Traumatic Brain Injury: Metabolic Stress & Nutrition Support

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Background Information: Metabolic Stress

<u>METABOLIC RESPONSE TO STRESS</u>: response to critical illness, traumatic injury, sepsis, burns, or major surgery; involves most metabolic pathways

- Characterized by catabolism of lean body and skeletal mass resulting in muscle wasting and negative nitrogen balance
- Involves the ebb and flow phases

Ebb Phase

- Occurs immediately following injury
- Involves:
 - o Hypovelemia
 - Shock
 - o Tissue hypoxia
 - $\circ \downarrow Oxygen consumption$
 - o ↓Cardiac output
 - $\circ \downarrow$ Body temperature
 - Low insulin & high glucagon

Flow Phase

- Acute phase and adaptive phase
- ↑ Cardiac output
- ↑ Oxygen consumption
- ↑ Body temperature
- ↑ Energy expenditure
- ↑ Total body protein catabolism

Background Information: Traumatic Brain Injury

- TRAUMATIC BRAIN INJURY (TBI): Occurs when a sudden trauma causes damage to the brain
 - Results when the head suddenly and violently hits an object or when an object pierces the skull and enters brain tissue. Symptoms can be mild, moderate, or severe

The Glasgow Coma Scale

- Tool for quantifying a patient's state of consciousness. Includes the patient's:
 - Eye opening response
 - Verbal response
 - Motor response
- The scale is from 1 (most severe) 15 (least severe)

_	Table II: Gia	syow coma score	
	Infant <1 yr	Child 1-4yrs	Age 4–Adult
2		EYES	9A
4	Open	Open	Open
3	To voice	To voice	To voice
2	To pain	To pain	To pain
1	No response	No response	No response
		VERBAL	
5	Coos, babbles	Oriented, speaks, interacts, social	Oriented and alert
4	Irritable cry, consolable	Confused speech, disoriented, consolable	Disoriented
3	Cries persistently to pain	Inappropriate words, inconsolable	Nonsensical speech
2	Moans to pain	Incomprehensible, agitated	Moans, unintelligible
1	No response	No response	No response
	in,	MOTOR	
6	Normal, spontaneous movement	Normal, spontaneous movement	Follows commands
5	Withdraws to touch	Localizes pain	Localizes pain
4	Withdraws to pain	Withdraws to pain	Withdraws to pain
3	Decorticate flexion	Decorticate flexion	Decorticate flexion
2	Decerebrate extension	Decerebrate extension	Decerebrate extension
1	No response	No response	No response

GCS Score: •14-15 indicates minor head injury •9-13 indicates moderate head injury •<8 indicates severe injury

Background Information Continued

• Leading causes of TBI:

• Falls (28%)

• Motor vehicle-traffic crashes (20%)



Symptoms of TBI

General symptoms:

- Headaches or neck pain
- Slowness in acting, speaking, thinking
- Mood changes
- Light-headedness, dizziness
- Urge to vomit
- Increased sensitivity to lights, sounds, or distractions

Symptoms in children:

- Changes in:
 - Eating
 - Sleeping
 - Performance at school
- Loss of new skills
- Loss of balance or unsteady walking
- Vomiting
- Irritability or crankiness

Research Article: MNT

Nutritional treatment of patients with severe traumatic brain injury during the first six months after injury

- **Objective**: To look at the nutritional outcome in patients with severe traumatic brain injury, as well as current nutritional treatment policies.
- **Methods**: a retrospective, structured survey of the medical records of 64 patients up to 6 months after injury or until the patients were independent in nutritional administration.
- **Materials**: Patients were 16-64 years of age, all with severe TBI. (Scoring 3-8 on GCS)

Nutritional treatment of patients with severe traumatic brain injury during the first six months after injury

- **Data Collection**: information was taken from patient records, from the time of the injury until the patient became nutritionally independent or, if not, 6 months after the injury.
- Seven questions were created to collect and analyze data derived from patient records:
- 1. How long was the need for parenteral nutrition (PN)
- and enteral nutrition (EN)?
- 2. How many patients received a gastrostomy? When
- was it placed and for how long was it needed?
- **3.** How long was the need for assisted feeding?
- 4. What was the relation between energy intake (EI) and
- calculated basal energy metabolism?
- **5.** How did the patients' body mass change over time?
- 6. How many patients fulfilled criteria for malnourishment?
- 7. What was the frequency and possible effect of "important factors" in malnourished compared with nonmalnourished patients?

Nutritional treatment of patients with severe traumatic brain injury during the first six months after injury

- All patients received PN while in the intensive care unit, total number of days ranged from 2 to 64
- 86% of patients received EN, total number of days varied from 1 to 178 d
- Assisted feeding varied from 9 to 180 days
- 54 patients had gained total nutritional independence, after 6 months
- 5 patients received all their food, orally but needed assistance
- 2 were fed with a combination of oral nutrition and EN
- 2 could not swallow any food orally and were given all food enterally.
- 1 patient died, and received both PN and EN

Nutritional treatment of patients with severe traumatic brain injury during the first six months after injury

• **Conclusion:** This study concludes that most patients with severe traumatic brain injury, will regain their nutritional independence within the first 6 months after injury, but at the same time will develop signs of malnutrition.

Research Article: CAM

Snoezelen: A controlled multi-sensory stimulation therapy for children recovering from severe brain injury

• Objective:

• To investigate the physiological, cognitive, and behavioral changes in children recovering from TBI undergoing Snoezelen therapy

• Hypothesis:

• Assist nervous system recovery in an enriched atmosphere allowing patients to process varieties of information.

• Study Design:

• An observational study design

Snoezelen: A controlled multi-sensory stimulation therapy for children recovering from severe brain injury

- Methods:
 - Fifteen children aged 1.2-16.9: 11 boys and 4 girls; mean age of 9.87
 - Each children received a different number of Snoezelen treatment session depending on their length of stay
 - Data was calculated after 10 consecutive sessions (mean # of sessions 6.7)
 - Cause of injury:
 - × 8: pedestrians hit by a car
 - × 5: MVA
 - × 1: Near drowning
 - × 1: Motorcycle accident

Snoezelen: A controlled multi-sensory stimulation therapy for children recovering from severe brain injury

• Procedures:

30 minute treatment
 Sessions using up to 3 pieces
 of equipment, 3 x week until
 patient was discharged.

• Data was calculated based on the difference of pre & post treatment measurements

- Involved 3 phases:
 - × Introduction to room
 - × Carrying out the session w/ Equipment use
 - × Winding the session down



Snoezelen: A controlled multi-sensory stimulation therapy for children recovering from severe brain injury

• Results:

- Physiological: Heart rate showed significant decrease pre- to post-treatment
- Cognitive and behavioral:
 - × Agitation Behavioral Scale (AGS) measures agitation levels. Agitation decreased overtime but was not considered significant. Each subject varied.
 - Cognitive and functional outcome measures (Rancho Los Amigos Scale & Functional Independent Measure) showed considerable improvement
- **Conclusion:** The study showed that Snoezlen therapy is helpful for children recovering from severe TBI, but more research for this population in the environment should be performed

Chelsea Montgomery



- Age: 9
- Sex: Female
- **Complaint:** Admitted through ER after high-speed MVA-head on collision with truck. Chelsea was a restrained front seat passenger.
- **Medical Hx:** Full-term infant weighing 9lbs. 1oz, delivered via cesarean. Healthy except for severe myopia. Good student; competitive gymnast, softball player, and participant in Girl Scouts and after-school program.
- **Nutrition Hx:** Parents indicate that patient had normal growth and normal appetite.

Medical Diagnosis

• Closed head injury secondary to MVA



- **General appearance:** 9-year-old female child alternating between crying and unconciousness
- Vitals: Temp: 97°F, BP 138.90 mm Hg, HR 100 bpm, RR 27 bpm
- Eyes: Pupils 4 mm reactive; no battle/raccoon signs
- Ears/Nose/Throat: Within normal limits
- **Neurologic:** GCS = 10 E4 V2 M4 (moderate injury). Obtundation and L-sided hemiparesis. No verbal responses. Withdrawal and moaning when touched

Anthropometrics:

- Height: 4'4" (52 inches)
- Weight: 61 lbs
- **Biochemical:** Albumin 3.3 g/dL, Prealbumin 15 mg/dL, Glucose 145 mg/dL, ALT 105 U/L, AST 111 U/L, Alk phos 261 U/L
- **Radiology**: Day 5-MRI shows areas of hemorrhagic edema in deep white matter of L frontal lobe anteriorly. Heme and edema found in the splenium of corpus callosum (ASK DEB)

- Drug nutrient interactions:
 - **Zantac:** Reduces the amount of acid the stomach produces, treats GERD. May increase the risk for deficiencies in calcium, iron, zinc, folic acid, and vitamin B12
 - **Tylenol:** Pain reliever and fever reducer
 - **Ibuprofen:** Reduces hormones that cause inflammation and pain in the body
 - **Zofran:** Blocks the actions of chemicals in the body that trigger nausea and vomiting.

- Usual dietary intake:
 - Breakfast: Cereal, juice, milk, toast
 - Lunch: At school cafeteria



- Snacks: Prior to gymnastics or softball practice: cookies, fruit, juice or milk
- Dinner: Meat, pasta, or potatoes, rolls or bread. Likes only green beans, corn, and salad as vegetables. Will eat any fruit
- 24 hour recall: NPO
- Food allergies/intolerances/aversions: No known allergies
- Vit/min intake: General multivitamin with iron

- Needs: 2180 kcals (Harris-Benedict equation), 55 g protein (2.0g/kg)
 - Overfeeding or underfeeding can be harmful
 - Monitor GCS improvement, to determine changes in energy requirements

Diagnosis

• PES Statement

- Swallowing difficulty (NC-1.1) related to closed head injury, fatigue, and decreased cooperation as evidenced by video fluoroscopy and speech/swallowing evaluation and choking after 5-7 ice chips.
- Increased protein needs (NI-5.1) related to catabolic state of head injury as evidenced by low albumin and prealbumin lab values on day 10 of hospital stay.

Intervention

- Recommendations for enteral feeding, nasograstric:
 - Nutren Jr. with fiber @ 25 ml/hr. ↑ 10 ml every 4-6 hrs to goal rate of 95 ml/hr via continuous drip X 16 hrs then gradually switch to bolus as patient tolerates. Start bolus q 4 hrs @ 60 ml; then ↑ 120 ml; then ↑ 340 ml.
 - × 2280 kcals
 - × 68.4 g PRO
 - × 1870 ml Water
 - × 100 ml flushes q 6 hrs.

 Bolus feeding: measure gastric residuals before each feeding and should be less than 150 ml (restrict water due to cerebral swelling?)

Patient Goals

• Outcome goal:

- ↑ serum protein levels within normal range
- Improve speech, physical and occupational health (speech, OT, PT)

• Action oriented:

 Nutrition counseling on behavior modification therapy, for both patient and family

- **Monitor all lab values**: Albumin, Prealbumin, Glucose, ALT, AST & Alk phos
- Evaluate: refferal to PT weekly; OT 3-5 X week and speech therapy 3-5 X week.

References

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