ICU Rehabilitation: Current Issues

Changing the ICU Paradigm: Role of Early Mobilization

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Introduction: Statement of the Problem

- ~13-20 million people worldwide require life support in ICUs
- ~25-65% of patients who require prolonged mechanical ventilation develop global and persistent muscle weakness
- ~1 million patients develop syndrome of ICU-acquired weakness (ICUAW) annually
  - ~30% of patients with single organ failure
  - 50-100% of patients with sepsis and multiple organ failure
- Weakness often lasts months-years after hospital discharge

Adhikari, Lancet ‘10; 376:1339; Kahn, NEJM ‘06; 355:41; Fan, AJRCCM ‘14;190:1437; Ali, AJRCCM ‘08; 178:261;
Muscle Weakness in Critically Ill Patients

- Skeletal muscle dysfunction common among persons with many chronic illnesses (COPD, CHF, renal failure etc.)

- ICU-acquired weakness:
  - Broad differential diagnosis
  - Critical illness neuromyopathy

- Immobility plays a significant role:
  - Muscle mass decreases by 1.5-2% per day
  - 3 -11% decrease in muscle strength for each day of bed rest in ICU (2yr f/u)
  - Weight bearing muscles (limb/torso) most affected
  - Alterations in anabolic/catabolic signaling

ICU-acquired Weakness is Associated with Poor Outcomes

- Increased duration of mechanical ventilation \(^1,^2\)
- Increased hospital/ICU length of stay \(^3,^4\)
- Prolonged physical symptoms/functional disability \(^5,^6\)
- Impaired quality of life \(^5\)
- Increased mortality \(^3,^7,^8\)
- Increased healthcare costs \(^8\)

Cognitive and Psychological Disorders Result from Critical Illness

- **Encephalopathy/sedation/sleep deprivation**
- **Delirium (19-80%)**
  - Decreased consciousness
  - Disorganized thinking
  - Delusions/hallucinations
- **Cognitive Impairment**
  (47% ARDS survivors @ 1 yr)
  - Memory and attention deficits
  - Processing
  - Impaired problem solving, decision making and executive function
- **Psychological Disturbances**
  - Anxiety
  - Fear
  - PTSD

Poor recall of events
Disturbing memories/nightmares
Poor understanding of limitations and rehabilitation needs
Difficulty mastering skills

Brummel, Crit Care Med ‘14; 42:369-77
Brummel, Crit Care Med ‘15; 43:1265-75
Wilcox, Crit Care Med ‘13; 41:S81-98
Parker, Crit Care Med ‘15; 43:1121-9
Goals of Early Mobilization in the ICU

- Maintenance of function
  - Prevention of weakness and comorbidities
- Restoration of function
- Prevention of adverse outcomes

- Early recognition of weakness (!)
- Rehabilitation intervention
Early Mobilization in the ICU

Needham D, JAMA ’08; 300:1685-90
Early Mobilization of Critically Ill Patients

- Feasible and safe 1-4
- Improves short-term outcomes 5-7
  - Improved exercise tolerance and physical function 1,2
  - Fewer days of delirium 1
  - Fewer ventilator-dependent days 5
  - Reduced ICU/hospital length of stay 8

36:2238-43.
<table>
<thead>
<tr>
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<th>Morris ‘08</th>
<th>Burtin ‘09</th>
<th>Schweickert ‘09</th>
<th>Needham ‘10</th>
<th>Dong ‘14</th>
<th>Brummel ‘14 (3 mo)</th>
<th>Kayambu ‘15</th>
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<td>Type of trial</td>
<td>Prospective cohort</td>
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<td>Intervention</td>
<td>Mobility team</td>
<td>Bedside cycling</td>
<td>PT/OT during awakenings</td>
<td>PT/OT/awakenings</td>
<td>Early mobilization</td>
<td>UC vs. PT vs. PT + Cog.</td>
<td>Early PT + EMS</td>
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<td>Patient “n”</td>
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Effect of Early Rehabilitation during ICU Stay on Functional Status

Systematic review and meta-analysis (6 trials), total 774 pts.  

Castro-Avila, Plos One ’15; 10(7)e013722
Current Shortfall in Rehabilitative Interventions

- Focus remains more on survivorship than on prevention +/- or Rx of functional impairment
- Rehabilitation often delayed until after critical illness or limited to range of motion and turning
- Inconsistent availability of rehab providers
- Lack of protocols for providing rehabilitation
  - Goal-oriented plan rarely developed
  - Communication across care providers limited
- Overall ICU Culture:
  - Functional impairment in critical illness inevitable
  - Patients are “too sick” to participate in/tolerate activity

Morris Crit Care Med ’08; 36:2238-43, Needham, J Crit Care ’07; 22:275-84
Physical Rehabilitation is Underutilized in the ICU

• 24% of 783 pts. on mechanical ventilation mobilized out of bed; 55% no mobilization other than turning

• 0% of 222 pts. on mechanical ventilation mobilized/stood/ambulated

• Exploratory study, 20 pts. on mechanical ventilation
  • Over 8 hrs observation:
  • Mean total 39 min activity per subject
  • All pts: > 3 turns in bed (11 min required for turn)
  • No pt had > 1 ROM (ave. 8 min); only 2 episodes sitting in chair
  • RN provided 147/196 of the activity events

A paradigm shift is needed.....

Barriers Rehabilitation of Critically ill Patients

- Conventional physical rehabilitation is complicated, effort-intensive
- Conventional PT requires resources: skilled personnel, equipment, time and costs
- Under-recognition/delayed identification of weakness, cognitive/psychological impairment
- Variable staff knowledge about feasibility and benefits of rehab, concern for pt safety
- Patient factors: pain, sedation, cog. impairment, delirium, procedures, lines, tubes, catheters, morbid obesity

Cross-sectional survey study of MICU physicians, nurses, physical therapists

Jolley, BMC Anesthesiology 2014; 14:84
Neuromuscular Electrical Stimulation (NMES)

- Skeletal muscle contraction elicited by delivering electrical impulses via surface electrodes applied on skin
- Can stimulate single muscle or several muscles simultaneously or sequentially
- NMES helps to preserve muscle mass\(^1\)-\(^3\) and strength\(^4\)-\(^6\) in critically ill patients
- Insufficient information regarding functional outcomes\(^7\),\(^8\)

How to Undertake Rehabilitation in the ICU

- Formal patient evaluation:
  - Medical, physical, psychological, cognitive
  - Multidisciplinary team

- Early recognition of weakness
  - Daily awakenings from sedation
  - Consider specialty consultations/testing
  - Adhere to ICU protocols

- Formulate individualized, goal-oriented rehab plan, clarify rehabilitation providers

- Systematic, progressive activity program
Early Mobilization Protocol at Yale New Haven Hospital

STEPS PROGRAM

- S - Sit on the edge of the bed
- T - Transfer to chair
- E - Exercise in bed & chair
- P - Position upright in chair
- S - Steps around the unit

Megan Panico M.D., Geoffrey Connors M.D.
The “ABCDE” Bundle for ICU Patients

- **A**: Awakening
- **B**: Breathing (coordination of awakening and breathing: daily sedation and ventilator removal trials)
- **C**: Choice of sedative and analgesic
- **D**: Delirium monitoring and management
- **E**: Early mobility and exercise

**Effectiveness of “ABCDE”**
- Prospective cohort before-after study (18 mo), 296 pts., 5 ICUs, 1SDU, 1 Onc unit
- Fewer days of mechanical ventilation
- Reduced risk of delirium (OR 0.55)
- Increased odds of mobilizing out of bed (OR 2.11)

Vasilevskis et al., Chest 2010; 138(5)1224-33  
Balas et al., Crit Care Med ‘14; 42:1024-36
Expert Consensus Recommendations for Early Mobilization

Hodgson, Critical Care ’14; 18:658

Low Risk of Adverse Event:

Cardiovascular:
- Satisfactory BP with minimal or no vasopressor requirement and/or no orthostatic hypotension

Respiratory:
- $\text{FIO}_2 \leq 60\%$; $\text{PEEP} \leq 10 \text{ cm H}_2\text{O}$, $\text{SaO}_2 \geq 90\%$, RR $\leq 30$

Neurologic:
- Alert or drowsy, responds to stimuli, no or minimal delirium

- Endotracheal tubes/tracheostomies, NGT, Central venous/arterial catheters, chest tubes or wound drains, urinary catheters do NOT preclude mobility

Complications of early mobilization for mechanically ventilated patients:
- --mean complication rate 3.9%
- --serious complications in 0.3%
- NO falls, cardiac arrest or death

(Nydahl, British Association of Critical Care Nurses, 2014, Systematic Review: 13 clinical trials, 3 reviews: 453 pts, 3613 mobilizations)
Rehabilitation Across the Trajectory of Illness and Recovery: From ICU to Home

• An under-studied, but important area!
• Three RCT have not shown substantial clear benefits in the rehabilitation intervention group \(^1,^2,^3\)
  
  • Single center, 150 ICU pts. UC vs. ICU rehab followed by ward (1 hr daily) then outpatient (1 hr 2X/wk for 8 wk) \(^1\)
    
    • No difference in 6MWT, TUG, QOL at 6 or 12 mo
  
  • Multi-center trial, UC vs. 8 week home based rehab in 195 survivors of critical illness after hospital d/c; focus on walking and strength training \(^2\)
    
    • Both groups had improvement in 6MWT and PF scores at 8 wk that lasted at 26 wk; no difference between groups
  
  • Parallel group RCT, 240 ICU pts ≥ 48 hr MV, intensive individualized post ICU d/c rehab vs. UC; 3, 6, 12 mo outcomes→improved pt satisfaction \(^3\)
    
    • No difference in QOL, TUG, handgrip strength, mobility index, fatigue, pain, dyspnea

1. Denehy, Crit Care ‘13; 17:R156; 2. Elliott D, Crit Care ‘11; 15;R142; 3. Walsh, JAMA Intern Med ‘15; 175(6)901-10
Improving Long-term Outcomes: Focus on Transitions of Care

- Multidisciplinary collaboration and coordination of staff
  - Integral role for nurses, physiotherapists, case manager/care coordinator

- Detailed and accurate information transfer
  - Written and verbal communication
  - Medications, equipment, safety, O2, psychosocial and physical issues
  - Inter-facility transfer form, d/c summary, arranged follow-ups

- Consider rehabilitation needs
  - Medical issues, physical function, rehab tolerance, psychological issues

- Assess patient, define goals/intervention at each stage of illness
  - Address barriers to function and practice problem solving skills
  - Reassess/modify until goals achieved

- Engage patients: enable stronger sense of control over their health

- Engage family members/caregivers

- Consider vocational, leisure issues, promote community-based physical activity, address community support

Areas for Future Study

• Pathophysiology and optimal medical management of ICU-acquired weakness
• Optimal timing, content and processes of ICU rehabilitation
• Metabolic/physiologic costs/effects and safety of training
• Establish metrics for measures of function (eg. strength, joint mobility, balance, ADLs) to guide early mobilization
• Impact of cognitive and psychological impairment on rehabilitation outcomes
• Impact of early mobilization on infections, DVT, readmissions
• Impact of rehabilitation across trajectory of illness on long-term outcomes, including recovery to independent living, cognitive and psychological outcomes, return to work and recreational activities

Additional clinical trials are awaited!
Thank You For Your Attention!