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Book review

**Essential metals in medicine: Therapeutic use and toxicity of metal ions in the clinic, Vol. 19 of Metal Ions in Life Sciences (Guest Editor Peggy L. Carver. Series Editors Astrid Sigel, Eva Freisinger, Roland K. O. Sigel), Walter de Gruyter, Berlin, Germany, 2019, 456 pp, ISSN: 1559-0836; 1868-0402 (electronic). ISBN: 978-3-11-052691-2; 978-3-11-052787-2 (electronic PDF); 978-3-11-052698-1 (electronic EPUB). DOI: https://doi.org/10.1515/9783110527872.**

Significant advances have been made in recent years in the use of metals in medicine. Hence the latest volume: *Essential Metals in Medicine: Therapeutic Use and Toxicity of Metals in the Clinic* edited by Peggy L. Carver in the series: *Metal ions in Life Sciences* is a timely contribution. It contains 14 chapters contributed by researchers in the field who are known for their special expertise and significant contributions to the current state of knowledge. Chapters have been from various subject areas, but they all focus on the general theme of metals in medicine. Importantly, a broad range of metals is discussed.

The book begins with an overview of metals in medicine, metal-related diseases and therapeutic uses of metals in clinical setting in Chapter 1. There are specific discussions on platinum-based agent cisplatin, selenium, copper and metal-based imaging agents such as gallium and gadolinium. It is followed by Chapter 2 which reviews the importance of small molecules in drug innovation. Authors discuss therapeutic challenges in treating malaria by antimalarial drugs and regulation of copper homeostasis in Alzheimer's disease.

Iron plays a critical role in human physiology being both essential and toxic. These properties are well presented in Chapters 3 to 7. Iron overload in thalassemia is a serious human health problem. Removal of iron from thalassemic patients by safe, inexpensive and orally available chelator is a great challenge. Chapter 3 discusses several new chelators that are currently undergoing clinical trials. While much work has been published on cellular and systemic iron homeostasis, disposition of iron in the brain has remained a relatively less researched topic. Chapter 4 provides an excellent review of increased levels of iron in specific regions of brain, their effects in neurodegenerative diseases and current clinical studies of the potential and effective iron chelation therapy. Chapter 5 succinctly describes what is known about regulatory processes of iron metabolism and interaction between iron and immune response against microbes. Authors critically address some unanswered questions on the association of iron administration and infections. Chapter 6 provides a detailed description of iron oxide nanoparticle formulations for supplementation. Further, it discusses the complexities of intravenous iron formulations, notably their potential toxicities, along with a cautionary note about their widespread use. Antimicrobial resistance is a major global health issue. Chapter 7 discusses a "Trojan horse" strategy to solve this problem capitalizing on the innate need for iron by pathogens using siderophores to scavenge iron. There are discussions around siderophore structure, production and transport. It is followed by a clear description of what has been learned from the successes and failures of siderophore-conjugate drugs evaluated during the development of novel agents using this strategy.

Vanadium has been vigorously pursued for its beneficial effect on human health. Most of these claims focus on its potential use as an antidiabetic agent, as described in Chapter 8. These authors also describe vanadium as human health supplement and summarize some recent work addressing vanadium as a potential adjunctive immunomodulatory agent for cancer treatment. Chapter 9 presents a historical background of essentiality of chromium in human health and discusses the contentious issue whether Cr(III) complexes are safe, since hexavalent chromium Cr(VI) (chromate) is known to be genotoxic. Manganese is another essential element which is a critical component of many enzymes and proteins. However, the environmental overexposure to manganese through industrial occupation and contaminated drinking water can cause neurological impairment. Chapter 10 discusses manganese neurotoxicity with a brief discussion on remediation methods of excess level of manganese. Cobalt-Schiff base complexes have a wide variety of potential therapeutic applications as antimicrobials, anticancer agents and inhibitors of protein aggregates. Chapter 11 pays special attention to those agents for which a detailed mechanism of action has been investigated. Copper is an essential element to sustain life. Interestingly, copper has also been shown to be essential for metastatic cancer progression. Consequently, copper depletion has emerged as a possible therapeutic strategy in the treatment of metastatic cancer. Chapter 12 reviews the available preclinical data of several copper-chelating agents across a variety of tumor types. Chapter 13 discusses the design of prospective metal-based drugs for the treatment of Chagas disease, human African trypanosomiasis and leishmaniasis. While some antiparasitic agents showed positive results, none has been approved for use in humans due to rigorous regulatory guidelines.

Finally, Chapter 14 is devoted to cyanide, whose life-threatening toxicity is well known. It interacts with over 40 metalloenzymes, but its lethal action is non-competitive inhibition of cytochrome C oxidase, shutting off cellular respiration and causing hypoxic cellular damage. The authors discuss these effects in detail and provide newer understanding of chemical and clinical aspects of metal-containing antidotes for poisoning by cyanide.

Overall, this volume is a nice compilation of articles describing some of the emerging therapeutic uses of metals in medicine. Each chapter has an extensive literature survey which would be of benefit to the researchers in their areas. It would also serve as an excellent introduction to readers interested in metals in medicine and their possible therapeutic benefits.

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