AbstractID: 5617 Title: Characterization of Cardiac Motion in the Lung using a Novel Electromagnetic System in an Animal Model

Purpose: Previous studies have examined the accuracy of the use of three internal AC electromagnetic transponders and wireless tracking system (Calypso® Medical) for tumor localization in prostate cancer. This study focuses on the use of the system to investigate and characterize cardiac induced lung tissue motion to better predict three-dimensional lung tumor position in real-time.

Method and Materials: Under an institutional approved animal study, three 1.8 mm AC electromagnetic transponders are bronchoscopically implanted in the periphery of the lungs of five hounds. The transponders are positioned in a triangle, each spaced 1-3 cm apart. The transponder positions are sequentially measured every 50 ms at five time points. During each measurement, the subject is stressed with several respiratory patterns. Signal processing of the data involves the design and application of a Butterworth highpass filter to obtain the component of transponder movement due to cardiac motion.

Results: The data for the 1st three time points of the first animal are presented. FFT spectrum analysis indicated signal frequency components of 13.05 and 123.8 cycles/minute, due to respiration and cardiac motion respectively. Cardiac-induced lung tissue motion was detected in vivo, ranging from 0.0007cm – 0.3592cm, by applying the highpass filter to the data. The motion was smaller on the implant day compared with the other two time points. Moreover, transponder position and distance from the heart had an effect on calculated motion. Finally, breathing patterns also affected the observed motion at a statistically significant 0.1% level.

Conclusion: Cardiac contractions cause quantifiable motion in surrounding lung tissues that cannot be measured with existing onboard imaging capabilities. The motion varies depending on transponder position, distance from the heart, breathing pattern, and day of measurement. Though the motion maximum was 3.6mm, this motion could cause imaging artifacts when using respiratory correlates.

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