**Introduction**

Lung cancer is a leading cause of death globally,¹ is the third most common form of cancer in Europe and is increasing among women, notably in western countries.² The lifetime risk of developing lung cancer in the UK is one in 14 for men and one in 21 for women.³

Fluorodeoxyglucose (FDG) positron emission tomography (PET) was initially thought of as an accurate staging method that improves patient outcome by optimising the choice of treatment and avoiding unwarranted interventions.⁴,⁵ The PLUS study demonstrated that inclusion of PET in conventional workup prevented unnecessary thoracotomies in one-fifth of patients with suspected non-small cell lung cancer (NSCLC).⁶

Over the last few years the remit of FDG PETCT has expanded, and it is now regarded as essential for lung cancer management, including accurate diagnosis, staging, treatment planning, diagnosis or confirmation of disease relapse and monitoring of treatment response,⁷ and has been shown to provide prognostic information. Interestingly, although staging should be carried out according to the newest TNM classification, PETCT data was not included in version seven of the TNM, but is planned to be incorporated into version eight. Although all scanners are now PETCT scanners, some of the original data used to promote the use of PET services worldwide was PET alone, and this data appears, for the most part, to have stood the test of time.⁸,⁹

**Recent changes in UK guidelines in lung cancer management and PETCT**

In 2011, the National Institute for Health and Clinical Excellence (NICE) updated its previous guidelines on the diagnosis and treatment of lung cancer.¹⁰ Importantly, it reviewed not only the utility of investigations in lung cancer, but also their place in the diagnostic pathway, and in different patient groups. There is a shift towards investigations that give both diagnostic and staging information. There are sensible suggestions on the likelihood of nodal involvement in patients with peripheral and central tumours, and the need for nodal sampling at the time of bronchoscopy where possible. The diagnostic and staging algorithms provided highlight the benefit of performing PETCT and mediastinal nodal sampling at different stages in the different patient groups. For instance, PETCT is recommended as potentially of value as an early investigation in patients with suspected lung cancer presenting as a T1 peripheral lesion without mediastinal lymphadenopathy, whereas endoscopic bronchoscopic ultrasound is recommended prior to PETCT in patients with a central lesion and large volume mediastinal lymphadenopathy (figure 1). PETCT continues to be recommended in all patients undergoing therapy with curative intent.¹¹

The British Thoracic Society 2010 guidelines updated the selection and assessment of patients with lung cancer who can potentially be managed by radical treatment.¹² Notably, following PETCT, radical treatment can be offered even without further mediastinal lymph node sampling in cases of no significant uptake in normal sized mediastinal lymph nodes on PETCT scans. Both guidelines recommend that solitary metastases detected on PETCT are confirmed either by biopsy or a second confirmatory imaging test.¹²,¹³

**Recent studies concerning the role of PETCT in lung cancer**

There are multiple studies that have previously demonstrated that the maximal standardised uptake volume (SUVmax) measured by PET is an independent predictor of survival, although there are at present no usable thresholds that are currently in practice to alter patient management.¹⁴,¹⁵ Recently, two groups have reported on additional methods of measuring the tumour-based metabolic activity of patients with lung cancer. Zhang and co-workers studied 104 NSCLC subjects by PETCT and reported that baseline whole body metabolic tumour burden (metabolically active parts of the tumour) is a prognostic measure independent of clinical stage and other prognostic factors (better prognostic measure than SUVmax) and may potentially be favourably used to further risk stratify surgical patients with NSCLC.¹⁶ Hyun et al published a paper demonstrating that the volume-based parameter of PET may be an additional new, independent prognostic factor for survival in addition to TNM stage in patients with early-stage NSCLC after surgical resection.¹⁷

There has been significant debate in the literature and in clinical practice on the value and accuracy of FDG determined mediastinal nodal involvement. There are different methods of deciding whether to report a node as involved, such as activity above background or above a pre-determined SUVmax threshold. A recent meta-analysis on the assessment of mediastinal lymphadenopathy and FDG avidity has detailed its accuracy, reporting on its activity per node and per patient.¹⁸ While sampling to confirm involvement is the gold standard, we now have sufficient data to enable us to make informed decisions on the likelihood of metastatic nodal involvement when this is not possible.

Although those of us using PETCT regularly in our practice assume that it is adding value to patient care and improving survival by increasing staging accuracy, there is unfortunately no published literature to support this. The recent publication in *Annals of Internal Medicine* in 2009 failed to demonstrate improved survival in those staged by PETCT in comparison to CT alone.¹⁹ This study was underpowered for this secondary outcome measure, and it seems clinically improbable that it has no effect on outcome, although the more rigorous approach to staging and achieving a tissue diagnosis as the standard of care, in comparison to practice when PET and PETCT was first introduced, suggest its effect may now be less marked. The recent abstract and presentation at the World Lung Cancer Congress 2011 hinted at potentially improved survival in patients with NSCLC failing to respond to chemotherapy diagnosed on PETCT and changed to an alternative treatment.²⁰ This study suggests that early detection of chemotherapy treatment failure by PETCT may, as with other tumours, be yet another indication for its use.

Its use in the detection of lung cancer relapse has at pre-
sent not shown that it should be used routinely. This is probably unsurprising, as some guidelines on lung cancer follow-up post radical therapy have questioned the value of both PETCT and CT alone.\textsuperscript{23} Perhaps more importantly, we need to consider which patients treated for lung cancer may benefit from early relapse detection and investigate whether these patients would be best served by use of PETCT.

Although we are used to routinely performing PETCT in patients with NSCLC, its use in patients with small cell lung cancer is not currently routine. Interestingly, a recent meta-analysis of PETCT in patients with CT diagnosed limited stage small cell lung cancer suggested that imaging using PETCT in these patients prior to treatment significantly affects their treatment,\textsuperscript{23} altering the treatment area in patients with limited disease referred for radiotherapy.

Lung cancer studies, as with other tumour groups, are awash with genotyping and receptor status analysis. Imaging is likely to play a part in tumour categorisation by applying modern molecular and functional techniques, as is seen from the recent report of tumour phenotyping using combined dynamic contrast-enhanced CT and PET by assessing vascular-metabolic associations.\textsuperscript{29}

Finally, the article by MacPherson et al in \textit{Clinical Radiology} raises the possibility of performing PETCT earlier in the pathway of some good performance status patients with lung cancer\textsuperscript{2} (figure 2).

\textbf{Conclusions}

Although it is now accepted wisdom that PETCT is a key part of lung cancer management, there are still many unanswered questions related to its use, including its role in stratifying patients outside TNM staging; assessing disease response; and where it should be positioned in the investigation and treatment pathway.

\textbf{References}

FIGURES 2a, 2b and 2c
A small, potentially operable presumed bronchogenic carcinoma seen in the right upper lobe on CXR (arrowed), confirmed on CT and seen to be FDG avid on PETCT. Dr MacPherson et al have reported that this patient type may be suitable to move straight to PETCT without the need for a CT.

FIGURES 1a and 1b
A large right-sided lung cancer seen on CXR, with a 2cm right paratracheal node. NICE Guidelines 2011 recommend EBUS as the initial investigation rather than PETCT.