asking a detailed information as to the use of radiopharmaceuticals and radiation protection equipment. All 45 completed questionnaires and answers to supplementary enquires were analyzed. Results. Replies ranged over the following topics: administered radiopharmaceuticals for diagnostics and therapy and their activities, preparation, storage and dispensing of radiopharmaceuticals, types of dispensing cabinets, location of scintillation cameras and lead glass observation windows, shielding of a patient bed in the imaging room, shielded waste containers, rotation of staff members and others. Concerning the particular items of protection equipment (tongs, lead containers, vial and syringe shields, syringe carriers, moveable lead shields, waste shielded containers, eye protection, lead aprons etc.) this information was evaluated: the extent to which protective tools were used, their purpose and origin (commercial or home-made), approximate design etc. The effectiveness of syringe shields, lead aprons and movable lead glass screens in reducing exposure of workers were assessed in detail. Conclusion. Results of the extensive survey confirm a fairly good quality of radiation protection in nuclear medicine in our country. The acquaintance of departments with some shortcomings found is believed to stimulate nuclear medicine workers to continue improving local radiation protection in compliance with legislative requirements.

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Individual Dosimetry in a PET Unit

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Aim The aim of this study is to demonstrate that all the people working in the PET Unit are in good safety and radiation protection conditions against ionizing radiation. Method The doses (fingers and hands) of the personnel are investigated using thermoluminous material. One dosimeter is around the wrist and the other is used as a ring in the right hand. All the professionals who work in this unit are monitored with the ring. The physicians and the technicians with the two types of dosimeters. The physicist only with the ring dosimeter. The measurements are made once a month. Results The absorbed dose values in the hands and fingers, are between 0,2 mSv/year and 2,9 mSv/year for hands and between 0,09 mSv/year and 5,5 mSv/year for fingers, for the physicians, technicians and the physicist. Conclusions The recommended dose limits for effective and equivalent doses for hands and feet, for occupational exposure are: 500 mSv/year to the hands and feet and 500 mSv/year to the skin. The effective dose (H) to an individual is found by calculating a weighted average of the equivalent dose to different body tissues, with the weighting factors (W) designed to reflect the different radiosensitivities of the tissues:$H = \sum i\ Ei\ Wi$ The equivalent dose (HT) is a measure of the radiation dose to tissue where an attempt has been made to allow for the different relative biological effect of different types of ionizing radiation. Equivalent dose (E) is calculated by multiplying the absorbed dose (D) with the evaluation factor. The radiation weighting factor (wR) should be used as the evaluation factor. It is calculated by multiplying the quality factor Q and the modified factor N. The equivalent dose is thus calculated by the equation: $HT,R = WR\ DT,R$ as where DT,R is the averaged absorbed dose in the tissue or organ T as a result of radiation R. We evaluate the results of the last 3 years (2003, 2004 and 2005) in terms of equivalent doses. Those results are far below the legal established limits. We can conclude that the work inside the PET Unit in good conditions of safety and protection against ionizing radiation.

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Radiation exposure of nuclear medicine workers in the Czech Republic in 2003 and its relation to various factors - results of questionnaire survey I

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Aim. To give a review of radiation exposure of 826 workers at 45 departments performing nuclear medicine procedures in vivo in 2003 and to present results of the study of some factors which can influence it. Method. Data from the SONS Central Registration System of occupational radiation exposure and the results of questionnaire were used. The questionnaire sent to all departments asked an additional information as to division of workers into professional groups, total activity of radiopharmaceuticals handled in 2003, number of examinations in vivo, staff rotation and others. Results. The mean personal annual effective dose E calculated on the basis of equivalent dose measured by film dosimeters was found to be 1.12 mSv. In groups the mean E were: physicians 0.98 mSv, staff preparing radiopharmaceuticals 1.2 mSv, ambulatory staff 1.44 mSv, in vitro staff 0.35 mSv, ward nurses 0.83 mSv, physicists 0.51 mSv and assistant staff 0.62 mSv. Mean annual hand dose measured by ring thermoluminiscent dosimeters was evaluated in three groups: radiopharmacy staff 25.4 mSv, physicians 4.73 mSv and ambulatory staff 6.43 mSv. Unfortunately, practically no correlation was found between personal effective dose, total activity of radiopharmaceuticals, number of examinations in vivo etc. Several causes of this finding will be discussed, obviously the most important factor affecting it being the frequent rotation of workers doing highly exposed procedures. Conclusion. Relatively low occupational radiation exposure which is far below radiation limits and somewhat lower than in other countries indicates the appropriate use of radiation protection methods including the extensive employment of available protective tools. Ways are investigated how to decrease large differences in the mean personal effective dose E varying by a factor as large as 8 among departments.

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Cat brain perfusion with a multi-pinhole SPECT imaging system.

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Purpose: HiSPECT is a small animal SPECT system. The system consists of pinhole apertures fixed on a multi-detector gamma camera. Normally this system and other micro-SPECT systems are used for mouse and rat studies. We tested the system on the brain of a middle-sized animal like the cat.Methods: Pinholes with 6 apertures of 2.5 mm inner diameter each designed for rat studies (Bioscan Inc.) were mounted on a Trionix triple-head gamma camera. A Jaszczak phantom with hot rods ranging from 2.0 mm to 2.5 mm was scanned at varying detector radius from 180 mm to 220 mm. Cat brains were scanned at a radius of 199 mm. This radius is about 30 mm larger than a typical rat scan. Images are reconstructed using a dedicated OSEM algorithm (Scivis GmbH).Results: The 2.0 mm rods of the phantom are clearly separated at a radius of 180 mm. The resolution loss was about 0.1 mm per 10 mm radius increase. The resolution of the cat brain scan can be estimated at 2.2 mm. The quality of the cat brain scan is at least equal to the perfusion SPECT of humans using fanbeam collimators. The different cortical areas can be discriminated and semi-quantification of the regional activity is possible.Conclusions: This system allows diagnostic brain perfusion imaging of the cat brain. This small animal SPECT system can be used to evaluate the cat brain for research purposes.

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Pinhole scintigraphy using 99mTc tetrofosmin in mice: timing of VEGF Expression for the formation of Stable and Mature Blood Vessels .

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Aim Aim of this study was to determine the functional capability of the newly formed vessels and to assess the kinetics of the angiogenic response by determining the optimal duration of the VEGF stimulus required to promote functional vessel formation in mice using Pinhole scintigraphy with 99mTc tetrofosmin. Methods and matherials To assess the kinetics of the angiogenic response and to ascertain the optimal duration of the VEGF stimulus required to promote functional vessel formation, we have constructed novel AAV vectors in which the VEGF165 gene expression is regulated by an inducible Tet-On system . The vectors were delivered to the tibialis anterior muscles in mice. Expression of the VEGF mRNA in vivo was stimulated by administration of doxycycline in the animals drinking water. In order to determine the functional capability of the newly formed vessels, we performed static scintigraphy by using a gamma camera equipped with pinhole collimator (Siemens Ecam), after 30 days of VEGF expression and after withdrawing the doxycycline for 15 days. At both time points functional images of the mice legs were acquired by injection of 3.7mBq of 99mTc Tetrofosmin in basal condition and 37MBq after 10minutes of hind-limb muscle contraction, to resemble physiological exercise. Moreover we performed confocal microscopy analysis by injection of fluorescent lectins. Results Qualitative and semiquantitative analysis of activity distribution of 99mTc Tetrofosmin showed after muscle contraction a worsening of muscle perfusion in the treated leg after 30 days of VEGF stimulus. After switching off VEGF expression, the perfusion in the treated leg increased significantly after exercise. The injection of fluorescent lectins followed by confocal microscopy analysis confirmed remarkably increased leakiness after one month of continuous VEGF expression, and revealed the formation of large cloud-like arteries surrounding the skeletal muscle fibers. Following the cessation of the VEGF stimulus, the number of vessels remained stable, while normal structure and permeability was restored. Conclusion Our results clearly indicate that functional blood vessel formation requires appropriate duration of the VEGF stimulus, which should be longer that 30 days, but not indefinite. Pinhole scintigraphy 99mTc tetrofosmin seems to be an appropriate tool to demonstrate the functional proper timing of VEGF expression. Moreover scintigraphy analysis allows to investigate physiology variation during prospective research.

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Determining viability of demineralised bone matrix and autogenous bone grafts in early stages by three phase bone scintigraphy

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Aim: Demineralized Bone Matrix (DBM) is a product, which has been developed to improve incorporation and formation of new bones. Here, in this study, we aimed to identify whether autogenous bone graft or DBM is better for early bone formation.Materials and Methods: One squarecentimeter sized and 1 mm depth bone defects were made on parietal bones in 12 one year old rabbits (*Oryctolagus Cuniculus L.*). Autogenous bone grafts taken from right parietal were placed on contralateral defects. DBM was placed to right side defects and defects were surgically closed. Two weeks later, 3-Phase Bone Scintigraphies by using pinhole collimators were performed after iv injection of 20 mCi Tc99m-HDP under general anesthesia. Early blood flow, blood pool and late static images were evaluated visually and quantitatively.Results: Parietal regions were evaluated both visually and quantitatively. Blood flow and blood pool patterns were similar for all rabbits and relatively increased flow and hypermia were determined in right regions with DBM. When late static images were evaluated, increased osteoblastic radioactivity accumulation on DBM placed sides were more impressive. Quantitative analysis was applied on bilateral parietal and occipital Region of Interests (ROI). Left parietal ROI/right parietal ROI were found to be 0.81±0.12. Left parietal ROI/occipital ROI was 0.62±0.10 and right parietal ROI/occipital ROI was 76±0.10. Paired Samples Test determined a difference of 0.14 (min: 0.10, max: 0.18 at 95% confidence interval), ($t=7.302$ and $p < 0.0001$) between correlations for right parietal ROI/occipital ROI and left parietal ROI/right parietal rates.Conclusions: DBM, which actively induces bone development was found to be more effective than autogenous grafts for early bone formation. However, more research on this subject still needed to be carried out in future.