

# Contents

|                     |      |
|---------------------|------|
| Videos .....        | x    |
| Preface .....       | xi   |
| Acknowledgment..... | xii  |
| Contributors .....  | xiii |

## Part A: Introduction

|     |                                                                                       |   |
|-----|---------------------------------------------------------------------------------------|---|
| 1   | The Scope of This Book.....                                                           | 3 |
| 2   | The Challenge to Treat Infiltrating Brain Tumors.....                                 | 4 |
| 3   | The Impact of Lesionectomy on the Prognosis of Infiltrating Intracerebral Tumors..... | 5 |
| 3.1 | Evidence for Surgical Resection of Malignant Intracerebral Tumors .....               | 5 |
| 3.2 | Low-Grade Gliomas .....                                                               | 5 |
| 3.3 | High-Grade Gliomas .....                                                              | 5 |
| 3.4 | Cerebral Metastases.....                                                              | 6 |
|     | References.....                                                                       | 6 |
| 4   | The Philosophy Behind Supramarginal Resection: Functionality Becomes the Limit .....  | 9 |

## Part B: The Theoretical Part

|       |                                                      |    |
|-------|------------------------------------------------------|----|
| 5     | The Relevant Anatomy of the Functional Systems ..... | 13 |
| 5.1   | The Scope of This Chapter .....                      | 13 |
| 5.2   | Cortical Anatomy .....                               | 13 |
| 5.2.1 | Lobes .....                                          | 14 |
| 5.3   | Motor System .....                                   | 15 |
| 5.4   | The Somatosensory System.....                        | 15 |
| 5.5   | Focus: Functional Aspects of Language.....           | 16 |
| 5.5.1 | Structural and Functional Anatomy .....              | 18 |
| 5.5.2 | Sensory Input and Projection Pathways.....           | 21 |
| 5.5.3 | Dorsal Stream .....                                  | 22 |
| 5.5.4 | Ventral Stream .....                                 | 23 |
| 5.5.5 | Dorsoventral Integration .....                       | 24 |
| 5.5.6 | Language Planning and Output.....                    | 25 |
|       | References.....                                      | 26 |

|            |                                                                                                 |           |
|------------|-------------------------------------------------------------------------------------------------|-----------|
| <b>6</b>   | <b>What You Need to Know About Electricity</b>                                                  | <b>28</b> |
| <b>6.1</b> | <b>The Scope of This Chapter</b>                                                                | <b>28</b> |
| <b>6.2</b> | <b>Basics of Electricity—Some Useful Definitions</b>                                            | <b>28</b> |
| 6.2.1      | Voltage (V), Potential (P), Current (I), Resistance ( $\Omega$ ), Power (W), and Frequency (Hz) | 28        |
| 6.2.2      | How to Measure Electricity                                                                      | 29        |
| <b>6.3</b> | <b>The Electric Fields</b>                                                                      | <b>29</b> |
| <b>6.4</b> | <b>The Electricity of the Nervous System</b>                                                    | <b>29</b> |
| 6.4.1      | The Action Potential                                                                            | 29        |
| 6.4.2      | Postsynaptic Potentials                                                                         | 32        |
| 6.4.3      | Induction of Muscle Action                                                                      | 34        |
| 6.4.4      | Compound Muscle Activity                                                                        | 35        |
| <b>6.5</b> | <b>Detect the Electricity of the Nervous System</b>                                             | <b>35</b> |
| 6.5.1      | The Dipole                                                                                      | 36        |
| 6.5.2      | The Electrical Field of a Dipole                                                                | 36        |
| 6.5.3      | Volume Conduction: Detecting Dipoles                                                            | 38        |
| 6.5.4      | Solid Angles                                                                                    | 38        |
| <b>7</b>   | <b>Transcranial Monitoring—Methods to Monitor CNS Functions: Principles</b>                     | <b>39</b> |
| <b>7.1</b> | <b>The Scope of This Chapter</b>                                                                | <b>39</b> |
| <b>7.2</b> | <b>EEG</b>                                                                                      | <b>39</b> |
| 7.2.1      | How EEG Works—Principles                                                                        | 39        |
| <b>7.3</b> | <b>SSEP</b>                                                                                     | <b>41</b> |
| 7.3.1      | Correlation Between SSEPs and Cerebral Perfusion                                                | 43        |
| 7.3.2      | How SSEP Works—Principles                                                                       | 43        |
| 7.3.3      | How SSEPs Work—Details                                                                          | 46        |
| 7.3.4      | Performed Practice                                                                              | 47        |
| <b>7.4</b> | <b>MEP</b>                                                                                      | <b>48</b> |
| 7.4.1      | How MEP Works—Principles                                                                        | 49        |
| 7.4.2      | How MEP Works—Details                                                                           | 50        |
| <b>7.5</b> | <b>Electromyography (EMG)</b>                                                                   | <b>51</b> |
| 7.5.1      | How EMG Works—Principles                                                                        | 51        |
| 7.5.2      | How EMG Works—Details                                                                           | 51        |
|            | References                                                                                      | 52        |
| <b>8</b>   | <b>Direct Cortical and Subcortical Mapping</b>                                                  | <b>53</b> |
| <b>8.1</b> | <b>The Scope of This Chapter</b>                                                                | <b>53</b> |
| <b>8.2</b> | <b>Direct Cortical and Subcortical Mapping: Principles</b>                                      | <b>53</b> |
| <b>8.3</b> | <b>High-frequency Stimulation/ Monopolar Stimulation: Principles</b>                            | <b>53</b> |
| <b>8.4</b> | <b>Low-Frequency/Bipolar Stimulation: Principles</b>                                            | <b>54</b> |
| <b>8.5</b> | <b>Direct Cortical and Subcortical Mapping: Details</b>                                         | <b>55</b> |
| <b>8.6</b> | <b>High-Frequency Stimulation: Details</b>                                                      | <b>55</b> |
| <b>8.7</b> | <b>High-Frequency Monitoring with a Grid Electrode</b>                                          | <b>57</b> |
| <b>8.8</b> | <b>Low-Frequency Stimulation—Details</b>                                                        | <b>57</b> |
| <b>8.9</b> | <b>Focus: How to Test Language Intraoperatively</b>                                             | <b>58</b> |
| 8.9.1      | Temporo-Parieto-Occipital Junction                                                              | 59        |

|                                   |                                                                      |    |                                          |           |
|-----------------------------------|----------------------------------------------------------------------|----|------------------------------------------|-----------|
| 8.9.2                             | Temporo-Occipital, Temporo-Basal, and Occipital Resections .....     | 60 | References .....                         | 63        |
| 8.9.3                             | Visual and Acoustic Pathways Mapping .....                           | 61 |                                          |           |
| <b>9</b>                          | <b>Checklist for Awake Procedure .....</b>                           |    |                                          | <b>64</b> |
| <b>Part C: The Practical Part</b> |                                                                      |    |                                          |           |
| <b>10</b>                         | <b>Introduction to the Practical Part.....</b>                       |    |                                          | <b>69</b> |
| <b>11</b>                         | <b>Finding the Indication for Surgery .....</b>                      |    |                                          | <b>70</b> |
| 11.1                              | Decision-Making in Neurooncological Neurosurgery.....                | 70 | 11.2.1 Analyze the Lesion .....          | 70        |
|                                   |                                                                      |    | 11.2.2 Run Through Your IONM Options ... | 70        |
|                                   |                                                                      |    | 11.2.3 Risk Assessment .....             | 70        |
| 11.2                              | A Systematical Approach to Evaluate the Indication for Surgery ..... | 70 |                                          |           |
| <b>12</b>                         | <b>Setting up the Monitoring .....</b>                               |    |                                          | <b>75</b> |
| 12.1                              | Setup of SSEPs.....                                                  | 75 | 12.2 Setup of MEPs.....                  | 75        |
| <b>13</b>                         | <b>The Surgery .....</b>                                             |    |                                          | <b>76</b> |
| 13.1                              | Case Summary .....                                                   | 76 | 13.3 The Surgery.....                    | 76        |
| 13.2                              | Planning the Case.....                                               | 76 |                                          |           |
| <b>14</b>                         | <b>Summary: Key Features from the Video .....</b>                    |    |                                          | <b>81</b> |
| 14.1                              | Getting the Threshold .....                                          | 81 | 14.3 Subcortical Bipolar .....           | 81        |
| 14.1.1                            | Monopolar .....                                                      | 81 | 14.4 Subpial Resection .....             | 81        |
| 14.1.2                            | Bipolar.....                                                         | 81 | 14.5 Anomia .....                        | 81        |
| 14.2                              | Subcortical Monopolar.....                                           | 81 |                                          |           |
| <b>15</b>                         | <b>Epilogue.....</b>                                                 |    |                                          | <b>83</b> |
|                                   | List of Abbreviations .....                                          | 84 |                                          |           |
|                                   | Index .....                                                          |    |                                          | <b>85</b> |