



Quantitating the Activity in Lesions and Organs Guides Delivery of SIRT

Selective Internal Radiation Therapy (SIRT) is a new method for delivering radiation to treat inoperable liver cancers. Performed during an interventional procedure, a catheter is placed in the hepatic artery and millions of tiny radioactive microspheres are delivered through the blood stream to the tumor, where the radiation then attacks the tumor and the blood vessels feeding the tumor.

This novel treatment is offered by Gustave Roussy Hospital in Villejuif, France, one of the world's leading comprehensive cancer centers. The clinicians and medical physicists at the center use the Discovery™ NM/CT 670 and Q.Metrix to quantitate the activity of Technetium-99m (99mTc) present in some relevant organs of the patient.

According to Marcel Ricard, PhD, Medical Physicist, it is very important to calculate the activity inside the liver and lung before administration of SIRT and again after implantation. He says that using Q.Metrix in conjunction with SPECT/CT and the ability to quantify the uptake in the lesion relative to the organ and rest of the body is very useful and easier than planar imaging.

“Q.Metrix is very user friendly and a powerful tool. We don't perform SIRT without Q.Metrix because it provides us with quantitative values that may improve our treatment approach,” Dr. Ricard explains.

Dosimetry is an essential step in nuclear medicine, explains Serena Grimaldi, MD, nuclear medicine physician at Gustave Roussy Hospital. “In our daily practice, Q.Metrix provides a reliable method to optimize the dosimetry work up, allowing the evaluation of the dose to the lesions relative to the normal liver and to non-target organs.”

When performing calculations using planar imaging, it is difficult to correct for the scatter after administration of 99mTc.

“Sometimes there is significant activity inside the right lung, mainly due to the activity from the liver,” Dr. Ricard explains. “Using Q.Metrix, it is easier to grade the right and left lung volume with the CT data and it is more accurate than when using planar imaging alone.”

With the 3D data acquired from CT, Dr. Ricard can fuse the data with SPECT, correct for attenuation, and be more precise in terms of the region of interest that is being quantified. The merged CT and SPECT data is then used to identify the location of the 99mTc activity in the liver and the lung.

Having data on the radionuclide activity administered to the patient is important, as it helps clinicians deliver effective activity to the lesion and evaluate the radiation dose, which leads to better therapeutic results for the patient. Dr. Grimaldi explains, “Reducing the radiation dose guarantees the lowest risk of side effects. A dosimetric plan carried out with software such as Q.Metrix is a feasible and accurate method to determine the radionuclide activity to administer in SIRT.”

“In nuclear medicine, the limitation is in the number of counts—or referred to as statistics,” Dr. Ricard says. “If you have a sufficient number of counts, then it is easier to quantitate.” Q.Metrix enables personalized, quantitative SPECT SUV results with multi-dimensional organ and lesion characterization. Dr. Ricard also notes that GE's CZT technology, which can increase the number of “cleaner” counts, could have an impact on the accuracy of the quantitative value generated by Q.Metrix.

Interestingly, Dr. Ricard has noted that the MAA activity measured in the lungs using SPECT/CT is lower than the activity measured when using planar imaging.¹ While further studies are needed, he believes that it may indicate that patients could receive an increased SIRT activity, which could improve their response to treatment.

“Q.Metrix enables personalized, quantitative SPECT SUV results with multi-dimensional organ and lesion characterization.”

Dr. Marcel Ricard

Patient Case

Patient history

Patient in his 60s with inoperable hepatocellular carcinoma referred for liver SIRT.

Acquisition

LEHR collimator: 360° SPECT, 60 steps of 15 sec, 128 x 128 zoom 1.0

CT: CTDI_{vol} 5 mGy, DLP 242 mGy.cmn

Injection: 264.9 MBq	Organ	Mean (g/ml)	Maximum (g/ml)	% Inj. Dose
Patient height: 166 cm	Lungs	0.30	41.98	1.93
Patient weight: 80 kg	Pathologic liver	166.91	439.91	45.54
Sensitivity (cnt/second/MBq): 76.20	Liver, right lobe	49.52	170.89	51.57
Units: SPECT SUVbw				

Findings

Patient work up before radioembolization with Yttrium-90 microspheres indicates favorable liver tumor targeting (86% of injected activity) versus normal liver (3.5%). Low pulmonary shunting was also noted. Treatment by Yttrium-90 microspheres can be planned with favorable dosimetry.

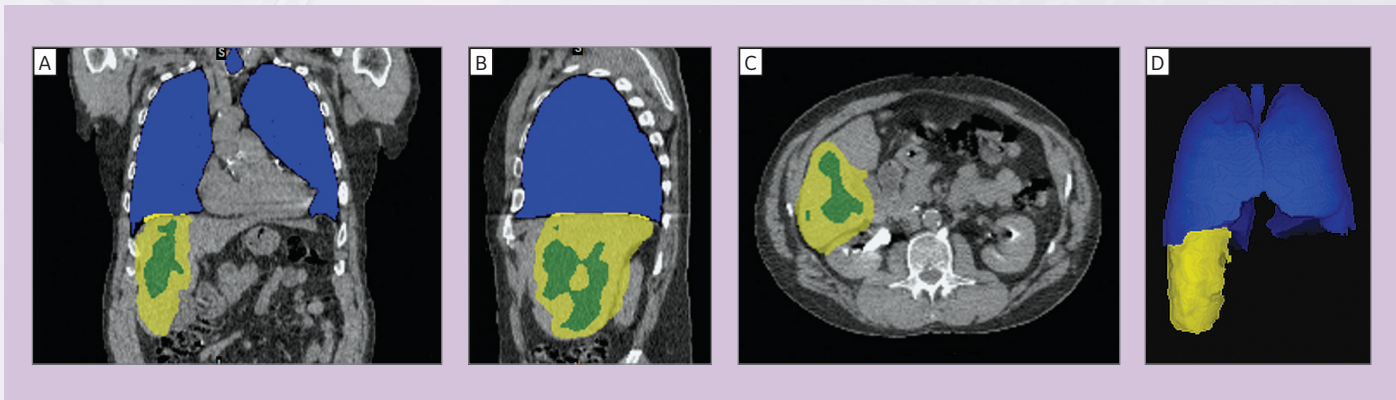


Figure 1. Q.Metrix assists in planning liver SIRT dose distributions by helping provide personalized dosimetric values (see table).

“SIRT is not simple, it requires a very precise dose distribution in the liver,” Dr. Ricard says. He sees potential to utilize Q.Metrix for enhancing the accuracy of the activity quantitation, which can help the clinician determine the precise dose distribution.

Dr. Grimaldi believes that a personalized dosimetry is a better choice for patients. “However, in clinical practice it is necessary to prove that using a dosimetric approach leads to a better response of lesions, reduces side effects, and, above all, provides a real gain in the final outcome of the patient. Moreover, in the dosimetric work up there are margins of uncertainty mainly related to the difference in the biodistribution of MAA and spheres.”

Nevertheless, Dr. Grimaldi adds, a dosimetric planning of the SIRT is the best choice, and this approach is supported by the literature.² “In general, I think that quantitation is one of the most important factors in the growth of therapy in nuclear medicine and it can also have a potential role in serial scans for therapy response evaluation.” ■

References

1. Dittmann H, Kupferschlaeger J, Feil D, laFougère C. Quantitative SPECT/CT for evaluation of lung shunting prior to SIRT: Results of a pilot study. *J Nucl Med.* May 1, 2015; 56(3):162.
2. Chiesa C, Maccauro M, Romito R, et al. Need, feasibility and convenience of dosimetric treatment planning in liver selective internal radiation therapy with (90)Y microspheres: the experience of the National Tumor Institute of Milan. *Q J Nucl Med Mol Imaging.* April, 2011; 55(2):168-97.