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99m-Tc-MAA planar vs SPECT/CT evaluation of Lung Shunt Fraction before Selective Internal Radiotherapy of liver tumors

Emmanouil Papanastasiou[1], Alexandra Kriari[1], Georgios Giakoumettis[1], Antigoni Charoupa[2], Panos Charalambous[3], Evanthia Giannoula[3], Paraskevi Exadaktylou[3], Ioannis Iakovou[3]

[1]Medical Physics & Digital Innovation Laboratory, School of Medicine, Aristotle University of Thessaloniki, AHEPA University Hospital, Greece
[2]Mediray, 224 Mesogeion Avenue, Holargos, Athens, Greece
[3]2nd Nuclear Medicine Department, School of Medicine, Aristotle University of Thessaloniki, AHEPA University Hospital, Greece

1. Background-Aim

- **Selective Internal Radiotherapy (SIRT)** using Y-90 microspheres is an established locoregional therapy for hepatocellular carcinoma (HCC) and the treatment of hepatic metastases.

- A 99m-Tc-MAA work-up procedure, performed in the Interventional Radiology Department, is always required prior to therapy for the calculation of **Lung Shunt Fraction (LSF)**, as an LSF higher than 20% is an absolute contraindication.

This work aims to compare calculated LSF values from planar versus SPECT/CT 99m-Tc-MAA work-up scans.

2. Materials & Methods

23 patients with HCC or liver metastases

Injected with 185 MBq of 99m-Tc-MAA for their work-up

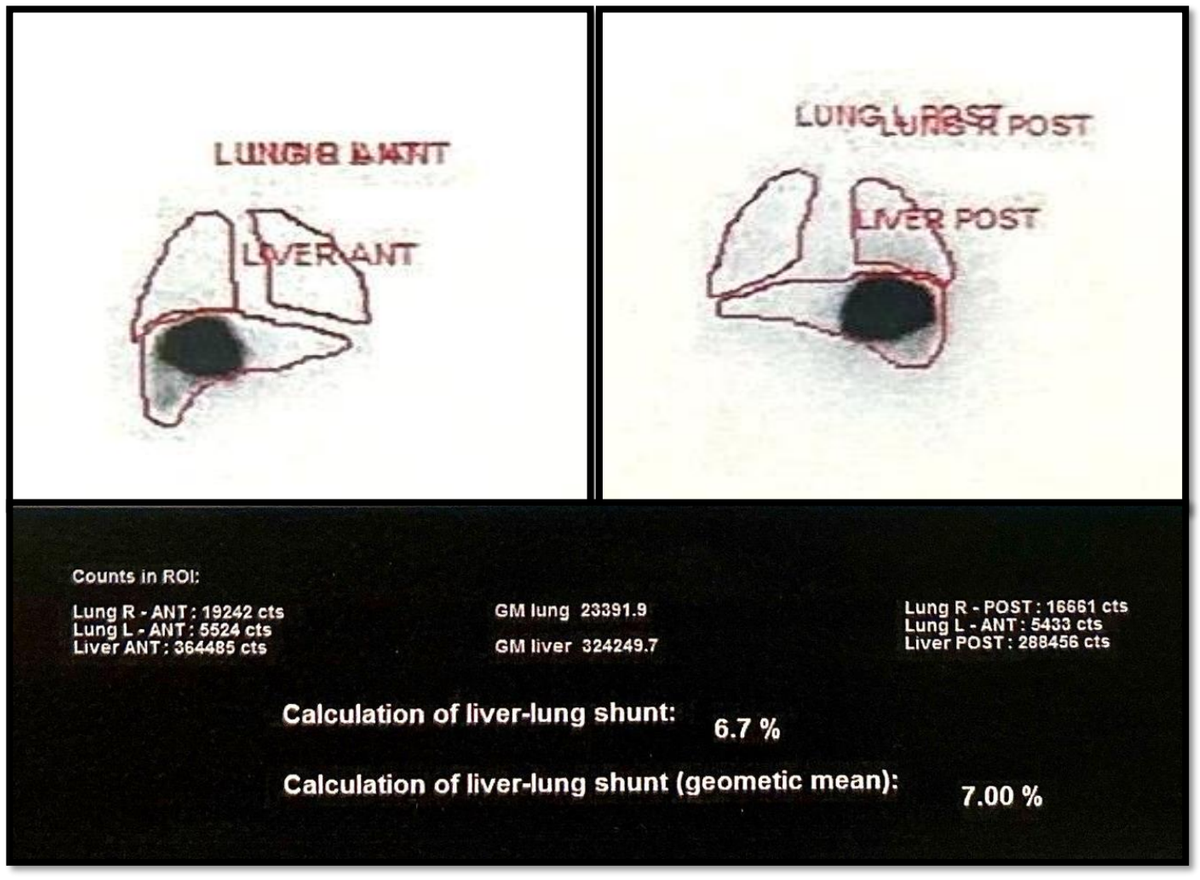
Scanned on a GE Discovery NM/CT 850 SPECT/CT system

99m-Tc-MAA simulates the biodistribution of microspheres in the tumor, healthy liver and lungs to quantify the LSF in terms of percentage.

2. Materials & Methods

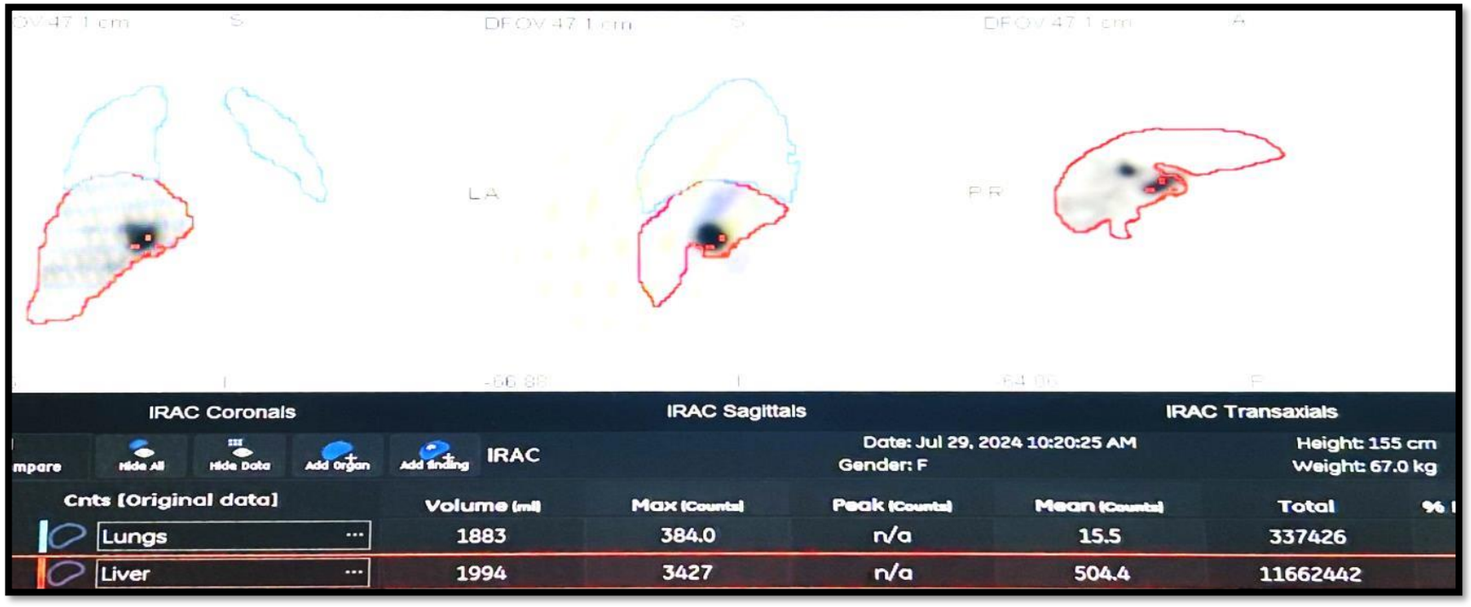
✓**Planar LSF (LSF-P)** was calculated from whole body anterior (A) and posterior (P) scans, by manually drawing **Regions of Interest (ROIs)** of both lungs and liver and calculating the geometric mean (GM) of ROI counts.

$$GM\ (lung\ or\ liver) = \sqrt{counts\ A \times counts\ P} \qquad LSF(\%) = 100\frac{GM\ lung}{(GM\ lung + GM\ liver)}$$

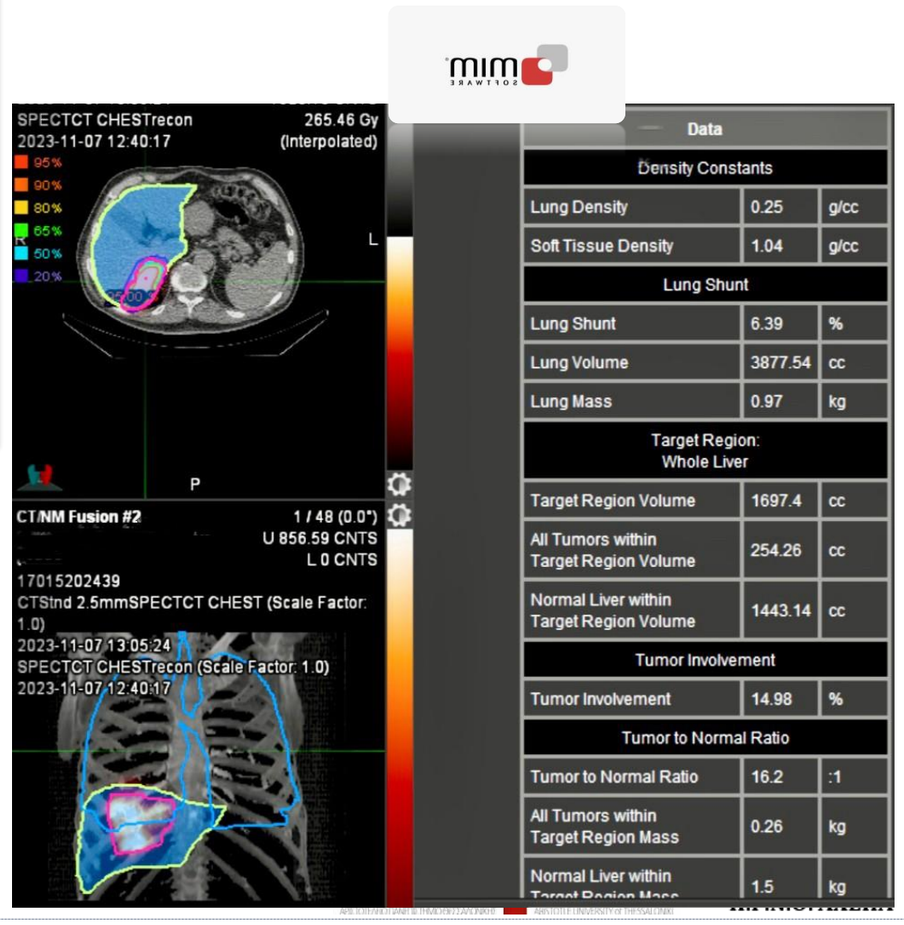


2. Materials & Methods

- ✓ **SPECT/CT images**, corrected for attenuation and scatter, were segmented using the Q.Volumetrix software and the LSF was calculated from the total counts of the lung and liver segmented volumes **(LSF-Q)**.



- ✓A second independent SPECT/CT LSF calculation was performed using the MIM SurePlan dosimetry software **(LSF-M).**



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3. Results

- Mean values in LSF (%) based on Planar Images and SPECT/CT Images

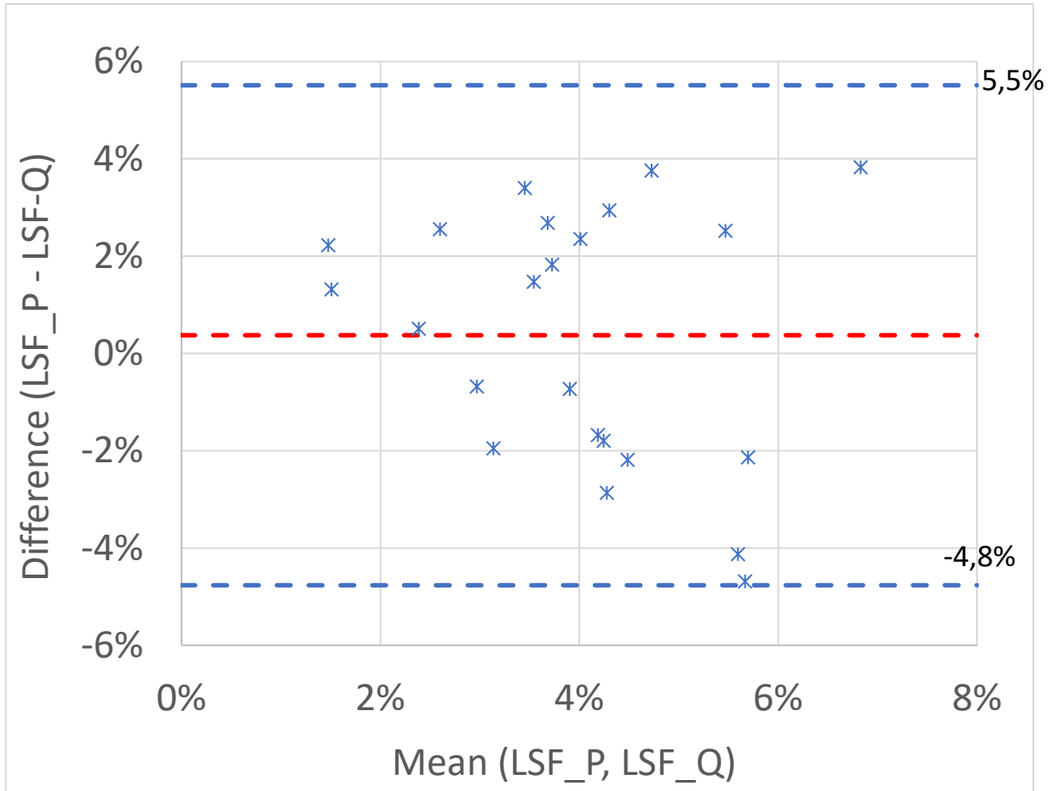
Method	Mean Range	
LSF-P	4.2%	(2.2%-8.7%)
LSF-Q	3.8%	(0.4%-8.0%)
LSF-M	3.9%	(0.1%-8.0%)

- Paired samples t-test showed that differences between the three LSFs were not statistically significant ($p>0.05$).

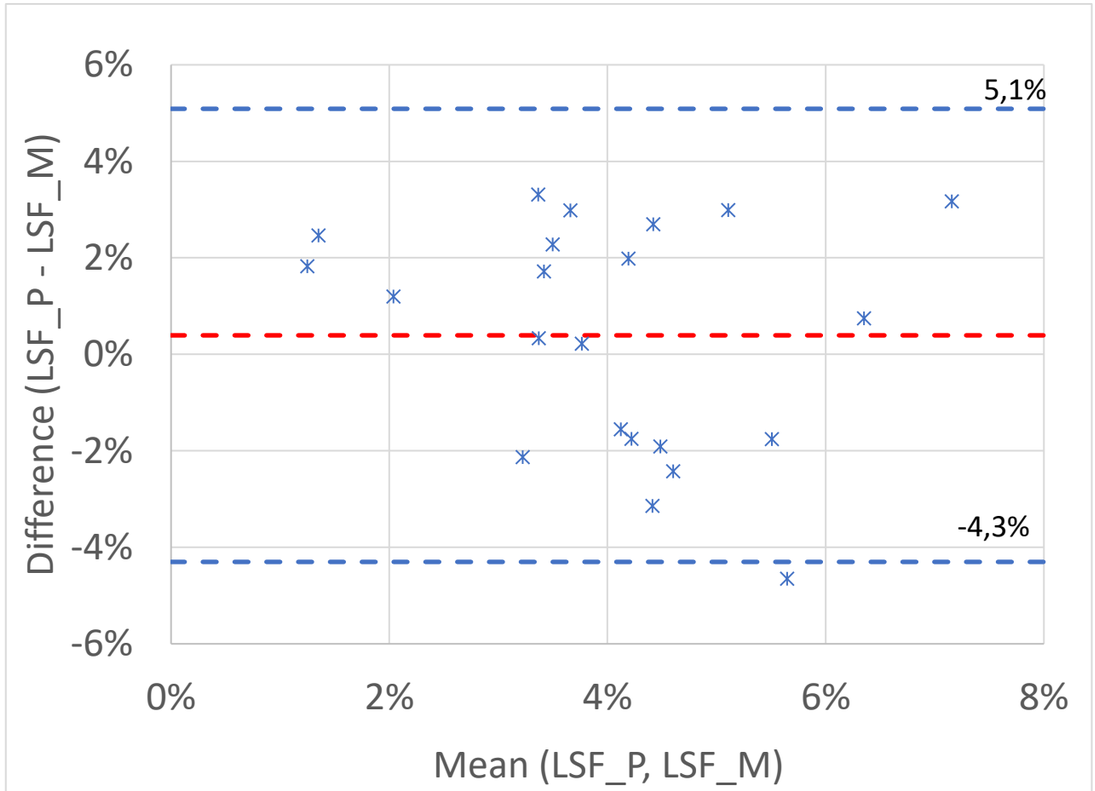
- LSF-P was higher than LSF-Q in 13/23 patients.

3. Results

- **Bland-Altman limits of agreement** (LoA) (±1.96SD) between LSF-P and LSF-Q were (-4.8%, 5.5%), between LSF-P and LSF-M were (-4.3%, 5.1%) and are both considered clinically significant.



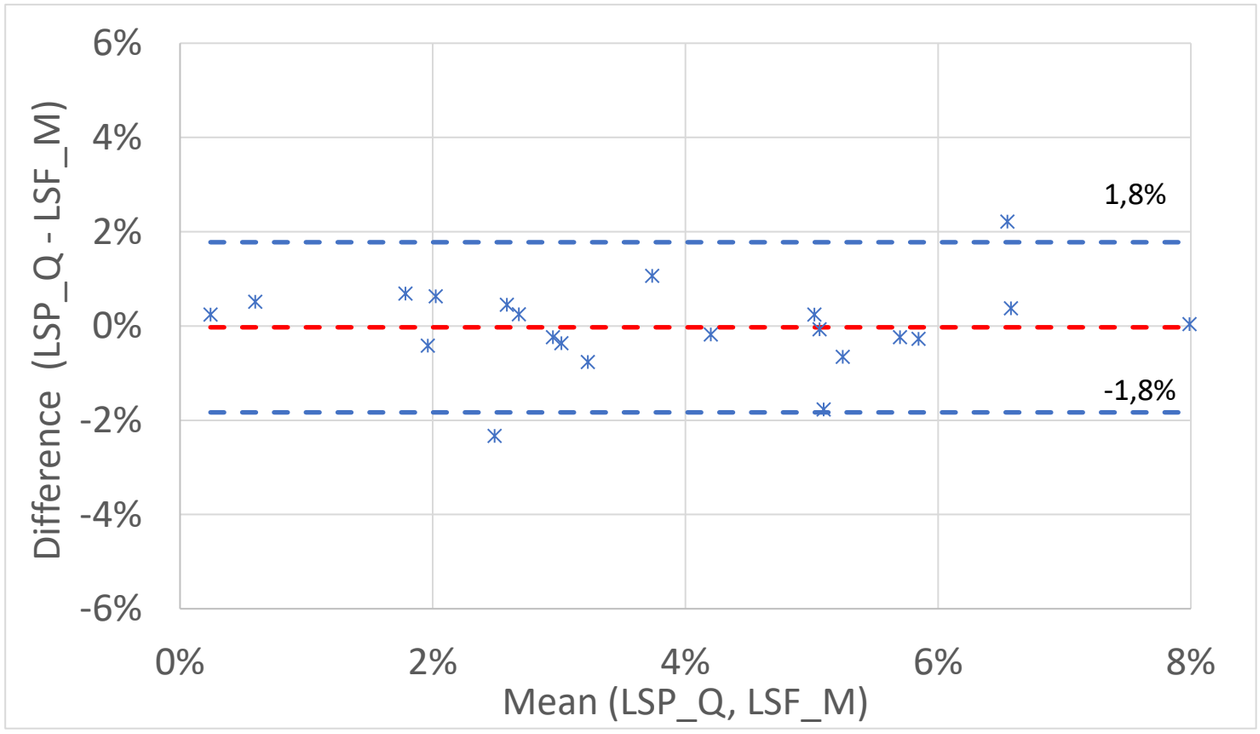
1. Bland – Altman plot: LSF_P vs LSF_Q



2. Bland – Altman plot: LSF_P vs LSF_M

3. Results

- LSF calculation from SPECT/CT images using the two different software provided comparable results. The LoA between LSF-Q and LSF-M were (-1.8%, 1.8%).



3. Bland – Altman plot: LSF_M vs LSF_Q

4. Conclusions

1. Planar 99m-Tc-MAA imaging more often **overestimates** LSF compared to SPECT/CT.

2. Bland-Altman analysis showed that planar and SPECT/CT LSFs **cannot be used interchangeably**.

3. Planar LSF **should always be calculated**, since the 20% LSF contraindication for therapy has been established from planar LSF images.

5. References

1. H. Gill, J. Hiller., "*Systematic review of lung shunt fraction quantification comparing SPECT/CT and planar scintigraphy for Yttrium 90 radioembolization planning.",* Clinical and Translational Imaging, 9:181–188, 2021.

2. H. Dittmann, D. Kopp, et al., "*A Prospective Study of Quantitative SPECT/CT for Evaluation of Lung Shunt Fraction Before SIRT of Liver Tumors*.", The Journal of Nuclear Medicine, Vol. 59, No. 9, Septeember 2018.

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4. M. Riveira-Martin, A Akhavanallaf, *et al*., "*Predictive value of 99mTc-MAA-based dosimetry in personalized 90Y-SIRT planning for liver malignancies.", EJNMMI Research, 13:63, 2023.*