



## Optimizing Ventilation Power to Avoid VILI

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Mechanical ventilation is an inherently dynamic process. Nonetheless, static tidal airway pressures (plateau, PEEP, and their difference, the driving pressure) have long served as the primary variables targeted to prevent ventilator-induced lung injury (VILI). Despite their prominence in current medical practice, such non-dynamic pressures cannot act alone to cause physical wounding injury; to inflict damage, a pressure must be paired with a volume change. More specifically, any instigator of damage must be the combination of pressure applied directly to the lung i.e. transpulmonary pressure (stress) coupled to the associated change of lung volume relative to its resting volume (strain). Because the capacity to damage depends not only on the frequency of this pairing but on the rate of tidal stress/strain development within the extracellular fibrils that oppose lung expansion, the distribution of mechanical local microstresses and strains are keys to VILI hazard. Repeated input of high tidal energy is needed to provide the excessive strain required to damage tissue. It is rather surprising, therefore, that frequency and duration of exposure have been so little considered until quite recently. Moreover, the rate at which the inflation energy is delivered—the ‘Intracycle Power’—have also been ignored. It seems logical to direct increasing clinical attention toward several constituents of ventilating *power*, i.e., profile of energy delivered per tidal cycle, the ventilating frequency, and the capacity of the lung to accept it. The ‘baby’ ventilated lungs of ARDS will have higher *specific* power and greatly reduced tolerance to a fixed total energy load. As enticing as the energy/power hypothesis for VILI causation might be, these all-inclusive variables must be modified to enhance their value for guiding clinical practice. For example, a stress threshold must be crossed before energy and power become damaging. Moreover, In the ‘baby lung’ of ARDS, a given amount of ventilating energy and power concentrates within a ‘container’ with innately smaller capacity to accept it. This spatial concentration of intracycle power and cumulative energy amplifies both the magnitude and velocity of the stretching forces of the tidal breath, a process that may initiate  
A downward spiraling ‘VILI Vortex’.