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Short Communication

Metabolomics in Cardiology: Is There a Role for Precision Medicine?

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Introduction

Heart diseases are the leading causes of death worldwide. In this regard, metabolic complications such as diabetes and obesity, promote systemic alterations, mainly characterized by the availability of energetic substrates, such glucose and lipid levels, and amino acids concentrations. In addition to the presence of ketone bodies, and an abnormal hormonal levels, mainly androgen mediators, growth factors as well as changes in insulin homeostasis. These general metabolic alterations promote disturbances in cardiomyocytes energetic metabolism, increasing the risk of cardiovascular complications.

One of the main focus of cardiology research nowadays is to improve diagnosis and prognosis, as well as, preventive medicine. These research topics are currents needs, since heart diseases, are usually diagnosed advanced pathological stages, when patients are symptomatic. In these stages, the effectiveness of treatments, in order to revert the cardiovascular performance decrease. In this context, tools for diagnosis and risk stratification, in a precision manner, are mandatory to improve the outcomes of these patients and prevent severe chronic physiological alteration induced by heart diseases.

Metabolomics Methodologies: Strength and Weaknesses

Metabolomics is an emerging tool that is growing in both basic science and clinical applications. Metabolomics has arisen as one of the most complete and reliable source of data concerning physiological screening of circulatory molecules and biomarker discovery. Small circulatory molecules, such as amino acids, vitamins, hormone metabolites and products of both anaerobic and aerobic metabolism, can reflect the global health and physiological status, which provide important advances for clinical and therapeutic supervision in a personalized manner. Regarding its technology, metabolomics is based on groundbreaking mass spectrometry (MS) and nuclear magnetic resonance (NMR) analytical technologies, bioinformatics and statistics, providing an unprecedented understanding at system-level and pathways dynamics [1,2].

Limitation factor and points to be improved: despite its' impressive development in the last years, there is still room for improvement. A key aspect to be further developed are the databases, since an important part of the circulatory molecules found in the plasma by metabolomics are still unknown. Regarding the mass spectrometry analytics, a phenomenon named ion suppression might limit the identification as well as quantification of some metabolites. The ion suppression is an important mechanism mainly for very complex sample matrices such as blood and might also limit data reproducibility [3-5]. On the other hand, NMR is also a very powerful instrument for metabolomics, producing very reliable quantification and data reproducibility. However, the total number of the identified metabolites by NMR are still low, preferably detecting the most highly expressed compounds [6,7].

Clinical Applications

The metabolic alterations in heart metabolism caused by diseases lead to alterations in metabolites profiles as described previously. For instance, quantification of branched-chain amino acids and its' oxidized metabolites in the plasma can give insights of cardiac pathophysiology [8]. The gut microbiota plays an important role in different heart diseases, in this context, another interesting application of metabolomics is the analysis of circulatory metabolites from bacterial activities [9]. Atherosclerosis is a major risk for heart complications, however, the identification of atherosclerotic plaques by imaging techniques are costly. In this regard, the quantification of trimethylamine-N-oxide (TMAO) represents an interesting biomarker for risk of myocardial infarction risk and stroke. Furthermore, the inhibition of the TMAO generation, by targeting gut microbial production, might serve as a potential therapeutic method for the treatment of cardiometabolic diseases [10].

Conclusion and Perspectives

Metabolomics is a growing field and its applications is promoting great progress in both basis science and clinical application. Regarding metabolomics methodology, an impressive development has been done in the last decade and some point such databases are still improving. It is believed that in a near future metabolomics will be part of daily diagnostics and prognostics for cardiac diseases as well as many other specialties. In this regard,

medical professionals must learn about data mining, chemical analysis of mass spectrometry and bioinformatics, in order to apply metabolomics in preventive and personalized medicine.

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