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BOOK REVIEW

Radiotheranostics – A Primer for Medical Physicists I: Physics, Chemistry, Biology and Clinical Applications, Ed. Cari Borrás and Micheal G. Stabin. Boca Raton, FL: CRC Press, 2024. ISBN: 978-1-032-13897-8

DESCRIPTION

Radiotheranostics – A Primer for Medical Physicists I: Physics, Chemistry, Biology and Clinical Applications is the first book of a two-volume set with the aim to introduce the reader to radiotheranostics. This volume focuses on describing four key parts of radiotheranostics: its rich history, past and current clinical applications, chemistry and physics, and the future outlook. These topics provide a strong foundational base that both educates the reader and lays the groundwork for the more advanced second volume which examines radiobiology, dosimetry, and radiation safety.

PURPOSE

The editors of this book, Drs. Cari Borrás and Micheal G. Stabin, are world-renowned experts in the field of radiotheranostics and have dedicated much of their careers towards its advancement. They clearly indicate in the preface and first chapter that the purpose of this book is to provide a clear definition of what radiotheranostics is to medical and health physicists involved in related research and/or in the clinic.

Both editors are aware that radiotheranostics has been part of medicine for almost 80 years (as is well described in the second chapter) and that a concise introduction and summary of all topics of radiotheranostics for medical and health physicists has been absent. Their goal was to create a primer that is both accessible and easy to understand, while also providing a substantial bibliography allowing any interested individual to delve deeper. This is clearly indicated by the editors who almost forcefully state this is *not* a textbook.

In my opinion as someone who has entered the field relatively recently and seen the exponential growth of radiotheranostics, this purpose and goal are both well-justified and timely; indeed, Drs. Borrás and Stabin have shown great vision in providing this key resource for medical and health physicists. Radiotheranostics is a rapidly expanding field and there is a need to provide education to the medical and health physics workforce; this is evidenced not just in the literature but also by the recent AAPM Summer School (Radiopharmaceutical Therapy and Dosimetry, 2023), the newly redefined Radiopharmaceuticals Scientific Session: Theranostics track at the AAPM Annual Meeting (2024), and the new SNMMI Therapeutics Conferences (offered annually beginning in 2022).

AUDIENCE

As alluded to above, this text is intended for medical and health physicists (academic or clinical). The expectation is that these individuals will have a basic understanding of nuclear medicine and will find this book to be an easily digestible primer for entry into radiotheranostics. I emphatically do not believe this is the only target audience. While medical and health physicists may be the target audience who benefit from the largest percentage of the book content, this primer can be easily picked up by anyone working in radiotheranostics who wants to learn more. A nurse navigator might have a great interest in reading the chapters written regarding clinical trials (Chapter 8) and adverse effects (Chapter 10). A physician may gain significant knowledge in the current state of the field by reading about the history of radiotheranostics (Chapter 2) and current clinical applications (Chapters 4-6). Individuals in nuclear medicine departments who are just learning their department will be supporting these radionuclide therapies will find value in this book; a technologist might brush up on the biology behind radiotheranostics (Chapter 3) and an administrator might try to identify where the field is going and its growth potential (Chapters 8, 14, and 15). A great strength of this primer is that each chapter is written by experts in the field and can be easily read on its own by a relevant audience.

In short, while this book may be intended for medical and health physicists, it has been written in such a manner that any individual who is part of the radiotheranostics team (Figure 14.1) will find value in certain chapters and sections.

CONTENT / FEATURES

As noted above, this book is comprised of four sections: 1) history and general cancer biology; 2) clinical applications of radiotheranostics; 3) radiation chemistry and physics; and 4) future perspectives. Throughout the entirety of the text, one will note a key strength of this primer is the substantial number of relevant and useful references provided.

Section 1: History and General Cancer Biology

This section begins with an introductory chapter by the editors, which sets the stage for both this primer and its soon to be published second volume. This chapter provides an exceptional resource (Tables 1.1-5) outlining the properties of the various isotopes, targets, pharmaceuticals, and applications used in radiotheranostics.

Chapter 2 provides an extremely well-written and illuminating history of radiotheranostics encompassing the past approximately 125 years, starting with the works of Röntgen, Becquerel and the Curies and ending with a discussion of the most recent clinical trials. This chapter provides a phenomenal resource for any individual interested in learning more about where radiotheranostics originated and where it is going.

Chapter 3 introduces the biology of radiotheranostics. This section will be of value to medical and health physicists with backgrounds in the physical sciences, as it succinctly breaks down both the biology of cancer and how radiotheranostics works (e.g., how and why a specific molecule will preferentially target specific cancer). Making this information easily digestible is a key strength as oftentimes review articles or textbooks assume a certain level of expertise in the reader that detracts from the reader's ability to interpret the text.

Section 2: Clinical applications of radiotheranostics

This section will be of the greatest use and interest to medical and health physicists entering the world of radiotheranostics. This section fully explains how and why past and current radiopharmaceuticals were/are used in radiotheranostics. In particular, the reader will greatly appreciate how the authors have distilled the results of many lengthy studies (e.g., ALSYMPCA, DOSISPHERE-01, NETTER 1, VISION) into easily parsed text and figures demonstrating therapy effectiveness, typical dosimetry, and patient safety.

This section also provided an excellent discussion of the current and future paradigms of radiotheranostics (e.g., imaging, adjuvant and cocktail therapies, patient specific dosimetry, etc.). Finally, the reader will value the detailed explanations of how a particular drug reaches the area of interest.; for radiopharmaceuticals such as Lu-177 PSMA-617, it is not always obvious that the target is PSMA or that PSMA is not expressed solely by prostate cells.

Finally, there is a discussion of less commonly used and/or more exotic mechanisms to perform radionuclide therapies (e.g., nanoparticles), a discussion of the clinical trial and drug development process, and patient safety as it relates to epidemiology and adverse effects. These are “must-read” materials as they describe the future of the field, how to get there, and the challenges to overcome.

Section 3: Radiation chemistry and physics

This section describes radionuclide production, activity measurement, and instrumentation. For many health and medical physicists, this section may provide the least value as these individuals will likely be relatively well-versed in these areas from their didactic, research, and/or clinical efforts. For individuals that are not trained as physicists, however, this section will provide intense value as it effectively summarizes the nature of physics (and some of its associated problems) in radiotheranostics. This section also provides tabulated data describing the production and properties of relevant radionuclides (Tables 11.1-5) that will serve as excellent reference materials to even experts in the field.

Section 4: The future

The final section provides an overview of the multidisciplinary team required to effectively manage a radiotheranostics program, and what the future of radiotheranostics will hold. This section will be valuable to individuals who are starting radiotheranostics programs; however, the value may be limited for those already in the field. The final chapter adequately summarizes the text and provides a brief glimpse of the future.

Shortcomings

This primer did have several shortcomings; this is expected as an approximately 200-page book (even as the first volume of two volume sets) will not be able to cover the

entirety of radiotheranostics. As noted above, one limitation is that for medical and health physicists, some sections (Section 3) may have limited value; here the interested reader will likely turn to more substantial references related to the chemistry and physics of nuclear medicine[1-3].

Chapter 14 points out the large multidisciplinary team required for radiotheranostics; however, the potential for so-called “turf wars” was not touched upon (indeed, in Figure 14.1 radiation oncology is not included, which was somewhat surprising considering the large number of institutions in which radiotheranostics is firmly in the purview of this department). This can be challenging to manage and is something medical and health physicists should be prepared to address.

Finally, and this may be discussed in the second volume, the financial implications of radiotheranostics were not fully elaborated upon. Radiotheranostics, particularly following the current paradigm of almost only outpatient therapies, often results in substantial positive revenue streams and has an expected market share that will continue to increase for the foreseeable future. While this is briefly described in Chapter 15, more information will give medical and health physicists more tools at their disposal to advance the cause of radiotheranostics to health systems that require more convincing on its benefit.

ASSESSMENT / COMPARISON

This primer fills a much-needed space in radiotheranostics. While there have been numerous review articles published regarding radiotheranostics[4-6], to the best knowledge of this book reviewer there are no other books that provide the same level of radiotheranostics introduction to medical and health physicists. There is an excellent SNMMI primer on radiopharmaceutical dosimetry[7] and an AAPM monograph on radiopharmaceutical therapy and dosimetry[8]; however, these are more advanced texts that will most likely be comparable to the second volume of this radiotheranostics set. There are additionally many texts that are more physician[9] and biology[10] focused; these are likely too far estranged from the knowledge foundation of the medical and health physicist at the entry point of radiotheranostics to be of much initial value.

The main strength of this primer is the concatenation of information that would otherwise require a very substantial literature review. This book provides an easy to read and

understand resource for medical and health physicists becoming acquainted with radiotheranostics. As a primer, the text does not provide incredibly detailed information or explanation; however, the interested reader can explore the very substantial bibliography to satisfy their desire to know more.

I will be keeping this book readily available as a reference, in particular regarding the excellent tabulated data of radioisotopes and radiopharmaceuticals. I am looking forward to reading the second volume.

BOOK REVIEWER BIOGRAPHY

Joseph Steiner Ph.D. is an Assistant Professor and clinical nuclear medical physicist at the University of Chicago. He has been in the field of nuclear medicine and radiotheranostics for six years, including completing a nuclear medical physics residency program, and has helped develop and advance radiotheranostics at three institutions.

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