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Early cognitive and physical rehabilitation: one step towards improving post-critical illness outcomes

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Current data indicate that large numbers of individuals not only survive an episode of critical illness but many of these survivors develop new and long-lasting physical, cognitive, and psychological (depression, anxiety, and post-traumatic stress disorder) morbidities that adversely affect their functional outcome and quality of life [1]. A recent systematic review found that moderate to severe post-ICU cognitive impairments occur in 45–80 % of survivors of critical illness, affecting a wide range of cognitive domains and persisting years after ICU discharge [2]. Given the prevalence and severity of cognitive impairments following critical illness, interventions are needed to prevent or ameliorate cognitive morbidity with the ultimate goal to improve functional outcomes.

Brummel and colleagues [3] examined safety and feasibility of protocolized early cognitive plus physical therapy administered early during a critical illness in the ICU. Patients were randomized to usual care, early physical therapy, or early cognitive plus physical therapy. Cognitive and physical therapy were administered on average 1 day after study enrollment in the intervention

groups with few adverse events (4 %) for physical therapy. In patients that were randomized to usual care the average time of the first physical therapy session occurred 2 days later than physical therapy in the intervention group. Further, the patients in the usual care group underwent substantially fewer physical therapy sessions: in the usual care group 48 % received physical therapy compared to 95 % in the physical therapy group and 98 % in the combined cognitive and physical therapy group. This important study found that early physical rehabilitation was safe and feasible in critically ill patients, confirming previous findings [4]. The data also confirms previous research that found that use of protocolized mobility/physical therapy initiated early during ICU treatment increased the number of critically ill patients who receive physical therapy and the number of physical therapy sessions [5, 6].

Patients in all three treatment groups in the study by Brummel et al. had high rates of cognitive impairment at hospital discharge and 3-month follow-up, which is similar to previous studies [2]. There was no difference in cognitive function at 3 months among the three groups, likely because the small sample size resulted in low power [3]. The lack of between-group differences in cognitive outcome raises several questions as to whether the cognitive and physical rehabilitation during the ICU may have short-term effects such as reducing sedative use, decreasing delirium prevalence or duration resulting in an individual who is more alert and able to interact with clinical care providers, family, and caregivers. Thus, other short-term outcomes may elucidate the potential benefits of early cognitive and physical rehabilitation in the ICU that were not assessed by Brummel and colleagues. For example, studies in critically ill populations have shown that early physical therapy reduces mortality, shortens hospital and ICU length of stay, decreases hospital readmission rates, reduces delirium, and improves physical function [7–9]. It is unclear whether early cognitive and

Table 1 Hypothetical multi-faceted cognitive rehabilitation program

Physical impairments and interventions	Cognitive impairments	Cognitive interventions
Weakness and prevent debilitation	Basic skills	
Range of motion	Attention	Attention—continuous performance/ concentration tasks
Passive	Reaction time	Computerized tasks (response time)
Active	Processing speed	Multiple task demands (follow recipe)
Stand at bedside	Working memory	
Stand unassisted		
Transfer from standing to sitting in a chair	Complex skills	
	Sequencing	Sequencing tasks (objects, tasks, social sequences)
Functional skills for discharge home	Memory	Diminishing cues, errorless learning, spaced retrieval
Walk	Short-term memory	Compensatory—external memory aids (notebook, electronic organizers)
Walk >100 feet	Long-term memory	
Get up from chair and walk		
	Executive function	
Return to pre-ICU functional abilities	Problem solving	Multi-stage problem solving
Strength exercises (weights)	Abstract reasoning	Goal management training
Weight training	Decision making	Self-monitoring
Aerobic exercise	Shifting sets	Emotional self-regulation strategies
Yoga	Analytical skills	
Sports (tennis, running, etc.)		

physical rehabilitation would have similar benefits—as one might hypothesize. In addition, it is unclear whether early cognitive and physical therapy will accelerate post-ICU recovery (i.e., change trajectory of outcome) or prevent physical debilitation, thereby preventing or reducing the severity of cognitive and physical morbidity. Research is needed to answer these questions.

Other questions include whether the innovative interventions used for cognitive rehabilitation in the Brummel study are the right interventions—a difficult question to address. There is little uniformity in the field of cognitive rehabilitation regarding which interventions best remediate the different domains of cognitive impairments. The interventions were selected as they addressed cognitive domains shown to be impaired in prior studies. The interventions were adapted from the standard neuropsychological tests that are used to assess cognitive function, such as remembering a string of digits which may improve a specific skill (e.g., attention) but may not generalize to other cognitive tasks or improving functional outcome. Cognitive rehabilitation research often finds that cognitive abilities or skills acquired through one cognitive intervention do not generalize to other related and important real-world functional outcomes that use a similar cognitive domain (e.g., memory) [10]. Studies are needed to determine if the cognitive rehabilitation interventions should be based on more real-world cognitive functions such as memory (e.g., remembering clinical information or autobiographical events) or attention such as crossword puzzles, sudoku, or video games which may improve functional outcomes. Alternatively, should cognitive rehabilitation be individualized and occur in a real-world setting such as home rather than in isolation in the clinic? Should cognitive rehabilitation interventions used

in other populations (i.e., stroke, traumatic brain injury) be adapted to critically ill populations? Is combined physical and cognitive rehabilitation during ICU treatment the ideal intervention, as one would hypothesize, or is only physical therapy needed to improve outcomes? A recent paper by Hopkins et al. [11] reviewed data showing that physical activity is associated with improved physical, psychological, and cognitive function in healthy humans and humans with disease, including dementia, stroke, and chronic obstructive pulmonary disease. Alternatively, will a multi-pronged intervention that targets multiple areas of morbidity (physical and cognitive morbidities) result in optimal outcome? Table 1 shows a hypothetical multi-pronged intervention where interventions gradually progress from basic abilities through a hierarchy of abilities. The timing of when to begin cognitive rehabilitation is also critical. A recent study found that survivors of critical illness had various trajectories of cognitive outcome (impaired and stable, normal and stable, improvement, or decline) [12] raising questions as to whether one intervention will fit all or do the interventions need to be targeted to specific populations or specific times based on mechanisms of injury, risk factors, or outcome trajectories, all of which we are just beginning to be studied in critically ill populations [13]?

There is limited but positive evidence that post-ICU cognitive rehabilitation improves long-term outcomes. A recent small study that assessed cognitive rehabilitation after ICU discharge in individuals who received a 6-week protocolized intervention (goal management training along with physical rehabilitation) found improved executive function in the intervention group compared to controls [14]. Although Brummel and colleagues took a giant step forward showing that early cognitive and

physical therapy done in the ICU are feasible and safe in critically ill patients, much remains to be done. Research is needed to determine which patients will benefit from early cognitive rehabilitation, when to initiate cognitive rehabilitation, what interventions are effective, and what

outcome measures are ideal in which situations to promote optimal cognitive and functional outcomes for survivors of critical illness [13].

Conflicts of interest None.

References

1. Adhikari NK, Fowler RA, Bhagwanjee S, Rubenfeld GD (2010) Critical care and the global burden of critical illness in adults. *Lancet* 376(9749):1339–1346
2. Wolters AE, Slooter AJ, van der Kooi AW, van Dijk D (2013) Cognitive Impairment after intensive care unit admission: a systematic review. *Intensive Care Med* 39:376–386. doi: [10.1007/s00134-012-2784-9](https://doi.org/10.1007/s00134-012-2784-9)
3. Brummel NE, Girard TD, Ely EW, Pandharipande PP, Morandi A, Hughes CG, Graves AJ, Shintani A, Murphy E, Work B et al (2013) Feasibility and safety of early combined cognitive and physical therapy for critically ill medical and surgical patients: the activity and cognitive therapy in ICU (ACT-ICU) trial. *Intensive Care Med*. doi: [10.1007/s00134-013-3136-0](https://doi.org/10.1007/s00134-013-3136-0)
4. Bailey P, Thomsen GE, Spuhler VJ, Blair R, Jewkes J, Bezdjian L, Veale K, Rodriguez L, Hopkins RO (2007) Early activity is feasible and safe in respiratory failure patients. *Crit Care Med* 35(1):139–145
5. Morris PE, Goad A, Thompson C, Taylor K, Harry B, Passmore L, Ross A, Anderson L, Baker S, Sanchez M et al (2008) Early intensive care unit mobility therapy in the treatment of acute respiratory failure. *Crit Care Med* 36(8):2238–2243
6. Needham DM (2008) Mobilizing patients in the intensive care unit: improving neuromuscular weakness and physical function. *JAMA* 300(14):1685–1690
7. Schweickert WD, Pohlman MC, Pohlman AS, Nigos C, Pawlik AJ, Esbrook CL, Spears L, Miller M, Franczyk M, Deprizio D et al (2009) Early physical and occupational therapy in mechanically ventilated, critically ill patients: a randomised controlled trial. *Lancet* 373(9678):1874–1882
8. Needham DM, Korupolu R, Zanni JM, Pradhan P, Colantuoni E, Palmer JB, Brower RG, Fan E (2010) Early physical medicine and rehabilitation for patients with acute respiratory failure: a quality improvement project. *Arch Phys Med Rehabil* 91(4):536–542
9. Morris PE, Griffin L, Berry M, Thompson C, Hite RD, Winkelmann C, Hopkins RO, Ross A, Dixon L, Leach S et al (2011) Receiving early mobility during an intensive care unit admission is a predictor of improved outcomes in acute respiratory failure. *Am J Med Sci* 341(5):373–377
10. Cicerone KD, Langenbahn DM, Braden C, Malec JF, Kalmar K, Fraas M, Felicetti T, Laatsch L, Harley JP, Bergquist T et al (2011) Evidence-based cognitive rehabilitation: updated review of the literature from 2003 through 2008. *Arch Phys Med Rehabil* 92(4):519–530
11. Hopkins RO, Suchyta MR, Farrer TJ, Needham D (2012) Improving post-intensive care unit neuropsychiatric outcomes: understanding cognitive effects of physical activity. *Am J Respir Crit Care Med* 186(12):1220–1228
12. Woon FL, Dunn CB, Hopkins RO (2012) Predicting cognitive sequelae in survivors of critical illness with cognitive screening tests. *Am J Respir Crit Care Med* 186:333–340
13. Needham DM, Davidson J, Cohen H, Hopkins RO, Weinert C, Wunsch H, Zawistowski C, Bemis-Dougherty A, Berney SC, Bienvenu OJ et al (2012) Improving long-term outcomes after discharge from intensive care unit: report from a stakeholders' conference. *Crit Care Med* 40(2):502–509
14. Jackson JC, Ely EW, Morey MC, Anderson VM, Denne LB, Clune J, Siebert CS, Archer KR, Torres R, Janz D et al (2012) Cognitive and physical rehabilitation of intensive care unit survivors: results of the RETURN randomized controlled pilot investigation. *Crit Care Med* 40(4):1088–1097