

Contents

Introduction 1

Part I Development of the Fetal Brain

1 Techniques 5

T1-Weighted Sequences 5

T2-Weighted Sequences 7

Gradient-Echo T2-Weighted Sequences 9

Diffusion Tensor Imaging 9

Gadolinium Injection 9

Conclusion 9

2 Materials 11

3 Methodology 13

Examination Protocol 13

Reference Slices 13

neuropathology: MRI Correlation of the Ten Reference Slices 14

Biometric Study 25

Study of Gyration 32

Study of Myelination 33

4 Results 35

Chronological Presentation of the Results

by Week of Gestation:

From 22–23 Weeks of Gestation 35

From 27–34 Weeks of Gestation 35

Chronological Presentation of the Results by Slice 65

Detailed Results of Biometry for Each Parameter Studied 86

Detailed Results of Gyration for Each Sulcus Observed 107

Detailed Results for Myelination in Each Area 113

5 Comments on the Results 115

Biometry 115

Gyration 117

Myelination 119

6 Appendix 121

Pituitary Gland 121

Optic Chiasm 121

Brain Stem 122

Orbital Face of the Frontal Lobes 123

Cerebral Mantle 124

7 References 125

Part II Imaging the Pathological Fetal Brain

8 Pathology of the Midline 131

Corpus Callosum Dysgenesis 131

Corpus Callosum Agenesis 131

Embryology Overview 131

Signs of CCA in Ultrasonography 131

Contribution of MRI to the Antenatal Diagnosis of CCA 132

Prognosis 139

Thick Corpus Callosum:

Corpus Callosum Lipoma 140

Thick Corpus Callosum 140

Corpus Callosum Lipoma 140

Holoprosencephaly and Absence of Septum Pellucidum 140

Holoprosencephaly 140

Embryology Overview and Classification 140

Signs in Ultrasonography 141

Contribution of Fetal MRI to the Antenatal Diagnosis of Holoprosencephaly 142

Prognosis 144

| | | | |
|---|-----|---|-----|
| Absence of Septum Pellucidum | 144 | Type II Lissencephaly | 167 |
| Embryology Overview | 146 | Definition, Mechanism and Prognosis | 167 |
| Signs in Ultrasonography | 146 | Signs in Ultrasonography | 167 |
| Contribution of Fetal MRI | | Contribution of Fetal MRI | 169 |
| to the Diagnoses of Septal Agenesis | | Polymicrogyria Without Laminar Necrosis | 169 |
| and Septo-optic Dysplasia | 146 | Clastic and Other Causes | 170 |
| Prognosis | 148 | Polymicrogyria with Laminar Necrosis | 170 |
| References | 148 | Definition, Mechanism and Prognosis | 170 |
| | | Antenatal Imaging | 171 |
| 9 Abnormalities of Proliferation, | | Schizencephaly | 171 |
| Neuronal Migration | | Definition and Mechanism | 171 |
| and Cortical Organization | 151 | Signs in Ultrasonography | 171 |
| | | Contribution of Fetal MRI | 171 |
| Embryology Overview and Classification | 151 | Prognosis | 172 |
| Brain Volume Abnormalities | 152 | Tuberous Sclerosis Complex | 172 |
| Microcephaly | 152 | Definition, Mechanism and Prognosis | 172 |
| Microcephaly with Simplified Gyral Pattern | 155 | Signs in Ultrasonography | 172 |
| Definition, Mechanism and Prognosis | 155 | Contribution of Fetal MRI | 172 |
| Signs in Ultrasonography | 157 | References | 173 |
| Contribution of Fetal MRI | 157 | | |
| Macrocephaly | 157 | 10 Intracranial Space-Occupying Lesions | 177 |
| Symmetrical | 157 | | |
| Asymmetrical: Hemimegalencephaly | 159 | Intracerebral Tissue Space-Occupying Lesions | 177 |
| Definition, Mechanism and Prognosis | 159 | Ultrasonographic Patterns | |
| Signs in Ultrasonography | 159 | of Cerebral Tumours | 177 |
| Contribution of Fetal MRI | 160 | Contribution of Fetal MRI to the | |
| Abnormalities of Gyration | 160 | Diagnosis of Cerebral Tumours | 180 |
| Migratory Causes | 160 | Prognosis | 180 |
| Nodular Heterotopias: | | Cystic Intracranial Space-Occupying Lesions | 180 |
| Subependymal Heterotopias | 160 | Arachnoid Cysts | 180 |
| Definition, Mechanism and Prognosis | 160 | Description | 181 |
| Signs in Ultrasonography | 161 | Location and Sex | 181 |
| Contribution of Fetal MRI | 162 | Stage of Discovery | 181 |
| Prognosis | 163 | Ultrasonographic Diagnosis | 181 |
| Subcortical Heterotopias | 163 | Contribution of Fetal MRI | 182 |
| Definition, Mechanism and Prognosis | 163 | Progression and Prognosis | |
| Antenatal Imaging | 163 | of Arachnoid Cysts | 186 |
| Prognosis | 163 | Arteriovenous Malformations | 188 |
| Intracortical Heterotopias | 163 | Vein of Galen Aneurysmal Malformation | 188 |
| Molecular and/or Meningeal Heterotopias | 164 | Anatomical Substratum | 188 |
| Subcortical Band Heterotopia: | | Ultrasonographic Diagnosis | 188 |
| Double Cortex Syndrome | 164 | Contribution of Fetal MRI | 189 |
| Definition and Mechanism | 164 | Progression of VGAM and Prognosis | 192 |
| Antenatal Imaging | 164 | Meningocoeles and Encephalocoeles | 192 |
| Prognosis | 164 | Definition, Description of the | |
| Type I Lissencephaly | 165 | Malformation and Epidemiology | 192 |
| Definition and Mechanism | 165 | Ultrasonographic Diagnosis | 195 |
| Signs in Ultrasonography | 167 | Contribution of Fetal MRI | 196 |
| Contribution of Fetal MRI | 167 | Natural History and Prognosis | 196 |
| Prognosis | 167 | References | 198 |

| | |
|--|-----|
| Ventricular Dilatation | 201 |
| Definition of Ventricular Dilatation | 201 |
| Etiological Diagnosis of Ventricular Dilatation: Limits of Ultrasonography and Contribution of MRI | 202 |
| Which Ventricles Are Affected by Dilatation? Is This Dilatation Unilateral or Bilateral? | 202 |
| What Do the Ventricular Walls Look Like? | 203 |
| Contents of the Ventricles. How Do the Choroid Plexuses Look? | 203 |
| Are the Corpus Callosum and Leaves of the Septum Pellucidum Present? | 203 |
| How Does the Cerebral Parenchyma Look? Study of the Germinal Zone, the Signal of the Cerebral Parenchyma and Gyration | 203 |
| How Is the Posterior Fossa? | 206 |
| What Are the Biparietal Diameter, Head Circumference and Width of the Pericerebral Space? | 206 |
| Are There any Extracerebral Abnormalities? | 207 |
| Natural History of Ventricular Dilatation, Effect on the Cerebral Parenchyma and Prognosis | 210 |
| References | 215 |

12 Abnormalities of the Posterior Cerebral Fossa 217

| | |
|---|-----|
| Congenital Cystic Abnormalities of the Posterior Fossa | 217 |
| Anatomical and Embryological Data | 217 |
| Ultrasonographic Analysis of the Posterior Cerebral Fossa | 218 |
| MRI Analysis of the Posterior Cerebral Fossa | 220 |
| Classification of Congenital Cystic Abnormalities of the Posterior Fossa | 221 |
| Dandy-Walker Malformation | 221 |
| Cerebellar Ageneses and Hypoplasias | 223 |
| Vermian Ageneses | 223 |
| Cerebellar Hypoplasia | 225 |
| Mega Cisterna Magna, Blake's Pouch Cyst, Retrocerebellar Arachnoid Cysts | 229 |
| Diagnostic Difficulties | 230 |
| Conclusion | 231 |
| Rhombencephalosynapsis | 231 |
| Capillary Telangiectasia of the Rhombencephalon | 233 |
| References | 235 |

13 Antenatal Cerebral Pathologies of Infectious Origin 237

| | |
|--|-----|
| Cytomegalovirus Infection | 237 |
| Other Infectious Agents | 241 |
| Varicella | 241 |
| Toxoplasmosis | 242 |
| Rubella | 242 |
| References | 244 |

14 Abnormalities of the Fetal Cerebral Parenchyma: Ischaemic and Haemorrhagic Lesions 247

| | |
|---------------------------------------|-----|
| General Information | 247 |
| Haemorrhagic Lesions | 248 |
| Signs in Ultrasonography | 248 |
| Contribution of MRI | 251 |
| Ischaemic Lesions | 253 |
| Signs in Ultrasonography | 253 |
| Contribution of MRI | 256 |
| Prognosis | 261 |
| References | 261 |

Subject Index 263