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WHERE IS THE SPIRIT OF THE "VEGETABLE"? (MINIMALLY? CONSCIOUS?? STATE!)

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SUMMARY

Objective: *Is "loss of consciousness" an appropriate term for a medical diagnosis? Does this terminology serve for decision making about treatment (initiation or termination)? Does unconsciousness mean no awareness of anything beyond the body? Can one be aware of oneself without being aware of the surroundings? Is it possible that information which was possibly registered in the unconscious can be transferred to the conscious state? Who controls these changes, and where? This article discusses a pragmatic approach to treatment and therapy for patients in vegetative and minimally conscious states in respect to palliative care, rehabilitation and emotional aspects.*

Conclusions: *Evaluation and treatment of a person in "Altered State of Consciousness" (ASC) should integrate cognitive and emotional elements. We should always remember that even if we are not able to detect reaction to input, this does not mean that the person who received the input did have any self-reaction (feeling) toward it, even though he is diagnosed as ACS. Clinical pragmatism can help us to anticipate the needs of these patients by presenting familiar and strongly emotionally loaded visual displays, by approaching them with consistent stimulation through associations of visual, auditory and tactile stimuli that might trigger an emotional reaction. We attempt to elicit motor output, starting with barely recognizable reaching for the target object, and to anticipate "signaling" responses that resemble classical conditioned reflexes, which could be considered a prime positive effect of systematic stimulation.*

Key words: *unconsciousness, emotions, arousal, orientation, alertness, wakefulness, mind, vegetative state*

INTRODUCTION

Constituent brain activities, such as the status of arousal, orientation, alertness, and wakefulness, should be used for describing the functions of the mind. At the diagnostic level, the endeavor to group the signs of coma into syndromes associated with severe alterations of consciousness faces difficulties, because of the lack of clinical methods to assess consciousness, particularly self-awareness. Scales of coma symptoms (e.g., the Glasgow Coma Scale) typically deal only with observed behavior, and not with the subjective aspects of consciousness and awareness.

Emotions appear to play a crucial role in modulating memory and learning. The topic of brain and emotion should be understood as the affective mind of a person. Thus the goal of developing strategy for the treatment of a person who has suffered from severe alterations of consciousness is to incorporate the theory of mind to practical steps of management. A person who is in a “vegetative state” has suffered from a physical injury, he may well have emotional disturbances. If there are still some emotional functions, they may influence the ability to recover, as well as being influenced by the recovery process.

Few studies have been published concerning the clinical aspects of patients in the minimally conscious state. The literature about comatose patients and /or patients who succeeded in recovering from coma to active life is much more readily available. Therapists get satisfaction and the glory of success when patients recover. The drama of treatment in the Intensive Care Unit, where the major emphasis is on the saving of the life of the patient, often ceases to interest the medical staff once the patient has gained stability. The quality of that life which has been saved may be largely ignored. That is to say, minimally conscious state patients draw “minimal response” from the medical and scientific personnel.

There are, however, two main reasons why it is important to focus on this group of patients:

– Developments in medicine have enabled more people to survive the acute phase severe brain damage and remain in a minimally conscious state.
– Focusing our investigation on the life of a person who is in a minimal responsive state can enrich our understanding about what the term “consciousness” actually means.

A policy pertaining to the care of this group of patients must be developed and should be based on two questions: What is the optimum way of assessing this state, and what level of consciousness does it actually reflect? The answers to these questions should be the basis of the rationale for guide lines for practical clinical management.

To understand better the meaning of the syndrome of minimally conscious state, it may be useful to interpret first the meaning of its components. The conscious component is not a measurable parameter, which means it has no quantitative value, so the older definition, i.e. the “response state” is more practical from this point of view. To determine the meaning of response is not a pure medical and/or laboratory decision, but depends upon the value it has (a qualitative declaration). Thus the decision that a response is minimal should not be made only by the medical team. The response should be measurable and repeatable. Then the main questions arise: What kinds of responses can be called meaningful? Who should decide this? How (by what tools)? When and for how long? Since the answers to these questions are both qualitative and quantitative, they should be given by the medical team working together with other non-medical personal, such as the family, religious authorities, and/or a legal representative.

Practically, since we are dealing with patients who are suffering from very severe neural damage, their "minimal response" is not a constant one, but may rather change under the influence of various endogenous and exogenous factors. The syndrome of minimal response therefore takes in a wide range of patients, and cannot be defined for some time after the initial neural insult (at least several months).

Consciousness is a psychological and philosophical term. The concepts of unconsciousness, on the one hand, and coma and vegetative state on the other hand, are sometime used in medical reports as though they were synonyms. There are many terms used to describe an "Altered State of Consciousness" (ASC), i.e. coma, vegetative or near-vegetative state, post-comatose unawareness, post-comatose cortical unresponsiveness, slow to recover, minimally responsive, minimal activity, and minimally conscious state (Giacino et al., 2002). These reflect several different diagnoses, which are based on the perspective of description and/or function (International Working Party…, 1996). The existence of so many similar names may point to two issues:

1. There are disagreements about terminology and classification.
2. ASC is a "basket" or a spectrum of diagnoses, and not a nosological entity (Gill-Thwaites, 1997), its very definition being a precarious enterprise.

The philosopher John Searle (2000), in his endeavor to elucidate this concept, has come up with a broad, comprehensive formulation. Consciousness begins when we wake in the morning from a dreamless sleep and continues until we fall asleep again, die, go into a coma, or otherwise become unconsciousness. This includes all of the enormous variety of awareness that we think of as characteristic of our waking life: everything from feeling pain, to perceiving objects visually, to states of anxiety and depression (Searle, 2000: 559). Yet he does not seem to have produced broad agreement, and the foregoing sounds more like a description than a definition. Indeed, we can observe a strong desire to achieve better insight into the nature of consciousness. In particular, the effort is focused on the grasp of its relationships with the human mind in general, notably with phenomena and experiences beyond the proper realm of consciousness. Furthermore, a major concern of students of consciousness is its linkage with attention (Posner & Rockbart 1998, Raichle 1998).

Under these circumstances, one may wonder at the use of such an abstract term as “loss of consciousness” for a medical diagnosis. Can this serve as grounds for the initiation and/or termination of treatment? Who can be aware of information in unconsciousness? It would appear that attention play a central role in the recognition of objects. Is it a matter of a specific “visual” attention, the loss of which may prevent the patient in a comatose state from identifying objects in the environment? Rees (2001) distinguished between “pre-attentive” and “attentive” mechanisms in vision. Is it possible that information that was registered in the unconscious state could be transferred to the conscious state? Who controls these changes?

Neural synchrony with a precision in milliseconds may be crucial for conscious processing, and may be involved in arousal, perceptual integration, attention selection and working memory (Engel & Singer, 2000). Consciousness is a complex concept, which incorporates several issues, such as wakefulness, the experience of oneself and one’s surroundings, and the possession of intentions. Consciousness, in all its aspects, is a phenomenon on a continuum. It is not surprising, therefore, that diagnostic classification and assessment of patients who remain unconscious for prolonged periods and recover from coma, only to demonstrate a very low level of response, has not yet been well developed (Jennet & Pulm 1972; Sazbon & Groswasser, 1991; Glenn, 1992). It might be useful to analyze recovery from coma and from unconsciousness as one extreme of the spectrum of restorgenesis (Keren et al., 2008). The differential diagnosis becomes more questionable when sophisticated tools for evaluation are used (Menon et al., 1998). This group of researchers used evoked response in the oddball paradigm (P300) and a 15O PET subtraction paradigm in the response to presented familiar faces. These tests could be used to demonstrate responsiveness in a patient who was otherwise diagnosed as being in the vegetative state.

Consciousness involves not just the passive experience of sensory contents, but the active involvement of the person. “Self”-related phenomena may be central to an understanding of consciousness, such as volition, social cognition, metacognition, self-recognition, self-modeling, reflection, and planning. As was stated here, consciousness is composed of various subcategories of concepts, one of which can be termed “metacognition” (Farber & Churchland, 1995). This term may incorporate some aspects of the vague terms “spirit” or “soul.”. By a deeper understanding of the meaning of the term “consciousness,” it may be possible to better perceive elements of the processes that probably exist in the inner world of someone who is unable to respond properly. This statement depends on our assumption that inability to respond does not automatically implicate complete unawareness. The aim of the present study, then, is to clarify somewhat the term ASC, in the hope that this will help the therapist to find ways of reaching the inner world of ASC patients.

An increasing number of severely brain-damaged patients survive as a result of improved technology, but they face severe, incapacitating disabilities. The goal of this article is also to enlighten the conflicts involved in using the term consciousness as a diagnostic entity. These difficulties arise because it is based on an effort to define a state of mind with physical tools. The difficulty to define this situation or state has practical applications concerning making treatment plans for patients who are usually diagnosed as minimally conscious, in permanent vegetative state.

DISCUSSION

The standard, most popular assessment used for the Traumatic Brain Injury (TBI) patient immediately after the insult is the Glasgow Coma Scale (GCS, Teasdale & Jennet, 1974). This is a 15-point scale that includes motor, vision, and vocal functions. Essentially, this scale is based on the patient's responsiveness, spontaneously and/or to stimulation. This form of grading does not describe the constituent brain activities, such as the status of arousal, orientation, alertness, or wakefulness. At the diagnostic level, it endeavors to group the signs of coma into syndromes associated with severe alterations of consciousness. Difficulties arise because of the lack of clinical methods to assess important aspects of consciousness, such as self-awareness. These patients are non-responsive to arousal, deprived of awareness to environmental events. Thus the cooperation of physiological tools to measure response should be considered for evaluating the cognitive and emotional abilities of the patient who has lost "logical contact."

Since there is no definite way to evaluate the mental status of a person who is in an ASC, it is probable that this entity includes a variety of gradations of altered consciousness and phases of return to a normal state. Thus the challenge is to navigate between one expert an another in these still barely definable labels for extensive brain damage syndromes. The diagnosis of ASC includes victims at different phases after the insult, from days to years post-injury.

Diagnosis is very much linked to definition. Coma is the extreme manifestation of severe brain insult. Loss of consciousness and coma are synonymous terms for the diagnosis of a patient who has no contact or connection with his surroundings. Coma is a profound or deep state of unconsciousness. The affected individual is alive, but is not able to react or respond to life around her. Coma can develop as the consequence of the expected progression of a disease, or as the result an acute illness (such as brain trauma or complications of an underlying sickness) (Young, 2009). The development of a practical way of assessment for coma, such as the GCS, enables the medical team to deal with these patients using more concrete (regular) medical terminology. This does, however, mask the complexity of this diagnosis, since "coma" is no longer a vague concept, but a measurable entity; i.e. it has a quantitative value, i.e. 9 or less on the GCS. So, on the one hand, there is a tendency to incorporate into medical practice more definite quantitative criteria, but on the other hand, this forces us to use a definition that is very concrete, less abstract and broad. One of the ways to deal with this controversy is that of Farber and Churchland (1995), who stated that it is more fruitful not to define consciousness, but to describe the various subcategories within the concept. These subcategories are:

– *Sensory awareness* – this includes stimuli from the sensory organs, but also modality-specific imagery.
– *Generalized awareness* – this includes an inner state with no clear link to any one modality, such as "comfort."
– *Metacognition awareness* – "there are all sorts of things that one can be aware of in the realm of one's own cognition".

These subcategories give us some insight to the concept of consciousness, since it is not only synonymous with awareness, but carries with it also an implication of agency and control. We should be able to evaluate the location of the main obstacle that is responsible for the patient being in this state. Such an obstacle might be due to the inability to deal with input information, as a consequence of sensory and/or perceptual disturbances. The inability to perceive can be the cause of many abnormalities, such as loss or distortion of meaningfulness, abnormal responsiveness (between disconnections from input to minimal undifferentiated responses to intensive stimulation). There are neocortical structures involved in dealing with consciousness of perceptual experiences of explicit and voluntary recall of information (Bodovitz, 2008). These structures are the latest to have emerged in the course of evolution. As such, they may be most sensitive to damage, so that their functioning may be the first to be compromised. Yet in recent years research has documented previously obscure cognitive and, possibly, executive abilities in supplementary cortical and subcortical structures (Cavanna & Trimble, 2006).

The medial frontal lobe, notably the anterior cingulate cortex (ACC), is singled out as a prime example of a brain structure in which a regulatory network composed of cells from the modulator brainstem nuclei interacts with an executive network (Crick & Koch, 1990). It is believed that the ACC has a triple role in behavioral control. It is involved in motor control, due to its connections with both motor cortex and spinal cord. Akinetic mutism caused by bilateral lesions is an extreme example. Furthermore, it is assumed to have a role in cognition, through the reciprocal cortico-cortical connections with the lateral prefrontal cortex.

Emotions appear more and more to play a modulating role in memory and learning (LeDoux, 1993; Panksepp, 1998). When the medical team is treating a patient who is suffering from a catastrophic medical condition, such as ASC, it usually focuses more on monitoring the vital (vegetative) functions, rather than those of the emotions. It has to be emphasized that emotions are a part of the whole integrated brain activity, and there are interrelationships between all the different cognitive and affective activities. The affective mind of a person in coma could be a candidate for a companion to "cognitive neurophysiology" (i.e. "affective neuroscience"). The limbic system, and in particular the amygdale, has quite extensive links with cortical structures (21). Associating cognition with emotions is believed to be deeply rooted in early life, and can enhance the impact of a behaviorally relevant environmental stimulation. This should enable learning of the conditioned-reflex associative type. LeDoux (1993)discusses the role of the amygdala in the emotional circuits in the brain, stating that "Various aspects of emotional and motivational behavior require the amygdala, a complex and multifunctional structure." He points out that consciousness is an important part of the study of emotion. It may be related to working memory, when things can be compared and contrasted and mentally manipulated. In the case of an affectively charged stimulus, such as a stimulus that triggers fear, the same sorts of processes will be called upon, but the brain system associated with fear is activated. Eventually, this can produce an emotional state of fear.

However, LeDoux (1993) cautioned against a disturbing rush to embrace the amygdala as the new center of the emotional brain. It is unlikely that the amygdala is the answer to how all emotions work, and may not even explain how all aspects of fear work. These may somehow be released by brain injury. Their participation in normal functioning is masked by the predominant manifestation of high-level structures. Their solicitation and promotion might be considered as a target in a prospective, tentative intervention program for patients in a vegetative state. In a millennium essay on the role of emotion in brain functioning and cognition, Davidson (2000) pointed out that:

a) emotion has evolved to facilitate the organism's adaptation to complex challenges;
b) cognition would be rudderless without the accompaniment of emotion, just as emotion would be primitive without the participation of cognition (p. 91);
c) there are no parts of the brain dedicated exclusively to cognition, while others are dedicated exclusively to emotion.

According to Gulyas (2000), relearning suggests that the shift between being non-conscious and being conscious during information processing depends upon the number of cells (and, consequently the volume of brain tissue) that participate in the underlying processes and constitute the same macro-networks, or the same networks with additional recruited neuronal populations.

What could be the implications of these recent advancements in understanding the brain-behavior relationships for the management of a patient in a vegetative state? What could be its contribution to reach a badly required measurable appreciation of the yet undisclosed mental life? Returning to the concept of consciousness as a mental state, we may be able to extrapolate from the manner in which definite cognitive processes are defined. Perception, memory, thinking, and attention, are components of consciousness – as is language – and these are receiving very clear and accepted definitions. For instance, visual perception is widely defined as a process of recognition of features of things in the environment. Their color, shape, size, position in space, and class membership are processed by a sensory system.

Most probably it is impossible to locate consciousness in any particular cerebral substrate, since it is not a monolithic entity. Generally speaking, any entity which cannot be broken down into components is more difficult to apprehend. If there is no way of parceling consciousness, are there no ways to grade it, in particular with respect to its alteration in the better-known entities, despite their complexity? Perception, thinking, memory, and attention are largely conscious activities. Their complexity is closely linked to being parts of human consciousness. Yet at the same time their structure is more accessible to decomposition and gradation. The argument boils down to the following question: could this avenue of systematic, cognitive, clinical observation and investigation lead to a better insight into coma and its gradations, before we reach more neurological and neuropathological knowledge? It is our belief that deepening the understanding of components of consciousness would be a path leading to better insight into consciousness as an entity.

Perception would be an appropriate starting point. There is recent experimental evidence that normal visual perception takes a variety of forms. Some of them may not be under voluntary conscious control. This is dependent upon the conditions of presentation of the visual displays to be recognized (Chaumon et al., 2008). Neuroimaging studies of visual awareness in normal subjects have shown that there are at least two distinct aspects of perceptual experience: first, the neural correlates of those mechanisms responsible for maintaining a particular level of awareness, and secondly, the neural correlates of the specific contents of consciousness (Alvarez & Cavanagh, 2008). These fMRI studies have been able to demonstrate the different role of two mechanisms of the cerebral cortex, beyond the traditional view about the role of visual cortex, i.e. the occipital lobe. These studies distinguished between the neural bases of conscious experience and unconscious perception and behavior. Pre-attentive mechanisms transform visual input rapidly and in parallel, and pare down the image into coherent parts. One of these parameters may pop out and trigger a behavioral response. In many cases, pre-attentive mechanisms are not sufficient, and proper visual attention is needed. This is the problem of focal attention: it can be targeted only on one or a few parts of the scene. Furthermore, there is neuropsychological and psychophysiological evidence for a distinction between attentive processing that leads to awareness, and processing that does not (Alvarez & Cavanagh, 2008).

It appears that attention holds a central role in the recognition of objects. Is this a question of a specific "visual" attention, the loss of which may prevent the patient in a coma state from identifying things in the environment? A distinction has been made between pre-attentive and attentive mechanisms in vision (Spekreijse, 2000). Is it possible that information registered in the unconsciousness could be transferred to consciousness? To define what is self-regulation or voluntary control is to distinguish between what is meant by regulation without awareness as opposed to awareness without regulation. Does unconsciousness mean no awareness of anything outside the body? Can one be aware of himself without being aware of the surroundings? Who can be aware of information in unconsciousness? There is no consciousness without the ability to communicate and react. There is no existence without reaction to changes. The surroundings can never be in total stasis, so homeostasis must require changes.

One useful way to quantify the depth dimension of awareness might be to deal separately with the "biological definition of consciousness" and the "psychological meaning of consciousness," and then to convert these two concepts to different approaches towards understanding this phenomenon. To be conscious does not mean only that the person is not unconscious.

Even if the examiner were able to communicate in a "non-concrete" way, such as in some sort of "telepathic mode," reception would not enable the examiner to decide that the examined person is conscious. Thus the decision that someone is conscious is an absolute decision, but it is a diagnosis based on dictated roles of activity. No decision of consciousness can be performed without a response that can be recognized by the examiner. Obviously, then, only a conscious examiner can decide that the examined person is conscious, and his decision should be based upon the latter's ability to respond to basic codes of communication. For example, a reflex response, such as the patellar reflex, is not accepted as an indicator of conscious response. The decision that someone is conscious means he has at least a minimal response. As such, the ability to receive the right answer is dependent upon the right question being asked initially. This means that before we can decide that someone is unconscious, we should be sure that we used the optimal means to study whether he is conscious and responsive. Perception of sensory input is not sufficient to decide that someone is conscious, but he should also be able to communicate somehow that he has his own perspective of self-awareness of this input. Our ability to receive his output is dependent upon the tools we use: whether it is only our own senses, or whether information on neural activity registered in response to specific input is enough. Such information can be passive, for example P3 activity can also be registered in patients who seem to be in a vegetative state (Kotchoubey et al., 2002). Is such neural activity enough to imply that there is a person who reacts? Is there a mind (and/or spirit) in unconscious patients?

The point has been made that more attention needs to be given to investigating the natural evolution of disorders of consciousness. This seems a logical and necessary first step toward establishing greater diagnostic accuracy, better prognostic specificity, and more effective treatment interventions (Giacino, 1997). This argument leads straight to our notorious and frustrating lack of knowledge about the neural substrate of consciousness. Nevertheless, the notable methodological advances in the study of the brain made in recent years, and the emergence of neuroimaging procedures, are also being felt in the obscure field of consciousness (Menon et al., 1998).

Constituent brain activities, such as the status of arousal, orientation, alertness, and wakefulness, should be used for describing the functions of the mind. The ability of the examiner to monitor such capacities is a factor of her own sensory abilities and the assessment tools she uses. There are no clinical methods to assess consciousness, particularly self-awareness. The coma scales in use assess only symptoms, and typically deal only with observed behavior, not with the subjective aspects of consciousness. As mentioned above, emotions appear to play a crucial role in modulating memory and learning. Thus the goal of developing a strategy for treatment of a person who has suffered from severe alterations of consciousness is to incorporate the theory of mind into practical steps of management. We should remember that a person who is in a vegetative state is not suffering only from a physical deficit, but also from emotional disturbances. Both the physical and emotional functions are governed by the brain, and they do interplay one with the other. The main obstacle to using general cognitive models for consciousness is that they are based on a central role for "executive systems" in understanding these self-related phenomena, and this ability is lacking in ASC patients

CONCLUSIONS

A conclusion based on the conceptual line sketched in this paper is that the evaluation and treatment of a person in ACS should integrate cognitive and emotional elements. We should always remember that even if we are not able to detect reaction to input, this does not mean that the person who received the input did have any self-reaction (feeling) toward it, even though he is diagnosed as ACS. Wilson et. al. (2001) demonstrated in a case report that substantial cognitive recovery from vegetative or minimally conscious state is possible for 6 months. Broadly, it is a matter of designing an adequate set of very elementary probes at the sensory – perceptual confines to elicit and eventually heighten barely perceptible mental abilities. The visual domain is apparently the proper ground for such a neuropsychological-mental enterprise. Broadly, the visual probes would consist of three components: (a) presentation of familiar and strongly emotionally loaded visual displays, keeping under control the conditions of stimulation; (b) consistent associations of visual, auditory and tactile stimulation; (c) eliciting motor output, starting with barely recognizable reaching for the target object. Learning to anticipate "signaling" responses that resembled classical conditioned reflexes would be considered a prime positive effect of systematic stimulation.

Recently it was presented that novel interventions, such as deep brain stimulation, activates prompt recovery in the minimally conscious patient (Schiff et al., 2009). Emotional aspects, as well as other criteria concerning recovery, should be considered while evaluating the effect of different treatments plans in these patients.

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