Article type: Perspective

Home Page URL: https://www.alliedacademies.org/neurology-and-neurorehabilitation-research/

Emerging biomarkers in early detection of neurodegenerative disorders.

Emily Carter*

Department of Neurology, Maplewood University, United States.

*Correspondence to: Emily Carter, Department of Neurology, Maplewood University, United States, E-mail: emily.carter@maplewood.edu

Received: 03-Jan-2025, Manuscript No. JNNR-25-169090; **Editor assigned:** 04-Jan-2025, PreQC No. JNNR-25-1690905(PQ); **Reviewed:** 18-Jan-2025, QC No JNNR-25-1690905; **Revised:** 21-Jan-2025, Manuscript No. JNNR-25-1690905(R); **Published:** 28-Jan-2025, DOI:10.35841/ aajnnr -10.1.241

Introduction

Neurodegenerative disorders represent a broad category of chronic and progressive conditions that affect the structure and function of the nervous system. These disorders, such as Alzheimer's disease, Parkinson's disease, Huntington's disease, amyotrophic lateral sclerosis, and multiple sclerosis, have a profound impact on cognitive, motor, and behavioral functions. Despite significant advances in our understanding of the pathophysiological mechanisms underlying these diseases, effective treatments remain elusive, primarily due to the late stage at which these disorders are typically diagnosed [1]. By the time clinical symptoms are evident, extensive neuronal damage has already occurred, limiting the efficacy of therapeutic interventions. Thus, there has been an increasing focus on the early detection of neurodegenerative disorders, with the aim of identifying disease-specific changes before the onset of significant symptoms. This early detection could allow for timely interventions that may slow or halt disease progression, significantly improving patient outcomes and quality of life. In recent years, emerging biomarkers have shown promise as critical tools for early diagnosis, disease monitoring, and therapeutic development [2].

Biomarkers are objectively measurable indicators of biological processes, pathogenic processes, or pharmacologic responses to therapeutic interventions. In the context of neurodegenerative disorders, biomarkers can reflect molecular, biochemical, genetic, structural, or functional changes in the nervous system. These markers can be derived from various sources, including cerebrospinal fluid, blood, urine, saliva, neuroimaging modalities, and even digital health technologies. The ideal biomarker should be sensitive enough to detect disease at its earliest stages, specific to a particular neurodegenerative disorder, reproducible across different populations, and easily measurable using non-invasive or minimally invasive methods. Technological advances, coupled with a deeper understanding of disease pathophysiology, have expanded the range of potential biomarkers, enabling a multi-modal approach to disease detection [3].

One of the most intensely studied areas in biomarker research for neurodegenerative disorders involves cerebrospinal fluid (CSF) analysis. Because CSF is in direct contact with the brain and spinal cord, it provides a valuable medium for assessing molecular changes associated with neurodegeneration. In Alzheimer's disease, for instance, characteristic changes in CSF levels of amyloid-beta (Aβ42) and

Citation: Carter E. Emerging biomarkers in early detection of neurodegenerative disorders. J Neurol Neurorehab Res. 2025;10(1):241.

tau proteins have been observed. Reduced levels of Aβ42 reflect its aggregation into amyloid plaques within the brain, whereas elevated total tau (t-tau) and phosphorylated tau (p-tau) concentrations indicate neuronal injury and tangle formation [4]. The combination of decreased Aβ42 and increased tau levels has been shown to predict the development of Alzheimer's disease in individuals with mild cognitive impairment, sometimes years before the onset of dementia. Similarly, in Parkinson's disease, alterations in CSF alpha-synuclein levels have been linked to disease pathology, although results have been somewhat inconsistent, possibly due to methodological differences and disease heterogeneity. Advances in proteomic technologies are enabling the discovery of additional CSF biomarkers that may enhance diagnostic accuracy for multiple neurodegenerative disorders [5].

Conclusion

In conclusion, emerging biomarkers hold tremendous promise for the early detection of neurodegenerative disorders, offering opportunities to diagnose disease before the onset of irreversible neurological damage. Advances in fluid biomarkers, neuroimaging, genetic profiling, and digital health technologies are converging to create a more comprehensive and sensitive diagnostic toolkit. While significant challenges remain in validating, standardizing, and implementing these biomarkers, their potential to transform clinical practice is undeniable. The future of neurodegenerative disease management lies in a proactive, biomarker-driven approach that not only detects disease earlier but also enables timely, targeted interventions, ultimately improving the lives of millions affected by these devastating conditions.

References

1. Masrori P, Van Damme P. Amyotrophic lateral sclerosis: a clinical review. Eur J Neurol. 2020;27(10):1918-29.
2. Abati E, Bresolin N, Comi G, Corti S. Silence superoxide dismutase 1 (SOD1): a promising therapeutic target for amyotrophic lateral sclerosis (ALS). Expert Opin Ther Targets. 2020;24(4):295-310.
3. Goutman SA, Hardiman O, Al-Chalabi A, et al. Recent advances in the diagnosis and prognosis of amyotrophic lateral sclerosis. Lancet Neurol. 2022;21(5):480-93.
4. Niedermeyer S, Murn M, Choi PJ. Respiratory failure in amyotrophic lateral sclerosis. Chest. 2019;155(2):401-8.
5. Chiò A, Mazzini L, Mora G. Disease-modifying therapies in amyotrophic lateral sclerosis. Neuropharmacology. 2020;167:107986.

Citation: Carter E. Emerging biomarkers in early detection of neurodegenerative disorders. J Neurol Neurorehab Res. 2025;10(1):241.