
Table of Contents

PART 1: GENERAL AND CLINICAL ASPECTS, RISK ASSESSMENT, AND GENOTOXICITY OF METALS

Section I: Monitoring Environmental and Health Risk Assessments

Section Head: Anna M. Fan

Overview

An Introduction to Monitoring and Environmental and Human Risk Assessment of Metals.....	5
Anna M. Fan	

Chapter 1

Monitoring and Assessment of Metal Contaminants in the Air	9
Jozef M. Pacyna	

Chapter 2

Assessment of Ecological and Health Effects of Soil-Borne Trace Elements and Metals.....	29
Andrew C. Chang and Albert L. Page	

Chapter 3

Assessment of Metals in Drinking Water With Specific References to Lead, Copper, Arsenic, and Selenium	39
Anna M. Fan	

Chapter 4

Risk Assessment of Metals.....	55
J. Michael Davis and Robert W. Elias	

Chapter 5

Techniques Employed for the Assessment of Metals in Biological Systems	69
Richard M. Jacob	

Chapter 6

Concepts on Biological Markers and Biomonitoring for Metal Toxicity	81
Lars Gerhardsson and Staffan Skerfving	

Section II: Bioresponses and Reactivities in Metal Toxicity
Section Head: Louis W. Chang

Overview

An Introduction to Bioresponses and Reactivities of Metals	111
Louis W. Chang	

Chapter 7

Determinants of Reactivity in Metal Toxicology.....	113
Evert Nieboer and Glenn G. Fletcher	

Chapter 8

Metals and Biological Membranes.....	133
Ernest C. Foulkes	

Chapter 9

Interactions Between Glutathione and Mercury in the Kidney, Liver, and Blood.....	145
Rudolfs K. Zalups and Lawrence H. Lash	

Chapter 10

The Role of General and Metal-Specific Cellular Responses in Protection and Repair of Metal-Induced Damage: Stress Proteins and Metallothioneins	165
Brenda M. Sanders, Peter L. Goering, and Kenneth Jenkins	

Chapter 11

Metal-Metal Interactions.....	189
Ananda S. Prasad and Frances W. J. Beck	

Section III: Carcinogenesis and Genotoxicity of Metals
Section Heads: Max Costa and Lionel A. Poirier

Part A: Carcinogenicity and Genotoxicity of Specific Metals

Overview

An Introduction to Metal Toxicity and Carcinogenecity of Metals	203
Max Costa	

Chapter 12

Carcinogenicity and Genotoxicity of Chromium.....	205
Catherine B. Klein	

Chapter 13

The Carcinogenicity of Arsenic.....	221
Zaolin Wang and Toby G. Rossman	

Chapter 14

Cadmium Carcinogenicity and Genotoxicity	231
Michael P. Waalkes and R. Rita Misra	

Chapter 15

Mechanisms of Nickel Genotoxicity and Carcinogenicity	245
Max Costa	

Chapter 16

Carcinogenicity and Genotoxicity of Lead, Beryllium, and Other Metals	253
Mitchell D. Cohen, Darlene H. Bowser, and Max Costa	

Part B: Selected Concepts in Metal Carcinogenesis

Overview

An Introduction to Selected Concepts in Metal Carcinogenesis.....	287
Lionel A. Poirier	

Chapter 17

Metal Interactions in Chemical Carcinogenesis.....	289
Lionel A. Poirier and Neil A. Littlefield	

Chapter 18

Oxidative DNA Damage in Metal-Induced Carcinogenesis.....	299
Kazimierz S. Kasprzak	

Chapter 19

Metal-Induced Gene Expression and Neoplastic Transformation	321
Joseph R. Landolph, Michael Dews, Laurent Ozbun, and Douglas Parker Evans	

Section IV: Clinical Aspects of Metal Toxicity

Section Heads: Kazuo T. Suzuki and Tsuguyoshi Suzuki

Overview

An Introduction to Clinical Aspects of Toxicity.....	333
Kazuo T. Suzuki and Tsuguyoshi Suzuki	

Chapter 20

Minamata Disease and Other Mercury Syndromes	337
Rikuzo Hamada and Mitsuhiro Osame	

Chapter 21

Itai-Itai Disease and Health Effects of Cadmium	353
Koji Nogawa and Teruhiko Kido	

Chapter 22

Genetic Disorders of Copper Metabolism.....	371
Hiroko Kodama	

Chapter 23

Alzheimer's Disease and Other Aluminum-Associated Health Conditions.....	387
D.R. McLachlan, P.E. Fraser, E. Jaikaran, and W.J. Lukiw	

Chapter 24

Current Status of Childhood Lead Exposure at Low Dose	405
Herbert L. Needleman	

Chapter 25

Neurological Aspects in Human Exposure to Manganese.....	415
Naohide Inoue and Yuji Makita	

Chapter 26

Health Effects of Arsenic.....	423
Gonzalo G. García-Vargas and Mariano E. Cebrián	

Chapter 27		
Toxicity of Bismuth and Its Compounds	439	
Anja Slikkerveer and Frederik A. de Wolff		
Chapter 28		
Human Exposure to Lithium, Thallium, Antimony, Gold, and Platinum	455	
Gijsbert B. van der Voet and Frederik A. de Wolff		
Chapter 29		
Cobalt and Nickel Induced Hard Metal Asthma.....	461	
Yukinori Kusaka		
Chapter 30		
Aspects on Health Risks of Mercury from Dental Amalgams.....	469	
Jan A. Weiner and Magnus Nylander		
Chapter 31		
Chelation Therapies for Metal Intoxication	487	
Carol R. Angle		

PART 2: TARGET ORGAN TOXICOLOGY

Section V: Neurotoxicology of Metals

Section Head: Louis W. Chang

Overview		
An Introduction to Neurotoxicology of Metals	509	
Louis W. Chang		
Chapter 32		
Toxico-Neurology and Neuropathology Induced by Metals.....	511	
Louis W. Chang		
Chapter 33		
Comparative Neurobehavioral Toxicology of Heavy Metals.....	537	
Deborah A. Cory-Slechta		
Chapter 34		
The Blood-Brain Barrier in Normal CNS and in Metal-Induced Neurotoxicity	561	
Ignacio A. Romero, N. Joan Abbott, and Michael W.B. Bradbury		
Chapter 35		
Astrocytes: Potential Modulators of Heavy Metal-Induced Neurotoxicity	587	
Michael Aschner and Harold K. Kimelberg		
Chapter 36		
Choroid Plexus and Metal Toxicity.....	609	
Wei Zhang		
Chapter 37		
Effects of Toxic Metals on Neurotransmitters	627	
Richard B. Mailman, Mechelle Mayleben, and Cindy P. Lawler		

Chapter 38	
Cytoskeletal Toxicity of Heavy Metals	639
Ronald D. Graff and Kenneth R. Reuhl	
Chapter 39	
Lead Neurotoxicity: Concordance of Human and Animal Research	659
Deborah Rice and Ellen Silbergeld	
Chapter 40	
Effects of Metals on Ion Channels.....	677
Toshio Narahashi	
Chapter 41	
Oxygen Generation as a Basis for Neurotoxicity by Metals.....	699
Stephen C. Bondy	
Chapter 42	
Disruption of Protein Synthesis as Mechanistic Basis of Metal Neurotoxicity.....	707
M. Anthony Verity	

Section VI: Renal Toxicology of Metals
Section Head: Bruce A. Fowler

Overview	
An Introduction to Metal-Induced Nephrotoxicity	719
Bruce A. Fowler	
Chapter 43	
The Nephropathology of Metals.....	721
Bruce A. Fowler	
Chapter 44	
Roles of Metal-Binding Proteins in Mechanisms of Nephrotoxicity of Metals	731
Katherine S. Squibb	
Chapter 45	
In Vivo Measurement and Speciation of Nephrotoxic Metals.....	737
Donald R. Smith and Fiona McNeill	
Chapter 46	
Metal-Induced Alterations in Renal Gene Expression.....	751
Hiroshi Yamauchi and Bruce A. Fowler	
Chapter 47	
Biomarkers of Metal-Induced Nephrotoxicity	759
Bruce A. Fowler and Monica Nordberg	
Chapter 48	
Study on the Transport and Toxicity of Metals Along the Nephron by Means of the Isolated Perfused Tubule Technique	765
Rudolfs K. Zalups and Delon W. Barfuss	

Section VII: Immunomodulation by Metals
Section Heads: Judith T. Zelikoff and Donald E. Gardner

Overview	
An Introduction to Immunomodulation by Metals	783
Donald E. Gardner and Judith T. Zelikoff	
Chapter 49	
Effects of Metals on Cell-Mediated Immunity and Biological Response Modulators.....	785
Raghbir P. Sharma and Raviprakash R. Dugyala	
Chapter 50	
Effects of Metals on the Humoral Immune Response.....	797
Jerry H. Exon, Elizabeth H. South, and Kathleen Hendrix	
Chapter 51	
Metal-Induced Alterations in Innate Immunity.....	811
Judith T. Zelikoff and R.J. Smialowicz	
Chapter 52	
Contact Hypersensitivity to Metals	827
Ian Kimber and David A. Baskettter	
Chapter 53	
Autoimmunity Induced by Metals.....	835
Pierluigi E. Bigazzi	
Chapter 54	
Altered Host Defenses and Resistance to Respiratory Infections	
Following Exposure to Airborne Metals	853
Mary Jane K. Selgrade and Donald E. Gardner	
Chapter 55	
Concepts of Immunological Biomarkers of Metal Toxicity	861
Hassan A. N. El-Fawal	
Chapter 56	
Modulation of Immune Functions by Metallic Compounds	871
Lee S. F. Soderberg, John R. J. Sorenson, and Louis W. Chang	
Section VIII: Effects of Metals On Other Organ Systems	
Section Head: Louis W. Chang	
Overview	
An Introduction to Metal Effects on Other Organ Systems	885
Louis W. Chang	
Chapter 57	
Hepatic Injury by Metal Accumulation.....	887
Anna-Liisa Nieminen and John J. Lemasters	
Chapter 58	
Influences on the Gastrointestinal System by Essential and Toxic Metals	901
Julian P. Keogh and Claus-Peter Siegers	

Chapter 59	
Copper and Other Chemical Elements That Affect the Cardiovascular System.....	921
Leslie M. Klevay	
Chapter 60	
Respiratory Toxicology of Metals	929
Janet M. Benson and Judith T. Zelikoff	
Chapter 61	
Effects of Metals on the Hematopoietic System and Heme Metabolism	939
James S. Woods	
Chapter 62	
Bone Metabolism: Effects of Essential and Toxic Trace Metals.....	959
Maryka H. Bhattacharyya, Elizabeth Jeffery, and Ellen K. Silbergeld	
Section IX: Reproductive and Developmental Toxicology of Metals	
Section Head: John M. Rogers	
Overview	
An Introduction to Developmental and Reproductive Toxicology of Metals	975
John M. Rogers	
Chapter 63	
Teratogenic Effects of Essential Trace Metals: Deficiencies and Excesses	977
Carl L. Keen	
Chapter 64	
Placental Transport, Metabolism, and Toxicology of Metals	1003
Carol J. Eisenmann and Richard K. Miller	
Chapter 65	
The Development of Cadmium and Arsenic With Notes on Lead.....	1027
John M. Rogers	
Chapter 66	
The Developmental Cytotoxicity of Mercurials.....	1047
Edward J. Massaro	
Chapter 67	
Developmental and Reproductive Effects of Aluminum, Uranium, and Vanadium.....	1083
Jacinto Corbella and Jose L. Domingo	
Chapter 68	
Cell Adhesion Molecules in Metal Neurotoxicity	1097
Kenneth R. Reuhl and P. Markus Dey	
Chapter 69	
The Effects of Metals on Neurite Development	1111
Teresa Audesirk and Gerald Audesirk	
Chapter 70	
Mammary Heavy Metal Content: Contribution of Lactational Exposure to Toxicity in Suckling Infants	1129
Sam Kacew	

Chapter 71	
Constitutive and Induced Metallothionein Expression in Development	1139
George P. Daston and Lois D. Lehman-McKeeman	
Chapter 72	
Developmental and Reproductive Effects of Metal Chelators.....	1153
Jose L. Domingo	
Epilogue	1171
László Magos	
Index.....	1177