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Functional Neurological Disorder in the Context of Persisting Symptoms after Concussion (PSaC): Time to Shift our Perspective?

Concussion: Metabolic Cascade

A concussion initiates a neurometabolic cascade, disrupting neuronal balance[1]. Ion pumps respond by increasing glucose use and reduced cerebral blood flow creates an energy mismatch. Mitochondrial dysfunction and oxidative stress lead to a prolonged reduction in the brain's ability to produce energy.[1]

Disruption of Brain Network Configuration

Alterations in functional connectivity of brain networks, such as changes in DMN, CEN, and SN connectivity, are linked to cellular disruptions described by the neurometabolic cascade[3,4]. The cascade's effects on neurotransmission, axonal integrity, and energy metabolism provide the pathophysiological basis for the observed network dysfunction and associated clinical symptoms.

PSaC within the Biopsychosocial Framework

Disruptions in brain networks often emerge and persist through a combination of predisposing, precipitating, and perpetuating factors – of which concussion acts as a precipitant. This biopsychosocial framework captures how biological, psychological, and social influences interact to shape this vulnerability.[2]

Persistent Network Changes: Compensatory or Maladaptive?

Early alterations in connectivity may reflect compensatory mechanisms that help maintain function. However, persistent brain network changes in patients with PSaC are associated with neurocognitive symptoms[5]. This supports a model that continued presence and specific patterns of network disruption, (e.g. within the CEN and between CEN and DMN) are more consistent with maladaptive changes or failed compensation, rather than a beneficial adaptive response[6].

DMN = default mod network; CEN = central executive network; SN = salient network;

FND is increasingly being considered as an emergent phenomenon which can be triggered by an initial concussion & sustained under conditions which perpetuate symptoms.

More information

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Similarities in Brain Network Changes in PSaC and FND

Feature / Network	Functional Neurological Disorder (FND)	Persisting Symptoms after Concussion (PSaC)
Emotion/Limbic Networks[3T,7T,8T]	Increased connectivity between limbic (emotion-processing) and motor circuits; heightened salience network involvement	Changes less prominent, but emotional symptoms and comorbid depression can further alter connectivity
Sensorimotor Networks[2T,3T,5T]	Abnormal integration with emotion networks; increased limbic-motor coupling	Reduced connectivity, especially with symptom severity; decreased connectivity in somato-motor network
Default Mode Network[2T,3T,4T]	Altered connectivity, often involving increased coupling with salience and motor networks	Reduced within- and between-network connectivity in DMN; persistent DMN disruptions linked to symptom severity
Attention Networks[2T,4T]	Decreased fronto-parietal connectivity; impaired attentional shifting	Reduced connectivity, especially in executive (fronto-parietal) networks; hypoconnected posterior nodes in fronto-parietal and salience networks
Direction of Change[1T,2T,4T,5T]	Often increased (limbic-motor, salience-motor), sometimes decreased (fronto-parietal, DMN); network-specific increases and decreases depending on symptom profile	Mostly reduced connectivity across multiple networks (DMN, executive, sensorimotor); some subgroups show global increases or decreases depending on symptom load

Future Direction

No studies to date have directly compared functional imaging findings in PSaC and FND. Future study should consist of a three-way functional imaging comparison between patients with PSaC, FND (without history of head injury) and healthy controls.

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