# Contents

## Section-1: Concepts of Radiotherapy and its Planning


**1. Radioactivity 3**

- Introduction 3
- Types of Electromagnetic Waves 3
- Radioactive Decay 6
- Radioactive Material 6
- Radioactive Equilibrium 8
- Quantities of Radioactive Material 9
- Use of Radioactivity 9
- Radioactive Bone Scanning 9

**2. Measurement of Radiation Dose 10**

- Introduction 10
- Other Measuring Methods 12

**3. Principles of Radiation Therapy 18**

- Electromagnetic Radiation 18
- Absorption Mechanism of Electromagnetic Radiation 19
- Spectrum of Electromagnetic Radiations 20
- Movement of Cobalt Machine 20
- Ideal BrachyTherapy Source 24
- Practical Aspects in Brachytherapy 26
- Interstitial Implant 27
- Pulsed Dose Rate 31

**4. Time, Dose and Fractionation in Radiotherapy 33**

- Four R's of Radiobiology 33
- StrandQuist Plot and the Ellis Nominal Standard Dose System 34
- Proliferation as a Factor in Normal Tissue 34
- Dose Response Relation for Early and Late Responding Tissue 35
- Accelerated Repopulation 36
- Multiple Fractions Per Day 37
- Time Interval Between Multiple Daily Fractions 38
- Linear Quadratic Concept to Calculate Effective Dose in Radiotherapy 38

**5. Current Concepts of Radiotherapy Planning 40**

- General Principles 40
- You must know? 40
- How to do Treatment Planning 41
- Techniques in Localization at the Time of Treatment Delivery 47

**6. Basic Radiology for Radiation Oncologist 50**

- X-Rays 50
- Intravenous Pyelography 52
- Thermoluminescence Dosimeter 53
- Barium Meal 53
- Computed Tomography 54
- Basic Concept of Ultrasonography 55

**7. Radiotherapy in Emergency 56**

- General Principles 56
- Bone Metastases 59
- External Beam Radiation Therapy and Stereotactic Body Radiation Therapy for Spine Metastases 60
- Brain Metastases— Whole Brain Radiation Therapy 63
- Brain Metastases—Stereotactic Radiosurgery 64
- Malignant Obstructions and Bleeding 65
- Skin and Soft Tissue Metastases 67

**8. Radiofrequency Ablation 69**

- Principle 69
- Inhalation 69
- Major Advantage 69
- Complications 69
- Follow-up of Radiofrequency Ablation Done Patients 70

**9. Effects of Radiation on Normal Human Tissues 71**

- Acute Effects 71
- Early Lethal Effects 72
- Acute Radiation Induce Toxicity Profile 73

- Management of Acute Radiation Exposure at the Dose Close to $LD_{50}$ 74
- Bone Marrow Transplantation 74
- Complication Due to Bone Marrow Transplantation 75

**10. Latest Radiotherapy Techniques 76**
- The Image-Guided Radiation Therapy 76
- Intensity-Modulated Radiation Therapy 77
- Conclusion 78

**11. Imaging in Oncology 79**
- Introduction 79
- Tumor Morphology 80
- Treatment Planning and Response Assessment 81
- Conclusion 82

**12. Radiation Oncologist with Benign Tumors 83**
- Ocular Disorder 83
- Exophthalmos 83
- Orbital Pseudotumor 83
- Skin Disorders 84
- Plantar Warts 84
- Hemangiomas 84
- Desmoid Tumor 85
- Peyronie's Disease 85
- Prevention of Restenosis after Percutaneous Transluminal Coronary Angioplasty 85
- Ameloblastoma of Jaw 85
- Aneurysmal Bone cyst 85
- Vertebral Hemangioma 86
- Rheumatoid Arthritis 86
- Juvenile Nasopharyngeal Angiofibroma 86
- Inverted Papilloma 86
- Eosinophilic Granuloma 86

## Section 2: Concepts of Radiobiology

**13. Radiobiology of Radiation Absorption 89**
- Introduction 89
- Direct and Indirect Action of Radiation 89
- Absorption of Neutrons 90
- Difference Between Neutrons and Photons 91

**14. Deoxyribonucleic Acid Strand Breaks on Radiation 92**
- Introduction 92
- Double Strand Breaks Repaired by Two Processes 93
- Measuring the Deoxyribonucleic Acid Strand Breaks 93
- Chromosome and Cell Division 94
- Role of Telomeres 94
- Radiation-Induced Chromosome Aberration 94
- Radiation-Induced Chromosomal Aberration 95
- Two Nonlethal Type Chromosomal Aberration 96
- Chromosomal Aberration in Human Lymphocytes 96

**15. Oxygen Effect and Reoxygenation 97**
- Oxygen Enhancement Ratio 97
- Mechanism of Oxygen Effect on Radiation 97
- Chronic and Acute Hypoxia 98

**16. Linear Energy Transfer and Relative Biological Effectiveness 100**
- Linear Energy Transfer 100
- Relative Biologic Effectiveness 101
- Relative Biologic Effectiveness and Fractionated Dose 101
- Relative Biologic Effectiveness for Different Tissues 101
- Relation Between Relative biologic effectiveness and Linear energy transfer 101
- Radiation Weighting Factor 102

**17. Cell Survival Curve 103**
- Introduction 103
- Apoptotic and Mitotic Death 104
- Survival Curve Shape and Mechanism of Cell Death 105
- Effective Survival Curve for Multifraction Regimen 106

**18. Repair of Radiation Damage and Dose Rate Effect 107**
- Potentially Lethal Damage 107
- Sublethal Damage Repair 107
- According to Linear Quadratic Model 108
- Mechanism of Sublethal Damage 108

- Repair and Radiation Quality 108
- Dose Rate Effect 108
- Inverse Dose-Rate Effect 109

**19. Radiosensitivity of Cell and Cell Cycle 110**

- Autoradiography is a Technique 110
- Cell Cycle 110
- What is Retroactive Synchronization-($G_2$) 111

**20. Radiosensitizers 112**

- Halogenated Pyrimidines 112
- Radiosensitizing Hypoxic Cells 112

**21. Radioprotectors 114**

- Linear Energy Transfer 114
- Relative Biological Effectiveness 114
- Radiation Weighting Factor 116

**22. Brachytherapy or Endocurietherapy 117**

- Intracavitary Therapy 117
- Interstitial Therapy 117
- Permanent Interstitial Implants 118
- Radiolabeled Immunoglobulin Therapy 119

## Section 3: Concepts of Chemotherapy and Common Drugs

**23. Concepts of Chemotherapy 123**

- Introduction 123
- Classification of Cancer Chemotherapeutic Agents 126
- Clinical Considerations during Chemotherapy 126

**24. Chemotheraputic Drugs 128**

- Induction Chemotherapy 128
- Adjuvant Chemotherapy 128
- Primary Chemotherapy 129
- Concomitant Chemoradiotherapy 129
- Salvage Chemotherapy 129
- Aldesleukin 130
- Amifostine 132
- Aminoglutethimide 132
- Anastrozole 133
- Arsenic Trioxide 134
- Asparaginase 135
- Capecitabine 137
- Carboplatin 138
- Carmustine 139
- Cetuximab 140
- Cisplatin 141
- Cladribine 142
- Corticosteroids 143
- Cyclophosphamide 144
- Cytarabine 145
- Dacarbazine 146
- Dactinomycin 147
- Daunorubicin, Liposomal 148
- Docetaxel 149
- Doxorubicin 150
- Doxorubicin, Liposomal 151
- Epirubicin 152
- Epoetin 153
- Estrogens 154
- Etoposide 155
- Filgrastim 156
- Fludarabine 157
- Fluorouracil 158
- Flutamide 159
- Fulvestrant 159
- Gefitinib 160
- Gemcitabine 161
- Hydroxyurea 161
- Ifosfamide 162
- Imatinib Mesylate 163
- Interferon-$\alpha$ 164
- Irinotecan 166
- Letrozole 167
- Luteinizing Hormone-Releasing Hormone Analogs 168
- Melphalan 169
- Mercaptopurine 169
- Mesna 170
- Methotrexate 170
- Mitomycin 172
- Mitoxantrone 172
- Octreotide 173
- Oxaliplatin 174
- Paclitaxel 175
- Pamidronate 177
- Pegfilgrastim 177
- Porfimer 178
- Procarbazine 179
- Progestins 179
- Rituximab 180
- Sargramostim 181
- Suramin 182
- Tamoxifen 183

- Temozolomide 184
- Thalidomide 185
- Thiotepa 186
- Topotecan 187
- Toremifene 187
- 131I-Tositumomab 188
- Trastuzumab 189
- Vinblastine 190
- Vincristine 191
- Vinorelbine 191
- Zoledronic Acid 192

**25. Targeted Cancer Therapy 194**
- Cancer Biology 194
- Mechanisms of Carcinogenesis 194
- Mathematical Modeling 198
- Targeted Therapy in Chronic Lymphocytic Leukemia 201
- Cyclosporine 203

**26. New Hope with Gene Therapy 203**
- Immunosuppressant Antibodies 203
- Approaches in Gene Therapy 203
- Adenoviruses Entry into Cell 204
- Applications of Gene Therapy 205

**27. Side Effects of Chemotherapy 207**
- What Causes Side Effects? 207
- Chemo Agents and Its Toxicity 208
- Common Side Effects 209

**28. Hormone Treatment in Cancer 216**
- Role of Hormone 216

## Section 4: Common Cancers and its Radiotherapy, Chemotherapy Planning

**29. Head and Neck Cancer 223**
- Classification 223
- Cancer of Oral Cavity 223

**30. Breast Cancer 234**
- Pretreatment Evaluation 234
- Ductal Carcinoma In Situ 234
- Early Stage Breast Carcinoma 235
- Recommendation for Axillary Radiation 238
- Role of Interstitial Implant in Breast Carcinoma 238
- Hormone Treatment 238

**31. Palliative Treatment in Breast Cancer 240**
- Palliative Radiotherapy Indicated in Breast Cancer 240
- Brain Secondary 241
- Spinal Cord Compression 241
- Orbital Metastasis 242
- Brachial Plexopathy 242
- Neoplastic Plexopathy 242
- Lung Metastasis 242
- Complications of Radiotherapy in Breast Cancer 242

**32. Management of Cervical Cancer 244**
- Treatment of Cervical Intraepithelial Neoplasia/Dysplasia 244
- Treatment of Carcinoma Cervix 245
- Management Pre-treatment Evaluation 245
- Limitation of Biopsy and Importance of PV Examination 245
- Pelvic Lymph Nodes Around Cervix 245
- Radiotherapy 247
- Type of Hysterectomy 248
- Recurrence of Carcinoma Cervix 249
- Break Through in Carcinoma Cervix 250

**33. Ovarian Carcinoma 252**
- Introduction 252
- Incidence 252
- Anatomy 252
- Lymph Node Metastasis 253
- Role of Radiotherapy 257

**34. Carcinoma Nasopharynx 259**
- Introduction 259
- Nasopharyngeal Tonsil 260
- Lymphatic Drainage 260
- Epidemiology 260
- Result of Treatment 263

**35. Lung Cancer 264**
- Introduction 264
- Classification 265
- Brain Metastasis in Lung Cancer 266
- Contrast-enhanced Computed Tomography Thorax of Lung Cancer 268

**36. Endometrial Cancer 273**
- Introduction 273
- Classification 274

- Histology 274
- Signs and Symptoms 275
- Risk Factors 275
- Diagnosis and Clinical Evaluation 275
- Endometrial Adenocarcinoma 276
- Further Evaluation 276
- Treatment 278
- Complications of Treatment 278
- Prognosis 279
- Survival Rates 279

**37. Hodgkin's Lymphoma 280**

- Clinical Presentation 280
- Lymphadenopathy 280
- Treatment 282

**38. Non-Hodgkin's Lymphoma 284**

- Pathology 284
- Principles of Management 288

**39. Multiple Myeloma 292**

- Introduction 292
- Radiotherapy for Myeloma 295
- Radiotherapy Planning for Multiple Myeloma 297

**40. Testicular Cancer 299**

- Incidence 299
- Risk Factors 299
- Pathology 299
- Diagnosis 300
- Staging and Prognosis 301
- Treatment 301

**41. Bladder Cancer 306**

- Incidence 306
- Risk Factors 306
- Pathology 306
- Diagnosis 306
- Staging and Prognosis 306
- Treatment of Bladder Cancer 307
- Radiotherapy Planning for Urinary Bladder Cancer 308

**42. Prostate Cancer 311**

- History 311
- Anatomy 311
- Prostate Cancer 313
- Epidemiology and Carcinogenesis 313
- Relevant Histopathology of Prostate Cancer 314
- Gleason Grading System 314
- Management by Stage and Type 314
- Metastatic Cancer 320

**43. Kidney Cancer/Renal Cell Carcinoma 323**

- Incidence 323
- Risk Factors 323
- Pathology 323
- Diagnosis 324
- Staging and Prognosis 324

**44. Gastric Cancer 327**

- Epidemiology 327
- Etiology and Risk Factors 328
- Clinical Presentations 329
- Pathology 329
- Management of Gastric Cancer 329

**45. Colorectal Cancer 335**

- Introduction 335
- Causes of Colorectal Cancer 336
- Epidemiology of Colorectal Cancer 338
- Pathology of Colorectal Cancer 338
- Treatment of Colorectal Cancer 340

**46. Pancreatic Cancer 346**

- Introduction 346
- Signs and Symptoms 346
- Symptoms of Pancreatic Cancer Metastasis 347
- Diagnosis 348
- Management of Pancreatic Cancer 348
- The Role of Adjuvant Therapy 351
- Management of Patients with Locally Advanced Disease 353
- Management of Metastatic Disease 353
- Pancreas Cancer Radiotherapy Planning Technique 355

**47. Neuroendocrine Tumor 357**

- Neuroendocrine System 357
- Metastases and Malignancy 361
- Therapy 363

**48. Esophageal Cancer 367**

- Epidemiology 367
- Etiology and Risk Factors 367
- Clinical Presentations 368
- Pathology 368

- Risk Factors 369
- Treatment of Esophageal Cancer 370

**49. Anal Canal Cancer 373**

- Anatomy 373
- Pathology 373
- Clinical Features 373
- Diagnosis and Investigation 374
- Staging 374
- Treatment 374
- Technique 375
- Complications 376

**50. Gallbladder Cancer 378**

- Artery Supply of Gallbladder 378
- CAGB Etiology/Risk Factor 378
- Pathology of CAGB 380
- Histological Classification 380
- Clinical Features 381
- Staging 381
- Management 381

**51. Skin Cancer 384**

- Etiology of Skin Cancers 384
- Surgical Management 387
- Radiation Treatment 387
- Skin Cancer Radiotherapy Planning Technique 389

**52. Osteosarcoma 392**

- Introduction 392
- Pathology 393
- Clinical Features 393
- Diagnosis and Staging Investigations 393
- Treatment 393
- Chemotherapy in Osteosarcoma 394
- Radiotherapy 394
- Results of Treatment 395

**53. Soft Tissue Sarcoma 396**

- Overview 396
- Risk Factors 396
- Pathology 396
- Diagnosis 397
- Staging and Prognosis 397
- Management of Soft Tissue Sarcoma 398
- Limbs 401
- Soft Tissue Disease 402
- Radiotherapy Planning for Soft Tissue Sarcoma 402
- Extremity Sarcoma External Beam Radiotherapy 403
- Extremity Sarcoma: Brachytherapy 404
- Retroperitoneal Sarcoma: EBRT and Brachytherapy 405
- Chemotherapy 406
- Results of Treatment 406
- Stagewise Treatment of Soft Tissue Sarcomas 406

**54. Carcinoma Larynx 408**

- Introduction 408
- Transglottic Carcinoma 408
- Connective Tissue Barriers of the Larynx (Laryngeal Compartments) 409
- Larynx Blood Supply/Lymphatic Chain/ Nerve Supply 409
- Local and Distant Spread of Laryngeal Cancer 411
- Lymphatic Spread 411
- Distant Spread 411
- Staging for Larynx Cancer 411
- Prognostic Factors for Larynx Cancer 412
- Clinical Presentation 413
- PreTreatment Work-up for Larynx Cancer 413
- Indirect Laryngoscopy 413
- Use of Direct Laryngoscopy 413
- Radiography in Laryngeal Cancer 414
- CT Scan 414
- Management of Larynx Cancer 414
- Veterans Affairs Laryngeal Study Group 415
- Radiotherapy 415
- Management of Supraglottic Larynx 416

**55. Brain Tumor 417**

- Classification and Incidence 418
- Meningiomas 419
- Brain Metastases 419
- Clinical Presentation and Diagnosis 420
- Diagnosis 421
- Treatment and Prognosis 422
- Clinical Management 423
- Anaplastic Oligodendroglioma 424
- General Principles of Brain Tumor Radiotherapy Planning 426
- Single-Fraction stereotactic radiosurgery 427
- Glioma—High Grade 428
- Glioma—Low Grade 430

- Brainstem Glioma 430
- Meningioma 430
- Pituitary Adenoma 431

**56. Leukemia 433**

- Classification 433
- Signs and Symptoms 434
- Causes 435
- Treatment 436
- Acute Lymphoblastic Leukemia 436
- Chronic Lymphocytic Leukemia 437
- Acute Myelogenous Leukemia 437
- Chronic Myelogenous Leukemia 438
- Hairy Cell Leukemia 438
- T-cell Prolymphocytic Leukemia 439
- Juvenile Myelomonocytic Leukemia 439

**57. Pediatric Oncology 440**

- General Considerations 440
- Rhabdomyosarcoma 442
- Neuroblastoma 444
- Metaiodobenzylguanidine 445
- Wilms' Tumor 445
- Hodgkin's and Non–Hodgkin's Lymphoma 448

**58. Thyroid Cancer 450**

- Introduction 450
- Symptoms of Thyroid Cancer 451
- Types of Thyroid Cancer 451
- Radical Radiotherapy in Thyroid Cancer 452
- Overview of Typical Thyroid Cancer Treatment 453

## Section 5: General Management in Oncology

**59. Role of Steroids in Cancer 459**

- How Steroids Help? 459
- Side Effects 460

**60. Role of Antacids in Cancer 462**

- Acid-related Pathophysiology 462
- Antacids 463
- Histamine Type 2 ($H_2$) Antagonists 465
- Proton Pump Inhibitors 465
- Other Drugs 466

**61. Management of Bleeding in Cancer Patients 467**

- Introduction 467
- Etiology and Clinical Presentation 467
- Physiology of Hemostasis 467
- Management 468
- Conclusion 474

**62. Anemia in Cancer 476**

- Introduction 476
- Changes in Health-Related QoL Parameters 476
- Cancer Therapy Outcomes 477
- Dosing Regimens 477
- Comparisons Between Erythropoietic Agents 477
- Iron Supplementation And Response To Erythropoietic Agents 478
- Safety and Tolerability 478
- Pharmacoeconomic Considerations 479
- Conclusion 479

**63. Management of Cancer Pain 481**

- Incidence of Pain 481
- Types of Neurogenic Cancer Pain 481
- Types of Pain 481
- Assessment of Pain Visual Analog Scale 482
- Chronic Pain 482
- Neuropathic Pain 482
- Mechanistic Approach to Therapy 483
- Pharmacokinetic Goals 483

*Bibliography 485*

*Index 495*