

Title: Controversies regarding mobilisation and rehabilitation following acute spinal cord injury

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Abstract

Spinal cord injury is a debilitating condition associated with significant physical and emotional burden for the patients and families involved. Despite advances in care of patients following spinal cord injury, rehabilitation following injury remains an underfunded area of research that is in need of significant change. Although bed rest has been suggested to improve spinal cord perfusion after acute cord injury, there is no data to suggest that long periods of bed rest following spinal cord injury (in the absence of haemodynamic or biomechanical instability) leads to better outcome. Despite paucity of evidence, prolonged flat bed rest is still practiced in many spinal cord injury rehabilitation units across United Kingdom with no consensus on timing of mobilisation. Here we review some of the controversies on mobilisation and rehabilitation following spinal cord injury with the aim to emphasise on the benefits of early mobilisation following spinal cord injury and to challenge the old practice of long periods of flat bed rest.

Keywords: Spinal Cord Injury, Spinal Rehabilitation, Early Mobilisation

Abbreviations: Blood Pressure (BP), Cerebrospinal Fluid (CSF), Mean arterial Pressure (MAP), Spinal Cord Perfusion Pressure (SCPP), Spinal Cord Injury (SCI),

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Introduction

Acute spinal cord injury (SCI) has significant impact on patient's physical, psychological, and social well-being. Sekhon and Fehlings reported an annual global incidence of acute spinal cord injury of 14 to 40 per million.¹

The management of acute spinal cord injury requires significant health care resources and can place financial burden on patients, their relatives and family, and the community as a whole. These costs are associated with a need for acute care in the short term along with longterm complications associated with this condition.²

Although the management of patients with spinal cord injury has improved significantly over the years, there is still significant amount of controversy regarding various management strategies after cord injury.³ One the areas of controversy lies regarding timing of mobilisation and rehabilitation following acute spinal cord injury.

There is a large variation in timing of rehabilitation and mobilisation in hospitals and spinal rehabilitation units across United Kingdom (UK) with some advocating early mobilisation while others implementing a minimum 6 week period of bed rest post spinal cord injury.

Historically traditional practice of long bed rest (6 weeks or more) post spinal cord injury was adopted over the years for multiple reasons. These included conservative management of certain types of spinal fractures associated with spinal cord injury and therefore time necessary to allow for fusion and bony healing. Furthermore many patients following acute spinal cord injury have haemodynamic instability due to neurogenic shock and therefore maintaining blood pressure (BP) plays an important role in improving cord perfusion in acute phase of injury.³ In addition, patients can have episodes of symptomatic orthostatic hypotension which may limit their ability to mobilise early.⁴ Despite reasons above, with emerging new evidence, management of spinal cord injury has evolved significantly with shift towards active and early stabilisation following injury to allow early mobilisation after the acute i.e 2 weeks following the injury. This early mobilisation has been adopted in many countries although traditional prolonged bed rest is still practiced in some spinal rehabilitation units across United Kingdom.

In this article, we aim to review the available literature on this topic and challenge the traditional practice of long bed rest beyond 2 weeks and emphasize the need for a unified practice across UK spinal rehabilitation units to improve patient outcomes.

Effects of Mean arterial pressure and cord perfusion pressure on neurological recovery

One of the main reasons for bed rest management following acute spinal cord injury is maintaining cord perfusion. In immediate aftermath following spinal cord injury with neurogenic shock, haemodynamic instability may affect spinal cord perfusion. This has led to common practice of bed rest immediately following spinal cord injury to avoid orthostatic hypotension. There are multiple studies investigating the role of maintaining of blood pressure (BP) and mean arterial pressure (MAP) on neurological recovery after spinal cord injury with most studies being retrospective and lacking control groups. The period of maintaining BP above target in most studies ranges from 24 hours up to 7 days.

Two prospective trials have investigated the role of BP management in spinal cord injury patients either treated conservatively or with surgery. In this two prospective trials, they maintained mean arterial pressure (MAP) of above 85 and 90 respectively for 1 week post injury with reported improvement in neurological outcomes in follow up period.⁵⁻⁶ However both studies are limited by lack of control groups.

There have been multiple retrospective studies which have further investigated the role of maintaining MAP above 85 on neurological recovery. Due to lack of control groups, many studies have overcome this problem by attempting to compare patients with satisfactory BP management above set target versus patients who have failed to achieve optimal BP above target MAP despite implementation of BP management protocols. Using failed BP management groups as internal controls, some studies have demonstrated better neurological recovery in groups with better MAP control in acute phase post spinal cord injury.⁷⁻⁹

Other studies have found no correlation between the use of vasopressors to maintain MAP or number of failures to meet the target MAP on improvement in neurological recovery.¹⁰⁻¹¹ One study has found neurological deterioration during period of follow up while maintaining MAP above 85.¹²

The current clinical practice guidelines for hemodynamic management of acute spinal cord injury recommend for MAP to be maintained between 85 and 90 mm Hg for the first 7 days post-injury with use of vasopressors if necessary.¹³

Some have argued that management of spinal cord injury patient guided by MAP can be misleading and has limited value.

Squire J et al report that limitation with the present MAP orientated approach is that spinal cord perfusion may be suboptimal even with such MAP management.³ They conducted a study in spinal cord injury patients while measuring both MAP and CSF pressure to allow measurement of cord perfusion. They define spinal cord perfusion pressure (SCPP) as the difference between MAP and CSF pressure. Authors reported that individuals who improved in neurologic grade dropped below SCPP of 50 mm Hg fewer times than those who did not improve. This effect was not observed for MAP or CSF pressure. They suggest that SCPP can provide useful information to guide the hemodynamic management of patients with acute spinal cord injury.³

Similarly Saadoun et al have demonstrated that intraspinal pressure negatively and spinal cord perfusion pressure positively correlated with American Spinal cord Injury association impairment scale at 9 to 12 months post injury but no such correlation was seen using Mean arterial pressure and outcomes.¹⁴

Consistent with limitation of purely MAP orientated approach, Gallagher et al have identified different patterns of blood flow in acute spinal cord injury and have demonstrated that although increasing MAP increased overall blood flow to the injured cord, it can also cause hypoperfusion in other areas of cord.¹⁵

In light of findings, some units have implemented spinal cord perfusion pressure in their standard acute care of patients in immediate aftermath of spinal cord injury as a more accurate measure.¹⁶

Despite controversies regarding effect of MAP and SCPP on neurological recovery in first week after injury, beyond the acute phase of spinal cord injury (1-2 weeks), there is currently no evidence to support prolonged bed rest has any positive effect on outcome and recovery of patients with spinal cord injury.

Effect of conservative versus surgical intervention on mobilisation timing

Beyond the immediate acute phase of spinal cord injury where bed rest is implemented to improve cord perfusion and prevent haemodynamic instability in intensive care unit, there is currently no evidence to suggest prolonged bed rest has any positive effect on outcomes. Despite this, bed rest sometimes is advocated in the management of fractures associated with spinal cord injury. The reason for conservative management and prolonged bed rest after spinal fractures can range from lack of resources to patient choice, medical comorbidities precluding surgical fixation. Some authors however have reported that following spinal cord injury, conservative management is a viable option and many such patients can be treated non-operatively with prolonged bed rest until bony healing/fusion is achieved without need for surgical fixation and risks associated.¹⁷ It is argued that with such conservative management and prolonged bedrest, many patients will make some spontaneous recovery without added risk of cord hypoperfusion during surgery.¹⁷

On the other hand, surgical management and fixation and early mobilisation is recommended by many to prevent further secondary neurological deterioration and to prevent prolonged periods of bed rest and related complications.¹⁸⁻¹⁹ Surgical decompression is normally recommended for progressive neurological deficit or to prevent further secondary neurological deterioration in incomplete spinal cord injury. Surgical fixation is advocated in patients with unstable fractures as this facilitates patient care and nursing allowing easy positioning without fear of instability. This in turn leads to improved chest physiotherapy and further optimises

their ability to engage in rehabilitation. This has led to many European and North American spinal units adopting early fixation and mobilisation approach.

The timing of surgical intervention is a further subject of controversy. Results surrounding the efficacy of early (<24 hours) versus late decompressive surgery, as well as the quality of evidence available has been shown to be variable depending on the level of spinal cord injury, the timing of follow-up, and the specific outcome assessed. Based on most recent systematic review, the existing evidence support improved neurological recovery amongst cervical cord injury patients undergoing surgery ≤ 24 hours post injury; evidence regarding remaining spinal cord injury populations and clinical outcomes was inconsistent.¹⁹⁻²⁰

Regardless of impact of timing of surgical intervention on amount of neurological recovery in spinal cord injury, it is evident that with mounting evidence regarding advantages of early mobilisation, more spinal units are adopting early surgical fixation approach as soon as possible once haemodynamic instability has been addressed to allow early rehabilitation and mobilisation.

Effects of prolonged bed rest

Prolonged bed rest is associated with significant complications including pressure ulcers, muscle atrophy, contractures, recurrent respiratory tract infections, resulting in repeated intensive care unit admissions.²¹⁻²² This in turn leads to delays in initiating the rehabilitation required for spinal cord injury patients.

In addition, prolonged bed rest in spinal cord injury patient can be associated with worse psychological wellbeing. Some have identified higher rate of pressure ulcer and re-hospitalisation with longer time interval between time of injury and rehabilitation.²³ Other studies have suggested that increased time between injury and rehabilitation is associated with reduced function (activities of daily living) and quality of life.²³⁻²⁵

Rapid transfer of spinal cord injury patients to specialist spinal cord injury units with multidisciplinary teams with relevant expertise can reduce complications related to prolonged bed rest following spinal cord injury. Earlier mobilisation and care in specialist spinal cord injury unit is associated with less complications in spinal cord injury patients.²⁶

In addition to patient related complications, prolonged bed rest can pose a significant logistic challenge and economical burden on hospitals with regards to bed flow/availability. With the limited number of spinal rehabilitation units available within UK, currently there are usually long waiting times for rehabilitation bed availability resulting in prolonged bed rest periods in peripheral hospitals with no access to spinal rehabilitation specialists. In addition to negative impact of this long waiting time on patient care and outcomes, this long waiting time of weeks to months in peripheral hospitals can be particularly detrimental for smaller hospitals where bed availability limits their ability to offer services to other patients in a world with increasing demand on limited health resources.

Effects of early mobilisation and rehabilitation

With increasing evidence on benefits of early mobilisation in other fields of surgery in post-operative patients and lack of evidence on negative impact on patient outcomes following mobilisation, aggressive and early mobilization is becoming a primary tenet of rehabilitation after spinal cord injury.²⁷

Early mobilisation of spinal cord injury patients with no haemodynamic instability or biomechanical instability is likely to have significant effect on improving respiratory function of the patients and clearance of secretions. In addition, early mobilisation is likely to have significant impact in prevention of pressure ulcers and play an important role in psychological wellbeing/recovery of patients with spinal cord injury.

Although mobilisation does not equate to rehabilitation, it constitutes a significant component of it. No studies to date have compared early versus late mobilisation post spinal cord injury on outcome. In addition there are no studies on timing of rehabilitation on effectiveness of rehabilitation. There are 3 studies however reporting that an increased time between injury and rehabilitation is associated with reduced function (activities of daily living) and quality of life.²³⁻²⁵ Two of these trials have reported on pressure ulcer and rehospitalisation with one demonstrating higher rate of rehospitalisation and pressure ulcers with bigger time interval between time of injury and rehabilitation²³ and the other showing no statistically significant link.²⁴

In light of paucity of evidence, expert opinion and guidance development group of experts play significant role in directing the management of spinal cord injury patients. Based on most recent comprehensive guidance development group (GDG) review in 2017, in the absence of direct studies comparing early versus late mobilisation/rehabilitation and review of all risks versus benefits, early rehabilitation is recommended. GDG agreed that when confronted with a life-altering event such as a SCI, patients and individuals are understandably eager to initiate rehabilitation and begin working towards recovery as soon as possible. In this context, early rehabilitation would reduce the adverse psychological events that may occur due to delayed treatment.¹⁸ The GDG also unanimously agreed that the anticipated desirable effects are probably large and indicated that other benefits to early rehabilitation include reduced burden on the health care system, decreased length of stay in acute care, and improved patient flow through the continuum of care.¹⁸ This has led to the recommendation for early rehabilitation in patients with traumatic SCI when they are medically and haemodynamically stable and can tolerate the treatment intensity.¹⁸

Effects of different types of rehabilitation after spinal cord injury

The concept of what constitutes rehabilitation is also further topic of controversy in the field of spinal cord injury. Although mobilisation does not equate to rehabilitation, mobilisation forms an important component of rehabilitation process. There are 5 studies that directly have assessed the role of different types of rehabilitation in spinal cord injury patients.¹⁸

Dobkin et al evaluated whether spinal cord injury patients treated with body weight–supported treadmill training would have better outcomes compared with a control group receiving defined overground mobility training of similar intensity. They concluded based on their study that, there were no significant differences between the groups with respect to functional independence measure scores, lower extremity motor scores, walking velocity or walking distance at different time points of 6 weeks, 3 months, 6 months, or 12 months.²⁸

Lucareli et al further compared range of motion and spatial-temporal variables between patients treated with body weight–supported treadmill training and those receiving conventional gait training. Patients receiving body weight–supported treadmill training had better improvements in maximum hip extension during stance and maximum plantarflexion during preswing. There were no differences between groups with regards to other range of motion variables. Body weight-supported treadmill training was more effective at improving spatial-temporal gait parameters (gait velocity, time of gait cycle, stance time/duration of support, swing time/balance duration, step length, distance, and cadence) than the control group.²⁹

Harvey et al compared outcomes between patients who received additional training time for unsupported sitting exercises and those treated with standard in-patient therapy. No benefit was observed based on their results on any of the outcome measures, including the spinal cord injury Falls Concern Scale, maximal lean test and the Canadian Occupational Performance Measure.³⁰

Functional electrical therapy is a further mode of rehabilitation. Popovic et al compared outcomes between patients treated with functional electrical stimulation and occupational therapy with those treated with only occupational therapy. They concluded that patients receiving the functional electrical stimulation demonstrated greater improvements on the functional independence measure motor subscore, functional independence measure self-care subscore and spinal cord independence measure self-care subscore than the control group.³¹

Based on above studies, GDG in 2017 have suggested that body weight-supported treadmill training is a viable option for ambulation training in addition to conventional overground walking, dependent on resource availability, context, and local expertise. They further have suggested that individuals with acute and subacute cervical SCI can be offered functional electrical stimulation as an option to improve hand and upper extremity function. However based on the absence of any clear benefit, they suggest not offering additional training in unsupported sitting beyond what is currently incorporated in standard rehabilitation.¹⁸

Conclusions

Beyond the acute phase of spinal cord injury where there is some evidence to suggest maintaining blood pressure for 1 week may be associated with better neurological recovery, there is no evidence to suggest prolonged bed rest has positive effect on patient outcomes. In the absence of haemodynamic or biomechanical instability where patients can tolerate intensity of rehabilitation, early mobilisation is likely to have significant advantages for the patients involved both by reducing complications associated with long bed rest and also by improving psychological wellbeing. The current practice of bed rest and mobilisation timing is varied across centres in UK and a more updated unified approach is required to optimise the care of patients following spinal cord injury in spinal rehabilitation units.

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Conflict of interest:

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