VIA MEDICA

Nuclear Medicine Review 2009
Vol. 12, No. 1, pp. 31–56

ISSN 1506–9680

Chosen abstracts of the Hungarian Society of Nuclear Medicine Congress Debrecen, 2009

INVITED LECTURES

1

DEVELOPMENT OF MOLECULAR IMAGING BIOMARKERS

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Biomarkers are anatomical, physiological, biochemical or molecular parameters associated with the presence and severity of specific pathophysiological and/or disease states. With various methodologies they can be objectively measured, parametrically quantified and evaluated as indicators of normal biological processes, pathological processes or pharmacological responses to a therapeutic intervention.
Molecular imaging biomarkers are means that can visualize disease biomarkers with the help of molecular imaging techniques, including PET. They have a tremendous potential for (i) the early diagnosis of diseases, (ii) accelerating the development of pharmaceuticals, (iii) following up therapies and (iv) designing individual medications ("personalized medicine").
The search for molecular imaging biomarkers has in recent years become one of the primary objectives of PET research world-wide, as PET imaging biomarkers may have multiple benefits: (i) They can be important imaging tools in drug development studies by the visualization of drug effects on molecular target systems; (ii) they can help researchers to identify surrogate endpoints of normal and pathological biochemical and physiological processes in the living organisms; (iii) they can be used as diagnostic agents for the early diagnosis of various diseases, and (iv) they can be important progression indicators during the follow-up of medical treatments.
The presentation will survey the principles of imaging biomarker developments for PET studies and give particular examples, based upon the Karolinska PET center's research and development activities, regarding imaging biomarkers for neuropsychiatric drug development, neuroinflammation and neurodegeneration.

2

NUCLEAR DIAGNOSTICS OF BRAIN DISEASES

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Both single photon emission tomography (SPECT) and positron emission tomography (PET) can be used for molecular imaging of brain diseases. Hybrid PET/CT and SPECT/CT scanners improve anatomical localization of lesions, and localization is further enhanced with PET/MRI registration or direct PET/MRI hybrid imaging. Most notable clinical applications are brain tumors, epilepsy and dementia. Less frequent utilizations include motor disorders, inflammation, trauma and cerebrovascular diseases.
In dementia, PET can provide characteristic patterns for Alzheimer's disease and frontotemporal degeneration, and has been used for assessment of disease severity and prediction of long term outcome. Characteristic changes have also been described for Lewy body dementia and posterior cortical atrophy.
Primary brain tumors can accurately be diagnosed with contrast MRI while PET can be implemented for differentiation of post-radiation inflammatory changes from recurrent glioma. Radiolabeled amino acids will delineate low grade astrocytomas. In patients with HIV infection, both FDG PET and thallium SPECT have been used for differentiation of CNS lymphoma from toxoplasmosis. In children with medulloblastoma, whole body PET/CT has been used for detection of recurrent local, and distant metastatic disease.
When scalp EEG and MRI are inconclusive, both SPECT and PET can provide localization and surgery guidance in mesial temporal lobe seizures, which represents the most frequent form of lesional partial epilepsy. Ictal SPECT and interictal PET are less reliable for localization of extratemporal forms of epilepsy.

3

LABELLING OF BIO-MACROMOLECULES: CHALLENGE IN RADIOLABELLING FOR RADIOPHARMACY

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Over the last two decades, radiolabeled antibodies and peptides have been introduced in research and in clinical application of nuclear medicine. Such substances are utilized for tumor targeting as radiotracers and for therapeutic purposes as well. Labelling of such substances with PET radionuclides such as F-18 offers the chance of introduction the label without drastic changes of the molecular properties in conjunction with highest image quality, i.e. high diagnostic value. Radiometal-labeled bioactive substances offer both: The possibility of diagnostics and therapeutic intervention as well. However, the labelling procedure is a considerable alteration of the molecules radiopharmacological properties. This is due to the need of introducing a chelating moiety to bind the radiometals kinetically and thermodynamically inert. Beside this geometric impact, the labelling conditions are of highest importance. Whereas peptides may withstand rather drastic conditions proteins e.g. antibodies need ambient labelling conditions such as aqueous solution, room temperature, near physiological pH. Furthermore, various proteins tend to coagulate in the presence of heavy metals as radio-copper.
The talk will present such results of scientific investigations at the Institute of Radiopharmacy during the last five years. This involves the application of established methods such as the use of [^{18}F]SFB (N-succinimidyl-4-[^{18}F]fluorobenzoate) for labelling of biomolecules, the development of alternative labelling agents/prosthetic groups as well as current efforts to establish methods for pre- and postlabelling with radiometals. All these investigations are directed to corresponding applications with biomolecules and bioactive compounds, respectively.

4

DIAGNOSIS AND TREATMENT OF THYROID CARCINOMA

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Background: The aim of the study is to review the database of thyroid carcinoma of the Institute of Oncology "Prof. Dr. I. Chiricuþă" in Cluj-Napoca, the largest therapeutic centre in this field in Romania.
Material and methods: Were analyzed the latest guidelines for the diagnosis and treatment of thyroid cancer published by the European and American Thyroid Associations (ETA, ATA), and also by the British Thyroid Association, American Association of Clinical Endocrinologists (AACE) and Endocrine Surgeons, also by the European Association of Nuclear Medicine (EANM), by the American and European Societies of Clinical Oncology (ASCO and ESMO). According to these publications, the study will present the national guideline; the personal experience of the authors will be presented in this study relying on the data more than 4000 patients, representing more than half of all the patients with thyroid cancer registered at national level in the period from 1970 util 2008.
Results/discussion: The results present the incidence of thyroid cancer, the evolution of the frequency in the last decade after Chernobyl, the age and gender distribution, the histopathology distribution and the prognosis, the evolution of the strategies of treatment in this period of about 40 years, the different radioiodine doses administered for therapeutic purposes, and their significance in the survival rate.
Conclusion: The significant increase in the incidence of thyroid cancer and the high percentage of clinically and sonographically detected thyroid nodules in the general population calls for a clear and uniform strategy of diagnosis and treatment of this pathology.

ONCOLOGY — THERAPY

7

FDG PET-CT IN LYMPHOMA — DIFFICULTIES IN EVALUATION PROCESS AND PITTFALLS

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Nowadays the FDG PET examination has a definitive, important role in the clinical management of patients with lymphoma. The basic condition for risk adapted treatment of these patients is exact staging and early objective evaluation of the effectiveness of therapy.
Based on experience obtained from lymphoma patients' routine PET-CT scan, we analysed the difficulties of evaluation in different time frames of clinical follow up.
We studied data from 125 patients, 59 Hodgkin lymphoma (HD) and 66 non-Hodgkin lymphoma (NHL) sufferers, according to histological type and FDG avidity, rare types of extranodal involvement, and accompanying disease.
In accordance with the data in the literature in contrast to indolent NHL we measured higher mean FDG uptake (SUV_{max}) in patients with HD and aggressive type of NHL although, in individual cases, different FDG uptake can be measured in patients with the same histology pattern. This is the reason why in the case of follow up studies the basic examination is essential to do.
Extranodal involment has been found in 40% of the patients. In certain cases such as liver, spleenand bone involvement the PET-CT study has higher sensitivity compared to other affected organs e.g. the bowels, brain and bone marrow. Because an accompanying disease may cause false results detailed anamnesis is required.

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THE DIAGNOSTIC ACCURACY OF 18-FDG-PET/CT AS A RESTAGING METHOD FOR MALIGNANT LYMPHOMAS

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Background: Approximately two-thirds of patients suffering from Hodgkin lymphoma, and about half of those with aggressive diffuse large B-cell lymphoma present residual mass after the completion of therapy. Moreover, approximately 30% of both groups will relapse. Several studies have demonstrated the usefulness of PET/CT in the restaging of patients with malignant lymphoma. The purpose of this study was to test the diagnostic accuracy of PET/CT as a restaging method.
Material and methods: Between August 2005 and July 2006, PET/CT was performed in 43 patients (22 with HL and 21 with NHL) after the completion of planned treatment. PET/CT findings were analyzed retrospectively, and compared to the clinical and/or pathological follow-up data.
Results: The sensitivity, specificity, positive predictive value and negative predictive value of PET/CT were 75%, 91%, 67%, and 94%, respectively.
Conclusion: FDG-PET/CT with its high sensitivity, specificity and negative predictive value proved to be a reliable restaging method. Our results confirm the recommendations of the International Harmonization Project in Lymphoma (J Clin Oncol 2007; 25: 571–578) into clinical practice. Additionally, since the positive predictive value of PET/CT is not high, the positive findings must be carefully analyzed, including the performance of biopsy and thorough observation.

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EARLY RESPONSE EVALUATION IN PATIENTS WITH HIGH GRADE LYMPHOMA USING FDG PET/CT

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Background: Metabolic imaging has officially been included in the response criteria of lymphoma treatment since 2007 when a revised system was established under the auspices of an international cooperation in the framework of the International Harmonization Project. However, clinical trials are now aimed at the assessment of the prognostic power of the so-called interim PET/CT scans in the early response evaluation of lymphomas. The authors of this study present their own experiences in this field.
Material and methods: Since January 2008, forty-five patients with high grade lymphoma have been investigated by interim FDG PET/CT between the second and third chemotherapy cycles. The patients were referred from the Internal Department "A" of National Institute of Oncology. An end-therapy scan was also performed in nine patients. The maximal SUV of lymphoma lesions was calculated and compared between different time points.
Results: In 71% of the patients (32/45) the reduction in SUV_{max} was more than 50% at the interim PET compared to the baseline value. Smaller reduction in SUV_{max} or progression of the disease was established in thirteen patients. In patients in whom the reduction of SUV_{max} was greater than 50%, the end-therapy scan confirmed complete metabolic remission.
Conclusions: It can be concluded in agreement with data in the literature that lymphomas that show a marked decrease in SUVmax at interim PET/CT are likely to reach complete metabolic remission at the end of therapy. Further studies are needed to elucidate the prognostic threshold of decrease in metabolic activity, the timing of interim scan and the relation to complete pathologic remission.

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^{18}F-FDG PET/CT IN LUNG CANCER: A RETROSPECTIVE ANALYSIS OF 415 STUDIES

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Background: FDG PET is the most sensitive noninvasive imaging modality for the evaluation of solitary pulmonary nodules (SPN). This technique is superior to CT in terms of sensitivity and specificity for the diagnosis and staging of lung cancer. Results of multiple studies have confirmed the benefit of FDG PET in the management of primary lung carcinoma. Our purpose was to evaluate the clinical impact of PET/CT in our patients.
Material and methods: The results of PET/CT studies in 408 patients/415 studies were analyzed, retrospectively. PET/CT studies were performed with indication of metabolic characterization of SPN (n = 154), preoperative staging (n = 175), and restaging (n = 86) of primary lung carcinoma.
Results: N-Staging resulted in 17 mediastinoscopies, and 54 thoracotomies. The sensitivity, specificity, positive predictive value and negative predictive value of ^{18}F-FDG PET/CT were 92%, 75%, 72%, and 94%, respectively.
Conclusion: The ^{18}F-FDG PET/CT dramatically improved the sensitivity, specificity, and diagnostic accuracy of the evaluation of our patients with lung carcinoma. However, due to the low specificity of the method, tissue sampling of suspicious mediastinal lymph nodes is highly recommended for the optimal selection of patients for surgery or radiotherapy.

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HOW CAN SPECT-CT HELP IN THE DIAGNOSIS OF NEUROENDOCRINE TUMORS?

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Background: Neuroendocrine tumors (NET) are very rare neoplasms. Our aim was to show the importance of combining SPECT and CT in the diagnosis of NET. Primary tumors and metastatic lesions can be detected via methods of nuclear medicine. However, SPECT and CT image fusion can increase sensitivity and diagnostic accuracy. Many times, we cannot distinguish the specific and aspecific signs (accumulation in other malignant tumors, acute and chronic inflammations) thus, in this problem, the role of CT will be important in the future.
Material and methods: ^{111}In-Octreoscan examinations were performed for 6 patients. We made a whole body scan and additional images, and each patient had a SPECT examination 24, 48 and 72 hours after the iv. injection of the radiopharmacon. In all the cases, a low-dose CT examination was also performed in an other institute. We made fusion images using MEDISO-Interview XP Software.
Results: In every case, the accumulation of ^{111}In-Octreoscan was detected, but in all the patients the uptake of radioactive isotope had unusual localization and/or uncommon extension. It was very difficult to locate many lesions without CT. Fusion images could help to identify atypical signs.
Conclusions: The role of ^{111}In-Octreoscan examination completed with SPECT is very important in the diagnosis of NET. We need to detect the exact location of the tumor and eliminate the aspecific signs. CT examination and the methods of image fusion increased the sensitivity and accuracy of SPECT.

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COMPARISON OF THE DETECTABILITY OF BONE METASTASES BY FDG PET-CT AND BONE SCINTIGRAPHY

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Background: Both FDG PET-CT (PET) and bone scintigraphy are sensitive methods for the detection of bone metastases. We compared retrospectively the results of these methods when both investigations were performed within one month.
Material and methods: 48 pairs of PET and bone scan investigations (96 investigations) of 46 patients (ages: 34–75 years) were compared. The primary tumors were cancers of the breast, lung, cervix and pancreas and non-Hodgkin lymphoma. In case all of the abnormalities could be depicted by one of the two methods we evaluated the detectability by the other investigation. As far as bone metastases were concerned, we determined the results on a patient by patient and a lesion by lesion base.
Results: Patient by patient evaluation showed findings of bone metastases with both methods in 12 cases; in 36 cases neither of the investigations raised the suspicion of bone metastases. PET, however, detected more single lesions in the same patient according to the lesion by lesion analysis in 5 cases. We could not perform lesion by lesion evaluation in 1 case because of more diffuse and conflating bone disease.
Conclusions: For the detection of bone metastatic state bone scintigraphy and PET provided the same effectiveness in each single patient while PET proved more sensitive based on the lesion by lesion comparison.

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FDG-PET FOR AXILLARY NODAL STAGING IN EARLY BREAST CANCER

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Background: Management of the axilla in operable breast cancer is of capital importance, since the most powerful predictor of survival and recurrence is the status of lymph nodes. Recently many centers introduced the less invasive axillary sampling techinque of sentinel lymph node biopsy (SLNB) for axillary staging. However, axillary lymph node dissection (ALND) is still considered as the standard examination procedure for the assessment of axillary lymph node metastases. This study analyzed the value of [18F]-fluorodeoxyglucose positron emission tomography (FDG-PET) in detecting axillary metastases in women with early (operable) breast cancer.
Material and methods: Thirty-eight patients with newly diagnosed invasive breast cancer participated in the present, prospective study. All patients had clinically negative axilla, and underwent FDG-PET before surgery, which was complemented with SLNB. Histopathology of ALND and SLNB were compared with the imaging results of the axilla.
Results: The prevalence of histopathologically verified axillary metastases was 45% (17 women). The sensitivity and specificity of FDG-PET for the detection of axillary involvement were 82% and 95% respectively, with 1 false positive and 3 false negative cases. The semiquantitative analysis of the PET images revealed that axillary nodal maximal standardized uptake value normalized to body weight more than 1.2 had a positive predictive value of 93%.
Conclusions: The high specificity of PET suggests that women who have focal FDG uptake in the axilla should undergo full ALND rather than SLNB. In contrast, there is a need for SLNB in the case of PET-negative axilla.

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FDG PET/CT IN RADIOTHERAPY TREATMENT PLANNING

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Background: To demonstrate the importance of PET/CT in radiotherapy treatment planning (RTP) based on our experiences.
Material and methods: PET/CT based RTP has been performed in fifty-three patients between 2006 and 2008 at our institute as follows: head and neck cancer (n = 19), lung cancer (n = 12), lymphoma (n = 7); gynecologic (n = 3) or gastrointestinal recurrence (n = 3), and sarcoma (n = 2). Pinnacle planning software was used for fusion and planning. The influence of PET/CT based planning on target definition and gross tumor volume (GTV) delineation was evaluated.
Results: Radiotherapy was omitted in 3 patients (5.7%) due to distant metastases revealed by PET/CT. In four patients (7.5%) the lesion was FDG-negative. GTV and/or doses to different lymph node regions were changed in patients with lung cancer (66.7%, 8/12) and head and neck cancer (63.2%, 12/19) based on the PET/CT data. In 2 of 7 patients (28.6%) with lymphoma residual bone involvement could be detected and delineated only by PET/CT. CT- and PET/CT-based change in GTVs > 20% were observed in 27/46 patients (58.69%).
Conclusion: The use of PET/CT in radiotherapy treatment planning may affect treatment strategy, selection of target volumes and delineation of GTV. PET/CT based treatment planning results in changing the target volume and/or prescribed dose in more then 50% of the patients compared with conventional CT based planning.

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EXPERIENCE WITH SPECT/CT STUDIES IN PATIENTS WITH DIFFERENTIATED THYROID CANCER AFTER HIGH-DOSE RADIOTHERAPY

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Background: Whole body scans (WBS) completed with SPECT/CT examinations were investigated in patients with papillary and follicular thyroid cancer after high-dose radiotherapy. The anatomical localization and the etiology of the hot spots were evaluated.
Material and methods: Between July 2007 and March 2009 102 examinations were performed in 83 thyroid cancer patients. Among them 19 patients had been involved in a follow-up study after the repeated therapy. Sixty four women (mean age 51 years) and 19 men (mean age 44 years) were examined on the 6th day after radioablation. WBS, scintigraphy of the neck and completed SPECT/CT examinations about the neck, the chest and the other suspect regions were evaluated.
Results: In 37 cases of the 102 studies pathological ^{131}I cumulations were found in the region of the head, neck, chest and/or abdomen. Among them 17 cases proved to be metastases. The results were not obvious in 4 patients, so multislice CT and MRI examinations were recommended. Metastasis was proved by CT without a hot spot in 2 patients. Only remnant activity was found in 63 cases.
Conclusion: Only 46% of the hot spots on the WBS and on the completed SPECT/CT were verified as metastases. The completed examinations by SPECT/CT system after WBS give more information about the etiology of the hot spots and the staging of the disease, which has a crucial role in providing efficient therapy.

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BIOLOGICAL HAZARDS OF RADIATION SYNOVECTOMY. CHROMOSOMAL ANALYSIS OF PERIPHERAL LYMPHOCYTES OF PATIENTS BEFORE AND AFTER RADIATION SYNOVECTOMY WITH 166-HOLMIUM-PHYTATE

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Background: The aim of this study was to identify any increase in specific chromosome-type abnormalities, using published criteria, in patients following 166-Holmium-phytate (166-Ho) radiosynoviorthesis (RSO) of the knee.
Material and methods: 18 patients with rheumatoid arthritis (RA), 7 males, 11 females, mean age: 45 years (24–72) were included in the study. The cytogenetic analysis was performed in each patient before and 4 weeks after the RSO. Conventional cytogenetic analysis was performed on the peripheral blood sample. Cells were incubated for 72 hours in RPMI 1640 containing 20% fetal calf serum, antibiotics and 0.1 ml Phytohemagglutinin. Colcemid was subsequently added for 1 hour. 100 metaphases were analyzed from each sample. The following chromosomal aberrations were scored: ring chromosome, gap lesion, terminal and interstitial deletion, translocation ring chromosome.
Results: The normal range of structural deviation is 0–4%. The pathologic rate of chromosomal aberrations is above 5%. In our study, a ring chromosome was identified in the post-therapy sample (0.00055%) in only one case.
Conclusion: There was no increase in the scored chromosome-type abnormalities after 166-Ho RSO. This study further supports the relative safety of 166-Holmium-phytate compared to other radiopharmaceuticals.

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EFFECTIVENESS OF REPEATED YTTRIUM-90 MULTIBONE THERAPY ON PAINFUL BONE METASTASIS

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Backround: As we have presented earlier, the Yttrium-90 Multibone therapy is an efficient method for relieving pain in patients suffering from metastatic bone pain. What is the effect of repeated therapy?
Material and methods: Over the past 10 years, we have retreated 24 out of 215 patients. The total number of pretreatments was 68, in which the number of patients/number of therapies was as follows: 12/2, 7/3, 3/4, 1/5, and 1/6. Nineteen out of the 24 patients complained of painful breathing, and 5 of them suffered from painful prostate cancer. We analyzed the degree and duration of the pain-killing/analgesic effect, and the changes of lesions by repeated bone scan (on 0–3 scale system).
Result: The number of patients/duration of the pain-killing/analgesic effect, (in months) was as follows: 3/3, 15/4–12, 3/12–24, and 3/ > 24. No irreversible side effect was detected — the blood count changes were the same as in the case of single therapy. So there was not any cumulative side effect. No correlation was found between the positivity of bone scintigraphy (the number and/or intensity of the lesions) and the effectiveness of the therapy either.
Conclusion: We can conclude that the mean duration of the pain-killing effect was longer in the case of repeated therapy. There was not any correlation between the severity of the illness and the effectiveness; even in serious cases, long pain-free periods were experienced without any irreversible side effect.

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EFFICACY OF REPEATED USE OF SM-153-EDTMP FOR PAIN PALLIATION IN PATIENTS WITH BONE METASTASIS OF BREAST CANCER

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Backround: The objective of this study was to evaluate therapeutic efficacy and bone marrow toxicity of repeated application of Samarium-153-ethylene-diamine-tetramethylene phosphonate (Sm-153-EDTMP) for bone pain palliation in patients with multiple bone metastases from breast cancer.
Material and methods: 22 consecutive patients with painful multiple bone metastases and significant (mild: n = 7, good: n = 11 or excellent: n = 4) pain relief without severe hematological side effects after a standard therapeutic dose of Sm-153-EDTMP were enrolled in a prospective study. All patients had repeated injection of Sm-153-EDTMP. The second activity was the same as the first one. Between the two applications of Sm-153-EDTMP chemotherapeutic protocols were continued. The therapeutic effect and hematological toxicity (using NCI toxicity index) of the first and the second injection of Sm-153-EDTMP were compared. The therapeutic effect was evaluated by using Karnofsky performance score and duration of pain palliation, using interviews before and after 18 weeks of the treatment.
Results: The second treatment was effective in all patients. No differences of improvements on Karnofsky scale were found. The numbers of patients with mild, good or excellent pain relief were 9, 9 and 4 respectively. The mean duration of pain reduction after the first and the second therapeutic dose was 14.2 and 13.4 weeks ($p > 0.05$). There were no statistically significant differences in the decrease of granulocytes and platelets, but red blood corpuscles were moderately fewer after the second injection.
Conclusions: The second application of Sm-153-EDTMP is of the same therapeutic efficacy (in terms of pain palliation and duration of effect) and is characterized by similar bone marrow toxicity.

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SPECT CT EXAMINATION OF ASPECIFIC MDP CUMULATIONS

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Background: We aimed to evaluate the etiology of aspecific cumulations detected on bone scintigraphy by the SPECT-CT imaging system.
Material and methods: We used the data of 17 patients obtained by 99mTc-MDP bone scintigraphy, in the period between September 2007 and March 2009. The selected patients were detected with aspecific cumulation not related to bone tissue. In order to define the exact anatomical position and etiology of the cumulation, a SPECT-CT examination was performed. Most of the bone scintigraphy examinations of these 17 patients were carried out for control purposes or staging known malignancies. The remaining group was examined for bone pain of unknown origin.
Results: In 7 cases the increase of radiopharmaceuticals was due to/because of malignancy. In 6 patients aspecific enrichment was proven to be of benign origin. In 4 patients isotope accumulation was due to urine flow obstruction in the upper urinary tract.
Conclusion: SPECT-CT imaging is an effective examination to diagnose cumulation detected using bone scintigraphy unrelated to bone structure. In most of the cases it revealed the benign or malignant origin of the lesion and could be utilized to recommend further adequate diagnostic procedures.

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WHOLE BODY BONE SCINTIGRAPHY IN ASSESSING THE THERAPEUTIC EFFECT OF BIPHOSPHONATES IN PATIENTS WITH BONE METASTASES

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Background: The aim of this retrospective study was to evaluate the role of whole body bone scintigraphy (WBS) in monitoring the therapeutic effect of biphosphonates in patients with documented multiple bone metastases.
Material and methods: 24 patients (7 males and 17 females, aged 51 to 83 years) were studied. Thirteen of them had breast cancer, 5 had lung cancer and 6 had prostate cancer. Two WBSs (after *i.v.* injection of 740 MBq Tc-99m-MDP) were performed in each patients: the first one before the start of the treatment with new-generation biphosphonates (ibandronic acid, zolendronate or pamidronate) and the second one 6 months thereafter. The number and intensity of scintigraphic lesions were compared in all patients.
Results: After biphosphonate treatment no bone lesions were visualized in 3 (12.5%) patients; the number and/or the intensity of the lesions were decreased in 9 (37.5%) patients; no change was seen in 5 patients (21%). Seven patients (29%) showed progression on bone scintigraphy.
Conclusions: A total of 50% of patients had a complete or partial scintigraphic improvement after biphosphonate treatment. The whole body bone scintigraphy is a useful imaging modality for assessing the effect of the biphosphonate therapy in patients with bone metastases. The clinical significance of "bone scintigraphic remission" needs further investigation.

IMAGING

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THE ROLE OF BONE SCINTIGRAPHY IN THE DIAGNOSIS OF SAPHO SYNDROME

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Background: SAPHO syndrome includes a variety of inflammatory bone disorders that may be associated with skin changes, such as Synovitis, Acne, Pustulosis, Hyperostosis and Osteitis. Bone scintigraphy can play a significant role in the diagnosis beside other imaging methods. The aim of our work is to draw attention of SAPHO syndrome through the introduction of two cases, since the complex and varied symptoms can be confusing.
Material and methods:
1st patient: 51-year-old male, who had signs of local inflammation on the left and right shins at the age of 20for the first time and at the age of 21 for the second time, respectively. These symptoms recurred several times a year. Later, symptoms characteristic of acne and pustular changes appeared on the skin. Occasional nonsteroid therapy had a positive effect on the clinical symptoms, however antibiotics were ineffective.
The 3-phase bone scintigraphy shows a 10–12 cm long increased activity in the blood-pool and bone phase in the middle part of the diaphysis of the left tiba, proving the irritation.
2nd patient: 38-year-old female. A year ago, the medial end of her right clavicle became swollen and, in addition, acne and pustulosis appeared in the gluteal region. The laboratory examinations did not yield pathological results. The bone scan showed increased isotope accumulation in the right sternoclavicular joint.
Results/Conclusions: Although SAPHO syndrome has no specific therapy, recently several publications have reported positive effects of biphosphates. The precondition of using the appropriate therapy is a correct diagnosis, bone scintigraphy playing an important role in making it.

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THE MINIPET PROJECT IN DEBRECEN

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Background: The examination of small animals using high resolution *in vivo* imaging methods is a crucial tool in pharmaceutical research projects. Too suffice this demand, a full ring small animal PET camera (MiniPET-II) has been built in our Institute as part of succesive R+D projects.
The aim of the study was to develop a complete hardware and software system supporting 3D PET-data acquisition, image reconstruction, image processing and evaluating the performance parameters of this scanner according to the guidelines of National Electrical Manufacturers Associations (NEMA) NU-4 standards.
Material and methods: The fully modular MiniPet-II scanner consists of 12 detector modules in a single ring with LySO scintillator crystal blocks and position sensitive PNTs. Each crystal block comprises 35 × 35 pins of 1.27 × 1.27 × 12 mm size. Detector signals are processed by FPGA based digital signal processing boards with embedded Linux operating system.
Results: Using cluster technique we have implemented a network based data aquisition system comprising embedded Linux environment of the detectors and data aquisition computer. A signal processing software controls the processing of the primary data. To support the image reconstruction, software was developed capable of running either on multi-core computers, clusters and computers equipped with graphical processing units as mathematical co-processors. Performance parameters were evaluated by NU-4 protocols.
Conclusion: Based on the successful performance test measurements and the first biological studies the MiniPET-II scanner is an appropriate *in vivo* imaging tool supporting small laboratory animal investigations.

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GPU TECHNOLOGY IN MEDICAL IMAGING

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Background: R&D projects by the Institute of Nuclear Medicine of the University of Debrecen comprise the development of PET-related data acquisition, image reconstruction, image processing software libraries, and test applications. An important task of this kind is to study how the 2D–3D image reconstruction, noise-reduction, and image registration methods can be implemented on HPC platforms. The application of a graphics processing unit as multiprocessor system is one of the most important HPC solutions, because GPU's computational performance is 2 orders of magnitude larger than that of CPU.
The aim of the study was to develop special software components running on GPU hardware, significantly reducing the processing time of common 2D–3D iterative image reconstruction, 3D image filtering, manipulation, and image registration algorithms.
Results: The developed components are part of a larger multimodal imaging package developed by our institute. The easy to use and well scalable nVIDIA's hardware and CUDA software architecture have been used, because they have remarkably good price/value ratio. Our results affect three image processing areas. The new PET-reconstruction component allows a reduction by factor of 8 the reconstruction runtime as compared to the conventional, CPU-based solutions. The running time of GPU directed image manipulation and most of the 3D image filter algorithms were ~300 times faster than the same operations by an average computer, without GPU support. The cost-function calculation of the automatic image registration has been successfully improved.

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DEVELOPMENT AND ERROR-ANALYSIS OF SINOGRAM CORRECTION METHODS FOR MINIPET-II

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Background: The examination of small animals using high resolution in-vivo imaging methods is a crucial tool in pharmaceutical research projects. To suffice this demand, a small animal PET camera has been developed in our institute as part of a R+D project. The implementation of image reconstruction components was an important part of the development. In order to reduce the high time- and computation-demand of the full 3D reconstruction, data acquired in 3 dimensions have to be separated into 2D slices (rebinning) followed by 2D filtered backprojection (FBP) and iterative reconstruction algorithms. Our detector system is polygonally shaped, thus the sinograms we use for 2D reconstruction are not continuous, which may interfere with the reconstruction process.
The aim of the study was the adaptation and analysis of the methods for the estimation of missing data in the sinograms of polygonal detector systems, and the elaboration of a new method based on special segmentation techniques.
Results: We succeeded in working out a new mathematical algorithm to generate the missing data used during image reconstruction. This method was compared to 3 conventional procedures using real and simulated data. The traditional single slice method was used for the rebinning followed by the FBP and ML-EM image reconstruction algorithms. The comparison was carried out applying profile curve and ROI analysis.
Conclusions: The performed tests revealed that our method provides results similar to those by conventional methods and, at the same time, it has the benefit of having lower noise sensitivity.

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INTERRELATIONSHIP BETWEEN ACQUISITION TIME AND LESION DETECTABILITY BY TIME-OF-FLIGHT PET/CT CAMERA

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Background: Lesion detectability depends on several factors such as the amount of the injected pharmaceutical, body/mass index (BMI), acquisition time per bed position (ATB), lesion to background accumulation ratio (T/B ratio), etc. With TOF PET cameras ATB is usually about 1 minute but only limited information is available how the image quality changes using different timing.
Material and methods: The studies were carried out on Philips Gemini TF 64 PET/CT camera. Images belonging to 10, 30, 60, 90, 120, 150 and 180 sec exposition times were reconstructed from list mode stored data and further analysed by visualization software of the manufacturer and a Matlab program.
Results: Analysis has shown that small lesions (≤ 4 mm) with T/B ≥ 5 are easily detectable using as short as 30 sec data acquisition. Larger lesions (≥ 4 mm) of similar accumulation ratios can be visualized even in 10 sec ATB. However, if T/B = 2–4 (e.g. lesion next to the liver), detection requires longer acquisition time (ATB = 1–3 min.)
Conclusions: Setting acquisition time belonging to different tissue regions in a way as detailed above, total scan time may be much shorter compared to the 10.15 min standard. Under these conditions good quality images and standard examination time can be achieved by using less than the usual FDG dose. This could result in a decreased radiation dose and decreased radiopharmaceutical demand.

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NOVEL OPPORTUNITIES IN NUCLEAR MEDICINE PROVIDED BY THE INTERNET

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Background: The birth of Web 2.0 opened a new chapter in the history of the Internet. Since 2004, a large number of services have been developed which emphasize collaboration, communication and creativity. Facilities provided by this "social Web" may be utilized in higher education and patient education. To examine these opportunities, we founded our diagnostic imaging blog, called Tomographyblog.com, in 2007. Later, we developed a search page and a community portal.
Material and methods: We registered our blog with a free service provider, and since then we have been informing our audience about the latest in diagnostic imaging. We hosted a four-week educational quiz in partnership with the University of Debrecen Nuclear Medicine Department during the Fall semester of 2007/2008. Our search page, SeekRadiology.com, puts all the relevant search engines in diagnostic imaging on an easy-to-use webpage. Our community site, NuklearisMedicina.hu, aims to provide information for patients and to facilitate learning, but it also offers content for professionals.
Results: Our blog is one of the most popular diagnostic imaging blogs with over 7000 visitors per month. The quiz got 561 visitors and 26 students sent in answers at least once. Traffic on SeekRadiology.com is around 150 per day, while NuklearisMedicina.hu is currently in beta testing.
Conclusion: Web 2.0 may facilitate medical education and it can help improve the efficiency of patient education as well. These opportunities may be employed in any area of medicine, but it is vital that doctors and other experts create this content.

RADIOPHARMACEUTICALS

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KIT-FORMULATED THERAPEUTIC RADIOPHARMACEUTICALS

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Background: The aim of the kit formulation is to perform 'on-the-spot' radiolabelling reactions, providing immediate use of therapeutic agents. Two kit-formulated active substances, EDTMP and sodium phytate, were investigated using various radionuclides.
Material and methods: Active substances were preapred according to GMP. ^{90}Y, ^{153}Sm, ^{165}Dy, ^{166}Ho, ^{169}Er, ^{177}Lu were used as labelling radionuclides. Radiochemical purity was measured by radio-TLC methods. The particle size limit of suspensions was determined by filtering.
Results:
1. Kit-formulated EDTMP: The kit, if stored in a refrigerator, is stable for 36 months. Higher than 98% labelling efficiency could be achieved using ^{90}Y, ^{153}Sm or even ^{177}Lu. The radiochemical purity of labelled ^{90}Y- and ^{153}Sm-EDTMP, stored at ambient temperature, is higher than 95% after 24 hrs, while ^{177}Lu-EDTMP is stable at ambient temperature for 30 days. The stability of radioactive complexes obtained by labelling the kit-formulated EDTMP are significantly higher than that of the ready-made ^{153}Sm-EDTMP.
2. Kit-formulated phytate: Radiocolloids of a particle size of 0.2–1.5 μm were obtained within 1 hour. The radiochemical purity of phytates exceeded 98 % and 95%, just after labelling and within 3 hrs, respectively. Leakage values of ^{90}Y-, ^{165}Dy, ^{166}Ho- and ^{169}Er-phytate from rabbit knee after 2 hrs p.i. were 1.8; 0.9; 1.2 and 1.3%, respectively. Leakage of ^{166}Ho-holmium phytate in humans was found lower than 0.72% after 3 days.
Conclusions: Although the application of the kits requires more care and work in the hospital's hot lab, kit formulation can be considered rather a promising approach than a blind path.

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AN ALTERNATIVE METHOD FOR ALIPHATIC NUCLEOPHILIC RADIOFLUORINATION

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Background: Aliphatic nucleophilic substitution with [^{18}F]fluoride ion can be highly efficient; and under favourable circumstances yields may be quantitative. These reactions are usually performed in a polar aprotic solvent such as acetonitrile, DMSO, etc. Despite the good reactivity of anhydrous [^{18}F]fluoride in this medium , the method has some drawbacks. Fluoride can cause the elimination of alkyl halides or alkyl sulfonates to alkenes, and hydroxylation can occur to alcohols because "naked" fluoride can act not only as a nucleophile but also as a base. In general, as the dryness and therefore nucleophilicity of the [^{18}F]fluoride ion increases, there is an increasing tendency for its adsorption onto reaction vessel walls, which decreases the overall radiochemical yield.
It has been reported that ionic liquids containing imidazolium cations can act as powerful media in some catalytic organic reactions to accelerate reaction rate and improve selectivity. Recently, it was reported that tert-alcohol solvents show good performance in nucleophilic fluorination, allowing side reactions to be remarkably suppressed via a weak F-H hydrogen bond, which maintains the inherent nucleophilicity but reduces the basicity of the fluoride. More recently a synergistic effect in nucleophilic fluorination was demonstrated when ionic liquid and tert-alcohol were combined into one molecule.
Material and methods: We have synthesised a combined catalyst molecule (1-(2-hydroxy-2-methyl-n-propyl)-3-methylimidazolium mesylate, and tested it in some aliphatic nucleophilic substitutions.
Results and conclusions: We have demonstrated the viability of the new concept, but we need an extensive optimisation of this method to develop it into a competitive alternative of the current radiofluorination.

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SYNTHESIS OF L-[METHYL-^{11}C] METHIONINE FOR HUMAN DIAGNOSTIC PURPOSES

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Background: L-[methyl-^{11}C]methionine (MET) is a useful aminoacidic tracer for the diagnosis of brain tumors. Most brain tumor examinations are based on MET, found to be more accurate in imaging the extent of brain tumors than FDG and conventional CT. PET examinations were carried out between 1997 and 2004 in Hungary with MET produced by the Institute of Nuclear Research. Moving of the PET Centre to a new building necessitated the development of a fast, high-yield, automatic synthesis method.
Material and methods: For the production of MET we use materials suitable to GMP, if possible pharmacopoeia quality. The $^{11}CO_2$ content of the irradiated target gas is first converted into ^{11}C-methyl iodide in a gas phase reaction. In the new synthesis module using sterile, disposable syringes and tubing ^{11}C-methyl iodide was converted into MET. Due to the catalyst, we only get L-form without any byproduct. We obtain the isotonic concentration by adding physiological saline and purifying the product on SPE cartridges. The QC and the release of the product take place according to the European Pharmacopoeia.
Results: 5 minutes after the ^{11}C-methyl iodide gas phase synthesis (12 minutes) purified MET is obtained in an isotonic solution. After 20 minutes' bombardment (30 μA) 3594 $\pm$ 1464 MBq MET is synthesized (n = 5). The QC found 100% enantiomeric purity, > 99% radiochemical purity and 100% radionuclidic purity. Our institute has recently obtained the Marketing Authorization of the L-[methyl-^{11}C]methionine (MET-PET injection).
Conclusions: Since March 2009, the human diagnostic PET investigation of brain tumors has been re-set in Debrecen, using the MET-PET injection produced by our institute.

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ASCORBIC ACID STABILIZER EFFECT TO REDUCE RADIOLYTIC FDG DECOMPOSITION

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The 2-deoxy-2-[^{18}F]fluoro-D-glucose (FDG) has been widely used in nuclear medicine for diagnostic studies with positron emission tomography (PET). Due to the relatively short (109 min) half-life of the ^{18}F isotope, this compound has to be produced in large quantities, at high radioactivity concentration. Usually the initially prepared radioactivity concentrations of FDG are 10 to 50 times higher than actually required at the time of administration. The decomposition of radiopharmaceuticals depends on high levels of radioactivity and specific activity. FDG becomes unstable in highly radioactive solutions and alkaline pH and at higher temperatures. The ionizing radiation emitted from the ^{18}F isotope in water solvent and air makes hydrogen peroxide accelerate the FDG decomposition rate and therefore shortens the useful shelf life of the radiopharmaceutical. The objective of our study is to monitor the degradation of FDG at various radioactive concentrations by determining radiochemical purity at different time intervals, and to assess the effects of ascorbic acid as a stabilizer for FDG preparation. The results of the study show that the ascorbic acid as antioxidant agent is an effective stabilizer.

PRECLINICAL STUDIES

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DRUG INTERACTIONS, TOXICITY DATA AND FEASIBILITY ASPECTS OF SPECT/CT EXAMINATIONS IN DOGS

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Background: Combining the advantages of morphological and functional imaging the so called fusion (or hybrid) imaging is a novel diagnostic tool in more developed human oncological centers. The same technique and instrumentation is theoretically very useful in localizing, staging and following-up canine oncological cases as well. Only few data exist currently whether or not rapid intravenous injections (e.g.intravenous anaesthetics, intravascular contrast agents and radiopharmaceuticals) haveany interactions, side effects or limitations of detection during an intervention.
Material and methods: Client-owned dogs, altogether 18, were referred to SPECT/CT examination at our Institute, with different known malignant diseases. The dogs were sedated (propofol and diazepam iv), and injected with different radiopharmaceuticals 20–50 MBq/10 bwkg (^{99m}Tc-MIBI, ^{99m}Tc-DMSA(5), ^{99m}Tc-MDP, Medi-Radiopharma Ltd., Hungary). All the dogs were also given intravascular contrast agent in a dose of 0.5 g iodine/bwkg (Iomeron, Bracco, Milan, Italy). Fusion images were taken, evaluated and before and, immediately after data acquisition, haematological and biochemical parameters were checked.
Results: During and after the examinations, no unusual clinical signs were observed and no significant changes were detected between the blood parameters. All the 18 dogs tolerated the procedure well and the required data were ready for analysis. No chemical and in vivo interactions were recognized during the procedure.
Conclusions: Based on the above it can be concluded that the novel type of SPECT/CT hybrid imaging is feasible in dog patients. This diagnostic imaging technique is harmless and provides important information for veterinary oncologists as well.

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DETERMINATION OF TUMOR SIZE AND PERFUSION AS *IN VIVO* BIOMARKER IN THE TREATMENT OF MOUSE TUMOR MODELS

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Background: We examined the possibilities of monitoring lesion size and blood perfusion as biomarkers for mouse tumor model treatments. We decided to use quantification of uptake and size as marker of perfusion.
Material and methods: Studies have been performed using the dedicated multiplexed multipinhole SPECT/CT small animal imager. 10 MBq of 99mTc-protein colloid (Nano-Albumon) was injected intravenously for 6 SCID mice implanted with hepatoma cells in the spleen metastatizing to the liver. For CT scans, eXiaTM was used as a liver agent. SPECT/CT scans were made 3h post injections. Subcutaneous tumor models were represented by 3 × 5 mice with subcutaneous melanoma with two types of treatment, erythropoietin plus Avastin (E + A) or Avastin (A) alone. Animals were scanned at start and 1 week post start of therapy. Hepatomas were treated with a proprietary derivative of Avastin. Tumor perfusion was defined as absolute activity content in the tumor compared to one part of the (clearly identified) aorta.
Results: In all mice metastatic liver tumor foci were visualized as cold spots while CT identified the contrast-enhancement in all lesions. We could not find significant difference between tumor size reduction in E + A and A treatments that however in turn differed significantly from untreated control.
Discussion: Multiplexed multipinhole helical SPECT is an excellent tool to perform in and *ex vivo* non invasive studies in small animals. This method allowed accurate identification of *in vivo* biomarkers of a model for further therapy screening.

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SCINTIGRAPHIC DETECTION OF SPLENIC TISSUE AFTER SPLEEN PRESERVING SURGICAL TECHNIQUES IN CANINE MODEL

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Background: Spleen preserving techniques performed for the surgical treatment of traumatized spleen may prevent serious postoperative complications, such as Overwhelming Postsplenectomy Infection (OPSI) Syndrome or Disseminated Intravascular Coagulation (DIC). Investigation into the restoration of splenic function could help in human clinical practice to find non-invasive methods for the detection of possible hyposplenic-asplenic states/conditions. We tested whether scintigraphy with denatured red blood cells (RBCs) is suitable for the detection of functioning splenic tissue in beagle dogs.
Material and methods: Tc-99m labeled RBCs were denatured by stannous chloride and heat treatment was adapted for dogs. The efficiency of the imaging method was tested in six groups: whole spleen was retained (sham-operated) or removed (splenectomy) (n = 1–1), 1/3 or 2/3 part of the spleen was resected (n = 2–2), 5 or 10 spleen-chips were reinserted into the greater omentum by Furka's method following splenectomy (n = 2–2).
Images by a two-headed gamma camera were started with dynamic series simultaneously from anterior and left lateral views, then SPECT acquisition followed. From the dynamic series parametric images of change rate were calculated. Tomographic images reconstructed using OS-EM algorithm were attenuation-corrected using Chang's method, and the total uptakes of foci accumulating radiopharmaceutical were expressed as fractions of injected dose.
Results: The parametric images of animals showed that the scintigraphic method specifically visualized splenic tissue (where activity increased with time). 77% of autotransplanted spleen-chips were visualized with varying uptake values.
Conclusion: Scintigraphy with labeled denatured RBCs proved to be capable of detectingfunctioning splenic tissue in a non-invasive way.
Grants: OTKA T-049331, ETT 387/2006.

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CHROMATOGRAPHIC AND BIOLOGICAL ANALYSIS OF ^{99M}TC-SESTAMIBI PREPARATIONS

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Background: Our aim was to compare the impurity profiles of various ^{99m}Tc-sestamibi preparations by using radio-HPLC, radio-TLC, radio-PC and the cardiac uptake evaluated in rats.
Material and methods: We used the current European Pharmacopoeia methods and the European Pharmacopoeia reference standard for comparison of various ^{99m}Tc-sestamibi preparations. The following compounds were evaluated: Cardiolite®, Medi-MIBI 500 micrograms, CARDIO-SPECT, TechneScan Sestamibi, European Pharmacopoeia reference standard: Sestamibi Labelling Kit CRS. All the kits were labeled according to their instructions. In rats, the standard biodistribution was evaluated. All the chromatographic evaluations were focused to determine the three main impurities having a given limit value in the European Pharmacopoeia. For impurity A ([^{99m}Tc]O_4^-) radio-TLC, radio-HPLC, for impurity B (^{99m}Tc in colloidal form) radio-TLC, radio-PC and for impurity C ((OC-6-22)-pentakis[1-(isocyano-κC)--2-methoxy-2-methylpropane][1-(isocyano-κC)-2-methylprop-1-ene][^{99m}Tc]technetium (1+)) radio-HPLC were used. The radiochemical purity (^{99m}Tc-Sestamibi) was estimated from the results of the three different chromatographic methods.
Results: All the studied products have radiochemical purity above the European Pharmacopoeia limit value (minimum 94%). However the impurity profiles showed differences concerning the amount of impurity C. Cardiac uptake in rats ranged between 1.2–2.0% of injected dose.
Conclusion: Different radio-chromatographic methods (especially radio-HPLC) combined with biodistribution studies provide adequate information about the impurity profile and the required pharmaceutical quality of various 99mTc-sestamibi preparations used daily in the nuclear medicine practice. In our experience, these widely used methods are also useful in the development of new radiopharmaceuticals.
Acknowledgment: This work was partially sponsored by the New Hungary Development Plan supported by the European Union.

CLINICAL STUDIES

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RENAL CAPSULE PARATHYMIC LYMPH NODE COMPLEX: IMAGING OF A NEW IN VIVO METASTATIC MODEL IN RATS WITH ^{18}F-FDG

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Background: In our experiments, we wished to prove — using mini-PET, autoradiography and organ distribution examinations — that rat hepatocarcinoma (He/De), and mesoblastic nephroma (Ne/De) cells give metastases to the parathymic lymph nodes.
Material and methods: 10^6 He/De or Ne/De cells were placed under the capsule of the left kidney. Two weeks after implantation, control and tumor-bearing rats were anesthetized and a radioligand, ^{18}FDG (15.0 MBq), was injected *i.v.* For autoradiography, 60 μm thick cryostate sections (Leica cryomacrotome) were cut and exposed to phosphor imaging plates. Results were expressed in intensity pixel units. For organ-distribution, different tissues were removed and their activities were measured. The radioactivity of the samples was used to determine the differential absorption ratio (DAR).
Results: By taking the pixel density of resting striated muscle as one unit, the relative pixel densities were in decreasing order: 14.23 in He/De tumor, 10.82 in parathymic lymph nodes, 5.36 in kidney, 2.35 in blood and 1.57 in liver. In the case of the Ne/De, the results were the same. The DAR values also showed that the majority of the radioactivity was accumulated in the tumors and in the parathymic lymph nodes.
Conclusions: From the autoradiographic, phosphor image and tissue distribution experiments, we concluded that He/De and Ne/De tumors grown under the capsule of kidney represent a significant metastatic burden manifested primarily in parathymic lymph nodes. The renal capsule and parathymic lymph node complex seems to be suitable for the isolated *in vivo* examination of metastatic development and for the detailed analysis of secondary tumors.

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SIGNIFICANCE OF SPECT/CT IMAGING IN THE SPECIFIC METHODS OF NUCLEAR ONCOLOGY

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Background: There are many specific methods in nuclear medicine to verify the different tumors on the basis of metabolic changes, hormonal synthesis or receptors overexpressed on the surface of tumor cells. Does fusion imaging give more information in that case?
Material and methods: Scintigraphy completed by SPECT is a tomographic technique to image local radioactive tracer distribution in tumor tissue to indicate functional changes. In the case of specific binding of radiopharmaceuticals to the tumor cells, very few other structures are seen in the picture. Multimodality equipment (SPECT/CT, PET/CT) is used to try and solve this problem.
Results: This presentation reports about almost 2 years of experience with the first Hungarian multislice SPECT/CT (DHV/CT, Mediso). We evaluated the exact localization of parathyroid adenomas (93), somatostatin receptor content of the lung and GEP tumors (48), adrenergic receptor density of neuroendocrine tumors ($^{23\,131}$I-MIBG + $^{20\,123}$I-MIBG), iodine accumulation of the remnant and metastases of thyroid cancer after high-dose ^{131}I treatment (102). Some studies have demonstrated that the information obtained by SPECT/CT is more accurate in evaluating patients than the ones obtained from either SPECT or CT alone.
Conclusion: SPECT/CT systems provide both the functional information from SPECT and the anatomical information from CT in a fusion examination, which increases the success of the therapy. It plays a very important role in the differential diagnosis of the tumors and the improvement of the specificity of methods in nuclear medicine.

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THE SIGNIFICANCE OF SPECT/CT IN THE DIAGNOSIS OF PARATHYROID ADENOMAS

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Background: The aim of our study was to determine the role of ^{99m}Tc-pertechnetat and ^{99m}Tc-MIBI scintigraphy using planar, subtracted, SPECT and SPECT/CT scans in the diagnosis and localisation of parathyroid adenomas.
Material and methods: 50 hyperparathyroid patients were observed. Fifteen and 120 minutes after the injection of 370 MBq 99mTc-MIBI, planar scans of the neck and mediastinum were performed, with subtraction (99mTc-MIBI/99mTc-pertechnetat) in both phases, and 90 minutes after the injection with the completion of SPECT/CT examination.
Results: In 22 cases planar, subtracted, SPECT and SPECT/CT scans were positive. In 10 patients, parathyroid adenomas were successfully extracted and proved by histology. Nineteen cases were negative in all examinations. Even so, 1 patient was operated on and histology did not find parathyroid tissue. Besides the negativity of planar and subtracted scans, SPECT and SPECT/CT examinations were positive in 5 cases. In 1 case, the SPECT image was positive besides the negativity of planar and subtracted scans, but SPECT/CT did not show adenoma in the location of increased cumulation. In 2 patients, on the basis of suspect planar and subtracted scans, SPECT and SPECT/CT and successful operation confirmed the diagnosis in 1 case, but in the other one SPECT and SPECT/CT did not support the initial diagnosis. In 1 case, besides the positivity of planar and subtracted scans, SPECT and SPECT/CT were negative.
Conclusions: In addition to planar and subtracted scans, a SPECT image increases the specificity and sensitivity of the method but accurate localisation, insured by SPECT/CT, is the key to a successful operation.

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COMPARISON OF TL-201 AND NITROGLYCERIN-AUGMENTED T

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Background: Tl-201 and nitroglycerin-augmented Tc-99m-tetrofosmin scintigraphy (Ngl-TF) are used for rest myocardial perfusion scintigraphy (MPS) to evaluate myocardial viability in patients with ischaemic heart disease (IHD) and fixed perfusion defects on stress MPS. Our aim was to compare the results of rest MPS using Tl-201 and Ngl-TF by quantitative myocardial SPECT.
Material and methods: 47 patients (12 female, 35 male, median age: 636 ± 32 years) with angiographic evidence of IHD and fixed perfusion defects on ergometric stress MPS were enrolled in the study. Rest MPS with Tl-201 and rest Ngl-TF were performed within two weeks using a dual-head SPECT system and quantitative analysis (Emory Tool Box, 17-segments model, 5-point score system, normal database).
Results: We analysed 799 segments, 411 (51.4 %) of which had normal uptake on both scintigraphy, 252 (31.6%) had decreased uptake of both radiopharmaceuticals. In 136 cases, (17.0%), segments uptake of Tl-201 and TF were different, 91 segments (11.4%) had normal Tl-201 but decreased TF uptake. The number of segments with abnormal Tl-201 but normal TF uptake was 45 (5.6%). However, the mean severity of perfusion defects of Tl-201 and TF did not differ significantly (1.78 and 1.81 respectively). Discrepancies in the uptake of the two radiopharmaceuticals were significantly more frequent in the anteroseptal region.
Conclusion: The extent of perfusion defects on resting Ngl-TF is larger than that on Tl-201 scintigraphy. Tl-201 seems to be more sensitive in detecting viable myocardial segments. The follow-up of these patients after revascularization is needed to evaluate clinical relevance of our observation.

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MYOCARDIAL PERFUSION SPECT AND CORONARY CTA CUMULATIVE EFFECT COMPARED TO "GOLD STANDARD" ICA

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Background: Myocardial perfusion SPECT has been one of the most accurate examinations in the diagnosis of ichaemic heart disease, but sometimes it has lead to unjustified invasive coronary angiographies. 64-slice CT angiography (CTA) has become a reliable diagnostic method of coronary artery disease, but it has also resulted in false positive investigations.
Material and methods: We compared the CTA, SPECT and ICA findings of 30 patients (18 males, 12 females, mean age: 58 ± 9 years), who had undergone all of the 3 examinations within 6 months. An important precondition was that CT and SPECT preceded ICA. We applied a Phillips Brilliance PET/CT scanner for the CT examination and we determined the coronary lumen using quantitative coronary analysis. The coronary tree was dissolved on the basis of the 16-segment coronary model. Narrowing of the coronary lumen by more than 50% was regarded to be significant. Myocardial perfusion tests were carried out under dipyridamole loading. The perfusion images were evaluated using Emory Tool Box Software. We determined cumulative CTA and SPECT per segment sensitivity, specificity, and positive predictive and negative predictive values.
Result: Examining the two non-invasive methods together we found a significant improvement of PPV, but due to the small sample, these results should be interpreted with care. Since NPV is high in both CTA and SPECT, there was no significant change in these values.
Conclusion: The two non-invasive methods, CTA and stress SPECT, can be successfully combined to exclude false positive values, which can also help us to reduce the number of unjustified ICAs.

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DIAGNOSTIC USEFULNESS OF QUANTITATIVE ECG-GATED MYOCARDIAL PERFUSION SCINTIGRAPHY IN ISCHEMIC HEART DISEASE

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Background: The aim of our study was to evaluate the usefulness of the quantitative resting ECG-gated SPECT (R-gSPECT) in stress myocardial perfusion scintigraphy (MPS) to diagnose ischemic heart disease (IHD).
Material and methods: 30 patients with IHD were studied. The patients underwent coronary angiography (CAG) within two months. Stress-rest MPS with R-gSPECT was performed (one-day protocol, 500 + 900 MBq Tc-99m-tetrofosmin, GE-Infinia-Xeleris). Emory Cardiac ToolBox and QPS/QGS (Cedars-Sinai) programs were used for quantitative evaluation. Perfusion, motion (M) and systolic thickening (T) of the 510 myocardial segments (17-segments model) were evaluated quantitatively with score-systems.
Results: 298 segments had normal perfusion, 121 segments had reversible, and 91 had fixed perfusion defects. In 298 segments with normal perfusion, decreased M was found in 32 (10.7%), decreased T in 16 (5.3%) cases. These abnormalities were moderate; two-thirds of them were located in the septal region. From 121 ischemic segments 19 (15.7%) showed decreased M, and 17 (14.0%) decreased T. In 91 segments with fixed perfusion defect 52 (57.1%) had decreased M and 40 (44.0%) decreased T. The frequencies of decreased M and T were higher in segments with severe perfusion defect (73.3% and 66.6%, respectively).
Conclusions: Quantitative R-gSPECT improves the accuracy of MPS. Based on comparison to CAG, it decreases the number of false-negative findings, and significantly decreases false-positive diagnoses of IHD caused by attenuation. It may detect stress-induced myocardial stunning. In the evaluation of M and T of the septum, R-gSPECT is less reliable. M analysis is more sensitive, T analysis is more specific in detecting regional left-ventricular dysfunction.

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DIAGNOSTIC USEFULNESS OF EARLY GATED MYOCARDIAL PERFUSION SPECT

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Background: ECG-gated myocardial perfusion SPECT (GSPECT) gives simultaneous information on myocardial perfusion and global/regional left-ventricular (LV) function in ischemic heart disease (IHD). Ergometric stress can provoke myocardial stunning. We studied the usefulness of early GSPECT (15-G: 15-minutes after exercise) compared to standard GSPECT (60-G: 60-minutes after exercise) in detecting exercise-induced reversible LV dysfunction.
Material and methods: Twenty three patients with IHD were studied. Six had decreased, 17 had normal LV-EF at rest. We performed 15-G, 60-G and resting GSPECT (R-G). LV-EF, segmental wall-motion and systolic wall-thickening of the three examinations were compared using QPS/QGS-program.
Results: Out of the 6 patients with low EF at rest, EF was decreased by 15-G in 5, and by 60-G in 3. Of the 17 patients with normal EF, decreased EF was found in 3 by 15-G and 60-G as well. The decrease was more prominent by 15-G.
In segments with normal perfusion (n = 220), no significant changes of motion/thickening were found. By 15-G decreasing motion in 23%, decreasing wall-thickening in 19% of the segments with ischemia (n = 105) were found — compared to 60-G and R-G as well. In segments with fix perfusion defect (n = 52) further decrease of thickening was found in 25% by 15-G and in 6% by 60-G. (14 segments with "inverse redistribution" were not analyzed).
Conclusions: 15-G is useful in detecting exercise-induced LV-dysfunction. It detects transient decrease of LV-EF more frequently than by 60-G. Worsening of segmental motion/thickening occurs in some ischemic segments. They can be detected by 15-G only. The deterioration of wall-thickening in segments with fixed perfusion defect can be found more frequently by 15-G.

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SIGNIFICANCE OF 99MTC-DTPA EYE SPECT IN PATIENT SELECTION FOR ORBITAL IRRADIATION IN GRAVES' OPHTHALMOPATHY/ /ENDOCRINE ORBITOPATHY

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Background: Therapy remains without any obvious effect in a large proportion of patients with endocrine orbitopathy (EOP). Those with active orbital inflammation usually respond to treatment. Using the DTPA technique before and after irradiation, we measured the inflammatory activity in the retrobulbar region to determine if it was suitable for the selection of patients for this therapeutic modality.
Material and methods: Thirty-two patients with EOP treated with standard external irradiation were included in this retrospective study (age 52.1 ± 11.0 years). Before and within 12 weeks after irradiation, SPECTs were performed (400 MBq DTPA Nucline Xring/4R). Beside visual assessment, the uptake values were calculated. Based on disease-free orbits the upper normal uptake value, was $8 \pm 1 \times 10^{-6}$/ml.
Results: Depending on the change in the DTPA uptake value after vs. before radiotherapy, we assigned the patients into 3 groups: decreased, increased or did not change. The initial DTPA uptake of these groups was significantly different. Improvement was observed only at higher initial values. Comparing the low (< 12) and the high (≥ 12) initial uptake groups, an unexpected rise was observed in the first group after therapy (+ 2.89), while the DTPA uptake decreased in the latter group as expected.
Conclusion: In patients with initially normal DTPA uptake, irradiation had no effect. In these patients, the inflammation might intensify, therefore, in their case, other therapeutic measures should be considered. In contrast, an anti-inflammatory effect of irradiation with high uptake has been shown. The DTPA orbital SPECT is a suitable technique in selecting patients with EOP for irradiation.

TECHNOLOGISTS' SESSION

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DOPAMINE TRANSPORTER SPECT: 123I-FP-BETA-CIT *VS.* ^{99M}TC-TRODAT-1

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Background: Functional imaging with specific dopamine transporter ligands provides a marker for presynaptic neuronal degeneration. Striatal uptake correlates with disease severity and monitoring of progression assists in clinical trials of potential neuroprotective drugs. A comparative study was carried out on two presynaptic dopamine transporter SPECT radioligands with a fast pharmacokinetic profile, 123I-FP-beta-CIT (FP) and 99mTc-TRODAT-1 (TR), in order to assess their differences of uptake.
Material and methods: We performed 30 123-FP-beta-CIT SPECT and within 4 days 99mTRODAT-1 SPECT, in the same subjects using the same standard imaging protocol. On the transversal reconstructed SPECT slices at the level of the basal ganglia, regions of interest were fixed manually in the caudate head and putamen separately; we used the occipital cortex as reference non-specific binding site. The binding potential was estimated by the ratio of the specific to non-specific activity (C/O, P/O). The caudate/putamen ratio was also calculated (C/P).
Results: The mean binding potential with TR in the caudate and putamen was 1.57 (range: 1.45–1.65) and 1.52 (range: 1.45–1.60); with FP these values were significantly higher 4.2 (range: 3.2–4.6) and 3.8 (range: 3.3–4.2). The overall correlation between the two radiopharmaceuticals was significant but the values showed individually large variation (Spearman's rank correlation overall: $p = 0.0002$, C/O: $p = 0.006$, P/O: $p = 0.0288$, C/P: $p > 0.5$). The possible auses are: 1. small range of uptake variations around the normal values (no real pathological data). 2. statistical bias because of the low C/O, P/O values of TR.
Conclusion: 99mTc-TRODAT-1 is applicable but has a lower specific to non specific uptake ratio than 123I-FP-beta-CIT.

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THE SIGNIFICANCE OF MYOCARDIAL PERFUSION SPECT IN TOLNA COUNTY AND ITS PLACE IN IMAGE DIAGNOSTICS

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Background: Based upon our study of Tolna county's statistical data of 2007, we investigated into mortality having occurred in relation with ischemic heart disease. Then we examined the diagnostic role of myocardial perfusion SPECT among the diagnostic imaging techniques. If suspicion of cardiac disease arises, the first imaging technique to be chosen is ultrasound. This is followed by the myocardial perfusion SPECT, which reflects the perfusion relations. The use of MRI and cardio –CT is not yet spread in our region.
Material and methods: In 2007 we examined 560 patients (340 women, 220 men), who underwent dipyridamol stress and rest myocardial perfusion SPECT with 99mTc-MIBI and 201-TlCl. To determine myocardial viability we used the reinjection technique with the patient being in resting position.
Results: With the myocardial perfusion SPECT method, we detected ischemic heart disease in 186 patients and myocardial infarction in13 patients. We performed myocardial viability investigation using the 201-TlCl reinjection technique in 26 patients and we detected ischemia in 13 patients, and viability in 4 cases. In one patient, the myocardial perfusion SPECT showed normal perfusion relations.
In 2007, the mortality figures in Tolna County were as follows: 801 ischemic heart diseases, 754 tumours, 326 cerebral artery diseases, and 192 digestive system diseases.
Conclusions: Ischaemic heart disease is the leading cause of death in Tolna County. Our results prove that because of the national health significance of this disease, its early detection is of great importance and myocardial perfusion SPECT has an outstanding role in confirming the condition.

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PET-CT THROUGH THE EYES OF AN ASSISTANT

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Background: Positron emission tomography is a functional imaging procedure that is capable of depicting the body's biochemical processes with the aid of molecules marked with isotopes that radiate positrons. Today, PET imagers are integrated into CT devices, making it possible to combine the functional images from the PET with the morphological information from the CT in the same anatomical "slices" within the context of one imaging. The major advantage of PET/CT devices compared to earlier diagnostic procedures is that, with their aid, even malignant lesions of a few millimeters in size can be detected. PET/CT exams at the same time make it possible to avoid numerous other examination procedures, and therefore the path to a precise diagnosis may be shortened and treatment can be quicker and more effective.
Material and methods: With our presentation we would like to introduce this new examination method, inform the general public/audience about its basis in physics and follow the path the patient takes from admission, through the injection of the isotope to the examination.
Results: The significance of PET-CT examinations is primarily in the area of oncology, in staging, restaging and detecting reoccurrence.
Conclusions: In many cases, the examination results in the alteration of treatment. This provides the patients with better chances for recovery.

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THE ROLE OF PET-CT IN THE DIAGNOSIS AND TREATMENT OF LYMPHOMA

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Background: By now, it has become part of the daily routine to request for a PET-CT examination completed with diagnostic quality CT as a staging examination, and PET-CT is the preferred method for restaging, too. The aim of this presentation is to show the role of PET-CT imaging using IV X-ray contrast agents in the primary staging of lymphomas, and introducing its indications and areas of utilization. The authors will present the course of the examination and the advantages/disadvantages of its use.
Material and methods: Since 2005, more than 4000 PET/CT examinations were performed in the Pozitron Diagnostic Center for the staging or restaging of lymphoma patients. Only 1% of these scans was completed with diagnostic quality CT.
Results: Based on the fact that the injection of the IV contrast agent makes it possible to determine precisely the size of lymph nodes, it seems indispensable for PET/CTs used in primary staging. This way PET/CT can entirely replace diagnostic CTs utilized for this purpose. At the end of treatment, if the primary tumor has shrunk and shown no FDG uptake, it can be considered as complete metabolic remission. However, if the residual tissue was metabolically active, it might indicate the necessity of further treatment. To demonstrate this phenomenon, the authors will present a few cases.
Conclusion: In the future, FDG PET-CTs, performed with the injection of an IV X-ray contrast agent, are expected to become more frequently used during the course of primary staging for lymphomas and other malignant tumors.

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RADIO-IMMUNOTHERAPY OF NON-HODGKIN LYMPHOMA AT THE NATIONAL INSTITUTE OF ONCOLOGY

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Background: Zevalin therapy has been used in our hospital since 2005 in the treatment of patients with non-Hodgkin's lymphoma.
Indications: Patients with recurrent or therapy resistant CD20+ B-cell non-Hodgkin's lymphoma.
Purpose: "Cross fire" effect, the simultaneous treatment of all involved areas.
Methods:
— radio-immunotherapy;
— antigen: CD20;
— antibody: ibritumomab tiuxetan;
— isotope: Y-90.
Application: Zavalin was given after the second rituximab infusion as an ambulatory injection.
Result: Radiation may kill even tumour cells with surface antigen density insufficient to bind an adequate quantity of antibodies. This kind of treatment does not make the quality of life worse. Zevalin therapy may become an alternative and effective treatment for B-cell non-Hodgkin's lymphoma.

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I-123-FP-CIT: BIOMARKER IN THE DIAGNOSIS OF PARKINSON'S DISEASE — ROLE OF THE TECHNOLOGIST

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Background: Dopamine transporter scintigraphy with I-123-FP-CIT reflects presynaptic dopamine transporters in the striatum and it is a marker for dopaminergic nigrostriatal neuron integrity. Therefore, it has been used in the differential diagnosis of Parkinson's disease and parkinsonism. Our aim was to summarize the task of the technologist in performing an appropriate investigation.
Material and methods: Fourteen patients were studied. Informed consent of the patients is needed. A detailed explanation of the investigation is important, because the cooperation of the patients is essential to avoid motion artefacts. The thyroid uptake should be blocked by peroral iodine solution (or by perchlorate in known iodine allergy). Three to six hours after an injection of 185 MBq of I-123-FP-CIT *i.v.*, SPECT is performed (LEHR collimator, 128 × 128 matrix, energy peak: 159 KeV ± 10%, close proximity of the patient, circular rotation, 64 projections, reconstruction with predefined programs, reorientation, software motion correction, if needed).
Results: In all of our 14 patients good-quality I-123-FP-CIT scintigraphy was performed.
Conclusions: The appropriate knowledge and skills of the technologist are the prerequisites of investigating this special group of patients with motion disorders. A good-quality scintigram results in a diagnostically useful scan, serving the interest of the patient.

SCIENTIFIC POSTERS

ONCOLOGY — THERAPY

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THE EXAMINATION OF THE EFFECTIVENESS OF RFA WITH PET/CT

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Background: In the treatment of liver metastates, the use of radio frequency ablation (RFA), which is accompanied with lower risks, can serve as an alternative to resection. This intervention may be performed in the case of foci that are of precise and definite size and number. During the intervention electrodes are led to the tumor focus, which is heated to a high temperature with the aid of electromagnetic waves. The examination of the effectiveness of RFA is difficult due to the limitations of CT and MR imaging in differentiating a viable tumor from reactive changes. PET/CT offers a possibility to detect residual viable tumor before inflammatory processes develop.
Material and methods: We performed PET/CT exams before and after (within 24 hours) RFA. In addition to the routine PET/CT exams, 3-phase liver exams were performed with the injection of Omnipaq IV contrast agent. The patients required special treatment including the prescribed 24 hours of bed rest.
Results: In our presentation we would like to introduce the cases of two patients who participated in examinations at our Institute before and after the intervention. In both cases the presence of residual viable tumor tissue was confirmed.
Conclusions: Compared to other examination methods, the advantage of a follow-up performed with a PET/CT is that the presence of viable malignant tissue remnant can be determined with great certainty, and therefore the succes of the ablation can be settled in the first 24 hours following the intervention. It offers the possibility of early reintervention.

P1

THE ROLE OF BONE SCINTIGRAPHY IN SELECTING PATIENTS FOR VERTEBROPLASTY

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Background: The aim of the study was to direct attention on the importance of properly selecting patients for vertebroplasty.
Material and method: Radiography was the first examination in all of the patients complaining of vertebral pain. Additional examinations mostly included CT and /or MRI. If on the basis of the morphological image of the vertebrae vertebroplasty was considered, we always performed bone scintigraphy (planar imaging and SPECT). Vertebroplasty was only carried out if increased activity could be detected in the corpus of the affected vertebra.
Results: Vertebroplasty was performed in 18 cases. (In 3 patients it was a second intervention on another vertebra). Six patients had to undergo the operation due to metastases, while in 12 patients the reason for surgery was compression fracture due to osteoporosis. The pain diminished immediately after surgery and all of the patients made long-term recovery.
Conclusion: The authors consider it necessary to perform bone scintigraphy in all the cases of vertebroplasty because the intervention is only effective if the patients are properly selected.

P2

THE REQUIREMENT OF FURTHER IMAGING EXAMINATIONS TO CLARIFY BONE SCAN ABNORMALITIES OF ONCOLOGICAL PATIENTS IN THE AGE OF MDCT AND PACS

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Background: Due to the low specificity of bone scintigraphy, further imaging examinations are frequently required in order to clarify the etiology of positive bone scan findings. MDCT is very useful in the evaluation of bone abnormalities based on high and isotropic resolution. In the frame of oncological staging, cross-sectional imaging modalities have become the standard imaging method of choice. The PACS system allows a good access to these investigations.
Material and methods: Bone scintigraphy images were compared with chest, abdominal and pelvic MDCT examinations of 78 oncological patients.
Results: In 31 cases the lesions were metastatic, while, based on CT appearance; in 32 patients the lesions were benign. In 11 cases the morphology of the lesions was equivocal. In 4 patients the CT has shown no corresponding abnormalities.
Conclusion: In the 80.5% revisiting, CT scans were sufficient to determine whether a positive lesion on bone scintigraphy was benign or malignant. In the case of bone scan abnormalities the comparison with previously performed MDCT images may help to make a final diagnosis without further imaging examinations.

P3

ABSENT CUMULATION OF META-IODO-BENZYL-GUANIDINE (MIBG) IN HISTOLOGICALLY VERIFIED NEUROBLASTOMA IN CHILDHOOD ON THE WHOLE BODY AND SPECT/CT SCAN

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Background: The aim of the study was the examination of absent MIBG cumulation in the primary tumor tissue in cases of verified neuroblastoma in childhood by SPECT/ /CT studies.
Material and methods: Two children were examined after the ^{123}I-MIBG injection. Anterior and posterior whole body scintigraphy and completed SPECT/CT studies of the chest and abdomen were performed.
Results:
1st patient (2.5-year-old girl): solid tumor tissue of 90 × 70 × 50 mm in size was shown by abdominal US examination in December 2008. Distant metastases were found by other imaging techniques. A stage IV neuroblastoma was histologically proved. There was no ^{123}I-MIBG cumulation in the primary tumor tissue, but increased activity was found in other localizations.
2nd patient (3.5-year-old girl): she was observed from August 2006 because of primary neuroblastoma and chemotherapy was given several times. A retroperitoneally localized 45 × 25 mm tumor was detected by US and MRI in December 2008. Surgical state: the tumor connected strongly to the aorta, therefore only a biopsy was performed. Histology: Schwann cell stromal component is ca. 25–30%. Most of the tumor cells were partially or completely differentiated ganglion cell populations. There was not any mitotic activity. The MIBG scan did not show any activity in the retroperitoneal tumor but increased activity was found in the liver with no evidence of liver metastasis.
Conclusion: The voluminous tumor mass, stage IV, well-differentiated tumor cells and the previous chemotherapy could result in false negative ^{123}I-MIBG findings, so the results should be evaluated in the possession of the anamnestic data and the results of other examinations.

P4

ASSESSMENT OF THE EFFECTIVENESS OF RADIOFREQUENCY ABLATION PERFORMED IN THE CASE OF LIVER METASTASES BY USING AN FDG PET-CT EXAMINATION THROUGH PRESENTING THE EXAMPLE OF ONE PATIENT

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Background: FDG PET-CT scans are a routinely recommended procedure for detecting liver metastases in patients suffering from colorectal carcinomas. One method in the treatment of the detected metastases is radiofrequency ablation but its results are hard to verify immediately. Hyperaemia exists around the zone of the intervention for 2–3 weeks, in accordance with which it is possible to detect false positives during a PET-CT examination performed between 1 day — 4 weeks after the treatment. On the basis of the literature, PET-CT examinations performed within 24 hours after the RFA seem to be suitable for assessing its effectiveness, thereby indicating the existence of residual viable tumors before the development of an inflammatory reaction.
Material and methods: We performed PET-CT examinations four times on our patient suffering from a rectal tumor. The third examination was within 24 hours after the RFA of a solitary hepatic metastasis.
Results: At first/initially we suspected a lung metastasis, which was removed. During a follow-up examination in 7 months, we found a solitary accumulation in the liver indicating a metastasis, upon which an RFA was later performed. During the examination made within 24 hours of the intervention we detected an accumulation indicating viable residuum on the edge of the ablated area. The PET-CT examination performed 3 months after that found the progression of the accumulation in question.
Conclusions: The FDG PET-CT examination, in addition to showing the hepatic metastasis sooner than the other imaging examinations, also provided additional information about whether the RFA was complete or not.

P5

ONCOLOGICAL CASES WITH PET/CT

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Several factors should be considered in the analysis of a PET/CT study. Factors such as the circumstances of examination, physical parameters of the scans, distribution of the injected tracer, biological behavior of the basic and associated diseases or the changes induced by previous therapies may influence the final conclusions of the study.
Through case reviews, the authors demonstrate the advantages and limitations of PET/CT imaging.

P6

INTRAOPERATIVE IMPRINT CYTOLOGY IN SENTINEL LYMPH NODES OBTAINED BY RADIOGUIDED SENTINEL NODE BIOPSY IN BREAST CANCER PATIENTS

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Background: Axillary lymph node clearance can be avoided in the majority of breast cancer patient by using radioguided sentinel node biopsy, though in approximately one fifth of the patients the intervention has to be performed in a second operation. The number of these operations can be decreased by intraoperative imprint cytology therefore we decided to introduce this method. The aim of this study was to evaluate the feasibility and efficacy of imprint cytology.
Material and methods: Eighty-five patients with breast tumour (one bilateral) were enrolled in the study. The technique of radioguided sentinel node biopsy was not changed (intra- or peritumoral administration of 150 MBq 99mTc-Senti-Scint, sentinel node mapping, intraoperative gamma probe detection), and we continued to combine it with the blue dye technique. But sentinel node removal was performed first, and the samples were directly carried to the Department of Pathology for imprint cytology, and tumour removal was carried out after all this. We were informed about the result by phone. In case a positive result was reported, we performed axillary block dissection as well.
Results: Imprint cytology was positive in 13 cases, which were all proved by later full examination, but the final results showed metastatic involvement in an additional 7 cases.
Conclusions: If well organized, the method is well applicable, although it slightly extends the time of surgery. In spite of providing false negative result in 8% of cases, imprint cytology made it possible to avoid second operation in 15% of all patients, and no unnecessary intervention was made due to false positive results.

P7

THE ROLE OF ATYPICAL SENTINEL LYMPH NODES

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Background: In patients with malignant melanoma (MM) of the trunk and the extremities the usual locations of sentinel lymph nodes (SN) are the cervical, axillary and inguinal regions. Some authors found SN of atypical localization in 3–10% of the cases.
The aim of this study was to analyze the frequency of atypical SNs and investigate the malignant involvement of these SNs.
Material and methods: Preopeative SN mapping was performed in 665 consecutive MM patients applying 99mTc-nanocolloids (Senti-Scint) using the gamma camera technique. Intraoperative SN location was performed using the gamma probe method.
Results: An atypical SN was found preoperatively in 54 cases (8%): only atypical SN was detected in 11 cases, both typical and atypical SNs were revealed in 43 patients. In 37 cases the biopsy of the atypical SN was performed. Atypical SNs showed MM involvement in 10 cases (27%): in 3 patients only atypical SN was detected, in 6 cases the typical and atypical SNs were also involved, although metastatic MM cells were detected only in the atypical SN with negative typical SN in one patient. More than two-year clinical follow-up was possible in 24 patients: 3 patients died in association with MM (all of them showed MM involvement of both typical and atypical SNs).
Conclusions: We detected atypical SNs atthe same frequency as it was previously described. On the basis of the common MM involvement of atypical SNs, we suggest the biopsy of these SN-s.

P8

INTERESTING CASES OF FDG PET-CT EXAMINATION

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Background: Today, for numerous tumors, PET or particularly PET-CT examinations performed with FDG are procedures routinely utilized in staging and re-staging. They are also used to indicate the location for biopsies, non-invasively estimate the degree of malignancy, confirm or refute recurrence, indicate the target mass for radiation therapy and assess the effectiveness of therapy. In everyday work, we also find quite a few interesting cases of FDG distribution patterns that deviate from the ordinary. In the case of these patients if we do not have sufficient foresight we could even make incorrect conclusions with our opinions.
Materials, methods and results: In our present poster we have disclosed the images of some patients in whom we found a distribution of radiopharmaceuticals during the course of an FDG PET-CT examination that deviated from the ordinary, and that was instructive.
Conclusions: The primary significance of FDG PET-CT examinations with an atypical appearance is that they indicate the doctor the importance of making the diagnosis. In addition to inspecting the images thoroughly, the doctor should always be fully aware of the patient's exact/detailed case history and the reasons for accumulations causing false positives or false negatives.

P9

INOPERABLE PARAGANGLIOMA: A CASE REPORT

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Background: Paraganglioma is a rare neuroendocrine tumor; therefore it is usually difficult to specify its characteristics. Nuclear medicine methods have great importance in the diagnosis of paraganglioma. Our case was a retroperitoneal inoperable paraganglioma identified by CT, but the US guided biopsy was unable to give exact histological characterization.
Material and methods: I-123 MIBG, In-111 Octreoscan, low dose CT and F-18 FDG PET-CT examinations were performed. I-123 MIBG scan was made 24 and 48 hours, while In-111 Octreoscan images were made 24, 48 and 72 hours after the tracer injection. Every examination included whole body, additional planar and SPECT images. For the SPECT and CT fusion images MEDISO-Interview XP Software was used. Whole body PET-CT exam included plain CT and 2D emission PET.
Results: All nuclear medicine methods detected tracer accumulation in the retroperitoneal tumor but unlike the I-123 MIBG scan, both with the Octreoscan and PET method aspecific sites of tracer uptake were also found. CT could help to localize the origin of these aspecific lesions. The I-123 MIBG accumulation was also the highest - determining the therapy of choice i.e. I-131 MIBG.
Conclusions: Nuclear medicine plays an important role in the diagnostics of paraganglioma. These methods give the only possibility to determine the proper therapy. However, the verification of the origin of aspecific signs is also of great importance. For this purpose, we have to use other imaging modalities, in our case: CT. It is crucial to find the specific, non surgical therapy.

P11

OCTREOSCAN SCINTIGRAPHY AND FDG PET-CT INVESTIGATION OF A PRIMARY SMALL BOWEL NEUROENDOCRINE CANCER WITH HEPATIC METASTASIS

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Background: In the diagnosis of neuroendocrine tumors (NET) several imaging methods can be applied. Somatostatin receptor scintigraphy has a high impact among nuclear medicine (NM) modalities and FDG PET may also depict these diseases. The complementary result of the two methods in a case of primary small bowel NET with hepatic metastasis will be presented.
Material and methods: Case report: A 51-year-old male patient was investigated because of skin itch. Abdominal ultrasonography detected a focal liver lesion (LL). The histology based on US guided core biopsy was NET. Beside CT and MR investigations Octreoscan SPECT-CT (O-SPECT-CT) and FDG PET-CT investigations were performed.
Results: The morphologic imaging modalities detected only the LL. There was high level accumulation in the LL at O-SPECT-CT and no such high grade uptake distinguishable from physiological bowel activity was detected elsewhere. PET-CT showed mildly increased FDG uptake in the LL and an intense focal activity in the ileum. According to this uptake CT images of PET-CT showed a small suspicious soft tissue mass of the bowel. Histological investigation following the resection of the liver and the bowel provided the diagnosis of a primary small bowel neuroendocrine cancer with hepatic metastasis.
Conclusions: Functional imaging modalities performed in this case showed the different biologic behaviour of the primary tumor and its metastasis. This case supports the requirement for a combined use of several imaging modalities even with the combination of multiple NM methods according to the difficulties in the diagnostic work up of NET.

P12

POTENTIAL ROLE OF 18F-FDG PET-CT IN THE STAGING OF HEAD AND NECK CANCER — PRELIMINARY RESULTS

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Background: We assessed the potential role of PET-CT in the complex treatment planning of head and neck cancer (HNC).
Material and methods: In the present study 10 whole body PET-CT examinations were performed after radiotherapy presimulation and mask production for patients with squamous cell head and neck cancer (SCHNC). Seven of the ten patients had mesopharyngeal, one patient had epipharyngeal, and another one had laryngeal cancer. In one case the indication for the examination was cervical lymph node metastasis with unknown primary tumor. The PET-CT examinations were obtained on a compatible examination table with the use of positioning aids (mask), and in the same position as in radiotherapy. The subsequent 3D planned radiotherapy contained PETCT based target volume delineation information.
Results: In 6 of the 10 cases the PET-CT led to modification in the patient's further treatment. In 4 cases lymph node metastases were identified although in the previous stage there were none detected, which resulted in additional chemotherapeutic treatment. In 2 cases the previously planned target volume was altered according to the information provided by PET-CT.
Conclusions: PET-CT may help in the evaluation of regional lymph node involvement in SCHNC, thus providing important information for complex therapeutic management planning. Further comprehensive studies are needed to assess the exact role of PET-CT and to evaluate the accuracy of PET-CT based therapy planning.

P13

CRITICAL POINTS IN AN INTERLABORATORY COMPARISON

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Background: The Neuroimaging Committee of the EANM recently initiated the generation of a database of [^{123}I]FP-CIT (DaTSCAN) SPECT scans of healthy controls through collaboration between 15 European institutions. In order to check on and maintain the quality of SPECT imaging in the participating laboratories, the equipment was validated through an interlaboratory comparison study.
Material and methods: Visits were made by a physicist to the 15 participating institutions to perform the protocol on the 24 SPECT cameras in conjunction with the locally assigned project leader. Via the application of 99m-Tc, 57-Co and 123-I radioisotopes, point and flood sources, fillable SPECT and tissue-equivalent brain SPECT phantoms, the intrinsic and extrinsic uniformities, COR, and spatial resolution were determined. SPECT studies of the brain phantom were performed with different striata/backround ratios.
Results: Several problems emerged during the study. In some cases, the radioactive solution started to leak from the brain shell. Delivery of the phantoms, or the 123-I solution was sometimes delayed. In some centres, the acquisition software did not permit the setting-up of the parameters required by the protocol, and service assistance was necessary. Other problems occurred too. The data obtained have been submitted to the core lab and are currently under evaluation.
Conclusion: Prevention of the above-mentioned problems would significantly increase the success and lower the costs of such studies.

P14

VARIOUS APPEARANCE OF OSSEOUS METASTASES ON PET/CT

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The accurate localization and assessment of the extent of metastatic bone disease is essential for the selection of an optimal therapy in oncological patients. To detect bone metastases, fluorodeoxyglucose (FDG) positron emission tomography (PET) offers metabolic information including the assessment of tumor viability and activity. Fused images produced by PET/CT, through computed tomography (CT) provide additional morphologic information and precise localization of bone involvement. For a correct evaluation of PET/CT examination you have to know the different appearances of metastatic bone lesions. We would like to demonstrate different images of osseous metastases.

P15

ULTRASOUND MONITORING OF SYNOVIAL THICKNESS AFTER 166-HOLMIUM-PHYTATE RADIOSYNOVIORTHESIS — SEVEN YEARS' RESULTS (PHASE I–IIA, COMPARATIVE, RANDOMIZED, SINGLE-BLIND, PLACEBO-CONTROLLED STUDY WITH INCREASING DOSAGE)

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Background: The aim of the study was to measure the synovial thickness after 166-Holmium radiosynoviorthesis by sonography.
Material and methods: 31 patients suffering from chronic synovitis, rheumatoid arthritis, or seronegative spondylarthritis were examined. The patients were randomly distributed into four treatment groups:
— group I — 185 MBq ^{166}Holmium phytate (166-Ho) injectable suspension and 40 mg of 1 ml triamcinolone acetonide and 1 ml of lidocaine injection 1%, (injections);
— group II — 555 MBq 166-Ho, and injections;
— group III — 925 MBq 166-Ho and injections;
— group IV — solely 40 mg of 1 ml triamcinilon acetonide and 1 ml of lidocaine injection 1%.
There was an 84-month follow-up period after the administration of the isotope. We measured synovial thickness at the following locations: In the midline, laterally and medially, medial and lateral to the condylus of the femur.
Results: The thickness of the synovia decreased significantly in groups II (555 MBq) and III (925 MBq). After transient improvement (the steroid effect) the thickness of the synovia began to increase in the group I (185 MBq) and in the control group. We have found significant correlation between synovial thickness and the clinical improvement.
Conclusions: The 166-Ho is an effective new radiopharmacon in the treatment of synovitis. We detect clinical improvement by sonography. The effective dose is 555–925 MBq.

P16

SEVEN YEARS' RESULTS WITH ^{166}HOLMIUM-PHYTATE TREATMENT OF CHRONIC SYNOVITIS. PHASE I-IIA, RANDOMIZED, INCREASING DOSAGE, SINGLE-BLIND, PLACEBO-CONTROLLED COMPARATIVE STUDY

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Background: The aim of the study was the examination of the anti-inflammatory effect of 166-Holmium-phytate injection.
Material and methods: 31 patients suffering from chronic synovitis, rheumatoid arthritis and seronegative spondylarthritis were examined.
The patients were randomly distributed into four treatment groups:
— group I — holmium phytate injectable suspension marked by 185 MBq ^{166}Ho + 40 mg of 1 ml triamcinolone acetonide + 1 ml of 1% lidocaine injection (injections);
— group II — 555 MBq ^{166}Ho + injections;
— group III — 925 MBq ^{166}Ho + injections;
— group IV — solely 40 mg of 1 ml triamcinolone acetonide + 1 ml of 1% Lid. injection.
Inflammatory activity tests were done based on the following parameters:
1. Measurement of the swelling of the knee-joint [cm]; 2. Flexion — heal buttocks distance [cm]; 3. Degree of knee-joint pain; 4. Visual Analogue Scale (VAS 1-100); 5. Patient's opinion on inflammation of knee-joint (VAS 1–100); 6. Doctor's opinion on given inflammation of knee-joint (VAS 1–100).
Results: Even after a 7-year-period, 88.2% of the findings were rated as excellent or good. 86.66% of the patients do not need another punction even after a 7-year-period. During the study period, the inflammation decreased in the group receiving 555 and 925 MBq.
Conclusion: The Ho-166 isotope is an effective radiopharmacon in treating synovitis. Due to its physical parameters it is optimal to treat large joints (knee) and medium size joints (hips, shoulder, elbow, wrist, ankle). The effective dose is 555–925 MBq.

P17

^{166}HOLMIUM-PHYTATE-RADIOSYNOVIORTHESIS IN RHEUMATOID ARTHRITIS. FIVE YEARS' CLINICAL RESULTS, PHASE III PROSPECTIVE STUDY

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Background: The aim of the study was the examination of the anti-inflammatory effect of 166-Holmium-phytate injection.
Material and methods: Phase III, prospective study. We examined 30 patients suffering from chronic synovitis, and rheumatoid arthritis were examined. The protocol was commenced with screening. The patients were selected according to inclusion and exclusion criteria.
Holmium phytate injectable suspension marked by 600 MBq ^{166}Holmium phytate injectable suspension, and 40 mg of 1 ml triamcinolone acetonide and 1 ml of lidocaine 1%. There was a 60-month follow-up period after the administration of the isotope.
The inflammatory activity of the affected knee-joint was tested prior to treatment, and 3, 6, 9, 12, 24, 36, 48 and 60 months after treatment. The evaulation was based on the criteria as described by Müller, Rau and Scütte, while the score system was developed by the authors.
Results: During the study period, the inflammations decreased. In the first five years excellent and good results were recorded in 93.3%. Five years after radiosynoviorthesis 93.3% of patients did not need another punction. We found no deviations in either haematological or chemical parameters during the study period.
Conclusion: The Holmium-166 phytate isotope is an effective radiopharmacon in treating synovitis. Due to its physical parameters it is optimal to treat large joints (knee) and medium sized joints (hips, shoulder, elbow, wrist, ankle). The effective dose is 555–925 MBq.

P18

ULTRASOUND MONITORING OF SYNOVIAL THICKNESS AFTER 166-HOLMIUM-PHYTATE RADIOSYNOVIORTHESIS. FIVE-YEAR RESULTS, PHASE III PROSPECTIVE STUDY

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Background: The aim of the study was to measure the synovial thickness after 166-Holmium radiosynoviorthesis by sonography.
Material and methods: Phases III, prospective study. 30 patients suffering from chronic synovitis, rheumatoid arthritis were examined. The protocol commenced with screening. The patients were selected according to inclusion and exclusion criteria.
Holmium phytate injectable suspension marked by 600 MBq ^{166}Holmium phytate injectable suspension, and 40 mg of 1 ml triamcinolone acetonide and 1 ml of lidocaine 1%. There were 60 months follow-up period after the administration of the isotope. Inflammatory activity of the affected knee-joint was tested prior to treatment, and the 3th and 3, 6 12, 24, 36, 48 and 60 months after treatment. We measured the synovial thickness the following locations: In the midline, lateral and medial, by the condylus of femur medial and lateral.
Results: During the study period, inflammation decreased. In the first five years excellent and good results were recorded in 93.3%. Five years after radiosynoviorthesis 93.3% of patients did not need another punction. The thickness of the synovia decreased significantly. We find a significant correlation between the synovial thickness and the clinical improvenes.
Conclusion: The 166-Holmium-phytate is an effective new radiopharmacon in the treatment of synovitis. We detect the clinical improvement by sonography. The effective dose is 600 MBq.

IMAGING

P19

NOVEL IMAGE EVALUATION SYSTEM FOR MULTI-MODALITY IMAGING

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Background: Most of the uncertainty in non-invasive imaging diagnostics is reducible with high efficiency by applying multi-modality imaging technology. Three modality integrated imaging systems — SPECT/PET/CT — have been constructed in order to create the "high-tech" conditions in a cost-effective way, mainly for functional diagnostics. Nevertheless, novel image processing technology had to be developed to perform the 3D presentation by simultaneous and fused way to enhance the advantages of each modality.
Material and methods: The image evaluation system — InterView® Fusion — can be activated individually and from the upgraded InterViewXP® system. Its basis is our self-developed DICOM database supported by Windows Vista 32/64bit or XP. Graphics is powered by high performance GPU (nVIDIA) algorithms with 2 ÷ 4 Mpixel resolutions. Presentations of the multi-modality images are provided by predefined and user defined layout sets. Several versatile ROI, VOI techniques are available for quantitative and semi-quantitative analysis. The image processing system supports both auto and manual co-registration methods in order to present the fused image of various modalities. Aunique transparent colorization procedure has been developed for simultaneous presentation of max. four modality fusion techniques. The particular image processing operations can be accessed by pop-up menus, hotkeys combinations and/or user-localized toolboxes. Reporting of the results may be obtained through a user pre-defined template set on either hardcopy or optical media.
Results: Stability test and validation of InterView® Fusion is running in many assigned clinics now.
Conclusion: The novel image evaluation system will be suitable to apply as a modality manufacturer independent image processing system too.

P20

DETERMINING PERFORMANCE PARAMETERS OF THE SMALL ANIMAL PET SCANNER MINIPET-II ACCORDING TO NEMA NU-4 STANDARD

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Background: *In vivo* imaging of small laboratory animals is a valuable tool in the development of new drugs. For this purpose a small animal PET scanner (MINIPET-II) has been developed in our institute, as part of an R & D project.
After the first successful technical and biological studies, our goal was to determine the performance parameters of the scanner according to NEMA NU-4 standard.
Results: The numerical values of spatial resolution as measured at 1 mm, 10 mm and 20 mm from the centre of FOV were 1.12 mm, 1.23 mm and 1.45 mm, respectively. The absolute sensitivity of the scanner is 2.13% applying 5ns coincidence time window. The time resolution of detector pairs was 2.9 ns and the maximal detectable count rate is 650.000 cps. Appropriate total radioactivity depends on the spatial distribution of the tracer. Accordingly, using point source or mouse and rat phantom filled up with FDG the total activity should not exceed approximately 40 MBq, 80 MBq and 150 MBq, respectively. Following the successful performance tests the first measurements of radiotracer distributions in small laboratory animals have already been completed.
Conclusion: Based on these results MiniPET-II can competewith any other PET scanner with a similar detector system in every aspect.

P21

THE SOFTWARE SYSTEM OF THE MINIPET-II SCANNER

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Background: The examination of small animals using high resolution in-vivo imaging techniques is a crucial tool in pharmaceutical research projects. To suffice this demand, a small animal PET camera has been developedin our institute as part of a R + D project.
The aim of the study was to develop a complete software system supporting 3D PET-data acquisition and the appropriate image reconstruction and image processing.
Results: Using cluster-technique we have implemented a network based data acquisition system. This system comprised programs running on the embedded Linux environment of the detectors and the data acquisition computer. A signal processing software system running on an eight-cored computer controls primary data processing. To support the image reconstruction, we developed a software system capable of running either on multi-core computers, or clusters, and computers using graphical processing units as mathematical co-processors. In addition to the conventional methods, the newest OpenGL and OpenCL tools were also used in the processing and visualization of the reconstructed images.
Conclusion: Based on the successful performance test measurements and the first biological studies the software system of the MiniPET-II is an appropriate package to support in vivo imaging.

P22

COMPLEX SOFTWARE FRAMEWORK FOR TRACER KINETIC ANALYSIS OF RECEPTOR LIGAND BINDING

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Background: Human and small animal PET receptor studies belong to the most important in vivo tools of pharmaceutical research. Tracer kinetic analysis and digital brain atlas methods belong to the commonly used techniques to process images obtained by dynamic scanning. Regional analysis can be done either on the basis of individually drawn brain regions or using regional databases of human-, mouse- and rat brain atlases.
The aim of the study was to work out validated, complex software framework supporting the effective processing of multi-subject binding experiments and model-calculations.
Results: The *Image Sorter* is the first element of the software framework which converts the format of the images arriving at the DICOM server of the institute to MINC (a useful working format) and carries out each task in an executable automated manner. Generation of summation images, MRI-PET registration and spatial standardization belong to the latter type of tasks. *BrainTrace*, a multimodal, interactive image processing software have been developed for the interactive work up of images produced by the *Image Sorter*. The verification and the eventually necessary correction of MRI-PET registration can be done by *BrainTrace*. The same program can support the manual or brain atlas based drawing of regions required by the tracer kinetic analysis as well as the evaluation of the parametric images. *BrainTrace's* components responsible for model calculations were validated by PVELab a Matlab based tracer kinetic software.
Conclusion: The developed software framework containing automated and interactive elements allows the routine work up of dynamical binding examinations carried out using PET ligands.

P23

ANATOMICAL LOCALIZATION IN PET BRAIN RECEPTOR STUDIES

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Background: Human and small animal PET receptor studies belong to the most important *in vivo* tools of pharmaceutical research. The analysis of dynamic PET data requires the use/application of tracer-kinetic and digital brain atlas related image processing methods. The investigation of receptor binding can be supported by manually drawn regions or the application of human, mouse or rat brain atlas databases. The latter plays an important role in the anatomical localization, as well. None of the available database software products are capable of handling more than a single data base.
The aim of the study was to work out a platform-independent framework and application that, beyond elementary image processing tasks, enables us to handle several brain atlas databases at the same time.
Result: In accordance with the main objectives a complete program called BrainLoc has been developed. It supports Talairach Daemon, LONI Probabilistic Brain Atlas (LPBA) and International Consortium for Brain Mapping (ICBM) databases. Based on the strength of this database selecting strategy, a brain atlas dependent numerical value can be rendered to a given location describing the probability that it belongs to a possible anatomical structure. The operation of the elaborated software has been validated using BrainVoyager and Anatomy Toolbox.
Conclusion: BrainLoc may be instrumental in the post processing phase of receptor studies by the miniPET-II small animal PET scanner.

P24

DEVELOPMENT OF A MONTE CARLO BASED ALGORITHM FOR PET RECONSTRUCTION

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Background: The presentation summarizes the results achieved so far within the framework of the TeraTomo project. The aim of the project r is to develop a high-speed PET algorithm optimized for graphics processors (GPU) which would provide more accurate reconstructions utilizing CT data.
Material and methods: The proposed Monte Carlo simulation technique makes it possible to trace the trajectory of the photons produced in the positron annihilation process through the scattering events inside the body. By linking the Monte Carlo calculation to the usual filtered backprojection, we can elaborate a tecgnique which is more precise than the conventional iteration algorithm. The drawback of the Monte Carlo method is the need of massive computing capacity. However, in the meantime, it is an ideal subject to GPU based calculations which might be faster than CPU based ones by two orders of magnitude.
Results: The Monte Carlo photon transport calculation involves a lot of different methods which could be of primary importance regarding the accuracy and speed of the final algorithm. The methods taken into account are the Woodcock algorithm, different techniques of variance reduction based on particle weight, together with the possible approximations in the modeling of Compton scattering.
Conclusions: Our aim in the current phase of the TeraTomo project was to produce a complete computational model which is capable of analyzing the aforementioned parameters both on conventional and on graphics processors.

P25

QUANTITATIVE EVALUATION OF TISSUE HETEROGENEITY IN PET

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Background: The aim of the study was the influence of tissue heterogeneity on results of fitting nonlinear model equations to regional tracer uptake curves: with an application to compartmental models used in positron emission tomography.
Material and methods: The limited resolution of PET devices implies that, in general, more than one tissue component, each with a different physiological status, contribute to the measured signal in a volume element. In general, it is impossible to recover the signals form the different components.
One possibility for examining the effects of tissue heterogeneity, the analytical method, is based on Taylor expansion of the expression for the tracer radioactivity around the mean values of the parameters, and can be used for models which give the tissue radioactivity as an explicit function of the models' parameters. The experimental procedure we use follows tracer (FDG, 1-gluc, methyl-glucose, FESP) and different kinetic models and algorithms. The steady state method was found to be more sensitive to tissue heterogeneity than the dynamic method.
Conclusions: In conclusion, tissue heterogeneity may have profound effects. Some parameters, which enter linearly in the model expressions for tissue radioactivity, are, under normal conditions, comparatively insensitive to heterogeneity, and other factors, such as noise and errors in the input function, can have more serious effects.

P26

CT DOSE-OPTIMIZATION IN PET/CT EXAMINATIONS

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Background: Performing FDG PET/CT, the effective dose for a patient is usually in the range of 10–25 mSv. The dose issued by a radiopharmacon is approximately 6-12 mSv and the effective dose of a CT examination is between 5–20 mSv, depending on the settings (kV, mA, mAs, pitch). However, the optimal setting required for a CT image of acceptable quality depends, to a large extent, on the explicit figure (and not just the weight) of the patient. In this study, our goal was to optimize the settings of CT examinations using two PETCT cameras.
Material and methods: The examinations were carried out on GE Discovery-ST and Philips Gemini-TF PET/CT cameras. During the optimization we changed the kV, pitch and mA values and applied the dose-modulation programs provided by the manufacturer. For dose calculation we used the CTDI and DLP values and the data of the "ImPACT" software.
Results: We could develop CT protocols by which, depending on the shape of the patient, the effective dose of the CT can be decreased by as much as 10–50% in the case of a Philips camera (bigger-smaller patient) and by 25–70% in the case of a GE Discovery. The current dose values of the CT are between 2–6 mSv in a Philips PETCT (smaller-bigger patient) and 3–8 mSv in a GE PETCT camera.
Conclusions: In PET/CT examinations, the effective dose for patients can be significantly decreased if we use protocols optimized for the patient's figure.

RADIOPHARMACEUTICALS

P27

MANUFACTURING [^{18}F]-FALLYPRIDE

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Background: Dysfunction in dopaminergic neurotransmission has been implicated in a number of neuropsychiatric disorders including Parkinson's disease, Alzheimer's disease, schizophrenia, and Huntington's disease. The availability of small molecule PET ligands that can selectively target dopamine receptors (D1–D4), transport and synthesis is important to learn more about of these complex diseases. Fallypride radiolabeled with fluorine-18 was first synthesized by Mukherjee in 1995, and is currently being used as a dopamine D2/D3 receptor-imaging agent in PET studies because of its selectivity, affinity, and reversibility. The first article about [^{18}F]-Fallypride was published in 1993. Since that time more than 100 publications have been written. Our aim was to make this tracer available for biology and possible human studies in Hungary.
Material and methods: We used materials suitable for GMP, and of the highest purity available for the synthesis of [^{18}F]-Fallypride. The synthesis was a one-step nucleophile substitution accomplished by isocratic HPLC purification, and followed by solvent change on a SPE cartridge and formulation. The quality of the [^{18}F]-Fallypride was investigated with HPLC and TLC methods.
Results: The reaction yield was 20% without decay correction. The total synthesis time was 1 hour including the 20-minutes reaction time. In a typical experiment from 30GBq ^{18}F- we could produce 7 GBq [^{18}F]-Fallypride. The synthesized [^{18}F]-Fallypride had a physical concentration of 3–5 nmol/ml and its specific activity was about 70–200 GBq/μmol (1900–5400 mCi/μmol). The product was tested using small animal model (mice). The animals were investigated using the autoradiography technique and a mini-PET scanner, which was developed in our institute. The authorization of [^{18}F]-Fallypride for purposes of investigation in humans is in progress.

P28

IMPROVED PRODUCTION OF GAS PHASE [^{11}C]CH_3I BY I_2-CONCENTRATION-CONTROL

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^{11}C-methyl iodide is the most important starting material in the production of ^{11}C-labelled tracers used for Positron Emission Tomography (PET). The method of choice for its production is the high temperature iodination of ^{11}C-methane in a circulating gas phase (Larsen, Appl Radiat Isot 1997).
Since the yield is dependent on the I_2 concentration in the gas phase (Link, Nucl Med Biol 1997), we developed a spectroscopic method to determine the optimal iodine concentration.
The heating temperature of the oven, which sublimates the iodine, is automatically adjusted to achieve and keep this concentration during the reaction period.
The concentration of I_2 in the gas phase was measured immediately behind the iodine oven using a UV/VIS microspectometer equipped with a high-grade, low-noise silicon detector suitable for the spectral range of 350–850 nm. The absorbance of I_2 was measured in between 510–540 nm and continuously corrected for background and the absorption of solid material on the walls of the quartz tube. Finally the relationship between heating temperature and I2 absorbance was investigated.
The I_2 concentration in the vapour phase was calculated by determination of the amount of sublimated I_2 in a continuous He2-gas flow. Preliminary experiments at a flow rate of 50 mL/min for 1 h led to a concentration of 80 μMol/L for a stable absorption of 0.2 and a ^{11}C-MeI yield of 30% (5 min after EOB, uncorrected). The optimal concentration of I_2 vapour is under investigation in ongoing experiments.

PRECLINICAL STUDIES

P29

ELECTROMAGNETIC HYPERTHERMIA (ONCOTHERMIA®) SHOWS ANTITUMORAL EFFECTS AS A SINGLE TREATMENT AND SEEMS TO ENHANCE THE EFFECTIVITY OF COBALT IRRADIATION — FIRST VETERINARY CLINICAL RESULTS

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Background: Advantageous thermal and induced non-thermal effects of electromagnetic hypertermia (EHT) in oncology is known for decades. This ever-developing technique has been utilized in human oncology for a long time but surprisingly no veterinary clinical data are available therefore.
Material and methods: We applied EHT with capacitive coupled modulated 13.56MHz radiofrequency method (oncothermia OT). OT was provided as a single treatment in 6 cases, and in a combination with fractionated Cobalt irradiation in 18 cases. Superficially located skin tumors (mastocytoma GrII, III 7 cases, 2 histiocytomas), 5 malignant oral tumors (3 melanomas, 1 carcinoma), 3 osteosarcomas, 2 nasal cavity adenocarcinoma and 1 insulinoma were treated in dog patients and 2 feline mammary carcinoma and 3 soft tissue sarcoma cases were enrolled to the study.
Results: Single OT resulted significant tumor size decrease 2 out of 6 cases, 3 stable disease and 1 progression of disease. Cobalt irradiation followed by OT resulted 3/18 tumor-free status, 12/18 partial remissions, 2/18 stable disease, and progression of disese in 1 case. Side effects eg.: erythema (2 cases), necroses (2 cases) occurred at the learning phase of technique, later on we could prevent this side effects with the constant superficial and deep temperature control in or patients.
Conclusion: We concluded that local OT could be a useful tool as a single antitumoral modality but even more clinical utilities could be reached in a combination with radiotherapy (maybe with chemotherapy as well) by the local increase of the blood-perfusion. Further clinical studies needed to implement this novel technique into veterinary oncological practice.
OTKA T042584 and T049708 EMIL-NoE 503569-2.2, IAEA CRP No E1.30.33

P30

MANY RELEVANT DATA FROM A HOPELESS SINGLE VETERINARY PATIENT — THE POOR LATE KAZMER

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Background: Kazmer, the 7-year-old castrated male cat presented at the Department of Surgery, Veterinary Faculty (Budapest, Hungary) following a 2-month-history of fast progressing neurological signs. The cat underwent a thoroughphysical, neurological and orthopaedic examination, complete blood testing, myelography and CT examination. The initial diagnosis was tumor involvement of the 5th cervical vertebra with no detectable metastases.
Material and methods: Cytoreductive surgery was performed within one week after the diagnosis. The histopathological examination of the removed mass revealed low-differentiated fibrosarcoma of osseous origin. Two weeks after surgery the cat was referred into our institute for further diagnosis and treatment. Multiple scintigraphic examinations were carried out by injecting ^{99m}Tc-MDP (Skeleton, Medi-Radiopharma), ^{99m}Tc-DMSA(5) (Penta DMSA, Medi-Radiopharma), and ^{99m}Tc-MIBI (Cardio-SPECT, Medi-Radiopharma).
Results: All the three radiopharmaceuticals showed significant focal uptake in the neck region indicating the presence of remnant tumor tissue but nowhere else in the body. *In vivo* ^{99m}Tc-MIBI wash-out examination and *in vitro* immunohistochemistry and real time PCR tests from the removed tumor proved the multidrug resistance of the case. Post-surgical local irradiation (Cobalt-60, 12 × 3 Gray) was given on a Mo-We-Fri schedule. There was no improvement in the neurological signs, and the cat started to lose weight so euthanasia was performed at the owner's request. Gross pathology, ex vivo nanoSPECT/CT examination of the excised neck region and further histopathological examinations were carried-out.
Conclusions: Although the case we have presented proved to be totally un-treatable, it provided a lot of experience for the veterinary staff/team.
OTKA T042584 and T049708 EMIL-NoE 503569-2.2

P31

IN VITRO AND *IN VIVO* EXAMINATIONS OF LU-177-EDTMP

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Background: Phosphonate compounds can strongly adsorb onto bone surfaces, which makes it possible to apply them in bone scintigraphy and palliative radiotherapy of bone metastases. Earlier we made examinations with labeled phosphonates such as Tc-99m-MDP and Re-188-HEDP and now we have had the opportunity to test EDTMP (Ethylene diamine tetramethylene phosphonic acid) which was labeled with Lu-177 isotope.
Material and methods: Lu-177 isotope was purchased from the Institute of Isotopes Ltd. in chemical form LuCl3 in 1mM HCl solution and Mediradiopharma Ltd. provided EDTMP for our experiments. For quality control we applied Raytest MiniGita device. We examined the labeling efficiency 20 min, 1 h, 6 h, 24 h, 2 d and 4 d after application. Two healthy beagle dogs and three other dogs with spontaneous osteosarcoma were injected with Lu-177-EDTMP. The test material was followed up by Nucline X-ring (Mediso) gamma camera 1, 2, 3, 6 and 24 hours, and 2, 4 and 7 days after injection. Images and ROI calculations were made using Interview software.
Results: The evaluation of labeling efficiency by ITLC scanner and in vitro radiochemical stability at RT after application proved very good (99%). In the dogs with osteosarcoma more than 50% of injected activity was adsorbed in the skeleton 3 h after application, and daily follow-up showed that this adsorption was almost ultimate/ complete. In bone tumors we could measure 2.5 to 8% of total injected activity, depending on the patient.
Conclusion: The excellent radiochemical purity and stability of Lu-177-EDTMP, good adsorption effect of polyphosphonates, and favorable features of the Lu-177 isotope can make this complex a good agent in the palliative radiotherapy of bone metastases.

P32

IMAGING OF REGIONAL RED BLOOD CELL MASS IN THE RAT BRAIN BY HIGH-RESOLUTION, QUANTITATIVE NANOSPECT/CT TECHNOLOGY

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Background: Regional oxygen supply by red blood cells (RBCs) has a major impact on brain functions. Our aim was to image RBC mass in the brain.
Material and methods: Male Wistar rats (n = 4) were anesthetized by Ketamine-Xylasine. Catheters were inserted into the femoral artery and vein. RBCs were labeled with 99mTc using stannous pyrophosphate as reducing agent. Thirty minutes later, 1 mL of pre-treated arterial blood was withdrawn and gently mixed with 1 mL of 99mTc-pertechnetate solution of ~ 200 MBq activity. Labeled RBCs were reinjected (70 MBq) 5 minutes pi. Two animals were treated by L-NAME. Scans were acquired for control and at 44 minutes following the L-NAME injection. Animals were sacrificed by washing out blood with saline infusion.
Cerebral RBC mass (CRBCM) was characterized by activities normalized to the brain's volume.
Results: No activities were found in the thyroids and in the stomach, an evidence of a larger then 99% purity of radiolabeling. Hot spots in the brain were detected at venous sinuses and the circus of Willis. CRBCM decreased in the L-NAME treated animals, 99mTc-activity became a magnitude smaller (0.03 mBq/cm3) after saline infusion.
Conclusions: Quantitative NanoSPECT technology is efficient to assess regional RBC mass in the rodent brain.

P33

PRODUCTION OF A MTC-LABELED STANDARD STABLE SOLID MEAL FOR GASTRIC MITILITY STUDIES

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Background: Studies of the gastrointestinal tract (GIT) have featured investigations in nuclear medicine for more than 40 years. A wide range of radiolabeled test meals have been used in GIT scintigraphy, and therefore the results are not comparable. The American College of Radiology has issued practice guidelines for the performance of GIT and consensus recommendations. Our aim was to develop and produce a standard stable solid meal (SSSM) with stable 99mTc-labeling that satisfies the consensus recommendations.
Material and methods: Whole egg powder, egg substitute powder (for egg protein — sensitive individuals), HSA, Sn-colloids, various Sn compounds, spices and formulation substances were used to produce an SSSM that can be readily labeled with 99mTc.The labeled SSSM was analyzed for labeling efficiency, stability, biodistribution and biological stability in beagle dogs.
Results: 99mTc-labeling can be accomplished simply by adding 99mTcO4 to SSSM (LE ~ 100%). The *in vitro* stability of 99mTc-SSSM is suitable for our purpose. The 99mTc-SSSMs were incubated in artificial gastric fluid. The gastric fluid did not contain free 99mTcO4. Gastric emptying (GE) scintigraphy revealed complete GE after 24 h in these dogs. Target organs of free $99mTcO4^-$, e.g. the thyroid, were not visible.
Conclusion: A kit has been compiled from suitable basic compounds that can be utilized for the simple 99mTc-labeling of SSSM. This 99mTc-SSSM is of great value for the scintigraphic investigation of GIT, GE and meets all the recommended standards. A lead-shielded heater kit has also been developed for the handling of the 99mTc-SSSM.

P34

COMPARISON OF TUMORIGENICITY OF LIVER AND KIDNEY TUMORS INDUCED BY N-NITROSODIMETHYLAMINE BY 18FDG UPTAKE AND THE EXPRESSION OF GLUCOSE TRANSPORTERS

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Background: To estimate the tumorigenic potential, the ^{18}FDG uptake and expression of facilitative glucose transporters have been suggested (Rastogi et al., 2007). Malignant cells that are known to take up an increased amount of ^{18}FDG, have overexpressed GLUT-1 and/or GLUT-3. The aim of the study was to determine the tumorigenic potential of two cell lines established from N-nitrosodimethylamine-induced rat hepatocarcinoma (HeDe) and mesenchymal renal tumors (NeDe).
Material and methods: Fibroblast, HeDe and NeDe cell lines were used for in vitro uptake studies of ^{18}FDG glucose analogue. 10^6 cells were preincubated in PBS containing 1 mM D-glucose. Preincubation was followed by the addition of 185 kBq ^{18}FDG to each sample, then the cells were incubated for 15, 30 and 60 minutes and the radioactivity was measured. Cells were cultured on coverglasses, fixed and anti-GLUT-1,-3 antibodies were used to visualize the transporters.
Results: The uptake of ^{18}FDG was 4 times higher in hepatocarcinoma cells and nearly 3 times higher in mesenchymal renal tumor cells than in fibroblasts. The level of GLUT-3 transporter was low in hepatocarcinoma cells, and high in mesenchymal kidney tumor cells. In the case of GLUT-1 the effect was reverse.
Conclusions: *In vitro* parameters support the view that the tumorigenic potential of cancer cells cannot be determined by the expression of a single parameter. We found that the higher ^{18}FDG uptake correlate with the GLUT-1 and GLUT-3 expression, but not simultaneously. These data indicate that the expression of GLUT transporters *per se* is not sufficient to judge tumorigenicity.

P35

INVESTIGATION OF THE DISTRIBUTION OF BIOLOGICALLY ACTIVE MOLECULES IN TISSUES OF SMALL ANIMALS USING AUTORADIOGRAPHY AND MINIPET IMAGING

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Background: The aim of the study was the implementation of methods for high resolution imaging of PET radioligand distribution in mice and rat tissues.
Material and methods: *Ex vivo* auto-radiographic (Leica CM3600 whole body cryomacrotome) and *in vivo* PET (miniPET-II) techniques were used to study the accumulation, binding and clearing of biologically active molecules (tumor and perfusion tracers, receptor ligands) in tissues of small animals.
Results: The localization of tumor tissues in rats and mice applying PET tracers (FDG, methionine, choline, FLT) and auto-radiographic slices combined with Phosphorimager evaluation is possible at a resolution of 50 microns . The procedure also allows the demonstration of inhomogeneities (e.g. necrotic area) and eventual metastases. The efficiency of treatment can also be followed up if applied in relatively large populations. Similarly, detailed quantitative data can be obtained from receptor densities in case the experiments are carried out using labeled receptor-ligands. In rat and mice models, the miniPET-II camera with a resolution of 1 mm appears to be an efficient tool in drug development as well as in *in vivo* molecular biology investigations. This technique allows the study of numerous physiological and pathological processes provided an appropriate PET tracer is available.
Conclusion: *Ex vivo* imaging using the auto-radiographic technique and *in vivo* imaging applying a miniPET-II scanner may play an important role in preclinical and clinical investigations.

P36

BLOCKING THE P-GP PUMP BY COMBINED TREATMENT MODIFIED THE ACCUMULATION OF ^{99M}TC-MIBI AND ^{18}FDG IN MULTIDRUG RESISTANT CELLS

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Background: It has been shown earlier that the combined application of modulators and UIC2 antibody is an effective way of blocking P-glycoprotein (P-gp) function (J Pharm Exp Ther 2007; 320: 81–88). Here we describe the effect of this combined treatment on the ^{18}FDG and ^{99m}Tc-MIBI accumulation in carcinoma cells.
Material and methods: Human ovarian carcinoma cell lines were used. Following the preincubation of tumor cells with P-gp modulators for 10 min they were further incubated with UIC2 mAb and then washed. The cells were incubated in the presence of ^{18}FDG, ^{99m}Tc-MIBI, rhodamine 123 (R123) and/or daunorubicin (DNR) at 37°C, and the isotope accumulations and fluorescence intensities were measured.
Results: The decreased accumulation of R-123, DNR and ^{99m}Tc-MIBI by MDR positive cells was not reinstated by the incubation of the cells with UIC2 alone. Co-incubation of the cells with UIC2+CSA resulted in the manifold binding of UIC2 and reverted the R-123, DNR and the ^{99m}Tc-MIBI accumulation in the P-gp$^+$ cells. A similar effect was shown by the combined treatment of the cells with UIC2+paclitaxel. Blocking the P-gp pump with CSA+UIC2 or paclitaxel+UIC2 decreased the glucose metabolic rate of the P-gp$^+$ cells. Similar treatments of the P-gp$^-$ cells did not result in a significant change in the R123, DNR and ^{99m}Tc-MIBI accumulation.
Conclusion: The combined treatment with UIC2 antibody and P-gp modulators effectively blocked the function of the P-gp pump in multidrug resistant cells and this effect could be followed using ^{99m}Tc-MIBI and ^{18}FDG tumor-diagnostic tracers.
This work was supported by MEC-11/2008 grant.

P37

EFFECT OF ANTHRACYCLINE DERIVATIVES ON THE [^{11}C]CHOLINE AND [^{18}F]FDG ACCUMULATION IN CANCER CELLS

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Background: With the spread of PET studies it happens more and more often that patients undergo chemotherapy. It is not yet known, how the chemotherapeutic agents influence the outcome of the evaluation of a PET scan. Our aim was to study how treatment with anthracycline derivatives modifies the accumulation of tumor-diagnostic radiotracers in P-glycoprotein (P-gp) positive and negative cancer cells.
Material and methods: Human ovarian A2780 and A2780AD, human B lymphoid JY, human epidermoid KB-3-1 and KB-V-1, and smooth muscle DDT1 MF-2 cell lines were used. The tumor cells were pre-incubated with daunorubicin (DNR) and doxorubicin (DOX), and the uptake of ^{18}FDG and ^{11}C-choline was measured.
Results: DNR treatment decreased the ^{11}C-cholin accumulation of all of the investigated cells in a concentration dependent manner, while it did not modify the ^{18}FDG uptake of the cells significantly. The effect of DNR and DOX on choline accumulation of P-gp positive cells was lower, than that of the P-gp negative pair. When extracellular DNR was removed the blocking effect of the drug on the ^{11}C-choline uptake was smaller.
Conclusion: DNR and DOX treatment significantly decreased the ^{11}C-choline accumulation of cancer cells. The blocking effect may have plasma membrane as well as intracellular components. Our results indicate that the possible disturbing effect of anthracycline medication should be taken into consideration during the diagnostic interpretation of PET scans.
This work was supported by MEC-11/2008 grant.

P38

EFFECT OF ONCOTHERMIA ON MRNA LEVELS OF HSP70A1A AND HSP90AA1

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Background: Electromagnetic hyperthermia has been a complementary method in human cancer treatment for several years. Oncothermia (OT) is electromagnetic heat delivery, applied in oncology. Our objective is to study the gene expression of two human HSPs (HSP70A1A, HSP90AA1) at mRNA level using real-time PCR *in vivo* after OT treatment.
Material and methods: OT utilizes modulated 13.56 MHz RF-current conduction in capacitive coupled arrangement. *In vivo*, a HT-29-21 cell line-derived nude-mouse xenograft double tumor model was used (one tumor was used as control, the other one was treated) and treatments were done using a capacitivly coupled applicator. Samplings were performed at different time-points after the treatments (1 h, 6 h, 12 h, 24 h, 48 h). First strand cDNA was synthetised from total RNA for quantitative real-time PCR, and primers were designed by Primer3 based on sequences published in NCBI database.
Results: Both HSPs showed increased mRNA level in every sample examined. Both HSPs showed the highest expression level (hsp70 — about 10-fold, hsp90 — about 5-fold) at the same time-point (12 h after treatment). In the case of the first (1 h) and the last (48 h) samplings only a slight difference could be observed in the relative mRNA levels.
Conclusion: A significant increase was proved *in vivo* in the case of both HSPs, at the mRNA level. So these methods could affect apoptosis through HSPs synthesis and signal-transduction pathway, and might also trigger a specific immune-response.

CLINICAL STUDIES

P40

STAGING PORTAL HYPERTENSION AND PORTOSYSTEMIC SHUNTS USING DYNAMIC NUCLEAR MEDICINE INVESTIGATIONS

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Background: The exploration of portal hypertension and portosystemic shunts, and staging chronic liver disease based on the pathophysiology of portal hemodynamics have been in the focus of our interest for some time now.
Material and methods: Per-rectal portal scintigraphy (PRPS) was performed on 312 patients with chronic liver disease (CLD), and 231 of them also underwent liver angioscintigraphy (LAS). The control groups included 25 healthy subjects. We developed a new model of PRPS interpretation by introducing two new parameters called "liver transit time" (LTT) and 'circulation time between right heart and liver' (RHLT).
Results: The normal LTT value was established at 24 ± 1 s. Abnormal LTT had PPV = 100% for CLD. Twenty seven non-cirrhotic patients had increased LTT up to 35 s, the median value being 27 s. RHLT (42 ± 1 s) was not related to liver disease. Cirrhosis was excluded in all the patients with PRSI < 5%. PRSI > 30% had PPV = 100% for cirrhosis. Based on PRPS and LAS, we propose the classification of CLD in 5 hemodynamic stages. Stage 0 is normal. In stage 1, LTT is increased, but PRSI remains normal. In stage 2, LTT is decreased between 16–23 s, while PRSI is increased between 5% and 10%. In stage 3, PRSI is increased by 10–30%, and LTT becomes undetectable. Stage 4 includes patients with PRSI > 30%.
Conclusions: LTT allows both the detection of early portal hypertension and opening of transhepatic shunts. PRSI is useful in CLD with extrahepatic portosystemic shunts. Our hemodynamic model, staging the evolution of portal hypertension and portosystemic shunts, is inclusively useful in the selection for Interferon therapy.

P42

INVESTIGATION OF COLON TRANSIT IN CHILDREN WITH CHRONIC IDIOPATHIC CONSTIPATION

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Background: In childhood, constipation is a very common problem with diverse etiology. Most of the cases involve functional constipation. The types of chronic idiopathic constipation (CIC) are as follows: slow colonic transit, functional fecal retention, their combination, and constipation which is predominant in irritable bowel syndrome. The first steps in diagnosing/treating the condition should involve the exclusion of primary organic causes, as well as the metabolic, neurological and iatrogenic ones.. Then special anorectal physiological investigations are needed.
Material and methods: In our laboratory, the aim of the radionuclide study was to demonstrate the two types of CIC, the slow colon transit (SCT) and the functional fecal retention (FFR). They make it easier for the clinician to plan the patient's treatment. The radionuclide study is conducted as follows: after adequate pretreatment, Tc-99m Fyton is administered peros, and images are collected at 2, 6, 12, 24, 30 and 48hours following administration. In children, the tracer normally reaches the cecum in 6 hours and is evacuated in 30 to 48 hours. Slow transit is identified when the tracer reaches the cecum in 6 hours, but most of the radioactivity is retained in the proximal colon and transverse colon for 24, 30 and 48 hours. In the case of FFR the tracer reached the rectosigmoid in 24 to 30 hours but was not passed for 48 hours.
After the evaluation of the specific studies, exploration of the causes and exact diagnosis, the appropriate treatment always has to be planned individually. We would like to demonstrate this by presenting 3 cases.

P43

EXPERIENCE WITH SPECT/CT IN UNCOMMON ENDOCRINE DISEASES

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Background: We aimed to demonstrate the clinical applicability of SPECT/CT through case reports of uncommon endocrine disorders such as insulinoma and ectopic Cushing's disease.
Material and methods: A total of 43 octreoscan examination was performed between July 2007 and March 2008. Two interesting cases are discussed here in detail. In all cases, static, AP and PA SPECT scans were carried out on the chest and abdomen at 24 and 48 hours after injecting the radiopharmacon. Additionally, SPECT/CT was performed at 48 hours using a Nucline DHV/CT Hybrid equipment.
Results: Most of the patients suffered from intestinal or pancreatic carcinoid tumor. Insulinoma and ectopic Cushing's disease were revealed in 10% of the patients. In the patient with ectopic Cushing's disease, focal accumulation of the radiopharmacon was detected in the 9th segment of the right lung and behind the pancreas; similarly, the CT scan showed topographically identical alterations in density. Histologically the tumor removed from the right lung was a typical carcinoid tumor with ACTH receptors on the surface. In the patient with insulinoma, somatostatin receptors of abnormally increased density were detected in the border region of the head and body of the pancreas, while the CT scan suggested a circumscribed abnormality with fatty-density. The histology of the tumor confirmed the diagnosis of insulinoma.
Conclusion: Multimodal SPECT/CT provides clinically significant help in the localization of ectopic and uncommon tumors supporting the indication of surgery and improving the outcome.

P44

SPECT EXAMINATION OF *DÉJA VU* ELICITED BY PALLIDAL DEEP BRAIN STIMULATION

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Background: *Déja vu*, as aura, is very common in temporal lobe epilepsy (TLE). In a young woman with hemidystonia, *déja vu* was accidentally elicited by deep brain stimulation. Functional imaging during *déja vu* had not been performed yet, therefore we aimed to determine the structures involved in generating *déja vu*.
Material and methods: Preoperative fMRI (at 1T) was performed for testing language dominance, and then an electrode was inserted into the left globus pallidus interna (GPi). Postoperative localization of the electrode was examined with coronal and sagittal MP-RAGE. In agreement with the patient, "ictal" (during DBS stimulation) and one week later "interictal" (normal stimulation) HMPAO-SPECT was performed. The evaluation was carried out by subtraction ictal SPECT co-registered to MRI (SISCOM).
Results: Hyperactivity was revealed in the right hippocampus, parahippocampal gyrus, fusiform gyrus, cerebellum and superior temporal pole and in the left cerebellum, operculum, insula, lingual gyrus, precuneus and middle temporal gyrus. In contrast, hypoactivity was found bilaterally in the fronto-parietal region.
Conclusion: Accidentally, a non-aura *déja vu* was elicited in a reproducible way by DBS in a patient without epilepsy. Furthermore, déja vu related brain structures (contralateral mesiotemporal hyperperfusion) became identifiable by using functional imaging (SISCOM).

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CASE REPORT OF A RARE NUCLEAR MEDICINE EXAMINATION

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Background: With the spread and development of morphological devices, and the relatively easy access to these examinations, certain examinations using a radioisotope have become less common. An example of the above is the liquorrhoea examination, which is very sensitive in detecting liquorrhoea.
Case report: A 4.5-year-old girl pricked the point of scissors into the inner corner of her right eye. After the accident sanguineous secretion was discharged from her right nostril, which was followed by clean liquid that was presumed to be liquor. PlainCT scans of the skull (slice width 4 mm) did not confirm bone damage, but suggested bilateral sinusitis. To prove liquorrhoea, radioisotope examination was requested, which confirmed liquorrhoea by both the images and using quantitative methods. Bone damage was confirmed and localized by thin-slice CT scans. In the surgical exposure the 5 mm injury was tamponed. The patient is free of complaint after the surgery.
Conclusion: The radioisotope examination clearly confirmed liquorrhoea. That is, if the examinations do not confirm liquorrhoea unambiguously, first a radioisotope examination is advised, which should be followed by a morphologic examination in order to find the exact location of the injury.

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SPECT/CT IMAGING OF ABDOMINO-PELVIC INFECTIONS

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Background: Leukocyte scintigraphy (LS) can be inaccurate in the exact localization of abdomino-pelvic infection (API) even in use of SPECT imaging, surgical treatment, however, needs exact localization.
The aim of the study was to investigate the value of additional SPECT/CT imaging in suspicion of API.
Material and methods: 50 patients (pts) (17 men, 33 women) with suspicion of API underwent LS.
Radiopharmaceuticals: 1. 99mTc-HMPAO-labelled leukocytes 700 MBq: 29 pts; 2. 99mTc-antigranulocyte MAb 600 MBq: 21 pts.
Instruments: DHV SPIRIT dual headed SPECT and AnyScan SPECT/CT (Mediso).
Imaging after injection: ad 1 — 30, 120 minutes and 20 hours, ad 2 — 3 hours.
Images: whole body scan, abdominal/pelvic planar and SPECT scintigraphy (50 pts) and additional abdominal/pelvic plain low-dose CT+SPECT (7/50 pts).
Results: API was verified by final diagnosis in 22/50 pts whereas API was ruled out in 28/50. API cases: tubo-ovarian abscess (4), adnexitis (6), subphrenic abscess (2), abdominal wall abscess (2), liver abscess (1), pancreatic abscess (1), presacral abscess (3), post-nephrectomy abscess (2), perianal abscess (1). Leukocyte accumulation was detected by planar and SPECT imaging in 22/22 positive pts, but in 6/22 pts the localization of accumulation was uncertain. The correct site of infection was determined by SPECT/CT in 2 positive cases with uncertain localization. LS was negative in 22/28 pts and there were 6 false positive cases. API was ruled out by SPECT/CT in 4/6 pts showing intraluminal cecal or urethral accumulations. Further 2 cases of false positivity weredue to abdominal wall stoma (SPECT/CT was not done).
Conclusions: SPECT/CT can determine the exact location and extent of API using LS. Moreover, the accurate localization of physiologic leukocyte accumulation by SPECT/CT could reduce the number of false positive results.

TECHNOLOGISTS' SESSION

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SEASONAL APPEARANCE OF NEW BONE METASTASES IN BREAST AND PROSTATE CANCER PATIENTS

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Background: The seasonal appearance of new bone metastases in breast and prostate cancer patients was investigated on the bone scans.
Material and methods: 8405 whole body bone scans were performed from January 2006 to December 2008. Two hundred and ninety-one patients with breast cancer and 203 patients with prostate cancer were studied, in whom new hot spots were found on their control bone scans. One or two control scans in 62% of the cases, 3 or 4 control scans in 33%, 5 or more control scans in 5% of the cases were performed.
Results: In the 291 breast cancer patients the appearance of new hot spots 33, 49, 43% were found in the spring months, 15, 15, 17% were found in the summer months, 32, 21, 17% were seen in the autumn months and 20, 15, 23% were seen in the winter months. The results in the 203 prostate cancer patients were as follows: 37, 32, 39% in spring, 20, 23, 15% in summer, 23, 20, 17% in autumn and 20, 25, 29% in winter.
Conclusion: The new hot spots (metastases) appeared on the control bone scans significantly more often in spring, while the progression rate was the least/was less in summer.

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SIGNIFICANCE OF SPECT/CT EXAMINATION IN BONE SCINTIGRAPHIES

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Background: The aim of the study was the investigation of the etiology of hot spots on the whole body bone scan by SPECT/CT fusion imaging.
Material and methods: Between July 2007 and December 2008, 4059 whole body bone scans (WBBS) were performed; in 244 cancer patients they were completed by SPECT/CT examination. There were 71 patients with breast cancer, 58 patients with prostate cancer, 37 patients with lung cancer, 25 patients with malignant melanoma and 53 patients with other tumors. The SPECT/CT investigations involved the regions of bone structure where the hot spots were found.
Results: In 78% of the cases the hot spots were in the spine while in 22% they were detected in the skull, extremities and other localization. 7% all of the hot spots proved to be bone metastases. In 12% of the patients with 2–4 hot spots on their scans — 17% of the hot spots were verified as metastases and 83% happened to be degenerative processes. In 15% of the cases the hot spots were the consequence of operation, fracture, compression or other traumatic lesions. In 66% of the cases only degenerative lesions were verified.
Conclusion: The completed SPECT/CT examinations after WBBS can give more information about the etiology of the hot spots in the bones, which has a crucial role in providing efficient therapy. Our results suggest the importance of the careful evaluation of hot spots, because they are caused by metastases in only 7% of the cases.

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ROLE AND PLACE OF THE TECHNOLOGISTS IN THE NUCLEAR MEDICINE PROTOCOLS

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In the last years — owing to fast developing molecular medicine — a lot of new diagnostic methods have been introduced into the practice of nuclear medicine. From these new methods, we are routinely using some receptor- and immunoscintigraphic investigations. In these types of examinations the accuracy of the assistants' work is of great importance. When preparing the patients, we have to pay special attention to their' medication. We have to give detailed information about the examination (instructing them to stop certain medications, or to drink for hydration, etc.). In I-123-MIBG scintigraphy — used for patients with neuroblastoma or phaeochromocytoma — the diagnostic value can significantly decrease, if the patient does not stop taking certain antihypertensive medications on the day prior to the intervention. If we do not inform him to take iodine orally, the radiation burden to the thyroid gland will be unnecessarily increased. Neuroblastoma is a pediatric disease and the examination of children requires special skills and care (to avoid movement artefacts).

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WAYS AND WRONG WAYS IN EVERYDAY NUCLEAR MEDICINE

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More than 20 different diagnostic examinations and therapies are performed in the Department of Nuclear Medicine. Diagnostic protocols depend on the physical and biological characteristics of the radiopharmaceuticals we use. Precise and efficient work demands teamwork on behalf of physicians and technologists alike. The Close co-operation of the patients is also essential. The examinations in our department are strongly influenced by the type, amount, availability of the radiopharmaceuticals (accumulation, excretion, gamma-energy, physical half-life, camera-time, etc.). Appropriate assistant-doctor relation is needed for continuous effective work. Alarge share of the work in a hot-lab is done by technologists. The appropriate preparation of radiopharmacons is very important, because of the required high quality (purity, exact amount of activity). Almost every examination demands different ways of patient preparation (stopping certain medications, hydration, etc.). Data acquisition and processing are also very variable. The distribution of radiopharmacons in the human body is examined with different gamma cameras (including double-head SPECT systems). Their technical parameters are defined by the characteristics of the different radiopharmacons (physical characteristics of SPECT, collimators, acquisition time). In dynamic examinations it is extremely important to prevent the patient from moving. Our work in the Department of Nuclear Medicine is regulated according to the Quality control handbook. All of our examinations require close co-operation among doctors, assistants, therapists and patients; otherwise we can get lost in an endless labyrinth and it is the patient who will be put at a disadvantage.

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