

Contents

Task Force on Neonatal Encephalopathy vii

Task Force Consultants ix

Endorsements xv

Preface xvii

Executive Summary xxi

Chapter 1: Background 1

- Neonatal Encephalopathy and Cerebral Palsy 1
- Historical Understanding of Neonatal Encephalopathy and Relation With Cerebral Palsy 2
- Neonatal Encephalopathy Epidemiology 6
- Long-Term Neurologic Outcome 12
- Neonatal Encephalopathy in Cerebral Palsy 15
- Research Recommendations 17

Chapter 2: Fetal Physiology and Cell Biology 21

- Fetal Cardiovascular and Metabolic Defenses Against Hypoxia 21
- Primary Hypoxic–Ischemic Insult 24
- Induced Hypothermic Neuronal Rescue 28
- Research Recommendations 30

Chapter 3: Maternal Conditions 37

- Maternal Bleeding in Pregnancy 37
- Maternal Trauma During Pregnancy 38
- Coagulation Abnormalities and Autoimmune Disorders 39
- Maternal Infection 40
- Maternal Thyroid Disorder 41
- Maternal Epilepsy 42
- Environmental Factors and Alcohol and Drug Exposure 44
- Infertility Treatment 47
- Other Risk Factors 48
- Research Recommendations 48

Chapter 4: The Role of Placental Pathology in Neonatal Encephalopathy and Cerebral Palsy 55

- Placental Histology and Neonatal Neurologic Outcome 55
- Fetal Vascular Thrombosis 57
- Inflammation and Infection 58
- Umbilical Cord Abnormalities 60
- Guidelines for Examination of the Placenta 64
- Research Recommendations 65

Chapter 5: Fetal Considerations and Assessment 71

- Defining the Fetus at Risk of Neonatal Encephalopathy and Cerebral Palsy 71
- Antepartum Fetal Surveillance and Neonatal Encephalopathy 72
- Fetal Growth Restriction and Neonatal Neurologic Injury 72
- Doppler Assessment in Fetal Growth Restriction 74
- Neurologic Outcome in Multifetal Pregnancy 75
- Postterm Birth, Postmaturity, and Cerebral Palsy 80
- Fetomaternal Hemorrhage 80
- Research Recommendations 81

Chapter 6: Intrapartum Considerations and Assessment 87

- Fetal Heart Rate Monitoring 87
- Association of Electronic Fetal Monitoring Patterns With Acidemia 89
- Iatrogenic Heat in Labor 92
- Chorioamnionitis and Intrapartum Fever 92
- Acid-Base Parameters of Umbilical Cord Blood 94
- Neonatal Neurologic Outcome Following Acute Intrapartum Events:
 - The Effect of Time From Diagnosis to Delivery 98
- Operative Vaginal Delivery 102
- Cesarean Delivery 104
- Intrauterine Resuscitation 105
- Meconium and Cerebral Palsy 106
- Research Recommendations 107

Chapter 7: Neonatal Assessment 115

- Apgar Scores 116
- Physical Examination 118
- Blood Gases 118
- Organ Dysfunction 118
- Hypoglycemia 119
- Electroencephalography 120
- Biomarkers of Neonatal Brain Injury in Hypoxic-Ischemic Encephalopathy 120
- Research Recommendations 121

Chapter 8: Focal Ischemic Stroke 125

- Diagnosis 126
- Risk Factors, Pathophysiology, and Evaluation 127
- Acute Treatment 130
- Long-Term Outcomes and Management 131
- Research Recommendations 131

Chapter 9: Role of Genetics 139

- Neuronal Reaction to Exogenous Insult: Genetic Aspects 139
- Genetic Conditions Mimicking Neonatal Encephalopathy 140
- Research Recommendations 145

Chapter 10: Role of Neuroimaging 149

- Patterns of Brain Injury in the Encephalopathic Term Infant 149
- Major Neuroimaging Modalities 155
- Patterns of Neuroimaging Abnormalities Found in Neonatal Encephalopathy in the Newborn Infant 159
- Neurodevelopmental Correlates of Neuroimaging Patterns 166
- Research Recommendations 167

Chapter 11: Neonatal Interventions 173

- Effect of Neonatal Resuscitation on Outcomes 173
- Common Diagnostic Issues in the Delivery Room and Neonatal Intensive Care Unit 174
- Assisted Ventilation for Infants With Neonatal Encephalopathy 177
- Cooling for Neuroprotection 179
- Adjuvant Therapies for Treatment of Encephalopathy 187
- Research Recommendations 189

Chapter 12: Patient Safety Efforts and Neonatal Encephalopathy 195

- Definitions 196
- Culture of Safety 197
- Identifying Medical Errors 197
- Root Cause Analysis as a Tool for Learning and Prevention 197
- Disclosure of Errors 198
- Communication 200
- Team Training 200
- Simulation 201
- Fatigue 202
- Research Recommendations 202

Chapter 13: An Acute Hypoxic–Ischemic Event and Neonatal Encephalopathy 205

- Updated Perspective on Neonatal Encephalopathy and Intrapartum Hypoxia 205
- The Utility of Identifying an Acute Intrapartum Hypoxic–Ischemic Event as a Contributory Factor to Neonatal Encephalopathy 207
- Assessment of an Acute Peripartum or Intrapartum Event Sufficient to Cause Neonatal Encephalopathy 208
- Neuroimaging Advances Over the Past Decade 211
- Other Advances 211
- Patient Safety 212
- Conclusions 212

Appendixes

- A. Data Collection Guideline for Infants Delivered at 35 Weeks of Gestation or More With Risk of Neonatal Encephalopathy 213
- B. Data Collection Guideline for Neonatologists and Pediatricians Who Manage Infants With Neonatal Encephalopathy 217

Glossary 223**Index 225****Color Plate 235**