The minimally conscious state: Definition and diagnostic criteria

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Definition and diagnostic criteria

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Abstract—*Objective:* To establish consensus recommendations among health care specialties for defining and establishing diagnostic criteria for the minimally conscious state (MCS). *Background:* There is a subgroup of patients with severe alteration in consciousness who do not meet diagnostic criteria for coma or the vegetative state (VS). These patients demonstrate inconsistent but discernible evidence of consciousness. It is important to distinguish patients in MCS from those in coma and VS because preliminary findings suggest that there are meaningful differences in outcome. *Methods:* An evidence-based literature review of disorders of consciousness was completed to define MCS, develop diagnostic criteria for entry into MCS, and identify markers for emergence to higher levels of cognitive function. *Results:* There were insufficient data to establish evidence-based guidelines for diagnosis, prognosis, and management of MCS. Therefore, a consensus-based case definition with behaviorally referenced diagnostic criteria was formulated to facilitate future empirical investigation. *Conclusions:* MCS is characterized by inconsistent but clearly discernible behavioral evidence of consciousness and can be distinguished from coma and VS by documenting the presence of specific behavioral features not found in either of these conditions. Patients may evolve to MCS from coma or VS after acute brain injury. MCS may also result from degenerative or congenital nervous system disorders. This condition is often transient but may also exist as a permanent outcome. Defining MCS should promote further research on its epidemiology, neuropathology, natural history, and management.

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Precise estimates of the incidence and prevalence of severe disorders of consciousness are unavailable. In the United States, the number of individuals who sustain severe traumatic brain injury (i.e., brain injury caused by externally inflicted trauma[1]) with prolonged loss of consciousness each year is estimated to be between 56 and 170 per one million.[2,3] The economic impact of the problem is enormous. Projected average per person lifetime costs of care alone for severe traumatic brain injury range from $600,000 to $1,875,000.[4] A single case described by Paris[5] reported in-hospital lifetime costs of $6,104,590. In the last 5 years, there have been some attempts to clarify and define diagnostic, prognostic, and treatment issues concerning patients with severe disturbances of consciousness.[6-10] Disorders of consciousness include coma and the vegetative state (VS). Patients in coma have complete failure of the arousal system with no spontaneous eye opening and are unable to be awakened by application of vigorous sensory stimulation.[11] VS is characterized by the complete absence of behavioral evidence for self or environmental awareness. There is preserved capacity for spontaneous or stimulus-induced arousal, evidenced by sleep–wake cycles.[12] The locked-in syndrome, characterized by anarthria and quadriplegia with general preservation of cognition, must be distinguished from disorders of consciousness.[11] The table outlines the clinical features of disorders of consciousness and the locked-in syndrome.

Some patients with severe alteration in consciousness have neurologic findings that do not meet criteria for VS. These patients demonstrate discernible

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Table *Comparison of clinical features associated with coma, vegetative state, minimally conscious state, and locked-in syndrome*

Condition	Consciousness	Sleep/ wake	Motor function	Auditory function	Visual function	Communication	Emotion
Coma	None	Absent	Reflex and postural responses only	None	None	None	None
Vegetative state	None	Present	Postures or withdraws to noxious stimuli	Startle	Startle	None	None
			Occasional nonpurposeful movement	Brief orienting to sound	Brief visual fixation		Reflexive crying or smiling
Minimally conscious state	Partial	Present	Localizes noxious stimuli	Localizes sound location	Sustained visual fixation	Contingent vocalization	Contingent smiling or crying
			Reaches for objects	Inconsistent command following	Sustained visual pursuit	Inconsistent but intelligible verbalization or gesture	
			Holds or touches objects in a manner that accommodates size and shape				
			Automatic movements (e.g., scratching)				
Locked-in syndrome	Full	Present	Quadriplegic	Preserved	Preserved	Aphonic/Anarthric	Preserved
						Vertical eye movement and blinking usually intact	

behavioral evidence of consciousness but remain unable to reproduce this behavior consistently. This condition is referred to here as the minimally conscious state (MCS). MCS is distinguished from VS by the partial preservation of conscious awareness.[13] This distinction is important for prognosis, treatment decisions, resource allocation, and medicolegal judgements. Some studies suggest a high rate of misdiagnosis (false positives and false negatives) among disorders of consciousness.[14,15] The prevalence of adult and pediatric cases of MCS is estimated to be between 112,000 to 280,000, based on operationally defined diagnostic criteria extracted from a large state registry.[16]

This article, prepared by the Aspen Neurobehavioral Conference Workgroup, proposes diagnostic criteria for MCS.

Methods. *Evidence review process.* Nine formal meetings of the Aspen Workgroup were held between March 1995 and October 2000. National and international delegates represented the fields of bioethics, neurology, neuropsychology, neurosurgery, physiatry, nursing, and allied health. Although it was not possible for each participant to attend all nine meetings, the current document was approved by all members of the workgroup. All delegates previously participated in the development of discipline-specific position statements on disorders of consciousness or made substantial contributions to the peer-reviewed literature. A list of the organizations represented by each author appears in the appendix, which also includes the names of all conference participants.

Selected members of the workgroup completed independent MEDLINE searches of published articles using the key words coma, vegetative state, minimally responsive state, stupor, slow-to-recover, severe disability, and Glasgow Coma Scale. These terms were then cross-indexed with brain injury, diagnosis, and outcome in eight different permutations to retrieve articles that included patients who did not meet diagnostic criteria for VS, but at the same time, were not considered fully conscious. A total of 260 abstracts containing one or more of the terms were retrieved. Only five reports[8,17–20] differentiated patients in VS from those with inconsistent signs of consciousness, defined here as MCS. The workgroup concluded that there were insufficient data to establish evidence-based guidelines for diagnosis, prognosis, and management of MCS. Consequently, consensus-based recommendations were developed for the definition of MCS as well as criteria for entry into and emergence from this condition.

Results. *Definition of the minimally conscious state.* The minimally conscious state is a condition of severely altered consciousness in which minimal but definite behav-

ioral evidence of self or environmental awareness is demonstrated.

Diagnostic criteria for the minimally conscious state. MCS is distinguished from VS by the presence of behaviors associated with conscious awareness. In MCS, cognitively mediated behavior occurs inconsistently, but is reproducible or sustained long enough to be differentiated from reflexive behavior. The reproducibility of such evidence is affected by the consistency and complexity of the behavioral response. Extended assessment may be required to determine whether a simple response (e.g., a finger movement or eye blink) that is observed infrequently is occurring in response to a specific environmental event (e.g., command to move fingers or blink eyes) or on a coincidental basis. In contrast, a few observations of a complex response (e.g., intelligible verbalization) may be sufficient to determine the presence of consciousness.

To make the diagnosis of MCS, limited but clearly discernible evidence of self or environmental awareness must be demonstrated on a reproducible or sustained basis by one or more of the following behaviors:

- Following simple commands.
- Gestural or verbal yes/no responses (regardless of accuracy).
- Intelligible verbalization.
- Purposeful behavior, including movements or affective behaviors that occur in contingent relation to relevant environmental stimuli and are not due to reflexive activity. Some examples of qualifying purposeful behavior include:
  - appropriate smiling or crying in response to the linguistic or visual content of emotional but not to neutral topics or stimuli
  - vocalizations or gestures that occur in direct response to the linguistic content of questions
  - reaching for objects that demonstrates a clear relationship between object location and direction of reach
  - touching or holding objects in a manner that accommodates the size and shape of the object
  - pursuit eye movement or sustained fixation that occurs in direct response to moving or salient stimuli

Although it is not uncommon for individuals in MCS to demonstrate more than one of the above criteria, in some patients the evidence is limited to only one behavior that is indicative of consciousness. Clinical judgments concerning a patient's level of consciousness depend on inferences drawn from observed behavior. Thus, sensory deficits, motor dysfunction, or diminished drive may result in underestimation of cognitive capacity.

Proposed criteria for emergence from the minimally conscious state. Recovery from MCS to higher states of consciousness occurs along a continuum in which the upper boundary is necessarily arbitrary. Consequently, the diagnostic criteria for emergence from MCS are based on broad classes of functionally useful behaviors that are typically observed as such patients recover. Thus, emergence from MCS is characterized by reliable and consistent demonstration of one or both of the following:

- Functional interactive communication.
- Functional use of two different objects.

Functional interactive communication may occur through verbalization, writing, yes/no signals, or use of augmentative communication devices. Functional use of objects requires that the patient demonstrate behavioral evidence of object discrimination.

To facilitate consistent reporting of findings among clinicians and investigators working with patients in MCS, the following parameters for demonstrating response reliability and consistency should be used:

- Functional communication: accurate yes/no responses to six of six basic situational orientation questions on two consecutive evaluations. Situational orientation questions include items such as, "Are you sitting down?" and "Am I pointing to the ceiling?"
- Functional object use: generally appropriate use of at least two different objects on two consecutive evaluations. This criterion may be satisfied by behaviors such as bringing a comb to the head or a pencil to a sheet of paper.

To help ensure that the operational parameters for demonstrating functional communication and object use described above are equivalent in terms of difficulty, the neurobehavioral profiles of a convenience sample of patients in MCS (n = 24) extracted from a database maintained by one of the authors were reviewed (unpublished data). From this pool, 17 patients were identified who met criteria for either functional object use (FO) or functional communication (FC). The temporal course of recovery of FO and FC was investigated to determine whether the sequence of recovery could serve as an index of difficulty. For example, if most patients met criteria for FO before the criteria for FC were satisfied, it could be concluded that the criteria for FC were more stringent. Data were analyzed for 15 of the 17 available patients. Two patients were excluded because both FO and FC were intact on the admitting examination. Among the remaining 15 patients, seven recovered FO before FC; three recovered FC before FO; and five recovered FO and FC concurrently. The mean time between recovery of FO and FC (independent of sequence) was 8 days (range, 5 to 14 days). Based on these findings, it was concluded that the operational criteria for FO and FC are of equal difficulty.

It is necessary to exclude aphasia, agnosia, apraxia, or sensorimotor impairment as the basis for nonresponsiveness, as opposed to diminished level of consciousness. As noted previously, the criteria for emergence from MCS may underestimate the level of consciousness in some patients. For example, patients with some forms of akinetic mutism demonstrate limited behavioral initiation but are capable of occasional complex cognitively mediated behavior. When there is evidence to suggest that the assessment of level of consciousness is confounded by diminished behavioral initiation, further diagnostic investigation is indicated. Until these diagnostic ambiguities can be resolved by future research, the above definitions should be applied to all patients whose behavior fails to substantiate higher levels of consciousness. It is likely that studies investigating the neurologic substrate underlying subgroups of MCS patients will, in the future, allow the development of diagnostic criteria that are more reliably tied to the level of consciousness.

Recommendations for behavioral assessment of neurocognitive responsiveness. Differential diagnosis among states of impaired consciousness is often difficult. The following steps should be taken to detect conscious awareness and to establish an accurate diagnosis:

1. Adequate stimulation should be administered to ensure that arousal level is maximized.
2. Factors adversely affecting arousal should be addressed (e.g., sedating medications and occurrence of seizures).
3. Attempts to elicit behavioral responses through verbal instruction should not involve behaviors that frequently occur on a reflexive basis.
4. Command-following trials should incorporate motor behaviors that are within the patient's capability.
5. A variety of different behavioral responses should be investigated using a broad range of eliciting stimuli.
6. Examination procedures should be conducted in a distraction-free environment.
7. Serial reassessment incorporating systematic observation and reliable measurement strategies should be used to confirm the validity of the initial assessment. Specialized tools and procedures designed for quantitative assessment may be useful.[17,19,21-25]
8. Observations of family members, caregivers, and professional staff participating in daily care should be considered in designing assessment procedures.

Special care must be taken when evaluating infants and children younger than 3 years of age who have sustained severe brain injury. In this age group, assessment of cognitive function is constrained by immature language and motor development. This limits the degree to which command following, verbal expression, and purposeful movement can be relied on to determine whether the diagnostic criteria for MCS have been met.

Prognosis. The natural history and long-term outcome of MCS have not yet been adequately investigated. It is essential to recognize that MCS may occur in a variety of neurologic conditions, such as traumatic brain injury, stroke, progressive degenerative disorders, tumors, neurometabolic diseases, and congenital or developmental disorders. Clinical experience indicates that MCS after an acute injury can exist as a transitional or permanent state. Few studies of the natural history of MCS have been reported.[22,26,27] Giacino and Kalmar[22] followed 104 patients diagnosed with VS (n = 55) or MCS (n = 49) on admission to rehabilitation during the first 12 months after injury. The diagnosis of MCS was made retrospectively using clinical criteria that approximate the current definition. The MCS group showed more continuous improvement and attained significantly more favorable outcomes on the Disability Rating Scale[28] by 1 year than did the VS group. These differences were more pronounced in patients diagnosed with MCS after traumatic brain injury. Fifty percent of patients in the MCS group with traumatic brain injury were found to have none to moderate disability at 12 months, whereas none of the patients in the MCS group without traumatic brain injury were classified in these outcome categories. Although it is not known how many patients will emerge from MCS after 12 months after injury, most patients in MCS for this length of time remain severely disabled according to the Glasgow Outcome Scale.[29] As with VS, the likelihood of significant functional improvement diminishes over time.

Consensus-based general approaches to care. There are no existing guidelines regarding the care of patients in MCS. Until sufficient empirical data become available, the following general consensus-based approaches to care are recommended. Evaluation and management decisions will differ depending on the prognosis and the needs of the patient. In all circumstances, the patient should be treated with dignity, and caregivers should be cognizant of the patient's potential for understanding and perception of pain. In early MCS, prevention of complications and maintenance of bodily integrity should be emphasized because of the likelihood of further improvement. Efforts should be made to establish functional communication and environmental interaction when possible. A person with experience in neurologic assessment of patients with impaired consciousness should be primarily responsible for establishing the diagnosis and prognosis and for coordinating clinical management. An additional opinion of a physician or other professional with particular expertise in the evaluation, diagnosis, and prognosis of patients in VS and MCS is recommended when the assessment will impact critical management decisions. Such decisions include, but are not limited to, those regarding changes in level of care, disputed treatment decisions, and withdrawal of life-sustaining treatment.

Future directions for research. The care of patients with severe disturbances of consciousness remains a complex challenge partly because of an inadequate foundation of scientific evidence. There are a number of critical areas in which scientific evidence is lacking and additional research is indicated. These areas include:

1. Incidence and prevalence of MCS.
2. Natural history, recovery course, and outcome.
3. Interrater and test–retest reliability of the diagnostic criteria for MCS.
4. Validation of diagnostic criteria for MCS with respect to pathophysiologic mechanisms and outcome.
5. Differences in rate of recovery and outcome between adults and children.
6. Interactions among cause of the injury (e.g., trauma vs anoxia vs dementia), length of time after onset, and recovery of consciousness.
7. Predictors and patterns of emergence from VS and MCS.
8. Utility of existing assessment methods and scales for monitoring recovery and predicting outcome.
9. Treatment efficacy.
10. Efficacy and cost analysis of different care settings.
11. Issues related to family beliefs and their relation to functional outcome, service use, and evaluative decisions regarding quality of life.
12. Cross-cultural differences in evaluation and management practices.

These recommendations are intended to serve as a reference for clinicians involved in the examination and treatment of patients with severe alterations in consciousness. They are based on the current state of knowledge and are expected to be revised and refined as additional empirical data become available. The primary purpose of these recommendations is to facilitate future scientific investigation and multidisciplinary discussion by providing a common frame of reference for the examination and treatment of patients in MCS.

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