The Role of PET/CT Imaging in the Evaluation of Bronchogenic Carcinoma

Essay

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Abstract

PET/CT is now an important cancer imaging tool, both for diagnosis and staging, as well as offering prognostic information based on response. This study attempts to review the value of PET/CT in the staging of lung cancer, illustrate the potential effect on patient's management and give a short overview of newer applications. Specifically, PET/CT can improve initial staging, guide surgical and radiotherapy planning, predict tumor response and can detect early tumor recurrence.

Keyword PET/CT – Bronchogenic carcinoma

List of contents

List of abbreviation

ACF	Attenuation correction factor
AC/AL	Attenuation correction/Alignment
BAC	Bronchioloalveolar carcinoma
COPD	chronic obstructive pulmonary disease
cm	Centimeter
CT	Computed Tomography
CXR	Chest X Ray
FDG	FluoroDeoxyGlucose
18FDG	^{18}F- FluoroDeoxyGlucose
FLT	F-18-3-Fluoro-3-deoxy-L-Thymidine
FP	False positive
FN	False negative
GLUT	Glucose transporters
HU	Hounsfield Unit
KeV	Killo electron Volt
KV	Killo Volt
MA	Milli Ampere
MAS	Milli Ampere Second
mCi	Micro Curies
MeV	Mega electron Volt

MRI	Magnetic Resonance Imaging
NSCLC	Non small cell carcinoma
PET	Positron Emission Tomography
PET/CT	Positron Emission Tomography/ Computed Tomography
SCLC	Small cell lung carcinoma
SPN	Solitary pulmonary nodule
SUV	Standardized uptake value
TNM	Tumor Node Metastasis
TTNA	Transthoracic needle aspiration
ß$^{+}$	Positron
ß-	Electron

List of figures

List of tables

INTRODUCTION

Bronchogenic carcinoma has become a major health heading in the new millennium being the most common cause of cancer-related death in the Western world, with approximately 3 million new cases per year estimated worldwide. Statistically, Bronchogenic Carcinoma is the second most common cancer in men and the third most common cancer in women ***(Patz et al, 2000).***

Bronchogenic carcinoma is a form of highly malignant primary lung cancer tumor. Four types of bronchogenic carcinoma include: Squamous cell, undifferentiated small cell bronchogenic carcinoma, undifferentiated large cell, and adenocarcinoma. The prognosis for patients with bronchogenic carcinoma is poor, with an overall 5 years survival of 10%-15%. In general, patients with squamous cell carcinoma have the best prognosis; those with adenocarcinoma and undifferentiated large cell carcinoma have an intermediate prognosis **(*Sokhandon et al, 2003).***

Diagnosing, staging, and following up bronchogenic carcinoma often presents a clinical and radiographic challenge. There are no definitive imaging findings or markers for detecting this disease at an early stage. Diagnosis is still dependent on accurate imaging studies and histologic or cytologic evaluation ***(Komaki et al, 2001).***

The optimal treatment of lung cancer relies on accurate disease staging, which is based on tumor size, site, regional nodal involvement, and the presence of metastasis and thus accurate staging is necessary to determine resectability and overall prognosis. Surgical resection is the only curative hope for patients with lung cancer. One goal of staging is to classify properly operable patients and avoid surgery in those with unresectable disease ***(Shine Shim et al, 2005).***

Current imaging studies provide valuable information, however, not specific enough to aid in clinical management. CT and MRI rely on anatomic and morphologic changes for diagnosing, staging and follow-up however; many lesions remain indeterminate making the distinction between benign and malignant disease a constant challenge. Positron emission tomography (PET) offers a different approach to diagnosis of chest diseases ***(Bybel et al, 2006).***

Positron emission tomography (PET) performed with 2-fluoro-2-deoxy-d-glucose (FDG) has proved valuable in providing important tumor-related qualitative and quantitative metabolic information that is critical to diagnosis and follow-up. It has been reported to increase diagnostic accuracy in the differentiation of benign and malignant lesions and to improve identification of nodal metastasis. Functional scans obtained with FDG PET not only are complementary to those obtained with conventional modalities but also may be more sensitive because alteration in tissue metabolism generally precede anatomic changes ***(Rohren et al, 2004).***

PET/computed tomography (CT) is a unique combination of the cross-sectional anatomic information provided by CT and the metabolic information provided by PET, which are acquired during a single examination and fused. FDG PET/CT offers several advantages over PET alone; the most important is the ability to accurately localize increased FDG activity to specific normal or abnormal anatomic locations, which may be difficult or even impossible with PET alone ***(Kapoor et al, 2004).***

Integrated PET/CT imaging will become the new standard of mediastinal staging. The high reliability of integrated PET/CT is in the exact localization of extrathoracic versus intrathoracic and mediastinal versus hilar lymph nodes. FDG PET/CT imaging strength lies in its very high negative predictive value and

increased sensitivity. It may alleviate the need for surgical staging when FDG PET/CT studies of the mediastinum are negative **(*Schimmer et al, 2006).***

The high sensitivity and high negative predictive value of FDG PET/CT in most malignant tumors enable this technique to play an even greater role in tumor management at initial staging and follow-up ***(Kostakoglu et al,2003).***

PET/CT is an exciting innovation in medical imaging. It offers many opportunities for the patients, the clinician and the researcher. The functional and anatomic information offered by PET/CT is being recognized as crucial in the care of oncology patients being able to define the primary tumor as well as local and distant metastases in a single noninvasive examination, and in its overall greater accuracy than conventional imaging procedures, hence, the potential impact of PET on stage designation and therapeutic management. PET and PET/CT are playing an ever-increasing role in the management of oncologic disease ***(Schrevens et al, 2004).***

AIM OF WORK

PET/CT has the potential to become the most efficient oncologic examination in the near future.

The aim of this work is to highlight the role of PET/CT studies in the evaluation and staging of bronchogenic carcinoma.

Bronchogenic Carcinoma

Bronchogenic carcinoma has become the number one killer among cancers worldwide ***(Molina et al, 2008).*** Death from lung cancer has surpassed death from breast cancer in women. Early detection is still a major problem because there are no definitive imaging findings or markers for detecting this disease at an early stage. In its earliest stages, 70% of cases can be cured by surgery. Diagnosis is still dependent on accurate imaging studies and histologic or cytologic evaluation ***(Komaki et al, 2001).***

CLASSIFICATION:

For the purpose of treatment and prognosis, lung cancer is divided into 2 categories: small-cell lung cancer and non–small cell lung cancer.

Non-Small Cell Lung Carcinoma

Accounts for approximately 80% of all bronchogenic carcinomas, and is typically classified into specific cell types. The most common types are adenocarcinoma, squamous cell carcinoma, and large cell carcinoma; although a variety of other unusual cell types have been classified according to the World Health Organization ***(Patz et al, 2000).***

Adenocarcinoma:

It accounts for 25 to 30% of NSCLC and is the most common type ***(Patz et al, 2000)***. The lesion is located peripherally in approximately one half of cases. Adenocarcinoma may arise from a previous scar, it rarely cavitates and an eccentric pattern of calcification may be evident ***(Sharma et al, 2005)***.

Bronchioloalveolar cell carcinoma (BAC)

Is a peculiar subtype of adenocarcinoma usually peripherally located. It may appear in a variety of ways, including a solitary pulmonary nodule (45%), multiple