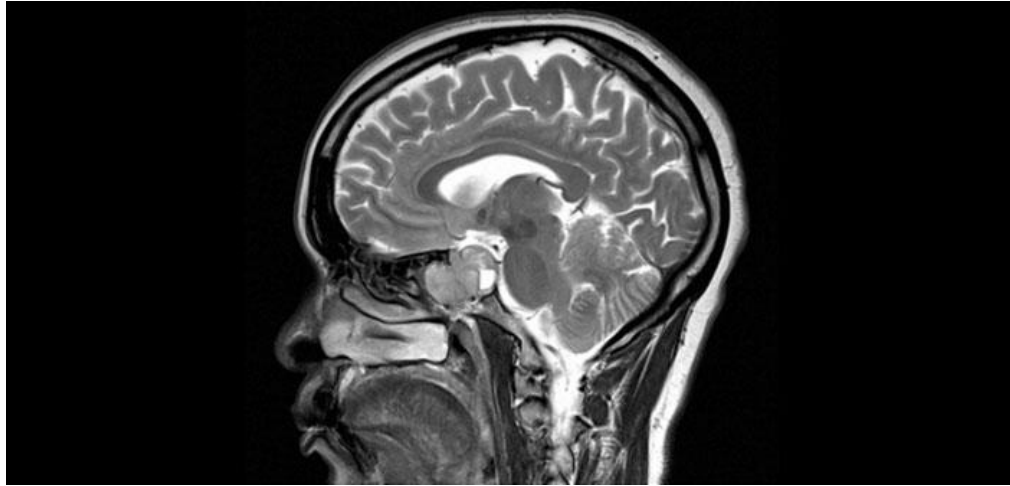


# **Pediatric Traumatic Brain Injury: Metabolic Stress with Nutrition Support**



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# Metabolic Stress:

- Hypermetabolic and/or catabolic response to acute injury or disease.
- The level varies with the severity of the injury
- Causes:
  - Trauma from gunshot wound
  - MVA
  - Closed head injury
  - Burns
  - Postsurgery

# Ebb Phase

- Ebb Phase (1st phase)
  - Begins immediately after injury
  - 2-48 hours
  - Shock resulting in hypovolemia
  - Decreased oxygen available to tissues
  - Decreased cardiac and urinary output
  - Insulin levels drop because glucagon is elevated
- Role of Ebb phase
  - Maintenance of blood volume, catecholamines
- Hormones involved
  - Catecholamines, cortisol, aldosterone

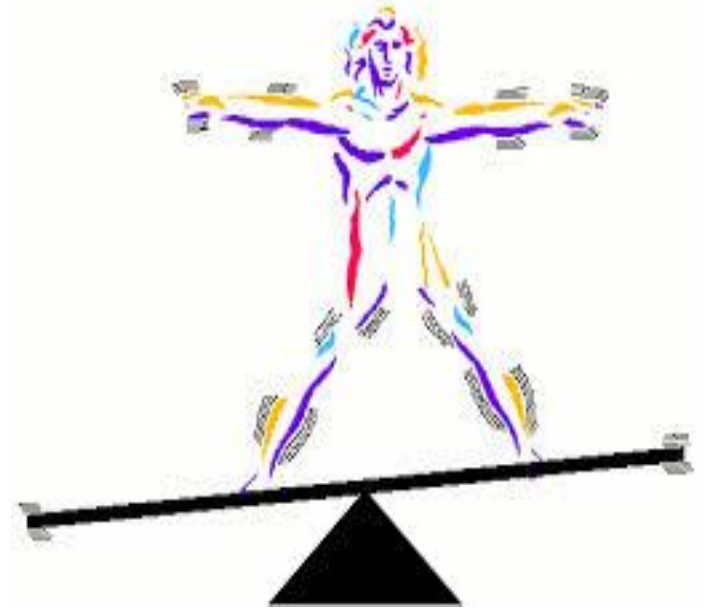


# Flow Phase

- Flow phase (2nd phase)
  - 3-10 days
  - Hypermetabolism, catabolism
  - Altered immune and hormonal response
  - Increases BMR, increase temperature, increase O<sub>2</sub> consumption
- Role of flow phase
  - Maintenance of energy
- Hormones involved
  - Increase Insulin, Glucagon, Cortisol, Catechol but insulin resistance.

# Recovery Phase

- Recovery phase (Anabolic)
  - 10-60 days
  - Return to anabolism and normal metabolic rate
- Role of Recovery Phase
  - Replacement of lost tissue and restoration of well being
- Hormones Involved
  - Growth hormone, IGF



# Traumatic Brain Injury (TBI):

- A violent assault to the brain from an external force
  - permanent or temporary impairment of cognitive, physical and psychological functions
  - Penetrating and closed-head injuries
- Primary Brain Injury
  - Actual penetration or violent contact (object striking head, concussion)
- Secondary Brain Injury
  - Occur as a result of primary injuries
  - May take days to present
    - Hematoma, hemorrhage, infection, edema



# Common Diagnostic Test or Procedures

## Neuroimaging techniques:

- X-Ray
- CT (computer tomography)
- MRI (magnetic resonance imaging)

## Physical test:

- Glasgow Coma Scale (GCS)

## Laboratory test:

- CMP
- Renal panel
- CBC



- Coagulation factors
- C-reactive protein

# Glasgow Coma Scale:

- A 3 to 15-point scale used to assess a patient's level of consciousness and neurological functioning .
  - 3-8 = Severe TBI
  - 9-12 = Moderate TBI
  - 13-15 = Mild TBI

Example: E2V2M3 = 7 (Severe)

<b>Glasgow Coma Scale (GCS)</b>
<b>Eye Response (1-4)</b>
1. No eye opening
2. Eye opening to pain
3. Eye opening to verbal command
4. Eyes open spontaneously
<b>Verbal Response (1-5)</b>
1. No verbal response
2. Incomprehensible sounds
3. Inappropriate words
4. Confused
5. Orientated
<b>Motor Response (1-6)</b>
1. No motor response
2. Stereotyped extension to pain
3. Stereotyped flexion to pain
4. Withdrawal from pain
5. Localizing pain
6. Obeys commands



# Common Therapeutic Procedures

- Mechanical ventilation
- Blood pressure medications
- Fluid resuscitation (IV drips)
- Enteral/Parenteral feeding



# Surgical Treatment

Depending level of injury:

Intracranial pressure and cerebral perfusion pressure will be monitored and treated as necessary

Severe head injury:

Removal or repair of hematomas and contusions



# Rehabilitation

In-house: Rehabilitation hospitals

Out-patient clinics: In home care setting

Require extensive health care team:

- Physical therapy
- Occupation therapy
- Speech therapy
- Nutrition therapy
- Kinesiotherapy
  
- Psychiatry
- Physical medicine



# Patient History: C.M.

- 8 yo, Female
- Height: 52” inches, Weight: 61 lbs
- PMH: Full-term infant weighing 9 lbs 1 oz, delivered via cesarean. No previous surgeries. Severe myopia (nearsightedness).
- Physical Activity: Competitive gymnast, softball player and a participant in Girl Scouts
- Meds: None, Kid’s Multivitamin
- Smoker, Drinker: No
- Family Hx: CAD, Diabetes



# Patient History: C.M.

## PI:

Admitted to ER on April 22nd, restrained front-seat passenger in a MVA, transferred PICU with TBI

## CC:

Non-verbal upon admission, alternating between crying and unconsciousness.

## PE:

CM has warm and dry skin with no signs of edema.

Abdomen is soft, diminished bowel sounds and a linear mark on her upper left quadrant.

Guarding (tension) throughout her body which is a sign of pain.

CM has a 2 cm laceration on her right knee and her deep tendon reflex is symmetric.

Vital signs: Temperature 97oF, BP 138/90, PR of 100, tachycardia, RR of 27.



# Medications

## CM Admission drugs:

D50.9NS with 10 mEq KCL @ 65mL/hr- Fluid, electrolyte and caloric replenishment.

Zantac 25 mg every 6 hours- Antacid

Tylenol 450 mg every 6 hours- Pain reliever

Zofran 2 mg via IV every 6 hours- Antiemetic agent

O2- Sat >95%- Prevent hypoxia, reduce pain, and breathing discomfort



# Patients Hospitalization

4/22- Glasgow Coma- 10 E4V2M4

4/22- CT Head- Two areas of bleeding: Left frontal lobe near vertex and left central-control language and sensory characteristics

4/22 Laboratory studies- Metabolic Stress- Ebb phase; increased Glucose, Bilirubin, Lactate, Fibrinogen and C-reactive protein

4/27- MRI head- Bleeding and edema deep white matter of left frontal lobe- regulation of B/P, body temperature and heart rate. Additionally bleeding and swelling in splenium of corpus callosum- cognitive and academic achievement

5/2- Fiberoptic Endoscopic Evaluation of Swallowing (FEES)/ Swallowing evaluation- showed appropriate tongue lateralization and chewing, but choked after 5-7 ice chips, fatigue and decreased cooperation

5/2- Laboratory studies- Metabolic Stress- Flow phase; decrease Protein, Albumin, Hemoglobin and Hematocrit. Increased Alkaline phosphatase, Fibrinogen, C-reactive protein.

5/2- Patient's weight 23kg or 50.6lbs, since admission date 4/22 has lost 10.4lbs

No surgeries

Upon discharge: OT/ ST/ PT/ Nutrition Therapy

# Nutrition Assessment

**PMH:** no medication (except for Gummy vitamin-Target brand)/ hospitalizations/ surgeries. Has severe myopia.

**Anthropometric data:** 8 year old; Ht: 52 inches; Weight: 61 lbs; BMI: 15.9

**CDC growth charts:** Stature: 75th-90th percentiles, Weight: 50th-75th percentiles, and BMI: 50th percentiles

## **Caloric need:**

Using Mifflin St. Jeor:  $10(27.7) + 6.25(132.08) - 5(8) - 161 \times (1.3) \times (1.4) = \mathbf{1641 \text{ kcal}}$

Using Harris Benedict:  $655.1 + 9.6(27.7) + 1.9(132.08) - 4.7(8) \times (1.3) \times (1.4) = \mathbf{2065 \text{ kcal}}$

Protein: 1.5-2.0 g/kg = **42-55g of protein**, Fluid: **1.7 L**

**Diet history:** Parents report that CM had normal growth and appetite

## **Usual dietary intake:**

AM: Cereal, milk, juice, toast

Lunch: At school cafeteria

Snack (before or after school activity): Granola bar, juice box, crackers

PM: Meat, pasta or potatoes, rolls or bread. Likes only green beans, corn, salad with Ranch dressing. Likes all fruit.



# Nutrition Assessment (cont.)

Nutrition consult on 4/22: Recommended enteral feeding Pediasure 1.5@ 10 mL/hr. Increased by 10 mL every 6 hours continuous drip.

Goal rate Pediasure 1.5@ 57 ml/hr continuous drip.

**Pediasure 8 fl. oz. can = 237 mL with 14g protein**

Fluid: 57 mL/hr x 24 hr = 1368 mL or **1.4L**

Calories: 1368 mL x 1.5kcal/mL = **2052 kcal**

Protein: 1368 mL x (14/237 mL) = **80.8g of protein**



# Nutrition Assessment:

On 5/2: I/O calculated; re-evaluate nutrition assessment; nitrogen balance

Total volume feeding (5/2): **1026 mL**

Total energy (5/2):  $1026 \text{ mL} \times 1.5 =$  **1539 kcal**

**75% of her caloric needs were met**

Total protein (5/2):  $1026 \text{ mL} \times (14/237 \text{ mL}) =$  **60.6g protein**

**75% of her protein needs were met**

24-hour urine sample was collected for nitrogen balance. Total urine urea nitrogen was 12g.

Nitrogen balance: Dietary protein intake  $((60.6\text{g})/6.25) - 12\text{g} - 4 =$  **-6.3 Negative nitrogen balance**

# Nutrition Diagnosis

1. Unintentional weight loss related to inadequate enteral feeding secondary to traumatic brain injury as evidenced by severe weight loss of 10.6 lbs in 11 days.
1. Swallowing difficulty related to mental impairment secondary to traumatic brain injury as evidenced by failed speech/swallow study.
1. Hypermetabolism related to metabolic stress secondary to traumatic brain injury as evidenced by laboratory studies; Total protein: 5.1g/dL (L), Alkaline phosphatase 138U/L (H).

# Nutrition Intervention

Nutrition Prescription: 5/3 Continue Pediasure 1.5 increases to 65 mL/hr continuous drip for total: 2340 kcal, 92.2 grams protein, 1.7 L (1560 mL + 150 mL water flushes)

1. For unintentional weight loss we would increase her Pediasure dosage to include more calories and protein to eliminate catabolism of essential nutrients. In addition increase her protein needs are concurrent with treatment of low protein levels as indicated in her labs
1. For swallowing difficulties we would continue enteral feeding until cleared for oral diet by speech/swallow study. We would like to keep the patient on continuous feeding until closer to discharge date where we would like to start bolus feeding until final transition to oral diet.
1. For hypermetabolism we would like to treat that with increased Pediasure dosage.

# Monitoring and Evaluation



Recovery phase: CM is transitioned onto soft mechanical diet:

5/14: oatmeal ¼ c; brown sugar 2 tbs; whole milk 1 c; 240 mL Carnation Instant Breakfast (CID) prepared with 2% milk; mashed potatoes 1 c; gravy 2 tbsp

**Total calories: 743 kcal with 31g Protein**

5/15: Cheerios 1 c; whole milk 1 c; 240 mL Carnation Instant Breakfast with 2% milk; grilled cheese sandwich (2 slices bread, 1 oz. American cheese, 1 tsp margarine); Jello-O c; 240 mL Carnation Instant Breakfast prepared with 2% milk

**Total calories: 1061 kcal with 39 g Protein**

Average: 902 kcal or **55% of her caloric needs**

Average: 39g protein or **74% of her protein needs**

# Monitoring and Evaluation (con't.)

Supplement soft mechanical diet with enteral feeding  
Bolus feeding, not continuous

New dosage: Pediasure 1.5 @ 69 mL/ feeding for 72 hours:  
828 kcal, 33 g protein, 522 ml of fluid

Re-evaluate in 72 hours determine if patient can tolerate  
increased diet

Continue if energy and protein needs are adequate





**KEEP  
CALM**

ITS

**QUESTION  
TIME**

# Question One

Which of the following test is used to assess a patient's level of consciousness and neurological functioning ?

- A. Ebb and Flow Test
- B. Glasgow Test
- C. Cerebral Perfusion Pressure Test
- D. Mifflin Test



## B. Glasgow Test

## Question Two

Which of the following is **NOT** a common therapeutic procedure for a patient suffering a TBI?

- A. Enteral/Parenteral Feeding
- B. Mechanical Ventilation
- C. Blood Pressure Medication
- D. Chemotherapy

## D. Chemotherapy

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