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RESEARCH ARTICLE

Clinical Assessment of Malnutrition in Patients With Gastrointestinal Cancer During Chemotherapy: A Prospective Study

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Abstract

Background: Malnutrition is common in patients with cancer, and in many cases can result in shortened survival rate. More than 20% of cancer mortality can be attributed to the effects of malnutrition, rather than malignancy itself. Malnutrition results in poor response to treatment, increased length of hospital stay, immunodeficiency, reduced quality of life, and increased health care costs in patients with cancer.
Objectives: The aim of this study was to assess the nutritional status of patients with gastrointestinal cancer during chemotherapy.
Patients and Methods: In this study, 92 patients over the age of 18 who were referred to Valie-e-Asr hospital of Zanjan (since Apr, 2011 to Dec, 2011) were selected. Nutritional status of patients during 3 cycles of chemotherapy was assessed by a questionnaire. The obtained data were statistically analyzed by ANOVA, using SPSS 16.0.
Results: There was a significant relationship between duration of treatment and the average of mid arm circumference (MAC) and body mass index (BMI). BMI can be considered as an anthropometric index which can be used to alarm the physicians about nutrition problems of the patient.
Conclusions: At the end of treatment, patients who survived had better nutritional statuses compared to the ones who passed away. During chemotherapy, malnutrition got worse in patients with metastatic esophageal cancer. Our findings show that patients with moderate or severe malnutrition are in the critical need to improve their malnutrition status.

Keywords: *Gastrointestinal Cancer; Malnutrition; Chemotherapy*

1. Background

Malnutrition is common in patients with cancer and in many cases can result in shortened survival (1-3). The incidence of disease-related malnutrition in general hospitals is estimated to be 15 - 60%, while this figure can be as high as 30 to 80% in hospitalized patients with cancer. In addition, it has been suggested that more than 20% of deaths in patients with cancer -directly or indirectly- can be attributed to malnutrition, rather than to the malignant disease itself (1, 4-12).

Causes of malnutrition are multifactorial including type of tumor, tumor location, production of specific cytokines, anti-cancer treatment including chemotherapy, stage of the disease, and age-related physiological changes (4, 7, 8, 10, 13-15). All treatments of cancer, such as chemotherapy, radiotherapy, and surgery can have adverse effects on the nutritional status of the patients. Cancer cachexia, which is more prevalent in patients with advanced or metastatic disease, is characterized by reduced food intake, weight loss, increase morbidity, and decreased quality of life (11, 14, 16-21). The Patient- Generated-Subjective Global Assessment (PG-SGA) score is a valid nutritional assessment tool for screening the nutritional status and assessing the risk of malnutrition in patient with cancer (7, 9-11, 21-25).

2. Objectives

The purpose of this study was to assess the nutritional status of the patient with different gastrointestinal cancer (GI cancers) at the beginning, in the middle, and at the end of chemotherapy by using PG-SGA. Furthermore, we tried to evaluate the effect of treatment and stage of the disease on the prevalence of malnutrition and weight loss.

3. Patients and Methods

3.1. Data Collection

In this descriptive-analytic study, the data were collected since Apr 2011 to Dec 2011 at Vali-e-Asr hospital of Zanjan. Ninety two patients over the age of 18 who had a primary diagnosis of a gastrointestinal cancer (colorectal, esophageal or gastric and regardless of stage) and were candidate to take part in the study were included. Exclusion criteria were as follows: recurrent cancer, history of treatment for other cancers within the past five years, psychological or cognitive impairments (e.g. schizophrenia, dementia), unstable condition, immune deficiency disorders (such as being HIV positive), and patients who had commenced chemotherapy treatment at another center. Nutritional status was assessed at commencement and completion of treatment (4, 24, 26). Chemotherapy and radiotherapy schedules were chosen from internationally recognized guidelines.

3.2. Measurements

The nutritional status of the patients was measured by a questionnaire at the beginning, in the middle, and at the end of chemotherapy. Stages of disease (II, III, and IV), type of surgery and radiotherapy, and the chemotherapy protocols were also recorded.

Anthropometric measurements included body mass index (BMI), mid arm circumference (MAC), triceps skin fold (TSF), arm muscle area (AMA), and mid arm muscle circumference (MAMC). Height measurements were rounded to the nearest 0.1 cm and body weight measurements were rounded to the nearest 0.5 kg.

Circumference of right arm between acromion and olecranon was measured and rounded to nearest 0.1 cm. TSF was measured in right arm with calipers (Germany VOGEL 0.1 mm). BMI, AMA, MAC, MAMC, and TSF were calculated using their formulas. BMI was classified as: underweight (BMI < 18.5 kg/m^2), normal weight (18.5 - 24.9 kg/m^2), overweight (25 - 29.9 kg/m^2), and obese (BMI > 30 kg/m^2) (27). MAC and TSF were measured by the same physician for all patients. Assessment of nutritional status was done by using PG-SGA, which is a tool designed to assess nutritional status in cancer patients. The questionnaire consists of several questions, and different scores are given to different answers.

Part A of the questionnaire which is completed by the patient addresses current weight, changes in weight over the past 1 to 6 months and percentage of weight loss, alterations in food intake compared with the usual intake, the presence of symptoms potentially affecting a patient's food intake (such as nausea, vomiting, and diarrhea that have persisted for 2 weeks), and activities and functional capacity.

The second (B), third (C), and the fourth (D) parts of the PG-SGA are completed by the treating health professional. Taken together, patients can be classified into three global assessment categories: well-nourished (A), suspected malnutrition or moderately malnourished (B), and severely malnourished (C) (3, 4, 9, 14, 22-24, 26, 28-33).

4. Results

Sixty three patients (68.5%) were male. Fifty two patients (56.5%) had gastric cancer (40 males and 12 females). Seventeen patients (18.5%) had esophageal cancer (9 males and 8 females), and 23 patients (25%) of patients had colorectal cancer (14 males and 9 females). Mean age of the patients was 63.6 ± 11.4 years (ranged from 28 to 88) (Table 1) and patients with esophageal cancer had the highest mean age. Mean age of metastatic patients was 66.6 ± 10 years, which was more than that of non-metastatic patients (62.4 ± 11.8). The mean age of the patients at the beginning of the treatment was 69.8 ± 10.4 years, which was more than that of the patients at end of the treatment (62.1 ± 11.8).

Patients weighed 37 to 94 kg at the beginning of the treatment, with the mean weight of 58.71 kg (SD = 10.787) (Table 1), and the difference of the weight between two genders was not significant. Interestingly, there was no significant difference between the mean weight in the beginning, middle, and the end of treatment among the patients. Twenty nine patients (13.5%) had stage IV disease, and the rest had stage II or III (Table 2). The mortality rate was significantly higher in male patients (73.3% of all deaths), with gastric cancer as the main cause of death. Among all 92 patients, 57 (62%) were alive until the completion of treatment (Table 3).

Results of AMA, MAC, TSF, BMI, and MAMC are presented in Tables 4 - 7. Percentage of malnutrition in accordance with malnutrition indices is provided in Table 8. Mean BMI at the beginning of the treatment for female and male patients was 24.44 ± 4.2 and 22.55 ± 3.9 kg/m^2, respectively. BMI and MAC at the beginning of the treatment were significantly higher in female patients (P = 0.045 and P = 0.008, respectively).

Generally, in all patients suffering from gastrointestinal cancers, MAC and TSF at the beginning of the treatment were higher compared to the middle and end of the treatment. By starting the treatment, BMI decreased slowly at first, but increased in the further stages of the treatment. All three types of cancer were more common in male patients, with gastric cancer as the most common type.

4.1. Ottery's PG-SGA Questionnaire

According to data gathered from the questionnaire, about 95% of the patients at the beginning of the chemotherapy suffered from malnutrition (C + B) (Table 8). Furthermore, 94.8% of patients who were alive until the end of the treatment, 100% of patients who died before the end, and 77.7% of patients who died after the middle of the treatment suffered from severe malnutrition. In population of the patients who were alive at end of the treatment, a decrease in the number of the individuals suffering from malnutrition was detected.

At the beginning of the chemotherapy, 72.8% of patients scored 9 or more in the PG-SGA questionnaire (mean score = 13.65) and only 2.2% had scores between 2 and 3. According to the type of the cancer, 94% of patients with esophageal cancer scored 9 and over 9 (Table 9). The degree of weight reduction of patients between months 1 to 6 is shown in Table 10. The least and highest values for malnutrition during the treatment was observed for esophagus and gastric cancers, respectively (84.6% and 96.6%).

At the beginning of the treatment, less female patients suffered from malnutrition compared to male patients. The highest percentage of good nutrition (stage A of the questionnaire) was observed at the beginning of the chemotherapy (8.7%). In this study, the value of malnutrition was the highest value compared to the similar studies. This value in patients who were alive until the end of the treatment was higher than that of patients who were alive until the middle of the treatment, which suggests that using questionnaires can be considered as a feasible method to establish a connection between malnutrition and death. Weight loss over 10% was observed in 75% of patients with esophageal and 25% of patients with colorectal cancer. The highest rate of weight loss was observed in patients with stage IV metastatic cancer (56%).

The highest mean weight loss in patients with esophageal and colorectal cancer in 1 - 6 months from beginning of the treatment was recorded. The least scores, 9 or less, was observed in patients with colorectal cancer. The highest mean average scores were seen in patients with esophageal cancer. 70.2% of patients who were alive until the end of the treatment, 92.3% of patients alive until before the middle of the treatment, and 66.7% of patients alive until after the middle of the treatment had scores of 9 or more at the beginning of the treatment. In this study, at the beginning of the treatment, 95.5% of patients were categorized as B + C from whom 72.8% had scores of 9 or more. According to the findings, 98.9% of patients at the beginning of the treatment required critical attention to address their nutritional needs.

Table 1. Mean Weight and Mean Age of the Patients [a]

Variable	Age	Weight
Type of Cancer		
Esophagus	65.8 ± 9.8	58.1 ± 13.5
Gastric	63.9 ± 10.5	58.3 ± 10.2
Colorectal	61.3 ± 14.1	60.0 ± 10.0
Gender		
Male	63.9 ± 11.4	59.0 ± 10.1
Female	63.0 ± 11.5	57.9 ± 12.1
Stage of Cancer		
2 or 3 [b]	62.4 ± 11.8	59.8 ± 10.2
4 [c]	66.1 ± 10.9	56.8 ± 12.2
Mortality		
Alive until end of treatment	62.1 ± 11.8	58.9 ± 11.2
Alive in the middle of treatment	62.1 ± 12.5	60.5 ± 13.8
Alive at the beginning of treatment	69.8 ± 10.4	58.3 ± 9.1

[a] Data are presented as mean ± SD.
[b] Non-metastatic.
[c] Metastatic.

Table 2. Characteristics of Patients According to the Stage of the Cancer

Stage	No. (%)
II	4 (4.3)
III	55 (59.8)
IV	29 (31.5)
Unrecognized	4 (4.4)

Table 3. Characteristics of Patients According to the Mortality Status [a]

Parameter	Alive Until End of Treatment
Esophageal cancer (N = 10)	10 (58.8)
Gastric cancer (N = 52)	29 (55.8)
Colorectal cancer (N = 23)	18 (78.3)
Male (N = 63)	35 (55.6)
Female (N = 29)	22 (79.8)

[a] Data are presented as No. (%).

Table 4. Anthropometric Indices According to Type of Cancer and Stage of Chemotherapy in Patients With gastrointestinal Cancer [a]

Type of Cancer [b]	AMA (SD), sm^2	MAMC (SD), cm	MAC (SD), cm	BMI (SD), kg/m^2	TSF (SD), mm
Gastrointestinal (N = 92)					
Beginning	34.19 (7.6)	20.74 (2.0)	235.40 (26.9)	23.14 (4.2)	9.18 (5.3)
Middle	33.91 (7.9)	20.50 (2.4)	239.12 (32.7)	23.61 (4.6)	10.86 (6.8)
End	33.08 (8.6)	20.20 (2.6)	236.63 (37.0)	23.18 (4.9)	11.10 (6.9)
Esophagus (N = 17)					
Beginning	35.77 (7.9)	21.07 (2.3)	541.18 (35.1)	23.50 (5.2)	10.28 (6.5)
Middle	33.52 (6.7)	20.42 (2.0)	238.18 (41.4)	24.37 (5.9)	10.81 (9.4)
End	32.01 (9.9)	19.78 (3.4)	231.00 (53.8)	24.36 (6.1)	10.56 (9.5)
Gastro (N = 52)					
Beginning	34.20 (6.8)	20.62 (2.0)	232.12 (27.0)	22.41 (3.6)	8.56 (5.3)
Middle	33.67 (6.8)	20.45 (2.1)	236.60 (30.5)	22.22 (2.2)	10.19 (6.0)
End	32.60 (5.9)	20.15 (1.8)	232.86 (29.5)	21.27 (3.3)	10.16 (2.2)
Colorectal (N = 23)					
Beginning	33.01 (9.0)	20.74 (1.7)	238.41 (18.3)	24.54 (4.3)	9.72 (4.4)
Middle	34.51 (10.3)	20.61 (3.0)	243.81 (32.6)	25.52 (5.4)	11.99 (6.8)
End	34.41 (11.3)	20.53 (3.3)	245.83 (37.4)	25.61 (5.5)	12.90 (6.2)

[a] Abbreviations: AMA, arm muscle area; BMI, body mass index; MAC, mid arm circumference; MAMC, mid arm muscle circumference; TSF, triceps skin fold.
[b] Data are presented for the stage of chemotherapy.

Table 5. Anthropometric Indices According to Stage of Cancer and Stage of Chemotherapy in Patients With Gastrointestinal Cancer [a]

Type of Cancer [b]	AMA (SD), sm^2	MAMC (SD), cm	MAC (SD), cm	BMI (SD), kg/m^2	TSF (SD), mm
Gastrointestinal (N = 92)					
II (N = 4)					
Beginning	37.11 (3.6)	21.57 (1.0)	236.67 (11.5)	22.63 (2.3)	6.66 (1.4)
Middle	37.03 (4.6)	21.54 (1.3)	250.00 (28.2)	23.97 (6.5)	10.99 (4.7)
End	40.30 (0)	22.50 (0)	270.00 (0)	28.57 (0)	14.33 (0)
III (N = 55)					
Beginning	33.73 (8.3)	20.66 (2.0)	237.38 (25.9)	23.45 (4.1)	9.89 (5.7)
Middle	35.11 (8.2)	20.86 (2.4)	241.30 (32.2)	23.70 (4.6)	10.39 (6.2)
End	34.00 (8.9)	20.48 (2.7)	237.32 (36.6)	23.02 (5.0)	10.50 (6.2)
IV (N = 29) Metastatic					
Beginning	35.26 (6.6)	20.59 (1.9)	233.45 (30.1)	22.79 (4.7)	7.87 (4.5)
Middle	31.47 (7.2)	19.75 (2.3)	233.25 (36.2)	23.51 (5.1)	11.38 (8.4)
End	30.52 (7.5)	19.43 (2.4)	231.79 (41.8)	23.40 (5.3)	11.92 (8.9)

[a] Abbreviations: AMA, arm muscle area; BMI, body mass index; MAC, mid arm circumference; MAMC, mid arm muscle circumference; TSF, triceps skin fold.
[b] Data are presented for stage of cancer and stage of chemotherapy.

Table 6. Parameters Related to Mortality Status and Stage of Chemotherapy in Patients With Gastrointestinal Cancer [a]

Type of Cancer	AMA (SD), sm^2	MAMC (SD), cm	MAC (SD), cm	BMI (SD), kg/m^2	TSF (SD), mm
Gastrointestinal (N = 92)					
Until End (N = 57)					
Beginning	33.71 (8.0)	20.66 (2.0)	237.96 (26.9)	23.49 (4.4)	10.09 (5.8)
Middle	33.86 (8.0)	20.48 (2.3)	240.63 (33.5)	23.57 (4.6)	11.38 (7.2)
End	33.08 (8.6)	20.20 (2.6)	236.63 (27.0)	23.18 (4.9)	11.10 (6.9)
Before End (N = 9)					
Beginning	36.60 (7.9)	21.33 (2.2)	235.56 (29.6)	23.33 (5.3)	7.07 (3.4)
Middle	34.27 (8.7)	20.57 (2.8)	230.56 (29.8)	24.31 (5.6)	7.88 (3.2)
Before Middle (N = 13)					
Beginning	34.26 (6.8)	20.65 (2.0)	230.91 (27.0)	22.86 (3.7)	8.53 (5.8)

[a] Abbreviations: AMA, arm muscle area; BMI, body mass index; MAC, mid arm circumference; MAMC, mid arm muscle circumference; TSF, triceps skin fold.
[b] Data are presented for Mortality Status and Stage of Chemotherapy.

Table 7. Percentage of BMI of Cancer Patients According to Gender and Term of Chemotherapy

Type of Cancer [a]	Grade 3 Obesity (Over 40)	Grade 2 Obesity (35 to 39.9)	Grade 1 Obesity (30 to 34.9	Overweight (25 to 29.9)	Normal (18.5 to 24.9)	Underweight (Less Than 18.5)
Gastrointestinal (N = 92)						
Male and Female (N = 92)						
Beginning (N = 92)	1.10	1.10	5.40	18.50	63.00	10.90
Middle (N = 67)	0.00	2.98	7.46	19.40	62.68	7.46
End (N = 55)	0.00	3.63	7.27	20.00	60.00	12.72
Male (N = 63)						
Beginning (N = 63)	1.60	0.00	4.80	15.90	63.50	14.30
Middle (N = 45)	0.00	2.22	6.66	20.00	62.22	8.88
End (N = 35)	0.00	2.85	5.71	20.00	51.42	20.00
Female (N = 29)						
Beginning (N = 29)	0.00	3.40	6.90	24.10	62.10	3.40
Middle (N = 22)	0.00	4.45	9.09	18.18	63.63	4.45
End (N = 22)	0.00	4.04	9.09	18.18	68.18	0.00

[a] Data are presented for gender and chemotherapy term.

Table 8. Percentage of Malnutrition According to Mortality rate and Type of Cancer in Gastrointestinal Cancer Patients [a]

Attribute [b]	Questionnaires Ottery's GS-SGA			MAC Less Than 5	MAC Less Than 5	MAC Less Than 5
	B + C	B	C			
Mortality						
Until End (N = 57)						
Beginning	47.4	47.4	94.8	73.7	8.8	50.9
Middle	64.9	26.3	91.2	63.2	7.00	45.6
End	71.9	17.5	89.4	63.2	12.3	45.6
After Middle (N = 9)						
Beginning	33.3	44.4	77.7	77.8	22.2	55.6
Middle	66.7	22.2	88.9	78.8	11.1	44.4
Before middle						
Beginning	23.1	76.9	100	46.2	15.4	53.8
Type of Cancer						
Gastrointestinal (N = 92)						
Beginning (N = 92)	44.6	50.0	95.6	75.8	10.9	53.4
Middle (N = 66)	66.6	25.7	92.3	65.1	7.5	45.4
End (N = 57)	71.9	17.5	89.4	64.9	12.2	45.6
Esophagus (N = 17)						
Beginning (N = 17)	29.4	70.6	100	64.7	5.9	58.8
Middle (N = 11)	45.4	54.5	99.9	63.63	9.09	63.63
End (N = 10)	60	30	90	60	0	80
Gastro (N = 52)						
Beginning (N = 52)	34.6	59.6	94.2	75.0	17.3	50.0
Middle (N = 35)	65.7	28.5	94.2	71.42	11.42	45.71
End (N = 29)	79.3	17.2	96.5	60	20.68	28.27
Colorectal (N = 23)						
Beginning (N = 23)	78.3	13.0	91.3	69.6	0	43.5
Middle (N = 20)	80	5.0	85	55.0	0	35
End (N = 18)	66.6	11.1	77.7	55.5	5.55	22.22
Gender						
Male (N = 63)						
Beginning (N = 63)	39.7	54.0	93.7	88.1	14.3	60.3
Middle (N = 44)	65.9	29.5	95.4	81.8	9.0	59.0
End (N = 22)	71.4	22.8	94.2	82.8	20	54.2
Female (N = 29)						
Beginning (N = 29)	55.2	41.4	96.6	48.3	3.4	37.9
Middle (N = 22)	68.1	18.1	86.2	31.8	4.5	18.1
End (N = 22)	72.7	9.0	81.7	36.3	0	31.8
Metastatic Status						
4 metastatic (N = 29)						
Beginning (N = 29)	41.4	55.2	96.6	82.8	13.8	62.1
Middle (N = 20)	65	25	90	70	5.0	45
End (N = 14)	78.5	14.2	92.7	78.5	0	64.2
3 and 2 non-metastatic (N = 59)						
Beginning (N = 59)	45.8	49.2	95	64.4	10.2	45.8
Middle (N = 44)	65.9	27.2	93.1	63.6	9.0	47.7
End (N = 41)	68.2	19.5	87.7	68.2	17.0	41.4

[a] Abbreviations: MAC, mid arm circumference.
[b] Data are presented for status and chemotherapy term.

Table 9. Scores of PG-SGA Questionnaire According to Type of Cancer and Mortality Status of Patients Suffering From Gastrointestinal Cancer [a, b]

Attribute [c]	Mean Score of Patients	9 or more	4 to 8	2 to 3
Type of Cancer (N = 92)				
Gastrointestinal (N = 92)				
Beginning (N = 92)	13.65 (5.4)	72.8	23.9	2.2
Middle (N = 66)	9.82 (5.2)	53.03	33.33	13.63
End (N = 57)	9.68 (4.9)	56.14	29.82	14.03
Esophagus (N = 17)				
Beginning (N = 17)	16.65 (3.6)	94.1	5.9	0
Middle (N = 11)	12.64 (4.3)	72.72	27.27	0
End (N = 10)	11.70 (4.9)	80	10	10
Gastro (N = 52)				
Beginning (N = 52)	14.48 (4.9)	80	15.4	1.9
Middle (N = 34)	10.79 (5.2)	61.76	32.35	5.88
End (N = 29)	10.78 (4.7)	65.51	31.03	3.44
Colorectal (N = 23)				
Beginning (N = 23)	9.61 (5.6)	39.1	56.5	4.3
Middle (N = 21)	6.76 (4.1)	28.57	38.09	33.33
End (N = 18)	6.78 (3.9)	27.77	38.88	33.33
Mortality Status (N = 92)				
Until End (N=57)				
Beginning	12.94 (5.6)	70.2	26.3	3.5
Middle	9.84 (5.1)	56.1	29.8	14
End	9.68 (4.9)	65.1	29.8	14
After Middle (N = 9)				
Beginning	13.87 (4.7)	66.7	2.22	0
Middle	9.88 (6.3)	33.3	44.4	11.1
Before Middle (N = 13)				
Beginning	14.00 (6.1)	92.3	7.7	0

[a] Score 0 - 1: no nutrition intervention, Score 2 - 3: help from family, dietitian, Score 4 - 8: need help from professional dietitian, nurse, and physician, Score 9 or more: critical need for elimination of malnutrition symptoms.
[b] Data are presented as mean (SD) or %.
[c] Data are presented for status and chemotherapy mtatus.

Table 10. Percentage of Weight Reduction of Patients Between Months 1 to 6 According to Type of Cancer, Stage of Cancer and Mortality Status [a]

Attribute	Mean Weight Reduction in 6 Months	Mean Weight Reduction in 1 Month	Weight Reduction in 6 Months Over 10% [b]	Weight Reduction in 6 Months Over 5 - 10% [c]
Type of Cancer				
Gastrointestinal (N = 82)	12.04 (8.2)	11.62 (8.7)	47.56	37.80
Esophagus (N = 16)	13.69 (6.8)	13.69 (6.8)	75	18.75
Gastro (N = 46)	13.61 (8.8)	13.29 (9.3)	47.82	43.47
Colorectal (N = 20)	7.11 (5.7)	5.99 (5.8)	25	40
Metastatic Status				
Stage 4 - metastatic (N = 25)	13.44 (8.8)	12.82 (9.4)	56	32
Stages 3 and 2 (N = 54)	11.43 (8.1)	11.26 (8.4)	42.59	40.47
Until end (N = 51)	11.34 (8.3)	10.75 (8.8)	47.05	33.33
After middle (N = 7)	10.97 (7.5)	10.03 (7.5)	42.85	42.85
Before middle (N = 12)	14.77 (8.8)	15.13 (9.8)	47.05	58.33

[a] Data are presented as mean (SD) or %.
[b] Severe malnutrition.
[c] Moderate malnutrition.

5. Discussion

In this study, 92 patients were investigated for their nutritional status; at the beginning, in the middle, and at the end of their treatment. SGA and PG-SGA are among the screening tools that sufficiently measure the anthropometric parameters. PG-SGA is a scoring system with very high sensitivity (98%) and a high specificity (82%) (34). One of the advantages of this questionnaire is evaluating the factors which may affect the nutrition status indirectly. In the present study according to the type of the cancer, the patients with esophageal cancer had the highest mean age and those with colorectal cancer had the lowest one. The mean age was higher in patients with metastasis compared with those without metastasis. Kim (11), Laky (23, 24), and Isenring (5, 9, 10) reported the same results, the mean age was higher than 50 in the most cases.

In this study, one of the determinants of survival of women was MAC, which was higher in women compared to men. Also, the percentage of BMI < 18.5 kg/m^2 during the therapy was higher in men. MAC and TSF under the 5th percentile were also higher in males. TSF, and MAC during the treatment were higher among men. In a study conducted by Zarif Yeganeh et al. (35) a strong relation between BMI and mortality was found. In this study, 10.9% of patients were underweight, and 26.1% were overweight or obese. These results were quite similar to that of Zarif Yeganeh (9.9% and 38%). In the present study, 13.8% of patients with stage IV disease had BMI less than 18.5 kg/m^2, which was higher than that of Zarif Yeganeh study (19.2%) (35).

The highest percentage of good nutrition status (questionnaire stage A) was at the beginning of chemotherapy (8.7%) and during the treatment of colorectal cancer (14.5%). Bauer et al. reported a high percentage of malnutrition (76%) (4). In Segura et al. study (14) more than 50% of patients had moderate to severe malnutrition. Zarif Yeganeh et al. (35) also reported the same result with 71.2% of malnutrition indicating that the prevalence of malnutrition in patients with cancer is often more than 50% and this malnutrition can be one of the main causes of death in patients with cancer.

In this study, the prevalence of malnutrition was higher than that of other studies and 95.5% of patients were categorized as B + C from whom 72.8% patients had the score of 9 or more. The same results were seen in Bauer et al. study in which 78% of patients had the score of 9 or more. According to the present study, 98.9% of patients need critical nutritional interference.

Many patients with cancer suffer from malnutrition, which is usually overlooked by the health care professionals. Findings of the present study show that patients with moderate or severe malnutrition are critically required to improve their malnutrition status. PG-SGA questionnaire can be considered as a reliable tool for quick evaluation of nutrition status in patients with cancer.

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