



Post-Intensive Care Syndrome After Prolonged Mechanical Ventilation: A Narrative Review of Physical, Cognitive and Psychological Recovery

Ruben Castillo^{1*}, Ingeborg Mueller² and Tanel Saar³

¹Department of Intensive Care Medicine, Balearic Institute of Clinical Medicine, Palma, Spain

²Department of Rehabilitation Medicine, Westphalian Institute of Clinical Research, Munster, Germany

³Department of Critical Care, Livonian Medical Centre, Tartu, Estonia

***Correspondence to:** Ruben Castillo, Department of Intensive Care Medicine, Balearic Institute of Clinical Medicine, Palma, Spain

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Abstract

Intensive care has become steadily better at preventing death and no better at returning people to the lives they had. A substantial proportion of survivors leave with cognitive impairment comparable in magnitude to a moderate brain injury, and it is not the illness they were admitted with.

Objectives: *To review the published evidence on post-intensive care syndrome after prolonged mechanical ventilation: what is known about the physical, cognitive and psychological components, how severe and how persistent they are, and what rehabilitation trials have and have not shown.*

Material and Methods: *Narrative review of prospective cohort studies, randomised trials of rehabilitation and follow-up services, consensus statements and long-term outcome studies indexed in PubMed and the major critical care and general medical journals. No new patient data were generated; every estimate quoted is one published by the original investigators.*

Results: *In a prospective cohort of adults with respiratory failure or shock, 40 per cent had global cognition scores at three months worse than those typically seen after moderate traumatic brain injury, and 26 per cent had scores two standard deviations below population means, comparable to mild Alzheimer's disease. At twelve months the corresponding figures were 34 and 24 per cent. Only 6 per cent had documented cognitive impairment before admission. Impairment was not confined to older patients: those aged 49 or under had median global cognition scores of 78 at three months and 80 at twelve, against a population mean of 100. Longer delirium duration was independently associated with worse cognition.*

Conclusion: *The syndrome is common, severe, largely new and only partly reversible. Randomised trials of rehabilitation and follow-up clinics have repeatedly failed to improve these outcomes, which shifts the emphasis towards prevention during the admission itself, and towards preparing patients and families for what recovery will actually involve.*

Abbreviations: ARDS – Acute Respiratory Distress Syndrome, ICU – Intensive Care Unit, PICS – Post-Intensive Care Syndrome, PTSD – Post-Traumatic Stress Disorder, RBANS – Repeatable Battery for the Assessment of Neuropsychological Status, SD – Standard Deviation.

Keywords: Post-Intensive Care Syndrome; Mechanical Ventilation; Cognitive Impairment; Delirium; Rehabilitation

Introduction

Survival from critical illness has improved substantially, and the population of people living after prolonged mechanical ventilation has grown with it [1,2]. Post-intensive care syndrome is the term agreed at a stakeholders' conference for the new or worsened impairments in physical, cognitive or mental health that persist after critical illness, in patients and in their families [3,4], and overviews of the syndrome have since set out its pathophysiology and prevention [32,33].

The components are usually described separately but occur together. Intensive care acquired weakness affects a large proportion of those ventilated for a week or more [5,6]. Cognitive impairment is common and was inadequately characterised until prospective cohorts measured it directly [7]. Symptoms of anxiety, depression and post-traumatic stress are frequent in survivors and in relatives [8,9,10].

What has changed the field is the recognition that these are not simply the residue of the presenting illness. This review sets out how large the deficits are, how long they last, what predicts them, and what interventions have been shown to alter them.

Material and Methods

Search strategy: PubMed and the archives of the major critical care, respiratory and general medical journals were searched for studies of outcomes after critical illness. Search terms combined post-intensive care syndrome, critical illness and mechanical ventilation with cognitive impairment, delirium, ICU-acquired weakness, post-traumatic stress, rehabilitation and follow-up clinic. Reference lists of consensus statements [3,4] were screened by hand for primary sources.

Eligibility: Studies were included if they measured physical, cognitive or psychological outcomes in survivors of critical illness using validated instruments, or evaluated an intervention intended to improve them. Studies of family members are cited where they address the family component of the syndrome and are identified as such.

Data extraction and handling: Design, sample size, the instrument used, the timing of assessment and the reported outcome were extracted as published. Whether pre-morbid function was measured is reported alongside every impairment figure, because the central question in this literature is whether the deficits are new, and cohorts without baseline assessment cannot answer it. No pooling or re-analysis was performed. Figures 1 to 4 and Tables 1 and 2 reproduce published values only. This is a narrative synthesis and was not registered as a systematic review.

Results

The scale of cognitive impairment: A prospective cohort enrolled adults with respiratory failure or shock in medical and surgical intensive care units, assessed them for in-hospital delirium, and measured global cognition and executive function at three and twelve months after discharge. At three months, 40 per cent had global cognition scores worse than those typically seen after moderate traumatic brain injury, and 26 per cent had scores two standard deviations below population means, comparable to mild Alzheimer's disease (Figure 1) [7].

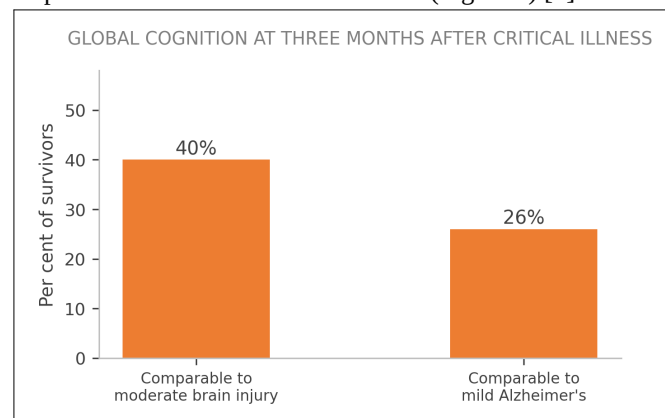


Figure 1: Global cognition at three months after critical illness, by severity band [7]

How much recovers: Very little. At twelve months, 34 per cent still had scores comparable to moderate traumatic brain injury and 24 per cent comparable to mild Alzheimer's disease (Figure 2) [7]. Reviews of the wider literature describe the same trajectory: impairment that is often severe at discharge, improves only slightly, and then stabilises with persistent difficulty at remote time points [11,12].

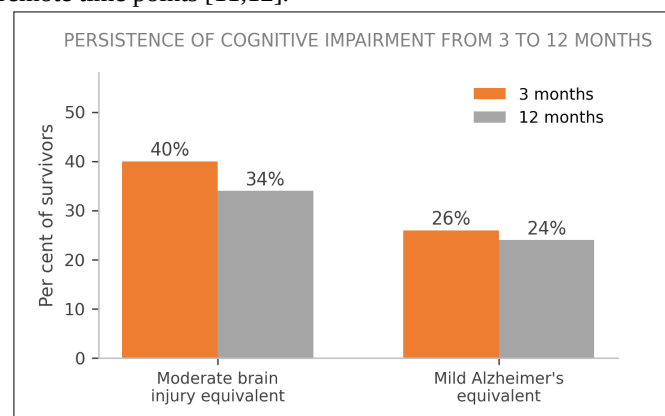


Figure 2: Persistence of cognitive impairment between three and twelve months [7]

The deficits are new: Only 6 per cent of the cohort had documented cognitive impairment before admission, against 40 per cent impaired at three months (Figure 3) [7]. This is the observation that transformed the field, because it excludes the explanation that critical illness simply selects people who were already declining.

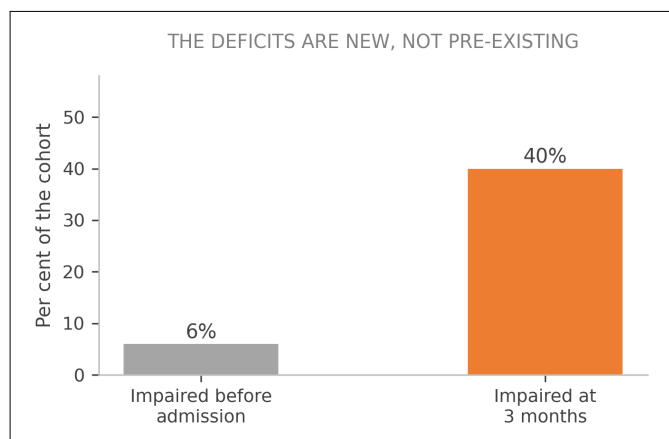


Figure 3: Documented cognitive impairment before admission against impairment at three months [7]

Not confined to the old: Patients aged 49 or under had median global cognition scores of 78 at three months and 80 at twelve, against an age-adjusted population mean of 100 with a standard deviation of 15 (Figure 4) [7]. A younger survivor returning to employment, study or the management of a household is therefore doing so with a measurable and persistent deficit that nobody may have named for them.

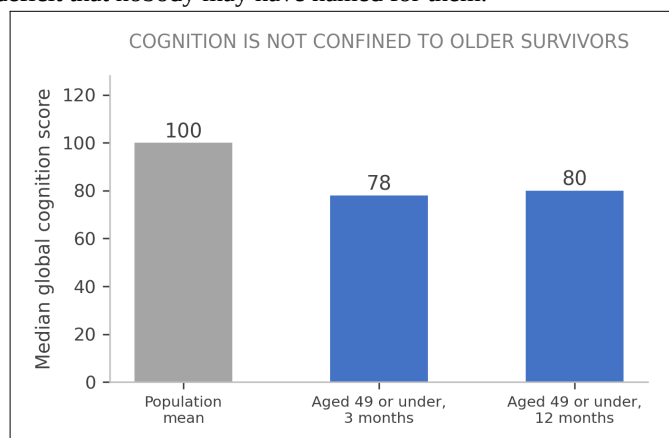


Figure 4: Median global cognition scores in survivors aged 49 or under, against the population mean [7]

What predicts it: Longer duration of delirium was independently associated with worse global cognition at three and twelve months, and with worse executive function at both time points. Use of sedative or analgesic medication was not consistently associated with cognitive outcome [7,13]. Delirium is also an independent predictor of subsequent disability among survivors of mechanical ventilation [14,15]. That relationship is the strongest available lever, because delirium duration is partly modifiable during the admission.

Study	Design and cohort	Principal reported finding
Pandharipande et al. 2013 [7]	Prospective cohort, respiratory failure or shock	40% and 26% impaired at 3 months; 34% and 24% at 12 months
Pandharipande et al. 2013 [7]	Same cohort, baseline	Only 6% impaired before admission; deficits are new
Needham et al. 2012 [3]	Stakeholders' conference report	Defines post-intensive care syndrome and its components
Herridge et al. 2011 [16]	5-year follow-up, ARDS survivors	Persistent functional disability years after discharge
Jackson et al. 2014 [8]	BRAIN-ICU longitudinal analysis	Depression, PTSD and functional disability in survivors
Cuthbertson et al. 2009 [17]	RCT, nurse-led follow-up programme	No improvement in quality of life at 12 months
Walsh et al. 2015 [18]	RCT, enhanced post-ICU rehabilitation	No significant improvement in physical recovery

Table 1: Principal studies reviewed, with the finding as reported by the original investigators

The physical component: Intensive care acquired weakness is common after prolonged ventilation and reflects a combination of critical illness polyneuropathy and myopathy [5,6,19]. Long-term follow-up of survivors of acute respiratory distress syndrome documented persistent exercise limitation and functional disability years after discharge, with the burden falling disproportionately on younger patients who had more to lose functionally [16,20]. Recovery is slow, incomplete and dominated by weakness rather than by residual lung disease [16,21].

The psychological component: Symptoms of depression, anxiety and post-traumatic stress are frequently reported by survivors and persist for months to years [8,9,22,23]. Delusional memories formed during critical illness are associated with later post-traumatic symptoms [24]. Family members experience their own burden, sometimes described as post-intensive care syndrome-family, with anxiety, depression and complicated grief documented in relatives of both survivors and those who died [4,10,25]. This is a sensitive area clinically, and the relevant point for services is that distress in survivors and relatives is common enough to be anticipated rather than treated as exceptional.

What interventions have shown: The therapeutic record is poor. A randomised trial of a nurse-led follow-up programme found no improvement in quality of life at twelve months [17], and a trial of enhanced rehabilitation after discharge from intensive care found no significant improvement in physical recovery [18]. Trials of in-ICU physical rehabilitation have produced mixed results [26,27,28]. What has stronger support is prevention during the admission: coordinated bundles reducing sedation, promoting early mobility and addressing delirium are associated with better outcomes [29,30,31].

Component	What is established	What interventions show
Cognitive impairment	40% at 3 months; 34% at 12 months	No trial has reliably improved it [7,17]
New versus pre-existing	Only 6% impaired before admission	Deficits attributable to the illness or its care [7]
Age	Present in those aged 49 and under	Not explained by ageing [7]
Delirium	Longer duration predicts worse cognition	Partly modifiable during admission [7,14]
Physical weakness	Common and persistent after ventilation	Post-discharge rehabilitation trials negative [16,18]
Psychological symptoms	Common in survivors and relatives	Follow-up clinics have not improved outcomes [10,17]

Table 2: Components of post-intensive care syndrome and the current state of intervention evidence

Discussion

Three findings from the prospective cohort deserve to be better known than they are. Forty per cent of survivors had cognition at three months comparable to moderate traumatic brain injury. Only 6 per cent had been impaired beforehand. And the impairment was present in patients aged 49 and under, with median scores of 78 [7]. Taken together, these describe a large, new, age-independent injury acquired during a hospital admission for something else.

The comparison the authors chose is worth pausing on. Describing a deficit as equivalent to moderate traumatic brain injury is not rhetorical: it is a statement about where the scores fall relative to a population with a recognised acquired brain injury. Nobody discharges a patient after a moderate head injury without explanation, follow-up or a rehabilitation plan. A comparable deficit acquired in intensive care is frequently discharged with none of those, and the patient is left to discover it when they attempt to return to work. Return to employment and lost earnings after critical illness have been followed prospectively and are substantially affected [34,35].

The difficulty is that the interventions tried so far have not worked. Nurse-led follow-up did not improve quality of life; enhanced post-discharge rehabilitation did not improve physical recovery [17,18]. This is a consistent and uncomfortable pattern, and it should be reported rather than glossed with the assertion that follow-up clinics are self-evidently valuable. They may be valuable for reasons the trials did not capture, and they have not been shown to alter the outcomes they were designed to alter.

Where that leaves practice is with two propositions the evidence does support. The first is prevention during the admission: delirium duration predicts later cognition, delirium is partly modifiable, and bundles reducing sedation and promoting mobility have supporting evidence [7,29,30]. The second is honesty at discharge. If four in ten survivors will have measurable cognitive impairment at three months, telling patients and families that in advance costs nothing, prevents them attributing difficulty to personal failure, and is the one intervention that does not require a positive trial to justify.

Study limitations

The limitations belong to the underlying literature. Pre-morbid cognition in the principal cohort was assessed by informant questionnaire rather than formal testing, so the 6 per cent baseline figure is an estimate [7]. Attrition in survivor cohorts is substantial and non-random, and those lost to follow-up are plausibly the more impaired. Cognitive instruments validated in dementia populations may behave differently in critical illness survivors, and the comparisons with traumatic brain injury and Alzheimer's disease are benchmarks against separate reference populations rather than direct comparisons [7,11]. Follow-up rarely extends beyond one to five years [16]. Rehabilitation trials differ substantially in intervention, timing and intensity, so a null result across them does not establish that no rehabilitation works [17,18,26]. Family outcome studies are largely observational [10,25]. And almost all of this evidence comes from high-income settings with formal critical care follow-up infrastructure [1,3].

Conclusion

A patient who survives prolonged mechanical ventilation has roughly a four in ten chance of leaving with cognitive function comparable to that seen after a moderate brain injury, most of it new, much of it still present a year later, and none of it restricted to the elderly. The trials of follow-up clinics and post-discharge rehabilitation designed to fix this have not succeeded, and saying so plainly is more useful than repeating that such services must help. What the evidence does support is attention to delirium while the patient is still in the unit, and telling survivors and their families before discharge what the recovery is likely to involve. The second of those has no trial behind it and needs none: people are entitled to know what happened to them.

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Conflict of Interest

The authors declare no competing interests.

Ethics Statement

This article reviews previously published studies only. No new patient data were collected and no participants were recruited, so ethical approval was not required.

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