Title of Project: Noninvasive assessment of lung function in mouse models of obesity and pseudomonas infection using Unrestrained Video-Assisted Plethysmography

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The assessment of lung function in small animals is important for investigations into the pathophysiology of pulmonary disease. However, the most accurate methods for making this assessment are highly invasive and provide data with questionable relevance to normality. Present non-invasive methods measure empirical parameters that vary with relationship to the mechanical properties of the lung, thus excluding these methods as reliable indicators of lung mechanics. We developed a new method, Unrestrained Video-Assisted Plethysmography (UVAP), for non-invasively estimating mouse lung function by placing the animal* inside a heated, humidified chamber. Tidal volume (Vt), breathing frequency (f), and specific airway resistance (sRaw), were estimated by respiratory-related changes in chamber pressure and total body volume changes from orthogonal video body silhouettes. Previously UVAP provided useful estimates of these physiologic parameters in normal and post-methacholine challenge BALB/c-mice.

We investigated the ability of UVAP to assess mouse physiologic phenotypes. First, we examined effects of* obesity on UVAP parameters. Control BALB/c and leptin-knockout obese-mice exhibited similar 0.16mL and 0.18mL Vt respectively, whereas diet-induced obese-mice Vt was greater at 0.28mL. sRaw was greater in diet-induced obese-mice relative to controls and leptin-knockouts (1.24 vs. 0.30 and 0.42cmH2O.s, respectively). f was similar in control, leptin-knockout and diet-induced obese-mice (5.5, 5.8, and 6.6breaths/s, respectively). This demonstrates UVAP can provide useful physiologic parameter estimates under substantially altered body habitus, suggesting diet affects lung function to a greater degree than genetic variability.

A second series of experiments used UVAP to study pseudomonas-infected mice. Vt in healthy, plcH- and wild-type pseudomonas-infected mice was 0.40, 0.17, and 0.21mL, while f was 5.0, 2.9, and 2.8breaths/s, respectively. sRaw was 0.87, 1.26, and 1.20cmH2O.s, respectively. This indicates the work of breathing increases in pseudomonas infection in mice and supports the efficacy of UVAP as a non-invasive phenotyping methodology in mouse models of lung disease.

References:
Bates et al. J Appl Physiol 104:253-261, 2008