

Contents

Reviewers vi

Preface vii

Acknowledgments viii

1. GROSS ANATOMY OF THE BRAIN **1**

Objectives 1

- I. Introduction 1
- II. Divisions of the Brain 1
- III. Atlas of the Brain and Brainstem 10

Review Test 22

2. MENINGES AND CEREBROSPINAL FLUID **24**

Objectives 24

- I. Meninges 24
- II. Ventricles 28
- III. Cerebrospinal Fluid 30
- IV. Hydrocephalus 30
- V. Meningitis 31
- VI. Herniation 32
- VII. Circumventricular Organs 34

Review Test 36

3. BLOOD SUPPLY OF THE CENTRAL NERVOUS SYSTEM **39**

Objectives 39

- I. Arteries of the Spinal Cord 39
- II. Venous Drainage of the Spinal Cord 40
- III. Arteries of the Brain 41
- IV. Cerebral Arterial Circle (of Willis) 45
- V. Meningeal Arteries 45
- VI. Veins of the Brain 45
- VII. Venous Dural Sinuses 46
- VIII. Angiography 48
- IX. Intracranial Hemorrhage 52

Review Test 54

4. DEVELOPMENT OF THE NERVOUS SYSTEM 58

Objectives 58

- I. Overview 58**
- II. Development of the Neural Tube 58**
- III. Neural Crest 59**
- IV. Placodes 61**
- V. Stages of Neural Tube Development 61**
- VI. Spinal Cord (Medulla Spinalis) 63**
- VII. Medulla oblongata (Myelencephalon) 64**
- VIII. Metencephalon 66**
- IX. Mesencephalon (Midbrain) 67**
- X. Development of the Diencephalon, Optic Structures, and Hypophysis 68**
- XI. Development of the Telencephalon 70**
- XII. Congenital Malformations of the Central Nervous System 71**

Review Test 77

5. NEUROHISTOLOGY 79

Objectives 79

- I. Overview 79**
- II. Neurons 79**
- III. Neuroglia 82**
- IV. Nerve Cell Degeneration and Regeneration 86**
- V. Axonal Transport 87**
- VI. Capillaries of the Central Nervous System 87**
- VII. Sensory Receptors 89**

Review Test 91

6. SPINAL CORD 93

Objectives 93

- I. Introduction 93**
- II. External Morphology 93**
- III. Internal Morphology 98**
- IV. Myotatic Reflex 101**

Review Test 102

7. TRACTS OF THE SPINAL CORD 104

Objectives 104

- I. Ascending Tracts 104**
- II. Descending Tracts 109**
- III. Integrative Pathways 111**
- IV. Clinical Correlations 112**

Review Test 114

8. LESIONS OF THE SPINAL CORD **117**

Objectives 117

- I. Lower Motor Neuron Lesions 117**
- II. Upper Motor Neuron Lesions (UMNs) 119**
- III. Sensory Pathway Lesions 119**
- IV. Peripheral Nervous System Lesions 120**
- V. Combined Upper and Lower Motor Neuron Lesions 120**
- VI. Combined Motor and Sensory Lesions 121**
- VII. Intervertebral Disk Herniation 124**

Review Test 125

9. BRAINSTEM **129**

Objectives 129

- I. Introduction 129**
- II. Medulla Oblongata (Myelencephalon) 129**
- III. Pons 134**
- IV. Mesencephalon (Midbrain) 138**
- V. Corticobulbar (Corticonuclear) Fibers 142**

Review Test 143

10. CRANIAL NERVES **145**

Objectives 145

- I. Introduction 145**
- II. Nervus Terminalis (NT; Cranial Nerve 0) 145**
- III. Olfactory Nerve (CN I) 145**
- IV. Optic Nerve (CN II) 146**
- V. Oculomotor Nerve (CN III) 148**
- VI. Trochlear Nerve (CN IV) 149**
- VII. Trigeminal Nerve (CN V) 150**
- VIII. Abducent Nerve (CN VI) 151**
- IX. Facial Nerve (CN VII) 151**
- X. Vestibulocochlear Nerve (CN VIII) 154**
- XI. Glossopharyngeal Nerve (CN IX) 154**
- XII. Vagus Nerve (CN X) 155**
- XIII. Accessory Nerve (CN XI) 156**
- XIV. Hypoglossal Nerve (CN XII) 157**

Review Test 159

11. TRIGEMINAL SYSTEM **162**

Objectives 162

- I. Trigeminal Nerve (CN V) 162**
- II. Ascending Trigeminothalamic Tracts 163**

- III. Trigeminal Sensory Nuclei 165
- IV. Trigemino cerebellar Fibers 166
- V. Trigeminal Reflexes 167
- VI. Clinical Correlations 168

Review Test 170

12. LESIONS OF THE BRAINSTEM

172

Objectives 172

- I. Introduction 172
- II. Vascular Lesions of the Medulla 172
- III. Vascular Lesions of the Pons 173
- IV. Lesions of the Midbrain 175
- V. Acoustic Neuroma (Schwannoma) 176
- VI. Internuclear Ophthalmoplegia 177
- VII. Jugular Foramen (Vernet) Syndrome 177
- VIII. Subclavian Steal Syndrome 178

Review Test 179

13. DIENCEPHALON: THALAMUS AND HYPOTHALAMUS

183

Objectives 183

- I. Introduction: The Thalamus 183
- II. Boundaries of the Thalamus 183
- III. Primary Thalamic Nuclei and their Major Connections 184
- IV. Blood Supply of the Thalamus 187
- V. Internal Capsule 187
- VI. Blood Supply of the Internal Capsule 188
- VII. Clinical Correlations 188
- VIII. Overview: The Hypothalamus 189
- IX. Surface Anatomy of the Hypothalamus 189
- X. Hypothalamic Regions and Nuclei 189
- XI. Major Hypothalamic Connections 192
- XII. Major Fiber Systems 194
- XIII. Functional Considerations 195
- XIV. Clinical Correlations 196

Review Test 197

14. AUDITORY SYSTEM

202

Objectives 202

- I. Introduction 202
- II. Outer, Middle, and Inner Ear 202
- III. Auditory Pathway 204
- IV. Efferent Cochlear (Olivocochlear) Bundle 206
- V. Hearing Defects 206

- VI. Tuning Fork Tests 207
- VII. Brainstem Auditory Evoked Response (Baer) 207
- Review Test 209

15. VESTIBULAR SYSTEM

211

Objectives 211

- I. Introduction 211
- II. Labyrinth 211
- III. Vestibular Pathways 213
- IV. Efferent Vestibular Connections 214
- V. Medial Longitudinal Fasciculus 214
- VI. Vestibulo-Ocular Reflexes 215
- VII. Decerebrate and Decorticate Rigidity 216
- VIII. Clinical Correlations 216

Review Test 218

16. VISUAL SYSTEM

220

Objectives 220

- I. Introduction 220
- II. The Retina 220
- III. Visual Pathway 224
- IV. Pupillary Light Reflexes and Pathway 225
- V. Pupillary Dilation Pathway 227
- VI. The Convergence-Accommodation Reaction 227
- VII. Centers for Ocular Motility 228
- VIII. Clinical Correlations 229

Review Test 232

17. OLFACTORY, GUSTATORY, AND LIMBIC SYSTEMS

236

Objectives 236

- I. Olfactory System 236
- II. Gustatory System 237
- III. Limbic System 239

Review Test 245

18. BASAL NUCLEI AND THE EXTRAPYRAMIDAL MOTOR SYSTEM

249

Objectives 249

- I. Basal Nuclei 249
- II. Extrapyrarnidal Motor System 249

Review Test 256

19. CEREBELLUM **258**

Objectives 258

- I. Overview 258
- II. Major Divisions of the Cerebellum 258
- III. Cerebellar Cortex 260
- IV. Major Cerebellar Pathways 262
- V. Cerebellar Dysfunction 264
- VI. Cerebellar Lesions 264

Review Test 266

20. AUTONOMOUS NERVOUS SYSTEM **268**

Objectives 268

- I. Overview 268
- II. Divisions of the Autonomic Nervous System 268
- III. Visceral Afferent Fibers and Pain 272
- IV. Autonomic Innervation of Selected Organs 273
- V. Clinical Correlations 275

Review Test 276

21. NEUROTRANSMITTERS AND PATHWAYS **278**

Objectives 278

- I. Introduction 278
- II. Acetylcholine 279
- III. Dopamine 280
- IV. Norepinephrine (Noradrenalin) 281
- V. Serotonin (5-Hydroxytryptamine [5-HT]) 282
- VI. Opioid Peptides 283
- VII. Nonopioid Neuropeptides 284
- VIII. Amino Acids 284
- IX. Nitric Oxide 287
- X. Functional and Clinical Correlations 287

Review Test 289

22. CEREBRAL CORTEX **293**

Objectives 293

- I. Overview 293
- II. Neocortex 293
- III. Functional Areas of the Cerebral Cortex 294
- IV. Cerebral Dominance 299
- V. Split-Brain Syndrome 301
- VI. Blood Supply to the Major Functional Cortical Areas 302

VII. Apraxia 303

VIII. Aphasia 304

IX. Dysprosodies 305

Review Test 306

Comprehensive Examination 311

Appendix: Table of Cranial Nerves 339

Glossary 342

Index 353