Short-term Effects of Postural Drainage With Clapping vs Autogenic Drainage on Oxygen Saturation and Sputum Recovery in Patients With Cystic Fibrosis

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To compare the short-term effects of postural drainage with clapping (PD) and autogenic drainage (AD) on oxygen saturation, pulmonary function, and sputum recovery, we studied ten patients with cystic fibrosis (CF) randomly treated with PD or AD on separate days. Pulse oximetry was monitored and sputum was collected during and for 1 h following each treatment. Pulmonary function was measured before and then 1, 15, and 60 min after each treatment. There was no significant difference in the amount of sputum recovered with AD (14.0±3.5 g) vs PD (10.4±3.0 g) and no significant differences in pulmonary function occurred. Oxygen saturation during PD fell from 93.3±0.7% to 91.2±0.8% (p<0.01) and required 15 min following treatment to return to baseline. Oxygen saturation did not fall during AD and increased to 94.5±0.7% by 1 h following treatment (baseline, 93.3±0.8%; p<0.01). We conclude that AD is less likely to produce oxygen desaturation and may be better tolerated by patients with CF, while producing similar benefits in sputum clearance.

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Cystic fibrosis (CF) is a genetic disorder involving abnormal chloride channels resulting in lung destruction due to chronic mucus impaction and infection of the airways. Clearance of this mucus is an important part of therapy in CF but is complicated by impaired mucociliary clearance. Conventional therapy involves enhanced mucus clearance with postural drainage and clapping (PD). This therapy, however, requires assistance from another person and is inconvenient for adolescent and adult patients. In addition, PD has been associated with a fall in oxygen saturation, suggesting the need for improved secretion removal techniques.

Autogenic drainage (AD) is an airway clearance technique that allows patients to do their own therapy. This provides more independence and control over daily care when compared with PD. The short-term effects of AD, however, have not been compared with PD. We designed this study to compare the short-term effects of AD and PD on oxygen saturation, pulmonary function, and sputum production.

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Methods

Patient Population and Study Design

Ten patients diagnosed as having CF by positive sweat iontophoresis who expressed interest in learning a new form of chest physiotherapy were entered into the study after written consent by the patient and their parent (for patients younger than 18 years old). Each patient received both PD and AD by the same respiratory therapist at about the same time of day, on separate days, and in random order. The study was approved by the institutional review board on human research.

Techniques of Secretion Removal

Postural Drainage and Clapping: Patients received PD for 3 min in each of seven different positions with coughing between each position. PD consisted of placing the patient in different positions while the therapist manually clapped and vibrated various areas of the chest wall to increase secretion removal from a particular segment of the lung. Following clapping in each position, the patient was instructed to huff and cough to expectorate the mobilized mucus.

Autogenic Drainage: Patients were instructed in the technique of AD described by Schon1. The first step involves the patient's learning to relax and breathe with his/her diaphragm. Once this is accomplished, the patient breathes at three different lung volumes (or phases) utilizing a controlled expiratory flow rate to avoid airway compression. Although the mechanisms are not completely understood, it is thought that AD loosens mucus from the peripheral airways and moves it through the midsize airways to the large airways. Mucus is then expectorated, usually avoiding the paroxysmal cough often associated with PD. This second step is repeated until the lungs are clear, usually requiring time similar to PD.
Sputum was collected during and for 1 h following treatment. Total sputum wet weight was recorded to the nearest gram.

Physiologic Evaluation

Patients were randomly assigned to receive either PD or AD at their first visit and then received the alternate treatment during their second visit. Patients who were currently receiving bronchodilator therapy at home received a bronchodilator 30 min before their first pulmonary function test and treatment. During treatments, the oxygen saturation was monitored continuously with a pulse oximeter (Nellcor N-200; Nellcor Inc; Pleasanton, Calif) and additional recordings were made immediately after, 15 min after, and 1 h after each treatment. FVC, FEV₁, peak expiratory flow rate, forced expiratory flow at 25%, 50%, and 75% of vital capacity, and the forced expiratory flow at the midportion of vital capacity were measured (Express Spirometry System; Cybermedics; Boulder, Colo) and recorded as percentages of predicted values. Measurements were obtained before each treatment, and immediately after, 15 min, and 1 h following each treatment.

Statistical Analysis

Data were analyzed through repeated measures analysis of variance using a commercially available statistical software package (SAS). Differences were tested for significance at α=0.05 level.

RESULTS

The ten patients (seven male and three female) ranged from 12 to 42 years old (mean, 23.2 years).

During PD, oxygen saturation fell from 93.3±0.7% to 91.2±0.8% (p<0.01). Oxygen saturation fell greatest when each patient was placed in the head down (Trendelenburg) positions. Fifteen minutes after PD, oxygen saturation returned to pretreatment values. During AD, oxygen saturation increased from 93.3±0.8% to 94.9±0.7% (p<0.01). Oxygen saturation was maintained at a higher level 1 h following AD (94.5±0.7%; p<0.01) (Fig 1).

There were no significant differences noted in pulmonary function test results with either treatment (Fig 2).

Sputum recovery was similar between AD and PD (14±3 g vs 10.4±3 g) (Fig 3).

DISCUSSION

Compared with PD, AD was well tolerated and re-sulted in less of a fall in oxygen saturation and an increased oxygen saturation after 1 h, while producing similar sputum recovery in these patients with CF. This suggests that AD may be useful, and for some patients with CF, superior to PD as a secretion clearance technique.

Oxygen saturation in these study patients with CF increased both during and following AD. The de-

\[ \text{Figure 1. Oxygen saturation in patients treated with postural drainage with clapping (closed circles) or autogenic drainage (open circles). Asterisk}=p<0.01. \]

\[ \text{Figure 2. Pulmonary function in patients treated with postural drainage with clapping (closed circles) or autogenic drainage (open circles).} \]
creased saturation we observed during PD was similar to results found by McDonnell and coworkers. Webber and Hodson reported that PD, combined with the active cycle of breathing technique, did not produce a fall, but actually produced a marginal increase in oxygen saturation during treatment. Although there was a tendency for oxygen saturation to rise during the clamping phase of their study, they included pauses between clapping, which allowed patients an opportunity to control their breathing pattern. This ability to control breathing pattern and avoid the frequently paroxysmal coughing noted with PD may explain the overall improved oxygenation we observed.

We did not see a significant improvement in spirometry results with either PD or AD during the treatment or 1-h follow-up period in our patients. Kerrebijn and coworkers also found no significant difference in pulmonary function test results following a PD treatment. However, Desmond and colleagues detected an increased peak expiratory flow at 30 min after PD treatment and Feldman and associates reported that PD significantly improved lung function at both low and high lung volumes. Pryor and coworkers reported that PD, combined with the forced expiration technique, significantly increased FEV1 and FVC immediately after the treatment. Five minutes later, the difference had decreased and by 15, 30, and 45 min, the difference was no longer significant. We did not combine PD with the forced expiration technique and we did not see any trends, either up or down, in air flows during our 1-h follow-up period.

Sputum recovery was similar in AD when compared with PD. We did not measure 24-h sputum production, although the variability of this volume is so great that it is unlikely that we would have seen a more significant difference over a longer time period. Thus, the improvement in oxygenation we observed with AD is unlikely related to absolute mucus clearing, although improved matching of ventilation to perfusion may occur owing to redistribution of airway secretions.

Overall, our results suggest that AD and PD have similar short-term benefits in patients with CF. Mucus clearance was similar and we did not see any prolonged harmful effects on pulmonary function. The improving oxygenation with AD might suggest its advantage, especially when one considers the brief worsening oxygenation in patients during PD. However, no single technique may be best for every patient. Each patient needs to be repeatedly assessed to determine the most appropriate and effective technique for that particular patient. Our study suggests that there are no deleterious short-term effects of AD and that this technique should be considered for secretion removal in older patients with CF. Further studies will be needed to address the long-term effects of AD, particularly with respect to compliance.

References

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