Commentary

IMedPub Journals
http://www.imedpub.com/

Journal of Clinical and Molecular Pathology
ISSN: 2634-7806

2025
Vol.9 No.1:2

Circulating microRNAs as Non-Invasive Biomarkers in Cardiovascular and Metabolic Diseases

Elena Rossi *

Department of Clinical Pathology and Precision Medicine, University of Milan, Milan 2012, Italy

***Corresponding author:** Elena Rossi, Department of Clinical Pathology and Precision Medicine, University of Milan, Milan 2012, Italy; E-mail: rossielena09@unimi.it

Received date: February 22, 2025, Manuscript No. ipjcmpy-25-20880; **Editor assigned date:** February 25, 2025, PreQC No. ipjcmpy-25-20880 (PQ); **Reviewed date:** March 14, 2025, QC No. ipjcmpy-25-20880; **Revised date**: March 22, 2025, Manuscript No. ipjcmpy-25-20880 (R); **Published date:** March 31, 2025, DOI: 10.36648/IPJCMPY/25.9.2

Citation: Rossi E (2025) Circulating microRNAs as Non-Invasive Biomarkers in Cardiovascular and Metabolic Diseases. J Clin Mol Pathol Vol.9 No.1:2

Introduction

In recent years, circulating microRNAs (miRNAs) have emerged as promising non-invasive biomarkers for diagnosing and monitoring cardiovascular and metabolic diseases. miRNAs are small, non-coding RNA molecules that regulate gene expression by targeting messenger RNAs, influencing several cellular processes such as apoptosis, metabolism, and inflammation. Unlike conventional biomarkers, miRNAs are highly stable in blood and other bio fluids, protected from degradation by encapsulation within exosomes or binding to proteins. This stability, combined with their disease-specific expression profiles, makes miRNAs ideal candidates for early detection and prognosis of diseases like Coronary Artery Disease (CAD), Myocardial Infarction (MI), heart failure, diabetes mellitus, and obesity. The advent of next-generation sequencing and quantitative PCR technologies has further advanced the identification of miRNA signatures associated with these conditions, paving the way for precision diagnostics and personalized medicine [1].

Description

Cardiovascular Diseases (CVDs) are the leading cause of mortality worldwide, and timely diagnosis remains a key challenge. Several studies have demonstrated the potential of circulating miRNAs as diagnostic and prognostic markers for CVDs. For example, miR-1, miR-133a, miR-208a, and miR-499 are released into the circulation during myocardial injury and serve as early indicators of acute myocardial infarction.

Similarly, specific miRNA profiles such as miR-21, miR-126, and miR-155 are associated with atherosclerosis, endothelial dysfunction, and cardiac remodeling. These molecules not only reflect disease presence but also provide insight into underlying pathophysiological mechanisms.

Their remarkable stability in blood and other body fluids makes circulating miRNAs highly attractive for non-invasive biomarker development.

Advances in high-throughput sequencing and qRT-PCR technologies have further improved the sensitivity and specificity of miRNA detection, enabling precise disease stratification [2].

In metabolic disorders, dysregulated miRNAs Contribute to insulin resistance, adipogenesis, and lipid metabolism. Circulating miR-122 and miR-223 are linked to non-alcoholic fatty liver disease and obesity, while miR-375 is implicated in pancreatic β-cell dysfunction in diabetes. Thus, the combined study of miRNA patterns offers a holistic understanding of cardio-metabolic health. The integration of miRNA profiling into clinical practice is being explored through multi-marker panels and machine learning algorithms that enhance diagnostic accuracy. Moreover, miRNAs hold therapeutic potential synthetic miRNA mimics and inhibitors are being developed to restore normal gene regulation in diseased tissues. Challenges remain, including standardization of detection methods, normalization strategies, and differentiation between disease-specific and systemic alterations [3].

However, ongoing research continues to validate miRNA signatures across diverse populations, emphasizing their role in early disease detection, prognosis, and therapeutic monitoring. The non-invasive nature of miRNA-based assays, using blood or plasma samples, supports their translation into routine clinical diagnostics [4,5].

Conclusion

Circulating miRNAs represent a revolutionary step toward non-invasive, precise, and personalized diagnostics for cardiovascular and metabolic diseases. Their unique stability, specificity, and regulatory significance make them superior to traditional biomarkers. While technical and biological challenges must be addressed, growing evidence suggests that miRNA-based diagnostics will soon complement or even replace conventional blood tests for CVDs and metabolic disorders. With further validation and integration into clinical workflows, miRNAs could transform patient care by enabling earlier diagnosis, better risk assessment, and targeted therapeutic strategies.

Acknowledgement

None

Conflicts of Interest

None

References

1. Karimi M, Brazier J (2016) Health, health-related quality of life, and quality of life: What is the difference? Pharmacoeconomics 34: 645-649

2. Gantenbein KV, Kanaka-Gantenbein C (2021) Mediterranean diet as an antioxidant: The impact on metabolic health and overall wellbeing. Nutrients 13: 1951

3. Alshammary AF, Alharbi KK, Alshehri NJ, Vennu V, Ali Khan I (2021) Metabolic syndrome and coronary artery disease risk: A meta-analysis of observational studies. Int J Environ Res Public Health 18: 1773

4. Alvarez-Alvarez I, Toledo E, Lecea O, Salas-Salvadó J, Corella D, et al. (2020) Adherence to a priori dietary indexes and baseline prevalence of cardiovascular risk factors in the PREDIMED-Plus randomised trial. Eur J Nutr 59: 1219-1232

5. Bibiloni MDM, Gallardo-Alfaro L, Gómez SF, Warnberg J, Oses-Recalde M, et al. (2022) Combined body mass index and waist-to-height ratio and its association with lifestyle and health factors among Spanish children: The PASOS study. Nutrients 14: 234