Annual Congress of the European Association of Nuclear Medicine

October 12 – 16, 2019
Barcelona, Spain

eanm19.eanm.org
TECHNOLOGIST SESSIONS

on the occasion of the 32nd Annual Congress of the European Association of Nuclear Medicine, CCIB, Barcelona, Spain | October 12 – 16, 2019

Technologist Committee

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<tr>
<td>Chair</td>
<td>A. Santos (Portugal)</td>
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<tr>
<td>Vice Chair</td>
<td>L. Camoni (Italy)</td>
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<td>Members</td>
<td>C. Terwinghe (Belgium)</td>
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<td>S. Rep (Slovenia)</td>
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<td>S. Rac (Croatia)</td>
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<td>M.C. Attard (Netherlands)</td>
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<td>A. Pietrzak (Poland)</td>
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<td>M. Mada (United Kingdom)</td>
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<td>Senior Advisor</td>
<td>P. Fragoso Costa (Germany)</td>
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Technologist’s Guide Launch
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Generators used in Nuclear Medicine
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Martin Lee (London, United Kingdom)

Risk Communication - Why and How to Communicate about Ionizing Radiation?
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CTE 6 - Parathyroid Imaging

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WEDNESDAY, OCTOBER 16, 2019

CTE 7 - Updates in Lung Imaging

New PET Radiotracers for Lung Imaging
Domenico Albano (Brescia, Italy)

Metabolic Volumes Delineation for External Beam Radiotherapy and its Prognostic Role in Lung Cancer
Witold Cholewinski (Poznan, Poland)

Radiomic Features in Non-Small-Cell Lung Cancer FDG-PET/CT Studies
Margarita Kirienko (Milan, Italy)
Join the TECHNOLOGIST COMMITTEE INTEREST GROUP MEETING

Tuesday, October 15, 2019 | 13:00 - 14:30, Level P1, Hall 117

eanm19.eanm.org
Dear Colleagues and Friends,

It is with great satisfaction and happiness that I welcome you to the 32nd Annual Congress of the EANM in Barcelona, Spain.

The European Association of Nuclear Medicine Technologist Committee (EANM-TC) is very proud of the diverse and up-to-date programme that it is offering at the congress. From Oct 12 to 16, 2019, a vast number of professionals from across the entire world will come together at this unique event, creating an excellent opportunity to share knowledge and experience and to strengthen bonds.

The focus of the technologist programme is topics of great relevance for practice in the field of nuclear medicine, where scientific and technological developments continue to be so influential. The coverage ranges from preclinical studies to theranostics, without neglecting the importance of patient communication in the practice of the nuclear medicine technologist.

Following last year’s good experience, we will again be providing seven sessions of Continuous Technologist Education (CTE) and three Mini-Courses (MC) where specialists in each topic will share their expertise and knowledge. There will be scope for debating and active participation through special interactive sessions.

As a reflection of the multidisciplinary approach adopted in the EANM-TC’s work, we will count on the collaboration of the Radiation Protection Committee in the organisation of CTE 2. Also, a joint session with the EANM Neuroimaging Committee will take place during the Congress, aiming to cast light on the artefacts and pitfalls in brain imaging (Pitfalls & Artefacts, session 5).

Mirroring the international outreach of the EANM-TC, sessions will be held with the participation of representatives from the Society of Nuclear Medicine and Molecular Imaging – Technologist Section (SNMMI-TS), the Canadian Association of Medical Radiation Technologists (CAMRT) and the Australian and New Zealand Society of Nuclear Medicine – Technologist Special Interest Group (ANZSNM-T).

Three sessions of oral presentations and four e-poster sessions have been organised to promote the exchange of ideas and report on the work that is being undertaken across the world. As an additional motivating factor, awards will be given for the best two oral presentations as well as the best two e-Poster Session presentations.

Finally, I highly recommend that you attend the Technologist Interest Group Meeting. During this meeting, the EANM-TC will share the current endeavours of the Committee, as well as future perspectives. In addition, we will be announcing the prize winners during this session!

I wish you a great experience at the EANM Congress. Bearing in mind all of the above events and activities, I truly believe that you will find it a most fruitful occasion.

With my best regards,

Andrea Santos
Chair, EANM Technologist Committee
EANM Congress Düsseldorf 2018 – Technologist Awards

**BEST ORAL PRESENTATION**

Semi-quantitative criteria for the diagnosis of the myocarditis using 99mTc-Pyrophosphate SPECT/CT  
J. Ilyushenkova, S. Sazonova, K. Zavadovsky

**2ND NOMINEE FOR BEST ORAL PRESENTATION**

Usefulness of SPECT for the semiquantitative assessment of regional 123I MIBG myocardial uptake in heart failure: comparison between iterative reconstruction (OSEM) versus filtered back projection  
A. Ruzza, I. Andreoli, G. Romagna, P. Basile, L. Filippi, O. Bagni

**3RD NOMINEE FOR BEST ORAL PRESENTATION**

Comparison of Gastric Emptying Results Using 60min, 90min and 120min Protocol – A Retrospective Study  
D. Teixeira Macarico, C. Laurins, A. Nicol

**BEST e-POSTER AWARD**

99mTc-MAA SPECT/CT-based dosimetry in SIRT: Why personalized dosimetry matters – A retrospective study  
L. Esteves, B. Collette, E. El Darazi, G. Verset, V. Lucidi, S. Goldman, R. Moreno-Reyes

**2ND NOMINEE FOR BEST e-POSTER PRESENTATION**

Standardised Uptake Value & Hounsfield Unit in lumber spine & head of the femur for Alkaptonuria measured from 18F-NaF PET/CT bone scan  
E. H. M. A. Alawadhi, S. Vinjamuri, J. Gallagher, R. Lakshminarayan

**3RD NOMINEE FOR BEST e-POSTER PRESENTATION**

Incidence of asymptomatic nephroptosis detected by 99mTc-MAG3 renogram  
1) SCAN YOUR BADGE
Scan your badge at the beginning of each session when entering the room in order to acquire CME or CTE credits.

2) EVALUATE (Deadline - October 30, 2019)
A short evaluation has to be completed for each attended CME/CTE session until Oct 30, 2019.
Evaluation has to be done online at evaluation.eanm.org

3) DOWNLOAD YOUR CERTIFICATE
Once the steps above are completed, your certificate will be available within 24 hours in your vEANM area.

To obtain your CME/CTE credits (for single sessions as well as the congress itself) the respective evaluations are mandatory. Deadline: October 30, 2019. After this date, or without proper evaluation, no points will be accredited.
# Programme

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<td>Opening Technologist Track</td>
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<td>08:10 – 09:30</td>
<td><strong>CTE - with ANZSNM / CAMRT - Technologist Approach to Global</strong></td>
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<td>Dose Optimization</td>
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<td>Chair: Luca Camoni (Brescia, Italy), Pedro Fragoso Costa (Essen, Germany)</td>
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<td>Chair: Luca Camoni (Brescia, Italy)</td>
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<td>10:00 – 11:15</td>
<td>Plenary 1 - Radiomics and Artificial Intelligence (incl. Marie Curie Lecture)</td>
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<td>Chair: Francesco Giammarile (Vienna, Austria), Jan Pruim (Groningen, Netherlands)</td>
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<td>11:30 – 13:00</td>
<td><strong>CTE 2 - Interactive - with Radiation Protection - Risk and Incidents</strong></td>
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<td>Chair: Sebastijan Rep (Ljubljana, Slovenia), Giorgio Testanera (London, United Kingdom)</td>
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<td>Risks and Incidents in Nuclear Medicine - A Medical Physics Perspective (incl. 10 Min. Discussion)</td>
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<td>Chair: Giorgio Testanera (London, United Kingdom)</td>
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<td>14:30 – 15:30</td>
<td>Mini Course 1 - Research Methodology</td>
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<td>Chair: Marius Mada (Cambridge, United Kingdom)</td>
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<td>14:30 – 15:30</td>
<td>Research Methodology for Technologists</td>
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<td>Chair: Christina Malamateniou (London, United Kingdom)</td>
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<td>15:45 – 16:45</td>
<td>Mini Course 2 - Interactive - Stress Testing for Technologists</td>
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<td>Chair: MarieClaire Attard (Zwolle, Netherlands)</td>
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<td>Chair: Sonja Rac (Rijeka, Croatia), Sebastijan Rep (Ljubljana, Slovenia)</td>
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<tr>
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<td>General Aspects of Theranostics in Nuclear Medicine</td>
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<td>Chair: Nick Gulliver (London, United Kingdom)</td>
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**Programme**

**Monday, October 14, 2019**

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| 08:00 – 09:30 | Technologist Oral Presentations 1  
Chair: Pedro Fragoso Costa (Essen, Germany), Wendy Kemps (Brussels, Belgium) |
| 10:00 – 11:15 | Plenary 2 - Prostate Cancer - Reload  
Chair: Jolanta Kunikowska (Warsaw, Poland), Stefano Fanti (Bologna, Italy) |
| 11:30 – 13:00 | Technologist e-Poster Presentation 1-4  
**e-Poster Presentation 1**: Chair: Edgar Pereira (Almada, Portugal), Agata Pietzak (Poznan, Poland);  
(Room 133/134)  
**e-Poster Presentation 2**: Chair: Marie Claire Attard (Zwolle, Netherlands), Rodrigo Garcia Gorga (Sabadell, Spain);  
(Meeting Room 120/121)  
**e-Poster Presentation 3**: Chair: Luísa Pereira (Maidstone, United Kingdom), Marius Mada (Cambridge, United Kingdom);  
(Meeting Room 130)  
**e-Poster Presentation 4**: Chair: Sonja Rac (Rijeka, Croatia), Louise Rimanic (Vancouver, Canada);  
(Meeting Room 118/119) |
| 14:30 – 16:00 | CTE 3 - Preclinical Studies, from Bench to Bedside  
Chair: Christelle Terwinghe (Leuven, Belgium), Jan Grimm (New York, United States of America)  
**How to Develop the Ideal Radiopharmaceutical**  
Guy Bormans (Leuven, Belgium)  
**Preclinical PET Imaging and Quantification**  
Michel Koole (Leuven, Belgium)  
**Nanobody Applications for Radionuclide Imaging and Therapy - Process from Camel to Patient**  
Marleen Keyaerts (Brussels, Belgium) |
| 16:30 – 18:00 | CTE 4 - with SNMMI - Technologist’s Guide Launch - Radiopharmacy: An Update  
Chair: Marie Claire Attard (Zwolle, Netherlands), Mark Crosthwaite (Richmond, United States of America / SNMMI)  
**Technologist’s Guide Launch**  
Marie Claire Attard (Zwolle, Netherlands)  
**Generators used in Nuclear Medicine**  
Mark Crosthwaite (Richmond, United States of America / SNMMI)  
**Theoretical Basics of Radiopharmacy**  
Zéna Wimana (Brussels, Belgium) |
Programme
Tuesday, October 15, 2019

08:00 – 09:30  Technologist Oral Presentations 2
Chair: Pedro Costa (Porto, Portugal), Giorgio Testanera (London, United Kingdom)

10:00 – 11:15  Plenary 3 - Next Generation PET Technology in the Clinical Setting
Chair: Michael Lassmann (Würzburg, Germany), Wolfgang Wadsak (Vienna, Austria)

11:30 – 13:00  Technologist Oral Presentations 3
Chair: Sebastijan Rep (Ljubljana, Slovenia), Ana Resende Geão (Ramada, Portugal)

14:30 – 16:00  CTE 5 - Interactive - Patient Communication
Chair: Pedro Fragoso Costa (Essen, Germany), Karren Fader (Halifax, Canada)

14:30 – 15:00  Health Communication through Design Thinking and Idea Reframing
Débora Miranda (Lisbon, Portugal)

15:00 – 15:30  Patient Welfare and Advocacy - A View from the Inside
Martin Lee (London, United Kingdom)

15:30 – 16:00  Risk Communication - Why and How to Communicate about Ionizing Radiation?
Tanja Perko (Mol, Belgium)

16:30 – 18:00  CTE 6 - Parathyroid Imaging
Chair: Sebastijan Rep (Ljubljana, Slovenia), Claudiu Pestean (Cluj, Romania)

16:30 – 17:00  Comparison of [99mTc]Tc-MIBI and [18F] Fluorocholin Scintigraphy in Localization of Hyperfunctioning Parathyroid Tissue
Luka Lezaic (Ljubljana, Slovenia)

17:00 – 17:30  [11C]Methionine PET-CT Imaging in Hyperparathyroidism
Giovanna Pepe (Milan, Italy)

17:30 – 18:00  The role of a technologist in the preparation of acquisition protocols and the processing of image data in Nuclear Medicine Parathyroid Imaging
Sebastijan Rep (Ljubljana, Slovenia) & Giorgio Testanera (London, United Kingdom)
Programme
Wednesday, October 16, 2019

10:00 – 11:30  CTE 7 - Updates in Lung Imaging
   Chair: Andrea Santos (Lisbon, Portugal), Agata Pietrzak (Poznan, Poland)
   10:00 – 10:25  New PET Radiotracers for Lung Imaging
                  Domenico Albano (Brescia, Italy)
   10:25 – 10:50  Metabolic Volumes Delineation for External Beam Radiotherapy and its Prognostic Role in Lung Cancer
                  Witold Cholewinski (Poznan, Poland)
   10:50 – 11:30  Radiomic Features in Non-Small-Cell Lung Cancer FDG-PET/CT Studies (incl. 15 Min. Discussion)
                  Margarita Kirienko (Milan, Italy)

11:45 – 12:45  Plenary 4 - Highlights Lecture
   Chair: Wim Oyen (Arnhem, Netherlands), Francesco Giammarile (Vienna, Austria)
## Programme Overview

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<td>08:30 - 09:00</td>
<td>CTE 1 Technologist Committee / ANZSNM / CAMRT Technologist Approach to Global Dose Optimization</td>
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<tr>
<td>09:00 - 09:30</td>
<td>204 (in Auditorium) Plenary 1 incl. Marie Curie Lecture Radiomics and Artificial Intelligence</td>
<td>704 (in Auditorium) Plenary 2 Prostate Cancer-Reload</td>
<td>1704 (in Auditorium) Plenary 7 Next Generation PET Technology in the Clinical Setting</td>
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### Mini Courses
- **Mini Course 1**: Research Methodology
- **Mini Course 2**: Interactive Stress Testing for Technologists
- **Mini Course 3**: Theranostics - Fundamental
CTE SESSION 1
October 13, 2019 | 08:00 - 09:30

Technologist Approach to Global Dose Optimization
Dose Optimization Principles

Pedro Fragoso Costa (Essen, Germany)

Health professionals working with ionising radiation have faced a continuous development of the radiation protection system. Integrating evidence-based knowledge into this system is a key factor for a successful implementation on the different applications.

Historically, the principles of radiation protection were defined at a very early stage, just after the discovery of radiation. However, these have been issued at the light of very limited knowledge of the health impact of ionising radiation on organisms and quite bond to the technical equipment particularly used for the investigations of that early stage. After the widespread use of ionising radiation in many sectors and the maturation of radiation protection as a discipline, with an international body representing it, the three fundamental principles were drawn: justification of uses, limitation of exposure and radiation protection optimisation.

In the recently reviewed European directive laying down basic safety standards for protection against the deleterious effects arising from exposure to ionising radiation, a unique conjugation of evidence-based knowledge, international standards harmonisation and clear definition of responsibilities and tasks has been achieved. Particularly, in the field of medicine, much more detail has been granted to a set of exposures and related concepts that contribute greatly to a more informed and organised radiation protection practice.

Nuclear Medicine Technologists (NMT) are constantly facing optimisation opportunities during their daily practice. It is their duty and responsibility to review all practices at the light of recent discoveries in the field, with the available means.

This session will provide an overview on the coordinated campaign including technologist associations from Europe, United States of America, Australia and New Zealand and Canada, which goal was to diffuse the involvement of NMT in dose optimisation around the world. Laying down the principles of dose optimisation and the available resources and systematic views on optimising radiation exposure in the daily routine.

References:

Dose References Levels in Nuclear Medicine

Elizabeth A. Bailey (Sydney, Australia)

There has been an increasing requirement for professionals working in nuclear medicine to consider patient radiation exposure prior to performing the procedure. Internationally, many guidelines and regulatory documents exist that specify the maximum dose thresholds for safe exposure as well as instructions on how to optimize patient dose without compromising image quality and the diagnostic accuracy of the procedure.

In medical imaging the standard used to for defining and guiding radiation exposure to the patient is the Diagnostic Reference Level (DRL) which is defined as the ‘level of activity for a typical examination for groups of standard sized patients or standard phantoms for broadly defined types of examinations’(1). It is accepted that the DRL should be used to guide best practice and should not be exceeded for the majority of routine practice and procedures.

In understanding the best method for interpreting and using DRL in clinical practice, it is important to recognize that DRL refer to a typical practice for a specific examination and do not apply to a specific individual patient. However they should be used as a general principal for minimizing patient radiation dose and modifying an individual protocol to ensure compliance with current best practice for that procedure.

Professional associations globally have been active in revising and educating nuclear medicine professionals in collaboration with the regulatory authorities specific to your local practice to provide tools for implementing dose optimization techniques on a daily basis. These include initiatives such as the SNMMI ‘Image Gently’ approach to nuclear medicine practice, the revised DRLs using 25th, 50th and 75th percentile guidelines adopted by the IAEA and ANZSNM (ARPANSA) and the EANM paediatric dosage card.

At the conclusion of this presentation, you should have a better understanding of the importance of dose reference levels in nuclear medicine, how to use them in daily clinical practice and the resources available to better assist with reducing patient radiation dose without compromising image quality and diagnostic accuracy.

References:

Dose optimization is relevant in all diagnostic imaging modalities that use radiation. In PET/CT imaging, dose optimization goals include minimizing the dose to the patient while generating high quality images. In addition to dose optimization, workflows should be designed so the technologists receive the lowest possible radiation exposure while working with the patients.

CT imaging parameters and PET radiopharmaceutical administered activities contribute to the radiation impact on patients. The CT parameters of a PET/CT scan should be reviewed on a regular basis to establish if the CT dose to the patient can be decreased while preserving the technical quality of the CT images. Determining the necessity for a diagnostic CT scan rather than a low-dose CT scan is another important consideration. Technological advances in PET scanners, such as improved scanner sensitivity, provides departments the ability to lower the administered radiopharmaceutical activities to a range that still produces high quality PET images with less radiation to the patient.

Occupational radiation exposure of technologists working predominantly with higher energy PET radiopharmaceuticals is more than technologists employed in general Nuclear Medicine departments. It is essential that PET imaging departments evaluate the shielding and workflow, as well as the techniques of the individual technologists, during the dose drawing and injection phases due to higher levels of technologist radiation exposure occurring during those stages of the PET procedure. With the introduction of auto-injectors, departments are finding a reduction in technologists’ dosimeter readings. Increasing the distance from the patient after the injection and when positioning the patient on the PET/CT scanner, being mindful that patient care and safety is the priority, can also reduce technologists’ occupational radiation exposure. Continually monitoring and reviewing group and individual’s dosimeter reports is beneficial in identifying changes or trends of increasing radiation levels that should be addressed promptly.

In this presentation, dose optimization goals and methods for reducing technologist exposure will be discussed. This talk could prompt a technologist to review the radiation impact on patients and to evaluate the technologists’ daily workflow in one’s own department.

References:

4. Leide-Svegborn S. Radiation exposure of patients and personnel from a PET/CT procedure with 18F-FDG. Radiat Prot Dosimetry. 2010;139:208–213
Cardiac Imaging Methods for Dose Reduction

Luca Camoni (Brescia, Italy)

According to the European Council Directive 2013/59 the optimization must take into account the current state of technical knowledge, including selection of equipment, to obtain a clinical diagnosis.

The selection of the equipment for the dose optimization in the myocardial perfusion imaging is a complex topic where a great number of factors are considered. The main categories are: radiopharmaceutical, protocol selection and imaging instrumentation. Each one has a high influence on the final clinical output.

The radiopharmaceutical selection, strongly connected to the exam request and to the justification process, is one of the gatekeepers of the optimization process. The growing number of radioisotopes used in the nuclear cardiology field requires an accurate selection by the practitioner to reduce the patient and staff exposure.

Protocol selection is another key strategy in dose optimization. Starting from the choice of a fixed-activity protocol or a weight-based to the selection of a stress-first or a rest-first protocol.

In the nuclear cardiac imaging context also, the injected activity depends on the imaging instrumentation: PET or SPECT, scintillation camera or a cadmium-zinc-telluride (CZT) detector, imaging time, pixel size, gated acquisition, reconstruction algorithms, CT based attenuation correction, MR imaging. Advances in technology have greatly contributed to nuclear cardiology and highly influenced the dose reduction. Despite this, it is not possible to make precise quantification and standardization of the injected activities; they must fit to the software- or hardware-based features of the available instrumentation in the laboratory.

This talk would try to lead the technologist to an awareness of the instruments' operating performance and how to adapt them to the best practice procedures.

References:

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CTE SESSION 2

October 13, 2019 | 11:30 - 13:00

Risk and Incidents
A significant amount of incidents and accidents from medical radiation exposure have been reported in literature. Most of them are related to patient’s over or underexposure due to non-optimized acquisition protocols or defective equipment. The storage, manipulation and administration of unsealed radioactive sources result in specific potential hazards in diagnostic and therapeutic nuclear medicine(1). Especially in therapeutic applications, the risk for incidents and accidents is increased due to the high amounts of activity used. Accidents of varying severity are reported. They involve not only patients but also staff members.

Incidents and accidents in nuclear medicine can originate from different phases in the workflow such as the patient reception, the radiopharmaceutical preparation, the calculation of he administered activity, etc. Apart from contamination events, errors in administration, under or overexposure of patients and problems in radioactive waste management are the most prevalent issues.

In diagnostic nuclear medicine, patient dose as well as acquisition settings and overall quality of the equipment will directly affect image quality and thereby the diagnostic accuracy.

In therapeutic settings, the target should receive a sufficiently high radiation dose, whereas doses to organs-at-risk should be minimized in order to avoid side-effects of the treatment. The latter balance can be optimized by means of the individualized calculation of the administered activity. Failing to do so may result in significant under treatment of the patient or introduction of severe or even lethal side-effects of the therapy.

The availability of well-defined procedures as well as an appropriate and continuing education of all staff members is essential to minimize incidents and accidents. Moreover, specific duties and responsibilities of the staff involved should be clearly identified. More specifically, both technologists and medical physicists play an important role in the management of incidents and accidents in nuclear medicine. (Near) incidents and accidents should be reported and analyzed thoroughly in order to avoid them in the future.

Reference:

1. Martin CJ. A survey of incidents in radiology and nuclear medicine in the West of Scotland. BJR, 2005:913-921

Risks and Incidents in Nuclear Medicine - A Medical Physics Perspective

Klaus Bacher (Ghent, Belgium)
The operations in a radiopharmacy generally fall in two distinct categories: procurement and production of radiopharmaceuticals and maintenance of quality (materials, environment, facilities and people) (1). Majority of radiopharmaceuticals are administered by injection, usually intravenously, as this route offers the most immediate access to the target organs or tissues. Parenteral administration requires a sterile injectable formulation, and all pharmacopoeial injections are required to be sterile. Radiopharmaceuticals must be treated differently from conventional parenteral preparations due to the limited half life of the radionuclide, and since many of the ingredients are not stable to heating and the preparation cannot be sterilised by heating in an autoclave. These limitations mean that a rapid aseptic assembly or dispensing procedure must be used in the finished product released without the «seal» of a sterility test (1). In these circumstances the quality of the manufacturing or dispensing unit environment is paramount: the design and operation of the facility must conform to strict standards specified by regulation and good manufacturing practice (GMP). All operators must be fully trained and demonstrate their competence at working in an aseptic environment through competency tests at regular intervals (1).

Radiopharmaceuticals are also radioactive and constitute a health hazard. Precautions must be taken and procedures developed to reduce the radiation exposure to operators, to prevent ingestion of radioactive material, and to prevent contamination of the working area and the general environment enjoyed by the public at large (1). Conditions normally employed to keep microbial organisms out of the aseptic dispensing area will effectively aid the spread of radioactive contamination and increase the likelihood of ingestion of radioactive material. A compromise is necessary, usually by design of special cabinets or enclosures which provide containment of adventitious radioactive material (i.e. capsules). Patient safety and operator and public protection must be satisfied and demonstrated through numerous environmental monitoring (microbiological and radiation) schemes and records – a system of parametric release for the final radiopharmaceutical (1).

To ensure that patient receives radiopharmaceutical of suitable quality, Quality Assurance (QA), a wide-ranging concept that covers all matters that individually or collectively influence the quality of the product was developed. It is the total sum of organised arrangements made with the object of ensuring that medical products are of the quality required for their intended use. QA incorporates Good Manufacturing Practice (GMP) plus other factors. GMP is that part of QA that ensures that products are consistently produced and controlled to the quality standards appropriate to their intended use. GMP is concerned with both production and quality control (QC). QC is the part of GMP that is concerned with sampling, specifications and testing, and with the organisation, documentation and release procedures that ensure that the necessary and relevant tests are actually carried out and that materials are not released for use, nor products released for sale or supply, until their quality has been judged to be satisfactory (1).

References:
Management of Risks and Incidents in Nuclear Medicine

Giorgio Testanera (London, United Kingdom)

All imaging modality utilizing ionizing radiations has general health and safety hazards associated with the radiation risk. Hazards examples are patient’s over or underexposure due to non-optimized acquisition protocols, defective equipment, wrong manoeuvres. There are specific hazards in Nuclear Medicine procedures associated with the storage, manipulation and administration of unsealed radioactive sources, labelled with specific tracers. All the steps involved in the nuclear medicine workflow are subjected to potential accidents: from patient reception, to patient preparation, radiopharmaceutical preparation, administration and uptake phase of the examination, examination and quality controls of the equipment. Risk assessments on radiation and contamination risks should be carried out before any new work within Nuclear Medicine commences. In UK, these assessments are drafted, usually based on advice form the RPA (Radiation Protection Advisor), to ensure relevant staff are aware of risks in each area of the department. They need to be read by all personnel who would be working in the assessed areas and regularly reviewed. The review need to happen preferably once a year or if an incident or “near miss” has taken place. During the review process, control measures must be updated to minimise the risk as much as possible.

Unfortunately incidents do happen in Nuclear Medicine, even when assessments are made. The potential accidents must be understood, acknowledged and respected. The most diffuse accidents in nuclear medicine are contamination events, followed by overexposure of patients and failure in the managements of radioactive materials. The primary means of minimising adverse accidents are education of all staff (from nuclear medicine doctors, to radiographers and nurses) with regular updates, blank or dry tests during radiopharmaceutical preparation, clear identification of duties and responsibilities of the staff involved, traceability of procedural steps from patient reception to patient leaving the department, and the flagging of patient notes and request forms. Incident reporting is also crucial.

Accidents should be discussed locally and lessons learned should be disseminated to the wider NM and imaging community.

In this talk we will discuss hazards, incidents and risks in Nuclear Medicine and a possible system to manage them taken from UK and European experience.

References:

MINI COURSE 1

October 13, 2019 | 14:30 - 15:30

Research Methodology
Research is vital in healthcare to ensure efficiency of current techniques is improved and new methods are being utilised for the benefits of the patients. Research in Radiography is highlighted as a key priority in the UK radiographers’ professional body, vision and research strategy planning for 2016-2021 (Society and College of Radiographers, SCoR) 2016. Similar to other professions, practitioner-led research has shown multiple benefits to the workforce, to the patients and to society. First and foremost engaging with research allows practitioners to keep up-to-date with recent technological developments, which is vital for Radiography and Medical Imaging in general as the essence of the work lies on the interface between patient care and optimal use of the available medical imaging technology (Harris, 2013). Keeping abreast of advancements of medical imaging equipment (hardware, software) but also driving these forward with their unique insight is vital for radiographers to ensure efficiency in using the currently available resources, particularly in a financial climate where demand for better results is increasing, whereas funds are decreasing (Hanney, 2015).

Research capacity building as a mechanism to improve patient experience and outcomes is one of the most contemporary issues in healthcare in the last decade. According to the Department of Health (DoH) Operating Framework 2008-2009 practitioner research is not just an exciting opportunity but also—and perhaps most importantly—a requirement to carry the profession forward (DoH, 2008). In a similar fashion, the most recent NHS operating Framework 2012-2013 highlights that the promotion and conduct of research is a core NHS function and that on-going commitment to increasing research quality and quantity is vital to address future challenges in healthcare. Furthermore it stresses the need to embed a research culture throughout the NHS (DoH, 2012). This is also in line with the NHS Constitution (DoH, 2009), which affirms the sustained commitment of the NHS to the promotion and conduct of research as a means to improve patient outcomes.

Different healthcare professions offer varied approaches to embedding research into practice and to building a critical research capacity to ensure evidence-based practice.

Radiography is a relatively young profession and research capacity remains low compared to medicine, nursing and other allied health professions. Different barriers to doing research include, but are not limited to: lack of time, lack of recognition in the appraisal, lack of a research culture at work, workload, staff shortages, lack of funding. Different methods have been employed to increase research capacity: Role modelling, mentoring, up-skilling of the workforce.

This session will discuss the following:
• What is considered research in the NM technologists’ community
• Common enablers and barriers for practitioner research
• Identify opportunities for undertaking research and for disseminating results
• Realise the importance of an institution-led research culture and the role of mentors

It will also work with a real life example and offer top tips on how to prepare (content) and deliver (oral skills) a high level oral presentation.

References:
1. Society and College of Radiographers, SCoR. 2016-2021 SCoR Research Strategy
4. Department of Health (DoH). The NHS Constitution
5. Department of Health (DoH). NHS operating Framework 2012-2013
MINI COURSE 2

October 13, 2019 | 15:45 - 16:45

Stress Testing for Technologists
The chambers of the heart consist of the left and right atria and the left and right ventricles. The electrical conductivity of the heart represents the communication between the atria and the ventricles. It also gives an indication of the contraction known as depolarisation and the repolarisation of the left atrium and left ventricle. The sinoatrial node is the place where electrical conductivity originates, that results in what we know as systole, i.e. the contraction of the left atrium.

What happens after the stimulation from the sinoatrial node can be read from an ECG. Pathologies such as atrial fibrillation and left or right bundle branch block can be easily diagnosed when performing an ECG. Patients might have various complaints, and have different expectations and results when attending their examination.

When performing a stress test with adenosine, there are a number of points to consider before its administration, such as asthma or COPD, and patient preparation. Asthmatic patients usually follow the same preparation as non-asthmatic patients, however, a different pharmacological stressing agent is used.

Caffeine and caffeine-containing products and energy drinks should be abstained at least 24 hours before the start of the examination. Caffeine is a vasoconstrictor therefore will counteract the mechanism of action of the pharmacological stressing agent. Blood pressure should be measured before the start of the stress test. The reason being that low blood pressure is a contraindication to starting a pharmacological stress test, since the pharmacological stressing agent is a vaso-dilator.

A radiopharmaceutical is administered during the stress test to be able to perform myocardial perfusion imaging. Administering the radiopharmaceutical too fast might result in complaints during the stress test, which could be seen on the ECG.

The technologist should be trained to know and decide when to start, administer and stop the pharmacological stressing agent, note any changes seen in the ECG and document the drugs administered in the hospital system.

References:

MINI COURSE 3

October 13, 2019 | 17:00 - 18:00

Theranostics – Fundamental
A theranostic system integrates a diagnostic test to determine the presence of a molecular target for which a personalised treatment plan is intended. Molecular imaging serves this diagnostic function and provides powerful means for noninvasively detection and characterization of disease. The visualisation of potential targets enables the prediction whether a patient will benefit from a particular treatment, especially in oncology. Further, theranostics can be useful for estimating the potential response and eventual toxicity and monitoring the therapy course. Theranostics in nuclear medicine couples diagnostic imaging and therapy using the same or similar molecules which are either radiolabeled differently (123I-MIBG vs. 131I-MIBG) or given in different dosages (131I). It has its roots in the pioneering work of G. Seaborg et al. who in 1938 discovered radioactive Iodine-131. This radioisotope became the gold standard in the diagnosis and treatment of thyroid cancer, which is still widely used throughout the world. During the past decades, similar models have been developed for neuroendocrine tumours (NET) which use different radionuclides, such as 111In, 99mTc, 68Ga, 18F, 64Cu, 90Y, 177Lu, etc.. These tracers are chelated to Somatostatin analoga (DOTA-TATE, DOTA-TOC, DOTA-NOC) and are utilised in tumour diagnosis, staging and treatment. Similar approaches with very promising results have been performed more recently in prostate cancer with different prostate-specific membrane antigen (PSMA) ligands (68Ga-, 64Cu-, 18F-, 44Sc-, and 177Lu-PSMA) for diagnosis and treatment, since prostate cancer cells overexpress PSMA on their cell surface. Most therapeutic radiopharmaceuticals are β-emitting isotopes, since they have a cytotoxic effect, but they also spare the surrounding healthy tissue due to their short tissue penetration of only a few millimetres. However, there have been also promising approaches with α-particle emitters for treatment of NET and prostate cancer (225Ac-DOTATOC, 225Ac-PSMA). Further developments are expected in the coming years in the field of radioimmunotherapy, i.e. for treatment of lymphoma. In this lecture, important milestones of nuclear diagnostics and therapies in the context of theranostics are highlighted.

Further Readings:

Neuroendocrine tumours (NET) are a rare and slow-growing group of tumours that arise from cells of the diffuse neuroendocrine system and are characterized by a wide spectrum of clinical manifestations. They are often categorized according to their histopathology (well or poorly differentiated), tumour proliferation (using Ki67 index: G1 (≤2%), G2 (3-20%), or G3 (>20%) and TNM staging. In NET theranostics the important target is the somatostatin receptor (SSTR) which is overexpressed in NET tumours. This can be exploited for both imaging and therapy. SSTR imaging with 111In-Octreoscan® SPECT has been available since the 1990s. It is now largely being replaced in many centres with 99mTc-octreotide (Tektrotide®) SPECT. Many centres also now have access to 68Ga-labelled DOTA-peptide PET tracers (DOTATOC, DOTANOC, and DOTATE). However 68Ga is a generator-produced radionuclide with relatively short half-life and therefore is not readily accessible in many EU countries. 64Cu is a generator-produced radionuclide with a significantly longer half-life and therefore is widely used as a potential alternative. The therapeutic part of theranostic targeting is peptide receptor radionuclide therapy (PRRT) which has often been referred to as a “magic bullet” – with good targeting of dose to tumour cells while normal tissue is largely spared. The diagnostic gamma or positron emitting radiopharmaceuticals are substituted with beta-emitting equivalents. SSTR analogues used for diagnostic scintigraphy are thus replaced with radiometals 90Y or 177Lu. Initial efficacy results were based on very high doses of 111In-DTPA-octreotide, but more promising results were subsequently found with 90Y-DOTATOC and with 177Lu-DOTATATE. In Europe, 177Lu-oxodotreotide (Lutathera®) is indicated for the treatment of unresectable or metastatic, progressive, well differentiated (G1 and G2), SSTR-positive gastroenteropancreatic neuroendocrine tumors (GEP-NETs) in adults. In 2017 the publication of the NETTER-1 Phase III clinical trial demonstrated markedly longer progression-free survival and a significantly higher response rate than high-dose long-acting release (LAR) octreotide among patients with advanced midgut NET. The kidney is the major critical organ during PRRT in addition to bone marrow and patients require thorough diagnostic workup prior to therapy plus an amino acid solution administered intravenously during therapy to reduce nephrotoxic effects. Haematological markers and liver function are kept under surveillance following each treatment until returned to normal and to detect any possible delayed adverse reactions. The advantage of 177Lu is the emission of low-energy gamma rays which not only allow assessment of biodistribution with post-therapy scans but also enables individualized dosimetry, facilitating calculations of absorbed radiation dose to critical organs.

References:

2. Ambrosini V, Fanti S (eds) Clinicians’ guide to radionuclide hybrid imaging: PET-CT in neuroendocrine tumours. doi: 10.1.007/978-3-319-29203-8
Technologist Oral Presentations 1
Chair: Pedro Fragoso Costa (Essen, Germany), Wendy Kemps (Brussels, Belgium)

**OP-253** Ability of artificial intelligence to diagnose coronary artery stenosis using hybrid images of coronary computed tomography angiography and myocardial perfusion SPECT
H. Yoneyama¹, K. Nakajima¹, J. Taki¹, H. Wakabayashi¹, T. Konishi¹, K. Okuda¹, T. Shiburani², M. Onoguchi¹, S. Kinuya²; ¹Kanazawa University Hospital, Kanazawa, JAPAN, ²Kanazawa Medical University, Kanazawa, JAPAN.

**OP-254** The ratio between RPP in stress and rest in patients with and without myocardial ischemia as assessed by ¹³NH⁺PET/CT
C. Bulder, S. V. Lazarenko, R. J. J. Knol, W. A. M. Broos, F. M. van der Zant; Noordwest Ziekenhuisgroep, Alkmaar, NETHERLANDS.

**OP-255** Studies On Sterile Filters In The Preparation N-13 Ammonia Injection
C. Oh, S. Kim, J. Shin, M. Cha, Y. Ji, S. Choi; Samsung Medical Center, Seoul, KOREA, REPUBLIC OF.

**OP-256** The Importance of Timing of MRAC Acquisition on Co-Registration in PET/MR Cardiac Stress Examinations
M. Thueringer, M. Hofbauer, S. Epp, E. von Felten, D. Patriki, T. Fuchs, R. R. Buechel; University Hospital Zurich, Zurich, SWITZERLAND.

**OP-257** Investigation into method for radiolabelling erythrocytes with Tc-99m for use in red cell volume
W. A. Sanders, J. Croasdale, A. Notghi; SWBH NHS Trust, Birmingham, UNITED KINGDOM.

**OP-258** Review of protocol change for SLN injections in patients with breast cancer
P. J. Campbell, H. Sharman, C. Caro; The Royal Marsden NHS FT, London, UNITED KINGDOM.

**OP-259** Twin Peaks: Should we use Dual Energy Windows for [⁷⁵Se] SeHCAT Studies?
A. List, B. Stiles, A. Paramithas; The Royal Marsden NHS FT, London, UNITED KINGDOM.

**OP-260** Establishing Local Dose Reference Levels for Low-dose CT Scans Associated with SPECT and PET Imaging Examinations - Experience at Sultan Qaboos University, Oman
Y. Bouchareb¹, N. Tag², A. Al-Jabri³, N. Makhmari³, A. Al-Hajj³, H. Al-Dhuhl³; ¹Sultan Qaboos University, Muscat, OMAN, ²Sultan Qaboos University Hospital, Muscat, OMAN.

**OP-261** Estimation of radiation dose to the eye lens of patients undergoing PET/CT scan with lowdose-CT compared to diagnostic-CT head
E. C. Streefkerk, T. Young - Mylvaganan, J. olde Heuvel, D. Huizing, B. de Wit - van der Veen; Cancer institute, Amsterdam, NETHERLANDS.
Technologist e-Poster Presentation 1

Chair: Edgar Pereira (Almada, Portugal), Agata Pietzak (Poznan, Poland)

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TEPS-11  Cost saving of PET/CT and contrast enhanced CT in lymphoma patients
C. Vazzana, R. Sanco, M. Trevisan, F. Lincetto, A. Biscotto, L. Evangelista; Istituto Oncologico Veneto IRCCS, Padova, ITALY.

TEPS-12  Managing patients and working spaces during facilities upgrade: a single-center experience
M. Maccagnani1, D. Pedrini2, A. Farinetti1, A. Lambertini1, S. Fant1, S. Barbieri1; 1Nuclear Medicine Department, Sant’Orsola-Malpighi Hospital, University of Bologna, Italy, Bologna, ITALY, 2Technical Department, Sant’Orsola-Malpighi Hospital, University of Bologna, Italy, Bologna, ITALY.

TEPS-13  Discovery, A New Zealand Nuclear Medicine Department voyage that has made a real difference
P. E. Lamerton; Hawkes Bay District Health Board, Hastings, NEW ZEALAND.

TEPS-14  Tracer extravasation in PET/CT: could we predict it?
M. Trevisan, A. Biscotto, F. Lincetto, M. De Rossi, F. Ruffo, P. Reccia, A. Cervino, M. Burei, L. Cuppari, A. Carraro, L. Evangelista; Nuclear Medicine Unit, Veneto Institute of Oncology IOV - IRCCS, Padua, ITALY.

TEPS-15  Lutetium (177Lu) Oxodotreotide Therapy - Increasing Capacity and Demand
E. Seal; University Hospital Birmingham, Birmingham, UNITED KINGDOM.

TEPS-16  Estimate of thyroid volume aimed at radiometabolic treatment of hyperthyroidism

TEPS-17  Biodistribution Mapping of 223Radium Dichloride during the course of Treatments 2 to 6. A Patient Case Study
J. Weekes, I. Sayers, M. Foley; New Cross Hospital, Wolverhampton, UNITED KINGDOM.

TEPS-18  Referral Rates and Overall Survival of Patients Receiving Ra223 Therapy for mCRCP at the Beatson West of Scotland Cancer Centre
Kerr, C. Brown, C. Findlay, G. Buchanan; Beatson West of Scotland Cancer Centre, Glasgow, UNITED KINGDOM.
TEPS-19  Impact of TOF (Time of Flight) reconstructions on SUVmax (Standard uptake value) in AD (Alzheimer Disease)/PD (Parkinsonism Disease) patients: Using of $^{18}$F-FDG, $^{11}$C-CFT and $^{11}$C-PIB
D. Wimalarathne$^{1,2}$, X. Lan$^1$, Y. Zhang$^1$, W. Ruan$^1$; $^1$Department of Nuclear Medicine, Union Hospital, Tongji Medical College, Huazhong University of Science and Technology, Wuhan 430022, CHINA; $^2$Department of Radiography and Radiotherapy, Faculty of Allied Health Sciences, General Sir John Kotelawala Defence University, SRI LANKA.

TEPS-20  Validation of Standardized Uptake Value about Hardware Components in Integrated PET/MRI
B. Kim$^1$, M. Kim$^2$, J. Moon$^1$, H. Lee$^1$, G. Noh$^1$; $^1$Department of Nuclear Medicine, Seoul National University Hospital, Seoul, KOREA, REPUBLIC OF; $^2$Department of Radiology, Seoul National University Hospital, Seoul, KOREA, REPUBLIC OF.

TEPS-21  Optimization of Bayesian penalized likelihood reconstruction parameters for quantitative brain Positron Emission Tomography (PET) imaging
D. Ribeiro$^1$, W. Hallett$^1$, O. Howes$^{2,4}$, R. McCutcheon$^{2,4}$, M. Nour$^{2,4}$, A. A. S. Tavares$^2$; Invicro, London, UNITED KINGDOM; $^1$Medical Research Council London, Institute of Medical Sciences, London, UNITED KINGDOM; $^2$Institute of Psychiatry, Psychology & Neuroscience, London, UNITED KINGDOM; $^4$Institute of Clinical Sciences, Faculty of Medicine, Imperial College London, London, UNITED KINGDOM; $^5$Edinburgh Imaging, The University of Edinburgh, Edinburgh, UNITED KINGDOM.

TEPS-22  Correlation of the Standardized Uptake Value (SUV) and the Apparent Diffusion Coefficient (ADC) Value in Breast Carcinoma with Simultaneous [$^{18}$F]-FDG PET/MRI
M. Kim$^1$, B. Kim$^2$, H. Jung$^1$, Y. Bang$^1$; $^1$Department of Radiology, Seoul National University Hospital, Seoul, KOREA, REPUBLIC OF; $^2$Department of Nuclear Medicine, Seoul National University Hospital, Seoul, KOREA, REPUBLIC OF.
Technologist e-Poster Presentation 2

Chair: MarieClaire Attard (Zwolle, Netherlands), Rodrigo Garcia Gorga (Sabadell, Spain)

TEPS-23  Case-by-case Evaluation of Clearance of Waste contaminated with Residues of the Radiopharmaceutical Xofigo
O. Nitzsche1, S. Thierfeldt1, R. Kunz1, K. Wittke1; 1Brenk Systemplanung GmbH, Aachen, GERMANY, 2Bayer AG, Wuppertal, GERMANY.

TEPS-24  A sensitive analytical method for the determination of the long-lived impurity $^{227}$Ac in production batches of Xofigo® has been developed in order to allow for unconditional release of clinical waste after decay-in-storage
J. Gay1, K. Wittke1, I. Hunnes3; 1Bayer AG, Berlin, GERMANY, 2Bayer AG, Wuppertal, GERMANY, 3Bayer AS, Oslo, NORWAY.

TEPS-25  Differentiated thyroid cancer patients treated with radioiodine-therapy and individualized recommendation of radioprotection
C. Moisescu-Goia, A. Sabo, C. Pestean, I. Cecan, M. Crisan, E. Olariu, D. Piciu; Oncological Institute of Cluj-Napoca, CLUJ-NAPOCA, ROMANIA.

TEPS-26  A Phantom Study on Radiotracer Dose Reduction in Integrated PET/MR System
J. Zhuang, M. Bai; Xuanwu Hospital, Capital Medical University, Beijing, CHINA.

TEPS-27  Examination of the Correlation between patient-dependent parameters and radiation dose rates measured around patients undergoing PET/CT imaging using 18F-FDG
S. Alqahtani; PSMMC, Riyadh, SAUDI ARABIA.

TEPS-28  Typical patient doses from CT part of PET/CT examinations in Slovenia and comparison with other countries
J. Peric1,2, I. Zagar1, D. Zontar3; 1Institute of Oncology, Ljubljana, SLOVENIA, 2Faculty of Health Sciences, University Ljubljana, Ljubljana, SLOVENIA, 3Slovenian Radiation Protection Administration, Ljubljana, SLOVENIA.

TEPS-29  CT Dose Optimization
B. Gillman; British Columbia Institute of Technology, Vancouver, BC, CANADA.

TEPS-30  Evaluation in animal imaging of the new generation of pre-clinical all-digital PET/CT
W. Xiao; Huazhong University of Science & Technology, Wuhan, CHINA.

TEPS-31  Conventional vs. digital Philips PET/CT: evaluation of phantom data
A. Ebbens, T. Kuijer, E. Martens, B. J. de Wit-van der Veen; Netherlands Cancer Institute, Amsterdam, NETHERLANDS.
TEPS-32  PET-CT acquisition protocol optimization with a new digital PET-CT
S. Cola¹, F. Fioroni², A. Palmieri¹; Nuclear Medicine S. Maria Nuova Hospital, Reggio Emilia, ITALY.¹ Physical Department S. Maria Nuova Hospital, Reggio Emilia, ITALY.

TEPS-33  Quantitative harmonization of Biograph mCT systems using post-reconstruction filter (EQ Filter) and its validation in clinical studies for whole body ¹⁸F-FDG
A. Hurtado de Mendoza¹, C. Soza², J. Flores³, S. Lopez⁴, J. Spuler⁴, H. Amaral⁴; Center for Nuclear Medicine & PET/CT Positromed, Santiago, CHILE.

TEPS-34  Image quality of ¹⁸F-FDG for patients with a high body mass index examined on Si-photomultiplier based PET
B. Olsson¹, J. König², E. Trägårdh³, J. Oddstig⁴; Clinical Physiology and Nuclear Medicine, Skåne University Hospital and Lund University, Malmö-Lund, SWEDEN.² Department of Radiology, Central Hospital, Kristianstad, SWEDEN.³ Radiation Physics, Skåne University Hospital and Lund University, Malmö-Lund, SWEDEN.

TEPS-35  Studies On Decision Of The Cut-off Standardized Uptake Values For Normal Bones In ¹⁸F-fluoride Pet/ct And ¹⁸F-fdg Pet/ct
R. Ono³, N. Fujita¹, C. Hasegawa², Y. Ito², T. Tada², R. Murayama², Y. Tsutsumi², H. Odagawa³, M. Tamura², S. Abe³; Department of Radiological and Medical Laboratory Sciences, Nagoya University Graduate School of Medicine, Nagoya, JAPAN.² Department of Radiological Technology, Nagoya University Hospital, Nagoya, JAPAN.

TEPS-36  Verification of acquisition condition in dynamic imaging using continuous bed motion PET/CT
T. Umezawa¹, T. Iimori, T. Murata, K. Sawada, Y. Masuda, T. Uno; Chiba University Hospital, Chiba, JAPAN.

TEPS-37  Evaluation of Respiratory Motion Correction on Liver Kinetic Analysis for Dynamic PET Imaging
Y. Shao¹, J. Wang², X. Wang², J. Cui², N. Li³, L. Huo², H. Zhang¹;¹ Department of Biomedical Engineering, Tsinghua University, Beijing, CHINA.² Department of Nuclear Medicine, Peking Union Medical College (PUMC) Hospital, Chinese Academy of Medical Science and PUMC, Beijing, CHINA.³ SinoUnion (Beijing) Healthcare Technologies Co., Ltd, Beijing, CHINA.

TEPS-38  Bayesian penalized-likelihood reconstruction algorithm in the advanced digital PET/CT system for ¹⁸F-NaF PET/CT in morbidly obese patients
M. Al-Daas¹, L. Al³, A. Sosikumar⁴, A. Esmai³, F. Marafi⁴;¹ Jaber Al-Ahmad Center for Molecular Imaging, Shuwaikh, KUWAIT.² Kuwait University, Jabiya, KUWAIT.¹ Jaber Al-Ahmad Center for Molecular Imaging, Shuwaikh, KUWAIT.
TEPS-39  Influence of statistical fluctuation on the accuracy and stability of SUV and TBR - A phantom study
X. Xie, M. Yun, H. Mi, X. Zhang; Department of Nuclear Medicine, Beijing Anzhen Hospital, Beijing, CHINA.

TEPS-40  Optimization of image reconstruction for rapid image acquisition by $^{18}$F-NaF bone PET: Comparison of OSEM and Bayesian penalized likelihood algorithms

TEPS-41  Development of a fully automatic analytical program for the $^{123}$I- MIBG myocardial uptake measurement method
R. Sako, Y. Uchiyama, Y. Kamiya, S. Ito; 1Graduate school of health sciences, Kumamoto University, Kumamoto, JAPAN, 2Faculty of Life Sciences, Kumamoto University, Kumamoto, JAPAN, 3Chibana Clinic, Okinawa, JAPAN.

TEPS-42  Accuracy of Planar Scan based and SPECT/CT based Quantification Methods in Bone Scintigraphy
D. Sercic, A. Doma, I. Zagar, D. Skrk; 1Institute of Oncology Ljubljana, Ljubljana, SLOVENIA, 2Faculty of Health Sciences, University of Ljubljana, Ljubljana, SLOVENIA, 3Slovenian Radiation Protection Administration, Ljubljana, SLOVENIA.

TEPS-43  Evaluation of cingulate island sign ratios for the differentiation of dementia with Lewy bodies versus Alzheimer’s disease using $^{123}$I-IMP SPECT
N. Hayashi, Y. Murata, A. Hirota, N. Akagi, H. Iwasa, K. Ito, H. Kazui, T. Yamagami; Kochi Medical School Hospital, Nankoku, JAPAN.

TEPS-44  Introduction of a New 3D Analysis for the DATscan and the Realisation of a larger and more up to date Reference Set
A. Gelderblom, P. Brinks, J. Habraken, J. Lavalaye, J. Salcedo, M. Vredenduin; 1St Antonius Hospital, Nieuwegein, NETHERLANDS, 2Diaconessenhuis, Utrecht, NETHERLANDS.
Technologist e-Poster Presentation 3
Chair: Luisa Roldão Pereira (Maidstone, United Kingdom), Giorgio Testanera (London, United Kingdom)

TEPS-45  Cut-Off Frequency Optimization on Hot Bone Spine Lesions in 99mTc-HDP SPECT-CT
C. Ferreira, C. Low, N. Rao, J. Cullis; University Hospital of Coventry and Warwickshire, Coventry, UNITED KINGDOM.

TEPS-46  The Influence Of Attenuation Correction On The Image Quality In Single Photon Emission Computed Tomography
S. Rep1, N. Freih1, L. Lezai1; J. Zibert2; University Medical Centre Ljubljana, Ljubljana, SLOVENIA, 2Faculty of Health Sciences, University of Ljubljana, Ljubljana, SLOVENIA.

TEPS-47  Usefulness of partial volume effect correction in 201TI/123I dual-isotope myocardial SPECT on CZT-SPECT camera
D. Ichioka1, S. Shiraishi1, S. Tomiguchi2; 1Graduate School of Health Science, Kumamoto, JAPAN, 2Kumamoto University Hospital, Kumamoto, JAPAN.

TEPS-48  The Evaluation of the impact of 99mTc gamma rays on x-ray detectors during a CT low dose acquisition
A. Resende Geao; Hospital CUF Descobertas, Lisboa, PORTUGAL.

TEPS-49  The effect of metal artifact reduction on quantitative SPECT/CT imaging
T. Konishi1, T. Shibutani2, K. Okuda3, H. Yaneyama4, R. Moribe1, M. Onoguchi4, K. Nakajima4, S. Kinuya5; 1Department of Radiological Technology, Kanazawa University Hospital, Kanazawa City, JAPAN, 2Department of Quantum Medical Technology, Institute of Medical, Pharmaceutical and Health Sciences, Kanazawa University, Kanazawa City, JAPAN, 3Department of Physics, Kanazawa Medical University, Kaho-ku, JAPAN, 4Department of Functional Imaging and Artificial Intelligence, Kanazawa University, Kanazawa City, JAPAN, 5Department of Nuclear Medicine, Kanazawa University Hospital, Kanazawa City, JAPAN.

TEPS-50  Performance Evaluation of a New Collimator Optimized for 177Lu Preclinical SPECT Imaging
N. Colpo1, C. Uribe1, J. Rousseau1, C. Kamphuis2, F. Beekman3, 2MILabs B.V., Utrecht, NETHERLANDS, 3Delft University of Technology, Delft, NETHERLANDS, 4University of British Columbia, Vancouver, BC, CANADA.

TEPS-51  Repeatability and stability evaluation of 177Lutetium quantification
M. C. Dekker; D. M. V. Huizing, B. J. de Wit - van der Veer; Antoni van Leeuwenhoek, Amsterdam, NETHERLANDS.

TEPS-52  Agreement between functional parameters of myocardial perfusion assessed with gated IQ-SPECT and conventional SPECT/CT
W. Martinez, V. Poblete, E. Noriega Alvarez, E. Noriega Alvarez, E. Noriega Alvarez; Servicio de Medicina Nuclear, Hospital General Universitario de Ciudad Real, Ciudad Real, SPAIN.
TEPS-53 Development of cardiac phantom for evaluation of fusion image of Myocardial perfusion imaging and CT-A
A. Kikuchi1, Y. Honma1, H. Honma2, A. Andou2, M. Kitama1, G. Okuyama1; 1Department of Radiological Technology Faculty of Health Sciences, sapporo, JAPAN, 2Ono Memorial Hospital, Sapporo, sapporo, JAPAN.

TEPS-54 Examination of myocardial extraction using Semantic Segmentation by Deep learning
K. Okada1, A. Kikuchi1, T. Kawakami1, Y. Honma1, K. Nakajima2, H. Yoneyama2; 1Hokkaido University of Science, Sapporo, JAPAN, 2Kanazawa University, Kanazawa, JAPAN.

TEPS-55 mcARM An Automated Motion Correction Algorithm For MPI Spect
A. Szucs1,2, Z. Fegyvári2, B. Kőrä1,2, O. Pártos4; 1Eotvos Lorand University, Budapest, HUNGARY, 2Mediso Medical Imaging Systems, Budapest, HUNGARY, 3Semmelweis University, Department of Radiology, Budapest, HUNGARY, 4Semmelweis University, Nuclear Medical Center, Budapest, HUNGARY.

TEPS-56 The use of effervescent granules in myocardial perfusion imaging; the full secret to a man's heart
J. Goh; Sengkang General Hospital, Singapore, SINGAPORE.

TEPS-57 Diagnostic utility of 99mTc-DPD scintigraphy in patients with suspected cardiac amyloidosis
E. N. Andersen1, A. Hodt1, E. Gude1, T. Bach-Gansmo1; 1Oslo University Hospital Ullevål, Department of Radiology and Nuclear Medicine, Oslo, NORWAY, 2Oslo University Hospital Rikshospitalet, Department of Cardiology, Oslo, NORWAY.

TEPS-58 Analysis Of Influence Factors And Correlation For Quality Of Wholebody Bone Scan Imaging
T. Lu, G. Yang; Shandong Cancer Hospital affiliated to Shandong University, Jinan In ShanDong province, CHINA.

TEPS-59 Performance And Analysis Of Vertebral99 TcM-mdp Uptake After Chest Tumor Radiotherapy
T. Lu, G. Yang; Shandong Cancer Hospital affiliated to Shandong University, Jinan In ShanDong province, CHINA.

TEPS-60 Quantitative accuracy of standardized uptake value (SUV) for xSPECT Bone technology using new supine phantom
T. Shibutani1, M. Onoguchi1, T. Konishi2, H. Yoneyama2, H. Ichikawa3, K. Okuda4, K. Nakajima4; 11. Department of Quantum Medical Technology, Institute of Medical, Pharmaceutical and Health Sciences, Kanazawa University, Kanazawa city, JAPAN, 22. Department of Radiological Technology, Kanazawa University Hospital, Kanazawa city, JAPAN, 33. Department of Radiological Technology, Toyohashi Municipal Hospital, Toyohashi city, JAPAN, 44. Department of Physics, Kanazawa Medical University, Kanazawa city, JAPAN, 55. Department of Functional Imaging and Artificial Intelligence, Kanazawa University, Kanazawa city, JAPAN.
TEPS-61  Creation Of A Labeled Technetium-99m Colloid Drug For The Detection Of Guarding Lymph Nodes
A. Rogov, E. Stasyuk, E. Nesterov, V. Sadkin, E. Shelikhova; National Research Tomsk Polytechnic University, Tomsk, RUSSIAN FEDERATION.

TEPS-62  Lymphoscintigraphy and sentinel node localization in gynaecological cancers into practice: a UK single-centre protocol
L. Pereira, K. Brooks, T. Barnard; Maidstone and Tunbridge Wells NHS Trust, Maidstone, UNITED KINGDOM.

TEPS-63  Net Administered Activity As A Surrogate Quality Control Indicator For Non-Imaging Breast SLNB Procedures
L. Wason, A. Nicol, J. Dennis, C. Flynn; NHS Greater Glasgow And Clyde, Glasgow, UNITED KINGDOM.

TEPS-64  Clinical Effectiveness Of Sentinel Node Biopsy In Early Oral Cavity Carcinoma
Y. Herrera-Martinez, A. Bonilla De Damid, V. Pachón Garrudo, D. Tamayo Carabaño, R. Álvarez Pérez, J. Jiménez-Hayuela García; Hospital Universitario Virgen del Rocío, Seville, SPAIN.

TEPS-65  Quantitative estimation of the renal tubular function with 99mTc- MAG3: comparative software approach using two methods in a pediatric population

TEPS-66  Comparison of Single and Dual Isotope Imaging for 3D Lung Lobar Quantification with SPECT-CT
T. Sousa, S. Gregg, K. Wechalekar; Royal Brompton and Harefield Foundation Trust Hospital, London, UNITED KINGDOM.
Assessment of 2-hour Images for 99mTc-HYNIC-TOC Studies Using Image Interpretation and Image Analysis

S. Tavares¹, M. Jessop¹, D. Pencharz², E. Manca³, N. Singh⁴, S. Figueiredo⁵, Royal Sussex County Hospital, Brighton, UNITED KINGDOM, ²Lisbon School of Health Technology, Lisbon, PORTUGAL.

Quantification Of Technetium-99m Sestamibi Scintigraphy In Ait Type I And II

E. Kranenborg, M. v Rutte, J. Lavalaye, J. Habraken; St. Antonius Hospital, Nieuwegein, NETHERLANDS.

Serum creatinine measurement as a predictor for single sample GFR using 99mTc-DTPA

G. Hilland, A. Matos, C. Findlay; NHS Greater Glasgow and Clyde, Glasgow, UNITED KINGDOM.

End of Chromium-51 availability: Setting-up of a new protocol, validation and impact analysis

S. A. Figueiredo, G. Allenbach, J. O. Prior, J. Delage, J. Costes; CHUV, Lausanne, SWITZERLAND.

Glomerular filtration rate: Comparison of two tracers

L. Janus, T. Andersen, K. Thilsing-Hansen, D. Roholdt, C. Led, P. Andersen, H. Thomsen, O. Gerke, P. Høilund-Carlsen, J. Simonsen; Odense University Hospital, Odense C, DENMARK.

Association between TNM staging and primary tumor parameters assessed in ¹⁸F-FDG-PET/CT study in NSCLC patients

K. Pietrasz¹, P. Cegla¹, K. Witkowska², R. Czepcyński³, M. Bryl⁴, W. Cholewinski³¹; ¹Nuclear Medicine Department, Greater Poland Cancer Centre, Poznan, POLAND, ²Affidea Medical Center, Poznan, POLAND, ³Department of Endocrinology, Metabolism and Internal Medicine, Poznan University of Medical Science, Poznan, POLAND, ⁴Oncoogy Department at Regional Centre of Lung Diseases in Poznan and Department of Thoracic Surgery, Poznan University of Medical Sciences, Poznan, POLAND, ⁵Chair and Department of Radiology, Poznan University of Medical Science, Poznan, POLAND.

Assessment of ¹⁸F-FDG PET/CT texture analysis to discriminate NSCLC from radiation pneumonitis after CIRT

M. Suga¹², R. Nishii¹, K. Yamazaki¹, Y. Kamitaka¹², K. Miwa², R. Kohno³, K. Tanimoto¹, T. Higashi¹, H. Tsuji¹; ¹IST hospital, National Institute of Quantum and Radiological Science and Technology, Chiba, JAPAN, ²Department of Radiological Sciences, International University of Health and Welfare, Tochigi, JAPAN, ³Department of Molecular Imaging and Theranostics, National Institute of Radiological Sciences, QST, Chiba, JAPAN, ⁴Department of Accelerator and Medical Physics Therapy Systems Section, National Institute of Radiological Sciences, QST, Chiba, JAPAN.
TEPS-75 Impact of respiratory and ECG gated $^{18}$F-FDG PET/CT for cardiac sarcoidosis
K. Hanaoka, S. Watanabe, Y. Shibata, H. Kaida, K. Ishii; Institute of Advanced Clinical Medicine, KINDAI University, Osaka-sayama, JAPAN.

TEPS-76 Correlation of HPV status and biological parameters assessed in $^{18}$F-FDG-PET/CT study in head and neck cancer patients
P. Cegła1, E. Majchrzak1, R. Czepczynski1, K. Pietrasz1, A. Kaczmarek1, W. Golusinski2; 1Nuclear Medicine Department, Greater Poland Cancer Centre, Poznan, POLAND, 2Department of Otolaryngology, Head and Neck Surgery and Oncology, Greater Poland Cancer Centre, Poznan, POLAND.

TEPS-77 Parametric Whole Body FDG PET Scan: Just Do It!
H. Danielsen, M. F. Pedersen, L. C. Gormsen, O. L. Munk; Aarhus University Hospital, Aarhus, DENMARK.

TEPS-78 18F-FDG PET/CT prone vs. supine
D. Boon, C. de Haan; Dijklander ziekenhuis, Hoorn, NETHERLANDS.

TEPS-79 The effect of image based motion correction on the HRRT scanner
R. B. Bertelsen, M. L. F. Schwartz; Nuclear Medicine and PET, Skejby, DENMARK.

TEPS-80 $^{18}$F-FDG PET/MR multiparametric measurement of head and neck cancer patients underwent modern 3D based radiotherapy - preliminary results
A. Kedves1,2,3, Z. Tóth1,5, S. Tóth1,5, T. Pintér1,5, B. Sánta1, Z. Cselik1,5, V. Koczka1,5, D. Sipos1,2,3, F. Omar1,2,4, G. Bajzik2,4, J. Hadijev2,4, I. Repa2,4, M. Moizs3,4, Á. Kovács1,5, D. Sipos1,2,3, F. Omar1,2,4, G. Bajzik2,4, J. Hadijev2,4, I. Repa2,4, M. Moizs3,4, Á. Kovács1,5; 1Department of Medical Imaging, Faculty of Health Sciences, University of Pécs, Kaposvár, HUNGARY, 2Department of Medical Imaging, Faculty of Health Sciences, University of Pécs, Kaposvár, HUNGARY, 3Department of Medical Imaging, Faculty of Health Sciences, University of Pécs, Kaposvár, HUNGARY, 4PET Medicopus Nonprofit Ltd. “Moritz Kaposi” Teaching Hospital, Kaposvár, HUNGARY, 5Department of Occupational Health and Public Health, University of Pécs, Kaposvár, HUNGARY.

TEPS-81 Comparison And Evaluation Of The Effectiveness Between Respiratory Gating Method Applying The Flow Mode And Additional Gated Method In PET/CT Scanning.
D. Jang, Y. Park, G. Lee, H. Cho; Seoul national university bundang hospital, Bundang-Gu, Seongnam-Si, Gyeonggi-Do., KOREA, REPUBLIC OF.

TEPS-82 Technical acquisition modality of cerebral PET/CT images in patients with memory disorders
TEPS-83 Caloric Restriction improves Established Proteinuria in Adriamycin-Induced Nephropathy: A N13-ammonia PET study
J. W. A. Sijbesma¹, A. van Waarde¹, A. Klooster², R. H. J. A. Slart¹, H. H. Boersma¹, R. A. J. O. Dierckx¹, H. van Goor¹, S. J. L. Bakker²; NMMI, Groningen, NETHERLANDS, ²Dept. of Pathology, Pathologie Friesland, Leeuwarden, NETHERLANDS, ³Pathology and Medical Biology, Groningen, NETHERLANDS, ⁴Nephrology, Groningen, NETHERLANDS.

TEPS-84 Influence of intravenous diuretics on the detectability of local prostate cancer recurrence in ⁶⁸Ga-PSMA-11 PET/CT
L. Dijkstra, I. Alberts, G. Prenosil, A. Rominger, A. Afshar-Oromieh; Nuclear Medicine Inselspital, Bern, SWITZERLAND.

TEPS-85 Tracer Uptake Of Hepatocellular Carcinoma In Psma Pet Is Associated With Arterial Phase Hyperenhancement In Mri
A. Kanzog, L. Stegger, M. Schaefers, B. Noto; Department of Nuclear Medicine, Münster, GERMANY.

TEPS-86 SUVmax in Organ Confined Prostate Cancer and Its Correlation with PSA level and Gleason Score. A Single Center Study
M. Khaskhali; Sindh Institute of Urology and Transplantation, Karachi, PAKISTAN.

TEPS-87 The addition of late PSMA-ligand PET/CT imaging for the differentiation between benign and malignant PSMA uptake
L. Dijkstra, I. Alberts, G. Prenosil, A. Rominger, A. Afshar-Oromieh; Nuclear Medicine Inselspital, Bern, SWITZERLAND.

TEPS-88 Correlative assessment of lumbar intervertebral disc degeneration in alkaptonuria patients using quantitative analysis in ¹⁸F-NaF PET/CT and MRI grading systems.
E. H. Alawadhi¹, A. Mistry¹, S. Vinjamuri¹, J. Gallagher¹, R. Lakshminarayan¹, J. Dillon¹; ¹Institute of Ageing & Chronic Disease, University of Liverpool, Liverpool, UNITED KINGDOM, ²Department of Radiology, Royal Liverpool and Broadgreen University Hospitals, Liverpool, UNITED KINGDOM, ³Department of Nuclear Medicine Royal Liverpool University Hospital, Liverpool, UNITED KINGDOM, ⁴Liverpool Clinical Laboratories, Royal Liverpool & Broadgreen University Hospitals Trust, Liverpool, UNITED KINGDOM.

TEPS-89 Relationship between standardised uptake values, Hounsfield Units and bone density value of vertebral body in the lumbar spine: a study in alkaptonuria subjects using 18 F-NaF PET/CT and DEXA scan
E. H. Alawadhi¹, S. Vinjamuri¹, J. Gallagher¹, R. Lakshminarayan¹, J. Dillon¹; ¹Institute of Ageing & Chronic Disease, University of Liverpool, Liverpool, UNITED KINGDOM, ²Department of Nuclear Medicine Royal Liverpool University Hospital, Liverpool, UNITED KINGDOM, ³Liverpool Clinical Laboratories, Royal Liverpool & Broadgreen University Hospitals Trust, Liverpool, UNITED KINGDOM.
Preclinical Studies, from Bench to Bedside
How to Develop the Ideal Radiopharmaceutical

Guy Bormans (Leuven, Belgium)

The characteristics of the “ideal” radiopharmaceutical depend on whether the radiopharmaceutical is applied for diagnosis and/or therapy or their combination (theranostic). In general, the radiopharmaceutical consists of a radionuclide and a vector. The vector is responsible for the specific interaction with the target which will ultimately lead to image contrast or selective irradiation of the target tissue.

The development of a new radiopharmaceutical starts with the selection of the target which has an altered expression in the pathology that needs to be imaged or treated. The expression levels (Bmax) of the target in the tissue of interest should be explored since the expected contrast is driven by Bmax/Kd values and from this value the minimal Kd (equilibrium dissociation constant reflecting the affinity) of the radiopharmaceutical is estimated. Literature is screened for molecules that have high affinity and selectivity for the target. These molecules and their derivatives can be advanced as vector molecules and can consist of small molecules, biologics (peptides, proteins) or nanoparticles.

In a next step, the vector molecules are radiolabelled with an appropriate radionuclide using organic chemistry (small molecules) or radiometal complexation techniques. The radiolabelled molecule is evaluated in vitro using e.g. cell binding, tissue autoradiography, stability testing. If successful, the radiolabelled molecule will be further evaluated in vivo/ex vivo in healthy animals and animal models of the disease using biodistribution or imaging experiments combined with plasma and tissue analysis to quantify the fraction of radiometabolites.

If the radiolabelled molecule is validated non-clinically it becomes a radiotracer that can be advanced to the status of radiopharmaceutical for clinical evaluation.

Before clinical evaluation starts, the stable (non-radioactive) version of the radiotracer is evaluated in a limited toxicological study using the microdosing approach.

A Good Manufacturing Practice (GMP) compliant production and QC method is developed and three validation runs are performed to validate the performance of the production process. An IMPD (investigational medicinal product dossier), IB (investigators brochure) and a study protocol are drafted and are bundled into a CTA (clinical trial application) which is submitted to the ethical committee and the national authorities or EMA (European Medicines Agency). Upon approval, the investigational radiopharmaceutical can be administered to the clinical study subjects (human volunteers or patients) in the envisaged clinical studies.

For diagnostic radiopharmaceuticals, the initial clinical evaluation usually consists of dosimetry and test-retest studies. The diagnostic or therapeutic potential of the radiopharmaceutical is evaluated in small (phase I) or larger groups (phase 2 and 3) of patients. Based on the results of the clinical studies, a marketing authorisation (MA) is filled and upon approval, the ideal radiopharmaceutical can be commercialised.

References:

1. EU draft guideline on Non-clinical requirements for radiopharmaceuticals : https://www.ema.europa.eu/en/non-clinical-requirements-radiopharmaceuticals
Preclinical PET Imaging and Quantification

Michel Koole (Leuven, Belgium)

Preclinical PET imaging plays a crucial role in the characterization of new PET tracers and the selection of the most suitable clinical drug or tracer candidate. It has received a major boost during the past decade, partly because pharmaceutical companies started using PET imaging in preclinical phases of their drug development. New advances in digital detector technology resulted in dedicated PET systems for small animals with sub-millimetre resolution and high sensitivity. Moreover, the development of compact MR-compatible PET inserts makes it possible to perform simultaneous preclinical PET/MR imaging. These new developments have shifted the attention from a merely visual assessment of tracer uptake towards quantification using tracer kinetic modelling. However, there are still some issues related to the accurate quantification of preclinical PET imaging.

First, the use of blood plasma data in combination with kinetic models is challenging in a preclinical context. Arterial blood sampling requires an invasive, arterial cannulation procedure which hampers sequential PET imaging of the same animal. Therefore, less invasive preclinical PET procedures or simplified quantitative measures are to be considered for applications involving longitudinal preclinical PET scanning.

Besides this more technical challenge, there is also challenge of appropriate animal handling in terms of tracer injection, heating, monitoring of vital signs and use of anaesthesia during the PET scan. Especially the repeated delivery of anaesthetics for longitudinal PET scanning can interfere with underlying biological and physiological processes.

In studies with repeated PET scanning, there is also the issue of radiation not only from a point of view of radiation protection for the researchers and those involved in the imaging and care of the animals, but in terms of the radiation burden on the animal which can also interfere with the experiment.

Therefore, quantitative preclinical PET imaging requires appropriate training of staff and investigators, regular QC of small animal PET systems, including cross calibration with other activity measurement devices and standardized imaging procedures.

References:


At VUB, camelids such as llama, alpacas and camels were discovered to possess a special type of antibodies in their blood. A Nanobody is derived from these, and represents the smallest naturally occurring antigen-binding protein. Its small size and robustness make it an ideal targeting moiety for radionuclide imaging as well as therapy. Since 2005, ICMI VUB has focused on all aspects of nanobody selection, radiolabeling, preclinical development, validation and translation to clinical trials. The different steps in this process will be explained, using anti-HER2 and anti-MMR nanobodies as examples.

References:


In this book, the technologist’s committee tried to include as much information as possible related to radiopharmacy. This book is definitely an addition to every technologist working in radiopharmacy as well as radiopharmacists, radiochemists and laboratory technicians and physicists.

**Chapter 1 - History of Radiopharmaceuticals**
A historical timeline of important moment in development has been discussed, including the discovery of radiation, radiotracers, the different imaging equipment, and hybrid imaging.

**Chapter 2 - Theoretical basics of radiopharmacy**
The basic principles of radioisotopes have been highlighted, and their development into radiopharmaceuticals.

**Chapter 3 - Radiopharmacy design and radiation protection**
The requirements for setting up a radiopharmaceutical laboratory have been illustrated, together with the competencies and training required. The principles and practice of radiation protection, QA and QC, waste management and infection control have been discussed.

**Chapter 4 - Generators used in nuclear medicine**
The generator has been illustrated and the production of SPECT and PET radionuclides has been highlighted. The advantages and disadvantages of having a generator has been discussed.

**Chapter 5 - Cyclotron and nuclear reactor produced radioisotopes**
Production of cyclotron and nuclear reactor based isotopes is the main component of this chapter, which discusses the basic concepts of radionuclide production.

**Chapter 6 - Conventional Nuclear Medicine radiopharmaceuticals**
The most common radiopharmaceuticals in conventional nuclear medicine have been outlined and discussed. The technologist should be able to understand the techniques involved for the optimal preparation of radiopharmaceuticals and keep track of the daily quality control involved.

**Chapter 7 - PET radiopharmaceuticals**
The advantages over SPECT tracers has been highlighted and PET radiotracers have been discussed. The new radiotracers have been mentioned, and the possibility of combining them with MRI.

**Chapter 8 - Radiopharmaceuticals used in therapy**
Radiotherapy radiopharmaceuticals makes a large component of this chapter, which covers their common clinical applications and some future aspects.

**Chapter 9 - Blood labelling for infection/inflammation imaging**
This chapter covers blood-labelling, which is performed in a sporadic amount of hospitals. The basics of blood labelling and the radioisotopes used is covered, together with different methods of labelling and their clinical applications.

**Chapter 10 - GMP**
Good Manufacturing Practice (GMP) is a very important point in radiopharmacy, and this chapter involves the description of the location needed and the equipment relevant for the implementation of GMP.

**Chapter 11 - Translational approach to radiopharmaceutical development**
This highly extensive chapter regarding clinical trials and animal studies has been included to acknowledge which steps are involved in clinical translational studies.
Generators Used in Nuclear Medicine

Mark Crosthwaite (Richmond, United States of America / SNMMI), David Gilmore (United States of America), Daniel Tempesta (United States of America)

Radionuclide generators are a convenient method to produce and isolate medical isotopes for use in nuclear medicine. In principle, the parent radionuclide with a longer half-life decays to a daughter radionuclide, which has a significantly shorter half-life. As the parent/daughter reach equilibrium, the daughter is eluted from the generator for diagnostic or therapeutic applications. For the elution to be successful, the chemical properties of the daughter must be different from the parent nuclide allowing it to be separated from the parent nuclide. The daughter radionuclide is either directly administered for medical application or it may be radiolabeled to another compound. After elution, the generator builds up additional daughter radionuclide as the parent continues to decay which produces a continuing supply of the short-lived radionuclide. Over time, the parent’s activity diminishes to a point where it can no longer supply enough of the short-lived by-product material and a new generator acquired. In addition, all generators have an expiration date.

In order to deliver these short-lived radionuclides generators must be portable, efficient, cost-effective, and safe. Types of generator under discussion include 99Mo/99mTc, 82Sr/82Rb, 68Ge/68Ga, 81Rb/81mKr, 90Y/90Sr, and 62Zn/62Cu.

Objectives
- Identify key characteristics that pertain to all types of radionuclide generators.
- Discuss the various uses application of the different generator systems.
- Review the following types of generators: 99Mo/99mTc, 82Sr/82Rb, 68Ge/68Ga, 81Rb/81mKr, 90Y/90Sr, and 62Zn/62Cu.

References
2. Cardiogen-82 package insert
Radiopharmacy is the art of preparing high quality, radioactive, medicinal products for use in diagnosis and therapy. The starting point of the generation of a radiopharmaceutical is always based on the target biomarker/function, and the use of a specific vector molecules against it. The vector molecule is then label with a radioactive flag, a radionuclide. This last step, is commonly referred to as radiolabelling, a particular step for radiopharmaceuticals.

The radiolabelling starts with the choice of the radionuclide. It is predominantly based on three factors: the purpose for which the radiopharmaceutical is to be used, the compatibility of the radionuclide with the vector molecule as well as its availability and price. Once chosen the radionuclide will directly dictate the radiolabelling method used to obtain a radiopharmaceutical. Some radionuclides will allow direct radiolabelling of the vector molecule whereas with others only indirect radiolabelling is possible.

Indirect or direct radiolabelling methods can be executed by means of manual, automatic or kit-based synthesis. Independent of the radionuclide or the method, aseptic techniques should be adopted, with sterile filtration if necessary and everything should be in place to protect the operator when preparing the radiopharmaceutical.

Finally, after the radiolabeling process and before the release of the radiopharmaceutical to the patients the quality controls (QCs) are performed. These can be quite limited, such as for kit-based synthesis when a leaflet describing the required QC is enclosed, or rather extensive, following the European Pharmacopoeia.

The obtained radiopharmaceuticals can then be used in nuclear medicine to study specific targets and biological functions based on their accumulation in the human body following ten fundamental principles.

Conclusion:

Although radiopharmaceuticals are medicinal products, the enclosed radionuclide make them unlike any other pharmaceutical product. Radiopharmaceuticals are unique and are at the core of the diagnosis and the therapy performed in nuclear medicine. Consequently, the production and handling of radiopharmaceuticals requires specific knowledge on several topics, the radionuclide, the radiolabelling and synthesis methods, the quality controls as well as the principles of accumulation of the radiopharmaceuticals; which together form the theoretical basics of radiopharmacy.
Technologist Oral Presentations 2
Chair: Pedro Costa (Porto, Portugal)

OP-483 Prevention of activated brown adipose tissue in F18-FDG-PET-imaging in children and adolescents - Which measures are effective?
C. Pötzsch1, S. Naumann1, L. Kurch1, T. W. Georgi1, M. Weckesser1, S. Klutmann3, D. Schmidt4, K. Hermann5, J. Scuik6, D. Hasenclever7, C. Mauz-Körholz8, D. Körholz8, O. Sabri1, R. Kluge8; 1Department of Nuclear Medicine, University of Leipzig, Leipzig, GERMANY, 2Department of Nuclear Medicine, University of Münster, Münster, GERMANY, 3Department of Nuclear Medicine, University Hospital Eppendorf, Hamburg, GERMANY, 4Department of Nuclear Medicine, University of Erlangen, Erlangen, GERMANY, 5Department of Nuclear Medicine, University of Essen, Essen, GERMANY, 6Department of Nuclear Medicine, University of Augsburg, Augsburg, GERMANY, 7Institute for Medical Informatic, Statistics and Epidemiology, University of Leipzig, Leipzig, GERMANY, 8Department of Pediatric, Hamatology and Oncology, University of Gießen, Gießen, GERMANY.

OP-484 Combined 18F-Fluorocholine and 11C-Methionine PET-CT for parathyroid adenoma localization: a pilot acquisition protocol
A. Pereira Gomes, L. Silva; Erasme Hospital, Anderlecht, BELGIUM.

OP-485 Dual time-point 18F-Flutemetamol PET protocol for the imaging of neurodegenerative and amyloid biomarkers in mild cognitive impairment
A. Ruzza, L. Filippi, G. Cicco, P. Basile, R. Pirisino, O. Bagni; Santa Maria Goretti Hospital, Latina, ITALY.

J. Pilz, L. Hehenwarter, J. Holzmannhofer, G. Schweighofer-Zwink, C. Pirich; Department of Nuclear Medicine and Endocrinology, University Hospital Salzburg, Paracelsus Medical University, Salzburg, AUSTRIA.

OP-487 Automated preparation and dispensation of 68 Ga-DOTATOC on the same synthesizer - impact on the dosimetric exposure of technologists compared to manual practice
M. Frindel1, N. Varmenot1, A. Rauscher1, P. Baumgartner1, F. Delaunay1, C. Rousseau1, F. Kaeber-Bodere1; 1Institut de Cancérologie de l’Ouest, Saint-Herblain, FRANCE, 2CHU de Nantes, Nantes, FRANCE.

OP-488 PET/CT SiPM: Feasibility of a breath-hold acquisition in a clinical routine
M. Pappon, M. Jeige, C. Beigelman, P. Genoud, J. Prior; CHUV, Lausanne, SWITZERLAND.

OP-489 Clinical Benefit Of Routine True-whole-body 18F-fdg Pet/ct For Patients With Malignant Melanoma
A. M. von den Berk, J. P. Esser; Meander Medical Centre, Armersfoort, NETHERLANDS.

OP-490 The role of ultra-low dose (0.04mCi/kg) 18F-Sodium Fluoride (NaF) PET/CT in the evaluation of metastatic bone disease
M. Al-Daas, T. Al-Ahmad, A. Esmaiil, S. Usmani, F. Marafi; Jaber Al-Ahmad Center for Molecular Imaging, Shuwaikh, KUWAIT.

OP-491 Experiences from the Technologist Point of View: Automatic Nuclear Medicine DICOM Image Observer Tool for Quality Management
M. Szoliková, Ferenc Nagy, Áron K. Krizsán, Kornél Kukuts, Sándor Banna, Zsolt Hascsi, Ildikó Garai, Attila Forgác; ScanoMed Kft., Debrecen, HUNGARY.
Technologist Oral Presentations 3

Chair: Ana Resende Geão (Ramada, Portugal), Sebastijan Rep (Ljubljana, Slovenia)

**OP-547**
Long-term trends in occupational radiation exposure and associated health risks among technologists performing nuclear medicine procedures: new findings and future research directions
*C. Kitahara¹, M. Bernier¹, M. Van Dyke³, C. Yoder⁴, M. Doody¹, S. Simon¹, M. Linet¹, B. Alexander⁵, D. Villoing¹;¹ National Cancer Institute, Rockville, MD, UNITED STATES OF AMERICA, ²Institute for Radiological Protection and Nuclear Safety, Laboratory of Epidemiology, Fontenay-aux-Roses Cedex, FRANCE, ³Emory University, Atlanta, GA, UNITED STATES OF AMERICA, ⁴Independent consultant, Weddington, NC, UNITED STATES OF AMERICA, ⁵University of Minnesota, Minneapolis, MN, UNITED STATES OF AMERICA.

**OP-548**
177Lu peptide receptor radionuclide therapy, availability, radioprotection, cost: comparison of two administration methods
*F. Herbaut; CHRU Lille, Lille, FRANCE.

**OP-549**
The Impact of Metastable Lutetium-177 on a Nuclear Medicine Department
*A. Brown; Oregon Health and Science University, Portland, OR, UNITED STATES OF AMERICA.

**OP-550**
Analysing and improving working procedures in radiopharmacy laboratories in three European countries
*G. De Mol¹, H. François¹, T. Sälä¹, T. Starc², T. Taatila², S. Rep³, H. Mol¹;¹ Odisee vzw, Brussel, BELGIUM, ²Department of Radiography and Radiotherapy, Tampere University of Applied Sciences, Tampere, FINLAND, ³Faculty of Health Sciences, University of Ljubljana, Ljubljana, SLOVENIA.

**OP-551**
An MRT Shares Her Experience: When Health Care Provider Becomes the Patient
*L. Rimanic; British Columbia Institute of Technology, Burnaby, BC, CANADA.

**OP-552**
Amyloid Positron Emission Tomography (PET) scanning: Process and pathway pitfalls and review
*L. Alves, B. Williams, D. Vilic, Z. Win; Imperial College Healthcare NHS Trust, London, UNITED KINGDOM.

**OP-553**
Opening minds to Lean management in Nuclear Medicine
*J. Lemos, D. Vieira, N. Arantes, P. Costa; Nuclear Medicine Department, School of Health, Polytechnic Institute of Porto (ESS|P.Porto), Porto, PORTUGAL.

**OP-554**
Barriers And Limitations For Nuclear Medicine Technologists' Research In Spain
*R. García Gorga¹,², C. Romero Magdalena¹, N. Vega de Andrea¹, L. Rincon Gayán¹, I. Herrera Peco¹;¹ Sociedad Española de Graduados y Técnicos en Radiología, Madrid, SPAIN, ²Servei de Medicina Nuclear, Hospital Universitari Parc Taulí, Sabadell, SPAIN, ³Health Sciences College, Alfonso X El Sabio University, Madrid, SPAIN.

**OP-555**
Nuclear Medicine Technologists: Professional Identity - Can leadership profiles makes a difference?
*A. Martins¹,²,³, J. Faro de Albuquerque⁴, G. Cunha³,¹ Higher School of Health of the Portuguese Red Cross, Lisbon, PORTUGAL, ²Joaquim Chaves Saúde, Lisbon, PORTUGAL, ³Lisbon School of Health Technology, Lisbon, PORTUGAL, ⁴NOVA-SBE, Lisbon, PORTUGAL.
CTE SESSION 5
October 15, 2019 | 14:30 - 16:00

Patient Communication
Health communication is an umbrella term covering a wide range of communication types that are relevant to the field of health. These include health literacy and promotion, research dissemination, clinical communication, health advocacy, or simply communication skills that help scientists and health institutions to reach who they need in an engaging, accessible way.

Very often, the lack of communication expertise in the health sector means that a certain type of health communication is chosen and acted upon without the tools that will allow to maximise its impact. As a consequence, many health communication efforts result in projects and products that although tangible and widely shared, represent little impact for people, particularly for patients.

Design thinking strategies may be helpful to understand which type of health communication is most suitable for certain needs and how it should be applied. Key elements of the design thinking process include: i) identifying the problem and exploring a solution that addresses it; ii) choosing the target audiences and developing empathy for them by carefully listening to their opinion on the problem and solution; iii) bringing together a multidisciplinary team with varying viewpoints to ensure that the solution will emerge from diversity.

Nuclear medicine represents an opportunity to potentially combine different aspects of health communication such as clinical communication skills and health literacy. The experimentation step within the design thinking process – whereby problems and solutions are tested and reframed with target audiences – raises particular relevance to patient involvement. By engaging patients in understanding their real needs, medical experts will make more informed, cost-effective choices, build capacity in health communication and ultimately bridge the gap between them and their patients.

References

A paediatric patient, in the United Kingdom, had autism and was given an anaesthetic for a scan after becoming “extremely anxious”. But a hormone given for a growth defect led to an undiagnosed condition which enlarged her heart and put her at danger when anaesthetised. The patient had hormone treatment to combat her growth defect but this meant her heart had grown to about twice the size it should have been.

She was due to be seen first on the day of her scan but had to wait several hours, which led to her needing the anaesthetic because of her anxious state. Her mother, said: “The nurses pointed out to the doctors they were concerned about her anxiety and as soon as the doctors realised there was a problem they should have aborted the procedure straight away. They didn’t do enough homework into her condition in knowing what they were dealing with the day before,” she said. The patient was transferred to a Hospital in the South West of England. She died three days later. The NHS report said she had a heart attack during the scan. It concluded that the general anaesthetic was the “precipitating factor” in her death. This event took place in 2018.

Patient welfare and advocacy has received international recognition over the past two decades, informing patients about their rights in a particular situation, making sure they have all the information necessary to make informed decisions, supporting them in decisions they make, providing detailed communication and understanding the patients’ needs, and safeguarding their interests.

There is a need to understand and share patient focused goals, which include the patient perspective and needs in the decision-making and nuclear medicine procedure compliance processes. We need to understand the differences that reflect individual patient needs. We should also attempt to understand and overcome the fears and concerns of patients regarding nuclear medicine processes where the level of awareness is extremely low and to improve patient communication protocols as part of our standard service delivery.

The most important role for patient welfare and advocacy is to work together with nuclear medicine professionals to ensure appropriate information (written and verbal) is provided in an understandable and timely manner. Patient advocates are well placed to provide a picture to nuclear medicine bodies of how particular service delivery processes would impact the patient and the information each patient should receive. Patients input and opinion should be present from the start of the process and should not simply be brought in at the end. There should be representation from a collection of patient advocates, not just a token patient voice, to ensure that the nuclear medicine profession acknowledge a range of values that are important to patients safety, understanding and welfare.

References

In the case of a patient undergoing treatment or diagnosis with radionuclides, the practitioner shall provide the patient or their representative with information on the risks of ionising radiation and appropriate instructions with a view to restricting doses to persons in contact with the patient as far as reasonably achievable. For therapeutic procedures these shall be written instructions. These instructions shall be handed out before leaving the hospital or clinic or a similar institution. (COUNCIL DIRECTIVE 2013/59/EURATOM of 5 December 2013 laying down basic safety standards for protection against the dangers arising from exposure to ionising radiation).

On one hand, this legal requirement indicates that whether you are dealing with application of ionizing radiation in medicine or with radiation protection in a medical field, it’s crucial to be able to communicate effectively to the patients, the employees, carers, comforters and other stakeholders about risks, benefits of ionizing radiation or protection measures against radiation. On the other hand, research and experiences show that communication about ionizing radiation in a medical field can be challenging and that there is a space for improvement.

This presentation will discuss a state-of-the-science understanding of the individual, psychological, interpersonal and societal factors that influence the:

• communication of radiological risk information before during and after a medical exposure;

• impact of radiological risk communications on risk perceptions, knowledge, attitudes, and behaviors;

• and apply this knowledge to designing effective risk communication and develop patient-centered communication with the goal to empower medical personnel and patient to make informed decisions in situations related to radiological risks;

This interactive presentation will provide the latest science of radiological risk communication and skills needed to design effective radiological risks communication that improves outcomes, help key stakeholders make informed decisions, increase trust among stakeholders and cope with anxiety. Good and bad communication examples, state-of-the-art ideas and ways to use them in radiation protection practice will be introduced.

Recommended reading:


Hyperfunctioning parathyroid tissue is found in different forms of hyperparathyroidism, characterised by increased secretion of parathyroid hormone. Imaging of hyperfunctioning parathyroid glands is most commonly performed in primary hyperparathyroidism, which is typically caused by a parathyroid adenoma, more rarely parathyroid hyperplasia or, rarely, parathyroid carcinoma. Secondary hyperparathyroidism is caused by prolonged hypocalcaemia which stimulates the glands to secrete parathormone, typically in vitamin D deficiency or chronic kidney failure. Tertiary hyperparathyroidism develops after prolonged stimulation of the parathyroid glands (typically an adenoma) and is biochemically similar to primary hyperparathyroidism.

Imaging in hyperparathyroidism is performed when surgical intervention is required for treatment: it is mandatory when focused minimally invasive approach is planned and in case of recurrent or persistent disease after surgery. Imaging typically involves ultrasound of the neck and parathyroid scintigraphy; in addition, CT or MRI of the neck can be performed when the first two techniques are negative or discordant. Parathyroid scintigraphy frequently involves the use of two radiopharmaceuticals – “parathyroid specific” tracer (such as $^{99m}$Tc-sestaMIBI or $^{99m}$Tc-tetrofosmin) that accumulates in both hyperfunctioning parathyroid tissue and thyroid tissue and “thyroid specific” tracer (such as $^{99m}$TcO_4$^-$ or $^{123}$I) that preferentially accumulates in the thyroid. The two images are aligned, normalized an subtracted for enhanced depiction of the hyperfunctioning parathyroid gland(s). With $^{99m}$Tc-sestaMIBI, early an delayed imaging enhances the hyperfunctioning parathyroid tissue by washout from the thyroid in the delayed phase. Tomographic (SPECT) or hybrid (SPECT/CT) imaging can be performed to enhance contrast and localize the hyperfunctioning parathyroid tissue accurately, which can be favoured by the surgeon to plan the procedure. According to current guidelines and older meta-analyses and reviews, subtraction scintigraphy is considered as the imaging procedure of choice due to its proven diagnostic accuracy, but is gradually being replaced by SPECT/CT.

Recently, $^{18}$F-fluorocholine PET/CT was introduced for imaging of hyperfunctioning parathyroid glands. Available literature on the use of $^{18}$F-fluorocholine PET/CT as preoperative imaging in patients with primary hyperparathyroidism demonstrates excellent diagnostic performance in comparison with conventional scintigraphic methods and supports the method as a potential imaging approach of choice. In addition, imaging time is typically shorter and the radiation dose lower as with conventional scintigraphic modalities. Limited data is available on the diagnostic performance of $^{18}$F-fluorocholine PET/CT in the context of recurrent or persistent disease and other forms of hyperparathyroidism; in these settings, further studies are needed to better define the role of the method in patient management.

References:

Comparison of $^{[99mTc]}$TC-MIBI and $^{[18F]}$Fluorocholine Scintigraphy in Localization of Hyperfunctioning Parathyroid Tissue

Luka Lezaic (Ljubljana, Slovenia)
[\textsuperscript{11}C]-Methionine PET-CT Imaging in Hyperparathyroidism

- Giovanna Pepe (Milan, Italy), Giorgio Testanera (London, United Kingdom)

Parathyroid glands disorders usually present with alteration of calcium levels, being primary hyperparathyroidism the most common cause of hypercalcemia in outpatients, with a prevalence of four in 1000 persons, caused by single adenoma in 85% of cases [1].

The diagnosis of hyperparathyroidism is set clinically and biochemically, but the identification of a parathyroid adenoma is fundamental for the correct treatment as the removal of the functioning mass is the first choice in symptomatic patients clinically eligible for surgery.

Dual-phase scintigraphy with MIBI, combined with ultrasound, is considered the imaging approach of choice for pre-operatively localizing parathyroid adenomas. The introduction of single photon emission computed tomography (SPECT) contributed to increase the sensitivity [2].

MIBI SPECT accuracy can be potentially affected by coexisting multi-nodular goiter and size of enlarged glands; moreover, false negatives are reported in about 25% of adenomas, requiring additional localization studies [3].

PET seems to be a promising new possibility, but not all radiopharmaceuticals are suitable, based on multiple factors, including tracer half-life, specificity to parathyroid uptake, and individual hospital characteristics. We know from the literature, that 18F-FDG PET/CT, despite its high sensitivity in the detection of parathyroid glands, demonstrates low specificity, rarely providing additional information to conventional nuclear imaging [4]. 11C-methionine PET, offers a superior spatial resolution and, potentially, a more specific radionuclide uptake. Although the tracer uptake mechanism by parathyroid glands is not fully explained yet, methionine accumulates specifically and intensively in hyperactive and/or enlarged parathyroid glands.

Moreover 11C-methionine appears to be of high diagnostic performance with a pooled sensitivity of 81 % (95 %CI 74–86 %) and a "detection rate" of 70 % (95 %CI 62–77 %) [5]. Experience is still limited and heterogeneous, but methionine PET shows high sensitivity, specificity, and accuracy and could have a major role in complicated Patients or in case of discordant findings at routine imaging.

References:

Imaging of hyperfunctional parathyroid glands (HPG) has been a successful Nuclear Medicine methodology, thanks to the sensitivity of the traditional parathyroid scintigraphy. The scan is based on the accumulation and the distribution of the radiopharmaceutical (RF) 99mTc-MIBI in HPG and in the adjacent tissues, which can be detected and diagnosed by using imaging techniques SPECT/CT or subtraction scintigraphy. In recent years the demand for more sensitivity and availability of Positron Emission Tomography (PET) technology led to development of new acquisition methods. PET-CT proved a lot of potential in functional imaging to diagnose of primary hyperparathyroidism (PHP). 18F-fluorodeoxiglucose (FDG) is the most widely available and well-established PET RF due to a relatively long half-life, but it has proven to be of limited use with a wide range of sensitivity and is not routinely used. Very limited accessible, cyclotron-produced RF (11C-methionine) also showed a wide range of sensitivity and resulted effective in a small number of studies performed in comparison with SPECT when the latter does not localize the lesion. In recent years a new RF 18F-Choline and PET/CT imaging technology has been increasingly more available and proved to also have good sensitivity and specificity. Clinical PET/CT procedures are more appealing, since scanners have better spatial resolution than SPECT/CT. PET/CT can provide an internal spatial resolution of approximately 4 to 6 mm, and SPECT/CT can hardly reach less than 10 mm full width at half the maximum (FWHM). Sensitivity of detector system is also significantly higher in PET/CT compared to SPECT/CT, which reflects the time of imaging. Image analysis showed greater contrast in FCH PET/CT versus MIBI SPECT/CT. In the analysis of PET/CT images, absolute quantification (SUVmax or SUVmean) can be used. Similar quantification is also possible with recent SPECT/CT, but the most commonly used is the number of counts/pixels.

In this talk we will present an overview of both SPECT-CT and PET-CT for Parathyroid imaging, focusing mainly in technologist’s role is the preparation of acquisitions and processing protocols, which is related to the choice of parameters to optimize both image quality and quantitative processing of images.

References:


CTE SESSION 7
October 16, 2019 | 10:00 - 11:30

Updates in Lung Imaging
18F-fluorodeoxyglucose (18F-FDG) positron emission tomography/computed tomography (PET/CT) is widely used for characterising indeterminate pulmonary nodules, tumour staging, treatment planning, and prognosis assessment in lung cancer. But tissue glucose metabolism is not malignancy specific; moreover, many benign conditions (inflammation, infective, granulomatous disease,…) may have increased FDG-activity. In addition to energy metabolism, multiple microenvironmental factors, including cellular proliferation, receptor expression, amino acid transport, hypoxia and angiogenesis may characterize lung cancer and studied with other radiotracers. In recent years, many progress has been made to develop new PET tracers to improve the sensitivity and specificity of PET imaging in lung cancer [1,2]. Neuroendocrine lung tumours express somatostatin receptors on their cell membrane and 68Ga-DOTA-peptides radiotracers (like DOTANOC, DOTATATE, DOTATOC) bind specifically to subtypes 2 of somatostatin receptor. DOTA-peptides are reported to be excellent candidates for imaging and detecting the localization of primary tumours and the diagnosis of pulmonary carcinoid tumours [3,4]. Cellular proliferation can be studied with 18F-Fluorothymidine (FLT), a PET tracer that directly targets cellular proliferation activity. FLT is a thymidine analogue and is trapped in dividing cells during the S phase. FLT PET has a high specificity for detecting lung malignancies but with less accuracy for N staging compared with FDG PET [5]. Tumour hypoxia and oxygen metabolism are crucial factors in oncology and response to treatment is significantly related to the level of tumour oxygenation. There are multiple PET tracers to detect hypoxia, as 18F-fluoromisonidazole (FMISO), 64Cu-methyl thiosemicarbazone (64Cu-ATSM) and 18F-fluoroazomycin arabinoside (18F-FAZA) [1,2]. Angiogenesis, or new blood vessel formation, is a physiologic process that may occur in numerous inflammatory conditions but is more prominent also in malignancies. Radiolabelled integrin avb3 antagonists have been the main interest in PET tracer development for imaging angiogenesis; arginine-glycine-aspartic acid (RGD) peptides can be labelled with 18F, 68Ga or 64Cu for PET imaging [6].

References:
Lung cancer, with its most frequent NSCLC type, is one of the leading causes of death by cancer in Europe and North America. Recent substantial technological progress in treatment modalities, especially in radiation oncology demands personalized treatment plan that rests on our best knowledge within the area described as ‘evidence based medicine’.

In many treatment methods and especially in the radiation therapy, the definitions of Metabolic Tumour Volume (MTV) and subsequently Biologic Target Volume (BTV) are crucial for planning a proper radiation delivery to the tumour mass as well as prognosis.

PET/CT has been successfully used for accurate delineation of tumour within the lung as well as in other localization. Several advantages of PET delineation over CT have been highlighted, including relatively easier exclusion of non-tumoral tissue or inter and intra observer reproducibility. With the advantages of current radiotherapy techniques allowing precise and non-homogenous dose delivery, accurate tumour delineation by PET/CT makes dose escalation more precise and minimises early and late toxicity.

For tumour delineation based on PET images dozens of methods have been proposed, however the optimal way to delineate tumour on PET is still to be determined. Nevertheless, manual delineation of MTV remains the method of choice in many radiation oncology centres resulting in common problem of interobserver variability of radiation target volume definition.

The most popular segmentation methods vary from relatively simple ones based on fixed SUV or threshold value to more advanced adaptive iterative algorithms. All of them combined with more accurate imaging modalities should lead to decrease the interobserver variability. The majority of the segmentation methods will accurately delineate tumour with the diameter larger than 20mm and high, homogenous tracer uptake. Lungs’ site-related issues will cause more difficulties when analysing low-FDG-avid tumours or malignant tumours surrounded by atelectasis or inflammatory infiltrations resulting in relatively high non-malignant background. A precise definition of the border between tumour and non-malignant process will potentially reduce target volume decreasing lung toxicity and makes this treatment viable option to patients with impaired lung function.

Metabolic Tumour Volume is the final result of delineation process in PET/CT however many other MTV derivatives in lung cancer have been described in literature, some of them with potential prognostic values.

References:

Positron emission tomography (PET)/computed tomography (CT) with the use of $^{18}$F-fluorodeoxy-glucose (FDG) has a paramount role in the management of lung cancer patients. The information provided by FDG-PET/CT influence patient management in the setting of tumour staging, response assessment, and restaging. The standardized uptake value (SUV) is the most widely used parameter for lesion assessment. Additionally, volumetric parameters, such as metabolic tumour volume (MTV) and total lesion glycolysis (TLG), have also been introduced for prognosis prediction. In the last few years, radiomics and machine learning approaches, including deep neural networks, have been proposed to extract data from medical images – Image Mining. Radiomics consists of calculation of parameters, that capture the intensity distribution and texture of voxels or pixels within the region of interest. These parameters are, then, tested for correlation with histological, clinical and outcome data. Indeed, evidence has emerged that the heterogeneity of density values on CT, of intensity values on MRI, and of FDG uptake on PET can permit in-vivo lesion characterization and provide predictive information in malignances, including non-small cell lung cancer (NSCLC).\(^1\) Machine learning, that rely on multiple data-driven algorithms, take medical images or image-derived parameters as inputs, identify the relevant features within the image or among the tested parameters, and then provide a prediction with respect to a classification or clustering.\(^2\) Image mining has been evaluated with the aim to capture and quantify the inhomogeneity of images and to allow a non-invasive tumour characterization, in particular for differentiating between benign and malignant lesions or for classifying NSCLC subtypes. Moreover, radiomics features have been tested for correlation with genetic alterations. It is recognized that biologic heterogeneity is associated with poorer outcome in cancer patients and can contribute to treatment failure, both systemic and radiotherapy, and drug resistance. Radiomics features have been proposed as imaging biomarkers on the assumption that they are an index of the degree of tumor heterogeneity. Therefore, they can provide useful prognostic information to guide patient treatment. However, image mining is still a matter of research since various methodological issues need to be addressed. A close collaboration among clinical researchers, imagers, technicians, algorithm developers and data scientists is essential to provide successful image-driven solutions for a personalized medicine.\(^3\)

References:

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