

Contents

1 Basic Considerations	1
1.1 Nuclear Medicine and Molecular Imaging	1
1.2 Historical Background	2
1.3 Scientific Basis of Nuclear Medicine	5
1.3.1 Atomic Structure	5
1.3.2 Isotopes	7
1.3.3 Radioactivity	7
1.3.4 Radiopharmaceuticals	8
1.4 Technical Principles of Nuclear Medicine	9
1.5 Scope of Nuclear Medicine	9
1.5.1 Diagnostic Nuclear Medicine	9
1.5.2 Nuclear Medicine Therapy	11
1.6 Summary	12
Further Reading	12
2 Genitourinary System	13
2.1 Introduction	13
2.2 Radiopharmaceuticals	14
2.3 Imaging Studies	14
2.4 Clinical Uses	16
2.4.1 Dynamic Renal Scintigraphy	16
2.4.2 Static Renal Scintigraphy	16
2.4.3 Vesicoureteral Reflux Study	16
2.4.4 Scrotal Imaging	16
2.5 Commonly Used Applications	16
2.5.1 Diagnosis of Renovascular Hypertension	16
2.5.2 Urinary Tract Obstruction	18
2.5.3 Urinary Tract Infection	19
2.5.4 Vesicoureteral Reflux	23
2.5.5 Evaluation of Renal Transplant Complications	25
2.5.6 Diagnosis of Testicular Torsion	27
2.6 Summary	30
Further Reading	30
3 Digestive and Hepatobiliary System	31
3.1 Introduction	32
3.2 Clinical Uses	32
3.3 Evaluation of Esophageal Transit Time	32
3.4 Detection of Gastroesophageal Reflux	33
3.5 Evaluation of Gastric Emptying	33

3.6	Lower Gastrointestinal Bleeding Localization	34
3.7	Diagnosis of Meckel's Diverticulum	37
3.8	Diagnosis and Follow-Up of Inflammatory Bowel Disease	38
3.9	Diagnosis of Hepatic Hemangioma	39
3.10	Diagnosis of Acute Cholecystitis	40
3.11	Diagnosis of Common Bile Duct Obstruction	41
3.12	Evaluation of Neonatal Hyperbilirubinemia	41
3.13	Diagnosis of Hypokinesia Syndrome	44
3.14	Evaluation of Complications After Hepatobiliary Surgery and Liver Transplantation	44
3.15	Protein Loss Study	44
3.16	Scintigraphic Nonimaging Procedures	45
3.16.1	Carbon-14 Breath Tests	45
3.17	Summary	47
	Reference	47
	Further Reading	47
4	Endocrine System	49
4.1	Introduction	49
4.2	Thyroid Gland	50
4.2.1	Clinical Uses	50
4.2.2	Thyroid Imaging Study	50
4.2.3	Thyroid Uptake Measurement	53
4.2.4	Thyroid Cancer Imaging Studies	56
4.3	Parathyroid Gland	57
4.3.1	Clinical Uses	57
4.3.2	Preoperative Parathyroid Localization	58
4.3.3	Intraoperative Parathyroid Localization	60
4.4	Adrenal Gland	60
4.4.1	Clinical Uses	60
4.4.2	Adrenal Cortex Disorders	61
4.4.3	Adrenal Medulla Disorders	62
4.5	Summary	65
	Further Reading	66
5	Soft Tissue Infection and Inflammation	69
5.1	Introduction	69
5.2	Clinical Uses	70
5.3	Diagnosis of Infection	70
5.4	Imaging Diagnosis of Soft Tissue Infections	72
5.4.1	Localizing Signs Present	72
5.4.2	No Localizing Signs Present	74
5.5	Algorithm	75
5.6	Summary	77
	Further Reading	77
6	Respiratory System	79
6.1	Introduction	79
6.2	Clinical Uses	80
6.3	Diagnosis of Pulmonary Embolism	80
6.4	Pulmonary Sarcoidosis	81
6.5	Idiopathic Pulmonary Fibrosis	83

6.6	<i>Pneumocystis carinii (jiroveci)</i> Pneumonia	84
6.7	Alveolar Permeability	84
6.8	Lung Cancer	85
6.9	Summary	87
	Further Reading	87
7	Skeletal System	89
7.1	Introduction	89
7.2	Clinical Uses	90
7.3	Non-neoplastic Disease	90
7.3.1	Imaging of Skeletal Infections	90
7.3.2	Avascular Necrosis (Osteonecrosis)	94
7.3.3	Trauma and Related Conditions	96
7.3.4	Metabolic Bone Diseases	101
7.4	Diagnosis of Neoplastic Bone Disease	102
7.4.1	Imaging of Primary Bone Tumors	103
7.4.2	Imaging of Metastatic Bone Disease	105
7.5	Summary	108
	Further Reading	109
8	Cardiovascular System	111
8.1	Introduction	111
8.2	Clinical Uses	112
8.3	Evaluation of Cardiac Function	112
8.4	Evaluation of Myocardial Perfusion and Metabolism	112
8.4.1	Diagnosis	114
8.4.2	Prognosis	114
8.4.3	Follow-Up After Acute Myocardial Infarction	115
8.4.4	Follow-Up After Revascularization Procedures	116
8.4.5	Preoperative Evaluation	117
8.4.6	Viability Assessment	117
8.5	Soft Tissue Hemangioma Study	118
8.6	Lymphoscintigraphy	119
8.7	Summary	120
	Further Reading	121
9	Central Nervous System	123
9.1	Introduction	123
9.2	Clinical Uses	125
9.3	Dementia	125
9.4	Brain Death	125
9.5	Seizure Localization	127
9.6	Brain Tumor	128
9.7	Cerebrospinal Fluid Abnormalities	130
9.8	Summary	130
	Further Reading	130
10	Nuclear Oncology	131
10.1	Introduction	131
10.2	Clinical Uses	132
10.3	Diagnosis of Tumors	132
10.4	Staging of Malignant Disease	132

10.5	Detection of Residual or Recurrent Disease	135
10.6	Evaluating Response to Therapy	136
10.7	Radiotherapy Planning	137
10.8	Sentinel Lymph Node Localization	137
10.9	Summary	140
	Further Reading	140
11	Therapeutic Applications of Nuclear Medicine	143
11.1	Introduction	143
11.2	Clinical Uses	144
11.3	Treatment of Hyperthyroidism and Other Benign Thyroid Conditions	144
11.4	Treatment of Differentiated Thyroid Cancer	145
11.5	Treatment of Pain Secondary to Skeletal Metastases	145
11.6	Treatment of Neuroendocrine Tumors	146
11.7	Radioimmunotherapy	147
11.8	Radionuclide Synovectomy	147
	11.8.1 Radiopharmaceuticals for Synovectomy	147
	11.8.2 Clinical Use	148
11.9	Peptide Receptor Radionuclide Therapy	148
11.10	Treatment of Hepatocellular Carcinoma and Liver Metastases	149
11.11	Summary	149
	Further Reading	150
	Glossary	151
	Index	155