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The Need for WFNS Standard Simplified Guidelines for the Management of Severe Traumatic Brain Injuries

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Several protocols have been published for the management of severe traumatic brain injuries (TBI) starting 1995 (4). Primary brain damage occurs at the time of impact; however, the cornerstone of neurotrauma management lies in preventing secondary brain events. Post-traumatic brain edema will develop within 4–24 hours and may cause brain herniation with consequent ischemia, hypoperfusion, water hemostasis dysregulation, and metabolic starvation as the leading causes of post-traumatic morbidity and mortality (28). Most of the management protocols aim at abolishing, minimizing, attenuating, or negating edema formation and/or consequences. There was a tremendous saving of money and lives as a result of the adoption of brain trauma guidelines in the United States (9).

Many post-traumatic injurious mechanisms are temperature dependent. Hypothermic control of experimental refractory intracranial hypertension remains to be validated in adults or children (2, 10, 15, 24, 27, 29), especially if prolonged (15), to avoid hypokalemia and possible pneumonia. Hypothermia to 35°C produced the same reduction in intracranial pressure (ICP) as 33°C, with fewer complications (27). Discrete cerebral hypothermia has failed to show an effect in a prospective randomized, controlled, single institute study (10). The reason for failed clinical trials to show a beneficial effect of hypothermia in TBI may reflect the neuroscientist's poor understanding of the actual mechanisms responsible for the pathophysiology of secondary post-traumatic brain apoptosis (24). Marked improvement of outcomes was reported on adherence to the trauma guidelines (11).

Wiki-based reminders to promote trauma care were also studied in Quebec, Canada (3). These include a protocol of check boxes, clinical decision rules, and decision aids together with admission order sets, and patient hand outs. A 9-year retrospective review of a pediatric trauma data bank in France was conducted to identify the outcome predictors in a level III trauma center in 585 children with a Glasgow coma score (GCS) less than 8 (7). GCS and hypotension on arrival were predictors of poor outcome. In a prospective follow-up study of 2 years on 125 children in 12 French pediatric intensive care units (ICU), Javouhey et al. (14) found that a better outcome was obtained when brain injuries were appropriately managed in a more aggressive trauma center with ICP monitoring and with more extensive experience of the trauma team.

The impact of the pediatric brain trauma guidelines publication in 2003 on the incidence of severe hypocarbia in 85 severely head-injured children was compared with that of 375 patients before 2003 in Seattle, Washington (6). The incidence of severe hypocarbia was highest during the first 48 hours after hospitalization in both study groups and decreased during the study years. More frequent sampling of partial pressure of carbon dioxide was performed after the publication of the guidelines. ICP measurement was also more frequent after publication of the guidelines. Both were predictors of outcome. It was found that even in the United States there is geographically limited distribution of specialized trauma centers and lack of specialized surgeons. Outcome differences were noted depending on where children were managed (21).

Key words
- Guidelines
- Neurosurgeon
- Survey
- Traumatic brain injury

Abbreviations and Acronyms
CPP: Cerebral perfusion pressure
CT: Computed tomography
GCS: Glasgow coma score
ICP: Intracranial pressure
ICU: Intensive care unit
MRI: Magnetic resonance imaging
TBI: Traumatic brain injuries
WFNS: World Federation of Neurosurgical Societies

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The use of modified cerebral perfusion pressure (CPP) target therapy to 60 mm Hg has yielded better results and fewer complications than CPP targeted therapy to 70 mm Hg or ICP targeted therapy (13). The consequences of traumatic injuries may sometimes be halted or reversed (20).

The guidelines for medical management of TBI have been implemented in Latvia since 2001. The hospital case fatality rate of patients with TBI has decreased significantly during the 2002–2004 period compared with the 1998–2000 period (16).

The effect of compliance of guideline-based management on outcome in Austria was reported (17, 23). Close adherence to ICP threshold treatment was noted in 89% of cases, whereas CPP compliance was only 30%. Prehospital and early resuscitation were adhered to in 84% and 78% of patients, respectively. ICU survival was statistically significantly related to blood pressure, oxygenation, and CPP resuscitation. Adherence to guideline recommendations on type of monitoring, use of hyperventilation, or antiseizure drugs, as well as the total scores of compliance was positively correlated to ICU survival. Reduction in both ICU and hospital stay resulted from compliance to the recommended type of monitoring. Shortened ICU stay, with an increased hospital stay, was related to adherence to the hyperventilation guideline. On the contrary, compliance to the guideline on mannitol administration was associated with reduced hospital stay, but not ICU stay. Implementing standard corticosteroid use has reduced hospital and ICU stays. Using the standard on prophylactic use of antiseizure drugs was related to a reduction in ICU days. If all recommendations had been strictly adhered to patients with TBI would have spent more ICU days and less hospital days. The same group showed that better outcome was associated with prehospital administration of 1000 mL or more of fluid, use of hypertonic saline, and helicopter transfer (17). Interestingly, intubation did not alter the outcome.

In the United States, improved adherence to guidelines has resulted in improved outcome of patients with TBI (28). The United States' recommendations on TBI management was published 1995 and were adhered to in 50% of cases in 1996 and 86% the next year. ICU and hospital stays were significantly reduced after implementation of the guidelines, with consequent major money savings. Significant improvement in Glasgow outcome score of good recovery and moderate disability was noted, although mortality did not change significantly (8). Use of evidence-based management protocol improves outcome and saves money in developed countries and possibly in economically underprivileged areas.

In Nordic countries (Denmark, Norway, Finland, and Sweden), 67% of hospitals have specific treatment protocols for severe head injuries. A linked computed tomography (CT) scan to regional neurosurgical departments was available in 59% of hospitals (25). In spite of an efficient transport system 16%–33% of neurosurgical trauma surgeries are performed outside of neurosurgical centers, except in Denmark where all operations are done by neurosurgeons.

The significant influences of the Scandinavian Guidelines for the Initial Management of Minimal, Mild, and Moderate Head Injuries have been reflected in compliance of 51% of physicians caring for 508 patients in a Norwegian university hospital, in spite of its implementation by clinical leaders. Noncompliance costs the health care system (12).

White matter changes of diffuse axonal injury, which are recently recognized as precursors of bad outcome and are not visualized on routine CT scans, may be now visualized with diffusion tensor magnetic resonance imaging (MRI) in suspected emergency situations (30).

Some of recent trends of management, including hypertonic saline and decompressive craniectomy, have proved effective but deserve further elucidation of patient selection and medication timing. Guided therapy with brain tissue oxygenation, ICP, and CPP monitoring may improve outcomes after TBI (26). It is to be noted that no class I evidence exists about the value of CPP, pressure- or volume-targeted management guidelines. More controversial issues include hyperventilation, hypertonic saline or mannitol, cerebrospinal fluid drainage, barbiturate coma, decompressive craniectomy, hypothermia, and normobaric or hyperbaric oxygen therapy (1, 19).

The guidelines published by the European Brain Injury Consortium are based on expert opinion and consensus compared with US evidence-based guidelines (18). A multicenter prospective survey by the European Brain Injury Consortium during a 3-month period in 67 centers from 24 countries on 729 patients (397 patients with GCS less than 8) was conducted. Current approaches to surgical treatment of intradural post-traumatic mass lesions and increased ICP with emphasis on utilization of decompressive craniectomy was studied (5). Decompressive craniectomy, either during an emergency procedure or as a delayed procedure, was performed in 33% and 31% of patients, respectively. It was nearly always combined with evacuation of a mass lesion.

Subcellular substrate pharmacologic agents acting on white or gray matter, such as immune histochemical and serum biomarkers markers of axonal injury, superoxide radicals, glutamate receptors, calcium channel influx, and inflammatory up-regulators, which are instrumental in the production of brain cellular injury, have failed to result in improved outcome when applied in the clinical setting, especially with regard to the effect of hypothermia (20, 22). This reflects multiplicity, as well as complexity of interaction, and our incomplete understanding of how and when these mechanisms interact in the production of progressive detrimental changes in TBI. It is possible that new effective drugs may emerge from further understanding of the molecular mechanisms underlying post-traumatic secondary brain injury.

In the present issue, Suehiro et al. review the current management of severe TBI in Japan. The Japanese guidelines for management of severe head injuries were implemented in 2000. They analyzed the responses to their questionnaire from 233 Japanese Neurosurgical Society specialist training centers. Although initial care for severe TBI is nearly equally shared by emergency room departments and neurosurgery departments, 90% of surgeries were performed by neurosurgeons who care for 75% of the patients postoperatively. MRI and acute ICP monitoring were performed in slightly more than 50% of cases, whereas jugular venous was sampled in only 20% of cases, Hypothermia was liberally used, so was barbiturate coma. The