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DOSIMETRIC TREATMENT PLANNING IN NUCLEAR MEDICINE THERAPIES

G.Sarti, C.Fabbri,F.Busca,F.Del Dottore and S.Sanniti

Medical Physics and Clinical Engineering Unit, AUSL della Romagna, Ghirotti Street 286, 47521 Cesena (FC), Italy

SERVIZIO SANITARIO REGIONALE
EMILIA-ROMAGNA
Azienda Unità Sanitaria Locale della Romagna

graziella.sarti@auslromagna.it
cinziafabbri@hotmail.com

Purpose

Dosimetric studies are presented for the **^{90}Y** Radiopeptide therapy and the **^{131}I** thyroid treatments.

In the Radiopeptide therapy timed in 6-8 cycles, after the first and last cycle **PostTherapeutic Dosimetric verification** is performed.

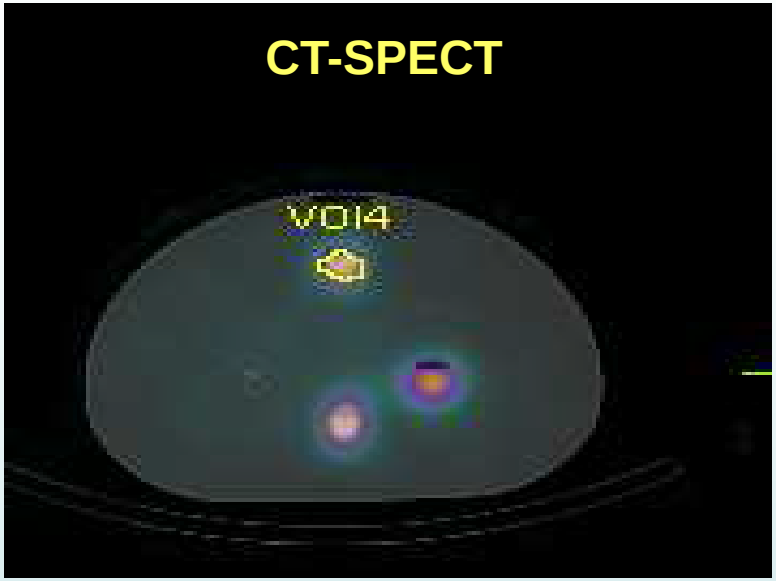
In the ^{131}I thyroid treatments, the **PreTherapeutic dosimetry** has the purpose of identifying the optimal **activity to be administered** to the target in a single solution and in the metastases to evaluate the dose to targets, to red marrow and other organs at higher risk

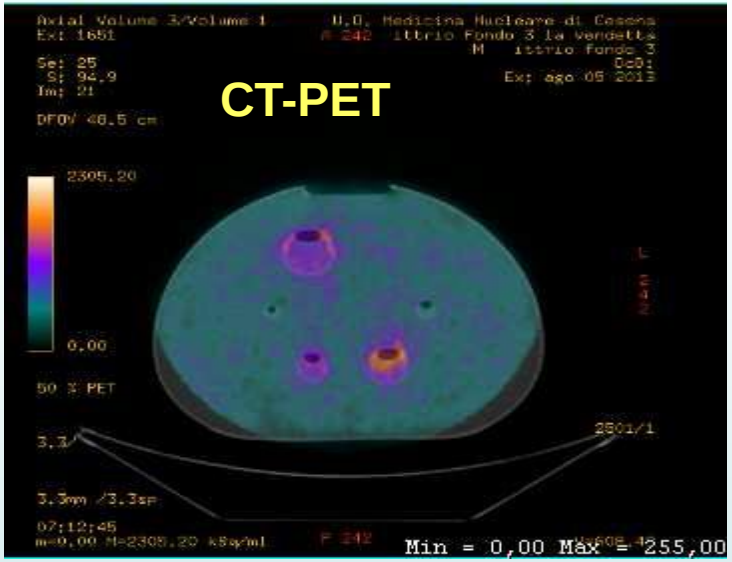
Methods

CT-PET and CT-SPECT systems were **characterized** for the activity quantification for dosimetric evaluation and **planar scintigraphy systems** for dosimetric evaluation to thyroid
sensitivity in cps/MBQ, **reproducibility and linearity range** (in IEC phantom with scatter attenuation correction, iterative method-PSF correction, dead time correction)
partial volume post imaging correction , **Recovery Coefficients curves** with method isovolume ecc.
segmentation method of the targets with variable threshold at differents Lesion/Background ratios
3D uniformity analisys

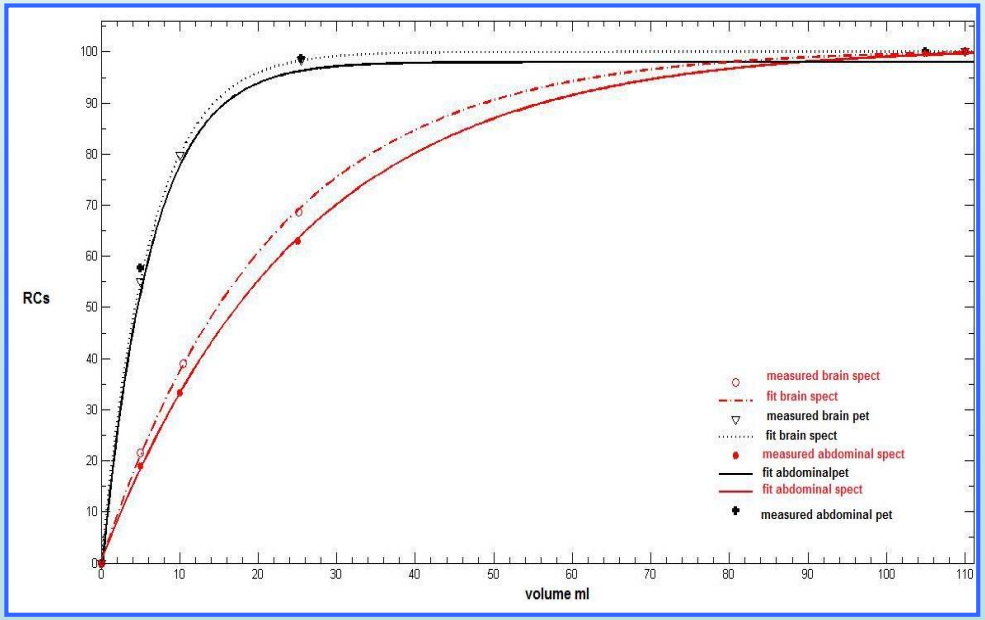
Methods:calibration curves

IEC phantom





Recovery Coefficients PET and SPECT
Activity concentration range:
0.05 – 50 MBq/cc
Volume range:
5 - 100 ml



Methods : kinetics study and factors S

Series of images are repeated in times varying from 4, 24, 48 hours up to 7 days to study biokinetics parameters

models mono-or bi-exponential (or the rule of the trapezoid) for evaluations Time-Integrated Activity Coefficients are

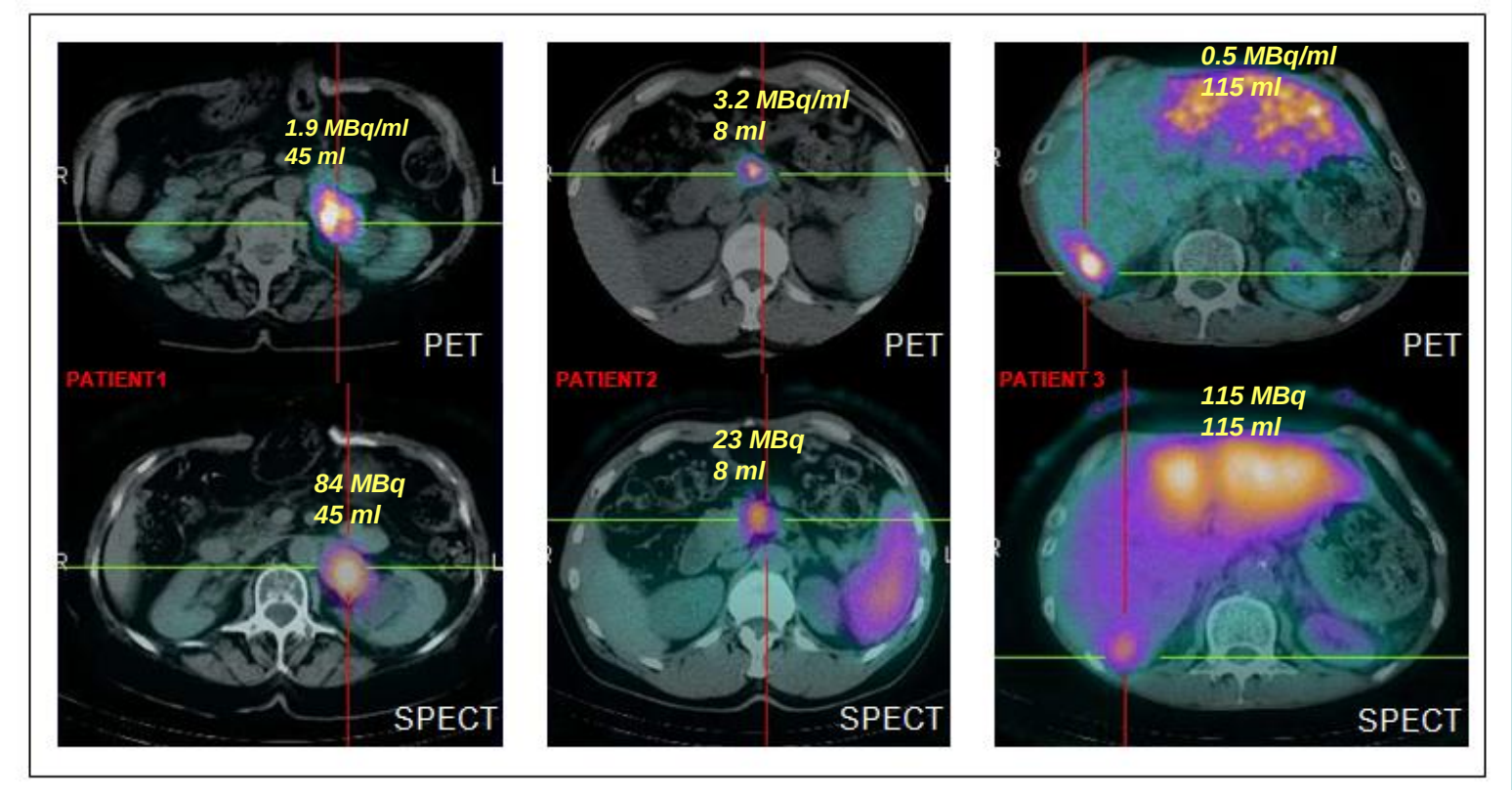
applied

factors S Olinda with mass adjustement are finally used for the calculation of the dose

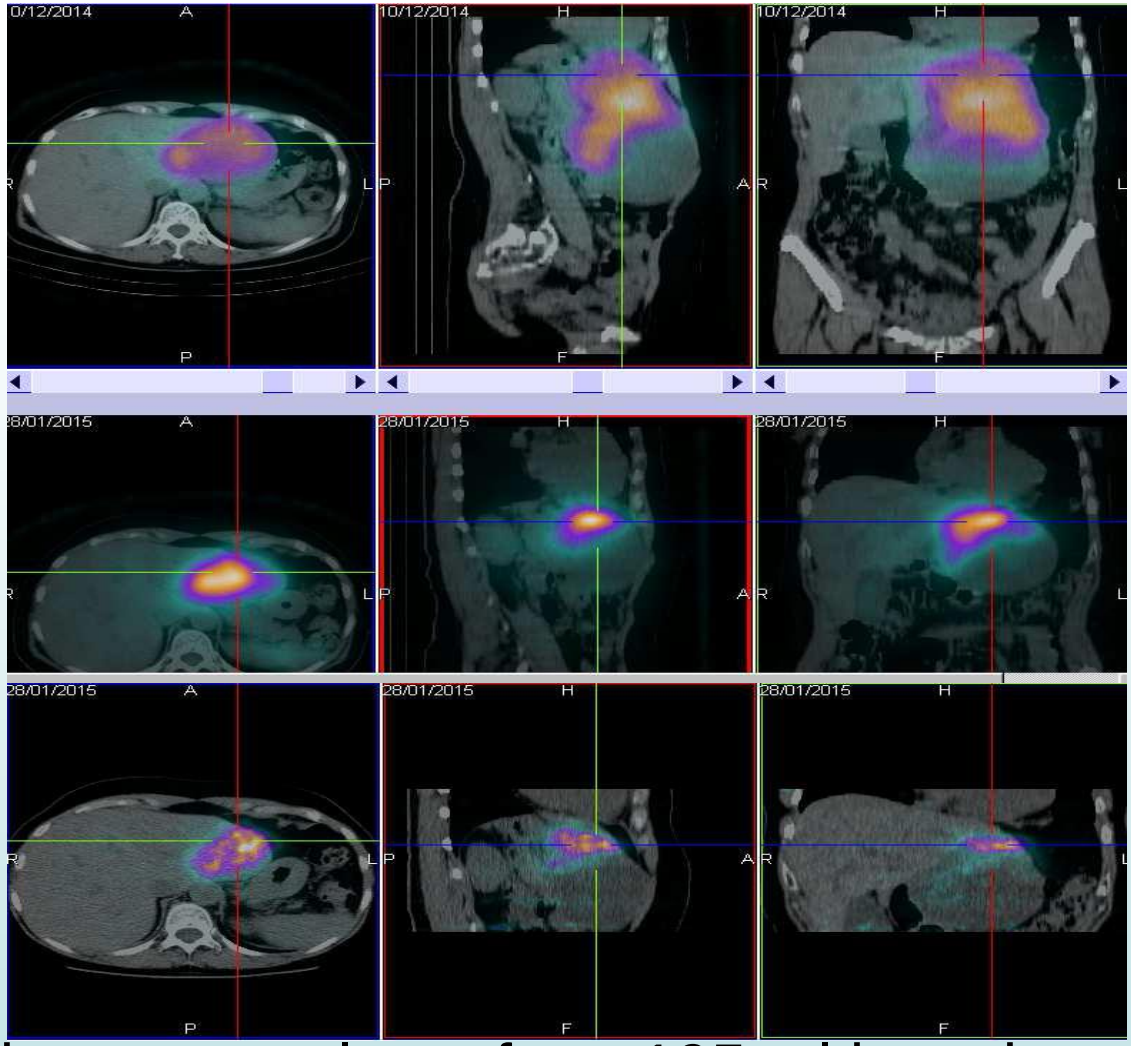
For the assessment of dose distributions we have also developed voxel dosimetry in MATLAB with convolution matrix method according MIRD Pamphlet No. 17

Results

Therapeutic Imaging by PET/CT and SPECT/CT in ^{90}Y-PRRT concentration and activity quantification



Fabbri et al CBR2015 DOI: 10.1089/cbr.2015.1819



Results: Case of large shrinkage of the mass in ^{90}Y PRRT

SPECT/CT 1° cycle

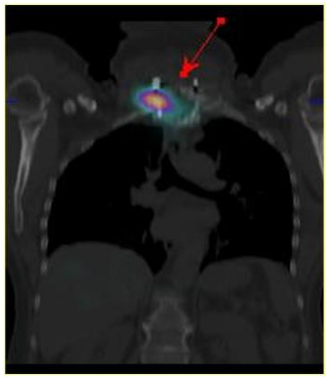
SPECT/CT 2° cycle

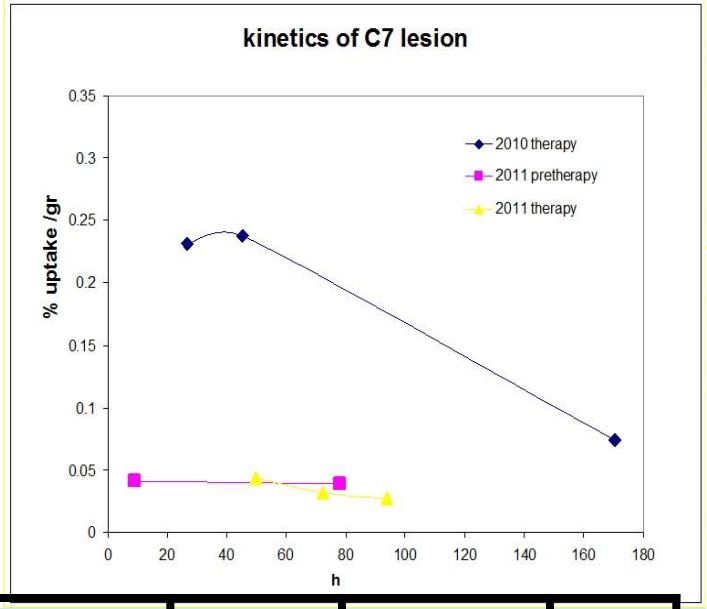
PET/CT 2° cycle

the tumor volume from 195 ml has shrunk to 41 ml (reduction 79%), the largest shrinkage has been that of the first cycle (reduction 64%), the activity administered per cycle ranges from 1.7 to 2.4 GBq , the absorbed dose (Gy/GBq) per cycle has progressively decreased

Results: metastatic differentiated thyroid cancer 131I therapy- dosimetric studies by SPECT/CT are carried out before and, to verify, after therapy

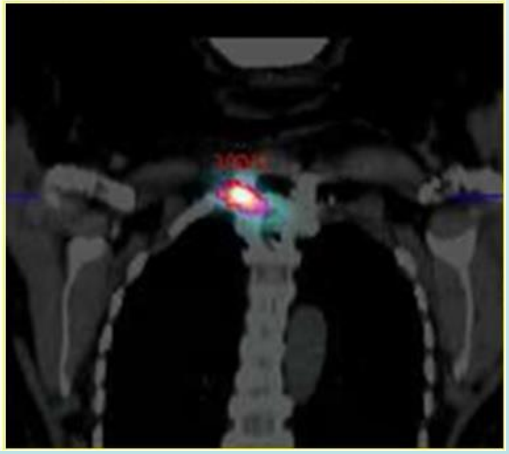
PRETHERAPY





1° CYCLE

3° CYCLE



	% max uptake/gr	$T_{1/2}$ h	Gy/GBq	Gy
1° cycle	Therapy 0.24	80	31.48	157
3° cycle	Pretherapy: 0.041 Therapy:0.043	65	6.06	39

Conclusions

For lesions of known volume > 5 ml (using CT or ultrasound tecniques) and homogeneous distributions, **the error associated with the evaluation of the activity/concentration** may be regarded as not higher than 20%.

For lesions of volume not known, for target segmentation, the **method with variable threshold at different L/B ratios was adopted**

In ^{90}Y PET/CT, quantification(MBq/ml) was carried out in phantom tests and in clinical studies in presence of a **minimum detectable activity concentration** (0,2 -0,7 MBq/ml). A superior resolution from PET acquisitions compared with ^{90}Y Bremsstrahlung brings a better evaluation of the rim of the lesion and the distribution of activity in the target