Decreased circulating mitochondrial DNA copy number in patients with multiple sclerosis: A potential blood-based biomarker

Ghada Al Kafaji, Hala Bakheit, Ahmad Alsayed Farahat and **Moiz Bakhiet**
Arabian Gulf University, Bahrain

Multiple sclerosis (MS) is a chronic immune-mediated disease of the central nervous system, characterized by neuroinflammation and neurodegeneration with demyelination and neuroaxonal loss. At present, there is no cure for MS and the validation of biomarkers can improve disease diagnosis and clinical outcome. Growing evidence suggests that mitochondrial dysfunction is associated with the pathogenicity of MS. In addition, maintaining mitochondrial DNA (mtDNA) copy number, which is a surrogate measure of mitochondrial function, is important for preserving mitochondrial activity.

In this study, we investigated changes in mtDNA copy number in the peripheral blood of patients with relapsing-remitting MS (RRMS) and healthy individuals to evaluate the feasibility of mtDNA copy number as a biomarker for MS.

The mtDNA copy number was quantified as the DNA ratio between a target mitochondrial gene and a reference nuclear gene (mtDNA/nDNA) in blood samples from 46 RRMS patients and 47 healthy controls using real-time polymerase chain reaction (PCR).

Patients with RRMS showed a significant decrease in peripheral blood mtDNA (59.23±7.2) compared to controls (75.34±9.4), ($P<0.001$). In multivariant regression analysis, the decreased mtDNA copy number was significantly associated with the presence of MS (odds ratio [OR]: 0.861; confidence interval [CI]: 0.803-0.924; $P<0.001$). Receiver operating characteristic curve analysis revealed a significant ability of peripheral blood mtDNA copy number to distinguish RRMS patients from controls with an area under the curve (AUC) of 0.859 (CI: 0.785-0.933; $P<0.001$).

To the best of our knowledge, this is the first study to show the utility of circulating mtDNA copy number in the peripheral blood as a non-invasive biomarker for early detection of MS, which can offer a clinical applicability over other invasive biomarkers. Our results also suggest that the decreased peripheral blood mtDNA copy number is a consequence of impaired mitochondrial function, which is an early event in MS.

Speaker Biography

Ghada Al Kafaji is an associate professor of molecular genetics in the department of molecular medicine and Al-Jawahar centre for molecular medicine, genetics and inherited disorder, and the director of personalized medicine master program in the college of medicine, Arabian Gulf University, Bahrain. She obtained her MSc degree in molecular biology from Baghdad University in Iraq and her PhD degree in molecular genetics from King's college London, University of London, UK. Following her PhD, she worked in the UK as a postdoctoral research fellow at the school of medicine, King's college London, and as an assistant professor in molecular genetics at the college of science, University college Kensington. Currently, she is involved in lecturing and tutoring undergraduate and graduate students and supervising graduate theses. Her research interest includes genetic variations and novel biomarkers for cancer, diabetes and other complex diseases. She has abundant publications in the area of Molecular Genetics that have been cited over 350 times. She participated as an active member in many International Scientific Associations. She acted as a potential reviewer for many journals and received several certificates of excellence in reviewing scientific articles. She also received a number of awards for best presentations and outstanding work in regional and international conferences.

e: ghadaa@agu.edu.bh

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