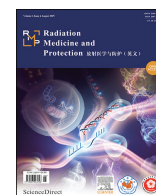




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Review

The role of small molecule metabolites in radiation-induced cardiovascular injury

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ABSTRACT

Radiation exposure from medical exposure, occupational exposure, or accidental incidents, increases significant risks to cardiovascular health. Small molecule metabolites have attracted widespread attention owing to the role in cardiovascular cell metabolism, immune response and inflammatory injury. This article reviews the classification and characteristics of small molecule metabolites and their multiple roles in radiation-induced cardiovascular inflammatory injury. This article explored the potential of small molecule metabolites as biomarkers in the diagnosis and prognosis of cardiovascular diseases, and the potential as therapeutic targets. Based on the relevant research in recent years, this article summarizes the relationship between small molecule metabolites and cardiovascular inflammatory injury, as well as the mechanisms on the cardiovascular system under radiation, aiming to understand the potential mechanism of small molecule metabolites in radiation-induced cardiovascular diseases to develop new prevention and treatment strategies.

1. Introduction

Metabolites can be divided into small molecule metabolites, medium molecule metabolites, and large molecule associated metabolites according to their molecular weight. As the largest proportion of small molecule metabolites, which refers to compounds with low molecular weight, usually below 1000 Da, produced during various complex biochemical reactions in cell small molecule metabolites can serve as functional biomarkers of some diseases and its biochemical pathways can be indicators of pathological dysfunction and injury^{1–4}(Table 1, Fig. 1)

Radiation-induced cardiovascular injury is a series of cardiovascular diseases after exposed to radiation such as endothelial damage, atherosclerosis and so on. Recently, the discovery of some small molecule metabolites, including 3-hydroxybutyrate,⁵ vitamin E,⁶ C-reactive protein⁷ have been proved to be beneficial in the treatment of cardiovascular injury. Current research indicates that small molecule compounds have shown promising potential in biomarkers and therapeutic targets, including in radiation-induced cardiovascular injury events.

This review will outline the potentiality in biomarkers and therapeutic targets, and focus on radiation-induced cardiovascular injury events.

2. The role of small molecule metabolites in the diagnosis and treatment of radiation injury events

Small-molecule metabolites have not only emerged as promising diagnostic biomarkers for radiation injury, but also garnered increasing attention for their therapeutic potential in mitigating radiation-induced tissue damage.^{8,9}

2.1. Small molecule metabolites as promising biomarkers in radiation accidents

Biomarkers are associated with disease progression disease, which can be used for early diagnosis, predication of prognosis, selection of therapeutic targets.¹⁰ Various of small molecule metabolites were discovered and used to diagnose or detect radiation-related diseases. Small molecule metabolites related to oxidative stress, including LPO (lipid peroxidation), NO (nitric oxide) and NOS (nitric oxide synthase), were significantly elevated after radiation exposure. These small-molecule metabolites can serve as biomarkers for radiation injury, as radiation disrupts intracellular redox balance and affect normal metabolic processes.

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