



Traumatic Brain Injury - What's new and where do the guidelines lead us?

Chair: Özlem Korkmaz Dilmen

Sunday, May 26, 2024

1. TREATMENT OF TRAUMATIC BRAIN INJURY PATIENTS ACCORDING TO THE GUIDELINES - WHERE DO WE STAND?

Özlem Korkmaz Dilmen

The main management goals in severe traumatic brain injury cases are:

1. Reducing intracranial pressure
2. Maintaining an optimal perfusion pressure.

MONITORING

- Monitoring intracranial pressure is recommended to reduce mortality caused by traumatic brain injury (at the hospital and 2 weeks after the trauma)¹.
 - Intraventricular catheters are the first choice: they provide information on pressure but also on *intracranial compliance*¹.
- Advanced monitoring is recommended, since it lowers mortality and improves outcomes within 3-6 months after the trauma¹.
 - A cerebral oxygen tissue pressure (PtO₂) < 15 mgHg is associated with cerebral ischemia and worse neurological outcomes. If persistent, it is also associated with a higher mortality.
 - *BONANZA and BOOST3 trials will determine whether using PtO₂ is associated with improved outcomes.*

HYPEROSMOLAR THERAPY

- This a rescue therapy, only administered if intracranial pressure is high.
- Mannitol has proven to be effective to control intracranial pressure, but it is important to avoid low blood pressure¹.
- Administering mannitol by continuous infusion is not recommended².

DRAINAGE OF CEREBROSPINAL FLUID

- Continuous drainage is recommended over intermittent¹.
- Lumbar drainage is not recommended².

VENTILATION

- Hyperventilation is recommended exclusively as a temporary measure to reduce intracranial pressure¹.
- Prolonged prophylactic hyperventilation is not recommended¹.
- Hyperventilation must be avoided for 24 hours within trauma¹.

ANESTHESIA, ANALGESIA, AND SEDATION

- Barbiturates are not recommended as a prophylactic measure for intracranial hypertension, and they must be used as a last resort in cases refractory to the medical or surgical treatment¹.
- Corticosteroids are not recommended^{1,2}.

PROPHYLAXIS OF DEEP VEIN THROMBOSIS

- Heparins are recommended in combination with mechanical prophylaxis¹.

PROPHYLAXIS OF CONVULSIONS

- Levetiracetam is the first-line treatment, and phenytoin is the second-line treatment if the former is contraindicated.

DECOMPRESSIVE CRANIECTOMY

- It is associated with a decrease in intracranial pressure and a shorter ICU stay, but also with a higher incidence of non-favorable neurological outcomes than the standard treatment³. Along the same line, another trial correlated it to a lower mortality, but higher disability rates⁴.
- It is recommended in refractory late cases of intracranial pressure increase¹.

THERAPEUTIC HYPOTHERMIA

- It is not recommended as a routine measure with temperatures below 35 °C².

The Seattle International Severe TBI Consensus Conference made a number of recommendations on the therapeutic approach of traumatic brain injury in 2019, in the form of a therapeutic algorithm²:



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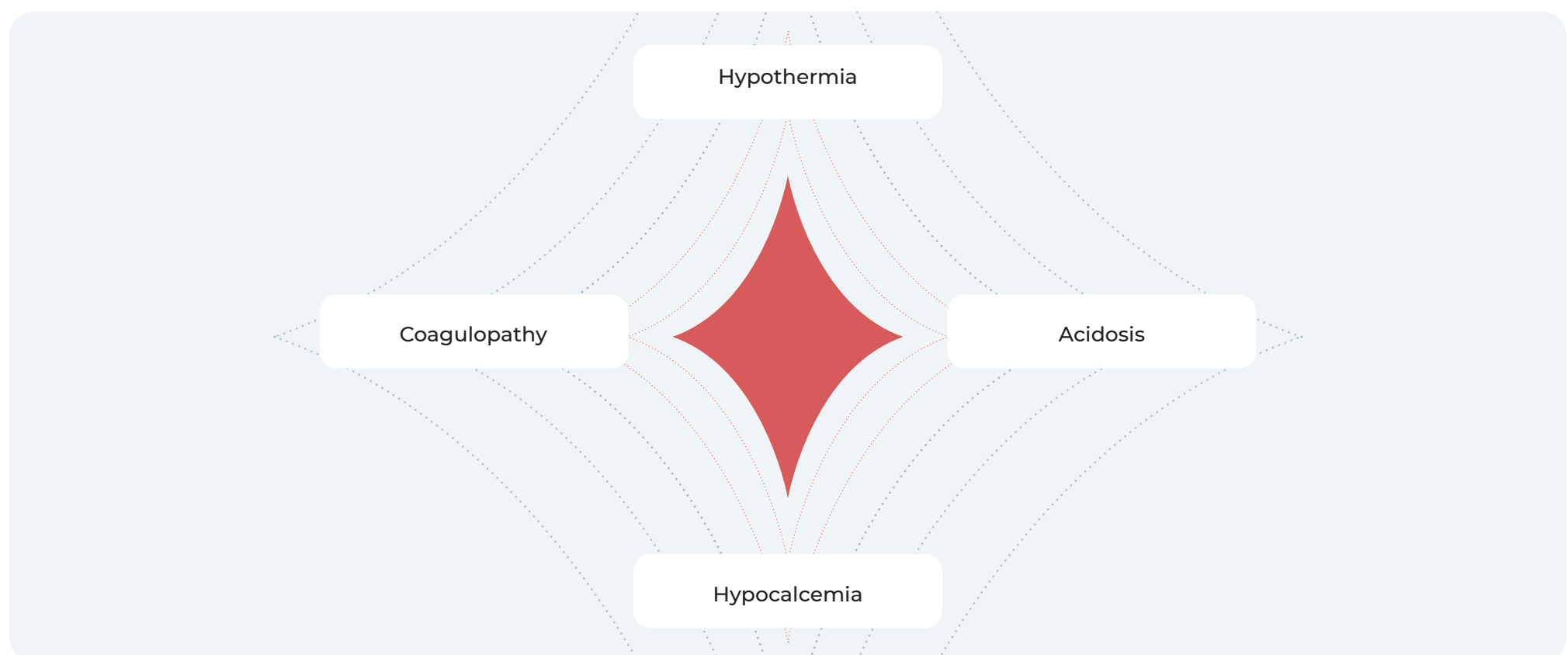
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2. MANAGING BLOOD CALCIUM LEVELS IN TRAUMATIC BRAIN INJURY PATIENTS

Aeyal Raz

Ca²⁺ is a critical cofactor for bleeding control. In fact, hypocalcemia is correlated to worse outcomes⁵⁻⁸.

Hypocalcemia is part of the so-called lethal diamond:



However, Ca²⁺ may increase brain cell damage after traumatic brain injury and may lead to secondary damage⁹.

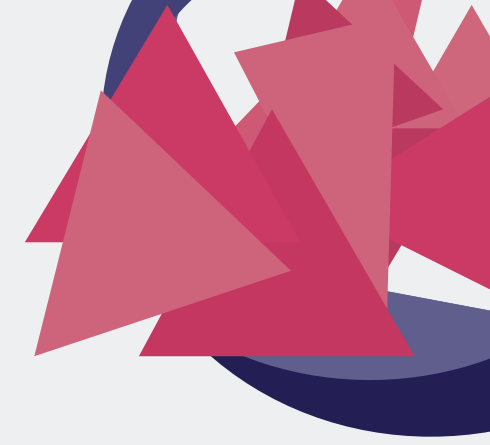
- Secondary damage prevention is recommended, by administering Ca²⁺ channel inhibitors.

It was observed in a retrospective cohort study that three quarters of patients admitted to the ICU due to traumatic brain injury presented hypocalcemia¹⁰.

- Hypocalcemia was independently associated to a good neurological state upon discharge.
- Between patients with Glasgow Coma Score > 8 and those with bilateral reactive pupils (less severe), the rate of patients in a good neurological state upon discharge was significantly higher in hypocalcemic patients than in patients with normal Ca²⁺ levels.

Currently, optimal Ca²⁺ levels for traumatic brain injury patients are not known. Therefore, caution must be exercised when approaching hypocalcemia in these patients.

Prospective trials are required (if possible randomized) to determine optimal Ca²⁺ levels in patients with traumatic brain injury.



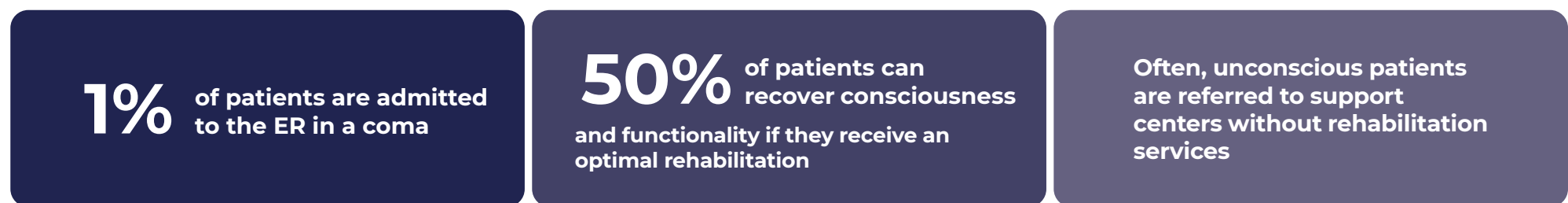
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3. PERSONALIZED APPROACH TO REHABILITATION FOLLOWING TRAUMATIC BRAIN INJURY

Dana Baron Shahaf



A great deal of patients considered unconscious may have a normal brain activity pattern in response to stimuli.

Magnetic resonance and electroencephalogram are not available at the bedside, so some **tool to assess the state of consciousness** of patients is required:

ELECTROENCEPHALOGRAM OF A CHANNEL

- Attention markers have previously been validated in patients with stroke, delirium due to encephalopathy, effective anesthesia, attention deficit disorder, anxiety, and during effective rehabilitation.
- It allows to identify attention in patients with an induced unconsciousness state.

The **EyeCon** system is based on the EEG/EMG for the rehabilitation of communication in unconscious critical patients. It comprises an automated protocol following the same process once and over again.



Benefits of the EyeCon system:

- ✓ Patient attention can be monitored, which is variable depending on the patients being admitted.
- ✓ A feedback/response is elicited from the patient (attention markers and blinking).

LITERATURE

1. Carney N, Totten AM, O'Reilly C, Ullman JS, Hawryluk GWJ, Bell MJ, et al. Guidelines for the Management of Severe Traumatic Brain Injury, Fourth Edition. *Neurosurgery* [Internet]. 2017 Jan 1 [cited 2024 Jun 13];80(1):6–15. Available from: <https://pubmed.ncbi.nlm.nih.gov/27654000/>
2. Hawryluk GWJ, Aguilera S, Buki A, Bulger E, Citerio G, Cooper DJ, et al. A management algorithm for patients with intracranial pressure monitoring: the Seattle International Severe Traumatic Brain Injury Consensus Conference (SIBICC). *Intensive Care Med* [Internet]. 2019 Dec 1 [cited 2024 Jun 17];45(12):1783–94. Available from: <https://pubmed.ncbi.nlm.nih.gov/31659383/>
3. Cooper DJ, Rosenfeld J V., Murray L, Arabi YM, Davies AR, D'Urso P, et al. Decompressive craniectomy in diffuse traumatic brain injury. *N Engl J Med* [Internet]. 2011 Apr 21 [cited 2024 Jun 13];364(16):1493–502. Available from: <https://pubmed.ncbi.nlm.nih.gov/21434843/>
4. Hutchinson PJ, Kolias AG, Timofeev IS, Corteen EA, Czosnyka M, Timothy J, et al. Trial of Decompressive Craniectomy for Traumatic Intracranial Hypertension. *N Engl J Med* [Internet]. 2016 Sep 22 [cited 2024 Jun 13];375(12):1119–30. Available from: <https://pubmed.ncbi.nlm.nih.gov/27602507/>
5. Magnotti LJ, Bradburn EH, Webb DL, Berry SD, Fischer PE, Zarzaur BL, et al. Admission ionized calcium levels predict the need for multiple transfusions: a prospective study of 591 critically ill trauma patients. *J Trauma* [Internet]. 2011 Feb [cited 2024 Jun 17];70(2):391–7. Available from: <https://pubmed.ncbi.nlm.nih.gov/21307739/>
6. Epstein D, Freund Y, Marcusohn E, Diab T, Klein E, Raz A, et al. Association Between Ionized Calcium Level and Neurological Outcome in Endovascularly Treated Patients with Spontaneous Subarachnoid Hemorrhage: A Retrospective Cohort Study. *Neurocrit Care* [Internet]. 2021 Dec 1 [cited 2024 Jun 17];35(3):723–37. Available from: <https://pubmed.ncbi.nlm.nih.gov/33829378/>
7. Epstein D, Solomon N, Korytny A, Marcusohn E, Freund Y, Avrahami R, et al. Association between ionised calcium and severity of postpartum haemorrhage: a retrospective cohort study. *Br J Anaesth* [Internet]. 2021 May 1 [cited 2024 Jun 17];126(5):1022–8. Available from: <https://pubmed.ncbi.nlm.nih.gov/33341222/>
8. Korytny A, Klein A, Marcusohn E, Freund Y, Neuberger A, Raz A, et al. Hypocalcemia is associated with adverse clinical course in patients with upper gastrointestinal bleeding. *Intern Emerg Med* [Internet]. 2021 Oct 1 [cited 2024 Jun 17];16(7):1813–22. Available from: <https://pubmed.ncbi.nlm.nih.gov/33651325/>
9. Song JL, Westover MB, Zhang R. Computational Neuroscience: A mechanistic model of calcium homeostasis leading to occurrence and propagation of secondary brain injury. *J Neurophysiol* [Internet]. 2022 Nov 11 [cited 2024 Jun 17];128(5):1168. Available from: <https://pubmed.ncbi.nlm.nih.gov/3621713/>
10. Badarni K, Harush N, Andrawus E, Bahouth H, Bar-Lavie Y, Raz A, et al. Association Between Admission Ionized Calcium Level and Neurological Outcome of Patients with Isolated Severe Traumatic Brain Injury: A Retrospective Cohort Study. *Neurocrit Care* [Internet]. 2023 Oct 1 [cited 2024 Jun 17];39(2):386–98. Available from: <https://pubmed.ncbi.nlm.nih.gov/36854866/>