


CLINICAL PRACTICE: CURRENT OPINION

Post-Acute Level Of Consciousness scale revised (PALOC-sr): adaptation of a scale for classifying the level of consciousness in patients with a prolonged disorder of consciousness[†]

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(Received 9 September 2021; revised 4 March 2022; accepted 15 March 2022; first published online 26 April 2022)

Abstract

Objective: To present an updated version of the ‘Post-acute Level Of Consciousness scale’ (PALOC-s), in accordance with the latest scientific insights.

Methods: Within the context of a research project, 20 years ago, the PALOC-s was developed for the purpose of following the development of the level of consciousness of young unconscious patients participating in a rehabilitation program. Meanwhile, the understanding of the behavior related to different levels of consciousness has developed and terminology has changed, resulting in the need to revise the PALOC-s. With the preservation of the original description of the eight hierarchical levels of PALOC-s, adaptations are made in the terminology and grouping of these levels.

Results and conclusion: This manuscript presents the revised version of PALOC-sr, which is suitable for use in clinical practice. The validation of this scale is recommended for its optimal use in future (international) research projects.

Keywords: Severe brain injury; prolonged disorders of consciousness; observation scale; recovery evaluation

Introduction

Qualifying level of consciousness (LoC) of patients with a prolonged disorder of consciousness (PDoC) is challenging, in clinical practice as well as in research. Although neuroimaging techniques (i.e. fMRI or EEG) help our understanding of neural correlates of consciousness and aid in the diagnosis of PDoC, behavioral assessment scales remain the gold standard for qualifying LoC.

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[†]This manuscript is a translation with some contextual relevant changes of the in Dutch published article: Eilander HJ, van Erp WS, Driessen DMF, Overbeek BUH, Lavrijsen JCM. Post-Acute Level Of Consciousness scale revised (PALOC-sr): voorstel tot aanpassing van een schaal om het bewustzijnsniveau van mensen met een langdurige bewustzijnsstoornis te classificeren. *Neuropraxis*. 2020;24(5):141-5.

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In the acute phase, the Glasgow Coma Scale is the most commonly used instrument (Formisano *et al.*, 2019). When patients are no longer dependent on intensive care treatment, but still do not show clear signs of consciousness, the use of other behavioral observation scales is the standard assessment method to determine the different LoC and possible changes over time (Giacino, Fins, Laureys & Schiff, 2014).

Within the context of the evaluation of a treatment program for young (<25 years) PDoC patients in the early 2000s, the ‘Post-acute Level Of Consciousness scale’ (PALOC-s) was developed (Eilander *et al.*, 2009; Eilander, Wijnen, Scheirs, de Kort & Prevo, 2005). This scale offers a simple assessment tool using systematically observed behaviors, which can be classified into eight hierarchical levels, from coma to full consciousness. The classification was based on the landmark publications from two specialized task forces: the ‘International Working Party on the Management of the Vegetative state’ (Andrews, 1996) and the ‘Aspen Neurobehavioral Conference’ (Giacino *et al.*, 1997). The eight levels were coma (level P1), vegetative state with three sublevels (levels P2, P3 and P4), the low awareness state with three sublevels (levels P5, P6 and P7) and consciousness (level P8). Ideally, the PALOC-s was designed to be used in combination with another standardized instrument, like the Western Neuro Sensory Stimulation Protocol (Ansell & Keenan, 1989) or the JFK Coma Recovery Scale (CRS) (Giacino, Kezmarisky, DeLuca & Cicerone, 1991), but it could also be used as an observational scale at any other moment.

Over the past 20 years, the progress in PDoC research changed our understanding of behaviors related to different levels of consciousness. Therefore, revision of the PALOC-s on this aspect is of importance. Second, the terminology has been changed. In 2010, the ‘Vegetative State (VS)’ has been proposed to be renamed as the ‘Unresponsive Wakefulness Syndrome’ (UWS) (Laureys *et al.*, 2010). Also, the term ‘Low Awareness State’ is no longer used and replaced by the term ‘Minimally Conscious State’ (MCS) (Giacino *et al.*, 2002). To prevent possible misdiagnosis and to prevent ambiguous descriptions, an update of the PALOC-s is needed.

Levels of consciousness

The validity of LoC measurements in PDoC patients and the underlying cerebral processes has been a subject of academic debate for decades (Nettleton, Kitzinger & Kitzinger, 2014; Wade, 2017). Different interrelated concepts can be distinguished, without knowing the exact underlying mechanism: *wakefulness* (not sleeping), *alertness* (being able to process information) and *consciousness* (to be aware of oneself or their surroundings) (Lindsley, 1988). In the past 20 years, active functional neuroimaging or electrophysiological paradigms have been developed to detect willful brain activity in unresponsive patients (Schnakers *et al.*, 2020.) However, in clinical practice, these methods cannot be used easily. Therefore, behavioral observation in a standardized situation is the preferred way of examining the LoC. The commonly used instrument is the Coma Recovery Scale Revised (CRS-R) (Giacino, Kalmar & Whyte, 2004), as was recommended by the American Congress of Rehabilitation Medicine (Seel *et al.*, 2010).

Until recently, the categories that could be scored in the CRS-R were UWS, MCS and consciousness. In the latest update, the distinction between MCS+ and MCS– has been added, based on a study by Thibaut, Bodien, Laureys & Giacino (2020).

For clinical use, research, as well as for communication with relatives, it can be useful to have the possibility to distinguish more (sub)levels, as described more than 20 years ago by the ‘International Working Party on the Management of the Vegetative state’ (Andrews, 1996). Research on the reliability and validity of the PALOC-s, distinguishing eight levels of consciousness, demonstrated a high interrater reliability (Eilander *et al.*, 2009). This means that it is possible to classify the behavior in a reliable manner. Moreover, the use of the mapping in these eight levels can be of additional value in the clinical description of the observed behavior, due to the overall behavioral repertoire represented by the PALOC-sr.

Table 1. PALOC-sr (Post-Acute Level Of Consciousness scale revised), revision 2020

Post-Acute Level Of Consciousness scale revised (PALOC-sr)	
<p>The classification presented below offers the possibility to discriminate between eight (8) levels of (un)consciousness in patients with disturbed consciousness, caused by severely acquired brain injury.</p> <p>The PALOC-sr is effective in evaluating possible changes in the level of consciousness after the acute phase (the ICU-period), usually several weeks after the injury.</p> <p>Scoring is completed by encircling the number that coincides with the level of consciousness, giving the most accurate reading corresponding to the patient's behavior, as described on the next page.</p>	
<p>a. What is the general level of consciousness the patient shows? P1 P2 P3 P4 P5 P6 P7 P8</p> <p>Were there any moments in which the patient showed another level of consciousness?</p> <p>b. What is the highest level of consciousness the patient shows? P1 P2 P3 P4 P5 P6 P7 P8</p> <p>c. What is the lowest level of consciousness the patient shows? P1 P2 P3 P4 P5 P6 P7 P8</p>	
Global level	Description of the levels
Coma	Eyes are closed all the time. No sleep-wake cycles present.
	P1 All major body functions such as breathing, temperature regulation or blood pressure can be disturbed. Generally, no reactions are noticed after stimulation. Sometimes reflexes (stretching or flexing) are observed as a reaction to strong pain stimuli. No other reactions are present.
Unresponsive Wakefulness syndrome (UWS)	Patient shows sleep-wake cycles, but not a proper day-night rhythm. Most of the body functions are normal. No further ventilation is required.
	P2 Very little responses (hyporesponsive) Generally, no responses after stimulation. Sometimes delayed presentations of reflexes are observed
	P3 Reflexive state Stimuli often result in massive stretching or startle reactions, without proper habituation. Sometimes these reactions evolve into massive flexing responses. Roving eye movements can be observed, without tracking. Sometimes grimacing occurs after stimulation.
Minimally Conscious State – (MCS–)	Patient remains awake most of the day
	P4 High active level and/or reactions in stimulated body parts Generally spontaneous undirected movements. Retraction of a limb following stimulation. Orientation towards a stimulus, without fixation. Following moving persons or objects, without fixation.
	P5 Automated reactive state Following and fixating of persons and objects. Generally, more directed reactions to stimuli. Behavior is automatic, i.e., opening of the mouth when food is presented, or reaching towards persons or objects. Sometimes emotional reactions are seen, such as crying or smiling towards family or to specific (known) stimuli.

(Continued)

Table 1. (Continued)

Global level	Description of the levels	
Minimally Conscious State+ (MCS+)	P6	Inconsistent reactions Occasionally obeying simple commands. Total dependency. The patient has profound cognitive limitations; neuropsychological testing is impossible. Level of alertness fluctuates but is generally low.
	P7	Consistent reactions Patient obeys simple commands. Alertness level is high and stable. Many cognitive disturbances remain. Total dependency.
Conscious (confused) state	P8	Functional understandable mutual communication is possible, sometimes with technical support. Cognitive and behavioral disturbances can still be present.

Classification

The category MCS, as described in 2002, is very heterogeneous. Therefore, clinicians and researchers felt the need to differentiate this level into sublevels (Giacino *et al.*, 2002). In 2011, two sublevels were proposed: the *minimally conscious state* – (MCS–) and the *minimally conscious state* + (MCS+) (Bruno, Vanhaudenhuyse, Thibaut, Moonen & Laureys, 2011). Patients in MCS– mainly show involuntary, nonreflexive behaviors, such as visual pursuit of a moving mirror, while patients in MCS+ show language-dependent behaviors, such as executing simple commands like shaking someone’s hand on request and/or intelligible verbalization and/or intentional communication. This subdivision is frequently used in new publications and is shown to be relevant for the prediction of the long-term functional recovery (Thibaut *et al.*, 2020). Therefore, this distinction is also of importance to the revision of the PALOC-s. Meanwhile, views have also changed about the distinction between UWS and MCS. In 2000, withdrawal of a limb following noxious stimulation was considered compatible with UWS, nowadays this behavior is judged as a sign of MCS– (Giacino *et al.*, 2018). The difference between UWS and MCS is of importance for both prognosis and treatment policies, for example, managing active treatment, pain relief and medical-ethical decision-making by professionals and proxies (Jox *et al.*, 2015). Previous research showed that patients admitted to an early rehabilitation program, initially scoring P4 on the PALOC-s, had the same 100% chance of recovery to level P7 or P8 as the patients who scored P5 or P6, while patients scoring P2 or P3 at admission only had half of that chance (Eilander *et al.*, 2013). This is in agreement with recovery patterns reported worldwide (Estraneo *et al.*, 2019).

In Table 1, we present the PALOC-sr. Level P4 (patients showing reactions in stimulated limbs, visual pursuit or localization) is no longer considered as UWS, but as MCS–. So, levels P2 and P3 are categorized as UWS, levels P4 and P5 as MCS– and the levels P6 and P7 as MCS+. With respect to the description of the conscious state, Giacino *et al.* (2014, page 101) stated that patients with severe brain injury ‘newly emerged from MCS remain acutely confused and disoriented and may be prone to episodes of agitation, a condition termed acute confusional state’. We included the term ‘confused’ in the PALOC-sr to point out that after recovery to consciousness, cognitive functions may still be severely impaired. The descriptions of the eight hierarchical levels in the PALOC-sr remain unchanged compared with the PALOC-s.

The PALOC-sr is suitable for all unresponsive patients from 2 years of age at all stages after an acute brain injury of any etiology. It is not intended for use in patients suffering from a progressive (neurodegenerative) disease.

Conclusion

The evaluation of the LoC in hyporesponsive patients is currently a matter of systematic behavioral observation. The PALOC-sr, a qualitative, descriptive scale that goes beyond the snapshot evaluations and instead does justice to the overall behavioral clinical picture, allows a detailed description of the LoC of PDoC patients, in research as well as in clinical practice. Especially the distinction in eight levels of consciousness can contribute to a better understanding of recovery processes.

The adaptation of the PALOC-s not only contributes to a more accurate description of the LoC of PDoC patients but may also aid in formulating a reliable prognosis regarding the long-term outcome.

The PALOC-sr should preferably be administered in combination with other instruments in order to prevent possible misdiagnosis. Using multiple instruments is recommended by the American Academy of Neurology (Giacino et al., 2018) and in the UK by the Royal College of Physicians (2020).

Scoring the PALOC-sr can be done in minutes, so it does not add to the burden of the patient or the practitioner.

Further research testing the validity of the PALOC-sr in a considerable cohort is recommended, especially in the patients aged 25 years and above. In the Netherlands, a nationwide network of institutions treating patients with disorders of consciousness makes such a validation study possible. Hopefully, international validation studies will also be performed, providing an opportunity to compare outcome studies worldwide.

Acknowledgements. The authors thank Manju Virk for her grammatical contribution.

Financial support. This research received no specific grant from any funding agency, commercial or not-for-profit sectors.

Conflicts of interest. None.

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Cite this article: Eilander HJ, van Erp WS, Driessen DMF, Overbeek BUH., and Lavrijsen JCM. (2023). Post-Acute Level Of Consciousness scale revised (PALOC-sr): adaptation of a scale for classifying the level of consciousness in patients with a prolonged disorder of consciousness. *Brain Impairment* **24**, 341–346. <https://doi.org/10.1017/BrImp.2022.7>