

**XVII CONGRESS OF THE HEVESY GYÖRGY  
HUNGARIAN SOCIETY OF NUCLEAR MEDICINE**

**BUDAPEST, HOTEL DANUBIUS HELIA**

**25–27 AUGUST, 2011**

**ABSTRACTS BOOK**

## **XVII Congress of The Hevesy György Hungarian society of Nuclear Medicine**

Budapest, 25–27 August, 2011

### **Organizing Committee Members**

Dr. Garai Ildikó (chairwoman)  
Dr. Bagosi Gabriella  
Dr. Buga Klára

### **Scientific Committee Members**

Prof. Szilvási István (chairman)  
Dr. Balogh Ildikó  
Dr. Balogh Lajos  
Dr. Dabasi Gabriella  
Prof. Galuska László  
Dr. Garai Ildikó  
Dr. Környei József  
Prof. Pávics László  
Dr. Varga József  
Prof. Zámbo Katalin

This publication includes submitted abstracts accepted by Scientific Committee of the Congress.

## ORAL SESSION

### E1

#### PRIMARY SYSTEMATIC TREATMENT OF BREAST TUMOUR: LINKS BETWEEN DIAGNOSTIC EXAMINATIONS OBJECTIVE

T. Tökés<sup>1</sup>, K. Iványi<sup>1</sup>, K. Somlai<sup>2</sup>, B. Székely<sup>2,3</sup>, J. Kulka<sup>3</sup>, Gy. Szentmártoni<sup>2</sup>, L. Torgyik<sup>2</sup>, M. Dank<sup>2</sup>, I. Kalina<sup>2</sup>, H. Galgóczy<sup>5</sup>, Zs. Lengyel<sup>6</sup>, T. Györke<sup>4,5</sup>

<sup>1</sup>Semmelweis University, Budapest, Hungary

<sup>2</sup>Department of Diagnostic Radiology and Oncotherapy, Semmelweis University, Budapest, Hungary

<sup>3</sup>2<sup>nd</sup> Department of Pathology, Semmelweis University, Budapest, Hungary

<sup>4</sup>Department of Nuclear Medicine, Semmelweis University, Budapest, Hungary

<sup>5</sup>ScanoMed Ltd., Budapest, Hungary

<sup>6</sup>Pozitron-Diagnosztika Ltd., Budapest, Hungary

**Background:** The role of metabolic imaging is increasing in the measurement of early therapeutic response during cancer patient treatment. Our aim was to measure the effect of primary systemic chemotherapy (PST) on high risk breast cancer patients by using imaging modalities and pathology diagnostics and to find correlation between the applied modalities. The results of FDG-PET-CT examinations, which helped identify the extent of the tumour and the existence of distant metastasis, were available for therapeutic decision, as well as the core biopsy results which showed the tumour's biological behaviour. We compared the metabolic and morphological response, and analysed the relationship of these responses with the proliferation of the tumour, with special emphasis on changes in Ki-67 expression.

**Material and methods:** We report 22 (21 women and 1 man) of patients treated with PST during 2008–2010. All of them were examined by FDG-PET-CT for staging before chemotherapy and surgery. We excluded patients with distant metastases on pre-operative PET-CT, and those who refused surgery (lack of tissue samples). Standard Uptake Value (SUV) changes were measured on PET scans in the primary tumour and the axillary lymph node region. The calculated  $\Delta$ SUVs were compared with morphological changes on native CT, as well as with the changes of the expression of Ki-67 proliferation marker measured by specific immune-histochemistry method in the core biopsy and surgical specimens. For analysing the changes we used two-sample T-test and Spearman rank correlation.

**Results:** The reduction of Ki-67 levels proved to be significant (49.41% vs. 16.23%,  $p = 0.001$ ). A significant decrease was detected in the SUV of primary tumours (12.18 vs. 2.59,  $p = 0.001$ ), and SUV of the axillary region (11.72 vs. 3.18  $p = 0.009$ ). A significant reduction was detected in the size of the primary tumour (30.86 mm vs. 17 mm,  $p = 0.002$ ), but in the axillary lymph node region the reduction in size proved to be insignificant (18.58 mm vs. 14.58 mm,  $p = 0.319$ ). Significant correlation was found between Ki-67 and SUV parameters before PST in primary tumours ( $p < 0.001$ ). There was also a significant correlation between initial Ki-67 values and changes in SUV ( $p < 0.001$ ), and between Ki-67 changes and in  $\Delta$ SUVs ( $p < 0.001$ , correlation coefficient: +0.734).

**Conclusions:** Metabolic changes correlate well with the regression indicated by the proliferation marker, and with the pathological tumour response, better than the morphological regression, especially in axillary lymph node region. Beside the Ki-67 expression based on core biopsy, the FDG-PET-CT results may play an essential role in the indication of PST. PET-CT seems useful in the assessment of response to treatment, and it can be particularly significant in assessing the early therapeutic response of the tumours.

### E2

#### COMPARISON OF FDG PET-CT AND MRI DWIBS TREATMENT FOLLOW UP EXAMINATIONS IN CHILDHOOD LYMPHOMAS

M. Zsbán<sup>1</sup>, G. Rudas<sup>2</sup>, L. R. Kozák<sup>2</sup>, Z. Tóth<sup>3</sup>, G. Kovács<sup>4</sup>, M. Csóka<sup>4</sup>, T. Györke<sup>3,5</sup>

<sup>1</sup>Faculty of Medicine, Semmelweis University, Budapest, Hungary

<sup>2</sup>Semmelweis University MR Research Center (MRKK), Budapest, Hungary

<sup>3</sup>ScanoMed Ltd., Budapest, Hungary

<sup>4</sup>2<sup>nd</sup> Department of Paediatrics, Semmelweis University, Budapest, Hungary

<sup>5</sup>Department of Nuclear Medicine, Semmelweis University, Budapest, Hungary

**Background:** In the treatment follow up of childhood lymphomas FDG PET-CT is widely used as the most suitable method to assess the tumor viability. The MRI DWIBS (diffusion-weighted whole-body imaging with background body-signal suppression) is a new method without radiation, which is — based on the literature — also reliably determines the viability, but its sensitivity and specificity in childhood lymphomas are unknown yet. The aim of this study is the comparison of the two methods, and determination of the role of DWIBS in childhood lymphomas.

**Material and methods:** In our prospective study we have investigated 7 children with Hodgkin's (HD) and 8 with non-Hodgkin's (NHL) lymphomas. 26 pairs (12 HD and 14 NHL) of comparative PET-CT and MRI DWIBS examinations were performed. The average ages of the patients at the diagnosis were 13 years with HD and 9 years with NHL. Average time between MRI and PET-CT was 4.1 (0–19) days. The imaging results were compared clinical follow up and/or biopsy results. The data processing was based on medical records and on the reports of imaging procedures. In case of uncertain results we reevaluated the MRI and PET-CT images.

**Results:** In HD the results of the 12 MRI and PET-CT examinations correlated well in terms of morphology and viability. In 6/12 cases however, both examination methods showed lymph node regions with FDG-uptake or reduced diffusion without any proven viable tumor. All clinically positive tumors were confirmed by both imaging methods. In the NHL patient group, among the 14 PET-CT and MRI comparative examinations in 3/14 cases the relapse was clinically confirmed, but in 2 cases (which were two relapses of the same patient) MRI gave negative result. In 1/14 interim examinations MRI was positive, while PET-CT negative, but following further additional treatments no viable tumor could be found. In case of 10/14 examinations, although the patients were in remission clinically, in only 4 cases could be supported this by both examinations. From the remaining 6 cases in 4 and 3 cases positivity was found by PET-CT and MRI, respectively.

### E3

#### 18F-FDG PET/CT IN THERAPY RESPONSE ASSESSMENT OF BONE-DOMINANT BREAST CANCER

Zs. Hascsi<sup>1</sup>, E. Nagy<sup>2</sup>, N. Fedinecz<sup>1</sup>, J. Varga<sup>2</sup>, J. Tóth<sup>3</sup>, K. Mezei<sup>4</sup>, I. Garai<sup>1</sup>

<sup>1</sup>ScanoMed Nuclear Medicine Centers, Debrecen, Hungary

<sup>2</sup>Institute of Nuclear Medicine, University of Debrecen, Debrecen, Hungary

<sup>3</sup>Institute of Oncology, University of Debrecen, Debrecen, Hungary

<sup>4</sup>Department of Radiooncology, Jósa András Teaching Hospital, Nyíregyháza, Debrecen, Hungary

**Background:** In patients with disseminated breast cancer malignant bone involvement occurs in approximately 70%. Conventional imaging methods, including bone scintigraphy, are highly sensitive for detecting bone me-

tastasis, although they have limited accuracy in assessment of response to therapy. There is no established standard method for monitoring bone metastases. Recent data suggest the promising performance of 18F-FDG PET/CT (PET/CT) for this purpose. Our aim was to retrospectively determine the prognostic value of sequential PET/CT in monitoring systemic therapy of bone-dominant metastatic (BDM) breast cancer.

**Material and methods:** Retrospective search of our image database identified 23 breast cancer patients with BDM disease, who underwent treatment and had serial PET/CT studies. In this patient group altogether 32 pairs (baseline and follow-up) of PET/CT imaging datasets were reviewed by two experienced specialists. For quantitative analysis the most FDG avid metastasis was defined as target lesion, in accordance with PERCIST criteria. Therapeutic responses were visually classified into four categories: complete and partial metabolic response (CMR, PMR), stable and progressive disease (SMD, PMD). Target lesion SUV and SUL, maximum and peak values were recorded at each time point. Visual response, target SUV/SUL max/peak on baseline, and the absolute and relative change of quantitative parameters were supposed to be predictive for time-to-progression (TTP), which served as a clinical outcome measure. TTP was clinically established by two oncologists independently from PET results (based on other imaging results, tumor markers, and symptomatic findings). The median follow-up time was 230 days.

**Results:** Forward stepwise Cox regression analysis was used to test for associations between TTP and both dichotomous and continuous variables. Percentage change in SULpeak ( $p = 0.001$ ), initial SULmax ( $p = 0.012$ ) and SULpeak ( $p = 0.030$ ) were most significantly correlated with the outcome. On Kaplan-Meier analysis the survivor curves of four visual and PERCIST response groups were shown to differ. Responders (CMR + PMR) had significantly longer TTP compared to patients with PMD ( $p = 0.02$ ).

**Conclusion:** Our retrospective study indicates that PET/CT might have a role in therapy response assessment of BDM breast cancer. Qualitative (visual) evaluation and SUL (rather than SUV) based quantification, as proposed by PERCIST, is feasible to apply when considering a prospective trial to validate these findings.

## E4

### COMPARING THE DIFFERENTIAL DIAGNOSTIC VALUE OF HYBRID IMAGING TECHNIQUES (SPECT/CT, PET/CT) IN BONE LESIONS

S. Szekeres<sup>1</sup>, Zs. Lengyel<sup>2</sup>, K. Dérczy<sup>3</sup>, Cs. Weninger<sup>3</sup>, E. Schmidt<sup>1</sup>, Zs. Szabó<sup>1</sup>, K. Zámbo<sup>1</sup>

<sup>1</sup>Department of Nuclear Medicine, University of Pécs, Pécs, Hungary

<sup>2</sup>Center for Pozitron Diagnostic, Budapest, Hungary

<sup>3</sup>Department of Radiology, University of Pécs, Pécs, Hungary

**Background:** The purpose of our study is to compare the diagnostic efficacy of 99Tc-MDP bone scintigraphy completed by SPECT/CT and the 18F-FDG PET/CT examinations in evaluation of bone metastases.

**Material and methods:** Due to the collaboration of two departments we have an opportunity to compare the results of patients who underwent the oncological evaluation program including 99Tc-MDP bone scintigraphy completed by SPECT/CT and the 18F-FDG PET/CT examinations.

**Results:** We diagnosed with SPECT/CT in 48% of patients some type of benign lesions (degenerative disease, traumatic injury or consequence of operation). In the cases of these patients the results of 18F-FDG PET/CT in the whole bone system concerning the bone metastasis were negative as well. Furthermore bone metastases were found in 22% of patients with the SPECT/CT and PET/CT, too. In the 30% of the patients the results of above mentioned between the two different methods were not concordant.

**Conclusions:** The 99Tc-MDP bone scintigraphy completed by SPECT/CT can particularly improve the detection of the exact etiology of lesions. The diagnostic value of these two different methods have a good correlation. The possible deviation can be caused by using different mechanisms to detect the pathologic lesions: 99Tc-MDP bone scintigraphy represents the phosphate metabolism while the 18F-FDG PET detects the glucose metabolism and the increased activation of osteoblasts are not always accompanied by increased glucose metabolism.

## E5

### IMPORTANCE OF FDG PET-CT IN DIAGNOSIS AND FOLLOW-UP OF PATIENTS WITH BREAST CANCER

H. Galgóczy<sup>1</sup>, A. Németh<sup>2</sup>, Zs. Varga<sup>1</sup>, P. Szabó<sup>1</sup>, L. Jorgov<sup>3</sup>, I. Garai<sup>1</sup>

<sup>1</sup>ScanoMed Kft., Budapest-Debrecen, Hungary

<sup>2</sup>Department of Transplantation and Surgery, Semmelweis University, Budapest, Hungary

<sup>3</sup>Department of Radiology and Oncotherapy, Semmelweis University, Budapest, Hungary

**Background:** Our aim was to define extra information of FDG PET-CT examination comparing to the previous diagnostic images; to evaluate the percentage of confirmation of clinically supposed status and to define its influence on oncologic treatment of patients.

**Material and methods:** The medical records of 143 consecutive patients with breast cancer referred from three oncologic centers from October 2008 to September 2009 were retrospectively reviewed. PET-CT imaging was performed with GE Discovery ST scanner according to the usual protocol. 143 patients (142 women, 1 man, mean age 56.9 years) have 155 breast tumors. The histologic subtypes of the primary tumors were infiltrating ductal carcinoma in 102, infiltrating lobular carcinoma in 18, DCIS alone in 9, other/unknown in 26 cases. Histologically Grade 2 carcinoma occurred in largest proportion. 70 conservative operations and 74 mastectomies were performed. In remainder cases the operation was not performed or type of surgical procedure was not known.

**Results:** Definite diagnosis was established in 129 cases (84.3%), the extent of disease was increased in 40 (31%), diagnosis was unchanged in 24 cases (18.6%), it was negative in 65 cases (50%). The PET-CT result was equivocal in 24 cases (15.6%) having caused partly inadequate referral, partly difficulty of differentiation between tumor and inflammation. PET-CT examination gave excess information for physicians in 31%. The therapy was altered in 40 cases (26%) based on PET-CT result.

**Conclusion:** FDG PET-CT examination is useful in management of patients with breast cancer in case of adequate indication.

## E6

### FDG PET-CT IN MANTLE CELL LYMPHOMA

Z. Tóth<sup>1</sup>, V. Tóth<sup>1</sup>, A. Fekésházy<sup>1</sup>, P. Szabó<sup>1</sup>, T. Györke<sup>1</sup>, L. Kiss<sup>2</sup>, S. Barna<sup>2</sup>, Á. Illés<sup>3</sup>, I. Garai<sup>2</sup>

<sup>1</sup>ScanoMed Ltd., Budapest

<sup>2</sup>ScanoMed Ltd., Debrecen

<sup>3</sup>DEOEC Department of Internal Medicine, Debrecen

**Background:** We assessed the potential role of PET-CT in the diagnostic workup of mantle cell lymphoma, which type of lymphoproliferative disease unites the unfavourable characteristics of aggressive and indolent lymphomas.

**Material and methods:** 122 PET-CT examinations of 56 patients were retrospectively analysed [11 pre-treatment, 17 interim, 20 restaging, 14 pre-, 23 post-Haemopoietic Stem Cell Transplantation (HSCT) evaluations, and 37 PET-CT examinations due to clinically suspected relapse].

**Results:** 9/11 staging examinations before initial therapy had revealed pathologic FDG accumulating focuses. Among the interim examinations (17) only 6 patients achieved complete metabolic remission (CMR), in 11 cases FDG-avid lesions were found. Among the 10/20 restaging PET-CT examinations indicating CMR, 4 patients relapsed within 1 year. Among the examinations showing CMR on the pre-transplantation PET-CT (9/14), relapse evolved in 1 case in the first year after transplantation. In 1 of 23 examinations CMR was not achieved after HSCT, from the 21 of 23 cases showing CMR on post-HSCT PET-CT, 2 patients relapsed within 1 year. In 1 of 23 post-transplantation examinations clinical signs of relapse did not develop after positive PET-CT. Clinical relapse suspicion was confirmed by PET-CT in 13 cases, in 5 of 37 cases it was found to be false positive, in the remaining patients relapse did not evolve after negative PET-CT (19/37).

**Conclusion:** FDG PET-CT seems to be an accurate method in the diagnostic workup of mantle cell lymphoma, including pre-treatment staging, interim,

and restaging assessments. Its negative predictive value appears to be acceptable, but remains below the results achieved in Hodgkin- and high grade B cell lymphomas. Regarding the characteristics of the disease its further role may mostly increase in the pre-HSCT prognostic evaluation.

## E7

### 18F-FDG PET/CT IN THE FOLLOW-UP OF BREAST CANCER PATIENTS WITH POSITIVE SLN WITHOUT ALND

Á. Sávolt<sup>1</sup>, G. Péley<sup>2</sup>, L. Tóth<sup>1</sup>, Z. Mátrai<sup>1</sup>, Cs. Polgár<sup>3</sup>, Zs. Horváth<sup>4</sup>, É. Szabó<sup>5</sup>, K. Borbély<sup>6</sup>

<sup>1</sup>Department of Surgery, Norfolk and Norwich University Hospital, Norwich, United Kingdom

<sup>2</sup>Department of General Surgery, Norfolk and Norwich University Hospital, Norwich, United Kingdom

<sup>3</sup>Department of Radiotherapy, National Institute of Oncology, Budapest, Hungary

<sup>4</sup>Department of Internal Medicine and Oncology, National Institute of Oncology, Budapest, Hungary

<sup>5</sup>Department of Radiology, National Institute of Oncology, Budapest, Hungary

<sup>6</sup>Department PET-CT, National Institute of Oncology, Budapest, Hungary

**Background:** The Hungarian National Institute of Oncology has just closed a randomized clinical phase III study. The OTOASOR (Optimal Treatment of the Axilla — Surgery or Radiotherapy) trial compared the result of the completion axillary lymph node dissection (ALND) and axillary nodal irradiation (ANI) without ALND in patients with early-stage breast cancer after positive sentinel lymph node biopsy (SLNB). In the investigational arm of the trial patients received 50 Gy ANI postoperatively without ALND. Actually we had information only about the sentinel lymph node (SLN) status, but the further nodal involvement remained unknown. Positron emission tomography combined with computed tomography (PET/CT) has been receiving increasing attention recently for restaging and follow-up of breast cancer. The aims of this study were to evaluate the therapeutic effect of the axillary nodal irradiation and to detect early axillary recurrences or residual diseases.

**Material and methods:** In year 2009, forty-five T1-2 SLNB positive patients were retrospectively selected from the investigational arm of the OTOASOR trial. All patients underwent surgery (breast-conserving or mastectomy) and SLNB, the SLN(s) were found positive and the patients received 50 Gy ANI instead of completion ALND. Six months after the end of the radiotherapy, patients underwent 18F-FDG PET/CT and mammography combined with breast and axillary ultrasound or breast MRI simultaneously. The findings of PET/CT, mammography and/or breast MRI were compared.

**Results:** Only 5 out of 45 patients had suspicious findings in the axillary tail on mammography combined with breast and axillary ultrasound. In those five patients PET/CT suggested locoregional residual disease in only one patient that was confirmed by core biopsy. In the remaining four cases both the PET/CT and the biopsy showed no evidence of malignancy.

**Conclusions:** Our preliminary data suggest that axillary nodal irradiation (ANI) without completion axillary lymph node dissection (ALND) does not increase the risk of recurrence of the sentinel positive patients. Furthermore, the results of our study demonstrate the benefit of 18F-FDG PET/CT in the follow-up of breast cancer patients with positive SLN without ALND.

## E8

### PROGNOSTIC VALUE OF INTERIM 18FDG-PET/CT IN PATIENT WITH HODGKIN'S LYMPHOMA, USING DIFFERENT 5-POINT VISUAL SCALE FOR INTERPRETATION

S. Barna<sup>1</sup>, N. Fedinecz<sup>1</sup>, Zs. Miltényi<sup>2</sup>, F. Magyari<sup>2</sup>, J. Varga<sup>3</sup>, Á. Illés<sup>2</sup>, I. Garai<sup>1</sup>

<sup>1</sup>ScanoMed Ltd., Debrecen, Hungary

<sup>2</sup>Department of Internal Medicine, DE OEC, Debrecen, Hungary

<sup>3</sup>Department of Nuclear Medicine, DE OEC, Debrecen, Hungary

**Background:** The results of interim 18FDG-PET/CT examinations have great significance in prognosis of HL patients follow-up. Currently definition

of MRU (minimal residual uptake) is not uniform when using 5-point visual scale. The aim of our study is to compare the affect on prognosis of the currently used MRU definition.

**Material and methods:** Interim 18FDG-PET/CT examination of 82 newly-diagnosed HL patients (male: 40, female: 42, average age: 36 year) were evaluated by London, Hutchings, Gallamini and Barrington criteria. The 18FDG-PET/CT examinations were performed on the same camera according to the standardised protocol. Two experienced specialist analysed the studies. All patients had six courses of ABVB/EBVD and if it was necessary received radiotherapy according to the protocol. The result of interim 18FDG-PET/CT did not affect the later used therapy. The median follow-up period was 24 months (9–47 month). Kaplan-Maier analysis was performed to determine the OS and PFS and Mantel-Cox probe to compare the outcome of the different groups.

**Results:** During the observation period 78% of patient had no progression (64 pts/82 pts) Compare to the PET negative group PET positive group were measured poor prognosis on the basis of all four criteria. The Barrington and Gallamini methods are more robust in estimating prognosis. By Cox regression, stepwise method [„forward stepwise” (likelihood ratio)] Barrington method has been proved the most effective of the 4 criteria ( $p < 10^{-4}$ ). However compared to PET negative group there wasn't significant difference in survival or PFS in either defined MRU group.

**Conclusion:** On the base of our study with the Barrington and Gallamini criteria PET + patients with worse prognosis can be clearly divided by the result of the interim PET-CT examinations, conversely the MRU category has no prognostic value in clinical aspect with any recommended definition. However more patients and longer follow-up is required to refine data.

## E9

### THE PREDICTIVE VALUE OF FDG-PET/CT IN RESTAGING OF HODGKIN LYMPHOMA — WHAT WE CONSIDER AS A POSITIVE REPORT?

K. Kajár<sup>1</sup>, Zs. Lengyel<sup>1</sup>, P. Molnár<sup>1</sup>, Sz. Szakáll<sup>1</sup>, Gy. Tóth<sup>1</sup>, A. Rosta<sup>1</sup>, Zs. Molnár<sup>2</sup>

<sup>1</sup>Pozitron Diagnostics Ltd., Budapest, Hungary

<sup>2</sup>National Institute of Oncology, Budapest, Hungary

**Background:** The negative predictive value (NPV) of FDG-PET(CT) at the end of treatment in Hodgkin lymphoma is high. However, the rather low positive predictive value (PPV) is often leads difficulties in the clinical practice. In the last years a method was developed for the assessment of PET results, which is based on both CT and PET criteria. The use of SUVs are generally not appropriate to correctly judge the dignity of the lesions. In this retrospective study the aim of the authors was to define the predictive value of restaging PET/CT with the help of a 5-point scoring system. This system, which was developed for interim PET exams to assessment of therapy-effectiveness, correlate lesion's intensities to mediastinal blood-pool or to liver uptake and takes no notice of CT-criteria.

**Material and methods:** They analysed 90 patients, who have PET/CT after the first line treatment between May 2006 and August 2010. The assignment of patients to "positive" and "negative" groups was performed by two different methods. Method 1: "positive" — the highest FDG uptake is higher than the liver uptake (point 4–5). Method 2: "positive" — the highest FDG uptake is higher than the mediastinal blood-pool uptake (point 3–5).

**Results:** The number of positive patients was 31 with Method 1, 14 out of which came to complete remission (CR) during the follow up. The number of negative patients was 59 out of which 56 came to CR. Based on these data PPV was 56% and NPV was 95%. The number of positive patients was 36 with Method 2 with 17 reaching CR during the follow up. The number of negative patients was 54 with 52 reaching CR. Based on these data PPV was 53% and NPV was 96%. The reason of false positivity mostly was inflammation what was already suggested by the reporting physician in some cases.

**Conclusions:** The authors concluded that PET/CT has high NPV and low PPV when using this 5-point scale. There was no significant difference between the results of the two methods. Reporting physicians can provide substantial help to the therapists by specifically stating of the most probably false positive lesions in the report, based on morphology, localization, clinical data, etc.

## E10

**INTERIM FDG PET/CT EXAMINATIONS IN ADVANCED STAGE HODGKIN LYMPHOMA**

Zs. Molnár<sup>1</sup>, B. Deák<sup>1</sup>, K. Kajáry<sup>2</sup>, Zs. Lengyel<sup>2</sup>, P. Molnár<sup>2</sup>, A. Rosta<sup>1</sup>, T. Schneider<sup>1</sup>, E. Szaleczky<sup>1</sup>, F. Varga<sup>1</sup>, E. Várady<sup>1</sup>, K. Borbély<sup>1</sup>

<sup>1</sup>National Institute of Oncology, Budapest, Hungary  
<sup>2</sup>Pozitron Diagnostic Ltd., Budapest, Hungary

**Background:** Hodgkin lymphoma (HL) is a highly curable hematologic malignancy. However, it is difficult to estimate the effectiveness of therapy during treatment. According to the literature FDG-PET/CT is the most suitable method for this purpose. The aim of this retrospective study was to summarise our experience with 18F-FDG PET/CT in interim staging.

**Material and methods:** Twenty five scans were performed in 19 patients between November 2007. and January 2010. Eighteen patients received ABVD combination, 1 patient escalated BEACOPP treatment. Fifty three patients were irradiated at the end of chemotherapy. The number of applied cycles varied between 4 and 8, tailored according to the international prognostic score and the rate of clinical response to treatment. Sixteen examinations were performed after 4–6 cycles, and 9 scans after 1 or 2.

**Results:** PET/CT results was evaluated using clinical follow-up data. Fourteen scans were true positive, 4 false negative, 4 true positive and 2 false positive. True negativity and false positivity were established by follow up data, true positivity and false negativity by the progression on repeated imaging (CT or PET/CT). Specificity, sensitivity, positive and negative predictive values were found to be 88%, 56%, 71% and 78%, respectively.

**Conclusion:** However the results are not as precise as in case of restaging, PET/CT may help in treatment personalisation.

## E11

**PROGNOSTIC VALUE OF STAGING FDG PET-CT IN PATIENTS WITH MALIGNANT MELANOMA IN CORRELATION WITH CLARKE LEVEL**

O. Sántha<sup>1</sup>, J. Varga<sup>2</sup>, J. Olajos<sup>3</sup>, I. Garai<sup>1</sup>

<sup>1</sup>ScanoMed Ltd., Debrecen, Hungary  
<sup>2</sup>Department of Nuclear Medicine, DE OEC, Debrecen, Hungary  
<sup>3</sup>Jósa András Hospital, Nyíregyháza, Hungary

**Background:** The aim of this study was to find correlation between early staging PET/CT results, Clark level and progression-free survival (PFS) of patients with primary cutaneous malignant melanoma (CMM) lesions.

**Material and methods:** 99 CMM patients (57 women and 42 men, mean age: 40,73; 18–61 years) who underwent PET/CT within 6 months from diagnosis were enrolled in this retrospective study. Diagnosis was determined by surgical removal and histological confirmation. PET/CT evaluation was concluded positive or negative depending on the presence of lesions related to CMM. Last clinical appearance was considered as positive or negative depending on the findings related to CMM. The median follow-up period was 19 months (8–45 mo).

**Results:** Positive PET/CT was found 39 pts/99 pts (37.3%) to be definitely more frequent in patients with higher Clark level lesion (khi-square test:  $p = 0.0066$ ). Unexpectedly, Kaplan-Meier analysis and Mantel-Cox log rank test found no relations between Clark level and progression-free survival ( $p > 0.1$ ). Our data showed a remarkable difference of the progression-free survival curves of patients with positive and negative PET/CT findings on Kaplan-Meier analysis, and Mantel-Cox log rank test ( $p < 0.005$ ). 46% of the patients with initial positive PET/CT result showed progression during the follow-up. The period of progression-free survival was not significantly different between the PET/CT-positive and negative groups which can be the result of relatively short follow-up.

**Conclusion:** PET positivity shows significant correlation with Clark level rising. Positive PET/CT result within 6 months after surgery indicates significantly higher risk of progression.

## E12

**IS CONTRAST ENHANCED CT NECESSARY BEYOND FDG-PET/CT FOR PRIMARY STAGING IN HODGKIN LYMPHOMA? — OUR EXPERIENCE**

K. Kajáry<sup>1</sup>, Zs. Lengyel<sup>1</sup>, P. Molnár<sup>1</sup>, Sz. Szakáll<sup>1</sup>, Gy. Tóth<sup>1</sup>, A. Rosta<sup>2</sup>, Zs. Molnár<sup>2</sup>

<sup>1</sup>Pozitron Diagnostic Ltd., Budapest, Hungary  
<sup>2</sup>National Institute of Oncology, Budapest, Hungary

**Background:** Several study supported the observation that PET-CT examination with "low dose", non-enhanced CT (PET/CT) is more accurate, than contrast enhanced CT (ceCT) in the staging of Hodgkin disease (HD). The aim of the authors was to compare the accuracy of PET/CT and ceCT for primary staging of HD in their practice, including those cases where ceCT was performed as a supplement to standard PET/CT.

**Material and methods:** The authors retrospectively analysed data obtained from imaging of 29 patients newly diagnosed with HD. In the evaluation of PET/CT images they used a 5-point scoring system which was developed for interim PET examinations. Two methods were used for each regions. In Method 1 the region was positive, if its uptake was higher than the liver uptake (point 4–5). In Method 2 the region was positive, if its uptake was higher than the mediastinal blood-pool activity (point 3–5). Two comparisons were made between the modalities, too: ceCT vs. PET/CT and PET/CT vs. PET/CT+ceCT.

**Results:** Disease was upstaged by PET/CT in 3 patients with Method 1 and in 4 patients with Method 2 as compared to ceCT. They did not find any case of downstaging with PET/CT. There were no change in stage when comparing PET/CT and PET/CT with ceCT.

**Conclusions:** The number of patients was rather low, but the results show that PET/CT is more accurate than ceCT in the primary staging of HD. In addition, the authors established that it is not reasonable to supplement standard PET/CT examinations with ceCT in this indication.

## E13

**IMPORTANCE OF INCIDENTALLY DISCOVERED FOCAL FDG UPTAKE IN THE LARGE INTESTINE**

V. Tóth<sup>1</sup>, P. Szabó<sup>1</sup>, Z. Tóth<sup>1</sup>, T. Löb<sup>2</sup>, M. Steierlein<sup>3</sup>, I. Garai<sup>1</sup>

<sup>1</sup>ScanoMed Ltd., Budapest, Hungary  
<sup>2</sup>Péterfy Hospital, Budapest, Hungary  
<sup>3</sup>Zala County Hospital, Zalaegerszeg, Hungary

**Background:** Incidental focal FDG uptake in the colorectal tract is relatively frequently described (0.6–3%) on PET/CT examinations. According to the relevant literature 13–30% of these findings is caused by malignant tumors. The aim of this study is to evaluate the frequency of malignancy in the background of incidental colorectal focal tracer uptake among our patients.

**Material and methods:** In 2009 3148 patients underwent FDG PET/CT scan in our center, mostly because of any malignant disease. Patients with known colorectal cancer were excluded from our study. The examinations were carried out by GE Discovery ST8 PET/CT camera. Only 18F-FDG was used as radiotracer and protocols compiled according to international guidelines were applied. In every case we drew the the referring doctor's attention to the detected focal colorectal tracer uptake and we suggested further investigation.

**Results:** We detected in 55/3148 (1.7%) patients focal incidental colorectal FDG-accumulation. In 43/55 (78%) patients colonoscopy was performed, on colonoscopy 56 circumscribed morphological lesions were described. In these 43 patients we detected 49 focal FDG-uptake, altogether. 9/49 (18%) FDG-accumulating lesions proved to be malignant (verified histologically). 19/49 (39%) lesions showing focal tracer uptake were described as polyp on colonoscopy, in 11/19 cases correct histology could be performed indicating dysplasia in 9/11 (82%) samples. In the remaining cases of focal FDG-uptake other lesions (inflammation, diverticel, etc. 9/49, 18%) or nothing (12/49, 24%) were visible on endoscopy.

**Conclusions:** In our study the frequency of incidental focal FDG accumulation in large intestine upon PET/CT scan and among them the proportion of malignant and premalignant lesions confirmed by histology is equal to data of the literature. Therefore we emphasize the importance of further investigation of patients with incidental focal colorectal FDG uptake.

## E14

### PROGNOSTIC VALUE OF INTERIM FDG PET-CT IN NON-HODGKIN'S LYMPHOMAS TREATED WITH COMBINED CHEMO-IMMUNOTHERAPY

T. Györke<sup>2,4</sup>, A. Lantos<sup>1</sup>, T. Masszi<sup>5</sup>, G. Mikala<sup>5</sup>, A. Sipos<sup>5</sup>, J. Demeter<sup>3</sup>, Zs. Nagy<sup>3</sup>, E. Sári<sup>3</sup>, Á. Illés<sup>6</sup>, L. Gergely<sup>6</sup>, Z. Tóth<sup>4</sup>, I. Garai<sup>4</sup>

<sup>1</sup>Semmelweis University, Budapest, Hungary

<sup>2</sup>Department of Nuclear Medicine, Semmelweis University, Budapest, Hungary

<sup>3</sup>1<sup>st</sup> Department of Internal Medicine, Semmelweis University, Budapest, Hungary

<sup>4</sup>ScanoMed Ltd., Budapest, Hungary

<sup>5</sup>Department of Haematology and Stem Cell Transplantation, St. István and St. László Hospital of Budapest, Budapest, Hungary

<sup>6</sup>3<sup>rd</sup> Department of Internal Medicine, University of Debrecen, Debrecen, Hungary

**Background:** As the individualised personal therapy of lymphomas is getting more widespread, the prognostic value of early (after 2–4 cycles of therapy) fluorodeoxyglucose (FDG) PET-CT (iPET) scans is growing in interest. Several early researches show, that a positive iPET examination indicates poor prognosis in Hodgkin's lymphoma, as well as in non-Hodgkin's lymphoma. Lately, the predictive value of iPET seems to be less obvious in the immunotherapy treated non-Hodgkin's lymphomas. One of the ways of standardised visual assessment of the iPET scans is rating using the London score (LS) system. In our actual research the prognostic significance of iPET was studied in patients with diffuse large B-cell lymphoma (DLBCL) receiving combined chemo-immunotherapy.

**Material and methods:** 35 patients (age: 23–89 years, 13 male, 22 female) with DLBCL, receiving R-CHOP combined chemo-immunotherapy (rituximab, cyclophosphamide, doxorubicin, vincristine, prednisolone) were included in our research, on whom iPET scan was performed after 2–3 cycles of therapy, and were followed clinically for 114–993 days (median follow-up: 405 days). Based on the PET results alone no change of therapy was introduced. The iPET scans were rated visually by the LS. The correlation between the iPET results and the event free survival (EFS) was examined with Kaplan-Meier analysis, considering scans positive with LS  $\geq 3$  (assessment A) and with LS  $\geq 4$  (assessment B). Our study was performed partially in the frame of an International Atomic Energy Agency Coordinated Research Project.

**Results:** Using assessment A, of the 35 patients 19 were PET+ and 16 were PET-. Of the 19 PET+ patients 7 experienced relapse or progression, and 1 of the 16 PET- patients. The difference of the EFS between PET+ and PET- cases was not significant statistically ( $p = 0.0682$ ). The positive and negative predictive value of the iPET regarding the EFS was 37 and 94%. With assessment B, 11 scans were PET+, and 24 PET-. In 11 PET+ cases relapse or progression occurred in 7 cases, and in the 24 PET- cases, they occurred once. PET+ cases presented with shorter EFS (median: 386 days) than PET- cases (median was not reached). The difference of the EFS between PET+ and PET- cases was statistically significant ( $p < 0.001$ ). The positive and negative predictive value of the iPET was 63 and 96%.

**Conclusions:** In combined chemo-immunotherapy treated DLBCL patients iPET has significant predictive value regarding the EFS, when the positivity criterion is any FDG avidity greater than liver activity (LS  $\geq 4$ ). It is important to use standardised criteria for the visual assessment of iPET scans.

## E15

### A SIMPLE SEMIQUANTITATIVE TECHNIQUE BY ANALYSING SOMATOSTATIN RECEPTOR SCINTIGRAPHY TO PREDICT THERAPEUTIC EFFECT OF PEPTIDE-RECEPTOR-RADIO-THERAPY

M. Barra<sup>1</sup>, G. Dabasi<sup>1</sup>, P. Reismann<sup>2</sup>, P. Igaz<sup>2</sup>, K. Rácz<sup>2</sup>

<sup>1</sup>Department of Nuclear Medicine, Semmelweis University, Budapest, Hungary

<sup>2</sup>2<sup>nd</sup> Department of Medicine, Semmelweis University, Budapest, Hungary

**Background:** Peptide-receptor-radiotherapy (PRRT) is an effective palliative treatment options for patients with inoperable progressive neuroendocrine tumours and increased uptake of labelled somatostatin analogues on somatostatin receptor scintigraphy (SRS).

**Material and methods:** At the Department of Nuclear Medicine of University Basel 51 Hungarian patients of the 2<sup>nd</sup> Department of Medicine (Semmelweis University) were treated between 2005–2010 with Y-90-DOTATOC or Lu-177-DOTATATE. We have retrospectively analysed correlation between scintigraphic findings (Octreoscan) and therapeutic effect of PRRT in 40 patients. All 40 patients had multiple hepatic metastases of progressive inoperable neuroendocrine tumours originating from the pancreas or lungs or small bowels. We calculated tumour/background ratios (T/BG) of visible liver metastases on pretherapy SRS images taken at 2 and 24 hours after iv. injection of Octreoscan. Patients were followed after PRRT by standard (radiology and laboratory) examinations. Correlation between T/BG values and therapeutic effect of PRRT was calculated.

**Results:** No complete remission was found. Six months after therapy 23 patients (57%) had partial remission. T/BG values at 2 hours of these patients were significantly higher than in patients without remission ( $2.07 + 0.22$  vs.  $1.84 + 0.13$ ,  $p < 0.05$ ). No significant difference of T/BG values at 24 hours was found ( $2.01 + 0.24$  vs.  $1.95 + 0.11$ , n.s.). All 20 patients with no progression at the one-year follow-up evaluation had also significantly higher T/BG values at 2 hours than patients with progressive disease.

**Conclusion:** Semiquantitative analysis of T/BG of liver metastases at 2 and 24 hours images of pre-therapy Octreoscan scintigraphy is a simple technique to predict therapeutic effect of PRRT in patients with inoperable neuroendocrine tumours. High T/BG at 2 hours predicts good therapeutic effect.

## E16

### SIGNIFICANCE OF SPECT/CT IN MIBG EXAMINATIONS OF CHILDREN'S NEUROBLASTOMA

M. Sarkadi<sup>1</sup>, E. Schmidt<sup>1</sup>, Zs. Szabó<sup>1</sup>, S. Szekeres<sup>1</sup>, K. Dérczy<sup>2</sup>, Cs. Weninger<sup>2</sup>, K. Zámbo<sup>1</sup>

<sup>1</sup>Department of Nuclear Medicine, University of Pécs, Pécs, Hungary

<sup>2</sup>Department of Radiology, University of Pécs, Pécs, Hungary

**Background:** Morphological and etiological verification of the increased activity on the early and delayed static and SPECT images with the help of complementary "low dose" SPECT/CT examination.

**Material and methods:** All of 28 MIBG examinations of 17 children with neuroblastoma were investigated between September 2007 and March 2011. 1131-MIBG examinations in 12 cases 1123-MIBG examinations in 16 cases were performed. Eleven control studies were made in 7 children, one time in 3 patients and two times in 4 patients. During the examinations of 10 boys (mean age 4 years) and 7 girls (mean age 3.5 years) early and delayed anterior and posterior static and SPECT imaging were performed. In 20 cases complementary SPECT/CT images were made of the skull, the neck, the chest, the abdomen and the extremities.

**Results:** Pathological increased MIBG activity were found in 18 cases in several regions. Multiplex hot spots were seen in 13 cases of them. Metastases were verified in 14 cases on the base of native CT. There were

no morphological changes on the native CT in the localization of the increased activity in 3 cases. In 3 children further contrast agent CT, MRI or US examinations, in 1 child US-guided biopsy were suggested to prove the suspected metastases. In other 3 children the native CT verified the metastases without increased activity beyond the proved MIBG positive metastases with morphological changes.

**Conclusions:** In the 78% of the MIBG positive cases metastases were proved by native CT. Hybrid SPECT/CT provides both the functional information from SPECT and the anatomical information from native "low dose" CT in a co-registered examination plays a very important role in the etiological diagnosis and staging of the neuroblastoma in childhood and increases the success of the therapy.

## E17

### COMPARATIVE DIAGNOSTIC VALUE OF Tc-99M AND IN-111 LABELLED SOMATOSTATIN ANALOGUES FOR SOMATOSTATIN RECEPTOR SCINTIGRAPHY. PRELIMINARY RESULTS

Z. Varga<sup>1</sup>, K. Buga<sup>2</sup>, E. Takács<sup>1</sup>, V. Valent<sup>2</sup>, G. Dabasi<sup>1</sup>, I. Szilvási<sup>2</sup>

<sup>1</sup>Department of Nuclear Medicine, Semmelweis University, Budapest, Hungary

<sup>2</sup>Department of Nuclear Medicine, Hungary Military Hospital-State Health Centre, Budapest, Hungary

**Background:** Somatostatin receptor scintigraphy (SRS) is a well-established method in evaluating patients with neuroendocrine tumours (NET). In-111-pentetreotide (Octreoscan: O) has remained the „gold standard“, but some new, Tc-99m-labelled somatostatin analogues are also used. Only few data are available on direct comparison of different radiopharmaceuticals. In our study we compared diagnostic value of O and Tc-99m-EDDA-HYNIC-octreotide (Tektrotyde: T).

**Material and methods:** We performed T scintigraphy in 63 patients in the last two years. 18 of them had O scintigraphy as well. Both methods were performed according to procedure guidelines. The first radiopharmaceutical was randomly chosen. The second scintigraphy was performed, if results of the first scintigraphy were equivocal or contradicting to clinical data. SRS was indicated for staging of histologically proven NETs (n = 5), or for postoperative restaging (n = 13). Nine males and nine females were studied, with mean age 57 (41–80) years.

**Results:** Abnormal SRS was found in 12 patients. In 6 postoperative cases no recidive/metastasis were detected. Findings of O and T scintigraphies were concordant in 13 patients. In 5 cases we had discordant results. In 1 patient O was false-negative (in the thorax), and in 1 case T was false negative (in the abdomen). In one patient O found less number of lesions, in another patient T. In one case T was positive in the thoracic and abdominal regions as well, but O was positive in the abdomen only.

**Conclusion:** Based on our study, O and T have similar diagnostic value in evaluating patients with NETs by a patient-by-patient analysis. In our small patient material and various type of NETs T seems to be more sensitive in the thorax, O seems to be better in the abdomen. Further studies are needed to define possible differences of diagnostic value of both radiopharmaceuticals in SRS of tumours with various histological types.

## E18

### THE IMPORTANCE OF SPECT AND/OR SPECT-CT FUSION IN SENTINEL LYMPH NODE DETECTION WITH PROSTATE CANCER PATIENTS

Z. Galler<sup>1</sup>, I. Balogh<sup>1</sup>, A. Páczelt<sup>2</sup>, J. Varga<sup>2</sup>, F. Salamon<sup>3</sup>, Z. Tóth<sup>4</sup>

<sup>1</sup>Department of Nuclear Medicine, Uzsoki Street Hospital, Budapest, Hungary

<sup>2</sup>Department of Urology, Uzsoki Street Hospital, Budapest, Hungary

<sup>3</sup>Department of Pathology, Uzsoki Street Hospital, Budapest, Hungary

<sup>4</sup>ScanoMed Ltd., Budapest, Hungary

**Background:** Our aim was studying the usefulness of sentinel lymph node detection with SPECT and/or SPECT-CT fused images in early stage (T1-2, N0, M0) of prostate cancer.

**Material and methods:** In 85 patients both planar and SPECT images were taken 3 and 21 hours after the transperineal-intraprostatic administration of 100-150 MBq Tc-99m-SentiScint. In 20 cases low dose CT has been made as well for better localization of sentinel lymph node (SLN). For SPECT-CT image fusion Mediso-Interview Fusion software was used. During operation Navigator gamma probe was utilized localizing the SLN found by SPECT and/or SPECT-CT examinations. The SLN(s) were examined separately for detailed pathological processing.

**Results:** Except of the 5 lymph nodes in presacral localization detected by SPECT-CT fused images all other SLN were excised. Only in 27 cases were found the SLN in the usual place, obturator triangle (OT), other 32 cases the SLN were excised outside the OT (along with the iliacal arteries, iliacal bifurcation - localized by SPECT-CT). In 10 cases SLN-s were detected both inside and outside the OT. In 9/85 cases micrometastasis could be found in SLN by pathological processing.

**Conclusions:** On the bases of our results (1) micrometastasis could be found in very early stage of prostate cancer (9/85) what emphasizes the importance of SLN detection. (2) The localization of SLN outside the OT is a common finding (32/85). In these cases (3) the importance of SPECT-CT fused images is essential for accurate localization of SLN, leading the hand of the surgeon (i.e. tailored surgery).

## E19

### PRELIMINARY EXPERIENCES WITH SENTINEL LYMPH NODE SCINTIGRAPHY IN VULVAR CARCINOMA PATIENTS

K. Bús, I. Uracs, C. Wisotzki, T. Derlin, J. Mester, S. Klutmann, M. Clausen

Department of Nuclear Medicine, University Medical Center, Hamburg-Eppendorf, Germany

Department of Nuclear Medicine, Semmelweis University, Budapest, Hungary

**Background:** Reducing radical surgery interventions like evading morbidity by regional block dissection is an important intention for surgeons of today. Since a vulvar carcinoma has an abundant lymphatic circulation it may rapidly create lymph node metastases. Lymph node status is one of the most important prognostic factors in vulvar malignancy, and is of great importance to assort between therapeutic possibilities. Consequently it's substantial to receive a representative sample from the affected region with minimal invasivity. For this purpose was the sentinel node biopsy concept introduced. The method is already broadly used in cases of mammal tumours and malignant melanoma though this technique is only applied in some specialized centres on patients with vulvar carcinoma, therefore the available data is limited.

The aim is to demonstrate the method and the early results from the aspect of the nuclear medicine.

**Material and methods:** Scintigraphic analysis in 28 patients with vulvar carcinoma was performed. In cases of midline tumours 4 x 25 MBq Tc-99m-Nanocoll were given peritumourally, the day before the operation. In cases of lateral tumours 2 x 25 MBq Tc-99m-Nanocoll were injected next to the tumour and additional 2 x 25 MBq Tc-99m-Nanocoll were given into the opposite side. Static planar scintigraphies were made from anterior direction and accessory SPECT/CT images were taken. The frontal projections of the sentinel lymph nodes were marked with the help of the acquired static planar images. During the operation the sentinel lymph node biopsies were done with the help of a gamma probe. The removed lymph nodes were pathologically processed and evaluated.

**Results:** We have managed to detect sentinel lymph nodes in every patients (28/28), in both inguinal regions. Surgical detection and removal of sentinel lymph nodes were successful in all cases. Pathological examinations confirmed sentinel lymph node positivity in 8 cases.

**Conclusions:** Sentinel node scintigraphy is a promising, easily performable and available process in vulvar carcinomic cases. Further investigations are necessary to show the reliability of the method, mainly to detect false negative cases and even to refine the diagnostic protocols.

## E20

**99mTc-MIBI SPECT/CT IN THE FOLLOW-UP OF NEOADJUVANT CHEMOTHERAPY OF BREAST CANCER**

E. Schmidt<sup>1</sup>, Y. Al-Farhat<sup>2</sup>, K. Dérczy<sup>3</sup>, Cs. Weninger<sup>3</sup>, Zs. Nemerey<sup>4</sup>, J. Czifra<sup>5</sup>, Zs. Szabó<sup>1</sup>, S. Szekeres<sup>1</sup>, K. Zámbo<sup>1</sup>

<sup>1</sup>Department of Nuclear Medicine, University of Pécs, Pécs, Hungary  
<sup>2</sup>Department of Oncology, Tolna County Hospital, Szekszárd, Hungary  
<sup>3</sup>Department of Radiology, University of Pécs, Pécs, Hungary  
<sup>4</sup>Department Radiology, Tolna County Hospital, Szekszárd, Hungary  
<sup>5</sup>Department Pathology, Tolna County Hospital, Szekszárd, Hungary

**Background:** The intensity of 99mTc- MIBI accumulation in breast cancer depends on tumor size, on vascularisation and on several important prognostic factors. The aim of our study was to determine the role of 99mTc-MIBI SPECT/CT in the follow-up of neoadjuvant chemotherapy of breast cancer. **Material and methods:** 8 breast cancer patients were observed, with the indication of neoadjuvant chemotherapy. Before the beginning of therapy, and after the III. and VI. cycle 99mTc-MIBI scintigraphy were performed. 10 and 60 minutes after the injection of 370 MBq 99mTc-MIBI, planar scans of the chest and axilla, whole body scan and SPECT/CT of the chest were completed. We observed the change of intensity of 99mTc- MIBI accumulation in the breast tumors and axillary lymph nodes, with the quantitative analyses on SPECT/CT slices (VOI, maximum pixel value), compared to the change of tumor and lymph node size and histological finding.

**Results:** In 7 cases histological findings showed ductal carcinoma. In 5 patients pathological axillary lymph nodes were detected by mammography and US, which were proved by 99mTc-MIBI planar and whole body scans, but chest SPECT/CT showed in all 7 patients pathological lymph node accumulation, in two cases with normal lymph node size. In 1 case the SPECT/CT scan found a pathological mediastinal lymph node and lung metastases, which was an indication for changing the therapy. In 6 cases, the intensity of 99mTc-MIBI accumulation shows a significant reduction already after the III. cycle of therapy. In 1 patient, with mastitis the histology proved an undifferentiated tumor with high malignity. There was no reduction in tumor size and intensity of 99mTc-MIBI accumulation and after mastectomy the histology proved extraosseal osteosarcoma.

**Conclusions:** 99mTc-MIBI SPECT/CT, combining function and morphology, in addition to quantitative analyses is a useful and sensitive method in the follow-up of neoadjuvant chemotherapy of breast cancer. The first examination, before the beginning of therapy can detect unknown metastases, which modifies the therapy.

## E21

**LIVER VISUALIZATION DURING PREOPERATIVE LYMPHOSCINTIGRAPHY IN BREAST CANCER**

Á. Bajner

Department of Nuclear Medicine, Szombathely, Hungary

**Background:** In a total of 362 breast cancer patients underwent preoperative lymphoscintigraphy at our department between January 2005 and March 2011, we found nonvisualization of axillary sentinel node (SN) in 5 cases. The cause of one failure was supposed technical (partial vascularization of the radiotracer dose during injection), because we detected intense liver activity. In this patient additional tracer injection resulted in SN visualization, histopathologic examination did not reveal metastasis in SN. From October 2010 we introduced an additional liver image as part of standard lymphoscintigraphy protocol.

In this study we investigated the reasons other than technical pitfall, such as pathophysiologic mechanisms, that may be responsible for visualization of liver during preoperative lymphoscintigraphy in breast cancer.

**Material and methods:** We reviewed the series of 39 unselected, consecutive patients with breast cancer who had additional liver image as part of standard preoperative lymphoscintigraphy procedure. All patients had

a subareolar injection of 60 MBq Tc-99m-albumin colloid (Senti-Scint, particles' size: 100–600 nm), in a volume of 0.5 ml, administered in the index quadrant. Gamma camera images of the axillary region and of liver activity were acquired 18 h after injection. Liver activity was assessed by visual evaluation. We analysed whether axillary SN metastasis was associated with an increased liver visualization rate.

**Results:** Three of 39 patients showed a faint visualization of the liver, all of them had detectable SN in axilla. In the visualized-liver group (n = 3) histology revealed axillary nodal metastasis in 2 patients (67%). In the nonvisualized-liver group (n = 36) the incidence of SN metastasis was only 8% (3 of 36).

**Conclusion:** There is a significant difference in incidence of axillary nodal metastasis between the visualized and nonvisualized-liver groups in our series, suggesting that pathophysiologic mechanisms associated with nodal involvement might be responsible for systemic radiocolloid uptake. Some studies showed direct lymphaticovenous connection in involved lymph nodes, suggesting an anatomic pathway for radiocolloid to gain access to the systemic circulation. These studies might provide an anatomical explanation for our findings. Our initial results should be confirmed in a larger patient population.

## E22

**SENSITIVITY AND SPECIFICITY OF IN 111 OCTREOTIDE WHOLE-BODY IMAGING IN THE DETECTION OF THORACIC AND ABDOMINAL ABNORMALITIES COMPARED TO SPECT-CT IMAGING**

A. Kiss<sup>1</sup>, S. Barna<sup>1</sup>, L. Szabados<sup>1</sup>, J. Varga<sup>2</sup>, I. Garai<sup>1</sup>

<sup>1</sup>ScanoMed Ltd., Debrecen, Hungary

<sup>2</sup>Department of Nuclear Medicine, University of Debrecen, Debrecen, Hungary

**Background:** The In 111 Octreotide scintigraphy is proved to be the most effective diagnostic method in detecting the somatostatine-receptor-positive neuroendocrine tumors.

The aim of our examination is the determination of region-dependent sensitivity and specificity of In 111 Ocreotide scintigraphy during whole-body and SPECT-CT imaging.

**Material and methods:** We have chosen 81 patients (26 male and 55 female, mean age 39.7 ± 9.5 yrs) to our retrospective examination, all of them were diagnosed with neuroendocrine tumor with histological evidence. Some of the examinations were primary health checks, to determine receptor status and to plan subsequent treatment, on the other hand the examination aimed to detect recidive process. 24 hours after injecting the In-111 Octreotide (Coviden) *i.v.* we did the examination with the help of an AnyscanSC (MEDISO) dual-head SPECT-CT camera. In every cases whole body imaging then SPECT-CT tomographic imaging were performed. The whole body and SPECT-CT evaluation were performed by two experienced physicians independently from each other, considering positive those focal accumulations having at least the same activity level as the liver. In SPECT-CT examination we considered those accumulations to be a clear positive that belong to pathological morphology. We determined its sensitivity and specificity of whole body study compared to SPECT-CT through statistical processing.

**Results:** There is a significant correlation between the two methods — whole body and SPECT-CT imaging — in the evaluation of the results ( $\chi^2 < 0.05$ ). The result of the whole body study differs significantly from the one of SPECT-CT study in the evaluation of both the thoracic and abdominal regions. During the whole body scan we found the negative predictive value to be over 80% regarding both the thoracic and abdominal regions. False positive results were often experienced during whole body scan.

**Conclusion:** Negative whole body scan excludes the presence of somatostatine receptor-positive tumors with a high probability. While in case of positive results it is recommended to perform an additional SPECT-CT scan to exclude false positive accumulations.

## E23

**HOW CAN SPECT-CT FUSION HELP IN THE DIAGNOSIS OF NEUROENDOCRINE TUMORS?**F. Halasi<sup>1</sup>, Z. Galler<sup>1</sup>, I. Balogh<sup>1</sup>, V. Tóth<sup>2</sup>, Zs. Varga<sup>1</sup><sup>1</sup>Department of Nuclear Medicine, Uzsoki Street Hospital, Budapest, Hungary<sup>2</sup>ScanMed Ltd., Budapest, Hungary

**Background:** Neuroendocrine tumors (NET) are an uncommon type of neoplasm frequently with late symptoms. The somatostatin receptor scintigraphy (In111-OctreoScan) is a very sensitive but lower specific method for detecting both the primary and the metastatic lesions. Some aspecific accumulation (acute and chronic inflammations, etc.) causes diagnostic problems.

The aim of our study was to analyze the importance of the SPECT-CT fused imaging at the diagnosis of NETs in the daily routine. Is it possible to distinguish the specific and aspecific accumulation with the fusion of SPECT and CT images? Is it able to increase the sensitivity and the specificity (the diagnostic accuracy) of the scintigraphy?

**Material and methods:** 12 patients with known NET underwent (1) diagnostic CT or MR examination (2) serum Chromogranin-A investigation and (3) In111-OctreoScan examination — whole body and the necessary additional images, SPECT examinations — after 24, 48, 72 hours of the intravenous injection of radiopharmaceutical. All of the patients low dose CT examination was performed as well. The SPECT-CT fused images were reconstructed with MEDISO Interview XP Fusion- software.

**Results:** In every (12/12) case accumulation sites of In111-OctreoScan were detected. Most (10/12) of the patients had unusual localization and/or uncommon extension of tracer uptake as well. In these cases localizing and identifying the accumulation was difficult by only-SPECT. With the help of the SPECT-CT fused images we were able to identify more precisely the extension, localization of OctreoScan accumulation and the previously described lesions by CT or MR than SPECT alone. We also compared the sensitivity of the serum Chromogranin-A levels with the OctreoScan examinations resulting a lower sensitivity for the Chromogranin-A.

**Conclusions:** The In111-OctreoScan examination completed with SPECT images plays an important role in the diagnosis of NETs. The sensitivity and the specificity, i.e. the diagnostic accuracy of the examination can be improved with SPECT-CT image fusion in the detection of primary and metastatic lesions as well.

## E24

**PREPARATION AND EVALUATION OF SOMATOSTATIN ANALOG CONTAINING KITS USED FOR *IN VIVO* LOCALIZATION AND TARGETED RADIONUCLIDE THERAPY**G. Jánoki<sup>1</sup>, R. Török<sup>1</sup>, L. Balogh<sup>2</sup>, Z. Pöstény<sup>2</sup>, J. Thuroczky<sup>3</sup>, Gy. A. Jánoki<sup>4</sup><sup>1</sup>Radiopharmacy Laboratory Ltd., Budaörs, Hungary<sup>2</sup>Natl. "FJC" Radiobiology and Radiohygiene Research Institute, Budapest, Hungary<sup>3</sup>St. Stephan University, Veterinary Faculty, Budapest, Hungary<sup>4</sup>Medi-Radiopharma Ltd., Érd, Hungary

**Background:** Radiolabelled somatostatin analogs are important tools for the *in vivo* localization and targeted radionuclide therapy of somatostatin receptor positive tumours. The aim of this study was to develop instant freeze-dried kit containing HYNIC-Tyr3-Thr8-octreotide and DOTA-Tyr3-Thr8-octreotide used for labelling with diagnostic (99mTc and 68Ga) and therapeutic (90Y and 177Lu) isotopes.

**Material and methods:** During our experiments HYNIC-TATE and DOTA-TATE peptid-chelate conjugate were selected. Experiments gained during technetium kit development were used to develop kit pharmaceutical form. Vials containing 20 microgram of HYNIC-TATE, tricin, EDDA, SnCl<sub>2</sub> and mannitol at pH 5.3 were compounded in one step and freeze-dried (Comp I) Simultaneously a therapeutical kit containing 100 microgram of DOTA-TATE, gentisic acid, sodium acetate puffer (pH 5.5) and glycine were compounded and freeze-dried (Comp.II) and filled with nitrogen gas. After formulation experiments the appearance, pH, water content and the amount

of Sn(II) were determined. During labelling experiments in 1 ml volume 2 GBq were used and reconstituted kit content was heated in boiling water for 20 minutes. For determination of labelling efficiency and stability ITLC and RP-HPLC were used up to 4 hours. For *in vitro* receptor binding AR4-2J cell line for *in vivo* distribution healthy Wistar rats were used. The Comp II kit was labelled with 177Lu-chloride and evaluated by all methods listed above. The compiled Comp I and Comp II kits were evaluated by studying the appearance (homogenous pellet) water content (less than 1%) solubility (fast clear solution within 1 minutes) and pH (5.2–5.4). Because of the proper selection of bulking agents and freeze-drying condition used during compounding the kits showed good stability as well.

**Results:** After radiolabelling the radio-TLC and radio-HPLC evaluations showed high labelling efficiency (more than 95%). During stability evaluation when solution were stored at room temperature up to 4 hours no decomposition were detected. Both compounds showed very fast blood clearance in rats with less than 0.1% of ID remained in blood after 3 hrs of injection. Excretion of radiopeptides occurred via the kidney and urinary system. After 6 hours more than 95% of ID were eliminated through kidneys. The developed kit containing HYNIC-TATE and DOTA-TATE during testing showed high labelling efficiency and stability. The cell binding and biodistribution results (high binding and fast blood and urinary excretion) were as expected.

**Conclusions:** Based on our good preliminary results experiments by using 68Ga and 90Y may start soon. Experiments in dogs and cats bearing spontaneous tumour expressing somatostatin receptors and using SPECT/CT and PET/CT technique may help to evaluate the clinical applicability of our radiolabelled somatostatin analogs for *in vivo* localization and targeted radionuclide therapy.

**Acknowledgements:** This work was supported by the New Hungary Development Plan. (KMOP-1.1.1-08/1-2008-0017)

## E25

**PREPARATION OF 18F-LABELLED SERUM ALBUMIN WITH CHEMOSELECTIVE METHODS**

I. Kertész, L. Kárpáti, T. Márián, Gy. Trencsényi, I. Lajtos, L. Galuska

Department of Nuclear Medicine, University of Debrecen, Debrecen, Hungary

**Background:** The overall aim of the present work is to develop a suitable method for fluorine labelling of serum albumin with the appropriate radioactive concentration for *in vivo* testing of tumour blood pool in small animal.

**Material and methods:** For the radiolabelling a simple method was selected which includes the preparation of [18F]-4-Fluorobenzaldehyde ([18F]FBA) and successive conjugation with SANH (Succinimidyl 6-hydrazinonicotinamide acetone hydrazone) — serum albumin conjugate via hydrazone formation. Alternatively, a thiol reactive compound (N-[6-(4-[18F]fluorobenzylidene)aminoxyhexyl]maleimide — [18F]FBAM was prepared from [18F]FBA and N-(6-aminoxyhexyl)maleimide. The labelling agent was reacted afterwards with a thiol functionalized serum albumin. The modified protein was synthesized by means of SATA linker (N-Succinimidyl S-Acetylthioacetate). After removal of the protecting group, the resulted free sulfhydryl group and the maleimide moiety of [18F]FBAM easily forms a stable thioether bond. The 18F-labelled serum albumins were purified with gel filtration. The purities of the compounds and the metabolic stabilities were assessed by HPLC and TLC. For *in vivo* experiments rats were injected *i.v.* with 18F-labelled serum albumins. After tracer injection animals were anaesthetized and 10 minutes PET scans were acquired using a small animal PET scanner (MiniPET-II) to visualize the biodistribution of the radiopharmaceuticals. For organ-distribution, different tissues were removed and their activities were measured with a gamma counter. The radioactivity of the samples was used to determine the differential absorption ratio (DAR).

**Results:** We have successfully radiolabelled the SANH modified serum albumins with [18F]FBA, and SATA modified BSA with [18F]FBAM also. During our labelling experiments [18F]FBAM was found to be an excellent agent for conjugation to thiol groups, even at low concentrations. After the gel filtration the radiochemical purities were over 98% in all cases. In preliminary biodistribution studies we have realised divergent properties of the compounds. 30 min after the administration of hydrazone bond containing albumin

(18F-SANH-BSA and 18F-SANH-HSA) the MiniPET-II images showed that the majority of the radioactivity remained in the blood in contrast to the thiol modified albumin (18F-SATA-BSA), where we found a fast blood clearance and the tracer was filtrated by the liver. It is perhaps due to the intermolecular reaction of the non-covered thiol groups and the formation of colloid. By taking the DAR values 60 min after the tracer injection high uptake was found in the urine (18F-SANH-BSA and 18F-SANH-HSA), liver (18F-SATA-BSA) and blood (18F-SANH-BSA and 18F-SANH-HSA).

**Conclusion:** We have compared two simple methods for the preparation of 18F-labelled serum albumins. All the compounds have good stability *in vitro*, and it is clear that the amount of the applied albumin has an essential role in the biodistribution pattern *in vivo*. Optimizing the parameters, 18F-SANH-HSA can be a promising candidate for the imaging of tumour blood-pool.

## E26

### PREPARATION OF AND INVESTIGATION ON SENTINEL LYMPH NODE SPECIFIC, DESIGNED RADIOPHARMACEUTICALS

J. Kórnyei, E. Szemenyei, V. Horváth, L. Baranyai

Institute of Isotopes Co. Ltd., Budapest, Hungary

**Background:** Localization of colloids used in the clinical routine for sentinel lymph node detection is based on their particles size and particle size distribution. On the other hand, a hypothesis is known from the literature that glycoproteine and/or phytate receptors are expressed on the lymph node(s) possessing direct drainage to the tumour. An IAEA project "CRP F 22045" aimed to prepare and investigate designed radiopharmaceuticals binding to these receptors. In this presentation the work of the Hungarian group is shown, regarding Tc-99m-dextran-cysteine-cysteine-mannose (DCCM) and Tc-99m-calcium-phytate (CAFY) colloids.

**Material and methods:** To prepare DCCM, aminoethanethiol was reacted with allyl-dextran followed by coupling cysteine-cysteine and serine-mannose side chains. The presence of the functional groups was investigated by ESI-MS technique while particle size and particle size distribution was controlled by dynamic light scattering method. Tc-99m labelling was accomplished via [Tc≡N], technetium nitrido intermedier, obtained when pertechnetate was reduced with stannous chloride in presence of a succinic acid dihydrazide derivative. To prepare CAFY, Calcimusc injection and the commercially available Fyton kit was used by adjusting phytate/calcium molar ratios of 4:1, 3:1, 2:1, 1:1, 1:2, 1:3 and 1:4. In the frame of this project, some preclinical studies on rat SLN model were carried out in Romania and India.

**Results:** Presence of functional groups in DCCM was proved. As for stoichiometry, 25 mmol cysteine-cysteine and 13 mmol serine-mannose groups were coupled to 1 mmol dextrane while 46 amino groups remained free. Size of DCCM particles was found as  $7.6 \pm 0.6$  nm. Yield of Tc-99m nitrido labelling was > 90%. On the other hand, DCCM was stable only for 3 months, the labelling yield decreased to 75–77% when labelling was carried out later. The average particle sizes of CAFY colloids, obtained in presence of phytate excess to calcium were in the range of 100–300 nm. On the other hand, when molar ratio was 1:1 or in the cases of calcium excess to phytate, the particle sizes were larger than 1  $\mu$ m and sedimentation was observed, too. Tc-99m labelling yields were always > 99%, but in the cases of phytate/calcium molar ratio  $\geq 1$ , some non-colloidal Tc-99m-phytate was also formed up to 10–13% of the total activity. Preclinical studies of Tc-99m-DCCM showed a rapid leakage of this colloid due to the very low specific binding (0.8% I.D.). At the same time, three lymph nodes were well visualized in case of Tc-99m-CAFY colloid, prepared at phytate/calcium molar ratio of 2:1, possessing average particle size of 278 nm.

**Conclusion:** Nitrido labelling of DCCM was successfully accomplished since cysteine-cysteine side chains on the dextran-matrix ensured an easy complexation with technetium. On the other hand, the lack of receptor specific binding of Tc-99m-DCCM can be explained partly by the effect of technetium nitrido core to the molecular geometry, partly by the relative low amounts of serine-mannose side chains (13 mmol/mmol dextran). Localization of Tc-99m-CAFY colloid in sentinel lymph nodes can be due to both receptor binding and the favourable particle size.

## E27

### HOW TO MAKE SATISFIED ANIMAL OWNERS, REFERRING VETS AND RADIOPHARMACEUTICAL INVESTIGATORS AT THE SAME TIME — SPECT/CT EXAMINATIONS IN DOGS AND CATS

L. Balogh<sup>1</sup>, Z. Pöstényi<sup>1</sup>, V. Haász<sup>1</sup>, A. Polyák<sup>1</sup>, K. Zambó<sup>2</sup>, E. Schmidt<sup>2</sup>, M. Sarkadi<sup>2</sup>, G. Janoki<sup>3</sup>, R. Török<sup>3</sup>, J. Thuróczy<sup>4</sup>, L. Seres<sup>5</sup>, Gy. Janoki<sup>3</sup>

<sup>1</sup>NRIRR, Budapest, Hungary

<sup>2</sup>Institute of Nuclear Medicine, University of Pécs, Pécs, Hungary

<sup>3</sup>Radiopharmacy Ltd., Budaörs, Hungary

<sup>4</sup>Veterinary Faculty, Szi University, Budapest, Hungary

<sup>5</sup>Mediso Ltd., Budapest, Hungary

**Background:** Few years earlier we cleared up that whole body SPECT/CT examinations are safe, non-invasive method in healthy animals and in late stage canine oncological patients too. Based on that preliminaries different whole body SPECT/CT by applying different 99mTc labelled radiopharmaceuticals have been started to carry-out in spontaneously diseased animal patients.

**Material and methods:** Healthy Beagles and laboratory cats, then client owned dogs and cats altogether over 30 suspected or known oncological cases were referred for SPECT/CT whole body examinations. Applied radiopharmaceuticals included 99mTc-pertechnetate, -MDP, -MIBI, -DMSA(V), -HYNIC TATE. The injected radioactivity differed between 5–12 MBq/bwkg. Anaesthesia was monitored during the scans and radiotoxicological effects were checked by monitoring the haematological and biochemical blood parameters before then 6 hours, 2 days and 1 week post examination. The goal was to detect primary tumor localizations, extensions and to visualize regional and far metastases (WHO staged diagnosis). On stadium based diagnosis optimum-therapy was offered to owners then follow-up examinations were carried-out in case of accepted offers.

**Results:** 99mTc-pertechnetate SPECT/CT proved to be extremely useful in diagnosing, staging and follow-up of thyroxin producing thyroid carcinomas and to select the patients for radioiodine therapy. 99mTc-MDP SPECT/CT revealed very important data in localization of primary and metastatic bone tumors, planning surgical procedures and/or bone pain palliation treatments. 99mTc-MIBI wash out examinations work also using the hybrid imaging. 99mTc-DMSA(V) SPECT/CT proved to be informative in a wide variety of soft tissue and bone tumors. Specific receptor affin agents showed higher sensitivity and specificity in SPECT/CT hybrid scans than in the single SPECT modality.

**Conclusion:** Whole body SPECT/CT examinations in many oncological diseases could be the choice of veterinary oncologists also from clinical point of view — and paralelly these examinations provide a very reliable data-pool for biomedical researchers.

**Acknowledgements:** Scientific work was supported by several national (OTKA-68376, JEDIONKO, KMOP-1.1.1-08/1-2008-0017, GOP-1.1.1.-09/1-2010-0107) and international projects (IAEA-CRPs, EMIL NoE).

## E28

### POSSIBILITIES OF PRODUCTION AND UTILIZATION OF PET RADIOPHARMACEUTICALS IN HUNGARY

P. Mikecz<sup>1</sup>, Gy. Tóth<sup>2</sup>, Z. Fodor<sup>1</sup>, L. Trón<sup>1</sup>, L. Galuska<sup>1</sup>

<sup>1</sup>Department of Nuclear Medicine, University of Debrecen, Debrecen, Hungary

<sup>2</sup>Positron Diagnostic Ltd., Budapest, Hungary

In the last 5 years the number of PET investigations had raised nearly tenfold in Hungary, this year it is near to 12000. In the procedures [18F]FDG (2-[18F] fluoro-2-deoxy-D-glucose) is used in nearly 100%. The use of C-11 labelled methionine and acetate besides the FDG is negligible. In our country the technical conditions of PET radiopharmaceutical production are excellent. Two laboratories obtained production licence, and marketing authorizations for FDG and the above mentioned C-11 tracers. This makes possible to provide FDG not only for Hungary, but for the neighbouring countries (Romania, Serbia, and Bulgaria) as well. The registered C-11 labelled tracers are used on the spot. The process of registration of C-11 labelled choline has been

started in Debrecen. Beyond the tracers for human use, numerous other positron emitting compounds are regularly produced for research purposes. For example fluoroethyl tyrosine is produced in the Pozitron Diagnosztika Health Centre. In the University of Debrecen a "radiopharmaceutical shelf" was established what contains several radio-chemicals for cell or small animal experiments. To help cancer research production methods were implemented for the proliferation marker — 3'-deoxy-3'-[18F]-fluorothymidine (FLT), for the tracer detecting bone lesions — sodium[18F]fluoride and for the hypoxia marker — 1-(5-fluoro-5-deoxy- $\alpha$ -D-arabinofuranosyl)-2-nitroimidazole (FAZA). The multidrug resistance can be investigated by [11C]verapamil. For neurology and addiction studies the [18F]fallypride and desmethoxy-[18F]fallypride are available. For these molecules besides of the production methods full scale quality control procedures were developed, so for a short notice they could be "taken from the shelf". These tracers could be used even for human applications. As it was emphasized in the recent interdisciplinary meetings, there is a real clinical need for the above mentioned and other radiopharmaceuticals in Hungary. However — because of the current legislation - marketing authorization would be required for each tracer. This is significantly differs from the practice of developed countries. In these the physicians can choose from a wide variety of pharmaceuticals. Although in Europe many companies and research laboratories obtained marketing authorization for FDG, only three further radiopharmaceuticals were registered (NaF, FDOPA and F-choline) by a professional company. Despite this in the PET laboratories one can use a lot of positron emitting diagnostics observing the regulation of local authorities. In order to make possible that the patients in Hungary could benefit from the most sophisticated PET technique, the change of the pharmaceutical legislation in Hungary have to achieved such a way, that the production and local use of PET radiopharmaceuticals in centres having cyclotrons and GMP conform laboratories would be faster licensed and easier to performed. It has to be emphasized, that these tracers have no pharmacological effects due to their very low concentration, they are short lived and from one batch only a few investigations can be performed. In the new legislation the relevant international examples have to be considered. These tracers have to be produced under GMP conditions, and must be used locally. For commercial purposes naturally marketing authorization must be required. If there would be no change in the recent practice, the expansion of the supply of PET radiopharmaceuticals in Hungary would take many years, even it could fail due to the administrative difficulties and financial burden.

## E29

### PET/CT IMAGING IN DOGS AND CATS — TUMOR TARGET SCALE AND UNUSUAL UPTAKE

L. Balogh<sup>1</sup>, Z. Pöstényi<sup>1</sup>, V. Haász<sup>1</sup>, A. Polyák<sup>1</sup>, T. Márián<sup>2</sup>, I. Garai<sup>2</sup>, L. Galuska<sup>2</sup>, L. Balkay<sup>2</sup>, Gy. Trencsényi<sup>2</sup>, T. Nagy<sup>2</sup>, J. Trencsényi<sup>2</sup>, Gy. Janoki<sup>3</sup>, G. Janoki<sup>3</sup>, R. Török<sup>3</sup>, J. Thuróczy<sup>4</sup>

<sup>1</sup>National Research Institute for Radiobiology and Radiohygiene, Budapest, Hungary

<sup>2</sup>Department of Nuclear Medicine, University of Debrecen, Debrecen, Hungary

<sup>3</sup>Radiopharmacy Ltd., Budaörs <sup>4</sup>Veterinary Faculty, Szt. I. University, Budapest, Hungary

**Background:** Despite that the clinical usefulness of 18FDG PET/CT in human oncology is well understood much less data are available from the veterinary side. Pet owners and referring vet clinician's expectations regarding to specific and sensitive diagnosis accompanied with researcher's needs and 3Rs expectations result a unique chance for co-operation in the field.

**Material and methods:** Client owned dogs and cats altogether over 60 suspected or known oncological cases were referred for 18FDG PET/CT whole body examinations. The goal was to detect primary tumour localizations, extensions and to visualize regional and far metastases (WHO staged diagnosis). On stadium based diagnosis optimum-therapy was offered to owners then follow-up examinations were carried-out in case of accepted offers.

**Results:** 18FDG PET/CT revealed very sensitive in case of a wide variety soft tissue and bone tumours eg.: osteosarcomas, mast cell tumours, soft tissue sarcomas, melanomas and different epithelial tumours. Some benign, low metabolic rate tumours (adenomas, lipomas, fibromas, intracranial) showed much lower 18FDG-uptake where the method seems to be questionable. Few degenerative-, inflamed- and hypertrophic tissues (arthrosis, lymph adenitis, muscle hypertrophy) revealed intense focal uptake that could be confusing in differential diagnoses.

**Conclusion:** Whole body PET/CT scans could be the choice of veterinary oncological imaging too from clinical point of view – and parallelly these examinations provide a very reliable data-pool for biomedical researchers.

**Acknowledgements:** Scientific work was supported by several national (OTKA-68376, JEDIONKO, KMOP-1.1.1-08/1-2008-0017, GOP-1.1.1.-09/1-2010-0107) and international projects (IAEA-CRPs, EMIL NoE).

## E30

### NEW QUALITY CONTROL KIT FOR EVALUATION OF 99mTc LABELLED RADIOPHARMACEUTICALS BEFORE PATIENT INJECTION AT CLINICAL SITE

G. Jánoki<sup>1</sup>, R. Török<sup>1</sup>, L. Balogh<sup>2</sup>, A. Polyák<sup>2</sup>, Gy. Jánoki<sup>3</sup>

<sup>1</sup>Radiopharmacy Laboratory Ltd., Budaörs, Hungary

<sup>2</sup>National „FJC” Research Institute for Radiobiology and Radiohygiene Budapest, Hungary

<sup>3</sup>Medi-Radiopharma Ltd., Érd, Hungary

**Background:** The drug authorities all over the world require quality control study of radiopharmaceuticals if it is prepared in a multidose form at the clinical/hospital site. Our aim was to develop a quality control kit with appropriate properties to be used at any clinical site for quick determination the quality of 99mTc labelled radiopharmaceuticals coming from any manufacturer. Additionally the sufficient documentation for recording and archiving with detailed user guidance were also considered.

**Material and methods:** Quality Control kit for measuring parameters that influence the clinical applicability of 99mTc labelled radiopharmaceuticals as radiochemical purity Al(III), Sn(II) and pH were compiled. The requirements were the following: The ITLC methods must be validated or based on verified pharmacopeial methods (PhEur, USP, BPh). The methods have to be fast and efficient and the kit should contain all the necessary tools and materials needed to carry out the selected method.

**Results:** The master chromatograms selected and provided will give a proper guidance for determination of radiochemical impurities (e.g.: 99mTcO<sub>4</sub>, 99mTc-Sn colloid). The newly developed Medi-Check kit can be applied for the following radiopharmaceuticals: MDP, HDP, DTPA, PYP, DMSA, BRIDA, HSA, MAA, HSA colloid (all size), MAG3, HM-PAO, MIBI, Tetrafosmin and Na99mTcO<sub>4</sub>. With the additional tests in the kit one can measure the limit value of Al(III) (10 µg/ml) and the stannus content semi-quantitatively (10–500 µg/ml). Based on our experience by using the Medi Check QC kit it is possible to determine the radiochemical purity of radiopharmaceuticals within 10 minutes. The prepared documentation and User guide will allow to determine the radiochemical purity of different radiopharmaceuticals simultaneously. The documentation prepared can be easily integrated into the quality management documentation of an accredited nuclear medicine laboratory and comply with the requirements (documentation, traceability, archiving etc...) of the drug authorities.

**Conclusion:** The newly compiled quality control kit can be upgraded modularly. Based on the experience gained during application of new MediCheck QC kit showed that it can be a quick efficient and very useful tool in the daily routine work in any nuclear medicine laboratory. The potential long lasting application of this kit fits into the planned or already existing quality assurance/accreditation program of any licensed nuclear medicine laboratory.

**Acknowledgements:** The research program is supported in the frame of the New Hungary Development Program (KMOP-1.1.1-09/1-2009-0056). The authors would like to express their appreciation for the support.

## E31

**MYOCARDIAL SUV OF C-11-ACETATE IN NORMAL HEART**M. Moravszki<sup>1</sup>, A. Radácsi<sup>2</sup>, D. Kiss<sup>2</sup>, Gy. Tóth<sup>3</sup>, Zs. Lengyel<sup>3</sup>, I. Szilvási<sup>1</sup><sup>1</sup>Department of Nuclear Medicine, Military Hospital — State Health Centre, Budapest, Hungary<sup>2</sup>Department of Nuclear Medicine, Semmelweis University, Budapest, Hungary<sup>3</sup>Pozitron Ltd., Budapest, Hungary

**Background:** C-11-acetate (C-A) PET has been used for imaging of prostate and some other types of cancer and for non-invasive evaluation of myocardial oxidative metabolism. Analysis of uptake and washout of C-A by using kinetic models informs on myocardial blood flow and oxygen consumption. Dynamic A-C PET/CT is useful in cardiology but the technique is complicated. Static parameters of various dynamic processes are used for functional evaluation in nuclear medicine. In our study we measured myocardial SUV of C-A on a static image taken at 20 minutes after injection in patients without cardiac disease.

**Material and methods:** Myocardial uptake of C-A was evaluated in patients with prostate cancer referred to PET/CT. 20 consecutive patients without known cardiac disease, cardiac medication or diabetes (mean age:  $63.5 \pm 11.4$  years) were enrolled in the study. After physical rest and 6 hours fasting  $3.7\text{--}9.25$  MBq/kg of C-A were injected. C-A was produced using our cyclotron and synthesis procedure approved by national authorities. Standard whole-body PET/CT (Siemens Biograph TruePoint HD, low dose non-enhanced CT) was performed from the skullbase to mid-thigh (6–7 bed positions with 3 minutes data acquisition). Imaging of the thorax started at 19–22 minutes after injection. After reconstruction (OSEM with 8 subsets/4 iterations) short and long axis slices of the heart were displayed. SUVmean values of C-A in manually selected myocardial, pulmonary, hepatic regions were calculated with Osirix 3.7.1. free DICOM viewer. Right ventricle, anterior, inferior, septal, and lateral walls of the left ventricle were separately analyzed with ROIs drawn on the midventricular slices.

**Results:** The heart was well visualized in all patients. Activity distribution was homogenous in each patient. No significant differences were found between SUVmean of the anterior, inferior, lateral and septal wall ( $3.42 \pm 0.25$ ,  $3.69 \pm 0.24$ ,  $3.52 \pm 0.22$ ,  $3.97 \pm 0.28$ ). Good correlations were found between the SUVmean of the different walls ( $r = 0.74\text{--}0.86$ ). SUVmean of the right ventricle ( $2.09 \pm 0.32$ ) was significantly lower than that of the left ventricular regions ( $p < 0.01$  for all) with no correlation to them. The liver had a mean SUVmean of  $5.47 \pm 0.89$ .

**Conclusion:** Myocardial SUV of C-A at 20 minutes after injection is an easy to get parameter. We have established normal values of the left and right ventricle. They seem to be statistically reliable. Clinical usefulness of these parameters need further studies in patients with various cardiac diseases. Based on our preliminary results, we have started dynamic C-A examinations to measure absolute myocardial perfusion (mL/min/g) by using dipyridamole, 5 minutes data acquisition, PMOD Cardiac Modeling data processing.

## E32

**COMPARISON OF THE ACCURACY OF CORONARY CT ANGIOGRAPHY (CTA) AND MYOCARDIAL PERFUSION SCINTIGRAPHY (MPS) IN THE DIAGNOSTICS OF CORONARY ARTERY DISEASE**Zs. Szabo<sup>1</sup>, T. Molnar<sup>2</sup>, E. Varadi<sup>3</sup>, A. Konyi<sup>4</sup>, E. Schmidt<sup>1</sup>, S. Szekeres<sup>1</sup>, K. Zambo<sup>1</sup><sup>1</sup>Department of Nuclear Medicine, University of Pecs, Pecs, Hungary<sup>2</sup>Department of Anesthesiology and Intensive Care, University of Pecs, Pecs, Hungary<sup>3</sup>Department of Radiology, University of Pecs, Pecs, Hungary<sup>4</sup>Heart Center, University of Pecs, Pecs, Hungary

**Background:** A comprehensive assessment of CAD should include both information on coronary artery anatomy and functional information about the haemodynamic relevance of coronary artery lesions in order to avoid

redundant revascularization procedures. Combination of CTA and myocardial perfusion imaging is non-invasive, and its diagnostic accuracy of flow-limiting coronary stenosis is as good as the “gold standard” quantitative coronary angiography (QCA). We aimed to compare the accuracy of the three different diagnostic tool in our cohort.

**Material and methods:** Consecutive patients with known or suspected CAD were retrospectively enrolled and referred to our institution for MPS and CTA between January 2009 and December 2010. Statistics:  $\chi^2$  test (SPSS 12.0 software).

**Results:** In 53 patients (mean age  $56.1 \pm 10.7$  years, male: 20) referred for coronary angiography (CTA) and MPI (using single-photon emission-computed tomography) were performed and the findings were analyzed retrospectively. One MPS és 3 CTA findings were rejected due to artefacts.

**MPS Results:** negative 10, transient 26, permanent 23, resting hypoperfusion 5 cases. CTA: negative 10, non-significant stenosis (NSS) 42, significant stenosis (SS) 9. Transient ischemia revealed by MPS correlates significantly with NSS detected by CTA ( $p = 0.003$ ). There is no significant correlation between permanent hypoperfusion revealed by MPS and SS detected by CTA ( $p = 0.09$ ). When transient or permanent perfusion abnormalities were compared (total number = 34) to findings of CTA, a significant correlation was found in both NSS and SS groups ( $p = 0.01$ ,  $p = 0.03$ , respectively). When transient+permanent perfusion defects were compared (total number = 12) to CTA, they significantly correlated only with NSS ( $p = 0.04$ ). Additionally, QCA was performed in 8 patients. The QCA was negative in 3 patients, despite both MPS and CTA have been detected transient ischemia and NSS previously in one case.

**Conclusion:** The clinical value of anatomical and functional information provided by MPS and CTA are very similar and the combination of them even seems as accurate as the quantitative coronary angiography in evaluation of coronary pathology in our relative small cohort.

## E33

**DIAGNOSTIC VALUE OF EARLY GATED MYOCARDIAL PERFUSION SPECT WITH ERGOMETRIC STRESS IN DETECTING MYOCARDIAL STUNNING.**M. Tóth<sup>1</sup>, K. Buga<sup>1</sup>, M. Moravszki<sup>1</sup>, I. Szilvási<sup>1</sup><sup>1</sup>Department of Nuclear Medicine, Military Hospital, Budapest, Hungary

**Background:** ECG-gated myocardial perfusion SPECT (GSPECT) gives simultaneous information on myocardial perfusion and global/regional left-ventricular (LV) function. Ergometric stress can provoke myocardial stunning.

We studied the usefulness of early GSPECT (15-G: 15-minutes after exercise) compared to the standard GSPECT (60-G: 60-minutes after exercise) in detecting exercise-induced reversible LV dysfunction in patients with ischemic heart disease (IHD).

**Material and methods:** 37 patients (mean age  $58 \pm 9$  year) with angiographic evidence of IHD were enrolled in the study. 21 had decreased (50%) LV ejection fraction (EF) at rest by echocardiography (US). We performed 15-G, 60-G and resting GSPECT. Standard two-days Tc-99m acquisition protocol was used (dual-head camera, 180° circular rotation, 8 frame/cycle gating). LV-EF of the three studies were compared using quantitative (QPS/QGS) program. Functional parameters were related to perfusion data.

**Results:** From 16 patients with normal LV-EF by US EF decreased in 5 patients by 60-G and in 7 patients by 15-G. In all of them decrease was more pronounced by 15-G (in 3 patients more than 5%). Mean decrease of EF value by 15-G was 2.4%, statistically non-significant. From 21 patients with low LV-EF by US EF decreased in 14 by 60-G and in 16 by 15-G. Decrease was more pronounced by 15-G in 12 patients. Mean decrease of EF value was 4.9% by 60-G ( $p < 0.05$ ) and 6.0% by 15-G ( $p < 0.01$ ).

**Conclusions:** 15-G is useful in detecting exercise-provoked LV-dysfunction. Transient decreasing of LV-EF is more frequently found by 15-G than by 60-G. Early gated myocardial perfusion SPECT is indicated routinely because it can detect myocardial stunning in patients with low and with normal resting EF as well.

**Acknowledgements:** Supported by the IAEA (RP:14676).

## E34

### RELATIONSHIP BETWEEN REVERSIBILITY SCORE ON CORRESPONDING LEFT VENTRICULAR SEGMENTS AND FRACTIONAL FLOW RESERVE IN CORONARY ARTERY DISEASE

B. Kracsó<sup>1</sup>, I. Garai<sup>1</sup>, P. Lugosi<sup>3</sup>, B. Tar<sup>3</sup>, Zs. Nagy<sup>3</sup>, G. Vajda<sup>2</sup>, Zs. Köszegi<sup>2,3</sup>

<sup>1</sup>ScanoMed Ltd., Debrecen, Hungary

<sup>2</sup>Department of Cardiology, University of Debrecen, Debrecen, Hungary

<sup>3</sup>Jósa András Hospital Ltd., Nyíregyháza, Hungary

**Background:** Currently the indication of percutaneous coronary intervention is based on the fractional flow reserve (FFR) in the intermediate coronary stenosis. It is a simple, reliable and reproducible method, but it does not take into consideration the lokalisation of stenosis. The aim of this study was to find correlation between the severity of perfusion abnormality detected by scintigraphy and the FFR value as well as the localization of a particular coronary lesion.

**Material and methods:** 28 patients (male: 22, female: 6, age  $62 \pm 7.62$ ) were enrolled our retrospective analysis. The supplied left ventricular segments on the standard 17-segment polar map were rendered to each coronary branch. FFR measurements on 36 vessels (20 LAD, 6 LCx, 10 RCA) were compared with the myocardium perfusion SPECT studies performed before the invasive procedure. The lesions belonged to  $6.47 \pm 2.47$  myocardial segments (range: 1–12). We introduced a new ischemic index by combining the FFR with the number of the corresponding myocardial segments (left ventricular ischemic index: LVli). This index was correlated with the regional myocardial perfusion defects identified on the scintigrams. Perfusion reversibility score of 2 or above was considered as indicative of active ischemia (regional Difference Score: rDSc).

**Results:** 13 lesion proved to be significant based on intracoronary pressure measurements (FFR < 0.75), which ones supplied 92 left ventricular segments. 50 segments showed reversibility out of the 92 segments (rDSc:76). The remaining non-significant 23 FFR values (> 0.75) corresponded to 138 LV segments (rDSc: 21). Close linear relationship was found between the LVli and the rDSc ( $p < 0.001$ ). Also a linear relationship ( $p < 0.001$ ) could describe the connection between the FFR and the rDSc among the cases with lesion-associated myocardial territory of similar extensions (7–8 segments). Analyzing all the FFR values independently of the localization of the lesions, they also correlated significantly to the rDSc but the relation was less tight. LVli predicted active ischemia (> 2 rDSc) on myocardial scintigraphy with 77.8% sensitivity and 94.4% specificity when the cut off value was set to 0.96. FFR alone predicted the ischemia on the scintigraphy with 72% sensitivity and 94% specificity at the best 0.8 cut off value. The area under the Receiver Operating Characteristic (ROC) curve was significantly higher for LVli than FFR (0.92 vs. 0.78;  $p = 0.03$ ).

**Conclusion:** The isotope data indicate that LVli > 0.96 associates clinically relevant stenotic lesion. In our opinion, the FFR value not alone, but together with the corresponding left ventricular segments should be taken into consideration for the correct clinical decision making.

## E35

### THE IMPORTANCE OF MYOCARDIAL PERFUSION SCINTIGRAPHY AND MULTISLICE CORONARY CT IMAGE FUSION IN SEVERE CORONARY CALCIFICATION

I. Balogh<sup>1</sup>, G. Kerecsen<sup>2</sup>, E. Marosi<sup>2</sup>

<sup>1</sup>Department of Nuclear Medicine, Uzsoki Street Hospital, Budapest, Hungary

<sup>2</sup>Pozitron-Diagnosztika Health Centre, Budapest, Hungary

**Background:** Even in the era of "state of the art" Multislice Coronary CT (MSCT) — 64 slices dual source — in the cases of serious coronary calcification the severity of coronary artery stenosis could be questionable.

We investigated the diagnostic importance of MSCT and myocardial perfusion scintigraphy (MPS) fused imaging on this field — is there any ischaemia on MPS, if there is how severe is it and in the cases of questionable multivessel disease where is the culprit lesion?

**Material and methods:** In 23 cases with severe coronary calcification (Agatston Score between 410–3959!) where the results of MSCT was questionable as a second examination stress MPS was performed. The number of coronary artery stenosis (CAS) in 16/23 cases was 1 coronary artery, in 5/23 cases 2 CAS and in 2/23 cases 3 CAS. The subsequent stress-rest MPS were performed using ECG gated SPECT with Tc99m tetrofosmin. MPS results were evaluated with Interview XP, Emory ToolBox and Cedars-Sinai QPS-QGS software, scoring the perfusion, wall motion, wall thickening abnormalities in 4 grade score system. For image fusion PMOD 2,75, MIP-3D display and/or GE CardIQ software was used.

**Results:** The fused imaging showed significant ischaemia in 6/23 cases and the ischaemia was mild (score 1) or moderate (score 2). In 4/6 positive MPS cases the ischaemia was detected only on one coronary artery supply territories and in 2/6 MPS positive cases in two coronary arteries supply territories. We could find more severe ischaemia in the localization of culprit ("dominant") lesion. In every case the functional stress and rest parameters (ejection fraction, wall motion, and wall thickening) were normal.

**Conclusion:** In many cases of severe coronary calcification on MSCT the significance of coronary artery stenosis remains questionable. The physiological significance of coronary stenosis on MPS and on the MSCT-MPS fused images can help to the correct diagnosis. On the basis of our preliminary results (1) ischaemia (on MPS) in the cases with severe coronary calcification (on MSCT) could be detected only in a few number of cases (6/23) and (2) the ischaemia proved to be mild to moderate. (3) The localization of culprit lesion could be established as well.

## E36

### DIAGNOSTIC VALUE OF QUANTITATIVE ANALYSIS OF MYOCARDIAL PERFUSION SPECT IN DETECTING REVERSIBLE PERFUSION DEFECTS

E. Takács<sup>1</sup>, Zs. Varga<sup>1</sup>, M. Barra<sup>1</sup>, A. Radácsi<sup>1</sup>, M. Janecskó<sup>3</sup>, P. Sárman<sup>2</sup>, I. Szilvási<sup>1</sup>

<sup>1</sup>Department of Nuclear Medicine, Kútvölgyi Hospital, Semmelweis University, Budapest, Hungary

<sup>2</sup><sup>3</sup>Department of Internal Medicine and Cardiology, Semmelweis University, Budapest, Hungary

<sup>3</sup>Department of Anaesthesiology, Kútvölgyi Hospital, Semmelweis University, Budapest, Hungary

**Background:** to determine the positive predictive value (PPV) of myocardial perfusion scintigraphy (MPS) using quantitative parameters compared with coronaria angiography (CAG) findings as gold standard and to analyze false positive cases.

**Material and methods:** During a one-year periode 253 patients with known or suspected coronary artery disease (CAD) had perfusion defect on Tc99m-tetrofosmin stress-rest MPS in our department. A quantitative software (Cedars-Sinai QPS/QGS, score values) was used to evaluate perfusion defects. Severity and extent of stress perfusion defects were quantitated by summed stress score (SSS), and reversibility by summed difference score (SDS) using a normal data base. Tissue attenuation correction was not applied. 86 of these 253 patients were investigated by invasive CAG within 1 month after MPS. 52 patients had significant coronary artery stenosis. PPV of reversible perfusion defects was determined in this group retrospectively.

**Results:** In patients without significant coronary stenosis on CAG ( $n = 34$ , false positive MPS) SSS was significantly less, than in patients with significant stenosis ( $n = 52$ , true positive MPS),  $9.5 \pm 5.02$  vs.  $14.0 \pm 9.12$ . The difference is statistically significant ( $p = 0.03$ ). There was no significant difference between SDS values of the two groups ( $5.0 \pm 3.98$  vs.  $6.0 \pm 2.89$ ,  $p = 0.82$ ). But if MPS was considered to be positive only with SDS equal or above 4, number of false positive results decreased from 34 to 12, and PPV increased from 62% to 86%. Majority of false positive perfusion defects (64.3%) were localized on the inferior wall, half of them had SDS value below 4.

**Conclusions:** According to our results, use of a higher cut-off value for significant perfusion defect is recommended to reduce the number of false positives cases, especially in case of inferior location. Evaluation of SSS value can help to avoid false positive MPS results.

## E37

### ROLE OF MYOCARDIAL PERFUSION SCINTIGRAPHY IN THE AGE OF CORONARY CT ANGIOGRAPHY. OUR PRELIMINARY RESULTS

M. Moravszki<sup>1</sup>, K. Buga<sup>1</sup>, M. Tóth<sup>1</sup>, G. Kerecsen<sup>2</sup>, I. Préda<sup>2</sup>, R. G. Kiss<sup>2</sup>, I. Szilvási<sup>1</sup>

<sup>1</sup>Department of Nuclear Medicine, Military Hospital — State Health Center, Budapest, Hungary

<sup>2</sup>Department of Nuclear Medicine, Military Hospital — State Health Center, Budapest, Hungary

**Background:** Role of myocardial perfusion scintigraphy (MPS) should be re-evaluated in the age of coronary CT-angiography (CCTA). In our study we have analysed results of MPS and CCTA in eighteen patients with ischaemic heart disease (IHD) to define diagnostic value of MPS.

**Material and methods:** 18 patients had CCTA and MPS within two months. CCTA was performed using Siemens dual-source CT (in Pozitron Ltd). Stress MPS was performed with one-day Tc-99m-tetrofosmin (400 + 900 MBq) protocol using a dual-head SPECT (GE Infinia, Xeleris). Mean age of patients: 59.5 (39–72) years. 10 patients had clinical suspicion of IHD. 8 patients after PCI were examined because new clinical symptoms. In 12 patients CCTA was the first examination and MPS was indicated to evaluate clinical significance of abnormal CCTA. In 6 patients CCTA was indicated because positive findings (ischaemia) of MPS.

**Results:** Seven patients had significant coronary stenosis on CCTA. 5 of them had ischemia on MPS. One of these patients with false-negative results had balanced three-vessels disease. Five patients had non-significant coronary artery stenosis, but 4 of them demonstrated ischaemia. Four patients had no stenosis (2 of them had previous PCI), and MPS was normal in all. One patient had coronary “bridging” with positive MPS. One patient had LAD anomaly, but normal perfusion.

**Conclusions:** Based on our preliminary results in small number of patients, MPS is indicated in patients with equivocal CCTA findings (non-significant stenosis, coronary anomalies), and ischaemia detected by MPS should be followed by CCTA (if invasive coronarography is not indicated).

## E38

### PERFORMANCE TEST OF THE MINIPET-II SCANNER FOR SEVERAL COINCIDENCE TIME AND ENERGY WINDOW USING THE NEMA NU-4 STANDARD

I. Lajtós<sup>1</sup>, S. A. Kis<sup>1</sup>, M. Emri<sup>1</sup>, G. Opposits<sup>1</sup>, D. Szikra<sup>1</sup>, G. Hegyesi<sup>2</sup>, L. Balkay<sup>1</sup>

<sup>1</sup>Institute of Nuclear Medicine, University of Debrecen, Debrecen, Hungary

<sup>2</sup>Institute of Nuclear Research of the Hungarian Academy of Sciences, Debrecen, Hungary

**Background:** The small animal PET scanner (MiniPET-II) performance parameters were evaluated with the National Electrical Manufacturers Association (NEMA) NU-4 standards. Although the measured and calculated parameters characterize well the actual PET scanner, they may depend on the basic settings of the PET system. Some settings cannot be altered at all (number of crystals, axial field of view), while others (energy window, coincidence time window, reconstruction algorithm etc.) can be changed both before the data acquisition and/or during the data processing. In this study we investigated how the calculated NEMA parameters depend on the used coincidence time window (t), and the low threshold settings of energy window (Elt).

**Material and methods:** The MiniPET-II small animal scanner includes 12 detector modules in one ring with LYSO scintillator crystal blocks and position sensitive PMTs. Each crystal block consists of 35 x 35 crystal pins of 1.27 x 1.27 x 12 mm size and the detector signals are processed

by FPGA based digital signal processing boards. Data collection and image reconstruction were performed by using the M3I (MultiModal Medical Imaging) software framework developed in our institute. All measurements and data evaluation were based on the NEMA standard protocol at three different t (2, 3 and 4 ns) and Elt (250 keV, 350 keV, 450 keV) values. The following parameters were determined: spatial resolution, sensitivity, noise equivalent count rate (NEC), uniformity, recovery coefficients (RC), spillover ratio (SOR).

**Results:** The spatial resolution varied between 1.3 to 2.1 mm at 5 and 25 mm radial distances, independently from the “time window” and Elt. However the NEC values depended on both the t and Elt. At t = 2, 3 and 4 ns using the rat phantom the NEC peaks were 13.1 kcps/38 MBq, 14.2 kcps/36 MBq and 14.5 kcps/37 MBq, respectively. The system sensitivity in the centre of FOV increased with the t by the following values: 0.55%, 0.6% and 0.61%. The sensitivity was changed by 20% by Elt. Using the NEMA NU-4 image-quality phantom RC, the SOR and uniformity were also calculated. As it was expected the RC and the uniformity were not dependent on the t and Elt. The SOR parameter changed 20% (water) and 10% (air) in case of the t, and 15–20% when altering Elt.

**Conclusion:** It can be concluded that the calculated performance parameters could depend on the basic settings of the PET system. It means that the t and Elt need to be optimized for a given small animal PET scanner.

## E39

### SEEKING A SIMPLIFIED FORMULA FOR DESCRIBING THE POSITION-DEPENDENT RESOLUTION OF GAMMA CAMERAS

J. Varga

Institute of Nuclear Medicine, University of Debrecen, Debrecen, Hungary

**Background:** Data characterizing the resolution of gamma cameras are necessary for restoration filters as well as resolution recovery reconstruction algorithms, which can effectively enhance the signal-to-noise ratio and improve the visibility of details in planar and SPECT images. Resolution depends both on the object-detector distance and the scattering medium. We searched for a simple formula to describe the dependence of the modulation transfer function MTF(f) of a gamma camera on the source position and the thickness of body tissue.

**Material and methods:** We acquired images of line sources with two different gamma energies using a general purpose gamma camera (DHV, Mediso): Tc-99m with a low energy, high resolution collimator (used for the majority of patient studies), and I-131 with a high energy collimator. Target-detector distance varied between 5 and 31 cm, with 0 to 26 cm layer of water as tissue equivalent scattering medium, giving 15 combinations altogether. First we fitted the MTF(f) measured in air by a function of the form  $\exp[-(f \wedge 2P)/S]$ , then included the effect of scattering in the model. The goodness of fit was characterized by the residual sum of squared differences.

**Results:** We found a close correlation between the source-detector distance d and the parameters of the exponential function in air; e.g. for Tc-99m:  $P = 0.00898 \times d + 0.81$ ,  $S = 1.173 \times \exp(-0.0865 \times d)$  In the presence of scatter we compared several functions, starting from a single exponential term as above, and testing various combinations (weighted sums and products) of such terms. When using a single exp term, we found that in a first approach parameter S depends on the distance only, while the effect of scattering medium appears in the value of P. 5 or 6 constants are sufficient to describe the MTF.

**Conclusion:** The modulation transfer function characterizing the system resolution of gamma cameras can be well approximated by an analytical function with a few parameters. A separate set of constants applies for each camera-collimator-radionuclide combination.

## E40

**FAST GPU BASED ITERATIVE IMAGE RECONSTRUCTION ALGORITHM FOR PARALLEL PROJECTION MYOCARDIAL PERFUSION SPECT STUDY**

Á. Szlávecz<sup>1</sup>, B. Kári<sup>2</sup>, G. Hesz<sup>1</sup>, T. Bükki<sup>3</sup>, O. Pártos<sup>2</sup>, B. Benyó<sup>1</sup>

<sup>1</sup>Department of Control Engineering and Information, Budapest University of Technology and Economics, Budapest, Hungary

<sup>2</sup>Department of Radiology and Oncotherapy, Semmelweis University, Budapest, Hungary

<sup>3</sup>Mediso Ltd., Budapest, Hungary

**Background:** Parallel projection based Single Photon Emission Computed Tomography (SPECT) is widely used method in isotope diagnostics for cardiac studies. Many phenomenon's, like photon absorption, scatter, as well as the distance dependent spatial resolution (DDSR) — as a consequence of the parallel projection — produce distortion in SPECT imaging, which may result false diagnostic value. Further imaging imperfection may be expected, if the activity distribution of the imaged object is not in the center of the field of view and 180 degree acquisition technique is applied. Our research activity mainly aimed to create image reconstruction algorithm to be optimized on novel technology based GPU (Graphic Process Unit) including inherent compensation of above mentioned most of the image distortion effects, where is possible to expect significant image quality improvement as a consequence.

**Material and methods:** The applied image reconstruction algorithm is based on expected maximization iterative algorithm (Ordered Subset Expected Maximization, i.e. OSEM). The imaging model of parallel projection as well as the non-homogeneous photon absorption effect has been included in the forward projection step. The non-uniform photon attenuation map is determined by coregistered and resampled CT imaging. Dedicated calibration procedure has been worked out in order to describe the point spread function of DDSR SPECT imaging. High performance computing method has been developed due to the intensive computation demand algorithm. The implementation has been carried out by novel nVidia based GPU's being much faster than the conventional multi-core CPU's (Central Process Unit). AnyScan® SC (multi-modality SPECT/CT) and CardioDESK dual head dedicated SPECT system (Mediso Ltd.) were considered for both simulation studies and real measurements (physical phantom and patient studies).

**Results and Conclusions:** The novel GPU based reconstruction algorithm resulted significant improvement in the spatial resolution. The reconstructed images showed clear-cut better spatial activity distribution. Considering the speed of the implemented reconstruction method is suitable for daily clinical application too (running time is less than 10min. in case of  $128 \times 128 \times 128$  volume discretization with nVidia 480GTX GPU). Nevertheless, during the verification procedures of algorithm has been discovered equivocal hypo-perfusion segment around the apical region of the heart. The effect could be observed systematically on mathematical and physical phantoms as well as on patient studies too. The phenomenon may originate from the partial volume effect (PVE), which is under consideration already. Further image quality improvement can be expected by the scatter correction application around the surrounded volume of the myocardium.

**Acknowledgements:** Financial background of the research work is supported by TECH\_08\_A2-TeraTomo (NKTH) and ÚMFT TÁMOP-4.2.1/B-09/1/KMR-2010-0002 grants.

## E41

**SCATTER AND ATTENUATION CORRECTION IN MONTE CARLO BASED ML-EM PET RECONSTRUCTION**

A. Wirth<sup>1</sup>, Á. Cserkaszky<sup>2</sup>, D. Légrády<sup>2</sup>, B. Kári<sup>1</sup>, B. Domonkos<sup>3</sup>

<sup>1</sup>Department of Radiology and Oncotherapy, Semmelweis University, Budapest, Hungary

<sup>2</sup>Institute of Nuclear Techniques, Budapest University of Technology and Economics, Budapest, Hungary

<sup>3</sup>Mediso Ltd., Budapest, Hungary

**Background:** In positron emission tomography the processes during the  $\gamma$ -photons lifetime have an essential effect on the reconstructed image quality. Our goal is to develop a reconstruction algorithm, which makes it possible

to take into account the most important events from the isotope decay till the end of the detection, hence providing an inherently artefact-free image.

**Material and methods:** The Maximum Likelihood Expectation Maximization (ML-EM) scheme — a member of the iterative reconstruction family — may include a physical model of arbitrary precision. The most realistic results can be achieved with the Monte Carlo (MC) simulation method. The simulation consists of the positron propagation and the  $\gamma$ -photon transport inside the body and the detector crystals. The material distribution map coming from the CT modality of a PET-CT device serves as the basis of the transport code. In order to stay inside the acceptable reconstruction time-frame, the algorithm has been implemented on the graphics processor (GPU) platform. GATE simulations of mathematical phantoms along with physical phantom and small animal acquisitions on the Mediso NanoPET/CT were used for image quality analysis and validation.

**Results:** The scatter and absorption correction capabilities of the reconstruction algorithm were systematically assessed. In case of realistic matter density values there were no significant scatter and attenuation artefacts in the small animal PET geometry. When the density was artificially increased, a gradual appearance of image deficiencies was observed. By simulating the scatter and absorption processes on-the-fly during the reconstruction process the intensity of the artefacts has been successfully decreased. The graphical processors proved to be an ideal platform for the Monte Carlo simulations: more than two order of magnitude faster runs could be achieved than on CPU.

**Conclusion:** The results achieved so far point toward the possibility of the clinical and pre-clinical usage of the reconstruction method in the future. The scatter and attenuation corrections will be a key feature in human PET applications.

## E42

**TOWARDS THE CLINICAL APPLICATION OF BRONCHOSCOPY SUPPORTED BY VIRTUAL PLANNING: FIRST RESULTS**

M. Koselák<sup>1</sup>, T. Spisák<sup>1</sup>, G. Opposits<sup>1</sup>, S. A. Kis<sup>1</sup>, L. Pohubi<sup>1</sup>, L. Galuska<sup>1</sup>, Zs. Hascsi<sup>2</sup>, P. Szabó<sup>3</sup>, M. Emri<sup>1</sup>

<sup>1</sup>Department of Nuclear Medicine, Medical and Health Science Center, University of Debrecen, Debrecen, Hungary

<sup>2</sup>ScanoMed Ltd., Debrecen, Hungary

<sup>3</sup>Pulmonology, Josa Andras Teaching Hospital, Nyíregyháza, Hungary

**Background:** The virtual bronchoscopy supported by PET/CT studies and performed before the operation allows to plan the intervention and thus increases the efficiency of the therapy. Since such method is not available at the University of Debrecen, we have aimed the development of a complex software system to support the bronchoscopic operations by virtual tools.

**Material and methods:** The MultiModal Medical Imaging software system developed in-house was used for the work. In the phase of the image procession, PET/CT and diagnostic CT scans of the patients are used. At first the low-dose CT and the diagnostic CT images are registered taking care of the quality, since the alignment should be optimal near the bronchi. The registered images, the 3D metabolic information of the PET and the vascular density information of the CT image are used for input data to aid the virtual navigation and the accurate localization of the transbronchial needle aspiration biopsy. The registration, the surface models and the input data of the navigation are prepared in the Department of Nuclear Medicine. The date of the scans and the state of the image sets are traceable by the partners on the R&D web site of the department ([www.minipetct.hu](http://www.minipetct.hu)). The completed PET/CT and diagnostic CT images prepared for the virtual bronchoscopy, the registered surface models and the functional data for the navigation are also downloadable from the website. The bronchoscopic operation is performed in the Department of Pulmonology of Jozsa Andras Teaching Hospital.

**Results:** An easy-to-use software system that supports the planning of bronchoscopic procedures has been developed. Besides, to support the project including the monitoring of states of image data, a web interface has also been designed. During the development, PET/CT studies of five patients (including the diagnostic CT data in three cases) were used to validate the software and build up the interactive interface of the virtual bronchoscopy.

**Conclusions:** The complex software system developed to support virtual bronchoscopy, enables to examine how the operation planning affects the quality of the diagnosis and the therapy, thus, a long-term clinical program can be launched. The experiences of the development can be useful in following tenders and projects.

#### E43

##### ANATOMICAL LOCALIZATION SOFTWARE FOR INDIVIDUAL AND POPULATION ANALYSIS OF PET DATA

T. Spisák<sup>1</sup>, G. Opposits<sup>1</sup>, A. Jakab<sup>2</sup>, M. Koselák<sup>1</sup>, S. A. Kis<sup>1</sup>, L. Trón<sup>1</sup>, E. Berényi<sup>2</sup>, M. Emri<sup>1</sup>

<sup>1</sup>Department of Nuclear Medicine, Medical and Health Science Center, University of Debrecen, Debrecen, Hungary

<sup>2</sup>Department of Biomedical Laboratory and Imaging Science Medical and Health Science Center, University of Debrecen, Debrecen, Hungary

**Background:** The anatomical localization of the physiological processes and pathological disorders of the brain investigated by cranial PET studies can be performed effectively using digital brain atlases. Although the number of the available brain atlases shows a significant increase, the support of this technique by information systems is still poorly accomplished. The purpose of our work was to develop a uniforming method and a database model handling various deterministic brain atlases, and based on it, an interactive software assisted by brain atlas databases for the promotion of the multi-modal medical imaging projects proceeded in our institute.

**Material and methods:** After the comparative analysis of 6 different anatomical, deterministic, web-accessible brain atlases a particular atlas definition was constructed, which enables the uniform handling of various atlases. As part of this system we have developed components and database models for maintaining the label maps and the region systems contained by the atlases. By implementing the deployed uniforming model, a framework was constructed, providing tools for the integration, maintenance and utilization of atlases in various tasks. A graphical user interface application, called BrainLOC, has also been developed to perform localization and region analysis tasks. The software is built upon the MultiModal Medical Imaging software development system.

**Results:** According to our purpose, a model and framework for uniforming the examined atlases has been developed. Based on these, the BrainLOC application ([www.minipetct.com](http://www.minipetct.com)) was deployed. The software became one of the most important tools of several institutional projects, and among others it permits of the atlas-assisted anatomical localization and region analysis of PET data aligned into atlas-space. BrainLOC is published under student and academic licenses for educational and research purposes.

**Conclusion:** Using BrainLOC, the database of 6 different brain atlases can be used simultaneously for localization and region analysis tasks emerging by cranial PET studies. Applying the appropriate atlas or an arbitrary collection of regions from different atlases provides the opportunity for the quantitative anatomical analysis of functional images. In the future our uniforming method and database model is planned to be extended towards integrating so-called probabilistic atlases.

#### E44

##### GRAPH THEORETICAL MODELING OF BRAIN CONNECTIVITY USING PERFUSION PET DATA

M. Emri, S. A. Kis, M. Koselák, G. Opposits, P. Mikecz, T. Spisák, L. Trón

Department of Nuclear Medicine, University of Debrecen, Debrecen, Hungary

**Background:** In the recent years, a large number of studies have investigated the complexity of structural and functional brain connectivities by graph theoretical analysis. This approach allows to characterize the nature of the human brain networks modeled by regional interactions of structural, functional, diffusion weighted magnetic resonance imaging (T1, fMRI, DWI), quantitative electroencephalography (EEG), magnetoencephalography (MEG) measurements, low resolution electromagnetic tomography

(LORETA) and PET tracer distribution, as well. The Institute of Nuclear Medicine takes efforts to develop PET ligands enabling the investigation of neurodegenerative diseases. In these projects we intend to apply graph theoretical network analysis besides the commonly used image processing methods. For this reason, we aimed to develop a complex image processing system which allows to examine the properties of brain networks derived by EEG, MRI- and PET data.

**Material and methods:** For the software development the MultiModal Medical Imaging system has been applied. Since complex PET image database, containing healthy and pathological data of volunteers, is available only in our previous projects based on the GE 4096 scanner, 15O-Butanol perfusion scans were used for tests. Perfusion scans of eight healthy subjects and eleven schizophrenic patients investigated by auditory odd-ball paradigm were used to create functional brain networks. SPM5 software was used to eliminate the global effects from the spatial standardized (MNI152) and Gaussian filtered (16 mm isotropic kernel) PET-data. Using these adjusted perfusion values, the nodes of the functional network were delineated by the regions of the LPBA40 probability brain atlas. The strength of the regional connections were modeled by the population level correlations and partial correlations. Graph theoretical analysis was applied to characterize the network properties of the investigated populations. During the development and the analysis, a number of graph parameters (edge density, global efficiency, characteristic path length, clustering coefficient, small-worldness etc.) were computed and a 2D- and 3D atlas driven graph visualization application was developed, as well.

**Results:** According to our goals, a complex graph theory based network analysis and visualization software has been worked out to investigate brain connections using MRI, EEG and PET data. For tests the networks created from brain activation data of healthy subjects (8) and schizophrenic patients (11) were used. We showed that the edge density and the clustering coefficient of brain networks decreased, while the length of the characteristic path increased. The networks of the control group showed small-world property, while this parameter was negligible in the case of diseased subjects. Although, the low number of measurements has not allowed to make robust statistical population-level inferences about the network differences but our results correspond to literature of the discipline.

**Conclusion:** Our software is an efficient tool to build, visualize and analyze brain connectivity investigated by MRI, EEG and PET studies. Due to the low number of measurements and the short axial field of view of GE 4096 scanner which has not allowed to create whole-brain related networks, the results are suitable only for tests. However, our experiences showed that the development of multimodal (PET/MRI/EEG) networks based on dynamic PET scans and advanced correlation techniques, belongs to the advanced topics of brain connectivity research.

#### E45

##### INTERDISCIPLINARY ON-LINE ACCESSIBLE EDUCATIONAL MATERIAL FOR DEVELOPING AND APPLYING EXPERTS OF IMAGING PROCEDURES

B. Kári<sup>1,3</sup>, K. Karlinger<sup>1</sup>, D. Légrády<sup>2</sup>, T. Györke<sup>3</sup>, Cs. Pesznyák<sup>2</sup>, Sz. Czifrus<sup>2</sup>, V. Bérczi<sup>1</sup>

<sup>1</sup>Department of Radiology and Oncotherapy, Semmelweis University, Budapest, Hungary

<sup>2</sup>Institute of Nuclear Techniques, Budapest University of Technology and Economics, Budapest, Hungary

<sup>3</sup>Department of Nuclear medicine, Semmelweis University, Budapest, Hungary

**Background:** Imaging diagnostic is one of the most intensively developing interdisciplinary scientific field, which is essential in the full spectrum of healthcare. The interdisciplinary knowledge and its continuous refreshment is absolute necessary for both experts training and specialists who are already working on this field (both engineering/physicists and medical, biologist's sides). Consequently, a modular on-line educational technique with its essential curriculum has been created, in order to do continuous refreshment as well as to adapt quickly to the current requirements and to support the tele-education by high level way on both theoretical and practical fields.

**Material and methods:** Complexity of the imaging field and the demands of the specialists on both medical and engineering/natural science sides have been deeply considered from the daily problems to the highest level scientific questions. Consortium has been created by leading SE, Dept. of Diagnostic Radiology and Oncotherapy (DDRO) with the collaboration of BME, Institute of Nuclear Technique (INT) in order to develop the educational technique and material. Financial background of the project is guaranteed by the TÁMOP 4.1.2-08/A/KMR-2009 (NFÜ) grant from the beginning of 2010, when the project has started. The curriculum is covered by the following main subjects:

1. Physical, technical and informatical background (INT, DDRO);
2. Medical-biological application fields (DDRO);
3. Image based practical method and material (DDRO, INT).

The theoretical chapters can be accessed by the Web based wikipedia user interface. The engineering/physical chapters will be created by Hungarian and English languages, while the medical chapters on gradual level on Hungarian, English and German languages. The post-gradual and continuous medical education (CME) curriculum exists only on Hungarian language. The (3) practical subject contains anonymous, continuously expandable real pre-selected image database (mathematical/physical/anatomical phantom set and human examinations). The image database can be evaluated independently of the geographical location with the available rights. Harmony of the theoretical and practical knowledge have serious role, because the main goal are the recognition, interpretation and discovering of the artifacts and noises originating from the digital imaging and image processing — at the „digital age”. Considering the above point of views is possible to understand, same information, knowledge and experiences are needed for the applying/researcher-developer experts. In order to get the useful practical skill, an image database system has been developed by tele-communication technique accessibility.

**Conclusions:** An integrated interdisciplinary knowledge base with tele-education support structure has been evolved by the development of the educational technique with the curriculum for the professionals on the fields of imaging procedures for research, development and application purposes (radiology, nuclear imaging, radiation therapy, ... etc.) on gradual, post-gradual, MSc., PhD. and CME levels. The created educational method and material is suitable for long term perspective for any medical imaging experts (SPECT/CT, PET/CT, PET/MR, SPECT/PET/CT, ...) who are using both directly and indirectly the curriculum (medical physicist, bio-engineers, medical electronics experts, radiologists, ... etc.). The evolved structure is the fundament of imaging procedure project already in the frame of medical physicist education (MSc.) at the BME Faculty of Natural Science (TTK)/ the education has started at September of 2010/.

## E46

### EXAMINATION OF VISUAL PERCEPTION VARIABILITY IN DETECTING LOW CONTRAST AREAS

L. Balkay, I. Lajtos, G. Opposits

Institute of Nuclear Medicine, University of Debrecen, Debrecen, Hungary

**Background:** In case of nuclear medicine — and in a wider sense in case medical imaging — it is a frequently asked question that under what conditions will an object (with contrast of Ct and area of A) visible in the final picture. Taking into account the mapping and imaging characteristics of the given device it is theoretically possible to estimate the expected Ck image-contrast resulting from the given CT contrast and to estimate the type and size of background's in the environment of the area. The decision if a given low contrast area is visible or not depends however on the analyst as well. In other words, detectability is not simply physical characteristic (for example the spatial resolution) of the imaging device, but also the result of the cooperation between the device and the analyst. Since the last decade the Rose-criterion, which says that an area is detectable if  $Ck \cdot s \cdot A > 4-5.9$ , can also be found in study books as a detectability rule of thumb. The Rose-criterion was born in the 1950s using to the TV imaging and from the examination of small (1–2 pixels) areas. Our aim was a quantitative analysis of the detectability in case of images in nuclear medicine, while examining the detectability of the different contrast areas at distinct human observers with different perception ability.

**Material and methods:** We developed a computer simulation program with which it is possible to randomly produce areas with differing activity (contrast) at the same time given a certain background distribution. We randomly set the following data when producing the images: the background activity, the number, size and contrast of the given lesion. We added Poisson noise to the images during the calculations. After each simulation the person who used the program had to indicate what he or she considered as suspected area. The program continuously stored the successful selections with all the actual data of the simulation. We also examined with the program how it influenced the detectability if the image contained postfiltering or if the palette used for the display was color or grey. Each person who took part in the research ran 500–1000 simulations. We evaluated and processed the stored simulation results.

**Results:** We found the Rose-criterion true only in case of small “A” areas. If the pixel number is larger another relationship seems to be acceptable. The type of the color palette, which we used for the simulation tests did not influence the detectability, however further image processing may alter the threshold value significantly. A skillful picture analyst can detect low contrast areas with larger probability however there is only small difference between professionals and not qualified people.

**Conclusions:** It is not possible to describe the detectability of low contrast lesions only with the technical parameters of the imaging device. The detectability can only be characterized with a probability because of the different visual perceptions ability of the evaluating persons. The different visual perceptions can be analyzed with properly built simulation programs.

## E47

### HOW EFFECTIVE IS THE RADIOIODINE THERAPY IN TREATING THE GRAVES-BASEDOW DISEASE?

K. Kállai<sup>1</sup>, J. Varga<sup>1</sup>, E. Nagy<sup>2</sup>

<sup>1</sup>Department of Nuclear Medicine, Debrecen, Hungary

<sup>2</sup>Department of Internal Medicine, Debrecen, Hungary

**Background:** Hyperthyroidism is becoming more and more common these days. One of its treatment is the radioiodine therapy, which has been practiced in Debrecen for more than 50 years now. Our aim was, to examine the success rate among the Graves-Basedow patients whom we treated, and to try to identify factors that should be taken into account in order to improve the outcome.

**Material and methods:** We reviewed the follow-up data 1, 6, 12 and 24 months after the radioiodine therapy of 27 Graves-Basedow patients with nodule and 92 without nodule, treated between 2007 and 2009. To determine the status of the thyroid we took into account the TSH, free T4 and T3 levels, and the necessity of further treatment. Cases with and without nodules were evaluated separately. We examined the connection between the estimated thyroid dose (54–252 Gy) and the developed thyroid status with Kruskal-Wallis test, and examined the connection between the initial anti-TPO level, presence of nodules, and the speed and rate of the development of hyperthyroidism using the chi-square test.

**Results:** The number of the patients followed after 1, 6, 12 and 24 months were — 116, 103, 86 and 49 respectively. The majority of the patients (66% without nodule, 69% with nodule) still had hyperthyroidism after one month, but these numbers gradually decreased later, and after 12 months — 67% and 47% of the patients were already hypothyroid, respectively. The difference between the outcome of the patients with or without nodule became significant after 12 months ( $\chi^2$ ,  $P = 0.014$ ). The developed thyroid status did not show a significant connection with either the (just slightly varying) thyroid dose used (Kruskal-Wallis test), or the increased starting level of anti-TPO ( $\chi^2$ ).

**Conclusion:** The planned absorbed doses of 70 Gy for Graves-Basedow disease without and 100 Gy with cold nodules present successfully terminated hyperthyroidism in the majority of the patients. Moreover, hypothyroidism developed in a significant number of cases. Based on our results an increase in the planned doses, as some recommendations suggest, does not seem justified. We did not find the anti-TPO level capable of predicting the outcome.

## E48

**SAFETY REGULATIONS FOR OPERATING PROCEDURES WITH UNSEALED RADIONUCLIDES**L. Ballay<sup>1</sup>, T. Séra<sup>2</sup><sup>1</sup>National Research Institute for Radiobiology and Radiohygiene, Budapest, Hungary<sup>2</sup>Department of Nuclear medicine, University of Szeged, Szeged, Hungary

The Hungarian radiation protection regulatory system is quite complete at the level of act, ministerial and governmental orders, standards, but at the lower level namely the set of operational guidance, safety regulation, is deficient. The basic safety standards for the application of ionizing radiations are found in the Decree No. 16/2000 (VI. 8.) EüM of the Minister of Health, while the recently revised MSZ 62-7 standard contains the information on how to design radiation safety of radioisotope laboratories, at the same time there is no guidance on what is considered as good practice working with radioactive materials. In the seventies and eighties the effectively used radioisotope and X-ray safety guides described good practice but these had become invalidated, and not considering some paragraphs of the Decree No.16/2000. (VI.8.) there are no safety guides which would have replaced these. The aim of the presentation is to raise attention, to the safety regulations for operating procedures with unsealed radionuclides and to review its aims, scope of applicability and delineate its general contents. The main goal of the safety guide is to become "The guide of good practice for working with unsealed radioactive sources", intended to be used by those who work at radioisotope laboratories, primarily at nuclear medicine departments. The first version of the document was developed with the support of the HAEA (Hungarian Atomic Energy Authority) (OAH ÁNI/ABA 01/09). The presented version was updated in collaboration with HSNM (Hungarian Society of Nuclear Medicine).

## E49

**RADIATION PROTECTION OF PERSONNEL WORKING IN A NUCLEAR MEDICINE DEPARTMENT**É. Szücs<sup>1</sup>, I. Garai<sup>1</sup>, O. Sántha<sup>1</sup>, J. Varga<sup>2</sup><sup>1</sup>ScanoMed Ltd., Debrecen, Hungary<sup>2</sup>University of Debrecen, Institute of Nuclear Medicine, Debrecen, Hungary

**Background:** The aim of this study was to identify the factors having a significant influence on the measured radiation doses, including the scope of activity and individual style of work, by processing the personal dosimetry data of an institute with extensive "in vivo" nuclear medicine profile. We compared the data of film and digital dosimeters in cases of radionuclides with different gamma energies, and tested the effect of using automatic FDG infusion system on the staff dose.

**Material and methods:** The exposure of personnel was measured by film dosimeters evaluated by the National Personal Dosimetry Service, and Thermo Scientific EPD Mk2+ digital personal dosimeters read out locally. Exposure data measured by film dosimeters were collected over a 10 years' period in three divisions, including gamma camera imaging and PET. 27 persons were enrolled in this study. Inactive periods and end of employment were noted. A total of 950 film dosimetry and 75 digital dosimetry data were analyzed. We classified film dosimetry data into 9 categories by the scope of activity. Digital dosimeters were utilized by PET/CT personnel (13 people) and in gamma camera hot lab (1 person). Since film data refer to 2 months' periods, digital dosimetry data were summarized for 2 month intervals as well. The normality of the distribution of data groups was checked by Shapiro-Wilk test. Because of the lack of normality, non-parametric tests were used to compare the groups: Mann-Whitney for two groups, and Kruskal-Wallis test for several groups. Since the differences between film and digital readings showed Gaussian distribution, Student's paired t-test was used for their comparison. The significance of various factors was tested using the general linear model.

**Results:** 85% of the doses were under 0.6 mSv/2 months. No significant difference was found between data obtained by film and digital dosimetry. However, there was a significant difference between the doses of person-

nel having different scopes of activity (Kruskal-Wallis test:  $p < 0.0001$ ). The highest doses were measured in the PET/CT department and the hot lab. Using the automatic infusion system significantly reduced the doses: digital dosimetry data showed an average reduction of the effective doses by 0.16  $\mu\text{Sv/h}$  (2 sample t-test,  $p = 0.008$ ). Exposures of people doing the same job showed high variances.

**Conclusion:** Our results suggest that the rotation of the staff between working places is justified to equalize radiation exposure. The individual variances of exposure point out the importance of regular theoretical and practical education, and the skilled usage of radiation protection devices available.

## E50

**AUTOMATED MONITORING OF THE MINIPET-II SMALL ANIMAL PET SCANNER OPERATION PARAMETERS**I. Lajtos<sup>1</sup>, S. A. Kis<sup>1</sup>, G. Opposits<sup>1</sup>, L. Balkay<sup>1</sup>, J. Imrek<sup>2</sup>, L. Trón<sup>1</sup>, M. Emri<sup>1</sup><sup>1</sup>Institute of Nuclear Medicine, University of Debrecen, Debrecen, Hungary<sup>2</sup>Institute of Nuclear Research of the Hungarian Academy of Sciences, Debrecen, Hungary

**Background:** The MiniPET-II small animal PET scanner was proved to be a useful tool in many biological projects, which require high level of availability. Thus the system requires systematic hardware and software monitoring, rapid identification and replacement of defective components. Furthermore we perform methodological developments, thus the MiniPET-II software system changes constantly. Our aim was to work out an effective automated monitoring system on daily basis to check the operating parameters and to send messages (SMS and e-mail) in case of failure.

**Material and methods:** The development of system was performed by using MultiModal Medical Imaging software framework developed in our institute. The monitoring software performs automated control of the detectors, the data acquisition and network infrastructure, and the image reconstruction and archiving pipelines. The evaluated system parameters are stored in a technical database available for technical material on [www.minipetct.hu](http://www.minipetct.hu). In case of error the software sends message to the authorized personnel of the scanner via SMS and e-mail. The backup storage devices and automated error reporting system allow for quick troubleshooting and high availability.

**Results:** We developed an automated monitoring system supported by a database, which is able to determine the technical status of the MiniPET-II, thus increasing system reliability. The software monitors the operation of the detector (signal processing electronics, FPGA code), the data acquisition system, network communications (network switch elements, data collection server, data acquisition program, disk capacity, archiving system), the reconstruction pipeline (server restoration, reconstruction software, image quality) and the operating environments (temperature of labs and servers, humidity rate and air pressure of the lab), as well.

**Conclusion:** The designed infrastructure and the developed monitoring system decreased the measurement failures of MiniPET-II scanner during clinical research projects and provided high availability (higher than 95%).

## E51

**SEMIQUANTIFICATION OF MYOCARDIAL PERFUSION AND ECG-GATED SCINTIGRAMS USING TWO SOFTWARE PACKAGES.**A. Radácsi<sup>1</sup>, Z. Olbrich<sup>1</sup>, I. Balogh<sup>1</sup>, K. Bor<sup>1</sup>, A. Rónaszéki<sup>2</sup><sup>1</sup>Euromedic Diagnostics Hungary Ltd., Budapest, Hungary<sup>2</sup>Department of Cardiology Péterfy Sándor Hospital, Budapest, Hungary

**Background:** The aim of this study was to compare the diagnostic value of ischemia, wall thickening and wall motion of the Corridor4DM (4DM) and Cedars-Sinai (QPS,QGS) software packages for semiquantification of myocardial perfusion (MPS) and EKG-gated (MGS) scintigrams.

**Material and methods:** we studied 123 (52 males with a mean age of 62.9 years, 71 females with a mean age of 61.4 years) consecutive patients who underwent two-day stress/rest (99m)Tc-tetrofosmin MPS and MGS studies. All patients had pharmacological stress-test with Dipyridamole. The reference classification for MPS and MGS studies regarding presence or absence

of ischemia and normal or decreased wall thickening and motion were obtained from two physicians (with more than 25-, 10 years experience in nuclear cardiology). Semiquantitative processing was done using 4DM, QPS, QGS software packages. A 17-segment analysis was performed. Ischemia was defined as a summed stress score  $> 5$ , plus a summed difference score  $> 2$ , normals as a summed stress score  $< 5$ . Decreased wall motion or thickening was defined as a summed score  $> 5$ .

**Results:** In 30/123 cases had myocardial ischemia according to the two physicians, and 24 and 26 patients fulfilled the criteria for 4DM and QPS. In 6/93 cases and in 9/93 cases were false positive ischemia for 4DM and QPS. In 8/123 cases had decreased wall thickening, and 16/123 had decreased wall motion and the criteria were fulfilled all of them for 4DM and QGS. In 28/105 cases and in 6/105 cases were false positive decreased wall thickening for 4DM and QGS. In 17/107 cases and in 4/107 cases were false positive decreased wall motion for 4DM and QGS. The differences in false positive rate between 4DM and QGS were statistically significant ( $p < 0.001$ ).

**Conclusion:** 4DM and QPS showed negligible difference for ischemia. QGS showed considerable significantly higher specificity for decreased wall motion and thickening.

## E52

### POST-STRESS SDMA, BUT NOT ADMA IS ELEVATED IN PATIENTS WITH TRANSIENT MYOCARDIAL ISCHAEMIA

T. Molnár<sup>1</sup>, Zs. Szabó<sup>2</sup>, E. Plózer<sup>3</sup>, É. Bartha<sup>3</sup>, B. Biri<sup>4</sup>, L. Nagy<sup>4</sup>, S. Kéki<sup>4</sup>, E. Schmidt<sup>2</sup>, S. Szekeres<sup>2</sup>, K. Zámbo<sup>2</sup>

<sup>1</sup>Department of Anaesthesiology and Intensive Therapy, University of Pécs, Pécs, Hungary

<sup>2</sup> Department of Nuclear Medicine, University of Pécs, Pécs, Hungary

<sup>3</sup>1st Department of Internal Medicine, University of Pécs, Pécs, Hungary

**Background:** Asymmetric and symmetric dimethylarginines (ADMA and SDMA, respectively) are protein breakdown products. ADMA inhibits directly eNOS, whereas SDMA competes with the NO precursor arginine for uptake into the cells. We aimed to analyse both biomarkers in patients with coronary artery disease (CAD) referred for stress/rest myocardium perfusion scintigraphy (MPS).

**Material and methods:** All patients with suspected CAD were undergone a two-day dipyridamole (DP) stress/rest protocol. Venous blood was taken before (as baseline) and after DP stress for biomarkers (L-arginine, ADMA, SDMA). Beside, hemodynamic parameters and respiratory rate were obtained during DP stress. Statistical analysis: chi-square test and independent sample test were used and data were presented as either mean  $\pm$  SD or mean and 95% confidence interval.

**Results:** In patients with CAD, baseline ADMA and SDMA were significantly higher when compared to healthy subjects. Post-stress SDMA, but not ADMA was significantly higher (mean: 0.57, 95% CI: 0.49–0.64 vs. 0.40, 0.33–0.49,  $p = 0.007$ ) in patients with transient myocardial perfusion abnormality revealed by myocardial perfusion scintigraphy. However, neither ADMA nor the L-arginine/ADMA and L-arginine/SDMA ratios were significantly different before and after DP stress.

**Conclusions:** Serum SDMA could distinguish patients with similar symptoms and risk factors nevertheless differential response to dipyridamole stress, thus with different stage of coronary atherosclerosis. In addition, sustained elevation of serum SDMA in combination with an abnormal myocardial perfusion scan should be also considered beside traditional risk factors in patients undergoing elective cardiac evaluation.

## E53

### DETECTION OF PULMONARY EMBOLISM WITH PERFUSION SPECT/CT

A. Radácsi, Z. Olbrich, K. Gyimesi, K. Bor

Euromedic Diagnostics Hungary Ltd., Budapest, Hungary

**Background:** The aim of our study was to present our experience of the detection of pulmonary embolism with perfusion SPECT/CT.

**Material and methods:** Consecutive patients (N = 81) suspected of pulmonary embolism from July 2010 to March 2011 were sent to perfusion pulmonary scintigraphy in our hospital. PLOPED criterions were taken into account at the evaluation.

**Results:** In 58/81 cases, it was clearly low or high probability of pulmonary embolism, so naive low-dose CT was not necessary. Based on SPECT/CT, in 6/23 cases it was a high probability -, and in 13/23 cases it was a low probability of pulmonary embolism. Only in 4/23 cases we found as medium probability of pulmonary embolism we suggested Dual-Energy CT.

**Conclusions:** Perfusion SPECT/CT was not sufficient to detect pulmonary embolism only in 4/81 cases. Taking into account the lower radiation exposure, whether perfusion SPECT/CT.

## E54

### ASSESSMENT OF BRAIN ACTIVITY CHANGES IN LONG-TERM SPINAL CORD STIMULATION BY SPECT/CT AND MRI FUSED TECHNIQUE

K. Zámbo<sup>1</sup>, G. Perlaki<sup>2</sup>, G. Orsi<sup>2</sup>, S. Komoly<sup>2</sup>, T. Dóczy<sup>3</sup>, J. Janszky<sup>2</sup>, N. Kovács<sup>2</sup>, I. Balás<sup>3</sup>, M. Aradi<sup>3</sup>, Zs. Szabó<sup>1</sup>, E. Schmidt<sup>1</sup>

<sup>1</sup>Department of Nuclear Medicine, University of Pécs, Pécs, Hungary

<sup>2</sup>Department of Neurology, University of Pécs, Pécs, Hungary

<sup>3</sup>Department of Neurosurgery, University of Pécs, Pécs, Hungary

**Background:** The neurophysiologic mechanisms of action underlying spinal cord stimulation (SCS) and especially the long-term adaptive changes initiated by SCS remain obscure.

**Material and methods:** CT fused single photon emission computed tomography (SPECT/CT) with 99mTc-HM-PAO brain perfusion study was applied to clarify these changes. Nine patients (4 men and 5 women) with a SCS for chronic neuropathic pain (FBSS in 4 patients; CRPS in 5 patients) underwent SPECT/CT scanning after switching off the SCS for at least 1 day and after turning on the stimulation for at least 3 days. Relative changes in regional cerebral blood flow (rCBF) related to stimulation compared with non-stimulation were assessed using statistical methods.

**Results:** Significant rCBF increases were observed during SCS in the right inferior parietal lobulus, the right lateral occipital cortex, the right thalamus, bilaterally in cuneal cortex, the frontal pole, primary motor and somatosensory cortices. Relative decreases in rCBF were noticed in the right inferior temporal gyrus, bilaterally in anterior cingulate gyrus and cerebellum.

**Conclusion:** SCS modulated rCBF in brain areas known to be associated with nociception, pain or emotional assessment of pain.

## E55

### THE ROLE OF ATTENUATION CORRECTION IN THE QUANTITATIVE EVALUATION OF DOPAMINE TRANSPORTER SPECT IMAGING

Zs. Besenyi<sup>1</sup>, N. Orosi<sup>2</sup>, T. Séra<sup>2</sup>, L. Pávics<sup>2</sup>

<sup>1</sup>Euromedic Hungary Ltd., Szeged, Hungary

<sup>2</sup>SZTE Department of Nuclear Medicine, University of Szeged, Szeged, Hungary

**Background:** The aim of this study is to evaluate the effect of attenuation correction on the quantitative assessment of dopamine transporter brain SPECT.

**Material and methods:** The results of 24 123-FP-beta-CIT SPECT studies were analysed. DAT SPECT-s of 12 healthy volunteers (4 males, 8 females, aged 25–51 years) and 12 depressed patients (1 male, 11 females, aged 20–56 years) were involved in the study. The injected doses were 185 MBq. The acquisition parameters included the step-and-shoot mode over 50 min, with 120 projection angles over 360° in a 128 × 128 matrix. 3D reconstruction was performed using a filtered backprojection (by means of the manufacturer's software), with a Butterworth filter (order 10, cut-off 0.61 cm<sup>-1</sup>). The SPECT images were reoriented in 3D and were further analysed with and without an automatic uniform Chang attenuation correction (cut-off 0.12 cm<sup>-1</sup>). On the transversal, reconstructed SPECT slices at the level of the basal ganglia, regions of interest were fixed (larger than 2 × FWHM of

the SPECT resolution) manually in the striatum bilaterally, and the occipital cortex was used as a reference for the non-specific binding site. The binding potential was estimated by the specific to non-specific activity ratio (S/NS, striatum/ occipital region). Each elliptical ROI was visually optimised to that of the actual structure in order to decrease partial volume effects. In the second group we repeated our ROI analysis for each subject without attenuation correction. In the next phase of our study on the reconstructed images, 3D VOI were fixed semi-automatically as well. The quantitative evaluation (S/NS determination) was performed on the corrected and uncorrected images in the same way. First, the images were spatially normalised in the Talairach space with SPM using a template. Then 3D masks were generated by WFU Pickatlas, and were used as a VOI, and Matlab script calculated the average photon impact.

**Results:** From our ROI analysis in the first group (with correction), the S/NS ratio was 2.78 (1.63–4.26). In the second group (without correction), the S/NS ratio was 2.05 (1.46–3.2). Overall, the correlation between the two groups was significant, but the values displayed an individually large variation of  $p = 0.02$ . However, after the 3D VOI analysis, these differences seemed less marked.

**Conclusion:** According to our data, the attenuation correction does indeed have an influence on the quantitative SPECT results of DAT scans. Hence it should be taken into account during the interpretation of DAT SPECT investigations.

## E56

### IMAGING EXPERIENCES IN NEURO-ONCOLOGY BASED ON 99 METHIONINE PET/CT, 91 MRI AND 50 FDG PET/CT FINDINGS

E. Nagy<sup>1</sup>, L. Novák<sup>2</sup>, J. Varga<sup>1</sup>, B. Szücs<sup>3</sup>, G. Fekete<sup>2</sup>, L. Galuska<sup>1</sup>

<sup>1</sup>Institute of Nuclear Medicine, University of Debrecen, Debrecen, Hungary

<sup>2</sup>Department of Neurosurgery, University of Debrecen, Debrecen, Hungary

<sup>3</sup>ScanoMed Ltd., Debrecen, Hungary

**Background:** More than a decade 11C-methionine (MET) PET is one of the diagnostic tools of brain tumors complementary to structural imaging methods. Although diagnostic performance of MET PET is well discussed, the

clinical impact of this technique on expected management of patients is not fully investigated. The aim of our retrospective study was to compare the diagnostic value of MET, FDG PET/CT (MET, FDG) and MRI in the detection of intracranial lesions. In addition, we evaluated the clinical impact of MET PET/CT on patient management.

**Material and methods:** MET, FDG and MRI findings were collected from PET/CT and Medsol data bases between 1 February 2007 and 20 January 2011 (average time interval from MET PET, 11 and 34 days). The diagnosis was confirmed either by histology or clinical follow-up applying additional follow-up imaging examinations (average follow-up time, 322 days). ROC-analyses were performed to assess the diagnostic efficacy of MET PET/CT and MRI. Neurosurgeons estimated the clinical impact of MET PET/CT using questionnaire.

**Results:** Altogether 115 MET, 58 FDG PET/CT and 101 MRI were assessed in 111 patients. 16 cases were excluded because of inconclusive clinical data. Therefore we analyzed 99 MET, 91 MRI and 50 FDG findings of 95 patients. 78 MET PET/CT scans of 74 patients with brain neoplasms were performed comprising 32 primary and 32 recurrent/residual neuroglial lesions as well as 14 other non neuroglial tumors. Sensitivity, specificity, positive and negative predictive values as well as accuracy of MET were 94%, 91%, 97%, 80% and 93%, whereas these values of MRI were 93%, 86%, 95%, 79% and 91% and that of FDG were 88%, 83%, 97%, 50% and 88%, respectively. The areas under the curve of MET and MRI were 0,916 and 0,922, respectively. Histological subgroup analyses revealed that the sensitivity of MET and MRI in gliomas including oligodendroglial component (oligodendrogliomas, oligoastrocytomas) was 95% and 86%, respectively, whereas in astrocytomas MET and MRI had 94% vs. 75% sensitivity. In grade II gliomas, the sensitivity of MET and MRI was 94% vs. 75%, respectively. Retrospectively, the clinical impact of MET PET/CT was estimated in 82 cases. Altogether the therapeutic management was changed after 62 examinations (76%), which implied the following options: treatment to watching, watching to treatment or change in treatment methods.

**Conclusion:** In conclusion, we can state that the diagnostic performance of both MET PET/CT and MRI are high in the detection of intracranial lesions. The diagnostic efficacy of MET is superior to MRI in cases of recurrent/residual and low grade tumors due to its typically increased amino acid transport and metabolism. Our study indicate that MET PET/CT might have major impact on patient management.