Purpose: To study planning strategies that can be used in small animal radiation-induced lung toxicity experiments using 6 MV accelerator with high density MLC.

Methods: Three different types of plans were designed on CT images of a Sprague Dawley rat model to irradiate 50% of the total lung volume (lung divided into apex and base) with a prescription dose of 24 Gy to the partial lung. Two VMAT arc therapy plans were optimized to cover to the prescription dose, either the apex or base of the lung. Two AP-PA plans were designed to completely block either lung apex or base while irradiating the remaining 50% of the lung. Finally, two AP-PA plans were designed to cover, to the prescription dose, the apex or base of the lung. The plans were designed and optimized using the Eclipse AAA algorithm and recalculated using the MMCTP/EGS/Beam Monte Carlo system.

Results: When completely blocking the lung base, the apex will be underdosed by up to 30%; when completely covering the apex by the prescribed dose, the base will receive overdosing (V50%=73%). The VMAT plan leads to a more conformal dose distribution and spares unnecessary skin exposure when compared to AP-PA MV or kV delivery. Despite the small size of rat model, the 6 MV VMAT delivery is superior in terms of dose conformality and sparing of the heart and the non-irradiated 50% of the lung compared to the standard, simpler, AP-PA delivery. MC dosimetry in lung shows that the delivered dose is 10% higher than predicted by AAA because of the predominance of small fields in the delivery.

Conclusions: Clinical state-of-the-art planning and delivery techniques can be scaled down accurately to rats. The use of these techniques is essential in small animal studies to render conclusions of radiation response investigations translatable to human studies.