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CHRONIC TRAUMATIC ENCEPHALOPATHY: MECHANISMS AND IDENTIFICATION TO DATE

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Chronic traumatic encephalopathy (CTE) as a particular clinical and scientific problem received diagnostic criteria for the first time in 2014. CTE develops on the basis of chronic traumatic brain injury (TBI). Autopsy results were the first evidence of special pathology that existed but not officially designated.

TBI can be a result of professional influences, peculiarities of life or lifestyle. Chronic traumatic encephalopathy, which occurs as a result of repetitive mild concussive or sub-concussive brain injury, was initially studied in athletes (football players, track and field athletes, hockey players, wrestlers) and military personnel. To date there is understanding that other groups of people may

have this pathology – patients with uncontrolled epilepsy, civilians in war zones, victims of domestic violence and those subjects with developmental/behavioral disorders, suffering from repetitive hand banging.

Currently, CTE is considered and studied in the group of neurodegenerative diseases such as Alzheimer's disease, frontotemporal degeneration, amyotrophic sclerosis. According to modern concepts, CTE is considered as the so called tau-pathy (from «tau-protein»). Tau-pathy associated with the presence of pathological forms of tau-protein in neurons of the human brain as a marker of the disease.

Normal tau protein, encoded by special gene, presents in 6 isoforms at a neuron as a part of axonal transport system. Normal tau-protein stabilizes axonal tubules, thereby fulfilling a vital role in interneuron communication. The chain of events in case of CTE starts from exposure to sub concussive repetitive TBI. As axons are long they are even more susceptible to repetitive sub concussive injury than neurons body. Subtle damage at chemical level activates hyperphosphorylation of tau protein. Hyperphosphorylated tau-protein loses normal connections with tubule proteins. Hyperphosphorylated tau gain new pathological prion-like properties; it is accumulated in form of tangles initially into neurons, than outside neurons and into astrocytes. Gradually (over the course of years or decades), various parts of the brain become involved. Hyperphosphorylated tau-protein and tangles are also recognized as DAMP (damage associated molecular patterns) by immune system. Some damage of blood brain barrier resulting from trauma facilitate immune influences and penetration of cytokines.

Today, diagnostic criteria have been developed - primarily postmortem histological ones - for the presence of CTE. Clinical equivalent of CTE or, better, clinical predictor of CTE in living individuals is TES (traumatic encephalopathy syndrome). By Montenigro et al., 2014, neuropathological clinical symptoms include range of unspecific signs and symptoms such as mood disorders (depression, suicidality), behavioral disturbances , cognitive impairment, and motor dysfunction (ataxia, dysarthria, parkinsonism). Renewed criteria, (by Katz et al., 2021, Ritter et al., 2022) include set of symptoms like: cognitive impairment, neurobehavioral dysregulation, progressive course over at least one year, in the absence of continued exposure to repetitive head impacts.

Combination may be different in different patients. Research indicates that each additional year of playing tackle football increases the risk of developing CTE by 30%. Furthermore, the age of first exposure is a critical factor. Beginning tackle football before age 12 is associated with an earlier onset of cognitive, behavioral, and mood symptoms by approximately 13 years on average, and may result in a tenfold higher risk of developing CTE compared to starting after age 14. This is likely because childhood and adolescence are periods of crucial brain development.