PercussiveTech ™ CLINICAL REFERENCE

Douglas N. Homnick, M.D., M.P.H.; Fred White, R.R.T.; and Carol de Castro, B.S., R.N.: Comparison of Effects of an Intrapulmonary Percussive Ventilator to Standard Aerosol and Chest Physiotherapy in Treatment of Cystic Fibrosis, Pediatric Pulmonary, 1995, 20:50-55.

Summary: Impaired mucociliary clearance due to defective ion and water transport and the effects of chronic airway infections lead to stasis of secretions and progressive pulmonary damage in patients with cystic fibrosis (CF). Methods to improve removal of tenacious lung secretions in CF patients contribute to slowing the decline in respiratory function. We have evaluated an intrapulmonary percussive ventilator (IPV), which is a device designed to enhance airway clearance and preserve lung function. A previous pilot study by us had determined that the device was acceptable to patients and is safe. We undertook a 6 month parallel comparative trial of the IPV versus standard, manual chest physiotherapy in 16 CF children and adults. No significant differences in spirometric measures, numbers of hospitalizations, use of oral or IV antibiotics, or anthropometric measurements were detected between the standard aerosol chest physiotherapy group and the IPV group over the duration of the trial. Patient acceptance, as determined by participant survey, was good. The device appeared to be safe and durable. It was concluded that the IPV is as effective as standard aerosol and chest physiotherapy in preserving lung function and anthropometric measures, and there was no difference in the use of antibiotics and hospitalizations.

M. King, D. M. Phillips, D. Gross, V. Vartian, H. K. Chang, and A. Zidulka: Enhanced Tracheal Mucus Clearance with High Frequency Chest Wall Compression, American Review of Respiratory Diseases 1983, 128:511-515.

Summary: The clearance and mucus in the trachea during high frequency chest wall compression (HFCSW) was studied in nine anesthetized dogs. High frequency chest wall compression was applied by oscillating the pressure in a thoracic cuff such that it produced oscillatory tidal volumes of 25 to 100 cc at frequencies of 3 to 17 Hz. The tracheal mucus clearance rate (TMCR) was determined by direct observation of the rate of displacement of a charcoal particle spot by means of a fiberoptic bronchoscope. Baseline TMCR during spontaneous breathing averaged 8.2 = 5.6 mm/min. in 9 dogs. The TMCR during 2 min of HFCWC was increased at 5, 8, 11, 13, 15, and 17 Hz but not at 3 Hz. The enhancement of clearance was most pronounced in the range of 11 to 15 HZ reaching a peak value of 340% of control at 13 Hz. These studies suggest that HFCWC might be of considerable potential benefit as a mode of chest physiotherapy.

J. M. Zahm, M. King, C. Duvivier, D. Pierrot, S. Girod, and E. Puchelle: Role of Simulated Repetitive Coughing in Mucus Clearance, European Respiratory Journal, 1991, 4, 311-315.

Abstract: The role of repetitive simulated coughing on the clearance of gel mucus simulant was investigated *in vitro*, by using a simulated cough machine. The repetition of cough induced a significant increase ($p<0.01$) in mucus simulant clearance (139.3 x 78.7 mm) in comparison to a single cough (24.9 x 27.5 mm). Moreover, the increase in frequency of the repetitive coughing induced a marked and significant increase in mucus simulant clearance (75.4 x 51.1 mm and 139.3 x 78.7 mm at 0.1 Hz and 1.6 Hz frequency, respectively). A significant ($p<0.05$) correlation was observed between the percentage increase of clearance and both shear-thinning index ($r = 0.62$) and the thixotropic index ($r = 0.63$). These results suggest that the shear-dependent properties of mucus, associated with repetitive coughing, may increase the efficiency of mucus clearance by air flow mechanisms.

PercussiveTech ™ CLINICAL REFERENCE

Castile, R.1; Tice, J. 1; Flucke, R.1; Filbrun, D.1; Varekojis, S.1; McCoy, K.1 COMPARISON OF THREE SPUTUM CLEARANCE METHODS IN IN-PATIENTS WITH CYSTIC FIBROSIS, ABSTRACT #:443 presented in 20th Annual North America Cystic Fibrosis Conference, October 15-18, 1998, Montreal, Quebec, Canada. (1. Pulmonary Division, Children's Hospital, Ohio State University)

Sputum production resulting from professionally delivered standard 12-position chest physical therapy and postural drainage (CPT&PD), high frequency chest wall oscillation (HFCWO) and intrapulmonary percussive ventilation (IPV) were compared in a group of 24 in-patients with cystic fibrosis (ages 14-34 years). Patients received 2 consecutive days of each form of therapy in random order. Therapies were delivered 3 times a day for 30 minutes. Sputum expectorated during each session was collected and weighed. Samples were then dried and weighed again. Mean per session wet sputum weights for CPT&PD, HFCWO and IPV were 5.53±3.56, 4.77±3.08 and 6.82±3.79 grams respectively. Mean dry sputum weights were 0.35± 0.25, 0.26±0.21 and 0.34±0.22 grams respectively. Weights of sputum produced were compared using paired t-tests. Sputum wet weights resulting from HFCWO and IPV did not differ significantly from those resulting from standard CPT&PD. Sputum wet weights resulting from IPV were significantly greater than those resulting from HFCWO ($p<0.02$). Dry sputum weights did not differ significantly between any of the three sputum clearance methods. The significantly greater wet weights of sputum produced by IPV can probably be explained by the fact that this modality is delivery using an aerosol-producing mouthpiece. The aerosol itself and salivation related to the use of the mouthpiece probably increase the moisture content of the sputum samples collected using this device. No adverse events occurred during the study. In the in-patient setting, the amounts of sputum produced using the HFCWO and IPV devices appear to be equivalent to amounts produced by vigorous professional CPT&PD. This suggests that HFCWO and IPV are as effective as CPT&PD and might reasonably be substituted for manual therapy during management of pulmonary exacerbations of cystic fibrosis lung disease. (Supported by Percussionaire Corporation and American Biosystems , Inc.)