B. I. Shumko, M. V. Lukashchuk

Radiation Medicine

A Textbook

Chernivtsi 2025

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У навчально-методичному посібнику викладений основний матеріал з дисципліни «Радіаційна медицина», який дозволить студентам якісніше підготуватися до практичних занять, звернувши увагу на фізичні і радіобіологічні основи радіаційної медицини, наслідки впливу радіації на організм, окремі органи та системи, диференційоване лікування і надання невідкладної допомоги при гострих радіаційних ураженнях, профілактику променевих уражень, методи реабілітації осіб, що постраждали внаслідок радіаційних аварій. Посібник вирізняє методологічна спрямованість викладення матеріалу та адаптованість до вимог програми з навчальної дисципліни «Радіаційна медицина» для студентів вищих медичних навчальних закладів III-IV рівнів акредитації (спеціальність лікувальна справа, педіатрія, медична психологія) МОЗ України.

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ABBREVIATIONS

SED – skin-erythema dose
MPD – maximum permissible dose
LET – linear energy transmission
PEM – photoelectron multiplier
ARS – acute radiation sickness
ESR – erythrocyte sedimentation rate
ESR – erythrocyte sedimentation reaction

PREFACE

The dynamic development of higher medical education in Ukraine requires improvement of the system of training specialists. The integration of domestic higher medical education into the European educational space requires the search for new forms of training and providing students with modern educational and methodological literature.

As has traditionally been the case in our education system, the human factor plays a significant role in the process of teaching and assessing knowledge. The level of students' knowledge and skills is directly proportional to the active work and experience of the teacher. Until now, students have acted as passive "recipients" of the information provided by the professor.

Today, the direction of education has changed radically, with a focus on the global educational space, which requires constant growth in independent work by students. The learning process should not be a process of transferring knowledge from professor to student, as it was before, but knowledge should be acquired through active independent work by the student. Independent work by students has moved from being secondary to being on the same level as lectures and seminars in the learning process, and it accounts for 50-70% of teaching time.

Despite the wide range of existing fundamental sources on oncology, which are somewhat outdated, there is an urgent need for a substantial update of educational literature, which is an essential component in the training system for future nurses in accordance with new European requirements.

Taking these facts into account, the author set out to create a textbook entitled Radiation Medicine: A Textbook, which will increase the effectiveness of students' independent preparation for practical classes and improve the organization of monitoring their implementation.

At the end of each section, there are questions for self-assessment, test questions with correct answers, clinical case studies, a list of basic and additional literature, methodological recommendations for patient care, a thematic plan for lectures and practical classes, types of independent work and its control, and a list of questions that students should know in order to successfully complete the final module “Radiation Medicine.”

The subject matter and scope of the textbook meet the requirements of the academic discipline “Radiation Medicine” for students of higher medical educational institutions of III-IV accreditation levels (Ministry of Health of Ukraine, Kyiv, 2008). The syllabus for the “Radiation Medicine” module allocates 45 hours, of which 10 hours are for lectures, 20 hours are for practical classes, and 15 hours are for independent study.

LIST OF QUESTIONS FOR FINAL MODULAR ASSESSMENT

1. Nature and propertiesof ionizing radiation (alpha, beta, gamma, neutrons, X-rays).

2.Concepts of dose and dose rate. Exposure, absorbed, equivalent,effective equivalent doses. Units of the International System (SI).

3.Methods of dose determination. Types of dosimeters.

4.Radioactivity (concept; units, types of radioactive decay).

5.Methods for determining radioactivity.

6.Natural and artificial sources of radiation. Their contribution to the total dose of radiation exposure of the population.

7. Main provisions of Radiation Safety Standards (NRSU-1997/D-2000, BSRU-2000).

8. Radiation situation after the accident at the Chernobyl Nuclear Power Plant.

9. Tasks and structure of special medical institutions providing medical care to persons exposed to excessive ionizing radiation.

10. Preventive measures during the period of environmental contamination with radioactive substances.

11. Determination and assessment of the degree of contamination of water and food products with radionuclides.

12. Current understanding of the main mechanisms of the biological effects of ionizing radiation.

13. The role of free radicals in cell damage due to the effects of ionizing radiation.

14. Pathogenesis of radiation damage to tissues.

15. Radio-sensitivity of various tissues of the body.

16. The importance of haematological (hematomorphological) research methods for detecting pathological changes in human organs and systems after exposure to ionizing radiation.

17. The principle of the cytogenetic method and its importance for detecting pathological changes in human organs and systems after exposure to ionizing radiation.

18. The importance of biochemical, biophysical, and other research methods for detecting pathological changes in human organs and systems after exposure to ionizing radiation.

19. The effect of ionizing radiation on the blood-forming organs.

20. The effect of ionizing radiation on the digestive organs.

21. The effect of ionizing radiation on the cardiovascular system.

22. The effect of ionizing radiation on the pulmonary system.

23. The effect of ionizing radiation on the central nervous system.

24. The effect of ionizing radiation on the endocrine system.

25. Methods and significance of physical dosimetry for assessing the degree of human damage in accidents at nuclear facilities.

26. Criteria and significance of biological dosimetry.

27. Etiological factors (effects of various types of ionizing radiation).

28. Clinical and biological criteria for the diagnosis of acute radiation sickness (ARS).

29. Pathogenesis of acute radiation sickness.

30. General and clinical classification of radiation damage.

31. Clinical signs of the initial reaction period of acute radiation sickness.

32. Clinical signs of the latent period of acute radiation sickness.

33. Clinical signs of the acute period of the disease.

34. Principles of diagnosis of acute radiation sickness and triage during medical evacuation.

35. Treatment of acute radiation sickness depending on the period of the disease and experience in treating victims of the Chernobyl nuclear power plant accident.

36. Features of the diagnosis of acute radiation sickness due to combined irradiation.

37. Features of the clinic manifestations of ARS due to combined irradiation.

38. Features of the treatment of ARS due to combined irradiation.

39. Principles of medical and psychosocial rehabilitation of persons who have suffered from ARS.

40. Classification, clinic, treatment of chronic radiation sickness.

41. Classification, diagnosis, and clinical presentation of radiation burns.

42. Treatment of radiation burns depending on the severity and clinical course, and experience in treating victims of the Chernobyl nuclear accident.

43. Prevention of radiation damage.

44. Biological effects of low doses of ionizing radiation.

45. Somatic consequences of radiation exposure.

46. Teratogenic effects of radiation exposure.

47. Genetic effects of radiation exposure.

48. Stochastic and non-stochastic effects of radiation.

49. Organization of medical care in radiation accidents.

50. Organization of radiation monitoring in accidents at nuclear facilities.

51. Routes of radionuclide entry into the body.

52. Distribution of incorporated radionuclides in the body.

53. Effective half-life. Determination of the half-life and effective half-life of a radionuclide.

54. Radiotoxicology of Cs^{137}. Emergency care when it enters the body.

55. Radiotoxicology of Sr^{90}. Emergency care when it enters the body.

56. Radiotoxicology of I^{131}. Emergency care when it enters the body.

57. Methods for determining the presence of radionuclides in the body.

58. Main directions in the treatment of internal contamination of the body with radionuclides.

59. Preventive and therapeutic measures for I^{131} incorporation (iodine prophylaxis)

60. Medical examination of nuclear industry personnel.

61. Medical examination of the population exposed to ionizing radiation as a result of a radiation accident.

62. Categories and levels of observation.

63. Medical consequences of large-scale accidents in nuclear production.

64. Social protection of people exposed to emergency radiation and psychological aspects of accidents at nuclear facilities.

65. Purpose and objectives of the National Register of Ukraine of persons affected by the Chernobyl disaster.

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