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Elastofibroma dorsi mimicking metastatic disease on fluorodeoxyglucose f-18 positron emission tomography in a breast cancer patient.

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Eur J Nucl Med Mol Imaging. 2007 Sep 9

Staging with PET and the "Will Rogers" effect: redefining prognosis and survival in patients with cancer.

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Eur J Nucl Med Mol Imaging. 2007 Sep 9

[(11)C]choline PET/CT imaging in occult local relapse of prostate cancer after radical prostatectomy.

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PURPOSE: The aim of this study was to assess the accuracy and clinical impact of [(11)C]choline PET/CT for localizing occult relapse of prostate adenocarcinoma after radical prostatectomy. METHODS: Forty-nine patients with prostate adenocarcinoma, radical prostatectomy, no evidence of metastatic disease, and occult relapse underwent [(11)C]choline PET/CT. Thirty-six of the patients had biochemical evidence and histological evaluation of local recurrence. Thirteen patients had PSA < 0.3 ng/ml and no evidence of active disease after 1 year follow-up. Focal nodular [(11)C]choline uptake in the prostatic fossa was visually assessed and graded on a five point scale. Maximum standardized radioactivity uptake value (SUV(max)) and the lesion size were measured. A receiver operating characteristic (ROC) analysis was performed and the clinical impact of the PET/CT study was determined. RESULTS: [(11)C]choline PET/CT was true positive in 23/33 patients and true negative in 12/13 controls. SUV(max) of local recurrence was 3.0 (median, range 0.6-7.4) and 1.1 (0.4-1.6) in controls (p = 0.0002). Lesion size was 1.7 cm (range 0.9-3.7). Area under the ROC curve for detecting relapse was 0.90 +/- 0.05 and 0.83 +/- 0.06 for visual evaluation and SUV(max), respectively. Sensitivity and specificity of [(11)C]choline PET/CT were 0.73 and 0.88, respectively. [(11)C]choline PET/CT identified 12/17 (71%) patients with a favourable biochemical response to local radiotherapy at 2 year (median, 0.8-3.2 range) follow-up. CONCLUSIONS: Focally increased [(11)C]choline uptake in the prostatic bed reliably predicted local low volume occult relapsing prostate adenocarcinoma after radical prostatectomy and identified 71% of patients with a favourable biochemical response to local radiotherapy.

Pediatr Surg Int. 2007 Sep 9

Somatic malignant transformation in a sacrococcygeal teratoma in a child and the use of F(18)FDG PET imaging.

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A 6-year-old female presented with a subcutaneous sacral mass. Biopsy revealed an adenocarcinoma most likely arising from a sacrococcygeal teratoma (SCT). CT imaging revealed a massive tumour consistent with SCT. F(18)FDG Positron Emission Tomography (PET) scan confirmed marked metabolic activity in the tumour mass and regional lymph node involvement. After chemotherapy repeat CT and PET studies revealed a poor response but no evidence of peritoneal or distant metastases. Radical abdomino-pelvic and gluteal surgery was performed with removal of the entire tumour confirmed as a moderately differentiated adenocarcinoma arising in an immature teratoma. Follow up imaging including PET scanning 5 months after her surgery revealed widespread peritoneal, hepatic and pulmonary metastases. Somatic malignant transformation of an SCT in a child of this age has not been previously reported.

Gynecol Oncol. 2007 Sep 7

Positron emission tomography and uterine leiomyomas.

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OBJECTIVES: The aim of this study is to assess the utility of FDG-PET in the evaluation of therapeutic effects at 4 weeks after the completion of the concurrent chemoradiotherapy (CCR) in patients with head and neck squamous cell carcinoma (HNSCC). METHODS: Thirty-one patients with previously untreated HNSCC were retrospectively investigated about FDG-PET, CT, MRI and biopsies of the tumor before and 4 weeks after the treatment. RESULTS: The results of pathological examinations after CCR showed 6 residual tumors in 11.4% (4/35), and changes in nodal status based on metabolic activity, i.e. upstaging in 34.3% (12/35) or downstaging in limited to 67%. CONCLUSIONS: FDG-PET has a high specificity but limited sensitivity to discriminate residual cancer from fibrosis or scar at 4 weeks after CCR. FDG-PET at 4 weeks after CCR was too early to perform because of limited sensitivity.

Patients suffering from hepatocellular carcinoma (HCC) with tumor thrombus in the portal vein generally have a poor prognosis. Portal morphological and functional imaging in achieving a correct diagnosis in such clinical situations. The impact of FDG-PET/CT on the management of head and neck tumours: The radiotherapist's perspective.

It was of interest to determine the impact of FDG-PET/CT on general therapy management and radiotherapy (RT) planning in patients with stage IV head and neck tumours. The study was conducted prospectively between March 2006 and March 2007 in 35 patients with histologically confirmed, locally advanced squamous cell carcinomas of the head and neck. Prior to primary radiochemotherapy, whole-body and head/neck FDG-PET/CT was performed. The FDG-PET information was integrated into RT planning. By comparison with anatomical imaging, the FDG-PET/CT yielded the following additional information: distant metastases in 17.1% (6/35), second primary tumours in 11.4% (4/35), and changes in nodal status based on metabolic activity, i.e. upstaging in 34.3% (12/35) or downstaging in 22.9% (8/35). As a result, treatment strategy was changed from curative to palliative in six patients, and additional curative therapy was implemented following exclusion of distant metastases in two patients with a simultaneous local second primary tumour. The discordant nodal status found with head/neck FDG-PET/CT compared with anatomical imaging led to modification of radiotherapy volume and dose in 20 patients (57.1%). From the radiotherapist's perspective FDG-PET/CT is therefore useful and justifiable in the management of stage IV head and neck tumours.

Early assessment of clinical response to concurrent chemoradiotherapy in head and neck carcinoma using fluoro-2-deoxy-d-glucose positron emission tomography.

OBJECTIVES: The aim of this study is to assess the utility of FDG-PET in the evaluation of therapeutic effects at 4 weeks after the completion of the concurrent chemoradiotherapy (CCR) in patients with head and neck squamous cell carcinoma (HNSCC). METHODS: Thirty-one patients with previously untreated HNSCC were retrospectively investigated about FDG-PET, CT, MRI and biopsies of the carcinoma before and 4 weeks after the treatment. RESULTS: The results of pathological examinations after CCR showed 6 residual cases and 25 ones with a pathologically complete response (pCR). The specificity of FDG-PET was 80%, although the sensitivity was limited to 67%. CONCLUSIONS: FDG-PET has a high specificity but limited sensitivity to discriminate residual cancer from fibrosis or scar at 4 weeks after CCR. FDG-PET at 4 weeks after CCR was too early to perform because of limited sensitivity.

Tumor hypoxia imaging in orthotopic liver tumors and peritoneal metastasis: a comparative study featuring dynamic (18)F-MISO and (124)I-IAZG PET in the same study cohort.

PURPOSE: The purpose of this paper is to compare the uptake of two clinically promising positron emission tomography (PET) hypoxia targeting agents, (124)I-iodoazomycin galactopyranoside ((124)I-IAZG) and (18)F-fluoromisonidazole ((18)F-FMISO), by dynamic microPET imaging, in the same rats bearing liver tumors and peritoneal metastasis. METHODS: Morris hepatoma (RH7777) fragments were surgically implanted into the livers of four nude rats. Tumors formed in the liver and disseminated into the peritoneal cavity. Each rat had a total of two to three liver tumors and peritoneal metastasis measuring 10-15 mm in size. Animals were injected with (18)F-FMISO, followed on the next day (upon complete (18)F decay) by (124)I-IAZG. The animals were imaged in list mode on the microPET system from the time of injection of each tracer for 3 h and then again at 6 h and 24 h for the long-lived (124)I-IAZG tracer (4.2-day half-life). Micro computed tomography (CT) scans of each rat were performed for co-registration with the microPET scans acquired with a
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liver contrast agent, allowing tumor identification. Regions of interest (ROIs) were drawn over the heart, liver, muscle, and the hottest areas of the tumors. Time-activity curves (TACs) were drawn for each tissue ROI. RESULTS: The (18)F-FMISO signal increased in tumors over the 3-h time course of observation. In contrast, after the initial injection, the (124)I-IAZG signal slowly and continuously declined in the tumors. Nevertheless, the tumor-to-normal-tissue ratios of (124)I-IAZG increased, but more slowly than those of (18)F-FMISO and as a result of the differentially faster clearance from the surrounding normal tissues. These pharmacokinetic patterns were seen in all 11 tumors of the four animals. CONCLUSIONS: (18)F-FMISO localizes in the same intra-tumor regions as (124)I-IAZG. The contrast ratios (tumor/background) reach similar values for the two hypoxia tracers, but at later times for (124)I-IAZG than for (18)F-FMISO and, therefore, with poorer count statistics. As a consequence, the (18)F-FMISO images are of superior diagnostic image quality to the (124)I-IAZG images in the Morris hepatoma McA-R-7777 tumor model.

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BACKGROUND.: The objective of this study was to evaluate cervical tumor uptake of F-18 fluorodeoxyglucose (FDG) measured as the maximal standardized uptake value (SUV(max)) by positron emission tomography (PET) and its association with treatment response and prognosis in patients with cervical cancer. METHODS.: The study population consisted of 287 patients with stage IIA2 through IVB cervical cancer who underwent pretreatment FDG-PET studies. SUV(max), tumor volume, and sites of lymph node metastasis were recorded. Therapy included surgery, chemoradiation, or palliation. RESULTS: The mean SUV(max) was 11.4 (range, 1-50.4). The mean tumor volume by stage was 42.1 cm3(3) for stage I tumors (using International Federation of Gynecology and Obstetrics [FIGO] staging criteria), 63.7 cm3(3) for stage II tumors, 129.2 cm3(3) for stage III tumors, and 166.2 cm3(3) for stage IV tumors. There was no correlation between tumor volume and SUV(max) (correlation coefficient [R(2)] = 0.01). No significant difference in SUV(max) was observed between squamous histology (n = 247 patients) and nonsquamous histology (n = 40 patients; P = .089). Higher SUV(max) was associated with an increased risk of lymph node metastasis at diagnosis (P = .0009). A Cox proportional-hazards model for death from cervical cancer was used to evaluate tumor histology, lymph node metastasis, tumor volume, and SUV(max). The results indicated that SUV(max) was the only significant independent factor (P = .0027). Three prognostic groups were established using SUV(max). The overall survival rates at 5 years were 95% for an SUV(max) <= 5.2, 70% for an SUV(max) > 5.2 and <=13.3, and 44% for an SUV(max) > 13.3 (P < .0001). Increasing SUV(max) was associated with abnormal FDG uptake in the cervix on 3-month FDG-PET studies in 238 patients who received curative chemoradiation (P = .04). CONCLUSIONS: The SUV(max) of the cervical tumor at diagnosis was a sensitive biomarker of treatment response and prognosis for patients with cervical cancer. Cancer 2007. (c) 2007 American Cancer Society.

Ann Oncol. 2007 Sep;18(9):1584-5.

Occasional FDG PET recognition of in situ breast cancer.

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Small tumor of the medial breast presenting with a contralateral lymph node involvement detected on positron emission tomography scan.


Department of Medical Oncology B. Ann Thorac Surg. 2007 Sep;84(3):959-65; discussion 965-6.

Role of positron emission tomography scanning in the management of lung nodules detected at baseline computed tomography screening.


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BACKGROUND: Indeterminate noncalcified lung nodules are a frequent finding when low-dose computed tomography (LD-CT) is used for lung cancer screening. The best clinical management for such nodules remains uncertain. We present results using positron tomography scanning (CT-PET) to evaluate LD-CT-detected lung nodules during the first year of the Continuing Observation of Smoking Subjects (COSMOS) early detection trial for lung cancer. METHODS: A total of 5200 asymptomatic current or former smokers (> or = 20 pack-years) older than 50 years of age were enrolled in a single-institution screening trial using annual LD-CT. Growing nodules and those with a maximum diameter exceeding 8 mm were studied with CT-PET. Transthoracic needle biopsy was not a routine part of the protocol. RESULTS: During the first year of study, 157 subjects underwent CT-PET, 66 of whom underwent surgical biopsy. Of the 58 lung cancers found on surgical biopsy, 51 were positive (standard uptake value > 2.0) and seven were negative for malignancy by CT-PET. Sensitivity was 88% overall, but 100% in the subgroup with solid nodules of 10 mm or more. Among the 8 patients with benign disease at surgical biopsy, CT-PET was positive in 6 and negative in 2. CONCLUSIONS: CT-PET is a highly promising modality for identifying potentially malignant lesions in screening-detected lung nodules and appears particularly useful as an alternative, in the screening setting, to invasive procedures for the further investigation of uncertain nodules. Our findings also indicate that the standard
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uptake value threshold for positivity should be lowered for small nodules (< 10 mm). Longer follow-up and larger prospective studies are necessary to confirm these preliminary findings.


FDG-PET is useful in staging and follow-up of primary uterine cervical lymphoma.

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A 35-year old woman presented with vaginal bleeding. She had a normal gynecologic examination and Papanicolaou test. A CT scan of the pelvis showed a cervical mass, which on biopsy proved to be B-cell lymphoma. PET before preoperative staging demonstrated a large area of increased FDG uptake in the pelvis, corresponding to the mass seen on the CT scan. There were no other abnormal F-18 FDG avid sites. The patient received chemotherapy followed by total abdominal hysterectomy. Histopathology was consistent with large B-cell lymphoma of the uterine cervix. Posttherapy CT scan and PET scan showed no evidence of active and or residual disease.


High-grade urothelial carcinoma of the prostate on FDG PET-CT.

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We report the PET-CT appearance of a high-grade prostatic urothelial carcinoma in a 68-year-old man with a long history of urothelial carcinoma. The patient was initially diagnosed with urothelial carcinoma in the left ureter, status postleft nephrourethrectomy. He was subsequently, 11 years later, diagnosed with low-grade urothelial carcinoma involving the bladder for which he received monthly Bacillus Calmette-Guerin treatment. Three months after the diagnosis of the bladder tumor, he was found to have biopsy-proven high-grade urothelial carcinoma of the prostate for which he was referred to have a PET-CT scan to evaluate for distant metastasis.


Metastatic eccrine porocarcinoma detected on FDG PET/CT.

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Eccrine porocarcinoma is an uncommon neoplasm of the sweat gland duct and poses a significant risk of cutaneous, regional lymph node, or visceral metastases. A 62-year-old woman with a history of eccrine porocarcinoma in the left flank area underwent an F-18 FDG PET/CT scan, which revealed increased FDG uptake in left pelvic (SUV 6.34) and left axillary regions (SUV 4.02). Wide excision of left axillary and left pelvic lymph nodes was performed, and histopathologic findings were consistent with eccrine porocarcinoma. PET/CT detects metastases accurately and is helpful in the management of patients with eccrine porocarcinoma.


F-18 FDG PET/CT following dental extraction in a patient with head and neck cancer.

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A 48-year-old man with squamous-cell carcinoma of the left tonsillar fossa and cervical lymph node metastases was being staged before radiation and chemotherapy. The patient had periodontal disease, and extraction of 2 teeth was performed before therapy. A staging PET/CT was performed 1 week after extraction. This case demonstrates increased FDG uptake at the extraction sites, which could be potentially mistaken for metastatic lesions, especially without the fused PET/CT images.
**Diagnostic accuracy of PET/CT in patients with extranodal marginal zone MALT lymphoma.**


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Background: (18)Fluoro-2-deoxyglucose ((18)FDG) positron emission tomography (PET) is widely used for initial staging and follow-up in patients with malignant lymphoma. While earlier studies suggested a limited role for PET in extranodal marginal zone mucosa-associated lymphoid tissue (MALT) lymphoma patients due to their non-FDG avidity, more recent reports have suggested that the issue is controversial. In the present study, we evaluated the diagnostic accuracy of PET integrated with CT (PET/CT) in patients with MALT lymphoma and assessed its reliability in clinical staging and monitoring response. Methods: Thirty-three patients with biopsy proven MALT lymphoma in 37 sites, who underwent PET/CT at diagnosis, were enrolled. Medical records, PET/CT findings and data obtained by other diagnostic procedures were reviewed. Results: Common sites of MALT lymphoma were the stomach (18), lung (5), orbit (4), and parotid gland (3). PET/CT detected active disease in 18 of 33 patients (54.5%) at diagnosis. Sensitivity in gastric MALT (38.9%) was lower when compared with non-gastric MALT (75%). PET/CT detected active disease in 100% patients with advanced disease (stage III-IV) but only in 42.3% with early stage disease (I-II). The incidence of gastric FDG uptake was higher in patients showing gastric ulcer on gastroscopy than in subjects with minimal or no macroscopic findings. Of the 33 patients in the study cohort, 12 had a follow-up PET/CT which detected relapse in three patients. Conclusions: These data suggest that PET/CT is a useful tool for both, initial staging and follow-up after therapy in patients with MALT lymphoma. Its sensitivity depends on disease location and stage at initial diagnosis.

**Eur J Nucl Med Mol Imaging. 2007 Sep 1**

Diagnosis of PET/CT is made when the lesion is not responsive to therapy and in the ability to detect disease. In the setting of high or rising levels of Tg, our study confirms that it is indicated to include PET/CT in the management of patients with differentiated thyroid cancer.

**Eur J Haematol. 2007 Sep;79(3):205-9.**
Non-invasive grading of brain tumours using dynamic amino acid PET imaging: does it work for (11)C-Methionine?


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BACKGROUND: Static imaging of amino acids does not allow differentiation of low versus high grade brain tumours. It has been shown that dynamic imaging of the amino acid analogue (18)F-fluoroethyltyrosine (FET) can achieve this goal. In many centres, (11)C-methionine (MET) is used for tumour imaging, but no clinical studies on the use of dynamic scanning for grading have been performed.

METHODS: Thirty-four patients with primary brain glioma and histopathological confirmation were retrospectively studied using 40 min dynamic MET-PET with 220 MBq 11C-methionine. In relation to histopathological grading, various metabolic indices and temporal parameters as documented by Poepperl et al. (JNM 2006;47:393-403) were analyzed. RESULTS: None of the evaluated static or temporal parameters allowed discrimination between high and low grade tumours. On average, low grade tumours showed washout after the initial uptake maximum, while both increases and decreases were seen for high grade tumours. Only the relative early versus late uptake ratio showed a trend towards significance (-0.16 +/- 0.17 for low grade versus 0.01 +/- 0.25 for high grade; p = 0.07). CONCLUSION: Unlike FET-PET, the uptake characteristics of MET-PET do not allow classification of low and high grade tumours on an individual patient basis. Since literature data indicate that both tracers have a similar performance regarding biopsy location, tumour delineation, and detection of recurrence, FET-PET should be advocated over MET-PET as its uptake mechanism also allows noninvasive grading in glioma.

Eur J Nucl Med Mol Imaging. 2007 Sep 1

FET PET for the evaluation of untreated gliomas: correlation of FET uptake and uptake kinetics with tumour grading.


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PURPOSE: To define the best threshold for tumor volume delineation of the (18)fluoro-2-deoxy-glucose positron emission tomography (18)FDG-PET) signal for radiotherapy treatment planning of intensity-modulated radiotherapy (IMRT) in head and neck cancer.

METHODS AND MATERIALS: In 25 patients with head-and-neck cancer, CT-based gross tumor volume (GTV(CT)) was delineated. After PET-CT image fusion, window level (L) was adapted to best fit the GTV(CT), and GTV(PET) was delineated. Tumor maximum (S) and background uptake (B) were measured, and the threshold of the background-subtracted tumor maximum uptake (THR) was used for PET signal segmentation. Gross tumor volumes were expanded to planning target volumes (PTVs) and analyzed. RESULTS: The mean value of S was 40 kBq/mL, S/B ratio was 16, and THR was 26%. The THR correlated with S (r = 0.752), but no correlation between THR and the S/B ratio was seen (r = -0.382). In 77% of cases, S was >30 kBq/mL, and in 23% it was <30 kBq/mL, with a mean THR of 21.4% and 41.6%, respectively (p < 0.001). Using PTV(PET) in radiotherapy treatment planning resulted in a reduced PTV in 72% of cases, while covering 88.2% of GTV(CT), comparable to the percentage of GTV(PET) covered by PTV(CT) (p = 0.15).

CONCLUSIONS: A case-specific PET signal threshold is optimal in PET-based radiotherapy treatment planning. Signal gating using a THR of 20% in tumors with S >30% +/- 1.6% kBq/mL and 40% in tumors with S <30% +/- 1.6% kBq/mL is suitable.


[(18)FDG] PET-CT-Based Intensity-Modulated Radiotherapy Treatment Planning of Head and Neck Cancer.

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Department of Radiation Oncology.

PURPOSE: To define the best threshold for tumor volume delineation of the [(18)F]fluoroethyltyrosine (FET) PET for non-invasive tumour grading in untreated patients.

METHODS: Dynamic FET PET studies were performed in 54 patients who, based on MRI, were estimated to have low grade (LG; n = 20), intermediate (WHO II-III; n = 4) or high grade (HG; n = 30) tumours. For standard evaluation, tumour SUV(max) and the ratio to background (SUV(max)/BG) were calculated (sum image: 20-40 min). For dynamic evaluation, mean SUV values within a 90% isocountour ROI (SUVR90) and the SUV90/BG ratios were determined for each time frame to evaluate the course of FET uptake. Results were correlated with histopathological findings from PET-guided stereotactic biopsies. RESULTS: Histology revealed gliomas in all patients. Using the standard method a statistically significant difference (p = 0.001) was found between LG (n = 20; SUV(max)/BG: 2.16 +/- 0.98) and HG (n = 34; SUV(max)/BG: 3.29 +/- 1.06) gliomas (opt. threshold 2.58; SN71%/SP85%/area under ROC curve [AUC]:0.798), however, with a marked overlap between WHO II to IV tumours. Time activity curves showed slight increase in LG, whereas HG tumours presented with an early peak (10-20 min) followed by a decrease. Dynamic evaluation successfully separated LG from HG gliomas with higher diagnostic accuracy (SN94%/SP100%/AUC:0.967). CONCLUSIONS: Based on the ratio-based method, a statistically significant difference was found between LG and HG gliomas. Due to the interindividual variability, however, no reliable individual grading was possible. In contrast, dynamic evaluation allowed LG and HG gliomas to be differentiated with high diagnostic power and, thus, should supplement the conventional method.


PET-CT Fusion in Radiation Management of Patients with Anorectal Tumors.

PURPOSE: To compare computed tomography (CT) with positron emission tomography-CT (PET-CT) scans with respect to anorectal tumor volumes, correlation in overlap, and influence on radiation treatment fields and patient care. PATIENTS AND METHODS: From March to November 2003, 20 patients with rectal cancer and 3 patients with anal cancer were treated with preoperative or definitive chemoradiation, respectively. Computed tomography simulation data generated a CT gross tumor volume (CT-GTV) and CT planning target volume (CT-PTV) and (18)F-fluoro-2-deoxy-glucose PET (FDG-PET) created a PET-GTV and PET-PTV. The PET-CT and CT images were fused using manual coregistration. Patients were treated with three-dimensional conformal therapy to traditional doses. The PET, CT, and overlap volumes (OVs) were measured in cubic centimeters. RESULTS: Mean PET-GTV was smaller than the mean CT-GTV (91.7 vs. 99.6 cm³). The mean OV was 46.7%. As tumor volume increased, PET and CT OV correlated significantly (p < 0.001). In 17% of patients PET-CT altered the PTV, and in 26% it changed the radiation treatment plan. For 25% of patients with rectal cancer, PET detected distant metastases and changed overall management. Ten rectal cancer patients underwent surgery. When the pretreatment PET standardized uptake value was >10 and the posttreatment PET standardized uptake value was <6, 100% of patients achieved pathologic downstaging (p = 0.047). CONCLUSIONS: Variation in volume was significant, with 17% and 26% of patients requiring a change in treatment fields and patient management, respectively. Positron emission tomography can change the management for anorectal tumors by early detection of metastatic disease or disease outside standard radiation fields.


Impact of positive positron emission tomography on prediction of freedom from progression after Stanford V chemotherapy in Hodgkin's disease.


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PURPOSE: To correlate [(18)F]fluorodeoxyglucose positron emission tomography ([(18)F]FDG-PET) status after chemotherapy, but before radiation, with outcome in patients treated with the Stanford V regimen. PATIENTS AND METHODS: We analyzed retrospectively 81 patients with Hodgkin's disease who had serial [(18)F]FDG-PET scans performed at baseline and again at the completion of Stanford V chemotherapy, before planned radiotherapy. Patients with favorable stage I/II (nonbulky mediastinal disease) and those with bulky mediastinal disease or stage III/IV were scanned after 8 and 12 weeks of chemotherapy, respectively. Radiotherapy fields were determined before starting chemotherapy based on baseline computed tomography scans. RESULTS: After chemotherapy, six of 81 patients had residual [(18)F]FDG-PET-positive sites, all in sites for which radiotherapy was planned. Four of the six patients with positive [(18)F]FDG-PET scans after chemotherapy experienced relapse compared with just three of 75 patients with negative [(18)F]FDG-PET scans. At a median follow-up of 4 years, the freedom from progression (FFP) was 96% in postchemotherapy [(18)F]FDG-PET-negative patients versus 33% in [(18)F]FDG-PET-positive patients (P < 0.0003). In a bivariate Cox model, [(18)F]FDG-PET positivity after chemotherapy remained a highly significant predictor of progression-free survival even after controlling for bulky disease and International Prognostic Score more than 2. CONCLUSION: These data indicate that PET status after chemotherapy is strongly predictive of FFP with the Stanford V regimen despite the use of consolidative radiotherapy. These results have implications for the design of clinical trials adapted to functional imaging.


Chemotherapy-Induced Normalization of FDG Uptake by Colorectal Liver Metastases Does Not Usually Indicate Complete Pathologic Response.

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Dramatic responses are being observed in colorectal cancer liver metastases treated with newer chemotherapeutic regimens. These have been associated with normalization of [(18)F]fluoro-2-deoxy-D-glucose (FDG) uptake (complete metabolic response) on follow-up Positron Emission Tomography with [(18)F]fluoro-2-deoxy-D-glucose (FDG-PET) scans in some patients. It is unclear how often complete metabolic response is indicative of complete tumor destruction. We analyzed a subset of patients who had neoadjuvant chemotherapy for hepatic metastases from colorectal adenocarcinoma. Inclusion criteria were: (1) FDG-avid hepatic lesions before initiation of chemotherapy; (2) complete metabolic response of the same lesions after chemotherapy; and (3) histopathologic examination of hepatic lesions. Complete pathologic response was defined as no histologically identifiable viable tumor. Fourteen patients fit the inclusion criteria. All had synchronous, hepatic-only colorectal metastases. On microscopic examination, complete pathologic response to the neoadjuvant regimen was found in only 5 of 34 lesions (15%) and in only 3 of the 14 patients (21%). Seven lesions had complete metabolic response and disappeared on computed tomography (CT); of these, six still contained viable tumor. We conclude that complete metabolic response on FDG-PET after neoadjuvant chemotherapy is an unreliable indicator of complete pathologic response. Therefore, currently, curative resection of liver metastases in these patients should not be deferred on the basis of FDG-PET findings.


Whole-body MR imaging vs. FDG-PET: Comparison of accuracy of M-stage diagnosis for lung cancer patients.

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PURPOSE: To conduct a prospective comparison of the accuracy of whole-body MR imaging and positron emission tomography (PET)
with fluorine-18 deoxyglucose (FDG) (FDG-PET) to assess the M-stage in lung cancer patients. MATERIALS AND METHODS: A total of 90 consecutive lung cancer patients (mean age = 68 years) underwent whole-body MR imaging and FDG-PET as well as other standard radiological imaging procedures before and after treatment. Probabilities of metastases on whole-body MR imaging and FDG-PET were assessed by using 5-point scoring systems on a per-site basis and on a per-patient basis. Receiver operating characteristic (ROC) curve analysis was used to compare diagnostic capabilities. Sensitivity, specificity, and accuracy were also compared by using the McNemar's test on a per-site and per-patient basis. RESULTS: For assessment of head and neck metastases and bone metastases, accuracies of whole-body MR imaging (95.0% and 94.8%, respectively) were significantly higher than those of FDG-PET (89.1% and 88.2%, respectively; P < 0.05). For assessment of the M-stage on a per-patient basis, accuracy of whole-body MR imaging (80.0%) was also significantly higher than that of FDG-PET (73.3%; P < 0.05). CONCLUSION: Whole-body MR imaging is an accurate diagnostic technique and may be considered at least as effective as FDG-PET for assessment of the M-stage of lung cancer patients. J. Magn. Reson. Imaging 2007;26:498-509. (c) 2007 Wiley-Liss, Inc.

Large B-cell lymphoma mimicking ischemic heart disease demonstrated by F-18 fluorodeoxyglucose PET/CT in a heart transplant patient.
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Would Patient Selection Based on Both Calcitonin Blood Level and Doubling Time Improve 18F-FDG PET Sensitivity in Restaging of Medullary Thyroid Cancer?
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Tumor Imaging Using 1-(2'-deoxy-2'-18F- Fluoro-(beta)-D-Arabinofuranosyl)Thymine and PET.
Tehrani OS, Muzik O, Heilbrun LK, Douglas KA, Lawhorn-Crews JM, Sun H, Mangner TJ, Shields AF.
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The kinetics of 1-(2'-deoxy-2'-fluoro-beta-d-arabinofuranosyl)thymine (FMAU) were studied using PET to determine the most appropriate and simplest approach to image acquisition and analysis. The concept of tumor retention ratio (TRR) is introduced and validated. METHODS: Ten patients with brain (n = 4) or prostate (n = 6) tumors were imaged using (18)F-FMAU PET (mean dose, 369 MBq). Sixty-minute dynamic images were obtained; this was followed by whole-body images. Mean and maximum standardized uptake values (SUVmean and SUVmax, respectively) of each tumor were determined as the mean over 3 planes of each time interval. For kinetic analyses, blood activity was measured in 18 samples over 60 min. Samples were analyzed by high-performance liquid chromatography at 3 selected times to determine tracer metabolites. FMAU kinetics were measured using a 3-compartment model yielding the flux (K1 x k3/(k2 + k3)) (K1, k2, and k3 are rate constants) and compared with TRR measurements. TRR was calculated as the tumor (18)F-FMAU uptake area under the curve divided by the product of blood (18)F-FMAU AUC and time. A similar analysis was performed using muscle to estimate (18)F-FMAU delivery. RESULTS: SUVmean measurements obtained from 5 to 11 min correlated with those obtained from 30 to 60 min (r(2) = 0.92, P < 0.0001) and 50 to 60 min (r(2) = 0.92, P < 0.0001) due to the rapid clearance of (18)F-FMAU. Similar results were obtained using SUVmax measurements (r(2) = 0.93, P < 0.0001; r(2) = 0.88, P < 0.0001, respectively). The measurement of TRR using either blood or muscle activity over 11 min provided results comparable to those of 60-min dynamic imaging and a 3-compartment model. This analysis required only 5 blood samples drawn at 1, 2, 3, 5, and 11 min without metabolite correction to produce comparable results. CONCLUSION: Tissue retention ratio measurements obtained over 11 min can replace flux measurements in (18)F-FMAU imaging. The SUVmean and the SUVmax in 5-11 min images correlated well with those of images obtained at 50-60 min. The quality of the images and tissue kinetics in 11 min of imaging makes it a desirable and shorter tumor imaging option.
Early Prediction of Response to Chemotherapy and Survival in Malignant Pleural Mesothelioma Using a Novel Semiautomated 3-Dimensional Volume-Based Analysis of Serial 18F-FDG PET Scans.


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The aim of chemotherapy for mesothelioma is to palliate symptoms and improve survival. Measuring response using CT is challenging because of the circumferential tumor growth pattern. This study aims to evaluate the role of serial (18)F-FDG PET in the assessment of response to chemotherapy in patients with mesothelioma. METHODS: Patients were prospectively recruited and underwent both (18)F-FDG PET and conventional radiological response assessment before and after 1 cycle of chemotherapy. Quantitative volume-based (18)F-FDG PET analysis was performed to obtain the total glycolytic volume (TGV) of the tumor. Survival outcomes were measured.

RESULTS: Twenty-three patients were suitable for both radiological and (18)F-FDG PET analysis, of whom 20 had CT measurable disease. After 1 cycle of chemotherapy, 7 patients attained a partial response and 13 had stable disease on CT assessment by modified RECIST (Response Evaluation Criteria in Solid Tumors) criteria. In the 7 patients with radiological partial response, the median TGV on quantitative PET analysis fell to 30% of baseline (range, 11%-71%). After 1 cycle of chemotherapy, Cox regression analysis demonstrated a statistically significant relationship between a fall in TGV and improved patient survival (P = 0.015). Neither a reduction in the maximum standardized uptake value (P = 0.097) nor CT (P = 0.131) demonstrated a statistically significant association with patient survival. CONCLUSION: Semiquantitative (18)F-FDG PET using the volume-based parameter of TGV is feasible in mesothelioma and may predict response to chemotherapy and patient survival after 1 cycle of treatment. Therefore, metabolic imaging has the potential to improve the care of patients receiving chemotherapy for mesothelioma by the early identification of responding patients. This technology may also be useful in the assessment of new systemic treatments for mesothelioma.

Role of 99mTc-Octreotide Acetate Scintigraphy in Suspected Lung Cancer Compared with 18F-FDG Dual-Head Coincidence Imaging.


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The aim of this study was to evaluate the clinical value of tomographic (99m)Tc-octreotide acetate (hereafter, (99m)Tc-octreotide) scintigraphy in the detection of patients with suspected lung cancer in comparison with that of (18)F-FDG dual-head coincidence imaging (DHC). METHODS: Forty-four consecutive patients with suspected pulmonary neoplasms underwent tomographic (99m)Tc-octreotide scintigraphy and (18)F-FDG coincidence imaging using the same gantry. The region of interest was drawn on the entire primary lesion. The tumor-to-normal tissue tracer values for both (99m)Tc-octreotide and (18)F-FDG were determined using region of interests and expressed as T/N(r) and T/N(m), respectively. Final diagnosis was confirmed by histopathologic analysis or clinical follow-up. RESULTS: Thirty-one of the 44 patients had lung cancer-6 with small cell lung cancer (SCLC) and 25 with non-small cell lung cancer (NSCLC). Thirteen of the 44 patients had benign lung lesions. The sensitivity, specificity, positive predictive value, and negative predictive value of (99m)Tc-octreotide were 100%, 75.7%, 90.1%, and 100%, respectively, and of (18)F-FDG DHC were 100%, 46.1%, 83.8%, and 100%, respectively. In the 31 patients with malignant tumors, all 38 abnormal lymph nodes in 20 patients showed abnormal high focal uptake of (18)F-FDG; only 7 patients with 10 regional lymph adenopathies showed moderate uptake of (99m)Tc-octreotide. Thirteen patients with 39 distant sites of abnormal uptake visualized (imaging stage IV) with (99m)Tc-octreotide included 2 patients with brain metastases, 6 patients with pleural invasion and multiple bone metastasis, 2 patients with contralateral internal lung metastasis and pleural invasion, and 3 patients with only multiple bone metastasis. The final diagnosis was confirmed by histopathology or clinical follow-up. CONCLUSION: The sensitivity of (99m)Tc-octreotide for the detection of lung cancer at the primary lesion was comparable with that of (18)F-FDG coincidence imaging. Tomographic (99m)Tc-octreotide scintigraphy had lower sensitivity for the detection of hilar and mediastinal lymph node metastasis compared with that of (18)F-FDG coincidence PET, but it had high sensitivity for the detection of remote metastatic lesions. However, because of the small population, further investigation is necessary.
PET-Oncology

Clinical Applications of PET in Brain Tumors.

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Malignant gliomas and metastatic tumors are the most common brain tumors. Neuroimaging plays a significant role clinically. In low-grade tumors, neuroimaging is needed to evaluate recurrent disease and to monitor anaplastic transformation into high-grade tumors. In high-grade and metastatic tumors, the imaging challenge is to distinguish between recurrent tumor and treatment-induced changes such as radiation necrosis. The current clinical gold standard, MRI, provides superior structural detail but poor specificity in identifying viable tumors in brain treated with surgery, radiation, or chemotherapy. (18)F-FDG PET identifies anaplastic transformation and has prognostic value. The sensitivity and specificity of (18)F-FDG in evaluating recurrent tumor and treatment-induced changes can be improved significantly by coregistration with MRI and potentially by delayed imaging 3-8 h after injection. Amino acid PET tracers are more sensitive than (18)F-FDG in imaging recurrent tumors and in particular recurrent low-grade tumors. They are also promising in differentiating between recurrent tumors and treatment-induced changes.

Routine Use of PET Scans After Completion of Therapy in Pediatric Hodgkin Disease Results in a High False Positive Rate.

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The Accuracy of PET(CT) in Evaluating Pediatric Lymphoma.

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Accuracy of 18F Fluorodeoxyglucose Positron Emission Tomography/Computed Tomography in Staging of Pediatric Sarcomas.


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The present study was conducted to clarify the diagnostic accuracy of F-fluoro-2-deoxy-D-glucose (FDG) positron emission tomography (PET)/computed tomography (CT) in the staging in pediatric sarcomas. Fifty pediatric patients with histologically proven sarcomas who underwent FDG PET/CT before treatment were evaluated retrospectively for the detection of nodal and distant metastases. Diagnostic accuracy of FDG PET/CT in detecting nodal and distant metastases was compared with that of FDG PET and conventional imaging (CI). The images were reviewed and a diagnostic consensus was reached by 3 observers. REFERENCE standard was histologic examination in 15 patients and confirmation of an obvious progression in size of the lesions on follow-up examinations. Nodal metastasis was correctly assessed in 48 patients (96%) with PET/CT, in contrast to 43 patients (86%) with PET, and 46 patients (92%) with CI. Diagnostic accuracies of nodal metastasis in 3 modalities were similar. Using PET/CT, distant metastasis was correctly assigned in 43 patients (86%), whereas interpretation based on PET alone or CI revealed distant metastasis in 33 patients (66%) and 35 patients (70%), respectively. Diagnostic accuracy of distant metastasis with PET/CT was significantly higher than that of PET (P=0.002) or CI (P=0.008). False negative results regarding distant metastasis by PET/CT in 7 patients (14%) were caused by subcentimetric lesions (n=4), bone marrow lesion (n=2), and soft tissue lesions (n=1). PET/CT is more accurate and probably more cost-effective than PET alone or CI regarding distant metastasis in pediatric sarcomas.

Non-[18]F-FDG PET in clinical oncology.

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PET is an exquisitely sensitive molecular imaging technique using positron-emitting radioisotopes coupled to specific ligands. Many biological targets of great interest can be imaged with these radionlabelled ligands. This review describes the current status of non-18-fluorodeoxyglucose PET tracers that have a potential clinical effect in oncology. With the help of these tracers, knowledge is being acquired on the molecular characterisation of specific tumours, their biological signature, and postinterventional response. The potential
role of these imaging probes for tumour detection and monitoring is progressively being recognised by clinical oncologists, biologists, and pharmacologists.

Lancet Oncol. 2007 Sep;8(9):754-5.

PET-guided induction chemotherapy.

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Leuk Lymphoma. 2007 Sep;48(9):1881-3.

Multicentric Castleman disease: Use of HHV8 viral load monitoring and positron emission tomography during follow-up.

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Leuk Lymphoma. 2007 Sep;48(9):1721-7.

Randomized comparison of consolidation radiation versus observation in bulky Hodgkin's lymphoma with post-chemotherapy negative positron emission tomography scans.

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This study aimed at evaluating the role of consolidation radiation in a setting of Hodgkin's lymphoma (HL) patients, using event-free survival (EFS) as end point. Among 260 patients treated with induction chemotherapy for bulky HL, 160 patients achieved negative residual masses at 2-[18F]fluoro-2-deoxy-d-glucose positron emission tomography (FDG-PET) scans. They were randomly divided into two well-matched groups to receive either 32 Gy radiotherapy to bulky area or no further therapy. At a median follow-up of 40 months, histology showed a malignancy in 14% of patients in the chemotherapy-only group (HL, 11 patients) and in 4% of patients in the chemotherapy + radiotherapy group (HL, 2 patients; carcinoma in previously irradiated area, 1 patient) (P = 0.03). All the relapses in the chemotherapy-only group involved the bulky site and the contiguous nodal regions. Thus, the overall diagnostic accuracy of FDG-PET to exclude future relapses in the patients nonprotected by radiotherapy was 86% with a false-negative rate of 14%. Our study suggests that the addition of irradiation helps improve EFS in HL patients with post-chemotherapy FDG-PET-negative residual masses.

Leuk Lymphoma. 2007 Sep;48(9):1667-9.

Omitting radiotherapy after attaining FDG PET-negative status following chemotherapy alone for Hodgkin lymphoma: A randomized study caveat.

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INTRODUCTION: Dynamic positron emission tomography (PET) studies with 2-deoxy-2-[F-18]fluoro-D-glucose (FDG) were performed in patients with advanced nonsmall cell lung cancer (NSCLC) who received palliative chemotherapy to evaluate the impact of full kinetic analysis and assess its value with regard to short or long survival. MATERIALS AND METHODS: The evaluation includes 42 metastatic lesions in 14 patients with NSCLC. All patients received a combined chemotherapeutic protocol consisting of vinorelbine and oxaliplatin. The survival data served as reference for the PET data. All patients were examined before onset of chemotherapy and on day 15-21 after onset of the first cycle. The following parameters were retrieved from the dynamic PET studies: standardized uptake value (SUV), fractal dimension, two-compartment model with computation of k1, k2, k3, k4 (unit: 1/min), the fractional blood volume, and the FDG-influx according to Patlak was calculated using the formula (k1 x k3) / (k2 + k3). We used a two-group classification, namely, a short- and long-term survival group based on the median survival time (193 days) as a cutoff. A support vector machines (SVM) analysis was used for classification of the two a priori defined groups. RESULTS: The observed survival times varied from 40 to 392 days with a median survival time of 193 days. Most kinetic parameters demonstrated only small changes mostly declining after one cycle. The change in all kinetic parameters did not correlate to the survival-based classification. The change in SUV was significant between the first and second study (p = 0.006) but without an impact on the prediction of short or long survival. SVM-based analysis revealed the highest correct classification rate (CCR) between short and long survival for the combination of SUV and influx of the first study and SUV. influx, k2, and k4 of the second study with a CCR of 95.2%. CONCLUSION: The results demonstrate that a full kinetic analysis of the FDG kinetics in NSCLC is helpful for the classification into short or long survival and may be used to identify those patients who may benefit from this palliative chemotherapeutic protocol.
Metastases in addition to multiple other metastases in the usual field of view. Fifty-nine of the 296 (19.9%) scans showed lower extremity abnormalities: two were false positive findings, and two (0.7% of all scans) represented metastases in addition to multiple other metastases in the usual field of view, and five represented metastases in addition to multiple other metastases in the usual field of view. In no case was an unanticipated isolated malignant lesion identified in the brain/scalp or lower extremities.

PET/CT evaluation of metastatic melanoma. SUBJECTS/METHODS: Reports of consecutive whole-body PET/CT scans from January 2003 to March 2006 in patients with melanoma were retrospectively reviewed. PET abnormalities in the brain/scalp and lower extremities were tabulated by location and whether they were 'anticipated' or 'unanticipated' based on previously available data. Findings were compared between the two groups, between individuals, and with expert reading. RESULTS: Overall we found good interobserver agreement (kappa 0.65). Experience with PET translated into a better ability to localize MLN stations (68% vs. 51%, respectively), and experienced readers appeared to be more familiar with translating PET readings into clinically useful statements. CONCLUSIONS: Although our results suggest that clinical experience with PET increases observers' ability to read and interpret results from PET adequately, there is room for improvement. Experience with PET does not necessarily improve the accuracy of image interpretation.


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PURPOSE: To evaluate 2-deoxy-2-[F-18]fluoro-D-glucose (FDG) accumulation in human ovarian carcinoma cell lines compared with control tumor cell lines known to accumulate FDG. PROCEDURES: FDG accumulation assays were performed in 15 different ovarian carcinoma cell lines at 1, 2, and 3 hours after incubation with 1 muCi of FDG. Results were compared with FDG accumulation in six different control tumor cell lines. 2-Deoxy-2-[F-18]fluoro-D-glucose accumulation was expressed as counts per minute (cpm) in cells and normalized to initial cpm in medium and total protein content of cell lysates. RESULTS: FDG accumulation in all 15 ovarian carcinoma cell lines was equal to or higher than 0.0005 +/- 8.6 10(-5) cpm in cells/cpm in medium/mug protein at all three different time points. In two ovarian carcinoma cell lines (ES-2, poorly differentiated clear cell carcinoma, and OVCAR-3, poorly differentiated papillary adenocarcinoma), FDG accumulation was not statistically, significantly different compared to the control cell line with the highest FDG accumulation (LS 174T human colorectal adenocarcinoma) at two or more time points (P >/= 0.07). In 2 of 15 (13%) ovarian carcinoma cell lines (OVCAR5 epithelial carcinoma and SKOV3 clear cell carcinoma), FDG accumulation was lower than that in the control cell line with the lowest FDG accumulation (HT-29 human colorectal adenocarcinoma) at one or more time points (P < 0.05). CONCLUSIONS: Most human ovarian carcinoma cell lines showed comparable FDG accumulations with control cell lines known to accumulate FDG. This study lays the foundations for further comparisons with other ovarian cancer cell lines and for other positron emission tomography tracers.

Clinical value of including the head and lower extremities in 18F-FDG PET/CT imaging for patients with malignant melanoma.

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OBJECTIVE: To assess the added benefit of scanning lower extremities and skull in addition to 'skull base to upper thigh' images in PET/CT evaluation of metastatic melanoma. SUBJECTS/METHODS: Reports of consecutive whole-body PET/CT scans from January 2003 to March 2006 in patients with melanoma were retrospectively reviewed. PET abnormalities in the brain/scalp and lower extremities were tabulated by location and whether they were 'anticipated' or 'unanticipated' based on previously available data. Findings were correlated with pathology, other imaging studies, and clinical follow-up. RESULTS: Two hundred and ninety-six PET/CT examinations in 173 patients with melanoma were included. Twenty-five of the 296 (8.4%) scans showed brain/scalp abnormalities. Of these, only four (1.4% of all scans) showed unanticipated abnormalities: two were false positive findings, and two (0.7% of all scans) represented metastases in addition to multiple other metastases in the usual field of view. Fifty-nine of the 296 (19.9%) scans showed lower extremity abnormalities. Of these, 13 (4.4% of all scans) showed unanticipated abnormalities which were equivocal or suggestive of malignancy: eight (2.7% of all scans) represented metastases in addition to multiple other metastases in the usual field of view, and five represented false positive findings. In no case was an unanticipated isolated malignant lesion identified in the brain/scalp or lower extremities. CONCLUSIONS: In patients with no known or suspected primary or metastatic melanoma involving the head or extremities, inclusion of these regions on PET/CT is of low yield and appears to offer little significant additional benefit, as detection of additional metastases in these patients is unlikely to change clinical management. Routine skull base to upper thigh images may be adequate for this subset of patients with melanoma.
evaluation of normal FDG uptake in palatine tonsil and its potential value for detecting occult head and neck cancers: a PET CT study.

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OBJECTIVE: The aims of the study were to (1) evaluate the range of physiological FDG uptake in normal pharyngeal palatine tonsil, and (2) investigate the possibility of establishing a cut-off threshold to distinguish between normal pharyngeal palatine tonsil FDG uptake from occult pharyngeal palatine tonsil primary cancer. METHODS: FDG PET CT of 43 consecutive patients with a low risk of head and neck cancer were reviewed by two observers. Axial PET CT was used to identify foci of FDG uptake related to the pharyngeal palatine tonsil. The highest standardized uptake value, SUVmax, of the left and right pharyngeal palatine tonsil was calculated. Similar analysis was performed on 10 consecutive patents with histologically proven occult pharyngeal palatine tonsil primary cancer. RESULTS: The mean SUVmax of the 43 right pharyngeal palatine tonsils was 4.82 (range, 1.16-12.74) and 4.68 (range, 0.88-13.65) for the 43 left pharyngeal palatine tonsils with no statistical difference observed (P=0.4). Normal pharyngeal palatine tonsil uptake was generally symmetrical and there was a positive correlation between SUVmax from the left and right sides which was statistically significant (r=0.9, P<0.0001). In the same patient the difference in SUVmax between left and right pharyngeal palatine tonsil ranged from 0.01 to 2.66 and patients with occult pharyngeal palatine tonsil primary cancer it ranged from 0.85 to 11.08. ROC analysis showed that an 'SUVmax difference' cut-off of 0.83 would achieve a sensitivity of 100% and specificity of 81% for detecting occult pharyngeal palatine tonsil primary cancers. CONCLUSIONS: There is considerable variation of pharyngeal palatine tonsil FDG uptake in patients with no pharyngeal palatine tonsil primary cancer. However, in the same patient there is generally only a small difference in uptake between left and right sides. The absolute difference in SUVmax between left and right pharyngeal palatine tonsil is a potentially useful parameter for distinguishing between normal FDG uptake in pharyngeal palatine tonsil from occult pharyngeal palatine tonsil primary cancer.


Incidence of thyroid carcinoma in fluorodeoxyglucose positron emission tomography-positive thyroid incidentalomas.

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OBJECTIVE: Fluorodeoxyglucose (FDG) whole body positron emission tomography (PET) scan may show clinically occult second lesions. Such lesions in the thyroid are increasingly common. There are several recent reports of a high probability of malignancy in these lesions ranging from 14% to 63%. STUDY DESIGN AND SETTING: This is a retrospective review of 15,711 PET scans at a multi-disciplinary thyroid clinic at a tertiary care university medical center. Twenty-two patients were referred with thyroid PET “incidentalomas.” The review included 18 FDG-PET scans, ultrasound guided fine needle aspiration biopsies, and thyroid surgery pathology. Aspiration cytology or pathology were the main outcome measures. RESULTS: Three patients had malignancy of the PET-positive thyroid lesions. Papillary thyroid micro carcinomas were detected in four of the specimens that showed a benign pathology of the incidentalomas. CONCLUSION: Our experience shows a 14% malignancy rate for the dominant (imaged) nodule and a total malignancy rate of 32% when the incidental micro carcinomas are included. Both of these rates are significantly lower than results published previously.


Prostate cancer: sextant localization with MR imaging, MR spectroscopy, and 11C-choline PET/CT.


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PURPOSE: To retrospectively compare sensitivity and specificity of magnetic resonance (MR) imaging, three-dimensional (3D) MR spectroscopy, combined MR imaging and 3D MR spectroscopy, and carbon 11 (11C)-choline positron emission tomography (PET/computed tomography (CT) for intraprostatic tumor sextant localization, with histologic findings as reference standard. MATERIALS AND METHODS: The local ethics committee on human research provided approval and a waiver of informed consent for the retrospective study. MR imaging, 3D MR spectroscopy, and 11C-choline PET/CT results were retrospectively reviewed in 26 men with biopsy-proved prostate cancer (mean age, 64 years; range, 51-75 years) who underwent radical prostatectomy. Cancer was identified as areas of nodular low signal intensity on T2-weighted MR images. At 3D MR spectroscopy, choline-plus-creatine-to-citrate and choline-to-creatine ratios were used to distinguish healthy from malignant voxels. At PET/CT, focal uptake was visually assessed, and maximum standardized uptake values (SUVs) were recorded. Agreement between 3D MR spectroscopic and PET/CT results was calculated, and ability of maximum SUV to help localize cancer was assessed with receiver operating characteristic analysis. Significant differences between positive and negative sextants with respect to mean maximum SUV were calculated with a paired t test. RESULTS: Sensitivity, specificity, and accuracy were, respectively, 55%, 86%, and 67% at PET/CT; 54%, 75%, and 61% at MR imaging; and 81%, 67%, and 76% at 3D MR spectroscopy. The highest sensitivity was obtained when either 3D MR spectroscopic or MR imaging results were positive (88%) at the expense of specificity (53%), while the highest specificity was obtained when results with both techniques were positive (90%) at the expense of sensitivity (48%). Concordance between 3D MR spectroscopic and PET/CT findings was slight (kappa=0.139). CONCLUSION: In localizing cancer within the prostate, comparable specificity was obtained with either 3D MR spectroscopy and MR imaging or PET/CT; however, PET/CT had lower sensitivity relative to 3D MR spectroscopy alone or combined with MR imaging. Copyright (c) RSNA, 2007.
PET and PET/CT in Pediatric Oncology.

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(18)F-fluorodeoxyglucose positron emission tomography (FDG-PET) and FDG-PET/computed tomography (CT) are becoming increasingly important imaging tools in the noninvasive evaluation and monitoring of children with known or suspected malignant diseases. In this review, we discuss the preparation of children undergoing PET studies and review radiation dosimetry and its implications for family and caregivers. We review the normal distribution of (18)F-fluorodeoxyglucose (FDG) in children, common variations of the normal distribution, and various artifacts that may arise. We show that most tumors in children accumulate and retain FDG, allowing high-quality images of their distribution and pathophysiology. We explore the use of FDG-PET in the study of children with the more common malignancies, such as brain neoplasms and lymphomas, and the less-common tumors, including neuroblastomas, bone and soft-tissue sarcomas, Wilms' tumors, and hepatoblastomas. For comparison, other PET tracers are included because they have been applied in pediatric oncology. Multiple multicenter trials are underway that use FDG-PET in the management of children with neoplastic disease; these studies should give us greater insight into the impact FDG-PET can make in their care. PET is emerging as an important diagnostic imaging tool in the evaluation of pediatric cancers. The recent advent of dual-modality PET-computed tomography (PET/CT) imaging systems has added unprecedented diagnostic capability by revealing the precise anatomical localization of metabolic information and metabolic characterization of normal and abnormal structures. The use of CT transmission scanning for attenuation correction has shortened the total acquisition time, which is an especially desirable attribute in pediatric imaging. Moreover, expansion of the regional distribution of the most common PET radiotracer, FDG, and the introduction of mobile PET units have greatly increased access to this powerful diagnostic imaging technology. Here, we review the clinical applications of PET and PET/CT in pediatric oncology. General considerations in patient preparation and radiation dosimetry will be discussed.
PET-Oncology

high-energy gamma probe designed to process the 511 keV photons of PET tracers. Intraoperative gamma probe performance is a function of radiopharmaceutical uptake, clearance kinetics, and probe engineering, all determining the target to background ratio (TBR) and detection threshold. A minimum TBR of 1.5:1 is needed in the operative field for the operating surgeon to be comfortable the differences between tumor tissue and normal adjacent tissue are real. Due to high-energy photon fluxes, achieving a satisfactory TBR intraoperatively is challenging and requires development of a clinically feasible PET-probe guided surgery protocol. J. Surg. Oncol. 2007;96:353-357. (c) 2007 Wiley-Liss, Inc.

J Surg Oncol. 2007 Aug 28;96(4):297-308
Radioimmunoguided surgery (RIGS), PET/CT image-guided surgery, and fluorescence image-guided surgery: Past, present, and future.

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(125)I-labeled anti-TAG-72 antibodies were applied in radioimmunoguided surgery (RIGS) to remove gross and occult tumors. It is challenging to handle (125)I-labeled materials. PET/CT image-guided surgery utilizes (18)FDG to monitor the biochemical activity of the tumor and to integrate pre- and postoperative imaging for complete tumor removal. PET/CT image-guided surgery only detects later stage disease. Fluorescence image-guided surgery using anti-TAG-72 antibodies may provide opportunities for intraoperative cancer detection of both gross and occult tumors. J. Surg. Oncol. 2007;96:297-308, (c) 2007 Wiley-Liss, Inc.

TNM staging with FDG-PET/CT in patients with primary head and neck cancer.

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PURPOSE: PET/CT, PET+CT, and CT were compared concerning accuracies in TNM staging and malignancy detection in head and neck cancer. The impact of PET/CT compared to the other imaging modalities on therapy management was assessed. MATERIALS AND METHODS: Fifty-five patients with suspected head and neck primary cancer underwent whole-body FDG-PET/CT. PET/CT and PET+CT were evaluated by a nuclear medicine physician and a radiologist; CT was evaluated by two radiologists, PET by two nuclear physicians. Histopathology served as the standard of reference. Differences between the staging modalities were tested for statistical significance by McNemar's test. RESULTS: Overall TNM-staging and T-staging with PET/CT were more accurate than PET+CT and CT alone (p < 0.05). PET/CT was marginally more accurate than CT alone in N-staging (p = 0.04); no statistically significant difference was found when compared to PET+CT for N-staging. PET/CT altered further treatment in 13 patients compared to CT only and in 7 patients compared to PET+CT. CONCLUSION: Combined PET/CT proved to be partly more accurate in assessing the overall TNM-stage than CT and PET+CT. These results were based on a higher accuracy concerning the T-stage, mainly in patients with metallic implants and marginally the N-stage. Therapy decisions have been influenced in a substantial number of patients. PET/CT might be considered as a first line diagnostic tool in patients with suspected primary head and neck cancer.

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Histological Aggressiveness of Fluorodeoxyglucose Positron-Emission Tomogram (FDG-PET)-Detected Incidental Thyroid Carcinomas.

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BACKGROUND: We previously reported a high incidence of primary thyroid cancer in fluorodeoxyglucose positron-emission tomogram (FDG-PET)-detected incidental thyroid abnormalities. The aim of our study was to determine if these FDG-PET-detected thyroid malignancies represent a more-aggressive variant of primary thyroid carcinoma. MATERIALS AND METHODS: All patients that underwent operative intervention for FDG-PET-detected incidental thyroid abnormalities were identified (June 2003 to April 2006). Patients with a diagnosis of primary thyroid carcinoma on final histopathology were included in the study. The patient demographics and histopathological findings were analyzed to identify adverse prognostic features. RESULTS: In 11,500 patients, 17,250 FDG-PET scans were performed; 377 of these patients (3.2% of patients and 2.1% of FDG-PET scans) had findings positive for thyroid abnormality. Of the 32 patients that underwent operative intervention, 22 patients with a final diagnosis of primary thyroid malignancy were included in the study. A greater number of patients [12 patients, (54%)] were noted to harbor poor prognostic variants of primary thyroid carcinoma on final histopathology [tall-cell variant: 11 patients (50%) and poorly differentiated thyroid carcinoma: 1 patient (4%)]. Extra-thyroidal extension (ETE) was noted in the majority of patients [14 patients (63%)]. In patients with tall cell variant on final histopathology, the rate of ETE was even higher [10 patients (90%)]. CONCLUSION: Thyroid malignancies incidentally detected on FDG-PET scan harbor
The impact of (18)F-FDG PET/CT in patients with liver metastases.

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PURPOSE: The aim of this study was to assess the performance of (18)F-fluorodeoxyglucose positron emission tomography/computed tomography ((18)F-FDG PET/CT) versus dedicated contrast-enhanced CT (CECT) in the detection of metastatic liver disease.

METHODS: All patients that presented to our Institution with suspected metastatic liver disease who underwent (18)F-FDG PET/CT and CECT within 6 weeks of each other, were retrospectively analyzed, covering a 5-year period. One hundred and thirty-one patients (67 men, 64 women; mean age 62) were identified. Seventy-five had colorectal carcinoma and 56 had other malignancies. The performance of CECT and that of (18)F-FDG-PET/CT in detecting liver metastases were compared. The ability of each to detect local recurrence, extrapleural metastases and to alter patient management was recorded. The final diagnosis was based on histology, clinical and radiological follow-up (mean 23 months).

RESULTS: In detecting hepatic metastases, (18)F-FDG-PET/CT yielded 96% sensitivity and 75% specificity, whilst CECT showed 88% sensitivity and 25% specificity. (18)F-FDG-PET/CT and CECT were concordant in 102 out of 131 patients (78%). In the colorectal group (18)F-FDG-PET/CT showed 94% sensitivity and 75% specificity, whilst CECT had 91% sensitivity and 25% specificity. In the noncolorectal group (18)F-FDG-PET/CT showed 98% sensitivity and 75% specificity whilst CECT had 85% sensitivity and 25% specificity. Overall, (18)F-FDG-PET/CT altered patient management over CECT in 25% of patients. CECT did not alter patient management over (18)F-FDG-PET/CT alone in any patients. CONCLUSION: (18)F-FDG-PET/CT performed better in detecting metastatic liver disease than CECT in both colorectal and noncolorectal malignancies, and frequently altered patient management. The future role of CECT in these patients may need to be re-evaluated to avoid potentially unnecessary duplication of investigation where (18)F-FDG/CT is readily available.

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FDG-PET in T-cell and NK-cell neoplasms.


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BACKGROUND: A growing number of studies demonstrate the utility of (18)fluoro-2-deoxyglucose positron emission tomography (FDG-PET) in the management of malignant lymphoma. The results of FDG-PET, however, have not been studied extensively for T-cell and natural killer (NK)-cell neoplasms.

RESULTS: FDG-PET detected a lymphoma lesion in at least one site in 36 out of 41 patients. The positive rate was equally high in most histological subtypes except for cutaneous lymphomas: PTCLu 91%, ENKL 100%, C-ALCL 60%, AILT 100%. All the patients without an FDG-avid lesion had lesions restricted to skin. Among patients who had cutaneous lesions, only 50% had FDG-avid cutaneous lesions, all of which were tumorous. The positive rate of FDG-PET for bone marrow involvement was only 20%.

CONCLUSION: T/NK-cell neoplasms incorporated in this study were generally FDG-avid except for cutaneous lesions and bone marrow involvement.

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Combined 18F-fluorodeoxyglucose-posietron emission tomoography and computed tomoigraphy as a primary screening method for detecting second primary cancers and distant metastases in patients with head and neck cancer.

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Department of Otolaryngology.

BACKGROUND: The aim of this study was to evaluate the ability of (18)F-fluorodeoxyglucose-positron emission tomography/computed tomography (FDG-PET/CT) to detect second primary cancers and distant metastases in patients with head and neck cancer (HNC).

RESULTS: Of the 349 eligible patients (267 men and 82 women), 14 (4.0%) had second primary cancers and 26 (7.4%) had distant metastases at initial staging or during mean follow-up of 15 months after treatment. FDG-PET/CT correctly identified second cancers or distant metastases in 39 of these 40 patients; there was one false negative and 23 false positive FDG-PET/CT results. Therefore, FDG-PET/CT had a sensitivity of 97.5%, a specificity of 92.6%, a positive predictive value of 62.9% and a negative predictive value of 99.7% in detecting second primary cancers and distant metastases. CONCLUSION: Combined FDG-PET/CT is useful as a primary method for detecting second cancers and distant metastases in patients with HNC.

Radiother Oncol. 2007 Aug 22

Is FDG-PET scan in patients with early stage Hodgkin lymphoma of any value in the implementation of the involved-node radiotherapy concept and dose painting?

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BACKGROUND AND PURPOSE: To evaluate the input of FDG-PET data in the implementation of the involved-node radiotherapy concept and dose painting. MATERIALS AND METHODS: Patients with early-stage Hodgkin lymphoma treated with combined modality treatments. First, patients underwent a PET/CT before chemotherapy in the treatment position using a head and shoulder immobilization mask. Second, all patients had a CT simulation for treatment planning. The CT simulation was coregistered with the prechemotherapy CT and FDG-PET scan. All prechemotherapy volumes were superimposed on the CT simulation. The initially involved lymph node areas to be irradiated were delineated on the CT scan and on FDG-PET were determined and compared. RESULTS: Before chemotherapy, FDG-PET-avid areas represented 25% of the total volume on CT. After chemotherapy, the influence of initial FDG-PET data on the delineation of involved-node radiotherapy fields was significant and was due to the fact that in 36% of the patients, FDG-PET helped pinpoint lymph nodes that were undetected on CT. After chemotherapy, the rates of tumor volume shrinkage on CT and FDG-PET were similar. This finding suggests similar chemosensitivity for FDG-PET-avid and non-avid areas. There was no correlation between initial FDG-PET-avid volumes and the clinical outcome. CONCLUSION: Prechemotherapy FDG-PET data are essential for correctly implementing the involved-node radiotherapy concept but seem to be of minimal value for applying the concept of dose painting.

Liver metastases from colorectal cancer: imaging with superparamagnetic iron oxide (SPIO)-enhanced MR imaging, computed tomography and positron emission tomography.

Rappeport ED, Loft A.

The literature about superparamagnetic iron oxide-enhanced MR imaging, computed tomography (CT) and PET (positron emission tomography using fluorine-18 labelled fluoro-deoxy-glucose) in detection of liver metastases (LM) from colorectal cancer is reviewed in this update. Special emphasis is given to studies with surgical standard of reference allowing for the lesion-by-lesion sensitivity to be determined. Based on the review, it is concluded that state-of-the-art anatomical imaging, e.g., SPIO-enhanced MR imaging and multidetector CT (MDCT), must be considered more sensitive than PET in detection of individual LM, due to technical developments in MR imaging, such as liver specific contrast agents, modern sequences and high performance gradients, and in modern MDCT have increased the performance of these modalities. MR imaging with a liver specific contrast agent is recommended for the preoperative evaluation before liver surgery for LM because of high sensitivity and better discrimination between small LM and cysts compared to MDCT. PET or PET/CT can be used for detection of extra-hepatic tumor before liver surgery.

Adding (11)C-methionine PET to the EORTC prognostic factors in grade 2 gliomas.

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PURPOSE: The management of adult patients with grade 2 gliomas remains a challenge for the clinical neuro-oncologist. Several clinical prognostic factors appear to be as important as treatment factors in determining outcome. From the European Organisation for Research and Treatment of Cancer (EORTC) trials 22844 and 22845, a prognostic scoring system has been proposed based on the presence of unfavourable prognostic factors. The aim of the present study was to assess the additional prognostic value of (11)C-methionine (MET) measured by positron emission tomography (PET) in the setting of the EORTC prognostic scoring system. METHODS: In this retrospective review, 129 patients with supratentorial grade 2 gliomas were subjected to a PET study as part of the pre-treatment tumour investigation. One hundred and three cases were classified as low-risk patients (0-2 unfavourable factors) and 26 cases as high-risk patients (3-5 unfavourable factors) according to the EORTC criteria. MET PET was evaluated as an extra prognostic factor in both groups. RESULTS: In the high-risk group, patients with high MET uptake had a worse outcome than patients with low MET uptake. A similar trend was found for the low-risk group in patients with oligodendrocytic tumours. CONCLUSIONS: Our findings further strengthen the role of MET PET as an important prognostic tool in the management of this group of patients.
The role of FDG-PET scans in patients with lymphoma.

Seam P, Juweid ME, Cheson BD.

18-fluoro-deoxyglucose positron emission tomography (FDG-PET) is a non-invasive, 3-dimensional imaging modality that has become widely used in the management of patients with malignant lymphomas. This technology has been demonstrated to be more sensitive and specific than either (67)gallium scintigraphy or computerized tomography, providing a more accurate distinction between scar or fibrosis and active tumor. PET scans have been evaluated in pretreatment staging, restaging, monitoring during therapy, post-therapy surveillance, assessment of transformation and, more recently, as a surrogate marker in new drug development. Data to support these various roles requires prospective validation. Moreover, caution must be exercised in the interpretation of PET scans because of technical limitations, variability of FDG-avidity among the different lymphoma histologic subtypes, and in the large number of etiologies of false-negative and false-positive results. Recent attempts to standardize PET in clinical trials, and incorporation of this technology into uniformly adopted response criteria will hopefully lead to improved outcome for patients with lymphoma.

Uptake characteristics of FDG in deep fibromatosis and abdominal desmoids: potential clinical role of FDG-PET in the management.

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In this preliminary report, we explore the uptake pattern of FDG in fibromatosis and hypothesize the potential clinical role of FDG-PET in the management of this benign but locally aggressive heterogeneous group of soft tissue tumours. Five patients were studied (two men and three women, age range 23-35 years), among whom were three cases of deep musculoskeletal fibromatosis, one was that of abdominal fibromatosis (abdominal desmoid) associated with familial adenomatous polyposis (Gardner's syndrome) and one case had both deep musculoskeletal fibromatosis and abdominal desmoid. The FDG uptake in the lesions was heterogeneous in four cases and relatively homogeneous in one case. The uptake ranged from low to moderate grade with areas or foci of relatively avid FDG uptake. The maximum standardized uptake value (SUVmax) observed was up to 4.7; the avidity probably related to the biological aggressiveness and tendency for recurrence, characteristic of fibromatosis. A dual-point FDG-PET carried out over four active foci in two cases registered an increase in SUV ranging from 6.93% to 25.85% (mean 19.28%). Treatment monitoring with chemotherapy was carried out in two cases: the reduction in FDG uptake was consistent with the histological evidence of fibrosis and reduction in mitosis. Hence, a baseline FDG-PET can serve a valuable role in monitoring the effect of systemic pharmacotherapy in patients with recurrent progressive disease after unsuccessful local-regional treatment. The findings in this report can be extrapolated and have implications for studying the utility of FDG-PET in defining aggressiveness, guiding biopsy and excision site in a large tumour and monitoring therapy in fibromatosis.

Early interim 2-[18F]fluoro-2-deoxy-D-glucose positron emission tomography is prognostically superior to international prognostic score in advanced-stage Hodgkin's lymphoma: a report from a joint Italian-Danish study.


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PURPOSE: Starting from November 2001, 260 newly diagnosed patients with Hodgkin's lymphoma (HL) were consecutively enrolled in parallel Italian and Danish prospective trials to evaluate the prognostic role of an early interim 2-[18F]fluoro-2-deoxy-D-glucose positron emission tomography (FDG-PET) scan and the International Prognostic Score (IPS) in advanced HL, treated with conventional ABVD (doxorubicin, bleomycin, vinblastine, and dacarbazine) therapy. PATIENTS AND METHODS: Most patients (n = 190) presented with advanced disease (stages IIIB through IVB), whereas 70 presented in stage IIA with adverse prognostic factors. All but 11 patients were treated with standard ABVD therapy followed by consolidation radiotherapy in case of bulky presentation or residual tumor mass. Conventional radiologic staging was performed at baseline. FDG-PET scan was performed at baseline and after two courses of ABVD (PET-2). No treatment change was allowed on the basis of the PET-2 results. RESULTS: After a median follow-up of 2.19 years (range, 0.32 to 5.18 years), 205 patients were in continued complete remission and two patients were in partial remission. Forty-three patients progressed during therapy or immediately after, whereas 10 patients relapsed. The 2-year progression-free survival for patients with positive PET-2 results was 12.8% and for patients with negative PET-2 results was 95.0% (P < .0001). In univariate analysis, the treatment outcome was significantly associated with PET-2 (P < .0001), stage IV (P < .0001), WBC more than 15,000 (P < .0001), lymphopenia (P < .001), IPS as a continuous variable (P < .0001), extranodal involvement (P < .0001), and bulky disease (P = .012). In multivariate analyses, only PET-2 turned out to be significant (P < .0001). CONCLUSION: PET-2 overshadows the prognostic value of IPS and emerges as the single most important tool for planning of risk-adapted treatment in advanced HL.
Inter-observer Variations in FDG-PET Interpretation for Cancer Screening.


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BACKGROUND: Diagnostic guidelines for the use of 2-(fluorine 18) fluoro-2-deoxy-D-glucose (FDG)-positron emission tomography (PET) in cancer screening have yet to be established. We assessed inter-operator variability in screening FDG-PET. METHODS: Subjects comprised 40 individuals who underwent FDG-PET and computed tomography (CT) for cancer screening. To assess various patterns of FDG uptakes, three subsets of the cases were selected: 'Cancer', 15 cases with cancer; 'Not malignant', 15 cases with suspected cancer by FDG-PET who were confirmed as cancer-free; and 'Normal', 10 cases without remarkable FDG uptake who were confirmed as cancer-free. A total of 68 lesions made up of malignancy (n = 18), benign (n = 21), and physiological FDG uptake (n = 29) were interpreted by six physicians. Each observer reviewed each case three times. Step 1 involved interpretation of PET images alone. Step 2 involved side-by-side reading of PET and CT images, and Step 3 involved re-evaluation of findings with the results of other screening tests. We assessed inter-operator agreement for each step. RESULTS: Inter-operator agreement for all lesions at each step was moderate, compared to fair agreement for 'Normal' subjects. Inter-operator agreement of 'Cancer' and 'Not malignant' subjects in Step 1 were better than those in Step 2 and 3; however, the differences were not statistically significant. CONCLUSION: The interpretation of FDG-PET is adequately reproducible, while that of 'Normal' subjects is less reproducible. Improvement of inter-operator variability in assessing physiological FDG uptakes requires universal reporting criteria in FDG-PET. Correlative interpretation of PET, CT and other information may require standardization in subjects with suspected cancer by FDG-PET.

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Positron emission tomography in the staging of patients with Hodgkin's lymphoma. A prospective multicentric study by the Intergruppo Italiano Linfomi.


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In this prospective multicentric study, we investigated the contribution of positron emission tomography (PET) scanning to the staging of Hodgkin's lymphoma (HL) by computed tomography (CT) and attempted to determine whether it has any impact on therapeutic approach. One hundred eighty six consecutive patients with HL from six Italian centers were enrolled in this study. They were staged with conventional methods; 2-(fluorine-18)fluoro-2-deoxy-D-glucose PET scanning were prospectively compared to CT. CT and FDG-PET stages were concordant in 156 patients (84%) and discordant in 30 patients (16%). PET stage in comparison to CT stage was higher in 27 patients (14%) and lower in 3 patients (1%). The programmed treatment strategy was modified in 11 out of 30 patients (37%) after the definition of final stage. If we considered the 123 CT staged patients with localized stage, ten patients (8%) with a change of stage from localized to advanced after PET evaluation were treated with different strategy. FDG-PET was shown to be a relevant, non-invasive method that supplements conventional procedures and should therefore be used routinely to stage HL, particularly in early stage patients, where a change in stage may modify disease management.


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Expression of the epithelial-specific integrin alphabeta6 is low or undetectable in most adult tissues but may be increased during wound healing and inflammation and is up-regulated dramatically by many different carcinomas, making alphabeta6 a promising target for the in vivo detection of cancer using noninvasive imaging. In addition, alphabeta6 is recognized as promoting invasion and correlates with aggressive behavior of human cancers and thus agents that recognize alphabeta6 specifically in vivo will be an essential tool for the future management of alphabeta6-positive cancers. Recently, we identified the peptide NAVPNLRGLQDLQVLAQKVART (A20FMDV2), derived from foot-and-mouth disease virus, as a potent inhibitor of alphabeta6. Using flow cytometry and ELISA, we show that this peptide is highly selective, inhibiting alphabeta6-ligand binding with an IC50 of 3 nmol/L, an activity 1,000-fold more selective for alphabeta6 than for other RGD-directed integrins (alphabeta3, alphabeta5, and alpha5beta1). A20FMDV2 was radiolabeled on solid-phase using 4-[18F]fluorobenzoic acid, injected into mice bearing both alphabeta6-negative and alphabeta6-positive (DX3puro/DX3purobeta6 cell lines) xenografts and imaged using a small animal positron emission tomography (PET) scanner. Rapid uptake (~30 min) and selective retention (~5 h) of radioactivity in the alphabeta6-positive versus the alphabeta6-negative tumor, together with fast renal elimination of nonspecifically bound activity, resulted in specific imaging of the alphabeta6-positive neoplasm. These data suggest that PET imaging of alphabeta6-positive tumors is feasible and will provide an important new tool for early detection and improved management of many types of cancers.
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PURPOSE: Positron emission tomography, combined with computed tomography (PET/CT) has provided clinicians with usefull information regarding the diagnosis, initial staging, restaging, and therapy monitoring of malignancies since the beginning of the current century. Our intent here is to identify the critical steps in clinical workups and follow-up, in the true outpatient clinical setting of a freestanding imaging center, for utilization of PET/CT in four different cancer types. METHODS: The four most common reasons for referrals to our facility were identified by reviewing two years of referral data. They were lung cancer (including solitary pulmonary nodule), lymphomas, breast cancer, and colorectal cancer. A review of published literature from 1996 and later was accepted as evidence of appropriateness for utilizing PET/CT in various clinical scenarios. In addition, a medical advisory board consisting of 15 referring physicians representing various specialties was established to provide practical advice regarding the appropriate use of PET/CT in clinical situations.

NATIONAL COMPREHENSIVE CANCER NETWORK (NCCN) guidelines were also referenced to establish a baseline for clinical workups at various stages of disease. RESULTS: Several inconsistencies were identified among the three primary sources of information that were reviewed. National Comprehensive Cancer Network (NCCN) guidelines did not always agree with published literature. After a reconciliation of the medical advisory board's clinical practices and several published articles, a consensus was established by the medical advisory board for the use of PET/CT imaging for the four cancer types, enabling us to identify the appropriate timing of PET/CT utilization in patient work-ups. CONCLUSIONS: A PET/CT-centric clinical practice decision tree algorithm can be established to provide practical advice regarding the appropriate use of PET/CT in clinical situations. Other NCCN guidelines did not always agree with published literature, which was also often different from actual clinical practices of referring physicians. The most common inconsistencies included differing opinions from the referrers vs what was published in the NCCN guidelines, especially with regard to the utilization of PET/CT for applications not yet covered by insurance companies. After a reconciliation of the medical advisory board's clinical practices and several published articles, a consensus was established by the medical advisory board for the use of PET/CT imaging for the four cancer types, enabling us to identify the appropriate timing of PET/CT utilization in patient work-ups.

CONCLUSIONS: A PET/CT-centric clinical practice decision tree algorithm can be established to provide practical advice regarding the appropriate use of PET/CT in clinical situations. A review of published literature from 1996 and later was accepted as evidence of appropriateness for utilizing PET/CT in various clinical scenarios. In addition, a medical advisory board consisting of 15 referring physicians representing various specialties was established to provide practical advice regarding the appropriate use of PET/CT in clinical situations. NCCN data did not always agree with published literature, which was also often different from actual clinical practices of referring physicians. The most common inconsistencies included differing opinions from the referrers vs what was published in the NCCN guidelines, especially with regard to the utilization of PET/CT for applications not yet covered by insurance companies. After a reconciliation of the medical advisory board's clinical practices and several published articles, a consensus was established by the medical advisory board for the use of PET/CT imaging for the four cancer types, enabling us to identify the appropriate timing of PET/CT utilization in patient work-ups. CONCLUSIONS: A PET/CT-centric clinical practice decision tree algorithm can be established to provide practical advice regarding the appropriate use of PET/CT in clinical situations. Other NCCN guidelines did not always agree with published literature, which was also often different from actual clinical practices of referring physicians. The most common inconsistencies included differing opinions from the referrers vs what was published in the NCCN guidelines, especially with regard to the utilization of PET/CT for applications not yet covered by insurance companies. After a reconciliation of the medical advisory board's clinical practices and several published articles, a consensus was established by the medical advisory board for the use of PET/CT imaging for the four cancer types, enabling us to identify the appropriate timing of PET/CT utilization in patient work-ups.


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PURPOSE: In patients with lymphoma, we investigated the impact of contrast-enhanced CT on PET attenuation correction in lesions and normal tissues, particularly when PET/CT was performed after chemotherapy. METHODS: Fifty patients (51+/18 years) with Hodgkin's disease (n=17) or non-Hodgkin lymphomas (n=33) were studied before and after chemotherapy. CT images were successively reconstructed using the unenhanced CT (PET-) and the CT+ (PET+) for attenuation correction, using iterative reconstruction (4 iterations, 8 subsets, 5 mm post-filtering). SUV(mean), SUV(max) and SUV(mean) were measured before and after chemotherapy in ten non-tumoural ROIs [aorta, femur, kidney, lung, iliohypogastric muscle, occipital cortex, T12 vertebra, liver, spleen and inferior vena cava (IVC)] and in tumoural lymphadenopathies or malignant tissues (n=397 and 51 VOIs respectively before and after chemotherapy) using a 3D-thresholding method (identical threshold for PET- and PET+). ROIs were defined on the PET- and automatically applied on the unenhanced CT (CT-), the CT+ and the PET+. RESULTS: In the non-tumoural tissues, SUV(mean) increased significantly in the CT+ compared with the CT- in the vessels and the highly vascularised organs, and slight increases were observed in the occipital cortex (+11%), the iliohypogastric muscle (+6%) and the femur (+3%). SUV(max) increased significantly in the PET+ compared with the PET- in the aorta (+14%), the liver (+10%), the spleen (+10%) and the IVC (+12%). SUV(mean) increased significantly in the PET+ compared with the PET- in the aorta (+15%), the kidney (+13%), the liver (+11%), the spleen (+10%) and the IVC (+12%). In the lesions, SUV(mean) increased significantly different before and after chemotherapy, whatever the normal region considered. SUV(max) increased significantly after treatment in the T12 vertebra (+12%). SUV(mean) increased significantly after treatment in the T12 vertebra (+13%) and in the liver (+12%). SUV(mean) increased significantly in the CT+ compared with the CT- in the lesions (+5%) before chemotherapy. No significant difference was seen in measurements (HU(mean), SUV(max) and SUV(mean)) after chemotherapy. CONCLUSION: Our study demonstrates that use of enhanced CT for attenuation correction has a negligible effect on quantification at staging and after chemotherapy. A "single-shot" enhanced PET/CT may thus be performed in the evaluation of patients with lymphoma at staging, during treatment and at follow-up.
A new PET tracer specific for vascular endothelial growth factor receptor 2.

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PURPOSE: Noninvasive positron emission tomography (PET) imaging of vascular endothelial growth factor receptor 2 (VEGFR-2) expression could be a valuable tool for evaluation of patients with a variety of malignancies, and particularly for monitoring those undergoing antiangiogenic therapies that block VEGF/VEGFR-2 function. The aim of this study was to develop a VEGFR-2-specific PET tracer. METHODS: The D63A,E64A,E67A mutant of VEGF(121) (VEGF(DEE)) was generated by recombinant DNA technology. VEGF(121) and VEGF(DEE) were purified and conjugated with DOTA for (64)Cu labeling. The DOTA conjugates were tested in vitro for VEGFR-2 specificity and functional activity. In vivo tumor targeting efficacy and pharmacokinetics of (64)Cu-labeled VEGF(121) and VEGF(DEE) were compared using an orthotopic 4T1 murine breast tumor model. Blocking experiments, biodistribution studies, and immunofluorescence staining were carried out to confirm the noninvasive imaging results. RESULTS: Cell binding assay demonstrated that VEGF(DEE) had about 20-fold lower VEGFR-1 binding affinity and only slightly lower VEGFR-2 binding affinity as compared with VEGF(121). MicroPET imaging studies revealed that both (64)Cu-DOTA-VEGF(121) and (64)Cu-DOTA-VEGF(DEE) had rapid and prominent activity accumulation in VEGF-2-expressing 4T1 tumors. The renal uptake of (64)Cu-DOTA-VEGF(DEE) was significantly lower than that of (64)Cu-DOTA-VEGF(121) as rodent kidneys expressed high levels of VEGFR-1 based on immunofluorescence staining. Blocking experiments and biodistribution studies confirmed the VEGFR specificity of (64)Cu-DOTA-VEGF(DEE). CONCLUSION: We have developed a VEGFR-2-specific PET tracer, (64)Cu-DOTA-VEGF(DEE). It has comparable tumor targeting efficacy to (64)Cu-DOTA-VEGF(121) but much reduced renal toxicity. This tracer may be translated into the clinic for imaging tumor angiogenesis and monitoring antiangiogenic treatment efficacy.

Interpretability of PET/CT imaging in head and neck cancer patients following composite mandibular resection and osteocutaneous free flap reconstruction.

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BACKGROUND: We investigated positron emission tomography (PET)/CT scanning following segmental resections and osteocutaneous free-flap reconstruction. The interpretability of PET/CT imaging with healing osteotomies and reconstruction hardware was analyzed. METHODS: Patient scans within 18 months of surgery were interpreted for malignancy. Interpretations were compared with clinical data to determine sensitivity/specificity. Standardized uptake values (SUVs) were determined for bony controls, osteotomies, and tumors and were analyzed using paired t test. RESULTS: Fifteen scans were visually interpreted, 13 underwent SUV analysis. Reconstruction hardware did not interfere with interpretability. Sensitivity and specificity were 88% and 86%, respectively. Osteotomy sites averaged 25% higher SUVs compared with bony controls (vs sternum p = .003, vs mandible p = .008). Tumor SUVs were higher than osteotomies (p = .023) and controls (vs sternum p = .013, vs mandible p = .025). CONCLUSION: Although osteotomies were characterized by an increased fluoro-deoxyglucose signal, scan interpretability was unimpaired. Our study suggests that PET/CT imaging can be utilized to survey free-flap patients at acceptable levels of sensitivity/specificity. (c) 2007 Wiley Periodicals, Inc. Head Neck, 2007 Aug 10.

Fusion of metabolic function and morphology: sequential [18F]fluorodeoxyglucose positron-emission tomography/computed tomography studies yield new insights into the natural history of bone metastases in breast cancer.

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PURPOSE: By monitoring bone metastases with sequential [(18)F]fluorodeoxyglucose positron-emission tomography/computed tomography ([(18)F]FDG-PET/CT) imaging, this study investigates the clinical relevance of [(18)F]FDG uptake features of bone metastases with various radiographic appearances. PATIENTS AND METHODS: Bone metastases were found in 67 of 408 consecutive patients with known/suspected recurrent breast cancer on [(18)F]FDG-PET/CT, characterized by CT morphology changes and/or bony [(18)F]FDG uptake. Twenty-five of the patients had sequential [(18)F]FDG-PET/CT examinations (86 studies) over an average follow-up period of 23 months. The temporal changes in [(18)F]FDG uptake and corresponding CT morphology features of 146 bone lesions identified in these 25 patients were followed up and correlated with therapeutic outcome retrospectively. RESULTS: The 146 lesions were classified as osteolytic (77), osteoblastic (41), mixed-pattern (11), or no change/negative (17) on CT. The majority of the osteolytic (72; 93.5%) and mixed-pattern lesions (nine; 81.8%), but fewer of the osteoblastic lesions (25; 61%), showed increased [(18)F]FDG uptake. After treatment, 58 osteolytic lesions (80.5%) became [(18)F]FDG negative and osteoblastic on CT and only 14 relatively large lesions (19.5%) remained [(18)F]FDG avid. Of the 25 [(18)F]FDG-avid osteoblastic lesions, 13 (52%) became [(18)F]FDG negative, but 12 (48%) remained [(18)F]FDG avid and increased in size on CT. Five of the mixed-pattern lesions remained [(18)F]FDG avid after treatment. All 17 CT-negative lesions became [(18)F]FDG negative; however, nine of them became osteoblastic. None of the initially


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[(18)F]FDG-negative lesions showed [(18)F]FDG avidity during follow-up. CONCLUSION: [(18)F]FDG uptake reflects the immediate tumor activity of bone metastases, whereas the radiographic morphology changes vary greatly with time among patients.


**Prediction of tumor response by FDG-PET: comparison of the accuracy of single and sequential studies in patients with adenocarcinomas of the esophagogastric junction.**


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PURPOSE: Positron-emission-tomography with the glucose analog fluorodeoxyglucose (FDG-PET) has shown encouraging results for prediction of tumor response to chemotherapy. However, there is no consensus as to what time after initiation of therapy FDG-PET should be performed. To address this question we studied the time course of changes in tumor FDG-uptake in patients with locally advanced adenocarcinomas of the esophagogastric junction (AEG) treated with preoperative chemotherapy. METHODS: Twenty-four patients with AEG were included and underwent FDG-PET prior to therapy (PET1), 2 weeks after initiation of therapy (PET2), and preoperatively (PET3). Tumor metabolic activity was assessed by standardized uptake values (SUV) and correlated with histopathologic response and patient survival. RESULTS: Baseline tumor SUV was 8.3 +/- 3.5 and decreased to 5.0 +/- 1.8 at PET2 (p < 0.0001). At PET3 there was further decrease to 3.5 +/- 1.9 (p < 0.0001). The relative decrease of tumor FDG-uptake from PET1 to PET2 and from PET1 to PET3 were both significantly correlated with histopathologic response. Reduction of tumor SUV from PET1 to PET2 was significantly correlated with survival (p = 0.03) and there was a similar trend for changes from PET1 to PET3 (p = 0.09). In contrast, absolute SUVs did not demonstrate a significant correlation with histopathological response or patient survival at any of the studied time points. CONCLUSION: In patients with AEG, relative changes in tumor FDG uptake are better predictors for treatment outcome than absolute SUVs. Metabolic changes within the first 2 weeks of therapy are at least as efficient for prediction of histopathologic response and patient survival as later changes.

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**Role of 18F-FDG PET in Preoperative Assessment of Cytologically Indeterminate Thyroid Nodules.**


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OBJECTIVE: To determine the diagnostic accuracy of (18)F-FDG PET in the preoperative diagnosis of thyroid nodules with indeterminate fine needle aspiration biopsy results. METHODS: Forty two consecutive patients with thyroid nodules with indeterminate cytological results participated in this study. Abnormal (18)F-FDG PET uptake was assessed visually and by measuring the maximum standardized uptake value (SUVmax) in thyroid topography. All these results were compared with the final pathologic results. RESULTS: The presence of focal uptake correlated with a greater risk of malignancy (p=0.018). All 11 malignant nodules had focal uptake (sensitivity of 100%). Of the 31 patients with benign nodules, there were 19 with positive uptake (specificity of 38.7%). The pre-PET probability of cancer was 26.2% (11/42) and this probability increased to 36.7% post-PET for those patients whose exam showed focal uptake (11/30). The preoperative use of FDG PET would result in a significant reduction (39%, 12/31) in the number of thyroidectomies performed in patients with benign lesions. SUVmax could not improve this degree of accuracy. There was no correlation between thyroid nodule size and SUVmax value (p=0.96). Patients with carcinomas were younger than patients with benign lesions (p=0.048). There was no other clinical, laboratorial or ultrasonographic variable related to malignancy. CONCLUSIONS: (18)F-FDG PET provides high sensitivity to malignant lesions and may be a potentially useful tool in the evaluation of thyroid nodules with indeterminate cytological findings. For these nodules the number of unnecessary thyroidectomies in a hypothetical algorithm using (18)F-FDG PET would be reduced by 39%.

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**Case report: PET/CT, a cautionary tale.**


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BACKGROUND: The use of combined positron emission tomography/computerised tomography (PET/CT) scanners in oncology has been shown to improve the staging of tumours and the detection of relapses. However, mis-registration errors are increasingly recognised to be a common pitfall of PET/CT studies. CASE PRESENTATION: We report a patient with a germ cell tumour of the testis, who underwent a PET/CT scan to detect the site of relapse with a view to surgical removal. However, the PET/CT scan mislocalised the tumour site to be within the T2 vertebral body. A subsequent endoscopic ultrasound scan however showed the tumour to be anterior to the vertebral body, which was confirmed at surgery. CONCLUSION: In this report, we highlight the artefactual mislocalisation errors which may occur with PET/CT imaging, and the need to review and verify these scans.
PET-Oncology

Diagnosis of endoneural sciatric nerve invasion by uterine cervical epidermoid cancer using [(18)F]FDG-PET/CT.


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FDG-PET/CT tumor segmentation-derived indices of metabolic activity to assess response to neoadjuvant therapy and progression-free survival in esophageal cancer: correlation with histopathology results.

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PURPOSE: To evaluate the diagnostic and prognostic abilities of PET tumor segmentation-derived indices of metabolic activity for the assessment of response to neoadjuvant chemoradiotherapy and progression-free survival in patients with esophageal cancer. METHODS: Twenty-five patients with histologically confirmed esophageal cancer were retrospectively evaluated. The patients underwent PET-CT imaging before and after completion of neoadjuvant therapy. Images were evaluated visually and quantitatively with a three-dimensional threshold-based region-growing program, which calculates SUVm, SUVa of the entire tumor, metabolic tumor length (Lm) and volume (Vm) before and after therapy (SUVm1, SUVm2, SUVa1, SUVa2, Lm1, Lm2, Vm1, and Vm2, respectively). Percentage changes in these metabolic variables before and after therapy were also calculated (%SUVm, %SUVa, %Lm, %Vm, respectively). RESULTS: SUVm1 (P = 0.018), SUVa1 (P = 0.019), Lm1 (P = 0.016), and Vm1 (P = 0.016) correlated with T-status. Advanced stage tumors (T3 + T4) had significantly higher glucose metabolism, metabolic length, and volume. Moreover, Lm1 >47.4 mm and Vm1 >29 cm3 were the best predictors of the level of tumor invasiveness. SUVm1 >12.7 and SUVa1 >5.9 could differentiate patients with positive lymph nodes from those without at presentation. %SUVa >32.3% and the SUVa1 >5.5 proved to be reliable predictors of pathologic response. SUVa2 >3.55 and SUVm2 >4.35 were the best predictors of disease progression during follow-up, with the latter having the best prognostic value. CONCLUSIONS: This study showed that FDG-PET tumor segmentation-derived indices of metabolic activity play a definite role in the evaluation of response to neoadjuvant chemoradiotherapy and progression-free survival in patients with esophageal cancer.


A (18)F-FDG-positive, (67)Ga-negative, and transferrin receptor expression-negative patient with diffuse large B-cell lymphoma.

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We recently experienced a case with uveitis suffering from fever of unknown origin suspected of being caused by sarcoidosis. Chest computed tomography showed right supraclavicular, bilateral mediastinal, and right hilar lymphadenopathy, and intensive abnormal uptake of 2-(18)Ffluoro-2-deoxy-D-glucose (18)F-FDG was observed on positron emission tomography with (18)F-FDG (FDG-PET). On the other hand, (67)Ga scintigraphy showed almost no abnormal findings. Histopathological examination revealed the lesion to be a diffuse large B-cell lymphoma (DLBCL), namely, an aggressive non-Hodgkin lymphoma from a right supraclavicular lymph node biopsy specimen. Additional immunohistochemical analysis showed the negative expression of transferrin receptor (TIR) on the formalin-fixed paraffin-embedded specimen. Although DLBCL is generally considered to be a (67)Ga-avid tumor, it does not always have a large number of TIRs and that leads to a discrepancy between the (67)Ga scintigraphy and FDG-PET findings. FDG-PET should be more appropriate for the initial staging of DLBCL than (67)Ga scintigraphy, whereas (67)Ga scintigraphy might be able to provide additional information including prognostic factors and to support strategies that target TIR for cancer therapy.


Metastasis of the gastrointestinal tract: FDG-PET imaging.


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We assess the usefulness of F-18-fluoro-deoxyglucose (FDG) positron emission tomography (PET) in the evaluation of gastrointestinal metastases. Four cases (five lesions) in which metastases from three lung cancers and one malignant fibrous histiocytoma (MFH) of the femur were found in the gastrointestinal tract were reviewed (men/women 3:1, age 63-78 years, mean 72 years). The five lesions were duodenal, jejunal metastasis, and two stomach metastases from lung carcinoma, and rectal metastasis from MFH of the femur. FDG-PET was unable to detect small masses, but it was able to detect unforeseen lesions such as gastrointestinal metastases because FDG-PET is a whole-body scan in a single-operation examination. FDG-PET imaging provided valuable information for the diagnosis of gastrointestinal metastasis.


Comparison of MET-PET and FDG-PET for differentiation between benign lesions and lung cancer in pneumoconiosis.
OBJECTIVE: The aim of this study was to evaluate and compare the ability of C-11-methionine (MET) and F-18 fluoro-deoxy-D-glucose positron emission tomography (FDG-PET) to diagnose lung cancer in patients with pneumoconiosis. METHODS: Twenty-six subjects underwent both whole-body MET-PET and FDG-PET on the same day. The first group was a lung cancer group, which consisted of 15 patients, and included those with pneumoconiosis with increased nodules (13 cases), hemoptysis (1 case), and positive spumten cytology (1 case). The second group was a no-malignancy control group, consisting of 11 patients with pneumoconiosis. RESULTS: Significant correlations between nodule size and the maximum standardized uptake value (SUV(max)) of the two PET tracers were observed in the control group. The larger the nodule size, the greater were the amounts of these tracers accumulated (MET: r = 0.771, P < 0.0001; FDG: r = 0.903, P < 0.0001). The SUV(max) of MET was significantly lower than that of FDG in the pneumoconiotic nodules (P < 0.0001). Lung cancer was found in 5 of 19 nodules (two with adenocarcinoma, one with squamous cell carcinoma, one with small cell carcinoma, and one with large cell carcinoma) in the first group. As for nodules equal to or less than 3 cm in diameter, the SUV(max) of MET was significantly higher in the lung cancer than in the pneumoconiotic nodules, with 3.48 +/- 0.18 (mean +/- SE) for the lung cancer and 1.48 +/- 0.08 for the pneumoconiotic nodules (P < 0.01), similar to the SUV(max) of FDG, with 7.12 +/- 2.36 and 2.85 +/- 0.24 (P < 0.05), respectively. On the basis of the criteria for the control group, MET and FDG identified lung cancer with specificities of 60% and 80%, sensitivities of 100% and 93%, and negative predictive values of 88% and 93%, respectively. CONCLUSIONS: Our results indicate that nodules with an intense uptake of MET and FDG relative to their size should be carefully observed because of a high risk for lung cancer.

Diffuse and diffuse-plus-focal uptake in the thyroid gland identified by using FDG-PET: prevalence of thyroid cancer and Hashimoto's thyroiditis.

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OBJECTIVE: To investigate and evaluate the prevalence of incidental thyroid diffuse and diffuse-plus-focal fluorine-18 fluoro-deoxyglucose (FDG) uptake in healthy subjects who underwent cancer screening on positron emission tomography (PET) scan, and also to evaluate the prevalence of thyroid cancer and Hashimoto's thyroiditis. METHODS: We carried out a retrospective review of 1626 subjects who underwent PET scanning at our institution. Diffuse uptake was defined as FDG uptake in the whole thyroid gland, whereas diffuse-plus-focal uptake was defined as a thyroid lesion with both diffuse uptake and focal FDG uptake. The maximum standardized uptake value of the thyroid lesions was recorded and reviewed. In each selected subject with positive thyroid FDG uptake, serum thyroid-stimulating hormone, thyroid hormone, and thyroid antibodies were measured. Fine needle aspiration cytology was performed on patients with a definite nodule using ultrasonography. RESULTS: Twenty-nine subjects (1.78%) were identified as having either diffuse FDG uptake (n = 25, 1.53%) or diffuse-plus-focal FDG uptake (n = 4, 0.24%). All subjects with diffuse FDG uptake were diagnosed as having Hashimoto's thyroiditis. In 1 of the 25 subjects with diffuse FDG uptake and two of the four with diffuse-plus-focal FDG uptake, histopathologic diagnosis showed papillary thyroid carcinoma associated with Hashimoto's thyroiditis. However, PET scan did not detect papillary carcinoma associated with Hashimoto's thyroiditis in one of the three subjects. CONCLUSIONS: Our results suggest that although diffuse FDG uptake usually indicates Hashimoto's thyroiditis, the risk of thyroid cancer must be recognized in both diffuse FDG uptake and diffuse-plus-focal FDG uptake on PET scan.

Therapeutic impact of 2-[fluorine-18]fluoro-2-deoxy-D-glucose positron emission tomography in the pre- and postoperative staging of patients with clinically intermediate or high-risk breast cancer.

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BACKGROUND: Positron emission tomography with 2-[fluorine-18]fluoro-2-deoxy-D-glucose (FDG-PET) is an accurate imaging modality for the staging of breast cancer. The aim of this study was to determine the potential therapeutic impact of pre- and postoperative FDG-PET in patients with clinically intermediate or high-risk breast cancer. PATIENTS AND METHODS: One hundred and fourteen patients with newly diagnosed breast cancer were examined before (73) or after (41) surgery. Patient data were translated into three scoring sheets corresponding to information available before positron emission tomography (PET), after PET and after further diagnostic tests. Three medical oncologists independently reviewed the retrospectively acquired patient data and prospectively made decisions on the theoretically planned treatment for each time point, according to the recommendations of St Gallen Consensus Guidelines 2005. RESULTS: FDG-PET changed the planned treatment in 32% of 114 patients. In 20% of cases, therapeutic intention (curative versus palliative) was modified. Radiation treatment planning was changed in 27%, surgical planning in 9%, chemotherapy in 11% and intended therapy with bisphosphonates in 13% of all patients. CONCLUSION: Based on current treatment guidelines, FDG-PET, as a staging procedure in patients with newly diagnosed clinically intermediate or high-risk breast cancer examined pre- and postoperatively, may have a substantial therapeutic impact on treatment planning.

Positron emission tomographic scanning predicts survival after induction chemotherapy for esophageal carcinoma.

BACKGROUND: The ability to accurately predict clinical and pathological response and survival in patients undergoing preoperative chemotherapy may have a significant impact on treatment strategy for esophageal carcinoma. This study assessed the predictive accuracy of clinical response (CR) and positron emission tomography (PET) scanning in determining pathological downstaging and disease free survival (DFS) after chemotherapy. METHODS: This is a retrospective review of patients who underwent chemotherapy prior to complete surgical resection for esophageal carcinoma between 1999 and 2005. Clinical response was correlated with pathological downstaging and survival. For PET scanning, the percent reduction in maxSUV after induction therapy was determined and we identified the optimal threshold of percent reduction in maxSUV for predicting clinical response and pathological downstaging. RESULTS: Sixty-two patients (52 men, median age 62.3) were evaluated. Thirty-nine patients (62.9%) had either a partial (n = 32) or complete clinical response (n = 7) to induction therapy. The sensitivity, specificity, positive, and negative predictive value of an objective clinical response in predicting downstaging in T and (or) N were 85.7%, 55.9%, 61.5%, and 82.6%, respectively. There was no difference in DFS between responders and nonresponders. The PET sensitivity, specificity, positive, and negative predictive values for predicting pathologic downstaging were 77.8%, 52.9%, 56.8%, and 75%, respectively. Thirty-seven patients (59.7%) had a 50% or greater reduction in the maxSUV of their primary tumor and had a significant improvement in DFS compared with patients with a less than 50% reduction in maxSUV (median DFS time: 35.5 months vs 17.9 months, respectively, p = 0.03). Significantly, 11 patients had a 100% reduction in maxSUV despite the presence of residual tumor. CONCLUSIONS: Complete response and PET appear equivalent in predicting pathological downstaging. However, a 50% reduction in the maxSUV after induction therapy is more significantly associated with improved DFS than CR or pathological downstaging. Additionally, a complete absence of PET signal cannot be equated with a complete pathological response.


Detection of occult bone metastases from head and neck squamous cell carcinoma: impact of positron emission tomography computed tomography with fluorodeoxyglucose F 18.

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OBJECTIVES: To assess the ability of positron emission tomography-computed tomography with fluorodeoxyglucose F 18 (FDG-PET/CT) to provide early, accurate detection of bone metastases from head and neck squamous cell carcinoma (HNSCC) and to determine the impact of detecting occult bone metastases on patient care. DESIGN: Retrospective medical chart review. SETTING: Single academic medical center. PATIENTS: The study population comprised 13 patients with FDG-PET/CT scans detecting bone lesions suggestive of HNSCC metastases. These patients were identified from a retrospective review of 683 consecutive FDG-PET/CT scans performed for initial staging (n = 198) or restaging (n = 485) of HNSCC between October 2002 and December 2005. MAIN OUTCOME MEASURES: Rate of biopsy confirmation of bone lesions detected by FDG-PET/CT as suggestive of metastases, presence of concurrent symptoms or laboratory serologic evidence for bone metastasis, timing of bone metastasis detection relative to initial diagnosis of HNSCC, and change in therapeutic decision making based on bone metastasis detection. RESULTS: Eleven FDG-PET/CT studies that detected bone metastases were performed to restage a suspected or known recurrence, and 2 studies were performed for radiographic restaging of disease after completion of therapy. Bone biopsy confirmation was performed in 5 patients, and 4 of the biopsy results were positive for metastatic HNSCC. All patients lacked clinical symptoms of bone involvement, and 82% (n = 9) had serum alkaline phosphatase levels in the normal (n = 7) or minimally elevated (n = 2) range. At the time of bone metastasis detection, 6 of the 12 patients (50%) had no other identifiable distant metastatic disease. Furthermore, 2 patients (17%) lacked disease at any other local, regional, or distant site. The identification of bone metastases influenced therapeutic decisions in 5 of 13 cases (38%). CONCLUSION: Use of FDG-PET/CT in restaging HNSCC allows for detection of occult bone metastases, and this early detection frequently influences therapeutic decision making.
Comparison of CT and positron emission tomography/CT coregistered images in planning radical radiotherapy in patients with non-small-cell lung cancer.


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Imaging with F-18 fluorodeoxyglucose positron emission tomography (PET) significantly improves lung cancer staging, especially when PET and CT information are combined. We describe a method for obtaining CT and PET images at separate acquisitions, which allows coregistration and incorporation of PET information into the radiotherapy (RT) planning process for non-small-cell lung cancer. The influence of PET information on RT planning was analysed for 10 consecutive patients. Computed tomography and PET images were acquired with the patient in an immobilization device, in the treatment position. Using specially written software, PET and CT data were coregistered using fiducial markers and imported into our RT planning system (Cadplan version 6). Treatment plans were prepared with and without access to PET/CT coregistered images and then compared. PET influenced the treatment plan in all cases. In three cases, geographic misses (gross tumour outside planning target volume) would have occurred had PET not been used. In a further three cases, better planning target volume marginal coverage was achieved with PET. In four patients, three with atelectasis, there were significant reductions in V20 (percentage of the total lung volume receiving 20 Gy or more). Use of coregistered PET/CT images significantly altered treatment plans in a majority of cases. This method could be used in routine practice at centres without access to a combined PET/CT scanner.

The usefulness of (18)F-fluorodeoxyglucose positron emission tomography ((18)F-FDG-PET) and a comparison of (18)F-FDG-pet with (67)gallium scintigraphy in the evaluation of lymphoma: relation to histologic subtypes based on the World Health Organization classification.


BACKGROUND.: Although studies comparing conventional imaging modalities with (18)F-fluorodeoxyglucose positron emission tomography ((18)F-FDG-PET) for the detection of lymphoma and although the relations between (18)F-FDG-PET and histologic types were reported previously, most studies were not systematic and involved relatively small numbers of patients. METHODS.: Two hundred fifty-five patients with lymphoma had their disease staged using (18)F-FDG-PET, and 191 of those patients also were assessed using gallium-67 scintigraphy ((67)Ga). Disease sites were identified on a site-by-site basis using computed tomography scans and/or magnetic resonance imaging. The results of these conventional imaging modalities were compared with the results from (18)F-FDG-PET and (67)Ga, and correlations between the imaging results and pathologic diagnoses were evaluated by using the World Health Organization classification system. RESULTS.: Of 913 disease sites in 255 patients, (18)F-FDG-PET identified >97% of disease sites of Hodgkin lymphoma (HL) and aggressive and highly aggressive non-Hodgkin lymphoma. For indolent lymphoma, the detection rate of (18)F-FDG-PET was 91% for follicular lymphoma (FL); 82% for extranodal marginal zone B-cell lymphoma of mucosa-associated lymphoid tissue, irrespective of plasmacytic differentiation; and approximately 50% for small lymphocytic lymphoma (SLL) and splenic marginal zone lymphoma (SMZL). The results from (67)Ga were similar to those from (18)F-FDG-PET for most histologic subtypes. However, the sensitivity of (67)Ga was unexpectedly poor for FL, for mantle cell lymphoma (MCL), and for the nasal type of natural killer/T-cell lymphoma (NK/T-nasal), ranging from 30% to 38%. CONCLUSIONS.: (18)F-FDG-PET was useful for all histologic subtypes of lymphoma other than SLL and SMZL. Compared with (67)Ga, the authors strongly recommend the use of (18)F-FDG-PET in patients with FL, MCL, and NK-nasal. Cancer 2007. (c) 2007 American Cancer Society.

A case of three synchronous primary tumors demonstrated by F-18 FDG PET.

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We present an F-18 FDG PET scan which demonstrates 3 synchronous primary malignancies. The patient is a 61-year-old man who presented with weight loss and dysphagia. He was initially diagnosed with squamous cell carcinoma of the midesophagus, and was then found to have an adenocarcinoma in the right lung. A staging PET scan additionally showed increased left tonsillar uptake. Subsequent biopsy confirmed squamous cell carcinoma of the left tonsil. The demonstration of 3 synchronous primaries by PET is probably rare.
PET-Oncology

Detection of primary choriocarcinoma in the mediastinum by F-18 FDG positron emission tomography.


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A 31-year-old woman with a history of infection with human papilloma virus was found to have an elevated human chorionic gonadotropin level (beta-HCG) of more than 9000 IU/L in January 2006. The patient reported an irregular menstrual cycle. Extensive clinical work-up including gynecologic examinations with laparoscopy, hysteroscopy, and curettage were performed but no pathologic explanation of this elevated beta-HCG could be found. In the initial computed tomography (CT) of the abdomen and the thorax, a tumor could not be detected. Based on a clinical decision, chemotherapy with methotrexate in a dose of 1 mg/kg body weight was started. Four months after beginning of the chemotherapy the beta-HCG level dropped to 3048 IU/L. At this time a first F-18 FDG PET was performed and the findings were negative. After completion of 7 cycles of chemotherapy the beta-HCG level rose again. In a second F-18 FDG PET in August 2006 focal, intense and pathologic F-18 FDG accumulation with a SUV max. of 5.4 was seen in the mediastinum in the region of the thymus. At this time the beta-HCG level was 7000 IU/L. In a subsequent CT of the chest a retrosternal mass of 4 x 1.7 cm was detected with contrast enhancement. Resection of the tumor and thymus gland demonstrated a choriocarcinoma in part adjacent to the thymus and in part in the thymus. Postoperative beta-HCG levels dropped to 105 IU/L.

Sciatic nerve neurolymphomatosis - extent and therapy response assessment with PET/CT.

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Neurolymphomatosis is a rare condition and may be the first and only manifestation of a non-Hodgkin lymphoma. We present the case of a 59-year-old patient with fluctuating gluteal pain for 5 years and progressive palsy of the left lower extremity, leading to severe walking difficulties. The neurologic examination revealed pronounced atrophy, flaccid paresis, and sensory loss in the area of innervation of the left sciatic nerve. Electroneuromyography showed a severe sensomotoric axonal lesion of the left sciatic nerve. Biopsy of the lesion revealed diffuse large B-cell lymphoma. Fluorodeoxy glucose (FDG)-positron emission tomography/computed tomography was performed for staging, showing a high FDG uptake of the left sciatic nerve. FDG-positron emission tomography/computed tomography after six cycles of chemotherapy showed complete metabolic response.

The additional value of FDG PET imaging for distinguishing N0 or N1 from N2 stage in preoperative staging of non-small cell lung cancer in region where the prevalence of inflammatory lung disease is high.


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PURPOSE: The aim of this study was to evaluate the efficacy of PET imaging and compare it with the performance of CT in mediastinal and hilar lymph node staging in potentially operable non-small cell lung cancer (NSCLC). METHODS: Fifty-nine patients with potentially resectable NSCLC who underwent preoperative PET and CT imaging were enrolled into this prospective study. All patients underwent surgical evaluation by means of mediastinoscopy with mediastinal lymph node sampling (14 patients) or thoracotomy (45 patients). RESULTS: The prevalence of lymph node metastases was 53%. Overall, the sensitivity, specificity, accuracy, PPV, and NPV of PET were 79%, 76%, 78%, 86%, and 76% for N0 and N1 lymph nodes and 76%, 79%, 80%, 67%, and 83% for N2 lymph nodes, while those values for CT were 66%, 43%, 76%, 43%, and 79% for N0 and N1 stations and 43%, 66%, 54%, 41%, and 66% for N2 lymph nodes, respectively. PET correctly differentiated cases with mediastinal lymph node involvement (N2) from those without such involvement (N0 or N1) in 76% of cases. Statistical analysis of the diagnostic accuracy of nodal involvement showed that PET improves diagnostic accuracy significantly in the detection of both N0 or N1 and N2 status in the individual patient based on analysis, compared with CT (P < 0.01 and P < 0.01, respectively). When preoperative nodal staging was compared with postoperative histopathological staging, 38 (65%) patients were correctly staged, 9 (15%) were overstaged, and 12 (20%) were understaged by PET, while 29 patients (49%) were correctly staged, 13 (22%) were overstaged, and 17 (29%) were understaged by CT. CONCLUSION: It has been clearly shown that PET is more accurate than CT for the differentiation of N0 or N1 from N2 disease in patients with NSCLC. However, PET imaging alone does not appear to be sufficient to replace mediastinoscopy for mediastinal staging in patients with lung cancer, especially in geographic regions with high granulomatous or inflammatory mediastinal disease prevalence.
PET-Oncology


Positron-emission tomography and computed tomography of cystic pancreatic masses.

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AIM: To investigate the sensitivity and specificity of computed tomography (CT), positron-emission tomography (PET), and both methods in combination, for determining whether cystic pancreatic tumours are malignant. MATERIALS AND METHODS: We retrospectively identified all patients with cystic pancreatic tumours who underwent separate PET and contrast-enhanced CT examinations within a 1-month interval. Tumours were classified as benign or malignant on CT (two radiologists, independently), PET [a reported standardized uptake value (SUV) of 2.5 was taken as the cut-off between benign and malignant], and with PET and CT images together (two radiologists, in consensus). Readers were blinded to pathological and other radiological findings. Mean patient age and lesion size were compared between benign and malignant groups using Student's t-test. For CT findings, odds ratios (OR) and confidence intervals (CI) were calculated using multivariate logistic regression models. For CT, PET, and the combined images, sensitivities and specificities were calculated, and compared between groups using Fisher's exact test. RESULTS: Thirty patients were identified. The best CT predictor of malignancy was size; mean diameter was 2.3 cm (benign) and 4.1 cm (malignant) (p<0.01); OR was 2.80 (95% CI, 1.26-6.20). Sensitivities of CT, PET and combined PET/CT images were 67-71, 57, and 86%, respectively. PET/CT was more sensitive than PET (p<0.01) or CT (p<0.01) alone. Specificities of CT, PET, and combined PET/CT images were 87-90, 65, and 91%, respectively. PET/CT was more specific than PET (p<0.01) but not CT (p>0.05). CONCLUSION: The sensitivity and specificity of combined PET and CT images is comparable with or superior to either CT or PET alone in determining malignancy in cystic pancreatic lesions.


PET-CT in clinical oncology.

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Anatomic imaging techniques such as computed tomography (CT) and magnetic resonance imaging (MRI) have been used for many years in clinical oncology. The emergence of positon emission tomography (PET) more than a decade ago was a major breakthrough in the early diagnosis of malignant lesions, as it was based on tumour metabolism and not on anatomy. The merger of both techniques into one thanks to PET/CT cameras has made this technology the most important tool in the management of cancer patients. PET/CT with 18F-FDG is increasingly being used for staging, restaging and treatment monitoring for cancer patients with different types of tumours (lung, breast, colorectal, lymphoma, melanoma, head and neck etc.). At many institutions, PET/CT has replaced separately acquired PET and CT examinations for many oncologic indications. This replacement has occurred despite the fact that only a relatively small number of well designed prospective studies have verified imaging findings against the gold standard of histopathologic tissue evaluation. However, a large number of studies have used acceptable reference standards, such as pathology, imaging and other clinical follow-up findings, for validating PET/CT findings. The impact on the management of patients and the benefits from the information obtained from this anatomo-metabolic procedure justify the term "clinical oncology based on PET-CT" as a new concept to be applied in clinical practice.


PET-CT in oncology.

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Evaluation of amplitude-based sorting algorithm to reduce lung tumor blurring in PET images using 4D NCAT phantom.

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PURPOSE: develop and validate a PET sorting algorithm based on the respiratory amplitude to correct for abnormal respiratory cycles. METHOD AND MATERIALS: using the 4D NCAT phantom model, 3D PET images were simulated in lung and other structures at different times within a respiratory cycle and noise was added. To validate the amplitude binning algorithm, NCAT phantom was used to simulate one case of five different respiratory periods and another case of five respiratory periods alone with five respiratory amplitudes. Comparison was performed for gated and ungated images and for the new amplitude binning algorithm with the time binning algorithm by calculating the mean number of counts in the ROI (region of interest). RESULTS: an average of 8.87 +/- 5.10% improvement was reported for total 16 tumors with different tumor sizes and different T/B (tumor to background) ratios using the new sorting algorithm. As both the T/B ratio and tumor size decreases, image degradation due to respiration increases. The greater benefit for smaller diameter tumor and lower T/B ratio indicates a potential improvement in detecting more problematic tumors.
Cancer screening of healthy volunteers using whole-body (18)F-FDG-PET scans: The Nishidai clinic study.


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In order to evaluate the diagnostic performance of cancer screening using whole-body (18)F-fluorodeoxyglucose positron emission tomography (FDG-PET) scanning for asymptomatic subjects, we conducted a historical cohort study. The study group comprised 5807 individuals who underwent PET scanning from 2002 to 2003. Each subject had carried out a procedure with whole-body (18)F-FDG-PET scan with some other diagnostic tests. Out of 5807 participants, data from 4881 subjects were analysed. Among them, PET screening revealed abnormal FDG uptake in 562 subjects, and possible or probable malignancy in 324 subjects, and histological diagnosis of cancer in 36 subjects (16 thyroid, seven colon, four lung, five breast, two prostate, and two others) out of them. The overall cancer detection rate was 0.7%, and PET scanning had a sensitivity of 70.6% and a specificity of 94.0%. This result warrants further prospective cohort studies to evaluate the usefulness of PET cancer screening for cancer prevention.

The accuracy of mediastinal staging is of paramount importance in the management of patients with non-small cell lung cancer (NSCLC) to select only those patients who might benefit from upfront resection or multimodality treatment. Although CT is the imaging technique of first choice, its performance characteristics have led to an increased use of both EUS-FNA and (18)FDG-PET to improve (mediastinal) staging. In view of the relatively few studies employing both techniques simultaneously, we evaluated 20 consecutive patients (median age 70 years, range 48-83 years) with NSCLC in whom CT suggested N2 and/or N3 involvement. The sensitivity, specificity, PPV and NPV of EUS-FNA and (18)FDG-PET was 86%, 100%, 100%, 90%, and 100%, 89%, 88% and 100%, respectively. EUS-FNA confirmed the absence of malignancy in all patients with a negative (18)FDG-PET scan. Similarly, in the PET-positive patients, EUS-FNA confirmed malignancy in seven out of nine (78%) sites. Unnecessary surgery was prevented in six out of 16 patients otherwise considered as surgical candidates (37%). We conclude that both EUS-FNA and (18)FDG-PET have excellent operating characteristics. However, initial (18)FDG-PET findings should guide the complementary use of EUS-FNA to define treatment options and to prevent unnecessary surgery in selected patients.

Reply: 18F-FDG PET in Planning Radiation Treatment of Non Small Cell Lung Cancer: Where Exactly Is the Tumor?

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18F-FDG PET in planning radiation treatment of non-small cell lung cancer: where exactly is the tumor?

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68Ga-labeled bombesin studies in patients with gastrointestinal stromal tumors: comparison with 18F-FDG.

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Dynamic PET studies with a 68Ga-bombesin analog, DOTA-PEG2-[d-Tyr6, beta-Ala11, Thi13, Nle14] BN(6-14) amide (68Ga-BZH3: DOTA is 1,4,7,10-tetraazacyclododecane-N,N’-N’’-N’’’-tetraacetic acid, and PEG is ethylene glycol [2-aminooethyl-carboxymethyl ether]), were performed on patients with gastrointestinal stromal tumors (GIST) to investigate the impact of complementary receptor scintigraphy on diagnosis and the potential of a radionuclide treatment. Furthermore, dynamic 18F-FDG studies were performed on the same patients. METHODS: This study comprised 17 patients with GIST. All patients were scheduled for therapy with imatinib because of unresectable primary or recurrent GIST or because of metastatic disease. Dynamic PET scans using 68Ga-BZH3 and 18F-FDG were obtained on 2 consecutive days. Multivariate analysis was used to evaluate the kinetic data. Standardized uptake values (SUVs) were calculated, and a compartmental model (2-tissue) and noncompartmental model were used for data evaluation of both tracers. RESULTS: Fourteen of 17 patients (82/30 lesions) were positive for uptake on 18F-FDG imaging, whereas 68Ga-BZH3 demonstrated an enhanced accumulation in 7 of 17 patients (8/30 lesions). Thirteen lesions were confirmed by histologic examination, and the remaining 17 were confirmed by follow-up. One recurrent tumor in the stomach could not be delineated on 18F-FDG imaging but showed enhanced 68Ga-BZH3 uptake. The median SUV for 68Ga-BZH3 was 3.3, in comparison with 7.9 for 18F-FDG. Best-subset analysis demonstrated that the global SUV
The purpose of this prospective study was to investigate whether correlations exist between 18F-FDG uptake of primary breast cancer lesions and predictive and prognostic factors such as estrogen receptor (ER), progesterone receptor (PR), and C-erbB-2 receptor (C-erbB-2R) states. METHODS: Before undergoing partial or total mastectomy, 213 patients with newly diagnosed breast cancer underwent 18F-FDG PET (5.2 MBq/kg of body weight). The maximum standardized uptake value (SUV) of the primary lesion was measured in each patient. Standard immunohistochemistry was performed on a surgical specimen of the cancer lesion to characterize the receptor state of the tumor cells. Pearson chi-square tests were performed on the cross-tables of different receptor states to test any association that may exist among ER, PR, and C-erbB-2R. Maximum SUV measurements for different receptor states were compared using factorial ANOVA in a completely random design. RESULTS: After exclusion of certain lesions, 118 lesions were analyzed for this study. The mean maximum SUVs of ER-positive and ER-negative lesions were 3.03 +/- 0.26 and 5.64 +/- 0.75, whereas those of PR were 3.24 +/- 0.29 and 4.89 +/- 0.67, respectively, and those of C-erbB-2R were 4.64 +/- 0.70 and 3.70 +/- 0.35, respectively. Chi-square tests for ER and PR showed that if one is positive then the other tends to be positive as well (chi2 = 13.026, P < 0.01). For ER and C-erbB-2R states, if ER is positive, C-erbB-2R will more likely be negative (chi2 = 71.054, P < 0.01). For ER and C-erbB-2R states, if ER is positive, C-erbB-2R will more likely be negative (chi2 = 71.054, P < 0.01). For ER and C-erbB-2R states, if ER is positive, C-erbB-2R will more likely be negative (chi2 = 71.054, P < 0.01).

CONCLUSION: SUV measurements may provide valuable information about the state of ER, PR, and C-erbB-2R and the effect on 18F-FDG uptake but ER state alone had an effect (F = 9.126, P < 0.01). ER and PR being together had no additional effect on SUV (F = 3.695, P > 0.05). ANOVAs showed that PR state alone (F = 0.095, P > 0.05) and C-erbB-2R state alone (F = 0.097, P > 0.05) had no effect on 18F-FDG uptake but ER state alone had an effect (F = 9.126, P < 0.01). ER and PR being together had no additional effect on 18F-FDG uptake. Our study also demonstrated that interactions exist between ER and C-erbB-2R state and between PR and C-erbB-2R state. CONCLUSION: SUV measurements may provide valuable information about the state of ER, PR, and C-erbB-2R and the associated glucose metabolism as measured by 18F-FDG uptake of the primary breast cancer lesions. Such an association may be of importance to treatment planning and outcome in these patients.

Diagnostic and prognostic value of 18F-FDG PET/CT for patients with suspected recurrence from squamous cell carcinoma of the esophagus.


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Patients with esophageal squamous cell carcinoma (ESCC) are commonly at high risk of recurrence within 2 years after initial treatment. The aim of this study was to evaluate the role of 18F-FDG PET/CT in patients with possibly recurrent ESCC who underwent definitive treatment. METHODS: Fifty-six patients with previously treated ESCC underwent PET/CT scans. The PET/CT findings were validated by histopathology or clinical follow-up of at least 6 months. The sensitivity, specificity, and accuracy of PET/CT for detecting recurrence were calculated. Comparison of the standardized uptake value (SUV) was performed between patients grouped according to their status at the last follow-up (relapsed or relapse-free, alive or dead). The overall survival rates were estimated by the Kaplan-Meier method. The Cox proportional hazards model was used to evaluate independent prognostic variables for both univariate and multivariate survival analysis. RESULTS: Forty-five (80.4%) patients had recurrence in 72 (66.1%) malignant sites. On PET/CT, there were 9 false-positive and 5 false-negative results. The overall sensitivity, specificity, and accuracy of PET/CT for detecting recurrence at all sites were 93.1% (67/72), 75.7% (28/37), and 87.2% (95/109), respectively. PET/CT was highly sensitive, specific, and accurate at regional and distant sites. At local sites, sensitivity was high, but specificity was lower (50%) because of a high incidence of false-positive findings. Patients who were confirmed with recurrence or who had died at the last follow-up had higher SUVs (P = 0.027 and <0.001, respectively). In multivariate survival analysis, therapeutic modality (hazard ratio = 0.437; P = 0.044), SUV (hazard ratio = 1.071; P = 0.029), and disease status on PET/CT (hazard ratio = 2.430; P = 0.045) were independent significant prognostic predictors for overall survival. The Kaplan-Meier survival curves indicated poor prognostic outcome in subgroup patients with higher SUVs or systemic disease on PET/CT. CONCLUSION: 18F-FDG PET/CT is highly effective for detecting recurrent ESCC. The relatively low specificity at local sites is associated primarily with a high rate of false-positive interpretations at anastomoses. PET/CT can also provide noninvasive and independent prognostic information using SUV and recurrent disease pattern on PET/CT images for previously treated ESCC.
Role of 18F-FDG PET/CT in management of high-grade salivary gland malignancies.

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The role of 18F-FDG PET/CT for planning the treatment of high-grade salivary gland malignancies was investigated and was compared with that with using contrast-enhanced CT. METHODS: The subjects chosen for the study had high-grade cancer of the salivary gland, as confirmed by surgical pathology. The diagnostic values from 37 CT and PET/CT scans of 33 subjects were compared. The ability to predict the extent of the disease was compared by performing a subsite-based analysis for the primary lesions and a level-by-level analysis for the neck node levels as well as for the final TNM staging. The surgical pathology (67.6%) and clinical follow-up examinations (32.4%) were used as the reference standards. Furthermore, the changes made in each subject's care, based on a PET/CT examination, were compared with the treatment received without using the PET/CT data. RESULTS: Using a primary subsite-based analysis, the diagnostic accuracy for predicting the pathologic tumor extent was significantly higher for PET/CT (91.0%) compared with that using CT alone (70.1%, P < 0.001). For the neck nodes on a level-by-level analysis, the metastasis could be predicted more accurately on the basis of a PET/CT examination (97.6%) than with using only CT (86.0%, P = 0.01). PET/CT was also far superior to CT in terms of the TNM staging (83.7% vs. 62.1%, P = 0.03). For 43.2% of the subjects, changes in the clinical decision making were made as a result of the PET/CT scan data over what was previously determined by using the CT scans alone. CONCLUSION: PET/CT provides more accurate diagnostic information for the evaluation of high-grade salivary cancer than does CT and it has a major impact on making treatment decisions for patients with a high-grade salivary malignancy.

Predictive value and diagnostic accuracy of F-18-fluoro-deoxy-glucose positron emission tomography treated grade 1 and 2 follicular lymphoma.

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F-18-fluoro-deoxy-glucose positron emission tomography (PET) is a powerful tool for the imaging of aggressive B-cell lymphomas. In contrast, there is relatively little data on PET in follicular lymphoma grade 1 (FL-1) and grade 2 (FL-2). In this manuscript, we present our findings utilizing PET in treated FL-1 and FL-2. A retrospective review of patients who underwent PET examinations at our institution produced 95 PET examinations among 31 patients with FL-1 and FL-2. PET was obtained at initial staging, mid-induction and post-treatment. Results were compared with clinical follow-up. PET had high sensitivity (95%) and specificity (88%) for lesion detection in treated FL-1 and FL-2. Abnormal foci in FL-1 and FL-2 had similar intensities. Post-induction PET positive patients had shorter mean progression free survivals compared with PET negative patients (p-value &lt;/=0.001), post-salvage PET positive trended toward shorter mean response duration compared with negative patients (p-value: 0.09). Our results indicate that PET is accurate in the diagnostic assessment of treated FL-1 and FL-2 and, post-treatment PET positive patients are likely to relapse prior to PET negative patients.

PET for follicular lymphoma: A work in progress!

Wirh A.
Detection of bone metastases in thyroid cancer patients: bone scintigraphy or 18F-FDG PET?

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BACKGROUND: Similar to the situation in other tumour types, it is currently unclear whether fluorodeoxyglucose (FDG) positron emission tomography (PET) is adequate in the detection of bone metastases of thyroid cancer. The purpose of this retrospective study was to evaluate the performance of bone scans in comparison with FDG PET in the detection of bone metastases in patients with differentiated thyroid cancer (DTC). MATERIALS AND METHODS: Twenty-four patients had undergone both FDG PET and bone scans within 6 months because of suspected bone metastases. All scans were re-evaluated using all available additional imaging and clinical data for verification. Scan findings were scored as positive, negative or doubtful. RESULTS: Bone metastases were present in eight of 24 (33%) patients. Only bone scintigraphy but not FDG PET suggested the presence of bone metastases in three patients, all confirmed with magnetic resonance imaging (MRI)/X-ray. Five patients were identified with bone metastases on both bone scan and FDG PET, which was confirmed by computed tomography (CT)/MRI/X-ray in four. Five patients had doubtful findings on bone scans whereas FDG PET scans were negative. MRI showed degenerative disorders in two of five and was normal in two. Eleven patients had both a negative bone scan and FDG PET scan. CONCLUSION: In three of eight (38%) thyroid cancer patients bone metastases were only correctly detected by 18F-FDG PET/CT. CONCLUSION: PET/CT with 18F-FDG provides additional value to TVUS for the differential diagnosis of benign from malignant pelvic lesions, and to CT for the staging of ovarian cancer patients.

Diagnostic accuracy of 18F-FDG PET/CT in characterizing ovarian lesions and staging ovarian cancer: correlation with transvaginal ultrasonography, computed tomography, and histology.


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AIMS: To (a) assess the accuracy of 18F-FDG PET/CT in distinguishing malignant from benign pelvic lesions, compared to transvaginal ultrasonography (TVUS) and (b) to establish the role of whole-body 18F-FDG PET/CT, compared to contrast enhanced computed tomography (CT), in staging patients with ovarian cancer. PATIENTS: Fifty consecutive patients with a pelvic lesion, already scheduled for surgery on the basis of physical examination, TVUS, and serum Ca125 levels, were enrolled in the study. Patients' age ranged between 23 and 89 years (mean 64). All patients underwent TVUS including a colour Doppler study followed by a thorax and abdominal CT scan, and whole-body 18F-FDG PET/CT within 2 weeks prior to surgery. Histological findings obtained at surgery were taken as the 'gold standard' to compare 18F-FDG PET/CT and TVUS, and 18F-FDG PET/CT vs. CT. When tissue analysis showed ovarian cancer, the accuracy of 18F-FDG PET/CT and CT were compared for the purpose of obtaining a precise staging. RESULTS: At surgery, the ovarian lesions were malignant in 32/50 patients (64%) and benign in the remaining 18/50 patients (36%). The sensitivity, specificity, NPV, PPV and accuracy of 18F-FDG PET/CT were 87%, 100%, 81%, 100% and 92%, respectively, compared with 90%, 61%, 78%, 80% and 80%, respectively, for TVUS. In staging ovarian cancer, 18F-FDG PET/CT results were concordant with final pathological staging in 22/32 (69%) patients while CT results were concordant in 17/32 (53%) patients. CT incorrectly down-staged four out of six stage IV patients by missing distant metastasis in the liver, pleura, mediastium, and in left supravacular lymph nodes, which were correctly detected by 18F-FDG PET/CT. CONCLUSION: PET/CT with 18F-FDG provides additional value to TVUS for the differential diagnosis of benign from malignant pelvic lesions, and to CT for the staging of ovarian cancer patients.

Second cancers discovered by (18)FDG PET/CT imaging for choroidal melanoma.

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BACKGROUND: Positron-emission tomography/computed tomography (PET/CT) is a unique imaging tool that aids in the detection of cancerous lesions. It is currently and widely used for cancer staging (both initial and follow-up). Here we report our findings of second primary cancers incidentally discovered during PET/CT staging of patients with choroidal melanomas. METHODS: We performed a retrospective case review of 139 patients with uveal melanoma who were subsequently evaluated by whole-body [18-fluorine-labeled] 2-deoxy-2-fluoro-D-glucose ([18]FDG) PET/CT imaging. In this series, 93 were scanned before treatment and 46 during the course of their follow-up systemic examinations. Their mean follow-up was 50.9 months. RESULTS: Six patients (4.3%) had second primary cancers revealed by PET/CT imaging. Three patients (50%) were synchronous (found at initial staging), and the remaining 3 patients (50%) were metachronous (found at follow-up staging). Second primary cancers were found in the lung, breast, uterus, colon, and thyroid. CONCLUSIONS: Although whole-body PET/CT scans were ordered as part of the staging process of patients with diagnosed choroidal melanoma, both synchronous and metachronous second primary cancers were found. PET/CT has become an indispensable tool for staging, diagnosis, and treatment planning for choroidal melanoma. The possibility of detecting second primary cancers should also be considered valuable.
Role of multidetector CT and FDG-PET/CT in the diagnosis of local and distant recurrence of resected rectal cancer.


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PURPOSE: The aim of this study was to compare the diagnostic value of multidetector computed tomography (MDCT) and F18-fluorodeoxyglucose positron emission tomography-computed tomography (FDG-PET/CT) for the detection of local and distant recurrence in patients operated for colorectal cancer. MATERIALS AND METHODS: Sixty-seven patients who underwent radical surgery for rectal cancer were followed up with FDG-PET/CT and MDCT were included in this retrospective study. The FDG-PET/CT and MDCT findings were independently compared with histological sampling or 2 years' follow-up. RESULTS: Local recurrence occurred in 15/67 patients. MDCT diagnosed local recurrence in 15/15 cases and FDG-PET/CT in 14/15. Sensitivity and specificity were 100% and 98% for MDCT and 93% and 98% for FDG-PET/CT, respectively. Hepatic lesions were found in 17/67 patients. All hepatic metastases were detected by both techniques. Pulmonary metastases occurred in 8/67 patients: they were correctly identified in all cases by MDCT and in 6/8 by FDG-PET/CT. CONCLUSIONS: MDCT and FDG-PET/CT showed high sensitivity and specificity for the detection of local recurrence of rectal cancer. Both techniques were equally accurate for the detection of hepatic metastases. MDCT showed slightly higher sensitivity and positive predictive value in detecting pulmonary metastases compared with FDG-PET/CT.


High-risk melanoma: accuracy of FDG PET/CT with added CT morphologic information for detection of metastases.

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PURPOSE: To prospectively determine the accuracy of positron emission tomography (PET)/computed tomography (CT) with added CT morphologic information for depiction of metastases in patients with high-risk melanoma and negative findings for metastases at PET, by using histologic findings or additional imaging and/or follow-up findings as reference standard. MATERIALS AND METHODS: Institutional review board approval was obtained. Informed consent was obtained from patients. One hundred twenty-four consecutive high-risk melanoma patients (65 female, 59 male; mean age, 54.4 years; range, 15-82 years) were included. Fluorine 18 fluorodeoxyglucose (FDG) PET/CT was performed. First, PET/CT scans were evaluated for presence of metastases with increased FDG uptake; CT anatomic location was determined. Lesions were considered metastases if there was focal uptake higher than that of background tissue. Second, coregistered CT images of combined PET/CT scans were evaluated for presence of lesions without FDG uptake. Findings were compared with reference standard findings to determine the accuracy of each evaluation. McNemar test was used to assess statistical differences in accuracy. RESULTS: In 53 of 124 patients, metastases were found. In 46 of 53 patients with metastases, lesions had increased FDG uptake. In seven patients with metastatic disease, metastases did not have increased FDG uptake (maximum standard uptake value [SUV], <1.5; n = 5) or had faint FDG uptake (maximum SUV, 2.5 and 2.9; n = 2)-findings that were inconclusive with PET alone. These lesions were interpreted as metastases only with coregistered CT images. Lesions missed with PET were located in the lungs, iliac lymph nodes, subcutis, and psoas muscle. Sensitivity, specificity, and accuracy, respectively, of PET/CT for depiction of metastases were 85%, 96%, and 91%, and those of PET/CT with dedicated CT interpretation were 98%, 94%, and 96% (P = .016). CONCLUSION: Dedicated analysis of coregistered CT images significantly improves the accuracy of integrated PET/CT for depiction of metastases in patients with high-risk melanoma.


Solitary brain lesions enhancing at MR imaging: evaluation with fluorine 18 fluorocholine PET.

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PURPOSE: To prospectively determine whether differences between benign and malignant brain lesions can be depicted with fluorine 18 ((18)F) fluorocholine positron emission tomography (PET). MATERIALS AND METHODS: Thirty consecutive patients (14 women, 16 men; age range, 26-79 years) with solitary brain lesions that were enhanced at magnetic resonance (MR) imaging underwent whole-brain (18)F fluorocholine positron emission tomography (PET). Lesions were considered metastases if there was focal uptake higher than that of background tissue. Second, coregistered CT images of combined PET/CT scans were evaluated for presence of lesions without FDG uptake. Findings were compared with reference standard findings to determine the accuracy of each evaluation. RESULTS: In 53 of 124 patients, metastases were found. In 46 of 53 patients with metastases, lesions had increased FDG uptake. In seven patients with metastatic disease, metastases did not have increased FDG uptake (maximum standard uptake value [SUV(max)], 1.89 +/- 0.78 [mean +/- standard deviation], metastases, 4.11 +/- 1.68), and benign lesions (0.59 +/- 0.31) were significant (P < .0001). LNRs also differed significantly (5.15 +/- 2.51, 10.91 +/- 2.14, and 1.28 +/- 0.32, respectively; P < .0001). These differences were also significant at pairwise analysis. The peritumoral LNR exceeded 2.0 in seven high-grade gliomas and no metastases (P = .02). In 14 radiation-treated patients, the lesions classified as benign demonstrated significantly less uptake compared with the recurrent tumors (SUV(max): 0.72 +/- 0.38 vs 2.27 +/- 1.24, P < .01; LNR: 1.36 +/- 0.43 vs 5.88 +/- 3.66, P < .01). CONCLUSION: High-grade gliomas, metastases, and benign lesions can be distinguished on the basis of measured fluorocholine uptake. Increased peritumoral fluorocholine uptake is a distinguishing characteristic of high-grade gliomas.
Integrated FDG-PET/CT does not make invasive staging of the intrathoracic lymph nodes in non-small cell lung cancer redundant: a prospective study.

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BACKGROUND: Staging of non-small cell lung cancer (NSCLC) is important for determining choice of treatment and prognosis. The accuracy of FDG-PET scans for staging of lymph nodes is too low to replace invasive nodal staging. It is unknown whether the accuracy of integrated FDG-PET/CT scanning makes invasive staging redundant. METHODS: In a prospective study, the mediastinal and/or hilar lymph nodes in patients with proven NSCLC were investigated with integrated FDG-PET/CT scanning. Pathological confirmation of all suspect lymph nodes was obtained to calculate the accuracy of the fusion images. In addition, the use of the standardised uptake value (SUV) in the staging of intrathoracic lymph nodes was analysed. RESULTS: 105 intrathoracic lymph node stations from 52 patients with NSCLC were characterised. The prevalence of malignancy in the lymph nodes was 36%. The sensitivity of the integrated FDG-PET/CT scan to detect malignant lymph nodes was 84% and its specificity was 85% (positive likelihood ratio 5.64, negative likelihood ratio 0.19). SUV(max), SUV(mean) and the SUV(max)/SUV(liver) ratio were all significantly higher in malignant than in benign lymph nodes. The area under the receiver operating curve did not differ between these three quantitative variables, but the highest accuracy was found with the SUV(max)/SUV(liver) ratio. At a cut-off value of 1.5 for the SUV(max)/SUV(liver) ratio, the sensitivity and specificity to detect malignant lymph node invasion were 82% and 93%, respectively. CONCLUSION: The accuracy of integrated FDG-PET/CT scanning is too low to replace invasive intrathoracic lymph node staging in patients with NSCLC. The visual interpretation of the fusion images of the integrated FDG-PET/CT scan can be replaced by the quantitative variable SUV(max)/SUV(liver) without loss of accuracy for intrathoracic lymph node staging.

Positron emission tomography (PET) in the urooncological evaluation of the small pelvis.


Positron emission tomography (PET) with the use of ((18)F)2-fluoro-D: -2-desoxyglucose (FDG) has been investigated to be a highly sensitive and specific imaging modality in the diagnostic of primary and recurrent tumors and in the control of therapies in numerous non-urologic cancers. The aim of this review is to validate the significance of PET as a diagnostic tool in malignant urological tumors of the small pelvis. A systematic review of the current literature concerning the role of PET for malignant prostate, testicular and bladder tumors was carried out. The data indicate no additional role for PET in comparison with conventional imaging in tumor detection and local staging for prostate, bladder or testicular cancer. Tumor recurrence in prostate cancer seems to be more effectively identified with acetate and choline than with FDG, but this effect is more pronounced with higher PSA values. The value of PET in the identification of metastatic disease in either tumor entity can not be finally outlined as the clinical data are partly missing, controversial or in the process of evaluation. FDG-PET can be regarded as accepted imaging modality in the restaging of seminomatous germ cell tumors after chemotherapy.

The role of (124)I-positron emission tomography in diagnosis and treatment of thyroid carcinoma.

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Iodine-124 is a positron-emitting iodine isotope, enabling measurement of iodine uptake using positron emission tomography (PET). There is a number of situations where the use of (124)I-PET/computed tomography (CT) can improve the current clinical practice in the diagnosis and treatment of thyroid cancer. Firstly, (124)I-PET/CT can aid in the staging of patients, because of better detection of metastatic disease and measurement of metabolic tumor volume, and thus separate low-risk from high-risk patients. Secondly, the much higher sensitivity and spatial resolution of PET compared to gamma scintigraphy can also improve detection of recurrent disease. Furthermore, (124)I-PET can be used for patient-specific radioiodine therapy radiation dosimetry. Simultaneous administration of the therapeutic dose of (131)I and a tracer dose of (124)I allows for accurate measurement of iodine uptake during therapy. The decay scheme of (124)I, with few positrons and many gamma rays emitted per decay, often simultaneously, poses a challenge to quantitative PET imaging. Improved correction methods and the use of last-generation PET/CT scanners with faster electronics and better energy resolution can overcome this.
carcinomas. In an attempt to identify the occult primary tumor the evaluation of this patient population has included a complete head and neck examination, flexible fiberoptic endoscopy, and imaging with CT/MRI. More recently, positron emission tomography (PET) has been advocated as a tool to detect primary tumors. METHODS: A cohort of 31 patients with fine-needle aspiration biopsy-confirmed occult tumor at staging endoscopy and the accuracy of the negative PET and negative panendoscopy in predicting the subsequent development of a primary tumor in the upper aerodigestive tract during follow-up. RESULTS: The PET detected 9 occult primary tumors in the 31 patients (detection rate, 29%). Five occult primary tumors (2 base of tongue and 3 palatine tonsil) were detected during diagnostic evaluation failed to identify a primary tumor, the patients then underwent whole body PET imaging followed by staging protocol included a comprehensive head and neck examination (including flexible endoscopy) and CT and/or MRI. If the initial evaluation failed to identify a primary tumor the patients then underwent whole body PET imaging followed by staging protocol included a comprehensive head and neck examination (including flexible endoscopy) and CT and/or MRI. If the initial quantitative approaches include partial volume correction for measured values in small lesions, dual-time point and delayed PET imaging, and global metabolic activity for assessment of various stages of disease. Major changes are likely to occur in the future that may overcome deficiencies that are associated with the current quantitative (standardized uptake value) techniques.

Breast Cancer Res Treat. 2007 Jul 26

Inflammatory breast cancer: PET/CT, MRI, mammography, and sonography findings.

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PURPOSE: To describe the role of Positron Emission Tomography/Computed Tomography (PET/CT), Magnetic Resonance Imaging (MRI), sonography, and mammography in patients with inflammatory breast cancer (IBC). MATERIALS AND METHODS: Patients who had been newly diagnosed with IBC and who had undergone mammography, sonography, MRI, PET/CT, or a combination of these were included in this study. The visibility of breast parenchymal lesion (BPLs), skin abnormalities, regional (axillary, supraclavicular, or internal mammary) nodal disease, and distant metastatic disease was documented with the imaging techniques. RESULTS: Eighty patients (median age, 51 years, [range, 25-78 years]) were included in this study: 75 (94%) had undergone mammography, 76 (95%) sonography, 33 (41%) MRI, and 24 (30%) PET/CT. A primary BPL was found in 60 patients (80%) on mammography (mass or calcifications), 72 (95%) on sonography (mass or architectural distortion), 23 (96%) on PET/CT (hypermetabolic BPL), and 33 (100%) on MRI (enhancing BPL). Regional axillary nodal disease was found in 74 patients (93%) by histologic or cytologic examination, in 71 patients (93%) on sonography, in 21 (88%) on PET/CT, in 29 (88%) on MRI, and in 34 (45%) on mammography. Distant metastases in the bone, liver, and contralateral lymph nodes were diagnosed in nine patients (38%) on PET/CT. CONCLUSION: MRI was the most accurate imaging technique in detecting a primary BPL in IBC patients. Sonography can be useful in diagnosing regional nodal disease. PET/CT provides additional information on distant metastasis, and it should be considered in the initial staging of IBC.

Head Neck. 2007 Jul 26

Management of the unknown primary carcinoma: Long-term follow-up on a negative PET scan and negative panendoscopy.

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BACKGROUND: The unknown primary carcinoma in the head and neck has been estimated to represent up to 7% of all head and neck carcinomas. In an attempt to identify the occult primary tumor the evaluation of this patient population has included a complete head and neck examination, flexible fiberoptic endoscopy, and imaging with CT/MRI. Recently, positron emission tomography (PET) has been advocated as a tool to detect primary tumors. METHODS: A cohort of 31 patients with fine-needle aspiration biopsy-confirmed squamous cell carcinoma were prospectively entered into a diagnostic protocol to identify the occult primary tumor. The diagnostic protocol included a comprehensive head and neck examination (including flexible endoscopy) and CT and/or MRI. If the initial diagnostic evaluation failed to identify a primary tumor, the patients then underwent whole body PET imaging followed by staging endoscopy with biopsy of the at-risk occult tumor sites. The outcome measures included the accuracy of the PET to predict the presence of occult tumor at staging endoscopy and the accuracy of the negative PET and negative panendoscopy in predicting the subsequent development of a primary tumor in the upper aerodigestive tract during follow-up. RESULTS: The PET detected 9 occult primary tumors in the 31 patients (detection rate, 29%). Five occult primary tumors (2 base of tongue and 3 palatine tonsil) were detected during panendoscopy despite a negative PET. The combination of PET and panendoscopy detected 45.2% of the unknown primary tumors. Seventeen patients (N1, n = 7; N2a, n = 4; N2b, n = 2; N3, n = 4) had no primary tumor detected and were treated as an unknown primary carcinoma with primary neck dissection +/- radiation therapy +/- chemotherapy. In this series of 17 patients, there were 3 neck recurrences (17.6%). In addition, only 1 patient (5.8%) developed a primary tumor of the upper aerodigestive tract with a mean follow-up of 31.1 months (range, 21-60 months). CONCLUSION: A negative PET study in patients with an occult primary head and neck carcinoma does not preclude the need for panendoscopy with biopsy to detect the occult primary tumor. The risk of subsequent primary
PET-Oncology

tumor appears to be low in the patients with a negative PET and a negative panendoscopy (<6%). (c) 2007 Wiley Periodicals, Inc. Head Neck, 2007.

J Cancer Res Clin Oncol. 2007 Jul 25

(18)FDG uptake in oesophageal adenocarcinoma: linking biology and outcome.

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PURPOSE: Variable uptake of (18)FDG has been noticed in positron emission tomography (PET) studies of patients with oesophageal adenocarcinoma. The aim of the present study was to investigate biological parameters involved in (18)FDG uptake in oesophageal adenocarcinoma for selection of patients with increased (18)FDG uptake and prediction of prognostic value of (18)FDG PET. PATIENTS AND METHODS: Preoperative PET scans were performed in 26 patients with histologically proven oesophageal adenocarcinoma. (18)FDG uptake was semiquantitatively measured by SUV(BSA). Tumour sections were stained by immunohistochemistry for angiogenic markers (VEGF, CD31), glucose transporter-1 (Glut-1), hexokinase (HK) isoforms, for proliferation marker (Ki67), for (18)FDG uptake and angiogenic markers. In contrast, a significant correlation was found between (18)FDG uptake and Glut-1 expression.

mucus, T-stage and tumour size were assessed. In addition follow-up was analysed. RESULTS: No association was found between (18)FDG uptake and angiogenic markers. In contrast, a significant correlation was found between (18)FDG uptake and Glut-1 expression. No correlations were found between (18)FDG uptake and HK isoforms, Ki67 or cleaved caspase-3. Also, no correlations were found between (18)FDG uptake and cell density, differentiation grade, CD68, mucus and necrosis. However, there was a significant correlation between (18)FDG uptake and tumour size and between (18)FDG uptake and tumour recurrence. CONCLUSIONS: Glut-1 expression and tumour size seem parameters associated with (18)FDG uptake in patients with biopsy proven oesophageal adenocarcinoma, and may be used to select oesophageal cancer patients in whom (18)FDG-PET is of diagnostic value and may predict disease outcome.

Eur J Radiol. 2007 Jul 23

Prospective study of bone marrow infiltration in aggressive lymphoma by three independent methods: Whole-body MRI, PET/CT and bone marrow biopsy.


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PURPOSE: Initial lymphoma staging requires bone marrow assessment in aggressive lymphomas. Bone marrow lymphoma infiltration is routinely assessed by bone marrow biopsy (BMB), considered as the “gold standard”. The aim of this study was to compare the performance of BMB, whole-body MRI and PET/CT for evaluation of BM infiltration. METHODS: Patients with newly diagnosed aggressive lymphoma were evaluated by BMB, MRI and PET/CT. Two radiologists, two nuclear medicine physicians and one pathologist independently assessed the results of the three modalities. Bone was considered as involved if BM was positive or if PET/CT or MRI was positive and if there was a resolution of the abnormal image shown on PET/CT or MRI halfway or at the end of therapy. RESULTS: Both MRI and PET/CT detected bone marrow lesions in the 9/43 patients, but two patients with multiple lesions had more lesions detected by PET/CT compared to MRI. Among these nine patients, two with an iliac crest lesion detected by both MRI and PET/CT had bone marrow involvement with large-cell lymphoma on histological examination. The other seven patients had focal MRI and PET/CT lesions in areas other than the iliac crest, where the blind BMB was done. The other patients had bone marrow without large-cell lymphoma involvement. In all cases, after lymphoma therapy bone marrow involvement regressed on histological examination, PET and MRI. CONCLUSION: These preliminary results suggest that non-invasive morphological procedures could be superior to BMB for bone marrow assessment in aggressive lymphomas. Ongoing study is underway to validate these results.


A pilot study of [18F]fluorodeoxyglucose positron emission tomography scans during and after radiation-based therapy in patients with non small-cell lung cancer.

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PURPOSE: To study whether changes of [18F]fluorodeoxyglucose positron emission tomography (FDG-PET) during treatment correlate with post-treatment responses in tumor and normal lung in patients with non-small-cell lung cancer (NSCLC). PATIENTS AND METHODS: Patients with stage I to III NSCLC requiring a definitive dose of fractionated radiation therapy (RT) were eligible. FDG-PET/computed tomography scans were acquired before, during, and after RT. Tumor and lung metabolic responses were assessed qualitatively by physicians and quantitatively by normalized peak FDG activity (the ratio of the maximum FDG activity divided by the mean of the aortic arch background). RESULTS: The study reached the goal of recruiting 15 patients between February 2004 and August 2005. Of these, 11 patients had partial metabolic response, two patients had complete metabolic response, and two patients had stable disease at approximately 45 Gy during RT. The mean peak tumor FDG activity was 5.2 (95% CI: 4.0 to 6.4), 2.5 (95% CI: 2.0 to 3.0), and 1.7 (95% CI: 1.3 to 2.0) on pre-, during, and post-RT scans, respectively. None of the patients had appreciable changes in the lung during RT. The peak FDG activity of the lung was 0.47 (95% CI: 0.36 to 0.59), 0.52 (95% CI: 0.40 to 0.64), and 1.29 (95% CI: 0.82 to 1.76), on pre-, during-, and post-RT scans, respectively. The qualitative response during RT correlated with the overall response post-RT (P = .03); the peak tumor FDG activity during RT correlated with those 3 months post-RT (R2 = 0.7; P < .001). CONCLUSION: This pilot study suggests a significant correlation in tumor metabolic response and no association in lung FDG activity between during RT scans and 3 months post-RT scans in patients with NSCLC. Additional study with a large number of patients is needed to validate these findings.

PET Oncology

18fluorodeoxyglucose positron emission tomography in the prediction of relapse in patients with high-risk, clinical stage I nonseminomatous germ cell tumors: preliminary report of MRC Trial TE22—NCRI Testis Tumour Clinical Study Group.


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PURPOSE: There are several management options for patients with clinical stage I (CS1) nonseminomatous germ cell tumors (NSGCT); this study examined whether an 18fluorodeoxyglucose positron emission tomography (18FDG PET) scan could identify patients without occult metastatic disease for whom surveillance is an attractive option. METHODS: High-risk (lymphovascular invasion positive) patients with CS1 NSGCT underwent 18FDG PET scanning within 8 weeks of orchidectomy or marker normalization. PET-positive patients went off study; PET-negative patients were observed on a surveillance program. The primary outcome measure was the 2-year relapse-free rate (RFR) in patients with a negative PET scan (the negative predictive value). Assuming an RFR of 90% to exclude an RFR less than 80% with approximately 90% power, 100 PET-negative patients were required; 135 scanned patients were anticipated. RESULTS: Patients were registered between May 2002 and January 2005, when the trial was stopped by the independent data monitoring committee due to an unacceptably high relapse rate in the PET-negative patients. Of 116 registered patients, 111 underwent PET scans, and 88 (79%) were PET-negative (61% of preorchidectomy marker-negative patients v 88% of marker-positive patients; P = .002); 87 proceeded to surveillance, and one requested adjuvant chemotherapy. With a median follow-up of 12 months, 33 of 87 patients on surveillance relapsed (1-year RFR, 63%; 90% CI, 54% to 72%). CONCLUSION: Though PET identified some patients with disease not detected by computed tomography scan, the relapse rate among PET negative patients remains high. The results show that 18FDG PET scanning is not sufficiently sensitive to identify patients at low risk of relapse in this setting.

Cancer Chemother Pharmacol. 2007 Jul 18

Plasma pharmacokinetic evaluation of cytotoxic agents radiolabelled with positron emitting radioisotopes.

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PURPOSE: This study aimed to evaluate the utility of plasma pharmacokinetic analyses of anti-cancer agents from data obtained during positron emission tomography (PET) oncology studies of radiolabelled anti-cancer agents. PATIENTS AND METHODS: Thirteen patients were administered fluorine-18 radiolabelled 5-FU ([(18)F]5-FU) admixed with 5-FU, corresponding to a total 5-FU dose of 380-407 mg/m(2) (eight patients) and 1 mg/m(2) (five patients). Nine patients received 2.2-19.2 mg/m(2) of carbon-11 radiolabelled N-[2-(dimethylamino)ethyl]acridine-4-carboxamide ([(11)C]DACA) at 1/1,000th of phase I dose, as part of phase 0 microdosing study. Radioactivity of parent drug obtained from arterial blood samples, the injected activity of the radiolabelled drug, and the total dose of injected drug were used to obtain plasma drug concentrations. Plasma pharmacokinetic parameters were estimated using model-dependent and model-independent methods. RESULTS: 5-FU plasma concentrations at therapeutic doses were above the Km and a single compartment kinetic model was best used to fit the kinetics, with a mean half-life of 8.6 min. Clearance and volumes of distribution (V (d)) obtained using both model-dependent and model-independent methods were similar. Mean (SE) clearance was 1.421 (144), ml min(-1) and 1,319 (119) ml min(-1) and the mean (SE) V (d) was 17.3 (1.8) l and 16.3 (1.9) l by the model-independent method and model-dependent methods, respectively. In contrast, with 1 mg/m(2), plasma concentrations of 5-FU were less than the Km and a two-compartment model was used to best fit the kinetics, with the mean 5-FU half-life of 6.5 min. The mean (SE) clearances obtained by the model-independent method and model-dependent methods were 3,089 (314) ml min(-1) and 2,225 (200) ml min(-1), respectively and the mean (SE) V (d) were 27.9 (7.0) l and 2.3 (0.4) l, by the model independent and dependent methods, respectively. Extrapolation of AUC(0-Clast) to AUC(0-infinity) was less than 3% in both these cohort of patients. A two-compartment model with a mean half-life of 42.1 min was used to best fit the kinetics of DACA; considerable extrapolation (mean 26%) was required to obtain AUC(0-infinity) from AUC(0-Clast). Mean (SE) clearance of DACA was 1,920 (269) ml min(-1), with the model-independent method and 1,627 (287) ml min(-1) with the model-dependent method. Similarly, V (d) [mean (SE)] of DACA with the model-independent and model-dependent methods were 118 (22) l and 50 (15) l, respectively. CONCLUSIONS: Pharmacokinetic parameters can be estimated with confidence from PET studies for agents given at therapeutic doses, whose half-lives are significantly less than the total sampling time during the scan. Tracer studies performed alone, wherein plasma levels below the Km are expected, may also provide valuable information on drug clearance for the entire range of linear kinetics. However, drugs with half-lives longer than the sampling duration are inappropriate for PET plasma pharmacokinetic evaluation.
The use of PET scan in glioblastoma multiforme.

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Lung Cancer. 2007 Jul 17

Adenoid cystic carcinoma of the lung: Interest of 18FDG PET/CT in the management of an atypical presentation.


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Adenoid cystic carcinoma (ACC) is a common head and neck tumor originating from salivary glands but that can also exceptionally develop in the trachea and major bronchi. ACC is generally considered as a slow-growing, low-grade malignancy with prolonged clinical course. Metastases are very unusual and recurrences are more often local. Treatment for localized ACC is surgery. We here report for the first time a case of lung ACC with a synchronous liver metastasis proved by biopsy. Moreover, we report the interest of performing a 18FDG PET-CT as both primary tumor and liver metastasis presented an intense FDG uptake. The specificity of the liver 18FDG uptake was confirmed by Glut-1 positive immunostaining. We propose that 18FDG PET-CT should be considered in the initial staging of lung ACC in selected patients.

Head Neck. 2007 Jul 16

Does (18)fluoro-fluorodeoxyglucose positron emission tomography improve recurrence detection in patients treated for head and neck squamous cell carcinoma with negative clinical follow-up?


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BACKGROUND: The aim of this study was to determine the benefits of (18)fluoro-fluorodeoxyglucose positron emission tomography ((18)F-FDG PET) in the detection of head and neck squamous cell carcinoma (HNSCC) recurrence in patients with negative clinical follow-up. METHODS: Whole-body (18)F-FDG-PET was performed in 30 patients treated for HNSCC without any clinical element for recurrence. RESULTS: Twenty-one negative PET and 9 positive results were seen. One patient with abnormal (18)F-FDG uptake in the laryngeal area did not have recurrent HNSCC (false positive). Eight had proven recurrence. The sensitivity and specificity of (18)F-FDG PET for the diagnosis of HNSCC recurrence were 100% (8/8) and 95% (21/22), respectively. The positive predictive value was 89% (8/9). The negative predictive value was 100% (21/21). The overall accuracy was 97% (29/30). CONCLUSION: The results of our study confirm the high effectiveness of (18)F-FDG PET in assessment of HNSCC recurrence and suggest that it is more accurate than conventional physical examination follow-up alone. (c) 2007 Wiley Periodicals, Inc. Head Neck 2007.


Combined use of preoperative 18F FDG-PET imaging and intraoperative gamma probe detection for accurate assessment of tumor recurrence in patients with colorectal cancer.


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BACKGROUND: The purpose of this study was to combine intraoperative gamma probe detection (GP) detection with preoperative fluorine 18-fluoro-2-deoxyglucose positron emission tomography (18F FDG-PET) imaging in order to improve detection of tumor recurrence in colorectal cancer (CRC) patients. METHODS: Twenty-one patients (12 females, 9 males) with a mean age of 54 years (range 31-78) were enrolled. Patients were suspected to have recurrent CRC by elevated CEA (n = 11), suspicious CT findings (n = 1), and clinically suspicious findings (n >= 9). Preoperative FDG-PET scan and intraoperative GP study were performed in all patients. Mean time interval between preoperative FDG-PET scan and surgery was 16 days (range 1-41 days) in 19 patients. For intraoperative GP studies, 19 patients were injected with a dose of 10-15 mCi 18F FDG at approximately 30 minutes before the planned surgery time. In two patients, the intraoperative GP study was performed immediately after preoperative FDG-PET scan. RESULTS: Preoperative FDG-PET and intraoperative GP detected additional small lesions in the omentum and pelvis which were not detected on preoperative FDG-PET scan. Intraoperative GP detected additional small lesions in the omentum and pelvis which were not seen on preoperative FDG-PET scan. FDG-PET scan demonstrated additional liver metastases which were not detected by intraoperative GP. Preoperative FDG-PET detected distant metastasis in the lung in one patient. The estimated radiation dose received by a surgeon during a single 18F FDG surgery was below the occupational limit. CONCLUSION: The combined use of preoperative FDG-PET and intraoperative GP is potentially helpful to the surgeon as a roadmap for accurately locating and determining the extent of tumor recurrence in patients with CRC. While intraoperative GP appears to be more sensitive in detecting the extent of abdominal and
Abdom Imaging. 2007 Jul 14

**Staging of peritoneal carcinomatosis: enhanced CT vs. PET/CT.**


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**PURPOSE:** To assess and compare the performance of CT and 18F-FDG-PET/CT in the evaluation of peritoneal carcinomatosis (PC). **METHOD AND MATERIALS:** Thirty consecutive patients with PC and scheduled for a surgery underwent a CT of the abdomen and pelvis and a whole-body 18F-FDG PET/CT. The extent of PC was assessed precisely using the peritoneal cancer index combining the distribution of tumor through 11 abdominal/pelvic regions with a lesion size score. CT and PET/CT imaging results were compared in all patients with intraoperative findings using an interclass correlation test. **RESULTS:** The presence of PC was correctly determined on CT and PET/CT in 23/28 and 16/28 patients, respectively. The extent of PC was understaged with CT and PET/CT in 27 patients and overstaged with CT and PET/CT in 1 and 2 patients, respectively. The interclass correlation was 0.53 (moderate) between CT and surgery and 0.12 (low) between PET/CT and surgery. The interclass correlation was higher for mucinous tumor (0.63) than for non-mucinous (0.16) on CT imaging whereas no difference was found in PET/CT. **CONCLUSION:** The intraperitoneal assessment of the extent of carcinomatosis, necessary to assess prognosis and treatment planning, is not accurate enough with CT and PET/CT imaging.

Abdom Imaging. 2007 Jul 10

**Role of PET/PET CT in the staging and restaging of thoracic oesophageal cancer and gastro-oesophageal cancer: a literature review.**

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**BACKGROUND:** Current evidence for the use of FDG PET/CT in staging thoracic oesophageal and GOJ cancer is reviewed. **METHODS:** PubMed, Medline, Embase (1988-November 2006) and the Cochrane database identified studies in which FDG PET and PET CT were used for the assessment of thoracic and GOJ cancer. **RESULTS:** Conventional assessment remains the mainstay for evaluating the primary site. EUS is used for assessing the primary site, but when EUS is incomplete or not tolerated FDG PET CT is invaluable. The major of advantage of FDG PET CT lies in the ability to detect metastatic disease beyond the celiac axis. There is growing evidence to show that FDG PET CT is useful for assessment of treatment response. FDG PET CT will also detect other occult primary cancers. **CONCLUSIONS:** The contribution of FDG PET CT to the investigation of patients with primary thoracic oesophageal and GOJ cancer has resulted in improved staging, so providing the ability to optimise treatment.


**(11)C/(18)F-choline PET or (11)C/(18)F-acetate PET in prostate cancer: may a choice be recommended?**

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**Optimization of FDG-PET/CT imaging protocol for evaluation of patients with primary and metastatic liver disease.**

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**BACKGROUND:** Accurate determination of the extrahepatic extent and intrahepatic distribution of disease is very important in patients with primary and metastatic liver disease for deciding whether a patient receives potentially curable surgery or palliative treatment. Our objective was to evaluate the efficacy of delayed phase FDG-PET/CT imaging in lesion detection and to define its clinical impact compared to triple-phase contrast enhanced CT (CECT). **METHODS:** 30 patients underwent delayed phase FDG-PET/CT imaging (90 min whole body scan followed by a delayed abdominal scan at 120 min). Maximum standard uptake values (SUVs) and SUV ratios compared to triple-phase contrast enhanced CT (CECT). In addition, comparison was made to CECT obtained within 10 days and 0.12 (low) between PET/CT and surgery. The interclass correlation was higher for mucinous tumor (0.63) than for non-mucinous (0.16) on CT imaging whereas no difference was found in PET/CT. **CONCLUSION:** The intraperitoneal assessment of the extent of carcinomatosis, necessary to assess prognosis and treatment planning, is not accurate enough with CT and PET/CT imaging.


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A 61-year-old man presented with spontaneous pneumothorax. After diagnosis of emphysemic bullae, the patient underwent talc pleurodesis and had no further complaints. Five years later a routine chest X-ray showed suspicious pleural lesions in addition to the emphysema, which was deemed compatible with the known history of talc pleurodesis. Subsequent chest CT, however, revealed one lesion in the right lung that appeared not typical for this condition in multiple lesions in pleural proximity. FDG-PET/CT demonstrated high glucose uptake in all the lesions. Subsequent needle biopsy of the suspicious intrapulmonary and also of one mediastinal lesion yielded the histopathological diagnosis of tcalcum granuloma with long-standing calcific fibrotic changes and no evidence of malignancy. This report on PET/CT after talc pleurodesis addresses the potential pitfalls caused by this condition, as chronic granulomatous reactions, like other inflammatory lesions, may account for highly increased FDG uptake which should be interpreted with caution and not simply read as a sign of malignancy. PET/CT offers the opportunity to exactly localize the areas of increased FDG uptake within regions of pleural thickening caused by talc deposition, however, the dilemma of misleading FDG accumulation cannot be solved by this hybrid imaging modality.

Preoperative staging of colorectal cancer: CT vs. integrated FDG PET/CT.

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Accurate preoperative staging is essential in determining the optimal therapeutic planning for individual patients. The computed tomography (CT) in the preoperative staging of colorectal cancer, even if controversial, may be useful for planning surgery and/or neoadjuvant therapy, particularly when local tumor extension into adjacent organs or distant metastases are detected. There have been significant changes in the CT technology with the advent of multi-detector row CT (MDCT) scanner. Advances in CT technology have raised interest in the potential role of CT for detection and staging of colorectal cancer. In recent studies, MDCT with MPR images has shown promising accuracy in the evaluation of local extent and nodal involvement of colorectal cancer. Combined PET/CT images have significant advantages over either alone because it provides both functional and anatomical data. Therefore, it is natural to expect that PET/CT would improve the accuracy of preoperative staging of colorectal cancer. The most significant additional information provided by PET/CT relates to the accurate detection of distant metastases. For the evaluation of patients with colorectal cancer, CT has relative advantages over PET/CT in regard to the depth of tumor invasion through the wall, extramural extension, and regional lymph node metastases. PET/CT should be performed on selected patients with suggestive but inconclusive metastatic lesions with CT. In addition, PET/CT with dedicated CT protocols, such as contrast-enhanced PET/CT and PET/CT colonography, may replace the diagnostic CT for the preoperative staging of colorectal cancer.

Toxicity evaluation of radiotracer doses of 3'-deoxy-3'-[18F]fluorothymidine (18F-FLT) for human PET imaging: Laboratory analysis of serial blood samples and comparison to previously investigated therapeutic FLT doses.


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BACKGROUND: 18F-FLT is a novel PET radiotracer which has demonstrated a strong potential utility for imaging cellular proliferation in human tumors in vivo. To facilitate future regulatory approval of 18F-FLT for clinical use, we wished to demonstrate the safety of radiotracer doses of 18F-FLT administered to human subjects, by: 1) performing an evaluation of the toxicity of 18F-FLT administered in radiotracer amounts for PET imaging, 2) comparing a radiotracer dose of FLT to clinical trial doses of FLT. METHODS: Twenty patients gave consent to a 18F-FLT injection, subsequent PET imaging, and blood draws. For each patient, blood samples were collected at multiple times before and after 18F-FLT PET. These samples were assayed for a comprehensive metabolic panel, total bilirubin, complete blood and platelet counts. 18F-FLT doses of 2.59 MBq/Kg with a maximal dose of 185 MBq (5 mCi) were used. Blood time-activity curves were generated for each patient from dynamic PET data, providing a measure of the area under the FLT concentration curve for 12 hours (AUC12). RESULTS: No side effects were reported. Only albumin, red blood cell count, hematocrit and hemoglobin showed a statistically significant decrease over time. These changes are attributed to IV hydration during PET imaging and to subsequent blood loss at surgery. The AUC12 values estimated from imaging data are not significantly different from those found from serial measures of FLT blood concentrations (p = 0.66). The blood samples-derived AUC12 values range from 0.232 ng x h/mL to 1.339 ng x h/mL with a mean of 0.802 +/- 0.303 ng x h/mL. This corresponds to 0.46% to 2.68% of the lowest and least toxic clinical trial AUC12 of 50 ng x h/mL reported by Flexner et al (1994). This single injection also corresponds to a nearly 3,000-fold lower cumulative dose than in Flexner's twice daily trial. CONCLUSION: This study shows no evidence of toxicity or complications attributable to 18F-FLT injected intravenously.

Fine needle aspiration outcomes of masses detected by positron emission tomography: correlation with standard uptake value.

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OBJECTIVES: To characterize the cytopathologic outcome of lesions detected on positron emission tomography (PET) scan. STUDY

Abdom Imaging. 2007 Jul 4
DESIGN: Cases with fine needle aspiration (FNA) performed because of a PET-positive lesion over an 18-month period were reviewed. Correlation with the standard uptake value (SUV) (using 2.5 as a cutoff value) was carried out. RESULTS: A total of 112 FNAs were found, of which 83 had adequate tissue for evaluation and available corresponding SUVs to be included in the final study. Fisher’s exact test was carried out for correlation between FNA diagnosis and SUV. Sixty-one (73.5%) lesions had an SUV > or = 2.5, 53 (87%) of which were malignant and 8 (13%) benign on cytology. Twenty-two (26.5%) lesions had an SUV < 2.5, of which 12 (54.5%) showed benign and 10 (45.5%) showed malignant cytology. The overall sensitivity, specificity, positive predictive value (PPV), negative predictive value (NPV) and diagnostic accuracy of SUV were 84%, 60%, 87%, 56% and 78%, respectively. CONCLUSION: Our data show that FNA procedures performed for PET-positive lesions have high PPV, but low NPV. Therefore interpretation of PET SUV values < 2.5 as benign should be made with extreme caution.


Adenomyomatosis of the gallbladder: another cause for a "hot" gallbladder on 18F-FDG PET.

Maldjian PD, Ghesani N, Ahmed S, Liu Y.

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Teflon granuloma results in a false-positive "second primary" on 18F-2-deoxyglucose positron emission tomography in a patient with a history of nasopharyngeal cancer.


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F-18 FDG PET/CT imaging of low-grade mucoepidermoid carcinoma of the bronchus.

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Mucoepidermoid carcinomas in the bronchial tree are extremely rare tumors. Such tumors are classified into low-grade and high-grade on the basis of histological criteria. Fluorine-18-fluorodeoxyglucose positron emission tomography (F-18 FDG PET) is a useful technique for the evaluation of pulmonary lesions; however, to our knowledge, F-18 FDG PET findings in mucoepidermoid carcinoma of the bronchus have been described in only a few cases. Identifiable focal F-18 FDG uptake has been reported in high-grade mucoepidermoid carcinoma, but it is unclear whether F-18 FDG accumulates in low-grade mucoepidermoid carcinoma. Here, we present the case of a 37-year-old woman, with pathologically proven low-grade mucoepidermoid carcinoma, who underwent high-resolution computed tomography (CT) and F-18 FDG PET/CT before treatment.
Prediction of response to definitive chemoradiotherapy in esophageal cancer using positron emission tomography.


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BACKGROUND: Positron emission tomography (PET) with 18-F-fluorodeoxyglucose (FDG) has already proven useful in assessing the extension of esophageal carcinomas, detecting tumor recurrence and monitoring responses to therapy. The current study aims to assess the potential role of FDG-PET in predicting the response of esophageal squamous cell carcinoma (SCC) to definitive chemoradiotherapy (CRT). PATIENTS AND METHODS: Twenty-seven patients with thoracic esophageal SCC who received definitive CRT between January 2001 and December 2005 underwent PET before and after CRT. The clinical evaluation of the primary tumor response to treatment was classified as either complete response (CR) or non-CR. RESULTS: All patients had intensive FDG uptake in the primary tumor prior to CRT. The standardized uptake value (SUV) averaged 8.2+/−4.7 before CRT and decreased significantly to 2.8+/−1.8 after CRT (p<0.0001). The SUV before CRT averaged 10.2 in the non-CR group (n=17) and 4.9 in the CR group (n=10). The SUV after CRT averaged 3.7 in the non-CR group and 1.4 in the CR group. The change in SUV for the CR group was higher than that in the non-CR group (p<0.05). The relationship between clinical features and clinical CR was analyzed using logistic regression analysis which revealed significant correlations between clinical CR and the longitudinal dimension of the tumor (p <0.05), SUV before CRT (p<0.05), SUV after CRT (p<0.01) and tumor classification (p <0.05). If the clinical features before CRT were limited, multivariate analysis revealed that the SUV prior to definitive CRT is one of the most reliable predictors of response, along with tumor dimensions and classification.

Clinical relevance of positron emission tomography and magnetic resonance imaging in the progression of internal plexiform neurofibroma in NF1.

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Neurofibromatosis type 1 (NF1) is a frequent and inherited disease with a predisposition for malignant peripheral nerve sheath tumor (MPNST) development. MPNST are soft tissue sarcomas that arise from peripheral nerves, being one of the most aggressive malignancies in humans with extremely poor prognosis. MPNST frequently arise from a previously undetected plexiform neurofibroma (PNF). The malignant transformation of an internal PNF to an MPNST is difficult to assess and requires advanced imaging techniques like magnetic resonance imaging or positron emission tomography. Despite the high quality of current diagnostics, the changing tumor biology inside a plexiform neurofibroma cannot currently be visualized accurately. We report 4 cases of NF1 patients with PNF who showed imaging findings suspicious for malignant degeneration, but proved to have MPNST in only one case. Three tumors might represent an intermediate type between PNF and MPNST. Ablative surgery and complete histological work-up of specimens is the only way to clarify tumor status, thereby enabling provision of adequate local treatment.

Serial integrated (18)F-fluorodeoxythymidine PET/CT monitoring neoadjuvant chemotherapeutic response in invasive ductal carcinoma.

Beresford M, Lyburn I, Sanghera B, Makris A, Wong WL.

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Detection of recurrent adenoid cystic carcinoma with PET-CT.

Bhagat N, Zuckier LS, Hameed M, Cathcart C, Baredes S, Ghesani NV.

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Posttransplant lymphoproliferative disease in a pediatric patient as seen on PET/CT scan.

Bagga S.

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Localized nodular synovitis mimicking metastatic melanoma in a patient with metastatic melanoma on whole-body F-18 FDG PET/CT with MRI and pathological correlation.

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Delayed development of radiation vasculopathy of the brain stem confirmed by F-18 FDG PET in a case of anaplastic astrocytoma.

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We present the imaging findings of a 38-year-old female patient who underwent resection and radiation therapy for an anaplastic astrocytoma in her left temporal lobe 12 years ago. She was symptom-free until 1 month before admission at which time she presented with symptoms of right hemiparesis, right facial droop, and slurred speech. Magnetic resonance imaging (MRI) of the brain showed a new mass lesion in the left pontine region of the brain stem. Magnetic resonance spectroscopy imaging of the lesion demonstrated an increase in choline (Cho)/N-acetyl aspartate (NAA) metabolite values which were nondiagnostic. Since viable tumor recurrence was strongly suspected, a biopsy was planned, although this posed significant risk. Therefore, an F-18 FDG brain PET scan was performed, which demonstrated no metabolic activity in the pontine lesion leading to the less common diagnosis of long-term postradiation vasculopathy. Over the next 6 months, the patient's symptoms slowly improved and a follow-up MRI scan showed a decrease in the size of the lesion, consistent with postradiation vasculopathy and infarction. This case illustrates the importance of considering the rare diagnosis of radiation-induced vasculopathy in the differential diagnosis when symptoms of recurrent brain tumor occur.

Detection of metastases in patients with cutaneous melanoma using FDG-PET/CT.


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This study aimed to detect metastases in patients with stage III or IV cutaneous melanoma by (18)F-fluorodeoxyglucose positron emission tomography combined with computed tomography (FDG-PET/CT). Thirty-nine patients with clinically evident stage III or IV melanoma underwent whole-body FDG-PET/CT scans for metastatic disease and these results were compared with those of biopsy. Scans for 38 of the patients were evaluated; one patient's scan could not be evaluated. There were 11 true-positive, two false-positive, 24 true-negative and one false-negative scans for the detection of melanoma metastases, with sensitivity 91%, specificity 92%, accuracy 92%, and positive and negative predictive values 84% and 96%, respectively. False-positive FDG-PET/CT scans were due to sarcoidosis in the lung and infected cyst in the liver. It is concluded that FDG-PET/CT scanning has high sensitivity and specificity for detecting stage III or IV metastatic melanoma.

Lesion detectability and clinical effectiveness of dual-head coincidence gamma camera imaging in comparison with dedicated PET systems in tumour patients.

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The lesion detection capability and clinical effectiveness of dual-head coincidence gamma camera imaging (c-PET) were compared with those of dedicated positron emission tomography (d-PET) in 37 cancer patients who underwent whole-body c-PET and d-PET imaging after administration of 370 - 540 MBq (18)F-fluorodeoxyglucose. Eighty-nine lesions were detected on c-PET whereas 133 lesions were seen with d-PET imaging. The relative sensitivity of c-PET compared with d-PET was 62% and 73% for lesions < 15 mm and > or = 15 mm, respectively, and the relative concordance rate was 84% when the patients were restaged. Since the lesion detection rate of c-PET imaging was lower than that of d-PET, the detection of small lesions, therefore, requires care. The clinical effectiveness of c-PET, however, was similar to that of d-PET and, therefore, it is concluded that c-PET can be used as an alternative to d-PET, particularly considering the high cost and limited availability of d-PET cameras.
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**Brown fat imaging with (18)F-6-fluorodopamine PET/CT, (18)F-FDG PET/CT, and (123)I-MIBG SPECT: a study of patients being evaluated for pheochromocytoma.**

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Several radiopharmaceuticals such as (18)F-FDG, (123)I-metaiodobenzylguanidine (MIBG), and (99m)Tc-tetrofosmin have demonstrated uptake in brown adipose tissue (BAT). It is important to recognize these normal variants so that they are not misinterpreted as a significant pathologic state. In addition, these radiopharmaceuticals may shed light on BAT physiology. (18)F-6-fluorodopamine (F-DA) is being used as a PET radiopharmaceutical to image adrenergic innervation and suspected pheochromocytoma. Past reports have suggested that BAT is increased in pheochromocytoma patients. METHODS: The images of 96 patients evaluated with (18)F-F-DA or (18)F-FDG PET/CT for known or suspected pheochromocytoma were reviewed retrospectively to determine whether localized uptake of a pattern typically associated with BAT was present. When available, contemporaneous images obtained using (123)I-MIBG were also reviewed for the presence of BAT. RESULTS: Of 67 patients imaged with (18)F-F-DA, BAT was found in 17.9%. Of 83 patients imaged with (18)F-FDG, 19.2% had BAT. Discordant findings related to uptake in BAT were often seen in patients studied with (18)F-FDG, (18)F-F-DA, or (123)I-MIBG. Overall, 26 (27.0%) of 96 patients showed BAT on at least 1 of the 3 imaging modalities. CONCLUSION: (18)F-F-DA can image BAT, most likely by localizing to sympathetic innervations in a manner similar to (123)I-MIBG. Patients with pheochromocytoma may have a greater BAT tissue mass or activation because of elevated levels of circulating catecholamines. Quantitative PET with (18)F-FDG and (18)F-F-DA may have a role in in vivo studies of BAT physiology in humans or animal models.


**Spatial heterogeneity of low-grade gliomas at the capillary level: a PET study on tumor blood flow and amino acid uptake.**

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Many low-grade gliomas (World Health Organization grade II) respond to chemotherapy. Cerebral blood flow (CBF) and microvessel density may be critical for drug delivery. We used PET with (18)F-fluoro-ethyl-l-tyrosine (FET) to measure the spatial distribution of the amino acid carrier, which is located at the brain capillaries, and (15)O-H(2)O to measure tumor CBF. METHODS: Seventeen patients with low-grade glioma were studied. Region-of-interest (ROI) analysis was used to quantify tumor tracer uptake, which was normalized to cerebellar uptake (tumor-to-cerebellum ratio). "Active" tumor was defined as tumor having a radioactivity concentration that was at least 110% of the cerebellar activity. This threshold provided measures of active tumor volume, global and peak tumor CBF, and (18)F-FET uptake. Trace ROIs were applied to create voxelwise profiles of CBF and (18)F-FET uptake across tumor and brain. Standard MRI sequences were used for spatial correlations. RESULTS: Fourteen of 17 tumors showed increased global CBF and (18)F-FET uptake. Active tumor volumes ranged between 3 and 270 cm(3) for (18)F-FET and between 1 and 41 cm(3) for CBF. Global (18)F-FET uptake in tumors corresponded to CBF increases (Spearman rank rho = 0.771, P < 0.01). The volumes of increased CBF and (18)F-FET uptake spatially coincided and were also correlated (rho = 0.944, P < 0.01). Trace ROIs showed that irrespective of increased (18)F-FET uptake at the tumor periphery, CBF increases were more confined to the tumor center. Within individual tumors, spatial heterogeneity was present. Particular tumors infiltrating the corpus callosum showed low CBF and (18)F-FET uptake in this tumor region. The patterns observed with PET were not reflected on MRI of the tumors, all of which presented as homogeneous non-gadolinium-enhancing lesions. CONCLUSION: Low-grade gliomas are heterogeneous tumors with regard to the distribution of amino acid uptake and CBF. Both are coupled in the tumor center. At the tumor periphery, where tumor infiltration of surrounding brain occurs, CBF may be low irrespective of increased (18)F-FET uptake. An ongoing study is investigating the effect of chemotherapy on these observations.


**Impact of [18F]-2-fluorodeoxyglucose positron emission tomography/computed tomography on previously untreated head and neck cancer patients.**

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OBJECTIVES: The role of fused modality [F]-2-fluorodeoxyglucose-positron emission tomography/computed tomography (PET/CT) in diagnosing and accurately staging patients with primary, metastatic, and recurrent head and neck (HN) cancer is evolving, and the clinical implications need to be further defined. A few retrospective studies have been performed, but adequate sample sizes are lacking because the number of HN cancer patients is relatively small. This study evaluates the positive predictive value (PPV), sensitivity, specificity, and accuracy of PET/CT in previously untreated HN cancer patients at a single tertiary care institution. The purpose of this study is to evaluate the role of this new technology in the management of previously untreated HN cancer patients. STUDY DESIGN: Retrospective cohort outcomes study at a tertiary National Cancer Institute Comprehensive Cancer Center. MATERIALS AND METHODS: Institutional review board exemption #4 (45 CFR 46.101 [4]) criteria were applied for and accepted by the office of responsible research practices at the Ohio State University College of Medicine. The authors identified 268 consecutive PET/CT examinations between March 2005 and January 2006 for HN cancer ordered by the two senior authors at the James Cancer Hospital and Solove Research Institute of the Ohio State University Medical Center. PET/CT examinations were interpreted by one of three neuroradiologists. PPV, sensitivity, specificity, accuracy, diagnostic upstaging, and treatment management changes were determined from subset analysis of 123 previously untreated patients with HN cancer. Synchronous lesions were detected in 10 patients with use of this modality. PET/CT was also used to help manage 22 patients with unknown primary HN cancer. The statistics were verified by comparing PET/CT results with surgical specimen histopathology. RESULTS: PET/CT was true-positive in 82.9% (102/123), with a per patient PPV of 87.2% and a per lesion
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PPV of 89.4%. PET/CT was false-positive in 12.2% (15/123) of patients and had a false-positive rate of 8.3% when calculated per lesion. In 67 patients who underwent neck dissection, PET/CT had a PPV of 92.7%. The accuracy was 89.7% in 20 patients who had bilateral neck dissections. The unknown primary site was found in 72.7% (16/22) of patients with unknown primary HN cancer. Synchronous lesions were found in 8.1% of patients by PET/CT, with a PPV of 66.6%. Distant metastases were detected in 15.4% (19/123) of patients. Treatment was altered in 30.9% (38/123) of patients as a result of this imaging modality. CONCLUSIONS: The benefit of the PET/CT imaging resides in its fusion of anatomic detail of the HN region with the sensitivity of detecting tumors with increased metabolic activity at distant sites. Treatment was altered in 30.9% of our previously untreated HN cancer patients because of this imaging technique, with altered treatment including upstaging, diagnosing distant and unresectable disease, and working-up second primary malignancies. The false-positive findings did not result in additional morbidity to these patients. Although PET/CT is sensitive in detecting occult cervical nodal metastases, it does not yet have the ability to replace neck dissection as the diagnostic standard of care. This study supports the use of PET/CT in patients with newly diagnosed HN cancer because of its high PPV and superiority of detecting distant metastases and synchronous lesions.

FDG-PET: an important tool in the diagnosis of lung cancer.

Abenhardt W.


Value of positron emission tomography in staging ocular adnexal lymphomas and evaluating their response to therapy.

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BACKGROUND AND OBJECTIVE: An observational case series to assess the value of positron emission tomography (PET) in staging ocular adnexal lymphomas and evaluating their response to therapy. PATIENTS AND METHODS: The clinical records of 16 consecutive patients with ocular adnexal lymphoma for whom pretreatment and posttreatment PET scans and corresponding computed tomography (CT) and magnetic resonance imaging (MRI) scans were available were compared. RESULTS: Pretreatment PET scans demonstrated fluorine 18-fluorodeoxyglucose (FDG) positive lesions in 15 orbits of 12 patients. In 1 patient with low-grade follicular lymphoma of the orbit, PET revealed an additional focus of lymphoma in the deltoid muscle that was missed on clinical examination and conventional radiography. All of the posttreatment PET scans showed complete resolution of FDG uptake, suggesting good response to therapy. However, posttreatment CT and MRI scans demonstrated residual masses in 3 patients. CONCLUSIONS: PET is valuable for initial staging of orbital adnexal lymphomas and may be a good adjunct to conventional imaging in evaluation of response to therapy.

The role of FDG-PET/CT imaging in head and neck malignant conditions: impact on diagnostic accuracy and patient care.


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BACKGROUND: To assess the value of positron emission tomography/computed tomography (PET/CT) with 18F-Fluorodeoxyglucose (FDG) in patients with head and neck carcinoma as compared with PET and conventional imaging alone, and to assess the impact of PET/CT on further clinical management. STUDY DESIGN: Prospective nonrandomized study. SETTING: Ninety patients with head and neck tumors had 107 PET/CT examinations. RESULTS: The study analysis showed that PET/CT had a sensitivity of 89%, specificity 95%, PPV 94%, NPV 90%, and accuracy of 92%. PET/CT altered management in 51 patients (56%). PET/CT eliminated the need for previously planned diagnostic procedures in 24 patients, induced a change in the planned therapeutic approach in 21 patients and guided biopsy in 6 patients. CONCLUSIONS: PET/CT is an imaging modality with high diagnostic performance in the assessment of head and neck cancer, and induced a change in further clinical management in more than half of the study population.

Fluorine-18 Fluorodeoxyglucose PET/CT Patterns of Extranodal Involvement in Patients with Non-Hodgkin Lymphoma and Hodgkin's Disease.


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Lymphoma may originate in extranodal sites. Extranodal lymphoma may also be secondary to and accompany nodal disease. Fluorine-18 fluorodeoxyglucose (18F-FDG) imaging has an essential role in the staging of lymphoma, in monitoring the response to therapy, and in detection of recurrence. The introduction of 18F-FDG PET/CT hybrid imaging allows for accurate localization of disease and may be specifically beneficial for the detection of unexpected extranodal sites of disease or exclusion of disease in the presence of nonspecific extranodal CT findings. Accurate staging and localization often dictate the appropriate treatment strategy in patients with lymphoma. Therefore, at any stage in the course of the disease, the potential presence of extranodal disease should be considered when interpreting 18F-FDG PET/CT studies in patients with non-Hodgkin lymphoma and Hodgkin’s disease.

PET and PET/CT in Management of the Lymphomas.

Podoloff DA, Macapinlac HA.
Within recent years, F-18 fluorodeoxyglucose (FDG) PET has become the most important nuclear medicine and radiology imaging modality in the management of lymphoma. FDG-PET detects more disease sites and involved organs than conventional staging procedures, including CT, and has a large influence on staging. FDG-PET performed during and after therapy seems to provide considerable prognostic information. The impact on patient outcome is not clear, however, because no controlled trials have yet been conducted and follow-up periods are generally short.

Normal and Abnormal Patterns of (18)F-Fluorodeoxyglucose PET/CT in Lymphoma.

Bar-Shalom R.

In spite of the high performance of 18F-fluorodeoxyglucose (FDG) PET for the evaluation of lymphoma, inherent limitations of this modality underscore the additional value of PET/CT as an important tool in the assessment of this disease. Accumulating data on the use of PET/CT in lymphoma indicate the contribution of hybrid imaging to improved interpretation accuracy of PET using FDG and CT. Knowledge of the normal and abnormal patterns of FDG-PET/CT imaging and their variability in patients with lymphoma is important to provide a comprehensive clinically significant interpretation that has an impact on patient management and potentially on outcome.

Detection of bone metastases in breast cancer by positron emission tomography.

Schirrmeister H.

Positron emission tomography (PET) is able to demonstrate changes in the metabolism of malignant tumors and metastases before they become visible on anatomical imaging. The skeleton is the most common site of distant metastases of breast cancer. There is convincing evidence that FDG-PET is more sensitive in detecting osteolytic metastases than bone scintigraphy, whereas bone scintigraphy is more sensitive in detecting osteoblastic metastases. Because both types of metastases can occur in breast cancer, bone scintigraphy and FDG-PET should be considered as complementary and can currently be regarded as standard of care for staging in breast cancer patients, whereas the decision to use F-18 fluoride PET should be made individually for each patient, depending on the expected change of therapy management.

Diagnosis of recurrent and metastatic disease using f-18 fluorodeoxyglucose-positron emission tomography in breast cancer.

Eubank WB.

One of the major strengths of F-18 fluorodeoxyglucose-positron emission tomography (FDG-PET) in breast cancer imaging is in the evaluation of patients who have suspected loco-regional recurrence or distant metastasis. In general, FDG-PET is more sensitive than conventional imaging for the detection of recurrent disease. Because of its ability to more accurately stage patients who have advanced breast cancer, FDG-PET has a significant impact on choice of treatment and management in this patient group.

F-18 Fluorodeoxyglucose-Positron Emission Tomography Imaging for Primary Breast Cancer and Loco-Regional Staging.

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Breast cancer is the most common female malignancy in Western countries. The limitations of mammography, ultrasound and MRI do not allow reliable identification of primary breast cancer at early stages. Functional breast imaging with positron emission tomography (PET) and F-18 fluorodeoxyglucose (FDG) enables the visualization of increased glucose metabolism of breast cancer. However, despite the successful identification of primary breast cancer, FDG-PET provides a low sensitivity to detect small tumors. Therefore, FDG-PET does not allow screening of asymptomatic women and cannot be used to exclude breast cancer in patients with suspicious breast masses or abnormal mammography. FDG-PET is a powerful tool for staging of breast cancer patients, but does not detect micrometastases and small tumor infiltrated lymph nodes. Nevertheless, in patients with locally advanced breast cancer, PET accurately determines the extent of disease, particularly the loco-regional lymph node status. Advances in technology, for example the development of dedicated breast imaging devices such as positron emission mammography, hold promise to improve the detection of primary tumors in the future.
PET Versus PET/CT Dual-Modality Imaging in Evaluation of Lung Cancer.

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Non-small cell lung cancer (NSCLC) accounts for approximately 80% of bronchogenic malignancies. The choice of therapy options, including surgery, radiation therapy, and chemotherapy-used alone or in combination-is based on the tumor stage. Consequently, the accurate determination of tumor size, potential infiltration of adjacent structures, mediastinal lymph node involvement, and the detection of distant metastases are of central importance. The purpose of this article is to summarize the accuracy of dual-modality FDG-PET/CT imaging in staging of NSCLC as compared with FDG-PET alone, and with FDG-PET as well as CT read side by side. Furthermore, an optimized PET/CT protocol for patients who have lung cancer is outlined.


Impact of PET on Radiation Therapy Planning in Lung Cancer.

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The superiority of PET imaging to structural imaging in many cancers is rapidly transforming the practice of radiotherapy planning, especially in lung cancer. Although most lung cancers are potentially treatable with radiation therapy, only patients who have truly locoregionally confined disease can be cured by this modality. PET improves selection for high-dose radiation therapy by excluding many patients who have incurable distant metastasis or extensive locoregional spread. In those patients suitable for definitive treatment, PET can help shape the treatment fields to avoid geographic miss and minimize unnecessary irradiation of normal tissues. PET will allow for more accurately targeted dose escalation studies in the future and could potentially lead to better long-term survival.


Hodgkin disease: diagnostic value of FDG PET/CT after first-line therapy--is biopsy of FDG-avid lesions still needed?

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PURPOSE: To retrospectively determine the sensitivity and specificity of co-registered fluorine 18 fluorodeoxyglucose (FDG) positron emission tomography (PET)computed tomography (CT) in patients with Hodgkin lymphoma after first-line therapy, with use of clinical follow-up or biopsy results as the reference standard. MATERIALS AND METHODS: Informed consent was obtained for imaging and included consent to use patient data for research purposes. Institutional review board approval was obtained. Between May 2001 and July 2005, the data for all patients (n=66) at the authors' institution with proved Hodgkin lymphoma after first-line therapy were retrospectively reviewed. PET/CT scans were evaluated for the presence of abnormal FDG uptake and residual masses after the end of treatment and at further follow-up. All patients with pathologic FDG lesions underwent surgical biopsy for histopathologic confirmation. All patients with negative PET/CT scans at follow-up were evaluated for disease-free survival. RESULTS: An FDG-avid lesion was detected at PET/CT in 27 of the 66 patients (mean age +/- standard deviation, 33.0 years +/- 12.2). Recurrence of Hodgkin lymphoma was confirmed with biopsy in 23 of the 27 patients. The mean maximum standardized uptake value (SUV) of the histopathologically proved lesions was 7.32 (+/-2.01). Four patients had false-positive findings at PET/CT: Biopsy revealed only inflammatory changes, and the mean maximum SUV was 7.30 (+/-2.53). Thirty-nine patients (mean age, 36.7 years +/- 10.8) did not have FDG-avid lesions and remained free of disease after a mean clinical follow-up of 26.2 months (+/-12.5) (specificity, 91% [39 of 43 patients]; sensitivity, 100% [23 of 23 patients]). The presence of bulky disease (>5 cm) after the end of treatment was a significant predictor of recurrent disease (P<.05). CONCLUSION: The authors conclude that FDG PET/CT can help exclude persistent and/or recurrent Hodgkin lymphoma after first-line therapy. Because of the false-positive results and the toxicity of salvage chemotherapy, including high-dose chemotherapy with autologous stem cell support, biopsy of the FDG-avid lesion is still needed. (c) RSNA, 2007.
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Panaortitis diagnosed by 18F-FDG PET/CT scan in a patient with diffuse large B-cell lymphoma.

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Improvement in sensitivity with delayed imaging of pulmonary lesions with FDG-PET.

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PURPOSE: This study was undertaken to determine the value of using dual-time point 18F-fluorodeoxyglucose positron emission tomography (FDG-PET) imaging to distinguish malignant from benign pulmonary lesions after lesion detection by conventional computed tomography chest imaging. METHODS: Patients referred for characterization of lung lesions were included in this prospective study. Eighty-three patients had histopathologic confirmation of disease. Patients underwent FDG-PET coincidence imaging, performed with a dual-headed gamma camera at 1 h (“early” scan) and 3 h (“late” scan) after injection of 185 MBq of FDG. Studies were read independently by 2 physicians who had knowledge of the lesion location but not the final diagnosis. For both early and late images, readers graded FDG lesion uptake intensity on a scale of 1 (definitively benign) to 5 (definitively malignant) and classified studies dichotomously for malignancy. Tumor-to-background (T:B) ratios were computed using contralateral lung sites as controls. RESULTS: Sixty one lesions (74 %) were non-small cell lung cancer, and 10 (12 %) were other primary tumors or metastases. Twelve lesions (14 %) were benign. T:B ratios were significantly higher for early versus late scans (+ 5.1 +/- 4.9 versus + 8.2 +/- 8.7, p = 0.01, n = 71) for malignancies but not for benign lesions (+ 3.1 +/- 3.4 versus + 2.6 +/- 2.2, n = 12). The percent change of T:B ratios was higher for malignant than benign lesions (+ 48.3 +/- 40.2 % versus + 7.2 +/- 22.8 %, p = 0.0009). No malignant lesion of any type demonstrated a time-decrease in FDG T:B ratios. The accuracy and sensitivity of lesion characterization were significantly higher for late scans than early scans for dichotomous visual readings. Quantitative analysis was found to provide significantly higher sensitivity and accuracy than visual analysis for lesion characterization, with no significant difference in test specificity. CONCLUSIONS: In malignant pulmonary nodules, there is a progressive, although variable, increase in FDG uptake over time. Increasing FDG uptake is a nonspecific finding, as some benign lesions also demonstrate increasing uptake, particularly those associated with granulomas. The use of late PET images increases the accuracy and sensitivity of visual detection of malignancy.


[Verdacht auf Lungenkrebs - Verification-Bias beeinflusst Genauigkeit der PET-Diagnose.]

[Article in German]


[Nasopharynxkarzinom - Kombinierte PET/CT erhöht Sensitivität der Diagnose.]

[Article in German]


[Lungenknoten unklarer Dignität in der PET/CT - Engmaschige Kontrolle oder Histologie empfohlen.]

[Article in German]


2-[18F]fluoro-2-deoxyglucose positron-emission tomography in staging, response evaluation, and treatment planning of lymphomas.

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2-[18F]fluoro-2-deoxyglucose positron-emission tomography (FDG-PET) is used increasingly in the clinical management of lymphomas. With regard to staging, FDG-PET is more sensitive and specific than conventional staging methods in FDG avid lymphomas (ie, Hodgkin lymphoma and most aggressive non-Hodgkin lymphomas). Despite methodological problems, in particular the lack of a valid reference test, FDG-PET is approved and generally used for this purpose. With regard to response evaluation, FDG-PET at the end of treatment seems to aid considerably in differentiating between residual masses with or without residual lymphoma. Hence, new revised response criteria have been proposed, incorporating the result of FDG-PET at the end of treatment. An early interim FDG-PET scan after 1 to 3 cycles of chemotherapy is a very strong predictor of outcome, and trials are now in progress testing treatment modifications on this basis. With regard to treatment planning, in the context of combined-modality therapy, radiotherapy for lymphomas is moving toward more conformal techniques reducing the irradiated volume to include only the macroscopic lymphoma. In this situation, accurate imaging is essential, and FDG-PET coregistered with the planning computed tomography (CT) scan is used increasingly. The availability of PET/CT scanners suited for virtual simulation has aided this process. However, clinical data evaluating this technique are at present sparse.
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Colorectal tubulovillous adenomas identified on fluoro-2-deoxy-d-glucose positron emission tomography/computed tomography scans.

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Objective The aim of this retrospective study was to assess the significance of incidental focal colonic lesions on fluoro-2-deoxy-d-glucose positron emission tomography/computed tomography (FDG PET/CT) scans in patients undergoing staging for noncolorectal cancer. Method Of the 110 patients in our PET/CT database, 10 were found to have abnormally high uptake of tracer in their large bowel. Results Seven patients who underwent further endoscopic evaluation of these abnormalities had intermediate to high-risk adenomatous polyps. Conclusion Benign colonic polyps produce high-intensity focal FDG uptake in large bowel. Endoscopic evaluation is recommended before curative resectional surgery of the presenting cancer where appropriate.


pO2 polarography, contrast enhanced color duplex sonography (CDS), [18F] fluromisonidazole and [18F] fluorodeoxyglucose positron emission tomography: validated methods for the evaluation of therapy-relevant tumor oxygenation or only bricks in the puzzle of tumor hypoxia?


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BACKGROUND: The present study was conducted to analyze the value of ([18F] fluromisonidazole (FMISO) and [18F]-2-fluoro-2'-deoxyglucose (FDG) PET as well as color pixel density (CPD) and tumor perfusion (TP) assessed by color duplex sonography (CDS) for determination of therapeutic relevant hypoxia. As a standard for measuring tissue oxygenation in human tumors, the invasive, computerized polarographic needle electrode system (pO2 histography) was used for comparing the different non invasive measurements. METHODS: Until now a total of 38 Patients with malignancies of the head and neck were examined. Tumor tissue pO2 was measured using a pO2-histograph. The needle electrode was placed CT-controlled in the tumor without general or local anesthesia. To assess the biological and clinical relevance of oxygenation measurement, the relative frequency of pO2 readings, with values \( < \text{or} \leq 2.5 \), \( < \text{or} \leq 5.0 \) and \( < \text{or} \leq 10.0 \text{mmHg} \), as well as mean and median pO2 were stated. FMISO PET consisted of one static scan of the relevant region, performed 120 min after intravenous administration. FMISO tumor to muscle ratios (FMISOM/M) and tumor to blood ratios (FMISOB/T) were calculated. FDG PET of the lymph node metastases was performed 71 +/- 17 min after intravenous administration. To visualize as many vessels as possible by CDS, a contrast enhancer (Levovist, Schering Corp., Germany) was administered. Color pixel density (CPD) was defined as the ratio of colored to grey pixels in a region of interest. From CDS signals two parameters were extracted: color hue—defining visibility (v) and color area—defining perfused area (A). Signal intensity as a measure of tissue perfusion (TP) was quantified as follows: \( TP = v_{\text{mean}} \times A_{\text{mean}} \). RESULTS: In order to investigate the degree of linear association, we calculated the Pearson correlation coefficient. Slight \( (|r| > 0.4) \) to moderate \( (|r| > 0.6) \) correlation was found between the parameters of pO2 polarography (pO2 readings with values \( < \text{or} \leq 2.5 \), \( < \text{or} \leq 5.0 \) and \( < \text{or} \leq 10.0 \text{mmHg} \), as well as median pO2), CPD and FMISOM/T. Only a slight correlation between TP and the fraction of pO2 values \( < \text{or} \leq 10.0 \text{mmHg} \), median and mean pO2 could be detected. After exclusion of four outliers the absolute values of the Pearson correlation coefficients increased clearly. There was no relevant association between mean or maximum FDG uptake and the different polarographic- as well as the CDS parameters. CONCLUSION: CDS and FMISO PET represent different approaches for estimation of therapy relevant tumor hypoxia. Each of these approaches is methodologically limited, making evaluation of clinical potential in prospective studies necessary.


Sequential (gemcitabine/vinorelbine) and concurrent (gemcitabine) radiochemotherapy with FDG-PET-based target volume definition in locally advanced non-small cell lung cancer: first results of a phase I/II study.


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BACKGROUND: The aim of the study was to determine the maximal tolerated dose (MTD) of gemcitabine every two weeks concurrent to radiotherapy, administered during an aggressive program of sequential and simultaneous radiochemotherapy for locally advanced, unresectable non-small cell lung cancer (NSCLC) and to evaluate the efficacy of this regime in a phase II study. METHODS: 33 patients with histologically confirmed NSCLC were enrolled in a combined radiochemotherapy protocol. 29 patients were assessable for evaluation of toxicity and tumor response. Treatment included two cycles of induction chemotherapy with gemcitabine (1200 mg/m2) and vinorelbine (30 mg/m2) at day 1, 8 and 22, 29 followed by concurrent radiotherapy (2.0 Gy/d; total dose 66.0 Gy) and chemotherapy with gemcitabine every two weeks at day 43, 57 and 71. Radiotherapy planning included [18F] fluorodeoxyglucose positron emission tomography (FDG PET) based target volume definition. 10 patients were included in the phase I study with an initial gemcitabine dose of 300 mg/m2. The dose of gemcitabine was increased in steps of 100 mg/m2 until the MTD was realized. RESULTS: MTD was defined for the patient group receiving gemcitabine 500 mg/m2 due to grade 2 (next to grade 3) esophagitis in all patients resulting in a mean body weight loss of 5 kg (SD = 1.4 kg), representing 8% of the initial weight. These patients showed persisting dysphagia 3 to 4 weeks after completing radiotherapy. In accordance with expected complications as esophagitis, dysphagia and odynophagia, we defined the MTD at this dose level, although no dose limiting toxicity (DLT) grade 3 was reached. In the phase II median follow-up was 15.7 months (4.1 to 42.6 months). The overall response rate after completion of therapy was 64%. The median overall survival was 19.9 (95% CI: [10.1; 29.7]) months for all eligible patients. The median disease-free survival for all patients was 8.7 (95% CI: [2.7; 14.6]) months.
CONCLUSION: After induction chemotherapy, the maximum tolerated dose and frequency of gemcitabine was defined at 500 mg/m² every two weeks in three cycles during a maximum of 7 weeks of thoracic radiotherapy for the phase II study. This regimen represents an effective and tolerable therapy in the treatment of NSCLC.

Imaging of tumour hypoxia using PET and (18)F-labelled tracers: biology meets technology.

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Correlation Between Hybrid 18F-FDG PET/CT and Apoptosis Induced by Neoadjuvant Chemotherapy in Breast Cancer.

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Quantitative or semi-quantitative analysis of fluorine-18 fluorodeoxyglucose positron emission tomography ((18)F-FDG PET) has been reported to correlate with the clinical and pathological response of tumors to preoperative treatment. This study was conceived to evaluate the correlation between hybrid (18)F-FDG PET/CT and apoptosis in breast cancer after neoadjuvant chemotherapy. Three cycles of neoadjuvant chemotherapy were given to forty-five patients with primary breast cancer proven by core needle biopsy. Hybrid PET/CT was performed before and after treatment and tumor to non-tumor radioactivity ratio (T/N) was calculated. The apoptotic index (AI) in core-cut and surgically resected samples was determined using TUNEL techniques. The mean T/N pre- and postchemotherapy was 3.23 +/- 0.63 and 2.31 +/- 0.49, respectively (p = 0.006), with the mean reduction rate below baseline of 31.18 +/- 13.18% (range, 6.4-50.8%). The mean AI pre- and post-chemotherapy was 2.81 +/- 0.76% and 17.31 +/- 6.85%, respectively (p < 0.0001). The mean AI change was 14.34 +/- 5.36% (range, 1.9-41.3%). A positive correlation was detected between the T/N reduction rate and AI change (r(s) = 0.850, p < 0.0001). At a threshold of 20% decrease from baseline in T/N, the mean AI change in the tumors with a reduction of 20% or more in T/N was 20.86 +/- 4.29%, while that in the tumors with a reduction of less than 20% in T/N was 8.59 +/- 2.87% (p < 0.0001). The sensitivity, specificity, positive and negative predictive values, and the accuracy of PET/CT for the prediction of clinical response were 90.9%, 83.3%, 93.8%, 76.9% and 92%, respectively. These data suggested that neoadjuvant chemotherapy may effectively induce apoptosis in breast tumors and decrease their glucose uptake. Hybrid PET/CT imaging appeared to be positively related to apoptosis level and therefore to be of value in predicting the response of breast cancer to neoadjuvant chemotherapy.

([18]F)FDG-PET predicts complete pathological response of breast cancer to neoadjuvant chemotherapy.


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PURPOSE: To evaluate, in breast cancer patients treated by neoadjuvant chemotherapy, the predictive value of reduction in FDG uptake with regard to complete pathological response (pCR). METHODS: Forty-seven women with non-metastatic, non-inflammatory, large or locally advanced breast cancer were included. Tumour uptake of FDG was evaluated before and after the first course of neoadjuvant chemotherapy. Four indices were used: maximal and average SUV without or with correction by body surface area and glycaemia (SUV(max), SUV(avg), SUV(max-BSA-G) and SUV(avg-BSA-G), respectively). The predictive value of reduction in FDG uptake with respect to pCR was studied by logistic regression analysis. Relationships between baseline ([18]F)FDG uptake and prognostic parameters were assessed. RESULTS: The relative decrease in FDG uptake (DeltaSUV) after the first course of neoadjuvant chemotherapy was significantly greater in the pCR group than in the non-pCR group (p < 0.000066). The four FDG uptake indices were all strongly correlated with each other. A decrease in SUV(max-BSA-G) of 85.4% +/- 21.9% was found in pCR patients, versus 22.6% +/- 36.6% in non-pCR patients. DeltaSUV(max-BSA-G) < -60% predicted the pCR with an accuracy of 87% and DeltaSUVs were found to be only factors predictive of the pCR at multivariate analysis. An elevated baseline SUV was associated with high mitotic activity (p < 0.0016), tumour grading (p < 0.004), high nuclear pleomorphism score (p < 0.03) and negative hormonal receptor status (p < 0.005). CONCLUSION: In breast cancer patients, after only one course of neoadjuvant chemotherapy the reduction in FDG uptake is an early and powerful predictor of pCR.
11C-choline vs. 18F-FDG PET/CT in assessing bone involvement in patients with multiple myeloma.


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BACKGROUND: Multiple Myeloma (MM) is a B cell neoplasm causing lytic or osteopenic bone abnormalities. Whole body skeletal survey (WBSS), Magnetic resonance (MR) and 18F-FDG PET/CT are imaging techniques routinely used for the evaluation of bone involvement in MM patients. AIM: As MM bone lesions may present low 18F-FDG uptake; the aim of this study was to assess the possible added value and limitations of 11C-Choline to that of 18F-FDG PET/CT in patients affected with MM. METHODS: Ten patients affected with MM underwent a standard 11C-Choline PET/CT and an 18F-FDG PET/CT within one week. The results of the two scans were compared in terms of number, sites and SUVmax of lesions. RESULTS: Four patients (40%) had a negative concordant 11C-Choline and 18F-FDG PET/CT scans. Two patients (20%) had a positive 11C-Choline and 18F-FDG PET/CT scans that identified the same number and sites of bone lesions. The remaining four patients (40%) had a positive 11C-Choline and 18F-FDG PET/CT scan, but the two exams identified different number of lesions. Choline showed a mean SUVmax of 5 while FDG showed a mean SUVmax of 3.8 (P = 0.042). Overall, 11C-Choline PET/CT scans detected 37 bone lesions and 18F-FDG PET/CT scans detected 22 bone lesions but the difference was not significant (P = 0.8). CONCLUSION: According to these preliminary data, 11C-Choline PET/CT appears to be more sensitive than 18F-FDG PET/CT for the detection of bony myelomatous lesions. If these data are confirmed in larger series of patients, 11C-Choline may be considered a more appropriate functional imaging in association with MRI for MM bone staging.

Usefulness of F-18 FDG-PET in a long-term hemodialysis patient with renal cell carcinoma and pheochromocytoma.

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A patient who had been on long-term hemodialysis (HD) was diagnosed as having renal cell carcinoma (RCC) and pheochromocytoma. Abdominal computed tomography scanning demonstrated a right renal mass and a right adrenal mass, whereas positron emission tomography (PET) using F-18 fluorodeoxyglucose (FDG) revealed increased accumulation in both the renal and adrenal masses. FDG-PET is useful for detecting RCC in HD patients because FDG is not excreted in the urine, but it is difficult to distinguish pheochromocytoma from an adrenal metastasis by this imaging method.

2-[Fluorine-18]-fluoro-2-deoxy-D-glucose positron emission tomography/computed tomography versus whole-body diffusion-weighted MRI for detection of malignant lesions: initial experience.


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OBJECTIVES: The new magnetic resonance whole body diffusion-weighted imaging with background body signal suppression (DWIBS) uses short tau inversion recovery-echo planar imaging sequence under normal respiration. DWIBS is different from 2-[Fluorine-18]-fluoro-2-deoxy-D-glucose positron emission tomography (18F-FDG PET) imaging in technology, but their images are similar. We compared the two modalities regarding the detection and characterization of malignant tumors. METHODS: DWIBS and (18)F-FDG PET/computed tomography (CT) were performed on 16 cancer patients on the same day. The diagnoses were the following: lung cancer (n = 12), colon cancer (n = 2), breast cancer (n = 1), and pulmonary metastasis (n = 1). A total of 27 malignant tumors (15 lung cancer, 5 pulmonary metastases of parathyroid cancer, 3 pulmonary metastases of lung cancer, 3 colon cancer, 1 breast cancer) and seven reference organs around malignant lesions (two liver regions, four normal lymph nodes, one muscle region) were evaluated visually and quantitatively using the apparent diffusion coefficient (ADC) (x10(-3) mm(2)/s) and standardized uptake value (SUV). RESULTS: Twenty-five (92.6%) of the 27 malignant lesions were detected visually with DWIBS imaging in contrast to 22 malignant tumors (81.5%) with (18)F-FDG PET/CT imaging. The quantitative evaluation showed that there was a significant difference between the mean SUVs of the reference organs (n = 7, 1.48 +/- 0.62) and the malignant (n = 22, 5.36 +/- 2.80) lesions (P < 0.01). However, there was no significant difference between the mean ADCs of the reference organs (n = 7, 1.54 +/- 0.24) and the malignant (n = 25, 1.18 +/- 0.70) lesions. CONCLUSIONS: DWIBS can be used for the detection of malignant tumors or benign tumors; however, it may be difficult to differentiate between benign and malignant lesions by ADC.

Diagnostic performance of CT, PET, side-by-side, and fused image interpretations for restaging of non-Hodgkin lymphoma.


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OBJECTIVE: The purpose of this study was to compare the diagnostic performance of positron emission tomography (PET) alone, computed tomography (CT) alone, side-by-side reading, and fused images for restaging or follow-up of patients with malignant lymphoma. METHODS: Fifty patients with histologically confirmed non-Hodgkin lymphoma underwent an (18)fluoro-2-deoxyglucose (FDG)-PET scan, followed by a CT scan. CT alone, PET alone, side-by-side reading, and fused images were interpreted separately and visually using a five-point grading scale for the following eight regions: cervical, supraclavicular, axillary, mediastinal, para-aortic to iliac, mesenteric, inguinal, and extra-nodal. Diagnostic accuracy was compared on the basis of the final diagnoses determined by histological confirmation and/or clinical course. RESULTS: For all regions combined, the interpretation of PET alone (sensitivity = 86.1%, specificity = 99.4%, accuracy = 91.0%), side-by-side reading (96.0%, 99.4%, 98.9%), and fused images (98.0%, 99.4%, 99.2%) yielded significantly higher diagnostic performance than that of CT alone (59.4%, 96.1%, 91.0%; P < 0.001). The cervical, supraclavicular, and extra-nodal regions were more accurately diagnosed with PET (P < 0.05), whereas the para-aortic to iliac regions were diagnosed more accurately with side-by-side reading and fused images than with CT alone or PET alone (P < 0.05). CONCLUSIONS: Although fused images are clinically valuable, side-by-side reading showed equivalent performance, whereas the interpretation of PET alone yielded reasonably high diagnostic performance for restaging or follow-up of patients with malignant lymphoma.