AbstractID: 3298 Title: Quantitative assessment of tumor heterogeneity using spatial statistical methods

Purpose:
To quantitatively define and compare tumor heterogeneity via spatial statistical analyses of PET images for assessment of tumor response to treatment.

Method and Materials:
Canine tumor images, acquired through 65 minute dynamic ^{18}F-thymidine PET scans pre and three, six days post treatment, displayed varying heterogeneous uptake and tracer concentration in specific regions. CT/PET scans co-registered over multiple scan days provided single day slices averaged after uptake (16-65 min) and cropped to the tumor area for each imaging stage. Images were tested for correlation and clustering using global Moran I and local G spatial statistics.

Results:
For each image, global I(d) statistics gave values greater than 0.5 (indicating positive spatial correlation) within a distance of 10 mm before going to zero (no correlation) at longer distances. The rate at which I(d) went to zero for each image differed. Six days post treatment decreased to zero most rapidly, three days post decreased most slowly, and the pre scan between these two rates. Local G statistics revealed the position and redistribution of high Z(G) value cluster regions in the pre and post six day scans over various distances. The post three day image revealed uniform Z(G) values over the majority of the tumor region.

Conclusion:
Results showed that global Moran I(d) and local G statistics are useful tools in assessment of tumor heterogeneity. Mean correlation lengths and cluster re-distribution can be obtained through I and G statistics. Greater I(d) values and a slower I(d) rate to zero for three days post treatment implied that a longer correlation length was present after radiotherapy as FLT uptake and proliferation increased in uniformity. Shorter correlation lengths six days post treatment indicated uptake and proliferation heterogeneities returning larger than prior to treatment. Local G statistics visually displayed how regions of proliferation clusters were re-distributed throughout treatment.