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Mini Review

Identifying Mental Disorders: Assessment Options Thanks to Technological Advancement

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Abstract

A clinically relevant and profoundly devastating group of medical conditions known as Disorders of Consciousness (DOC) present a considerable diagnostic difficulty. Resolution of states with overlapping symptoms is hampered by patients' inability to explain their physical state and uncertainty in our understanding of consciousness. Additionally, the demographics of a patient group that is susceptible are growing, which worsens the effects of these conditions. In an effort to clarify the complexities of consciousness, a variety of diagnostic strategies have been developed. These strategies prioritise behavioural assessment but also call for additional technical approaches in order to formally identify the underlying brain correlates. The two main technologies employed in clinical settings today are electropotential technology and neuroimaging, both of which have unique diagnostic advantages. Although lacking in temporal fidelity, neuroimaging allows for the precise spatial resolution of brain regions connected to arousal and awareness, two aspects of consciousness that are altered by DOC. In contrast, electropotential recordings can record electrical impulses on physiological time scales but are unable to precisely identify their source. The technical boundaries of both technology classes are being surpassed by current innovations. Qualitatively new dimensions of analysis, such as distinct physical signatures, dynamic causal relations, representational information content, and elicitation paradigms for detecting covert awareness, can be anticipated, supported by parallel developments in digital processing and artificial intelligence.

Keywords: Electrophysiological diagnosis • Cognitive aging • Acute confusion state • Unresponsive wakefulness syndrome

Introduction

A clinically significant and devastating class of medical conditions that are difficult to diagnose are disorders of consciousness. This problem is complicated. Even while it is clearly real, consciousness itself is mysterious. A frequent connection has been made with subjective awareness, an equation with attention access or conceptual elasticity.

Finding appropriate solutions is made more difficult by communication issues with patients who have overlapping or similar symptoms. Due to this complex situation, diagnostic approaches are now attempting to balance partially subjective and behavioral methods of detecting DOC disorders against more objective clinical criteria for neural correlates that are impaired in DOC [1]. Traumatic brain injuries and stroke, two factors that are statistically significant and demographically affected, are the main causes of consciousness disturbances. For instance, Feigen et al.'s analysis of stroke victims between 1990 and 2010 [2] finds a noticeable increase in stroke incidence during this time period, which appears to be directly related to a roughly 40% decrease in the morbidity to prevalence ratio of stroke.
Traumatic brain injuries and stroke, two factors that are statistically significant and demographically affected, are the main causes of consciousness disturbances. For instance, Feigen et al.'s analysis of stroke victims between 1990 and 2010 [2] finds a noticeable increase in the incidence of stroke during this time period, which appears to be directly related to a roughly 40% decrease in the morbidity to prevalence ratio of stroke patients. Only a tiny but considerable portion of them [3] acquire some kind of awareness impairment. As a result of better medical treatment and an ageing, vulnerable population, the incidence of DOC has increased and is projected to continue to do so for some time.

Trauma or a stroke Patients who survive serious brain injuries may go into a coma as a result of substantial cerebral damage or structural or metabolic defects in the brain stem reticular system. These may pass away, totally recover, evolve into a different state of awareness, or follow different paths towards such states. Although patients can get better, they might also stay in DOC conditions for a long time or possibly never leave them. Coma, Unresponsive Wakefulness Syndrome (UWS), formerly known as the vegetative state, Minimally Conscious State(s) (MCS), and Locked In Syndrome (LIS) are some of the clinically recognised entities of DOC [4-6]. MCS has been recognised as having categorical characteristics that separate contingent behaviour (MCS-) from linguistic comprehension (MCS+). Acute Confusional State (ACS), a brief episode of confusion associated with recovery from MCS, has also been named.

A coma is characterised by a severe lack of responsiveness and the absence of any arousal. Due to significant bilateral lesions of the cerebral hemispheres and/or traumatic lesions to the brainstem or bilateral thalami, the arousal system is impaired globally in comas. A restoration of the brain stem reticular system has been demonstrated to be accompanied by arousal symptoms in patients with UWS. However, context dependent behaviour is typically not present even while intact brain correlates of arousal and behavioural wakefulness are present. Commonly, UWS patients exhibit extensive fibre tract damage and neocortical and thalamic abnormalities.

MCS patients, in contrast, have a restricted awareness, as evidenced, for instance, by their understandable verbalization and reaction to orders. In the uncommon disease known as LIS, consciousness is still there, but there has been significant damage to the cortico-spinal and cortico-bulbar circuits, leaving just the extrinsic eye muscles with any voluntary control left [7]. Small eyelid movements are the only means of communication with the LIS patient.

Diagnostic precision has a substantial impact on prognosis and therapy success for DOC patients. Rehabilitation is predicated on diagnostic assessment, and DOC patients react differently to therapy [8]. The current gold standard for clinical diagnoses is behavioral markers, and several assessment measures are now in use. Based on the Aspen criteria, the American Congress of Rehabilitation Special Interest Group found that the Coma Recovery Scale had the strongest content validity of the bunch [9]. In European clinics, scales that priorities the identification of sensory, communicative, and arousal abilities but differ in the relative diagnostic emphases are also frequently used [10,11].

Despite the extensive use of behavioural assessments, tests of their diagnostic accuracy still show that about 40% of DOC patients receive the incorrect diagnosis [12]. Misdiagnosis can be caused by a variety of factors, such as patient motor disability, sensory deficiencies, changed cognition and shifts in attentiveness. The search for techniques that may, objectively evaluate the neurological correlates of awareness deficits has been sparked by this notable person. Many of these techniques are currently applied in therapeutic settings.

As a result, the emphasis of this study will be on the enhanced diagnostic differentiation that these "objective" methodologies have brought to the evaluation of DOC. It will examine the capabilities now available and the constraints faced by electro potential versus neuroimaging technologies, and it will address suggested tactics aimed at increasing technology versatility and symbiosis for DOC diagnosis.

Neuroimaging in Consciousness Assessment

Currently, Positron Emission Tomography (PET) and structural and functional magnetic resonance imaging (MRI/fMRI) are the neuroimaging techniques most frequently employed to diagnose DOC [13]. The tremendous spatial resolution that these technologies bring to the diagnostic environment makes them stand out. For instance, functional MRI can resolve spatial pictures of the brain to an accuracy of 1 mm or somewhat better, but signal-to-noise ratios are greatly improved when obtained at 3 to 5 mms. At this resolution, the brain's surface area may be divided into around 10,000 discernible voxels for one brain "slice." However, estimates of the neuronal density in these regions put the number of neurons there at around 1 million (together with an equal number of related glial cells); as a result, activity signals captured by fMRI show the contribution of huge neuron groups.

Despite the fact that this level of resolution does not allow for the intrusive isolation of activity from specific neurons as is possible with intracranial electrode recording, fMRI technology is able to clearly identify the regions of interest of the majority of brain nuclei. Importantly, a large body of research indicates that functional activity zones in the brain are made up of neuronal populations rather than being restricted to a single or a small number of cardinal neurons. Large clusters of neurons are, in fact, involved in representational brain activity, which has been generally accepted [14]. Long regions of the occipital cortex, for instance, will be activated by the visual presentation of a single object at multiple sites, leading to the technical goal of monitoring the activity covariance of these sites in order to connect neural activity patterns to a structured representational content in classification technologies.

This great spatial resolution is important for the identification of concepts like arousal and awareness in diseases of consciousness. Patients with UWS show little activity in the fronto-parietal, associative, and extrinsic connectivities with the thalami. On the other hand, the presence of brain stem activity distinguishes UWS from coma, a condition in which the brain stem has extensive lesioning. Additionally, the presence of significant cortical activity, a trait of less severe disorders of consciousness and a diagnosis on which beneficial therapies reserved for the latter class of patients depend, can be used to distinguish MCS patients who have been clinically diagnosed as UWS on the basis of behavioural criteria.

However, the parameters measured by imaging technologies do not exactly correspond to the brain's neuronal activity, and as a result, they are linearly unrelated to physiological activity in general. For instance, the diagnostic potential of PET technology allows for the differentiation of distinct compositional changes, which often occur on time periods very different from the dynamics of neuron activation. On the other hand, the use of PET imaging has been crucial for identifying some important DOC traits. For instance, it has been feasible to identify a drastically lowered metabolism in the UWS patient, using radio-labeled glucose tracers, which is almost half that seen in the minimally conscious condition.

Electrophysiological Diagnosis of DOC

Electropotential monitoring systems utilised in clinical settings are unable to distinguish between signals coming from tissue locations that are adjacent to one another, in contrast to neuroimaging technologies that can resolve activity in microvolumes of brain tissue. However, they provide significantly better temporal resolution of brain signals, making it possible to directly track the timing of physiologically significant events. In addition, electropotential recording systems provide a major physical benefit over the size of equipment required for neuroimaging.

By placing electrodes on the scalp, the Electroencephalogram (EEG) enables direct, noninvasive detection of spontaneous brain electrical activity. However, this clear methodological benefit is negated by the weak electrical signal that is actually captured, which ranges from 10 to 100 uvolts. Direct cortical recording from brain tissue, however, can yield voltage signals that are 10 to 50 times more amplified. However, since 1990, signal digitising and processing methods have considerably increased the signal to noise ratio of the recorded electrical events, allowing the detection of signals that would otherwise be obscured by background noise.

Because of the temporal accuracy of the technology, it is possible to directly observe the electrical signatures of brain activity, which can be evoked by external stimulation and referred to the time of beginning of a created electrical event. However, because these evoked potentials must be averaged due to the low amplitude of the scalp signals, the evoked potential is actually a time-locked average of several EEG signal responses. For signals to be discernible, current stimulation techniques either use auditory or somatosensory stimulation. The N100, P300, and N400 potentials are examples of auditory evoked potentials that are routinely used in therapeutic settings. The N20 potential, which is triggered by somatosensory stimulation, is also often used. There are now numerous paradigms that can identify different brain states in DOC patients. Mismatch negativity, such as an early negative waveform generated by an off-key tone in a repeated sequence, is evident in MCS patients but is infrequently noticed in people with the diagnosis.

Conclusion

The development of electro potential and neuroimaging techniques for DOC diagnosis provides proof of the intricacy and importance of consciousness impairment. This is a gift and a commitment to the DOC patient. These technologies should be able to identify global and hierarchical aspects that are represented by imaging activity, as well as essential information like activity signatures and causal relationships. However, underlying questions concerning the holistic function of consciousness attest to the medical mystery that is a part of every patient and that is still being revealed today.

References

1. Eapen, Blessen C., et al. "Disorders of consciousness." Physical Medicine and Rehabilitation Clinics 28.2 (2017): 245-258.
2. Feigin, Valery L., et al. "Global and regional burden of stroke during 1990–2010: findings from the Global Burden of Disease Study 2010." The lancet 383.9913 (2014): 245-255.
3. Gray, Max, et al. "A systematic review of an emerging consciousness population: focus on program evolution." Journal of Trauma and Acute Care Surgery 71.5 (2011): 1465-1474.
4. Cavanna, Andrea E., et al. "Consciousness: a neurological perspective." Behavioural neurology 24.1 (2011): 107-116.
5. Giacino, Joseph T., et al. "Disorders of consciousness after acquired brain injury: the state of the science." Nature Reviews Neurology 10.2 (2014): 99-114.
6. Zasler, Nathan, Douglas Katz, and Ross D. Zafonte, eds." Brain injury medicine: Principles and practice." Demos Medical Publishing, 2007.
7. Laureys, Steven, et al. "The locked-in syndrome: what is it like to be conscious but paralyzed and voiceless?." Progress in brain research 150 (2005): 495-611.
8. Pistoia, Francesca, et al. "Disorders of consciousness: painless or painful conditions?—Evidence from neuroimaging studies." Brain sciences 6.4 (2016): 47.
9. Kalmar, Kathleen, and Joseph T. Giacino. "The JFK coma recovery scale—revised." Neuropsychological rehabilitation 15.3-4 (2005): 454-460.
10. Gill-Thwaites, Helen, and Rosalind Munday. "The Sensory Modality Assessment and Rehabilitation Technique (SMART): a valid and

reliable assessment for vegetative state and minimally conscious state patients." Brain injury 18.12 (2004): 1255-1269.

11. Schnakers, Caroline, et al. "Diagnostic accuracy of the vegetative and minimally conscious state: clinical consensus versus standardized neurobehavioral assessment." BMC neurology 9 (2009): 1-5.
12. Gosseries, Olivia, et al. "Suppl-1, M5: The Role of Neuroimaging Techniques in Establishing Diagnosis, Prognosis and Therapy in Disorders of Consciousness." The Open Neuroimaging Journal 10 (2016): 52.
13. Averbeck, Bruno B., Peter E. Latham, and Alexandre Pouget. "Neural correlations, population coding and computation." Nature reviews neuroscience 7.5 (2006): 358-366.
14. Laureys, Steven. "The neural correlate of (un) awareness: lessons from the vegetative state." Trends in cognitive sciences 9.12 (2005): 556-559.

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