Traumatic spinal cord injury pathophysiology

Pathophysiologically, the initial mechanical trauma (the primary injury) permeabilizes neurons and glia and initiates a secondary injury cascade that leads to progressive cell death and spinal cord damage over the subsequent weeks.

Over time, the lesion remodels and is composed of cystic cavitations and a glial scar, both of which potently inhibit regeneration. Several animal models and complementary behavioural tests of SCI have been developed to mimic this pathological process and form the basis for the development of preclinical and translational neuroprotective and neuroregenerative strategies.

Triggering of inflammatory responses and disruption of blood-spinal cord barrier (BSCB) integrity are considered pivotal events in the traumatic spinal cord injury pathophysiology (TSCI). Yet, these events are poorly understood and described in humans. A study aimed to describe inflammatory responses and BSCB integrity in human TSCI.

Fifteen TSCI patients and fifteen non-TSCI patients were prospectively recruited from Aarhus University Hospital, Denmark. Peripheral blood (PB) and cerebrospinal fluid (CSF) were collected at median day 0 [IQR: 1], median day 9 [IQR: 2], and median day 148 [IQR: 49] after injury. PB and CSF were analyzed for immune cells by flow cytometry, cytokines by multiplex immunoassay, and BSCB integrity by IgG Index.

Eleven TSCI patients completed follow-up. Results showed alterations in innate and adaptive immune cell counts over time. TSCI patients had significantly increased cytokine concentrations in CSF at the first and second follow-up, while only concentrations of interleukin (IL)-4, IL-8, and tumor necrosis factor-α remained significantly increased at the third follow-up. In PB, TSCI patients had significantly increased IL-6, IL-8, and IL-10 concentrations and significantly decreased interferon-γ concentrations at the first follow-up. Results further showed increased IgG Index indicative of BSCB disruption in seven TSCI patients at the first follow-up, five TSCI patients at the second follow-up, and two patients at the third follow-up.

The results suggest that TSCI mainly triggers innate inflammatory responses that resolves over time, although with some degree of non-resolving inflammation, particularly in CSF. The results cannot confirm BSCB disruption in all TSCI patients [1)].

1)
Wichmann TO, Kasch H, Dyrskog S, Høy K, Møller BK, Krog J, Hviid CVB, Hoffmann HJ, Rasmussen MM. The inflammatory response and blood-spinal cord barrier integrity in traumatic spinal cord injury: a prospective pilot study. Acta Neurochir (Wien). 2022 Oct 3. doi: 10.1007/s00701-022-05369-6. Epub ahead of print. PMID: 36190569.