

Molecular mechanisms of metal toxicity and carcinogenesis

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Abstract

Many metals and metal-containing compounds have been identified to be potent mutagens and carcinogens. Recently, a new sub-discipline of molecular toxicology and carcinogenesis has been developed. The combination of newly developed molecular techniques and free radical approach makes it possible to insightfully examine metal-induced carcinogenesis in precise molecular terms so that intricate biological interrelationships can be elucidated. In consideration of the increased amount of new findings deciphered by utilizing these new methods, the 1st Conference on Molecular Mechanisms of Metal Toxicity and Carcinogenesis was held. In this conference, more than 50 scientists from nine countries presented their novel discoveries concerning metal-induced carcinogenesis, delineated molecular mechanism of metal carcinogenesis, and proposed novel therapeutic intervention and prevention strategies. This article reviews some of the state-of-the-art information presented at the meeting regarding the molecular mechanisms of metal cytotoxicity and carcinogenesis. (*Mol Cell Biochem* 222: 3–9, 2001)

Key words: ROS, cell growth regulation, transcription factor, signal transduction, cytotoxicity and carcinogenesis

Introduction

Both environmental and occupational exposures to chromium (Cr), nickel (Ni), and arsenic (As) compounds have been reported to cause human tumors in various systems [1, 2]. Although a variety of metals, including Cr, Ni, As, vanadium (V), cadmium (Cd), and cobalt (Co), have been reported to induce carcinogenesis both in animals and in humans, the underlying mechanisms are not well understood. Since carcinogenesis induced by metals involves a variety of facets, it is difficult to identify one common mechanism. It is very likely that each metal has its own unique molecular mechanisms which contribute to the cancer development.

During the last two decades, chemical and cellular studies have provided a variety of contributions to extend our understanding for metal-induced carcinogenesis. Generally, carcinogenesis is considered to have the following four stages: initiation, promotion, progression, and metastasis. Although

mutations on genome DNA which are capable of activating oncogenes or inactivating tumor suppressors, are traditionally considered to be the crucial factor for cancer initiation, other events, such as transcription activation, recombination, and oncogene amplification, which may or may not require DNA damage, also contribute to the tumor initiation process [3–7]. Altered gene expression and cell signaling are considered to be related to tumor promotion and progression [8, 9]. The mechanisms of metal-induced carcinogenesis are believed to be involved in all stages of cancer development.

Metal compounds are found to have effects on the cellular organelles and components, such as cell membrane, mitochondrial, lysosome, endoplasmic reticulum, nuclei, and some enzymes involved in metabolism, detoxification, and damage repair [10]. All these systems are considered to influence metal-induced cellular responses. Metal ions have been found to directly bind to some cell components such as DNA and nuclear proteins through ionic and coordination bonds, causing

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SJ Ball

A decorative graphic element consisting of a light blue horizontal bar with a rounded right end, followed by a red circular shape with a gradient, resembling a stylized arrow or a molecular structure.

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Molecular Mechanisms of Metal Toxicity and Carcinogenesis Xianglin Shi,Vince Castranova,Val Vallyathan,William G. Perry,2012-12-06 During the last two decades chemical and cellular studies have contributed enormously to our understanding of metal induced carcinogenesis and many hypotheses on the role of metals in pathophysiological processes have been investigated In addition new techniques are available to shed light on the mechanism of carcinogenesis in molecular terms This conference on Molecular Mechanisms of Metal Toxicity and Carcinogenesis in September 2000 focused on the latest research in molecular mechanisms of metal induced toxicity and carcinogenesis The conference promoted a multidisciplinary investigative approach and included presentations from international experts on state of the art information in this field

Molecular Mechanisms of Metal Toxicity and Carcinogenesis Xianglin Shi,Vince Castranova,Val Vallyathan,2004 **Molecular Mechanisms of Metal Toxicity and Carcinogenesis** Xianglin Shi,Vince Castranova,Val Vallyathan,William G. Perry,2012-12-15 These proceedings focus on the latest research in molecular mechanisms of metal induced toxicity and carcinogenesis The conference promoted a multidisciplinary investigative approach and included presentations from international experts on state of the art information in this field

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Molecular Mechanisms of Metal Toxicity and Carcinogenicity ,1994 **Environmental Health Perspectives** ,1993

Molecular Mechanisms of Metal Toxicity and Carcinogenicity ,1989 *Cancer: Cell Structures, Carcinogens and Genomic Instability* Leon P. Bignold,2006 Tumors can be induced by a variety of physical and chemical carcinogens The resulting tumor cells are usually abnormal in their morphology and behavior and transmit their abnormalities to their daughter tumor cells Most theories of the pathogenesis of tumors suggest that carcinogens in some way cause alterations either of the genomes or of inheritable patterns of gene expression in normal cells which then cause morphological and behavioral changes This volume presents a collection of articles aimed at the question by what genetic or epigenetic mechanisms carcinogens can cause morphological abnormalities of tumor cells It includes reviews of cellular targets of known carcinogens and presents varying viewpoints of how morphological abnormalities and the actions of carcinogens might be related The volume will be of interest to all those who are involved in cancer research or in the prevention diagnosis or management of tumors in humans or animals

Metal Toxicology Handbook Debasis Bagchi,Manashi Bagchi,2020-11-19 Heavy metals and metalloids singly or in combination induce toxic manifestations either through acute or chronic pathology In particular long term chronic exposure to diverse heavy metals and metalloids to humans and animals can lead to numerous physical muscular neurological nephrological and diverse degenerative diseases and dysfunctions including multiple sclerosis muscular dystrophy Parkinson s and Alzheimer s diseases cardiovascular disorders and several others Recognized heavy metals such as lead mercury arsenic cadmium thallium and hexavalent chromium are known for enormous

toxicity The immediate vital signs of acute heavy metal exposure include nausea vomiting diarrhea and acute abdominal pain Mercury has been identified as the most toxic heavy metal and mercury poisoning is known as acrodynia or pink disease Similarly lead another toxic heavy metal was at one time an integral part of painting Metal Toxicology Handbook further explains and discusses the varying attributes of metals discussing toxicity safety and proper human utilization of metals Beginning with a broad overview of metals metalloids redox biology and neurodegeneration and going further into the roles benefits and toxicity of metals with each section the text contains 28 chapters from eminent researchers and scientists in their respective fields and is a must have for anyone researching the potential toxicity in metals Key Features Discusses the pathology of metal toxicity Highlights the benefits of metals Explains the mechanism and salient features of restoring metabolic homeostasis Highlights dose dependent beneficial and adverse effects of vanadium safety and toxicity The initial introductory section provides a broad overview of metals metalloids redox biology and neurodegeneration The second section discusses the pathology of metal toxicity in two chapters while the third section highlights the mechanism and salient features of restoring metabolic homeostasis in two chapters The fourth section demonstrates the aspect of radionuclides toxicity In a change of pace the fifth section discusses the benefits of metals in four chapters The sixth section titled Toxic Manifestations by Diverse Heavy Metals and Metalloids provides fourteen chapters that discuss the toxicological mechanism and manifestation of individual metals The editors have crafted a commentary titled A Treatise on Metal Toxicity and summarized a vivid scenario of metal toxicity and its consequences

This book delves into Molecular Mechanisms Of Metal Toxicity And Carcinogenesis. Molecular Mechanisms Of Metal Toxicity And Carcinogenesis is a crucial topic that must be grasped by everyone, ranging from students and scholars to the general public. The book will furnish comprehensive and in-depth insights into Molecular Mechanisms Of Metal Toxicity And Carcinogenesis, encompassing both the fundamentals and more intricate discussions.

1. This book is structured into several chapters, namely:
 - Chapter 1: Introduction to Molecular Mechanisms Of Metal Toxicity And Carcinogenesis
 - Chapter 2: Essential Elements of Molecular Mechanisms Of Metal Toxicity And Carcinogenesis
 - Chapter 3: Molecular Mechanisms Of Metal Toxicity And Carcinogenesis in Everyday Life
 - Chapter 4: Molecular Mechanisms Of Metal Toxicity And Carcinogenesis in Specific Contexts
 - Chapter 5: Conclusion
 2. In chapter 1, this book will provide an overview of Molecular Mechanisms Of Metal Toxicity And Carcinogenesis. The first chapter will explore what Molecular Mechanisms Of Metal Toxicity And Carcinogenesis is, why Molecular Mechanisms Of Metal Toxicity And Carcinogenesis is vital, and how to effectively learn about Molecular Mechanisms Of Metal Toxicity And Carcinogenesis.
 3. In chapter 2, the author will delve into the foundational concepts of Molecular Mechanisms Of Metal Toxicity And Carcinogenesis. This chapter will elucidate the essential principles that must be understood to grasp Molecular Mechanisms Of Metal Toxicity And Carcinogenesis in its entirety.
 4. In chapter 3, this book will examine the practical applications of Molecular Mechanisms Of Metal Toxicity And Carcinogenesis in daily life. This chapter will showcase real-world examples of how Molecular Mechanisms Of Metal Toxicity And Carcinogenesis can be effectively utilized in everyday scenarios.
 5. In chapter 4, the author will scrutinize the relevance of Molecular Mechanisms Of Metal Toxicity And Carcinogenesis in specific contexts. This chapter will explore how Molecular Mechanisms Of Metal Toxicity And Carcinogenesis is applied in specialized fields, such as education, business, and technology.
 6. In chapter 5, this book will draw a conclusion about Molecular Mechanisms Of Metal Toxicity And Carcinogenesis. This chapter will summarize the key points that have been discussed throughout the book.
- The book is crafted in an easy-to-understand language and is complemented by engaging illustrations. It is highly recommended for anyone seeking to gain a comprehensive understanding of Molecular Mechanisms Of Metal Toxicity And Carcinogenesis.

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Molecular Mechanisms Of Metal Toxicity And Carcinogenesis Introduction

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