Traumatic Brain Injury:

A Case Study

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Introduction

The following case study will discuss the nutrition implications of traumatic brain injuries, as well as the patient's medical history, treatment, and progress.

Patient Profile and Social History

SB was a 14 year old Female from Anabella, Utah. SB had two younger healthy brothers and parents that were divorced but cordial to each other. SB was exposed to second hand smoke at home but had no significant medical family history.

Medical History

SB was admitted to the Pediatric Intensive Care Unit at Primary Children's Medical Center on September 26, 2012 after an All-Terrain Vehicle (ATV) roll-over accident. SB was admitted status post cardiac arrest with an anoxic brain injury and Glasgow coma score of 3, facial bruising, nasal bone fracture, rib fracture, liver laceration, moderate bilateral pneumothoraces, extensive pneumomediastinum, left heart shift, and pupils were fixed and dilated. SB was intubated, medically paralyzed, and sedated upon admittance. Previous to this admittance, SB had no past medical or surgical history other than mild scoliosis.

Traumatic Brain Injury and Nutrition Support

Traumatic brain injuries (TBI) are one of the leading causes of death in young people (1). The Brain Trauma Foundation has found that 1.5 million brain injuries occur each year, and 5.3 million Americans currently live with disabilities from TBIs (2). Traumatic brain injuries are categorized as blunt or penetrating. Blunt head injuries include concussions, fractures, or contusions. Penetrating head injuries are caused by objects such as fragments of explosive devices, bullets, or other such items that enter the brain by force (2). Primary and secondary injuries are associated with TBIs. Primary injuries describe the wound left from the TBI. Secondary injuries describe the effects of cerebral ischemia such as hypoxemia, hypotension, edema, intracranial pressure (ICP), seizures, and decreased perfusion

pressures (2). It appears that traumatic brain injury patients' prognoses are highly affected by nutrition support during hospitalization.

Patients (Pt) with severe TBIs experience hypermetabolism and increased protein catabolism due to factors such as posttraumatic stress response, infection, and a metabolic increase of glucose use in the brain. (1,3). It appears that as long as pts are receiving adequate nutrition, hypermetabolism is viewed as a critical component in repairing and replacing damaged tissues (2). When a patient's hypermetabolic needs are not met, the patient experiences higher rates of catabolism and muscle breakdown (2). It seems that patients that do not receive adequate or timely nutrition have increased morbidity and mortality rates (1,4). Malnutrition can sometimes result from the delay of nutrition support initiation and can lead to an increased risk of muscle wasting, infections, prolonged wound healing, and increased dependence on mechanical ventilation which affect morbidity and mortality rates (4). Adequate and timely nutrition opposes hypercatabolism that accompanies injury and inflammation (1,4). Patients with TBIs have been found to have metabolic rates ranging from 120%-250% of normal resting energy expenditure (4).

Patients under the stress of a traumatic brain injury have been found to excrete increased rates of Nitrogen during their healing process due to the hypercatabolic state, and increased skeletal muscle breakdown associated with such trauma (1). In most critically ill patients, 20% of their daily caloric intake is recommended to come from protein, whereas up to 30% daily caloric intake of someone with a TBI is recommended to come from protein to promote positive nitrogen balance and preservation of skeletal muscle(2).

Fluid and mineral balance is also crucial in TBI patients. Trace elements such as zinc, copper, iron, and selenium are excreted in increased amounts by TBI patients and must be monitored and replaced as needed to maintain optimal recovery and healing (2). Additionally, a serum sodium of 145-155 mEq/L is desired as a means to control intracranial and arterial pressures and is usually obtained by

administering normal saline solution or 3-5% saline solutions intravenously (2,3). In addition to avoidance of arterial hypotension hypoxemia, and high intracranial pressure, nutrition support may be as important an intervention in good prognoses (3).

It appears that that the initiation of nutrition support is more important than the type of nutrition support in terms of mortality and disability(3). The greatest outcomes in TBI patients seem to be associated with nutrition support provided within the first 5 days after the TBI regardless of the type feeding (enteral/parenteral) (3). Parenteral nutrition can often be initiated sooner than enteral, but may be associated with higher risks of infection and overfeeding (3). If enteral nutrition can be initiated within the first 5 days, it leads to similar positive outcomes and has additionally been found to help maintain the integrity of the stomach mucosa, cost less, improve immune function, reduce incidences of sepsis, and have fewer complications associated with it (1,3,4). R Hartl et al found a remarkable relationship between the nutrition given and death."Each 10 kilocalories (Kcals) per kilogram (kg) decrease in caloric intake is associated with a 30-40% increase in mortality (3)." It appears that TBI patients' prognoses are indeed highly affected by nutrition support during hospitalization and that nutrition support is crucial in the healing and recovery process.

Treatment and Progress

Immediately after her admission on September 26, 2012, SB underwent placement of a triple lumen central venous catheter as means of invasive hemodynamic monitoring, central venouse access, and administration of vasoactive medications. SB also underwent placement of a right radial arterial catheter to monitor blood pressure and for arterial access for frequent blood gas sampling. Additionally, a Kelly hemostat and 28 French thoracostomy tube was placed to relieve SB's pneumothorax.

Dietary Evaluations

SB had severe facial bruising due to the ATV accident but showed no clinical signs of nutrient deficiencies. SB was admitted at a high nutritional risk level because of the TBI admit diagnosis,

intubation, and diet order of nothing by mouth (Nothing per os, NPO). NPO diet order related to intubation, sedation, and paralytic. SB was well nourished prior to admit with a body mass index (BMI) in the 31st percentile.

Dietary needs were calculated upon admission using SB's actual body weight. For a patient (pt) that has a TBI but is intubated, sedated, and paralyzed, their Basal Metabolic Rate (BMR) is multiplied by 1.3 and 1.6 to provide an appropriate calorie range. For a 14 year old female in critical condition, 1.5 to 2.0 grams (g) of protein is recommended for every kilogram (kg) of body weight. Based on these guidelines, SB needs were 1,819 to 2,238 kilo-calories (kcals) daily,d 75 to 100g of protein daily, and 12-16g of nitrogen daily. Based on SB's actual body weight (ABW), 2100 milliliters (ml) of fluids were recommended on a daily basis.

On September 27, 2012 SB was started on enteral nutrition support of Impact with Fiber with a goal rate of 88ml per hour for 24 hours a day providing 2100ml/day of fluid, 2100 kcals/day (42kcals/kg), and 115.5g (2.3g/kg) protein daily. On October 3, 2012 SB's enteral feedings were increased to Impact with Fiber with a goal rate of 95ml/hr for 24 hours a day providing 2300ml/day of fluids, 2300kcals (46 kcals/kg), and 126.5g (2.5g/kg) protein daily. Increase in feeds due to pt extubation leading to increased caloric and protein needs . On October 6. 2012 SB was allowed clear liquids orally as tolerated.

SB weighed 50kg upon admit with a BMI of 18.37 which places SB in the 31%ile for BMI. SB had an elevated blood glucose which was due to the traumatic injury and systemic inflammatory response syndrome (SIRS). Aspartate Amino Transferase (AST) and Alanine Amino Transferase (ALT) were elevated because of SB's liver laceration. Albumin low due to dilution by fluids. Calcium, Magnesium, Phosphorus, Hematocrit and Hemoglobin also low due to dilution by fluids. A low Alkaline Phosphatase (ALP) in combination with trauma of a TBI may indicate a Zinc deficiency

Because of SB's TBI, SB was given a 500 milliliters (ml) 3% Sodium Chloride solution through an intravenous (IV) drip and 4ml of Norepinephrine every 33 hours to increase aterial blood pressure and

prevent the blood from pooling in the brain. To decrease inflammation, SB was given 650 milligrams (mg) of Acetaminophen every 4 hours. SB was given 1500 mg of Fentanyl to help control pain. In addition, SB needed to be sedated, and medically paralyzed to prevent further injury and was given 150mg every 30 hours of Midazolan and Vecuronium. In attempt to prevent pneumonia, pt was given 15 ml of Chlorhexidine every 12 hours. Heparin was given as needed to keep blood from clotting. Fosphenytoin was given in 80 mg doses every 8 hours to help prevent seizures and maintain arterial blood pressure. Magnesium Sulfate was given in 2000 mg doses every 6 hours to prevent diarrhea, pancreatitis, and renal disease. To help control nausea, SB was given 4 mg of Zofran every 8 hours. In addition, SB was receiving 50 mg of Zantac to help reduce stomach acid and, in turn, prevent stomach ulcers.

Patient diet history was unobtainable due to condition. A seven day calorie count was conducted from September 26, 2012 until October 2, 2012. On 9/26/2012 SB was NPO. On 9/27/2012 SB received 90ml of enteral formula. On 9/28/2012 SB received 68ml. On 9/29/2012 SB received 200ml. On 9/30/2012 SB received 1,190 ml. On 10/1/1012 SB received 2,024ml, and on 10/2/2012 SB received 2,112ml. The calorie count indicated an average of 812ml/day which provided 812kcals (16kcals/kg), 44g (.89g/kg) protein, and 16ml/kg fluid daily. Overall this average is inadequate to meet SB's needs, but did show daily progression and was meeting pt’s needs by post trauma day (PTD) six.

Summary and Conclusions

SB progressed off from her paralytic medications, sedatives, and mechanical ventilation before she was transferred out of the Pediatric Intensive Care Unit. She was awake and communicating frequently throughout the day and tolerating her Enteral Nutrition support. Her prognosis was good but her long term deficit was unknown.

Nutrition Notes

9/26/2012 Pt admitted with TBI. intubated, sedated, paralyzed and on vasopressors. BMI 31%ile appropriate for age. Elevated glucose due to injury/SIRS. Consider insulin if gluc remains above 180. Low ALP in combination with TBI may indicate Zn deficiency. AST/ALT elevated likely due to liver laceration. Tbil WNL. Noted possible bowel ischemia. Current diet order NPO. Upon diet advancement recommend Impact 2/fiber 87.5ml/hr x24hrs providing 2100ml/day fluids, 2100 kcals/day (42kcals/kg) and 115.5g (2.3g/kg) protein daily.

10/3/2012 Pt admitted w/TBI. No longer paralyzed, sedated, or intubated. No new weight measured. Gluc likely elevated due to stress. Hct Hgb likely low due to due to fluids. Noted high portein via RF, but not of concern because BUN is well WNL. 7 day calorie count indicates an average of 812ml/day providing 16 kcals/kg and 0.89g/kg protein which is not adequate to meet pt needs. Now that pt is extubated, increase feeds to Impact with Fiber 95 ml/hr x24hrs providing 46kcals/kg, 2.5g/kg pro and 46 ml/kg fluid. No additional free fluid needed. Recommend switching to Fibersource PTD 14 if diet does not advance.

PES Statements

9/26/2012 Increased energy expenditure related to physiological causes increasing nutrient needs due to maintenance of body temperature as evidenced by TBI and catabolism.

10/3/2012 Inadequate oral intake related to decreased ability to consume sufficient energy, nutrients as evidenced by brachial plexus injury of right upper extremity (pt is right handed) and concern for swallowing ability.

Goals

9/26/2012 Adequate intake to promote optimal growth and development for age/condition.

10/3/2012 Feeding Goal: Impact with Fiber 95ml/hr x24hrs providing 46kcals/kg, 2.5g/kg protein, and 46ml/kg fluids

Interventions

9/26/2012 IV fluids

9/26/2012 NPO

10/3/2012 Impact with Fiber 95ml/hr x24hrs providing 46kcals/kg, 2.5g/kg protein, and 46ml/kg fluids

Nutritional Recommendations

9/26/2012 Please initiate TF within 72hrs. If TF is not appropriate, consider TPN

9/26/2012 Please obtain Zn serum PTD 3-5 and provide supplementation if needed

9/26/2012 Please obtain actual wt (admit wt is estimated) when medically able

10/3/2012 Re-check Zn and CRP within 3-5days

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