

## AbstractID: 12820 Title: A statistical and radiobiological analysis of circulating blood heterogeneity in conformal TBI

### **Purpose:**

Improvements in delivery techniques of Total Body Irradiation (TBI) using Tomotherapy® and intensity modulated radiation therapy (IMRT) have been proven feasible. Despite the promise of improved dose conformality, application of these "sequential" techniques has been hampered by concerns over dose heterogeneity to circulating blood. The present study was conducted to provide quantitative evidence regarding the potential clinical impact of this heterogeneity.

### **Method and Materials:**

Blood perfusion was modeled analytically as possessing linear, sinusoidal motion in the cranio-caudal dimension. The average perfusion period for human circulation was estimated to be 50 s. Sequential treatment delivery was modeled as a Gaussian-shaped dose cloud with a 10 cm length that traversed a 183 cm patient length at a uniform speed. Total dose to circulating blood voxels was calculated via numerical integration and normalized to 2 Gy per fraction. Dose statistics and equivalent uniform dose (EUD) were calculated for relevant treatment times, radiobiological parameters, blood perfusion rates and fractionation schemes.

### **Results:**

The dose received by individual blood voxels exhibited asymmetric behavior that depended on coherence between the blood velocity, circulation phase and beam velocity. Heterogeneity increased with perfusion period and decreased with treatment time. Notwithstanding, heterogeneity was less than +/- 10% for perfusion periods less than 150 s. The EUD was compromised for radiosensitive cells, long perfusion periods and short treatment times. However, the EUD was unaffected (within 10%) for perfusion periods of less than 150 s or treatment times of 20 minutes or greater. Treatment over 6 fractions improved the EUD per fraction such that all parametric combinations resulted in unaffected EUD.

### **Conclusion:**

Dose heterogeneity in circulating blood cells is clinically acceptable for typical treatment times, perfusion rates and cell types. Development of conformal, sequential TBI treatment techniques should not be withheld based on concerns over circulating blood dose heterogeneity.