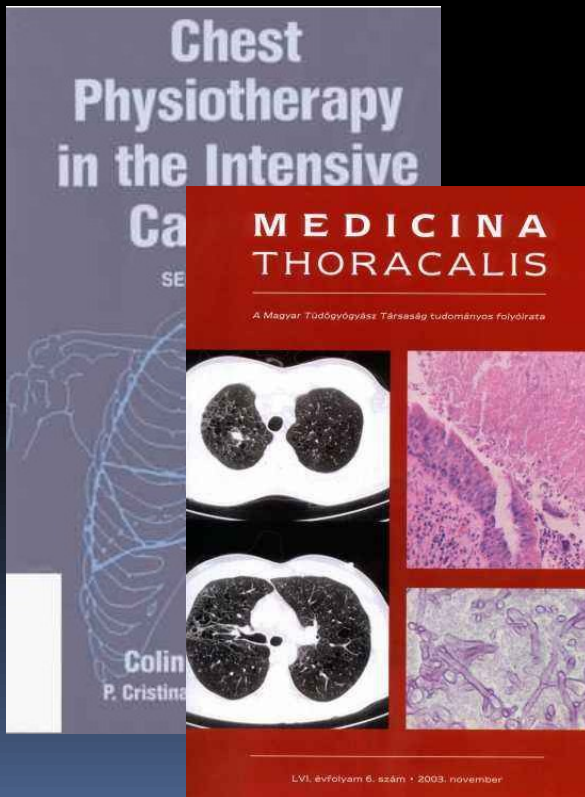




Edit Benkovics, Dániel Bolla
Semmelweis University Department of Anesthesiology and Intensive Therapy

PHYSIOTHERAPY IN THE INTENSIVE CARE UNIT

The story...



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

Evidence-Based Physiotherapy in the ICU 2011.

- 

Physiotherapy in Intensive Care*

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Australia 2000.

- Focused on intubated patients receiving mechanical ventilation
 - Incidence of pulmonary complications
 - Haemodynamic and metabolic factors
 - Overall outcomes
 - Haemodynamic monitored is carefully
- The routine physiotherapy of intubated mechanically ventilated patients is not recommended, individual physiotherapy techniques are effective



Australia 2000.

- **Strong evidences:**
 - Physiotherapy effective in the treatment of lobar atelectasia
 - Prone positioning to improve V/Q matching and increase FRC for patients with ARDS
 - Side lying with the affected lung uppermost to improve V/Q matching for patients with unilateral lung disease
 - Hyperoxygenisation is preventing suction-induced hypoxemia
 - The haemodynamic monitoring is recommended



European Respiratory Society,
European Society of Intensive Care Medicine
Task Force 2008

Aim & Methods

- Stabilization & improvement of pulmonary condition
- Prevention & treatment of deconditioning and related complication

Intensive Care Med (2008) 33:1188–1199
DOI 10.1007/s00134-008-1026-7

ESICM STATEMENT

R. Gosselink
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Physiotherapy for adult patients with critical illness: recommendations of the European Respiratory Society and European Society of Intensive Care Medicine Task Force on Physiotherapy for Critically Ill Patients

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Abstract The Task Force reviewed 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 were level C (evidence from uncontrolled or nonrandomized trials, or from observational studies) and D (expert opinion). However, the following evidence-based targets for physiotherapy were identified: deconditioning, impaired airway clearance, atelectasis, immobility avoidance, and weaning failure. Discrepancies and lack of data on the efficacy of physiotherapy in

clinical trials support the need to identify guidelines for physiotherapy assessments, in particular to identify patient characteristics that enable treatments to be prescribed and modified on an individual basis. There is a need to standardize pathways for clinical decision-making and education, to define the professional profile of physiotherapists, and increase the awareness of the benefits of prevention and treatment of immobility and deconditioning for critically ill adult patients.

Introduction

Critical illness can last from hours to months, depending on the underlying pathophysiology and response to treatment. It carries high morbidity and mortality rates, and the associated care is a major determinant of healthcare costs. The evolution of intensive care medicine and integrated team management has greatly improved the survival of critically ill patients [26, 69]. In view of the high costs associated with ICU, every attempt should continue to be made to prevent complications and appropriately treat the primary underlying pathophysiology to minimize length of stay in ICU. There are common complications particularly associated with a prolonged ICU stay, including deconditioning, muscle weakness, dyspnea, depression and anxiety, and reduced health-related quality of life [17, 41, 70]. Chronic critical illness is associated with prolonged immobility and intensive care unit (ICU) stay [29] and accounts for 5–10% of ICU stays, a proportion that appears to be increasing [13]. Because of these detrimental sequelae of long-term bed rest, there is a need for rehabilitation throughout the critical illness [16, 38, 66, 73, 114] and thereafter [49], to address these effects. The amount of rehabilita-

tion performed in ICUs is often inadequate [20] and, as a rule, is better organized in weaning centers [66, 73].

Physiotherapy in the management of patients with critical illness

Physiotherapists are involved in the management of patients with acute, subacute and chronic respiratory conditions and in the prevention and treatment of the sequelae of immobility and recumbency [47, 77]. Their role varies across units, hospitals, and countries [77], with respect to patient referral, roles, treatment goals and selection of interventions [47, 77]. Due to a lack of substantive evidence, an earlier review could not draw firm conclusions on the effectiveness of physiotherapy for critically ill patients [98]. The purpose of this document is to critically review the evidence currently available for the use of physiotherapy in the adult critically ill patient and to make recommendations for assessment and monitoring and best practice in three relevant clinical areas:

- Deconditioning and related complications
- Respiratory conditions (retained airway secretions, atelectasis, pneumonia, acute lung injury, inhalation injury, postoperative pulmonary complications, chest trauma, intubation avoidance and weaning failure)
- Emotional problems and communication

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

- Chest physiotherapy
- Positioning
- Mobilization
- Exercise

European Respiratory Society,
European Society of Intensive Care Medicine
Task Force 2008

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 interventions are both therapeutic and safe

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



Physiotherapy interventions are safe

Zeppos et al: Safety of physiotherapy intervention in intensive care

Physiotherapy intervention in intensive care is safe: an observational study

Lisa Zeppos¹, Shane Patman², Susan Barney³, Julie A Adsett⁴, Julie M Brisdon⁵ and Jennifer D Paratz^{1*}

¹La Trobe University; ²University of New South Wales; ³Acute Hospital; ⁴Royal Brisbane and Women's Hospital; ⁵Royal Hobart Hospital; ⁶University of Queensland; Australia

Question: How often do adverse events (including adverse physiological changes) occur during physiotherapy intervention in intensive care? **Design:** A multi-centre prospective observational study. **Participants:** Five tertiary level university-affiliated intensive care units. **Outcome measures:** All physiotherapy interventions in five intensive care units over a three month period. When certain specified changes occurred during physiotherapy intervention, audits were noted including diagnosis of patient, intervention, vital signs, radiological changes, co-morbidities, chemical pathology, and fluid balance. **Results:** 12 281 physiotherapy interventions were completed with 77 interventions resulting in adverse physiological changes (0.7%). The incidence was significantly lower than a previous study of adverse physiological changes (6%) in 24 patients over a 24-hour period. The incidence during physiotherapy intervention was lower than during general intensive care. Common factors in the patients who had an adverse physiological change were a deterioration in cardiovascular status (ie, decrease in blood pressure or arrhythmia), in patients on medium to high doses of inotropes/vasopressors, unstable baseline haemodynamic values, previous cardiac co-morbidities and intervention consisting of positive pressure or right side lying. **Conclusion:** The incidence of adverse events during physiotherapy intervention in these five tertiary hospitals was low, demonstrating that physiotherapy intervention in intensive care is safe. **Zeppos L, Patman S, Barney S, Adsett J, Brisdon J, Paratz JD (2007) Physiotherapy intervention in intensive care is safe: an observational study. Australian Journal of Physiotherapy 53: 275-280**

Key words: Intensive Care, Physiotherapy, Audit, Task Performance Analysis, Critical Incident

Introduction

Physiotherapy intervention is regarded as an important component in the management of patients in intensive care (Haley and Jones 2003) and has been demonstrated to provide both short- and medium-term benefits (Honey and Desbry 2002, Hodgson et al 2000, Nunezopolos et al 2002, Paratz et al 2007). However, there have been some claims that, in intensive care, physiotherapy intervention results in adverse physiological changes (Hansson et al 1982, Singer et al 1994, Weisman et al 1994), ie, clinically significant alterations in haemodynamic, respiratory, or internal parameters necessitating medical intervention. Since intensive care patients are critically ill, they do have the potential to become unstable during all aspects of management, such as with basic nursing care, position changes, suction, or physiotherapy intervention. Adverse physiological changes can also occur spontaneously in intensive care patients, as shown by Shoemaker et al (1989) who recorded 637 such events in 247 patients over a 24-hour period.

Many of the studies reporting adverse physiological changes during physiotherapy intervention in intensive care have been methodologically flawed. These studies have included patients who were haemodynamically unstable and not representative of patients to whom the intervention would be applied (Hansson et al 1982, Singer et al 1994, Weisman et al 1994). In contrast, other studies have found beneficial or minimal adverse effects during physiotherapy intervention (Honey and Desbry 2002, Honey and Desbry 2003, Hodgson et al 2000, Nunezopolos et al 2002, Paratz et al 2007, Paratz et al 2006, Patman et al 1998). These studies

included patients for whom the questionnaire respondents (Hodgson et al 1990, King and Morell 1995) had a physiological rationale for physiotherapy intervention.

Audit is an effective way to identify deficiencies in quality of care and are an accepted method of improving patient safety by identifying factors contributing to adverse events. Large audits of adverse events in intensive care have been published (Rockman et al 1996, Rockman et al 2003, Buckley et al 1997, Hart et al 1994) which did not record or report any adverse physiological changes associated with physiotherapy intervention. Data concerning the actual incidence of adverse physiological changes during physiotherapy intervention are required in order to determine the safety of physiotherapy intervention in intensive care. Therefore the research question for this prospective observational study was:

How often do adverse events (including adverse physiological changes) occur during physiotherapy intervention in intensive care?

Using information obtained from auditing adverse physiological changes associated with physiotherapy intervention in intensive care, experimental studies can be planned to investigate if these changes occur in particular patients or during particular interventions.

Method

Design

A multicentre prospective observational study was conducted at five tertiary level intensive care units in Australia. Over

School of Physiotherapy, University of Melbourne Australia, 2006

Is Physiotherapy effective in the ICU?

- 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 physiotherapist

Physical Therapy Review 2006; 11: 40-56

PHYSIOTHERAPY IN THE INTENSIVE CARE UNIT

LINDA DENEHY¹ and SUSAN BERNEY²

¹School of Physiotherapy, Faculty of Medicine, Dentistry and Health Sciences,
The University of Melbourne, Melbourne, Victoria, Australia
²Department 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 physiotherapists in the adult ICU. The efficacy of 'chest physiotherapy' on short-term patient physiological outcomes has been studied extensively and there is moderate-to-strong evidence in support of its role. The safety of physiotherapy treatment in ICU has also recently been established. In addition, there is growing evidence for the role of exercise rehabilitation beginning in ICU and extending to beyond ICU discharge. Urgent research is required by physiotherapists to establish the effectiveness of such treatments.

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

Intensive care is a dynamic environment where physiotherapists are vital members of the multi-disciplinary 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 notwithstanding, 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 adult ICU 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 hyperinflation and exercise; searches were limited to English

language. The reference lists of extracted articles were also reviewed.

Several surveys report on specific physiotherapy practice in the ICU;²⁻⁴ generally, these are limited to respiratory management. However, the assessment and management of neurological and musculoskeletal complications form an important part of the physiotherapist's role.^{1,5} It is this individualised, multi-system patient assessment and treatment that defines the role of physiotherapists compared with respiratory therapists and nurses. Physiotherapists may be involved with specific patient positioning, suction, mobilisation, exercise, passive movements, manual airway clearance techniques, manual (MI) and ventilator hyperinflation (VH), NIV and weaning.^{1,6-8} The country of origin of published research reflects differences in types of healthcare professionals employed in the ICU, with research from the US predominantly reporting respiratory therapist roles. In the UK, parts of Europe and Canada, South Africa, and Australia, the role of physiotherapists encompasses respiratory as well as neurological and musculoskeletal patient



The Physiotherapist has to focus on the efficacy of treatment!

Evidence-Based Physiotherapy in the ICU 2011.

Physiotherapy and metabolic demand

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- 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_2 and VO_2

Physiotherapy and metabolic demand

- Cohen et al - haemodynamic and metabolic changes caused by chest physiotherapy during invasive ventilation

- 32 postoperative patients
- Control group: HR↑↑↑, SBP and MBP↑↑↑, CO↑↑↑, VO₂↑↑↑, CO₂ production, pCO₂↑
- Propofol : HR↑, SBP and MBP↑, CO↑, VO₂↑↑



Sympathetic stimulation ↑
WOB↑

Physiotherapy and metabolic demand



- I.Pénzes, J. Elek, E. Benkovics. - NIPPV + manual support in side-lying position
 - 20 postoperative patient with respiratory failure
 - During chest physiotherapy + FiO_2 0.6-1
 - $\text{PaO}_2 \uparrow \uparrow$, $\text{HR} \uparrow$, $\text{CO} \rightarrow \uparrow$, $\text{DO}_2 \uparrow \uparrow$, $\text{VO}_2 \uparrow \uparrow \uparrow$
 - 20 minutes after NIPPV+ manual support in side-lying position
 - $\text{PaO}_2 \uparrow$, $\text{HR} \rightarrow$, $\text{CO} \rightarrow$, $\text{DO}_2 \uparrow$, $\text{VO}_2 \rightarrow$



WOB \uparrow , but efficient!

Clinical algorithm of physiotherapy pulmonary dysfunction



Increased secretion during invasive ventilation:

- Positioning
- Manual therapy
- Hyperinflation
 - $MHI < 7.5 \text{ cmH}_2\text{O PEEP}$, $VHI > 7.5 \text{ cmH}_2\text{O PEEP}$

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 dysfunction

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 occurence of the VAP**

Clinical algorythm of physiotherapy mobilisation

- **In patients, who have stable haemodynamic status**

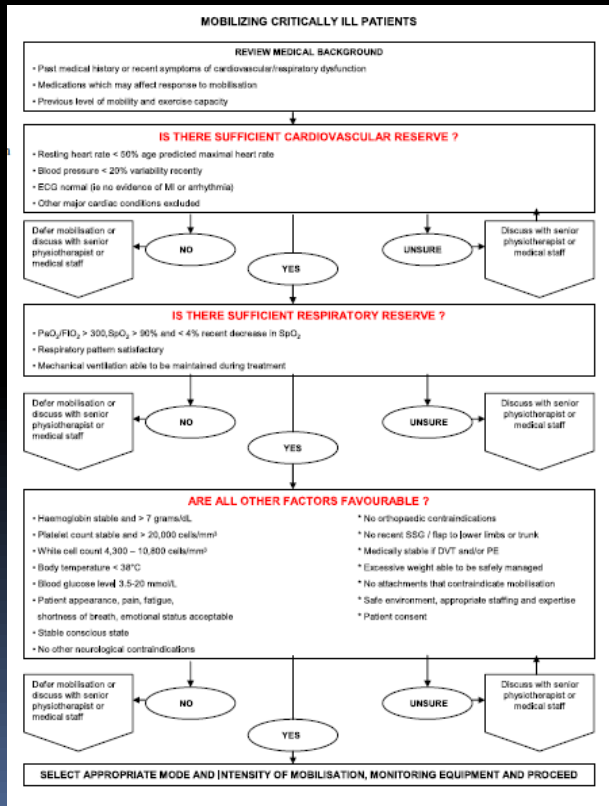
Stiller et al 2004, Bailey et al 2006, Thomsen et al 2008

- **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 algorithm of physiotherapy mobilisation



- **Review medical background**
 - Past medical history or recent symptom of cardiovascular /respiratory dysfunction
 - Medications which 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 algorithm of physiotherapy mobilisation

- **Haemodynamic stability:**
 - ◆ $HR_{rest} < HR_{max} 50\%$
 - ◆ SBP 100 – 140 Hgmm, DBP 80-105 Hgmm and variability recently < 20%
 - ◆ Normal ECG
- ◆ **Respiratory stability:**
 - ◆ $PaO_2/FiO_2 > 150$ – sitting in chair
 - ◆ $PaO_2/FiO_2 > 300$ - 30m walking
 - ◆ $SpO_2 > 90$ and recent decreases in $SpO_2 < 4\%$
- ◆ **Hb stable and > 7 g/dl**
- ◆ **Body temperature < 38**
- ◆ **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
 - ↓ Resting and maximum SV , ↓ maximum CO
 - ↑ Risk of venous thrombosis and thromboembolism
 - Orthostatic tolerance ↓
 - ↓ Aerobic conditioning
 - ↓ VO_2
 - ↓ Muscle mass, ↓ muscle strength, ↓ 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**
 - ↑Regional ventillation
 - ↑Regional perfusion
 - ↑Regional diffusion
 - ↑Zone 2 V/Q ratio
 - ↑TV
 - **Altered breathing frequency**
 - ↑Minute ventillation
 - ↑Efficiency of respiratory mechanism
 - ↓Airflow resistance
 - ↑Flow rates
 - ↑Strenght and quality of a cought
 - ↑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**
 - ↑Venous return
 - ↑SV, HR, CO
 - ↑Myocardial contractility
 - ↑Coronary perfusion
 - ↑Circultaing blood volume
 - ↑Chest tube drainage
 - ↓Peripheral vascular resistance
- **Neuromuscular system**
 - ↑cerebral elektrical aktivitiy
 - ↑Symphatetic stimulation
 - ↑Postural reflexes

Mobilisation during invasive ventilation

- **Level of mobilisation during invasive ventilation**
 - Turning in bed passive/active
 - Sitting over the edge of the bed
 - Transferring from the bed passive/active
 - Standing up passive/active
 - Walking with mobile ventilator
 - walking with or without modified walking frames or walker

The postoperative 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 length of stay in ICU and mortality**
- **Enhances the functional capacity**

Chest physiotherapy interventions	Resident physician	Physiotherapist		ICU nurse
		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 – physiotherapy with NIPPV	+	+	+/R	+
Volumetric exerciser	+	+	+	+
Breathing exercises	+	+	+	+
Breathing training		+	+/R	
NMES		+	+/R	
6 MWT		+	+/R	

*European Respiratory Society,
European Society of Intensive Care Medicine
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Airway clearance

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 vibration	CPAP	
Breathing exercise	Assisted coughing		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