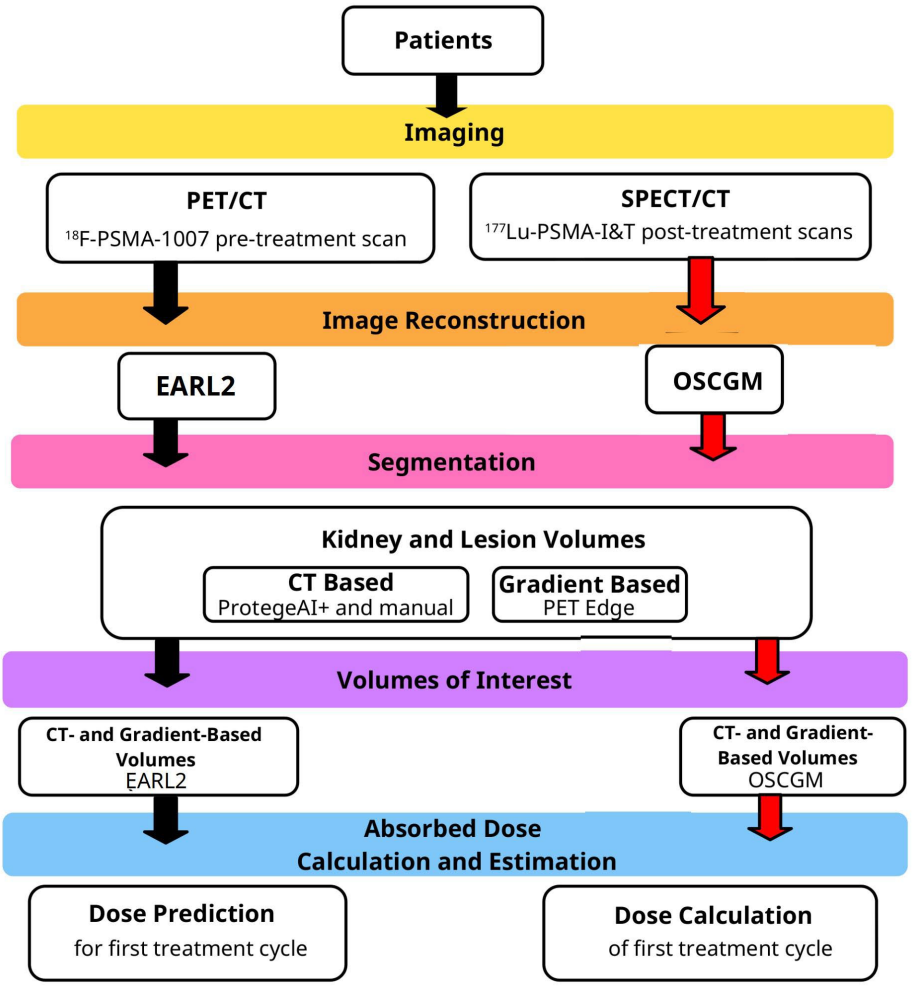
Supplementary Material

Appendix A:

Figure A: The workflow of methods used.



Appendix B:

Table B: Imaging/reconstruction parameters. The patients' pre-treatment scanning was carried out with two different PET/CTs (EARL2 accredited), and post-treatment scanning with one SPECT/CT.

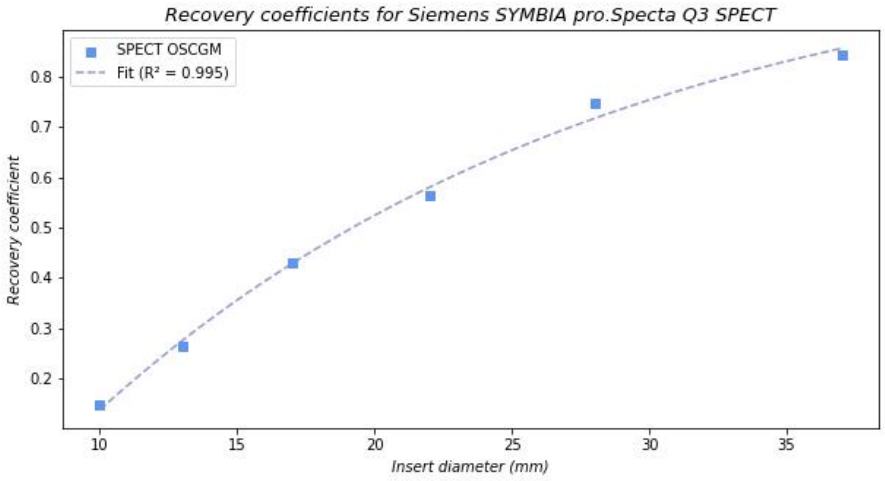
Parameter	GE Healthcare Discovery MI PET/CT	Siemens Biograph mCT 64 R4 PET/CT	Siemens SYMBIA pro.Specta Q3 SPECT/CT with 5/8'' crystals and MELP collimators
Axial field of view	20 cm	21.6 cm	38.7 cm
Acquisition time	2:45 min / bed position	flow table: 1 mm/s	60 views, 10 s per view
Scan range	Orbits to thighs	Orbits to thighs	3 bed positions from the crown of the head
Reconstruction	OSEM + TOF	OSEM + TOF	OSCGM
Iterations/Subsets	3/16	2/21	8/4
Post-filtering	Gaussian filter 6.0 mm	Gaussian filter 5.5 mm	Gaussian filter 8.4 mm
Corrections	CT based AC, scatter, PSF, random, dead time	CT based AC, scatter, PSF, random, dead time	CT based AC, scatter, dead time, Siemens BroadQuantTM
Matrix size	256 × 256	400 x 400	256 × 256
Slice Thickness	5 mm	5 mm	3 mm

Appendix C:

Table C: The phantom's insert diameter and the calculated recovery coefficient, using OSCGM reconstruction and CT-based segmentation based on the known diameters. The phantom was SPECT/CT imaged using Siemens Pro.Specta Q3.

Diameter [mm]	Volume [ml]	RC
10	0.5	0.15
13	1.2	0.26
17	2.6	0.43
22	5.6	0.56
28	11.5	0.75
37	26.5	0.84

Figure C: The recovery coefficients were fitted using a monoexponential model, shown in the Figure. The fitted model describes the data well with $R^2 = 0.995$.



Appendix D:

Table D: Absorbed dose predictions derived from pre-treatment PET/CT scan using SPECT observed effective half-lives ($D_{SPECT/CT}$), literature values reported by Schuchardt et al. [23] ($D_{Schuchardt}$), and literature values reported by Karimzadeh et al. [24] ($D_{Karimzadeh}$) for CT-based and gradient-based kidney and bone lesion volumes. Kidneys are denoted as L for left kidney and R for right kidney. SPECT/CT observed mean absorbed doses (D_{ref}) for both segmentation methods are presented as well.

PET/CT							SPECT/CT	
CT-Based Segmentation							CT-Based Segmentation	
Kidneys							Kidneys	
	$D_{SPECT/CT}$ [Gy]		$D_{Schuchardt}$ [Gy]		$D_{Karimzadeh}$ [Gy]		D_{ref} [Gy]	
Patient	L	R	L	R	L	R	L	R
1	7.4	6.9	7.5	6.6	8.8	8.8	3.1	3.1
2	4.6	5.4	5.0	5.8	5.8	6.8	2.0	2.4
3	5.0	2.6	4.5	2.8	5.3	3.3	3.7	4.3
4	6.3	5.4	5.5	5.5	7.1	6.5	2.0	2.1
5	4.2	5.5	4.6	6.0	5.4	7.1	4.1	5.9
Bone lesions								

1	2.3		1.5		1.9		10.4	
2	19.2		13.7		17.4		21.2	
3 (1)	102.1		28.1		35.7		68.9	
3(2)	51.5		14.2		18.0		49.2	
4	34.7		24.6		31.3		46.3	
5	18.2		23.9		30.4		16.7	
Gradient-Based Segmentation								
Kidneys								
	$D_{SPECT/CT}$ [Gy]		$D_{Schuchardt}$ [Gy]		$D_{Karimzadeh}$ [Gy]		D_{ref} [Gy]	
	L	R	L	R	L	R	L	R
1	6.6	7.2	6.6	6.9	7.8	7.8	2.8	2.6
2	4.3	4.8	4.7	5.1	5.5	6.0	1.8	2.1
3	4.5	2.6	4.1	2.8	4.8	3.3	3.2	5.5
4	5.6	5.1	5.5	5.3	6.4	6.3	1.9	2.3
5	3.3	4.5	4.1	5.6	4.8	6.6	6.6	8.9
Bone Lesions								
1	5.1		3.7		4.7		6.5	
2	19.2		11.6		14.7		14.5	
3 (1)	103.4		28.4		36.2		39.6	
3 (2)	49.5		13.6		17.3		26.7	
4	33.3		24.0		30.6		44.5	
5	21.4		28.9		36.7		3.3	

Appendix E: Ratio between the PET/CT-based absorbed dose predictions ($D_{SPECT/CT}$, $D_{schuchardt}$, $D_{karimzadeh}$ and the reference SPECT/CT-based observed absorbed dose (D_{ref}) for kidneys, denoted as L and R for left and right kidney, and bone lesions for the two segmentation methods used (CT- and gradient-based segmentation).

Ratio of absorbed doses from PET/SPECT						
CT-Based Segmentation						
Kidneys						
	$D_{SPECT/CT}/D_{ref}$		$D_{Schuchardt}/D_{ref}$		$D_{Karimzadeh}/D_{ref}$	
Patients	L	R	L	R	L	R
1	2.4	2.2	2.4	2.1	2.8	2.8
2	2.3	2.3	2.5	2.4	2.9	2.8
3	1.4	0.6	1.2	0.7	1.4	0.8
4	3.2	2.6	2.8	2.6	3.6	3.1
5	1.0	0.9	1.1	1.0	1.3	1.2

Median (range)	2.3 (0.6 – 3.2)		2.3 (0.7 – 2.8)		2.8 (0.8 – 3.6)	
Bone Lesions						
1	0.2		0.1		0.2	
2	0.9		0.6		0.8	
3 (1)	1.5		0.4		0.5	
3 (2)	1		0.3		0.4	
4	0.7		0.5		0.7	
5	1.1		1.4		1.8	
Median (range)	1.0 (0.2 – 1.5)		0.5 (0.1 – 1.4)		0.6 (0.2 – 1.8)	
Gradient-Based Segmentation						
Kidneys						
	$D_{SPECT/CT}/D_{ref}$		$D_{Schuchardt}/D_{ref}$		$D_{Karimzadeh}/D_{ref}$	
	L	R	L	R	L	R
1	2.3	2.8	2.4	2.7	2.8	3.0
2	2.4	2.2	2.6	2.4	3.1	2.8
3	1.4	0.5	1.3	0.5	1.5	0.6
4	2.9	2.2	2.8	2.3	3.3	2.7
5	0.5	0.5	0.6	0.6	0.7	0.7
Median (Range)	2.2 (0.5 – 2.9)		2.4 (0.5 – 2.8)		2.8 (0.6 – 3.3)	
Bone Lesions						
1	0.8		0.6		0.7	
2	1.3		0.8		1.0	
3 (1)	2.6		0.7		0.9	
3 (2)	1.9		0.5		0.6	
4	0.7		0.5		0.7	
5	6.6		8.8		11.2	
Median (Range)	1.6 (0.7 – 6.6)		0.7 (0.5 – 8.8)		0.8 (0.6 – 11.2)	