Beyond Survival: Preventing long-term complications of ICU Survivors

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Conflicts of Interest

• No conflicts to declare
Case Presentation

- 39 yr old presents to emergency with “The Flu”
  - Day 0: Initially admitted to ward with CAP. Treated with antibiotics and oxygen.
  - Day 3: Weaned off vasopressors.
  - Day 5 to 8 – Sedatives discontinued. Patient became agitated and confused so sedatives restarted each day.
  - Day 9 – Sedatives discontinued. Patient extubated.
Day 14 – Tracheostomy. Urine output returned and renal function improved.

Day 19 – Liberated from the ventilator.


Day 41 – Tracheostomy discontinued.

Day 45 – Transfer to Rehab

Day 60 – Discharged home. Still weak but able to walk independently

1 Year post presentation – Still weak, easily fatigued. Starting to go back to gym but having difficulty with exercise endurance. Not back at work.
Things to Consider

• Successful Outcome?
• What will be her long-term outcome?
• Are some of the complications seen preventable?
Typical ICU timeline for ARDS patients

Day

0  2  4  6  8  10  12  14  16  18  20  22

- Admit to Hospital, Pneumonia
- Mechanical Ventilation
- Corticosteroids
- Heavy Sedation
- Extubation
- Rehab Consult
- Transfer to ward
- Discharge to Rehab
- Rehab Therapy

Dale Needham, 2011
Objectives

• Describe the long-term physical, cognitive and psychological consequences of critical illness

• Review preventative strategies to optimize long-term outcomes in ICU

Questions

1) What are long-term outcomes of critical Illness?
2) Why do survivors have poor outcomes?
3) How can we improve our patients outcomes?
1) What are the long-term Outcomes of ICU survivors?

- Physical
- Cognitive
- Mental Health
Physical Outcomes
Immediately after ICU discharge

- Prospective study of functionally normal patient prior to ICU
- 69 survivors with LOS > 48hrs
- Evaluated 3 – 7 days post ICU d/c


Percent of patients

Unable to walk or requires >=2 person assist: 39%
Walks with heavy 1 person assist: 17%
Walks with moderate 1 person assist: 7%
Walks with stand-by assist: 10%
Walks independent on flat surface: 14%
Walks independent anywhere: 11%
Physical Outcomes Following Hospital Discharge

- 116 patients
- Ventilated for >48 hours
- Evaluated at 3 and 12 mo
- At one year only 42% of the previously employed people returned to work

Physical Long-term Outcomes

• 109 Canadian ARDS survivors
• Median Age - 45 years
• Median APACHE II - 23
• Median ICU los - 25 days
ARDS Cohort Outcomes
Physical Long-term Outcomes

- At 1 year back to baseline weight and essentially normal PFT
- At 1 year, all patients report fatigue, weakness or neuromuscular complaints
- Below average 6 minute walk and Physical component of Quality of life measures at 1 and 5 years
- Return to work – 49% at one year, 77% at 5 years

Herridge et al (2011) NEJM
Psychological Sequela of Critical Illness
Mental Health Outcomes

Prevalence:

- Depression 25 – 50% ¹
  (Prevalence will decrease over the first year)
- Anxiety 23-41% ²
- PTSD 8-27% ³,⁴
- Irritability
- Social isolation

¹ Davydow et al. Intensive Care Med.. 2009
² Myhren et al. Crit Care. 2010
⁴ Davydow et al. Gen Hosp Psych. 2008
Poor Cognitive Outcomes of ICU survivors

5% to 78% of patients have long-term cognitive impairment following critical illness.

Evidence of Poor Physical Outcomes

*Herridge, MS et al: One-year Outcomes of Survivors of the Acute Respiratory Distress Syndrome. NEJM. 2003; 348:8
Angus DC et al. Quality – adjusted survival in the first year after the acute respiratory distress syndrome. AJRCCM 2001;163:1389 – 94.
*Chelluri L et al. Long-term mortality and quality of life after prolonged mechanical ventilation. CCM. 2004; 32(1)
*Heyland DK et al Survivors of acute respiratory distress syndrome: Relationship between pulmonary dysfunction and long term health-related quality of life. CCM; 2005:33(7)
Davidson TA et al. Reduced quality of life in survivors of acute respiratory distress syndrome compared with critically ill control patients. JAMA. 1999;281(4)
Fletcher SM et al. Persistent neuromuscular and neurophysiologic abnormalities in long-term survivors of prolonged critical illness. CCM. 2003;31(4)

ICU SURVIVAL  \rightarrow  LONG-TERM IMPACT
“Gifted a second chance at life, how is it possible that so many feel lost between feeling grateful and hopeless”
Improving long-term outcomes after discharge from intensive care unit: Report from a stakeholders’ conference*

Dale M. Needham, MD, PhD; Judy Davidson, DNP, RN; Henry Cohen, PharmD; Ramona O. Hopkins, PhD; Craig Weinert, MD, MPH; Hannah Wunsch, MD, MSc; Christine Zawistowski, MD; Anita Bemis-Dougherty, PT, DPT; Susan C. Berney, PT, PhD; O. Joseph Bienvenu, MD, PhD; Susan L. Brady, MS; Martin B. Brodsky, PhD; Linda Denehy, PT, PhD; Doug Elliott, RN, PhD; Carl Flatley, DDS; Andrea L. Harabin, PhD; Christina Jones, RN, PhD; Deborah Louis, RN; Wendy Meltzer, JD; Sean R. Muldoon, MD, MPH, MS; Jeffrey B. Palmer, MD; Christiane Perme, PT, CCS; Marla Robinson, OTR/L, MSc, BCPR; David M. Schmidt, MD, PhD; Elizabeth Scruth, RN; Gayle R. Spill, MD; C. Porter Storey, MD; Marta Render, MD; John Votto, DO; Maurene A. Harvey, RN, MPH, FCCM

Crit Care Med 2012 Vol. 40, No. 2

• “Post Intensive Care Syndrome” defined
• Called for recognition and further research into long-term impact of critical illness and ICU stay on patients and families
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

Post Intensive Care Syndrome

Patients (PICS)
- Mental Health
  - Anxiety
  - PTSD
  - Depression
- Cognitive Impairment
  - Executive function
  - Memory
  - Attention
  - Visuo-spatial
  - Mental Processing Speed

Physical Impairments
- Pulmonary
- Neuromuscular
- Physical function

Family Members (PICS-F)
- Mental Health
  - Anxiety/ASD
  - PTSD
  - Depression
  - Complicated Grief

Needham et al. CCM (2012)
Why do ICU survivors have poor long-term outcomes?
Weakness associated with Critical Illness
Pathophysiology of physical outcomes

Weakness 2° Deconditioning

- Common
- Mechanical unloading of muscles causes atrophy.
- Bed rest associated with loss of muscle mass 1% to 2.5% per day
- Weakness can be demonstrated after 1 – 2 days of Mechanical ventilation
- Process increased in elderly and acute inflammatory states

ICU Acquired Weakness (ICU-AW)

- AKA: ICU neuropathy/myopathy
- Nerve and muscle dysfunction due to:
  - Mechanical unloading
  - Inflammation
  - Oxidative stress
  - Nutritional deficits
- 25-75% of ICU patients
- May take months to reverse

Kress & Hall (2014) NEJM.
Critical Illness and ICU can be Stressful

Frequent Sources of Stress for Patients:

- Pain
- Thirst
- Inability to Communicate
- Lack of Control
- Delirium
- Lack of Sleep
- Noise
- Fear of Death

Rotondi et al (2002) CCM.
Barr et al (2013) CCM.
Delirium in the ICU is Common

- Medical ICU: 40 – 80%
- Mechanically ventilated patients: 60 – 80%
- Mixed ICU: 10 – 40%

Fig. 1. Lorazepam and the probability of transitioning to delirium. The probability of transitioning to delirium increased with the dose of lorazepam administered in the previous 24 h. This incremental risk was large at low doses and plateaued at around 20 mg/day.
Delirium is distressing

Theoretical model of PTSD in ICU survivors

Pathogenesis

**pre-ICU (baseline) risk factors**
- female sex, younger age, less education
- trait anxiety, pessimism
- depression, anxiety, other psychiatric morbidity

**critical illness/ICU risk factors**
- high-dose benzodiazepines/opiates
- stressful ICU experiences, including nightmares, hallucinations, and delusions, severe pain, and shortness of breath
- agitation, physical restraint
- type of illness (ALI/ARDS, septic shock)
- longer stays (esp. with ALI/ARDS)

**ICU protective factors**
- stress-dose corticosteroids (sepsis, ARDS)
- social support
- psychological intervention

**post-ICU risk factor**
- early psychiatric distress/PTSD symptoms
- less adaptive coping

**post-ICU protective factor**
- ICU diary

↑

Beinvenu (2014) Personal Communication
Poor Cognitive Outcomes
Pathogenesis

Fig. 1. Relationships between critical illness and outcomes.

How can we improve our patients’ long-term outcomes?
Addressing Pain, Agitation and Distress
Optimizing Patient Outcomes

Pain
- Routine Pain assessment using validated pain score
- Treat pain
- Analgesia first sedation second strategy

Sedation
- Light sedation preferred over Deep sedation
- Use of Sedation Scores
- Use Strategies to minimize over-sedation
- Non-benzodiazepine sedation preferred

Delirium
- Routine delirium assessment
- Delirium prevention strategies
Monitoring Pain in ICU
Optimizing patient Outcomes

- Vitals are insufficient for assessing pain
- Non-verbal pain scores validated in ICU patients
  - Critical Care Pain Observational Tool (CPOT)
  - Behavioral Pain Scale (BPS)

### Behavioral Pain Scale (BPS)

<table>
<thead>
<tr>
<th>Item</th>
<th>Description</th>
<th>Score</th>
</tr>
</thead>
<tbody>
<tr>
<td>Facial expression</td>
<td>Relaxed</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>Partially tightened (e.g., brow lowering)</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>Fully tightened (e.g., eyelid closing)</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>Grimacing</td>
<td>4</td>
</tr>
<tr>
<td>Upper limb movements</td>
<td>No movement</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>Partially bent</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>Fully bent with finger flexion</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>Permanently retracted</td>
<td>4</td>
</tr>
<tr>
<td>Compliance with</td>
<td>Tolerating movement</td>
<td>1</td>
</tr>
<tr>
<td>mechanical ventilation</td>
<td>Coughing but tolerating</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>Fighting ventilator</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>Unable to control ventilation</td>
<td>4</td>
</tr>
</tbody>
</table>

**Critical Care Pain Observation Tool** *(For patients unable to give a numerical pain score. Score out of 8.)*

<table>
<thead>
<tr>
<th>Category</th>
<th>Score</th>
</tr>
</thead>
<tbody>
<tr>
<td>Face Expression</td>
<td></td>
</tr>
<tr>
<td>Relaxed, neutral</td>
<td>0</td>
</tr>
<tr>
<td>Tense</td>
<td>1</td>
</tr>
<tr>
<td>Grimacing</td>
<td>2</td>
</tr>
<tr>
<td>Body Movements</td>
<td></td>
</tr>
<tr>
<td>Absent of movements or normal position</td>
<td>0</td>
</tr>
<tr>
<td>Protective movements</td>
<td>1</td>
</tr>
<tr>
<td>Restlessness, agitation</td>
<td>2</td>
</tr>
<tr>
<td>Compliance with ventilator</td>
<td></td>
</tr>
<tr>
<td>Tolerating ventilator</td>
<td>0</td>
</tr>
<tr>
<td>Coughing</td>
<td>1</td>
</tr>
<tr>
<td>Asynchrony</td>
<td>2</td>
</tr>
<tr>
<td>Vocalization (only if extubated)</td>
<td></td>
</tr>
<tr>
<td>Talking in normal tone or no sound</td>
<td>0</td>
</tr>
<tr>
<td>Sighing, moaning</td>
<td>1</td>
</tr>
<tr>
<td>Crying out, sobbing</td>
<td>2</td>
</tr>
<tr>
<td>Muscle Tension</td>
<td></td>
</tr>
<tr>
<td>Relaxed</td>
<td>0</td>
</tr>
<tr>
<td>Tense</td>
<td>1</td>
</tr>
<tr>
<td>Rigid</td>
<td>2</td>
</tr>
</tbody>
</table>

BPS score ranges from 3 (no pain) to 12 (maximum pain).
Monitoring Sedation Level in ICU
Optimizing Patient Outcomes

<table>
<thead>
<tr>
<th>Score</th>
<th>Term</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>+4</td>
<td>Comatose</td>
<td>Overtly combative, violent, immediate danger to staff</td>
</tr>
<tr>
<td>+3</td>
<td>Very agitated</td>
<td>Pulls or removes tube(s) or catheter(s); aggressive</td>
</tr>
<tr>
<td>+2</td>
<td>Agitated</td>
<td>Frequent nonpurposeful movement, fights ventilator</td>
</tr>
<tr>
<td>+1</td>
<td>Restless</td>
<td>Anxious but movements not aggressive or vigorous</td>
</tr>
<tr>
<td>0</td>
<td>Alert and calm</td>
<td>Not fully alert, but has sustained awakening (eye opening/eye contact) to voice</td>
</tr>
</tbody>
</table>
Minimizing Excessive Sedation
Optimizing Patient Outcomes

- Pairing DAT with daily assessment for SBT increasing ventilator free days
  (14.7 vs 11.6 days, p=0.02)\(^a\)

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\(Strom et al.\) *Lancet.* 2010; 275:475-480
\(^a\) *Girard et al.\) *Lancet.* 2008; 371;126-134.
Screening for Delirium in ICU
Optimizing Patient Outcomes

ICDSC
- Checklist with 7 features
- >= 4 suggestive of delirium
- Subsyndromal delirium

CAM - ICU
- Assesses acuity, inattention, altered LOC and disorganized thinking
- Positive or negative
Delirium Prevention
Optimizing Patient Outcomes

- Analgesia and Sedation Management
  - Target pain management
  - Avoid benzodiazepines (Propofol and Dexamethasone)
  - Minimize excess sedation

- Early Mobility

- Promote Sleep

- Avoid unnecessary deliriogenic medication

- Optimize environment and sensory input

Brummel et al. CCM (2013).
Early physical and occupational therapy in mechanically ventilated, critically ill patients: a randomised controlled trial

William D Schweickert, Mark C Pohlman, Anne S Pohlman, Celerina Nigos, Amy J Pawlik, Cheryl L Esbrook, Linda Spears, Megan Miller, Mietka Franczyk, Deanna Deprizio, Gregory A Schmidt, Amy Bowman, Rhonda Barr, Kathryn E McCallister, Jesse B Hall, John P Kress

Lancet 2009; 373: 1874–82

- RCT of 104 mechanically ventilated pts
- Intervention of early Mobility vs usual care
- All patients received DAT/SBT assessments

<table>
<thead>
<tr>
<th></th>
<th>Traditional</th>
<th>Early Mobility</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>Days with delirium</td>
<td>4</td>
<td>2</td>
<td>0.02</td>
</tr>
<tr>
<td>Duration of Mechanical Ventilation</td>
<td>6.1</td>
<td>3.4</td>
<td>0.02</td>
</tr>
<tr>
<td>ICU LOS</td>
<td>7.9</td>
<td>5.9</td>
<td>0.08</td>
</tr>
<tr>
<td>Hospital LOS</td>
<td>13.5</td>
<td>12.9</td>
<td>0.9</td>
</tr>
</tbody>
</table>
Early Mobilization improves functional status at Hospital Discharge

Early Mobility associated with ↑ in Functional Independence at hospital discharge

59% vs 35% (p=0.02)

Lancet 2009; 373: 1874-82.
Early Mobilization occurs Early!
↑ Liberation from ventilator
↑ Earlier ICU and hospital discharge
↑ Return to normal brain function
↑ Independent functional status
↑ Survival

Awakening and Breathing trial coordination
Choice of sedatives and analgesics
Daily delirium monitoring
Early Mobility Exercise

ABCDE Approach to ICU care

Morandi et al. Curr Opin Crit Care 2011
Preventing poor functional outcomes
Interventions throughout the ICU stay

Phase-specific Approach to Rehabilitation in Critical Illness: Targeting Muscle, Nerve and Brain during and after the ICU Stay

Rehabilitation in ICU

- Resuscitation
  - Steroids, NMB, Ventilation
- Glycemic Control
- Sedation
- Delirium Treatment
- Wakefulness
  - Early Mobility
  - Physical Therapy

Serial Measures of Muscle Weakness: MRC, Strength, Function
Serial Measures of Wakefulness, Sedation, Delirium

Herridge (2009) CCM.
ICU Diary
Preventing PTSD

- Bedside notebook for family, friends, visitors and hospital staff to document a patient’s time in ICU
- Prospective, Real time
- Daily entries written in second-person using everyday language
- Photographs and diary entries

www.icudiaries.org
Intensive care diaries reduce new onset post traumatic stress disorder following critical illness: a randomised, controlled trial

Christina Jones¹,², Carl Bäckman³, Maurizia Capuzzo⁴, Ingrid Egerod⁵, Hans Flaatten⁶, Cristina Granja⁷, Christian Rylander⁸, Richard D Griffiths¹,²*, the RACHEL group

RCT involving 352 patients and families

ICU diaries associated with:

↓ PTSD in patients
5% vs 13% (p<0.02)

↓ PTSD scores in families ¹
(p<0.03)

¹ Jones et al. (2012) AJCC
Other Potential Interventions
Optimizing Mental Health Outcomes

• ABCDE Strategy
• Low dose hydrocortisone $^{1-3}$
• In and post ICU psychologist lead intervention $^4$
• Targeted post-ICU psychological follow-up $^5$
• Family Centered Care Interventions

$^1$ Schelling et al (1999) CCM.
Access to Loved Ones in the ICU
Optimizing Patient and Family Outcomes

- Open Visitation Hours
- Open door policies
- Family participation in care
  - During Rounds
  - During procedures
  - During Resuscitation
  - During Change of Shift
- Facilitated sense-making

Jabre. ICM. 2014.
Davidson. CCNQ. 2010; 33 (2): 177–89.
Changing ICU Paradigm

- Day 0: Admit to Hospital, Pneumonia
- Day 2: Intubation, ICU
- Day 4: Mechanical Ventilation
- Day 6: Corticosteroids
- Day 8: SEDATION AS NEEDED
- Day 10: Extubation
- Day 12: Rehab Consult
- Day 14: Transfer to ward
- Day 16: Rehab Therapy
- Day 18: Discharge to Rehab
- Day 20: Discharge to Home?
- Day 22: ICU diaries, Family involvement

Adapted from Dale Needham, 2011
Conclusions
Moving Beyond Survival

- Many ICU survivors have long-lasting effects on physical, mental and cognitive function impairing quality of life and function
- The cause of poor outcomes are multifactorial and complex
- Although more research is needed, current interventions shown to improve outcomes include
  - Addressing pain and delirium
  - Sedation minimization strategies
  - Early Mobilization
  - ICU Diaries