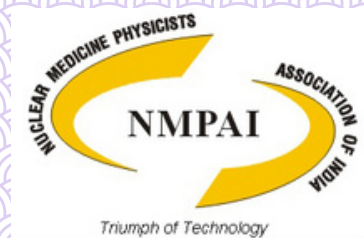




शरीरमाद्यं खलु धर्मसाधनम्



# **ABSTRACT BOOK**

## **NMPAICON - 2025**

**9<sup>th</sup> ANNUAL CONFERENCE OF  
NUCLEAR MEDICINE PHYSICISTS ASSOCIATION OF INDIA**

**"Radiating Excellence: Innovations in Nuclear Medicine"**

**(15<sup>th</sup> - 16<sup>th</sup> FEB, 2025)**

**ALL INDIA INSTITUTE OF MEDICAL SCIENCES  
NEW DELHI**





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# ABSTRACT BOOK

## NMPAICON - 2025

### 9<sup>th</sup> ANNUAL CONFERENCE OF NUCLEAR MEDICINE PHYSICISTS ASSOCIATION OF INDIA

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# ORAL PRESENTATIONS

## ORAL-01

Ajay Kumar  
Postgraduate Institute of Medical Education, Chandigarh.

### **Residual Activity Correction in Liquid Radioiodine I-131 Uptake: A Clinical Necessity**

#### **Introduction**

Radioiodine (I-131) uptake studies are critical for evaluating thyroid function and the effectiveness of radioiodine therapy. Traditionally, I-131 is administered in capsule form, and uptake is measured using a thyroid uptake probe calibrated for capsule counts. When capsules are used, there is no need for correction for residual counts as the capsule is administered in its entirety. Furthermore, most software systems lack a step for subtracting residual counts. However, when using liquid I-131 administered via a test tube, residual activity remains in the test tube even after dilution and administration to the patient. This study evaluates the impact of residual test tube counts on thyroid uptake values measured at 2 hours and 24 hours post-administration.

#### **Materials and Methods**

A total of 44 patients were administered liquid I-131 (8-15  $\mu$ Ci). The dose was measured using a dose calibrator, and standard counts were recorded using a thyroid neck phantom before oral administration of I-131. Post-administration, the test tube was diluted with distilled water to ensure no residual activity remained. Thyroid uptake values were calculated with and without correcting for residual test tube counts at 2 hours and 24 hours post-administration. Normality of data was assessed using the Shapiro-Wilk test, and paired statistical comparisons were performed using the Wilcoxon signed-rank test.

#### **Results**

A total of 44 patients (27% male, 73% female; mean age:  $42.15 \pm 16.85$  years) were included. At 2 hours, the mean uptake value was 12.73% (SD: 6.81%), while the corrected mean was 13.55% (SD: 7.38%), showing a statistically significant difference ( $p < 0.001$ ) with corrected values being 6.91% higher on average. At 24 hours, the mean uptake was 38.98% (SD: 15.72%), and the corrected mean was 41.25% (SD: 16.11%), also showing a statistically significant difference ( $p < 0.001$ ) with corrected values being 6.92% higher. The results emphasize the consistent impact of residual test tube counts on increasing corrected uptake values.

#### **Conclusion**

The study highlights the significant influence of residual test tube counts on the accuracy of thyroid radioiodine uptake measurements. Corrected values were consistently

higher than uncorrected ones at both 2 hours and 24 hours, with mean percentage differences of 6.91% and 6.92%, respectively. These findings underscore the necessity of incorporating residual correction in clinical practice to avoid underestimation of uptake values, which could lead to misinterpretation of thyroid function or suboptimal treatment planning.

## ORAL-02

Komalpreet Kaur, Ashwini Sood, B.R. Mittal  
Postgraduate Institute of Medical Education and Research,  
Chandigarh.

### **Preoperative Localisation and Absolute Quantification of Parathyroid Uptake and Volume in Patients Diagnosed with Primary Hyperparathyroidism Using Quantitative SPECT/CT**

#### **Introduction**

Parathyroid adenomas are benign tumors of the parathyroid glands that can lead to primary hyperparathyroidism (pHPT). Accurate localization and quantification of these adenomas are crucial for effective surgical intervention. Nuclear medicine techniques, particularly, quantitative SPECT/CT plays an important role in absolute quantification of uptake which is now possible due to the availability of correction algorithms for attenuation, scatter, CDR, partial volume, motion and also can be calibrated to convert the counts into activity and further to SUV. Aim of the study was to quantify parathyroid adenoma uptake and volume along with its preoperative localisation in patients using quantitative SPECT/CT and QMetrix software.

#### **Materials and methods**

The prospective study was performed in the Department of Nuclear Medicine, PGIMER, Chandigarh. A total of 50 patients (32F:18M, mean age  $38 \pm 5$  years and range 26-61 years) diagnosed with pHPT were included in this study. Tc-99m Sestamibi (10-15 mCi) was administered and planar early/ delayed regional scan with preoperative early quantitative SPECT/CT was acquired in all the patients. The acquired data was reconstructed and analysed using QMetrix software for parathyroid adenoma uptake, SUV and volume. Concordance correlation coefficient was derived to compare the volume of adenoma obtained by volumetric SPECT/CT and the pathological weight.

#### **Results**

Preoperative accurate localisation of parathyroid adenoma was possible in all patients using quantitative SPECT/CT. The median maximum SUVs were significantly higher in adenomas compared to thyroid tissue in early SPECT/CT (26.43 vs. 4.43). A strong correlation was found between SPECT/CT-estimated weight and pathologic weight, with a

concordance correlation coefficient (W) 0.72, indicating that quantitative SPECT/CT can reliably predict adenoma volume and weight.

#### Conclusion

Volumetric Quantification of parathyroid adenomas using nuclear medicine techniques such as Tc-99m Sestamibi scintigraphy and SPECT/CT provides valuable information that helps surgeons plan minimally invasive procedures effectively and improves outcomes for patients with primary hyperparathyroidism. SUV derived from parathyroid SPECT/CT using QMetrix was reproducible and adenomas were detected with very high sensitivity and specificity.

#### ORAL-03

Vishal Singh, Bhakti Shetye, V. Rangarajan  
Department of Nuclear Medicine and Molecular Imaging, Tata Memorial Hospital, Mumbai. Homi Bhabha National Institute, Deemed University.

#### Performance Evaluation of Radioimmunoconjugate $^{177}\text{Lu}$ -CHX-A''-DTPA-Trastuzumab over the Time: An Institutional Experience

#### Aim

Over expression of the human epidermal growth factor receptor 2 (HER-2) is observed on breast tumors. It plays an important role in management of breast cancer by prediction and prognosis. Monoclonal antibody named as Trastuzumab binds to HER-2, a protein involved in cell growth. It blocks HER-2 mediated signalling by inhibition of homodimerization of HER-2, facilitates antibody dependant cellular toxicity. It further leads to death of the cell. Conjugation of antibody with chelator is a complex procedure. Its efficacy over the time plays a crucial role in synthesis of  $^{177}\text{Lu}$ -CHX-A''-DTPA-Trastuzumab. Hence, we studied labelling efficiency of  $^{177}\text{Lu}$ -CHX-A''-DTPA-Trastuzumab by preparation of immunoconjugate using freshly reconstituted trastuzumab, trastuzumab reconstituted nine months back and immunoconjugate prepared nine months earlier.

#### Material and Methods

Immunoconjugate of CHX-A''-DTPA-Trastuzumab was prepared by keeping the molar ratio of 1:10 (Antibody: BFCA).  $^{177}\text{LuCl}_3$  was procured from radiopharmaceutical division, BARC. Immunoconjugates were prepared using 22 mg of Trastuzumab. Batch-I was prepared using freshly reconstituted trastuzumab, batch-II using trastuzumab reconstituted nine months back and for batch-III we used immunoconjugates prepared nine months back. Immunoconjugation was performed using CHX-A''-DTPA as a chelator, incubating reaction mixture at  $25^\circ\text{C}$  for 2 hours, followed by 24 hours incubation at  $4^\circ\text{C}$  at pH 9. Excess of chelator was removed by buffer exchange with

0.1M sodium acetate (pH= 6.5).

Synthesis was done using 30-40 mCi of  $^{177}\text{LuCl}_3$ , by incubating mixture at room temperature for 15 minutes. Purification of labelled product was done using PD-10 column and eluent as 0.05M phosphate buffer (pH= 7.4). Quality control of labelled product was done by HPLC scanner using gel chromatography column and 0.05M phosphate buffer (pH= 6.8) as a mobile phase. Chromatogram was created using TLC scanner, mobile phase was 10 mM sodium citrate. RCP was calculated at 0 hr, 6 hrs, 24 hrs and 48 hrs. %labelling efficiency, specific activity, RAC were estimated.

#### Results

HPLC chromatogram of all three batches showed RCP as 100% with a mean retention time as 10.2 minutes. TLC chromatogram showed RCP as  $>98 \pm 0.2$  % for 24 hours but it is declined after 24 hours.

#### Conclusion

HPLC and TLC data of all three batches showed 100% integrity and  $>98 \pm 0.2$  % of RCP. Immunoconjugate showed reliable stability over the different period.

#### ORAL-04

<sup>1</sup>Sejal Chopra, <sup>1</sup>Jaya Shukla, <sup>2</sup>Arun S. Oinam, <sup>2</sup>Gaganpreet Singh, <sup>1</sup>Komalpreet Kaur, <sup>1</sup>Bhagwant Rai Mittal  
<sup>1</sup>Department of Nuclear Medicine, Postgraduate Institute of Medical Education and Research, Chandigarh 160012, India  
<sup>2</sup>Department of Radiotherapy, Postgraduate Institute of Medical Education and Research, Chandigarh 160012, India

#### Lu-177/ Re-188- Selective Internal Radionuclide Therapy: Absorbed Dose Estimates using High-Resolution, Absolute, Gafchromic Film Dosimetry and Theoretical Methods

#### Background

Personalized dosimetry is crucial for overcoming variability in absorbed doses (AD) in radionuclide therapies. We introduce a cost-effective, high-resolution Gafchromic film dosimetry using a custom-made phantom for Re-188 and Lu-177.

#### Method

AD estimates as function of radioactivity, with Percentage Depth Dose and lateral spread distributions were calculated at 0.1mm increments. Based on dose fall-off curves, volume of irradiation sphere generated by isotropic emission by point source was quantified and termed as Dosimetric Volume Unit (DVU). DVU dosimetry was employed in ten patients undergoing Re-188/Lu-177-SIRT, comparing results with OLINDA/EXM® V2.0. Post-therapy regional SPECT/CT for OLINDA dosimetry were conducted at 24, 48, 72, 96 and 120 hours, with late

imaging at 1, 2, and 3 months after Lu-177-SIRT. In DVU dosimetry, lesion activity (%IA) was calculated via manual ROI processing and Q-Matrix software. SPECT functionalized tumor volume calculated from pre-dosimetry Tc-99m-Microspheres SPECT/CT.

## Results

DVU dimensions for Re-188 and Lu-177 were 4.8 x 4.8 x 7.4 mm and 3.7 x 3.7 x 1.6 mm respectively. Overall, mean cumulative absorbed-dose (CAD) and absorbed-dose rate (ADR) for Lu-177/Re-188-SIRT calculated by OLINDA was 20 (51-17) Gy and 24 (63-14) mGy/MBq respectively. For film dosimetry, manual and Q-matrix derived % IA in liver lesions were 46±14 and 27±12 respectively. DVU dosimetry revealed 2.4±1.5 times higher CAD and ADR values of 54(81-30) Gy and 78(174-24) mGy/MBq in comparison to OLINDA. OLINDA calculated mean lesion residence time for Re-188-Microspheres was 6.2 ± 2.3 hours. Manual and Q-matrix derived % IA in liver lesions were 21 ± 3 and 25 ± 9 respectively. DVU dosimetry revealed 3.6 ± 1.1 times higher CAD and ADR values of 81(96-68) Gy [vs 21(28-18) Gy for OLINDA] and 87 (119-64) [vs 31(37-21)] mGy/MBq. For Lu-177, early time-point based OLINDA dosimetry revealed a lesion residence time of 45 ± 10 h. Corresponding CAD and ADR values were 15 ± 8 Gy and 11 ± 5 mGy/MBq respectively. DVU dosimetry revealed 1.9 ± 0.5 times higher CAD and ADR values of 29 ± 15 Gy and 30 ± 21 mGy/MBq. Furthermore, in same cohort, late-time point imaging increased (OLINDA) lesion residence time to 184 ± 109 h. Corresponding CAD and ADR values increased to 88 ± 66 Gy and 30 ± 17 mGy/MBq respectively.

## Conclusion

DVU dosimetry yielded higher CAD and ADR estimates than early-time point OLINDA, and aligning with late-time point estimates, suggesting it could replace multi-point OLINDA, when effective half-life matches physical half-life.

## ORAL-05

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<sup>3</sup>Department of Biochemistry, PGIMER, Chandigarh, India

## Incremental Value of Rhenium-188 Microspheres Over Rhenium Perrhenate in Primary Hepatic Cancer Cell Lines

## Background

Hepatocellular carcinoma (HCC) is a prevalent contributor to global mortality rates. The main palliative treatments are trans-arterial chemoembolization (TACE) and selective intra-arterial radionuclide therapy (SIRT). Nevertheless, TACE is contraindicated when the portal vein is thrombosed. A novel freeze-dried non-radioactive microsphere kit formulation has been developed. The behaviour of microspheres and the therapeutic potential of 188Re-Microspheres have been assessed.

## Methods

The non-radioactive microspheres were formulated and freeze-dried. The microspheres were labeled with Fluorescein isothiocyanate (FITC) and the uptake of FITC-Microspheres by HepG2 cells was examined at various time intervals. The impact of 188Re-Microspheres on cell viability and the mode of cell death in HepG2 cells were investigated using MTT and Annexin FITC-V/PI apoptosis assay.

## Results

The labeling efficiency of microspheres was more than 99% with FITC and 188ReO4-. The maximum uptake of FITC-Microspheres by HepG2 cells was achieved in 6 hours. The exposure to 188Re-Microspheres has shown a decrease in cellular viability of HepG2 cells from 77.81 ± 0.015% to 42.03 ± 0.148% at 192 h incubation (>11 half-lives). The delivered radioactivity by 188Re-Microspheres was 0.255 to 0.901 MBq. These values were concordant with the flow cytometric analysis with Annexin FITC-V/PI apoptosis assay. At 192h, 53.28 ± 0.01% cells entered the apoptotic phase after treatment with 188Re-Microspheres and only 39.34 ± 0.02% remained viable. However, the cells treated with 188ReO4- showed 74.86 ± 0.005% cells in the viable phase and only 24.75 ± 0.577% cells in early apoptotic phase at 192h. The data revealed that 188Re-Microspheres treatment led to significant growth inhibition in HepG2 cells as compared to 188ReO4-.

## Conclusion

188Re-Microspheres showed better cytotoxicity as compared to 188ReO4-. The 188Re-Microspheres entered inside the cells, behaved as permanent radiation source, and delivered continuous radiation exposure to HepG2 cells, induced apoptosis and resulted in better cytotoxicity as compared to 188ReO4-.

## ORAL-06

Saima Jan  
Sher-I-Kashmir Institute of Medical Sciences, Soura, Srinagar

### **Incremental Value of Rhenium-188 Microspheres Over Rhenium Perrhenate in Primary Hepatic Cancer Cell Lines**

Radioactive iodine-131 (RAI) treatment may cause suppression in the bone marrow. In this study, hemoglobin levels, leukocyte, platelets, neutrophil and lymphocyte counts was compared before total thyroidectomy and 1week, 1month and 6 months after RAI treatment. 68 patients (52 females, 16 males) with a diagnosis of well-differentiated thyroid cancer who had undergone total thyroidectomy and received 50-220 mCi RAI treatment were included in the study. Hemoglobin levels, leukocyte, platelet, neutrophil and lymphocyte counts of the patients before the treatment and in 1week, 1month and sixth month after the treatment were compared retrospectively. When the patients were analyzed, We found that lymphocytes are more sensitive than other blood cells in radiation induced damage. It shows significant decline with p value = 0.001 at 1 week after ablation. By the period of one month p value = 0.005 which is still statistically significant. Leukocytes also shows sensitivity toward radiation induced damage with statistically significant drop at 1 week and 1 month (p value = 0.024, p = 0.026 respectively) after RIA ablation. However at 6 month post treatment the mean leukocyte count reached normal value.

Hemoglobin level also decreased after radioiodine ablation but compared to other parameters its drop is insignificant at 1 week post ablation however at 1 month the drop in level is significant with p value = 0.064. Six month post ablation mean hemoglobin reached a normal value.

Platelet count decreased after radioiodine ablation but compared to other parameters its drop is insignificant at 1 week post ablation however at 1 month the drop in level is significant with p value = 0.095. Six month post ablation mean platelet reached a normal value.

Neutrophil shows relative resistance to radiation induced damage as the drop in neutrophil count is insignificant at 1 week post ablation. After 1 month of ablation these cells shows drop in count with p value = 0.057. However at 6 month post ablation the mean cell count reached normal value. Despite the decrease in the parameters, the mean values were still in normal reference ranges, showing that the bone marrow suppression is mild. A high dose of RAI can be used without severe haematological effects.

## POSTERS : GROUP 1

### POSTER-01

Sangmitra Bodhi, Satyawati Deswal, Ajai Kumar Shukla, Praveen S. Pareek, Sathyanarayan P, Mohd. Khalid  
Dr. Ram Manohar Lohia Institute of Medical Sciences, Lucknow.

#### **Type: Radiation protection and dosimetry in nuclear medicine targeting Vectors**

##### **Introduction**

Cross fused renal ectopia is the second most common congenital fusion abnormality (behind horseshoe kidney) with an incidence of approximately 1:1300 to 1:7500. We present a case report of misdiagnosed case of cross fused ectopia as solitary kidney.

A 34-year-old puerperal woman presented with a two-week history of intermittent lower abdominal pain, frequent urination, and febrile episodes. During prenatal ultrasound screening, she was diagnosed with right renal agenesis. Blood investigations revealed an elevated total leukocyte count, indicative of infection or inflammation, while renal function tests were within normal limits. Urine culture was sterile. USG abdomen revealed left mild hydronephrosis raising suspicion of partial PUJ obstruction. Further evaluation with CT urography confirmed right renal agenesis, with absent renal vasculature. Final report of CT urography was given as hypertrophied and lobulated contoured left kidney with single pelvic collecting system and right renal agenesis. Given the findings and the suspicion of a single functioning kidney with suspicious Pelvic ureteric junction obstruction, the patient was referred for Technetium-99m EC Scintigraphy to evaluate renal function and drainage.

##### **Methods**

The patient was positioned supine, with the detector field set from the xiphisternum to the pelvis. Scan was acquired in GE-Discovery 670 gamma camera. Following intravenous administration of 5 mCi Tc-99m EC, flow images were obtained (1 min, 2 sec/frame), followed by dynamic images (20 min, 1.5 min/frame). A 40 mg diuretic was given 10 minutes post-injection.

##### **Results**

The Tc-99m EC scan demonstrated significant differences in radiotracer extraction and excretion between upper and lower half of left kidney (unobstructed drainage) with no significant tracer localisation in right renal fossa region, raising suspicion of duplex/ cross fused kidney. A Tc-99m DMSA scan was performed 48 hours later (acquired 3 hours post-injection) for further evaluation. DMSA planar images revealed demarcated cortical tracer localisation in upper and lower half with differential split function. SPECT/CT confirmed the above mentioned findings and the diagnosis of cross fused ectopia with single pelvic system was made.

### **Conclusion**

This case highlights the importance of multimodal investigations in evaluating congenital renal anomalies. Nuclear medicine investigations provided a comprehensive assessment in this patient and it entirely changed the case history and management from renal agenesis to cross fused ectopia with single collecting system. This case underscores the importance of nuclear medicine over contemporary investigations in solving clinical dilemma.

### POSTER-02

Asfaq Ahmed S  
Cancer Institute (WIA), Adyar, Chennai.

#### **Renogram Analysis Provides the Most Accurate Assessment of Split Renal Function Compared to Other Renal Parameters, Ensuring Superior Diagnostic Precision.**

##### **Aim**

The aim of this study is to investigate the accuracy and reliability of renogram analysis in assessing split renal function, highlighting its advantages over other renal parameters. By comparing renogram-derived data with alternative diagnostic methods, this study seeks to establish the superior diagnostic precision of renogram analysis in evaluating renal function. Additionally, the study aims to explore how renogram contributes to clinical decision-making, particularly in conditions requiring precise renal function differentiation for Lu-177 radionuclide based therapy.

##### **Materials and Methods**

This study was conducted on 30 patients presenting with neuroendocrine tumor and prostate cancer conditions requiring evaluation of split renal function. Ethical clearance was obtained, and informed consent was secured from all participants

##### **Materials**

- Gamma Camera: A dual-head gamma camera with SPECT capability was used for renogram acquisition.
- Radiopharmaceuticals: Tc-99m DTPA used for dynamic renogram.
- Software: Specialized software to process renogram curves and calculate split renal function.
- Laboratory Parameters: Baseline renal function was assessed using serum creatinine, estimated glomerular filtration rate (eGFR).and creatinine clearance.

##### **Methods:**

- Study Design: This study involved 30 patients who underwent renogram using Tc-99m DTPA.
- Renogram Procedure
- Comparative Parameters: eGFR and creatinine clearance

## Result

Out of the 30 patients included in the study, renogram analysis successfully provided split renal function measurements in all cases with a high degree of precision. The calculated split renal function values showed a strong correlation with clinical indicators of renal performance, surpassing the diagnostic accuracy of other parameters such as serum creatinine levels.

Renogram identified significant differences in renal function between kidneys in patients. Compared to eGFR and creatinine clearance, renogram analysis demonstrated superior sensitivity (96%) and specificity (92%) in detecting functional asymmetry.

These findings underscore the efficacy of renogram analysis in offering precise and reliable assessments of split renal function, making it an indispensable tool in both diagnostic and planning Lu-177 radionuclide based therapy.

## Conclusion

Renogram analysis proves to be the most accurate and reliable method for assessing split renal function, offering superior diagnostic precision compared to other renal parameters such as eGFR and creatinine clearance. By providing detailed insights into the individual performance of each kidney, renogram play a critical role in identifying functional asymmetry and guiding clinical decision-making in Lu-177 radionuclide based therapy. Renogram analysis is an indispensable tool for providing the most accurate assessment of split renal function, superior diagnostic precision compared to other renal parameters.

## POSTER-03

Madhuri More, Umesh B. Sherkhane, Nilendu Purandare, Ashish Kumar Jha, Venkatesh Rangarajan  
Department of Nuclear Medicine, Tata Memorial Hospital,  
Mumbai, Parel, Maharashtra, India  
Homi Bhabha National Institute, BARC Training School  
Complex, Anushaktinagar, Mumbai, Maharashtra, India

### Repeatability and Reproducibility of Averaging Computed Tomography Radiomics: A Phantom Study.

#### Objective

The repeatability and reproducibility of radiomics features extracted from CT scans need to be investigated. Only robust and stable features should be used in prognostication/ prediction models to improve generalizability across multiple institutions. Aim of this study is to access the temporal stability of imaging features with respect to a controlled scenario (test–retest), as well as their dependence on acquisition parameters such as slice thickness, or tube current.

## Material and methods

The PET NEMA IQ phantom was filled with water and image acquisition of phantom performed on two PET/CT scanner (Scanner1: Gemini TF16, Scanner 2: Gemini TF64) by changing imaging parameters to check reproducibility and tests were repeated after 30 minutes (Test-Retest) to check repeatability of the radiomic feature. CT image acquisition performed using constant tube voltage i.e. 120kVP and changing tube current to 100mAs, 200mAs, and 300mAs and changing slice thickness to 2mm and 5 mm. Scans were repeated after 30 minutes. The largest sphere (i.e. 37 mm diameter) was contoured on Philips IntelliSpace Discovery workstation and saved as RT-Struct for all the image sets. The original CT images were preprocessed and 1080 radiomics features were extracted from RT-Struct using PyRadGUI software. The average of 90 first order and textural features were calculated which were extracted from original image (1 set), LoG filtered image (3 sets) and wavelet images (8 sets). The repeatability and reproducibility of original and average radiomics features was calculated using Inter Class Correlation (ICC). The radiomics features were classified based on ICC range as Excellent ( $ICC \geq 0.9$ ), Good ( $0.9 > ICC \geq 0.75$ ), Moderate ( $0.75 > ICC \geq 0.5$ ), and Poor ( $ICC < 0.5$ ) correlated features.

## Results

In repeatability (Test-Retest) study performed for original radiomics features obtained for scanner 1, scanner 2 and combining (scanner 1 & 2), 77%, 51% and 43% features showed excellent correlation. In reproducibility study (inter scanner variability) performed for original, 25.55% radiomics features presented with excellent correlation.

In repeatability (Test-Retest) study performed for average radiomics features obtained for scanner 1, scanner 2 and combining (scanner 1 & 2), 81.11%, 57.77%, and 76.66% features showed excellent correlation. In reproducibility study (inter scanner variability) performed for average, 54.44% radiomics features presented with excellent correlation.

## Conclusion

Our study demonstrates that average radiomic features are more robust in comparison of original features. The robust features need to be investigated further in larger sets of data and also for its utility to develop prognostic and predictive models.

## POSTER-04

Mohd Khalid  
Dr. Ram Manohar Lohia Institute of Medical Sciences, Lucknow.

### Trouble Shooting in Myocardial Perfusion Imaging in SPECT

#### Objective

This study aims to investigate troubleshooting strategies for diminished image quality in myocardial imaging using the Discovery NM 670 gamma camera, specifically focusing on the off-peak performance of Detector 2. Off-peak behaviour in Detector 2 can lead to suboptimal image resolution and sensitivity, resulting in compromised diagnostic quality for patients undergoing Single Photon Emission Computed Tomography (SPECT) imaging. The objective is to identify the underlying causes of off-peak performance. This study evaluates diagnostic procedures, corrective measures to restore detector functionality and improve image quality. Ultimately, the findings aim to enhance imaging reliability and ensure accurate myocardial assessments for clinical decision-making.

#### Methodology

During a Tc-99m MIBI myocardial perfusion stress scan, a dose of 25 mCi of Tc-99m-MIBI was administered to the patient. An issue was observed with the gamma camera, specifically with Detector 2. We observed blurring of image and a shift in peak to off-peak condition. We later observed erroneous sinogram. This resulted in compromised image quality for a patient of age 65. To address this, we implemented corrective measures by performing an energy peaking procedure. A radioactive source of 1 mCi of Tc-99m was placed between both detectors, which enabled calibration and restored optimal performance.

#### Result

The off-peak issue was resolved after energy window was peaked to 140 keV. The scan was repeated once again for the same patient. The subsequent imaging results were of significantly improved quality, confirming the effectiveness of the corrective actions taken.

#### Conclusion

Effective troubleshooting in SPECT imaging, especially through proper peaking in gamma cameras, is essential for accurate imaging and diagnostic precision. Regular quality control and precise peaking optimize image quality, reduce artifacts, and improve clinical outcomes in nuclear medicine.

## POSTER-05

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### Performance Assessment of Dose Calibrator by Cross-Calibration Method

#### Objective

Dose calibrators are critical instruments in nuclear medicine, used to measure the activity of radiopharmaceuticals before administration to patients. Accurate and precise measurements are crucial for patient safety and treatment efficacy. The aim of the study is to evaluate the accuracy and precision of the cross-calibration method over a wide range of activity measurements. This study will also be useful in finding accuracy and precision in a situation with more than one dose calibrator in an institution without availability of a standard reference source, provided one dose calibrator is calibrated from certified lab with reference standard, whereas the other calibrator's calibration is due. Therefore, by utilizing this cross-calibration methodology, one can evaluate the performance characteristics of other dose calibrators.

#### Materials and Method

In our study, the Picomed Srl, model AcMe dose calibrator was pre-calibrated using a standard reference source. Different doses of activities were first measured with a pre-calibrated dose calibrator and then with test dose calibrator to evaluate the accuracy and precision parameter of Test dose calibrator. The experiment was performed using a radioactive source of Tc-99m with separate activities of 1015 mCi, 546 mCi, 254 mCi, 104.6 mCi, 56 mCi, 25 mCi, 13.04 mCi, 6.41 mCi, and 1.676 mCi, which was measured in Pre-calibrated Dose Calibrator and was used as reference activity (A). Decay corrected reference activity (Ad) measurement was taken in the Test Dose calibrator CRC-55tR for 6 times to obtain the mean of the Observed activity (Ao) with a gap of 2-3 seconds. 5cc syringes were used along with needle capping to avoid spillage for containing and measuring the activity. Standard deviation of mean, % Error, Accuracy, % Coefficient of variation (COV%), and Precision was calculated for each set of activity.

## Results

Results of measurements are tabulated in the table provided below.

| Sr. No. | Reference activity from pre-calibrated dose calibrator. (A) | Decay Corrected reference activity (for pre calibrated dose calibrator.) (A <sub>d</sub> ) | Mean activity measurement from Test Dose calibrator (for 6 consecutive measurement of each dose) ( $\bar{A} \pm \text{STD. Deviation}$ ) | Accuracy =100 - error% | Precision =100- COV% |
|---------|-------------------------------------------------------------|--------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------|------------------------|----------------------|
| 1       | 1015 mCi                                                    | 847.11 mCi                                                                                 | (848.6 mCi $\pm$ 5.35) mCi                                                                                                               | 99.82%                 | 99.36%               |
| 2       | 546 mCi                                                     | 537.663 mCi                                                                                | (537.16 mCi $\pm$ 0.897) mCi                                                                                                             | 99.90%                 | 99.83%               |
| 3       | 254 mCi                                                     | 250.12 mCi                                                                                 | (249.28 mCi $\pm$ 1.484) mCi                                                                                                             | 99.66%                 | 99.40%               |
| 4       | 104.6 mCi                                                   | 102.607 mCi                                                                                | (101.66 mCi $\pm$ 0.756) mCi                                                                                                             | 99.07%                 | 99.25%               |
| 5       | 56 mCi                                                      | 54.303 mCi                                                                                 | (54.13 mCi $\pm$ 0.149) mCi                                                                                                              | 99.66%                 | 99.40%               |
| 6       | 25 mCi                                                      | 23.96 mCi                                                                                  | (24.8 mCi $\pm$ 0.057) mCi                                                                                                               | 96.61%                 | 99.76%               |
| 7       | 13.04 mCi                                                   | 12.50 mCi                                                                                  | (12.57 mCi $\pm$ 0.0211) mCi                                                                                                             | 99.44%                 | 99.83%               |
| 8       | 6.41 mCi                                                    | 6.097 mCi                                                                                  | (6.13 mCi $\pm$ 0.0074) mCi                                                                                                              | 99.46%                 | 99.87%               |
| 9       | 1.676 mCi                                                   | 1.610 mCi                                                                                  | (1.598 mCi $\pm$ 0.0021) mCi                                                                                                             | 99.25%                 | 99.86%               |

## Conclusion

Accurate and precise dose calibrator measurements are critical for patient safety and treatment efficacy in nuclear medicine. The present study results indicate that at higher activities >250 mCi, the standard deviation was more compared to <250 mCi ranges, but it was within the NRC-recommended criteria of <10%. Overall accuracy and precision was maintained by more than 99% with all the ranges of activities. Therefore, the test calibrator can be used for clinical purpose. Regular QC procedures and adherence to best available practices can help to ensure that dose calibrators are functioning correctly and providing reliable measurements.

### POSTER-06

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### Effect of Different Solvents and Stationary Phase on Retardation Factor of <sup>68</sup>Ga-PSMA

## Background

Thin layer or paper chromatography (TLC/PC) is a routinely used quality control technique for determining the radiochemical purity (RCP) of formulated radiopharmaceutical. The retardation factor (R<sub>f</sub>), which represents the ratio of distance a component has moved up on the chromatography plate relative to the distance the solvent front has moved, ranges between 0-1. The R<sub>f</sub> is dependent both on the stationary and mobile phase used.

## Aim of the Study

The present study aims to see the effect of different stationary and mobile phase on <sup>68</sup>Ga-PSMA R<sub>f</sub> using radio-TLC scanner.

## Materials and Methods

The study was performed using silica gel coated ITLC and Whatman paper number 3, 80 x 10 mm (L x B) as stationary phase. The <sup>68</sup>Ga-PSMA (2 μL) was spotted 10 mm above the base of strip. The strips were developed in 3 different mobile phase 0.5 M sodium citrate, absolute methanol and ultra pure water. The developed strips were read on BGO crystal based radio-TLC scanner. Each strip was run for 3 min and R<sub>f</sub> values were calculated from the radio-chromatogram.

## Results

Different values of R<sub>f</sub> for <sup>68</sup>Ga-PSMA was noted for different mobile and stationary phases which are presented as Table 1.

**Table 1** Values of R<sub>f</sub> noted for different mobile and stationary phases

| Mobile Phase    | R <sub>r</sub> (Silica) |            |         | R <sub>r</sub> (Whatman no.3) |            |         |
|-----------------|-------------------------|------------|---------|-------------------------------|------------|---------|
|                 | <sup>68</sup> Ga-PSMA   | Hydrolysed | Unbound | <sup>68</sup> Ga-PSMA         | Hydrolysed | Unbound |
| Sodium citrate  | 0.31                    | 0.0        | 1.0     | 0.81                          | 0.0        | 1.75    |
| Abs Methanol    | 0.52                    | 0.0        | 1.0     | 0.12                          | 0.0        | 3.37    |
| Ultrapure water | 0.62                    | 0.0        | 1.0     | 0.93                          | 0.0        | 2.27    |

## Conclusion

Different combination of mobile phase and stationary phase can be used to determine the different components and RCP of <sup>68</sup>Ga-PSMA. Depending upon the availability either of sodium citrate, absolute methanol, and ultrapure water can be used as mobile phase with ITLC or whatman paper. However, caution need to be practiced while selecting the mobile/ stationary phase and analysing the results as same radiopharmaceutical behaves differently when either of the phases are changed.

## POSTERS : GROUP 2

### POSTER-01

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#### Texture Analysis of 18F-PSMA-1007 PET/CT Images in Prostate Cancer Patients.

##### Introduction

Extracting features from the medical images such as texture parameters (TP) has gained momentum in recent years owing to the information provided in terms of quantification. Texture parameters (TP) can be calculated based on different parent matrices like grey level co-occurrence matrix (GLCM), grey level run length matrix, grey level size zone matrix, neighbourhood grey level dependence matrix etc. The present study aims to quantify GLCM based TPs and explore their potential in disease evaluation using 18F-PSMA-1007 PET/CT studies in prostate carcinoma patients.

##### Material and Methodology

A total of 17 male patients, mean age 61 years (range: 54-81) were included in the study. The clinical characteristics of the patients including PSA level, Gleason score and histopathology of prostate lesion were noted. All patients underwent 18F-PSMA-1007 PET/CT whole body study. Six texture parameters based on grey level co-occurrence matrix namely second angular moment, contrast, entropy, homogeneity, dissimilarity and inverse difference moment were calculated using CGITA software on 18F-PSMA-1007 PET images. The correlation of these TPs with PSA value as well as with Gleason score were assessed by calculating Karl's Pearson correlation coefficient(r). Mann-Whitney U test was used to compare the difference of TPs between benign and malignant groups. The difference was considered to be statistically significant for  $p < 0.05$ .

##### Results

The mean value of the GLCM based texture parameters were 816328.4, 283549.5, -17079.3, 1753.56, 27770.47 and 1286.08 for second angular moment, contrast, entropy, homogeneity, dissimilarity and inverse difference moment. The correlation coefficient with PSA levels and Gleason score was found to be poor ( $r < 0.4$ ) for all GLCM based TPs. There was no statistically significant difference in the mean values of TPs in benign and malignant patients group.

##### Conclusion

The texture parameters based on GLCM cannot differentiate between benign and malignant disease in prostate carcinoma patients. However, TPs based on other parent matrices can be evaluated for their potential in prostate carcinoma patients.

### POSTER-02

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#### Quantitative Comparison of Two Different Dosimetry Softwares for 177Lu-PSMA Therapy

##### Introduction

Dosimetry contributes to the evaluation of the outcome and the optimization process of targeted radionuclide therapy. There are various commercially available dosimetry software applications, but they do not address all the same parts of the dosimetry workflow. Some allow raw data reconstruction but stop after the calculation of the TIA(C) Others consider activity maps (or equivalent, i.e., count-indexed images + calibration factor). Some consider only the absorbed dose calculations. In addition, some software only accepts a certain type of data (e.g., SPECT-only). Therefore, a fair comparison of available software is a challenging task since they address different parts of the workflow.

##### Aim

This study aimed to quantitatively compare two commercial dosimetry software platforms based on the analysis of clinical datasets of patients who received 177Lu-PSMA therapy in terms of accuracy and effort in clinical routine

##### Methods

Six patients underwent dosimetry analysis during single cycles of 177Lu-PSMA. Single photon emission computed tomography/computed tomography images were acquired at 2, 24 and 96 h post injection on Siemens Symbia Intevo 6 using medium energy collimator and utilizing dual energies (113keV and 203keV, 20% window). 20% Upper and lower scatter windows were also incorporated for scatter correction. Reconstructed images were generated using 2D OSEM by Siemens®. Reconstructed images were uploaded into Hybrid Dosimetry Module™ from HERMES, and MIM SurePlan™ MRT from MIM Software Inc. Mean absorbed doses were calculated from each application using their recommendations.

##### Results

Mean absorbed doses estimated by MIM (MIM SurePlan™ MRT) and HERMES (Hybrid Dosimetry Module™) were  $0.28 \pm 0.06$  Gy/GBq &  $0.24 \pm 0.08$  Gy/GBq for the kidneys,  $0.06 \pm 0.02$  Gy/GBq &  $0.08 \pm 0.03$  Gy/GBq for the liver,  $0.06 \pm 0.02$  Gy/GBq &  $0.07 \pm 0.02$  Gy/GBq for the spleen. No significant difference exists between the mean absorbed doses of kidneys, liver and spleen as estimated by both the softwares.

## Conclusion

Results obtained were of similar magnitude for liver, kidneys and spleen, however, head-to-head comparison of the performance of the softwares is difficult owing to several variable factors involved in processing of the data.

## POSTER-03

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### Assessment of Similarities among the Original Radiomic Features in Various Disease Group Using Clustering Method

## Aim and Objective

In last one-decade radiomics has been utilized as imaging biomarker to predict outcomes in cancer. However, these features can be redundant, leading to overfitting in prediction models. This study aims to analyse radiomic features across different diseases to identify similarities and potential correlations, helping to avoid redundancy and improve feature selection in model development.

## Methodology

This study included 97 patients of lung (28), cervical (23), and rectal (46) cancer who underwent pre-treatment PET/CT scans in our department. All the CT images of the patients were loaded on the EBW Workstation Philips Healthcare Limited and tumor delineation was performed. CT Radiomic features were extracted using PyRadGUI software. Subsequently, radiomic features were analysed to know the association among them using K-Means clustering techniques in Python 3.12.3.

## Result

A total of 1093 features were extracted from each set of images, utilizing only original features for the study. Two sets were considered: one involved randomly selecting 5 clusters, while the other involved plotting Silhouette scores for each disease group, resulting in 2 clusters. After performing K Mean clustering, features were divided among the clusters for both sets. Upon intersecting clusters of Set 1 lung and rectal cancer, a total of 13 features were found to be common; for rectal and cervical cancer, 29 features were common; and for cervical and lung cancer, 12 features were common. Additionally, when intersecting clusters of all three disease groups, 3 common features were identified.

Similarly, for Set 2, 65 features were common between lung and rectal cancer, 43 features between lung and cervical cancer, and 25 features between rectal and cervical cancer. After intersecting clusters of all three disease groups for Set 2, 17 features were found to be common.

## Conclusion

From our study we found some features that were shared across all diseases, and also some unique features to each disease group. These shared and unique features can help us to make prediction models in future.

## POSTER-04

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### Validation of Dosimetry Tool Kit Software using NEMA IQ phantom

## Introduction

The use of dosimetry software has become increasingly important in nuclear medicine due to the expanding use of radionuclide therapy in oncology. Many manufacturers have developed their dosimetry software and have been marketed for commercial use. Validation of these software, thus, becomes an important aspect for their liability of dosimetry calculation. Our study is set out to validate the Dosimetry Toolkit (DTK) software, which is installed on the Xeleris 4.1 workstation, GE Healthcare.

## Materials and Methods

The DTK software validation was performed using NEMA IQ PET phantom in multi-SPECT setting for Lu-177 radionuclide. NEMA IQ phantom has six spherical inserts of diameters, 37, 28, 22, 17, 13, and 10 mm respectively. Spheres of IQ phantom were used to mimic an organ/tumor. Three studies were performed using sphere-to-background ratio (SBR) of activity concentration 6:1, 8:1, and 12:1 respectively. SPECT/CT scans were performed at eight distinct time points at approximately 4hr, 24hr, 48hr, 72hr, 96hr, 120hr, 144hr, 168hr post-phantom preparation using the Discovery 670 pro SPECT/CT scanner, GE Healthcare. Normalized cumulated activity (NCA) was calculated by the mono-exponential fitting method by the Dosimetry Toolkit software (NCAdtk). Similarly, NCA theoretical (NCAt) was also calculated using following formula.  $NCAt = 1.44 * T_p * A_s / A_0$ ; where,  $T_p$ =Physical half-life of Lutetium-177 (No biological clearance),  $A_s$ =initial activity in sphere,  $A_0$ =Total initial activity in phantom. NCA calculated by using Toolkit was compared with theoretically calculated values.

## Results

The mean percentage difference between the software calculated NCAdtk and theoretically calculated (NCAt) was found to be increasing in decreasing volume of the sphere. The mean percentage difference in decreasing order

of sphere diameter are 8.094%, 34.2%, 52.68%, 140.4%, 130.56%, 119.65% respectively. For largest diameter sphere the percentage difference for the SBR 6:1, 8:1, 12:1 were found to be 13.746%, 9.186% and 1.35% respectively.

## Conclusion

Our study revealed that the NCA estimation by DTK software was found to be more reliable in the largest sphere having least mean percentage difference with that of theoretical NCA, whereas, the percentage difference increased with decreasing volume of sphere. This could possibly be due to the known phenomena of partial volume effect. Further studies need to be conducted with varying concentration of radionuclide for better understanding.

## POSTER-05

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### Advancements of AI in Nuclear Medicine

## Purpose

This study explores the application of AI in addressing challenges in nuclear medicine, including time delays, high costs, and human errors, with the goal of enhancing workflow efficiency, diagnostic accuracy, and overall patient care.

## Background

Nuclear medicine plays a vital role in diagnosing and treating a wide range of diseases, particularly through imaging techniques like PET and SPECT. However, challenges such as lengthy procedures, high costs, and manual errors continue to hinder optimal care. Processes like patient scheduling, image acquisition, diagnostic interpretation, and treatment planning are often inefficient and prone to inaccuracies. The integration of AI in these areas promises to optimize workflows, reduce human error, and lower operational costs.

## Methods

AI technologies are being integrated into various stages of nuclear medicine to streamline operations and improve outcomes. In imaging, AI-driven systems automate patient positioning and motion correction, ensuring more precise and quicker scans. Deep learning algorithms enhance image reconstruction, enabling more accurate diagnoses. AI also supports the automation of dosimetry calculations and personalizes treatment planning by analyzing patient-specific data. Additionally, AI is applied to scheduling systems, where it predicts patient wait times, optimizes appointment flow, and helps reduce delays, thus improving overall efficiency and patient satisfaction.

## Results

The integration of AI in nuclear medicine has resulted in significant improvements in both efficiency and diagnostic accuracy. AI has reduced manual intervention, improved the quality of imaging, and facilitated faster diagnostic interpretation. AI-powered scheduling systems have optimized patient flow, minimized wait times, and increased patient satisfaction. These advancements contribute to cost savings and more timely, accurate treatment planning.

## Conclusion

AI significantly outperforms traditional methods in nuclear medicine by reducing time, minimizing errors, and enhancing diagnostic precision. Rapid integration and further investment in AI are crucial to revolutionizing clinical workflows and improving patient outcomes.

## POSTER-06

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### Evaluation of the Success Rate of Two Different Fixed-Doses of I-131 Radioiodine Therapy in Graves' disease Patients Based on Tc-99m Thyroid Uptake by Gamma Camera

## Introduction

Graves' disease is the most common cause of hyperthyroidism. Based on their effectiveness and limits, treatment options include antithyroid medications, Low Dose Radioactive Iodine Therapy (RIT) and Surgery. RIT is administered using either the Fixed Dose Method (FDM) or the Calculated Dose Method (CDM), which is based on the radioactive iodine thyroid gland percentage uptake value. Thyroid Uptake Probe is regarded as the gold standard method for calculating thyroid uptake. As an alternative, <sup>99m</sup>Tc-Thyroid scintigraphy on a Gamma Camera can also be used to get estimated thyroid uptake by administration of <sup>99m</sup>Tc pertechnetate to the patient. However, not enough studies are available on the administration of RIT by FDM using the thyroid uptake calculated by Gamma Camera technique. In order to evaluate the success rate of two different fixed-doses of <sup>131</sup>I radioiodine therapy in Graves' Disease patients based on <sup>99m</sup>Tc thyroid uptake by gamma camera.

## Materials and Method

Graves' Disease patients with and without history of antithyroid drugs referred to department of Nuclear Medicine for Low Dose RIT were included. <sup>99m</sup>Tc pertechnetate thyroid scan was performed and thyroid scan

was performed and thyroid uptake was calculated as per given formula:

$$\% \text{Thyroid Uptake} = \frac{(\text{Thyroid counts} - \text{Background counts})}{\text{Pre} - \text{syringe counts} - \text{Post} - \text{syringe counts}} \times 100$$

Patients with thyroid uptake values  $>4.5$  and  $\leq 30\%$  were included. Antithyroid drugs were stopped for 5 days prior to scan and RIT. Patients were divided into 2 groups based on the random team generator method: Group 1 (administered 10 mCi) and Group 2 (administered 15 mCi). Clinical and biochemical evaluation was done at 2 and 4 months post RIT.

## Results

A total of 30 patients were included in this present study. 28 patients completed 2 and 4 months follow up. Of these 28 patients, 19 were females (mean age 42.3 yrs) and 9 were males (mean age 40.5 yrs). Both, Group 1 & Group 2 included 14 patients. Mean thyroid uptake values were 13.35% and 16.20% in Group 1 and 2 respectively (p value 0.12). At the end of 4 months follow-up, 17/28 (60%) patients became hypothyroid. In Group 1 - 11/14 (78%) and in Group 2 - 6/14 (42%) patients became hypothyroid at the end of 4 months.

## Conclusion

Low dose RIT based upon thyroid uptake is a cost-effective and less time intensive method of treating patients of Graves' Disease. However, no statistically significant difference was observed in the success rate for the treatment of Graves' Disease at the end of 4 months between the fixed dose of 10 mCi ( $^{131}\text{I}$ ) and 15 mCi ( $^{131}\text{I}$ ). Due to small sample size and limited time of the present study, our results showed fixed dose of 10mCi of  $^{131}\text{I}$  is relatively preferable over 15 mCi of  $^{131}\text{I}$  in treatment of Graves' Disease. However, longer follow-up study periods and larger sample size may help to give better picture about dose preference.

## POSTERS : GROUP 3

### POSTER-01

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#### Dual Tracer MWSR: Redefining Standard Practice

##### Aim

Multiple Window Spatial Registration (MWSR) defines ability of position logic circuitry of the Gamma Camera to accurately superimpose X-Y gains from different Pulse Height Analyzer (PHA) energy windows, which is measured as positional deviation. This positional deviation in a gamma camera image is a function of gamma ray energy and has particular application in imaging isotope with multiple peaks. The aim of the study is to evaluate the feasibility of dual-tracer method for NEMA Multiple Window Spatial Registration (MWSR) assessment using Tc-99m in combination with either Lu-177 or I-131 as a replacement for Ga-67.

##### Method

The MWSR test was conducted on a GE NM860 dual-head gamma camera equipped with rectangular NaI (Tl) crystals (3/8 inch thick) with 59 photomultiplier tubes per detector head. The point sources of 1.85 MBq activity of Tc-99m (140 keV) in a mixture of 3.7 MBq activity of Lu-177 (208 keV) and in a mixture of 3.7 MBq activity of I-131 (364 keV) were used. A 3000 kcps (kilo-counts per second) static acquisition was done with 30% energy window centred on each radionuclide. The acquired images were then processed on xeleris to calculate centroid. The X & Y deviation in spatial registration were obtained and compared with manufacturer's standard.

##### Result

The obtained X & Y deviation in spatial registration for both isotope combinations (Tc-99m & I-131) & (Tc-99m & Lu-177) was  $\leq 0.5$  mm. The obtained results are within the manufacturer's tolerance limits.

##### Conclusion

The MWSR assessment with dual-tracer method using combination of Tc-99m along with either Lu-177 or I-131 can be used as an alternative to routine MWSR assessment using Ga-67, where the availability of this source is not feasible. This approach is potentially an effective alternative for MWSR test done with Ga-67.

### POSTER-02

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#### HPLC Based Comparative Analysis of Reaction Vial Contents Before and After Rinsing in Automated <sup>68</sup>Ga-PSMA-11 Synthesizer

##### Introduction

<sup>68</sup>Ga-PSMA-11 is a radioactive imaging agent used in Positron Emission Tomography (PET) scans to help locate prostate cancer cells. Production of <sup>68</sup>Ga-PSMA involves elution of <sup>68</sup>GaCl<sub>3</sub> from <sup>68</sup>Ge/<sup>68</sup>Ga Generator, mixing of buffer and reaction at an elevated temperature of 95°C for a specific time with PSMA-11 ligand in reaction vial. After the reaction, the crude <sup>68</sup>Ga-PSMA product is purified by solid-phase extraction method using Sep-Pak C-18 Cartridge and the product is collected into the production vial. The final product undergoes quality control testing to ensure it meets the required specifications for radiochemical purity, chemical purity, and sterility. After the product is delivered, the automatic synthesis module runs rinsing program to clean the reaction vial as well as the cassette vessels.

##### Materials and Methods

ITM <sup>68</sup>Ge / <sup>68</sup>Ga Generator was used for <sup>68</sup>Ga Radioisotope and iQS-TS fully automated theranostic synthesizer was used for the production of <sup>68</sup>Ga-PSMA. Immediately after product delivery and without any rinsing of the reaction vial, the first sample was withdrawn directly from the reaction vial. This sample represented the final reaction mixture as delivered by the automated synthesis process. The automated synthesis module performed its programmed rinsing procedure. A second sample was collected from the reaction vial following this automated rinse cycle. This sample assessed the effectiveness of the automated rinsing process in removing residual product. Finally, a manual rinse was performed using 10 mL of ultrapure water. The reaction vial was rinsed thoroughly, and the final sample was collected. All the samples were analysed using ITM Fully Integrated Radio-HPLC System.

##### Results

##### Pre -Rinsing sample of Reaction vial

<sup>68</sup>GaCl<sub>3</sub> and <sup>68</sup>Ga-PSMA peak was observed at 1.6 minutes and 8.7 minutes respectively. PSMA-11 Peptide slope was observed at 9.7 Minutes with 28.6 peak height.

### Post-Automatic Rinsing sample

$^{68}\text{GaCl}_3$  peak was observed at 1.7 minutes,  $^{68}\text{Ga}$ -PSMA peak was observed at 8.7 minutes with lesser counts compared to pre-rinsing sample and PSMA-11 Peptide slope was observed at 9.9 minutes with 20.6 peak height.

### Post Manual Rinsing sample

No activity peak was observed. PSMA-11 Peptide curve was observed at 9.7 minutes with 0.057 peak height.

### Conclusion

Free  $^{68}\text{GaCl}_3$ ,  $^{68}\text{Ga}$ -PSMA and unlabelled PSMA-11 peptide residue was observed in reaction vial after Pre and Post automatic rinsing. It was also observed that counts were decreased after the automatic rinsing. Our study suggested that after manual rinsing with 10mL of Ultrapure Water free  $^{68}\text{GaCl}_3$  and  $^{68}\text{Ga}$ -PSMA completely disappeared as well as unlabelled PSMA-11 Peptide was also reduced from the reaction vial.

### POSTER-03

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### Activated Charcoal to Decontaminate Iodine-131?

#### Background

Sodium iodide I-131 ( $\text{NaI-I-131}$ ), a theranostic agent, is extensively used in nuclear medicine for treating differentiated thyroid carcinoma. Handling I-131 poses risks of radiation contamination, particularly during wet operations in the lab. Although preventive measures such as wearing PPE, using absorbent sheets, and monitoring for contamination are routine, the potential for contamination of PPE and work surfaces remains high. Common decontamination practices involve the use of EDTA solutions, which are stable under specific conditions, but alternatives such as moist activated charcoal sheets have shown promise due to their iodine adsorption properties.

#### Aim

This study is aimed to evaluate the efficacy of moist activated charcoal sheets as a decontaminating agent in radioiodine pharmacy laboratories compared to the traditional EDTA solution.

#### Materials and Methods

11 Small vinyl carpet pieces (3x3 cm) were contaminated with 20  $\mu\text{Ci}$  of I-131. The decontamination process utilized moist activated charcoal sheets (5x5 cm) and standard EDTA solution.

### Results

**Table 1** Reference for I-131 Decontamination with standard EDTA solution

| Contaminated surfaces | Before cleaning with EDTA solution (cps) | After cleaning with EDTA solution (cps) | BKG | % contamination remaining= $\frac{\text{post}}{\text{pre}} \times 100$ |
|-----------------------|------------------------------------------|-----------------------------------------|-----|------------------------------------------------------------------------|
| Sample carpet 1       | 440                                      | 2                                       | 1.2 | 0.45                                                                   |
| Sample carpet 2       | 3800                                     | 2                                       | 1.2 | 0.05                                                                   |
| Sample carpet 3       | 1000                                     | 50                                      | 1.2 | 5                                                                      |
| Sample carpet 4       | 970                                      | 2                                       | 1.2 | 0.21                                                                   |

**Table 2** I-131 Contamination Levels after decontamination with moist activated charcoal

| Contaminated poly vinyl carpet surfaces | Before cleaning with moist ac (cps) | After cleaning with moist ac (cps) | BKG cps | %contamination remaining= $\frac{\text{post}}{\text{pre}} \times 100$ |
|-----------------------------------------|-------------------------------------|------------------------------------|---------|-----------------------------------------------------------------------|
| Sample carpet 1                         | 2700                                | 740                                | 1.2     | 27.40                                                                 |
| Sample carpet 2                         | 3400                                | 1.1                                | 1.2     | 0.03                                                                  |
| Sample carpet 3                         | 14000                               | 140                                | 1.2     | 1                                                                     |
| Sample carpet 4                         | 501                                 | 1.5                                | 1.2     | 0.299                                                                 |
| Sample carpet 5                         | 93                                  | 37                                 | 1.2     | 39.7                                                                  |
| Sample carpet 6                         | 670                                 | 140                                | 1.2     | 20                                                                    |
| Sample carpet 7                         | 1100                                | 30                                 | 1.2     | 2.7                                                                   |

This table shows drop in I 131 Contamination level after decontamination with moist activated charcoal.

Decontamination was performed under controlled conditions in a fume hood with proper PPE. Measurements included pre- and post-cleaning counts per second (cps), and the percentage of remaining contamination was calculated.

Moist activated charcoal demonstrated high efficacy in reducing I-131 contamination levels. For instance, one sample showed a reduction from 14000 cps to 140 cps, achieving a contamination retention rate of 1%. The adsorption efficiency of activated charcoal, with its high surface area (1000  $\text{m}^2/\text{g}$ ), was evident as it effectively trapped iodine vapors, preventing further dispersion. Comparatively, EDTA solution also reduced contamination but varied in effectiveness across different surfaces. Moist activated charcoal proved to be a reliable alternative, with results showing significant reductions in contamination percentages across various test surfaces.

### Conclusion

Moist activated charcoal sheets provide an effective, accessible, and affordable alternative to EDTA solutions for decontaminating I-131 in nuclear medicine settings. Their ability to adsorb iodine efficiently highlights their potential as a practical tool for managing radioactive contamination in laboratory environments.

## POSTER-04

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### Development and Validation of a Novel <sup>68</sup>Ga-Labeled Bis-ATRIDAT for Dual CXCR4/CXCR7 Targeting in Glioma

#### Introduction

Glioblastoma is known to exhibit elevated expression of the chemokine receptors CXCR4 and CXCR7, both of which play crucial roles in tumor progression and metastasis. Targeting these dual receptors simultaneously may enhance imaging efficacy compared to conventional single-receptor targeting approaches. The present study aims to develop and validate a novel <sup>68</sup>Ga-labeled bis-ATRIDAT, a macrocyclic compound designed to target both CXCR4 and CXCR7 in glioma.

#### Materials and methods

The research was conducted at the Department of Nuclear Medicine, Post Graduate Institute of Medical Education and Research, Chandigarh, with institutional ethical clearance (IEC-INT/2024/MSc-2039). Bis-ATRIDAT was synthesized in-house, purified using column chromatography, and characterized by LCMS (liquid chromatography-mass spectrometry) to confirm its identity and purity. The radiolabeling procedure was optimized for <sup>68</sup>Ga, with a particular focus on reaction parameters such as pH and incubation time. The labeling efficiency was evaluated by Radio-TLC, and the optimal conditions were established.

#### Results & Discussion

The radiolabeling reaction was performed at a pH range of 3-5, with the optimal pH determined to be between 4.5 and 5.0, as pH values above 5 led to the formation of gallium hydroxide species that hindered complexation with the macrocyclic ligand. Varying the incubation time from 5 to 15 minutes revealed that the maximum radiochemical yield (73%) was achieved at 10 minutes. Under optimized conditions, the radiolabeling efficiency exceeded 90%, and the <sup>68</sup>Ga-Bis-ATRIDAT complex demonstrated stability for up to 90 minutes post-labeling.

#### Conclusion

These findings indicate that <sup>68</sup>Ga-Bis-ATRIDAT is a promising dual-targeting imaging agent with high labeling efficiency and stability. Future studies will focus on in vitro and in vivo preclinical validation to assess the compound's affinity for CXCR4 and CXCR7, along with its potential for tumor imaging and biodistribution in glioma models.

## POSTER-05

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### Utility of 4 Hour Delayed Protocol in Tc-99m Parathyroid Scintigraphy: An Experience at a Tertiary Care Hospital

#### Background

Parathyroid scintigraphy is a non-invasive pre-operative tool to identify and localize hyperfunctioning adenomas and other parathyroid disorders precisely. The technique utilizes Technetium-99m sestamibi (Tc-99m MIBI) due to its superior binding to both thyroid and parathyroid gland. The delayed spot is often a selective protocol for determination of hyperfunctioning parathyroid adenomas and improves the sensitivity and specificity of the scan.

#### Aim

To study 4 hour scanning in cases of parathyroid adenoma in strong clinical and biochemical suspicion.

#### Materials & Methodologies

We retrospectively analyzed 54 patients, referred to Nuclear Medicine Department for parathyroid scintigraphy from 2021 till 2024. The data has majority female population (n=52) and male population (n=7). All of them have elevated Serum Parathyroid hormone ranging from 49 to 431 pg/ml and many have elevated alkaline phosphatase ranging from 359.42 to 820.35 IU/ml and 5 of them have raised serum calcium levels.

All the patients were administered intravenously with Tc-99m MIBI 10-20 mCi and anterior static/ planar images were obtained at 15 minutes, 50 minutes and 2 hours respectively. The delayed 4 hour is occasionally done when suspecting strong probabilities of parathyroid adenoma. The study was performed under GE New Discovery 870 series Gamma camera and image protocol selected are of high counts 300-500 kilo counts under 128\*128 matrix size.

#### Results

From our analysis, we found that scanning was done at 04 hours in 8 patients out of 54 (14.81%) and 2 patients (3.7%) showed retained Tc-99 MIBI (Sestamibi) uptake by parathyroid gland which was not seen in earlier images. 17 patients (31.48%) showed parathyroid adenoma at 15 minutes, 9 patients (16.67%) showed parathyroid adenoma at 50 minutes, 13 patients (24.07%) showed parathyroid adenoma at 02 hours. One patient parathyroid adenoma could be identified only on SPECT done at 50 minutes due to strong clinical and biochemical history. Rest 7 patients were reported as normal functioning parathyroid gland.

## Conclusion

Delayed scans till 4 hours can be considered when suspecting a strong possibility of functioning Parathyroid adenoma, when clinical and biochemical history are in strong correlations in such cases. Our experience in obtaining delayed images has significantly impacted patients' clinical management and has helped clinicians in better treatment regimes.

## POSTER-06

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### Role of PET CT Simulator in Radiotherapy

## Background

Radiotherapy is a primary cancer treatment that targets tumors with radiation while protecting healthy tissues. Positron Emission Tomography (PET) uses a radioactive tracer, like FDG (Fluorodeoxyglucose), to detect metabolic activity through the annihilation of positrons and electrons, producing gamma rays. The PET-CT combination merges PET's metabolic imaging with CT's anatomical detail, allowing oncologists to accurately locate tumors and assess their metabolic activity. This is especially useful for cancers with narrow Planning Target Volume (PTV) margins or those that are hard to localize. While CT simulators offer detailed anatomy, they struggle to distinguish between viable tumours and non-viable tissues like necrosis or fibrosis.

## Aim

Improved delineation of Gross Tumour Volume (GTV). Identification of metabolically active tumour regions. Reduction of geographic miss and unnecessary irradiation to normal tissues. Enhancing treatment planning for dose escalation to biologically active tumour sub-regions.

## Materials and Methods

**PET-CT Scanner:** Equipped for simulation with a large bore which compatible for immobilization devices, flat carbon-fibre couch resembling a LINAC couch, wall-mounted lasers for alignment and reference marking, and DICOM connectivity for data transfer to the Treatment Planning System (TPS).

**Patient Preparation:** Patients fast 4–6 hours pre-scan to minimize non-cancerous glucose uptake; blood glucose control is critical.

**Patient Positioning and Immobilization:** involve Thermoplastic masks, vacuum cushions, or body moulds ensure consistent patient positioning ensure reproducibility and accuracy.

**Radiotracer Administration:** 18F-FDG, a glucose analogue

accumulates in metabolically active tissues, aiding cancer detection. Intravenous injection of 18F-FDG, followed by a 45–60 minute uptake period.

**Image Acquisition:** Simultaneous PET (metabolic activity) and CT (anatomical detail) scan. The imaging data is imported into radiotherapy planning software.

**Treatment Planning :** Radiation oncologists use PET-CT for Target Volume Delineation (GTV, CTV, PTV) and to plan treatment fields, including beam angles, energy, modulation (e.g., IMRT, VMAT), and dose escalation to PET-identified metabolically active regions.

**Verification and Quality Assurance:** Pre-treatment verification using Cone Beam CT (CBCT) or EPID confirms alignment and accuracy of tumour irradiation.

## Result

- Improved Tumour Delineation
- Reduced Geographic Miss
- PET-CT reduces the chances of missing active tumor regions, leading to better local control of the disease.
- Dose Escalation to Biologically Active Tumor Regions:
- High Standardized Uptake Values (SUV) on PET indicate regions that are more active
- Detection of Occult Metastasis: PET-CT can detect small metastatic lesions or lymph node involvement that are invisible on CT alone, leading to treatment plan modifications
- Improved Clinical Outcomes: improves tumor control and reduces toxicity

## Conclusion

PET-CT simulation plays a critical role in modern radiotherapy by combining metabolic and anatomical imaging for precise treatment planning. It plays a pivotal role in:

- Accurate tumor delineation.
- Identification of biologically active sub-regions for dose escalation.
- Avoiding unnecessary radiation exposure to healthy tissues.
- Improving detection of nodal and distant metastases.

## POSTERS : GROUP 4

### POSTER-01

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#### Performance Evaluation of Two Contamination Monitors in terms of Efficiency

##### Aim

The contamination monitor is an important radiation safety tool. Its primary role is to measure the radioactivity contamination of surfaces and occupational workers. A contamination monitor's most important performance parameter is its efficiency in detecting low-level radiations. Hence, the present study is conducted to evaluate and compare the performance parameters of two routinely used contamination monitors in a Nuclear Medicine department.

##### Material and Methodology

In the present study, two GM tube-based contamination monitors i.e., SE Ranger and Ray Safe Fluke 452, were compared. A standard Cesium-137 disc source (121 kBq, Sept 2023) was used to determine the percentage efficiency of both detectors by placing the standard source at a fixed distance. To simulate the surface contamination monitoring and regulatory survey monitoring, a 5 cm to 100 cm distance range was used to measure counts. The efficiency was calculated using the formula  $(\text{CPS/DPS}) \times 100$ , where, CPS is the counts measured by the contamination monitor at a particular distance (d) and DPS is the decay corrected disintegration per second of the standard source used for this study.

##### Results

The efficiency of both detectors at variable distances is tabulated in Table 1. The Ray Safe Fluke 452 was found to be 59% more efficient in detecting surface contamination as compared to the SE Ranger.

**Table 1** Efficiencies of both detectors at variable distances

| Distance (cm) | SE Ranger (CPS) | Efficiency (in %) | Ray Safe Fluke 452 (CPS) | Efficiency (in %) |
|---------------|-----------------|-------------------|--------------------------|-------------------|
| -             | Bkg - 1.0       |                   | Bkg - 1.4                |                   |
| 05            | 124             | 1.05              | 195.6                    | 1.67              |
| 10            | 47              | 0.4               | 50.6                     | 0.43              |
| 20            | 11              | 0.09              | 12.6                     | 0.1               |
| 40            | 2.3             | 0.01              | 0.9                      | 0.01              |
| 60            | 1.0             | 0.008             | 1.4                      | 0.01              |
| 80            | 1.0             | 0.008             | 1.4                      | 0.01              |
| 100           | 1.0             | 0.008             | 1.4                      | 0.01              |

### Conclusion

The study demonstrates the superiority of Ray Safe Fluke 452 over SE Ranger in detecting low-level radioactivity contamination during radiation surveys.

### POSTER-02

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#### Quantitative Assessment of Radioiodine Capsule Count Variation on Both Gamma Camera and Thyroid Uptake Probe

##### Aim

In Nuclear Medicine, quantitative assessment of radioiodine uptake in thyroid gland is commonly performed by thyroid uptake probe. However, researchers have also evaluated radioiodine uptake in thyroid gland using gamma camera as an alternate. The present study was conducted in order to quantitatively assess the variation in radioiodine capsule counts in both Gamma Camera and Thyroid Uptake Probe.

##### Methods

To conduct the present study, radioiodine capsule of 25 mCi and 50 mCi was purchased from Board of Radioisotopes and Technology (BRIT), Mumbai. Radioiodine capsule was placed inside Lucite neck phantom and measurements were obtained at isoresponse region i.e., 25 cm from thyroid uptake probe (CAPINTEC Captus ® 4000e) and similarly counts were collected under gamma camera (GE Discovery NM/CT 670 Pro) at different time points. All the measurements were performed for 100 seconds in triplets maintaining same position of phantom on both the modalities. In order to calculate the variability in the capsule count response of thyroid uptake probe and gamma camera, capsule readings were taken for 1 week and also theoretical activity calculated by using decay correction formula for that particular radioisotope.

##### Results

The percentage variations obtained in the radioiodine capsule counts in both the modalities were less than 5% (2.4 % in Gamma Camera and 3% in thyroid uptake probe).

##### Conclusion

The present study infers that the radioiodine capsule counts variation in Gamma camera is equivalent to thyroid uptake probe. Therefore, gamma camera can be used as a potent alternative of thyroid uptake probe for the evaluation of thyroid uptake in different thyroid associated pathologies.

## POSTER-03

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### **The Impact of Small Medical Cyclotrons on Radiopharmaceutical Production and Advancement in Healthcare**

#### **Introduction**

Cyclotrons are charge particle accelerators that produce radionuclides by bombarding stable nuclei with high energy particles. Small medical cyclotrons with proton energy below 20 MeV are widely utilized in hospitals, universities, and small scale industrial production facilities. Over the past two decades, their installation has grown significantly with around 700 cyclotrons operational in 2008, increasing to 1300 by 2022. These include approximately 1000 small medical cyclotrons primarily used for producing radionuclides for medical research and commercial purpose. This study highlights the critical role of small medical cyclotrons in producing radiopharmaceutical for diagnostic and to enhance safety efficiency and accessibility.

#### **Material**

Data received on the production and applications with focus on commonly used isotopes such as F-18, C-11, O-15, N-13 challenges like radioactive waste management, neutron activation, ventilation requirements, occupational exposure and professional shortage were examined. Strategies to address these challenges including advanced shielding techniques adherence to ALARA principle and specialized training were examined.

#### **Result**

Small medical cyclotrons contribute significantly to healthcare with 95 percent of radiopharmaceuticals production which is critical for diagnosing and treating cancers, neurological disorder and cardiovascular disease. Local cyclotron production enhance accessibility to PET imaging, mitigating issues related to the isotopes short half-life and transportation limitations.

#### **Conclusion**

The operation of cyclotron required addressing safety and operational challenges through innovation, solution and interdisciplinary collaboration. Emphasizing specialized staff training, advanced shielding and adherence to safety principles ensure the efficient and safe production of radiopharmaceuticals. Small cyclotrons remain essential for advancing nuclear medicine and improving healthcare outcomes.

## POSTER-04

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### **Preparation and Preliminary Analysis of <sup>99m</sup>Tc-HYNIC-TRASTUZUMAB-Fab for Diagnostic Imaging of HER2 Expressing Breast Cancers**

#### **Aim**

HER2 targeting monoclonal antibody, Trastuzumab has potential for treatment of HER2-positive breast cancer treatment and diagnosis. This study aimed to explore the development of a SPECT radio immunodiagnostic agent by radiolabeling fragmented Trastuzumab with Tc-99m radioisotope and assess its stability over a period of time.

#### **Methodology**

Fragmentation of trastuzumab into Fab fragments was performed using enzymatic digestion with immobilized papain. Purification and characterization of resulting Fab fragments was conducted. Conjugation of F(ab)' fragment with Succinimidyl- Hynic- hydrochloride and subsequent radiolabeling with varying amounts of conjugate and Tc-99m were performed. Radiochemical purity and post radiolabeling stability of <sup>99m</sup>Tc-HYNIC- F(ab)'- Trastuzumab over a period of 6 hours were assessed.

#### **Results**

Optimal conditions and appropriate reagent concentrations for trastuzumab fragmentation, conjugation and radiolabeling were identified. Higher yields were achieved with increased incubation time of the radiolabeled conjugate. HPLC analysis confirmed successful generation of Fab fragments with >80% yield and high purity. Radiolabeling of fragments with Tc-99m showed promising results with >98% mean radiochemical purity and stability for up to 6hrs.

#### **Conclusion**

The standardized methodology for preparation of <sup>99m</sup>Tc-HYNIC- F(ab)'- Trastuzumab gave good radiochemical purity with sufficient in-vitro stability. It paves the way for exploring radiolabeled fragmented antibodies such as <sup>99m</sup>Tc-HYNIC-Trastumab-Fab for cancer diagnosis and staging.

## POSTER-05

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### **Role of Volume-Based Metabolic Parameter of Primary Tumour of Breast Cancer in Preoperative 18-F FDG PET-CT Scan to Predict Axillary Lymph Node Metastasis**

#### **Introduction**

Breast cancer is one of the most common malignant diseases. Nearly 30% of them die due to the disease progression despite treatment. Among many clinical factors, axillary lymph node (ALN) metastasis is an important adverse prognostic factor. Although 18F-Fluorodeoxyglucose positron emission tomography-computed tomography (18F FDG PET/CT) has developed into a standard staging investigation in breast cancer, its present ability to detect axillary lymph nodes involvement by semi-quantitative metabolic characterization of tissues is not optimal.

#### **Objective**

The purpose of this study was to evaluate the role of volume-based metabolic parameters of primary lesion in staging PET-CT scan for prediction of axillary lymph node metastasis (ALNM) in early stage breast cancer.

#### **Patients and methods**

We retrospectively analysed records of 126 patients with invasive carcinomas of breast, who had undergone preoperative 18F-FDG PET/CT scan followed by surgery in our institution. Fixed threshold based segmentation method was used to measure maximum standardized uptake value (SUVmax), mean standardized uptake value (SUVmean), metabolic tumor volume (MTV) and total lesion glycolysis (TLG) of primary tumour in PET images. SUVmax of axillary lymph node (SUVnode) and maximum short axis diameter of axillary lymph node (SADmax) were also calculated. In addition, mammography (with USG correlation) reports were considered for analysis. Histopathological report of ALN metastasis was considered as the gold standard.

#### **Observation**

85 out of 126 (67.46%) patients showed ALNM in our study. Univariate and multivariate logistic regression analysis showed SUVmean of primary tumour, SUVnode and SADmax had a significant difference between ALNM and non-metastatic groups. We also found that a combination of mammography reports along with 18F-FDG PET/CT increased the sensitivity in detection of ALNM.

## Conclusion

Staging PET/CT scan along with mammography can increase the accuracy in detection of ALNM in early stage breast cancer.

## POSTER-06

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### **Instead of Well Counter, Gamma Camera Role in Measuring for Disposing Delay Tank I-131 Liquid Waste for High-Dose Therapy Patients**

#### **Background**

Radioactive waste management is critical in I-131 high-dose therapy for thyrotoxicosis, yet optimal methods for measuring waste samples remain uncertain.

#### **Purpose**

This study aims to evaluate the accuracy of different measuring devices, including gamma cameras and well counters, for assessing I-131 waste samples.

#### **Methods**

I-131 waste samples were measured using a gamma camera, uptake probe, well counter, contamination monitor, and gamma probe. Comparisons were made to determine the accuracy and reliability of each device.

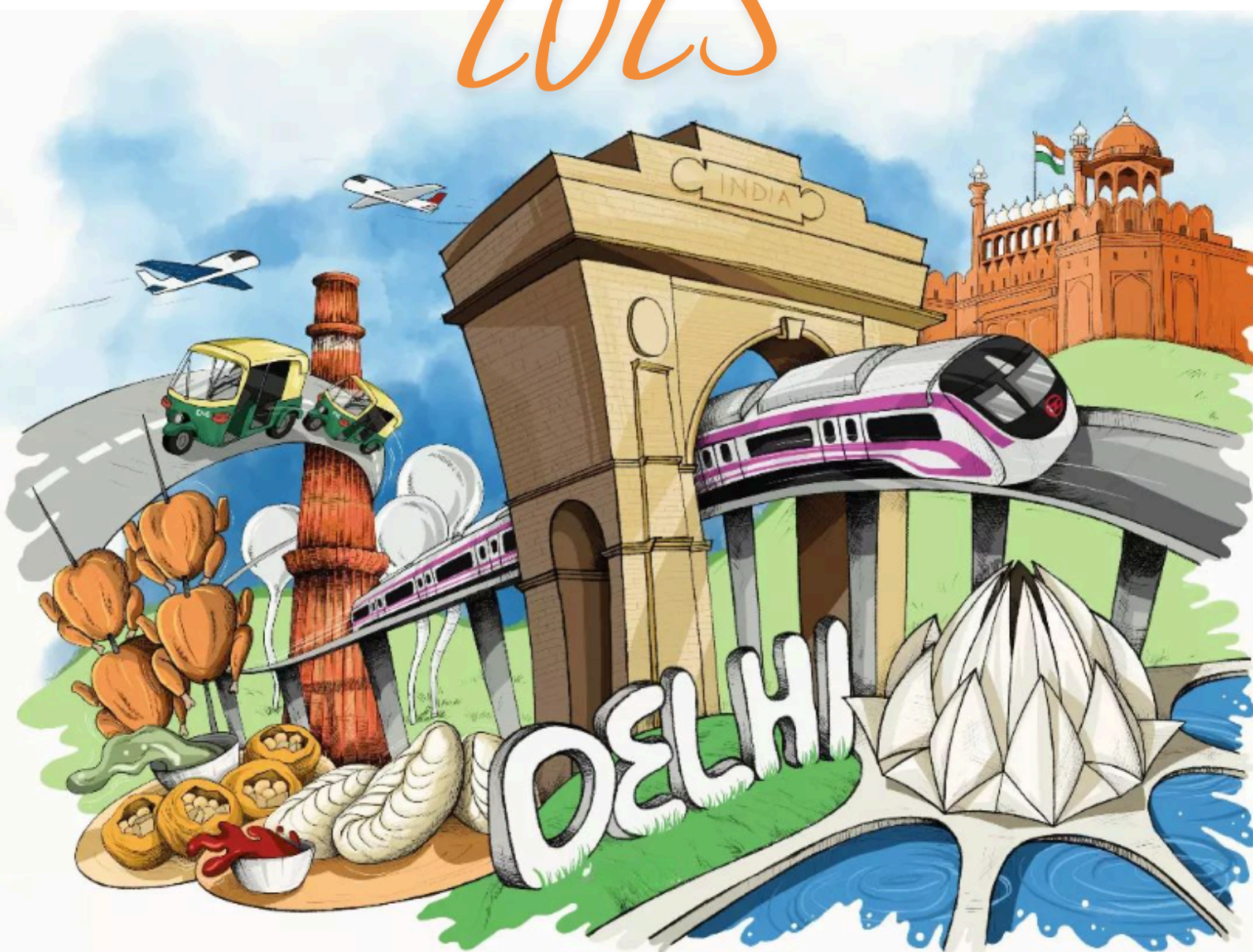
#### **Results**

Results indicate that while the well counter provided the most precise measurements, the gamma camera demonstrated comparable efficacy, making it a viable alternative in clinical settings.

#### **Conclusion**

The findings suggest that gamma cameras can serve as an effective, alternative tool for measuring I-131 waste in settings where well counters are unavailable, aiding in safer, more efficient waste management.

# NMPAICON 2025



15<sup>th</sup> - 16<sup>th</sup> FEB, 2025

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