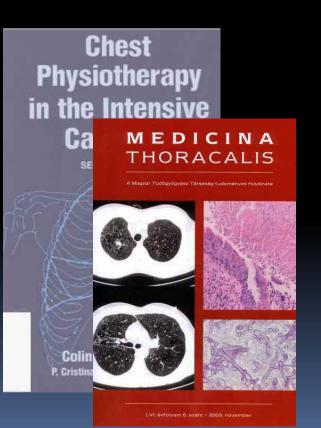
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### Edit Benkovics, Dániel Bolla Semmelweis University Department of Anesthesiology and Intensive Therapy

# PHYSIOTHERAPY IN THE INTENSIVE CARE UNIT

## The story...



- 1985. C.F. Mackenzie USA
- 1989. I. Pénzes HU
- 1992. Chest physiotherapy "on-call service"
  - UK 97%
  - Australia 49%

## Australia 2000.



#### critical care reviews

Physiotherapy in Intensive Care Towards an Evidence-Based Practice

Keely Seller, 760

Key Yards' critical care, extreme laged mediators interation

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I n mean hospitalit in developed councries, physio-therapy in seen as an integral part of the manage-ment of patients in NUN. The precise role that physiotherapitus play in the KU varies considerably from one unit to the next, depending on factors such at the country in which the ICU is located, local methics, mailing levels, maining, and operate. The referral process is one energies of this variation, whereby in some ICUs, physiocherapten assess all patients, whereas in other ICUs, patients are seen salv after reformi from medical mall.<sup>1</sup> The moncommon techniques used by phyriothempters in the ICU are postelesing, mobilization, manual hypertaflation (MH), portuniton, vibration, muchin, cough, and various broaching espectate.<sup>1,7</sup> Some physiother-apins rotationly area more, if not all, KU patients agate routinely rive texts, it not al., it.1 painters with a combination of theme sochasticates,<sup>1</sup> regerillers of the partent's underlying pathophysiologic cond-tion, with the instantion of proventing pathroamy complications, whereas other physicalsemptes are rach uschniques selectively when they believe they are gootifically indicated.

the can appriated with the management of ICU patients is very high, the requirement for all those who work in KZUs, inclusing physiochempiss, so provide evidence-based practice is mandatory. The size of this article is so review the evidence regarding the effectiveness of physiochempy for pa-

<sup>1</sup> From the Parasitionary Department, Royal Adulatile Haspital, Adulation, Nuclin Association 2020, Association. ript matterned July 22, 1980; revision arregated May 17, 1000 Correspondence to Kally Hiller, Phil, Physiology, Defect. Reed, David Addato Profiled, Media Torrang, Addato Arthur. Alternative 2008, Alternative S. Radi Andrew The Arthur

(CMUST 2000, 118:1001-1013) tions in the ICU and thus provide a framework for evidence-based practice. Possential areas for factors research are also discussed. This review is primarily concerned with the management of incubated, me chanically ventilated, aduk partenzy. The role of physiochempy for noninvalued patience, including these receiving noninvarive mechanical contlation, and pollaric patients is beyond the scope of this

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ing physicsherapy. To exame that the major relevant articles were reviewed, instants asarches were performed using a CD-ROM version of the database MEDLINE and CINABL (Consulative Index to Nation and Alised Health Literature) with appropriate subject headings and keywords, including physical cherapy, incontrol

#### CHEET/ Har/s/ DECEMBER 2000 TH

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- Positioning
- **Mobilisation**
- Manual hyperinflation
- Percussion, manual or mechanical vibration
- **Airway suctioning**
- Coughing, huffing
- **Breathing exercise**

## Australia 2000.



Physiotherapy in Intensive Care' Towards an Evidence-Based Practice

Keely Seller, 762

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### **Focused on intubated patients** receiving mechanical ventillation

- Incidence of pulmonary complications
- Haemodinamic and metabolic factors
- Overall outcomes
- Haemodinamic monitored is carefully
- The routine physiotherapy of intubated mechanically ventilated patients is not recommended, individual physiotherapy techniques are effective

## Australia 2000.



- Physiotherapy effective in the treatment of lobar atelectasia
- Prone positioning to improve V/Q mathing and increase FRC for patienst with ARDS
- Side lying with the affected lung uppermost to improve V/Q matching for patiens with unilateral lung disease
- Hyperoxigenisation is preventing suction-induced hypoxemia
- The haemodinamic monitoring is recommended



critical care reviews

Physiotherapy in Intensive Care' Towards an Evidence-Based Practice

Keely Seller, 760

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### Aim & Methods

- Stabilization & improvement of pulmonary condition
- Prevention & treatment of deconditioning and related complication
  - Chest physiotherapy
  - Positioning
  - Mobilization
  - Exercise

ESICM STATEMENT

There is a need to standardize path-

ways for clinical decision-making

and education, to define the profes-

and increase the awareness of the

lity and deconditioning

sional profile of physiotherap

priately treat the primary under

complications particularly associ-

ated with a prolonged ICU stay,

including deconditioning, muscle

weakness, dyspnea, depression and

anxiety, and reduced health-related

quality of life [17, 41, 70]. Chronic

prolonged immobility and intensive

care unit (ICU) stay [29] and ac-

increasing [13]. Because of these

detrimental sequelae of long-term

habilitation throughout the critical illness [16, 38, 66, 73, 114] and

effects. The amount of rehabilita-

bed rest, there is a need for re-

counts for 5-10% of ICU stay

R. Gosselink J. Bott M. Johnson E. Dean S. Nava M. Norrenberg B. Schönhofer K. Stiller H. van de Leur LL. Vincent

Physiotherapy for adult for critically ill adult patients. patients with critical illness: recommendations of the European Respiratory Introduction Society and European Society of Intensive Care Medicine Task Force on Physiotherapy for Critically III Patients

Received: 27 March 2007 Accepted: 3 January 2008 Published online: 19 February 2008 O Springer-Verlag 2008

Electronic supplementary material The online version of this article (doi: 10.1007/s00134-008-1026-7) contains pplementary material, which is available authorized users.

Abstract The Task Force reviewed of stay in ICU. There are common and discussed the available literature on the effectiveness of physiotherapy for acute and chronic critically ill adult patients. Evidence from randomized controlled trials or meta-analyses was limited and most of the recommendations critical illness is associated with were level C (evidence from uncontrolled or nonrandomized trials. or from observational studies) and D (expert opinion). However, the a proportion that appears to be following evidence-based targets for physiotherapy were identified: deconditioning, impaired airway clearance, atelectasis, intubation voidance, and weaning failure. Discrepancies and lack of data on thereafter [49], to address these efficacy of physiotherapy in

clinical trials support the need to tion performed in ICUs is often identify guidelines for physiotherapy assessments, in particular to identify patient characteristics that enable centers [66, 73]. treatments to be prescribed and modified on an individual basis.

#### Physiotherapy in the manazement of patients with critical illness

Physiotherapists are involved in the management of patients with acute, benefits of prevention and treatment subacute and chronic respiratory conditions and in the prevention and treatment of the sequelae of immobil ity and recumbency [47, 77]. Their role varies across units, hospitals, and countries [77], with respect to rationt referral, roles, treatment gos

Critical illness can last from hours to selection of interventions [47, 77]. months, depending on the underly-ing pathophysiology and response to itment. It carries high morbidity firm conclusions on the effectiveness and mortality rates, and the assoof physiotherapy for critically ill patients [98]. The purpose of this ciated care is a major determinant of healthcare costs. The evolution of intensive care medicine and intedocument is to critically review the evidence currently available for the grated team management has greatly use of physiotherapy in the adult improved the survival of critically ill critically ill patient and to make patients [26, 69]. In view of the high recommendations for assessment and costs associated with ICU, every attempt should continue to be made relevant clinical areas: monitoring and best practice in three to prevent complications and appro-

· Deconditioning and related

communication

complications · Respiratory conditions (retained airway secretions, atelectasis, pneumonia, acute lung iniury shalation injury, postoperat pulmonary complications, chest trauma, intubation avoidance and weaning failure) Emotional problems and

The Task Force members met twice face to face and agreed on the identified areas and the working pro cedures (see details in ESM). Details of the effectiveness of physiotherapy in specific pulmonary conditions, im-plications for staffing and suggestions for future research are discussed in the ESM

### Aim & Methods

Assessment prior to treatment should determine the underlying problem amenable to physiotherapy and which, if any interventions are appropriate

Appropriate monitoring of vital functions should be used and acted upon to help ensure that physiotherapy intervetions are both therapeutic and safe

R. Gosselink J. Bott M. Johnson E. Dean S. Nava M. Norrenberg B. Schönhofer K. Stiller H. van de Leur I.L. Vincent

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#### Physiotherapy in the management of patients with critical illness

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Introduction Critical illness can last from hours to selection of interventions [47, 77].

ESICM STATEMENT

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priately treat the primary under · Deconditioning and related Abstract The Task Force reviewed pathophysiology to minimize length of stay in ICU. There are common complications · Respiratory conditions (retained airway secretions, atelectasis, complications particularly associated with a prolonged ICU stay, pneumonia, acute lung injury, including deconditioning, muscle weakness, dyspnea, depression and pulmonary complications, chest anxiety, and reduced health-related trauma, intubation avoidance and quality of life [17, 41, 70]. Chronic weaning failure) critical illness is associated with Emotional problems and prolonged immobility and intensive communication care unit (ICU) stay [29] and accounts for 5-10% of ICU stays a proportion that appears to be The Task Force members met twice face to face and agreed on the identified areas and the working proeasing [13]. Because of these detrimental sequelae of long-term cedures (see details in ESM). Details bed rest, there is a need for reof the effectiveness of physiotherapy habilitation throughout the critical illness [16, 38, 66, 73, 114] and in specific pulmonary conditions, im-plications for staffing and suggestions thereafter [49], to address these for future research are discussed in

effects. The amount of rehabilita-

Intensive Care, Royal Brisbane Hospital, Queensland Australia, 2007 Is physiotherapy safe in the ICU?

> Five tertiary level university-affiliated ICU, three month period, 12 281 phsysiotherapy interventions

- 27 (0.2%) interventions resulted adverse physiological changes: deteorioration in cardiovascular status
  - In patients on medium or high doses of inotropes
  - Unstable baseline haemodinamic values
  - Previous cardiac co-morbidities
  - Intervention consisting positive pressure

### Physiotherapy interventions are safe

Zeppos et al: Salety of physiotherapy Intervention in Intensive car

Audits are an effective way to identify deficiencies

ne the actual incidence of adv

prospective observational study was

at five tertiary level intensive care units in Australia. Ow

erany intervention are required in onal study was

during physic ation obtained from auditing adverse changes associated with physiotherapy intensive care, experimental studies can be stigate if these changes occur in particular ing particular interventions.

#### Physiotherapy intervention in intensive care is safe: an observational study

#### Litsa Zeppos<sup>1</sup>, Shane Patman<sup>2</sup>, Susan Berney<sup>3</sup>, Julie A Adsett<sup>4</sup>, Julie M Bridson<sup>2</sup> and Jennifer D Paratz<sup>4,6</sup> y of Notre Dame "Actin Hospital "Royal Brishane and Women's Hospital "Royal Hobart Hosp "University of Queensland Manufactures

It here their a advance events (including advance physicispical changes) courd using physicihanges intervention events (Petralardin advances) physicispical changes) courd using a measures. All physicihanges intervention in the intervention is the intervention in the intervention in the intervention in the intervention is the intervention in the intervention is the intervention in the intervention in the intervention is an advance physicity of the intervention in the intervention is using informative years of advance physicity of change is physicity of change in physicity of advance physicity of change is physicity of change in physicity of advance physicity of change is physicity of advance physicity of change is physicity of the intervention in the intervention is the physicity of advance physicity of change is physicity of change is physicity of the intervention is the physicity of advance physicity of change is phys gical change were a dete m to high doses of inints who had an adverse physiological ive care is safe. [Zoppos L, Patman S, Berney S, Adsett J, Bridson J, Paratz JD (2007) Physi sitve care is safe: an observational study. Australian Journal of Physiothorapy 53: 279–283 Key words: Intensive Care, Physiotherapy, Audit, Task Performance Analysis, Critical In

Method

Design

#### troduction

arounceron imposent in the management of patients in interview imposent in the management of patients in interview provide but shorts. An advance and the state of the state of the state of the state of the label shorts and the state of the state of the label shorts and the state of the label shorts and the state of the (Hodgson et al 1999, King and Morrell 1992) had a physiological rationale for physiotherapy intervention. Audits are an effective way to identify dehicitences in quality of care and are an accepted method of impriving patient safety by identifying factors contributing to advence vents. Large audits of advence events in intensive care have been published (Beckmann et al 1996, Beckmann et al 2003, Buckley et al 1997, Hart et al 1994) which did not record or report any advence physiological changes associated with physiolometryo intervention. Data parameters necessitating remedial intervention, sive care patients are critically ill, they do stential to become unstable during all aspects nent, such as with basic nursing care, position action, or physiotherapy intervention. Adverse al changes can also occur spontaneously in re-ordined re-observed by theoretic at (1080) ents in 247 patients over a 24 hour

otherapy intervention in intensive care have ologically flawed. These studies have included 5 were haemodynamically unstable and not e of natients to whom the intervention would be 1992, Singer et al 1994, Weissman et other studies have found beneficial or imal adverse effects during physiotherapy intervention nev and Denehy 2002, Berney and Denehy 2003, Hodgson et al 2000, Ntoumenopulos et al 2002, Paratz et al 2002, Paratz et al 2006, Patman et al 1998). These studies

an Journal of Physiotherapy 2007 Vol. 53 - © Australian Physiotherapy I

### School of Physiotherapy, University of Melbourne Australia, 2006 Is Physiotherapy effective in the ICU?

Physical Therapy Reviews 2006; 11: 49-56

#### PHYSIOTHERAPY IN THE INTENSIVE CARE UNIT

LINDA DENEHY<sup>1</sup> AND SUSAN BERNEY<sup>3</sup>

<sup>1</sup>School of Physiotherapy, Faculty of Medicine, Dentistry and Health Sciencen, The University of Melbourne, Melbourne, Victoria, Australia Department of Physiotherapy, Austin Hospital, Heidelberg, Victoria, Australia

Physiotherapy is reported to be an integral part of patient management in the intensive care unit (ICU) of hospitals in industrialised countries. There is substantial literature which supports the role of respiratory management and rehabilitation of critically ill patients, although there is a paucity of randomised controlled trials in this area and trials examining patient outcomes. The aims of this review are to present the current evidence for the role of physiotherapy on short-term patient hysiological outcomes has been studied extensively and there is moderate-to-strong evidence n support of its role. The safety of physiotherapy treatment in ICU has also recently been stablished. In addition, there is growing evidence for the role of exercise relabilitation egginning in ICU and extending to beyond ICU discharge. Urgent research is required by anists to establish the effectiveness of such treatme

Keywords: Chest physiotherapy, exercise, intensive care, non-invasive ventilation, rehabilitation

Intensive care is a dynamic environment where phys-iotherapists are vital members of the multidisciplinary team providing a spectrum of care from acute respiratory to rehabilitation.

The education and training of physiotherapists and their role in relation to other health professionals such as nurses and respiratory therapists varies greatly. This withstanding, physiotherapy is reported to be an integral part of patient management in the intensive care unit (ICU) of hospitals in industrialised countries.1 The aims of this review are to present the current evidence for the role of physiotherapists in the callett CVL in relation to respiratory management including non-invasive ventilation (NIV), exercise, and short and longer term rehabilitation of patients. Literature searches were performed using the databases MEDLINE and CINAHL (cumulated index to nursing and allied health literature) with appropriate subject headings including intensive care, rehabilitation, physiotherapy, physical therapy, critical care, critical illness, chest physiotherapy, manual hyperin-

language. The reference lists of extracted articles were also reviewed. Several surveys report on specific physiotherapy

practice in the ICU;<sup>24</sup> generally, these are limited to respiratory management. However, the assessment respiratory management. However, the assessment and management of neurological and musculoxkeletal complications form an important part of the physio-therapist's role.<sup>13</sup> It is this individualised, multisystem patient assessment and treatment that defines the role of physiotherapists compared with respiratory thera pists and nurses. Physiotherapists may be involved with specific patient positioning, suction, mobilisation, exercise, passive movements, manual airway clearance techniques, manual (MH) and ventilator hyperinflation (VH), NIV and wearing.<sup>1,6,4</sup> The coun-try of origin of published research reflects differences in types of healthcare professionals employed in the ICU, with research from the US predominately reporting respiratory therapist roles. In the UK, parts of Europe and Canada, South Africa, and Australia, the role of physiotherapists encompasses respirator flation and exercise; searches were limited to English as well as neurological and musculoskeletal patient

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DOI 10.1179/108331906X98921

### Chest physiotherapy is well known and efficient

- Reducing Ventilator Associated Pneumonia/VAP
- Helping the weaning process
- Helping in the recovery process

#### Further studies needed:

- The efficacy of physiotherapy
- The efficacy of physiotherapyst

### The Physiotherapist has to focus on the efficacy of treatment!

### Physiotherapy and metabolic demand

Intensive Care Med (2008) 34:1188-1199 DOI 10.1007/s00134-008-1026-7

ESICM STATEMENT

ways for clinical decision-making

and increase the awareness of the

complications particularly associ-

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#### There is a need to standardize path-Physiotherapy in the management of patients with critical illness

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· Deconditioning and related pathophysiology to minimize length of stay in ICU. There are common complications

communication

· Respiratory conditions (retained airway secretions, atelectasis, pneumonia, acute lung injury, shalation injury, postoperati pulmonary complications, chest trauma, intubation avoidance and quality of life [17, 41, 70]. Chronic weaning failure) Emotional problems and

> The Task Force members met twice face to face and agreed on the identified areas and the working proedures (see details in ESM). Details of the effectiveness of physiotherapy in specific pulmonary conditions, im-plications for staffing and suggestions for future research are discussed in the ESM

The metabolic demand of physiotherapy is one of the highest in the ICU.

Thus the physiotherapist has to be familiar with the facts related to DO and VO<sub>2</sub>

## Physiotherapy and metabolic demand

- Cohen at al haemodinamic and metabolic changes caused by chest physiotherapy during invasive ventilation
  - 32 postoperative patients
  - Control group: HR<sup>↑</sup><sup>↑</sup>, SBP and MBP<sup>↑</sup><sup>↑</sup>, CO<sup>↑</sup><sup>↑</sup>, VO<sub>2</sub><sup>↑</sup><sup>↑</sup>, CO<sub>2</sub> production, pCO<sub>2</sub><sup>↑</sup>
  - Propofol : HR $\uparrow$ , SBP and MBP $\uparrow$ , CO $\uparrow$ , VO<sub>2</sub> $\uparrow\uparrow$





## Physiotherapy and metabolic demand



- I.Pénzes , J. Elek , E. Benkovics. NIPPV + mannual support in side-lying position
  - 20 postoperative patient with respiratory failure
  - During chest physiotherapy + FiO<sub>2</sub> 0.6-1
    - $PaO_2\uparrow\uparrow$ ,  $HR\uparrow$ ,  $CO\rightarrow\uparrow$ ,  $DO_2\uparrow\uparrow$ ,  $VO_2\uparrow\uparrow\uparrow$
  - 20 minutes after NIPPV+ mannual support in side-lying position
    - $PaO_2\uparrow$ ,  $HR\rightarrow$ ,  $CO\rightarrow$ ,  $DO_2\uparrow$ ,  $VO_2\rightarrow$



## Clinical algorythm of physiotherapy pulmonary disfunction



# Increased secretion during invasive ventilation:

- Positioning
- Manual therapy
- Hyperinflation
  - MHI < 7.5 cmH<sub>2</sub>O PEEP, VHI > 7.5 cmH<sub>2</sub>O PEEP

## Clinical algorythm of physiotherapy pulmonary disfunction

Atelectasia:

- Positioning+ deep breathing + coughing/suctioning
   Ntoumenopoulos et al 2002, Krause et al 2000
- Kinetic bed is inefficient Goldhill et al 2007

### Clinical algorythm of physiotherapy pulmonary disfunction

### VAP:

- Routin chest physiotherapy is NOT RECOMMENDED Ntoumenopoulos et al 2002
- Inclined bed 30 ° 45° Dodek et al 2004, Gastmeier et al 2007
- Open or closed suctioning does not influence the occurrence of the VAP

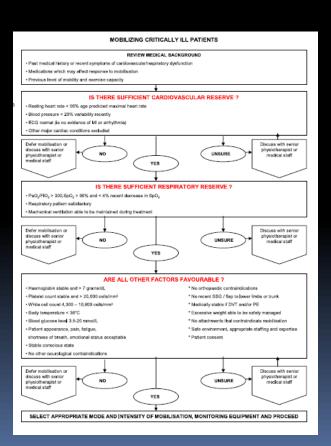
Clinical algorythm of physiotherapy mobilisation

- In patients, who have stable haemodinamic status Stiller et al 2004, Bailey et al 2006, Thomsen et al 2008
- Special documentation form is needed!
- It does not decrease the time of ventilation and the mortality

Thomsen et al 2008

 It increases the level of activity and the quality of long term survival

### Clinical algorythm of physiotherapy mobilisation



### Review medical background

- Past medical history or recent symptom of cardiovascular /respiratory dysfunction
- Medications wich may affect response to mobilisation
- Determine the current level of mobility
  - Active or passive
- The form and timing of mobilisation has to be harmonised with the staff
- The physical therapist is responsible for the mobilisation's process

### Clinical algorythm of physiotherapy mobilisation

### Haemodynamic stability:

- ♦ HR<sub>rest</sub> < HR<sub>max</sub> 50%
- SBP 100 140Hgmm, DBP 80-105 Hgmm and variability recently < 20%</li>
- Normal ECG

### Respiratory stability:

- $PaO_2/FiO_2 > 150 sitting in chair$
- PaO<sub>2</sub>/FiO<sub>2</sub>>300 30m walking
- $SpO_2 > 90$  and recent decreas in  $SpO_2 < 4\%$
- Hb stable and > 7 g/dl
- Body temperature < 38</p>
- Blood glucose level 3.5 20 mmol/L

## Clinical algorythm of physiotherapy mobilisation

- Physiological Consequences of Bed Rest
  - ↓Plasma and blood volume
  - Total heart and left LV volumes
  - HR at rest and all levels of activity
  - $\downarrow$  Resting and maximum SV ,  $\downarrow$  maximum CO
  - Risk of of venous thrombosis and thromboembolism
  - Orthostatic tolerance ↓
  - Aerobic conditioning
  - □ ↓VO<sub>2</sub>
  - ↓Muscle mass, ↓ muscle strengh, ↓ muscle endurance
  - diameter of vessels
  - ↑ Insulin resistance
  - Catabolism
  - Paralytic ileus
  - Anxiety, depression, psychosis

## Clinical algorythm of physiotherapy mobilisation

- Acute Physiological Effects of Mobilization and Exercise - Pulmonary System

  - ↑Zone 2 V/Q ratio
  - □ ↑TV
  - Altered breathing frequency
  - ^Minute ventillation
  - ↑Efficiency of respiratory mechanism
  - ↓Airflow resistance
  - ↑Flow rates

  - Mucociliary transport and airway clearence
    - **†Distribution and function of pulmonary immune factors**

### Clinical algorythm of physiotherapy mobilisation

- Acute Physiological Effects of Mobilization and Exercise
- Cardiovascular System

  - □ ↑SV, HR, CO
  - ^Myocardial contractility
  - Coronary perfusion

  - ↓Peripherial vascular resistance
- Neuromuscular system
  - ↑cerebral elektrical aktivity

  - Postural reflexes

### Mobilisation during invasive ventilation

### Level of mobilisation during invasive ventillation

- Turning in bed passive/active
- Sitting over the edge of the bed
- Transfering from the bedpassive/active
- Standing up passive/active
- Walking with mobile ventilator
- walking with or without modifided walking frames or walker

The postoprative cases

- Primarely choose mobilisation
- Choose breathing exercises only, If the mobilisation is contraindicated

Conde et al 2006, Pasquina et al 2006.

 Patients with hypoxemia use NIPPV, NIV or IV Ferreyra et al 2008

Exercise

### **≥14** days of invasive ventilation:

- It does not decrease the lenght of stay in ICU and mortality
- Enhances the functional capacity

Chest physiotherapy	Resident physician	Physiotherapyst		ICU nurse
interventions		Junior	Senior	
Exam, treatment planning	+	+	+/R	
Drug inhalation	+/R	+	+	+
Percussion, mechanical or manual vibration	+	+	+/R	+
MH or VH	+	+	+/R	+
Suctioning	+	+	+	+/R
Positioning	+	+	+/R	+
Mobilisation	+	+	+/R	+
Volume therapy – physioterapy with NIPPV	+	+	+/R	+
Volumetric exerciser	+	+	+	+
Breathing exercises	+	+	+	+
Breathing training		+	+/R	
NMES		+	+/R	
6 MWT		+	+/R	

**R** - Responsible

### Airway clearence

Retrained airway secretions							
Increase inspiratory volume	Increase expiratory flow rate	Oscillation	Increase expiratory volume	Airway suctioning			
Mobilisation	Positioning	Percussion	Positioning				
Positoning	Coughing/ huffing	Manual or mechanical	CPAP				
Breathing exercise	Assisted coughing	vibration	PEP				
Volumetric exerciser	Exsufflator	HFO, IPV/Flutter					
NIV							
MH or VH							

## Take home message...

- Physiotherapy is safe and efficient in critical ill patients also
- During mechanical ventilation chest physiotherapy with positioning is very usefull in pulmonary diseases
- Early and safe mobilisation is important in intubated and cricitally ill patients
- The volumen therapy/NIPPV with positioning and manual therapy is efficient in the weaning process
- Haemodynamic monitoring is necessary