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Editorial

Progress and Challenges in Understanding Disorders of Consciousness following Acute Brain Injury

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Severe acute brain injuries can give rise to different disorders of consciousness (DoC), including coma in the acute phase, vegetative state or unresponsive wakefulness syndrome (VS/UWS), and minimally conscious state (MCS) during the post-acute phase. Despite significant progress in understanding DoC, a precise forecasting of consciousness recovery remains a challenge. This is primarily due to the difficulties in assessing the integrity of neural circuits that support consciousness and to the limited understanding of the synaptic, neuronal, and system-level mechanisms of brain plasticity that are involved in consciousness recovery [1]. Additionally, the prospect of long-term secondary neurodegeneration further complicates the chances for recovery [2]. Consequently, therapeutic interventions aimed at restoring consciousness often lack specificity and, hence, may only achieve limited outcomes [3]. Furthermore, while a standardized neurobehavioral assessment is required to distinguish between VS/UWS and MCS patients [4], it may underestimate the patient's responsiveness and lead to incorrect VS/UWS diagnoses, especially in cases of severe visual, language, or motor impairments [5].

The challenges faced by the science of consciousness in patients with DoC extend beyond those previously mentioned. Another major challenge arises from the subjective nature of consciousness itself, which makes it highly challenging to measure objectively and reliably. In this special issue of the Journal of Integrative Neuroscience on "Disorders of consciousness: from pathophysiology to treatment", the paper by Fingelkurts and Fingelkurts explores the nature of selfhood (or self-awareness) in patients with DoC from a neurophenomenological perspective [6]. Specifically, the authors argue that the traditional approach of studying DoC from a neurobehavioral perspective alone is limited in its ability to capture the subjective experience of selfhood, which is critical to understanding consciousness in these patients. The paper also highlights the importance of studying the subjective experience of selfhood in patients with DoC with a neurophenomenological approach, which combines neurophysiological and phenomenological data, in order to provide valuable insights into the nature of consciousness and the potential for its recovery. It underscores the need for a more holistic approach to the study and treatment of DoC, considering both the objective and subjective aspects of consciousness.

Another challenge in this area of research is the lack of animal models that accurately replicate prolonged DoC, which hinders the development of effective treatments and our understanding of the underlying pathophysiology. In this context, the paper by Sun and colleagues hypothesizes that the evaluation of indexes suitable for nonhuman primates can be extracted from scales for the assessment of DoC in humans [7]. This could have important implications for improving the accuracy of diagnosis and assessment of DoC in both humans and nonhuman primates. However, further research is needed to validate this hypothesis and determine the specific evaluation indexes that are most relevant for nonhuman primates.

The paper by Sung and colleagues explores the relationship between the consciousness state assessed with the Coma Recovery Scale Revised and the integrity of specific connections within the default mode network assessed with diffusion tensor tractography in patients with traumatic brain injury (TBI) [8]. The authors found that patients with TBI exhibited a close correlation between their consciousness level and the connectivity between the medial prefrontal cortex and the precuneus. This study extends previous data on the role of the default mode network in patients with DoC [9,10], provides valuable insights into the neural mechanisms underlying DoC, and highlights the importance of studying brain networks in understanding these conditions.

Two papers in this special issue explore the promotion of therapeutic strategies for patients with DoC, highlighting the potential for developing effective interventions to improve outcomes in this challenging population. The paper by Lancioni and colleagues reviews a behavioral approach to the treatment and assessment of patients with VS/UWS and MCS, known as the response-contingent stimulation strategy [11]; it involves the presentation of brief periods of patients' preferred stimulation immediately after their emission of a specific behavioral response. The authors suggest that this approach may have promising therapeutic potential for patients with DoC, but further research is needed to determine its efficacy and optimal implementation. Finally, the paper by Dang and colleagues proposes a novel procedure for cervical spinal cord stimulator implantation in pa-

tients with DoC [12]. The study found that this procedure can improve midline coverage of the electrode array, potentially leading to better outcomes for patients. This approach represents an important contribution to the development of new therapeutic interventions for DoC, but additional research is necessary to confirm its actual effectiveness.

In conclusion, the papers included in this special issue of the Journal of Integrative Neuroscience explore a diverse range of approaches to understanding and treating DoC following acute brain injury. Overall, these studies emphasize the requirement of interdisciplinary efforts in this field to develop new therapeutic strategies in order to advance our still limited knowledge and management of DoC.

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SB conceived and wrote this manuscript.

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