AbstractID: 10282 Title: Evaluating extent of cell death in 3D mid-to-high frequency ultrasound by registration with whole-mount tumor histopathology

Purpose: In this study, we investigate the precision and accuracy of mid-to-high frequency ultrasound imaging to assess non-invasively cell death for incorporation of this method in pre-clinical and clinical practice to characterize tumor response to radiotherapy.

Method and Materials: Tumor xenografts (n=8) of head and neck cancer were exposed to radiation doses of 2, 4 and 8Gy. Ultrasound images were collected with an ultrasound scanner using frequencies of 15-35MHz before and 24 hours after exposure to radiation. Irradiated tumors exhibited large hyperechoic regions in ultrasounds images 24 hours after exposure to radiation that corresponded to areas of cell death in histology. The ultrasound images were registered with the histological images of the tumor slices taken at regular intervals. The tumor was contoured on histological slices and ultrasound images, the regions of cell death were contoured on histological slices and the hyperechoic regions were contoured on ultrasound images. Each set of contours was converted to a surface mesh. The volume and center of mass were calculated for each representation determined by a surface mesh.

Results: The average difference between the relative (to histology) volume representations in histology and ultrasound were 10.7%±8.9% for tumor and 21.7%±12.2% for cell death. The average differences between the relative (to the maximum dimension of the tumor) center of mass of volume representations in histology and ultrasound images were 2.7%±2.0% for tumor and 15.5%±8.9 % for cell death.

Conclusion: The method provides the correspondence between the volumes of cell death assessed from histology and from ultrasound imaging and can be used to assess early tumor response to radiotherapy. Part of the differences associated with cell death representation in histological and ultrasound images (21.7%) was caused by the differences in tumor representation (10.7%) in these images. The effect of these uncertainties is the subject of ongoing investigation.