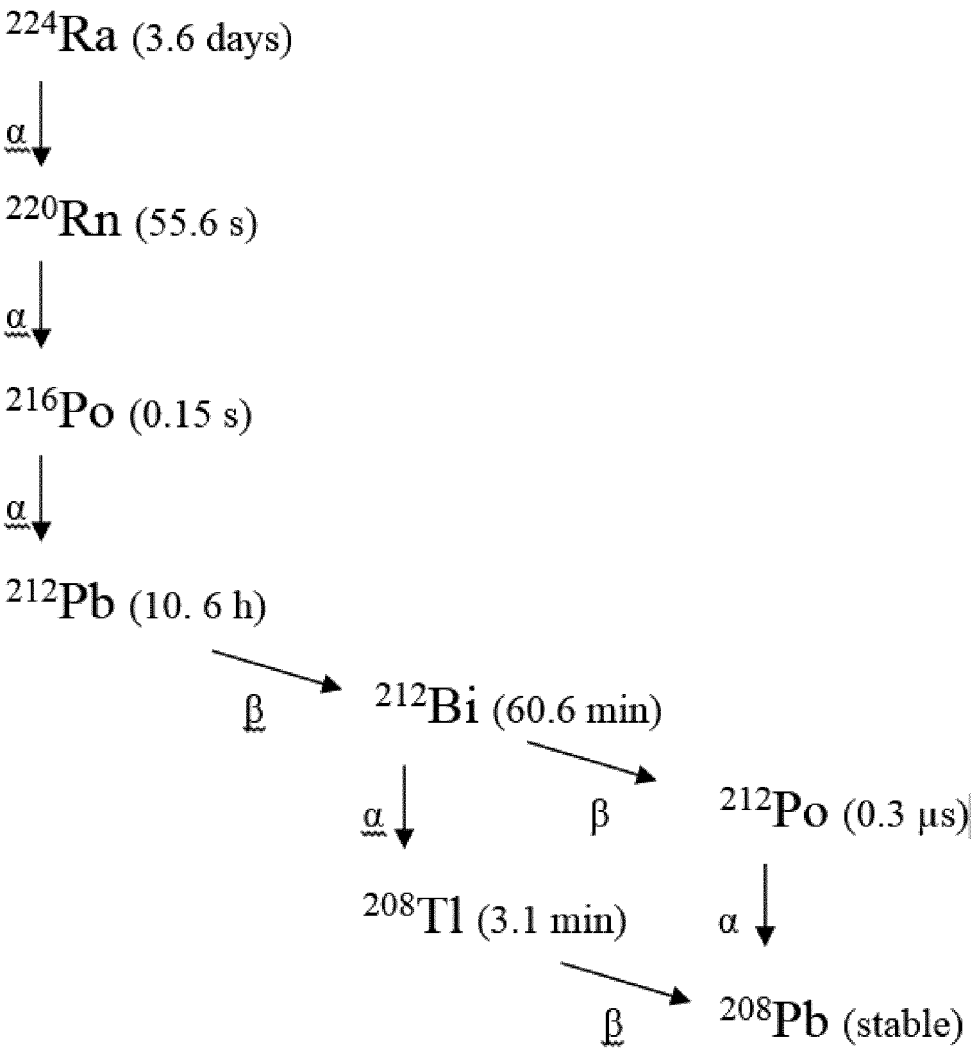

224Ra (3.6 days)
α
220Rn (55.6 s)
α
216Po (0.15 s)
α
212Pb (10. 6 h)
β
212Bi (60.6 min)
α
β
212Po (0.3 μs)
208Tl (3.1 min)
α
β
208Pb (stable)

Fig. 1

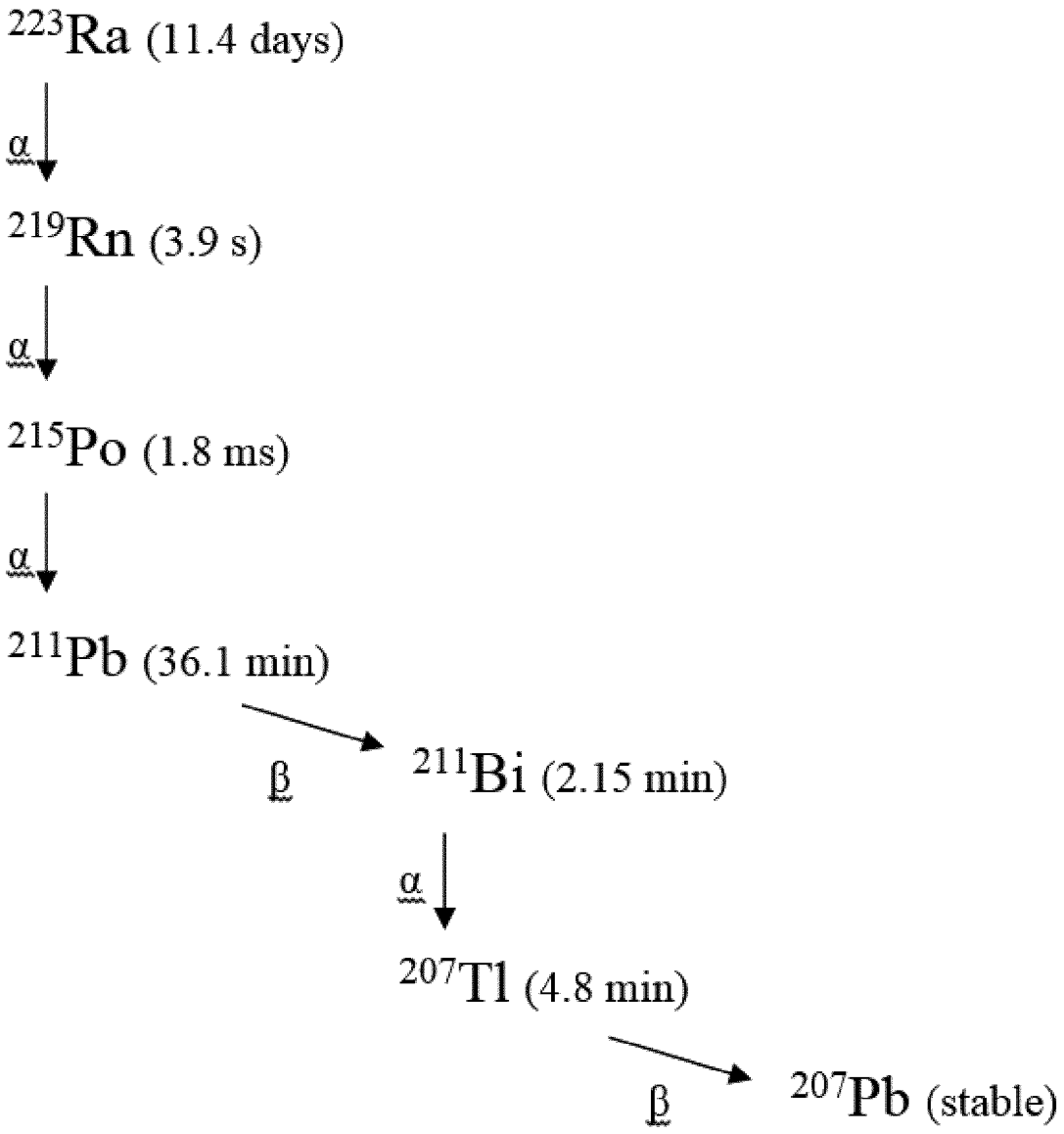
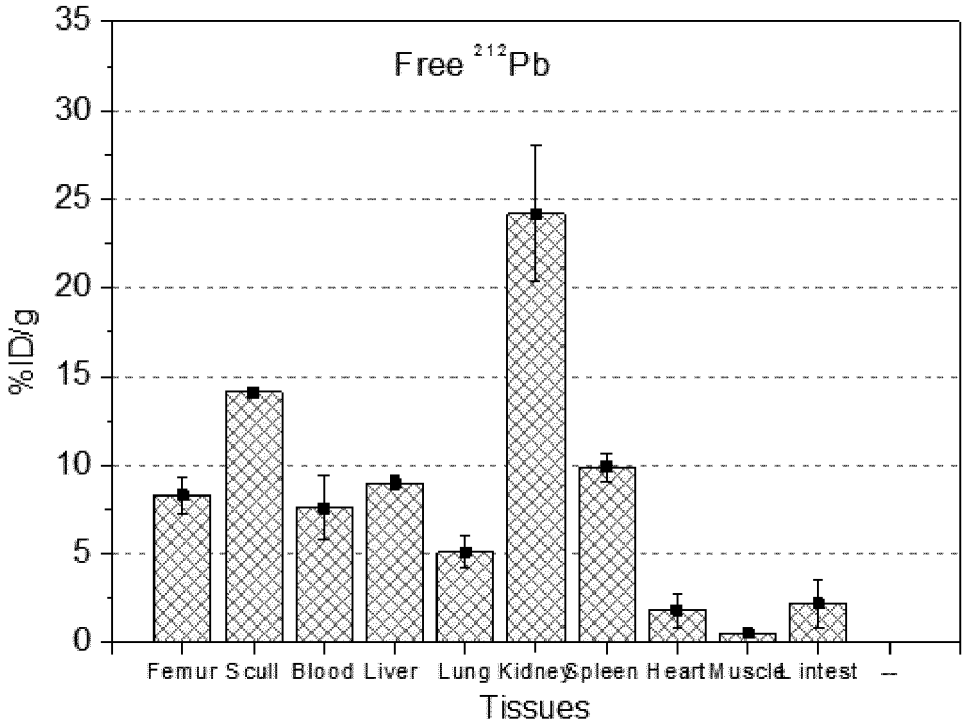

223Ra (11.4 days)
α
219Rn (3.9 s)
α
215Po (1.8 ms)
α
211Pb (36.1 min)
β
211Bi (2.15 min)
α
207Tl (4.8 min)
β
207Pb (stable)

Fig. 2


Free ^{212}Pb
%ID/g
0
5
10
15
20
25
30
35
Femur
Scull
Blood
Liver
Lung
Kidney
Spleen
Heart
Muscle
L intest
Tissues

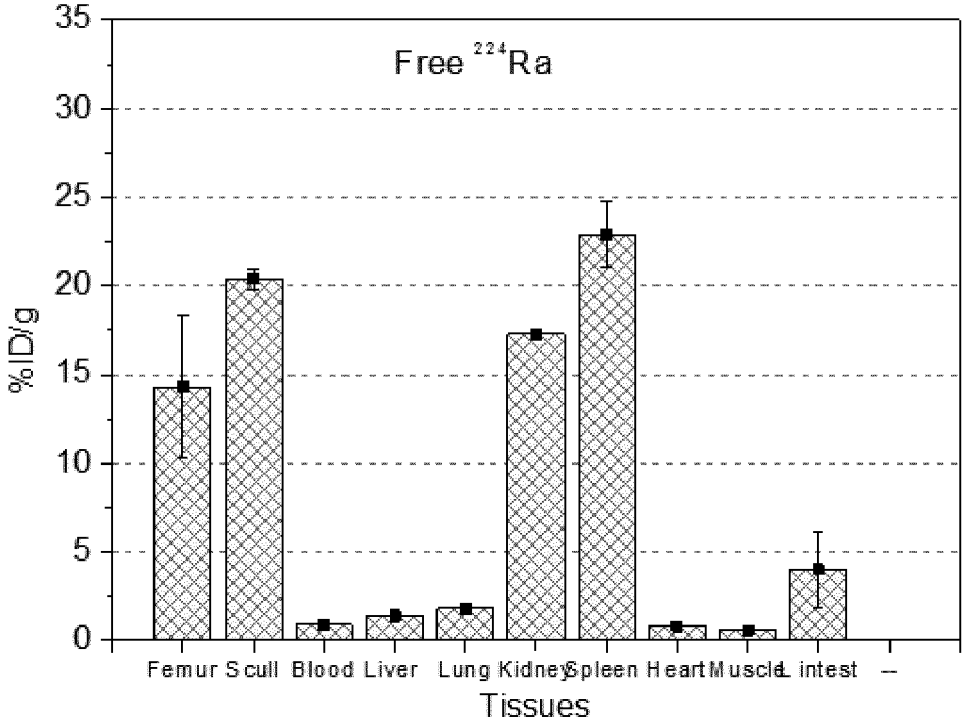
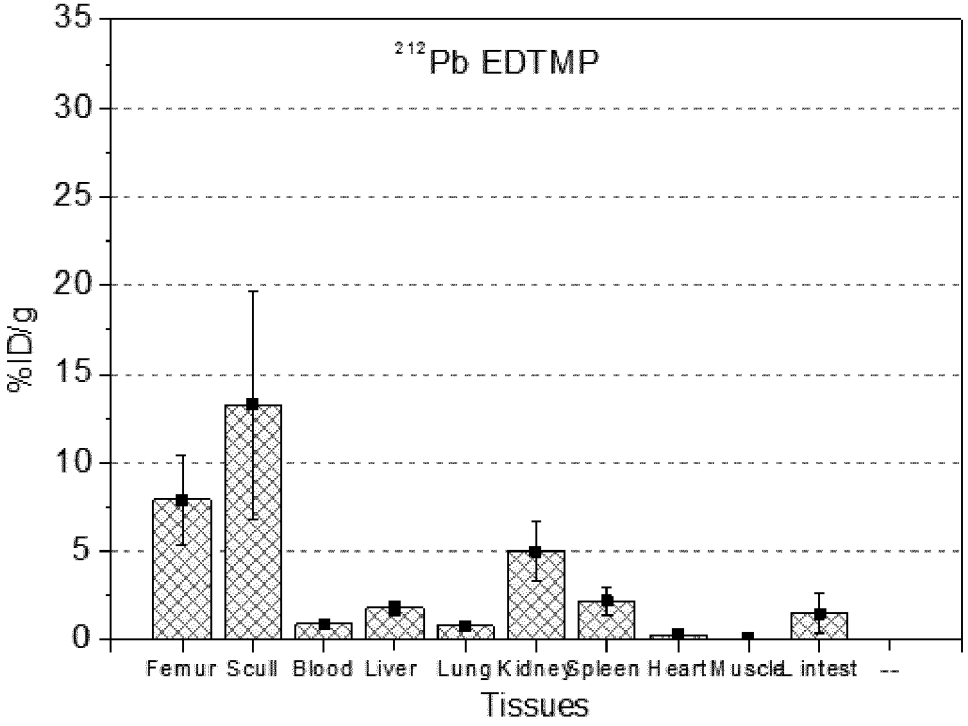

Free ^{224}Ra
%ID/g
0
5
10
15
20
25
30
35
Femur
Scull
Blood
Liver
Lung
Kidney
Spleen
Heart
Muscle
L intest
Tissues

Fig. 3A


^{212}Pb EDTMP
%ID/g
35
30
25
20
15
10
5
0
Femur Scull Blood Liver Lung Kidney Spleen Heart Muscle L intest --
Tissues

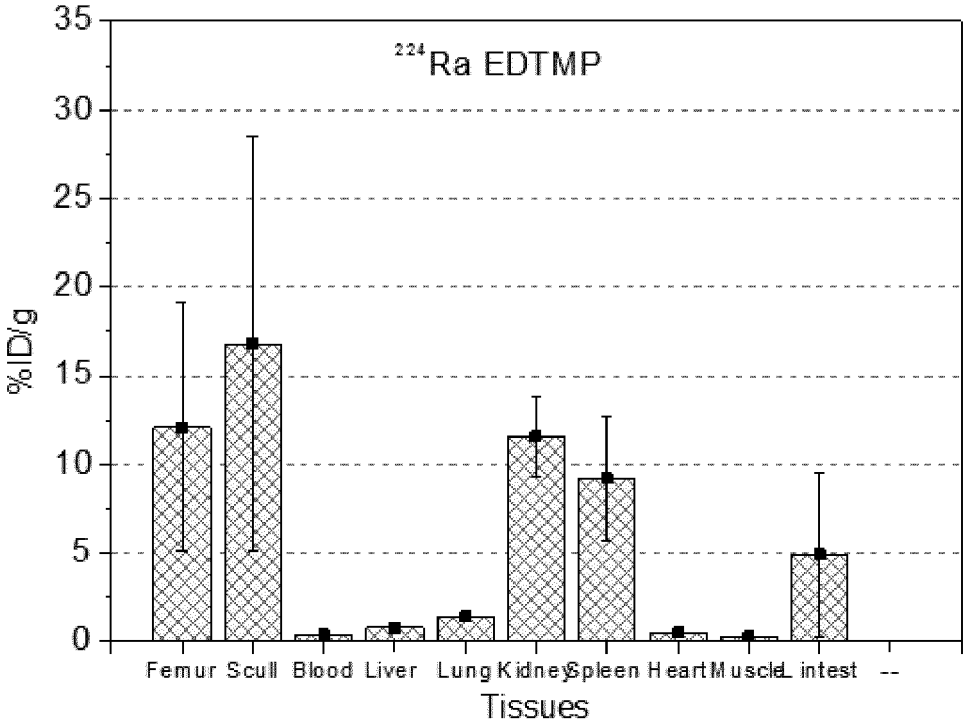
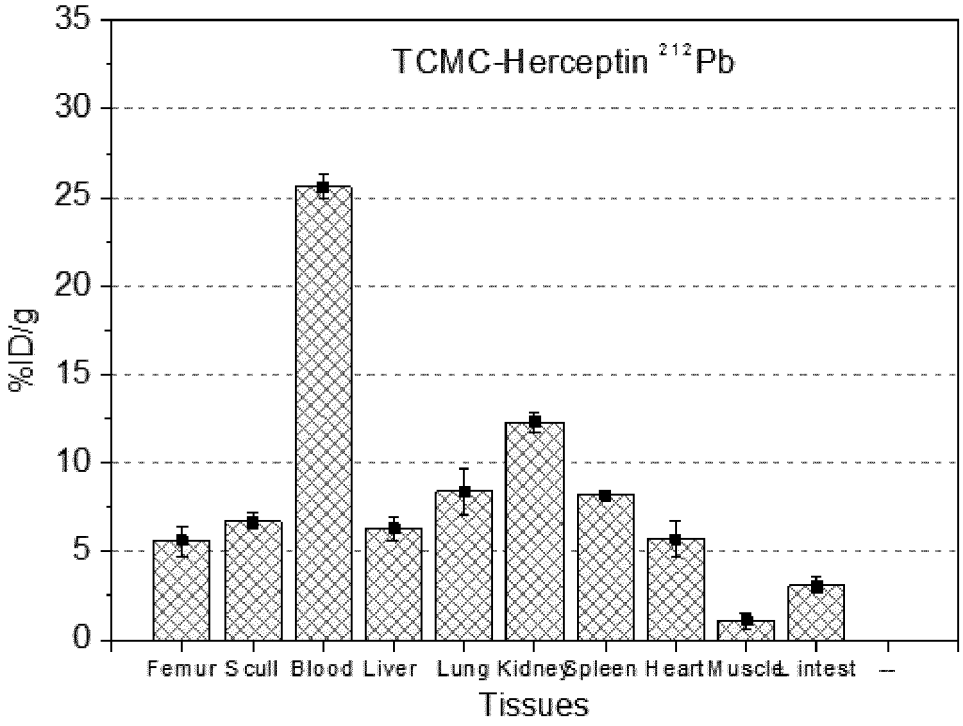

^{224}Ra EDTMP
%ID/g
35
30
25
20
15
10
5
0
Femur Scull Blood Liver Lung Kidney Spleen Heart Muscle L intest --
Tissues

Fig. 3B


TCMC-Herceptin 212Pb
%ID/g
35
30
25
20
15
10
5
0
Femur
Scull
Blood
Liver
Lung
Kidney
Spleen
Heart
Muscle
L. intest
Tissues

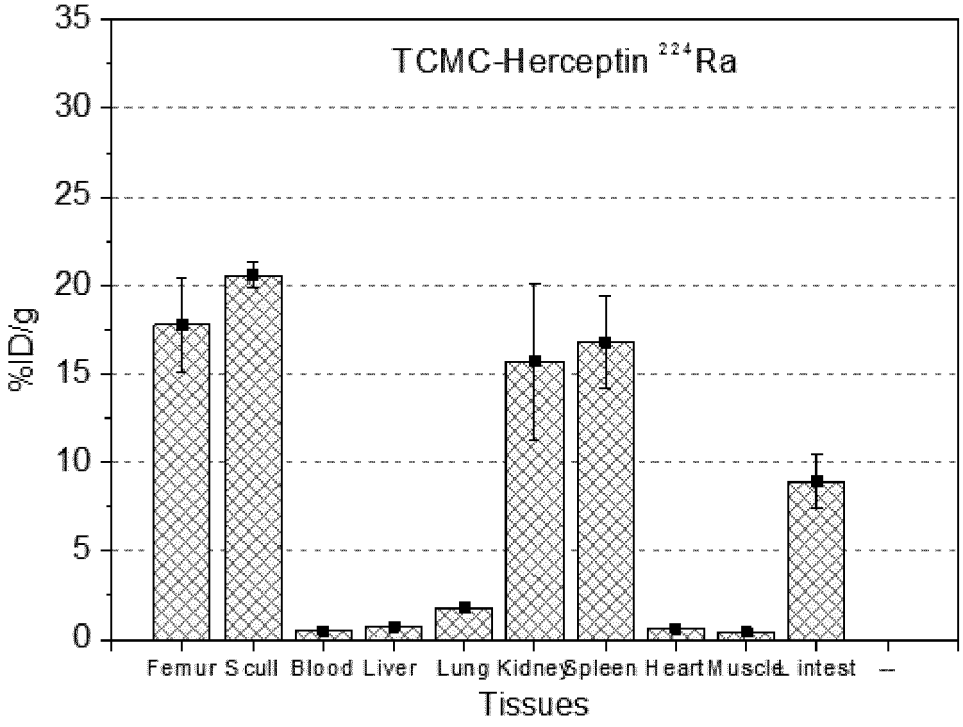

TCMC-Herceptin 224Ra
%ID/g
35
30
25
20
15
10
5
0
Femur
Scull
Blood
Liver
Lung
Kidney
Spleen
Heart
Muscle
L. intest
Tissues

Fig. 3C

Radionuclide (half life)	Alphas and betas (mean energy in MeV)	X-rays and gammas Energy and % abundance
^{224}Ra (3.6 days)	α 5.6	241 keV, 4.1%
^{220}Rn (55.6 s)	α 6.3	
^{216}Po (145 ms)	α 6.8	
^{212}Pb (10.6 h)	β 0.1	75 keV, 10.3% 77 keV, 17.1% 87 keV, 6.0% 90 keV, 1.5% 239 keV, 43.6% 300 keV, 3.3%
^{212}Bi (10.6 h)	α 6.1 × 0.36 (2.2 MeV effective[1]) β 0.7 × 0.64 (0.4 MeV effective)	727 keV, 6.7% (4.3% effective)
^{212}Po (299 ns) (64% branch)	α 8.8 (5.6 effective)	
^{208}Tl (3.1 min) (36% branch)	β 0.6 (0.2 MeV effective)	75 keV, 3.4% (1.2% effective) 511 keV, 22.6% (8.1% effective) 583 keV, 85.0% (30.6% effective) 860 keV, 12.5% (4.5% effective) 2615 keV, 99.8% (35.9% effective)

Fig. 4

Time point	0 h	2 h	6 h	12 h	24 h	36 h	2 days	3 days	1 week
^{224}Ra (MBq)	10	9.8	9.5	9.1	8.3	7.5	6.8	5.7	2.7
^{212}Pb (MBq)	0	1.2	3.1	5.1	7.0	7.5	7.3	6.3	3.0
Activity ratio ^{212}Pb vs. ^{224}Ra	0	0.12	0.33	0.56	0.84	1.0	1.1	1.1	1.1

Fig. 5

Applied sample	**^{224}Ra**	**^{224}Ra + FB**	**^{224}Ra + EDTMP**	**^{224}Ra + DOTMP**	**^{224}Ra + DOTMP + FB**
Upper half of TLC-strip		> 97% of ^{212}Pb	> 95% of ^{212}Pb		
Lower half of TLC-strip	> 97% of ^{212}Pb			>97% of ^{212}Pb	> 77% of ^{212}Pb

Fig. 6A

Applied sample	**^{224}Ra + TCMC-mAb + FB**	**^{224}Ra + TCMC-mAb + EDTMP**	**^{224}Ra + DOTA-mAb + FB**
Upper half of TLC-strip			
Lower half of TLC-strip	> 92% of ^{212}Pb	> 92% of ^{212}Pb	> 94% of ^{212}Pb

Fig. 6B

	Bone vs. blood	Bone vs. kidney
^{212}Pb non-complexed	1.1	0.36
^{212}Pb-EDTMP	9.5	1.57
^{212}Pb-TCMC-Herceptin	0.22	0.46

Fig. 7

Product	Dosing (kBq/kg)	Dosing (number of Ra atoms per kg)	Median survival increase vs. saline control
^{223}Ra (Xofigo)	250	3.6×10^{11}	43%*
^{224}Ra + ^{212}Pb-EDTMP	179	8.6×10^{10}	41%

Fig. 8