Dosimétrie pour les patients traités en médecine nucléaire

Nancy Lafrenière

Technologue en médecine nucléaire

ACNM/CANM Québec 2018

Conflit d'intérêt

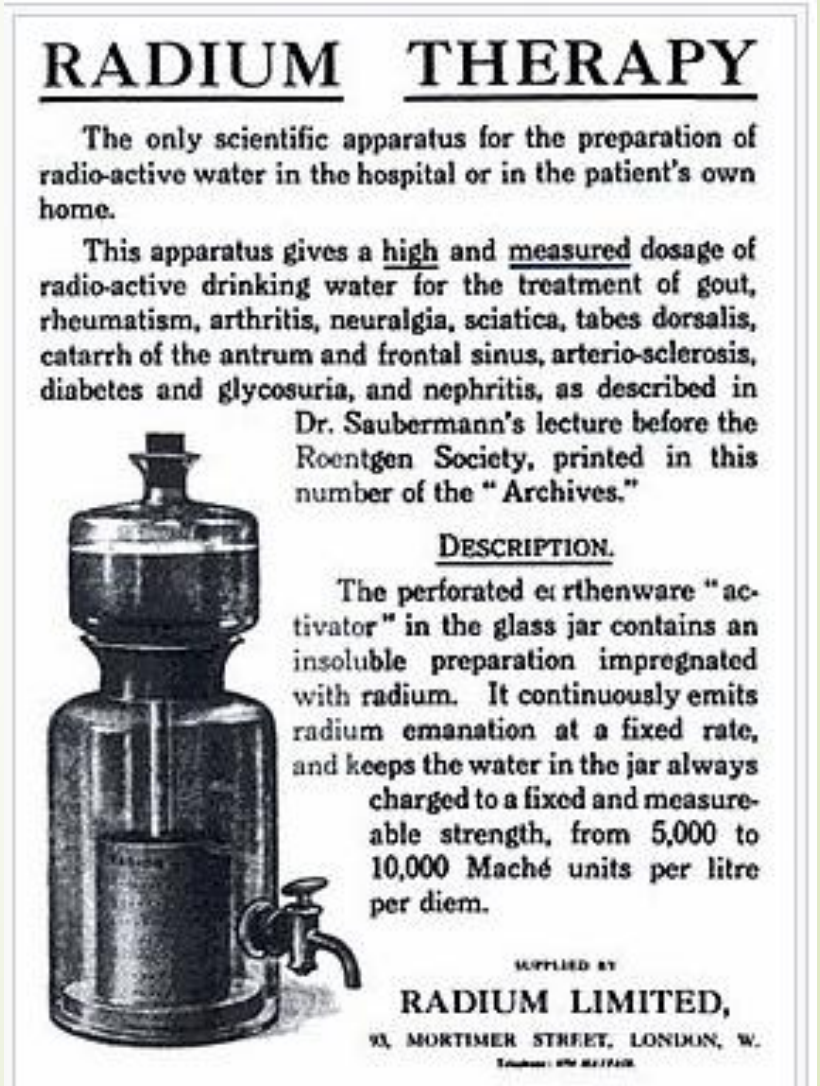
- Aucun

Objectifs

- Connaître la biodistribution et les organes cibles
- Comprendre la démarche scientifique derrière les calculs de dosimétrie
- Démontrer la possibilité pour les technologues en médecine nucléaire de faire la dosimétrie

Historique de la thérapie en médecine nucléaire

- Thérapie au radium a partir de 1901
- Première thérapie avec de l'iode 131 en 1939
- Début de la thérapie au Lu177 en 1993



RADIUM THERAPY

The only scientific apparatus for the preparation of radio-active water in the hospital or in the patient's own home.

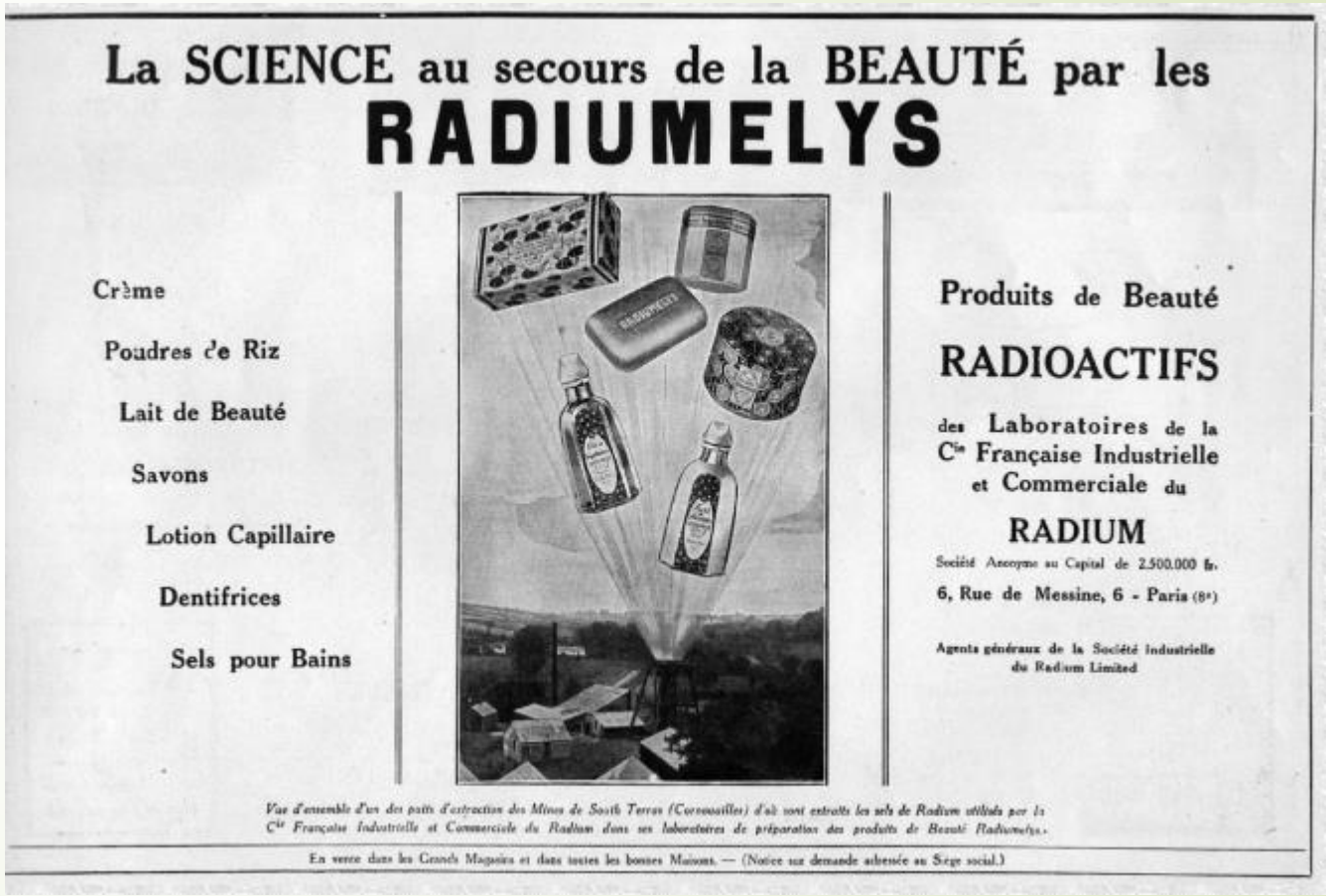
This apparatus gives a high and measured dosage of radio-active drinking water for the treatment of gout, rheumatism, arthritis, neuralgia, sciatica, tabes dorsalis, catarrh of the antrum and frontal sinus, arterio-sclerosis, diabetes and glycosuria, and nephritis, as described in Dr. Saubermann's lecture before the Roentgen Society, printed in this number of the "Archives."

DESCRIPTION.

The perforated earthenware "activator" in the glass jar contains an insoluble preparation impregnated with radium. It continuously emits radium emanation at a fixed rate, and keeps the water in the jar always charged to a fixed and measureable strength, from 5,000 to 10,000 Maché units per litre per diem.

SUPPLIED BY
RADIUM LIMITED,
93, MORTIMER STREET, LONDON, W.

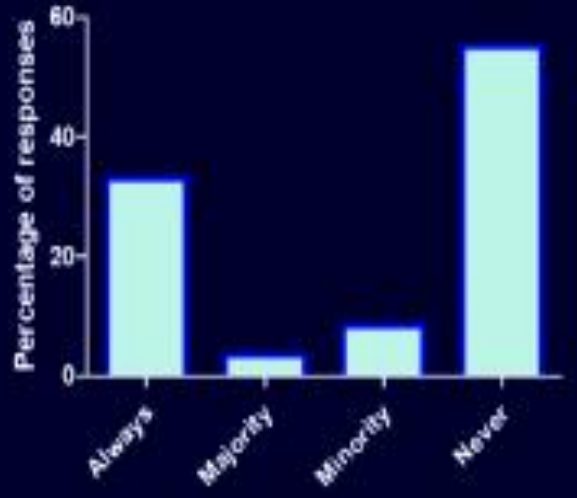
Publicité de 1937 pour les gaines Radiante.



Une saine et douce chaleur,
radio-active...
Une laine, souple, élastique, résistante, épaisse et confortable, qu'un traitement physico-chimique a doué d'un remarquable pouvoir : la radio-activité. Chacun connaît les extraordinaires effets de stimulation organique, d'excitation cellulaire, transmis par le radium. Une laine ainsi traitée allie aux avantages propres du textile une indéniable valeur hygiénique. Pour tricoter la layette de Bébé, les lainages des enfants, vos sous-vêtements et vos pull-over, utilisez la
LAINE ORADIUM
Source précieuse de chaleur et d'énergie vitale, irrétrécissable, infeutrable. C'est un Produit de la LAINE MÉDICALE, 20, rue St-Georges, PARIS - Trud. 07-28
La LAINE ORADIUM est vendue chez votre pharmacien au prix imposé de frs : 8.50 la pelote de 50 grammes.
DEMANDEZ LA BROCHURE ET LA CARTE DES COLORIS
Si votre pharmacien habituel n'est pas encore approvisionné ou n'a pas en stock le coloris que vous désirez, veuillez nous en aviser en nous donnant son adresse et nous nous ferons un plaisir de vous faire parvenir les pelotes de LAINE ORADIUM par son intermédiaire.
ORA

Survey on dosimetry practice in Europe

"Is the absorbed dose individually planned for each patient?"



Sjögreen Gleisner et al. EJNMMI Physics (2017) 4:28

Number of responding centers
208 responders from 26 countries

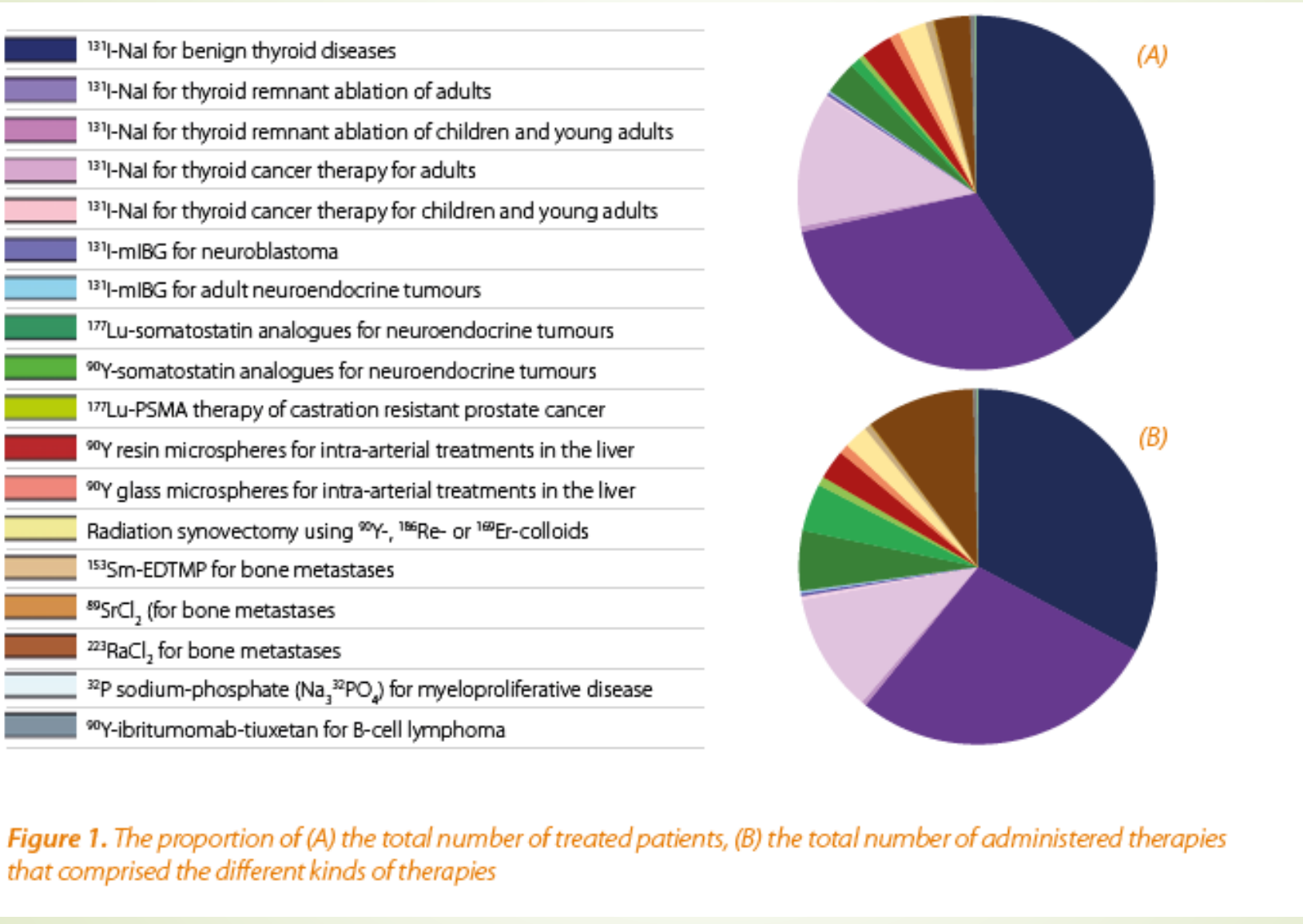


Figure 1. *The proportion of (A) the total number of treated patients, (B) the total number of administered therapies that comprised the different kinds of therapies*

Internal Dosimetry Task Force Report on:

Treatment Planning For Molecular Radiotherapy: Potential And Prospects

European Association of Nuclear Medicine

Table 1

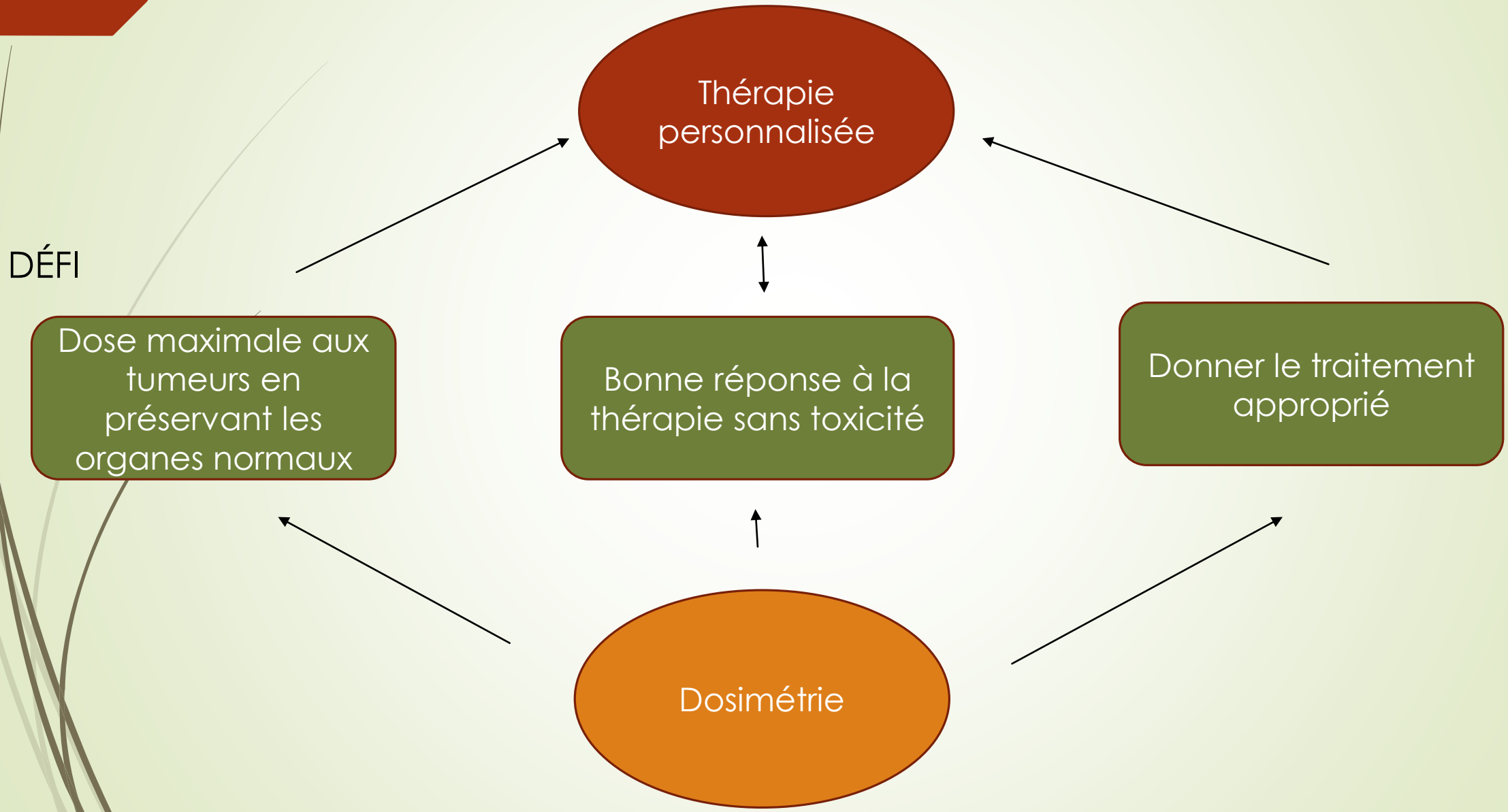
Radionuclides applied in targeted radionuclide therapy.

Radionuclide	$T_{1/2}$, h	E_{max}, MeV (*)	Method of Producing
^{124}I	100.1	β – 1.6 (~90%); 2.2 (~10%)	cyclotron
^{131}I	192.0	β – 0.7 (89%); γ – 0.4 (82%); β/γ ** = 1	nuclear reactor
^{86}Y	14.7	β – 1.2 (~90%); 1.6 (~10%)	cyclotron
^{90}Y	64.8	β – 2.2 (100%)	generator $^{90}Sr \rightarrow ^{90}Y$
^{177}Lu	160.8	β – 0.5 (100%)	nuclear reactor
^{188}Re	17.0	β – 2.0 (100%)	generator $^{188}W \rightarrow ^{188}Re$
^{64}Cu	12.7	β – 0.65 (61.5%), β – 0.58 (38.5%)	Cyclotron
^{67}Cu	61.9	β – 0.4 (100%)	cyclotron
^{89}Zr	78.0	B ± 0.9 (100%)	cyclotron
^{212}Pb	10.6	β – 0.6 (~80%); γ – 0.2 (44%); 0.08 (18%)	generator $^{228}Th \rightarrow ^{220}Rn \rightarrow ^{216}Po \rightarrow ^{212}Pb$
^{212}Bi	1.0	α – 6.0 (100%); β – 2.0 (100%); α/β ** = 0.67	generator $^{228}Th \rightarrow ^{224}Ra \rightarrow ^{212}Bi$
^{213}Bi	0.7	α – 5.8 (97%); β – 1.4 (100%); α/β ** = 0.02	generator $^{229}Th \rightarrow ^{225}Ac \rightarrow ^{213}Bi$
^{211}At	7.21	α – 5.9 (42)	cyclotron
^{225}Ac	240.2	α – 5.7 (100%)	generator $^{229}Th \rightarrow ^{225}Ac$
^{223}Ra	273.6	α – 5.7 (100%)	cyclotron
^{149}Tb	4.1	α – 4.0 (~80%)	cyclotron
^{226}Th	0.5	α – 6.3 (~50%)	generator $^{230}U \rightarrow ^{226}Th$
^{227}Th	448.8	α – 6.0 (48%)	generator $^{227}Ac \rightarrow ^{227}Th$
^{89}Sr	1212	β – 1.5 (100%)	nuclear reactor
^{153}Sm	46.3	β – 0.81 (100%)	cyclotron

- Thérapie en Médecine nucléaire
  - -200 mci Iode 131
  - -200 mci de MIBG-I131
  - -200 mci de Lu177 pour TNE
  - -200 mci de PSMA-Lu177

Pourquoi??????????

DÉFI


Thérapie personnalisée
Dose maximale aux tumeurs en préservant les organes normaux
Bonne réponse à la thérapie sans toxicité
Donner le traitement approprié
Dosimétrie

PRRT(personnalisé) au CHU de Québec

- Début en 2012 avec un accès spécial de Santé Canada
- En 2015 sous protocole de recherche
- En 2018 dosimétrie par les technologues

Del Prete et al. EJNMMI Physics (2018) 5:25
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EJNMMI Physics

ORIGINAL RESEARCH Open Access

Accuracy and reproducibility of simplified QSPECT dosimetry for personalized ^{177}Lu-octreotate PRRT

Michela Del Prete[1,2], Frédéric Arsenault[1,2], Nassim Saighi[1,2], Wei Zhao[3,4], François-Alexandre Buteau[1,2], Anna Celler[3,4] and Jean-Mathieu Beauregard[1,2*]

*Correspondence: jean-mathieu.beauregard@chudequebec.ca
[1]Department of Radiology and Nuclear Medicine and Cancer Research Center, Université Laval, Québec City, Canada
[2]Department of Medical Imaging and Oncology Branch of CHU de Québec Research Center, CHU de Québec – Université Laval, 11 côte du Palais, Québec City, QC G1R 2J6, Canada
Full list of author information is available at the end of the article

Abstract

Background: Routine dosimetry is essential for personalized ^{177}Lu-octreotate peptide receptor radionuclide therapy (PRRT) of neuroendocrine tumors (NETs), but practical and robust dosimetry methods are needed for wide clinical adoption. The aim of this study was to assess the accuracy and inter-observer reproducibility of simplified dosimetry protocols based on quantitative single-photon emission computed tomography (QSPECT) with a limited number of scanning time points. We also updated our personalized injected activity (IA) prescription scheme.

Methods: Seventy-nine NET patients receiving ^{177}Lu-octreotate therapy (with a total of 279 therapy cycles) were included in our study. Three-time-point (3TP; days 0, 1, and 3) QSPECT scanning was performed following each therapy administration. Dosimetry was obtained using small volumes of interest activity concentration sampling for the kidney, the bone marrow and the tumor having the most intense uptake. Accuracy of the simplified dosimetry based on two-time-point (2TP; days 1 and 3, monoexponential fit) or a single-time-point (1TP$_{D3}$ day 3) scanning was assessed, as well as that of hybrid methods based on 2TP for the first cycle and 1TP (day 1 or 3; 2TP/1TP$_{D1}$ and 2TP/1TP$_{D3}$, respectively) or no imaging at all (based on IA only; 2TP/no Imaging (NI)) for the subsequent induction cycles. The inter-observer agreement was evaluated for the 3TP, 2TP, and hybrid 2TP/1TP$_{D3}$ methods using a subset of 60 induction cycles (15 patients). The estimated glomerular filtration rate (eGFR), body size descriptors (weight, body surface area (BSA), lean body weight (LBW)), and products of both were assessed for their ability to predict IA per renal absorbed dose at the first cycle.

(Continued on next page)

Avant de débuter:

- Connaître notre équipement , les spécifications , les limitations et si la réponse correspond à ce que l'on s'attend:

-Calibrateur de dose: réponse

-Caméra : sensibilité , temps mort , correction pour l'atténuation et scatter

$$\overline{D}_T = \int_{t_1}^{t_2} A\left(r_S, t\right)\, \mathrm{d}t \cdot \frac{1}{m_T} \sum_i n_i E_i \cdot \phi\left(r_T \leftarrow r_S, E_i\right),$$

Caméra utilisée :

-Siemens Symbia T6 avec un crystal de 15,8 mm d'épaisseur et un FOV de 40 cm X 50 cm. Collimateur MEGP

- Paramètre d'acquisition de la tomo:
- 128X128 pixel 4,8mm
- Zoom 1
- 96 images sur 360 en step and shoot
- Contouring
- 10-15 sec /images pour les patients
- 10-40 sec/images pour le phantom et les calibrations
- Fenêtre d'énergie :

A (photopeak 280 keV +/- 20%)187,2-228,8 keV

B (Lower scatter 10%) 166,4-187,2 keV

C (General scatter 110,9 keV+/- 100%) 55,5-166,4 keV

D (General scatter 37,0 keV+/- 100%) 18,5-55,5 keV

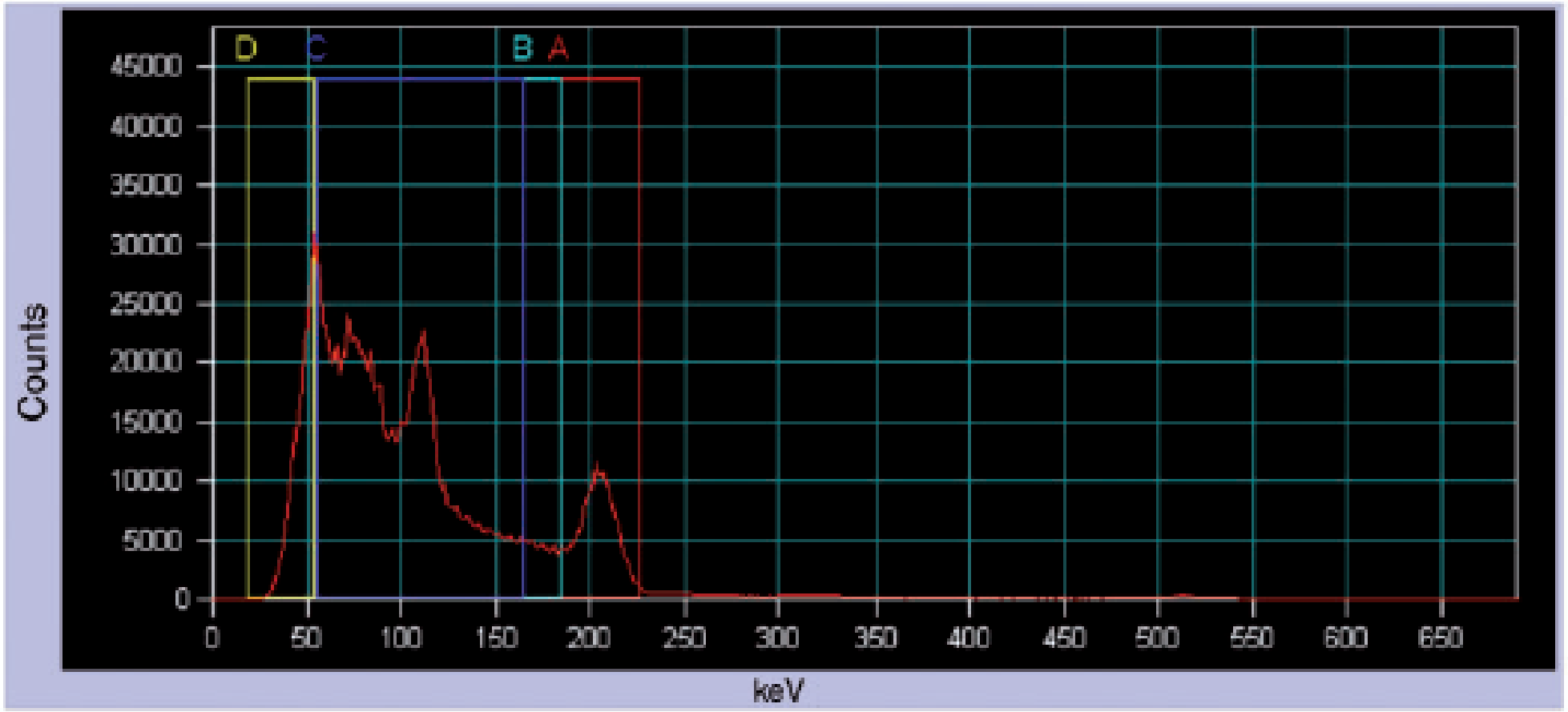
- Paramètre du CT
- Topogramme FOV
- Ct FOV 40 X 50 cm
- Collimation 6 X 3,0 mm
- Pitch 1,0
- Rotation 0,6 s
- Voltage 130 kV
- 70 mAs Care Dose 4D
- Reconstructions CTAC B08s Filter 512X512

5,0 mm slice

CT pour visualisation B41s medium+filter

512X512

5,0 mm slice


D
C
B
A
45000
40000
35000
30000
25000
20000
15000
10000
5000
0
Counts
0
50
100
150
200
250
300
350
400
450
500
550
600
650
keV

- Pour calibrer la caméra:

  -10 sources de Lu de 1 ml de différentes activités

  -8 sacs de saline de 1 Litre

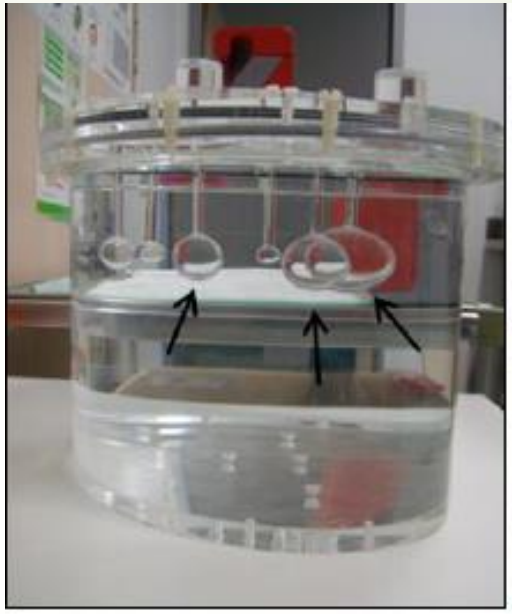
  -phantom avec 3 cylindres contenant différentes activités

En tout 34 SPECT/CT on été mis en image sur environ 2 mois

Avec des activités de Lu177 variant entre 92-12400 Mbq

- Phantom utilisé pour valider nos calculs:

  -22,6 a 1730 Mbq



5 Patients traités avec 7,9-10,2 GBq on été mis en images entre 40-60 min post traitement (patients pesés et mesurés avec vessie non vidée pour dose complète de thérapie)

Table 5 QSPECT patient validation

No.	Dose (GBq)	Body volume (L)			Body background (SUV)[a,b]	Body activity (SUV L)[b]			Dead-time count loss (%)		Deviation (%)	
		Total[c]	Scanned[d]	Extra-scan		Scanned	Extra-scan[e]	Total	Bed 1	Bed 2	DTC[b]	No DTC[f]
1	8.3	82.0	54.9	27.1	0.43	67.8	11.7	79.5	10.8	6.8	−3.1	−12.2
2	8.3	71.0	46.5	24.5	0.47	57.7	11.4	69.1	10.4	7.2	−2.6	−11.6
3	7.9	74.6	39.5	35.1	0.16	66.0	5.7	71.7	7.1	11.7	−3.8	−15.1
4	10.2	103.5	67.7	39.8	0.41	87.2	16.3	103.5	7.7	11.6	0.0	−10.2
5	7.9	78.0	45.9	32.1	0.43	60.3	13.9	74.2	9.5	6.9	−4.9	−14.0
5	9.1	78.0	51.9	26.1	0.47	65.1	12.2	77.3	11.3	6.6	−1.0	−10.3

[a]Average activity concentration in volumes of interest over shoulder and thigh.
[b]QSPECT data with dead-time correction (DTC).
[c]Based on patient's weight, assuming that 1 g = 1 cm^3 and 1 kg = 1 L.
[d]Based on CT.
[e]Extrapolated from body volume outside FOV and body background activity concentration.
[f]SPECT data corrected for attenuation, scatter and sensitivity, but not for dead-time.

9 étapes pour transformer le Spect en Qspect avec Syngo MI applications

Table 3 QSPECT processing workflow in Syngo MI Applications

Step	Activity	Description
1	Data selection	Selection of raw SPECT acquisition and CTAC series
2	Scatter estimation	Extraction of the photopeak acquisition series (energy window A) and generation the lower scatter series (from energy window B) using the DEW technique
3	Series reconstruction	Non-corrected filtered backprojection reconstruction, for the purpose of generating the SPECT matrix for CTAC resampling
4	Series registration	Resampling of CTAC to the SPECT matrix
5	Attenuation map	Conversion of resampled CTAC into an attenuation map using 208 keV narrow beam geometry settings (no filtering)
6	Series reconstruction[a]	Iterative reconstruction (OSEM Flash 3D, 4 iterations, 8 subsets) with AC and SC (no zoom, no filtering)
7	Series arithmetic	Multiplication (rescaling) of the raw SPECT acquisition series by 0.01 to avoid pixel saturation (>65,535 counts/pixel) during the next step. The Use Scale Factor option was enabled in this activity[c]
8	Series arithmetic	Sum of the rescaled raw SPECT acquisition series frames (96 × 4 energy windows = 384 frames) into one static image. The displayed count sum of this static image times 100 is the wide-spectrum counts (C_{Wo})
9	Series arithmetic[b]	Multiplication of the reconstructed SPECT series by a coefficient (K) converting counts to dead-time corrected quantitative uptake data. The resulting series is saved as QSPECT

[a]For the calibration studies, the photopeak and scatter series were scaled down before reconstruction (by a factor up to 100) in order to avoid voxel saturation (>65,535 counts/voxel) in the reconstructed SPECT dataset.
[b]This step was not performed for the calibration studies.
[c]This allows fractions of counts (e.g. 2 decimal digits) to be preserved in subsequent step.

ORIGINAL ARTICLE

Quantitative ^{177}Lu SPECT (QSPECT) imaging using a commercially available SPECT/CT system

Jean-Mathieu Beauregard[a,b], Michael S. Hofman[b], Jucilene M. Pereira[c], Peter Eu[b] and Rodney J. Hicks[b]

[a]Molecular Imaging Research Group, Medical Imaging Department, Centre hospitalier universitaire de Québec and Laval University, Quebec City, Canada; [b]Centre for Cancer Imaging, Peter MacCallum Cancer Centre and University of Melbourne, Melbourne, Australia; [c]Consultant Health Physicist, Nashville, TN, USA

Corresponding address: Jean-Mathieu Beauregard, Hôtel-Dieu de Québec, 11 côte du Palais, Quebec City (QC) G1R 2J6, Canada.
Email: jean-mathieu.beauregard@chuq.qc.ca

Date accepted for publication 30 March 2011

Abstract

Un patient type pour une PRRT personnalisé

- Éligibilité
- Examens antérieurs et prise de sang
- Consultation et explication du projet de recherche
- Déterminer la date de thérapie et la dose :

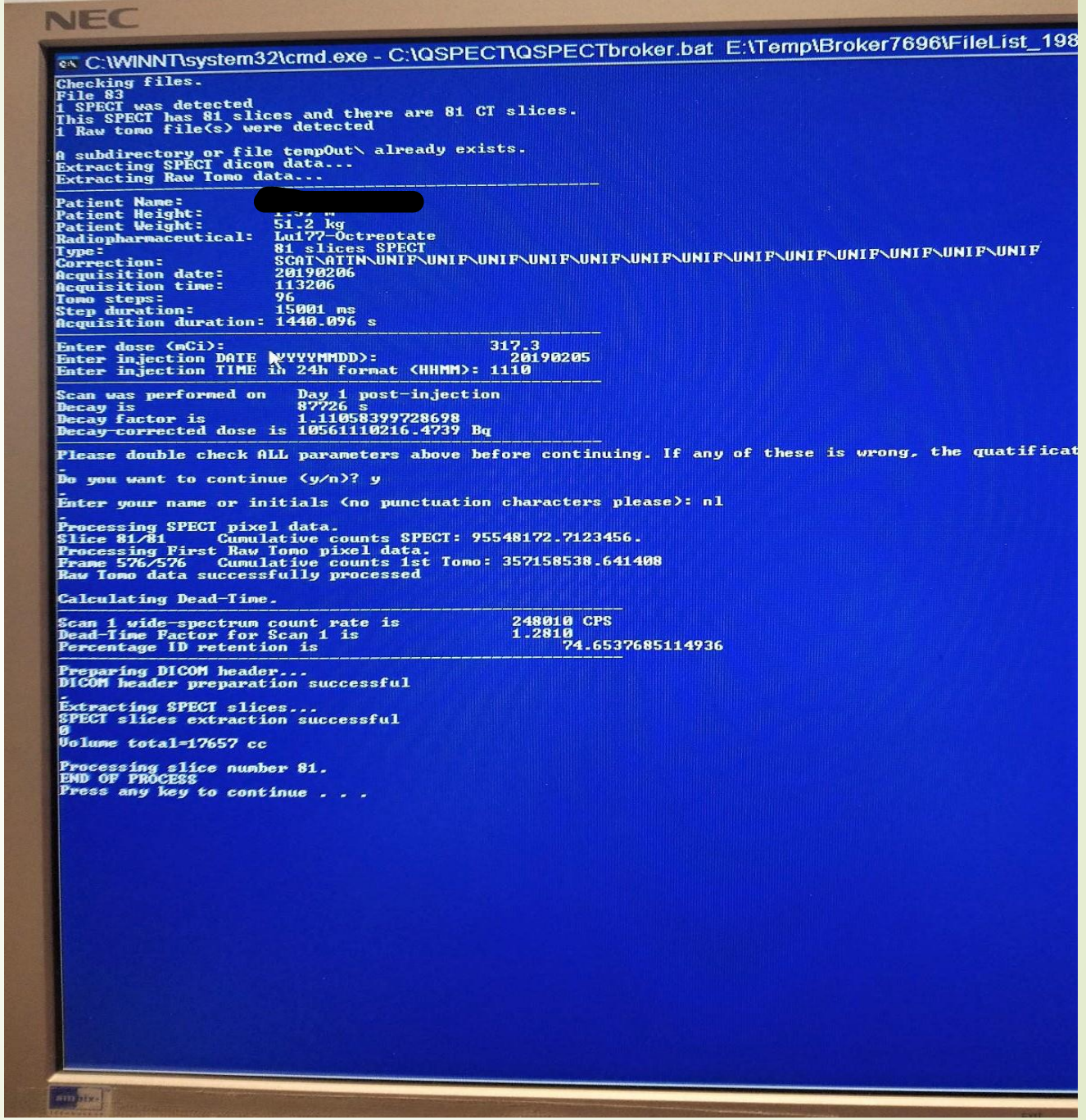
-Dose personnalisée avec objectif pour le premier cycle de 5 Gray

pour les reins et de 23 gray pour les 4 cycles

- Le Mardi , arrivée du patient vers 7H00 pour prise de sang et installation d'accès veineux.

-les prises de sang nous permettent de modifier la dose jusqu'à la dernière minute.

- Infusion des Acides aminés sur une période de 4 Hres et débutant 30 minutes avant le traitement
- Traitement infusé sur 20 minutes ou plus
- Départ des patients vers 14H30
- Retour le lendemain dès 8 Hres pour une mise en image WB et tomo
- Images prises Jour 1 et Jour 3 avec tomographie en fonction des atteintes
- Générer les Qspect avec le poids et la taille pour les 2 jours
- Sauvegarde des données


NEC
C:\WINNT\system32\cmd.exe - C:\QSPECT\QSPECTbroker.bat E:\Temp\Broker7696\FileList_198
Checking files.
File 83
1 SPECT was detected
This SPECT has 81 slices and there are 81 CT slices.
1 Raw tomo file(s) were detected
A subdirectory or file tempOut\ already exists.
Extracting SPECT dicom data...
Extracting Raw Tomo data...
Patient Name:
Patient Height:
Patient Weight: 51.2 kg
Radiopharmaceutical: Lu177-Octreotate
Type: 81 slices SPECT
Correction: SCAT\ATTN\UNIF\UNIF\UNIF\UNIF\UNIF\UNIF\UNIF\UNIF\UNIF\UNIF\UNIF\UNIF\UNIF
Acquisition date: 20190206
Acquisition time: 113206
Tomo steps: 96
Step duration: 15001 ms
Acquisition duration: 1440.096 s
Enter dose (mCi): 317.3
Enter injection DATE (YYYYMMDD): 20190205
Enter injection TIME in 24h format (HHMM): 1110
Scan was performed on Day 1 post-injection
Decay is 87726 s
Decay factor is 1.110583997286 98
Decay-corrected dose is 10561110216.4739 Bq
Please double check ALL parameters above before continuing. If any of these is wrong, the quatificat
Do you want to continue (y/n)? y
Enter your name or initials (no punctuation characters please): nl
Processing SPECT pixel data.
Slice 81/81 Cumulative counts SPECT: 95548172.7123456.
Processing First Raw Tomo pixel data.
Frame 576/576 Cumulative counts 1st Tomo: 357158538.641408
Raw Tomo data successfully processed
Calculating Dead-Time.
Scan 1 wide-spectrum count rate is 248010 CPS
Dead-Time Factor for Scan 1 is 1.2810
Percentage ID retention is 74.6537685114936
Preparing DICOM header...
DICOM header preparation successful
Extracting SPECT slices...
SPECT slices extraction successful
0
Volume total=17657 cc
Processing slice number 81.
END OF PROCESS
Press any key to continue . . .

Organes cibles

- Pour fin de calcul , plusieurs régions d'intérêt sont générés sur le Qspect:

  -Rein droit

  -Rein gauche

  -Foie

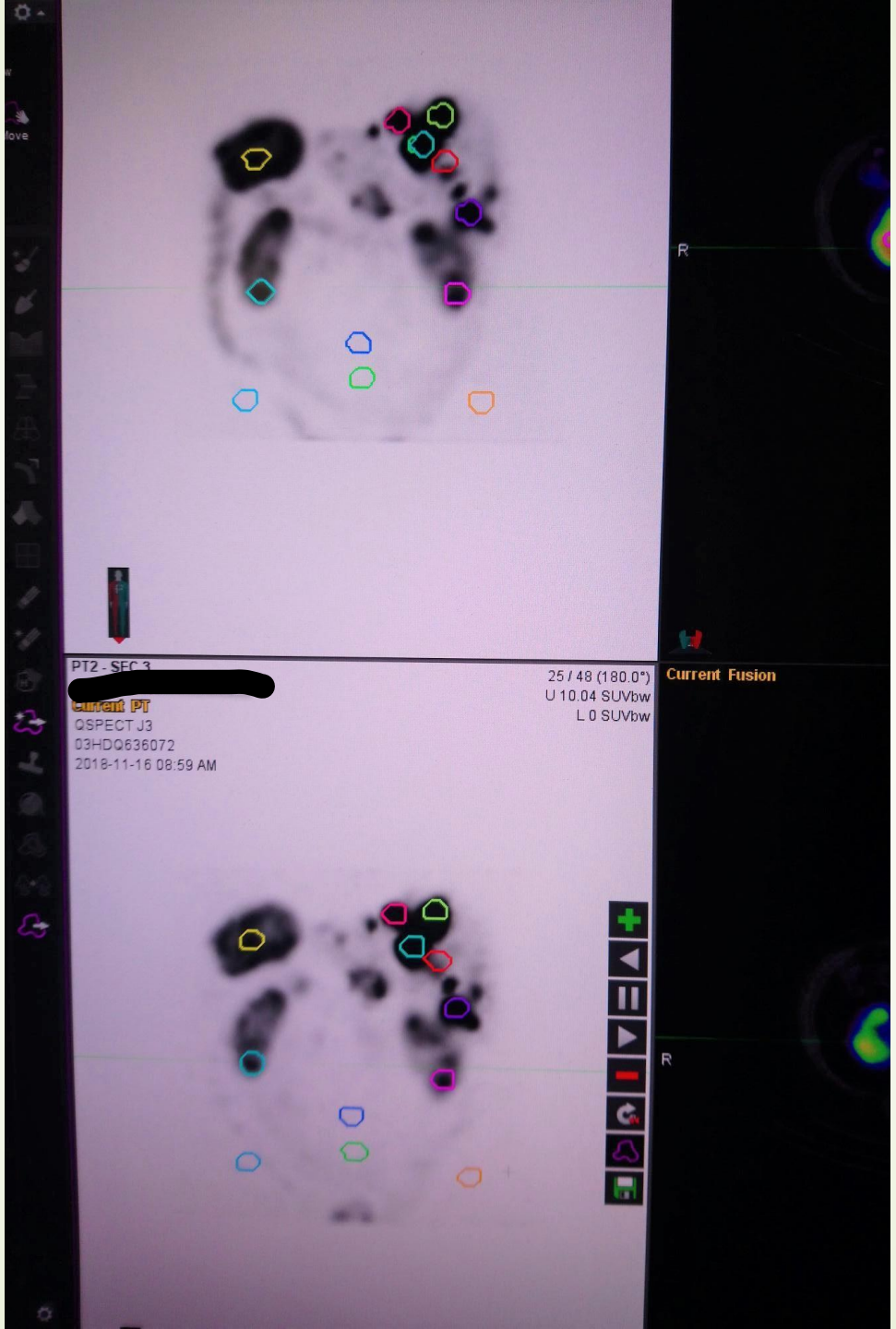
  -Rate

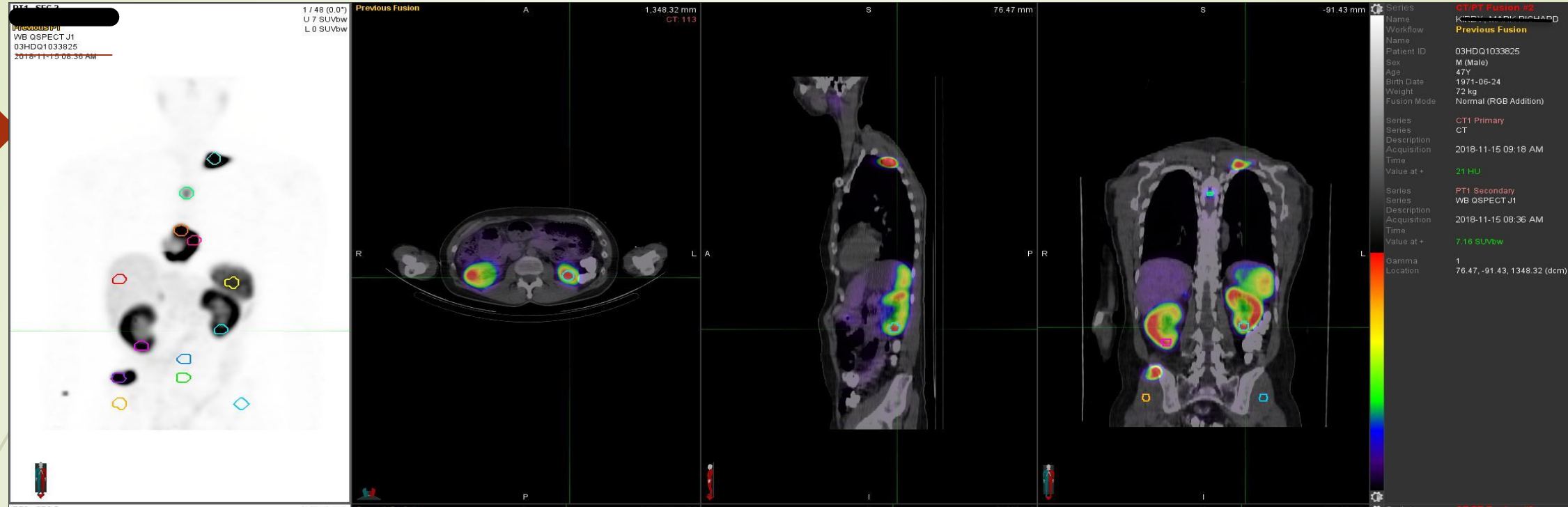
  -L4-L5

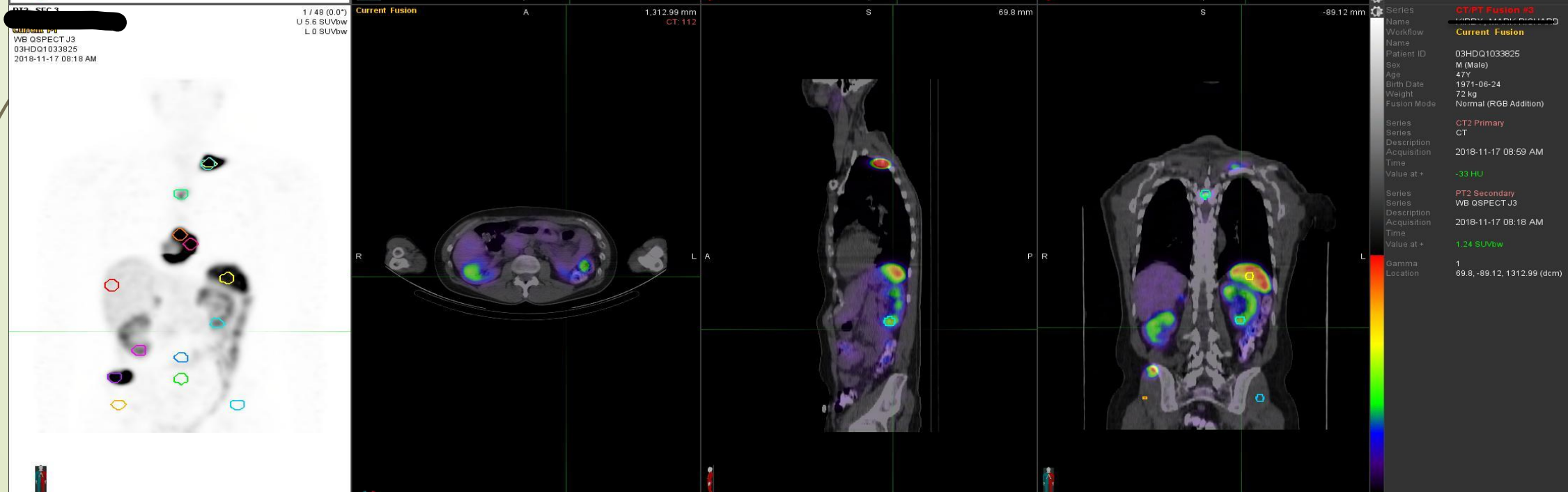
  -Bkg droit

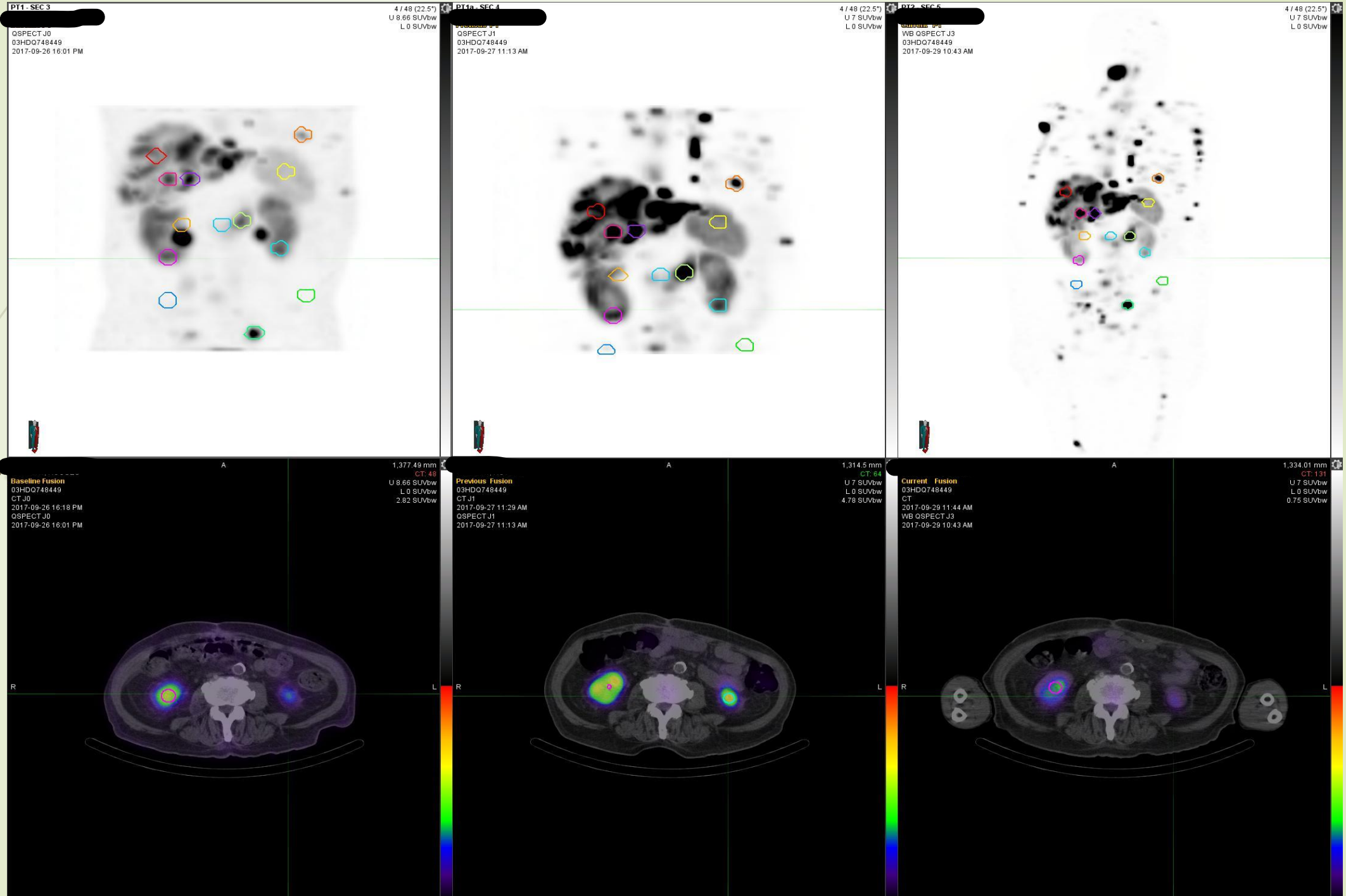
  -Bkg gauche

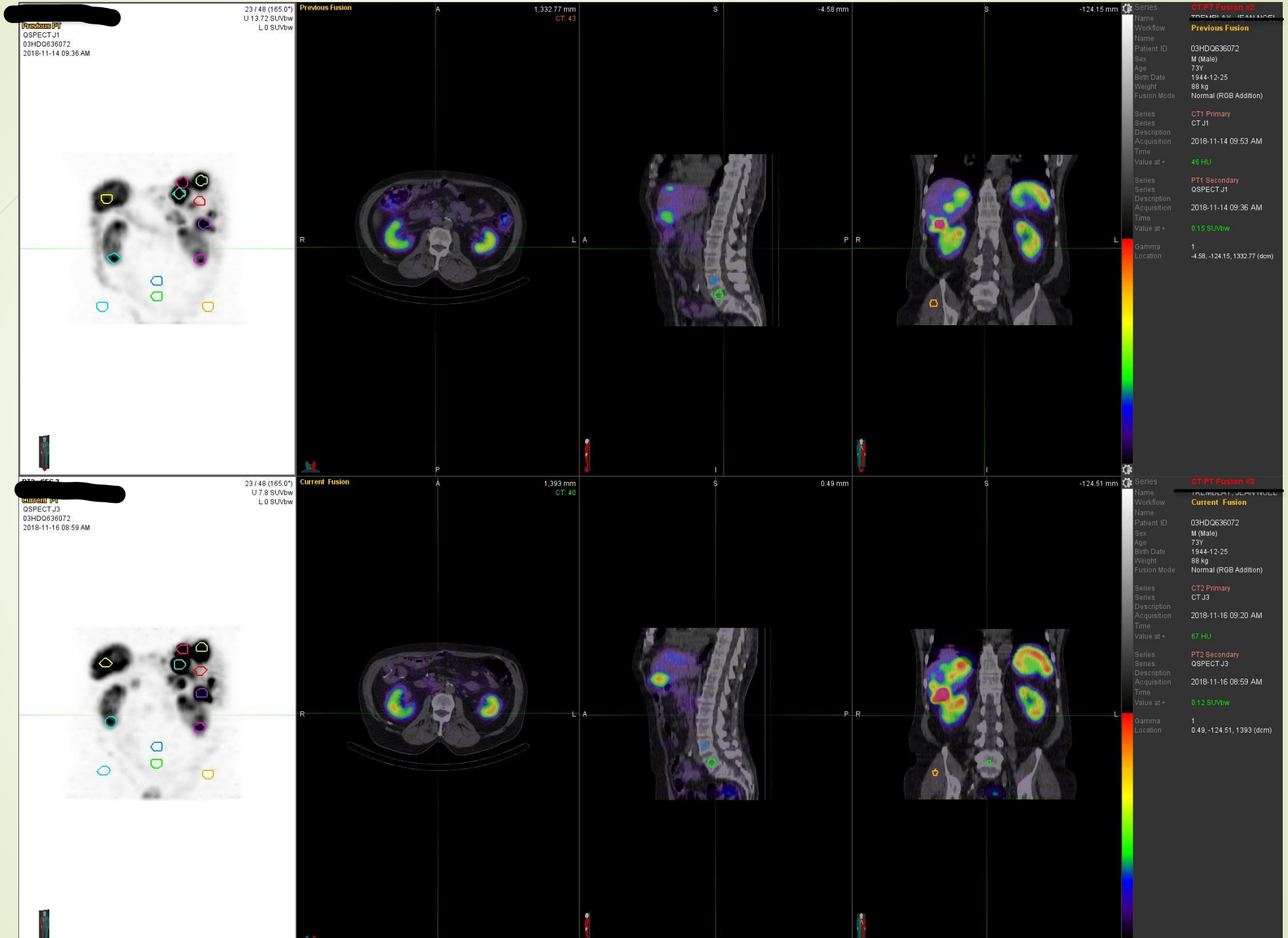
  -Régions sur la ou les tumeurs qui captent le plus

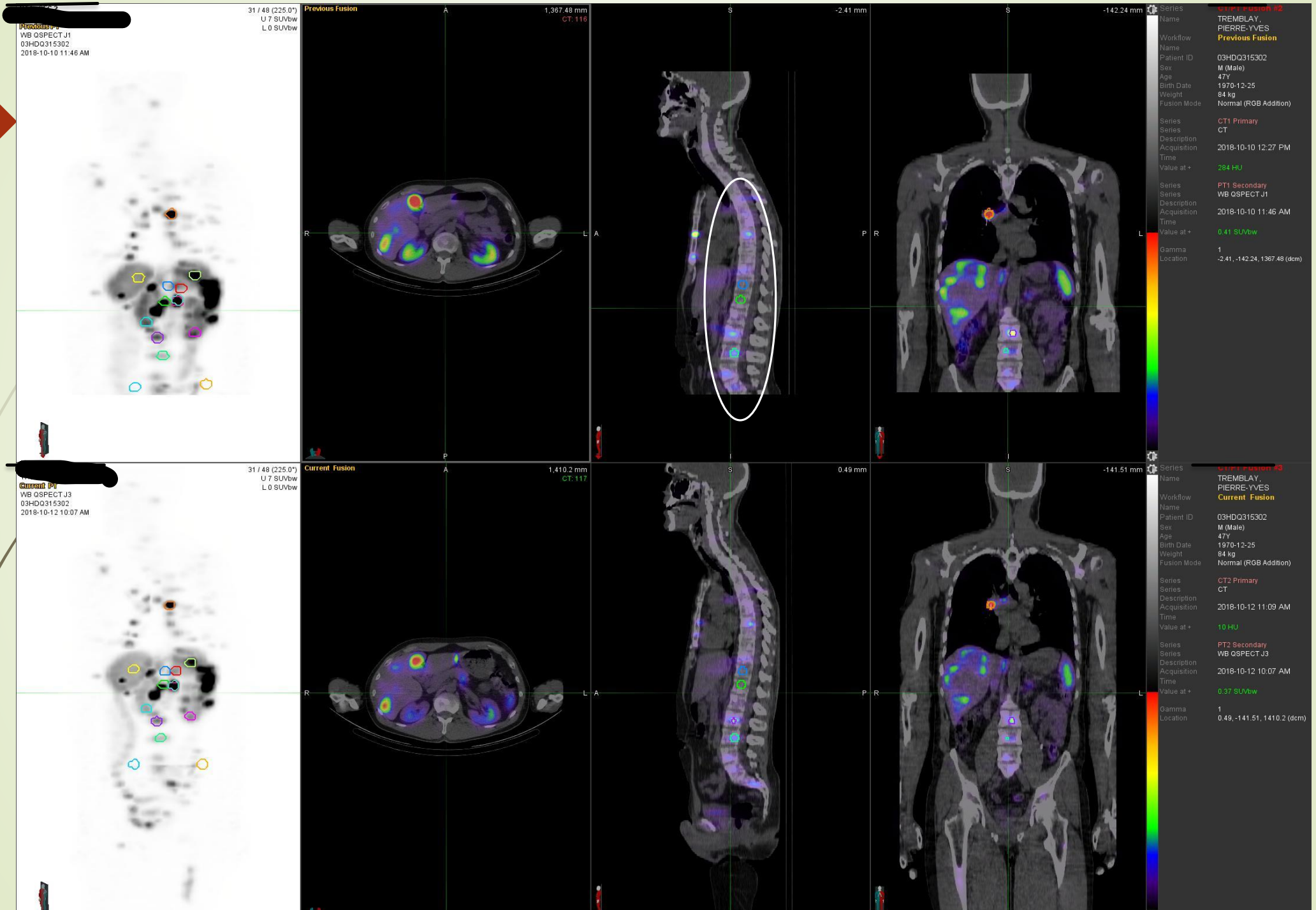

R
PT2 - SEC 3
[redacted]
Current PT
QSPECT J3
03HDQ636072
2018-11-16 08:59 AM
25 / 48 (180.0°)
U 10.04 SUVbw
L 0 SUVbw
Current Fusion
R

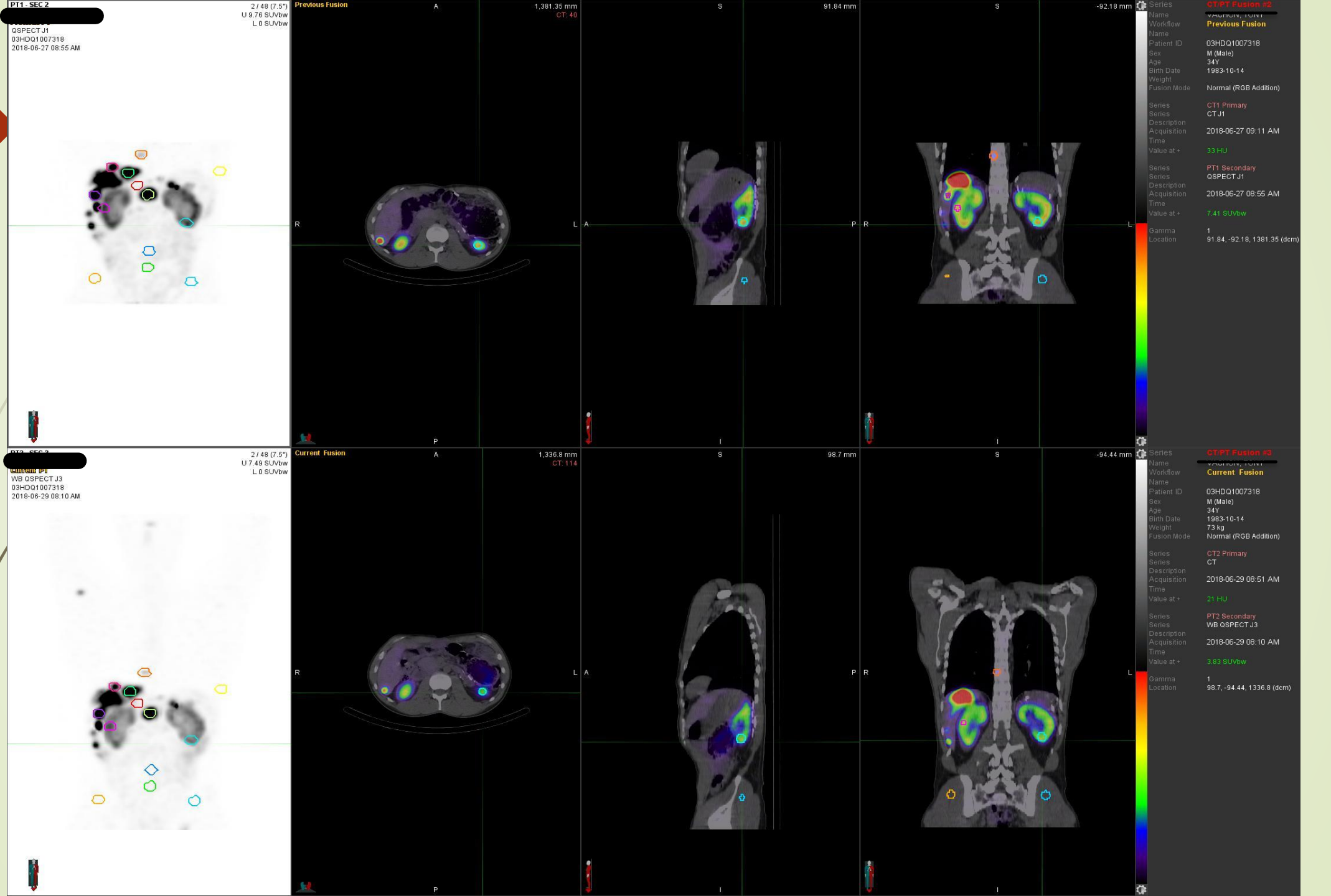

1 / 48 (0.0*)
U 7 SUVbw
L 0 SUVbw
WB QSPECT J1
03HDQ1033825
2018-11-15 08:36 AM
Previous Fusion
A
1,348.32 mm
CT: 113
S
76.47 mm
S
-91.43 mm
R
L
A
P
R
L
P
I
I
Series
CT/PT Fusion #2
Name
Workflow
Previous Fusion
Name
Patient ID
03HDQ1033825
Sex
M (Male)
Age
47Y
Birth Date
1971-06-24
Weight
72 kg
Fusion Mode
Normal (RGB Addition)
Series
CT1 Primary
Series
CT
Description
Acquisition
2018-11-15 09:18 AM
Time
Value at +
21 HU
Series
PT1 Secondary
Series
WB QSPECT J1
Description
Acquisition
2018-11-15 08:36 AM
Time
Value at +
7.16 SUVbw
Gamma
1
Location
76.47, -91.43, 1348.32 (dcm)

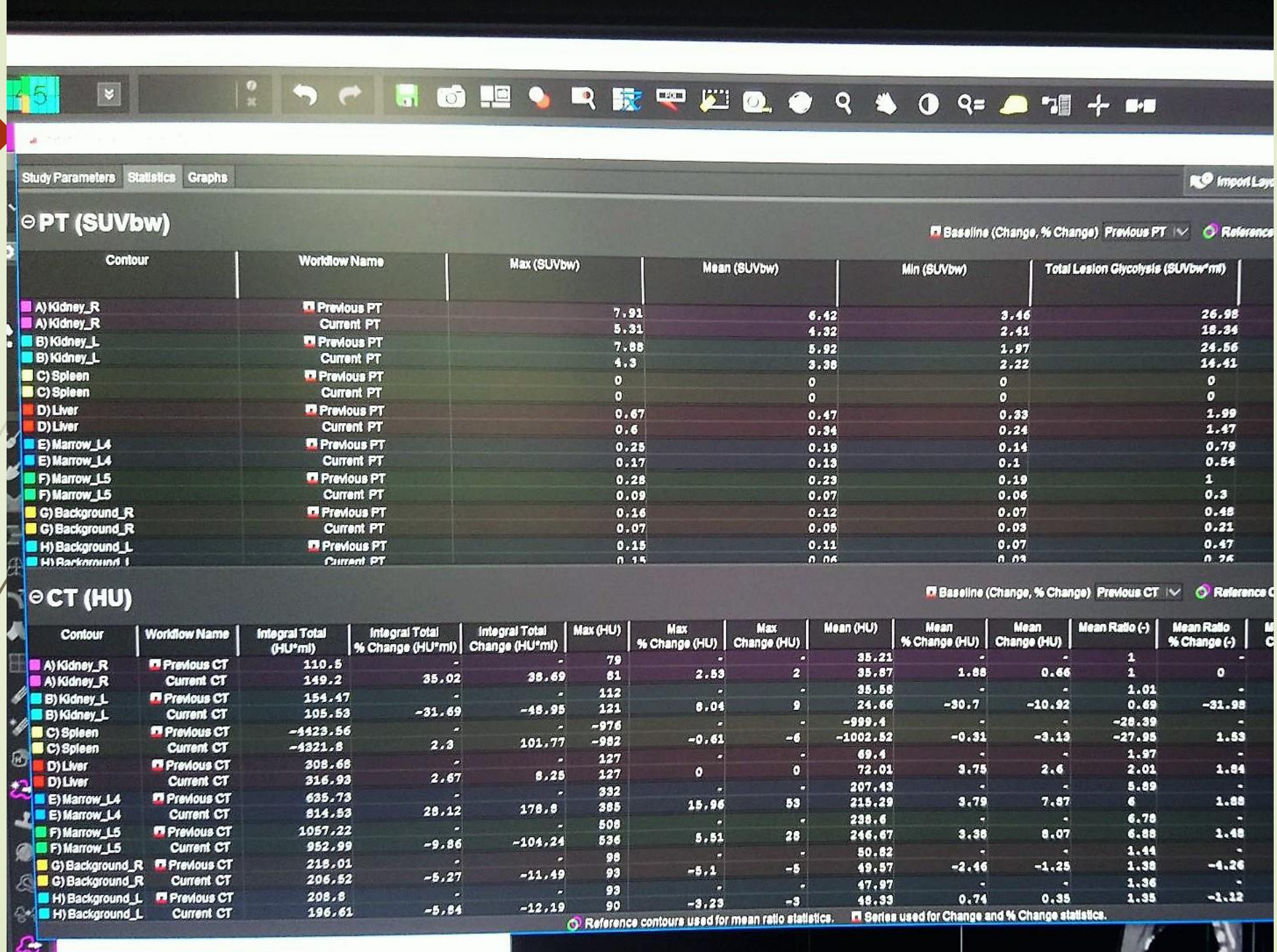

1 / 48 (0.0*)
U 5.6 SUVbw
L 0 SUVbw
WB QSPECT J3
03HDQ1033825
2018-11-17 08:18 AM
Current Fusion
A
1,312.99 mm
CT: 112
S
69.8 mm
S
-89.12 mm
R
L
A
P
R
L
P
I
I
Series
CT/PT Fusion #3
Name
Workflow
Current Fusion
Name
Patient ID
03HDQ1033825
Sex
M (Male)
Age
47Y
Birth Date
1971-06-24
Weight
72 kg
Fusion Mode
Normal (RGB Addition)
Series
CT2 Primary
Series
CT
Description
Acquisition
2018-11-17 08:59 AM
Time
Value at +
-33 HU
Series
PT2 Secondary
Series
WB QSPECT J3
Description
Acquisition
2018-11-17 08:18 AM
Time
Value at +
1.24 SUVbw
Gamma
1
Location
69.8, -89.12, 1312.99 (dcm)


PT1 - SEC 3
4 / 48 (22.5°)
U 8.66 SUVbw
L 0 SUVbw
QSPECT J0
03HDQ748449
2017-09-26 16:01 PM
PT1a - SEC 4
4 / 48 (22.5°)
U 7 SUVbw
L 0 SUVbw
QSPECT J1
03HDQ748449
2017-09-27 11:13 AM
PT2 - SEC 5
4 / 48 (22.5°)
U 7 SUVbw
L 0 SUVbw
WB QSPECT J3
03HDQ748449
2017-09-29 10:43 AM
A
1,377.49 mm
CT: 48
Baseline Fusion
03HDQ748449
CT J0
2017-09-26 16:18 PM
QSPECT J0
2017-09-26 16:01 PM
U 8.66 SUVbw
L 0 SUVbw
2.82 SUVbw
R
L
A
1,314.5 mm
CT: 64
Previous Fusion
03HDQ748449
CT J1
2017-09-27 11:29 AM
QSPECT J1
2017-09-27 11:13 AM
U 7 SUVbw
L 0 SUVbw
4.78 SUVbw
R
L
A
1,334.01 mm
CT: 131
Current Fusion
03HDQ748449
CT
2017-09-29 11:44 AM
WB QSPECT J3
2017-09-29 10:43 AM
U 7 SUVbw
L 0 SUVbw
0.75 SUVbw
R
L


Previous Fusion
Previous PT
QSPECT J1
03HDQ636072
2018-11-14 09:36 AM
23 / 48 (165.0°)
U 13.72 SUVbw
L 0 SUVbw
1,332.77 mm
CT: 43
-4.58 mm
-124.15 mm
Series CT PT Fusion #2
Name
Workflow Previous Fusion
Name
Patient ID 03HDQ636072
Sex M (Male)
Age 73Y
Birth Date 1944-12-25
Weight 88 kg
Fusion Mode Normal (RGB Addition)
Series CT1 Primary
Series CT J1
Description
Acquisition Time 2018-11-14 09:53 AM
Value at + 46 HU
Series PT1 Secondary
Series QSPECT J1
Description
Acquisition Time 2018-11-14 09:36 AM
Value at + 0.15 SUVbw
Gamma 1
Location -4.58, -124.15, 1332.77 (dcm)
Current Fusion
Current PT
QSPECT J3
03HDQ636072
2018-11-16 08:59 AM
23 / 48 (165.0°)
U 7.8 SUVbw
L 0 SUVbw
1,393 mm
CT: 40
0.49 mm
-124.51 mm
Series CT PT Fusion #3
Name
Workflow Current Fusion
Name
Patient ID 03HDQ636072
Sex M (Male)
Age 73Y
Birth Date 1944-12-25
Weight 88 kg
Fusion Mode Normal (RGB Addition)
Series CT2 Primary
Series CT J3
Description
Acquisition Time 2018-11-16 09:20 AM
Value at + 67 HU
Series PT2 Secondary
Series QSPECT J3
Description
Acquisition Time 2018-11-16 08:59 AM
Value at + 0.12 SUVbw
Gamma 1
Location 0.49, -124.51, 1393 (dcm)


[redacted]
WB QSPECT J1
03HDQ315302
2018-10-10 11:46 AM
31 / 48 (225.0°)
U 7 SUVbw
L 0 SUVbw
Previous Fusion
1,367.48 mm
CT: 116
-2.41 mm
-142.24 mm
Series
Name
TREMBLAY, PIERRE-YVES
Workflow
Previous Fusion
Patient ID
03HDQ315302
Sex
M (Male)
Age
47Y
Birth Date
1970-12-25
Weight
84 kg
Fusion Mode
Normal (RGB Addition)
Series
CT1 Primary
Series
CT
Description
Acquisition
2018-10-10 12:27 PM
Time
Value at +
284 HU
Series
PT1 Secondary
Series
WB QSPECT J1
Description
Acquisition
2018-10-10 11:46 AM
Time
Value at +
0.41 SUVbw
Gamma
1
Location
-2.41, -142.24, 1367.48 (dcm)
[redacted]
WB QSPECT J3
03HDQ315302
2018-10-12 10:07 AM
31 / 48 (225.0°)
U 7 SUVbw
L 0 SUVbw
Current Fusion
1,410.2 mm
CT: 117
0.49 mm
-141.51 mm
Series
Name
TREMBLAY, PIERRE-YVES
Workflow
Current Fusion
Patient ID
03HDQ315302
Sex
M (Male)
Age
47Y
Birth Date
1970-12-25
Weight
84 kg
Fusion Mode
Normal (RGB Addition)
Series
CT2 Primary
Series
CT
Description
Acquisition
2018-10-12 11:09 AM
Time
Value at +
10 HU
Series
PT2 Secondary
Series
WB QSPECT J3
Description
Acquisition
2018-10-12 10:07 AM
Time
Value at +
0.37 SUVbw
Gamma
1
Location
0.49, -141.51, 1410.2 (dcm)


PT1 - SEC 2
2 / 48 (7.5°)
U 9.76 SUVbw
L 0 SUVbw
QSPECT J1
03HDQ1007318
2018-06-27 08:55 AM
Previous Fusion
A
1,381.35 mm
CT: 40
S
91.84 mm
S
-92.18 mm
R
L
A
P
R
L
P
I
I
Series
CT/PT Fusion #2
Name
Workflow
Previous Fusion
Name
Patient ID
03HDQ1007318
Sex
M (Male)
Age
34Y
Birth Date
1983-10-14
Weight
Fusion Mode
Normal (RGB Addition)
Series
CT1 Primary
Series
CT J1
Description
Acquisition
2018-06-27 09:11 AM
Time
Value at +
33 HU
Series
PT1 Secondary
Series
QSPECT J1
Description
Acquisition
2018-06-27 08:55 AM
Time
Value at +
7.41 SUVbw
Gamma
1
Location
91.84, -92.18, 1381.35 (dcm)
2 / 48 (7.5°)
U 7.49 SUVbw
L 0 SUVbw
WB QSPECT J3
03HDQ1007318
2018-06-29 08:10 AM
Current Fusion
A
1,336.8 mm
CT: 114
S
98.7 mm
S
-94.44 mm
R
L
A
P
R
L
P
I
I
Series
CT/PT Fusion #3
Name
Workflow
Current Fusion
Name
Patient ID
03HDQ1007318
Sex
M (Male)
Age
34Y
Birth Date
1983-10-14
Weight
73 kg
Fusion Mode
Normal (RGB Addition)
Series
CT2 Primary
Series
CT
Description
Acquisition
2018-06-29 08:51 AM
Time
Value at +
21 HU
Series
PT2 Secondary
Series
WB QSPECT J3
Description
Acquisition
2018-06-29 08:10 AM
Time
Value at +
3.83 SUVbw
Gamma
1
Location
98.7, -94.44, 1336.8 (dcm)



Study Parameters | Statistics | Graphs

PT (SUVbw)

Baseline (Change, % Change) Previous PT

Contour	Workflow Name	Max (SUVbw)	Mean (SUVbw)	Min (SUVbw)	Total Lesion Glycolysis (SUVbw*ml)
A) Kidney_R	Previous PT	7.91	6.42	3.46	26.98
A) Kidney_R	Current PT	5.31	4.32	2.41	18.34
B) Kidney_L	Previous PT	7.88	5.92	1.97	24.56
B) Kidney_L	Current PT	4.3	3.38	2.22	14.41
C) Spleen	Previous PT	0	0	0	0
C) Spleen	Current PT	0	0	0	0
D) Liver	Previous PT	0.67	0.47	0.33	1.99
D) Liver	Current PT	0.6	0.34	0.24	1.47
E) Marrow_L4	Previous PT	0.25	0.19	0.14	0.79
E) Marrow_L4	Current PT	0.17	0.13	0.1	0.54
F) Marrow_L5	Previous PT	0.28	0.23	0.19	1
F) Marrow_L5	Current PT	0.09	0.07	0.06	0.3
G) Background_R	Previous PT	0.16	0.12	0.07	0.48
G) Background_R	Current PT	0.07	0.05	0.03	0.21
H) Background_L	Previous PT	0.15	0.11	0.07	0.47
H) Background_L	Current PT	0.15	0.06	0.03	0.26

CT (HU)

Baseline (Change, % Change) Previous CT

Contour	Workflow Name	Integral Total (HU*ml)	Integral Total % Change (HU*ml)	Integral Total Change (HU*ml)	Max (HU)	Max % Change (HU)	Max Change (HU)	Mean (HU)	Mean % Change (HU)	Mean Change (HU)	Mean Ratio (-)	Mean Ratio % Change (-)
A) Kidney_R	Previous CT	110.5	-	-	79	-	-	35.21	-	-	1	-
A) Kidney_R	Current CT	149.2	35.02	38.69	81	2.53	2	35.87	1.88	0.66	1	0
B) Kidney_L	Previous CT	154.47	-	-	112	-	-	35.58	-	-	1.01	-
B) Kidney_L	Current CT	105.53	-31.69	-48.95	121	8.04	9	24.66	-30.7	-10.92	0.69	-31.98
C) Spleen	Previous CT	-1423.56	-	-	-976	-	-	-999.4	-	-	-28.39	-
C) Spleen	Current CT	-1321.8	2.3	101.77	-982	-0.61	-6	-1002.52	-0.31	-3.13	-27.95	1.53
D) Liver	Previous CT	308.68	-	-	127	-	-	69.4	-	-	1.97	-
D) Liver	Current CT	316.93	2.67	8.25	127	0	0	72.01	3.75	2.6	2.01	1.84
E) Marrow_L4	Previous CT	635.73	-	-	332	-	-	207.43	-	-	5.89	-
E) Marrow_L4	Current CT	814.53	28.12	178.8	365	15.96	53	215.29	3.79	7.87	6	1.88
F) Marrow_L5	Previous CT	1057.22	-	-	508	-	-	238.6	-	-	6.78	-
F) Marrow_L5	Current CT	952.99	-9.86	-104.24	536	5.51	28	246.67	3.38	8.07	6.88	1.48
G) Background_R	Previous CT	218.01	-	-	98	-	-	50.82	-	-	1.44	-
G) Background_R	Current CT	206.52	-5.27	-11.49	93	-5.1	-5	49.57	-2.46	-1.25	1.38	-4.26
H) Background_L	Previous CT	208.8	-	-	93	-	-	47.97	-	-	1.36	-
H) Background_L	Current CT	196.61	-5.84	-12.19	90	-3.23	-3	48.33	0.74	0.35	1.35	-1.12

Reference contours used for mean ratio statistics. Series used for Change and % Change statistics.

Cycle	induction	1

Poids	66.0	kg	Sexe	M	
Taille	1.73	m			
Act. Rx		mCi	Pept. conc.	1.53	mcg/mCi
Act. admin.	207	mCi	Pept. admin	316.71	mcg
	7.659	GBq			

Jour		Date	Heure	Volume (cc)	%Rétention	DTC	Bkg1	Bkg2
	Injection	2015-10-20	12:24					
0	Scan	2015-10-20	16:37	23488	76.3	1.139	0.08	0.04
1	Scan	2015-10-21	11:04	22640	63.9	1.110	0.04	0.03
3	Scan	2015-10-23	11:45	38096	47.8	1.056	0.04	0.02

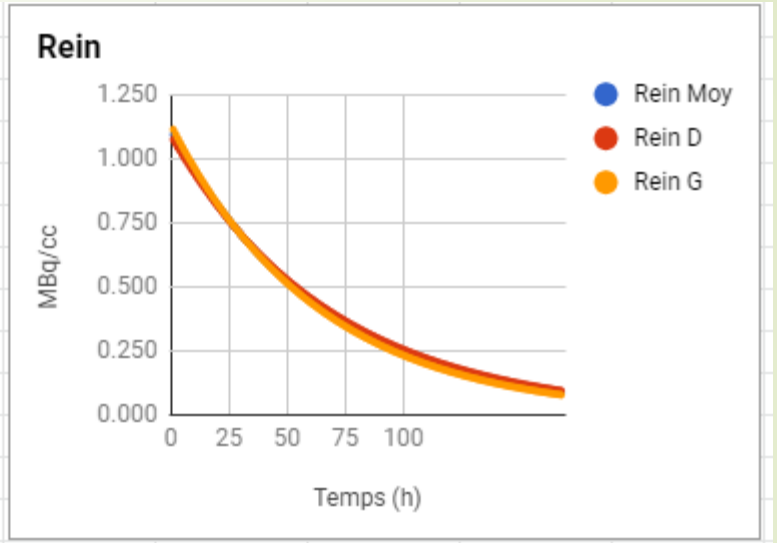
T1/2 Lu-177	161	h											H	F
mGy/MBq-h	87	87	87	86	87	87	87	87	84	84	84	84	84	0.000129	0.000

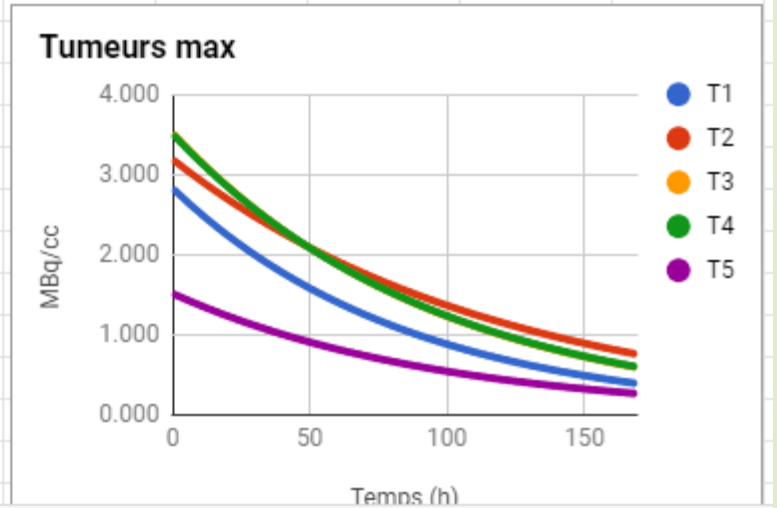
									Primitif (par	M foie 1	M foie 2				
Temps (h)	Rein D	Rein G	Rein Moy	Rate	Foie	Moelle L4	Moelle L5	Moelle Moy	T1	T2	T3	T4	T5	Rétention	Moelle T
0.00	0	0	0	0	0	0	0	0	0	0	0	0	0	100	
4.22	2.95	2.18	2.565	4.72	0.98	0.93	0.37	0.65	27.32	11.24	16.68			80.2	
22.67	2.39	2.17	2.28	4.77	0.67	0.91	0.33	0.62	22.36	8.94	12.47			66.2	
71.35	1.6	1.63	1.615	3.76	0.58	0.81	0.25	0.53	16.18	6.66	9.26			49.1	
T1/2 biol (h)	84.1	117.9	97.9	141.8	233.9	289.9	121.5	215.2	104.3	114.6	113.4	#DIV/0!	#DIV/0!	112.7	
Monoexp (Gy)	2336	2422	2365	5708	1028	1441	379	891	23357	9793	13720	#DIV/0!	#DIV/0!	72	
Trapezoid (Gy)	4135	4026	4080	9071	1429	1931	621	1276	39539	16199	22668	0	0		
Dose (Gy)	2336	2422	2365	5708	1028	1441	379	891	23357	9793	13720	#DIV/0!	#DIV/0!	72	

Jour	Tissu	Voi	Mean	Min	Max	Median	Peak
0	Rein D	Voi 1	2.95	2.29	3.41	2.97	3.25
0	Rein G	Voi 2	2.18	1.87	2.54	2.2	2.33

Cycle	Induction	2													
									Poids	112.7	kg	Sexe	M		
Jour		Date	Heure	Volume (cc)	%Rétention	DTC	Bkg1	Bkg2	Taille	1.70	m				
	Injection	2018-09-11	11:48												
									Act. Rx	494	mCi	Pept. conc.	1.60		
1	Scan	2018-09-12	10:50	46137	8.4	1.031	0.05	0.05	Act. admin.	495.55	mCi	Pept. admin	792.88		
3	Scan	2018-09-14	09:48	75234	6.9	1.017	0.03	0.03		18.34	GBq				
T1/2 Lu-177	161	h	LambdaPhy	0.0043	h-1								H		
mGy/MBq-h	87	87	87	86	87	87	87	87	84	84	84	84	84	0.000129	
Temps (h)	Rein D	Rein G	Rein Moy	Rate	Foie	Moelle L4	Moelle L5	Moelle Moy	T1	T2	T3	T4	T5	Rétention	
23.03	4.51	5.09	4.8	3.12	0.64	0.12	0.15	0.14	13.53	11.1	9.34	7.23	8.27	11.4	
70.00	2.51	2.74	2.625	2.25	0.49	0.1	0.13	0.12	13.26	11.04	8.78	6.93	7.7	7.9	
T1/2 biol (h)	55.6	52.6	53.9	99.6	121.9	178.6	227.5	203.0	1615.0	6006.3	526.5	768.2	455.9	90.0	
Monoexp (Gy)	5070	5581	5324	4549	1034	227	310	268	39443	34406	23404	19372	20091	27	
Trapezoid (Gy)	8252	9008	8630	7312	1611	329	427	378	42091	35044	27870	21998	24442		
Dose (Gy)	5070	5581	5324	4549	1034	227	310	268	39443	34406	23404	19372	20091	27	

Jour	Tissu	Heure	Max	Mean	Min	Volume
1	Rein D	2018-07-11	8.22	6.89	4.14	4.28
3		2018-07-13	5.1	4.29	2.95	4.16
1	Rein G	2018-07-11	8.87	6.93	3.47	4.25
3		2018-07-13	5.05	4.06	1.64	4.27
1	Rate	2018-07-11	8.61	7.36	4.31	4.08
3		2018-07-13	6.58	5.46	3.04	4.06
1	Foie	2018-07-11	2.84	1.97	1.54	4.07
3		2018-07-13	2.28	1.66	1.29	4.06
1	Moelle L4	2018-07-11	0.27	0.23	0.17	4.23
3		2018-07-13	0.14	0.12	0.09	4.06
1	Moelle L5	2018-07-11	0.32	0.28	0.21	4.13
3		2018-07-13	0.19	0.14	0.12	4.15
1	Bkg D	2018-07-11	0.12	0.06	0.03	4.08
3		2018-07-13	0.14	0.07	0.02	4.06
1	Bkg G	2018-07-11	0.12	0.08	0.05	4.06
3		2018-07-13	0.14	0.09	0.04	4.11
1	T1	2018-07-11	38.82	19.18	3.79	4.18
3		2018-07-13	25.51	13.63	2.36	4.07
1	T2	2018-07-11	27.68	23.33	18.41	4.28
3		2018-07-13	21.61	19.21	12.22	4.07
1	T3	2018-07-11	30.48	24.53	13.09	4.17
3		2018-07-13	22.67	18.37	10.73	4.08
1	T4	2018-07-11	28.19	24.47	19.05	4.07
3		2018-07-13	20.84	18.4	13.28	4.2
1	T5	2018-07-11	23.72	19.65	1.8	4.07





Cycle	Type	Date	Act admin	Act admin	Rein	Rein/Activité	Exactitude	Moelle auto	Moelle cross	Moelle totale	Moelle/Activité	Exactitude
			mCi	GBq	Gy	mGy/GBq	%	mGy	mGy	mGy	mGy/GBq	%
	B1	C4	L6	L7	D21			I21	O21	P21		
1	Induction	2017-05-23	262	9.7	3,017	311	-38.8%	131	21	151	16	
2	Induction	2017-07-18	394	14.6	4,406	302	-3.0%	198	23	221	15	-3.0%
3	Induction	2017-09-12	592	21.9	6,024	275	-10.3%	301	27	328	15	-2.7%
4	Induction	2017-11-14	876	32.4	8,742	270	-6.6%	473	30	503	16	3.0%
5												

Tumeur 1	Tumeur 2	Tumeur 3	Tumeur 4	Tumeur 5	Tumeur Max
mGy	mGy	mGy	mGy	mGy	mGy
J21	K21	L21	M21	N21	
37,566	30,874	15,686	6,219	3,465	37,566
13,812	29,327	10,329	4,893	2,837	29,327
14,247	17,379	6,558	7,613	1,837	17,379
11,624	20,444	1,878	10,569	1,942	20,444

ID	Initials	DOB	Sex	Race (afro)
074-[redacted]		1949-07-18	F	Non

Évaluation préliminaire prescription						
Date lab	2018-02-27	Age	68	y		
Weight	134	lbs	60.8	kg		
Height	65	in	1.65	m	BSA (m2)	1.67
Creatinin		mg/dl	161	µmol/l		
eGFR lab		ml/min/1.73m2				
eGFR CKD-EPI	28	ml/min/1.73m2			Gy/GBq	1.78
Plt	Neutro	GFR	Pire grad	Rx Dose	Rx Act	
Grade	Grade	Grade			GBq	mCi
		2	2	3.75	2.10	57

Évaluation finale prescription			
Date	2018-02-27	Age	68
Weight	60.8	kg	
Height	1.65	m	
Creatinin	161	µmol/l	
eGFR lab		ml/min/1.73m2	
eGFR CKD-EPI	28.1	ml/min/1.73m2	
Plt	Neutro	GFR	Pire grad
Grade	Grade	Grade	
		2	2

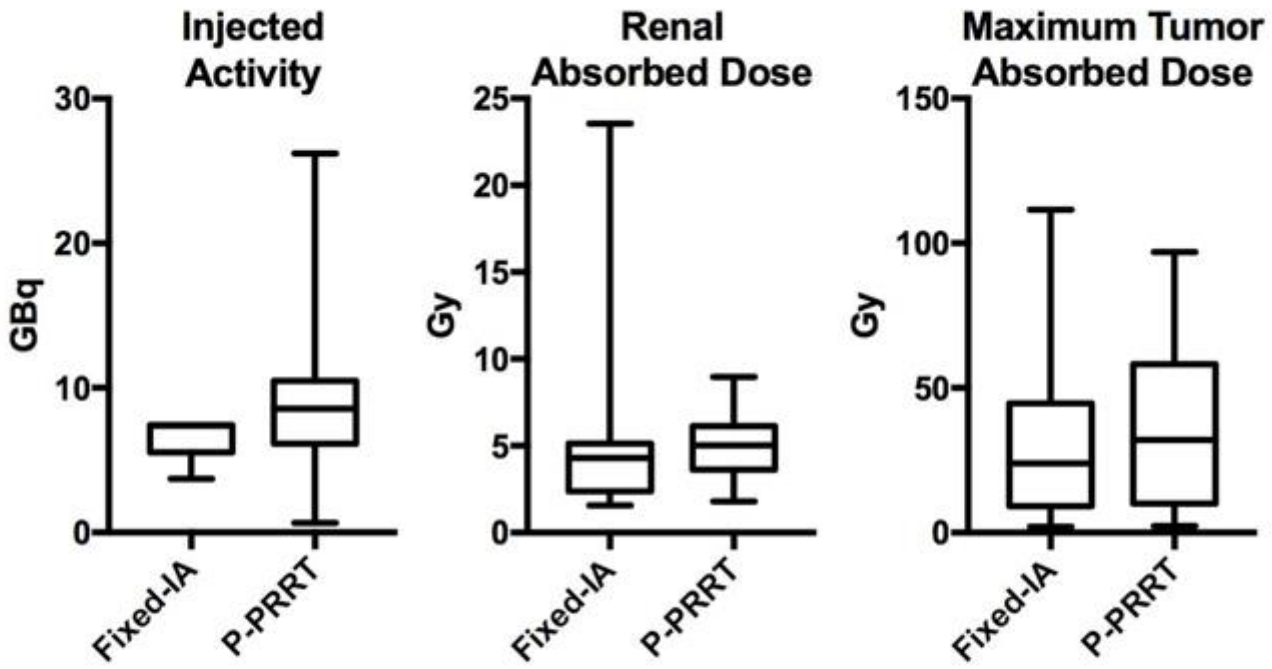
			Toxicité subaigue			Dysfonction/toxicité chronique				Rx rein						Rx Activité	
Cycle	Type	Date	Plt	Neutro	Pire grade	Plt	Neutro	GFR	Pire grade	Cible cycle	Cible Ind	Rx Cycle	Act perso	Limite aug	atteinte?	Rx Act	
						Grade	Grade	Grade		Gy	Gy	Gy	GBq			GBq	mCi
	B1	C4															
1	Induction	2018-02-27				1	0	2	2	3.75						2.10	57
2	Induction	2018-04-24			0	1	0	2	2	4.5	17.25	4.95	4.4	50%	oui	3.2	86
3	Induction	2018-06-19			0			2	2	4.5	17.25	6.05	6.0	50%	oui	4.7	126
4	Induction	2018-08-14			0	1	2	2	2	4.5	17.25	5.15	4.4	50%	non	4.4	118

ID	Initials	DOB	Sex	Race (afro)
083[redacted]		1932-11-10	F	Non

Évaluation préliminaire prescription						
Date lab	2018-05-30	Age	85	y		
Weight		lbs	51.0	kg		
Height		in	1.50	m	BSA (m2)	1.44
Creatinin		mg/dl	54	µmol/l		
eGFR lab		ml/min/1.73m2				
eGFR CKD-EPI	82.7	ml/min/1.73m2			Gy/GBq	0.70
Plt	Neutro	GFR	Pire grad	Rx Dose	Rx Act	
Grade	Grade	Grade			GBq	mCi
0	0	1	1	5	7.17	194

Évaluation finale prescription			
Date	2018-07-17	Age	85
Weight	51.0	kg	
Height	1.5	m	
Creatinin	53	µmol/l	
eGFR lab	83	ml/min/1.73m2	
eGFR CKD-EPI	83.2	ml/min/1.73m2	
Plt	Neutro	GFR	Pire grad
Grade	Grade	Grade	
0	0	1	1

			Toxicité subaigue			Dysfonction/toxicité chronique				Rx rein						Rx Activité	
Cycle	Type	Date	Plt	Neutro	Pire grade	Plt	Neutro	GFR	Pire grade	Cible cycl	Cible Ind	Rx Cycle	Act perso	Limite aug	atteinte?	Rx Act	
						Grade	Grade	Grade		Gy	Gy	Gy	GBq			GBq	mCi
	B1	C4															
1	Induction	2018-07-18				0	0	1	1	5						7.17	194
2	Induction	2018-09-11			0			1	1	6	23	6.69	16.4	50%	oui	10.8	292
3	Induction	2018-11-20			0				0	6	23	7.23	15.6	50%	non	15.6	421
4	Induction	2019-01-22	2		2	1			1	6	23	6.32	12.1	25%	non	12.1	328



[redacted]al. J Nucl Med 2017;58:242

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- Je vous présente la procédure pour la thérapie des TNE au Lu177

  mais l'avenir est aussi prometteur pour le PSMA-Lu177 .

- Les organes cibles pour ce type de traitement sont encore les reins mais les glandes salivaires , lacrymales et la moelle osseuse doivent également être surveillés

- Prochaine étape ……

En conclusion

- Partir un programme de dosimétrie est un travail minutieux qui demande une collaboration étroite entre médecin spécialiste , physicien et les technologues en médecine nucléaire.
- La qualité des données obtenues dépend presque entièrement de l 'équipe de technologues car la mise en image doit être reproductible pendant les 4 cycles.
- Générer les données demande une bonne connaissance de l'anatomie et une rigueur dans la reproduction des différentes étapes
- Sous supervision l'apprentissage est a portée de tous