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Supplementary Information

Carboxyl-polyethylene glycol-phosphoric acid: A ligand for highly stabilized iron oxide nanoparticles

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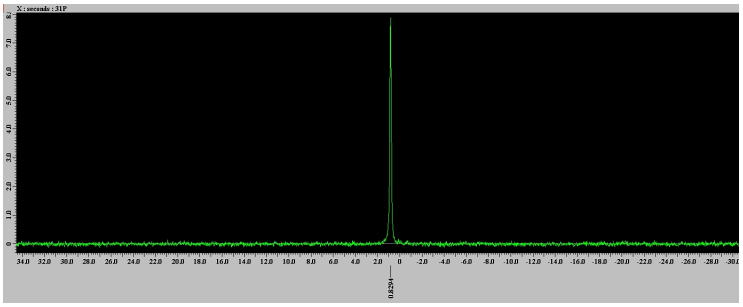
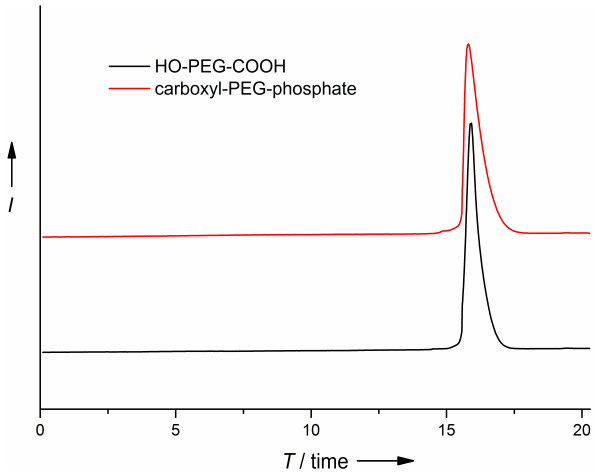


Fig. S1 ^{31}P NMR spectrum of carboxyl–PEG–phosphoric acid conjugate in $CDCl_3$.



Polymer	M_n	M_w	M_w/M_n
HO–PEG–COOH	3397	4289	1.26
carboxyl–PEG–phosphoric acid	3258	4167	1.28

Fig. S2. GPC curves and analysis of HO–PEG–COOH and carboxyl–PEG–phosphoric acid.

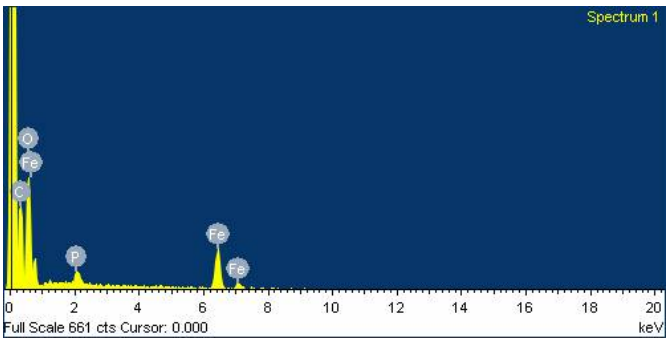


Fig. S3 EDX spectra of the carboxyl–PEG–phosphoric-acid-stabilized Fe_3O_4 nanoparticles.

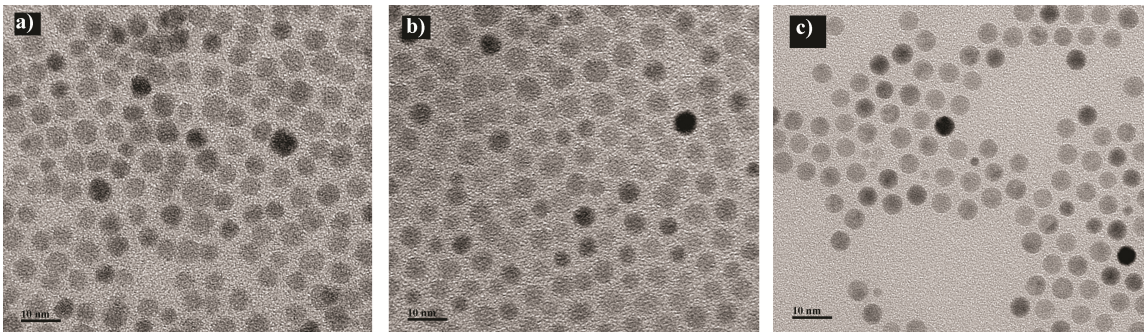


Fig. S4 TEM images of a) oleic-acid-capped Fe_3O_4 nanoparticles, b) carboxyl–PEG–phosphoric-acid-stabilized Fe_3O_4 nanoparticles, and c) folic-acid-conjugated Fe_3O_4 nanoparticles. After FA immobilization, the nanoparticle dispersion was maintained and no significant aggregation was observed.

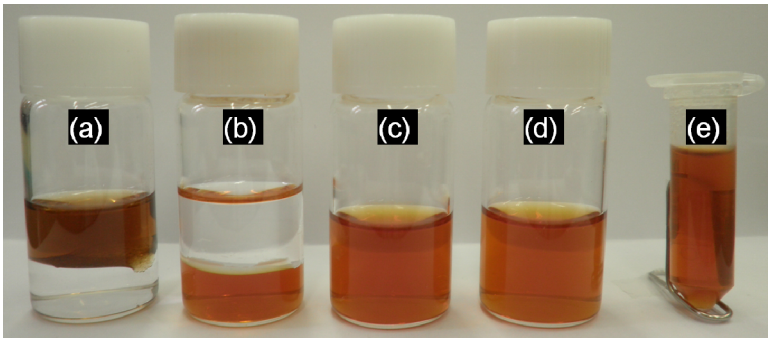


Figure S5. Photographs of 6-nm a) oleic-acid-capped Fe_3O_4 nanoparticles solution, b) carboxyl–PEG–phosphoric-acid-stabilized Fe_3O_4 nanoparticles solution (upper phase: hexane, lower phase: water), c) carboxyl–PEG–phosphoric-acid-stabilized Fe_3O_4 nanoparticles aging at room temperature for a month, d) heated to 100 °C for 3 h, and e) centrifugation at 6,000 g for 30 min. In all cases of b-e, no detachment of carboxyl–PEG–phosphoric acid from nanoparticles is seen evidenced by the lack of any visible aggregation of the nanoparticles, as confirmed by dynamic light scattering experiments.

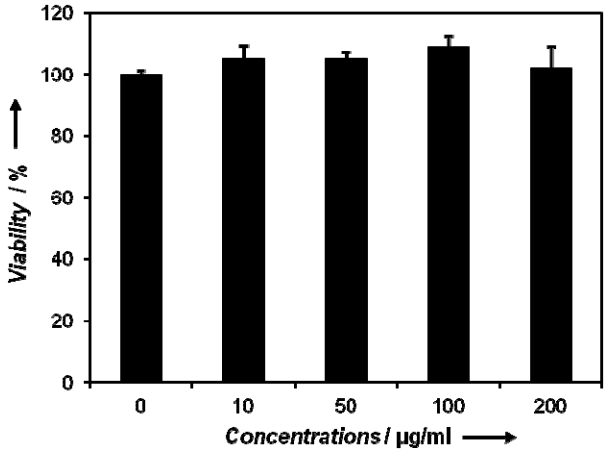


Fig. S6 The effect of the carboxyl–PEG–phosphoric-acid-stabilized Fe_3O_4 nanoparticles on the viability of RAW 264.7 cells. Cells were incubated with or without the nanoparticles for 48 h at 37 °C, followed by the MTT assay.

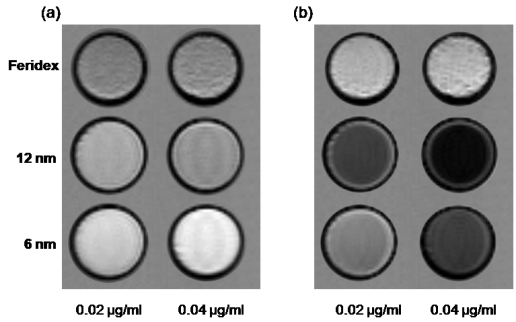


Fig. S7 MR images of 6-nm carboxyl–PEG–phosphoric-acid-stabilized Fe_3O_4 nanoparticles at different concentrations generated on a (a) T_1-weighted spin-echo sequence with an echo time (*T*E) of 11 ms and pulse repetition time (*T*R) of 361 ms; and (b) T_2-weighted spin-echo sequence with *T*E of 36 ms and *T*R of 3,500 ms.

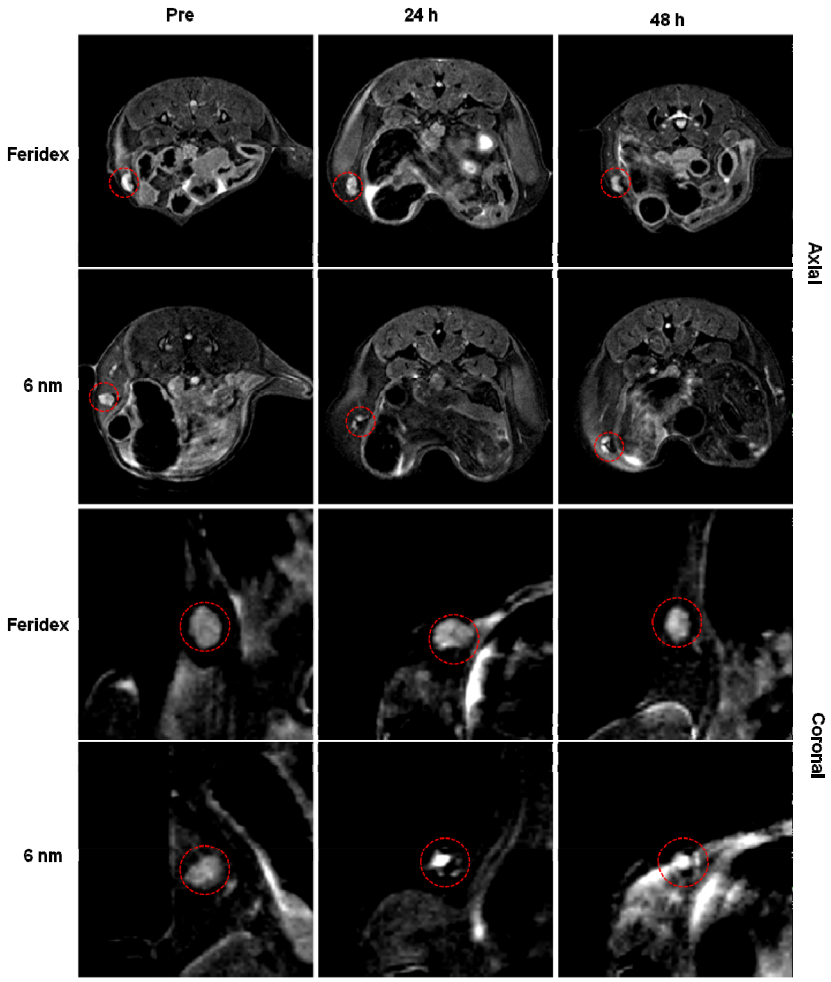


Fig. S8. Time-dependent T_2-weighted MR images of lymph node acquired from mice prior to administration and 24 h/48 h after administration of Feridex or carboxyl–PEG–phosphoric-acid-stabilized Fe_3O_4 nanoparticles. Images were obtained with on axial and coronal plane.