STEVENS Institute of Technology

STEVENS INSTITUTE OF TECHNOLOGY
DEPARTMENT OF MECHANICAL ENGINEERING

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Carnegie Room 315, Time 1:30 pm

Patterns of Alveolar Expansion During Lung Inflation

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High tidal volume mechanical ventilation can be injurious to the lung, however the injury mechanism is not known. Lung inflation is believed to distend alveoli uniformly. As most pulmonary morphology studies have been in fixed lungs, however, direct data are lacking. Confocal microscopy of the isolated, perfused rat lung offers a new approach. To fluorescently mark the alveolar perimeter, I microinfused an alveolus with the cell-permeable, cytosolic dye calcein-AM. To optically section the alveolus in the same plane at low and high lung inflation, I identified that plane by a morphologic landmark ~20 mm below the plural surface. To distinguish alveolar epithelial type I and II cells, I used a surface marking antibody. Inflation expanded the alveolus, but heterogeneously. Inflation distended septa of the same alveolus to markedly different degrees. Inflation distended type I cell-lined septa significantly more than adjacent, type II cells. Further, to model single alveolar edema, I filled an alveolus with Ringer's solution. In contrast to liquid-filling the whole lung, which increases lung volume, liquid-filling an alveolus shrank that alveolus and expanded the adjacent, aerated alveolus. Lung inflation distended the adjacent, aerated alveolus significantly more than the liquid-filled alveolus. Surfactant addition partially abrogated liquid-filling induced shrinkage. These findings demonstrate marked lung inflation causes non-uniform alveolar expansion. Damage caused by over-distension of the lung may initiate in discrete segments of the alveolar wall or in aerated alveoli adjacent to edematous regions.

DR. CARRIE PERLMAN is a postdoctoral fellow in the Physiology and Cellular Biophysics department at Columbia University. Her research interests are in the mechanical determinants of lung disease. Dr. Perlman has as BS in mechanical engineering from MIT and a PhD in biomedical engineering from Northwestern University. Her doctoral research was on cardiac mechanics in conjunction with the development of an artificial lung. Prior to her doctoral studies, Dr. Perlman worked for two years as a design engineer at Human Factors Industrial Design, in New York, on the development of a needleless injector for intramuscular drug delivery.

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