1112 POSTER

The effect of irradiation on the sensitivity and specificity of FDG-PET to detect post-irradiation recurrence in cervical cancer patients

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Background: To investigate the effect of previous irradiation (RT) on the sensitivity, specificity, true (false) positive (negative) value and Standard Uptake Value (SUV) of FDG-PET in cervical cancer patients with post-RT recurrence.
Material and Methods: There were 97 previously irradiated recurrent cervical cancer patients being analyzed with respect to clinical factors including age, pathology, Figo stage, treatment methods, recurrent sites by location and previous RT dose in effecting aforementioned value of FDG-PET to detect recurrence. Previous RT dose can be divided into high (primary lesion sites receiving tele- and brachytherapy), low (regional lymphatic draining sites receiving teletherapy only) and non-RT areas.
Results: Most of clinical factors yield no significant impact on either sensitivity or specificity of FDG-PET. There was a significant difference in specificity between previously non-RT mediastinal lymph node and thoracic spine: 67/73 (91.8%) vs. 95/95 (100%), $p = 0.006$. Recurrent rates by anatomic sites revealed a significantly higher PET documented recurrent rate at paraaortic lymphatic region: 34 (35%) than did at peritoneam (9.3%), bone (2.1%), liver (5.2%) and lung (9.3%) ($p = 0.000$). Recurrent rates by RT dose revealed, however, no significant difference among high dose, low dose and non-RT area in term of PET (+) (22.7% 13.9% and 11.9%, $p = 0.151$), PET (−) (71.1%, 77.2% and 79.6%, $p = 0.108$), false (+) (3.1%, 6.9% and 6.7%, $p = 0.840$) and false (−) rates (3.1%, 1.9% and 1.8%, $p = 0.908$). SUV at cervix, vagina & parametria which corresponded to previously high dose area yield a significantly higher SUV than low dose or non-RT area did (2.45 ± 5.63 vs. 1.39 ± 2.95 or 1.31 ± 3.29, $p = 0.010$)
Conclusions: PET documented recurrent rates correlate well to anatomic sites but not previous RT dose. A significantly high SUV corresponded to areas receiving previously high RT dose. This does not translate into high recurrent rates mainly due to a relatively high mean SUV (9.73 ± 7.96) required to document PET (+) cases. Mean SUV for PET (+) low dose and non-RT areas were 5.91 ± 3.75 and 6.04 ± 4.27.

1113 POSTER

Thallium-201 single photon emission computed tomography assessment in the detection of recurrent glioma and ependymoma.

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Background: To establish the diagnostic accuracy of thallium-201 single-photon emission computed tomography (^{201}Tl-SPECT) in the detection of recurrences in the follow-up of patients with astrocytic and ependymal supratentorial tumors after treatment.
Patients and methods: From October 1999 to November 2003, 63 ^{201}Tl-SPECT procedures were performed in 36 patients (12 males and 24 females; median age of 46 ± 13 years). Tumour histologies included, high grade glioma in 19 patients (15 multiform glioblastoma and 4 anaplastic astrocytoma); 2 oligoastrocytomas, 11 oligodendroglioma and 4 ependymoma. Because of the heterogeneity of tumor histology, the sample was dichotomized resulting in 19 high grade glioma and 17 low grade neuroepithelial tumors. All patients underwent surgery (13 complete resection, 13 partial resection and 10 biopsy) and adjuvant radiotherapy (mean dose of 60 Gy and 54 Gy for high and low grade tumors respectively). Eighteen patients also received chemotherapy. Follow up was performed every 3 months with morphological imaging (CT and IMR). When recurrence or progression was suspected, ^{201}Tl-SPECT was performed. Whole group median follow-up was 18.3 ± 14 months. ^{201}Tl-SPECT was started 60 minutes after intravenous injection of 180 mBq of Thallium; a dual-head gamma camera was used. Images were reconstructed with filtered backprojection (Butterworth 0.5/4). ^{201}Tl-SPECT information was correlated with clinical and imaging features. At least four month follow up after the SPECT was taken in account to state a result as a true positive. Overall survival was calculated by the Kaplan-Meier estimates. Breslow and the log-rank tests were used for univariate analysis.
Results: Sensitivity and specificity of ^{201}Tl-SPECT in recurrence detection was 0.88 and 1.0 respectively. Accuracy rate was 93%. Sensitivity and specificity for high grade tumours, were both 1.0. Sensitivity for low grade tumors was 0.78 because of 4 false negative. Two year overall survival was 18% and 74% for the positive and negative ^{201}Tl-SPECT group respectively. ($p = 0.0003$)
Conclusions: ^{201}Tl-SPECT is a valuable and non invasive diagnostic tool in the detection of recurrence or progression disease in patients treated with radiotherapy for gliomas and supratentorial ependymomas. There is a close relationship between, tumor grade,^{201}Tl-SPECT results and patients survival. However, more studies are warranted to further explore the real diagnostic potential.

1114 POSTER

The impact of F-18 FDG PET in primary bone lymphoma: comparison with MRI

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Objectives: Primary lymphoma of bone (PLB) is one of the rarest primary bone malignancies, described as a distinct entity called reticulum cell sarcoma, and the main treatment modality is chemotherapy, which is a far from other primary bone tumor. We evaluated the clinical impact of F-18 FDG PET (PET) in the PLB.
Methods: A survey of 1,422 NHL patients diagnosed at our institute from 1989 and 2003 were identified 28 patients with PLB (2.0%) and 18 patients (42, range: 16–74). who wer performed PET study were enrolled. Attenuated corrected whole PET images (ECAT EXACT HRf+, advance PET) were reviewed, and the assessment was done using visual grading (definitely higher or iso/lower) and semiquantative (max SUV) methods. Then it compared with the clinicophatological and MRI.
Results: A total of the 92 lesions were evaluated from above 18 patients and direct comparison between PET and MRI available in 81 lesions of these. Comparing with MRI, overall diagnositic value of PET was similar (MRI vs PET; sensitivity 89% vs 81%, specificity 70% vs 82%, NPV 60% vs 53%, PPV 91% vs 94%, accuracy 85% vs 81%). In PET alone, 53 of these were considered benign; 38, equivocal; and 101, malignant or suspicious for malignancy. The undefinitable 32 lesions of MRI only, after the PET added, it were reclassified as normal and/or benign (n 21) or malignant (n 11). The accuracy of these 32 lesions which was reclassified by PET, 78% (sensitivity 72%, specificity 81%)
Conclusions: Compared the MRI, FDG-PET was shown similar diagnostic ability and it was accurately reclassified undefinitable lesions which were detected on MRI alone. FDG-PET was contributed in mangement of PBL.

1115 POSTER

Accuracy of positron emission tomography for diagnosis of pulmonary lesions with low 18F-fluorodeoxyglucose uptake less than 2.5 in standardized uptake value

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Background: Differentiation between benign and malignant pulmonary lesions in ^{18}F-fluorodeoxyglucose positron emission tomography (FDG PET) has been commonly accomplished by using a semi-quantitative criterion for FDG uptake of 2.5 in standardized uptake value (SUV). However, malignancies <2.5 in SUV are frequently encountered, and thus pulmonary nodules with low FDG uptake are often diagnostic challenges.
Materials and methods: Among consecutive 360 patients who underwent FDG PET for evaluation of pulmonary nodules or masses on CT, we retrospectively analyzed 49 patients with pulmonary lesions (excluding ground-glass opacity or infiltrative ones) <2.5 in SUV. FDG uptake was determined by visual scoring (absent, faint, moderate or intense, compared with mediastinal uptake), and two semi-quantitative methods, including SUV and CR (contrast ratio, defined as lesion uptake minus contralateral normal lung uptake divided by the sum of these uptakes, according to Nomori et al.). Final classification was based on histopathological findings or clinical and radiological follow-up. The ROC curve analysis was applied to determine optimal cut-off criteria and diagnostic accuracies.
Results: The lesions consisted of 14 malignant (diameter, 8–32 mm) and 35 benign (7–36 mm) ones. Prevalence of malignancy was 29%. Visual FDG uptake $\geqslant$faint correctly identified 12 of 14 malignancies, and was falsely positive in 15 of 35 benign lesions. Sensitivity was 86%, specificity 57%, positive predictive value 44%, and negative predictive value 91%. Semi-quantitative SUV >1.48 correctly detected 12 of 14 malignancies, and was falsely positive in 10 of 35 benign lesions. Sensitivity was 86%, specificity 71%, positive predictive value 55%, and negative predictive value 92%. CR >0.28 correctly diagnosed 10 of 14 malignancies and was falsely

positive in 5 of 35 benign lesions. Sensitivity was 71%, specificity 86%, positive predictive value 67%, and negative predictive value 88%. Area under the curve in ROC analysis did not significantly differ among the three analytical methods (visual, 0.77; SUV, 0.81; and CR, 0.84; p = ns).
Conclusions: These results suggested that in pulmonary lesions with low FDG uptake, semi-quantitative methods did not improve the accuracy of FDG PET compared with visual analysis. Pulmonary lesions with visually absent uptake indicate a low probability of malignancies <10%. In contrast, any visually recognized lesions have a probability of malignancies of about 50%.

1116 POSTER

Induced tumor fluorescence using fluorophore-tagged anti-tumor antigen antibodies in the nude mouse model—an example for use in humans

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Background: Inducible tumor fluorescence is possible using fluorophore-tagged anti-tumor-antigen antibodies.
Method: Female athymic nude mice were subcutaneously or othotopically implanted with cells from either of 2 human tumor cell lines; (1) the colon cancer line (SW1116 (ATCC™)) known to express carcinoembryonic antigen (CEA) (11 mice) and (2) the breast cancer line, MDA 468 (ATCC™) known to express CA 15–3 (10 mice). Tumor nodules grew to 3–8 mm within 3–6 weeks after implantation. Commercially available anti-CEA and anti-CA 15–3 antibodies were tagged with a green fluorophore. Seven study mice with colon cancer nodules were injected intravenously with 100 μL of anti-CEA, and 6 study mice with breast cancer nodules were injected with 100 μL of anti-CA 15–3. Eight control mice were injected with fluorophore-tagged mouse IgG. Mice were observed and photographed using a CCD camera. Initial observations and photographs were done at 24–48 hours after injection and mice were euthanized between 1 to 7 days. All mice were euthanized and dissected to expose tumor nodules and again photographed. Mice were also examined using a simple pocket LED light source with a 470 nm band pass filter and goggles with a 519 nm band pass filter. Tumor tissue was then excised and fixed for histologic examination.
Results: Tumor nodules in all 13 study mice, injected with anti-CEA or anti-CA 15–3, demonstrated bright fluorescence. Fluorescence was as readily visible with the LED light source and goggles as that seen using the CCD camera. Tumor nodules in the 8 control mice did not fluoresce. Tumor fluorescence was readily visible from 24 hours up to 1 week. Several lymph node metastases 0.5 mm in diameter were distinguishable from surrounding normal tissue. Histologic examination of fluorescent tissue confirmed the presence of the malignant cells.
Conclusions: Induced tumor tissue fluorescence allows clear visualization of primary tumor margins and of very small metastases. When the tumor antigens are known and antibodies to the antigens are available, this methodology is clearly reproducible. Tumor fluorescence can be easily seen with a simple LED light source. This technique could be readily applied to oncologic surgery with significant potential benefits to the patient and the surgeon.

Publication
Imaging

1117 PUBLICATION

CT findings of gefitinib-related interstitial pneumonitis in 65 patients: Multi-institutional analysis of West Japan Thoracic Oncology Group

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Purpose: To clarify the image characteristics of interstitial pneunonitis (IP) induced by newly developed the molecular-targeting drug gefitinib.
Materials and Methods: In a total of 1,976 patients with non-small cell lung cancer who were administered gefitinib from August to December 2002, 102 were suspected to have IP. In these patients, 65 patients had undergone CT as well as chest roentgenogram at onset. Based on the findings of chest roentgenogram and CT reviewed and analyzed by three radiologists, the final definite diagnosis of gefitinib-related IP was determined, adding clinical data in the medical records. Moreover, CT findings were classified into four patterns; Pattern A: nonspecific areas with ground-glass attenuation, B: multifocal areas of airspace consolidations, C: patchy distribution of areas with ground-glass attenuation accompanied by interlobular septal thickening, such as acute eosinophilic pneumonia, and D: extensive bilateral areas with ground-glass attenuation or airspace consolidations with traction bronchiectasis, such as acute interstitial pneumonia.
Results: The diagnostic images were classified as pattern A in 29 patients, B in 3, C in 7, D in 20 and others in 11. 24 patients with pattern A, 1 with pattern B, 7 with C and 12 with D were classified into single pattern. The patients dying due to gefitinib-related IP were significantly more frequent in pattern D.
Conclusion: Gefitinib is considered to induce IP at a certain rate and the images are similar to drug induced pneumonitis of conventional anticancer agents.

1118 PUBLICATION

Preoperative staging by 18F-FDG-PET-CT-Scan in malignant pleural mesothelioma

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Background: Trimodal treatment in malignant pleural mesothelioma (MPM) is the combination of chemotherapy, surgery (extrepleural pneumonectomy) and irradiation. This is a treatment possibility with potentially severe morbidity and even mortality for few selected low-stage patients (pts). Staging is difficult in MPM and it is important to identify pts who may not be candidates for such extensive surgery. The purpose was accordingly to evaluate wether preoperative 18F-FDG-PET-CT-scan (PET-CT) identified MPM patients (pts) having non-resectable disease better than CT-scan alone.
Material and methods: Pts having epithelial subtype MPM in IMIG stages Ia-III MPM based on conventional CT-scan, with performance status 0–1, age <70 yrs and good organ function were candidates for trimodal treatment. They received 3–6 courses of neoadjuvant platinum-based combination chemotherapy before evaluation for extrapleural pneumonectomy. Preoperative staging included PET-CT and mediastinoscopy.
Results: 24 consecutive pts judged resectable by conventional CT-scan were included for PET-CT before extrapleural pneumonectomy. There were 22 males and 2 females with median age 60 yrs (range 30–70 yrs). The PET-CT revealed 12 pts (50%) to be non-resectable, due to either too high T-stage, N-stage, metastasis, or any combination of these (9 pts due to N2 gland, 5 pts had extensive T3 thoracic wall invasion, 4 pts had T4 direct mediastinal extension, and one patient had subdiaphragmatic metastasis). Among the remaining 12 pts considered further for resection, two had positive N2 glands by mediastinoscopy and were hence not amenable to surgery, while two other pts had N2 gland involvement by perioperative lymph-node dissection. Among resected pts, three could not be microscopically completely resected at the thoracic wall due to too extensive invasion, which was not detected preoperatively on the PET-CT. The sensitivity of PET-CT to detect N2 glands was 82% and to detect non-rectable T3 or T4 disease was 75%.
Conclusions: Preoperative PET-CT may detect cases of otherwise subclinical spread to N2 glands, distant metastasis, or extensive, non-resectable local disease, thereby avoiding major surgical procedures in such non-curable disease. There may however also be false negative PET-CT findings, and the use in the preoperative staging of MPM should be further explored.