Evidence of PEP and OPEP Devices Used in Conjunction with Aerosol Medication which Improves Distribution and Effectiveness

Previously we had assumed that PEP and OPEP devices (like AirPhysio) would help improve the effectiveness and distribution of medication due to the fact that they clear mucus and expand the airways in the lungs, allowing better distribution of the aerosol medication and better access to the inflamed airways in the lungs.

These 5 studies are verification that there are measurable benefits for combining positive expiratory (PEP) and Oscillating Positive Expiratory Pressure (OPEP) therapy with aerosol medication and gas therapies/treatments.

The 5 medical studies use 4 different medical studies with the use of bronchodilators and PEP devices, and 1 study with Pressure Support through different aerosol distribution methods:

1. Effectiveness of a positive expiratory pressure device in conjunction with beta2-agonist nebulization therapy for bronchial asthma.
2. Evaluation of lung function and deposition of aerosolized bronchodilators carried by heliox associated with positive expiratory pressure in stable asthmatics: A randomized clinical trial
3. Treatment of bronchial asthma with terbutaline inhaled by conespacer combined with positive expiratory pressure mask.
4. Inhaled beta 2-agonist and positive expiratory pressure in bronchial asthma. Influence on airway resistance and functional residual capacity.
1. Effectiveness of a positive expiratory pressure device in conjunction with beta2-agonist nebulization therapy for bronchial asthma.

This study assessed the effectiveness of a positive expiratory pressure (PEP) device on beta2-agonist (short term reliever) nebulization therapy by measuring the pulmonary function before and after nebulization therapy in 54 asthmatic patients.

The results show that the use of PEP device after beta2-agonist nebulization therapy improved pulmonary function compared with the use of beta2-agonist nebulization therapy alone, as shown by the increases in forced mid-expiratory flow and forced vital capacity (FVC).

Patients with forced expiratory volume in 1 sec (FEV1) below 85% FVC obtained a significant improvement in FEV1 and FVC after using the PEP device.

When the PEP device was used before beta2-agonist nebulization therapy, there were no obvious direct bronchodilative effects, but the use of PEP device after beta2-agonist therapy, showed significantly enhanced the bronchodilative effect of beta2-agonist therapy in patients with an FEV1 below 85% FVC.

Conclusion
The use of PEP device after the use of beta2-agonist shows a significant enhanced effect of bronchodilative effect in patients with an FEV1 below 85% FVC, over beta2-agonist therapy by itself.

It was put down as this outcome of the additional effect of the PEP device use in improving pulmonary function after beta2-agonist nebulization therapy might be a result of an enhancement in mucus clearance.

Full Article - https://www.researchgate.net/publication/11886240_Effectiveness_of_a_positive_expiratory_pressure_device_in_conjunction_with_b2-agonist_nebulization_therapy_for_bronchial_asthma
https://www.pubfacts.com/detail/11456366/
2. Evaluation of lung function and deposition of aerosolized bronchodilators carried by heliox associated with positive expiratory pressure in stable asthmatics: A randomized clinical trial

This randomized, double blinded study was carried out to differentiate the effect of heliox (helium and oxygen) and oxygen with and without positive expiratory pressure (PEP), on delivery of radiotagged inhaled bronchodilators on pulmonary function and deposition in asthmatics.

They chose 32 patients between the ages of 18 and 65 years who were diagnosed with stable moderate to severe asthma, and they were randomly assigned into four groups: (1) Heliox + PEP (n = 6), (2) Oxygen + PEP (n = 6), (3) Heliox (n = 11) and (4) Oxygen without PEP (n = 9).

Both gas type and PEP level were blinded to the investigators. Images were acquired with a single-head scintillation camera with the longitudinal and transverse division of the right lung as regions of interest (ROIs).

While all groups responded to bronchodilators, only group 1 showed increase in Forced Expiratory Volume in 1 second (FEV1) %predicted and Inspiratory Capacity (IC) (the amount of air that can be inhaled after the end of a normal expiration) compared to the other groups (p < 0.04).

When evaluating the ROI in the vertical gradient we observed higher deposition in the middle and lower third in groups 1 (Heliox + PEP) (p = 0.02) and 2 (Oxygen + PEP) (p = 0.01) compared to group 3 (Heliox).

In the horizontal gradient, a higher deposition in the central region in groups 1 (Heliox + PEP) (p = 0.03) and 2 (Oxygen + PEP) (p = 0.02) compared to group 3 (Heliox) and intermediate region of group 2 (Oxygen + PEP) compared to group 3 (Heliox).

The increase in IC could be explained by the physical characteristics of heliox, which allows the formation of a less turbulent airflow, thereby generating more flow and time during expiration, leading to a reduction in dynamic hyperinflation and increase in IC. On the other hand, the use of PEP prevents airway collapse during expiration, decreases expiratory resistance, prolongs expiratory time and reduces the intrinsic positive end expiratory pressure (PEEPi), promoting an increase in IC.

A significant increase in FEV1 was observed in the heliox + PEP group, which did not occur in other groups. Our findings can be correlated with those of Tsai et al.28 (document mentioned above) who assessed 54 stable asthmatic patients before and after nebulization with bronchodilators associated with PEPP and observed improvement with respect to FEV1, PEF, FVC, as well as improvement in mucociliary clearance.

Conclusion

They concluded that aerosol deposition was higher in groups with PEP independent of gas used (i.e. both oxygen and Heliox), while bronchodilator response with Heliox + PEP
improved FEV1 % and IC compared to administration with Oxygen, Oxygen + PEP and Heliox alone.


3. Treatment of bronchial asthma with terbutaline inhaled by conespacer combined with positive expiratory pressure mask.

The influence of positive expiratory pressure (PEP) applied during inhalation of a beta 2-agonist in treatment of bronchial asthma was investigated in a randomized crossover study with two-week treatment periods.

In one period, two puffs (0.5 mg) of terbutaline was given from a metered dose inhaler and inhaled through a device consisting of a conespacer connected to a facemask giving PEP (10 to 15 cm H2O).

In a second period, terbutaline 0.5 mg was inhaled similarly but without PEP, and in a third period placebo spray was inhaled with PEP.

Treatments were given three times daily. Peak expiratory flow (PEF) was measured before and after each inhalation and symptom scores for dyspnea, cough, and mucus production were noted in a diary.

All treatments increased PEF significantly (p less than 0.0001). The mean increase was 32 L/min during treatment with terbutaline and PEP.

This was greater than the increase of 25 L/min during terbutaline treatment (p = 0.005).

The increase in PEF during terbutaline treatment was significantly higher than the achieved 18 L/min during PEP (p = 0.026).

Conclusion

The study showed improved bronchodilation when PEP was combined with inhalation of beta 2-agonist compared with beta 2-agonist alone.


4. Inhaled beta2-agonist and positive expiratory pressure in bronchial asthma. Influence on airway resistance and functional residual capacity.

INTRODUCTION:
Positive expiratory airway pressure seems to dilate narrowed or collapsed airways, but this may be accompanied by a maintained and harmful increase in resting lung volume in obstructive pulmonary disease.

**PURPOSE:**

To evaluate the influence of inhaled terbutaline and positive expiratory pressure (PEP) on airway resistance (Raw) and functional residual capacity (FRC) in bronchial asthma.

**DESIGN:**

Randomized crossover design, single blind with regard to inhaled medication, open with regard to PEP (PEP can be felt).

**MATERIAL AND METHODS:**

Ten patients with bronchial asthma inhaled placebo and terbutaline in doses of 0.125 mg, 0.5 mg, and 1.5 mg by cone spacer combined with a facemask giving 0, 10, or 15 cm H2O PEP on separate days. FRC and Raw were measured by body plethysmography before and after inhalations. Data were analyzed by analysis of variance with terbutaline dose and PEP as factor levels.

**RESULTS:**

The effect of terbutaline: Raw decreased significantly (p < 0.0001) after 0.125 mg and 1.5 mg. The FRC did not change significantly. The effect of PEP: Raw decreased, but significantly only when the dose of 1.5 mg terbutaline was excluded from the analysis. Raw decreased with PEP 10 and 15 cm H2O, mean 0.6 (95 percent CI: -1.1, -0.2) and 0.9 (95 percent CI: -1.3, -0.4) cm H2O/L/s. The FRC did not change significantly with the PEP level.

**CONCLUSION:**

PEP only had influence on Raw when insufficient doses of terbutaline were inhaled, whereas once an efficient dose of terbutaline was administered, significant bronchodilation was achieved with or without PEP. Positive expiratory pressure did not increase FRC.


5. **Optimization of aerosol deposition by pressure support in children with cystic fibrosis: an experimental and clinical study.**

Nebulized aerosols are commonly used to deliver drugs into the lungs of patients with cystic fibrosis (CF).
The aim of this study was to assess the effectiveness of pressure-support (PS) ventilation in increasing aerosol deposition within the lungs of children with CF.

An in vitro study demonstrated the feasibility of coupling a breath-actuated nebulizer to a PS device. An in vivo study was done with 18 children (ages 6 to 21 yr) with clinically stable CF, each of whom underwent both a standard and a PS-driven ventilation scan (control session and PS session, respectively).

In addition, a perfusion scan was used to determine lung outlines and to construct a geometric model for quantifying aerosol deposition by radioactivity counting in MBq.

Homogeneity of nebulization was evaluated from the four first-order moments of aerosol distribution in the peripheral and central lung regions. The time-activity nebulization curve was linear in all patients, with higher slopes during the PS than during the control session (0.43 +/− 0.07 [mean +/− SD] MBq/min and 0.32 +/− 0.23 MBq/min, respectively; p < 0.018).

Quantitatively, aerosol deposition was about 30% greater after the PS session (4.4 +/− 2.7 MBq) than after the control session (3.4 +/− 2.1 MBq; p < 0.05).

Similarly, deposition efficacy (as a percentage of nebulizer output) was significantly better during the PS session than during the control session (15.3 +/− 8.3% versus 11.5 +/− 5.7%, p < 0.05).

No differences in the regional deposition pattern or in homogeneity of uptake were observed.

**Conclusion**

In conclusion, our data show that driving the delivery of a nebulized aerosol by noninvasive PS ventilation enhances total lung aerosol deposition without increasing particle impaction in the proximal airways.


https://www.researchgate.net/publication/12216300_Optimization_of_aerosol_deposition_pressure_support_in_children_with_cystic_fibrosis_Anperimental_and_clinical_study