

Flutter Device Review: Effects on Secretion and Pulmonary Function

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Abstract

The flutter is a respiratory device that produces an oscillatory positive expiratory pressure that can be used as an alternative for removal of secretions. The effects of flutter have been studied in patients with different diseases, using different protocols and outcomes, and its effects on secretions and pulmonary function are not well established. In this review, we present the results from studies that have used flutter as a physical therapy intervention compared with a control or sham group or compared to other physical therapy techniques. The device has demonstrated its beneficial effect on removal of secretions increasing the volume of expectoration and a decrease in the viscosity of secretions, increasing *in vitro* transport of secretions from cystic fibrosis and bronchiectasis patients. The effects of flutter on pulmonary function are controversial with no changes or improvement in some studies, and some possible negative effects that could be associated with the flow dependent mechanism. The airways resistance or respiratory resistance were not changed in some studies and the only one that showed a decrease in the respiratory system resistance studied patients with large amounts of secretions. In conclusion, the flutter can decrease the viscoelasticity of respiratory secretions favouring the secretions transport and elimination, which can be used for stable patients or during exacerbation. The effects in the pulmonary function / mechanics needs to be better investigated.

Keywords: Flutter device; Physical therapy modalities; Intrathoracic oscillation; Chest physical therapy; Pulmonary function

Abbreviations: COPD: Chronic Obstructive Pulmonary Disease; PEP: Positive Expiratory Pressure; CF: Cystic Fibrosis; Log G': Mucus Impedance; MCI: Mucociliary Clearance Index; CCI: Cough Clearance Index; PDPV: Postural Drainage, Percussion, and Vibration; IPV: Intrapulmonary Percussive Ventilation; ACBT: Active Cycle Breathing Technique; HFCWC: High Frequency Chest Wall Compression; ELTGOL: Slow Expiration With Glottis Opened in Infralateral Decubitus Position; VC: Vital Capacity; FEV1: Forced Expiratory Volume in 1 Second; PEF: Peak Expiratory Flow; FVC: Forced Vital Capacity; RV: Residual Volume; FEF: Forced Expiratory Flow; TLC: Total Lung Capacity; FET: Forced Expiration Technique; HAT: Hydro Acoustic Therapy; AD: Autogenic Drainage; PDP: Postural Drainage And Percussion; Raw: Airway Resistance; R5: Respiratory System Resistance at 5 Hz; X5: Respiratory System Reactance at 5 Hz; Fres: Resonant Frequency

Introduction

The physical therapy can contribute to prevent or treat complications arising from the retention of secretion in patients with hypersecretory chronic diseases or during exacerbations. Different physical therapy techniques can help patients patients that are not able to produce enough expiratory flow or because they have too much secretions or because their secretions are too thick [1-3].

The flutter is a respiratory device that can be used as an alternative for removal of secretions proposed by Lindeman [4]. It is a simple and small plastic device shaped like a pipe, with a mouthpiece at one end and a perforated cover at the other end and with a stainless steel ball resting in a plastic cone inside (Figure 1). During the expiration through the flutter, the expiratory flow causes the steel ball up and down movement, creating an oscillatory positive expiratory pressure (PEP) with a back transmission to the patient. This device is a combination of two different techniques: PEP and oscillations [4-6].

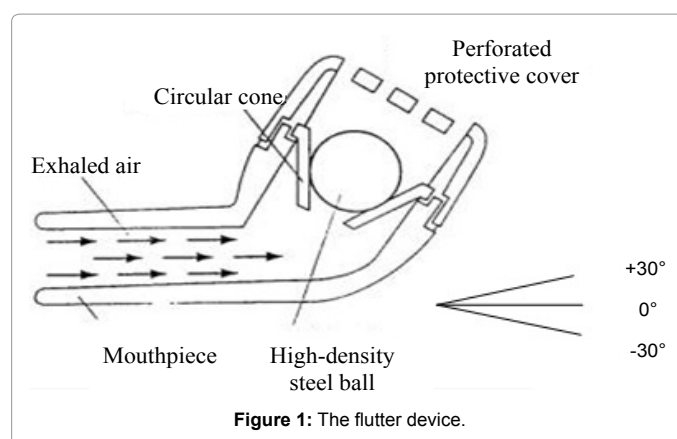
The PEP helps the removal of secretions by increasing the alveolar pressure due to expiration against resistance producing a positive pressure which helps hold airways open and may reducing peripheral airway resistance. The oscillations produce a thixotropic effect, which

is a decrease in the viscoelasticity of secretions when subjected to a constant vibration [4-7].

The effects of flutter have been studied in patients with cystic fibrosis, chronic obstructive pulmonary disease (COPD), bronchiectasis, and others, using different protocols and outcomes, in children and adult patients, and its effects on secretions and pulmonary function are not well established. The objective of this paper was to review the effects on respiratory secretions and pulmonary function.

Methods

Electronic literature searches for articles published between 1992 and 2015 were conducting using PubMed, ScienceDirect, PEDro



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(Physiotherapy Evidence Database), and Scielo databases. The search terms used were flutter VRP1, flutter valve, flutter desitin, intrathoracic oscillation, oscillating positive pressure, and oscillating positive expiratory pressure.

The search included articles in English or with English abstract that have investigated the flutter device. There were no exclusions on the basis of age, gender or physiological status. All reviews and study protocols were excluded.

Mechanical principles

The generation of oscillation and pressure are dependent on the expiratory flow and gravity forces. The neutral position (or zero degrees) is considered the one which the device has an angle of 90 degrees with the head position, i.e., parallel to the ground. In general, with the device turned upward (positive degrees) there is an increase in the pressure and oscillation, and with the device turned downward (negative degrees), pressure and oscillation decrease 4 (Figure 1).

The flutter was studied by Lindemann [4] using the angles of -30, 0, and + 30° and flows ranging from 1.6 to 5.5 L/s, which produced 8 to 75 cm H₂O of pressure range, and oscillation frequency of 2 to 32 Hz. These angles were later used by other authors who reproduced similar results for comparable flows [4,8-12].

For low flow rates (30-65 L/min), the sphere moves in the horizontal and vertical directions, touching the conical wall and vibrating. For airflow rates higher than 100 L/min, the sphere movement is basically vertical, suggesting the use of the flutter device during normal (not forced) expiration [9,10].

Brooks et al. [13] increased the number of angles and studied the device at -40, -30, -20, 0, +20, +30 e +40°, while Volsko et al. [14] partially reproduced positive angles of 0, 20 and 40°. The results of Brooks et al. [13] also show a similar behavior to that was described by Lindemann [4], which means a decrease in PEP and oscillation frequency with negative angles and increased with positive angles. They recommended special attention to PEP values above 20 cm H₂O that could be obtained at angles of zero and positive, which can be detrimental in susceptible patients.

Among the clinical trials, the pressure and oscillation variation were registered during the breathing exercises by some authors. They described a pressure varying from 6 to 25 cm H₂O [15-23], whereas oscillation variation has been mentioned only in McIlwaine's study [19], ranging 8-26 Hz.

Effects on removal of secretions

The effect of breathing exercises with flutter on the volume of expectorated secretions was evaluated in 19 studies, in stable patients with cystic fibrosis (CF), chronic obstructive pulmonary disease (COPD), bronchiectasis and panbronchiolitis, and in hospitalized patients with CF and chronic bronchitis. These studies are in Table 1 and their results suggest that the device is effective for removal of secretions.

In five of these studies the flutter was compared with a control or sham group and their results showed a higher volume of expectorated secretion after flutter [24-31].

Other studies compared flutter with other (s) technique (s) of physical therapy. In six of these studies, the volume of sputum secretion after flutter was greater after flutter than with other techniques [14,15,18,32-35]; in four studies the volume were similar [4,17,29,30];

and in three, the sputum volume was higher with the other physical therapy technique [36-38] (Table 1).

However, the effects on secretions can also be related to the effect of the oscillations on the physical properties, i.e., the tixotropic effect that means a decrease in the viscosity when the mucus is submitted to an oscillation and/or flow.

The use of oscillations was based on the mechanism that was first demonstrated in dogs that were submitted to oral and thoracic vibration, showing that the best transport of their respiratory secretion was obtained at frequencies of oscillation between 13 and 15 Hz [39,40].

The acute effect of flutter oscillations on viscoelastic properties of respiratory mucus was demonstrated in secretions from patients with cystic fibrosis and bronchiectasis, in studies without a control group and after one single session. After 30 minutes of oscillation there was a decrease in the log G* that is a measure of the total impedance of mucus samples [41] and a decrease in the mucus viscosity [22], besides no change in the ciliary and cough transport [42].

Another studies have evaluated the flutter effects after four weeks of treatment, using one or two 30 minutes sessions per day. App et al. [30] demonstrated an increase in the mucociliary and cough clearance indexes in cystic fibrosis patients, while Tambascio et al. [43] demonstrated an increase in the cough transport and contact angle measurements that can be related with a change in the rheological and surface properties in patients with bronchiectasis. These studies are detailed in the Table 2.

Effects on pulmonary function

The beneficial effects of flutter exercises on pulmonary function have been studied in clinical trial and crossover studies, in adults and children, and their results are controversial and not well established yet. Fourteen studies, comparing flutter with a control or sham group, or other techniques have presented positive effects on pulmonary function, with an increase in the slow and forced vital capacity and pulmonary flows and a decrease in the residual volume, functional residual capacity and total lung capacity, in patients with cystic fibrosis, COPD and others. In two studies flutter was used with a medication improving the bronchodilator response [16-18,20,24,27,33,44-50] (Table 3).

However, other 15 studies with similar designs, have showed no change in the pulmonary function [15,18,21,25,29-32,34-36,51-53] (Table 4).

And two other studies in cystic fibrosis patients showed a decrease in pulmonary function. Both have used the flutter exercises twice a day, one for one week and another one with year of follow-up [19,26].

Some studies have been used airway or respiratory system resistance to evaluate the effects produced by the flutter exercises. In three of them there were no changes in the airways resistance by body plethysmograph in patients with cystic fibrosis and COPD [29,52-54].

Compared with a control group	
↑ With flutter	[24-28]
Compared with other physiotherapy techniques	
Both ↑	Newhouse et al. [17] ; Lindeman et al. [24]; [29-31]
Greater with flutter	Orlik et al. [18]; Konstan et al. [15,32-35]
Greater with other techniques	[36-38]

Table 1: Effects of flutter on the volume of sputum.

Acute effects				
Dasgupta et al. [41]	CF secretions	n=19	30 min	↓ log G*
Valente et al. [42]	bronchiectasis	n=8	20 and 40 min	transport not changed
Ramos et al. [22]	bronchiectasis	n=15	20 min	↓ viscosity
Effects after 4 weeks of using				
App et al. [30]	CF	n=14	2 x 30 min/day	↑ MCI and CCI
Tambascio et al. [43]	bronchiectasis	n=18	30 min/day	↑ cough transport ↓ contact angle

CF: Cystic Fibrosis; Log G*: Mucus Impedance; MCI: Mucociliary Clearance Index; CCI: Cough Clearance Index

Table 2: Effects of flutter on the physical properties of sputum.

Author	Disease	n	age (years)	Comparison group	Protocol	Results
Cegla et al. [24]	COPD	51	53	control	2 weeks 3x, 5min	↑ VC, ↑ FEV1, ↑ PEF
Girard et al. [44]	asthma	18	43	-	45 days 3x, 5min	↑ FVC, ↑ FEV1, ↑ PEF
Weiner et al. [45]	COPD	20		sham	3 months	↑ VC
Jones et al. [16]	thoracic restriction	30	18-24	breathing exercises	1 session 15 min	restore FVC
Homnik et al. [46]	CF hospitalized	16	16,1	PDPV	9 days 15 min/30 min	↑ FVC, ↑ FEV1, ↓ RV
Burioka et al. [33]	panbronchiolitis	8	56,1	cough	1 week 4x/day, 5 min	↑ PEF
Newhouse et al. [17]	CF	8	17	IPV	1 session 20 min	↑ FVC
Gondor et al. [47]	CF hospitalized	8	11,9	PDPV	2 weeks	↑ FVC, ↑ FEV1, ↑ FEF25-75
Orlik and Sands, [18]	CF	80	11,44	PDP x PDPV x ACBT	7 months 3x/day	↑ FVC, ↑ FEV1
Wolkove et al. [20]	severe COPD	23	71,7	sham	1 session 10 min	↑ FEV1 (>effect of bronchodilator)
Wolkove et al. [48]	COPD	15	71 ± 10	sham	1 week	↑ FVC, ↑ FEV1 (>effect of bronchodilator)
Wang et al. [49]	>85 years	60	87,2	control	28 days	↑ FVC, ↑ FEV1
Sontag et al. [50]	CF	16	14,6	PDP x HFCWO	3 years 2x/day 20-40 min	<decline rate FEF25-75
Guimarães et al. [27]	bronchiectasis	10	55,9	control x ELTGOL	1 session 15 min	↓ RV, ↓ FRC, ↓ TLC

COPD: Chronic Obstructive Pulmonary Disease; CF: Cystic Fibrosis; PDPV: Postural Drainage, Percussion, and Vibration; IPV: Intrapulmonary Percussive Ventilation; ACBT: Active Cycle Breathing Technique; HFCWC: High Frequency Chest Wall Compression; ELTGOL: Slow Expiration with Glottis Opened in Infralateral Decubitus Position; VC: Vital Capacity; FEV1: Forced Expiratory Volume in 1 Second; PEF: Peak Expiratory Flow; FVC: Forced Vital Capacity; RV: Residual Volume; FEF: Forced Expiratory Flow; TLC: Total Lung Capacity.

Table 3: Positive effects of flutter on pulmonary function.

It needs to be noted that one of these studies have included 90 patients to a flutter or control group [52].

Three studies using the impulse oscillometry system (IOS) showed different results. In the study of Veiga et al. [55] there was no change in the resistance at 5 Hz (R5) after 15 minutes of flutter. On the other hand, two crossover studies comparing flutter with a control group have improved the respiratory system resistance. Figueiredo et al. [56] have demonstrated a decrease in the R5 after 15 minutes of flutter in bronchiectasis patients with a large amount of secretions while Gastaldi et al. [28] have obtained a decrease in the resistance, reactance and resonant frequency after 30 minutes of flutter in COPD patients with small amount of secretions (Table 5).

Discussion

The flutter device produces pressure and oscillation that can help the removal of secretions. This oscillatory pressure is dependent on the patient's expiratory flow as well as the position of the device. According to the mechanical studies, the patient can, using normal (not forced) expiration, produce pressures up to 25 cm H₂O and oscillation range

between 10 and 20 Hz [4,8-12], but there is not enough information in the papers included in this review about instructions to the patients or patient's performance.

The flutter device has been studied in clinical trials and crossover studies, ranging from one single session to 3 years of follow-up. It is interesting to note that, among the selected studies in this review, only 11 have compared the flutter with a control or sham group [20,24-28,45,48,40,51,52], and only four have studied hospitalized patients [18,34,46,47].

The device has demonstrated its beneficial effect on removal of secretions increasing the volume of expectoration when compared with a control group or with another physical therapy technique or device for removal of secretions [4,15,17,18,24-35]. Some studies have used the flutter time ranging from five to 30 minutes or five times of 15 breaths, suggesting that the effect on the volume of secretions was not related with the therapy time.

However, it is important to discuss if the volume of expectoration is a good outcome to express the secretion clearance. Besides the flutter

Author	Disease	n	age (years)	Comparison group	Protocol	Results
Swift et al.[51]	asthma	20		control	2 week	PEF
Pryor et al.[36]	CF	20	16-36	ACBT	1 session 20 min	FVC, FEV1
Konstan et al.[15]	CF	18	22	cough	2 sessions 15 min	FVC
Ambrosino et al.[32]	COPD and bronchiectasis	14	65±16	PDP	2 sessions 30 min	FVC, FEV1, PEF
Nakamura et al.[25]	hypersecretive	17		control	3 days 15 min	PEF
Cegla et al.[52]	COPD	90	57	control	1 week	FVC, FEV1, RV
van Winden et al.[29]	CF	22	7-17	PEP + FET	2 weeks 2x/day 5x15br	FVC, FEV1
App et al.[30]	CF	14	19,6	AD	4 weeks 2x/day 30 min	FVC, FEV1
Padman et al.[53]	CF	15	5-17	PDP	1 month 3x/day 15 min	FVC, FEV1, FEF25-75
Bellone et al.[34]	chronic bronchitis hospitalized	10	57,5	ELTGOL x DP	1 session 30 min	FVC, FEV1
Orlik and Sands [18]	CF hospitalized	21	5-18	PDP x PDPV x ACBT	-	PEF
Oerman et al. [54]	CF	24	23 ± 9,4	HFCWO	4 weeks 2-3x/day 20 min	FVC, FEV1
Thompson et al. [35]	bronchiectasis	17	59	ACBT	4 weeks	FVC, FEV1
Lagerkvist et al. [21]	CF	15	12,5 ± 5,1	PEP	8 weeks 3x/day 2 min	FVC, FEV1
Gastaldi et al. [28]	COPD	15	67.3 ± 9.1	sham	1 session	FVC, FEV1

CF: Cystic Fibrosis; COPD: Chronic Obstructive Pulmonary Disease; ACBT: Active Cycle Breathing Technique; PDPV: Postural Drainage, Percussion, and Vibration; PEP: Positive Expiratory Pressure; Forced Expiration Technique; AD: Autogenic Drainage; ELTGOL: Slow Expiration With Glottis Opened in Infralateral Decubitus Position; HFCWC: High Frequency Chest Wall Compression; Br: Breath; PEF: Peak Expiratory Flow; FVC: Forced Vital Capacity; FEV1: Forced Expiratory Volume in 1 Second; RV: Residual Volume; FEF: Forced Expiratory Flow.

Table 4: Studies with no change in pulmonary function results with flutter.

Author, year	Disease	n	Comparison group	Duration	Results
Cegla et al.[52]	COPD	90	control	1 week	Raw (no change)
van Winden et al.[29]	CF	22	PEP + FET	2 weeks	Raw (no change)
Padman et al.[53]	CF	15	PDP	1 month	Raw (no change)
Veiga et al.[55]	COPD, asthma and bronchiectasis	39	-	1 session	R5 (no change)
Figueiredo et al.[56]	bronchiectasis	8	sham	1 session	↓ R5
Gastaldi et al.[28]	COPD	15	sham	1 session	↓ R5, ↓ X5, ↓ Fres

COPD: Chronic Obstructive Pulmonary Disease; CF: Cystic Fibrosis; PEP: Positive Expiratory Pressure; FET: Forced Expiration Technique; PDP: Postural Drainage and Percussion, Raw: Airway Resistance; R5: Respiratory System Resistance At 5 Hz; X5: Respiratory System Reactance At 5 Hz; Fres: Resonant Frequency.

Table 5: Effects of flutter on airway and respiratory system resistance.

device objective is to favour the clearance of secretions, there are some studies that did not evaluate the volume of expectoration probably because the volume may not be a precise or reliable measurement. Some patients can move the secretions from the lungs and swallow, and some others can expectorate pulmonary secretions with saliva, which can increase the expectoration volume. It is possible to minimize this confounding factor using the dry weight, or dry/wet ratio, but, with dry secretions, it is possible to become similar secretions with different densities.

Another effect on secretions is the thixotropic effect that was speculated by some authors and was demonstrated for secretions from cystic fibrosis and bronchiectasis patients. This effect is related with the produced oscillations but the mechanisms remain unclear [39,40].

Dasgupta [41] and Ramos [22] have demonstrated the acute effects of the flutter device decreasing the rigidity and viscosity of secretions,

while Valente [42] observed no change in the *in vitro* secretion transport. App [30] and Tambascio [43] have demonstrated beneficial effects after four weeks of treatment in patients with cystic fibrosis and bronchiectasis. There was a decrease in the rigidity and an increase in the calculated ciliary and cough transport index and the measured *in vitro* cough transport. These effects were studied in adult patients and the changes in the physical properties of secretions were obtained only with 30 minutes of flutter exercises.

The effects of flutter on pulmonary function are controversial and the differences among the results could be related with different flows and positions that were not controlled during the studies. It is important to note that the device has a flow dependent resistance, which means a decrease in the resistance as the flow decreases.

Some studies have demonstrated an acute improvement in the pulmonary function but it is necessary to question some important

points. Among the 14 studies with positive results [16-18,20,27,33,44-50], there are four studies that have used the flutter in one single session [16,17,20,27] and the improvement in pulmonary function after one single session can be related to the removal of secretions or to the airways opening effect.

In fact, we do not know what changes in pulmonary function would be expected when you move secretions from the peripheral to central airways. When the patients can move and expectorate secretions the pulmonary function can increase, but if the patient moves the secretions inside the airways with a late expectoration, he/she can experience a transitory decrease in the pulmonary function.

The long-term effects needs to be better defined. It needs to be noted that there was a higher decrease in the FVC, FEV [1], and FEF [25-55] after one year [19] but there was a smaller decline rate FEF [25-55] after three years of follow up [50].

Nevertheless, it is possible to use more sensitive methods to evaluate the pulmonary function. The airways resistance was not changed in some studies [29,52,53,55] and there are two studies that showed a decrease in the respiratory system resistance in bronchiectasis and COPD patients, one with large amounts of secretions (50 mL/day) [56] and the other with a small amount of secretions [28]. Additionally, among the studies that presented beneficial effects on respiratory secretions, some of them have showed no changes in pulmonary function [15,18,25,29,30,32,34]. For future protocols, it is important to know if the effects can be related to the amount of secretions, to the protocols of use, or to the sensitivity of the outcomes.

Conclusion

The flutter can decrease the viscoelasticity of respiratory secretions favouring the secretions transport and elimination, which can be used for stable patients or during exacerbation, in children and adults. Because it can be as good as other physiotherapy techniques for removal of secretions, the clinicians can be guided by the better ratio preference and effectiveness.

It is important to know the mechanisms that are involved in the decrease of secretions viscosity and the effects in the pulmonary function / mechanics needs to be better investigated, as well as whose patients can have beneficial effects using the flutter device for short and long term.

Competing Interests

There are not funding in the paper. The author declares no relevant conflicts of interest.

References

- Mackenzie D, Frith PA, Burdon JGW, Town GI, Australian Lung Foundation, et al. (2003) The COPDX Plan: Australian and New Zealand Guidelines for the management of Chronic Obstructive Pulmonary Disease. *Med J Aust* 178: S7-S39.
- Main E, Prasad A, Schans C (2005) Conventional chest physiotherapy compared to other airway clearance techniques for cystic fibrosis. *Cochrane Database Syst Rev* 25: CD002011.
- Langer D, Hendriks E, Burtin C, Probst V, van der Schans C, et al. (2009) A clinical practice guideline for physiotherapists treating patients with chronic obstructive pulmonary disease based on a systematic review of available evidence. *Clin Rehabil* 23: 445-462.
- Lindemann H (1992) The value of physical therapy with VRP 1-Desitin ("Flutter"). *Pneumologie* 46: 626-630.
- Chatburn RL (2007) High-frequency assisted airway clearance. *Respir Care* 52: 1224-1235.
- Bhowmik A, Chahal K, Austin G, Chakravorty I (2009) Improving mucociliary clearance in chronic obstructive pulmonary disease. *Respir Med* 103: 496-502.
- Zayas G, Dimitry J, Zayas A, O'Brien D, King M (2005) A new paradigm in respiratory hygiene: increasing the cohesivity of airway secretions to improve cough interaction and reduce aerosol dispersion. *BMC Pulm Med* 5: 1-12.
- Cegla UH (2000) Physiotherapy with oscillating PEP systems (RC-Cornet, VRP1) in COPD. *Pneumologie* 54: 440-446.
- Lepore Neto FP, Lima LC, Gastaldi AC (2000) Dynamic evaluation of a new device for respiratory physiotherapy. *Rev Cenciae Engenharia* 9: 62-68.
- de Lima LC, Duarte JB, Lépre Neto FP, Abe PT, Gastaldi AC (2005) Mechanical evaluation of a respiratory device. *Med Eng Phys* 27: 181-187.
- Alves LA, Pitta F, Brunetto AF (2008) Performance analysis of the Flutter VRP1 under different flows and angles. *Respir Care* 53: 316-323.
- dos Santos AP, Guimarães RC, de Carvalho EM, Gastaldi AC (2013) Mechanical behaviors of Flutter VRP1, Shaker, and Acapella devices. *Respir Care* 58: 298-304.
- Brooks D, Newbold E, Kozar LF, Rivera M (2002) The flutter device and expiratory pressures. *J Cardiopulm Rehabil* 22: 53-57.
- Volsko TA, DiFiore J, Chatburn RL (2003) Performance comparison of two oscillating positive expiratory pressure devices: Acapella versus Flutter. *Respir Care* 48: 124-130.
- Konstan MW, Stern RC, Doershuk CF (1994) Efficacy of the Flutter device for airway mucus clearance in patients with cystic fibrosis. *J Pediatr* 124: 689-693.
- Jones A, Tse E, Cheung L, To C, Lo C (1997) Restoration of lung volume using the Flutter VRP1 or breathing exercise. *Aust J Physiother* 43: 183-189.
- Newhouse PA, White F, Marks JH, Homnick DN (1998) The intrapulmonary percussive ventilator and flutter device compared to standard chest physiotherapy in patients with cystic fibrosis. *Clin Pediatr (Phila)* 37: 427-432.
- Oriik T, Sands D (2001) Long-term evaluation of effectiveness for selected chest physiotherapy methods used in the treatment of cystic fibrosis. *Med Wieku Rozwoj* 5: 245-257.
- McIlwaine PM, Wong LT, Peacock D, Davidson AG (2001) Long-term comparative trial of positive expiratory pressure versus oscillating positive expiratory pressure (flutter) physiotherapy in the treatment of cystic fibrosis. *J Pediatr* 138: 845-850.
- Wolkove N, Kamel H, Rotaple M, Baltzan MA Jr (2002) Use of a mucus clearance device enhances the bronchodilator response in patients with stable COPD. *Chest* 121: 702-707.
- Lagerkvist AL, Sten GM, Redfors SB, Lindblad AG, Hjalmarson O (2006) Immediate changes in blood-gas tensions during chest physiotherapy with positive expiratory pressure and oscillating positive expiratory pressure in patients with cystic fibrosis. *Respir Care* 51: 1154-1161.
- Ramos EM, Ramos D, Iyomasa DM, Moreira GL, Melegati KC, et al. (2009) Influence that oscillating positive expiratory pressure using predetermined expiratory pressures has on the viscosity and transportability of sputum in patients with bronchiectasis. *J Bras Pneumol* 35: 1190-1197.
- Chicayban LM, Zin WA, Guimaraes FS (2011) Can the Flutter Valve improve respiratory mechanics and sputum production in mechanically ventilated patients? A randomized crossover trial. *Heart Lung* 40: 545-553.
- Cegla UH, Retzow A (1993) Physical therapy with VRP1 in chronic obstructive respiratory tract diseases-results of a multicenter comparative study. *Pneumologie* 47: 636-639.
- Nakamura S, Kawakami M (1996) Acute effect of use of the Flutter on expectoration of sputum in patients with chronic respiratory diseases. *Nihon Kyobu Shikkan Gakkai Zasshi* 34: 180-185.
- Jarad NA, Powell T, Smith E (2010) Evaluation of a novel sputum clearance technique—hydro-acoustic therapy (HAT) in adult patients with cystic fibrosis: a feasibility study. *Chron Respir Dis* 7: 217-227.
- Guimaraes FS, Moco VJ, Menezes SL, Dias CM, Salles RE, et al. (2012) Effects of ELTGOL and Flutter VRP1Â® on the dynamic and static pulmonary volumes and on the secretion clearance of patients with bronchiectasis. *Rev Bras Fisioter* 16: 108-113.
- Gastaldi AC, Paredi P, Talwar A, Meah S, Barnes PJ, et al. (2015) Oscillating Positive Expiratory Pressure on Respiratory Resistance in Chronic Obstructive

- Pulmonary Disease with a small amount of secretion: A Randomized Clinical Trial. *Medicine (Baltimore)* 94: e1845.
29. van Winden CM, Visser A, Hop W, Sterk PJ, Beckers S, et al. (1998) Effects of flutter and PEP mask physiotherapy on symptoms and lung function in children with cystic fibrosis. *Eur Respir J* 12: 143-147.
30. App EM, Kieselmann R, Reinhardt D, Lindemann H, Dasgupta B, et al. (1998) Sputum rheology changes in cystic fibrosis lung disease following two different types of physiotherapy: flutter vs autogenic drainage. *Chest* 114: 171-177.
31. Orlik T (2000) Evaluation of the efficiency of selected thoracic physiotherapy methods used in the treatment of patients with cystic fibrosis. *Med Wiek Rozwoj* 4: 233-246.
32. Ambrosino N, Callegari G, Galloni C, Brega S, Pinna G (1995) Clinical evaluation of oscillating positive expiratory pressure for enhancing expectoration in diseases other than cystic fibrosis. *Monaldi Arch Chest Dis* 50: 269-275.
33. Burioka N, Sugimoto Y, Suyama H, Hori S, Chikumi H, et al. (1998) Clinical efficacy of the FLUTTER device for airway mucus clearance in patients with diffuse panbronchiolitis. *Respirology* 3: 183-186.
34. Bellone A, Lascioli R, Raschi S, Guzzi L, Adone R (2000) Chest physical therapy in patients with acute exacerbation of chronic bronchitis: effectiveness of three methods. *Arch Phys Med Rehabil* 81: 558-560.
35. Thompson CS, Harrison S, Ashley J, Day K, Smith DL (2002) Randomized crossover study of the flutter device and the active cycle of breathing technique in non-cystic fibrosis bronchiectasis. *Thorax* 57: 446-448.
36. Pryor JA, Webber BA, Hodson ME, Warner JO (1994) The Flutter VRP1 as an adjunct to chest physiotherapy in cystic fibrosis. *Respir Med* 88: 677-681.
37. Eaton T, Young P, Zeng I, Kolbe J (2007) A randomized evaluation of the acute efficacy, acceptability and tolerability of flutter and active cycle of breathing with and without postural drainage in non-cystic fibrosis bronchiectasis. *Chron Respir Dis* 4: 23-30.
38. Borka P, Gyurkovits K, Bódis J (2012) Comparative study of PEP mask and Flutter on expectoration in cystic fibrosis patients. *Acta Physiol Hung* 99: 324-331.
39. King M, Phillips DM, Gross D, Vartian V, Chang HK, et al. (1983) Enhanced tracheal mucus clearance with high frequency chest wall compression. *Am Rev Respir Dis* 128: 511-515.
40. King M, Phillips DM, Zidulka A, Chang HK (1984) Tracheal mucus clearance in high-frequency oscillation. II: Chest wall versus mouth oscillation. *Am Rev Respir Dis* 130: 703-706.
41. Dasgupta B, Brown NE, King M (1998) Effects of sputum oscillations and rhDNase in vitro: a combined approach to treat cystic fibrosis lung disease. *Pediatr Pulmonol* 26: 250-255.
42. Valente AM, Gastaldi AC, Cravo SL, Afonso JL, Sologuren MJJ, et al. (2004) The effect of two techniques on the characteristics and transport of sputum in patients with bronchiectasis. A pilot study. *Physiotherapy* 90: 158-164.
43. Tambascio J, de Souza LT, Lisboa RM, Passarelli RC, de Souza HC, et al. (2011) The influence of Flutter VRP1 components on mucus transport of patients with bronchiectasis. *Respir Med* 105: 1316-1321.
44. Girard JP, Terki N (1994) The Flutter VRP1: a new personal pocket therapeutic device used as an adjunct to drug therapy in the management of bronchial asthma. *J Investig Allergol Clin Immunol* 4: 23-27.
45. Weiner P, Zamir D, Waizman J, Weiner M (1996) Physiotherapy in chronic obstructive pulmonary disease: oscillatory breathing with flutter VRP1. *Harefuah* 131: 14-17.
46. Homnick DN, Anderson K, Marks JH (1998) Comparison of the flutter device to standard chest physiotherapy in hospitalized patients with cystic fibrosis: a pilot study. *Chest* 114: 993-997.
47. Gondor M, Nixon PA, Mutich R, Rebovich P, Orenstein DM (1999) Comparison of Flutter device and chest physical therapy in the treatment of cystic fibrosis pulmonary exacerbation. *Pediatr Pulmonol* 28: 255-260.
48. Wolkove N, Baltzan MA Jr, Kamel H, Rotaple M (2004) A randomized trial to evaluate the sustained efficacy of a mucus clearance device in ambulatory patients with chronic obstructive pulmonary disease. *Can Respir J* 11: 567-572.
49. Wang Q, Zhang X, Li Q (2010) Effects of a Flutter Mucus-Clearance Device on Pulmonary Function Test Results in Healthy People 85 Years and Older in China. *Respir Care* 2010 55: 1449-1452.
50. Sontag MK, Quittner AL, Modi AC, Koenig JM, Giles D, et al. (2010) Lessons learned from a randomized trial of airway secretion clearance techniques in cystic fibrosis. *Pediatr Pulmonol* 45: 291-300.
51. Swift GL, Rainer T, Saran R, Campbell IA, Prescott RJ (1994) Use of flutter VRP1 in the management of patients with steroid-dependent asthma. *Respiration* 61: 126-129.
52. Cegla UH, Bautz M, Frode G, Werner T (1997) Physical therapy in patients with COPD and tracheobronchial instability-comparison of 2 oscillating PEP systems (RC-Cornet, VRP1 Desitin). Results of a randomized prospective study of 90 patients. *Pneumologie* 51: 129-136.
53. Padman R, Geouque DM, Engelhardt MT (1999) Effects of the flutter device on pulmonary function studies among pediatric cystic fibrosis patients. *Del Med J* 71: 13-18.
54. Oermann CM, Sockrider MM, Giles D, Sontag MK, Accurso FJ, et al. (2001) Comparison of high-frequency chest wall oscillation and oscillating positive expiratory pressure in the home management of cystic fibrosis: a pilot study. *Pediatr Pulmonol* 32: 372-377.
55. Veiga J, Miranda IA, Dames KK, Jansen JM, Melo PL (2008) Respiratory mechanics effects of Flutter VRP1 in healthy subjects and COPD, asthma and bronchiectasis patients. *Pulmno RJ* 17: 18-21.
56. Figueiredo PH, Zin WA, Guimaraes FS (2012) Flutter valve improves respiratory mechanics and sputum production in patients with bronchiectasis. *Physiother Res Int* 17: 12-20.

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