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Title: Regional Lung Behavior Measured by Parenchymal Markers and CT Imaging in Ovine Acute Lung Injury

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Edema formation and atelectasis are responsible for dependent consolidation in acute lung injury. Differentiation of flooding, collapse, and/or fluid inflation of dependent regions cannot be done with CT alone. This study combined CT imaging with the implanted parenchymal marker technique to address this controversial question.

Methods: Two anesthetized, mechanically ventilated sheep were studied. 50-100 steel beads were placed into the lung parenchyma of the L apex and R base during open surgery and the animals recovered for 6 weeks. Subjects underwent whole lung CT scanning in supine and prone positions

at Paw 0, 8, 16, 24, and 32 cm H₂O, both before and after saline lavage injury. 3-D marker positions were determined and tracked across different Paw via an image registration process. Individual markers were grouped into tetrahedral volume elements (TET) and the volume, CT density, and location of each TET determined at each condition.

Results: Injury shifted TET positions towards the dependent lung, suggesting dependent volume loss. In the healthy lung, inflation caused incremental increases in volume and decreases in density, greatest at the lower Paw steps. After injury, the supine nondependent base TET increased volume and aeration with each step. In contrast, the most dependent TET increased volume without changing density up to Paw 16, then began increasing aeration with additional volume increases. The prone lung did not exhibit this behavior.

Conclusions: Changes in TET volume without changes in density in the dependent, supine injured lung is consistent with the inflation of these regions with displaced fluid. This behavior decreased with height and was not present when in the prone position.

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