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Original Research Paper

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TO STUDY OF THE PROPORTION AND PATTERN OF SELECTIVE MICRONUTRIENT AND MACRONUTRIENT DEFICIENCY IN TRAUMATIC BRAIN INJURY PATIENT ADMITTED IN NEUROSURGERY ICU

Dr. Ram Sevak	Mch Resident, Department Of Neurosurgery,sms Medical College, Jaipur. Rajasthan, India.
Dr. Surendra Jain	Assistant Professor, Department Of Neurosurgery, SMS Medical College, Jaipur. Rajasthan. India.
Dr. Arvind Sharma	Associate Professor, Department Of Neurosurgery, SMS Medical College, Jaipur. Rajasthan. India.
Dr. Vinod Sharma	Professor, Department Of Neurosurgery, SMS Medical College, Jaipur. Rajasthan. India.
Dr. Sanjeev Chopra	Professor, Department Of Neurosurgery, SMS Medical College, Jaipur. Rajasthan. India.
Dr. Achal Sharma	Professor, Department Of Neurosurgery, SMS Medical College, Jaipur. Rajasthan, India.

ABSTRACT

Aim: To study the proportion of selective micronutrient and macronutrient deficiency in traumatic brain injury. **Material And Methods:** A prospective observational Study performed at department of neurosurgery, SMS medical college, Jaipur.200 traumatic head injury patient of age 15 to 80 years admitted at neurosurgery trauma ICU with post resuscitation Glasgow coma scale (GCS) score of 3 to 8 (severe traumatic brain injury) were included in the study."Malnutrition Universal Screening Tool" (MUST) was used to assess the nutritional status of all subjects and it was classified as: no risk, moderate risk and high risk of malnutrition when MUST score was 0, 1 and ≥ 2respectively. Severity of TBI was classified into mild, moderate, and severe based on Glasgow Coma Scale (GCS) when it ≥13, 9 -12 and ≤ 8 respectively. Serum electrolytes were measured at time of admission in emergency before starting intravenous fluid and repeated at 24 hours after resuscitation and Serum electrolytes (serum sodium, potassium) were repeated at 24 hours after resuscitation and along with calcium, phosphate, B12. **Results:** Mild, moderate and severe TBI was revealed in 26%, 30.5% and 43.5% of the subjects respectively. All the nutrients intake viz. energy (kcal/d), protein (gm/d), CHO (gm/d) and fat (gm/d) was found to be significantly less among the TBI subjects. Macronutrients inadequacy viz. energy (kcal/d), protein (gm/d), CHO (gm/d) and fiber (gm/d) inadequacy was reported among 93.5%, 69%, 4.5% and 71.5% of the subjects respectively. **Conclusion:** Nutrition assessment upon admission of TBI patients could be a vital factor in identifying patients with malnutrition, and prevention from nutrition-related complications.

KEYWORDS :

INTRODUCTION:

Traumatic brain injury (TBI) can be defined as an intracranial injury due to an external force exerted on the brain. Acute and subacute TBI refer to the duration of post-injury<7 days and 8 days-3 months, respectively.[1] TBI patients who go to the emergencydepartment usually need to be hospitalized at least a night formonitoring, in which an increase in severity or disability can prolongthe length of stay (LOS). Malnutrition is expected as a commonsequel among hospitalized patients. Previously, the prevalence ofmalnutrition in hospitalized patients was reported to range from20% to 50%, but the prevalence of malnutrition among hospitalized TBI patients is still unknown.[2,3]

Generally, the injury causes abnormality of cellular metabolism, hormonal changes, and systemic inflammation response. Calorie expenditure among TBI patients usually increase by 87%-200% above the usual requirement and may be elevated for 30 days due to metabolic changes.[4] Hormonal changes increase the production of corticosteroids, counter-regulation hormones, and cytokines which may cause the patient to develop hyper-metabolism state.[5,6]Furthermore, a lot of physiological challenges may alter their calories needs.[7] The alteration of systematic catabolism of the body will lead to hyperglycemia, protein wasting and increased calories demands.[8]

The main consequences of traumatic injury in body composition are weight loss; consumption of lean body mass, mainly skeletal muscle mass; negative nitrogen balance; and water and salt retention. These basic alterations will leave these patients prone to immune depression and increased susceptibility to infection, sepsis, and generalized organ failure, leading to prolonged intensive care unit (ICU) and hospital stays and increased morbidity and mortality.[9]

The present study was conducted with the following objectives:

Primary objective:

To study the proportion of selective micronutrient and macronutrient deficiency in traumatic brain injury.

Secondary Objective:

1. To study the pattern of selective micronutrient and macronutrient deficiency in traumatic brain injury.
2. To study the relationship of micro and macro nutrient deficiency i.r.t. type of traumatic brain injury.

MATERIAL AND METHODS:

A prospective observational Study performed at department of neurosurgery, SMS medical college, Jaipur, After Institutional Ethical approval and written informed consent, prospective observational study was conducted at Trauma Centre, SMS medical college from July 2021 to March 2022. 200 traumatic head injury patient of age 15 to 80 years admitted at neurosurgery trauma ICU with post resuscitation Glasgow coma scale (GCS) score of 3 to 8 (severe traumatic brain injury) were included in the study. Patients with a history of end-organ dysfunction, hypertension, endocrine disorder, history of allergy, pregnancy and on chronic diuretic therapy were excluded. From the date on which the institutional ethics committee clearance is obtained, till sample size is obtained or for a maximum of 9 months.

The severity of head injury was assessed with Glasgow coma scale (GCS) and type of injury was assessed by head computed tomography (CT). "Malnutrition Universal Screening Tool" (MUST) was used to assess the nutritional status of all subjects and it was classified as: no risk, moderate risk and high risk of malnutrition when MUST score was 0, 1 and ≥ 2 respectively.[10] Severity of TBI was classified into mild, moderate, and severe based on Glasgow Coma Scale (GCS) when it ≥13, 9-12 and ≤ 8 respectively.[11]

Serum electrolytes (serum sodium, potassium) were measured at time of admission in emergency before starting intravenous fluid and repeated at 24 hours after resuscitation and Serum electrolytes (serum sodium, potassium) were repeated at 24 hours after resuscitation and along with calcium, phosphate, B12. All parameter were measures weekly till discharge. All investigation done at laboratory at SMS medical college, Normal reference range for sodium is 130-145 mEq/L, for potassium is 3.5-5.5 mEq/L, for calcium 8.8-10.5 mg/dL and for Phosphate 2.5-4.5 mg/dL. Outside this range considered as electrolyte imbalance.

The data was collected and subjected to statistical analysis.

Statistical Analysis:

Data so collected was tabulated in an excel sheet, under the guidance of statistician. The means and standard deviations of the measurements per group were used for statistical analysis (SPSS 22.00 for windows; SPSS inc, Chicago, USA). For each assessment point, data were statistically analyzed using one way ANOVA. Difference between two groups was determined using student t-test as well as chi square test and the level of significance was set at $p < 0.05$.

RESULTS:

Out of 200 subjects, 68.5% were males and 31.5% were females. Maximum subjects were from the age group of 31-45 years (62%). Mild, moderate and severe TBI was revealed in 26%, 30.5% and 43.5% of the subjects respectively. Most common cause of TBI was road traffic accident (69.5%) as shown in table 1.

All the nutrients intake viz. energy (kcal/d), protein (gm/d), CHO (gm/d) and fat (gm/d) was found to be significantly less among the TBI subjects when compared to recommended daily allowance (RDA) as $p<0.05$ (table 2).

It can be appreciated from table 3 that energy, protein, CHO and fat intake werenegatively affected by the severity of trauma.

Macronutrients inadequacy viz. energy (kcal/d), protein (gm/d), CHO (gm/d) and fiber (gm/d)inadequacy was reported among 93.5%, 69%, 4.5% and 71.5% of the subjects respectively (table 4).

It was found that serum sodium was significantly directly correlated with the severity of trauma. Mean calcium level was found to be least in severe TBI subjects followed by moderate and mild. When mean calcium level was compared according to severity of TBI using anova test, significant difference was found. No significant association was found between the severity of TBI and serum potassium as well as phosphate level (table 5).

DISCUSSION:

Nutritional needs for the brain at both macro and micro-levels have been well reported and concluded that nutrient-dense diets that supply ample levels of vitamins, minerals, antioxidants, and essential fatty acids are beneficial and should be recommended for betterment.[12] The present study was conducted to evaluate the pattern of micro and macro nutrient deficiency in traumatic brain injury and also the relationship of micro and macro nutrient deficiency i.r.t. type of traumatic brain injury.

Out of 200 subjects, 68.5% were males and 31.5% were females. Maximum subjects were from the age group of 31-45 years (62%). Most common cause of TBI was road traffic accident (69.5%) in the present study. The severity and type of injury correlated to the degree of catabolic state, as categorized by Glasgow Coma Scale (GCS) score, which ranges from 15(fully conscious) to 3 (near death). We found that 43.5% of the patients enrolled in our study were under severe TBI status, which is supported by Krakauet al[13]. They reported that 50% of the enrolled patients in their study were within the lowest range of GCS (3 to 5) which represents severe TBI. Another study alsoshowed that there is a significant association with poorer admission GCS SCORE, and the clinical features of malnutrition in TBI subjects (Dhandapani et al).[14]

All the nutrients intake viz. energy (kcal/d), protein (gm/d), CHO (gm/d) and fat (gm/d) was found to be significantly less among the TBI subjects when compared to recommended daily allowance (RDA) as $p<0.05$. In our study; energy, protein, CHO and fat intake were negatively affected by the severity of trauma. Protein intake is reduced in severe TBI as the whole food intake is reduced, that's might be because severe injury required more time to cure as well as mouth muscles and esophageal muscle integrity and swallowing control process have an effect on protein as well as other nutrients intake. Macronutrients in adequacy viz. energy (kcal/d), protein (gm/d), CHO (gm/d) and fiber (gm/d) inadequacy was reported among 93.5%, 69%, 4.5% and 71.5% of the subjects respectively in this study.

In a study by Ghazi Daradkehet al[15], it was found that protein intake was deficient (71.0%) and varies as per severity of injury in TBI patients ($p < 0.0001$). They have also shown that the TBI patient's intake of macronutrients and fiber were deficient with regards to RDA. Energy and protein intake correlated with the severity of trauma as predicted by the GCS.Studies showed that protein intake of TBI subjects could be below the recommended daily intake, which is based on the severity of injury (HadisSabour)[16], which supports our present findings. Generally, the mean recommended dietary intake of fiber is 35 g/d for men and 25 g/d for women (Tomeyet al)[17]. The mean fiber intake in our patient cohort was significantly below the adequate recommendation ($p=0.001$). Walter et al[18] and Tomey et al[17] reported similar findings in their study population. Furthermore, they recommended to nutritional education sessions to enhance fiber intake by focusing on high –fiber breakfast cereals and encouraging regular consumption of fruits and vegetables.

Nutrient deficiency in TBI could be due to insufficient dietary intake. Dietary intake might be affected by several factors including anorexianervosa due to anxiety or depression, mouth muscle weakness,chewing difficulty, dysphagia and reduction in appetite sensation as a result of: changes in cytokines, glucocorticoids,insulin and insulin-like growth factors.Dysphagia, or swallowing difficulty, is considered as one of the common problem following severe traumatic brain injury.It has been reported that it is as high as in adults (60%) and in pediatric patients (68%). Several risk factors include the severity of the injury,abnormal tongue control, and presence of a tracheostomy,feeding tubes and mechanical ventilation for more than 2 weeks leads to dysphagia following head injury.Several cognitive issues include sensory reception,memory deficit, attention span and problem solving/judgment could affect on the management of dysphagia in TBI patients. Swallowing impairments were commonly reported as a cause of malnutrition in severe head injury patients (Krakau et al)[13]. Malnutrition is a common and dangerous health problem and it can be defined as inadequate or imbalanced nutritional intake, with adverse effects on physiological function and clinical outcome (Stratton et al).[19]Denes et al[20] reported that 68% of severe brain injury was developed malnutrition with its serious complications including pressure sores and infections[3].

It was found that serum sodium was significantly directly correlated with the severity of trauma. Mean calcium level was found to be least in severe TBI subjects followed by moderate and mild. When mean calcium level was compared according to severity of TBI using anova test, significant difference was found. No significant association was found between the severity of TBI and serum potassium as well as phosphate level in the present study.

The limitation of this study was inability of some participants to remember exactly his food intake forthe previous day and sample size was low and this study results are not representative ones.

We believe that result of our study could give some input for better understanding of the role of nutritional status in TBI and the importance of nutritional assessment and intervention in TBI.

CONCLUSION:

In conclusion, the balance of macronutrients was shifted toward fat intake, while energy, protein and fiber intake were significantly deficient. Energy and protein intake correlated with the severity of trauma as predicted by The GCS. Nutrition assessment upon admission of TBI patients could be a vital factor in identifying patients with malnutrition, and prevention from nutrition-related complications.

Table 1: Demographic Characteristics Of The Study Population

Variables	N=200	%
Gender		
Male	137	68.5
Female	63	31.5
Age Group (in years)		
15-30	61	30.5
31-45	104	62
>45	35	17.5
TBI		
Mild	52	26
Moderate	61	30.5
Severe	87	43.5
Etiology		
RTA	139	69.5
Fall from Height	61	30.5

Table 2:Nutrients Intake Of TBI

Nutrients	Mean	SD	RDA		p value
			Mean	SD	
Energy (kcal/d)	2104.37	34.69	2363.81	42.95	0.038*
Protein (gm/d)	79.62	6.83	91.04	4.78	0.007*
CHO (gm/d)	331.57	7.01	248.45	6.22	<0.01*
Fiber (gm/d)	24.49	2.38	-	-	
Fat (gm/d)	20.06	0.78	61.68	0.41	<0.01*

*: statistically significant

Table 3: Nutrients Intake According To Severity Of TBI

Nutrients	Mild		Moderate		Severe		p value
	Mean	SD	Mean	SD	Mean	SD	
Energy (kcal/d)	2358.2	30.87	2139.13	37.64	1945.41	32.81	0.028*
Protein (gm/d)	85.09	6.21	81.42	5.71	76.94	7.37	0.006*
CHO (gm/d)	343.48	7.18	330.81	6.93	319.77	7.08	0.003*
Fat (gm/d)	29.11	0.86	22.42	0.81	17.32	0.75	<0.01*

*: statistically significant

Table 4: Proportion Of Subjects Having Macronutrients Inadequacy

Variables	N=200	%
Energy (kcal/d)	187	93.5
Protein (gm/d)	138	69
CHO (gm/d)	9	4.5
Fiber (gm/d)	143	71.5

Table 5: Electrolytes And Other Parameters According To Severity Of TBI

Variables	Mild		Moderate		Severe		p value
	Mean	SD	Mean	SD	Mean	SD	
Serum Sodium (MEq/L)	138.92	11.53	147.31	10.27	164.58	12.44	0.007*
Serum Potassium (MEq/L)	3.98	1.72	4.31	1.39	4.49	1.87	0.09
Calcium	8.9	2.12	8.26	1.85	7.08	2.06	0.021*
Phosphate	3.11	0.55	3.36	1.03	3.32	0.97	0.22

*: statistically significant

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