A practical and comprehensive overview of PET/CT – Part III

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Presently, the list of advantages of oncology PET/CT is growing longer as more studies are being published. Although PET/CT seems relatively expensive, it should now be considered a first choice investigation for staging and re-staging of most cancer pathologies, together with complementary imaging and laboratory investigations. The advantages outweigh the apparent 'expense drawback' since the increased sensibility, specificity and accuracy of this methodology over stand-alone CT allows better therapeutic planning and follow-up, and this could substantially reduce overall costs, where and when available[1,2].

Further advantages of current PET/CT Technology

1. Economical aspects: For example Zubeldia *et al*[1] (University at Buffalo, New York) analysed in detail the costs of adding ^{18}FDG-PET to CT preoperatively in colorectal cancer patients with resectable hepatic metastases[1]. CT with and without ^{18}FDG-PET was compared among patients with colorectal cancer in staging for surgical resection of hepatic metastases. Complication rates and costs for CT, ^{18}FDG PET/CT, and surgical procedures were also obtained. The average expected surgical cost per patient when ^{18}FDG-PET was used to determine the presence of extrahepatic disease was US$16,278 compared to $21,547 for conventional management: a net savings of $5,269 which results from the unique ability of ^{18}FDG-PET in excluding patients with extrahepatic disease, and avoiding unnecessary surgical expenses. Another group of researchers supported by the Ontario Ministry of Health and Long Term Care have recently published a similar study for non-small cell lung carcinoma (NSCLC)[2]. In NSCLC, staging with PET/CT better identifies those patients with mediastinal and extrathoracic disease, sparing some from stage-inappropriate surgery. Once again, this strategy has an economic impact by avoiding costs related to unnecessary surgery, besides the costs related to staging abdominal CT and bone scan (an average total of $900 per patient for the latter two investigations), and also impacts on patient safety by avoiding CT-associated radiation exposure and risk of nephrotoxicity (due to contrast medium). PET/CT imaging for the preoperative assessment of potentially resectable NSCLC is now being used widely in Ontario. One must also keep in mind that with one dose and one examination a whole-body scan is acquired, therefore all organs are examined for metastases.

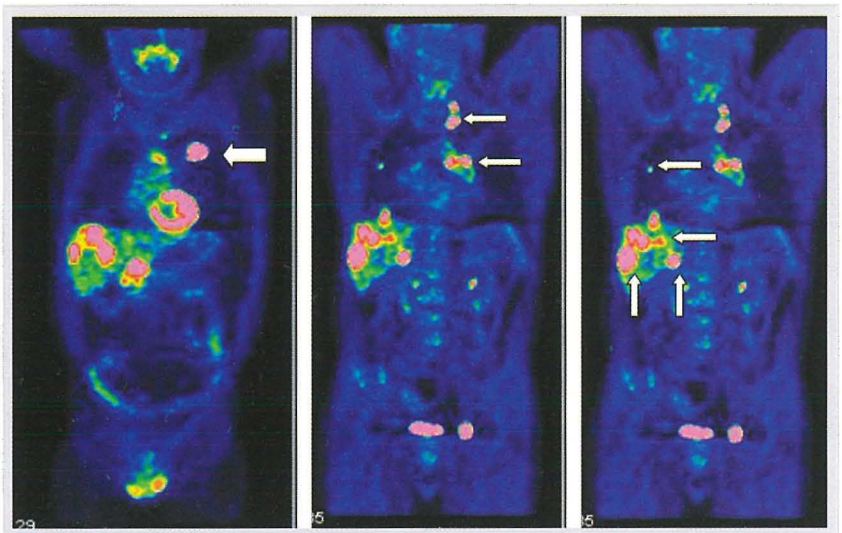

Figure 1. *A single whole-body scan allows comprehensive TNM staging of disease both at diagnosis and during follow-up. In the first image on the left, the primary T is marked by the arrow. Mediastinal Lymph Nodes are marked in the middle image. Liver and lung metastases are shown in the third image on the right. Images courtesy of San Raffaele Hospital, Milan.*

2. Earlier diagnosis and assessment of response to treatment: Another practical example is the early diagnosis of peritoneal carcinomatosis with ^{18}FDG PET/CT which shows superior sensitivities and positive predictive values over stand-alone CT.[3] Already discussed in the previous article is the usefulness of PET/CT in the earlier identification of the cause of rising tumour markers. Assessment of response to therapy has also been extensively discussed previously. Of particular interest is the essential role of PET/CT in lymphomas.

3. Clear characterisation of findings: Other studies demonstrate how high resolution conventional radiological techniques manage to identify unsuspected, clinically silent adrenal lesions (incidentalomas) morphologically, but fail to distinguish benign from malignant. A distinguishing methodology is essential in such cases considering that most incidentalomas are benign adenomas (70-94%) and that adenomas are common in the general population (2-9%). ^{18}FDG PET/CT reaches a specificity and sensitivity close to 100%.[4,5] As already explained in the previous article, PET/CT is very useful in the characterisation of most pulmonary nodules, especially those which are difficult to reach with a biopsy needle. The same concept applies for indeterminate pancreatic, liver or spleen lesions, and residual masses after therapy.

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4. Better staging and/or restaging: One example is yet another study in which the efficacy of ^{18}FDG-PET was evaluated and its impact in staging of patients with newly diagnosed breast cancer was assessed.[6] 271 patients with biopsy-proven primary breast cancer were examined. PET results were compared with the histopathology results. In this particular study the sensitivity of ^{18}FDG-PET for detecting axillary lymph node metastasis was 100% in pN3, and the specificity was 89% for pN0 stage. Detection of extra-axillary regional node or distant metastatic lesions revealed by PET scan in 22 of 24 patients resulted in a significant change in the TNM stage. Distant metastasis without axillary lymph node metastasis was noted in 21% (5/24) of patients. The results revealed that ^{18}FDG-PET upgraded TNM stage in 9.2% (22/240) of patients and 7.5% (18/240) of patients were diagnosed as having one or more distant metastases. ^{18}FDG-PET was able to identify extra-axillary regional nodal and distant lesions in newly diagnosed patients with breast cancer and altered the staging and management of therapy in patients with newly diagnosed breast cancer. There are numerous other examples in scientific literature which one may read about[7-10].

5. Use in patients allergic to contrast medium or in whom CT is contraindicated: Adverse reactions from contrast medium administration can occur and symptoms can range from mild to life-threatening. Serious side-effects include an anaphylaxis-like reaction and kidney damage which may occur because the contrast media are eliminated renally. There is no such risk in carrying out PET/CT since contrast media are not involved. Thus PET/CT can be carried out by patients who are allergic to contrast medium and by patients who cannot carry out a CT scan with contrast medium due to deranged creatinine levels or history of kidney problems.

Patient with lung cancer and bone metastases (vertebra). The bone lesion was not detected by CT. Sensibility for bone lesions is 90% in both PET/CT and bone scintigraphy, but specificity is much higher in PET/CT (98%) when compared to ^{99}Tc bone scan (61%).[11] A bone scan was avoided. Images courtesy of San Raffaele Hospital, Milan.

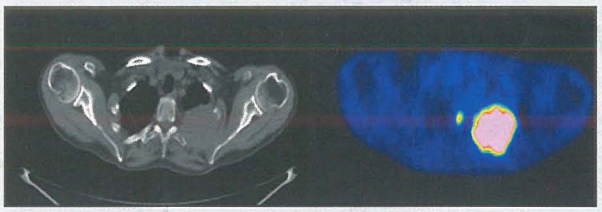

Figure 2. CT and PET image

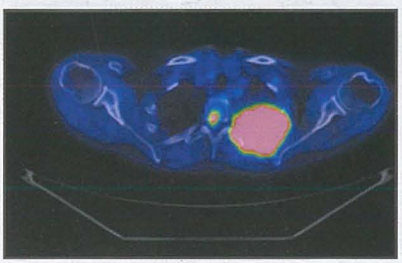

Figure 3. Superimposed PET-CT image showing both the lung and bone lesion in one scan.

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