Traumatic Brain Injury Biomarkers

- Distinct clinical phenotypes and their neuroanatomic correlates in chronic traumatic brain injury
- Identification of Serum Biomarkers for Blast-induced Traumatic Brain Injuries: Low vs. High-intensity Exposure in a Rat Model
- DTI-Derived Evaluation of Glymphatic System Function in Veterans with Chronic Multisymptom Illness
- The Diagnostic and Prognostic Role of Biomarkers in Mild Traumatic Brain Injury: An Umbrella Meta-Analysis
- The Many Faces of Child Abuse: How Clinical, Genetic and Epigenetic Correlates Help Us See the Full Picture
- Assessment of White Matter Changes Using Quantitative T1rho Mapping in an Open-Field Low-Intensity Blast Mouse Model of Mild Traumatic Brain Injury (mTBI)
- Budget Impact Analysis of the Use of Specific Biomarkers GFAP and UCH-L1 in the Management of Mild Traumatic Brain Injury in Spain
- Traumatic Brain Injury: Novel Experimental Approaches and Treatment Possibilities

Traumatic brain injury (TBI) biomarkers are specific molecules or indicators that can be measured in bodily fluids like blood, cerebrospinal fluid (CSF), or urine. These biomarkers provide insights into the presence, severity, and potential outcomes of traumatic brain injuries. They are crucial for diagnosing TBIs, assessing their severity, predicting outcomes, and monitoring the effectiveness of treatments.

Examples

S100B: S100B is a protein released by astrocytes in the brain following injury. Elevated levels of S100B in blood shortly after a head injury can indicate the presence of brain damage and help in assessing the severity of the injury.

GFAP (Glial Fibrillary Acidic Protein): Similar to S100B, GFAP is released by astrocytes in response to brain injury. Increased GFAP levels in blood or CSF can indicate brain damage and may correlate with TBI severity.

Tau Protein: Tau is a protein found in neurons. Elevated levels of tau in CSF have been associated with more severe forms of TBI, and abnormal tau accumulation is linked to chronic traumatic encephalopathy (CTE) and other neurodegenerative disorders.

Neurofilament Light Chain: Neurofilaments are proteins that make up the structural framework of neurons. NFL levels in CSF and blood can reflect axonal damage and are being studied as markers of TBI severity and prognosis.

UCH-L1 (Ubiquitin C-Terminal Hydrolase L1): UCH-L1 is an enzyme found in neurons. Elevated UCH-L1 levels in blood shortly after a head injury can indicate brain damage and may be useful for assessing the severity of a TBI.

NSE (Neuron-Specific Enolase): NSE is an enzyme found in neurons. Elevated levels of NSE in blood or CSF are associated with brain injury and can provide information about the extent of damage.

BDNF (Brain-Derived Neurotrophic Factor): BDNF is a protein that supports the growth and survival of neurons. Changes in BDNF levels have been observed after TBI and could be indicative of injury

severity and recovery.

MicroRNAs: MicroRNAs are small RNA molecules that regulate gene expression. Changes in specific microRNA profiles have been linked to TBI and could serve as biomarkers.

Cytokines and Inflammatory Markers: Inflammation is a common response to TBI. Elevated levels of certain cytokines and inflammatory markers in blood or CSF can indicate the presence of TBI-related inflammation.

Although many experimental studies have been conducted, clinical consolidation of these biomarkers is still needed to increase the predictive power and reduce the poor outcome of TBI. Interestingly, several of these TBI biomarkers are oxidatively modified to carbonyl groups, indicating that markers of oxidative stress could be of predictive value for the selection of therapeutic strategies [1)].

Unlike other organ-based diseases where rapid diagnosis employing biomarkers from blood tests are clinically essential to guide diagnosis and treatment, there are no rapid, definitive diagnostic blood tests for TBI. Over the last decade there has been a myriad of studies exploring many promising biomarkers. Despite the large number of published studies there is still a lack of any FDA-approved biomarkers for clinical use in adults and children. There is now an important need to validate and introduce them into the clinical setting [2)].

Glial fibrillary acidic protein in traumatic brain injury

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Systematic reviews

Mozaffari et al. created a comprehensive appraisal of the most prominent serum biomarkers used in the assessment and care of TBI.The PubMed, Scopus, Cochrane, and Web of Science databases were queried with the terms “biomarker” and “traumatic brain injury” as search terms with only full-text, English articles within the past 10 years selected. Non-human studies were excluded, and only adult patients fell within the purview of this analysis. A total of 528 articles were analyzed in the initial search with 289 selected for screening. A further 152 were excluded for primary screening. Of the remaining 137, 54 were included in the final analysis. Serum biomarkers were listed into the following broad categories for ease of discussion: immune markers and markers of inflammation, hormones as biomarkers, coagulation and vasculature, genetic polymorphisms, antioxidants and oxidative stress, apoptosis and degradation pathways, and protein markers. Glial fibrillary acidic protein(GFAP), S100, and neurons specific enolase (NSE) were the most prominent and frequently cited markers. Amongst these three, no single serum biomarker demonstrated neither superior sensitivity nor specificity compared to the other two, therefore noninvasive panels should incorporate these three serum biomarkers to retain sensitivity and maximize specificity for TBI [3)].

S100B in mild traumatic brain injury

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1)
Mendes Arent A, de Souza LF, Walz R, Dafre AL. Perspectives on Molecular Biomarkers of Oxidative Stress and Antioxidant Strategies in Traumatic Brain Injury. Biomed Res Int. 2014;2014:723060. Epub 2014 Feb 13. Review. PubMed PMID: 24689052.
2)
Papa L, Edwards D, Ramia M. Exploring Serum Biomarkers for Mild Traumatic Brain Injury. In: Kobeissy FH, editor. Brain Neurotrauma: Molecular, Neuropsychological, and Rehabilitation Aspects. Boca Raton (FL): CRC Press/Taylor & Francis; 2015. Chapter 22. PubMed PMID: 26269900.
3)
Mozaffari K, Dejam D, Duong C, Ding K, French A, Ng E, Preet K, Franks A, Kwan I, Phillips HW, Kim DY, Yang I. Systematic Review of Serum Biomarkers in Traumatic Brain Injury. Cureus. 2021 Aug 10;13(8):e17056. doi: 10.7759/cureus.17056. PMID: 34522534; PMCID: PMC8428323.

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