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BONES

1

INITIAL STUDY FOR APPLICATION CA 15-3, PSA AND CEA TO ASSESS EFFICACY OF RADIONUCLIDE THERAPY IN BREAST AND PROSTATE CANCER PATIENTS WITH PAINFUL BONE METASTASES

M. Konieczna[1], A. Kołodziejczyk[2], J. Żebrowski[2], E. Dziuk[1]

[1]Zakład Medycyny Nuklearnej WIM Warszawa
[2]Zakład Medycyny Nuklearnej 4. Wojskowy Szpital Kliniczny, Wrocław, Poland

Background: Serial measurements of CA 15-3,PSA and CEA are used for follow-up of treatment of breast and prostate cancers .Aim of our work was to find out if it is possible to connect their concentration with response of patients with bone metastases to radionuclide treatment with 153 samarium (breast cancer) and 89 strontium (prostate cancer).
Material and methods: Analysis was made in 15 patients with prostate cancer and 16 patients with breast cancer on radionuclide treatment. Numerous bone lesions were confirmed scintigraphically before the start of treatment.
CA 15-3, CEA were measured in serum of patients with breast cancer and PSA, CEA in serum of patients with prostate cancer. Blood was collected before start of treatment and 1 month later. Change in concentration of tumor markers after 1 mons was calculated as percent of baseline value at the beginning of radionuclide treatment.
Tumor markers were estimated with FIA method: CEA and PSA on AutoDelfia analyser by Wallac and CA 15-3 on Axsym analyser by Abbott. Improvement of pain was assessed with scale 0–10: 0 — no improvement, 10 — full improvement, no pain.
Results: Reduction of pain was achieved in 24 patients/31 (77%) with mean response 8,3.Weak response or no response in 7 patients/31 (23%) with mean value 2,14 on 0–10 scale. Mean pretreatment value of PSA in prostate cancer patients was 361 ng/ml (0.61–1050 ng/ml), after month it was 174% (84–315%).
Mean pretreatment concentration of CEA in prostate cancer patients was 13.6 ng/ml (0.9––130 ng/ml), change after month was 160% (92–240%). In group of patients with breast cancer mean pretreatment value for CA 15-3 was 452 U/l (15.1–2080 U/l) and change after month was 110% (47-267%). Mean pretreatment value of CEA in this group was 71 ng/ml (1.48–290) and change after month was 92% (54–600%). There was no correlation between change in concentrations of tumor markers and reducing of pain as a response for radonuclide treatment.
Conclusion: Tumor markers used as a routine in follow-up of anticancer treatment don't reflect effect of radionuclide treatment on pain reduction.

CARDIOLOGY

2

COMPLEMENTARY ROLE OF CARDIAC SPECT AND MRI

J. Misko[1], M. Dziuk[2], E. Skrobowska[3], N. Szalus[4], J. Pietrzykowski[4], A. Warczynska[3]

[1]Departmentt of Nuclear Medicine, Central Rail Hospital, Warsaw, Poland
[2]Department of Internal Medicine and Cardiology, Military Institute of Health Services
[3]Department of Radiology, Military Institute of Health Services
[4]Department of Nuclear Medicine, Military Institute of Health Services,
[4]Department of Internal Medicine and Cardiology, Military Institute of Health Services, Warsaw, Poland

Background: Myocardial perfusion is routinely measured by SPECT. Cardiac MRI has higher spatial resolution than SPECT and excellent sequences for myocardial function and necrosis detection. The aim of the study was to explore a potential role of co-registration of delayed enhancement MRI (DE MRI) and gated SPECT (GSPECT) in the comprehensive evaluation of reversible and irreversible forms of myocardial ischemia in anatomically matched myocardial segments in patients with CAD.
Material and methods: We analysed perfusion and transmural extend of necrosis in 685 matched segments of the heart obtained as a result of MRI and GSPECT studies performed in 18 patients. Perfusion was evaluated in GSPECT. Extension of infarction was determined in DE MRI . In order to obtain a precise manual co-registration of MRI and GSPECT images we used PMOD software and anatomic landmarks. All myocardial segments were divided into three groups: 596 segments without delayed enhancement (viable), 71 segments with necrosis below 50% of segmental volume (viable), 18 segments with necrosis above 50% of segmental volume (nonviable). In all segments with hypoperfusion and/or enhancement we evaluated regional myocardial function by cine MRI.
Results: In the first group of 596 myocardial segments without enhancement we found 185 segments with abnormal perfusion (correlated with abnormal function). In 71 segments with subendocardial necrosis below 50% of segmental volume we found that hypoperfusion and hypokinesis had occurred in 45 segments (63%). The remaining 26 segments (37%) had normal or equivocal perfusion (with normal function).
In our study all 18 segments with delayed enhancement above 50% of segmental volume (nonviable) were dysfunctional with severe perfusion defects.
Conclusion: Our study confirms that DE MRI is the best method for evaluation of presence, location and transmural extension of myocardial infarction in segments with normal or abnormal function but myocardium at risk with ischemia causing dysfunction could be detected only by SPECT. Co-registration of DE MRI and SPECT images could be a solution for better differentiation of myocardial infarction and myocardium at risk in well defined, matched segments.

3

LEFT VENTRICULAR PERFUSION AND CONTRACTILITY IN PATIENTS WITH MYOCARDIAL INFARCTION TREATED WITH INTRACORONARY TRANSPLANTATION OF AUTOLOGOUS BONE MARROW STEM CELLS

R. Czepczyński[1], S. Grajek[2], M. Popiel[2], R. Oleksa[1], P. Bręborowicz[2], M. Lesiak[2], A. Cieśliński[2], L. Gil[3], J. Sowiński[1]

[1]Department of Endocrinology and Metabolism, Poznan University of Medical Sciences, Poland
[2]1st Department of Cardiology, Poznan University of Medical Sciences, Poland
[3]Department of Haematology and Proliferative Diseases, Poznan University of Medical Sciences, Poland

Background: Intracoronary transplantation of bone marrow stem cells (BMC) is a new treatment method of ischemic heart disease. Ongoing trials in many centres are aimed at evaluation of the impact of BMC transplantation on the course of ischemic heart disease after myocardial infarction. The aim of our study was to evaluate the influence of BMC transplantation in patients with acute myocardial infarction (AMI) on cardiac perfusion and contractility in a 6-months follow-up.
Material and methods: 30 patients (26 men, 4 women) aged 50.3 ± 9.2 years in whom isolated stenosis of left anterior descendant artery (LAD) was treated with percutaneous transluminal coronary angioplasty (PTCA) on the 1st day of AMI. The patients were randomized into two groups: 1 — patients treated with BMC transplantation (n = 19), 2 — control group (n = 11). On 2nd day of AMI bone marrow sample was taken in all patients by the means of trepanobiopsy. BMC (CD34+ cells) were isolated from the bone marrow and cultivated. On 5 — 7th day intracoronary infusion of BMC (group 1) or saline (group 2) into LAD was performed. Myocardial perfusion SPECT using ^{99m}Tc-MIBI was performed on 5–8th day of AMI (1 m, only at rest) and after 6 months (6 m, rest and following dipyridamole with the dose 0.56 mg/kg). Myocardial perfusion was semiquantitatively evaluated in 16 segments using 5-points scale (1 — normal perfusion, 5 — no perfusion). The quotient of the sum of scores in each segment and number of the segments constituted the 'perfusion index' (PI; at rest PI-R, after dipyridamole PI-D). Separately, PI for the segments supplied by LAD was calculated (PI-Ra, PI-Da). Radionuclide ventriculography at rest was performed on 5–10th day of AMI and after 6 months. Left ventricular ejection fraction (EF) was measured with the automatic method. Varicam (Elscint) gamma camera was used for all radionuclide imaging procedures.
Results: Perfusion indices are presented in the Table 1.

Table 1.

Group	PI-R 1m	PI-R 6m	PI-D 6m	PI-Ra 1m	PI-Ra 6m	PI-Da 6m
1 *n*	*19*	*16*	*16*	*19*	*16*	*16*
	2.44 ± 0.64	2.16 ± 0.44	2.16 ± 0.44	3.07 ± 0.85	2.65 ± 0.70	2.50 ± 0.84
2 *n*	*11*	*9*	*9*	*11*	*9*	*9*
	2.50 ± 0.54	2.49 ± 0.35	2.49 ± 0.45	2.97 ± 0.70	2.96 ± 0.38	3.12 ± 0.49
p	ns	0.06	0.09	ns	ns	0.05

EF on 5–10th day of AMI was 45.5 ± 7.4 in group 1, and 41.6 ± 6.6 (p = NS) in group 2. After 6 months EF was: 47.7 ± 8.9 in group 1, and 41.4 ± 12.3 in group 2 (p = NS). The trial is being continued — further results will be presented later.
Conclusion: 6 months after AMI parameters of myocardial perfusion tend to improve in patients treated with BMC transplantation.

ENDOCRINOLOGY

4

CORRELATION BETWEEN THE PARATHYROID HISTOLOGICAL STRUCTURE AND THE RESULT OF PARATHYROID 99MTC-MIBI SCINTIGRAPHY. COMPARISON OF DOUBLE PHASE AND COMBINED PROTOCOL

M. Kobylecka, J. Mączewska, W. Chudziński, J. Kunikowska, M. Jankowska, L. Królicki

Nuclear Medicine Department, Medical University Warsaw, Chair and Department of General, Vascular and Transplant Surgery, Medical University Warsaw

Background: One of the principle methods of localizing diseased parathyroid glands is scintigraphy, however no uniform protocol has been established.
The aim of the study was to assess the relationship between the parathyroid histological structure and the result of parathyroid scintigraphy using two different 99mTc--MIBI protocols.
Material and methods: The parathyroid 99mTc-MIBI scintigraphy was performed in the group of 145 patients (115 women and 28 man) with primary, secondary or tertiary hyperparathyroidism. During operation 242 nodules of the neck were removed. During histological examination 207 was confirmed to be enlarged parathyroids (57 adenomas, 150 hyperplasic glands). Two different scintigraphic 99mTc--MIBI protocols were used. A standard two phase protocol was performed in 56 patients. The combined protocol (consisted of two parts: double phase and subtraction was performed in 89 cases.
Results: The highest sensitivity (86%) is found in patients with adenomas: 83% for double phase protocol and 89% for combined protocol. The sensitivity 59% is noted in patients with parathyroid hyperplasia: 38% for double phase and 66% for combined protocol. There 70% sensitivity was noted for nodular hyperplasia and 52% for diffuse hyperplasia. The lowest sensitivity (26%) was found in subjects with diffuse parathyroid hyperplasia in double phase scintigraphy, the value increased to 65% when the combined protocol was used.
Conclusions: Type of histological structure of enlarged parathyroid glands has significant impact on the result of scintigraphy performed according to both analyzed protocols. The combined protocol increases sensitivity of scintigraphic examination in patients with parathyroid adenoma and parathyroid hyperplasia as well. The combined protocol has the highest impact on the result of scintigraphy in subjects with diffuse parathyroid hyperplasia.

IMAGE FUSION

5

COMPARISON OF 99MTC-MIBI SCINTIGRAPHY AND ULTRASONOGRAPHY IN PREOPERATIVE LOCALIZATION DIAGNOSIS IN PATIENTS WITH HYPERPARATHYROIDISM

M. Kobylecka[1], J. Mączewska[1], W. Chudziński[2], J. Kunikowska[1], M. Jankowska[1], L. Królicki[1]

Nuclear Medicine Department, Medical University Warsaw, Chair and Department of General, Vascular and Transplant Surgery, Medical University Warsaw

Background: Despite development of imaging techniques, algorithm of diagnostics in patients with hyperparathyroidism is still a matter of controversy.
Aim: Aim of the study was to compare the results of 99mTc-MIBI scintigraphic examination and ultrasonography of the neck in patients with primary, secondary and tertiary hyperparathyroidism. After operation, the sensitivity and specificity of both methods were assessed.
Material and methods: The scintigraphic and ultrasonographic results were compared in the group of 135 patients, the 218 parathyroid nodules were analyzed. The 99mTc-MIBI scintigraphy due to our own modification and the neck ultrasonographic examination was performed to all the patients.
Results: In 152 (70%) cases the result of scintigraphy was positive. In 95 (44%) cases the result of ultrasonography was positive $p = 0.00001.76$ enlarged parathyroids glands were visualized in both examinations. Additionally, the ultrasound examination showed 19 glands. 76 further glands were seen only in scintigraphy. Both methods were unable to show 47/218 (21%) enlarged parathyroids. The sensitivity and the specificity was calculated in the subgroup of 103 operated patients, the 172 parathyroid glands were analyzed. The sensitivity of the ultrasound examination was 49%, and the specificity 85%. The sensitivity of the scintigraphy was 68%, and the specificity 60% Assuming the positive results of either ultrasonography or scintigraphy as "true positive" sensitivity and specificity of both analyzed method was 76% and 50% respectively. Assuming the positive results of both analyzed methods as "true positive" the sensitivity and specificity was 37% and 95% respectively.
Conclusions: The scintigraphy showed better sensitivity than ultrasonography in the preoperative diagnosis of enlarged hyperfunctioning parathyroid glands. The ultrasound examination showed better specificity. The best 95% specificity was achieved when ultrasonography and scintigraphy was applied together.

6

SPECT-CT FUSION: WHEN, WHERE AND WHY

A. d'Amico[1], R. Panek[1], D. Borys[2], K. Szczuka[1], R. Mielczarek[1], A. Etmańska[1]

[1]Department of Nuclear Medicine and Endocrine Oncology, Memorial Cancer Center and Institute of Oncology, Gliwice Branch
[2]Institute of Automatic Control, Silesian University of Technology

Background: Co-registration of different types of studies into one multimodal image is a very powerful tool, providing more information then both studies separately. By using hybrid devices, as PET-CT or SPECT-CT, the images are simply overlapped on the display. On the other hand, for scans performed on different tomographs, different methods of image fusion are possible, depending on the information carried by the images. The most popular are the point-based methods (manual) and the mutual information method (automatic). Images of patients after administration of iodine-131 do not carry any additional anatomical information, so automated fusion algorithms, like i.e. mutual information do not give reliable results, because assumptions of this method are not met. The point based methods assumes only existence of four pairs of points visible in both modalities. This information is provided by placing external markers on the patient's body.
The aim of this paper was to show the more important indication for SPECT-CT fusion, the methodology of this operation and the most common sources of error.
Material and methods: An easy and fast algorithm of estimation of image fusion was presented and applied in our department to 70 consecutive studies. SPECT studies was performed on Siemens e.cam Duet gamma-camera and CT scans was performed on Siemens Somatom Sensation 16. Seventy consecutive scans was examinated. Twenty-six was performed after receiving metabolic radiotherapy with I-13 1(18 patients) or MIBG-I-131 (8 patients), 6 after a diagnostic dose of I-123-MIBG , 3 after a diagnostic dose of I-131-MIBG, 18 with radiolabelled somatostatine-analogues and 17 after administration of other radiopharmaceuticals.
Results: The most common indication to the fusion was the need of metabolic characterization of suspect neoplastic lesion detected on CT scan. The anatomic localization of a focal uptake seen on SPECT and the evaluation of the radiometabolic therapy were the other most popular indication. The operator time needed for marker positioning and CT scheduling is complexively about 40 min, with a strong correlation with the training level. The operator time for software fusion can vary from 20 to 120 min. A variance of error level observed was a result of human factor, choice of marker's placement, respiratory movement and marker's displacement between acquisitions. Is of fundamental importance to choose the level of confidence, according to image and equipment parameters. More than 60% of patients in our series has fusion results classified as "very good" or "good". The patient selection, the training of the personnel (especially technologist and physics) and the cooperation with radiologist are the more important factor for a correct application and interpretation of the SPECT-CT imaging fusion.

LIVER

7

DUAL-MODALITY INTEGRATED IMAGING SYSTEM. SPECT/CT BY HYBRID CAMERA INFINIA HAWEKEY — PRELIMINARY ASSESSMENT OF DIAGNOSTIC BENEFITS

M. Górska-Chrząstek[1], M. Bieńkiewicz[2], J. Kuśmierek[1]

[1]Department of Nuclear Medicine, Central Clinical Hospital, Medical University of Lodz
[2]Department of Procedure Quality Control and Radiological Protection, Medical University of Lodz

Background: Integrated system for combined radioisotope (SPECT) and X-ray (CT) tomograms, by use of single device — with no necessity for changing patient position, provides better precision of fusion than traditional method of image fusion from two different diagnostic modalities.
The aim of the study was the assessment of additional value of hybrid SPECT/CT imaging compared with SPECT scintigraphy alone.
Material and methods: Studies acquisitions were performed with use of hybrid device SPECT/CT Infinia Hawkeye GE — combining dual-detector gamma camera with a low-dose X-ray tube attached to the same gantry. Comparison of combined SPECT/CT and single SPECT images was made for all SPECT acquisitions performed in first 6 months of operation of new device. Field of view of tomographic study (CT) — was usually narrower than one in scintigraphy (SPECT), as restricted to ROI defined on scintigraphic preview or already existing X-ray tomograms.
Assessment was based on 76 consecutive studies, performed in various clinical situations: 6 brain studies (suspicion of primary or recurrent tumor), 12 studies of parathyroid (hyperparathyroidismus), 25 studies of thorax or abdomen in search for foci of malignant growth, 17 bloodpool liver studies (diagnostics of haemangioma), 15 bone scintigraphy procedures (different indications), 1 abdomen study in diagnostics of gastric bleeding.
Visual analysis of images processed on Xeleris workstation was performed separately for SPECT alone and fused SPECT/CT.
Results: Assessment of single scintigraphic SPECT study, providing information on radiotracer uptake in 3 planes, allows for diagnosis of pathology, better recognition of its characteristics and localization — than planar study. Combining SPECT images with diagnostic CT studies facilitates the diagnostic procedure but might lead to movement artefacts and does not allow for using contrast medium. Initial assessment of fused SPECT/CT images indicates that there is: better anatomical localisation of SPECT-detected lesions — in all studies with positive result a possibility of differentiating sites of pathological with physiological radiotracer uptake — in all cases of studies in abdomen and pelvis and in 5 out of 7 liver studies for the diagnosis of haemangioma, better detection of small lesions in sites difficult for diagnosis — 3 cases of small parathyroid adenoma and 2 haemangiomas, easier localisation of the site of greatest activity of radiopharmaceutical in structures of pathological nature, better localisation of site for biopsy or planning of appropriate therapeutic options (direction of the beam in radiotherapy) — in 5 cases of glioma recurrence.
Conclusions: Preliminary findings from 6 months of application confirm diagnostic benefits of assessment of fused images from hybrid device SPECT/CT vs. SPECT analysis alone, especially when better localisation of lesions (including small ones in sites difficult for diagnosis) and differentiating sites of pathological with physiological radiotracer uptake are concerned.

8

CLINICAL USEFULNESS OF SIMPLIFIED METHODS OF 99MTC-HEPIDA PLASMA (CLPL) AND SPECIFIC HEPATIC (CLHP) CLEARANCE DETERMINATION FOR ASSESSMENT OF FUNCTIONAL CONDITION OF THE LIVER

M.J. Surma, K. Jencz, I. Frieske, J. Kuśmierek

Department of Nuclear Medicine, Central University Hospital of Medical University of Lodz, Poland

Background: A simplified method was elaborated [1, 2] for determination of 99mTc-HEPIDA clearances (plasma, specific hepatic) which is based on one measurement of radiopharmaceuticals concentration in blood plasma in the interval from 68 to 83 min post injection of a known activity of the compound, and upon determination the activity in urine, voided 5 min post blood sampling. Multisample methods for determination of these clearances proved clinically useful for assessment of the functional condition of liver; the aim of present investigation was to see whether simplified procedures offer a similar usefulness from the clinical standpoint.
Material and methods: Archived data from 134 individuals (48 healthy volunteers and 84 patients with chronic liver parenchyma diseases) in whom both clearances were determined by means of standard multisample methods.
Plasma and hepatic clearances were determined by a simplified method, utilizing alternative 3 blood sampling times at: 60, 75 and 90 min p.i. For clearance calculation the stored archived data were utilized: of administered activity, of plasma concentration of the radiopharmaceutical sampled at three above mentioned times, and of voided activity at times shorter than 100 min post injection. The clearances were standardized to body surface.
As a reference information on clinical condition of the liver function an assessment was used based upon several commonly applied biochemical indicators (AsT, AlT, GGTP, bilirubin, proteinogram, and protrombin indicator) as well as for comparison purposes the values of the clearances determined by multiplesample method. The latter were correlated with results of the simplified determinations of the clearances to see which single sampling time yields the results most close to the standard method. The clearances (ClPl, ClHp) were also correlated with score of liver function impairment (SP), as published earlier [3].
Results: The correlation of results for clearances obtained by two methods (standard, simplified) were tightly correlated ($r > 0.9$); the most strict correlation was that for single sample timing of 75 min. For the simplified procedures of ClPl and ClHp determinations there was a negative correlation with SP: $|r| \geq 0.65$. The values of r are very close to those obtained previously by using the standard multisample determinations. The χ^2 values for ClPl and ClHp vs. SP > 50 and > 60, respectively, speak also for existence of a significant relationships between the clearance values and liver parenchyma condition. These χ^2 values are very close to those seen previously when multiplesample methods were used. Similarly also, the analysed relationships are more tight for ClHp than for ClPl.
Conclusions: Both clearances ClPl and ClHp, determined by a simplified method, reflect the functional conditions of liver. Specific hepatic clearance reflects the liver condition more adequately than the plasma clearance of 99mTc-HEPIDA.
A simplified method for hepatic clearance may be used for diagnostics of the liver parenchyma performance.
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NEPHROLOGY

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ASSESSMENT OF ACCURACY AND PRECISION OF 99MTC-HEPIDA CLEARANCES DETERMINED BY MEANS OF A SIMPLIFIED METHODS

M.J. Surma

Department of Nuclear Medicine, Central University Hospital, Medical University of Lodz

Background: In the Nuclear Medicine Department of Medical University of Lodz simplified methods had been worked out for determination of 99mTc-HEPIDA plasma (ClPl) and specific hepatic (ClHp) clearance [1, 2]. The **aim** of the present study was assessment of accuracy and precision of the methods in question.
Material and methods: It has been assumed that archived results of ClPl and ClHp determined by means of multisample methods, could be legitimately used as a reference standard. (They ranged from 64 do 370 ml/min and 16 to 305 ml/min, respectively).
Accuracy and precision of simplified methods was assessed by means of a Monte Carlo method utilizing alternatively three blood sampling times (t) of 68, 75 and 83 minutes post *i.v.* administration of 99mTc-HEPIDA. The coresponding alternative three urine voiding times (Y) were: 75, 80 i 95 min p.i. The analysed model was created accepting values of ClPl and ClHp, of administered activity Ap and parameters of biexponential function C(t), describing concentrations of the radiopharmaceutical (RF) in plasma as a function of time, as real values. Using the function C(t) for each individual the concentrations of RF at three sampling times were calculated. Values of urinary clearance (ClPl–ClHp) and respective functions C(t) made it possible to calculate the activity eliminated with urine AUr(Y) at the assumed voiding times (Y).
Simulated random errors were added to assumed T times from 0 to ∀20 sec and to Y values from 0 to ∀6 min. To the activity Ap and AUr(Y) random errors were added, assuming normal distribution with coefficient of variation from 0 to 5%. Clearance values were computed as well as their uncertainty. For each process there were 5000 repeated simulated determinations.
Accuracy of the simplified methods was assessed comparing mean values of simulated clearance computations with the reference values (results of standard multisample determinations). Comparison of standard deviations with mean uncertainties made it possible to gain insight into degree of agreement of the astimator of relative uncertainty with coefficient of variation as a measure of precision.
Results: There were tight correlations between reference clearance values and the mean values of determinations by means of simplified procedures ($r > 0.93$). The correlations are practically insensitive to the uncertainty of pipetting. The lines of regression differ slightly from lines of identity, and this gives an indication there is a systematic error involved; it amounts to +4 ml/min at ClPl = 60 ml/min and to – 7ml/min for ClPl of 370 ml/min. For ClHp the bias was found of +6 ml/min for clearance value of 16 ml/min and — 13 ml/min at ClHp > 300 ml/min. An uncertainty of pipetting of 2% the precision of 6-7% was found for ClPl of 300 ml/min. For ClPl of 200 and 150 ml/min the corresp. precisions were 7–8% and 10%. For ClHp of 200, 150 and 100 ml/min the corresponding precisions were 10, 12 and 17%. These precisions are by 5 per cent worse than those for corresponding ranges obtained from determinations by means of multisample procedures.
Conclusions: Accuracy of simplified methods for determination of 99mTc-HEPIDA clearances is satisfactory. Precision of ClPl depends predominantly on its value and ranges from 5% (high ranges) to 20% at low values of the clearance. Precision of ClHp is somewhat less satisfactory than that of ClPl and in the of the range from 100 to 200 ml/min it varies from 17 to 10%.

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SIMPLE FUNCTIONAL PROCEDURES — THE UNFASHIONABLE CINDERELLA OF NUCLEAR DIAGNOSTICS

S.Z. Górski

Radiophysics Laboratory of J. Struś Hospital, Poznań, Poland

In current diagnostics, one observes a clear domination of imaging and laboratory methods. Functional methods are rarely employed. Particularly useful in functional diagnostics are radioisotope methods, whose use in Poland is currently restricted to endocrinology, oncology and various types of scintigraphy, increasingly seldom in its dynamic version — beyond, that is, cardiac testing. Imaging analysis is costly, especially when one takes account of depreciation, which is rising particularly markedly with the accelerating technological aging of gamma cameras. As a result, nuclear diagnostics is focussed chiefly on university clinics and large district hospitals. What is more, the Polish National Health Fund has designated isotope diagnostics as highly specialized, which means in effect that patients cannot be referred for such diagnosis by their 'first-contact doctor'. The predominantly academic character of laboratories means that the accent is rightly placed on implementing the latest technological advances and complex, highly specific, procedures. These are suitable mainly during the final phase of the diagnostic process. As a result, such laboratories less frequently carry out the simplest routine testing, which is most frequently needed in the field. The development and application of simple functional procedures has slowed and contracted, despite showing promising initial results in such areas as nephrology, neurology, diabetology, gynecology and urology (RENOMIC II), hepatology (IDA derivatives) and cardiology (RENOMIC II in hypertension and the nuclear stethoscope, used to assess the functioning of the right ventricle of the heart). Simple functional procedures are suitable chiefly for use in the initial phase of the diagnostic process, for early diagnosis, for controlling the progress of pathological processes and of treatment, and also for more wide-ranging screening procedures. This is because they are cheaper, more sensitive than specific, and require very little chemical and radiation exposure. In the author's opinion, they should be made available to 'first-contact doctors' in primary-level nuclear medicine laboratories carrying out simple functional procedures and hormone testing. Laboratories of this type could provide a natural springboard for further expansion, in line with needs and capacities. It would be beneficial to attract young people into specializing in middle- and higher-level nuclear medicine, in its medical and technical aspects. Primary-level laboratories might constitute the first level of their interests in this area, allowing them to gain experience and to develop within the profession. These individuals would also be natural 'activists' for nuclear medicine within their own medical environments, doubtless aspiring to transform their laboratories into fully-equipped units. The author estimates that around 100 primary-level laboratories would ultimately be needed to satisfy domestic requirements. This would lead to an expansion of the market for technical and radiopharmaceutical equipment. Multiplier investment effects could lead to indirect savings, and even profits, for the national budget. To conclude, the author postulates that an appropriate policy be adopted by the PTMN.

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RENOMIC II FUNCTIONAL SCINTIGRAPHY OF KIDNEYS AND BLADDER. ITS PLACE IN NEPHROLOGICAL DIAGNOSTICS

S.Z. Górski

Radiophysical Laboratory of J. Struś Hospital, Poznań, Poland

In current nephrological diagnostics, one observes a clear domination of imaging and laboratory methods. Functional methods are rarely employed. Particularly useful for functional diagnostics in relation to kidneys are radioisotope methods. Their use in Poland is currently restricted almost exclusively to the dynamic scintigraphy of kidneys, which is relatively expensive and available chiefly in university clinics and large district hospitals. Even more seldom employed is traditional renography, using technologically and methodologically outdated apparatus of limited accessibility. Functional methods are particularly sensitive, and if they are also precise and repeatable then they are useful primarily in initial diagnosis, in directing and increasing the effectiveness of further diagnosis and therapy in financial terms, as well as with regard to the chemical and radiological load, and in following the progress of therapy. Discussion regarding the application of functional scintigraphy of kidneys according to the RENOMIC II system, described in the methodological profile, particularly at various stages of chronic disorders, established its diagnostic usefulness mainly in the early stages of illness and in following the progress of therapy through all its stages. Of crucial importance here is the exclusion and continuing evaluation of renal dysfunctioning.
The cost-effect ratio with regard to radiation dosage turned out to be 30–140 times lower for RENOMIC II than for classical dynamic scintigraphy. The equivalent cost-effect ratio in financial terms was at least three times lower, not taking into account the depreciation of the apparatus. The cost of the RENOMIC II equipment is at least ten times lower than a second-hand gamma camera. Testing using the RENOMIC II system involves a negligible chemical and radiation load and is several times cheaper than minute urography. These results justify the transferral of minute urography, DSA, arteriography and classical scintigraphy to later stages in the diagnostic process, requiring a great specificity rather than a great sensitivity, and also point to the possibility of a relatively frequent repetition of testing. Basic domestic demand for procedures of this type in diagnosing and treating individuals with arterial hypertension has been estimated at 40,000–80,000 per annum.

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SOME OF THE POSSIBILITIES FOR OPTIMIZING NEPHROLOGICAL DIAGNOSIS IN RENOVASCULAR HYPERTENSION USING THE RENOMIC II SYSTEM

S.Z. Górski

Radiophysical Laboratory of J. Struś Hospital, Poznań, Poland

Principles were elaborated for the optimization of nephrological diagnosis, taking account in particular of procedures applied in cases of vascular hypertension, with regard to the psychological, chemical, radiation and financial burdens. After specifying the principles governing the costs of each procedure, its indicators of diagnostic effectiveness and the frequency of the occurrence of renovascular hypertension RVH in the population of individuals with hypertension, comparative analysis was then carried out into the chemical and radiation loads, costs and cognitive effects for diagnostic, functional and imaging nephrological procedures for USG, minute intravenous urography, DSA, renal arteriography, classical dynamic scintigraphy and RENOMIC II system functional scintigraphy. In particular, four diagnostic approaches were considered for the detection of RVH – always taking account first and foremost of the clinical picture: A) where the first test is DSA or renal arteriography, B) where the first test is RENOMIC II functional scintigraphy, without captopril, and patients are selected for DSA/arteriography on the basis of its results, C) where the first test is RENOMIC II without captopril; on the basis of this test, cases are selected for testing with captopril, and a combined evaluation informs the selection for DSA/arteriography, D) where analysis begins with a double test, with or without captopril; on the basis of a combined evaluation, regardless of the result of the first of the tests carried out, patients are directed to DSA/arteriography. An analysis of the cost of detecting a single case of RVH — out of 1000 cases of arterial hypertension — showed that the cheapest is procedure B and the most expensive procedure A; meanwhile, the greatest probability of detecting RVH among individuals with arterial hypertension is given by procedure D. The choice depends on the aim of the testing, the consequences of a lack of diagnosis or misdiagnosis, and costs, e.g. of screening procedures.

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RENOMIC II FUNCTIONAL SCINTIGRAPHY OF KIDNEYS AND BLADDER. REASONS FOR INCOMPATIBILITY WITH THE RESULTS OF OTHER METHODS OF DIAGNOSIS

S.Z. Górski

Radiophysical Laboratory of J. Struś Hospital, Poznan, Poland

A comparative analysis was carried of the variances in the results of research carried out by means of analytical, functional and imaging methods employed in nephrological diagnostics. The variances resulted from a number of factors: A) differences in the sensitivity and specificity of particular methods, B) differences in the capacities and precision of the evaluation of various morphological and functional features of kidneys obtained in laboratory, functional and imaging analysis, C) different principles and criteria for the interpretation of results (qualitative, quantitative, functional, morphological), D) differences in the precision and standardization of methodology and apparatus, E) differences in the scrupulousness with which the tests were carried out and the apparatus checked.
The existence of these differences does not automatically discredit the method being compared — usually a new method — in favour of a method with a longer tradition of use. E.g. the usefulness of more sensitive methods cannot be evaluated on the basis of their compatibility with the results of less sensitive methods. One possible solution in this case is to evaluate compatibility with the clinical picture and with the results both of 'ex iuvantibus' evaluation and of tests repeated over the course of the disorder, until the symptoms become so acute that a less sensitive method also signals a departure from the norm.

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RENOMIC II FUNCTIONAL SCINTIGRAPHY OF KIDNEYS AND BLADDER. METHODOLOGICAL PROFILE

S.Z. Górski

Radiophysical Laboratory of J. Struś Hospital, Poznan, Poland

The RENOMIC II functional scintigraphy system of diagnosis for kidneys and bladder, tested in over 9500 cases, was devised for the early detection of vascular-renal causes of hypertension, dysfunctioning and impaired drainage of urine from the kidneys and bladder. The inventors of the system abandoned images in favour of a complex quantitative analysis of the time--flow of renograms, cystogram and vasogram and an analysis of the balance of the excretion of indicators. The testing enables functional pathology in kidneys to be excluded with a sensitivity of approx. 98%; it provides indicators for the orienting of further diagnosis and therapy; it represents a vital complement to USG and laboratory testing; it is especially suitable for scientific research. The testing produces eighteen quantitative parameters, with the standardization of testing conditions strictly preserved: the kidneys' participation in filtration; indicators of filtration as a percentage of DTPA excreted over 30 minutes, for each kidney separately and both combined; total and estimated DTPA clearance per litre of plasma; average time of renal transport of DTPA for both kidneys; indicators of DTPA drainage from kidneys at 10, 15 and 30 minutes; urinary residue in the bladder after micturation in millilitres and as a percentage; value of average diuresis during testing. All the parameters are given with the respective norms. In addition, there are four qualitative evaluations: the influx of blood to each kidney, with a suggestion of the presence or absence of the narrowing of the renal arteries (modification of the captopril test); expansion of collectin system volume with evaluation of drainage patency from each kidney (furosemide test).
The system is suitable for testing with the radioisotopes I125, I131, Tc99m, Cr51, e.g. in the compounds Hipuran I125, Hipuran I131, Etylenodicystein Tc 99m, DTPA Tc99m, EDTA Cr51, given individually or simultaneously in pairs, e.g. Hipuran I125 — DTPA Tc99m, Hipuran I125 — EDTA Cr51, and also in other compounds marked with the above-mentioned radioisotopes. The choice of indicator automatically alters the correctors applied in calculating and printing out the results. Standardization covers the measurement of the completeness of the intravenous injection, corrections to the given dosage, to RR, diuresis, the depth of kidneys, estimation of hydration, and doses of furosemide and captopril per litre of plasma. The rigorous standardization of measurements, stipulated by the programme, together with the versatility of the information, eliminates the main sources of error and ensures a good repeatability, which is particularly important in the quantitative evaluation of tendencies towards the recession, stabilization or intensification of the pathology and the progress of therapy. The low costs and doses absorbed allow the testing to be repeated relatively often. The system is particularly suitable for scientific research, e.g. into the chronology of development and the dynamic of functional pathologies in kidneys and bladders and for the optimization and evaluation of the effectiveness of therapy. For research purposes, the system possesses a programme for the automatic selection of data according to over 30 conditions, relating to the scope of the measured parameters and the profile of the patient (e.g. sex, age, weight, height, blood pressure, etc.), analysed individually or in groups. Selected sets of results are suitable for immediate printing, for selected parameters, their frequency distribution, linear and second-degree correlation, and further processing in the EXCEL system. Doses of radiation absorbed: whole body ca. 10% of the dose with abdominal RTG; in testicles ca. 3% of the dose with abdominal RTG; ca. 1% of the dose with intravenous urography; ca. 1–2% of the dose with classical imaging scintigraphy of kidneys.

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RADIONUCLIDE ASSESSMENT OF RENAL PERFUSION BEFORE AND AFTER PERCUTANEOUS TRANSLUMINAL ANGIOPLASTY OF STENOSED RENAL ARTERY

M. Kostkiewicz[1], W.M. Szot[2], T. Przewlocki[1], A. Kablak-Ziembicka[1], W. Jarosz[1], W. Tracz[1]

[1]Klinika Chorób Serca i Naczyń, *Collegium Medicum* Uniwersytetu Jagiellońskiego, Kraków
[2]Ośrodek Diagnostyki i Rehabilitacji Chorób Serca i Płuc, Krakowski Szpital Specjalistyczny im. Jana Pawła II, Kraków

Background: Stenosis of renal artery is the most common cause of secondary hypertension and renal insufficiency. Renal perfusion imaging (RPI) with ACE inhibitors is well acknowledged study in diagnosis of these diseases. Percutaneous transluminal angioplasty (PTA) of stenosed arteries is currently one of methods of treatment in this group of patients, however, there are no effective methods of non-invasive control in those subjects and indications for PTA still remain unclear.
Material and methods: The group of patient studied comprised of 24 people (14 males and 10 females, mean age 61.04 ± 8.72) with ischemic heart disease, referred for PTA, in whom angiography revealed stenosis of one or both renal arteries. All the patients had RPI with ACE inhibitors performed with 2-days protocol with minimum 48 hours between the first and second study — initially and 3 months after PTA. The values of GFR, time to peak of renographic curve (Tmax), renal perfusion images, value of renal inflow and shape of renographic curves were analyzed. Two independent observers were evaluating data in aim to refer the patient for PTA. 3-grade scale was used: 1 — stenosis not significant or normal images, 2 — borderline stenosis, 3 — significant stenosis. The data obtained were compared with ultrasonographic studies. RPI was repeated after 3 months to evaluate late outcome of treatment and probability of recurrent stenosis.
Results: In studied group of patients left renal artery stenosis was found in 13 patients, right in 9 patients and bilateral in 2 patients. PTA proved to be successfully performed in all those pts. In 2 patients recurrent stenosis was found and subsequent PTA was performed. In 2 patients, despite successful PTA, no improvement in renal function was found in control study. Those patients had low GFR values (below 20 ml/min.) together with nephrectomic type of renographic curve. Scintigraphic image was consistent with angiographic localization of renal artery stenosis. In 2 patients, despite the presence of significant stenosis the scintigraphic images were normal.
Conclusions: RPI with ACE inhibitor is substantially efficient study in referring patients for PTA and evaluation of late results. In case of severely impaired renal function the RPI should be the reason for postponing the PTA.

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AMPLIFICATION OF DIAGNOSTIC CAPABILITY OF DYNAMIC KIDNEY STUDIES WITH ERPF DETERMINATION BY PARAMETRIC CLEARANCE RENAL IMAGES. DIABETIC NEPHROPATHY AS AN EXAMPLE

I. Frieske[1], J. Kuśmierek[1], M. Gadzicki[2], A. Rogozińska-Zawiślak[3], A. Szadkowska[4], J. Bodalski[4], M.J. Surma[1]

[1]Department of Nuclear Medicine, Medical University of Lodz, Poland
[2]Department of Diagnostics and Radiological and Isotopic Therapy, Medical University of Lodz, Poland
[3]Department of Pediatric Radiology, Institute of Pediatrics, Medical University of Lodz, Poland
[4]Department of Children Diseases, Medical University of Lodz, Poland

Background: Conventional dynamic kidney study yields information on global function of each kidney separately in form of images in various places of RF passage via kidneys plus quantitative and semiquantitative data of renal secretory and excretory function (renographic curve, relative contribution of each kidney to total extraction of RF from blood, or transport times — MTT and PTT). Additional quantitative data are provided by determination of ERPF or GFR.
Aim of the study was investigation whether clearance parametric images of kidneys widen the diagnostic capacity of traditional procedures listed above.
Material and methods: 64 individuals were studied (35 males, 29 females) in whom diabetes type I (insulin dependent) was diagnosed (age 10–30 years, av.19 years). A second group of 34 healthy volunteers (15 males, 19 females); 18–25 years (av. 19 years) served as controls (Bioethical Commissions approval was obtained prior to the beginning of the study). 196 individual kidneys were studied and their images and renoscintigraphic curves evaluated. In all individuals a dynamic kidney study was performed after administration of the 99mTc-ethylenodicysteine (EC) and ERPF determined. After processing of acquired data conventional images were created by summation of scintigrams received in the phase of secretion of RF (up to 2,5 min post injection). Parametric clearance images were created by a method of Surma. Additionally, renographic curves were deconvoluted. Both types of images, which serve for evaluation of uptake — secretory function, served for the evaluation of defects of kidney parenchyma. For both types of images a 3 level score scale was used to provide semiquantitative measure of observed pathology. Renographic curves were evaluated by analyzing their shape, taking into account relative contribution of each kidney to total uptake (or ERPF) as well as computing mean parenchymal transit time by deconvolution. Qualitatively elimination of urine from the pelvic and ureteral space was evaluated on basis of III phase of the renogram. Mean renal transit time (MTT) of the tracer was also calculated.
Results: Analysis of clearance parametric images revealed that regional defects in function of renal parenchyma were more frequent in kidneys of patients with diabetes than in the controls (35.7% vs. 8.6%, $p < 0.001$). In conventional summation images there were no significant differences in defect frequency noted between the groups (3.1% vs.4.4%, $p = 0.2$). There were no differences between PTT and ERPF between the groups ($p = 0.2$ and 0.4 resp.). Relative uptake of the radiopharmaceutical in both groups did not differ and was within the normal range of values. There was a larger av. value of MTT and more frequent flattening of the curve in phase III in patients with diabetes as compared with the control group ($p = 0.02$ and $p = 0.001$, resp.), what could be due to the functional uropathy, seen in diabetic patients.
Conclusions: 1. Clearance parametric images reveal additional information on regional function of kidneys. This information can be useful from the standpoint of early diagnosis of nephropathy of different background (e.g. diabetes) when other values characterizing global secretory and excretory function of kidneys are still within the normal range. 2. Parametric clearance images should be included as a component of dynamic kidney studies because these images may perhaps reveal early pathology not diagnosable by usual routine procedures.

NEUROLOGY

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SEMI-QUANTITATIVE ASSESSMENT OF 131I-ALPHA-METHYL-TYROSINE UPTAKE IN CEREBRAL GLIOMAS

M. Górska-Chrząstek[1], M. Bieńkiewicz[2], K. Tybor[3], E. Zakrzewska[4], R. Mikołajczak[4], J. Kuśmierek[1]

[1]Department of Nuclear Medicine, Central Clinical Hospital, Medical University of Lodz, Poland
[2]Department of Procedure Quality Control and Radiological Protection, Medical University of Lodz, Poland
[3]Department of Neurosurgery, Medical University of Lodz, Poland
[4]Radioisotope Centre POLATOM Otwock-Świerk, Poland

Background: The aim of the study was the assessment of degree of uptake of a new Polish make of radiopharmacetical 131J-alfa-metylo-tyrozine (IMT — OBRI-POLATOM Świerk) in cerebral gliomas and recognition of association between indices of uptake and WHO grades of malignancy.
Material and methods: The subjects were 33 patients with visually increased IMT uptake (hot focus) — in 22 cases tumor recurrence, in 11 cases — primary tumor. SPECT scintigraphy of the brain was performed with a double head gamma camera Varicam ELSCINT, 15 min after intravenous administration of IMT. In all the patients histopathology was done.
For the purpose of assessment of relative uptake in tumor, 2 transaxial slices with most visible tumor region were chosen. On each of the slices the region of the tumor (ROItumor) was marked automatically as a set of pixels with count rate not smaller than 90% of maximum value for that slice. For a reference region (ROIref) mirror reflection of ROItumor on the contralateral cerebral hemisphere was chosen or/and the hemisphere itself (if the tumor overlapped with hemisphere, the upper or the bottom part of the cerebral sphere was chosen). Relative index of uptake in the tumor was calculated as a ratio of average count values of ROItumor and ROIref (average value from 2 slices).
Results: Relative indices of radiotracer uptake in all 33 subjects were in range between 1,15 and 2,69. For recognition of association between grade of malignancy and degree of uptake, mean values of those indices in 2 subgroups:
— tumors of WHO grade I/II — 11 cases;
— tumors of WHO grade III/IV — 22 cases
were compared. On average, relative uptake (ROI/tumor/ROI/ref) in group of III/IV WHO grade tumors was higher than in group of I/II grade, but the observed difference was non highly significant. When the group of III/IV grades was restricted to tumors not treated with radiation (15 cases), the differences in the degree of uptake between groups with different grades of malignancy — were significantly greater (Table 1).

Table 1.

Indices of uptake	I/II grade	III/IV grade	p value
Tumor/non tumor	1.35 ± 0.13 (1.15 ÷ .53)	1.63 ± 0.38 (1.17 ÷ 2.43)	0.05
Tumor/hemisphere sphere	1.52 ± 0.13 (1.34 ÷ .80)	1.79 ± 0.41 (1.29 ÷ 2.69)	0.06
	I/II grade	**III/IV — without radiotherapy**	**p value**
Tumor/non tumor	1.35 ± 0.13 (1.15 ÷ 1.53)	1.73 ± 0.36 (1.26 ÷ 2.43)	0.02
Tumor/hemisphere sphere	1.52 ± 0.13 (1.34 ÷ 1.80)	1.88 ± 0.42 (1.29 ÷ 2.69)	0.04

Conclusions: Polish radiopharmaceutical 131J-alfa-metylo-tyrozine shows significant uptake in cerebral gliomas (as compared to non-tumor tissues). Average relative indices of radiotracer uptake in group of III/IV WHO grade tumors are higher than in tumors with I/II grade. In tumors after radiotherapy with III/IV grade of malignancy, relative uptake of radiotracer seems to be significantly lower than in non treated tumors.

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POSSIBLE APPLICATION OF REGIONAL CEREBRAL BLOOD FLOW SPECT SCANNING IN FORENSIC MEDICINE SENTENCING

M. Piskunowicz[1], M. Krzyżanowski[2], P. Lass[1]

[1]Department of Nuclear Medicine, Medical University of Gdansk, Poland
[2]Department of Forensic Medicine, Medical University, Gdansk, Poland

Background: Increasing amount of cranio-cerebral trauma is mostly due to the increasing incidence of traffic and criminal incidents. The role of neuroradiologic techniques in medico-legal arguing is not clearly defined yet. There is an established position of X-ray, CT and MRI. The role of rCBF SPECT scanning is of not clearly defined, despite its advantages, such as high sensitivity and its usefulness in forensic medicine is still under investigation. The aim of the study was to assess the usefulness of rCBF brain scanning in modern medico-legal sentencing.
Material and methods: We analysed 30 medico-legal sentences given in the years 2000–2004. Those opinions were asked by the courts from the Pomeranian Province both in penal and civil cases. All the persons had performed rCBF SPECT scanning as well as CT and/or MRI scanning. Scanning has been performed utilising ^{99m}Tc-ECD and Multispect-3 triple-head gammacamera (Siemens, Erlangen, Germany).
Results: SPECT scanning proved to be highly useful in excluding simulation of cranio-cerebral trauma in young patients. In brain concussion long-lasting rCBF changes were seen, up to few months, in those with encephalopathy much longer. In at least 15 out of 25 cases it influenced the final shape of medico-legal opinion.
Conclusions: rCBF SPECT scanning may visualize pathologic changes not showed by CT and MRI scanning. It should be applied in medico-legal sentencing as an auxiliary to CT and MRI in post-traumatic cerebrastenia and encephalopathy. In justified cases it may be used as a court proof.

ONCOLOGY

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COMPLEX RADIONUCLIDE EXAMINATION OF PATIENTS WITH SUSPICION ON BRAIN METASTASES

S.S. Makeev[1], D.S. Metchev[2], V.M. Semenova[1]

[1]Institute of Neurosurgery AMS of Ukraine, Kyiv, Ukraine
[2]Medical Academy Postgraduate Education, Kyiv, Ukraine

Background: Brain metastases (BM) are observed in 10–30% of adult patients with diagnosed cancer of various organs. Usually metastases are multiple and simultaneously affect different organs. Radionuclide diagnostics is of high informativity in revealing of these tumors and enabling to investigate brain and other organs during one examination.
The aim of the study was estimation of the diagnostic significance of complex radionuclide examination of patients with suspicion on BM for definition of the primary tumor localization and multiplicity of metastases.
Material and methods: Single photon emission computer tomography (SPECT) of brain and whole body scintigraphy (WBS) with ^{99m}Tc-MIBI and ^{99m}Tc(V)-DMSA (prepared from 99mTc-DMSA), produced by "Polatom", were conducted in 115 patients (63 women, and 52 men, age 29–74) with suspicion on BM according to data of CT, MRI or anamnesis. In 100 patients the diagnosis of a brain tumor was verified, and in 58 of them BM of various histogenesis were diagnosed, 45 of which were examined before the surgery, and 13 — after it.
Results: 44 patients from 45 surveyed according to preoperational SPECT had brain focal accumulation of radiopharmaceuticals. Only in one patient SPECT signs of the focus were not diagnosed. Thus, sensitivity of the method in patients with BM was 97.8%. According to the WBS the focuses of extracerebral localizations were detected in 28 of the total number (100) of operated patients. In 22 of them with the histological diagnosis of brain metastasis extracerebral focuses were localized in: bones — 7 (31.8 %), breast — 5 (22.7 %), lungs — 4 (18.1%), intestine — 2 (9.0%), skin, thyroid gland, kidney and mediastinum — in ones (in 4.5%). In 11 patients visual signs of extracerebral focuses allowed to guess their tumor nature.
While the comparative analysis of efficiency of radiopharmaceuticals application, the frequency of revealing of the intracerebral focuses using 99mÒńMIBI was — 80.8%, but 99mÒń(V)DMSA — 77.9%, and of revealing extracerebral focuses — 27.6% and 30.9% accordingly.
Conclusions: Our data testify the significance of complex radionuclide diagnostic studies of patients with suspicion on BM. After revealing one focus of a tumor affection of a brain it is most rationally to conduct the surgical treatment. Revealing of multiplicity of tumor affection of intra- and extracerebral localization demands for improved diagnostics with the subsequent correction of treatment tactics of these patients.

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COMPARATIVE ANALYSIS OF 99MTC-DEPREOTIDE AND 99MTC-EDDA/ /HYNIC-TOC THORAX SCINTIGRAMS ACQUIRED FOR THE PURPOSE OF DIFFERENTIAL DIAGNOSIS OF SOLITARY PULMONARY NODULES

A. Płachcińska[1], R. Mikołajczak[2], J. Kozak[3], K. Rzeszutek[4], J. Kuśmierek[1]

[1]Department of Nuclear Medicine, Medical University, Lodz, Poland
[2]Radioisotope Centre POLATOM, Otwock-Świerk, Poland
[3]Ward of Thoracic Surgery, Copernicus Hospital, Lodz, Poland
[4]Centre for Treatment of Pulmonary Diseases, Lodz, Poland

Background: Aiming at comparison of diagnostic efficacy of 2 radiopharmaceuticals (RPhs): 99mTc-depreotide (Neospect, Amersham) and 99mTc-EDDA/HYNIC-Tyr3-octreotide (Tektrotyd, Polatom), in differentiation between malignant and benign etiology of solitary pulmonary nodules (SPNs), radionuclide studies with 2 RPhs were performed in 18 patients. Studies were acquired with SPECT technique, after administration of 740 MBq of RPh, the same acquisition and processing protocols were applied. Scintigrams were assessed visually, according to the following score system: positive (+), equivocal (+/–) and negative (–). Additionally, uptake intensity of both RPhs in nodules was assessed semiquantitatively, using a tumour-to-background ratio. Verification of scintigraphic results was based in 14 cases upon a pathological examination of tumor samples (histopathology) and in the remaining 4 — on clinical observation and bacteriological studies.
Results: Normal scintigrams obtained with both RPhs differ significantly. 99mTc-depreotide is markedly accumulated in spine, sternum, ribs and lungs (mean lung/heart ratio = 2.2). This accumulation was not observed on 99mTc-EDDA/HYNIC-TOC scintigrams (mean lung/ /heart ratio = 0.7). In 6 patients a malignant etiology was revealed (6 cases of lung cancer: 5 — adenocarcinoma, 1 — squamous cell) and 12 cases turned out benign (4 hamartomas, 3 tuberculomas, a tuberculous infiltrate, an alien body with inflammatory reaction, a hyperplasia of lymphatic tissue and 2 cases of unknown etiology, of which one had a stable size and the other resolved during a 2 year observation period). In all 6 cases of lung cancer positive results were obtained with both RPhs. Moreover, in 2 patients metastases in mediastinum could be observed on scintigrams obtained with both RPhs. From among 12 cases of benign etiology 6 99mTc-depreotide scintigrams were true negative, 1 — equivocal and 5 — false positive, whereas 6 99mTc-EDDA/HYNIC-TOC scintigrams were true negative, 4 — equivocal and 2 false positive. Moreover, 99mTc-depreotide additionally revealed mediastinal and hilar lesions in 9 patients with benign lesions and 99mTc-EDDA/HYNIC- -TOC — in 8. 99mTc-Depreotide showed higher absolute accumulation in lungs and lung tumours, a mean tumour/background ratio, however, was equal for both RPhs (2.2 in malignant and 1.4 in benign lesions, resp.)
Conclusions: 1. Although both RPhs show similar diagnostic efficacy in differentiation of SPNs, a tendency toward a higher number of false positive results on 99mTc-depreotide scintigrams probably leads to a lower specificity. 2. Better statistical quality of 99mTc-depreotide scintigrams facilitates their interpretation and a distinct outline of lungs simplifies localization of lesions, 3. A substantial number of false positive lesions in mediastinal and hilar regions in patients without a neoplastic process hampers the usefulness of both RPhs for effective detection of lung cancer metastases to lymph nodes.

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RADIOPHARMACEUTICAL IMAGING TO PREDICT AND EVALUATE THE RESPONSE OF BREAST CANCER TO NEOADJUVANT CHEMOTHERAPY

M.H. Listewnik[1], B. Birkenfeld[1], P. Zorga[1], M. Foszczyńska-Kłoda[2], M. Jędrzejczak[2], I. Damianowicz[2], A. Karpińska[2], M.J. Listewnik[3]

[1]Department of Nuclear Medicine, Pomeranian Medical University, Szczecin, Poland
[2]Regional Oncology Hospital, Szczecin, Poland
[3]Chair and Clinic of Cardiosurgery, Pomeranian Medical University, Szczecin, Poland

Background: The aim of the study was to assess the efficacy of Tc-99m sestamibi scintimammography in the prediction and evaluation of tumor response to neoadjuvant chemotherapy (NCh) in patients with locally advanced breast cancer (LABC).
Material and methods: The subjects consisted of fourteen female patients with unilateral LABC eligible for anthracycline-bases NCh followed by surgery. The early and delayed static breast scans were undertaken in all subjects at 10 and 120 minutes after intravenous injection with 20–30 mCi of Tc-99m MIBI. Early and delayed tumor to background ratios (TBR) and washout rate (WOR) were calculated. Three sets of examinations images were obtained: baseline study (BL), the first follow up study (FF) after two cycles of chemotherapy and the second follow up (SF) scan on completion of chemotherapy. Clinical response was evaluated following WHO criteria. Ten patients revealed partial response and two stable diseases. All patients underwent mastectomy.
Results: All patients underwent a BL scan; 7 had a FF scan and 8 had a SF scan performed. TBR10 ranged from 1.35 to 3.35 with a mean ±SD of 2.2 ± 0.68. In delayed acquisition (120 minutes) Tc-99m MIBI uptake (TBR120) ranged from 1.08 to 3.17 (1.79 ± 0.588). WOR was evaluated in all cases and all tumors showed radioactivity clearance over time. WOR ranged from 0.103 to 0.53 (0.352 ± 0.124). The FF and SF scan showed TBR10 1.96 ± 0.785 and 2.177 ± 0.977, respectively. TBR120 of FF was 1.61 ± 0.62 while in the SF study — 1.55 ± 0.278. WOR of the FF was 0.37 ± 0.11 and for the SF study — 0.38 ± 0.19. The only statistically significant differences in Student's t Test for matched pairs were found between mean values of TBR10 and TBR120 in BL ($p = 0.00550$) and FF study ($p = 0.00792$) however in SF study it was not significant. Other differences — between mean values of TBR10, TBR120 and WOR in BL/FF, BL/SF and FF/SF studies — were not statistically significant.
Conclusion: The only statistically significant difference of TBR10 and TBR120 in BL and FF suggest that uptake shows dynamic changes, what may be promising for application in patients with LABC.
The study was supported by Nuclear Medicine Section, IAEA.

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RADIONUCLIDE AND DRUG THERAPY OF METASTATIC BONE DISEASE

D. Metchev, N. Polyakova, N. Krushinsky

Medical Academy Postgraduate Education, Kiev, Ukraine

Background: The number of the patients with bone metastases of a cancer of various localization constantly increase; that predetermines necessity of use some new approaches to treatment this kind of pathology.
The aim of the study was to analyse the results of combined radionuclide (89Sr--chloride) and drugs (hormones, amifostin, bisphosphonates, xeloda) systemic therapy in 125 patients (168 episodes) with bone metastases of breast (86) and prostata (39) cancer.
Material and methods: The anthers recommend the protocol for 9-10 monthes treatment: 85Sr-chloride (150 MBk) with amifostin, like a citoprotector (first part of treatment) and multimodelity drugs therapy (second part) — hormonetherapy (femara or zoladex — breast cancer, casodex, fosfestrole or flutamid-prostate cancer), bisphosphonates (bonefos and zometa) and chemotherapy with xeloda. The efficacy of the treatment was evaluated using Karnofski scale as well as laboratory (blood count, blood calcium) and radiological (RIA, radiography, osteoscintigraphy, MRI) methods.
Results: Combined radionuclide and drug systemic therapy was shown to be the most effective scheme. It is provided 96.4% of the "comfort" life (Karnofski indexs — 60–80) during the first year treatment (against 78.9% for single 89Sr-chloride therapy). It is also noted that this scheme would inhibit bone metastases development, stabilize existing changed and promote topical osteosclerosis in some cases.
Conclusion: The experience of clinical use the 89Sr-chloride with supportive drugs gives a foundation to estimate positively this method of treatment: improving guality of life of the patients with multiple metastases in bones; refusal of consumption of narcotic analgesia; delay development of new pain sites; elimination of necessity of radiotherapy in indicated periods of observation.

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THE VALUE OF CHOLESCINTIGRAPHY FOR DIAGNOSIS OF EXTRAHEPATIC CHOLEDOCHAL CYSTS IN CHILDREN AND THEIR MONITORING AFTER SURGERY TREATMENT

E. Świątek-Rawa, A. Kamiński

Memorial Child Health Center, Nuclear Medicine Department,

Background: Choledochal cysts are uncommon anomalies of the biliary tract in children. The etiology of this phenomenon is unknown. Pathophysiology consist of hepatic cirrhosis, pancreatitis, bile duct carcinomas. Usually symptoms of pancreatitis, ascending cholangitis are developed before age 2. Total excision of extrahepatic choledochal cyst is the only accepted method of treatment. Postoperative complication included: bile leaking, anastomotic stricture, hepatic failure.
The aim of the study was the assesment of cholescintygraphy sensivity for diagnosis of choledochal cyst. Usefulness of cholescintigraphy for diagnosis of extrahepatic choledochal cysts. Usefulness of cholescintigraphy for monitoring after surgery treatment. The place of cholescintigraphy in diagnostic — treatment algorytm in children with extrahepatic choledochal cysts.
Material and methods: In the period of 20 years 68 children aged from 2 month to 14 years who underwent total excition of extrahepatic choledochal cysts, underwent cholescintigraphy before and after operation. Method The qualitative cholescintigraphy estimating of liver uptake, liver size, homogenity, the morphology of biliary tract and bile flow was performed before and after operation. Results of cholescintigraphy were compared to clinical presentation, usg, serum bilirubin level, histopathology, surgically proven existence and type of the extrahepatic choledochal cysts. Statistical analysis was performed using Fisher, χ^2, Kruskal Wallis, t test, $p < 0,05$ was estimated as a significant.
Results: The sensivity of cholescintigraphy for diagnosis of choledochal cyst was 92.6%. The sensivity of USG for diagnosis of choledochal cyst was 87%. The positive correlation of scintigraphic liver uptake, liver size, homogenity to serum bilirubin level < 1 were 92%, 78.5%, 72.5% respectively. The positive correlation of scintigraphic liver uptake, liver size, homogenity to histopathology of liver biopsy were 92%, 75%, 78% respectively. The scintigraphy of intrahepatic biliary tree correlation to USG was 46%. The scintigraphy evaluation of liver uptake before and after operation revealed: improvement in 17.5% and worsening in 1.5% of patients. The scintigraphy evaluation of liver size before and after operation revealed: improvement in 70.5 and worsening (enlarged) in 1.5% of patients. The scintigraphy evaluation of tracer homogeneity before and after operation revealed: improvement in 28% and worsening in 1.5% of patients. The dilatation of intrahepatic biliary tree estimated on scintigraphy before and after operation improved 44% and worsen in 3% of patients. The scintigraphy estimation of bile flow over Roux — Y loop were correct in 81% of patients, slower in 17,5% and obstructed in 1,5%.
Conclusions: Cholescintigraphy is very sensitive for evaluation of biliary tract diseases and shoud be performed in all patients suspected of liver and biliary tract anomalies. There is good correlation between cholescintigraphy, USG, serum bilirubin level and histopathology examination. Cholescintigraphy is useful to monotoring operation effects estimating liver uptake, liver size, homogenity, imaging of biliary tree and bile flow before and after total excision extrahepatic choledochal cyst. Cholescintigraphy is useful in monitoring short and long term outcome after surgery for choledochal cysts and should be performed 6 months after operation and always when biliary tract complication is suspected.

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LUNG PERFUSION IN PATIENTS FOLLOWING CORRECTION OF FALLOT SYNDROME

G. Romanowicz[1], R.Sabiniewicz[2], P. Lass[1], J. Ereciński[1]

Medical University of Gdańsk, Poland

Background: Lung perfusion abnormalities (LPA) are frequently observed in patients with tetralogy of Fallot (TOF). They can be of primary origin or occur as a result of different causes including surgery. There are several diagnostic modalities used clinically to assess LPA. Among others lung perfusion scintigraphy is a non invasive, sensible and easy accessible method. The main aim of the study was assessment of frequency of lung LPA (both asymmetry of lung perfusion and regional perfusion defects) in patients after total surgical correction of TOF and its relation to treatment method (primary total correction vs. palliative shunt prior to correction). Moreover analysis of gathered data was expected to evidence possible correlation between frequency and extent of LPA and treatment history.
Material and methods: 110 patients (49 men and 61 women) after surgical repair of TOF were studied. In 33 cases palliative surgery (Blalock-Taussig shunt) was done prior to complete repair. Mean age was 15 ± 8.2 years. Lung perfusion scans with use of 99m-Tc macroaggregates of albumin were analyzed semiquantitatively with assessment of relative uptake and regional perfusion defects.
Results: asymmetric pattern of pulmonary perfusion was observed in 65 (59.1%) patients. Appearance of perfusion asymmetry was equal in patients after primary surgical repair and in those who underwent palliative shunt prior to correction. There was no prevalence of relative hypoperfusion of right or left lung in both groups of patients. Regional perfusion defects were observed in 44 (40%) cases. There was no difference in frequency of regional perfusion defects in patients after primary surgical repair and in those who underwent palliative shunt prior to correction and they appeared more often ($p < 0.05$) in right than in left lung in both groups of patients. There was a significant correlation between age at surgical repair and prevalence of regional perfusion defects appearance.
Conclusions: Asymmetric lung perfusion and regional perfusion defects are frequent findings in patients with TOF. There is no significant difference in appearance of LPA in patients after primary surgical repair and in those who underwent palliative shunt prior to correction. Correction of TOF at early age decreases the risk of regional perfusion defects but has no impact on asymmetry of pulmonary perfusion.

PET

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LYMPHOSCINTIGRAPHY IN THE DIAGNOSIS OF TUMOURS OF THE ORAL CAVITY, PHARYNX AND LARYNX

R. Czepczyński[1], D. Mielcarek-Kuchta[2], J. Manasterski[2], J. Sowiński[1], W. Szyfter[2]

[1] Department of Endocrinology and Metabolism, Poznan University of Medical Sciences, Poznań, Poland
[2]Department of Otolaryngology, Poznan University of Medical Sciences, Poznań, Poland

Background: Presence of lymph node metastases is a negative prognostic factor in the tumours of head and neck. Depending on the local experiences, patients with tumours of the oral cavity, pharynx and larynx who present no clinical or ultrasound signs of regional lymph node metastases (N0 staging) are treated either with elective lymphadenectomy or using the 'wait and watch' strategy. The significance of the sentinel lymph node in the further decision-making has not been established. The aim of this study was to evaluate the prognostic role of the sentinel node identified by the means of lymphoscintigraphy.
Material and methods: 19 patients (17 men) aged 42 – 76 years with the diagnosis of planoepithelial carcinoma located in the tongue (n = 10), in the tonsil (n = 4), on the palate (n = 1), at the base of oral cavity (n = 1), in phahrynx (n = 1) and in larynx (n = 2) with staging T2-4 N0 Mx were included in the study.
Lymphoscintigraphy was performed using ^{99m}Tc-nanocolloid (Nanocoll, Amersham Health) — activity ca. 1 mCi — that was injected intramucosally at the edge of the tumour. The acquisition was performed at 15, 60 i 100 min. The Nucline (Mediso, Hungary) gamma camera was used. On the next day, the tumour and the detected sentinel lymph node, as well as 1–4 other lymph nodes were surgically removed. All nodes were subjected to the histopathological examination.
Results: Lymphoscintigraphy revealed tracer uptake in 1–7 lymph nodes. In case more than one lymph node was visualised, the one that appeared as the first was regarded as the sentinel node. In the histopathological examination, metastatic lesions were found in scintigraphically identified sentinel lymph nodes in 5 patients (26%). In two of them, cancer cells were present also in other removed lymph nodes. In the follow-up both these patients presented with recidives: one in the lymph nodes, one in the site of the primary tumour. In 14 patients the sentinel node was free of metastases, although in two cases (11%) the metastatic lesions were found in single lymph nodes adjacent to the sentinel node.
Conclusions: Lymphoscintigraphy is an effective method of sentinel lymph node identification in cases of tumours of oral cavity, pharynx and larynx. In majority of patients, the sentinel node is representative for the whole lymphatic system of the neck.

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THE VALUE OF THE PET/CT FDG IN THE DIAGNOSTICS OF CANCERS OF UNKNOWN ORIGIN (FPI)

B. Małkowski, T. Pietrzak, A. Dąbkowski, A. Kowalska, M. Frankowska, J. Szefer

Department of Nuclear Medicine, Center of Oncology, Bydgoszcz, Poland

Background: As diagnostic technology progresses the number of undiagnosed patients with FPI systematically decreases. But there still remain 3 to 5% of cases in which Page: 24 the origin of the cancer could not be found with ultrasonography (US), computed tomography (CT) or magnetic resonance (MR). According to the library amount of the 30 to 50% of the cases could be properly diagnosed by the use of PET FDG technology. The aim of the study was the retrospective assessment of the value of the PET/CT in the diagnostics FPI.
Material and methods: In the period between March 2003 and December 2005, 346 studies were performed to diagnose FPI. We selected 246 studies in which we have full information about other imagining techniques such as US, CT, MR. These studies were included into assessment. PET/CT studies were made on the Siemens Biograf LSO scanner according the typical PET protocol. We performed the comparison of the particular methods of diagnostics.
Results: Pathological focuses of FDG metabolism were found in 134 patients (54.5% of the group), indicating the primary site of the cancer on the PET-CT study.
Conclusion: Hybrid PET/CT was found to be more effective than other imagining techniques. There is a need to conduct a prospective study with histopathological comparison to assess the value of the PET/CT in the diagnostics of the FPI cancer.

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PET/CT IN THE DIAGNOSTICS OF THE HEAD AND NECK CANCERS

T. Pietrzak, J. Szefer, B. Kowal, B. Małkowski

Department of Nuclear Medicine, Center of Oncology, Bydgoszcz, Poland

Background: In patients with head and neck cancer, PET with [F-18] fluorodeoxyglucose (FDG) is both more sensitive and specific than CT, US or MR for detection of both primary and recurrent neoplasm. This value can be increased if we coregister PET and CT and next overlap these images. In the literature we have found a few studies describing the value of combined PET/CT studies made by the use of FDG in this localization. The aim of this study was the retrospective assessment of the value of the PET/CT in the diagnostics of the head and neck cancers.
Material and methods: In the time between March 2003 and December 2005, 95 studies were made to diagnose head and neck cancers. In 50 studies in 36 patients we have information about other imagining techniques such as CT, US or MR. These studies were included into assessment. Studies were made in patients with cancers of: pharynx and peripharyngeal space — 21 studies, tonsils — 7 studies, larynx — 11 studies and tongue 6 studies. We performed the comparison of the results of the particular methods of the imagining diagnostics. Studies were made on the Siemens Biograf LSO scanner according the typical PET protocol.
Results: Positive results (confirming the presence of neoplasm) were found in patients with cancers of: pharynx and peripharyngeal space — 13 studies, tonsils — 1 study, larynx — 6 studies and tongue — 0 studies. Doubtful results (not confirming and not excluding the presence of neoplasm) were found in patients with cancers of: pharynx and peripharyngeal space — 3 studies, tonsils — 2 study, larynx — 3 studies and tongue — 1 studies. In the assessed material the PET/CT study found more cancer location in comparison to the results of the particular methods of the imagining diagnostics changing the way of the treatment of the patients.
Conclusion: In the assessed material the PET/CT study appeared to be the one which is the most powerful in the diagnostics of the head and neck cancers. To small group of the study divided in to subgroups enable us to draw conclusions dealing with sensitivity and specificity of the method of PET/CT. There is a need to conduct a prospective study to assess the value of the PET/CT in the diagnostics of the head and neck cancer.

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THE VALUE OF THE PET/CT FDG IN THE DIAGNOSTICS OF NEUROENDOCRINE CANCERS (NECHM/NECLM)

B. Małkowski, J. Szefer, T. Pietrzak, J. Ćwikła, N. Seklecka, J. Walecki

Department of Nuclear Medicine Center of Oncology Bydgoszcz
Department of Nuclear Medicine, Department of Radiology CSK MSWiA, Warsaw, Poland

Background: Neuroendocrine cancers with high malignancy (type III WHO), mixed form of adenocarcinomas, as well as neuroendocrine cancers (type IV WHO) compose the group of tumors NET poorly differentiated with more aggressive course than most of NET tumors. The characteristic feature of this group is lack of an active form of the somatostatin receptor. Tumors with low malignancy (NECLM) in their natural course or in the course of treatment can differentiate to NECHM changing the receptor's system. Taking into consideration the unsatisfactory results of anatomical techniques of imagining and somatostatin receptors scintigraphy (SRS) in the assessment of the course of disease, FDG PET/CT study can be a valuable supplement. In literature we did not find studies describing the value of FDG PET/CT studies in the selected group cancers type III and IV WHO. The aim of the study was the retrospective assessment of the value of the PET/CT in the diagnostics of the neuroendocrine cancers and their mixed forms.
Material and methods: In 2005, 19 studies FDG PET/CT were made to diagnose: NECHM — 12 patients, mixed forms — 3 patients, 2 cases with the bronchial carcinoid with the high activation of the proliferation and 2 cases of NECLM type gastrinoma. All patients passed the SRS study and CgA test.
Results: In the NECHM group true positive results were achieved in 10 cases, true negative in 1 case, false negative in 1 case with the presence of active disease in repeated SRS study. In the group of 3 with a mixed form of cancer we confirm active disease additionally showing its extent. In 2 cases of the atypical carcinoid of the bronchi we confirm active disease but with lesser extent than in SRS studies. From two cases of NECLM type gastrinoma we confirm disease in 1 case (true positive) and the lack of disease in the second (true negative according clinical follow up and other studies). The CgA study In the case of NECHM and mixed form has relatively low value because of the lack of pathological changes in the course of active disease. In the cases of bronchial carcinoid and NECLM type the gastrinoma results of SRS studies correspond to FDG PET/CT.
Conclusion: In the assessed group PET/CT was found to have the highest value in the NECHM subgroup. In the subgroup with NECLM we observed high variability of the results. Because of the low number of patients in particular subgroups of NECLM there is no possibility to draw statistical conclusion. There is the need to conduct the prospective study with histopathological analysis and receptor typing to assess the value of the PET/CT in the diagnostics of the neuroendocrine cancers.

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ASSESSMENT OF THE VALUE OF THE PET/CT18F STUDIES IN THE DIAGNOSTICS OF THE BONE METASTASES

B. Małkowski, T. Pietrzak, K. Kasprzak, B. Kowal, D. Króliczewski, J. Szefer

Departament of Nuclear Medicine, Center of Oncology, Bydgoszcz, Poland

The bone studies by the use of technique PET/CT are performed by means of fluorine in the form of (18F) NaF. The tracer is selectively taken up by osteoblasts in proportion to theirs activity. The sensitivity of the technique is near absolute — described on the level between 96 to 100%. It means that PET/CT has a higher diagnostic value than bone scan (BS) or magnetic resonance. Oncological approach of this study focuses on the detection of metastases in bone tissue. The aim of the study was to compare the PET/CT(18F) NaF and bone scan in the diagnostics of bone metastases.
Material and methods: We 35 patients with one bone metastasis or with doubtful result of the bone scan were enrolled on the study. PET/CT studies were made on the Siemens Biograf LSO scanner 60 min after the iv. injection of the 6 MBq/kg (18F) NaF . The bone scans were made 3h after *iv.* injection of 740 MBq of the 99Tc MDP. The patient to patient and lesion to lesion assessment was performed.
Results: Lesions of high MDP uptake described as bone metastases were found in 18 patients on the bone scan and 35 patients on the PET/CT study. In the lesion to lesion analysis we found 27 metastatic lesions in the bone scans and 76 in the PET/CT studies.
Conclusion: Hybrid PET/CT was found to be the higher value than bone scans. There is a need to conduct a prospective study with histopathological comparison to assess the value of the PET/CT in the diagnostics of the ovarian cancer.

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THE VALUE OF THE PET/CT FDG IN THE DIAGNOSTICS OF OVARIAN CANCERS

J. Szefer, T. Pietrzak, V. Pankowska, B. Małkowski

Departament of Nuclear Medicine, Center of Oncology, Bydgoszcz, Poland

Background: The ovarian cancer almost always grows in insidious way and is diagnosed in such stage that enable us the effective surgical treatment. In patients with this kind of neoplasm, PET with [F-18] fluorodeoxyglucose (FDG) is both more sensitive and specific than CT, MR or Ca 125 marker level for detection of both metastases and recurrent neoplasm. This value should increase if we coregister PET and CT and next overlap (fuse) these images. In literature we have found only one study describing the value of combined PET/CT studies made by the use of FDG in cancers in this localization. The aim of the study was the retrospective assessment of the value of the PET/CT in the diagnostics of the ovary cancers.
Material and methods: In the time between March 2003 and December 2005, 126 studies were made to diagnose ovarian cancer'. We selected 97 studies in which we have full information about other imagining techniques such as CT, MR and Ca 125 marker level. These studies were included in the assessment. PET/CT studies were made on the Siemens Biograf LSO scanner according the typical PET protocol. We performed the assessment of the sensitivity and specificity of the particular methods of diagnostics.
Results: The sensitivity and specificity of the PET/CT were 98,41% and 97% respectively. Combined sensitivity and specificity of the CT and MR as well as Ca 125 marker level were 67.3%, 86.66% and 70.96%, 88.57% respectively.
Conclusion: Hybrid PET/CT was found to be the most sensitive and specific for detection of the ovarian cancer reaching 98.41% and 97% respectively. There is the a need to conduct the prospective study to assess the value of the PET/CT in the diagnostics of the ovarian cancer.

RADIOPHARMACY

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PET/CT IN RADIOTHERAPY PLANNING

K. Kobus-Błachnio, J. Armatys-Sowa, J. Szefer, T. Pietrzak,
V. Pankowska, B. Małkowski

Departament of Nuclear Medicine, Center of Oncology, Bydgoszcz, Poland

Background: Previous methods of the radiotherapy planning have based only on morphological imagining originating from computed tomography (CT) or magnetic resonance (MR) The lack of functional information have caused irradiation depended only on the thickness and density of the lesion. There are some premises in the literature that planning based on functional imagining can add some advantages. The aim of the study was work out the procedure of planning on the base of PET/CT study and compare them with based on CT.
Material and methods: The retrospective study which use the PET/CT and CT studies made for radiotherapy planning. 23 patients with non small cell carcinoma treated in the Centre of Oncology in Bydgoszcz were enrolled to the study. All patients had PET/CT and CT studies. PET/CT study was made after 60min of the iv. injection of the 5MBq/kg cc. (18F)FDG. PET and CT images were sent to the planning station Eclipse 7. PET and CT images were acquired on the base of common benchmarks DICOM ORIGIN. Tracing and planning of the radiotherapy was on the base of CT images on which PET images were applied. We determined the area of GTV.
Results: In 10 patients we achieved results concordant with the CT, in 8 patients the area was enlarged and in 5 diminish.
Conclusions: PET/CT contribute to the modification of the planning system changing in 56.5% of cases the area of radiotherapy. PET/CT delivering additional information about functional character of the proliferative process is the supplement to traditional system of planning in radiotherapy.

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RADIOCHEMICAL SYNTHESIS OF SODIUM FLUORIDE — NEW TRACER FOR BONE IMAGING

K. Kasprzak, A. Dąbkowski, Z. Zuchora, A. Kowalska, B. Kowal,
T. Pietrzak, K. Kobus-Błachnio, B. Małkowski

Departament of Nuclear Medicine, Center of Oncology, Bydgoszcz, Poland

Background: Fluoride 18F is taken up in bone in proportion to blood flow and bone metabolism activity. The fluoride ion becomes incorporated into bone as a result of ion exchange. It was known that (18F)NaF has the highest sensitivity in detecting bone metastases. In our department we have performed only FDG PET-CT studies so far. The aim of the study was to obtain the sodium fluoride (18F)NaF suitable for PET-CT diagnostics.
Material and methods: Enriched 18O water was irradiated with protons to form 18F via the reaction 18O(p,n)18F. The irradiated H2O was passed by a 18F separation cartridge. Fluoride was eluted from the cartridge with 3% NaCl solution. After that the product was thinned down with 9 ml of water.
Results: Finally the solution was collected, passed through a sterile filter (0.2 mm) and prepared for quality control procedures. We carried out: HPLC (0,1 M NaOH as a mobile phase, flow 1,0 ml/min, 18F RT 3.15 min), TLC (silica gel plate, methyl cyanide/water 9.5/0.5, RF of fluoride was 9 mm), pH was 7.5. Amount of fluoride per sample was 100%. Radiochemical yield was over 90%. LPS level < 0.125 EU/ml. Microbiological tests: direct culture — sterile.
Conclusion: Produced (18F)NaF can be used for PET-CT diagnostics.

RADIOPROTECTION

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DOSIMETRY IN DIAGNOSTIC NUCLEAR MEDICINE

J. Liniecki[1], M. Bieńkiewicz[2]

[1]Department of Nuclear Medicine, Central Clinical Hospital, Medical University of Lodz, Poland
[2]Department of Procedure Quality Control and Radiological Protection, Medical University of Lodz, Poland

Assessment of radiological risk is based on results of epidemiological studies of atomic bomb survivors, of patients exposed to ionizing radiation in course of diagnostics and radiotherapy, and those exposed while at work. The most important source of quantitative information on the risk is the follow up of about 120.000 individuals who survived the bomb explosions in Hiroshima and Nagasaki (Life Span Study). The latter study provided data on dose response relationship for radiation induced malignancies in various organs after approximately uniform and instantaneous irradiation of the whole body with gamma rays and neutrons.
In diagnostic nuclear medicine one deals with highly non-uniform irradiation of patients body and with low doses and dose rates. For evaluation of the risk of such an exposure the International Commission for Radiation Protection (ICRP) recommends the effective dose. This quantity takes account of varying sensitivity of individual organs and tissues to induction of stochastic effects of radiation and of different distribution of equivalent doses in parts and tissues of the body. For calculation of the effective dose several conditions must be met and informations secured. These are: shape and organ masses have to be approximated by three-dimensional phantoms, separately for several age categories. At present the phantoms are being used which approximate human organs by various geometric figures; there is also a highly advanced work progressing to use voxel phantoms of a standard male and female, obtained from tomographic 3-D reconstruction of the organs of human body.
A second prerequisite is the information, obtained experimentally, on kinetics of retention (in the whole body, individual organs, blood, a migration inside and excretion from the system via urinary and gastrointestinal track of administered activity of a nuclide (in form of a given radiopharmaceutical). In other words, there is the necessity to formulate a specific kinetic model for each radiopharmaceutical. One has also to take into account possible modifications in the normal kinetics by a disease. To obtain equivalent doses for individual organs one has to use contemporary dosimetric theory and procedures. They have to provide information on organ doses from activity contained in each of them but also from cross-fire irradiation of every one by all the remaining organs (MIRD procedures).
The permanent ICRP Task Group for doses to patients from radiopharmaceuticals (diagnostics) and individual authors have calculated so far effective doses per unit of activity administered for about 240 substances and for 5 age categories.
These data are average values for a typical standard individual representing both sexes. One should be aware of anatomical variations, characteristic for human population. In addition there is a pronounced individual variation in kinetics of radiopharmaceuticals, substantially deviating from parameters characterising the postulated model values. Thus, calculated effective doses and absorbed doses in specific organs after administration of a given activity of the selected substance yield information of substantial uncertainty. Moreover, the radiological risk is a function of the age of an individual. Thus, the final result — computed effective dose should be treated as an indicator of the order of value of the risk, and not as an accurate and precise information regarding dosimetry and magnitude of risk with one or two digits for a given patient. On the other hand, one should remember that individual radiopharmaceuticals and, therefore specific diagnostic procedures, might lead to widely differing doses and categories of the risk.
There will be presented estimations of effective dose for commonly used categories of diagnostic radiopharmaceuticals.

RADIOSYNOVIORTHESIS

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RADIATION SYNOVECTOMY WITH 90Y COLLOID IN THE THERAPY OF RECURRENT KNEE JOINT EFFUSIONS — EVALUATION OF THE PROCEDURE EFFICACY

B. Chrapko[1], R. Zwolak[2], R. Gołębiewska[1], A. Nocuń, M. Majdan[2], J. Zaorska-Rajca[1]

[1]Chair and Department of Nuclear Medicine, Skubiszewski Medical University of Lublin, Poland
[2]Chair and Department of Rheumatology and Connective Tissue Diseases, Skubiszewski Medical University of Lublin, Poland

Background: The purpose of this study was to assess the effectiveness of radiation synovectomy (RSV) in treatment of recurrent joint effusions, using Y-90 colloid in patients with rheumatoid arthritis (RA) and seronegative spondyloarthropaties (SPA).
Material and methods: The group of treated patient included 30 persons with RA and SPA (41 knee joints); 9 males and 21 females, aged 48 ± 10.6 years. Qualification for the treatment was based on subjective evaluation of pain (four degrees scale of joint pain) and clinical estimation (four degrees scale of joint effusion, stability and range of movement). Three-phase bone scintigraphy was also performed (BS3) after injection of 740 MBq MDP-99mTc. The serum levels of C-reactive protein (CRP) (using immunoturbidimetric method — normal value: 0–5 mg/l) and fibrinogen (with coagulometric method — normal value: 1.8–3.3 g/l) were estimated. During the procedure, evacuation of effusive fluid was followed by intra- articular injection of 185 MBq of Y-90 (CIS bio international) and triamcinolone. Biochemical analysis was repeated after 48 hours, 3 and 6 months, whereas BS3 was repeated after 6 months. Changes in the second phase of BS3 were assessed visually, using four degrees scale and in the third phase-semiquantitatively with J/B ratio, which was calculated by dividing mean counts per pixel in the knee joint region by mean counts per pixel in the distal part of the femoral shaft. 24 weeks after RSV, blood pool and metabolism of the treated joints were compared with the data obtained before the therapy. Evaluation of selected positive acute phase proteins was carried out before the therapy and 48 hours, 4 weeks, 24 weeks after.
Results: During observation after RSV, the knee effusion reappeared only in 4 joints in patients with RA (9.4% of treated joints), whereas in SPA relapse was not observed. Obtained the following mean levels of CRP (mg/l): before RSV-37.3 ± 44.7; after 48 hours — 26.8 ± 28.7, after 4 weeks — 16.8 ± 16.5, after 24 weeks — 18.5 ± 16.2. The mean levels of fibrinogen (g/l) were respectively: 5.2 ± 1.6; 4.4 ± 1.9; 4.7 ± 1.2; 4.7 ± 1.6. CRP level 4 and 24 weeks after RSV was significantly lower then before the therapy, whereas fibrinogen values before and after RSV were not different. Changes in blood pool before RSV — 3.4 ± 0.6; after the therapy — 2.00 ± 0.8 ($p < 0.001$). Changes in the third phase of BS3-J/B ratio- before RSV — 2.58 ± 08, after treatment — 2.09 ± 0.9 ($p < 0.05$).
Conclusion: RSV makes an effective method to treat recurrent effusions in patients with RA and SPA.

THYROID

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GRAVES' OPHTALMOPATHY AFTER RADIOIODINE TREATMENT — REVIEW OF EIGHT YEARS EXPERIENCE

M.H. Listewnik[1], B. Birkenfeld[1], G. Kulig[2], K. Pilarska[2]

[1]Department of Nuclear Medicine, Pomeranian Medical University, Szczecin, Poland
[2]Clinic of Endocrinology, Arterial Hypertension and Metabolic Diseases, Pomeranian Medical University, Szczecin, Poland

Background: The relationship between Graves' ophtalmopathy (GO) and radioactive iodine (RAI) treatment of Graves' disease is still a matter of controversy. The aim of the study is to establish the rate of this complication and analyse the factors which may interfere.
Material and methods: A retrospective analysis of patients data emphasising those with Graves' hyperthyroidism receiving RAI from 1998 to 2005 was done.
Results: The total number of 4059 patients were treated according to Marinelli«s formula with RAI. Among them 843 suffered from Graves' disease. After RAI 9 patients developed severe form of GO and were qualified for specific treatment at the department of endocrinology. The patients data are gathered in the table:

Patient number/ sex	AGE (years)	Thyroid Volume before RAI [ml]	AD (Gy)	Thyroid function one year after RAI	Time (years) interval between RAI and GO	IO/RE	IO/LE	Methyl-prednisolon (*i.v* pulses)	RTG therapy
1/F	51	89	300*	HYPO	8	7	6	IV courses	No
2/F	48	35	250	HYPER	1	8	4	V courses	Yes
3/F	70	140	200	HYPER	2	1	4	V courses	Yes
4/M	69	28	150	HYPO	4	4	5	I course	No
5/F	53	35	250	HYPO	2	2	2	III courses	Yes
6/F	53	10	150	HYPO	4	5	3	VI courses	Yes
7/F	63	35	200	HYPO	1	3	4	IV courses	Yes
8/M	57	25	120	E	1	0	3	No	Yes
9/F	50	25	120	HYPO	5/12	3	4	III courses	No

THV — thyroid volume; AD — absorbed dose; IO/RE — ophtalmopathy index according to Donaldson-R Eye; IO/LE — ophtalmopathy index according to Donaldson-L Eye; HYPER — persistent hyperthyroidism; E — normal thyroid status; HYPO — hypothyroidism; *the patient was given seven RIT doses ranged 150–300 Gy

Conclusion: RAI because of Graves' hyperthyroidism is given to nearly one hundred patients per year at our department but severe GO occurred only at about 1% of treated patients. According to our data GO is not so often encountered complication after RAI. Hypothyroidism after RAI may increase the GO rate.

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COMBINED RADIATION THERAPY FOR BONE METASTASES IN THYROID CANCER

N.I. Afanasyeva, G.V. Grushka, O.V. Muzhychuk, O.M. Astapieva

Grigoriev Institute for Radiology (Academy of Medical Sciences of Ukraine), Kharkiv, Ukraine, Kharkiv State Medical University, Ukraine

Distant metastases of thyroid carcinoma (TC) occur due to dissemination of cancer cells through the lymph and blood vessels. They develop in 10–15% of patients with differentiated thyroid carcinoma and are the main cause of death in cancer patients. Appearance of distant metastases depends on a number of factors, i.e. the age of the patients (chiefly in children and those over 45); small size tumors; invasive growth of the tumor outside the thyroid capsule; involvement of the sentinel lymph nodes; poor differentiation of the tumor; incomplete surgical removal of the tumor. Distant metastases mainly localize in the lungs and/or bones. In thyroid cancer patients with suspected bone metastases the latter are revealed radiologically on the primary examination (approximately in 95.9% of cases). In 25% of them, they are seen at body scan with I-131 on residual activities. Probability of visualization of iodine-positive bone metastases is higher at ablation of residual thyroid tissue. When the metastases are revealed by X-ray study, they cannot be treated using I-131, which emphasizes the necessity of other methods of treatment: surgery and distant radiation therapy. But due to multiple character of bone metastases surgery for these metastases is impossible. Within the period of 1999–2004 we studied 310 patients with differentiated TC aged 22–72 (of them 254 women and 56 men). Bone metastases were revealed in 15 (4.8%) patients, of them 13 women and 2 men aged 46–68. As to the stage of the tumor with bone metastases, the patients were grouped as follows: T1N0M0 — 1 (6.7%), T2-3N0M0 — 1 (6.7%), TxNxM0 — 4 (26.7%), T1-4N0-1M1 — 9 (60%) patients. Of the 15 patients with bone metastases, papillary cancer was verified in 5 (33.3%) patients, follicular in 5 (33.3%) papillary cancer follicular variant in 1 (6.7%), medullary in 4 (26.3%). Together with bone metastases, 5 (33.3%) had metastases to the lung parenchyma, both diffuse and solitary; 12 (80%) had metastases to sentinel and distant lymph nodes.
The presence of bone metastases was revealed using x-ray study and confirmed using bone scan with Tc-99m pyrophosphate. During the treatment the patients with bone metastases were administered 1480–14134 MBq of I-131. Of all patients with bone metastases, bone metastases accumulated I-131 only in 4 (19%) patients. Thus, treatment of TC with bone metastases only with I-131 did not produce a desirable analgesic effect as well as did not control the progress of metastasizing. Therefore, together with I-131 treatment the patients received P-32 (natrium phosphate) treatment. P-32 treatment was started not earlier then 4 months after treatment with I-131. P-32 was administered orally in 100 ml of 10% glycose solution on an empty stomach, 74–120 MBq pert treatment with 4–7-day intervals. Total P-32 activity during one course of treatment made up 296–444 MBq. Combination of radionuclide therapy with I-131 natrium iodide and P-32 natrium phosphate was given to 4 patients with papillary and follicular TC with bone metastases which did not accumulate I-131. Two of these patients had diffuse metastases to the lung parenchyma. The patients received 305-369 MBq of P-32. The radiation load on the red bone marrow was 1098–1328.4 mSv at oral P-32 administration, that on the body was 823.5–996.3 mSv. The signs of myelosuppression were not observed during the stay at the Institute. One patient had insignificant reduction of thrombocyte level up to 91.0 × 109/l and leucocyte level to 2.4 ō 109/l 2 month after the treatment. Three months after systemic radionuclide therapy the signs of inconsiderable myelosuppression disappeared. Pain syndrome disappeared 5–12 days after combination systemic radionuclide therapy, and the patients were able to care for themselves. Flash phenomenon was not seen. A positive feature of combination radionuclide therapy with I-131 natrium iodide and P-32 natrium phosphate together with treatment of bone metastases is possibility continue the treatment of metastases to the sentinel lymph nodes and lung parenchyma, which often accompany bone metastases. Observation of the patients for a year demonstrated that all the patients, which had received combination radionuclide therapy, were alive, pain syndrome was absent in two, in two this was moderate but better then the pain before the beginning of the treatment. All patients did not accumulate I-131 natrium iodide in the lymph nodes.
Combination systemic radionuclide therapy with I-131 natrium iodide and P-32 natrium phosphate in TC with metastases to the bones is a method of choice and allows to perform adequate treatment of the patients with a continuing process in the thyroid with metastatic involvement of the sentinel lymph nodes and lung parenchyma.

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RESULTS OF RADIOIODINE TREATMENT OF 317 PATIENTS WITH DISTANT METASTASES FROM DIFFERENTIATED THYROID CARCINOMA

O.A. Baranovsky, Z.A. Gedrevich, U.E. Demidchik

Therapy with I-131 is recognised as the most effective method for cure of differentiated cancer of the thyroid and indicated for ablation of thyroid or tumor remnants after surgery, palliative treatment of recurrences and lymph node or distance metastases. Metastases outside the neck occur in 10–15% of cases. The lungs and bones are the most frequent locations. Meta-stases in the brain, liver or skin tend to appear late in patients who already have multiple bone or lung metastases.
We assessed the results in 317 patients with distant metastases from differentiated thyroid carcinoma who were followed for up to 30 years (median 36 month) after the discovery of the metastases. For ablation of thyroid remnants 1 to 4 Gbq and for treatment of metastases 5 to 7.5 Gbq of I 131 are administered after withdrawn of T4 therapy approximately 4 weeks prior therapy. The site of metastases (lung or bone) was not a prognostic factor for survival after radioiodine treatment of metastases disease. Complete remission was achieved in 83 patients (28.18%), stable remission in 132 (41.6%), partial remission in 49 (15.45%).
Our results suggest that the aim of management should be to detect and treat metastases in patients with thyroid cancer as early as possible. In patients with distant metastases up to 50% of complete responses may be achieved with radioiodine treatment.

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WHAT FACTORS INFLUENCE OCCURRENCE OF HYPOTHYROIDISM AFTER 131I TOXIC ADENOMA (TA) TREATMENT?

M.H. Listewnik, B. Birkenfeld, B. Elbl, D. Kosińska, B. Zaborek

Department of Nuclear Medicine, Pomeranian Medical University, Szczecin, Poland

Background: Hypothyreosis (HYPO) after 131I treatment of toxic adenoma (TA) happens but its rate may be as low as possible if calculation is precise. The aim was to establish the relationship between post 131I treatment hypothyreosis, toxic adenoma volume (TAV) and thyroid volume (THV) and absorbed dose (AD).
Material and methods: Group of 88 patients (78 F, 10 M; aged 63.4 ± 11.0; range 34–81 were treated with 131I. Doses were calculated according to Marinelli formula by four different doctors at the department of nuclear medicine. For 131I dose calculation TAV was taken from planimetry or sonography. Planned arbitrary absorbed dose (AD) for hot nodule was between 350–500 Gy. Patients were followed up for three years. Additional retrospective recalculation was done after this time. TAV, THV and "real" absorbed dose were recalculated on the basis of more accurate nodule volume taken from sonography. Statistical analysis was employed.
Results: Recalculated TAV before 131I ranged 0.4–68 ml (11.83 ± 15.67) and THV before 131I ranged 8–73 ml (28 ± 16). Recalculated AD for TA ranged 174–1511 Gy (486 ± 162 Gy) and for THV 78–682 Gy (270 ± 122 Gy). Overall outcome of the treatment was: persistent hyperthyroidism (PH) in 6 (6.82%) patients, normal thyroid status (E) in 55 (62.5%), hypothyroidism (HYPO) in 27 (30.68%) patients. The main factors influencing the occurrence of HYPO revealed to be: TAV and THV ($p = 0.0282$ and 0.008 respectively) — in HYPO patients were smaller; 24 hrs uptake ($p = 0.07$) in HYPO patients was higher; AD for THV — if AD was more than 350 Gy, the probability of hypothyroidism was statistically higher ($p = 0.0127$). Age, 131I effective half time, AD for the TA, ratio TAV/THV had no influence on the three years overall outcome.
Conclusion: 1. Presented results revealed that occurrence of HYPO after 131I treatment of TA depends on AD for the THV. 2. If AD for THV is higher then 350 Gy the probability of HYPO is statistically significant.

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THE EFFECT OF RADIOIODINE THERAPY OF 420 PATIENTS WITH SUBCLINICAL HYPERTHYROIDISM

S. Abdelazek, F. Rogowski, P. Szumowski, A. Sawicka, A. Parfieńczyk, B. Kiersznowska-Rogowska, A. Zonenberg

Departments of Nuclear Medicine and Endocrinology, Medical University of Bialystok, Poland

Background: Subclinical hyperthyroidism is a state of increased thyroid function with few or no clinical definitive signs or symptoms of hyperthyroidism, characterised by a decrease of serum thyrotropin (TSH) concentration below 0.1 mU/L, when serum levels of total and free thyroxin and triiodothyronin concentration are within normal reference ranges. The incidence ranges between 0.2% and 11.3%. The clinical diagnosis of subclinical hyperthyroidism is very difficult in the absence of the typical symptoms of hyperthyroidism therefore the use of radioisotope scan is important to confirm the provisional diagnosis. There is no strategy for the management of subclinical hyperthyroidism in Polish literature. The aim of our study was to evaluate the influence of radioiodine therapy on the achievement of euthyroidism, and prevention of progression to hyperthyroidism.
Material and methods: We treated 420 patients with subclinical hyperthyroidism, (84%) of the studied groups was female and (16%) male; 160 with toxic multinodular goitre(MNG), and 260 with autonomous nodule (ATN).
Qualification of these patients was based on clinical features, normal levels of serum fT3 and fT4, low levels of serum TSH (RIA and IRMA methods) and characteristic appearance on thyroid scans and ultrasound. Most of the patients didn't not treate with antithyroid drugs (360 patients), Some of patients were treated with antithyroid drugs for 6 to 24 months before radioiodine therapy (60 patients). Malignant changes were excluded in all nodules by fine needle aspiration biopsy. All the patient had serum TSH levels less than 0.1 mU/l and effective T-half of 131I measured by the use of T24 and T48 was more than 3 days at the time of treatment. The therapeutic activity was calculated by the use of Marinelli's formula. The absorbed dose (Gy) for MNG ranged between 150 and 260, and for ATN: 200–300 and was proportional to thyroid volume. Follow up control was done every 6 weeks. Repeated radioiodine therapy if indicated was given after 6 months of the first dose.
Results: In general the success of treatment was: 99% of patient with ATN and 92% of patient with MNG achieved euthyroidism. 1% of patient with ATN and 7% of patient with MNG develop hypothyroidism. In all of the patients the symptoms and signs of subclinical hyperthyroidism disappeared (palpitation, tachycardia, atrial fibrillation relieved, exercise tolerance improved, the blood pressure normalized and the quality of life improved). 1% of patient had persistent or relapse of hyperthyroidism.
Conclusions: Our results are good in comparison to those from the existing literature in this field. It was due to well preparation of the patients; accurate measurement of administered activity, effective half-life, and well-organised follow up. We recommend good co-operation of the patient to come for follow up visit in our department after 5 and 10 years of therapy to evaluate the long term effect of 131I therapy.

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USE OF ^{99m}TC-LABELLED $_D$GLU-OCTAGASTRIN IN THE DETECTION OF CHOLECYSTOKININE-2/GASTRIN RECEPTORS IN MEDULLARY THYROID CARCINOMA

J. Kosowicz, R. Czepczyński, K. Ziemnicka, M. Gryczyńska, J. Sowiński

Department of Endocrinology and Metabolism, Poznan University of Medical Sciences, Poznań

Background: Medullary thyroid carcinoma (MTC) presents with overexpression of somatostatin, cholecystokinine-2/gastrin and calcitonin receptors. Previous attempts of the use of ^{131}I-gastrin and ^{111}In-minigastrin in diagnosis and therapy of MTC were not satisfying due to the lack of internalization of these tracers and their nefrotoxicity. Therefore, the aim of our study was to evaluate a new analogue, octapeptide $_D$Glu-octagastrin, that in experimental studies has shown the best characteristics among 11 gastrin analogues but it has not been used in clinical practice in patients with MTC.
Material and methods: HYNIC-$_D$Glu-octagastrin was purchased from piCHEM (Graz, Austria), ^{99m}Tc generator from Amersham Health, The coligands (tricine and EDDA) as well as other reagents were purchased from SIGMA. Biological tests performed on Balb/c mice were performed in the Department of Toxicology. Clinical investigations were performed in 20 patients with MTC. The diagnosis was confirmed by histopathological examination of the tumour and by the elevated plasma levels of calcitonin. Whole body scintigraphy, as well as SPECT of head, neck and chest were performed using Varicam (Elscint) gamma camera after intravenous injection of 15–20 mCi ^{99m}Tc-HYNIC-octagastrin.
Results: The use of coligands, EDDA and tricine allowed the synthesis of ^{99m}Tc--HYNIC-ocagastrin with high specific activity and high radiochemical purity, confirmed by thin layer and fluid chromatography on SepPack minicolumns. Biological test on mice proved safety of the use of octagastrin since 10–50-fold higher doses than those used in human subjects caused no adverse reations. Scintigraphy using labelled octagastrin in patients with MTC detected CCK-2/gastrin receptors in the MTC tumours and metastases in half of the patients.
Conclusions: Detection of the CCK-2/gastrin receptors using the scintigraphic method with $_D$Glu-octagastrin shows possibility of the use of this analogue labelled with beta-emitters (^{177}Lu and ^{90}Y) or alpha-emitters (^{211}At i ^{225}Ac) in peptide receptor--targetted radionuclide therapy in patient with medullary thyroid carcinoma.

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COMPARISON OF SCINTIGRAPHY USING ^{99M}TC-HYNIC-TOC AND ^{99M}TC(V)-DMSA IN THE DIAGNOSIS OF MEDULLARY THYROID CARCINOMA

R. Czepczyński[1], J. Kosowicz[1], R. Mikołajczak[2], K. Ziemnicka[1], M. Gryczyńska[1], J. Sowiński[2]

[1]Department of Endocrinology and Metabolism, Poznan University of Medical Sciences, Poznan, Poland
[2]Radioisotope Research Centre POLATOM, Otwock-Świerk, Poland

Background: Scintigraphy with the use of labelled peptides is one of the basic imaging method in the diagnosis of neuroendocrine tumours. In several ongoing studies ^{99m}Tc-labelled somatostatin analogues (f.i.^{99m}Tc-HYNIC-TOC), are used in place of ^{111}In-labelled octreotide that might improve image quality, shorten the time of the investigation, minimize the radiation dose, as well as reduce the costs of imaging. Another older and inexpensive agent used in the diagnosis of medullary thyroid carcinoma (MTC) is ^{99m}Tc(V)-DMSA. Aim of this study was to compare the scintigraphy using ^{99m}Tc-HYNIC-TOC and ^{99m}Tc(V)-DMSA in patients with MTC at different stages of the disease.
Material and methods: 17 patients (11 women and 6 men) aged 22–83 years (median 53 yrs.) with MTC 3 months — 6 years after thyroidectomy were included in the study. All patients had increased calcitonin concentrations at baseline after pentagastrin stimulation and/or elevated plasma level of CEA.
Both radiopharmaceuticals were developed and produced by Radioisotope Research Centre Polatom. Scintigraphy using ^{99m}Tc-HYNIC-TOC and using ^{99m}Tc(V)--DMSA was performed 2 and 4 h after injection (activity 20 mCi/740 MBq) on two seperate days. Each image acquisition consisted of anterior and posterior whole body scans as well as the scan of head, neck and chest. All images were acquired by Varicam (Elscint) double-head gamma camera. Any focal activity above the background level was treated as a pathological focus.
Results: Scintigraphy using ^{99m}Tc-HYNIC-TOC detected pathological foci in 13 patients, and it was negative in 4 (sensitivity 76.4%). Scintigraphy with ^{99m}Tc(V)-DMSA was positive in 10 cases and negative in 7 (sensitivity 58.8%). Only in one patients none of the methods was positive. In six cases of negative scan using ^{99m}Tc(V)--DMSA the scintigraphy using ^{99m}Tc-HYNIC-TOC showed increased uptake in supraclavicular and mediastinal lymph nodes. In three cases of negative ^{99m}Tc-HYNIC--TOC scan, the other method showed pathological uptake in mediastinal lymph nodes. Among 7 patients with both positive scans following pattern was found: a) similar images in both methods in 3 patients, b) different localisation of foci in 1 patient, c) higher number of foci detected at ^{99m}Tc-HYNIC-TOC scans in 2 cases, d) higher number of foci detected with ^{99m}Tc(V)-DMSA scintigraphy in 1 case.
Conclusions: Both scintigraphic methods are useful in the diagnosis of MTC. Although the scintigraphy using ^{99m}Tc-HYNIC-TOC appears to be more sensitive than ^{99m}Tc(V)-DMSA, both methods are complementary.