A Laboratory Assessment into the Efficiency and Effectiveness of Different Oscillating Positive Expiratory Pressure Devices by Means of Patient Simulated Expiratory Waveforms

RATIONALE

- Oscillating Positive Expiratory Pressure (OPEP) devices can be used to manage a variety of conditions, such as CF, COPD, bronchiectasis and post-surgical recovery.
- OPEP devices function through a general mechanism of opening/vibrating airways and loosening mucus, however, the specific mechanism by which this is achieved differs between different devices.
- This investigation assesses the positive pressure oscillation waveforms of various devices and evaluates eachcritically in terms of consequential efficiency and effectiveness of action.

MATERIALS & METHODS

- A simulated OPEP exhalation maneuver was generated based on previous research in which a flowmeter (TSI4040 TSI, US) was used to record the waveforms of 5 healthy adults.
- An average profile was then scaled so the Peak Expiratory Flow rate (PEF) was 30 L/min, thereby being more patient representative.

- This patient representative waveform was then used to operate, via a breathing simulator (ASL9000 IngMar, US), a range of different OPEP devices.
  - n = 3 devices, 3 replicates of each.

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- Each device waveform had its own unique pattern, as summarized in Table 1.

- The therapeutic effectiveness of the air flow oscillations, and the average oscillation pressure amplitude, the Aerobika® OPEP device exhibited the highest values for both, with the vPEP® and Flutter® devices the lowest for each respectively.

- In addition, various critical performance parameters were determined.
  - Percentage of exhaled breath with discernable oscillations (> 1.0 cm H2O), tosc [%]
  - Average oscillation amplitude
  - Total Pressure Pulse Impact (TPPI)

- In terms of the percentage of breath with oscillations and the average oscillation pressure amplitude, the Aerobika® OPEP device exhibited the highest values for both, with the vPEP® and Flutter® devices the lowest for each respectively.

- Such differences in laboratory performance should be considered when evaluating clinical performance studies and when selecting a device for clinical practice.

RESULTS

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- The TPPI values showed the Aerobika® OPEP device to be the most effective, with double the value of the second ranking device.

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- The therapeutic effectiveness of the air flow oscillations, as assessed here via the TPPI value, is considered to be dependent, in part, on the ability of the device to generate and maintain a pressure amplitude or turbulent spike throughout the maneuver.

- The TPPI value of the Aerobika® OPEP device would be considered the highest, followed by the vPEP® and Flutter® devices, respectively.

- TPPI = \[ \text{SUM of discernable pressure amplitudes in a single exhalation} \]

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