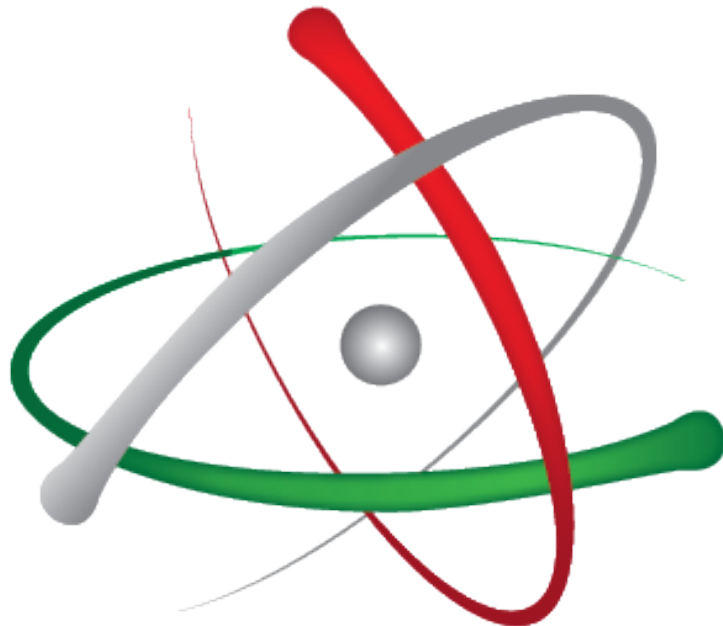


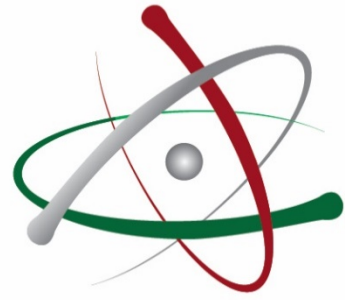
6th Balkan Congress of 2017 Nuclear Medicine

APRIL 20-23, SOFIA, BULGARIA



*Targeting disease through
science and technology*

6th Balkan Congress of
2017 Nuclear Medicine
April 20-23, Hilton Hotel, Sofia



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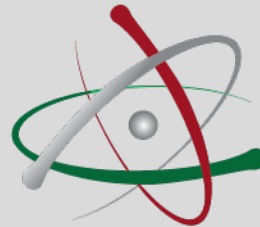
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INVITED LECTURES

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IMAGING IN CHILDREN WITH URINARY TRACT INFECTION

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Urinary tract infection (UTI) is common in childhood, and most children recover without complications. Use of imaging to check for abnormalities or complications therefore needs to be targeted carefully.

Because a renal ultrasound (US) is noninvasive and may give supplemental information about a child's risk for lower tract infections by showing bladder abnormalities, a renal US should be initially ordered study in children with UTI.

Obtaining a voiding cystourethrogram (VCUG) with first UTI in all male patients, females younger than 3 years, children clinically suspected of having pyelonephritis, and those with US abnormalities has been recommended ("bottom-up" approach).

Because of the risks and cost of the VCUG test, as well as its low yield (<10%) for clinically significant (ie, high-grade) VUR, many have advocated obtaining VCUGs selectively. Another approach to imaging is the so-called "top-down" approach, where cortical renal scintigraphy (CRS) is obtained after initially US.

Advocates of this approach cite that it focuses on identification of renal scarring, the long-term adverse effect that we are hoping to avoid, regardless of whether reflux is present or not. A normal CRS allows to safely dismiss the child without programming further investigation(s) as outpatient. On the contrary, in case of true acute pyelonephritis, investigation for VUR can be scheduled without waiting for a relapse. A first paper lends further support to this approach. Suson & Mathews 2014., retrospectively analysing the clinical application of the American Academy of Pediatrics guidelines to a population of children with the first episode of febrile-UTI, found that one third of those with abnormal renal scan has a normal US and 62% had an undiagnosed grade 3 or more VUR.



PRACTICAL APPROACHES TO ESTIMATE PATIENT DOSES FROM HYBRID IMAGING IN NUCLEAR MEDICINE

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Introduction

The first hybrid single photon emission computed tomography/computed tomography (SPECT/CT) system appeared on the market in 1999 and the first positron emission tomography/computed tomography (PET/CT) commercial system was released in 2001. This kind of equipment delivers high doses to patients due to the use of X-rays from the CT, and gamma or annihilation radiation from the SPECT/PET part of the system. Consecutively the estimation of patient exposures is important for the clinical practice. Such estimations may be used for optimization purposes and elaboration of diagnostic reference levels (DRL). Measurable quantities, like mean activity administered, computed tomography dose index (CTDI) and dose-length product (DLP) are used for that purpose. For risk estimations and for comparison of the contribution of different imaging techniques like SPECT/PET and CT to the overall exposure, the quantity effective dose is used.

Aim and topics to be presented

The aim is to discuss simple approaches to calculate patient exposures from hybrid imaging techniques in Nuclear Medicine. The Medical Internal Radiation Dose (MIRD) Committee of the Society of Nuclear Medicine and Molecular Imaging and the International Commission on Radiological Protection (ICRP) provide generalized schema for calculation of patient doses from internal exposure. Some ICRP publications provide biokinetic and dosimetric data on radiopharmaceuticals used in clinical practice, as well as organ absorbed dose and effective dose per unit activity administered, for different age groups. These data can be applied on averaged administered activities per groups of patients with mean weights, for a particular examination, in order to calculate the typical mean effective dose delivered by the radiopharmaceutical. For calculation of the CT contribution to the total patient exposure, conversion coefficients from DLP to effective dose for standard examined body regions are provided in the literature. This is not always feasible in Nuclear Medicine, as different anatomical regions may be scanned for the same type of examination. Software packages are available for more precise CT dose estimations.

Conclusions

Patient dose calculations, dosimetric comparisons between hospitals performing the same types of examinations, and elaboration of DRL, are important tools for optimization of clinical practice. It has been proven that the implementation of these instruments led to decrease of medical exposure of the population.



EVALUATION OF QUANTITATIVE SCINTIGRAPHIC PARAMETERS FOR ACUTE RENAL ALLOGRAFT DYSFUNCTION

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Renal transplantation is the ultimate treatment for chronic renal failure. Renal allograft functions in the early postoperative period and long-term graft survival are affected by several factors. These factors include cold ischemia time, the process of rejection, living/deceased-donor transplants, and properties of recipients/donors such as age, gender, and race. In the early postoperative period, the most common causes of deteriorated renal function are acute tubular necrosis (ATN) and acute allograft rejection (AR). By early diagnosis and treatment of the functional disorders that shorten the life of grafts after kidney transplantation, the progression of acute dysfunctions to the chronic stage can be prevented or delayed. Serial renal transplant scintigraphic images after surgery give crucial quantitative information which play very significant role in evaluation of renal allograft functions early after transplantation. Monitoring the long-term outcomes is also possible.

The scintigraphic findings of ATN are normal or slightly reduced perfusion with a delayed uptake and excretion, besides cortical retention at the end of the imaging. However in AR, reduced perfusion, decreased extraction and delayed excretion are demonstrated in renography. Technetium (Tc)-99m mercaptoacetyltriglycine (MAG3) which is excreted by tubular secretion and Tc-99m diethylenetriamine pentaacetic acid (DTPA) which is excreted by glomerular filtration, are the most common agents used for renal allograft scintigraphy. DTPA was found to be to be more sensitive than MAG3 when perfusion and parenchymal function parameters have to be assessed together in early diagnosis of renal allograft dysfunction. However, MAG3 has been reported to be a more suitable choice in those with weak renal function due to its high renal extraction. The treatment protocol can be determined by comparing the serial scintigraphic images of the renal allograft.

Newer agents and methods are also under investigation. Tc-99m labelled anti-CD3 monoclonal antibody has been used for the imaging of AR. Positron emission tomography (PET) tracers such as ¹³N-ammonia and hydrogen-2 oxygen-15 (H₂[¹⁵O]) are being studied for their use in local renal blood flow mapping in renal transplant grafts and in evaluation of local blood flow response to drug treatment.



THE ROLE OF VENTILATION/PERFUSION TOMOGRAPHY IN DETECTION OF CARDIOPULMONARY DISEASES

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The objective

Pulmonary embolism (PE) can only be diagnosed with imaging techniques, which in practice is performed using ventilation/perfusion scintigraphy (V/P scintigraphy), or multi-detector computed tomography of the pulmonary arteries (MDCT). V/P scintigraphy for diagnosis of PE is universally available but imaging protocols and interpretative strategies show large variation. Unfortunately, the large Prospective Investigation of Pulmonary Embolism Diagnosis (PIOPED I) showed a high number of non-diagnostic examinations (65%) due to the not standardized method, the stiff and probabilistic interpretation criteria that were confusing to the clinicians. Bajc et al. validated ventilation/perfusion single photon emission tomography (V/P SPECT) for diagnosis of PE on pigs, and showed the superior value of V/P SPECT over V/P planar imaging. Clinical studies showed similar results as validated on pigs by many authors (Bajc et al, Reinartz et al. Gutte et al. Quirice et al.). Latest study by Gruning et al. also confirmed high sensitivity of V/P SPECT of 95.7%, specificity 98.6%, positive predictive value 95.7%, negative predictive value 98.6% on about 2000 examinations. V/P SPECT images have documented value also over CT. The PIOPED II study showed sensitivity of MDCT for PE of only 78% and high proportion of false positive study (45%) in patients with low clinical probability.

The strength of V/P SPECT is in the new interpretation criteria with clear answer to the clinicians regarding PE. To be clinically useful, interpretation of an imaging test should be affirmative or negative with respect to PE (PE: yes or no) and should not be based on probability categories. European Nuclear Medicine Guidelines recommend V/P SPECT as a first choice method for diagnosis of PE and follow-up, due to the high negative predictive value, high sensitivity and specificity, feasibility in almost all patients and low radiation exposure.

Results and conclusion

V/P SPECT allows also quantification of the PE extent which might be used to personalize treatment such as outpatient and inpatient treatment. Furthermore, Begic et al. showed that significant resolution of mismatched perfusion defects occurred between V/P SPECT controls within the first 3 months of anticoagulation ($p < 0.001$) but not thereafter. It is therefore recommended that V/P SPECT follow-up should be considered at 3 months after diagnosis. The authors recently reported that tailoring anticoagulant treatment is feasible by incorporating V/P SPECT in the clinical decision tree. Latest study by Begic et al. shows high prevalence of other cardiopulmonary diseases among patients suspected with PE that might be identified by V/P SPECT. V/P SPECT additional findings can clarify patients symptoms and might have impact on treatment. The result of V/P SPECT findings had influence on treatment patients with pneumonia, COPD, in new diagnosed patients with left heart failure.



PET BRAIN IMAGING: DEMENTIA, EPILEPSY, NEOPLASM

Gunnalp B.

ANKARA

Functional and molecular imaging of brain with newly developed PET ligands provides important information on major histopathologic hallmarks of different types of dementia, degenerative and movement disorders. PET functional anatomy, stereotaxic alignment, statistical comparison with normal population and PET findings with different types of dementia will be discussed. Inter-ictal epileptic foci detection with FDG PET and brain tumor imaging with radiolabeled amino acids [¹¹C methyl-L-methionine (MET)] and cellular proliferation agents [¹⁸F-Fluorothymidine (FLT)] will be presented in this lecture.



MYOCARDIAL VIABILITY TESTING: SQUABBLES AND CONTROVERSIES

Bharadwaj P.

SINGAPORE

Although therapeutic options have vastly increased and improved in quality over years, the morbidity and mortality of ischemic left ventricular (LV) dysfunction remain high. When there is no angina, the merit of surgical revascularization over medical therapy has been a case for debate. Nonrandomized studies performed more than 2 decades ago suggested that performing coronary artery bypass graft (CABG) in moderate-to-severe ischemic LV systolic dysfunction may improve outcome, but the results were offset by limitations in study design and the high risks of procedures prevalent at that time. Optimal treatment strategy remained uncertain in these patients which provided the rationale for viability testing.

The concepts of myocardial viability and viability testing are scientific but there are controversies with definitions of viability and hibernation. Although evidence from many nonrandomized studies has demonstrated its (viability testing) usefulness, there has no randomized controlled studies in this area until the publication of STICH (Surgical Treatment for Ischemic Heart Failure) trial. However, after the publication of STICH and its viability sub-study, questions were raised regarding the utility of viability testing in patients with ischemic LV dysfunction prior to revascularization. There are many controversies related to the definition of viability in the study itself. There are several methodological issues with regard to performance and interpretation of nuclear studies for viability assessment in general. Whether perfusion or both perfusion and metabolism need to be tested, whether a stress perfusion scan is essential, whether nitrate enhancement is mandatory before resting studies or whether a euglycemic clamp provides the best metabolic images in diabetic patients, are some of the uncertain areas in methodology. Interpretation of images have generated substantial controversies and uncertainties which includes whether we look at the amount of viability or scar or both, whether reversible ischemia is important and how much viability is enough to justify revascularization. An outline of the above issues are highlighted in this talk



FDG PET/CT IN CARDIAC MALIGNANCIES – DO WE NEED ANOTHER IMAGING MODALITY?

Bochev P.

CLINIC OF NUCLEAR MEDICINE, ST MARINA HOSPITAL, VARNA

Heart tumors are a rare and exotic pathology, infrequently diagnosed in everyday routine, which results in an even lower recognition rate and in most of the cases – delayed treatment if ever possible. Though primary cardiac tumors are indeed a rare entity, seen in less than 0.1% in post-mortem series, heart metastases appear not to be that uncommon, reaching in autopsy series up to 10% in cancer patients. Benign primary cardiac tumors are by far dominated by myxomas, while malignant primary cardiac tumors are mostly leiomyosarcomas and angiosarcomas. Metastatic involvement of the heart is most frequently seen in lung and breast cancer (lymphatic or direct spread to pericardium) in melanomas and sarcomas (hematogenous spread, myocardium), renal cell carcinoma (embolism through cava vein) and lymphomas.

Diagnosis of heart malignancies is difficult; because of non-specific clinical presentation and complicated morphological conformation. Imaging includes Echocardiography, CECT, cardiac MRI. The role of PET CT is addressed in the literature in very few case series focusing mostly in differential diagnosis of benign from malignant heart tumors (with the awareness that most of cardiac masses are thrombi) and staging of proven primary cardiac malignancies. With the emerging role of FDG PET in oncology it becomes more and more evident that secondary heart malignancies are not that rare but rather heavily overlooked by conventional imaging. Since very few of secondary cardiac tumors are eligible to curative surgery there should be awareness among nuclear medicine physicians that this pathology exist, in order to recognize those particular patients, candidates for curative intent treatment.



GUIDED INTRAOPERATIVE SCINTIGRAPHIC TUMOR TARGETING (GOSTT)

BOZKURT M.

ANKARA

Intraoperative nuclear medicine techniques are widely used in recent years especially in the field of oncology surgical applications. At the beginning of these techniques there is the detection of sentinel lymph nodes. The sentinel lymph node concept, which means the lymph node which first drains the tumor, allows the understanding of whether the entire lymphatic bed is invaded by the tumor due to the dissection of one or several lymph nodes, thereby significantly reducing unnecessary large surgical applications and significantly reducing surgical morbidity and mortality. The concept of sentinel lymph node is now routinely applied to cutaneous tumors, especially head and neck tumors and gynecologic tumors, especially breast cancer, malignant melanoma.

In this technique, radioactive agents are injected colloiddally from tumor skin or subcutaneous tissue and lymphatic mapping of the tumor is done scintigraphically under gamma camera. Radioactivity accumulation at the end of the lymphatic channel in the mapping process indicates sentinel lymph nodes, which are marked on the skin at the surgical site. It is possible to surgically remove the lymph nodes from a small incision by taking counts from the sentinel lymph node region with the aid of radiation detectors called gamma probes during surgery.

At this stage, labeling of lymphatics with intraoperative blue dye is often preferred as an adjunctive method. Properly determining the lymphatic spread of the tumor in the first staging is very important in determining the appropriate treatment to be applied to the patient. Sentinel lymph node mapping and lymph node dissection with gamma probe are the results of histopathologic examination of the lymph nodes. If metastasis is detected, the patient is usually given radiotherapy for extensive lymphatic dissection and local control. However, if there is no tumor spread in the sentinel lymph nodes, the patient does not have to undergo extensive surgery and additional treatment.

Therefore, with the sentinel lymph node imaging and removal by the gamma probe at the beginning of the GOSTT techniques, it is possible that the cancer patients who applied this method can be directed to the right treatment options early. GOSTT applications also include hybrid imaging techniques that are performed intraoperatively. With the help of specially designed gamma cameras for use in the operating theater environment, today some centers display tumor foci marked with radioactive agents during surgery and focus surgery can be performed with a small surgical incision. In addition to scintigraphic imaging for this purpose, the use of intraoperative imaging devices such as ultrasound also increases the success of tumor imaging and removal. In recent years, GOSTT applications have enabled the real-time 3D imaging of tumors during surgery thanks to the use of nuclear medicine methods together with virtual reality imaging methods, thereby increasing the success of the surgical technique significantly and shortening the duration of surgical application. In parallel with the developments in imaging and information technology, it is expected that GOSTT methods will be used routinely in more centers in the future



RECENT EVOLUTION OF HYBRID IMAGING IN LYMPHOMAS: SPECT/CT, PET/CT, QPET, SUV-SPECT.

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Lymphomas represent a very heterogenous group of malignancies with different histopathology, biological features, clinical behavior and prognosis. Correct staging and therapy effect monitoring via imaging methods have been recognized as crucial for achieving the best therapeutic results with as few long-term side effects as possible.

This lecture describes the evolution of nuclear medicine technologies in refining the diagnostic process and therapy effect assessment in lymphoma. Nuclear medicine diagnostics of lymphoma evolved from planar whole-body imaging through SPECT and PET up to modern hybrid methods. ⁶⁷Ga-citrate used to be the standard of care in lymphoma diagnostics but the appearance of ¹⁸F-FDG-PET with its much better imaging characteristics replaced it quickly. Hybrid PET/CT, showing both morphologic and functional lymphoma characteristics, led to the acknowledgement of the method as the “gold standard” in staging and restaging FDG-avid lymphomas. It also keeps on evolving – nowadays mostly in the prognostic field, especially concerning interim PET. Interpretation of therapy-related metabolic changes is essential for the individualized treatment strategy. Different visual scales (e.g. Deauville) and semiquantitative parameters (e.g. SUVmax) have been used to guide it. Recent studies show the potential of newer developing semi-quantitative parameters, such as qPET, in order to better assess the early metabolic response presented as a continuum.

The more recent introduction of SPECT/CT and the success of PET/CT have partly excluded the first from being used as a diagnostic tool in detecting malignancies. However, gamma-photon SPECT with tumor-seeking radiopharmaceuticals (RP) proved its diagnostic role for lymphomas in the “pre-PET” era so it could be presumed, that hybrid tumor-seeking SPECT/CT could serve as an alternative to PET/CT in certain occasions. Moreover, recently developed SUV-SPECT “gains speed” and could probably serve as a suitable semi-quantitative parameter for monitoring therapeutic effect via SPECT/CT. Additional benefits of using SPECT/CT with tumor-seeking RP in staging and restaging lymphomas is the possibility to assess multi-drug resistance prior to therapy and posttherapeutic cardiotoxicity with one single injection of RP.

This lecture also presents our own experience and scientific contribution in semiquantitative PET/CT (qPET) and SPECT/CT (SUV-SPECT) in lymphoma.



MYOCARDIAL IMAGING –CURRENT POSITION IN EVALUATION OF MYOCARDIAL ISCHEMIA AND VIABILITY

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The Nuclear Cardiology is one of the oldest noninvasive imaging methods in Cardiology. Nowadays it competes with echocardiography, CTA and MRI. Many trials have determined its prognostic power in combination with CAC evaluation. One of its strength is the quantification of the detected abnormalities, which permits taking decision about the execution of revascularization. The functional data like left ventricular post stress ejection fraction and volumes evaluations give important additional information in this regard too. The PET viability evaluation is still recognized as the most sensible method for detecting hibernating myocardium and a gold standard for preventing the cardiac failure. The advantages of integrated images improves the interpretation of MPI and permits to obtain combined images of vascular anatomy and perfusion/function. The most interesting perspective in MPI today is the opportunity to calculate the coronary flow reserve by CZT technology, using the conventional radiopharmaceuticals: tetrofosmin and sestamibi, instead of the PET radiopharmaceuticals. The radiation exposure of examination is lowered by the adjustment of the activity according to the body weight and “stress only” procedures. Now it goes to mSv. Another important decrease of exposure is given by CZT technology, with additional benefit of shortening the time of the procedure. The ^{99m}Tc -tetrofosmin contribution to stress examination was 3.1 mSv and to stress and rest it was 7.2 mSv. The contribution of ^{99m}Tc -MIBI to the stress exam was 3.2 mSv and to the stress and rest exam the value was 8.7 mSv. The total weighted effective dose for myocardial perfusion was 4.6 mSv.

The MPI remains well established, cheap and with great prognostic power nuclear examination.



THE VALUE OF F-18 CHOLINE PET/CT IN PROSTATE CANCER PATIENTS

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Introduction

Prostate cancer is the second most common malignancy in men and is one of the most common cause of cancer related death. As the treatment of any type of cancer is dependant on establishing early diagnosis and the correct stage, maintaining high cancer treatment and diagnostic standards, by introducing new modalities, is a high priority of modern healthcare systems. Because of prostate cancer is not avid for the currently most used radiopharmaceutical, F-18-fluorodeoxyglucose (F-18-FDG/CT), other radiopharmaceuticals have been developed. In some Western European countries Ga-68 PSMA has been introduced recently as the most advertised tracer, but many departments don't yet have the infrastructure necessary for the implementation of Ga-68 PET/CT. The aim of this study is to explore the value of F-18 choline PET/CT in patients with prostate cancer with emphasis on the change of patient management.

Materials and methods

Over 300 prostate cancer patients have been imaged with F-18-choline PET/CT in the Department of Nuclear Medicine at the University Hospital Centre Zagreb from November 2012, when the facility became operational, to January 2017. In this study 221 patient were included, scanned with F-18 choline PET/CT for staging or restaging of prostate cancer. The majority of our patients (115 patients, 52%) were referred from their urologists and oncologists due to biochemical relapse of prostate cancer. Mean age of our patient population was 70 years (range 52 to 83 years). Mean PSA value at referral to our Department was 10,8 ng/ml (range 0,2 to 229) and the mean Gleason score was 7. Mean follow up period was 23 months (range 44 to 9 months). Mean administered activity was 202 MBq of F-18 choline (2-3 MBq/kg, IASOCholine, IASON GmbH).

Results

Eighty five patients out of the biochemical relapse group had a positive finding on the F-18 choline PET/CT (74%). Thirty three patients had bone metastases with a mean SUVmax value of 13 (range 3,3-30) and lymph node metastases were found in 50 patients (43%), with a mean SUVmax value of 7,9 (range 1,9-20,1). Other localizations of increased tracer uptake were reported in 10 patients in one of the seminal vesicals, and in 2 patients a lung metastases. A second primary carcinoma was found in several patients – in one a CLL, in 1 mesothelioma, in another a HCC and in two patients a thyroid papillary carcinoma. In 80% of our patients a change of management was reported in the

follow up period. This includes the start of androgen deprivation therapy, salvage radiotherapy and palliative bone radiotherapy, the beginning of radiotherapy and orchidectomy. Mean PSA value in the follow up period was found to be 29,3 ng/ml, higher than the initial value due to progression of disease in several patients, with change of therapy implemented but no control PSA value available by January 2017. Nonspecific F-18 choline uptake in lymph nodes of the mediastinum, axillae and inguinal regions was reported in 40 patients, mean SUVmax value of 2,98 in the axillary nodes, 4,6 in the inguinal nodes and 5,3 in the mediastinum.

Conclusion

F-18 choline PET/CT provides clinicians with valuable information in staging and restaging of prostate cancer. It has an important impact on therapeutic strategy, providing physicians with clinical certainty to decide between palliative treatment to treatment with curative intent. As other functional imaging modalities, F-18 choline PET/CT provides more information necessary for the appropriate and individual patient management.



THE REAL CLINICAL IMPACT OF PSMA PET/CT

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Recent series suggest that even high risk patients with locally advanced prostate cancer (PCa) and minimal lymph node (LN) involvement can be cured by extended pelvic lymph node dissection (ePLND) during radical prostatectomy (RP). Moreover, up to 80 % of patients with an intermediate or high risk develop nodal metastases in LNs of normal size. Localization of prostate cancer lesions is a major challenge in patients with biochemical recurrence. The differentiation of localized disease and metastatic spread is of great importance for further disease management, especially when considering salvage radiotherapy (RT) with most effective rates at serum PSA values <0.5 ng/ml. These developments underscore the need for a reliable staging/restaging modality. Current guidelines suggest bone scintigraphy, CT and MRI for staging and restaging patients with intermediate and high risk. Newer imaging modalities include PET with choline-based tracers, however, despite their advances in imaging, these procedures still have considerable limitations and current guidelines do not recommend choline PET imaging for primary nodal staging, neither for detecting relapses at PSA value below 2,0 ng/ml.

Molecular imaging targeting the prostate-specific membrane antigen (PSMA) has so far shown very convincing results, especially regarding detection of small lymph node metastases. Thus, in patients with high-risk prostate cancer, 68Ga-PSMA-PET is already considered the reference standard wherever it is available. While the clinical value of PSMA PET/CT in (suspected) recurrent prostate cancer is largely uncontested, its worth in the setting of primary staging is still unclear. Recent studies suggest that 68Ga-PSMA PET/CT is also limited in detecting all LNMs prior to RP when using histology as the reference standard. Therefore, in high risk group ePLND remains standard of care. In this setting, a lot of questions concerning the future clinical impact of PSMA PET/CT has to be raised, with the most challenging ones as follows: can PSMA could help in selection of patients with high risk or locally advanced PCa (cT3b-T4 N0 or any T N1) who will benefit from RPa or definitive RT, can PSMA be used in the decision for sparing the eLND in intermediate risk PCa, can PSMA could support the decision for deferred treatment in patients on active surveillance or watchful waiting, can it be used to guide surgery or RT in distant LNMs, can it be implemented in the decision for salvage RT of the prostatic bed in patient with biochemical recurrence The aim of this article is to review the current clinical outcomes and to discuss the future challenges in the application of 68 Ga PSMA PET/CT.



LYMPHOSCINTIGRAPHY AND SENTINEL LYMPH NODE BIOPSY IN CUTANEOUS MELANOMA: ANALYSIS OF 201 PATIENTS FROM A SINGLE INSTITUTION

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OBJECTIVE Sentinel lymph node biopsy (SLNB) is widely accepted method in the management of clinically localized cutaneous melanoma. The aim of this study was to report the results on patients scheduled for preoperative lymphoscintigraphy and SLNB. **METHODS** At Medical Military Academy, Belgrade, 250 patients were identified for SLNB between 2010-2014. Out of them, retrospective review of 201 patients with cutaneous melanoma was performed. Lymphoscintigraphy was used in all the patients and dual labeling method (blue dye/nanocolloid) in less than one half of them. To delineate the relation of patients', tumors' and scintigraphic characteristics with positive SLN status, we examined all variables by univariate logistic regression with odds ratios representing effect size.

RESULTS: Overall identification rate of SLN was 98.5%. The extracted SLN nodes were visibly blue stained in only 20/79 (25.3%) patients. Positive SLN (metastatic, one or more) was seen in 47 (23.4 %) patients. Drainage to one regional basin was seen in 176 (87.6 %) and multiple drainage regions (up to three) - in 24 patients (11.9%). In transit lymph nodes were detected in 20 patients. Univariate regression analysis with 201 cases included in model revealed Breslow thickness, nodular melanoma histological subtype and acral localization - to be significant independent predictors of SLN status ($p < 0.05$).

CONCLUSION Beside the well established primary tumor thickness as the predictor of SLN positivity, we observed acral body site location and nodular melanoma subtype to significantly enhance the risk for regional metastases. Our data confirm that multidisciplinary approach of SLNB is relevant as a diagnostic and staging procedure in cutaneous melanoma patients.



THE ROLE OF PET-CT IN HEAD AND NECK TUMORS /HNT/

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Diagnosis of HNT is based on clinical data, laparoscopy and endoscopy with biopsy.

Contemporary imaging methods, such as CT and MRT are used for a noninvasive determination of the tumor size and invasion of the neighboring structures or distant metastases. Unfortunately, they have some disadvantages, as they are based mainly on morphological criteria which are not always specific and it is difficult to achieve information for a whole body disease spread. In the most cases, HNT are squamous cell, which are hypermetabolic and it is possible they to be detected through highly sensitive molecular imaging using ¹⁸F-FDG PET-CT. Summarized data in the literature show that this is the most accurate technology for a proof of recurrence of HNT and it has a very important role in the initial staging, visualization of synchronous and a tumor of unknown primary for determination of the most adequate therapy.

Future trends are connected with application of PET-CT in determination of the target volume for radiotherapy and modulation of its intensity, determination of the definite role of PET-MRI and implementation of some new radiopharmaceuticals for characterization of tumor biology and individualization of the therapy.



REGADENOSON A NEW STRESSOR AGENT IN CONJUNCTION WITH GATED SPECT MPI - ONE CENTER EXPERIENCE: AT ONASSIS CARDIAC SURGERY CENTER IN GREECE

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ATHENS

Purpose

To assess the safety and the tolerability of the first selective A₂A receptor agonist, Regadenoson, in 300 patients (pts) who were referred to the Nuclear Medicine Department for Single photon Emission Computed Tomography (SPECT) Myocardial Perfusion Imaging (MPI) using Tc-99m Sestamibi.

Methods and Results

Three hundred pts (182 male and 118 female) underwent Gated-MPI using Tc-99m sestamibi after bolus administration of 400 µgr as a stressor agent. Hemodynamic parameters were recorded before, during, and after administration of the Regadenoson as well the side effects (SE). The mean age of pts was 68±9 years. One hundred twenty pts had history of coronary artery disease. All pts had left ventricle ejection fraction >40%, 6 pts with history of asthma, 5 pts of chronic obstructive pulmonary disease without bronchospasm, and 3 pts with renal failure. Medical intervention was required only in 4 pts, (in 2 pts use of oxygen distribution, 1 pt defibrillated and in 1pt use of administration of aminophylline)

Systolic blood pressure was decreased in 206 pts and increased in 94 pts.

The mean heart rate increase was 29% (from 69 to 96 bpm), in 40 pts the increase was >40% compared to the baseline and in 64 <20%. Symptoms during Regadenoson were recorded in most pts as mild dyspnea in 53 %, gastrointestinal discomfort in 30%, flushing in 24%, arrhythmias in 22%, chest discomfort in 22 % pts, headache in 19%, , ST changes in 11.5%, dry mouth or metallic taste in 2.5%. Less common SE as fatigue, nausea, dizziness were identified only in few pts. No other serious SE of the drug were observed.

Conclusion

The use of Regadenoson as a stress agent in conjunction with SPECT MPI appears to be safe, feasible and a well tolerated stress test without significant cardiovascular SE.



SPECT/CT APPLICATIONS IN MUSCULOSKELETAL PATHOLOGY

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Skeletal scintigraphy depicts functional alterations of bone with great sensitivity. Difficulties in precisely localizing abnormalities of bone metabolism relative to the complex anatomy of the skeleton have greatly weakened its crucial role. Dual modality imaging, referred as hybrid imaging offers combination of functional (SPECT) and structural information (CT) in a single scanning session with the multiple advantages for the diagnostic decision process.

The most common application of skeletal scintigraphy in musculoskeletal pathology is diagnosis of bone secondaries, The vertebral column and pelvis are the most frequent sites of metastatic bone disease regarding high red bone marrow content. Accurate detection of metastases is of crucial clinical importance in staging of cancer patients. Correlation of skeletal scintigraphy with other radiologic examinations is often required to increase the specificity and accuracy of identifying the etiology of the bony lesions. SPECT/CT imaging has proved helpful in providing more specific diagnosis as well as superior localization of the lesions. Using SPECT/CT it is possible to categorize most of the lesions as benign or malignant, while few of them remain indeterminate. CT itself provides information regarding changes in organ size and tissue density and recognizes most of the benign lesions in the skeleton.

SPECT/CT is expected to improve specificity without reducing its sensitivity. There is clear benefit in adding SPECT/CT to conventional imaging algorithms during the evaluation of benign and especially malignant skeletal diseases. Skeletal SPECT/CT should be the new imaging gold standard when searching for bone metastases.



NUCLEAR MEDICINE TECHNIQUES IN MULTIPLE MYELOMA

Mititelu R.

BUCAREST

Multiple Myeloma is a severe malignancy which affects primarily plasma cells. It represents the third most common blood cancer after lymphoma and leukemia. Since 1975, overall myeloma incidence has increased nearly 1 percent annually. Overall mortality rates peaked in the mid-1990s and decreased in recent years due to new and modern therapies available.

Myeloma bone disease is due to proliferation of tumor cells and to the release of Interleukin 1 (IL-1) also known as osteoclast activating factor (OAF). Bone lesions have an important lytic component and are usually seen in plain radiographs, which may reveal "punched-out" lesions. It is known that up to 90% of myeloma patients develop osteolytic lesions during the course of their disease. This fact represents a major cause of morbidity and mortality and for this reason imaging techniques are essential in order to identify bone lesions, to determine the extent of intramedullary and extramedullary foci and to assess progression of disease. Moreover, bone pain due to a myeloma lytic lesion is one of the major diagnostic criteria of Multiple Myeloma, together with demonstrating of a larger percentage of medullary plasma cells - >10% and with the identification of the monoclonal Ig proliferation.

For all this reason it's of a great importance continuous improvement of methods which assess the presence and extension of bone and bone marrow involvement in Multiple Myeloma patients.

MRI together with ¹⁸F-FDG PET-CT and ^{99m}Tc-MIBI scan allow identification of medullar and bony lesions and help diagnose myeloma disease activity with very high sensitivity and specificity. Diagnostic criteria were recently changed in order to include PET-CT and MRI in the diagnostic algorithm – Durie Salmon PLUS system.

In this paper we review the literature about diagnostic imaging of Multiple Myeloma, with emphasize on Nuclear Medicine techniques – PET-CT and ^{99m}Tc-MIBI scan and we'll present our experience in using ^{99m}Tc-MIBI whole-body scan in evaluating Multiple Myeloma patients, in correlation with other imaging modalities.



OUR EXPERIENCE IN THE CLINICAL APPLICATION OF SPECT SCINTIGRAPHY WITH 123I-IOFLUPANE (DATSCAN) IN PARKINSONISM

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Parkinson's disease is a neurodegenerative disease characterized by progressive loss of dopaminergic neurons in the brain. 173 patients with symptoms of parkinsonism - 84 women and 89 men aged 19 to 76 years are included in the retrospective study. After iv administration of 123I-Ioflupane /DaTSCAN/, acquisition of images by single photon emission computed tomography / SPECT / gamma camera Philips Meridian 2 is performed.

Scintigraphic images composed of 4 consecutive transverse slices with the most clearly visualized striatums were classified into 4 groups - normal and 3 pathological types : Type 1. - Asymmetric accumulation of the radiopharmaceutical, significantly reduced or absent in one putamen and relatively preserved in nuclei caudati forming a comma shaped or crescentic image of the striatum in one hemisphere and a circle or oval in the contralateral ,

Type 2. - missing accumulation in the putamens bilaterally and visualization only nuclei caudati in both hemispheres forming two ovals , Type 3 . – Lack of accumulation in putamen bilaterally and significantly reduced in the nuclei caudati, with the blurring of the radiopharmaceutical in the brain outside the structures of dopaminergic neurons.

In 57 patients the study showed pathological image type 1., in 53 patients showed pathological picture type 2 and in 12 patients was established pathological image type 3. In 51 patients nuclear medicine study rejected the presence of Parkinsonism

The author concluded that the SPECT imaging with 123I-Ioflupane (DATSCAN) is a valuable diagnostic tool to prove the presence of Parkinson's disease or other forms of parkinsonism with depletion of functioning dopaminergic neurons in the brain. The scintigraphic study demonstrates the severity of the pathological process and is important for the treatment and prognosis of the disease.

Keywords: *DatScan, Parkinsonism, SPECT scintigraphy.*



PET/MRT IN NUCLEAR ONCOLOGY

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PET/MRT (Positron Emission Tomography/Magnetic Resonance Tomography) is the most recent hybrid imaging method with new perspectives in clinical oncology. If PET/CT (Positron Emission Tomography/Computed Tomography) has made a revolution in the diagnosis and monitoring of oncologic diseases, PET/MRT represents an evolution with even better image quality and soft-tissue resolution overcoming some disadvantages of PET/CT. This leads to much better diagnostic accuracy, especially for staging, radiotherapy planning, chemotherapy sensitivity assessment and restaging mainly of soft-tissue and sub-diaphragmatic malignancies. PET/MRT has a special impact for brain tumor primaries and metastases. Lacking radiation exposure, PET/MRT has a great potential in pediatric oncology.

Oncologic diseases represent a very heterogeneous group with over 350 histologic entities having different biologic behavior, distribution and prognosis.

The lecture describes the development of PET/MRT and the discrepancy between PET/CT and PET/MRT in different oncologic diseases. Together with a review of the published data and achievements from all over the world, this presentation includes own experience with this highly specialized technology.



NEW HYBRID SPECT-CT MODALITIES IN NUCLEAR ONCOLOGY

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Among the various imaging techniques used to assess malignant diseases SPECT-CT can provide an accurate diagnostic information of the presence and extend of neoplastic diseases as well as unique data about tumor biological characteristics such as rate of cell proliferation or somatostatin-receptor overexpression intensity. Role of SPECT studies with selective organotropic radiopharmaceuticals: cationic lipophilic ^{99m}Tc -MIBI/TF, $^{111}\text{In}/^{99m}\text{Tc}$ -Octreotide, ^{99m}Tc -MDP, ^{99m}Tc -Nanocoll, ^{131}I etc, in nuclear oncology is well known. The added diagnostic value of SPECT-CT has recently been investigated. Scintigraphic data provides a description of functional tumor tissue whereas CT depicts the precise tumor localization and type of morphological changes that have occurred in the same lesions. Several clinical applications of SPECT-CT studies in oncology has been observed in this work:

- Combined SPECT-CT images enables to discover occult primary tumors, to visualize loco-regional or distant metastatic spots for correct N/M staging, to evaluate effect of neoadjuvant chemotherapy or radiotherapy in locally advanced and non-operable tumors.
- SPECT-CT studies are useful in post-therapeutic follow-up of patients to image suspicious local recurrence, lymphadenopathy and disease extension.
- CT part of fusion imaging can increase SPECT specificity by more accurate anatomical assessment of sites with abnormal activity and unclear iatrogenic character such as radiation pneumonitis, postoperative parenchymal changes, seroma, etc or to differentiate pathological intensive uptake from physiological activity.
- SPECT-CT is a new diagnostic tool to visualize sentinel lymph nodes in various malignancies for radioguided surgery.
- SPECT-CT images are applicable in radiotherapy planning to target precise functional gross tumor volume delineation.

In conclusion the introduction of multimodal SPECT-CT methods in nuclear oncology increased the diagnostic specificity and sensitivity of the nuclear medical diagnostic approaches, which is of an important clinical value in determining and planning individual therapeutic management in patients with malignant diseases.



SENTINEL NODE IMAGING & BIOPSY IN BREAST CANCER & MELANOMA

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Solid tumours such as melanoma and breast cancer can potentially metastasize to regional lymph nodes. Regional lymph node dissection is therefore recommended for patients with clinically suspicious nodes or pathologically proven nodal metastases but leads to unnecessary morbidity in patients without nodal involvement. The advent of sentinel lymph node (SLN) imaging and dissection, has now led to selective dissection of sentinel node(s) in the affected lymphatic basins. If the SLN is free of tumour, then it is highly unlikely that subsequent nodes along the same pathway will contain metastasis. Complete nodal dissection can therefore be replaced by the less aggressive selective resection of the SLNs only in an affected lymphatic basin.

SLN imaging/biopsy in breast cancer and melanoma patients is aimed at identifying and removing the sentinel node(s) draining these cancers. Selective removal and carefully examination of sentinel nodes can now accurately determine the metastatic melanoma status of a complete lymphatic field with minimal associated morbidity. The SLN status has been recognized as an important factor in the staging and prognosis of melanoma patients. With sentinel lymph node biopsy, a distinction can be made between patients who may or may not benefit from regional lymph node dissection, which is now recommended in case of a positive sentinel lymph node(s) in about one-fifth of the patients.

Axillary nodal status is the most powerful prognostic factor predicting recurrence and survival in breast cancer. Axillary node dissection (AND), the staging procedure to determine systemic spread, has been supplanted by SLNB procedure in patients with early-stage biopsy-proven breast carcinoma without cytologically or histologically proven axillary lymph node metastases for which removal of primary tumour and axillary node dissection would be indicated. SLN imaging and biopsy is now the de facto standard-of-care in breast cancer patients. However, in the case of breast cancer, the methodology is highly non-standardized with proponents of a variety of techniques. Published studies provide evidence to support that the false-negative results do not differ with the injection site though superficial injections are better for axillary staging and deep injections for detection of SLN in the extra axillary nodal basins. Pre-operative lymphoscintigraphic imaging is highly recommended as it improves accuracy, reduces morbidity and allows speedy identification of SLN. Indications for SLNB have been extended to encompass most patients with non-metastatic breast cancer.

The impact of SLNB on the treatment received by patients is different in breast cancer and melanoma; in patients with breast cancer, it prevents routine lymph node dissection, whereas in patients with melanoma, the technique is performed as an extra procedure with no well-established benefits. In patients with cutaneous melanoma in the head, neck, trunk or extremities, SLNB provides accurate staging and important prognostic information; however, SLNB has no impact on disease outcome in cutaneous head and neck melanoma.



SENTINEL LYMPH NODE DETECTION IN COLORECTAL CANCER-FIRST EXPERIENCE

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SKOPJE

Introduction

One of the most important factors for prognosis in colorectal cancer patients is the status of the regional lymph nodes. International recommendations suggest that at least 12 lymph nodes must be analyzed microscopically for correct staging. SLN is considered to be the first barrier of metastatic disease.

Aim

To implement the method for SLN detection using radioactive colloid, and test its accuracy, sensitivity and specificity. Also to correlate the SLN findings with other regional lymph nodes.

Material and Methods: the study is performed at the University Clinic for digestive surgery and the Institute for Nuclear Medicine since January 2013 and is still ongoing. So far the study includes 40 colorectal patients, age 63+/-14 years. SLN detection is performed using gamma camera and gamma detection probe after endoscopically peri and intratumoral injection of 99m-Technetium-SENTISCINT in the amount of 4mCi/4ml 24h prior to operation. All patients undergo standard surgical technique: resection with systemic lymphadenectomy. Promptly after resection, the gamma probe is used to detect the SLN or SLNs. Pathohistological analysis (HE and immunohistochemistry) is performed to all the resected lymphnodes, including the SLN.

Results

Until now the identification rate is 38 / 2, which means that SLN has not been detected only in 2 procedures. In 2 patients two SLNs have been detected. The average lymph nodes analysed pathohistologically after resection is 14,2. In 3 patients false negative SLNs have been detected. The accuracy of the procedure so far is 90% and the sensitivity is 87,5%. In 5 patients, the SLN is the only positive lymphnode of all examined LNs.

Conclusion

From the results obtained so far, we can present that the identification of the SLN with this method is possible and the accuracy and sensitivity are satisfactory. We plan to continue this study up to 100 patients minimum, and we expect that this would be the highest number of discovered and analysed SLNs in our institution. We also expect to contribute in the diagnosis and up staging of the colorectal cancer patients, which is important for the oncology treatment protocols.



ANALYSIS OF CORRECTIVE FACTORS OF STANDARDIZED UPTAKE VALUES IN ORDER TO IMPROVE BREAST CANCER IMAGING WITH 18F-FDG PET

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A major advantage of PET is the ability to quantify radiotracer accumulation. One of the parameters used to measure 18F-FDG accumulation is standardized uptake value (SUV) which is commonly used in clinical practice. Using SUV in evaluation of early response to therapy in breast cancer has become significant because it offers more objective and observer-independent criteria. Moreover, methods for differentiation between benign and malignant breast tumors, using SUV cutoff values, showed great sensitivity and specificity. Therefore, it is very important to take all the factors affecting SUV into account. Biologic and technologic factors and their influence on SUV are going to be described.

Two correction factors used to reduce SUV dependence on weight are SUV calculated using lean body mass (SUV_{lbm}) and body surface area (SUV_{bsa}). If the patient serum glucose level is in the reference range normalization of the SUV to blood glucose level is not recommended. Uptake time in breast cancer should be at least one hour in order to have higher SUV and better differentiation between malignant and inflammatory lesions. Patient breathing has influence when following lesions are in the lower thorax and upper abdomen. Because different scanner models have different acquisition and reconstruction properties, it is recommended to perform follow-up and baseline studies on the same PET/CT scanner. Reconstruction parameters such as matrix size, field of view (FOV) can have impact on SUV for small lesions. Errors in calculations of the SUV can be present if the dose calibrator and scanner are not time synchronized and the residual activity within the syringe is not taken into account.

SUV measurements are convenient method for quantitative image analysis of breast malignancies and it is important to understand and implement corrective factors in order to make better therapy decisions and to have more efficient monitoring of the therapy response.



CLINICAL APPLICATIONS OF 18F-FLUOROCHOLINE BEYOND PROSTATE CANCER

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18F-fluorocholine (FCH) has been approved as a clinical PET tracer in France in 2010 and then in several EU countries. The registered indication is imaging prostate cancer and for some preparations hepatocellular carcinoma.

Since the very beginning of its clinical development, FCH proved to be an effective cancer-seeking metabolic tracer, being also taken-up by breast cancer, brain tumours, lung cancer, head and neck cancers, lymphoma, myeloma ...

When compared with FDG, FCH has several advantages:

- it can detect neoplasia of low aggressiveness or non-enhanced glucose metabolism (e.g. prostate cancer, well differentiated hepatocellular carcinoma, bronchoalveolar cancer ...),
- it can detect brain metastases or cancer lesions close to the brain (skull, base of the skull),
- the cancer uptake is generally rapid and plateaus after a few minutes, which allows an easier follow-up of tumour uptake than with FDG that requires a constant delay from injection to imaging for monitoring tumour uptake.

Its limitations are the high background in the liver, hepatic metastases generally appearing photopenic, and a significant background in the bone marrow.

Furthermore, the utility of FCH is not limited to cancer imaging; it can be useful in the detection and characterisation of benign tumours such as meningiomas, pituitary adenomas and adenomas or hyperplasia of the parathyroid glands.

In summary, FCH is a useful tool in detecting benign tumours that must be resected and cancers of low malignancy, while it is also taken up by most aggressive forms of cancer. The clinical settings where it may be overpass FDG are becoming more numerous.



MEMORY FOR HAL ANGER - 60 YEARS GAMMA CAMERA (IL)

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QC IN NUCLEAR MEDICINE CONSULTANT, SOFIA

Although not of the best quality, nuclear medicine images give additional info on other imaging diagnostics, which are essentially morphological. The emergence of nuclear medicine goes back to the time after the end of WORLD WAR II. Then the researchers who had worked on the creation of the atomic bomb in the United States returned to civilian laboratories with a lot of acquired experience in radionuclides.

The first and by 1960 only radionuclide used in nuclear medicine is ¹³¹I that builds up in the thyroid gland. The need for representing its distribution in the body arose. In 1941, Hamilton made the first nuclear medicine study – projecting a network of squares onto the surface of a thyroid gland and with the GM-counter registers the accumulation in each square.

Only in 1947 PMT was attached to scintillation crystal, with which the sensitivity of detection rose dramatically. The scintillation detector (SD) was born – a key element of the nuclear medicine equipment today.

In 1951 Herbert Allen attached a collimated SD to the mechanical structure which allowed by means of manual navigation to explore the gland in 400 different point positions. Later Cassen et al added an automatic electrical drive to it and the first scanner appeared.

Naturally emerged the idea to construct a device able to visualize the entire area of radionuclide distribution at the same time continuously. Many researchers put a lot of efforts to build such a device but the luck came to one of them. At the end of 1956, Anger found the solution - a compact set of PMT's attached to a large scintillation crystal and a genius scheme that connects the outputs of PMT's and generates x-y location signals of a scintillation in the crystal. The first Anger- gamma camera (GC) installed in medical department was in 1962 at Ohio State University Hospital.

Despite the obvious advantages of GC, production of scanners continued for another 10 years because the GC was came into being too early, being ahead of its time by 10-15 years. In the 1960s computing starts becoming more confident going into the industry. It became clear that the computer was the solution without an alternative that provides logging of the enormous volume and flow rate information from GC.

A quantum leap in construction, but also in the kind of acquired information was achieved in 1976 by Union Carbide with the first SPECT GC. In 1979, General Electric presented the first clinically significant SPECT GC, which also incorporated CT for the correction of the attenuation of the radiation.

Today 60 years of well being the epoch of Anger camera approaches the end with the advent of new detector presented by GE.



NUCLEAR MEDICINE METHODS FOR CARDIOTOXICITY ASSESSMENT IN ONCOLOGY

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The lecture discusses Cardio-Oncology, which is the discipline that focuses on the intersection of cardiovascular disease and cancer. With the prognosis for many cancers improving, an appropriate sharpening of focus on the cardiovascular risks of patients who have survived cancer or are being treated for cancer is important, as well as a growing recognition of the impact this competing morbidity has on both short- and long-term health outcomes. There are increased risks of congestive heart failure in adults treated with anthracycline-based chemotherapy regimens, which in current practice includes patients with breast cancer, leukemia, lymphoma, sarcoma, and other cancer types. Targeted therapies, which has increased exponentially in the last decade, would target only cancer cells, but the potential for cardiovascular effects exists due to the presence of identical molecular pathways in cardiovascular cells

The potential cardiotoxicities include hypertension, cardiomyopathy, QT prolongation, arrhythmias and metabolic abnormalities. For many cancers, including breast cancer and lymphoma, chest radiation remains an important component of the treatment regimen. The cardiovascular risks of radiotherapy include coronary artery disease, valvular heart disease, pericardial disease, conduction system abnormalities, and myocardial fibrosis.

The development and validation of approaches to minimize this long-term risk is the focus of early diagnosis. There is no ideal monitoring test for patients at high risk for cardiotoxicity. Although attempts have been made to monitor cardiotoxicity with techniques such as EchoCG or MUGA, they have been virtually inapplicable because of their low sensitivity and specificity. The first manifestations of injury are predominantly functional, and nuclear medicine techniques are particularly appropriate for monitoring function, enabling damage to be detected at an early stage before morphological alterations occur.

We provide a comprehensive cardiovascular evaluation with nuclear medicine methods for early recognition of cardiotoxic side effects and to minimize cardiovascular complications. Myocardial perfusion scintigraphy for early detection of myocardial damage in treated cancer patients is assessed. Myocardial perfusion scintigraphy GSPECT –CT with coronary calcium score achieves complex assessment of myocardial systolic and diastolic function, myocardial perfusion and coronary calcium score, which can detect early signs of myocardial damage before positive results from routine tests for cardiotoxicity and before severe morphologic myocardial damage has been occurred. A multidisciplinary team approach prior and during cancer therapy is needed to mitigate the cardiovascular risk of modern cancer treatment. Cancer survivors should be offered access to regular cardiovascular testing to identify those at risk for late cardiovascular toxicity.



SPECT AND PET IN NEURODEGENERATIVE DEMENTIAS

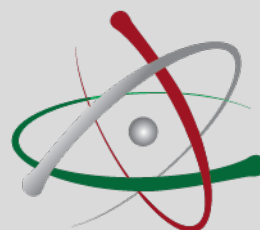
Valotassiou V.

LARISSA

SPECT and PET functional brain imaging have been used for the early diagnosis and differential diagnosis of neurodegenerative dementias. SPECT and PET imaging studies of cerebral blood flow and brain glucose metabolism have revealed characteristic patterns of reduced perfusion and glucose metabolism in various degenerative dementia disorders. Moreover, they provide significant prognostic information about the progression of disease and response to treatment. The last years, molecular nuclear medicine imaging aims various dementia underlying pathophysiological targets. A great number of specific radiopharmaceuticals have been developed for the in vivo imaging of beta amyloid deposits and tau protein aggregation, as well as for the imaging of cholinergic and serotonergic neurotransmitters deficits and activation of microglia.

ORAL PRESENTATIONS

6th Balkan Congress of
2017 Nuclear Medicine





OPTIMIZATION OF CLINICAL CT PROTOCOLS FOR THYROID AND PARATHYROID SPECT-CT IMAGING

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Introduction

A national survey of patient exposures from hybrid imaging in Nuclear Medicine, performed in Bulgaria in 2014, revealed that single photon emission computed tomography/computed tomography (SPECT/CT) thyroid or parathyroid imaging was performed by applying a CT scan of the whole anatomical region, neck and chest, subject to SPECT. In most cases it was not necessary to perform a CT scan of the whole SPECT region.

The aim of this study is to propose an optimized CT protocol on patients sent for thyroid and parathyroid examinations by reducing the CT scan length.

Materials and methods

The standard CT protocol for both types of examinations on a GE Discovery NM/CT 670 Pro SPECT/CT system included neck and chest scan with the same exposure data, applying tube current modulation. After the optimization the CT scan was restricted to the region of radiopharmaceutical uptake. Comparison of scan length, dose-length product (DLP) and effective dose from the old and the new protocols was performed. CT Expo software was used to estimate effective dose from the CT scan.

Results

A total of 16 patients undergoing either thyroid or parathyroid examination received CT of the neck and chest before the optimization. After the introduction of the optimized protocol, the mean scan length and the mean DLP were decreased by about 43 % and 41 % respectively. The weighted over both sexes effective dose was reduced by 38 %.

Conclusions

A simple method for optimization of the CT part of hybrid SPECT/CT imaging of the thyroid or parathyroid glands was introduced. It led to significant decrease of the CT contribution to the total effective dose from the examinations.



BONE SPECT/CT IMAGING IN ORTHOPEDICS

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ANKARA

Bone scintigraphy is sensitive imaging modality but its most significant limitation is low specificity for the diagnosis of bone pathologies. SPECT/CT improves the diagnostic accuracy of bone scintigraphy by providing precise anatomic localization of functional abnormalities and characterization of morphological findings. Role and impact of bone SPECT/CT for the definitive diagnosis of traumatic/sports injuries, benign/malign bone neoplasm, systemic bone conditions (fibrous dysplasia, Paget disease), vascular and inflammatory bone pathologies, evaluation of low back pain and painful prosthesis will be discussed.



PITFALLS IN FDG PET/CT DUE TO HYPERPARATHYROIDISM

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Hyperparathyroidism (HPT) is a subject of other imaging modalities and those patients are not directly studied with FDG PET/CT, at least not for this particular indication. However hyperparathyroidism can cause changes, especially in bones, that, if studied by FDG PET could be severely misinterpreted.

Aim of the study

is to define patterns of FDG findings in patients with hyperparathyroidism that could cause misinterpretation.

Materials and methods

Among all patients, referred for FDG PET CT for oncologic indications to the Clinic of nuclear medicine for the period 2010-2015 we identified only five with known (3pts) or diagnosed afterwards, based on the FDGPET CT findings (2pts) hyperparathyroidism. Three of the patients were referred to PET because of known malignancy (one with primary and two with secondary HPT), one patient was scanned because of bone metastases reported on a CT scan and one was scanned for radiotherapy planning of a giant cell tumor of the maxilla.

Results

Among the five patients identified three presented as highly FDG avid brown tumors, one presented as almost diffusely increased bone uptake with a "rugger jersey spine" pattern and one presented with highly FDG avid tumor-like periarticular calcifications. Of the three patients with brown tumors one had a known diagnosis before FDG PET, one was erroneously sent to FDG PET due to misinterpreted "bone metastases" on CT and was again initially misdiagnosed on FDG PET as having bone metastases and one was initially diagnosed and treated as giant cell tumor, but was correctly identified as having HPT on FDG PET.

Conclusion

Three basic patterns of FDG avid bone changes in HPT can be recognized – focal lytic lesions/brown tumors, diffuse uptake, FDG avid periarticular calcifications. All patterns are potential pitfalls in interpretation as lytic metastases, diffuse bone marrow infiltration and osteosarcoma respectively.



PROTECTIVE EFFECT OF MELATONIN ON SPERM QUALITY AGAINST RADIOIODINE TOXICITY IN RATS

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Oxidative stress has been identified as one of mediators of male infertility and particularly related with DNA integrity alterations in spermatozoa. Melatonin is as an antioxidant that detoxifies harmful reactants and reduces molecular damage. However, the effect of melatonin on sperm parameters and male infertility are not clear and numerous controversies exist in the reported results. Based on the antioxidant and anti-apoptotic properties of melatonin, the current study was designed to determine the possible radioprotective effects of melatonin on testis tissue and sperm quality in rats after of radioactive iodine (I-131) therapy. Thirty rats were randomly divided into three groups as untreated control (group 1); oral radioiodine (RAI, 111 MBq, administrated rats- group 2); and melatonin group (oral radioiodine and daily intraperitoneal 25 mg/kg melatonin administrated rats-group 3). In the third group melatonin administration was started 2 days before and continued for 7 days after RAI administration. Twenty-four hours after the administration of the last dose of melatonin, blood samples were taken from the heart to determination of total antioxidant capacity (TAS) and hormone analysis (testosterone, follicle stimulating hormone). Sperm samples from the cauda epididymis were examined for spermatological parameters (sperm concentration, motility, viability and sperm DNA fragmentation). Tissue samples obtained from rat testes were stained by TUNEL assay and hematoxylin-eosin stain to detect apoptosis and histological changes. The results showed that epididymal sperm concentration, motility and viability significantly decreased in all treatment groups when compared to the control group. There was also a significant decrease in sperm DNA fragmentation, the index of apoptotic leydig and sertoli cells in melatonin group compared with the radioiodine group ($P < 0.05$). While no significant changes were seen in testosterone levels, follicle-stimulating hormone levels also showed significant decreased in the melatonin groups compared with the radioiodine group ($P < 0.05$). It is concluded that melatonin prevents the adverse effects on apoptosis and spermatozoa quality induced by RAI. Melatonin could be used to reduce the damage of RAI.

Key words: Apoptosis, sperm, rat, testis



MALIGNANT STRUMA OVARIII: WHY AND WHEN IS ¹³¹I THERAPY CONSIDERED?

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Struma ovarii represents a germ cell tumor (teratoma) that mainly consist of thyroid tissue. This pathology is very rare and can be found in about 1% of all teratomas.

Although a clear guideline for the management of this tumor is not published, some information about the treatment lines have been established. In those cases where malignant thyroid cells are found surgical removal of both the ovarian tumor and the patient's thyroid is needed for the ¹³¹I ablation therapy of any potential residual malignant cells.

The most common types of thyroid cancer encountered in malignant struma ovarii are papillary and follicular, which varies in its degree of differentiation.

The similarities of malignant struma ovarii and primary thyroid carcinoma are histological and functional, so the follow-up and therapeutic approach of these two entities is in general lines the same. The first treatment line of struma ovarii involves surgical resection, generally due to the risk of malignancy.

Scintigraphy with ¹³¹I is useful prior the surgery to diagnose hyperfunctioning struma ovarii and also after for diagnosing pelvic or cervical residual thyroid cells. Total thyroidectomy is recommended to exclude a histologic diagnosis of primary thyroid cancer and to allow effective ablative therapy with ¹³¹I.

The follow up of the patients with malignant struma ovarii include periodic assessment of thyroglobulin levels and ¹³¹I scan examinations, the same procedures that are used in the follow up of thyroid cancer.

We want to present a review of the literature regarding this pathology and the findings of the patients that were treated in our department for malignant struma ovarii.



MEDICAL WORKERS OPERATING IN NUCLEAR MEDICINE VS PET/CT: RADIATION EXPOSURE COMPARISON

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Purpose:

Personnel monitoring results provide information on routine radiation exposure, assist in work planning and allow control of the workplace. The aim of this study was to compare the gamma dose received by dedicated medical workers operating in the first PET/CT department in Greece and also by dedicated medical workers operating in conventional Nuclear Medicine procedures in the same center. PET/CT studies are restricted to the use of ¹⁸F fluorodeoxyglucose (FDG). In addition Tc-99m, Tl-201, Ga-67 and I-131 are the radiotracers mostly used in our Nuclear Medicine department.

Method:

To estimate the effective dose from external exposure, all 9 members of the staff (2 nurses, 2 medical physicists, 5 technologists) had TLD badges worn at the upper pocket of their overall and digital dosimeters worn at the side pocket. Nurses and Medical Physicists also had TLD rings. The nurses and technologists 1,2 are working only in the PET/CT department, while technologists 3,4,5 are operating only in the Nuclear Medicine department covering the most common procedures. Medical Physicists 1,2 are operating in both departments.

Results:

In the period of January 2013 to December 2013 a total of 982 PET/CT studies and 2157 conventional Nuclear Medicine procedures were performed. The collective effective and finger doses received by all 4 members of the PET/CT staff were the following: Nurse 1 received 2,94 mSv as a whole body dose and 6,84 mSv as a hand dose and Nurse 2 received 2,87 mSv whole body dose and 5,91 mSv hand dose respectively. Technologists 1 and 2 received 1,95 mSv and 1,56 mSv as the whole body dose respectively. Medical Physicist 1 received 1,75 mSv whole body dose and 7,77 mSv hand dose and Medical Physicist received 2 2,17 mSv and 4,68 mSv respectively. Technologists 3,4 and 5 received 1,85 mSv, 1,76 mSv and 1,82 mSv as whole body doses respectively

Conclusion:

The personnel dose results are significantly lower than the recommended annual dose by International Commission for Radiological Protection. The higher value of gamma dose for PET/CT workers by comparison with the staff operating conventional Nuclear Medicine procedures is attributable to the higher specific gamma constant of ¹⁸F, as well as the longer exposure time required for accurate positioning.



DOSIMETRIC EVALUATION TO MEDICAL WORKERS OPERATING IN A PET/CT DEPARTMENT AFTER THE USE OF DYNAMIC TECHNIQUES.

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Aim Positron Emission Tomography is considered to be one of the most relevant diagnostic imaging techniques having peculiar characteristic to provide both functional and morphological information for the patient. Due to the high-energy tracers emitting 511 KeV used in PET/CT departments and considering the risks associated to ionizing radiation that have been derived from previous studies, special attention is needed when dealing with radiation protection aspects in a PET/CT modality . Since new radiopharmaceuticals such us [18F]-fluorothymidine and 18F fluoromethylcholine are used, new imaging dynamic techniques are performed and new measurements concerning the doses to medical staff are needed.

The aim of this study was to measure the effective wholebody dose of the personnel in comparison with measurements that have been made in the past.

Method The estimation of equivalent dose from external dosimetry for all seven members of the staff was monitored with the use of TLDs badges and electronic dosimeters worn at the upper pocket of their overall. The average workload of the department is 6-8 patients per day. In 2013, 983 patients were examined. In our department 18F-FDG, 18F-FCT, 18F-FCH is available in multi dose vials. Data were collected day-to-day concerning the interaction of the staff during PET/CT procedures.

Results: We compared the first six months of 2013 a period in which no FLT or FCH procedures were performed, with the second semester in which 96 FLT and 66 FCH examinations were performed. The average number of FDG patients was the same for every day, and all patients received 330-390 MBq dose each.

Regarding the whole body doses no changes were observed concerning medical physicist. The measurements for the nurses show increased wholebody dose of about 7-12% and that is due to the longer time spent near the patient. Concerning the technologist doses, an increase of about 15-21% was measured because they are near to patient at the time of the injection.

Conclusions Regulations exist to ensure safety of the medical workers according to ALARA principles. From our results we can observe that although there is an increase of the doses for technologists and nurses the numbers are significantly lower than the recommended annual dose limit by Euratom 97/43.



DIAGNOSTIC SIGNIFICANCE OF PET/CT IN FOLLOW UP AND RESTAGING OF STAGE IIA-IIIC MALIGNANT MELANOMA PATIENTS.

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Introduction

Malignant Melanoma is one of the most aggressive malignant diseases. The risk of recurrent disease increases with the higher TNM stage at presentation. Early detection of a melanoma recurrence is a major concern for the clinician. Studies have evaluated different aspects of follow-up management, but no consensus exists. There is not enough evidence-based supporting data for establishing a follow up schedule with PET/CT for melanoma patients.

The aim of our study was to determine the diagnostic value of PET/CT in follow up and restaging of melanoma malignant patients with stage IIA-IIIC.

Material

We retrospectively assessed 52 patients with stage IIA-IIIC malignant melanoma, from 2012 to 2016 and examined the usefulness of PET/CT in follow up and restaging. There were 32 male and 20 female subjects included, aging between 10 and 81 years, and with a mean age 56.6. We used PET/CT to follow up 47 of these patients in different time intervals (3, 6, 9, 12 months), but there was not any additional value to the conventional follow up studies – clinical exam, ultrasonography of the draining lymph node basins etc. PET/CT was extremely useful in restaging after appearing of clinical symptoms, CT or ultrasonography suspicion for recurrent disease and elevated S100. In all of these cases PET/CT was helpful in fast management changing. There was only a minimal local disease in 22 (46.8%) of the patients, who were properly managed afterwards. We found statistically significance in PET/CT findings, lead to change in patient management, when performed after CT/USD suspicious findings ($p < 0.0001$), and in clinically symptomatic patients ($p = 0.27$). There was another group of 16 patients, in whom PET/CT was delayed after clinical or imaging suspicion of recurrent disease and the patient was not immediately restaged with PET/CT. In those patients PET/CT was performed too late, when distant metastatic spread was present in most of them (75%).

Conclusion

PET/CT is of a great importance for restaging in patients with initial stages IIA-IIIC, after clinical, biochemical or conventional imaging modality suspicion of disease progression. A routine follow up with PET/CT after radical treatment did not contribute significantly to the patient management.



APPLICATION OF 18F-FDG IN PATIENTS WITH FEVER OF UNKNOWN ORIGIN

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Fever of unknown origin (FUO) is a state in which the body temperature remains continuously above 38.3. Currently, 18F-FDG PET-CT is considered the most accurate diagnostic tool for visualization and localization of inflammatory (infectious processes) tumors due to the possibility of conducting a whole body examination and its relatively low specificity. Our study includes 30 patients with FUO, who were examined by PET/CT.

Twenty four of them had concomitant antibiotic treatment due to inability to control the fever and 7 received corticosteroid therapy prior to the examination. The cause of FUO was confirmed in 21 (70%) of these 30 patients, by the use of all previously known clinical, para-clinical and conventional imaging modalities (excluding PET-CT), data comparable to the results from other authors. PET-CT helped to obtain true positive results in 14 patients, 9 of whom received concomitant antibiotic therapy, and 2/14 had lymphoma. The remaining 12 patients had - infection/inflammation: abscess, pneumonia, spondylodiscitis, vasculitis, arthritis, thrombophlebitis. In 9 of the patients - FUO remained unexplained, in 3 of them PET-CT supported the provisional-diagnosis by visualizing sites with pathologically high glucose metabolism. True negative findings were observed in 2/14 patients, false-negative in 3/14 – eventually diagnosed with toxoplasmosis and Adult onset Still's disease. There were no false positives. PET-CT examination contributed to establishing the correct diagnosis in a total of 19/30 patients, 63.3% with a sensitivity of 74%, specificity - 100% and accuracy reaching 76%. In 3/9 patients with unspecified diagnosis, as well as in all cases with a false negative diagnosis, corticosteroid therapy had been administered prior to the examination.

In conclusion we can say that PET-CT is a sensitive method for demonstrating and locating the cause of the FUO, but should be applied earlier in the diagnostic algorithm of patients, if possible before the initiation of corticosteroid therapy and preferably before the use of antibiotics.



QUALITY CONTROL OF DOSE CALIBRATORS USED IN CLINICAL PRACTICE

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The dose calibrators are routinely used in nuclear medicine practices to quantify the radioactivity dose of the radiopharmaceuticals to be administered to the patients. Obviously, the administration of the prescribed amount of activity to the patient requires proper operation of the dose calibrator, which shall be verified by implementing the required quality control tests on the instrument. Several guides of national and international organizations summarize the recommended tests for the quality control of the dose calibrators namely: accuracy, precision, reproducibility, linearity and geometry. The main objective of this study was to provide data on the technical condition of all 25 dose calibrators in the country after a long period of work (some more than 35 years), without preventive maintenance. The tests were focused mainly on accuracy and precision and were carried out using two sealed certified reference sources: Cs-137 (662 keV), with manufacturer serial number LB 165 and Ba-133 (356 keV), with manufacturer serial number KF 951.

This approach was imposed by the fact that half of all 18 departments do not have certificates for the reference source (Cs -137) attached to each dose calibrator. The results of the accuracy test for Cs-137 show deviations from the expected value in a wide range -20.5% to $+21.3\%$, while for Ba-133, deviation are in the range from -5.2% to $+16.6\%$. According to the requirements specified by the Nuclear Regulatory Commission (NRC) only 6 of 25 dose calibrators are in the range $\pm 5.5\%$, four in the range $\pm 5\%$ and three of them installed in 2016 are located in one department. The results of this study have shown that the accuracy of the dose calibrators not meets the requirements of National regulations and requires special attention and adequate response. In addition, according to the data obtained in the study, more than 90% of nuclear medicine departments do not carried out tests for quality control of dose calibrators and do not record the results. The results reflect the need for regular implementation of programs developed for quality control of radionuclide dose calibrators used in nuclear medicine departments.



CLINICAL VALUE OF LATE POST STRESS IMAGING OF MYOCARDIAL PERFUSION SCINTIGRAPHY GATED SPECT AFTER STRESS ONLY INJECTION. PRELIMINARY RESULTS.

Garcheva M., A Tzonevska, S Shalamanov, S Avramova.

Introduction.

The stress images are the most important part of myocardial perfusion (MP) gated SPECT, because they reveal and quantify the extent of the stress related myocardial ischemia, but with this registration only the post stress function can be determined. The comparison with rest left ventricular functional parameters from echocardiography cannot be accurate, because of the objective differences in their evaluation.

The aim of the study was to obtain additional information for rest left ventricular (LV) function from decay corrected late registration of MP images, without reinjection of radiopharmaceutical. The early and late post stress functional parameters of left ventricle: ejection fraction (EF), kinetic and volumes were compared in order to determine the presence, or absence of post ischemic LV dysfunction for improvement of the prognostic evaluation and patients management.

Material and methods.

Twenty patients with impaired post stress left ventricular function were examined on GE Discovery NM 960pro SPECT/CT by two registrations after one application of 99m Tc tetrofosmin (6 MBq/Kg) The early registration was executed at the 15th minutes after injection, the late registration - 2 hours later and the registration time was prolonged from 25 sec/projection to 30 sec/projection in order to compensate the Technetium decay and to obtain the equal count statistics for determination of the functional parameters.

Results. Changes in LV functional parameters were detected in 8/12 patients. Kinetic improvement was found in four patients with significant coronary stenosis and in 2 patients, examined for assessment of viable myocardium after recent (1.5 month) myocardial infarction. Improvement in LVEF was detected in 4 patients: 2 of them with multi-vessel diseases and 2 – with left main disease.

Conclusion.

These preliminary results showed opportunity to improve the information, obtained by one application of 99m Tc tetrofosmin concerning the functional part of examination, by revealing reversible functional abnormalities, determining of their severity, without increase of the patients exposure. Since LVEF together with regional wall motion and thickening can be assessed both: at rest and in post-stress period, it is important to detect transient ischemic dysfunction, especially when LV contractile function is significantly deteriorated after stress. This stunning phenomenon which reflects severe ischemia is related to poor prognosis.



ALARA PRINCIPLES IN RADIATION ONCOLOGY – IMPLEMENTATION OF INNOVATIVE FOR BULGARIA VOLUNTARY DEEP INSPIRATION BREATH-HOLDS (DIBH) IN CITY CLINIC ONCOLOGY CENTER, SOFIA

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Background:

The adjuvant radiotherapy to the whole breast or the chest wall is an integral part of the treatment of breast cancer cases. With left side breast tumours, inevitably a small portion of the lung and the heart get irradiated, when tangential radiotherapy fields are used. The problem is even larger when internal mammary lymph nodes (IMN) need to be included in the radiotherapy area of interest. This study is aimed at evaluating the dosimetric consequences and the potential for sparing of the heart and lung with breathing adapted radiotherapy (BART), using voluntary breath-hold technique for radiotherapy to left sided breast or chest wall.

Patients and methods:

During the period 09 -12. 2016 15 patients had planning CT scans in the different distinct respiratory phases, using Varian Real Time Positioning Management System® for monitoring of the respiratory anterior-posterior chest wall excursions. Each patient had two planning CT scans: one during free breathing (FB) and another one with voluntary deep inspiration breath-holds (DIBH). The Planning Target Volume (PTV) in some of the patients included the whole breasts and the IMN, whereas in other patients the PTV included the breast (or the chest wall), IMN and supraclavicular nodal groups (SCL). For each patient two radiotherapy plans were prepared using the FB and the DIBH planning scans respectively. For all patients – the radiotherapy plan was prepared with tangential fields for the breast/chest wall part of the volume, that included also the IMN. Anterior-posterior field arrangement was used for the supraclavicular and axillary area.

Results:

The DIBH was very well tolerated by the patients. The duration of the breath hold was from 22 to 30 seconds. The mean anterior-posterior chest wall excursion during FB was 3.1 mm. With the DIBH, the front chest wall position was between 10 mm and 18 mm anteriorly to its mid-FB position.

In the post lumpectomy case the portion of the heart that received more than 50% of the prescribed to the volume dose, was decreased from 2.07 % to 0 % (39.7 % max dose). At the same time, relative lung volume irradiated to >50% of the prescribed target dose was reduced from 17.63 % (for FB) to 13.2 % (for DIBH).

In one of the cases with SCL nodes irradiation, the volume of the heart, receiving more than 50% of the prescribed to the target dose, was: 5.74 % for FB and 0 % for DIBH (36 % max dose); the ipsilateral lung received: 21.2 % with FB and 8% with DIBH.

In another case, where the SCL nodes were irradiated, the median relative heart volume receiving >50% of the prescribed dose was ~0 % for both scans, but the max point dose was 77.5 % for FB and 11.4 % for DIBH.

In another case, the median relative heart volume receiving >50% of the prescribed dose was 12.21 % for FB and 1.26 % for DIBH. In this case the median ipsilateral relative lung volume receiving >50% was higher for DIBH – 14.17 % and 10.91 % for FB.

Conclusions

This is the first study in Bulgaria which demonstrates the dosimetric benefits of breathing adapted radiotherapy (BART). Our results showed that Irradiated cardiac volumes can consistently be reduced for left-sided breast cancers using DIBH for wide tangential treatment fields.



THE ROLE OF INTERIM PET/CT IN PATIENTS WITH HODGKIN'S DISEASE

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Background.

The contemporary treatment of Hodgkin's Disease /HD/ has transformed the outlook for patients with this illness over the last years. The idea of response-adapted therapy now is simple – measure the effect of treatment early in the course to distinguish the patients with treatment failure and modify the strategy. Attempts to use conventional imaging or blood – based biomarkers have not yet provided to be effective in this contexts. Positron emission tomography/computed tomography (PET/CT) imaging has brought into significant improvements in staging, treatment planning and monitoring therapy response in lymphoma patients. The aim of the study was to assess the role of interim PET/CT after standard chemotherapy for determination of the further management.

Material and methods:

Thirty patients with HD were examined before and 20 days after 2/4 cycles of standard chemotherapy (ABVD or BEACOPP) by 18-F-FDG PET/CT, according to the accepted protocol. The 5-point Deauville scale for objective comparison with normal physiologic uptake to grade abnormalities was used. The widely accepted Lugano classification, based on the combined metabolic and morphologic response was applied in the conclusion to stratify the responding and non-responding patients. The response was categorized as complete in score 1,2,3, partial or non (at score 4,5), and progressive disease (score 4,5 with increased FDG uptake or new lesions compared to the previous scan). The change in SUV between baseline and interim PET was also used to quantify metabolic response for prognostic purposes.

Results: After 2/4 cycles of standard therapy, a negative interim PET results is obtained in 17 (58%) of the patients (score 1, 2, 3). These patients were in continuous complete remission. In the remaining 13(42%) of the patients, interim PET varied from definitively positive to minimally positive (score 4, 5). By using the Deauville 5 point scale we found that the most frequently positive sites included the mediastinum, followed by superficial lymph nodes, abdominal nodes, lung nodes. All reported localizations of persistent residual uptake were at the original disease sites seen at baseline staging. In one patient was found a new site of disease (score 5).

In patients with HD there were two different treatment strategies, one starting with a less intensive regimen (ABVD) and another with a more efficacious regimen (BEACOPP), adopting opposite decisions by escalating or deescalating treatment based on interim PET results, while maintaining the original therapy for PET-negative and PET positive patients, respectively.

Conclusion:

¹⁸F-FDG PET is a well-established modality for interim assessment of tumor chemosensitivity early during therapy, rather than final therapy response at the time of evaluation, even proving to be a more accurate prognostic factor. PET-adapted strategy can modify management by individualizing therapy in the HD. Consequently, it is suggested that an adaptive therapy strategy based on interim PET results might distinguish high-risk patients who would benefit from escalated treatment regimens from low-risk patients whose treatment cycles could be abbreviated to minimize long-term adverse effects.



DOES ORAL METOPROLOL HAVE ANY EFFECT ON THE FUNCTIONAL PARAMETERS AND PERFUSION DEFECTS OF THE LEFT VENTRICLE?

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Background: The role of Technetium-99 m (Tc-99m) labeled tracers has been discussed for the detection of viable myocardium. One of the methods that is considered to be used in the diagnosis of viability is gated myocardial perfusion imaging (gMPI) conducted under the influence of beta blocker drugs (BBD).

Objective: The aim of this study is twofold: First, to evaluate the role of the beta blocker drugs (BBD) on fixed perfusion defects on gated myocardial perfusion imaging (gMPI) (myocardial viability) and second, to assess the role of BBD on the functional parameters of the left ventricle.

Method: 31 patients (28 men, 3 women) who were on BBD treatment and had fixed perfusion defects on their gMPI and submitted to fluorodeoxyglucose positron emission tomography/computed tomography (FDG PET/CT) were prospectively enrolled to the study. One week after the completion of the stress-rest gMPI, rest gMPI was repeated to each patient while they were on BBD treatment. All systolic and diastolic functional measurements, perfusion defect extent and size were obtained during both rest gMPI studies with and without BBD. The parameters derived from FDG PET/CT were compared to those that were derived from gMPI without BBD.

Results: A statistically significant difference between the scores of both groups was not observed, except the time to peak filling rate (TTPFR). End-systolic/diastolic volumes derived from gated FDG PET/CT were significantly lower than the ones derived from the gMPI presumably due to higher spatial resolution of the FDG PET/CT while the study didn't reveal a statistically significant difference between the ejection fraction values.

Conclusion: According to our results, metoprolol doesn't seem to change functional parameters of the left ventricle that were detected by gMPI except TTPFR. Besides, it seems that metoprolol doesn't affect the size of the perfusion defect, and therefore, it doesn't have a role to demonstrate the presence of viability that was confirmed via FDG PET/CT.

Key words: beta blocker; ¹⁸F FDG PET/CT; gated myocardial perfusion imaging; fixed perfusion defect; metoprolol; viability



NEW PET-CT TRACERS IN THE BALKAN PENINSULA – ARE THERE HERE ALREADY AND HOW TO ACCELERATE THEIR ARRIVAL AND WIDESPREAD USE?

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VELIKO TARNOVO

PET-CT remains one of the fastest developing nuclear medicine imaging modalities. After the introduction of F-18 FDG almost half a century ago, even nowadays FDG-PET accounts for more than 90% of all PET imaging procedures in North America and Europe, and almost 100% in the emerging markets. There are numerous reports describing the introduction and patient use of both generic (F-18 FLT, F-18 sodium fluoride, F-18 florocholine, F-18 FET, F-18 FES) and proprietary (AMYVID, NEURACEQ, VIZAMYL) new PET tracers in the academic centers and in private nuclear medicine clinics; yet none of them has become as popular as FDG. This phenomena is a result of both drug availability issues and confusing and contradictory regulatory environments. This presentation will address the questions plaguing the popularization of new PET-CT tracers in the emerging markets (including the Balkan countries) and will review possible pathways to overcoming them.



SPECT-CT IMAGING OF SENTINEL LYMPH NODES (SLNS) – TECHNICAL ASPECTS

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Lymphoscintigraphy (LS) allows the surgeon easily to identify and biopsy the sentinel lymph node in various malignant diseases mainly in breast cancer and melanoma. The first node draining the lymphatic flow from primary tumor site is defined as “Sentinel Lymph Node - SLN”. The method of selective biopsy of SLN is based on the hypothesis that at the absence of metastatic lesions, other lymph nodes are not involved. But if the metastatic growth is found in it, then a radical axillary dissection is mandatory due to a possibility of infiltrating of the neighboring lymph nodes. ^{99m}Tc-nanoparticles of human serum albumin is a radiotracer widely used for subcutaneous administration in lymphoscintigraphy. It is applicable in SLN imaging because of the ability to map nodes on tumor drainage pathway through the intralymphatic kinetics of the tracer. Nodes visualization is considered influenced by several factors as method and site of injection, volume and administered dose of used radiopharmaceutical, scanning time, performed imaging techniques – dynamic, planar, SPECT. The recent studies provide results showing the clinical role of technological developments involving hybrid SPECT-CT cameras for the detection of SLNs. Clinical protocol for SPECT-CT imaging of SLN in melanoma and breast cancer in our Department is as follows:

1. ^{99m}Tc-Nanocoll with average size of particles between 50-80 nm was used. The tracer was injected subcutaneously in cases with outer tumor location or peri-tumoral in cases with inner or central tumor location. The specific radioactivity was 37 MBq at the injection point in a volume 0,2 - 0,3 ml for superficial application in breast cancer patients and in volume 0.5-1 ml for deep administration around tumor.
2. Planar images were acquired 30-60 min p.inj. in anterior, oblique and lateral positions for 10min/view on SPECT-CT camera, SyngoT2, Siemens. SPECT-CT of the chest was performed after planar imaging up to 2 hrs p.inj; 30sec/frame. Low-dose CT was used (130kV; 30mA). Late SPECT-CT (more than 3 hrs p.inj.) were carried out in 3 cases with non-visualization
3. Dynamic study after subdermal application of the tracer on the 4th sites around the melanoma scar was acquired for 15 min (30sec/frame) followed by planar and SPECT-CT studies (Low Dose CT: 130 kV, 30mA).
4. Transmission scans using refillable ^{99m}Tc plexi-glass source were realized.
5. Tattooing to externally localize the SLN position was accomplished.
6. Radio-guided SLN biopsy was performed at the Department of Thoracic Surgery in Military Hospital.
7. Histological examinations were carried out using standard method H&E. Immunohistochemistry was carried out for total Cytokeratin AE1/AE3.

In conclusion SPECT-CT improved SLN detection and shows exact topographic location of all SLNs for radio-guided biopsy.



RADIATION EXPOSURE OF PEDIATRIC PATIENTS ON PET/CT SYSTEM

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The radiation doses delivered to patients undergoing PET/CT are relatively low, but repeated procedures may lead to significant cumulative doses. This is of a particular concern for pediatric patients, because of their higher tissue radiosensitivity and longer life expectancy.

The purpose of this survey was to estimate paediatric patient doses from all PET-CT procedures performed during the period 2012-2016 and to explore potential for optimisation.

Data were retrospectively collected for all paediatric patients examined with the system GE Discovery 600 until 2016. The following parameters were recorded for all patients: indication and type of examination; patient's age, weight, height and gender; tube voltage (kV); tube current (mA); pitch; rotation time; slice width and number of frames; CTDI_{vol}; administered activity of the radiopharmaceutical ¹⁸F-2-fluoro-2-deoxy-D-glucose (FDG). Two types of examinations were performed: whole-body or head.

Large variations in CTDI_{vol}, up to 5, were found within one of the age groups. For head examinations the average CTDI_{vol} varied between 1.8 and 2.2 mGy for different age groups. The average administered activity for the same type of examination varied between 123 and 187 MBq (the lowest value was observed in the age group 5-9 y). Pure correlation was found between administered activity and patient weight.

The average CTDI_{vol} for the whole body PET/CT varied between 1.2 and 3.8 mGy. The average administered activity varied between 90 and 279 MBq. For this examination strong correlation was found between administered activity and patient weight for all age groups except 1-4 y. Automatic exposure control was used for all the patients, types of examinations and body regions. Good practice for patient dose registration and records has been observed.

A potential for optimisation of procedures was found. Recommendation was given for proper selection and registration of the exposure parameters for the CT part of examination according to patient age and weight. Low dose paediatric head CT protocols should be developed. A protocol for appropriate manipulation and administration of radiopharmaceuticals according to patient's weight should be implemented and reduction of total exposure time in the department.



THE ADVANTAGES OF PERFORMING STRESS-ONLY MYOCARDIAL PERFUSION IMAGING (MPI) IN A BUSY GREEK NUCLEAR MEDICINE DEPARTMENT

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Background

The purpose of this study is to evaluate the advantages of performing Stress-Only MPI protocol. The European and American Guidelines for Myocardial Perfusion Imaging (MPI) suggest that rest SPECT images are not acquired when stress images are normal.

Method

The study was conducted in the Nuclear Medicine Department of Onassis Cardiac Surgery Center. Data from a period of 15 months was analysed (Jan 2015- March 2016). When stress MPI is normal, rest images provide no additional prognostic value, and are therefore eliminated. One-day protocol was performed using a stress dose of 8-10 mCi Tc^{99m} Sestamibi and a rest dose of 18-20 mCi Tc^{99m} Sestamibi.

Results

4952 patients underwent MPI using Tc^{99m}Sestamibi , 1114 of which (22.5%) performed a stress-only imaging protocol. The practice of omitting rest images resulted in the decrease of the test's duration (90 min compared to 2-3 hours) which is more convenient for both patients and staff. It also improves the logistics of the department. It has as a result a lower radiation exposure to the patients 2.7mSv vs 9.3mSv (when both stress and rest imaging is performed). By using stress-only protocol a reduced occupational exposure to the staff of the nuclear medicine laboratory is expected. In addition, this practice reduces the cost of the department as with the same number of vials we can perform a larger number of examinations.

Conclusion: Stress-only MPI has many benefits. It helps the logistics of the department, saves time, contributes in reduction of radiation exposure, and improves cost-effectiveness of the examinations, without any compensation of its quality, diagnostic accuracy and prognostic value.



CLINICO-EPIDEMIOLOGICAL STUDY OF THYROID CARCINOMAS

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Background: Thyroid malignomas (TM) are heterogenous group of neoplasmas. Epidemiological data indicates that TM are most frequent endocrinological tumors, participating with around 1 % in all malignomas. Etiology involved in the development of thyroid carcinomas includes external influences, as well as constitutional predispositions and genetic etiological factors.

Aim: Our aim was to perform detailed analysis of epidemiological and clinical data of diagnosed thyroid carcinomas in our country for period 1999 - 2010 and to correlate those data with previous similar studies on the same population.

Materials and methods: We performed retrospective analysis of medical data of all diagnosed and treated thyroid carcinomas at Institute of pathophysiology and nuclear medicine for above mentioned period. Analyzed cohort is representative for our population. Demographic data, clinical characteristics at initial presentation and follow up features were analyzed.

Results: A total of 204 cases of TM were registered, with three time higher rate of thyroid carcinomas in female (153 pts) then male patients (51 pts). Most of the cases were encountered in population age 30 to 60 years. Papillary thyroid carcinoma (PTC) with 131 pts (64,2%) was most frequently found, followed by follicular thyroid carcinoma (FTC) with 13 pts (6,37%), medullary thyroid carcinoma (MTC) 12 pts (5,88%), anaplastic 11 pts (5,39%) and most rarely found was Hurthle cell adenocarcinoma in only 1 patient (0,49%). Annual incidence rate was 0,49/100.000 population for 2003 and had increased up to 1,1/100.000 in 2006. Most of diagnosed tumors were with dimensions 15 - 50 mm (42,65%), small tumors < 15 mm accounts for 9,8% and occult carcinomas were 5,88%. Initial neck lymph nodes involvement was found in 26,96% of all diagnosed thyroid carcinomas. Total thyroidectomy was performed in 145 (71,08%), in only 6 (2,94%) cases lobectomy was done and near total thyroidectomy in 9 (4,41%) patients. Postoperative complications were registered in only 18 pts (11,7%) with laryngeal recurrent nerve paralysis and 9 pts (5,8%) ended with hypoparathyroidism. Only 19 pts (9,3%) developed distant metastases during follow up. Conclusions: We found increased incidence of thyroid carcinomas in our country in comparison to previous epidemiological data, mostly attributed to the PTC. When compared to epidemiological studies in other European countries and US Cancer statistics data, we have still very low incidence rate of thyroid carcinomas. Frequency distribution in age groups and incidence rate among sexes are similar with described in literature. Further studies are needed to elucidate the low prevalence rate of thyroid carcinomas in our population, is it due to environmental factors or is it a result of underdiagnosed microcarcinomas.

Key words: *Thyroid carcinoma, epidemiology.*



IRST MOBILE PET-CT SCANNER IN BULGARIA AND THE BALKAN PENINSULA – CHALLENGES AND SOLUTIONS

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SHUMEN

PET-CT is one of the most innovative nuclear medicine imaging modalities in many emerging markets, including the Balkan countries. Unlike North America and Western Europe, our countries face issues such as budgetary restrictions, unstable, incomplete and limited supply of PET radiopharmaceuticals, and insufficient number of motivated nuclear medicine specialists. This makes it very difficult for numerous oncology and university centers in Eastern Europe to procure their own PET-CT scanners and set up their full time PET diagnostic operations. A similar problem is faced by nuclear medicine departments in the developed world as well, not due to budgetary restrictions, but because of some medical centers remote geographic locations (arctic regions, isolated islands) and the fewer number of patients they serve. The mobile PET-CT scanner solution is a most perfect approach in such cases. Here we present the successful installation and licensing of the first mobile PET-CT scanner in Eastern Europe, based in Oncology Center Shumen, Bulgaria. The challenges we faced and continue to face, and our solutions will be presented as well.



COMPARISON OF GALLIUM-68 AND FLUORINE-18 IMAGING CHARACTERISTICS IN POSITRON EMISSION TOMOGRAPHY.

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This presentation compares PET imaging performance with Gallium-68 (⁶⁸Ga) and Fluorine-18 (¹⁸F). In these days, Gallium-68 has gained much attention because the Ga-68 generator is convenient to use and it has reasonable half-life for imaging studies.

Gallium-68 (⁶⁸Ga) is becoming a relevant isotope for routine clinical examinations because of the availability of commercial germanium-68 (⁶⁸Ge) generators (271 days half-life) that allow obtaining ⁶⁸Ga on-site without the need for a cyclotron. The ⁶⁸Ge/⁶⁸Ga generator can be used for 1–2 years. However, Ga-68 has lower positron yield (89.1%) and longer positron range due to higher positron energy ($E_{max}=1,899$ keV) than F-18 (96.7% and 633 keV).

Keywords: Germanium-68 (⁶⁸Ge) generators; Fluorine-18 (¹⁸F), Positron emission tomography, PET/CT hybrid scanner.



THE ROLE OF 18F-FDG-PET-CT IN RESTAGING AND MANAGEMENT OF PATIENTS WITH COLORECTAL CANCER

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Colorectal carcinoma is the third most common cancer worldwide. It consists mainly of adenocarcinoma which in most cases is 18F-FDG avid. Thus the evaluation of patients with known or suspected recurrent colorectal carcinoma is an established indication for FDG-PET/CT imaging.

We analyzed a total number of 58 consecutive patients (Pts) with colorectal carcinoma ranging from stage I to stage IV. 30 (52%) of them with histopathologically verified adenocarcinoma of the colon and 28 (48%) with rectal adenocarcinoma. All of them has undergone surgical resection of the primary tumor and chemotherapy. The investigated Pts met the following inclusion criteria– there was either an elevated tumor marker in 18 (31%) cases, suspicion from another imaging modality of recurrence of the disease – 15 (26%) cases or a need for a follow up of the treatment response- in 25 (43%) cases. In addition to the standart PET OSEM reconstruction algorithm we have processed all images with the new Q.Clear algorithm, which according to the first literature data shows up to 2 times improvement in both PET image quality and quantitation accuracy.

Using the revised RECIST the Pts have been divided in categories as follows: complete response – 23 (39%), partial response -4 (7%), stable disease –4 (7%) or progressive disease - 27 subjects (47%).

In two of the patients with unclear results from the conventional reconstruction Q.clear has helped us to make more certain diagnosis with a better visualization of the zone of interest. As a result of the performed PET/CT studies in all of the patients with progressive disease the treatment plan was changed.

In conclusion we could say that PET/CT is a technique of choice for restaging Pts with colorectal cancer and adjustment of the treatment strategy

Keywords: FDG-PET/CT, recurrent colorectal cancer, clinical impact, treatment strategy



IS THE PRIMARY IMMUNE THROMBOCYTOPENIA THE ONLY INDICATION FOR RADIOLABELLED PLATELETS APPLICATION?

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The first platelet labelling was performed in 1956 (Leeksa and Cohen) for the purpose of platelet lifespan estimation. Platelet sequestration site could not be determined because the labelling was performed with beta emitter phosphorus-32 (^{32}P -DFP). Aas and Gardner in 1958, and Najean in 1959, managed to label platelets with gamma emitter chromium-51 (^{51}Cr - Na_2CrO_4), although the labelling efficacy was low. Platelet sequestration site was determined by the use of thyroid system (gamma scintillating probe), but no images could be obtained because of the low gamma photon yield during radioactive decay of ^{51}Cr and its relatively high energy for gamma camera detection. In 1976 Thakur introduced indium-111-oxine for platelet labelling. Indium-111 had better labelling efficacy than chromium-51, and thanks to its convenient physical characteristics, it was for the first time possible to get images of labelled platelet distribution in the patient.

At Clinical center of Serbia in Belgrade we perform autologous platelet labelling with In-111 oxinate since 1991. Due to unfavourable economic situation (numerous war refugees from the neighborhood, the war destruction of the country thereafter) the supply with indium-111 oxinate was not always possible. Nevertheless, we performed 688 autologous platelet separation and labelling procedures.

In order to verify our separation and labelling method adequacy, we investigated six healthy subjects (4 females and 2 males), aged 31 - 43 years. Platelet blood count on the day of platelet labelling ranged from $214 - 266 \times 10^9/\text{l}$. We obtained 8-10 days lifespan with mean value of 9 days (normal values range from 7 to 10 days). This results confirmed that our separation and labelling procedures did not affect platelet lifespan.

We consider initial platelet kinetics investigation (performed during the first 20 minutes after ^{111}In -Pt intravenous injection) to be the most sensitive indicator of slight cell disturbance. Therefore we perform it (besides the platelet labelling efficacy parameters) as a part of routine quality control of platelet labeling in each and every patient that we examine.

The aim of this lecture will not be only to present method of autologous platelet separation and labelling with indium-111 oxinate, the importance of platelet lifespan, sequestration site and production investigation in chronic immune thrombocytopenia (pre-operative prediction of planned splenectomy result; differentiation between low platelet production and chronic immune thrombocytopenia, which is not easy without it even with myelogram or bone biopsy results; detection of accessory spleens after splenectomy and their role in thrombocytopenia assessment, etc.), but also to show the capability of labelled platelets to discover different causes of low platelet blood count (due to their role in infection and inflammation or due to augmented platelet consumption, with the localization of the problem) and to depict important life-threatening states in

the investigated patients (unstable atherosclerotic plaques, recent thrombosis, arterial graft reocclusion, etc.).

More than 25 years lasting experience at Clinical center of Serbia in Belgrade and large data base will enable me to show practical examples of benefit to the patients from this kind of investigation.



ADVANTAGES OF SPECT/CT IN THE DIFFERENTIAL DIAGNOSIS OF BENIGN AND MALIGNANT BONE LESIONS IN PATIENTS WITH ONCOLOGIC DISEASES

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Bone scintigraphy is a sensitive method that can detect significant metabolic changes very early, often several weeks or even months before they become apparent on conventional radiological imaging. Osteotropic radioisotopes are bone seeking agents that accumulate at the site of active bone production regardless of whether the aetiology is benign or malignant.

Diagnostic sensitivity and specificity of bone scanning can be significantly increased by using SPECT/CT.

Our study included 1269 patients with different primary malignancies - 34% with breast carcinoma, 19% with prostate cancer, 47% with other different solid tumors. Staging whole-body bone scintigraphy with ^{99m}Tc- MDP was performed in all patients. Pathologically increased accumulation of the radiopharmaceutical was found in 269 (21%) patients and targeted SPECT/CT was performed to clarify these findings. In our analysis 53% of the lesions proved benign, 23% - malignant and 23% remained suspect and required further active follow-up. SPECT/CT helped in differentiating unclear bone lesions in 76% of the patients.

In oncology, tomographic hybrid images should be used not only for better localization of unclear lesions on planar scans but also in patients with high pretest tumor marker levels, recurrent cancer, or an advanced tumor that predominantly metastasizes to bone to increase sensitivity and specificity of bone scintigraphy.



THE IMPACT OF PET/CT IN THERAPEUTIC MANAGEMENT OF PATIENTS WITH LYMPH NODE METASTASIS AND CANCER OF UNKNOWN PRIMARY

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Recent data suggest that cancer of unknown primary (CUP) accounts for approximately 3-5 % of all malignant neoplasm's and therefore represents the seventh to eighth most frequent type of cancer and fourth commonest cause of cancer death. Despite of general poor prognosis of these patients, the favorable sub-sets are proven to respond to treatment and have better life expectancy. The aim of the study is to evaluate the role of positron emission tomography/computed tomography (PET/CT) in detecting primary site in patients with lymph node metastasis and guide treatment management.

Material and methods: Fifty three patients (aged from 35 to 72 years) were evaluated and followed up since 2012 to 2016 period by FDG-PET/CT on GE Discovery 16T, using the weight adjusted activity, 60 minutes delay between injection and registration, hydration of patients with diuretic stimulation by furosemide and oral/ i.v. contrast intake. The inclusion criteria were patients with proved malignant histology by lymph node biopsy or by highly suspicious data from other imaging modalities, which were divided into several groups according to the primary location - (gr.LN neck, n= 39),(gr.LN axilar, n=6), (gr.LN inguinal, n=3),(gr.LN mediastinal, n=2) and (gr.LN retroperitoneal and pelvic, n=3).

Results: By performing PET/CT the primary tumor was successfully found in 19 (35,8 %) of the patients with highest positive rate in head and neck region (9p, 16,9%) , followed by lung cancer (5p, 9,4%), breast cancer (2p, 3,7 %), sarcoma (1 p), lymphoma (1 p), prostate cancer (1 p). Six patients (11,3%) were found to be TN (true negative) with no further treatment after the PET/CT examination. There were two false negative (FN) results, which are proved in the time to be carcinoma of breast and nasopharynx and one false positive result, which was not confirmed by the guided biopsy. In twenty-five (47,1 %) patients the primary site was not found and they were guided for different types of treatment according to the extent of the disease. The calculated average survival rate, based on the date of pet/ct examination and the date of initial diagnosis were 238,9 days and 324,8 days, respectively.

Conclusion: Our results demonstrates positive PET/CT findings in almost one third of the patients with highest positive rate in the diagnosis of head and neck tumors. PET/CT is a valuable tool in planning treatment strategy, following up therapy response and could be used successfully for more precise determination of the so called "favorable subgroups", which are proved to have better prognosis and benefits of the treatment.



DIAGNOSIS AND EVALUATION OF CONGENITAL ANOMALIES OF THE KIDNEY AND URINARY TRACT - THE EXPERIENCE OF NUCLEAR MEDICINE/PEDIATRIC NEPHROLOGY/SURGERY CENTERS.

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Scintigraphic examination in congenital anomalies of the kidney and urinary tract is very useful because it provide functional, morphological and topographic information.

We started our activity in 2007; we evaluate about 400 patient/year and the youngest patient was 4 weeks.

We present our experience in pediatric nuclear examination regarding: 1.Obstruction Syndrome (Furosemide renal scan): evaluate functional significance of hydronephrosis; determine need for surgery; obstructive hydronephrosis - surgical treatment; non-obstructive hydronephrosis - medical treatment; monitor effect of therapy. 2. Urinary tract infection in vesico ureteral reflux (dynamic and static study), acute and chronic pyelonephritis (Tc99m DMSA). 3. Diagnosis of congenital anomalies (Renal Cortical Scintigraphy): Agenesis; Ectopy ; Fusion (horseshoe, crossed fused ectopia) ; Polycystic kidney; Multicystic dysplastic kidney; Pseudomasses (fetal lobulation, hypertrophic column of Bertin). 4. Renal artery stenosis diagnosis and quantification (Captopril renal scan) in children with unilateral nonfunctional or hypoplastic kidney. 5. Differential diagnosis of kidney masses – cold defect: focal (acute/chronic pyelonephritis), hydronephrosis, cysts, tumor, trauma (contusion, laceration, rupture, hematoma), Infarct.



REVIEW OF OUR EXPERIENCE IN TREATMENT OF LIVER TUMORS WITH Y-90 SIR-SPHERES

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AIM: The review of our experience in treatment of liver tumors with Y-90 sir-spheres, an emerging and evolving therapy option.

Materials and methods: Between October of 2012 and July 2016, 14 patients (mean age 67±6 years old) with unresectable liver tumors were treated in our hospital with radioembolization. Criteria for selection of the specific therapy were unresectable liver tumors non responding to chemotherapy. Seven (7) patients had metastases from colon cancer, 4 patients had hepatocellular cancer (HCC), 1 patient had metastases from holangiocarcinoma, 1 from pancreatic cancer and 1 from breast cancer.

At the initial phase of the therapy the patients underwent angiography for identifying anatomic variations and coil embolization of hepatic artery branches that supply extra-hepatic organs (gastroduodenal, right gastric etc.). In the second phase the patient underwent a Tc-99m MAA SPECT/CT for calculation of lung and gastrointestinal shunt and tumor to normal liver calculations. If all the requisites were in concordance with guidelines the patient proceeded within 4 weeks to therapy. In 6 patients the therapy was performed in one phase with subsequential administration of the microspheres through the right and left hepatic artery. In 6 patients the therapy was performed in two phases with 4-6 weeks interval, while in 2 patients the therapy was performed with superselective administration (HCC cases). Patient's dose was calculated with the BSA method.

Results: From a technical aspect the procedure was successful in all the patients. One patient 15 days from the radiopharmaceutical administration developed a REILD syndrome and deceased. The specific patient had a major tumor burden and borderline bilirubin levels (1,8 mg/dl). The rest of the patients did not develop any major complication. Minor side effects like fatigue were given supportive care. Two patients did not respond to the therapy with rapid disease progression, 4 patients had an excellent response with necrosis of the tumor sites within 3 months, while the rest of the patients showed a relatively mixed response with overall slowing of disease progression for about 9-12 months. Overall patients reported an excellent tolerance to therapy with no major undesirable effects on life quality.

Conclusion: Radioembolization when performed with the right planning is a procedure with good results and minor side effect for the patients compared with other treatments. The combination of the method with first line chemotherapy (SIRFLOX study) is expected to expand the usage in earlier cancer stages.



^{99m}Tc-PHYTATE: TEACHING AN OLD RADIOPHARMACEUTICAL NEW TRICKS

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Introduction

^{99m}Tc-Phytate, when injected into the organism, reacts with calcium found in the serum, forming particles in the nanometer range (< 200 – 300 nm). This size can favor its extravasation into tumor, inflammation or other porous lesions through the enhanced permeability and retention (EPR) effect. The aim of this work is the evaluation of the use of ^{99m}Tc-Phytate to assess inflammation in mice.

Methods

^{99m}Tc-Phytate was prepared by reconstitution of a Phytacis cold kit (IBA Molecular). The radiochemical yield was assessed by Thin-Layer Chromatography, as described in the SPC, using Whatman 1 paper and MeOH/H₂O (80/20 v/v) as the solvent system. The pH of the radiopharmaceutical was 6 and the radiolabeled product was kept at RT before use.

Biodistribution studies were performed in male Swiss Albino mice at 2 h and 24 h p.i., after intravenous administration via the tail vein. For the sterile inflammation model, mice were injected in the left thigh muscle with 100 µL of turpentine. The mice were then allowed to recover for 24 h before being injected with 100 µL (3.7 MBq/100 µCi) of the radiotracer via the tail vein. The animals were sacrificed by cardiectomy under slight ether anaesthesia and the main tissues and organs (blood, heart, liver, stomach, intestines, spleen, muscle, lungs, pancreas, muscle and bones) were excised. Radiolabelled complex biodistribution over time was expressed as injected dose per gram (%ID/g).

Results

The radiochemical purity of ^{99m}Tc-Phytate was 98% ± 0.5 as measured by thin layer chromatography. Biodistribution measurements reveal a significant uptake in the inflamed thigh (0.54 ± 0.11 % ID/g at 2h p.i. and 0.13 ± 0.07 % ID/g at 24h p.i.), when compared to radiotracer uptake in the control tissue/non-inflamed thigh (0.17 ± 0.10 % ID/g at 2h p.i. and 0.05 ± 0.01 % ID/g at 24h p.i.). Moreover, as expected there is a high uptake in the liver and spleen.

Conclusions

^{99m}Tc-Phytate has the ability to form particles (nm) when injected into the circulation, so it can be effective in the detection of inflammation through porous vasculature leaks. The results were promising and have prompted us to continue our work toward the development of ^{99m}Tc-Phytate as an imaging agent for inflammation.



THE ROLE OF FDG PET/CT IN DIAGNOSIS AND FOLLOW UP OF THE CARDIAC DISEASES: BEYOND VIABILITY ASSESSMENT

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The purpose of this review is to highlight the utility of FDG PET/CT for diagnosis and management of different cardiac diseases beyond viability assessment. Special emphasis would be put toward cardiac sarcoidosis (CS), extrapulmonary tuberculosis' pericarditis (TBP) and endocarditis. The advantage of FDG PET/CT is that it can detect FDG accumulation in the activated inflammatory cells, allowing visualization of active sites of CS, TBP and endocarditis. The development of appropriate preparation protocols that minimize physiological FDG uptake in the myocardium and optimal imaging protocols that allow sensitive and accurate detection of CS, TBP and endocarditis will be discussed. In CS, aside from early diagnosis, FDG PET/CT may inform when to start the therapy and whether the patient responded to treatment. FDG PET/CT may also be useful for follow-up and risk assessment of patients with CS. TBP, most commonly as pericardial effusion, is present in 2% of extrapulmonary TB. It could be also life threatening and FDG PET/CT could be useful in diagnosis and in evaluation of treatment response. Final part of this review will be on the role of FDG PET/CT in diagnosis of endocarditis based on European Society of Cardiology guidelines published in 2015.

The limitations of FDG PET/CT are discussed with respect to a radiation exposure and control of glucose metabolism and insulin levels to avoid non-specific myocardial uptake of FDG.

Key words: *18F-fluorodeoxyglucose, PET/CT, Cardiac Sarcoidosis, Extrapulmonary Tuberculosis' Pericarditis, Endocarditis*



QUALITY CONTROL OF SPECT/CT IN BULGARIA

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The diagnostic information obtained from a nuclear medicine procedure is contained in the images of the distribution of radiopharmaceuticals that emit gamma rays that are transmitted through body tissues and externally detected. Compared with other imaging modalities, nuclear medicine images have higher statistical fluctuations (image noise) and poorer spatial resolution.

To optimize the image quality, a great deal of effort has been devoted to using all the available gamma rays efficiently and to make sure that the imaging systems are in proper working order. That is the mission of quality control (QC) - to check the multiple parameters of gamma camera (GC) responsible for its perfect performance and to detect problems of the systems before they impact on clinical patient studies.

A regular quality control (QC) of nuclear medicine equipment is established in Bulgaria since 2003. Here we present our 14 years experience in implementation of QC procedures for gamma cameras in Bulgaria and the problems encountered. In particular we show the essential difference between the reliability of results obtained by QC procedures and by preventive service maintenance procedures. The difference mentioned so far affects the following aspects: reliability of quantitative results, quality of reconstructed tomographic images to name a few.

The annual QC of SPECT/CT in Bulgaria is already an established practice. Almost every our visit in a NM department reveals a problem, which requires a service intervention. This validates the usefulness of a QC program activity and encourage some of NM departments to require QC of SPECT/CT more than once per year.



REDUCING THE HISTOPATHOLOGICAL CHANGES OF RADIOIODINE TO THE LACRIMAL GLANDS BY A POPULAR ANTI-OXIDANT: LYCOPENE

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Radioiodine (RAI) has been used for the treatment of hyperthyroidism and well-differentiated thyroid carcinoma for more than 70 years. Lycopene is an anti-oxidant, which is plentiful in red fruits. The purpose of this study was to investigate the possible inhibitory effect of lycopene on the RAI-induced acute histopathological changes in rat lacrimal glands. In this experimental animal study, 32 rats were randomly divided into three groups. The first group (control group, n=8) was not given neither ¹³¹I nor lycopene, the second group (RAI group, n=12) was administered a single dose of 3 mCi ¹³¹I and 1 cc physiologic saline by gastric gavage. The third group (lycopene group, n=12) was administered 3 mCi ¹³¹I and 1 cc lycopene by gastric gavage. After 24 h of the last dose, the animals were decapitated on the seventh day and their lacrimal glands were removed for histopathological examination. According to study results, the cell shape and the cell size variation and poorly defined acidophilic cell outlines in all lacrimal glands were observed significantly less frequently in the lycopene group than in the RAI group. In the conclusions, our histopathological examinations have revealed that lycopene prevents rat lacrimal glands against RAI-related acute histopathological changes.

Keywords: Anti-oxidant, lacrimal glands, lycopene, radioiodine, radioprotection, rat.



OPTIMIZED CONTRAST-ENHANCED CT PROTOCOL FOR DIAGNOSTIC WHOLE-BODY 18F-FDG PET/CT: TECHNICAL ASPECTS OF SINGLE-PHASE CONTRAST CT IMAGING

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Background

The use of CT contrast in combined imaging has been the subject of debate among PET/CT users, the reason being that standard, segmentation, and other scaling methods of CT-AC fail to adequately scale contrast-enhanced tissues or filled organs, thus giving rise to artifacts or obtain a non satisfying image quality putting a patient into additioanla radiation exposure, compared to the stadndard CT protocol. However, most of these issues can be addressed by using modified imaging protocols. The aim of this study was to compare various PET/CT examination protocols that use contrast-enhanced single-phase CT scans and to determine the best fitted injection parameters which would occur most quality computer - tomographic image depending on the patient characteristics. Material and methods: There were examined over 300 patients with different malignant tumors on PET/CT Discovery 600, 15 slices system, using contrast-enhanced single phase whole body CT scan by injecting an average of 90 ml of intravenous contrast (Ultravist 370; iodine at 370 mg/mL) with flow rate of 3 ml/s, 3.5 ml/s and 5 ml/s, depending on the patient characteristics /blood vessel damage after chemotherapy/ and the type of intravenous catheter (22G or 20G). Patients were divided into 3 groups (protocols) according to the delay of the contrast injection: Group A (140 patients): with delay of 30s; Group B (100 patients) : with delay of 40s; Group C (60 patients): with delay of 60s. A final 6 point scale evaluation of the image quality was performed by two qualified experts, including a radiologist and nuclear medicine physician. Results: Our results demonstrated that the best image quality was achieved in the early phase protocols (A and B), presenting with satisfying arterial phase image enchantment for head and neck region and intermediate phase enchantment for liver and abdominal area in 190 (63%) of the examined patients. This protocol (A or B) seems to fit best in patients with good performance status, with suspected head and neck tumors/lymphoma or liver metastases. In the rest of the patients 110 (37%) the image quality of the contrast enhanced CT scan was not satisfying due to the very long delay (60 s.) or the use of narrow intravenous catheter and lower injection speed, respectively, in patients with blood vessel damage. Our practice demonstrated that in this particular patient group the CT scan should be initiated in no more than 5 second after the end of the contrast injection in order to obtain a satisfying intermediate phase enchantment into the abdominal area. Conclusion: Optimized Single Phase CT protocols presented a technical advantage in patients with good performance status providing hybrid PET/CT images with higher quality and more complex diagnostic information compared to the non-enhanced CT. Nevertheless, each protocol should be adapted to the particular patient characteristics, including age and blood vessel status as well as to the suspected disease localization and examination purposes.

Receptor-oriented 68-Gallium labeled peptides – recent developments and new trends

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⁶⁸Gallium-PET (⁶⁸Ga-PET) offers significant clinical advantages. The radionuclide ⁶⁸Ga can be eluted on demand from a ⁶⁸Ge/⁶⁸Ga generator, presenting a convenient alternative to cyclotron-produced PET isotopes. The long shelf life of such a generator, combined with a pleasant Ga³⁺ complexation chemistry result in a growing interest in development of new ⁶⁸Ga-labelled compounds, including somatostatin analogues, CCK/ gastrin receptor and glucagon-like peptide receptor tracers, gastrin-releasing peptide receptor targeting peptides, RGD peptides, vascular adhesion protein-1 and vascular endothelial growth factor binding agents, PMSA inhibitors, affibodies and nanobodies.

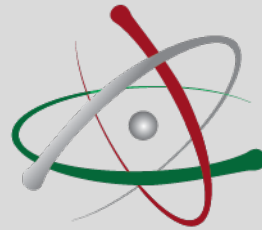
We report recent trends in development of receptor-binding ⁶⁸Ga labeled peptides, advantages, disadvantages and fields of application, with RGD-peptides under the scope.

The Arg-Gly-Asp (RGD) sequence binds with the $\alpha v\beta 3$ integrin that is expressed on the surface of angiogenic blood vessels or tumor cells. Angiogenesis imaging is important for diagnostic and therapeutic evaluation of many malignant and nonmalignant diseases such as breast and lung cancer, glioma, myocardial infarction, moyamoya disease, atherosclerosis, psoriasis. We characterize a few potent ⁶⁸Ga-RDG biomarkers for angiogenesis (PET) imaging.

Key words: ⁶⁸Ga-PET, RGD peptides, ⁶⁸Ga-labelled peptides, angiogenesis.

POSTERS

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INTRODUCTION OF A NEW WB-SPECT/CT PROTOCOL IN THE DIAGNOSIS OF LYMPHOPROLIFERATIVE DISEASES

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A new Whole-body (WB)-SPECT/CT protocol for diagnostics of lymphoproliferative diseases has been proposed and introduced as daily routine in the Clinic of Nuclear medicine by Dr. L. Chavdarova.

Applying this protocol 48 studies were performed in the Clinic in the period 1.01.2016 - 1.11.2016. The histologic entities were as follows: Non-Hodgkin lymphoma – 20 patients; Hodgkin lymphoma – 13; Chronic Lymphocytic Leukaemia – 15.

The participation of the technician in performing the study includes the preparation, the right positioning of the patient and the technical acquisition operations with the hybrid scanner.

The preparation of the patient includes removal of all metallic objects (belt, earrings, necklace etc.). Five minutes after the intravenous application of ^{99m}Tc -TF/MIBI and emptying of the bladder the patient is set in supine position on the SPECT/CT (Symbia T16), with one's arms above the head and the feet right to the edge of the bed. The scan includes two or three bed positions hanging on the patient's height and starts from the middle of the thighs up to skull basis. The parameters of low-dose WB-SPECT/CT are as follows:

SPECT: photo-peak 140 keV, matrix 128x128, zoom 1, 180° rotation with 32 detector positions, time per frame 8 s, autocontour;

Low-dose CT: 130 kV, 20 mAs, $t(\text{rot.})=1$ s, pitch– 1,5, slice 3.0 mm.

The duration of the study is about 20 minutes.

The introduced image protocol improves image quality and semiautomatic measurements and leads to better diagnostic accuracy due to precise correlative assessment of SPECT and CT in the staging and follow-up of patients with lymphoproliferative diseases.



PET/CT AND SURVIVAL IN LUNG CANCER AS A MULTIPLE PRIMARY TUMOR

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Aim of the study

To determine the significance of PET/CT in the diagnosis of lung cancer as a multiple tumor and to define the therapeutic management and patient prognosis.

Material and methods

We examined 26 patients with PET/CT – 10 men (35,7%) and 16 women (64,3%), at the age 35-80 years with lung cancer as a multiple primary tumor, between July 2009 and July 2012. The patients were staged according to TNM. The survival was followed up until April 2016. Survival analysis was performed by Kaplan-Meier method.

Results

The lung cancer was first tumor in 5 patients and second tumor in 21 patients. It was synchronous tumor in one case. The lung cancer has developed as metachronous tumor for 1,5 to 35,25 years. The median for development of second tumor is 3,5 years. Most often the lung cancer is multiple together with colon carcinoma or corpus uteri carcinoma. The squamous cell carcinoma and adenocarcinoma prevail each one in 7 cases of lung cancer. Eight patients were found in III and IV stage. The total survival rate in lung cancer as a multiple tumor (in months) has Mean=29,1, SE=5,6, 95% CI (18,1; 40) and Median=22,3, SE=4, 95% CI (14,5; 30).

Conclusions

The patients with lung cancer as a multiple tumor are more often female, with similar rate of squamous and adenocarcinoma, and diagnosed predominantly in III and IV stage. The median for development of the second tumor is 3,5 years, while the median of average survival after diagnosis of the lung cancer is 22,3 months. PET/CT in lung cancer together with other tumor contributes for the more accurate localization and assessment of tumors dissemination, hence for their adequate treatment.

Key words: lung cancer, multiple tumors, survival, PET/CT



CLINICAL IMPACT OF 223 RADIUM AND 68GA-PSMA PET/CT IN A PATIENT WITH BIOCHEMICAL RECURRENCE OF PROSTATE CANCER

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A 57 year old patient with history of high risk prostate cancer (pT3b, PSA 39 ng/ml, Gleason score 2) underwent laparoscopic prostatectomy in 2015, together with complete antiandrogen deprivation. He remained with undetectable prostate-specific antigen levels (SA < 0,003 ng/ml) until July 2015 when he then presented rising PSA levels up to 0,72 ng/ml and performed a bone scintigraphy with insignificant to absent tracer uptake in the thoracic spine. Restaging images with pelvic MRI, FDG PET/CT and Choline PET/CT were also negative. The patient is referred as a biochemical recurrence without morphological evidence and was directed for postoperative radiotherapy with overall dose of 66 Gy. In January 2016 the PSA rises up to 5,54 ng/ml and the patient underwent 68 Ga PSMA PET/CT that showed a remarkable PSMA uptake in eight thoracic vertebra consistent with bone metastases. Therefore in March, 2016 the patient is referred for radiotherapy of the thoracic spine (DOD 25 GY up to OOD 25 GY, BED 108 GY), together with new hormonal treatment for castration-resistant prostate cancer, including Enzalutamide (160 mg). As a result the PSA levels declines significantly, but still at a detectable level (<0,18). Since the 68 PSMA PET/CT did not revealed any metastatic spread in the soft tissue, in May 2016 the patient was considered for 223 Radium (Xofigo) therapy. After four applications of 223 Ra the he was restaged again with 68 PSMA PET/CT which revealed a complete metabolic and morphologic response to the treatment, with undetectable PSA levels <0,00 ng/ml. In addition the PSMA scan demonstrated a significant uptake in the jaw as well as in the kidney region signaling for initial jaw necrosis and renal insufficiency. Based on this imaging result the patient was considered in complete remission and the prescheduled two additional applications of 223 Ra were rejected. **In conclusion**, PET/CT PSMA can be very useful in detecting recurrent disease in patient with biochemical failure and negative conventional imaging results and may play a major role for stratifying patient management - local radiotherapy treatment, systematic treatment or targeted therapy with 223 Radium. In addition it might have a significant benefit in monitoring of treatment response even after 3-4 cycles of 223 Ra reducing the need for additional radiation and drug toxicity exposure. The treatment with 223 Ra seem to have a satisfying positive results in a patient with initial metastatic spread in the bone.



CALCULATING THE EFFECTIVE DOSE OF PATIENT UNDERGO PET/CT PROCEDURES ON PHILIPS GEMMINI TF FACILITY

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Background

F-18 FDG is the most common PET/CT radiotracer used in oncology. In Bulgaria PET/CT was first installed in 2009 to the Nuclear Medicine Department in St. Marina University Hospital, Varna. It is used for diagnostic purposes (oncology, neurology and cardiology) and for treatment planning in radiotherapy. In 2013 the on site "dose on demand"[®] F-18 FDG production cyclotron was installed at the above mentioned hospital.

Aim

As we have more than seven years opportunity working with PET/CT and we have injected more than 16 000 patients using F-18 FDG, we can make the evaluation of average effective dose of patient from PET/CT procedure. The aim of this study is to collect and analyze the data and evaluate the radiation exposure of patients from PET/CT procedure.

Methods: From the data that we have gathered 7 years now we took 100 patients with whole body scans and we calculate the effective dose of patient from one diagnostic PET/CT procedure. We calculate separately dose from CT and dose from PET and at the end the effective dose from the whole PET/CT procedure. We also calculate the effective doses of patients undergo PET/CT procedures more than once.

Results

As a result we determine that average effective dose of patient undergo PET/CT procedure is under 12 mSv, as it is around 7 mSv from CT and 5 mSv for PET.

Conclusion

Analyzed data from radiation exposure of the patients undergo PET/CT procedure show decreases of dose in the years. This is caused due to changes of EANM guidelines for PET/CT procedures on the one hand and on the other hand the fact that the latest years we rely on ALARA rule - injecting lower activity and increasing the time for bed position as we do not cause any changes of the image. As a result we keep the good quality and achieve lower doses for patients.



REOPERATIVE SENTINEL LYMPH NODE MAPPING IN MALIGNANT CUTANEOUS MELANOMA

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PLEVEN

Introduction: Sentinel lymph node / SLN / biopsy is currently “the gold standart” for patients with Malignant cutaneous melanoma whose primary tumor has thickness between 1 – 4 mm or more according to Breslow. We use lymphoscintigraphy as preoperative procedure in cases of certain or ambiguous Lymphatic drainage to identify lymph node(s) in the lymph basin (s) that are at risk of harboring metastasis. SLN biopsies are used to identify intraoperatively only by using patent blue dye.

Here we analyzed the effectiveness of this procedure.

Patients and methods

Clinical and operative details are retrieved from the maintenance database. In all patients' cases the procedure is performed after diagnostic surgical excision between 1 – 3 mm from tumors margins. Lymphoscintigraphy is conducted on Dual Head gamma camera Toshiba CGA 7200 UI. The visualized lymph nodes are projected and marked on the skin via point radioactive source under monitoring control.

Results

From January 2012 till Decembre 2016, 50 patients with malignant cutaneous melanoma, Breslow between 1 – 4 mm underwent lymphoscintigraphy before SLN biopsies and radical surgical treatment on primary tumor site. Intraoperatively before procedure was injected 1-2 ml patent blue dye near the scar of diagnostic excision. Only in two cases was it impossible to find the sentinel lymph node – patients with tumors on skin of the head: hair-bearing area. In fifteen patients SLNs were more that one Lymph basin. In one case we have allergy to patent blue dye, in five cases there was unpredictable drainage.

Conclusion

Preoperative lymph node mapping was conducted by using lymphoscintigraphy in patient with malignant cutaneous melanoma. That is a useful procedure which allows: successful SLN biopsy, to identify regional Lymph node basins at risk and also enable the clinicians to understand if there is unpredictable lymph drainage – ectopic basins or nodes.



ADVANTAGES OF ^{99m}Tc-SESTAMIBI/^{99m}Tc-PERTECHNETATE SUBTRACTION SCINTIGRAPHY IN THE EVALUATION OF THYROID MALIGNANCY

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Introduction

^{99m}Tc-sestamibi (MIBI) imaging is a valuable method for the investigation of parathyroid disease, contributing to the determination of the optimal strategy in patients with primary hyperthyroidism. However, image interpretation may be challenging in the presence of thyroid lesions.

Case report

A female patient, 46 years old, was referred to our department for parathyroid scintigraphy. PTH levels were increased (129 pg/mL) and neck ultrasound findings were indicative of parathyroid adenoma at the right inferior pole of the thyroid gland. The depicted nodule (17x23x16 mm) was homogeneously hypo echoic to the overlying thyroid tissue, from which it was clearly separated by an echogenic capsule. Hyper-vascularity was also observed. Scintigraphic evaluation revealed the presence of a MIBI avid lesion at the same anatomical site. Nevertheless, thyroid scan with technetium-99m pertechnetate showed a photopenic area at the site of the nodule. Consequently, taking into account the results of ^{99m}Tc-sestamibi/^{99m}Tc-pertechnetate-subtraction scintigraphy, the observed lesion could also correspond to a thyroid malignancy. The patient was treated surgically (minimal invasive technique) about a month later. Intraoperatively, a reduction of about 40% in PTH levels was recorded, while no other abnormal tissue was found at the region. Rapid biopsy processing supported the diagnosis of parathyroid adenoma, excluding the possibility of papillary thyroid carcinoma. Interestingly, based on the final histopathological examination, the lesion possibly corresponded to oncocytic follicular thyroid tumour.

Conclusions

Although the "single-isotope, double-phase" technique may provide the required information for the accurate diagnostic investigation in patients with primary hyperparathyroidism, the subtraction scintigraphy seems to be more accurate and helpful in many cases, particularly in those with complicated or uncommon pathology. Therefore, it is performed as a standard imaging procedure in our department. In our presentation, we will further discuss the advantages of this technique as well as other available techniques, including SPECT and SPECT/CT.



NUCLEAR IMAGING OF FAMILIAL TRANSTHYRETIN CARDIAC AMYLOIDOSIS - A CASE STUDY

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Background

Amyloidosis is a rare but potentially fatal disease characterized by excessive building up and tissue deposition of various abnormal proteins. In different forms of the disease different tissues and organs can be affected. Significant cardiac involvement is most often present in cases of familial and senile transthyretin amyloidosis and light-chain amyloidosis. There are several radiotracers that could be successfully implemented in the diagnosis of cardiac amyloidosis, differentiating amyloid subtype and monitoring patients over time.

Methods

We present a case of familial transthyretin amyloidosis (ATTR) in a 53 year old male with recently confirmed mutation on gene for transthyretin. Patient was complaining of weight loss, diarrhea, signs of peripheral neuropathy, fatigue and exertional dyspnea in past two years. Within his cardiac workup, a nuclear study was asked by referring cardiologist. We performed 99mTc-pyrophosphate scintigraphy (99m Tc-PYP) with both planar and SPECT imaging at one and two hours post injection. Semi-quantitative visual score as well as quantitative analysis by drawing region of interest over heart and corrected for contralateral counts to calculate heart-to-contralateral ratio (H/CL) was done.

Results

Visual scan analysis showed prominent diffuse cardiac uptake of the radiotracer. When compared to bone uptake, cardiac uptake was higher and visual semi-quantitative score was 3. Quantitative analysis confirmed intense myocardial retention with high H/CL ratio of 1.76. According to the literature data, H/CL ratio ≥ 1.5 has high sensitivity and specificity for identifying ATTR type of cardiac amyloidosis.

Conclusions

99mTc-PYP scintigraphy is simple and available nuclear method for both diagnosis and confirmation of ATTR subtype of cardiac amyloidosis. It can be used along with other imaging tests, such as echocardiogram and cardiac MRI, in the complete cardiac workup of affected individuals.



PRESENTATION OF RARE HISTOPATHOLOGICAL VARIANT OF MIXED MEDULLARY-FOLLICULAR THYROID CARCINOMA

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Introduction: Thyroid carcinomas are most frequent endocrine tumors. Differentiated thyroid carcinomas arising from follicular cells are predominant, while Medullary thyroid carcinoma (MTC) originating from neuroendocrine calcitonin producing C-cells are less common and according to epidemiological data constitutes only 2 – 8% of all thyroid carcinomas. Mixed presentations of Medullary and Follicular thyroid carcinomas (FTC) are very rare type of thyroid tumors and their diagnosis and treatment are still challenging.

Case presentation: One year ago 18 years old female presented at Institute of pathophysiology and nuclear medicine with tachycardia, fatigue and positive familial history for thyroid disorders, mother with hypothyroidism and grandmother from father's side deceased from aggressive metastatic FTC with bone and lungs involvement. First ultrasound examination detected small hypoechoic lesion 10 mm in diameter in the middle of the right thyroid lobe and clinically and biochemically euthyroid state. After 3 months ultrasound examination revealed besides first lesion, another one small 12 mm, irregular in shape hypoechoic lesion in isthmus. Ultrasound guided fine needle biopsy (FNAB) was performed and cytopathology finding revealed high suspicion for malignant lesion, category V, Bethesda system for reporting thyroid cytopathology. Total thyroidectomy was performed and according to histopathology, confirmed by immunohistochemical staining, Mixed Medullary-Follicular Thyroid carcinoma was diagnosed. According to pTNM staging IVA stage was concluded due to infiltration of tracheal fibrous tissue. Molecular analysis of genomic DNA revealed two homozygous polymorphisms at RET proto-oncogene: G691S and L769L. After surgery ablation with radioiodine was performed. Levothyroxine suppressive doses were started. Initial calcitonin postoperatively was 78,9 pg/mL. After 3 months thyroglobulin and CEA levels were low, but there was increase in calcitonin level (116 pg/mL). Ultrasound examination didn't reveal persistent loco-regional disease.

Conclusion: Mixed Medullary – Follicular Thyroid carcinomas are rare thyroid histopathological variant of thyroid malignoma. Treatment and follow up is combination of therapy management and follow up protocols for both Medullary and Follicular thyroid carcinomas. In this case because of elevated calcitonin level alkaline DMSA is considered to be done. There are not sufficient recommendations for follow up options and prognosis for this variant of thyroid carcinoma. Future recommendation should include more precise analysis of mixed thyroid tumors.

Key words: Mixed Medullary- Follicular, Thyroid carcinoma, Calcitonin.



THE ROLE OF RADIOLOGY TECHNICIAN IN THE DAILY QUALITY CONTROL OF SINGLE-PHOTON EMISSION COMPUTED TOMOGRAPHY (SPECT-CT)

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Introduction

Quality Control is a very important and essential factor for the proper and normal functioning of the SPECT-CT. Performing permanent quality control ensures production of test results that are with high diagnostic value. The daily procedures of quality control are observed by the radiology technician in collaboration with the medical physicist.

Purpose

The purpose of the quality control procedures is to prepare the SPECT-CT for optimum functionality. Professionals are seeking constant high quality of the produced images. Carrying out quality control on a daily basis helps uncover possible changes in the optimum operation parameters on time.

Discussion

The daily work of the radiology technician includes Tube Warmup, FastCalibration, and system check-up to secure patient safety.

Performing constant quality control of the SPECT-CT ensures images that are qualitative and with good contrast, and provides safety for the patients.

Conclusions

Regular observance of the quality control procedures determines that images that are produced will be of high diagnostic value, and that the device will be used safely. The produced quality images help doctors to interpret the results properly.



PET/CT IN LYMPHOMA PATIENTS AFTER STANDARD CHEMOTHERAPY

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Background: The lymphomas are a heterogeneous group of malignant disease. The exact diagnosis, precise staging and follow up is very important for treatment and prognosis of patients with malignant lymphomas. Accurate pretreatment evaluation and response assessment are critical to the optimal management of patients with lymphoma. Differentiation of post-therapeutic residual tissue from active lymphoma is unsatisfactory when using only morphological imaging approaches. Positron emission tomography/computed tomography (PET/CT) is the most sensitive and specific imaging technique for monitoring therapy response currently available for patients with lymphoma after standard chemotherapy and to determine which patients would benefit from additional treatment.

Aim: The aim of the study was to assess the clinical value of 18F-FDG PET/CT for diagnosis, staging and response evaluation in lymphoma patients with Hodgkin's disease - and non-Hodgkin's lymphoma.

Material and methods: 226 patients with biopsy proven Lymphoma - Hodgkin's disease (HD), n-92 and non-Hodgkin's lymphoma (NHL) n- 134 , aged from 18-76 years, were investigated. These patients were examined 4-6 weeks after the end of the standard chemotherapy by 18F-FDG PET/CT, according to the accepted protocol. PET/CT will be used to assess response in FDG-avid histologies using 5-point scale, both for interim analysis and for end of treatment assessment. The Lugano classification has proved extremely useful in the standardization of treatment response. A score 1, 2, 3 is considered to represent complete metabolic response; score of 4, 5 – partial, no response or stable disease.

Results: Two patients groups were formed by applying PET/CT results: 1.group- a negative PET results was observed in 153 patients (Deauville score 1-3) and 2.group- 73 patients with PET/CT positive results (partial metabolic response or progressive disease). Using Deauville criteria complete response was observed in 95 patients (62%) HD and 58 (38%) NHL patients. These patients were in continuous complete remission. Twenty seven patients with HD (37%) and 46 with NHL (63%) had partial response, stable or progressive disease (Deauville score 4-5). Thirty one of them had one hypermetabolic lesions and 52 - disseminated nodal or extranodal involvement located in the lungs, thyroid gland or bones. All reported localizations of persistent residual uptake were in the original disease site seen at baseline staging. PET/CT revealed 3 previously unknown additional lesions in two patients, undetected by conventional visualization methods. The patients with one hypermetabolic lesions were considered for radiotherapy, while patients with more than one nodal and extranodal lesions after completion of standard chemotherapy were considered for high dose chemotherapy ± autologous stem cell transplantation (ASCT).

Conclusion:18F-FDG PET was useful in patients with HD and NHL after standard chemotherapy treatment not only for determination of those who need additional therapy, but for the choice of the further management: radiotherapy, chemotherapy, or ASCT. A negative PET/CT study is also an excellent predictor of good prognosis. Positive PET/CT after the end of therapy is a strong predictor of relapse.



IMPACT OF BONE SPECT/CT IN RENAL ECTOPY DETECTION – CASE REPORT

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Radionuclide bone scan is a cornerstone in nuclear medicine imaging. It is the most sensitive method for diagnosis of bone metastases from different malignancies.

The most frequently used radiopharmaceutical is ^{99m}Tc-MDP. It has a biexponential plasma clearance with up to 60 % accumulation in the skeleton and up to 34% urinary excretion. This makes it possible to detect not only skeletal, but also kidney function pathologies.

We present a breast cancer patient, who had radical right mastectomy in 2011. During the follow-up the patient was screened several times for skeletal metastases with bone scintigraphy. The first planar whole-body bone scan showed slightly increased accumulation in the pelvis which was reported as external contamination. The finding persisted on the following scintigraphy without being further reported. At the time of the last control study we performed SPECT/CT of the area and detected an ectopic kidney with congenital pelvic location.

This case proves once again the impact of hybrid techniques for accurate diagnosis.



APPLICATION OF HYBRID IMAGING METHOD - SINGLE PHOTON EMISSION TOMOGRAPHY / COMPUTED TOMOGRAPHY (SPECT / CT) IN A PATIENT WITH SQUAMOUS CELL CARCINOMA OF THE LEFT UPPER RIM.

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The head and neck neoplastic processes can be divided in two main types - squamous cell carcinoma (SCC) and basal cell carcinoma (BCC). The basal cell carcinoma is the most common malignant tumor of the skin (60-80%). It is characterized by local invasive growth and tendency to frequent relapses. Metastasis are very rare and can occur at a very late stage of development. Squamous cell carcinoma is the second most common malignant epithelial tumor of the skin with a high propensity for loco-regional spread through lymphatic system. The hematogenous spread in patients with SCC occurs only in about 10% of cases. Localization of distant metastases most often include lungs, brain, bones and skin.

In our case, we presented a patient with carcinoma of the gingiva and a rare abnormal localization of metastases in the bones of the forearm. Due to the unusual location of the changes detected with bone scintigraphy, we applied hybrid imaging modality SPECT / CT, which combines the capabilities of single photon emission tomography with those of CT for the purpose of morphologic clarification.



INFLUENCE OF THE BACKGROUND REGION OF INTEREST OVER VALUES OF GLOMERULAR FILTRATION RATE ESTIMATED BY ^{99m}Tc DTPA SCAN GATE'S METHOD COMPARED WITH CKD-EPI CREATININE EQUATION

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Objective

To compare the glomerular filtration rate (GFR) estimated by ^{99m}Tc DTPA scan using the Gate's method with four different background regions of interest (ROI's) and the GFR estimated by the CKD-EPI creatinine equation.

Materials and methods

The study included 86 patients (37 males and 49 females) that underwent dynamic renal scintigraphy with ^{99m}Tc DTPA scan at the Institute of Pathophysiology and Nuclear Medicine at the Medical Faculty in Skopje in the period between January 2015 and June 2016.

The GFR values were obtained with the following four different background ROI's for all included patients:

1. rectangle shape between the upper renal poles
2. semilunar shape on the external lower side
3. semilunar shape on the upper side
4. rectangle shape below the lower renal poles

The GFR was automatically calculated by a software in a commercially available computer according to the Gate's algorithm. The values were normalized for standard body surface area (BSA). The results are compared with the GFR values obtained by CKD-EPI creatinine equation for each patient with all different background ROIs. The statistical analysis was performed with Pearson's correlation.

Results

The statistical evaluation of the results has shown that the overall correlation between the methods is around $R^2 = 0.4$. The best relationship was acquired for the first chosen background ROI where the value of correlation coefficient was $R^2 = 0,4686$. All other ROIs showed lower correlation coefficient.

Conclusion

The background ROI is one of the factors that can influence the estimation of GFR by Gate's method. Our study showed that the rectangle shape between the upper renal poles is the background ROI that will give best correlation of GFR acquired by Gates method and GFR estimated by CKD-EPI.



FREQUENCIES OF CHROMOSOMAL ABERRATIONS AND MICRONUCLEI IN PATIENTS UNDERGOING ¹³¹I THERAPY FOR DIFFERENTIATED THYROID CARCINOMA

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Patients undergoing ¹³¹I therapy for differentiated thyroid carcinoma (DTC) after thyroidectomy were investigated to estimate the genotoxic risk of this therapy. Chromosomal aberration (CA) and micronuclei (MN) frequencies were analyzed in the peripheral blood lymphocytes of twenty-six patients underwent radioiodine ablation (RIA) or radioiodine therapy (RIT) after radical thyroidectomy. The amount of administered ¹³¹I activity was varied from 3,330 to 4,030 MBq according to the kind of therapy (RIA or RIT). Among patients three were male and 23 female with age ranged between 23 and 76 years (mean age: 48.6 years). Five of them were with previous therapy 6 months to 1 year before this therapy. Blood samples were collected along with routine blood tests immediately before and 1 month after ¹³¹I administration. The mean frequency of CA before treatment was $1.16\% \pm 0.36\%$ and increase to $2.3\% \pm 0.87\%$ after therapy. For MN results were $10.72\% \pm 5.84\%$ and $25.28\% \pm 12.6\%$ respectively. The differences are statistically significant.

Keywords: Chromosomal aberration, Micronuclei, ¹³¹I therapy, Genotoxic effect



DIAGNOSTIC CONTRIBUTION OF QCLEAR RECONSTRUCTION IN 18FDG-PET-CT

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Introduction

The accuracy for PET measurements using the routine OSEM (Ordered Subsets Expectation Maximization) image reconstruction algorithm is limited since it usually employs a low number of iterations to mitigate noise amplification, and thus convergence is never reached. The recently introduced Q.Clear reconstruction algorithm (Regularized Reconstruction Iterative Algorithm) controls noise at higher iterations by applying a relative difference penalty built into the objective function. Q.Clear is designed to provide excellent image quality and consistent and accurate quantitation.

The aim of the study was to compare PET-CT images obtained with standard reconstruction algorithm with those after QClear reconstruction and to assess the contribution of QClear in the diagnostic accuracy.

Material and Methods

We included randomly 29 patients with different oncological diseases. 38 lesions were assessed, in which PET-CT was performed for staging or restaging. PET-CT was performed using standard protocol on hybrid scanner Discovery IQ, GE Healthcare. The PET reconstruction is made using standard OSEM and for the first the new algorithm for reconstruction Q.Clear. The quantitative analysis of FDG uptake is performed with SUVmax. measurement in the lesions, mediastinum, liver and lung, using both reconstructed images from OSEM and Qclear,

Results

The comparison analysis of SUVmax. in SD reconstruction and QClear reconstruction demonstrates: SUV max in lesions increases with 30 % in QClear images, SUV max. in liver, lung and mediastinum do not differ significantly in the images from SD and QClear.

Conclusion: QClear reconstruction of PET-CT images allows: 1.differentiate normal from abnormal tracer uptake, especially in regions with high background uptake; 2.small lesions become visible, especially in lungs and liver; 3.study accuracy increases.



ABSENT THYROID UPTAKE DURING PLANAR 99MTC MIBI PARATHYROID SCINTIGRAPHY

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The aim of this case report is to describe the unusual pattern of 99mTc MIBI bio distribution during parathyroid scintigraphy.

The patient 37 year old female was referred to our department for parathyroid scintigraphy because of the signs of osteoporosis and laboratory findings that suggested hyperparathyroidism. She didn't have any other chronic disease or condition. The serum ionized calcium levels (1,43 mmol/L) and PTH levels (140 .1 pg/ml) were above normal. The tests for thyroid function (FT4, FT3, TSH, thyroid peroxidase and thyroglobulin antibodies) were in the normal range. The ultrasound revealed normal sized thyroid with isoechoic structure. At the posterior wall of the thyroid at the lower pole of the left lobe hypoechoic nodule was present with dimensions 8x10x17mm. The node was interpreted as parathyroid adenoma. The 99mTc pertechnetate scan showed normal sized and shaped thyroid, with homogenous distribution of the tracer. The patient didn't take any medications or supplements at the time and 3 months prior the scintigraphy.

Parathyroid scintigraphy was performed after iv injection of 740 MBq 99mTc MIBI. Early scan was obtained 10 minutes after injection with planar gamma camera. Late planar and SPECT scan were obtained 2 hours after injection. The early and late planar scintigraphy revealed increased uptake in the region below the thyroid bed on the left consistent with parathyroid adenoma. The unusual finding was complete absence of 99mTc MIBI uptake in the thyroid gland during both early and late planar scintigraphy. The uptake in the salivary glands and the heart was normal. The SPECT scan revealed very faint uptake in the thyroid gland in the coronal series which suggests a possible low uptake in the thyroid during the early scans that was not visible on the planar scans.

We couldn't find any plausible explanation for this very low 99mTc MIBI uptake in the thyroid that was not visible during the early & late planar scans. The conclusion from this case report is that during the interpretation of the parathyroid scintigraphy one should be aware of this possibility.



THE ROLE OF 18F-FDG PET/CT IN PATIENTS WITH HEAD AND NECK CARCINOMA FOR TREATMENT RESPONSE ASSESSMENT

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Objective: 18F FDG PET/CT is well known imaging technique for pretreatment staging, radiotherapy planning, restaging of Head and Neck carcinoma and detection of primary site in unknown primary tumors with cervical lymph node metastases (CUP).

Aim: We assessed the treatment response of PET/CT in patient with Head and Neck carcinomas.

Material and methods: We reviewed retrospectively 233 patients who underwent 18F-FDG PET/CT in University Hospital St. Marina Varna Bulgaria, between date January 2016 and November 2016 with diagnosis of primary Head and Neck carcinoma and unknown primary tumor with cervical lymph node metastases. We used PET/CT image technique for pretreatment staging, restaging of Head and Neck carcinoma and detection of primary site in unknown primary tumors with cervical lymph node metastases. We reviewed PET/CT images before and after treatment (radiotherapy and/or chemotherapy management) and assessed the treatment response. We included in our study 67 patients with 134 PET/CT exams.

Results: The various sites involved among the study group are larynx 14 (20.9 %), hypopharynx 10 (14.9 %), oropharynx 7 (10.4%), nasopharynx 11 (16.4 %), oral cavity 14 (20.9 %), nasal cavity and paranasal sinuses 2 (3.0 %), salivary glands 1 (1.5 %), oropharynx/hypopharynx 3 (4.5 %), pharynx 2 (3.0%), larynx/hypopharynx 1 (1.5 %) and CUP 2 (3 %). We included patients with histology proved squamous cell carcinoma 58 (86.6%), adenocarcinoma 2 (3.0%), lymphoepithelial carcinoma 4 (6%), mucoepidermoid carcinoma 2 (3%), malignant atypical fibroxanthoma 1 (1.5%). We used 18 F-FDG PET/CT for detected cervical lymph nodes, distant metastases, synchronous primary tumors, local tumor persistence after treatment and detected primary site of unknown occult tumor. Pretreatment 18F-FDG PET/CT found primary site in 2 patients with occult malignancy: histology report confirmed SCC cancer of larynx and SCC cancer of nasopharynx. PET/CT detected synchronous tumors in 2 patients: rectal cancer and renal cancer. Post-treatment PET/CT showed: tumor persistent in 12 patients, nodal persistent in 9 patients, new nodal sites of involvement in 1 patient, distant metastasis in 11 patients. The localizations of distant metastases: lung (45%), bones (27%), mediastinum (18%) and other (muscles and soft tissue 18%). We assessed partial response (PR) in 17 patients (25.4%), complete response (CR) in 38 patients (56.7%) and progression of the disease in 12 patients (17.9%).

Conclusion: ¹⁸F-FDG PET-CT is particularly useful for staging, restaging and radiotherapy planning as well as for assessment of treatment response in head and neck cancer patients.



MEASUREMENT OF IODINE 131 WITH GAMMA SPECTROMETRY PROBE INTO THE SEWAGE SYSTEM

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Nuclear medicine radiotherapy requires the use of unsealed radionuclide's that have the potential to expose not only the medical people (workers professionally exposed to ionizing radiations) but also members of the public, relatives and visitors. Usually, the main source of radiations exposure to the public and to the close relatives is the patient, himself, having been treated with radioiodine ¹³¹I either for hyperthyroidism or for thyroid cancer. Other radionuclide's might be used in therapy but usually they are pure beta emitters such as: phosphorus ³²P, strontium ⁸⁹Sr and yttrium ⁹⁰Y and pose much less risk. In the Republic of Macedonia, two public nuclear medicine departments and one private are dealing with radioiodine ¹³¹I therapy. The largest among of the three departments is nuclear medicine in Skopje, which performs approximately fifty patients per year treated with radioiodine ¹³¹I for thyroid cancer and about thirty patients treated for hyperthyroidism. Hyperthyroid patients are treated on outpatient basis, and their impact on environment is difficult to follow exactly. Thyroid cancer patients have to be hospitalized for three to four days and monitoring of external dose rate measurements are performed during their stay at hospital. A great percentage of the administered dose is released through the patient excreta within first 24 hours. For that purpose, a water gamma spectrometry monitoring system has been installed at the Radiotherapy and oncology unit where thyroid cancer patients are treated. In order to estimate the amount of released radioiodine ¹³¹I, from patient's excreta, the probe was placed into the sewage system. The installation of the equipment was a result of a bilateral collaboration between IRE Elit from Belgium and Radiation Safety Directorate from Macedonia. The design and the installation of the monitoring system were in charge of IRE Elit. Spectral data show both radioisotopes, radioiodine ¹³¹I and ^{99m}Tc, that are currently used in nuclear medicine department and released through the same sewage line. This system gives us opportunity to follow the presence of radioisotopes into the sewage system directly after release near the hospital. With installation of the aforementioned equipment, the Radiation Safety Directorate as a regulatory authority, established a monitoring of the radioactive discharges into environment, and ensured that the results are produced and verified every time when a radiation safety inspector visits the department.

Keywords: radioiodine, radioactive discharges, monitoring, gamma spectrometry



MODIFIED PROTOCOL FOR BONE SPECT-CT

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Aim

Establishing a new protocol for SPECT-CT bone scan, which includes low dose whole body CT.

In a six months period a total of 255 bone scan with SPECT-CT were performed in the clinic. The proposed protocol has been applied to 168 patients. Additional diagnostic information apart from the tumor area was localized in 50 of them /30%/.

Importance, diagnostic interest

The final interpretation of the results eventually could:

- change the stage of the disease
- save time for patients not to carry out two separate studies
- lead to a change in a patient's therapy

For overweight patients the modification of the protocol include improving image quality by changing mA – values close to the diagnostic ones. The reason - seeking potential tumor formations in the pelvis, additional pathological lesions in the soft tissues, abdominal and pelvic lymph nodes.

Conclusion

The new protocol could expand the diagnostic capabilities of SPECT-CT. The technology has important clinical significance to determine the exact stage of cancer and to make the right decision for adequate therapy.