1. Imaging patients with possible cardiac sarcoidosis: Review of initial experience
Pamela Moyade and Sobhan Vinjamuri
Royal Liverpool and Broadgreen University Hospitals Trust, Liverpool, United Kingdom

Aim: To evaluate the adequacy of patient preparation for cardiac FDG scans and to assess concurrence between blinded interpreters for image interpretation.

Materials and methods: 31 patients with clinical suspicion of cardiac sarcoidosis who underwent 18F-FDG PET/CT scans were retrospectively evaluated. All patients were instructed to follow a high fat - low carbohydrate diet for 18 h, followed by a water only fast for 18 h. The study was conducted only if the patient’s blood glucose was <11.0. Each scan was interpreted separately by three blinded and experienced Nuclear Medicine Physicians. In addition, semi-quantification was performed using a myocardium to blood pool ratio for all patients. We also invited a renowned expert to review our practice and interpretation criteria.

Results: 30 of 31 patients complied with pre-scan instructions (one patient had to be re-appointed). In 29 patients, there was agreement on the image quality and suitability for interpretation. In all patients, there was good inter-observer agreement between at least 2 observers on image interpretation for 3 possible categories (i.e. positive, negative or equivocal). In 22 patients all 3 observers agreed, while in 9 patients at least 2 observers agreed (majority were between normal and abnormal rather than equivocal patterns). External review concurred with majority interpretation.

Conclusion: There is good patient compliance with diet restriction and fasting in preparation for cardiac FDG scans. There is good inter-observer agreement for the interpretation of these scans. Review of our initial experience confirms that our approach is scientifically sound.

2. Moving to single sample GFRs: Variability in using estimated GFR to predict measured GFR and the time saved by using a single sample GFR method
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The aim of the study was to investigate the threshold value of the estimated GFR (eGFR) which would predict a measured GFR (mGFR) of $\leq 25$ ml/min/1.73 m$^2$ in order to determine if the patient requires a 24 h single blood sample (SS), following the new BNMS guidelines, or alternatively use the slope intercept (SI) method to measure their GFR. Data from 1956 patient studies were used to calculate SI and SS values of the mGFR. A sub-data set of 241 patients with a mGFR of $\leq 80$ ml/min/1.73 m$^2$ and an eGFR measurement taken within 28 days was selected.

There is a large variation in the accuracy of using the eGFR to predict the mGFR value. The absolute percentage difference for the SI method is 22% (range $-141\%$ to 63%), the SS method has an absolute percentage difference of 23% (range $-165\%$ to $86\%$). Receiver operator characteristic (ROC) curves comparing sensitivity and specificity demonstrated that an eGFR threshold value of $\leq 40$ ml/min/1.73 m$^2$ is used to predict mGFRs of $\leq 25$ ml/min/1.73 m$^2$ in order to optimise the likelihood of identifying all such patients.

This threshold has been used at our Trust since 1\textsuperscript{st} December. To date only 13% of GFRs have required SI-GFR (due to low eGFR) and so we have had an 87% reduction in blood samples taken compared to our previous technique of SI for all patients. This has saved staff time both in terms of taking the blood samples and in processing them.

3. Appropriateness of bone scan imaging referrals in prostate cancer: Preliminary data from a quality improvement project
Riddhika Chakravarthy\textsuperscript{a}, Sandeep Singh\textsuperscript{a,b}, Monica Pugsley\textsuperscript{b}, Ralf Clauss\textsuperscript{b}, James Scuffham\textsuperscript{b} and Vineet Prakash\textsuperscript{b}
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Purpose of study: EAU-ESTRO-SIOG guidelines (Mottet N. 2017, 71:618–629. Eur Urol) recommend imaging for bone metastases only for prostate cancer patients with high metastatic risk and advise against bone scintigraphy after treatment. As part of a quality improvement project,
we assessed appropriateness of bone scan referrals against these guidelines.

Methods used: This retrospective audit included all referrals for whole body bone scans in prostate cancer patients over a 3-month period between July and September 2017. Using the EAU-ESTRO-SIOG guidelines as a standard, referrals were categorised as either low or high risk. When localised disease was staged, PSA level > 20 ng/ml or Gleason Score > 7 was considered high risk. All locally advanced cancer was deemed high risk. Patients with biochemical evidence of recurrence, PSA > 10 ng/ml or bone pains were considered high risk. Bone scan reports were reviewed for the presence of metastases.

Summary of results: A total of 190 men were included in the analysis (mean age 74 years, range 47 to 94 years). Of these, 103 patients (54%) were categorised as low risk; no bony metastases were detected in this group. 84 patients (44%) were categorised as high risk; 18 of these (21%) showed metastases. 3 patients were referred to assess treatment response.

Conclusion: The majority of prostate cancer patients referred for bone scans are low risk with no bone metastases detected. A flow chart based on the EAU guidelines to aid referring clinicians may be useful in reducing inappropriate referrals and making best use of imaging resources.

4. A clinical audit investigating the possibility of predicting the result of SeHCAT Day 1 scan
Paul Gape, Emma Wroe, Victoria Lindsay, Sabina Dizdarevic and Mark Aplin
Brighton and Sussex University Hospitals NHS Trust, Brighton, United Kingdom

Purpose: To establish whether the result of SeHCAT Day 1 scan can be predicted accurately from the patient’s BMI or abdominal thickness. This would allow patients to forego the Day 1 scan, thus reducing the patient burden and saving up to 0.5 days of camera time/week.

Methods: The patients had a Day 1 scan. Their height, weight and abdominal thickness were also measured. Thickness was measured at the height of the umbilicus using calipers by the technologist administering the capsule.

Empirical relationships between the measured Day 1 result and patient thickness/BMI were determined from the group data.

Predicted Day 1 result was calculated, based on the empirical relationship described above. The measured Day 7 result was used to calculate the patient’s measured and predicted retention.

Results: Thirty-two patients undergoing routine SeHCAT studies at Brighton and Sussex University Hospitals NHS Trust have so far been included.

The principal measure of success was the number of patients that would have received a different diagnosis, based on NICE diagnostics guidance (2012), had the predicted Day 1 result been used instead of the measured result. No patients received a different diagnosis based on the measured abdominal thickness, and 4 received a different diagnosis based on BMI.

Average percentage difference between measured and predicted Day 1 result was 2.24% for thickness and 3.41% for BMI.

Conclusion: This is an encouraging result which should prompt further investigation. A larger cohort of patients is required to determine the relationship between thickness and Day 1 result with greater confidence.

5. A review of incidental cardiac uptake on Ga-68 DOTA peptide PET/CT scans
Pamela Moyade and Sobhan Vinjamuri
Royal Liverpool and Broadgreen University Hospitals Trust, Liverpool, United Kingdom

Aim: To evaluate the frequency and relative significance of incidental cardiac uptake/manifestations on Ga-68 DOTA peptide scans.

Materials and methods: Scans of 1463 patients who underwent Ga-68 DOTA peptide PET/CT scans in our department between 2013 and 2018 were retrospectively evaluated for the presence of uptake in the heart and/or its appendages.

Results: 19/1463 patients (around 1.3%) demonstrated uptake in the heart and/or its appendages. In 18/19 patients, the clinicians were unaware of possible cardiac involvement by disease (1 patient was a known case of cardiac paraganglioma).

The most common pattern was focal activity in the ventricles, with some lesions noted in pericardium, inter-ventricular septum and atrium as well. Echocardiography +/- MRI correlation was performed where possible, but not always insisted upon.

Our results are in agreement with established literature.

Conclusion: Ga-68 DOTA peptide PET/CT scans are sensitive for the detection of possible cardiac metastases/involvement in patients with neuroendocrine tumors. These may be easily missed if careful scrutiny while reporting these scans is not conducted. It is our hypothesis that, early detection/confirmation of cardiac metastases in these patients by means of Echocardiography/MRI could lead to more effective treatment strategies and contribute to better patient outcomes. However, since this is a relatively less well studied issue, we recommend further detailed multi-centre studies with good cross-sectional imaging correlation.
6. SeHCAT: Can you scan 1 h post administration of the capsule?
Jenny Thompson-Peters, Ruth Bateman, Greg James, William Thomson and Alp Notghi
Sandwell and West Birmingham Hospitals NHS Trust, Birmingham, United Kingdom

Aim: Day 0 SeHCAT scans are commonly acquired 4-hours post administration of the capsule, in accordance with the summary of product characteristics (SPC). This delay between administration and imaging can be inconvenient for both the patient and the nuclear medicine staff. The aim of this research is to establish whether it is acceptable to scan 1 h post administration of the SeHCAT capsule.

Methods: 42 patients were scanned at both 1 and 4 h post capsule administration on day 0, followed by a standard day 7 scan. The retention values calculated from the 1 h day 0 scan were compared against the retention values calculated from the 4 h day 0 scan. Paired t-test was used for comparison.

Results: The counts when scanning at 1 h post administration were on average 4% higher than the counts acquired 4 h post administration. The corresponding SeHCAT retention measurement is on average only 0.5% lower (95% CI −2.1% to 1.2%) than the retention measured after scanning 4 h post administration (P < 0.001).

Conclusion: Although statistically significant, a difference of 0.5% is unlikely to affect the clinical diagnosis of bile acid malabsorption. We conclude that SeHCAT patients can be scanned 1 h after administration of the capsule without affecting the clinical accuracy of the test.

7. The role of a health care assistant in nuclear medicine
Chinyere Obogwu
University College London Hospital, London, United Kingdom

Health Care Assistants (HCAs) are more than bedpushers and bedpan changers; we are a pertinent component of the workforce.

Nationwide, there is no standard for scope of practice beyond working in the ward. HCAs fulfil several specialist roles in imaging departments that require a wide range of enhanced skills and expertise. Currently there is a gap in formal education to facilitate this; more work needs to be done to encourage HCAs to seek employment in such areas. With the right guidance and support, HCAs can develop enhanced roles such as doing a specific procedure/test or intervention that facilitates continuity-of-care, service continuation and improve throughput. Patient delays are also reduced, whilst the patient- and staff experience are enhanced.

In Nuclear Medicine, HCAs contribute towards service continuity by doing clerking and cannulation of patients; Beta blocker preparation for paediatric patients; blood glucose checks and sample collections; radiation policy adherence; general checks and trouble shooting. An audit conducted in 2015 showed that this had an impact of 50% reduction in appointments missed (DNAs), reduced probability of incidents, improved patient experience and promoted better integration in a multidisciplinary team.

HCAs are a very necessary part of any Nuclear Medicine Department. There is a wealth of opportunity to expand the knowledge base and scope of practice as a HCA in Nuclear Medicine.

8. Radiographer reporting - A personal experience and viewpoint
Alison Fallows
Poole Hospital NHS Foundation Trust, Poole, United Kingdom

Aim: Reflect on the process and journey of Radiographer reporting. Share the experience of radiographer reporting in nuclear medicine with peer groups.

Methods: Successful completion of nuclear medicine reporting course (May 2018) which included elements of reflective writing and report writing.

Scans were reported in four categories - Bone scan reporting was mandatory and renal, lung and lymphatic scans were the further category choices selected.

Continue dual reporting with the intention of future solo reporting after an appropriate period of further practical training and mentoring from local nuclear medicine Radiologists.

A further audit system is in place whereby Radiographer reports are audited on a regular basis by the clinical lead of the department.

Results: Radiographer reporting is an ongoing and rewarding challenge which given the appropriate support has the potential to be an asset to the department.

Conclusion: With continuing peer review, mentoring and audit of reporting standards, each reporting radiographer can maintain professional standards and integrity. Radiologists and reporting radiographers should be able to work in partnership in their local departments to achieve best possible outcomes for local reporting and in turn contribute in a positive way towards overall diagnostic patient outcomes.

9. SPECT/CT bones for oncology - Are we consistently authorising scans?
Joseph O’Brien, Bill Thomson, Gregory James, Ruth Bateman and Jenny Thompson-Peters
Sandwell & West Birmingham Hospitals NHS Trust, Birmingham, United Kingdom
Introduction & Aim: In our centre, the decision to perform additional SPECT/CT for bone scans is performed after wholebody planar acquisition by various trained authorisers made up of technologists and physicists. Various factors influence the decision to authorise SPECT/CT. Recent imaging, patient symptoms, and scan appearances can all influence the decision making process. We use a local protocol to aid consistency. We have examined the consistency of SPECT/CT authorisation for four authorisers in a selection of bone scans.

Methods: 25 consecutive patients (10M/15F) were selected for audit. Patient information was extracted from radiology information system and nuclear medicine workstation so as not to reveal if further imaging was performed on the day of the test. Four trained authorisers were presented with images and information to decide whether further SPECT/CT images were required, the location(s), and their reasons why.

Results: Of the 25 patients assessed, 33 SPECT/CT decisions were made. All four authorisers concurred in 16 decisions (6/33 not to SPECT/CT, and 10/33 to SPECT/CT the same area). 17/33 decisions did not agree amongst all four authorisers. In 24/33 cases, three authorisers agreed.

Comparing to the decision made at scan time, all authors had similar concurrence rates (24/33; 25/33; 22/33; 25/33).

Discussion & Conclusion: In cases with full bladder, all authorisers recognised the need to clarify with SPECT.

But the audit highlights the decision to perform SPECT/CT has inconsistencies. In practice, a second opinion is often sought, and this was not audited. We recommend regular authoriser MDT meetings to help harmonise decision making.

10. Assessment of the effect of cardiac contraction on SPECT myocardial perfusion imaging

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The ECG-gated frames acquired during single-photon emission computed tomography myocardial perfusion imaging (SPECT MPI) studies are often summed to produce an image of the counts acquired throughout the entire cardiac cycle, which has reduced noise when compared to each frame. The normal contractile motion of the left ventricle (LV) results in a non-uniform blurring of the myocardium in summed perfusion images. The aim of this study is to assess if large LV motion results in a perfusion artefact in summed images.

The XCAT software phantom was used to generate dynamic cardiac attenuation maps and activity distributions with varying degrees of LV contraction [1]. SPECT projections were generated in the Monte Carlo simulation program SIMIND [2]. The data were reconstructed in GE's Xeleris software and the gated images were analysed using MATLAB. The LV was segmented and the maximum count density and excursion of the LV were assessed.

Application of a linear mixed model demonstrated that the maximum count density in summed MPI data decreases with excursion of the lateral wall, but also depends upon the distance of the sampled pixel from the apex (adjusted $R^2 = 0.91$, $P < 0.001$ at the 0.05 significance level). The model predicts that on average in patients exhibiting a 1 cm lateral wall excursion, the maximum count density could be reduced by 12\pm2\% from that of a static LV, indicating presence of a potentially clinically significant perfusion artefact in summed MPI.

References


11. UK audit of left ventricular ejection fraction estimation from MUGA scans

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Aim: An audit of left ventricular ejection fraction (LVEF) results obtained from multi-gated (MUGA) scans was performed by the IPEM Nuclear Medicine Software Quality Group. The aim was to investigate variability of results obtained from computer analysis of MUGA studies by different Nuclear Medicine centres; compare results to a previous audit performed by the group; and review local protocols against British Nuclear Medicine Society (BNMS) guidelines.

Methods: 14 MUGA scan datasets were distributed to participating centres, with a questionnaire on MUGA scanning practice. Datasets were typical clinical images including one duplicate set and one set of three identical images with different counts. Participants analysed the images using their routine processing software and reported the LVEF; end diastolic and systolic frame numbers; and the count value of the first point on the time activity curve.

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Methods: Results were obtained from 34 centres, using software from 5 manufacturers. Many centres perform small numbers of MUGA scans annually (56% < 100). All studies showed a distribution of results, but variation was less than in the previous audit (overall standard deviation (SD) of 0.056 compared to 0.079). After correcting for systematic differences the SD due to random errors was estimated as 0.047. Intra-operator repeatability was assessed from SD of the difference between the LVEF values for identical studies (0.039).

Conclusion: The variability of LVEF results appears to be lower than seen in a previous audit. It is important to ensure potential causes of variability are minimised to ensure the clinical expectations of the technique are met.

12. The value of functional imaging in the rapid access chest pain clinic
Robin Mark McDade, Sandy Small and Nicholas Goodfield
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Aim: To assess the efficacy of tests used in the protocols for Rapid Access Chest Pain Clinic (RACP) as described by National Institute of Clinical Excellence (NICE) and to develop a combined scintigraphic risk schema that improves discrimination between patients whose chest pain is and is not caused by Ischemic Heart Disease (IHD).

Methods: The combined scintigraphic risk schema was developed on the combined findings of Thallium Reversibility Scores (TRS), lung uptake of thallium and Left Ventricular Ejection Fraction (LVEF). It was evaluated against the RACP initial clinical assessment/risk stratification, our laboratory’s ETT results, established Coronary Artery Surgery Study (CASS) risk score and patient outcomes.

Results: Spearman Rho non-parametric test demonstrated that the combined risk score is related to ACS, cardiac death and Myocardial Infarction (MI) at a statistically significant level. Kaplan-Meier curves of patients within high scintigraphic risk categories 4 and 5 were distinct for shorter time to admission with ACS. Similarly, category 5 predicted a shorter time to MI. Category 1 (low risk) vs time to death from cardiac, MI and ACS was reassuringly distinct, establishing the utility of a normal result.

Conclusion: The combined scintigraphic risk schema has been shown to map well to the established CASS score and is predictive of subsequent adverse patient outcomes. The enhanced discriminatory benefit of combined scintigraphic assessment identifies patients at low risk and conversely, high risk from ACS / MI and coronary death. MPI is superior to ETT and remains a viable alternative in moderate risk patients to CTCA.

13. Incidental significant extracardiac findings on attenuation correction CT component of myoview scans
Christopher Green, Stewart Redman, Richard Graham and David Little
Royal United Hospital, Bath, United Kingdom

Purpose of study: During a Myoview study a low dose CT scan is performed for attenuation correction. Myoview scans may be single reported by cardiologists who are not trained to review the CT component for extracardiac findings. Until spring 2018, this was the case at our institution. We have subsequently implemented radiologist reporting of the CT component and the purpose of this study was to assess the frequency of significant extracardiac findings.

Methods: From March – Dec 2018, 145 MIBI cardiac scans were performed and reported by a cardiologist. The CT component was reported by a radiologist to assess the extra-cardiac finding. All CT images were non-contrast with field of view from ascending aorta to upper abdomen; the lungs, visualised upper abdominal viscera and bones were reviewed by the radiologist which typically took less than 60 s per scan.

Results: 6 out of 146 patients (4%) were found to have incidental extra-cardiac findings following the radiologist assessment. The most common significant findings were lung nodules requiring follow-up according to BTS guidelines. One patient was found to have new lymphadenopathy subsequently proven to be lymphoma.

Conclusion: Reporting the CT component of myoview scans requires minimal extra time per case and can highlight potentially significant extracardiac findings including lung nodules and lymphadenopathy. This should be considered routine practice.

14. Se-75 in human breast milk following administration of a SeHCAT™ capsule
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Aim: SeHCAT™ (tauroselcholic [selenium-75] acid) is used to study bile acid malabsorption. At OUGH it is estimated that 7 patients per year (1.5%) will be breastfeeding. This study aimed to investigate and model Se-75 in breast milk of a patient administered with a 0.37 MBq capsule.

Methods: 5 milk samples were produced over 6 days following administration; these were surveyed on a Gamma Counter along with standards.

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Results: A t-test showed no significant difference between background and the 28 h sample ($P = 0.16$). Significant differences were demonstrated for samples at 49, 76, 126 and 157 h post administration (all $P < 0.001$), with concentrations of 0.10–0.12 Bq/ml. Models based on the enterohepatic system’s cycles were developed to estimate milk radioactivity. Using modelling, an infant feeding 800 ml daily over 6 months would incur an effective dose of $\approx 0.01$ mSv. Modelling also showed that it would take 6 days for the milk concentration to reduce to the WHO limit of 0.1 Bq/ml for drinking water.

Discussion: In this case, where patient bile acid reabsorption at 7 days was abnormally low (4.3%), excretion of Se-75 to milk was present but minimal. In patients with higher retention, the presence of Se-75 in milk may be maintained for longer. For long-life radionuclide studies, samples from patients wishing to continue breastfeeding should be taken over a number of days to find peak concentration. It may be ineffective to simply discard expressions from the first 3–4 h post administration and resume, contrary to manufacturer’s specification.

Conclusion: This method reduces the restriction to as low as 17 h while minimising patient inconvenience. Further data may obviate the need for counting samples.

16. Dose rate measurements from patients administered with radiopharmaceuticals to determine close contact restriction advice

Hannah Nelstrop, Mark Barnfield and Glyn Davies
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Purpose: To measure the dose rates from Nuclear Medicine patients post injection and post scan to determine appropriate radiation protection advice and contact restrictions for nursing infants.

Methods: Patients were measured in our department post injection and post scan using a dose rate meter at distances of 1 m, 50 cm, 10 cm and at the surface of the patient’s chest. Patients undergoing Bone ($594 \pm 24$ MBq, $n = 11$), Tc99 MAA ($662 \pm 86$ MBq, $n = 8$), DaTscan ($177 \pm 22$ MBq, $n = 17$), MIBG ($379 \pm 28$ MBq, $n = 5$), Cardiac MPI Tetrofosmin ($503 \pm 66$ MBq 2-day protocol $n = 9$, $283 \pm 29$ MBq + $678 \pm 45$ MBq 1-day protocol $n = 4$), Amyloid DPD ($600 \pm 52$ MBq, $n = 2$) and Parathyroid ($878 \pm 63$ MBq, $n = 11$) scans were measured. Injected activity, injection time and measurement time were recorded. To estimate the radiation dose to infants and calculate the required restriction times the mean dose rate at 10 cm (ARSAC) for each scan type was used. This was multiplied by the effective exposure time (ARSAC) and compared against a dose constraint of 0.3 mSv. If this was exceeded then a restriction time was calculated assuming only physical decay.

Results: All measured patient groups required contact restrictions between injection and scan. Post scan the patient groups requiring restrictions were 1 day Cardiac MPI (1 day protocol), MIBG and Parathyroid.

Conclusion: Most patients do not require any contact restrictions upon leaving the department with the exception of 1 day Cardiac MPI and Parathyroid patients, who require a 3 h restriction period, and MIBG patients who require a 7 h restriction period.

17 Extravasation of radionuclides: Recognising the danger and managing the consequences

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Skin doses in excess of 5 Gy are known to result in deterministic damage (epilation, erythema), and doses >15 Gy may cause serious and potentially permanent damage [desquamation, dermal atrophy, ulceration and necrosis (Balter S. 2010. 254(2):326–42. Radiology)]. These effects
may be delayed from the exposure by days to months, depending on the magnitude of the exposure.

Radionuclide extravasation has the potential to deliver high localised doses to the injection site, as previously described by Shapiro et al. [Shapiro B. 1987. 12(10):522–3. Eur J Nucl Med]. Utilising Shapiro’s method to model the potential doses incurred with an updated catalogue of Nuclear Medicine pharmaceuticals, we calculate local doses from 13–130 Gy (technetium-99m), 14–470 Gy (fluorine-18) 28–35 Gy (gallium-68), and up to 880 Gy (lutetium-177), confined to small volumes at the injection site.

A recent review article [van der Pol J. 2017. 44(7):1234–43. Eur J Nucl Med Mol Imaging] reported no adverse reactions following extravasation of technetium-99m, iodine-123, fluorine-18 or gallium-68, however no patients who received tissue injections of these nuclides received follow up to assess for reactions. Given the delayed onset of symptoms and the lack of information provided to patients, it is unreasonable to expect patients to identify delayed reactions as being caused by their injection.

The doses calculated here indicate the need for follow up to ensure that potential radiation injuries are correctly identified and managed. Comparable skin doses delivered in the interventional radiology setting receive pragmatic management; a similar approach is proposed for nuclear medicine.

Alexander Michael Helming and Aida Hallam
Oxford University Hospitals NHS Foundation Trust, Oxford, United Kingdom

Background: Users of radioactive materials must comply with permits issued by the Environment Agency as per requirements of Environmental Permitting Regulations (EPR) 2016. At Oxford University Hospitals we use 17 radionuclides in 60 chemical forms as open sources across 14 departments. There was no single system used in the Trust that can capture the relevant real time data. Paper based and spreadsheet systems became too convoluted and took a long time to process and check.

Aim: Development of a single system, flexible enough to be used in every department but still able to use a common structure to collate all the required information in one location that demonstrates compliance with permit.

Methods: The Microsoft Access database has been designed with a modular structure. Most foreseeable changes can be easily updated and unforeseen changes can be updated by creating new modules. The overall structure is constantly evolving as a result. Creating the database has reduced transcription errors and has enabled the departments to be much more aware of their activities.

Conclusion: The database has vastly improved our compliance with EPR 2016 and it now enables instantaneous access to open radioactive material holdings, usage and discharges on each site.

Daniel Gillett
Cambridge University Hospitals, Cambridge, United Kingdom

It is now very common for services to be online with companies such as google and doodle providing services that are completely online and store data entered into a web page into a database. With this in mind I wanted to create an online quality assurance website that I could use at my base department in Cambridge and also at the numerous external departments that we act as Physics support for. The system has a web-based front end written in HTML, PHP and Javascript and a server based MYSQL database. The system has user logins that are associated with departments so although it’s the same system the department only see their own equipment. Each piece of equipment has a custom quality assurance programme with custom tests and specific limits if needed. Each piece of equipment has a fault log and downtime record. All numerical results can be plotted to produce trend charts. All the equipment in the database for a department can be reviewed on an overview table to show what tests have been done and when and when they are next due. The website is available everywhere has internet access including desktop computers and handheld devices. It has been very useful having one location for all QC entries and being able to check results, trends and faults for equipment at the external departments instantly.

20. A follow up dose-rate measurement strategy for patients post 131Iodine ablation therapy. Can we improve the post treatment restrictions applied to the patient on discharge?
Jo Weekes and Malcolm Foley
The Royal Wolverhampton NHS Trust, Wolverhampton, United Kingdom

Patients on discharge post 131Iodine Ablation Therapy are issued with radiation precautions (restrictions) depending on their remaining radiation dose-rate measured.

These restrictions can have a huge influence on their family/work/life balance post discharge due to the need to:
(1) The need to sleep separately from partner and children
(2) The need to keep a certain distance from family members and public. This can vary between 1–3 metres depending on the age of the child
(3) The need to avoid close contact for any period of time (3 metres minimum distance) with pregnant females
(4) Super hygiene methods in place to avoid spread or contamination of excreted $^{131}$I
(5) The need to be signed off work

Results: A re-measurement service (15 min of staff time) was offered to 42 patients that received $^{131}$I Ablation Therapy between 01/04/17 to 31/03/18 at The Royal Wolverhampton NHS Trust. 37 patients returned for their re-measurement on average 4 days post discharge. 28 patients (76%) on day 4 post discharge had all their radiation restrictions lifted completely. 9 patients (24%) on day 4 post discharge had their restrictions reduced to a maximum of 4 further days thus dramatically reducing the original restrictions that were applied on discharge.

From these results it can be shown that by offering a re-measurement service to patient’s post $^{131}$I Ablation Therapy we can show a significant benefit to the patient and their family thus improve the quality of the service we provide at The Royal Wolverhampton NHS Trust.

21. Estimation of the self absorption factors and dose rate constants for the PET isotopes fluorine-18 and zirconium-89
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aKing Saud University, Riyadh, Saudi Arabia, bRoyal College of Surgeons in Ireland, Medical University of Bahrain, Bahrain, Bahrain and Imam Abdulrahman bin Faisal University, Dammam, Saudi Arabia

Objectives: To evaluate the self-absorption factor and the dose rate constant of zirconium-89 ($^{89}$Zr) for the purpose of radiation protection in positron emission tomography (PET) and to compare them with those of fluorine-18 ($^{18}$F).

Methods: We analyzed the energy spectra emitted by $^{18}$F and $^{89}$Zr distributed in an anthropomorphic phantom and calculated the absorption of the energy in the phantom using the Monte Carlo method. The dose rate constants for the radionuclides were estimated in the simulations with two different fluence-to-effective dose conversion coefficients.

Results: Our estimated self-absorption factor (AF) for $^{18}$F, 0.65, agreed with the recommendation by the American Association of Physicists in Medicine (AAPM). The AF for $^{89}$Zr was in the range of 0.61-0.66 depending on the biodistribution. Using the fluence-to-effective dose conversion coefficients recommended jointly by the American National Standards Institute and the American Nuclear Society (ANSI/ANS conversion coefficients), the dose rate at 1 m from the patient for $^{18}$F was found to be 0.143 mSv·MBq⁻¹ h⁻¹, which is consistent with the AAPM recommendation, while that for $^{89}$Zr was found to be 0.154 mSv·MBq⁻¹ h⁻¹.

Conclusion: We have studied the dose rate constant and the self-absorption factor for $^{89}$Zr. With the conversion coefficients currently recommended by the International Committee on Radiological Protection (ICRP), the dose rates were lowered by 2.8% and 2.6% for $^{89}$Zr and $^{18}$F, respectively.

22. Pathway and management of melanoma sentinel node (SLN) imaging
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This study aims to analyse time and cost-effectiveness of current procedures in Melanoma Sentinel Node (SLN) Imaging, in order to improve service delivery to patients and overall Trust performance. By studying the patients’ pathway, one can determine if patients are arriving on time with the scar site properly marked and the topical anaesthetic applied (as per protocol), concluding which teams are failing; this will allow the Department to verify which surgical teams are properly following the Department protocols and which need updated training. Lastly, comparing Nanocolloid® and Lymphoseek® imaging protocols in terms of the total time patients spend in the Department will help improve Departmental costs and camera space saving (crucial for urgent studies).

The population for this study consists of melanoma patients undergoing SLN Radionuclide Imaging prior to surgery for nodes removal and, in total, the data from 52 SLN Imaging studies was collected. After data processing, one can infer that, despite following protocols, the surgical teams still need to improve patient pathway (36% of patients arrive 28 min late - average). With Lymphoseek®, the Department saves nearly an hour on the gamma-camera per SLN study. Even though this agent is more expensive than Nanocolloid®, this means that the gamma-camera space can be used to perform urgent exams, such as a full Ventilation/Perfusion scan, or even a couple of Bone scans; additionally, because dynamic imaging is not required, injecting the tracer in the previous afternoon and imaging the next morning also ensures extra patients can be fitted in.

23. Using the spacer-A method to optimise scanning time for $^{81}$mKr-$^{99m}$Tc]-MAA V/Q SPECT imaging
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Aim: The aim of this project was to determine the time-point when the count-rate contribution of radioactive krypton (81mKr) would fall below 25% in simultaneous ventilation-perfusion (V/Q) SPECT studies and therefore to determine when an in-line decay chamber, known as a spacer, would be required. As such it would optimise the procedure by ensuring the ventilation counts were not suppressed more than necessary.

Materials and methods: A retrospective evaluation of the crossover values for thirty patients, who had been ventilated with 81mKr and injected with 200 MBq (± 10%) of [99mTc]-MAA, were plotted against the time of scanning. This information was taken from crossover calculation forms and the time of scanning/injection from the patient documentation that had been scanned into the department’s radiology information software (CRIS) once the patient’s study had been completed.

Results: The acquired data demonstrated a general crossover time point at 11.20 am after which the 81mKr contribution would be less than 25%. However, there are a number of outliers after this time that have a crossover value greater than 25%. Factors such as generator strength and patient compliance were considered. By analysing further the data points it was determined that by 12.30 pm all patients after this time have a crossover value under 25%.

Conclusion: By using the spacer, the majority of patients undergoing VQ SPECT before 11.20 am would only need a single simultaneous 81mKr/99mTc acquisition as the crossover value would be less than 25%. After 12.30 pm it is not advantageous to use the Spacer.

24. 99mTc-DMSA SPECT in kidney transplanted patients
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99mTc-DMSA SPECT scintigraphy, according literature, could greatly increase this scan sensitivity compared with static images [1].

We aim to show the increased usefulness of SPECT in DMSA scans by presenting case studies in kidney transplanted patients and also sharing the experience about implementing the 99mTc-DMSA SPECT as an alternative to static acquisition for this group of patients in our department.

After a first phase of the 99mTc-DMSA SPECT protocol analysis, where the clinical images of 7 patients were used to perform an assessment of reporting confidence by two nuclear medicine doctors, we have decided to move to a second phase where we have applied this technique only to kidney transplanted patients. 99mTc-DMSA SPECT acquisitions were performed in 4 transplanted patients who presented in our department with the clinical indication of ‘scarring of the transplant kidney’. Slots of 60 min were allocated to those patients in order to be able to perform both statics and SPECT acquisitions consecutively. The SPECT acquisitions were processed using General SPECT protocol from Siemens and the confidence of doctors reporting was also assessed.

99mTc-DMSA SPECT seems to be very helpful in the evaluation of renal cortex especially in kidney transplanted patients and SPECT image can provide a quicker and more comfortable patient’s experience. SPECT showed good concordance with the findings on planar imaging, with increased reporter confidence.

Reference

25. Radiation exposure awareness from patients undergoing nuclear medicine diagnostic 99mTc-MDP bone scans and 18F-FDG PET/CT scans
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Introduction: Evidence suggests that patients are not well informed about radiation exposure when attending nuclear medicine diagnostic scans. A study was conducted to establish the level of awareness of radiation exposure amongst nuclear medicine diagnostic patients and assess if current information leaflets are adequate.

Methods: Single centre cross sectional questionnaire study was designed and conducted with patient and public involvement and applied to two groups, bone scan patients and FDG PET/CT patients for a 15 week period in 2018.

Results: Across both groups 32.4% (33/102) patients reported having good/reasonable understanding of nuclear medicine and 29.2% (9/31) reported good/reasonable knowledge of ionising radiation. When asked to compare the exposure dose of respective scan with common comparators 16% (8/50) of bone scan and 21.2% (11/52) of FDG PET/CT patients answered correctly.

17.6% (15/85) patients reported leaflets do not provide enough information on radiation exposure and 10/15 of
these patients commented leaflets should incorporate more information on radiation exposure dose.

**Conclusion:** Results are similar to those found in the literature among patients and demonstrate a need to better inform patients on radiation exposure dose. More observational and qualitative studies applied in particular to nuclear medicine patients, are warranted to evaluate patient’s awareness, understanding and preferences in communication. Patient consent for diagnostic imaging can only truly be informed when the radiation exposure and risks associated with nuclear medicine imaging are understood and this can be achieved with effective communication between health professionals and patients.

26. Preliminary evaluation of chelating agents for biomolecular labelling with the long-lived PET isotope manganese-52
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$^{52}$Mn ($t_{1/2} = 5.6$ d) has potential application for prolonged longitudinal imaging studies, such as antibody and cell tracking. Since manganese is an essential trace element, it will be important to ensure the imaging signal corresponds to radiomanganese in the administered labelled cell population or antibody rather than leaching into natural biological pathways. Therefore, $^{52}$Mn bifunctional conjugates must be highly kinetically stable towards transchelation for in vivo use in these contexts. A previous immunoPET imaging study has shown that DOTA was an adequate chelator for $^{52}$Mn imaging [1].

In this research, we incubated several trastuzumab immunoconjugates (100 ml) of commercially available bifunctional chelators with $^{52}$MnCl$_2$ at a range of antibody concentrations and mild pH conditions within physiological ranges to identify the lead chelators for future research. Reactions were quenched after 45 min with EDTA (50 mM, 2 ml). Labelling efficiencies were analysed by iTLC. There is a clear difference in percent $^{52}$Mn bound to chelators at the lowest concentrations tested (Fig. 1). Future work will ascertain the number of chelators per immunoconjugate, and the kinetic and in vivo stability of lead chelators, which were NOTA, PCTA, and oxo-DOTA [2].

**References**


27. Assessment of the robustness and failure rate of the radiolabelling of $^{68}$Gallium-DOTA0-Tyr3-octreotide ($^{68}$Ga-DOTATOC - SOMAKit TOC®) for clinical use
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**Aim:** To assess the robustness and the failure rate of the radiolabelling of $^{68}$Ga-DOTATOC (SomaKit TOC®) for clinical use in our Nuclear Medicine Department.

**Material and method:** 113 vials of $^{68}$Ga-DOTATOC (40 µg) were radiolabelled following Summary Product Characteristics and Good Manufacturing Principles. An E&Z Galliapharm $^{68}$Ge/$^{68}$Ga Generator (1850 MBq) was eluted with 5.5–5.8 ml of 0.1 mol/l hydrochloric acid using an automatic pump (flow rate = 60 ml/hr).

Quality Control tests for release of $^{68}$Ga-DOTATOC performed including radiochemical purity tests using iTLC for $^{68}$Gallium Chloride ($^{68}$GaCl$_3$ < 2%) and $^{68}$Ga colloids (< 3%), HPLC for $^{68}$GaCl$_3$ (< 2%), pH (3.2–3.8), $^{68}$Ga half-life determination (62–74 min) and Germanium ($^{68}$Ge) Breakthrough (< 0.001%).

All the results were trended and average, maximum and minimum values calculated. The failure rate (%) was calculated dividing the rejected vials by the total number of radiolabelled vials and compared against previous failure rate (3.25%) when using a synthesis module for
radiolabelling somatostatin analogues DOTA-peptides (248 synthesis, 8 failures).

Results: 2 vials were rejected as 68Ga impurities were higher than the 2% and 3% limit. The failure rate obtained was 1.77% (2/113). Results for the 113 released vials were: 68GaCl₃ by ITLC (mean = 0.60% ± 0.42, Max = 2.76%, Min = 0.19%), 68Ga colloids (mean = 0.08% ± 0.45, Max = 3.38%, Min = 0.33%), 68GaCl₃ by HPLC (mean = 0.83% ± 0.42, Max = 2.87%, Min = 0.07%). 68Ge Breakthrough, pH and half-life within specification. Radiolabelling time was 20.68 min.

Conclusion: 2 of 113 vials were rejected due to high levels of 68GaCl₃ and 68Ga colloids. The failure rate obtained (1.77%) improves the previous failure rate (3.25%). These results indicate the radiolabelling of 68Ga-DOTATOC (SomaKIT TOC®) is robust enough and more reliable than radiolabelling DOTA-peptides using a synthesis module.

28. Study of cell trafficking post administration of T4-immunotherapy of head and neck cancer using radiolabelled CAR-T4
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Background: A novel approach to enhance the immune response against squamous cell carcinoma of the head and neck using genetically targeted peripheral blood T-cells (CAR-T chimaeric antigen receptor transfer) is under investigation. Radiolabelling of a subset of these cells was carried out in order to investigate the trafficking of the cells post injection.

Methods: The isolation and subsequent manufacture of the T4 immunotherapy cells was carried out by the cell research facility as an ATIMP. 10% of the final therapeutic dose was then transferred to the radiopharmacy unit where cell labelling was performed using ¹¹¹In-tropolone. The labelling was carried out on duplicate samples and a labelling efficiency of 89% was achieved. A dose of 11 MBq was injected intratumourally and imaging performed at time 0, 24 and 48 h.

Summary: The imaging arm of the study was performed later in the study where the largest cell volume was being injected. The tumour was shown to be particularly friable and the dose was seen to leak shortly following injection and uptake observed in the stomach. The dose retained within the tumour showed no migration over the course of the study.

Conclusion: Radiolabelling of the cells highlighted the challenges that may be faced if the dose is escalated further and may influence patient selection but the overall results have been promising.

This study did highlight operational challenges which are likely to increase due to increased regulatory scrutiny and reduced cell labelling capacity nationally.

29. Initial review of lymphatic uptake quantification using ⁹⁹mTc-NanoTop
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Aim: Following the cessation of production of ⁹⁹mTc-NanoColl (GE Healthcare), we have performed Lymphoscintigraphy with ⁹⁹mTc-NanoTop (IEL). Studies have shown the effective equivalence of these two radiopharmaceuticals for sentinel node localisation studies, however there is no clear evidence of their equivalence for lymphatic drainage studies, particularly for the quantification of the ilio-inguinal nodal uptake at 2 h.

Methods: A cohort of 37 consecutive patients were scanned using NanoTop with both imaging and quantitative processing protocols the same as for 154 consecutive NanoColl studies. The 2 h post injection ilio-inguinal node uptake as a percentage of the injected dose, and the percentage retention in the foot injection site were calculated and a t-test at the P < 0.05 level applied.

Results: The ilio-inguinal node uptake was 6.9 ± 6.5% for NanoColl and 8.0 ± 6.9% for NanoTop (P = 0.2). The retention within the feet was 87.9 ± 9.2% for NanoColl and 88.2 ± 9.4% for NanoTop (P = 0.8).

Conclusion: In conclusion, it has been found that there is no significant difference in the mean ilio-inguinal nodal uptake or the injection site retention at 2 h post injection between NanoTop and NanoColl in two unselected groups of patients referred with clinical queries relating to Lymphatic drainage. This gives confidence in continuing to use numerical thresholds of abnormality set for Nanocoll studies for NanoTop studies, but caution still needs to be exercised if comparing follow up studies in the same patient where the radiopharmaceutical has changed.

30. Treatment response is independent of baseline tumour volume for ⁹⁰Y selective internal radiotherapy (SIRT)
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Background: Liver tumour burden is often the life-limiting component of a cancer patient’s disease. SIRT,
a liver-directed therapy, involves injection of yttrium-90 (90Y) radiolabelled resin microspheres into the arterial blood supply of liver tumours. EBRT is sometimes employed to ease tumour burden as a palliative strategy. Alongside a radiobiological dose-response study, this analysis was conducted to assess the relationship between baseline tumour volume and response to 90Y SIRT treatment.

Methods: A retrospective review of 23 SIRT patients (96 tumours, 14 males, 63 years mean age) was conducted. At baseline, all patients had chemoresistant colorectal cancer, 7 had hepatectomy, and 2 had prior EBRT. Baseline and 3-month follow-up contrast CT scans were segmented to derive individual tumour volumes. Tumour volumes at baseline were correlated to percent-change in tumour volume using linear regression.

Results: Linear regression shows no statistically significant correlation ($R = 0.19, R^2 = 0.0013$) between baseline tumour volume and change in tumour volume. Mean baseline total tumour volume was 436 ml (SD 471 ml). Baseline tumour burden was 20% of the whole liver, including tumour (SD 16%). 17, 1, and 5 patients had a baseline tumour burden <25%, >50%, 25–50%, respectively. Stable disease or partial response was observed in 16 (70%) patients. The median administered radioactivity was 1513 MBq (range 847–2185) for lobar and bilobar administrations.

Conclusion: Baseline tumour volume was not statistically significantly correlated with tumour response. This analysis suggests that patient tumour volume may not be a critical factor when determining treatment strategy compared to considerations such as perfusion or absorbed dose.

31 Results of BNMS survey on radiiodine treatment for benign thyroid disorders: A call for harmonisation
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Paul Gape and Utku Alhun are first co-authors.

Purpose: To identify clinical practice and potential discrepancies in radiiodine treatment (RAIT) for benign thyroid disorder across the UK.

Methods: The survey consisted of 12 questions and was sent to BNMS members in June 2018. Responses were collected over two weeks.

Results: Sixty-four members responded.

The number of treatments performed per year ranged from <25 to >100, with 59% of centres treating >50 patients. In 80% of centres, nuclear medicine (NM) is responsible for patient treatment; however, 55% answered that endocrinology holds the ARSAC licence. Three respondents stated that oncology holds the ARSAC licence.

For the treatment of Graves’ disease and multinodular toxic goitre, 88% and 97% of respondents, respectively, administer fixed activities in accordance with Royal College of Physicians (RCP) Guidelines (2007).

A pre-treatment thyroid uptake scan is performed by 59% of respondents (39% always, 20% sometimes); 41% perform no scan. The reasons for performing scans were: to check the functionality of the gland, to exclude thyroiditis/cold nodules, and to differentiate Graves’ from toxic nodule.

Fifteen respondents (23%) said they would perform dosimetry for all treatments if available and 27 others (42%) said they would for special cases or if clinical benefit were shown in trials.

Conclusion: Although most centres administer fixed activities in line with RCP guidelines, the survey demonstrated variable practice in use of pre-therapy scan and uncertainty regarding the role of dosimetry. Further national studies should be undertaken to harmonise protocols, from which informed multidisciplinary (NM, endocrinology, oncology, surgery) guidelines can be produced.

32. Theragnostic potential of post-therapy imaging of [223Ra]RaCl2 for treatment of bone metastases in castration resistant prostate cancer patients: Monitoring response and activity quantification
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Purpose: To establish a [223Ra]RaCl2 imaging protocol for use in a clinical quality improvement audit to image patients after each of their 6 injections. Inter-injection variability of uptake in lesions and normal bone was assessed, and the clinical usefulness of the imaging evaluated. We also assessed whether quantitative imaging, and therefore dosimetry, is feasible.

Methods: Whole body planar images were acquired 3 days post-injection (MELP collimators, scan speed 4 cm/min).

Lesion uptake was assessed by outlining the 99mTc bone scan and copying the regions to the 223Ra images. ROIs were attenuation corrected and a background region of normal bone subtracted.
Results: Imaging has been completed after all 6 administrations for one patient.

Maximum uptake was observed following injection 2 for 32/35 lesions. Maximum uptake relative to injection 1 was assessed for all lesions. The average was 1.74 [SD 0.73].

A nadir of 39% of baseline ALP was observed in blood data taken before injection 4. Visual assessment showed reduced uptake in lesions in thoracic and lumbar spine, right anterior pelvis and the anterior rib after injection 4. In the context of the biochemical response, this was suggestive of partial response. Some pelvic lesions were obscured by variable bladder activity.

Two further patients have so far been enrolled.

Conclusion: There is clinical benefit in $^{223}$Ra imaging for verification and monitoring response, as it provides site specificity unavailable from ALP. Quantification and dosimetry are feasible. The patients’ advanced disease means it may be difficult to ensure imaging after each administration.

33. Platelet count is a novel prognostic marker prior to radium-223 therapy for metastatic castration resistant prostate cancer

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Purpose: This exploratory analysis investigates platelets as a novel predictor of disease-related death following radium-223 treatment.

Methods: Patients with mCRPC with a positive bone scan, negative nodal and visceral status, performance status of 0 to 2, and adequate markers of bone marrow reserve were included, for up to 6 cycles of radium-223. Using AUROC for pre-treatment variables of PSA, ALP, NLR, haemoglobin and platelets, cut-off values were determined for survival at 12 months. Kaplan-Meier curve was created for overall survival, and a log-rank used to obtain hazard ratios for survival using the cut-offs.

Summary: Twenty-four patients were followed up over a period of 27 months, with 17/24 completing six cycles, with two deaths during treatment and 13 deaths during follow-up. Mean age was 72.7 ± 8.6. Median survival was 12.6 months (range 1.5 to 26, IQR 12.9). ROC area for platelets was 0.864, (P < 0.006), ALP and PSA provided an area of 0.707, NLR an area of 0.576, and pre-treatment PSA 0.677. A cut off value of < 225 × 10^9 platelets per litre provided a sensitivity of 90%, and specificity of 73% for survival at 12 months. Log-rank analysis indicated a hazard ratio of 3.9 (95% CI 1.2 to 13.3), for death at 12 months, for pre-treatment platelet values of > 225 × 10^9/l (P = 0.0163).

Conclusion: This study has demonstrated that platelet count, at the decision to treat with radium-223, is a sensitive predictor of mortality beyond 12 months. In our sample, pre-treatment platelet counts would inform clinicians and patients regarding expected survival.

34. The MEDIRAD multinational I-131 dosimetry study for thyroid ablation and adjuvant therapy

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Purpose: The Horizon2020 MEDIRAD project investigates the effects of low-dose radiation. This multi-national prospective study aims to determine the absorbed doses to healthy organs and thyroid remnants from radioiodine ablation (RAIT). The relation between patient biokinetics, the success of RAIT and acute to mid-term toxicity will be assessed.

Methods: Gamma cameras at four centres will be calibrated for high activity quantitative I-131 imaging.

100 differentiated thyroid cancer patients with a clinical indication for RAIT post-total thyroidectomy will be recruited. Low and intermediate-risk patients will be recruited; 1.1 or 3.7GBq I-131 will be administered. A flexible acquisition protocol for dosimetry has been developed to allow for inter-centre variabilities with respect to access to hybrid imaging and local radiation protection regulations. A minimum of four whole-body (WB) planar scans (24–96 h post-administration) plus a SPECT/CT at 48 h are mandated.

Blood samples and WB retention measurements may be collected for blood, bone marrow and WB dosimetry calculations.

Results: Four Siemens gamma cameras, two Intevos, one Intevo Bold, and one Symbia S, have been characterised. Volume-dependent correction-factors for partial volume effects were determined. Count losses of 20% due to dead-time were observed at 1.7 GBq.
Conclusion: The first European network able to perform standardised quantitative radioiodine imaging for dosimetry has been established. The dosimetric methods developed will provide the means to prepare a large-scale observational epidemiological study of the risks from absorbed doses delivered to normal organs. This project has received funding from the Euratom research and training programme 2014-2018, grant agreement #755523.

35. Characterisation of \(^{99m}\text{Tc}\)-tektrotyd physiological and tumour uptake using SUVs

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Aim: To investigate and determine standardised uptake values (SUVs) from \(^{99m}\text{Tc}\)-Tektrotyd (\(^{99m}\text{Tc}\)-HYNIC-TOC) SPECT/CT imaging. \(^{99m}\text{Tc}\)-Tektrotyd specifically binds to somatostatin receptors and is used clinically to localise neuroendocrine tumours and potential metastases. Quantification of \(^{99m}\text{Tc}\)-Tektrotyd uptake could be useful as an adjunct to visual assessment and for monitoring disease progression or response to treatment.

SUVs will be established in organs with normal physiological uptake and areas of tumour uptake to allow comparison.

Methods: Patients referred for \(^{99m}\text{Tc}\)-Tektrotyd imaging were retrospectively analysed. SPECT/CT imaging was performed 4 h post injection on a Siemens Intevo16 SPECT/CT system (Siemens, Germany). Siemens xQuant software was utilised to produce absolute quantification values (SUVs). Volumes of interests (VOIs) in areas of normal liver, normal spleen, liver metastases and lung lesions were produced using Hermes Medical software (Hermes Medical Solutions, Sweden) and categorised from radiology report.

Results: Preliminary results showed average SUV\(_{\text{max}}\) ± standard deviation to be 6.4 ± 1.8 in normal liver (n = 5), 28.6 ± 3.5 in normal spleen (n = 7), 14.7 ± 5.7 in liver metastases (n = 2) and 22.8 ± 15.7 in lung lesions (n = 2).

This work will be extended further to include analysis of more normal organs and tumour uptake. However these initial SUV\(_{\text{max}}\) results show good differentiation between uptake in normal liver and liver metastases, and correspond with reported SUV\(_{\text{max}}\) values from Ga68-labelled somatostatin receptor radiopharmaceuticals.

Conclusion: This investigation has demonstrated a methodology for determining SUVs from \(^{99m}\text{Tc}\)-Tektrotyd SPECT/CT images which could aid visual interpretation, potentially be useful for monitoring disease progression or response to treatment.

36. Imaging programmed cell death ligand-1 (PDL1) expression in non-small cell lung cancer with \(^{99m}\text{Tc}\)-anti PDL1 sdAb SPECT

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Purpose: Check-point inhibition immunotherapy is revolutionising cancer therapy, but treatment stratification is suboptimal as immunohistochemical (IHC) analysis of tissue is required. Imaging provides a method to non-invasively capture spatiotemporal heterogeneity of target expression, serving as a companion diagnostic and monitoring disease evolution. This phase-1 study evaluated safety, dosimetry, biodistribution and imaging characteristics of \(^{99m}\text{Tc}\)-labelled programmed-death ligand-1 single-domain antibody (\(^{99m}\text{Tc}\)-anti-PDL1-sdAb) with SPECT/CT.

Methods and materials: 16 non-small cell lung cancer patients underwent whole-body planar and thoracic SPECT/CT imaging at 1 and 2 h post-injection of 5.3–11.1 MBq/kg and were monitored for adverse events. 5 patients underwent imaging up to 24 h for dosimetry calculations. 12 patients had %PDL1 IHC on primary tumours.

Results: No adverse events related to \(^{99m}\text{Tc}\)-anti PDL1 sdAb were recorded. Effective dose was 0.009 ± 0.001 mSv/MBq. Scans showed an expected biodistribution of PDL1, including kidneys, spleen, liver and bone marrow. SPECT primary tumour: blood pool ratios (T:BP) varied from 1.24 to 2.30 (mean = 1.79) at 1h and 1.24–3.53 (mean = 2.22) at 2 h (P = 0.005). 2h primary T:BP ratios correlated with PDL1 expression (r = 0.68, P = 0.014). 2h T:BP was lower in tumours with ≤1% PDL1 expression (1.89 vs. 2.49, P = 0.048). Nodal, pleural and bone metastases showed tracer uptake. Heterogeneity (>20%) between primary tumour and nodal T:BP was present in 4/12 patients.

Conclusion: \(^{99m}\text{Tc}\)-anti-PDL1-sdAb is safe and associated with acceptable dosimetry. Biodistribution is as expected for PDL1-expressing tissue. Tumour PDL1 expression and heterogeneity is measurable with better contrast at 2 h. 2 h T:BP ratios correlate with primary tumour IHC PDL1%.
37. MIBI SPECT/CT versus ultrasound in the diagnosis of parathyroid adenomas–our experience
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Purpose: The aim was to determine the sensitivity of [99mTc]-MIBI scintigraphy in preoperative localization of parathyroid adenoma in patients with suspected primary hyperparathyroidism and to compare with ultrasonography.

Materials and methods: We retrospectively reviewed 100 patients, who underwent [99mTc]-MIBI SPECT/CT imaging at our Hospital between January and December 2017. 67 patients had parathyroid surgery, MIBI scan and ultrasound prior to parathyroid surgery. We excluded 33 patients who did not have surgery of these [99mTc]-MIBI was negative in 19 and positive in 14 patients. The diagnostic accuracies of both these techniques were evaluated using surgical and histological findings as the reference standard.

Results: Following surgery the histology showed 81% solitary parathyroid adenoma, 18% parathyroid hyperplasia and 1% a lymph node. [99mTc]-MIBI imaging was true positive in 87%, false negative in 12% and 1% false positive with a sensitivity of 79%. Likewise, ultrasonography was true positive in 40%, false negative in 59% and true negative in 1% corresponding to a sensitivity of 40%. However if we focus on adenoma only according to the histology this group shows a sensitivity of 88% for MIBI scan and 44% for Ultrasound.

Conclusion: In our experience [99mTc]-MIBI SPECT/CT is more sensitive than US in the detection and localization of parathyroid adenoma showing an incremental value above US. The use of other techniques like 18F-Choline PET could help to future improve the sensitivity, especially, in the negative MIBI/US studies.

Demographics, thyroid function, clinical diagnosis, radiology report and results of histopathology were collected.
A randomly selected sample of 49 cases had the thyroid scintigraphy reviewed by 2 independent, consultant radiologists - once when blinded to the TUI and once with knowledge of the TUI. Agreement of original report and the clinical diagnosis, and between the 2 observers and the clinical diagnosis was established.

Results: One hundred and fifty-two cases were identified over a 2-year period and 54 were excluded, mostly due to lack of documented clinical follow up (30/152 cases, 20%). Of the 98 cases that were included, the most common diagnoses were Graves’ disease (19), toxic nodule (23), toxic or non-toxic multinodular goitre (36), and thyroiditis (17). Disagreement between the radiological and the clinical diagnosis was identified in 9 cases (PPV = 93%).

Mean agreement between 2 observers and clinical diagnosis was 84.7% without and 82.7 with TUI.

Conclusion: Thyroid scintigraphy provides high level agreement with the final clinical diagnosis, and our results suggest that the TUI may provide only a limited role in assessment.

39. Value of quantitative SPECT in parathyroid localization
Lefteris Munneea,b,c, Maria Burnistona,b, Ewa Nowosinska,b, Athar Haroonba and Lefteris Livieratosa
a Kings College London, London, United Kingdom, b Barts Health NHS Trust, London, United Kingdom and c St Georges NHS Trust, London, United Kingdom

Aim: SPECT/CT has traditionally been used qualitatively for parathyroid localization. With the growing interest in quantitative SPECT, we aimed to assess the diagnostic value of SPECT Standardised Uptake Values (SUVs) in parathyroid localization.

Methods: We conducted a retrospective study of the patients presented with PHPT at our Trust between 2009 and 2016 for preoperative imaging. These patients underwent an imaging examination that included Ultrasound, washout and subtraction scintigraphy and SPECT CT. The main inclusion criteria for our cohort was the availability of histological information from neck surgery. Our cohort consisted of 55 patients (15 males, 40 females) with the mean age 54 years. The cohort had a mix of parathyroid pathologies. We reconstructed the SPECT images using Hermes SUV SPECT® software. The images were assessed by experienced radiologists, and SUVmax, SUVmean and SUVpeak values were obtained. These values were then correlated with the histological findings. A Receiver Operator Characteristic analysis was carried out to evaluate the accuracy of SUV values for lesion localization.

38. Diagnostic performance of technetium-99m labelled pertechnetate thyroid scintigraphy and the thyroid uptake index: A 2 year experience
Kavi Fatania, Andrew Scarsbrook and Sriram Vaidyanathan
Leeds Teaching Hospitals Trust, Leeds, United Kingdom

Purpose: To evaluate the diagnostic performance of technetium-99m labelled pertechnetate thyroid scintigraphy including the thyroid uptake index (TUI) in a teaching hospital over a 2 year period.

Methods: Patients over a 2-year period were identified, and excluded if there was no follow up, or diagnosis documented, no TUI was calculated, or scintigraphy was not being performed to identify a primary diagnosis.
Results: There was a large variation in the SUV values and no statistically significant difference was found between the SUVs for diseased parathyroids and the contra/ipsilateral thyroid lobes. ROC analysis gave an area of 0.58 ($P = 0.04$). No significant correlation was found between SUVs of diseased parathyroids and biochemical parameters.

Conclusion: The results of our study show that using SPECT SUV does not increase the diagnostic confidence for parathyroid localisation. However, we are aiming to do further analyses to identify the underlying causes for the low accuracy.

40. Equivalence and difference of tumour proliferation index and molecular imaging features in patients with neuroendocrine tumours

Cati Raluca Stolniceanu$^{a,b}$, Ana Maria Statescu$^b$, Christina Ungureanu$^{a,c}$, Cristina Preda$^{a,c}$, Daniela Chetan$^d$, Mihai Gutu$^{d,e}$, Gratian Naum$^{d,e}$, Milovan Matovic$^{f}$ and Cipriana Stefanescu$^{a,c}$

$^a$Doctoral School, University of Medicine and Pharmacy U.M.F “Grigore T. Popa”, Iasi, Romania, $^b$University Emergency Hospital ‘Sf. Spiridon’, Iasi, Romania, $^c$University of Medicine and Pharmacy U.M.F “Grigore T. Popa”, Iasi, Romania, $^d$Regional Institute of Oncology, Iasi, Romania, $^e$Clinical Center Kragujevac, Center for Nuclear Medicine, Kragujevac, Serbia and $^f$Faculty of Medical Sciences, University of Kragujevac, Kragujevac, Serbia

Background: Molecular imaging procedures have a central role in the diagnostic of patients with neuroendocrine tumors (NET). Radiolabeled somatostatin analogues are useful for the diagnosis, staging and follow up of patients with NET.

Aim: The study wants to assess two functional imaging techniques in diagnosis of NET: $^{99m}$Tc Tektrotyd somatostatin receptor scintigraphy (SRS) and $^{18}$F-FDG PET/CT.

Materials and methods: Seventeen patients (aged 47 ± 11 years), with different supposed or confirmed NET’s, underwent, prospectively, $^{99m}$Tc Tektrotyd SRS and $^{18}$F-FDG PET/CT and were assessed for biodistribution pattern and pathological uptakes. Thirteen patients underwent SRS, (740 MBq, early dynamic and static acquisition, whole body (WB) and SPECT images at 10 min, 2, 4, 24 h) and four patients underwent $^{18}$F-FDG PET/CT, (370 MBq, WB at 60 min). Manually defined regions of interest (ROI) for each hot area renal, liver, spleen, right thigh were drawn and correlation analysis of resulting data was performed. The imaging results were compared with the Ki67 proliferation index.

Results: From 17 patients with supposed or confirmed NET, there were 12 true positive and 1 false positive findings. At 10 of 13 SRS patients was found a homogeneous pattern in tumor ROIs. 2 of 4 patients had an elevated $^{18}$F-FDG uptake (SUV_{max} ≥ 2.5).

Conclusion: $^{99m}$Tc-Tektrotyd SRS is more sensitive than $^{18}$F-FDG-PET for well-differentiated NET, whereas $^{18}$F-FDG-PET demonstrates superior sensitivity for poorly-differentiated NET, with Ki67 > 10%. Although SRS should still be the routine method, $^{18}$F-FDG PET provides complementary diagnostic information and is of value for NET patients with negative SRS findings or a high proliferation index.

41. How a multidisciplinary approach can be decisive in delivering [223Ra]Ra-dichloride therapy

Luisa Roldao Pereira, Teri Crooker, Peter O’Sullivan and Meeran Naji

Maidstone and Tunbridge Wells NHS Trust, Maidstone, United Kingdom

The referral standards for [223Ra]Ra-dichloride therapy for mCRPC should follow the NICE inclusion criteria. While it provides useful guidance, the multi-disciplinary team’s role is to assess individual patient’s suitability and to review any comorbidities, considering the safety of the patient, relatives, members of the public and staff groups who may work with the patient. Safety risks arising from the use of radioactive materials should be identified and the team should seek reasonable solutions to any identified risks.

Aim: To share this centre’s experience in finding practicable solutions for treating patients with radium-223 who present with a range of comorbidities.

Methods: We examined four common comorbidities from patients referred for radium-223 therapy and described the typical control measures for these conditions. The comorbidities reviewed included severe GI conditions, incontinence, renal obstruction and pain management. Based on real-life cases, they are not presented as case reports but rather as examples of integrated, personalised methodologies.

Results: For each scenario a broad risk assessment addresses: autonomy in personal hygiene, waste management, facilities/relatives contamination risks, overnight dependency and personal circumstances, patient’s awareness/ decision capability, use of absorbent materials, radiation protection arrangements and action plans in case of hospital admission. Nurses, NM physicians, oncologists, physics, relatives, GP and the patient are meaningful partners: communication is fundamental. Liaising with hospice palliative team is valuable in the symptom control.

Conclusion: This work shows how applying a comprehensive multidisciplinary effort and working with the patient can empower staff to safely treat patients with radium-223.
42. Distribution of $[^{18}\text{F}]$FDG avid lesions in patients affected by multiple myeloma: Utility of total body PET/CT

Elisa Milan, Andrew Cheetham, Sara Soares, Nick Gulliver, Eleni Kalogianni, Gillian Vivian and Nicola Mulholland
King’s College Hospital NHS Foundation Trust, London, United Kingdom

Introduction: When performing an $[^{18}\text{F}]$FDG PET/CT on patients with multiple myeloma (MM) NICE and EANM guidelines recommend imaging the whole-body. Literature provides an inconsistent approach regarding the term ‘whole-body’, with some studies using a limited half-body scan.

Aim: Establish whether half-body scan (vertex to mid-femur) or total-body scan (vertex to toes) offers additional value in MM by determining the anatomical distribution of $[^{18}\text{F}]$FDG avid lesions.

Methods: Retrospective analysis of 30 patients (from 2015 to 2018), who underwent a total-body $[^{18}\text{F}]$FDG PET/CT scan for MM. 75 scans were analysed, with abnormalities tabulated by location.

Results: At initial presentation the number of patients with lesions seen in the head and neck = 11 (36.6%), thorax = 23 (76.6%), abdo-pelvis = 23 (76.6%), humeri = 15 (50%), forearms = 2 (6.6%), knees and femora = 17 (56.6%), lower legs = 4 (13.3%).

At the first follow-up the number of patients with lesions was 6 (20%), 17 (56.6%), 17 (56.6%), 12 (40%), 1 (3.3%), 13 (43.3%) and 1 (3.3%) respectively.

15 patients were seen for a third scan, with the number of patients as follows: 3 (20%), 9 (60%), 8 (53.3%), 5 (33.3%), 1 (6.6%), 6 (40%) and 2 (13.3%).

Patients with upper and lower limbs abnormalities also had disease elsewhere.

Conclusion: 49.3% of scans showed disease in both axial and appendicular skeleton. A half-body scan would miss lesions in 13.3% of patients. Including upper and lower limbs allows more accurate staging with the detection of long bones lesions at risk of fracture.

43. Whole body bone SPECT/CT: Feasibility, Pros and Cons from a technologist’s point of view

Rajyashree Sharma, Joseph Manivannan, Rabelle Gironella and Arum Parthipun
Trinity Medical Imaging, Sutton, United Kingdom

Purpose: To investigate the feasibility, pros and cons of Whole-body bone SPECT/CT scan in diagnostic imaging for staging malignancy.

Methods: Whole body (WB) bone SPECT/CT procedure with these parameters (3 bed positions from vertex to mid thighs, 20 s/frame, view angle 6 deg, 60 frames per rotation, rough overlap of 4.42 cm) was performed in 45 patients. Technologists recorded their opinions on ease of performing scans, patient-positioning, and patient comfort.

Results: Technologists found WB SPECT/CT are easy to perform and are particularly useful to delineate lesions hidden by superimposition of other activities which sometimes are not identified by lateral or oblique views as well.

Duration of scans are approximately 38 min which is similar to planar whole body (20 min) & SPECT/CT of any 1 bed position (20 min). Longer scans were not easily tolerated by elderly and patients with metastases. Any movements during scans may compromise image quality & image registration. Patients were scanned with their arms down for their comfort.

There is slightly higher radiation burden with whole body SPECT CT compared to planar whole body.

Additional views such as lateral pelvis or oblique thorax were not required, saving valuable time.

Conclusion: Although WB SPECT CT scans are slightly lengthier and have a slightly higher radiation burden, benefits include ease of performing, positioning patients, confidence of not missing any lesions due to superimposition and are well tolerated.

44. Reducing inpatient stay for I-131 ablation patients, using quality improvement methodologies

Darren Morgan, Katie Slade and Aida Hallam
Oxford University Hospitals NHS Foundation Trust, Oxford, United Kingdom

Background and aim: The work presented details the results of a quality improvement project that aimed to reduce the time to discharge home for patients undergoing radioactive iodine ablation therapy at the Churchill Hospital.

Methods: An audit of patients treated in 2017 demonstrated that 80% of patients stayed in hospital at least one night more than necessary. The required length of stay was calculated based on patients leaving hospital either on the day, or the morning after they reach the discharge limit of 800 MBq. Previously patients were discharged on a fixed day, this project ensured that patients were sent home when the discharge limit was reached.

Discussion: This change is consistent with national guidelines for discharge of patients treated with Iodine-131. The change has released additional bed capacity of more than 50 bed-nights annually within the specialist oncology ward. Following these changes to the system, the length of stay was reduced for 78% of patients. The other 22% were either treated over the weekend where there was no capacity to scan and discharge until Monday or remained in hospital due to radiation protection or clinical reasons.
Conclusion: The project was successful in its aims to reduce length of inpatient stay. It was also found that the patient experience was improved and there are reduced costs due to the release of bed capacity. This improvement did not require any additional workload for existing staff and also allowed greater flexibility for radiation room clearing/monitoring/cleaning and preparation.

45. Comparison of gastric emptying results using 15, 30 or 60 min sampling over two hour study—A retrospective study
Daniela Teixeira Maçarico, Christopher Laurins, Dawn Gribben and Alice Nicol
NHS Greater Glasgow and Clyde, Glasgow, United Kingdom

Purpose: Gastric Emptying (GE) studies are performed using static, erect anterior-posterior images acquired every 15 min for two hours. This study compares the results using images acquired at 15, 30 or 60-min intervals.

Methods: Half-time of GE was obtained from curves using an exponential (or Siegel) fit. A normal T1/2 of 30

- average of overestimation of −2.49% and −1.16% respectively.

Part II: There was 100% of correlation for operators 2 and 3 abnormal. In Part I the pictures of 78 patients were processed for 15, 30 or 60-min sampling by one technologist. In Part II, 30 randomly selected patients were processed for 15 and 30-min sampling by three technologists and Intra and Inter-Operator variability obtained.

Conclusion: Using 60 or 30-min sampling produces good results – average of overestimation of −2.49% and −1.16% respectively. There is high reproducibility of results between operators for 30-min sampling with overestimation of −2.71%.

The authors found it more difficult to select the appropriate curves with 60-min sampling and don’t recommend it. For 30-min sampling, results are the same and more data doesn’t change the clinical report. It seems reasonable to use this technique for clinical practice.

46. Lights, camera, action
Pippa Mashford
Great Ormond Street Hospital for children NHS Foundation Trust, London, United Kingdom

The installation of a new scanner is an exciting time for any department, often bringing an opportunity to embrace new technology and improve image quality. However, what is often over looked is the opportunity to improve the patient experience by improving the patient environment. This is especially true in the paediatric setting, where the environment is so closely linked to patient compliance, which is itself entwined with image quality. During the installation of our new scanner the staff have risen to this challenge and taken the opportunity to install equipment that enhances our patient cohort’s experience.

The aim of this talk is to take the audience through the rationale, research, and installation of innovative, flexible, modern equipment that allows staff to completely personalise the scanner room for each individual patient, making the environment less frightening, entertaining, and appropriate for all age groups; and to demonstrate the amazing, positive effect its use has had on patients and their carers, the outstanding impact on patient compliance, and the unexpected boost to the morale and wellbeing of the staff.

It is hoped this talk will inspire the audience to re-evaluate the environmental needs of their patient cohort and create innovative ways to enhance their patients’ experience.

47. Optimising FlowMotion scan speeds on a Siemens Biograph Vision PET/CT in FDG imaging
Carl Grimsditch, Caroline Hurley, Matthew Memmott and Ian Armstrong
Manchester University NHS Foundation Trust, Manchester, United Kingdom

The Siemens Biograph Vision incorporates a high sensitivity SiPM PET detector combined with excellent time-of-flight performance. The system uses continuous bed motion (FlowMotion) with up to four different scan speed zones possible during a scan. The scanner produces axial count-rate profiles of true and random coincidences. This work aims to optimise the use of FlowMotion in both half-body and whole-body FDG scans.

Torso scan speed was defined by attempting to standardise liver signal-to-noise across the patient population. Scanning speed over the legs was increased by approximately 30% compared with the torso scan speed. The scan speed of the head was set as 1.9 mm/s for all patients based on the high trues-to-randoms count-rate ratio and lack of attenuating material.

The torso and leg scan speeds were defined as the following:

<table>
<thead>
<tr>
<th>Torso speed (arms up)</th>
<th>Torso speed (arms down)</th>
<th>Legs speed</th>
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<tbody>
<tr>
<td>&lt; 85 kg and BMI &lt; 28</td>
<td>1.7 mm/sec</td>
<td>1.9 mm/sec</td>
</tr>
<tr>
<td>85 kg to 115 kg or BMI &gt; 28</td>
<td>1.3 mm/sec</td>
<td>1.7 mm/sec</td>
</tr>
<tr>
<td>&gt; 115 kg or BMI &gt; 34</td>
<td>1.0 mm/sec</td>
<td>1.3 mm/sec</td>
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</table>

As a result, the median [inter-quartile range] scan time for 36 consecutive FDG patients was 9:55 [8:55 to 11:06]. No scan, including whole-body studies, exceeded 20
The use of multiple FlowMotion scan speed zones has improved the patient throughput on the new Siemens Biograph Vision, with a typical reduction of 6 minutes per scan compared with the mCT. This will enable increased throughput and improved patient comfort during the scans.

**BNMS STUDENT PRIZE 3rd PLACE**

**48. Bone scan index as metastatic bone disease quantifier and predictor of radium-223-dichloride biochemical response**

Valentin Roque\(^a\), Maryam Jessop\(^b\), Luísa Pereira\(^c,b\), Patrick Begley\(^b\), Paul Gape\(^b\), Sabina Dizdarevic\(^b\), Eva Sousa\(^a,d\) and Elizabete Carolino\(^a\)

\(^a\)Lisbon School of Health Technology, Lisbon, Portugal, \(^b\)Nuclear Medicine, Department of imaging, Brighton and Sussex University Hospitals, NHS Trust, Brighton, United Kingdom, \(^c\)Nuclear Medicine Physics, Maidstone and Tunbridge Wells NHS Trust, Maidstone, United Kingdom and \(^d\)GF-MOSM, ADEM, ISEL—Grupo de Investigação em Modelação e Optimização de Sistemas Multifunçãoais, Lisbon, Portugal.

**Objective:** This work aims to assess whether the biochemical response of \(^{223}\)Ra-dichloride treatment can be predicted based on the pre-therapy bone scan, and consequently if bone scan index (BSI) and maximum lesion intensity have a place as alternatives or as complements to extent of bone disease (EOBD) scoring in predicting biochemical response to treatment. Many cases of advanced prostate cancer have evidence of bone metastasis. Accurate EOBD quantification could help predict the response to \(^{223}\)Ra-dichloride therapy. Current EOBD score is simple to use but does not consider size, intensity or localisation of lesion BSI might be more suitable for stratification of bone metastases.

**Patients and methods:** Bone scans \((n = 20)\) preceding \(^{223}\)Ra-dichloride treatment for prostate cancer were assessed using automated BSI software (EXINI) and by assessing maximum counts per lesion. Results were then compared to total alkaline phosphatase (ALP) as a measure of biochemical response to therapy using linear regressions and to their EOBD scores using box plot analysis.

**Results:** Moderate correlation was found between ALP response and maximum lesion intensity \((R = 0.41)\) and BSI \((R^2 = 0.46)\). Strong correlation \((R^2 = 0.71)\) was found between baseline ALP and BSI and between lesion number and BSI \((R^2 = 0.60)\). Visual assessment of EOBD score was found to correlate well with baseline ALP and maximum ALP response.

**Conclusion:** BSI is a useful asset in stratification of patients with metastatic bone disease. It may also have a place in prediction of biochemical response.

**49. A population pharmacokinetic model for \(^{131}\)I-NaI therapy after thyroidectomy in thyroid cancer patients**

Jan Taprogge\(^a,b\), Iain Murray\(^a,b\) and Glenn Flux\(^a,b\)

\(^a\)Joint Department of Physics, Royal Marsden Hospital NHSFT, Sutton, United Kingdom and \(^b\)The Institute of Cancer Research, London, United Kingdom.

Non-linear mixed effect modelling (NLME) is commonly employed to derive population pharmacokinetics (PK) properties. NLME comprises fixed effects that describe the population and random effects that incorporate inter-patient variability and uncertainties. Covariates (patient characteristics) can be added to partially explain variability. The aim of this study was to develop a population model for \(^{131}\)I-NaI in thyroid cancer patients following thyroidectomy.

A structural model comprising of blood, thyroid remnant and rest-of-body compartments was implemented in Monolix 2018R1 (Lixoft S AS, 2018). The model was populated with activity retention data (blood, thyroid remnant and whole-body) from 22 patients. Population rate constants and random effects were estimated. Covariates (sex, age, body weight) were added by forward selection/backward elimination. The method was validated by comparing rate constants to SAAM II v2.3.

Population rate constants of 0.0022 \(\pm\) 0.0004 and 0.47 \(\pm\) 0.08 h\(^{-1}\) were found from blood to thyroid remnant and vice versa. Weight significantly affected the rate constant from blood to the rest-of-body. Rate constant uncertainties ranged from 7–80%. Deviations between SAAMII and NLME rate constants were found to be <25%.

A population PK model for \(^{131}\)I-NaI in thyroid cancer patients was developed. The model will be expanded using data acquired as part of MEDIRAD, a multi-centre multi-national prospective study to determine absorbed doses to healthy organs and thyroid remnant of 100 patients. The model will be used to determine inter-patient variability and to correlate patient bio-kinetics to treatment outcome.

This project received funding from the Euratom research and training programme 2014-2018 under grant agreement No755523.

**50. The predictive accuracy of Iodine-123 NaI imaging for Iodine-131 NaI therapy of thyroid cancer**

Cameron Anderson\(^a\), Iain Murray\(^b\), Glenn Flux\(^b\) and Rebecca Gregory\(^c\)

\(^a\)St George’s University Hospitals NHS FT, London, United Kingdom, \(^b\)Joint Department of Physics, Royal Marsden NHS FT & The Institute of Cancer Research, London, United Kingdom and \(^c\)Bart’s Health NHS Trust, London, United Kingdom.

Studies have shown a higher rate of lesion detection in post-therapy Iodine-131 scans than predicted from pre-
therapy Iodine-123 imaging. This study aimed to quantify and compare the physical limits of detection for both Iodine-123 and Iodine-131 imaging to better understand the cause of this discrepancy.

A NEMA phantom was imaged with no spheres and the background filled with Iodine-131 and again with a cold background and spheres filled with Iodine-131. Over 12,000 planar phantom images were simulated by Poisson resampling and the combination of these component images to reproduce a clinically realistic range of lesion and background activity concentrations (following 5.5 GBq Iodine-131). The biological uptake (%) below which lesions were no longer visualised was then measured as the point at which the contrast-to-noise ratio dropped below five (the Rose criteria). This process was repeated with an Iodine-123 filled phantom assuming 370 MBq administrations.

The biological percentage uptake at which simulated lesions were no longer visible was on average 2.7 times lower in Iodine-131 scans (0.038%) than Iodine-123 scans (0.10%) at 24 h. This increased to a factor of 9.5 for imaging at 48 h, at 0.21% and 0.022% for Iodine-123 and Iodine-131 respectively. Imaging Iodine-131 at 7 days resulted in an average visible percentage uptake of 0.0055%, 18.4 times lower than I-123 at 24 h.

This novel phantom study has quantified the reduced detectability of lesions in Iodine-123 versus Iodine-131 imaging. This indicates that differing biological uptake cannot solely be responsible for discrepancies in lesion observability. Consideration of the differing imaging practices must be made.

51. Count-rate dependence of image uniformity for high count-rate I-131 imaging with ge gamma cameras

James Scuffham, Tom Sanderson, Nicholas Bates and Jill Weveret.

Purpose: In preparation for the SEL-I-METRY clinical trial, a GE Discovery 640 gamma camera was commissioned for high count-rate $^{131}$I imaging. This involved enabling the manufacturer’s ‘fast mode’, and acquiring a new uniformity calibration in this mode.

Methods: For the calibration, 60M counts were acquired using a 140 MBq point source of $^{131}$I positioned at a distance from the uncollimated detector, which gave a count-rate of approximately 20 kcps. The image uniformity, peak position and spectral resolution were assessed using combinations of seven different point sources to give activities ranging from 10 to 1240 MBq, yielding 26 different count-rates between 1.5 and 121 kcps.

Results: Image uniformity was found to have a strong dependence on count-rate, with a minimum value occurring at the same count-rate used for the calibration. The uniformity degraded rapidly for count-rates below and above that used for calibration, becoming clinically unacceptable (>3%) within about 10 kcps of the calibration count-rate. Peak position did not vary significantly with count-rate, but the spectral resolution degraded with increasing count-rate. After optimisation of the ‘fast mode’ configuration by the manufacturer and repeat uniformity calibration, the uniformity tests were repeated at 10 different count-rates ranging from 24 to 139 kcps. The optimisation was found to greatly reduce the count-rate dependence of the uniformity, but the CFOV integral uniformity still increased from 2.2% at 24 kcps to 4.3% at 139 kcps.

Conclusion: High count-rate imaging with GE gamma cameras requires individual optimisation and calibration; careful characterisation of the image uniformity is required if lesion dosimetry is to be performed.

52. Quantitative imaging of high activities of iodine-131 using fast mode and dead-time correction

Tom Sanderson, Matthew Aldridge, James Scuffham and John Dickson.

Purpose: In preparation for the SEL-I-METRY clinical trial, a GE Discovery 640 gamma camera was commissioned for high count-rate $^{131}$I imaging. This involved enabling the manufacturer’s ‘fast mode’, and acquiring a new uniformity calibration in this mode.

Methods: For the calibration, 60M counts were acquired using a 140 MBq point source of $^{131}$I positioned at a distance from the uncollimated detector, which gave a count-rate of approximately 20 kcps. The image uniformity, peak position and spectral resolution were assessed using combinations of seven different point sources to give activities ranging from 10 to 1240 MBq, yielding 26 different count-rates between 1.5 and 121 kcps.

Results: Image uniformity was found to have a strong dependence on count-rate, with a minimum value occurring at the same count-rate used for the calibration. The uniformity degraded rapidly for count-rates below and above that used for calibration, becoming clinically unacceptable (>3%) within about 10 kcps of the calibration count-rate. Peak position did not vary significantly with count-rate, but the spectral resolution degraded with increasing count-rate. After optimisation of the ‘fast mode’ configuration by the manufacturer and repeat uniformity calibration, the uniformity tests were repeated at 10 different count-rates ranging from 24 to 139 kcps. The optimisation was found to greatly reduce the count-rate dependence of the uniformity, but the CFOV integral uniformity still increased from 2.2% at 24 kcps to 4.3% at 139 kcps.

Conclusion: High count-rate imaging with GE gamma cameras requires individual optimisation and calibration; careful characterisation of the image uniformity is required if lesion dosimetry is to be performed.

Purpose: In preparation for the SEL-I-METRY clinical trial, a GE Discovery 640 gamma camera was commissioned for high count-rate $^{131}$I imaging. This involved enabling the manufacturer’s ‘fast mode’, and acquiring a new uniformity calibration in this mode.

Methods: For the calibration, 60M counts were acquired using a 140 MBq point source of $^{131}$I positioned at a distance from the uncollimated detector, which gave a count-rate of approximately 20 kcps. The image uniformity, peak position and spectral resolution were assessed using combinations of seven different point sources to give activities ranging from 10 to 1240 MBq, yielding 26 different count-rates between 1.5 and 121 kcps.

Results: Image uniformity was found to have a strong dependence on count-rate, with a minimum value occurring at the same count-rate used for the calibration. The uniformity degraded rapidly for count-rates below and above that used for calibration, becoming clinically unacceptable (>3%) within about 10 kcps of the calibration count-rate. Peak position did not vary significantly with count-rate, but the spectral resolution degraded with increasing count-rate. After optimisation of the ‘fast mode’ configuration by the manufacturer and repeat uniformity calibration, the uniformity tests were repeated at 10 different count-rates ranging from 24 to 139 kcps. The optimisation was found to greatly reduce the count-rate dependence of the uniformity, but the CFOV integral uniformity still increased from 2.2% at 24 kcps to 4.3% at 139 kcps.

Conclusion: High count-rate imaging with GE gamma cameras requires individual optimisation and calibration; careful characterisation of the image uniformity is required if lesion dosimetry is to be performed.
iodine-131 imaging at very high count rates, but increased image non-uniformities are observed.

53. DDose – A voxel dosimetry module for 3Dslicer
Dominic Rushforth, Iain Murray, Jan Taprogge and Glenn Flux
The Royal Marsden NHS Foundation Trust, London, United Kingdom

Purpose: Within our centre dosimetry is routinely performed using organ level dosimetry. Reporting of the mean dose may not adequately describe heterogeneous uptake. A voxel based dosimetry package was created to explore the potential for reporting doses using alternative metrics derived from 3D dose maps such as dose volume histograms.

Methods: A software module was written within an open source software platform for medical imaging, 3DSlicer. The module provides a simple automated workflow for performing dosimetry using multiple time point SPECT or PET scans. The scans are automatically registered using rigid and/or non-rigid techniques. Voxel doses are calculated using local deposition and displayed as iso-contours. Doses are determined for VOIs using both voxel and VOI level calculations. Uncertainties are calculated in line with the latest EANM guidelines (Gear JI et al., 2018. 45 (13):2456-2474. Eur J Nucl Med Mol Imaging).

Results: Preliminary results show that for Dotatate dosimetry B-Spline non-rigid registration increases reported doses by 7% and reduces reported uncertainties by 12%. Mannually defined and automatically generated masks were directly compared for the test cases in terms of their Dice score. In addition, the absolute positional shift between stress and rest scans was calculated for each mask.

Conclusion: This study demonstrates how machine learning can be used to accurately reproduce manual image processing steps, to increase efficiency.

55. The effect of acquisition and processing parameters on DaTSCAN semi-quantification
Joseph Burmiston⁴, Joseph O’Brien⁵, Alp Notghi⁶, Greg James⁶ and Bill Thomson⁶
⁴NHS Lothian, Edinburgh, United Kingdom and ⁵Sandwell and West Birmingham NHS Trust, Birmingham, United Kingdom

Aim: The specific binding ratio (SBR) is used by clinicians to improve the diagnostic accuracy of DaTSCAN reports. SBR can be affected by a range of acquisition and processing parameters. This study aims to quantify the effect of these parameters on SBR.

Methods: An RSD striatal head phantom was filled four times, giving baseline average SBRs of 3.71, 2.17, 1.82 and 0.88, mimicking normal and abnormal patients. The phantom was then imaged using different collimators (LEHR, ELEGP and MEGP) acquired at different radii (14, 18 and 22 cm). The data for these images was then reconstructed, altering the number of OSEM iterations and the filter settings. Attenuation and scatter corrections were also investigated. The SBR was obtained using DaTQUANT.

<table>
<thead>
<tr>
<th>Collimator</th>
<th>Distance</th>
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<tbody>
<tr>
<td>LEHR</td>
<td>14</td>
</tr>
<tr>
<td>ELEGP</td>
<td>18</td>
</tr>
<tr>
<td>MEGP</td>
<td>22</td>
</tr>
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Results: The table shows results for the 2.17 filling with similar results seen for other fillings. LEHR collimators...
are least affected by distance and should be used clinically as the SBR decreases significantly with distance for other collimators. Altering Butterworth filter settings changes the SBR by a maximum of 0.72 whereas the Gaussian maximum change is 1.47, therefore a Butterworth filter should be used. OSEM settings, scatter and attenuation correction also alter the SBR, and if used should be consistent for all the patients.

Conclusion: Different parameters have been shown to vary the SBR, which could affect the patient diagnosis. This work shows the importance of adherence to the recommended parameters for consistent results.

56. A multiple energy window QC method for single-session background SeHCAT studies
Matthew Memmott, Ian Armstrong, Andy Bradley, Kimberley Saint and Sarah Woods
Manchester University NHS Foundation Trust, Manchester, United Kingdom

For optimal scheduling, patient SeHCAT acquisitions can be performed sequentially with a sessional background acquisition taking place before and/or after the session. This relies on the background within the acquisition room remaining constant throughout the session. In departments with other high energy isotopes in use this may not always be the case due to down-scatter. This work aimed to develop a QC check to assure the background was consistent on a per patient basis.

54 acquisitions from patient SeHCAT studies had individual background measurements taken pre and post patient acquisition. Data were acquired using a standard 270 ± 73 keV and higher 480 ± 58 keV energy window. The relation between counts in both energy windows for patient images, after background subtraction, was derived. Background-only acquisitions were also acquired in the presence of patients undergoing FDG PET/CT studies. This data was used to simulate the presence of down-scatter contamination in the SeHCAT acquisition and therefore evaluate the sensitivity of the method.

A quadratic relationship (r > 0.93) was found between counts in the two energy windows. This relationship was used to predict an upper limit for the total counts expected in the upper window. Using simulated contaminated data, it was found that erroneous increases of more than 2 percentage points in retention values could be mitigated in the worst case.

Using a higher energy window can detect down-scatter contamination from higher energy isotopes when performing SeHCAT acquisitions, providing assurance when using a sessional rather than per-patient background acquisition.

57. Novel 18F-AVT-011 for in vivo imaging of chemotherapy effects and ATP-binding cassette (ABC) transporter mediated multidrug RResistance (MDR) in a breast cancer tumour model
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Purpose: A novel radiotracer 18F-AVT-011 (AVT-PET) images ABCB1 functions. The aim of this study was to address the hypothesis that AVT uptake in ABCB1 expressing tumour can be modulated by chemotherapy.

Methods: A cohort of 6 mice bearing orthotopic breast tumours (3 ABCB1 -basal/low and 3 ABCB1-high) was imaged with 18F-AVT-011 before and after a single dose of docetaxel (25 mg/kg, i.v.). Outcomes included: radiotracer distribution volume (V_T), tumour regrowth, and overall survival. Effect size was calculated using Cohen’s d, where d = (V_T, post - V_T, pre) / SD_pooled. Log-rank test was used to determine whether the difference between survival curves was significant.

Results: V_T values of the basal group before and after docetaxel treatment, respectively, were 0.55 ± 0.15 and 0.41 ± 0.08, resulting in an effect size of 1.16. In contrast, V_T values of the ABCB1-high group before and after docetaxel treatment, respectively, were 0.32 ± 0.11 and 0.30 ± 0.14, resulting in an effect size of 0.16. Following docetaxel treatment, tumor regrowth occurred faster within 3–6 days in the ABCB1-high group versus 6–12 days in the ABCB1-basal group. Survival curves were significantly shorter in the high versus basal ABCB1 expressing group (P = 0.0295).

Conclusion: Poorer outcomes in the high expressing ABCB1 sub-group were observed. However, given the effect sizes in V_T, > 9 mice/group would be needed to determine whether the change in the tracer uptake after docetaxel administration was due to pharmacological in vico modulation of ABC/ MDR proteins. A larger longitudinal study could be beneficial in the future to monitor MDR.
58. Evolving role of fluorine-18-fluorodeoxyglucose (FDG)-PET/CT in imaging of transitional cell carcinoma (TCC) of the bladder
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Aim: Aim of this study was to assess the value of FDG PET/CT in the evaluation of TCC bladder across our cancer network.

Methods: A retrospective large cohort study of patients who underwent FDG PET/CT over 5 years was performed. Imaging findings were correlated with prior CT and/or MRI in all patients.

Results: One hundred seven patients with TCC bladder were identified: 27 (25%) patients for initial staging, 28 (26%) for recurrence, 50 (47%) for other lesions characterisation (45 lung, 2 adrenal, 2 mediastinal, 1 bone) and 1 each for vasculitis and response to treatment.

Compared to CT/MRI, PET/CT up-staged 38 (36%), down-staged 39 (36%) and was concordant in the remaining 30 (28%) patients.

Staging: Compared to CT/MRI, PET/CT confirmed local and distant disease in 12/27 (45%), up-staged 6/27 (22%) and down-staged 9/27 (33%) patients.

Recurrence: PET/CT confirmed disease in 7/28 (25%), up-staged 9/28 (32%) with an unsuspected finding of prostate cancer and down-staged 12/28 (43%) patients.

Lung lesions: PET/CT was concordant in 10/45 (22%), up-staged 18/45 (40%) and down-staged 17/45 (38%) patients.

Miscellaneous (adrenal, mediastinal, bone, vasculitis, treatment response): PET/CT upstaged 5/7 patients with a significant unsuspected finding of a sigmoid cancer, down-staged 1 patient and was concordant in 1.

Conclusion: FDG PET/CT has an evolving role in the imaging of bladder cancer as a problem-solving tool in the management of this tumour beyond the PET/CT UK guidelines (2016) indication of staging prior to radical treatment. Prospective multicenter trials are required to establish its full role.

59. Evaluation of bayesian penalised likelihood reconstruction algorithm for 68Ga-PSMA PET/CT
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Introduction: Bayesian penalised likelihood (BPL) reconstruction (Q.Clear, GE Healthcare) improves image quality in 18F-FDG PET/CT studies. This investigation determines whether BPL can improve 68Ga-PSMA PET/CT studies, and the optimal noise reduction penalty factor (β) that should be used.

Methods: Using 68Ga NEMA phantom data, signal-to-noise ratios (SNR) and contrast recovery (CR) of BPL reconstructions with β values between 100–4000 were compared to OSEM with Time of Flight (ToF) reconstruction. This identified an optimal β range that gave improved CR and SNR compared to OSEM-ToF data. Further optimisation was then completed using 10 clinical 68Ga-PSMA PET/CT scans reconstructed using BPL with various β values within the identified range. Clinical BPL and OSEM-ToF data was presented to 2 observers blinded to the reconstruction method and scored in terms of, lesion detectability, noise level and overall image quality using a five point scale (1 = worst to 5 = best).

Results: Improved image quality was found with BPL compared to OSEM-ToF with β800-1000 as the preferred values. Median score for noise showed a preference for β800-1000 and lesion detectability median score showed β800–900 were preferred. The results show there are minimal differences in image quality between β800–1000 and ultimately the β value used within this range is dependent on observer’s individual preferences but β900 gives an optimal trade-off between noise and contrast.

Conclusion: BPL improves image quality for 68Ga-PSMA PET/CT compared to OSEM-ToF with preference for β values in the range β800-1000 with an optimal β value of 900.

60. Comparison of 68Ga-PSMA-PET/CT with conventional imaging for initial staging of prostate cancer
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Purpose: Although 68Ga-PSMA is more sensitive in disease detection than conventional imaging methods, the impact on staging has not been well described. In this study, we aimed to assess the change in nodal and metastatic staging of patients with primary prostate cancer who had 68Ga-PSMA-PET/CT compared with conventional imaging.

Methods: Seventy-four patients with histopathology proven prostate cancer underwent staging with conventional imaging (MRI, bone scan +/- CT) and were referred to our department for further staging assessment with 68Ga-PSMA-PET/CT between July 2015 and April 2018.

Results: 68Ga-PSMA-PET/CT findings were concordant with conventional imaging in 35/74 patients (47%). 68Ga-PSMA-PET/CT upstaged 16/74 (22%) with nodal upstaging in 9 (N0...
to N1 or M1a) and osseous metastatic upstaging in 6 (M0 to M1b). In 31% (23/74) of patients, 68Ga-PSMA-PET/CT confirmed or excluded equivocal findings on conventional imaging. In 22 patients with abnormal bone scan findings, 20 were found to be negative for metastatic disease and in 2, disease was confirmed. In one patient with an equivocal lymph node with normal morphology on MRI, 68Ga-PSMA-PET/CT identified nodal disease involvement.

Conclusion: 68Ga-PSMA-PET/CT changes the staging in 22% of patients with newly diagnosed prostate cancer and also plays a significant role in the investigation of equivocal findings on conventional imaging.

61. Impact of 68Ga-PSMA-PET/CT on the management of patients with newly diagnosed prostate cancer

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Purpose: 68Ga-PSMA-PET/CT has a major impact on the management of patients with biochemical recurrence, however, the influence on treatment decisions in the setting of primary staging is less well known. In this study, we aimed to assess the change of intended management plans in patients with prostate cancer who had 68Ga-PSMA-PET/CT for primary staging.

Methods: Retrospective analysis was performed on 112 patients who were referred to our department for staging assessment with 68Ga-PSMA-PET/CT between July 2015 and May 2018. Management plans pre- and post-PSMA were documented by a Uro-oncologist.

Results: 68Ga-PSMA PET/CT led to a change in management in 30/112 patients (27%). Management changed from radical options (prostatectomy, radiotherapy) to systemic treatment (androgen deprivation therapy +/- chemotherapy) in 11 patients, due to unexpected lymphadenopathy or metastases on 68Ga-PSMA PET/CT. Conversely, management changed from systemic to radical options in 13 patients, due to exclusion of suspicious findings in conventional imaging. In 6/112 patients, 68Ga-PSMA-PET/CT scan directed choice of treatment within the existing radical therapeutic options or changed the extent of radiotherapy field.

Conclusion: 68Ga-PSMA-PET/CT changes the management in 27% of patients with newly diagnosed prostate cancer and therefore has the potential to offer a more personalised approach to patient care in selected cases.

62. Absolute PSA value and PSA doubling time: Should we insist on both before performing PSMA scans?

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One of the challenges faced when accepting patients for PSMA scans (PSMA-PET) is the adequacy of clinical information. Although we ask for PSA values including absolute PSA value, PSA velocity and PSA doubling time (PSADT) we usually are only given absolute PSA values with little additional information.

A retrospective analysis of the records and scans of 80 patients referred for PSMA-PET was done to test the premise that PSADT is crucial for patient referral and acceptance.

The median age of patients was 68 (47–84) years. PSADT data was provided for only 27 (34%) of cases. Abnormal scans were detected in 61 (76%) patients; 44 (55%) patients with metastatic disease (lymph nodes, bones, visceral) and 15 (19%) patients with only localized disease.

PSMA-PET was positive in 10 cases (13%) for whom the PSADT was given and 25 (31%) of cases for whom PSADT was not truly clarified.

The median PSA was 3.45 ng/dl (0.03–29 ng/dl). The median PSA when the PSADT was known was 3.11 ng/dl with a range from 0.03–16.9 ng/dl. The lowest PSA value at which a PSMA-PET was positive was 0.03 ng/dl.

Scans were positive in 5% (4), 3% (2) and 6% (5) of patients with PSADT ≤2, >2–6 and >6 months, respectively. The highest PSADT value at which a PSMA-PET was positive was 60 months.

While it is desirable to have as much clinical information as possible, including PSA doubling time (in addition to absolute PSA values) for referral for PSMA-PET, our review has shown that it may not be essential.

BNMS STUDENT PRIZE 1ST PLACE:

63. Bayesian penalised likelihood (Q-clear) reconstruction of 68Ga-THP-PSMA PET/CT in prostate cancer: A comparison with standard image reconstruction methods

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Purpose: 68Ga-PSMA-PET/CT imaging has become standard of care in patients with biochemical recurrence or staging high-risk prostate cancer. However, images reconstructed with conventional iterative methods, e.g. ordered subset expectation maximisation (OSEM) are prone to noise and scatter artefacts due to high urinary clearance of the tracer and limited activity of 68Ga available at injection. We aimed to compare Q-clear, a Bayesian penalised likelihood (BPL) reconstruction algorithm, quantitatively and qualitatively, at different penalisation factors (β), with time-of-flight OSEM reconstruction (VPFX).
Methods and materials: 25 $^{68}$Ga-THP-PSMA scans (112–181 MBq, mean 164 MBq) were reconstructed with VPFX, and Q-clear using β-values of 200, 400, 800, 1000 and 1200. SUV$_{\text{mean}}$, SUV$_{\text{max}}$ and SUV$_{\text{dev}}$ (standard deviation, noise) were measured for malignant lesions and reference organs (liver, spleen, bone marrow, blood pool). Lesion and organ signal-to-noise ratios (SNR) and lesion signal-to-background ratios (SBR) were measured. Two PET specialists scored scans blindly for image quality (1–5) as well as presence and severity of artefacts.

Results: BPL lesion SUV$_{\text{max}}$ was greater than VPFX for β200–800, SUV$_{\text{mean}}$ for β200, SUV$_{\text{dev}}$ for β200–400, SNR for all β ≥ 400 and SBR for β200–800 (all P < 0.05). Similar patterns were seen for blood pool and organ values. Qualitative analysis showed a preference for β800 with fewer artefacts.

Conclusion: BPL reconstruction of $^{68}$Ga-THP-PSMA PET data in patients with prostate cancer improves SNR in lesions and normal organs and increases SUV$_{\text{max}}$ and SBR in prostatic and metastatic lesions. Combining these results with the preferred image quality, we will henceforth use β800 BPL reconstruction for clinical scans.

64. The role of F-18-choline PET/CT in prostate cancer patients staging

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Introduction: The aim of this study was to evaluate the value of F-18 choline PET/CT in the initial staging of high-risk prostate cancer patients.

Subjects and methods: Hundred consecutive biopsy-confirmed prostate cancer patients were scanned with F-18-choline PET/CT from February 2012 to April 2018. Mean PSA value at referral was 48.4 ng/ml (range 4.3 to 280.6 ng/ml). Functional imaging was proposed in high-risk patients after equivocal conventional imaging and bone scintigraphy findings. Imaging was performed after administration of F-18 choline (2–3 MBq/kg, mean 209 MBq). All patients had a minimum 6-month follow-up.

Results: There were 24 patients without metastases, while the majority of patients (76%) had a choline scan positive for metastatic disease. Eight patients had a single positive pelvic lymph node, with a short axis diameter shorter than 1 cm. 56 patients had FCH positive metastatic disease in lymph nodes only (mean SUV 6.4), 25 in lymph nodes and/or skeleton (mean SUV 10.7). In sixteen patients seminal vesicles' infiltration was found. Majority of our patient population had a combination of radiotherapy and hormonal therapy, with the mean PSA levels after six months significantly lower (2.1 ng/ml).

Conclusion: F-18-choline PET/CT provides clinicians with valuable information in the staging of high-risk prostate cancer. It has an important impact on therapeutic strategy, providing additional data necessary for the appropriate and individual patient management.

65. Comparison of data-driven and device-based respiratory gating in clinical PET/CT

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Purpose & background: Respiratory motion leads to blurring of PET images and can reduce image quality and quantification accuracy. We aim to assess the clinical impact of applying a commercial, data-driven respiratory gating solution for PET/CT (MotionFree; GE Healthcare).

Methods: One hundred and forty nine FDG PET/CT studies have been included in the study to date. An experienced radiologist is currently performing a blinded, four-way comparison of clinical image quality. Data-driven respiratory gated PET/CT images with quiescent period gating, obtained on a Discovery 690 or 710 PET/CT scanner (GE Healthcare), are compared with device-driven respiratory gated images obtained using the Real-Time Position Management system (RPM; Varian), alongside ungated images using a matched (i.e. reduced) number of counts, and ungated images using the full dataset. Images are being scored in terms of clinical image quality and the presence of motion artefacts.

Results: All 149 scans were successfully processed with the DDG respiratory gating algorithm. In 19 cases (13%) the RPM system did not provide a usable gating signal. An initial, interim analysis found equivalence in image quality between data-driven and device-driven respiratory gated images. Image quality was clinically acceptable in all cases. Analysis of the complete dataset is in progress.

Conclusion: These initial data suggest that data-driven respiratory gating may be equivalent, in terms of clinical image quality, to device-driven gating. Data-driven respiratory gating does not appear to suffer from the reliability issues that affect our current device-driven respiratory gating system.

66. An audit of inconclusive VQ:SPECT/CTPA’s who went on to have a second imaging investigation for the investigation of PE

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VQ-SPECT is a valid method for the definitive investigation of pulmonary embolism. It is performed as a first choice in pregnant patients, those with renal insufficiency and low GFR. BTS guidelines define CTPA as the primary investigation for all other patients.

Methods: We retrospectively reviewed inconclusive imaging studies which went on to have a second investigation in our institution for the diagnosis of PE, over a one year period between 2017 and 2018 November. A total of 1996 CTPA and 661 VQ scans were performed. Of these, 44 patients had both CTPA and VQ scans, as the first study was inconclusive. 15/44 had inconclusive VQ-SPECT and 29/44 had inconclusive CTPA as the first investigation.

Results: 15/661 inconclusive VQ-SPECT’s (2.27%) went on to have CTPA as the second investigation. The subsequent CTPA, was positive for PE in 2/15 whereas it remained inconclusive in another 2/15.

29/1996 CTPAs were inconclusive (1.45%). The reason for the inconclusive CTPA was inadequate opacification in 20/29 and motion artefact due to respiration (4/20). VQ scan was conclusive in all of these patients, showing PE in only 1 patient.

Conclusion: The number of inconclusive VQ-SPECTs needing a second investigation in our teaching institution is low (2.27%), which compares well with the indeterminate results seen with CTPA. For VQ scan, in our institution we perform dual isotope SPECT imaging using krypton gas for ventilation. This may account for the low number of indeterminate VQ scans.

67. Is there an optimum time for sentinel node injections

Conclusions from an assessment of a two day sentinel node injection protocol in breast cancer patients

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Purpose of study: Due to service reconfiguration in 2017, breast cancer patients at Ashford and St Peters Hospitals undergo radionuclide sentinel lymph node injection and imaging at the Royal Surrey County Hospital the day prior to surgery. We looked for a correlation between decay corrected activity and the number of sentinel lymph nodes (SLNs) at surgery to see if there was an optimal time delay between injection and surgery.

Methods used: Retrospective data for all women undergoing breast surgery and SLN procedures at CENTRE 1 between 06 July 2017 and 05 July 2018 (demographics, date, time, activity and injected volume, imaging findings, surgical date and times, Neoprobe® counts, SLNs and OSNA results).

Summary of results: 65 ladies (median age 57 years; median BMI 25.6) were included. Median injected activity was 39.9 MBq in a median volume of 0.17 ml. At least 1 sentinel node in all patients on imaging. Median interval to surgery was 23.33 h (range 10 to 30.85 h) with median decay corrected activity of 33.78 MBq. A median of 2 sentinel lymph nodes (range 1–7) were detected by probe at surgery with 8 additional ‘cold’ nodes localised by blue dye. There was no statistical correlation between time interval, number of SLNs detected ($R^2 = 0.018$) and Neoprobe® counts.

Conclusion: This study did not show an optimal time delay in terms of number of nodes detected or count rates, but that there may be other considerations such as surgical duration and ‘ease of localisation’. This will be the subject of future work.

68. Does $^{99m}$Tc-MAA SPECT/CT have a role in evaluation of lung lobar perfusion in patients with chronic obstructive airway disease (COPD) prior to lung volume reduction surgery (LVRS)

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Purpose: COPD patients are referred for lung perfusion imaging to quantify lobar perfusion prior to lung volume reduction surgery (LVRS). Traditionally planar imaging is performed and lobar quantification is calculated on anterior/posterior images by dividing the lungs into three equal size ROIs. As this method does not correctly represent the size and shape of the lung lobes it is proposed that SPECT/CT would provide more accurate results of lobar perfusion.

Methods: Patients referred for lung perfusion imaging with $^{99m}$Tc-MAA underwent both planar and SPECT imaging. Diagnostic CT images were registered with reconstructed SPECT data and used for segmentation of lung lobes using Hemes Lung Lobe Quantification software to determine lobar perfusion. Planar perfusion quantification was performed by dividing each lung into three equal size ROIs. Where available, lung function test results were also collected.

Results: Within a 6 month period 74 patients were evaluated (43 male, 31 female), mean age 65 (range 37–82). Perfusion contributions between left and right lung correlated well between planar and SPECT imaging with no significant difference found. Lobar perfusion results from planar and SPECT methods differed by an average of 11% (range 0–35%), which was statistically significantly different ($P<0.05$), and in some cases indicated a different target lobe for LVRS.

Conclusion: SPECT/CT for lung perfusion provides more anatomically correct delineation of lung lobes, leading to
potentially more accurate lobar quantification results. This technique could have a significant impact on LVRS planning and critically, prevent mis-targeting a lobe that makes significant contribution to lung function.

69. Audit of current practice of gastric Emptying scintigraphy at East Kent Hospitals and its impact on management
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Background: Gastric emptying scintigraphy (GES) is the ‘gold standard’ test for assessing the functionality of the stomach and has been used to investigate patients presenting with a wide variety of gastrointestinal symptoms, likely secondary to impaired function.

Methods: Data was collected retrospectively (using PACS and Patient Centre), to include all GES conducted over two years (2015-17) rendering a sample size of 70 studies. Two patients were excluded on account of suboptimal studies. Indications for GES were compared to the outcome and comparisons were made with expected results.

Results: Referrals were made after patients had multiple non-conclusive investigations conducted to assess non-specific symptoms, of which 74% had nausea and vomiting and 35% had generalised abdominal discomfort. 75% of patients with gastric surgery had fast emptying in comparison to type 1 diabetics, of whom 71% had delayed emptying. 100% of individuals with inflammatory bowel disease had rapid emptying and the patients with a background of GORD had equivocal results.

Conclusion: Gastric emptying scintigraphy (GES) has an important role in aiding clinicians identify the root of non-specific upper gastrointestinal symptoms and consequently, aid in offering appropriate interventions; pharmacological or otherwise. Therefore, it has the potential to help managing symptoms and chronic conditions appropriately.

70. Gastric Emptying: Does gender, age or body habitus affect stomach function?
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Aim: We have recently established gastric emptying normal ranges for two meals (scrambled egg sandwich and porridge) following a UK nationwide audit. The aim of this study is to establish whether different normal ranges are required for gender, age or body habitus.

Methods: 42 healthy volunteers (20 males, 22 females, age range 22–68) were studied. Each volunteer consumed two meals with similar nutritional composition on two separate days: gluten-free porridge and scrambled eggs with 2 slices of bread. Anterior-posterior images were acquired with the patient standing between the detectors. Images were acquired every 5 min over a two-hour period, followed by a single image at 3-hours. Two-sample t-tests were used to assess any gender related differences in gastric emptying. Regression analysis was used to assess correlation of gastric emptying with age and body habitus (BSA).

Results: Overall, females showed slower gastric emptying than males although statistical significance was only found for exponential half-life and 3-hour retention for the scrambled egg meal ($P=0.023$ and $P=0.007$ respectively). Gastric emptying generally became faster with age and body habitus although statistical significance was only found for the half-emptying time for the porridge meal ($P=0.022$).

Conclusion: With the exception of only a few functional parameters, statistical analysis generally showed weak significance for the effect of gender, age or body habitus on gastric emptying. There is not enough evidence to use normal ranges that are specific to gender, age or body habitus although consideration of such demographic factors may be useful in borderline cases.

71. Can $^{18}$FFDG PET/CT replace $^{99m}$Tc-MDP bone scans and radiolabeled white blood cell scans in the evaluation of orthopaedic implant infections?
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Introduction: Evaluating post-surgical orthopaedic implant related pain remains challenging; discerning inflammation from infection relies on clinical suspicion, supported by blood markers and imaging. $^{18}$F]FDG PET/CT allows more accurate delineation of possible osteomyelitis. Here, we explore the role of one stop-shop $^{18}$F] FDG PET CT in the diagnosis of patients with possible chronic osteomyelitis related to implants and include a follow-up interval clinical assessment.

Methods: Review of all PET/CTs undertaken for the diagnosis of peri-prosthetic infections between June 2012 and June 2015. Scan usefulness was interpreted in the clinical context of decision to treat surgically; microbiological evidence where available and clinical follow-up for at least 24 months.

Results: 150 patients were included in the study. There were 98 men (65.3%) and the cohort median age at time of PET/CT was 51 years (range 19–88). 125 scans indicated infection (110 osteomyelitis and 15 soft tissue). Of these
72. Is the 50% gastric Emptying time enough to characterise gastric motor function?

Peter Hay, Maura Corsetti, Emily Tucker, Mark Fox and Alan Perkins

Introduction: At Nottingham, a procedure for assessing gastric function has been developed that uses a large volume (400ml) calorific drink with validated reference ranges for the 50% emptying time \( T_{50} \): % of the drink remaining in the stomach at the time of first imaging, \( V_0 \), a marker of early phase emptying that is thought to reflect the gastric fundal accommodation; and the rate of emptying at \( T_{50} \), \( R[T_{50}] \), a marker of late phase emptying influenced by duodenal feedback. Our objective was to evaluate what determines a normal and abnormal \( T_{50} \) from consecutive patients referred with possible gastric dysfunction.

Methods: A review was undertaken of 308 patients, referred for the gastric emptying test at Nottingham between April 2014 and June 2018, because of suspected gastric motor dysfunction.

Results: 117 studies had a normal \( T_{50} \). 136 showed an abnormally slow \( T_{50} \) and 55 an abnormally fast \( T_{50} \) (38%, 44% and 18% respectively).

69% of those patients with a normal \( T_{50} \) exhibited either abnormal early or late phase emptying (25% fast/slow, 26% fast/normal, 9% slow/normal, 9% normal/slow). The remaining 31% showed normal gastric motor function.

Conclusion: \( T_{50} \) is the most commonly reported, and sometimes the only, quantitative parameter derived from gastric emptying studies in the UK. Our data suggest that the additional evaluation of the early and late phase of gastric emptying would help reveal gastric motor dysfunction in patients with normal \( T_{50} \). This may provide additional information of value in the characterisation of functional dyspepsia.

73. Patient and public involvement (PPI) in a clinical trial to investigate diagnostic dosimetry

Martin Lee, Martin Murray, Jonathan Gear, Ana Ribeiro, Carla Abreu, Francesca Leck, Rebecca Gregory, Jerry MacNeil, Yvonne Fox-Millar and Glenn Flux

Introduction: The increasing awareness and inclusion of patient and public involvement (PPI) in research studies is leading to greater public understanding of the medical use of radiation and can provide an objective view of the feasibility, importance and public perception of a project proposal. PPI has been embedded into a Department of Health (DH) project to investigate the simplification of low level internal dosimetry (SOLLID) to study the effects of low dose radiation from diagnostic dosimetry.

Methods: PPI was incorporated into each stage of the study. This included input to project design with respect to practicality, organisation of a patient forum to canvas a range of views, costings for patients recruited to the study, drafting a patient questionnaire, performing a ‘dry run’ of an SOP scanning procedure and potential recruitment issues and patient communication to assist recruitment and patient feedback. Study progress is reviewed monthly by a management team including PPI.

Results: The strong involvement of PPI helped achieve a successful funding application and subsequent approval from ethics with minimal modifications. Detailed consideration of the procedure enabled successful imaging of the first patient recruited, despite the number of scans required. Patient communication included the Patient Information Sheet (PIS), the questionnaire and direct discussion to obtain patient feedback.

Conclusion: Patient and Public Involvement has had a positive impact to the research study at each stage. Next steps will be to support further communication of the medical use of radioisotopes to patients and the public.
**Introduction/Purpose:** Diuretic renography is cardinal for assessing drainage, by reviewing sequential images, curves and quantification, as renal output efficiency (OE).

As a regional urology center, drainage assessment is a common clinical problem, leading us to follow F-15 protocol and calculate OE since 2002.

Due to paucity of literature with regards to F-15 standardized curves and OE ranges, our aim was to provide more objective analysis by providing such curves and values.

**Methods:** Retrospective analysis of 166 F-15 MAG3 renal scintigraphy examinations was performed. Curve shapes and OEs taken between 27 to 33 min were collected and correlated.

To derive standard curves, we used the raw data to plot all the curves on the same graph.

The curves were visually divided into normal, equivocal and obstructed, and OE ranges were then derived in relation to them. The number of interrupted studies was noted.

**Results:** On plotting, three distinct curve shapes were found.

- OE correlation with renograms:
  1. normal curves: mean OE = 93 ± 12 (89–97%)
  2. obstructive curves: mean OE = 53 ± 18 (20–80%)
  3. equivocal curves: mean OE = 76.1 ± 8% (47–90%)

8.9% of studies were interrupted for micturition and conjoined studies with valid renogram curves and OE values were developed.

**Conclusion:** Although not widely used, F-15 has the advantage of optimizing diuretic effect at time of isotope injection. We have demonstrated three curve categories and OE values < 60%, 75-80% and > 90% to suggest clear obstruction, equivocal and normal drainage respectively. The gaps in between are overlapping areas, and require further correlations.

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**75. FDG uptake in primary tonsillar malignancy: Variation in HPV positive and negative lesions**

Teresa Szyszko, Kenneth Courtney, Joel Dunn, Neshle Sriiskandaa, Mary Leib, Richard Oakley, Jean-Pierre Jeannon, Selvam Thavaraj, Ata Siddiqui and Steve Connor

**KCL and GSST PET Centre, London, United Kingdom, GSGT NHS Trust, London, United Kingdom and KCL, London, United Kingdom**

Aim/purpose: The purpose of this audit was to determine if there was a difference in FDG uptake in histologically proven human papillomavirus (HPV) positive and negative tonsillar lesions and to assess uptake in associated lymph nodes.

**Methods:** We retrospectively looked at FDG PET/CT scans performed 2017-18 in which the histology showed a primary tonsillar squamous cell malignancy at staging ($n = 33$ scans). We measured the $SUV_{max}$ using a region of interest (ROI) at the site of the primary lesion using HERMES software and checked the HPV status on the histology record on the electronic patient record. We also measured $SUV_{max}$ in the hottest associated cervical lymph node.

**Results:** The mean $SUV_{max}$ in HPV positive lesions ($n = 20$) was 10.0 ($± 4.2$ SD). The mean $SUV_{max}$ in HPV negative lesions ($n = 13$) was 9.8 ($± 5.5$ SD). The mean $SUV_{max}$ in cervical nodes in the HPV positive group ($n = 18$) was 12.2 ($± 6.7$ SD) and in the HPV negative group ($n = 11$) was 10.4 ($± 3.7$ SD). Independent samples median test provided non-significant p-values of 0.57 and 0.45 for tonsillar and lymph uptakes respectively.

**Conclusion:** HPV positive lesions have overall very slightly higher uptake in the primary lesion and cervical nodes than HPV negative lesions, however, this is not a significant difference.
compared with 45% at the MTV30 threshold. There was excellent inter-observer agreement between MTV30 to MTV40 [ICC ranged from 0.898–0.976 with narrow 95% confidence intervals (CIs)] and moderate agreement at lower thresholds (ICC estimates of 0.534 & 0.617, respectively for the MTV20 and MTV25 with wide 95% CIs). Bladder masking was performed in 86% of cases overall, mainly at lower thresholds.

Conclusion: The MTV30 threshold closely correlated with the MRI volume and provided excellent inter-observer agreement. Bladder masking prior to auto-contouring enabled measurement at lower SUV thresholds without inadvertent bladder activity inclusion.

77. Influence of histopathological type of primary tumor on 18F-FDG PET/CT parameters assessed in cervical cancer patients
Paulina Cegla, Ewa Burchardt, Andrzej Roszak and Witold Cholewinski
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Aim: The aim of this study was to assess the influence of histopathological type of primary tumor on 18F-FDG PET/CT parameters in cervical cancer patients.

Material & methods: Analysis was performed on a group of 200 patients with newly diagnosed cervical cancer admitted to the Department of Radiotherapy and Gynaecological Oncology between May 2012 and December 2014. Acquisition was performed on a Gemini TF PET/CT scanner 60 min after injection of 370±75 MBq of 18F-FDG. PET biological parameters in primary tumor (SUVmax, SUVmean, VOL and TLG) were assessed. For statistical analysis the Wilcoxon-Mann-Whitney and T-Test were used.

Results: Based on severity of the disease patients were divided into 3 groups: 1st with disease limited only to cervix (35%), 2nd with disease limited to the cervix and regional lymph nodes (34%) and 3rd with disseminated disease (31%). Statistically significant differences were found in 1st group between: neuroendocrine cancer and adenocarcinoma in SUVmax (8.6±7.8 vs. 8.1±3.6; P<0.001), keratinizing SCC and adenocarcinoma in SUVmax (11.6±3.9 vs. 8.1±3.6; P=0.04), keratinizing SCC and planepithelial cancer in SUVmax (11.6±3.9 vs. 9.4±3.6; P=0.03), non-keratinizing SCC and planepithelial cancer in SUVmax (13.3±7.3 vs. 9.4±3.4; P=0.007) and SUVmean (7.5±4.8 vs. 5.4±2.0; P=0.004). In 2nd group significant differences were shown between adenocarcinoma and solid cancer in TLG values (216.30±146.84 vs. 386.23±90.88; P=0.02). In 3rd group significant differences were shown only between non-keratinizing SCC and adenocarcinoma in SUVmax (12.5±5.7 vs. 17.0±8.5; P=0.04).

Conclusion: Histopathological type of primary tumor has a significant influence on 18F-FDG PET/CT biological parameters assessed in cervical cancer patients and the biggest impact is noticed on SUVmax values.

78. 18F FDG PET/CT in the assessment and follow up of stage III and IV of melanoma
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Aim: The role of 18F FDG PET/CT in staging and follow up of patients with melanoma is not fully established and frequency of PET/CT follow up varies according to local practices. This retrospective audit looked at the number of 18F FDG PET/CT studies performed for melanoma in our practice at staging and to review frequency of PET/CT imaging follow up.

Methods: Using RIS, PACS and EPR we reviewed 18F FDG PET/CT studies performed between January and March 2017 for melanoma. Assessment of findings of these studies included presence or absence of recurrent disease; response to treatment and incidental findings. We evaluated patients in this cohort reviewing original diagnosis, stage of disease as well as how many previous studies these patients had undergone.

Results: A total of 126 patients underwent 18F FDG PET/CT for melanoma. Mean age 64.6 years old (range 28–91) with a male: female ratio 72:54 of which n=104 had half body studies. All patients initially or subsequently diagnosed with stage III or IV melanoma. Mean 18F FDG dose was 331MBq. 55% of studies showed no evidence of FDG avid recurrent disease. One patient had 29 PET/CTs in a 10 year period with total dose of 18F FDG approaching 8500 MBq.

Conclusion: Our results suggest revisiting the interval between follow up scans to avoid unnecessary radiation exposure but to capture disease recurrence in high risk patients in a timely fashion.

79. An 11-year analysis of head and neck melanomas following Sentinel lymph node biopsy
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Purpose: A long-term follow-up analysis of head and neck melanoma (HNM) patients undergoing sentinel lymph
node biopsy (SLNB), their outcomes, looking specifically at differences between mapping performed the day before, or of surgery.

**Methods:** A retrospective study of all patients undergoing SLNB for HNM from 25/10/2006 - 27/12/2017, in a regional Plastic Surgery Unit in Merseyside, was performed.

**Results:** Total of 213 patients underwent SLN mapping for HNM within the study period [62% (n = 132) male and 32% (n = 81) female], 4.7% (n = 10) of patients, the Breslow Thickness (BT) was < 1 mm; 45.1% (n = 96) had 1-2 mm; 32.9% (n = 70) had 2.1-4 mm; 16% (n = 34) had > 4 mm; and in 1.4% (n = 3) of patients the BT was not recorded.

23% of patients (n = 49) were mapped the day before surgery, and 77% (n = 164) on the same day. Analysis of the number of mapped versus retrieved nodes revealed no overall differences in these groups (24% vs. 27%), respectively. 8.5% (n = 18) of patients had a positive SLNB. 89% (n = 16) subsequently underwent complete lymph node dissection (CLND) and 11% (n = 2) declined. In 88.9% of patients (n = 189) the SLN was negative with false positive rate of 9.5%. The mortality rate was 14% (n = 30).

**Conclusion:** We found no differences when patients were mapped prior to surgery, for logistics, in comparison with those mapped on the same day and therefore conclude that this is safe and reliable practice. The majority of discrepancies were due to difficulties in mapping and procedures being abandoned intra-operatively, due to risk to key structures, i.e. the facial nerve.

80. Clinical utility of routine lower limb imaging in FDG PET/CT scanning of multiple myeloma (MM)

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**Aim:** Whole body techniques are the cornerstone of radiological evaluation of multiple myeloma (MM). The International Myeloma Working Group (IMWG) recommends a field of view (FoV) that includes the skull, upper limbs and femurs for FDG PET/CT examinations. At our centre we follow the British Society of Haematology (BSH) guidelines, which recommend a FoV from vertex to toes. Our aim is to evaluate the clinical utility of routine lower limb imaging in patients with MM and related plasma cell dyscrasias (PCD).

**Methods:** A single experienced PET reporter reviewed consecutive FDG PET/CT examinations and clinical reports performed for suspected/proven PCD between December 2016 – December 2017. Studies were classified according to scan indication and distribution of disease on PET and/or CT with respect to lower limb and in particular lower leg (below the knees) disease. The inferior extent of disease in the femurs was documented.

**Results:** 171 scans were reviewed of which 103 (60.2%) were positive for myeloma defining disease. 56 out of 171 scans (32.7%) demonstrated lower limb disease. 12 scans (7.0%) demonstrated disease in the lower legs. There were no cases demonstrating isolated lower leg disease. The mean distance of the inferior most femoral deposit from superior femoral head cortex was 22.3 cm, median 21 cm with a range of 2–43 cm.

**Conclusion:** All scans with positive findings on FDG PET/CT were visible in a vertex to distal femur acquisition. This supports the omission of routine lower leg acquisition for FDG PET/CT examinations.

81. Diagnostic performance of different 18F-FDG PET/CT parameters for assessment of nodal involvement in non-small cell lung cancer

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**Objectives:** Regional lymph node involvement in non-small cell lung cancer (NSCLC) is a major prognostic factor, and assessment of nodal stage is important for determining best management. We aimed to assess the accuracy of the PET/CT mediastinal blood pool (MBP) activity cut-off for staging nodal involvement in NSCLC and to examine other variables which may improve diagnostic performance of PET/CT.

**Methods:** All patients who underwent 18F-FDG PET/CT and endobronchial ultrasound-guided transbronchial needle aspiration (EBUS-TBNA) between June 2016 - August 2018 and received a diagnosis of NSCLC were included. Nodal station-based analyses were performed to compare the PET/CT parameters node SUVmax, node/MBP SUVmax ratio and node/tumour SUVmax ratio with pathology results obtained from EBUS-TBNA or surgery. The optimal cut-off value for each PET/CT parameter was determined using receiver operating characteristic curve analysis.

**Results:** 113 patients with a total of 321 nodes with pathological sampling were included. Nodal activity above MBP on PET/CT demonstrated sensitivity 97.4%, specificity 35.8%, positive predictive value 32.8% and negative predictive value 97.8%. With cut-off values of 3.9, 1.7, and 0.20 for node SUVmax, node/MBP SUVmax, and node/tumour SUVmax respectively.
ratio, and node/tumour SUV_{\text{max}} ratio, respectively, the sensitivity of PET/CT was 90.9%, 90.9%, and 91.7%, and specificity improved to 61.9%, 60.7%, and 53.3%.

**Conclusion:** Compared to the MBP cut-off, use of a higher node SUV_{\text{max}} cut-off or node/MBP SUV_{\text{max}} ratio cut-off can improve specificity for detecting malignant nodal involvement while maintaining high sensitivity.

### 82. The effect of a novel bayesian penalised likelihood (BPL) PET reconstruction algorithm on the assessment of malignancy risk in pulmonary nodules according to the british thoracic society (BTS) guidelines

David Murphy^a^, Leanne Royle^b^, Zacharias Chalampalakis^a^, Luis Alves^a^, Nuno Martins^a^, Paul Bassett^c^, Ronan Breen^b^, Arjun Nair^b^, Andrea Bille^b^, Sugama Chicklorea, Gary Cook^a^ and Manil Subasinghe^a^.

**Purpose:** British Thoracic Society (BTS) guidelines advocate using FDG PET/CT with the Herder model to estimate malignancy risk in solitary pulmonary nodules (SPNs). Qualitative assessment of SPN uptake is based upon analysis of Ordered Subset Expected Maximisation (OSEM) PET images. Our aim was to assess the effect of a novel Bayesian Penalised Likelihood (BPL) PET reconstruction on the assessment of FDG uptake and estimation of risk of malignancy (Herder score) in SPNs.

**Methods:** Subjects with SPNs who underwent FDG PET/CT between 2014-2017 with histological confirmation of malignancy or histological/imaging follow-up confirmation of benignity were included. Two blinded readers independently classified SPN uptake on both OSEM and BPL (BTS score; 1 = none; 2 = ≤ mediastinal blood pool (MBP); 3 = > MBP but ≤ 2 x liver; 4 = > 2 x liver), with resultant calculation of the Herder score (%) for both reconstructions.

**Results:** 97 subjects with 75 (77%) malignant SPNs were included. BPL increased the BTS score in 25 (26%) SPNs; 9 SPNs (7 malignant) increased from BTS score 2 to 3, 16 (13 malignant) from BTS score 3 to 4, with a mean Herder score increase of 18±22%. The mean Herder score for all SPNs with BPL was higher than OSEM (73±29 vs. 68±32%, P = 0.001). There was no difference in Herder model diagnostic performance between BPL and OSEM, with similar areas under the curve (0.84 vs. 0.83, P = 0.39).

**Conclusion:** BPL increases the Herder score in 26% of SPNs compared to OSEM but does not alter the Herder Model diagnostic performance.

### 83. Inter-observer agreement of visual herder scale for the assessment of solitary pulmonary nodules (SPN) on FDG PET/CT

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**Aims:** British Thoracic Society guidelines advise the use of a Herder visual score for the assessment of SPN with FDG PET/CT. We investigated the inter-observer variability of its use.

**Methods:** The local PET/CT database was searched for 100 consecutive patients undergoing an FDG PET/CT for the evaluation of a SPN All imaging was performed on a Siemens Biograph 64 PET/CT scanner with the same iterative reconstruction parameters. Anonymised images were reviewed independently by three consultant Nuclear Medicine Radiologists and the Herder score was documented, with a confidence score graded 1–3. Inter-observer agreement was assessed using Interclass Correlation Coefficient modelling.

**Results:** Preliminary results for 30 cases showed complete agreement between all three reviewers in 76.7% cases, and interclass correlation with Cronbach’s Alpha was excellent at 0.963 (95% CI, 0.932–0.982). The agreement between pairs of reviewers was good (Kappa scores for reviewer1 vs. 2 = 0.722, 1 vs. 3 = 0.807, 2 vs. 3 = 0.625). In the 23.3% (7/30) of cases with disagreement, 3 cases involved disagreement between absent and faint uptake, with a change in Herder model risk of malignancy which might have prompted a biopsy, however in practice these cases were followed up with repeat CT thorax. The other discrepant cases disagreed on moderate vs intense uptake with little difference in calculated risk of malignancy. The confidence scores were high (confidence score of 3 in 82.2% of cases).

**Conclusion:** Preliminary data from our study suggests excellent inter-observer agreement for use of the Herder scale in evaluating SPNs.

### 84. 18F-FDG PET/CT is useful in diagnosis of polymyalgia rheumatica: A retrospective study of 110 patients

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**Objective:** Increasing evidence suggests that the majority of patients with polymyalgia rheumatica (PMR) have increased 18F-fluorodeoxyglucose (FDG) uptake around the large joints and at cervical and lumbar spine on PET. The specificity of these findings is, however, unclear.
Materials and methods: 110 consecutive patients (42 male; mean age 72 ± 8 years) with clinical suspicion of PMR were referred to 18F-FDG PET/CT imaging before treatment was started. The clinical suspicion of PMR was quantified by experienced rheumatologists in conjunction with blood analysis (scores 1-5). 18F-FDG uptake was systematically scored in 12 articular regions (scores 0-2) and a total skeletal score was calculated reflecting the overall inflammatory activity in these regions. Receiver operating characteristics analysis was performed to determine the optimal clinical and total skeletal score for diagnosing PMR. The control test for PMR diagnosis was considered a good clinical response to treatment on at least 6 months clinical follow-up up.

Results: 88 patients were considered true PMR with 22 patients receiving another diagnosis. A clinical score of ≥ 4 had a sensitivity of 74%, specificity of 96%, positive predictive value of 95.6% and a negative predictive value of 62, while a total skeletal score of ≥ 16 has shown values of 94%, 97%, 99% and 81%, respectively.

Conclusion: 18F-FDG PET/CT has a good diagnostic accuracy in patients with clinical suspicion of PMR but equivocal evidence according to standard current clinical guidelines.

85. 18F-choline PET/CT in parathyroid imaging: Experience from a single tertiary referral centre
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Aim: To assess the utility of 18F-choline PET/CT in the localisation of parathyroid adenomas in a new service in a tertiary referral centre.

Methods: Data was retrospectively collated for patients who underwent 18F-choline PET/CT for localisation of parathyroid adenomas between October 2016 and September 2018 in our centre. Collected data included details of ultrasound (US) and 99mTc-sestamibi SPECT/CT prior to 18F-choline PET/CT and surgical results.

Results: Thirty-two patients (20 female, mean age 58 years) had 18F-choline PET/CT scans of the neck and thorax. Nineteen had US, 24 had 99mTc-sestamibi SPECT/CT. Twenty-five patients had a positive 18F-choline PET/CT scan, twenty-six 18F-choline focal abnormalities were identified (one scan demonstrated two focal abnormalities). 13/26 18F-choline PET/CT abnormalities showed ectopic parathyroid foci. Twelve patients had surgery/biopsy. 11/12 directly corresponded with 18F-choline PET/CT localisation. Of the 7 negative 18F-choline PET/CT scans, 1/7 patient had a positive 99mTc-sestamibi SPECT/CT scan. All 7/7 patients had negative US scans. Of the 18 US scans done before PET, 14 were negative, 8 of which were subsequently 18F-choline PET/CT-positive (4/8 ectopic). Of the 24 99mTc-sestamibi scans, 18 were negative, 14 of which were 18F-choline PET/CT-positive. One negative 18F-choline PET/CT scan was positive on 99mTc-sestamibi, with surgical confirmation.

Conclusion: 18F-choline PET/CT detects potential parathyroid abnormalities in 78% of cases, particularly when US and/or 99mTc-sestamibi SPECT/CT have been negative. 92% of the cases with histological correlation have shown direct concordance with the 18F-choline PET/CT result to date.

86. The utility of 18F-Choline PET/CT for the localisation of parathyroid adenoma in patients with primary hyperparathyroidism (PHP) with negative or equivocal conventional imaging
Rishi Ramaesh, Gavin Browning, Fraser Gibbs, Sonia Wakelin and Dilip Patel
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This retrospective study was performed to assess the accuracy of 18F-Choline PET/CT in localising parathyroid adenomas in patients with PHP with negative or equivocal ultrasound (US), 99mTc-sestamibi, and 4D CT imaging.

Over a 15 month period, 18F-Choline PET/CT was performed in 83 patients with negative or equivocal conventional imaging.

Of the 29 patients who had undergone surgery; surgical notes, pathology reports and post-operative outcomes were reviewed and correlated with imaging and pathological findings.

Of the 83 patients, 59 had a positive PET/CT result. Of these, 37 were not detected on ultrasound and 9 were equivocal. 99mTc-sestamibi scan did not locate 47 and was equivocal in 8. SPECT did not localise 47 with 4 equivocal studies. 4D-CT failed to detect 39 of these, with 2 equivocal studies.

Of the 29 surgical cases, PET/CT correctly localised the site of the adenoma in 26 patients. There were 2 false positive cases and one false negative, which was correctly identified on sestamibi imaging. The sensitivity of PET/CT was 96.2%, with a precision of 93%.

US detected 7 (24%), 99mTc-sestamibi 4 (14%) and 4D CT detected 6 (17%) cases that were apparent at surgery.

In our cohort, F18 choline PET/CT has been shown to identify a significant number of parathyroid adenoma in patients with PHP with negative or equivocal US, 99mTc-sestamibi or 4D CT and should be performed for preoperative localisation in those patients being considered for surgery with negative or conventional imaging.
87. \(^{51}\text{Cr-EDTA}\) versus \(^{99m}\text{Tc-DTPA}\) for GFR measurement: Is there a systematic difference?
Helena McMeekin\(^a\), Fred Wickham\(^b\), Mark Barnfield\(^c\) and Maria Burniston\(^d\)
\(^a\)Barts Health NHS Trust, London, United Kingdom, \(^b\)Royal Free London NHS FT, London, United Kingdom and \(^c\)Leeds Teaching Hospitals NHS Trust, Leeds, United Kingdom

**Aim:** The study aimed to investigate whether a systematic difference exists between \(^{51}\text{Cr-EDTA}\) and \(^{99m}\text{Tc-DTPA}\) for measurement of glomerular filtration rate (GFR).

**Methods:** GFR results from candidates attending the Royal Free Hospital nuclear medicine department for assessment of suitability for kidney donation during the period October 2008 to May 2015 were reviewed. The clinical protocol for GFR measurement had changed from using \(^{51}\text{Cr-EDTA}\) to \(^{99m}\text{Tc-DTPA}\) in October 2012, allowing the comparison of measured GFR distribution in this normal population before and after the change of radiopharmaceutical. A second cohort of oncology patients attending Leeds Teaching Hospitals NHS Trust underwent simultaneous GFR measurement with both tracers.

**Results:** From the first cohort, 184 GFR studies performed with \(^{51}\text{Cr-EDTA}\) and 154 performed with \(^{99m}\text{Tc-DTPA}\) were included in the analysis. A systematic difference of 5.8% (95% confidence interval: 1.5–10.1%) was found in the normalised GFR, with \(^{99m}\text{Tc-DTPA}\) giving the higher result. This difference was found to be statistically significant, with a \(P\)-value of 0.008 for a \(t\)-test and \(P = 0.01\) for Mann-Whitney \(U\)-test. Results from the second cohort of patients will be included in the presentation.

**Conclusion:** There is a small systematic difference between normalised GFR measured with \(^{51}\text{Cr-EDTA}\) and \(^{99m}\text{Tc-DTPA}\). However, this is not clinically significant in the context of intra-patient variability of GFR measurement, especially when GFR is measured without exercise restriction.

88. Tailoring the sampling time of single-sample GFR according to renal function: is the proposal in the BNMS GFR guidelines practical and supported by evidence?
Helena McMeekin\(^a\), Sam Townrow\(^a\), Fred Wickham\(^b\), Ben Fongenie\(^b\), Charlotte Porter\(^c\), Daniel McGowan\(^c\), Matthew Memmott\(^d\), Andy Bradley\(^d\), Nick Venner\(^c\), Mark Barnfield\(^f\) and Maria Burniston\(^a\)
\(^a\)Barts Health NHS Trust, London, United Kingdom, \(^b\)Royal Free London NHS FT, London, United Kingdom, \(^c\)Oxford University Hospitals NHS FT, Oxford, United Kingdom, \(^d\)Manchester University NHS FT, Manchester, United Kingdom, \(^e\)Gateshead Health NHS FT, Gateshead, United Kingdom and \(^f\)Leeds Teaching Hospitals NHS Trust, Leeds, United Kingdom

**Aim:** The 2018 BNMS GFR guidelines recommend a single-sample technique with the sampling time dictated by the expected renal function, but this is not known with any accuracy before the test. We aimed to assess whether the sampling regime suggested in the guidelines is optimal, and determine the expected error in GFR result if the sample time is chosen incorrectly. We can then infer the degree of flexibility in the sampling regime.

**Methods:** Data from 4633 patients referred for GFR assessment at 6 different hospitals for a variety of indications were reviewed. The difference between the single-sample (Fleming) GFR result at each sample time and the slope-intercept GFR result in routine clinical use at each hospital was calculated. Data points were excluded if the sample was taken outside a twenty minute window around the intended time.

**Results:** Mean absolute difference values (ml/min/1.73 m\(^2\)) for each of the expected GFR ranges proposed by the guidelines are summarised in the table below. The recommended sample times in the guidelines are underlined.

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**Conclusion:** The data supports the approach of the guidelines and demonstrates a reassuringly wide range of sample times for an acceptably accurate single-sample GFR result. This needs to be validated with a reference technique rather than a limited sample slope-intercept GFR calculation.

89. GFRs without standards
Alexander Smout, James Scuffham and Paul Hinton
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In GFR calculations, a standard is conventionally used to convert the measured sample counts into the percentage administered activity. In this work, we explored whether the administered activity and sample counter sensitivity could be used to accurately calculate the GFR, avoiding the need to use standards.

The SI-GFR is calculated by multiplying the volume of distribution (VD) by the slope of the excretion curve. We calculated VD as the ratio of the injected CPM (injected activity multiplied by counter sensitivity factor) and intercept CPM per millilitre of plasma. We retrospectively applied this calculation to our database of 15,205 chromium-51 GFR patients and compared to the conventional results obtained using standards.

The ‘no-standard’ and ‘conventional’ normalised GFRs had a correlation coefficient of 0.995 and median absolute
deviation of 1.5%. Part of this variability was from the chromium-51 reference activity concentration across different batches. After correcting for this (by assuming the counter sensitivity was constant) the correlation coefficient improved to 0.9995 with a median absolute deviation of 0.35%. Only 30 of 15 205 calculated GFRs were more than 2% different and none were over 3% different.

Eliminating the need for standards in GFR calculations has significant logistical advantages, particularly for technetium-99m GFRs where standards must be made daily. In addition, this method eliminates the risk of major errors such as counting the wrong standards. The method relies on a stable counter sensitivity which can be checked easily using a long-lived sealed source. Our Trust is implementing this new method into routine clinical practice.

90. Accuracy of 24 h single sample measurement for low GFR and comparison with same day slope-intercept GFR
Helena McMeekin, Fred Wickham, Ben Fongenie, and Maria Burniston

Aim: We aimed to investigate the accuracy of a single sample GFR (SS-GFR) technique with a sample taken at 24 h (24 h) post-injection for patients with GFR lower than 25 ml/min/1.73 m². A comparison with the results from same day slope-intercept GFR (SI-GFR) was also performed.

Methods: Data from patients referred for GFR assessment to inform the management of chronic kidney disease at the Royal Free Hospital were reviewed. 4-sample SI-GFR calculation with samples at 2, 4, 6, and 24 h post-injection was taken as the reference measurement to which the Gref and Karp SS-GFR (24 h sample) (Gref MC, Karp KH. 2009, 30:202–205. Nucl Med Commun) and same day SI-GFR (2, 4 h samples) were compared.

Results: 43 GFR examinations with reference GFR less than 25 ml/min/1.73 m² were included in the analysis. Bland-Altman analysis gave mean differences of 0.5 (95% confidence interval: 0.1–1.0) ml/min/1.73 m² for SS-GFR (24 h) and 3.9 (95% confidence interval: 2.5–5.3) ml/min/1.73 m² for same day SI-GFR. 95% limits of agreement were -3.0–4.5 ml/min/1.73 m² for SS-GFR (24 h) and -5.6–13.8 ml/min/1.73 m² for same day SI-GFR.

Conclusion: SS-GFR with a 24 h sample is more accurate than same day SI-GFR in patients with GFR less than 25 ml/min/1.73 m². Using SS-GFR with a 24 h sample in routine clinical practice will result in clinically insignificant differences in GFR result compared with the reference technique, whereas a same day SI-GFR measurement could cause large inaccuracies.

91. Implementation of the new BNMS GFR guidelines: An oncology study
Andrew Bussey, Mark Richardson and Adam Baker
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Purpose: The 2018 BNMS GFR guidelines recommend a single sample method for the majority of cases with the blood sample time based on the expected GFR. An audit of GFR data was carried out to evaluate the efficacy of moving from slope intercept (SI) to a single sample (SS) method and to validate which sample time should be used.

Methods: An audit was carried out on the GFR results of all adult oncology patients referred to the Nuclear Medicine Department at James Cook University Hospital over a 4 month period for chemotherapy dosing.

The patient’s GFR as calculated by the slope intercept method was compared against a single sample estimate using the Fleming method at each of the three blood sampling times currently used for GFR measurement (2, 3, and 4 h post administration).

Summary of Results: Data from 106 patients was included in the audit with GFR values demonstrating a normal distribution (mean: 70 ml/min, stdev: 28 ml/min).

By comparing the accuracy and precision of SS results based on SI GFR it was determined that a sample at 4 h post injection was most appropriate for GFRs between 25 and 69 ml/min. For patients with GFR values > 70 ml/min a sample at 3hrs was slightly more precise. This improvement was not deemed significant enough to justify banding sample time based on predicted GFR.

Conclusion: Based on these audit findings, the adoption of a single sample technique with all sampling at 4 h post administration is justified in our oncology population.

92. Establishing a standardised approach for sampling times in single sample ⁹⁹mTc DTPA studies in paediatric patients
James Hubber and Alan Britten
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Recent BNMS Guidelines on GFR studies recommend a single sample approach. Post-injection blood sampling should be timed according to estimation of BSA-normalised GFR. For adults this will be based on previous GFRs, or eGFR calculated from creatinine levels. At St George’s Hospital, paediatrics account for around 70 GFR referrals annually. These patients do not generally undergo regular blood testing, thus eGFR is inconvenient.

This retrospective study focused on 102 recent paediatric GFR patients, who were sub-divided into 6 categories based on referral type. The aim was to investigate the range of GFR values for each category to establish a standardised protocol for sample time based on referral.
102 paediatric patients were included with referrals divided as follows: oncology, renal, neuropathic bladder, spina-bifida, general urology and elevated creatinine. Data reviewed was BSA-corrected GFR using a 3 sample $^{51}$Cr-EDTA slope-intercept technique.

Average normalised GFR (ml/min/1.73m$^3$) for each patient cohort is; neuropathic bladder 89 (Range 50–138), spina-bifida 95 (68–118), urology 89 (65–106), renal 74 (53–110), elevated creatinine 99 (85–110) and oncology 122 (89–141). For all referrals except oncology the average GFR of that cohort falls between 70 to 100, thus 3 h sampling is recommended. For oncology referrals 2 h sampling is recommended. Of all 103 patients included, 35% would fall outside of the above. For all of these patients the maximum difference in recommended sampling time was 1 h.

In paediatric patients with no indication of estimated GFR it is possible to determine the appropriate sampling time based on referral type.

93. Does semi-quantification add to visual interpretation of DaTScan images?
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DaT scan evaluation is usually qualitative. We wanted to evaluate the added value of semi-quantification software (DaTQUANT) to the interpretation of DaT scan images.

A comparative retrospective analysis of 20 DaT scans between visual interpretation and semi-quantification software, with two separate analysis thresholds (Z score $<-2$ and Z score $<-2.5$), was done to test the concordance and added value for equivocal scans.

The median age of patients was 72 (53–87) years. The male to female ratio is 1:1.

Using these thresholds we found 8 out of 20 scans were abnormal with semi-quantification, while visual interpretation identified 12 abnormal patients.

A 65% qualitative to quantitative concordance was seen for both putamen. A 100% qualitative to quantitative concordance was seen for both caudate nuclei.

A Z score $-2$ versus $-2.5$ did not make a difference to the interpretation for the putamen. Semi-quantification software was more sensitive for identification of asymmetry in the caudate nucleus with slight difference when a Z score of $-2$ was used.

There is overall good concordance between qualitative and semi-quantitative DaT assessment especially for the putamen. However in cases of equivocal caudate activity DaTQUANT software may be more useful. We would like to extend our study to include a wider data set to strengthen our correlations.

94. The role of $^{18}$F-Florbetapir PET/CT imaging in differentiating depression from Alzheimer’s disease; feasibility study with regional sub-analysis of amyloid deposition by brain regions
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**Purpose:** To evaluate the clinical use of $^{18}$F-Florbetapir PET/CT in imaging patients with cognitive impairment and suspicious AD with underlying depression.

**Methods:** 10 prospective patients with cognitive impairment and depression underwent 18-F-Florbetapir PET/CT imaging. Studies were visually assessed by 2 Nuclear Medicine consultants and semi-quantitatively using Hermes BRASS software with SUV ratio ‘normal’ cut-off value 1.1. Clinician diagnostic confidence was assessed before and after imaging using a scale of 1 to 10 (1 = no confidence and 10 = complete confidence).

**Results:** 7/10 were abnormal, 2/10 were normal. 1 study was equivocal; mildly abnormal on semi-quantitative analysis with normal visual assessment.

Four of 10 (40%) patients had a change in diagnosis following imaging. 3 were changed from depression to AD. One patient thought to have Alzheimer’s disease was changed to likely depression.

One patient with a normal study was diagnosed with suspected non amyloid pathology (SNAP). Clinician confidence levels increased on average by 36% (range = 10–60%).

Regional brain analysis showed that all patients with an overall abnormal study (8/10) had increased amyloid plaque deposition in the frontal medial-orbital, anterior cingulate, lateral temporal, precuneus and posterior cingulate regions. The parietal region was spared in 2/8. Both the normal subjects demonstrated normal uptake in all regions of the brain.

**Conclusion:** $^{18}$F-Florbetapir PET/CT changed clinical diagnosis in 40% of cases and increased clinical confidence by 36%. Negative scan is reassuring as AD is highly unlikely in these cases. Larger studies are required to assess the significance of regional amyloid plaque deposition.
95. The impact of perfusion SPECT imaging on clinician diagnostic confidence in dementia
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Background: Regional cerebral blood flow (rCBF) single photon emission computed tomography (SPECT) imaging is commonly used to aid dementia diagnosis, however there has been little investigation of its real-world utility using clinical samples. This study aimed to assess the clinical impact of rCBF SPECT imaging on diagnosis and clinician diagnostic confidence in a cohort of individuals with cognitive impairment.

Methods: 41 clinicians who referred for a 99mTc-Hexamethylpropyleneamine oxime (HMPAO) SPECT scan for 79 patients with cognitive complaints completed a two-part questionnaire to determine diagnosis and diagnostic confidence (using a 0–100 mm visual analogue scale; VAS) before and after imaging. SPECT images were analysed using statistical parametric mapping and interpreted semi-quantitatively. Clinicians were also asked directly for their opinion on whether the imaging contributed to their diagnostic process.

Results: Diagnosis changed after imaging in 44% of cases, and confidence was significantly improved (VAS score change = +26.3±22.2) after imaging in cases where pre-imaging confidence was low (P<0.001). Clinician confidence was not significantly different (VAS score change = −6.6±25.5) after imaging when pre-imaging confidence was moderate to high (P>0.05). Interestingly, a proportion of clinicians with the highest pre-imaging confidence levels became less certain about their diagnosis following imaging results. When asked directly, 96% of clinicians stated that the imaging contributed to their diagnostic process.

Conclusion: In a mixed clinical cognitive impairment cohort perfusion SPECT imaging is valued by referring clinicians and contributes to diagnostic decision making. Imaging is of particular value when diagnostic confidence is low prior to imaging.

96. Can DaTscan quantification help single readers of 123I Ioflupane SPECT for Parkinson’s disease (PD) and Dementia of Lewy Bodies (DLB).

Methods: A retrospective analysis of thirty-four 123I Ioflupane SPECT studies was performed. A single reporter reviewed each study and made a diagnosis based solely on visual analysis of the SPECT acquisition. DaTQUANT software analysis was performed independently and a positive diagnosis of PD or DLB was made if striatal uptake was more than 2 standard deviations below the mean for the age matched population. The final diagnosis was made by consensus of visual analysis and quantification.

Results: 20 (59%) patients were normal and 14 (41%) abnormal. In 27 (79%) there was agreement between visual analysis and quantification. In the 7 cases of disparity between the visual analysis and quantification, the final diagnosis agreed with the visual analysis in 5 (71%) cases. Two of these cases were with asymmetrical uptake likely related to structural pathology. In the two cases where the final diagnosis disagreed with the visual analysis, there was subtle bilateral reduced uptake which was within normal limits on quantification.

Conclusion: DaTQUANT quantification of striatal uptake can be useful for single readers of 123I Ioflupane SPECT studies. It can change the diagnosis in equivocal cases or when there is only subtle reduced striatal uptake. However it should not be used in isolation and can be falsely positive in cases of asymmetric uptake due to structural pathology.

97. The utility of FDG PET/CT in the investigation of suspected paraneoplastic neurological conditions
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Purpose: PET/CT can be used to investigate patients with suspected paraneoplastic neurological syndromes (PNS). However evidence suggests low rates of detection of malignancy, other than in patients who are antibody positive where conventional imaging is negative. We aimed to assess the value of FDG PET/CT in the investigation of suspected PNS in our institution.

Methods: In 41 consecutive patients who underwent body FDG PET/CT for suspected PNS in a tertiary neurology centre, we analysed the clinical syndrome, results of previous investigations and PET/CT, and the final diagnosis.

Results: 5/41 (12%) were antibody positive, 32/41 (78%) had preceding CAP CT. In one antibody-negative patient PET/CT diagnosed a previously unknown metastatic lung cancer. In one patient PET/CT identified FDG-avid lymph nodes which appeared normal on CT, which led
to a diagnosis of sarcoidosis. Two patients had a known malignancy, and in the remaining 37 no malignancies were identified on PET/CT. None later developed malignancy during the follow-up period (range: 10–33 months, median 22 months) - a NPV of 100%.

Conclusion: The reassuring 100% NPV for PET/CT is in line with the majority of previously published NPVs which are >95%. We found a lower rate of detection of malignancy than reported in the literature. This could be explained by low rates of antibody positivity and the small, heterogeneous cohort. These findings reinforce the need for centres to review their own selection criteria and the results of PET/CT in suspected PNS. A separate but important diagnosis was of previously unsuspected sarcoidosis.

98. DaTSCAN service transfer to a new SPECT/CT system: Head-to-head comparison of visual and quantitative assessments
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Quantification of DaTSCAN images is affected by the choice of hardware, acquisition parameters, image reconstruction and analysis methods. This study explores the challenges encountered when moving to a different vendor SPECT/CT camera, concentrating in particular on the transferability of the existing European database (ENC-DAT) of healthy controls.

15 patients were imaged sequentially on two cameras, at 3 h post-injection on the well-validated GE Infinia-Hawkeye, then on a Siemens Intevo-Bold system. Both were equipped with LEHR collimators, although their different construction and performance (lead-cast and foil respectively) required different acquisition parameters. The photopeak window, in particular, was narrowed from the ENC-DAT 20% to the Siemens-recommended 15%. Images were reconstructed with several methods - FBP and OSEM without and with corrections for attenuation (AC) and scatter/penetration (SC) on Link-Medical and Siemens workstations.

Striatal specific-binding-ratios (SBR) were quantified using the Southampton method; ‘calibrations’ were derived, based on the 15 patients, to harmonize the SBRs from the two cameras for each considered reconstruction. SBRs concordance was assessed in terms of percentage agreement in the binary classification normal/abnormal using the ENC-DAT normality ranges.

Visual assessment showed good agreement between the two cameras.

Intevo-derived SBRs were systematically lower than Infinia ($P < 0.001$), except for Link-Medical OSEM-ACSC reconstructions ($P = 0.3$), demonstrating that the difference is due to collimation and that is resolvable with SC. SBR calibrations led to over 80% concordance between the two cameras.

These preliminary results indicate that the ENC-DAT database is potentially transferable subject to a larger number of cross-over patients for a robust calibration.

POSTERS

P01. Contribution of thyroid scintigraphy and SPECT/CT scan in the diagnosis of thyroid ectopia. A case report
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Introduction: Thyroid ectopy is a rare condition associated with a failure of thyroid gland migration during embryonic development. It may be asymptomatic or manifest as clinical or biological hypothyroidism.

Patient and method: This is a girl of 9 years and 6 months, with no notable family history, who has a staturo-ponderal delay. The clinical examination found a girl in good condition, a weight of 15 kg (-3SD) and a height of 114 cm (-3SD). At the cervical examination the thyroid was not visible. The hormonal assessment revealed hypothyroidism with an uTSH level of 22.6 μIU/ml. Cervical ultrasound did not indicate thyroid tissue in the thyroid gland. Cervical CT concluded that there was no thyroid in the normal position with doubt about the presence of thyroid tissue at the upper cervical level in the left peri-laryngeal region. We prescribed therefore a thyroid scintigraphy for a functional imaging after IV injection of 16 MBq of Technetium-99m.

Results: Thyroid scintigraphy showed an ectopic thyroid tissue in a high cervical position, with a fairly intense uptake but without the possibility of localisation. Complement with SPECT/CT was performed and allowed the localisation of ectopic thyroid tissue in basilical and left peri-laryngeal.

Conclusion: Thyroid ectopy location can be multiple. In our case, thyroid scintigraphy revealed two ectopic thyroid foci not visualized on cervical ultrasound and one of which could not be visualized on CT scan, thus testifying to the superiority of hybrid imaging mode in the exploration of thyroid ectopias.

P02. Diagnostic contribution of bone scintigraphy in pierre-marie-foix or pierre marie-bamberger syndrome
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Introduction: We report our experience in the diagnostic contribution of bone scintigraphy in Pierre-Marie-Foix syndrome in 15 patients.
Materials and method: We conducted a 5 year retrospective study of patients for whom a bone scan was requested as part of the assessment of a primary tumour. The diagnosis of the syndrome was made according to precise semiological characteristics found in planar bone scintigraphy. SPECT/CT was performed as needed for clarification.

There were 15 patients [10 male (67%); 5 female (33%)] with a mean age of 49 years (range 18–62 years).

The main aetiologies of the syndrome were bronchopulmonary cancer in 73.33%, followed by breast cancer in 13.33%, nasopharyngeal carcinoma in 6.66% and cancer of unknown origin in 6.66%.

The scintigraphic examination, carried out in all the patients, showed on the planar images a heterogeneous increased tracer uptake of the axial and appendicular limbs, associated with hypertrophy of the bone involved which is very pathognomonic for Hypertrophic pulmonary osteoarthropathy (HPOA).

The utilisation of SPECT/CT made it possible to diagnose secondary bone sites in 13% of cases.

Conclusion: The Pierre-Marie-Foix syndrome is a paraneoplastic syndrome mainly found in bronchopulmonary cancers but can also be found in extra-pulmonary cancers associated with bone metastasis.

P03. Incidental head and neck findings

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Aim: Incidental findings in the head and neck on \textsuperscript{18}F-fluorodeoxyglucose (FDG)-PET/CT pose challenges due to the difficulty of differentiating malignancy from benign or physiological variants. The aim of this study was to examine our current practice of reporting head and neck incidental findings and make recommendations for follow-up, and to determine the proportion of patients with incidental findings who were diagnosed with head and neck cancer (HNC).

Method: Patients who underwent PET/CT scanning between 2013 and 2018 and received a recommendation for Ear, Nose and Throat (ENT) referral or direct visualisation were retrospectively identified. For each PET/CT study, the following information was obtained: indication for PET/CT study, anatomic location of head and neck incidental finding, and the specific wording used to describe the incidental finding and make recommendations for further investigation.

Results: 48 of 104 (46%) patients were referred to ENT, while for 2 (2%) patients, the referring clinician noted the head and neck incidental finding and arranged investigation via a non-ENT route. Of the 37 patients with known outcome after ENT review, 4 (11%) were diagnosed with HNC. All 4 patients had undergone PET/CT scanning for suspected malignancy.

Conclusion: About half of patients with head and neck incidental findings on PET/CT and a recommendation for ENT referral were referred, of whom about 10% were diagnosed with HNC. All HNCs were diagnosed in the context of suspected malignancy.

P04. Use of \textsuperscript{18}F-FDG PET/CT as a predictive biomarker of outcome in patients with head-and-neck cancer

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\textsuperscript{18}F-FDG PET/CT is valuable in baseline staging, treatment planning, therapy response and follow-up; according to (Vasavi P et al., 2012. 4:633–647. Imaging Med) the sensitivity and the specificity to detect head-and-neck (HN) cancer are 83% and 90%, respectively.

The aim of this retrospective observational study is to discuss the value of these biomarkers in squamous cell carcinoma (SCC) and papillary thyroid carcinoma (PTC) when a primary tumour is located in the HN area.

This study was performed in a total of 86 patients with SCC and 7 patients with PTC who were scanned according to the gold standard protocol and an extra image at 90 min.

SUV\textsubscript{max} and SUV\textsubscript{mean} and descriptive variables were studied. Parameters were evaluated having in consideration the potential as a non-invasive biomarker and correlated with the histology results (using the TNM staging).

Five females, 2 males were studied in PTC and obtained the following results: T2 (SUV\textsubscript{max} = 2.52; SUV\textsubscript{mean} = 1.39), T3 (SUV\textsubscript{max} = 8.94; SUV\textsubscript{mean} = 5.42), T4 (SUV\textsubscript{max} = 13.74; SUV\textsubscript{mean} = 8.02). Nineteen females, 67 males with SCC were also analysed: T1 (SUV\textsubscript{max} = 8.26; SUV\textsubscript{mean} = 5.12), T2 (SUV\textsubscript{max} = 9.12; SUV\textsubscript{mean} = 4.94), T3 (SUV\textsubscript{max} = 9.80; SUV\textsubscript{mean} = 5.96), T4 (SUV\textsubscript{max} = 7.28; SUV\textsubscript{mean} = 4.20).

In PTC patients, both SUV increase proportionally to the TNM classification. In SCC patients, both SUV behaviour is the same from T1-T3, but it decreases in T4. This way, both SUV had a predictive significance related to SCC and PTC differentiation. SUV\textsubscript{max} is the best option to choose the treatment because it allows
access to the highest uptake in the area, matching with the results obtained by (Imsande HM et al., 2011.197:976-980. AJR).

**P05. Dual-time-point PET/CT with 18F-FDG for differentiation of malignant and benign lesions**

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According to (Chen S et al. 2016, 85:1744–1749.SJR), dual-time-point (DTP) improves the specificity of PET considering the difference in SUV$_{\text{max}}$ between early and delayed scans to help differentiate benign and malignant pulmonary nodule.

In the present study, the clinical value of 18F-FDG was evaluated to differentiate malignant from benign lesions and compare the single image with DTP protocol.

The subjects were 247 lesions in 155 patients were evaluated at 60 (early) and 90 minutes (delayed scan).

The evaluation was based in SUV$_{\text{max}}$, SUV$_{\text{avg}}$ between the early and delayed images and retention index (RI). Cut-off values were evaluated using ROC curve and AUC for each parameter. A RI of 10% was chosen as a cut-off.

The 155 patients, average age of 59.91 years, presented higher SUVs in delayed scans. A SUV$_{\text{max}}$ = 8.62 and SUV$_{\text{avg}}$ = 5.03 were obtained in the early images; SUV$_{\text{max}}$ = 9.58 and SUV$_{\text{avg}}$ = 5.65 in the delayed images ($P = 0.023$ and $P = 0.027$, respectively).

Malignant lesions have higher SUV$_{\text{max}}$ and SUV$_{\text{avg}}$ in early images (10.16 and 6.46) and benign lesions have a higher SUVs in the late images (6.76 and 4.04).

The RI is 15.30% reveals that 15.30% of the radio-pharmaceutical is retained in delayed images.

The AUC varies 0.607–0.611 meaning that a complete separation between them is poor.

The sensitivity, specificity, positive and negative predictive values were calculated as 97.74%, 70.59%, 78.26% and 92.31%.

The data show that DTP 18F-FDG PET/CT is useful to distinguish malignant and benign lesions. It helps in the therapeutic approach, especially in oncology patients because some therapies induce inflammation.

**P06. Is post-treatment surveillance somatostatin receptor scintigraphy of pancreatic neuroendocrine tumours clinically useful?**

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Introduction: Somatostatin receptor scintigraphy (SRS) is frequently used for pre-treatment staging of pancreatic neuroendocrine tumours (NET), however, there is a paucity of evidence on the utility of routine post-treatment surveillance of patients with SRS for recurrence detection. European Neuroendocrine Tumour Society (ENETS) guidelines recommend conventional imaging with CT and/or MRI in the follow-up of these patients. The purpose of this study was to review the value of routine surveillance SRS in post-surgical patients with pancreatic NET.

Methods: Consecutive patients with histologically confirmed pancreatic NET undergoing post-treatment SRS in a large tertiary referral centre between 2010 and 2017 were identified from an institutional database. Staging and post-treatment SRS scans were reviewed retrospectively along with any other conventional imaging performed and correlated with patient outcome.

Results: 57 post-treatment SRS scans were performed in 23 patients. 53 (93%) scans were negative for recurrence; the number of scans performed per patient ranged between 1–5 scans. 4 (7%) scans were positive for recurrence; however, in each of these cases recurrence was also demonstrable on contemporaneous cross-sectional imaging with contrast-enhanced CT and/or MRI liver. The costs associated with these imaging techniques are significantly different in our institution: CT (£102), MRI liver (£262), SRS (£1166).

Conclusion: This single centre experience demonstrated limited value in performing routine post-treatment surveillance SRS in patients with pancreatic NET. Potentially significant cost-savings (£1k per episode) can be made by replacing SRS in this scenario without reducing diagnostic accuracy, as supported by ENETS guidance which recommends CT or MRI instead.

**P07. Missed metastases: Using PET/CT in scottish lung cancer patients as a retrospective learning tool to highlight blind spots on oncological CT**

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Purpose: The aim of the study was to utilise the large volume of lung cancer PET/CT data as a learning tool to highlight reporting discrepancies on prior contrast-enhanced CT.

Methods: The West of Scotland PET centre is one of UK’s busiest. Retrospective review of 2631 patients who underwent PET/CT from January 2016 - December 2017. Patients with FDG-avid distant metastatic disease were identified. The prior CT scan and accompanying report were reviewed to determine if the PET-positive metastases were present and reported correctly.

Results: 197 (7.5%) patients had FDG-avid distant metastatic disease (Female 51%; Male 49%; mean age 68 years). 49% of patients had prior CT chest and
abdomen, 31% CT chest, abdomen and pelvis and 20% CT chest.

A total of 35 CT reporting discrepancies were identified - 86% perceptual errors (missed) and 14% cognitive errors (misinterpretation).

(1) PET-positive adrenal metastases (58 patients): 25% missed, 7% misinterpreted as adrenal adenomas, 37% correctly identified and 32% CT-occult.
(2) Bone metastases (126 patients): 10% missed, 9% correctly identified and 81% CT-occult.
(3) Liver metastases (31 patients): 0% missed, 4% misinterpreted as hepatic haemangiomas, 37% correctly identified and 60% CT-occult.
(4) 12 cases of intramuscular metastasis (29% missed), 9 cases of distant nodes (11% missed) and 8 cases of peritoneal metastasis (71% missed).

Conclusion: Adrenal metastases were most commonly missed or misinterpreted by CT reporters. Adrenal lesions must be viewed with suspicion, especially in cases without the retrospectoscope of PET. Peritoneal nodules were also a notable metastatic blind spot and must be scrutinised for on CT. The strengths of PBS are the high sensitivity and whole body skeletal survey; CT and MRI detect osteolytic lesions and bone marrow infiltration, respectively.

P09. Patient outcomes in abnormal and equivocal SeHCAT studies
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Introduction: SeHCAT scans use [tauroselscholic (75-selenium) acid], a radiolabelled synthetic bile acid to measure bile salt absorption. Bile acid malabsorption (BAM) is a common cause of diarrhoea which can be resolved by the use of bile sequestrants. Up to 35.3% of IBS-D patients have been shown to have an element of BAM.

Methods: Retrospective review of 300 patients who had SeHCAT scans at the Royal United Hospital (RUH) in 2015 and 2016; including patient demographics and outcomes. Clinic letters were then analysed to assess the tolerance and efficacy of treatment with BAS. The parameters used in this trust are; normal >15%, equivocal 8–15%, abnormal <8%.

Results: Out of the patients with abnormal results (n = 74), 78% were documented as offered BAS, 44% of these had recorded subsequent symptom improvement. BAS was offered in 75% of cases in patients with equivocal results (n = 53) and 20% of them had recorded symptom improvement. Looking at all of the patients with <15% uptake (n = 127) BAS was offered in 77% of cases and symptom improvement was recorded in 23%.

Conclusion: Our evaluation showed similar percentages of abnormal/equivocal results and in offering treatment with BAS as other studies but we have lower percentages of symptom improvement (Summers JA. 2016. 3:e000091. BMJ open Gastro and Wilcox C. 2014. 4;39:923–939. Aliment Pharmacol Ther).

P10. Is F18 FDG PET/CT of value in thymic masses characterisation
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**Objective:** To assess the role of F18 FDG PET/CT in evaluation of thymic masses.

**Methods:** We retrospectively reviewed all the patients with thymic masses with F18FDG PET/CT visually (intensity and pattern of tracer distribution), quantitative analysis (Standardized Uptake Value = SUVmax), invasion of the surrounding structures, presence of metastasis and necrosis. Those findings were correlated with pathology results.

**Results:** Within a 5 year period, 9 patients were identified (all males), mean age 58 yrs (range 38–89).

2 of 9 patients were diagnosed with thymic hyperplasia, 3/9 patients had low grade and 1/9 patients had a high grade thymoma. 3/9 patients had thymic cancer (2/3 of them had squamous cell cancer). The SUVmax of thymic hyperplasia was significantly lower when compared to low and high grade thymoma (P < 0.05). There was also significant difference between SUVmax of the low/high grade thymoma and thymic cancer (P < 0.05). There was no significant difference between the low grade and high grade thymoma. Homogenous pattern of tracer distribution was more common in thymic hyperplasia and thymic cancer than low and high risk thymoma. Satellite lesions were seen in the high grade thymoma (n = 1) and thymic cancer (n = 1). Vascular invasion was demonstrated in the thymic cancer (n = 1).

**Conclusion:** F18FDG PET/CT is a useful tool to differentiate between benign and malignant thymic lesions but cannot predict the histological grade of thymoma.

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**P11. The diagnosis of chronic spinal implant infection using FDG PET/CT**

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**Aim:** The diagnosis and management of chronic implant related infection remains a challenge to the spinal surgeon. Patients often present with minimal radiographic and biochemical indication of infection.

We present our 5 year experience of the use of FDG PET/CT in the diagnosis and management of suspected infection of spinal instrumentation.

**Methods:** Retrospective review of all patients at a single centre referred over 5 years for PET/CT to assess for possible implant related infection. All FDG PET/CT scan reports of symptomatic patients with implants in situ at the time of scanning were assessed. Case notes and microbiology where applicable were reviewed.

**Results:** 57 patients were referred for scan at greater than 1 year following intervention. 53 patients had full record available for assessment. Median age at scan was 25 yrs (range 18–75 yrs). Time from index surgery ranged from 18–216 months.

24 scans (45%) were reported as consistent with low grade infection of which 10 were managed operatively with revision or removal of implant. Microbiology was positive in 70% of cases with Propionibacterium Acnes the predominant positive finding (4/7). 33 patients were managed conservatively on the basis of a negative scan.

**Conclusion:** In our review spanning 5 years of using FDG PET/CT for evaluating spinal infections, we have found the technique useful in guiding patient management. A positive scan correlated strongly with the presence of microbiological infection. A negative scan was useful in reassuring surgeons and patients of the absence of infection.

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**P12. Hepatic and splenic blood FDG phosphorylation rates in diabetes mellitus and hepatic steatosis**

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**Aim:** The study aim was to investigate relationships of blood glucose level (BGL) with hepatic and splenic FDG phosphorylation rates (Ki) in patients with diabetes mellitus (DM) and/or hepatic steatosis (HS).

**Methods:** 239 patients, including 92 with type-2 DM (DM2) and 12 with type-1 DM (DM1), had routine whole body FDG PET/CT. Patients with lymphoma were excluded. ROI were placed over liver and spleen for measurement of SUVmax and left ventricular cavity (LV) for measurement of SUVmean. Tissue SUVmax was divided by LV SUVmean giving Z. This eliminates bias from the whole body metric used to calculate SUV and renders SUVmax a closer surrogate of Ki. CT density (CTD) of ≤ 40 HU was taken to indicate HS.

**Results:** Highest Z and BGL were recorded in patients with both DM2 and HS and lowest in those with neither. DM1 patients, in contrast, showed low Z in relation to BGL. Hepatic and splenic Z both correlated positively with BGL and inversely with CTD, but only in patients with HS and no DM.

**Conclusion:** As BGL increases, hepatocytes are induced by insulin to phosphorylate an increasing fraction of the glucose presented to them. The data also support the existence of hepato-splenic metabolic coupling.
P13. Intracranial pathology in routine 18F-FDG PET/CT imaging
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Whole body 18F-FDG PET/CT is well recognised as an imaging tool in its routine use for staging and guidance of treatment options for a range of patients with malignancy. At our institute, PET/CT imaging also includes complete head imaging as part of a standard local protocol. Head imaging with more conventional modalities such as CT or MRI is not routinely performed for all oncological patients. Consequently, the first head imaging for some patients may be at PET/CT.

The incidence of unexpected intracranial findings at PET/CT is relatively low, and the background of normal physiological brain activity can make interpretation challenging. However, identification of both malignant and non-malignant intracranial pathology can have a significant impact on patient prognosis and management options.

We aim to present a comprehensive pictorial review of useful findings using sample cases to demonstrate a range of intracranial pathology and reinforce review areas.

P14. How useful is imaging of the legs in whole body SPECT/CT for cancer staging?
Joseph Manivannan, Arum Parthipun, Rajyashree Sharma and Rabelle May Gironella
Trinity Medical Imaging, Surrey, United Kingdom

Objective: Whole body SPECT/CT is the optimal imaging technique for metastatic workup with higher sensitivity and specificity compared with planar and targeted SPECT/CT. The aim is to determine if planar static images of the legs are clinically useful when performing whole body SPECT/CT for cancer staging.

Patients and method: Thirty-three patients with a clinical indication of cancer staging (breast and prostate cancer) were included in this study. A 3-bed position bone SPECT/CT from the vertex to mid-thighs was performed approximately 3 h after an intravenous injection of 99mTc-HDP and static planar images of the legs were performed.

The scan report and acquired images were reviewed to identify how many lesions were reported as benign or malignant, and whether the static imaging identified bone metastases not seen on SPECT/CT.

Result: 33 patients were included (25 had prostate cancer and 8 had breast cancer). 16 patients (48%) had abnormal uptake in the lower leg on static imaging. Of these, one patient (3%) had bone metastases on static imaging. However, in this case there was widespread metastatic disease on SPECT/CT. There were no cases of isolated metastases in the legs.

Conclusion: Routinely performing planar static views of the legs for cancer staging was not clinically useful in this series.

P15. PICC line in PET/CT: Y or N
Joana do Mar Machado, David Little, Stewart Redman and Richard Graham
Royal United Hospitals Bath, Bath, United Kingdom

Difficult venous access is not rare in patients who undergo Positron Emission Tomography/Computed Tomography (PET/CT). The preferable route of administration is via a peripheral intravenous cannula with a three-way valve system attached to allow 0.9% NaCl saline flush following injection of 18F-fluorodeoxyglucose (FDG). However, its insertion may be difficult due to several factors: dehydration, intravenous drug users, and patients having repeated courses of chemotherapy.

The aim of this study is to determine whether the Peripherally Inserted Central Catheter (PICC) is prone to retain PET radiopharmaceuticals. A total of eight patients (n = 8) underwent an injection of 18F-FDG through a PICC and flushed with 20 ml of saline, between January 2018 and June 2018. The group consisted of 4 women and 5 men whose age ranged from 22 to 83 y (mean age 61 ± 20 y). A visual interpretation of the PET/CT images was used by a subspecialty trained radiologist to determine if the images were of diagnostic quality and if lines associated uptake caused any diagnostic dilemmas.

No intense FDG activity was seen at the distal end of the catheter. Three patients had a mild amount of uptake at the tip of the catheter as well as in the lumen but without causing significant issues. PICCs are suitable for 18F-FDG injection in PET/CT and cause no problems in PET/CT interpretation.

P16. The role of FDG PET/CT in a regional multidisciplinary MDT for oligometastatic SABR
Karen Mullin, Eoin Napier and Aidan Cole
Belfast Health and Social Care Trust, Belfast, United Kingdom

Background: SABR (stereotactic ablative radiotherapy) for oligometastases is increasing in standard practice and a weekly regional oligometastatic SABR (oSABR) multidisciplinary meeting (MDT) was implemented in our institution from January 2018.

The aim of this study was to evaluate the role of FDG PET/CT in our MDT, particularly as the detection of metastatic disease is crucial for consideration of oSABR.
The limitations of FDG PET/CT were also evaluated as a range of tumour types were presented for the consideration of therapy.

**Methods:** Retrospective review of 64 patients discussed at the oSABR MDT from January 2018–December 2018.

**Results:** The MDT had 77 case discussions (64 patients) from January–December 2018.

Of the 64 patients, 25 patients were referred on the basis of PET/CT findings and 8 PET/CTs were requested by the MDT for further assessment prior to consideration for oSABR. 31 were evaluated with conventional imaging and did not have a PET/CT.

Of the 8 PET/CT requests, 4 patients had confirmed oligometastatic disease and 4 detected multiple metabolically active metastases.

**Conclusion:** The use of FDG PET/CT significantly influenced decisions regarding patient management in our oSABR MDT. As there is no local access for prostate specific PET/CT tracers, the evaluation of patients referred for consideration of therapy for metastatic prostate malignancy relied on conventional imaging and did not have a PET/CT.

**P17. Time lost = time gained (Gastric Emptying Studies)**

Amie Mitchell, Leslie Mousseau, Helen Davison, David Little, Richard Graham and Stewart Redman
Royal United Hospitals Bath NHS Foundation Trust, Bath, United Kingdom

**Statement of purpose:** Our current gastric emptying protocol taken from Guo et al. [1] requires six 1min images to be acquired over 4 h. Although this is a small amount of camera time it can be difficult to schedule patients around this.

We performed a retrospective analysis to see whether, changing to the SNMMI protocol [2] which reduced the number of scans to 4, would change the report for our studies.

**Methods used:** We retrospectively re-analysed images acquired for the last 30 patients (consecutively from 03/05/2016 - 04/12/2018) to see if acquiring fewer reference points would change the final report.

**Summary of the results:** The patient cohort is 70% female, 30% male with a mean age of 50 y.

Using the original method the results showed 18 normal, 10 abnormal and 2 equivocal studies.

After consultant review of the results it was thought that when immediate, one, two and four hour scans are reported this left the results from the original report unchanged.

**Conclusion:** Taking out the 30 min and 3 h scans for the Gastric Emptying Studies helps appointment scheduling and improves the department efficiency by releasing time to perform extra scans.

**References**


**P18. Chronic inflammation within von-Meyenburg complexes mimicking hepatic lymphoma on Fluorine-18-fluorodeoxyglucose (FDG)-PET/CT**

Guven Kaya, Sameer Gangoli, Sabina Dizdarevic and Nitasha Singh

“Brighton and Sussex University Hospitals NHS Trust, Brighton, United Kingdom, *St Richard’s Hospital Western Sussex NHS Foundation Trust, Chichester, United Kingdom and Brighton and Sussex Medical School, Brighton, United Kingdom*

**Purpose:** To illustrate an unusual case of false positive uptake within inflamed von-Meyenburg complexes on post-treatment FDG PET/CT in a patient with Non-Hodgkin’s Lymphoma.

**Methods:** A 52-year-old male with Non-Hodgkin’s Burkitt’s lymphoma of the stomach underwent an FDG PET/CT scan for response assessment post-chemotherapy. The scan demonstrated a new intensely FDG-avid liver lesion co-registering to a low-density geographic lesion on CT in the region of the falciform ligament with no metabolically active disease elsewhere. The imaging appearances were concerning for a new FDG-avid liver deposit (Deauville Score 5) although the differential diagnosis included the possibility of FDG-avid post-treatment focal fatty infiltration. In view of the importance of diagnosis to guide further management, a liver biopsy was performed.

**Results:** Histology was negative for lymphoma but demonstrated benign enlarged bile ducts with surrounding fibrosis suggestive of von-Meyenburg complexes (biliary hamartomas) with associated chronic inflammatory infiltrate. A follow-up PET/CT 3 months later showed complete resolution of the hepatic uptake in the absence of further treatment.

**Conclusion:** Von-Meyenburg complexes are rare benign malformations of the intra-hepatic bile ducts, not typically FDG-avid, but which may mimic malignancy on CT. Focal fatty infiltration can have similar CT appearances to von-Meyenburg complexes but in contrast is a recognised rare cause of false positive uptake on FDG PET/CT post-chemotherapy. We present a case, not known to be previously described in the literature, of false positive liver uptake due to inflammation within von-Meyenburg complexes.
complexes mimicking new lymphoma deposit/progression post-chemotherapy.

P19. Role of 18F FDG PET/CT in the imaging of adrenocortical carcinoma
Saafia Rehman and Kevin Bradley
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Adrenocortical carcinoma (ACC) is a rare and aggressive malignancy with a high recurrence rates and poor prognosis. Radical surgical resection is the only effective treatment option with systemic therapies mainly reserved for palliation. This requires accurate preoperative staging. ACC is usually an FDG-avid tumor and thus 18F FDG PET/CT scan can be used for characterisation of adrenal masses and staging.

The purpose of this presentation is to review 18F FDG PET/CT imaging features of the histologically proven adrenocortical carcinoma cases at our institution. We will discuss the imaging and FDG uptake features.

ACC usually presents as a large, heterogeneous mass with intense FDG uptake which is indicative of the mitotic rate. The degree and volume of uptake have been shown to be indicators of prognosis. Assessment of morphological characteristics such as tumor size, heterogeneity, and irregular margins as well as attenuation value and metabolic activity (SUV analysis and comparison to liver uptake ratio) all help in characterisation. However, the differentiation from metastases, lymphoma, or pheochromocytoma needs a careful correlation with patient’s history, pathology results and other imaging findings.

Imaging has an important role in the management of patients with ACC both at diagnosis and during follow-up. 18F FDG PET/CT may also be useful for evaluation of tumor response to treatment.

P20. Multimodality functional imaging of the brain of HIV patients with neurocognitive impairment
Priya Rogersa, Katie Alfordb, James Hunterb, Nicolas Eftychioua, Basil Ridhaa, Jaime Veraa and Sabina Dizdarevica

“Brighton and Sussex University Hospitals, Brighton, United Kingdom and 1Brighton and Sussex Medical School, Brighton, United Kingdom

Purpose: We aim to demonstrate the value of multimodality functional imaging in the cohort of HIV-positive patients with neurocognitive impairment.

Methods: We present a series of 3 cases of neurocognitive impairment in the context of HIV: the first presented with vacancy, ataxia and cognitive impairment; the second presented with generalised cognitive impairment; the third presented with a 4-year history of cognitive impairment and parkinsonism.

Results: CASE 1: CT and gadolinium-enhanced MRI head showed a small parafalcine meningioma without mass effect and old ischaemia. 18F-FDG PET/CT showed evidence of posterior cortical hypometabolism suggestive of posterior cortical atrophy (PCA). 18F-Florebetaben imaging showed moderate amylloid plaque deposition and hence an increased likelihood of Alzheimer’s disease (AD) pathology.

CASE 2: MRI showed evidence of a subacute haemotoma, and numerous white matter lesions suggestive of vasculopathy. Subacute haemotoma resolved on subsequent contrast CT. 18F-Florebetaben showed evidence of moderate amylloid deposition, suggestive of AD in the relevant clinical context.

CASE 3: Initial MRI brain showed brain volume loss. 18F-Florebetaben scan was negative and demonstrated no evidence of amylloid deposition. Follow up MRI 1 year later showed midbrain volume loss suggestive of progressive supranuclear palsy. DAT imaging showed reduced dopaminergic reuptake /dopamine transporter dysfunction at presynaptic level favouring diagnosis of atypical Parkinsonism.

Conclusion: Multimodality functional imaging is a helpful diagnostic tool in aiding the differential diagnosis of neurodegenerative disease in HIV positive patients, but further research studies are needed to establish HIV-associated neurocognitive disorders’ (HAND) specific bio-distribution of different tracers in the brain.

P21. 99mTc HYNIC-TOC scintigraphy in the evaluation of neuroendocrine tumour (NET): Single centre experience
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Jipmer, Puducherry, India

Materials & methods: It was a retrospective cross-sectional study from department of Nuclear Medicine, JIPMER, Puducherry, India. Records and images of 99mTc HYNIC-TOC scans performed between Jan’15 and Jan’19 were retrospectively reviewed from hospital information system. A total of 77 99mTc HYNIC TOC scans were included in the study. Demographic details and all relevant clinical details were collected. The results of Tc-99m HYNICTOC study was confirmed with biopsy, biochemical results, CECT and MRI.

Results: A total of 77 scans were included in the analysis. The referral was for initial diagnosis, staging, recurrence and response detection in 29, 28, 9 and 11 scans respectively. A total of 52 scans were positive and 25 were negative for presence of disease. The study cohort included referral for gastroenteropancreatic NET (GEPN), medullary carcinoma of thyroid (MCT), tumour induced osteomalcia (TIO), paraganglioma and neuroblastoma (P&N) and other NET’s
comprising carotid body tumors, meningioma, bronchial carcinoid, NET of breast, cervix and perianal region. For GEPN group sensitivity, specificity, diagnostic accuracy, positive likelihood ratio, negative likelihood ratio were 76.92%, 83.33%, 78.12%, 4.62 and 0.28 respectively. For TIO the sensitivity, specificity, diagnostic accuracy, positive likelihood ratio, negative likelihood ratio were 100%, 66.67%, 83.33%, 3.0 and 0 respectively. For P&N group the sensitivity, specificity, diagnostic accuracy, positive likelihood ratio, negative likelihood ratio were 83.33%, 66.67%, 77.78%, 2.50 and 0.25 respectively. All scans were positive for disease in MCT. In other NET groups the diagnostic accuracy was 80%.

P22. Do the guidelines surrounding 68Ga-DOTA-conjugated peptide PET/CT and octreotide treatment for neuroendocrine tumours require updating? James Cohen\textsuperscript{a}, Arman Parsa\textsuperscript{b} and Ewa Nowosinska\textsuperscript{b} \\
\textsuperscript{a}Queen Mary University London, London, United Kingdom and \textsuperscript{b}Barts Health NHS Trust, London, United Kingdom

The somatostatin receptor status of neuroendocrine tumours can be visually determined with 68Ga-DOTA-conjugated peptide PET/CT, which can also be used for localisation of primary tumours, detection of metastatic disease and restaging of patients with known disease. NETs which express a high density of SST receptors are more likely to respond to octreotide (somatostatin analogue) therapy.

Theoretically, the sensitivity of 68Ga-DOTA-conjugated peptide PET/CT may be reduced in patients receiving cold somatostatin therapy due to receptor blockade. However, there is evidence to suggest that this is not the case and that concurrent therapy may even improve scan quality. EANM guidelines recommend that patients undergoing 68Ga-DOTA-conjugated peptide PET/CT should allow a time interval of 3–4 weeks following their last dose of long-acting octreotide. This is undesirable; some patients may not tolerate withdrawal of treatment as well as difficulty in coordinating scans, clinic appointments and patients’ own schedules.

We present a case of a 71-year-old patient with octreotide-sensitive metastatic phaeochromocytoma who received a dose of long-acting octreotide only 3 days prior to 68Ga-DOTA-conjugated peptide (specifically 68Ga-DOTA-TATE) PET/CT for restaging of his disease. 68Ga-DOTA-TATE and octreotide are both agonists of SST receptor subtype-2. Despite high plasma concentration of octreotide, the PET/CT image demonstrates strong signal from affected areas as confirmed by previous CT and MRI imaging with high tumour-to-background ratio.

There is evidence to suggest that there is insignificant interaction between octreotide treatment and 68Ga-DOTA-conjugated peptide PET/CT sensitivity and that the current guidelines are potentially detrimental to patient outcomes.

P23. Development of a 223Radium dichloride (Xofigo) patient pathway (Post ERA 223) for metastatic castrate-resistant prostate cancer (MCRPC) that present to the royal wolverhampton NHS trust with no visceral disease Jo Weekes \\
The Royal Wolverhampton NHS Trust, Wolverhampton, United Kingdom

Nobody knows the exact number in the UK, but approximately 90% of the prostate cancer deaths per year in this country are from cancer that has metastasized to bone.

There are numerous possible sequences of therapy available for these patients, so the remit of the 223Radium Dichloride Therapy Group (RDTG) was to devise a simple pathway for clinicians/referers to follow thereby ensuring the patient has a tailored therapy approach following the best known available practice at this time depending on their presentation.

There are 4 main pharmacological options that are available as front-line therapies:

1. Abiraterone (Zytiga, Janssen Biotech)
2. Enzalutamide (Xtandi, Astellas/Medivation)
3. 223Radium Dichloride (Xofigo, Bayer)
4. Docetaxel (Taxotere, Sanofi-Aventis).

These 4 pharmacological therapies can be used in any sequence, thus this produces a varying treatment plan that patients are enrolled onto depending on local clinical preference.

There is also a sixth pharmacological therapy to be taken into consideration in this patient pathway and that is, Cabazitaxel (Jevtana, Sanofi-Aventis). However this must only be prescribed post docetaxel therapy.

The RDTG have formulated simple flow diagrams to show the patient pathways for asymptomatic and symptomatic referrals not just from this Trust but for external referrals as well.

These simple flow diagrams can be used to demonstrate to the patient and family the various therapy options available and their sequencing, and they also aid in ensuring the best available treatment options are delivered to the patient thus improving patient experience and outcomes.

P24. Biodistribution mapping of 223Radium dichloride during the course of treatments 2 to 6. A patient case study
Ian Sayers, Jo Weekes and Malcolm Foley \\
The Royal Wolverhampton NHS Trust, Wolverhampton, United Kingdom

\textit{Aim:} To evaluate the biodistribution of 223Radium Dichloride (Xofigo) at 36 set anatomical sites (anterior and posterior) in Patient X over a period of at least 22 days post administration. This was performed for treatments 2 – 6 of Patient X’s 223Radium Dichloride therapy.
The aim of this unique study was to look at the Effective and Biological half-life of $^{223}$Radium Dichloride during the individual treatments and evaluate any changes in the half-life’s that occur over the course of Patient DN’s therapy.

**Methods:** By using a scintillation counter, readings were acquired over set anatomical sites (anterior and posterior) for treatments 2-6. The readings were taken at the skin surface and the mean counts per second during a 20 s observation period were recorded for all sites. Background readings were also acquired and recorded.

The data was recorded into identifiable Excel files eg., treatment number etc., The whole analysis was done with R, a statistical programming language. Activity/time curves were plotted for each anatomical measurement site.

**Results:** A Biphase decay curve was observed in 98% of sites on a log$_{10}$ scale.

**Question:** Why would there appear to be a longer biological uptake of $^{223}$Radium Dichloride at sites of disease as a result of increase treatments which naturally increases the effective half-life of $^{223}$Radium Dichloride therapy.

**P25. Should CTPA be performed in pregnant women out-of-hours?**

Phei Shan Chuah and Rashika Fernando  
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**Introduction:** Pregnant women have higher risk of developing pulmonary embolism (PE) due to hypercoagulability status and venous stasis. Computed tomography pulmonary angiography (CTPA) and lung scintigraphy (VQ scan) are used to diagnose PE in pregnant women. In our centre, low dose VQ scan is the primary investigation during working hours and CTPA scans are performed in patients with abnormal chest radiograph and out-of-hours. CTPA has been reported to have high incidence of non-diagnostic yield due to physiological haemodynamic effect of increased blood volume and tachycardia in pregnant women. The main objective of this study is to assess the local diagnostic quality of CTPA and VQ scan in pregnant women.

**Methods:** Retrospective study on the use of CTPA and VQ scan in pregnant women in a single tertiary centre over 2 year period.

**Results:** Of the 169 patients who had a low dose VQ scan, 4% were deemed high probability and 1% was indeterminate which was confirmed to be negative on subsequent CTPA. Of the 23 CTPAs performed, 4% were positive, 44% were negative while 52% were deemed indeterminate due to suboptimal opacification of pulmonary arteries. Majority of CTPAs were scanned out of hours and had normal chest radiograph.

**Conclusion:** There was significant higher incidence of inconclusive CTPA studies compared to VQ studies. We propose that all haemodynamically stable pregnant women with normal chest radiograph have VQ scan the next working day instead of an out-of-hours CTPA.

**P26. Streamlining of radium-223 referral pathways to reduce patient waiting times**

James Scuffham, Tracy Juleff and Ralf Clauss  
*Royal Surrey County Hospital NHS Foundation Trust, Guildford, United Kingdom*

**Purpose:** The referral pathway for Radium-223 therapies at our Trust was reviewed and optimised, with the aim of reducing patient waiting times.

**Methods:** Taking into account feedback from referring consultants, our referral pathway was re-designed with the Nuclear Medicine Department assuming responsibility for funding applications and e-prescribing, which were previously carried out by the referer. A specific referral form for Ra-223 therapy was created, which was designed to capture all the necessary information required for the expedient approval and booking of patient appointments. This form also replaced a separate ‘chemotherapy’ referral form that was previously required by the pharmacy department in order to check funding approval prior to treatment. In order to assess the impact of these changes, we audited the time taken for each step of the pathway for the last 18 patients referred under the ‘old’ system, and the first 18 patients referred under the ‘new’ system.

**Results:** Under the new pathway, the overall median time from referral form completion to the first cycle of therapy was reduced by 15%, from 37 days to 31 days. This was largely due to the more expedient submission of funding applications, and the removal of the need for separate pharmacy approval prior to booking patient appointments.

**Conclusion:** By taking full ownership of the complex referral process for these therapies, our department has reduced overall patient waiting times for Radium-223 therapy. Further process improvements are planned to reduce the time taken to register patients referred from neighbouring Trusts.

**P27. Impact of intra-cycle changes in dose heterogeneity, biokinetics and tumour volume on dose-based personalisation of administered activity for $^{177}$Lu-based treatment**

Javian Malcolm, Boon-Quan Lee, Nadia Falzone, Matthew Aldridge, Mark Gaze and Katherine Vallis  
*Oxford University, Oxford, United Kingdom and University College London Hospital, London, United Kingdom*
Recent reports to optimise administered activity (AA) per cycle based on the predicted dose to the kidneys (dose-limiting organ) have been promising, however, critics claim an avoidance of biology in this approach. Indeed, the assumption of identical intra-cycle kinetics, tumour volume and dose distribution allows for a clinically-feasible dosimetry approach but may lead to over-or-under estimation of the optimal AA per cycle.

A further step towards AA optimisation of multi-cycle PRRT would be to investigate the influence of earlier cycles on the biokinetics, dose distribution and tumour volume of subsequent cycles. This step requires 3D voxelised dosimetry, longitudinal SPECT/CT after each cycle and radiobiologic modelling to account for the radiobiological effects of the changes.

Here, we describe a simulation study based on actual dosimetry data from patients who had undergone four-cycles of weight-based Lu177-DOTATATE therapy. We determine whether the predictions of previously reported dose-based optimisation strategies prove robust to variable intra-cycle biokinetics, dose distribution and tumour volume.

In this study, there is considerable deviation between the predicted intra-cycle kidney absorbed dose per AA and those calculated based on the SPECT/CT data. The intra-cycle kidney pharmacokinetics as quantified by the effective half-life increased between cycles 1 and 4 while the heterogeneity of the dose distribution changed significantly within each cycle based on the equivalent uniform dose radiobiological metric.

Patient-specific dosimetry simulations based on data from previous multi-cycle Lu177-DOTATATE clinical study demonstrate the importance of considering changing intra-cycle dose heterogeneity, tumour volume and kidney biokinetics in personalising patient administered activity.

**Methods:** Our shielded box consists of 10 mm of Perspex encased in a further 10mm of lead, with small ports to allow access for infusion lines, and contains a holder for the unshielded stock vial. A small action camera was mounted within this shielded box together with battery-operated LED lights. The camera connects via a private WiFi signal to a small tablet computer.

**Results:** The images from the camera enable the infusion to be monitored at a distance of several metres from the patient, reducing the radiation exposure to the operator. Additional battery packs were found to be required in case of any delays during the infusion.

**Conclusion:** Proprietary action cameras are suitable devices for use in remote monitoring of radiopharmaceutical infusions in lead shielded containers. This facilitates a reduction in operator radiation dose during therapy procedures.

**P28. Use of a compact action camera to monitor infusions of Lu-177 DOTATATE**

James Scuffham, Alexander Smout and Ralf Clauss
Royal Surrey County Hospital NHS Foundation Trust, Guildford, United Kingdom

**Purpose:** A widely-used method for infusion of Lu-177 DOTATATE is to apply saline under pressure to the stock vial, resulting in the flow of the radiopharmaceutical into an intravenous line. This requires careful monitoring of the stock vial and associated connections to ensure there are no leaks. At our Trust, a custom shielded box with a lead glass window previously facilitated this. However, in order to further reduce operator eye doses, we investigating the use of remote monitoring using a camera.

**Methods:**

- **Equipment:** A compact action camera was used. The camera was mounted within a custom shielded box, which was enclosed in 10mm of lead. The camera was connected to a private WiFi network via a small tablet computer.
- **Procedure:** Infusions were monitored remotely using the camera. The camera was positioned at a distance of several metres from the patient, allowing for real-time monitoring of the infusion process.

**Results:**

- **Dose-rate Monitoring:** The images from the camera enabled accurate dose-rate monitoring, allowing for timely adjustments to the infusion rate.
- **Operator Radiation Exposure:** By monitoring infusions remotely, the radiation exposure to the operator was significantly reduced.

**Conclusion:** The use of a compact action camera for monitoring infusions of Lu-177 DOTATATE offers several benefits, including reduced radiation exposure to the operator, improved monitoring of the infusion process, and enhanced patient safety.

**P29. A comparative study of different electronic personal dosimeters used for NM dose assessments**

Carla Abreu, Cameron Anderson, Ana Aguiar, Jonathan Gear and Glenn Flux
Royal Marsden Hospital, London, United Kingdom and St. George’s University Hospitals NHSFT, London, United Kingdom

**Introduction:** Electronic personal dosimeters (EPD) are a useful tool for monitoring, auditing and alerting staff to radiation exposure. However, the reliability and accuracy of the data from EPD’s is often unclear and a routine QA and calibration program is not always followed. We investigated the variation in output of a range of EPD’s used clinically at the Royal Marsden NHSFT.

**Methods:** Six different EPD’s models were evaluated utilising a variation of Geiger-Muller and Si-PM detectors. Output was tested with exposures of technetium-99m, lutetium-177 and fluorine-18 sources. H(10) Equivalent-Dose-Rates (EDR) were recorded at increasing distances from a collimated source of each isotope. Response time was tested by recording the EDR periodically from the start of exposure. Accumulative Equivalent Doses (AEDs) were compared for prolonged exposures at low (~2 μSvh⁻¹) and high (~1 mSvh⁻¹) dose rates. In addition a single operator wore all EPD’s during a working day and the AED for each monitor compared.

**Results:**

- **EDR Variations:** There was significant variation in EDR recorded by different EPD’s models for the same exposure conditions.
- **AED Differences:** The AED recorded by each EPD during a working day varied significantly.

**Conclusion:** The reliability and accuracy of EPD’s data is often unclear and a routine QA and calibration program is not always followed. This study highlights the need for a standardized QA and calibration program to ensure reliable and accurate radiation exposure monitoring.

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P30. Patient satisfaction with [223Ra]Ra-dichloride service Brighton and sussex university hospitals
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“Brighton & Sussex University Hospitals, Brighton, United Kingdom, bGuy's and St Thomas Foundation Trust, London, United Kingdom and cBrighton & Sussex Medical Schools, Brighton, United Kingdom

Radium-223 treatment aims to prolong and improve quality of life in metastatic (bone) prostate cancer patients. An additional challenge of the healthcare provider is to deliver high-quality services and achieve patient satisfaction. This study evaluated satisfaction in patients who received Radium-223, in correlation with the quality of life, in a period of 18 months at Brighton & Sussex University Hospitals.

Objectives: To investigate factors which modulate satisfaction, find the weak points and improve all aspects of the service.

Methods: Three questionnaires were used. First measured patient satisfaction. Second (EORTC QLQ-C30) and third (QLQ-PR-25) assessed quality of life and health. Question-D2 regarding satisfaction of waiting areas was separated (these changed during collection of data). Questions with <90% satisfaction were correlated with age, education and perceived quality of health and life (QLQ-C30).

Results: 30 questionnaires collected. Four questions demonstrated 100% satisfaction. These include overall satisfaction, interaction with staff and precautions (information/perception). Only in 3 questions (involving waiting times and supporting services) satisfaction was <90% (but >80%). No significant association (Chi-square) was found between satisfaction and age/education, and no significant correlation (Spearman coefficient) with perceived quality of health/life. Question-D2 demonstrated 85% satisfaction. First 9 questionnaires were completed when in the old premises. 65% of these 9 patients were not satisfied. Percentage satisfaction increased to >90% after the department moved to new premises.

Conclusion: High levels of satisfaction were achieved in this institution. No correlation between satisfaction and quality of life, health and age/education was found however this is a small sample. Study is continuing.

P31. Ultrasounds and microbubbles enhance the delivery of a liposomal formulation for targeted chemo-radionuclide therapy
Eloise Thomasa, Jyothi U. Monoa, Joshua Owenb, Sheena Wallingona, Michael Graya, Irini Skaripa-Koukellia, Robert Carlisleb and Katherine Vallsib

“CRUK/MRC Oxford Institute for Radiation Oncology, University of Oxford, Oxford, United Kingdom and bInstitute of Biomedical Engineering, University of Oxford, Oxford, United Kingdom

Purpose: Nanoparticles are powerful tools in oncology as they can combine various active species but their low penetration into tumours sometimes hinders their efficacy. In this study, we used ultrasounds and microbubbles to improve the intratumoural delivery of a novel liposome for chemo-radionuclide therapy. The epidermal growth factor receptor (EGFR) is over-expressed on tumor cells in many cancers, making it a prime therapeutic target.

Methods: Liposomes were loaded with doxorubicin and surface modified with radiolabelled epidermal growth factor (111In-DTPA-EGF). 111In-DTPA-EGF causes cytotoxicity through emission of Auger electrons, particularly when it accumulates in cell nuclei.

111In-DTPA-EGF-tagged and doxorubicin-containing liposomes (111In-EGF-DOX-LP) were internalised in a dose-dependent manner with greater uptake in MDA-MB-468 (high EGFR) than in MCF7 (low EGFR) cells. The stability, pharmacokinetics and biodistribution of 111In-EGF-DOX-LP were studied in vivo following intravenous administration to mice bearing MDA-MB-468 xenografts.

Results: More radioactivity was detected in the nuclei of MDA-MB-468 than MCF7 (16.8±0.9% vs. 2.2±0.7% of the internalized activity). The cytotoxicity of 111In-EGF-DOX-LP (assessed in clonogenic assays) and the amount of DNA damages caused was higher for MDA-MB-468 than MCF7. When co-delivered, doxorubicin and 111In-DTPA-EGF had an additive effect in MDA-MB-468.

Application of ultrasound to the tumour and i.v. administration of microbubbles increased the tumour uptake by 66%.

Conclusion: 111In-EGF-DOX-LP are promising in vitro in terms of targeted cellular uptake and drug delivery. In vivo, ultrasounds and microbubbles enhance their delivery to tumour. The extent of tumour vascularisation is believed to be a determinant of success of this delivery strategy and will be further studied.

P32. A method of determining when solid radioactive waste can be considered very low level waste (VLLW) via contamination monitoring
Andrew Morgan, Nathaniel Scott, Alexander Helming and Aida Hallam
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Background: Small users of radioactive materials can make use of VLLW exemption (EPR2016) for disposal with...
non-radioactive refuse if waste is <400kBq/0.1m³ and/or each item <40kBq. They may also utilise off-site transfer to a contractor; however these costs are considerable. Determining accurately when waste is VLLW is critical for compliance with the EA permit. Due to uncertainties in the contents of radioactive waste bins, estimating when waste will be VLLW is not straightforward.

The aim was to determine sensitivity factors for different contamination monitors and different radionuclides, which could be used to easily determine when solid radioactive waste is VLLW, ensuring compliance with EA permit volume and time restrictions.

Methods: Commonly used radionuclides (222Ra, 131I, 125I, 131I, 111In, 51Cr) of known activity were individually positioned inside a 5L waste bin. Measurements were taken with different monitors on the surface of the bin and at various distances. Measurements were repeated as sources decayed to VLLW level, to establish individual sensitivity factors.

Results: We found a large range in sensitivity across radionuclides [0.0494 cps/kBq (51Cr) to 10.7 cps/kBq (125I)], attributed mainly to differences in type of emissions, their energies and the type of monitor used. Using the previous double-background method to determine when waste is VLLW is a conservative estimate for all radionuclides except 51Cr. Results can be deduced for different bin sizes, and this new method can easily be put into everyday practice.

Conclusion: Using contamination monitors with sensitivity factors for specific radionuclides is a useful method for estimating when waste is VLLW, ensuring permit compliance and cost savings.

P33. External dose-rate modelling of RRA radioiodine patients
Andrew Bussey, Mark Richardson and Adam Baker
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Purpose: Patients undergoing radioactive remnant ablation present a radiation hazard to those around them but particularly to family members on their return home, meaning patients are generally hospitalised after administration. Although an effective control, this inconveniences the patient and burdens hospital resources. By better understanding the spatial and temporal behaviour of the radiation emissions more robust risk assessments can be made which may support shorter periods of hospitalisation.

Methods: Over a 12 month period instantaneous dose rate measurements were taken of 1.1GBq and 3.7GBq RRA radioiodine patients throughout their inpatient stay and at post ablation imaging the following week. These included measures at multiple distances and locations around the patient.

Results: We found a large range in sensitivity across radionuclides [0.0494 cps/kBq (51Cr) to 10.7 cps/kBq (125I)], attributed mainly to differences in type of emissions, their energies and the type of monitor used. Using the previous double-background method to determine when waste is VLLW is a conservative estimate for all radionuclides except 51Cr. Results can be deduced for different bin sizes, and this new method can easily be put into everyday practice.

Conclusion: Using contamination monitors with sensitivity factors for specific radionuclides is a useful method for estimating when waste is VLLW, ensuring permit compliance and cost savings.

P34. Internal dosimetry of common diagnostic radionuclide studies - initial results from the SOLLID trial
Jonathan Gear, Rebecca Introduction, Carla Abreu, Ana Ribeiro, Jerry MacNeil, Iain Murray, Dominic Rushforth, Francesca Leek, Richard Lee, Yong Du and Glenn Flux
Royal Marsden Hospital, London, United Kingdom

Introduction: Effective doses from diagnostic nuclear medicine procedures are often obtained from historical studies, animal data and small cohorts of patients. A clinical trial funded by the Department of Health (DH), Simplification Of Low Level Internal Dosimetry (SOLLID), will determine optimal simplified methodologies to determine patient-specific absorbed doses from nuclear medicine investigations.

Methods: The first patient recruited in the SOLLID study was imaged 5 times during a 68Ga-PSMA procedure. Following intravenous injection, a single bed position dynamic PET/CT image of the myocardium was acquired for 15 min, followed by a 40 min half-body dynamic WB scan. WB counting using a ceiling mounted scintillation detector was used to determine excretion from the first and subsequent bladder voids. The clinical PET/CT was acquired at 60 min followed by further imaging at 120 and 240 min post administration. Absorbed dose calculations were performed for whole-body, liver, spleen, kidney and salivary glands. Uncertainty estimates of doses were determined following the methodology described within the EANM guidance.

Results: Observed retention data was described by single, bi- and tri-exponential functions. The highest uptake observed in any organ was the liver with 20% of the injected activity after 10 min. The kidneys received the highest absorbed dose of 0.25±0.03 mGy/MBq. No
observed bladder excretion over 4 h was observed despite hydration and regular voiding.

**Conclusion:** This study will enable accurate dosimetry for a range of diagnostic procedures with minimal additional patient burden and is expected to inform a subsequent epidemiological study for the DH.

**P35. Comparing relative lung function values from planar scans with those from SPECT V/Q scans following a correction for the counts from the ventilation phase of the scan**

Joseph Spoora and David McCullochb
City Hospitals Sunderland, Sunderland, United Kingdom and Newcastle-upon-Tyne Hospitals, Newcastle-upon-Tyne, United Kingdom

Planar imaging is the gold standard for measuring relative lung function (RLF). RLFS were derived from simulated SPECT V/Q scans of a lung phantom and compared to RLFS from planar imaging. The activity in the lungs was known so the difference between true and measured left lung percentages was calculated [referred to as left lung difference (LLD)]. Perfusion-only activities were generated by subtracting the activities in ventilation and ventilation scans. Perfusion-only RLFS were derived from SPECT V/Q scans using two methods: subtracting the counts measured in hand-drawn VOIs on ventilation datasets from those in hand-drawn perfusion VOIs; and subtracting ventilation from perfusion datasets and generating automatic VOIs on the resultant datasets. The latter method was more repeatable when analysing one dataset. A SPECT/CT scanner was used so the effects of attenuation correction and hand-drawing VOIs with CT localisation were assessed. It was found that planar (n = 8) was least accurate but most precise (mean LLD = 1.7%; SD = 0.7%); SPECT-only (n = 15) was more accurate than planar (Subtracting VOIs: mean LLD = 1.4%; SD = 1.3%/Image Subtraction: mean LLD = 1.0%; SD = 1.4%) but less accurate than SPECT/CT (n = 15) (Subtracting VOIs: mean LLD = 0.0%; SD = 1.3%/Image Subtraction: mean LLD = -0.1%; SD = 1.2%). The differences between SPECT and planar mean LLDs were less than the 3% (P = 0.005) that local guidance indicated would be clinically significant but several individual data points had differences greater than 3%. A study to improve local confidence in RLFS from Dual-Energy CT using pulmonary hypertension patient data is feasible. These patients receive SPECT V/Q and Dual-Energy CT scans.

**P36. Phantom evaluation and optimisation of OSEM reconstruction algorithms on in-111 SPECT imaging**

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Radiation Physics and Protection, Churchill Hospital, Oxford University Hospitals NHS Foundation Trust, Oxford, United Kingdom and Department of Oncology, University of Oxford, Oxford, United Kingdom

Aim: Neuroendocrine tumours are commonly studied using Indium-111 Pentetreotide SPECT/CT imaging. In this study, OSEM reconstruction was optimised and quantitatively compared with the default method.

**Methods:** A NEMA IQ phantom filled with In-111 in a sphere to background ratio of 8:1 was imaged three times on a GE Discovery 670 SPECT/CT camera. Following this, the GE default reconstruction of ordered subset expectation maximisation (OSEM) with 10 iterations and 2 subsets (10_2) was performed on the Xeleris workstation (GE Healthcare). OSEM reconstructions were then performed using HybridRecon (Hermes Medical Solutions AB) with 15 subsets and 1 to 7 iterations.

**Results:** The 4 largest sphere diameters of 37, 28, 22 and 17mm were analysed using contrast recovery (CR) and background variability (BV) with the optimal reconstruction found to be 5 iterations and 15 subsets. The optimised OSEM protocol improved the CR for spheres in descending size order by 1.2, 1.5, 1.6 and 1.8 times (all P < 0.01), compared to the default. For BV, an increase was produced for these spheres in descending order by 1.1, 1.4, 1.6 and 1.6 times (all P < 0.02). For the optimised OSEM protocol the mean CR obtained for the spheres in descending order was 57%, 50%, 38% and 26%.

**Conclusion:** Improvement in contrast recovery is achieved by applying the optimised HybridRecon OSEM protocol (5_15). However, there is an increase in BV of 1.5 times. As CR and BV are not completely indicative of clinical preference, further semi-quantitative analysis of clinical images is required.

**P37. Comparison of wizard 1470 and HIDEIX gamma counters for measuring glomerular filtration rate samples**

Anne-Marie Stapleton and Alex Smout
Royal Surrey County Hospital, Guildford, United Kingdom

The work aimed to whether significant differences were measured in the glomerular filtration rates (GFRs) calculated for patients when $^{51}$Cr-EDTA or $^{99m}$Tc-DTPA samples were counted in a Wizard 1470 gamma counter compared to a HIDEIX gamma counter. Eighty-three patients’ $^{51}$Cr-EDTA GFR blood samples taken at 2, 3 and 4 h after administration were measured in both gamma counters and their GFR results were calculated and compared. Additional test were performed using 20 patients worth of dispensed technetium-99m sources to simulate GFR samples. Overall, the HIDEIX gave a statistically significant (P < 0.0001) 2.0% higher absolute GFR than the Wizard for the chromium samples. On the chromium-51 window, the measured background was found to be 3 times higher in the HIDEIX counter compared to the Wizard, which resulted in typical patient sample counts that were only ~2–5 times those of the
background count rates in the HIDEX counter compared to a ratio of ~6–15 in the Wizard counter. The technetium-99m simulated patient GFR samples were largely consistent with the expected values on both the Wizard and HIDEX gamma counters. The HIDEX background counts were 1.6 times higher than the Wizard, and the ratio of sample counts to background counts were more than two orders of magnitude higher for both counters in this window.

P38. Selecting the energy window for gamma probe sensitivity constancy
Alan Britten and Belinda Stiles
St George’s Hospital, London, United Kingdom

Gamma probe QC to determine the constancy of sensitivity may be performed with a $^{57}$Co source with a $^{99m}$Tc energy window to simplify the procedure and to avoid window setting errors for non-technical users. This work aims to evaluate how the sensitivity of the constancy checks depends on the energy window settings.

Methods: A $^{57}$Co spectrum was used to simulate the count rate effects of shifting the energy window. The experimental count rate with a $^{57}$Co source was recorded with a $^{99m}$Tc window and a window of the same width but shifted in steps of 10 keV.

Results: The simulation indicates the count rate for a $^{57}$Co source in a $^{99m}$Tc window falls by under 5% for a 20 keV drop in the energy window position (100–160 keV dropped to 80–140 keV). A 13% fall in count rate occurs if the energy window position increases by 10 keV (100–160 keV increase to 110–170 keV). Experimentally there was a 21% fall in count rate for a rise in energy window of 10 keV, but the window could not be set below 100 keV to check the effect of a fall in window position.

Conclusion: Using a $^{99m}$Tc energy window for QC with a $^{57}$Co source has attractions for non-technical users, but the test has a poor sensitivity to detect relative shifts in energy window and detector pulse height. A relatively narrow window set to match the isotope used is recommended for routine QC.

P39. Single sample GFRs: Should there be a tolerance on the optimal sample time?
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$^a$St George’s University Hospitals NHS FT, London, United Kingdom, $^b$Joint Department of Physics, Royal Marsden NHS FT & The Institute of Cancer Research, London, United Kingdom and $^c$Singleton Hospital, Swansea, United Kingdom

New BNMS guidelines for glomerular filtration rate (GFR) measurement advocate the use of a calculation based on a single blood sample (SS-GFR). The optimal blood sample time is based on a prospective estimated GFR (eGFR) calculation, although there is no guidance relating to the point at which sample time is no longer ‘optimal’. The aim of this study was to assess the effect of sampling times that differed from the optimal time by comparison of the SS-GFR to the two-sample slope intercept (SI-GFR) undertaken in our centre.

Retrospective study of 691 patients who underwent a GFR measurement from 2015–2018 was undertaken. The Modification of Diet in Renal Disease (MDRD) eGFR was calculated for each patient using serum creatinine to obtain the optimal time for SS-GFR blood samples. Patients with a sample taken within 0–30, 30–60, 60–90 and 90–120 min from the optimal sample time had a SS-GFR calculated. This was then compared to the SI-GFR.

For a deviation of 0–30 mins ($n = 333$) the average difference ($\pm$SD) between the SS-GFR and the SI-GFR was $2.0 \pm 4.0 \text{ ml/min/1.73 m}^2$ (range $–6.0$ to $18.7 \text{ ml/min/1.73 m}^2$). For 30–60 mins ($n = 218$) the average difference was $1.1 \pm 4.8 \text{ ml/min/1.73 m}^2$ (range $–10.2$ to $25.7 \text{ ml/min/1.73 m}^2$). For 60–90 mins ($n = 112$) the average difference was $1.2 \pm 5.4 \text{ ml/min/1.73 m}^2$ (range $–10.8$ to $18.5 \text{ ml/min/1.73 m}^2$) and for 90–120 mins ($n = 128$) the average difference was $2.8 \pm 5.6 \text{ ml/min/1.73 m}^2$ (range $–17.9$ to $22.7 \text{ ml/min/1.73 m}^2$).

Increased deviation from the optimal sample time does not alter the average difference between the SS-GFR and the SI-GFR. However, the range of differences increased with deviation from the optimal sample time.

P40. FDG oncology image quality measurements using FlowMotion in the Biograph Vision PET/CT
Chris Mathews$^a$ and Ian Armstrong$^b$
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The Siemens Biograph Vision PET/CT is equipped with a high sensitivity SiPM PET detector with continuous bed motion (CBM) acquisition. This work aims to optimise scan speeds and administered activity to achieve a consistent signal to noise ratio (SNR) across all patient demographics.

Administered FDG activity was adjusted for weight by 3.5 MBq/kg up to a maximum of 280 MBq. Scan speeds were adjusted based on patient body mass index (BMI) where speeds recorded in this cohort are 1.0, 1.3 and 1.5 mm/s. Data was then reconstructed using TOF reconstruction (4 iterations, 5 subsets, 4.0 mm Gaussian filter). Signal-to-noise ratio (SNR) in the liver was measured for each patient within a 3 cm diameter spherical VOI. Patients are also divided into groups with arms up and down to evaluate the impact that this has on SNR.
Further adjustments may be made to the current imaging protocol in order to get a more consistent SNR across patient demographics. Where possible, implementation of faster scanning times may lead to better departmental efficiency.

**Table 1. Median and inter-quartile range of liver signal-to-noise ratio for the three scan speeds and patient arm position**

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<th>1.5-U</th>
<th>1.5-D</th>
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<th>1.3-D</th>
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<th>1.0-D</th>
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<td>11.0</td>
<td>10.9</td>
<td>12.3</td>
<td>12.6</td>
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<tr>
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<td>11.0</td>
<td>10.3</td>
<td>9.6</td>
<td>12.2</td>
<td>11.8</td>
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<tr>
<td>Quart 3</td>
<td>13.4</td>
<td>13.2</td>
<td>12.0</td>
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U, up; D, down.

**P41. Preparing a Gamma Counter for Calculating \[^{99m}\text{Tc}\] Tc-DTPA GFRs**

Belinda Stiles, Anton Paramithas and Alan Britten
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It is best practice to characterise the linearity with respect to activity of a gamma counter for \[^{99m}\text{Tc}\], in preparation for \[^{99m}\text{Tc}\]-DTPA for GFR measurements.

100 kBq of pertechnetate in 2 ml was measured using the Wallac 1480 Wizard 3. The sample was measured for 3 min approximately every 10 min over 5 days. The linearity was reviewed using both the raw counts and the counts per minutes (CPM) as calculated by the counter.

It was found that the results are markedly more linear when using the counter’s calculated CPM than when using the raw counts, due to the deadtime correction included in the counter’s calculations.

The linear region, defined as the region which is within 5% of the expected counts, was found to be <60 kBq when using the CPM, but <10 kBq when using the counts.

The linearity was also measured using the linear fitting method as described in NPL Good guidance 93. The CPM results are considered to be linear below 60 kBq, as the linear fit was within 0.1% of the expected gradient. However, even below 10 kBq the raw counts would not be considered linear, as this fit has a gradient 0.8% smaller than that expected.

CPM offers an extended linearity range. It is recommended that the counter’s calculated CPM is used for plasma and standards for \[^{99m}\text{Tc}\]-DTPA GFR calculations.

**P42. Investigating the success rate of fixed dose radioiodine therapy in patients with Graves’ disease and toxic multinodular goitre**

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aRoyal Surrey County Hospital, Guildford, United Kingdom and bUniversity of Surrey, Guildford, United Kingdom

**Objective:** To compare the success rate for patients with Graves’ disease and toxic multinodular goitre who received radioiodine therapy at the Royal Surrey County Hospital.

**Methods:** In this retrospective study, 649 patients were included who had radioiodine therapy between January 2013 and October 2018. Patients were split into two groups – those treated with 424 MBq (Graves’ disease) and those treated with 495 MBq (toxic multinodular goitre). The success rate was calculated, with a successful treatment defined as one where a patient only has one treatment in the time period. A drawback of the method we used means that patients could have had a retreatment outside of this time period or may have opted for surgery instead of another radioiodine therapy.

**Results:** 92.9% of patients treated with 424 MBq and 93.9% of patients treated with 495 MBq had a successful first treatment. There is only a very small difference between the two activities. Regarding re-treatment, 41 patients had a second treatment, while 3 other patients needed a second and third treatment.

**Conclusion:** Our figures are higher than the 90% success rate suggested by the Royal College of Physicians’ Working Party Report and the British Thyroid Foundation. Our re-treatment results are also in line with the findings of a study similar to ours (Khalid et al., 2011. 4:435. BJMP), which found that giving 550 MBq for hyperthyroidism has a 93% success rate. The activities of 424 MBq and 495 MBq used at our centre appear to result in a high success rate.

**P43. The effect of SPECT partial volume correction on I-131 voxel dosimetry using 3D printed inserts**

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Molecular Radiotherapy is an increasingly common therapy for a range of cancers that provides a unique challenge for accurate dosimetry. Tumour dosimetry must be performed at the voxel-level due to variations in size and shape. Dosimetry is typically performed by obtaining a sequence of SPECT images, converting these images to activity, integrating, and convolving the resulting distribution with a voxel s-factor. Degradations in the SPECT images, attenuation, scatter, partial volume effects, therefore lead to inaccuracies in the calculated dose distributions.
A library of 3D printed tumour representative inserts was created to optimise the Iterative Yang Partial Volume Correction (PVC) algorithm for iodine-131 SPECT images. Tumours were modelled as spheroids and the ratio between the two radii, \( r \), was varied to include prolate (\( r < 1 \)) and oblate (\( r > 1 \)) spheroids, as well as spheres (\( r = 1 \)). The volume of the inserts was varied from 16 ml to 100 ml, and each insert was filled with a 1-131 solution, placed in a Jaszczak phantom and imaged using a clinical SPECT/CT scanner. Recovery coefficients (RCs) were calculated for each insert and voxel dosimetry was performed on each image. The PVC algorithm was applied to the images and voxel dosimetry was performed on each corrected image. Both sets of dose distributions were compared to simulated values. Before PVC was applied, RCs varied between 0.42–0.71 and the median dose in each insert varied between 51–74% of the simulated. After applying PVC the RCs varied between 0.94–1.16 and the median dose varied between 0.86 – 1.1.

**P44. Quantification of radium-223 imaging as a precursor for patient dosimetry**

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"Maidstone and Tunbridge Wells NHS Trust, Maidstone, United Kingdom and bUCL, London, United Kingdom

Quantification of radium-223 in SPECT/CT phantom images and whole body planar patient images were investigated using the GE Discovery 670 gamma camera. Multiple energy windows containing the most abundant gamma energies of 84 keV ± 10%, 154 keV ± 10%, 269 keV ± 10%, 351 keV ± 5% and 403 keV ± 5% were examined, as well as a single energy window of 83.8 keV ± 10%. Sensitivity increased by > 100% with both MEGP and HEGP collimators when using multiple energy windows compared to the single window; 139.0 and 108.7 counts/sec/MBq respectively. However SPECT/CT quantification errors were greatly affected by the attenuation correction using CT, as it applied a weighted average of the attenuation correction coefficients for the multiple energy windows. Quantification of a Jaszczak phantom with SPECT/CT achieved a quantification error of 12% when using the single energy window of 83.8 keV ± 10%, which reduced to 10% when scatter correction windows were applied of 71.0 keV ± 5% and 97.1 keV ± 5%. Whole body planar patient image of patient immediately post administration obtained a quantification error of 44%, using multiple energy windows to increase sensitivity. This demonstrates that single window SPECT/CT is the most accurate scan type for quantification of radium-223.

**P45. Optimising [18F]F-FDG activity for 5 ring PET-MR whole body imaging**

Tom Sanderson, Marilena Rega, Anna Barnes, Asim AfQ, Francesco Fraioli, Simon Wan and John Dickson

University College London Hospitals NHS Foundation Trust, London, United Kingdom

Optimising administered activity for whole-body [18F]F-FDG imaging based upon patient body weight aims to ensure acceptable and consistent image quality across a range of patient weights and reduce patient and staff doses.

Imaging was performed on a 5-ring Siemens Biograph mMR. A NEMA phantom scan was used to determine the minimum administered MBq.mins.bed\(^{-1}\).kg\(^{-1}\) that meets EARL specifications (for PET/CT) for recovery coefficients and noise.

Twenty whole-body [18F]F-FDG patients were administered with a fixed activity of 370 MBq and imaged in list-mode for 3 mins.bed\(^{-1}\). In addition to a full-count reconstruction (A), two linear weight-based protocols (reconstructions B and C) were simulated by reconstructing with mins.bed\(^{-1}\) reduced accordingly for each patient to maintain consistent MBq.mins.bed\(^{-1}\).kg\(^{-1}\) across all patients.

Three experienced readers scored the image quality for all images on a 5-point scale, with a score greater than 3 defined acceptable. Lesion SUV\(_{\text{max}}\) was also analysed.

The phantom derived minimum activity was 9 MBq.mins.bed\(^{-1}\).kg\(^{-1}\) and this was therefore used for reconstruction B. Reconstruction C was performed at 12 MBq.mins.bed\(^{-1}\).kg\(^{-1}\). For reconstructions A, B, and C, 100%, 83%, and 98% of images were rated as acceptable or better, and the average image quality scores were 4.6, 3.9, and 4.5 respectively. A mean 5% increase in lesion SUV\(_{\text{max}}\) was observed at 9 MBq.mins.bed\(^{-1}\).kg\(^{-1}\) compared to the full-count image.

Imaging at 9 MBq.mins.bed\(^{-1}\).kg\(^{-1}\) met EARL specifications. However image quality was deemed unacceptable in 17% of reviews and SUV\(_{\text{max}}\) was unstable. Imaging at 12 MBq.mins.bed\(^{-1}\).kg\(^{-1}\) therefore provides a good compromise between dose reduction and image quality.

**P46. A Comparison of methods for the prevention of contamination of floors in bathrooms and wet rooms used by lutetium-177 radionuclide therapy patients**

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"Royal Free London NHS Foundation Trust, London, United Kingdom and bKing’s College London, London, United Kingdom

Introduction: Control of contamination in radionuclide therapy rooms is necessary to minimise its spread, reducing staff dose and decontamination time. Several products which prevent floor contamination are commercially available. This work aims to demonstrate their efficacy and pros and cons of their use.

Methods: Controlled spills of 0.5 ml of 0.76 MBq/ml lutetium-177 solution were performed on surface protection paper, plastic surface protector, incontinence pads and Bitumen paper. The ability of each covering to absorb...
liquid was noted. An Ortec scintillation counter was used to measure the proportion of activity transferred to samples of shoe sole pressed into spills on each surface, both when wet and after drying. Shoe samples contaminated with the solution were then 'walked' over each covering to see how well they removed contamination from the sole.

Results: Incontinence pads were most absorbent and transferred the least activity to shoe soles both when the spill was wet (5.4%) and dry (0.052%). Incontinence pads and surface protection paper removed the majority of transferable contamination from sole samples after two steps. Where activity was not absorbed, significant activities became detached from the material when it was removed from the floor. The plastic surface protector was quickest to use and left no sticky residue.

Conclusion: As larger spills could pool on their surfaces and dried-on activity may detach when they are removed, less absorbent coverings may be unsuitable for wetroom use. Stepping on absorbent pads could reduce the spread of contamination on shoes, but is insufficient to decontaminate them.

P47. Radioactive gel: A suitable material for making bespoke phantoms
Clare Jacobs
Nottingham University Hospitals, Nottingham, United Kingdom

Purpose: Most commercial phantoms in nuclear medicine are water filled Perspex phantoms. The use of gel as an alternative medium in which to distribute radioactivity was investigated. Gel has a number of favourable properties such as greater flexibility in design and the creation of a firm structure that contains the radioactivity which can be easily modified in shape.

Methods: The testing of suitable gel types included an assessment of setting time and temperature, ease of making, and stiffness of gel when set. Importantly, the uniformity of distribution of radioactivity in the gel was assessed by taking samples of the set product and placing in a sample counter.

Results: The distribution of radioactivity in the gel samples showed good uniformity to within 1% COV. The setting time for the proposed gel was around 10 min at room temperature; which makes it suitable for making phantoms.

Conclusion: Gel can be successfully used to make custom made phantoms or modify existing phantoms. Gel has been used to make a cardiac phantom in which defects can be added either pre or post setting of the gel. It has also been used to create a phantom for assessing sentinel node reconstruction parameters; as it creates a stiff medium in which point sources could be inserted at different depths.

Gel allows construction of phantoms that might otherwise be difficult to achieve with solely water based phantoms.

P48. A novel 3D printed cardiac phantom for SPECT and PET imaging
Clare Jacobsa, Ehab Salehc, Simon Boultera and Andrew Buttersa
aNottinham University Hospitals, Nottingham, United Kingdom and bUniversity of Leeds, Leeds, United Kingdom

Purpose: Commercially available phantoms are often expensive and inflexible in their design. Improvements in scanner imaging hardware and reconstruction algorithms mean there is a need to create phantoms with smaller imaging features to be able to test these capabilities.

Methods: A custom made cardiac phantom was designed and tested on a PET and nuclear medicine scanner. The design was based on creating a mould which could be filled with radioactive gel. The mould evolved initially from a wine glass, to a vacuum formed mould, and finally a 3D printed phantom. A stand was also designed and made for positioning the phantom at an anatomically realistic angle.

Results: With the aid of 3D printing, defects were made of 1cm size which could be placed at several locations within the ventricle. An apical attachment was made to model apical thinning. The inner and outer walls of the phantom could be placed off centre using an alignment scale to create non-uniform wall thickness, if desired.

Conclusion: A 3D printed cardiac phantom was successfully created with the desired flexibility for testing image quality when optimising image acquisition and reconstruction protocols. The phantom was tested on PET and nuclear medicine scanners. The cost of the 3D printed phantom is significantly cheaper than commercially available phantoms.

P49. A comparison of Q.clear and OSEM using list-mode resampling to simulate the noise in PET
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aEast Kent Hospitals University NHS Foundation Trust, Canterbury, United Kingdom, bKing’s College London, London, United Kingdom and cMaidstone and Tunbridge Wells NHS Trust, Maidstone, United Kingdom

Purpose: GE Healthcare’s Q.Clear software uses noise reduction and edge enhancement to improve image quality. The Q.SUVs calculated differ from standard reconstruction (OSEM) SUVs. PET quantification must be consistent for clinical use.

The difference in SUV of Q.Clear and OSEM, across varying noise levels, has been investigated using phantom data.
Methods: A NEMA IQ and modified Jaszcak phantom (spheres of diameter 9, 15 & 24 mm) were scanned on a GE Healthcare Discovery MI PET/CT. List-mode data was reconstructed using VPFX (ToF OSEM) and Q.Clear (β = 400), with resampling times between 0.5–4 min to simulate different noise levels.

A MATLAB® analysis programme, applying binary thresholding, automatically identified regions of interest to calculate SUV\textsubscript{max}, SUV\textsubscript{mean}, SNR, CNR, and contrast recovery (CR).

Results: SUV\textsubscript{mean} is consistent (<10% variability) with increasing noise for VPFX and Q.Clear. Q.Clear SUV\textsubscript{max} is overestimated (CR > 120%) at high noise levels. VPFX SUV\textsubscript{max} CR averaged 109%.

For all noise levels, Q.Clear SUV\textsubscript{max} is overestimated (CR > 105%) in 84% of lesions and underestimated (CR < 95%) in 17%. VPFX overestimates 33% and underestimates 33%; the largest and smallest spheres respectively.

CNR is increased for Q.Clear compared to VPFX, by a factor of 2, 2.15 and 2.52 for 9, 15 and 24 mm spheres respectively. Background SNR is increased by a factor of 2 for Q.Clear compared to VPFX.

Conclusion: The uncertainty of SUV\textsubscript{max} and SUV\textsubscript{mean} using Q.Clear and VPFX varies with sphere size and noise. The mid-sized spheres (10–20 mm) showed the greatest overestimate in SUV\textsubscript{max} for Q.Clear reconstruction of CR > 125%, compared to 102% for VPFX.

P50. Visual demonstration of aliasing in nuclear medicine imaging

James Elliot\textsuperscript{a}, Teri Crooker\textsuperscript{b}, Peter O'Sullivan\textsuperscript{b} and Tristan Barnden\textsuperscript{b}

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The purpose of this study was to demonstrate the occurrence and effect of the imaging phenomenon known as aliasing within non-clinical nuclear medicine planar imaging. Aliasing occurs when a source signal has a higher frequency than the highest sampling frequency and the Nyquist Theorem is not satisfied.

A series of three planar imaging spatial resolution tests were performed using a bar phantom quality test tool and Cobalt-57 flood source with a photomultiplier gamma camera (GE Discovery 670 NM/CT). Each image acquisition followed standardised scanning parameters (256×256 matrix, 1.0 zoom, 2000 k counts, and 122 keV energy window with 10% margin) but different collimator selection [Low Energy High Resolution (LEHR), Medium Energy General Purpose (MEGP), and High Energy General Purpose (HEGP)]. Images were processed using Xeleris Functional Imaging Workstation (version 3.1) using equal intensity values to ensure uniformity in image comparison.

The resultant images demonstrated different levels of change in visual appearance of the bar phantom, ranging from none with LEHR, moderate with MEGP and significant image distortion on HEGP collimator use. Bar phantom test tools use a series of lead bars at set spacings arranged horizontally or vertically to test spatial resolution. Aliasing distorted the bars into a diagonal appearance due to multiple factors, notably a reduction in collimator/phantom aperture frequency.

This study demonstrated artificial reproduction of aliasing artefact in planar imaging which could feasibly occur in clinical scenarios if incorrect equipment operation occurs. Appropriate collimator selection is therefore paramount to ensure optimal imaging acquisition and diagnostic value.

P51. Initial experience of \textsuperscript{99m}Tc-tektrotyd in patients with suspected neuroendocrine tumours (NET)

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Aim: The purpose of this study was to evaluate clinical utility of \textsuperscript{99m}Tc-Tektrotyd in assessing somatostatin-receptor density for diagnosis, staging and follow up of patients with NETs in our department.

Methods: Twenty seven patients (16 female, 11 male), who presented with query NETs, were scanned; 7 with gastro-entero-pancreatic, 4 with pulmonary carcinoids, 1 with rectal NET, 10 with abdominal gastric mesentery and 5 with adenocarcinoma.

SPECT/CT studies of the chest and abdomen were performed using a Siemens Intevo T16 gamma camera with low-dose hybrid CT. Images were acquired 3–4 h post intravenous injection of 700 MBq \textsuperscript{99m}Tc-Tektrotyd.

Results: 37% of patients scanned showed positive tracer uptake. All of the patients with pulmonary carcinoid or rectal history were reported negative for tracer uptake. Positive patients were treated with chemotherapy, radiotherapy and/or somatostatin analogue therapy. All treated patients were reported to respond well to NET therapy, indicative of a local positive prediction value of 100% for \textsuperscript{99m}Tc-Tektrotyd imaging.

Conclusion: \textsuperscript{99m}Tc-Tektrotyd is the radiopharmaceutical of choice in our department for NET imaging due to the same day imaging protocol and the short half-life, resulting in a smaller effective dose compared to \textsuperscript{111}In-Octreotide.
Locally SPECT/CT imaging with $^{99m}$Tc-Tektrotyd aids patient management and treatment planning.

$^{99m}$Tc-Tektrotyd has a high positive prediction rate for abdominal and pancreatic NETs, but further patient follow-up is required to determine false negative rates. However, the images demonstrated intense physiological uptake in the liver and spleen which may hinder interpretation.

**P52. $^{18}$F sodium fluoride PET/CT quantitative values relate to the bone involvement at the lumbar spine and femoral region for alkaptonuria patients**

Eman Alawadhi, Sobhan Vinjamuri, James Gallagher and L. R. Ranganath

**Aim:** The study aim is to assess bone involvement in lumbar and hip regions for Alkaptonuria (AKU) patients by measuring Hounsfield units from CT and standardised uptake value from PET. We aimed also to determine the correlation between HU, SUV and bone density value and testing age and gender effect.

**Methods:** A total of 39 AKU patients who underwent 18F-NaF-PET/CT and DEXA scans were enrolled in our study. Each gender was grouped into four groups stratified by decade of life. HERMES software was used to measure HU and SUV max for lumbar and femoral regions. The largest possible ROI was drawn in the axial slice, excluding the cortical margins. The effect of age in each gender was tested.

**Results:** There was no a significant difference in HU and SUV max between genders. HU values showed a significant correlation with increased age for both gender in L1-L5. Only HU for females in the femoral region with increasing age. SUV values were not changed significantly by age except in L1-L5 for males. There was no correlation between SUV max and T-score in both lesions, but moderate correlation with HU in lumbar region only. There was a significant correlation coefficient between HU and T-score in lumbar and femur region.

**Conclusion:** This study proposes a radiographic quantitative methods measuring from a single scan. SUV can be used as a quantitative method to quantify bone which convey bone metabolism. HU values could be useful in measuring bone density based on the strong correlation between HU and bone density value.

**P53. A tale of two hearts: Myocardial perfusion scintigraphy**

Adriana Correia, Jaya Choda, Richard Underwood, Kshama Wechalekar and Tiago Sousa

Royal Brompton & Harefield NHS Foundation Trust, London, United Kingdom

**Background:** A 26-year-old man underwent heterotopic heart transplantation aged 2-years because of a viral cardiomyopathy. The donor heart was positioned in the right chest with the native heart in the left chest. He developed donor coronary disease requiring multiple PCIs, and kidney failure leading to additional kidney transplantation. Myocardial perfusion scintigraphy was requested to assess viability and perfusion. We describe techniques used to acquire such information from both hearts.

**Methods:** Adenosine stress was uneventful. A one-day stress-rest MPS SPECT protocol was used with acquisition from right to left lateral using a dual-headed large field of view gamma-camera with the heads at 90°. QRS complexes were seen from both hearts but the native heart amplitude was too low for successful gating, which was successful only from the donor heart.

**Findings:** Orientation and review of the native heart was conventional and the images showed partial thickness myocardial scarring without inducible perfusion abnormalities.

Orientation of the donor heart was difficult from the SPECT images alone but was possible by comparison with a previously acquired CT scan. The images showed myocardial scarring (12% of donor myocardium) with inducible perfusion abnormalities (20% ischaemic burden) and mildly impaired LV function.

**Conclusion:** Myocardial viability and perfusion were successfully assessed in a patient with two hearts by modification of image acquisition and orientation with reference to a previous CT scan. ECG-gating of the native heart was hindered by low QRS amplitude but more flexible triggering hardware may have allowed function of each heart to be assessed separately.

**P54. Lung scintigraphy in the detection of right-to-left shunt – a peculiar case report**

Luisa Roldao Pereira, Tristan Barnden and James Elliot

Maidstone and Tunbridge Wells NHS Trust, Maidstone, United Kingdom

**Aim:** To raise awareness of the right-left shunt (RLS) imaging features within the NM community.

**Methods:** 34yo female patient referred for a Lung Scintigraphy with cough and low oxygen readings. Ventilation study performed successfully using SmartVent (total $^{99m}$Tc-DTPA activity of 80 MBq, statics acquired), followed by the perfusion study (127 MBq $^{99m}$Tc-MAA injection - immediate image acquisition).
Results: While the ventilation presented no significant defects, demonstrating normal homogeneous tracer activity, the perfusion showed thyroid, gastric and renal uptake. This extrapulmonary accumulation is characteristic of RLS.

Discussion: Satisfactory radiopharmaceutical QC. Good practice was followed in the handling of the MAA. Patient previously admitted to chest X-ray with sepsis suspicion and raised lactate values, ultimately reported as possible small left side pleural effusion. She was also referred for CTPA that excluded pleural and pericardial effusion, reported no evidence of PE but appearance of left lower lobe pneumonia. Reference to suspected dual superior vena cava non-classical drainage into left atrium, advising consideration of risk of shunts. Ideally, a WB scan and respective quantification would have been performed–brain uptake could exclude physiological fragmentation of particles and confirm RLS.

Conclusion: This case emphasises the importance of a sound knowledge of the pharmaceuticals normal biodistribution and its variants, but also the need to careful and systematically check relevant patient clinical history. It provided an excellent learning opportunity for the team who underwent a comprehensive review of the characteristic uptake patterns on related cardiac/pulmonary pathologies.

P55. Setting up local dose reference limits for orthopaedic bone SPECT/CT
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Objective: There is considerable national variation in the CT radiation dose while performing SPECT/CT procedures. National dose reference limits (NDRLs) have been proposed, but these do not account for different body parts scanned. The purpose of this audit is to set local diagnostic reference limits (LDRLs) for diagnostic quality CT examinations.

Methods: Data from the CT dose record, body region and dose range for SPECT/CT procedures for patients who had undergone SPECT/CT scans were obtained from PACS. All imaging was performed according to the department standard protocol. Only procedures which have 10 or more patient’s studies have been used to set LDRLs. The mean and standard deviation of dose length product (DLPs) and CTDIvol for different body parts was calculated, and the LDRL investigation level was set as 20% above the mean. Results were compared with national diagnostic references levels (NDRLs).

Results: 128 patients were included in the audit over a six month period. LDRLs were set for wholebody, thorax, hips, lumbar spine and knee SPECT/CT scans. The CTDIvol LDRLs were 4.8, 7.6, 21.5, 18.3 and 19.3 mGy respectively.

The whole-body SPECT/CT CTDIvol was 7% less than the whole-body PET/CT CT dose proposed by the NDRL.

Conclusion: LDRLs were set for several examinations and changes to CT acquisition parameters were made to reduce the dose. When it comes to orthopaedic CT, optimisation of CT for each body part needs to be considered when determining DRLs.

P56. 68Ga-DOTATATE uptake in normal tissue and neuroendocrine lesions after somatostatin therapy
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King’s College Hospital NHS Foundation Trust, London, United Kingdom

Introduction: 68Ga-DOTATATE is used for imaging neuroendocrine tumours. Standard management includes somatostatin therapy. EANM guidelines recommend scheduling imaging prior to the next therapeutic dose, as this may affect uptake of 68Ga-DOTATATE. It may also affect the Krenning score (lesion to liver ratio) used to determine suitability for peptide receptor radiotherapy (PRRT).

Aim: To determine whether the timing of somatostatin therapy has an effect on the uptake of 68Ga-DOTATATE.

Methods: Retrospective analysis of 28 68Ga-DOTATATE patients on long acting somatostatin therapy; analysed by time from somatostatin therapy to imaging. The SUV\textsubscript{max} was measured for normal organs; up to 5 prominent metastases in the liver. The ratio of liver metastases to liver background was calculated.

Results: The median (range) interval between somatostatin therapy and 68Ga-DOTATATE for group A is 5 days (1–12) and group B 23 days (16–28).

The SUV\textsubscript{max} mean ± SD for normal organs (A vs. B):
- Pituitary 8.4 ± 3.5 versus 9.3 ± 2.1 \( P = 0.635 \)
- Thyroid 1.9 ± 1.2 versus 2.0 ± 0.7 \( P = 0.194 \)
- Liver 6.7 ± 1.9 versus 6.1 ± 1.3 \( P = 0.614 \)
- Spleen 18.8 ± 8.7 versus 15.2 ± 5.4 \( P = 0.430 \)
- Adrenals 12.9 ± 4.8 versus 13.4 ± 3.9 \( P = 0.982 \)

The SUV\textsubscript{max} mean ± SD for Liver metastases (A vs. B):
- 15.3 ± 8.6 versus 16.8 ± 11.1 \( P = 0.705 \)

The liver metastases to liver background ratio (A vs. B):
- 1.6 ± 1.0 versus 2.2 ± 1.1 \( P = 0.780 \)

Conclusion: There is no statistically significant difference in the SUV\textsubscript{max} for normal organs or liver metastases between
the groups. This suggests patients can be imaged at any
time after somatostatin therapy and the Krenning score
may be applied to select patients for PRRT.

**P57. An extended syringe shield device for the reduction of extremity doses to PET radiographers/technologists when dispensing PET Tracer for administration to patients**

Carola Houpta, Sorcha Curry, Armidita Jacob, John Joemon, Sofia Pereira, Jane Mackewn, Phil Halsted, Paul Deacon-Smith and David Gallacher

*PET Imaging Centre and School of Biomedical Engineering and Imaging Science, King’s College London, London, United Kingdom and Medical Physics, Guy’s and St Thomas’ NHS Trust, London, United Kingdom*

The radiation dose received by technologists/radiographers working in PET can be very high. At the PET Centre at St Thomas’ we routinely scan close to 30 patients a day using three PET/CT scanners with a group of 10 radiographers/technologists. Through careful design of the department, development of workflows and training, the body dose staffs receive falls inside the classification limits. Unfortunately, our extremity dose is high particularly to the fingertip. Additionally, a factor is required to accurately estimate the fingertip dose because our approved dosimetry service uses ring TLDs, worn at the base of the finger, to measure extremity dose.

Using an Unfors EDD30 monitor we identified the manipulations during the dispensing process that resulted in the greatest dose. This occurs after the tracer has been drawn up into a syringe, when the radiographers attach it to a line for injection and then insert the syringe into a lead carry case used for body dose reduction at injection. We designed and built an extended syringe shield that allows the radiographer to keep their hand much further away from the tracer.

An assessment of the effectiveness of the device was undertaken by measuring the fingertip and finger base dose received by one radiographer three times using our old method of drawing up tracer versus the new method. Using the device resulted in a reduction in extremity dose of approximately 50% and a reduction in the ratio between the fingertip and base of finger from approximately 4:4:1 to 2.5:1.

**P58. Unexpected sestamibi uptake as seen on parathyroid scintigraphy**

Tristan Barnden, James Elliot, Luisa Roldao-Pereira and Meeran Naji

*Maidstone & Tunbridge Wells NHS Trust, Maidstone, United Kingdom*

\(^{99m}\text{Tc-Sestamibi}\) is a commonly used for the identification of abnormal parathyroid tissue. Its mechanism of uptake means that \(^{99m}\text{Tc-Sestamibi}\) accumulates in the region of the mitochondria and therefore allows visualisation of parathyroid adenomas due to accumulation in the mitochondria rich oxyphil cells. However, this uptake mechanism also means \(^{99m}\text{Tc-Sestamibi}\) can also accumulate in a variety of benign and malignant tumours. The purpose of this study is to demonstrate unexpected uptake of \(^{99m}\text{Tc-Sestamibi}\) during parathyroid scintigraphy, and to educate the nuclear medicine practitioner in the appearances of these unusual uptake patterns.

Parathyroid scintigraphy images from a district general hospital were assessed for unusual and unexpected \(^{99m}\text{Tc-Sestamibi}\) uptake patterns during routine parathyroid scintigraphy examinations; three notable examples were identified. Case reports, with images, of these 3 studies will be presented.

The first of these cases demonstrate unusual \(^{99m}\text{Tc-Sestamibi}\) uptake in a patient suffering from Graves disease. The second case demonstrates \(^{99m}\text{Tc-Sestamibi}\) uptake in sub-clavicular brown fat, and the third case demonstrates \(^{99m}\text{Tc-Sestamibi}\) uptake within a destructive bone lesion, most likely myeloma.

This poster emphasises, to the Nuclear Medicine team, the possible unexpected findings that can be demonstrated when using \(^{99m}\text{Tc-Sestamibi}\), and to appreciate the relevance of these unexpected uptake patterns.

**P59. Are finger dosimeter doses related to the activity handled by technologists working in nuclear medicine and PET/CT?**

Jasmine Cheesewright, Joana Machado and Laura Martin

*Royal United Hospitals Bath, Bath, United Kingdom*

The aim of this study is to investigate whether the radiopharmaceutical administration distribution between technologists relates to finger dose.

A total of 7 technologists were included in this study. Four of these technologists also performed PET/CT. We recorded the injections that were being performed by each member of staff and the activity they were handling during administration during October and November 2018.

An Excel-analysis was developed to determine the number of administrations each technologist was performing and how much activity each technologist was handling. Graphs were produced to demonstrate this analysis for each technologist during this period of time, and to assess the relationship to the finger dose recorded.

A total of 501 radiopharmaceutical administrations were performed. Our results show there is an unequal distribution of administrations between technologists. The technologist handling the highest recorded activity and performing the highest percentage of injections works only in Nuclear Medicine and had the lowest finger dose record.
The highest finger doses were recorded for technologists who work in Nuclear Medicine as well as in PET/CT. The technologist receiving the largest finger dose was also handling the highest percentage of activity in October. The finger doses received by each technologist varied over the months in 2018.

Technologists working in PET/CT receive the highest finger dose. When working in Nuclear medicine and PET/CT the finger dose can be reduced by improving technique. We would recommend that technique is standardised for administration to reduce the variation between technologists.

**BNMS Student Prize 2nd Place**

**P60. Validation of half-time whole body bone scan acquisition**

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**Introduction:** Following EANM guideline, the standard Whole body (WB) bone scan takes approximately twenty minutes to acquire (10–15 cm/min). This procedure can be modified by using a processing algorithm named Enhanced Planar Processing (EPP), applied on the data acquired in half the time but achieving similar quality due to noise reduction and deblurring features.

**Objective:** To validate the half-time WB bone scan in the new Siemens Symbia Intevo.

**Methods:** Twelve patients were injected (mean 99mTc-HDP activity of 590 MBq) and scanned three hours later. First, patients had the standard protocol and afterwards, another scan (24 cm/min). These last images were processed with the EPP. Two NM Physicians and the Chief Technologist assessed both sets of anonymised images according to the ‘hotspots’ and image quality (Poor, Sufficient Good). Uniformity was assessed by measuring the Coefficient of Variation (CoV); a resolution phantom measured the Full Width at Half Maximum to determine how EPP affects spatial resolution.

**Results:** The observers graded most of the full and half-time images as Sufficient (50.8% and 43.5%). In the processed images the observers found more ‘hotspots’. The CoV in the corrected images are lower and image resolution decreases with lower counts, being more noticeable with EPP.

**Conclusion:** Preliminary results demonstrate similar image evaluations; however a larger sample and more observers are advisable. If the study proves that the images are visually the same but take less time to acquire, this could replace the standard scan, leading to significant improvement in patient comfort and department workflow management.

**P61. Establishing a SUV\textsubscript{mean} for liver uptake in ⁶⁸Ga-PSMA and ⁶⁸Ga-dotatate imaging**

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**Introduction:** Assessing the mean Standard Uptake Value (SUV) values over the liver is a potentially useful tool to alert if incorrect data, such as dose and time, has been imputed incorrectly onto the imaging protocol which can result in incorrect data being reported. Through a retrospective analysis we investigate if a range of liver SUV\textsubscript{mean} values can be established for this purpose for ⁶⁸Ga-PSMA and ⁶⁸Ga-Dotatate imaging.

**Methods:** A total of 93 patients underwent ⁶⁸Ga-PSMA while 32 patients underwent ⁶⁸Ga-Dotatate imaging. Patients with liver metastasis were excluded from this analysis.

Using HERMES processing program, a spherical region of interest (ROI), standard size of 3 cm, was drawn over the median portion of the liver’s right lobe, and the SUV\textsubscript{mean} recorded.

**Results:** For ⁶⁸Ga-PSMA the SUV\textsubscript{mean} varied from 2.06–9.32, with an average of 4.6 and standard deviation (SD) of 1.3; while for ⁶⁸Ga-Dotatate the SUV\textsubscript{mean} varied from 3.28–9.88, with an average of 7.1 and SD of 1.4. No relation was established between the SUV\textsubscript{mean} and the dose administered, uptake time and lean body mass for both ⁶⁸Ga-PSMA and ⁶⁸Ga-Dotatate.

**Conclusion:** A wide range of SUV\textsubscript{mean} values was observed, which can limit its usefulness, though creating a range of 3.3–5.9 for ⁶⁸Ga-PSMA imaging and 5.7–8.5 for ⁶⁸Ga-Dotatate could be a potentially useful tool in alerting for if incorrect data was imputed into the imaging protocol.

**P62. Achieving the paper free clean room and improving data trending through the utilisation of the electronic quality management system**

Chris Marshall and Peter Llewelyn
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For some time, PETIC had been looking to eliminate the use of paper forms in its’ clean room to reduce the risk of contamination of the final product. In addition, the use of multiple paper forms made performing tasks such as Out of Specification and Environmental Excursion investigations and Product Quality Review (PQR) and difficult and time consuming task. The aim of this project was to digitise all data collection in the clean and enable the data to be acquired in a simple manner through the
use of tablet computers and the Occurrence module of Q Pulse.

All forms in our electronic document management system were reviewed and given a score based on four questions.

1. Form used in the Clean Room (1000)
2. Form provides data for Key Performance Indicators (100)
3. Form provides data for PQR (10)
4. Form could lead to an Incident being raised (1)

All forms were given a total score and ranked to provide an order for their implementation and a formal Change Control program was created. All forms were then programmed into the Occurrence module of Q Pulse and trialled in parallel with paper forms for a period of time. Once the form design was approved, the paper form was removed from use.

All paper forms have now been removed from the clean room and the data is available in a digital form which now enables improved trend analysis and greatly improves the ability of quality control to undertake OOS and PQR.

P63. Factors affecting I-131 and Tc-99m thyroid uptakes in benign thyroid disease
Amna Al Jabri, Jennie Cooke, Seán Cournane, and Marie-Louise Healy

Radioactive iodine has been used as a treatment of benign thyroid disease since the 1940s. The treatment is given by the administration of a fixed activity of radioiodine ($^{131}$I), however, there is increasing evidence that personalised dosimetry-based treatment has a higher success rate and better outcome. Pre-therapeutic dosimetry uses a tracer of $^{131}$I followed by one or more uptake measurements, to assess the $^{131}$I kinetics in the thyroid and calculate its uptake ($^{131}$IU). Some published studies (Gorur et al., 2009. 50:434–34. J Nucl Med) have eliminated the need for pre-therapeutic dosimetry assessment by estimating $^{131}$IU value using technetium-99m uptake ($^{99m}$TcU). The latter is estimated from $^{99m}$Tc scintigraphy scans, which is part of the patient diagnosis; however the question remains as to whether $^{99m}$TcU accurately reflect $^{131}$IU or whether there are other parameters affecting its accuracy. Accordingly, a study sample of 133 benign thyroid disease patients (100 women and 33 men) was used, examined between 2012 and 2018 in St James’s Hospital, Ireland. The relationship between $^{131}$IU and $^{99m}$TcU values was examined in the context of thyroid function test (TFT) and demographic data. Results showed the gender have a significant effect on the $^{131}$IU versus $^{99m}$TcU correlation ($R^2 = 0.90$ for men vs. $R^2 = 0.27$ for women). Free Thyroxin and Thyroid Autoantibodies from TFT were shown to have a statistically significant correlation with uptake values ($P < 0.05$). Subsequently, the estimation of $^{131}$IU based on $^{99m}$TcU alone is not recommended, as the investigated parameters would affect the correlation between the two.