ORIGINAL ARTICLE

DIAGNOSTIC ACCURACY OF CONTRAST ENHANCED CT SCAN IN DIAGNOSING BRONCHOGENIC CARCINOMA, TAKING HISTOPATHOLOGY AS GOLD STANDARD

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ABSTRACT

OBJECTIVES: To determine the diagnostic accuracy of contrast enhanced CT scan in diagnosing bronchogenic carcinoma, taking histopathology as gold standard. **STUDY DESIGN:** Cross-sectional validation study. **SETTING:** Department of Radiology, Armed Forces Institute of Radiology, Rawalpindi from 8th December 2020 to 7th June 2021. **METHODOLOGY:** A total of 148 patients with suspected bronchogenic carcinoma between 20-70 years of age were included. Patients with already taking treatment, CRF and h/o allergy to contrast agent were excluded. Then CT was performed on Toshiba Asteion Multi Slice Scanner with I/V contrast.CT scan findings were interpreted by one consultant radiologist (at least 5 years of experience) and was looked for bronchogenic carcinoma as per-operational definition. All patients were then undergone CT guided trans-thoracic biopsy of pulmonary lesions by the relevant interventional radiologist and specimen was sent to institutional pathology laboratory for histopathology. **RESULTS:** Overall sensitivity, specificity, positive predictive value, negative predictive value and diagnostic accuracy of contrast enhanced CT scan in diagnosing bronchogenic carcinoma, taking histopathology as gold standard was 94.32%, 91.67%, 94.32%, 91.67% and 93.24% respectively. **CONCLUSION:** This study concluded that the diagnostic accuracy of contrast enhanced CT scan in diagnosing bronchogenic carcinoma is very high.

Keywords: Bronchogenic carcinoma,computed tomography, sensitivity.

Introduction

Bronchogenic carcinoma, in theory, should lend itself to screening. It is very common and in earliest stages it is estimated that ≤70% of cases can be cured with the help of surgery.[1] Despite this, bronchogenic carcinoma has an overall prognosis so dismal that incidence exceeds prevalence. In western world, it is a leading cause of cancer related deaths accounting to 32% in males and 25% in females and the age group affected is between 40-70 years.[2] In developing countries like Pakistan, death rate due to bronchogenic carcinoma is continuously increasing but the true incidence is not known in Pakistan due to lack of available data.[3] Smoking is considered to be the main risk factor which is easily identifiable and noninvasive screening tests should be done such as chest radiography and sputum cytology which are widely available.[3]

Prognosis and treatment outcomes are known to be related to the disease stage at the time of diagnosis.[4] Therefore, an accurate assessment of the extent of disease is critical to determine the most appropriate therapy. At present on hand imaging modalities for

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diagnosis and follow-up contain both anatomical and functional imaging. Anatomical investigations are mainly executed with computed tomography (CT) and magnetic resonance imaging (MRI).[5] Given its adequate spatial resolution and wide availability of this imaging modality, chest CT-scan is the primary and most commonly used modality for early diagnosis and initial staging of patients with bronchogenic carcinoma based on morphologic criteria. Recent CT developments involve perfusion and spectral imaging with promising results on tissue characterization.[6,7] Khaiq N et al[8] in his study has shown the prevalence of bronchogenic carcinoma in 56.7% patients and has shown the sensitivity and specificity of contrast enhanced CT scan in diagnosing bronchogenic carcinoma as 90% and 88% respectively.

Computed tomography (CT) scan provides the detailed morphological imaging information, hence it is generally used as a routine imaging procedure in the tumour, node, metastasis (TNM)-staging of patients diagnosed with bronchogenic carcinoma. However, regardless of the constantly ongoing process of development in CT scanning techniques in which today's CT scanners merge fast acquisition, fast data reconstruction and accuracy, the technique has important limitations.

CT scan has demostrated very accurately tumour extent within, and forecast spread beyond the lung in some cases. However, the query of whether the tumour has extended to the chest wall or the mediastinal strctures and, if so, is it still potentially surgically curable often remains unanswered. Furthermore the only sign to anticipate lymph node involvement using CT is enlargement in size or loss of fatty hila. Studies have shown that this sign is not very dependable. CT is also being used to evaluate distant metastases and helping staging of the tumour although other techniques such as ultrasound and magnetic resonance imaging can have similar or higher preciseness. Since the available literature on this is very scant, so there must be more studies on this. I have planned this study to determine the diagnostic accuracy of contrast enhanced CT scan in diagnosing bronchogenic carcinoma, taking histopathology as gold standard. The results of my study will not only be a useful addition in the existing literature but if it s diagnostic accuracy will be found high, then we can provide these particular patients with a non-invasive imaging modality which can be used routinely in our general practice for detecting bronchogenic carcinoma for selection of timely and proper treatment option in order to reduce the missery and mortality rate of these patients.

Methodology

The study was conducted at Armed Forces Institute of Radiology and Imaging, Rawalpindi from 8th December 2020 to 7th June 2021. After approval from institutional ethical review committee (IERB approval certificate no. 0027). Sample size was calculated by using open epi calculator (https://www.openepi.com/SampleSize/SSPropor.htm) and having 95% confidence level with expected prevalence of lung cancer as 56.7% with 10% absolute precision for sensitivity and specificity of contrast enhanced CT scan in diagnosing bronchogenic carcinoma as 90% and 88% respectively.[8] 148 patients with mean age mean age of 53.64 – 8.14 years(20-70 years) presenting to Armed Forces Institute of Radiology And Imaging, Rawalpindi, fulfilling the inclusion criteria were selected by non-probability, consecutive sampling. Informed consent was taken from each patient. After this, age, gender, smoker, place of living were noted. Then CT was performed on Toshiba Asteion Multi Slice Scanner with I/V contrast. Axial images were taken with patients lying supine.

The scanning values were 5 mm section thickness; 17.2 sec average scan time, 7mm reconstruction interval, 200 mAs and 120 KVP. Images were analyzed and CT scan findings were interpreted by one consultant radiologist (at least 5 years of experience) and was looked for bronchogenic carcinoma as per-operational definition. All patients were then undergone CT guided transthoracic biopsy of pulmonary lesions by the same radiologist and specimen was sent to institutional pathology laboratory for histopathology. CT scan findings were compared with histopathology findings. All this data was recorded on a specially designed proforma (Annexure-I).

Inclusion Criteria:

Age 20-70 years.
Both genders.

All patients with suspected bronchogenic carcinoma(as mentioned in operational definition).

Exclusion Criteria:

Patients who are already taking treatment (as further evaluation not required).
Radiotherapy to the chest in the past year.
Patients who cannot hold breath for optimum examination or cannot lie on the CT table due to some problem e.g. increased weight or back problem.
Patients with h/o allergy to contrast agents.
Patients with chronic renal failure (assessed on history and medical record (s/creatinine >1.1 mg/dl).

Collected data was analyzed through computer software SPSS 25.0. Age was presented as mean and standard deviation.

Bronchogenic carcinoma on contrast enhanced CT: Diagnosed by nature of lesion, either benign or malignant, will made using the following criteria and category d & e was taken as lung cancer. Scoring is done as follows:

a. **Not suspicious for malignancy:** homogenous, round, well-defined margins, 3 cm.
b. **Low suspicion:** Non homogenous, round, well-defined margins, <3 cm.
c. **Intermediate suspicion:** non homogenous attenuation, well-defined margins, >3 cm.
d. **Moderately high suspicion:** Irregular margins, > 3cm, non-homogenous attenuation.
e. **High suspicion:** non homogenous attenuation, lobulated, spiculated margins, >3 cm.

Bronchogenic carcinoma on histopathology: presence of all these i.e. polygonal cell with boundaries clearly visible, eosinophilic cytoplasm, large, hyperchromatic and irregular nuclei with marked pleomorphism and numerous atypical mitosis was taken as positive.

2 2 contingency table was used to calculate sensitivity, specificity, positive predictive value, negative predictive value and diagnostic accuracy of contrast enhanced CT scan in diagnosing bronchogenic carcinoma, taking histopathology as gold standard.

Results

Age range in this study was from 20-70 years with mean age of 53.64 – 8.14 years. Majority of the patients 76 (51.35%) were between 20-45 years of age. Out of these 148 patients, 100 (60.57%) were males and 48 (32.43%) were females with ratio of 2.1:1. Distribution of patients according to smoking status showed preponderance were smokers being112 cases (75.68 %) and 36 cases (24.32%) have no prior history of smoking. All the patients were subjected to contrast enhanced CT and found that 83 were True Positive and 05 were False Positive. Among 60, CECT negative patients, 05 (False Negative) had bronchogenic carcinoma on histopathology whereas 55 (True Negative) had no bronchogenic carcinoma on histopathology as shown in (Tab.1). Overall sensitivity, specificity, positive predictive value, negative predictive value and diagnostic accuracy of contrast enhanced CT scan in diagnosing bronchogenic carcinoma, taking histopathology as gold standard was 94.32%, 91.67%, 94.32%, 91.67% and 93.24% respectively. Diagnostic accuracy with respect to male gender (n=100) showed that 59 were True Positive and 01 were False Positive, among remaining 40 CECT negative male patients, 05 (False Negative) had bronchogenic carcinoma on histopathology whereas 35 (True Negative) had no bronchogenic carcinoma on histopathology . The sensitivity, specificity, positive predictive value, negative predictive value and diagnostic accuracy of contrast enhanced CT scan in diagnosing bronchogenic carcinoma in male gender patients, taking histopathology as gold standard was 89.36%, 97.22%, 97.67%, 87.50% and 92.77% respectively. In case of female gender (n= 48) stratification diagnostic accuracy showed that 24 were True Positive and 04 were False Positive and among remaining 20 cases, CECT negative female patients, 0 (False Negative) had bronchogenic carcinoma on histopathology whereas 20 (True Negative) had no bronchogenic carcinoma on histopathology. The sensitivity, specificity, positive predictive value, negative predictive value and diagnostic accuracy of contrast enhanced CT scan in diagnosing bronchogenic carcinoma in female gender patients, taking histopathology as gold standard was 100.0%, 83.33%, 85.71%, 100.0% and 91.67% respectively.

Collected data was analyzed through computer software SPSS 25.0. Age was presented as mean and standard deviation.

Bronchogenic carcinoma on contrast enhanced CT: Diagnosed by nature of lesion, either benign or malignant, will made using the following criteria and category d & e was taken as lung cancer. Scoring is done as follows:

	Positive result on Histopathology	Negative result on Histopathology
Positive result on CECT	83 **(TP)***	05 **(FP)*****
Negative result on CECT	05 **(FN)****	55 **(TN)******

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

Table 1: Diagnostic accuracy of contrast enhanced CT scan in diagnosing bronchogenic carcinoma, taking histopathology as gold standard

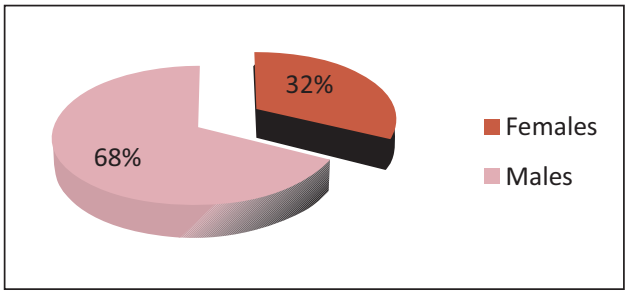

Figure 1a: Distribution of patients according to Gender (n=148)

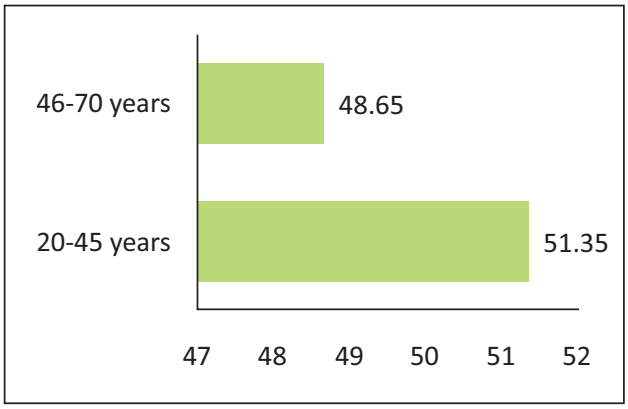

Figure 1b: Distribution of patients according to Age

Discussion

In the Western world, bronchogenic carcinoma remains the leading cause of cancer-related death in both males and females. The disease has a poor prognosis with an overall 5-year mortality rate of approximately 84%.[9] In patients with suspected bronchogenic carcinoma, the first imaging examination that is generally performed is a chest radiograph PA view which is followed by a high resolution CT scan (HRCT) and then contrast-enhanced CT scan of the thorax, abdomen and pelvis for staging. Depending on the setup, this is followed by other examinations such as dynamic contrast-enhanced CT (DCE-CT) scan. DCE-CT is a tool which, in theory, can quantify the perfusion of tissues by calculating the delivery of a contrast agent, and therefore blood, to these tissues.[10] I have conducted this study to determine the diagnostic accuracy of contrast enhanced CT scan in diagnosing bronchogenic carcinoma, taking histopathology as gold standard. Age range in this study was from 20-70 years with mean age of 53.64 – 8.14 years. Majority of the patients 76 (51.35%) were between 20-45 years of age. Out of these 148 patients, 100 (60.57%) were males and 48 (32.43%) were females with ratio of 2.1:1. The reason is due to high prevalence of smoking in men in our population and not in women. This is in contrast with the western data, where the bronchogenic carcinoma is the leading cause of cancer related deaths in women.[11] According to a survey, bronchogenic carcinoma is rarely diagnosed in people younger than 30 years and most cases occur in people over age of 40 years.[12,13] In my study, sensitivity, specificity, positive predictive value, negative predictive value and diagnostic accuracy of contrast enhanced CT scan in diagnosing bronchogenic carcinoma, taking histopathology as gold standard was 94.32%, 91.67%, 94.32%, 91.67% and 93.24% respectively. Khaiq N et al[8] in his study has shown the prevalence of bronchogenic carcinoma in 56.7% patients and has shown the sensitivity and specificity of contrast enhanced CT scan in diagnosing bronchogenic carcinoma as 90% and 88% respectively. Study conducted by Choi et al concluded that sensitivity and specificity of 92.0% and 89.0% respectively.[14]

These results closely matches the study of Toyoda et al in which sensitivity and specificity was found to be 88.9% and 92.6% respectively.[15] Currently CT continues to play a major role in the preoperative staging of non small cell lung cancer, for separating those patients with localized disease who are likely to benefit from surgical resection from those who have inoperable disease. However, recurrently scan-

ning disagrees with the tumour stage that is found at surgery. Even though CT provides important information such as to whether or not the tumour has invaded the main vessels/ bronchial tree or the chest wall or has traverse the fissure, in numerous cases the surgeon still makes ultimate decision based on the findings at bronchoscopy and thoracotomy. Herman et al[13] demonstrated that the positive predictive value for vascular invasion changed from 56%, when using a criterion of contact >90 , to 100% when >180 was used. Glazer et al16 suggested that a tumor is likely to be technically resectable if ≥1 of the following features are present: 1) <3 cm of contact between the tumor and the mediastinum; 2) <90 of circumferential contact with the aorta; and 3) a visible mediastinal fat plane between the tumor and the mediastinal structure. This does, however, not mean that a tumor with a contact of >3 cm or with an absent mediastinal fat plane is always irresectable. In the series of Glazer et al,[16] in almost 50% of the tumours that proved resectable a contact of >3 cm was present.[16,17] Conversely, in a study of 108 patients, Izbicki et al[18] reported one false-positive case for aortic invasion and multiple false negative cases for invasion of an atrium, pulmonary artery, superior vena cava or mediastinal bronchus. It is thus concluded that the morphological accuracy of CT to distinguish between resectable (stage T3) and unresectable (stage T4) cancers is low.

Conclusion

This study concluded that the diagnostic accuracy of contrast enhanced CT scan in diagnosing bronchogenic carcinoma is very high. So, we recommend that contrast enhanced computed tomography should be used routinely in our general practice for detecting bronchogenic carcinoma for selection of timely and proper treatment option in order to reduce the morbidity and mortality of these patients.

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