A Model for Prostate Cryoablation

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One area of male specific health issues would certainly be disease affecting the prostate. Three main prostatic ailments include Prostatitis, Benign Prostatic Hyperplasia (BPH), and Cancer. Prostate cancer is the most common malignant form of cancer in men in the Western world. Treatment via radical prostatectomy can have serious complications and has resulted in the use of thermal therapies such as microwave, cryotherapy, and laser methods.

Cryoablation, a form of cryotherapy, can be used to destroy cancer cells within the prostate. This therapy involves the controlled freezing to cellular kill temperatures of -40 degree C. Ice nodules that form in the -40 degree C temperature range will effectively kill cancerous cells and if a steep temperature gradient can be attained it will allow the edge of the hard frozen tissue to virtually reach out to the extremities of the prostate.

This project's goal is to provide a fast efficient and user-friendly modeling scheme that will allow individualized treatment and maximize temperature gradient at prostate extremities. Modeled time rate freeze development will enhance preoperative planning. Mathematical modeling provides a time dependent view of prostatic temperature gradient for various combinations of probe quantities, placement, and on/off ratios. Physical prostate sizing and selected probe quantities are entered into a spreadsheet that displays instantaneous graphical predictive results. The transient cooling rate calculations are based on bioheat equations and include automatic material phase change adjustments. Sample results based on average prostate sizing are also explored to estimate optimum probe spacing.