Solid Tumor Therapy Using Ferromagnetic Seeds Utilizing Radiation and High Temperature Hyperthermia

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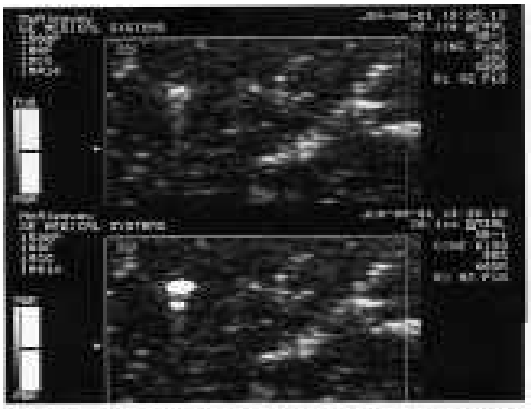
Of the currently accepted methods for treating solid neoplastic structures (tumors), there are two very promising approaches based on the implantation of ferromagnetic seeds. The first is referred to a Brachytherapy, which refers to the application or implantation of a radioactive source that supplies a lethal dose of radiation to the surrounding tissue. The second involves heating a non-radioactive ferromagnetic seed, which is heated by applying an oscillating electromagnetic field, either radio-frequency or microwave. This approach is referred to as High Temperature Hypothermia.

In the case of Brachytherapy, a small titanium seed, approximately 0.8mm in diameter and 4.5mm long, is inserted into the tumor. The seed contains both a radioactive element and a radio-opaque marker, the latter being used for identification in CT and X-Ray imaging. The size and location of the seed makes it difficult to locate precisely using ultrasound, as the surrounding tissue can often produce echoes that are equal in intensity to the seed itself. It would be much more advantageous if ultrasound imaging could replace the need for CT imaging. This is where the oscillating magnetic field reveals its usefulness. The unique Doppler signature associated with different metals allows them to be distinguished easily from any other surrounding tissue. The need to use a more ferromagnetic material than Titanium is realized.

An alternate approach to Brachytherapy is simply an extension to that therapy. Inserting a ferromagnetic seed and heating it by means of an applied electromagnetic field is the basis for High Temperature Hyperthermia. At a temperature of 48˚ to 50˚ C, the cellular tissue becomes necrotic, the physiological state of dead tissue.



A critical issue to both applications is the nature of the necrotic field. Too much radiation, either nuclear or heat, will extend the necrotic field beyond the tumor and into the surrounding live tissue. This can be minimized using Brachytherapy by reducing the quantity of the radioactive material. Likewise, High Temperature Hyperthermia affects can be attenuated by controlling both the intensity of the electromagnetic signal and the duration of that signal.

Badini, Paolo, et al. ***Necrosis Evolution During High Temperature Hyperthermia Through Implanted Heat Sources.*** *IEEE Transactions on Biomedical Engineering, Vol., 50, NO. 3, March 2003*

McAleavey, Stephen, et al. ***Doppler Ultrasound Imaging of Magnetically Vibrated Brachytherapy Seeds.*** *IEEE Transactions on Biomedical Engineering, Vol., 50, NO. 2, Feburary 2003*