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Development of intelligent nanogels by gamma radiation as theranostic agents for diagnosis and therapy of cancer

Nowadays, cancer is well known that it cause the most disease of human death. Chemotherapy or direct uptake of anticancer drugs was generally employed for cancer treatment. To ease the risk of normal cells and side effects of patient, nanocarrier contained anticancer drug and contrast agent is continuously developed to increase the survival rate. Theranostic agent is a multifunctional molecule, which is well-designed for more specificity to disease area or targeting area by combination of diagnostic and therapeutic capabilities into one single molecule. Based on this reason, researchers are interesting to develop a theranostic agent from biocompatible and biodegradable polymers for cancer treatment. In this research, the proton-donating polyacrylic acid (PAA) and the proton-accepting polyethylene oxide (PEO) were used as the starting materials, PAA and PEO were mixed with 1:1 molar stoichiometric ratio in 25% (v/v) acetone/water mixture to form the inter-polymer complex (IPC) through cooperative H-bonding interaction. Subsequently, IPC solution was irradiated to create a strong covalent bond between polymer chains as IPC nanogels. The effects of dose, pH and temperature on size and stability of IPC nanogel were studied, comparing with IPC. After irradiation only at 3 kGy, IPC nanogel exhibited suitable size for drug delivery (87.01 ± 9.04 nm) and stable size over a period of 1 month at ambient temperature. Furthermore, Berberine (BBR) as a model anticancer drug was encapsulated into the IPC nanogel. The particle size, number of particle and surface area as well as surface charge of IPC nanogel before and after encapsulation was observed by dynamic light scattering, zetasizer and transmission electron microscopy. Drug release study revealed that the BBR drug was slowly released from IPC nanogels into PBS buffer (pH 7.4) at 37 °C over a period of 54 hrs. IPC nanogels not only encapsulate anticancer drug but also chelate metal ion as a contrast agent. The results of this research indicated that IPC nanogel prepared by radiation processing has the potential to be used as theranostic agents.

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