F18 FDG PETCT detection for liver metastases

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Prior to the introduction of PET, imaging in oncology has relied on CT, US and MRI in which interpretation relies on anatomical and morphological features for diagnosis. These features can be non-specific and are poor predictors of disease involvement, especially post-chemotherapy, at surgical resection sites and in the assessment of lymphadenopathy, particularly in normal sized nodes.

PETCT is a non-invasive functional imaging technique that provides a metabolic assessment of the whole body and in current clinical use relies on uptake of the glucose analogue 18FDG (2-(fluorine-18)fluoro-2-deoxy-D-glucose). There has been rapid development and increased utilisation of PET over the last decade with marked improvements in the hardware including integration with CT (PETCT) to aid in the anatomical localisation of areas of uptake. The aim of this article is to review the current role of PET in the evaluation and management of hepatic metastases.

In common with other nuclear medicine techniques, PET imaging relies on differential uptake of the tracer (18FDG) by the tissue of interest relative to background tissue. Metastases are often easily identified on review of the PET images as focal areas of increased uptake against the normal intermediate uptake of the liver (figure 1a & b); areas of necrosis and fibrosis are not metabolically active and show reduced or no 18FDG uptake (figure 1c). Semiquantitative analysis of 18FDG uptake can be made using the standardised uptake value (SUV) which allows a degree of standardisation between examinations and patients. The SUV can be of use in differentiating between benign and malignant lesions and in providing an objective measure of treatment response on follow-up examinations.

Most benign lesions in the liver have lower FDG uptake values in comparison with the higher values typically seen in malignancy. Hepatic 18FDG uptake is not specific for malignancy and a number of causes of both false positive and negative results have been reported. Reduced or intense 18FDG uptake has been reported with mucinous hepatic metastases from ovarian and colorectal primaries, low grade lymphomatous deposits and following chemotherapy. It has been postulated that the reduced sensitivity of PET following chemotherapy is due a combination of reduced size of the metastases and “metabolic shutdown.” Where possible, PET-CT examinations should be delayed by a suitable interval following chemotherapy to help avoid false negative results. A number of benign conditions can be non-specific and are poor predictors of disease involvement, especially post-chemotherapy, at surgical resection sites and in the assessment of lymphadenopathy, particularly in normal sized nodes.

The literature relating to PETCT use in the management of hepatic metastases has concentrated on restaging and follow-up of patients with colorectal metastatic disease and, in particular, looking at potential candidates for hepatic resection. There are more limited data on liver metastases from a non-colorectal origin. This bias reflects the high prevalence of metastatic and recurrent colorectal cancer in and an increasing trend towards conservative treatment with potential and real survival benefits. For the detection of intrahepatic metastases, PETCT has been shown to be sensitive for a number of primary tumour types with a sensitivity of over 90% for lesions greater than 1cm in size. Recently, a number of studies directly comparing lesions using PETCT and MRI have shown that the sensitivity of PETCT decreases with lesion size and for small (<1cm) lesions most studies conclude that MRI is a more sensitive technique for intrahepatic lesion detection. Although there will be a continuing role for MRI due the superior detection of smaller lesions, PETCT is a whole body technique and is able to detect extrhepatic disease that will often alter patient management in those with liver metastases. For this reason, PETCT is likely to have an increasing role in selection of patients for hepatic resection and follow-up of patients with colorectal cancer.

Surgical treatment of colorectal hepatic metastases offers the only opportunity for cure and without surgery hepatic metastases are invariably fatal with a median life expectancy of 7-10 months from diagnosis. It is paramount that all hepatic and extrhepatic disease is identified prior to surgery as survival benefit is minimal in the presence of residual disease following surgery. Pre-operative assessment using conventional imaging modalities is associated with a high rate of failed laparotomies and post-operative recurrence. Currently the overall five year survival post-hepatic resection is approximately 30%. Of note, about half of the surgical failures are due to extrhepatic disease, an area where PETCT has been shown to be superior to conventional imaging. As would be expected with the superior detection of extra hepatic disease, PETCT has been shown to significantly alter management of approximately 20-49% of patients in whom hepatic resection is being considered.

The resultant prevention of inappropriate surgery is reflected in the increased five-year survival (58%) in patients who are staged using PET prior to hepatic resection. In patients not suitable for resection of hepatic metastases it is now accepted that PETCT has a role in the detection of recurrent disease, particularly in patients with raised tumour markers (CEA) where changes in CEA levels can predate CT detectable disease by many months. PETCT has been shown to be superior to CT in the detection of recurrent disease although this is often due to increased detection of extrhepatic disease by PETCT rather than detection of intrahepatic disease. In patients who have undergone RF ablation or surgical resection of hepatic metastases there is emerging evidence that PETCT may detect intrahepatic recurrence earlier than CT. Follow-up following RF ablation of hepatic metastases is often problematic due to haemorrhagic, inflammatory and anatomical changes making detection of early recurrence difficult. 18FDG uptake does not occur in cells post-ablation and a small study has shown that PETCT at one week identified residual disease post-RF ablation. If these findings are confirmed by larger studies PETCT would have an important role in identification of residual viable tumour post-RF ablation. Patients who undergo hepatic resection may also provide a challenge for follow-up for similar reasons as patients post-RF ablation and although the data in this group is limited it might be expected that PETCT may find a role in these patients.
Increased SUVs are associated with a poor prognosis for a small number primary tumours and there is some evidence on colorectal cancer that SUV values can predict long-term survival and response to adjuvant therapy (ARS). Unfortunately, the significance of FDG uptake in secondary deposits in the liver is unclear. It has been suggested that for colorectal metastases the SUV may act as an independent prognostic indicator irrespective of subsequent treatment for colorectal metastases, although there is no evidence that the SUV can be used to predict which patients will relapse patients following hepatic resection.

In summary, it is likely that there will be increasing use of PET in the management of hepatic metastatic disease. At present, characterisation of small lesions within the liver is best achieved by MRI. Currently, PET should be considered early in all patients in whom resection of hepatic metastases is being considered to exclude extrahepatic disease and prevent unnecessary laparotomies. More recent literature suggests that PET will have an increasing role to play following RF ablation and hepatic surgery.

References

5. Luhebzy N. The role and limitations of FDG-PET scan and CT in restaging patients with hepatic colorectal metastases following neoadjuvant chemotherapy: Comparison with operative and pathological findings. J Gastrointest Surg 2007 11: 473-478.

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