

SECTION 1 NORMAL AND ABNORMAL DEVELOPMENT

- 1.1 Embryo at 18 Days, 2
- 1.2 Embryo at 20 to 24 Days, 3
- 1.3 Central Nervous System at 28 Days, 4
- 1.4 Central Nervous System at 36 Days, 5
- 1.5 Defective Neural Tube Formation, 6
- 1.6 Defective Neural Tube Formation (Continued), 7
- 1.7 Spinal Dysraphism, 8
- 1.8 Spinal Dysraphism (Continued), 9
- 1.9 Fetal Brain Growth in the First Trimester, 10
- 1.10 Craniosynostosis, 11
- 1.11 Extracranial Hemorrhage and Skull Fractures in the Newborn, 12
- 1.12 Intracranial Hemorrhage in the Newborn, 13
- 1.13 External Development of the Brain in the Second and Third Trimesters, 14
- 1.14 Mature Brain Ventricles, 15
- 1.15 Hydrocephalus, 16
- 1.16 Surgical Treatment of Hydrocephalus, 17
- 1.17 Cerebral Palsy, 18
- 1.18 Establishing Cellular Diversity in the Embryonic Brain and Spinal Cord, 19
- 1.19 Generation of Neuronal Diversity in the Spinal Cord and Hindbrain, 21
- 1.20 Circuit Formation in the Spinal Cord, 23
- 1.21 Sheath and Satellite Cell Formation, 24
- 1.22 Development of Myelination and Axon Ensheathment, 25
- 1.23 Brachial Plexus and/or Cervical Nerve Root Injuries at Birth, 26
- 1.24 Morphogenesis and Regional Differentiation of the Forebrain, 27
- 1.25 Neurogenesis and Cell Migration in the Developing Neocortex, 28
- 1.26 Neuronal Proliferation and Migration Disorders, 29
- 1.27 Developmental Dyslexia, 30
- 1.28 Autism Spectrum Disorders, 31
- 1.29 Rett Syndrome, 32
- 1.30 Rett Syndrome (Continued), 33

SECTION 2 CEREBRAL CORTEX AND NEUROCOGNITIVE DISORDERS

- 2.1 Surfaces of Cerebrum: Superolateral Surface, 36
- 2.2 Surfaces of Cerebrum: Medial Surface, 37
- 2.3 Surfaces of Cerebrum: Inferior Surface, 38
- 2.4 Cerebral Cortex: Function and Association Pathways, 39
- 2.5 Major Cortical Association Bundles, 40
- 2.6 Corticocortical and Subcorticocortical Projection Circuits, 41
- 2.7 Corpus Callosum, 42
- 2.8 Rhinencephalon and Limbic System, 43
- 2.9 Hippocampus, 44
- 2.10 Fornix, 45
- 2.11 Amygdala, 46
- 2.12 Forebrain Regions Associated With Hypothalamus, 47
- 2.13 Thalamocortical Radiations, 48
- 2.14 Neuronal Structure and Synapses, 49
- 2.15 Chemical Synaptic Transmission, 50
- 2.16 Summation of Excitation and Inhibition, 51
- 2.17 Types of Neurons in Cerebral Cortex, 52
- 2.18 Astrocytes, 53
- 2.19 Testing for Defects of Higher Cortical Function, 54
- 2.20 Memory Circuits, 55

- 2.21 Amnesia, 56
- 2.22 Dominant Hemisphere Language Dysfunction, 57
- 2.23 Nondominant Hemisphere Higher Cortical Dysfunction, 58
- 2.24 Alzheimer Disease: Pathology, 59
- 2.25 Alzheimer Disease: Distribution of Pathology, 60
- 2.26 Alzheimer Disease: Clinical Manifestations, Progressive Phases, 61
- 2.27 Frontotemporal Dementia, 62
- 2.28 Dementia with Lewy Bodies, 63
- 2.29 Vascular Dementia, 64
- 2.30 Treatable Dementias, 65
- 2.31 Normal-Pressure Hydrocephalus, 66

SECTION 3 EPILEPSY

- 3.1 Electroencephalography, 68
- 3.2 Focal (Partial) Seizures, 69
- 3.3 Generalized Tonic-Clonic Seizures, 70
- 3.4 Absence Seizures, 71
- 3.5 Epilepsy Syndromes, 72
- 3.6 Neonatal Seizures, 73
- 3.7 Status Epilepticus, 74
- 3.8 Causes of Seizures, 75
- 3.9 Neurobiology of Epilepsy: Ion channels, 76
- 3.10 Neurobiology of Epilepsy: Synaptic Receptors, 77
- 3.11 Neurobiology of Epilepsy: Antiepileptic Drug Targets, 78
- 3.12 Treatment of Epilepsy: Preoperative Evaluation, 79
- 3.13 Treatment of Epilepsy: Resective Surgery, 80

SECTION 4 PSYCHIATRY

- 4.1 Limbic System, 82
- 4.2 Major Depressive Disorder, 83
- 4.3 Postpartum Depression, 84
- 4.4 Bipolar Disorder, 85
- 4.5 Bipolar Disorder (Continued), 86
- 4.6 Generalized Anxiety Disorder, 87
- 4.7 Social Anxiety Disorder, 88
- 4.8 Panic Disorder, 89
- 4.9 Posttraumatic Stress Disorder, 90
- 4.10 Obsessive-Compulsive Disorder, 91
- 4.11 Somatization, 92
- 4.12 Conversion Disorder, 93
- 4.13 Schizophrenia, 94
- 4.14 Alcohol Use Disorder, 95
- 4.15 Treatment for Alcohol Use Disorder, 96
- 4.16 Alcohol Withdrawal, 97
- 4.17 Opioid Use Disorders: Brain Substrates of Addictive Behaviors, 98
- 4.18 Opioid Use Disorders: Overdose Reversal, 99
- 4.19 Opioid Withdrawal, 100
- 4.20 Borderline Personality Disorder, 101
- 4.21 Antisocial Personality Disorder, 102
- 4.22 Intimate Partner Violence, 103
- 4.23 Abuse in Later Life, 104
- 4.24 Delirium and Acute Personality Changes, 105
- 4.25 Delirium and Acute Personality Changes (Continued), 106
- 4.26 Insomnia, 107
- 4.27 Pediatrics: Depressive Disorders, 108
- 4.28 Pediatrics: Anxiety Disorders, 109
- 4.29 Pediatrics: Disruptive Behavior Disorders, 110
- 4.30 Pediatrics: Attention-Deficit/Hyperactivity Disorders, 111
- 4.31 Pediatrics: Eating and Feeding Disorders, 112
- 4.32 Child Abuse: Fractures in Abused Children, 113
- 4.33 Child Abuse: Staging of Injuries and Injury Patterns, 114

SECTION 5 HYPOTHALAMUS, PITUITARY, SLEEP, AND THALAMUS

- 5.1 Anatomic Relationships of the Hypothalamus, 116
- 5.2 Development and Developmental Disorders of the Hypothalamus, 117
- 5.3 Blood Supply of the Hypothalamus and Pituitary Gland, 118
- 5.4 General Topography of the Hypothalamus, 119
- 5.5 Overview of Hypothalamic Nuclei, 120
- 5.6 Hypothalamic Control of the Pituitary Gland, 121
- 5.7 Hypothalamic Control of the Autonomic Nervous System, 122
- 5.8 Olfactory Inputs to the Hypothalamus, 123
- 5.9 Visual Inputs to the Hypothalamus, 124
- 5.10 Somatosensory Inputs to the Hypothalamus, 125
- 5.11 Taste and Other Visceral Sensory Inputs to the Hypothalamus, 126
- 5.12 Limbic and Cortical Inputs to the Hypothalamus, 127
- 5.13 Overview of Hypothalamic Function and Dysfunction, 128
- 5.14 Regulation of Water Balance, 129
- 5.15 Temperature Regulation, 130
- 5.16 Fever: Cytokines and Prostaglandins Cause the Sickness Response, 131
- 5.17 Fever: Hypothalamic Responses During Inflammation Modulate Immune Response, 132
- 5.18 Regulation of Food Intake, Body Weight, and Metabolism, 133
- 5.19 Stress Response, 134
- 5.20 Hypothalamic Regulation of Cardiovascular Function, 135
- 5.21 Hypothalamic Regulation of Sleep, 136
- 5.22 Narcolepsy: A Hypothalamic Sleep Disorder, 137
- 5.23 Sleep-Disordered Breathing, 138
- 5.24 Parasomnias, 139
- 5.25 Divisions of the Pituitary Gland and Its Relationships to the Hypothalamus, 140
- 5.26 Posterior Pituitary Gland, 141
- 5.27 Anatomic Relationships of the Pituitary Gland, 142
- 5.28 Effects of Pituitary Mass Lesions on the Visual Apparatus, 143
- 5.29 Anterior Pituitary Hormone Deficiencies, 144
- 5.30 Severe Anterior Pituitary Hormone Deficiencies (Panhypopituitarism), 145
- 5.31 Postpartum Pituitary Infarction (Sheehan Syndrome), 146
- 5.32 Pituitary Apoplexy, 147
- 5.33 Thalamic Anatomy and Pathology, 148
- 5.34 Thalamic Anatomy and Pathology (Continued), 149

SECTION 6 DISORDERS OF CONSCIOUSNESS (COMA)

- 6.1 Coma, 152
- 6.2 Disorders of Consciousness, 153
- 6.3 Emergency Management: Full Outline of Unresponsiveness Score (FOUR), 154
- 6.4 Emergency Management: Prognosis in Coma Related to Severe Head Injuries, 155
- 6.5 Differential Diagnosis of Coma, 156
- 6.6 Hypoxic-Ischemic Brain Damage, 157
- 6.7 Vegetative State, Minimally Conscious State, and Unresponsive Wakefulness Syndrome, 158
- 6.8 Brain Death or Death by Neurologic Criteria, 159
- 6.9 Ventilatory Patterns and the Apnea Test, 160

SECTION 7 BASAL GANGLIA AND MOVEMENT DISORDERS

- 7.1 Basal Nuclei (Ganglia), 162
- 7.2 Basal Ganglia and Related Structures, 163
- 7.3 Schematic and Cross Section of Basal Ganglia, 164
- 7.4 Parkinsonism: Early Manifestations, 165
- 7.5 Parkinsonism: Successive Clinical Stages, 166
- 7.6 Neuropathology of Parkinson Disease, 167
- 7.7 Progressive Supranuclear Palsy, 168
- 7.8 Corticobasal Degeneration, 169
- 7.9 Parkinsonism: Hypothesized Role of Dopamine, 170
- 7.10 Surgical Management of Movement Disorders, 171
- 7.11 Hyperkinetic Movement Disorder: Idiopathic Torsion Dystonia, 172
- 7.12 Hyperkinetic Movement Disorder: Cervical Dystonia, 173
- 7.12 Chorea/Ballism, 173
- 7.13 Tremor, 174
- 7.14 Tics and Tourette Syndrome, 175
- 7.15 Myoclonus, 176
- 7.17 Wilson Disease, 178
- 7.18 Psychogenic Movement Disorders, 179
- 7.19 Cerebral Palsy, 180

SECTION 8 CEREBELLUM AND ATAXIA

- 8.1 Cerebellum and the Fourth Ventricle, 182
- 8.2 Cerebellum Gross Anatomy, 183
- 8.3 Cerebellar Peduncles, 184
- 8.4 Cerebellar Cortex and Nuclei: Neuronal Elements, 185
- 8.5 Cerebellar Cortex: Neuronal Elements, 186
- 8.6 Cerebellar Cortical and Corticonuclear Circuitry: Cerebellar Neuronal Circuitry, 187
- 8.7 Cerebellar Cortical and Corticonuclear Circuitry: Circuit Diagram of Afferent Connections, 188
- 8.8 Cerebellum Subdivisions and Afferent Pathways, 189
- 8.9 Cerebellum Subdivisions and Afferent Pathways: Spinocerebellar Pathways, 190
- 8.10 Cerebellar Efferent Pathways, 191
- 8.11 Cerebellovestibular Pathways, 193
- 8.12 Cerebellum Modular Organization, 194
- 8.13 Cerebrocerebellar Connections, 195
- 8.14 Cerebellar Motor Examination, 196
- 8.15 Cerebellar Cognitive Affective Syndrome, 197
- 8.16 Cerebellar Disorders: Differential Diagnosis I, 198
- 8.17 Gait Disorders: Differential Diagnosis II, 199
- 8.18 Gait Disorders: Differential Diagnosis III, 200
- 8.19 Friedreich Ataxia, 201
- 8.20 Friedreich Ataxia: Cardiac Abnormalities and GAA Expansion Mutation, 202

SECTION 9 CEREBROVASCULAR CIRCULATION AND STROKE

Overview and Approach to Stroke Patient

- 9.1 Arteries to Brain: Schema, 204
- 9.2 Arteries to Brain and Meninges, 205
- 9.3 Temporal and Infratemporal Fossae, 206
- 9.4 Territories of the Cerebral Arteries, 207
- 9.5 Arteries of Brain: Lateral and Medial Views, 208
- 9.6 Arteries of Brain: Frontal View and Section, 209
- 9.7 Types of Stroke, 210
- 9.8 Temporal Profile of Transient Ischemic Attack (TIA) and Completed Infarction, 211
- 9.9 Clinical Evaluation and Treatment of Stroke, 212
- 9.10 Clinical Evaluation and Treatment of Stroke (Continued), 213
- 9.11 Uncommon Etiologic Mechanisms of Stroke, 214

Anterior Circulation Ischemia

- 9.12 Common Sites of Cerebrovascular Occlusive Disease, 215
- 9.13 Other Etiologies of Carotid Artery Disease, 216
- 9.14 Clinical Manifestations of Carotid Artery Disease, 217
- 9.15 Occlusion of Middle and Anterior Cerebral Arteries, 218
- 9.16 Diagnosis of Internal Carotid Disease, 219
- 9.17 Diagnosis of Carotid Artery Disease, 220
- 9.18 Carotid Endarterectomy, 221
- 9.19 Endovascular ICA Angioplasty and Stenting Using a Protective Device, 222

Vertebral Basilar System Disorders

- 9.20 Arterial Distribution to the Brain: Basal View, 223
- 9.21 Arteries of Posterior Cranial Fossa, 224
- 9.22 Clinical Manifestations of Vertebrobasilar Territory Ischemia, 225
- 9.23 Intracranial Occlusion of Vertebral Artery, 226
- 9.24 Occlusion of Basilar Artery and Branches, 227
- 9.25 Occlusion of Top-of-the-Basilar and Posterior Cerebral Arteries, 228

Brain Emboli

- 9.26 Cardiac Sources of Brain Emboli, 229
- 9.27 Uncommon Cardiac Mechanisms in Stroke, 230

Lacunar Stroke

- 9.28 Lacunar Infarction, 231
- 9.29 Risk Factors for Cardiovascular Disease, 232

Other

- 9.30 Hypertensive Encephalopathy, 233
- 9.31 Hypoxia, 234

Coagulopathies

- 9.32 Role of Platelets in Arterial Thrombosis, 235
- 9.33 Inherited Thrombophilias, 236
- 9.34 Antiphospholipid Antibody Syndrome, 237

Venous Sinus Thrombosis

- 9.35 Meninges and Superficial Cerebral Veins, 238
- 9.36 Intracranial Venous Sinuses, 239
- 9.37 Diagnosis of Venous Sinus Thrombosis, 240

Intracerebral Hemorrhage

- 9.38 Pathogenesis and Types, 241
- 9.39 Clinical Manifestations of Intracerebral Hemorrhage Related to Site, 242
- 9.40 Vascular Malformations, 243

Intracranial Aneurysms and Subarachnoid Hemorrhage

- 9.41 Distribution and Clinical Manifestations of Congenital Aneurysm Rupture, 244
- 9.42 Giant Congenital Aneurysms, 245
- 9.43 Ophthalmologic Manifestations of Cerebral Aneurysms, 246
- 9.44 Approach to Internal Carotid Aneurysms, 247
- 9.45 Flow Diversion Stent for Treatment of Unruptured Intracranial Aneurysm, 248

Pediatrics

- 9.46 Pediatric Cerebrovascular Disease, 249

Rehabilitation

- 9.47 Introduction and Initial Stroke Rehabilitation, 250
- 9.48 Aphasia Rehabilitation, 251
- 9.49 Other Rehabilitative Issues: Gait Training, Upper Limb Function, Locked-in Syndrome, 252
- 9.50 Other Rehabilitative Issues: Dysphagia, 253

SECTION 10 MULTIPLE SCLEROSIS AND OTHER CENTRAL NERVOUS SYSTEM AUTOIMMUNE DISORDERS

Multiple Sclerosis

- 10.1 Overview, 256
- 10.2 Clinical Manifestations, 257
- 10.3 Diagnosis: Typical MRI Findings—Brain, 258
- 10.4 Diagnosis: Typical MRI Findings—Spinal Cord, 259
- 10.5 Diagnosis: Visual Evoked Potential and Spinal Fluid Analysis, 260
- 10.6 Pathophysiology, 261
- 10.7 Pathophysiology (Continued), 262
- 10.8 Relapses: Steps 1 to 5, 264
- 10.9 Relapses: Step 6, 265
- 10.10 Relapses: Steps 7 to 8, 266
- 10.11 Relapses: Consequences, 267
- 10.12 Enigma of Progressive Multiple Sclerosis, 268
- 10.13 Pathology, 269
- 10.14 Treatment, 270

Neuroimmunologic Syndromes

- 10.15 Neuromyelitis Optica, Acute Disseminated Encephalomyelitis, and Acute Hemorrhagic Leukoencephalitis—Radiologic Findings, 272
- 10.16 Neuromyelitis Optica, Acute Disseminated Encephalomyelitis, and Acute Hemorrhagic Leukoencephalitis—Histopathologic Findings, 273
- 10.17 Introduction to Autoimmune Neurologic Syndromes, 274
- 10.18 Stiff-Person Syndrome Spectrum Disorder, 275
- 10.19 Autoimmune and Paraneoplastic Neurologic Syndromes, 276
- 10.20 Autoimmune and Paraneoplastic Neurologic Syndromes (Continued), 277
- 10.21 Autoimmune Neurologic Syndromes: Central and Peripheral Nervous System Manifestations, 278
- 10.22 Autoimmune Neurologic Syndromes: Central and Peripheral Nervous System Manifestations (Continued), 279

SECTION 11 INFECTIONS OF THE NERVOUS SYSTEM

- 11.1 Bacterial Meningitis I, 282
- 11.2 Bacterial Meningitis II, 283
- 11.3 Brain Abscess, 284
- 11.4 Parameningeal Infections, 285
- 11.5 Infections in the Immunocompromised Host: Progressive Multifocal Leukoencephalopathy and Nocardiosis, 286
- 11.6 Infections in the Immunocompromised Host: Listeriosis and Toxoplasmosis, 287
- 11.7 Neurocysticercosis, 288
- 11.8 Spirochetal Infections: Neurosyphilis, 289
- 11.9 Spirochetal Infections: Lyme Disease, 290
- 11.10 Tuberculosis of Brain and Spine, 291
- 11.11 Tetanus, 292
- 11.12 Aseptic Meningitis and Select Arthropod-Borne Virus Infections, 293
- 11.13 Human Immunodeficiency Virus: Primary Infection of the Nervous System, 294
- 11.14 Human Immunodeficiency Virus: Life Cycle and Antiretroviral Medications, 295
- 11.15 Poliomyelitis, 296
- 11.16 Acute Flaccid Paralysis, 297
- 11.17 Herpes Zoster, 298
- 11.18 Herpes Simplex Virus Encephalitis and Rabies, 299
- 11.19 Parasitic Infections: Cerebral Malaria and African Trypanosomiasis, 300
- 11.20 Parasitic Infections: Trichinosis (Trichinellosis), 301
- 11.21 Parasitic Infections: Cryptococcal Meningitis, 302

- 11.22 Creutzfeldt-Jakob Disease, 303
- 11.23 Neurosarcoidosis, 304
- 11.24 Neurologic Complications of COVID-19, 305

SECTION 12 NEURO-ONCOLOGY

- 12.1 Clinical Presentations of Brain Tumors, 308
- 12.2 WHO Classification of CNS Tumors, 309
- 12.3 Gliomas, 310
- 12.4 Glioblastoma, 311
- 12.5 Pediatric Brain Tumors: Medulloblastoma, 312
- 12.6 Pediatric Brain Tumors: Brainstem Glioma, 313
- 12.7 Ependymomas, 314
- 12.8 Metastatic Tumors to Brain, 315
- 12.9 Meningiomas, 316
- 12.10 Meningiomas (Continued), 317
- 12.11 Pituitary Tumors, 318
- 12.12 Clinically Nonfunctioning Pituitary Tumor, 319
- 12.13 Craniopharyngioma, 320
- 12.14 Tumors of Pineal Region, 321
- 12.15 Vestibular Schwannomas, 322
- 12.16 Removal of Vestibular Schwannoma, 323
- 12.17 Intraventricular Tumors, 324
- 12.18 Chordomas, 325
- 12.19 Differential Diagnosis of CNS Tumors, 326
- 12.20 Spinal Tumors: Classification, 327
- 12.21 Spinal Tumors: Clinical Profile, 328
- 12.22 Treatment Modalities, 329

SECTION 13 HEADACHE

- 13.1 Overview of Headaches, 332
- 13.2 Migraine Pathophysiology, 333
- 13.3 Migraine Presentation, 334
- 13.4 Migraine Aura, 335
- 13.5 Migraine Management, 336
- 13.6 Trigeminal Autonomic Cephalalgias: Cluster Headache, 337
- 13.7 Trigeminal Autonomic Cephalalgias: Paroxysmal Hemicrania, 338
- 13.8 Tension-Type Headache and Other Benign Episodic and Chronic Headaches, 339
- 13.9 Pediatric Headache, 340
- 13.10 Cranial Neuralgias: Trigeminal Neuralgia, 341
- 13.11 Other Cranial Neuralgias, 342
- 13.12 Idiopathic Intracranial Hypertension, Pseudotumor Cerebri, 343
- 13.13 Intracranial Hypotension/Low Cerebrospinal Fluid Pressure Headache, 344
- 13.14 Giant Cell Arteritis, 345
- 13.15 Contiguous Structure Headaches, 346
- 13.16 Thunderclap Headache and Other Headaches Presenting in the Emergency Department, 347
- 13.17 Headaches Presenting in the Emergency Department (Continued), 348
- 13.18 Headaches Presenting in the Emergency Department (Continued), 349
- 13.19 Headaches Presenting in the Emergency Department (Continued), 350

SECTION 14 HEAD TRAUMA

- 14.1 Skull: Anterior View, 352
- 14.2 Skull: Lateral View, 353
- 14.3 Skull: Midsagittal Section, 354
- 14.4 Calvaria, 355
- 14.5 External Aspect of Skull Base, 356
- 14.6 Internal Aspects of Base of Skull: Bones, 357
- 14.7 Internal Aspects of Base of Skull: Orifices, 358
- 14.8 Skull Injuries, 359
- 14.9 Concussion, 360
- 14.10 Acute Epidural Hematoma, 361
- 14.11 Acute Subdural Hematoma, 362
- 14.12 CT Scans and MR Images of Intracranial Hematomas, 363
- 14.13 Vascular Injury, 364
- 14.14 Glasgow Coma Score, 365
- 14.15 Initial Assessment and Management of Head Injury, 366
- 14.16 Neurocritical Care and Management After Traumatic Brain Injury: Devices for Monitoring Intracranial Pressure, 367
- 14.17 Neurocritical Care and Management: Decompressive Craniectomy, 368

Selected References, 369
Index, 373