

CONTENTS

Preface	11
Introduction and Definitions	13
1. Nuclear Medicine, What For?	15
<i>I. The Original Case of Thyroid Cancer</i>	18
<i>II. The Diagnosis Aspect</i>	19
<i>III. The Therapeutic Aspect</i>	25
1. Cancer Therapy.....	25
2. Non-oncological Therapeutic Application: Rheumatology ...	32
<i>IV. Miscellaneous Aspects of Medical Radioactivity Applications</i> ...	32
2. A Little History...	35
3. Some Basic Notions of Radiation	43
<i>I. Different Types of Radiation</i>	45
<i>II. Measurement Units and Doses</i>	50
<i>III. Radionuclides for Nuclear Medicine</i>	59
1. Gamma Emitters (γ)	60
2. Positron Emitters (β^+)	61
3. Electron Emitters (β^-).....	63
4. Alpha Emitters (α).....	66

5. Radionuclides for Brachytherapy and External Radiotherapy	68
6. Other Radionuclides	69
Summary.....	71
4. SPECT Imaging: Gamma Ray Imaging	73
I. Nuclear Medicine Imaging Methods	80
1. Scintigraphy.....	83
2. The Products used in Scintigraphy	85
II. Imaging Tools	88
III. Detection of the Sentinel Node	90
Summary.....	92
5. PET Imaging: Positron Emission Tomography	95
I. The Imaging Principle	97
II. The Radiation Source	99
III. The Labelled Product: Fludeoxyglucose	101
IV. Production and Equipment	102
V. Applications in Cancerology	104
VI. Applications beyond Oncology.....	106
VII. Positron Emitters Evolution	107
Summary.....	108
6. Therapeutic Applications.....	109
I. Metabolic Radiotherapy	110
II. Local Radiotherapy	113
III. Radioimmunotherapy	114
IV. Targeted Radiotherapy.....	122
V. Alphatherapy and Alpha-immunotherapy	123
VI. The Theranostic Approach	129
VII. Radiotherapeutic Substances	130
VIII. The Dose Issue.....	131
IX. Mechanism of Action – The Bystander Effect	133
X. The Limitations	135
Summary.....	136

7. The Development of Radiopharmaceuticals	139
I. <i>The Molecule Discovery Phase</i>	142
II. <i>Pharmacological and Predinical Studies</i>	142
III. <i>Pharmacokinetics</i>	144
IV. <i>Toxicological Analysis</i>	145
V. <i>Phase I Clinical Studies</i>	147
VI. <i>Phase II Clinical Studies</i>	149
VII. <i>Phase III Clinical Studies.....</i>	152
VIII. <i>Regulatory Issues and Registration</i>	155
IX. <i>Marketing.....</i>	157
X. <i>Post-marketing Authorisation and Drug Monitoring</i>	158
Summary.....	159
8. The Production of Radiopharmaceuticals	161
I. <i>Definitions</i>	162
II. <i>Production of Radionuclides</i>	163
1. <i>Reactors.....</i>	164
2. <i>Particle Accelerators.....</i>	164
3. <i>Generators</i>	167
4. <i>Fission Products</i>	168
III. <i>The Production of Vectors and Ligands</i>	168
IV. <i>The Industrial Production of Radiopharmaceuticals.....</i>	169
V. <i>Transport and Logistics.....</i>	171
VI. <i>Radiopharmacies</i>	172
VII. <i>Nuclear Medicine Centres in the World</i>	175
Summary.....	179
9. The Future of Nuclear Medicine	181
I. <i>Hybrid Imaging Tools and Equipment Evolution</i>	182
II. <i>Individualised Medication and the Development of Theranostics</i>	183
III. <i>Orphan Diseases and Orphan Drugs</i>	186
IV. <i>Ethical and Regulatory Limitations</i>	188
1. <i>Regulation and Administration</i>	188
2. <i>Side Effects and Toxicity.....</i>	188
3. <i>Dosage and Indication Extensions</i>	190

CONTENTS

<i>V. Politics and Legislation</i>	191
<i>VI. The Future</i>	193
Glossary	197
For Further Reading	207