A1149
October 17, 2011
12:00:00 PM - 3:00:00 PM
Room Hall B2 Area P

Fluid-Filled Dependent Loops in Chest Drainage Systems Impede Lung Re-Inflation in an In-Vitro Model

Samsun **Lampotang**, Ph.D., Kelly A. **Lampotang**, Student, David E. Lizdas, B.S., Wilhelm K. Schwab, Ph.D., Nikolaus Gravenstein, M.D.
University of Florida, Gainesville, Florida, United States

Background: Fluid-filled dependent loops are often observed in the drainage tubing of chest drainage systems, with the meniscus that is closer to the chest drainage canister higher than the other meniscus. We hypothesized that fluid-filled dependent loops attenuate the vacuum level set by the user by an amount equal to the difference in elevation (ΔH) between the two menisci (H_2, H_1).

Methods: We built an in-vitro model of the lung, rib cage, and pleural space by modifying an ascending bellows assembly of an anesthesia ventilator (Ohmeda 7800, Madison, WI). Five different volumes of fluid (water) were introduced in the pleural cavity and subsequently removed via a chest drainage system (A-6000 Cactus Set, TeleFlex Medical, Research Triangle Park, NC) with a fixed dependent loop, with the vacuum level set at -10, -15, -20, -30 and -40 cm H_2O. In the figure for the experimental setup, H_5 = 96 cm, H_4 = 11 cm, H_6 = 82 cm, H_a = 35 cm, W_1 = 25 cm. Each combination of initial water volume and vacuum level setting was repeated three times for a total of 75 experiments. The difference in elevation ΔH of the two menisci and the pleural pressure (P_{pl}) were measured with a ruler with mm gradations and a U-tube water manometer (Model # AC-010, Wescor Medical, Logan, UT) respectively. Bellows lung inflation was noted.

Results: When a fluid-filled dependent loop was present in the drainage tubing, instead of being equal to the set vacuum, P_{pl} was less than the set vacuum level by an amount equal to the difference in meniscus elevations, ΔH (R^2 = 0.9757). When a fluid-filled dependent loop was present, the bellows re-inflated fully only once in 75 runs.

Conclusions: Our hypothesis - that fluid-filled dependent loops attenuate vacuum transmission to the pleural space - was proven in an in-vitro model. Given the high observed clinical incidence of fluid-filled dependent loops in chest drainage tubing, our in-vitro data suggest that many patients may not have optimal management of intrapleural pressure, even when the vacuum level is "properly" set at the vacuum canister. Within the limitations that they were collected in an in-vitro model, our data indicate that clinical practice should be re-evaluated to prevent or mitigate fluid-filled dependent loops in chest drainage systems so that the set vacuum level can be transmitted unimpeded to the pleural cavity.

Figure 1

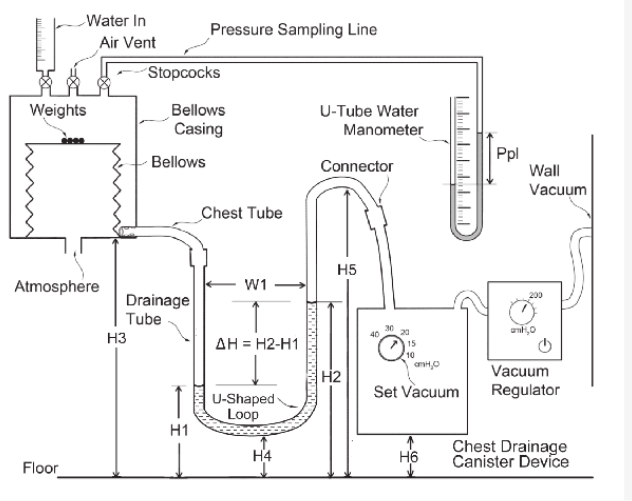

Figure 2