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Cognition and Intervention in Traumatic Brain Injury

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Introduction

The destructive ravages of externally- or internally-induced damage to the brain and CNS trauma, whether this be of mild, moderate or severe extent, will invariably be the consequence of proximal-distal causation, proliferation and severity [1-3], such as cerebral ischemia which afflicts millions of individuals worldwide with eventual survivors suffering from long-term functional and cognitive deficits. Cerebral damage in traumatic brain injury (TBI) may be accompanied by headache, of varying intensities and localizations, dizziness and ill-feeling, loss of consciousness, blurring of vision, hearing impediments, confusion states, loss of memory and cognitive capacity, seizure activity, paralysis and coma as the primary-registered symptoms and expressions, with the expectation of accompanying damage to blood-brain-barrier integrity, accelerated apoptosis and excitotoxicity [4-6]. Further, there is a profusion of balance and attentive disorders in TBI independent of several other injury parameters. Neurobehavioral problems, mood and cognition disorder, especially with regard to memory performance, attention, planning and executive functioning are invariably impaired in individuals afflicted by TBI, a major and leading cause of chronic disability over the globe. All of these signs and symptoms in various wound-combinations, intensities and severities, locations and stages will offer the determination of the dimensions of short-term and long-term disruption of physical, sensory-motor, cognitive-emotional, behavioral and emotional domains [7-9]. Efforts to establish diagnostic and symptomatic instruments for establishing deficits in cognitive domains of TBI, not least regarding self-awareness [10,11] and mindfulness [12-14], have produced several essential methodological ingredients.

Rehabilitative progress has been obtained despite much destruction of the higher-order cognitive systems [15]. One obstacle barring interventional progress is related to insufficiency of development and the norm-achieving basis of instruments/methods applicable for detection of impairments to social cognition [16]. Examinations of the sub-acute effects of TBI upon gray matter volumetric analyses in children presenting severe TBI have shown the existence of marked reductions in the Cerebro-Cerebellar Mentalizing Network, the Salience Network, the Mirror Neuron/Empathy Network, the Central Executive Network and the Default Mode Network, as well as reduced gray-matter volumes of several central-hub regions of these essential neural networks [17]. Similar volumetric deterioration in the Cerebro-Cerebellar Mentalizing Network and several of its hub regions, including the cerebellum, predicted poorer cognitive ToM. Contrastingly, the disrupted cognitive-affective and conative aspects of Theory of Mind were predicted by volumetric reductions in the Salience Network and Mirror Neuron/Empathy Network, respectively. Overall, these findings imply that cognitive, affective and conative ToM may be predicted imminently through the individual differences in structures of different neural systems-the Cerebro-Cerebellar Mentalizing Network, Salience Network, and Mirror Neuron/Empathy Network, in each turn. TBI patients were observed to perform markedly worse than the healthy-volunteer control group with regard to all of the tests of emotion recognition, intention-comprehension, and on one particular task of response selection that together describe social learning [18]. The assessed ratings of current behavioral activity implied important alterations among the TBI patients' behavioral expressions relative to the situation prior to injury through a notable deterioration of community integration and interpersonal behavior than the healthy control group. Of the above three functions that were assessed, emotion recognition was associated with both deleterious post-injury behavior and community integration with the evidence that the association was not to be completely explained by injury severity, time since injury, or education.

Nevertheless, several useful interventions have been found to be effective [19]. For example, in an experimental laboratory setting it was observed that 6-hours of environmental enrichment provision on a daily basis was effective in conferring neurobehavioral and histological amelioration following TBI with extended improvements through the realization that the acquired benefits were comparable despite the manner in which the 6-hours of enriched environment were accrued [20]. The development of coping strategies for thriving and disorder adaptation, as well as the psychological adaptation to stressors and serious life events, have been discover to exert a marked influence on the progressive improvement and against the persistence of posttraumatic injury complaints. Ongoing and prospective interventional therapies are aimed at the restoration brain plasticity in that they are designed to induce the recovery of cognitive functioning, the achievement which may implement the alleviation of other more-or-less related disorders which commonly are defined by the disruptions of diverse cognitive processing [21]. Wong et al. [22] have argued that psychosocial and physical environments appear to mediate the influence of systems, services, and policies on participation after acquired neurological disorders [22]. Furthermore, randomized clinical trials upon pediatric patients presenting moderate-to-severe TBI and involving more than 600 participants from eight clinical centers have proven relatively efficacious [23]. The active, as opposed to passive, style of coping strategy has been found to be significant for patient well-being and self-esteem progressive since the former are much more effective [24].

In afflicted individuals, the loss of structural connectivity following mild-to-moderate TBI may be applied as a biomarker estimation both of damage extent and of any putative improvements following intervention. In adolescents presenting TBI, global efficiency level, mean local efficiency scores, modularity, normalized clustering coefficient expression, normalized characteristic path length, a measure of structural connectivity abnormality, and small-worldness assessments, as well as Post-Concussion Symptom Inventory scoring,

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were all inferior to healthy control adolescents, but following aerobic training, global efficiency level was increased and normalized characteristic path length was decreased [25]. Also, the enhanced Post-Concussion Symptom Inventory scores were correlated significantly with the global efficiency level improvements and normalized characteristic path length decrease. A novel interventional approach designed to improve both mobility and attention deficits through application a reward-learning procedure is offered through video-gaming therapy [26,27]. In a study of TBI patients, it was observed that the patients receiving video-gaming therapy performed better than those receiving 'balance-platform' therapy on the Community Balance & Mobility Scale, the Unified Balance Scale, the Timed Up and Go test (TUG), the static balance test and the selective visual attention evaluation test thereby implying positive assets with the technique [28]. In a recent study performed on army (US) veterans suffering from mild TBI, it was observed that Compensatory Cognitive Training presented higher levels of improvement in cognitive difficulties and application of cognitive strategies as well as on neuropsychological measures of attention, learning, and executive functioning than the comparison group that received only 'usual-care' treatment [29]. Interestingly, it has been reported also that pharmaco-therapeutic interventions using a compound co-administration regimen of the antioxidants, 2,4-disulfonyl α-phenyl tertiary butyl nitrone (HPN-07), a spin-trapagent, and N-acetylcysteine (NAC) decreased markedly both the pathologic Tau accumulation and signs of ongoing neurodegeneration in the cochlea and the auditory cortex of laboratory rats [30]. Physical, psychological and mental fatigue distress 70-90% of TBI with serious aggravation of other symptoms and biomarkers. In a study of adults with a history of TBI that were presented cognitive behavior therapy or 'treatment-as-usual', the former recipients reported better sleep quality together a significant decrease in daily fatigue levels compared with the latter [31].

Taken together, the evidence implies that the cognitive-emotion condition of TBI patient is hazardous from the point of view of health and well-being, particularly with to the mild, moderate and severe levels of infirmity [32]. Despite the cognitive impairments arising from limited-to-substantial connectivity with white and gray matter that result in widespread disharmony among essential network systems, the potential for promising interventional therapies seems both efficacious and technologically innovative, such as at synaptic sites of neural plasticity [33]. It is becoming increasingly apparent that the social determinants of TBI, e.g. physical environment, gender, interpersonal violence-propensity, personal health practices and coping skills and availability of rehabilitation services, require greater attention, particularly among minority ethnic groups [34].

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