

# Contents

## Historical Perspective

|   |   |
|---|---|
| <b>Digitised ICP over Three Decades</b> . . . . . | 1 |
| David J. Price                                    |   |

## Methods of Brain Monitoring and Data Analysis

|   |   |
|---|---|
| <b>Latency Relationships Between Cerebral Blood Flow Velocity and Intracranial Pressure</b> . . . . . | 5 |
| Shadnaz Asgari, Paul M. Vespa, Marvin Bergsneider, and Xiao Hu  |   |

|   |    |
|---|----|
| <b>The Linear Relationship Between Transcranial Doppler Pulsatility Indices and Intracranial Pressure Is Influenced by Traumatic Brain Injury and Vasospasm</b> . . . . . | 11 |
| Thomas C. Glenn, Arun K. Sherma, David L. McArthur, Xiao Hu, Christopher R. Hanuscin, Mehjabeen S. Furreedan, David A. Hovda, Paul M. Vespa, and Neil A. Martin           |    |

|   |    |
|---|----|
| <b>Time Constant of the Cerebral Arterial Bed</b> . . . . .   | 17 |
| Magdalena Kasprowicz, Jennifer Diedler, Matthias Reinhard, Emmanuel Carrera, Peter Smielewski, Karol P. Budohoski, Enrico Sorrentino, Christina Haubrich, Peter J. Kirkpatrick, John D. Pickard, and Marek Czosnyka |    |

|   |    |
|---|----|
| <b>Pulse Amplitude and Lempel–Ziv Complexity of the Cerebrospinal Fluid Pressure Signal</b> . . . . . | 23 |
| D. Santamarta, D. Abásolo, J. Fernández, and R. Hornero   |    |

|  |    |
|--|----|
| <b>Association Between ICP Pulse Waveform Morphology and ICP B Waves</b> . . . . . | 29 |
| Magdalena Kasprowicz, Marvin Bergsneider, Marek Czosnyka, and Xiao Hu              |    |

|  |    |
|--|----|
| <b>Computerized Data Analysis of Neuromonitoring Parameters Identifies Patients with Reduced Cerebral Compliance as Seen on CT</b> . . . . . | 35 |
| Rupert Faltermeier, Martin A. Proescholdt, and Alexander Brawanski   |    |

|   |    |
|---|----|
| <b>Early Warning of EUSIG-Defined Hypotensive Events Using a Bayesian Artificial Neural Network</b> . . . . .   | 39 |
| Rob Donald, Tim Howells, Ian Piper, I. Chambers, G. Citerio, P. Enblad, B. Gregson, K. Kiening, J. Mattern, P. Nilsson, A. Ragauskas, Juan Sahuquillo, R. Sinnott, and A. Stell |    |

|   |            |
|---|------------|
| <b>Trigger Characteristics of EUSIG-Defined Hypotensive Events . . . . .</b>  | <b>45</b>  |
| Rob Donald, Tim Howells, Ian Piper, I. Chambers, G. Citerio, P. Enblad,<br>B. Gregson, K. Kiening, J. Mattern, P. Nilsson, A. Ragauskas, Juan Sahuquillo,<br>R. Sinnott, and A. Stell |            |
| <b>Go Green! Reusing Brain Monitoring Data Containing Missing Values:<br/>A Feasibility Study with Traumatic Brain Injury Patients . . . . .</b>                                      | <b>51</b>  |
| Mengling Feng, Liang Yu Loy, Feng Zhang, Zhuo Zhang, Kuralmani Vellaisamy,<br>Pei Loon Chin, Cuntai Guan, Liang Shen, Nicolas K.K. King, Kah Keow Lee,<br>and Beng Ti Ang             |            |
| <b>Investigation of the Relationship Between Transcranial Impedance<br/>and Intracranial Pressure . . . . .</b>   | <b>61</b>  |
| Martin Shaw, I. Piper, P. Campbell, C. McKeown, J. Britton, K. Oommen,<br>L. Stewart, I. Whittle, R. Gregson, and E. Clutton  |            |
| <b>Bioinformatics Analysis of Mortality Associated with Elevated<br/>Intracranial Pressure in Children . . . . .</b>  | <b>67</b>  |
| Mark S. Wainwright and Remigiusz Lewandowski  |            |
| <b>ICM+: A Versatile Software for Assessment of CSF Dynamics . . . . .</b>  | <b>75</b>  |
| Peter Smielewski, Zofia Czosnyka, Magdalena Kaspruwicz, John D. Pickard,<br>and Marek Czosnyka  |            |
| <b>Modified Brainstem Auditory Evoked Responses in Patients<br/>with Non-brainstem Compressive Cerebral Lesions . . . . .</b>   | <b>81</b>  |
| James L. Stone, John Fino, Prasad Vannemreddy, and Fady Charbel   |            |
| <b>Analysis of Intracranial Pressure Time Series Using Wavelets<br/>(Haar Basis Functions) . . . . .</b>  | <b>87</b>  |
| Hans E. Heissler, Kathrin König, Joachim K. Krauss, and Eckhard Rickels   |            |
| <b>Stationarity in Neuromonitoring Data . . . . .</b>   | <b>93</b>  |
| Hans E. Heissler, Kathrin König, Joachim K. Krauss, and Eckhard Rickels   |            |
| <b>Methods of Invasive and Non-invasive ICP Assessment</b>  |            |
| <b>Is ICP Solid or Fluid? In Vitro Biomechanical<br/>Model Using a Fluid-Saturated Gel . . . . .</b>  | <b>97</b>  |
| M. Ros, P. Yameogo, P. Payoux, P. Swider, and Eric Schmidt  |            |
| <b>Implantable ICP Monitor for Improved Hydrocephalus Management . . . . .</b>  | <b>101</b> |
| Ellyce Stehlin, Simon Malpas, Peter Heppner, Patrick Hu, Matthew Lim,<br>and David Budgett  |            |
| <b>Intracranial Pressure Telemetry: First Experience of an Experimental<br/>In Vivo Study Using a New Device . . . . .</b>  | <b>105</b> |
| Berk Orakcioglu, Christopher Beynon, Modar M. Kentar, Regina Eymann,<br>Michael Kiefer, and Oliver W. Sakowitz  |            |

|  |            |
|--|------------|
| <b>Telemetric ICP Measurement with the First CE-Approved Device:<br/>Data from Animal Experiments and Initial Clinical Experiences. . . . .</b>                      | <b>111</b> |
| Michael Kiefer, Sebastian Antes, Steffen Leonhardt, Melanie Schmitt,<br>Berk Orakcioglu, Oliver W. Sakowitz, and Regina Eymann                                       |            |
| <b>The New ICP Minimally Invasive Method Shows That the Monro–Kellie<br/>Doctrine Is Not Valid . . . . .</b>   | <b>117</b> |
| Sérgio Mascarenhas, G.H.F. Vilela, C. Carlotti, L.E.G. Damiano, W. Seluque,<br>B. Colli, K. Tanaka, C.C. Wang, and K.O. Nonaka                                       |            |
| <b>Non-Invasively Estimated ICP Pulse Amplitude Strongly Correlates<br/>with Outcome After TBI . . . . .</b>   | <b>121</b> |
| Karol P. Budohoski, Bernhard Schmidt, Peter Smielewski, Magdalena Kasprówska,<br>Ronny Plontke, John D. Pickard, Jürgen Klingelhöfer,<br>and Marek Czosnyka          |            |
| <b>Realization of a Comprehensive Non-invasive Detection of Intracranial<br/>Pressure Analyzer Based upon FVEP and TCD. . . . .</b>                                  | <b>127</b> |
| J.I. Zhong, Yang Li, Xu Minhui, and Zhang Yihua  |            |
| <b>Electrophysiological Monitoring of Cochlear Function as a Non-invasive<br/>Method to Assess Intracranial Pressure Variations . . . . .</b>                        | <b>131</b> |
| Laurent Sakka, Aurélie Thalamy, Fabrice Giraudet, Thierry Hassoun,<br>Paul Avan, and Jean Chazal   |            |
| <b>The Role of Autoregulation</b>  |            |
| <b>Autoregulatory Model Comparison and Optimisation Methodology . . . . .</b>  | <b>135</b> |
| Martin Shaw, Ian Piper, and Michael Daley  |            |
| <b>Assessment of Cerebral Autoregulation from Respiratory Oscillations<br/>in Ventilated Patients After Traumatic Brain Injury . . . . .</b>                         | <b>141</b> |
| Philip M. Lewis, Peter Smielewski, Jeffrey V. Rosenfeld, John D. Pickard,<br>and Marek Czosnyka  |            |
| <b>Monitoring of the Association Between Cerebral Blood Flow Velocity<br/>and Intracranial Pressure . . . . .</b>  | <b>147</b> |
| Philip M. Lewis, Peter Smielewski, Jeffrey V. Rosenfeld, John D. Pickard,<br>and Marek Czosnyka  |            |
| <b>How Does Moderate Hypocapnia Affect Cerebral Autoregulation<br/>in Response to Changes in Perfusion Pressure in TBI Patients? . . . . .</b>                       | <b>153</b> |
| Christina Haubrich, Luzius Steiner, D.J. Kim, Magdalena Kasprówska,<br>Piotr Smielewski, Rolf R. Diehl, John D. Pickard, and Marek Czosnyka                          |            |
| <b>Correlation of Clinical Outcome and Angiographic Vasospasm<br/>with the Dynamic Autoregulatory Response After Aneurysmal<br/>Subarachnoid Hemorrhage. . . . .</b> | <b>157</b> |
| Martin Barth, Julius Moratin, Martin Dostal, Armin Kalenka, Johann Scharf,<br>and Kirsten Schmieder  |            |

## **The Role of Tissue Oxygenation and Near-Infrared Spectroscopy**

|  |            |
|--|------------|
| <b>Comparison of a New Brain Tissue Oxygenation Probe with the Established Standard . . . . .</b>  | <b>161</b> |
| Stefan Wolf, P. Horn, C. Frenzel, L. Schürer, P. Vajkoczy, and J. Dengler  |            |
| <b>Comparing Brain Tissue Oxygen Measurements and Derived Autoregulation Parameters from Different Probes (Licox vs. Raumedic) . . . . .</b>         | <b>165</b> |
| M. Dengl, M. Jaeger, C. Renner, and J. Meixensberger   |            |
| <b>Experimental Comparison of the Measurement Accuracy of the Licox® and Raumedic® Neurovent-PTO Brain Tissue Oxygen Monitors. . . . .</b>           | <b>169</b> |
| Matthias H. Morgalla, R. Haas, G. Grözinger, Christian Thiel, Karolin Thiel, Martin U. Schuhmann, and Martin Schenk                                  |            |
| <b>Is <math>P_{br}O_2</math> Pressure Reactivity Index (ORx) Dependent on the Type of Oxygen Probe? An In Vivo Study . . . . .</b>                   | <b>173</b> |
| G. Grözinger, Martin Schenk, Christian Thiel, Karolin Thiel, Matthias H. Morgalla, and Martin U. Schuhmann   |            |
| <b>Continuous Quantitative Monitoring of Cerebral Oxygen Metabolism in Neonates by Ventilator-Gated Analysis of NIRS Recordings . . . . .</b>        | <b>177</b> |
| Thomas Heldt, Faisal M. Kashif, Mustafa Suleymanci, Heather M. O’Leary, Adré J. du Plessis, and George C. Verghese                                   |            |
| <b>Near Infrared Spectroscopy as Possible Non-invasive Monitor of Slow Vasogenic ICP Waves. . . . .</b>  | <b>181</b> |
| Ruwan Alwis Weerakkody, Marek Czosnyka, Christian Zweifel, Gianluca Castellani, Peter Smielewski, Ken Brady, John D. Pickard, and Zofia Czosnyka     |            |
| <b>Drift of the Bowman Hemedex® Cerebral Blood Flow Monitor Between Calibration Cycles . . . . .</b>   | <b>187</b> |
| Stefan Wolf, P. Vajkoczy, J. Dengler, L. Schürer, and P. Horn  |            |
| <b>Hydrocephalus/IIH: Imaging and Diagnosis</b>  |            |
| <b>Quantification of Pulsatile Cerebrospinal Fluid Flow within the Prepontine Cistern. . . . .</b>   | <b>191</b> |
| Robert Hamilton, Justin Dye, Andrew Frew, Kevin Baldwin, Xiao Hu, and Marvin Bergsneider   |            |
| <b>Delta-ADC (Apparent Diffusion Coefficient) Analysis in Patients with Idiopathic Normal Pressure Hydrocephalus. . . . .</b>                        | <b>197</b> |
| T. Osawa, M. Mase, T. Miyati, H. Kan, K. Demura, H. Kasai, M. Hara, Y. Shibamoto, and K. Yamada  |            |
| <b>Evidence for Altered Spinal Canal Compliance and Cerebral Venous Drainage in Untreated Idiopathic Intracranial Hypertension. . . . .</b>          | <b>201</b> |
| Noam Alperin, Byron L. Lam, Rong-Wen Tain, Sudarshan Ranganathan, Michael Letzing, Maria Bloom, Benny Alexander, Potyra R. Aroucha, and Evelyn Sklar |            |

|   |     |
|---|-----|
| <b>Automated Extraction of Decision Rules for Predicting Lumbar Drain Outcome by Analyzing Overnight Intracranial Pressure</b> .....  | 207 |
| Xiao Hu, Robert Hamilton, Kevin Baldwin, Paul M. Vespa, and Marvin Bergsneider  |     |
| <b>Lack of Correlation of Overnight Monitoring Data and Lumbar Infusion Data in iNPH Patients</b> .....   | 213 |
| Andreas Speil, Jordana C. Sosa, Bernd E. Will, and Martin U. Schuhmann  |     |
| <b>Shunt-Dependent Hydrocephalus Following Subarachnoid Hemorrhage Correlates with Increased S100B Levels in Cerebrospinal Fluid and Serum</b> .....  | 217 |
| S. Brandner, Y. Xu, C. Schmidt, Irene Emtmann, Michael Buchfelder, and Andrea Kleindienst   |     |
| <b>Normal Hypocretin-1 (Orexin A) Levels in Cerebrospinal Fluid in Patients with Idiopathic Intracranial Hypertension</b> .....   | 221 |
| Maria Antonia Poca, Rosa Galard, Elena Serrano, Mari Angels Merino, Patricia Pozo-Rosich, Elisabeth Solana, Olga Mestres, Maria Dolores de la Calzada, and Juan Sahuquillo  |     |
| <b>Frontal and Temporal Horn Ratio: A Valid and Reliable Index to Determine Ventricular Size in Paediatric Hydrocephalus Patients?</b> .....  | 227 |
| Sebastian Antes, Michael Kiefer, Melanie Schmitt, Miriam Lechtenfeld, Martina Geipel, and Regina Eymann   |     |
| <b>Intraventricular Cooling During CSF Infusion Studies</b> .....   | 231 |
| Melanie Schmitt, Regina Eymann, Sebastian Antes, and Michael Kiefer   |     |
| <b>An Uncommon Case of Idiopathic Intracranial Hypertension with Diagnostic Pitfalls</b> .....  | 235 |
| Manuel Mrfka, Karin Pistracher, Bernadette Schökler, Sonja Wissa, and Senta Kurschel-Lackner  |     |
| <b>Management and Therapy of Hydrocephalus</b>  |     |
| <b>Micro-fabricated Shunt to Mimic Arachnoid Granulations for the Treatment of Communicating Hydrocephalus</b> .....  | 239 |
| Francis Kralick, Jonghyun Oh, Tim Medina, and Hongseok (Moses) Noh  |     |
| <b>On the Method of a Randomised Comparison of Programmable Valves with and Without Gravitational Units: The SVASONA Study</b> .....  | 243 |
| Johannes Lemcke, Ullrich Meier, Cornelia Müller, Michael Fritsch, Michael Kiefer, Regina Eymann, Uwe Kehler, Niels Langer, Martin U. Schuhmann, Andreas Speil, Friedrich Weber, Victor Remenez, Veit Rohde, Hans-Christoph Ludwig, and Dirk Stengel |     |
| <b>Idiopathic Normal Pressure Hydrocephalus: Results of a Prospective Cohort of 236 Shunted Patients</b> .....  | 247 |
| Maria Antonia Poca, Elisabeth Solana, Francisco Ramón Martínez-Ricarte, Mónica Romero, Dario Gándara, and Juan Sahuquillo   |     |
| <b>Idiopathic Normal Pressure Hydrocephalus (iNPH) and Co-Morbidity: An Outcome Analysis of 134 Patients</b> .....  | 255 |
| Johannes Lemcke and Ullrich Meier   |     |

|   |            |
|---|------------|
| <b>Intracranial Pressure Measurement in Infants Presenting with Progressive Macrocephaly and Enlarged Subarachnoid Spaces . . . . .</b>           | <b>261</b> |
| M. Schulz, S.A. Ahmadi, B. Spors, and Ulrich-W. Thomale   |            |
| <b>Treatment Options for Intracranial Arachnoid Cysts: A Retrospective Study of 69 Patients . . . . .</b>   | <b>267</b> |
| Anders Vedel Holst, Patricia L. Danielsen, and Marianne Juhler  |            |
| <b>Management and Therapy of Traumatic Brain Injury</b>   |            |
| <b>A Microdialysis Study of Oral Vigabatrin Administration in Head Injury Patients: Preliminary Evaluation of Multimodal Monitoring . . . . .</b> | <b>271</b> |
| Keri L.H. Carpenter, Ivan Timofeev, Jürgens Nortje, Marek Czosnyka, John D. Pickard, and Peter J. Hutchinson                                      |            |
| <b>The Atrial Natriuretic Peptide Does Not Serve Osmoregulation but Predicts Outcome Following Brain Injury . . . . .</b>                         | <b>277</b> |
| Andrea Kleindienst, Georg Brabant, Nils G. Morgenthaler, Irene Emtmann, Nadine Scheufler, and Michael Buchfelder                                  |            |
| <b>Bedside Study of Cerebral Critical Closing Pressure in Patients with Severe Traumatic Brain Injury: A Transcranial Doppler Study. . . . .</b>  | <b>283</b> |
| Corina Puppo, J. Camacho, B. Yelich, L. Moraes, A. Biestro, and H. Gomez  |            |
| <b>Traumatic Brain Injury in the Elderly: A Significant Phenomenon. . . . .</b>   | <b>289</b> |
| B. Depreitere, G. Meyfroidt, G. Roosen, J. Ceuppens, and F. Guiza Grandas   |            |
| <b>Fixed, Dilated Pupils Following Traumatic Brain Injury: Historical Perspectives, Causes and Ophthalmological Sequelae . . . . .</b>            | <b>295</b> |
| Adel Helmy, Peter J. Kirkpatrick, Helen M. Seeley, Elizabeth Corteen, David K. Menon, and Peter J. Hutchinson                                     |            |
| <b>Why Mortality Is Still High with Modern Care of 613 Evacuated Mass Lesions Presented as Severe Head Injuries 1999–2009 . . . . .</b>           | <b>301</b> |
| Leon Levi, Joseph Guilburd, Jean Soustiel, Gill Sviri, Marius Constantinescu, and Menashe Zaaroor   |            |
| <b>Late Decompressive Craniectomy as Rescue Treatment for Refractory High Intracranial Pressure in Children and Adults. . . . .</b>               | <b>305</b> |
| Catrien van der Meer, Erik van Lindert, and Ronald Petru  |            |
| <b>CT Angiography as a Confirmatory Test in Brain Death . . . . .</b>   | <b>311</b> |
| Stefan Welschehold, Stephan Boor, Katharina Reuland, Christian Beyer, Thomas Kerz, Andre Reuland, and Wibke Müller-Forell                         |            |
| <b>The Imaging Diagnosis and Prognosis Assessment of Patients with Midbrain Injury in the Acute Phase of Craniocerebral Injury . . . . .</b>      | <b>317</b> |
| Ming-kun Yu and Wei Ye  |            |

## Management and Therapy of Subarachnoid and Intracranial Haemorrhage

|  |     |
|--|-----|
| <b>The Effect of Intraventricular Thrombolysis in Combination with Low-Frequency Head Motion After Severe Subarachnoid Hemorrhage: Interim Analysis of Safety, Clot Clearance Rate and Delayed Cerebral Ischemia</b> ..... | 323 |
| Sven O. Eicker, Kerim Beseoglu, Nima Etminan, Jason Perrin, Arzu Taskin, Hans-Jakob Steiger, and Daniel Hänggi   |     |
| <b>Early CT Perfusion Measurement After Aneurysmal Subarachnoid Hemorrhage: A Screening Method to Predict Outcome?</b> .....   | 329 |
| Marcel A. Kamp, Hi-Jae Heiroth, Kerim Beseoglu, Bernd Turowski, Hans-Jakob Steiger, and Daniel Hänggi  |     |
| <b>Cerebrospinal Fluid Lactate Concentration After Withdrawal of Metabolic Suppressive Therapy in Subarachnoid Hemorrhage</b> .....  | 333 |
| Marco Stein, Julia Schomacher, Wolfram Scharbrodt, Matthias Preuss, and Matthias F. Oertel   |     |
| <b>Effect of Increased ICP and Decreased CPP on DND and Outcome in ASAH</b> .....  | 339 |
| Krissanee Karnchanapandh   |     |
| <b>Prior Statin Use Has No Effect on Survival After Intracerebral Hemorrhage in a Multiethnic Asian Patient Cohort</b> .....   | 343 |
| Nicolas K.K. King, Vincent Khwee-Soon Tay, John Carson Allen, and Beng-Ti Ang  |     |
| <b>The Impact of Silver Nanoparticle-Coated and Antibiotic-Impregnated External Ventricular Drainage Catheters on the Risk of Infections: A Clinical Comparison of 95 Patients</b> .....                                   | 347 |
| Johannes Lemcke, Felix Depner, and Ullrich Meier   |     |
| <b>Experimental Approaches to Acute Brain Disease</b>  |     |
| <b>Dependence of Cerebrospinal Fluid Pressure and Volume on the Changes in Serum Osmolarity in Cats</b> .....  | 351 |
| Ivana Jurjević, Jurica Maraković, Darko Chudy, Ivona Markelić, Marijan Klarica, Ana Froebe, and Darko Orešković  |     |
| <b>The Effect of Body Position on Intraocular and CSF Pressures in the Lateral Ventricle, and in Cortical and Lumbar Subarachnoid Spaces in Cats</b> .....   | 357 |
| Tomislav Kuzman, Ivana Jurjević, Inga Mandac, Milan Radoš, Darko Orešković, Hrvoje Jednačak, and Marijan Klarica   |     |
| <b>Pressure Reactivity Index Correlates with Metabolic Dysfunction in a Porcine Model of Intracerebral Hemorrhage</b> .....  | 363 |
| Edgar Santos, Berk Orakcioglu, Modar M. Kentar, Jennifer Diedler, Yoichi Uozumi, Michael Schöll, Andreas Unterberg, and Oliver W. Sakowitz   |     |

|  |     |
|--|-----|
| <b>Evidence of Spreading Depolarizations in a Porcine Cortical Intracerebral Hemorrhage Model</b> . . . . .  | 369 |
| Berk Orakcioglu, Yoichi Uozumi, Modar M. Kentar, Edgar Santos, Andreas Unterberg, and Oliver W. Sakowitz   |     |
| <b>Spontaneous Cortical Spreading Depression and Intracranial Pressure Following Acute Subdural Hematoma in a Rat</b> . . . . .  | 373 |
| B. Alessandri, J. Stephan Tretzel, Axel Heimann, and Oliver Kempfski   |     |
| <b>The Peptide AF-16 and the AF Protein Counteract Intracranial Hypertension</b> . . . . .   | 377 |
| Hans-Arne Hansson, Mohamed Al-Olama, Eva Jennische, Kliment Gatzinsky, and Stefan Lange  |     |
| <b>Influence of Isoflurane on Neuronal Death and Outcome in a Rat Model of Traumatic Brain Injury</b> . . . . .  | 383 |
| Daniel Hertle, Christopher Beynon, K. Zweckberger, B. Vienenkötter, C.S. Jung, K. Kiening, Andreas Unterberg, and Oliver W. Sakowitz   |     |
| <b>Correlation of the Intracranial Pressure to the Central Venous Pressure in the Late Phase of Acute Liver Failure in a Porcine Model</b> . . . . .   | 387 |
| Kathrin Scheuermann, Christian Thiel, Karolin Thiel, Wilfried Klingert, Elmar Hawerkamp, Johannes Scheppach, Alfred Königsrainer, Matthias H. Morgalla, Pamela Leckie, Andrew Proven, Rajiv Jalan, Nathan Davies, Martin U. Schuhmann, and Martin Schenk |     |
| <b>Visualisation of Cortical pO<sub>2</sub> During an Epidural Mass Lesion in Rodents</b> . . . . .  | 393 |
| Jan Warnat, Gregor Liebsch, Eva-Maria Stoerr, and Alexander Brawanski  |     |
| <b>Development of an Experimental Model to Study the Pathophysiology of Cerebral Salt Wasting Following Subarachnoid Hemorrhage</b> . . . . .  | 399 |
| Andrea Kleindienst, Sven M. Schlaffer, Nikhil Sharma, Lisa Linde, Michael Buchfelder, and Joseph G. Verbalis   |     |
| <b>Author Index</b> . . . . .  | 405 |
| <b>Subject Index</b> . . . . .   | 409 |





<http://www.springer.com/978-3-7091-0955-7>

Intracranial Pressure and Brain Monitoring XIV

Schuhmann, M.; Czosnyka, M. (Eds.)

2012, XIV, 421 p., Hardcover

ISBN: 978-3-7091-0955-7