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ASSESSMENT OF ADEQUACY OF PROTEIN INTAKE IN ENTERAL FEEDING PATIENTS WITH NEUROLOGICAL PROBLEMS

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ABSTRACT

Introduction: Enteral tube feeding can provide sole source of nutrients in patients who cannot eat orally. In order to get adequate nutrients, it is essential to choose enteral feeding formula correctly and provide sufficiently.
Aims: Therefore this study was carried out to determine the adequacy of protein intake with blenderized tube feeding diet in comparison to traditional tube feeding diet by studying nitrogen balance.
Methods: This study was conducted on 25 participants with neurogenic dysphagia who had been admitted to Kwe Ka Baw Hospital at Yangon. The participants were divided into three groups: the first group who received 1800 ml/d of traditional tube feeding diet (Group T, n = 10), the second group was supplied with 1500 ml/d of blenderized tube feeding diet (Group B1, n = 9) and the third group was supplied with 2000 ml/d of blenderized diet (Group B2, n = 6). The nitrogen balance study was done on day 4, day 5 and day 6 of enteral feeding.
Results: The mean nitrogen balance of Group T was profoundly negative (-7.3 g/d) and of Group B1 was still negative (-2.6 g/d). The nitrogen balance of Group B2 improved to positive balance (0.6 g/d). In conclusion, the protein intake was inadequate with traditional tube feeding diet and 1500 ml/d of blenderized tube feeding diet. The protein intake was adequate with 2000 ml/d of blenderized tube feeding diet.
Conclusion: Based on the result of this study, the blenderized tube feeding diet with 2000 ml/d intake should be recommend to use for enteral feeding patients with underlying neurological problems.

Keywords: Enteral Nutrition, Traditional tube feeding diet, Blenderized tube feeding diet, Protein intake, Nitrogen balance

INTRODUCTION

Malnutrition is commonly found in patients with neurological diseases. A large group of neurological disease patients were malnourished and at risk of becoming malnourished at the time of hospital admission [1]. This malnutrition in neurological diseases is strongly associated with adverse outcomes [2-4]. There are a lot of factors in neurological diseases which are associated with reduction in intake [5]. Among these factors, dysphagia; difficulty in swallowing is the most frequent cause of impaired oral intake and the most important cause of malnutrition in neurological patients [6].

The feeding method is very important for patients with dysphagia to provide adequate nourishment [7]. Enteral feeding via a tube can provide sole source of nutrients in patients who cannot consume adequate caloric intake orally [8]. The enteral tube feeding formula or diet is one of the most important things in

order to receive adequate nutrition in enteral tube feeding patients. There are a wide variety of enteral tube-feeding formulae ranging from home made blenderized diet to commercially available enteral formulae [9].

In Myanmar, commercial tube feeding formulae have to be imported from other foreign countries and so they are very expensive that enteral tube feeding patients at Myanmar cannot feasible to use commercial formula effectively. According to previous survey on current enteral feeding practice in Myanmar among neurological-diseased patients, they found out that they were using diluted commercial formula (this means they didn't follow the instruction on the package of commercial formula and add more water and less powder), homemade chicken broth and rice porridge [10].

Recently, a blenderized tube feeding diet which was formulated with local Myanmar ingredients was introduced. This blenderized tube feeding diet contains balance and complete nutrition with low cost. Therefore this study was carried out to determine the adequacy of protein intake with this blenderized tube feeding diet on nitrogen balance in comparison to traditional tube feeding diet.

METHODS

This study was approved by the Mahidol University Central Ethical Institutional Review Board (COA No.MU-IRB 2016/172.2912). This study was carried out at Kwe Ka Baw Hospital, Yangon, Myanmar. This hospital is a private hospital and specialized for neurological diseases. Patients with neurological problems, who had been admitted to this hospital during study period from 1, January, 2017 to 30, March, 2017 were included for this study. The inclusion criteria were patients aged 35 to 80 years, patients who required hospital admission and enteral tube feeding for at least seven days. The participants would be excluded if they required intensive care, they had liver disease, renal disease and multiple injury. The participants who had been admitted during the first month of study period was allocated into traditional tube feeding group (Group T) and received 1800 ml/d of traditional tube feeding diet. The participants who had been admitted during the second month was allocated into blenderized tube feeding group with 1500 ml/d intake (Group B1) and received 1500 ml/d of blenderized tube feeding diet. The participants who had been admitted to hospital during the last month was allocated into blenderized tube feeding group with 2000 ml/d intake (Group B2) and received 2000 ml/d of blenderized tube feeding diet.

All the participants were supplied with their enteral feeding diet for 7 days and studied nitrogen balance on day 4, day 5 and day 6 of enteral feeding. The tolerability to enteral feeding with blenderized tube feeding diet was assessed by measuring the gastric residual volume and monitoring the gastrointestinal signs and symptoms such as vomiting, absent of bowel sound, bowel distension and diarrhea throughout the 7 days of study period.

Traditional tube feeding diet was food that had been commonly used for enteral tube feeding at Myanmar. These foods may contain chicken broth, rice porridge and commercial formula without any standard recipe and procedure for preparation. Blenderized tube feeding diet was food that has been liquidized by using an electric blender. The blenderized diet will be prepared according to standard procedure and recipe by using fresh ingredients. The ingredients and nutrients value of 1000 ml of blenderized tube feeding diet was showed in Table 1. The participants in Group T were given enteral feeding by bolus feeding methods and they received 200 ml every 2 hours for 9 times per days. The participants in Group B1 and Group B2 were given by gravity drip method and they received 300 ml for Group B1 and 400 ml for Group B2 every 4 hours for 5 times per days.

If the participants used the commercial formula, the protein intake was calculated by using nutrition facts information of this commercial formula. If the participants used homemade soup, the protein intake was calculated by using INMUCAL-Nutrients V 3. The protein intake of the blenderized tube feeding diet was calculated based on the protein value of the blenderized formula and the amount of the blenderized formula. Urinary urea nitrogen was measure by using enzymatic calorimetric test and

multiplied with 24 hours urine volume. The addition of constant factors (2 + 2) to nitrogen output represented the fecal and other miscellaneous nitrogen loss and non-urea urinary nitrogen loss [11, 12]. Nitrogen balance was studied for three consecutive days and mean of these three days was taken in order to minimize the day to day within-subject variation for urinary nitrogen excretion [13].

Table 1 Ingredients and nutrient values* of 1000 ml of blenderized diet

Ingredients	Amount	Energy (kcal)	Carbohydrate (g)	Fat (g)	Protein (g)
Banana	120 g	146	35	0	1
Carrot	100 g	41	8	0	2
Chicken Breast	100 g	219	2	11	27
Hen egg (whole)	100 g	134	1	9	13
Peanut oil	15 g	133	0	15	0
Sugar (Brown)	60 g	222	57	0	0
Red Lentil	50 g	179	32	1	12
Table Salt	1.5 g	0	0	0	0
	Total	1075	135	36	55
	Energy Distribution		50%	30%	20%

*Nutrient values were calculated by using INMUCal-Nutrients V3

Nitrogen Balance Study

Nitrogen balance was calculated by using following equation.

Nitrogen balance = Nitrogen Intake – (Nitrogen output + 2 + 2)

Nitrogen balance = (Protein intake (g/d))/6.25 – (Urinary urea nitrogen (g/d) + 2 + 2)

All the statistical analysis was done by using the Statistical Package for the Social Science software (IBM SPSS software version 20). The significant differences of continuous outcome variables between two groups were tested by using one way analysis of variance if outcome variables were normally distributed or Kruskal-Wallis test if outcome variables were non-normally distributed. The significant differences of categorical variables were tested with chi-square test. P-value less than 0.05 was considered as statistical significant.

RESULTS

This study was carried out with 10 participants in Group T, 9 participants in Group B1 and 6 participants in Group B2. Their baseline characteristics and anthropometric measurements were showed in Table 2. Most of the participants were suffered from cerebral infarct and followed by intracranial hemorrhage. Body weight and height of most of the participants were calculated from knee height and mid arm circumference because they cannot stand up properly and limited facilities to measure body weight. These parameters were not different significantly between three groups. The mean energy and protein intakes of Group T were significantly lower than the other two groups, Group B1 and Group B2.

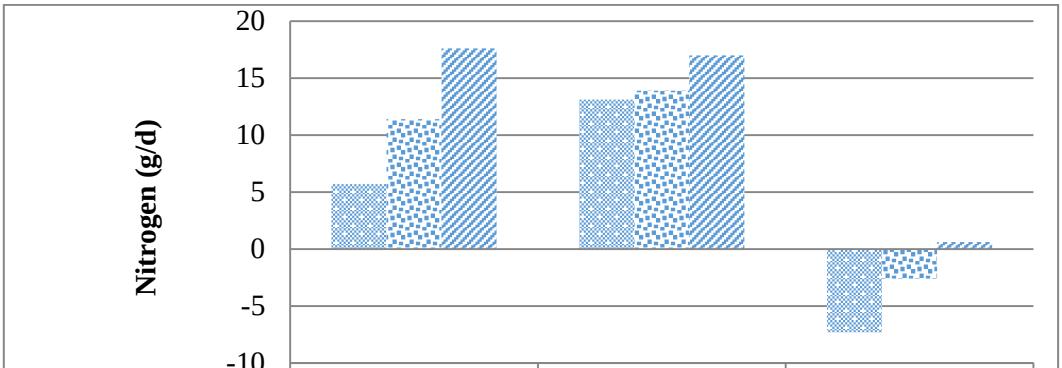
The comparison of nitrogen intake, nitrogen output and nitrogen balance between three study groups were showed in Figure 1. One participant from group B1 was suffered from hematuria and one participant from Group B2 was suffered from urinary tract infection on urine collection day and the nitrogen outputs of these particular days were excluded from analysis. The nitrogen balance of Group T was profoundly negative (-7.3 g/d). The nitrogen balance of Group B1 was less negative (-2.6 g/d) and the nitrogen balance of Group B2 was improved up to positive balance (0.6 g/d). The nitrogen intake, nitrogen output and nitrogen balance of three study group were significantly different from each other.

Gastrointestinal symptoms of patients during blenderized tube feeding were shown in Table 3. There was no case of vomiting and large gastric residual volume. One participant developed diarrhea and one participant developed abdominal distension. Two participants developed abdominal bloating together with constipation. Nine participants got constipation during the study period. All the participants were well tolerated to both 1500 ml/d and 2000 ml/d of blenderized tube feeding diet.

Table 2 Baseline characteristics and anthropometric measurements of three study groups

	Group T (n = 10)	**Group B1 (n = 9)**	**Group B2 (n = 6)**
Age (years)	61 ± 13.1	63 ± 11.1	65 ± 11.4
Gender			
Male	5 (50%)	4 (40%)	4 (67%)
Female	5 (50%)	5 (60%)	2 (33%)
Diagnosis			
Cerebral Infarct	6 (60%)	5 (60%)	5 (83%)
Intracranial Hemorrhage	3 (30%)	4 (40%)	-
Tuberculous Meningitis	-	-	1 (17%)
Tentorial Tumor	1 (10%)	-	-
Treatment			
Conservative	8 (80%)	6 (67%)	5 (83%)
Surgery	2 (20%)	3 (33%)	1 (17%)
GCS	12 ± 1	12 ± 2	11 ± 2
Knee Height (cm)	44.6 ± 2.8	45.4 ± 1.1	47.5 ± 2.3
MAC (cm)[1]	26.2 ± 4.2	27.1 ± 3.0	28.1 ± 4.1
Weight (kg)[2]	53.4 ± 14.1	56.6 ± 9.6	62.2 ± 11.8
Height (cm)[2]	150.9 ± 5.7	152.0 ± 3.7	156.7 ± 6.3
BMI (kg/m^2) [3]	23.2 ± 5.1	23.9 ± 3.2	25.5 ± 5.4
Energy Intake			
kcal/d	934.3 ± 245^a	1484 ± 0^b	1996 ± 0^c
kcal/kg/d	17.8 ± 3.9^a	25.8 ± 5.1^b	33.5 ± 9.1^c
Protein Intake			
g/d	36.3 ± 13.6^a	66 ± 0^b	102 ± 0^c
g/kg/d	0.7 ± 0.2^a	1.2 ± 0.2^b	1.7 ± 0.5^c

Values are number (percentage) or mean ± SD;
No significant difference in all baseline characteristics and anthropometric data among three groups.
Different superscripts denote significant differences between groups.
[1]MAC = Mid Upper Arm Circumference
[2] Weight and height were calculated from knee height based on the formula:
For Men: Weight (kg) = Knee height x 1.10 + MAC x3.07 – 75.81;
Height (cm) = (2.08 x knee height) + 59.01
For Women: Weight (kg) = Knee height x 1.01 + MAC x 2.81 – 66.04;
Height (cm) = (1.91 x knee height) – (0.17 x age) + 75.00
[3] BMI = Body Mass Index



	Nitrogen Intake (g/d)	Nitrogen Output (g/d)	Nitrogen Balance (g/d)
Group T (n = 10)	5.7	13.1	-7.3
Group B1 (n = 9)	11.4	13.9	-2.6
Group B2 (n = 6)	17.6	17	0.6

Different superscripts denote significant differences between groups.

Figure 1 Comparison of nitrogen intake, nitrogen output and nitrogen balance between three study groups

Table 3 Gastrointestinal Symptoms of Participants during Blenderized Tube Feeding

GI symptoms	Group B1 (n = 9)	Group B2 (n = 6)	Total (n = 15)
Vomiting[1]	0 (0%)	0 (0%)	0 (0%)
Abdominal Distension[2]	1 (11%)	0 (0%)	1 (7%)
Large Gastric Residual Volume[3]	0 (0%)	0 (0%)	0 (0%)
Diarrhea[4]	1 (11%)	0 (0%)	1 (7%)
Abdominal bloating	1 (11%)	1 (17%)	2 (13%)
Constipation[5]	4 (44%)	5 (83%)	9 (60%)

[1]Vomiting: any visible regurgitation of gastric contents
[2]Abdominal distension: visible increased in abdominal girth
[3]Large GRV: more than half volume of previous feeding
[4]Diarrhea: liquid stool more than 3 times per day
[5]Constipation: less than 1 evacuation during 3 days

DISCUSSION

Nitrogen balance study is very useful method in assessing the adequacy of protein intake. It is an old method used in protein metabolism study for long time ago but it is still gold standard in assessing the protein requirement. Negative nitrogen balance means nitrogen output exceeded nitrogen intake and assumed that protein intake was inadequate. Positive nitrogen balance means nitrogen intake exceeded nitrogen output and assumed that protein intake was adequate [14].

The nitrogen intake of Group T (5.7 g/d) was much lower than its nitrogen output (13.1 g/d) and their nitrogen balance was profoundly negative (-7.3 g/d). Therefore it is implied that the protein intake of Group T was inadequate. In our study, the protein intake with traditional tube feeding diet was 36.3 g/d and this was in accordance with previous study conducted by Hsu Mon MZ at Yangon General Hospital who found out that protein intake was 36 g per day among enteral feeding patients with neurological problem [10]. Current situation at Myanmar, because of disproportionate doctors-patients population

and low expenditure of health, there was no hospital food service and nutritional support lagged behind the other care [15, 16]. For the enteral feeding also, the health care professionals can give only recommendation and instruction and let the patients' caregiver give the enteral feeding. That is why inappropriate use of enteral feeding formula occurred and patients received inadequate nutrients intake. For the Group B1, the nitrogen output (13.9 g/d) was higher than their nitrogen intake (11.4 g/d) and their nitrogen balance was still negative (-2.6 g/d). This result indicated that the protein intake (1.2 g/kg/d) with 1500 ml/d of blenderized tube diet was still inadequate for patients with neurological diseases. In the study conducted by Pailin Santivoranan with head injury patients, they got positive nitrogen balance (3.58 g/d) with nitrogen intake of 12.96 g/d [17]. In their study, their participants were supplied with 1800 kcal/d. But in our study, the participants in Group B1 received only 1484 kcal/d of energy. The negative nitrogen balance of Group B1 might be due to the provided energy from tube feeding was not enough. The more protein was used as source of body energy need when dietary calorie was limited [11, 18]. So nitrogen equilibrium cannot achieve with low calorie intake although protein intake was high enough.

When the intake was increased to 2000 ml/d of blenderized diet in Group B2, the nitrogen intake (17.6 g/d) became equilibrium with nitrogen output (17.8 g/d) and almost positive nitrogen balance (0.6 g/d) was obtained. In a study conducted by Wada and colleagues, they got positive nitrogen balance with protein intake of 1.1 g/kg/d [19]. But they studied with subacute and chronic stroke patients who didn't had any other complication. In our study, the participants were in acute state and most of them were in stress conditions such as surgery, infection and fever [20, 21]. So urine urea nitrogen excretion was high due to catabolism and more protein intake was required to compensate these hypermetabolic reactions.

In our study, all of the participants were well tolerated to blenderized tube feeding. This result was in accordance with the study conducted by Sukumar and colleagues[22]. They also found out that their blenderiezed diet was well tolerated by hospitalized patients and there was also no case of nausea, vomiting and malabsorption. The abdominal bloating was most probably due to fiber content of lentil, banana and carrot. The gas producing effect of fiber was thought to contribute in abdominal bloating [23]. The constipation might be due to inadequate water intake. In our study, 60 ml of water before and after feeding (600 ml per day) according to the A.S.P.E.N guideline was recommended. [24] However, it was not clear whether caregivers fed water according to our suggestion or not. Immobility of our participants also contributed to this high incident of constipation [25].

CONCLUSION

In conclusion, our study showed that the protein intake with traditional tube feeding diet was very low and this was inadequate for patients on enteral nutrition due to neurological problems because it got highly negative nitrogen balance. If this condition was not correct, this can easily lead to malnutrition and result in adverse outcomes. The blenderized tube feeding diet could increase protein intake and improve nitrogen balance. But it was important to provide an adequate amount of blenderized tube feeding diet. According to result of nitrogen balance of our study, protein intake was still inadequate with 1500 ml/d of blenderized diet and needed to supply 2000 ml/d to achieve positive nitrogen balance. The participants were still well tolerated up to 2000 ml/d of blenderized diet. Based on the result of this study, the blenderized tube feeding diet with 2000 ml/d intake should be recommend to use for enteral feeding patients with underlying neurological problems.

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