

range of this electromagnetic field. The frequency of this electromagnetic field would be selected as the one closest to the resonant frequency of the cancer cells and furthest from that of the normal cells. The cancer cells will absorb energy at their resonant frequency and will be destroyed intracellularly while the normal cells are unharmed.

This destruction of the cancer cells can be monitored by repeating the first part after completion of the second in order to monitor the destruction of the cancer cells. This destruction can be monitored by observing the absence of cells which absorb energy at the cancer cells resonant frequency.

This technology has application in the treatment of Atherosclerosis. Research work by the inventor and studies in the literature suggest that the development of atherosclerotic lesions is in many ways similar to tumor formation with the multiplication of a single cell line and the proliferation of smooth muscle cells (the monoclonal theory). These proliferating smooth muscle cells along with the deposition of cholesterol allow the components of the atherosclerotic plaque to have resonant frequencies different from those of the normal intimal wall. The magnetic resonant frequencies of lipids in bilayers and membranes as well as of phospholipids in relation to membrane permeability (which of course is very important to this discussion of atherosclerosis), have been studied. Membrane perturbations by physical agents can actually be followed using electron spin probe analysis. Using selective irradiation of the specimen in switched magnetic field gradients, blood flow in a vessel can be measured due to the different spin characteristics of the new polarized blood entering a specific region of the vessel. Studies by the inventor along with others found in the literature, illustrate the changes in the newly formed atherosclerotic plaques.

Therefore by performing a three-dimensional scan utilizing magnetic resonant sensing techniques, the areas of atherosclerotic lesions may be identified. Subsequently by subjecting the subject to the frequency closest to the resonant frequency of the atherosclerotic lesions, the lesions may be destroyed due to the absorption of energy, without affecting the normal vessel wall whose cells respond to a different set of frequencies.

The uptake of particles by tumors and atherosclerotic plaques in certain stages of their formation has been demonstrated. Magnetic resonant sensing techniques may be utilized to characterize the magnetic parameters of the structures. Electron spin probe analysis has been used to detect membrane perturbation by physical agents. By allowing the tumor or atherosclerotic plaque to take up the particles, be they ferromagnetic, paramagnetic, or diamagnetic, the process of determining the resonant frequencies of the cancer cells or the atherosclerotic lesions and of energy absorption at the desired resonant frequency, may be enhanced.

The production of interferon is triggered by a foreign substance which the cell senses. A magnetically excitable particle which is absorbed intracellularly by the tumor cell and then magnetically excited, results in energy absorption, temperature rise, and some mechanical vibration, which acts to trigger and to stimulate interferon production as well as prostaglandins production in the cell and other intracellular immunological responses. These responses aid in the processes' ability to destroy the cancer cells. The intracellular absorption of resonant energy, alone, will excite and alter the intracellular biophysical characteristics and will stimulate

the intracellular production of interferon and/or prostaglandins.

The intracellular absorption of agents other than magnetically excitable particles; i.e. various sugars, agents affecting cyclic-AMP, a material or materials capable of generating heat intracellularly by chemical reaction and/or the application of an increased oxygen supply to the cells resulting in an increased rate of chemical reaction and increased intracellular metabolism can also be utilized to alter the magnetic susceptibility of the cell and to help the absorption of energy at the cancer cell's resonant frequency. The intracellular production of interferon, prostaglandins, and other immunological agents, is also stimulated. The intracellular absorptions enhance the difference in the resonant frequencies between the cancer cells and the normal cells as well as to affect the magnetic susceptibility of the cell thereby enhancing the processes in this invention to selectively destroy cancer cells.

The cancer cells and the normal cells metabolic rate and activity are affected differently by agents such as sugars, prostaglandins, interferon, and agents affecting cyclic-AMP as well as by the intracellular resonant energy changes, themselves. This differential response of the cancer cells and normal cells metabolic activity allows for a variation with time in the respective resonant frequencies of the cancer cells and the normal cells. These differences can be utilized in choosing the specific time when the resonant frequencies of the cancer cells and the normal cells differ the most so as to enhance the process of detecting cancer cells and the process of selectively killing the cancer cells without injuring the normal cells and tissues.

"A method according to the present invention is illustrated in the form of a flow chart in the drawings."

EXAMPLE I

Determination of resonant energy absorption frequency for materials or tissues is obtained by using a high frequency signal generator with the capability of sweeping the frequency range to be scanned which is connected to an antenna. A receiving coil connected to a power meter (so as to measure the power received) is placed a short distance away. The material or tissues (whose resonant absorption frequency is to be determined) is placed in the space between the transmitting antenna and the receiving coil. Appropriate shielding is placed laterally around the specimen being tested in such a manner that any RF energy being transmitted from the antenna to the receiving coil must pass through the specimen. As the frequency range of the signal generator is scanned and the power received by the coil is measured, the resonant absorption frequency for the specimen being tested will be indicated by a significant drop in the power received by the receiving coil (since at this resonant frequency, the specimen will be absorbing some of the power).

This method will be applicable to determining different resonant absorption frequencies for cancer cells and for normal cells and for the various additive materials. The method will also be useful in measuring the alteration of the resonant absorption frequency by the intracellular absorption of various materials and by changes in the intracellular metabolic rate.

EXAMPLE II

As a specific example of the simplest form of the present invention, prior to treatment, tumor tissue biop-

sies are taken and examined under light microscopy to confirm tumor cell identification. 2 cc. of an aqueous colloidal solution of FeOOH and dextran is injected intravenously into the subject. This solution when injected intravenously is capable of being intracellularly absorbed and thus greatly increases the magnetic susceptibility of the intracellular structure of the cell. Moreover, after this solution is intracellularly absorbed, it is capable of being metabolized by the cell thus producing a variable magnetic susceptibility with reference to time. Biopsies taken several hours after the intravenous injection of the solution and examined under electron microscopy, confirm the intracellular absorption of this solution, particularly by the cancer cells. Biopsies of cancer tissue and normal tissue taken at 1 hour, 2 hours, 4 hours, 12 hours, 24 hours, and 48 hours after the intravenous injection of this solution are immediately frozen and subsequently taken for measurements of magnetic susceptibility in a Vibrating Sample Magnetometer, Princeton Applied Research Model No. 159. Using this data, it is possible to plot the rise in magnetic susceptibility due to the intracellular absorption of the solution in the cancer cells and to compare it to the magnetic susceptibility changes in the normal cells. This gives data on the increase in magnetic susceptibility not only due to the intracellular absorption of the solution, but also with reference to the metabolism in the time period. Using frozen samples from a time period which indicates high relative magnetic susceptibility of cancer cells to normal cells, and using the method described in Example I earlier, for determining the optimal resonant absorption frequency, it was determined that a high frequency electromagnetic field of 450 kilohertz applied approximately 4 hours after the intravenous injection of this solution, would provide optimal resonant energy absorption and resultant biophysical alterations by the cancer cells. Approximately 48 hours after this procedure was followed, biopsies are taken and examined under light microscopy and electron microscopy which confirmed the effectiveness of this procedure in destroying cancer cells without injuring surrounding normal cells and normal tissue.

EXAMPLE III

Basically this invention relates to achieving biophysical alterations in the intracellular structure of living cells, particularly cancer cells, by raising the energy level inside the cells, intracellularly. The application of energy derived from chemical reaction can be utilized for this purpose, for example; ferric oxyhydroxide particles of 0.7 micron size are colloiddally suspended in a 5% dextrose aqueous solution in an amount of approximately 50 mg. of the particles per cc. Dosages in the amount of 30 mg. per kg. of body weight of the subject are intravenously injected. Techniques described in U.S. Pat. No. 4,106,488 may be employed to more selectively direct the particles to the cancer cells. Approximately 4 hours after injection, particles will have been intracellularly absorbed by the cancer cells. Subject is then placed in a hyperbaric oxygen chamber and subjected to an approximate 50% oxygen concentration at a pressure of 3 atmospheres for a period of approximately 3 hours. Normal hyperbaric chamber safety procedures in achieving compression and decompression would be followed.

The hyperbaric oxygen chamber procedure would serve to raise the oxygen level of the subject's blood which, in turn, would raise the rate of intracellular

absorption of oxygen. The increased rate of intracellular oxygen absorption, especially by the cancer cells, coupled with the already intracellularly absorbed ferric oxyhydroxide, results in an increased rate of oxidation and metabolism of the ferric oxyhydroxide and therefore in a significant rise in intracellular energy. This significant rise in intracellular energy further results in intracellular thermal changes, stimulates the intracellular production of interferon and/or stimulates the intracellular production of prostaglandins, resulting in a destruction of cancer cells wherever they exist in the subject.

EXAMPLE IV

The subject is placed on a table with the electromagnetic energy transmitter on one side and the detection receiver on the opposite side. The transmitter and the receiver are on a moveable axis which can rotate 360° and move laterally the length of the subject. The frequency is varied from 1 Kilohertz to 50 Megahertz at each point on the 360° circle. The input from the detection receiver is fed into a computer which composes a three-dimensional picture of the resonant frequencies of all points in the subject. The distribution of cancer cells is noted as is their resonant frequency.

The subject is then placed in a large coil approximately 3 feet-6 feet in diameter. The coil is energized at the frequency determined by the computer. The subject is then treated for an increment of time determined from computer data. This increment of time could range from 2 minutes-30 minutes. Approximately 48 hours later, the subject is placed back on the original table and the procedure of detection repeated. Should any cancer cells with their specific resonant frequency be detected, then the subject is treated again, etc.

There are many variations of the invention as described and this invention should be limited solely by the scope of the following claims.

I claim:

1. A process for the treatment of cancer cells in a subject's living tissue comprising the steps of:
 - determining a resonant absorption frequency of said cancer cells,
 - generating an electromagnetic field,
 - turning said electromagnetic field to said absorption frequency of said cancer cells, and
 - exposing the subject to said tuned field to achieve biophysical alteration in said cancer cells' intracellular structures, said biophysical alteration including the stimulation of intracellular production of interferon.
2. The process according to claim 1 further comprising the step of:
 - intravenously injecting into said tissue metabolic and activity varying substances to alter the biophysical characteristics of the intracellular structure of the living cell.
3. The process according to claim 1 further comprising the step of:
 - introducing into said tissue intracellular chemically generated energy substances to stimulate the intracellular production of interferon.
4. A process for the treatment of cancer cells in a subject's living tissue comprising the steps of:
 - determining the resonant absorption frequencies of said cancer cells,
 - determining the resonant absorption frequencies of the normal cells of said subject,

- calculating the frequency closest to said resonant frequency of said cancer cells and furthest from said resonant frequency of said normal cells, generating an electromagnetic field, tuning said electromagnetic field to said calculated frequency, and exposing the subject to said tuned field to achieve biophysical alteration in said cancer cells' intracellular structures, said biophysical alteration including the stimulation of intracellular production of interferon.
5. The process according to claim 4 further comprising the step of:
intravenously injecting into said tissue metabolic and activity varying substances to alter the biophysical characteristics of the intracellular structure of said cancer cell.
6. The process according to claim 4 further comprising the step of:
introducing into said tissue intracellular chemically generated energy substances to stimulate the intracellular production of interferon.
7. A process for the treatment of cancer cells in a subject's living tissue comprising the steps of:
determining a resonant absorption frequency of said cancer cells, generating an electromagnetic field which includes energy with variable frequency in the range of 1 kilohertz to 50 megahertz, tuning said electromagnetic field to said absorption frequency of said cancer cells, and exposing the subject to said tuned field to achieve biophysical alteration in said cancer cells' intracellular structures, said biophysical alteration including the stimulation of intracellular production of interferon.
8. A process for the treatment of cancer cells in a subject's living tissue comprising the steps of:
determining the resonant absorption frequencies of said cancer cells, determining the resonant absorption frequencies of the normal cells of said subject, calculating the frequency closest to said resonant frequency of said cancer cells and furthest from said resonant frequency of said normal cells, generating an electromagnetic field which includes energy with variable frequency in the range of 1 kilohertz to 50 megahertz, tuning said electromagnetic field to said calculated frequency, and, exposing the subject to said tuned field to achieve biophysical alteration in said cancer cells' intracellular structures, said biophysical alteration including the stimulation of intracellular production of interferon.
9. A process for the treatment of cancer cells in a subject's living tissue comprising the steps of:
determining a resonant absorption frequency of said cancer cells, generating an electromagnetic field, tuning said electromagnetic field to said absorption frequencies of said cancer cells, and exposing the subject to said tuned field to achieve biophysical alteration in said cancer cells' intracellular structures, said biophysical alteration including the stimulation of intracellular production of interferon and the intracellular heat rise of said cancer cells.

10. A process for the treatment of cancer cells in a subject's living tissue comprising the steps of:
determining the resonant absorption frequencies of said cancer cells, determining the resonant absorption of the normal cells of said subject, calculating the frequency closest to said resonant frequency of said cancer cells and furthest from said resonant frequency of said normal cells, generating an electromagnetic field, tuning said electromagnetic field to said calculated frequency, and exposing the subject to said tuned field to achieve biophysical alteration in said cancer cells' intracellular structures, said biophysical alteration including the stimulation of intracellular production of interferon and the intracellular heat rise of said cancer cells.
11. A process for the treatment of cancer cells in a subject's living tissue comprising the steps of:
determining the resonant absorption frequency of said cancer cells, generating an electromagnetic field, tuning said electromagnetic field to said absorption frequency of said cancer cells, intravenously injecting into said tissue metabolic and activity varying substances to alter the biophysical characteristics of the intracellular structure of the living cell, said biophysical characteristics including the magnetic susceptibility of said intracellular structure and therefore the resonant energy absorption frequency of said living cell, and exposing the subject to said tuned field to achieve biophysical alteration in said cancer cells' intracellular structures, said biophysical alteration including the stimulation of intracellular production of interferon.
12. A process for the treatment of cancer cells in a subject's living tissue comprising the steps of:
determining the resonant absorption frequencies of said cancer cells, determining the resonant absorption frequencies of the normal cells of said subject, calculating the frequency closest to said resonant frequency of said cancer cells and furthest from said resonant frequency of said normal cells, generating an electromagnetic field, tuning said electromagnetic field to said calculated frequency, intravenously injecting into said tissue metabolic and activity varying substances to alter the biophysical characteristics of the intracellular structure of the living cell, said biophysical characteristics including the magnetic susceptibility of said intracellular structure and therefore the resonant energy absorption frequency of said cancer cells, and exposing the subject to said tuned field to achieve biophysical alteration in said cancer cells' intracellular structures, said biophysical alteration including the stimulation of intracellular production of interferon.
13. A process for the treatment of cancer cells in a subject's living tissue comprising the steps of:
determining a resonant absorption frequency of said cancer cells,

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generating an electromagnetic field which is external of the subject, tuning said electromagnetic field to said absorption frequencies of said cancer cells, and exposing the subject to said tuned field to achieve biophysical alteration in said cancer cells' intracellular structures, said biophysical alteration including the stimulation of intracellular production of interferon.

14. A process for the treatment of cancer cells in a subject's living tissue comprising the steps of:

determining the resonant absorption frequencies of said cancer cells, determining the resonant absorption frequencies of the normal cells of said subject, calculating the frequency closest to said resonant frequency of said cancer cells and furthest from said resonant frequency of said normal cells, generating an electromagnetic field which is external of the subject, tuning said electromagnetic field to said calculated frequency, and exposing the subject to said tuned field to achieve biophysical alteration in said cancer cells' intracellular structures, said biophysical alteration including the stimulation of intracellular production of interferon.

15. A process for the treatment of cancer cells in a subject's living tissue comprising the steps of:

intravenously injecting into said tissue particles selected from the group of ferromagnetic, paramagnetic, and diamagnetic materials and capable of

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being absorbed in said cancer cells to enhance the determination of the resonant absorption frequencies of said cancer cells, determining a resonant absorption frequency of said cancer cells, generating an electromagnetic field, tuning said electromagnetic field to said absorption frequency of said cancer cells, and exposing the subject to said tuned field to achieve biophysical alteration in said cancer cells' intracellular structures, said biophysical alteration including the stimulation of intracellular production of interferon.

16. A process for the treatment of cancer cells in a subject's living tissue comprising the steps of:

introducing into said tissue substances capable of being absorbed by said cancer cells to alter the biophysical characteristics of said cancer cells, determining the resonant absorption frequencies of said cancer cells, generating an electromagnetic field tuned to at least one said absorption frequencies of said cancer cells, and placing said subject within the effective range of the electromagnetic field and exposing the said subject to field to achieve biophysical alteration, including the stimulation of intracellular production of interferon, in said cancer cells' intracellular structures.

17. The process according to claim 16 wherein, said placing step commences before said generating step.

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