

Rehabilitation of the patient with a Prolonged Disorder of Consciousness

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Post Cardiac Arrest Care
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**Karolinska
Institutet**



Danderyds Sjukhus

University Dept of Rehabilitation Medicine for the Stockholm region, Danderyd Hospital



In-patients:

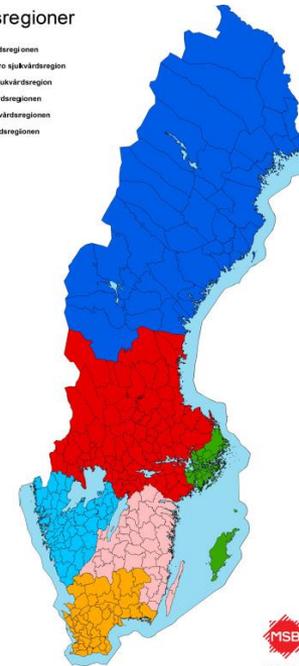
- Specialised rehabilitation after moderate to profound acquired brain injury, 35 beds
- Intake from 7 acute hospitals in Stockholm region
- Disorders of Consciousness care programme since 2013

Out-patient programmes

Health Care Regions

Sjukvårdsregioner

- Norra sjukvårdsregionen
- Uppsala-Örebro sjukvårdsregion
- Stockholms sjukvårdsregion
- Västra sjukvårdsregionen
- Södra sjukvårdsregionen



MSB
Myndigheten för
samhällets
sikkerhet och
beredskap
© Bakgrundskarta Lantmäteriet

Population:

Sweden	10 million
Stockholm Region	2.3 million

Views of the audience (MKON app – "dialog")

What period of inpatient care do you consider is appropriate for rehabilitation interventions on a rehabilitation ward for a patient who continues to be in a vegetative state?

- a. None, admission to rehabilitation ward inappropriate
- b. < 1 week
- c. 1 to < 2 weeks
- d. 2 to < 4 weeks
- e. 1 to < 3 months
- f. 3 to < 6 months
- g. \geq 6 months
- h. Don't know

Answers in 2010 from Swedish Physicians working with rehabilitation:

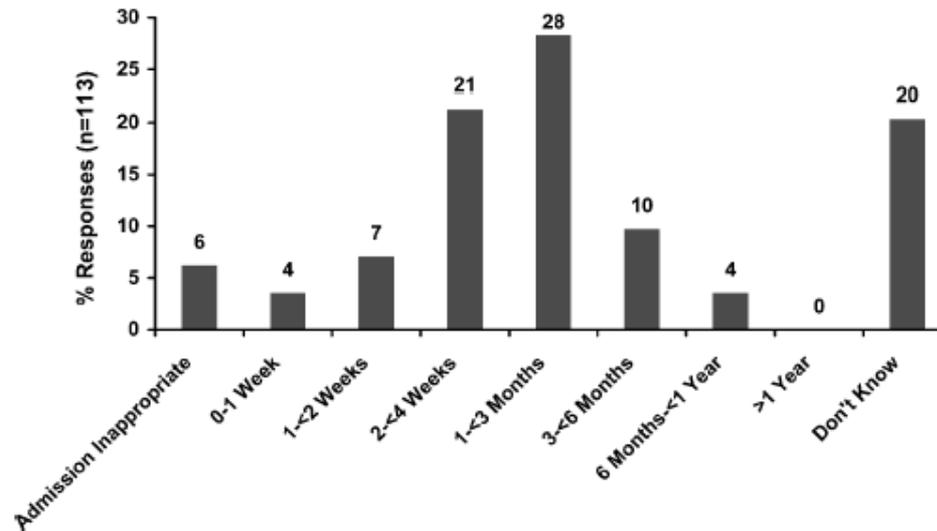


FIGURE 3 *Opinions on appropriate duration of inpatient care on a rehabilitation ward for patients who continue to be in a vegetative state.*

Opportunity for inpatient brain injury rehabilitation for persons in a vegetative state: survey of Swedish physicians. Godbolt AK, Tengvar C, Johansson B, Stenson S, Borg J. *Am J Phys Med Rehabil.* 2011 Jun;90(6):482-9.

Views of the audience (MKON app – ”dialog”)

Availability of specialist neurorehabilitation for a patient with a Prolonged Disorder of Consciousness in the area where I work is generally

- a. Good (always or nearly always available)
- b. Reasonable (often available)
- c. Limited (often unavailable)
- d. Poor (seldom or never available)
- e. I don't know whether it is available or not

Definitions – Disorders of Consciousness

Term	Abbr.	Notes	Reference
Disorder of Consciousness	DOC	Coma, vegetative state or minimally conscious state	Royal College of Physicians UK. Prolonged disorders of consciousness: National guidelines 2013
Prolonged Disorder of Consciousness	PDOC	DOC persisting longer than 4 weeks	
Coma		Absence of eye opening	
Vegetative State (Also known as Unresponsive Wakefulness syndrome, UWS or Apallic Syndrome)	VS	Eye opening but absence of behavioural signs of awareness.	Jennett and Plum 1972
Minimally Conscious State	MCS	Inconsistent but clearly discernible behavioral evidence of consciousness	Giacino et al 2002
Emerged from Minimally Conscious State	EMCS	Reliable and consistent demonstration of one or both of the following: <ul style="list-style-type: none"> • Functional interactive communication. • Functional use of two different objects. 	

Shifting terms to describe temporal aspects of vegetative state

Vegetative state (VS) descriptor	Definition	Origin of term	Year	Ref
Persistent	VS sustained over time	UK	1972	Jennett and Plum
Persistent	VS for ≥ 1 month	USA	1994	Multi-Society Task Force
Permanent	VS for ≥ 3 months after non-traumatic brain injury	USA	1994	Multi-Society Task Force
Permanent	VS for ≥ 6 months after non-traumatic brain injury	UK	2003, 2013	Royal College of Physicians guidelines
Continuing	VS for ≥ 4 weeks	UK	2013	Royal College of Physicians guidelines
Chronic	VS for ≥ 3 months after non-traumatic brain injury	USA	2018	American Academy of Neurology & American College of Rehabilitation Medicine guidelines

Shifting terms to describe temporal aspects of vegetative state

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“a persistent vegetative state can be considered to be permanent after three months; recovery does occur, but it is rare and at best associated with moderate or severe disability”.

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“a persistent vegetative state can be considered to be permanent after three months; recovery does occur, but it is rare and at best associated with moderate or severe disability”.

“Continued use of the term permanent VS is not justified. It implies irreversibility, which is not supported by the current research and has implications fordecision making and ethics...”.

What is rehabilitation?

Swedish Board of Health and Welfare (Socialstyrelsen)

Interventions that, taking into account the needs & condition of a person with acquired disabilities, support restitution or maintenance of the best possible level of function and create good conditions for an independent life and active participation in society.

*(own translation from the Swedish
<http://www.socialstyrelsen.se/sosfs/2007-10>)*

Diagnosis of a PDOC: steps before behavioural assessment

<i>Consider</i>	<i>Evaluate</i>
Is brain injury established as the primary cause of reduced conscious level?	<ul style="list-style-type: none"> • What does brain imaging show? • What does EEG show? • Are clinical examination findings in keeping with the purported brain injury diagnosis?
Are reversible or treatable factors impacting on behavioural responses?	<ul style="list-style-type: none"> • Medication • Medical complications • Peripheral neurological factors, e.g. critical illness neuro-myopathy
If conscious, could the patient <u>understand</u> instructions?	<ul style="list-style-type: none"> • Can the patient see, hear and feel? <ul style="list-style-type: none"> • Are primary visual, auditory, somatosensory pathways intact? • Does the patient understand the examiner's language? • Is aphasia likely?
If conscious, could the patient <u>respond to</u> instructions?	<ul style="list-style-type: none"> • Can the patient move? <ul style="list-style-type: none"> • Are primary motor pathways intact? • Are contractures or spasticity limiting possible responses? • Does the patient have the language skills to respond? <ul style="list-style-type: none"> • is aphasia likely?

Diagnosis of a PDOC: behavioural assessment

Synthesis of:

1. Reported and observed behaviours

- spontaneous
- related to everyday stimuli

2. Behaviours occurring during structured, standardized assessment (assessment scales)

- repeated assessments necessary
- unclear *how many* assessments should be performed
 - most published studies use 4 - 5
 - some authorities suggest 10

Standardized behavioural assessment

- Coma Recovery Scale Revised (CRS-R) has become the gold standard:

SPECIAL ARTICLE

A Practice Parameter of the American Congress of Rehabilitation Medicine



Assessment Scales for Disorders of Consciousness: Evidence-Based Recommendations for Clinical Practice and Research

Report of the American Congress of Rehabilitation Medicine, Brain Injury-Interdisciplinary Special Interest Group, Disorders of Consciousness Task Force: Ronald T. Seel, PhD, Task Force Chair, Mark Sherer, PhD, John Whyte, MD, PhD, Douglas I. Katz, MD, Joseph T. Giacino, PhD, Amy M. Rosenbaum, PhD, Flora M. Hammond, MD, Kathleen Kalmar, PhD, Theresa Louise-Bender Pape, DrPH, MA, Ross Zafonte, DO, Rosette C. Biester, PhD, Darryl Kaelin, MD, Jacob Kean, PhD, Nathan Zasler, MD

Arch Phys Med Rehabil 2010;91:1795-1813.

Rehabilitation for patients with PDOC

Assess and prioritize

- Evaluate current level of consciousness
- Understand co-morbidities

Minimize factors contributing to lack of responses:

- Prevent and treat early medical complications
- Minimise sedating medications
- Manage the environment
- Optimize aids

Promote consciousness:

Research and Development

- Pharmacotherapy
- Sensory stimulation
- Neuromodulation

Prevent deterioration

For example:

- Prevent and treat late medical complications
- Preserve joint range of movement

Rehabilitation for patients with PDOC

Assess and prioritize

- Evaluate current level of consciousness
- Understand co-morbidities

Minimize factors contributing to lack of responses

- Prevent and treat early medical complications
- Minimise sedating medication
- Maximize the environment
- Optimize nutrition

**A process: assessment,
prioritization and follow up of
interventions, re-evaluation**

Promote consciousness:

- Pharmacotherapy
- Sensory stimulation
- Neuromodulation

Research and Development

Prevent deterioration

For example:

- Prevent and treat late medical complications
- Preserve joint range of movement

Maintaining function and preventing complications

	Interventions may include
Spasticity	Specialized seating, positioning through 24 hours, orthotics, passive movements, tilt table, drugs (<i>but beware sedation</i>)
Epilepsy	Medication review: minimize seizures, avoid sedating drugs
Respiratory secretion management	Positioning, physiotherapy, PEP breathing, assisted cough, tracheostomy management
Urinary tract management	Avoid catheters, consider urinary stones as possible source of pain
Gastrointestinal management	Usually feeding via PEG, bowel management.
Pressure sore prevention	Regular turning. Air mattress may trigger spasticity
Environmental regulation	Avoid uncontrolled stimuli (e.g. TV)
Sleep	Investigation and treatment of possible sleep disorders, e.g. sleep apnoea
Pain management	Use of behaviour based scale to optimize management whilst minimising sedation

Promoting consciousness - pharmacotherapy

1. Reduce sedating drugs
2. Reduce sedating drugs
3. Reduce sedating drugs
4. Consider use of drug to promote awareness:

- Amantadine

Good evidence in PDOC after trauma

RCT n=184, NEJM, Giacino 2012

Limited evidence in PDOC after anoxic brain injury

- Zolpidem

Reported paradoxical effects with increased responsiveness

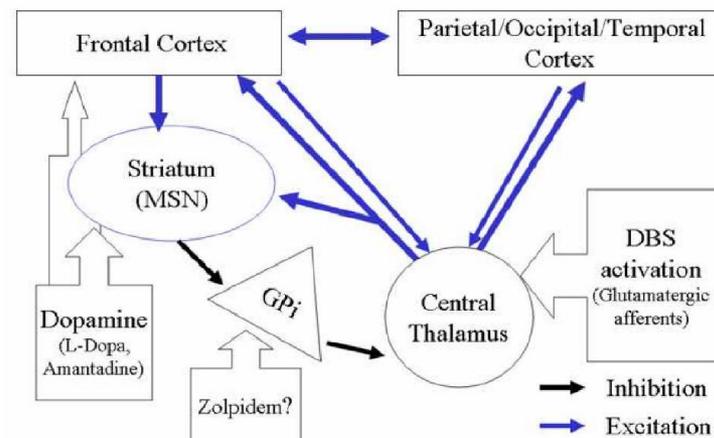
Initial studies not confirmed

- (Apomorphine – await trials)

Difficult balance with drugs for
Pain – e.g. opioids
Epilepsy – e.g. phenytoin
Anxiety – e.g. benzodiazepines

Theoretical basis for drug effects:

Mesocircuit model, *Schiff 2010*



Promoting consciousness – sensory stimulation

Principle:



Promotion of
neuroplasticity
via environmental
enrichment

Neuroplasticity – examples of mechanisms

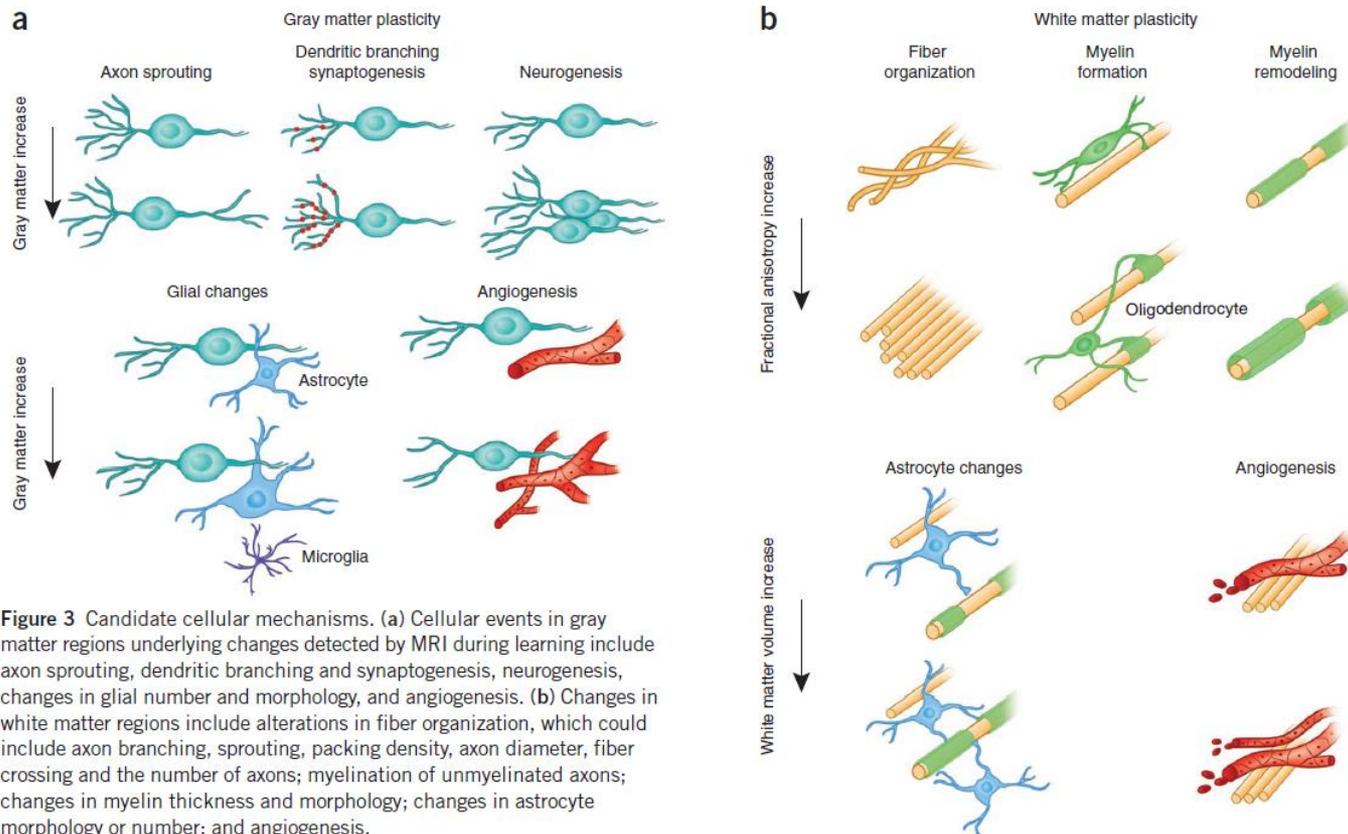


Figure 3 Candidate cellular mechanisms. (a) Cellular events in gray matter regions underlying changes detected by MRI during learning include axon sprouting, dendritic branching and synaptogenesis, neurogenesis, changes in glial number and morphology, and angiogenesis. (b) Changes in white matter regions include alterations in fiber organization, which could include axon branching, sprouting, packing density, axon diameter, fiber crossing and the number of axons; myelination of unmyelinated axons; changes in myelin thickness and morphology; changes in astrocyte morphology or number; and angiogenesis.

Plasticity in gray and white: neuroimaging changes in brain structure during learning

Robert J Zatorre^{1,4}, R Douglas Fields^{2,4} & Heidi Johansen-Berg^{3,4}

Promoting consciousness – sensory stimulation and experience dependent plasticity

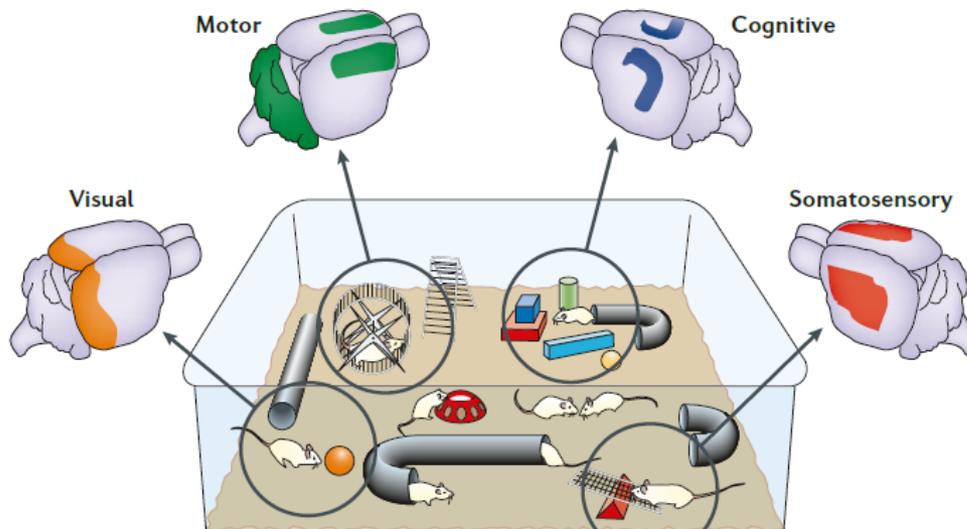


Figure 1 | Environmental enrichment and the effects of enhanced sensory, cognitive and motor stimulation on different brain areas. Enrichment can promote neuronal activation, signalling and plasticity throughout various brain regions. Enhanced sensory stimulation, including increased somatosensory and visual input, activates the somatosensory (red) and visual (orange) cortices. Increased cognitive stimulation— for example, the encoding of information relating to spatial maps, object recognition, novelty and modulation of attention — is likely to activate the hippocampus (blue) and other cortical areas. In addition, enhanced motor activity, such as naturalistic exploratory movements (including fine motor skills that differ radically from wheel running alone), stimulates areas such as the motor cortex and cerebellum (green).

Enriched environments, experience-dependent plasticity and disorders of the nervous system

NATURE REVIEWS | **NEUROSCIENCE**
VOLUME 7 | SEPTEMBER 2006 |

Promoting consciousness – sensory stimulation 1

Type	Method	Studies	Findings	Brain injury aetiology
Unimodal	Familiar Auditory Sensory Training	Pape et al 2015, RCT, n=7 treatment group	Greater improvement on one measure of consciousness, Rx group	Trauma
	Music Therapy	Magee, O’Leary 2015 (review)	Indirect evidence for positive effects on arousal and attention	Mixed
	Other auditory stimulation	Cheng et al 2013, case series, n=86	Auditory localisation more frequently in response to own name than a bell	Unclear, ”recovering from coma”

Promoting consciousness –sensory stimulation 2

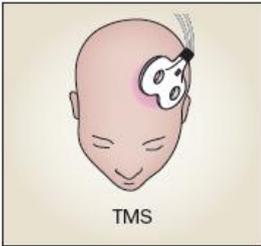
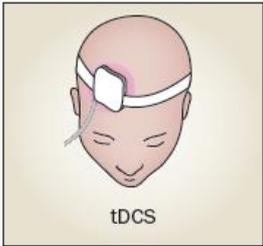
Type	Method	Studies	Findings	Brain injury aetiology
Multimodal	Auditive, tactile, kinetic, olfactory and/or gustatory stimulation in various combinations	Padilla, Domina 2016 (review)	Some evidence of effect, but conclusions not fully supported	Mixed
	Physiotherapy based methods incorporating sensory stimulation (e.g. Affolter method)	No studies found in the English language literature		Used for acquired brain injury of mixed aetiology in some centres

Promoting consciousness – sensory stimulation

Potential conflict:



Promoting consciousness – neuromodulation *promise for the future?*

Method	Studies	Findings
 <p>TMS</p>  <p>tDCS</p>	<p>tDCS</p> <p>Ragazzoni 2017 (review)</p> <ul style="list-style-type: none"> - Randomised controlled cross-over study, n=55 - Non-randomized, controlled study n=10 	<p>No clear effect</p> <p>Effect only in MCS</p>
rTMS	Ragazzoni 2017 (review): Two small controlled studies, case reports, case series.	Conflicting results
Median nerve stimulation	deFina 2010 - Case series, part of multimodal rehabilitation	Inconclusive
Deep Brain Stimulation	Vanhoecke, Hariz 2017 (review)	Sceptical, ethical issues, "no clear evidence"
Vagal Stimulation	Corazzol 2017, single case report	improvement
Epidural spinal cord stimulation	Ragazzoni 2017 (review): case studies, uncontrolled case series	inconclusive

Responding to requests for non-established investigations and interventions:

A framework for discussions with relatives

	Positive if	Negative if
Theoretical basis	<ul style="list-style-type: none"> • Good 	<ul style="list-style-type: none"> • Weak or non-existent
Evidence for effect	<ul style="list-style-type: none"> • Published study in peer reviewed scientific journal • Control group • Several studies 	<ul style="list-style-type: none"> ▪ No published research studies ▪ Research studies that have not been evaluated by an independent ethics board ▪ No control group
Risks <ul style="list-style-type: none"> - Medical - Economic - Participatory - Impact on care and rehabilitation 	<ul style="list-style-type: none"> • Few risks 	<ul style="list-style-type: none"> • Considerable or unknown risks

Inspired in part by Jox et al 2012, Lancet Neurology

Late recovery from PDOC due to anoxic brain injury

Author	Methods	n	n with anoxic brain injury	At study start:		Follow up time	Findings (patients with anoxic brain injury)
				PDOC type	PDOC duration		
Estraneo <i>et al</i> , 2010	Prospective cohort study	50	14	VS	6 – 18 months	12 – 48 months	2 emerged from MCS
Luauté <i>et al</i> , 2010	Retrospective cohort study	51	16	VS (n=9) MCS (n=7)	≥ 1 year	≥ 5 years	VS → none improved MCS → one emerged from MCS
Yelden <i>et al</i> , 2018	Cross-sectional cohort study	34	12	VS	1 year (mean)	6 years (mean)	3 improved from VS to MCS None emerged from MCS
Howell <i>et al</i> , 2015	Retrospective cohort study	113	113	VS (n=66) MCS (n=47)	27 days (mean)	4 months	22 emerged from MCS

VS – vegetative state

MCS – minimally conscious state

Further reading

USA guidelines 2018

SPECIAL ARTICLE LEVEL OF RECOMMENDATION

Practice guideline update recommendations summary: Disorders of consciousness

Report of the Guideline Development, Dissemination, and Implementation Subcommittee of the American Academy of Neurology; the American Congress of Rehabilitation Medicine; and the National Institute on Disability, Independent Living, and Rehabilitation Research

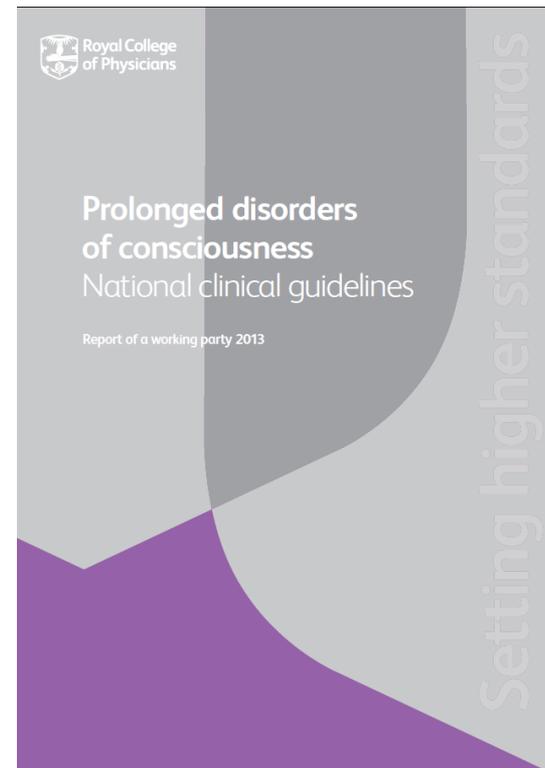
Joseph T. Giacino, PhD, Douglas I. Katz, MD, Nicholas D. Schiff, MD, John Whyte, MD, PhD, Eric J. Ashman, MD, Stephen Ashwal, MD, Richard Barbano, MD, PhD, Flora M. Hammond, MD, Steven Laureys, MD, PhD, Geoffrey S.F. Ling, MD, Risa Nakase-Richardson, PhD, Ronald T. Seel, PhD, Stuart Yablon, MD, Thomas S.D. Getchius, Gary S. Gronseth, MD, and Melissa J. Armstrong, MD, MSc

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Neurology
guidelines@aan.com

Neurology® 2018;91:450-460. doi:10.1212/WNL.0000000000005926

Neurology | Volume 91, Number 10 | September 4, 2018

UK guidelines 2013



<https://www.rcplondon.ac.uk/guidelines-policy/prolonged-disorders-consciousness-national-clinical-guidelines>

Further reading

Swedish recommendations 2014

Läkartidningen 2014,
Godbolt, Lindgren, Stenberg,
Cronberg, Tengvar, Sörbo

Läkartidningen

■ KLINIK & VETENSKAP ÖVERSIKT

Citera som: Läkartidningen. 2014;111:CZEE

Långvarig svår medvetandestörning efter hjärnskada hos vuxna

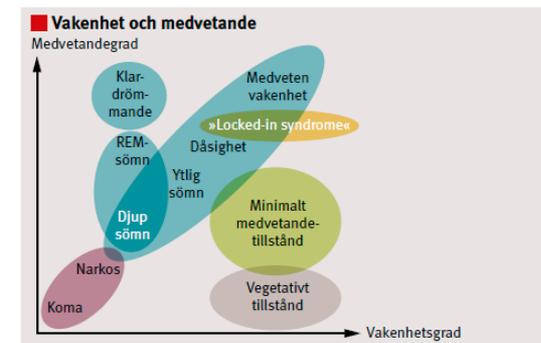
Nya rekommendationer ger underlag för utredning och rehabilitering

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CHRISTER TENGVAR, med dr, överläkare, rehabiliteringsmedicinska kliniken, Akademiska sjukhuset, Uppsala
ANN SÖRBO, med dr, överläkare, rehabiliteringskliniken, Södra Älvsborgs sjukhus, Borås



Figur 1. Vakenhet och medvetande. Efter Laureys [43].

tas i Fakta 1. Sökorden gällande andra aspekter inkluderade »vegetative state«, »minimally conscious state«, »disorders of consciousness«, »prognosis«, »treatment«, »rehabilitation«, »recovery« och »assessment«.

Forskningsunderlaget för samtliga rekommendationer graderas (Tabell I) som »starkt« (minst en högkvalitativ randomiserad kontrollerad studie) eller »visst« (minst en studie av acceptabel kvalitet). Där forskningsevidens saknas baseras rekommendationerna på expertkonsensus (Tabell I). Alternativa metoder för evidensgradering (såsom GRADE-systemet) är mindre lämpade med tanke på de ofta komplexa interventioner [2] som används för denna patientgrupp.

Patienter med progressiva sjukdomar, som MS och demens, omfattas inte av rekommendationerna.

Svårigheter vid omhändertagande och olikheter i vården
Patienter som utvecklar långvarig svår medvetandestörning vårdas i akutskedet på ett flertal olika vårdenheter beroende på hjärnskadans etiologi. Enskilda kollegor inom de flesta be-

Thank you

Tack

