The 4th Annual International ASNMT Conference

November 6, 2014.
Osaka International Convention Center, Osaka, Japan

Dear colleagues and friends,

On behalf of the Organization Committee, it gives me great pleasure and honor to welcome you to "**The 4th Annual International ASNMT Conference**", which will be held at Osaka International Conventional Center in Osaka, Japan, on November 6, 2014.

The Federation of Asian Society of Nuclear Medicine Technology has been established in 2011 in Japan. The 4th Annual International ASNMT Conference is aimed at providing a platform for academic exchanges and share valuable information in nuclear medicine technology with Asia countries.

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Once again, with open arms and warm regards, we welcome you all to Osaka, Japan!

Sincerely yours,

Hiroshi WATANABE (President, The Japan Society of Nuclear Medicine Technology)

Hiroyuki TSUSHIMA

(Chairperson of Executive Committee, The Asian Society of Nuclear Medicine Technology)

Invited lecture 1

Chairperson
Tomoaki YAMAMOTO
Graduate School of Health Sciences, Department of Medical Radiological Technology, Faculty of Health Sciences, Kyorin University, Japan

The Current Status of Nuclear Medicine in Singapore

Michael TONG
Department of Diagnostic Imaging, National University Hospital, Singapore

Local development of Nuclear Medicine in Singapore can be traced back to the 1980s where there was only one hospital providing such a speciality. Radionuclide therapy began in the same era with isotopes such as I-131, P-32 and Y-90.

With lifestyle changes in the years gone by and the prominent shift in chronic and noncommunicable diseases as the leading causes of mortality, the role of Nuclear Medicine in clinical management has become salient. From its humble beginning of imaging with single-head gamma cameras, Singapore has moved fast in adopting new technologies in the 21st century with hybrid imaging such as PET/CT, SPECT/CT and now PET/MR.

The past decade, in particular, has witnessed significant advances in the field of Nuclear Medicine in Singapore, in terms of both clinical and research capabilities and potential, all extensively documented.

Currently, Singapore has 18 gamma cameras, 6 SPECT/CTs, 7 PET/CTs and 2 cyclotrons serving a population of slightly over 5 million, carrying out in excess of 20 thousand nuclear medicine imaging and therapeutical studies annually. The country has also been hosting various international Nuclear Medicine training courses and meetings. Forward plans include continuous strives to upgrade current knowledge and growth in this field through exchanges, updates and learning from counterparts, to improve the clinical management of patients on a holistic level in the country.

Invited lecture 2

Chairperson
Kenta MIWA
Department of Nuclear Medicine, Cancer Institute Hospital of Japanese Foundation for Cancer Research, Japan

Current status of Nuclear Medicine in Viet Nam

Dang An BINH[1)], Bui Dieu HANG[1)], Tran Vu Quynh VY[1)], Ngo Thuy TRANG[2)], Mai Trong KHOA[2)], Trinh Thi Minh CHAU[3)], Nguyen Xuan CANH[4)], Nguyen Thi THU[5)]

1) Department of Nuclear Medicine, Cho Ray Hospital, Ho Chi Minh city, Viet Nam
2) Nuclear Medicine and Oncology Center, Bach Mai Hospital, Ha Noi, Viet Nam.
3) Department of Nuclear Medicine, University Medical Center, Ho Chi Minh city, Viet Nam.
4) PET/CT & Cyclotron Unit, Cho Ray Hospital, Ho Chi Minh city, Viet Nam.
5) Nguyen Thi Thu,Center for Reseach and Production of Radioisotopes, Nuclear Research Institute, Da Lat, Viet Nam.

Nuclear Medicine in Viet Nam has made a dramatic change since 2009. In 2009, there were only 2 cyclotrons, 4 PET-CT scanners and 1 SPECT-CT scanner in the country; by 2014 there have been 4 cyclotrons, 7 PET-CT scanners, 3 SPECT-CT scanners were being used in practical. The number of patient, who require for radioactive iodine therapy has increased every year.
Despite the improvement of high-tech equipment, the development of nuclear medicine in Viet Nam has two main limits. The first is the dependence on imported radioactive products and preparation kits from other country. We have a Nuclear Research Institute, which owns a Nuclear Reactor and is capable of producing several preparation kits; however, they can only provide a small amount of product compare to the large demand of nuclear medicine requirement. Some cyclotron can only make popular product because the lack of multi- purpose radiotracer synthesizer module and their small power. The second limitation is the inadequate training of the workforce. Nuclear medicine physician and technologist come from different background, which may create incoherence in clinical practice. Nuclear medicine physicist's major in universities is nuclear physic, they are lacking of proper medical training. Physician, technologist and physicist have to update their knowledge by self-study while working at a department of nuclear medicine in a hospital. In order to improve these above limitations, we are waiting permission to establish a distance assisted training program throughout the country for nuclear medicine technologist and the establishment of departments of nuclear medicine training in almost every medical university is conceived in the near future. Also, the construction of a new Nuclear Research Institute is being considered in a national strategy of nuclear energy application for peaceful purpose until 2020. In addition to social activities, the Viet Nam Association of Radiology and Nuclear Medicine was established in 1961 and the Viet Nam Association of Radiological Technologist was established in 2013. Annual conference was held once a year with the participation of both local and foreigners. Viet Nam also has a good relationship with international society of nuclear medicine, especially with IAEA, Japan and Korea, who frequently provide our country with technical assistance, education programs and cooperation in science research.

Scientific Paper Session 1 (Oral): SPECT imaging, Others 15:40~16:40

Chairperson

Kao-Yin TU

Department of Nuclear Medicine, Mackay Memorial Hospital, Taiwan

Kohei HANAOKA

Department of Radiology, Kinki University Hospital, Faculty of Medicine, Japan

Department of Nuclear Medicine and Tracer Kinetics, Osaka University Graduate School of Medicine, Japan

No. 01

Quantitative Analysis of ^{99m}Tc-TRODAT-1 SPECT by Skew Distribution

Department of Nuclear Medicine, E-DA Hospital

Po-Wei TU (Taiwan)

No. 02

Fundamental study of imaging conditions in ^{123}I-FP-CIT SPECT

Department of Radiological Technology, Chiba University Hospital

Koichi SAWADA (Japan)

No. 03

Combine use of chromogranin B may reduce the false positive rate of chromogranin A

Department of Laboratory Radioimmunoassay , Cathay General Hospital

Ya-Chieh FANG (Taiwan)

No. 04

The Study of Influence on Reducing Exposure Dose According to the Applied Flat-panel CT in Extremity Bone SPECT/CT

Department of Nuclear Medicine, Seoul Medical Center

Ji-Hyeon KIM (Korea)

No. 05

Gamma Camera Quality Assurance Survey

Mackay Memorial Hospital

Wen-Wen CHENG (Taiwan)

No. 06

Evaluation of personnel neutron dose in SK cyclotron center by using different personnel neutron dosimeters

Department of Cyclotron Center, Shin Kong Wu Ho-Su Memorial Hospital

Ming-Jay KUO (Taiwan)

Scientific Paper Session 2 (Oral): PET imaging 16:50~17:50

Chairperson
Shee Man CHO
Department of Nuclear Medicine, Asan Medical Center, Korea
Minoru TANAKA
Department of Radiology, Fukuoka University Hospital, Japan

No. 07

Evaluation of recovery coefficient for various positron emitters in preclinical PET scanner

Department of Nuclear Medicine and Tracer Kinetics, Osaka University Graduate School of Medicine
Takashi KAMIYA (Japan)

No. 08

Interobserver and Intraobserver Reproducibility of SUL Measurements in Reference Organs on FDG PET/CT

Department of Nuclear Medicine, Wonkwang University Hospital
Seong Su KIM (Korea)

No. 09

Effect of statistical noise on reproducibility and accuracy of maximum and peak SUV: a phantom study

Division of Molecular Imaging, Institute of Biomedical Research and Innovation
Go AKAMATSU (Japan)

No. 10

Consideration of Standardized Uptake Value (SUV) according to the Change of Volume Size through the Application of Astonish TF Reconstruction Method

Graduate School of Public Health, Yonsei University
Juyoung LEE (Korea)

No. 11

Clinical Usefulness of PET-MRI in Lymph Node Metastasis Evaluation of Head and Neck Cancer

Department of Nuclear Medicine, Seoul National University Hospital
Jung-Soo KIM (Korea)

No. 12

A new quantitative correction method for pulmonary nodules on chest FDG-PET

Tsukuba International University
Keisuke TSUDA (Japan)

Scientific Poster Session 11:30~12:00

P - 1

Effects of a tungsten rubber shield and time of flight on quality of cerebral images acquired using 3D PET and ^{15}O gas inhalation study

Tokyo Metropolitan Institute of Gerontology, Research team for Neuroimaging
Kei WAGATSUMA (Japan)

P - 2

The Evaluation of Usefulness of ^{99}Mo-^{99m}Tc Generator Using (n,γ) ^{99}Mo Developed by Korea Atomic Energy Research Institute

Department of Nuclear Medicine, Chonbuk National University Hospital
Han Kyung SEO (Korea)

P - 3

Improvement of patient compensation device to reduce movement at fusion imaging

Department of Nuclear Medicine, Inha University Hospital
Yong Gwi CHO (Korea)

P - 4

Hand Equivalent Dose of Nuclear Medicine Staffs in Lin Shin Hospital

Lin Shin Hospital, Nuclear Medicine Department,
Hui-Ping CHEN (Taiwan)

P - 5

Improvement of ways in restraining patient in nuclear medicine examination table to enhance patient's safety-sharing of experience

Chi Mei Hospital Nuclear Medicine Department
Lin Fan ZHEN (Taiwan)

Quantitative analysis of ^{99m}Tc-TRODAT-1 SPECT by skew distribution

Po-Wei TU [1,3], Yun-Hsuan HSU [1], Huei-Yung CHEN [1,2], Ming-Chia LIN [1], Yi-Chen WU [1,2], Yung-Hui HUANG [2], Tai-Been CHEN [2]

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2) Department of Medical Imaging and Radiological Sciences, I-Shou University, Taiwan
3) Department of Information Engineering, I-Shou University, Taiwan

Abstract:
The ^{99m}Tc-TRODAT-1 single photon emission computed tomography (SPECT) is used to diagnose the dopamine neurotransmitter diseases. However, the diagnostic results were difficult to quantify according to the pixels intensity. In this study, the retrospective experiment design was applied to collect effective cases. The skewness of images were utilized to quantify and classify negative and positive cases where are identified as Parkinson's disease. One hundred and forty seventy ^{99m}Tc-TRODAT-1 SPECT were involved in this study. The features of image are defined as target and reference skewness of 2D slice with respectively to including and excluding striatum corpus. The target and reference of skewness were shown statistically significant difference between negative and positive groups by Mann-Whitney U Test ($P<0.05$). The sensitivity, specificity and accuracy of skewness were higher that 75%. The area under receiver operating characteristic curve (AUC) is greater than 87.5%. The skewness of SPECT not only provides potentially significant feature to quantify negative and positive groups, but shows feasible and reasonable to be one of important classified factors in this study.

Keywords:
SPECT, ^{99m}Tc-TRODAT-1, Skewness

—The 4th Annual International ASNMT Conference—

Scientific Paper Session 1 (Oral): SPECT imaging, Others

No. 02

Fundamental study of imaging conditions in ^{123}I-FP-CIT SPECT

K. SAWADA[1)], T. IIMORI[1)], T. UMEZAWA[1)], K. SHIMOKAWA[1)], Y. BITO[1)], Y. MASUDA[1)], S. HIRANO[2)], T. UNO[3)]

1) Department of Radiological Technology, Chiba University Hospital, Japan

2) Department of Neurology, Chiba University Graduate School of Medicine, Japan

3) Diagnostic Radiology and Radiation Oncology, Graduate school of Medicine, Chiba University, Japan

Purpose:

This study is fundamental to research on imaging methods using a simulated striatum phantom in ^{123}I-FP-CIT-SPECT.

Methods:

The simulated striatum phantom was made with the ratios of the specific imaging areas to the non-specific imaging areas set in the range of 8:1, 6:1, 4:1 and 2:1 respectively. The images were acquired using a two-head gamma camera equipped with LEHR and ELEGP collimators. Projection images were obtained where the radius of rotation was 15 cm. The matrix size was 128×128, and the magnification factor was 1.5. Evaluations of image concentrations were performed with the three types of image reconstruction, FBP, OSEM and CTAC, and were performed regardless of whether attenuation and scatter correction was present. SBR was evaluated by the ratio of specific to non-specific concentrations of radioactivity bands at the striatum.

Results:

1. The type of collimator used wasn't significant.

2. The expected SBR ratios were not obtained, and the actual ratio concentrations obtained were unpredictable because reconstruction method, attenuation correction and scatter correction had at least some effect on image quality. In order to acquire both stable and reproducible image quality and SBR ratio, the combination of OSEM, CTAC without scatter correction was recommended.

Conclusion:

This study was performed using the simulated striatum phantom to determine optimal imaging conditions for clinical study. It was indicated that constructions of imaging protocols were important for future clinical studies of phantom simulations.

—The 4th Annual International ASNMT Conference—
Scientific Paper Session 1 (Oral): SPECT imaging, Others
No. 03

Combine use of chromogranin B may reduce the false positive rate of chromogranin A.

Ya-Chieh FANG[1)],Kuan-Yu CHEN[1)], Pei-Yun HO[1)], Ching-Yang YU[1)], Chia-Ching LU[1)], Ching-Ling LIN[1,2)]

1) Department of Laboratory Radioimmunoassay, Cathay General Hospital, Taipei, Taiwan
2) Department of Endocrinology and Metabolism, Cathay General Hospital, Taipei, Taiwan

As a tumor marker serum chromogranin A (CGA) is not only very useful for the screening of neuroendocrine tumors, its level is also significantly correlated with tumor burden, response to treatment, as well as the prognosis of patients with neuroendocrine tumors. Therefore clinicians are very concerned about how the CGA value is reported in their neuroendocrine tumor patients. Report such as “greater than the upper detection limit” appeared to be unacceptable for many clinical oncologists because this does not reflect the clinical result of their patients during treatment. This means that routine dilution for CGA sample may be necessary especially in those neuroendocrine tumor patients who undergo series of follow up check during their therapeutic courses. In the first part of this presentation we will report a case with high dose hook effect in his CGA sample when dilution was requested by our oncologist who thought that the original reported value of CGA did not match the clinical presentation of the patient. As the clinical use of CGA becomes more frequent we found that clinical use of proton pump inhibitor and impaired renal function become the 2 most encountered sources of falsely positive CGA in our RIA lab. In the second part of this presentation we will report our experience about how the concurrent use of both CGA and CGB could effectively solve the above problem and effectively identify those patients with neuroendocrine tumors.

—The 4th Annual International ASNMT Conference—
Scientific Paper Session 1 (Oral): SPECT imaging, Others
No. 04

The study of influence on reducing exposure dose according to the applied flat-panel CT in extremity bone SPECT/CT

Ji-Hyeon KIM

Department of Nuclear Medicine, Seoul Medical Center, Korea

Introduction:
Recently the demand of SPECT/CT increasing along with the interest in complex diagnostic information of CT. Therefore, in this study, the goal is to identify how much dose reduction exists when performing the extremity bone SPECT/CT using the flat-panel CT.
Materials and Methods:
The extremity bone SPECT/CT was performed with two equipments -BrightView XCT and Brilliance 16 CT to identify the exposed dose and image quality resulted by changing scan parameter (mAs) applying for both equipment respectively. The noise value of image and spatial resolution were measured with AAPM CT phantom. kVp was fixed to 120 mAs calculated at each mA (20,30,40,50,60,70,80) was applied to both equipments respectively. DLP were calculated at the same distance at respective mAs. Also, we acquired images and %contrast with NEMA IEC body phantom to confirm the effect on image. The output of statistics was analyzed by SPSS ver.18.
Result:
Regarding AAPM phantom, the noise decreased as the mAs increased and flat-panel had less noise than helical CT. Both spatial resolution are same by 0.75mm. With scan parameter (mA) growing, the value of DLP increased up to 54-216 mGy•cm at flat-panel CT and up to 177-709 mGy•cm at helical CT. Regarding IEC phantom, same sphere with varied mA shows that similar results.
Conclusion:
There is no significant differences of image quality in both flat-panel and helical CT when mA is changed respectively. Moreover, we can identify the reduction of exposure dose and confirm %contrast analysis value with maintaining image quality. Therefore, at the extremity bone SPECT/CT requiring high spatial resolution without the wide ROI, the flat-panel CT is considered to be more useful and it expected to result in the similar image quality with lower exposure dose compared to helical CT. Additionally, through this study, we expect to help the reduction of the unnecessary exposure dose.

Gamma camera quality assurance survey

Wen-Wen CHENG, In-Chi LIN, Kao-Yi TU

Mackay Memorial Hospital, Taiwan

Introduction:

Concerning the computed tomography, we started to survey in 2010 and put in practice on July, 2011. The issue that I'm going to discuss is accuracy of image and stability of the machine. The isotope introduced into the patients' body by different way will accumulate in specific organs and we acquire a series of images for diagnosis. Hence, accuracy of image and stability of the machine are important.

Methods:

The questionnaire design combines suggestion of SNM, NEMA, EANM, and IAEA. The questionnaire contents are: uniformity, with/without collimator, spatial resolution, spatial energy resolution, sensitivity map, linearity, centre of rotation (COR), SPECT reconstruction, system alignment, and physical phantom test.

Results:

Thus far, we received 46 completed questionnaires. All information we have at present is: Siemens company occupies 48% in Taiwan, General Electrical company (GE) has 38%, and Philips company has 14%. Siemens has 48% in northern, 10% in middle, 42% in southern; GE has lion share in northern, 70%, 9% in middle, 15% in southern, and 6% in eastern; Philips has 59% in northern, 8% in middle, 33% in southern.

Discussion:

We found out some disadvantages: 1.Some radiologists don't understand what is quality assurance or quality control, and the importance of it. 2. Some nuclear medicine departments don't have enough manpower or have other problems; they cut down the procedure of quality control and even shrink the practicing frequency and list to save the time. 3. There is no regulation about quality assurance of gamma cameras in Taiwan.

Conclusion:

For nuclear medicine, reducing radiation dose and increasing image quality are the most important things over a long term period. We believe that all of the hospitals in the world should.

Keywords:

Quality Assurance, Quality Control

—The 4th Annual International ASNMT Conference—
Scientific Paper Session 1 (Oral): SPECT imaging, Others
No. 06

Evaluation of personnel neutron dose in SK cyclotron center by using different personnel neutron dosimeters

Ming-Jay KUO[1,2], Fang-Yuh HSU[2,3], Ching-Han HSU[2], *Kuo-Wei YIN[1]

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2) Department of Biomedical Engineering and Environmental Sciences, National Tsing Hua University, Hsinchu, Taiwan
3) Nuclear Science and Technology Development Center, National Tsing Hua University, Hsinchu, Taiwan

Introduction:
The radionuclide ^{18}F is produced during the operation of cyclotron, when proton beam (9.6 MeV) bombard the ^{18}O-water target and occurred (p,n) reactions. The production yield of ^{18}F increased as beam current and amount of (p,n) reaction are increased. The doses and intensities of neutrons and secondary radiation around the cyclotron room are proportional to the amount of (p,n) reactions. The radiation damage caused by neutron is more serious than by photon; because of the radiation weighting factor for neutron is higher than photon's. Due to the complication and difficulty for neutron dose estimation, therefore, this study used the different personal dosimeters for estimating the neutron doses to the staffs and the environment during the operation of cyclotron.
Methods:
In this study, the personal neutron badges of optically stimulated luminescent dosimeter (OSLD) and thermal-luminescent-dosimeter (TLD) were used to estimate the neutron doses. Different neutron dosimeters were placed in the points with higher neutron fluence rate to estimate the neutron doses to the staffs and the environment during the operation of cyclotron. The dose results estimated by different methods using different neutron dosimeters were compared and discussed.
Results:
From the results, the higher dose rates of photon (6.40-16.88 uSv/45 uA/100 min) and neutron (4.19-10.28 uSv/45 uA/100 min) were found in the surrounding cyclotron. However, the outside of the cyclotron room was produced lower contributions of photon and neutron doses for the workers. The contributions of neutron dose could not ignore in the outside of the cyclotron room, when the workers needed stay for a long time. According to the results, the equivalent dose of a worker for a year were calculated about 0.81 mSv/y for Hn and 0.57 mSv/y for Hp(10) (assumed the frequency of operation cyclotron is 450 times per a year and the neutron radiation weight factor is 20). In order to approach ALARA, the workers would avoid into the cyclotron room and keep away from the surrounding of cyclotron room, when the cyclotron was operated.
Keywords:
OSLND, Neutron dose, TLD Badge, Cyclotron

—The 4th Annual International ASNMT Conference—
Scientific Paper Session 2 (Oral): PET imaging
No. 07

Evaluation of recovery coefficient for various positron emitters in preclinical PET scanner

Takashi KAMIYA[1, 3], Tadashi WATABE[2], Genki HORITSUGI[1], Keiko MATSUNAGA[1], Yasukazu KANAI[2], Hayato IKEDA[1], Hiroki KATO[1], Mana ISHIBASHI[1], Kayako ISOHASHI[1], Eku SHIMOSEGAWA[1], Kouichi FUJINO[3], Jun HATAZAWA[1]

1) Department of Nuclear Medicine and Tracer Kinetics, Osaka University Graduate School of Medicine, Japan
2) Department of Molecular Imaging in Medicine, Osaka University Graduate School of Medicine, Japan
3) Department of Medical Technology, Division of Radiology, Osaka University Hospital, Japan

Objectives:
Position travels through tissue with losing their proper energy principally by Coulomb interactions with electrons. Although preclinical PET system has high spatial resolution, travel length (positron range) affects spatial resolution. The purpose of this study was to evaluate difference in recovery coefficient of preclinical PET systems among positrons with different positron range.

Methods:
The National Electrical Manufactures Association (NEMA) NU 4-2008 image-quality phantom was filled with O-15 (maximum positron range in water=8.0 mm), N-13 (5.1 mm), C-11 (3.9 mm) and F-18 (2.4 mm) labeled liquid. The PET images were reconstructed with 2 dimentional OSEM (OSEM-2D. Pixel size and transaxial field of view were 0.776 mm and 10 cm.

Results:
In O-15 labeled liquid, recovery coefficient values of 1, 2, 3, 4 and 5 mm were 0.14, 0.28, 0.43, 0.56 and 0.70. In C-11 labeled liquid, recovery coefficient values of 1, 2, 3, 4 and 5 mm were 0.19, 0.65, 0.84, 0.87 and 0.93.

Conclusion:
Recovery coefficient was different among positron emitters depending on their positron range.

—The 4th Annual International ASNMT Conference—
Scientific Paper Session 1 (Oral): SPECT imaging, Others
No. 08

Interobserver and intraobserver reproducibility of SUL measurements in reference organs on FDG PET/CT

Seong Su KIM

Department of Nuclear Medicine, Wonkwang University Hospital, Iksan, Korea

Purpose:
The use of SUV which should be normalized by lean body mass (LBM) is recommended for PET response criteria in solid tumors. LBM which was determined by whole body CT was used for SUV normalization (SUL) in this study. The purpose of the present study was to assess interobserver and intraobserver reproducibility of SUL measurements in reference organs.

Methods:
F-18 FDG PET/CT was conducted on 52 subjects and LBMs were directly determine by whole body CT for normalization of SUV. The 3 cm diameter spherical VOI, 1×2 cm cylindrical VOI, 2 cm diameter spherical VOI were placed in the liver, descending aorta and spleen, respectively. Experienced two observers measured SULmax and SULmean in each organ. Repeated measurements were conducted two weeks apart by observer 1 blind to previous results. Similarly, measurements were conducted on the same patients by observer 2. For assessing reproducibility (or repeatability), the paired t-test, Pearson's correlation coefficients (CC), and technical error of measurement (TEM) were calculated.

Results:
For interobserver reproducibility in liver SULmax and SULmean, no significant differences were found between observers (paired t-test, p=0.536, 0.293, respectively). CC and TEM for liver SULmean were 0.909 (p=0.000) and 0.067 SUL unit, respectively. Corresponding figures for liver SULmax were 0.882 (p=0.000) and 0.117 SUL unit, respectively. For intraobserver reproducibility in liver SULmax and SULmean , no significant differences were observed within observer1 (paired t-test, p=0.374, 0.268, respectively). CC and TEM for liver SULmean were 0.924 (p=0.000) and 0.061 SUL, respectively. Corresponding figures for liver SULmax were 0.908 (p=0.000) and 0.104 SUL, respectively. Similarly, no significant differences were found in SULmax and SULmean of the spleen and aorta between observers.

Conclusion:
The current study demonstrated that both SULmean and SULmax measurements in normal reference organs are highly reproducible. Reproducibility of SULmean in reference organs were slightly better than SULmax. Interobsever technical error of measurement was less than 0.10 SUL unit for liver SULmean , and 0.12 SUL unit for liver SULmax. Intraobsever technical error of measurement was less than 0.07 SUL unit for liver SULmean , and 0.11 SUL unit for liver SULmax.

Key Words:
Standardized uptake value, Lean body mass, PET/CT, Reproducibility

—The 4th Annual International ASNMT Conference—
Scientific Paper Session 2 (Oral): PET imaging
No. 09

Effect of statistical noise on reproducibility and accuracy of maximum and peak SUV: a phantom study

Go AKAMATSU[1, 2], Yasuhiko IKARI[1], Hiroyuki NISHIDA[1], Tomoyuki NISHIO[1], Akihito OHNISHI[1], Masayuki SASAKI[2], Michio SENDA[1]

1) Division of Molecular Imaging, Institute of Biomedical Research and Innovation, Japan
2) Department of Health Sciences, Graduate School of Medical Sciences, Kyushu University, Japan

Introduction:
Accurate and reproducible quantification is critical to the clinical efficacy of sequential PET/CT imaging since the SUV is often used to guide clinical decision making. The purpose of this study was to evaluate the effect of noise on reproducibility and accuracy of maximum SUV (SUVmax) and peak SUV (SUVpeak) in phantom experiments.
Materials and Methods:
We used a Discovery 690 (GE Healthcare) and a NEMA IEC body phantom with 6 spheres (10, 13, 17, 22, 28 and 37 mm). The PET data were acquired for 1800 seconds in list-mode, from which a total of 15 PET images were reconstructed for each scan time of 60, 90, 120, 150 and 180 seconds, respectively. Coefficients of variation for SUV of each sphere were calculated to evaluate variability of SUV (CVmax and CVpeak). Percent differences between the SUV for each scan time and SUV in 1800 seconds data were calculated for evaluation of accuracy (%Diffmax and %Diffpeak).
Results:
The CVmax and CVpeak for 13-mm-diameter sphere were 7.0%, 6.7%, 6.0%, 6.2%, 5.3% and 3.5%, 3.6%, 3.5%, 3.5%, 2.9% for 60, 90, 120, 150 and 180 seconds images, respectively. SUVmax and SUVpeak of 37-mm-diameter sphere for 60 seconds images had average positive biases of 28.3% and 4.4% compared with those of 1800 seconds image.
Conclusions:
SUVmax is considerably variable and is overestimated in images of low count statistics. SUVpeak is a more robust and accurate metric. Although clinical situations vary from cases to cases, it is recommended to use SUVpeak for accurate prognostic stratification and monitoring of responses to therapy.

—The 4th Annual International ASNMT Conference—
Scientific Paper Session 2 (Oral): PET imaging
No. 10

Consideration of standardized uptake value (SUV) according to the change of volume size through the application of Astonish TF reconstruction method

Juyoung LEE[1)], Sik Nam-KUNG[2)], Ji-Hyeon KIM[3)] and Hoon-Hee PARK[4)]

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2) Department of Nuclear Medicine, Konkuk Univeristy Medical Center, Korea
3) Department of Nuclear Medicine, Seoul Medical Center, Korea
4) Department of Radiological Technology, Shingu College, Korea

Purpose:
As the quality of the PET image has improved, various programs have been developed through many studies. Astonish TF reconstruction techniques by Philips can confirm the improved contrast of the lesion because the image of 2 mm can be reconstructed at a higher speed than previous devices. In this study, we compared and evaluated standardized uptake value (SUV) according to the reconstruction of new techniques of 2 mm and traditional 4 mm from the ^{18}F-FDG PET whole body image.

Subjects and Methods:
In the phantom experiment, NEMA IEC body phantom (sphere: 10, 13, 17, 22, 28, 37 mm) was used to obtain the images by using GEMINI TF 64 PET/CT (Philips, Cleveland, USA). In the clinical images, we performed ^{18}F-FDG PET/CT examination to 30 women (Age: 55.1 ± 11.3, BMI: 24.1 ± 2.9) with a diagnosis of breast cancer. Then we reconstructed the images in 2 mm and 4 mm respectively. The region of interest was drawn to the acquired images. We measured SUV and statistically analyzed with SPSS ver.18 by using EBW (Extended Brilliance Workstation) NM ver.1.0.

Results:
The result of the phantom study showed that the bigger size of the hot sphere tended to have the higher SUV. As we compared the techniques of the 2 mm reconstruction to the 4 mm, it increased 95.78% in 10 mm, 50.60% in 13 mm, 25.00% in 17 mm, 30.04% in 22 mm, 31.81% in 28 mm, and 27.84% in 37 mm. The result of the analysis of the techniques of 2 mm reconstruction and 4 mm in clinical images showed that SUV of 2 mm was higher than that of 4 mm. Also, the smaller the volume was, the more the change rate increased.

Conclusion:
In the result of the clinical images and phantom experiments applied by Astonish TF reconstruction techniques, as the size of the volume was smaller, the rate of change in SUV increased. Therefore, it is necessary to study further in the SUV correction for accurate and active utilization of the techniques of 2 mm reconstruction which had an excellent ability of the lesion discrimination and contrast in clinic.

Key Words:
Astonish TF, Reconstruction method, Volume size, SUV

—The 4th Annual International ASNMT Conference—
Scientific Paper Session 2 (Oral): PET imaging
No. 11

Clinical usefulness of PET-MRI in lymph node metastasis evaluation of head and neck cancer

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Purpose:
As PET-MRI which has excellent soft tissue contrast is developed as integration system, many researches about clinical application are being conducted by comparing with existing display equipments. Because PET-MRI is actively used for head and neck cancer diagnosis in our hospital, lymph node metastasis before the patient’s surgery was diagnosed and clinical usefulness of head and neck cancer PET-MRI scan was evaluated using pathological opinions and idiopathy surrounding tissue metastasis evaluation method.

Materials and Methods:
Targeting 100 head and neck cancer patients in SNUH from January to August in 2013. ^{18}F-FDG (5.18 MBq/kg) was intravenous injected and after 60 min of rest, torso (body TIM coil, Vibe-Dixon) and dedication (head-neck TIM coil, UTE, Dotarem injection) scans were conducted using Bio-graphTM mMR 3T (SIEMENS, Munich). Data were reorganized using iterative reconstruction and lymph node metastasis was read with Syngo.Via workstation. Subsequently, pathological observations and diagnosis before-and-after surgery were examined with integrated medical information system (EMR, best-care) in SNUH. Patient’s diagnostic information was entered in each category of 2×2 decision matrix and was classified into true positive (TP), true negative (TN), false positive (FP) and false negative (FN). Based on these classified test results, sensitivity, specificity, accuracy, false negative and false positive rate were calculated.

Results:
In PET-MRI scan results of head and neck cancer patients, positive and negative cases of lymph node metastasis were 49 and 51 cases respectively and positive and negative lymph node metastasis through before-and-after surgery pathological results were 46 and 54 cases respectively. In both tests, TP which received positive lymph node metastasis were analyzed as 34 cases, FP which received positive lymph node metastasis in PET-MRI scan but received negative lymph node metastasis in pathological test were 4 cases, FN which received negative lymph node metastasis but received positive lymph node metastasis in pathological test was 1 case, and TN which received negative lymph node metastasis in both two tests were 50 cases. Based on these data, sensitivity in PET-MRI scan of head and neck cancer patient was identified to be 97.8%, specificity was 92.5%, accuracy was 95%, FN rate was 2.1% and FP rate was 7.00% respectively.

Conclusion:
PET-MRI which can apply the acquired functional information using high tissue contrast and various sequences was considered to be useful in determining the weapons before-and-after surgery in head and neck cancer diagnosis or in the evaluation of recurrence and remote detection of metastasis and uncertain idiopathy cervical lymph node metastasis. Additionally, clinical usefulness of PET-MRI through pathological test and integrated diagnosis and follow-up scan was considered to be sufficient as a standard diagnosis scan of head and neck cancer, and additional researches about the development of optimum MR sequence and clinical application are required.
Key Words:
PET-MRI, head and neck cancer, decision matrices, sensitivity, specificity, accuracy

—The 4th Annual International ASNMT Conference—
Scientific Paper Session 2 (Oral): PET imaging
No. 12

A new quantitative correction method for pulmonary nodules on chest FDG-PET

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Objectives:

To develop a theoretically-based, new quantitative correction method for pulmonary nodules under normal respiratory motion on chest positron emission tomography (PET) with fluorine-18 fluorodeoxyglucose ([^{18}F] FDG) based on the results of experiments using a dynamic thorax phantom.

Methods:

In the experimental study, a thorax phantom with spheres (diameter = 10 mm) filled with FDG solution (4.4 kBq/mL) with no background activity was used. Both static and dynamic images of the phantom were obtained for 3 min using three-dimensional (3D) list mode, and each test was repeated five times. Dynamic images were acquired under continuous reciprocal movement with a period of 4 s (respiratory rate: 15 breaths/min) and a range of 0-30 mm along the body axis. Acquired image data were reconstructed using a 3D ordered subsets expectation-maximization algorithm. Regions of interest (ROIs) were placed on the hot spheres of the reconstructed images. In the theoretical analysis, the recovery coefficients for partial volume effects and motion effects were estimated based on the maximum counts in the ROIs.

Results:

Application of a Gaussian function and correction based on the configuration of the detectors contributed to the theoretical analysis of quantitative correction methods for pulmonary nodules under normal respiratory motion on chest FDG-PET. The newly proposed method could correct for the decrease of counts of pulmonary nodules due to partial volume effects and motion effects for spheres (diameter = 10 mm) with acceptable errors.

Conclusions:

A new quantitative correction method for pulmonary nodules under normal respiratory motion on chest FDG-PET was developed, and acceptable results were obtained.

Research Support:

This work was partially supported by a Grant-in-Aid for Young Scientists (B) (No. 25861115) from the Japan Society for the Promotion of Science.

—The 4th Annual International ASNMT Conference—
Scientific Poster Session
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Effects of a tungsten rubber shield and time of flight on quality of cerebral images acquired using 3D PET and ^{15}O gas inhalation study

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Introduction:
Activity outside the field of view (FOV) degrades the quality of commercial 3D PET images. The present study aimed to determine the effect of an originally designed tungsten rubber neck-shield and time of flight (TOF) on the image quality of 3D PET with ^{18}F phantom and ^{15}O-labeled gas inhalation human studies.
Methods:
As phantom study, two cylinder phantoms containing ^{18}F and with and without neck-shield simulated the human head and body to validate effects of reduction of scatter radiation from outside the FOV. As human study, ^{15}O-gas images were acquired using three static emission scans with and without the neck-shield from two healthy volunteers under ^{15}O-labeled CO_2, O_2 and CO gas inhalation. All images were reconstructed using OSEM and OSEM+TOF. Regional cerebral blood flow (CBF), oxygen extraction fraction (OEF) and cerebral metabolic rates of oxygen ($CMRO_2$) were calculated from ^{15}O-gas dynamic images and arterial blood sampling data by autoradiographic method. Background counts were measured in the images acquired from the ^{18}F phantom and ^{15}O-labeled gas images. Mean counts and standard deviation (SD) were measured in 18-cm circular regions of interest (ROI) on each slice from the ^{18}F phantom images and 10-mm circular ROIs on the cortices of cerebellum and cerebrum in CBF, OEF and $CMRO_2$ images. Signal to noise ratios (SNR) were calculated from the mean counts and SD.
Results:
Background counts using the neck-shield and OSEM+TOF was the lowest in ^{18}F phantom and ^{15}O-labeled gas images. The neck-shield and OSEM+TOF resulted in a better average SNR in the ^{18}F phantom study. The SNRs without TOF were larger without the neck-shield than with the neck-shield by 7.0, 6.5, 7.5 and 6.8 for CBF with and without the neck-shield and $CMRO_2$ with and without the neck-shield, respectively. The SNRs were not differences between OSEM and OSEM+TOF with and without the neck-shield. Thus, the neck-shield did not improve the SNRs of CBF and $CMRO_2$.
Conclusion:
The neck-shield and TOF improved the quality of 3D PET images in ^{18}F phantom study, whereas the neck-shield did not improve them in ^{15}O-gas inhalation human study.

The evaluation of usefulness of ^{99}Mo-^{99m}Tc generator using (n,γ) ^{99}Mo developed by Korea Atomic Energy Research Institute

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Purpose:
The Molybdenum which is the raw material of ^{99}Mo-^{99m}Tc generator is produced from the nuclear reactor. However, output has dwindled as the two nuclear reactors supplying the bulk of radioactive material-one in Chalk River, Ontario and the other in Petten, the Netherlands-have been closed for repairs or maintenance. This resulted in the enhancement of its price. So ^{99}Mo-^{99m}Tc generator using (n,γ) ^{99}Mo is developed by Korea Atomic Energy Research Institute (KAERI). Medicinal availability of this generator is evaluated in this study.

Materials and methods:
The radioactivity of ^{99m}Tc eluted in generator 1, 2 and 3 unit developed by KAERI was measured. The quality control test of generator such as appearance test, pH test, LAL test, sterility test, chemical impurity (Al) test and radiochemical purity test were performed. Planar and SPECT/CT images of SD rat (6weeks, Female) at 2hr after injection of ^{99m}Tc-HDP (hydroxymethylenediphosphonate) (TechneScan HDP, Malinckrodt Medical, Dutch) and ^{99m}Tc-DPD (diphosphono-1,2-propanedicarboxylicacid) (TECEOS, CIS bio international, France) which were labeled with ^{99m}Tc eluted in KAERI and commercial generator (40.5 GBq, Malinckrodt Medical, Dutch) using SPECT/CT camera (Symbia, Siemense, Germany) were obtained respectively.

Results:
The mean radioactivity of ^{99m}Tc elution generator 1unit was 4.18 GBq (113 mCi), generator 2unit was 4.73 GBq (128 mCi) and generator 3unit was 3.33 GBq (90 mCi). All quality control tests were within normal limit except pyrogentest. Pyrogen test was positive. Planar and SPECT/CT images of rat injected ^{99m}Tc-HDP which was labeled with ^{99m}Tc eluted in commercial generator show increased uptake in bone, stomach and bowl. Planar images show increased uptake in liver and bone in case of ^{99m}Tc-DPD. However, images of rat injected ^{99m}Tc-HDP and ^{99m}Tc-DPD which were labelled ^{99m}Tc eluted in KAERI generator show increased uptake in bone, liver and spleen.

Conclusion:
If shortcoming is removed such as pyrogen and liver appearance, domestic role as an alternative generator is thought to be able to fill and to secure the national medical service by supplying ^{99m}Tc when the supply of ^{99m}Tc becomes short.

Key Words:
Korea Atomic Energy Research Institute (KAERI) generator, (n,γ) ^{99}Mo, Quality control

Improvement of patient compensation device to reduce movement at fusion imaging

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Purpose:
Patients' movement during long image acquisition time for the fusion image of PET-CT (positron emission tomography-computed tomography) results in unconformity, and greatly affects the quality of the image and diagnosis. The arm support fixtures provided by medical device companies are not manufactured considering the convenience and safety of the patients; the arm and head movements (horizontal and vertical) during PET/CT scan cause defects in the brain fundus images and often require retaking. Therefore, this study aims to develop patient-compensation device that would minimize the head and arm movements during PET/CT scan, providing comfort and safety, and to reduce retaking.

Method:
From June to July 2012, 20 patients who had no movement-related problems and another 20 patients who had difficulties in raising arms due to shoulder pain were recruited among the ones who visited nuclear medicine department for PET Torso scan. By using Patient Holding System (PHS), different range of motion (ROM) in the arm (25°, 27°, 29°, 31°, 33°, 35°) was applied to find the most comfortable angle and posture. The manufacturing company was investigated for the permeability of the support material, and the comfort level of applying bands (velcro type) to fix the patient's head and arms was evaluated. To find out the retake frequency due to movements, the amount of retake cases pre/post patient-compensation were analyzed using the PET Torso scan data collected between January to December 2012.

Result:
Among the patients without movement disorder, 18 answered that PHS and 29° arm ROM were the most comfortable, and 2 answered 27° and 31°, respectively. Among the patients with shoulder pain, 15 picked 31° as the most comfortable angle, 2 picked 33°, and 3 picked 35°. For this study, the handle was manufactured to be adjustable for vertical movements. The material permeability of the patient-compensation device has been verified, and PHS and the compensation device were band-fixed (velcro type) to prevent device movements. A furrow was cut for head fixation to minimize the head and neck movements, fixing bands were attached for the head, wrist, forearm, and upper arm to limit movements. The retake frequency of PET Torso scan due to patient movements was 11.06% (191 cases/1,808 patients) before using the movement control device, and 2.65% (48 cases/1,732 patients) after using the device; 8.41% of the frequency was reduced.

Conclusion:

Recent change and innovation in the medical environment are making expensive medical image scans, and providing differentiated services for the customers is essential. To secure patient comfort and safety during PET/CT scans, ergonomic patient-compensation devices need to be provided. Therefore, this study manufactured a patient-compensation device with vertically adjustable ergonomic ROM according to the patient's body shape and condition during PET Torso scan. The defects in the basal ganglia images due to arm movements were reduced, and retaking was decreased.

Key Words:

PET Torso, Patient compensation device

Hand equivalent dose of nuclear medicine staffs in Lin Shin hospital

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Purpose:
Nuclear medicine department staffs accept higher radiation dose then medical imaging diagnosis department or radiation therapy department. Because medical procedures requires at Nuclear Medicine department were injected radiopharmaceuticals well increase of extremity doses. This study demonstrates a possible increase extremity doses at the nuclear medicine department, Lin Shin hospital (LSH) resulting from perform medical procedures for the safety of workers and the public to accord 「ALARA」 principles.
Materials and Methods:
ED hand measurements were performed with ring dosimeters (TLD-100H) from physician and Radiologists conducting radioimmunoassay, therapeutic radiopharmaceuticals perform medical procedures of SPECT and PET/CT in 6 month survey at Lin-Shin hospital. TLDs via annealing produce glow curve measured by Harshaw 3500 TLD reader translated effective dose.
Results:
The maximum ED hand were 1.76±0.26 mSv/mo and 0.96±0.11m Sv/mo of SPECT, PET/CT radiologists respectively. ED hand were far below the annual dose limit of 500 mSv/yr recommended by ICRP 60. One of the staffs was pregnancy during the experiment execution and the dose was lower the other staffs.
Conclusion:
The higher extremity radiation dose resulted from PET/CT room staff ring dosimeter monitor, the SPECT room staff and RIA room staff was equivalent the back ground radiation dose, survey the higher dose in the other location was without lead shield. The staffs extremity radiation dose are within acceptable limits and lower then Atomic Energy Commission (AEC) laws and regulations .
Keywords:
TLD-100H, Hand equivalent doses

Improvement of ways in restraining patient in nuclear medicine examination table to enhance patient's safety-sharing of experience

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Summary:

Accepting in-patients for nuclear medicine examination, usually involve patient with various lengths of tubings. But the “devil strip set” of nuclear medicine examination table or acrylic strap pallets are difficult to completely cover the patient's infusion tubings. In this department, there were cases whose infusion tubings were exposed and got entangled in examination equipment and which seriously affect patients' safety. After review, we initially designed a restraining belt that fully encompasses the upper limb, and then use the blanket to cover the whole body as a way of patient restrain. We found that this can effectively eliminate the problems caused by infusion tubings exposure which affect patients' safety. Up to the present in this department, there has been no recurrence of cases of infusion tubings exposure that got entangled in examination equipment. In addition, in large body size patient, this approach can reduce the problem of not covering the patient's elbow. Meanwhile, the operating time of radiologic technologist did not increase in this procedure.