Gold Nanoparticles Work as the Beta-emitter to Treat Brain Tumor

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Abstract

Brain tumor therapy is extremely stringent because of very poor prognosis and limited advances of therapeutics. Concurrent chemo-radiotherapy (CCRT) has been employed for patients who have received maximal surgical resection to prohibit tumor recurrence. However, there is an off-therapeutic gap after surgery and before CCRT. In this work, gold nanoparticles (GNP) work as the beta-emitter and show the merit of loco-regional treatment to complement current protocol of brain tumor therapy. The unique nano-sized beta-emitter was prepared in a nuclear reactor without participation of reducing agents and radioactive precursors. Trivalent gold ions (Au^{3+}) were reduced into GNP in which particular portion of natural gold atoms (^{197}Au) were simultaneously converted into radioactive gold (^{198}Au) atoms through a one-pot/one-step reaction. The ^{198}Au-incorporated gold nanoparticle (^{198}Au-GNP) renders GNP extraordinary physical properties and provides multimodality to benefit patients bearing brain tumor. Firstly, the fluidic ^{198}Au-GNP is feasible to be delivered through intracranial injection for interstitial radiotherapy. Furthermore, simultaneous emission of beta particles (E_{max}: 0.96 MeV) and gamma rays (412 keV) provide the niche for killing tumor cells and tracking ^{198}Au-GNP *in vivo*. The ^{198}Au-GNP also demonstrates striking property of X-ray contrast for computed tomography (CT), which is useful to evaluate the distribution of GNP in the micro-environment of brain. We first report the application of ^{198}Au-GNP to effectively suppress orthotopic brain tumor using positron emission tomography (PET) imaging. Significant results give us an insight into harnessing nuclear energy for preparing multimodality GNP; and further, highlight its potential for brain tumor therapy.

References

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Figures

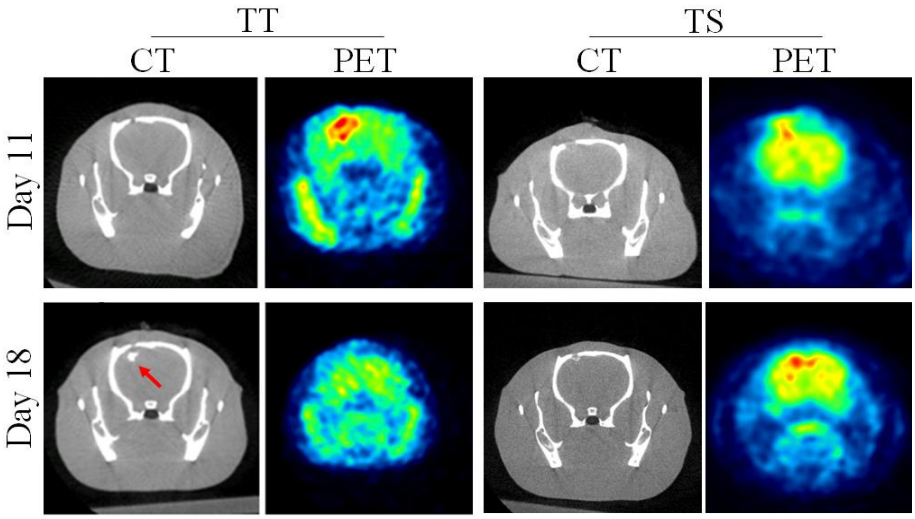

Figure1. Using PET/CT imaging to evaluate orthotopic glioblastoma-bearing rats treated by ^{198}Au-GNP. (TT: tumor treated, TS: tumor sham, CT: computed tomography, PET: positron emission tomography, red arrow: implanted ^{198}Au-GNP