Targeted treatment of vulnerable plaque by using bio specific magnetic – One year research summary

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In order to verify the proposed concept the following ex-vivo setup was used: A 300Khz 3KW industrial inductive heating system (HFI3kW; RDO induction L.L.C.) and a water cooled coil were used to generate the AMF. The tissue phantom was a porcine tissue which included the skin, the subcutane fat tissue and a muscle layer. The magnetically market vulnerable plaque was simulated using a MNP solution (6 mg/ml, γ-Fe_2O_3 , mean diameter 20 nm) which was suspended in agar gel as a small sphere at the diameter of 1.5mm. The vulnerable plaque phantom was inserted into the fat tissue from the side, a few millimeters below the skin surface. The tissue phantom together with the embedded vulnerable plaque phantom was placed at the middle of the coil. IR camera (ThermoVision A40, FLIR) was placed above the phantom in order to capture its surface temperature during the experiment. The camera was connected to a PC by a Firewire connection. In addition, the temperature measurement of only the magnetically marketed tissue phantom suspended in air was done.

A temperature increase of up to 10 degree was monitored with magnetically marketed tissue phantom suspended in air (figure 1); however once it was inserted into the tissue phantom much lower temperature increase was achieved due to increased heat conduction. During the experiments a very slight increase of the surface temperature (<0.1 degree) was monitored, indicating that the endothelium will not be damaged during the procedure. In addition, a temperature increase of about one degree at the middle of the vulnerable plaque phantom was estimated. This verifies that heat can be specifically delivered into a magnetically marked tissue; however, the magnitude of this heating is still not sufficient for effective treatment. An ongoing research in our lab is trying to improve this by using a rotating magnetic field as a mean to increase the amount of dissipated heat at the tumor. Currently, a numerical module is constructed in order to evaluate the heat dissipation improvement and the optimal system parameters. An experimental setup based on the current setup and numerical simulation results will be built in order to verify the concept.

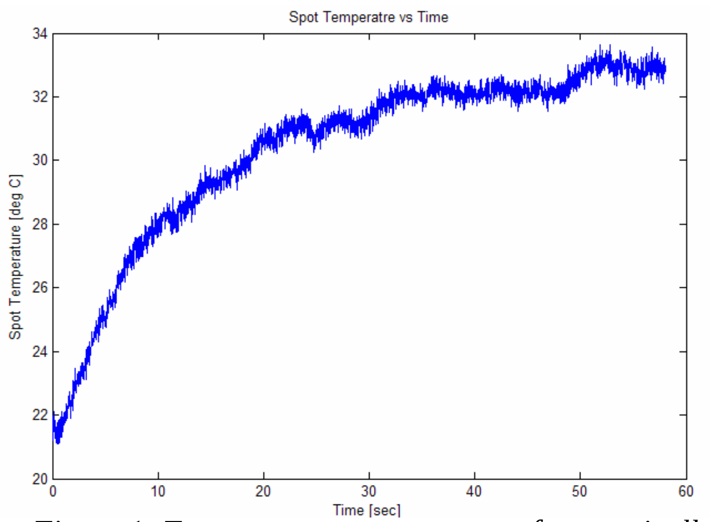

Figure 1: Temperature measurement of magnetically marked tissue phantom suspended in air during the