

## EDITORIAL

### Neuromonitoring: The Concept of Targeted Therapy Revisited

Traumatic brain injuries (TBI) appear as one of the most prominent causes of death, responsible for 50,000 deaths each year in the United States and in Europe and result in major neurological, psychological and social impairment in survivors. Since TBI are most often the consequence of road traffic accidents, they primarily target young patients and represent, therefore, a major economical burden. In response to this major threat, neuroscientists have engaged themselves into an intense and sustained effort for the development of therapeutic solutions that may affect the outcome of TBI, leading to extensive research pointing at various pathophysiological pathways and identifying numerous key factors in the generation of neuronal damage. As an anticipated outcome of this research, numerous drugs were developed, eliciting several encouraging animal studies though none of them has shown any significant benefit in successive clinical trials [1].

In the absence of any significant pharmacological breakthrough, TBI management has mostly focused on the control of increased intracranial pressure (ICP). For decades, impairment of cerebral metabolism has been attributed to impaired oxygen delivery mediated by reduced cerebral perfusion through the swollen cerebral parenchyma. Accordingly, control of ICP elevation has been advocated for restoration of previously compromised cerebral perfusion as a sine qua non condition for improvement of cerebral metabolism. At the beginning of the past decade, Rosner *et al.* proposed the elevation of cerebral perfusion pressure (CPP) for optimization of cerebral hemodynamics [2]. Despite some criticism related to the absence of solid physiological evidence, the concept of CPP management gained a wide acceptance, and various CPP thresholds were introduced as an additional neuromonitoring-based targeted therapy [3].

The concept of CPP management itself is based on the assumption of preserved cerebral autoregulation, at least to some level, and on manipulations of blood volume and systemic arterial pressure necessary for CPP increase. As such, CPP management stresses the importance of evaluation of autoregulation as a true monitoring modality prior implementation of significant and otherwise potentially harmful hemodynamic manipulations [4, 5].

Further studies investigating cerebral blood flow (CBF) in TBI patients failed to disclose a useful correlation between CPP and CBF, suggesting that CBF could not be accurately estimated by means of CPP [6]. As a consequence, the need for CBF assessment lead to the implementation of alternative neuromonitoring modalities such as jugular bulb oxymetry, transcranial Doppler or near-infrared transcranial spectroscopy representing surrogates for CBF though eventually enhancing the need for definite quantitative and accurate CBF measurement. With the development of mobile CT units, CBF measurements by means of stable xenon computerized tomography (CT) at patients' bedside, authorized for the first time the emergence of CBF-targeted management of TBI patients [7]. More recently, the introduction of functional perfusion CT has even further simplified the quantitative assessment of regional CBF and suggested its implementation within the neuromonitoring armamentarium.

As all monitoring tools carry specific advantages and limitations, one may assume that the safest and most appropriate approach should rely on a multimodal monitoring and the capability of neurointensivists to integrate complex data [8]. Eventually, our ability to outline an accurate physiological profile of the patient would probably represent the cornerstone in the definition of the best targeted management.

## REFERENCES

- [1] Dopperberg EM, Choi SC, Bullock R. Clinical trials in traumatic brain injury: lessons for the future. *J Neurosurg Anesthesiol* 2004; 16: 87-94.
- [2] Rosner MJ, Rosner SD, Johnson AH. Cerebral perfusion pressure: management protocol and clinical results. *J Neurosurg* 1995; 83: 949-962.

- [3] Cruz J, Jaggi JL, Hoffstad OJ. Cerebral blood flow, vascular resistance, and oxygen metabolism in acute brain trauma: redefining the role of cerebral perfusion pressure? *Crit Care Med* 1995; 23: 1412-1417.
- [4] Czosnyka M, Brady K, Reinhard M, Smielewski P, Steiner LA. Monitoring of cerebrovascular autoregulation: facts, myths, and missing links. *Neurocrit Care* 2009; 10: 373-386.
- [5] Sviri GE, Aaslid R, Douville CM, Moore A, Newell DW. Time course for autoregulation recovery following severe traumatic brain injury. *J Neurosurg* 2009; 111: 695-700.
- [6] Chierigato A, Tanfani A, Compagnone C, Turrini C, Sarpieri F, Ravaldini M, Targa L, Fainardi E. Global cerebral blood flow and CPP after severe head injury: a xenon-CT study. *Intens Care Med* 2007; 33: 856-862.
- [7] Hillman J, Sturnegk P, Yonas H, Heron J, Sandborg M, Gunnarsson T, Mellergard P. Bedside monitoring of CBF with xenon-CT and a mobile scanner: a novel method in neurointensive care. *Br J Neurosurg* 2005; 19: 395-401.
- [8] Czosnyka M, Whitehouse H, Smielewski P, Kirkpatrick P, Guazzo EP, Pickard JD. Computer supported multimodal bed-side monitoring for neuro intensive care. *Int J Clin Monit Comput* 1994; 11: 223-232.

### **Jean Francois Soustiel**

Acute Brain Injury Research Laboratory and  
Division of Neurosurgery,  
Rambam Medical Center, Faculty of Medicine,  
Technion – Israel Institute of Technology, Haifa,  
Israel  
Tel: +972-4-8541840  
Fax: +072-4-8543664  
E-mail: [j\\_soustiel@rambam.health.gov.il](mailto:j_soustiel@rambam.health.gov.il)

© Jean Francois Soustiel; Licensee *Bentham Open*.

This is an open access article licensed under the terms of the Creative Commons Attribution Non-Commercial License (<http://creativecommons.org/licenses/by-nc/3.0/>) which permits unrestricted, non-commercial use, distribution and reproduction in any medium, provided the work is properly cited.