Studiensammlung

inkl. Anwenderbefragung /

study summary

incl. user survey

RC-FIT® / RC-Cornet®

VARIANTEN / *VARIANTS*

CEGLA
MEDIZINTECHNIK

1 Inhalt / *table of content*

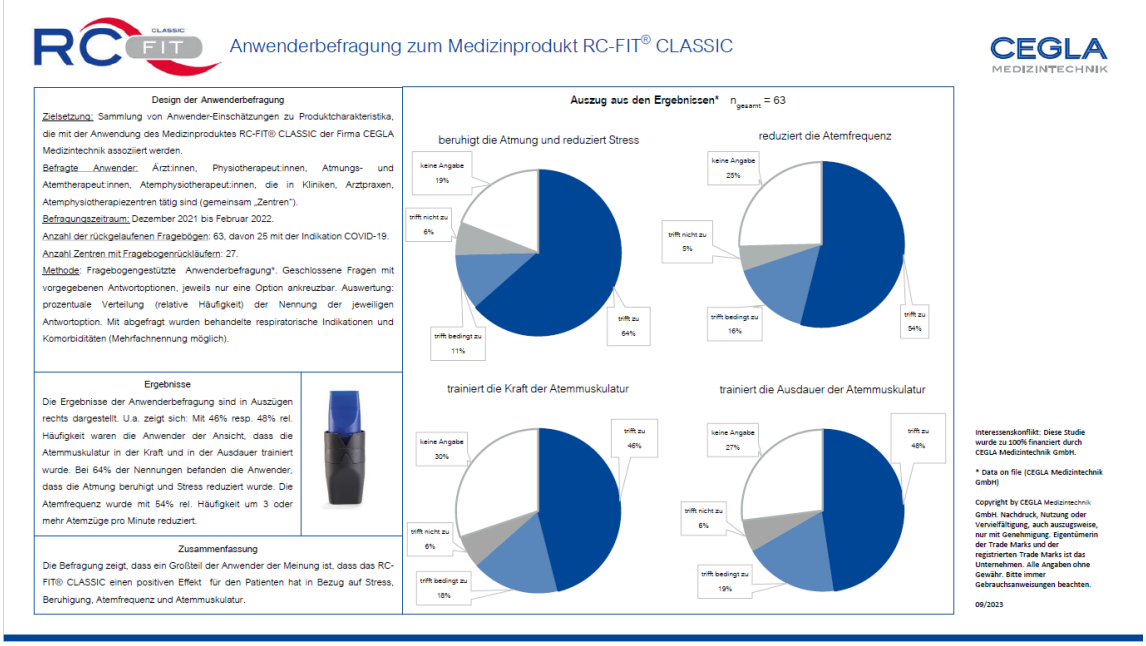
Please be aware that some studies have only been published in the German speaking area and therefore have not been translated.

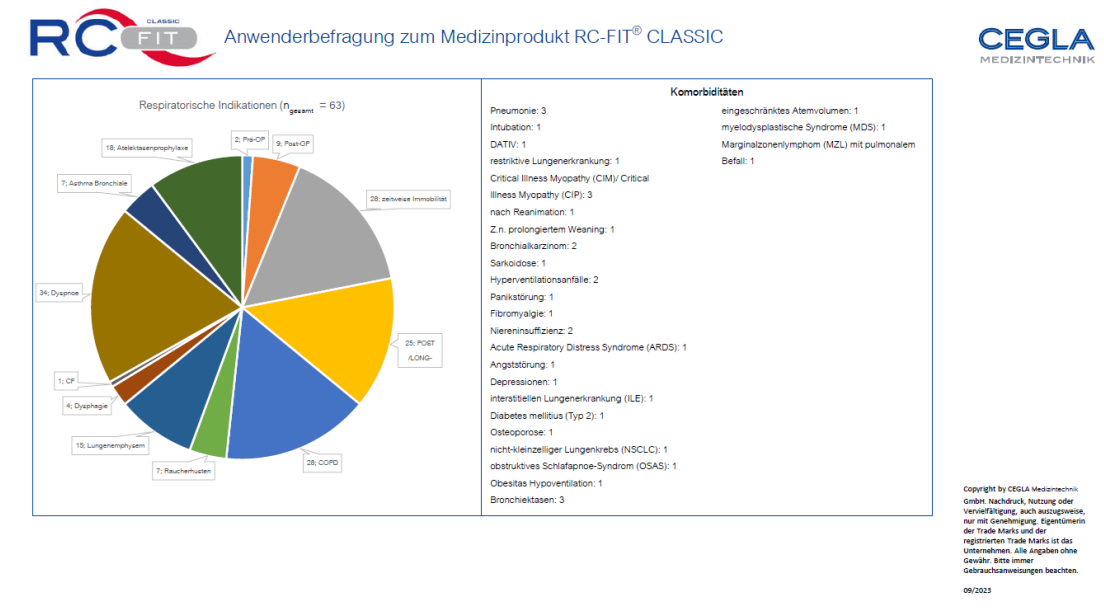
2 Aktuelles: Anwenderbefragung zum Medizinprodukte RC-FIT® / *topical subject: test user survey of the respiratory therapy and training device RC-FIT®*

Bei den Darstellungen aus den beiden nachfolgenden Kapiteln handelt es sich um Auszüge der Untersuchung.

Die gesamte Erprobung ist auf Nachfrage einsehbar.

2.1 RC-FIT® CLASSIC





2.2 RC-FIT® CLASSIC – Filterung COVID-19 (POST-/LONG-Covid) / *filtering COVID-19 (POST-/LONG-Covid)*

Anwenderbefragung zum Medizinprodukt RC-FIT® CLASSIC – POST-/LONG-COVID

Design der Anwenderbefragung

Zielsetzung: Sammlung von Anwender-Einschätzungen zu Produktcharakteristika, die mit der Anwendung des Medizinproduktes RC-FIT® CLASSIC der Firma CEGLA Medizintechnik im Kontext von COVID-19 assoziiert werden.

Befragte Anwender: Ärzt:innen, Physiotherapeut:innen, Atmungs- und Atemtherapeut:innen, Atemphysiotherapeut:innen, die in Kliniken, Arztpraxen, Atemphysiotherapiezentren tätig sind (gemeinsam „Zentren").

Befragungszeitraum: Dezember 2021 bis Februar 2022.

Anzahl der rückgelaufenen Fragebögen: 25.

Anzahl Zentren mit Fragebogenrückläufern: 17.

Methode: Fragebogengestützte Anwenderbefragung*. Geschlossene Fragen mit vorgegebenen Antwortoptionen, jeweils nur eine Option ankreuzbar. Auswertung: prozentuale Verteilung (relative Häufigkeit) der Nennung der jeweiligen Antwortoption. Mit abgefragt wurden behandelte respiratorische Indikationen und Komorbiditäten (Mehrfachnennung mögl.).

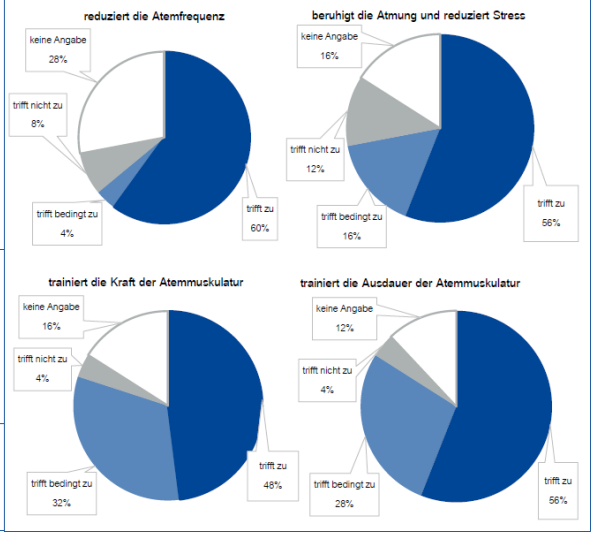
Ergebnisse

Die Ergebnisse der Anwenderbefragung sind in Auszügen rechts dargestellt. U.a. zeigt sich: Mit 48% rel. Häufigkeit waren die Anwender der Ansicht, dass die Atemmuskulatur in der Kraft und mit 56% ebenfalls in der Ausdauer trainiert wurde. Bei 60% der Nennungen reduzierte sich die Atemfrequenz und mit 56% rel. Häufigkeit wurde nach Einschätzung des Fachpersonals die Atmung beruhig und Stress reduziert.

Zusammenfassung

Die Befragung zeigt, dass ein Großteil der Anwender der Meinung ist, dass das RC-FIT® CLASSIC einen positiven Effekt für den Post-/ Long-COVID-Patienten hat in Bezug auf Stress, Beruhigung, Atemfrequenz und Atemmuskulatur.

Auszug aus den Ergebnissen* n_{gesamt} = 25



Interessenskonflikt: Diese Studie wurde zu 100% finanziert durch CEGLA Medizintechnik GmbH.

* Data on file (CEGLA Medizintechnik GmbH)

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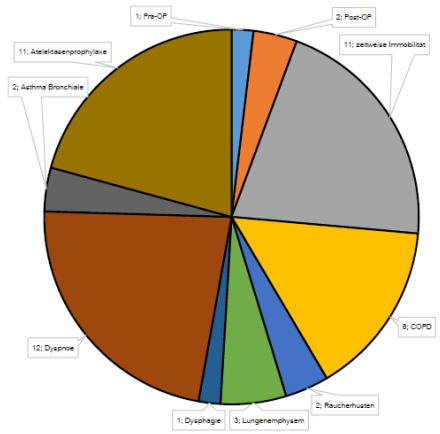
Anwenderbefragung zum Medizinprodukt RC-FIT® CLASSIC – POST-/LONG-*COVID*

Respiratorische Indikationen (n_{gesamt} = 25)



Komorbiditäten

Pneumonie: 2
Intubation: 1
DATIV: 1
Hyperventilationsanfälle: 2
Panikstörung: 1
Fibromyalgie: 1
Niereninsuffizienz: 1
Acute Respiratory Distress Syndrome (ARDS): 1

09/2023

2.3 RC-FIT® OIMT

Anwenderbefragung zum Medizinprodukt RC-FIT® OIMT

Design der Anwenderbefragung

Zielsetzung: Sammlung von Anwender-Einschätzungen zu Produktcharakteristika, die mit der Anwendung des Medizinproduktes RC-FIT® OIMT der Firma CEGLA Medizintechnik assoziiert werden.

Befragte Anwender: Ärzt:innen, Physiotherapeut:innen, Atmungs- und Atemtherapeut:innen, Atemphysiotherapeut:innen, die in Kliniken, Arztpraxen, Atemphysiotherapiezentren tätig sind (gemeinsam „Zentren").

Befragungszeitraum: Dezember 2021 bis Februar 2022.

Anzahl der rückgelaufenen Fragebögen: 32, davon 22 mit der Indikation COVID-19.

Anzahl Zentren mit Fragebogenrücklaufern: 16.

Methode: Fragebogengestützte Anwenderbefragung*. Geschlossene Fragen mit vorgegebenen Antwortoptionen, jeweils nur eine Option ankreuzbar. Auswertung: prozentuale Verteilung (relative Häufigkeit) der Nennung der jeweiligen Antwortoption. Mit abgefragt wurden behandelte respiratorische Indikationen und Komorbiditäten (Mehrfachnennung mögl.).

Ergebnisse

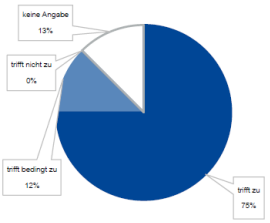
Die Ergebnisse der Anwenderbefragung sind in Auszügen rechts dargestellt. U.a. zeigt sich: Mit 75% rel. Häufigkeit waren die Anwender der Ansicht, dass die Atemmuskulatur in der Kraft und mit 69% ebenfalls in der Ausdauer trainiert wurde. Bei 28% der Nennungen wurde nach Ansicht des Fachpersonals Sekret gelöst; bei 34% verbesserte sich die Sauerstoffsättigung. Auch die Atemfrequenz (nicht grafisch dargestellt) konnte mit 44% rel. Häufigkeit signifikant reduziert werden.

Zusammenfassung

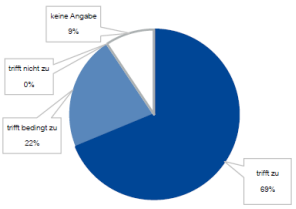
Die Befragung zeigt, dass ein Großteil der Anwender der Meinung ist, dass das RC-FIT® OIMT einen positiven Effekt für den Patienten hat in Bezug auf Kraft und Ausdauer der Einatemmuskulatur, Sekretolyse und in geringerem Maße auf die Sauerstoffsättigung.

Auszug aus den Ergebnissen* $n_{gesamt} = 32$

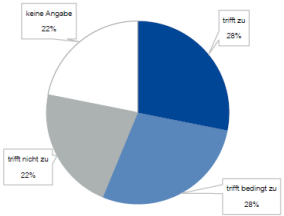
trainiert die Kraft der Einatemmuskulatur



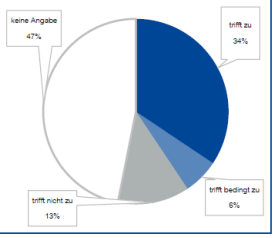
trainiert die Ausdauer der Einatemmuskulatur



löst Sekret



verbessert die Sauerstoffsättigung



Interessenskonflikt: Diese Studie wurde zu 100% finanziert durch CEGLA Medizintechnik GmbH.

* Data on file (CEGLA Medizintechnik GmbH)

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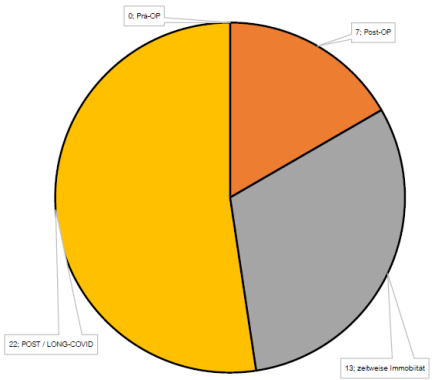
Anwenderbefragung zum Medizinprodukt RC-FIT® OIMT

Respiratorische Indikationen ($n_{gesamt} = 32$)



Komorbiditäten

Pleuraergüsse: 1
Herzinsuffizienz: 1
Narkolepsie: 1
Raucher: 1
Stress: 1
Hyperventilationssyndrom: 1
Migräne: 1
Belastungsdyspnoe: 2
Panikstörung: 1
Alveolitis: 1
Schädelhirntrauma: 1
Spastik (3. Grad): 1
Lungenquetschung: 1
komplette Lungenresektion rechts: 1
Pneumonie: 1
Video-assistierte Thorakoskopie (VATS): 1
Hodgkin-Lymphom: 1
aktuelle Chemotherapie: 1
kardiale Dekompensation: 1
Asthma Bronchiale: 1

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2.4 RC-FIT® OPEP

Anwenderbefragung zum Medizinprodukt RC-FIT® OPEP

Design der Anwenderbefragung

Zielsetzung: Sammlung von Anwender-Einschätzungen zu Produktcharakteristika, die mit der Anwendung des Medizinproduktes RC-FIT® OPEP der Firma CEGLA Medizintechnik assoziiert werden.

Befragte Anwender: Ärzt:innen, Physiotherapeut:innen, Atmungs- und Atemtherapeut:innen, Atemphysiotherapeut:innen, die in Kliniken, Arztpraxen, Atemphysiotherapiezentren tätig sind (gemeinsam „Zentren").

Befragungszeitraum: Dezember 2021 bis Februar 2022.

Anzahl der rückgelaufenen Fragebögen: 46, davon 6 mit der Indikation COVID-19.

Anzahl Zentren mit Fragebogenrückläufern: 20.

Methode: Fragebogengestützte Anwenderbefragung". Geschlossene Fragen mit vorgegebenen Antwortoptionen, jeweils nur eine Option ankreuzbar. Auswertung: prozentuale Verteilung (relative Häufigkeit) der Nennung der jeweiligen Antwortoption. Mit abgefragt wurden behandelte respiratorische Indikationen und Komorbiditäten (Mehrfachnennung mögl.).

Ergebnisse

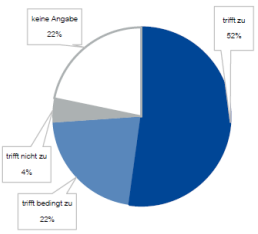
Die Ergebnisse der Anwenderbefragung sind in Auszügen rechts dargestellt. U.a. zeigte sich: Mit 52% rel. Häufigkeit waren die Anwender der Ansicht, dass die Atemnot reduziert wurde; mit 50%, dass Sekret gelöst wurde. Auch die Ausatemhilfsmuskulatur konnte bei 33% der Einschätzungen der Experten trainiert werden. Bei 41% rel. Häufigkeit verbesserte sich die Atemfrequenz deutlich.

Zusammenfassung

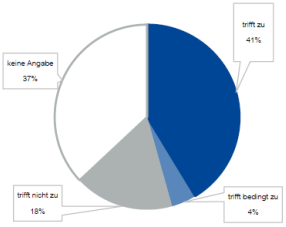
Die Befragung zeigt, dass ein Großteil der Anwender der Meinung ist, dass das RC-FIT® OPEP einen positiven Effekt für den Patienten hat in Bezug auf Sekretolyse, Atemnot, Atemfrequenz und Ausatemhilfsmuskulatur.

Auszug aus den Ergebnissen* $n_{gesamt} = 46$

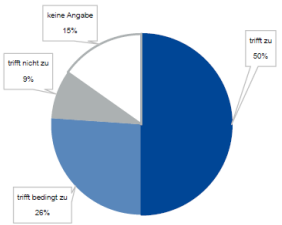
reduziert Atemnot



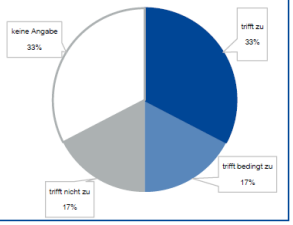
reduziert die Atemfrequenz



löst Sekret



trainiert die Ausatemhilfsmuskulatur



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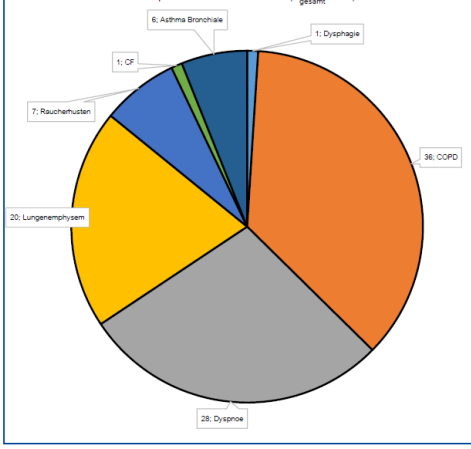
Anwenderbefragung zum Medizinprodukt RC-FIT® OPEP

Respiratorische Indikationen ($n_{gesamt} = 46$)



Komorbiditäten

COVID-19: 2
Post/Long COVID: 4
Schlaganfall: 1
Bronchialkarzinom: 1
OSAS: 4
LTOT-Therapie: 2
Tachyarrhythmia absoluta: 2
koronare Herzkrankheit (KHK): 1
peripheren arteriellen Verschlusskrankheit (PAVK): 2
arterielle Hypertonie: 3
Depressionen: 2
mikrozytäre Anämie: 1
Angiodysplasie des Magens: 1
Demenz: 1
transitorische ischämische Attacke (TIA): 1
Hemiparese rechts1
kardiologisch dekompensiert: 1
Post OP: 1
Pollenallergie: 1
RR erhöht: 1
Alkoholabusus: 1
Nikotinabusus: 1
Acute Respiratory Distress Syndrome (ARDS): 1
Zwerchfellparese rechts: 1
Bullektomie: 1
Fazialisparese + exazerbierte COPD (rezidiv): 1
atypische Pneumonie bei Kollagenose: 1
Obesitas-Hypoventilationssyndrom (OHS): 1
Atelektasen: 1
Vorhofflimmern (VHF): 1
Akute Myeloische Leukämie: 1
Myelodysplastisches Syndrom: 1

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2.5 RC-FIT® PEP/IMT

Anwenderbefragung zum Medizinprodukte RC-FIT® PEP/IMT

Design der Anwenderbefragung

Zielsetzung: Sammlung von Anwender-Einschätzungen zu Produktcharakteristika, die mit der Anwendung des Medizinproduktes RC-FIT® PEP/IMT der Firma CEGLA Medizintechnik assoziiert werden.
Befragte Anwender: Ärzt:innen, Physiotherapeut:innen, Atmungs- und Atemtherapeut:innen, Atemphysiotherapeut:innen, die in Kliniken, Arztpraxen, Atemphysiotherapiezentren tätig sind (gemeinsam „Zentren").
Befragungszeitraum: Dezember 2021 bis Februar 2022.
Anzahl der rückgelaufenen Fragebögen: 35.
Anzahl Zentren mit Fragebogenrückläufern: 20.
Methode: Fragebogengestützte Anwenderbefragung*. Geschlossene Fragen mit vorgegebenen Antwortoptionen, jeweils nur eine Option ankreuzbar. Auswertung: prozentuale Verteilung (relative Häufigkeit) der Nennung der jeweiligen Antwortoption. Mit abgefragt wurden behandelte respiratorische Indikationen und Komorbiditäten (Mehrfachnennung mögl.).

Ergebnisse

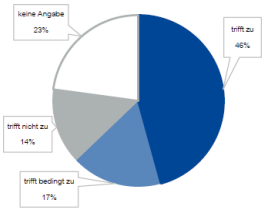
Die Ergebnisse der Anwenderbefragung sind in Auszügen rechts dargestellt. U.a. zeigt sich: Mit 48% rel. Häufigkeit waren die Anwender der Ansicht, dass die Atemmuskulatur in der Kraft und mit 37% Häufigkeit ebenfalls in der Ausdauer trainiert wurde. Mit 37% rel. Häufigkeit befanden die Anwender die Atemnot reduziert. Die Atemfrequenz wurde bei 48% der Nennungen signifikant reduziert.

Zusammenfassung

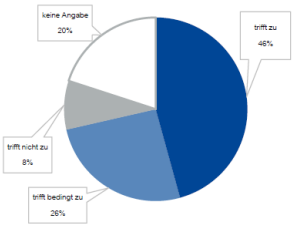
Die Befragung zeigt, dass ein Großteil der Anwender der Meinung ist, dass das RC-FIT® PEP/IMT einen positiven Effekt für den Patienten hat in Bezug auf Atemnot, Atemfrequenz und Atemmuskulatur.

Auszug aus den Ergebnissen* n_{gesamt} = 35

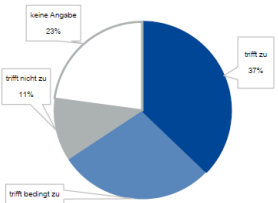
reduziert die Atemfrequenz



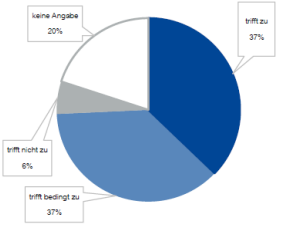
trainiert die Kraft der Atemmuskulatur



reduziert Atemnot



trainiert die Ausdauer der Atemmuskulatur



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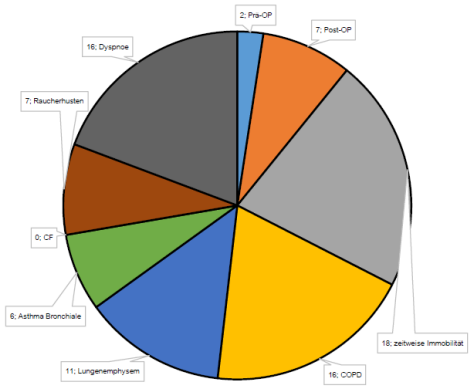
Anwenderbefragung zum Medizinprodukte RC-FIT® PEP/IMT

Respiratorische Indikationen (n_{gesamt} = 35)



Komorbiditäten

POST/LONG COVID: 6
Restriktive Lungenerkrankung: 1
COVID-19: 2
Tracheomalazie: 1
Destroyed Lung: 1
OL-Resektion: 1
koronaren Herzkrankheit (KHK): 1
arterielle Hypertonie: 1
Bypass : 1
Hypothyreose: 1
Epilepsie: 1
Schlaganfall (Apoplex): 2
tiefe Venenthrombose (TVT): 1
Demenz: 1
Adipositas: 1
psychische Belastung: 1
ALS: 1
Polyneuropathie: 1
Diabetes mellitus: 1
beidseitige Pneumonie : 1
respiratorische Insuffizienz: 1
z.n. Tonsillen CA: 1
neck dissection: 1
CRT-D Abfrage: 1
ICD Taschenninfektion: 1
Vorhofflimmern: 1
z.n. Thymustherapie (THX): 1

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3 Studien zur OPEP-Therapie / *studies on OPEP therapy*

3.1 Performance Characteristics of Positive Expiratory Pressure Devices

AUTOR: IN / *AUTHOR*:

Angela M Demchuk and Robert L Chatburn

QUELLE / *SOURCE*:

Respiratory Care, March 2021; Volume 66(3), pages 482-493.

ABSTRAKT / *ABSTRACT*:

Background: Positive expiratory pressure (PEP) therapy imposes expiratory flow resistance to increase airway diameter and enhance mucus clearance. PEP is achieved several ways. Oscillatory PEP devices (OPEP) generate repeated occlusions that are known to reduce mucus viscosity. There are many marketed devices, but comparative performance is mostly unreported. The purpose of this study was to evaluate performance characteristics of many PEP/OPEP devices. For OPEP devices, we defined an optimal performance metric by creating an oscillation index that combines the OPEP performance characteristics.

Methods: PEP devices (TheraPEP, EzPAP, VersaPAP, Resistex, AccuPEP, AccuPAP, and Threshold PEP) and OPEP devices (Acapella DH, Acapella DM, Acapella Choice, ShurClear, Aerobika, VibraPEP, vPEP, and PocketPEP with and without the Oxyjet attachment) were tested by adjusting simulated expiratory flow from 5 L/min to 30 L/min in increments of 5 L/min using a standard flow meter.

Results: All devices showed varying performance characteristics. As expiratory flow increased, mean PEP increased for most devices. The TheraPEP showed a mean PEP of 13 cm H2O across all settings. For OPEP devices, there was a major difference between pressure and flow waveforms. The Acapella DH, ShurClear, and Aerobika showed the highest flow amplitude, flow frequency, and oscillation index.

Conclusions: PEP devices behaved similarly and as expected, with increased pressure with increased flow (flow resistors) or flow independence (threshold resistors). There was much greater variation in the performance of the OPEP devices. A higher oscillation index indicates better mechanical performance characteristics. Many devices have similar characteristics. However, the devices with the highest oscillation index have the highest flow amplitude and frequency, which may indicate better clinical performance.

3.2 Technical Aspects of Devices and Equipment for Positive Expiratory PressureWith and Without Oscillation

Performance Characteristics of Positive Expiratory Pressure Devices

AUTOR: IN / *AUTHOR*:

Monika Fagevik Olse´n, Peter Olofsson, Peter Frejd, Louise Lannefors, and Elisabeth Weste

QUELLE / *SOURCE*:

Respiratory Care May 2021, 66 (5) 862-877

ABSTRAKT / *ABSTRACT*:

BACKGROUND: Breathing exercises with positive expiratory pressure (PEP) and oscillating PEP are common treatments for patients with respiratory impairments. There are several trials evaluating the clinical effects of a variety of commercially available and self-made devices. There is a lack of evaluation concerning technical aspects and construction of the devices. The aims of this review were to describe and compare technical aspects of devices and equipment used for PEP and oscillating PEP as a basis for clinical decisions regarding prescriptions.

METHODS: In this systematic review, we included trials evaluating different technical aspects of devices and equipment for PEP and oscillating PEP until June 2019. The literature search was performed in PubMed, CINAHL, Cochrane Library, Embase and PEDro.

RESULTS: The literature search resulted in 812 studies, which, after being read by 2 independent reviewers, were reduced to 21 trials that matched the inclusion criteria. The achieved PEP is dependent on the given resistance or achieved expiratory flow through the devices and their separate parts. Oscillation frequency in oscillating PEP devices affects the pressure and oscillation amplitude and flow. For some devices, the device's position also has an impact on the outcome. There are similarities and differences among all of the devices, and the equipment components are not interchangeable without changing the achieved PEP levels.

CONCLUSIONS: Many devices are available to provide PEP and oscillating PEP treatment. These devices differ substantially in design as well as in performance. When using PEP devices, it is important to understand how all parts of the devices affect outcomes. An increased understanding of how PEP is produced for the spontaneously breathing patient is important to achieve desired treatment effects.

3.3 Physical Therapist Management of COVID-19 in the Intensive Care Unit: The West China Hospital Experience

AUTOR: IN / *AUTHOR*:

Lei Li, MSc, Pengming Yu, PhD, Mengxuan Yang, MSc, Wei Xie, MM, Liyi Huang, MM, Chengqi He, PhD, Rik Gosselink, PhD, Quan Wei, MD, PhD, Alice Y M Jones, PhD

QUELLE / *SOURCE*:

Physical Therapy, Volume 101, Issue 1, January 2021, pzaa198,

ABSTRAKT / *ABSTRACT*:

Objective: Coronavirus disease 2019 (COVID-19) has dominated the attention of health care systems globally since January 2020. Various health disciplines, including physical therapists, are still exploring the best way to manage this new disease. The role and involvement of physical therapists in the management of COVID-19 are not yet well defined and are limited in many hospitals. This article reports a physical therapy service specially commissioned by the Health Commission of Sichuan Province to manage COVID-19 during patients' stay in the intensive care unit (ICU) at the Public Health Clinical Center of Chengdu in China.

Methods: Patients diagnosed with COVID-19 were classified into 4 categories under a directive from the National Health Commission of the People's Republic of China. Patients in the "severe" and "critical" categories were admitted to the ICU irrespective of mechanical ventilation was required. Between January 31, 2020, and March 8, 2020, a cohort of 16 patients was admitted to the ICU at the Public Health Clinical Center of Chengdu. The median (minimum to maximum) hospital and ICU stays for these patients were 27 (11–46) and 15 (6–38) days, respectively. Medical management included antiviral, immunoregulation, and supportive treatment of associated comorbidities. Physical therapist interventions included body positioning, airway clearance techniques, oscillatory positive end-expiratory pressure, inspiratory muscle training, and mobility exercises. All patients had at least 1 comorbidity. Three of the 16 patients required mechanical ventilation and were excluded for outcome measures that required understanding of verbal instructions. In the remaining 13 patients, respiratory outcomes—including the Borg Dyspnea Scale, peak expiratory flow rate, PAO2/FIO2 ratio, maximal inspiratory pressure, strength outcomes, Medical Research Council Sum Score, and functional outcomes (including the Physical Function in Intensive Care Test score, De Morton Mobility Index, and Modified Barthel Index)—were measured on the first day the patient received the physical therapist intervention and at discharge.

Results: At discharge from the ICU, while most outcome measures were near normal for the majority of the patients, 61% and 31% of these patients had peak expiratory flow rate and maximal inspiratory pressure,

respectively, below 80% of the predicted value and 46% had De Morton Mobility Index values below the normative value.

Conclusion: The respiratory and physical functions of some patients remained poor at ICU discharge, suggesting that long-term rehabilitation may be required for these patients.

Impact: Our experience in the management of patients with COVID-19 has revealed that physical therapist intervention is safe and appears to be associated with an improvement in respiratory and physical function in patients with COVID-19 in the ICU.

3.4 COPD Support Group Using Novel Harmonic Device Study

AUTOR: IN / *AUTHOR*:

Keller D., Keller, M.

QUELLE / *SOURCE*:

Chronic Obstructive Pulmonary Diseases: Journal of the COPD Foundation, Oct. 2015

3.3 The immediate effects of breathing with oscillated inspiratory and expiratory airflows on secretion clearance in intubated patients with cervical spinal cord injury

AUTOR: IN / *AUTHOR*:

Sujittra Kluayhomthong, Chulee Ubolsakka-Jones, Pornanan Domthong, Wipa Reechaipichitkul, David A Jones

QUELLE / *SOURCE*:

Spinal Cord. 2019 Apr;57(4):308-316.

ABSTRAKT / *ABSTRACT*:

Study design: A prospective, randomized crossover trial.

Objectives: To evaluate the efficacy of the combination of incentive spirometry with oscillation (OIS) and positive expiratory pressure with oscillation (OPEP) to promote secretion clearance in intubated patients with cervical spinal cord injury.

Setting: Spinal cord unit, tertiary care hospital, North East Thailand.

Methods: Thirteen intubated patients (C4-7, AIS score C) with secretion retention performed three interventions randomly allocated on consecutive days, a Sham deep breathing, OPEP and OPEP + OIS breathing exercise. Secretions were collected by sterile suction for 3 h before, and 3 h after, each intervention and wet weight recorded. Cardiopulmonary parameters were measured before and after each intervention.

Results: The median (IQR) secretion wet weight pre-intervention was 2.61 g (2.21, 3.85) and in the 3 h after Sham there was an increase of 1.97 g (0.6, 3.6). The increase after OPEP was 2.67 g (1.7, 3.9) and after OPEP + OIS, 4.28 g (2.4, 6.7); all the increases being significant ($p \leq 0.007$). The clearance after OPEP and OPEP + OIS were both greater than Sham while OPEP + OIS was greater than OPEP ($p \leq 0.019$). There were no significant changes in cardiopulmonary measures following any intervention or when compared between interventions.

Conclusions: Deep breathing with an oscillated and humidified air flow in a combination of OIS + OPEP more than doubled secretion clearance and was more effective than OPEP or Sham deep breathing. There were no adverse effects of the procedures which were well tolerated by the patients and may be used to complement existing methods for secretion clearance.

3.5 Effects of treadmill exercise versus Flutter® on respiratory flow and sputum properties in adults with cystic fibrosis: a randomised, controlled, cross-over trial.

AUTOR: IN / *AUTHOR*:

Tiffany J. Dwyer, Rahizan Zainuldin, Evangelia Daviskas, Peter T. P. Bye and Jennifer A. Alison

QUELLE / *SOURCE*:

BMC Pulm Med. 2017 Jan 11;17(1):14. doi: 10.1186/s12890-016-0360-8.

ABSTRAKT / *ABSTRACT*:

Background: Treadmill exercise and airway clearance with the Flutter® device have previously been shown to improve mucus clearance mechanisms in people with cystic fibrosis (CF) but have not been compared. It is therefore not known if treadmill exercise is an adequate form of airway clearance that could replace established airway clearance techniques, such as the Flutter®. The aim of this study was to evaluate respiratory flow, sputum properties and subjective responses of treadmill exercise and Flutter® therapy, compared to resting breathing (control).

Methods: Twenty-four adults with mild to severe CF lung disease (FEV1 28–86% predicted) completed a three-day randomised, controlled, cross-over study. Interventions consisted of 20 min of resting breathing (control), treadmill exercise at 60% of the participant's peak oxygen consumption and Flutter® therapy. Respiratory flow was measured during the interventions. Sputum properties (solids content and mechanical impedance) and subjective responses (ease of expectoration and sense of chest congestion) were measured before, immediately after the interventions and after 20 min of recovery.

Results: Treadmill exercise and Flutter® resulted in similar significant increases in peak expiratory flow, but only Flutter® created an expiratory airflow bias (i.e. peak expiratory flow was at least 10% higher than peak inspiratory flow). Treadmill exercise and Flutter® therapy resulted in similar significant reductions in sputum mechanical impedance, but only treadmill exercise caused a transient increase in sputum hydration. Treadmill exercise improved ease of expectoration and Flutter® therapy improved subjective sense of chest congestion.

Conclusions: A single bout of treadmill exercise and Flutter® therapy were equally effective in augmenting mucus clearance mechanisms in adults with CF. Only longer term studies, however, will determine if exercise alone is an adequate form of airway clearance therapy that could replace other airway clearance techniques.

3.6 Effect of cornet device to clear the excess trachea bronchial secretions in a 45 year old right middle and lower lobe pneumonia patient- a case report

AUTOR: IN / *AUTHOR*:

Muthukumar S, MohanKumar Thekkinkattil

QUELLE / *SOURCE*:

MedCave MOJ Yoga Physical Therapy, 2016; Volume 1: 1-3.

ABSTRAKT / *ABSTRACT*:

45- year old woman diagnosed as right middle and lower lobe pneumonia had been referred for chest physiotherapy to evacuate secretions and to improve oxygenation. The X-ray and Computed tomography findings revealed patchy areas of collapse, consolidation and fibrotic strands in right middle and lower lobes. The physical examination findings also confirmed the signs of consolidation and collapse i.e. decreased air entry on right side and presence of crepitations. Chest physiotherapy mainly aimed to clear the excess trachea bronchial secretions in pneumonia. Chest physiotherapy with the help of positive expiratory device – Cornet was given twice daily for ten days. Cornet device uses the principle of positive expiratory pressure which creates an airway oscillation inside the airways. This causes thinning down of mucus and the patient can expectorate the secretions with the help of cough or huff. The X-ray findings showed improvement in right lower lobe and there was no radiological evidence of consolidation and collapse post chest physiotherapy. The patient responded to treatment well and she was discharged successfully. It is concluded that the present case study advocates the use of Cornet device to clear the excess tracheobronchial secretions. Cornet device is easy to use without any supervision and the patient may use at home also.

3.6 Oscillatory Positive Expiratory Pressure on Respiratory Resistance in Chronic Obstructive Pulmonary Disease With a Small Amount of Secretion A Randomized Clinical Trial

AUTOR: IN / *AUTHOR*:

Gastaldi AC, Paredi P, Talwar A, Meah S, Barnes PJ, Usmani OS

QUELLE / *SOURCE*:

Medicine (Baltimore). 2015 Oct;94(42):e1845. doi: 10.1097/MD.0000000000001845

ABSTRAKT / *ABSTRACT*:

This study aims to evaluate the acute effects of an oscillating positive expiratory pressure device (flutter) on airways resistance in patients with chronic obstructive pulmonary disease (COPD). Randomized crossover study: 15 COPD outpatients from Asthma Lab-Royal Brompton Hospital underwent spirometry, impulse oscillometry (IOS) for respiratory resistance (R) and reactance (X), and fraction exhaled nitric oxide (FeNO) measures.Thirty minutes of flutter exercises: a "flutter-sham" procedure was used as a control, and airway responses after a short-acting bronchodilator were also assessed.Respiratory system resistance (R): in COPD patients an increase in X5insp (-0.21 to -0.33 kPa/L/s) and Fres (24.95 to 26.16 Hz) occurred immediately after flutter exercises without bronchodilator. Following 20 min of rest, a decrease in the R5, ΔR5, R20, X5, and Ax was observed, with R5, R20, and X5 values lower than baseline, with a moderate effect size; there were no changes in FeNO levels or spirometry.The use of flutter can decrease the respiratory system resistance and reactance and expiratory flow limitation in stable COPD patients with small amounts of secretions.

3.7 The use of a modified, oscillating positive expiratory pressure device reduced fever and length of hospital stay in patients after thoracic and upper abdominal surgery: a randomised trial.

AUTOR: IN / *AUTHOR*:

Zhang XY, Wang Q, Zhang S, Tan W, Wang Z, Li J.

QUELLE / *SOURCE*:

J Physiother. 2015 Jan;61(1):16-20. doi: 10.1016/j.jphys.2014.11.013. Epub 2014 Dec 19.

ABSTRAKT / *ABSTRACT*:

Question: Does the use of an oscillating positive expiratory pressure (PEP) device reduce postoperative pulmonary complications in thoracic and upper abdominal surgical patients?

Design: A multi-centre, parallel-group, randomised controlled trial with intention-to-treat analysis, blinding of some outcomes, and concealed allocation.

Participants: A total of 203 adults after thoracic or upper abdominal surgery with general anaesthesia.

Intervention: Participants in the experimental group used an oscillating PEP device, thrice daily for 5 postoperative days. Both the experimental and control groups received standard medical postoperative management and early mobilisation.

Outcome measures: Fever, days of antibiotic therapy, length of hospital stay, white blood cell count, and possible adverse events were recorded for 28 days or until hospital discharge.

Results: The 99 participants in the experimental group and 104 in the control group were well matched at baseline and there was no loss to follow-up. Fever affected a significantly lower percentage of the experimental group (22%) than the control group (42%), with a RR of 0.56 (95% CI 0.36 to 0.87, NNT 6). Similarly, length of hospital stay was significantly shorter in the experimental group, at 10.7 days (SD 8.1), than in the control group, at 13.3 days (SD 11.1); the mean difference was 2.6 days (95% CI 0.4 to 4.8). The groups did not differ significantly in the need for antibiotic therapy, white blood cell count or total expense of treatment.

Conclusion: In adults undergoing thoracic and upper abdominal surgery, postoperative use of an oscillating PEP device resulted in fewer cases of fever and shorter hospital stay. However, antibiotic therapy and total hospital expenses were not significantly reduced by this intervention.

3.8 Oscillating Positive Expiratory Pressure Therapy in Chronic Obstructive Pulmonary Disease and Bronchiectasis

AUTOR: IN / *AUTHOR*:

S. Svenningsen, G. Paulin, A. Wheatley, D. Pike, J. Suggett, D. McCormack, G. Parraga

QUELLE / *SOURCE*:

European Respiratory Journal 2014 44: P3679

ABSTRAKT / *ABSTRACT*:

RATIONALE: Airway clearance methods such as oscillating positive expiratory pressure (oPEP) are proposed to provide benefit in patients with chronic obstructive pulmonary disease (COPD) and bronchiectasis by mobilizing secretions and enhancing mucous movement.

METHODS: A six-week cross-over study was completed in 29 subjects (n=15 COPD, n=14 bronchiectasis) who provided written informed consent and were randomized to oPEP therapy (Aerobika®, Trudell Medical International) four-times daily. Pulmonary function tests, the Six Minute Walk distance (6MWD), St George's Respiratory Questionnaire (SGRQ) and the Patient Evaluation Questionnaire (PEQ) were used to evaluate therapy effects.

RESULTS: There were no adverse events related to oPEP use. There were statistically significant improvements in 6MWD (p=0.01), SGRQ total score (p=0.01), and the PEQ Cough Frequency (p=0.006), dyspnea (p=0.03) and ease in bringing up sputum (p<0.0001).

CONCLUSIONS: In subjects with COPD and bronchiectasis, three weeks of oPEP therapy (Aerobika®) was well-tolerated and there was improved dyspnea, quality of life, exercise capacity and ease in bringing up sputum.

3.9 Physiotherapy treatment in cystic fibrosis: airway clearance techniques

AUTOR: IN / *AUTHOR*:

S. Ammani Prasad, MCSP, Tamara Orska, MCSP, Kate Ferguson, MCSP, Penny Agent, MCSP and Mary Dodd, FCSP on behalf of the Association of Chartered Physiotherapists in Cystic Fibrosis. Updated by Elaine Dhouieb MCSP and Alison Gates MCSP.

QUELLE / *SOURCE*:

Cystic Fibrosis our focus, 2011, S.9-10

ABSTRAKT / *ABSTRACT*:

"The RC-Cornet® consists of a curved hard plastic tube within which sits a soft flexible rubber tube. It works in a very similar way as the flutter, producing a vibration and PEP effect in the airways. The degree of PEP and vibration can be altered by changing the twist in the rubber tube. The RC-Cornet® can be used in any treatment position and like the flutter a combination of breathing techniques are used to help to move and clear secretions".

3.10 Ist Atemphysiotherapie evidenzbasierte Therapie?

(only in German language available)

AUTOR: IN / *AUTHOR*:

U.H. Cegla

QUELLE / *SOURCE*:

Atemwegs- und Lungenkrankheiten, Jahrgang 36, NR. 5/2010, S.205-216

ABSTRAKT / *ABSTRACT*:

Von der heutigen Therapie wird verlangt, dass sie evidenzbasiert ist, das heißt ihre Wirksamkeit muss durch klinische Studien, die festgelegten statistischen Anforderungen genügen, bewiesen sein. Für die oszillierenden PEP-Geräte (Flutter, RC-Cornet® und Acapella) ist diese “Wirksamkeit” bewiesen. Die einzelnen Geräte zeigen bei unterschiedlicher Einstellung bzw. Neigung (Flutter) bei gleich großem Atemdruck unterschiedliche Flüsse und Frequenzen. Darüber hinaus ist bei den einzelnen Geräten je nach Einstellung auch der entstehende positive Ausatemdruck (PEP) im Sinne eines dauerpositiven Drucks, wie bei der PEP-Maske (statischer PEP), bzw. kombinierter PEP (Dauer positiver Druck mit aufgesetzten Druckschwankungen) oder dynamischer PEP (der Druck steigt von Null auf ein Maximum und fällt auf Null zurück) zu erreichen. Auch das zeitliche Verhalten des PEP-Anstiegs kann durch die Geräteeinstellungen beeinflusst werden (symmetrischer PEP, meist in Form einer Sinusschwingung, und asymmetrischer PEP, bei dem der Druck langsam ansteigt, um dann abrupt abzufallen). Das Druck- und Frequenzverhalten der einzelnen oszillierenden PEP-Geräte bei steigendem Druck wurde untersucht. Bei Normalpersonen wurde an den oszillierenden PEP-Geräten in verschiedenen Einstellungen der als “angenehm empfundene Druck” ermittelt; dieser lag deutlich höher (etwa ein Drittel) als bei einer Gruppe von 50 obstruktiven Patienten, bei denen der jeweils aufgebrachte Druck beim Blasen in die verschiedenen Einstellungen des RC-Cornet® gemessen wurde. Anhand der entstehenden unterschiedlichen PEP-Druck-Formen werden Vorschläge zur Einstellung der Geräte zur Therapie unterschiedlicher Störungen gemacht. Die Durchsicht der bestehenden Literatur zeigt, dass die Therapie mit oszillierenden PEP-Geräten evidenzbasiert ist.

3.11 Influence that oscillating positive expiratory pressure using predetermined expiratory pressures has on the viscosity and transportability of sputum in patients with bronchiectasis

AUTOR: IN / *AUTHOR*:

Ramos EM, Ramos D, Iyomasa DM, Moreira GL, Melegati KC, Vanderlei LC, Jardim JR, Oliveira AS

QUELLE / *SOURCE*:

J Bras Pneumol. 2009 Dec;35(12):1190-7

ABSTRAKT / *ABSTRACT*:

OBJECTIVE: To determine the effectiveness of oscillating positive expiratory pressure (OPEP) using predetermined expiratory pressures on the viscosity and transportability of sputum in patients with bronchiectasis. METHODS: The study involved 15 stable patients with bronchiectasis (7 males; mean age = 53 +/- 16 years), submitted to two consecutive OPEP interventions, with a 24-h interval between the two, using positive expiratory pressures set at 15 cmH2O (P15) and 25 cmH2O (P25). The protocol consisted of a voluntary cough; another voluntary cough 20 min later, designated time zero (T0); a 10-min rest period; and two 10-min series (S1 and S2, using OPEP at P15 and P25 in both), with a 10-min interval between the two. The viscosity and transportability of sputum were evaluated by viscometry, relative transport velocity on frog palate, transport in a simulated cough machine and contact angle. Sputum samples were collected at T0, after S1 and after S2. Specific statistical tests were performed depending on the type of data distribution. RESULTS: In comparison with the values obtained at T0, sputum viscosity decreased significantly after S1 at P15 and after S2 at P25. There were no significant differences among all of the samples in terms of transportability. CONCLUSIONS: The fact that sputum viscosity decreased whether OPEP was performed at P15 or at P25 suggests that there is no need to generate high expiratory pressure to achieve the desired result.

3.12 Ambulante Physiotherapie bei Patienten mit COPD Outpatient physiotherapy for COPD sufferers

AUTOR: IN / *AUTHOR*:

S. Weise, D. Pfeiffer-Kascha

QUELLE / *SOURCE*:

Atemwegs-und Lungenkrankheiten, 2008, Dustri-Verlag, Jahrgang 24 (33-42)

ABSTRAKT / *ABSTRACT*:

Ambulante Physiotherapie bei Patienten mit COPD

Ziel physiotherapeutischer Behandlungen ist es, zur Ver besse rung der Lebensqualität dieser Patienten beizutragen. Betroffene lernen, ein einfaches Verständnis der Pathomechanismen zu entwickeln und ihren Zustand mit Hilfe eines individuell abgestimmten Selbsthilfe-programms zu stabilisieren und so vorhersehbaren Fehlentwicklungen von Lunge und Atempumpe rechtzeitig entgegen zu wir ken. Durch Selbsthilfetechniken lernen Patienten, die Atemwege in Ruhe und unter körperlicher Belastung offen zu halten, Lungenüberblähung zu reduzieren, das Zwerchfell mobiler und kräftiger zu halten, die Atemwege effektiv und kraftsparend zu reinigen, so wie unproduktiven Reizhusten zu dämpfen. Auf diese Weise können die Atemnot reduziert und eine Verbesserung der allgemeinen körperlichen Leistungsfähigkeit erzielt werden. (...) Zur Entblähung der Lunge werden Techniken zum Offenhalten der Atemwege bei forcierter Ausatmung eingesetzt. Diese PEP-Techniken (positive expiratory pressure technique) werden mit körpereigenen Stenosen und Fremdstenosen geschult. Zur Selbsthilfe wird der Einsatz der dosierten Lippenbremse in Ruhe und in modifizierter Form unter Belastung vermittelt. In Länge und Durchmesser individuellangepasste Strohhalmstücke haben sich im Alltag als exspiratorische Stenose sehr bewährt. Bei Bedarf werden Patienten mit PEP-Geräten vertraut gemacht, beispielsweise Pari-PEPSystem® und BA-Tube als auch mit oszillierenden PEP-Geräten wie VRP1® Flutter, RC-Cornet®, Acapella®.

Physiotherapy for COPD sufferers is aimed at in creasing their quality of life. Patients should develop a simple under standing of the pathological mechanisms under lying COPD and learn to stabilise their condition through a selfmanagement program tailored to their individual needs, which counteracts predictable maladaptations of the lung and ventilatory pump. Self-management techniques reduce pulmonary hyper inflation, maintain strength and mobility of the diaphragm, allow efficient and energy conserving clearance of the airways, ameliorate non productive dry coughes and enable patients to keep their airways open both at rest and during physical activity. This helps to reduce dispnoea and to increase physical stamina.

3.13 Physikalische Therapie bei COPD - Evidence Based Medicine?

Physical Therapy in COPD - Evidence Based Medicine?

AUTOR: IN / *AUTHOR*:

SteierJ., Petro W.

QUELLE / *SOURCE*:

Pneumologie 2002, Jahrgang 56, S.388-396

ABSTRAKT / *ABSTRACT*:

(...) Ein weiteres Prinzip zur Lockerung des intrabronchialen Schleims sind die exspiratorisch benutzten Geräte, die eine Oszillation der Luftsäule bei positivem intrabronchialen Druck bewirken. Die Absicht liegt darin, die Viskosität des Schleims, den Hustenreiz, Atemwegswiderstand und die Dyspnoe zu vermindern und das FEV1 zu erhöhen.

Es existieren zwei verschiedene Systeme: der sogenannte Flutter (VRP-1 Desitin) und das RC-Cornet®. Das RC-Cornet® bietet dabei Vorteile, da es lageunabhängig verwendet werden kann und sich daher auch zur physikalischen Anwendungen (z.B. Lagerungsdrainage) anbietet, während der Flutter aufgrund seiner inseitigen Kugel nur in senkrechter Haltung zu verwenden ist. Außerdem können beim RC-Cornet® verschiedene Positionen des Mundstücks voreingestellt werdendie eine Variation der erzeugten Druckform zwischen peak to zero und Dauer-PEP mit aufgesetzten Druckschwankungen ermöglichen. (...)

Several therapeutical options of physical therapy in COPD show significant effects on the organism. Some of those effects are verified, but there is still an uncertainty about the exact influences on the disease and the beneficial outcome, especially because different trials describe contradictory results. Existing studies observed an improved respiratory mechanism with a more economical ventilatory work and a better gas exchange by use of physical therapy. Therefore the right indication for certain options of physical therapy should be defined, so that

the outcome can be controlled and a benefit can be drawn from the effects. Sufficient data of existing trials for the whole physical therapy in COPD is still deficient. Due to an inappropriate study design and/or the number of observed patients a lot of clinical studies are not qualified to lead to significant results and recommenda-

tions. For the future it is necessary to investigate the exact effects of physical therapy with controlled, randomised, clinical trials further on. Hereby an improvement of the care of patients with COPD can be achieved andthebeneficial effectsand theoutcome with physical therapy can better be estimated.

4 Studien zur PEP-Therapie / *studies on PEP therapy*

4.1 Leitlinie Idiopatisches Parkinson Syndrom

AUTOR: IN / *AUTHOR*:

Deutsche Gesellschaft für Neurologie (DGN)

QUELLE / *SOURCE*:

2016; S. 215

ABSTRAKT / *ABSTRACT*:

4.2 Aspiration and swallowing in Parkinson disease and rehabilitation with EMST: a randomized trial.

AUTOR: IN / *AUTHOR*:

Troche MS, Okun MS, Rosenbek JC, Musson N, Fernandez HH, Rodriguez R, et al.

QUELLE / *SOURCE*:

Neurology 2010 Nov 23;75(21):1912-9.

ABSTRAKT / *ABSTRACT*:

Objective: Dysphagia is the main cause of aspiration pneumonia and death in Parkinson disease

(PD) with no established restorative behavioral treatment to date. Reduced swallow safety may

be related to decreased elevation and excursion of the hyolaryngeal complex. Increased submen tal muscle force generation has been associated with expiratory muscle strength training (EMST)

and subsequent increases in hyolaryngeal complex movement provide a strong rationale for its use as a dysphagia treatment. The current study's objective was to test the treatment outcome of

a 4-week device-driven EMST program on swallow safety and define the physiologic mechanisms through measures of swallow timing and hyoid displacement.

Methods: This was a randomized, blinded, sham-controlled EMST trial performed at an academic center. Sixty participants with PD completed EMST, 4 weeks, 5 days per week, for 20 minutes

per day, using a calibrated or sham, handheld device. Measures of swallow function including judgments of swallow safety (penetration–aspiration [PA] scale scores), swallow timing, and hyoid

movement were made from videofluoroscopic images.

Results: No pretreatment group differences existed. The active treatment (EMST) group demon strated improved swallow safety compared to the sham group as evidenced by improved PA scores. The EMST group demonstrated improvement of hyolaryngeal function during swallowing, findings not evident for the sham group.

Conclusions: EMST may be a restorative treatment for dysphagia in those with PD. The mechanism may be explained by improved hyolaryngeal complex movement.

4.3 Expiratory and expiratory plus inspiratory muscle training improves respiratory muscle strenght in subjects with COPD: systematic review

AUTOR: IN / *AUTHOR*:

Neves L., Reis M., Plentz R, Matte D., Coronel C., Sbruzzi G.

QUELLE / *SOURCE*:

Respir Care . 2014 Sep;59(9):1381-8.

ABSTRAKT / *ABSTRACT*:

BACKGROUND: Inspiratory muscle training (IMT) produces beneficial effects in COPD subjects, but the effects of expiratory muscle training (EMT) and EMT plus IMT in ventilatory training are still unclear. The aim of this study was to systematically review the effects of EMT and EMT plus IMT compared to control groups of COPD subjects.

METHODS: This study is a systematic review and meta-analysis. The search strategy included MEDLINE, Embase, LILACS, PEDro, and Cochrane CENTRAL and also manual search of references in published studies on the subject. Randomized trials comparing EMT and EMT plus IMT versus control groups of subjects with COPD were included. The outcomes analyzed were respiratory muscle strength and functional capacity. Two reviewers independently extracted the data.

RESULTS: The search retrieved 609 articles. Five studies were included. We observed that EMT provided higher gain in maximum expiratory pressure (PEmax 21.49 cm H2O, 95% CI 13.39–29.59) and maximum inspiratory pressure (PImax 7.68 cm H2O, 95% CI 0.90–14.45) compared to control groups. There was no significant difference in the 6-min walk test distance (29.01 m, 95% CI −39.62 to 97.65) and dyspnea (0.15, 95% CI −0.77 to 1.08). In relation to EMT plus IMT, we observed that PEmax (31.98 cm H2O, 95% CI 26.93–37.03) and PImax (27.98 cm H2O, 95% CI 20.10–35.85) presented higher values compared to control groups.

CONCLUSIONS: EMT and EMT plus IMT improve respiratory muscle strength and can be used as part of the treatment during pulmonary rehabilitation of subjects with severe to very severe COPD.

4.4 Effect of respiratory muscle training on exercise performance in healthy individuals: a systematic review and meta-analysis

AUTOR: IN / *AUTHOR*:

Illi, Sabine K ; Held, Ulrike ; Frank, Irène ; Spengler, Christina M

QUELLE / *SOURCE*:

Sports Med. 2012;42: 707–724.

ABSTRAKT / *ABSTRACT*:

Objectives: Two distinct types of specific respiratory muscle training (RMT), i.e. respiratory muscle strength (resistive/threshold) and endurance (hyperpnoea) training, have been established to improve the endurance performance of healthy individuals. We performed a systematic review and meta-analysis in order to determine the factors that affect the change in endurance performance after RMT in healthy subjects.

Data sources: A computerized search was performed without language restriction in MEDLINE, EMBASE and CINAHL and references of original studies and reviews were searched for further relevant studies.

Review methods: RMT studies with healthy individuals assessing changes in endurance exercise performance by maximal tests (constant load, time trial, intermittent incremental, conventional [non-intermittent] incremental) were screened and abstracted by two independent investigators. A multiple linear regression model was used to identify effects of subjects' fitness, type of RMT (inspiratory or combined inspiratory/expiratory muscle strength training, respiratory muscle endurance training), type of exercise test, test duration and type of sport (rowing, running, swimming, cycling) on changes in performance after RMT. In addition, a meta-analysis was performed to determine the effect of RMT on endurance performance in those studies providing the necessary data.

Results: The multiple linear regression analysis including 46 original studies revealed that less fit subjects benefit more from RMT than highly trained athletes (6.0% per 10 mL · kg^{-1} · min^{-1} decrease in maximal oxygen uptake, 95% confidence interval [CI] 1.8, 10.2%; p = 0.005) and that improvements do not differ significantly between inspiratory muscle strength and respiratory muscle endurance training (p = 0.208), while combined inspiratory and expiratory muscle strength training seems to be superior in improving performance, although based on only 6 studies (+12.8% compared with inspiratory muscle strength training, 95% CI 3.6, 22.0%; p = 0.006). Furthermore, constant load tests (+16%, 95% CI 10.2, 22.9%) and intermittent incremental tests (+18.5%, 95% CI 10.8, 26.3%) detect changes in endurance performance better than conventional incremental tests (both p

< 0.001) with no difference between time trials and conventional incremental tests (p = 0.286). With increasing test duration, improvements in performance are greater (+0.4% per minute test duration, 95% CI 0.1, 0.6%; p = 0.011) and the type of sport does not influence the magnitude of improvements (all p > 0.05). The meta-analysis, performed on eight controlled trials revealed a significant improvement in performance after RMT, which was detected by constant load tests, time trials and intermittent incremental tests, but not by conventional incremental tests.

Conclusion: RMT improves endurance exercise performance in healthy individuals with greater improvements in less fit individuals and in sports of longer durations. The two most common types of RMT (inspiratory muscle strength and respiratory muscle endurance training) do not differ significantly in their effect, while combined inspiratory/expiratory strength training might be superior. Improvements are similar between different types of sports. Changes in performance can be detected by constant load tests, time trials and intermittent incremental tests only. Thus, all types of RMT can be used to improve exercise performance in healthy subjects but care must be taken regarding the test used to investigate the improvements.

4.5 PILOT STUDY: HYOLARYNGEAL MUSCLE ACTIVATION IN RESPONSE TO RMT USING THE BREATHER

AUTOR: IN / *AUTHOR*:

Matthew Dumican, M.S. CCC-SLP; Christopher Watts, Ph.D.

QUELLE / *SOURCE*:

Poster Presentation – DYSPHAGIA RESEARCH SOCIETY, 2019, San Diego, CA

4.6 Respiratory rehabilitation in elderly patients with COVID-19: A randomized controlled study

AUTOR: IN / *AUTHOR*:

Kai Liu a, Weitong Zhang, Yadong Yang, Jinpeng Zhang, Yunqian Li, Ying Chen

QUELLE / *SOURCE*:

Complementary Therapies in Clinical Practice Volume 39, May 2020, 101166

ABSTRAKT / *ABSTRACT*:

Background: Different degrees of disorders are reported in respiratory function, physical function and psycho logical function in patients with corona virus disease 2019 (COVID-19), especially in elderly patients. With the experience of improved and discharged COVID-19 patients, timely respiratory rehabilitation intervention may

improve prognosis, maximize functional preservation and improve quality of life (QoL), but there lacks of studies worldwide exploring the outcome of this intervention.

Objective: To investigate the effects of 6-week respiratory rehabilitation training on respiratory function, QoL, mobility and psychological function in elderly patients with COVID-19.

Methods: This paper reported the findings of an observational, prospective, quasi-experimental study, which totally recruited 72 participants, of which 36 patients underwent respiratory rehabilitation and the rest without any rehabilitation intervention. The following outcomes were measured: pulmonary function tests including

plethysmography and diffusing lung capacity for carbon monoxide (DLCO), functional tests (6-min walk distance test), Quality of life (QoL) assessments (SF-36 scores), activities of daily living (Functional Independence Mea sure, FIM scores), and mental status tests (SAS anxiety and SDS depression scores).

Results: After 6 weeks of respiratory rehabilitation in the intervention group, there disclosed significant differ ences in FEV1(L), FVC(L), FEV1/FVC%, DLCO% and 6-min walk test. The SF-36 scores, in 8 dimensions, were statistically significant within the intervention group and between the two groups. SAS and SDS scores in the intervention group decreased after the intervention, but only anxiety had significant statistical significance

within and between the two groups.

Conclusions: Six-week respiratory rehabilitation can improve respiratory function, QoL and anxiety of elderly patients with COVID-19, but it has little significant improvement on depression in the elderly.

4.7 Impact of Expiratory Strength Training in Amyotrophic Lateral Sclerosis

AUTOR: IN / *AUTHOR*:

Emily K. Plowman, Ph.D, Stephanie A. Watts, M.S., Lauren Tabor, M.S., Raele Robison, B.S., Joy Gaziano, M.S., Amanda S. Domer, M.S., Joel Richter, M.D., Tuan Vu, M.D., and Clifton Gooch, M.D.

QUELLE / *SOURCE*:

Muscle Nerve 2016 Jun;54(1):48-53.

ABSTRAKT / *ABSTRACT*:

Introduction: We evaluated the feasibility and impact of Expiratory Muscle Strength Training (EMST) on respiratory and bulbar function in persons with amyotrophic lateral sclerosis (ALS).

Methods: 25 ALS patients participated in this delayed intervention open-label clinical trial. Following a lead-in period, patients completed a 5-week EMST protocol. Outcome measures included: maximum expiratory pressure (MEP), physiologic measures of swallow and cough, and Penetration-Aspiration Scale (PAS) scores.

Results: Of those participants who entered the active phase of the study (n=15), EMST was well tolerated and led to significant increases in MEPs and maximum hyoid displacement during swallowing post-EMST ($P<0.05$). No significant differences were observed for PAS scores or cough spirometry measures.

Discussion: EMST was feasible and well tolerated in this small cohort of ALS patients and led to improvements in expiratory force-generating pressures and swallow kinematics. Further investigation is warranted to confirm these preliminary findings.

4.8 Rehabilitation of Swallowing and Cough Functions Following Stroke: An Expiratory Muscle Strength Training Trial

AUTOR: IN / *AUTHOR*:

Hegland KW, Davenport PW, Brandimore AE, Singletary FF, Troche MS.

QUELLE / *SOURCE*:

Arch Phys Med Rehabil. 2016;97: 1345–1351

ABSTRAKT / *ABSTRACT*:

Objective: To determine the effect of expiratory muscle strength training (EMST) on both cough and swallow function in stroke patients.

Design: Prospective pre-post intervention trial with 1 participant group.

Setting: Two outpatient rehabilitation clinics.

Participants: Adults (N=14) with a history of ischemic stroke in the preceding 3 to 24 months.

Intervention: EMST. The training program was completed at home and consisted of 25 repetitions per day, 5 days per week, for 5 weeks.

Main outcome measures: Baseline and posttraining measures were maximum expiratory pressure, voluntary cough airflows, reflex cough challenge to 200μmol/L of capsaicin, sensory perception of urge to cough, and fluoroscopic swallow evaluation. Repeated measures and 1-way analyses of variance were used to determine significant differences pre- and posttraining.

Results: Maximum expiratory pressure increased in all participants by an average of 30cmH2O posttraining. At baseline, all participants demonstrated a blunted reflex cough response to 200μmol/L of capsaicin. After 5 weeks of training, measures of urge to cough and cough effectiveness increased for reflex cough; however, voluntary cough effectiveness did not increase. Swallow function was minimally impaired at baseline, and there were no significant changes in the measures of swallow function posttraining.

Conclusions: EMST improves expiratory muscle strength, reflex cough strength, and urge to cough. Voluntary cough and swallow measures were not significantly different posttraining. It may be that stroke patients benefit from the training for upregulation of reflex cough and thus improved airway protection.

3.9 Muscle Impairment in Neuromuscular Disease Using an Expiratory/Inspiratory Pressure Ratio

AUTOR: IN / *AUTHOR*:

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QUELLE / *SOURCE*:

Respiratory Care April 2015, 60 (4) 533-539

ABSTRAKT / *ABSTRACT*:

BACKGROUND: Neuromuscular diseases (NMDs) lead to different weakness patterns, and most patients with NMDs develop respiratory failure. Inspiratory and expiratory muscle strength can be measured by maximum static inspiratory pressure (PImax) and maximum static expiratory pressure (PEmax), and the relationship between them has not been well described in healthy subjects and subjects with NMDs. Our aim was to assess expiratory/inspiratory muscle strength in NMDs and healthy subjects and calculate PEmax/PImax ratio for these groups.

METHODS: Seventy (35 males) subjects with NMDs (amyotrophic lateral sclerosis, myasthenia gravis, and myotonic dystrophy), and 93 (47 males) healthy individuals 20–80 y of age were evaluated for anthropometry, pulmonary function, PImax, and PEmax, respectively.

RESULTS: Healthy individuals showed greater values for PImax and PEmax when compared with subjects with NMDs. PEmax/PImax ratio for healthy subjects was 1.31 ± 0.26, and PEmax%/PImax% was 1.04 ± 0.05; for subjects with NMDs, PEmax/PImax ratio was 1.45 ± 0.65, and PEmax%/PImax% ratio was 1.42 ± 0.67. We found that PEmax%/PImax% for myotonic dystrophy was 0.93 ± 0.24, for myasthenia gravis 1.94 ± 0.6, and for amyotrophic lateral sclerosis 1.33 ± 0.62 when we analyzed them separately. All healthy individuals showed higher PEmax compared with PImax. For subjects with NMDs, the impairment of PEmax and PImax is different among the 3 pathologies studied ($P < .001$).

CONCLUSIONS: Healthy individuals and subjects with NMDs showed higher PEmax in comparison to PImax regarding the PEmax/PImax ratio. Based on the ratio, it is possible to state that NMDs show different patterns of respiratory muscle strength loss. PEmax/PImax ratio is a useful parameter to assess the impairment of respiratory muscles in a patient and to customize rehabilitation and treatment.

4.10 High-Frequency Airway Oscillating Device for Respiratory Muscle Training in Subjects With COPD

AUTOR: IN / *AUTHOR*:

Enya Daynes, Neil J Greening, Theresa C Harvey-Dunstan, Sally J Singh

QUELLE / *SOURCE*:

Respir Care. 2018 May;63(5):584-590. doi: 10.4187/respcare.05837. Epub 2018 Mar 13.

ABSTRAKT / *ABSTRACT*:

Background: COPD is characterized by expiratory flow limitation, which results in symptomatic dyspnea and reduced exercise capacity. Changes in breathing mechanics mean the respiratory muscles are unable to respond to the ventilatory demands, increasing the sensation of dyspnea. A high-frequency oscillating device has been developed to improve dyspnea in patients with COPD. We conducted a feasibility trial to gain insight into the potential for recruitment, retention, and study design for a future randomized controlled trial.

Methods: Symptomatic subjects with COPD were included on the basis of a Medical Research Council (MRC) score ≥ 3 and FEV1/FVC < 0.70). Patients were excluded if they received pulmonary rehabilitation within the last 6 months. The intervention employed the device for 8 weeks, 3 times daily. Clinical outcomes included the MRC score, maximal expiratory and inspiratory pressures (PEmax/PImax), the incremental shuttle walk test (ISWT), and the endurance shuttle walk test (ESWT).

Results: We successfully recruited 23 subjects with established COPD (65.2% male, mean age 65 ± 5.03 y, mean % predicted FEV1 43.9 ± 16, mean FEV1/FVC ratio 0.46 ± 0.13, and median [interquartile range] MRC 4 [3-5]). There was a significant change in MRC from 4 to 3 pre to post intervention (P = .003). There was a statistically significant difference in PEmaxP < .008 and PImaxP = .044. There were no significant differences observed in the ISWT or ESWT.

Conclusions: This study design appeared feasible to proceed to a clinical effectiveness trial. The use of the device for 8 weeks showed a significant improvement in PEmax, PImax, and reduced symptomatic dyspnea on the MRC dyspnea score. The results of this study should encourage a randomized controlled trial.

4.11 Effects of a simple prototype respiratory muscle trainer on respiratory muscle strength, quality of life and dyspnea, and oxidative stress in COPD patients: a preliminary study

AUTOR: IN / *AUTHOR*:

Jirakrit Leelarungrayub, Decha Pinkaew, Rungthip Puntumetakul, Jakkrit Klaphajone

QUELLE / *SOURCE*:

Int J Chron Obstruct Pulmon Dis. 2017 May 12;12:1415-1425. doi: 10.2147/COPD.S131062. eCollection 2017.

ABSTRAKT / *ABSTRACT*:

Background: The aim of this study was to evaluate the efficiency of a simple prototype device for training respiratory muscles in lung function, respiratory muscle strength, walking capacity, quality of life (QOL), dyspnea, and oxidative stress in patients with COPD.

Methods: Thirty COPD patients with moderate severity of the disease were randomized into three groups: control (n=10, 6 males and 4 females), standard training (n=10, 4 males and 6 females), and prototype device (n=10, 5 males and 5 females). Respiratory muscle strength (maximal inspiratory pressure [PImax] and maximal expiratory pressure [PEmax]), lung function (forced vital capacity [FVC], percentage of FVC, forced expiratory volume in 1 second [FEV1], percentage of FEV1 [FEV1%], and FEV1/FVC), 6-minute walking distance (6MWD), QOL, and oxidative stress markers (total antioxidant capacity [TAC]), glutathione (GSH), malondialdehyde (MDA), and nitric oxide (NO) were evaluated before and after 6 weeks of training. Moreover, dyspnea scores were assessed before; during week 2, 4, and 6 of training; and at rest after training.

Results: All parameters between the groups had no statistical difference before training, and no statistical change in the control group after week 6. FVC, FEV1/FVC, PImax, PEmax, QOL, MDA, and NO showed significant changes after 6 weeks of training with either the standard or prototype device, compared to pre-training. FEV1, FEV1%, 6MWD, TAC, and GSH data did not change statistically. Furthermore, the results of significant changes in all parameters were not statistically different between training groups using the standard and prototype device. The peak dyspnea scores increased significantly in week 4 and 6 when applying the standard or prototype device, and then lowered significantly at rest after 6 weeks of training, compared to pre-training.

Conclusion: This study proposes that a simple prototype device can be used clinically in COPD patients as a standard device to train respiratory muscles, improving lung function and QOL, as well as involving MDA and NO levels.

4.12 THE EFFECTS OF RESPIRATORY MUSCLE TRAINING ON VO2 MAX, THE VENTILATORY THRESHOLD AND PULMONARY FUNCTION

AUTOR: IN / *AUTHOR*:

William E. Amonette, Terry L. Dupler

QUELLE / *SOURCE*:

JEPonline.2002;5(2):29-35

ABSTRAKT / *ABSTRACT*:

This study evaluated the effect of inspiratory and expiratory muscle training on pulmonary function and maximal exercise performance in competitive triathletes and marathon runners. The participants in this study (N=12) had a mean weekly aerobic training time of 7.5 hours per week of swimming, cycling, or running. Eight subjects were assigned to a pulmonary resistance treatment group and four control subjects were given a sham device that allowed no greater than 15% resistance on inspiration or expiration. The subjects performed 30 maximal inhalation/exhalation maneuvers on their respective devices two times per day for fourweeks. The subjects were tested for forced vital capacity (FVC), forced expiratory volume in one second (FEV1), FEV1/FVC ratio, forced inspiratory vital capacity (FIVC), peak inspiratory flow rate (PIFR), and peak expiratory flow rate (PEFR). Each subject was also tested for peak exhalation force (PEF) as well as a maximal oxygen consumption (VO2 max), carbon dioxide production (VCO2), tidal volume (VT), ventilation (VE), ventilatory threshold (VT), and respiration rate (RR). The data revealed that training using the pulmonary resistance device produced significant increases in maximal VE and maximal VT while decreasing RR (although not statistically significant) at maximum exercise. However, no significant changes were seen in VO2 or any pulmonary function variables measured.

4.13 Respiratory muscle training improves swimming endurance in divers

AUTOR: IN / *AUTHOR*:

Juli A. Wylegala, David R. Pendergast, Luc E. Gosselin, Dan E. Warkander & Claes E. G. Lundgren

QUELLE / *SOURCE*:

European Journal of Applied Physiology volume 99, pages393–404 (2007)

ABSTRAKT / *ABSTRACT*:

Respiratory muscles can fatigue during prolonged and maximal exercise, thus reducing performance. The respiratory system is challenged during underwater exercise due to increased hydrostatic pressure and breathing resistance. The purpose of this study was to determine if two different respiratory muscle training protocols enhance respiratory function and swimming performance in divers. Thirty male subjects (23.4 ± 4.3 years) participated. They were randomized to a placebo (PRMT), endurance (ERMT), or resistance respiratory muscle training (RRMT) protocol. Training sessions were 30 min/day, 5 days/week, for 4 weeks. PRMT consisted of 10-s breath-holds once/minute, ERMT consisted of isocapnic hyperpnea, and RRMT consisted of a vital capacity maneuver against 50 cm H2O resistance every 30 s. The PRMT group had no significant changes in any measured variable. Underwater and surface endurance swim time to exhaustion significantly increased after RRMT (66%, P < 0.001; 33%, P = 0.003) and ERMT (26%, P = 0.038; 38%, P < 0.001). Breathing frequency (f b) during the underwater endurance swim decreased in RRMT (23%, P = 0.034) and tidal volume (V T) increased in both the RRMT (12%, P = 0.004) and ERMT (7%, P = 0.027) groups. Respiratory endurance increased in ERMT (216.7%) and RRMT (30.7%). Maximal inspiratory and expiratory pressures increased following RRMT (12%, P = 0.015, and 15%, P = 0.011, respectively). Results from this study indicate that respiratory muscle fatigue is a limiting factor for underwater swimming performance, and that targeted respiratory muscle training (RRMT > ERMT) improves respiratory muscle and underwater swimming performance.

5 Studien zur „OIMT“ / *studies on „OIMT“*

5.1 The immediate effects of breathing with oscillated inspiratory and expiratory airflows on secretion clearance in intubated patients with cervical spinal cord injury

AUTOR: IN / *AUTHOR*:

Sujittra Kluayhomthong, Chulee Ubolsakka-Jones, Pornanan Domthong, Wipa Reechaipichitkul, David A Jones

QUELLE / *SOURCE*:

Spinal Cord. 2019 Apr;57(4):308-316.

ABSTRAKT / *ABSTRACT*:

Study design: A prospective, randomized crossover trial.

Objectives: To evaluate the efficacy of the combination of incentive spirometry with oscillation (OIS) and positive expiratory pressure with oscillation (OPEP) to promote secretion clearance in intubated patients with cervical spinal cord injury.

Setting: Spinal cord unit, tertiary care hospital, North East Thailand.

Methods: Thirteen intubated patients (C4-7, AIS score C) with secretion retention performed three interventions randomly allocated on consecutive days, a Sham deep breathing, OPEP and OPEP + OIS breathing exercise. Secretions were collected by sterile suction for 3 h before, and 3 h after, each intervention and wet weight recorded. Cardiopulmonary parameters were measured before and after each intervention.

Results: The median (IQR) secretion wet weight pre-intervention was 2.61 g (2.21, 3.85) and in the 3 h after Sham there was an increase of 1.97 g (0.6, 3.6). The increase after OPEP was 2.67 g (1.7, 3.9) and after OPEP + OIS, 4.28 g (2.4, 6.7); all the increases being significant ($p \leq 0.007$). The clearance after OPEP and OPEP + OIS were both greater than Sham while OPEP + OIS was greater than OPEP ($p \leq 0.019$). There were no significant changes in cardiopulmonary measures following any intervention or when compared between interventions.

Conclusions: Deep breathing with an oscillated and humidified air flow in a combination of OIS + OPEP more than doubled secretion clearance and was more effective than OPEP or Sham deep breathing. There were no adverse effects of the procedures which were well tolerated by the patients and may be used to complement existing methods for secretion clearance.

6 Studien zu IMT / *studies on IMT*

6.1 Inspiratory muscle training affects proprioceptive use and low back pain.

AUTOR: IN / *AUTHOR*:

Lotte Janssens , Alison K McConnell, Madelon Pijnenburg, Kurt Claeys, Nina Goossens, Roeland Lysens, Thierry Troosters, Simon Brumagne

QUELLE / *SOURCE*:

Med Sci Sports Exerc. 2015 Jan;47(1):12-9.

ABSTRAKT / *ABSTRACT*:

Purpose: We have shown that individuals with recurrent nonspecific low back pain (LBP) and healthy individuals breathing against an inspiratory load decrease their reliance on back proprioceptive signals in upright standing. Because individuals with LBP show greater susceptibility to diaphragm fatigue, it is reasonable to hypothesize that LBP, diaphragm dysfunction, and proprioceptive use may be interrelated. The purpose of this study was to investigate whether inspiratory muscle training (IMT) affects proprioceptive use during postural control in individuals with LBP.

Methods: Twenty-eight individuals with LBP were assigned randomly into a high-intensity IMT group (high IMT) and low-intensity IMT group (low IMT). The use of proprioception in upright standing was evaluated by measuring center of pressure displacement during local muscle vibration (ankle, back, and ankle-back). Secondary outcomes were inspiratory muscle strength, severity of LBP, and disability.

Results: After high IMT, individuals showed smaller responses to ankle muscle vibration, larger responses to back muscle vibration, higher inspiratory muscle strength, and reduced LBP severity ($P < 0.05$). These changes were not seen after low IMT ($P > 0.05$). No changes in disability were observed in either group ($P > 0.05$).

Conclusions: After 8 wk of high IMT, individuals with LBP showed an increased reliance on back proprioceptive signals during postural control and improved inspiratory muscle strength and severity of LBP, not seen after low IMT. Hence, IMT may facilitate the proprioceptive involvement of the trunk in postural control in individuals with LBP and thus might be a useful rehabilitation tool for these patients.

6.2 Aerobic and breathing exercises improve dyspnea, exercise capacity and quality of life in idiopathic pulmonary fibrosis patients: systematic review and meta-analysis

AUTOR: IN / *AUTHOR*:

Masatoshi Hanada, Karina Tamy Kasawara, Sunita Mathur, Dmitry Rozenberg, Ryo Kozu, S. Ahmed Hassan, and W. Darlene Reid

QUELLE / *SOURCE*:

J Thorac Dis. 2020 Mar; 12(3): 1041–1055.

doi: 10.21037/jtd.2019.12.27

ABSTRAKT / *ABSTRACT*:

Background: Idiopathic pulmonary fibrosis (IPF) is a progressive disease associated with significant dyspnea and limited exercise capacity. This systematic review aimed to synthesize evidence of exercise interventions during pulmonary rehabilitation that aim to improve exercise capacity, dyspnea, and health-related quality of life (HRQL) in IPF patients.

Methods: Searches were performed in MEDLINE, Embase, CENTRAL, SPORTDiscus, PubMed and PEDro from inception to January 2019 using search terms for: (I) participants: 'IPF or interstitial lung disease'; (II) interventions: 'aerobic training or resistance training or respiratory muscle training'; and (III) outcomes: 'exercise capacity or dyspnea or health-related quality of life'. Two reviewers independently screened titles, abstracts and full texts to identify eligible studies. Methodological quality of studies was assessed using the Downs and Black checklist and meta-analyses were performed.

Results: Of 1,677 articles identified, 14 were included (four randomized controlled trials and 10 prospective pre-post design studies) that examined 362 patients receiving training and 95 control subjects. Exercise capacity was measured with the 6-minute walk distance, peak oxygen consumption, peak work rate, or endurance time for constant work rate cycling, which increased after exercise [aerobic exercise; aerobic and breathing exercises; aerobic and inspiratory muscle training (IMT) exercises] compared to the control groups. Dyspnea scores improved after aerobic and breathing exercises. HRQL also improved after aerobic exercise training alone or combined with breathing exercises. Aerobic training alone or combined with IMT or breathing exercises improved exercise capacity.

Conclusions: Breathing exercises appears to complement exercise training towards improved dyspnea and HRQL in patients with IPF.

6.3 Benefits of combining inspiratory muscle with 'whole muscle' training in children with cystic fibrosis: a randomised controlled trial

AUTOR: IN / *AUTHOR*:

Elena Santana-Sosa, Laura Gonzalez-Saiz1, Iris F Groeneveld, José R Villa-Asensi, María I Barrio Gómez de Aguero, Steven J Fleck, Luis M López-Mojares, Margarita Pérez, Alejandro Lucia

QUELLE / *SOURCE*:

Br J Sports Med . 2014 Oct;48(20):1513-7.

ABSTRAKT / *ABSTRACT*:

Background: The purpose of this study (randomised controlled trial) was to assess the effects of an 8-week combined 'whole muscle' (resistance+aerobic) and inspiratory muscle training (IMT) on lung volume, inspiratory muscle strength (PImax) and cardiorespiratory fitness (VO2 peak) (primary outcomes), and dynamic muscle strength, body composition and quality of life in paediatric outpatients with CF (cystic fibrosis, secondary outcomes). We also determined the effects of a detraining period.

Methods: Participants were randomly allocated with a block on gender to a control (standard therapy) or intervention group (initial n=10 (6 boys) in each group; age 10±1 and 11±1 years). The latter group performed a combined programme (IMT (2 sessions/day) and aerobic+strength exercises (3 days/week, in-hospital)) that was followed by a 4-week detraining period. All participants were evaluated at baseline, post-training and detraining.

Results: Adherence to the training programme averaged 97.5%±1.7%. There was a significant interaction (group×time) effect for PImax, VO2peak and five-repetition maximum strength (leg-press, bench-press, seated-row) (all ($p<0.001$), and also for %fat ($p<0.023$) and %fat-free mass ($p=0.001$), with training exerting a significant beneficial effect only in the intervention group, which was maintained after detraining for PImax and leg-press.

Conclusion: The relatively short-term (8-week) training programme used here induced significant benefits in important health phenotypes of paediatric patients with CF. IMT is an easily applicable intervention that could be included, together with supervised exercise training in the standard care of these patients.

6.4 Daily inspiratory muscle training lowers blood pressure and vascular resistance in healthy men and women

AUTOR: IN / *AUTHOR*:

Claire M. DeLucia, Roxanne M. De Asis, E. Fiona Bailey

QUELLE / *SOURCE*:

Experimental Physiology Volume103, Issue2 1 February 2018

ABSTRAKT / *ABSTRACT*:

Previous work has shown that inspiratory muscle training (IMT) lowers blood pressure after a mere 6 weeks, identifying IMT as a potential therapeutic intervention to prevent or treat hypertension. Here, we explore the effects of IMT on respiratory muscle strength and select cardiovascular parameters in recreationally active men and women. Subjects were randomly assigned to IMT (n = 12, 75% maximal inspiratory pressure) or sham training (n = 13, 15% maximal inspiratory pressure) groups and underwent a 6-week intervention comprising 30 breaths day−1, 5 days week−1. Pre- and post-training measures included maximal inspiratory pressure and resting measures of blood pressure, cardiac output, heart rate, spontaneous cardiac baroreflex sensitivity and systemic vascular resistance. We evaluated psychological and sleep status via administration of the Cohen–Hoberman inventory of physical symptoms and the Epworth sleepiness scale. Male and female subjects in the IMT group showed declines in systolic/diastolic blood pressures (−4.3/−3.9 mmHg, $P < 0.025$) and systemic vascular resistance (−3.5 mmHg min l−1, $P = 0.008$) at week 6. There was no effect of IMT on cardiac output ($P = 0.722$), heart rate ($P = 0.795$) or spontaneous cardiac baroreflex sensitivity ($P = 0.776$). The IMT subjects also reported fewer stress-related symptoms (pre- versus post-training, 12.5 ± 8.5 versus 7.2 ± 9.7, $P = 0.025$). Based on these results, we suggest that a short course of IMT confers significant respiratory and cardiovascular improvements and parallel (modest) psychological benefits in healthy men and women.

6.5 Daily respiratory training with large intrathoracic pressures, but not large lung volumes, lowers blood pressure in normotensive adults

AUTOR: IN / *AUTHOR*:

Jennifer R.Vranish, E.FionaBailey

QUELLE / *SOURCE*:

Respiratory Physiology & Neurobiology Volume 216, 15 September 2015, Pages 63-69

ABSTRAKT / *ABSTRACT*:

Inspiratory muscle training holds promise as a non-pharmacologic treatment that can improve respiratory muscle strength, reduce blood pressure, and improve autonomic balance in hypertensive patients. There is a gap in knowledge regarding the specific respiratory stimulus that gives rise to these favorable outcomes. We implemented five respiratory training protocols that differed in the magnitude and direction of the lung volumes and/or intrathoracic pressures generated by subjects in training. Normotensive adults were randomly assigned to each group and trained daily for 6 weeks. Pre-post and weekly measures of blood pressure showed significant declines in systolic [−8.96 mmHg (95% CI, 7.39–10.53)] and diastolic [−5.25 mmHg (95% CI, 3.67–6.83)] blood pressures for subjects who trained with large positive or negative intrathoracic pressures. Subjects who trained with modest intrathoracic pressures or large lung volumes saw no improvement in blood pressure ($P > 0.3$). Large intra-thoracic pressures are the specific respiratory stimulus underpinning breathing training related improvements in blood pressure.

6.6 Effect of Inspiratory Muscle Training in the Management of Patients With Asthma: A RANDOMIZED CONTROLLED TRIAL

AUTOR: IN / *AUTHOR*:

Neslihan Duruturk,Manolya Acar,Mustafa Ilgaz Doğrul

QUELLE / *SOURCE*:

National Library of Medicine - National Center for Biotechnology Information; Randomized Controlled Trial;J Cardiopulm Rehabil Prev . 2018 May;38(3):198-203.doi: 10.1097/HCR.0000000000000318.

ABSTRAKT / *ABSTRACT*:

Purpose: The aim of this study was to investigate the effects of inspiratory muscle training (IMT) on respiratory muscle strength, exercise capacity, dyspnea, fatigue, quality of life, and daily living activities of asthmatic patients.

Methods: Thirty-eight asthmatic patients, between 18 and 65 years of age, were enrolled in the study and randomly divided into 2 groups; IMT (n = 20) or control (n = 18). Participants in the IMT group performed 30 breaths using a patient-specific threshold pressure device, twice daily for 6 wk at 50% maximal inspiratory pressure (MIP), in addition to "breathing training" during this period. Participants in the control group performed only the "breathing training" (sham or no threshold pressure device). Outcome measurements, performed before and after the intervention, included pulmonary function test, respiratory muscle strength, 6-min walk test, modified Medical Research Council dyspnea scale, St George's Respiratory Questionnaire, Fatigue Severity Scale, and London Chest Activity of Daily Living scale.

Results: Among the outcomes in the study, changes to key variables including MIP (P < .01); MIP, percent predicted (P < .01); maximal expiratory pressure (MEP), percent predicted (P < .01); 6-min walk test walking distance (P = .001); modified Medical Research Council scale (P =<.001); Fatigue Severity Scale (P = .03); St George's Respiratory Questionnaire symptoms (P = .03); London Chest Activity of Daily Living domestic (P = .03); and London Chest Activity of Daily Living leisure (P = .01) were significantly different in favor of IMT versus control.

Conclusion: These findings suggest that IMT may be an effective modality to enhance respiratory muscle strength, exercise capacity, quality of life, daily living activities, reduced perception of dyspnea, and fatigue in asthmatic patients.

6.7 Effect of inspiratory muscle training intensities on pulmonary function and work capacity in people who are healthy: a randomized controlled trial

AUTOR: IN / *AUTHOR*:

Enright S., Unnithan V.

QUELLE / *SOURCE*:

Phys Ther . 2011 Jun;91(6):894-905

DOI: 10.1097/HCR.0000000000000318

ABSTRAKT / *ABSTRACT*:

Background: Inspiratory muscle training (IMT) has been shown to improve inspiratory muscle function, lung volumes (vital capacity [VC] and total lung capacity [TLC]), work capacity, and power output in people who are healthy; however, no data exist that demonstrate the effect of varying intensities of IMT to produce these outcomes.

Objectives: The purpose of this study was to evaluate the impact of IMT at varying intensities on inspiratory muscle function, VC, TLC, work capacity, and power output in people who are healthy.

Design: This was a randomized controlled trial.

Setting: The study was conducted in a clinical laboratory.

Participants: Forty people who were healthy (mean age=21.7 years) were randomly assigned to 4 groups of 10 individuals.

Interventions: Three of the groups completed an 8-week program of IMT set at 80%, 60%, and 40% of sustained maximum inspiratory effort. Training was performed 3 days per week, with 24 hours separating training sessions. A control group did not participate in any form of training.

Measurements: Baseline and posttraining measurements of body composition, VC, TLC, inspiratory muscle function (including maximum inspiratory pressure [MIP] and sustained maximum inspiratory pressure [SMIP]), work capacity (minutes of exercise), and power output were obtained.

Results: The participants in the 80%, 60%, and 40% training groups demonstrated significant increases in MIP and SMIP, whereas those in the 80% and 60% training groups had increased work capacity and power output.

Only the 80% group improved their VC and TLC. The control group demonstrated no change in any outcome measures.

Limitations: This study may have been underpowered to demonstrate improved work capacity and power output in individuals who trained at 40% of sustained maximum inspiratory effort.

Conclusion: High-intensity IMT set at 80% of maximal effort resulted in increased MIP and SMIP, lung volumes, work capacity, and power output in individuals who were healthy, whereas IMT at 60% of maximal effort increased work capacity and power output only. Inspiratory muscle training intensities lower than 40% of maximal effort do not translate into quantitative functional outcomes.

6.8 Effects of inspiratory muscle training in COPD patients:A systematic review and meta-analysis

AUTOR: IN / *AUTHOR*:

Beaumont M., Forget P., Couturaud F., Reychler G.

QUELLE / *SOURCE*:

Clin Respir J. 2018;12 2178–2188

DOI: 10.1111/crj.12905

ABSTRAKT / *ABSTRACT*:

Objectives: In chronic obstructive pulmonary disease (COPD), quality of life andexercise capacity are altered in relationship to dyspnea. Benefits of inspiratory muscletraining (IMT) on quality of life, dyspnea, and exercise capacity were demonstrated,but when it is associated to pulmonary rehabilitation (PR), its efficacy on dyspnea isnot demonstrated. The aim of this systematic review with meta-analysis was to verifythe effect of IMT using threshold devices in COPD patients on dyspnea, quality oflife, exercise capacity, and inspiratory muscles strength, and the added effect ondyspnea of IMT associated with PR (vs. PR alone).

Study selection: This systematic review and meta-analysis was conducted on thedatabases from PubMed, Science direct, Cochrane library, Web of science, andPascal. Following key words were used: inspiratory, respiratory, ventilatory, muscle,and training. The searching period extended to December 2017. Two reviewersindependently assessed studies quality.

Results: Forty-three studies were included in the systematic review and thirty-sevenstudies in the meta-analysis. Overall treatment group consisted of six hundred fortytwo patients. Dyspnea (Baseline Dyspnea Index) is decreased after IMT. Quality oflife (Saint George's Respiratory Questionnaire), exercise capacity (6 min walk test)and Maximal inspiratory pressure were increased after IMT. During PR, no addedeffect of IMT on dyspnea was found.

Conclusion: IMT using threshold devices improves inspiratory muscle strength,exercise capacity and quality of life, decreases dyspnea. However, there is no addedeffect of IMT on dyspnea during PR (compared with PR alone).

6.9 Inspiratory muscle strength training improves weaning outcome in failure to wean patients: a randomized trial.

AUTOR: IN / *AUTHOR*:

A Daniel Martin,corresponding author Barbara K Smith, Paul D Davenport, Eloise Harman, Ricardo J Gonzalez-Rothi, Maher Baz, A Joseph Layon, Michael J Banner, Lawrence J Caruso, Harsha Deoghare, Tseng-Tien Huang, and Andrea Gabrielli

QUELLE / *SOURCE*:

Crit Care. 2011; 15(2): R84.

ABSTRAKT / *ABSTRACT*:

Introduction: Most patients are readily liberated from mechanical ventilation (MV) support, however, 10% - 15% of patients experience failure to wean (FTW). FTW patients account for approximately 40% of all MV days and have significantly worse clinical outcomes. MV induced inspiratory muscle weakness has been implicated as a contributor to FTW and recent work has documented inspiratory muscle weakness in humans supported with MV.

Methods: We conducted a single center, single-blind, randomized controlled trial to test whether inspiratory muscle strength training (IMST) would improve weaning outcome in FTW patients. Of 129 patients evaluated for participation, 69 were enrolled and studied. 35 subjects were randomly assigned to the IMST condition and 34 to the SHAM treatment. IMST was performed with a threshold inspiratory device, set at the highest pressure tolerated and progressed daily. SHAM training provided a constant, low inspiratory pressure load. Subjects completed 4 sets of 6-10 training breaths, 5 days per week. Subjects also performed progressively longer breathing trials daily per protocol. The weaning criterion was 72 consecutive hours without MV support. Subjects were blinded to group assignment, and were treated until weaned or 28 days.

Results: Groups were comparable on demographic and clinical variables at baseline. The IMST and SHAM groups respectively received 41.9 ± 25.5 vs. 47.3 ± 33.0 days of MV support prior to starting intervention, P = 0.36. The IMST and SHAM groups participated in 9.7 ± 4.0 and 11.0 ± 4.8 training sessions, respectively, P = 0.09. The SHAM group's pre to post-training maximal inspiratory pressure (MIP) change was not significant (-43.5 ± 17.8 vs. -45.1 ± 19.5 cm H2O, P = 0.39), while the IMST group's MIP increased (-44.4 ± 18.4 vs. -54.1 ± 17.8 cm H2O, P < 0.0001). There were no adverse events observed during IMST or SHAM treatments. Twenty-five of 35 IMST subjects weaned (71%, 95% confidence interval (CI) = 55% to 84%), while 16 of 34 (47%, 95%

CI = 31% to 63%) SHAM subjects weaned, P = .039. The number of patients needed to be treated for effect was 4 (95% CI = 2 to 80).

Conclusions: An IMST program can lead to increased MIP and improved weaning outcome in FTW patients compared to SHAM treatment.

6.10 Inspiratory muscle training does not improve clinical outcomes in 3-week COPD rehabilitation: results from a randomised controlled trial

AUTOR: IN / *AUTHOR*:

Konrad Schultz, Danijel Jelusic , Michael Wittmann, Benjamin Krämer, Veronika Huber, Sebastian Fuchs, Nicola Lehbert, Silke Wingart, Dragan Stojanovic, Oliver Göhl, Harma J Alma, Corina de Jong, Thys van der Molen, Hermann Faller, Michael Schuler

QUELLE / *SOURCE*:

Eur Respir J. 2018 Jan 25;51

ABSTRAKT / *ABSTRACT*:

The value of inspiratory muscle training (IMT) in pulmonary rehabilitation in chronic obstructive pulmonary disease (COPD) is unclear. The RIMTCORE (Routine Inspiratory Muscle Training within COPD Rehabilitation) randomised controlled trial examined the effectiveness of IMT added to pulmonary rehabilitation.In total, 611 COPD patients (Global Initiative for Chronic Obstructive Lung Disease stage II-IV) received a 3-week inpatient pulmonary rehabilitation, of which 602 patients were included in the intention-to-treat analyses. The intervention group (n=300) received highly intensive IMT and the control group (n=302) received sham IMT. The primary outcome was maximal inspiratory pressure (PImax). The secondary outcomes were 6-min walk distance, dyspnoea, quality of life and lung function. Outcomes were assessed pre- and post-pulmonary rehabilitation. ANCOVA was used.The intervention group showed higher effects in PImax ($p<0.001$) and forced inspiratory volume in 1 s ($p=0.013$). All other outcomes in both study groups improved significantly, but without further between-group differences. Sex and pulmonary rehabilitation admission shortly after hospitalisation modified quality of life effects.IMT as an add-on to a 3-week pulmonary rehabilitation improves inspiratory muscle strength, but does not provide additional benefits in terms of exercise capacity, quality of life or dyspnoea. A general recommendation for COPD patients to add IMT to a 3-week pulmonary rehabilitation cannot be made.

6.11 Inspiratory muscle training facilitates weaning from mechanical ventilation among patients in the intensive care unit, a systematic review.

AUTOR: IN / *AUTHOR*:

Elkins M., Dentice R.

QUELLE / *SOURCE*:

Journal of Physiotherapy Jul 2015; 61 (3): 125-34

ABSTRAKT / *ABSTRACT*:

Question: Does inspiratory muscle training improve inspiratory muscle strength in adults receiving mechanical ventilation? Does it improve the duration or success of weaning? Does it affect length of stay, reintubation, tracheostomy, survival, or the need for post-extubation non-invasive ventilation? Is it tolerable and does it cause adverse events?

Design: Systematic review of randomised trials.

Participants: Adults receiving mechanical ventilation.

Intervention: Inspiratory muscle training versus sham or no inspiratory muscle training.

Outcome measures: Data were extracted regarding: inspiratory muscle strength and endurance; the rapid shallow breathing index; weaning success and duration; duration of mechanical ventilation; reintubation; tracheostomy; length of stay; use of non-invasive ventilation after extubation; survival; readmission; tolerability and adverse events.

Results: Ten studies involving 394 participants were included. Heterogeneity within some meta-analyses was high. Random-effects meta-analyses showed that the training significantly improved maximal inspiratory pressure (MD 7 cmH2O, 95% CI 5 to 9), the rapid shallow breathing index (MD 15 breaths/min/l, 95% CI 8 to 23) and weaning success (RR 1.34, 95% CI 1.02 to 1.76). Although only assessed in individual studies, significant benefits were also reported for the time spent on non-invasive ventilation after weaning (MD 16 hours, 95% CI 13 to 18), length of stay in the intensive care unit (MD 4.5 days, 95% CI 3.6 to 5.4) and length of stay in hospital (MD 4.4 days, 95% CI 3.4 to 5.5). Weaning duration decreased in the subgroup of patients with known weaning difficulty. The other outcomes weren't significantly affected or weren't measured.

Conclusion: Inspiratory muscle training for selected patients in the intensive care unit facilitates weaning, with potential reductions in length of stay and the duration of non-invasive ventilatory support after extubation. The heterogeneity among the results suggests that the effects of inspiratory muscle training may vary; this perhaps depends on factors such as the components of usual care or the patient's characteristics.

6.12 Preoperative inspiratory muscle training for postoperative pulmonary complications in adults undergoing cardiac and major abdominal surgery.

AUTOR: IN / *AUTHOR*:

Morihiro KatsuraAkira KuriyamaTaro TakeshimaShunichi FukuharaToshi A Furukawa

QUELLE / *SOURCE*:

Cochrane Database Syst Rev. 2015 Oct 5;(10):CD010356.

ABSTRAKT / *ABSTRACT*:

This is a protocol for a Cochrane Review (Intervention). The objectives are as follows:

Our primary objective is to compare the effectiveness of preoperative IMT and usual preoperative care on PPCs in adult patients undergoing cardiac or major abdominal surgery. We will look at the all-cause mortality and adverse events.

Our secondary objective is to investigate the effects of preoperative IMT on postoperative pulmonary functions, duration of hospital stay, and postoperative complications of other types. We will also evaluate the total drop-out, quality of life, and cost-effectiveness of preoperative IMT.

6.13 A pilot study of respiratory muscle training to improve cough effectiveness and reduce the incidence of pneumonia in acute stroke: study protocol for a randomized controlled trial

AUTOR: IN / *AUTHOR*:

Stefan Tino Kulnik, Gerrard Francis Rafferty, Surinder S Birring, John Moxham, and Lalit Kalra

QUELLE / *SOURCE*:

Trials 2014; 15:123 doi: 10.1186/1745-6215-15-123

ABSTRAKT / *ABSTRACT*:

Background: After stroke, pneumonia is a relevant medical complication that can be precipitated by aspiration of saliva, liquids, or solid food. Swallowing difficulty and aspiration occur in a significant proportion of stroke survivors. Cough, an important mechanism protecting the lungs from inhaled materials, can be impaired in stroke survivors, and the likely cause for this impairment is central weakness of the respiratory musculature. Thus, respiratory muscle training in acute stroke may be useful in the recovery of respiratory muscle and cough function, and may thereby reduce the risk of pneumonia. The present study is a pilot study, aimed at investigating the validity and feasibility of this approach by exploring effect size, safety, and patient acceptability of the intervention.

Methods/design: Adults with moderate to severe stroke impairment (National Institutes of Health Stroke Scale (NIHSS) score 5 to 25 at the time of admission) are recruited within 2 weeks of stroke onset. Participants must be able to perform voluntary respiratory maneuvers. Excluded are patients with increased intracranial pressure, uncontrolled hypertension, neuromuscular conditions other than stroke, medical history of asthma or chronic obstructive pulmonary disease, and recent cardiac events. Participants are randomized to receive inspiratory, expiratory, or sham respiratory training over a 4-week period, by using commercially available threshold resistance devices. Participants and caregivers, but not study investigators, are blind to treatment allocation. All participants receive medical care and stroke rehabilitation according to the usual standard of care. The following assessments are conducted at baseline, 4 weeks, and 12 weeks: Voluntary and reflex cough flow measurements, forced spirometry, respiratory muscle strength tests, incidence of pneumonia, assessments of safety parameters, and self-reported activity of daily living. The primary outcome is peak expiratory cough flow of voluntary cough, a parameter indicating the effectiveness of cough. Secondary outcomes are incidence of pneumonia, peak expiratory cough flow of reflex cough, and maximum inspiratory and expiratory mouth pressures.

Discussion: Various novel pharmacologic and nonpharmacologic approaches for preventing stroke-associated pneumonia are currently being researched. This study investigates a novel strategy based on an exercise intervention for cough rehabilitation.

6.14 Aktivierung der Atemmuskulatur durch spezifisches Atemmuskeltraining - Quantifizierung durch EMG

AUTOR: IN / *AUTHOR*:

Fabian Pietsch

QUELLE / *SOURCE*:

Inaugural-Dissertation zur Erlangung des Meidzinischen doktorgrades der Medizinischen Fakultät der albert-Ludwigs-Universität Freiburg im Breisgau 2014

ABSTRAKT / *ABSTRACT*:

Ziel dieser Pilotstudie war es, die Atemmuskelaktivierung durch drei wissenschaftlich anerkannte Methoden des Atemmuskeltrainings miteinander zu vergleichen. Für das Inspiratory pressure threshold loading (IPTL) wurde der POWERbreathe® (PB), für das Inspiratory flow resistive loading (IFRL) der Respifit® im Ausdauermodus (RFa) und für die Voluntary isocapnic hyperpnea (VIH) der SpiroTiger® (ST) verwendet. Zum Vergleich dynamischer Atemmanöver (PB, ST, RFa) mit statischen Atemmanövern führte jeder Proband zusätzlich ein statisches Atemmanöver (80% des PImax) mit dem Atemmuskeltrainer Respifit® im Kraftmodus (RFk) durch. Bei 41 gesunden Probanden wurde die elektromyographische Aktivität des Zwerchfells (Dia), der parasternalen Intercostalmuskulatur (Para) und des M. sternocleidomastoideus (SCM) über Hautelektroden während des Trainings mit den Atemmuskeltrainern gemessen. Die Atemmuskeltrainer ST, RFa und RFk wurden gemäß Bedienungsanleitung verwendet, der PB wurde auf 80% PImax eingestellt. Die H0-Hypothese besagte, dass es keinen Unterschied in der Muskelaktivierung der verschiedenen Trainingsmethoden gebe. Es zeigte sich, dass ST und PB alle drei Muskeln stärker aktivierten als RFa. Das Zwerchfell wurde am stärksten durch den PB aktiviert, die Aktivierung durch den RFk unterschied sich in allen drei Muskeln nicht von jener durch den PB. Die Ho-Hypothese konnte somit verworfen werden. Beim Vergleich der Aktivierungsgrade von SCM, Para und Dia durch denselben Atemmuskeltrainer zeigte sich, dass ST und PB die Atemhilfsmuskulatur stärker aktivierten als das Zwerchfell. Sowohl bei RFa als auch bei RFk gab es keinen Unterschied in der Aktivierung von SCM, Para und Dia. In einem zusätzlichen Studienteil wurde bei 10 Probanden ein Vergleich von PB und RFa bei gleichen Munddrücken durchgeführt. Unter dieser Bedingung zeigten sich in allen Muskeln keine Unterschiede der beiden Atemmuskeltrainer bei Munddrücken von 20%, 40%, 60% und 80% des PImax. Es konnte gezeigt werden, dass sich bei gleichem Munddruck weder IPTL und IFRL noch IPTL und 80% PImax in ihrer Muskelaktivierung unterscheiden. Es konnte weder im Vergleich der Atemmuskeltrainer miteinander noch beim Vergleich der Aktivierungsgrade von SCM, Para und Dia durch denselben Atemmuskeltrainer eine spezifische Zwerchfellaktivierung einzelner Verfahren gefunden werden.

6.15 Effects of inspiratory muscle training in elderly women on respiratory muscle strength, diaphragm thickness and mobility.

AUTOR: IN / *AUTHOR*:

Helga Souza, Taciano Rocha, Maíra Pessoa,Catarina Rattes, Daniella Brandão, Guilherme Fregonezi, Shirley Campos, Andrea Aliverti, and Armele Dornelas

QUELLE / *SOURCE*:

J Gerontol A Biol Sci Med Sci. 2014;69: 1545–1553

ABSTRAKT / *ABSTRACT*:

Background: Aging results in a decline in the function of the respiratory muscles. Inspiratory muscle training is emerging as a possible intervention to attenuate the decline of respiratory muscles in the elderly. The aim of this study was to evaluate the efficacy of inspiratory muscle training on respiratory strength, diaphragm thickness, and diaphragmatic mobility in elderly women.

Methods: This was a controlled, randomized, and double-blind clinical trial, performed on 22 elderly women distributed in two groups, training (TG) and control (CG). Over an 8-week period a moderate intensity inspiratory muscle training protocol was followed in the TG, while CG followed a sham protocol. In addition maximum expiratory and inspiratory pressure, mobility of the diaphragm and diaphragmatic thickness were evaluated by ultrasound.

Results: After training, in TG maximal inspiratory pressure, maximal expiratory pressure, diaphragm thickness, and mobility increased by 37%, 13%, 11%, and 9% respectively, and their values were significantly higher than CG ($p < .005$, $p = .013$, $p = .001$, and $p = .001$).

Conclusion: Inspiratory muscle training of moderate intensity improves respiratory muscle strength, diaphragm thickness, and diaphragm mobility in elderly women and it should be considered to minimize changes associated with senescence.

6.16 Effects of resistive breathing on exercise capacity and diaphragm function in patients with ischaemic heart disease

AUTOR: IN / *AUTHOR*:

Darnley M., Gray A., McClure S., Neary P., Petrie M., McMurray J., MacFarlane N.

QUELLE / *SOURCE*:

Eur J Heart Fail 1999 Aug;1(3):297-300.

ABSTRAKT / *ABSTRACT*:

Background: Muscle weakness has been suggested to result from the deconditioning that accompanies decreased activity levels in chronic cardiopulmonary diseases. The benefits of standard exercise programmes on exercise capacity and muscular strength in disease and health are well documented and exercise capacity is a significant predictor of survival in patients with chronic heart failure (CHF). Selective respiratory muscle training has been shown to improve exercise tolerance in CHF and such observations have been cited to support the suggestion that respiratory muscle weakness contributes to a reduced exercise capacity (despite biopsies showing the metabolic profile of a well trained muscle).

Aims:bThis study aimed to determine the effects of selective inspiratory muscle training on patients with chronic coronary artery disease to establish if an improved exercise capacity can be obtained in patients that are not limited in their daily activities.

Methods: Nine male patients performed three exercise tests (with respiratory and diaphragm function assessed before the third test) then undertook a 4-week programme of inspiratory muscle training. Exercise tolerance, respiratory and diaphragmatic function were re-assessed after training.

Results: Exercise capacity improved from 812 ± 42 to 864 ± 49 s, $P < 0.05$, and velocity of diaphragm shortening increased (during quiet breathing from 12.8 ± 1.6 to 19.4 ± 1.1 mm s^{-1}, $P < 0.005$, and sniffing from 71.9 ± 9.4 to 110.0 ± 12.3 mm s^{-1}, $P < 0.005$). In addition, five from nine patients were stopped by breathlessness before training; whereas only one patient was stopped by breathlessness after training.

Conclusion: The major findings in this study were that a non-intensive 4-week training programme of resistive breathing in patients with chronic coronary artery disease led to an increase in exercise capacity and a decrease in dyspnoea when assessed by symptom limited exercise testing. These changes were associated with significant increases in the velocity of diaphragmatic excursions during quiet breathing and sniffing. Patients

that exhibited small diaphragmatic excursions during quiet breathing were most likely to improve their exercise capacity after the training programme. However, the inspiratory muscle-training programme was not associated with any significant changes in respiratory mechanics when peak flow rate, forced expiratory volume and forced vital capacity were measured. The resistive breathing programme used here resulted in a significant increase in the velocity of diaphragm movement during quiet breathing and sniffing. In other skeletal muscles, speed of contraction can be determined by the relative proportion of fibre types and muscle length (Jones, Round, Skeletal Muscle in Health and Disease. Manchester: University Press, 1990). The intensity of the training programme used here, however, is unlikely to significantly alter muscle morphology or biochemistry. Short-term training studies have shown that there can be increases in strength and velocity of shortening that do not relate to changes in muscle biochemistry or morphology. These changes are attributed to the neural adaptations that occur early in training (Northridge et al., Br. Heart J. 1990; 64: 313–316). Independent of the mechanisms involved, this small, uncontrolled study suggests that inspiratory muscle training may improve exercise capacity, diaphragm function and symptoms of breathlessness in patients with chronic coronary artery disease even in the absence of heart failure.

6.17 Efficacy of a Novel Method for Inspiratory Muscle Training in People with Chronic Obstructive Pulmonary Disease

AUTOR: IN / *AUTHOR*:

Daniel Langer, Noppawan Charususin, Cristina Jácome, Mariana Hoffman, Alison McConnell, Marc Decramer, Rik Gosselink

QUELLE / *SOURCE*:

Physical Therapy, Volume 95, Issue 9, 1 September 2015, Pages 1264–1273,

ABSTRAKT / *ABSTRACT*:

Background: Most inspiratory muscle training (IMT) interventions in patients with chronic obstructive pulmonary disease (COPD) have been implemented as fully supervised daily training for 30 minutes with controlled training loads using mechanical threshold loading (MTL) devices. Recently, an electronic tapered flow resistive loading (TFRL) device was introduced that has a different loading profile and stores training data during IMT sessions.

Objective: The aim of this study was to compare the efficacy of a brief, largely unsupervised IMT protocol conducted using either traditional MTL or TFRL on inspiratory muscle function in patients with COPD.

Design: Twenty patients with inspiratory muscle weakness who were clinically stable and participating in a pulmonary rehabilitation program were randomly allocated to perform 8 weeks of either MTL IMT or TFRL IMT.

Methods: Participants performed 2 daily home-based IMT sessions of 30 breaths (3–5 minutes per session) at the highest tolerable intensity, supported by twice-weekly supervised sessions. Adherence, progression of training intensity, increases in maximal inspiratory mouth pressure (PImax), and endurance capacity of inspiratory muscles (Tlim) were evaluated.

Results: More than 90% of IMT sessions were completed in both groups. The TFRL group tolerated higher loads during the final 3 weeks of the IMT program, with similar effort scores on the 10-Item Borg Category Ratio (CR-10) Scale, and achieved larger improvements in PImax and Tlim than the MTL group.

Limitations: A limitation of the study was the absence of a study arm involving a sham IMT intervention.

Conclusions: The short and largely home-based IMT protocol significantly improved inspiratory muscle function in both groups and is an alternative to traditional IMT protocols in this population. Participants in the TFRL group tolerated higher training loads and achieved larger improvements in inspiratory muscle function than those in the MTL group.

6.18 Expiratory and expiratory plus inspiratory muscle training improves respiratory muscle strenght in subjects with COPD: systematic review

AUTOR: IN / *AUTHOR*:

Neves L., Reis M., Plentz R, Matte D., Coronel C., Sbruzzi G.

QUELLE / *SOURCE*:

Respir Care . 2014 Sep;59(9):1381-8.

ABSTRAKT / *ABSTRACT*:

BACKGROUND: Inspiratory muscle training (IMT) produces beneficial effects in COPD subjects, but the effects of expiratory muscle training (EMT) and EMT plus IMT in ventilatory training are still unclear. The aim of this study was to systematically review the effects of EMT and EMT plus IMT compared to control groups of COPD subjects.

METHODS: This study is a systematic review and meta-analysis. The search strategy included MEDLINE, Embase, LILACS, PEDro, and Cochrane CENTRAL and also manual search of references in published studies on the subject. Randomized trials comparing EMT and EMT plus IMT versus control groups of subjects with COPD were included. The outcomes analyzed were respiratory muscle strength and functional capacity. Two reviewers independently extracted the data.

RESULTS: The search retrieved 609 articles. Five studies were included. We observed that EMT provided higher gain in maximum expiratory pressure (PEmax 21.49 cm H2O, 95% CI 13.39–29.59) and maximum inspiratory pressure (PImax 7.68 cm H2O, 95% CI 0.90–14.45) compared to control groups. There was no significant difference in the 6-min walk test distance (29.01 m, 95% CI −39.62 to 97.65) and dyspnea (0.15, 95% CI −0.77 to 1.08). In relation to EMT plus IMT, we observed that PEmax (31.98 cm H2O, 95% CI 26.93–37.03) and PImax (27.98 cm H2O, 95% CI 20.10–35.85) presented higher values compared to control groups.

CONCLUSIONS: EMT and EMT plus IMT improve respiratory muscle strength and can be used as part of the treatment during pulmonary rehabilitation of subjects with severe to very severe COPD.

6.19 Effects of Inspiratory Muscle Training in Older Adults

AUTOR: IN / *AUTHOR*:

Mariana B Seixas, Leonardo B Almeida, Patrícia F Trevizan, Daniel G Martinez, Mateus C Laterza, Luiz Carlos M Vanderlei and Lilian P Silva

QUELLE / *SOURCE*:

Respiratory Care Vol. 66, Issue 1. 1 Jan 2021

ABSTRAKT / *ABSTRACT*:

BACKGROUND: Inspiratory muscle training (IMT) has been widely applied to different populations, including the general population of older adults. In addition to increasing inspiratory muscle strength, other benefits of IMT in the health of this population have been reported. The primary aim of this study was to review the effects of IMT on the general parameters of health (eg, respiratory, functional, physical, and other variables) in older adults (≥ 60 y), and the secondary aim was to analyze the main IMT protocol used in the studies.

METHODS: We searched the MEDLINE, PEDro, SciELO, and LILACS databases to identify relevant randomized controlled clinical trials, and we assessed their methodological quality according to the PEDro scale. The Preferred Reporting Items for Systematic review and Meta-Analysis (PRISMA) guidelines were used to guide the development of the protocol for this systematic review.

RESULTS: The search yielded 7 studies involving 248 participants from 917 titles. The main outcomes investigated in response to IMT were related to the respiratory, functional, and physical variables. The results indicate that IMT promotes an increase of inspiratory muscle strength and diaphragmatic thickness in older adults. There was heterogeneity in the protocols described for this population with respect to the total training time (4–8 weeks), intensity (30–80% of the maximum inspiratory pressure), and weekly frequency (5 or 7 sessions).

CONCLUSIONS: The reviewed studies revealed a positive trend for the effectiveness of IMT in improving inspiratory muscle performance in elderly subjects. More randomized studies are needed to evaluate other outcomes (eg, functional capacity, exercise capacity, cardiac autonomic control, quality of life, and others) to provide robust evidence that this training modality can promote improvements in health parameters in this population. In addition, the usual IMT prescription in this population is based on sets and repetitions, of mild to moderate intensity, performed on most days of the week, for ≥ 4 weeks.

6.20 Effect of respiratory muscle training on exercise performance in healthy individuals: a systematic review and meta-analysis

AUTOR: IN / *AUTHOR*:

Illi, Sabine K ; Held, Ulrike ; Frank, Irène ; Spengler, Christina M

QUELLE / *SOURCE*:

Sports Med. 2012;42: 707–724.

ABSTRAKT / *ABSTRACT*:

Objectives: Two distinct types of specific respiratory muscle training (RMT), i.e. respiratory muscle strength (resistive/threshold) and endurance (hyperpnoea) training, have been established to improve the endurance performance of healthy individuals. We performed a systematic review and meta-analysis in order to determine the factors that affect the change in endurance performance after RMT in healthy subjects.

Data sources: A computerized search was performed without language restriction in MEDLINE, EMBASE and CINAHL and references of original studies and reviews were searched for further relevant studies.

Review methods: RMT studies with healthy individuals assessing changes in endurance exercise performance by maximal tests (constant load, time trial, intermittent incremental, conventional [non-intermittent] incremental) were screened and abstracted by two independent investigators. A multiple linear regression model was used to identify effects of subjects' fitness, type of RMT (inspiratory or combined inspiratory/expiratory muscle strength training, respiratory muscle endurance training), type of exercise test, test duration and type of sport (rowing, running, swimming, cycling) on changes in performance after RMT. In addition, a meta-analysis was performed to determine the effect of RMT on endurance performance in those studies providing the necessary data.

Results: The multiple linear regression analysis including 46 original studies revealed that less fit subjects benefit more from RMT than highly trained athletes (6.0% per 10 mL · kg^{-1} · min^{-1} decrease in maximal oxygen uptake, 95% confidence interval [CI] 1.8, 10.2%; p = 0.005) and that improvements do not differ significantly between inspiratory muscle strength and respiratory muscle endurance training (p = 0.208), while combined inspiratory and expiratory muscle strength training seems to be superior in improving performance, although based on only 6 studies (+12.8% compared with inspiratory muscle strength training, 95% CI 3.6, 22.0%; p = 0.006). Furthermore, constant load tests (+16%, 95% CI 10.2, 22.9%) and intermittent incremental tests (+18.5%, 95% CI 10.8, 26.3%) detect changes in endurance performance better than conventional incremental tests (both p

< 0.001) with no difference between time trials and conventional incremental tests (p = 0.286). With increasing test duration, improvements in performance are greater (+0.4% per minute test duration, 95% CI 0.1, 0.6%; p = 0.011) and the type of sport does not influence the magnitude of improvements (all p > 0.05). The meta-analysis, performed on eight controlled trials revealed a significant improvement in performance after RMT, which was detected by constant load tests, time trials and intermittent incremental tests, but not by conventional incremental tests.

Conclusion: RMT improves endurance exercise performance in healthy individuals with greater improvements in less fit individuals and in sports of longer durations. The two most common types of RMT (inspiratory muscle strength and respiratory muscle endurance training) do not differ significantly in their effect, while combined inspiratory/expiratory strength training might be superior. Improvements are similar between different types of sports. Changes in performance can be detected by constant load tests, time trials and intermittent incremental tests only. Thus, all types of RMT can be used to improve exercise performance in healthy subjects but care must be taken regarding the test used to investigate the improvements.

6.21 Effects of Inspiratory Muscle Training by Using Breather Device in Participants with Chronic Obstructive Pulmonary Disease (COPD)

AUTOR: IN / *AUTHOR*:

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QUELLE / *SOURCE*:

International Journal of Health Sciences & Research (www.ijhsr.org)

Vol.9; Issue: 4; April 2019; 68-75

ABSTRAKT / *ABSTRACT*:

Background: Inspiratory muscle weakness is a clinical feature in patients with COPD. Due to hyperinflation, the shortened diaphragms generate lower force during contraction, contributing to dyspnea and reduced exercise tolerance. Due to pathological changes the strength of inspiratory muscle is reduced which leads to early fatigue and reduce in functional capacity. Therefore, inspiratory muscle training in COPD patients is designed to enhance respiratory muscle function and to reduce the severity of breathlessness and improve exercise tolerance.

Objective: To study the effect of the Breather device on inspiratory muscle strength and functional capacity by measuring Maximum Inspiratory Pressure (Pimax) and 6 Minute Walk Distance (6MWD).

Methodology: Thirty participants both male and female diagnosed with COPD were included in the study and were divided into two groups. Baseline assessment was done using Pimax and 6MWD. Participants in group A performed inspiratory muscle training by using breather device and diaphragmatic breathing and group B performed diaphragmatic breathing exercise twice a day for 2 weeks. Reassessment was done and data was compared.

Results: There was a highly significant (p=<0.0001) difference in Pimax between the pre (57.66±7.76cmH2o) and post (75.33±9.90cmH2o) intervention in group A with significant difference of 56±6.3cmH2o and 60±7.07cmH2o between the groups. Also there was significant (p=<0.0001) difference in 6MWD between the pre(273.66 ±25.07m) and post (273.66 ±25.07m) intervention in group A with the mean difference of 54.73m and 35.4m when compared between the two groups. Conclusion: The use of breather device for inspiratory muscle training showed significant improvement in Pimax and 6MWD in participants with COPD.

6.22 High-Intensity inspiratory muscle training in COPD

AUTOR: IN / *AUTHOR*:

K. Hill, S. C. Jenkins, D. L. Philippe, N. Cecins, K. L. Shepherd, D. J. Green, D. R. Hillman, P. R. Eastwood

QUELLE / *SOURCE*:

European Respiratory Journal 2006 27: 1119-1128;

ABSTRAKT / *ABSTRACT*:

The aim of the present study was to investigate the effects of an interval-based high-intensity inspiratory muscle training (H-IMT) programme on inspiratory muscle function, exercise capacity, dyspnoea and health-related quality of life (QoL) in subjects with chronic obstructive pulmonary disease.

A double-blind randomised controlled trial was performed. Sixteen subjects (11 males, mean forced expiratory volume in one second (FEV1) 37.4±12.5%) underwent H-IMT performed at the highest tolerable inspiratory threshold load (increasing to 101% of baseline maximum inspiratory pressure). Seventeen subjects (11 males, mean FEV1 36.5±11.5%) underwent sham inspiratory muscle training (S-IMT) at 10% of maximum inspiratory pressure. Training took place three times a week for 8 weeks and was fully supervised. Pre- and post-training measurements of lung function, maximum inspiratory pressure, maximum threshold pressure, exercise capacity, dyspnoea and QoL (Chronic Respiratory Disease Questionnaire; CRDQ) were obtained.

H-IMT increased maximum inspiratory pressure by 29%, maximum threshold pressure by 56%, 6-min walk distance by 27 m, and improved dyspnoea and fatigue (CRDQ) by 1.4 and 0.9 points per item, respectively. These changes were significantly greater than any seen following S-IMT.

In conclusion, high-intensity inspiratory muscle training improves inspiratory muscle function in subjects with moderate-to-severe chronic obstructive pulmonary disease, yielding meaningful reductions in dyspnoea and fatigue.

6.23 Inspiratory muscle training and respiratory exercises in children with asthma

AUTOR: IN / *AUTHOR*:

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QUELLE / *SOURCE*:

J Bras Pneumol. 2008 Aug;34(8):552-8.

ABSTRAKT / *ABSTRACT*:

Objective: The aim of the present study was to evaluate the effects that inspiratory muscle training (IMT) and respiratory exercises have on

muscle strength, peak expiratory flow (PEF) and severity variables in children with asthma.

Methods: This was a randomized analytical study involving 50 children with asthma allocated to one of two groups: an IMT group, comprising 25 children submitted to IMT via an asthma education and treatment program; and a control group, comprising 25 children who were submitted only to monthly medical visits and education on asthma. The IMT was performed using a pressure threshold load of 40% of maximal inspiratory pressure (MIP). The results were evaluated using analysis of variance, the chi-square test and Fisher's exact test, values of $p < 0.05$ being considered significant.

Results: In the comparative analysis, pre- and post-intervention values of MIP, maximal expiratory pressure (MEP) and PEF increased significantly in the IMT group: MIP from −48.32 ± 5.706 to −109.92 ± 18.041 ($p < 0.0001$); MEP from 50.64 ± 6.55 to 82.04 ± 17.006 ($p < 0.0001$); and PEF from 173.6 ± 50.817 to 312 ± 54.848 ($p < 0.0001$). In the control group, however, there were no significant differences between the two time points in terms of MIP or MEP, although PEF increased from 188 ± 43.97 to 208.80 ± 44.283 ($p < 0.0001$). There was a significant improvement in the severity variables in the IMT group ($p < 0.0001$).

Conclusions: Programs involving IMT and respiratory exercises can increase mechanical efficiency of the respiratory muscles, as well as improving PEF and severity variables.

6.24 Inspiratory muscle training for asthma

AUTOR: IN / *AUTHOR*:

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QUELLE / *SOURCE*:

Cochrane Library, Version published: 08 September 2013

ABSTRAKT / *ABSTRACT*:

Background: In some people with asthma, expiratory airflow limitation, premature closure of small airways, activity of inspiratory muscles at the end of expiration and reduced pulmonary compliance may lead to lung hyperinflation. With the increase in lung volume, chest wall geometry is modified, shortening the inspiratory muscles and leaving them at a sub-optimal position in their length-tension relationship. Thus, the capacity of these muscles to generate tension is reduced. An increase in cross-sectional area of the inspiratory muscles caused by hypertrophy could offset the functional weakening induced by hyperinflation. Previous studies have shown that inspiratory muscle training promotes diaphragm hypertrophy in healthy people and patients with chronic heart failure, and increases the proportion of type I fibres and the size of type II fibres of the external intercostal muscles in patients with chronic obstructive pulmonary disease. However, its effects on clinical outcomes in patients with asthma are unclear.

Objectives: To evaluate the efficacy of inspiratory muscle training with either an external resistive device or threshold loading in people with asthma.

Search methods: We searched the Cochrane Airways Group Specialised Register of trials, Cochrane Central Register of Controlled Trials (CENTRAL), ClinicalTrials.gov and reference lists of included studies. The latest search was performed in November 2012.

Selection criteria: We included randomised controlled trials that involved the use of an external inspiratory muscle training device versus a control (sham or no inspiratory training device) in people with stable asthma.

Data collection and analysis: We used standard methodological procedures expected by The Cochrane Collaboration.

Main results: We included five studies involving 113 adults. Participants in four studies had mild to moderate asthma and the fifth study included participants independent of their asthma severity. There were substantial

differences between the studies, including the training protocol, duration of training sessions (10 to 30 minutes) and duration of the intervention (3 to 25 weeks). Three clinical trials were produced by the same research group. Risk of bias in the included studies was difficult to ascertain accurately due to poor reporting of methods.

The included studies showed a statistically significant increase in inspiratory muscle strength, measured by maximal inspiratory pressure (PImax) (mean difference (MD) 13.34 cmH2O, 95% CI 4.70 to 21.98, 4 studies, 84 participants, low quality evidence). Our other primary outcome, exacerbations requiring a course of oral or inhaled corticosteroids or emergency department visits, was not reported. For the secondary outcomes, results from one trial showed no statistically significant difference between the inspiratory muscle training group and the control group for maximal expiratory pressure, peak expiratory flow rate, forced expiratory volume in one second, forced vital capacity, sensation of dyspnoea and use of beta2-agonist. There were no studies describing inspiratory muscle endurance, hospital admissions or days off work or school.

Authors' conclusions:There is no conclusive evidence in this review to support or refute inspiratory muscle training for asthma. The evidence was limited by the small number of trials with few participants together with the risk of bias. More well conducted randomised controlled trials are needed. Future trials should investigate the following outcomes: lung function, exacerbation rate, asthma symptoms, hospital admissions, use of medications and days off work or school. Inspiratory muscle training should also be assessed in people with more severe asthma and conducted in children with asthma.

6.25 Inspiratory Muscle Training Improves Sleep and Mitigates Cardiovascular Dysfunction in Obstructive Sleep Apnea

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Jennifer R. Vranish, PhD, E. Fiona Bailey, PhD

QUELLE / *SOURCE*:

Sleep, Volume 39, Issue 6, June 2016, Pages 1179–1185,

ABSTRAKT / *ABSTRACT*:

Study Objectives: New and effective strategies are needed to manage the autonomic and cardiovascular sequelae of obstructive sleep apnea (OSA). We assessed the effect of daily inspiratory muscle strength training (IMT) on sleep and cardiovascular function in adults unable to use continuous positive airway pressure (CPAP) therapy.

Methods: This is a placebo-controlled, single-blind study conducted in twenty four adults with mild, moderate, and severe OSA. Subjects were randomly assigned to placebo or inspiratory muscle strength training. Subjects in each group performed 5 min of training each day for 6 w. All subjects underwent overnight polysomnography at intake and again at study close.

Results: We evaluated the effects of placebo training or IMT on sleep, blood pressure, and plasma catecholamines. Relative to placebo-trained subjects with OSA, subjects with OSA who performed IMT manifested reductions in systolic and diastolic blood pressures (−12.3 ± 1.6 SBP and −5.0 ± 1.3 DBP mmHg;

$P < 0.01$); plasma norepinephrine levels (536.3 ± 56.6 versus 380.6 ± 41.2 pg/mL; $P = 0.01$); and registered fewer nighttime arousals and reported improved sleep (Pittsburgh Sleep Quality Index scores: 9.1 ± 0.9 versus 5.1 ± 0.7; $P = 0.001$). These favorable outcomes were achieved without affecting apneahypopnea index.

Conclusions: The results are consistent with our previously published findings in normotensive adults but further indicate that IMT can modulate blood pressure and plasma catecholamines in subjects with ongoing nighttime apnea and hypoxemia. Accordingly, we suggest IMT offers a low cost, nonpharmacologic means of improving sleep and blood pressure in patients who are intolerant of CPAP.

6.26 Inspiratory muscle training in heart disease and heart failure: a review of the literature with a focus on method of training and outcomes

AUTOR: IN / *AUTHOR*:

Lawrence P Cahalin, Ross Arena, Marco Guazzi, Jonathan Myers, Gerson Cipriano, Gaspar Chiappa, Carl J Lavie, Daniel E Forman

QUELLE / *SOURCE*:

Expert Rev Cardiovasc Ther. 2013 Feb;11(2):161-77

ABSTRAKT / *ABSTRACT*:

Evidence to date strongly suggests that poor inspiratory muscle performance is associated with dyspnea, poor exercise tolerance and poor functional status in patients with heart failure (HF). A growing body of literature has examined the effects of inspiratory muscle training (IMT) in HF patients with the majority of studies reporting favorable effects on several of the above limitations and a substantial number of related deficiencies due to inadequate inspiration and inspiratory muscle strength and endurance. The domains and manifestations of HF, which were significantly improved by IMT in one or more of the 18 out of 19 studies of IMT, included dyspnea, quality of life, balance, peripheral muscle strength and blood flow, peripheral muscle sympathetic nervous activity, heart rate, respiratory rate, peak VO2, 6-min walk test distance, ventilation, VE/VCO2 slope, oxygen uptake efficiency, circulatory power, recovery oxygen kinetics and several indices of cardiac performance. This paper will also review the available IMT literature with a focus on methods of IMT and clinical outcomes. Key differences between available IMT methods will be highlighted with a goal to improve IMT efforts and decrease the pathophysiological manifestations of heart disease and HF.

6.27 PILOT STUDY: HYOLARYNGEAL MUSCLE ACTIVATION IN RESPONSE TO RMT USING THE BREATHER

AUTOR: IN / *AUTHOR*:

Matthew Dumican, M.S. CCC-SLP; Christopher Watts, Ph.D.

QUELLE / *SOURCE*:

Poster Presentation – DYSPHAGIA RESEARCH SOCIETY, 2019, San Diego, CA

6.28 Physical Therapist Management of COVID-19 in the Intensive Care Unit: The West China Hospital Experience

AUTOR: IN / *AUTHOR*:

Lei Li, MSc, Pengming Yu, PhD, Mengxuan Yang, MSc, Wei Xie, MM, Liyi Huang, MM, Chengqi He, PhD, Rik Gosselink, PhD, Quan Wei, MD, PhD, Alice Y M Jones, PhD

QUELLE / *SOURCE*:

Physical Therapy, Volume 101, Issue 1, January 2021, pzaa198,

ABSTRAKT / *ABSTRACT*:

Objective: Coronavirus disease 2019 (COVID-19) has dominated the attention of health care systems globally since January 2020. Various health disciplines, including physical therapists, are still exploring the best way to manage this new disease. The role and involvement of physical therapists in the management of COVID-19 are not yet well defined and are limited in many hospitals. This article reports a physical therapy service specially commissioned by the Health Commission of Sichuan Province to manage COVID-19 during patients' stay in the intensive care unit (ICU) at the Public Health Clinical Center of Chengdu in China.

Methods: Patients diagnosed with COVID-19 were classified into 4 categories under a directive from the National Health Commission of the People's Republic of China. Patients in the "severe" and "critical" categories were admitted to the ICU irrespective of mechanical ventilation was required. Between January 31, 2020, and March 8, 2020, a cohort of 16 patients was admitted to the ICU at the Public Health Clinical Center of Chengdu. The median (minimum to maximum) hospital and ICU stays for these patients were 27 (11–46) and 15 (6–38) days, respectively. Medical management included antiviral, immunoregulation, and supportive treatment of associated comorbidities. Physical therapist interventions included body positioning, airway clearance techniques, oscillatory positive end-expiratory pressure, inspiratory muscle training, and mobility exercises. All patients had at least 1 comorbidity. Three of the 16 patients required mechanical ventilation and were excluded for outcome measures that required understanding of verbal instructions. In the remaining 13 patients, respiratory outcomes—including the Borg Dyspnea Scale, peak expiratory flow rate, PAO2/FIO2 ratio, maximal inspiratory pressure, strength outcomes, Medical Research Council Sum Score, and functional outcomes (including the Physical Function in Intensive Care Test score, De Morton Mobility Index, and Modified Barthel Index)—were measured on the first day the patient received the physical therapist intervention and at discharge.

Results: At discharge from the ICU, while most outcome measures were near normal for the majority of the patients, 61% and 31% of these patients had peak expiratory flow rate and maximal inspiratory pressure, respectively, below 80% of the predicted value and 46% had De Morton Mobility Index values below the normative value.

Conclusion: The respiratory and physical functions of some patients remained poor at ICU discharge, suggesting that long-term rehabilitation may be required for these patients.

Impact: Our experience in the management of patients with COVID-19 has revealed that physical therapist intervention is safe and appears to be associated with an improvement in respiratory and physical function in patients with COVID-19 in the ICU.

6.29 Respiratory Muscle Training: State of the Art

AUTOR: IN / *AUTHOR*:

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QUELLE / *SOURCE*:

Article Pneumologie January 2016

ABSTRAKT / *ABSTRACT*:

Specific respiratory muscle training (IMT) improves the function of the inspiratory muscles. According to literature and clinical experience, there are 3 established methods: 1.) resistive load 2.) threshold load and 3.) normocapnic hyperpnea. Each training method and the associated devices have specific characteristics. Setting up an IMT should start with specific diagnostics of respiratory muscle function and be followed by detailed individual introduction to training. The aim of this review is to take a closer look at the different training methods for the most relevant indications and to discuss these results in the context of current literature. The group of neuromuscular diseases includes muscular dystrophy, spinal muscular atrophy, amyotrophic lateral sclerosis, paralysis of the phrenic nerve, and injuries to the spinal cord. Furthermore, interstitial lung diseases, sarcoidosis, left ventricular heart failure, pulmonary arterial hypertension (PAH), kyphoscoliosis and obesity are also discussed in this context. COPD, asthma, cystic fibrosis (CF) and non-CF-bronchiectasis are among the group of obstructive lung diseases. Last but not least, we summarize current knowledge on weaning from respirator in the context of physical activity.

6.30 Safety and efficacy of inspiratory muscle training for preventing adverse outcomes in patients at risk of prolonged hospitalisation

AUTOR: IN / *AUTHOR*:

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QUELLE / *SOURCE*:

Trials. 2017; 18: 626.

ABSTRAKT / *ABSTRACT*:

Background: The early institution of inspiratory muscle training on hospitalised patients with no established respiratory deficits could prevent in-hospital adverse outcomes that are directly or indirectly associated to the loss of respiratory muscle mass inherent to a prolonged hospital stay. The objective of the clinical trial is to assess the impact of inspiratory muscle training on hospital inpatient complications.

Methods: This is a double-blind randomised controlled trial. Subjects in the intervention group underwent an inspiratory muscle training loaded with 50% maximum inspiratory pressure twice daily for 4 weeks from study enrolment. Patients were randomly assigned to an inspiratory muscle training group or a sham inspiratory muscle training group. All patients received conventional physiotherapy interventions. Baseline and post-intervention respiratory and peripheral muscle strength, functionality (performance of activities of daily living), length of hospital stay, and death were evaluated. Clinical outcomes were assessed until hospital discharge. This study was approved by the Institutional Hospital Ethics Committee (03/2014).

Results: Thirty-one patients assigned to the inspiratory muscle training group and 34 to the sham inspiratory muscle training group were analysed. Patients in the inspiratory muscle training group had a shorter mean length of hospital stay (35.3 ± 2.7 vs. 41.8 ± 3.5 days, $p < 0.01$) and a lower risk of endotracheal intubation (relative risk (RR) = 0.36; 95% confidence interval (CI) 0.27–0.97; $p = 0.03$) as well as muscle weakness (RR = 0.36; 95% CI 0.19–0.98; $p = 0.02$) and mortality (RR = 0.23; 95% CI 0.2–0.94; $p = 0.04$). The risk of adverse events did not differ significantly between groups.

Conclusion: Inspiratory muscle training was a protective factor against endotracheal intubation, muscle weakness, and mortality.

6.31 The Effects of Inspiratory Muscle Training in Older Adults

AUTOR: IN / *AUTHOR*:

MILLS, DEAN E.; JOHNSON, MICHAEL A.; BARNETT, YVONNE A.; SMITH, WILLIAM H. T.; SHARPE, GRAHAM R.

QUELLE / *SOURCE*:

Medicine & Science in Sports & Exercise: April 2015 - Volume 47 - Issue 4 - p 691-697

ABSTRAKT / *ABSTRACT*:

Purpose: Declining inspiratory muscle function and structure and systemic low-level inflammation and oxidative stress may contribute to morbidity and mortality during normal ageing. Therefore, we examined the effects of inspiratory muscle training (IMT) in older adults on inspiratory muscle function and structure and systemic inflammation and oxidative stress, and reexamined the reported positive effects of IMT on respiratory muscle strength, inspiratory muscle endurance, spirometry, exercise performance, physical activity levels (PAL), and quality of life (QoL).

Methods: Thirty-four healthy older adults (68 ± 3 yr) with normal spirometry, respiratory muscle strength, and physical fitness were divided equally into a pressure-threshold IMT or sham-hypoxic placebo group. Before and after an 8-wk intervention, measurements were taken for dynamic inspiratory muscle function and inspiratory muscle endurance using a weighted plunger pressure-threshold loading device; diaphragm thickness by using B-mode ultrasonography; plasma cytokine concentrations by using immunoassays; DNA damage levels in peripheral blood mononuclear cells by using comet assays; spirometry, maximal mouth pressures, and exercise performance by using a 6-min walk test; PAL by using a questionnaire and accelerometry; and QoL using a questionnaire.

Results: Compared with placebo, IMT increased maximal inspiratory pressure (+34% ± 43%, P = 0.008), diaphragm thickness at residual volume (+38% ± 39%, P = 0.03), and peak inspiratory flow (+35% ± 42%, P = 0.049) but did not change other spirometry measures, plasma cytokine concentrations, DNA damage levels in peripheral blood mononuclear cells, dynamic inspiratory muscle function, inspiratory muscle endurance, exercise performance, PAL, or QoL.

Conclusion: These novel data indicate that in healthy older adults, IMT elicits some positive changes in inspiratory muscle function and structure but neither attenuates systemic inflammation and oxidative stress nor improves exercise performance, PAL, or QoL.

6.32 The effects of threshold inspiratory muscle training in patients with obstructive sleep apnea: a randomized experimental study

AUTOR: IN / *AUTHOR*:

Huei-Chen Lin, Ling-Ling Chiang, Jun-Hui Ong, Kun-Ling Tsai, Ching-Hsia Hung, Cheng-Yu Lin

QUELLE / *SOURCE*:

Sleep Breath. 2020 Mar;24(1):201-209.

ABSTRAKT / *ABSTRACT*:

Objectives: Patients with obstructive sleep apnea (OSA) (an obstructed airway and intermittent hypoxia) negatively affect their respiratory muscles. We evaluated the effects of a 12-week threshold inspiratory muscle training (TIMT) program on OSA severity, daytime sleepiness, and pulmonary function in newly diagnosed OSA.

Methods: Sixteen patients with moderate-to-severe OSA were randomly assigned to a TIMT group and 6 to a control group. The home-based TIMT program was 30-45 min/day, 5 days/week, for 12 weeks using a TIMT training device. Their apnea-hypopnea index (AHI), Epworth sleepiness scale (ESS), and forced vital capacity (FVC) scores were evaluated pre- and post-treatment. Polysomnographic (PSG) analysis showed that 9 TIMT-group patients had positively responded (TIMT-responder group: post-treatment AHI < pre-treatment) and that 7 had not (TIMT non-responder group: post-treatment AHI > pre-treatment).

Results: Post-treatment AHI and ESS scores were significantly (both $P < 0.05$) lower 6% and 20.2%, respectively. A baseline AHI $\leq$ 29.0/h predicted TIMT-responder group patients (sensitivity 77.8%; specificity 85.7%). FVC was also significantly ($P < 0.05$) higher 7.2%. Baseline AHI and FEV6.0 were significant predictors of successful TIMT-responder group intervention. OSA severity and daytime sleepiness were also significantly attenuated.

Conclusions: Home-based TIMT training is simple, efficacious, and cost-effective.

6.33 Time-Efficient Inspiratory Muscle Strength Training Lowers Blood Pressure and Improves Endothelial Function, NO Bioavailability, and Oxidative Stress in Midlife/Older Adults With Above-Normal Blood Pressure

AUTOR: IN / *AUTHOR*:

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QUELLE / *SOURCE*:

Journal of the American Heart Assiciation; Vol 10 Nov13, 2021

ABSTRAKT / *ABSTRACT*:

Background: High-resistance inspiratory muscle strength training (IMST) is a novel, time-efficient physical training modality.

Methods and Results: We performed a double-blind, randomized, sham-controlled trial to investigate whether 6 weeks of IMST (30 breaths/day, 6 days/week) improves blood pressure, endothelial function, and arterial stiffness in midlife/older adults (aged 50–79 years) with systolic blood pressure ≥120 mm Hg, while also investigating potential mechanisms and long-lasting effects. Thirty-six participants completed high-resistance IMST (75% maximal inspiratory pressure, n=18) or low-resistance sham training (15% maximal inspiratory pressure, n=18). IMST was safe, well tolerated, and had excellent adherence (≈95% of training sessions completed). Casual systolic blood pressure decreased from 135±2 mm Hg to 126±3 mm Hg (P<0.01) with IMST, which was ≈75% sustained 6 weeks after IMST (P<0.01), whereas IMST modestly decreased casual diastolic blood pressure (79±2 mm Hg to 77±2 mm Hg, P=0.03); blood pressure was unaffected by sham training (all P>0.05). Twenty-four hour systolic blood pressure was lower after IMST versus sham training (P=0.01). Brachial artery flow-mediated dilation improved ≈45% with IMST (P<0.01) but was unchanged with sham training (P=0.73). Human umbilical vein endothelial cells cultured with subject serum sampled after versus before IMST exhibited increased NO bioavailability, greater endothelial NO synthase activation, and lower reactive oxygen species bioactivity (P<0.05). IMST decreased C-reactive protein (P=0.05) and altered select circulating metabolites (targeted plasma metabolomics) associated with cardiovascular function. Neither IMST nor sham training influenced arterial stiffness (P>0.05).

Conclusions:High-resistance IMST is a safe, highly adherable lifestyle intervention for improving blood pressure and endothelial function in midlife/older adults with above-normal initial systolic blood pressure.

6.34 Wirksamkeit von Inspirationsmuskeltraining in der pneumologischen Rehabilitation bei Post-Covid-19-Patienten

AUTOR: IN / *AUTHOR*:

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QUELLE / *SOURCE*:

Pneumologie 2021; 75(S 01): S52

ABSTRAKT / *ABSTRACT*:

Einleitung: Viele Post-Covid-19-Patienten leiden auch nach der Akutphase noch unter Atembeschwerden. Es gibt Hinweise, dass hieran eine Dysfunktion der Atemmuskulatur beteiligt ist. Diese kann durch ein Inspirationsmuskeltraining (IMT) gekräftigt werden. Die Wirksamkeit des IMT bei diesen Patienten ist bisher jedoch kaum untersucht. Ziel ist eine Analyse der Wirksamkeit von IMT bzgl. der maximalen Inspirationsmuskelkraft während einer 3-wöchigen pneumologischen Rehabilitation (PR) bei Post-Covid-19-Patienten.

Methode: Im Rahmen einer prospektiven Studie wurde direkt nach Aufnahme (T1) sowie vor Entlassung (T2) eine Lungenfunktion durchgeführt und die 6-Minuten-Gehstrecke (6MWD) gemessen. Analysiert wurden PI max und Vitalkapazität (VC). Die Erfassung der Leitsymptome Atemnot und Fatigue sowie von Lebensqualität (LQ) und Angst erfolgte mittels Fragebogen. Als Kontraindikation (KI) für ein IMT galten klinische Hinweise auf Thrombosen und erhöhte D-Dimere-Werte. Zudem wurde IMT nur bei Patienten mit reduziertem PI max verordnet (Hygienegründe). Das tägliche IMT wurde mit wöchentlicher Supervision zusätzlich zum routinemäßigen Post-Covid-Reha-Programm durchgeführt.

Ergebnisse: Es wurden 108 Patienten in die Analyse eingeschlossen (45,4% weiblich, Ø Alter 55 ± 9,6 Jahre; Range 33–86, mittlerer BMI 30 ± 6,0). 28 Patienten ohne KI und zumeist reduziertem PI max führten das IMT täglich zusätzlich zur sonstigen Standard-Reha durch. Die Gruppe ohne IMT ist in [Tab. 1] als orientierender Vergleich dargestellt, ist jedoch nicht als ‚Kontrollgruppe' zu sehen. PImax nahm in der Gruppe mit IMT am Ende der Reha signifikant zu (s. [Tab. 1]). In der Gruppe, die kein IMT erhielt (n = 80) änderte sich PI max nicht. VC verbesserte sich in beiden Gruppen vergleichbar. Beide Gruppen verbesserten sich bzgl. Dyspnoe, LQ und 6MWD gleichermaßen und mit großer Effektstärke.

Diskussion: Die Daten legen nahe, dass ein Add-on-IMT die Inspirationsmuskelkraft während einer 3-wöchigen-PR steigern kann. Inwieweit daraus ein Zusatznutzen bzgl. Dyspnoe, LQ oder 6MWD resultiert, kann aufgrund der Daten nicht beurteilt werden, hierfür wäre eine randomisierte Studie erforderlich.

6.35 Auswirkung von inspiratorischem Muskeltraining auf Leistungsfähigkeit und Atemökonomie von Ausdauerläufern

AUTOR: IN / *AUTHOR*:

Aline Janis Weiten

QUELLE / *SOURCE*:

Institut für Sport- und Präventivmedizin der Universität des Saarlandes, Saarbrücken, Institutsleiter: Univ.-Prof. Dr. med. Tim Meyer 2012

ABSTRAKT / *ABSTRACT*:

6.36 COPD Support Group Using Novel Harmonic Device Study

AUTOR: IN / *AUTHOR*:

Keller D., Keller, M.

QUELLE / *SOURCE*:

Chronic Obstructive Pulmonary Diseases: Journal of the COPD Foundation, Oct. 2015

ABSTRAKT / *ABSTRACT*:

6.37 Combined aerobic / inspiratory muscle training vs. Aerobic training in patients with chronic heart failure: The VENT-HeFT trail: a European prospective multicentre randomized trail

AUTOR: IN / *AUTHOR*:

Stamatis Adamopoulos Jean-Paul Schmid Paul Dendale Daniel Poerschke Dominique Hansen Athanasios Dritsas Alexandros Kouloubinis Toon Alders Aggeliki Gkouziouta Ilse Reyckers Vasiliki Vartela Nikos Plessas Costas Doulaptsis Hugo Saner Ioannis

QUELLE / *SOURCE*:

Eur J Heart Fail. 2014 May;16(5):574-82.

ABSTRAKT / *ABSTRACT*:

Aims: Vent-HeFT is a multicentre randomized trial designed to investigate the potential additive benefits of inspiratory muscle training (IMT) on aerobic training (AT) in patients with chronic heart failure (CHF).

Methods and results: Forty-three CHF patients with a mean age of 58 ± 12 years, peak oxygen consumption (peak VO2) 17.9 ± 5 mL/kg/min, and LVEF 29.5 ± 5% were randomized to an AT/IMT group (n = 21) or to an AT/SHAM group (n = 22) in a 12-week exercise programme. AT involved 45 min of ergometer training at 70–80% of maximum heart rate, three times a week for both groups. In the AT/IMT group, IMT was performed at 60% of sustained maximal inspiratory pressure (SPImax) while in the AT/SHAM group it was performed at 10% of SPImax, using a computer biofeedback trainer for 30 min, three times a week. At baseline and at 3 months, patients were evaluated for exercise capacity, lung function, inspiratory muscle strength (PImax) and work capacity (SPImax), quality of life (QoL), LVEF and LV diameter, dyspnoea, C-reactive protein (CRP), and NT-proBNP. IMT resulted in a significantly higher benefit in SPImax (P = 0.02), QoL (P = 0.002), dyspnoea (P = 0.004), CRP (P = 0.03), and NT-proBNP (P = 0.004). In both AT/IMT and AT/SHAM groups PImax (P < 0.001, P = 0.02), peak VO2 (P = 0.008, P = 0.04), and LVEF (P = 0.005, P = 0.002) improved significantly; however, without an additional benefit for either of the groups.

Conclusion: This randomized multicentre study demonstrates that IMT combined with aerobic training provides additional benefits in functional and serum biomarkers in patients with moderate CHF. These findings advocate for application of IMT in cardiac rehabilitation programmes.

6.38 Effectiveness of inspiratory muscle training on sleep and functional capacity to exercise in obstructive sleep apnea: a randomized controlled trial

AUTOR: IN / *AUTHOR*:

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QUELLE / *SOURCE*:

Sleep Breathing Physiology and Disorders • Original Article

Published: 09 November 2017

ABSTRAKT / *ABSTRACT*:

Purpose: The aim of this study was to evaluate the effectiveness of inspiratory muscle training (IMT) on sleep and functional capacity to exercise in subjects with obstructive sleep apnea (OSA).

Methods: This is a controlled, randomized, double-blind study conducted in 16 OSA patients divided into two groups: training (IMT: n = 8) and placebo-IMT (P-IMT: n = 8). IMT was conducted during 12 weeks with a moderate load (50–60% of maximal inspiratory pressure—MIP), while P-IMT used a load < 20% of MPI. Total daily IMT time for both groups was 30 min, 7 days per week, twice a day.

Results: There was no difference comparing IMT to P-IMT group after training for lung function ($p > 0.05$) and respiratory muscle strength ($p > 0.05$). Maximal oxygen uptake (VO2Max) was not significantly different between IMT and P-IMT group (mean difference − 1.76, confidence interval (CI) − 7.93 to 4.41, $p = 0.71$). The same was observed for the other ventilatory and cardiometabolic variables measured ($p > 0.05$). A significant improvement in sleep quality was found when Pittsburgh Sleep Quality Index (PSQI) values of IMT and P-IMT group after training were compared (mean difference: 3.7, confidence interval 95% (CI95%) 0.6 to 6.9, $p = 0.02$) but no significant changes were seen in daytime sleepiness between both groups after the intervention (mean difference: 3.4, CI 95%: − 3.3 to 10.0; $p = 0.29$).

Conclusion: According to these results, 12 weeks of moderate load IMT resulted in improved sleep quality, but there were no significant repercussions on functional capacity to exercise or excessive daytime sleepiness.

6.39 Effects of inspiratory muscle training on dynamic hyperinflation in patients with COPD

AUTOR: IN / *AUTHOR*:

Milos Petrovic, Michael Reiter, Harald Zipko, Wolfgang Pohl, and Theodor Wanke

QUELLE / *SOURCE*:

Int J Chron Obstruct Pulmon Dis. 2012; 7: 797–805.

ABSTRAKT / *ABSTRACT*:

Dynamic hyperinflation has important clinical consequences in patients with chronic obstructive pulmonary disease (COPD). Given that most of these patients have respiratory and peripheral muscle weakness, dyspnea and functional exercise capacity may improve as a result of inspiratory muscle training (IMT). The aim of the study was to analyze the effects of IMT on exercise capacity, dyspnea, and inspiratory fraction (IF) during exercise in patients with COPD. Daily inspiratory muscle strength and endurance training was performed for 8 weeks in 10 patients with COPD GOLD II and III. Ten patients with COPD II and III served as a control group. Maximal inspiratory pressure (Pimax) and endurance time during resistive breathing maneuvers (tlim) served as parameter for inspiratory muscle capacity. Before and after training, the patients performed an incremental symptom limited exercise test to maximum and a constant load test on a cycle ergometer at 75% of the peak work rate obtained in the pretraining incremental test. ET was defined as the duration of loaded pedaling. Following IMT, there was a statistically significant increase in inspiratory muscle performance of the Pimax from 7.75 ± 0.47 to 9.15 ± 0.73 kPa ($P < 0.01$) and of tlim from 348 ± 54 to 467 ± 58 seconds ($P < 0.01$). A significant increase in IF, indicating decreased dynamic hyperinflation, was observed during both exercise tests. Further, the ratio of breathing frequency to minute ventilation ($bf/V'E$) decreased significantly, indicating an improved breathing pattern. A significant decrease in perception of dyspnea was also measured. Peak work rate during the incremental cycle ergometer test remained constant, while ET during the constant load test increased significantly from 597.1 ± 80.8 seconds at baseline to 733.6 ± 74.3 seconds ($P < 0.01$). No significant changes during either exercise tests were measured in the control group. The present study found that in patients with COPD, IMT results in improvement in performance, exercise capacity, sensation of dyspnea, and improvement in the IF prognostic factor.

6.40 Inspiratory muscle training in children and adolescents living with neuromuscular diseases: A pre-experimental study

AUTOR: IN / *AUTHOR*:

Anri Human

QUELLE / *SOURCE*:

Neuromuscul Disord. 2017 Jun;27(6):503-517

ABSTRAKT / *ABSTRACT*:

Patients with neuromuscular diseases are at risk of morbidity and mortality due to respiratory compromise caused by respiratory muscle weakness. A systematic review was performed using pre-specified search strategies to determine the safety of inspiratory muscle training (IMT) and whether it has an impact on inspiratory muscle strength and endurance, exercise capacity, pulmonary function, dyspnoea and health-related quality of life. Randomised, quasi-randomised, cross-over and clinical controlled trials were included if they assessed the use of an external IMT device compared to no, sham/placebo, or alternative IMT treatment in children aged 5-18 years with neuromuscular diseases. Seven full-text articles and two on-going trials (n = 168) were included. Most studies used threshold IMT devices over a medium to long-term period, and none reported any adverse events. Studies differed regarding intensity, repetitions, frequency, rest intervals and duration of IMT. Six studies reported no significant improvement in pulmonary function tests following IMT. Two comparable studies reported significant improvement in inspiratory muscle endurance and four studies reported significantly greater improvement in inspiratory muscle strength in experimental groups. The latter was confirmed in a meta-analysis of two comparable studies (overall effect $p < 0.00001$). Other outcome measures could not be pooled. There is currently insufficient evidence to guide clinical IMT practice, owing to the limited number of included studies; small sample sizes; data heterogeneity; and risk of bias amongst included studies. Large sample randomised controlled trials are needed to determine safety and efficacy of IMT in paediatric and adolescent patients with neuromuscular diseases.

6.41 Inspiratory Muscle Training Improves Blood Flow to Resting and Exercising Limbs in Patients With Chronic Heart Failure

AUTOR: IN / *AUTHOR*:

Gaspar R. Chiappa, PT, SCD, Bruno T. Roseguini, PT, MSC, Paulo J. C. Vieira, PT, Cristiano N. Alves, PT, Angela Tavares, MSC, Eliane R. Winkelmann, PT, MSC, Elton L. Ferlin, BSEE, Ricardo Stein, MD, SCD, Jorge P. Ribeiro, MD, SCD

QUELLE / *SOURCE*:

Journal of the American College of Cardiology Vol. 51, No. 17, 2008

ABSTRAKT / *ABSTRACT*:

Objectives: We tested the hypothesis that inspiratory muscle loading could result in exaggerated peripheral vasoconstriction in resting and exercising limbs and that inspiratory muscle training (IMT) could attenuate this effect in patients with chronic heart failure (CHF) and inspiratory muscle weakness.

Background: Inspiratory muscle training improves functional capacity of patients with CHF, but the mechanisms of this effect are unknown.

Methods: Eighteen patients with CHF and inspiratory muscle weakness (maximal inspiratory pressure <70% of predicted) and 10 healthy volunteers participated in the study. Inspiratory muscle loading was induced by the addition of inspiratory resistance of 60% of maximal inspiratory pressure, while blood flow to the resting calf (CBF) and exercising forearm (FBF) were measured by venous occlusion plethysmography. For the patients with CHF, blood flow measurements as well as ultrasound determination of diaphragm thickness were made before and after a 4-week program of IMT.

Results: With inspiratory muscle loading, CHF patients demonstrated a more marked reduction in resting CBF and showed an attenuated rise in exercising FBF when compared with control subjects. After 4 weeks of IMT, CHF patients presented hypertrophy of the diaphragm and improved resting CBF and exercise FBF with inspiratory muscle loading.

Conclusions: In patients with CHF and inspiratory muscle weakness, inspiratory muscle loading results in marked reduction of blood flow to resting and exercising limbs. Inspiratory muscle training improves limb blood flow under inspiratory loading in these patients.

6.42 Inspiratory muscle training in addition to physical exercise for idiopathic pulmonary fibrosis

AUTOR: IN / *AUTHOR*:

Nykvist M., Sköld M., Ferrara G., Faager G.

QUELLE / *SOURCE*:

European Respiratory Journal 2016 48: OA1518

ABSTRAKT / *ABSTRACT*:

Background: Inspiratory muscle training (IMT) has beneficial effects on dyspnoea, physical function and health related quality of life (HRQL) in patients with COPD but has not yet been evaluated in idiopathic pulmonary fibrosis (IPF). The aim of the study was to compare IMT and physical exercise (PE) with PE alone in patients with IPF.

Method: In a randomised controlled study, patients with IPF were randomised to IMT(n=14) or sham IMT(n=10) during an 8-week exercise programme. Exercise capacity was assessed with six minute walking test (6 MWT), respiratory muscle strength (PI,max, PE,max), dyspnea by modified Medical Council Scale and quality of life with Chronic respiratory disease questionnaire (CRQ-SAS) including the dimension of dyspnoea, at baseline and after 8 weeks PE. In addition, lung function test was measured.

Results: Patients performing IMT and PE had a significant reduction in the dimension dyspnoea of CRQ-SAS($p \leq 0.05$) compared to controls. The IMT-group improved their walking distance from 466(±66) to 513(±102) m ($p \leq 0.05$), PI,max, from 90(±24) to 112(±29) cmH2O ($p \leq 0.001$), PE,max, from 109(±27) to 121(±37) cmH2O ($p \leq 0.05$). Fatigue ($p \leq 0.05$) and total score ($p \leq 0.05$) of CRQ-SAS was also improved. The IMT sham group improved significantly PI,max($p \leq 0.05$) after eight weeks.

Conclusion: Inspiratory muscle training in combination with exercise in patients with IPF showed a significant improvement in dyspnoea compared with sham IMT and exercise. The study also showed a positive trend in favour of IMT in addition to exercise compared to exercise alone in exercise capacity, fatigue and HRQL in patients with IPF. IMT may therefore be a valuable addition to PE in patients with IPF.

6.43 Inspiratory Muscle Training in Obstructive Sleep Apnea Associating Diabetic Peripheral Neuropathy: A Randomized Control Study

AUTOR: IN / *AUTHOR*:

Samah A. Moawd, Alshimaa R. Azab, Saud M. Alrawaili, and Walid Kamal Abdelbasset

QUELLE / *SOURCE*:

BioMed Research International June 2020

ABSTRAKT / *ABSTRACT*:

Objective. This work is aimed at assessing the effects of inspiratory muscle training on lung functions, inspiratory muscle strength, and aerobic capacity in diabetic peripheral neuropathy (DPN) patients with obstructive sleep apnea (OSA). Methods. A randomized control study was performed on 55 patients diagnosed with DPN and OSA. They were assigned to the training group (IMT,) and placebo training group (P-IMT,). Inspiratory muscle strength, lung functions, and aerobic capacity were evaluated before and after 12 weeks postintervention. An electronic inspiratory muscle trainer was conducted, 30 min a session, three times a week for 12 consecutive weeks. Results. From seventy-four patients, 55 have completed the study program. A significant improvement was observed in inspiratory muscle strength () in the IMT group while no changes were observed in the P-IMT group (). No changes were observed in the lung function in the two groups (5). Also, VO2max and VCO2max changed significantly after training in the IMT group () while no changes were observed in the P-IMT group (). Other cardiopulmonary exercise tests did not show any significant change in both groups (). Conclusions. Based on the outcomes of the study, it was found that inspiratory muscle training improves inspiratory muscle strength and aerobic capacity without a notable effect on lung functions for diabetic patients suffering from DPN and OSA.

6.44 Inspiratory muscle training reduces diaphragm activation and dyspnea during exercise in COPD

AUTOR: IN / *AUTHOR*:

Daniel Langer, Casey Ciavaglia, Azmy Faisal, Katherine A. Webb, J. Alberto Neder,

Rik Gosselink, Sauwaluk Dacha, Marko Topalovic, Anna Ivanova, and Denis E. O'Donnell

QUELLE / *SOURCE*:

J Appl Physiol 125: 381–392, 2018.

ABSTRAKT / *ABSTRACT*:

Among patients with chronic obstructive pulmonary disease (COPD), those with the lowest maximal inspiratory pressures experience greater breathing discomfort (dyspnea) during exercise. In such individuals, inspiratory muscle training (IMT) may be associated with improvement of dyspnea, but the mechanisms for this are poorly understood. Therefore, we aimed to identify physiological mechanisms of improvement in dyspnea and exercise endurance following inspiratory muscle training (IMT) in patients with COPD and low maximal inspiratory pressure (Pimax). The effects of 8 wk of controlled IMT on respiratory muscle function, dyspnea, respiratory mechanics, and diaphragm electromyography (EMGdi) during constant work rate cycle exercise were evaluated in patients with activity-related dyspnea (baseline dyspnea index <9). Subjects were randomized to either IMT or a sham training control group (n = 10 each). Twenty subjects (FEV1 = 47 ± 19% predicted; Pimax = −59 ± 14 cmH2O; cycle ergometer peak work rate = 47 ± 21% predicted) completed the study; groups had comparable baseline lung function, respiratory muscle strength, activity-related dyspnea, and exercise capacity. IMT, compared with control, was associated with greater increases in inspiratory muscle strength and endurance, with attendant improvements in exertional dyspnea and exercise endurance time (all $P < 0.05$). After IMT, EMGdi expressed relative to its maximum (EMGdi/EMGdimax) decreased ($P < 0.05$) with no significant change in ventilation, tidal inspiratory pressures, breathing pattern, or operating lung volumes during exercise. In conclusion, IMT improved inspiratory muscle strength and endurance in mechanically compromised patients with COPD and low Pimax. The attendant reduction in EMGdi/EMGdimax helped explain the decrease in perceived respiratory discomfort despite sustained high ventilation and intrinsic mechanical loading over a longer exercise duration.

6.45 Inspiratory muscle training in obstructive sleep apnea syndrom

AUTOR: IN / *AUTHOR*:

Hulya Arikan, Nurel Bellur, Hakan Caliskan, Melda Saglam, Naciye Vardar-Yagli, Ebru Calik, Deniz Inal-Ince, Sema Savci, Melike Yuce Ege, Hikmet Firat, Sadik Ardic

QUELLE / *SOURCE*:

European Respiratory Journal 2012 40: P491;

ABSTRAKT / *ABSTRACT*:

Aim: No information is known about the role of inspiratory muscle training in patients with obstructive sleep apnea syndrome (OSAS). The purpose of this study was to investigate the effects of inspiratory muscle training on respiratory muscle strength, polisomnographic results, snoring, and sleep quality in patients with OSAS.

Materials and Methods: Twenty-seven OSAS patients were randomly assigned to one of two groups: 15 patients in the training group and 12 patients in the control group. The patients in training group underwent a 12-week inspiratory muscle training program (30-80% of their maximal inspiratory pressures, MIP) using a threshold loading device for 30 minutes per day, seven days per week. The patients in the control group underwent standart medical treatment. In all patients, respiratory muscle strength (MIP, maximal expiratory pressure, MEP) was determined. Polisomnography recordings, snoring (The Berlin Questionnaire), and quality of life (The Functional Outcomes of Sleep Questionnaire, FOSQ) were also evaluated before and after the treatment.

Results: No significant differences were found between the two groups with regard to age, gender, and body mass index ($p>0.05$). After 12 weeks of inspiratory muscle training program, there were significant improvements in MIP, MEP, and total score of FOSQ compared with the control group ($p<0.05$). The presence of snoring, snoring frequency and severity decreased significantly after inspiratory muscle training ($p<0.05$).

Conclusions: Inspiratory muscle training ensures significant benefits in respiratory muscle strength, quality of life, and snoring for OSAS patients. It should be taken into consideration for the management of the patients.

6.46 Respiratory muscle training with normocapnic hyperpnea improves ventilatory pattern and thoracoabdominal coordination, and reduces oxygen desaturation during endurance exercise testing in COPD patients

AUTOR: IN / *AUTHOR*:

Bernardi E, Pomidori L, Bassal F, Contoli M, Cogo A

QUELLE / *SOURCE*:

Int J Chron Obstruct Pulmon Dis. 2015 Sep 10;10:1899-906

ABSTRAKT / *ABSTRACT*:

Background: Few data are available about the effects of respiratory muscle training with normocapnic hyperpnea (NH) in COPD. The aim is to evaluate the effects of 4 weeks of NH (Spirotiger®) on ventilatory pattern, exercise capacity, and quality of life (QoL) in COPD patients.

Methods: Twenty-six COPD patients (three females), ages 49–82 years, were included in this study. Spirometry and maximal inspiratory pressure, St George Respiratory Questionnaire, 6-minute walk test, and symptom-limited endurance exercise test (endurance test to the limit of tolerance [tLim]) at 75%–80% of peak work rate up to a Borg Score of 8–9/10 were performed before and after NH. Patients were equipped with ambulatory inductive plethysmography (LifeShirt®) to evaluate ventilatory pattern and thoracoabdominal coordination (phase angle [PhA]) during tLim. After four supervised sessions, subjects trained at home for 4 weeks – 10 minutes twice a day at 50% of maximal voluntary ventilation. The workload was adjusted during the training period to maintain a Borg Score of 5–6/10.

Results: Twenty subjects completed the study. After NH, maximal inspiratory pressure significantly increased (81.5±31.6 vs 91.8±30.6 cmH2O, P<0.01); exercise endurance time (+150 seconds, P=0.04), 6-minute walk test (+30 meters, P=0.03), and QoL (-8, P<0.01) all increased. During tLim, the ventilatory pattern changed significantly (lower ventilation, lower respiratory rate, higher tidal volume); oxygen desaturation, PhA, and dyspnea Borg Score were lower for the same work intensity (P<0.01, P=0.02, and P<0.01, respectively; one-way ANOVA). The improvement in tidal volume and oxygen saturation after NH were significantly related (R2=0.65, P<0.01).

Conclusion: As expected, NH improves inspiratory muscle performance, exercise capacity, and QoL. New results are significant change in ventilatory pattern, which improves oxygen saturation, and an improvement in thoracoabdominal coordination (lower PhA). These two facts could explain the reduced dyspnea during the endurance test. All these results together may play a role in improving exercise capacity after NH training.

6.47 The effects of inspiratory muscle training based on the perceptions of patients with advanced lung disease: a qualitative study

AUTOR: IN / *AUTHOR*:

Hoffman M., Assis M., Augusto V., Silveira B., Parreira V.

QUELLE / *SOURCE*:

Braz J Phys Ther. 2018 May-Jun; 22(3): 215–221.

ABSTRAKT / *ABSTRACT*:

Background: Advanced lung disease is a chronic non-neoplastic disease that compromises activities of daily living. Treatment includes pulmonary rehabilitation and inspiratory muscle training. Studies have shown the effectiveness of inspiratory muscle training in lung disease patients, but literature is scarce on the patients' perceptions about this topic.

Objective: To explore the perceptions of patients with advanced lung disease about inspiratory muscle training.

Methods: Qualitative study. Interviews were conducted using a semi-structured questionnaire regarding topics on the participation of patients in inspiratory muscle training and on daily activities performed before and after training. Interviews were transcribed and analyzed according to thematic content analysis.

Results: Ten patients (eight women and 2 men, ranging in age from 27 to 89 years) with inspiratory muscle weakness (maximal inspiratory pressure=44±13.9cmH2O) were included. Five patients were diagnosed with Chronic Obstructive Pulmonary Disease, two with bronchiectasis and three with pulmonary fibrosis. All patients completed at least 80% of the total training sessions. The reports were grouped into four thematic categories: (1) impact of inspiratory muscle training on breathlessness (e.g., "I wasn't feeling as tired as I previously felt."); (2) change in daily activities (e.g., "I needed to go to the supermarket, I felt less tired doing it."); (3) improved mobility (e.g., "I could not stand for long periods […] walking, for example […] Now I stand more, I have more capability."); and (4) increased communication (e.g., "More power, right? Even in speaking […] When I could, I felt my voice coming out better.").

Conclusion: There were improvements in breathlessness, daily activities, mobility, and communication, which positively affected the psychological and social aspects of the patients.

6.48 The role of inspiratory muscle training in the management of asthma and exercise-induced bronchoconstriction

AUTOR: IN / *AUTHOR*:

Ren-Jay Shei,Hunter L. R. Paris,Daniel P. Wilhite,Robert F. Chapman &Timothy D. Mickleborough

QUELLE / *SOURCE*:

The Physician and Sportsmedicine Volume 44, 2016 - Issue 4, Pages 327-334

ABSTRAKT / *ABSTRACT*:

Asthma is a pathological condition comprising of a variety of symptoms which affect the ability to function in daily life. Due to the high prevalence of asthma and associated healthcare costs, it is important to identify low-cost alternatives to traditional pharmacotherapy. One of these low cost alternatives is the use of inspiratory muscle training (IMT), which is a technique aimed at increasing the strength and endurance of the diaphragm and accessory muscles of respiration. IMT typically consists of taking voluntary inspirations against a resistive load across the entire range of vital capacity while at rest. In healthy individuals, the most notable benefits of IMT are an increase in diaphragm thickness and strength, a decrease in exertional dyspnea, and a decrease in the oxygen cost of breathing. Due to the presence of expiratory flow limitation in asthma and exercise-induced bronchoconstriction, dynamic lung hyperinflation is common. As a result of varying operational lung volumes, due in part to hyperinflation, the respiratory muscles may operate far from the optimal portion of the length-tension curve, and thus may be forced to operate against a low pulmonary compliance. Therefore, the ability of these muscles to generate tension is reduced, and for any given level of ventilation, the work of breathing is increased as compared to non-asthmatics. Evidence that IMT is an effective treatment for asthma is inconclusive, due to limited data and a wide variation in study methodologies. However, IMT has been shown to decrease dyspnea, increase inspiratory muscle strength, and improve exercise capacity in asthmatic individuals. In order to develop more concrete recommendations regarding IMT as an effective low-cost adjunct in addition to traditional asthma treatments, we recommend that a standard treatment protocol be developed and tested in a placebo-controlled clinical trial with a large representative sample.

6.49 Effects of respiratory muscle training versus placebo on endurance exercise performance

AUTOR: IN / *AUTHOR*:

D A Sonetti, T J Wetter, D F Pegelow, J A Dempsey

QUELLE / *SOURCE*:

Respir Physiol. 2001 Sep;127(2-3):185-99

ABSTRAKT / *ABSTRACT*:

We evaluated the effects of a 5 week (25 sessions); (30-35 min/day, 5 days/week), respiratory muscle training (RMT) program in nine competitive male cyclists. The experimental design included inspiratory resistance strength training (3-5 min/session) and hyperpnea endurance training (30 min/session), a placebo group which used a sham hypoxic trainer (n=8), and three exercise performance tests, including a highly reproducible 8 km time trial test. RMT intensity, measured once a week in terms of accumulated inspiratory pressure and the level of sustainable hyperpnea increased significantly after 5 weeks (+64% and +19%, respectively). The RMT group showed a significant 8% increase in maximal inspiratory pressure (P<0.05) while the placebo group showed only a 3.7% increase (P>0.10). RMT and placebo groups both showed significant increases in the fixed work-rate endurance test performance time (+26% and +16%, respectively) and in the peak work-rate achieved during the incremental maximal oxygen consumption (V(O2)max) test (+9 and +6%). The 8 km time trial performance increased 1.8+/-1.2% (or 15+/-10 sec; P<0.01) in the RMT group with 8 of 9 subjects increasing; the placebo group showed a variable non-significant change in 5 of 8 subjects (-0.3+/-2.7%, P=0.07). The changes observed in these three performance tests were not, however, significantly different between the RMT and placebo groups. Heart rate, ventilation, or venous blood lactate, at equal work-rates during the incremental exercise test or at equal times during the fixed work-rate endurance test were not changed significantly across these exercise trials in either group. We propose that the effect of RMT on exercise performance in highly trained cyclists does not exceed that in a placebo group. Significant placebo and test familiarization effects must be accounted for in experimental designs utilizing performance tests which are critically dependent on volitional effort.

6.50 Respiratory muscle training in obstructive lung disease: how to implement and what to expect

AUTOR: IN / *AUTHOR*:

McConnell A.K., Romer L.M., Weiner P.

QUELLE / *SOURCE*:

Breathe Volume 2 No. 1; p. 39-49; September 2005

ABSTRAKT / *ABSTRACT*:

Dyspnoea is influenced by inspiratory muscle strength and the load placed upon the inspiratory muscles. Dynamic hyperinflation is a major cause of dyspnoea and exercise intolerance in patients with expiratory flow limitation due to its detrimental effect upon inspiratory muscle loading. Specific IMT improves inspiratory muscle strength, reduces dyspnoea and improves exercise tolerance, even in individuals without inspiratory muscle weakness or hyperinflation. Pressure threshold IMT is the most reliable, convenient and commonly used method of IMT, eliciting improvements in a wide range of muscle functional characteristics, including strength, shortening velocity, power and endurance. Inspiratory muscles adhere to the same training principles as other skeletal muscles, with respect to overload, specificity and reversibility. Training loads must exceed 30% of inspiratory muscle strength, with at least once daily training and weekly increases in training load. Programmes should be least 6 weeks in duration, after which frequency can be reduced to two sessions, three times per week. IMT can be implemented as a stand-alone intervention or as part of a comprehensive programme of rehabilitation. Monitored outcomes should include inspiratory muscle strength, an index of dyspnoea (e.g. BDI/TDI and/or Borg CR-10) and exercise tolerance (e.g. 6MWD)

6.51 Inspiratory muscle training in pulmonary rehabilitation program in COPD patients.

AUTOR: IN / *AUTHOR*:

Magadle R, McConnell AK, Beckerman M

QUELLE / *SOURCE*:

Respir Med, 2007; 101: 1500–1505

ABSTRAKT / *ABSTRACT*:

Most pulmonary rehabilitation (PR) programs do not currently incorporate IMT in their PR programs for COPD patients. The aim of the present study was to assess the influence of adding IMT to the patients already involved in a rehabilitation program. Thirty-four patients with significant COPD were recruited for the study. All patients participated in a general exercise reconditioning (GER) program for 12 weeks. The patients were then randomized to receive IMT or sham IMT, in addition to GER for the next 6 months. Following three months of GER training there was a significant increase in the 6-min walk test (6MWT) (from mean+/-SEM 254+/-38 to 322+/-42 m, $p<0.01$), and small but non-significant decreases in the perception of dyspnea (POD), and in the St. George Respiratory Questionnaire score (SGRQ). Following the addition of IMT to the GER program there was a significant increase in the PI(max) in the GER+IMT group (from 66+/-4.7 to 78+/-4.5 cm H(2)O, $p<0.01$). This was accompanied by a significant improvement in the POD and a further significant improvement in the SGRQ score. IMT provides additional benefits to patients undergoing PR program and is worthwhile even in patients who have already undergone a GER program.

6.52 Inspiratory muscle training in pulmonary rehabilitation program in COPD patients

AUTOR: IN / *AUTHOR*:

Rasmi Magadlea, Alison K. McConnellb, Marinella Beckermana, Paltiel Weinera,

QUELLE / *SOURCE*:

Respiratory Medicine (2007)101, 1500–1505

ABSTRAKT / *ABSTRACT*:

Most pulmonary rehabilitation (PR) programs do not currently incorporate IMT in their PR programs for COPD patients. The aim of the present study was to assess the influence of adding IMT to the patients already involved in a rehabilitation program. Thirty-four patients with significant COPD were recruited for the study. All patients participated in a general exercise reconditioning (GER) program for 12 weeks. The patients were then randomized to receive IMT or sham IMT, in addition to GER for the next 6 months. Following three months of GER training there was a significant increase in the 6-min walk test (6MWT) (from mean+/-SEM 254+/-38 to 322+/-42 m, p<0.01), and small but non-significant decreases in the perception of dyspnea (POD), and in the St. George Respiratory Questionnaire score (SGRQ). Following the addition of IMT to the GER program there was a significant increase in the PI(max) in the GER+IMT group (from 66+/-4.7 to 78+/-4.5 cm H(2)O, p<0.01). This was accompanied by a significant improvement in the POD and a further significant improvement in the SGRQ score. IMT provides additional benefits to patients undergoing PR program and is worthwhile even in patients who have already undergone a GER program.

6.53 Inspiratory muscle training may increase peak inspiratory flow in chronic obstructive pulmonary disease

AUTOR: IN / *AUTHOR*:

Paltiel Weiner , Margalit Weiner

QUELLE / *SOURCE*:

Respiration. 2006;73(2):151-6

ABSTRAKT / *ABSTRACT*:

Background: When choosing a specific inhalation device for a chronic obstructive pulmonary disease (COPD) patient, the internal airflow resistance and the ability of the patient to overcome it and to create an optimal inspiratory flow are essential.

Objectives: The purpose of the present study was to investigate: (1) the peak inspiratory flow (PIF) that a patient with COPD can generate while breathing through two dry powder inhalers and (2) whether in patients with low PIF specific inspiratory muscle training (SIMT) will increase the PIF and exceed the minimal PIF that is considered necessary to guarantee optimal lung deposition of the drug.

Methods: Inspiratory muscle strength and PIFs were measured in 60 patients with COPD. Then 28 patients with severe COPD and low PIF were randomized to receive SIMT or to a control group.

Results: With the Turbuhaler, 12 patients (20%) could not generate the optimal flow of 60 l/min. PIF correlated very well with maximal inspiratory mouth pressure (PI(max)) for the Diskus and the Turbuhaler, as well as for both males and females ($p < 0.001$). Following the training period, there was a statistically significant increase in the PI(max) in the training group. This increase was associated with a significant increase in the PIF. All patients overcame the minimal threshold PIF following the training.

Conclusions: Some patients with severe COPD are not able to generate adequate flow to secure optimal lung deposition of the inhalation with the Turbuhaler. SIMT improves inspiratory muscle strength as well as PIF. Following 8 weeks of training, the optimal PIF enabling adequate lung deposition of the drug was attained in all the trained patients.

6.54 Inspiratory muscle training reduces blood pressure and sympathetic activity in hypertensive partients: a randomized controlled trail.

AUTOR: IN / *AUTHOR*:

Ferreira JB., Plentz RD, Stein C., Casalie KR., Arena R., Lago PD

QUELLE / *SOURCE*:

International Journal of cardiology, 2013; 166:61-7

ABSTRAKT / *ABSTRACT*:

Background: Autonomic imbalance, characterized by sympathetic hyperactivity and diminished vagal tone, is a known mechanism for essential hypertension. Inspiratory muscle training (IMT) demonstrates beneficial outcomes in a number of cardiovascular populations, which may potentially extend to patients with hypertension. The aim of this study was to further elucidate the effects of IMT on blood pressure and autonomic cardiovascular control in patients with essential hypertension.

Methods: Thirteen patients with hypertension were randomly assigned to an eight-week IMT program (6 patients) or to a placebo-IMT (P-IMT, 7 patients) protocol. We recorded RR interval for posterior analysis of heart rate variability and blood pressure, by ambulatory blood pressure monitoring (ABPM), before and after the program.

Results: There was a significant increase in inspiratory muscle strength in the IMT group (82.7 ± 28.8 vs 121.5 ± 21.8 cmH2O, $P < 0.001$), which was not demonstrated by P-IMT (93.3 ± 25.3 vs 106.1 ± 25.3 cmH2O, $P > 0.05$). There was also a reduction in 24-hour measurement of systolic (133.2 ± 9.9 vs 125.2 ± 13.0 mm Hg, $P = 0.02$) and diastolic (80.7 ± 12.3 vs 75.2 ± 1.0 mm Hg, $P = 0.02$) blood pressure, as well as in daytime systolic (136.8 ± 12.2 vs 127.6 ± 14.2 mm Hg, $P = 0.008$) and diastolic (83.3 ± 13.1 vs. 77.2 ± 12.2 mm Hg, $P = 0.01$) blood pressure in the IMT group. In relation to autonomic cardiovascular control, we found increased parasympathetic modulation (HF: 75.5 ± 14.6 vs. 84.74 ± 7.55 n.u, $P = 0.028$) and reduced sympathetic modulation (LF: 34.67 ± 20.38 vs. 12.81 ± 6.68 n.u; $P = 0.005$). Moreover, there was reduction of cardiac sympathetic discharge (fLF) in IMT group ($P = 0.01$).

Conclusions: IMT demonstrates beneficial effects on systolic and diastolic blood pressure as well as autonomic cardiovascular control in hypertensive patients.

6.55 Inspiratory muscle training reduces diaphragm activation and dyspnea during exercise in COPD

AUTOR: IN / *AUTHOR*:

Langer D, Ciavaglia C, Faisal A,

QUELLE / *SOURCE*:

Journal of Applied Physiology August 2018

ABSTRAKT / *ABSTRACT*:

Among patients with chronic obstructive pulmonary disease (COPD), those with the lowest maximal inspiratory pressures experience greater breathing discomfort (dyspnea) during exercise. In such individuals, inspiratory muscle training (IMT) may be associated with improvement of dyspnea, but the mechanisms for this are poorly understood. Therefore, we aimed to identify physiological mechanisms of improvement in dyspnea and exercise endurance following inspiratory muscle training (IMT) in patients with COPD and low maximal inspiratory pressure (Pimax). The effects of 8 wk of controlled IMT on respiratory muscle function, dyspnea, respiratory mechanics, and diaphragm electromyography (EMGdi) during constant work rate cycle exercise were evaluated in patients with activity-related dyspnea (baseline dyspnea index <9). Subjects were randomized to either IMT or a sham training control group (n = 10 each). Twenty subjects (FEV1 = 47 ± 19% predicted; Pimax = −59 ± 14 cmH2O; cycle ergometer peak work rate = 47 ± 21% predicted) completed the study; groups had comparable baseline lung function, respiratory muscle strength, activity-related dyspnea, and exercise capacity. IMT, compared with control, was associated with greater increases in inspiratory muscle strength and endurance, with attendant improvements in exertional dyspnea and exercise endurance time (all $P < 0.05$). After IMT, EMGdi expressed relative to its maximum (EMGdi/EMGdimax) decreased ($P < 0.05$) with no significant change in ventilation, tidal inspiratory pressures, breathing pattern, or operating lung volumes during exercise. In conclusion, IMT improved inspiratory muscle strength and endurance in mechanically compromised patients with COPD and low Pimax. The attendant reduction in EMGdi/EMGdimax helped explain the decrease in perceived respiratory discomfort despite sustained high ventilation and intrinsic mechanical loading over a longer exercise duration.

6.56 Inspiratory muscle training with threshold or incentive spirometry: Which is the most effective?

AUTOR: IN / *AUTHOR*:

Dulciane NunesPaiva,Laíse Bender Assmann,Diogo Fanfa Bordin, Ricardo Gass, Renan Trevisan Jost, Mario Bernardo-Filhod, Rodrigo Alves França, Dannuey Machado Cardoso

QUELLE / *SOURCE*:

Portuguese journal of pulmonology, Volume 21, Issue 2, March–April 2015, Pages 76-81

ABSTRAKT / *ABSTRACT*:

Inspiratory muscular training (IMT) increases the respiratory muscle strength, however, there is no data demonstrating its superiority over the incentive spirometry (IS) in doing so. Values of muscle strength after IMT (Threshold IMT®) and by the IS (Voldyne®) in healthy females was compared. Subjects (n = 40) were randomly divided into control group (CG, n = 14), IS group (ISG, n = 13) and threshold group (TG, n = 13). PImax was measured before (pre-IMT), at 15 and 30 days of IMT. There was an increase in PImax of the TG at 15 days ($p < 0.001$) and 30 days of IMT ($p < 0.001$). The same occurred with the ISG, which increased the PImax at 15 days ($p < 0.001$) and 30 days of training ($p < 0.001$). After 30 days of IMT, the TG presented a PImax which was significantly higher than ISG and the CG ($p = 0.045$ and $p < 0.001$, respectively). It can be concluded that IMT by threshold was more effective in increasing muscle strength than the Voldyne.

6.57 Influence of Gender and Inspiratory Muscle Training o h Perception of Dyspnea in Patients with Astma

AUTOR: IN / *AUTHOR*:

Paltiel Weiner 1, Rasmi Magadle, Fareed Massarwa, Marinella Beckerman, Noah Berar-Yanay

QUELLE / *SOURCE*:

Chest. 2002 Jul;122(1):197-201

ABSTRAKT / *ABSTRACT*:

Background: Men and women respond differently to asthma.

Patients and methods: Maximal inspiratory mouth pressure (P(Imax)), beta(2)-agonist consumption, and perception of dyspnea (POD) were measured in 22 women and 22 men with mild persistent-to-moderate asthma. Next, the women were randomized into two groups: those who received inspiratory muscle training and those who received sham training. The training ended when the P(Imax) of the training group was equal to that of the male subjects. POD was then measured once again.

Results: Baseline P(Imax) was significantly lower ($p < 0.01$) while POD and mean daily beta(2)-agonist consumption were significantly higher in the female subjects. P(Imax) reached the level of the male subjects at the end of the 20th week of training. The increase in the P(Imax) was associated with a statistically significant decrease in mean daily beta(2)-agonist use and in POD to a similar level as in male subjects.

Conclusions: POD and mean daily beta(2)-agonist consumption in asthmatic women are significantly higher, and the P(Imax) significantly lower, than that of their male counterparts. When the P(Imax) of female subjects following training is equal to that in male subjects, the differences in POD and mean daily beta(2)-agonist consumption disappear.

6.58 Muscle Impairment in Neuromuscular Disease Using an Expiratory/Inspiratory Pressure Ratio

AUTOR: IN / *AUTHOR*:

Guilherme Fregonezi, Ingrid G Azevedo, Vanessa R Resqueti, Armèle D De Andrade, Lucien P Gualdi, Andrea Aliverti, Mário ET Dourado-Junior and Verônica F Parreira

QUELLE / *SOURCE*:

Respiratory Care April 2015, 60 (4) 533-539

ABSTRAKT / *ABSTRACT*:

BACKGROUND: Neuromuscular diseases (NMDs) lead to different weakness patterns, and most patients with NMDs develop respiratory failure. Inspiratory and expiratory muscle strength can be measured by maximum static inspiratory pressure (PImax) and maximum static expiratory pressure (PEmax), and the relationship between them has not been well described in healthy subjects and subjects with NMDs. Our aim was to assess expiratory/inspiratory muscle strength in NMDs and healthy subjects and calculate PEmax/PImax ratio for these groups.

METHODS: Seventy (35 males) subjects with NMDs (amyotrophic lateral sclerosis, myasthenia gravis, and myotonic dystrophy), and 93 (47 males) healthy individuals 20–80 y of age were evaluated for anthropometry, pulmonary function, PImax, and PEmax, respectively.

RESULTS: Healthy individuals showed greater values for PImax and PEmax when compared with subjects with NMDs. PEmax/PImax ratio for healthy subjects was 1.31 ± 0.26, and PEmax%/PImax% was 1.04 ± 0.05; for subjects with NMDs, PEmax/PImax ratio was 1.45 ± 0.65, and PEmax%/PImax% ratio was 1.42 ± 0.67. We found that PEmax%/PImax% for myotonic dystrophy was 0.93 ± 0.24, for myasthenia gravis 1.94 ± 0.6, and for amyotrophic lateral sclerosis 1.33 ± 0.62 when we analyzed them separately. All healthy individuals showed higher PEmax compared with PImax. For subjects with NMDs, the impairment of PEmax and PImax is different among the 3 pathologies studied ($P < .001$).

CONCLUSIONS: Healthy individuals and subjects with NMDs showed higher PEmax in comparison to PImax regarding the PEmax/PImax ratio. Based on the ratio, it is possible to state that NMDs show different patterns of respiratory muscle strength loss. PEmax/PImax ratio is a useful parameter to assess the impairment of respiratory muscles in a patient and to customize rehabilitation and treatment.

6.59 Postoperative outcomes following preoperative inspiratory muscle training in patients undergoing cardiothoracic or upper abdominal surgery: a systematic review and meta analysis.

AUTOR: IN / *AUTHOR*:

Mans CM, Reeve JC, Elkins MR

QUELLE / *SOURCE*:

Clin Rehabil. 2015;29: 426–438

ABSTRAKT / *ABSTRACT*:

Objective: To evaluate whether preoperative inspiratory muscle training is effective in preventing postoperative pulmonary complications and reducing length of hospital stay in people undergoing cardiothoracic or upper abdominal surgery.

Data sources: Medline, CINAHL, AMED, PsychINFO, Scopus, PEDro, and the Cochrane Library.

Review methods: A systematic review and meta analysis of randomized controlled trials (or quasi-randomized controlled trials) investigating a form of preoperative inspiratory muscle training, compared with sham or no inspiratory muscle training. Participants were adults (16 years and over) awaiting elective open cardiac, thoracic, or upper abdominal surgery. Methodological quality was assessed using the PEDro scale.

Results: Eight studies involving 295 participants were eligible for inclusion. The trained group had significantly higher maximal inspiratory pressure at the end of the preoperative training period (mean difference: 15 cm H2O, 95% confidence interval (CI): 9 to 21). This benefit was maintained through the early postoperative period, when lung function also recovered significantly more quickly in the trained group. Inspiratory muscle training also substantially reduced postoperative pulmonary complications (relative risk 0.48, 95% CI 0.26 to 0.89). Although not statistically significant, length of hospital stay also tended to favour the trained group. There were no statistically significant differences between the groups for the remaining outcomes. Participant satisfaction with inspiratory muscle training was high.

Conclusion: Preoperative inspiratory muscle training significantly improves respiratory (muscle) function in the early postoperative period, halving the risk of pulmonary complications. The training does not increase length of stay, but more data are required to confirm whether it reduces length of stay.

6.60 Präoperatvies Training der Inspirationsmuskeln mit überzeugenden Resultaten

AUTOR: IN / *AUTHOR*:

Verra M., Monnin D,

QUELLE / *SOURCE*:

Physioactive 5, 2016 S. 48-50

ABSTRAKT / *ABSTRACT*:

6.61 Respiratory failure treated by ventilatory muscle training (VMT). A report of two cases

AUTOR: IN / *AUTHOR*:

Belman M.

QUELLE / *SOURCE*:

Eur J Respir Dis. 1981 Dec;62(6):391-5.

ABSTRAKT / *ABSTRACT*:

I used ventilatory muscle training by means of repeated runs of isocapnic hyperpnea to improve ventilatory muscle function in two patients with acute respiratory failure superimposed on chronic obstructive lung disease (COPD). The training was associated with successful weaning from mechanical ventilation and a rapid return to adequate ventilatory function. This method is easy to use and can be started while patients are still intubated. Furthermore, continued post extubation ventilatory muscle training provides further improvement in ventilatory muscle function.

6.62 Respiratory muscle training programs: impact on the functional autonomy of the elderly.

AUTOR: IN / *AUTHOR*:

Marilia de Andrade Fonseca, Samaria Ali Cader, Estelio Henrique Martin Dantas, Silvia Correa Bacelar, Elirez Bezerra da Silva, Silvania Matheus de Oliveira Leal

QUELLE / *SOURCE*:

Rev Assoc Med Bras (1992). Nov-Dec 2010;56(6):642-8

ABSTRAKT / *ABSTRACT*:

Objective: To compare two respiratory muscle training programs for improving the functional autonomy of institutionalized elderly.

Methods: Clinical randomized trial conducted at a long stay institution with 42 elderly volunteers that were divided into three groups: Group ® Threshold (GT) with mean age (70.93 ± 8.41), Group Voldyne ® (GV) (70.54 ± 7.73) and Control Group (CG) (73.92 ± 7.28). Groups GT and GV were treated with breathing exercises and muscle training by Threshold and Voldyne, respectively while the CG did just breathing exercises. Training of groups took 10 weeks. To assess the functional autonomy, the elderly were evaluated before and after training, according to the GDLAM protocol.

Results: All intra-group comparison (pre x post-test) showed a significant difference in GT for all tests (C10M: Δ% = -20.57, p = 0.0001; LPS: Δ% = -13.53, p = 0.020; VTC: Δ% = -27.96, p = 0.0001; LCLC: Δ% = -18.71, p = 0.0001 and IG:% Δ = -18.43, p = 0.0001), except in LPDV. In GV there was a significant difference only (p <0.05) for the C10M (% Δ = -17.11, p = 0.004). In the comparison between (post x post), there was a statistical significance (p <0.05) for VTC test between the GT and GV (Δ = -3.62%, p = 0.017), with favorable results for the GT. Similarly, there was a statistical difference (p <0.05) in GT C10M (% Δ = -3.83, p = 0.023), LCLC (Δ = -34.02%, p = 0.012) and IG (Δ% = -13.63, p = 0.004) compared to GC.

Conclusion: The trained groups improved functional autonomy, reaching 27.42; considered to be a weak level in both pre-and post-training.

6.63 The effects of 1 year of specific inspiratory muscle training in patients with COPD

AUTOR: IN / *AUTHOR*:

Beckerman M., Magadle R., Weiner M., Weiner P.

QUELLE / *SOURCE*:

Chest Nov 2005

ABSTRAKT / *ABSTRACT*:

Aim: We assessed the long-term benefits of inspiratory muscle training (IMT) on inspiratory muscle strength, exercise capacity, the perception of dyspnea, quality of life, primary care use, and hospitalizations in patients with significant COPD.

Patients: Forty-two consecutive COPD patients with FEV(1) < 50% of predicted were randomized into a group that received IMT for 1 year, and a control group that received training with a very low load.

Results: There was a statistically significant increase in inspiratory muscle strength (at the end of the third month of training) as assessed by maximal inspiratory pressure (from 71 +/- 4.9 to 90 +/- 5.1 cm H(2)O [+/- SEM], p < 0.005) and 6-min walk distance (at the end of the third month of training; from 256 +/- 41 to 312 +/- 54 m; p < 0.005), a decrease in the mean Borg score during breathing against resistance (at the end of the ninth month of training), improvement in the health-related quality-of-life scores (at the end of the sixth month of training) in the training group but not in the control group. At the end of the training year, these changes were maintained; in addition, a decrease in primary health-care use and hospitalization days was observed.

Conclusions: Our study shows that during IMT in patients with significant COPD, there is an increase in exercise capacity, improvement in quality of life, and decrease in dyspnea. Our study also provides evidence that long-term IMT can decrease the use of health services and hospitalization days.

6.64 High-Intensity Inspiratory Muscle Training Improves Scalene and Sternocleidomastoid Muscle Oxygenation Parameters in Patients With Weaning Difficulties: A Randomized Controlled Trial

AUTOR: IN / *AUTHOR*:

Marine Van Hollebeke, Diego Poddighe, Beatrix Clerckx, Jan Muller, Greet Hermans, Rik Gosselink, Daniel Langer and Zafeiris Louvaris

QUELLE / *SOURCE*:

Front. Physiol., 09 February 2022 | https://doi.org/10.3389/fphys.2022.786575

ABSTRAKT / *ABSTRACT*:

Background: Critically ill patients who have difficulties weaning from the mechanical ventilator are prone to develop respiratory muscle weakness. Inspiratory muscle training (IMT) can improve respiratory muscle strength. Whether IMT can improve scalene and sternocleidomastoid muscle oxygenation parameters is unknown.

Aim: To compare changes in muscle oxygenation parameters of scalene and sternocleidomastoid inspiratory muscles during a standardized task between patients with weaning difficulties who received either high-intensity IMT (intervention) or sham low-intensity IMT (control).

Method: Forty-one patients performed daily IMT sessions (4 sets, 6–10 breaths) until weaning success or for 28 consecutive days. The training load was progressively adjusted in the intervention group (n = 22) to the highest tolerable load, whilst the control group (n = 19) kept training at 10% of their baseline maximal inspiratory pressure (PImax). Breathing characteristics (i.e., work and power of breathing, PoB), respiratory muscle function [i.e., PImax and forced vital capacity (FVC)] were measured during a standardized loaded breathing task against a load of 30% of baseline PImax before and after the IMT period. In addition, during the same loaded breathing task, absolute mean and nadir changes from baseline in local scalene and sternocleidomastoid muscle oxygen saturation index (Δ%StiO2) (an index of oxygen extraction) and nadir Δ%StiO2 normalized for the PoB were measured by near-infrared spectroscopy.

Results: At post measures, only the intervention group improved mean PoB compared to pre measures (Pre: 0.42 ± 0.33 watts, Post: 0.63 ± 0.51watts, p-value < 0.01). At post measures, both groups significantly improved nadir scalene muscles StiO2% normalized for the mean PoB (ΔStiOnadir%/watt) compared to pre measurements and the improvement was not significant different between groups (p-value = 0.40). However, at post measures, nadir sternocleidomastoid muscle StiO2% normalized for the mean PoB (ΔStiOnadir%/watt) was

significantly greater improved in the intervention group (mean difference: +18.4, 95%CI: −1.4; 38.1) compared to the control group (mean difference: +3.7, 95%CI: −18.7; 26.0, between group p-value < 0.01). Both groups significantly improved PImax (Intervention: +15 ± 13 cmH2O p-value < 0.01, Control: +13 ± 15 cmH2O p-value < 0.01). FVC only significantly improved in the intervention group (+0.33 ± 0.31 L p < 0.01) report also change in control group.

Conclusion: This exploratory study suggests that high-intensity IMT induces greater improvements in scalene and sternocleidomastoid muscle oxygenation parameters attributed for oxygen delivery, utilization and oxygen saturation index compared to low-intensity IMT in patients with weaning difficulties.

6.65 High-Frequency Airway Oscillating Device for Respiratory Muscle Training in Subjects With COPD

AUTOR: IN / *AUTHOR*:

Enya Daynes, Neil J Greening, Theresa C Harvey-Dunstan, Sally J Singh

QUELLE / *SOURCE*:

Respir Care. 2018 May;63(5):584-590. doi: 10.4187/respcare.05837. Epub 2018 Mar 13.

ABSTRAKT / *ABSTRACT*:

Background: COPD is characterized by expiratory flow limitation, which results in symptomatic dyspnea and reduced exercise capacity. Changes in breathing mechanics mean the respiratory muscles are unable to respond to the ventilatory demands, increasing the sensation of dyspnea. A high-frequency oscillating device has been developed to improve dyspnea in patients with COPD. We conducted a feasibility trial to gain insight into the potential for recruitment, retention, and study design for a future randomized controlled trial.

Methods: Symptomatic subjects with COPD were included on the basis of a Medical Research Council (MRC) score ≥ 3 and FEV1/FVC < 0.70). Patients were excluded if they received pulmonary rehabilitation within the last 6 months. The intervention employed the device for 8 weeks, 3 times daily. Clinical outcomes included the MRC score, maximal expiratory and inspiratory pressures (PEmax/PImax), the incremental shuttle walk test (ISWT), and the endurance shuttle walk test (ESWT).

Results: We successfully recruited 23 subjects with established COPD (65.2% male, mean age 65 ± 5.03 y, mean % predicted FEV1 43.9 ± 16, mean FEV1/FVC ratio 0.46 ± 0.13, and median [interquartile range] MRC 4 [3-5]). There was a significant change in MRC from 4 to 3 pre to post intervention (P = .003). There was a statistically significant difference in PEmaxP < .008 and PImaxP = .044. There were no significant differences observed in the ISWT or ESWT.

Conclusions: This study design appeared feasible to proceed to a clinical effectiveness trial. The use of the device for 8 weeks showed a significant improvement in PEmax, PImax, and reduced symptomatic dyspnea on the MRC dyspnea score. The results of this study should encourage a randomized controlled trial.

6.66 Preliminary study: comparative effects of lung volume therapy between slow and fast deep-breathing techniques on pulmonary function, respiratory muscle strength, oxidative stress, cytokines, 6-minute walking distance, and quality of life in persons with COPD

AUTOR: IN / *AUTHOR*:

Jirakrit Leelarungrayub, Rungthip Puntumetakul, Thanyaluck Sriboonreung, Yothin Pothasak, Jakkrit Klaphajone

QUELLE / *SOURCE*:

Int J Chron Obstruct Pulmon Dis. 2018 Dec 5;13:3909-3921. doi: 10.2147/COPD.S181428. eCollection 2018.

ABSTRAKT / *ABSTRACT*:

Background: Lung volume therapy with the Voldyne® device can improve lung volume and has a nonsignificant benefit on respiratory muscle strength via the slow deep-breathing technique (SDBT); whereas respiratory muscle training with a respiratory muscle trainer via the fast deep-breathing technique (FDBT) has produced a significant improvement in people with COPD. Thus, the aim of this study was to compare the efficiency of lung volume therapy with the Voldyne® device with the SDBT and FDBT on pulmonary function, respiratory muscle strength, oxidative stress, cytokines, walking capacity, and quality of life (QoL) in people with COPD.

Methods: A total of 30 COPD patient volunteers with mild (stage I) to moderate (stage II) severity were randomized into two groups: SDBT (n=15) and FDBT (n=15). Pulmonary function (FVC, FEV1, and FEV1/FVC), maximal inspiratory mouth pressure (PImax), oxidative stress status (total antioxidant capacity [TAC], glutathione [GSH], malondialdehyde [MDA], and nitric oxide [NO]), inflammatory cytokines (tumor necrosis factor-alpha [TNF-α] and IL-6), 6-minute walking distance (6MWD), and total clinical COPD questionnaire (CCQ) score were evaluated before and after 4 weeks of training.

Results: All the parameters had no statistical difference between the groups before training. The PImax, TAC, IL-6, total QoL score, and 6MWD changed significantly in the SDBT group after the 4-week experiment as compared to those in the pre-experimental period, whereas FVC, FEV1, FEV1%, FEV1/FVC%, PImax, TAC, MDA, NO, TNF-α, IL-6, 6MWD, and total CCQ score changed significantly in the FDBT group as compared to those in the pre-experimental period. The FEV1%, PImax, TNF-α, IL-6, and total CCQ score differed significantly in the FDBT group in the post-experimental period as compared to those in the SDBT group.

Conclusion: This preliminary study concluded that the application of incentive spirometry with the Voldyne® device via fast deep breathing possibly improved respiratory muscle strength and QoL and reduced inflammatory cytokines, MDA, and NO better than that via slow deep breathing among people with COPD.

6.67 Effects of a simple prototype respiratory muscle trainer on respiratory muscle strength, quality of life and dyspnea, and oxidative stress in COPD patients: a preliminary study

AUTOR: IN / *AUTHOR*:

Jirakrit Leelarungrayub, Decha Pinkaew, Rungthip Puntumetakul, Jakkrit Klaphajone

QUELLE / *SOURCE*:

Int J Chron Obstruct Pulmon Dis. 2017 May 12;12:1415-1425. doi: 10.2147/COPD.S131062. eCollection 2017.

ABSTRAKT / *ABSTRACT*:

Background: The aim of this study was to evaluate the efficiency of a simple prototype device for training respiratory muscles in lung function, respiratory muscle strength, walking capacity, quality of life (QOL), dyspnea, and oxidative stress in patients with COPD.

Methods: Thirty COPD patients with moderate severity of the disease were randomized into three groups: control (n=10, 6 males and 4 females), standard training (n=10, 4 males and 6 females), and prototype device (n=10, 5 males and 5 females). Respiratory muscle strength (maximal inspiratory pressure [PImax] and maximal expiratory pressure [PEmax]), lung function (forced vital capacity [FVC], percentage of FVC, forced expiratory volume in 1 second [FEV1], percentage of FEV1 [FEV1%], and FEV1/FVC), 6-minute walking distance (6MWD), QOL, and oxidative stress markers (total antioxidant capacity [TAC]), glutathione (GSH), malondialdehyde (MDA), and nitric oxide (NO) were evaluated before and after 6 weeks of training. Moreover, dyspnea scores were assessed before; during week 2, 4, and 6 of training; and at rest after training.

Results: All parameters between the groups had no statistical difference before training, and no statistical change in the control group after week 6. FVC, FEV1/FVC, PImax, PEmax, QOL, MDA, and NO showed significant changes after 6 weeks of training with either the standard or prototype device, compared to pre-training. FEV1, FEV1%, 6MWD, TAC, and GSH data did not change statistically. Furthermore, the results of significant changes in all parameters were not statistically different between training groups using the standard and prototype device. The peak dyspnea scores increased significantly in week 4 and 6 when applying the standard or prototype device, and then lowered significantly at rest after 6 weeks of training, compared to pre-training.

Conclusion: This study proposes that a simple prototype device can be used clinically in COPD patients as a standard device to train respiratory muscles, improving lung function and QOL, as well as involving MDA and NO levels.

6.68 THE EFFECTS OF RESPIRATORY MUSCLE TRAINING ON VO2 MAX, THE VENTILATORY THRESHOLD AND PULMONARY FUNCTION

AUTOR: IN / *AUTHOR*:

William E. Amonette, Terry L. Dupler

QUELLE / *SOURCE*:

JEPonline.2002;5(2):29-35

ABSTRAKT / *ABSTRACT*:

This study evaluated the effect of inspiratory and expiratory muscle training on pulmonary function and maximal exercise performance in competitive triathletes and marathon runners. The participants in this study (N=12) had a mean weekly aerobic training time of 7.5 hours per week of swimming, cycling, or running. Eight subjects were assigned to a pulmonary resistance treatment group and four control subjects were given a sham device that allowed no greater than 15% resistance on inspiration or expiration. The subjects performed 30 maximal inhalation/exhalation maneuvers on their respective devices two times per day for fourweeks. The subjects were tested for forced vital capacity (FVC), forced expiratory volume in one second (FEV1), FEV1/FVC ratio, forced inspiratory vital capacity (FIVC), peak inspiratory flow rate (PIFR), and peak expiratory flow rate (PEFR). Each subject was also tested for peak exhalation force (PEF) as well as a maximal oxygen consumption (VO2 max), carbon dioxide production (VCO2), tidal volume (VT), ventilation (VE), ventilatory threshold (VT), and respiration rate (RR). The data revealed that training using the pulmonary resistance device produced significant increases in maximal VE and maximal VT while decreasing RR (although not statistically significant) at maximum exercise. However, no significant changes were seen in VO2 or any pulmonary function variables measured.

//study listed twice in order to fit the table of content

6.69 Respiratory muscle training improves swimming endurance in divers

AUTOR: IN / *AUTHOR*:

Juli A. Wylegala, David R. Pendergast, Luc E. Gosselin, Dan E. Warkander & Claes E. G. Lundgren

QUELLE / *SOURCE*:

European Journal of Applied Physiology volume 99, pages393–404 (2007)

ABSTRAKT / *ABSTRACT*:

Respiratory muscles can fatigue during prolonged and maximal exercise, thus reducing performance. The respiratory system is challenged during underwater exercise due to increased hydrostatic pressure and breathing resistance. The purpose of this study was to determine if two different respiratory muscle training protocols enhance respiratory function and swimming performance in divers. Thirty male subjects (23.4 ± 4.3 years) participated. They were randomized to a placebo (PRMT), endurance (ERMT), or resistance respiratory muscle training (RRMT) protocol. Training sessions were 30 min/day, 5 days/week, for 4 weeks. PRMT consisted of 10-s breath-holds once/minute, ERMT consisted of isocapnic hyperpnea, and RRMT consisted of a vital capacity maneuver against 50 cm H2O resistance every 30 s. The PRMT group had no significant changes in any measured variable. Underwater and surface endurance swim time to exhaustion significantly increased after RRMT (66%, P < 0.001; 33%, P = 0.003) and ERMT (26%, P = 0.038; 38%, P < 0.001). Breathing frequency (f b) during the underwater endurance swim decreased in RRMT (23%, P = 0.034) and tidal volume (V T) increased in both the RRMT (12%, P = 0.004) and ERMT (7%, P = 0.027) groups. Respiratory endurance increased in ERMT (216.7%) and RRMT (30.7%). Maximal inspiratory and expiratory pressures increased following RRMT (12%, P = 0.015, and 15%, P = 0.011, respectively). Results from this study indicate that respiratory muscle fatigue is a limiting factor for underwater swimming performance, and that targeted respiratory muscle training (RRMT > ERMT) improves respiratory muscle and underwater swimming performance.

//study listed twice in order to fit the table of content

7 Studien zu Vibrationstraining und Ganzkörpervibrationen / *studies on vibration training and whole body vibration*

7.1 Effect of 6-Month Whole Body Vibration Training on Hip Density, Muscle Strength, and Postural Control in Postmenopausal Women: A Randomized Controlled Pilot Study

AUTOR: IN / *AUTHOR*:

Verschueren S. MP, Roelants M., Delecluse C., Swinnen S., Vanderschueren D., Boonen M.

QUELLE / *SOURCE*:

Journal of Bone and Mineral Research 19(3):352-9

ABSTRAKT / *ABSTRACT*:

ABSTRACT: High-frequency mechanical strain seems to stimulate bone strength in animals. In this randomized controlled trial, hip BMD was measured in postmenopausal women after a 24-week whole body vibration (WBV) training program. Vibration training significantly increased BMD of the hip. These findings suggest that WBV training might be useful in the prevention of osteoporosis.

Introduction: High-frequency mechanical strain has been shown to stimulate bone strength in different animal models. However, the effects of vibration exercise on the human skeleton have rarely been studied. Particularly inpostmenopausal women—who are most at risk of developing osteoporosis—randomized controlled data on the safety and efficacy of vibration loading are lacking. The aim of this randomized controlled trial was to assess the musculoskeletal effects of high-frequency loading by means of whole body vibration (WBV) in postmenopausal women.

Materials and Methods: Seventy volunteers (age, 58–74 years) were randomly assigned to a whole body vibration training group (WBV, n 25), a resistance training group (RES, n 22), or a control group (CON, n 23). The WBV group and the RES group trained three times weekly for 24 weeks. The WBV group performed static and dynamic knee-extensor exercises on a vibration platform (35–40 Hz, 2.28–5.09g), which mechanically loaded the bone and evoked reflexive muscle contractions. The RES group trained knee extensors by dynamic leg press and leg extension exercises, increasing from low (20 RM) to high (8 RM) resistance. The CON group did not participate in any training. Hip bone density was measured using DXA at baseline and after the 6-month intervention. Isometric and dynamic strength were measured by means of a motor-driven dynamometer. Data were analyzed by means of repeated measures ANOVA.

Results: No vibration-related side effects were observed. Vibration training improved isometric and dynamic muscle strength (15% and 16%, respectively; p 0.01) and also significantly increased BMD of the hip (0.93%, p 0.05). No changes in hip BMD were observed in women participating in resistance training or age-matched controls (0.60% and 0.62%, respectively; not significant). Serum markers of bone turnover did not change in any of the groups.

Conclusion: These findings suggest that WBV training may be a feasible and effective way to modify well recognized risk factors for falls and fractures in older women and support the need for further human studies.

7.2 Acute effects of various whole-body vibration frequencies on lower-body power in trained and untrained subjects

AUTOR: IN / *AUTHOR*:

Rønnestad B.

QUELLE / *SOURCE*:

Journal of Strength and Conditioning Research: July 2009 - Volume 23 - Issue 4 - p 1309-1315

ABSTRAKT / *ABSTRACT*:

Rønnestad, BR. Acute effects of various whole-body vibration frequencies on lower-body power in trained and untrained subjects. J Strength Cond Res 23(4): 1309-1315, 2009-The purpose of this study was to investigate the acute effects of whole-body vibration (WBV) with different vibration frequencies on power production during squat jump (SJ) and countermovement jump (CMJ) with submaximal external loads in strength trained and untrained subjects. Subjects were randomly exposed to WBV with frequencies of 20, 35, or 50 Hz (amplitude: 3 mm), or no vibration. Peak average power during SJ and CMJ was assessed on a Smith machine while standing on a vibration platform. Both the trained and untrained group increased peak average power during SJ at an WBV frequency of 50 Hz (6.8 ± 1.9 and 7.3 ± 1.7%, respectively; $p < 0.05$). This increase was larger than in the other test conditions, in which no changes occurred ($p < 0.05$). Untrained subjects increased peak average power during CMJ with 4.4 ± 1.3% ($p < 0.05$) while vibrating at a frequency of 50 Hz, but there was no difference for the strength trained subjects. Furthermore, there was no difference in peak average power in CMJ and SJ while vibrating at frequencies of 20 and 35 Hz compared with no vibration in either of the groups. In conclusion, WBV with a frequency of 50 Hz increases peak average power in both trained and untrained subjects, whereas vibration frequencies of 20 and 35 Hz do not have this effect. Thus, if the purpose of using WBV is to increase the stimulus to the neuromuscular system to a greater extent than traditional explosive strength/power training, the WBV frequency should be 50 Hz and the exercises should be explosive and submaximally loaded (like traditional explosive strength/power training).

7.3 Prolonged Vibration of the Biceps Brachii Tendon Reduces Time to Failure When Maintaining Arm Position With a Submaximal Load

AUTOR: IN / *AUTHOR*:

Mottram C.J., Maluf K.S., Stephenson J.L, Anderson M.K., Enoka R.M

QUELLE / *SOURCE*:

J Neurophysiol 95: 1185–1193, 2006.

ABSTRAKT / *ABSTRACT*:

Vibration reduces the amplitudes of the tendon jerk response and the Hoffmann and stretch reflexes in the muscle exposed to the vibration, yet does not alter the time to task failure when the task involves exerting a submaximal force against a rigid restraint. Because the amplitude of the stretch reflex is greater when a limb acts against a compliant load than a rigid restraint, the purpose was to determine the influence of prolonged tendon vibration on the time to failure when maintaining limb position with the elbow flexor muscles. Twenty-five healthy men performed the fatiguing contraction by maintaining elbow angle at 1.57 rad until failure while supporting a load equal to 20% of maximal voluntary contraction (MVC) force. The fatiguing contraction was performed on 3 separate days with different levels of vibration applied to the biceps brachii tendon: no vibration, subthreshold for a tonic vibration reflex (TVR), and suprathreshold for a TVR. MVC force before the fatiguing contraction was similar across the three sessions (mean of 3 sessions: 313 ± 54 N, P = 0.83). Despite a similar decline in MVC force after the fatiguing contraction across conditions (–18.0 ± 8.0%, P > 0.05), the time to task failure was 3.7 ± 1.4 min for the suprathreshold TVR condition, 4.3 ± 2.1 min for the subthreshold TVR condition, and 5.0 ± 2.2 min for the no-vibration condition (P < 0 0.001). The average EMG of the elbow flexor muscles was similar (P = 0.22) during the fatiguing contractions. However, the fluctuations in limb acceleration at task onset were greater for the suprathreshold TVR condition (P < 0.01), but were not different between the subthreshold TVR and no-vibration conditions (P ≥ 0.22). Furthermore, the difference in the SD of limb acceleration between the no-vibration and vibration conditions was correlated with the difference in time to failure for the no-vibration and subthreshold TVR conditions (P = 0.03; r2 = 0.22), but not for the no-vibration and suprathreshold TVR conditions (P = 0.90; r2 = 0.001). These findings indicate that prolonged vibration reduced the time to failure of a sustained contraction when subjects maintained limb position, suggesting that peripheral inputs to the motor neuron pool play a significant role in sustaining a contraction during tasks that require active control of limb position.

7.4 The effects of whole-body vibration on muscle strength and power: a meta-analysis

AUTOR: IN / *AUTHOR*:

Osawa Y., Oguma Y., Ishii N.

QUELLE / *SOURCE*:

J Musculoskelet Neuronal Interact 2013; 13(3):380-390

ABSTRAKT / *ABSTRACT*:

Exercise with whole-body vibration (WBV) is becoming popular as an alternative to conventional training or as supplementary training. However, despite increasing research efforts in this field, additive effects of WBV on muscle performance remain unclarified. In this review, we investigated the additive effects of long-term WBV on muscle strength and power. This meta-analysis was restricted to randomized controlled trials lasting for at least 5 weeks comparing exercise with and without WBV, or comparing only WBV exposure and control. Data from a total of 314 participants in 10 studies on knee extension muscle strength, and 249 participants in 7 studies on countermovement jump height were pooled using random-effect models. Meta-analysis showed significant additional effects of WBV on muscle strength (standardized mean difference [SMD]=0.76, 95% confidence interval [CI]=0.21-1.32; p=0.007) and countermovement jump (SMD=0.87, 95% CI=0.29-1.46; p=0.003). Based on these findings, we concluded that the use of WBV would lead to greater improvements in both knee extension muscle strength and countermovement jump than under identical conditions without WBV.

7.5 Vibrating Platform Training Improves Respiratory Muscle Strength, Quality of Life, and Inspiratory Capacity in the Elderly Adults: A Randomized Controlled Trial

AUTOR: IN / *AUTHOR*:

Pessoa M., Brandão D., Barcelar J.,Barros de Sá R., Rocha T., Souza H., Dornelas de Andrade A.

QUELLE / *SOURCE*:

The Journals of Gerontology Series A Biological Sciences and Medical Sciences 72(5):2016

ABSTRAKT / *ABSTRACT*:

Background: Aging affects respiratory strength that could cause reduction in functional capacity and quality of life, playing a fundamental role in healthy aging and survival. To prevent these declines, the whole body vibration (WBV) has been proposed to increase strength and functional capacity. The aim of the study was to evaluate the effects of WBV on respiratory muscle strength, thoracoabdominal ventilation, and quality of life in the elderly adults. Methods: This study was a controlled, randomized double-blind clinical trial. The study included 28 elderly adults randomized into three groups: Resistance (n = 9), WBV (n = 9), or WBV + resistance exercises (n = 10), performing training, sham, or double training for 3 months, twice per week. The variables of the study were as follows: maximal inspiratory and expiratory pressures (MIP and MEP), distribution of thoracoabdominal volumes variation in optoelectronic plethysmography (pulmonary rib cage—V RCp, abdominal rib cage—V RCa, and abdomen—V AB), and quality of life. Results: After training, WBV and WBV + resistance groups increased MIP and MEP ($p < .001$). During inspiratory capacity maneuver, WBV groups had incremental increases in chest wall total volume ($p < .001$), showing a rise in pulmonary rib cage ($p = .03$) and abdominal rib cage ($p = .04$). Furthermore, WBV groups improved SF-36 scores in functional capacity, physical aspects, energy, pain, and general heath domains. Conclusions: The WBV is a training that could improve respiratory muscle strength and quality of life and promote different ventilatory strategies in chest wall and thoracoabdominal compartments in healthy elderly adults.

7.6 Effect of resistance training with vibration and compression on the formation of muscle and bone

AUTOR: IN / *AUTHOR*:

Zinner C., Baessler B., Weiss K., Ruf J., Michels G., Holmberg H.-C., Sperlich B.

QUELLE / *SOURCE*:

Muscle & Nerve, Dec 2017; 56(6): 1137-1142

ABSTRAKT / *ABSTRACT*:

Introduction: In this study we investigated the effects of resistance training with vibration in combination with leg compression to restrict blood flow on strength, muscle oxygenation, muscle mass, and bone formation. Methods: Twelve participants were tested before and after 12 weeks of resistance training with application of vibration (VIBRA; 1-2mm, 30Hz) to both legs and compression (?35?mm Hg, VIBRA+COMP) to only 1 leg. Results: VIBRA+COMP and VIBRA improved 1 repetition maximum (1-RM), increased the number of repetitions preceding muscle exhaustion, enhanced cortical bone mass, and lowered the mass and fat fraction in the thigh, with no changes in total muscle mass. The mass of cancellous bone decreased to a similar extent after VIBRA and VIBRA+COMP. Conclusions: Resistance training with VIBRA+COMP and VIBRA improved 1-RM, increased the number of repetitions preceding muscular exhaustion, and enhanced formation of cortical bone, with no alteration of muscle mass. Muscle Nerve, 2017.

7.7 Effects of 8 weeks of vibration training at different frequencies (1 or 15 Hz) in senior sportsmen on torque and force development and of 1 year of training on muscle fibers

AUTOR: IN / *AUTHOR*:

H. Kern,J. Kovarik,C. Franz,M. Vogelauer,S. Löfler,N. Sarabon,M. Grim-Stieger,D. Biral,N. Adami,U. Carraro,S. Zampieri &Ch. Hofer

QUELLE / *SOURCE*:

Neurological Research 32(1):26-31, 2010.

ABSTRAKT / *ABSTRACT*:

To examine the effects of 8 weeks of vibration training at different frequencies (1 and 15 Hz) on maximal isometric torque and force development in senior sportsmen, and of 1 year of heavy-resistance and vibration trainings on muscle fibers. Seven healthy senior sportsmen (mean age: 69.0 +/- 5.4 years) performed an 8 weeks of strength training of knee extensors. Vibrations were applied vertically to the axis of movement during training. One leg of each subject was trained at a frequency of 1 Hz, while the other leg was trained at 15 Hz. Measures of isometric peak torque (at knee-angles of 60, 90 and 120 degrees) and force development were recorded before and after training. Four sportsmen continued a year-long heavy-resistance training adding every second week a session of vibration training. After training, muscle biopsies were harvested from their quadriceps muscles and used for structural analyses. Morphometry of muscle fibers was performed by light microscopy. Immunohistochemistry using anti-MHCemb and anti-N-CAM antibodies was performed to measure potential muscle damage. Data from muscle morphometry were compared to that of a series of vastus lateralis biopsies harvested from 12 young sportsmen and four healthy elderly. Our results showed a significant increase in isometric peak torque at both 1 and 15 Hz vibration frequency in all three measured angles of the knee. There was no significant difference between the two frequencies, but we could find a higher increase in percentage of maximum power after the 1 Hz training. The results of force development showed a slight increase at the 1 Hz training in measured time frames from 0 to 50 and 200 ms, without statistical significance. A trend to significance was found at the 1 Hz training at the time window up to 200 ms. The 15 Hz training showed no significant changes of force development. Muscle biopsies show that the muscles of these well trained senior sportsmen contain muscle fibers which are 35% larger than those of sedentary elderly and, unexpectedly, 10% larger than those of young sportsmen. Despite 1 year of heavy resistance and vibration training, no evidence of muscle damage or denervation/reinnervation could be observed by light microscopy analyses, ATPase histochemistry and immunohistochemistry using anti-N-CAM or anti-MHC-emb antibodies. Integration of

vibration to conventional strength training in elderly sportsmen induces similar improvement of isometric peak torque and force development independently from the vibration frequency after 8 weeks of training, and long-term results in the surprising evidence of hypertrophic muscle fibers larger than those of young active sportsmen. The observation that the vibration training with low frequency is safe opens the possibility to test these rehabilitation procedures in sedentary elderly.

7.8 The effects of two different frequencies of whole-body vibration on knee extensors strength in healthy young volunteers: a randomized trial

AUTOR: IN / *AUTHOR*:

Esmaeilzadeh S.,Akpinar M.,Polat S.,Yildiz A., Oral A.

QUELLE / *SOURCE*:

J Musculoskelet Neuronal Interact. 2015 Dec; 15(4): 333–340.

ABSTRAKT / *ABSTRACT*:

The aim of this study was to investigate the effects of two different frequencies of whole-body vibration (WBV) training on knee extensors muscle strength in healthy young volunteers. Twenty-two eligible healthy untrained young women aged 22-31 years were allocated randomly to the 30-Hz (n=11) and 50-Hz (n=11) groups. They participated in a supervised WBV training program that consisted of 24 sessions on a synchronous vertical vibration platform (peak-to-peak displacement: 2-4 mm; type of exercises: semi-squat, one-legged squat, and lunge positions on right leg; set numbers: 2-24) three times per week for 8 weeks. Isometric and dynamic strength of the knee extensors were measured prior to and at the end of the 8-week training. In the 30-Hz group, there was a significant increase in the maximal voluntary isometric contraction ($p=0.039$) and the concentric peak torque ($p=0.018$) of knee extensors and these changes were significant ($p<0.05$) compared with the 50-Hz group. In addition, the eccentric peak torque of knee extensors was increased significantly in both groups ($p<0.05$); however, there was no significant difference between the two groups ($p=0.873$). We concluded that 8 weeks WBV training in 30 Hz was more effective than 50 Hz to increase the isometric contraction and dynamic strength of knee extensors as measured using peak concentric torque and equally effective with 50 Hz in improving eccentric torque of knee extensors in healthy young untrained women.

7.9 What's the secret behind the benefits of whole-body vibration training in patients with COPD? A randomized, controlled trial

AUTOR: IN / *AUTHOR*:

Gloeckl R., Jarosch I., Bengsch U., Claus M., Schneeberger T., Andrianopoulos V., Christle J., Hitzl W., Kenn K.

QUELLE / *SOURCE*:

Respir Med . 2017 May;126:17-24.

ABSTRAKT / *ABSTRACT*:

Background: Several studies have shown that whole-body vibration training (WBVT) improves exercise capacity in patients with severe COPD. The aim of this study was to investigate the determinants of improved exercise capacity following WBVT.

Methods: Seventy-four COPD patients (FEV1: 34 ± 9%predicted) were recruited during a 3-week inpa tient pulmonary rehabilitation (PR) program. Conventional endurance and strength exercises were

supplemented with self-paced dynamic squat training sessions (4bouts*2min, 3times/wk). Patients were randomly allocated to either a WBVT-group performing squat training on a side-alternating vibrationbplatform (Galileo) at a high intensity (24e26 Hz) or a control group performing squat training without WBVT.

Results: Patients in the WBVT group significantly improved postural balance in several domains compared to the control-group (i.e. tandem stance: WBVT þ20% (95%CI 14 to 26) vs. control 10% (95%CI 6 to 15), p < 0.001; one-leg stance: WBVT þ11% (95%CI 4 to 19) vs. control 8% (95%CI -19 to 3), p ¼ 0.009). Six-minute walk distance and muscle power but not muscle strength were also significantly improved compared to control group.

Conclusions: Implementation of WBVT improves postural balance performance and muscle power output. The neuromuscular adaptation related to improved balance performance may be an important mechanism of the improvement in exercise capacity after WBVT especially in COPD patients with impaired balance performance and low exercise capacity.

7.10 Whole-body vibration training compared with resistance training: effect on spasticity, muscle strength and motor performance in adults with cerebral palsy

AUTOR: IN / *AUTHOR*:

Ahlborg L., Andersson C., Julin P.

QUELLE / *SOURCE*:

J Rehabil Med 2006; 38: 302 308

ABSTRAKT / *ABSTRACT*:

Objective: The aim of this study was to evaluate the effect on spasticity, muscle strength and motor performance after 8 weeks of whole-body vibration training compared with resistance training in adults with cerebral palsy.

Methods: Fourteen persons with spastic diplegia (21-41 years) were randomized to intervention with either whole-body vibration training (n=7) or resistance training (n=7). Pre- and post-training measures of spasticity using the modified Ashworth scale, muscle strength using isokinetic dynamometry, walking ability using Six-Minute Walk Test, balance using Timed Up and Go test and gross motor performance using Gross Motor Function Measure were performed.

Results: Spasticity decreased in knee extensors in the whole-body vibration group. Muscle strength increased in the resistance training group at the velocity 30 degrees /s and in both groups at 90 degrees /s. Six-Minute Walk Test and Timed Up and Go test did not change significantly. Gross Motor Function Measure increased in the whole-body vibration group.

Conclusion: These data suggest that an 8-week intervention of whole-body vibration training or resistance training can increase muscle strength, without negative effect on spasticity, in adults with cerebral palsy.

7.11 COPD Support Group Using Novel Harmonic Device Study

AUTOR: IN / *AUTHOR*:

Keller D., Keller, M.

QUELLE / *SOURCE*:

Chronic Obstructive Pulmonary Diseases: Journal of the COPD Foundation, Oct. 2015

7.12 Didgeridoo playing as alternative treatment for obstructive sleep apnoea syndrome: randomised controlled trial

AUTOR: IN / *AUTHOR*:

Milo A Puhan, research fellow, Alex Suarez, didgeridoo instructor, Christian Lo Cascio, resident in internal medicine, Alfred Zahn, sleep laboratory technician, Markus Heitz, specialist in respiratory and sleep medicine4, Otto Braendli, specialist in

QUELLE / *SOURCE*:

BMJ 2006;332:266

ABSTRAKT / *ABSTRACT*:

Objective: To assess the effects of didgeridoo playing on daytime sleepiness and other outcomes related to sleep by reducing collapsibility of the upper airways in patients with moderate obstructive sleep apnoea syndrome and snoring.

Design: Randomised controlled trial.

Setting: Private practice of a didgeridoo instructor and a single centre for sleep medicine.

Participants: 25 patients aged > 18 years with an apnoea-hypopnoea index between 15 and 30 and who complained about snoring.

Interventions: Didgeridoo lessons and daily practice at home with standardised instruments for four months. Participants in the control group remained on the waiting list for lessons.

Main outcome measure: Daytime sleepiness (Epworth scale from 0 (no daytime sleepiness) to 24), sleep quality (Pittsburgh quality of sleep index from 0 (excellent sleep quality) to 21), partner rating of sleep disturbance (visual analogue scale from 0 (not disturbed) to 10), apnoea-hypopnoea index, and health related quality of life (SF-36).

Results: Participants in the didgeridoo group practised an average of 5.9 days a week (SD 0.86) for 25.3 minutes (SD 3.4). Compared with the control group in the didgeridoo group daytime sleepiness (difference −3.0, 95% confidence interval −5.7 to −0.3, P = 0.03) and apnoea-hypopnoea index (difference −6.2, −12.3 to −0.1, P = 0.05) improved significantly and partners reported less sleep disturbance (difference −2.8, −4.7 to −0.9, P < 0.01). There was no effect on the quality of sleep (difference −0.7, −2.1 to 0.6, P = 0.27). The combined analysis of sleep related outcomes showed a moderate to large effect of didgeridoo playing (difference between

summary z scores −0.78 SD units, −1.27 to −0.28, P < 0.01). Changes in health related quality of life did not differ between groups.

Conclusion: Regular didgeridoo playing is an effective treatment alternative well accepted by patients with moderate obstructive sleep apnoea syndrome.

7.13 Sex differences in the fatigability of arm muscles depends on absolute force during isometric contractions

AUTOR: IN / *AUTHOR*:

Hunter S.K., Enoka R. M.

QUELLE / *SOURCE*:

J Appl Physiol 91: 2686–2694, 2001.

ABSTRAKT / *ABSTRACT*:

Women are capable of longer endurance times compared with men for contractions performed at low

to moderate intensities. The purpose of the study was 1) to determine the relation between the absolute target force and endurance time for a submaximal isometric contraction and 2) to compare the pressor response and muscle activation patterns of men [26.3 6 1.1 (SE) yr] and women (27.5 6 2.3 yr) during a fatiguing contraction performed with the elbow flexor muscles. Maximal voluntary contraction (MVC) force was greater for men (393 6 23 vs. 177 6 7 N), which meant that the average target force (20% of MVC) was greater for men (79.7 6 6.5 vs. 36.7 6 2.0 N). The endurance time for the fatiguing contractions was 118% longer for women (1,806 6

239 vs. 829 6 94 s). The average of the rectified electromyo gram (%MVC) for the elbow flexor muscles at exhaustion was similar for men (31 6 2%) and women (30 6 2%). In contrast, the heart rate and mean arterial pressure (MAP) were less at exhaustion for women (94 6 6 vs. 111 6 7 beats/min and 121 6 5 vs. 150 6 6 mmHg, respectively). The target force and change in MAP during the fatiguing contraction were exponentially related to endurance time (r2 5 0.68 and r2 5 0.64, respectively), whereas the change in MAP was linearly related to target force (r2 5 0.51). The difference in fatiga bility of men and women when performing a submaximal contraction was related to the absolute contraction intensity and was limited by mechanisms that were distal to the activation of muscle

7.14 Intra versus extra-thoracic oscillations in chronic obstructive pulmonary disease

AUTOR: IN / *AUTHOR*:

Alaa M. Mohamed, Nagwa M. Badr , Aisha A. Hagag , Yasser M. Mohamed

QUELLE / *SOURCE*:

Journal of Advanced Pharmacy Education & Research |Jul-Sep 2019 | Vol 9 | Issue 3

ABSTRAKT / *ABSTRACT*:

Objective: This study was conducted to compare the efficacy of intra versus extra-thoracic oscillations in chronic obstructive pulmonary disease (COPD) patients.

Subjects and Methods: Sixty male patients with COPD with an age range between 50-60 years were randomly divided into two groups, equal in number. Patients in Group (A) were treated by Oscillatory Positive Expiratory Pressure Quake device and patients in Group (B) were treated by High-frequency chest wall oscillation (HFCWO) vest. The treatment protocol was 30-45 minutes 4 sessions/week for 6 weeks for both groups in addition to COPD medications. All patients were evaluated before and after treatment by spirometry and impulse oscillometry.

Results: Pre and Post-study comparison demonstrated that there was a significant improvement in the spirometric indices (FEV1, FVC, FEV1/FVC, and FEF25%-75%) and impulse oscillometry parameters (R5, X5) in both groups. A statistically significant difference was also found between the Quake device and vest HFCWO in most of the measured post-treatment parameters in favor of Quake device.

Conclusion: Both intra (Quake) and extra (vest HFCWO) thoracic oscillations have high effectiveness in the treatment of COPD patients by improving the impulse oscillometry parameters and ventilatory function with better results in favor of intrathoracic oscillations (Quake device).

7.15 Vibration as an exercise modality: How it may work, and what its potential might be

AUTOR: IN / *AUTHOR*:

Rittweger J.

QUELLE / *SOURCE*:

Arbeitsphysiologie 108(5):877-904: 2009

ABSTRAKT / *ABSTRACT*:

Whilst exposure to vibration is traditionally regarded as perilous, recent research has focussed on potential benefits. Here, the physical principles of forced oscillations are discussed in relation to vibration as an exercise modality. Acute physiological responses to isolated tendon and muscle vibration and to whole body vibration exercise are reviewed, as well as the training effects upon the musculature, bone mineral density and posture. Possible applications in sports and medicine are discussed. Evidence suggests that acute vibration exercise seems to elicit a specific warm-up effect, and that vibration training seems to improve muscle power, although the potential benefits over traditional forms of resistive exer cise are still unclear. Vibration training also seems to improve balance in sub-populations prone to fall, such as frail elderly people. Moreover, literature suggests that vibration is beneficial to reduce chronic lower back pain and other types of pain. Other future indications are perceivable

7.16 Abdominal functional electrical stimulation to assist ventilator weaning in critical illness: a double-blinded, randomised, sham-controlled pilot study

AUTOR: IN / *AUTHOR*:

Euan J. McCaughey, Annemijn H. Jonkman, Claire L. Boswell-Ruys, Rachel A. McBain, Elizabeth A. Bye, Anna L. Hudson, David W. Collins, Leo M. A. Heunks, Angus J. McLachlan, Simon C. Gandevia & Jane E. Butler

QUELLE / *SOURCE*:

Critical Care volume 23, Article number: 261 (2019)

ABSTRAKT / *ABSTRACT*:

Background: For every day a person is dependent on mechanical ventilation, respiratory and cardiac complications increase, quality of life decreases and costs increase by > $USD 1500. Interventions that improve respiratory muscle function during mechanical ventilation can reduce ventilation duration. The aim of this pilot study was to assess the feasibility of employing an abdominal functional electrical stimulation (abdominal FES) training program with critically ill mechanically ventilated patients. We also investigated the effect of abdominal FES on respiratory muscle atrophy, mechanical ventilation duration and intensive care unit (ICU) length of stay.

Methods: Twenty critically ill mechanically ventilated participants were recruited over a 6-month period from one metropolitan teaching hospital. They were randomly assigned to receive active or sham (control) abdominal FES for 30 min, twice per day, 5 days per week, until ICU discharge. Feasibility was assessed through participant compliance to stimulation sessions. Abdominal and diaphragm muscle thickness were measured using ultrasound 3 times in the first week, and weekly thereafter by a blinded assessor. Respiratory function was recorded when the participant could first breathe independently and at ICU discharge, with ventilation duration and ICU length of stay also recorded at ICU discharge by a blinded assessor.

Results: Fourteen of 20 participants survived to ICU discharge (8, intervention; 6, control). One control was transferred before extubation, while one withdrew consent and one was withdrawn for staff safety after extubation. Median compliance to stimulation sessions was 92.1% (IQR 5.77%) in the intervention group, and 97.2% (IQR 7.40%) in the control group (p = 0.384). While this pilot study is not adequately powered to make an accurate statistical conclusion, there appeared to be no between-group thickness changes of the rectus abdominis (p = 0.099 at day 3), diaphragm (p = 0.652 at day 3) or combined lateral abdominal muscles (p = 0.074 at day 3). However, ICU length of stay (p = 0.011) and ventilation duration (p = 0.039) appeared to be shorter in the intervention compared to the control group.

Conclusions: Our compliance rates demonstrate the feasibility of using abdominal FES with critically ill mechanically ventilated patients. While abdominal FES did not lead to differences in abdominal muscle or diaphragm thickness, it may be an effective method to reduce ventilation duration and ICU length of stay in this patient group. A fully powered study into this effect is warranted.

8 Studien zum Thema Atemtechniken & Digeridoo / *studies on breathing techniques & digeridoo*

8.1 Study of Brain Activity Analysis of Deep Breathing

AUTOR: IN / *AUTHOR*:

Wanee Rojviroj, Professor Dr. Vichit Punyahotra, Assistant Professor Dr. Wichian Sittiprapaporn, Dr. Ariya Sarikaphuti

QUELLE / *SOURCE*:

School of Anti-Aging and Regenerative Medicine, Mae Fah Luang University

ABSTRAKT / *ABSTRACT*:

Study of Brain Activity Analysis of Deep Breathing was examined in sixteen healthy participants on stress level, and each type of brainwaves related to deep breathing. All brainwaves were recorded by electroencephalogram (EEG). Deep breathing rate was at six breaths per minute: four seconds for inhalation, two seconds for holding the air, and four seconds for exhalation, respectively. The study found that deep breathing induced relaxation and improved mental health as confirmed by Thai Stress Test. In addition, deep breathing affected to both Theta and Delta brainwaves during resting state as in eyes-closed trial. The deep breathing at trial 2 and 3, ranging approximately four to six minutes might be the most appropriate time for the participants to successfully accumulate alpha brainwave.

8.2 The effects of deep breathing on 'tension-anxiety' and fatigue in cancer patients undergoing adjuvant chemotherapy

AUTOR: IN / *AUTHOR*:

Yuka Hayama, Tomoko Inoue

QUELLE / *SOURCE*:

Complement Ther Clin Pract. 2012 May;18(2):94-8.

doi: 10.1016/j.ctcp.2011.10.001. Epub 2011 Nov 9.

ABSTRAKT / *ABSTRACT*:

Aims: We investigated the effect of deep breathing intervention on 'tension-anxiety' and fatigue in Japanese women with gynaecological cancer undergoing adjuvant chemotherapy.

Setting: A total of 23 patients were randomly allocated to intervention (n = 11) and control (n = 12) groups.

Intervention: Deep breathing was practised in the intervention group, but not in the control group. Deep breathing comprised a 10-min breathing program comprising abdominal breathing, thoracic breathing and breathing with arms raised. Using the Profile of Mood States-Short Form (Japanese version) and the Cancer Fatigue Scale, the effects were assessed pre- and post-chemotherapy.

Results: 'Tension-anxiety' and fatigue of the intervention group were relieved more than those of the control group.

Conclusions: The findings indicated that deep breathing intervention is likely to ameliorate the 'tension-anxiety' and fatigue in patients with gynaecological cancer undergoing adjuvant chemotherapy.

8.3 The effect of playing a wind instrument or singing on risk of sleep apnea:a systematic review and meta-analysis

AUTOR: IN / *AUTHOR*:

Fawn N. van der Weijden, MSc, Frank Lobbezoo, PhD; Dagmar E. Slot, PhD

QUELLE / *SOURCE*:

Journal of Clinical Sleep Medicine 2020;16(9):1591-1601

ABSTRAKT / *ABSTRACT*:

Study Objectives: To systematically survey the scientific literature concerning the effect of playing a wind instrument or singing on sleep, snoring, and/orobstructive sleep apnea. The PubMed, EMBASE, and Cochrane databases were searched up to December 2019. Observational studies and (Randomized) Controlled ClinicalTrials that assessed sleep, snoring, or obstructive sleep apnea as clinicaloutcome or via a questionnaire were included. For the individual studies, the potential riskof bias was scored. Data between oral musicians and control participants were extracted. Descriptive analysis and meta-analysis were performed. **Results:** Six eligible studies (5 cross-sectional, 1 randomized controlled trial) were retrieved, with an estimated potential bias ranking from low to high. Thesample sizes ranged from 25 to 1,105 participants. Descriptive analysis indicated that players of a double-reed instrument have a lower risk of obstructive sleepapnea and that singers snore less compared with control participants.Playing a didgeridoo showeda positive effect on apnea-hypopnea index,daytimesleepiness,and partner's rating for sleep disturbance. The descriptive analysis could not be substantiated in the meta-analysis. The magnitude of the effect was zero to small,and the generalizability was limited because of long (professional) rehearsal time or small sample size.**Conclusions:** Playing a wind instrument and singing may have a small but positive effect on sleep disorders. Considering the practicality and investment of(rehearsal) time, didgeridoo and singing are the most promising interventions to reduce obstructive sleep apnea and snoring, respectively. However, the results ofthis review are based on few studies and the synthesis of the evidence is graded to have low certainty.

9 Leitlinien / *guidelines*

9.1 British Thoracic Society Guideline for Non-CF Bronchiectasis - A Quick Reference Guide

AUTOR: IN / *AUTHOR*:

Pasteur MC, Bilton D, Hill AT; British Thoracic Society Bronchiectasis non-CF Guideline Group

QUELLE / *SOURCE*:

Thorax. 2010 Jul;65 Suppl 1:i1-58. doi: 10.1136/thx.2010.136119

ABSTRAKT / *ABSTRACT*:

The diagnosis, investigation and particularly management of bronchiectasis has been largely empirical and the subject of relatively few controlled clinical trials. There are no clear guidelines, although an Australian position statement has been published concerning bronchiectasis in children. The purposes of these guidelines were therefore threefold: (1) to identify relevant studies in noncystic fibrosis (CF) bronchiectasis; (2) to provide guidelines on management based on published studies where possible or a consensus view; and (3) to identify gaps in our knowledge and identify areas for future study.

9.2 Leitlinie zur Diagnostik und Therapie von Patienten mit chronisch obstruktiver Bronchitis und Lungenemphysem (COPD) herausgegeben von der Deutschen Gesellschaft für Pneumologie und Beatmungsmedizin e.V. und der Deutschen Atemwegsliga e.V., unter Beteiligung der Österreichischen Gesellschaft für Pneumologie

Guideline for the Diagnosis and Treatment of COPD Patients

Issued by the German Respiratory Society and the German Atemwegsliga in Cooperation with the Austrian Society of Pneumology (only in German language available)

AUTOR: IN / *AUTHOR*:

C. Vogelmeier, R.Buhl, O. Burghuber, C.-P.Criée, S.Ewig, J. Godnic-Cvar, S.Hartl, F.Herth, P.Kardos, K. Kenn, D.Nowak, K.F.Rabe, M.Studnicka, H.Watz, T.Welte, W. Windisch, H.Worth

QUELLE / *SOURCE*:

DOI https://doi.org/10.1055/s-0043-125031 Online-Publikation: 9.3.2018 | Pneumologie 2018; 72: 253 – 308 © Georg Thieme Verlag KG Stuttgart · New York ISSN 0934-838

ABSTRAKT / *ABSTRACT*:

Das vorliegende Dokument ist eine Neufassung und Aktualisierung der Leitlinie zur Diagnostik und Therapie von Patienten mit COPD, die die bisherige Version aus dem Jahr 2007 ablöst. Die Fülle an neuen Erkenntnissen zu Risikofaktoren, Diagnostik, Schweregradeinschätzung, Prävention und medikamentösen sowie nicht medikamentösen Therapiemaßnahmen machten eine umfassende Überarbeitung erforderlich. Die neue Leitlinie baut auf das GOLD-Dokument unter Berücksichtigung von Besonderheiten in Deutschland und Österreich auf.

This document is a revision of the guideline for diagnosis and treatment of COPD that replaces the version from 2007. A multitude of recent reports regarding risk factors, diagnosis, assessment, prevention and pharmacological as well as non pharmacological treatment options made a major revision mandatory. The new guideline is based on the GOLD document taking into account specifics in Germany and Austria

9.3 Guidelines for the Physiotherapy Management of the Adult, Medical, Spontaneously Breathing Patient

British Thoracic Society Physiotherapy Guideline Development Group

AUTOR: IN / *AUTHOR*:

Bott J, Blumenthal S, Buxton M, Ellum S, Falconer C, Garrod R, Harvey A, Hughes T, Lincoln M, Mikelsons C, Potter C, Pryor J, Rimington L, Sinfield F, Thompson C, Vaughn P, White J; British Thoracic Society Physiotherapy Guideline Development Group

QUELLE / *SOURCE*:

Thorax. 2009 May;64 Suppl 1:i1-51. doi: 10.1136/thx.2008.110726

ABSTRAKT / *ABSTRACT*:

Physiotherapy should be offered to patients with a variety of medical respiratory conditions, with the aim of breathlessness management and symptom control, mobility and function improvement or maintenance, and airway clearance and cough enhancement or support. Strategies and techniques include: rehabilitation, exercise testing (including for ambulatory oxygen assessment), exercise prescription, airway clearance, and positioning and breathing techniques. Physiotherapy may be helpful for postural and/or musculoskeletal dysfunction and pain, and provide help in improving continence, especially during coughing and forced expiratory manoeuvres. Physiotherapists are usually central to the delivery of pulmonary rehabilitation and may be instrumental in the non-invasive ventilation service. Physiotherapists are frequently involved in the delivery of oxygen and some nebulised substances, as well as providing vital monitoring of, for example, ventilatory function and cough effectiveness. Some complementary therapies may be appropriate in some situations (Web Appendix 1).

9.4 Nationale VersorgungsLeitlinie Asthma

AUTOR: IN / *AUTHOR*:

Prof. Dr. Martin Schulz, Dr. Eric Martin, Prof. Dr. Klaus Dalhoff, Prof. Dr. Harald Schäfer, Elke Alsdorf, Dr. Michael Köhler, Prof. Dr. Heinrich Worth , Prof. Dr. Carl-Peter Criée, Dr. Michael Weber, Dr. Andreas Hellmann, Prof. Dr. habil. Marek Lommatzsc

QUELLE / *SOURCE*:

Programm für Nationale VersorgungsLeitlinien

ABSTRAKT / *ABSTRACT*:

Weil die identifizierte Evidenz nicht konklusiv und die Datenqualität sehr niedrig ist, grenzt die Leitliniengruppe die

Patienten, für die eine Atemphysiotherapie empfohlen wird, auf Basis ihrer klinischen Einschätzung ein. Patienten,

die neben dem Asthma eine dysfunktionale Atmung aufweisen, d. h. eine Abweichung des physiologischen Atem musters mit der Folge von rekurrierend oder chronisch auftretenden respiratorischen und nicht respiratorischen

Symptomen haben, haben ein erhöhtes Morbiditätsrisiko und können möglicherweise besonders von physiothera peutischen Maßnahmen profitieren. Ein Zusatznutzen dieser Maßnahmen ist ebenfalls bei Patienten plausibel, die

z. B. auffällig ängstlich bei Atemnot reagieren, die Belastungssituationen aus Angst vor Atemnot vermeiden oder

vermehrt Sekretretention aufweisen und gewohnheitsgemäß vorwiegend durch den Mund atmen.

9.5 Clinical Guidelines for the Physiotherapy management of cystic fibrosis

AUTOR: IN / *AUTHOR*:

Recommendations of a Working Group, Jan. 2002

QUELLE / *SOURCE*:

Cystic Fibrosis Trust 2002, ISBN 0- 9540536-4-8, Page 11-16

ABSTRAKT / *ABSTRACT*:

(...) Oscillating positive expiratory pressure - RC-Cornet® (Cornet) The RC-Cornet® is a curved tube that contains within its plastic casing a flexible inner tube. During expiration through the device, there is a slight positive expiratory pressure and an oscillation of the air within the airways. The pressure and flow can be varied, by rotating the mouthpiece, until an optimal effect is felt to facilitate airway clearance. (...) Positive expiratory pressure therapy increases intrabronchial pressure in central and peripheral airways splinting the airways open and preventing compression induced by airway collapse. This promotes inflow of air behind mucus obstructions either via a bronchial route or collateral airway channels. Smaller bronchial airways are prevented from collapse thus permitting the continuing upward movement of secretions. Several studies to date report PEP to be an acceptable and effective treatment regimen. (...) High pressure PEP is a modification of the original PEP technique. As disease severity increases, hyperinflation (due to obstructive secretions) and airway instability (due to airway damage) become increasing problems. Trapping of secretions distal to areas of airway collapse during forced expiration may have a negative effect on clearance. By performing forced expiration against a fixedresistance this effect may be negated. (...)

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April 2024 / April *2024*