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BioChip Journal

ISSN 1976-0280

BioChip J
DOI 10.1007/s13206-021-00018-z

Springer

BioChip Journal
https://doi.org/10.1007/s13206-021-00018-z

REVIEW ARTICLE

Advances for the Development of In Vitro Immunosensors for Multiple Sclerosis Diagnosis

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Received: 2 November 2020 / Revised: 5 February 2021 / Accepted: 9 February 2021

Abstract
The diagnosis of diseases based on immunosensors have been objective of research in the last years, providing an improvement for a rapid detection, high sensitivity, precision, accuracy, specificity and resolution. Areas of progress such as analytical technologies, interpretation and standardization has been done for common biomarkers. However, years of research and development of a functional immunosensor with an unusual biomarker require further investigation to be optimized in any aspect. Recent development of biosensors to diagnose nervous system diseases, such as immunosensors for multiple sclerosis, has been the object of study in the past 10 years to improve common in vitro diagnostic methods such as enzyme-linked immunosorbent assays (ELISA) on cerebrospinal fluid (CSF), showing a big opportunity for further diagnostic optimization. The aim of this review is to show a report on the development of in vitro immunosensors for multiple sclerosis diagnosis until today, with the particular focus on monitoring analyte concentration levels on cerebrospinal fluid and serum as a contribution and improvement to current diagnostic methods.

Keywords Multiple sclerosis · Myelin basic protein · Immunosensors · Nanotechnology · Diagnostic methods · Biomarkers

1 Introduction

Multiple sclerosis (MS) is a neuroinflammatory and neurodegenerative disease which is derived from the demyelination of neurons in the central nervous system [1]. The damage to the myelin sheaths on the axons of neurons disrupts the ability of nerve impulses to communicate the nervous system efficiently, resulting in physical and mental deterioration [2]. Myelin is a concentrated lipoprotein around the axons of neurons produced by oligodendrocytes in the central nervous system (CNS) and Schwann cells in the peripheral nervous system (PNS) [3]. Its function in the axons of the neurons is based on the formation of Ranvier nodes, where myelin acts as an insulating material in the way that the nervous impulses jump quickly from one node of Ranvier to another, resulting in fast and efficient communication of the nervous system [4, 5].

In part, it has been reported that the immune system is involved in the damage of the myelin sheaths, in which the presence of immune system cells such as T cells and macrophages in the affected areas has been confirmed [6]. Until today, demyelinating diseases do not have an existing cure, and their origin is not yet clearly known. However, there are innovations on treatments and therapies that can help limit the degradation of myelin in axons, as reported in Smriti Ojha and Babita Kumar review based on nanotechnology innovations for diagnosis and treatment of MS, showing improvements on suppressing T cells, macrophages and inflammatory cytokines [7], facilitating the conduction and proper functioning of the nervous system [8, 9]. The above can be more effective in early stages of the disease, such as Relapsing–Remitting Multiple Sclerosis (RRMS), in which the attacks are unpredictable, and there may or not be permanent damage [10].

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Published online: 25 February 2021