

## CONTENTS

|   |   |           |
|---|---|-----------|
| <b>1</b>  | <b>Integrative laser medicine and high-tech acupuncture<sup>®</sup> at the Medical University of Graz, Austria, Europe</b>  | <b>1</b>  |
| 1.1   | Introduction  | 1         |
| 1.2   | Modern high-tech acupuncture stimulation methods  | 3         |
| 1.2.1   | Laser acupuncture (405 nm)  | 3         |
| 1.2.2   | Laser acupuncture (685 nm, 785 nm)  | 6         |
| 1.2.3   | Electroacupuncture  | 7         |
| 1.3   | Modern high-tech acupuncture recording methods  | 9         |
| 1.3.1   | Peripheral effects  | 9         |
| Thermography  |   | 9         |
| Laser Doppler flowmetry   |   | 11        |
| Laser Doppler imaging (LDI)                                       |   | 12        |
| Electrical skin resistance  |   | 14        |
| 1.3.2   | Cerebral effects  | 15        |
| Multidirectional transcranial ultrasound Doppler sonography (TCD) |   | 15        |
| Cerebral near infrared spectroscopy (NIRS)                        |   | 20        |
| Functional magnetic resonance imaging (fMRI)                      |   | 21        |
| Bioelectrical methods   |   | 22        |
| 1.3.3   | Autonomic nervous system effects  | 26        |
| Heart rate variability (HRV)                                      |   | 26        |
| Blood pressure, pulse wave velocity and augmentation index        |   | 31        |
| 1.4   | Concluding remarks  | 33        |
| 1.5   | Acknowledgments   | 34        |
| 1.6   | References  | 35        |
| <b>2</b>  | <b>Sino-European transcontinental basic and clinical high-tech acupuncture studies, part 1: Auricular acupuncture increases heart rate variability in anesthetized rats</b> | <b>42</b> |
| 2.1   | Introduction  | 42        |
| 2.2   | Materials and Methods   | 42        |
| 2.2.1   | Animals   | 42        |
| 2.2.2   | Electrocardiographic monitoring   | 43        |
| 2.2.3   | Acupuncture stimulation and procedure   | 44        |
| 2.2.4   | Statistical analysis  | 45        |
| 2.3   | Results   | 45        |
| 2.4   | Discussion  | 48        |
| 2.5   | Conclusions   | 51        |
| 2.6   | Acknowledgments   | 52        |
| 2.7   | References  | 52        |

|  |           |
|--|-----------|
| <b>3 Sino-European transcontinental basic and clinical high-tech acupuncture studies, part 2: Acute stimulation effects on heart rate and its variability in patients with insomnia</b>    | <b>55</b> |
| 3.1 Introduction   | 55        |
| 3.2 Materials and Methods  | 55        |
| 3.2.1 Patients   | 55        |
| 3.2.2 Electrocardiographic monitoring  | 56        |
| 3.2.3 Acupuncture stimulation and procedure  | 56        |
| 3.2.4 Statistical analysis   | 58        |
| 3.3 Results  | 58        |
| 3.4 Discussion   | 62        |
| 3.5 Conclusions  | 63        |
| 3.6 Acknowledgments  | 64        |
| 3.7 References   | 64        |
| <b>4 Sino-European transcontinental basic and clinical high-tech acupuncture studies, part 3: Violet laser stimulation in anesthetized rats</b>  | <b>67</b> |
| 4.1 Introduction   | 67        |
| 4.2 Animals and Methods  | 67        |
| 4.2.1 Sprague-Dawley rats and blood pressure monitoring  | 67        |
| 4.2.2 Electrocardiographic monitoring in rats  | 68        |
| 4.2.3 Violet laser stimulation and procedure   | 68        |
| 4.2.4 Statistical analysis   | 70        |
| 4.3 Results  | 70        |
| 4.4 Discussion   | 77        |
| 4.5 Conclusion   | 78        |
| 4.6 Acknowledgments  | 79        |
| 4.7 References   | 79        |
| <b>5 Sino-European transcontinental basic and clinical high-tech acupuncture studies, part 4: ‘Fire of Life’ analysis of heart rate variability during acupuncture in clinical studies</b> | <b>82</b> |
| 5.1 Introduction   | 82        |
| 5.2 Materials and Methods  | 83        |
| 5.2.1 HRV monitoring   | 83        |
| 5.2.2 HRV data analysis  | 83        |
| 5.2.3 Patients   | 84        |
| 5.2.4 Procedure  | 84        |
| 5.2.5 Acupuncture points   | 85        |
| 5.3 Results  | 85        |
| 5.3.1 Standard analysis  | 85        |
| 5.3.2 HRV-scatterplots   | 87        |
| 5.3.3 HRV – frequency domain (‘Fire of Life’ analysis)   | 89        |

|          |   |            |
|----------|---|------------|
| 5.4      | Discussion  | 90         |
| 5.5      | Conclusions   | 91         |
| 5.6      | Acknowledgments   | 91         |
| 5.7      | References  | 92         |
| <b>6</b> | <b>Laser-induced evoked potentials in the brain after non-perceptible optical stimulation at the Neiguan acupoint? A preliminary report</b>   | <b>95</b>  |
| 6.1      | Introduction  | 95         |
| 6.2      | Materials and Methods   | 95         |
| 6.2.1    | Subject   | 95         |
| 6.2.2    | Laser needle stimulation  | 96         |
| 6.2.3    | EEG data acquisition and analysis   | 98         |
| 6.2.4    | Control measurement   | 98         |
| 6.2.5    | Optical acupuncture and placebo stimulation   | 98         |
| 6.3      | Results   | 99         |
| 6.4      | Discussion  | 101        |
| 6.5      | Acknowledgments   | 102        |
| 6.6      | References  | 103        |
| <b>7</b> | <b>Technical parameters for laser acupuncture to elicit peripheral and central effects – State of the art and short guidelines based on results from the Medical University of Graz, the German Academy of Acupuncture, and the scientific literature</b> | <b>105</b> |
| 7.1      | Introduction  | 105        |
| 7.2      | Technical parameters for laser acupuncture  | 106        |
| 7.2.1    | Wavelength  | 106        |
| 7.2.2    | Output power  | 108        |
| 7.2.3    | Power density   | 108        |
| 7.2.4    | Energy density  | 108        |
| 7.2.5    | Dose range  | 108        |
| 7.2.6    | Continuous or pulsed laser  | 108        |
| 7.3      | Results   | 109        |
| 7.3.1    | Minimal dose  | 109        |
| 7.3.2    | Optimal dose  | 109        |
| 7.4      | Discussion  | 111        |
| 7.5      | Acknowledgments   | 113        |
| 7.6      | References  | 113        |
| <b>8</b> | <b>Biomedical teleacupuncture between China and Austria using heart rate variability, part 1: Poststroke patients</b>   | <b>115</b> |
| 8.1      | Introduction  | 115        |
| 8.2      | Subjects and Methods  | 115        |
| 8.2.1    | Patients  | 115        |

|           |  |            |
|-----------|--|------------|
| 8.2.2     | Biosignal recording and evaluation parameters  | 116        |
| 8.2.3     | Acupuncture and procedure  | 118        |
| 8.2.4     | Statistical analysis   | 118        |
| 8.3       | Results  | 118        |
| 8.4       | Discussion   | 121        |
| 8.5       | Acknowledgments  | 124        |
| 8.6       | References   | 124        |
| <b>9</b>  | <b>Biomedical teleacupuncture between China and Austria using heart rate variability, part 2: Patients with depression</b>                               | <b>127</b> |
| 9.1       | Introduction   | 127        |
| 9.2       | Subjects and Methods   | 127        |
| 9.2.1     | Patients   | 127        |
| 9.2.2     | Biosignal recording in Asia and data analysis in Europe  | 128        |
| 9.2.3     | Clinical acupuncture and procedure   | 128        |
| 9.2.4     | Statistical analysis   | 130        |
| 9.3       | Results  | 130        |
| 9.4       | Discussion   | 132        |
| 9.5       | Acknowledgments  | 134        |
| 9.6       | References   | 134        |
| <b>10</b> | <b>Auricular acupuncture may suppress epileptic seizures via activating the parasympathetic nervous system: A hypothesis based on innovative methods</b> | <b>137</b> |
| 10.1      | Introduction   | 137        |
| 10.2      | Auricular acupuncture can increase parasympathetic tone  | 137        |
| 10.3      | Epilepsy is associated with decreased parasympathetic tone   | 138        |
| 10.4      | Hypothesis   | 139        |
| 10.5      | The mechanism of auricular acupuncture for epilepsy  | 139        |
| 10.6      | Potential application of auricular acupuncture for other diseases  | 140        |
| 10.7      | Abbreviations  | 141        |
| 10.8      | Acknowledgments  | 141        |
| 10.9      | References   | 142        |
| <b>11</b> | <b>Brain-modulated effects of auricular acupressure on the regulation of autonomic function in healthy volunteers</b>                                    | <b>145</b> |
| 11.1      | Introduction   | 145        |
| 11.2      | Methods and Subjects   | 146        |
| 11.2.1    | A new system for ear acupressure (vibration stimulation)   | 146        |
| 11.2.2    | Recording systems and evaluation parameters  | 147        |
| 11.2.3    | Volunteers, acupuncture and procedure  | 148        |

|   |            |
|---|------------|
| 11.2.4 Statistical analysis   | 149        |
| 11.3 Results  | 149        |
| 11.4 Discussion   | 155        |
| 11.5 Conclusion   | 158        |
| 11.6 Acknowledgments  | 158        |
| 11.7 References   | 158        |
| <b>12 Thermographical measuring of the skin temperature using laser needle acupuncture in preterm neonates</b>              | <b>162</b> |
| 12.1 Introduction   | 162        |
| 12.2 Materials and Methods  | 163        |
| 12.2.1 Probands   | 163        |
| 12.2.2 Laser acupuncture  | 163        |
| 12.2.3 Thermography   | 164        |
| 12.2.4 Statistics   | 165        |
| 12.3 Results  | 165        |
| 12.4 Discussion   | 167        |
| 12.5 Conclusion   | 169        |
| 12.6 Acknowledgments  | 170        |
| 12.7 References   | 170        |
| <b>13 System identification algorithm analysis of acupuncture effect on mean blood flux of contra-lateral Hegu acupoint</b> | <b>173</b> |
| 13.1 Introduction   | 173        |
| 13.2 Methods  | 174        |
| 13.2.1 Ethics statement   | 174        |
| 13.2.2 Subjects   | 174        |
| 13.2.3 Procedures   | 175        |
| Protocol for mean blood flux measurement  | 175        |
| Acupuncture protocol  | 176        |
| Image analysis protocol   | 176        |
| System identification algorithm   | 177        |
| 13.3 Results  | 178        |
| 13.3.1 Mapping model  | 178        |
| 13.3.2 Error evaluation and signal-noise ratio  | 179        |
| 13.3.3 Standard signal input  | 179        |
| 13.3.4 Determination of characteristic vectors  | 180        |
| 13.4 Discussion   | 182        |
| 13.5 Acknowledgments  | 184        |
| 13.6 References   | 184        |
| <b>14 List of references</b>  | <b>188</b> |