Fibrin glue system for adjuvant brachytherapy of brain tumors with ¹⁸⁸Re and ¹⁸⁶Re-labeled microspheres.

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Abstract:

Brain tumors such as glioblastoma reappear in their original location in almost 50% of cases. To prevent this recurrence, we developed a radiopharmaceutical system that consists of a gel applied immediately after surgical resection of a brain tumor to deliver local radiation booster doses. The gel, which strongly adheres to tissue in the treatment area, consists of fibrin glue containing the beta-emitters rhenium-188 and rhenium-186 in microsphere-bound form. Such microspheres can be prepared by short (2 h or less) neutron activation even in low neutron flux reactors, yielding a mixture of the two beta-emitters rhenium-188 (E<inf>max</inf> = 2.1 MeV, half life = 17 h) and rhenium-186 (E<inf>max</inf> = 1.1 MeV, half life = 90.6 h). The dosimetry of this rhenium-188/rhenium-186 fibrin glue system was determined using gafchromic film measurements. The treatment efficacy of the radioactive fibrin glue was measured in a 9L-glioblastoma rat model. All animals receiving the non-radioactive fibrin glue died within 17 +/- 3 days, whereas 60% of the treated animals survived 36 days, the final length of the experiment. Control animals that were treated with the same amount of radioactive fibrin glue, but had not received a previous tumor cell injection, showed no toxic effects over one year. The beta-radiation emitting rhenium-188/rhenium-186-based gel thus provides an effective method of delivering high doses of local radiation to tumor tissue, particularly to wet areas where high adhesive strength and long-term radiation (with or without drug) delivery are needed.