



RADIATION AND CANCER BIOLOGY

PRACTICE EXAMINATION

RABEX

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1. INTRODUCTION

The main purpose of the "*Radiation and Cancer Biology Practice Examination*", **RABEX**, is to provide an educational tool to guide radiation oncology residents in their studies of *radiation and cancer biology* and to assist them in preparation for this section of the board certification exam administered by the American Board of Radiology (ABR). To offer more specific direction in preparation for the ABR certification examination, the topics listed in the Study Guide for Cancer and Radiation Biology provided by the ABR on their web site, www.theabr.org, were used to create an outline for **RABEX** 2019. Each topic was then populated with questions. Similar to the ABR examination, **RABEX** consists of 200 multiple choice questions. For residents wishing to obtain a sense as to their performance on the certification exam, they should permit themselves 200 mins to take this test.

Radiation and cancer biology are dynamic fields with new results appearing daily in the scientific literature. The goal for radiation oncology residents during training is to acquire a solid base of knowledge in *cancer and radiation biology*, which will be built upon during their careers through regular reading of the scientific literature as well as attendance at seminars and scientific conferences. In addition, it is anticipated that many residents will pursue careers that will permit them to be involved in research for which a detailed understanding of *radiation and cancer biology* is essential. Of greatest importance, it is hoped that by providing residents with a firm foundation in the biologic principles underlying the treatment of cancer with radiation, they will be able to provide more effective radiation therapy and achieve improved clinical outcomes for their patients.

Siamak Shahabi, PhD

Chief-Technical Editor

2. RABEX history & its inception in 1995

The concept of a radiobiology practice examination was discussed in the early 1990's. After some encouragement from my colleagues, Drs. L. R. Coia, S. Shahabi, and B. Corn, I agreed to become Editor-in-Chief of this endeavor that produced its first exam in 1995. In 1999, the fifth consecutive radiobiology practice examination was produced at a quality level that has improved in each successive year.

The goals of this project were: 1) to provide an educational tool (*typical questions with comprehensive answers*) for assisting residents of diagnostic radiology and radiation oncology in self-study and preparation for their *American College of Radiology* board exams in this field of science, 2) to extend the teaching of traditional radiobiology into the new era of molecular biology, and 3) to provide a national scoring system that provided some information about relative standing. Most of these goals have now been achieved, but only after a difficult learning curve.

Each year, questions were generated by Associate Editors who are involved directly in the teaching of radiobiology to medical residents. From these, 300 questions of the A, B and X formats were selected and edited for inclusion in the annual exam. We trust that this project in radiation oncology and radiology medical education will find a useful niche in the formal instruction of future medical scholars. Dr. Shahabi has provided moral support and encouragement throughout this project and during this larger task of formatting and producing the compilation.

J.D. Chapman, PhD

Editor-in-Chief

Fox Chase Cancer Institute

Written and posted in January 2000

3. RABEX present and future

Well into its second decade of existence, RABEX continue to be a unique and important educational tool for the certification and continuous education for residents and senior radiation oncologist. The present edition of RABEX follows the original goals defined in the 90's by Drs. J. D. Chapman, S. Shahabi, L. R. Coia and B. Corn. However, due to the increase of knowledge in the field of biology and the rapid development of electronic distribution of information, RABEX need to be kept updated to match these challenges. The ultimate goal of the present edition is to maintain its level of excellence with permanent update in topics and contents.

The topics included in the RABEX practice examination continue to be based upon those listed by the American Board of Radiology for the cognitive exam in radiation and cancer biology. Also the number of questions in each section reflects the ABR's relative weight for each topic. Therefore, this practice examination guide provide guidance for residents and senior radiation oncologist in their preparation for the initial radiation oncology certification examination as well as to demonstrate cognitive expertise in radiation biology required for maintenance of certification.

Periodically, RABEX undertakes significant revisions in examination format, structure, and method of delivery, always with the aim of improving validity, consistence and quality. In addition, RABEX rigorously enforces criteria for question writing, editing, and review, including the use of clear and direct language, avoidance of embedded clues to test-wise examinees, and literature references to support all correct answers.

Finally, it's important to reaffirm that the RABEX practice examination is designed to help radiation oncologists to acquire a solid base of knowledge in radiation and cancer biology during their training with the ultimate goal of offering more effective radiotherapy and achieve improved clinical outcomes for their patients.

Marcelo E. Vazquez, MD, PhD

Editor-in-Chief

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4. Syllabus

(Based on ABR's 2019 syllabus)

- I. Interaction of radiation with matter
- II. Molecular and cellular damage and repair
- III. Cellular responses to radiation
- IV. Linear energy transfer (LET) and oxygen effect
- V. Tumor biology and microenvironment
- VI. Cancer biology
- VII. Radiobiology of normal tissues
- VIII. Dose delivery
- IX. Combined modality therapy
- X. Late effects and radiation protection

TOPICS (Based on ABR's 2019 syllabus and RABEX format)

I. Interaction of radiation with matter

- a. Definition of ionizing radiation, free radicals, and radical damage
- b. Direct and indirect action of radiation, numbers and types of DNA lesions
- c. Consequences of unrepaired DNA DSB

II. Molecular and cellular damage and repair

- a. Molecular mechanisms of DNA damage
- b. Molecular mechanisms of DNA repair
- c. Cellular recovery
- d. Chromosome and chromatid damage



III. Cellular responses to radiation

- a. Mechanisms of cell death
- b. Cell and tissue survival assays: measurement of response
- c. Models of cell survival

IV. Linear energy transfer (LET) and oxygen effect

- a. Linear energy transfer
- b. Oxygen Effect

V. Tumor biology and microenvironment

- a. Solid tumor assay systems
- b. Tumor microenvironment

VI. Cancer biology

- a. Cell and tissue kinetics
- b. Molecular signaling
- c. Mechanisms of cancer development
- d. Cancer genetics/genomics

VII. Radiobiology of normal tissues

- a. Clinically relevant normal tissue responses to radiation
- b. Mechanisms of normal tissue radiation responses
- c. Total body irradiation

VIII. Dose delivery

- a. Therapeutic ratio
- b. Time, dose, and fractionation
- c. Brachytherapy
- d. Radiobiological aspects of different radiation modalities

IX. Combined modality therapy

- a. Chemotherapeutic agents and radiation therapy
- b. Radiosensitizers, bioreductive drugs, and radioprotectors
- c. Immune therapeutics
- d. Hyperthermia



X. Late effects and radiation protection

- a. Radiation carcinogenesis**
- b. Heritable effects of radiation**
- c. Radiation effects in the developing embryo**
- d. Radiation protection**

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