Early Mobilization in the Intensive Care Unit

David Kennedy, MS, PT, CCS
Diane Madras, PT, PhD

Jan 23, 2012 8:00 a.m. – 10:00 a.m.
2 contact hours

Objectives:
1. Articulate factors that contribute to poor outcomes in patients treated in the ICU.
2. Explain the physiological contributors for deconditioning and the neuromuscular deconditioning observed in patients with prolonged ICU stays.
3. Discuss strengths of PTs’ knowledge related to prevention of ICU-acquired deconditioning.
4. Explore the threats and opportunities encountered by PTs while working with severely impaired patients in the ICU.
5. Cite evidence that supports utilization of PT providing early mobilization in the ICU.

Physiological Effects of Bed rest

<table>
<thead>
<tr>
<th>Decreased</th>
<th>Increased</th>
</tr>
</thead>
<tbody>
<tr>
<td>- Plasma &amp; blood volume</td>
<td>- Diuresis, naturesis</td>
</tr>
<tr>
<td>- Ventricular volumes</td>
<td>- Hematocrit, hemoglobin</td>
</tr>
<tr>
<td>- Muscle mass, strength, endurance</td>
<td>- Thrombosis/embolism risk</td>
</tr>
<tr>
<td>- Nerve conduction</td>
<td>- Venous stasis</td>
</tr>
<tr>
<td>- Resting &amp; max SV, CO</td>
<td>- Urinary stasis, calculus formation</td>
</tr>
<tr>
<td>- Orthostatic tolerance</td>
<td>- Insulin resistance</td>
</tr>
<tr>
<td>- VO₂</td>
<td>- HR (rest + activity)</td>
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<tr>
<td>- Bone mineralization</td>
<td>- Venous compliance</td>
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</tbody>
</table>

Dean, 2008

Critical Illness Polyneuropathy

Sensorimotor Polyneuropathy
- Critical ill + sepsis + multi-organ failure
  - Flaccid tetraparesis, predominantly distally
  - Respiratory muscle weakness
  - LE > UE
  - ↓ DTR
  - Sensory loss, pain temp, vibration


Critical Illness Myopathy

5 – 14 Up-regulation
- Proteolytic systems
- Oxidative stress response genes
- Cell cycle arrest
- Apoptosis
- Muscle development
- Myogenic factors

5 – 14 Down-regulation
- Contractile
- Regulatory
- Metabolic
- Developmental
- Structural
- Functional

Critical Illness Myopathy

9 – 14 Up-regulation
- Immune response genes

9 – 14 Up-regulation
- Caspase cascade
Critical Illness Myopathy

**Muscle Δ**
- **Sub-Type 1**
  - ↓ Type I and II fibers
  - CK normal
- **Sub-Type 2**
  - Myosin loss
  - ↑ CK
- **Sub-Type 3**
  - Rare
  - ↑ CK

**Functional Δ**
- Proximal & distal weak
- Sensation spared
- ↓ DTR


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**How ICU Staffing Is Evolving**

**Historical “open” ICUs**
- Any consultant may admit a pt. to the ICU with or without the knowledge of the consultant intensivist.

**“Closed” ICUs**
- Once pt. enters ICU, primary care is transferred to the consultant intensivist who makes all major decisions during ICU stay.

**Semiclosed or Transitional ICU**
- Mandatory daily consult and daily rounds with consultant intensivist for all pts. in ICU.

Divatia et al. 2006

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**Patient Management in ICUs**

**Historical Pt. Mgmt**
- Pts. admitted to ICU
- Pt. placed on ventilator
- Physicians round daily
- PT begun at discretion of MD

**Early Mobilization Mgmt**
- Pts. admitted to ICU
- Pt. placed on ventilator
- Interdisciplinary Team mtg
  - Sedation interruption
  - Assessment of wakefulness
  - Pt. physiologically & psychologically ready to be mobilized
  - Decisions made


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**Initiation of Services**

**Daily Screening**

Criteria to begin Mobilization Program
- Medically stable
- Sufficient Cardiopulmonary reserves
- Hemodynamically stable
- Adequate nutrition on board
- Safe to interrupt sedation

Assessment of wakefulness follows 3-4 commands
- Poor responsiveness – continue to assess

**Criteria for Initiating mobilization**
- Adequate oxygenation
  - Po2 60 mm Hg on Fio2 0.4
  - PEEP 5–10 cm H2O
  - Po2/Fio2 >150
  - RR >5, <40 breaths/min
  - SaO2 >85%
  - Secure airway

- Stable cardiovascular system
  - HR >40, <130 beats/min
  - Stable BP
  - MAP >65 mmHg
  - No (or minimal) pressors
  - Active myocardial ischemia

- Adequate mentation - arousable,< 38°C
- No significant respiratory acidosis
- Adequate hemoglobin - 8–10 g/dL

- K, Na, Cl

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**Criteria for Initiating mobilization**

- Adequate mentation - arousable,
- GCS > 13,
- Stable metabolic status
- Acceptable electrolytes
Criteria for Initiating mobilization

- Stable Intracranial Pressure
- No Active GI blood loss
- Change in WBC
- Resolution of disease acute phase
- Physician believes discontinuation possible
- Adequate cough

Contraindications to Early Mobilization

- MAP <65 mmHg
- HR <40, >130 beats/min
- RR <5, >40 breaths/min
- SaO₂ <88%
- ↑ Intracranial Pressure
- Active GI blood loss
- Active myocardial ischemia
- Undergoing a procedure
- Agitation (requiring sedation)
- Insecure airway

Ventilators

Modes of mechanical ventilation
- Volume cycle mode
- Load pressure cycle mode

Methods of ventilatory support.
- CMV – Continuous mandatory ventilation
- SIMV - Synchronized intermittent mandatory ventilation
- CPAP - continuous positive airway pressure
- PSV – Pressure support Ventilation

Mobilizing

Edge of the bed
- Increases arousal
- Establishes orthostatic tolerance
- Increases respiratory rate and depth of breathing
- Provides afferent sensory feedback
- Requires active muscle activation to maintain upright position

Mobilizing Cont

Transfers
- Standing first
- Weight Shifting
- Pivot to Chair

Line management
- Transferring to/away from vent
- Important lines (swan, central, arterial, catheters, etc)

Mobilizing cont

Ambulation
- On Vent
- Off Vent

Line Management
- Vent to bag
- O₂
- Drips
- Catheters
- ECG
**Ventilator Discontinuation**

In conjunction with weaning programs
- Intermittent trials without ventilator
- PEEP reduction while sitting in chair
- Vent off and ambu bag use for independent breaths
- Diaphragm and accessory muscle training

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**Inspiratory Muscle Training**

USE: Resistor to increase work of inspiration resulting in measurable changes in maximal inspiratory pressure (MIP)
For patients not tolerating resistor, a combination of intermittent mandatory ventilation and resistance training can be used.

Training:
- Principles of strength training apply
  - Intensity (resistance)
  - Duration (length of exercise bout)
  - Frequency (number of sessions)

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**Exercise**

Supplement to mobilization if able to tolerate the added energy expenditure
- Trunk – inherent in sitting edge of bed and transfers
- Limbs - general mobility but no strength gain generally seen until out of ICU

Most useful for the patient who is not ready to be mobilized.
Stimulation of CNS through movement, passive, active assist, etc to improve wakefulness.
Prevention of contracture or loss of range of motion

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**When to Stop**

<table>
<thead>
<tr>
<th>Obvious stuff</th>
<th>The not as obvious stuff</th>
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<tbody>
<tr>
<td>Cardiac</td>
<td>Fatigue: Sensitive observation of the patient:</td>
</tr>
<tr>
<td>HR, BP, MAP, ECG</td>
<td>- respiratory rate</td>
</tr>
<tr>
<td>Pulmonary</td>
<td>- color</td>
</tr>
<tr>
<td>SaO2/SpO2</td>
<td>- muscle recruitment</td>
</tr>
<tr>
<td>RR</td>
<td>- balance</td>
</tr>
<tr>
<td>Problems with any tube</td>
<td>- weight bearing</td>
</tr>
<tr>
<td>(including the patient’s)</td>
<td>- diaphoresis</td>
</tr>
</tbody>
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**Treatment Goals**

- Discontinue Ventilator
- Transfer from ICU to lower Acuity Ward
  - Increase wakefulness
  - Decrease breathlessness
  - Increase MIP
  - Improve independence with mobility

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**Physical Therapist Strengths**

- Specialists in assessing mobility
- PTs understand physiology
- Specialists in prevention of secondary comorbidities/limitations.
Weaknesses of PT as profession

• Member of team as ‘autonomous practice’

Divatia et al

Opportunities for PTs

• Research in optimal time to begin mobilization
• Research in appropriate exercise ‘dose’.
• Research regarding the optimal combination of settings.
• Research regarding cost efficiency
• Research to determine appropriate APACHE score for optimal PT benefit.
• Expand research regarding patient presenting characteristics, not setting based (SICU, MICU, CCU) to include burn units, step-down units.

Opportunities for PTs in the ICU

• Advantages of Early Mobilization
  – Early discharge
  – Increased function at ICU d/c
(Schweikert, Morris)
  – Economic advantages for pts./hospitals/3rd party payer

Threats

• To PT
• To other healthcare professionals
• To patients
• To 3rd party payers

Conclusions

• A patient-specific mobilization plan must be developed for each patient admitted to an ICU.
• The goal of this plan is the timely implementation of early patient-initiated activity.
• This plan must be developed in consultation with inter-professional team members, the patient and/or family, and include clear objectives and measurable outcomes.

Hanekom et al, 2010

• “Physical exercise training is the cornerstone treatment to improve health related quality of life and functional exercise capacity.”

Words to live by:

• MOVEMENT, DIAPHRAGM & TEAM

Langer, 2009