Bronchoalveolar Lavage Fluid Turbidity Measured by Optical Density as a Therapeutic Marker During Whole Lung Avage Procedure for Pulmonary Alveolar Proteinosis

G. J. Beltran Ale¹, B. C. Carey², C. Chalk², J. Stock², R. E. Wood³, B. C. Trapnell², C. Towe¹; 
¹Pulmonary Medicine, Cincinnati Children's Hospital Medical Center, Cincinnati, OH, United States, ²Cincinnati Children's Hospital Medical Center, Cincinnati, OH, United States, ³Pulmonary Medicine, Cincinnati Children's Hospital, Cincinnati, OH, United States.

Corresponding author's email: guillermojose.beltranale@cchmc.org

RATIONALE Whole lung lavage (WLL) is the standard of care for patients with hereditary pulmonary alveolar proteinosis (PAP). However, there is no standard technique for the WLL procedure. There has always been uncertainty regarding when to terminate the procedure (i.e., when maximal benefit has been reached). Most practitioners rely on subjective visual assessment of the turbidity of the effluent to decide when to terminate the procedure. We hypothesize that measurement of turbidity objectively with the optical density at a wavelength of 600 nm (OD600), would facilitate clinical application as well as the development of more effective WLL techniques. METHODS We studied 5 separate WLL procedures in a patient with hereditary PAP. WLL was performed through a double lumen endotracheal tube, with normal saline (NS) warmed to 40°C. Instillation of NS followed by emptying of the effluent was considered one cycle. Continuous mechanical percussion was applied to the chest throughout the cycles, and instillation and emptying were not separated by a dwell phase. We sampled each cycle by collecting the very last portion of the cycle’s effluent in order to obtain the maximal turbidity value during that cycle. Turbidity was measured in a Beckman spectrophotometer. The total effluent was collected in 3 liter aliquots, and the wet weight of sediment in each aliquot was determined. Normal turbidity range was calculated from BAL samples of pulmonary patients without PAP, these samples had to be sterile and have normal cytology. RESULTS The initial 2-4 cycles yielded the maximal turbidity (2.9 ±0.9), with gradual clearing, eventually reaching values equivalent to BAL specimens from non-PAP subjects (0.3 ±0.3). The data shows that at least 15-20 cycles were required to reach the lowest turbidity values. In two WLLs, we altered the technique used by applying mechanical percussion to the fluid circuit or the fluid in the airways with a bronchoscope, and saw increases in the turbidity as a result, suggesting that the alternative techniques were more effective. The turbidity seemed to correlate well with the measured sediment weights. CONCLUSIONS We believe that measurement of turbidity in real or near real-time could be a useful guide to the practice of WLL. Furthermore, our preliminary data would suggest that alterations in the WLL technique might be more effective than conventional methods, and that turbidity should be a useful tool to evaluate the efficacy of alternative techniques, especially if it could be performed in real time.
OD600 monitoring during WLL

WLL turbidity values (left Y axis) trend plotted by cycle number from 1-30 in the X axis, the turbidity values initially peak and then gradually decline to normal range values. The actual sediment recovered in 3 liters aliquots is plotted in the right Y axis (0-40 grams). Colors correlate the turbidity trend with the corresponding 3 liter bag aliquot. The sediment in Bag 1 is the highest, Bag 2 has lower but significant amount of sediment and Bag 3 typically has less than 10 grams of sediment.

This abstract is funded by: None

Am J Respir Crit Care Med 2020;201:A1977
Internet address: www.atsjournals.org