Abstract

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P01. Can Natural Language Processing Using Artificial Intelligence Identify Metastatic Status in [18F]FDG PET-CT Reports of Lung Cancer?

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Abstract

Introduction: Metastatic (M1) disease in [18F]FDG PET-CT lung cancer reports represent stage IV cancer and will have a major impact on a patient’s treatment pathway. PET-CT reports are free text, and this makes it difficult to retrospectively identify M1 staging in a cohort of patients without manually reading every report. Recent developments in artificial intelligence and natural language processing (NLP) provide new methods to retrieve this information automatically. Accordingly, we created a classifier to identify lung cancer reports that contain M1 disease.

Methods: A nuclear medicine physician labelled 1851 PET-CT lung cancer reports from King’s College London and Guy’s and St. Thomas’ PET Centre for M1 status. The task was framed as binary classification and a domain adapted pre-trained language model (GatorTron) was fine-tuned on a training set of 1489 reports. The remaining 362 reports were used for evaluation and testing. As we did not have data from an external centre no individual patient data were present in both training and test sets.

Results: An accuracy of 94% and AUROC of 0.97 was achieved on the test set demonstrating the model can differentiate between M0 and M1 staging.

Conclusions and future work: M1 status in lung cancer can be extracted from unstructured PET-CT reports using NLP. This has potential applications in retrospective analysis and audit of reports and clinical alert systems. We are acquiring external data to further test the models and are currently developing models which categorise multiple finding types simultaneously using TNM staging.

P02. Automatic Classification of Inflamed Joint Regions in Rheumatoid Arthritis using Deep Networks with [99mTc]Tc-maraciclatide imaging

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Abstract

Aims: A novel radiotracer [99mTc]Tc-maraciclatide (Serac Healthcare, UK), is being developed as an adjunct to MRI and ultrasound for detecting and monitoring rheumatoid arthritis. This research aims to develop a deep network to identify inflamed regions on [99mTc]Tc-maraciclatide scans of the hands and wrists.

Methods: Using a dataset of 96 wrist and hand scans (48 patients, palmar and dorsal views) with Boolean inflamed/non-inflamed labels for the wrist, metacarpophalangeal joints, and interphalangeal joints labelled by a nuclear medicine physician (GC), a deep learning model was trained to predict these labels (2x3=6 outputs per image). A DenseNet (Huang, Gao, et al. “Densely connected convolutional networks.” IEEE CVPR, 2017) model is used to classify each region of inflammation. The model was trained using an Adam optimiser (learning rate 0.0001 with binary cross entropy (BCE) loss). The network was trained using an 80:10:10 train, validation, test split for a maximum of 10,000 epochs with early stopping if the BCE loss over the validation dataset does not improve by 0.001 in 100 epochs.

Results: In a 10-fold cross fold the model predicts inflamed status with an accuracy of 0.776 ± 0.102 (specificity 0.752 ± 0.138; sensitivity 0.832 ± 0.121).

Conclusion: Our initial results are promising for being able to classify inflamed vs non-inflamed hand and wrist joint regions in rheumatoid arthritis from a [99mTc]Tc-maraciclatide scan using a deep learning model. Work is ongoing to further improve the performance of the model and to predict more joints within the hand.

References


P03. The Utility & imperfections of ChatGPT - Dabbling in domain-specific Chatbots

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Abstract

Purpose: There is a surfeit of nuclear medicine and radiology literature on conversations with ChatGPT exploring applications for both patients and healthcare providers.

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Whilst knowledge-based accuracy has vastly improved over the two iterations (i.e. ChatGPT3.5 & 4.0), reservations remain. We aim to leverage the more analytical (as opposed to knowledge-based) facet of this generative AI technology, wherein the user inputs the information dataset to be analysed.

Methods: 10 technologists enlisted to perform two exercises on ChatGPT3.5. (A) Use keywords to frame questions on patient preparation and aftercare. (B) Input verified information of relative complexity, (e.g. preparation for FDG PET in diabetes & radiation related cancer risk) and ask for simplified explanations. In addition, as a separate exercise(C), the authors trialled domain-specific chatbots using open-source customisable (GPT3.5 based) technology. We created topic-based chatbots on discrete subjects, such as Institutional IR(ME)R procedures and ARSAC guidance notes and tested responses to topic-specific questions.

Results: Exercise(A) showed 50-60% accuracy. Exercise(B) generated clear simplified versions of most concepts and procedures with 80-90% usability ratings. Chatbot exercise(C) revealed 80-100% accuracy, some lapses seemed related to formatting errors, reflecting our inexperience.

Conclusion: Leveraging the capability of large language models(LLL) that underpin ChatGPT3.5 & 4.0, to simplify technically complex information reliably (rather than search new information) is a potentially agile tool for healthcare providers in everyday practice. Similarly, even our amateur efforts with domain-specific chatbots suggest these may have value as interactive virtual assistants improving access and conversational understanding of protocols and imaging algorithms.

References

P04. Students in Nuclear Medicine, Reflections of a Clinical Liaison Radiographer and a Student.

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Abstract
In England, radiography undergraduate students have to undertake modality rotations as part of their clinical placement experience. This will involve at least one week per year rotating through nuclear medicine. This poster will present the reflections of a Clinical Liaison Radiographer (CLR) and a recently graduated student pertaining to student time in nuclear medicine. The CLR and the student work in the Nuclear Medicine department at Maidstone Tunbridge Wells NHS Trust.

The aim of combining these two reflective cycles into one reflective narrative is to promote
and strengthen the experiences of radiography students during their limited exposure to the department. The Rolfe et al. (2001) model of reflection is used to provide a framework for these reflections.

From these reflections, it was felt that tailoring the tasks and experiences of students in each subsequent year of study to better reflect their wider radiography training, in this case, specific to Canterbury Christ Church University (CCCU), would help to engage students more during their time in nuclear medicine.

An updated workbook for students to use is currently being created based on this work. The aim is to utilise knowledge of CCCU’s radiography curriculum and a spiral curriculum model (Bruner, 1960) to enable students to find their time in nuclear medicine becomes a way to enhance their other radiography studies as well as increase their exposure to the work of a radiographer in nuclear medicine.

References

P06. Variations In Referral Patterns Across NHS-England for $[^{18}F]FDG$ PET-CT

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Abstract

Purpose: This study aims to highlight differences in referral patterns and scanning accessibility for $[^{18}F]FDG$ PET-CT across England.

Methods: Analysis based on comprehensive examination of existing data available across Alliance Medical and some non-Alliance sites, against RCR 2016 PET-CT referral guidelines; coupled with in-depth review of our referrer/referrals database. PET-CT scanner distribution, referral criteria, and regional healthcare practices - evaluated for 2021-2022.

Results Summary: Regional disparities in PET-CT scanner availability still exist, with urban centres and larger teaching hospitals in England enjoying greater access; but scanners have been installed in some Community Diagnostics Centres. While RCR referral guidelines heavily influenced referral patterns and referral rates primarily correlated with cancer diagnosis/staging/treatment planning, there were other mitigating factors: Namely, research initiatives and clinical trials in certain areas, patient choice related to scanner geography; waiting times and private healthcare facilities had almost no effect. Some cancers, like melanoma, breast and oesophageal/upper GI malignancy, showed the greatest variability even between neighbouring regions (graphs and more details in poster). Lung cancer and lymphoma, accounting for the majority of referrals, were the most consistent, although timing of $[^{18}F]FDG$ PET-CT scan within patient’s pathway varied across regions.

Conclusion: Ongoing variation in PET-CT referral patterns across England exist despite increasing availability of PET-CT, with variations closely tied to perceived availability of scanners between regions. Ensuring equitable access to PET-CT resources and maintaining consistency in referral practices remain crucial for optimising patient care. Further work is ongoing to continue to optimise services.

References
1. AML/NHS-E referral data as part of NC1 and NC2 contract

P06. Nuclear data for medical radioisotope production in nuclear reactors

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Abstract

This work relates to an ongoing project on the optimisation of the production of radioisotopes in medical generating reactors. To understand the changes required to be implemented in the reactor, one must identify and gather qualitative and quantitative information relevant to the production process. These important considerations are made: ageing reactors which are near the end of life, which might come with shortages issues in the near future (Knapp Jr, 2001), radionuclides with special characteristics (emission of $\gamma$ particles alongside with $\alpha$ or $\beta$ particles) for theanostic (Van de Voorde et al., 2019) and novel radionuclides undergoing clinical trials or being considered for new forms of targeted treatments (Jean-François Chatal et al., 2018).

This work presents the findings made during the first stage of the project. A total of 24 medical radioisotopes have been identified, along with their production route. A sensitivity analysis followed this for each nuclear reaction, focusing on the decay chains and nuclear data. From the nuclear data perspective, the best energy ranges that should be targeted for the various radioisotope cross-sections were identified. Finally, a preliminary cost analysis was carried out, focusing on the natural abundance of
P07. Using Automation to Quantitatively Assess Lymphoscintigraphy Images

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Abstract

Lymphoscintigraphy is a pivotal diagnostic imaging technique for detecting lymphoedema. However, the qualitative assessment of lymphoscintigraphy images often falls short due to the time-consuming and inconsistent nature of manual region-of-interest identification in clinical settings. In this study, we present an innovative approach to automate the quantitative assessment of lymphoscintigraphy images in the feet, knees, pelvis, and abdomen. Our method employs a Laplacian of Gaussian filter to detect radiopharmaceutical uptake regions automatically. Subsequently, we draw rectangular bounding boxes around these detected regions, and a non-maximum suppression algorithm is applied to group adjacent boxes. This automation was rigorously tested on a sample of ten patients, who had previously undergone manual quantification by clinicians, allowing us to compare the results obtained from both methods. Some of these patients had abnormalities such as swelling in the foot and high bladder uptake. Our results reveal an outstanding level of agreement between automated and manual quantification methods, with a maximum deviation of only 0.5% observed for pelvic uptake and 4% for the 2-hour clearances in the feet. This study demonstrates a promising advancement in the field of lymphoedema diagnosis, streamlining the quantification process, and enhancing the consistency of results. By automating this critical aspect of lymphoscintigraphy, we aim to improve the efficiency of lymphedema diagnoses and ultimately contribute to enhanced patient care.

References


P08. Characterisation of an automatic dose dispenser for mobile PET-CT

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Abstract

Aims: The aim of this study is to characterise the performance of an automatic dose dispenser (ADD) used for controlled filling and emptying of syringes for [18F]-FDG dispensing. Manual dispensing of PET radiopharmaceutical is currently performed on the mobile PET-CT which contributes to high finger dose to the operator. The system performance of the ADD is evaluated before rolling out across the mobile fleet.

Methods: Weight-based measurements were carried out using a calibrated balance with an accuracy of ±0.0001g and saline to evaluate the minimum volume, precision and accuracy of volumes drawn up and residual volume. The pressure equalisation and recap features of the ADD were also tested. The system was tested using a range of syringe size and different brands. Droplet contamination is expected when a single vial is repeatedly pierced and emptying large volumes should be minimised if possible.

Results: The unit dispenses larger minimum volume than specified, with an accuracy of ±0.03 ml and ±0.2 ml for 3 and 5 ml syringes respectively. The precision of drawing up is < 1% and residual volume < 0.1 ml. The pressure equalisation feature ensures that pressure is normalised during filling up but is not activated during emptying.

Conclusion: The ADD achieved good accuracy and precision for a range of volumes. It is calibrated in factory and set up to work with a range of syringe size and different brands. Droplet contamination is expected when a single vial is repeatedly pierced and emptying large volumes should be minimised if possible.

References

P09. A simple gamma probe system for SeHCAT tests: 10 year review

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Abstract

Purpose: In 2013, a gamma probe system for SeHCAT tests was designed, built and implemented to ease the burden on camera capacity. This consists of a 5 inch scintillation detector, placed inside a lead sheath, powered via a laptop. The detector attaches to the wall above a bed. Patients are counted for 5 minutes (and post).

This review summarises the performance and acquisition statistics of the system over the subsequent 10 years.

Methods: SeHCAT result files acquired from patients since 2013 were analysed in python to provide summary statistics. A random sample of 20 cases was selected for calculation of relative uncertainties on retention fraction values. Additionally, quality control reports and maintenance records were examined to look for deviations in performance.

Results: There were 2636 patients scanned using the gamma probe system (44% considered abnormal with retention <15%). Mean count rate detected from patients on day 0 was: Anterior - 126.0cps (SD 22.9 cps) and posterior - 61.2cps (SD 15.9 cps).

Mean uncertainty on retention measurements was 7.0%, though for cases near the normal boundary (retention of 10-20%) the mean was 3.7%.

There have been no breakdowns and no significant deviations in performance recorded from routine QC since 2013.

Conclusion: Results show that a simple gamma probe system can provide a reliable means of performing SeHCAT tests without impacting on camera capacity.

Count rate statistics are adequate for achieving acceptable measurement uncertainties in short scan times, but could be improved through the use of wider energy windows.

P10. Impact of iterative metal artefact reduction (iMAR) methods with varying kernel sizes on computed tomography-based attenuation correction maps

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Abstract

Purpose: Metallic implants can lead to metal artifacts in CT images, affecting their quality by creating dark and
Methods: An in-house-developed total knee replacement (TKR) phantom with cortical and trabecular bone compartments and a metal prosthesis insert was scanned using \[^{18}F\]FDG PET-CT to acquire images with metal artifacts. Two different CT image kernels, one sharp (Br59) and one smooth (Br38), were employed to create attenuation correction maps for the phantom PET images and corrected using iMAR. The corrected u-maps were compared to the standard CT-based u-map with no iMAR to see if there is any difference. MATLAB was used to measure mean pixel values and standard deviations from the target area around the prosthesis in both the artifact-corrected and uncorrected u-maps.

Results: Relative to the uncorrected u-maps the corrected u-maps showed reduced visual streaking in the images, lower pixel values in areas away from the implant, and higher values in the immediate vicinity of the metal implant. The sharp kernel u-maps demonstrated higher pixel values than the smooth kernel in the periprosthetic area.

Conclusion: The iMAR algorithm with smoother kernels was found to improve activity estimation, particularly in the periprosthetic areas.

References

P11. Specialist centre 10-year audit to study the trend in Spinal CT doses when CT is performed with diagnostic intent, as part of Bone SPECT-CT.

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Abstract

Methods: Annual Spinal CT Local Diagnostic Reference Level (LDRL) audit data using median Dose Length Product (DLP) estimates over 10-years (2013-2022) pertaining to spinal Bone SPECT-CT examinations was grouped by anatomical volume (cervical, thoracic, lumbar spine) and absence or presence of metalwork, native or instrumented spine (2015-2022), all told, totalling n > 800 studies. The year-on-year trend in LDRL’s in each sub-group was correlated with local protocol revisions

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and changes in vendor hardware/software. Literature searched for national Spinal CT DRL data.

**Result summary:** Stability or reduction from baseline CT LDRL, in the range of 85-50% observed in native spine sub-groups, correlated with local protocol revisions and iterative reconstruction software. Median DLP decreased by 8%, 21% and 51% for native cervical, thoracic and lumbar spine groups, respectively. In the instrumented spine, stability or a 5-17% reduction compared to baseline LDRLs observed, aligned closer with original vendor acquisition parameters. Relative paucity of spinal CT DRL data in SPECT-CT literature, limited a meaningful comparison with national practice, albeit LDRLs were similar or lower than national DRLs for closest equivalent procedure.

**Conclusion:** As Bone SPECT-CT finds greater adoption in management of spinal disorders, optimising dose reduction, whilst maintaining image quality is crucial. This local audit could serve as a potential starting point to build a national reference data base for diagnostic CT in SPECT-CT practice. As majority of SPECT-CT scanners, bar some, house less advanced CT systems, it is pertinent to encourage industry to modernise technology.

**References**
2. Verfaillie & Bachet 2020 D2.10: ec.europa.eu

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**P12. Fundamentals of Auditing in Nuclear Medicine & PET-CT**

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**Abstract**

Clinical audits are fundamental to any healthcare setting. Audits form part of continuous improvement, a tool used to evaluate current processes and systems to deliver the best practice, and overall improve patient care against a defined standard.

This work focuses on the principles of auditing used in an imaging setting. A systematic review of the local internal audit process was conducted in the department. The identification of gaps and the implementation of process improvements have not only resulted in effective and efficient auditing, but also our approach to auditing in the department.

A case study will outline an example of the impact of the improvements made to the process which has brought about meaningful results leading to >85% compliance against internal audit program.

Successful implementation of improvements to the internal auditing process encouraged staff to take ownership of the process, to become familiar with key aspects of auditing and understanding the importance of auditing as a tool for continuous improvement.

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**P13. Interventional Radiologists performing SIRT - Is classification necessary?**

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**Abstract**

**Background:** Handling [90Y]microspheres for Selective Internal Radiation Therapy (SIRT) represents one of the highest radiation-risk activities undertaken by Nuclear Medicine staff. Whilst workers handling the raw product are typically classified, it is less clear whether this is required for interventional radiologists (IRs) delivering the treatment. In order to estimate the skin dose that could be received by IRs in an accidental release of [90Y]microspheres, a simulated spill was conducted using the same equipment and techniques used in clinical practice.

**Method:** An administration box containing 250MBq of [90Y]SIR-Spheres® was prepared as would be done for clinical administration. The product was delivered onto a saline bottle covered with a surgical glove, simulating a catastrophic leak onto the IR’s hand. PET-CT imaging of the spill was used to quantify the activity distribution. Modelling using Varskin+ v1.1 was used to estimate the skin dose from the exposure.

**Results:** PET-CT imaging demonstrated a hot-spot on the target containing approximately 2.2MBq of [90Y] microspheres spread across 5 cm2. Varskin simulations of a 1-minute exposure gave an estimated Hp07 dose of 11 mSv. If a higher concentration of microspheres had been used, leading to ten times this dose, the exposure would still be below the 150 mSv classification threshold.

**Conclusions:** The results of this work suggest that, with suitable training and contingency planning arrangements, it is unlikely that IRs would exceed 3/10ths of the skin dose limit in the event of an accident during SIRT, and so classification would not be warranted on this basis alone.

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**P14. Comparative Analysis of Close Contact Restriction Calculation Methods for Radiiodine Ablation Patients**

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**Abstract**

**Calculation Methods for Radioiodine Ablation Patients**

**Background:** Handling [131I]microspheres spread across 5cm2. Varskin simulations of a catastrophic leak onto the IR’s hand. PET-CT imaging of the spill was used to quantify the activity distribution. Modelling using Varskin+ v1.1 was used to estimate the skin dose from the exposure.
Abstract

Study Purpose: Radioiodine ablation therapy contact restrictions are necessary to ensure public radiation protection. Three methods for calculating durations of adult and children close contact restrictions were compared for 23, 1100 MBq radioiodine ablation patients.

Methods: The three methods of calculating contact restrictions were:

- Cohort Dose Rate Curve Integration (Barrington S.F., 1996, 23(2), pp.123–130 Eur. J. Nucl. Med.) in which exposure to close contacts is calculated by integrating the dose rate time curve for a cohort of patients according to a periodic contact pattern.
- Adapted Cohort Dose Rate Curve Method, in which a patient's individual activity retention percentage at discharge from hospital is used to forward project along the cohort dose rate time curve prior to integration.
- Dose Rate Extrapolation (Wadsley J. 2022, Jan;35(1):42-56 Clin. Oncol) in which measured patient dose rates are extrapolated on a logarithmic graph to determine when excretion will intersect predefined dose rate thresholds for ending restrictions.

Results: Median adult close contact restrictions were 0.9, 12.6 and 13 days for dose rate extrapolation, adapted cohort and cohort methods respectively. Median restrictions for children were 1.8 days for dose rate extrapolation, 6.1, 9.8 and 12.6 days for adapted cohort method and 7, 11, and 14 days for cohort method children aged 0-2, 2-5 and 5-11 years, respectively.

Conclusions: These finding reveal differences in restriction duration between methods. The cohort method provides a standardised approach, the adapted cohort and extrapolation methods offer personalization, striking a balance between a periodic method and the cohort method.

References

P15. Dosimetric modelling of extravasation events in nuclear medicine: preliminary findings

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Abstract

Purpose: There is no standardisation in the management of extravasation events in nuclear medicine involving diagnostic and therapeutic doses. This study aims to establish a realistic geometry for dosimetric modelling of extravasation using Monte Carlo simulation, and to validate and optimise the VARSKIN models with the ‘gold standard’ model.

Methods: A survey was carried out to better understand the frequency and current practices in managing extravasations in the UK. To establish a ‘gold standard’ model, tissue equivalent material was used to simulate different extravasation scenarios, by injecting CT contrast material. The phantom was imaged using CT, and the relevant structures were segmented and used as the reference activity distribution for inputting into the Monte Carlo code. This ‘gold standard’ model will then be used to compare to dose estimates calculated using the VARSKIN models that are limited to a point source geometry.

Results: From the audit (n=13), the rate of extravasations range from 1 - 2% for diagnostic procedures. Though relatively uncommon, significant therapeutic extravasations (up to 10 Gy) had been reported. Preliminary results showed that the total local and shallow dose simulated for 99mTc, 18F, 17Lu and 131I exceed 5 Gy at the basal cell layer depth.

Conclusion: The source geometry and injury depth affect the results, with spherical model giving the lowest dose estimate. Early phantom study showed a non-spherical geometry and dose estimates at clinically relevant activities exceed 5 Gy. The input parameter of VARSKIN needs to be optimised.

References

P16. Estimation of infant radiation exposure from ingestion of breastmilk after SeHCAT Capsule Administration

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Abstract

Purpose: The ARSAC guidance notes do not have breast-feeding interruption times for patients administered with selenium-75-homocholic acid taurine (SeHCAT). The purpose of this study was to assess the potential radiation dose an infant might receive through breast-feeding, following the administration of SeHCAT capsules.

Method: Following a SeHCAT capsule administration (370 kBq), the patient, 3 months post-partum, collected breast milk samples over a 7-day period (3 times per day). Activity concentration within the samples was estimated using a HIDEK sample counter. Following the methodology in the International Commission on Radiological Protection Publication (ICRP) 72, an effective dose was determined for the duration of the sample collection time, assuming 100 ml feeds to the infant.

SeHCAT excretion post administration was then estimated using the patient results and data from ICRP 128, assuming an infant were to consume 200 ml of breast milk every 4 hours for 6 months.

Results: The effective radiation dose was quantified at 7 µSv, for the duration of the sampling time. The patient had 51% retention of SeHCAT at 7 days post administration. The potential dose an infant might receive from milk ingestion over a 6-month period was estimated as 17 µSv, assuming exclusive breastfeeding. The activity of samples peaked on day 6.

Conclusion: The effective dose estimated to the infant from milk ingestion is well below any dose limits or constraints. External dose rate to the infant was not calculated. Further samples over an extended period are required to provide more robust advice.

References

P17. A comparison of residual activities, waste values, administering clinician doses, and dispensing times between the pumped gravity method and shielded syringe driver method of [177Lu]-based therapy administrations.

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Abstract

Introduction and Purpose: 177Lutetium [177Lu]-based intravenous therapeutic radiopharmaceuticals can be administered via several approaches including pumped gravity and shielded syringe driver methods. This study compared residual activities, total residual waste, administering clinician doses, and dispensing times between the pumped gravity method (used for [177Lu]Lu-DOTATATE administrations) and shielded syringe driver method (used for [177Lu]Lu-PSMA administrations) over an 18-month period.

Methods: Residual and total waste activities, clinician doses and dispensing times were measured following each intravenous therapy administration and tabulated. Differences between the datasets for both administration techniques were assessed using student’s t-test.

Summary of Results: The gravity method demonstrated preferable results to the syringe driver method with smaller vial residuals (1.02% compared with 1.76%, p<0.001), lower measured residual waste values (2.48% compared with 1.35%, p<0.001), and lower clinician doses per administration (6.86 µSv compared with 10.75 µSv, p<0.001). The gravity method vial preparation process was faster than the syringe driver method (4 minutes compared with 13 minutes), theoretically reducing dispenser extremity doses. Administration times were comparable between the two methods. The gravity method required fewer single-use consumable items per administration.

Conclusion: The gravity method of administering [177Lu]-based radiopharmaceuticals produced smaller vial residuals, lower measured residual waste values, lower clinician doses and faster preparation times compared to the syringe driver method. The syringe driver method offered the benefit of more manageable contingency scenarios subjectively, but required more consumables. Further work is required to account for the adhesive and viscosity differences between the radiopharmaceuticals.

P18. Quantification of [177Lu] on a Cadmium Zinc Telluride Gamma Camera

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Abstract

Aim: The aim of this work was to investigate the accuracy of quantitative [177Lu] gamma camera imaging on a cadmium zinc telluride (CZT) single photon emission computed tomography (SPECT) system.
Methods: A GE Discovery NM/CT 870 CZT system with wide energy high resolution (WEHR) collimators was used. $[^{177}\text{Lu}]$ image uniformity was calibrated and verified for both 113 and 208 keV primary photopeaks and adjacent scatter windows using a fillable flood phantom. A cylindrical phantom was filled with a known activity concentration of $[^{177}\text{Lu}]$ and imaged to derive a sensitivity calibration. A range of different size spheres (0.5 - 200 ml) were imaged with a known activity concentration of $[^{177}\text{Lu}]$ to optimise the SPECT reconstruction parameters and to calculate the partial volume correction. The gamma camera calibrations were validated by applying them to a 0.5 ml sphere imaged in a scatter material.

Results: The optimal reconstruction was determined to be with OSEM iterative reconstruction with 5 iterations, 10 subsets, CT attenuation correction, scatter correction and no resolution recovery. The sensitivity was calculated to be $7.84 \pm 0.39$ cps/MBq and $10.61 \pm 0.53$ cps/MBq for 113 and 208 keV photopeaks, respectively. The accuracy of the calibrations was -40% (95% confidence interval -75% to 102%) and -36% (95% confidence interval -83% to 40%) for 113 and 208 keV photopeaks, respectively.

Conclusion: Quantitative imaging of $[^{177}\text{Lu}]$ on a CZT gamma camera is possible and this work suggests some of the calibrations required. Further work is required to fully validate the gamma camera calibrations.

P19. Implementing patient-controlled dose rate measurements during $[^{131}\text{I}]$ ablation inpatient stays

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Abstract

Patients receiving radioiodine treatments are monitored at regular intervals during their inpatient stay to determine their radiation protection restrictions at discharge. We aim to simplify the repeated measurement process through radiation monitors installed in their room, with the facility for the patient to control when a measurement is taken. The new measurement setup is to be comparable to current measurements taken by staff.

As a first step, we designed a set of commissioning and quality control tests to verify the use of the installed dose rate monitor, including protocols to explore the practical implications of the patient and bed position. Through data collected from these tests, we aim to validate this setup in comparison to the current method and ensure compliance with radiation protection legislation. So far, we have run a simulation with 10 patients on our patient discharge restriction calculator using anterior dose rate measurements only versus anterior with posterior - one change aspect for this setup. From this, some cases of patient restrictions altered by 1-3 days, most of which were an increase rather than a reduction. Further data will be gathered regarding the effect of patient position and side-by-side comparison of the installed monitor acquisition versus the currently used equipment.

The results of these tests will facilitate the successful adoption of an installed monitor to improve our current assessment of measured exposure from radioiodine patients. This achievement paves the way for introducing patient-controlled measurements, allowing more measurements to be made while reducing exposure to nuclear medicine staff.

P21. Our early experiences in using renal volume to estimate split renal function in comparison with $[^{99m}\text{Tc}]$ Tc-DMSA scans.

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Abstract

Purpose: We set out to explore how renal volume, calculated from CT imaging and presented as ratios of left kidney volume: right kidney volume, compares to $[^{99m}\text{Tc}]$ Tc-DMSA split function. This is an account of our findings and areas identified for further investigation.

Methods: We used two methods of measuring renal volume to produce a ratio of left to right:
1. Volume calculations through Aquarius iNtuition
2. Ellipsoid volumes using reconstructed images on PACS insignia.

The search terms “renal donor” or “kidney donor” within the dates 01/01/2008 - 01/07/2022 identified 44 patients. 30 patients were identified after exclusion criteria: imaging before 01/01/2010; CT angiogram and $[^{99m}\text{Tc}]$ Tc-DMSA scan more than 6 months apart, and entire kidney not included on CT scan.

Results: When comparing the iNtuition volume ratios with the $[^{99m}\text{Tc}]$ Tc-DMSA split function, all the ratios were within $[^{99m}\text{Tc}]$ Tc-DMSA split value +/- 6% and 25 of the 30 (83%) were within 3%.

When comparing the ellipsoid volume ratios with the $[^{99m}\text{Tc}]$ Tc-DMSA split function, all ellipsoid ratios were within $[^{99m}\text{Tc}]$ Tc-DMSA split value +/- 12% and 22 of the 30 (73%) were within 3%.

Conclusion: This experience has identified an area for future study comparing iNtuition renal volumetric ratios to split function acquired from $[^{99m}\text{Tc}]$ Tc-DMSA scan. Furthermore, it highlights the potential to reduce radiation exposure for potential renal donors and reduce the burden on imaging departments if this unique...
population could be confidently spared the additional $[^{99m}Tc]Tc$-DMSA scan.

**P22. Assessment of right ventricular uptake on SPECT bone scan for investigation of cardiac amyloidosis and correlation with late Gadolinium uptake on CMR.**

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**Abstract**

**Purpose of Study:** The Perugini grading scale is a semi-quantitative method of scoring cardiac uptake following injection of $[^{99m}Tc]Tc$-DPD scintigraphy in the investigation of cardiac amyloidosis (particularly ATTR amyloidosis). The grading scale visually compares tracer uptake in the myocardium relative to rib uptake without differentiation between the right and left ventricle. It has recently been shown that right ventricle dysfunction is an independent prognostic factor and associated with worse outcomes (Tjahjadi C et al. 2022, 173:120-127. Am. J. Cardiol.).

We will review bone scans performed for investigation of amyloidosis at a London tertiary centre and assess for RV involvement on SPECT. This will be correlated with late Gadolinium for RV uptake on CMR.

**Methods:** All bone scans performed for investigation of amyloidosis over a 3 year period (between July 2020 and July 2023) were reviewed on PACS and Hermes software (Hermes Medical Solutions, Stockholm, Sweden). Using the fusion SPECT-CT, we looked at biventricular uptake and correlated with late gadolinium CMR.

**Results:** Of the 28 bone scan studies performed over a 3 year period, 17 were positive for ATTR. Of the ATTR positive studies, 15 showed RV uptake.

**Conclusion:** Right ventricle uptake is easy to identify on SPECT and is associated with worse outcomes. Scintigraphy reporting should include biventricular distribution and differentiate right from left ventricular uptake.

**References**


**P23. “I can see clearly now, the rain has gone...”**

Nishanth Dharmarajah, Micaela Costa, Smitha Thimmappa Shetty, Christine Powell,

Ronald Visperas, Tara Barwick, Sammer Khan, Bhavna Bhudia, Thomas Roberts, Amy Eccles, Constantine Alifrangis, Heather Payne,

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**Abstract**

**Purpose of Study:** $^{68}$Ga-labelled Prostate specific membrane antigen ($[^{68}Ga]$Ga-PSMA-11) PET-CT is widely used for localisation of biochemical relapse and primary staging of high-risk prostate cancer. However, physiological urinary tracer can reduce diagnostic confidence when assessing low-volume disease typical of these scenarios. Simultaneously performed IV contrast-enhanced urographic phase-CT, (UroCT-PSMA) has the potential to make this distinction easier. We present an illustrative case series from our 6-year experience in using this protocol.

**Methods:** At our centre, a split-dose (40 + 40ml) biphasic IV contrast enhanced diagnostic CT abdomen and pelvis is combined with a $[^{68}Ga]$Ga-PMSA PET-CT, when investigating biochemical recurrence (PSA<2.0) and high-risk primary staging (with 40ml contrast administered 10 minutes prior to portal venous phase). A series of cases highlighting the diagnostic refinements in this approach are presented, along with a review of published literature in use of similar protocols.

**Results:** The illustrative cases demonstrate how this protocol, can enable confident distinction between urinary and pathological pelvic tracer, improve structural CT definition of low-volume disease to guide targeted radiotherapy decisions and aid detection of PSMA negative visceral disease, all as a one-stop shop. Our experience is in alignment with elegant audit series in published literature assessing similar protocols (4 series from key Australian & German centres, about 300 cumulative patients). None of the regional UK centres surveyed (0/14) are currently using the (UroCT-PSMA PET) combined approach.

**Conclusions:** A UroCT-PSMA PET combined protocol has the potential to improve diagnostic mileage and should be considered in early biochemical recurrence and primary high-risk staging.

**References**

1. https://en.m.wikipedia.org/wiki/I_Can_See_Clearly_Now
P24. Semi-quantitative analysis of Temporomandibular Joint [99mTc]Tc HDP SPECT-CT – A Technological Perspective

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Abstract

Purpose: Unilateral condylar hyperplasia (UCH) is a rare condition that can require partial or total condylectomy. Bone SPECT-CT can be used to confirm diagnosis and optimise surgical management. Volume-rendered CT fused to bone SPECT reconstruction demonstrates the anatomical deformity and precisely localises the site of abnormal osteoblastic activity, helping to minimise the extent of surgical resection and preserve residual Temporomandibular Joint (TMJ) function. We report our experience of using SPECT-CT to inform surgical planning and accurately quantify condylar activity.

Method: Retrospectively, five patients imaged between 2019 and 2022 for suspected UCH was studied. Published literatures were reviewed and Bing Wen et al’s quantitative method was selected due to the large study population. Their method was adapted by fusing attenuation-corrected SPECT reconstruction to CT images, to confirm precise localisation (Bing Wen et al. 2014, Article ID 256256, The Scientific World Journal). Visual inspection and region of interest analysis assessed the tracer activity in each TMJ. The ratio of condylar activity was calculated for relative uptake and the condyle/parietal skull ratios were also calculated.

Results: 2/5 cases were positive for active condylar hyperplasia. Visual and condyle/parietal ratio assessments were concordant in all 5 cases. Relative condylar uptake was concordant in 4 cases but was inaccurate in a case with degenerative joint activity.

Conclusion: Accuracy of bone scan imaging performed for the assessment of UCH is improved by SPECT/CT technology. The CT component improves quantitation and facilitates surgical planning. Condyle/parietal ratios performed better than relative TMJ activity.

References

P25. Improving efficiency and patient experience of Sestamibi SPECT-CT for primary hyperparathyroidism: experience of the clinical utility of early phase scans

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Abstract

Background: Many centres perform both early and late phase [99mTc]Tc sestamibi SPECT-CT imaging for parathyroid adenoma localisation. This may increase the scan time without any significant improvement in adenoma localisation. In order to identify the optimal sequence to maximise adenoma localisation while minimising scan time and patient discomfort, we compared the accuracy of both early and late phase sestamibi SPECT-CT for adenoma with surgical confirmation.
Methods: 128 patients undergoing parathyroid adenoma localisation with sestamibi SPECT-CT between January 2018 and June 2020 were retrospectively reviewed. Surgical and pathological data was compared to the radiological site of the adenoma detected on both early and late phases of the sestamibi study.

Results: The late phase of the Sestamibi study had a sensitivity of 67% for correctly localising an adenoma compared to 48% for the early phase scan. In 16% (21/128) of cases, an adenoma was only detected on the late phase of imaging. There were no cases where an adenoma was only identified on early phase imaging.

Conclusions: The late phase sestamibi SPECT imaging had greater sensitivity for detecting parathyroid adenomas compared to the early phase. Early phase SPECT-CT did not detect any additional adenomas compared to the late phase SPECT-CT in this study.

Statement: This study assesses the clinical utility of both the early and late phases of the sestamibi study when compared to surgical localisation. We recently abandoned the early phase scan and introduced CT contrast to improve efficiency and accuracy of late phase imaging for localisation.

P26. The utility of $^{68}$Ga-DOTA-TATE PET-CT scans in patients with multiple endocrine neoplasia type 1 (MEN1) with suspected pancreatic neuroendocrine tumours.

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Abstract

Purpose: To evaluate the added benefit and accuracy of $^{68}$Ga-DOTA-TATE PET-CT scans in detecting pancreatic neuroendocrine tumours, compared to conventional cross-sectional CT or MRI imaging in patients with multiple endocrine neoplasia type 1 (MEN1).

Methods: A retrospective analysis was performed, comparing the initial $^{68}$Ga-DOTA-TATE PET-CT to the respective contemporary CT or MRI imaging in patients with MEN1 under a tertiary endocrine centre. Imaging and electronic patient records were analysed to identify treatment plans and multidisciplinary team discussions.

Results: 78.2% (n=36/46) of patients with MEN1 had a $^{68}$Ga-DOTA-TATE PET-CT study on the electronic patient record. 19 had contemporaneous contrast-enhanced CT scans, while 17 had MRI scans. $^{68}$Ga-DOTA-TATE PET-CT detected a total of 42 pancreatic lesions compared to 21 on CT, and 36 lesions compared to 24 on MRI. 19.4% of patients (n=7/36) had pancreatic lesions detected on $^{68}$Ga-DOTA-TATE PET-CT not seen on MRI or CT, while 36.1% (n=13/36) had extra-pancreatic lesions on $^{68}$Ga-DOTA-TATE PET-CT not seen on MRI or CT. Findings on $^{68}$Ga-DOTA-TATE PET-CT scans resulted in a change of management in 75% (n=27/36) of patients. Of these, 27.8% (n=10/36) were referred for further investigations, 25% (n=9/36) were started on somatostatin analogues, and 13.9% (n=5/36) were recommended surgery.

Conclusion: In patients with MEN1, $^{68}$Ga-DOTA-TATE PET-CT detected a greater number of pancreatic and metastatic lesions compared to conventional MRI/CT imaging. Management plans were changed in most patients following their initial $^{68}$Ga-DOTA-TATE PET-CT.

P27. The value of $^{99m}$Tc-MDP scintigraphy in lymph node amyloidosis; a case report and mini-literature review.

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Abstract

Purpose: $^{99m}$Tc-MDP scintigraphy is increasingly used to evaluate cardiac amyloidosis, $^{99m}$Tc-DPD or $^{99m}$Tc-HDP is typically used to assess bone pathology. The role of bone scintigraphy in extra-cardiac soft tissue amyloid disease is less well established.

Method: We present the first known case report of lymph node amyloidosis with $^{99m}$Tc-MDP uptake on scintigraphy. A mini-literature review was conducted using MEDLINE and EMBASE databases.

Results: A 67-year-old male presented to the uro-radiology MDT with a raised prostate specific antigen on a background of lymphoma and AL (amyloid light chain) amyloidosis. Prostate dedicated MRI confirmed suspicion of prostate malignancy with bilateral inguinal lymphadenopathy. $^{99m}$Tc-MDP scintigraphy demonstrated uptake more than physiological bone in the inguinal lymphadenopathy with no malignant appearing bone uptake or myocardial tracer uptake. Inguinal lymph node biopsy confirmed amyloid deposits without evidence of malignancy.

Literature search identified 5 articles commenting on at least 19 cases with positive bone scintigraphy findings in lymph node amyloid disease$^{1-5}$. Articles describe uptake with either $^{99m}$Tc-DPD or $^{99m}$Tc-HMDP, typically without cardiac uptake. One study describes lymph
node involvement only in the AL amyloid variant. The reason for bone tracer uptake is unknown but may be due to the high calcium content of amyloid protein.

Conclusion: Although cardiac amyloid is a well-recognised cause of incidental cardiac uptake on bone scintigraphy, this case report aims to increase awareness of the potential significance of nodal uptake. Bone scintigraphy shows promise in the evaluation of lymph node amyloid disease extent and biopsy targeting.

References

The final sample included 43 patients, 13 women and 30 men, with a mean age of 66 years, simultaneously with $[^{18}F]$FDG PET-CT study and lymphadenectomy.

Summary of the results: In 5/43 patients, the lymph nodes considered suspicious on PET-CT were not removed, and it was not possible to evaluate them histologically. Four of these patients did not repeat PET-CT and I underwent chemotherapy with control PET-CT, where previously described adenopathy showed a favorable response to therapy.

Among the remaining 38 patients, PET-CT identified suspicious nodes in 13, 11 of which were concordant with pathology results.

Of the operated patients in whom lymph nodes were also removed with the lung piece despite PET-CT being negative for lymph node involvement (N=25), only 1 case was positive for node metastasis (1 false negative on PET-CT).

Conclusion: This sample showed high sensitivity (91.7%), specificity (92.3%), positive predictive value (84.6%) and negative predictive value (96%) of PET-CT with $[^{18}F]$ FDG, relatively higher values than other series (with slightly larger dimensions) recently published [1].

References

P29. Pulmonary in-situ microvascular thrombosis detected with VQ SPECT-CT in community treated long COVID-19 patients with breathlessness. The role of molecular imaging.

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3National Pulmonary Hypertension Service, Royal Brompton Hospital Part of Guy’s and St Thomas’ NHS Foundation Trust, London, United Kingdom

Abstract
Purpose: Pulmonary microvascular thrombosis can be detected as peripheral, non-segmental mismatched defects on VQ SPECT-CT (Dhawan RT. 2021, 9(1):107-116, Lancet Respir Med). The aim of this study is to evaluate the prevalence and clinical significance of in-situ microvascular thrombosis in community treated patients with long COVID-19 and breathlessness using molecular imaging.

P28. Comparison between $[^{18}F]$FDG PET-CT lymph node staging with pathological evaluation in lung cancer patients

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Abstract
Statement on the purpose of the study: To evaluate the performance of $[^{18}F]$FDG PET-CT for mediastinal and hilar lymph node detection in patients with lung cancer.

Methods used: The clinical records of patients with lung cancer initially staged by $[^{18}F]$FDG PET-CT over the last 7 years at our institution (N=488) were reviewed.

Patients with PET-CT not suspected for atypical pulmonary disease, those who were not operated on in our hospital or not subjected to lymphadenectomy, were excluded.
Method: 44 patients with breathlessness referred to the long-COVID clinic between April 2020 and June 2021 underwent a VQ SPECT-CT. The exclusion criteria included diagnosed pulmonary thromboembolic disease, heart dysfunction and lung parenchymal abnormality secondary to acute SARS-CoV-2 infection. The micro-thrombosis burden, expressed as percentage of mismatched defect normalised by the total lung volume, was correlated with gas transfer function test. VQ SPECT-CT follow-up was performed.

Results: 18/44 patients (67%) female with mean±SD age 45.7±14.5 showed 36 total mismatched defects. 28/36 (77.8%) mismatched defects were non-segmental and suggestive of in-situ microvascular thrombosis. There was no difference in demographic and comorbidity between the group with and without mismatched defects. Higher micro-thrombosis burden significantly correlated with lower KCO values (p<0.05). Follow-up VQ SPECT-CT was performed in 9/18 subjects. The perfusion defects resolved in 5/9 (55.6%) subjects after anticoagulant therapy. No post-thrombotic sequelae were seen in both groups at follow up.

Conclusion: VQ SPECT-CT safely detected pulmonary in-situ microvascular thrombosis secondary to SARS-CoV-2 infection correlating significantly to gas exchange deficit and it should be considered the first-line tool to evaluate and follow-up long COVID-19 patients with breathlessness in absence of other identifiable causes of dyspnea.

References

P30. Assessing the Landscape of Amyloid PET Imaging in the UK through an online survey: Implications for Alzheimer’s Disease Therapeutics

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Abstract

Aim: To assess the landscape of Amyloid PET availability and utilisation in the UK, characterised by low scan volumes and a minority of departments engaging in quantification. This study aims to evaluate the current landscape of Amyloid PET availability and utilisation in the UK and assess the preparedness for implementing screening for anti-amyloid therapies through an online survey.

Methods: The survey included 27 multiple-choice questions designed to capture a snapshot of brain imaging and quantification for the most prevalent brain PET and SPECT scans. This abstract focuses on the availability and quantification of Amyloid PET scans. A panel of imaging experts reviewed and interpreted the survey findings.

Results: We collected and analysed responses from 46 distinct sources, with 84% originating from facilities engaged in brain imaging. Among these facilities, merely 33% performed Amyloid PET scans, and the majority conducted less than one scan per month. Quantitative analysis was employed in 42% of centres offering Amyloid PET services, with in-house software being more prevalent than commercially available alternatives.

Conclusion: Our survey findings highlight the limited availability of Amyloid PET scanning services across the UK, characterised by low scan volumes and a minority of departments engaging in quantification. To facilitate patient stratification and pave the way for adopting anti-amyloid therapies for Alzheimer’s disease, the UK needs to augment its Amyloid PET scanning capacity. Additionally, addressing barriers related to quantification, such as software availability and training, is essential for optimising the utility of this imaging modality.

P31. May [123I]Ioflupane-SPECT(DaTSCAN) differentiate between idiopathic Parkinson’s disease and atypical Parkinsonian syndromes?

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Abstract

Aim: To present atypical findings on [123I]Ioflupane-SPECT(DaTSCAN) in clinically suspected atypical Parkinsonian syndrome (APS) and emphasise the need for prospective research trials in this area.

Method: A 54-year-old female presented with a history of slowed speech, impaired language processing and verbal memory and decreased manual dexterity on the right. Clinically there was suspicion of multisystem atrophy (MSA).
**Results:** CT and MRI brain showed mild bilateral fronto-parietal atrophy. DaTSCAN demonstrated ‘comma shape’ striatal tracer distribution visually with preserved posterior putamina (PP) uptake. However, there was mild asymmetrical reduced uptake in the left caudate nucleus (CN) and at the junctions between anterior putamina (AP) and CNs bilaterally (left > right).

Semi-quantitatively, CN and AP binding ratios (BRs) were low (below 2SDs). The right and left PPBRs were within the lower range of normal and borderline low, respectively. The findings were not typical for idiopathic Parkinson’s disease (IPD), as PPBRs appeared less affected than CNBRs. In the absence of small vessel disease, the appearances favoured MSA.

**Conclusion:** Conventionally it is believed that DaTSCAN cannot discriminate IPD from APS. Typically, there is reduced tracer uptake in the striatum with early dysfunction in the posterior putamen and an asymmetrical distribution in IPD\(^1\). In contrast, a retrospective study demonstrated that APS, including MSA and progressive supranuclear palsy (PSP), have less uptake in the CN relative to IPD\(^2\). CN abnormalities should not be overlooked when interpreting DaTSCAN. The role of DaTSCAN in discriminating IPD from APS should be re-assessed in prospective research trials.

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**References**


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**P32. Assessing background counts in normal, abnormal and in repeat ioflupane studies**

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**Abstract**

Repeat ioflupane (DaTSCAN™ GE Healthcare) studies are performed to look at the rate of striatal specific binding ratio (SBR) changes in borderline studies. In this study we have investigated the consistency of background counts and how this related to disease progression.

**Method:** 26 patients with repeat DaTSCAN studies (mean interval of 2.26 ± 1.4 years range 0.6-5.3 years) were included. Attenuation corrected (AC) and non-corrected (NAC) mean background counts per pixel were derived using DaTQUANT software (GE healthcare). Student t-test (IBM SPSS software) was used for comparison.

**Results:** There was a wide variation in the background (BG) counts

<table>
<thead>
<tr>
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<th>Mean ± SD (Counts/sec)</th>
<th>Range (Counts/sec)</th>
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<tbody>
<tr>
<td>AC</td>
<td>43.3 ± 15.8</td>
<td>12.2 – 93.6</td>
</tr>
<tr>
<td>NAC</td>
<td>20.3 ± 7.4</td>
<td>5.8 – 41.8</td>
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There was no difference in the BG counts between the Normal (no progression) and abnormal (disease progression), p=0.79.

There was no difference in BG counts between first and second visit for the whole group (p=0.64), or in normal (non-progressive) group (p=0.25), or in abnormal (progressive disease) patients (p=0.11). This was reflected in AC, with no significant difference in background counts in normal, abnormal, or repeat studies.

**Conclusion:** BG count is independent of presence or absence of disease (PD/DLB) or disease progression.

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**Abstract**

The effects of immune checkpoint inhibitor (ICI) therapy in cancer have been extensively researched, yet its impact on normal organs including the mechanisms of immune-related adverse events (irAEs) remain poorly understood. Our aim was to investigate the effects of immune checkpoint inhibition on Programmed Death-Ligand 1 (PD-L1) expression and glucose metabolism in normal organs of patients with advanced non-small cell lung cancer (NSCLC).

**Methods:** Ten patients with advanced NSCLC receiving ICI therapy (pembrolizumab) +/- chemotherapy (carboplatin + pemetrexed) underwent baseline and 9-week imaging. PD-L1 imaging was performed using a single domain antibody to PD-L1, NM-01, radio-labelled with \[^{99m}Tc\] with quantifiable SPECT-CT. Glucose metabolism was assessed with \[^{18}F\] fluoro-deoxyglucose PET-CT. Two independent observers delineated regions of interest of non-malignant normal organs (liver, lung, spleen, bone marrow, muscle, kidney,
pancreas, left ventricle, blood pool) to measure maximum and mean standardised uptake values (SUV), and interobserver variation was measured with intraclass correlation coefficient.

Results: There was no significant change in SUVs representative of PD-L1 expression and glucose metabolism of normal organs in patients with advanced NSCLC after a 9-week treatment period (all p>0.05). No immune-related adverse events occurred during the study. There was excellent interobserver reliability of measurements with ICC of 0.996 (95% confidence interval 0.995-0.997).

Conclusions: This study demonstrated that there was no significant difference in normal organs following ICI therapy in a cohort of advanced NSCLC patients with no documented irAEs. Importantly, measurements were consistent between independent observers. Further investigation in larger cohorts and in the context of irAEs is required.

P34. [*89Zr*]Zr-DFO-girentuximab PET-CT imaging for detection and characterization of clear cell renal cell carcinoma, results from ZIRCON phase 3 study

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Abstract

Purpose: ZIRCON is an open-label, multicenter trial to evaluate performance of [*89Zr*]Zr-DFO-girentuximab PET-CT for detection of ccRCC in patients with indeterminate renal masses (IDRM).

Methods: Patients with an IDRM (≤7cm; tumor stage cT1) scheduled for partial or radical nephrectomy within 90 days from planned [*89Zr*]Zr-DFO-girentuximab administration received [*89Zr*]Zr-DFO-girentuximab IV (37 MBq±10%; 10mg girentuximab) on Day 0 and underwent abdominal PET-CT imaging on Day 5 (±2d) before surgery with optional whole-body PET-CT. Blinded central histology review determined ccRCC status. Coprimary objectives were to evaluate sensitivity and specificity of [*89Zr*]Zr-DFO-girentuximab PET-CT imaging in detecting ccRCC in patients with IDRM, using histology as the standard of truth. Secondary objectives included sensitivity and specificity of [*89Zr*]Zr-DFO-girentuximab PET-CT imaging in patients with IDRM ≤4cm (cT1a) and ≤2cm. Other objectives included assessment of positive and negative predictive values, and safety and tolerability.

Results: 300 patients (mean age 62±12y) received [*89Zr*]Zr-DFO-girentuximab. Of 284 evaluable patients included in primary analysis, the sensitivity and specificity were 86% [80%, 90%] and 87% [79%, 92%] respectively; and 86% [77%, 91%] and 90% [79%, 95%] respectively for key secondary endpoints. Positive and negative predictive values were ≥91.7% and ≥73.7%, respectively for the population of all evaluable patients.

Conclusions: Study findings confirm that [*89Zr*]Zr-DFO-girentuximab PET-CT is well tolerated and can accurately and noninvasively identify and characterize ccRCC and extrarenal lesions, with promising clinical utility.
P35. The clinical impact of $^{68}$Ga-Ga-PSMA PET-CT versus conventional restaging imaging in biochemically recurrent prostate cancer.

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Abstract

Purpose: This study aims to evaluate the clinical impact of $^{68}$Ga-Ga-PSMA PET-CT compared with conventional restaging imaging (multiparametric MRI and nuclear medicine bone scan) in patients with biochemically recurrent prostate cancer.

Methods: Single centre retrospective cohort study based at a tertiary oncology centre. Patients with biochemical recurrence following radical treatment who had undergone $^{68}$Ga-Ga-PSMA PET-CT were identified. Review of electronic medical records was performed and imaging, clinical and biochemical datapoints collated. $^{68}$Ga-Ga-PSMA PET-CT and conventional imaging findings and MDT decisions were recorded and reviewed.

Results: 206 patients with biochemical recurrence had $^{68}$Ga-Ga-PSMA PET-CT between August 2021 and 2023. 189 patients had conventional restaging imaging available.

$^{68}$Ga-Ga-PSMA PET-CT was found to alter management in 53% of patients (n=100). $^{68}$Ga-Ga-PSMA PET-CT identified additional foci of disease not detected on conventional restaging imaging in 37% (n=69) and in 14% (n=27) confirmed equivocal disease. In 2% (n=4), $^{68}$Ga-Ga-PSMA PET-CT excluded equivocal nodal or bone metastases identified on conventional restaging imaging.

$^{68}$Ga-Ga-PSMA PET-CT identified undetected or equivocal disease on MRI in 93% of patients with nodal recurrent disease (n=55/59) and in 54% of patients with prostatic bed recurrence (n=37/68). It identified additional or hitherto indeterminate sites of bone metastases in 90% (n=18/20) of patients with bony recurrent disease compared with bone scan.

Conclusion: This study demonstrates the clinical benefit of $^{68}$Ga-Ga-PSMA PET-CT in patients with biochemical recurrence of prostate cancer and affords the opportunity for targeted salvage treatments.

P36. First UK experience of $^{18}$F-DCFPyL PSMA PET-CT in primary staging and biochemical recurrence of prostate cancer.

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Abstract

Aim: To report the first UK experience of $^{18}$F-DCFPyL PSMA PET-CT in the staging of high-risk primary prostate cancer and localisation of disease at biochemical recurrence (BCR).

Methods: We performed a retrospective analysis of the first 100 consecutive prostate cancer patients who underwent $^{18}$F-DCFPyL PET-CT imaging for primary staging (n=71) or assessment for BCR (n=29) from May to August 2023. All scans were performed from base of skull to thighs 60 mins after injection of up to 280MBq $^{[18F]}$DCFPyL PSMA (Curium, UK) and images reconstructed using Q-clear (b=400). Additional 10-minute post-injection dynamic acquisitions were performed in patients with BCR. Clinical, qualitative and semi-quantitative assessment was made.

Results: In primary staging, 51 (72%) cases showed disease localised to the prostate and 17 (24%) cases demonstrated metastatic disease, thereby changing management to non-radical treatment strategies. In BCR active recurrent disease was localised in 21 (73%) cases (PSA 0.2-18ng/ml) with no abnormality in 8 (27%) cases (PSA 0.2-8.5ng/ml). Image quality was excellent in all cases with high tumour-to-background contrast in primary staging (prostate mean SUVmax = 17.9 +/- 10.4, nodes = 45.9 +/- 20.1, bones = 4.1 +/- 1.6) and BCR (prostate bed mean SUVmax = 34.4 +/- 17.2, nodes = 13.5 +/- 10.4, bones = 8.5 +/- 6.4). Nine (9%) cases showed low grade focal bone uptake which was deemed morphologically benign.

Conclusion: The first UK experience of $^{18}$F-DCFPyL PSMA PET-CT shows good image quality and clinical performance for primary staging and BCR of prostate cancer.

P37. Review of the practise of routinely using Ultra HD versus traditional iterative TOF reconstruction of PET-CT data in clinical interpretation of Herder's score for incidental pulmonary nodules.

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2Sultan Qaboos Comprehensive Care and Research Centre, Muscat, Oman.
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Abstract

Statement on the purpose of the study: The British Thoracic Society (BTS) guidelines(1) uses Herder model (HM)(2) for predicting risk of malignancy in pulmonary nodules. PET data has been traditionally reconstructed using
iterative techniques, however recently some proprietary reconstruction methods have been adopted in clinical practice(4). We wanted to determine whether the use of proprietary Ultra HD reconstruction introduced any significant difference in the Herder’s model classification of nodules when compared to the traditional Iterative reconstruction.

Methods used: A retrospective study of 50 patients undergoing PET scans for the characterization of pulmonary nodules was done as part of an audit of local practice. Quantitative and qualitative Herder model values for index nodules and mediastinal blood pool values were recorded using Ultra HD and Iterative TOF reconstructions. All scans were performed on a Siemens Biograph mCT Flow TOF scanner.

Summary of the results: Of the total patient cohort (n=50) reviewed, all consistently scored the same across both reconstruction algorithms for both visual and quantitative assessment using HM. The mean size of the pulmonary nodule was 11.9 mm (± 5.0). The mean SUV max for index pulmonary nodule using Ultra HD was 1.9 (±2.3) and 1.8 (±1.9) for Iterative TOF reconstructions (p=0.08) i.e no statistically significant difference between the two reconstructions was observed.

Conclusion: This study has demonstrated that using Ultra HD Reconstruction of PET-CT is comparable to traditional Iterative TOF and does not introduce any discrepancy in the use of HM for predicting risk of malignancy.

References
3. 2 The diagnostic tests: EarlyCDT Lung for assessing risk of lung cancer in solid lung nodules: Guidance (no date) NICE. Available at: https://www.nice.org.uk/guidance/dg46/chapter/2-The-diagnostic-tests (Accessed: 19 September 2023).

Abstract
Aim: To present an unusual \(^{18}\text{F}\)PSMA positive retroperitoneal metastasis from a thyroid carcinoma identified by PSMA-PET-CT in a patient with synchronous prostate cancer.

Method/Case report: A 68 year old man with prostate cancer, underwent a staging CT, which showed a new left 18 mm retroperitoneal soft tissue nodule lateral to the left psoas and left pelvic node.

Results: A repeat CT following a period of androgen deprivation demonstrated no response in the retroperitoneal lesion, whilst the pelvic node decreased in size. Subsequent \(^{18}\text{F}\)PSMA-PET-CT showed PSMA positive prostate disease, retroperitoneal lesion and pelvic node with an incidental finding of high-grade focus in the left thyroid lobe. Therefore, fine needle aspiration (FNA) was performed although a thyroid ultrasound was initially reported as U2 (benign nodule). FNA cytology (FNAC) was interpreted as THY-2 (benign). However, CT guided biopsy of the retroperitoneal lesion revealed follicular thyroid tissue without papillary features. The differential diagnosis was ectopic thyroid tissue in absence of proven thyroid or testicular malignancy. FNAC and ultrasound were reviewed at the thyroid multidisciplinary meeting and upgraded to Thy3a (follicular atypia)/U4 (suspicious malignancy). Left hemithyroidectomy confirmed a 33 mm angioinvasive follicular carcinoma. Completion thyroidectomy revealed a small incidental 1.2 mm micro papillary carcinoma. SPECT-CT post-first \(^{131}\text{I}\)NaI treatment showed high grade iodine avid thyroid tissue in thyroid bed and retroperitoneal deposit.

Conclusion: Unusual distribution of PSMA positive disease requires further investigations. This is the first case described of an unexpected significant finding of the retroperitoneal metastasis from follicular thyroid carcinoma.

P38. \(^{18}\text{F}\)PSMA tracer and \(^{131}\text{I}\)NaI avid retroperitoneal thyroid tissue in a patient with synchronous thyroid and prostate carcinomas: first case report and differential diagnoses

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Abstract

Purpose: Solid gastric emptying studies are used to diagnose issues with gastric motility. Some patients are fragile and unable to tolerate our acquisition protocol (2 minute pictures, every 5 minutes for 2 hours). The aim
was to establish if the frequency of imaging could be reduced with no adverse effect on the calculated key parameters.

**Method:** 20 patients were retrospectively analysed. 18 patients had eggs sandwich meal and 2 had porridge meal. 5, 10 and 30 minutes intervals were used to calculate lag time, half emptying and peak emptying rate, time to peak emptying and the exponential half-life. The measured parameters using different intervals were then compared using the paired samples test.

**Results:** The table below shows the P-value for each of the parameters when changing interval.

**Conclusion:** There is no statistically significant change in any of the parameters. Therefore, for patients who are unable to tolerate 5 minute intervals, we can reduce the frequency of imaging. This has been tested up to 30 minutes intervals.

<table>
<thead>
<tr>
<th>Parameters</th>
<th>Comparison (mins)</th>
<th>5 vs 10</th>
<th>5 vs 30</th>
<th>10 vs 30</th>
<th>5 vs 10</th>
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</thead>
<tbody>
<tr>
<td>Lag time</td>
<td></td>
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<td>0.199</td>
<td>0.212</td>
<td>0.243</td>
<td>0.397</td>
<td>0.347</td>
<td>0.887</td>
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<td>0.684</td>
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<td>0.957</td>
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<td>0.212</td>
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<td>0.199</td>
<td>0.212</td>
<td>0.243</td>
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<tr>
<td>Time to peak emptying time</td>
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<td>0.684</td>
<td>0.251</td>
<td>0.226</td>
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<td>0.199</td>
<td>0.212</td>
<td>0.243</td>
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<tr>
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<td>0.251</td>
<td>0.226</td>
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<td>0.212</td>
<td>0.243</td>
<td>0.397</td>
<td>0.347</td>
<td>0.887</td>
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</tbody>
</table>

**P40. Streamlining radiation protection assessment of patients prior to [177Lu]Lu-PSMA therapy**

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**Abstract**

Over 350 [177Lu]Lu-PSMA treatments have been delivered at Royal Marsden NHS Foundation Trust since January 2019. Given to a mixture of trial and private patients, administrations have been in dedicated radionuclide therapy rooms, standard private rooms, open bays and day-case rooms.

Data from literature suggests that 50% of administered radioactivity is excreted via urine in the first 4 hours following administration (Kurth J. et al. 2018, 8:32 EJNMMI Research), during the period when patients are typically on site. Patients regularly present with a spectrum of mobility and incontinence issues with a need for personal care whilst coming from a wide geographical area. These factors create a risk of contamination on site, as well as concerns relating to external radiation exposure, not typically observed with thyroid or neuroendocrine cancer patients.

We have developed a strategy to streamline patient assessment from a radiation protection perspective. This has been developed based on our experience, consultation with Nuclear Medicine Physicians and Nurses and the Urology team.

Following a clinic appointment in Nuclear Medicine, patients receive a telephone call from Physics where,
using a standard proforma, we discuss mobility, continence, contact, care needs and travel arrangements. The results feed into a flowchart, from which we form recommendations to the Practitioner concerning appropriateness for treating as a day case, staying overnight, further risk assessment by Physics or not treating. Our assessment strategy has helped achieve consistent, timely and transparent decisions with a high workload and will be presented with example case studies.

References