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Complications of enteral tube-fed patients at home

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ABSTRACT

Objective: Home enteral tube feeding (HETF) is a life-sustaining and vital form of treatment for medically stable patients who have functional gastroinstestinal tracts and do not need hospitilazation but can't meet their nutritional requirements with oral intake. However, this intervention is not without its complications. This study aimed to assess the nutritional status of adult patients undergoing HETF and to investigate the prevalence of nutrition-related complications.

Methods: A prospective study was conducted, with each HETF patient monitored over a 28-day period. Data regarding patient descriptive characteristics, HETF characteristics, biochemical parameters, anthropometric measurements, and occurrences of nutrition-related complications were collected and analyzed.

Results: The study enrolled 22 patients, comprising 10 males (mean age: 68.8±11.7 years) and 12 females (mean age: 67.7±13.7 years). Malnutrition was observed in 31.8% of patients. Inadequate intake of dietary fiber, vitamin D, vitamin K, potassium, and magnesium was noted. Gastrointestinal complications were prevalent in 77.3% of patients, followed by metabolic complications in the same proportion, mechanical complications in 50% of cases, and pressure ulcers in 45.5% of cases. Factors such as gender, age, feeding position, feeding route, type of product consumed, and fiber content did not significantly influence the incidence of gastrointestinal complications.

Conclusions: Complications associated with HETF were common among the study population. The findings underscore the necessity of a specialized multidisciplinary team to ensure effective HETF management and to mitigate or prevent associated complications.

Keywords: home enteral tube feeding, malnutrition, complication, nutritional status

Introduction

Enteral tube feeding (ETF) is a life-sustaining nutritional therapy in which nutrients are delivered directly into the gastrointestinal tracts via tubes to stable patients with functional gastrointestinal tracts but unable to meet their nutritional requirements with oral intake.[1,2] Keeping the patient in the hospital only for nutritional therapy is inappropriate in terms of bio-psycho-social and economically costly for health institutions and society.[3] Therefore, Home Enteral Tube Feeding (HETF) treatment can be applied to the patients who are medically stable and do not need hospitalization.[2]

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HETF has been described as a safe and effective nutritional intervention since its introduction in the 1970s.[4] The annual prevalence of HEN in the US has increased from 463 per million population in 1995 to 1385 per million in the most recent report published in 2017.[5,6] According to the British Artificial Nutrition Research (BANS) 2018 report, there are 6270 HETF patients in the UK.[7]

Although HETF is a safe and effective nutritional intervention, there are problems encountered during treatment. It can lead to complaints that are not life-threatening , but negatively affect the quality of life due to long-term use, and sometimes patients have to apply to a health center or even to stay in hospitals.[8-10] These complaints can be grouped under three headings as metabolic, mechanical, and gastrointestinal complications.[11] Although prevalence levels vary[3,12-14], these problems appear to be similar globally.

This study was planned and conducted to determine the nutritional status of adult patients receiving HETF in the province of Mardin, Turkey and to evaluate their nutrition-related complications.

Material and Method

Ethical requirements

Ethics committee approval was obtained for the study from Mardin Artuklu University (dated 01/11/2021 and numbered 2021/2). In addition, necessary permissions were obtained from the Mardin Provincial Health Directorate to access patient information. Informed consents were obtained from the caregivers since the cognitive status of the patients were not suitable for communication.

Main Points

- Enteral tube feeding is a life-sustaining nutritional therapy.
- Patients fed with an enteral tube may have inadequate macro and micronutrient intakes.
- Patients fed with enteral tube at home have a high incidence of gastrointestinal complications.
- A multidisciplinary team (physician, dietitian, nurse) needed for an effective Home Enteral Tube-Fed patients.

Study design

The study is a prospective study[15] with 28 days of follow-up enteral tube-fed patients at home between November 2021 and June 2022.

Participants

Patients living in Mardin and fed with enteral tube at home for more than one month were included in the study. They were registered by Home Health Services (HHS) and over 18 years of age when tube feeding was started. Their informed consent were duly obtained before the collection of data. The sample size was not calculated in the study and all patients who could be reached between November 2021 and June 2022, who met the inclusion criteria and agreed to participate in the study (consent was obtained from the caregiver) were included in the study. Individuals for whom accurate data could not be obtained from the caregiver and for whom anthropometric measurements were not possible due to extremities deformity were excluded.

The number of registered adult patients receiving HETF in November 2021 is 40. 18 patients were excluded from the study, including four patients with extremities deformities, three refused to participate in the study, nine died, one hospitalized, and one due to lack of information. The study was completed with 22 patients.

Data collection

Patients were visited at their homes. The data were collected by the researcher through a questionnaire prepared based on the literature. Demographic, health status, and nutritional information (24-hour food consumption record, route of administration, etc.) were obtained from caregivers. Biochemical findings were obtained from the HHS patient file (the most recent laboratory results in the last three months).

The results of the biochemical tests were obtained from HHS patient files. Since the biochemical tests prescribed by the doctors were not the same for all the patients, it was not possible to use them for the metabolic complications and malnutrition evaluation by biochemical tests; the malnutrition status were evaluated using BMI values. Sarcopenia evaluated by calf circumference (CC). Anthropometric measurements (knee height (KH), mid upper arm circumference (MUAC), calf circumference) were measured by the researcher in accordance with the technique. Body weight and height were calculated with

the formula developed for bedridden patients using CC and MUAC measurements, and then BMI was calculated by formula.[16]

MUAC was evaluated using the table of reference values published by the National Center for Health Statistics (NCHS) for men and women aged 18-74. CC evaluated using a cut-off value of 31 cm.[17] BMI value was assessed using ESPEN BMI cut-off points.[18]

The Bristol Stool Scale and a literature-based complication form prepared by us were used to determine complications related to tube feeding. Caregivers were asked to record daily the patient's stool type according to the Bristol Stool Scale, stool frequency, and complications for 28 days.

Metabolic complications were defined as follows: dehydration, fluid intake less than 90.0% of the daily estimated requirement, hyperglycemia glycemia>200 mg/dL, and hypoglycemia glycemia<80 mg/dL.[19] Other biochemical findings were evaluated using reference intervals.

Gastrointestinal complications were defined as follows: constipation, no defecation for more than 72 hours, or stool type 1, type 2 according to the Bristol Stool Scale, or use of medication for constipation, diarrhea, more than three defecations per day, or stool type as type 6 or type 7 according to the Bristol Stool Scale.

Energy, macro and micro nutrient and fluid requirements

Daily energy requirements were estimated using the Harris Benedict formula and Long Activity Factors.[20] Daily protein requirements were estimated as 1.2-2.0 g/kg/day by adjusting the patient's biochemical findings, body weight, and skin integrity in line with ESPEN recommendations.[21] The daily energy and protein requirements were determined after the necessary adjustments were made in body weight, taking into account the BMI value of the person.[22,23] The daily fluid requirement was taken as 30 ml/kg/day.[24]

It was considered sufficient if the patients daily energy, protein, and fluid intakes are more than 90.0% of the estimated requirements. Daily micronutrient and fiber intakes were considered adequate if average intakes equal to or above the estimated requirement.[22] The Turkey Dietary Guidelines (TUBER) 2022 data were used as a reference for micronutrients and fiber.[25]

Statistical analysis

After the data collection process was completed, all data were analyzed using the SPSS Statistics for Windows, version 25.0. Kruskal Wallis test, Mann Whitney U test and chi-square test were used for the non-parametric hypothesis tests. In all analyses, $p<0.05$ was accepted as a statistically significant value.

Results

The study was completed with 22 patients. The mean age of the patients was 68.2 ± 12.6 years. The indications for HETF of all patients were chronic neurological diseases. The descriptive data of the patients and antropometric measurements are shown in Table 1 and Table 2. HETF-related complications of patients are shown in Table 3. In the table, *"number of affected patients"* refers to the number of patients who have complications, and *"number of events"* refers to the number of complications.

The energy and nutrients intakes of the patients and the rates of meeting their estimated requirements are given in Table 4. In the table, the individual consumption of the patients and the rate of meeting their estimated requirements are not shown. Instead, the group's average consumption (mean ± SD; median: lower–upper) and the average rate of meeting their estimated requirements are given. Almost all of the patients with HETF received more than 100% of TUBER reference values of vitamins A, E, C, B1, B2, B6, niacin, pantothenic acid, biotin, and phosphorus, iron, zinc, copper and molybdenum. Energy intake of 27.3% of the patients, protein intake of 45.5%, potassium and fiber intake of all (five patients were on a fiber-free diet), vitamin D, vitamin K, and magnesium intake of more than 65%, folic acid, sodium, manganese and selenium intake of more than 50%, vitamin B12, calcium, and iodine intake of more than 25% were found to be at an inadequate intake level. When the average intakes of the group were evaluated, it was determined that dietary fiber, vitamin D, potassium, and magnesium intakes were inadequate.

It was found that the variables did not affect the occurrence of gastrointestinal complications (Table 5).

Table 1. The descriptive data of the patients

Descriptive Data	Male	Female	Total
Number of patients			
Number (%)	10 (45,5)	12 (54,5)	22 (100)
Age (years)			
Mean±SD	68,8 ± 11,7	67,7 ± 13,7	68,2 ± 12,6
Median (min-max)	72,5 (49,0-87,0)	70,0 (44,0-88,0)	72,5 (44,0-88,0)
≥ 70 years (Number (%))	6 (60,0)	6 (50,0)	12 (54,5)
Medical diagnosis* (n, %)			
Neurological diseases	10 (45,5)	12 (54,5)	22 (100)
Oncological diseases	0 (0,0)	1 (8,3)	1 (4,5)
Diyabetes Mellitus	3 (30,0)	2 (16,7)	5 (22,7)
State of consciousness (n, %)			
Conscious	5 (50,0)	3 (25,0)	8 (36,4)
Unconscious	5 (50,0)	9 (75,0)	14 (63,6)
Mobility status (n, %)			
Bedridden	9 (90,0)	11 (91,7)	20 (90,9)
Not-bedridden	1 (10,0)	1 (8,3)	2 (9,1)
Enteral nutrition routes of administration			
PEG	8 (80,0)	9 (75,0)	17 (77,3)
NG	2 (20,0)	3 (25,0)	5 (22,7)
Methods of enteral nutrition administration			
Bolus	10 (100,0)	10 (83,3)	20 (91,0)
Intermittent	0 (0,0)	1 (8,3)	1 (4,5)
Continuous	0 (0,0)	1 (8,3)	1 (4,5)
Duration of HETF			
< 1 year	1 (10,0)	5 (41,7)	6 (27,3)
≥ 1 and < 5 years	6 (60,0)	6 (50,0)	12 (54,5)
≥ 5 and < 10 years	2 (20,0)	0 (0,0)	2 (9,1)
≥ 10 years	1 (10,0)	1 (8,3)	2 (9,1)
Mean±SD (years)	4,3±3,4	2,2±2,8	3,1±3,2
Median (min-max) (years)	3,5 (0,5-12,0)	1,8 (0,5-10,5)	2 (0,5-12)
Pump			
Yes	0 (0,0)	1 (8,3)	1 (4,5)
No	10 (100,0)	11 (91,7)	21 (95,5)

* More than one answer was received, and percentages were calculated based on the number n.
PEG: Percutaneous endoscopic gastrostomy, NG: Nasogastric

Table 1. Continued

Descriptive Data	Male	Female	Total
Probe washing (pre and post)			
Yes	10 (100,0)	12 (100,0)	22 (100,0)
No	0 (0,0)	0 (0,0)	0 (0,0)
Position during and after feeding			
Lying position (0°)	1 (10,0)	1 (8,3)	2 (9,1)
Semi-recumbent position (30-45°)	3 (30,0)	10 (83,4)	13 (59,1)
Sitting position (90°)	6 (60,0)	1 (8,3)	7 (31,8)
Type of nutritional product			
Isocaloric	3 (30,0)	3 (25,0)	6 (27,3)
High energy and protein	1 (10,0)	3 (25,0)	4 (18,2)
Immunonutrition	4 (40,0)	3 (25,0)	7 (31,8)
Diabetes/hyperglycemia specific	2 (20,0)	3 (25,0)	5 (22,7)
Fiber content			
Yes	7 (70,0)	10 (83,3)	17 (77,3)
No	3 (30,0)	2 (16,7)	5 (22,7)
Use of blenderized tube food			
Yes	4 (40,0)	2 (16,7)	6 (27,3)
No	6 (60,0)	10 (83,3)	16 (72,7)
Stool type			
Mean ± SD	3,1±1,5	3,0±1,2	3,1±1,3
Median (min-max)	Type4 (Type1-Type5)	Type3,5 (Type1-Type4)	Type4 (Type1-Type5)
Defecation frequency (day)			
Mean ± SD	2,5±2,1	2,1±1,4	2,3±1,7
Median (min-max)	1,2(1,1-7,0)	1,7(1,0-6,0)	1,5(1,0-7,0)

* More than one answer was received, and percentages were calculated based on the number n.
PEG: Percutaneous endoscopic gastrostomy, NG: Nasogastric

Discussion

Nutrition-related complications in addition to the nutritional status of patients receiving HETF were evaluated prospectively. ESPEN guidelines recommend that life expectancy should be longer than one month for initiation of HETF. In our study, the median HETF duration of the patients was 2 (0.5-12 years) years. The median HETF duration and distribution were found to be significantly longer than those reported by other publications. Paccagnella et al. reported in a prospective study, 261, 251 and 788 HETF days for adult patients with neurovascular, neurodegenerative and head trauma, respectively.[26] Folwarski et al.[27] reported 615 HETF days (IQR 1275 days) for adult patients with neurological disease. Cawsey et al.[28] reported 187 HETF days.

In our study, the most commonly used enteral access for feeding was PEG (77.3%) and bolus (91%) administration. This finding is consistent with ESPEN guidelines, which recommend PEG for long-term enteral nutrition or PEJ tube when PEG is contraindicated.[4] The British Artificial Nutrition Research (BANS) 2018 report reported that 80% of patients had gastrostomy in the feeding route.[7]

Table 2. Anthropometric evaluations of the patients

Anthropometric measurement	Assessment	Male	Female	Total
		Number (%)	Number (%)	Number (%)
BMI (kg/m^2)				
Mean ±SD		21,5±2,8	25,2±4,6	23,5±4,3
Age <70				
BMI < 20	Malnutrition	1 (10,0)	1 (8,3)	2 (9,1)
20 ≤ BMI ≤ 27	Normal	3 (30,0)	3 (25,0)	6 (27,3)
BMI < 27	Obese	0 (0,0)	2 (16,7)	2 (9,1)
Age ≥70				
BMI < 22	Malnutrition	4 (40,0)	1 (8,3)	5 (22,7)
22 ≤ BMI ≤ 27	Normal	2 (20,0)	1 (8,3)	3 (13,6)
BMI < 27	Obese	0 (0,0)	4 (33,3)	4 (18,2)
Calf circumference				
Mean ±SD		26,5±4,4	29,0±3,7	27,9±4,2
< 31		8 (80,0)	9 (75,0)	17 (77,3)
≥ 31		2 (20,0)	3 (25,0)	5 (22,7)
MUAC percentile values				
Mean ±SD		26,4±2,8	27,9±3,5	27,2±3,2
≤ 5		4 (40,0)	2 (16,7)	6 (27,3)
> 5 and ≤ 25		6 (60,0)	4 (33,3)	10 (45,5)
> 25 and < 75		0 (0,0)	5 (41,7)	5 (22,7)
≥ 75		0 (0,0)	1 (8,3)	1 (4,5)

BMI: Body mass index, MUAC: Mid-upper arm circumference

It is not recommended the use of blenderized tube food in patients receiving HETF by ESPEN; because the macro and micronutrient content is not standardized and increses the contamination risk.[4] In our study, the use of blenderized tube food in addition to the industrial nutrition product was found to be 27.3% but low than literature.[29,30]

The mean BMI of the patients was 23.5±4.3 kg/m^2. When evaluated according to BMI, it was found out that 31.8% of the patients were malnourished. Our results were similar with the other studies.[31,32] The decrease in muscle mass, muscle strength and physical performance is defined as sarcopenia.[33] When the CC measurement was evaluated, it was seen that 77.3% of the patients are sarcopenic.[34]As a result of the evaluation by using the NCHS 18-74 age group precentile table, it was observed that 72.7% of the patientes had MUAC measurements below the 25th percentile. Other studies also have found the similiar results.[35,36] Decrease in body muscle mass and protein stores are explained by the malnutrition, the absence or decrease in physical activity, and the advanced age. Furthermore, the nutritional products are nutritionally less bioavailability compared to natural foods.

The mean energy intake of the patients in our study was found as 25±6 kcal/kg/day. Mean energy intake of patients were found 24 kkcal/kg/day and 24.4±8 kcal/kg/day in the litarature.[26,27] According to ESPEN guidelines, daily energy requirement varies between 25-30 kcal/kg/day during the recovery period.[37] In line with the recommendation, when studies evaluating adult patients receiving HETF are examined, it is seen that the average daily energy intake is 25-30 kcal/kg/day, similar to the result of our study.[3,24,26-28,38] In our study, daily estimated energy and protein requirements of the patients were

Table 3. The HETF-related complications of patients

Complications	Male (n:10)		Female (n:12)		Total (n:22)	
	Number of affected patients	Number of events	Number of affected patients	Number of events	Number of affected patients (%)	Number of events
Metabolic Complications						
Hyperglycemia[a] (n:20)	1	1	2	1	3 (15,0)	1
Hyponatremia[a] (n:20)	5	1	1	1	6 (30,0)	1
Hypokalemia[a] (n:20)	0	0	1	1	1 (5,0)	1
Hypocalcemia[a] (n:20)	2	1	1	1	3 (15,0)	1
Dehydration[b]	1	-	1	-	2 (9,1)	-
Malnutrition[c]	5	-	2	-	7 (31,8)	-
Mecanic Complications						
Obstruction of feeding tube	2	1	1	1	3 (13,6)	1
Dislocation of the feeding tube	0	0	1	1	1 (4,5)	1
Peristomal leak (chronic)[d]	7		1		8 (36,4)	
Granulation tissue[d]	0		1		1 (4,5)	
Gastrointestinal Complications						
Nausea/Vomiting	1 1 2	3 5 30	1	3	2 (9,1) 1 (4,5) 2 (9,1)	3 5 30
Total number of patients (%)	4 (40,0)		1 (8,3)		5 (22,7)	
Abdominal distention[e]	1 1	2 4	1	13	1 (4,5) 1 (4,5) 1 (4,5)	2 4 13
Total number of patients (%)	2 (20,0)		1 (8,3)		3 (13,6)	
Constipation	2 2 1 2	1 5 8 9	1 2 1 3	1 3 6 9	3 (13,6) 2 (9,1) 2 (9,1) 1 (4,5) 1 (4,5) 5 (22,7)	1 3 5 6 8 9
Total number of patients (%)	7 (70,0)		7 (58,3)		14 (63,6)	
Diarrhea	2	1	2	1	4 (18,2)	1
Total number of patients (%)	2 (20,0)		2 (16,7)		4 (18,2)	
Complications associated with skin integrity						
Pressure ulcer[d]	6		4		10 (45,5)	
Total number of patients (%)	6 (60,0)		4 (33,3)		10 (45,5)	

a: Metabolic complications were evaluated using the most recent biochemical data from the last three months in the HHS patient file. Percentages are given based on the number of patients for whom the relevant parameter was evaluated.
b: Hydration was evaluated using the rate of meeting the estimated daily fluid requirement.
c: Malnutrition was assessed using BMI.
d: Persistent complications during the 28-day follow-up
e: Number of days with complications

Table 4. The energy and nutrients intakes of the patients and the rates of meeting their estimated requirements

Energy and nutrients	Total		
	Mean ±SD	Median (min-max)	%
Energy (kcal/kg/day)	25,0±6,0	24,4 (13,8-42,9)	96,9±17,9
Protein (g/kg/gün)	1,3±0,4	1,2 (0,7-2,3)	97,1±27,9
Fiber (g/day)	13,4±8,8	16 (0-24)	53,5±35,0
Fluid (mL/day)	2479,3±700,7	2445 (1620-4841,5)	142,8±36,0
Vitamin A (mcg/day)	1234,3±476,4	1278 (0-2000,0)	174,5±72,8
Vitamin D (mcg/day)	13,9±11,6	10,7 (6,3-61,6)	81,8±79,8
Vitamin E (mg/day)	33,9±15,2	30,8 (13,7-84,0)	279,3±128,4
Vitamin K (mcg/day)	92,1±26,7	84,6 (59,4-162,0)	90,2±35,3
Vitamin C (mg/day)	172,1±77,6	160,0 (79,2-425,6)	168,4±72,8
Folate (mcg/day)	332,4±110,5	313,8 (180,0-608,0)	100,0±33,9
Thiamine (mg/day)	2,0±0,4	2,0 (1,1-2,8)	175,0±38,0
Riboflavin (mg/day)	2,4±0,6	2,4 (1,3-3,5)	197,1±57,2
Vitamin B6 (mg/day)	2,4±0,6	2,4 (1,4-3,4)	153,7±45,8
Vitamin B12 (mcg/day)	5,1±2,0	4,9 (2,2-9,8)	117,9±43,9
Niacin (mg NE/day)	21,3±7,3	20,2 (8,0-33,0)	211,0±58,6
Pantothenic acid (mg/day)	9,4±3,4	9,7 (2,6-16,0)	186,3±69,2
Biotin (mcg/day)	71,5±23,7	64,5 (28,8-140,0)	176,4±61,0
Potassium (g/day)	1998,3±498,4	1977,3 (936,0-2916,0)	41,1±10,3
Sodium (g/day)	1279,1±375,1	1334,1 (550,0-2140,0)	98,2±29,1
Calcium (mg/day)	1167,3±377,4	1151,0 (640,0-2451,6)	119,0±40,0
Phosphor (mg/day)	958,8±232,8	986,0 (468,0-1440,0)	170,5±41,6
Magnesium (mg/day)	290,0±67,0	282,9 (151,2-460,0)	89,6±24,0
Iron (mg/day)	18,1±4,8	17,5 (9,4-25,6)	157,5±43,3
Zinc (mg/day)	18,1±4,2	18,0 (8,6-30,0)	170,5±44,1
Manganese (mg/day)	3,6±1,2	3,4 (1,8-5,3)	121,1±42,1
Copper (mcg/day)	2237,1±549,8	2267,5 (1008,0-3400,0)	156,6±47,4
Iodine (mcg/day)	178,9±47,6	186,9 (79,2-300,0)	119,2±31,7
Selenium (mcg/day)	75,9±23,6	67,7 (36,0-120,0)	108,3±33,9
Molybdenum (mcg/day)	163,9±54,5	155,0 (72,0-320,0)	252,2±83,8

met at an average rate of 96.9±17.9% and 97.1±27.9%, respectively, and were at an adequate intake level. On the other hand, 27.3% of the patients had insufficient energy intake and 45.5% protein intakes. Narasimhan et al.[32] it was reported that the estimated daily energy needs of the patients were met by an average of 93.1±19.7%, and the estimated daily protein requirements were met by an average of 98.5±21.7%. Baker et al.[22] found that the estimated daily energy requirement was met by 63±15% and protein by 61±15%. Potassium and fiber intake were insufficient for all patients. Vitamin D, vitamin K and magnesium intake were insufficient for more than 65% patients. Folic acid, sodium, manganese and selenium intake were insufficient for more than 50% patients.

Table 5. Gastrointestinal complications related to patient characteristics, type and management of HETF

Complication	**Variable**	***p-value***
Nausea/Vomiting	Gender	0,135*
	Age	0,367***
	Product type[a]	0,582**
	Fiber content[b]	0,820***
	Route of administration[c]	1,000***
	Feeding position[d]	0,629**
Abdominal distention	Gender	0,571*
	Age	0,774***
	Product type[a]	0,397**
	Fiber content[b]	0,880***
	Route of administration[c]	0,595***
	Feeding position[d]	0,320**
Constipation	Gender	0,675*
	Age	0,539***
	Product type[a]	0,119**
	Fiber content[b]	0,649***
	Route of administration[c]	0,352***
	Feeding position[d]	0,960**
Diarrhea	Gender	1,000*
	Age	0,045***
	Product type[a]	0,484**
	Fiber content[b]	0,940***
	Route of administration[c]	0,907***
	Feeding position[d]	0,225**

*: Chi-square test, **: Kruskal Wallis H test, ***: Mann Whitney U test
a: Isocaloric, High energy and protein, Immunonutrition, Diyabetes/hyperglycemia specific
b: Fiber content, Fiber free
c: PEG: Percutaneous endoscopic gastrostomy, NG: Nasogastric
d: Lying position, Semi-recumbent position, Sitting position

Vitamin B12, calcium and iodine intake were insufficient for more than 25% patients. Vitamin A, E, C, B1, B2, B6, niacin, pantothenic acid, biotin, phosphorus, iron, zinc, copper and molybdenum intake were found to exceed 100% of the TUBER reference values for all patients. Similarly, Folwarski et al.[39] found that the vitamin levels consumed in their study were above the RDA level. In addition, it was reported that approximately 50% of the patients had insufficient intake of vitamin D, vitamin B3, vitamin B5 and vitamin B9, more than 20% of the patients had vitamin K intake, and the majority of patients had insufficient intake of sodium, chlorine, calcium and fluoride. Iacone et al.[40] reported that more than 50% of the patients had insufficient intake of fiber, potassium, fluorine and vitamin K. Considering the results of our study and publications, it is thought that there is a need for further studies and regulation of nutritional content of nutritional products in patients with long-term HETF.

In the literature, the incidence of peristomal leakage in patients receiving HETF is 60%, the incidence of granulation tissue development is 67%, the incidence of tube occlusion is 30%, the need for tube replacement is 26%, and the incidence of constipation is 63%. It is observed that the incidence of vomiting increased to 40%, the incidence of diarrhea to 34%, and the incidence of abdominal distension to 50%.[12,13,24,35] In our study peristomal leakage, granulation tissue, tube

obstruction (opened by the caregiver), tube replacement, constipation, vomiting/regurgitation and diarreha are reported 36%, 4.5%, 13.6 %, 4.5%, 63.6%, 22.7% and, 18.2% respectively. It is thought that the high average ages of the patients, 91% of them being bedridden, constantly feeding a liquid diet, low fiber consumption (5 patients were fed with fiber-free products) are effective in the development of constipation. In the study, 45.5% of the patients developed pressure ulcers. Pressure ulcers were seen higher rates than other studies (20%,18.7%).[35,41] It is thought that this may be due to the high rate of bed dependency (91%); 72.7% of the patients were fed with enteral tube at home for more than 1 year.

In our study, hyperglycemia was found in 15% of the patients, dyslipidemia in 33.3%, hyponatremia in 30%, hypocalcemia in 15%, and hypoproteinemia in 23.1%. Lim et al.[42] hyperglycemia and hypoglycemia developed in 12.1% of the patients, electrolyte disturbances were reported in 5.1% of the patients, and vitamin and trace element deficiency was reported in 4%. In the study, it is seen that the biochemical tests observed outside the reference range are not clearly given. De Luis et al.[36] reported hypernatremia in 6 patients (1.3%) and hyperglycemia in 33 patients (4.8%) in a study where they prospectively evaluated the incidence and characteristics of all adult patients fed enterally at home (with oral enteral and enteral tube) for 12 years. However, complications in the study were not categorized separately for patients fed oral enteral and tube enteral feeding. The effects of gender, age, product type, fiber content, feeding route and feeding position on the incidence of gastrointestinal complications were evaluated in the study. It was found that the incidence of complications was not affected for all variables. Similarly, Barone et al.[8] found that age and gender did not affect complication rates. In contrast, Wanden-Berghe et al.[3] found that gender, feeding position, route of feeding, type of product, and fiber content significantly affected the incidence of gastrointestinal complications. Our findings show that complications were common in the study group, but did not exceed the rates stated in the literature. The prevalence of complications in the study can be attributed to the fact that the patients evaluated within the scope of the study were old and had multiple diseases, 72.7% were fed with enteral tube for more than 1 year, 91% were bedridden, and their follow-up and evaluation could not be performed by an HHS/ multidisciplinary team.[4,8,32,43,44]

The study has some limitations. The results of the biochemical tests were obtained from HHS patient files. Since the biochemical tests prescribed by the doctors were not the same for all the patients, it was not possible to use them for the malnutrition evaluation; the malnutrition status were evaluated using only BMI values and metabolic complications were not evaluated all the patients.

Counclusion

It was found out that complications were common. A multidisciplinary team (physician, dietitian, nurse) specialized in this field is needed in Home Health Services for an effective HETF and prevention/reduction of complications. It is considered important and necessary to include a dietitian in the team in order to detect the risk of malnutrition in the early period, to make necessary interventions in nutrition therapy, to prevent malnutrition, to increase the quality of life, and to reduce medical expenses.

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Ethical approval

This study has been approved by the Mardin Artuklu University Non-Interventional Clinical Research Ethics Committee (approval date 01.11.2021, number 2021/2). Written informed consent was obtained from the participants.

Author contribution

The authors declare contribution to the paper as follows: Study conception and design: NNA, ZPÖ; data collection: NNA, KA; analysis and interpretation of results: NNA, KA; draft manuscript preparation: NNA. All authors reviewed the results and approved the final version of the article.

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Conflict of interest

The authors declare that there is no conflict of interest.

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