Early Physical Therapy in the ICU: No “One Size Fits All” Option

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Learning Objectives

1. Explain the pathology and clinical presentation of common diagnoses seen in the intensive care unit as relevant to physical therapy
2. Describe current evidence-based practices regarding physical therapy dosing for patients in the intensive care unit
3. Analyze patient scenarios to develop appropriate physical therapy management
4. Describe the role of physical therapy within the complex management of a patient with critical illness

ICU Acquired Weakness (ICUAW)

“Presence of clinically detectable weakness in ICU patients with no possible etiology other than critical illness” Hashem, Parker, Needham, 2016

Recovery of weakness takes weeks to months to recover, with some patients with deficits 2 years after ICU discharge

Hermans & Van den Berghe, 2015

Disclosure

• None

Background On Recent Early Mobility Culture And Climate

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Long Term Outcomes of Critical Illness

• >1/3 Survivors from Acute Respiratory Distress Syndrome with presence of muscle weakness at hospital discharge
  – Post ICU weakness defined as MRC ≤48
  – Every one point increase in sum score at discharge was associated with improved survival
• Strength at discharge was associated with improved 5-year survival
• Survivors of critical illness experience poor physical outcomes
  – Impaired muscle strength
  – Decreased exercise capacity
  – Impaired physical function

Dinglas Crit Care Med 2017
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Decreased Sedation and Increased Patient Mobility Reduce Risks of Poor Outcomes

- Sedation algorithm in critically ill patients without acute brain injury
- Early activity is feasible and safe in respiratory failure patients
- Early physical and occupational therapy in mechanically ventilated, critically ill patients: a randomised controlled trial

43 eligible studies
7,546 patients with 22,351 distinct mobilization/rehabilitation sessions
583 reported potential safety events (2.6%)
Only 2 instances reported of ETT removal

What is the prevalence in USA of PT/OT mobility for adult ICU patients with acute respiratory failure on mechanical ventilation?

- 42 ICUs across 17 ARDS Network hospitals
- Results
  - PT/OT Mobility with endotracheal tube: 32% of patient days
  - Mobility in absence of mechanical ventilation: 48% of patient days
  - Mechanically ventilated patients achieved out of bed: 16% of patient days

An Environmental Scan of Early Mobility

- Consistent practice
  - Multidisciplinary rounds (77%)
  - Setting daily sedation goal (89%)
  - Utilizing standardized sedation scoring system (98%)
- Inconsistent practice
  - Presence of early mobility practice (45%)
  - Utilization of written protocol (30%)
  - Variations in eligibility criteria, and early mobility interventions provided
  - 34% have dedicated PT/OT team for one or more ICU

Recap

- ICUAW is a significant complication of critical illness
- Early Mobility is a safe, feasible, and effective method for reducing this harm
- Ongoing barriers exist towards large scale implementation

What must be done to drive the practice of early mobility forward?
How Do We Standardize Care and Move Towards Best Practice

Who is best equipped to provide patient activity and/or mobility?

What should qualify a person as competent for practicing in the Intensive Care Unit?

What are the safety parameters and considerations for initiating mobilization?

A prospective observational study demonstrated that:
- Patients level of mobility achieved by PT was significantly higher compared with that achieved by RN staff
- Barriers to mobility vary by profession
  - Hemodynamic instability and Renal Replacement Therapy considered more significant barrier by RN than PT

Minimum Skills Task Force Defines Entry-Level Practice in Acute Care

Developed set of Core Competencies to ensure independent, safe, and effective entry level Physical Therapists in acute care

Key Area’s of Agreement For Minimum Standards

- Action and implication of Vasopressors, Anti-hypertensives, and Anti-arrhythmics
- Safe use of, or handling of common ICU lines, tubes, and airways
- Principles of providing modes of mechanical ventilation
  - Respiratory settings and measurements
  - Assessment of arterial blood gas measurements
- Pathophysiology of common range of conditions
- Assess and interpret vitals, labs, and chest radiographs
- Provide interventions with understanding of indications, contraindications, and evidence for the technique and progression

Minimal Standards Of Clinical Practice For Physical Therapists Working in Critical Care

Framework to enhance consistency of the role of the Physical Therapist in the critical care setting
Early Physical Therapy in the ICU: No “One Size Fits All” Option

Items Excluded from Minimal Standards

<table>
<thead>
<tr>
<th>Safe handling of ECMO</th>
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</thead>
<tbody>
<tr>
<td>Accurate interpretation of advanced EKG’s</td>
</tr>
<tr>
<td>Independent interpretation of imaging without imaging report</td>
</tr>
<tr>
<td>Ability to perform delirium assessments (CAM ICU)</td>
</tr>
<tr>
<td>Knowledge of advanced hemodynamic monitoring (Swan-Ganz)</td>
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<tr>
<td>Understanding pathophysiology, medical management, and implication for PT interventions for organ transplant</td>
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How Do We Standardize Care and Move Towards Best Practice

Who is best equipped to provide patient activity and/or mobility?

What should qualify a person as competent for practicing in the Intensive Care Unit?

What are the safety parameters and considerations for initiating mobilization?

Defining the “Early” in Early Mobility

“The interval starting with initial physiologic stabilization and continuing through the ICU stay… compared with activity that usually begins after ICU discharge”

- Bailey Crit Care Med 2007

Initiation of interventions are inconsistent throughout literature which contributes towards variation in results and outcomes

Expert Consensus

• Recommendations on safety criteria to consider prior to mobilizing adult, mechanically ventilated, patients
• Intended to be used as guide in conjunction with clinical reasoning and communication with multidisciplinary team

• Criteria to be assessed at time of mobilization with respect to recent trends

Hodgson Critical Care 2014

Relative Contraindications To Initiating Mobility

<table>
<thead>
<tr>
<th>criteria</th>
<th>reason</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mean arterial pressure ≤65</td>
<td>Active myocardial ischemia</td>
</tr>
<tr>
<td>PEEP &gt;10 cmH₂O</td>
<td>Actively undergoing a procedure</td>
</tr>
<tr>
<td>FiO₂ &gt;60%</td>
<td>Evidence of elevated intracranial pressure</td>
</tr>
<tr>
<td>Heart rate &lt;40, &gt;130 beats/min</td>
<td>Insecure airway (device)</td>
</tr>
<tr>
<td>Respiratory rate &lt;5, &gt;40 breaths/ min</td>
<td>New arrhythmia</td>
</tr>
<tr>
<td>Pulse oximetry &lt;98%</td>
<td>Marked ventilator dysynchrony</td>
</tr>
<tr>
<td>Increase in vasopressor dose within 2 hours</td>
<td>Physically combative</td>
</tr>
<tr>
<td>Patient distress evidenced by nonverbal cues, gestures</td>
<td>Agitation requiring increased sedative administration in the last 30 minutes</td>
</tr>
<tr>
<td>Active gastrointestinal blood loss</td>
<td></td>
</tr>
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Common ICU Presentations

• ICUAW
• Acute Kidney Injury
• Delirium
• Sepsis
• Respiratory Failure

Permission granted to reproduce this page for the purposes of academic assessment and teaching.
ICU Acquired Weakness (ICUAW)

- Generalized symmetrical weakness ranging from paresis to quadriplegia
- Present in 46% of adult ICU patients with sepsis, multi-organ failure, or prolonged mechanical ventilation
- Critical Illness Polyneuropathy (CIP): Diffuse and symmetric axonal neuropathy manifested by distal motor and sensory deficits with normal reflexes
- Critical Illness Myopathy (CIM): acquired myopathy clinically recognized by proximal muscle weakness without sensory deficits and decreased or absent reflexes

Risk Factors for ICUAW
- High severity of illness upon admission
- Sepsis & Multi-organ failure
- Prolonged immobilization
- Hyperglycemia
- Older age
- Corticosteroids & Neuromuscular blockers

Diagnosing ICUAW

| Clinical presentation | Difficult liberation from mechanical ventilation
| | Prolonged persistent weakness
| Electrophysiological testing | Nerve conduction studies
| | Direct muscle stimulation
| Medical Research Council Score | Strength testing of upper and lower extremities on 1-5 scale
| | ICUAW defined as MRC score <48

Pathophysiology of ICUAW

- Complex functional and structural changes in both muscles and nerves
- Muscle protein synthesis - ↓
- Muscle catabolism - ↑
- Muscle mass - ↓
- Axonal degeneration

Common ICU Presentations

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Role Of The Kidneys And Genitourinary System

- Excretion of cellular waste products
- Regulation of blood volume
- Blood pressure regulation
- Plasma electrolyte regulation
- Acid-base regulation
- Erythropoietin secretion
### Diagnostic Tests and Measures

- Urinalysis
- Creatinine tests
- Estimated Glomerular filtration rate (GFR)
- Blood Urea Nitrogen (BUN)
- Radiography
  - X-ray
  - Arteriography
  - MRI and MRA
  - Renal Biopsy

### Acute Kidney Injury (AKI) Definition

- Sudden impairment in kidney function resulting in retention of waste products normally cleared by kidneys
- Results in derangements of circulating volume and/or electrolyte and acid base balance
- Present in 30% of ICU admissions
- Occurs on >50% of cases of severe sepsis

### Classification of AKI

- **RIFLE, AKIN, KDIGO**

### Clinical Manifestations of AKI

- Hypovolemia
- Acid-base imbalance
- Electrolyte imbalance
- Infection
- Anemia
- Peripheral edema
- Pulmonary Vascular congestion
- Pleural effusion
- Elevated jugular venous pressure

### Medical Management of AKI

- Treatment of primary AKI cause
- Management of conditions associated with AKI
- Optimization of hemodynamics and fluid balance
- Optimization of acid-base and electrolytes
- Renal replacement therapy
- Transfusions and blood products
- Nutritional support
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## Renal Replacement Therapy

<table>
<thead>
<tr>
<th>Intermittent Hemodialysis (iHD)</th>
<th>Continuous Renal Replacement Therapy (CRRT)</th>
</tr>
</thead>
<tbody>
<tr>
<td>- Management of fluid volume, electrolyte balance, acid-base balance, filtration of nitrogenous waste</td>
<td>- Continuous management that more closely mimics normal kidney function</td>
</tr>
<tr>
<td>- Tolerance of 2-3 liters of volume removal per session</td>
<td>- Offers improved hemodynamic stability</td>
</tr>
<tr>
<td>- Typically administered 3-4 times per week for approximately 3 hours</td>
<td>- Tighter control on fluid status</td>
</tr>
<tr>
<td></td>
<td>- Various targeted modes</td>
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<tr>
<td></td>
<td>- CVVHD</td>
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<tr>
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<td>- CVVH</td>
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<td>- UF</td>
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</tbody>
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## Goals Of Physical Therapy Management

- Optimize functional mobility
- Maximize functional activity tolerance and endurance
- Prevent further complications related to critical illness

## Considerations For Managing the Patient With AKI

- Changes in mental status
- Decreased muscle and nerve stimulation
- Pulmonary edema
- Peripheral edema
- Altered fluid volume status
- Blood pressure regulation
- Activity tolerance and fatigability
- Hypothermia

## Considerations For Treatment Planning

- Trends in titration of vasoactive medications
- Shifts of interstitial fluid during position changes
- Limited cardiopulmonary reserve due to volume status
  - Current vent settings and FiO2 requirements
- Bleeding risks and dialysis access site stability
- Environmental considerations for progressing to out of bed activities

## Common ICU Presentations

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## ICU Delirium

- Affects 60%-80% of mechanically ventilated patients and 40%-60% of non-ventilated patients
- Associated with increased mortality, poor long term cognitive and functional outcomes, increased LOS, increased costs

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Hosker BMJ 2017  
Barr Crit Care Med 2013
Risk Factors for ICU Delirium

<table>
<thead>
<tr>
<th>Unmodifiable</th>
<th>Related to critical illness</th>
<th>Modifiable</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age</td>
<td>Metabolic derangement</td>
<td>Pain</td>
</tr>
<tr>
<td>Alcohol or drug use</td>
<td>Anemia</td>
<td>Immobility</td>
</tr>
<tr>
<td>Dementia or cognitive impairment</td>
<td>Infection/sepsis</td>
<td>Medications (opioid and benzodiazepines)</td>
</tr>
<tr>
<td>Depression</td>
<td>Hypotension</td>
<td>Sleep deprivation</td>
</tr>
<tr>
<td>Hypertension</td>
<td>Hypoxemia</td>
<td>Polypharmacy</td>
</tr>
<tr>
<td>Smoking</td>
<td>Illness severity</td>
<td>Restraints</td>
</tr>
<tr>
<td>Vision or hearing impairment</td>
<td>Intracranial pressure</td>
<td>Environment</td>
</tr>
<tr>
<td>Malnutrition</td>
<td>Urinary/fecal incontinence</td>
<td>Available daylight</td>
</tr>
</tbody>
</table>

Assessing ICU Delirium

- Clinical Practice Guidelines for Pain, Agitation, and Delirium suggest that all ICU patients be assessed for Delirium ≥1 per shift
- Suggested tools
  - The Confusion Assessment Method for the ICU (CAM-ICU)
  - Intensive Care Delirium Screening Checklist (ICDSC)
- Implementation of routine delirium monitoring is feasible in clinical practice

Confusion Assessment Method for the ICU (CAM-ICU)

Treatment and Prevention of ICU Delirium

- Early Mobilization as an effective intervention for delirium reduction
- Orientation protocols and cognitive stimulation
- Promotion of physiological sleep and day/night cycle
- Multidisciplinary involvement to address modifiable risk factors
- Provide visual and hearing aids when appropriate
- Alter verbal communication style
- Use communication boards and tools

ICU Delirium Subtypes

- Hyperactive
  - ↑ motor activity
  - Agitation
  - Restlessness
  - Wandering
  - Hallucinations
  - Delusions
- Hypoactive
  - ↓ activity
  - ↓ speed of movements
  - Reduced awareness of surroundings
  - Listlessness
- Mixed
  - Presentation of symptoms fluctuating between hyper and hypoactive

Engagement in structured Occupational Therapy interventions including cognitive stimulation activities decreased the duration and incidence of delirium in non-ventilated ICU patients

Incidence of delirium: 3% (experimental) vs. 20% (control)
Motor FIM on Discharge: 59 (experimental) vs 40 (control)
Tools For Communication

Considerations For Treatment Planning

• Assess for fluctuations in mental status
  – Agitation
  – Command following
  – Attention
  – Ability to redirect and reorient
• Discuss medication management and timing of therapy session
• Consider available assistance for mobilization
• Line management and organization

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Sepsis

• >750,000 cases per year →
  >200,000 deaths per year
• Leading cause of death in ICUs

Sepsis: Terminology

• Systemic Inflammatory Response Syndrome
  – Inflammatory response due to infectious or non-infectious sources
• Severe Sepsis
  – Sepsis with associated organ dysfunction
• Septic Shock
  – Volume-refractory hemodynamic failure

Sepsis: Pathophysiology

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**Sepsis: Diagnosing Criteria**

1. **Cardiovascular:** Arterial systolic blood pressure ≤90 mmHg or mean arterial pressure ≤70 mmHg that responds to administration of IV fluid
2. **Renal:** Urine output <0.5 mL/kg per hour for 1 h despite adequate fluid resuscitation
3. **Respiratory:** PaO₂/FiO₂ ≤200 or, if the lung is the only dysfunctional organ, ≤200
4. **Hematologic:** Platelet count ≤80,000/μL or 50% decrease in platelet count from highest value recorded over previous 3 days
5. **Unexplained metabolic acidosis:** A pH ≤7.30 or a base deficit ≥5.0 mEq/L and a plasma lactate level >1.5 times upper limit of normal for reporting lab

SIRS now replaced with qSOFA

- Low blood pressure (SBP ≤100 mmHg)
- High respiratory rate (>22 breaths/min)
- Altered mentation (GCS <15)

**Sepsis: Clinical Presentation**

- Tachycardia (>90 bpm)
- Hyperventilation (>20 breaths/min)
- Hypotension (<90/40 mmHg)
- ↑↓ WBC (>12,000/mm³ or <4,000/mm³)
- ↑↓ Temperature (>38°C or <36°C)
- Altered mental status

**Sepsis: Medical Management**

**Sepsis: PT considerations**

- Decreased tolerance to activity
  - Tachycardia
  - Hyperventilation
  - Hypotension
- Frequent assessment of vitals
- Frequent visual assessment of patient
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Sepsis: PT considerations
(Acute Stage)

- Strategies for decreased activity tolerance and hemodynamic instability
  - Supine resistance training
  - Chair position for modified upright positioning
- Technology
  - NMES
  - Supine cycle ergometry
  - Tilt table/bed

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Sepsis: PT considerations
(Progression of Treatment Plan)

- Mobility as exercise
- Resistance training
- Out of bed tolerance

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Sepsis: PT considerations

- Contraindications to therapy
  - Increasing lactate levels
  - Decreasing central venous oxygen saturation

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Common ICU Presentations

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Respiratory Failure

- **Type I**: Alveolar flooding with intrapulmonary shunt physiology
- **Type II**: Alveolar hypoventilation with CO2 retention
- **Type III**: Atelectasis
- **Type IV**: Hypoperfusion of respiratory muscles in patients with shock

12/11/2017

Respiratory Failure: Diagnosing Criteria

- Hypercapnea: PaCO2 >45 mmHg
- Respiratory acidosis: pH <7.35

12/11/2017

Respiratory Failure

- Hypoxemic
  - Decreased PaO2 levels
- Hypercapnic
  - Increased PaCO2 levels

Respiratory Failure: Medical Management

- Oxygen Therapy
  - 1st priority: Treat hypoxemia
  - 2nd priority: Avoid worsening hypercapnia
- Mechanical ventilation

Respiratory Failure: Clinical Presentation

- Tachypnea
- Altered mental status
- Oxygen desaturation
- Inspiratory crackles

Respiratory Failure: PT considerations

- Ventilator settings
- Decreased activity tolerance
- Mental status

Defining dosage

- Frequency
- Duration
- Intensity
- Timing

Every patient is different!
Exercise Prescription for ICU: Evidence from the Literature

What questions remain?

- Patient population
- Timing of intervention
- Dosing of intervention
- Type of intervention

Piecing together what we DO have...

- RCTs
- Protocols

Intensive versus standard physical rehabilitation therapy in the critically ill (EPICC): a multicenter, parallel-group, randomised controlled trial

Stephen E Wright, Kirsty Thomas, Gillian Nelson, Catherine Baker, Andrew Bryant, et al.
Intensive versus standard physical rehabilitation therapy in the critically ill (EPICC): a multicenter, parallel-group, randomised controlled trial

BMJ Thorax 2017

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Take home from literature

- Consider time to initiation
- Standardizing outcomes
- Comparing across populations
- Consideration for standard vs intensive care