

# Demography and Characteristics of Lung Cancer Patients Evaluated by $^{18}\text{F}$ -FDG PET- CT imaging - Retrospective Analysis in NINMAS

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## ABSTRACT

**Introduction:** Carcinoma of the lung is one of the most common cancer in Bangladesh. Fluorine-18-fluorodeoxyglucose positron emission tomography-computed tomography ( $^{18}\text{F}$ -FDG PET-CT) plays an important role in staging and evaluating therapy response. Currently, limited data is available about the demography and characteristics of lung cancer patients in Bangladesh by  $^{18}\text{F}$ -FDG PET-CT scan.

**Objectives:** To evaluate the demographic pattern and pattern of findings in lung cancer patients by  $^{18}\text{F}$ -FDG PET-CT scan in the National Institute of Nuclear Medicine and Allied Sciences (NINMAS), Dhaka.

**Materials and Methods:** This retrospective study was conducted in the PET-CT division of NINMAS. A total of 53 patients out of 103 patients with lung cancer were enrolled who were referred to NINMAS from October 2020 to December 2021 for either baseline PET CT or for assessment of therapy response. Data were collected in a predesigned format from old documents and analyzed for demographic characteristics, histopathologic, morphologic and metabolic patterns as well as a comparison of the overall number of lung cancer patients with previous years.

**Results:** Among the enrolled 53 lung cancer patients the majority (34%) are in the 6th to 7th decades with 56.6% male and 43.4 % female. Adenocarcinoma (62%) and squamous cell carcinoma (24%) were the most common lung cancer subtypes. The majority of patients (53%) came for a therapeutic response evaluation; among them, 32% had a good response following therapy, 25% with progressive disease and others had mixed response, partial response, and stable disease. Nine percent of the patients came for follow up and among them, recurrence is detected in 20%. Lung cancer patients who came for baseline study, (38%) were upstaged (80%) mainly with 20% remaining in the same stage.

**Conclusion:** The demographic pattern of lung cancer patients observed in this study belonged to 6th & 7th decades having male predominance. Most of the patients were diagnosed with advanced stages of lung cancer. The use of  $^{18}\text{F}$ FDG PET-CT is crucial for the staging and diagnosis of suspected lung cancer, as well as therapeutic response and follow-up.

**Key words:** Lung cancer,  $^{18}\text{F}$ -FDG PET-CT, baseline, therapy response, demography

## INTRODUCTION

One of the most common causative factors for cancer-related mortality is bronchogenic carcinoma with an incidence of about 1.5 million cases per year in the whole world (1). It is classified histopathologically as non-small cell lung cancer (NSCLC) and small cell type, with the non-small cell variety accounting for 87% of cases (2) A large proportion of lung cancer patients present at an advanced stage of the disease, imposing a significant social and economic burden. While several studies have been conducted in western countries, there is a scarcity of demographic and other data on lung cancer in Bangladesh (3).

Radiological and nuclear imaging modalities play a key role in the detection, staging, and monitoring of the therapy response of patients with lung cancer. Low-dose computed tomography is the screening tool for lung cancer. On the other hand,  $^{18}\text{F}$ -FDG PET-CT scan have been shown to benefit the staging of lung cancer and the evaluation of treatment response (4).

PET-CT is a radioisotope-based nuclear imaging modality that can assess metabolic activity within the tumor by measuring  $^{18}\text{F}$ -FDG uptake by the malignant cells. PET-CT can also efficiently separate malignant tissue mass from surrounding benign or reactive tissue and can delineate therapy response by detecting biological changes before the appearance of any structural changes (5). This state of the art hybrid imaging provides both structural and functional information about the tumor mass based on standardized uptake value (SUV) and metabolic activity all over the body as well as

that of the tumor and hence can accurately assess the tumor staging and tumor response to therapy (6).

The National Comprehensive Cancer Network (NCCN) recommends PET-CT scan for staging and planning of radiation therapy in lung cancer (7, 8). PET-CT scan is an expensive test that requires specialized expertise as well as the presence of a cyclotron on site. Since 2016, NINMAS has provided the PET-CT service with a PET-CT scanner installed in 2015, providing service to cancer patients, inflammatory and infectious diseases, and neurological disorders. On October 25, 2020, a Cyclotron was installed along with another PET-CT machine as part of the project "Establishment of Positron Emission Tomography- Computed Tomography (PET-CT) with Cyclotron facilities" at NINMAS, block F, BSMMU. This is the largest and first cyclotron facility established by the Government of Bangladesh. This cyclotron generates the most widely used PET tracer, <sup>18</sup>F-fluorodeoxyglucose (FDG) (9,10).

To better understand the trends in the use of PET-CT for lung cancer management, a retrospective analysis was conducted to see the functional association of <sup>18</sup>F-FDG PET-CT imaging of lung cancer patients. The demographic characteristics of patients and imaging findings of PET-CT scans are also evaluated.

### **Materials and Methods**

This retrospective study was conducted at the PET-CT division in of the NINMAS, Dhaka. Patients' records were collected from the archive after obtaining proper permission and maintaining anonymity. Data were collected in a predefined format and saved in Microsoft Excel. A total of 103 referred patients with lung cancer visited NINMAS from October 2020 to December 2021. Among them, 53 patients were analyzed who had <sup>18</sup>F-FDG PET-CT either for baseline study or therapeutic response evaluation. In the case of therapeutic response evaluation, those who already had surgery with removal of primary tumor were excluded. The demographic patterns of patients with histopathological findings and PET-CT characteristics were analyzed. Metabolic and morphologic parameters of PET-CT images were evaluated for therapy response assessment. Finally, data was analyzed using Microsoft Excel.

### **RESULTS**

The demographic characteristics of lung cancer patients are shown in Table 1. The age of the 53 lung cancer patients were ranging from 28 to 80 years. The number of lung cancer was two (4%) in 20 to 30 years, three (6%) in 31-40 years, 12 (22%) in 41-50 years, 15 (28%) in 51-60 years, 18 (34%) in 61-70 years and three (6%) in >70 years or above age group (Figure 1). The number of male patients was 30 (56.6%) and female patients was 23 (43.4%). Right lung was involved in 34 (64.2%) and the left lung in 19 (35.8%). Coexisting diseases in lung cancer patients were diabetes mellitus (DM) in twelve (23%), hypertension (HTN) in four (7.5%), chronic kidney disease (CKD) in six (11%), chronic obstructive pulmonary disease (COPD) in five (9%), Ischemic heart disease (IHD) in one (2%), both DM and HTN in four (7.5%), others e.g. thyroid or pulmonary infectious disease, etc. in three (6%) patients and no comorbidity in 18 (34%) patients (Table 1).

Histopathologically, adenocarcinoma was found in 33 (62%), squamous cell carcinoma in 13 (24%), small cell carcinoma in two (4%), large cell carcinoma in one (2%), and four (8%) patients were of other categories e.g. neuroendocrine tumors or patients with suspected lung cancer with unrevealing malignancy on biopsy (Table 2). Staging data was not available in 10 (19%) cases. Most of the remaining patients was diagnosed with advanced lung cancer stages with a distribution of TNM stages as follows: stage I in one (2%), II in seven (13%), IIIA in two (4%), IIIB in 13 (24%) and IV in 20 (38%) patients (Table 2). Therapeutic response evaluation was done in 28 (53%) patients, either during interim period or within three months of completion of neoadjuvant chemotherapy (NACT) / external beam radiotherapy (EBRT) or both chemo and radiotherapy. On the other hand, 20 (38%) patients were studied for baseline staging and five (9%) patients were followed up after 6-12 months of completion of therapy to detect any recurrence (Table 2). Findings of baseline PET-CT revealed upstaging from previous clinical stage in 14 (70%), suspected to have malignant involvement of lung tissue in two (10%), clinical stage remaining the same in four (20%) patients with no patient requiring to downstage (Table 2). Therapeutic response evaluation of 28 patients show good

outcome in 9 (33%), partial response in four (14%), mixed response in four (14%), disease progression suggesting a failure of therapy in seven (25%), and stable disease in four (14%) (Figure 2). Whereas, follow-up of five patients revealed recurrence in one (Table 2).

The total number of lung cancer patients attending NINMAS was 17 in the year 2016, 24 in 2017, 14 in 2018, 20 in 2019, 27 in 2020, and 76 in 2021 (Table 3 and Figure 3).

**Table 1: Demographic characteristics of lung cancer patients (N=53)**

Characteristics	Number of patients (n) and percentage (%)
<b>Age groups</b>	
20-30	02 (4)
31-40	03 (6)
41-50	12 (22)
51-60	15 (28)
61-70	18 (34)
>70 and above	3 (6)
<b>Gender</b>	
Male	30 (56.6)
Female	23 (43.4)
<b>Side of lung involved</b>	
Right	34 (64.2)
Left	19 (35.8)
<b>Coexisting disease</b>	
DM	12 (23)
COPD	5 (9)
HTN	4 (7.5)
IHD	1(2)
CKD	6 (11)
DM+HTN	4 (7.5)
Others (eg. pulmonary disease)	3 (6)
No comorbidity	18 (34)

**Table 2 Clinical and PET-CT Characteristics of analyzed lung cancer patients.**

Histopathological type of carcinoma	N=53 Number (%)
Squamous cell	13 (24)
Adenocarcinoma	33 (62)
Small cell	2 (4)
Large cell	1 (2)
Others	4 (8)
<b>TNM staging (clinically available)</b>	<b>Number (%)</b>
I	1 (2)
II	7 (13)
IIIA	2 (4)
IIIB	13 (24)
IV	20 (38)
Staging not available	10 (19)
<b>Indication of PET-CT study</b>	
Baseline	20 (38)
Therapy response	28 (53)
Follow up	05(9)
<b>Findings of PET-CT</b>	
<b>In the case of the baseline study</b>	<b>n= 20 (%)</b>
Malignancy detected in suspected carcinoma	2 (10)
Upstaged on baseline	14 (70)
Stage unchanged	04 (20)
Downstaged	00 (0)
<b>In case of therapy response</b>	<b>n=28 (%)</b>
Good response	9 (33)
Partial response	4(14)
Mixed response	4 (14)
Progressive disease	7 (25)
Stable disease	4 (14)
<b>In case of follow up</b>	<b>n = 5 (%)</b>
Recurrence detected on follow up	01 (20)

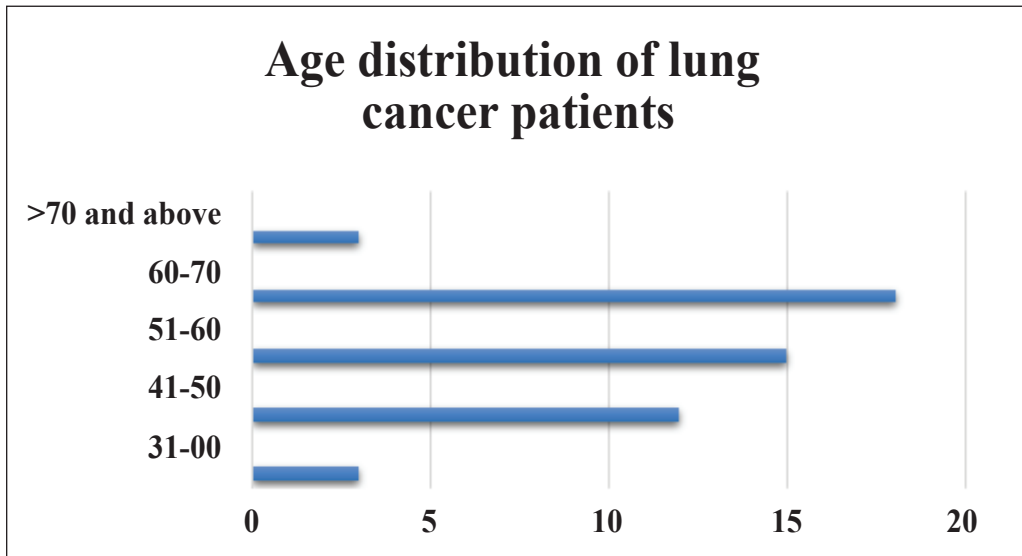


Figure 1: Age distribution of lung cancer patients attending NINMAS for <sup>18</sup>F-FDG PET-CT during the years 2016-2021

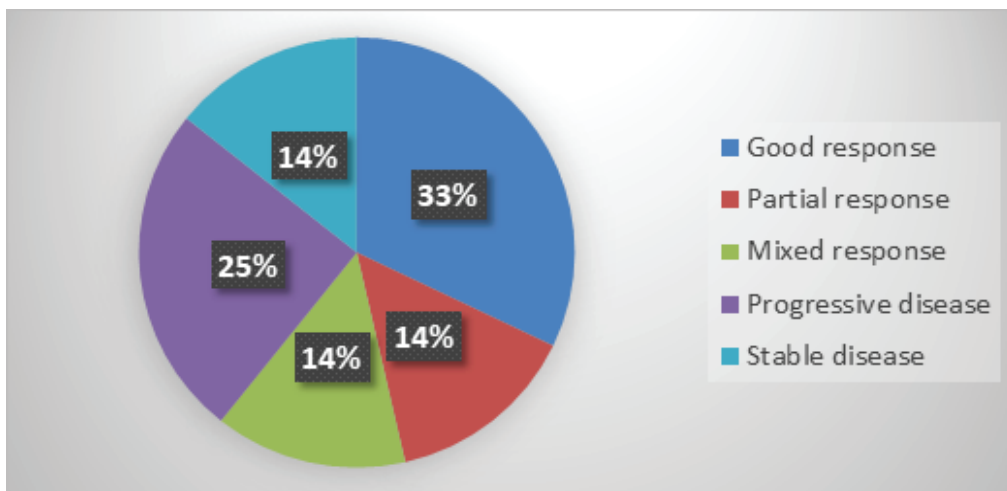


Figure 2: Pie chart demonstrating the distribution of response evaluations done by <sup>18</sup>F-FDG PET-CT imaging after initial therapy

Table-3: Total number of lung cancer patients who came for PET-CT scanning at NINMAS from 2016 to 2021

2016	2017	2018	2019	2020	2021
Male=14	Male=20	Male=09	Male=13	Male=21	Male=40
Female=03	Female=04	Female=05	Female=07	Female=06	Female=36
Total= 17	Total= 24	Total= 14	Total= 20	Total=27	Total=76

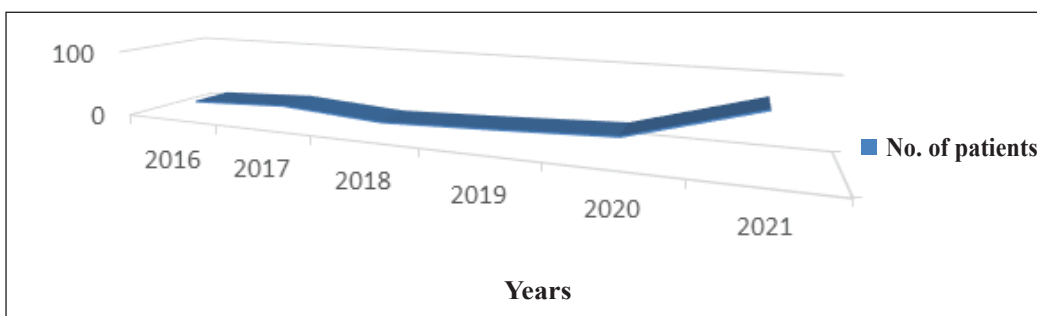


Figure 3: Chart demonstrating number of lung cancer patients came for PET-CT scanning at NINMAS from 2016 to 2021

## DISCUSSION

The majority of lung cancer patients of this study belonged to the age groups of 50 to 70 years and the frequency declining both above and below this age range. Interestingly, lung cancer is not uncommon in people under the age of 30 years which is supported by recent trends of increasing incidence of lung cancer being associated with a decrease in average age at diagnosis (11). Males are affected more than females. Recent studies also showed that males are more likely to develop lung cancer, but the male-female ratio is decreasing day by day which might be due to active or passive smoking as women's incidence rates rise (3). Looking at the presence of comorbidities, it was found that DM was the most common, followed by HTN, CKD and COPD. A good number of patients had no comorbidity but a significant proportion had CKD which is supported by a study of Wong G et.al. that found a link between chronic kidney disease and lung cancer (12). A critical issue is that, the coexistence of cancer and other comorbidities frequently causes a delay in the diagnosis.

Among the two histological types of non-small cell lung carcinoma (NSCLC), adenocarcinoma are more than squamous cell carcinoma. Whereas, small cell and large cell lung cancer were uncommon. Other studies have found that adenocarcinoma was the most prevalent type of lung cancer, accounting for 40% of all cases, while squamous cell carcinoma is the second most common (13). A small number of individuals had either a histopathologically established neuroendocrine lung tumor or a strongly suspected case of lung malignancy with no malignant cells identified by cytology or histology. This suggests that clinicians regard PET-CT as a reliable technique for cancer detection, even when tissue study shows no malignancy in a highly suspicious case. Our staging analysis revealed that the majority of patients were referred for PET-CT imaging after being diagnosed with stage III or IV lung cancer. Pathological staging is unavailable in few cases but our retrospective patient data found that the majority of patients were referred to assess therapy response evaluation with a good number for the initial baseline study, as recommended by the most recent NCCN guidelines (15).

The findings of the baseline study are very important for lung cancer management because a large proportion of patients were upstaged from their clinical stage, which entirely changes the modality of treatment according to cancer types.

PET-CT found malignancy in patients who had been clinically suspected as cancer but failed to get a clue from histology or cytology indicating that PET-CT could be used to non-invasively detect lung cancer in highly suspicious patients for whom no other non-invasive method was appropriate. A large proportion of patients demonstrated good therapeutic response, indicating that the therapy was chosen correctly. Whereas, patients with stable disease proved the need for regular follow-up. The rate of partial response is the same as that of a mixed response, which is present in a good number of patients.

In about 25% patients, disease progression was detected by PET-CT in this study and supported by another study of Shaheen et.al. that showed tumor progression in one-third of patients after first-line chemotherapy in lung cancer (16). This finding emphasizes the importance of tracking treatment response with advanced imaging modalities, which may aid in decision-making regarding treatment. <sup>18</sup>F-FDG PET-CT scan has proven to be a useful, efficient, and dependable tool in the follow-up of lung cancer patients because it provides an early and accurate metabolic response assessment before any CT changes, allowing for early therapy modification or confirmation of its efficacy. Serial <sup>18</sup>F-FDG PET-CT studies, before and after therapy allow prediction of the treatment response in patients with bronchogenic carcinoma, which leads to a significant change in therapeutic and management strategy by avoiding ineffective chemo-radiotherapy and supporting the decision to continue the primary treatment in responding patients, and this hopefully will improve the patient's outcome and prognosis (16).

After the establishment of the PET-CT scanner at NINMAS, about 10-30 lung cancer patients per year were evaluated by <sup>18</sup>F-PET-CT scan since 2016. The entire world was affected by the COVID-19 pandemic since year 2020 but the installation of an on-site cyclotron at the end of 2020 increased the number of patients significantly with a sharp

rise in 2021. This demonstrates that the availability of an on-site cyclotron reduces the cost and time required to schedule  $^{18}\text{F}$ -FDG PET-CT scanning, helping to serve more patients.

## CONCLUSION

This was an overview of the distribution of patients concerning age, sex, types of lung cancer, coexisting diseases, and the role of the  $^{18}\text{F}$ -FDG PET-CT scan in the detection and assessment of therapy response in lung cancer. However, detailed scientific research is required to determine the causative correlation, exact demographic profile, and relevant comorbidity.

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