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ORIGINAL ARTICLE

Added Value of PET/CT in Staging and Followup of Bronchogenic Carcinoma

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ABSTRACT

Background: Among the most frequent causes of cancer-related mortality is bronchogenic carcinoma. Radiological imaging is essential for prognosis, prediction, and therapy planning. PET/CT greatly improves management and offers more accurate staging and follow-up. This study aimed to assess PET/CT impact on lung cancer restaging and follow-up.

Methods: This prospective cross-sectional study included 48 cases of pathologically confirmed bronchogenic carcinoma incorporated for staging and follow-up after therapy. Every patient had PET/CT, and the data was analyzed using TNM staging, RECIST and PERCIST criteria used for treatment response assessment.

Results: PET/CT resulted in modification in TNM staging for 16 patients and 12 patients showed various surgical staging. In the follow-up group, ten cases had difference between RECIST and PERCIST results with most of them (6 cases) displayed alteration from partial response to stable response. When pre-treatment and post-treatment SUVs in responder and non-responder groups were compared, it was found that responder group's post-treatment SUV was significantly lower than baseline SUV ($P<0.001$). With an AUC of 0.948, P value <0.001, and at a cutoff value of ≤ 9, we discovered that post-treatment SUV can successfully distinguish responders from non-responders with 100% sensitivity, 63.64% specificity, 76.55% PPV, and 100% NPV and Δ SUV can distinguish with 100% sensitivity and 54.55% specificity.

Conclusions: PET/CT was found to be reliable and efficient in assessment of tumor, nodal and metastatic staging leading to significant impact on TNM staging of bronchogenic carcinoma and provide a more comprehensive and functional therapy assessment.

Keywords: Bronchogenic carcinoma; PET/CT; SUV; RECIST; PERCIST.

INTRODUCTION

With an incidence rate of approximately 2 million cases diagnosed annually worldwide, bronchogenic carcinoma is one of the main causes of death from cancer [1]. Radiological imaging is crucial for bronchogenic carcinoma staging, which is essential for prognosis, prediction, and treatment planning [2]. Stage I patients can undergo pneumonectomy or lobectomy, however stage II requires surgery followed by adjuvant treatment, patients in stage IIIB or IV do not benefit from surgery, whereas those in stage IIIA undergo chemo and radiotherapy followed by surgery when downstaging occurs [3].

For the objective of accurately staging lung cancer early and administering treatment to prevent side effects and increase overall survival rates, a multidisciplinary approach using modern imaging tools is required. This

will therefore influence the standard of living of the patient [4].

Since January 2017, the 8th edition of tumor, nodal, metastatic Staging (TNM), is the latest version used for bronchogenic carcinoma staging, and has taken the place of the previous 7th edition [5].

CT is easily accessible and provides fast, high-resolution imaging for tumor detection. When it comes to distinguishing the true tumoral borders from the surrounding benign pulmonary abnormalities such as consolidation, atelectasis, or collapse, it is quite limited. Furthermore, it is challenging to adequately identify pleural, pericardial, and mediastinal invasions using CT scan [6].

CT is used for lung cancer monitoring and to evaluate treatment according to alterations in tumor size. The response evaluation criteria in solid tumor (RECIST) criteria is used for this. However, structural alterations could happen later following a favorable biological reaction, creating the illusion of a fixed trajectory. Additionally, treatment-related central necrosis or bleeding may cause a pseudo-progression result on CT scans [7, 8].

PET/CT is a radiological technique based on the malignant tissue's uptake of fluorodeoxyglucose (FDG), can evaluate the tumor's malignant activity. As a result, it can precisely identify the tumor bulk and differentiate it from the benign response in its surroundings. In addition, it can recognize early biological modifications by therapy prior to any structural changes. Moreover, metastatic changes and the activity of pulmonary nodules discovered on CT chest interpretation can be detected using PET/CT allowing for the distinction of neoplastic ones [9].

Based on established guidelines, the PET/CT follow-up for bronchogenic carcinoma is carried out using the PERCIST criteria (Positron Emission Tomography Response Criteria in Solid Tumors) and depends on the tumor's variations in the uptake value (SUV uptake) [10]. PET/CT can precisely determine staging and response to therapy since it gives structural and functional details regarding cancer and the occurrence of metastasis throughout the body [11].

It is well known that the most often utilized radiotracer in PET imaging is fluorodeoxyglucose (FDG). Research has demonstrated that SUV measurement of radiotracer uptake by malignant cells is crucial to determine how well lung cancer treatment will work [12].

Our study was designed to evaluate the significance of PET/CT in staging and follow-up evaluation of bronchogenic carcinoma, as well as the degree to which PET/CT, relative to CT RECIST, can alter TNM staging and degree of therapy response. We also looked at how these modifications affected the management and decision-making process for therapy.

METHODS

Forty-eight patients with pathologically verified bronchogenic carcinoma were presented to the Radiology Department for this prospective study. The cases were divided into two groups: (group 1) of staging and (group 2) of follow-up, with 24 patients in each group. The study was carried out throughout the period from December 2022 to March 2024. All patients gave their consent in agreement with the guidelines set by the ethical committee. PET imaging and post-contrast CT were performed to all patients.The Institutional Review Board at Zagazig University's Medical Faculty approved the study after acquiring signed consent from all patients (IRB approval number #10252/19-12-2022). According to the Declaration of Helsinki, a global rule of ethics for human research, the research was carried out in agreement with the requirements.

Inclusion criteria:

All patients with pathologically established bronchogenic carcinoma with no age or sex predilection

Exclusion criteria:

Individuals with high renal function, pregnant women, and individuals whose blood sugar levels are higher than 200 mg/dl at examination time. In addition, the patients underwent surgery.

Patient preparation:

Prior to the study, a serum creatinine level was obtained, and it should be within the normal range. Furthermore, the patients with diabetes received instructions to maintain appropriate blood glucose levels preceding the imaging date. Prior to the scan, a 6-hour fast was asked. IV cannula was placed, and it was best to insert it in the contrary side of the tumor site. To minimize the quantity of FDG absorbed by brown fat, the patients were maintained in a regulated warm condition.

Technique:

- **PET/CT device:** GE Discovery IQ device
- **Radio-isotope dose:** 60–90 minutes prior to the exam, patients received an injection of 10–20 mCi of 18F-FDG. They were instructed to avoid activity, and to speak as little as possible.
    - **Technique:** For PET image acquisition from skull base to upper thigh, all cases were situated supine with their arms raised. Using same scan location, we performed post-contrast CT using a non-ionic contrast (300 mg iodine/ml) was given intravenously (2 ml/kg), at a rate 3-5 ml/s for 30 seconds after PET imaging.
    - **Post-imaging instructions:** lactating patients were instructed to cease breastfeeding for twenty-four hours, drink a lot of water, and stay away from children for twenty-four hours.

Image interpretation:

CT and PET images were moved to a designated workstation for processing of the fused images. The imaging interpretation was applied using the following parameters: for staging of primary tumors the 8th TNM staging system was used [5] and for therapy assessment, we employed the PERCIST 1.0 criteria for PET/CT analysis; and for CT interpretation, we used the RECIST 1.1 criteria. In contrast to PET images, the treatment response was evaluated by semi quantitative assessments of FDG uptake during pretreatment and post treatment scans, while CT images evaluated bronchogenic carcinoma based upon its size. RECIST criteria were then utilized to categorize patients as responders based on whether they displayed a complete response (CR) or a partial response (PR) and non-responders were those whose results indicated either stable disease (SD) or progressive disease (PD).

Statistical analysis

IBM SPSS statistics (IBM Inc., v28) were used for the data analysis. Categorical data were represented by a total number and percentage of patients, whereas non-parametric data were displayed as the median (IQR) and continuous parametric data as the mean ± SD. Fisher's exact test, paired sample t-test, chi-square test, and unpaired Student's t-test were the tests that were employed. Each test's diagnostic performance was evaluated based on its diagnostic sensitivity and specificity, PPV, and NPV; the total diagnostic performance of each test was ascertained by ROC curve analysis.

RESULTS

Our study included forty-eight patients who had been histopathological diagnosed with bronchogenic carcinoma. Their ages ranged from 26 to 75 years old, with average age of 56.7 ± 11.7 years. There were 38 (79.17%) males and 10 (20.83%) females with 75 % of all patients exhibiting smoking history. The pathological types of tumors were adenocarcinoma in 18 (37.5%), small cell carcinoma in 18 (37.5%) and large cell carcinoma in 12 (25%) individuals.

Regarding TNM staging for (group 1) included 24 cases; 16 patients representing 66.7 % of cases, the TNM staging results from the PET/CT staging and the CT alone differed (Table 1, Figs. 1, 2, 3 and S1), where four of them displayed different T staging, eight cases showed different N staging and four cases showed different M staging.

Regarding surgical staging, twelve patients out of 16 cases with differences in the results of T,N & M descriptors displayed change in the staging (Table 1, Figs. 1, 2 ,3 and S2); six of them representing 37.5 % showed upgrading while the other six cases representing 37.5 % revealed downgrading and the residual four cases representing 25 % revealed no change in the staging. The change in TNM classifications leads to change in the surgical staging with subsequent alteration in management plan, which happened in twelve patients representing 50 % of all cases.

Using RECIST/PERCIST criteria, 10 patients out of 24 cases in (group 2) demonstrated an alteration in the treatment response evaluation (Table 2, Figs. 4, 5 and 6). Six cases exhibited alteration from partial response by RECIST to stable response by PERCIST by PET/CT and four cases exhibited alteration from stable response by RECIST to progressive response by PERCIST and the management approach altered with the ten cases representing 41.7 % of all included patients.

In addition, 22 individuals in the whole study population representing 45.8% of all cases included in both groups had their treatment plans modified because of the PET/CT results.

When the pre-treatment and post-treatment SUVs in the responder and non-responder groups were compared, it was found that the responder group's post-treatment SUV was significantly lower than its baseline SUV ($P<0.001$) while the non-responder group did not show any significant variation between the post-treatment and baseline values (Table 2). There was no significant variation in the pre-treatment SUVs of both groups; however, in comparison to the non-responding data, the responder post-treatment % change in SUV (ΔSUV) was significantly higher ($P<0.001$) (Table 2).

To ascertain if SUV can distinguish between the various groups, namely, the progressive disease (PD), stable disease (SD) and partial response (PR) groups, comparisons of the different factors among the three groups were carried out. SUVs in the PD and SD groups did not alter significantly from baseline to post-treatment values; however, in the PR group, the post-treatment SUV was significantly lower than the pre-treatment result (Table 2).

The optimal threshold levels were determined using receiver operating characteristic (ROC) curves for differentiating responders from non-responders since post-treatment SUV and Δ SUV varied significantly between both groups. The area under the curve (AUC) of the two curves did not significantly vary ($P = 0.128$); however, in comparison to the post-treatment SUV, the AUC for the Δ SUV was higher (Figs. S3 and S4).

Post-treatment SUV can significantly differentiate responders from non-responders with AUC of 0.948, P value <0.001, and at cutoff value ≤ 9 with 100% sensitivity, 63.64 % specificity, 76.5 % PPV and 100% NPV.

Δ SUV can significantly differentiate responders from non-responders with AUC of 0.839, P value <0.001, and cutoff value >2.9 with 100% sensitivity, 54.55 % specificity, 72.2 % PPV and 100% NPV

Table (1): CT and PET/CT TNM staging and surgical staging of (group 1) included for staging (N=24).

CT and PET/CT TNM staging				
		CT	**PET/CT**	**P**
Tumor stage	T2	12 (50%)	10 (41.7%)	0.95
	T3	6 (25%)	6 (25%)	
	T4	6 (25%)	8 (33.3%)	
Lymph node stage	N0	6 (25%)	4 (16.7%)	0.94
	N1	10 (41.7%)	8 (33.3%)	
	N2	6 (25%)	8 (33.3%)	
	N3	2 (8.3%)	4 (16.7%)	
Metastasis stage	M0	18 (75%)	20 (83.3%)	0.71
	M1	6 (25%)	4 (16.7%)	
CT and PET/CT surgical staging				
Surgical staging		**CT**	**PET/CT**	**P**
	IA	6 (25%)	4 (16.7%)	0.06
	IB	---	---	
	IIA	2 (8.3%)	4 (16.7%)	
	IIB	6 (25%)	8 (33.3%)	
	IIIA	4 (16.7%)	2 (8.3%)	
	IIIB	4 (16.7%)	4 (16.7%)	
	IVA	2 (8.3%)	0 (0%)	
	IVB	0 (0%)	2 (8.3%)	

Table (2): Response criteria of solid tumors in (group 2), comparison between pre-treatment and post-treatment SUV, and % change in SUV (ΔSUV) in responder and non-responder groups and other groups.

Response criteria of solid tumors in (group 2) patients (n=24)			
		RECIST criteria (n=24)	PERCIST criteria (n=24)
	Complete response	4 (16.7%)	4 (16.7%)
	Partial response	10 (41.7%)	10 (41.7%)
	Stable disease	8 (33.3%)	6 (25%)
	Progressive disease	2 (8.3%)	4 (16.7%)
Responders		14 (58.3%)	14 (58.3%)
Non responders		10 (41.7%)	10 (41.7%)
RECIST: Response evaluation criteria in solid tumors **PERCIST: Positron emission tomography response criteria in solid tumors**			
Comparison between pre-treatment SUV, post-treatment SUV, and % change in SUV (ΔSUV) of the responder and non-responder groups			
		Responder (n=14)	**Non-responder (n=10)**	**P-value**
Pre-treatment SUV	Mean ± SD	14.6 ± 2.63	19.9 ± 11.06	0.107
	Range	10 - 19	5.2 - 35.6	
	Median (IQR)	14 (14-16)	21.5 (10.4-28.15)	
Post-treatment SUV	Mean ± SD	3.3 ± 2.63	14.1 ± 8.38	<0.001*
	Range	0 - 9	5 - 27.6	
	Median (IQR)	2 (2-5)	13.1 (6.6 - 21.6)	

P value within group	<0.001*	0.159	
ΔSUV	11.31	5.77	<0.001*
SUV: standardized uptake value, IQR: interquartile range, *: statistically significant as P value <0.05			
Comparison of baseline and post-treatment SUV in different groups			
	Pre-treatment SUV	**Post-treatment SUV**	**P value**
Progressive disease (n=4)	7.9 ± 0.31	10.1 ± 4.88	0.441
	7.4 - 8.1	4.6 - 14.8	
Stable disease (n= 6)	19.1 ± 6.28	14.1 ± 4.74	0.069
	8 – 27	9 - 20	
Partial response (n=10)	14.9 ± 1.82	7.2 ± 1.78	<0.001*
	12.4 - 17.2	3.6 - 9	
Data presented as mean ± SD, SUV: standardized uptake value, IQR: interquartile range, *: statistically significant as P value <0.05			

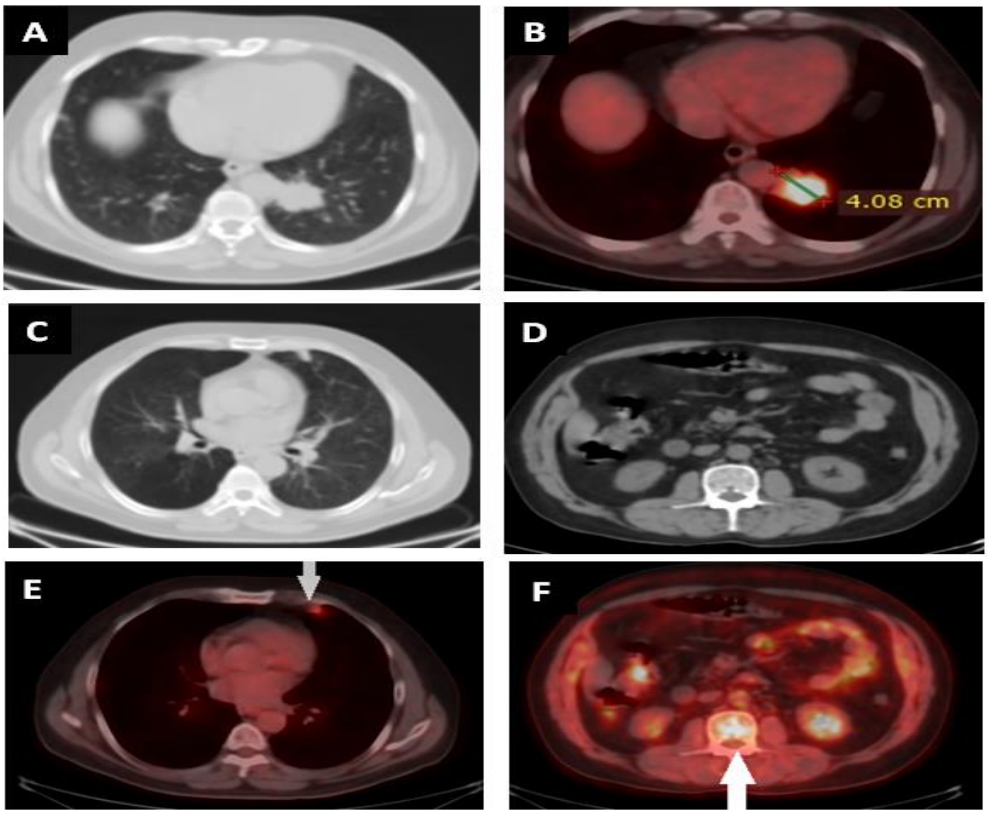


Figure (1): A 62-year-old male patient proven histopathologically to have adenocarcinoma referred for assessment by PET/CT examination. CT and PET/CT studies reveal a malignant hypermetabolic mass lesion involving the medial segment of the left lower lobe measuring about 4.08 cm staged as (T2) **(A,B)** with a small pulmonary nodule 6 mm seen in lingula anteriorly and considered by CT to be non-specific nodule, a bone study by CT was negative **(C,D)**. PET/CT reveals positive FDG uptake detected inside the pulmonary nodule (white arrow, **E**) staged as (T4), as well as positive active spots noted affecting the body of L2 vertebra (white arrow, **F**) staged as (M1). The surgical staging of the patient by PET/CT was upgraded from IIB to IVA.

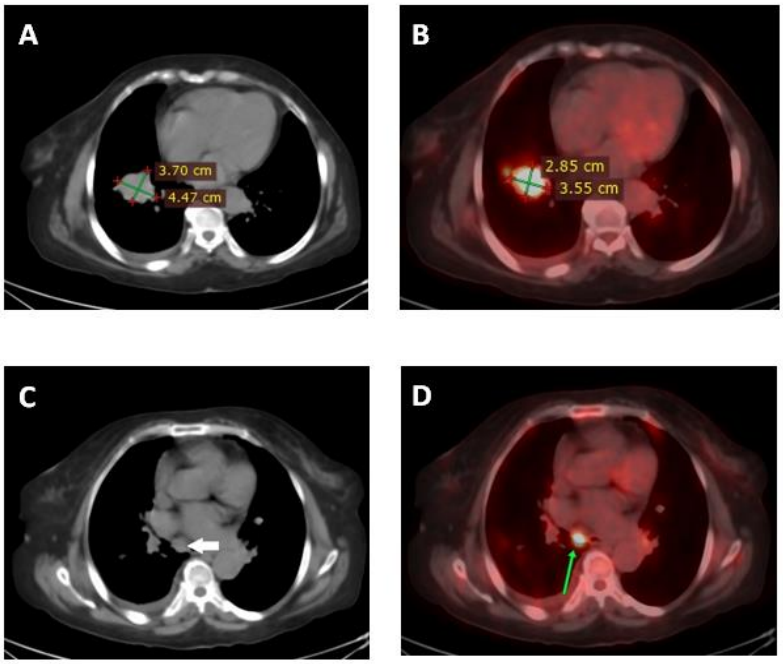


Figure (2): A 65-year-old female patient proven histopathologically ta have small cell carcinoma referred for assessment by PET/CT examination. CT study reveals a malignant mass lesion involving the right lower lobe measuring 4.4×3.7 cm staged as T2b **(A)** with subcarinal lymphadenopathy considered to be non-specific and staged as N0 **(**white arrow, **C)**. PET/CT study reveals the right lower lobe hypermetabolic mass lesion measuring 3.5 × 2.8 cm staged as T2a with a downgrade of the CT-T staging separating the actual tumoral tissue from the surrounding pulmonary non-malignant changes **(B)** and positive activity detected in subcarinal lymph node staged as N2 instead of N0 diagnosed by CT **(**green arrow, **D)**. The surgical staging of the patient by PET/CT was upgraded from IIA to IIIA.

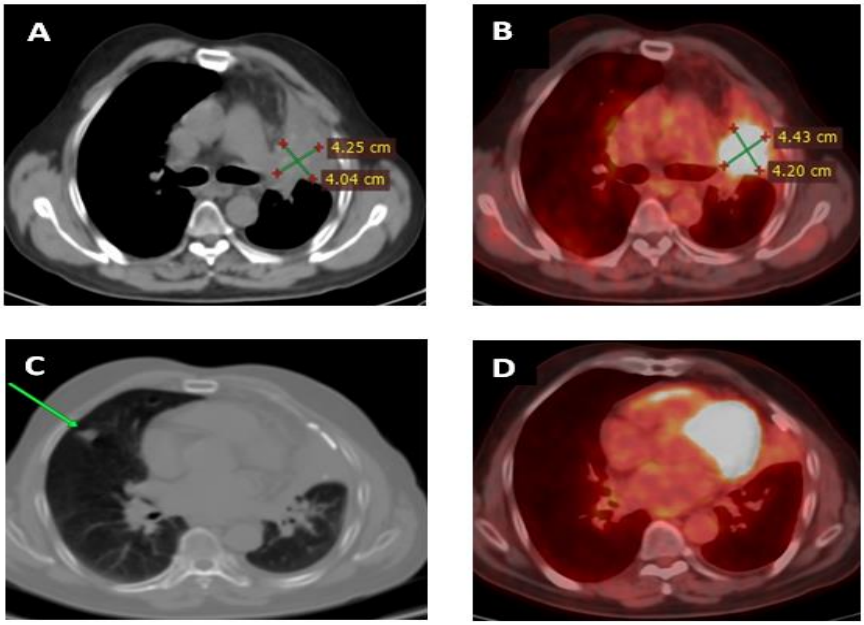
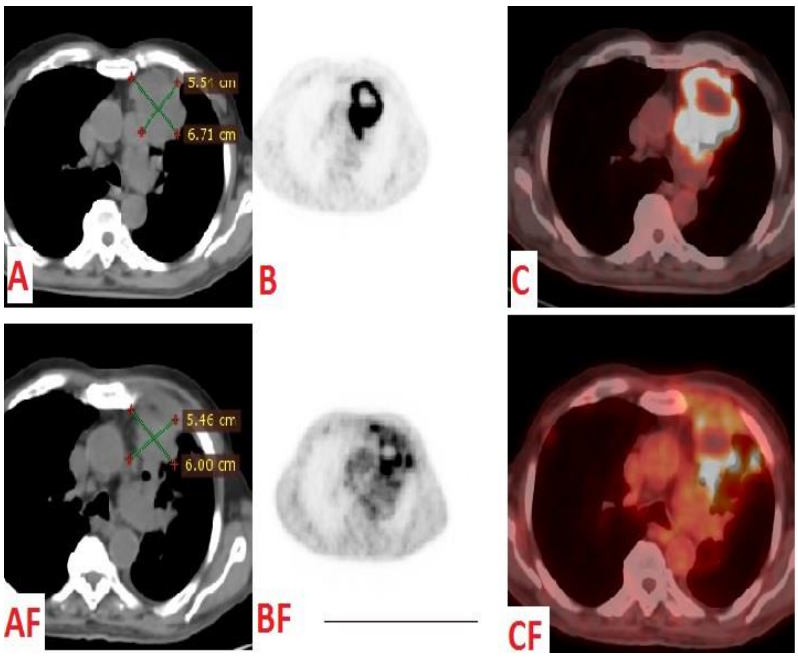
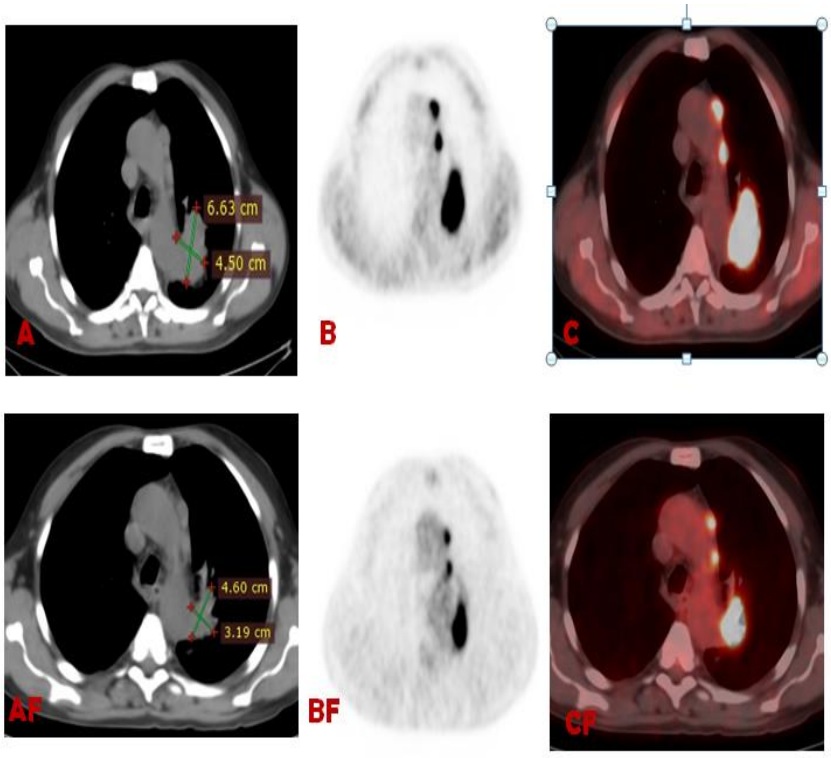


Figure (3): A 56-year-old male patient proven histopathologically ta have small cell carcinoma referred for assessment by PET/CT examination. CT and PET/CT studies reveal left upper lobe mass lesion measuring 4.2x4.04 cm (**A,B)** with multiple mediastinal lymphadenopathies and contralateral pulmonary nodule involving right middle lobe measuring 1.2 cm (green arrow, **C**) so the case was staged as (T2 N1 M1). PET/CT study shows no evidence of significant activity involving the pulmonary nodule and considered non-specific nodule **(D)**, so PET/CT study changed the staging to (T2 N1 M0). The surgical staging of the patient by PET/CT downgraded from IVA to IIB.



Figure(4): A 68-year-old male patient diagnosed to have large cell carcinoma received chemo and radiotherapy and referred for follow-up after 3 months. Baseline study **(A,B,C)** shows the mass lesion measuring 6.7x5.5 cm achieving SUV uptake = 17.7. Follow-up study **(AF,BF,CF)** shows almost stationary course regarding size of the mass by CT measuring 6x5.4 cm interpreted as stable disease by RECIST criteria while on PET/CT the SUV decreased to be 6.7 instead of 17.7 leading to change in the opinion to be partial disease response by PERCIST criteria instead of stable disease by RECIST criteria.



Figure(5): A 64-year-old male patient diagnosed to have adenocarcinoma received chemotherapy and referred for follow up after 6 months. Baseline study **(A,B,C)** shows LT upper lobe mass lesion measuring 6.6×4.5 cm achieving SUV uptake =15.45. Follow-up study **(AF,BF,CF)** shows morphological regression regarding size of the mass measuring 4.6×3.1 cm interpreted as partial disease response by RECIST criteria while on PET/CT the SUV uptake shows metabolic stability achieving same result 15.4 as baseline study leading to change in opinion to be stable disease by PERCIST criteria instead of partial disease response by RECIST criteria.

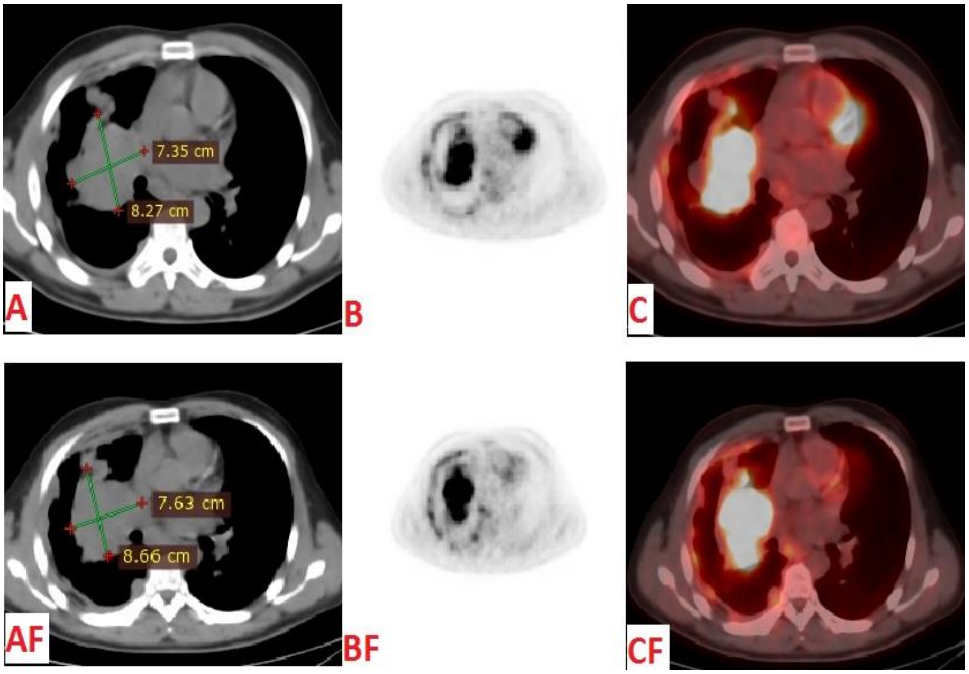


Figure (6): A 58-year-old male patient diagnosed to have small cell carcinoma received chemotherapy and referred for follow up after 6 months. Baseline study **(A,B,C)** shows right upper lobe mass lesion measuring 7.3×8.2 cm achieving SUV uptake = 10.8. Follow-up study **(AF,BF,CF)** shows almost no change in the size of the mass by CT measuring 7.5 × 8.6 cm interpreted as stable disease by RECIST criteria while on PET/CT the SUV uptake increased to be 17.2 instead of 10.8 leading to change in opinion to be progressive disease response by PERCIST criteria instead of stable disease by RECIST criteria.

DISCUSSION

This study was carried out to evaluate the importance of PET/CT scans in assessment of cases with bronchogenic carcinoma, either for staging purposes or for monitoring the effectiveness of treatment. In 66.7% of (group 1) patients included for staging, PET/CT revealed variation in TNM staging, and in 41.7% of (group 2) patients, it revealed alteration in the follow-up response. Twenty-two patients representing 45.8 % of the total research population, had their treatment plans modified because of changes in their surgical staging and treatment response evaluation PET/CT results.

This can be clarified due to differences between the two modalities: PET/CT can integrate both morphological and functional activity; with the additional benefit of detecting structural alterations in primary lesion and metastatic ones, whereas CT can only provide information regarding morphology of the tumors and metastatic deposits.

In the current study regarding TNM staging, 16 patients from (group 1) representing 66.7 % of cases revealed differences in TNM staging outcomes among CT alone and PET/CT results, this was in concordance with Osman *et al.* who found that of out the 30 patients in the T group of staging twelve patients had differences between PET/CT results and CT alone; 5 of them had different T staging, with 4 cases showed downgrade staging, 4 cases showed different N staging with upgrading in all of them, and five cases showed different M staging with downstaging in three of them [13].

Hicks *et al.* and Zheng *et al.* revealed difference in TNM staging of 35 % and 35% of their cases [14, 15]. Takeuchi *et al.* discovered that in 28.7% of their cases, the TNM staging had changed [16].

In our study twelve out of the sixteen cases with differences in TNM staging, displayed a modification in surgical staging, which was followed by modification in management approaches. In agreement with our results, Osman *et al.*found that the treatment plan was altered in 8 out of 12 cases in group T with changes in TNM classification (26.7%) due to change in the surgical staging [13]. This matcheswith the resultsof Hicks *et al.* who discovered that the management of 35% of their cases was affected by PET/CT [14].

The reason for the disparity in TNM staging between PET/CT and CT can be attributed to PET/CT's ability to precisely and adequately define the lesion and isolate it from perilesional non-malignant response, particularly in the T2 stage, this outcome is in line with the findings of Zhang *et al* [15]. According to Aydin *et al*. it was discovered that PET/CT evaluation of the lesion size was more in line with the size in pathology report than CT, and this finding could have an impact on T staging, which is contingent upon the mass size [17]. Furthermore, Hochhegger *et al.* mentioned the facility of PET/CT to discriminate between cancer and post-obstructive lung alterations that is believed to be challenging with T staging [18].

In our study, the capability of PET/CT to discriminate neoplastic lung nodules, that has impact on both T and M staging, resulted in changes in the TNM staging. This aligns with Volpi *et al.* who emphasized the accuracy of PET/CT in distinguishing between benign and malignant pulmonary nodules, which alters both T and M staging [3].

In our study 8 cases exhibited different N staging, 4 of them displayed downgrading due to prominent LNs considered metastatic by CT and found to be inactive by PET/CT and the other 4 cases showed upgrading due to non-specific subcarinal and contralateral mediastinal LNs by CT and discovered to be active with high FDG uptake.

With accuracy 90% in diagnosing malignant mediastinal lymphadenopathy, PET/CT is a recognized examination in identifying malignancy within mediastinal lymph nodes with greater precision than CT, which solely considers the node size [11]. When evaluatingNstage, CT may bear number of fallacies, for example, it can provide false-positive enlargement of the lymph nodes in post-obstructive pneumonitis, and even in nodes that are of normal size. According to Volpi *et al.*, biopsy via mediastinoscopy may be needed for those individuals whose lymph nodes show positive uptake by PET/CT to avoid false-positive results, while patients with negative results on PET/CT can continue with their management based on the remaining T and M staging [3].

In our study 4 cases showed different M staging, 2 of them displayed downgrading due to contralateral pulmonary nodules found to be inactive by PET/CT and the other 2 cases showed upgrading due to bony metastasis not detected by CT. PET/CT is a valuable technique for detecting concealed bone marrow infiltrates, outperforming CT and bone scans for detecting bony deposits, which are prevalent in patients with bronchogenic cancer [11].

Regarding RECIST in the current study, four patients (16.7 %) exhibited a complete response, ten patients (41.7%) a partial response, eight patients (33.3 %) a stable disease, and two patients (8.3%) a progressing disease. Regarding PERCIST, four patients (16.7%) exhibited a complete response, ten patients (41.7%) a partial response, six patients (25 %) a stable disease, and four patients (16.7%) a progressive disease. Ten cases displayed alterations in RECIST/PERCIST criteria-based treatment response assessment and the management plan altered with the ten cases representing (41.7 %) of all patients.

Shaheen *et al.*found that in spite the wide use of RECIST criteria for promptly evaluating the response of the tumor to treatment, it has certain limitations because the histopathologic response following therapy cannot be accurately predicted by changes in the tumor size as evaluated by CT [19].In the study of Osman *et al.*, there were differences in RECIST/PERCIST criteria in nine out of thirty patients included for assessment of treatment response. Of these, six cases demonstrated a shift from partial or stable response as determined by RECIST

criteria to progressive response as determined by PERCIST criteria, two demonstrated shifts from stable response by RECIST criteria to partial response by PERCIST. The final one demonstrated a shift from the RECIST criteria's progressive response to the PERCIST criteria's stable response. The management approach was modified in seven patients representing 23.3% of all cases [13].

William *et al.* reported a disparity among the CT RECIST and histological reports in 41% of the investigated cases during follow-up after neoadjuvant chemotherapy [20]. Marcus *et al.* concluded that among the cases who had PET/CT to assess the response to therapy, the results were changed in management plan in 28.1% [21].

Comparing the SUV in the responder and non-responder groups before and after treatment, this study revealed that post-treatment SUV in responder group was significantly lower than baseline SUV (P value <0.001), but non-responder group's post-treatment values did not significantly differ from their baseline levels. This closely resembles the results of studies by Bahce *et al.* and Yamamoto *et al*. who investigated the relationship between histology and post-therapeutic tumor SUV uptake in predicting tumoral alterations in NSCLC patients. They discovered that patients who responded to therapy had significantly different SUVmax values on their pre- and post-treatment FDG PET scans compared to those who did not respond [22, 23].

According to this study, The SUVs of the responder and non-responder groups did not differ substantially before treatment (P = 0.107); yet the responder group's SUV values after treatment were significantly lower than those of the non-responder group. This was consistent with Huang *et al.* study of SUVmax function in forecasting the short-term results of chemo and radiotherapy for patients with advanced NSCLC. They used the gold standard of RECIST criteria and found that responders' SUVmax value changes were noticeably smaller than those of non-responders. SUVmax variation had a sensitivity of 83.3%, specificity of 84.6, and accuracy of 84.9% for predicting tumor response [24].

With an AUC of 0.948, P value <0.001, and at a cutoff value of ≤9, we discovered that post-treatment SUV can successfully distinguish responders from non-responders with 100% sensitivity, 63.64% specificity, 76.55% PPV, and 100% NPV. With an AUC of 0.839, P value <0.001, and at a cutoff value >2.9, Δ SUV may distinguish responders from non-responders with 100% sensitivity, 54.55% specificity, 72.2 % PPV, and 100% NPV.

This was in line with Huang *et al.* study to determine whether SUV max could be used to predict how patients with advanced NSCLC will respond to short term chemotherapy and radiotherapy, they discovered that respondents had a considerable decline in SUV max values in comparison with non-responders. SUVmax change was 83.3% sensitive, 84.6 specific, and 84.9% accurate in predicting tumor response [24].

This also aligns with the results of Cerfolio *et al.* for assessment of the efficiency of chemo-radiotherapy in patients with NSCLC by using histological analysis, with 90% sensitivity, 100% specificity, and 96% accuracy, they discovered that SUVmax alterations of more than 80% can accurately predict a full pathological reaction [25].

Our study's principal weakness was the limited number of cases because of the expensive cost of the technique. Further multicenteric research with large patient populations is necessary to confirm the outcomes of our study.

CONCLUSIONS

PET/CT was found to be accurate in assessment of the tumor, nodal and metastatic staging leading to major influence on bronchogenic carcinoma TNM staging and provide a more comprehensive and functional assessment of therapy, potentially leading to more accurate treatment decisions and management strategies for patients.

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