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PHYSIOTHERAPY
IN THE INTENSIVE CARE UNIT
The story...

- 1985. C.F. Mackenzie USA
- 1989. I. Pénzes HU
  - UK 97%
  - Australia 49%
Positioning

Mobilisation

Manual hyperinflation

Percussion, manual or mechanical vibration

Airway suctioning

Coughing, huffing

Breathing exercise
Australia 2000.

- Focused on intubated patients receiving mechanical ventilation
  - 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
**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
- Hyperoxigenisation is preventing suction-induced hypoxemia
- The haemodinamic 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

- Chest physiotherapy
- Positioning
- Mobilization
- Exercise
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
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: deterioration 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
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

The Physiotherapist has to focus on the efficacy of treatment!
Physiotherapy and metabolic demand

- 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 $VO_2$. 

Evidence-Based Physiotherapy in the ICU 2011.
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↑

Evidence-Based Physiotherapy in the ICU 2011.
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 + FiO₂ 0.6-1
    - PaO₂↑, HR↑, CO→↑, DO₂↑↑, VO₂↑↑↑
  - 20 minutes after NIPPV+ manual support in side-lying position
    - PaO₂↑, HR→, CO→, DO₂↑, VO₂→

WOB↑, but efficient!

Evidence-Based Physiotherapy in the ICU 2011.
Increased secretion during invasive ventilation:

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

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

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

*Clinical algorithm of physiotherapy pulmonary disfunction*

Evidence-Based Physiotherapy in the ICU 2011.
VAP:

- Routin chest physiotherapy is NOT RECOMMENDED \(\text{Ntoumenopoulos et al 2002}\)
- Inclined bed 30° - 45° \(\text{Dodek et al 2004, Gastmeier et al 2007}\)
- Open or closed suctioning does not influence the occurrence of the VAP
Clinical algorithm of physiotherapy mobilisation

- In patients, who have stable haemodynamic status
  

- 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
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

Evidence-Based Physiotherapy in the ICU 2011.
Clinical algorythm of physiotherapy mobilisation

- **Haemodynamic stability:**
  - $HR_{\text{rest}} < HR_{\text{max}} \ 50\%$
  - 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 decrease in $SpO_2 < 4\%$
- **Hb stable and > 7 g/dl**
- **Body temperature < 38**
- **Blood glucose level 3.5 – 20 mmol/L**
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 of venous thrombosis and thromboembolism
- Orthostatic tolerance ↓
- ↓ Aerobic conditioning
- ↓ VO₂
- ↓ Muscle mass, ↓ muscle strength, ↓ muscle endurance
- ↓ diameter of vessels
- ↑ Insulin resistance
- Catabolism
- Paralytic ileus
- ↑ Anxiety, depression, psychosis
Clinical algorithm of physiotherapy mobilisation

- Acute Physiological Effects of Mobilization and Exercise - Pulmonary System
  - Regional ventilation
  - Regional perfusion
  - Regional diffusion
  - Zone 2 V/Q ratio
  - TV
  - Altered breathing frequency
  - Minute ventilation
  - Efficiency of respiratory mechanism
  - Airflow resistance
  - Flow rates
  - Strength and quality of a cough
  - Mucociliary transport and airway clearance
  - Distribution and function of pulmonary immune factors
Clinical algorithm of physiotherapy mobilisation

- Acute Physiological Effects of Mobilization and Exercise
  - Cardiovascular System
    - ↑Venous return
    - ↑SV, HR, CO
    - ↑Myocardial contractility
    - ↑Coronary perfusion
    - ↑Circulating blood volume
    - ↑Chest tube drainage
    - ↓Peripheral vascular resistance
  - Neuromuscular system
    - ↑Cerebral electrical activity
    - ↑Sympathetic 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
  - Transfering from the bed passive/active
  - Standing up passive/active
  - Walking with mobile ventilator
  - Walking with or without modified walking frames or walker
Primarily choose mobilisation

Choose breathing exercises only, If the mobilisation is contraindicated


Patients with hypoxemia use NIPPV, NIV or IV Ferreyra et al 2008
European Respiratory Society,
European Society of Intensive Care Medicine
Task Force 2008

Exercise

≥14 days of invasive ventilation:
- It does not decrease the length of stay in ICU and mortality
- Enhances the functional capacity
<table>
<thead>
<tr>
<th>Chest physiotherapy interventions</th>
<th>Resident physician</th>
<th>Physiotherapyst</th>
<th>ICU nurse</th>
</tr>
</thead>
<tbody>
<tr>
<td>Exam, treatment planning</td>
<td>+</td>
<td>+</td>
<td>+/R</td>
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<tr>
<td>Drug inhalation</td>
<td>+/R</td>
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<tr>
<td>Percussion, mechanical or manual vibration</td>
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<td>MH or VH</td>
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<td>Suctioning</td>
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<td>Positioning</td>
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<tr>
<td>Mobilisation</td>
<td>+</td>
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<tr>
<td>Volume therapy – physiotherapy with NIPPV</td>
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<td>Volumetric exerciser</td>
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<td>Breathing exercises</td>
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R - Responsible
## Airway Clearance

<table>
<thead>
<tr>
<th>Retrained airway secretions</th>
<th>Increase inspiratory volume</th>
<th>Increase expiratory flow rate</th>
<th>Oscillation</th>
<th>Increase expiratory volume</th>
<th>Airway suctioning</th>
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<tbody>
<tr>
<td>Mobilisation</td>
<td>Positioning</td>
<td>Percussion</td>
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<tr>
<td>Positioning</td>
<td>Coughing/huffing</td>
<td>Manual or mechanical vibration</td>
<td>CPAP</td>
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<td>Breathing exercise</td>
<td>Assisted coughing</td>
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<td>PEP</td>
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<td>Volumetric exerciser</td>
<td>Exsufflator</td>
<td>HFO, IPV/Flutter</td>
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<td>NIV</td>
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*Evidence-Based Physiotherapy in the ICU 2011.*
Physiotherapy is safe and efficient in critical ill patients also.

During mechanical ventilation chest physiotherapy with positioning is very useful in pulmonary diseases.

Early and safe mobilisation is important in intubated and critically ill patients.

The volumen therapy/NIPPV with positioning and manual therapy is efficient in the weaning process.

Haemodynamic monitoring is necessary.

Take home message...

Evidence-Based Physiotherapy in the ICU 2011.