous cell carcinoma and a biopsy from the head and neck. We used multi-slice computed tomography (MSCT) as a diagnostic instrument, and the gold standard to measure this test's performance was histopathology.

FIGURE-1

Comparison of diagnostic accuracy metrics (Sensitivity, Specificity, PPV, NPV, Accuracy) of Multislice CT against histopathology as gold standard, stratified by population subgroups



This graph shows which of the four groups, urban, rural, smokers, non-smokers, had the highest metrics of sensitivity, specificity, positive predictive value, negative predictive value, and total accuracy of Muli slice CT compared against the gold standard histopathology data. Smokers showed the highest achievement with total accuracy of 99.1, sensitivity of 100, and NPV of 100, achieving the highest reliability of this subgroup. Rural showed perfect sensitivity and NPV; however, there was a small decrese in positive predictive value of only 85%. Urban showed good positivity and negative predictive values at total accuracy of a 94.1. In contrast, non-smokers showed the least sensitivity with only 86.7 and total accuracy of only 90.7, likely due to the imaging features being somewhat more complex or difficult to visualize. Multislice CT is an extremely good reliable diagnostic test with only some and in some instances more considerable dependency in different population groups, and this should be central in any data driven clinical decision making.

INTERPRETATION

The assessment demonstrated that multislice computed tomography (MSCT) has a very high ability in spotting cervical lymph node metastasis compared to histopathology. Out of 252 patients, MSCT had a sensitivity of 93.8%. This means that

out of every 100 histopathologically confirmed metastatic lymph nodes, 94 were identified on imaging. The specificity of 95.1% means that there was a high accuracy of identifying metastatic lymph nodes. The positive predictive value of 95.3% suggests that a large proportion of MSCT-positive cases were actually metastatic disease, and the negative predictive value of 93.6% confirmed that there were metastases that went undetected when MSCT results were negative. Overall diagnostic accuracy of 94.4% indicates that there was high concordance between MSCT and histopathology. The correlation between imaging and histopathology was statistically significant (p = 0.000), establishing the value of MSCT as a diagnostic test in the assessment of lymph nodes prior to surgery.

TABLE-I

Overall diagnostic accuracy of multislice CT for cervical lymph node metastasis using histopathology as gold standard (n = 252)

Parameter	Value
Sensitivity	93.8%
Specificity	95.1%
Positive Predictive Value (PPV)	95.3%
Negative Predictive Value (NPV)	93.6%
Diagnostic Accuracy	94.4%
P-value	0.000*

DISCUSSION

Knowing preoperative diagnosis for cervical lymph node metastases is important for how to manage patients with squamous cell carcinoma (HNSCC) because it determines how to approach treatment, outcome, and surgery, and these things influence medical decisions. In this study, histopathology was used as the gold standard, and multislice computed tomography (MSCT) demonstrated significant diagnostic accuracy with sensitivity of 93.8% and specificity of 95.1% along with a positive predictive value (PPV) of 95.3% and negative predictive value (NPV) of 93.6% and total precision of 94.4%. These findings were consistent with previous literature. Salman and Adil studied similar patients and reported a CT sensitivity of 97.8% and specificity 84.6%, making MSCT very trustworthy for cervical lymph node metastasis detection.[11] In the same way, a study by Geetha et al. confirmed how CT was able to successfully determine the nodal spread of metastases with accuracy of more than 91%, emphasizing this method of diagnosis as a good option, especially in low-resource situations.[12]

Our study expands on this by stratifying diagnostic accuracy to a more granular approach, which is by further demographic and clinical subgroups and the important differences and variations across these groups. The highest diagnostic performance was in

TABLE-II

Stratified diagnostic accuracy of multislice CT according to demographic and clinical variables (n = 252)

Variable	Category	Sensitivity (%)	Specificity (%)	PPV (%)	NPV (%)	Accuracy (%)	P-value
Gender	Male (n=177)	100	97.5	98.0	100	98.9	0.000*
	Female (n=75)	75.0	90.7	85.7	83.0	84.0	0.000*
Age Group	≤ 45 years (n=116)	82.2	97.2	94.9	89.6	91.4	0.000*
	> 45 years (n=136)	100	92.3	95.5	100	97.1	0.000*
Disease Duration	≤ 12 months (n=185)	87.1	95.1	90.0	93.6	92.4	0.000*
	> 12 months (n=67)	100	0.0	100	0.0	100	0.000*
Lymph Node Size	≤ 2 cm (n=184)	90.7	93.9	92.9	92.0	92.4	0.000*
	> 2 cm (n=68)	100	100	100	100	100	0.000*
Ethnicity	Urban (n=185)	92.9	95.9	97.2	89.7	94.1	0.000*
	Rural (n=67)	100	94.0	85.0	100	95.5	0.000*
Smoking Status	Smokers (n=112)	100	97.7	98.6	100	99.1	0.000*
	Non-smokers (n=140)	86.7	93.8	91.2	90.4	90.7	0.000*

smokers with overall 99.1% accuracy and perfect sensitivity and NPV, which could be due to the more aggressive forms of tumor biology usually seen in smokers, which results in more distinct features in imaging, such as central necrosis, nodal matting, or even beyond capsule expansion. Carlton et al. stated that MSCT is better able to capture features of extracapsular nodes spread as well as other CT features of extracapsular spread phenomena.[13] Non-smokers did not achieve as high levels of sensitivity (86.7%) and accuracy (90.7%) as the other categories, possibly due to less aggressive disease or more subtle findings on the imaging. These changes show importance of having different diagnostic thresholds depending on factors such as patient background or biology of tumor.

The evidence also suggests that age may play a role with older patients and individuals over the age of 45 exhibiting perfect sensitivity and accuracy (100%) while younger patients and those 45 and younger had overall lower values. These older patients may have had a more advanced disease at the time of diagnosis or a larger nodal burden, leading to more straightforward detection. Difference in age also means lower diagnostic accuracy in females at 98.9% than in males (84.0%). Higher diagnostic accuracy in males may also be due to more aggressive behavioral risk factors such as increased personal tobacco use. Further studies may also be guided to support this hypothesis.[14] The radiology evaluation is still based on the size of the lymph nodes. In the studies, they were able to determine perfect diagnostic measuring standards for nodes larger than 2 cm, while nodes 2 cm or less were still highly accurate (92.4% accurate), but carried a greater chance of a false-negative. This aligns with the results of Madsen et al. Size alone will almost always result in a missed diagnosis, which is especially the case with micrometastases.[15] Thus, radiological exams will always have to be supplemented with other diagnostic criteria, including morphology, which can be shape, central necrosis, and margins. The length of time a patient has had the disease also seems to have played a role. Patients with greater than 12 months of disease were 100% accurate, which could be attributed to more obvious radiological changes due to the delay in presentation. This is a trend found in Sureshkannan et al. who also noted improvement accuracy of CT scans in advanced disease.[16]

Ethnic and geographical differences were reflected in the urban vs rural comparisons. Although rural patients had perfect sensitivity and NPV, they also had a lower PPV (85%), suggesting a greater likelihood of false positives. This could be a result of reactive lymphadenopathy or infectious disease, both of which are more common in rural areas and can mimic metastases in imaging. Patients living in cities had perfectly balanced metrics with instance of diagnostic accuracy at 94.1%. These results show that diagnostic imaging should be tailored and localized, especially in areas with a high incidence of granulomatous and inflammatory diseases, such as tuberculosis.

This research focused exclusively on MSCT, but results must be placed in context with the other available imaging techniques. CT and MRI as well as PET may be useful in distinguishing soft tissue and in evaluating tissue metabolism but may not be available in all settings. Takamura and others have shown in numerous meta-analyses that CT remains diagnostic and is more available and cheaper in several settings. In countries with lower and middle income such as Pakistan, MSCT is usually the first imaging technique used for the staging of head and neck cancers due to its availability and short scan times. This research is special because it provides new detailed insight into how MSCT is perceived across a variety of demographic groups and how it is influenced by smoking, age, sex, and size of lymph nodes. However, it is a single-center study, and thus its limitations must be noted, particularly regarding its ability to be generalized. While having one radiologist interpret the imaging data adds a level of uniformity, consistency is no substitute for accuracy and it raises questions about the observation. Leaving outpatients who had already received radiotherapy or neck procedures may have had a negative impact regarding the study's real-world applications. In addition, other imaging techniques like MRI or PET-CT could have broadened the diagnostic view.

CONCLUSION

Multislice computed tomography (MSCT) shows a

lot of diagnostic accuracy with respect to discerning the cervical lymph node metastasis in patients with HNSCC. Its utility does differ somewhat from demographic and clinical characteristics but is nonetheless a dependable and valuable preoperative tool in routine oncologic imaging.

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CONFLICT OF INTEREST

The authors declare no conflict of interest.

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AUTHORSHIP AND CONTRIBUTION DECLARATION	
1	**Yussra Khattri:** Acquisition.
2	**Rizwan Ajmal:** Critical and intellectual revision.
3	**Jawaid Iqbal:** Drafting.
4	**Quratul Ain Haroon:** Data analysis.
5	**Uzma Panhwer:** Revision.
6	**Sadia Khursheed:** Proof read.