



The Role of PET in NSCLC

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Introduction

- P.E.T. has developed significantly in the assessment and management of NSCLC.
- It has become an essential part of staging, treatment planning, therapeutic monitoring, assessment for recurrence and prognostic stratification.

Overview of PET in NSCLC

Pre treatment staging
Pre and post treatment prognostic stratification
Treatment planning
Assessment of treatment response
Assessment for recurrence

Clinical Impact of PET

Pre Treatment Staging

Pre Treatment N and M Staging

- Accurate staging crucial for appropriate treatment
- Conventional staging is by CT/US or surgery
 - CT staging of mediastinal nodes is low in accuracy
 - Surgical staging limited by morbidity and sampling errors
 - CT staging of adrenal involvement is dependent on size
 - Metastases to bone and liver often understaged

N Staging

N Staging

- PET-FDG imaging was significantly more sensitive, specific, and accurate for detecting N disease than CT
- PET changed N staging in 35% of patients.

*Comparative efficacy of FDG PET and CT scanning in preoperative staging of NSCLC.
Gupta NC et al Ann Surg. 1999 Feb;229(2):286-91.*

N Staging

- PET has a very high negative predictive value for nodal involvement.
- PET negative nodes do not require further evaluation with nodal sampling

N Staging

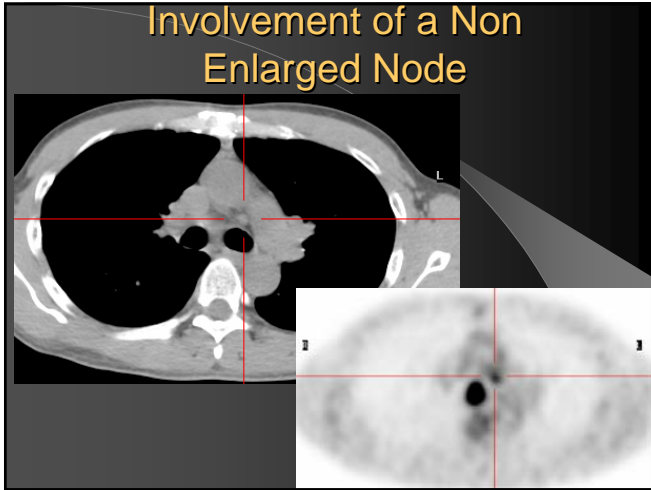
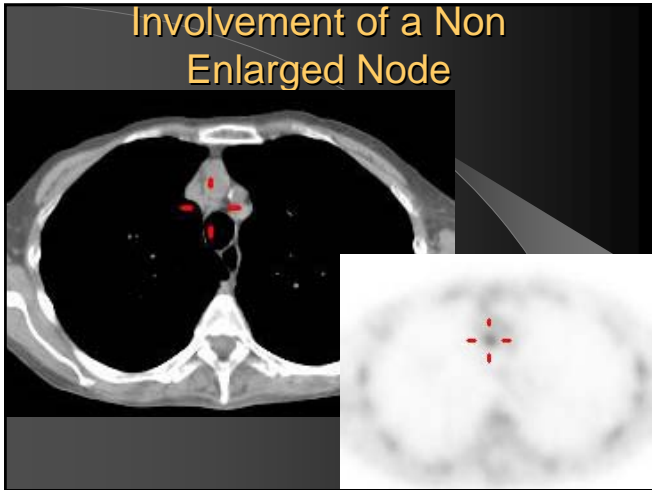
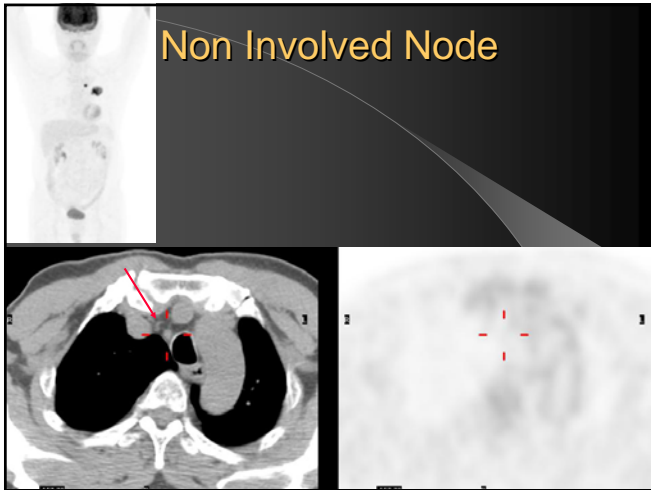
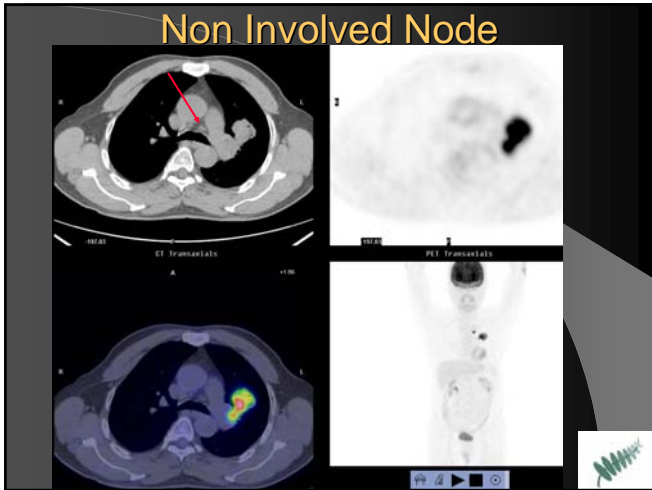
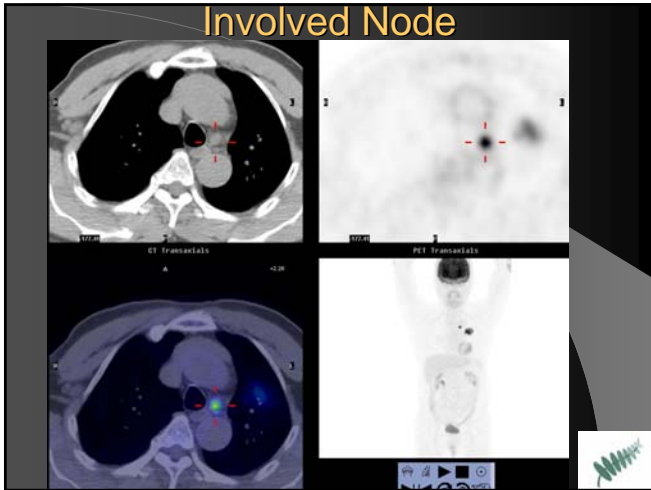
- Positive predictive value is also high but must be interpreted in conjunction with the the pre test likelihood of the presence of disease
- Positive predictive value of PET for nodes depends on the patient population and the likelihood of mediastinal involvement.

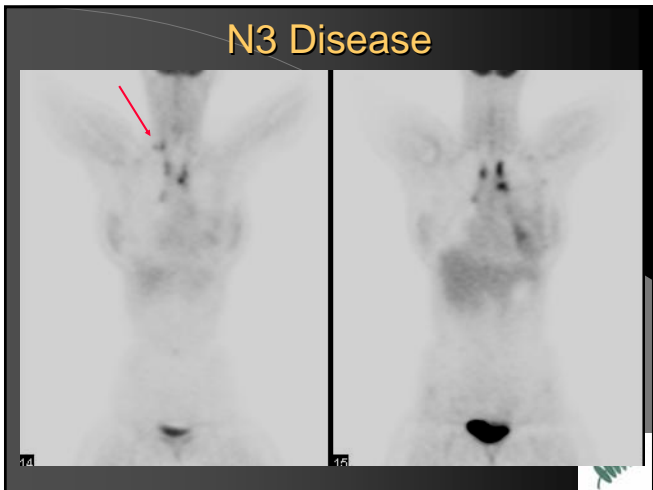
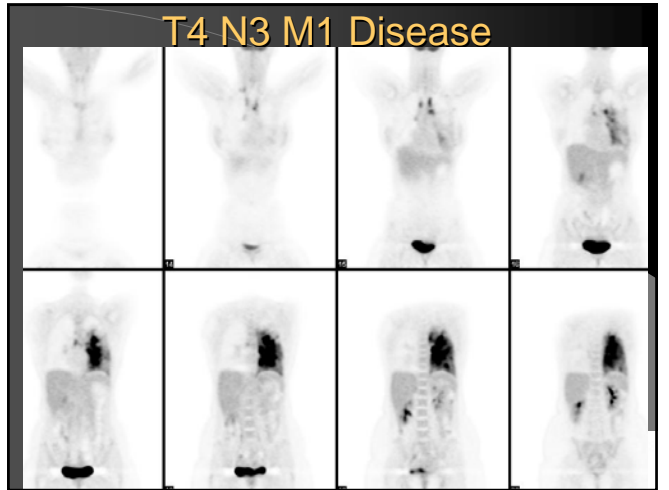
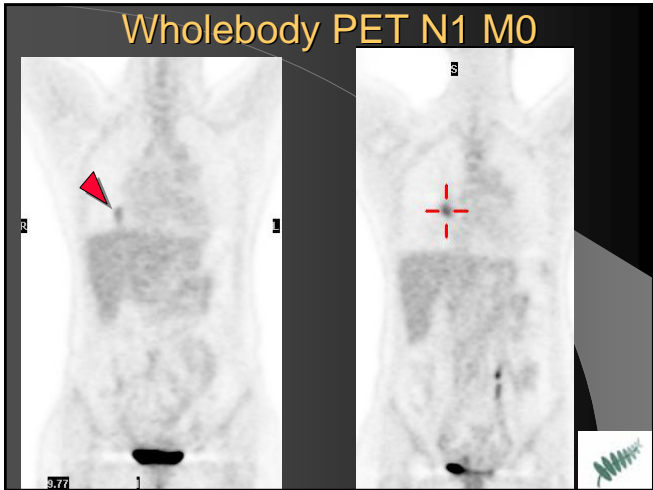
N Staging

- If T1/2 , likelihood of nodal involvement is low and more likely to get false positive from inflammation or granulomatous changes.
 - Therefore before excluding possible curative treatment in this group, should have mediastinal sampling of possible involved node seen on PET.
- If T3/4 then likelihood of nodal involvement is much higher and positive predictive value of PET is higher. No need for further sampling .

Nodal Involvement







M Staging

Traditionally reliant on conventional imaging CT, ultrasound, bone scan, MRI

M Staging of NSCLC

Whole body PET can replace all other forms of imaging for detection of distant metastases to all sites apart from the brain.

Pieterman et al New England Journal of Medicine July 27 2000 :254- 261

M Staging of NSCLC

Detection of distant metastatic disease on PET in patients negative on conventional imaging

- 7.5% Of Stage 1
- 18 % of Stage 2
- 24% of Stage 3 on CT

MacManus et al Int J Radiat Biol Phys: 2001 June 1; 50(2):287-93



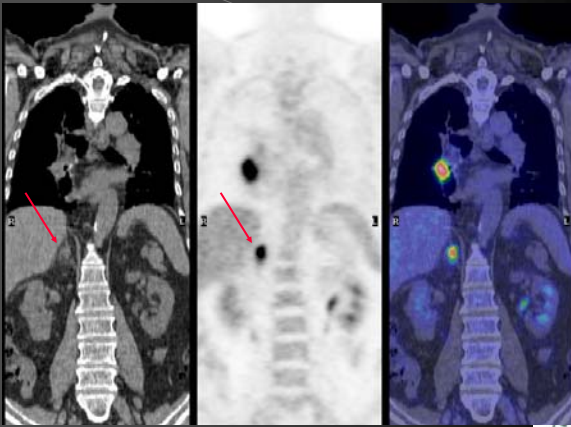
M STAGING OF NSCLC

PET staging detected unsuspected metastasis in >20%

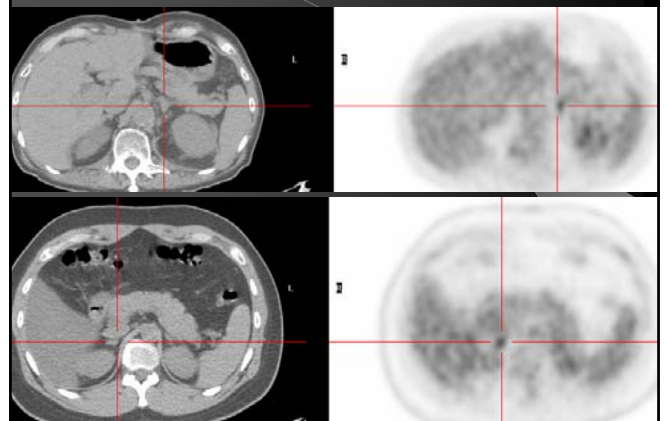
Will significantly alter stage, treatment options and survival



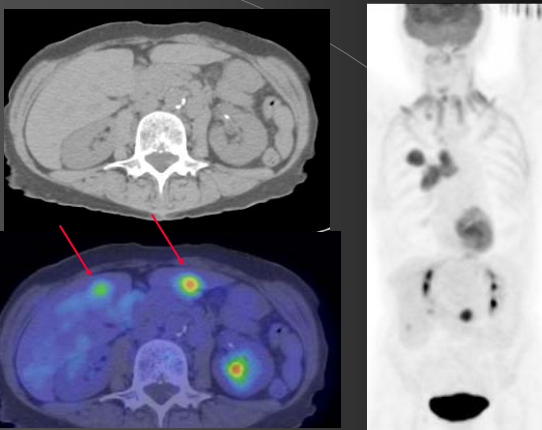
Adrenal Metastasis



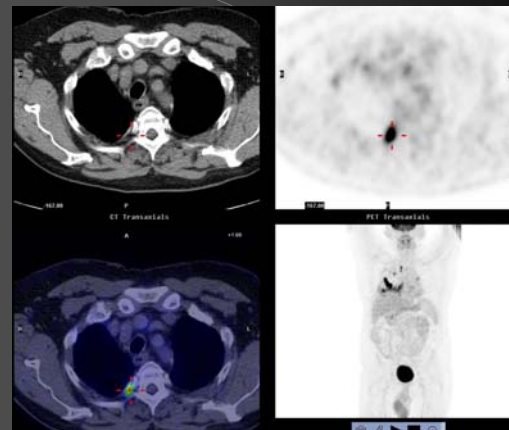
Adrenal Metastasis



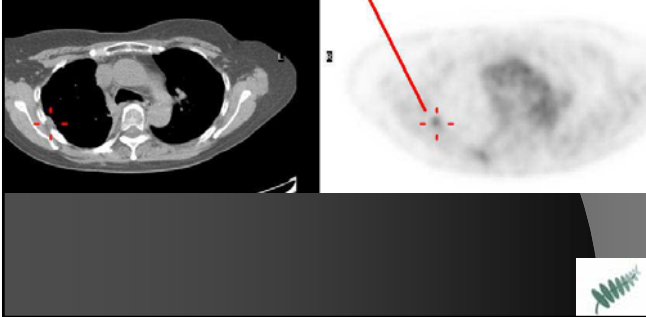
Liver Metastasis



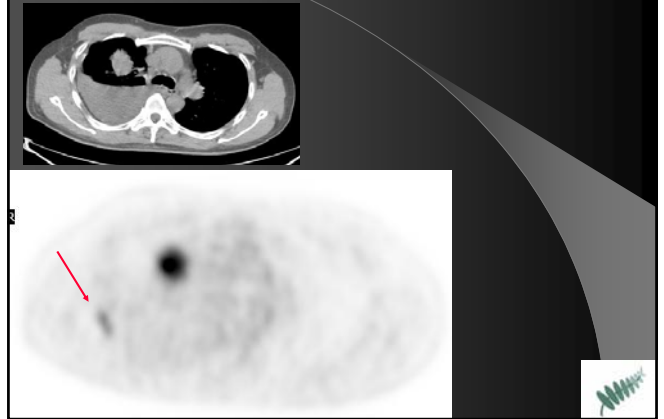
Pleural Metastasis



Pleural Metastasis



RIB METASTASIS



CLINICAL IMPACT

Clinical Impact

Effect of pre Radiotherapy PET on NSCLC

- Stage Migration
- Treatment modification
- Prognostic stratification

Stage Migration

PET stage different from pre PET conventional staging in 43%

10% downstaged and 33% upstaged

Hicks et al J of Nuclear Medicine Vol. 42 No 11 Nov2001 ; 1596-1604

Treatment Modification

High impact on treatment planning

22% went from curative to palliative

4% went from palliative to curative

Hicks et al J of Nuclear Medicine Vol. 42 No 11 Nov2001 ; 1596-1604

Prognostic Stratification

- Prediction of survival:

Pre treatment PET staging stronger prognostic factor than staging on conventional imaging

Treatment intent based on PET stage is highly predictive of survival

Hicks et al J of Nuclear Medicine Vol. 42 No 11 Nov2001 ; 1596-1600



Survival

Patients selected for radical radiotherapy based on pre treatment PET have a higher survival than those selected for RRT based on conventional imaging.

MacManus MP et al Int. J Radiat. Oncol. Biol. Phys 2002 Feb 1;52(2):351-61



Treatment Planning



Treatment Planning

Pre treatment P.E.T. can improve survival of patients with NSCLC

Reflection of better patient selection and better targeting of RT to tumour



Treatment Planning

FDG PET scanning changed or influenced management decisions in 67% patients with NSCLC.

Patients frequently spared unnecessary treatment, and management more appropriately targeted.

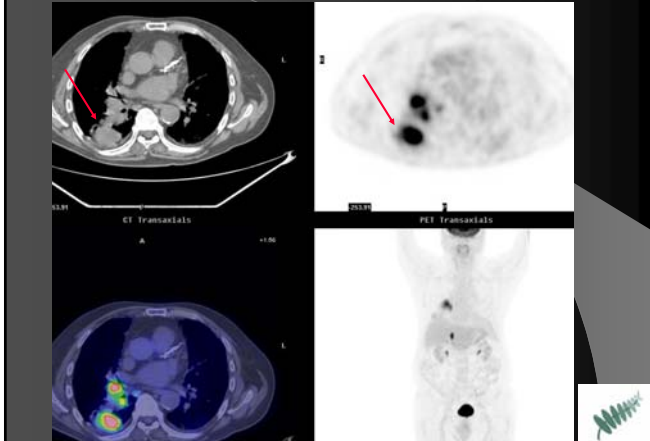
J Clin Oncol 2001 Jan 1;19(1):111-8 Kalf V, Hicks RJ



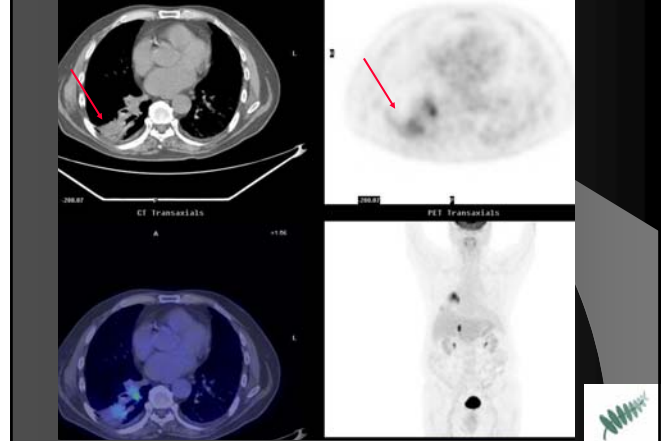
Differentiating Tumour from Distal Collapse



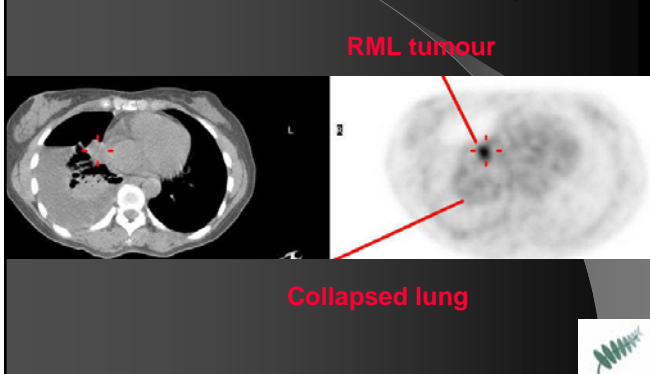
Tumour / Distal Collapse



Tumour / Distal Collapse

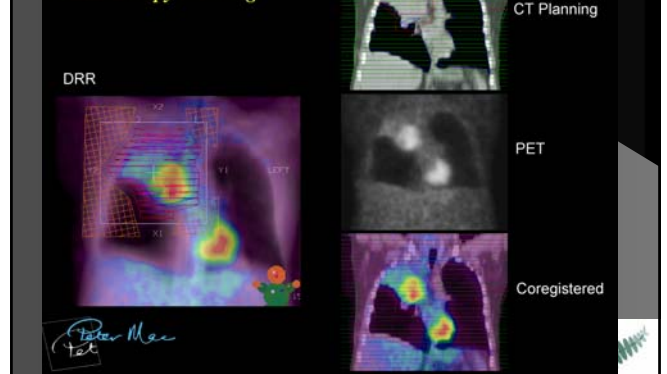


Tumour and Distal Collapse



RT PLANNING

PET in Lung Cancer Radiotherapy Planning



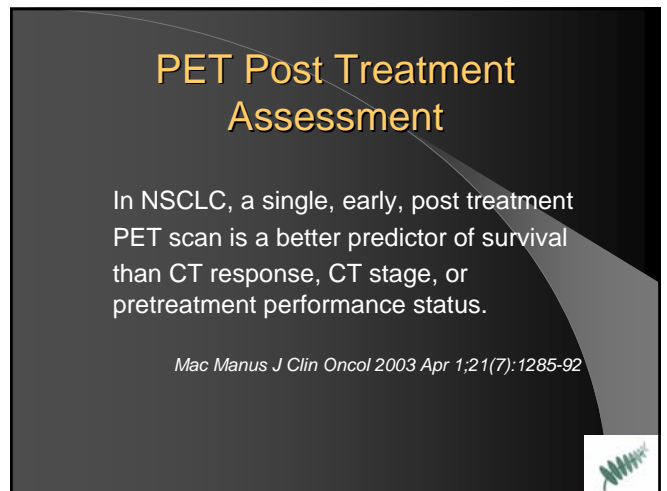
Treatment Response



PET Post Treatment Assessment

In NSCLC, a single, early, post treatment PET scan is a better predictor of survival than CT response, CT stage, or pretreatment performance status.

Mac Manus J Clin Oncol 2003 Apr 1;21(7):1285-92



Prognostic value of post treatment PET

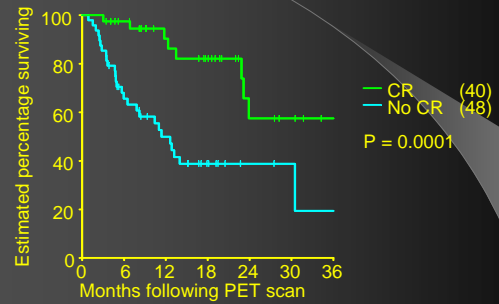
Post treatment FDG PET has high prognostic value and strongly correlates with survival rates of patients with treated lung cancer.

Patients with positive FDG PET results post treatment have a significantly worse prognosis than patients with negative results.

Prognostic value of thoracic FDG PET imaging after treatment for non-small cell lung cancer. Patz et al AJR 2000 Mar;174(3):769-74



Therapeutic Monitoring



Survival by PET response in 88 patients receiving radical radiotherapy

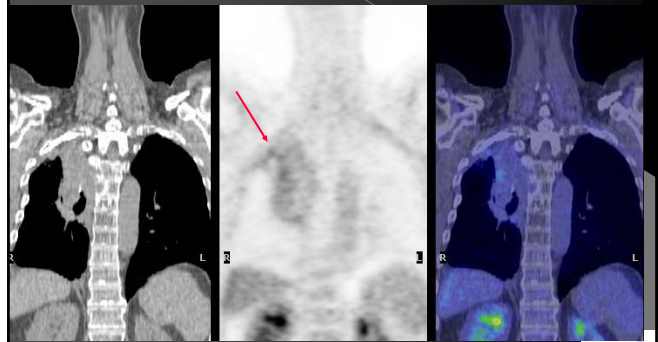
MacManus et al, J Clin Oncol 2003



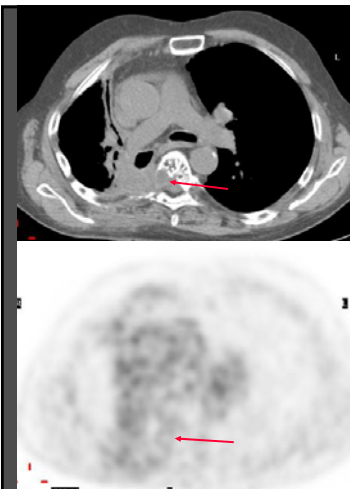
Complete Metabolic Response with Post RT Changes



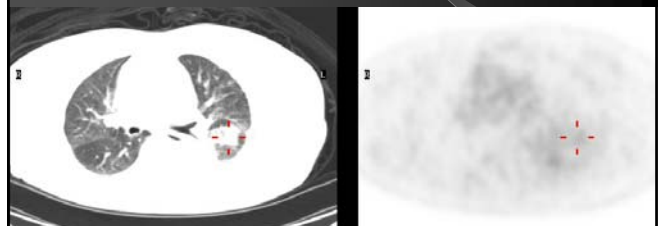
CMR Post RT Changes RUL



Post RT Changes RUL and Bone



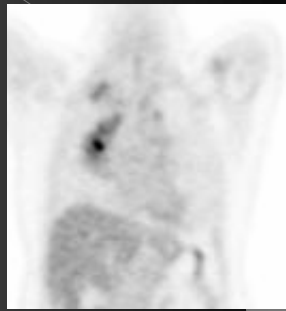
Post RT Mass CMR No FDG uptake



Partial Metabolic Response



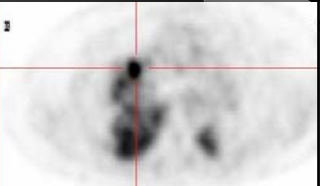
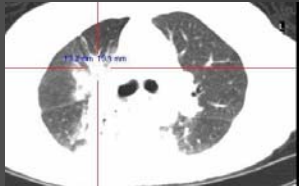
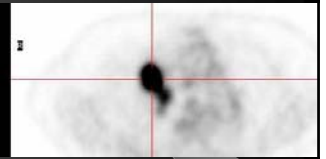
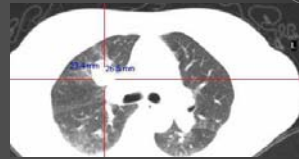
Pre Treatment



Post Treatment

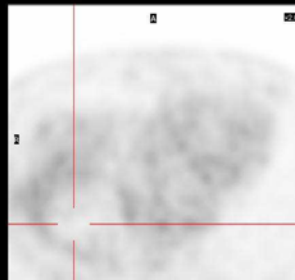
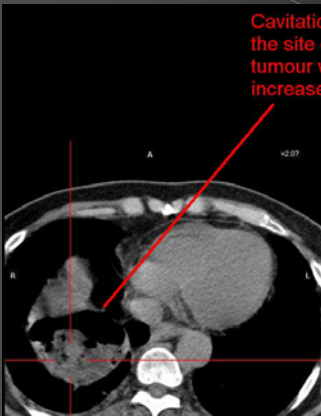


Partial Metabolic Response

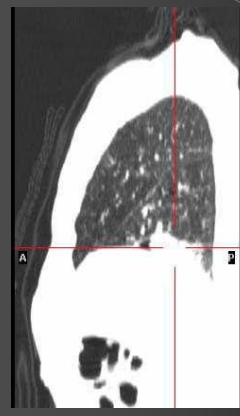


Post RF Ablation

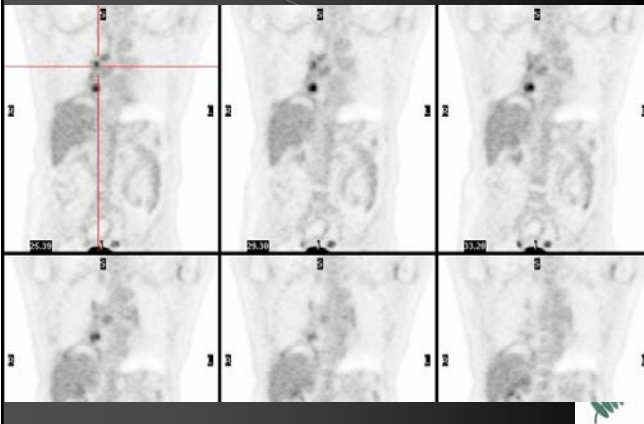
Cavitation and debris at the site of the primary tumour without increased FDG uptake.



Post RF Ablation



Post RF Ablation



Assessment for Recurrence



PET Assessment for Recurrence

- Differentiating fibrosis from tumour recurrence
- Restaging tumour recurrence



Assessment for Recurrence

PET showed increased FDG uptake in all cases (n = 60) of persistent or recurrent tumour, whereas CT was nonspecific in 17 cases

Value of FDG-PET in detecting residual or recurrent nonsmall cell lung cancer. Bury T et al Eur Respir J. 1999 Dec;14(6):1376-80.



Conclusion



Conclusion

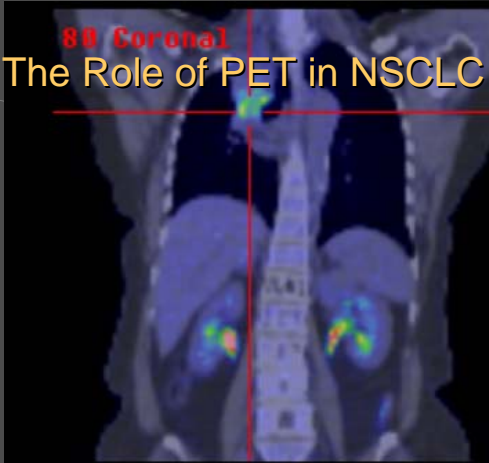
PET provides in a single test a complete evaluation of NSCLC

Staging, treatment planning, therapeutic response monitoring and evaluation for recurrence

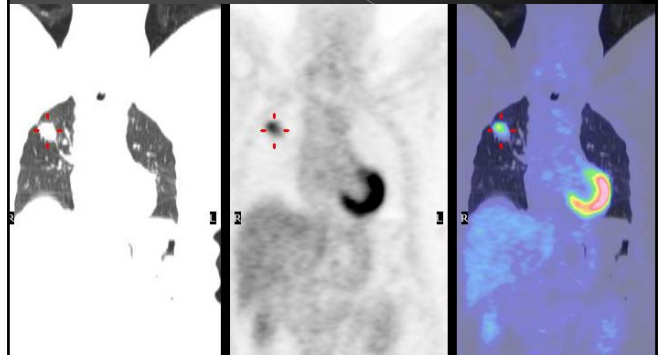
Importantly gives significant prognostic information impacting on the patient's management and survival

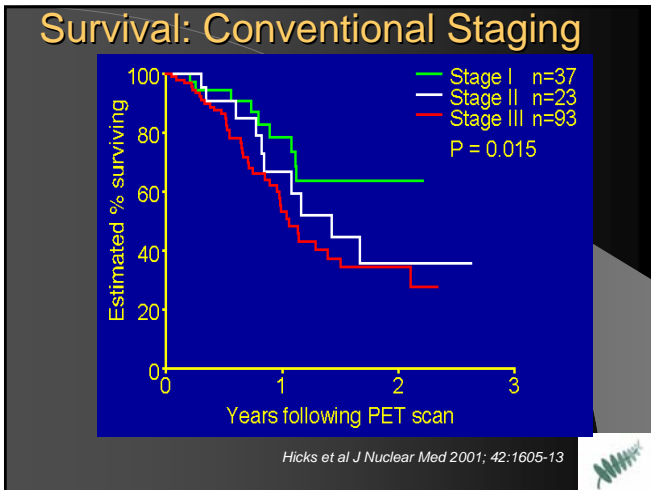
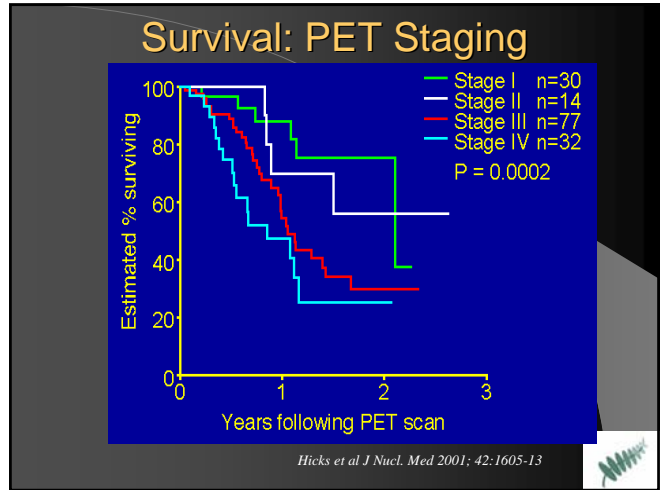
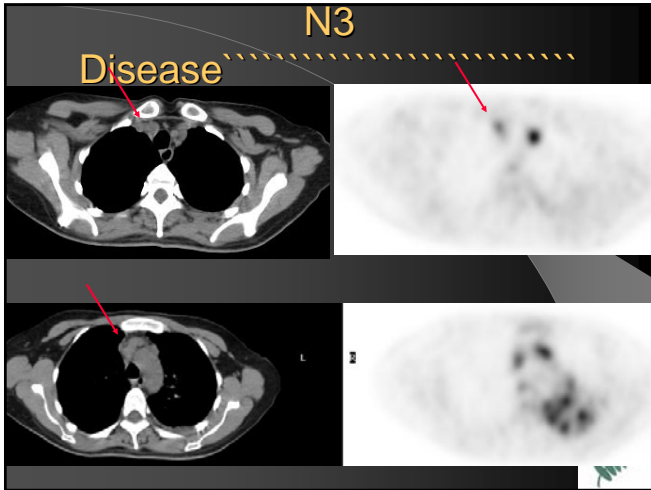


88 Coronal The Role of PET in NSCLC



N0 Disease





Survival

- Increase in stage on Conventional Imaging assoc with estimated average increase in death by 29%
- Increase in each stage with PET associated with estimated average increase in death by 69%

Hicks et al J Nucl. Med 2001; 42:1605-13