

Changes in Fatty Acid Composition of Extracellular Vesicles Obtained from Patients with a History of Myocardial Infarction

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Background

Myocardial infarction and ischaemia cause around 16% of deaths and is the main cause of death worldwide. Atherosclerosis-induced coronary heart disease is a major risk factor for myocardial infarction. Extracellular vesicles are involved in intracellular signalling and their specific membrane compositions have been associated with numerous pathophysiological processes. Understanding their compositional changes during atherosclerosis could lead to a better understanding of the disease.

Aims & Objectives

This study aims to identify significant differences in exosome fatty acid composition between healthy individuals and patients who have experienced myocardial infarction and evaluate the correlation between individual fatty acids and a marker of oxidative stress - malondialdehyde.

Methods

The study includes 24 healthy men aged 25 - 60 y.o. and 12 men aged 40 - 60 y.o., who have experienced myocardial infarction. Collected samples were ultracentrifuged to isolate exosomes. Samples were held at -80 °C until analysis was started. Fatty acid composition of extracellular vesicles was analysed using gas chromatography mass spectrometry (GCMS), and molecular vibration spectra were recorded using Fourier-transform infrared spectroscopy (FTIR). Comparisons between groups were performed using logistic regression models and Principal Component Analysis algorithms.

Results

Results showed statistically significant differences in volume of saturated fatty acids C14: 0 and C16: 0, and monounsaturated fatty acids C18: 1ω9 and C20: 1ω9 between study groups.

Significant correlations of malondialdehyde concentration with C14: 0, C18: 3ω3, total ω3 fatty acids, and the ratio of C18: 2ω6 to C20: 4ω6 fatty acids were observed.

FTIR analysis revealed differences in lipid bands at 2960 cm⁻¹, 2852 cm⁻¹, 1740 cm⁻¹, and 1453 cm⁻¹, and protein bands at 1650 cm⁻¹ and 1545 cm⁻¹ between study groups.

During the FTIR analysis, interference from Phosphate Buffered Saline (PBS) was observed.

High sensitivity and specificity classification models were developed using both fatty acid composition and FTIR spectra.

Conclusions

Results suggest that changes in extracellular vesicle fatty acid composition, measured using GCMS and FTIR methods, may serve as a potential biomarker for myocardial infarction. This could contribute to a development of more accurate and effective prognostic and prevention strategies. The study emphasizes the need for further standardization of extracellular vesicle isolation and analysis methodologies to ensure data reliability and reproducibility in future research. Future studies should combine fatty acid composition and FTIR spectra in creating a comprehensive classification model.

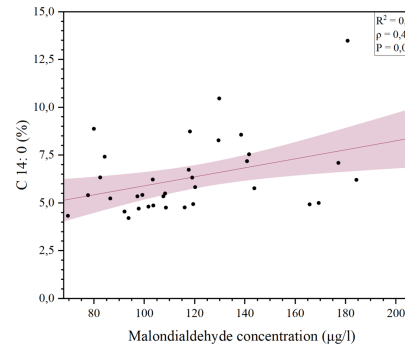


Fig. 1. Scatterplot diagram showing the correlation between C14: 0 fatty acid and malondialdehyde concentration.

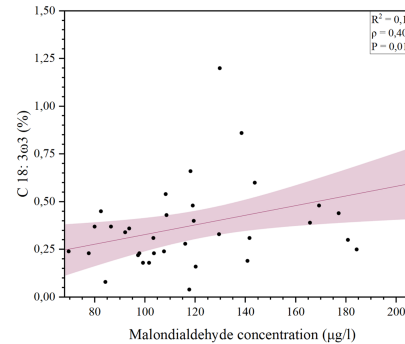


Fig. 2. Scatterplot diagram showing the correlation between C18: 3ω fatty acid and malondialdehyde concentration.

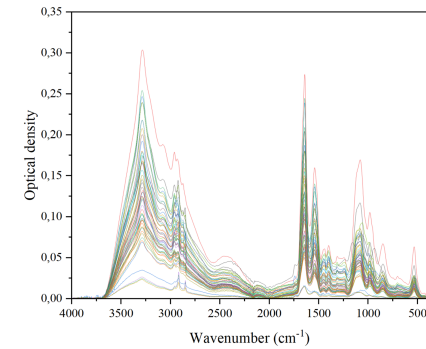


Fig. 3. Diagram showing all the spectra registered.

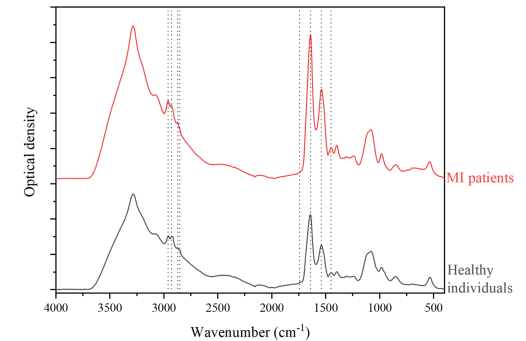


Fig. 4. Diagram comparing the differences between healthy individual and MI patient study groups.

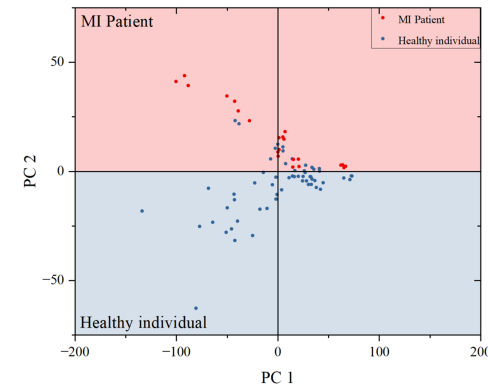


Fig. 5. Principal Component Analysis result graph.