Entering the ICU: Rehabilitation Begins Early

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Presentation outline

• The Need & Benefits of early rehabilitation in the ICU
• Basic components of ICU rehabilitation
• Barriers to early rehabilitation in the ICU
• Conclusion
MCQ 1.

Why are you attending this course?

a) It’s 2 days off ward work

b) Everyone else is attending so I follow

c) I hope to learn something of value for my clinical practice

d) Others
ICU Intensive Care is Doing a Great Job!

• In the USA, >50% of the estimated 790,000 patients hospitalized and mechanically ventilated in 2005 survived.

• In Aust and New Zealand, from 2000-2012: 101,064 patients with severe sepsis from 171 ICUs showed absolute mortality decreased from 35.0% to 18.4% ($P < .001$),

• By 2008 there were more than 1 million admissions for severe sepsis alone (USA).

• Annual number of 3-year survivors of severe sepsis increase 119% from 1996 to 2008 to the same public health-scale as of breast cancer.

→ the issues of post ICU survivalship are more and more significant

What are some broad categories of post-ICU care complications that you are aware of?

a) Physical- ICU associated weakness

b) Psychological- depression, PTSD

c) Cognitive- delirium, persistent cognitive deficits

d) All of the above
Significant Musculoskeletal and Neurological Weakness

Intensive care unit–acquired weakness (ICUAW)
• May occur in 25% of patients requiring mechanical ventilation for >1 week.
• Lengthens intubation period 2-7x.
• Independently associated with increased mortality.

Mechanisms:
• Prolonged bed rest and immobility → deconditioning and disuse atrophy
  • Critical illness polyneuropathy (CIP),
  • Critical illness myopathy (CIM),
  • or a combination of these conditions,
  → critical illness neuromyopathy (CINM),
  • or prolonged neuromuscular blockade.

• Intensive insulin therapy has been shown to be of benefit to reduce CIP/CIM.
• Corticosteroids are not shown to be significantly effective.
The prevalence of clinically significant depressive symptoms among a cohort of 1213 ICU survivors from 14 studies was 28%.

Five years post-ICU discharge, mean 6 min walk test distance was 476 metres (76% of predicted) for 109 ICU survivors of ARDS with median ICU stay of 25 days. 33% had not returned to work at 5 years post-ICU.

40-50% mortality within 12 months of an ICU admission occurs post-ICU.

The prevalence of clinically significant depressive symptoms 28% amongst a cohort of 1213 ICU survivors from 14 studies.
Post-Intensive Care Syndrome (PICS)

→ new or worsening impairments in physical, cognitive, or mental health status arising after critical illness and persisting beyond acute care hospitalization.

The term could be applied to a survivor (PICS) or family member (PICS-F).
Benefits of Early Rehabilitation

1. Decreased duration of mechanical ventilation.
   - Positive impact on depression, anxiety, and PTSD through reduced duration of mechanical ventilation.
   - Potentially decreased LOS both in ICU and hospital.

2. Lower odds of readmission or death at one year post ICU.

3. Improved outcomes after hospital discharge.
   - Better effort tolerance, better cognitive function.

<table>
<thead>
<tr>
<th>Study</th>
<th>Study Design (N= subjects)</th>
<th>Levels of Evidence (Sackett)</th>
<th>Physical Therapy Interventions</th>
<th>Functional Outcomes</th>
<th>Other notable findings</th>
</tr>
</thead>
<tbody>
<tr>
<td>Martin UJ. 2005²⁵</td>
<td>Retrospective</td>
<td>4</td>
<td>Treatment group underwent UE/LE therapy ex., trunk control tasks; cycle ergometry, inspiratory muscle training, and functional training x 5 days/week</td>
<td>Increased UE/LE strength as measured on 5 point scale; increased inspiratory muscle force (maximal NIF)</td>
<td>N/A</td>
</tr>
<tr>
<td>Chiang L.L. 2006²³</td>
<td>Prospective</td>
<td>2B</td>
<td>Treatment group underwent UE/LE therapy ex., breathing retraining ex., and functional training x 5 days/week x 6 weeks</td>
<td>Increased UE/LE strength (hand-held dynamometry) and respiratory muscle force (P_{\text{max}} &amp; P_{\text{max}})</td>
<td>N/A</td>
</tr>
<tr>
<td>Bailey P. 2007²²</td>
<td>Prospective</td>
<td>4</td>
<td>Twice daily PT/ activity session</td>
<td>N/A</td>
<td>N/A</td>
</tr>
</tbody>
</table>

- **Strength/ ROM**
  - Increased UE/LE strength as measured on 5 point scale.
  - Increased inspiratory muscle force.
- **QOL**
  - N/A
- **Mobility**
  - All patients bedridden initially; Following rehab program, patients demonstrated higher scores on FIM for supine <-> sit and sit <-> stand but no differences for ambulation/ stairs.

- **Other notable findings**
  - Setting is a post intensive care unit (vent rehab unit; MV > 14 days).
  - Negative correlation between UE strength at admission and weaning duration.
  - No control group.
  - Setting is a post-ICU.
  - Median MV days > 46.
  - May not be applicable to acute care/ ICU.
  - Increased ventilation time in treatment group.
  - Moderate correlation bw/ limb strength and ADL, performance and mobility.
  - Impaired cognitive status at a baseline.
  - Improved cognitive status throughout intervention period.
  - Small sample size.
  - Study provides criteria (neurologic/ circulatory/ respiratory) for initiating mobility.
  - Study verifies that early mobilization of ICU patients can be achieved.
  - Increased number of co morbid conditions did not influence ambulatory status.
  - Ambulation distance at ICU discharge may predict post-acute d.c. destination.
  - No control group for comparison.
<table>
<thead>
<tr>
<th>Study</th>
<th>Design</th>
<th>Participants</th>
<th>Intervention</th>
<th>Outcome Measures</th>
<th>Findings</th>
</tr>
</thead>
<tbody>
<tr>
<td>Thomsen GE. 2008&lt;sup&gt;24&lt;/sup&gt;</td>
<td>Prospective One-group pretest-posttest design</td>
<td>[N = 104 patients (91 Survivors)]</td>
<td>Functional mobility training (ROM; sitting at edge of bed and OOB; ambulation)</td>
<td>N/A</td>
<td>More advanced mobilization activities (OOB transfers &amp; sitting; ambulation) increased within 24 hours of transfer to the unit where mobilization is emphasized</td>
</tr>
<tr>
<td>Schweickert WD. 2009&lt;sup&gt;20&lt;/sup&gt;</td>
<td>Prospective RCT</td>
<td>(N=104; all patients completed study)</td>
<td>Treatment group underwent progressive UE/LE ther ex., trunk control/ balance activities and functional training including ADL's x 7 days/week</td>
<td>No difference in UE/LE strength as measured by MRC or hand grip</td>
<td>Increased % of intervention group returned to functional baseline as defined by FIM and Barthel Index and had greater unassisted walking distance at hospital d.c.</td>
</tr>
<tr>
<td>Burtin C. 2009&lt;sup&gt;21&lt;/sup&gt;</td>
<td>Prospective RCT</td>
<td>(N = 90 enrolled; 67 completed) (36 control; 31 treatment group)</td>
<td>Both groups received UE/LE ther ex and functional training x 5 days/week treatment group had additional cycling session x 20 minutes total duration x 5 days/week</td>
<td>Hand held dynamometry; no difference in quadriceps muscle force at ICU d.c., but increased quadriceps muscle force noted at hospital d.c.; No difference in hand grip strength at either time point</td>
<td>Improved QOL (SF-36 PF) at time of hospital d.c. No differences at time of discharge from ICU. Treatment group had increased 6 MWT distance and at time of hospital discharge</td>
</tr>
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</table>

**Findings:**
- Mean distance of ambulation at d.c. was > 200 feet
- Sedatives, even intermittent sedation administration decreased likelihood of ambulation
- Female gender and reduced illness severity (ie, APACHE score) associated with greater ambulation
- Early mobilization associated with reduced incidence of delirium and ventilator free days
- MV did not preclude acquisition of mobility milestones
- Study included performance of ADL's 87% of therapy sessions completed
- No differences in ICU or hospital length of stay
- No difference in ICU-acquired weakness
- Moderate correlation between quadriceps strength and 6 MWT and SF-36
- Trends noted for proportion of patients who were ambulatory and/or discharged home (study not adequately powered)
- No differences in ability to transfer from sit-stand or ambulate independently between groups
- No differences in weaning time, length of ICU or hospital stay

<table>
<thead>
<tr>
<th>Study</th>
<th>Design</th>
<th>Case Control/Retrospective</th>
<th>N</th>
<th>Mobilization Program</th>
<th>Patient Participation</th>
<th>Additional QOL Goals Accomplished</th>
</tr>
</thead>
<tbody>
<tr>
<td>Needham DM 2010*</td>
<td>Prospective QI project</td>
<td>Case controlled (N = 57 total (27 pre QI; N = 30 post QI))</td>
<td>N/A</td>
<td>Functional mobility training (supine to sit; sitting at edge of bed; OOB transfers; ambulation)</td>
<td>N/A</td>
<td>Increased number of PT/OT consults &amp; interventions; reduction in missed PT/OT sessions; reduced use of sedative drugs; increased alertness with reduced delirium; reduced ICU and hospital LOS</td>
</tr>
<tr>
<td>Morris PE 2011**</td>
<td>Retrospective cohort analysis of survivors from prior study*** (see Morris 2008)</td>
<td>N = 258 of 280 survivors of acute respiratory failure</td>
<td>N/A</td>
<td>Mobilization program implemented 7 days/week by “mobility team” consisting of PT, critical care RN and nursing assistant</td>
<td>Patient participation in an ICU mobilization program was associated with reduced hospital readmission or death in the year following hospitalization</td>
<td>&gt;50% of survivors will have a readmission or die in the year following hospitalization</td>
</tr>
<tr>
<td>Montagnani G 2011**</td>
<td>Retrospective Non-equivalent Pretest-Posttest Control Group Design</td>
<td>N = 56 weaning program (WP); N = 63 pulmonary rehab (PR)</td>
<td>N/A</td>
<td>WP patients performed UE/LE ther. ex including UE/LE cycling and mobilization 6 days/week; PR subjects exercise on treadmill/UE/LE ergometer and low intensity PRE’s daily x 15-21 days</td>
<td>Dyspnea scores declined in both groups</td>
<td>Both groups demonstrated improvement in FIM scores</td>
</tr>
</tbody>
</table>

PT = physical therapy, OT = occupational therapy, MV = mechanical ventilation, NIF = negative inspiratory force, QOL = quality of life, N/A = not applicable

FIM = functional independence measure, PImax = peak inspiratory pressure, PEmax = peak expiratory pressure, HR = heart rate, ICU = intensive care unit

D.C. = discharge, c/o = complaints of, s/p = status post, OOB = out of bed, RN = nurse, RCT = randomized controlled trial, LOS = length of stay

APACHE = acute physiology and health evaluation score, 6MWT = six minute walk test, MRC = Medical research council SF-36 = short form health survey
Benefits of Early Rehabilitation

- 2-site RCT of 104 mechanically ventilated patients receiving very early PT and OT started at the beginning of respiratory failure.
- Both intervention and usual care groups received daily sedation interruption and daily spontaneous breathing trials.
- Participants in the intervention group received progressive mobilization and activities of daily living interventions started at 1.5 days after intubation (vs 7.3 days in the usual care group, P < .01).
- Results: Better outcomes at hospital discharge, including return to independent function (59% vs 35%, P < 0.02), physical function (median Barthel Index 75 vs 55, P < 0.05), and ventilator-free days (median 23.5 vs 21.1, P < 0.05).

Presentation outline

• Benefits of early rehabilitation in the ICU
• Basic components of ICU rehabilitation
• Barriers to early rehabilitation in the ICU
• Conclusion
Components of ICU rehab- The Team

• A team: PTs and OTs, rehabilitation physicians, critical care physicians, nurses, nursing assistants, and respiratory therapists.

• Generally, one PT + one nursing attendant + one respiratory therapist needed to mobilise one patient

• Rehab Med/Intensivists need to identify suitable patients for therapy, plan goals of treatment, observe and deal with adverse events and plan for post ICU rehab.
Components of ICU rehab- The Equipment

- Basic Equipment: Portable ventilator (or Ambu bag with oxygen supply), a wheeled walker and a wheelchair.

For Sedated/ Non-responsive patients:
- A cycle ergometer - stationary cycling device used to passively mobilize limbs in patients who are sedated or non-responsive.
  - Improvement in muscle strength, 6-min walk distance and QOL at hospital discharge. (Burtin et Al, Crit Care Med 2009)
- Neuromuscular electrical stimulation generates passive muscle contraction through skin electrode stimulation of specific muscle groups
  - Increase in quadriceps muscle thickness in patients who were on mechanical ventilation >2 weeks + lower incidence of ICU-acquired weakness compared with standard care.
Components of ICU rehab - The Equipment

- Fixed and dynamic tilt tables - facilitates weight bearing to maintain LL strength and reduce ankle contractures.

Exclusion criteria
- ICP > 20
- Active BGIT
- Active MI
- Unsecure airway
- Rapidly dev NMD
- Mental state: agitation or comatose
- Med/ surg status necessitating immobility
- Comfort measure

Criteria to Initiate ICU Rehab

Neurologic Criteria
• Cooperative & follow commands
• RASS > -3

Respiratory Criteria
• PEEP < 10 cmH2O, FiO₂ < 0.6 (consult team if pt on higher support)
• SpO₂ > 88%, RR < 40, PF ratio > 100

Hemodynamic Criteria
• HR 50-125, MAP 60-100, SBP 90-180,
• no new arrhythmias
• Consult team for pt on vasoactive meds
• Hb > 7 / Plt > 20k

Absence of exclusion criteria
MCQ 3.

You are performing morning rounds in the ICU. Patient A is a 65yr old gentleman, D2 ICU, admitted for ARDS secondary to severe community acquired pneumonia.  
Past med hx: 1. Hypt, 2. IHD with BMS to LAD and Lcx 2yrs ago, 3. OA knees.  

On examination, pt opens eyes to calling for >10s. Can follow simple commands.  
Afebrile, BP 96/64 (MAP 65) (On noradrenaline 10mcg/min since yesterday), PR 105/min, SpO2 92% on AC (FiO2 40%, RR 12, Vt 380, PEEP +5).  
Femoral line site- no phlebitis.  

Is this patient ready for referral for early mobilization?  
a) Yes  
b) No
Rehabilitation Protocol

• Individualized treatment plan

• Mode & intensity of exercise will be guided by a multisystem assessment (respiratory, cardiovascular, neurological, and musculoskeletal systems)

• Typically last 20-40 minutes

• Predominantly used functional activities- arm & leg ROM while lying in bed/ sitting or standing or walking slowly
  - Any change in ventilator setting to facilitate exercise tolerance will need to be communicated *a priori* Pre & post activity rest period with Assist Control ventilation for 30min, incr FiO₂ by 0.2 before initiation of activity (Bailey 2007)
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Barriers to ICU Rehabilitation

The incidence of reported adverse events associated with early progressive mobilization of ICU patients is low (≤4%).

Identified barriers to initiating ICU rehab:
• Patient-related,
• Structural,
• ICU cultural,
• Process-related barriers.


<table>
<thead>
<tr>
<th>Study</th>
<th>Design</th>
<th>Frequency</th>
<th>Both Groups Received</th>
<th>Treatment Group</th>
<th>Overall, No Adverse Medical Consequences</th>
</tr>
</thead>
<tbody>
<tr>
<td>Burtin C. 2009&lt;sup&gt;2&lt;/sup&gt;</td>
<td>Prospective RCT</td>
<td>2B 5 days/week</td>
<td>Both groups received: Upper extremity ther. ex. Lower extremity ther. ex. Functional training. <strong>Treatment group:</strong> Additional cycling session x 20 minutes daily.</td>
<td>425 total exercise sessions • 16 sessions (&lt;4%) terminated due to desaturation &lt;90% or HTN; • 3 subjects withdrawn: ◦ Achilles tendon rupture (x1) ◦ Cardiorespiratory instability (x2)</td>
<td></td>
</tr>
<tr>
<td>Schweickert WD. 2009&lt;sup&gt;2&lt;/sup&gt;</td>
<td>Prospective RCT</td>
<td>1B 7 days/week</td>
<td>Treatment group: Progressive UE/LE ther ex.; Trunk control/ balance activities Functional training including ADL’s</td>
<td>498 PT/OT sessions: • 1 desaturation &lt;80% • 1 radial artery line removed • PT/OT was discontinued during 19 sessions (4%) for perceived patient-ventilator asynchrony</td>
<td><strong>Overall, no adverse medical consequences</strong></td>
</tr>
<tr>
<td>Pohlin MC. 2010&lt;sup&gt;2&lt;/sup&gt;</td>
<td>Retrospective Descriptive study/ case series using data from prior study (see Schweickert above)</td>
<td>4 As noted above</td>
<td>In patients receiving MV, the primary reasons for missed therapy session: • MV asynchrony (&lt;4%) • MAP &lt;65 mm Hg (&lt;1%) • Vasoactive medication (&lt;1%) • Active CIB (&lt;1%)</td>
<td>PT/OT sessions were terminated due to • Desaturation &gt;5% (6%) • HR &amp; MV asynchrony (4%) • Agitation/discomfort (2%) • Device/line removal (&lt;1%)</td>
<td><strong>Overall, no adverse medical consequences</strong></td>
</tr>
<tr>
<td>Zanni JM. 2010&lt;sup&gt;2&lt;/sup&gt;</td>
<td>Prospective Pilot Project One-group pretest-posttest design</td>
<td>4</td>
<td>Observational report to define patient profiles and therapy services in ICU: • consult &amp; treatment frequency • mobility/ADL’s • ROM/ strength • patient safety</td>
<td>50 reviewed PT/OT session with 19 patients</td>
<td><strong>Overall, no serious adverse medical consequences</strong></td>
</tr>
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</table>
## Patient related barriers and strategies

<table>
<thead>
<tr>
<th>Barrier</th>
<th>Strategies</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hemodynamic instability, arrhythmias</td>
<td>Stepwise approach to mobilization; Avoid mobilization until 2 hours after increase in vasopressor dose,</td>
</tr>
<tr>
<td>Respiratory instability/distress, ventilator asynchrony</td>
<td>Stepwise approach to mobility including a safety check after each step; protocol for standardized mobilization FiO2 &lt;0.6 before starting</td>
</tr>
<tr>
<td>Deep sedation and/or paralysis</td>
<td>Perform routine assessments of sedation and pain; target lighter sedation goals;</td>
</tr>
<tr>
<td>Patient refusal, lack of motivation, anxiety</td>
<td>Adjust treatment plan with patient input; provide patient education and encouragement</td>
</tr>
<tr>
<td>Barrier</td>
<td>Strategies</td>
</tr>
<tr>
<td>------------------------------------------------------------------------</td>
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<tr>
<td>Hemodynamic monitoring equipment</td>
<td>Use portable monitors; secure application of equipment and lines</td>
</tr>
<tr>
<td>ICU-related devices</td>
<td>Secure lines/tubes/drains; Pre-mobility planning; strategic choice of catheter insertion location</td>
</tr>
<tr>
<td>Lack of early mobility program/protocol (e.g. no routine delivery of PT), too many existing protocols, limited guidelines, no eligibility criteria</td>
<td>Development of protocols; Evaluation and feedback to medical team</td>
</tr>
<tr>
<td>Lack of mobility culture (e.g. inadequate staff buy-in, lack of multidisciplinary culture)</td>
<td>Interprofessional champions; promotion of mobility programs ; Physician support</td>
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<tr>
<td>Lack of patient/family knowledge</td>
<td>Media engagement and education</td>
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<tr>
<td>Barrier</td>
<td>Strategies</td>
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<tr>
<td>Lack of planning and coordination</td>
<td>Regular screening for appropriate patients; interprofessional planning and</td>
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<td></td>
<td>coordination of procedures; daily goal sheets with reminder about mobility;</td>
</tr>
<tr>
<td>Missing/delayed daily screening for eligibility, and standing bedrest</td>
<td>Mobility team; automatic therapy order; Daily screening for eligibility</td>
</tr>
<tr>
<td>order</td>
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<tr>
<td>Risks for mobility providers (stress, injuries)</td>
<td>Training, defining roles and responsibilities, screening staff risks, use</td>
</tr>
<tr>
<td></td>
<td>of appropriate equipment,</td>
</tr>
</tbody>
</table>
Conclusion

1. ICU admission may be associated with significant post-ICU weakness, disability and loss of function.

2. Early rehabilitation and mobilization in ICU may reduce the duration of mechanical ventilation, LOS in ICU and hospital and ultimately lead to improved outcomes post-discharge.

3. These interventions are safe if done properly, with appropriate level of care and equipment.
MCQ 4.

Who gave the best teaching this morning?

a) I agree it was Rehab Med Dept

b) Surely it was the Rehab Med Dept

c) Rehab Med Dept definitely

d) All of the above