

Sequelae and rehabilitation after critical illness

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Intensive care outcomes have traditionally been expressed in terms of survival. However, there is a significant reduction in health-related quality of life (QoL) and physical and social functioning for survivors of critical illness for at least two years following discharge from intensive care.^{1,2} There is also a significant negative impact in terms of economic, social, physical and psychological factors on those who care for

survivors of critical illness following their discharge home.³ It is increasingly recognised that survival following admission to intensive care is an inadequate outcome measure following critical illness. The optimal end-point is the return to activity and QoL levels similar to those experienced before the illness which led to the intensive care admission. This article highlights this morbidity and the need to provide a continuum of rehabilitation for patients following critical illness.

Examples of physical and non-physical sequelae following critical illness are summarised in Table 1. There is usually no support to address these longer-term problems specific to critical illness, and limited research into interventions which could improve physical function and QoL or enhance speed of recovery in these patients. There is interest in exploring whether rehabilitation could alleviate these sequelae, as recognised in the recent National Institute for Health and Clinical Excellence (NICE) guidelines on rehabilitation after critical illness.⁴ Extensive evidence supports the use of rehabilitation and exercise regimens to aid physical recovery in patient

groups such as chronic obstructive pulmonary disease, congestive heart failure, and chronic fatigue syndrome.^{5–7} They exhibit similar problems to survivors of critical illness: reduced functional ability, they are generally de-conditioned and often breathless. Exercise programmes in these patient groups have been shown to be safe and effective in improving QoL, exercise capacity and psychosocial status.

Rehabilitation while in intensive care

Research from surveys, cohort studies and randomised controlled trials (RCTs) relates to a range of different types of rehabilitation strategies for patients with critical illness during their intensive care unit (ICU) stay:

- Physical- and physiotherapy-based interventions include the use of various respiratory manoeuvres to improve ventilation and clear secretions, use of a tilt table, stretches, passive and assisted exercises, transfers, mobilisation and walking on the spot.^{8,9}

Table 1. Examples of physical and non-physical sequelae following critical illness.

Sequelae	
Physical	Non-physical
Pain	ICU-associated delirium
Fatigue	Relocation stress (eg changes in routine, unfamiliar staff, reduced monitoring)
Reduction in maximal O ₂ uptake, impairing ability to do physical work	Lower QoL
Reduced mobility and ongoing physical disability	Depression
Restricted ADLs	Anxiety
Critical illness polyneuro/myopathy	Mood changes
Disuse atrophy	Irritability
Heterotrophic ossification due to prolonged immobilisation	Poor concentration
Heart muscle atrophy, decline in stroke volume, increase in heart rate, reduced CV capacity, diminished cardiac and respiratory reserve	PTSD
Poor appetite	Cognitive dysfunction
Malnutrition	Sleeping difficulties
Voice and taste changes	Inability to cope and stress related to lifestyle modifications
Problems with swallow	Increased healthcare medical costs
	Slower return to work
	Burden and stress on families and informal caregivers

ADL = activities of daily living; CV = cardiovascular; ICU = intensive care unit; PTSD = post-traumatic stress disorder; QoL = quality of life.

- Early mobilisation in 103 patients with respiratory failure who received early activity as part of routine respiratory ICU care was found to be feasible and safe.¹⁰
- The use of a mobility team (critical care nurse, nursing assistant and physical therapist) and a mobility protocol resulted in decreased ICU and hospital stays in the intervention group (n=165) compared with usual care (n=165); the introduction of this early intervention was also reported to be safe.¹¹
- Supervised physical training during ICU improved muscle strength and functional status, and also increased ventilator-free time in the treatment group (n=20) compared with the control group (n=19).¹²
- The use of patient diaries has been proposed as a method of reducing non-physical sequelae associated with critical illness. In a large study of 352 patients recovering from critical illness, patient diaries helped psychological recovery and reduced post-traumatic stress disorder (PTSD) particularly in those with higher PTSD scores.¹³
- A multicomponent rehabilitation intervention of interrupted sedation together with physiotherapy and occupational therapy in ventilated patients reported earlier return to independent functional status at hospital discharge, shorter duration of delirium and more ventilator free days in the treatment group (n=49) compared with the control group (n=55).¹⁴

These examples of rehabilitation interventions during ICU highlight the importance and potential for interventions which could improve the outcome for patients in the early stages after critical illness.

Rehabilitation after the intensive care unit and hospital discharge

There is a paucity of literature to support rehabilitation following discharge from intensive care, particularly following discharge from hospital. It is also unclear what components should be included in this rehabilitation. Evidence of benefit for follow-up clinics is lacking and they are not routine practice. Their components are diverse and do not necessarily include important elements of rehabilitation which would target the physical and non-physical sequelae (Table 1).¹⁵

Rehabilitation studies

A recent study of nurse-led, intensive care follow-up programmes, starting when patients were discharged from ICU to a hospital ward and continued after discharge from hospital, reported no difference compared with usual care.¹⁶ It is difficult to determine whether the results of this study were affected by the timing and limited nature of the intervention.

A clinical trial investigating rehabilitation after critical illness randomised patients to receive a six-week rehabilitation manual or standard care, including advice on psychological, psychosocial

and physical problems and a self-directed exercise programme.¹⁷ Use of the manual reduced depression in patients but not delusional memories from the ICU. Patients in the intervention group also improved the short-form (SF) health survey physical function scores compared with the control group at eight weeks and six months ($p=0.006$).

There is one small cohort study providing encouraging results in support of the feasibility of recruitment into outpatient-based rehabilitation.¹⁸ Patients in the intervention group received a six-week rehabilitation programme which included education and supervised cardiovascular exercise classes as well as unsupervised home exercise sessions. It did not include blinded outcome assessment. Significant improvements in physical function were found using the six-minute walk test (6MWT) (median distance improved by 58%, $p<0.001$) and the incremental shuttle walk test (ISWT) (median distance improved by 89%, $p<0.001$). The hospital anxiety and depression (HADS) scores showed significant improvement in anxiety ($p=0.001$) and depression ($p=0.001$).

A recently completed RCT examined the effects of an eight-week home-based physical rehabilitation programme on physical and psychological recovery in survivors of critical illness after hospital discharge. A recently published RCT examined the effects of an eight-week, home-based physical rehabilitation programme on physical and psychological recovery in survivors of critical illness after hospital discharge.¹⁹ Physical function (6MWT) and health-related QoL (SF-36) were not significantly improved compared with standard care.

Comments on these studies

All these studies excluded patients likely to undergo a specific rehabilitation pathway: for example, those with neurological impairment, coronary artery disease and/or not physically able to participate in or access the rehabilitation intervention.^{16–19} However, the length of time in ICU and/or days on mechanical ventilation were relatively short, and it is

Key points

There is significant short- and long-term morbidity associated with survival after critical illness

All patients should be assessed at each stage of critical illness and managed by a multidisciplinary team with a range of skills

Return to activity and quality of life levels similar to those experienced before the critical illness is important

Further research is needed into methods to identify patients at risk and interventions which could improve patient outcomes after critical illness

KEY WORDS: critical illness, multidisciplinary team, quality of life, rehabilitation

Table 2. Inclusion criteria (only length of stay (LOS) in the intensive care unit (ICU) and time ventilated reported) and study interventions relating to rehabilitation after critical illness.

Ref	Study design	Inclusion criteria		Intervention or proposed intervention
		LOS in ICU	Ventilation duration	Results
16 (n=286) Study complete	Pragmatic, multicentred RCT Non-blinded outcome assessment	Level 3 dependency, ICU care received any time during hospital stay	n/a	Nurse-led, manual-based intervention with self-directed physical rehabilitation programme developed by physiotherapists, introduced by study nurse. Started in hospital, continued for three months after discharge. Assessment at baseline, six and 12 months. <i>Results:</i> no significant difference in SF-36 physical component score (mean 42.0 (SD 10.6) vs 40.8 (SD 11.9), $p=0.46$) at 12 months (n=192). No statistically significant differences in SF-36 mental component score ($p=0.83$) or secondary outcomes. Follow-up programmes significantly more costly than standard care.
17 (n=126) Study complete	RCT. Blinded outcome assessment	ICU >48 h	Ventilated during ICU stay	Six-week rehabilitation manual and self-directed exercise programme. Assessment at baseline, eight weeks post-discharge and six months. <i>Results:</i> significant improvement in SF-36 physical function compared with control group at eight weeks and six months ($p=0.006$). Incidence of new PTSD cases reduced in intervention group compared with controls (5% vs 13%, $p=0.02$).
18 (n=38) Study complete	Prospective cohort study. Non-blinded outcome assessment	n/a	Invasively ventilated ≥ 48 h	Six-week outpatient-based exercise programme with one weekly supervised exercise and education sessions and two unsupervised exercise sessions. Assessment one week before and one week after completing programme. <i>Results:</i> significant improvement in median 6MWT distance (277.5–437.5 m, $p<0.001$). Median ISWT distance significantly improved (180–340 m, $p<0.001$). Significant improvements in anxiety and depression scores.
19 (n=180) Study complete	Multicentre RCT Blinded outcome assessment	ICU >48 h	Mechanically ventilated ≥ 24 h	Eight-week home-based, individually tailored physical rehabilitation programme post-hospital discharge. Assessment at one, eight and 26 weeks after hospital discharge. <i>Results:</i> SF-36 physical function and 6MWT improved. No significant differences between control and intervention groups at eight or 26 weeks.
20* (n=200) Protocol	RCT. Blinded outcome assessment	ICU ≥ 5 days	n/a	15 min exercise/day while in ICU, 2 \times daily when patient disconnected from ventilator for >4 h or successfully weaned. On the ward, treatment 2 \times daily until discharge, then outpatient programme of 2 \times 1 h sessions per week for eight weeks. Home walking programme also encouraged. Assessment at baseline, three, six and 12 months. <i>Results:</i> n/a

Table 2. (Continued)

Ref	Study design	Inclusion criteria		Intervention or proposed intervention
		LOS in ICU	Ventilation duration	Results
21* (n=64) Protocol	Multicentre, parallel group RCT	Emergency ICU admission	Ventilatory support for minimum of three days	40 min exercise session, 2 × weekly under supervision and one unsupervised session per week (brisk 40 min walk) for eight weeks. Assessment at baseline, nine and 26 weeks. Results: n/a
22* (n=148) Protocol	RCT: short-term feasibility and follow-up pilot study	Admitted to critical care unit/ICU >48 h and evidence of SIRS	Ventilated >48 h (via ET tube) or given NIV/CPAP	Eight-week mostly outpatient programme of 2 × weekly (16 sessions) exercise and education sessions. Assessment after eight weeks. Results: n/a
23* (n=240) Protocol	Multicentre prospective, parallel group RCT. Blinded outcome assessment	n/a	Mechanical ventilation for ≥48 h	Ward-based rehabilitation by NHS service and additional access to enhanced rehabilitation during ward stay, telephone contact after discharge for three months, with follow-up at 12 months. Assessment at three, six and 12 months. Results: n/a
24* (n=68) Protocol	Phase II RCT Blinded outcome assessment	Patients included if ICU admission	Mechanical ventilation for >96 h	Mostly outpatient-based programme. Three exercise sessions per week (two supervised, one unsupervised with exercise manual) for six weeks. Assessment at baseline, six weeks and six months. Results: n/a

* information reported where available; n/a information not available.

CPAP = continuous positive airway pressure; ET = endotracheal tube; ISWT = incremental shuttle walk test; 6MWT = six-minute walk test; NIV = non-invasive ventilation; PTSD = post-traumatic stress disorder; RCT = randomised controlled trial; SD = standard deviation; SF-36 = short-form health survey; SIRS = systemic inflammatory response syndrome.

unclear whether this patient cohort would have significant disability and therefore represent the population that would benefit the most from rehabilitation interventions (Table 2). Future studies will need to explore rehabilitation interventions in patients who have a longer stay in ICU and longer duration on mechanical ventilation as they may be at higher risk of longer-term sequelae after critical illness.

Clinical implications

The 2009 NICE guidelines for rehabilitation after critical illness recommend a step-wise approach to rehabilitation through the different stages of critical illness using a screening and assessment process to target those most likely to benefit:⁴

- the critical care stay
- ward-based care
- after discharge from hospital.

This process encompasses a transition of the focus of care from ICU-led survival management towards rehabilitation delivered by a skilled multidisciplinary team (MDT), which includes the physician, and which can offer holistic care to patients with complex problems. It is important for physicians to help identify any physical and non-physical sequelae that develop at each stage and refer patients to appropriate services and to other members of the MDT. Access to other relevant team members and resources is important. It may be helpful to have a designated healthcare professional(s) to co-ordinate the rehabilitation process to ensure that all aspects of care are addressed:

- screening and assessment
- provision of rehabilitation
- access to welfare and benefits
- provision of information and contact details

- guidance for carers on how to support the patient after discharge.

A short clinical assessment at each stage of critical illness should identify risk for sequelae in all patients (low vs high risk) by considering pre-existing risk factors and asking about any new change in status, for example:

- reduced physical function and ability to perform activities of daily living (ADL)
- respiratory problems
- weight loss/gain
- pain
- difficulty sleeping
- anxiety and panic
- intrusive memories.

Comprehensive clinical assessment

If the risk for sequelae is high, recovery slower than expected or unanticipated sequelae have developed, there should be

a comprehensive clinical assessment and referral for rehabilitation.

This should include assessment of the impact of any functional limitations on the patient's ADL, identification of the patient's rehabilitation needs, as well as identification of any other issues, for example:

- sensory, nutritional and communication problems
- psychological issues
- new symptoms of delusions, anxiety, panic and depression.⁴

While very few evidenced-based screening tools are available, MDT members are familiar with a range of questions and outcome measures which can be used to gain a comprehensive assessment and identification of realistic patient goals. They also have access to further guidance relating to screening, assessment and management of many other sequelae such as PTSD, delirium, anxiety and depression.^{25–28}

Assessment on the ward of a patient at high risk for sequelae after critical illness could include, for example:

- the use of skilled questioning⁴
- assessment of function with the Rivermead Mobility Index²⁹
- assessment of delirium using the confusion assessment method (short confusion assessment method (CAM))³⁰
- anxiety and depression using HADS³¹
- pain and fatigue using a visual analogue scale³²
- screening for malnutrition using the Malnutrition Universal Screening Tool (MUST).^{33,34}

This highlights the need for access to a range of health professionals to complete a comprehensive assessment and then deliver an appropriate individualised rehabilitation package to counteract the sequelae and support the return of activity and QoL levels similar to those experienced before the critical illness.

Research implications

Further research is needed to develop simple and effective methods to screen

and identify patients at risk of developing sequelae following critical illness. The development of feasible, effective and sustainable rehabilitation interventions for the management of such sequelae following critical illness particularly requires further research. Evaluation of this complex intervention will involve an iterative process in order to determine the important characteristics such as the target population, the essential rehabilitation components, optimal timing for commencement of the intervention, the intensity, amount of supervision, duration and follow-up, all of which could contribute to improved patient outcomes.

A few different interventions have been investigated (Table 2). It is difficult to determine whether it is more important to study first the effects of a single component (eg exercise) or encompass multiple components, for example a rehabilitation intervention which includes physical, psychosocial and education elements, and involves patients and carers.

As this research is in its infancy, the inclusion of a process evaluation would be important.³⁵ Some studies using qualitative methods have provided valuable insights into the physical and psychological experiences of patients following transfer from the ICU. However, translating these findings into a feasible and acceptable intervention with patient-centred outcome measures requires further work. An economic evaluation would also be appropriate. It is anticipated that the results from ongoing and future trials (Table 2) will add to the evidence on rehabilitation after critical illness and inform clinical practice and implementation.

Conclusions

The desired outcome following critical illness is the return of activity and QoL levels similar to those experienced before the critical illness. There is a clear need to identify patients at risk of developing physical and non-physical sequelae, and to develop rehabilitation interventions which could target improved recovery for these patients.

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