AbstractID: 3339 Title: Analysis of Growth Dynamics of Treated Murine Liver Metastases Using Volumetric Ultrasound Micro-Imaging

Purpose: Two methods were compared for analyzing therapeutic responses in an experimental murine liver metastasis model using longitudinal high-frequency three-dimensional (3D) ultrasound imaging.

Method and Materials: B16F1 mouse melanoma cells were injected into the mesenteric vein of C57BL/6 mice to produce liver metastases. Treated mice received doxorubicin every second day starting seven days post injection and continuing until day 17. Untreated mice received saline injections on the same schedule. Imaging began eight days post injection and was performed every one to two days until day 19. Three-dimensional images were acquired using a VisualSonics Vevo 660 ultrasound system with a 40 MHz transducer. Metastasis volumes were measured in 3D images by manual segmentation. Two growth curves were constructed for each metastasis by computing least-squares fits of an exponential function and a Gompertz function, which is an exponential with a time-varying rate parameter, to the volume data.

Results: Eight untreated and 24 treated metastases were monitored. A significant ($p < 0.05$ in Wilcoxon rank-sum tests) difference in untreated and treated tumor volumes was observed as early as day 12. The growth of untreated metastases was described equally well by exponential (mean ± standard deviation of $r^2 = 0.963 \pm 0.045$) or Gompertz ($r^2 = 0.974 \pm 0.034$) functions. However, Gompertz functions modeled the growth of treated metastases more precisely ($r^2 = 0.985 \pm 0.024$) than exponential functions ($r^2 = 0.970 \pm 0.041$). The difference between exponential and Gompertz r^2 values for treated growth curves was significant ($p = 0.040$).

Conclusion: High-frequency 3D ultrasound imaging is sensitive to changes in murine liver metastasis growth rate produced by a chemotherapeutic agent, and may be capable of characterizing temporal variations in the growth rates of treated tumors.

Conflict of Interest: VisualSonics has licensed 3D reconstruction, visualization, and segmentation software from our laboratory.