

Dose Estimations for Applying ^{166}Ho -chitosan to Cystic Brain Tumor Treatment

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Chitosan labeled with ^{166}Ho is a candidate radiopharmaceutical to be used for treating cystic brain tumor. ^{166}Ho is a beta emitter of 99% yield, and the endpoint energy of beta particles is 1.855 MeV which corresponds to 9 mm of range in water. The relatively short (~26.9 hours) half-life results in high dose rate of the target volume. ^{166}Ho -chitosan is infused into a tumoral cyst, and beta particles emitted from ^{166}Ho deliver energy to the cells both in the cystic fluid and in the cyst wall. The activity of ^{166}Ho administered is determined to lead to the recommended dose of 200 Gy to the cyst wall. When ^{166}Ho -chitosan is infused into the cyst, it is predicted that part of the infused ^{166}Ho -chitosan is bound to the cyst wall. Since dose to the cyst wall is attributed to ^{166}Ho both in the cystic fluid and bound to the cyst wall, it is important to find the activity density both in the cystic fluid and in the cyst wall. The volume of the cyst can be estimated by measuring the cyst area in each image section obtained by MRI. The values of the cyst perimeter measured in each image section are used to calculate the area of the cyst wall. The fraction of ^{166}Ho -chitosan administered that is bound to the cyst wall can be obtained by subtracting the activity in the cyst of known volume from the total administered activity. The activity in the cyst is assessed by extracting cystic fluid and counting the activity density. In this study, dose to the cyst wall has been estimated by Monte Carlo simulation using the EGS4 code. A spherical cyst of a varying size (1 cm, 2 cm, and 3 cm in diameter) is the model geometry, and the target volume is a spherical shell of 1 mm in thickness located at a varying depth from the surface of the cyst wall.