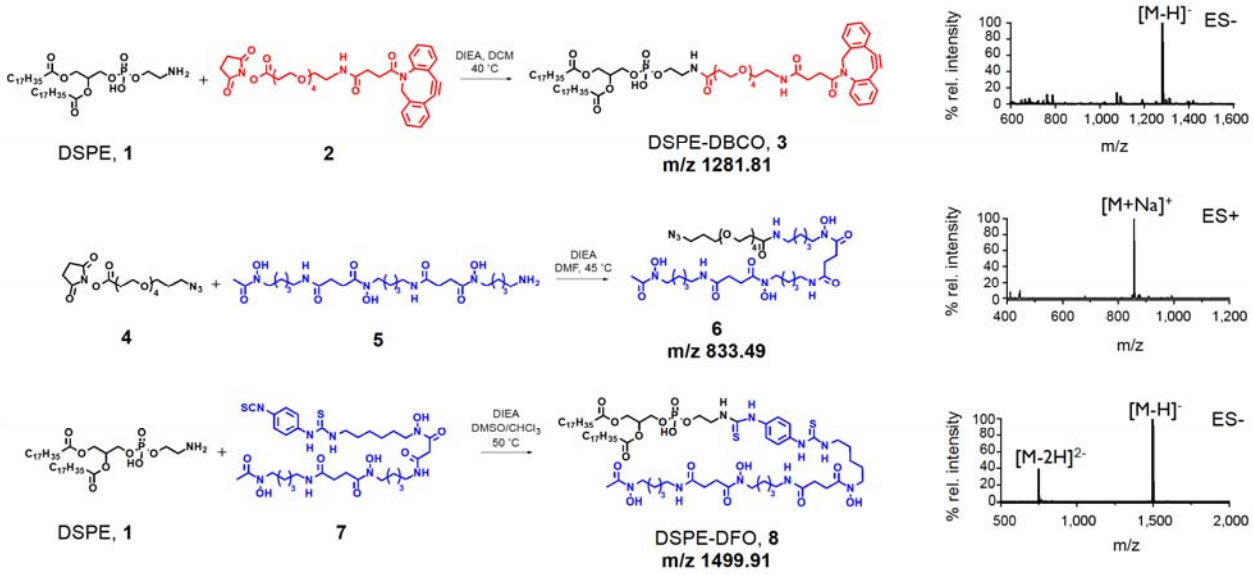
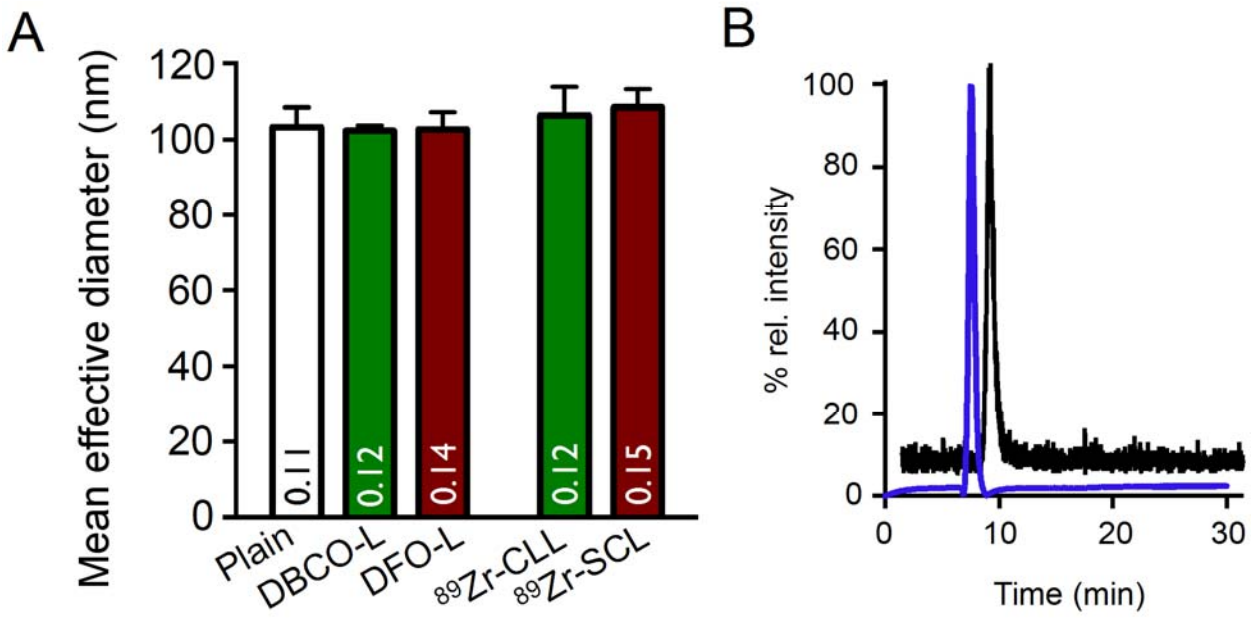
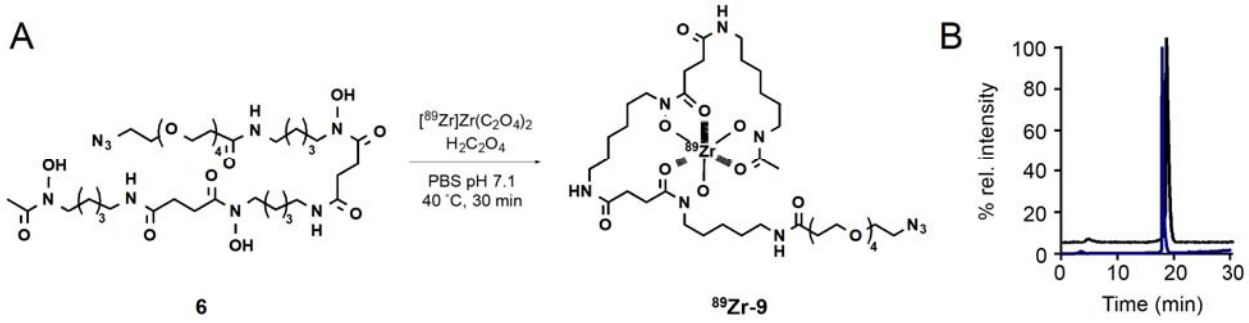


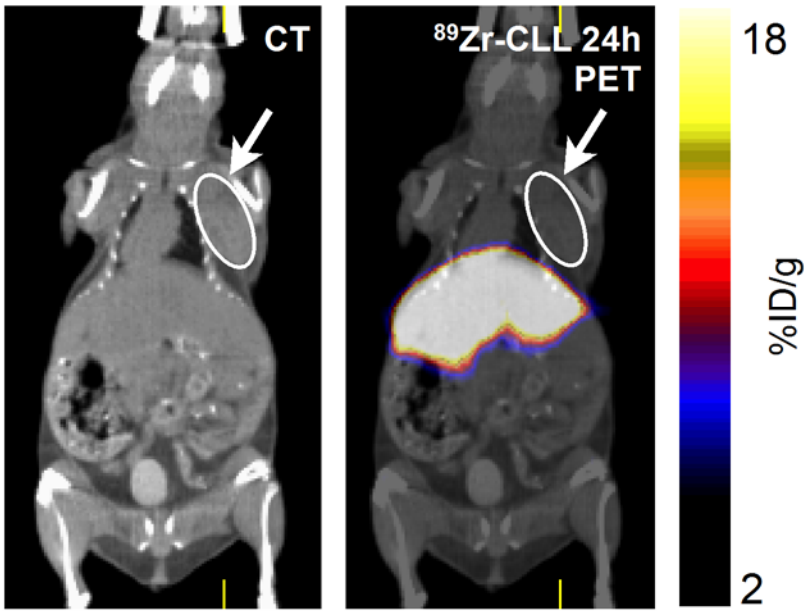
Supplemental Figure 1. Synthesis of building blocks **3, 6,** and **8,** and corresponding mass spectra.



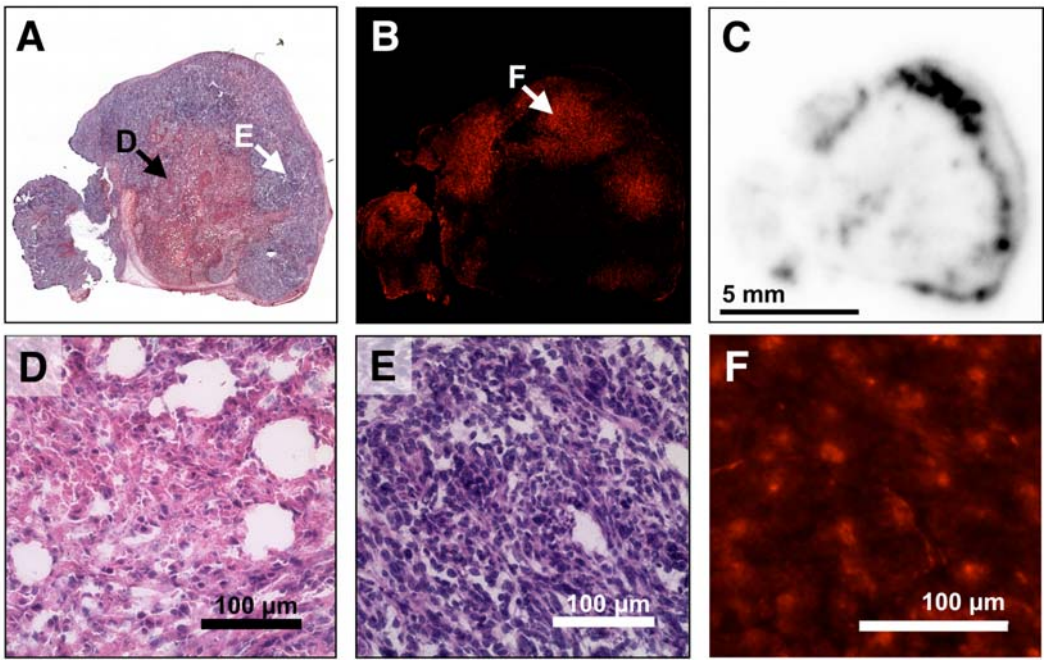
Supplemental Figure 2. (A) Sizes (expressed as mean effective diameter) and polydispersity values of different liposomes described in the present work. (B) Size-exclusion chromatogram showing absorption at 650 nm (front) and radioactive trace (back) of sample of DiIC@^{89}Zr-SCL.



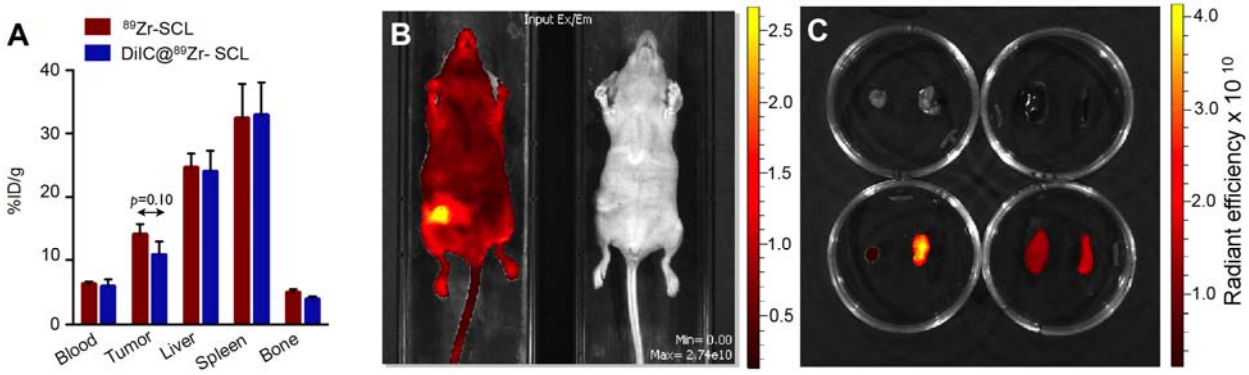
Supplemental Figure 3. (A) Radiosynthesis of ^{89}Zr-**9.** (B) HPLC chromatogram showing ultraviolet (absorption at 220 nm, front) and radioactive (back) traces of mixture of ^{89}Zr-**9** and reference compound **9,** demonstrating coelution.



Supplemental Figure 4. PET/CT imaging of ^{89}Zr-CLL showing CT only (left) and PET/CT fusion (right) at 24 h after injection. Arrow indicates location of tumor.



Supplemental Figure 5. Ex vivo analysis of tumor section at 24 h after administration of ^{89}Zr-SCL. (A) Hematoxylin and eosin staining (expanded regions shown in D and E). (B) IBA1 immunohistology section (expanded region shown in F). (C) Autoradiography.



Supplemental Figure 6. (A) PET-quantified radioactivity distribution in selected tissues 24 h after administration of ^{89}Zr-SCL (left) and DiIC@^{89}Zr-SCL (right), expressed as %ID/g ± SD ($n \geq 3$). (B) Whole-body near-infrared fluorescence imaging (λ_{Ex} = 650 nm/λ_{Em} = 670 nm) at 24 h after administration of DiIC@^{89}Zr-SCL (left) and ^{89}Zr-SCL (right), which was used as control. (C) Near-infrared fluorescence imaging (λ_{Ex} = 650 nm/λ_{Em} = 670 nm) of excised specimens of muscle, tumor, liver, and spleen (from left to right) collected at 24 h after administration of ^{89}Zr-SCL (top 2 dishes) and DiIC@^{89}Zr-SCL (bottom 2 dishes).

SUPPLEMENTAL TABLE 1. Tissue Radioactivity Distribution of ^{89}Zr-SCL in Female NCr Nude Mice Bearing 4T1 Breast Xenografts ($n \geq 3$ for Each Time Point)

Tissue	2 h		24 h		48 h	
	%ID/g	SD	%ID/g	SD	%ID/g	SD
Blood	36.9	1.65	6.81	0.29	1.89	0.76
Tumor	3.29	1.11	13.7	1.84	7.88	1.16
Heart	0.97	0.19	1.14	0.14	1.26	0.07
Lungs	1.12	0.35	1.05	0.22	1.03	0.15
Stomach	1.30	0.51	1.57	0.39	0.76	0.07
Small intestine	2.62	1.07	2.72	0.49	1.41	0.10
Large intestine	1.95	0.97	1.56	0.23	0.93	0.05
Spleen	33.5	4.72	58.9	12.2	36.0	7.03
Kidneys	2.64	0.50	3.36	0.43	3.19	0.21
Liver	17.1	6.22	24.7	4.59	22.2	6.15
Muscle	0.85	0.01	1.13	0.09	1.77	0.78
Bone	1.50	0.32	3.78	0.08	5.09	1.32

SUPPLEMENTAL TABLE 2. Tissue Radioactivity Distribution of ^{89}Zr-CLL in Female NCr Nude Mice Bearing 4T1 Breast Xenografts ($n \geq 3$ for Each Time Point)

Tissue	2 h		24 h		48 h	
	%ID/g	SD	%ID/g	SD	%ID/g	SD
Blood	5.53	0.35	1.04	0.20	0.68	0.24
Tumor	1.23	0.26	2.00	0.15	1.73	0.19
Heart	0.80	0.06	0.82	0.23	0.67	0.26
Lungs	1.19	0.06	0.72	0.16	0.71	0.28
Stomach	0.59	0.15	0.42	0.05	0.40	0.10
Small intestine	0.51	0.09	0.27	0.04	0.28	0.05
Large intestine	0.52	0.12	0.27	0.03	0.22	0.10
Spleen	54.3	14.3	51.4	6.14	23.3	7.29
Kidneys	2.40	0.65	2.75	0.17	3.24	0.40
Liver	49.7	13.0	46.7	5.49	40.1	8.34
Muscle	1.42	0.24	1.19	0.35	0.99	0.47
Bone	2.59	0.92	5.53	1.57	6.16	1.83