



ORIGINAL ARTICLE

Computed tomography as a prime modality for early detection of nasopharyngeal carcinoma.

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ABSTRACT... Objective: To determine the diagnostic accuracy of computed tomographic scan for the diagnosis of nasopharyngeal carcinoma, taking histopathology as gold standard. **Study Design:** Cross-sectional Validation study. **Setting:** Department of Radiology, Allied Hospital, Faisalabad. **Period:** 5th December 2020 to 4th June 2021. **Material & Methods:** Total 170 people between the ages of 20 and 60, of either gender, who were thought to have nasopharyngeal cancer were included. Patients with previous operation on the neck, previous radiotherapy to the neck, or patients with congenital lesions, claustrophobic and CRF were excluded. Then patients were undergone CT evaluation. Patients were labeled as positive or negative. Then patients were undergone biopsy and biopsy samples were evaluated from the Histopathology Department of Allied hospital Faisalabad. Biopsy results were followed and patients were confirmed as positive or negative. **Results:** Using histopathology as gold standard, computed tomographic scan has a sensitivity of 95.10%, specificity of 91.18%, positive predictive value of 94.17%, negative predictive value of 92.54%, and diagnostic accuracy of 93.53% for detecting NPC. **Conclusion:** This study proved computed tomography as a highly sensitive and accurate non-invasive modality for the detection of intracranial extension of NPC.

Key words: Computed Tomography, Nasopharyngeal Carcinoma, Sensitivity.

INTRODUCTION

Globally, around 80000 new cases of nasopharyngeal carcinoma (NPC) are reported annually, representing 0.7% of all cancer cases. In North America and Europe, the annual age-standardized incidence rate is less than 1 case per 100,000 people. However, in endemic areas such as Southern China (e.g. Hong Kong) and Southeast Asia, it can be as high as 20 to 30 cases per 100,000 people in men and 8 to 15 cases per 100,000 people in women.¹ An aggressive form of head and neck cancer, NPC frequently spreads both locally and systemically before being diagnosed. The parapharyngeal soft tissue, the base of the skull, and cerebral structures are all potential local spread targets for NPC.² According to research by King et al. the incidence of NPC is 31.03 percent.³

According to research conducted by Tang et al.,

age-standard incidence rate of NPC was reduced significantly between 1970 & 2007 in South and East Asia, North America, and Nordic countries, with average annual percentage decrease from 0.9% to 5.4% in men and 1.1% to 4.1% in females. Average annual percent decreases in death rates were between 0.9% and 3.7% for men and between 0.8% and 6.5% for women, depending on age group, between 1970 and 2013. The study speculated that tobacco control, dietary changes, and economic development were linked to the decline in incidence, while advances in diagnosis and radiation therapy were credited with lowering mortality rates.³

Subsequently, a biopsy of the original tumor location is performed endoscopically to confirm the diagnosis. Nodular phenotype, cauliflower phenotype, submucosal phenotype, infiltrating phenotype, and ulcerated phenotype are the five

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most common kinds of NPC. Due to the limited sampling capacity of a biopsy, it is conceivable that mucosal, submucosal, or infiltrating cancers of the nasopharynx may go unnoticed.⁴ Therefore, it is suggested that individuals with such malignancies have nasopharyngeal tissue sampled by endoscopic biopsies at random. Similarly, recent years have been searching towards the diagnostic potential of less intrusive and more patient-friendly imaging techniques.⁵ Many imaging modalities like CT and magnetic resonance imaging (MRI) of the head and neck have been employed to diagnose and stage NPC.⁶⁻⁸ Sensitivity of CT scan to diagnose NPC in a study was found to be 100% and specificity 93.10%.⁷ Specificity and sensitivity of CT scan in a meta-analysis in diagnosis of NPC was found to be 84.0% and 80.0% respectively.⁸ Latif et al. in his study has shown the sensitivity & specificity of CT scan in diagnosis of NPC as 77.8% and 66.7% respectively.⁹

As the previous literature has shown the controversy and large variation in the diagnostic accuracy of CT in detecting NPC and there is a need of a study on this topic for resolving the controversy, so I have decided to conduct this study to determine the diagnostic accuracy of CT scan to diagnose NPC, taking histopathology to be gold standard. In addition to filling a gap in the current literature, the results of my research will give valuable local statistics on the subject of interest. In addition, if it is found to have a high level of diagnostic accuracy, it will provide a non-invasive imaging modality for accurate assessment of the condition prior to surgery, allowing clinicians to choose the best treatment option for the patients and thereby lowering the patient's risk of morbidity and mortality.

OBJECTIVES & OPERATIONAL DEFINITIONS

The objective of this study was:

“To determine the diagnostic accuracy of computed tomography scan in diagnosing nasopharyngeal carcinoma, taking histopathology as gold standard.”

OPERATIONAL DEFINITIONS

1. **Diagnostic Accuracy:** was measured in

terms of;

- a. **Sensitivity:** was the chance that someone who got a negative CT did not have nasopharyngeal cancer.
 - b. **Specificity:** was the possibility that a person with a positive CT test truly had nasopharyngeal cancer.
 - c. **Positive Predictive Value (PPV):** was defined as the percentage of those who CT could rule out as having nasopharyngeal cancer.
 - d. **Negative Predictive Value:** was defined as the ability of CT to correctly identify those who have nasopharyngeal carcinoma.
2. **True Positive:** Patients with NPC on CT scan as well as on histopathology.
 3. **True negative:** Patients with no NPC on CT scan as well as on histopathology.
 4. **False Positive:** Patients with NPC on CT scan but absent on histopathology.
 5. **False Negative:** Patients with no NPC on CT scan but present on histopathology.
 6. **Suspected cases of NPC:** presence of all these i.e. nodule in neck (on palpation), odynophagia (difficulty in swallowing), hoarseness of voice, fever (>101 F), loss of weight (>10 kg within last one month), loss of appetite and foreign body sensation in throat as assessed on history was taken as positive.
 7. **NPC on CT scan:** Fossa of Rosenmüller asymmetry (blunting or obliteration), deglutition muscle layer thickening (due to tumor infiltration), parapharyngeal space obliteration (or parapharyngeal space displacement), and increased preoccipital soft tissue width (in axial slices) were all considered good findings.
 8. **Histopathology findings of laryngeal cartilage involvement:** tumour was identified within the collagen bundles that form the inner perichondrium with continuous cartilage destruction was taken as positive.

MATERIAL & METHODS

This Cross-sectional validation study was conducted at Department of Radiology, Allied Hospital, Faisalabad from 5th December 2020 to 4th June 2021.

Sample size of 170 cases has been calculated

with 95% confidence level, 10% desired precision, prevalence of NPC as 31.03%¹¹ and sensitivity and specificity of CT scan in diagnosing NPC as 84.0% and 80.0% respectively⁴. The sample technique used was Non-probability, consecutive sampling.

a. Inclusion Criteria

1. All patients with suspected nasopharyngeal carcinoma (as per-operational definition).
2. Duration of symptoms >1 month.
3. Patients 20-60 years of age.
4. Both genders.

b. Exclusion Criteria

1. Patients with previous operation on the neck, previous radiotherapy to the neck, or patients with congenital lesions.
2. Claustrophobic patients (with fear of closed spaces), unable to undergo CT scanning.
3. Patients with chronic renal failure (assessed on history and medical record (s/creatinine >1.1 mg/dl).

Data Collection Procedure

With approval from the hospital's ethical board, 170 patients who came to the Radiology department at Allied Hospital in Faisalabad and met the inclusion criteria were chosen. After obtaining consent, a Toshiba Aquilion Multislice CT scanner was used to obtain images of the patient's neck both before and after intravenous contrast was administered. CT scan findings were interpreted by one consultant radiologist (at least 3 years of post-fellowship experience) and were looked for presence or absence of NPC (as per-operational definition). Then all patients were undergone surgery in the concerning ward and resected specimen was sent to the institutional pathology laboratory. Specimen was analyzed by the consultant histopathologist (at least 3 years of post-fellowship experience). The results of the CT scan were compared to those of the histopathological analysis. All of these informations (patient age/gender/symptom duration/CT/histology findings for NPC) was entered on a custom-made proforma (Annexure-I).

Data Analysis Procedure

The collected data was analyzed using SPSS 25.0. The average age and median duration of symptoms were determined. Statistics were provided for both sexes and for the presence or absence of NPC on CT and histology. Using histopathology as the gold standard, we utilized a 22 contingency table to determine the sensitivity, specificity, positive predictive value, negative predictive value, and diagnostic accuracy of CT scan for the diagnosis of NPC. Using stratification, we were able to manage potential confounding factors, such as patient age, gender, and illness duration. The diagnostic accuracy after stratification was determined as well.

		Nasopharyngeal Carcinoma on Histopathology	
		Present	Absent
Nasopharyngeal Carcinoma on CT Scan	Present	True Positive (TP)	False Positive (FP)
	Absent	False Negative (FN)	True Negative (TN)

$$\text{Sensitivity: } \frac{TP}{TP+FN} \times 100$$

$$\text{Specificity: } \frac{TN}{FP+TN} \times 100$$

$$\text{Positive predictive value: } \frac{TP}{TP+FP} \times 100$$

$$\text{Negative predictive value: } \frac{TN}{FN+TN} \times 100$$

$$\text{Diagnostic accuracy: } \frac{TP+TN}{TP+FP+TN+FN} \times 100$$

RESULTS

Age range in this study was from 20-60 years with mean age of 42.06 ± 12.96 years. Majority of the patients 98 (57.65%) were between 20 to 40 years of age as shown in Table-I.

Out of these 170 patients, 104 (61.18%) were males and 66 (38.82%) were females with male to female ratio of 1.6:1 (Figure-I). Mean duration of NPC was 9.91 ± 2.85 months (Table-II).

In CT positive patients, 97 (True Positive) had nasopharyngeal carcinoma and 06 (False Positive) had no nasopharyngeal carcinoma on Histopathology. Among 67, CT negative patients,

05 (False Negative) had nasopharyngeal carcinoma on histopathology whereas 62 (True Negative) had no nasopharyngeal carcinoma on histopathology (p=0.0001) as shown in Table-III.

Overall sensitivity, specificity, positive predictive value, negative predictive value and diagnostic accuracy of CT scan in diagnosing nasopharyngeal carcinoma, taking histopathology as gold standard was 95.10%, 91.18%, 94.17%, 92.54% and 93.53% respectively.

Stratification of diagnostic accuracy with respect to age groups is shown in Table-IV & V. Gender stratification is shown in Table-VI & VII. Stratification of diagnostic accuracy with respect to duration of NPC is shown in Table-VIII & IX.

Age (years)	No. of Patients	%age
20-40	98	57.65
41-60	72	42.35
Total	170	100.0

Table-I. Distribution of patients according to Age.

Mean ± SD = 42.06 ± 12.96 years

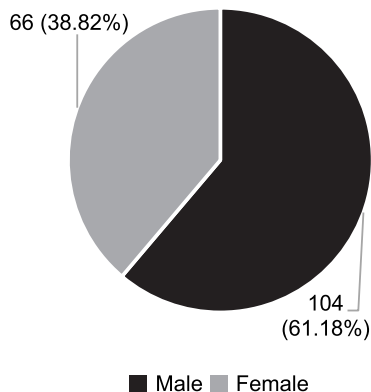


Figure-1. Distribution of patients according to Gender (n=170).

Duration of NPC (months)	No. of Patients	%age
≤12	125	73.53
>12	45	26.47
Total	170	100.0

Table-II. Distribution of patients according to duration of NPC.

• Mean ± SD = 9.91 ± 2.85 months

	Positive Result on Histopathology	Negative Result on Histopathology	P-Value
Positive result on CT	97 (TP)*	06 (FP)***	0.0001
Negative result on CT	05 (FN)**	62 (TN)****	

Table-III. Diagnostic accuracy of CT scan in diagnosing nasopharyngeal carcinoma, taking histopathology as gold standard.

*-TP=True positive **-FP=False positive ***-FN=False negative ****-TN=True negative

Sensitivity: 95.10%

Specificity: 91.18%

Positive Predictive Value (PPV): 94.17%

Negative Predictive Value (NPV): 92.54%

Diagnostic Accuracy: 93.53%

	Positive Result on Histopathology	Negative Result on Histopathology	P-Value
Positive result on CT	50 (TP)	05 (FP)	0.001
Negative result on CT	03 (FN)	40 (TN)	

Table-IV. Stratification of diagnostic accuracy with respect to age 20-40 years (n=98).

Sensitivity: 94.34%

Specificity: 88.89%

Positive Predictive Value (PPV): 90.91%

Negative Predictive Value (NPV): 93.02%

Diagnostic Accuracy: 91.84%

	Positive Result on Histopathology	Negative Result on Histopathology	P-Value
Positive result on MRI	47 (TP)	01 (FP)	0.001
Negative result on MRI	02 (FN)	22 (TN)	

Table-V. Stratification of diagnostic accuracy with respect to age 46-70 years (n=72).

Sensitivity: 95.92%

Specificity: 95.65%

Positive Predictive Value (PPV): 97.92%

Negative Predictive Value (NPV): 91.67%

Diagnostic Accuracy: 95.83%

	Positive Result on Histopathology	Negative Result on Histopathology	P-Value
Positive result on CT	55 (TP)	04 (FP)	0.001
Negative result on CT	03 (FN)	42 (TN)	

Table-VI. Stratification of diagnostic accuracy with respect to male gender (n=104).

Sensitivity: 94.83%
Specificity: 91.30%
Positive Predictive Value (PPV): 93.22%
Negative Predictive Value (NPV): 93.33%
Diagnostic Accuracy: 93.27%

	Positive Result on Histopathology	Negative Result on Histopathology	P-Value
Positive result on CT	42 (TP)	02 (FP)	0.001
Negative result on CT	02 (FN)	20 (TN)	

Table-VII. Stratification of diagnostic accuracy with respect to female gender (n=66).

Sensitivity: 95.45%
Specificity: 90.91%
Positive Predictive Value (PPV): 95.45%
Negative Predictive Value (NPV): 90.91%
Diagnostic Accuracy: 93.94%

	Positive Result on Histopathology	Negative Result on Histopathology	P-Value
Positive result on CT	77 (TP)	05 (FP)	0.001
Negative result on CT	03 (FN)	40 (TN)	

Table-VIII. Stratification of diagnostic accuracy with respect to duration of disease ≤12 months (n=125).

Sensitivity: 96.25%
Specificity: 88.89%
Positive Predictive Value (PPV): 93.90%
Negative Predictive Value (NPV): 93.02%
Diagnostic Accuracy: 93.60%

	Positive Result on Histopathology	Negative Result on Histopathology	P-Value
Positive result on CT	20 (TP)	01 (FP)	0.001
Negative result on CT	02 (FN)	22 (TN)	

Table-IX. Stratification of diagnostic accuracy with respect to duration of disease >12 months (n=45).

Sensitivity: 90.91%
Specificity: 95.65%
Positive Predictive Value (PPV): 95.24%
Negative Predictive Value (NPV): 91.67%
Diagnostic Accuracy: 93.33%

DISCUSSION

The most common nasopharyngeal neoplasm (NPC) is a locally aggressive tumor with a high risk of spreading to the cervical lymph nodes. The key to improving treatment success and lengthening survival time had been early detection, early diagnosis, correct staging, and assessment following therapy. When it comes to determining the stage of NPC and its overall extent, CT has proven to be the most trustworthy and well-established imaging technology. The most significant benefit of CT imaging is that it allows for the vivid visualization of the surrounding bone damage caused by NPC.^{10,11}

Using histopathology as the gold standard, I have investigated how well CT scans can detect NPC. My research showed that CT scan has a 95.10% sensitivity, 91.18% specificity, 94.17% positive predictive value, 92.54% negative predictive value, and 93.53% diagnostic accuracy in making the diagnosis of NPC when compared to the gold standard of histopathology. A research found that CT scan has a 100% sensitivity in diagnosing NPC and a 93.10% specificity.⁷ CT scan has a sensitivity of 84% and specificity of 80% when used to diagnose NPC, according to a meta-analysis.⁸ According to Latif et al. research, CT scan shows a 77.8 percent sensitivity and a 66.7 percent specificity for diagnosing NPC.⁹

Pathological examination of 44 patients with CT scan diagnosis of NPC found 35 cases of NPC,

2 cases of non Hodgkin's disease, 3 cases of nasopharyngeal TB, 3 cases of nasopharyngeal lymphadenosis, and 1 case of nasopharyngeal cyst. In 11 patients with CT-detected local mucosal thickening, pathology revealed either NPC, chronic inflammation, nasopharyngeal TB, or a nasopharyngeal cyst in 2 of the patients. Pathological investigation corroborated the CT diagnosis of nasopharyngeal fibrohemangioma in the remaining four instances.¹²

Over the course of two years, Abayomi and Bankoff examined the medical records of 23 individuals who were diagnosed with nasopharyngeal and maxillary sinus tumors. The aim of this study was to evaluate the impact of CT on treatment decision making by determining its use in defining tumor expansion to adjacent structures. Bone and soft tissue invasion can be clearly seen on a CT scan. The CT results impacted the choice of therapy and irradiation procedures for 11 of 15 patients with nasopharyngeal cancer and for 8 patients with maxillary sinus tumors. CT scans of the nasal cavity and maxillary sinus are very reliable diagnostic tools. The ability to provide effective therapy for tumors has been greatly enhanced by advances in pretreatment evaluation. Since local recurrence accounts for the vast majority of treatment failures, it stands to reason that better local control would lead to enhanced survival.¹³

CT scan had 100% sensitivity, 97% specificity, 80% positive predictive value, 100% negative predictive value, and 97% accuracy in another research examining the diagnosis of NPC.¹⁴

Cagici et al. made a similar discovery. They found that three-slice CT had a sensitivity of 95.1% and a specificity of 92.6% in detecting NPC.¹⁵

While CT was formerly the gold standard for staging NPC, MRI has since fully supplanted it, notably for primary and nodal staging as well as for detecting skull base tumor involvement with lytic or sclerotic lesions.^{16,17} While PET with 18F-FDG has largely replaced CT for usage in this setting, CT is still sometimes utilized for radiation planning. In NPC staging, PET/CT has been useful, especially for locating distant metastases.¹⁸ It is

also employed in post-treatment follow-ups to spot recurrences of NPC.

CONCLUSION

This study found that CT is a very sensitive and accurate non-invasive technique for identifying NPC, which has not only increased our capacity of accurate diagnosis of NPC but also enhanced patient care by allowing pre-operative planning for right management of patients. Therefore, we suggest that CT should be utilized frequently as a prime modality for precise identification of NPC, allowing appropriate pre-operative planning for these patients.




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