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F-FDG PET/CT- An Effective Diagnostic Tool for Non-Small Cell Lung Cancer: A Review

T. S. Saleena and P. Muhamed Ilyas

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F-FDG PET/CT- An Effective Diagnostic Tool for Non-Small Cell Lung Cancer: A Review

Saleena T.S[1] and Dr.Muhamed Ilyas P.[2]

[1]Research Scholar, Computer Science Department, SS College, Areekdoe, Kerala, India

[2]Principal, Computer Science Department, SS College, Areekdoe, Kerala, India

tssaleena@gmail.com , muhamed.ilyas@gmail.com

Abstract

We conducted a comprehensive review of literature for understanding how ^{18}F-FDG PET/CT became an inevitable imaging modality in staging, prognosis, treatment response, subtype classification etc in Non Small Cell Lung Cancer (NSCLC). Our main intension of this study is to select the best imaging technique as the input of artificial intelligence algorithms for automated digital image processing.

KEY WORDS: ^{18} F-FDG PET/CT, NSCLC, TNM staging, prognosis, lung cancer diagnosis.

1. INTRODUCTION

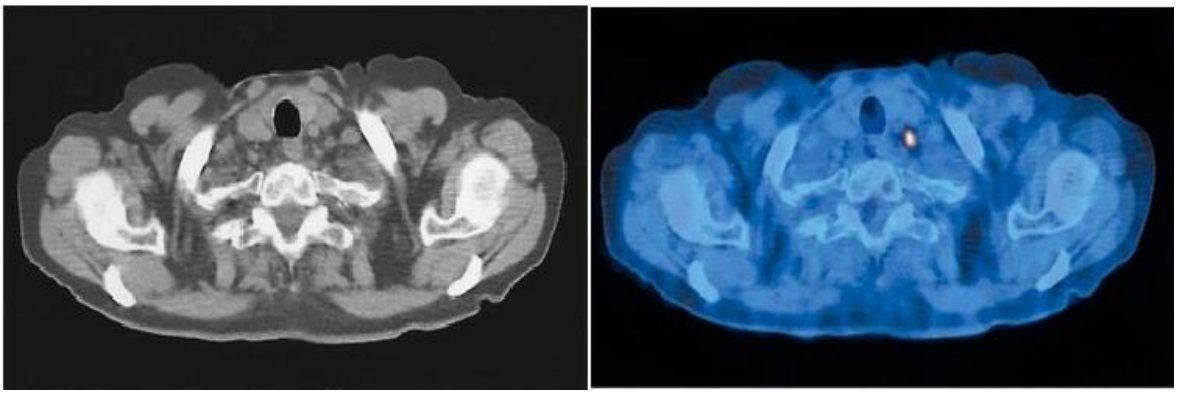
Bio - medical images plays a crucial role in diagnosis of any kind of diseases. Different modalities of such medical images are X-RAY, PET, SPECT, CT, ULTRA SOUND, MRI or combinations of such etc. They are the best and common way to identify the tumors inside the body. In the case of cancer, not only diagnosis, but also staging, prognosis, response to treatment, therapeutic selection, classification etc can be easily done through this. Among around 19 different types of cancers, lung cancer has the highest rate of mortality and from them 80% is Non Small Cell Lung Cancer(NSCLC) type[2,21]. So this study is focusing on that type.

Staging is the key factor which leads to the selection of treatment plan. Even if a cancer has been diagnosed, it may have plenty of subtypes and each subtype probably may have different treatment like surgery, chemotherapy, immunotherapy, bronchial therapy or even medicines only. So the selection of imaging techniques will be done in such a way that, its accuracy should be significantly high so that the treatment and management plan should be based on this.

Radiologists have an important role in the detection and diagnosis process because radiology images are used in the same. Since the evaluation by the human is time consuming and have chances of occurring error, the automation of this field has greater importance. Machine learning or neural networks are the best choice for that. Studies say that, an average radiologist may have to evaluate one image in every 3-4 seconds to clear out his daily workload. Digital image processing can reduce such complexities. As the name suggests, machine learning is a group of techniques that helps to build the artificial intelligence in machines. It is proved that, AI machines can diagnose lung cancer around

30% more accurately than humans. So a better medical imaging technique incorporated with a better machine learning or deep learning algorithm can increase the survival rate. The main reason for this is, the images may include minute lesions which are very difficult to interpret using human eye. Machine learning techniques use several preprocessing and augmentation steps to make the image much clearer. Also segmentation process can be done more accurately by the algorithms. The aim of this review is to prove that 18 F-FDG PET/CT is the one from medical image side, which can give better inputs to the AI algorithms than any other. Wang, H., Zhou et. al [16] compares the efficiency of different AI algorithms in the classification of lymph node from 18F-FDG PET/CT images.

When NSCLC has been diagnosed in a patient for the first time, the next step should be the correct staging and there by selecting the most appropriate treatment and determine the prognosis. TNM staging is used for staging in common practice. All other imaging methods other than PET, are making diagnosis based on anatomic features of the body. Whereas in PET, cellular metabolism will be taken into consideration. So anatomical abnormalities will not lead into false interpretation in such scanning. [29]The below figure shows, images obtained by CT and PET/CT. The figure itself shows how clearly the affected portion can be identified from the second one. No lymph nodes are seen in CT, which may lead to false staging.



Fig(1): Comparison of CT(image) and PET/CT(Right) images

1.1 ^{18}F- FDG PET/CT Scanning

Positron emission tomography/Computed Tomography (PET/CT) is done by injecting a radioactive substance or radio tracer(preferably Flourine-18 fluorodeoxyglucose, or FDG, a molecule similar to glucose) into patient's body. All patients were instructed to fast for at least 6 h before scan. Blood glucose levels were required to be < 145 mg/dl. Since cancer cells are more metabolically active, they can absorb the glucose in a rate higher than non-cancerous cells. This higher rate of absorption can be identified by special cameras which indicate that they are tumerous cells.

1.2 PET parameters

18 F- FDG PET/CT is the one that provide both anatomic and metabolic activities of patient. Three main parameters considered for the diagnosis are Standardized Uptake Value or SUV, Metabolic Tumour Volume or MTV and Total Lesion Glycolysis or TLG. SUV reflects the uptake of glucose components in metabolically active regions. [25]SUV alleviates the difference in patient size and amount of tracer injected.

$$\mathrm{SUV} = \frac{r}{(a'/w)}$$

[25]where r is the radioactivity activity concentration [kBq/ml] measured by the PET scanner within a region of interest (ROI), a' is the decay-corrected amount of injected radio labeled FDG [kBq], and w is the weight of the patient [g]. MTV is the metabolic volume of tumour segmented using PET. This will help in further radio therapy process. TLG is the level of glucose accumulation in the region of interest. MTV and TLG together increase the prognosis rate in NSCLC patients. Patients with high value of MTV and TLG has worse survival rate. Maximum SUV, mean SUV, peak SUV, standardized added metabolic activity, and normalized standardized added metabolic activity are some other values taken for some reason.

1.3 TNM staging

Tumor -node- metastasis (TNM) is the standard staging system used which is regularly maintained by the American Joint Committee on Cancer and the International Union Against Cancer. The 3 letters denoted as: T stands for volume of tumour, N stands for presence or absence of any kind of lymph node and M for whether metastasis occurred or whether the cancer has been spread to organs other than primary organ. Mainly 4 stages are there (stage I –IV) which can be again subcategorized.

2. LITERATURE REVIEW

Morbelli, S., Calcagni, M. L et al.[1] explains the prominent role of PET/CT in NSCLC patients especially in stage III and IV in both before the surgery and identifying the affected organs other than primary(especially in patients having greater risk of distant metastasis). The work observes how effective the discussion of its findings in multidisciplinary setting among clinicians and the nuclear medicine physician in therapeutic decisions. The low cost and high availability of CT scan may seem to be a better choice for some cases. But in cases like, occult distant metastases which is very difficult to identify using the normal modalities of medical imaging other than PET. This finding can also help in unexpected stage shift from stage III to IV. That is, the this paper explains how it is helping in

the early detection of recurrent lung cancer. Morbelli, S., Calcagni, M. L et al. also describes the challenges of FDG PET/CT facing in NSCLC patients. PET can also be applied in SCLC to get additional prognostic information.

Tao, X., Li, N et.al[2] made an investigation about the potential of PET/CT in predicting the Major Pathologic Response(MPR) of NSCLC patients to the immunotherapy and also how to filter out respondents and non- respondents from a group of patients. For that, they used neoadjuvant sintilimab as immunotherapy drug in resectable NSCLC patients. Neo adjuvant therapy means treatment given before the surgery where as adjuvant therapy is that given after surgery. 2 doses of sintilimab has been given to the patients and also two times the PET/CT, where one at the baseline and one before the surgery. This is to observe, how the therapy get affected in the patient's body. Patients are of the group of stage I to III. SULmax, SULpeak, MTV, TLG, ΔSULmax%, ΔSULpeak%, ΔMTV%, ΔTLG% are the different parameters that has been considered for the study. PERCIST criteria have been used for the PET response classification. Even though immunotherapy is one of best treatment for lung cancer, it may not have same effect on every patients. Since adeno carcenoma patients may have adverse effect on using immunotherapy in some patients, such cases has been excluded in the study and only squamous carcenoma patients are considered here. So such kind of selection will become a tedious task if we didn't use PET/CT.

Hye Lim Park et. al[3] describes early diagnosis of NSCLC, like any other cancer, can be cured by surgical resection. Even though the survival rate of stage IA is very high, the recurrence rate is not negligible. So the selection of patients for adjuvant chemotherapy is not so easy. Here the main focus is whether stage IA NSCLC patients with negative surgical margin require adjuvant chemotherapy or not. Surgical margin negative means, there is no cancerous cells around the outer edge of tissues after resection. Surgical margin positive patients are usually prescribed for further treatment. But in negative patients, those having high tendency of recurrent cancer suggested for such treatments. In the proposed system, the recurrence rate is 12.6% and also these patients were surgical margin negative. Also most of them are re appeared within 2 years. Among the several PET factors, only high value of tumor to liver ratio (TLR) is considered as the reason for recurrence. Another factor, total lesion glycolysis is related with the survival rate. FDG PET is the better way to calculate the value of TLR.

Sarah A. Mattonen et.al[8] analyses whether the bone marrow activity from FDG PET/CT has influence on the prediction disease free survival of NSCLC patients. The metabolic activities in the bone marrow due to FDG PET/CT and tumor radiomics together can improve the prognosis in the patients. The study took 6 features: cancer stage, two bone marrow texture features, one MTV with penumbra texture feature, and two penumbra texture features. The 5 year DFS rate in normal case is 88.5% in low-risk group and 44.3% in high risk group. Where as in this study it is, 78.2% and 42.6% respectively. The study also includes the hematologic parameters for analysis. But it doesn't include patient diabetic status, body mass index, genetic markers, and specific pack-years of smoking history, which may impact bone marrow metabolism and outcome prediction.

The objective of the system proposed by Julian Kirchner et al.[10] is to compare the performance of 18F-FDG PET/MRI and PET/CT in the diagnosis of non-small cell lung cancer (NSCLC) more specifically the primary lymph node staging. The patients underwent 18F-FDG PET/CT followed by 18F-FDG PET/MRI for the study. Both modalities together categorized T stage (area of cancer) in 97.4% patients, where PET/CT 92.3% and PET/MRI 89.7%. Similarly, N stage (spread to lymph nodes) was categorized concordantly in 98.8%, with PET/CT and PET/MRI 92.9%

and 91.7% respectively. T stage was overstaged and understaged in identical patients by both techniques. Almost similar cases in N stage also. Tumor size and SUVmax measurements derived from them have correlation as r = 0.963 and r = 0.901, respectively. Even though both of them have their own excellencies, this study concludes that, they are equally well at T stage and N stage of thoracic staging and leading to identical therapeutic decision in NSCLC patients.

Feng-Ming Kong, Ling Li et. al in [11] explains how the mid-treatment of FDG PET can increase the overall survival rate of NSCLC patients. The reason for choosing FDG PET as most widely used imaging modality is given here as a)high accuracy in tumor growth analysis b) monitoring of tumor control after RT c) prognosis prediction d)high sensitivity and specificity in detection of recurrent cancer etc. The observation group includes only patients of stage I to III who require daily fractionated radiation. In the normal case, the PET will be taken after RT and after treatment. But this study found that if the PET is taken in between the course of treatment, early response will be obtained. Based on this result, if it is not good enough, the rest of the treatment can be blocked (otherwise it may adversely affect the patient) and an alternative therapy can be suggested. This will definitely increase the survival rate.

The standard treatment for stage I NSCLC is surgery. But as per the studies, 24% of them will experience recurrence probably within 5 years after surgery. Hoda Anwar et. al [12] made a study to find out how different PET parameters(SUV index, MTV and TLG) are leading to the prediction of such recurrence. Here the optimal cut- off values of those parameters is indicated using receiver operating characteristic (ROC) curve and the Youden index which is used to predict the recurrence. They categorize the stage I NSCLC patients into high risk and low risk of recurrence. This classification is done because the high risk patients will require adjuvant chemo therapy for the overall survival but those having low risk, doesn't require that. Because such therapies will have innumerable side effects. PET allows metabolic and functional assessment of tumor rather than anatomical, which is more accurate in prediction.

Marta Cremonesi et. al [13] presented a review on the importance of doing interim FDG PET/CT(FDGint)imaging in between the radio therapy(RT) or chemo- radio therapy(CRT). The accurate prognosis, diagnosis, staging, recurrence detection, tumor volume identification etc. already made FDG PET/CT superior over other modalities. Apart from those qualities, FDGint has extra potential in early finding of the responders and non-responders towards the CRT or RT. It can detect the metabolic changes made by therapy before the completion of the course. This will help in a) in responders, they can have better survival rate where as in non-responders, the rest of the therapy can be discontinued because it no longer require for the body b) in non-responders, can chose another therapy based on the finding from FDGint. This review categorizes the papers based on their core part and explains the limitations and potential of this review.

Immune checkpoint inhibitors are the immune therapy drugs which are one of the effective treatment for lung cancer. But all patients will not get benefit from such treatment. But there is no effective tool to categorize the patients. Higuchi M, Nemoto T et. al[15] discussed about how FDG PET can be made use in evaluating the performance of checkpoint-based cancer immunotherapy. They also mentioned the ongoing clinical studies and pre-clinical experiments for the treatment of NSCLC. CT or MRI can be used for the diagnosis but they are based on anatomical changes. Where as FDG PET is more effective because they are metabolically assessing treatment response.

FDG-PET's efficiency is reflecting in the case where it can differentiate the tumour of size of around 1cm, as benign or malignant. Some studies concluded that FDG-PET/CT had sensitivity and specificity 96% and 82–88% respectively, and CT had 96% and 53% respectively.

Seyhan Karaçavuş et al. [17] introduced a new texture analysis method- Law's Texture Filter- in FDG PET/CT to pick more useful features which will be helpful in tumour staging and subtype classification in NSCLC patients. Texture analysis is proven as one of the best method to differentiate tissue types in CT, Ultrasonography, MRI etc. Some of them have more accuracy in prediction and prognosis compared with parameters like SUV, TLG and MTV. 12-20 PET slices of same patient have been taken and after segmentation, a 3D image of cancer lesion will be obtained. 3 stage classes and 2 subtypes are included in the result set. The classification is done using k-NN and SVM algorithms. In staging, k-NN shows 59.5% accuracy and SVM has 69%. In subtype classification, SVM shows 92.7% accuracy and k-NN has 85.7%.

Hyung-Jun Im et al.[21] published an article, which is a systematic review on the prediction of prognostic value and thereby the overall survival rate, based on F-FDG PET parameters. 3 main PET parameters referred here are SUV, MTV and TLG. The impact of PET analysis is measured in terms of hazard ratio(HR). Patients with high MTV has HR which is very close to HR for death(2.71 and 2.31 respectively). Similarly for high TLG(2.35 and 2.43 respectively). MTV and TLG in patients with lung cancer is considering here for predicting the survival rate or risk stratification factors. The article concludes that, Patients with a high value of MTV or TLG have several folds high risk of having death. It also describes the overall survival rate of patients in different stages (as per TNM staging).

Satoshi Takeuchi et al.[25] describes what is the impact of using 18F-FDG PET/CT (PET/CT) as medical imaging technique, in clinical staging, management plan and finding prognostic value in patients having NSCLC. This paper compares the above features using PET/CT and conventional CT images. 18F-FDG PET has been considered to be more accurate than CT and plays an important role in the diagnosis of NSCLC. Because of its accuracy, 18F-FDG PET has been widely used as a routine study in the initial staging evaluation of NSCLC. 592 patients with NSCLC who underwent both conventional CT and PET/CT at initial staging prior to initial therapy were included. Initial PET/CT changed the stage in 28.7% of patients, and initial PET/CT had a medium/high impact on the management plan in 37.2% of patients.

Since each stage has different treatment and prognosis, staging is the most crucial part in diagnosis. LIU Bao-jun [28] proposes a system that shows the efficiency of FDG PET/CT in lymph node staging. Metastatic lymph nodes or primary tumors can be localized in CT using anatomic features. If the diameter of the lymph nodes are greater than 1cm, then it may be malignant. But all swollen lymph nodes may not be metastatic and all metastatic lymph nodes may not be swollen. So along with morphologic data, metabolic data also should be there, for the correct diagnosis. There comes the importance of PET. If the lymph node have SUV value>=2.5, then it is treated as malignant. It can detect invasion of the chest wall much more accurately than other methods. The findings of this study has been compared with the histopathology results. It can be summarized as the percentage of sensitivity: 65%, specificity: 96.8%, accuracy:

92%, positive predictive value: 78.5% and negative predictive value: 90%. It has high accuracy in distinguishing N0-N1 stages from N2 to N3 stages in lung cancers. So this paper revealed that, PET/CT has high specificity while identifying metastatic mediastinal lymph nodes in NSCLCs and it has high accuracy in staging.

Lardinois D,WederW et al. in [29] compares the efficiency of PET/CT with PET alone and CT alone in the staging of NSCLC. In this study, PET/CT had given extra information in 41% of the patients. The information include finding exact location of lymph nodes, precise evaluation of chest-wall infiltration, mediastinal invasion, correct differentiation between tumor and peritumoral inflammation or atelectasis and exact location of distant metastases. The study proved that T-staging and N-staging are significantly more accurate in diagnosis and also 25% increased accuracy in M-staging. Even though CT and PET are very effective in staging, they are failed to find some mediastinal lymph nodes whose size is less than 5 mm. Since PET/CT has a faster acquisition time than PET scanner, the duration of the examination is less and thus of the patient's discomfort. Here the authors wish that once integrated PET–CT becomes more widely available, it will be the best choice for staging of NSCLC.

Antoch G, Stattaus J et al.[30] determines the accuracy of dual-modality PET/CT over PET alone and CT alone. Here the accuracy of T, N and M stage has been compared. Differences in the accuracy of overall tumor staging between PET/CT and CT (P =.008) and between PET/CT and PET (P = .031) were statistically significant. Use of dual-modality PET/CT significantly increases the number of patients with correctly staged NSCLC and thus has a positive effect on treatment.

Hicks RJ et al. [31], describes the impact of PET in lung cancer patients. The study involved newly diagnosed NSCLC cases. Study proved that staging is more accurate in this method because staging done by other conventional method have been changed significantly and also the previously selected treatment plan and therapy has been changed based on the findings from PET. It also has a high predictive accuracy than CT for staging. Also the additional information provided by PET significantly changed the management plan.

3. TABLE OF COMPARISON

Paper	Key area	Findings
(**2020**) "The need of a clinically oriented reporting of 18F-FDG PET/CT in non-small cell lung cancer (NSCLC). Clinical and Translational Imaging".	How effective PET/CT in NSCLC patients as compared to other modalities	PET/CT shows its excellency in stage shifting, diagnosis of recurrent cancer, occult distant metastasis etc.
(**2020**) "The efficiency of 18F-FDG PET-CT for predicting the major pathologic response to the neoadjuvant PD-1 blockade in resectable non-small cell lung cancer."	To find the pathologic response of NSCLC towards immunotherapy	Since PET/CT can reflect tumor metabolic level before morphological changes, it is assumed to be the most effective way to report the tumor response patterns of immunotherapy.
(**2019**) "Does FDG PET/CT have a	To suggest whether	Margin negative NSCLC stage IB & IIA and

role in determining adjuvant chemotherapy in surgical margin-negative stage IA non-small cell lung cancer patients?"	adjuvant chemotherapy is needed in surgical margin negative stage IA NSCLC patients.	also stage IA with high risk factor of recurrence is recommended for adjuvant chemotherapy. It decreases the mortality rate through recurrence. The recurrence rate can be calculated effectively by TLR value.
(**2019**)"Bone Marrow and Tumor Radiomics at 18F-FDG PET/CT: Impact on Outcome Prediction in Non–Small Cell Lung Cancer"	Impact of Bone Marrow and Tumor Radiomics at 18F-FDG PET/CT on prediction of NSCLC	Integration with radiomic features of the primary tumor, tumor penumbra, and bone marrow increases the accuracy in risk stratification and prognosis of lung cancer, than clinical outcome alone.
(**2018**)"Prospective comparison of ^{18}F-FDG PET/MRI and ^{18}F-FDG PET/CT for thoracic staging of non-small cell lung cancer"	Comparing PET/MRI and PET/CT in T and N thoracic staging of NSCLC.	Both FDG PET/CT and PET/MRI has similar kind of conclusion and decision making in treatment plan and same accuracy in T and N staging, tumor size and SUVmax.
(**2018**) "Greater reduction in mid-treatment FDG-PET volume may be associated with worse survival in non-small cell lung cancer"	Effect of mid-treatment FDG PET in overall survival rate in NSCLC	Patients who undergone extra mid-treatment FDG PET, has more survival rate.
(**2018**). "The value of different 18F-FDG PET/CT baseline parameters in risk stratification of stage I surgical NSCLC patients"	Role of PET/CT parameters in risk stratification of stage I NSCLC with surgery.	High risk and low risk of recurrence patients are distinguished and high risk patients are recommend for post operative adjuvant therapies.
(**2017**). "Role of interim 18F-FDG-PET/CT for the early prediction of clinical outcomes of Non-Small Cell Lung Cancer (NSCLC) during radiotherapy or chemo-radiotherapy. A systematic review	Contribution of FDGint on the early prediction of clinical outcomes during neo adjuvant therapy	FDGint is a tool for early detection of response of RT or CRT in the NSCLC. CRT is very toxic to the body. So if it is not fruitful to the patient, it is better to interrupt it rather than completing.
(**2017**) "Current status and future prospects of PET/CT in NSCLC treated with checkpoint-based immunotherapy"	Effect of immunotherapy on NSCLC patients.	FDG-PET/CT is very effective in categorizing NSCLC patients based on who will be beneficial from checkpoint based immunotherapy.
(**2016**) "Automatic Staging and Subtype Determination for Non-Small Cell Lung Carcinoma Using PET	How the Texture Analysis method affect in staging and	Using texture analysis method 3D view of the lesion created, which is used in stage and subtype classification. It is more accurate in

Image Texture Analysis"	classification of NSCLC?	prediction and prognosis than conventional parameters of PET.
(**2014**) "Prognostic value of volumetric parameters of 18F-FDG PET in non-small-cell lung cancer: a meta-analysis"	Influence of PET parameters on prognosis	PET parameters can accurately calculate the prognosis value and thereby predict the overall survival rate in NSCLC patients.
(**2009**) "Accuracy of 18F-FDG PET/CT for lymph node staging in non-small-cell lung cancers"	Accuracy of FDG PET/CT in diagnosis of lymph node in NSCLC.	FDG PET/CT can be used as one of the best assessment tool for tumor diagnosis, therapy evaluation and follow-up.
(2003) "Staging of non-small-cell lung cancer with integrated positron emission tomography and computed tomography"	Comparing the staging accuracy of PET,CT and integrated PET with CT.	The integrated PET–CT is superior to PET alone, CT alone, or visual correlation of PET with CT in predicting the stage of NSCLC
(**2003**) "Non-small cell lung cancer: dual-modality PET/CT in preoperative staging"	Comparison of effectiveness of PET/CT with CT and PET alone	Accuracy of staging increased and treatment plan get positively affected by it.
(**2001**) "(18)F-FDG PET provides high-impact and powerful prognostic stratification in staging newly diagnosed non-small cell lung cancer"	Impact of (18)F-FDG PET in newly diagnosed NSCLC patients	PET has high impact on the newly diagnosed NSCLC patients. Stage migration occurred in many of the cases and also it greatly influences the therapeutic decisions that have already taken based on other modalities.

3.1 Limitation of the review

The search has been mainly done by the keywords "FDG PET/CT" and "NSCLC". Search results contained several papers related to 18F-FDG PET/CT applied on NSCLC patients, all of them are focusing on different areas. They are not using the same techniques or not even patient's group of same stage or patient group of similar back ground at least. Among them, only some of the papers relevant to show the importance of PET in NSCLC patients have been taken. This modality has several other advantages in other diseases, but only NSCLC cases are considered here.

4. CONCLUSION

Medical imaging is the primary diagnosis method for any type of cancer. Among them, only 18F-FDG PET/CT provides anatomic as well as metabolic functioning of the patient. It shows excellent accuracy in staging and diagnosis. Finding exact location of lymph nodes, precise evaluation of chest-wall infiltration, mediastinal invasion, correct differentiation between benign and malignant tumors, exact location of distant metastases etc are some other

peculiarities of it. Even though the patients are in the same stage, the response of the body towards the treatment may be different. PET is very effective in detecting such responses. So it has great contribution towards the prediction of treatment and management plan.

Adjuvant and neo adjuvant therapies are prescribed for NSCLC patients for better results. Since it is not beneficial for all, it is critical to find the respondents and non-respondents to it. Here also this scanning has great impact. The non-respondents can be getting rid of the rest of the treatment and can find an alternative one. Adjuvant therapies are recommended only for those who have high chance of recurrence, because of its toxicity and chance for plenty of side effects. Such selection can be done by this. The occult metastasis stage is hard to find by any modalities other than PET. During the process, the glucose content will be absorbed by the cancerous cells and thus such area of cells can be easily segmented and such segmentation can be lead to easy radio therapy.

Apart from several advantages, it has some disadvantages too. It is not recommended for routine check up because of its side effects. During the process, radio active tracer is injected into the body which is very harmful to the patient. After the scanning, the patient will be emitting the radiation and they are suggested not to be with children or pregnant women. Also technically speaking, it produces false negative results in some cases. If the patient has abnormal rate of sugar level, the tracer uptake will show false result. Also it is very expensive and not readily available. Since radioactive substances are steadily decaying, it should not kept for so long and the unavailability of tracer is also affect scanning.

So this review concluding that, apart from all the disabilities, 18F-FDG PET/CT is an inevitable bio-medical imaging technique for non small cell cancer patients. So we decided to choose it as the best modality among several, as the input image in different machine learning algorithm.

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