

SUPPLEMENTARY MATERIAL

^{99m}Tc-CXCR4-L for Imaging of the Chemokine-4 Receptor-Associated with Brain Tumor Invasiveness: Biokinetics, Radiation Dosimetry and Proof of Concept in Humans

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1. Whole-body images of healthy subjects (volunteers), tables of corrected counts and % IA

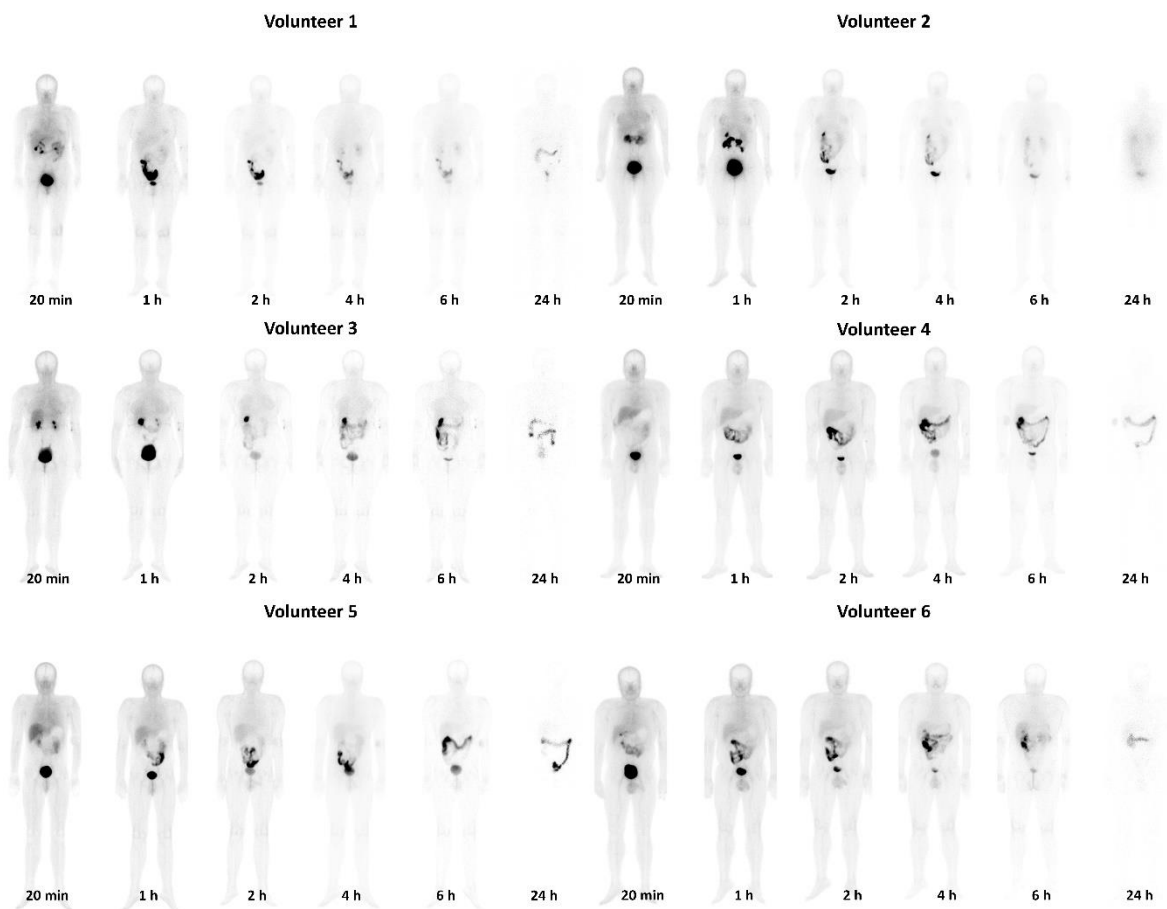


Fig. 1 Whole-body images of healthy subjects (volunteers) at 20 min, 1 h, 2h, 4 h, 6 h and 24 h after ^{99m}Tc -CXCR-4-L administration. The images depict the result of the geometric mean of anterior and posterior counts, according to the *conjugate views* method. Anterior and posterior images were previously corrected for attenuation and scattering.

Table 1. Corrected counts and %IA of source organs in healthy subject1

| Healthy subject 1 (FEMALE) | | | | | | |
|----------------------------|------------------|------------|-----------|-----------|-----------|----------|
| ORGAN | CORRECTED COUNTS | | | | | |
| | 20 min | 1 h | 2 h | 4 h | 6 h | 24 h |
| WHOLE BODY | 2028039.98 | 1256007.95 | 590316.16 | 397972.54 | 232264.10 | 11647.24 |
| LIVER | 110917.54 | 46421.76 | 26148.01 | 27857.61 | 18710.04 | 457.49 |
| URINARY BLADDER | 233362.80 | 225730.78 | 26472.35 | 44036.84 | 14210.67 | 1832.64 |
| INTESTINE | 123410.44 | 146607.99 | 81455.18 | 20193.33 | 13149.05 | 2135.02 |
| GALLBLADDER | 12765.06 | 5630.41 | 4643.95 | 4050.19 | 2610.93 | 55.05 |
| LUNGS | 132544.07 | 68949.60 | 37104.75 | 36200.78 | 19454.84 | 513.65 |
| KIDNEYS | 122766.85 | 47106.14 | 22066.54 | 18518.77 | 10509.47 | 676.99 |
| BREAST | 130711.85 | 57375.25 | 31139.42 | 30410.70 | 16711.74 | 413.65 |
| HEART | 31929.31 | 13742.89 | 7523.81 | 6309.39 | 3340.23 | 95.76 |
| REMAINDER | 1129212.66 | 644443.14 | 353762.15 | 210394.92 | 133567.14 | 5466.98 |

| Healthy subject 1 (FEMALE) | | | | | | |
|----------------------------|----------------|-------|-------|-------|-------|------|
| ORGAN | % UPTAKE (%IA) | | | | | |
| | 20 min | 1 h | 2 h | 4 h | 6 h | 24 h |
| WHOLE BODY | 100.00 | 61.93 | 29.11 | 19.62 | 11.45 | 0.57 |
| LIVER | 5.47 | 2.29 | 1.29 | 1.37 | 0.92 | 0.02 |
| URINARY BLADDER | 11.51 | 11.13 | 1.31 | 2.17 | 0.70 | 0.09 |
| INTESTINE | 6.10 | 7.23 | 4.02 | 1.00 | 0.65 | 0.11 |
| GALLBLADDER | 0.63 | 0.28 | 0.23 | 0.20 | 0.13 | 0.00 |
| LUNGS | 6.54 | 3.40 | 1.83 | 1.79 | 0.96 | 0.03 |
| KIDNEYS | 6.05 | 2.32 | 1.09 | 0.91 | 0.52 | 0.03 |
| BREAST | 6.45 | 2.83 | 1.54 | 1.50 | 0.82 | 0.02 |
| HEART | 1.57 | 0.68 | 0.37 | 0.31 | 0.16 | 0.00 |
| REMAINDER | 55.68 | 31.78 | 17.44 | 10.37 | 6.59 | 0.27 |

Table 2. Corrected counts and %IA of source organs in healthy subject2

| Healthy subject 2 (FEMALE) | | | | | | |
|-----------------------------------|-------------------------|------------|------------|------------|------------|-------------|
| ORGAN | CORRECTED COUNTS | | | | | |
| | 20 min | 1 h | 2 h | 4 h | 6 h | 24 h |
| WHOLE BODY | 2035039.48 | 1212237.13 | 680621.64 | 496172.59 | 289575.45 | 14521.20 |
| LIVER | 98550.66 | 46237.93 | 35696.83 | 33383.89 | 22421.66 | 548.25 |
| URINARY BLADDER | 291650.05 | 313095.92 | 64206.14 | 43423.24 | 14012.67 | 1807.10 |
| INTESTINE | 59219.65 | 59490.43 | 51949.61 | 30684.03 | 19980.15 | 3244.19 |
| GALLBLADDER | 10885.23 | 10664.96 | 8957.97 | 8058.99 | 7830.21 | 106.42 |
| LUNGS | 165652.21 | 77855.01 | 53699.81 | 45706.01 | 24563.09 | 648.52 |
| KIDNEYS | 112666.87 | 68633.73 | 38126.03 | 29963.47 | 17004.38 | 1095.37 |
| BREAST | 157010.60 | 66964.97 | 46430.17 | 37744.70 | 20742.03 | 513.41 |
| HEART | 29107.10 | 12406.83 | 8380.82 | 6789.52 | 3594.41 | 103.05 |
| REMAINDER | 1084269.04 | 556887.36 | 373174.25 | 260418.74 | 159426.86 | 6454.88 |

| Healthy subject 2 (FEMALE) | | | | | | |
|-----------------------------------|-----------------------|------------|------------|------------|------------|-------------|
| ORGAN | % UPTAKE (%IA) | | | | | |
| | 20 min | 1 h | 2 h | 4 h | 6 h | 24 h |
| WHOLE BODY | 100.00 | 59.57 | 33.45 | 24.38 | 14.23 | 0.71 |
| LIVER | 4.84 | 2.27 | 1.75 | 1.64 | 1.10 | 0.03 |
| URINARY BLADDER | 14.33 | 15.39 | 3.16 | 2.13 | 0.69 | 0.09 |
| INTESTINE | 2.91 | 2.92 | 2.55 | 1.51 | 0.98 | 0.16 |
| GALLBLADDER | 0.53 | 0.52 | 0.44 | 0.40 | 0.38 | 0.01 |
| LUNGS | 8.14 | 3.83 | 2.64 | 2.25 | 1.21 | 0.03 |
| KIDNEYS | 5.54 | 3.37 | 1.87 | 1.47 | 0.84 | 0.05 |
| BREAST | 7.72 | 3.29 | 2.28 | 1.85 | 1.02 | 0.03 |
| HEART | 1.43 | 0.61 | 0.41 | 0.33 | 0.18 | 0.01 |
| REMAINDER | 53.28 | 27.36 | 18.34 | 12.80 | 7.83 | 0.32 |

Table 3. Corrected counts and %IA of source organs in healthy subject3

| Healthy subject 3 (FEMALE) | | | | | | |
|----------------------------|------------------|------------|-----------|-----------|-----------|----------|
| ORGAN | CORRECTED COUNTS | | | | | |
| | 20 min | 1 h | 2 h | 4 h | 6 h | 24 h |
| WHOLE BODY | 1885489.95 | 1494775.75 | 806172.37 | 549420.93 | 320652.16 | 16079.59 |
| LIVER | 133280.07 | 91522.48 | 68269.86 | 35961.67 | 24152.97 | 590.58 |
| URINARY BLADDER | 245848.31 | 343610.57 | 41280.23 | 39522.84 | 12754.01 | 1644.79 |
| INTESTINE | 50908.23 | 50415.00 | 40730.07 | 38084.32 | 24798.90 | 4026.62 |
| GALLBLADDER | 12502.92 | 29381.99 | 19554.07 | 14935.96 | 10744.07 | 146.02 |
| LUNGS | 18986.88 | 120600.82 | 82810.76 | 51038.13 | 27428.65 | 724.18 |
| KIDNEYS | 96124.55 | 60078.52 | 32497.08 | 38305.95 | 21738.77 | 1400.35 |
| BREAST | 150676.59 | 96922.60 | 67584.63 | 41668.73 | 22898.42 | 566.79 |
| HEART | 28803.21 | 18571.73 | 11392.74 | 6715.25 | 3555.10 | 101.92 |
| REMAINDER | 977437.80 | 683672.04 | 442052.93 | 283188.07 | 172581.27 | 6878.35 |

| Healthy subject 3 (FEMALE) | | | | | | |
|----------------------------|----------------|-------|-------|-------|-------|------|
| ORGAN | % UPTAKE (%IA) | | | | | |
| | 20 min | 1 h | 2 h | 4 h | 6 h | 24 h |
| WHOLE BODY | 100.00 | 79.28 | 42.76 | 29.14 | 17.01 | 0.85 |
| LIVER | 7.07 | 4.85 | 3.62 | 1.91 | 1.28 | 0.03 |
| URINARY BLADDER | 13.04 | 18.22 | 2.19 | 2.10 | 0.68 | 0.09 |
| INTESTINE | 2.70 | 2.67 | 2.16 | 2.02 | 1.32 | 0.21 |
| GALLBLADDER | 0.66 | 1.56 | 1.04 | 0.79 | 0.57 | 0.01 |
| LUNGS | 1.07 | 6.40 | 4.39 | 2.71 | 1.45 | 0.04 |
| KIDNEYS | 5.10 | 3.19 | 1.72 | 2.03 | 1.15 | 0.07 |
| BREAST | 7.99 | 5.14 | 3.58 | 2.21 | 1.21 | 0.03 |
| HEART | 1.53 | 0.98 | 0.60 | 0.36 | 0.19 | 0.01 |
| REMAINDER | 51.84 | 36.26 | 23.45 | 15.02 | 9.15 | 0.36 |

Table 4. Corrected counts and %IA of source organs in healthy subject4

| Healthy subject 4 (MALE) | | | | | | |
|---------------------------------|-------------------------|------------|------------|------------|------------|-------------|
| ORGAN | CORRECTED COUNTS | | | | | |
| | 20 min | 1 h | 2 h | 4 h | 6 h | 24 h |
| WHOLE BODY | 3129097.28 | 2294855.64 | 1633927.01 | 1051893.01 | 675708.08 | 35254.54 |
| LIVER | 269909.53 | 161066.22 | 102766.71 | 61075.81 | 41334.81 | 1404.07 |
| URINARY BLADDER | 169673.7 | 94004.02 | 49904.94 | 30132.68 | 20055.20 | 572.76 |
| INTESTINE | 92308.37 | 130435.01 | 99333.21 | 72910.70 | 42310.01 | 3754.90 |
| GALLBLADDER | 18058.07 | 10775.94 | 6881.05 | 4825.02 | 3224.94 | 896.01 |
| LUNGS | 85024.93 | 179133.18 | 112032.10 | 60594.14 | 35401.86 | 896.01 |
| KIDNEYS | 122034.79 | 75552.96 | 105346.27 | 79708.79 | 77627.14 | 6794.20 |
| TESTES | 25675.92 | 23497.17 | 15906.16 | 9882.28 | 5640.17 | 143.02 |
| HEART | 39746.11 | 24001.27 | 15057.27 | 8353.78 | 4820.16 | 109.95 |
| REMAINDER | 2306665.86 | 1596389.87 | 1126699.30 | 724409.81 | 445293.78 | 20683.62 |

| Healthy subject 4 (MALE) | | | | | | |
|---------------------------------|-----------------------|------------|------------|------------|------------|-------------|
| ORGAN | % UPTAKE (%IA) | | | | | |
| | 20 min | 1 h | 2 h | 4 h | 6 h | 24 h |
| WHOLE BODY | 100.00 | 73.34 | 52.22 | 33.62 | 21.59 | 1.02 |
| LIVER | 8.63 | 5.15 | 3.28 | 1.95 | 1.32 | 0.04 |
| URINARY BLADDER | 5.42 | 3.00 | 1.59 | 0.96 | 0.64 | 0.02 |
| INTESTINE | 2.95 | 4.17 | 3.17 | 2.33 | 1.35 | 0.12 |
| GALLBLADDER | 0.58 | 0.34 | 0.22 | 0.15 | 0.10 | 0.03 |
| LUNGS | 2.72 | 5.72 | 3.58 | 1.94 | 1.13 | 0.03 |
| KIDNEYS | 3.90 | 2.41 | 3.37 | 2.55 | 2.48 | 0.22 |
| TESTES | 0.82 | 0.75 | 0.51 | 0.32 | 0.18 | 0.00 |
| HEART | 1.27 | 0.77 | 0.48 | 0.27 | 0.15 | 0.00 |
| REMAINDER | 67.32 | 51.02 | 36.01 | 23.15 | 14.23 | 0.66 |

Table 5. Corrected counts and %IA of source organs in healthy subject5

| Healthy subject 5 (MALE) | | | | | | |
|--------------------------|------------------|------------|------------|------------|-----------|----------|
| ORGAN | CORRECTED COUNTS | | | | | |
| | 20 min | 1 h | 2 h | 4 h | 6 h | 24 h |
| WHOLE BODY | 3443105.95 | 2602445.19 | 2167193.81 | 1611579.61 | 787276.70 | 44484.1 |
| LIVER | 292038.91 | 178806.78 | 122371.65 | 99842.76 | 47593.80 | 1783.32 |
| URINARY BLADDER | 285471.52 | 174562.91 | 198952.99 | 92316.26 | 62515.49 | 10633.76 |
| INTESTINE | 201421.70 | 186775.34 | 201794.93 | 132519.79 | 6979.97 | 3830.98 |
| GALLBLADDER | 19862.05 | 12177.95 | 8405.02 | 7458.96 | 30482.00 | 748.90 |
| LUNGS | 325029.20 | 249739.91 | 153823.10 | 141096.90 | 74336.74 | 2352.75 |
| KIDNEYS | 105359.04 | 78160.01 | 69059.09 | 42376.87 | 75234.57 | 4313.67 |
| TESTES | 29252.17 | 26727.79 | 18196.27 | 16798.78 | 3133.96 | 132.93 |
| HEART | 69522.75 | 42674.11 | 26237.95 | 23438.27 | 9019.71 | 257.92 |
| REMAINDER | 2115099.99 | 1652820.38 | 1368352.80 | 1055731.03 | 477980.46 | 20429.87 |

| Healthy subject 5 (MALE) | | | | | | |
|--------------------------|----------------|-------|-------|-------|-------|------|
| ORGAN | % UPTAKE (%IA) | | | | | |
| | 20 min | 1 h | 2 h | 4 h | 6 h | 24 h |
| WHOLE BODY | 100.00 | 75.58 | 62.94 | 46.81 | 22.87 | 1.18 |
| LIVER | 8.48 | 5.19 | 3.55 | 2.90 | 1.38 | 0.05 |
| URINARY BLADDER | 8.29 | 5.07 | 5.78 | 2.68 | 1.82 | 0.31 |
| INTESTINE | 5.85 | 5.42 | 5.86 | 3.85 | 0.20 | 0.11 |
| GALLBLADDER | 0.58 | 0.35 | 0.24 | 0.22 | 0.89 | 0.02 |
| LUNGS | 9.44 | 7.25 | 4.47 | 4.10 | 2.16 | 0.07 |
| KIDNEYS | 3.06 | 2.27 | 2.01 | 1.23 | 2.19 | 0.13 |
| TESTES | 0.85 | 0.78 | 0.53 | 0.49 | 0.09 | 0.00 |
| HEART | 2.02 | 1.24 | 0.76 | 0.68 | 0.26 | 0.01 |
| REMAINDER | 61.43 | 48.00 | 39.74 | 30.66 | 13.88 | 0.59 |

Table 6. Corrected counts and %IA of source organs in healthy subject6

| Healthy subject 6 (MALE) | | | | | | |
|---------------------------------|-------------------------|------------|------------|------------|------------|-------------|
| ORGAN | CORRECTED COUNTS | | | | | |
| | 20 min | 1 h | 2 h | 4 h | 6 h | 24 h |
| WHOLE BODY | 3129097.28 | 2255303.40 | 1799425.90 | 1024376.81 | 658032.41 | 20120.43 |
| LIVER | 165984.81 | 108960.89 | 87920.63 | 51429.52 | 34806.40 | 1082.38 |
| URINARY BLADDER | 390476.61 | 172096.65 | 76599.72 | 33078.65 | 22015.93 | 532.02 |
| INTESTINE | 188371.65 | 129122.76 | 116121.49 | 81420.01 | 47247.95 | 3841.75 |
| GALLBLADDER | 13035.98 | 6707.03 | 4882.71 | 5278.76 | 3528.21 | 89.20 |
| LUNGS | 249389.05 | 205490.86 | 158041.19 | 81527.16 | 47631.89 | 1461.20 |
| KIDNEYS | 93520.22 | 74135.04 | 71578.86 | 90908.40 | 88534.28 | 2170.84 |
| TESTES | 27385.59 | 22302.45 | 18319.15 | 10703.02 | 6108.60 | 147.67 |
| HEART | 49111.30 | 33370.17 | 24966.73 | 12957.81 | 7476.70 | 227.97 |
| REMAINDER | 1951930.88 | 1503117.55 | 1240995.43 | 657073.48 | 400682.45 | 10567.40 |

| Healthy subject 6 (MALE) | | | | | | |
|---------------------------------|-----------------------|------------|------------|------------|------------|-------------|
| ORGAN | % UPTAKE (%IA) | | | | | |
| | 20 min | 1 h | 2 h | 4 h | 6 h | 24 h |
| WHOLE BODY | 100.00 | 72.08 | 57.51 | 32.74 | 21.03 | 0.58 |
| LIVER | 5.30 | 3.48 | 2.81 | 1.64 | 1.11 | 0.03 |
| URINARY BLADDER | 12.48 | 5.50 | 2.45 | 1.06 | 0.70 | 0.02 |
| INTESTINE | 6.02 | 4.13 | 3.71 | 2.60 | 1.51 | 0.12 |
| GALLBLADDER | 0.42 | 0.21 | 0.16 | 0.17 | 0.11 | 0.00 |
| LUNGS | 7.97 | 6.57 | 5.05 | 2.61 | 1.52 | 0.05 |
| KIDNEYS | 2.99 | 2.37 | 2.29 | 2.91 | 2.83 | 0.07 |
| TESTES | 0.88 | 0.71 | 0.59 | 0.34 | 0.20 | 0.00 |
| HEART | 1.57 | 1.07 | 0.80 | 0.41 | 0.24 | 0.01 |
| REMAINDER | 62.38 | 48.04 | 39.66 | 21.00 | 12.81 | 0.34 |

3. Example of the dose assessment: Healthy subject 3 (female)

Table 7. Summary of %IA results, healthy subject 3

| | 20 min | 1 h | 2 h | 4 h | 6 h | 24 h |
|------------------------|--------|-------|-------|-------|-------|------|
| WHOLE BODY | 100.00 | 79.28 | 42.76 | 29.14 | 17.01 | 0.85 |
| LIVER | 7.07 | 4.85 | 3.62 | 1.91 | 1.28 | 0.03 |
| URINARY BLADDER | 13.04 | 18.22 | 2.19 | 2.10 | 0.68 | 0.09 |
| INTESTINE | 2.70 | 2.67 | 2.16 | 2.02 | 1.32 | 0.21 |
| GALLBLADDER | 0.66 | 1.56 | 1.04 | 0.79 | 0.57 | 0.01 |
| LUNGS | 10.07 | 6.40 | 4.39 | 2.71 | 1.45 | 0.04 |
| KIDNEYS | 5.10 | 3.19 | 1.72 | 2.03 | 1.15 | 0.07 |
| BREAST | 7.99 | 5.14 | 3.58 | 2.21 | 1.21 | 0.03 |
| HEART | 1.53 | 0.98 | 0.60 | 0.36 | 0.19 | 0.01 |
| REMAINDER | 51.84 | 36.26 | 23.45 | 15.02 | 9.15 | 0.36 |

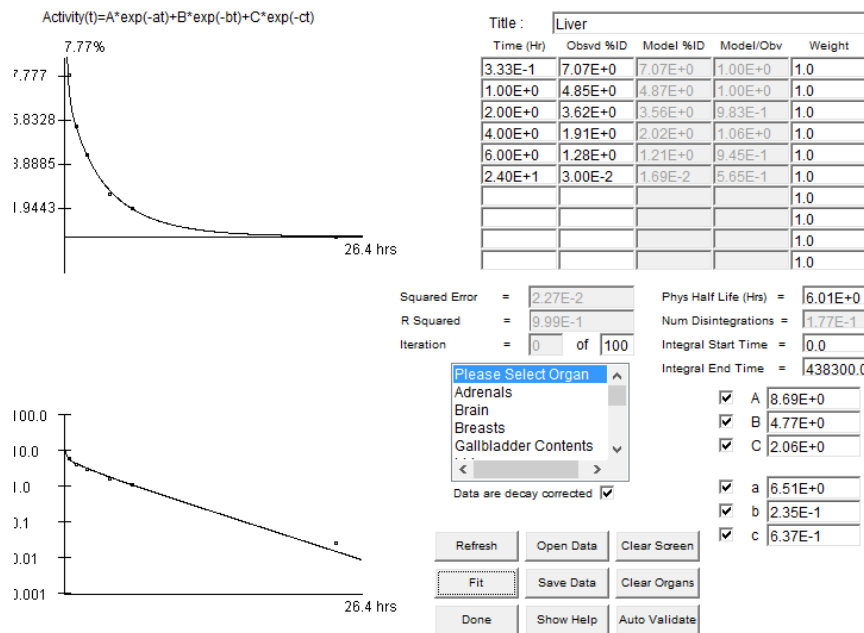


Fig. 2 Biokinetic model (e.g. liver) of healthy subject 3

From Fig. 1

$$q(t)_{ROI} = 8.69e^{-6.51(t)} + 4.77e^{-0.235(t)} + 2.06e^{-0.637(t)}$$

$$A(t)_{ROI} = 8.69e^{-(6.51+\lambda_{99mTc})(t)} + 4.77e^{-0.235+\lambda_{99mTc})(t)} + 2.06e^{-0.637+\lambda_{99mTc})(t)}$$

$$N = \int_{t=0}^{t=\infty} A(t)_{ROI} dt$$

$$N = \frac{8.69}{(6.51 + 0.1155)} + \frac{4.77}{(0.235 + 0.1155)} + \frac{2.06}{(0.637 + 0.1155)} = 17.7$$

As %Ia was used, the result is corrected to a fraction of the unit of activity administered to the patient by dividing N by 100

$$N = 0.177 \text{ MBq}\cdot\text{h/MBq}$$

Table 8. Summary of N values, healthy subject 3

| ORGAN | $N = \int_{t=0}^{t=\infty} A(t)_{ROI} dt$ (MBq·h/MBq) |
|------------------|--|
| LIVER | 1.77E-1 |
| *URINARY BLADDER | 1.99E-1 |
| *LLI CONTENT | 0.47E-1 |
| *SI CONTENT | 0.74E-1 |
| *ULI CONTENT | 0.96E-1 |
| GALLBLADDER | 2.83E-2 |
| LUNGS | 2.27E-1 |
| KIDNEYS | 1.59E-1 |
| BREAST | 1.82E-1 |
| HEART | 3.22E-2 |
| REMAINDER | 1.26E+0 |

*Note: The GI tract model (ICRP 30) included in the code was employed for the excretion model, considering an activity fraction of 0.027 (healthy subject 3) entering the small intestine, as images showed that 2.7% of the ^{99m}Tc-CXCR4-L injected activity is excreted to the intestine at 20 min after administration. *Considering voiding bladder model.

Table 9. Equivalent doses ($H_T = N \times DF, mSv/MBq$) and effective dose ($H_E = \sum w_T H_T, mSv/MBq$) values, healthy subject 3

| Target Organ | Alpha | Beta | Photon | Total | EDE Cont. | ED Cont. |
|------------------|----------|----------|----------|----------|-----------|----------|
| Adrenals | 0.00E+00 | 1.46E-04 | 1.66E-03 | 1.81E-03 | 0.00E+00 | 9.05E-06 |
| Brain | 0.00E+00 | 1.46E-04 | 4.52E-04 | 5.97E-04 | 0.00E+00 | 2.99E-06 |
| Breasts | 0.00E+00 | 3.32E-03 | 2.90E-03 | 6.22E-03 | 9.33E-04 | 3.11E-04 |
| Gallbladder wall | 0.00E+00 | 2.60E-03 | 2.94E-03 | 5.54E-03 | 3.32E-04 | 0.00E+00 |
| LLI wall | 0.00E+00 | 1.46E-04 | 1.28E-03 | 1.42E-03 | 0.00E+00 | 1.71E-04 |
| Small intestine | 0.00E+00 | 1.46E-04 | 1.63E-03 | 1.78E-03 | 0.00E+00 | 8.88E-06 |
| Stomach wall | 0.00E+00 | 1.46E-04 | 1.20E-03 | 1.35E-03 | 0.00E+00 | 1.62E-04 |
| ULI wall | 0.00E+00 | 2.75E-03 | 2.57E-03 | 5.31E-03 | 3.19E-04 | 2.66E-05 |
| Heart wall | 0.00E+00 | 4.86E-04 | 1.61E-03 | 2.10E-03 | 0.00E+00 | 0.00E+00 |

| | | | | | | |
|--------------------------|----------|----------|----------|----------|----------|----------|
| Kidneys | 0.00E+00 | 3.80E-03 | 3.52E-03 | 7.32E-03 | 4.39E-04 | 3.66E-05 |
| Liver | 0.00E+00 | 8.31E-04 | 2.18E-03 | 3.01E-03 | 1.81E-04 | 1.50E-04 |
| Lungs | 0.00E+00 | 1.87E-03 | 1.90E-03 | 3.77E-03 | 4.52E-04 | 4.52E-04 |
| Muscle | 0.00E+00 | 1.46E-04 | 8.36E-04 | 9.81E-04 | 0.00E+00 | 4.91E-06 |
| Ovaries | 0.00E+00 | 1.46E-04 | 1.55E-03 | 1.69E-03 | 4.23E-04 | 3.38E-04 |
| Pancreas | 0.00E+00 | 1.46E-04 | 1.59E-03 | 1.73E-03 | 0.00E+00 | 8.67E-06 |
| Red marrow | 0.00E+00 | 8.44E-05 | 9.03E-04 | 9.88E-04 | 1.19E-04 | 1.19E-04 |
| Osteogenic cells | 0.00E+00 | 5.86E-04 | 1.55E-03 | 2.14E-03 | 6.42E-05 | 2.14E-05 |
| Skin | 0.00E+00 | 1.46E-04 | 4.35E-04 | 5.81E-04 | 0.00E+00 | 5.81E-06 |
| Spleen | 0.00E+00 | 1.46E-04 | 1.28E-03 | 1.42E-03 | 0.00E+00 | 7.11E-06 |
| Thymus | 0.00E+00 | 1.46E-04 | 1.06E-03 | 1.20E-03 | 0.00E+00 | 6.02E-06 |
| Thyroid | 0.00E+00 | 1.46E-04 | 5.72E-04 | 7.17E-04 | 2.15E-05 | 3.59E-05 |
| Urinary bladder wall | 0.00E+00 | 5.53E-03 | 5.81E-03 | 1.13E-02 | 6.80E-04 | 5.67E-04 |
| Uterus | 0.00E+00 | 1.46E-04 | 1.83E-03 | 1.98E-03 | 0.00E+00 | 9.88E-06 |
| Whole body | 0.00E+00 | 2.46E-04 | 9.52E-04 | 1.20E-03 | 0.00E+00 | 0.00E+00 |
| Effective dose (mSv/MBq) | | | | | | 2.45E-03 |

3. Example of the dose assessment: Healthy subject 4 (male)

Table 10. Summary of %IA results, healthy subject 4

| | 20 min | 1 h | 2 h | 4 h | 6 h | 24 h |
|-------------------|---|-------|-------|-------|-------|------|
| WHOLE BODY | 100.00 | 73.34 | 52.22 | 33.62 | 21.59 | 1.02 |
| LIVER | 8.63 | 5.15 | 3.28 | 1.95 | 1.32 | 0.04 |
| URINARY BLADDER | 5.42 | 3.00 | 1.59 | 0.96 | 0.64 | 0.02 |
| INTESTINE | 3.89 | 4.17 | 3.17 | 2.33 | 1.35 | 0.12 |
| GALLBLADDER | 0.58 | 0.34 | 0.22 | 0.15 | 0.10 | 0.03 |
| LUNGS | 9.11 | 5.72 | 3.58 | 1.94 | 1.13 | 0.03 |
| KIDNEYS | 2.97 | 2.41 | 3.37 | 2.55 | 2.48 | 0.22 |
| TESTES | 0.82 | 0.75 | 0.51 | 0.32 | 0.18 | 0.00 |
| HEART | 1.27 | 0.77 | 0.48 | 0.27 | 0.15 | 0.00 |
| REMAINDER | 67.32 | 51.02 | 36.01 | 23.15 | 14.23 | 0.66 |
| healthy subject 4 | | | | | | |
| ORGAN | $N = \int_{t=0}^{t=\infty} A(t)_{ROI} dt$ | | | | | |
| | (MBq·h/MBq) | | | | | |
| LIVER | 1.84E-1 | | | | | |
| *URINARY BLADDER | 1.02E-1 | | | | | |
| *LLI CONTENT. | 0.68-1 | | | | | |
| *SI CONTENT | 1.07E-1 | | | | | |

| | |
|---------------------|---------|
| *ULI CONTENT | 1.39-1 |
| GALLBLADDER | 1.36E-2 |
| LUNGS | 1.87E-1 |
| KIDNEYS | 1.66E-1 |
| TESTES | 2.40E-2 |
| HEART | 2.56E-2 |
| REMAINDER | 1.81E+0 |

*Note: The GI tract model (ICRP 30) included in the code was employed for the excretion model, considering an activity fraction of 0.039 (healthy subject 4) entering the small intestine, as images showed that 3.89% of the ^{99m}Tc-CXCR4-L injected activity is excreted to the intestine at 20 min after administration. *Considering voiding bladder model.

Table 11. Equivalent doses ($H_T = NxDF, mSv/MBq$) and effective dose ($H_E = \sum w_T H_T, mSv/MBq$) values, healthy subject 4

| Target Organ | Alpha | Beta | Photon | Total | EDE Cont. | ED Cont. |
|--------------------------|----------|----------|----------|----------|-----------|----------|
| Adrenals | 0.00E+00 | 2.13E-04 | 1.77E-03 | 1.98E-03 | 0.00E+00 | 4.96E-06 |
| Brain | 0.00E+00 | 2.13E-04 | 6.18E-04 | 8.31E-04 | 0.00E+00 | 2.08E-06 |
| Gallbladder wall | 0.00E+00 | 1.27E-03 | 2.64E-03 | 3.91E-03 | 2.35E-04 | 0.00E+00 |
| LLI wall | 0.00E+00 | 2.13E-04 | 1.34E-03 | 1.55E-03 | 0.00E+00 | 1.87E-04 |
| Small intestine | 0.00E+00 | 2.13E-04 | 1.95E-03 | 2.16E-03 | 0.00E+00 | 5.41E-06 |
| Stomach wall | 0.00E+00 | 2.13E-04 | 1.33E-03 | 1.55E-03 | 0.00E+00 | 1.86E-04 |
| ULI wall | 0.00E+00 | 3.09E-03 | 2.97E-03 | 6.06E-03 | 3.63E-04 | 1.51E-05 |
| Heart wall | 0.00E+00 | 4.57E-04 | 1.46E-03 | 1.92E-03 | 0.00E+00 | 0.00E+00 |
| Kidneys | 0.00E+00 | 4.81E-03 | 4.10E-03 | 8.91E-03 | 5.35E-04 | 2.23E-04 |
| Liver | 0.00E+00 | 8.35E-04 | 2.20E-03 | 3.03E-03 | 1.82E-04 | 1.52E-04 |
| Lungs | 0.00E+00 | 1.62E-03 | 1.59E-03 | 3.21E-03 | 3.86E-04 | 3.86E-04 |
| Muscle | 0.00E+00 | 2.13E-04 | 9.44E-04 | 1.16E-03 | 0.00E+00 | 2.89E-06 |
| Pancreas | 0.00E+00 | 2.13E-04 | 1.71E-03 | 1.93E-03 | 0.00E+00 | 4.82E-06 |
| Red marrow | 0.00E+00 | 1.70E-04 | 1.06E-03 | 1.23E-03 | 1.48E-04 | 1.48E-04 |
| Osteogenic cells | 0.00E+00 | 1.10E-03 | 1.90E-03 | 3.00E-03 | 8.99E-05 | 3.00E-05 |
| Skin | 0.00E+00 | 2.13E-04 | 5.09E-04 | 7.22E-04 | 0.00E+00 | 7.22E-06 |
| Spleen | 0.00E+00 | 2.13E-04 | 1.42E-03 | 1.63E-03 | 0.00E+00 | 4.08E-06 |
| Testes | 0.00E+00 | 5.32E-03 | 2.88E-03 | 8.19E-03 | 2.05E-03 | 1.64E-03 |
| Thymus | 0.00E+00 | 2.13E-04 | 1.01E-03 | 1.23E-03 | 0.00E+00 | 3.07E-06 |
| Thyroid | 0.00E+00 | 2.13E-04 | 8.39E-04 | 1.05E-03 | 3.16E-05 | 5.26E-05 |
| Urinary badder Wall | 0.00E+00 | 2.31E-03 | 2.91E-03 | 5.22E-03 | 3.13E-04 | 2.61E-04 |
| Whole body | 0.00E+00 | 2.90E-04 | 1.05E-03 | 1.34E-03 | 0.00E+00 | 0.00E+00 |
| Effective dose (mSv/MBq) | | | | | | 3.36E-03 |

4. Images of ^{99m}Tc -CXCR4-L uptake in patients with evidence of brain tumor injury

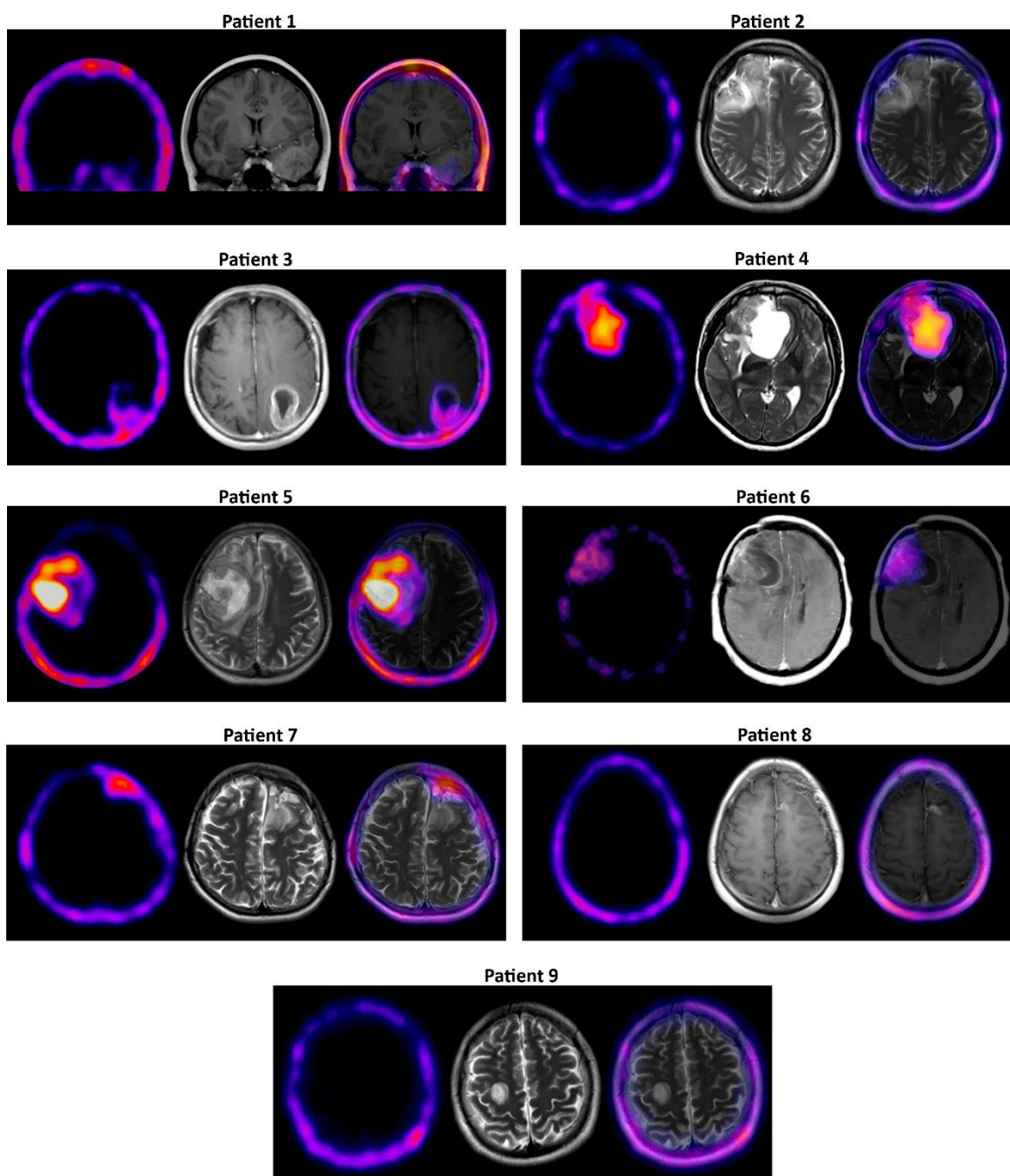


Fig. 3 Images show ^{99m}Tc -CXCR4-L SPECT (left), MRI (middle) and fused SPECT/MRI (right) of each patient that participated in the study.